Workshop Manual
Audi A6 1998 ➢

6-cylinder engine (2.7 ltr. 5-valve turbo), mechanics									
Engine ID	AJK	ARE	AZA	BES	BEL	APB			

Edition 03.2019

List of Workshop Manual Repair Groups

Repair Group

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10 - Removing and installing engine
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15 - Cylinder head, valve gear
17 - Lubrication
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26 - Exhaust system

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

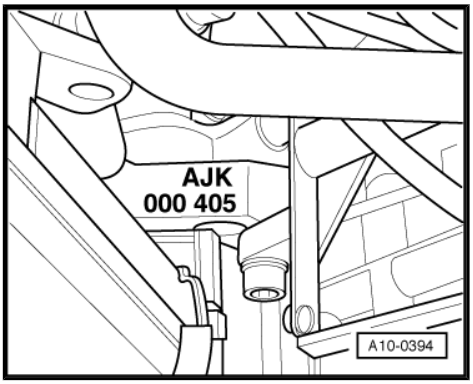
Contents

00 – Technical data

1 Engine number

(ARL006292; Edition 03.2019)

The engine number (“engine code” and “serial number”) is stamped on the right inner side of the cylinder block between the cylinder head and power steering pump.



Note

The engine code is also to be found on the vehicle data sticker.

2 Engine data

Code letters		AJK	APB	ARE
Capacity	ltr.	2.671	2.671	2.671
Power output	kW at rpm	169/5800	187/5800	184/5800
Torque	Nm at rpm	310/1700	350/1800	350/1800
Bore	∅ mm	81.0	81.0	81.0
Stroke	mm	86.4	86.4	86.4
Compression ratio		9.5	9.5	9.5
RON	at least	98[1)]	98[1)]	98[1)]
Injection/ignition system		Motronic	Motronic	Motronic
Emission standards		D 3	TLEV	EU 3
Exhaust gas recirculation		no	no	no
Exhaust gas temperature control		2 senders	2 senders	2 senders
Turbocharging/supercharging		Turbocharger	Turbocharger	Turbocharger
Catalytic converter		yes	yes	yes
Knock control		2 sensors	2 sensors	2 sensors
Lambda control		2 probes before catalytic converter	2 probes before catalytic converter 2 probes after catalytic converter	2 probes before catalytic converter 2 probes after catalytic converter
Variable valve timing		Inlet	Inlet	Inlet
Secondary air system		no	yes	yes

- [1)] In exceptional circumstances, fuel with not less than 95 RON can also be used, but this will cause a loss of power.

Code letters		AZA	BEL	BES
Capacity	ltr.	2.671	2.671	2.671
Power output	kW at rpm	169/5800	169/5800	169/5800
Torque	Nm at rpm	310/1700	310/1700	310/1700
Bore	∅ mm	81.0	81.0	81.0
Stroke	mm	86.4	86.4	86.4
Compression ratio		9.5	9.5	9.5
RON	at least	98[1)]	98[1)]	98[1)]
Injection/ignition system		Motronic	Motronic	Motronic
Emission standards		EU 3	TLEV	EU 4
Exhaust gas recirculation		no	no	no
Exhaust gas temperature control		2 senders	2 senders	2 senders
Turbocharging/supercharging		Turbocharger (2x)	Turbocharger (2x)	Turbocharger (2x)
Catalytic converter		yes	yes	yes
Knock control		2 sensors	2 sensors	2 sensors

Code letters	AZA	BEL	BES
Lambda control	2 probes before catalytic converter 2 probes after catalytic converter	2 probes before catalytic converter 2 probes after catalytic converter	2 probes before catalytic converter 2 probes after catalytic converter
Variable valve timing	Inlet camshaft	Inlet camshaft	Inlet camshaft
Secondary air system	yes	yes	yes

- [1] In exceptional circumstances, fuel with not less than 95 RON can also be used, but this will cause a loss of power.

3 Safety precautions

When working on the fuel system note the following warnings:

WARNING

Fuel under pressure - risk of injuries!

- *To reduce the pressure in the fuel system, wrap a clean cloth around the connection and loosen the connection carefully.*

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 connectors were unplugged and engine was started: “Interrogate fault memory” or “Generate readiness code” in “Vehicle self-diagnosis” ⇒ Vehicle diagnostic tester.

Caution

When disconnecting the battery there is a risk of irreparable damage to electronic components.

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

– Disconnect battery ⇒ Rep. gr. 27 .

When working on the cooling system note the following warnings:

WARNING

Risk of scalding due to hot steam and hot coolant.

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

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

WARNING

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

Injuries can also be caused if the passenger's airbag is triggered in a collision.

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

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

4 General repair instructions

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

Even small quantities of dirt can lead to defects. For this reason, please observe the following rules when working on the fuel supply system, injection system and turbocharger/supercharger:

- Clean connections and surrounding area thoroughly with engine cleaner or brake cleaner and dry cleaned area before loosening.
- Plug open lines and connections with suitable protective caps immediately.
- After removal, place parts on a clean surface and cover them. Only use lint-free 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.).
- Do not work with compressed air when the system is open. If possible, do not move vehicle.
- Protect unplugged electrical connectors against dirt and moisture and make sure connections are dry when attaching.

4.2 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 fitted.

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

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

Please note:

- We recommend using only genuine replacement parts; these have been tested and are compatible with aluminium.
- We recommend using Audi Genuine Accessories.
- Damage caused by contact corrosion is not covered by warranty.

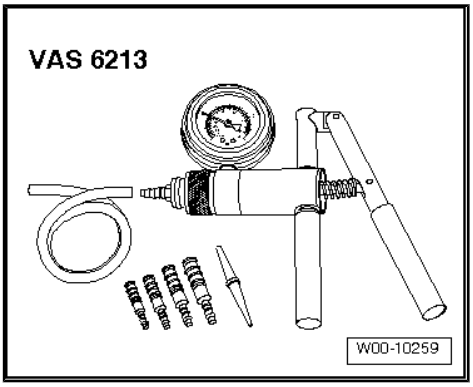
4.3 Installing radiators, condensers and charge air coolers

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

4.4 Checking vacuum system

Special tools and workshop equipment required

- Hand vacuum pump - VAS 6213-



Procedure

– Check all vacuum lines in the complete vacuum system for:

- Cracks
- Traces of animal bites
- Kinked or crushed lines
- Porous or leaking lines

– Check vacuum line to solenoid valve and from solenoid valve to corresponding component.

– If a fault is stored in the memory, check the vacuum lines leading to the corresponding component and also check the remaining vacuum lines in the system.

– If it is not possible to build up pressure with hand vacuum pump - VAS 6213- or if the pressure drops again immediately, check hand vacuum pump and connecting hoses for leaks.

4.5 Routing and attachment of pipes, hoses and wiring

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

4.6 Checking for leaks in the fuel system

– Allow engine to run for several minutes at moderate rpm.

– Switch off ignition.

– Check complete fuel system for leaks.

– If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.

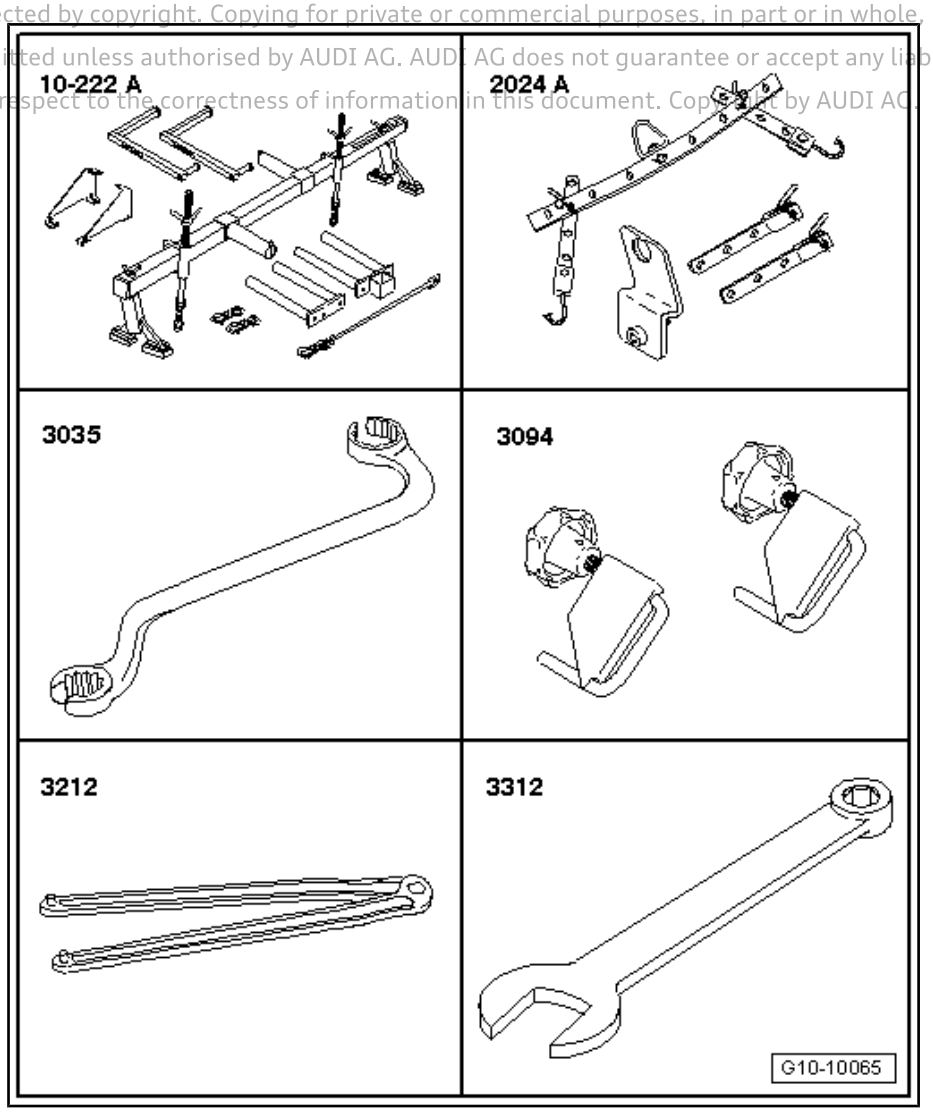
– Road-test vehicle and accelerate with full throttle at least once.

– Then inspect again for leaks.

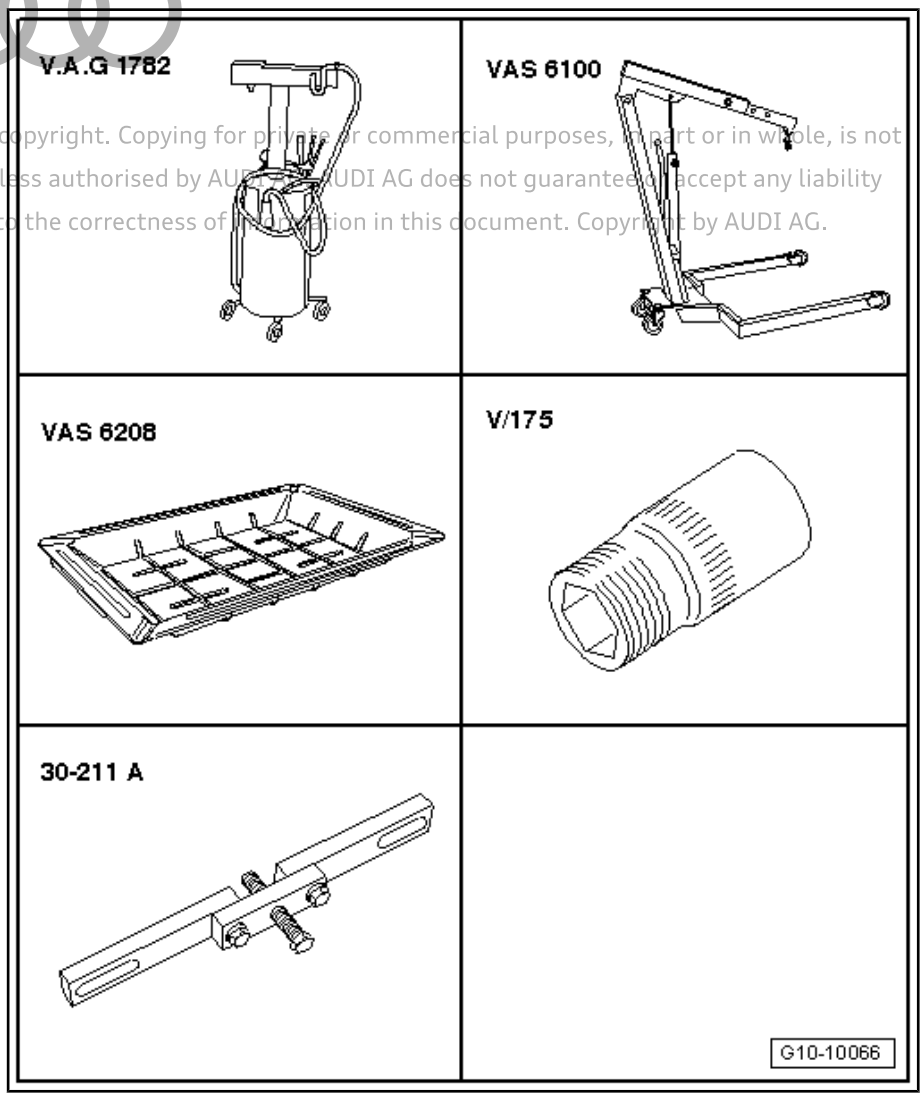
10 – Removing and installing engine

1 Removing engine

Special tools and workshop equipment required



- Support bracket - 10 - 222 A-
- Lifting tackle - 2024 A-
- Ring spanner - 3035-
- Hose clamps, up to 25 mm - 3094-
- Pin wrench - 3212-
- Open-end spanner - 3312-



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

Note

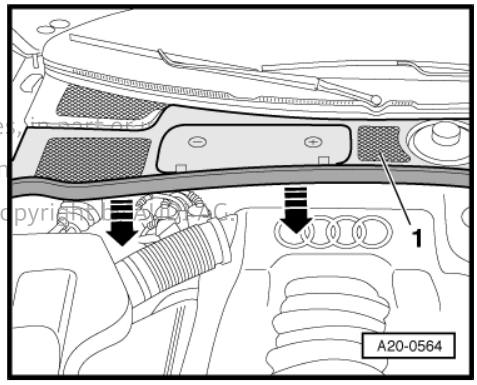
- *The engine is removed from the front without the gearbox.*
- *Fit cable ties in the original positions when installing.*

Caution

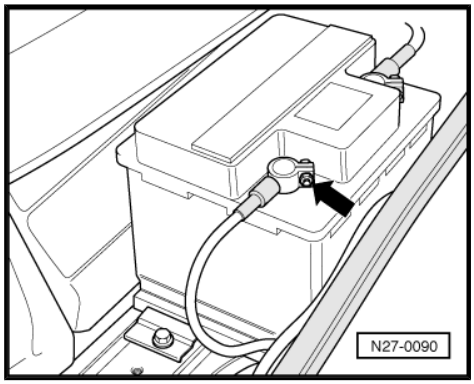
When disconnecting the battery there is a risk of irreparable damage to electronic components.

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

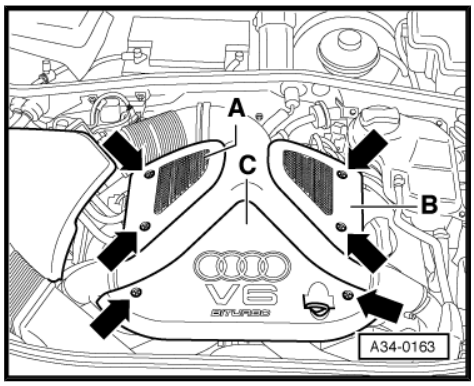
– Remove seal -arrows-.
– Pull off plenum chamber cover -1- towards front of vehicle.



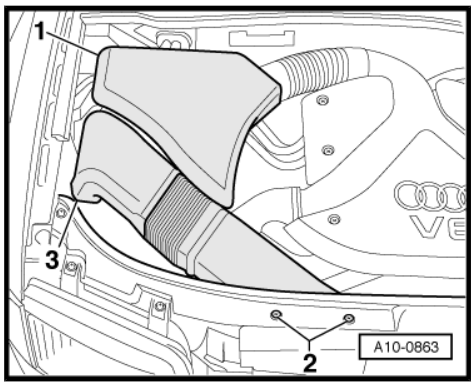
– Disconnect earth wire -arrow- from battery terminal ⇒ Rep. gr. 27 .



– Detach engine cover panels -A ... C- by removing bolts -arrows-.



– Remove cover -1- on right side of engine compartment.
– Remove bolts -2- and detach both air ducts -3-.



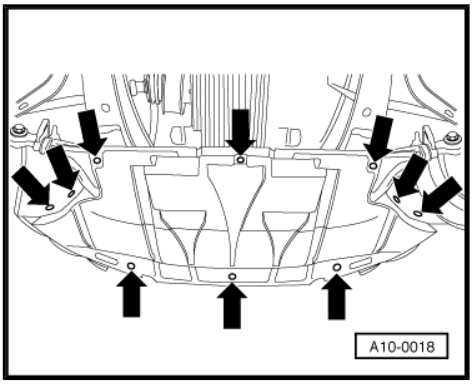
WARNING

Risk of scalding due to hot steam and hot coolant.

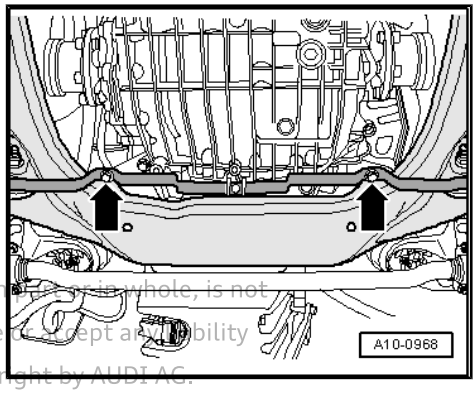
- ***The cooling system is under pressure when the power unit is hot.***
- ***To allow pressure to dissipate, cover filler cap on coolant expansion tank with cloth and open carefully.***

– Open filler cap on coolant expansion tank.

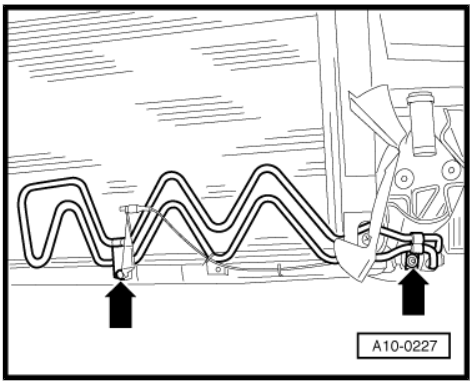
– Release fasteners -arrows- and remove noise insulation.



– Remove bolts -arrows- and detach bracket for noise insulation.



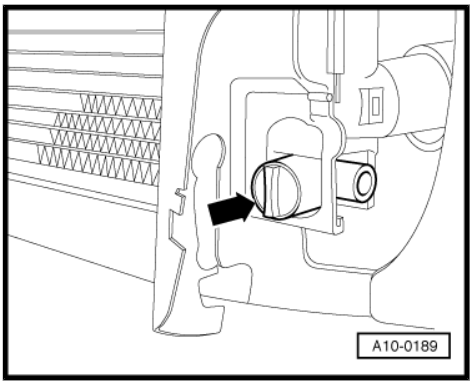
– Remove front bumper ⇒ Rep. gr. 63 .
– Unscrew cooling pipe for power steering hydraulic fluid -arrows- and move clear to side; do not open hydraulic fluid circuit.



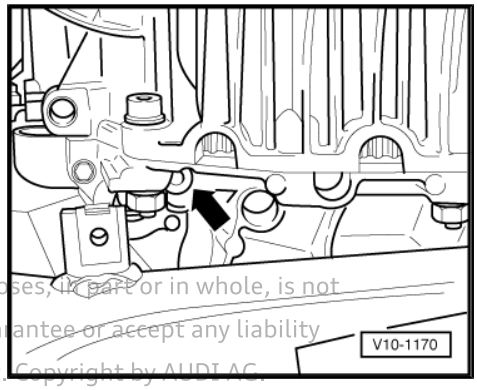
Note

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

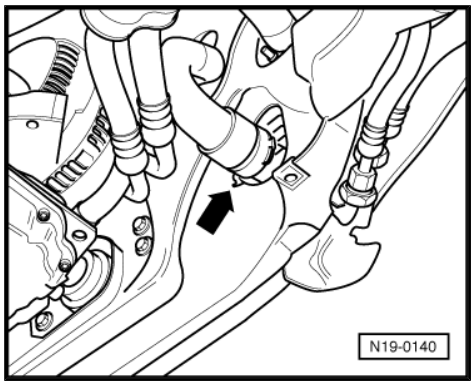
– Place drip tray for workshop hoist - VAS 6208- beneath engine.
– Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit auxiliary hose on connection.



– Also open coolant drain plug on engine -arrow-.



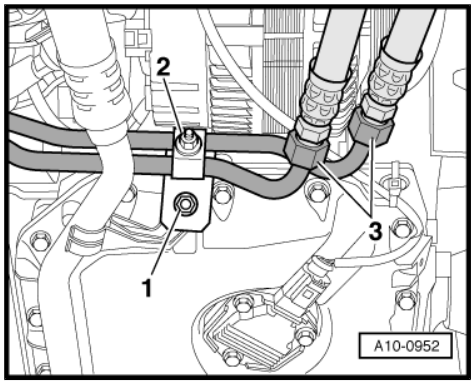
– Lift retaining clip -arrow- and disconnect coolant hose (bottom right) from radiator.



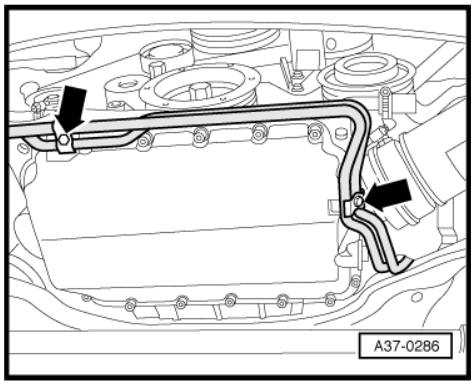
Note

Observe rules for cleanliness when working on gear oil pipes/ATF lines ⇒ Rep. gr. 00 .

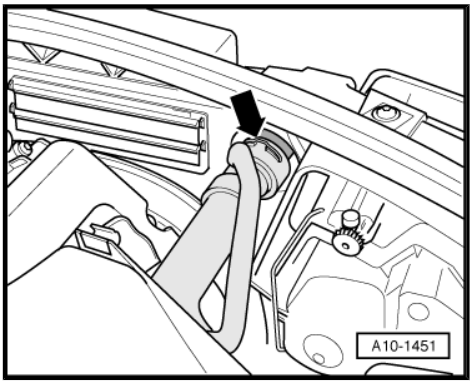
– Position used oil collection and extraction unit - V.A.G 1782- below connection point.
– Remove union nuts -3- and disconnect gear oil pipes/ATF lines.
– Unbolt bracket for gear oil pipes/ATF lines (unscrew nuts -1- and -2-).



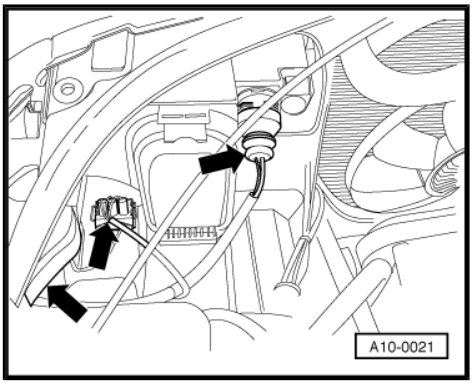
– Remove bracket for gear oil pipes/ATF lines from oil sump (bottom section) -arrows-.



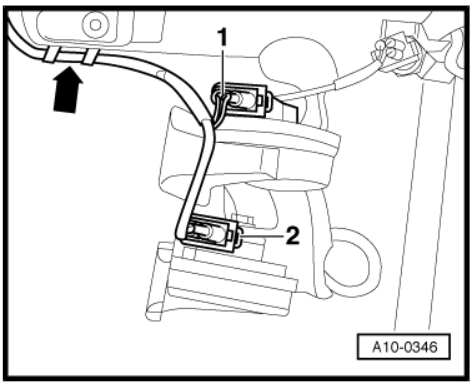
– Lift retaining clip -arrow- and disconnect coolant hose (top) from radiator.



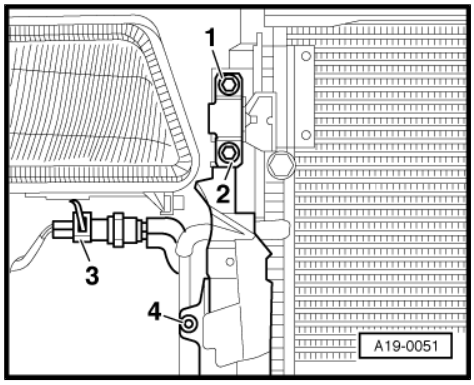
– Unplug electrical connectors (left and right) -right arrows- for headlights and headlight range control.
– Turn bulb holders for turn signals anti-clockwise and remove from turn signal housing -left arrow-.



– Unplug electrical connectors -1- and -2- on both horns.
– Disengage wiring at retainer -arrow-.



– Unscrew bolts (left and right) -4- and remove air ducts from radiator.
– Unplug electrical connector -3- at air conditioner pressure switch - F129- .



WARNING

Risk of injury caused by refrigerant.

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

– Remove bolts -1- and -2- for condenser.

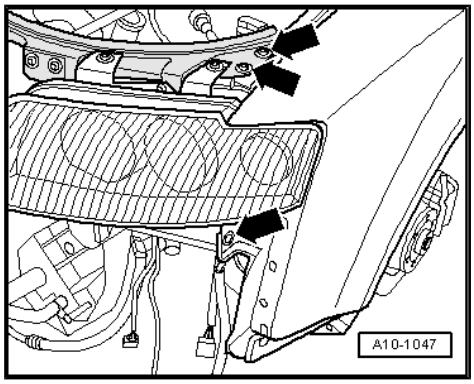
Caution

Risk of damage to refrigerant lines and hoses

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

– Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.

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

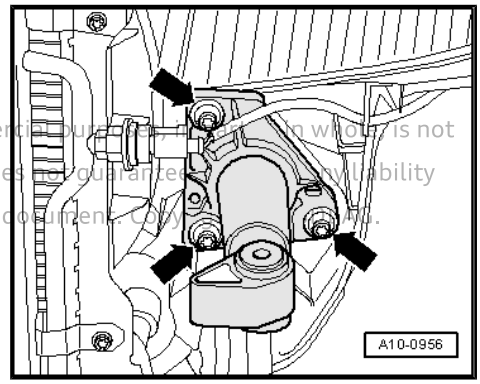


Note

Protect wing panels from damage.

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

– Remove bolts -arrows- from impact dampers on both sides.



Note

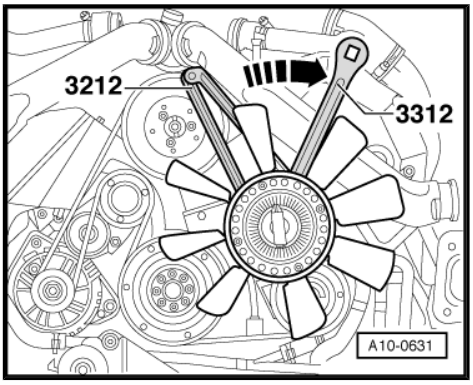
A second mechanic is required for removing the lock carrier.

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

Caution

Risk of damage to thread.

- *The viscous fan has a left-hand thread.*



– Use pin wrench - 3212- to counterhold and unscrew viscous fan with open-end spanner - 3312- -arrow- in clockwise direction.

– Carefully lift out viscous fan.

Caution

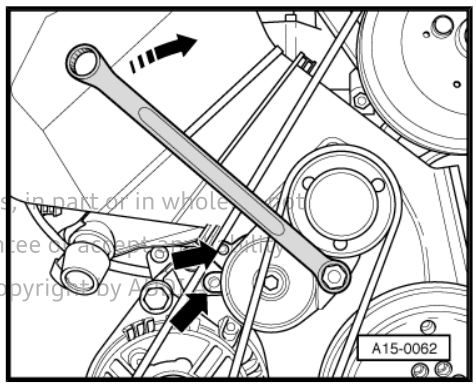
Running a used poly V-belt in the opposite direction could cause irreparable damage.

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

Tensioning roller with hexagon flats:

– To slacken poly V-belt use ring spanner to turn tensioner in clockwise direction -top arrow-.

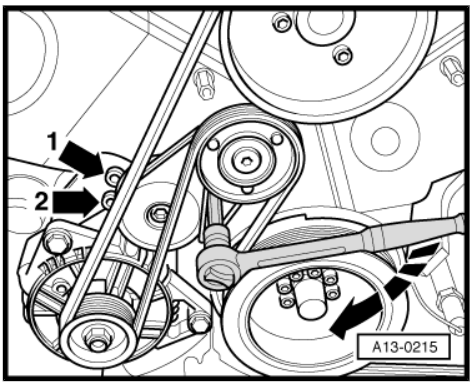
– Use locking pin - T10060 A- to lock poly V-belt tensioner in locating holes -bottom arrows- and detach poly V-belt.



Tensioning roller with hexagon socket:

– To slacken poly V-belt use 10 mm Allen key to turn tensioner in clockwise direction -right arrow-.

– Use locking pin - T10060 A- to lock poly V-belt tensioner in locating holes -arrow 1- and -arrow 2- and detach poly V-belt.

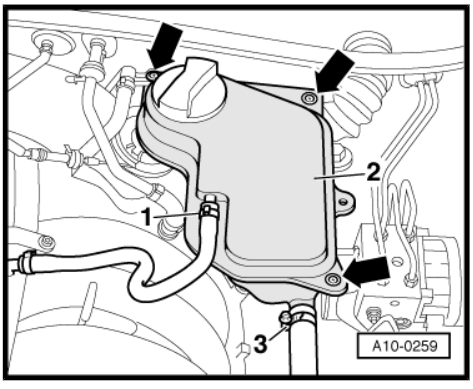


All vehicles (continued):

– Detach coolant hoses -1- and -3-.

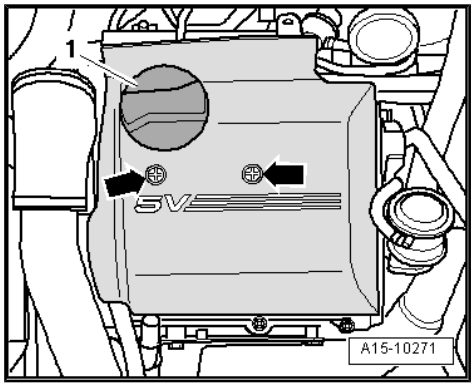
– Remove bolts -arrows-.

– Unplug electrical connector at coolant shortage indicator switch - F66- (bottom) and detach coolant expansion tank -2-.

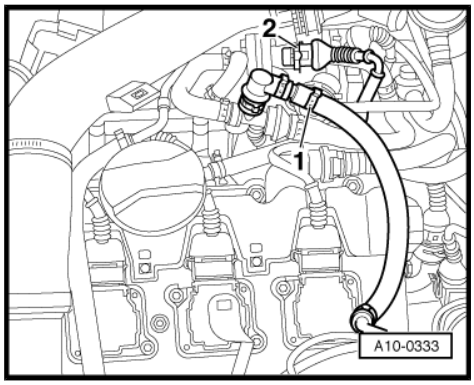


– Detach filler cap -1-.

– Open quick-release fasteners -arrows- and detach cover for cylinder head cover (left-side).



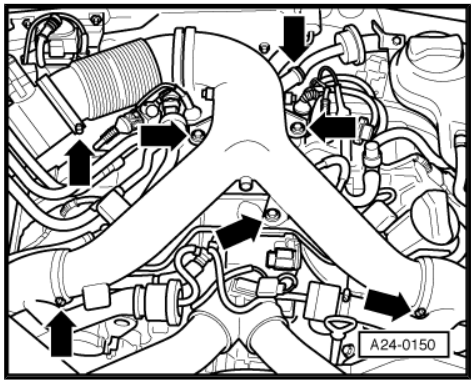
– Detach vacuum hose -1- going to vacuum reservoir.



Note

Disregard -item 2-.

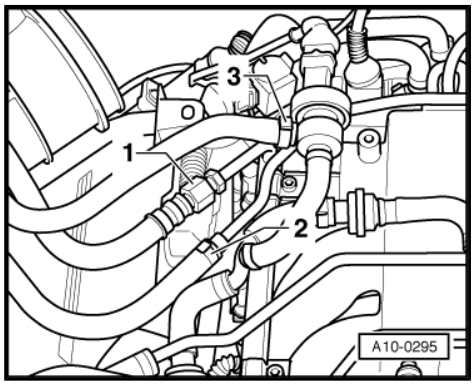
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



WARNING

Fuel under pressure - risk of injuries!

- ***To reduce the pressure in the fuel system, wrap a clean cloth around the connection and loosen the connection carefully.***

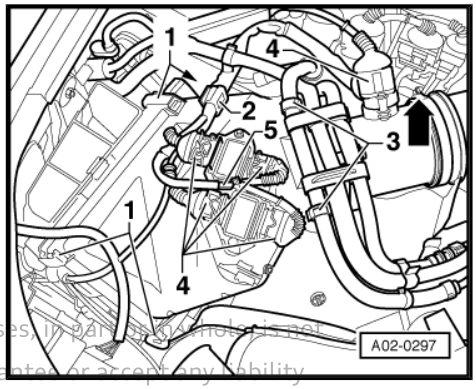


– Disconnect fuel supply line -1- and fuel return line -2-.

– Detach hose -3- from activated charcoal filter solenoid valve 1 - N80- .

– Move hose and pipes clear.

– Unplug electrical connector -4- at air mass meter - G70- .
– On vehicles with separate output stages, unplug remaining connectors -4-, cut through cable tie -5- and detach wiring harness from clip -2-. Then put down wiring harness next to intake opening of air cleaner.
– Open retaining clips -3- for fuel lines.
– Release hose clip -arrow-.
– Remove bolts and take off air filter housing.



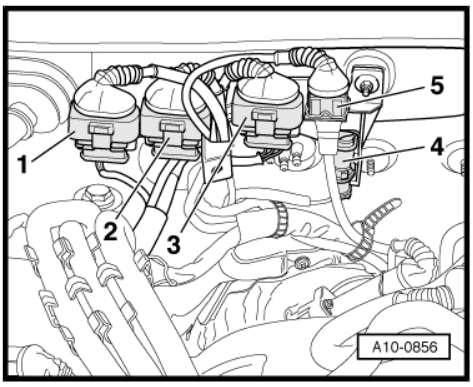
Note

Disregard -item 1-.

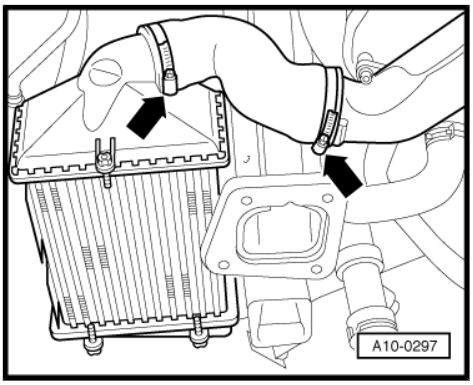
– Unplug electrical connectors:

1 - Lambda probe after catalytic converter - G130-
2 - Lambda probe 2 after catalytic converter - G131-
3 - Lambda probe - G39-
4 - Terminal 50 to starter
5 - Knock sensor 1 - G61-

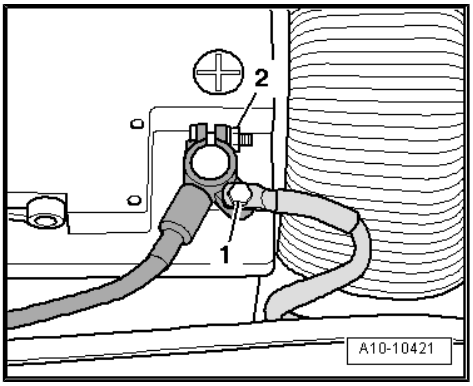
– Remove heat insulation sleeve at wiring harness and move wiring to Lambda probes clear.



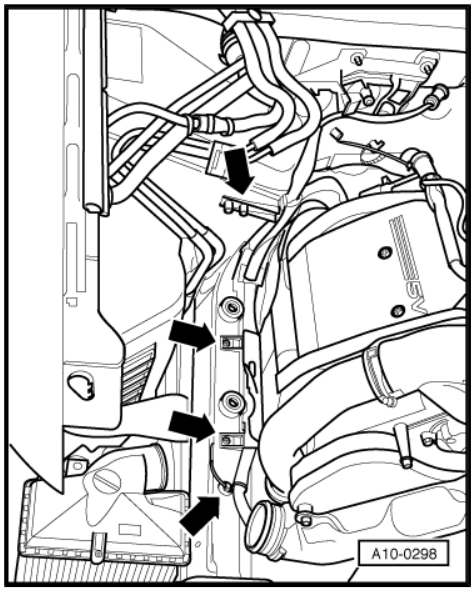
– Remove air hoses at top left and top right -arrows- between charge air cooler and air pipe.



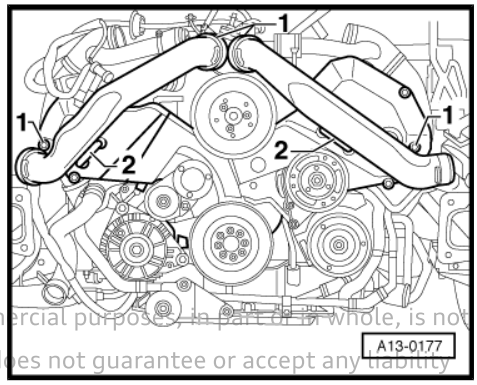
– Unscrew bolt -1- and remove positive battery terminal clamp.
– Slacken nut -2- a few turns and disconnect battery clamp -arrow- from positive battery terminal.



– Move clear wiring harness with wiring guide going to starter -arrows-.



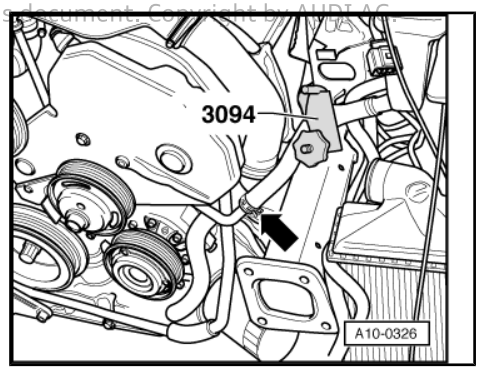
– Remove bolts -1- and detach air pipes.



Note

Pay attention to retaining strips -2-.

– Clamp off hydraulic hose for power steering using a hose clamp -3094- .



Note

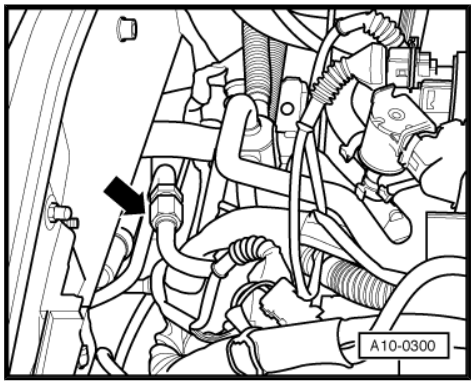
Lay a cloth under the separating point to catch escaping hydraulic fluid.

– Detach hydraulic hose for power steering -arrow-.

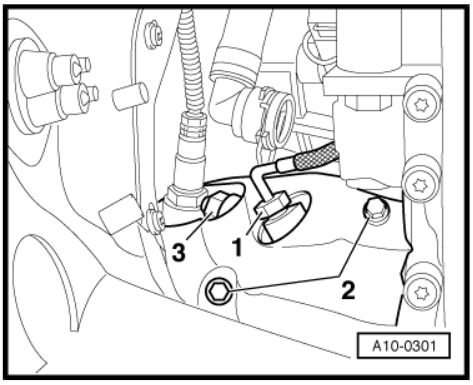
Note

Lay a cloth under the separating point to catch escaping hydraulic fluid.

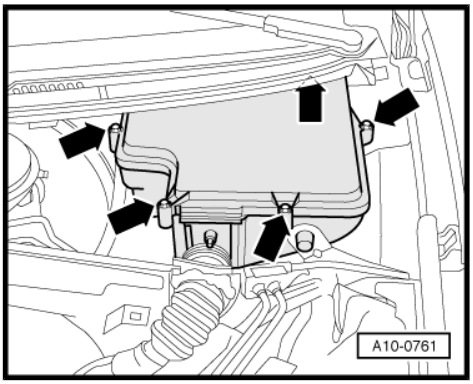
– Disconnect hydraulic line -arrow- for power steering at rear of engine.



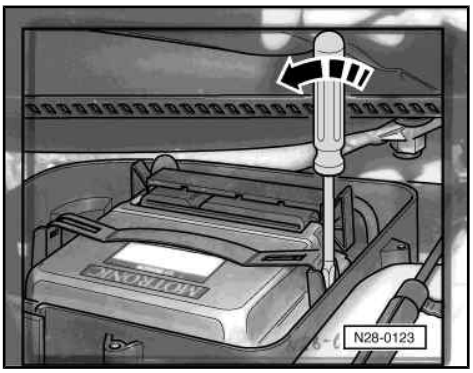
– Use ring spanner - 3035- to remove exhaust gas temperature sender 1 - G235- -item 1- from turbocharger (right-side).
– Remove bolts -2- for heat shield for turbocharger on both sides.
– Remove nut (top) -3- securing front exhaust pipe to turbocharger on left and right.



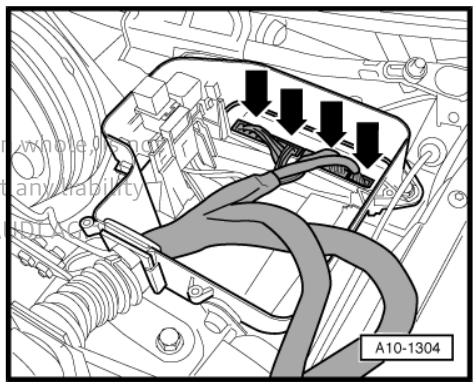
– Unscrew bolts -arrows- and take off cover for electronics box in plenum chamber.



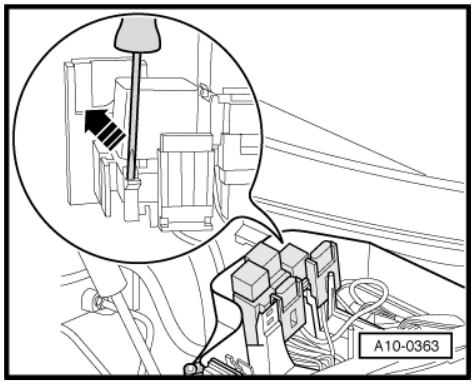
– Pry off retainer bar with a screwdriver -arrow-.
– Remove engine control unit from electronics box. The electrical wires remain connected.



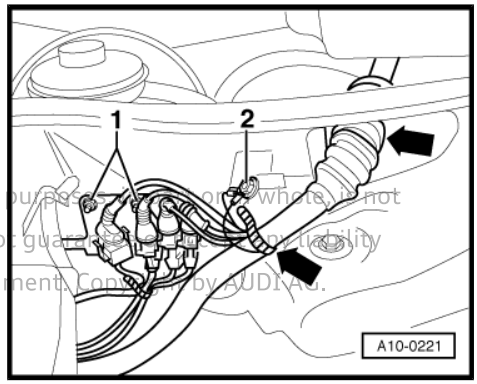
– Unplug electrical connectors -arrows- at connector console.



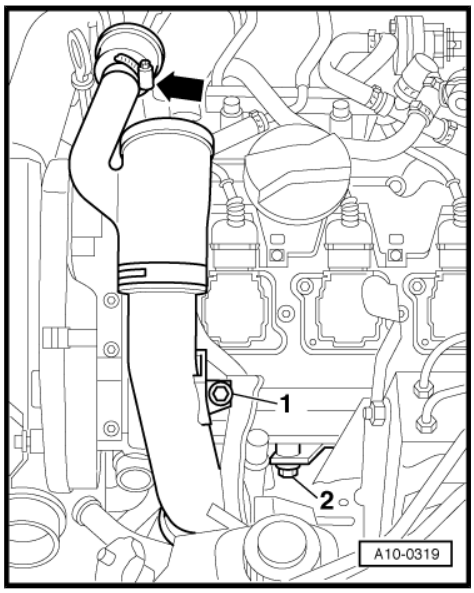
– Release retainer -arrow- and pull auxiliary relay carrier in electronics box upwards to remove.



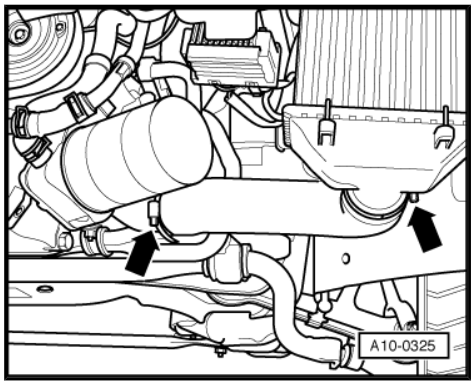
– Detach earth connection -2- and retainer -1- for electrical connectors from plenum chamber.
– Disengage engine wiring harness at electronics box and bulkhead -arrows- and move clear.
– Detach both coolant hoses going to heat exchanger at engine (lift retaining clips on connecting flange).



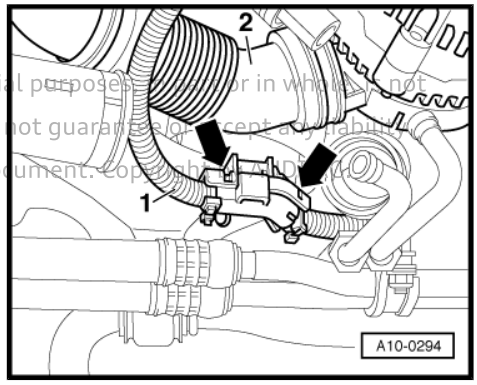
– Remove bolt -1-, release hose clip -arrow- and remove air pipe.
– Unscrew bolt -2- and remove coolant pipe.



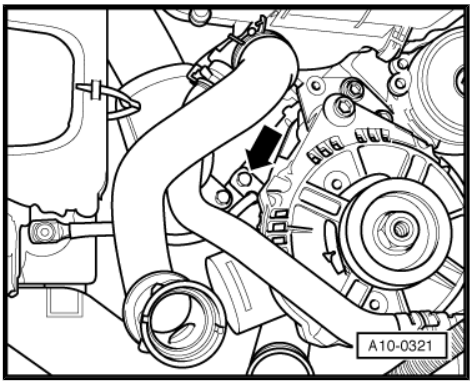
– Remove air hoses at bottom between turbocharger and charge air cooler on both sides -arrows-.



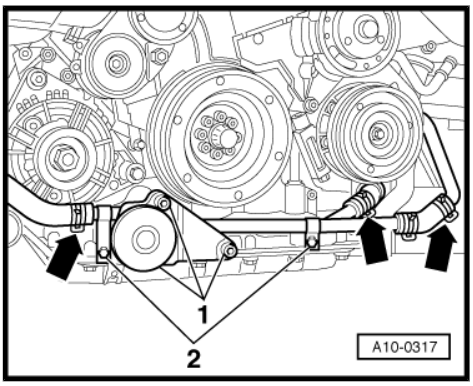
– Release electrical wire -1- leading to starter; to do so, cut open cable ties and unclip retainer -arrows-.
– Remove air hose -2- going to alternator.



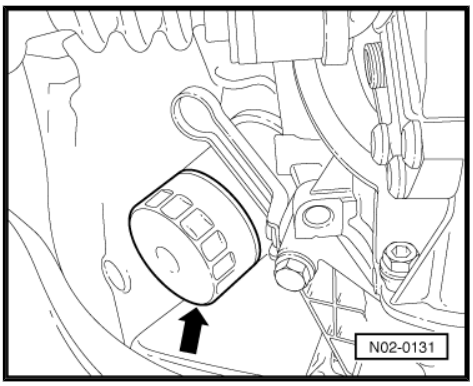
– Remove earth wire -arrow- from engine support.



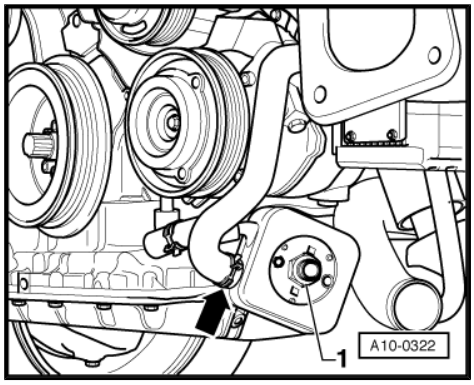
– Remove bolts -1- and detach torque reaction support.
– Remove bolts -2-.
– Detach coolant hoses -arrows- and coolant pipe (bottom).



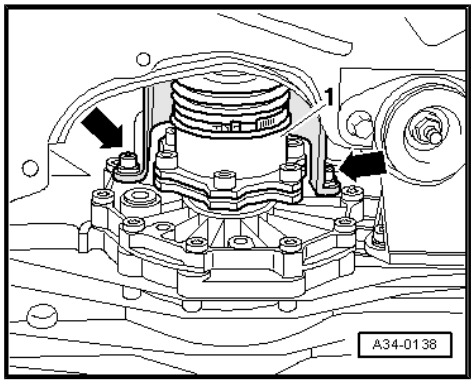
– Place used oil collection and extraction unit - V.A.G 1782- under engine and drain engine oil.
– Remove oil filter -arrow- ⇒ Maintenance ; Booklet 402 .



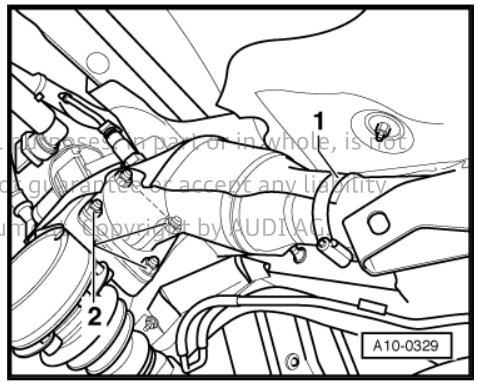
– Place drip tray for workshop hoist - VAS 6208- beneath engine.
– Unscrew nut -1-.
– Detach coolant hoses -arrow- and remove oil cooler.



– Remove bolts -arrows- on both sides and detach heat shield for drive shaft -1-.



– Release hose clip -1- for heat shield for turbocharger on both sides.
– Remove remaining nuts -2- securing front exhaust pipe to turbocharger on left and right.

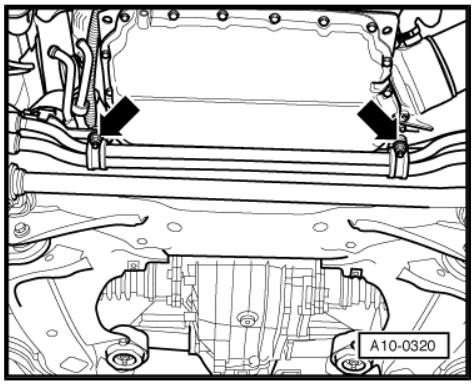


WARNING

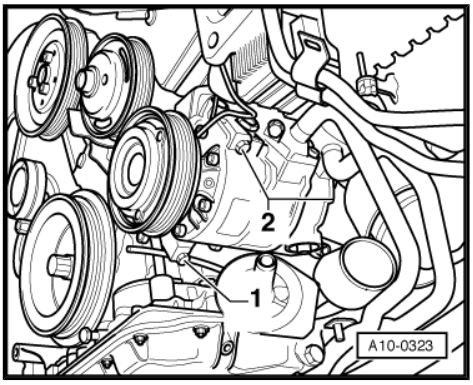
Risk of injury caused by refrigerant.

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

– Unbolt refrigerant pipe bracket -arrows- from sump (bottom section).



– Remove bolts -1- and -2-.



Caution

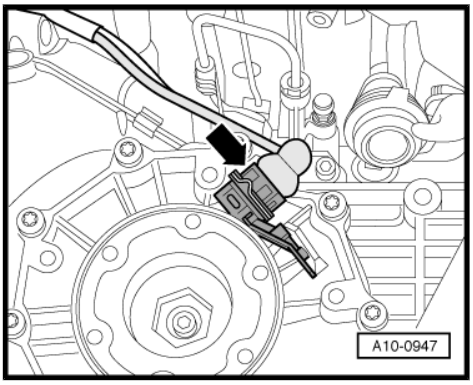
Risk of damage to refrigerant lines and hoses

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

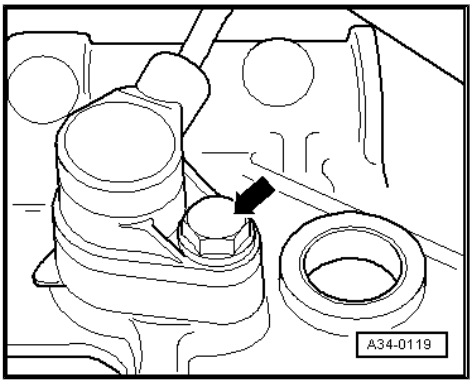
– Tie up air conditioner compressor to side at body (refrigerant lines remain connected).

Vehicles with manual gearbox:

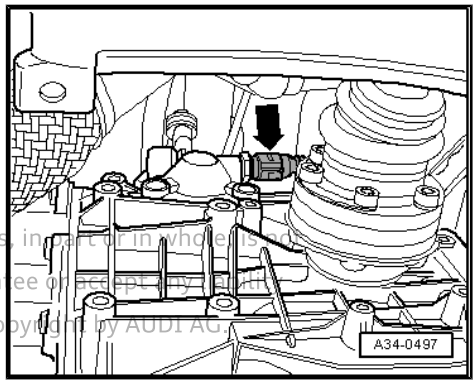
– Unplug electrical connector -arrow- at speedometer sender - G22- on gearbox.



– Unbolt engine speed sender - G28- from gearbox -arrow-.



– Unplug electrical connector -arrow- at reversing light switch - F4- and move wiring clear.



Vehicles with automatic gearbox:

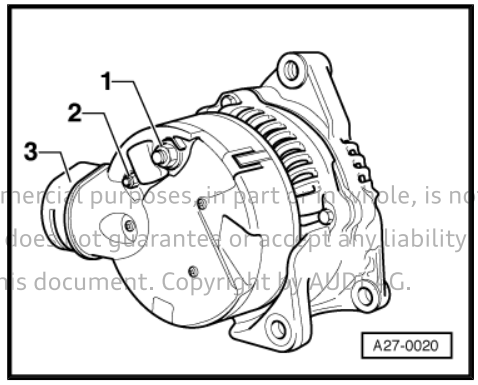
– Pull charge air cooler (right-side) out of rubber grommets and remove.

– Detach air duct from connection on alternator -3-.

– Remove electrical wiring:

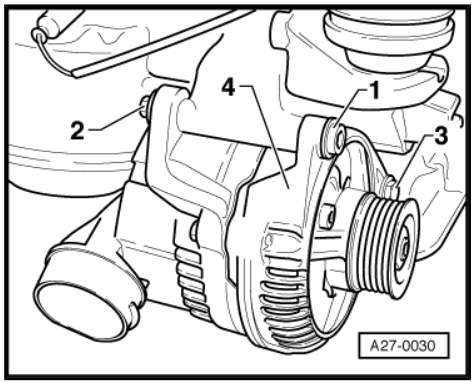
1 - Terminal 30/B+

2 - Terminal D+



– Remove nut -2- and pull out bolt -1-.

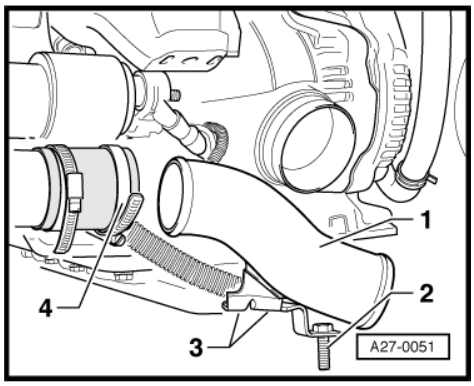
– Loosen bolt -3- and take out alternator -4- from below.



– Release hose clip -4- and remove air pipe -1-.

Note

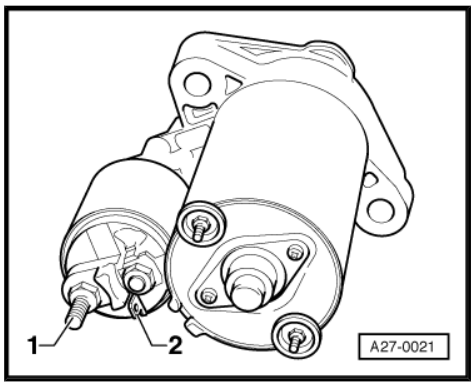
Disregard items -2 and 3-.



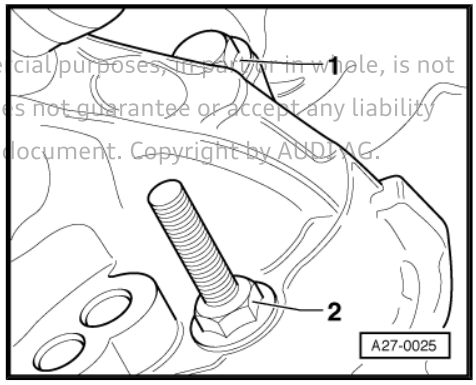
– Remove electrical wiring:

1 - Terminal 30/B+

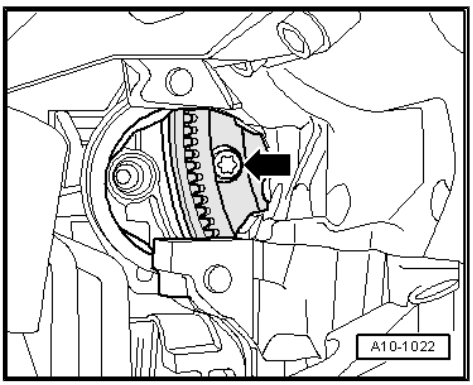
2 - Terminal 50



– Remove front right wheel.
– Remove top bolt -1- securing starter from wheel housing (right side).
– Remove bottom bolt securing starter (work from side facing engine).
– Take out starter to front.



– Use special tool -V/175- to unscrew 3 bolts -arrow- for torque converter through opening for starter (rotate crankshaft $^{1}/_{3}$ turn each time).

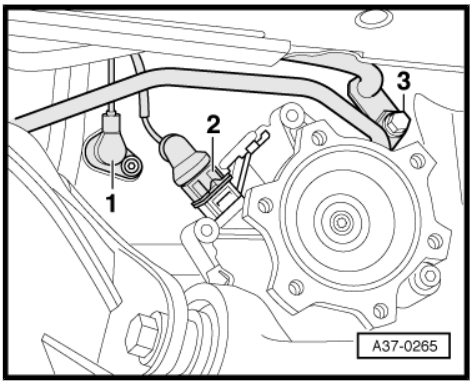


– Unbolt engine speed sender - G28- -item 1- at front left of gearbox.
– Unplug electrical connector -2- at speedometer sender - G22- .

Note

Observe rules for cleanliness when working on gear oil pipes/ATF lines ⇒ Rep. gr. 00 .

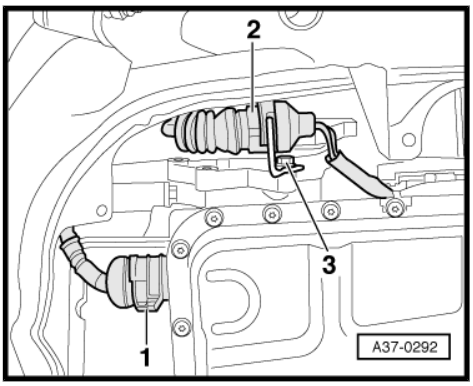
– Remove bolt -3- and detach gear oil pipes/ATF lines from gearbox.
– Move gear oil pipes/ATF lines clear to side.



Caution

Risk of damage to gearbox control unit because of static discharge.

- ***Do NOT touch connector contacts in gearbox connector with your hands.***



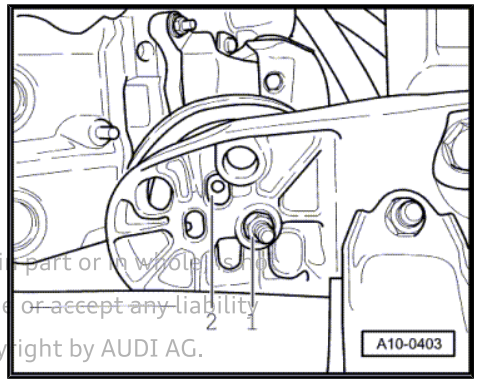
– Turn locking lever -1- and detach electrical connector for gearbox.
– Unplug electrical connector -2- at multi-function switch - F125- .

Note

Disregard -item 3-.

All vehicles (continued):

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



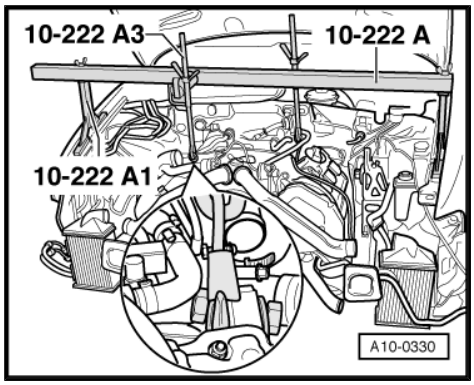
Note

Different mounting holes are provided for the different engine versions.

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

– Position support bracket - 10 - 222 A- on bolted flanges of wing panel as shown in illustration.

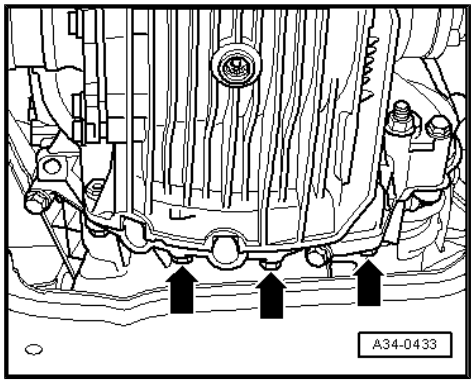
– Raise engine with support bracket.



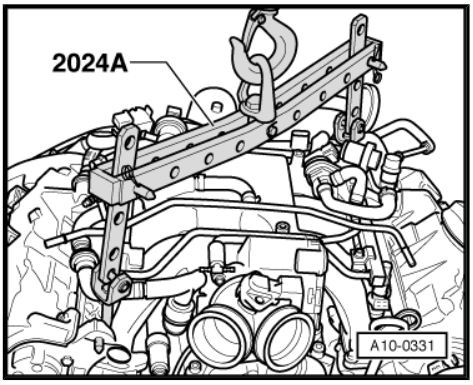
– Remove bottom bolts securing engine to gearbox -arrows-.

– Remove support bracket - 10 - 222 A- .

– Remove top bolts securing engine to gearbox.



– Attach lifting tackle - 2024 A- to rear right and front left of engine and to workshop hoist - VAS 6100- as shown in illustration.



Note

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

WARNING

Accident risk from loose components of support bracket.

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

– Remove front left wheel.

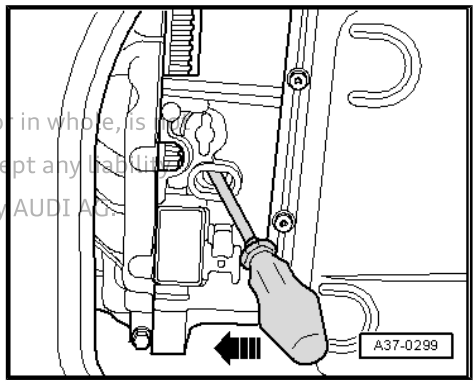
– Support gearbox with trolley jack.

Note

- *On vehicles with automatic gearbox, position trolley jack directly behind ATF pan (do NOT apply to ATF pan itself) with a piece of wood placed in between.*
- *Check that all hoses and other connections between engine and gearbox have been detached.*

Vehicles with automatic gearbox:

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

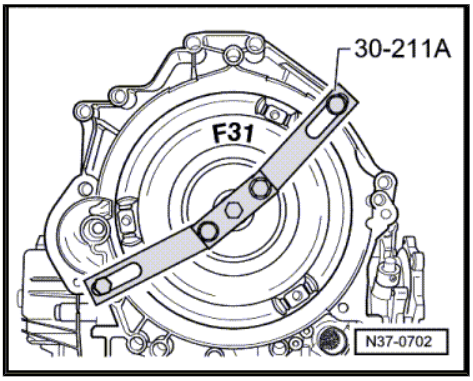


All vehicles (continued):

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

Vehicles with automatic gearbox:

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



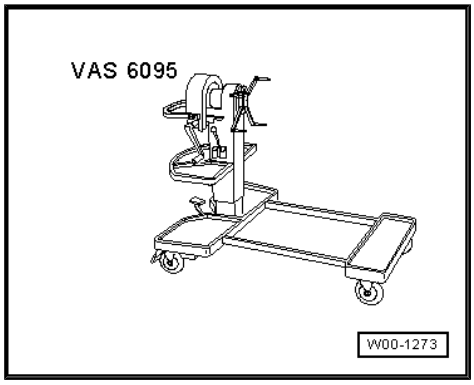
All vehicles (continued):

– Remove intermediate plate between engine and gearbox.

2 Securing engine to engine and gearbox support

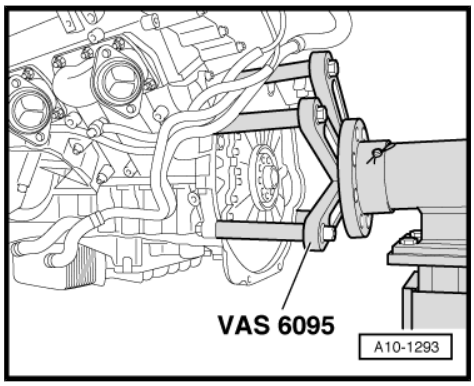
Special tools and workshop equipment required

- Engine and gearbox support - VAS 6095-



Procedure

– Secure engine to engine and gearbox support - VAS 6095- as illustrated.



3 Installing engine

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 %*

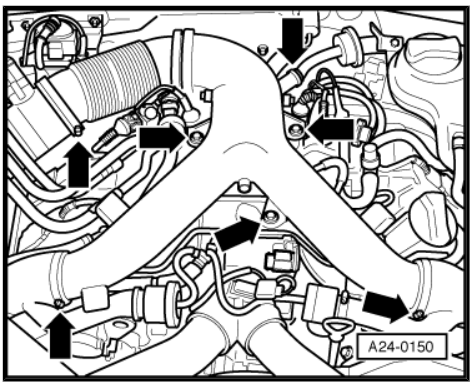
Component		Nm
Bolts/nuts	M6	10
	M8	20
	M10	45
	M12	65
Except for the following:		
Drive plate to torque converter		85 1)

- 1) Use new genuine ribbed bolts ⇒ Electronic parts catalogue .

Assembly mountings ⇒ page 39

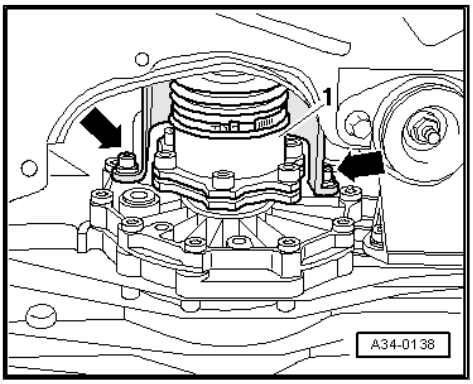
Air duct - tightening torque

– Tighten bolts -centre arrows- securing air duct to 10 Nm.



Heat shield for drive shaft - tightening torque

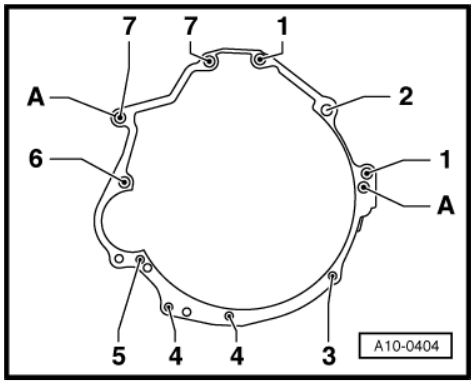
– Tighten bolts -arrows- for heat shield for drive shaft -1- to 23 Nm.



Engine to manual gearbox

Item	Bolt	Nm
1	M12x90	65
2	M12x100	65
3, 4	M10x60	45
5	M10x150	65[1)]
6	M12x130	65
7	M12x80	65
A	Dowel sleeves for centralising	

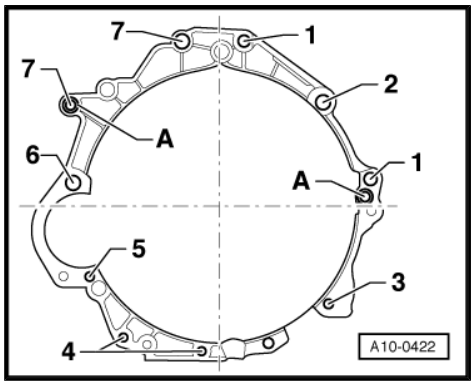
• [1)] Property class 10.9.



Engine to automatic gearbox

Item	Bolt	Nm
1	M12x90	65
2	M12x100	65
3	M10x70	45
4	M10x60	45
5	M10x100	65[1)]
6	M12x110	65
7	M12x80	65
A	Dowel sleeves for centralising	

• [1)] Property class 10.9.



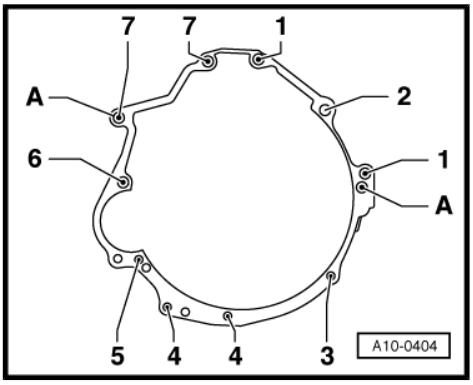
Procedure

Note

- *Renew the bolts tightened with specified tightening angle.*
- *Renew self-locking nuts and bolts as well as seals, gaskets and O-rings.*
- *Hose connections and hoses for charge air system must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*
- *Fit all cable ties in the original positions when installing.*

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

– Press intermediate plate between engine and gearbox onto dowel sleeves.



Vehicles with manual gearbox:

– Clean input shaft splines and (in the case of used clutch plates) hub splines. Remove corrosion and apply only a very thin coating of grease for clutch plate splines - G 000 100- to splines. Do not lubricate guide sleeve.

– Make sure that clutch plate is properly centred.

– Check clutch release bearing for wear and make sure that plastic ring is securely seated ⇒ Rep. gr. 30 .

– A needle bearing must be fitted in the flywheel on vehicles with manual gearbox. Install needle bearing if necessary ⇒ page 62 .

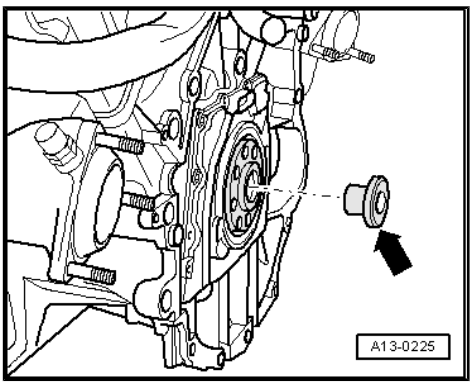
– When fitting a new clutch plate together with a used pressure plate (self-adjusting clutch), the adjuster ring in the pressure plate has to be reset by turning it back as far as it will go. If this is not done, pressure plate will operate with reduced clamping force, causing clutch slip ⇒ Rep. gr. 30 .

Note

- *If the clutch plate is not being replaced, it is not necessary to reset the adjuster ring.*
- *New SAC pressure plates are already pre-set accordingly, and do not have to be reset.*

Vehicles with automatic gearbox:

– Before installing an exchange engine in a vehicle with automatic gearbox, check whether the bearing bush -arrow- for the torque converter is fitted at the rear of the crankshaft.

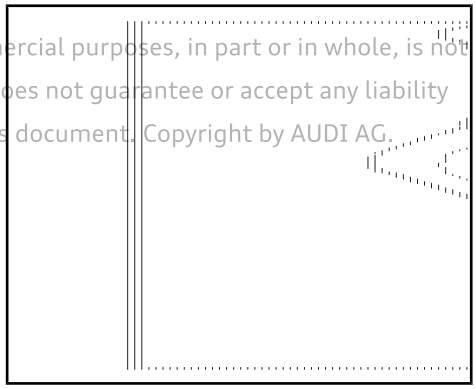


Checking installation depth of torque converter:

Caution

Risk of damage to drive lug of ATF pump if torque converter is installed incorrectly.

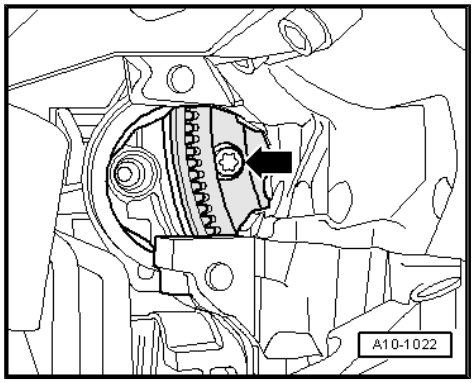
- ***Check installation depth of torque converter.***



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

– Before bringing engine and gearbox together, turn torque converter and drive plate on engine so that the holes for one securing bolt are in line with the opening for the starter motor -arrow-.

– To secure torque converter on drive plate, use only new ribbed bolts of the correct type (same as original equipment) as specified in ⇒ Electronic parts catalogue .



Caution

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

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

All vehicles (continued):

– Install engine mountings free of stress. To do so, shake engine before tightening engine mountings.

– Install starter and alternator ⇒ Rep. gr. 27 .

– Install charge air cooler ⇒ page 230 .

– Install air conditioner compressor ⇒ Rep. gr. 87 .

– Install front exhaust pipes: left-side ⇒ page 239 , right-side ⇒ page 245 .

– Install oil cooler ⇒ page 139 .

– Install coolant pipe (bottom) ⇒ page 178 .

– Install air pipes ⇒ page 220 , ⇒ page 220 .

– Install air hoses ⇒ page 227 .

– Install cover for electronics box in plenum chamber ⇒ Rep. gr. 97 .

– Install hose/pipe for power steering hydraulic fluid ⇒ Rep. gr. 48 .

– Install air cleaner housing ⇒ Rep. gr. 24 .

– Install viscous fan ⇒ page 189 .

– Install poly V-belt ⇒ page 41 .

– Install lock carrier with attachments ⇒ Rep. gr. 50 .

– Install condenser ⇒ Rep. gr. 87 .

– Install gear oil pipes ⇒ Rep. gr. 34 /ATF lines ⇒ Rep. gr. 37 .

– Install front bumper ⇒ Rep. gr. 63 .

– Connect coolant hoses with plug-in connectors to radiator ⇒ page 186 .

– Connect hoses ⇒ page 33

– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

– Observe measures required after connecting the battery ⇒ Rep. gr. 27 .

Caution

Risk of irreparable damage to control units because of excessive voltage.

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

– Check engine oil level ⇒ Maintenance ; Booklet 402 .

– Fill up with coolant ⇒ page 165 .

Note

- *Do not use drained coolant again if:*
- *the cylinder head or cylinder block have been renewed.*
- *the coolant is contaminated or dirty.*

– Check gear oil level ⇒ Rep. gr. 34 /ATF level ⇒ Rep. gr. 37 .

3.1 Diagrams of hose connections

Charge pressure control

Note

The turbochargers of the 6-cylinder biturbo engine are pressure controlled. The charge pressure control solenoid valve - N75- controls both turbochargers together.

1 - Turbocharger (right-side)

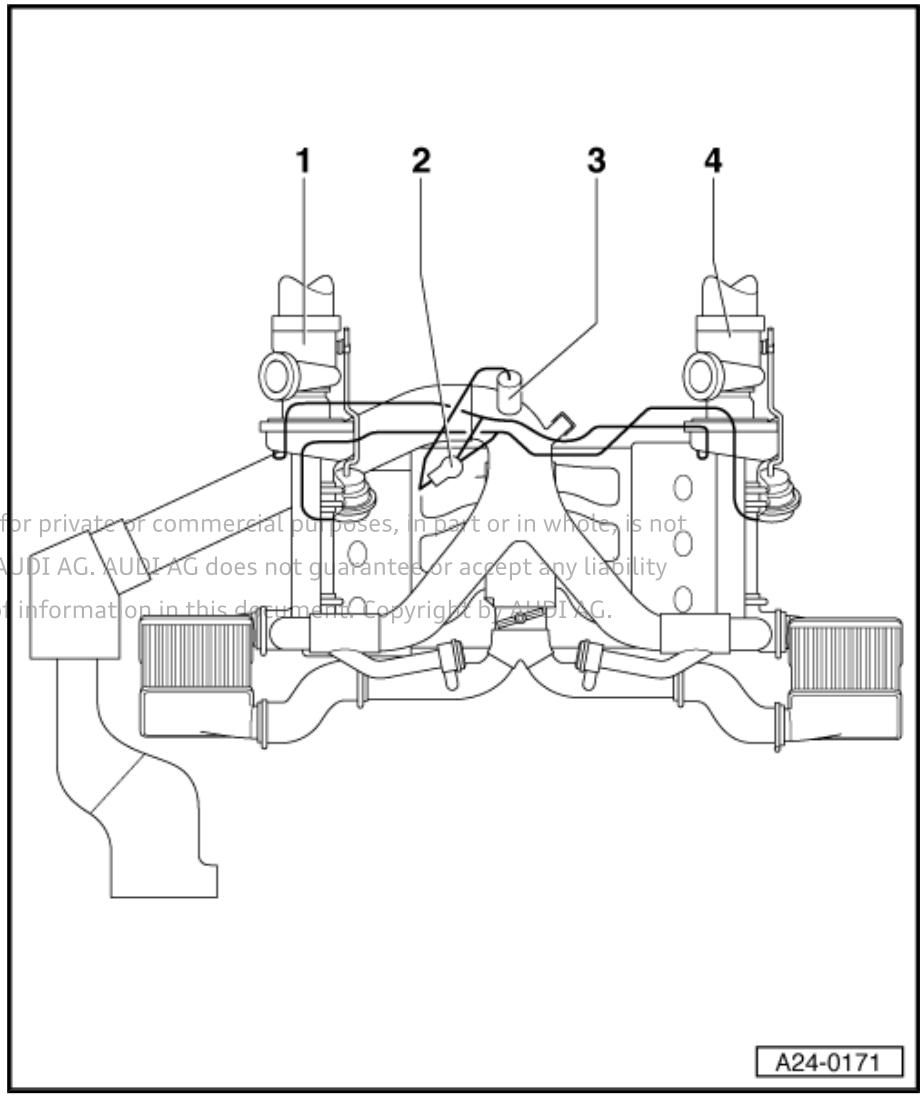
2 - Charge pressure control solenoid valve - N75-

- ❑ Checking ⇒ page 203

3 - Connecting piece

- ❑ For crankcase breather

4 - Turbocharger (left-side)



Overrun air recirculation control

1 - By-pass air cut-off valve for central idling speed - N8-

- ❑ Checking ⇒ page 212

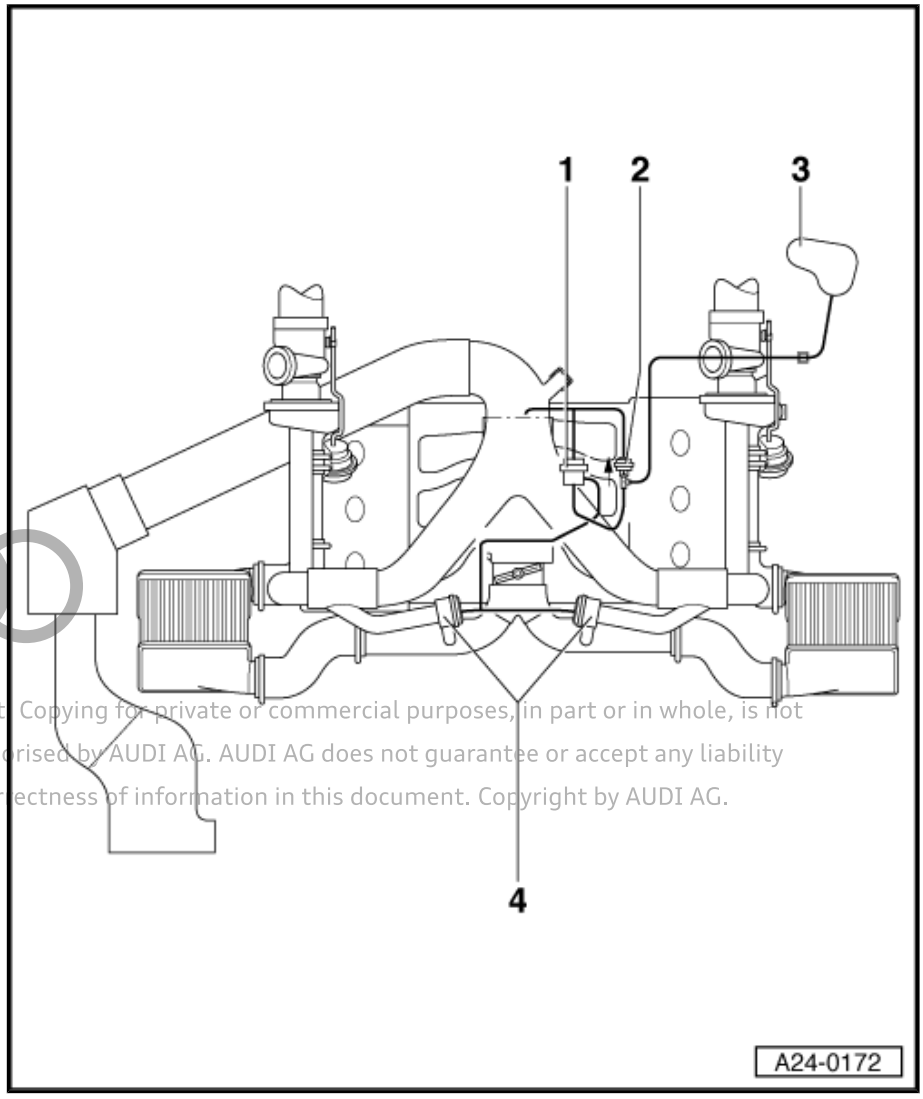
2 - Non-return valve

- ❑ Installation position: arrow points in through-flow direction

3 - Vacuum reservoir

4 - Mechanical air recirculation valves

- ❑ Checking ⇒ page 216



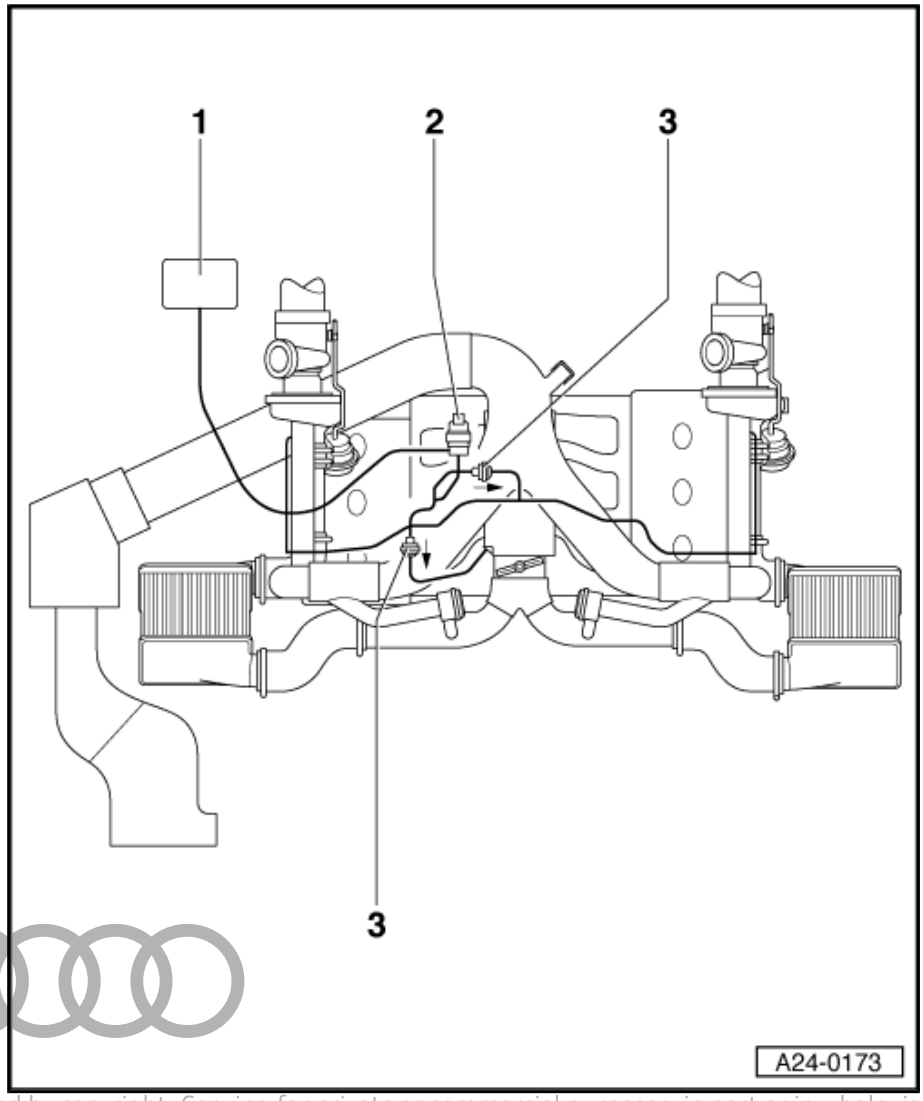
Fuel tank breather system

1 - Activated charcoal filter

2 - Activated charcoal filter solenoid valve 1 - N80-

3 - Non-return valves

- ❑ The arrow indicates the direction of flow



Crankcase breather

1 - Connection to cylinder head cover (right-side)

2 - Connecting piece

- ❑ Hose connections on vehicles with automatic gearbox ⇒ page 37

3 - Connection to cylinder block

4 - Pressure limiting valve

5 - Connection to cylinder head cover (left-side)

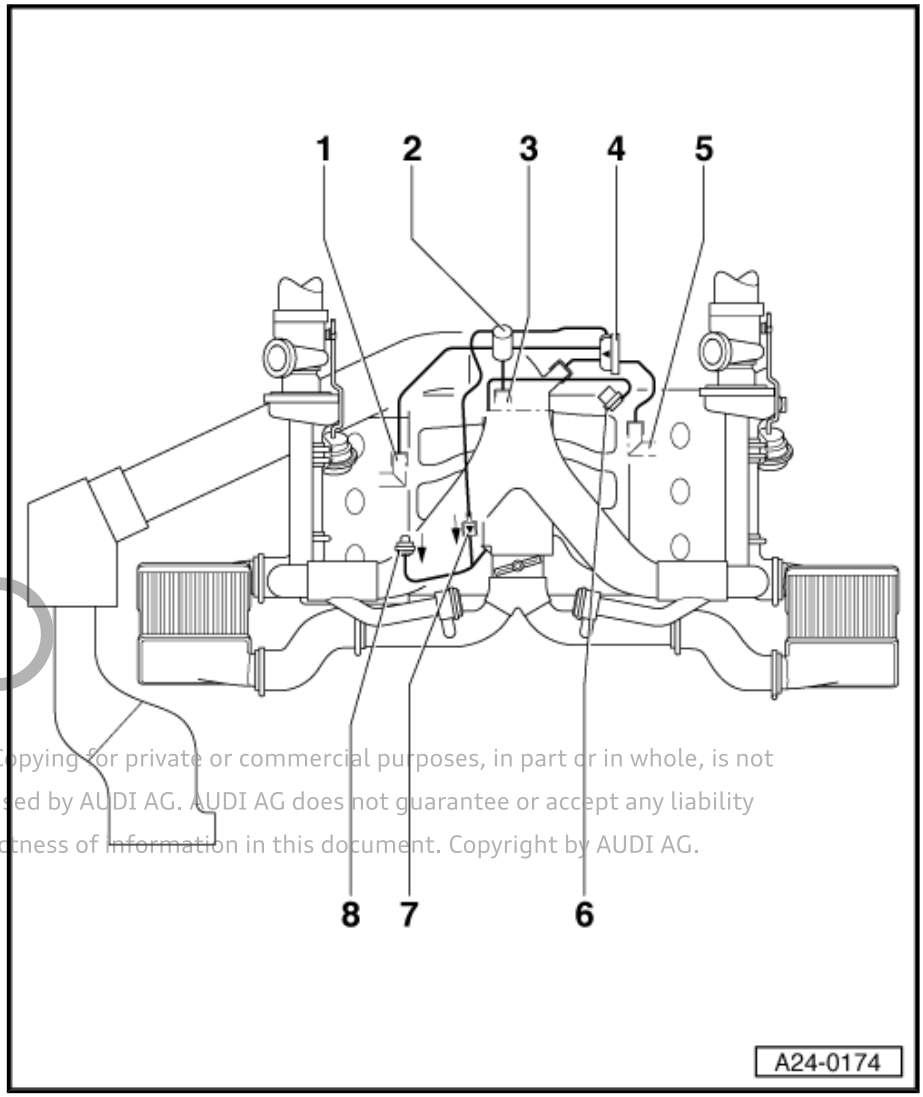
6 - Fuel pressure regulator

7 - Non-return valve

- ❑ The arrow indicates the direction of flow

8 - Non-return valve

- ❑ The arrow indicates the direction of flow



Suction-jet pump for vehicles with automatic gearbox

1 - To air cleaner

2 - Non-return valve

- ❑ The arrow indicates the direction of flow

3 - Connecting piece

- ❑ Schematic illustration

4 - To brake servo

5 - Suction-jet pump

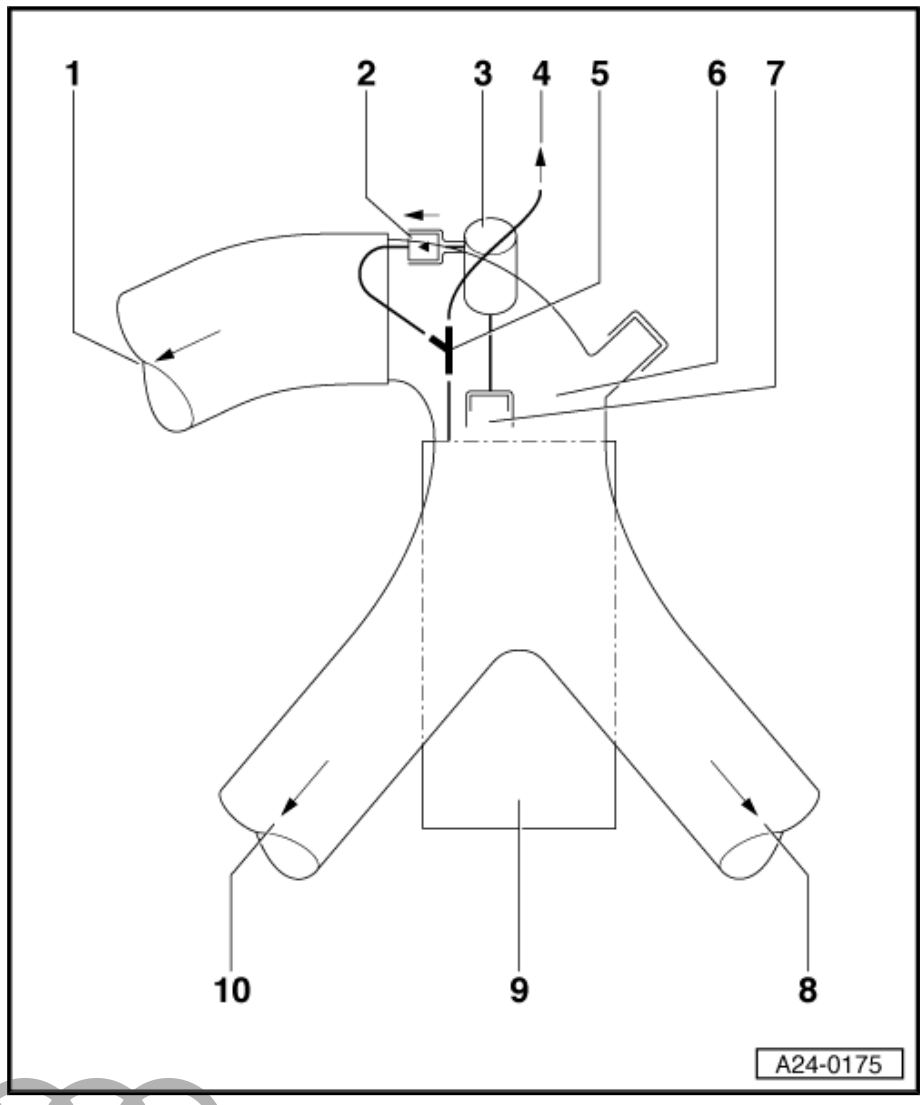
6 - Air duct

7 - Connection for crankcase breather

8 - To intake side of turbo-charger (right-side)

9 - Intake manifold

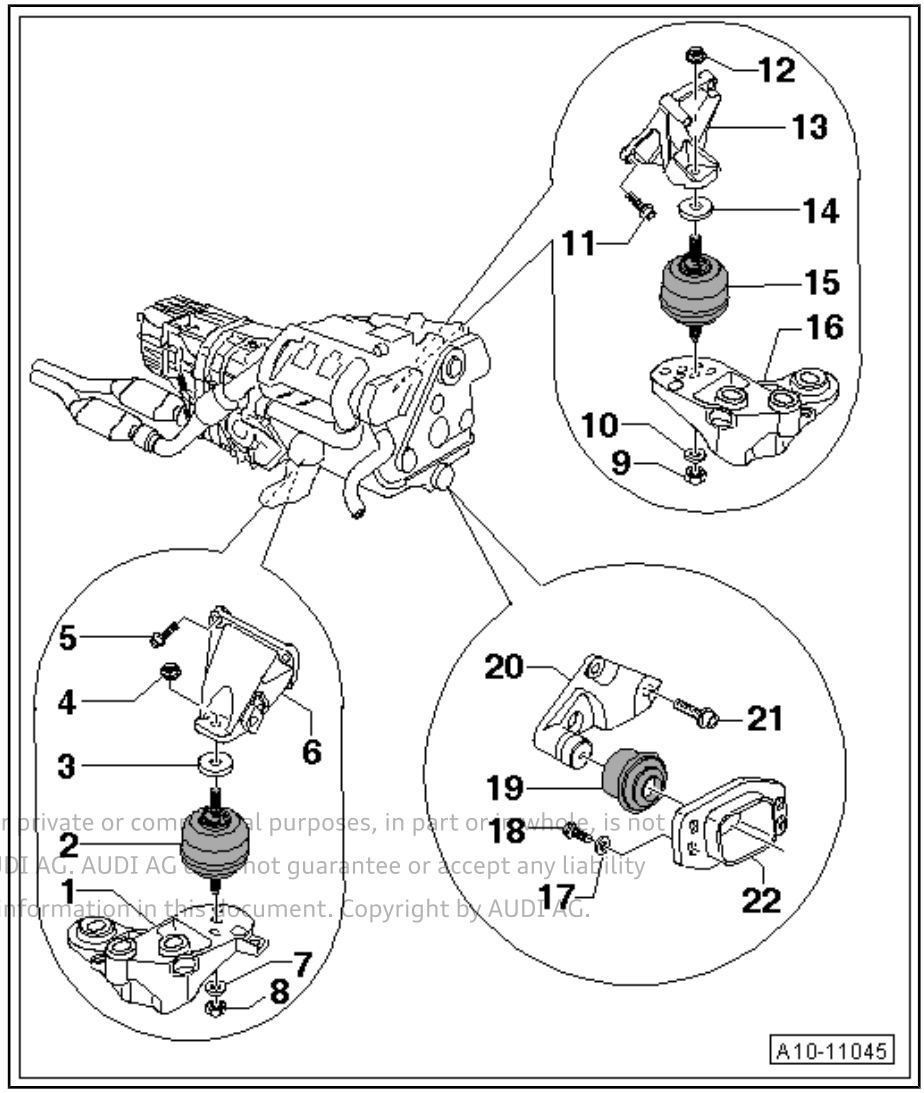
10 - To intake side of turbo-charger (left-side)



3.2 Fitting locations of electronic components in engine compartment

Fitting locations of electronic components in engine compartment ⇒ Rep. gr. 24 .

4 Exploded view - assembly mountings



1 - Console for engine mounting (right-side)

- ❑ Removing and installing ⇒ Removing and installing subframe; Rep. gr. 40

2 - Engine mounting (right-side)

3 - Washer

4 - Nut

- ❑ 23 Nm

5 - Bolt

- ❑ 46 Nm

6 - Engine support (right-side)

7 - Washer

8 - Nut

- ❑ 23 Nm

9 - Nut

- ❑ 23 Nm

10 - Washer

11 - Bolt

- ❑ 46 Nm

12 - Nut

- ❑ 23 Nm

13 - Engine support (left-side)

14 - Washer

15 - Engine mounting (left-side)

16 - Console for engine mounting (left-side)

- ❑ Removing and installing ⇒ Removing and installing subframe; Rep. gr. 40

17 - Washer

18 - Bolt

- ❑ 23 Nm

19 - Stop buffer

20 - Torque reaction support

21 - Bolt

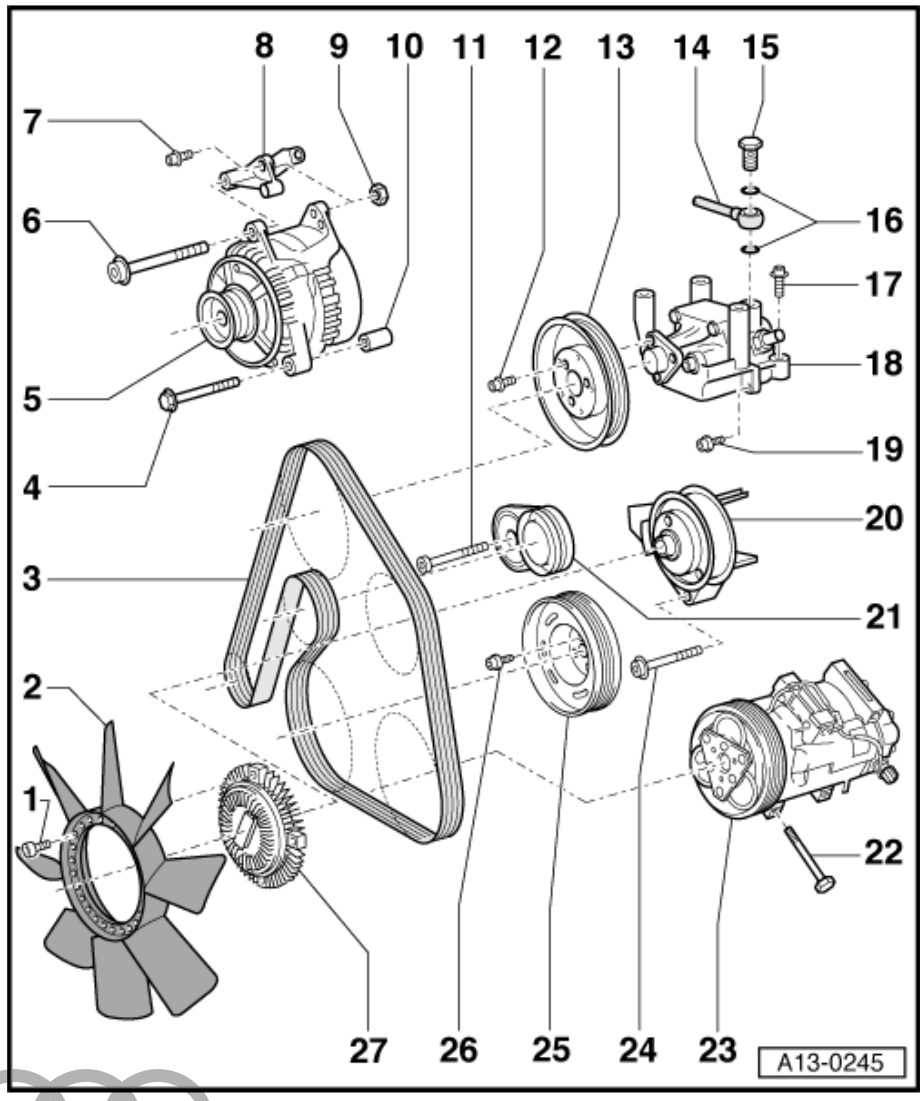
- ❑ 40 Nm

22 - Stop for torque reaction support

13 – Crankshaft group

1 Cylinder block (pulley end)

1.1 Exploded view - poly V-belt drive



1 - Bolt
- ❑ 11 Nm

2 - Fan wheel for viscous fan
- ❑ Removing and installing ⇒ page 189

3 - Poly V-belt
- ❑ Before removing, mark direction of rotation with chalk or felt-tip pen
- ❑ Removing and installing ⇒ page 41

4 - Bolt
- ❑ Tightening torque ⇒ Rep. gr. 27

5 - Alternator
- ❑ Removing and installing ⇒ Rep. gr. 27

6 - Bolt

7 - Bolt
- ❑ 22 Nm

8 - Bracket for alternator

9 - Nut
- ❑ Tightening torque ⇒ Rep. gr. 27

10 - Not fitted

11 - Bolt
- ❑ 55 Nm

12 - Bolt
- ❑ Tightening torque ⇒ Rep. gr. 48

13 - Poly V-belt pulley for power steering pump
- ❑ Removing and installing ⇒ Rep. gr. 48

14 - Pressure line
- ❑ To power-assisted steering

15 - Banjo bolt
- ❑ Tightening torque ⇒ Rep. gr. 48

16 - Seal
- ❑ Renew

17 - Bolt
- ❑ Tightening torque ⇒ Rep. gr. 48

18 - Power steering pump with bracket

- ❑ Removing and installing ⇒ Rep. gr. 48

19 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 48

20 - Poly V-belt pulley for viscous fan

- ❑ With bearing
- ❑ Removing and installing ⇒ page 190

21 - Poly V-belt tensioner

- ❑ Removing and installing ⇒ page 43

22 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 87

23 - Air conditioner compressor

- ❑ 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.
- ❑ Removing and installing ⇒ Rep. gr. 87

24 - Bolt

- ❑ M6: 10 Nm
- ❑ M8: 22 Nm

25 - Vibration damper

- ❑ Removing and installing ⇒ page 43

26 - Bolt

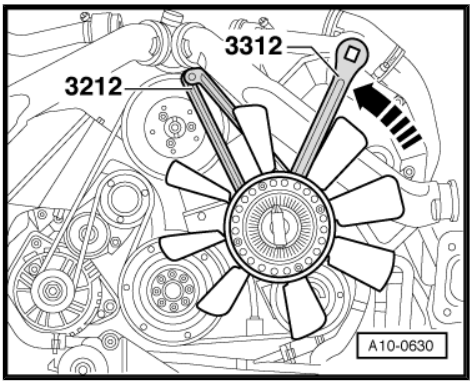
- ❑ 22 Nm

27 - Viscous fan coupling

- ❑ Removing and installing ⇒ “4.3 Removing and installing viscous fan”, page 189
- ❑ Tightening torque ⇒ page 41

Viscous fan - tightening torque

> **Caution**
>
> *Risk of damage to thread.*
>
> ♦ *The viscous fan has a left-hand thread.*



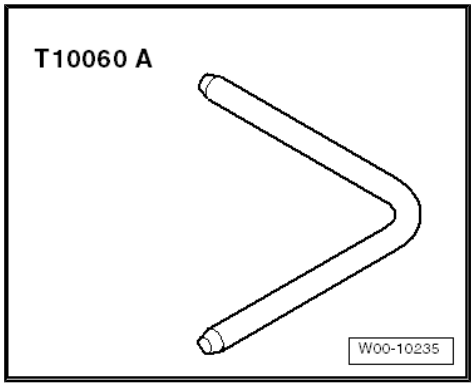
– Tighten viscous fan as follows:

- Viscous fan to bearing using torque wrench - V.A.G 1331- and open-end spanner - 3312- : 37 Nm
- Viscous fan to bearing using torque wrench - V.A.G 1332- without open-end spanner - 3312- : 70 Nm

1.2 Removing and installing poly V-belt

Special tools and workshop equipment required

- Locking pin - T10060 A-



Removing

– Release fasteners -arrows- and remove noise insulation.

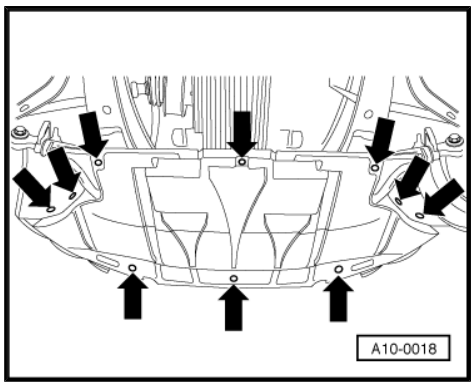
– Remove front bumper ⇒ Rep. gr. 63 .

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

Caution

Running a used poly V-belt in the opposite direction could cause irreparable damage.

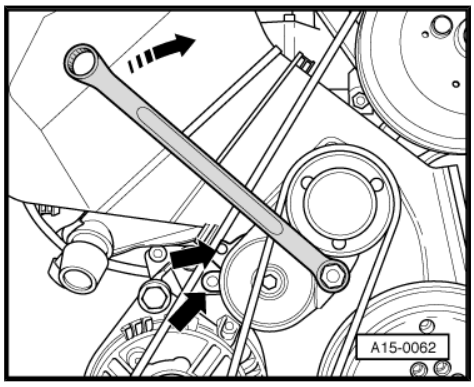
- *Before removing the poly V-belt, mark the direction of rotation with chalk or a felt-tip pen for re-installation.*



Tensioning roller with hexagon flats:

– To slacken poly V-belt use ring spanner to turn tensioner in clockwise direction -top arrow-.

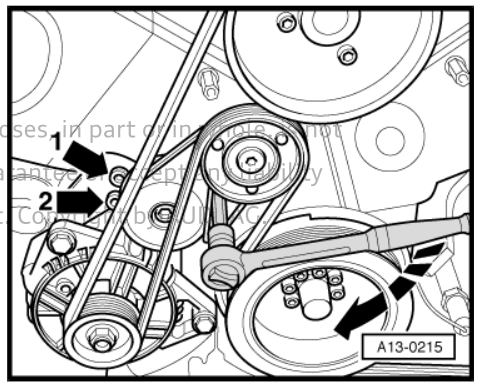
– Use locking pin - T10060 A- to lock poly V-belt tensioner in locating holes -bottom arrows- and detach poly V-belt.



Tensioning roller with hexagon socket:

– To slacken poly V-belt use 10 mm Allen key to turn tensioner in clockwise direction -right arrow-.

– Use locking pin - T10060 A- to lock poly V-belt tensioner in locating holes -arrow 1- and -arrow 2- and detach poly V-belt.



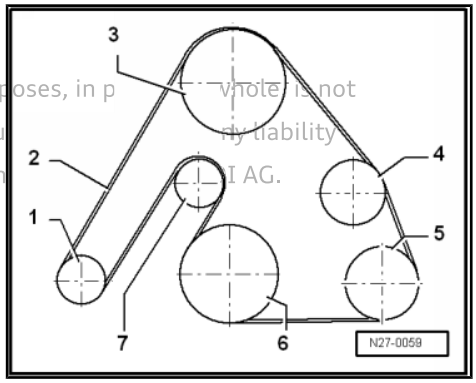
All vehicles (continued):

– Guide poly V-belt over viscous fan and detach belt.

Installing

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

– First fit poly V-belt on vibration damper. Push poly V-belt onto tensioning roller last.



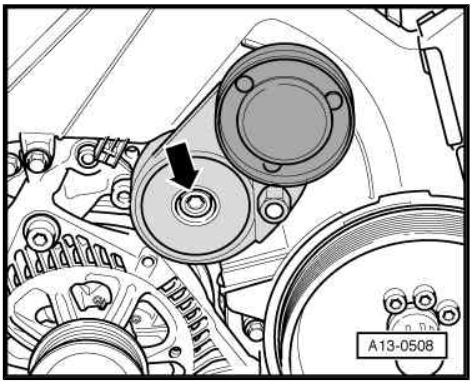
1 - Alternator
2 - Poly V-belt
3 - Power steering pump
4 - Viscous fan
5 - Air conditioner compressor
6 - Crankshaft
7 - Tensioner

– Start engine and check that belt runs properly.
– Install lock carrier with attachments ⇒ Rep. gr. 50 .
– Install front bumper ⇒ Rep. gr. 63 .
– Install noise insulation ⇒ Rep. gr. 50 .

1.3 Removing and installing tensioner for poly V-belt

Removing

– Remove poly V-belt ⇒ page 41 .
– Unscrew bolt -arrow- and remove poly V-belt tensioner.



Installing

• Tightening torque ⇒ page 40

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

– Install poly V-belt ⇒ page 41 .

1.4 Removing and installing vibration damper

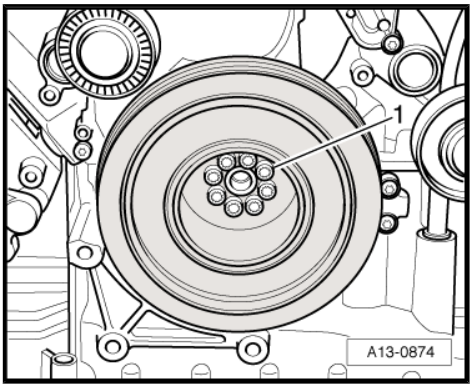
Removing

– Remove poly V-belt ⇒ page 41 .

Note

It is not necessary to unscrew bolt for crankshaft sprocket to remove vibration damper.

– Unscrew bolts -1- and remove vibration damper.



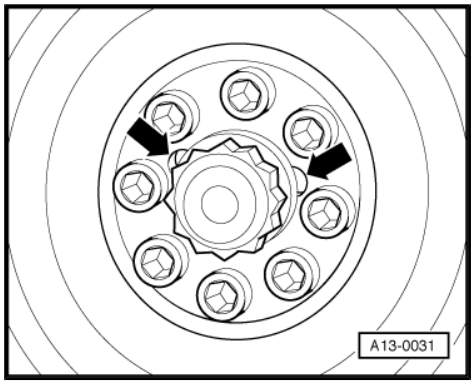
Installing

- Tightening torque ⇒ page 40

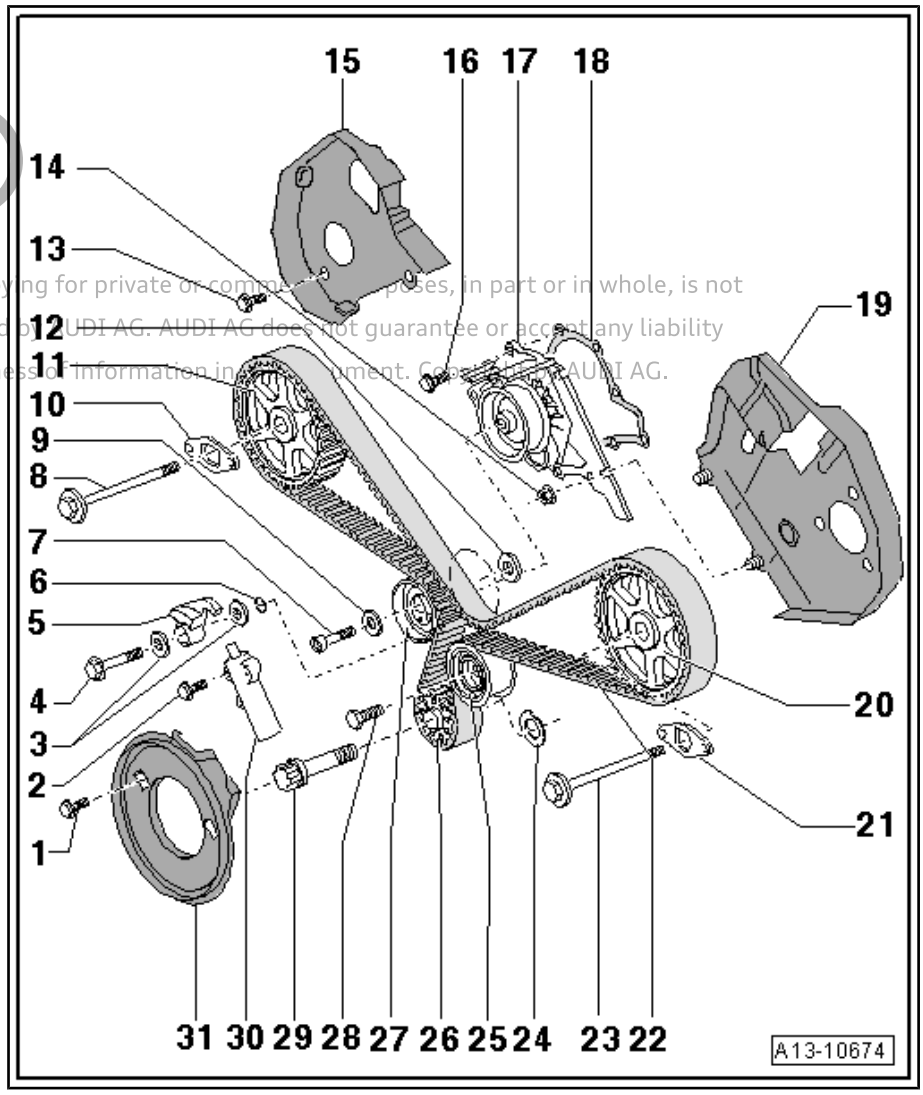
Installation is carried out in reverse order; note the following:

- Ensure that notches -arrows- in vibration damper are aligned with locating lugs on toothed belt sprocket.

– Install poly V-belt ⇒ page 41 .



1.5 Exploded view - toothed belt drive



1 - Bolt

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

2 - Bolt

- ❑ 10 Nm

3 - Washers

4 - Bolt

- ❑ 22 Nm

5 - Tensioning lever

- ❑ With bearing bush

6 - O-ring

- ❑ Renew if damaged
- ❑ Locates ⇒ Item 3 (page 44) , ⇒ Item 4 (page 44) and ⇒ Item 5 (page 44) when assembled

7 - Bolt

- ❑ 22 Nm

8 - Bolt

- ❑ 55 Nm

9 - Washer

10 - Locating plate

- ❑ Side labelled “rear/hinten” faces rear

11 - Camshaft sprocket (right-side)

- ❑ Removing and installing ⇒ “1.6 Removing and installing toothed belt”, page 46
- ❑ Remove using puller - T40001-

12 - Shim

13 - Bolt

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

14 - Nut

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

15 - Toothed belt cover (rear right)

16 - Bolt

- ❑ Tightening torque ⇒ Item 7 (page 170)

17 - Coolant pump

- ❑ Removing and installing ⇒ page 170

18 - Gasket

- ❑ Renew

19 - Toothed belt cover (rear left)

20 - Camshaft sprocket (left-side)

- ❑ Removing and installing ⇒ “1.6 Removing and installing toothed belt”, page 46
- ❑ Remove using puller - T40001-

21 - Locating plate

- ❑ Side labelled “rear/hinten” faces rear

22 - Toothed belt

- ❑ Before removing, mark direction of rotation with chalk or felt-tip pen
- ❑ Check for wear
- ❑ Removing ⇒ page 46
- ❑ Installing (adjusting valve timing) ⇒ page 50

23 - Bolt

- ❑ 55 Nm

24 - Diamond-coated washer for toothed belt sprocket

- ❑ Depending on version ⇒ Electronic parts catalogue
- ❑ Renew washer if toothed belt sprocket is removed

25 - Idler roller

26 - Crankshaft sprocket

- ❑ Renew diamond-coated washer ⇒ Item 24 (page 45) if removed
- ❑ Contact surfaces between toothed belt sprocket, diamond-coated washer and crankshaft must be free of oil
- ❑ Can only be installed in one position

27 - Tensioning roller

- ❑ With bearing bush

28 - Bolt

- ❑ 42 Nm

29 - Bolt

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

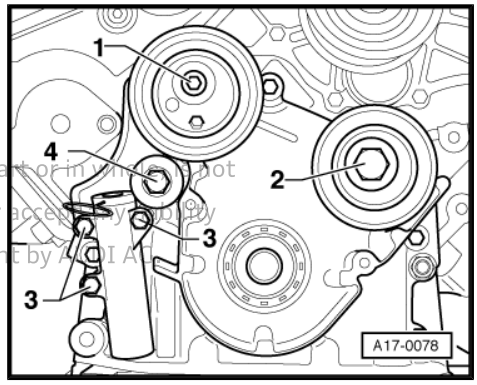
30 - Tensioner

31 - Toothed belt cover (bottom)

Installing tensioner, tensioning lever, toothed belt tensioning roller and idler roller

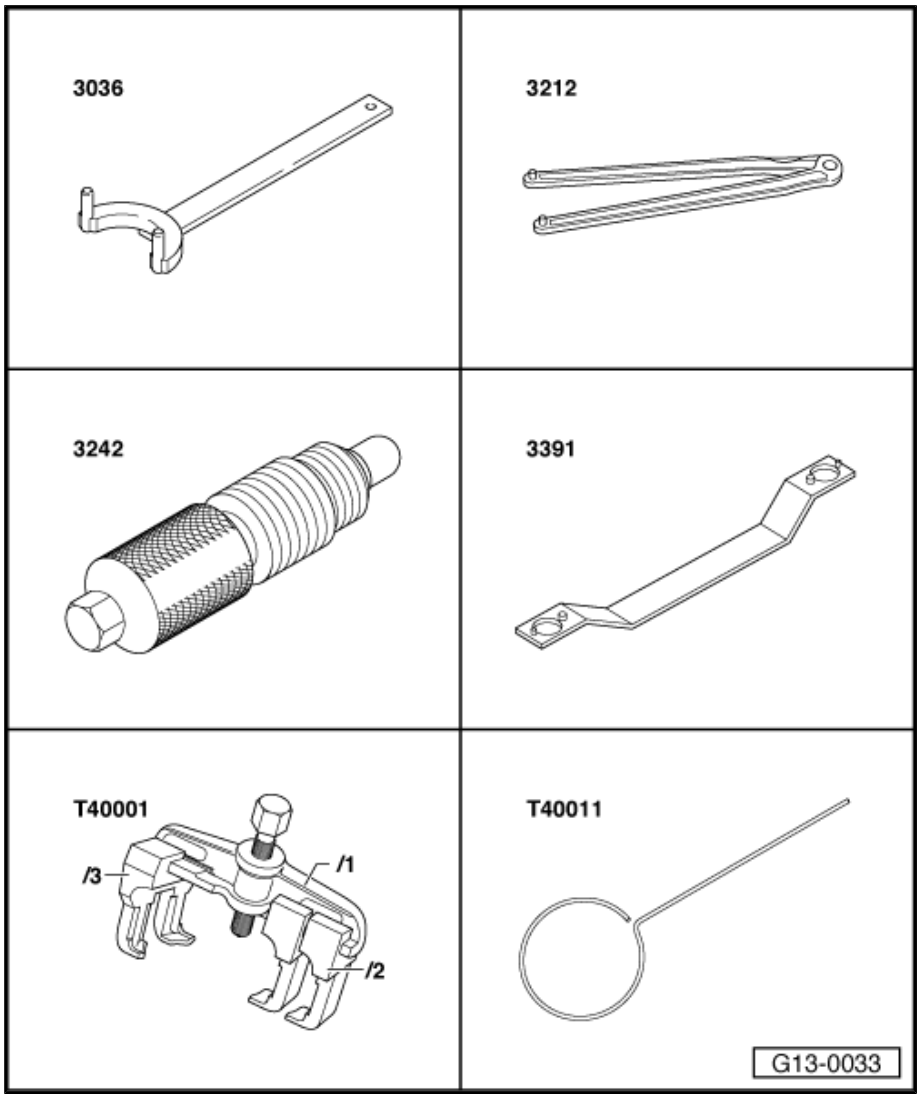
– Install components in the specified sequence:

1. Toothed belt tensioner -3-.
2. Tensioning lever -4-, note spacer.
3. Toothed belt tensioning roller -1-, note spacer.
4. Idler roller -2-.



1.6 Removing and installing toothed belt

Special tools and workshop equipment required



- Counterhold tool - 3036-
- Pin wrench - 3212-
- Locking pin - -
- Camshaft clamp - 3391-
- Two-arm puller - T40001- with claws -T40001/2-

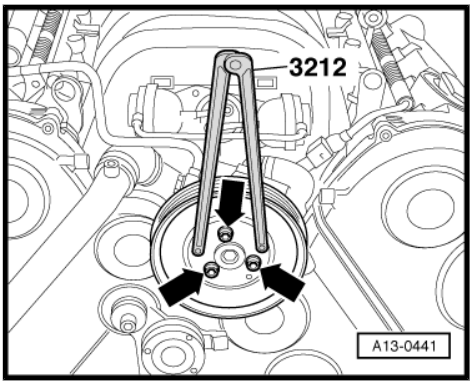
♦ Locking pin - T40011-

Removing

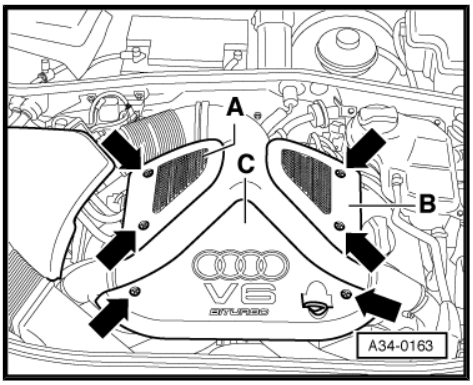
– Remove poly V-belt ⇒ page 41 .

– Remove viscous fan ⇒ page 189 .

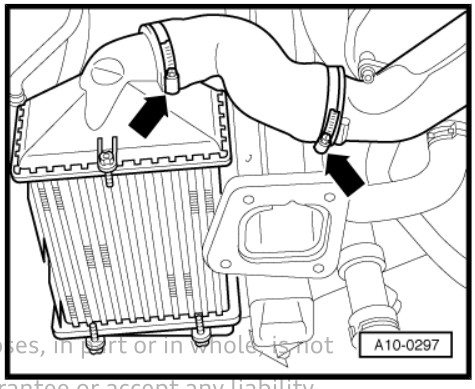
– Unbolt poly V-belt pulley for power steering pump -arrows- using pin wrench - 3212- as a counterhold.



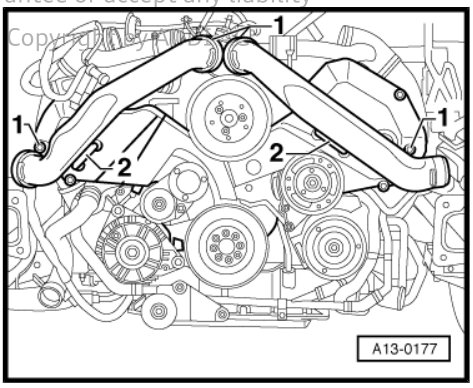
– Detach engine cover panel -C- by removing bolts -arrows-.



– Remove air hoses at top left and top right -arrows- between charge air cooler and air pipe.



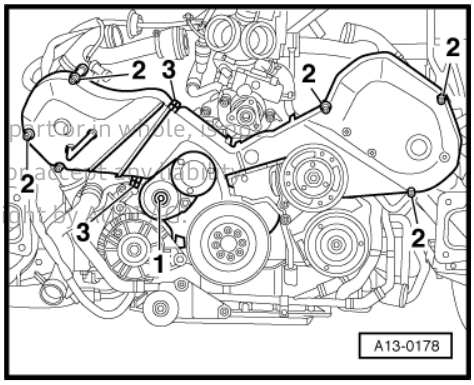
– Remove bolts -1- and detach air pipes.



Note

Pay attention to retaining strips -2-.

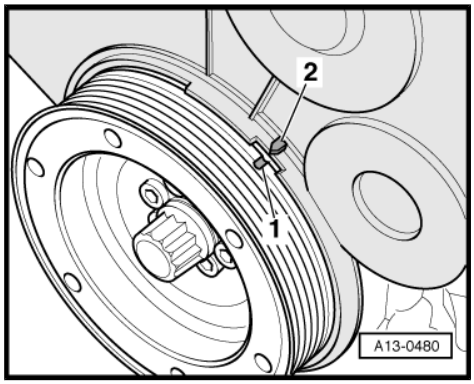
– Remove bolt -1- and take off poly V-belt tensioner.
– Release fasteners -2- and -3- and remove toothed belt cover on left, right and centre.



Caution

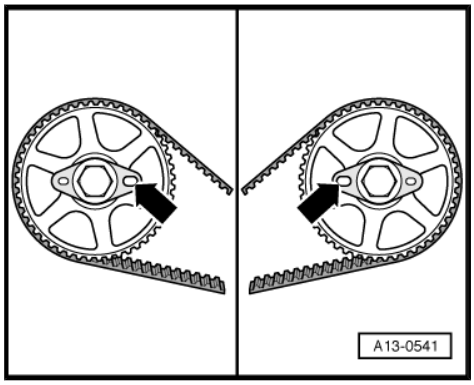
Irreparable damage can be caused if the toothed belt slips.

- *Only turn crankshaft in direction of engine rotation.*



– Turn crankshaft in direction of engine rotation via bolt for toothed belt sprocket until marking is at “TDC”.
• Notch -1- should align with marking -2-.

– Check position of camshafts:
• Large holes -arrows- in locating plates at camshaft sprockets must be opposite one another on inside.
– If this is not the case, turn crankshaft one revolution further.



– Unscrew plug for “TDC” marking from cylinder block.

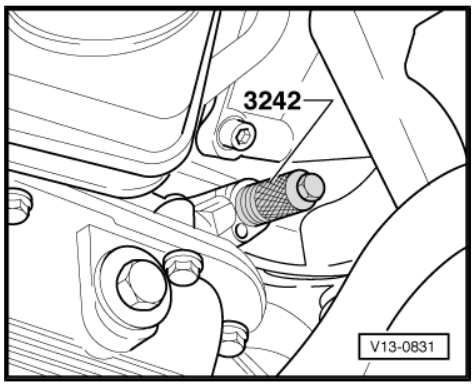
Note

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

WARNING

Risk of injury

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

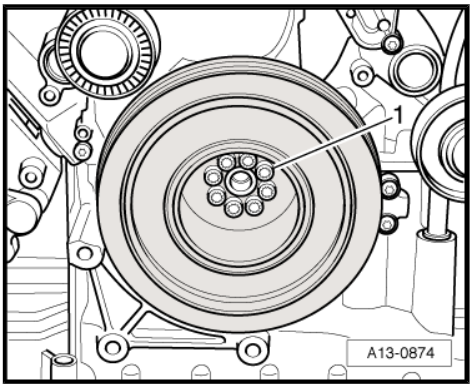


– Screw locking pin - 3242- into hole and tighten to 20 Nm. If necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.

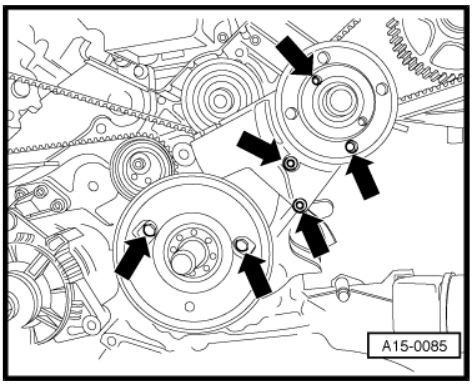
Note

It is not necessary to unscrew bolt for crankshaft sprocket to remove vibration damper.

– Unscrew bolts -1- and remove vibration damper.



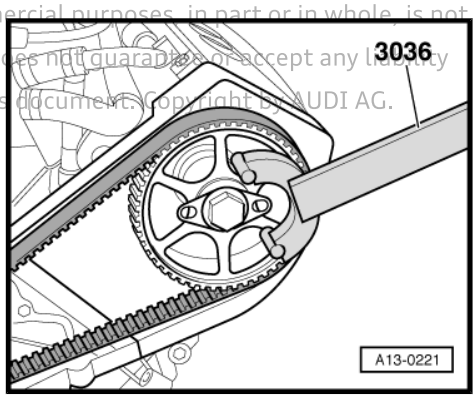
– Unscrew bolts -arrows- and remove toothed belt cover (bottom) and poly V-belt pulley for viscous fan.



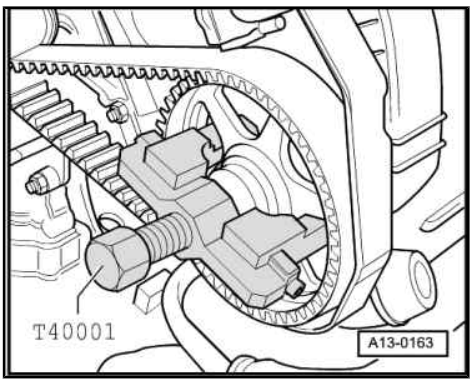
– Loosen bolts on both camshaft sprockets using counterhold tool - 3036- .

Note

Leave bolts screwed in loosely.



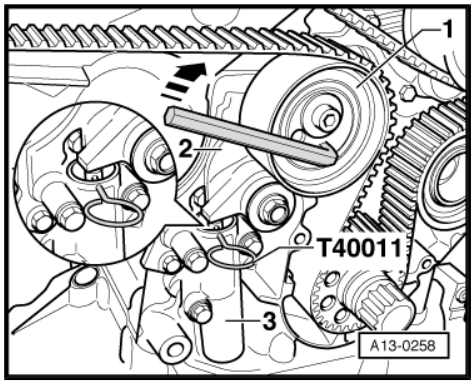
– Pull camshaft sprockets (left and right) off their tapers using two-arm puller - T40001- with claws - T40001/2- .



Caution

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

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



Note

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

– Turn toothed belt tensioning roller -1- clockwise in direction of -arrow- using an 8 mm Allen key until tensioning lever -2- compresses tensioner -3- far enough for pressure piston to be locked with locking pin - T40011- .

– Release pressure from toothed belt tensioning roller.

– Remove toothed belt.

Installing (adjusting valve timing)

• Tightening torques ⇒ page 44

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

• Crankshaft locked in position with locking pin - 3242- .

• Camshaft sprockets free to turn.

Caution

Risk of damage to valves and piston crowns.

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

Note

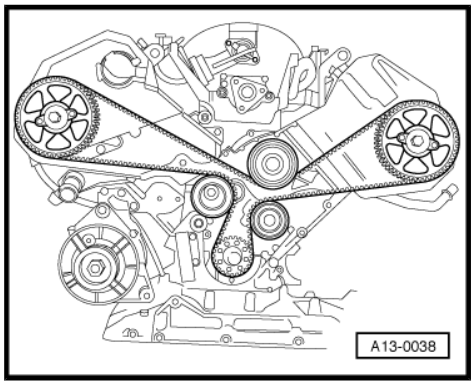
The valve timing must be adjusted as described below even when the toothed belt has only been removed from the camshaft sprocket.

– Fit both camshaft sprockets with locating plates, washers and bolts.

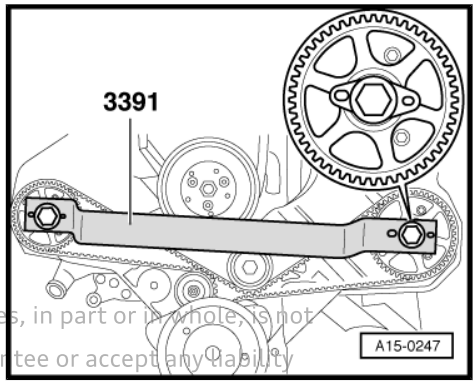
• Installation position of locating plates: labelled side "front/ vorne" faces front or marking "rear/hinten" faces rear.

– Tighten the two camshaft sprocket bolts until the sprockets can still just be turned without axial movement.

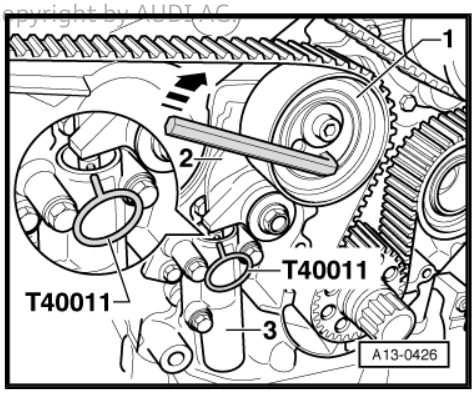
– Position toothed belt as shown on all sprockets and finally on tensioning roller.



– Insert camshaft clamp - 3391- in locating plates of both camshafts.



– Using an 8 mm Allen key, turn toothed belt tensioning roller -1- clockwise in direction of -arrow- until locking pin - T40011- can be removed.



Proceed as follows to pre-tension tensioning roller before first starting engine:

– Apply torque wrench at hexagon socket of tensioning roller and tension belt with a torque of 15 Nm.

• This provides the correct amount of initial tension.

– Tighten camshaft sprockets to 30 Nm.

– Remove camshaft clamp - 3391- .

– Tighten camshaft sprockets to final torque using counterhold tool - 3036- .

– Remove locking pin - 3242- .

– Tighten plug for TDC marking in cylinder block ⇒ page 53 .

– Install air pipe ⇒ page 220 .

– Install air hoses ⇒ page 227 .

– Install poly V-belt pulley for power steering pump ⇒ Rep. gr. 48 .

– Install viscous fan ⇒ page 189 .

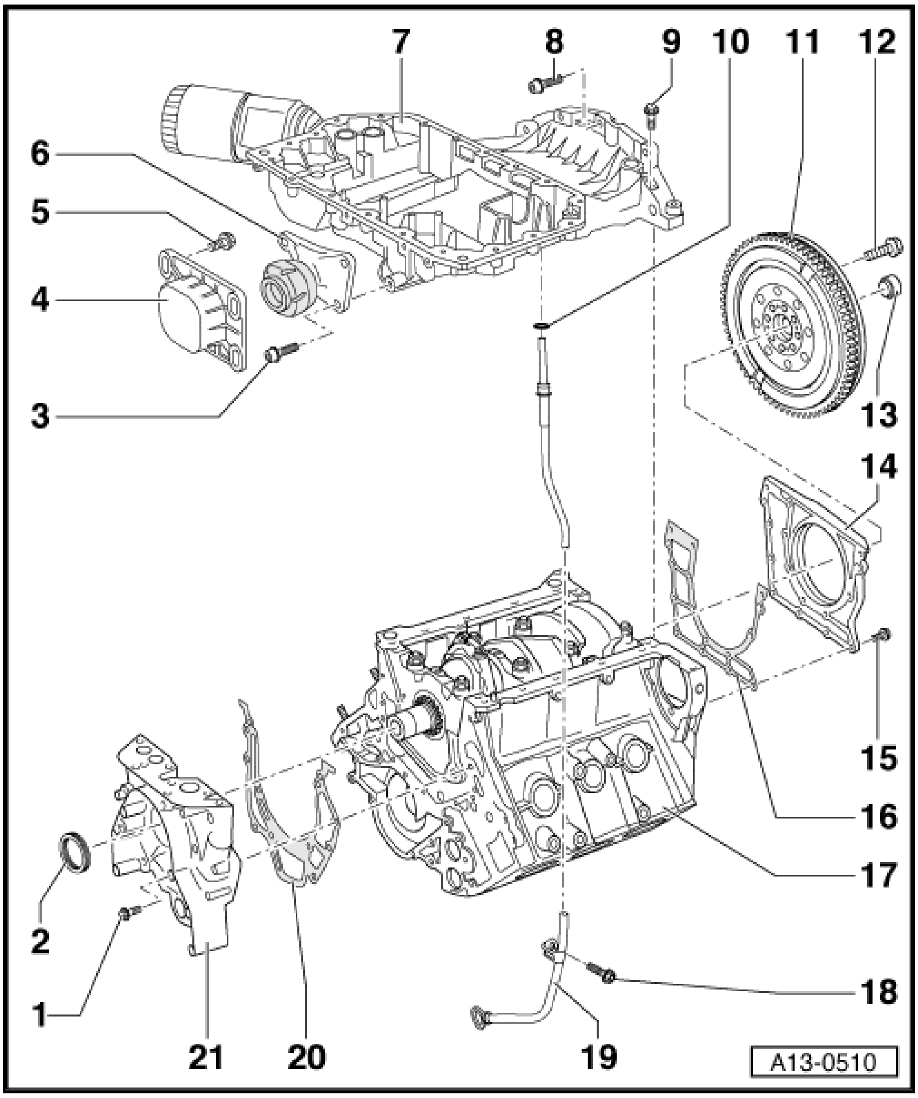
– Install poly V-belt ⇒ page 41 .

2 Sealing flanges and dual-mass flywheel/drive plate

Note

Servicing clutch ⇒ Rep. gr. 30

2.1 Exploded view - sealing flanges and dual-mass flywheel/drive plate



1 - Bolt
- ❑ M6: 10 Nm
- ❑ M8: 30 Nm; Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue

2 - Crankshaft oil seal
- ❑ Renewing ⇒ page 54

3 - Bolt
- ❑ Tightening torque ⇒ Item 21 (page 39)

4 - Stop for torque reaction support

5 - Bolt
- ❑ Tightening torque ⇒ Item 18 (page 39)

6 - Torque reaction support

7 - Sump (top section)
- ❑ Removing and installing ⇒ page 149

8 - Bolt
- ❑ Tightening torque and sequence ⇒ page 142

9 - Bolt
- ❑ Tightening torque and sequence ⇒ page 142

10 - O-ring
- ❑ Renew

11 - Dual-mass flywheel / drive plate
- ❑ Removing and installing ⇒ “2.4 Removing and installing dual-mass flywheel - vehicles with manual gearbox”, page 60 or ⇒ “2.6 Removing and installing drive plate - vehicles with automatic gearbox”, page 63

12 - Bolt
- ❑ Renew
- ❑ Dual-mass flywheel: 60 Nm + turn 180° further
- ❑ Drive plate: 60 Nm + turn 90° further

13 - Needle bearing
- ❑ Only with manual gearbox
- ❑ Extracting and driving in ⇒ page 62

❑ On vehicles with automatic gearboxes, a bearing bush is inserted ⇒ page 69

14 - Sealing flange (gearbox end) with oil seal

❑ Lubricate sealing lip of oil seal lightly

❑ Renewing ⇒ page 65

15 - Bolt

❑ 10 Nm

16 - Gasket

❑ Renew

17 - Cylinder block

18 - Bolt

❑ Tightening torque ⇒ Item 1 (page 140)

19 - Dipstick guide tube

20 - Gasket

❑ Renew

21 - Sealing flange (pulley end)

❑ Removing and installing ⇒ page 56

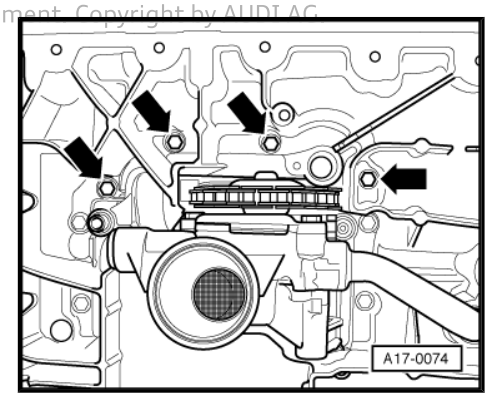
❑ Sealing flange to sump (top section) - tightening torque ⇒ page 53

Sealing flange (pulley end) to sump (top section) - tightening torque

– Tighten bolts -arrows- as follows:

♦ M6: 10 Nm

♦ M7: 16 Nm

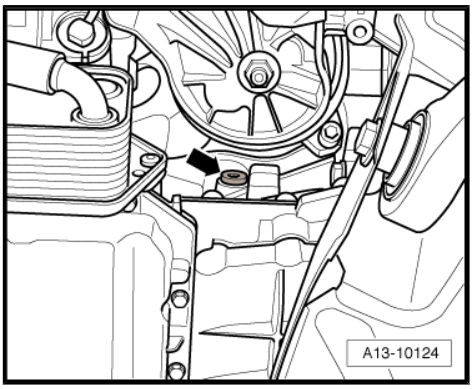


Plug for TDC drilling - tightening torque

Note

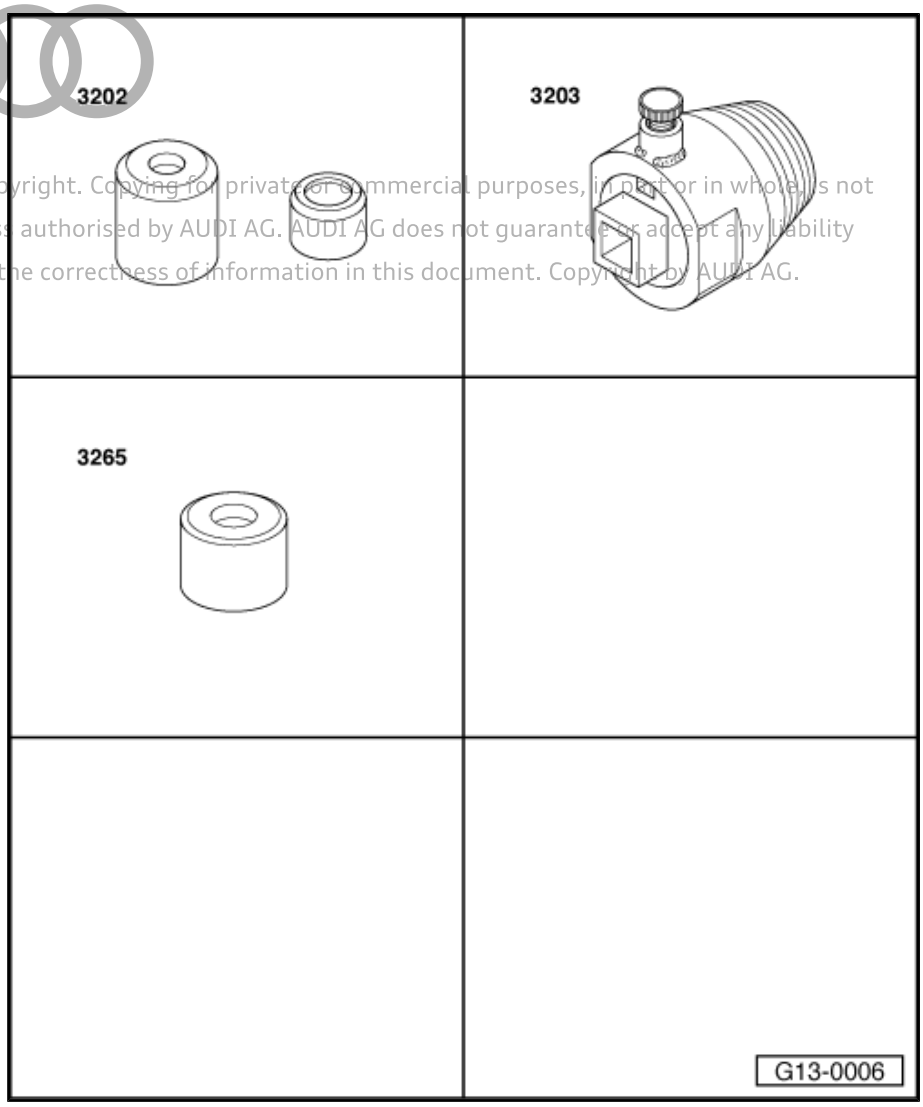
Renew O-ring.

– Tighten plug -arrow- to 35 Nm.



2.2 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required



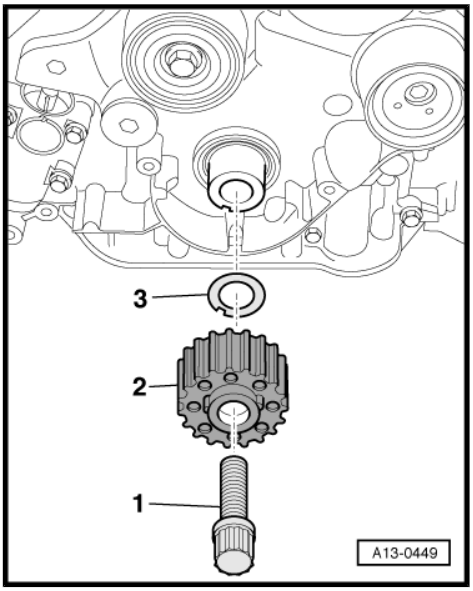
- Fitting sleeves - 3202-
- Oil seal extractor - 3203-
- Fitting sleeve - 3265-

Procedure

– Remove toothed belt ⇒ page 46 .

– Remove bolt -1- and detach crankshaft sprocket -2-.

– If fitted, remove diamond-coated washer -3- from toothed belt sprocket.



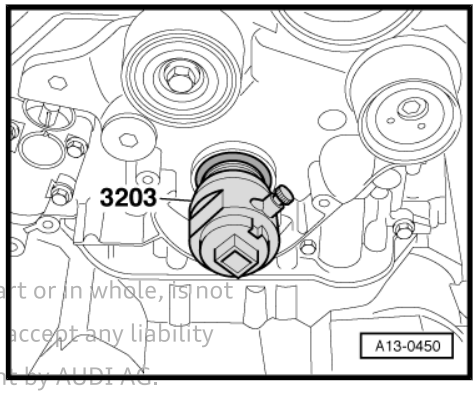
– Adjust inner section of oil seal extractor - 3203- so it is flush with outer section.

– Unscrew inner section of oil seal extractor 3 turns out of outer section and lock with knurled screw.

– Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).

– Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.

– Clamp flats of oil seal extractor in vice and use pliers to remove oil seal.



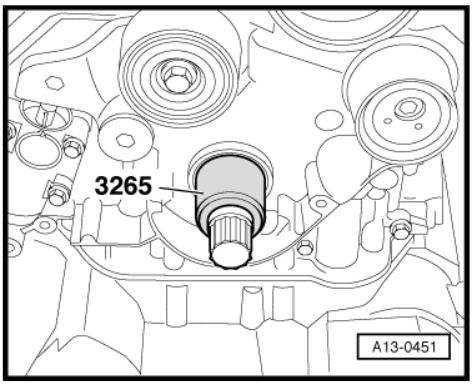
– Clean contact surface and sealing surface.

Note

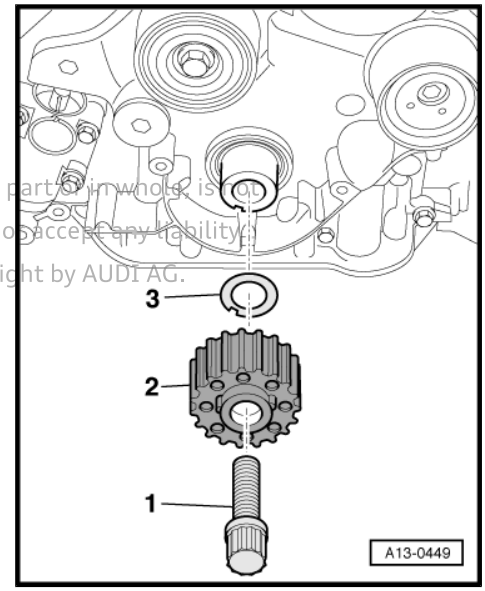
Do not lubricate sealing lip and outer rim of oil seal before pressing in.

– Push on oil seal using fitting sleeve - 3202/1- .

– Press oil seal in onto stop using fitting sleeve - 3265- and bolt.



– Install crankshaft toothed belt sprocket -2- with new diamond-coated washer -3- (depending on version) and new bolt -1-.



Note

♦ *The contact surfaces between toothed belt sprocket, diamond-coated washer and crankshaft must be free of oil.*

♦ *Do not additionally lubricate bolt for crankshaft toothed belt sprocket.*

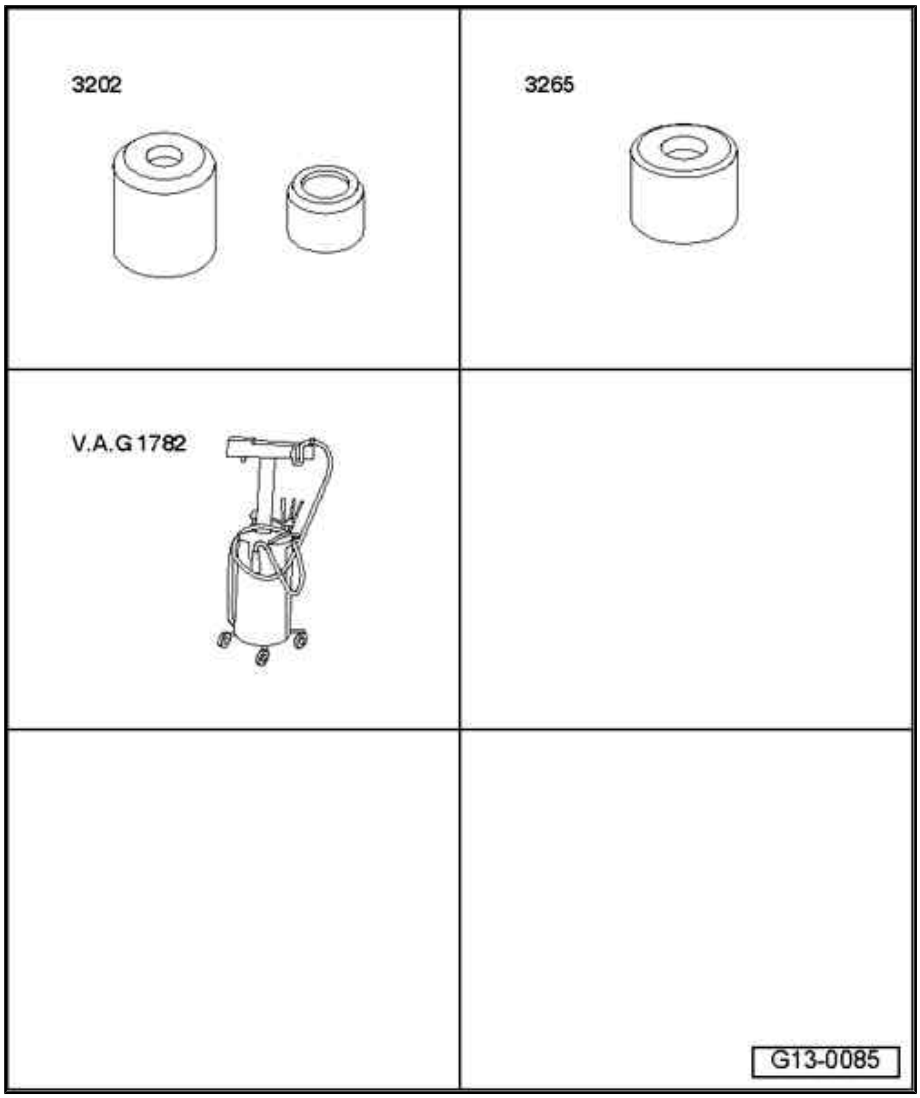
Installation is carried out in the reverse order; note the following:

– Install crankshaft sprocket ⇒ page 44 .

– Install toothed belt (adjust valve timing) ⇒ page 50 .

2.3 Removing and installing sealing flange (pulley end)

Special tools and workshop equipment required



♦ Fitting sleeve - 3202/1- from fitting sleeves - 3202-

- Fitting sleeve - 3265-
- Used oil collection and extraction unit - V.A.G 1782-
- Electric drill with plastic brush attachment
- Safety goggles
- Sealant ⇒ Electronic parts catalogue

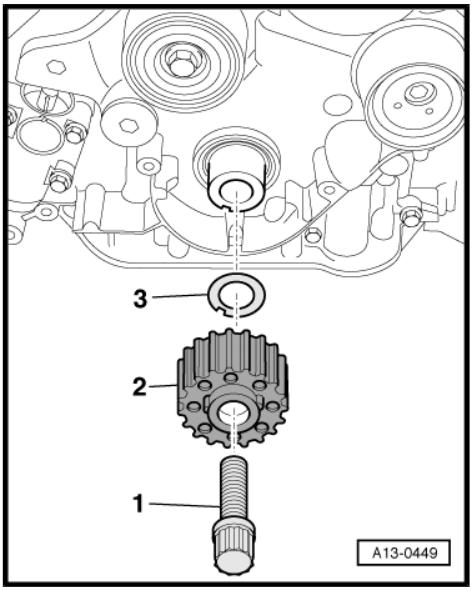
Removing

– Remove toothed belt ⇒ page 46 .

– Remove bolt -1- and detach crankshaft sprocket -2-.

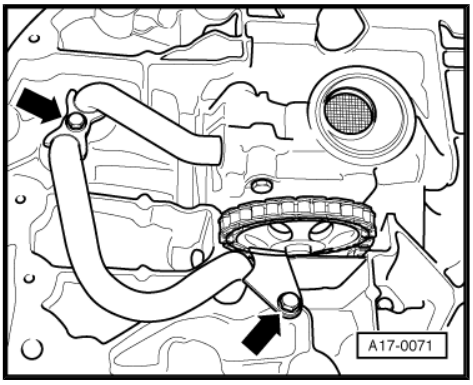
– If fitted, remove diamond-coated washer -3- from toothed belt sprocket.

– Remove sump (bottom section) ⇒ page 144 .

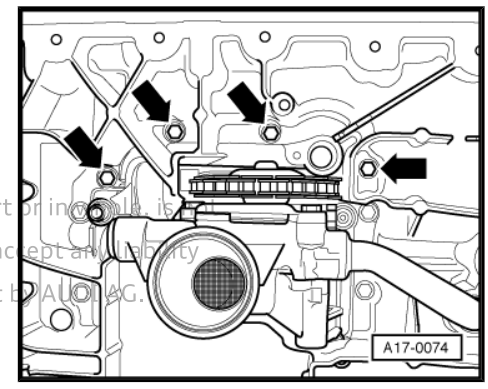


– Place used oil collection and extraction unit - V.A.G 1782- below engine.

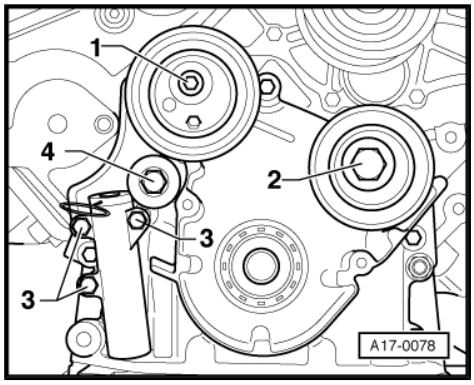
– Remove bolts -arrows- and pull off the longer of the two oil pipes.



– Remove bolts -arrows- from sump (top section).

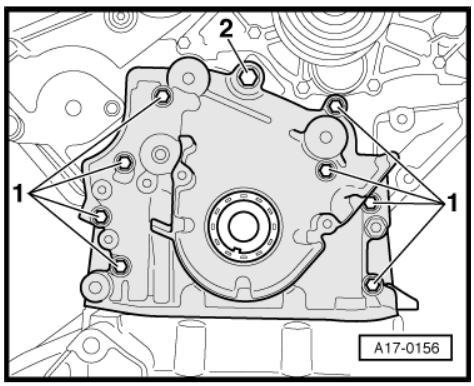


– Remove bolt -2- for idler roller, bolt -1- for tensioning roller, bolt -4- for tensioning lever and bolts -3- for tensioner and detach corresponding component.



– Remove bolts -1- and -2- and detach sealing flange (pulley end).

– Drive out oil seal at sealing flange (removed).



Installing

• Tightening torques ⇒ page 44 , ⇒ page 52 .

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

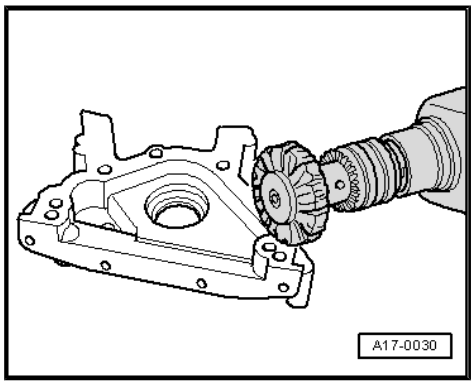
Note

Fit new O-rings.

Caution

Protect lubrication system against contamination.

- ***Cover exposed parts of the engine.***



WARNING

Risk of eye injury.

- ***Put on safety goggles.***

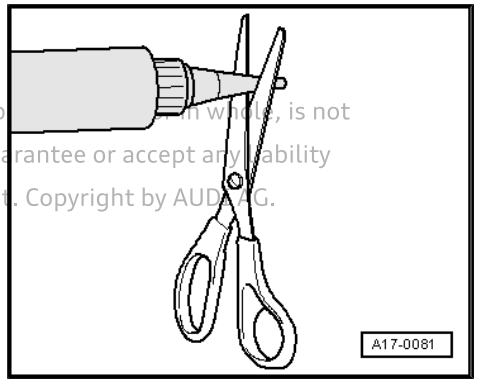
– Remove sealant residue from sealing flange, sump (top section, front) and cylinder block using rotating plastic brush or similar.

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

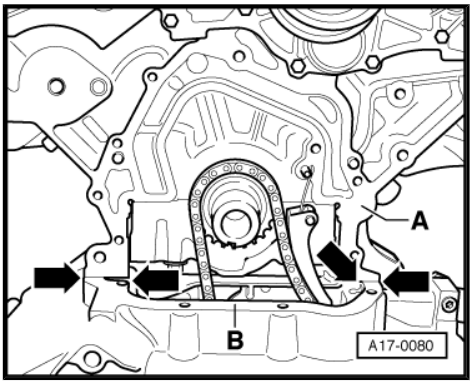
Note

Note the use-by date of the sealant.

– Cut off nozzle of tube at front marking (nozzle ∅ approx. 2 mm).



– Attach gasket to dowel pins on sealing surface -A-.



Note

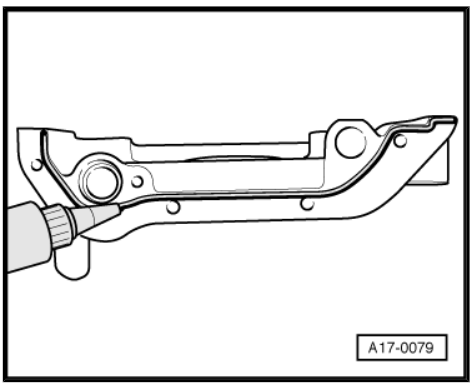
Do not apply sealant to sealing surface -A- on cylinder block.

– Apply a thin bead of sealant to the edge of the joints to sump -B- in area between -left arrows- and -right arrows-.

Caution

Make sure lubrication system is not clogged by excess sealant.

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



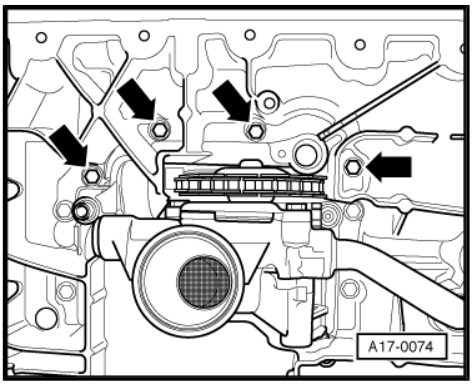
– Apply bead of sealant onto clean sealing surface of sealing flange as illustrated.

- Thickness of sealant bead: 2 ... 3 mm.

Note

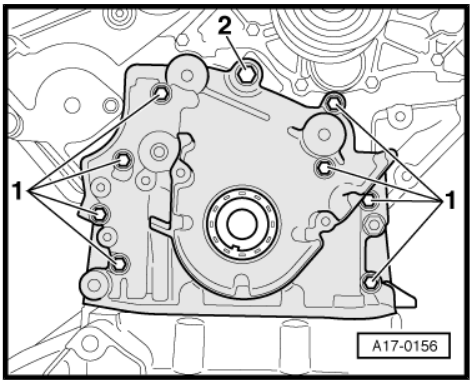
- *The sealing flange must be installed within 5 minutes after applying sealant.*
- *To position sealing flange with oil seal installed, attach fitting sleeve - 3202/1- to end of crankshaft.*

– Tighten bolts -arrows- hand-tight.



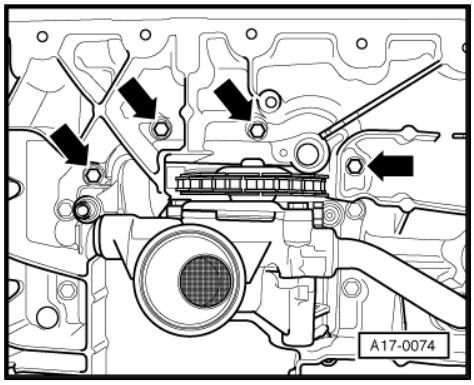
– Apply locking fluid when installing bolt -2-; for locking fluid refer to ⇒ Electronic parts catalogue .

– Tighten bolts -1- and -2-.



– Tighten bolts -arrows- ⇒ page 53 .

– Install sump (bottom section)
⇒ “1.4 Installing sump (bottom section) - engines with moulded gasket”, page 145 or
⇒ “1.5 Installing sump (bottom section) - engines with liquid gasket”, page 145 .



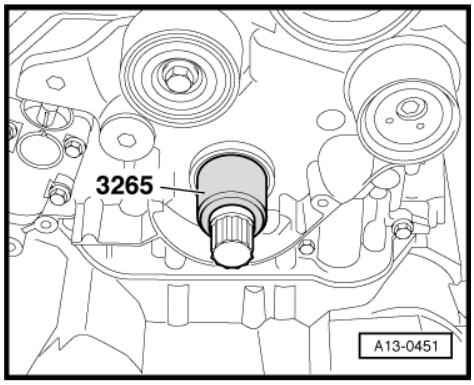
Note

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

– Fit oil seal using fitting sleeve -3202/1- .

– Press oil seal in onto stop using fitting sleeve - 3265- and bolt for crankshaft toothed belt sprocket.

– Install tensioner, tensioning lever, toothed belt tensioning roller and idler roller ⇒ page 46 .



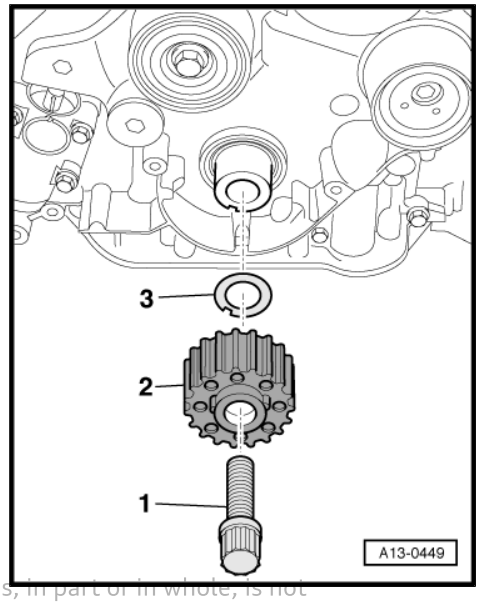
– Install crankshaft toothed belt sprocket -2- with new diamond-coated washer -3- (depending on version) and new bolt -1-.

Note

- *The contact surfaces between toothed belt sprocket, diamond-coated washer and crankshaft must be free of oil.*
- *Do not additionally lubricate bolt for crankshaft toothed belt sprocket.*

– Install crankshaft sprocket ⇒ page 44 .

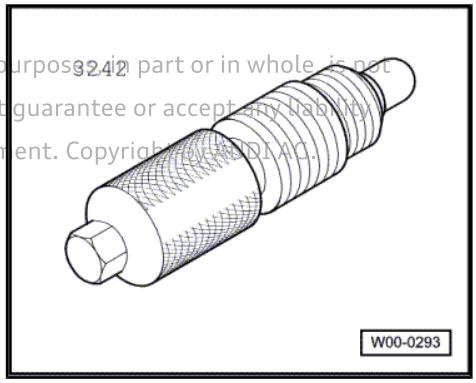
– Install toothed belt (adjust valve timing) ⇒ page 50 .



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

Special tools and workshop equipment required

- Locking pin - 3242-



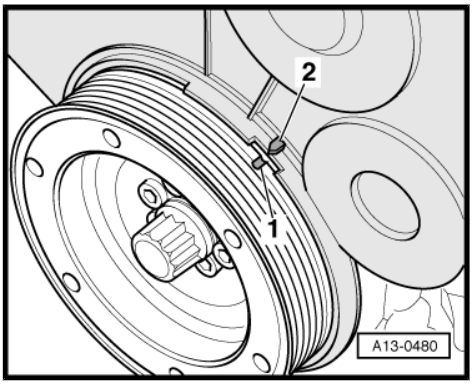
Removing

- Engine or gearbox removed.

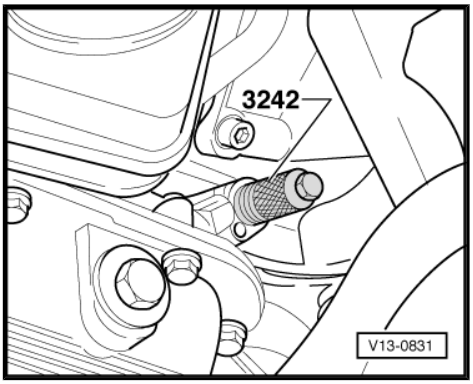
> **Caution**
>
> ***Irreparable damage can be caused if the toothed belt slips.***
>
> - ***Only turn crankshaft in direction of engine rotation.***

– Turn crankshaft in direction of engine rotation via bolt for toothed belt sprocket until marking is at “TDC”.

- Notch -1- should align with marking -2-.



– Unscrew plug for “TDC” marking from cylinder block.



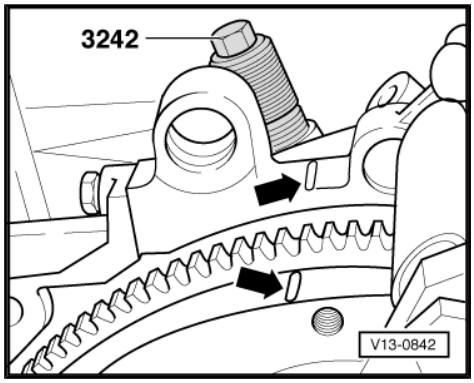
> **Note**
>
> *There is a TDC drilling in the crankshaft directly behind the sealing plug (it is possible to feel the hole).*

> **WARNING**
>
> ***Risk of injury***
>
> - ***Do not rotate the crankshaft while feeling for the TDC drilling with your finger.***

– Screw locking pin - 3242- into hole and tighten to 20 Nm. If necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.

– Remove clutch pressure plate ⇒ Rep. gr. 30 .

– Mark installation position of dual-mass flywheel -arrows-.
– Remove bolts and take off dual-mass flywheel.



Installing

• Tightening torque ⇒ page 52

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

Note

♦ *Renew bolts for dual-mass flywheel.*

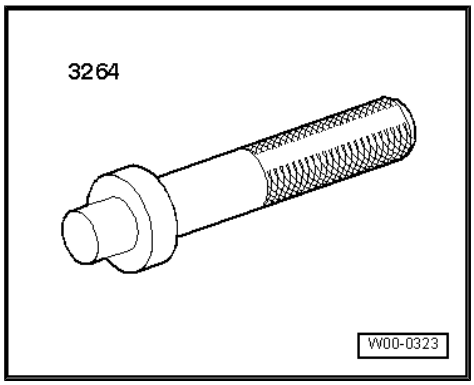
♦ *A needle bearing is fitted in the dual-mass flywheel; knock in the needle bearing when fitting a new flywheel* ⇒ page 62 .

– Remove locking pin - 3242-.
– Tighten plug for TDC marking in cylinder block ⇒ page 53 .

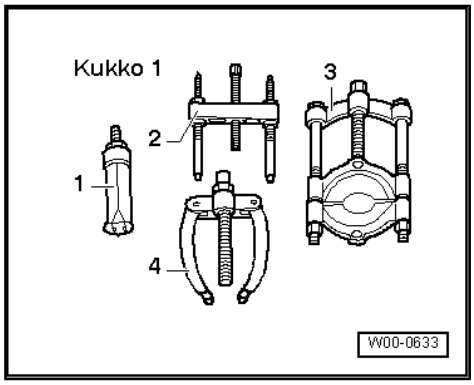
2.5 Extracting and driving in needle bearing for dual-mass flywheel

Special tools and workshop equipment required

♦ Punch - 3264-



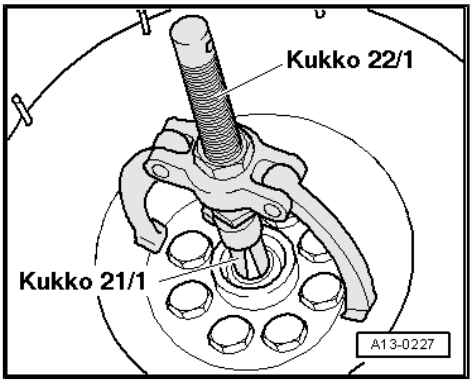
♦ -1- Internal puller - Kukko 21/1-



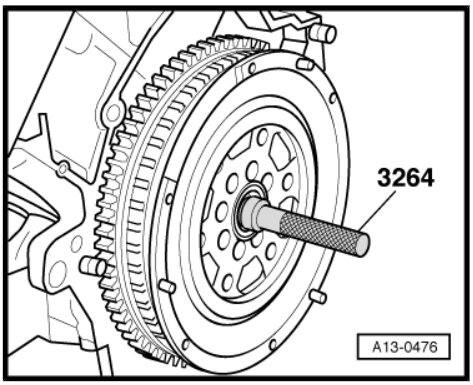
♦ -4- Counter-support - Kukko 22/1-

Procedure

– Pull out needle bearing with internal puller - Kukko 21/1- and counter-support - Kukko 22/1- .



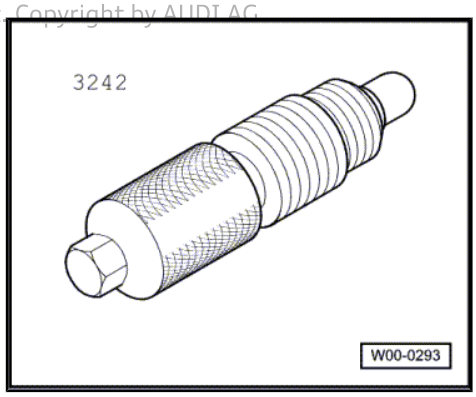
– Drive in needle bearing until flush using punch - 3264- .



2.6 Removing and installing drive plate - vehicles with automatic gearbox

Special tools and workshop equipment required

♦ Locking pin - 3242-



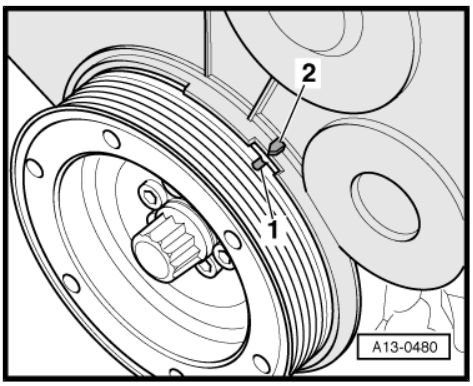
Removing

• Engine or gearbox removed.

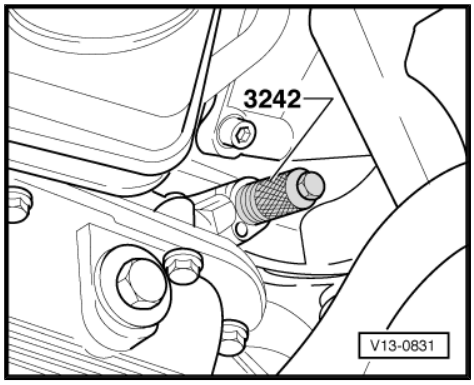
> **Caution**
>
> *Irreparable damage can be caused if the toothed belt slips.*
>
> ♦ *Only turn crankshaft in direction of engine rotation.*

– Turn crankshaft in direction of engine rotation via bolt for toothed belt sprocket until marking is at “TDC”.

• Notch -1- should align with marking -2-.



– Unscrew plug for “TDC” marking from cylinder block.



Note

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

WARNING

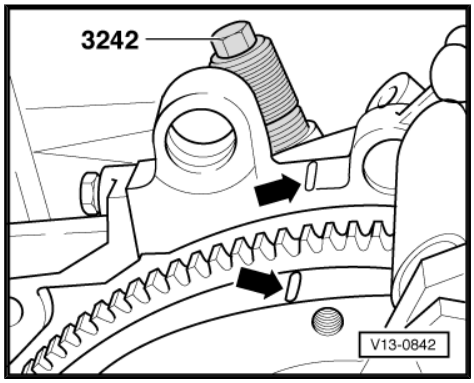
Risk of injury

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

– Screw locking pin - 3242- into hole and tighten to 20 Nm. If necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.

– Mark installation position of drive plate on crankshaft -arrows-.

– Remove bolts and take off drive plate.



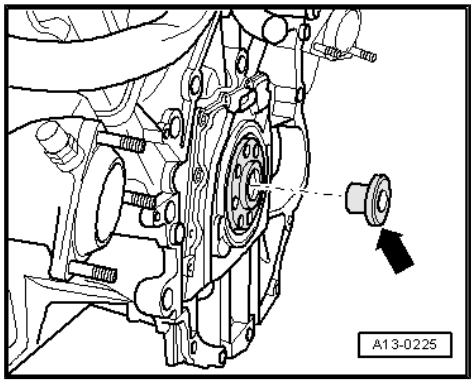
Installing

• Tightening torque ⇒ page 52

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

Note

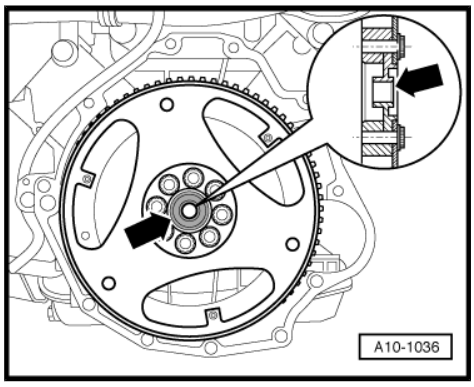
- *Renew bolts for drive plate.*
- *Short engines and reconditioned (exchange) engines are supplied without bearing bush for drive plate in crankshaft. Drive in new bearing bush -arrow- for drive plate before installing a drive plate in a vehicle with automatic gearbox.*
- *This bearing bush must not be fitted on vehicles with manual gearbox.*



– Bolt drive plate with bearing bush -arrow- to crankshaft.

– Remove locking pin - 3242- .

– Tighten plug for TDC marking in cylinder block ⇒ page 53 .



2.7 Renewing sealing flange (gearbox end)

Special tools and workshop equipment required

♦ Assembly sleeve - T20097-

♦ Sealant ⇒ Electronic parts catalogue

Procedure:

- Engine or gearbox removed.
- Tightening torque ⇒ page 52

– Remove dual-mass flywheel on vehicles with manual gearbox ⇒ page 60 .

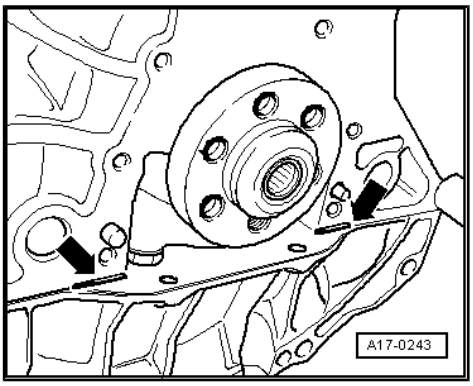
– Remove drive plate on vehicles with automatic gearbox ⇒ page 63 .

– Remove bolts and detach sealing flange (gearbox end).

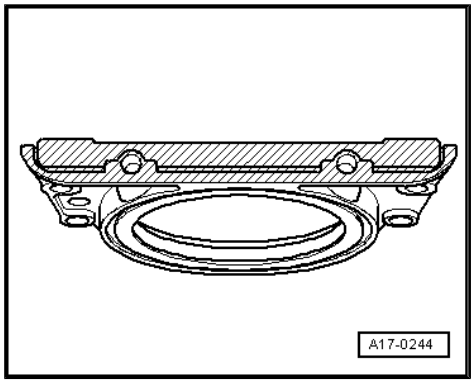
– Clean sealing surface on cylinder block; it must be free of oil and grease.

– Use assembly sleeve - T20097- to install sealing flange.

– After fitting gasket, apply a thin bead of sealant to edges -arrows-.



– Apply sealant onto clean sealing surface -shaded area- of sealing flange as illustrated.



Note

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

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

– Install dual-mass flywheel on vehicles with manual gearbox ⇒ page 60 .

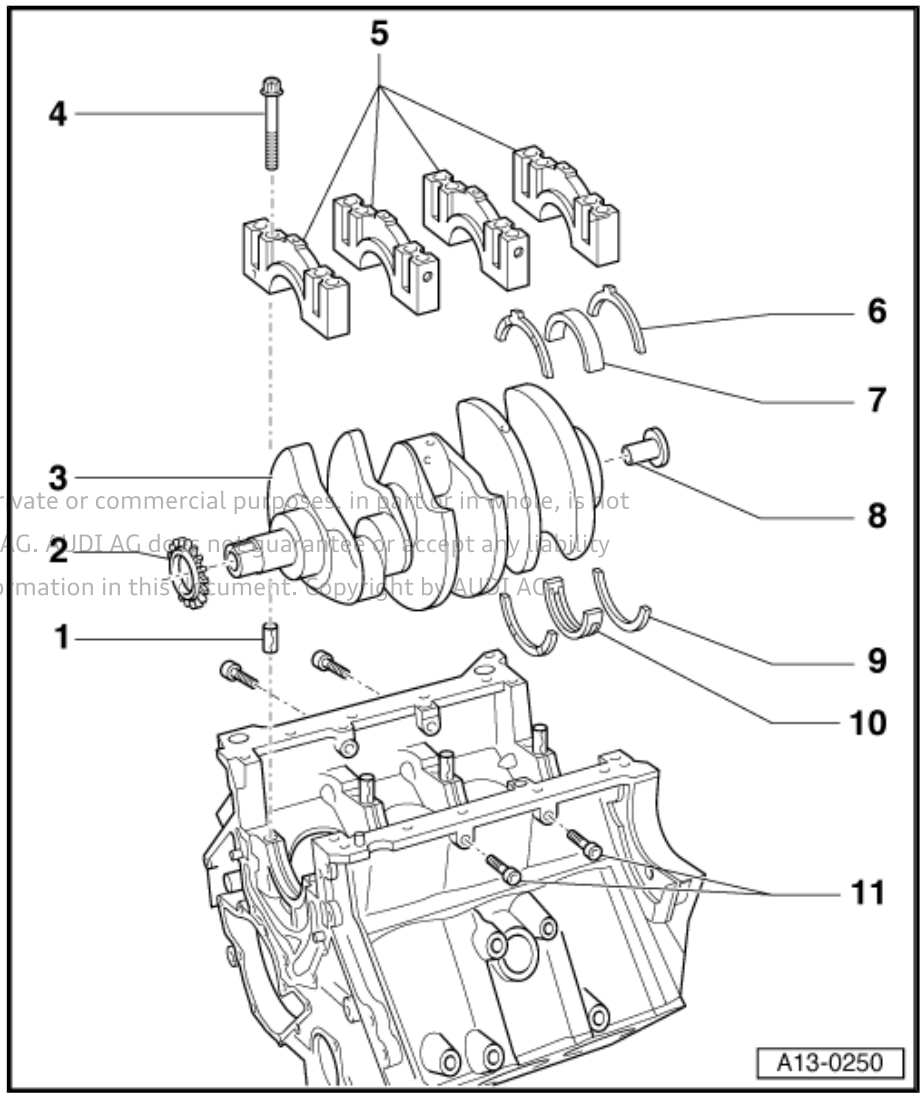
– Install drive plate on vehicles with automatic gearbox ⇒ page 63 .

3 Crankshaft

Note

When performing assembly work, secure engine to engine and gearbox support - VAS 6095- ⇒ page 28 .

3.1 Exploded view - crankshaft



1 - Dowel sleeve
- ❑ Insert in cylinder block

2 - Drive chain sprocket
- ❑ Removing and installing ⇒ page 71

3 - Crankshaft
- ❑ Measuring axial clearance ⇒ page 70
- ❑ Measuring radial clearance ⇒ page 70
- ❑ Do not rotate the crankshaft when checking the radial clearance
- ❑ Crankshaft dimensions ⇒ page 69

4 - Bolt
- ❑ Renew
- ❑ Tightening torque and sequence ⇒ page 69

5 - Bearing caps
- ❑ Note marking ⇒ page 68
- ❑ Installing ⇒ page 69

6 - Thrust washer
- ❑ Only fitted on 4th crankshaft bearing
- ❑ Oil grooves face outwards
- ❑ Note location
- ❑ Measuring axial clearance of crankshaft ⇒ page 70

7 - Bearing shell for bearing cap
- ❑ Without oil groove
- ❑ Do not interchange used bearing shells (mark positions)
- ❑ Install new bearing shells for the bearing caps with the correct coloured markings ⇒ page 69

8 - Bearing bush
- ❑ Automatic gearbox only
- ❑ Driving in ⇒ page 69

9 - Thrust washer
- ❑ Only fitted on 4th crankshaft bearing
- ❑ Oil grooves face outwards

- ❑ Measuring axial clearance of crankshaft ⇒ page 70

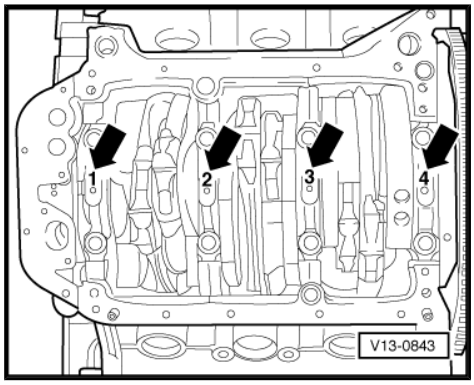
10 - Bearing shell for cylinder block

- ❑ With oil groove
- ❑ Do not interchange used bearing shells (mark positions)
- ❑ Install new bearing shells for the cylinder block with the correct coloured markings ⇒ page 68

11 - Bolts

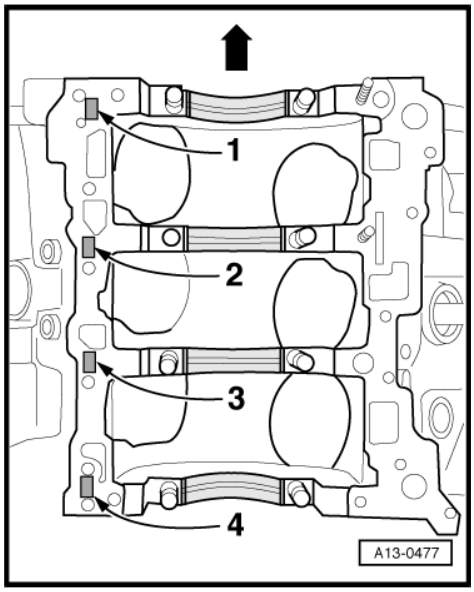
- ❑ Tightening torque and sequence ⇒ page 69

Markings on crankshaft bearing caps



- ◆ Bearing -1- is on pulley end.
- ◆ Bearing -4- is on flywheel end

Matching crankshaft bearing shells to bearings in cylinder block



Note

The -arrow- points to pulley end.

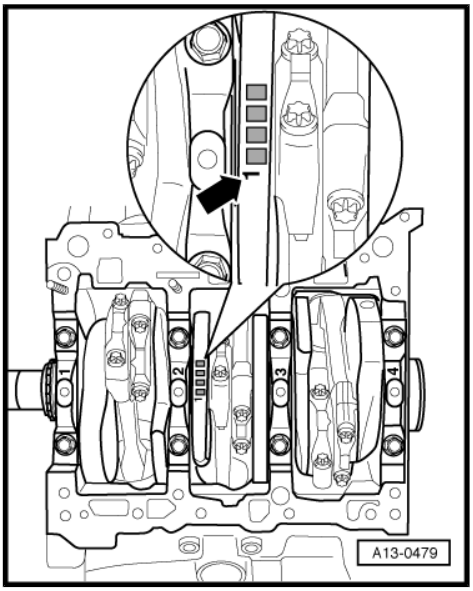
- ◆ Bearing shells of the correct thickness are matched to the bearings in the cylinder block at the factory. Coloured dots on the bearing shells are used to identify the bearing shell thickness.
- ◆ The allocation of the bearing shells to the cylinder block is identified by a code letter next to the relevant bearing.

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

Matching crankshaft bearing shells to bearing caps

- Bearing shells of the correct thickness are assigned to the bearing caps at the factory. Coloured dots on the bearing shells are used to identify the bearing shell thickness.
- The correct allocation of bearing shells to crankshaft is indicated by a sequence of letters on the crankshaft web. The number “1” -arrow- preceding the sequence of letters indicates the colour code for No. 1 bearing.

Letter on crankshaft	Colour coding of bearing
B =	Blue
G =	Yellow
R =	Red
S =	Black



Main bearing cap - tightening torque and sequence

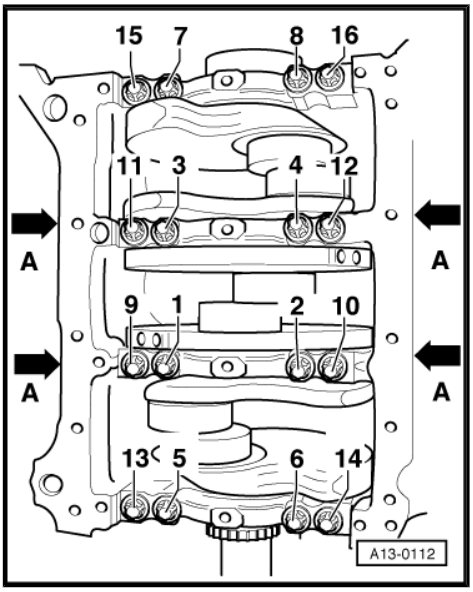
- Main bearing cap “1” = pulley end.
- Main bearing cap “4” = gearbox end.

– Renew bolts -1 … 16-.

– Insert dowel sleeves ⇒ Item 1 (page 67) in cylinder block.

– Tighten main bearing cap bolts in five stages as follows:

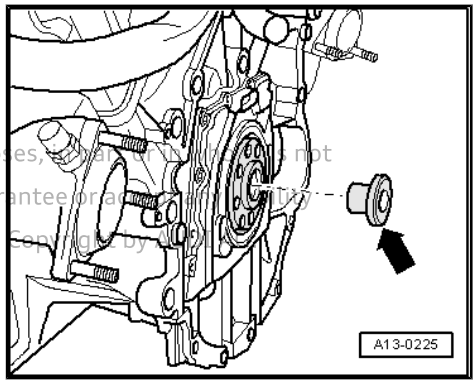
1. Screw in bolts -A- hand-tight.
2. Tighten bolts -1 ... 16- to 30 Nm.
3. Tighten bolts -1 ... 16- to 60 Nm.
4. Turn bolts -1 ... 16- 90° further ($^1/_4$ turn).
5. Tighten bolts -A- to 25 Nm.



Bearing bush for torque converter

Note

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



3.2 Crankshaft dimensions

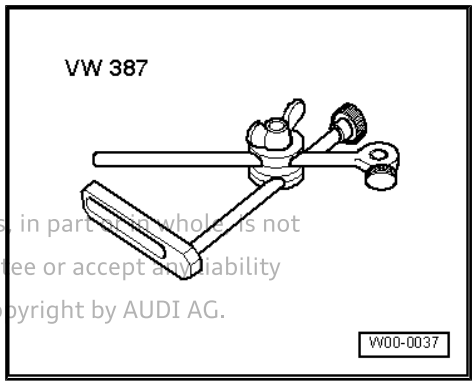
Honing dimension (in mm)	Main bearing journal Ø	Conrod journal Ø
Basic dimension	65.00 – 0.022 – 0.042	54.00 – 0.022 – 0.042
Repair undersize 1	64.75 – 0.022 – 0.042	53.75 – 0.022 – 0.042

Honing dimension (in mm)	Main bearing journal ∅	Conrod journal ∅
Repair undersize 2	64.50 – 0.022 – 0.042	53.50 – 0.022 – 0.042
Repair undersize 3	64.25 – 0.022 – 0.042	53.25 – 0.022 – 0.042

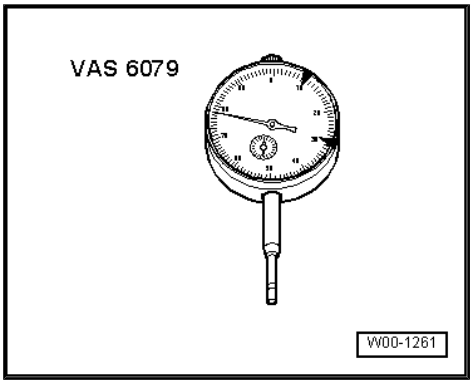
3.3 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

- Universal dial gauge bracket - VW 387-



- Dial gauge - VAS 6079-



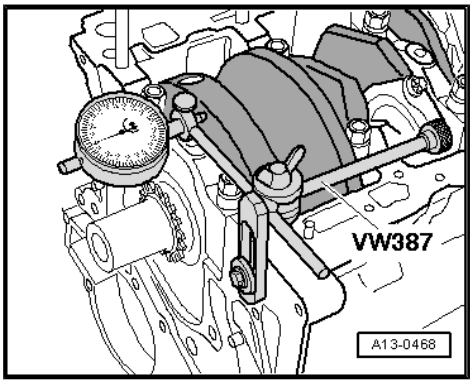
Procedure

– Secure dial gauge - VAS 6079- with universal dial gauge bracket - VW 387- to cylinder block as shown in illustration.

– Set dial gauge against crank web.

– Press crankshaft against dial gauge by hand and set gauge to “0”.

– Push crankshaft away from dial gauge and read off value.



Axial clearance:

- New: 0.090 ... 0.251 mm.
- Wear limit: 0.28 mm.

3.4 Measuring radial clearance of crankshaft

Special tools and workshop equipment required

- Plastigauge

Procedure

Note

- *Mark used bearing shells for re-installation (but do not mark bearing surface).*
- *If bearing shells are worn down to nickel layer they must be renewed.*

– Remove bearing cap and clean bearing journal.

– Place a length of Plastigauge corresponding to the width of the bearing on the bearing journal or in the bearing shell.

• The Plastigauge must be positioned in the centre of the bearing shell.

– Fit bearing cap and tighten to 30 Nm. Do not rotate crankshaft.

– Remove bearing cap again.

– Compare width of Plastigauge with measurement scale.

Radial clearance:

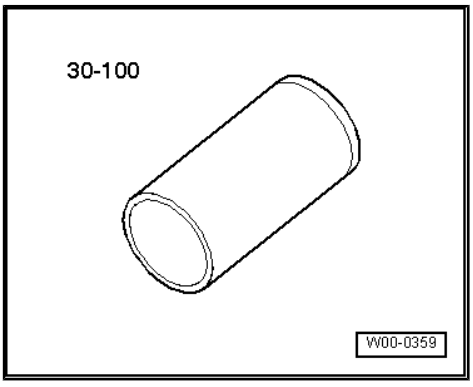
• New: 0.018 ... 0.045 mm.

• Wear limit: 0.10 mm.

3.5 Removing and installing drive chain sprocket

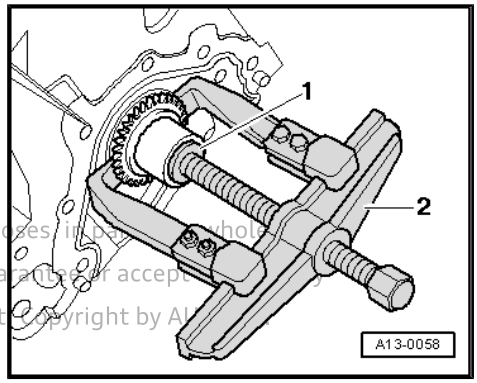
Special tools and workshop equipment required

- Drift sleeve - 30 - 100-



- Puller (commercially available)

Removing



– Remove drive chain for oil pump ⇒ page 148 .
– Pull drive chain sprocket off crankshaft with commercially available puller -2-; use a suitable washer -1- to protect end of crankshaft.

Installing

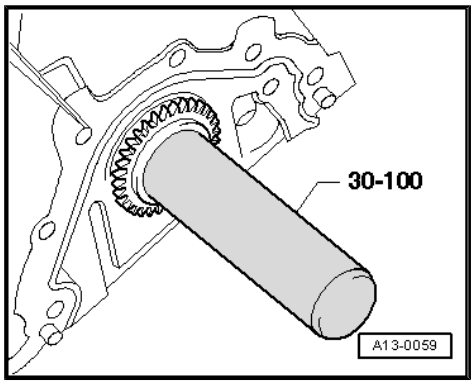
Installation is carried out in reverse order; note the following:

- Installation position: lettering on drive chain sprocket must be visible.
– Heat drive chain sprocket in oven for approx. 15 minutes to 220 °C.

WARNING

Risk of burns.

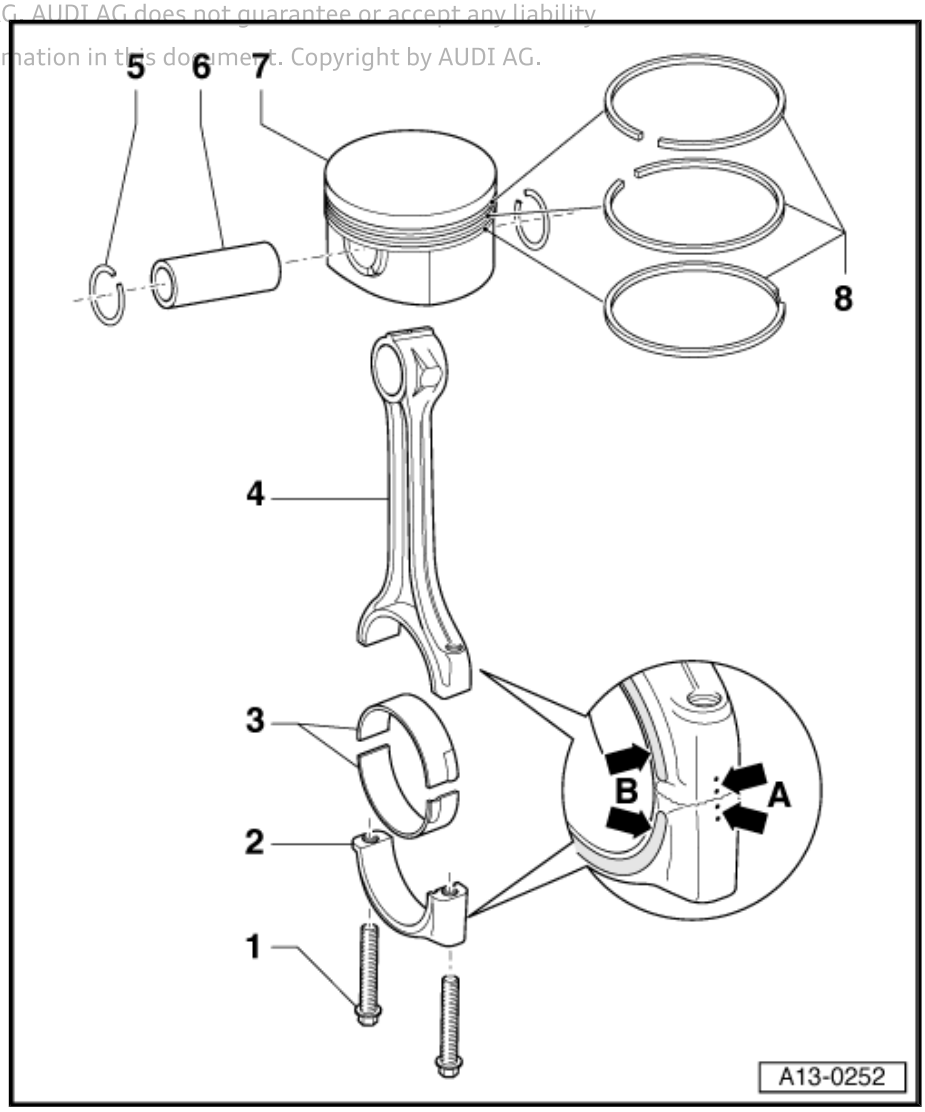
- *Wear protective gloves.*



– Fit drive chain sprocket on end of crankshaft using pliers, and press onto crankshaft as far as stop using drift sleeve - 30 - 100- .
– Install drive chain for oil pump ⇒ page 148 .

4 Pistons and conrods

4.1 Exploded view - pistons and conrods



1 - Bolt

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

2 - Conrod bearing cap

- ❑ Installation position: split contact surfaces on side of conrod must be in alignment -B-

3 - Bearing shell

- ❑ Note installation position
- ❑ Mark used bearing shells for re-installation but not on bearing surface
- ❑ Note type: upper bearing shell (closest to piston) is made of more wear-resistant material. Distinguishing feature on new bearing shells: black marking on contact surface near separating point
- ❑ Check that it is securely seated

4 - Conrod

- ❑ Only renew as a complete set
- ❑ Mark cylinder allocation -A- ⇒ page 75
- ❑ Note when fitting bearing cap: split contact surfaces on side of conrod must be in alignment -B-
- ❑ Installation position of conrod pairs ⇒ page 76
- ❑ Measuring radial clearance ⇒ page 76

5 - Circlip

- ❑ Renew

6 - Piston pin

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

7 - Piston

- ❑ Mark installation position ⇒ page 75
- ❑ Arrow on piston crowns points to pulley end
- ❑ Checking ⇒ page 74
- ❑ Install using piston ring clamp
- ❑ Checking cylinder bore ⇒ page 75

❑ Piston and cylinder dimensions ⇒ page 76

8 - Piston rings

❑ Offset gaps by 120°

❑ Use piston ring pliers to remove and install

❑ "TOP" must face towards piston crown

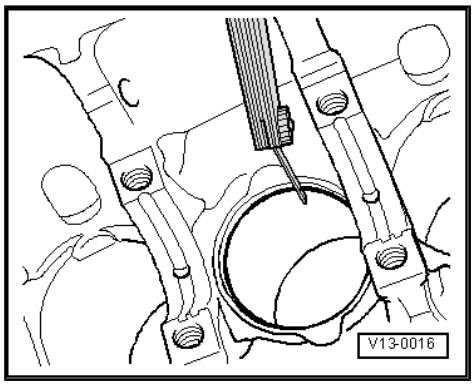
❑ Checking ring gap ⇒ page 74

❑ Checking ring-to-groove clearance ⇒ page 74

Checking piston ring gap

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

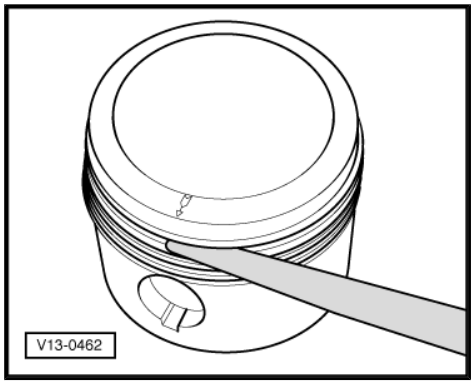
Piston ring	new mm	Wear limit mm
1st compression ring	0.35 … 0.50	1.0
2nd compression ring	0.50 … 0.70	1.4
Oil scraper ring	0.25 … 0.50	0.8



Checking ring-to-groove clearance

– Clean groove in piston before checking clearance.

Piston ring	new mm	Wear limit mm
Compression rings	0.02 … 0.08	0.10
Oil scraper ring	0.02 … 0.08	0.10

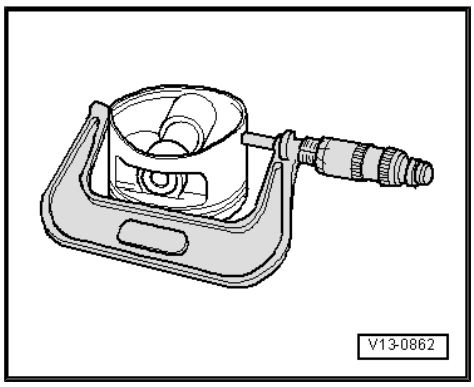


Checking piston

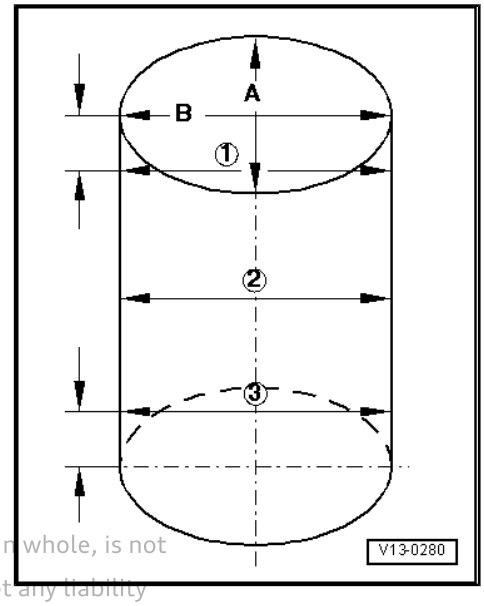
– Using a micrometer (75 ... 100 mm), measure approx. 12 mm from the lower edge, perpendicular to the piston pin axis.

• Maximum deviation from nominal dimension: 0.04 mm.

Nominal dimension
⇒ "4.2 Piston and cylinder dimensions", page 76



Checking cylinder bore

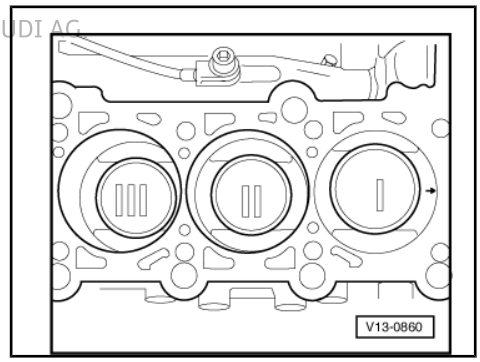


– Use a cylinder gauge - VAS 6078- to take measurements at 3 points in transverse direction -A- and in longitudinal direction -B-.

• Maximum deviation from nominal dimension: 0.08 mm.

Nominal dimension
⇒ “4.2 Piston and cylinder dimensions”, page 76

Installation position of pistons



Caution

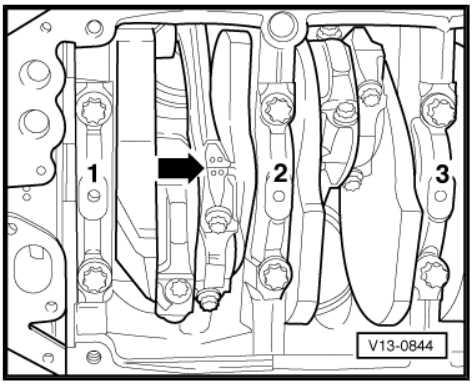
Do not damage the coating of the piston crown.

- *If you intend to re-install used pistons, mark the cylinder number on the piston crown using paint. Do not mark piston crown by means of centre punch, notch or similar.*

Installation position:

• Arrows on piston crowns point to pulley end.

Marking conrods



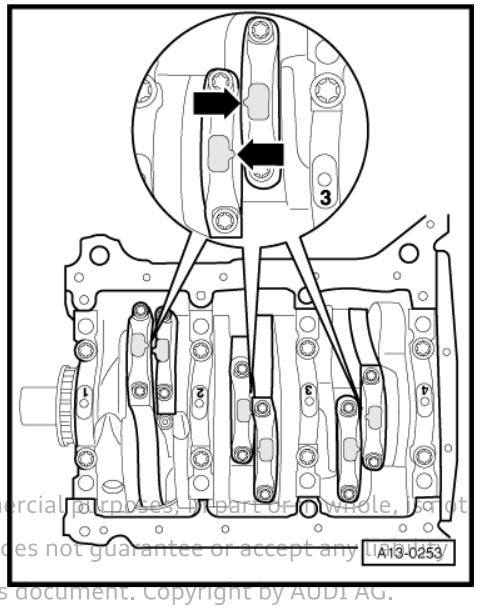
Note

Only renew conrods as a complete set.

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

Installation position of conrod pairs

- The cast lugs -arrows- on the ground surfaces of the conrod pairs 1 and 2, 3 and 4, and 5 and 6 must face one another.



4.2 Piston and cylinder dimensions

Honing dimension	Piston ∅ mm	Cylinder bore ∅ mm
Basic dimension	80.95	81.01

Note

Replacement pistons are only available with basic dimension.

4.3 Measuring radial clearance of conrods

Special tools and workshop equipment required

- Plastigauge

Procedure

– Remove conrod bearing cap.

– Clean bearing cap and bearing journal.

– Place a length of Plastigauge corresponding to the width of the bearing on the bearing journal or in the bearing shell.

– Fit conrod bearing caps and tighten to 30 Nm without rotating crankshaft.

– Remove conrod bearing cap again.

– Compare width of Plastigauge with measurement scale.

Radial clearance:

- New: 0.015 ... 0.062 mm.
- Wear limit: 0.12 mm.

– Renew conrod bolts.

15 – Cylinder head, valve gear

1 Cylinder head

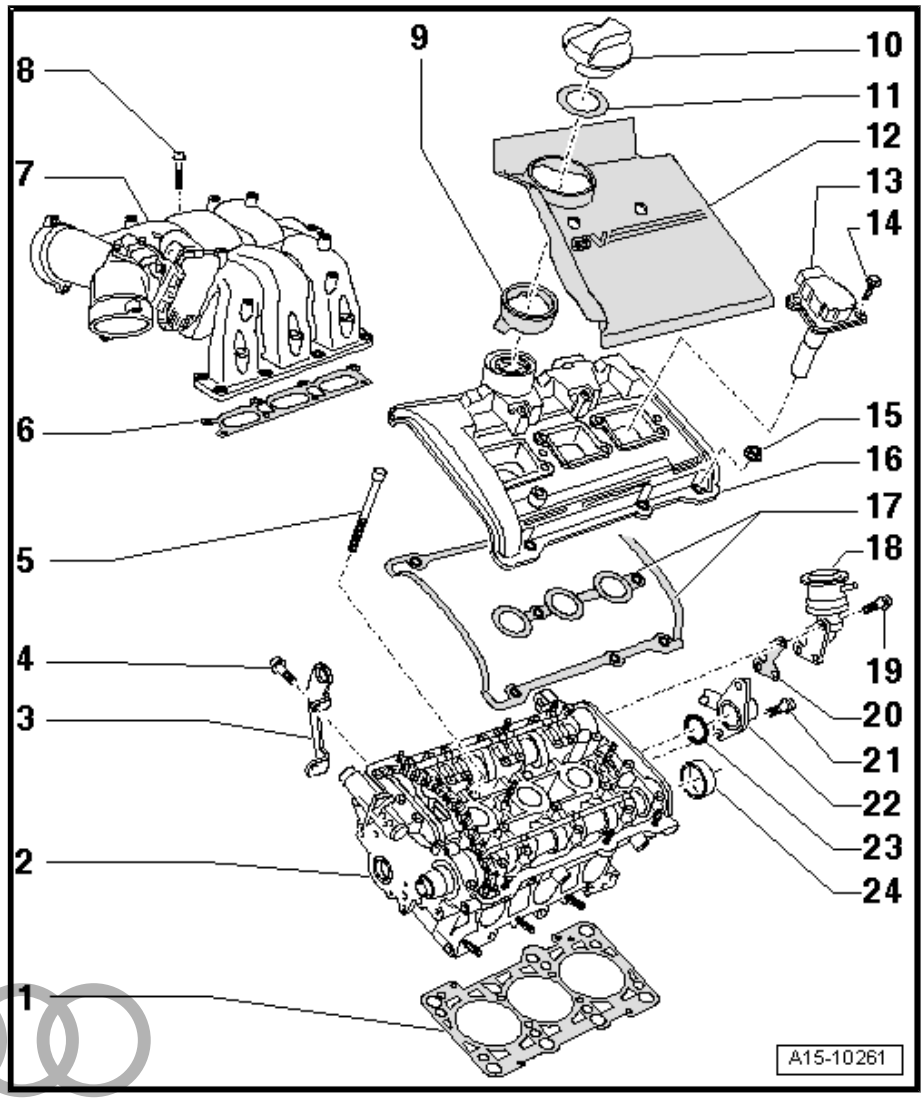
Note

All bearing and running surfaces must be oiled before assembling.

1.1 Exploded view - cylinder head

Note

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



1 - Cylinder head gasket

- ❑ Renewing ⇒ “1.4 Removing cylinder head (left-side)”, page 86 , ⇒ “1.5 Removing cylinder head (right-side)”, page 90 and ⇒ “1.6 Installing cylinder head”, page 93
- ❑ Installation position: Part No. towards cylinder head
- ❑ If renewed, change coolant and engine oil

2 - Cylinder head

- ❑ Removing: left-side ⇒ page 86 ; right-side ⇒ page 90
- ❑ Installing ⇒ page 93
- ❑ Checking for distortion ⇒ page 79
- ❑ Machining limit ⇒ page 80
- ❑ Driving in sealing cap ⇒ page 80
- ❑ If renewed, change coolant and engine oil

3 - Engine lifting eye

4 - Bolt

- ❑ 25 Nm

5 - Bolt

- ❑ Renew
- ❑ Note correct sequence when loosening ⇒ page 90
- ❑ Tightening torque and sequence ⇒ page 80

6 - Intake manifold gasket

❑ Renew

7 - Intake manifold

❑ Removing and installing ⇒ Rep. gr. 24

8 - Bolt

❑ Tightening torque ⇒ Rep. gr. 24

9 - Rubber grommet

10 - Filler cap

11 - Seal

❑ Renew if damaged or leaking

12 - Cover panel for cylinder head cover

13 - Ignition coil

14 - Bolt

❑ 10 Nm

15 - Bolt

❑ Tightening torque and tightening sequence: cylinder head cover (left-side) ⇒ page 79 , cylinder head cover (right-side) ⇒ page 79

16 - Cylinder head cover

❑ Removing and installing: left-side ⇒ page 80 , right-side ⇒ page 83

17 - Gaskets for cylinder head cover

❑ Renew if damaged or leaking

❑ Before fitting, apply sealant at sealing points ⇒ page 79

18 - Combination valve for secondary air system

❑ Not installed on all versions

❑ Removing and installing: left-side ⇒ page 289 , right-side ⇒ page 291

19 - Bolt

❑ Secondary air combination valve to connection and connection to cylinder head

❑ 10 Nm

20 - Gasket

❑ Renew

21 - Bolt

❑ Tightening torque ⇒ Item 13 (page 177)

22 - Coolant pipe (rear)

❑ Removing and installing ⇒ page 182

23 - O-ring

❑ Renew

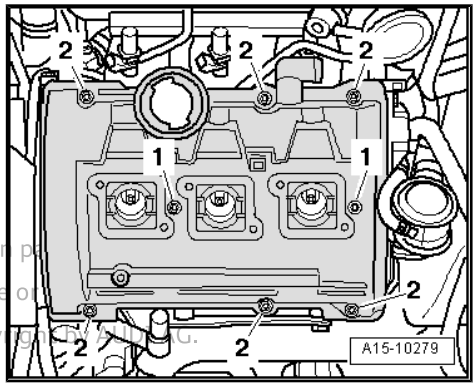
24 - Filler cap

❑ Driving sealing cap into cylinder head ⇒ page 80

Cylinder head cover (left-side) - tightening torque and sequence

– Tighten nuts for cylinder head cover in two stages as follows:

1. Tighten inner nuts -1- to 10 Nm.
2. Tighten outer nuts -2- in stages and in diagonal sequence; final torque 10 Nm.

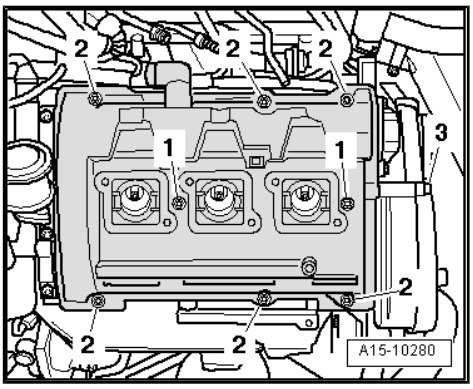


Cylinder head cover (right-side) - tightening torque and sequence

– Tighten nuts and bolt for cylinder head cover in two stages as follows:

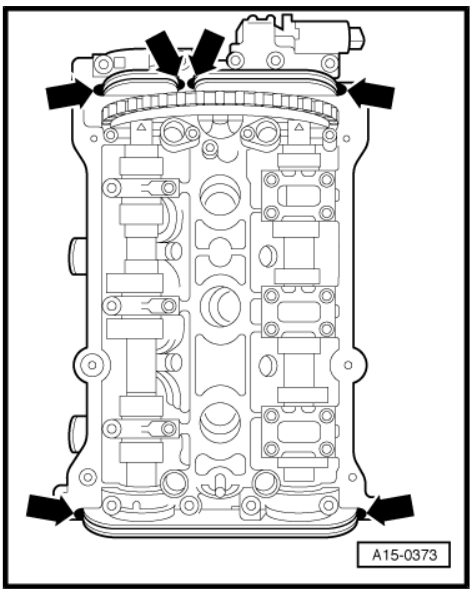
1. Tighten inner nuts -1- to 10 Nm.
2. Tighten outer nuts -2- in stages and in diagonal sequence; final torque 10 Nm.

– Tighten bolt -3- on toothed belt cover to 10 Nm.



Sealing points for bearing caps on cylinder head

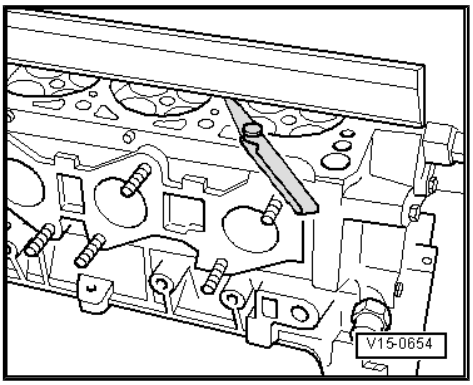
– Apply small quantity of sealant to sealing points -arrows- at top sealing surface of cylinder head; for sealant refer to ⇒ Electronic parts catalogue .



Checking cylinder head for distortion

– Use straight edge and feeler gauge to measure for distortion at several points.

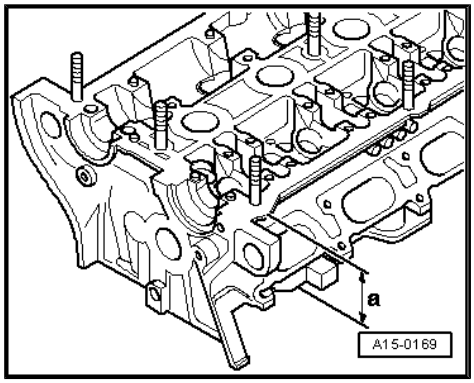
• Max. permissible distortion: 0.1 mm



Cylinder head machining limit

– Machining of the cylinder head (surface grinding) is only permissible down to the minimum dimension -a-.

• Minimum dimension: -a- = 139.25 mm

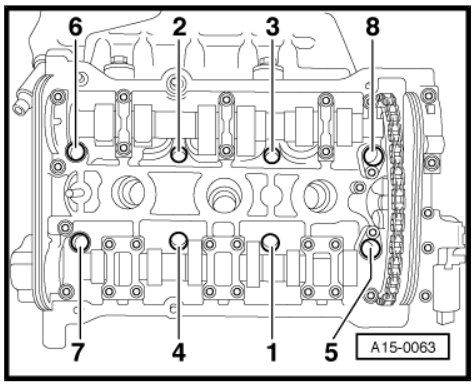


Cylinder head - tightening torque and sequence

– Renew cylinder head bolts.

– Tighten bolts in the sequence -1 ... 8- in 4 stages as follows:

1. Screw in by hand until contact is made.
2. Tighten to 60 Nm.
3. Turn 90° further.
4. Turn 90° further.

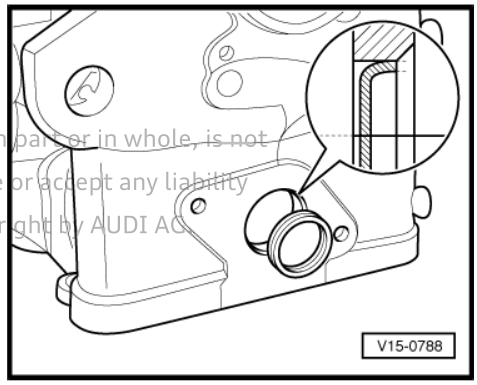


Driving sealing cap into cylinder head

Replacement cylinder heads without camshafts can be used on both the left and right-side and must be fitted with a sealing cap on the appropriate front side.

– Coat rim of sealing cap with sealant; for sealant refer to ⇒ Electronic parts catalogue .

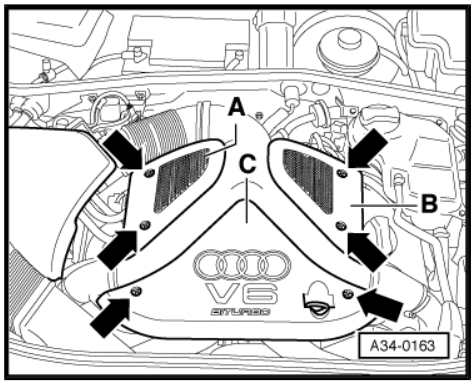
– Using drift - VW 295- , knock in sealing cap until outside rim is flush with end of chamfer on cylinder head.



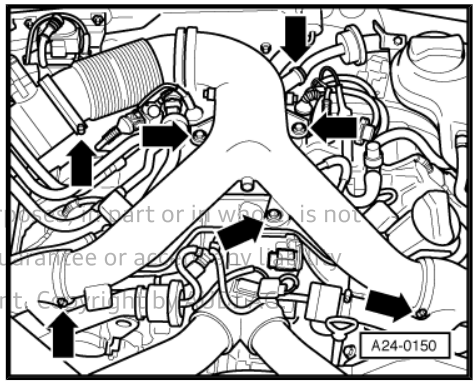
1.2 Removing and installing cylinder head cover (left-side)

Removing

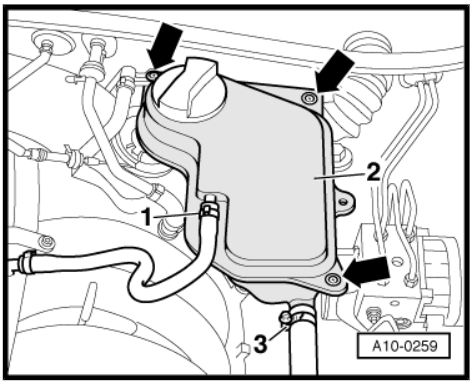
– Detach engine cover panels -A ... C- by removing bolts -arrows-.



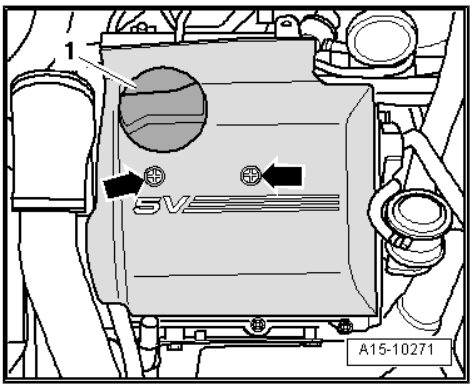
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



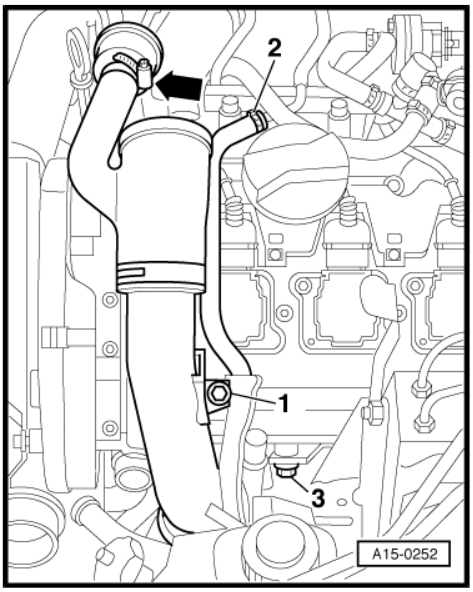
– Remove bolts -arrows-.
– Unplug electrical wiring to coolant shortage indicator switch -F66- and move coolant expansion tank -2- to one side with coolant hoses -1- and -3- attached.



– Detach filler cap -1-.
– Open quick-release fasteners -arrows- and detach cover for cylinder head cover (left-side).



– Remove bolt -1-, detach hoses -2- and -arrow- and remove air pipe.
– Remove bolt -3- for coolant pipe.

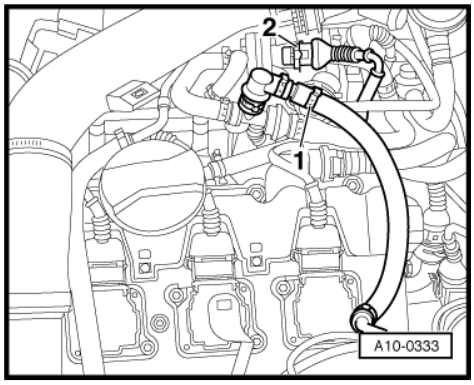


Caution

Risk of irreparable damage to engine.

- *Block off the opening of the air pipe (bottom) with a clean cloth to prevent small items from dropping into the engine through the air pipe (bottom).*

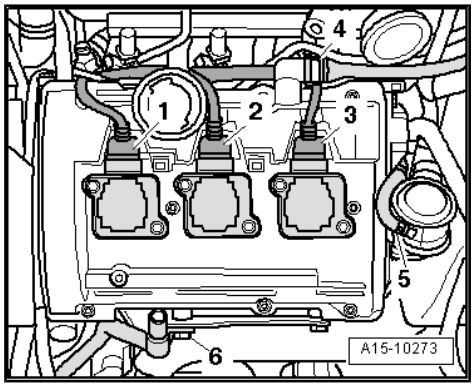
– Detach vacuum hose -1- going to vacuum reservoir.



Note

Disregard -item 2-.

– Unplug electrical connectors -1, 2, 3-.
– Remove ignition coils.
– Cut through cable tie and move electrical wiring clear.
– Detach crankcase breather hose -4- from cylinder head cover.
– If fitted, detach vacuum hose -5- from combination valve for secondary air system.
– Remove bolt -6-.

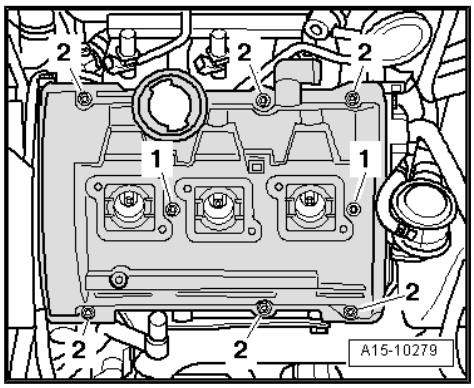


– Remove nuts -1- and -2- and detach cylinder head cover.

Installing

• Tightening torques ⇒ page 77

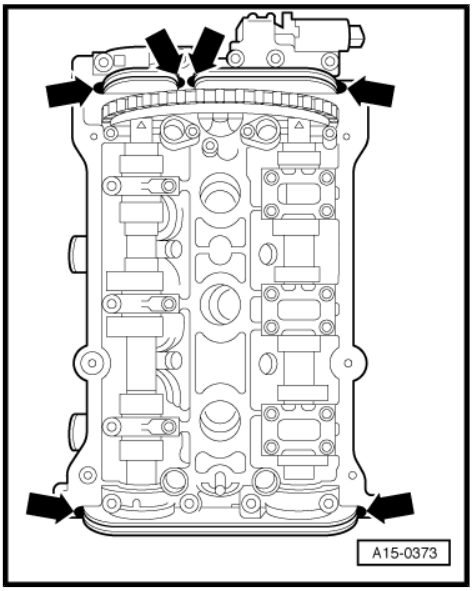
Installation is carried out in reverse order; note the following:



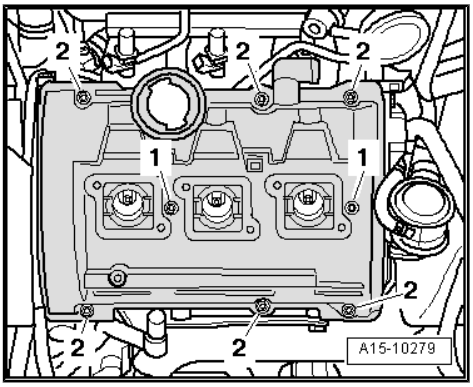
Note

- ♦ *Renew gaskets for cylinder head cover if damaged.*
- ♦ *Hose connections and hoses for charge air system must be free of oil and grease prior to fitting.*
- ♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- ♦ *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*
- ♦ *Fit all cable ties in the original positions when installing.*

– Apply small quantity of sealant to sealing points -arrows- at top sealing surface of cylinder head; for sealant refer to ⇒ Electronic parts catalogue .



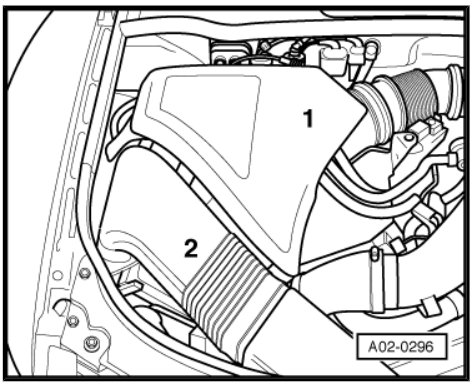
– Tighten nuts for cylinder head cover ⇒ page 79 .
– Install air pipe ⇒ page 220 .
– Install air hoses ⇒ page 227 .
– Install air duct ⇒ page 29 .



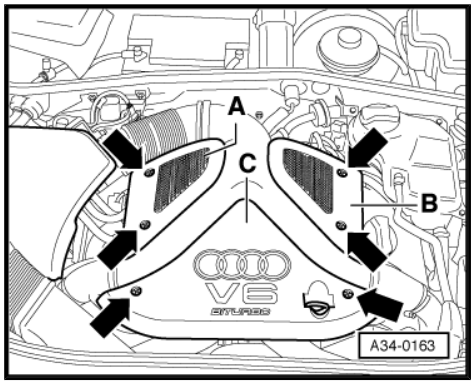
1.3 Removing and installing cylinder head cover (right-side)

Removing

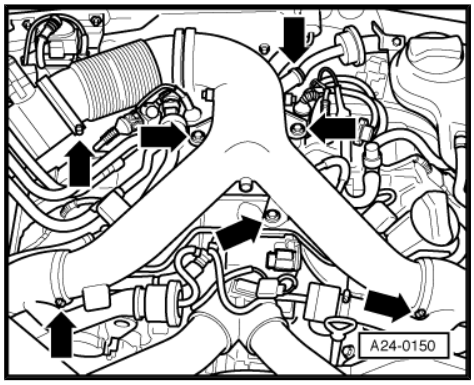
– Remove cover -1- on right side of engine compartment.



– Detach engine cover panels -A ... C- by removing bolts -arrows-.



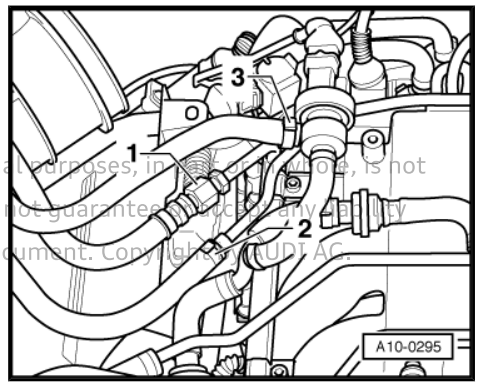
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



WARNING

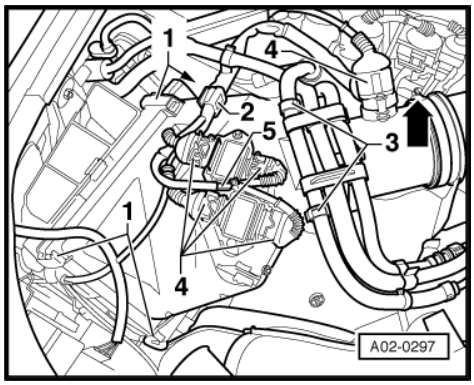
Fuel under pressure - risk of injuries!

- *To reduce the pressure in the fuel system, wrap a clean cloth around the connection and loosen the connection carefully.*



– Disconnect fuel supply line -1- and fuel return line -2-.
– Detach hose -3- from activated charcoal filter solenoid valve 1 - N80- .
– Move hose and pipes clear.

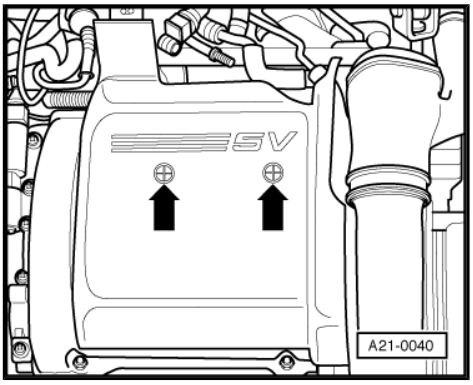
– Unplug electrical connector -4- at air mass meter - G70- .
– On vehicles with separate output stages, unplug remaining connectors -4-, cut through cable tie -5- and detach wiring harness from clip -2-. Then put down wiring harness next to intake opening of air cleaner.
– Open retaining clips -3- for fuel lines.
– Release hose clip -arrow-.
– Remove bolts and take off air filter housing.



Note

Disregard -item 1-.

– Open quick-release fasteners -arrows- and detach cover for cylinder head cover (right-side).

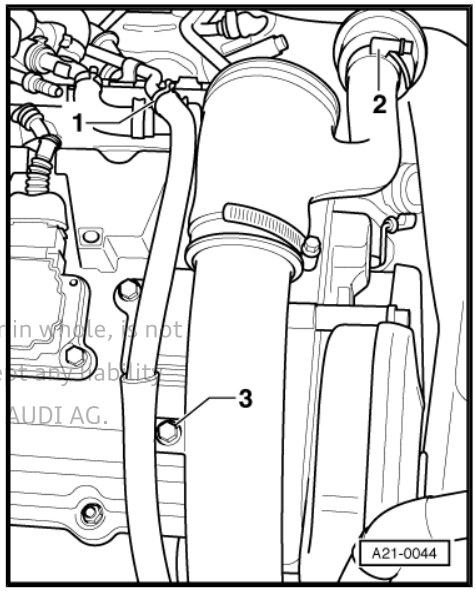


– Remove bolt -3- , detach hoses -1- and -2- and remove air pipe.

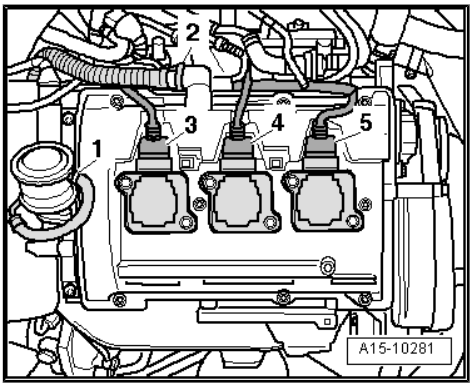
Caution

Risk of irreparable damage to engine.

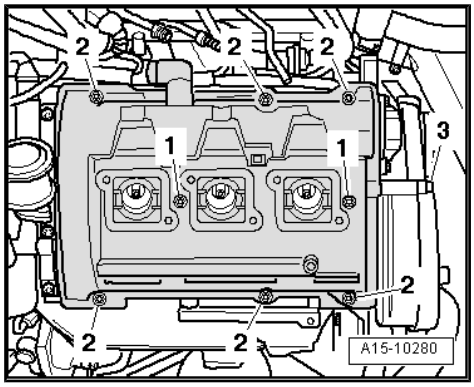
- *Block off the opening of the air pipe (bottom) with a clean cloth to prevent small items from dropping into the engine through the air pipe (bottom).*



– Unplug electrical connectors -3, 4, 5-.
– Remove ignition coils.
– Cut through cable tie and move electrical wiring clear.
– Detach crankcase breather hose -2- from cylinder head cover.
– If fitted, detach vacuum hose -1- from combination valve for secondary air system.



– Remove bolt -3- at toothed belt cover (right-side).
– Remove nuts -1- and -2- and detach cylinder head cover.



Installing

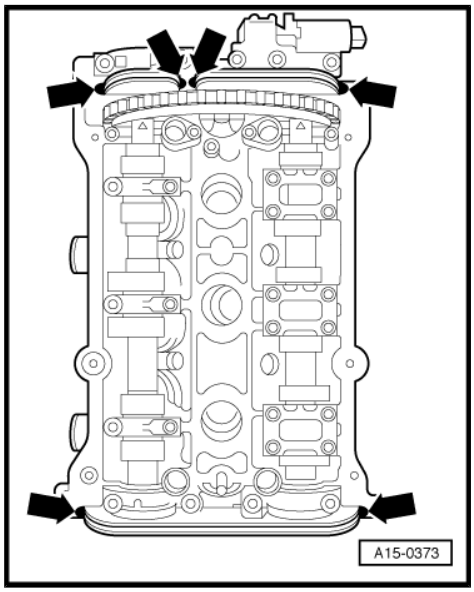
- Tightening torques ⇒ page 77

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

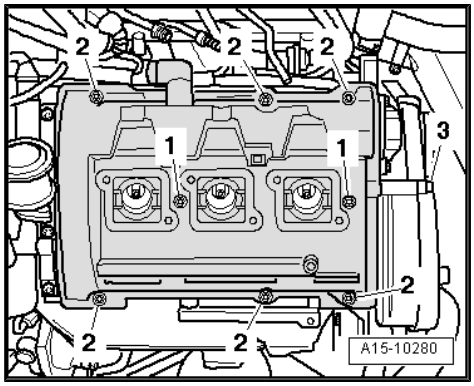
Note

- *Renew gaskets for cylinder head cover if damaged.*
- *Hose connections and hoses for charge air system must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*
- *Fit all cable ties in the original positions when installing.*

– Apply small quantity of sealant to sealing points -arrows- at top sealing surface of cylinder head; for sealant refer to ⇒ Electronic parts catalogue .



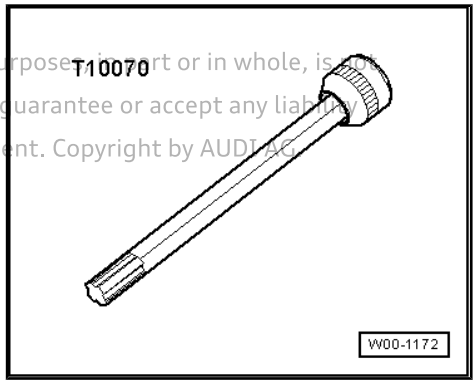
– Tighten nuts for cylinder head cover ⇒ page 79 .
– Install air pipe ⇒ page 220 .
– Install air hoses ⇒ page 227 .
– Install air duct ⇒ page 29 .



1.4 Removing cylinder head (left-side)

Special tools and workshop equipment required

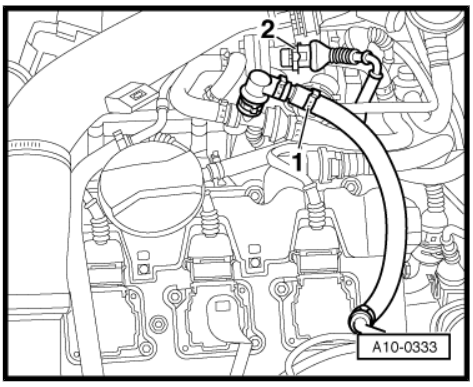
♦ Socket - T10070-



Procedure

- Engine removed

– Unplug electrical connector -2- at by-pass air cut-off valve for central idling speed - N8- .



Note

Disregard -item 1-.

– Unplug electrical connectors:

1 - Camshaft control valve 2 - N208-

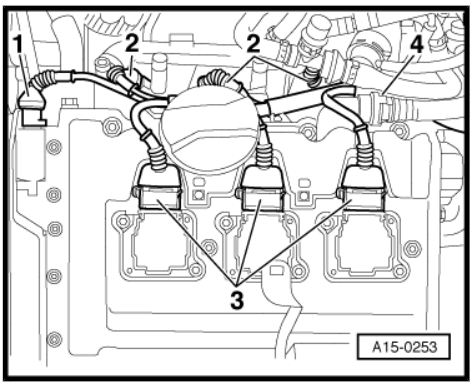
2 - Injectors

3 - Ignition coils

– Move electrical wiring harness clear.

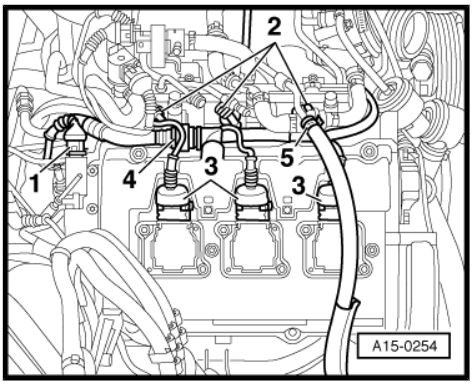
– Disconnect crankcase breather hose -4-.

– Remove ignition coils.



– Unplug electrical connectors -2- for injectors on cylinder head (right-side) and move wiring harness clear.

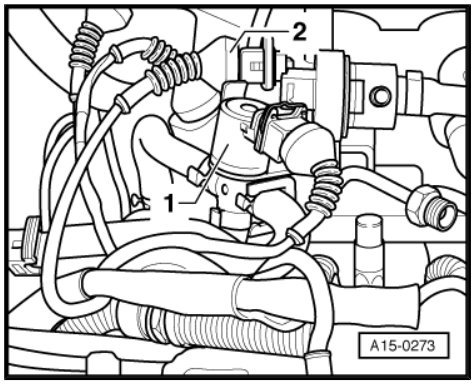
– Detach hose -5- going to turbocharger.



Note

Disregard -items 1, 3, 4-.

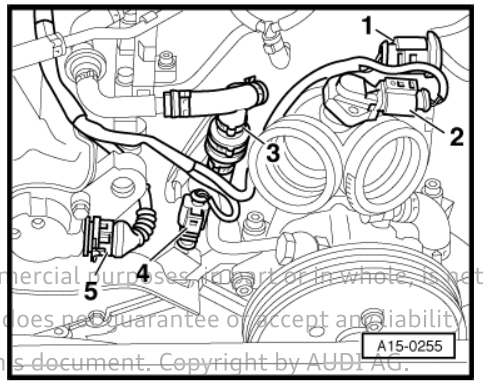
– Unclip charge pressure control solenoid valve - N75- -item 1-.
– Unplug electrical connector -2- at activated charcoal filter solenoid valve 1 - N80- .



– Unplug electrical connectors:

1 - Throttle valve module - J338-
2 - Charge pressure sender - G31-
4 - Intake air temperature sender - G42-

– Disconnect crankcase breather hose -3-.

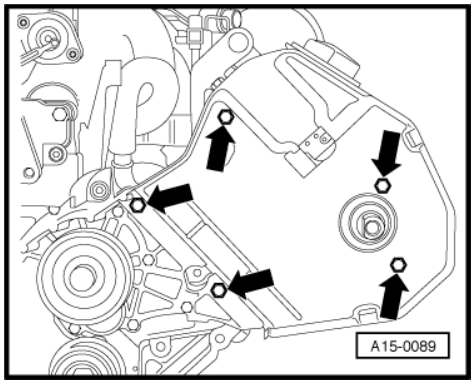


Note

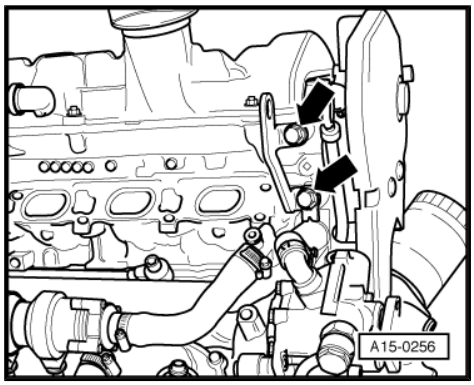
Disregard -item 5-.

– Remove toothed belt ⇒ page 46 .

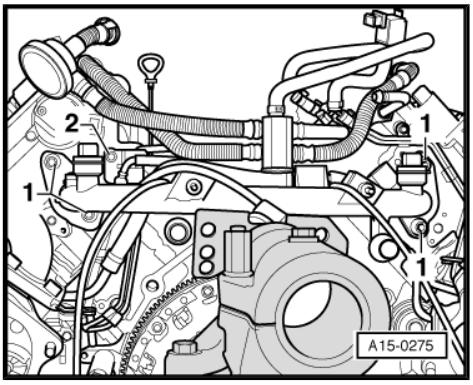
– Unscrew bolts -arrows- and remove toothed belt cover (rear left).
– Remove intake manifold ⇒ Rep. gr. 24 .



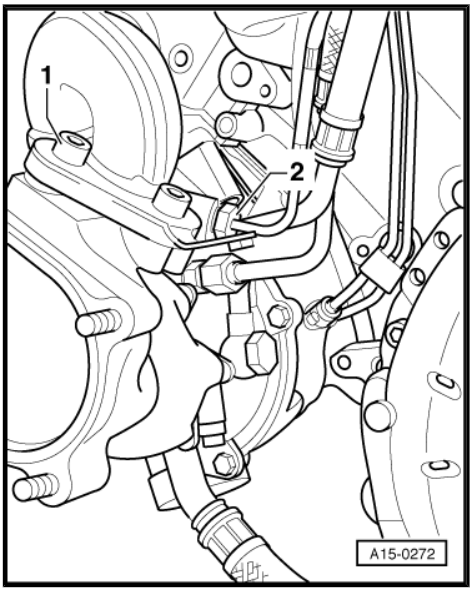
– Remove engine lifting eye and coolant pipe -arrows-.



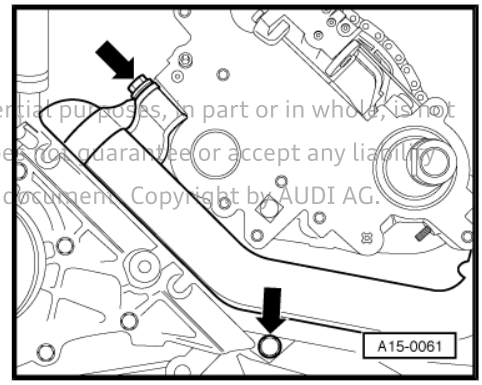
– Unscrew bolts -1- and remove coolant pipe (rear).
– Unbolt bracket -2- from cylinder head.



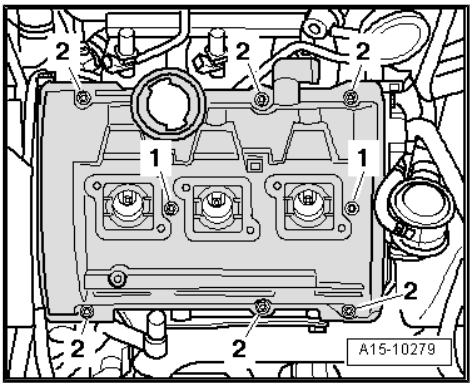
– Unscrew exhaust gas temperature sender 1 for bank 2 - G236- -item 2-.
– Remove bolts -1- securing turbocharger to exhaust manifold (3x).



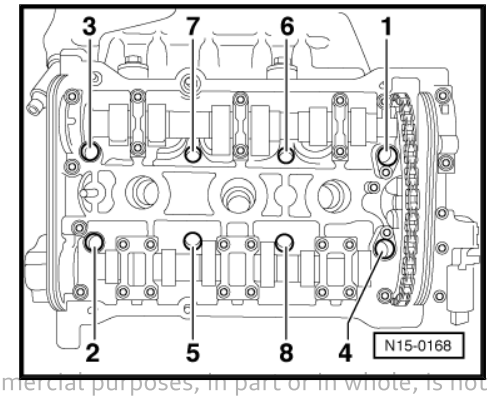
– Remove bolts -arrows- and detach coolant pipe (front) from cylinder head.



– Remove nuts -1- and -2- and detach cylinder head cover.



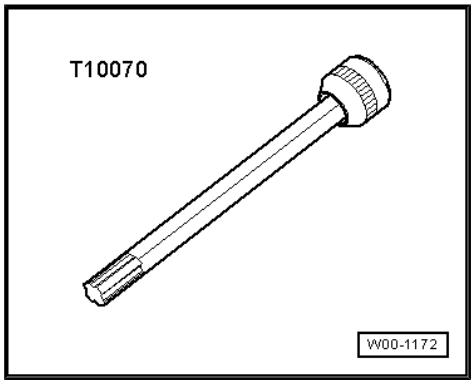
– Use special wrench, long reach - T10070- to slacken cylinder head bolts in sequence -1 ... 8-.
– Remove bolts and carefully take off cylinder head.
– Place cylinder head onto soft surface (foam plastic).



1.5 Removing cylinder head (right-side)

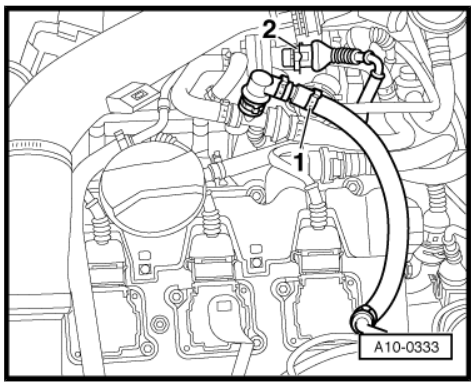
Special tools and workshop equipment required

♦ Socket - T10070-

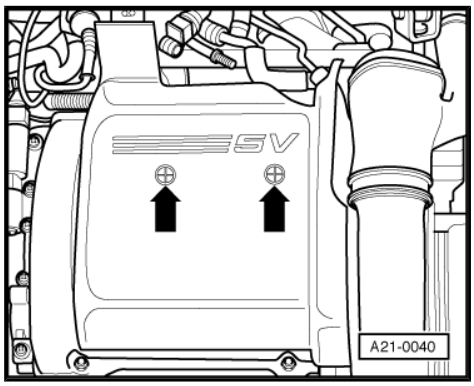


Procedure

• Engine removed
– Unplug electrical connector -2- at by-pass air cut-off valve for central idling speed - N8- .



– Open quick-release fasteners -arrows- and detach cover for cylinder head cover (right-side).

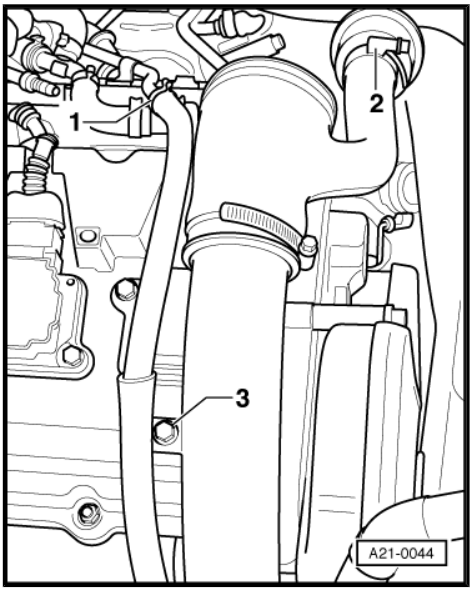


– Remove bolt -3- , detach hoses -1- and -2- and remove air pipe.

Caution

Risk of irreparable damage to engine.

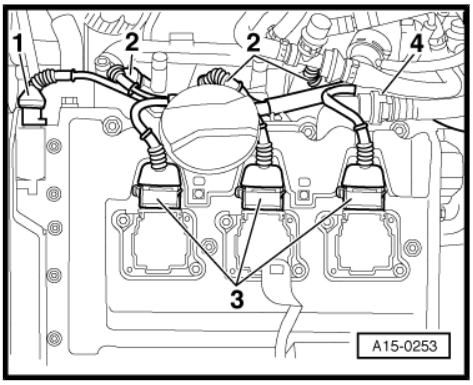
- *Block off the opening of the air pipe (bottom) with a clean cloth to prevent small items from dropping into the engine through the air pipe (bottom).*



– Unplug electrical connectors -2- for injectors on cylinder head (left-side) and move wiring harness clear.

Note

Disregard -items 1, 3, 4-.



– Unplug electrical connectors:

1 - Camshaft control valve - N205-

2 - Injectors

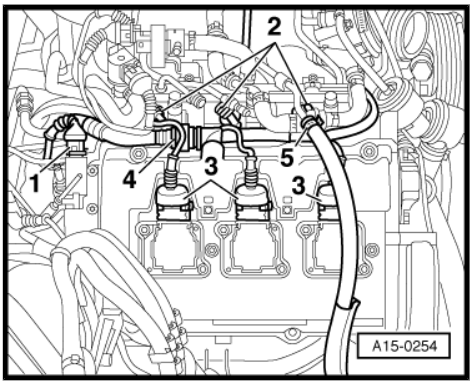
3 - Ignition coils

– Move electrical wiring harness clear.

– Disconnect crankcase breather hose -4-.

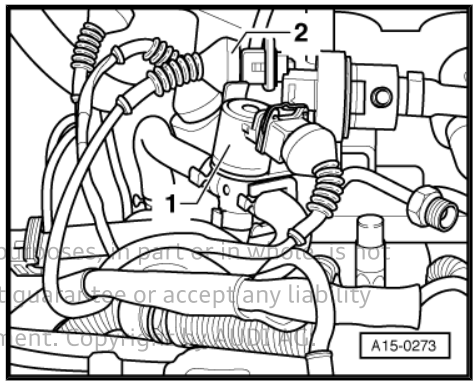
– Detach hose -5- going to turbocharger.

– Remove ignition coils.



– Unclip charge pressure control solenoid valve - N75- -item 1-.

– Unplug electrical connector -2- at activated charcoal filter solenoid valve 1 - N80- .



– Unplug electrical connectors:

1 - Throttle valve module - J338-

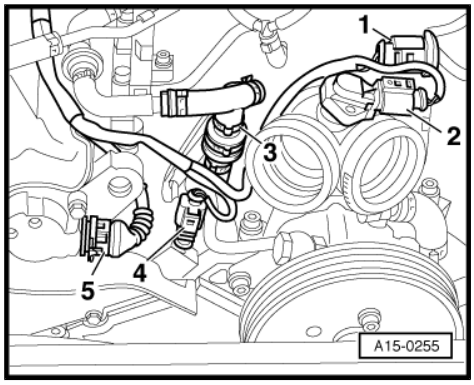
2 - Charge pressure sender - G31-

4 - Intake air temperature sender - G42-

5 - Hall sender - G40-

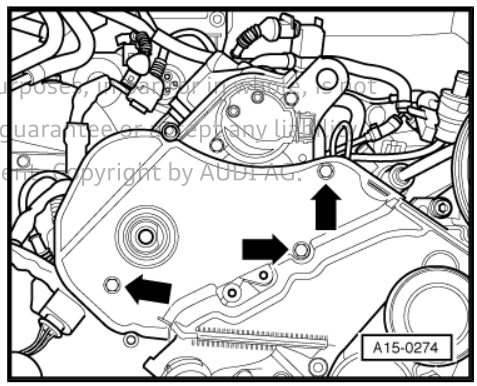
– Disconnect crankcase breather hose -3-.

– Remove toothed belt ⇒ page 46 .



– Unscrew bolts -arrows- and remove toothed belt cover (rear right).

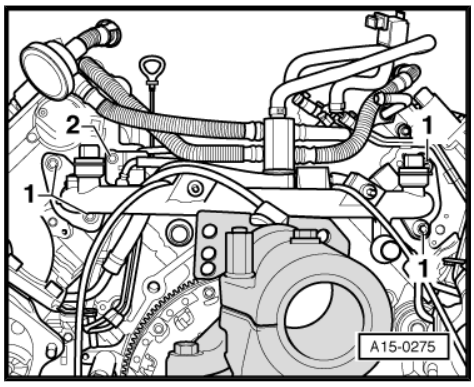
– Remove intake manifold ⇒ Rep. gr. 24 .



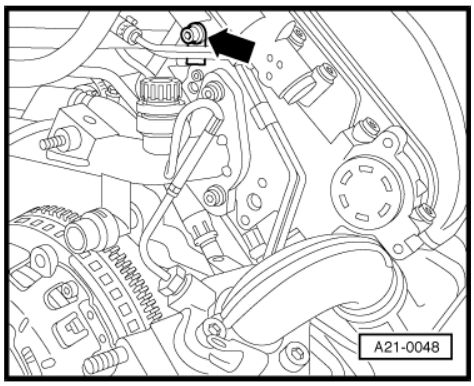
– Remove bolts -1- and pull coolant pipe (rear) to the rear.

Note

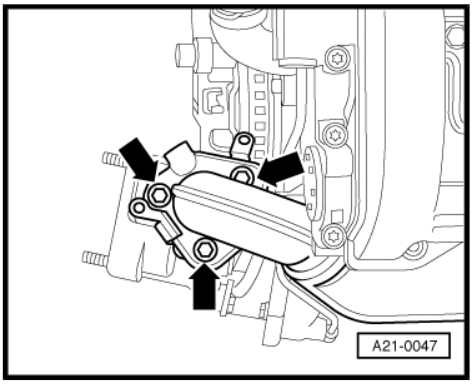
Disregard -item 2-.



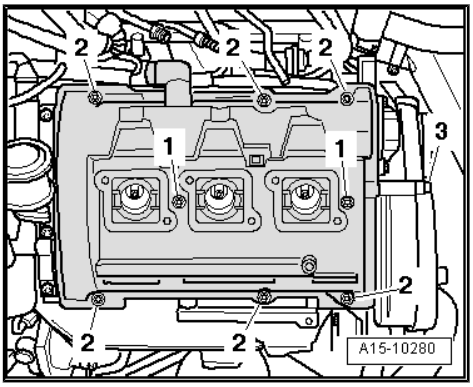
– Unbolt pipe -arrow- from cylinder head.



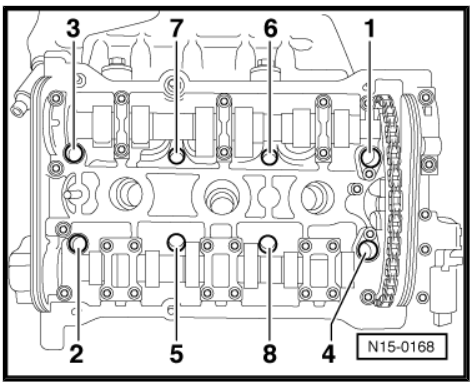
– Remove bolts -arrows- securing turbocharger to exhaust manifold.



– Remove nuts -1- and -2- and detach cylinder head cover.



– Use special wrench, long reach - T10070- to slacken cylinder head bolts in sequence -1 ... 8-.
– Remove bolts and carefully take off cylinder head.
– Place cylinder head onto soft surface (foam plastic).



1.6 Installing cylinder head

• Tightening torques ⇒ page 77

Caution

Risk of damage to sealing surfaces.

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

Risk of damage to cylinder block.

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

Risk of leaks at cylinder head gasket.

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

Risk of damage to open valves.

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

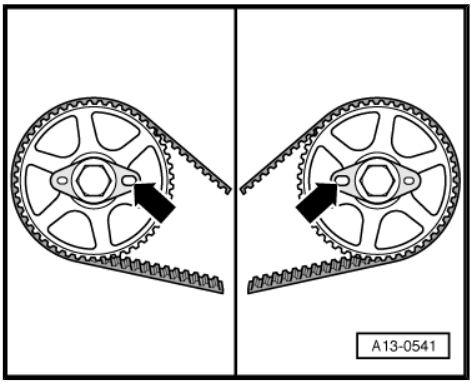
Note

- *Renew the bolts tightened with specified tightening angle.*
- *Renew self-locking nuts as well as seals, gaskets and O-rings.*
- *When installing an exchange cylinder head, the contact surfaces between the bucket tappets and the running surfaces of the cams must be oiled after installing the cylinder head.*
- *When installing a replacement cylinder head supplied without fitted camshafts, a sealing cap must be driven into the front of the respective cylinder head* *⇒ page 80* *.*
- *When installing a replacement cylinder head, a centring pin for the intake manifold must be screwed in.*
- *Hose connections and hoses for charge air system must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*
- *After fitting a new cylinder head or cylinder head gasket, change the engine oil and coolant.*

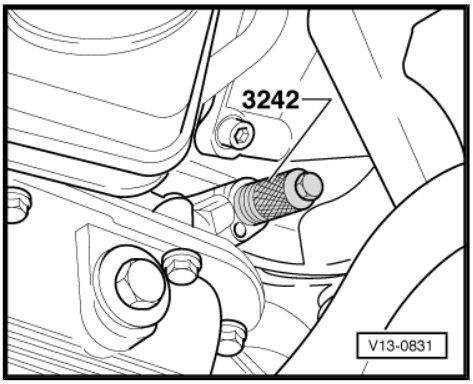
Installation is carried out in reverse order; note the following:

– Before installing cylinder head, set crankshaft and camshafts to TDC:

• Large holes -arrows- in locating plates at camshaft sprockets must be opposite one another on inside.



• The locking pin - 3242- must be screwed in.

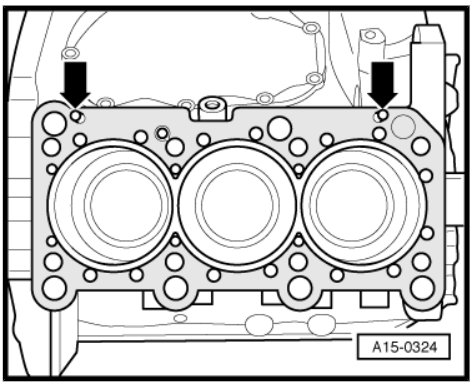


– Place cylinder head gasket in position.

• Note position of centring pins -arrows- in cylinder block.

• Check installation position of cylinder head gasket: the word “oben” (top) or the Part No. should face towards the cylinder head.

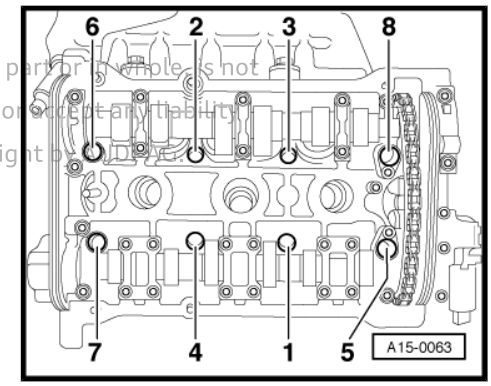
– Fit cylinder head.



– Tighten cylinder head bolts ⇒ page 80 .

Note

Cylinder head bolts do not have to be torqued down again.



– Install cylinder head cover: left-side ⇒ page 80 ; right-side ⇒ page 83 .

– Install turbocharger ⇒ page 218 .

– Install coolant pipe (rear) ⇒ page 177 .

– Install intake manifold ⇒ Rep. gr. 24 .

– Install toothed belt cover (rear) ⇒ page 44 .

– Install toothed belt (adjust valve timing) ⇒ page 50 .

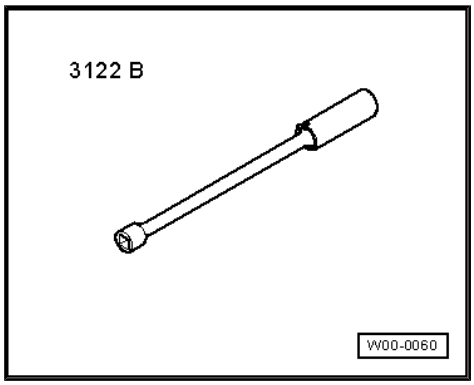
– Change engine oil ⇒ Maintenance ; Booklet 402 .

– Fill cooling system with fresh coolant ⇒ page 163 .

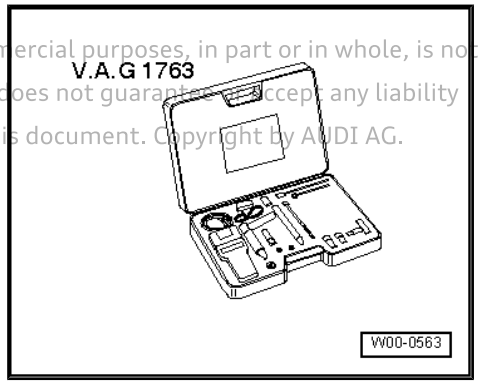
1.7 Checking compression

Special tools and workshop equipment required

- Spark plug spanner - 3122 B-



- Compression tester - V.A.G 1763-

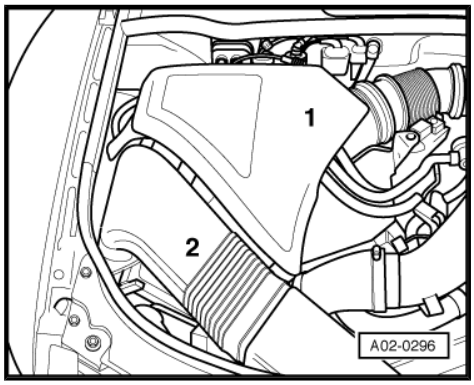


Procedure

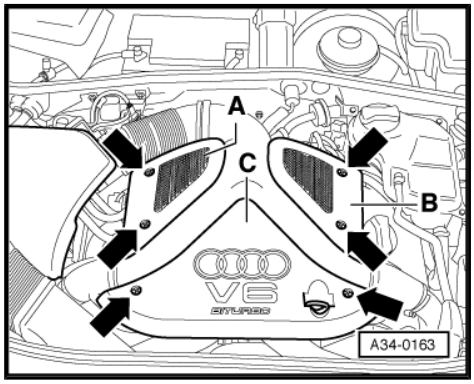
- Engine oil temperature at least 30 °C
- Battery voltage at least 12.5 V

– Switch off ignition.

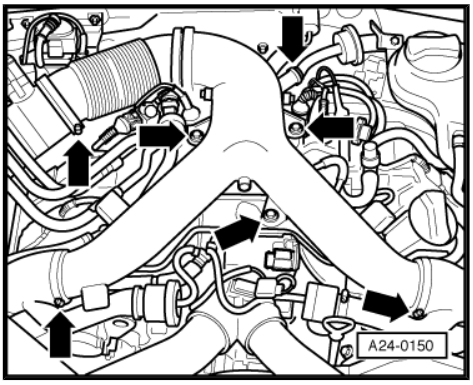
– Remove cover -1- on right side of engine compartment.



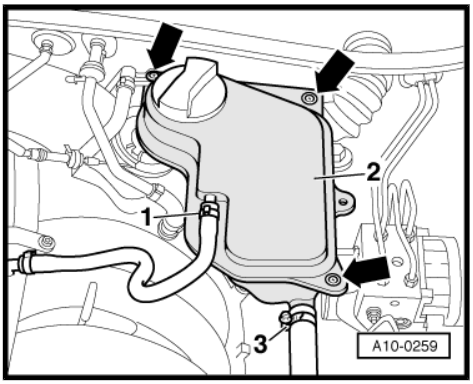
– Detach engine cover panels -A ... C- by removing bolts -arrows-.



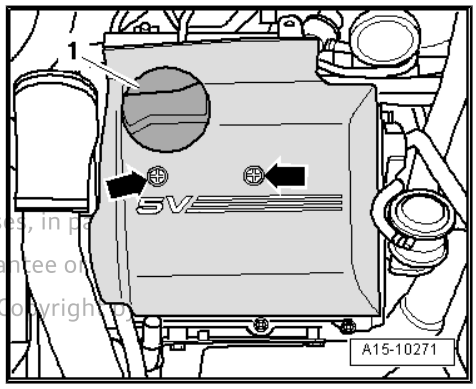
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



– Remove bolts -arrows-.
– Unplug electrical wiring to coolant shortage indicator switch -F66- and move coolant expansion tank -2- to one side with coolant hoses -1- and -3- attached.



– Detach filler cap -1-.
– Open quick-release fasteners -arrows- and detach cover for cylinder head cover (left-side).



– Unplug electrical connectors:

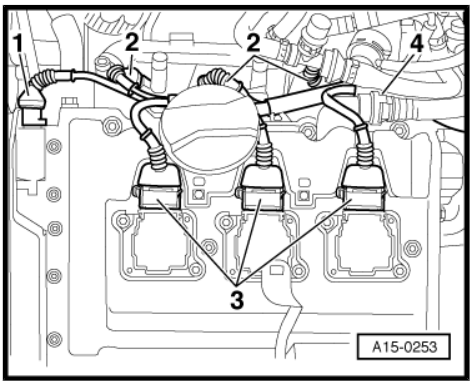
1 - Injectors

2 - Ignition coils

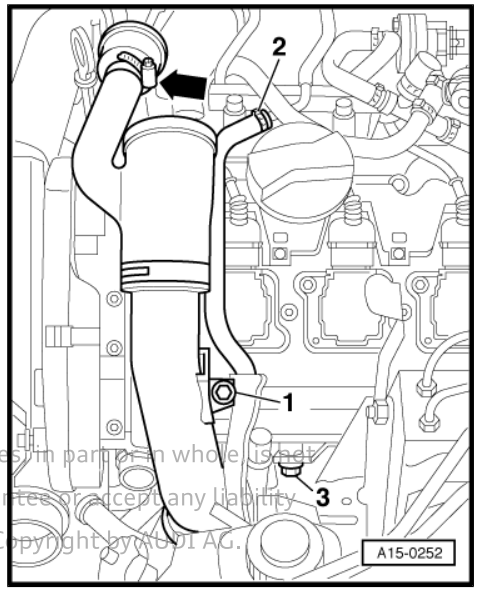
Note

Disregard items -3 and 4-.

– Move electrical wiring harness clear.
– Remove ignition coils.



– Remove bolt -1-, detach hoses -2- and -arrow- and remove air pipe.
– Remove bolt -3- for coolant pipe.

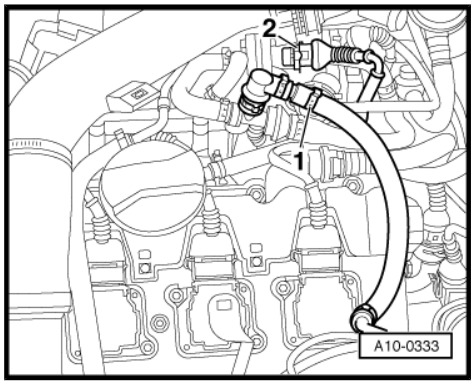


Caution

Risk of irreparable damage to engine.

- *Block off the opening of the air pipe (bottom) with a clean cloth to prevent small items from dropping into the engine through the air pipe (bottom).*

– Detach vacuum hose -1- going to vacuum reservoir.



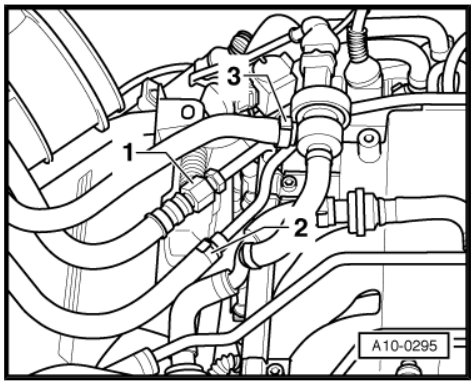
Note

Disregard -item 2-.

WARNING

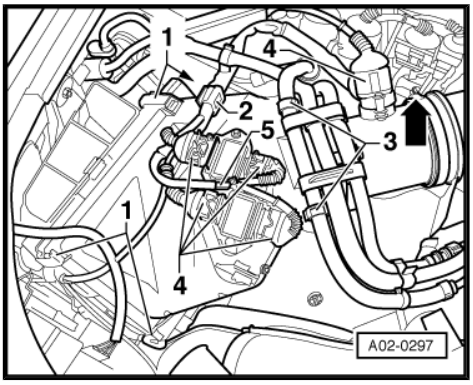
Fuel under pressure - risk of injuries!

- *To reduce the pressure in the fuel system, wrap a clean cloth around the connection and loosen the connection carefully.*



– Disconnect fuel supply line -1- and fuel return line -2-.
– Detach hose -3- from activated charcoal filter solenoid valve 1 - N80- .

– Unplug electrical connector -4- at air mass meter - G70- .
– On vehicles with separate output stages, unplug remaining connectors -4-, cut through cable tie -5- and detach wiring harness from clip -2-. Then put down wiring harness next to intake opening of air cleaner.
– Open retaining clips -3- for fuel lines.
– Release hose clip -arrow-.
– Remove bolts and take off air filter housing.



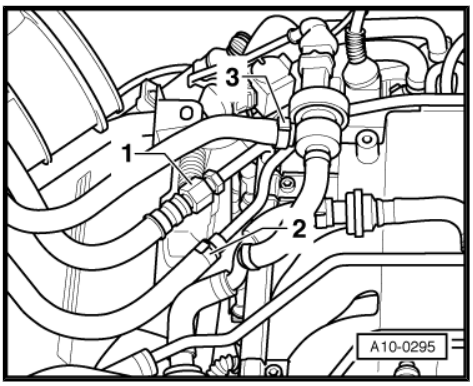
Note

Disregard -item 1-.

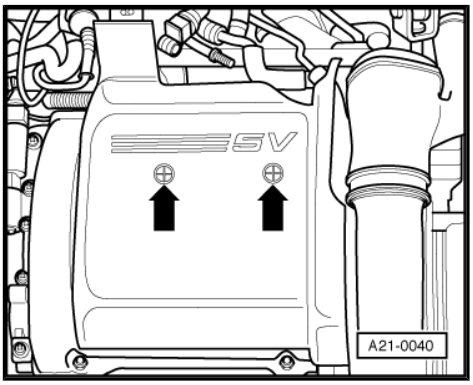
– Reconnect fuel supply line -1- and fuel return line -2-.

WARNING

The electrical fuel pump starts up during the compression pressure test - make sure the fuel pipes remain attached.



– Open quick-release fasteners -arrows- and detach cover for cylinder head cover (right-side).

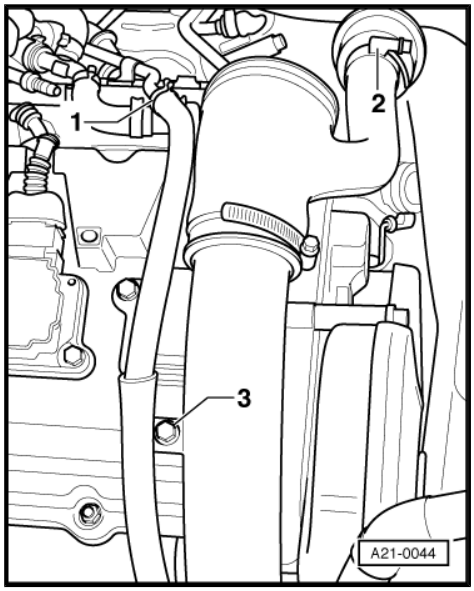


– Remove bolt -3- , detach hoses -1- and -2- and remove air pipe.

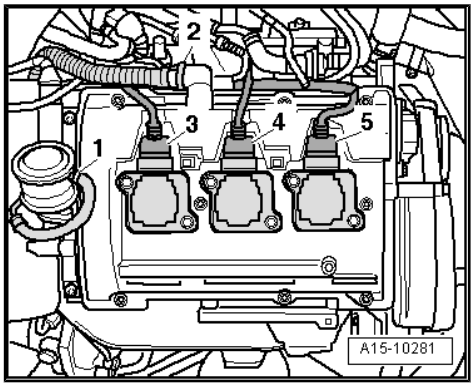
Caution

Risk of irreparable damage to engine.

- *Block off the opening of the air pipe (bottom) with a clean cloth to prevent small items from dropping into the engine through the air pipe (bottom).*



– Unplug electrical connectors -3, 4, 5-.



Note

Disregard items -1 and 2-.

– Remove ignition coils.
– Unplug electrical connectors at injectors.
– Remove all spark plugs with spark plug socket and extension - 3122 B- .
– Check compression pressure with compression tester - V.A.G 1763- (see ⇒ operating instructions for details of how to use tester).
– 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 ... 13.0
Wear limit	7.0
Maximum difference between cylinders	3.0

Assembling

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

Note

Fit all cable ties in the original positions when installing.

– Install spark plugs ⇒ Maintenance ; Booklet 402 .
– Install air pipes ⇒ page 220 , ⇒ page 220 .
– Install air hoses ⇒ page 227 .
– Install air duct ⇒ page 29 .
– Faults are stored in engine control unit if connectors were unplugged and engine was started: “Interrogate fault memory” or “Generate readiness code” in “Vehicle self-diagnosis” ⇒ Vehicle diagnostic tester.

2 Valve gear

Caution

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

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

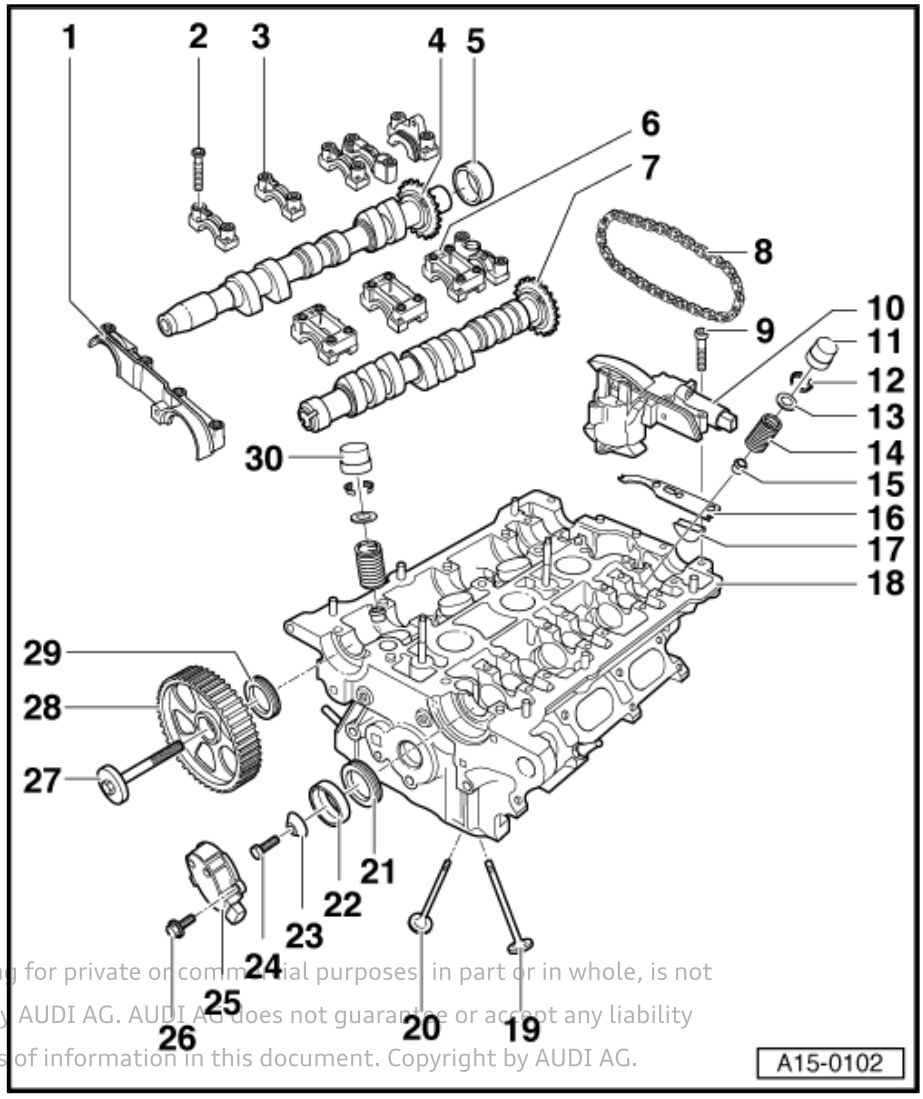
Note

- *All bearing and running surfaces must be oiled before assembling.*
- *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.*

2.1 Exploded view - valve gear

Note

The diagram shows the cylinder head on cylinder bank 1 (right-side).



1 - Double bearing cap

- ❑ Before installing, coat contact surfaces of bearing caps at front and rear with a small quantity of sealant ⇒ page 105

2 - Bolt

- ❑ 10 Nm

3 - Bearing cap on exhaust camshaft

- ❑ Watch position of dowel sleeve
- ❑ Note installation position and allocation ⇒ page 114
- ❑ Prior to installation, apply thin coat of sealant to bearing cap next to chain ⇒ page 105

4 - Exhaust camshaft

- ❑ Removing and installing ⇒ page 112
- ❑ Measuring axial clearance ⇒ page 105
- ❑ Measuring radial clearance ⇒ page 106
- ❑ Runout: max. 0.01 mm

5 - Sealing cap

- ❑ Renewing ⇒ page 108
- ❑ Detach bearing cap to remove
- ❑ With bearing cap in position, drive in carefully with fitting sleeve - 3202-

6 - Bearing cap on inlet camshaft

- ❑ Watch position of dowel sleeve
- ❑ Note installation position and allocation ⇒ page 114

7 - Inlet camshaft

- ❑ Removing and installing ⇒ page 112
- ❑ Measuring axial clearance ⇒ page 105
- ❑ Measuring radial clearance ⇒ page 106
- ❑ Runout: max. 0.01 mm

8 - Drive chain

- ❑ Installing ⇒ page 115

9 - Bolt

- ❑ 10 Nm

10 - Mechanical camshaft adjuster

- ❑ With camshaft control valve 1 - N205-
- ❑ Before removing, lock in position with chain tensioner retainer - 3366- ⇒ page 112

11 - Hydraulic bucket tappet (inlet valve)

- ❑ Checking ⇒ page 116
- ❑ Removing and installing ⇒ “2.7 Removing and installing camshafts and camshaft adjuster”, page 112

- ❑ Do not interchange
- ❑ Place down with contact surface facing downwards
- ❑ Check axial clearance of camshaft before installing ⇒ page 105
- ❑ Lubricate contact surface

12 - Valve cotters

13 - Valve spring plate

14 - Valve spring

15 - Valve stem oil seal

- ❑ Renewing with cylinder head installed ⇒ page 117
- ❑ Renewing with cylinder head removed ⇒ page 122

16 - Rubber/metal gasket

- ❑ Renew

17 - Seal

- ❑ Renew

18 - Cylinder head

- ❑ Checking valve guides, grinding-in valve seats ⇒ page 127
- ❑ Machining valve seats ⇒ page 128

19 - Exhaust valve

- ❑ Do not machine, only grinding-in is permitted
- ❑ Valve dimensions ⇒ page 126

20 - Inlet valve

- ❑ Do not machine, only grinding-in is permitted
- ❑ Valve dimensions ⇒ page 126

21 - Oil seal

- ❑ Note direction of rotation
- ❑ Renewing ⇒ page 108 and ⇒ page 109

22 - Rotor for Hall sender

- ❑ Note fitting position (notch on camshaft)

23 - Washer

- ❑ Conical

24 - Bolt

- ❑ 25 Nm

25 - Hall sender - G40-

26 - Bolt

- ❑ 10 Nm

27 - Bolt

- ❑ Tightening torque ⇒ Item 8 (page 44)

28 - Camshaft sprocket

29 - Oil seal for Hall sender

- ❑ Note direction of rotation
- ❑ Renewing ⇒ page 106

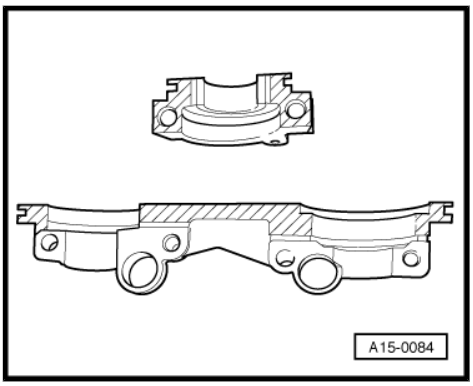
30 - Hydraulic bucket tappet (exhaust valve)

- ❑ Checking ⇒ page 116
- ❑ Removing and installing ⇒ “2.7 Removing and installing camshafts and camshaft adjuster”, page 112
- ❑ Do not interchange
- ❑ Place down with contact surface facing downwards

❑ Check axial clearance of camshaft before installing ⇒ page 105
❑ Lubricate contact surface

Installing bearing caps

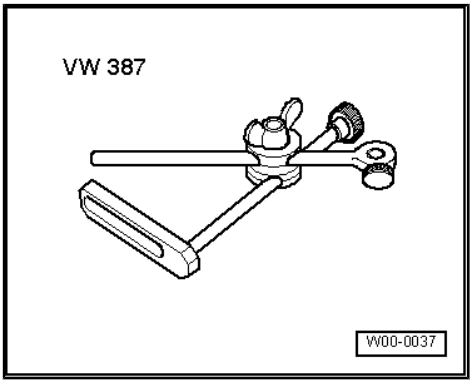
– Apply a small quantity of sealant to -hatched- area of bearing caps; for sealant refer to ⇒ Electronic parts catalogue .
– Install bearing caps (pay attention to dowel sleeves).



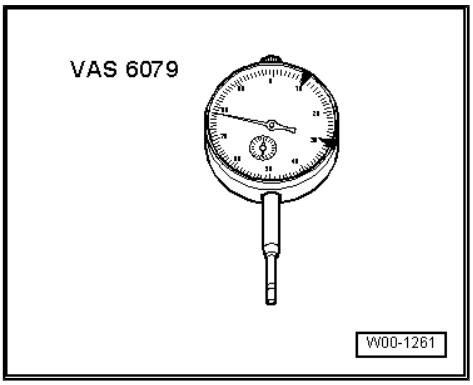
2.2 Measuring axial clearance of camshafts

Special tools and workshop equipment required

♦ Universal dial gauge bracket - VW 387-



♦ Dial gauge - VAS 6079-



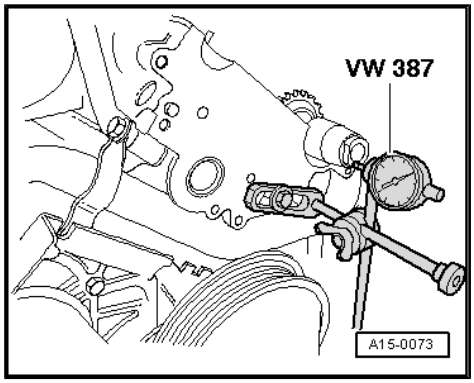
Procedure

– Remove camshafts ⇒ page 112 .
– Mark allocation of bucket tappets for re-installation.
– Remove bucket tappets from guides and put them down on a clean surface with contact surface facing downwards.
– Fit camshafts in cylinder head without drive chain and secure with bearing caps “2” and “4”.

– Secure dial gauge - VAS 6079- to cylinder head with universal dial gauge bracket - VW 387- as shown in illustration.

– Press camshaft against dial gauge by hand and set gauge to “0”.

– Press camshaft away from dial gauge and read off value.



Axial clearance:

- New: 0.05 ... 0.15 mm.
- Wear limit: 0.20 mm.

2.3 Measuring radial clearance of camshafts

Special tools and workshop equipment required

♦ Plastigauge

Procedure

– Remove camshafts ⇒ page 112 .

– Mark allocation of bucket tappets for re-installation.

– Remove bucket tappets from guides and put them down on a clean surface with contact surface facing downwards.

– Clean bearings and bearing journals.

– Place a length of Plastigauge corresponding to the width of the bearing on the bearing journal or bearing shell to be measured.

- The Plastigauge must be positioned in the centre of the bearing.

– Fit camshafts in cylinder head without drive chain and secure with bearing caps “2” and “4” without rotating camshafts.

– Remove camshafts again.

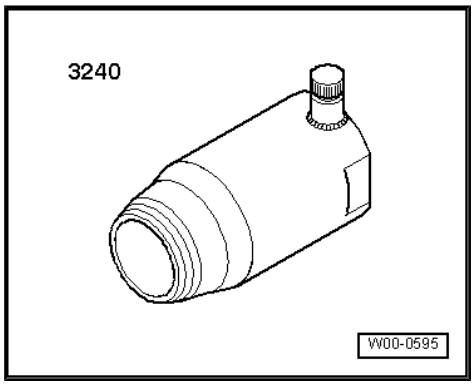
– Compare width of Plastigauge with measurement scale.

- Radial clearance (wear limit): 0.1 mm

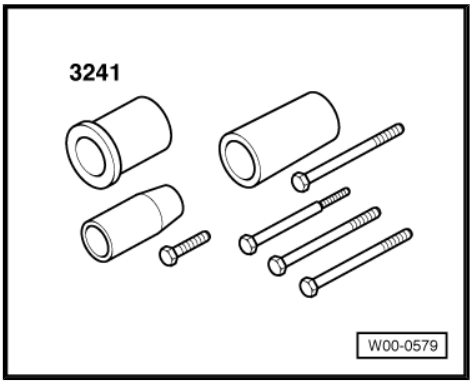
2.4 Renewing oil seals for camshafts

Special tools and workshop equipment required

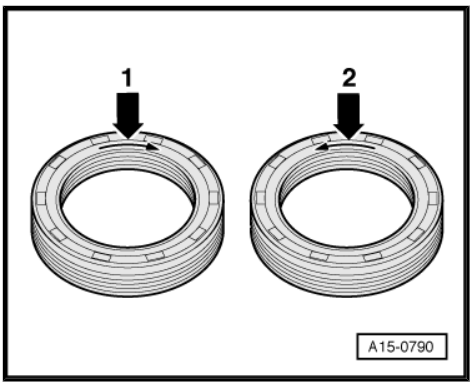
♦ Oil seal extractor - 3240-



♦ Fitting sleeves - 3241-



Procedure



Note

♦ *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.*

♦ *The direction of rotation of the oil seals at the front of the engine is "clockwise" -arrow 1-. The direction of rotation of the oil seals on the back of the engine is "anti-clockwise" -arrow 2-.*

– Remove toothed belt ⇒ page 46 .

– Detach camshaft sprockets.

Note

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

Cylinder head (left-side):

– Adjust inner section of oil seal extractor - 3240- so it is flush with outer section.

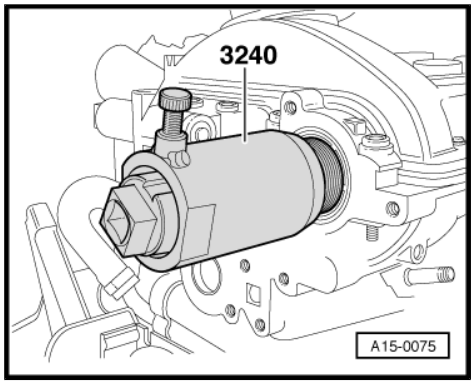
– Unscrew inner section of oil seal extractor 5 turns and lock with knurled screw.

Cylinder head (right-side):

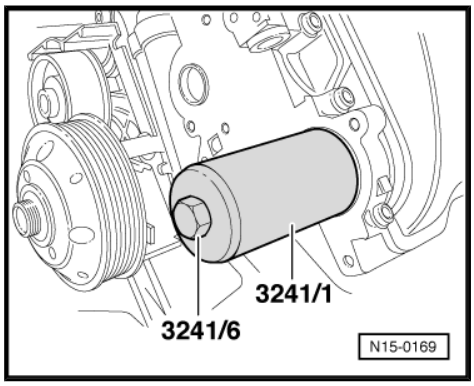
– Adjust inner section of oil seal extractor - 3240- so it is flush with outer section.

– Unscrew inner section of oil seal extractor 11 turns and lock with knurled screw.

Both sides (continued):



- Lubricate threaded head of oil seal extractor - 3240- , place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice and use pliers to remove oil seal.
- Clean contact surface and sealing surface for oil seal.
- Check direction of rotation of oil seal before fitting.
- Direction of rotation “clockwise” (arrow on oil seal).
- Slide oil seal over taper on camshaft.



- Press in oil seal until flush using fitting sleeve - 3241/1- and hexagon bolt - 3241/6- .

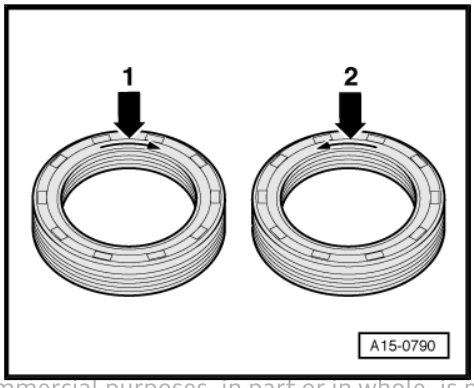
Assembling

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

- Install toothed belt cover (rear) ⇒ page 44 .
- Install toothed belt (adjust valve timing) ⇒ page 50 .

2.5 Renewing oil seal for Hall sender and sealing cap on cylinder head (left-side)

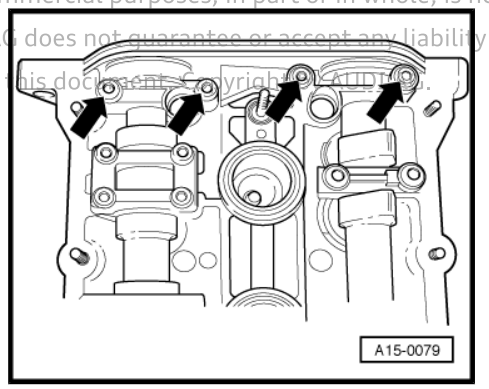
Procedure



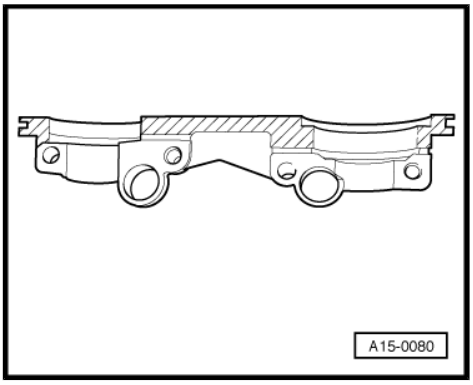
Note

- *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.*
- *The direction of rotation of the oil seals at the front of the engine is “clockwise” -arrow 1-. The direction of rotation of the oil seals on the back of the engine is “anti-clockwise” -arrow 2-.*

- Remove cylinder head cover (left-side) ⇒ page 80 .
- Remove Hall sender ⇒ Item 25 (page 104) and rotor for Hall sender ⇒ Item 22 (page 104) .
- Remove bolts -arrows- and detach double bearing cap.
- Take out oil seal and sealing cap.



– Clean running/sealing surfaces and contact surfaces of double bearing cap.
– Apply a small quantity of sealant to -hatched- contact area of double bearing cap; for sealant refer to ⇒ Electronic parts catalogue .
– Check direction of rotation of oil seal before fitting.
• Direction of rotation “anti-clockwise” (arrow on oil seal)
– Position oil seal and install double bearing cap.
– Use assembly lever to press in sealing cap.



Note

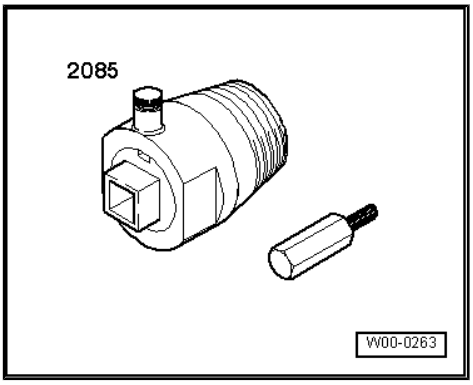
When engine is removed, bearing cap can remain installed when renewing oil seal and sealing cap. Procedure ⇒ page 109

Installation is carried out in the reverse order; note the following:
– Install rotor for Hall sender ⇒ Item 22 (page 104), washer ⇒ Item 23 (page 104) and Hall sender ⇒ Item 25 (page 104) .
– Install cylinder head cover (left-side) ⇒ page 80 .

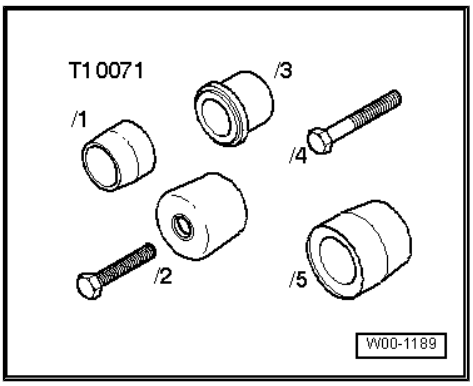
2.6 Renewing oil seal for Hall sender on cylinder head (right-side)

Special tools and workshop equipment required

♦ Oil seal extractor - 2085-



♦ Assembly tool - T10071-

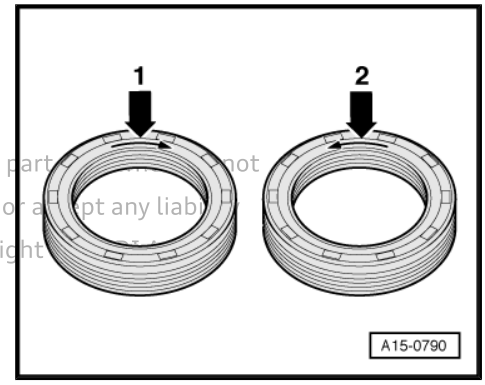


♦ M8x50 bolt
♦ M8x60 bolt

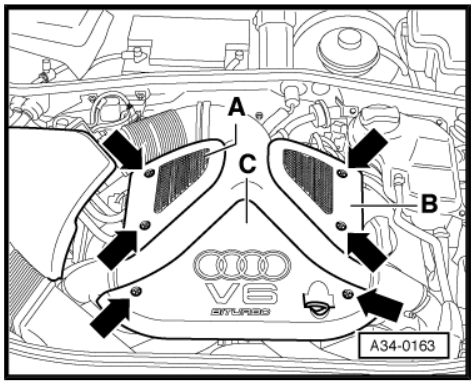
Procedure

Note

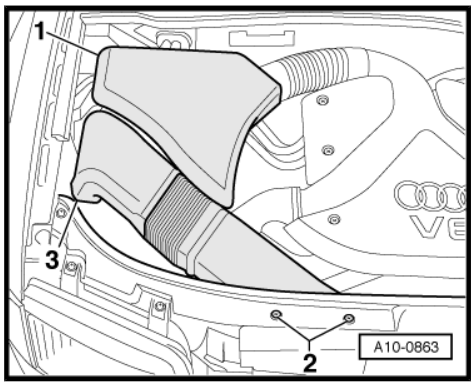
- *PTFE oil seals are matched to the direction of shaft rotation (see arrow on oil seal). Incorrect allocation to direction of rotation will result in oil leaks.*
- *The direction of rotation of the oil seals at the front of the engine is “clockwise” -arrow 1-. The direction of rotation of the oil seals on the back of the engine is “anti-clockwise” -arrow 2-.*



– Detach engine cover panels -A ... C- by removing bolts -arrows-.



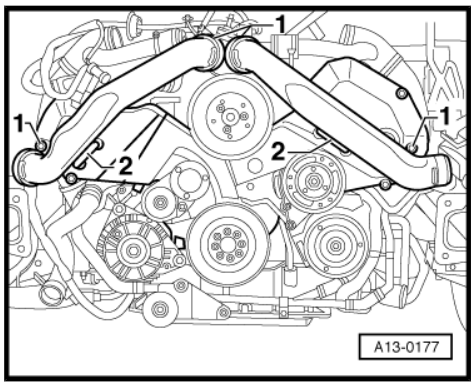
– Remove cover -1- on right side of engine compartment.
– Remove bolts -2- and detach both air ducts -3-.



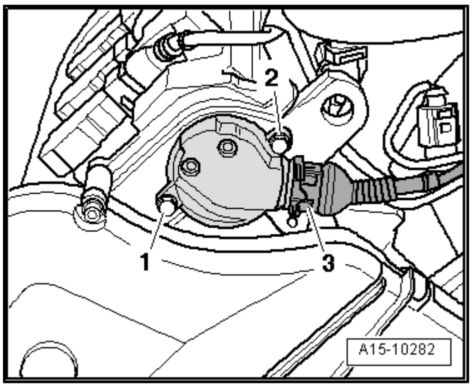
– Remove bolts -1- and detach air pipe (right-side).

Note

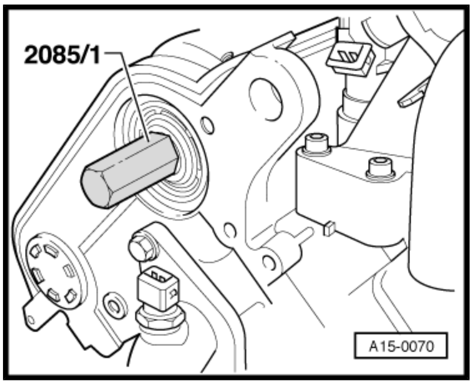
Pay attention to retaining strips -2-.



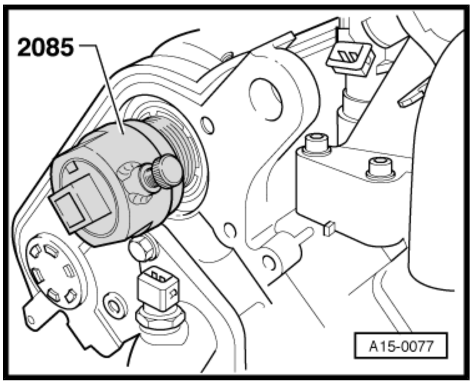
– Unplug electrical connector -3- at Hall sender - G40- .
– Remove bolts -1- and -2- and remove Hall sender.
– Remove rotor for Hall sender ⇒ Item 22 (page 104) and washer ⇒ Item 23 (page 104) .



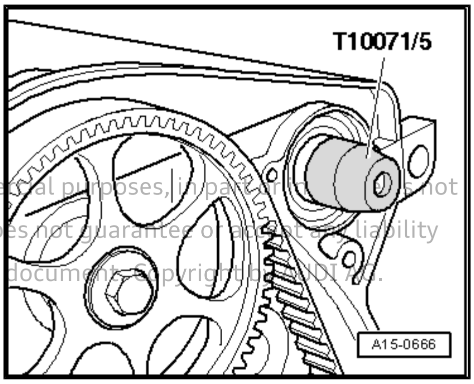
– Screw in bolt - 2085/1- for oil seal extractor - 2085- .
– Position inner section of oil seal extractor flush with outer section.
– Unscrew inner section of oil seal extractor 3 turns and lock with knurled screw.



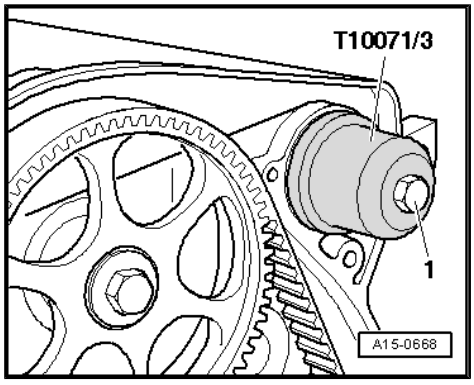
– Lubricate threaded head of oil seal extractor - 2085- , place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
– Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.
– Clamp flats of oil seal extractor in vice and use pliers to remove oil seal.
– Clean contact surface and sealing surface for oil seal.
– Unscrew bolt - 2085/1- for oil seal extractor - 2085- .



– Clean contact surface and sealing surface for oil seal.
– Fit guide sleeve - T10071/5- onto camshaft journal and secure with M8x50 bolt.
– Check direction of rotation of oil seal before fitting.
• Direction of rotation “clockwise” (arrow on 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 M8x60 bolt -item 1-.



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

Note

- *Renew O-rings.*
- *Hose connections and hoses for charge air system must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*

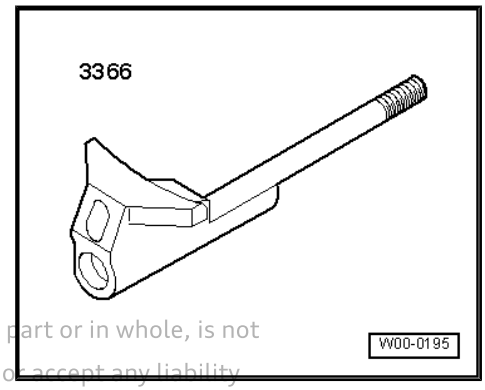
– Install rotor for Hall sender ⇒ Item 22 (page 104) , washer ⇒ Item 23 (page 104) and Hall sender ⇒ Item 25 (page 104) .

– Install air pipe ⇒ page 220 .

2.7 Removing and installing camshafts and camshaft adjuster

Special tools and workshop equipment required

- Chain tensioner retainer - 3366-



- Sealant ⇒ Electronic parts catalogue

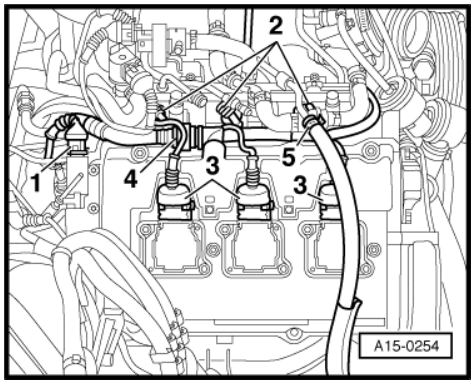
Removing

– Remove toothed belt ⇒ page 46 .

– Detach camshaft sprocket.

– Remove cylinder head cover: left-side ⇒ page 80 ; right-side ⇒ page 83 .

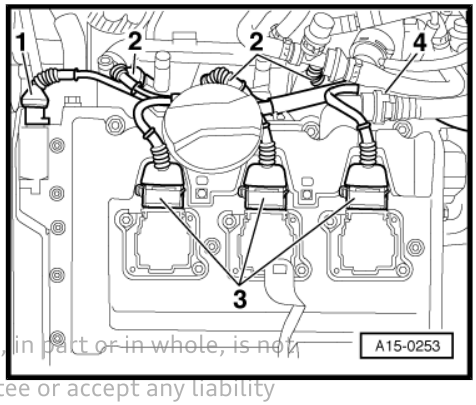
– Unplug electrical connector -1- at camshaft control valve 1 - N205- .



Note

Disregard items -2 and 3-.

– Unplug electrical connector -1- at camshaft control valve 2 - N208- .



Note

Disregard items -2 and 3-.

– Remove Hall sender ⇒ Item 25 (page 104) and rotor for Hall sender ⇒ Item 22 (page 104) .

Caution

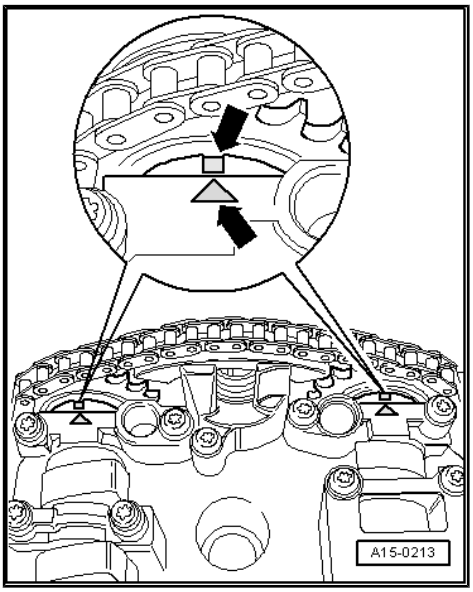
Avoid damage to retainers.

- ***Carefully prise camshaft bearing oil lines off camshaft bearings using a screwdriver.***

– Turn crankshaft approx. 45° anti-clockwise at bolt for toothed belt sprocket so that all pistons are clear of “TDC” position.

– Check “TDC” position of camshafts again:

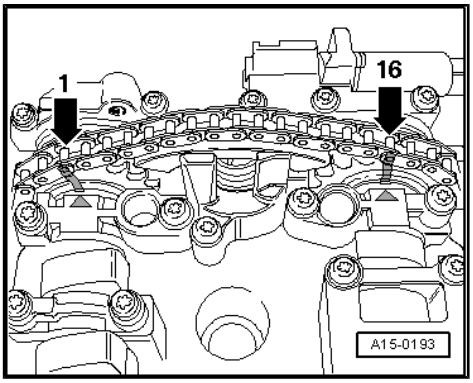
- The two marks on the camshafts must be opposite the two arrows on the bearing caps -arrows-.



If old drive chain is to be reused:

– Clean drive chain and sprockets of camshafts opposite two arrows on 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-.

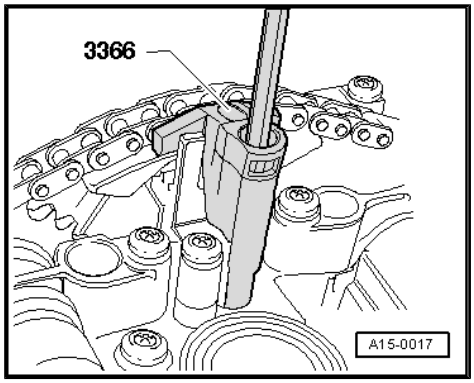


Note

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

Continued for all drive chains:

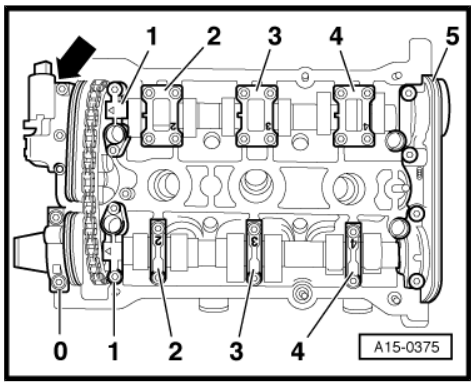
– Hold camshaft adjuster in position with chain tensioner retainer - 3366- .



Note

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

– Mark the sequence and installation positions of all bearing caps, as shown, regardless of any existing markings on the bearing caps.



– Remove bolts for camshaft adjuster -arrow-.

– Unbolt bearing cap -0-.

– Remove bearing caps -1-, -3- and -5- and place them in the correct order on a clean surface.

– Slacken off bearing caps -2- and -4- of inlet and exhaust camshafts alternately and diagonally, and remove.

– Lift out both camshafts together with camshaft adjuster.

Installing

• Tightening torques ⇒ page 102

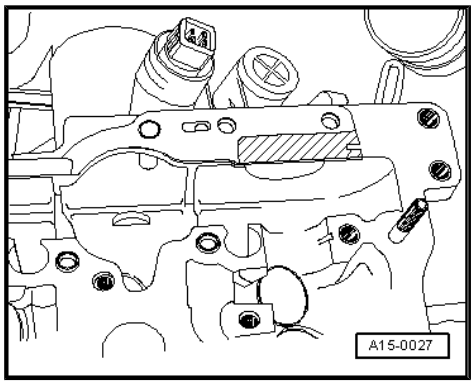
Installation is carried out in reverse order; note the following:

Note

♦ *Renew the semi-circular sealing plug.*

♦ *Renew rubber/metal gasket for camshaft adjuster.*

– Apply a small quantity of sealant to -hatched- area; for sealant refer to ⇒ Electronic parts catalogue .



– Position drive chain as follows on camshaft chain sprockets:

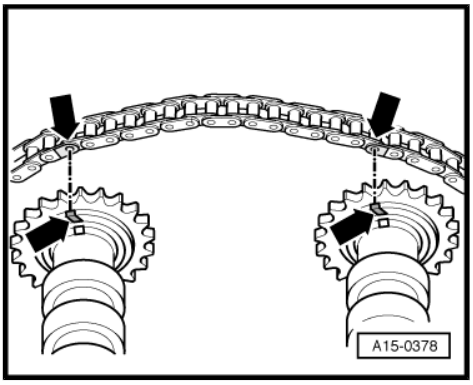
If old drive chain is to be reused:

- Align coloured marks -arrows-.

If new drive chain is being used:

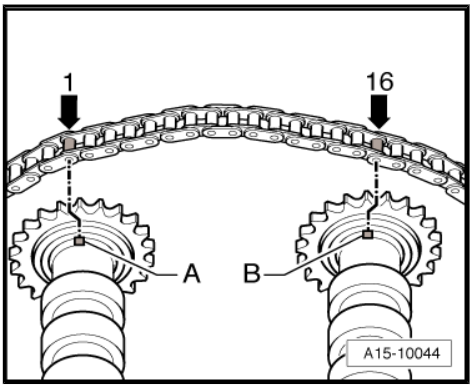
Caution

- ***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 116*** ***.***



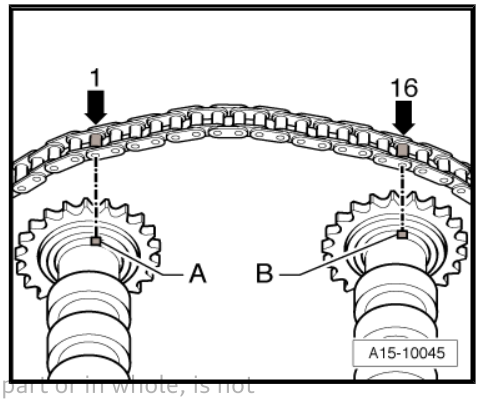
Cylinder head (left-side):

- 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.
- The chain rollers -1- and -16- are offset $^{1}/_{2}$ tooth outwards in relation to notches -A- and -B-



Cylinder head (right-side):

- 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.
- The chain rollers -1- and -16- are located vertically above notches -A- and -B-.



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

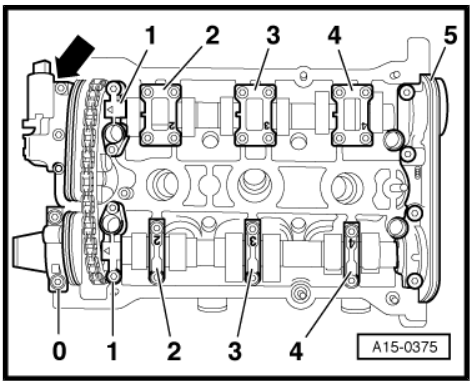
– Secure camshaft adjuster -arrow- (pay attention to dowel sleeves).

– Install bearing caps -2- and -4- according to markings.

– Tighten bolts for bearing caps -2- and -4- of inlet camshaft and exhaust camshaft alternately in diagonal sequence.

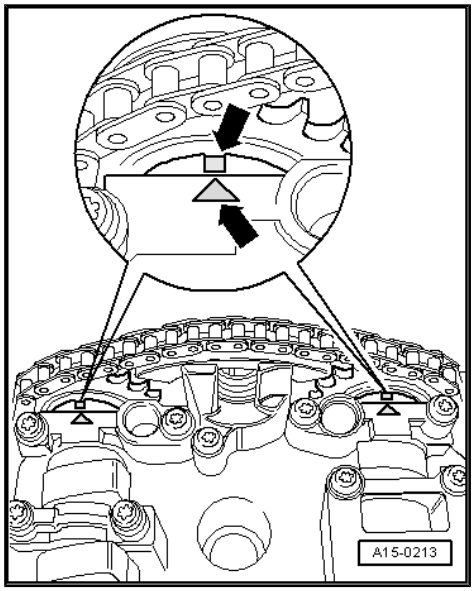
– Install both bearing caps -1- next to chain sprockets on inlet and exhaust camshaft.

– Remove chain tensioner retainer - 3366- .



– Check that camshafts are positioned correctly:

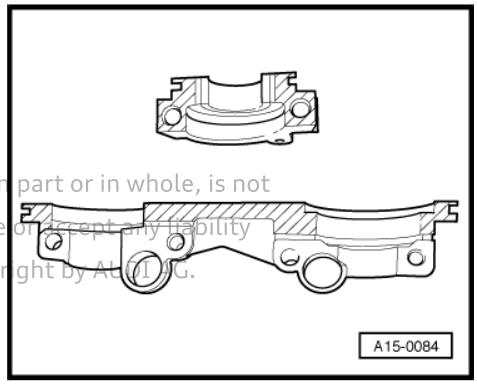
• The two marks on the camshafts must be opposite the two arrows on the bearing caps -arrows-.



Note

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

– Before installing, apply a small quantity of sealant to -hatched area- of double bearing cap and outer bearing cap adjacent to camshaft adjuster; for sealant refer to ⇒ Electronic parts catalogue .



– Install remaining bearing caps (pay attention to dowel sleeves).

– Renew oil seals for inlet and exhaust camshaft ⇒ page 106 .

– Secure remaining bearing caps.

– Turn crankshaft approx. 45° clockwise back to “TDC” at toothed belt sprocket bolt and secure crankshaft with locking pin.

– Install cylinder head cover: left-side ⇒ page 80 ; right-side ⇒ page 83 .

– Install toothed belt (adjust valve timing) ⇒ page 50 .

Caution

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

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

2.8 Checking hydraulic bucket tappets

Note

- *Hydraulic bucket tappets cannot be serviced.*
- *Irregular valve noises when starting engine are normal.*

Special tools and workshop equipment required

- Feeler gauge

Procedure

– Start engine and run until coolant temperature reaches approx. 80 °C.

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

Note

If irregular valve noise disappears but repeatedly re-occurs when travelling short distances, renew oil retention valves ⇒ *page 156* .

– If hydraulic bucket tappets are still noisy, locate defective compensation element as follows:

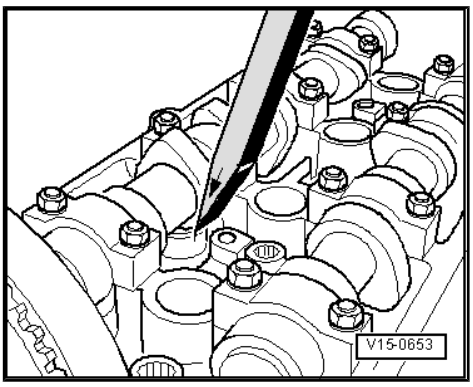
– Remove cylinder head cover: left-side ⇒ page 80 ; right-side ⇒ page 83 .

– Rotate crankshaft in direction of engine rotation until cams of cylinder to be checked point upwards.

- Vehicles with manual gearbox: push vehicle forwards with 5th gear engaged and ignition switched off.
- Vehicles with automatic gearbox: rotate crankshaft in clockwise direction via bolt on toothed belt pulley.

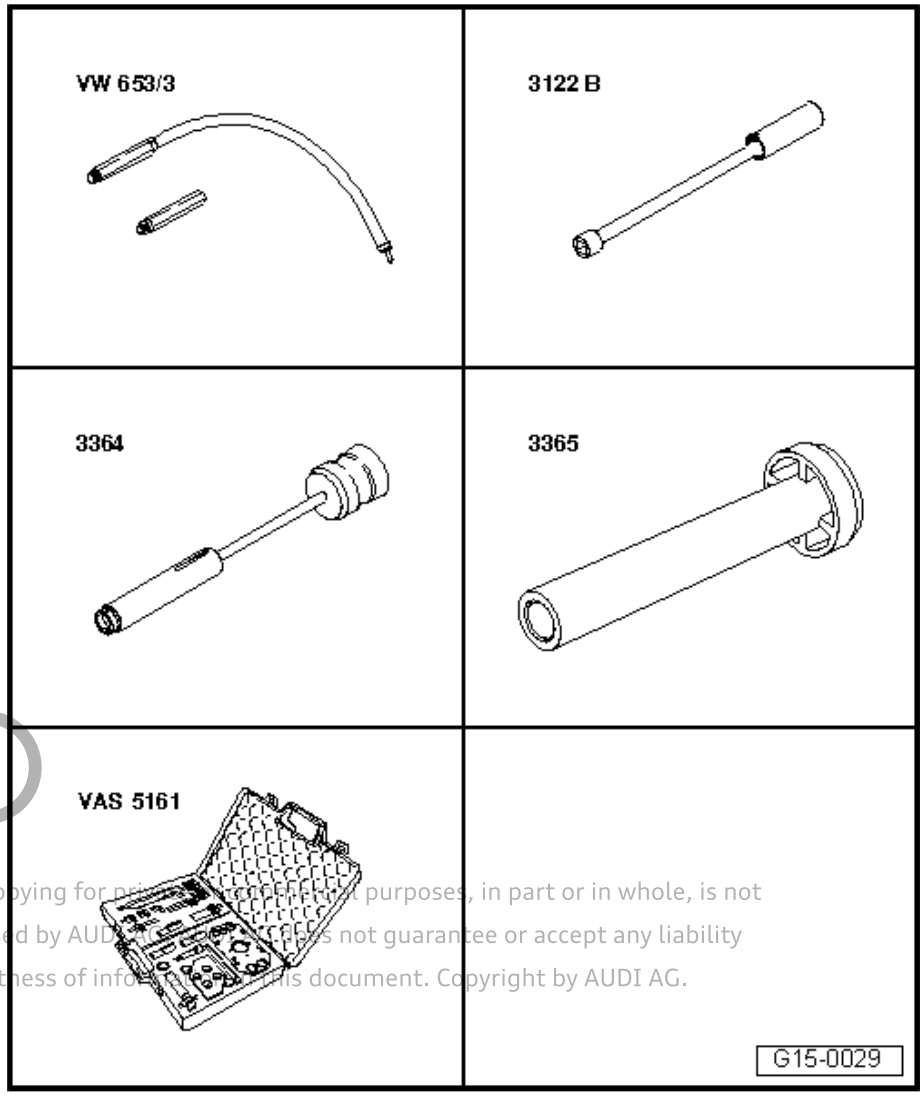
– Push bucket tappet down with a wooden or plastic wedge to determine play between cam and bucket tappet.

– If an 0.20 mm feeler gauge can be inserted between cam and bucket tappet, renew tappet ⇒ “2.7 Removing and installing camshafts and camshaft adjuster”, page 112 .



2.9 Renewing valve stem oil seals with cylinder head installed

Special tools and workshop equipment required



- Pressure hose - VW 653/3-
- Spark plug spanner - 3122 B-
- Valve stem seal puller - 3364-
- Valve stem seal fitting tool - 3365-
- Removal and installation device - VAS 5161-

Procedure

– Remove camshafts and camshaft adjuster ⇒ page 112 .

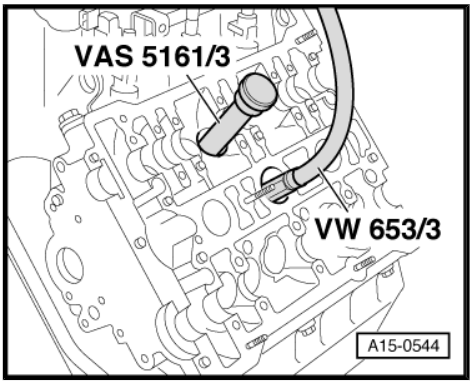
– Mark allocation of bucket tappets for re-installation.

– Remove bucket tappets from guides and put them down on a clean surface with contact surface facing downwards.

– Unscrew spark plugs using spark plug socket - 3122 B- .

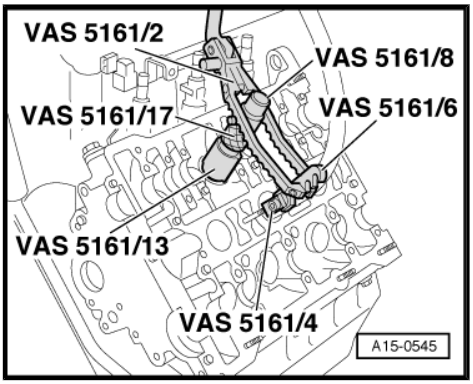
– Set piston of appropriate cylinder to “bottom dead centre”.

– Apply drift -VAS 5161/3- to valve spring plate and use plastic-headed hammer to release stuck valve cotters on all valves of appropriate cylinder.
– Screw pressure hose - VW 653/3- into appropriate spark plug thread.
– Connect pressure hose to compressed air and apply a steady pressure.
• Minimum pressure: 6 bar

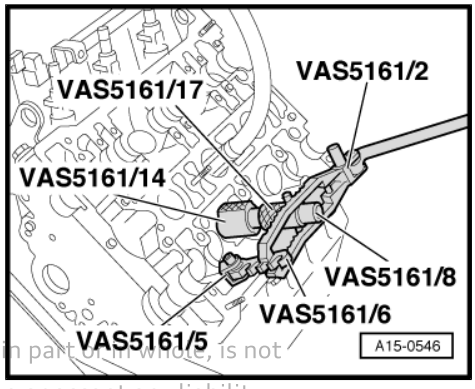


Inlet side:

– 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 and push assembly cartridge down.
– At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
– Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.
– Release pressure fork.
– Take out assembly cartridge with knurled spacer ring.
– Take out guide bush.
• The compressed air hose remains connected.
– Detach valve spring with valve spring plate.



Exhaust side:



– Screw snap-in device -VAS 5161/6- with engaging fork - VAS 5161/5- 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 and push assembly cartridge down.

– At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.

– Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.

– Release pressure fork.

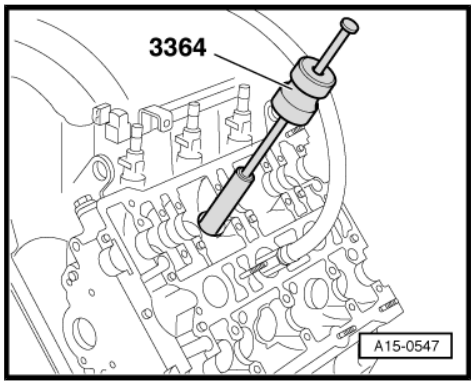
– Take out assembly cartridge with knurled spacer ring.

– Take out guide bush.

• The compressed air hose remains connected.

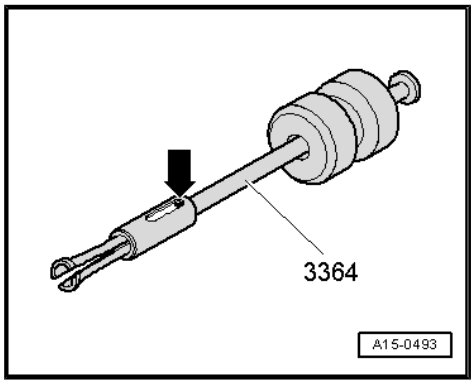
– Detach valve spring with valve spring plate.

Both sides (continued):



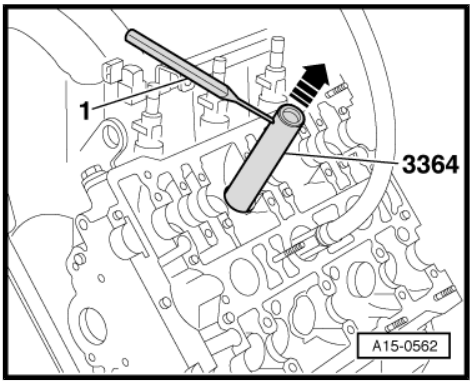
– Pull off valve stem oil seal with valve stem seal puller - 3364- .

If the puller -3364- cannot be used on some of the valve stem oil seals due to the confined space, proceed as follows:



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

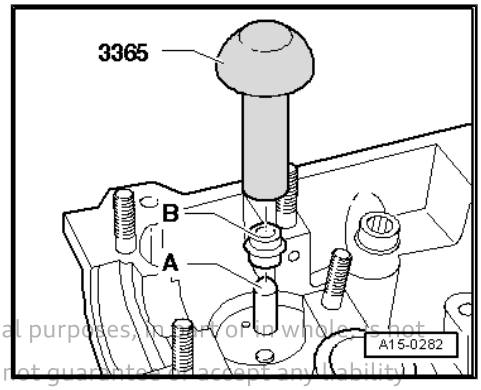
– Apply bottom section of puller -3364- to valve stem oil seal.
– Secure puller with a punch -1- or other suitable tool as shown in the illustration.
– Apply assembly lever to puller and pull out valve stem oil seal -arrow-.



Caution

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

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



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

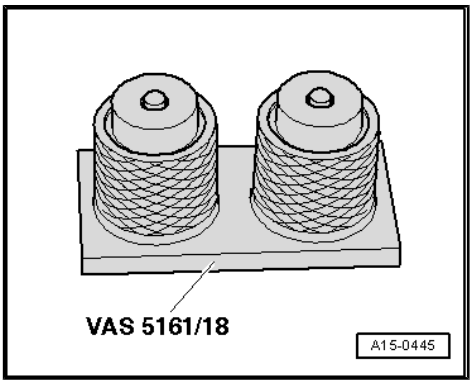
Note

Ensure correct positioning in cylinder head when fitting valve springs of exhaust valves (otherwise assembly is not possible).

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

- Larger diameter of valve cotters faces upwards.

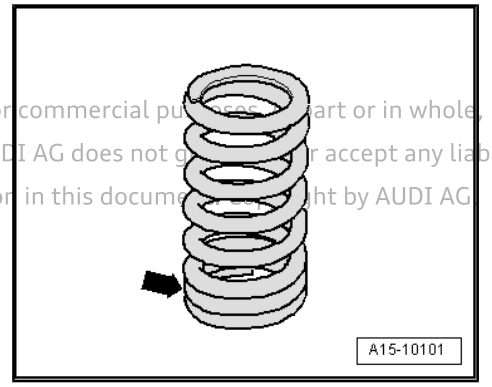
– Press assembly cartridge onto insertion device from above and take up valve cotters.



– Insert valve spring and valve spring plate.

• Installation position: Closely spaced spring coils -arrow- face towards cylinder head.

– Press assembly cartridge onto insertion device from above and take up valve cotters.

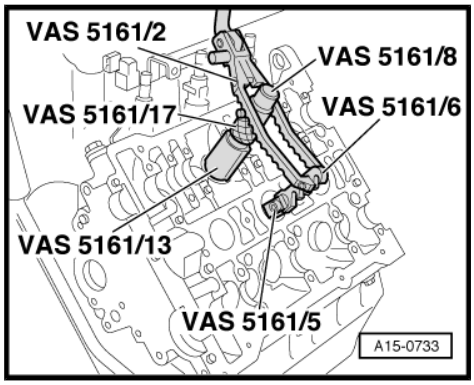


– Fit guide bush -VAS 5161/13- or -VAS 5161/14- .

– 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.

– Repeat procedure for each valve.



Assembling

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

– Install bucket tappets.

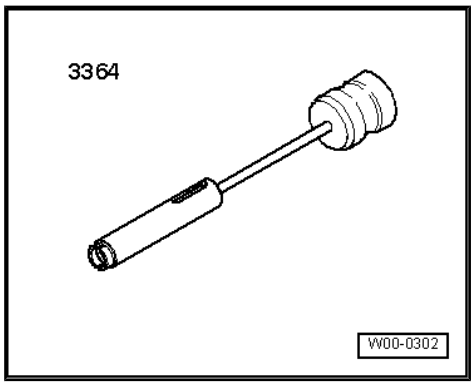
– Install spark plugs ⇒ Maintenance ; Booklet 402 .

– Install camshafts and camshaft adjuster ⇒ page 112 .

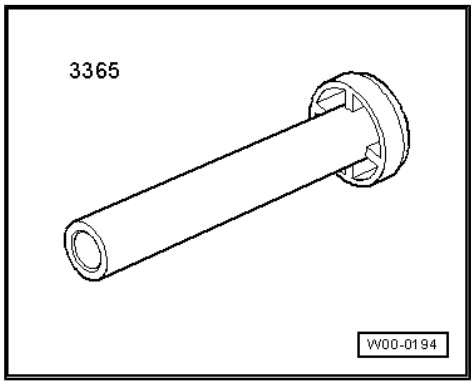
2.10 Renewing valve stem oil seals with cylinder head removed

Special tools and workshop equipment required

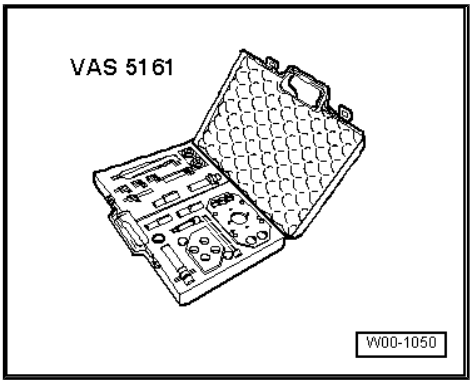
♦ Valve stem seal puller - 3364-



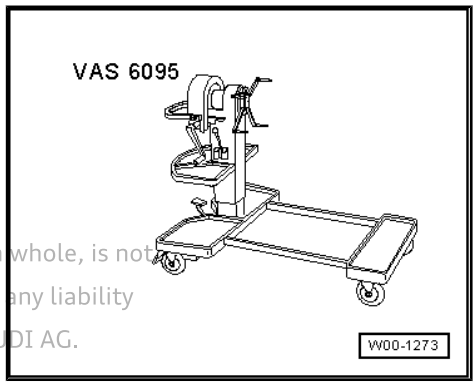
♦ Valve stem seal fitting tool - 3365-



♦ Removal and installation device for valve cotters - VAS 5161-



♦ Engine and gearbox support - VAS 6095-



♦ Tensioning device -VAS 6419-

Procedure

– Attach tensioning device -VAS 6419- to engine and gearbox support - VAS 6095- .

– Secure cylinder head in cylinder head tensioning device -VAS 6419- as illustrated.

– Remove camshafts and camshaft adjuster ⇒ page 112 .

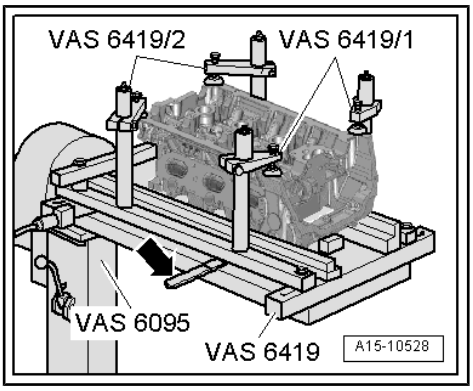
– Mark allocation of bucket tappets for re-installation.

– Remove bucket tappets from guides and put them down on a clean surface with contact surface facing downwards.

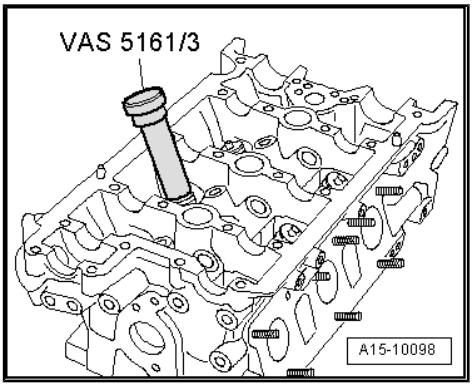
– Connect compressed air line to tensioning device -VAS 6419- .

– Using lever -arrow-, slide air pad under cylinder where valve stem oil seal is to be removed.

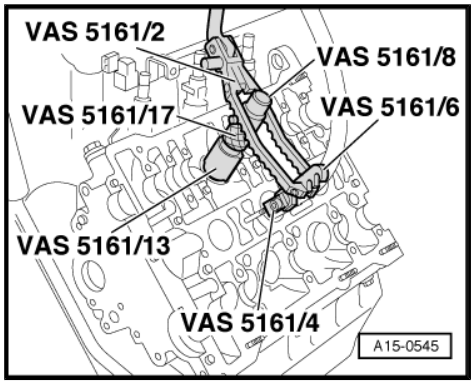
– Apply just enough compressed air to bring air pad into contact with valve heads.



– Apply drift -VAS 5161/3- to valve spring plate and use plastic-headed hammer to release stuck valve cotters on all valves of appropriate cylinder.

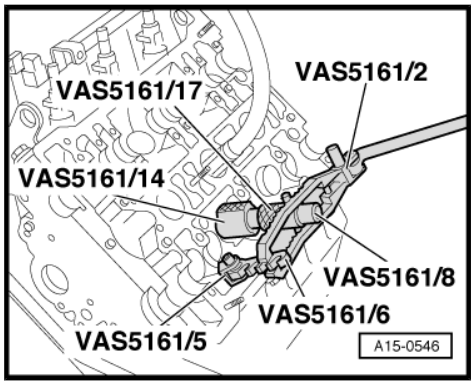


Inlet side:



– 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 and push assembly cartridge down.
– At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
– Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.
– Release pressure fork.
– Take out assembly cartridge with knurled spacer ring.
– Take out guide bush.
• The compressed air hose remains connected.
– Detach valve spring with valve spring plate.

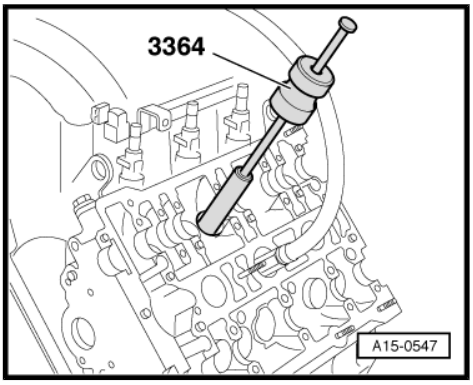
Exhaust side:



– Screw snap-in device -VAS 5161/6- with engaging fork - VAS 5161/5- 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 and push assembly cartridge down.
– At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
– Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.
– Release pressure fork.
– Take out assembly cartridge with knurled spacer ring.
– Take out guide bush.
– Detach valve spring with valve spring plate.

Both sides (continued):

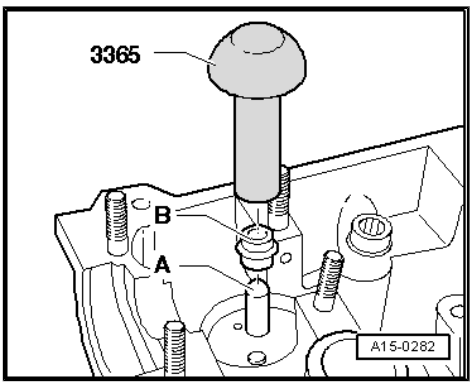
– Pull off valve stem oil seal with valve stem seal puller - 3364- .



Caution

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

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



– Lightly oil sealing lip of valve stem oil seal.

– Slide valve stem oil seal onto plastic sleeve.

– Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool - 3365- .

– Remove plastic sleeve.

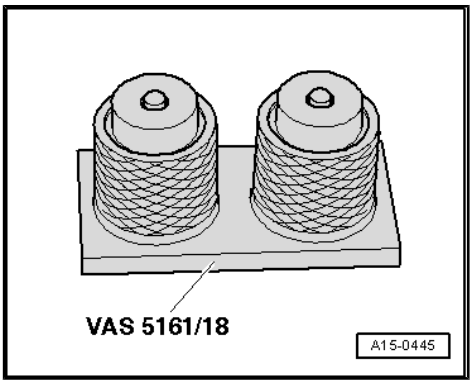
Note

Ensure correct positioning in cylinder head when fitting valve springs of exhaust valves (otherwise assembly is not possible).

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

- Larger diameter of valve cotters faces upwards.

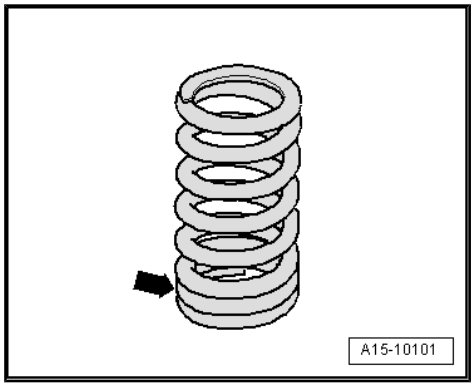
– Press assembly cartridge onto insertion device from above and take up valve cotters.



– Insert valve spring and valve spring plate.

• Installation position: Closely spaced spring coils -arrow- face towards cylinder head.

– Press assembly cartridge onto insertion device from above and take up valve cotters.

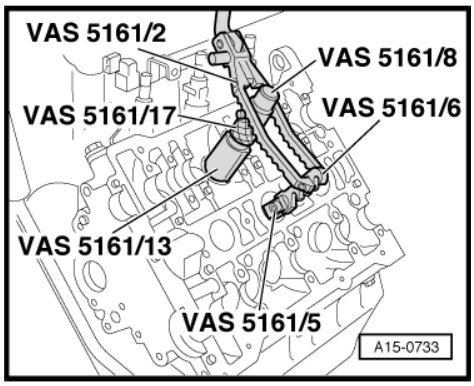


– Fit guide bush -VAS 5161/13- or -VAS 5161/14- .

– 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.

– Repeat procedure for each valve.



Assembling

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

– Install bucket tappets.

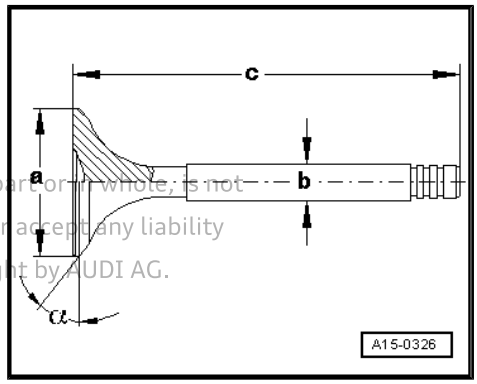
– Install camshafts and camshaft adjuster ⇒ page 112 .

2.11 Valve dimensions

Note

Valves must not be machined. Only grinding-in is permitted.

Dimension		Inlet valve	Exhaust valve
∅ a	mm	26.80 … 27.00	29.80 … 30.00
∅ b	mm	5.960 … 5.970	5.940 … 5.950
c	mm	104.84 … 105.34	103.64 … 104.14
α	∠°	45	45



WARNING

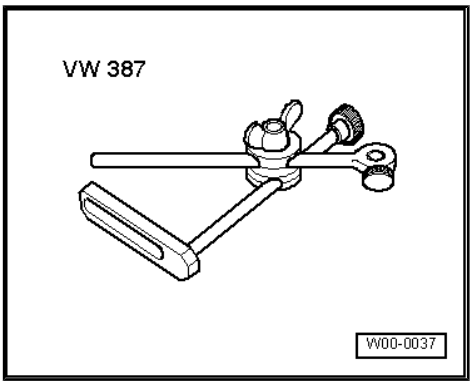
Care must be taken when disposing of old sodium-cooled exhaust valves - risk of injury.

- ***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.***
- ***Then throw a maximum of ten valves into a bucket of water and step away immediately.***
- ***A sudden chemical reaction will occur upon contact with water in which the sodium filling burns.***
- ***After performing these steps the valves can be disposed of in the normal way.***

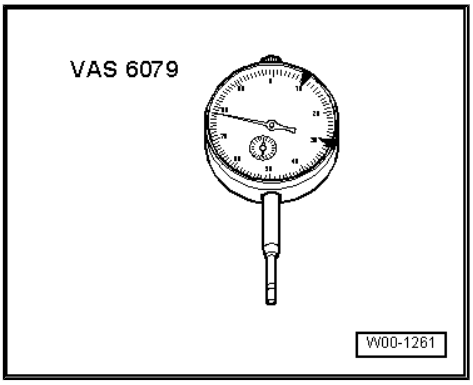
2.12 Checking valve guides

Special tools and workshop equipment required

- Universal dial gauge bracket - VW 387-



- Dial gauge - VAS 6079-



Procedure

Note

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

– Insert valve into guide.

• End of valve stem must be flush with valve guide.

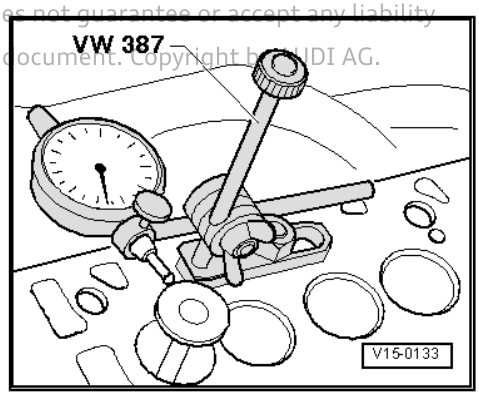
– Secure dial gauge - VAS 6079- to cylinder head with universal dial gauge bracket - VW 387- as shown in illustration.

– Measure the amount of sideways play.

• Wear limit: 0.8 mm.

– If the wear limit is exceeded, repeat the measurement with new valves.

– Renew cylinder head if wear limit is still exceeded.



Note

Valve guides cannot be renewed.

2.13 Checking valves

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

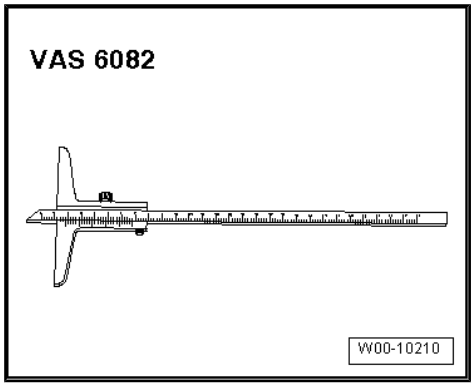
2.14 Machining valve seats

Note

- *If a good seating pattern cannot be obtained by grinding the valve seats (lapping), they must be refaced (machined).*
- *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 127* *.*
- *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 play compensation can no longer be guaranteed and the cylinder head must be renewed.*

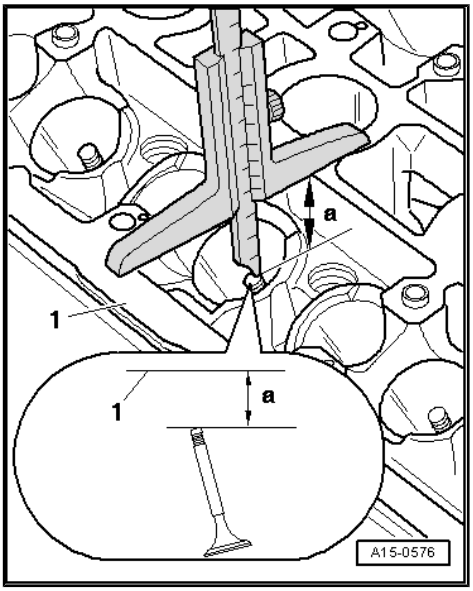
Special tools and workshop equipment required

- Depth gauge - VAS 6082-



- Valve seat machining tool

A - 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.

– Use depth gauge - VAS 6082- to measure distance between end of valve stem (upper edge) and top surface of cylinder head -1-.
– Calculate maximum permissible machining dimension from measured distance -a- and minimum dimension.

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

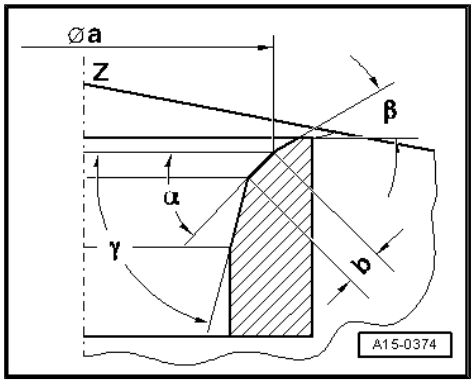
Measured distance minus minimum dimension = max. permissible machining dimension

Example for inlet valve (outer):	
Measured distance	31.4 mm
Minimum dimension	– 31.0 mm
Max. permissible machining dimension	= 0.4 mm

Note

- *If the calculated 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.*

B - Machining valve seats



Inlet valve seat:

a - ⌀ 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

Exhaust valve seat:

a - ⌀ 29.0 mm

b - Approx. 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 129 .

3 Checking variable valve timing

The timing of the inlet camshafts is controlled according to engine load and engine speed. The oil pressure is fed to the mechanical camshaft adjuster via camshaft control valve 1 - N205- or camshaft control valve 2 - N208- .

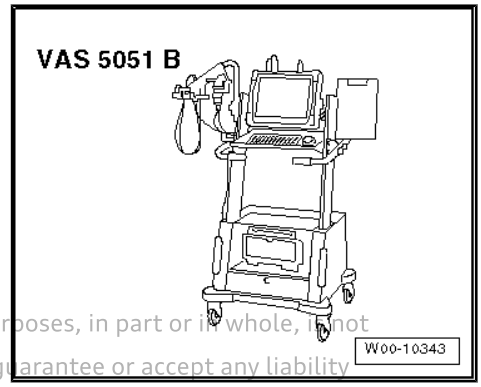
3.1 Checking function of variable valve timing

Note

The variable valve timing is not activated until about 25 seconds after the engine has started.

Special tools and workshop equipment required

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



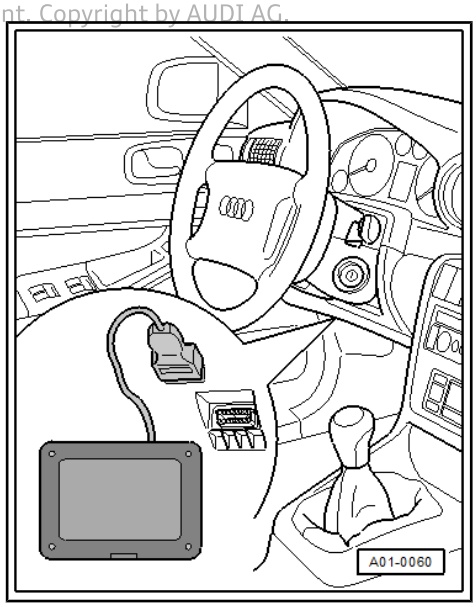
Procedure

- Coolant temperature at least 80 °C.

WARNING

Risk of accidents when road testing the vehicle with test equipment.

- ***Observe safety precautions when testers and measuring instruments have to be used during a road test*** ***⇒ page 5*** ***.***

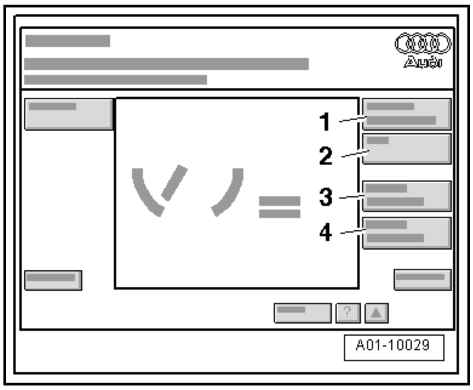


– With ignition switched off, connect vehicle diagnostic, testing and information system - VAS 5051B- with diagnostic cable.

Display on -VAS 5051B- :

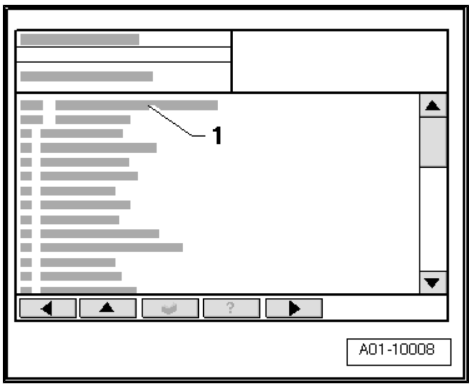
– Start engine and run at idling speed.

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



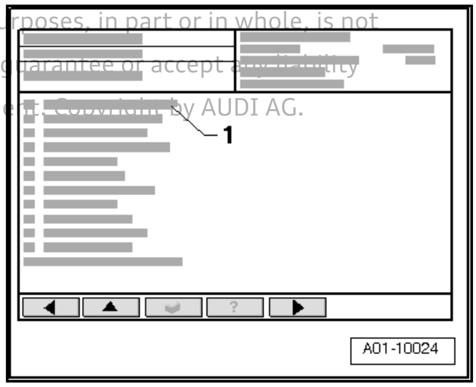
Display on -VAS 5051B- :

– From menu -1-, select vehicle system “01 - Engine electronics” and press [→] key to continue.



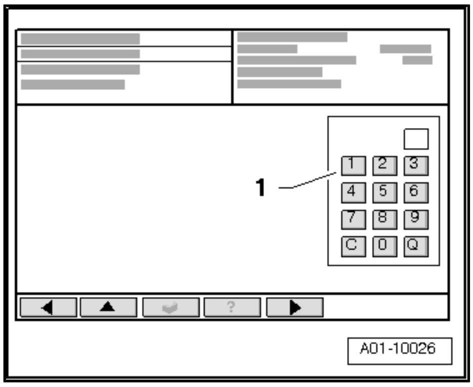
Display on -VAS 5051B- :

– From menu -1-, select diagnostic function “Measured values” and press [→] key to continue.

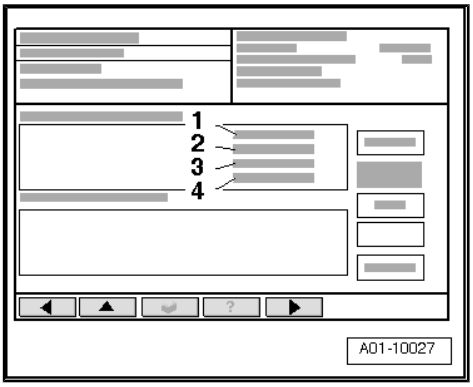


Display on -VAS 5051B- :

– Press keys [9] [0] on keypad -1- to select “Display group 90” and confirm entry by pressing [Q] key.



Display on -VAS 5051B- :



- Engine running at idling speed.

– Check displays in zones -2, 3, 4-.

Display zone	Display	Specification
-2-	Variable valve timing	• “CS-ctrl OFF”
-3-	Variable valve timing bank 1 (cylinder bank, right-side)	• -3 … 6° CA
-4-	Variable valve timing bank 2 (cylinder bank, left-side)	• -3 … 6° CA

– Perform road test and have a second mechanic check display in zones -2-, -3- and -4-.

Display zone	Display	Specification
-2-	Variable valve timing	• “CS-ctrl ON”
-3-	Variable valve timing bank 1 (cylinder bank, right-side)	• 16 … 25° CA [1)]
-4-	Variable valve timing bank 2 (cylinder bank, left-side)	• 16 … 25° CA [1)]
• [1)] If the readout only shows a value between 6.0° CA (crankshaft angle) and 16.0° CA during the test drive, this indicates that camshaft control valve 1 - N205- or camshaft control valve 2 - N208- is working correctly and feeding the oil pressure to the camshaft adjustment mechanism, but the mechanism is not able to reach its end position (possibly because it is not moving freely).		

If the specifications are not obtained:

– Check camshaft control valves ⇒ page 133 .

– Press ← key to terminate diagnostic function “Measured values”.

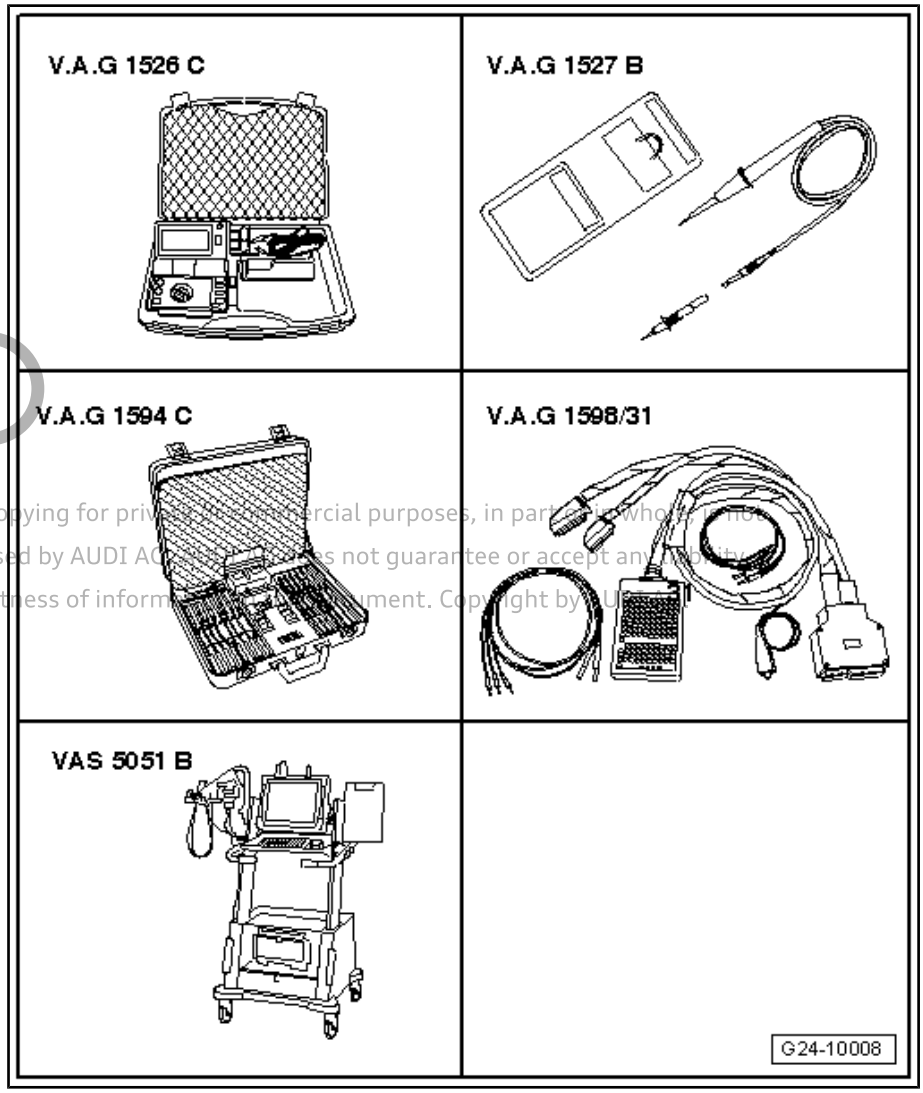
If the specifications are obtained:

– Select “End output”.

– Switch off ignition and unplug diagnostic connector.

3.2 Checking camshaft control valves (solenoid valves)

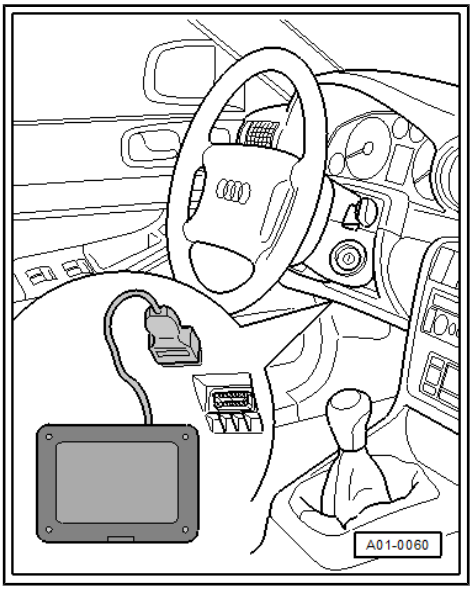
Special tools and workshop equipment required



- 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-

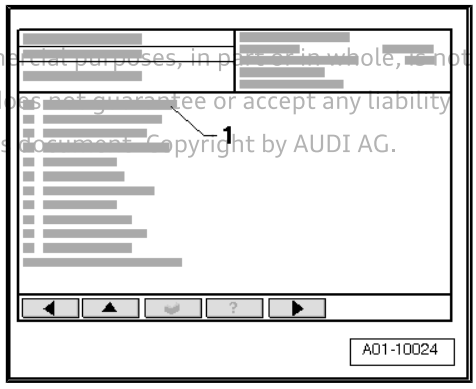
Procedure

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Ignition switched on, engine not running.
- Vehicle self-diagnosis and vehicle system “01 - Engine electronics” selected.



Display on -VAS 5051B- :

– From menu -1- select diagnostic function “Final control diagnosis”.



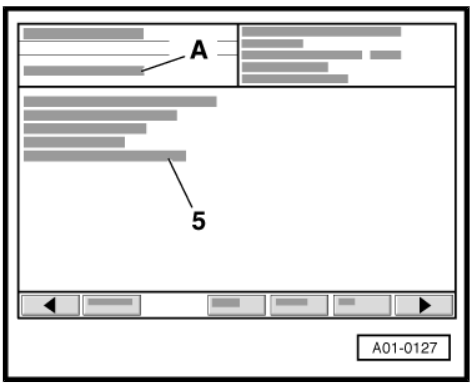
– Press → key repeatedly until the following display appears:

Display on -VAS 5051B- :

5 - Camshaft control valve 2 - N208-

A - Actuator is running; continued switching is allowed

- The valve should click.



– Press → key repeatedly until the following display appears:

Display on -VAS 5051B- :

7 - Camshaft control valve 1 - N205-

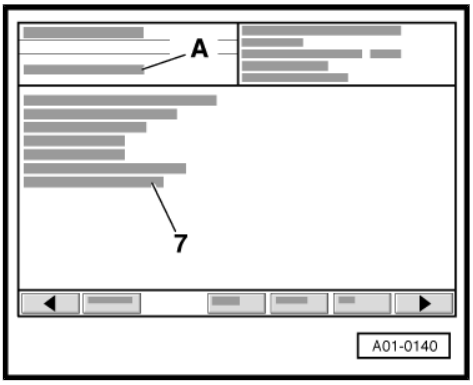
A - Actuator is running; continued switching is allowed

- The valve should click.

– Press ← key to exit diagnostic function “Final control diagnosis”.

– Select “End output”.

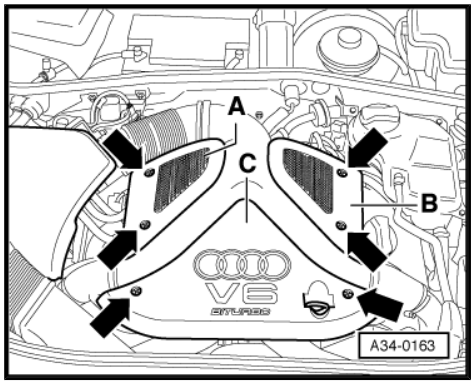
– Switch off ignition and unplug diagnostic connector.



If one of the valves does not click:

Checking internal resistance

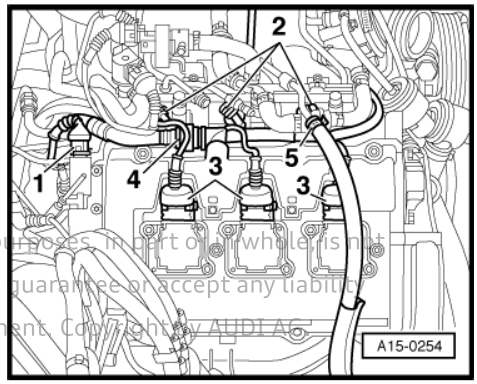
– Detach engine cover panels -A, C- by removing bolts -arrows-.



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

Note

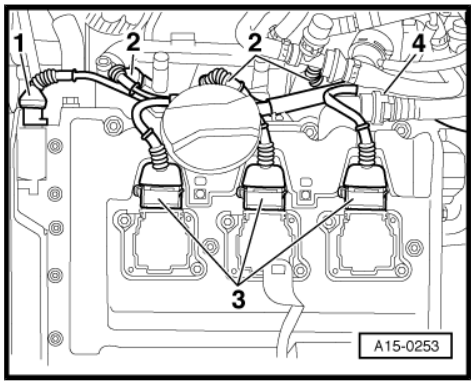
Disregard items -2 and 3-.



– Unplug electrical connector -1- at camshaft control valve 2 - N208- .

Note

Disregard items -2 and 3-.

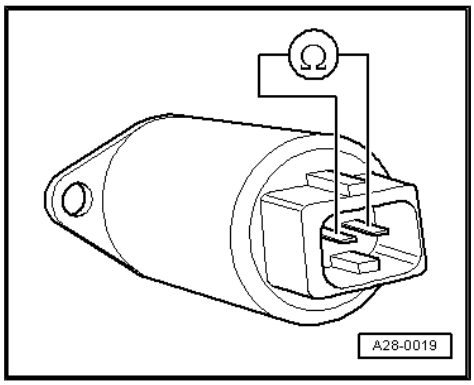


– Connect hand-held multimeter - V.A.G 1526C- to measure resistance between contacts of -N205- or -N208- .

- Specification: 10 … 18 Ω

If specification is not obtained:

– Renew relevant camshaft control valve.



Checking voltage supply

- Fuse for camshaft control valve 1 - N205- and camshaft control valve 2 - N208- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay - J17- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

Note

-N205- and -N208- are supplied with power via the fuel pump relay - J17- .

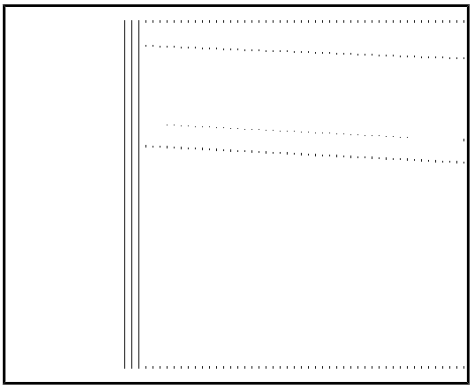
– Connect voltage tester - V.A.G 1527B- between contact -1- of electrical connector for -N205- or -N208- and earth.

– Briefly operate starter.

• The LED should light up.

– If LED does not light up, check for open circuit in wiring from contact -1- of electrical connector via fuse to fuel pump relay ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

– Repair wiring connection if necessary.

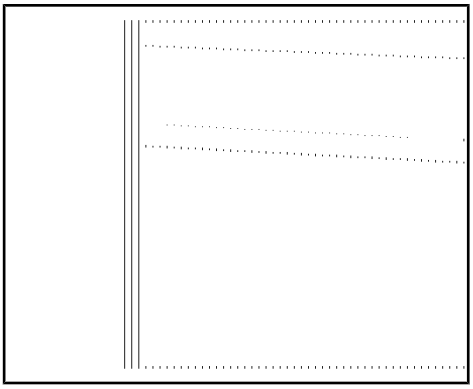


If LED does not light up:

Checking activation

– Connect voltage tester - V.A.G 1527B- between contacts -1- and -2- of electrical connector for -N205- or -N208- .

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



– Repeat diagnostic function “Final control diagnosis”.

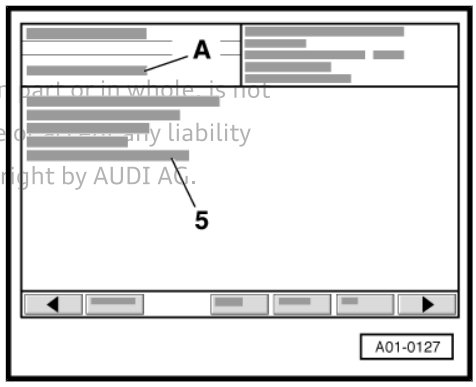
– Press [→] key repeatedly until the following display appears:

Display on -VAS 5051B- :

5 - Camshaft control valve 2 - N208-

A - Actuator is running; continued switching is allowed

• The LED should flash.



– Press [→] key repeatedly until the following display appears:

Display on -VAS 5051B- :

7 - Camshaft control valve 1 - N205-

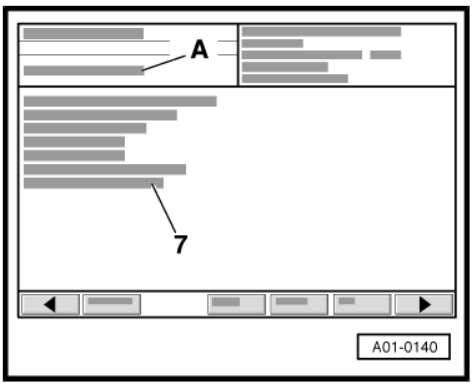
A - Actuator is running; continued switching is allowed

• The LED should flash.

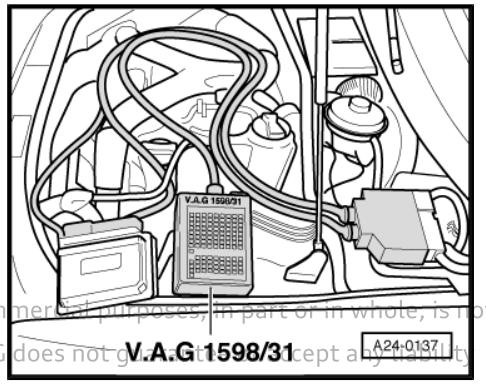
– Press [←] key to exit diagnostic function “Final control diagnosis”.

– Select “End output”.

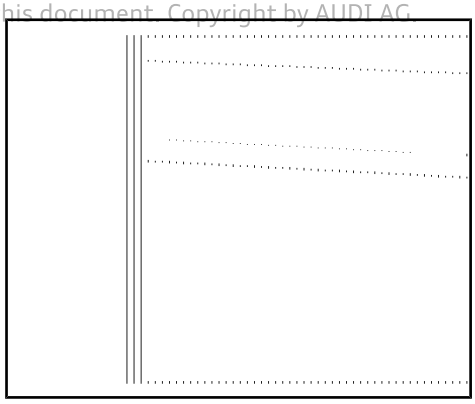
– Switch off ignition and unplug diagnostic connector.



– If LED does not light up or lights up continuously, connect adapter cable - 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 (not shown in illustration).



– Check for open circuit and short to positive or earth in the following wiring of -N205- or -N208- :



Connector Contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-2-	115

– Repair wiring connection if necessary.

– If no fault is found, renew mechanical camshaft adjuster
⇒ “2.7 Removing and installing camshafts and camshaft adjuster”, page 112 .

17 – Lubrication

1 Lubrication system

Caution

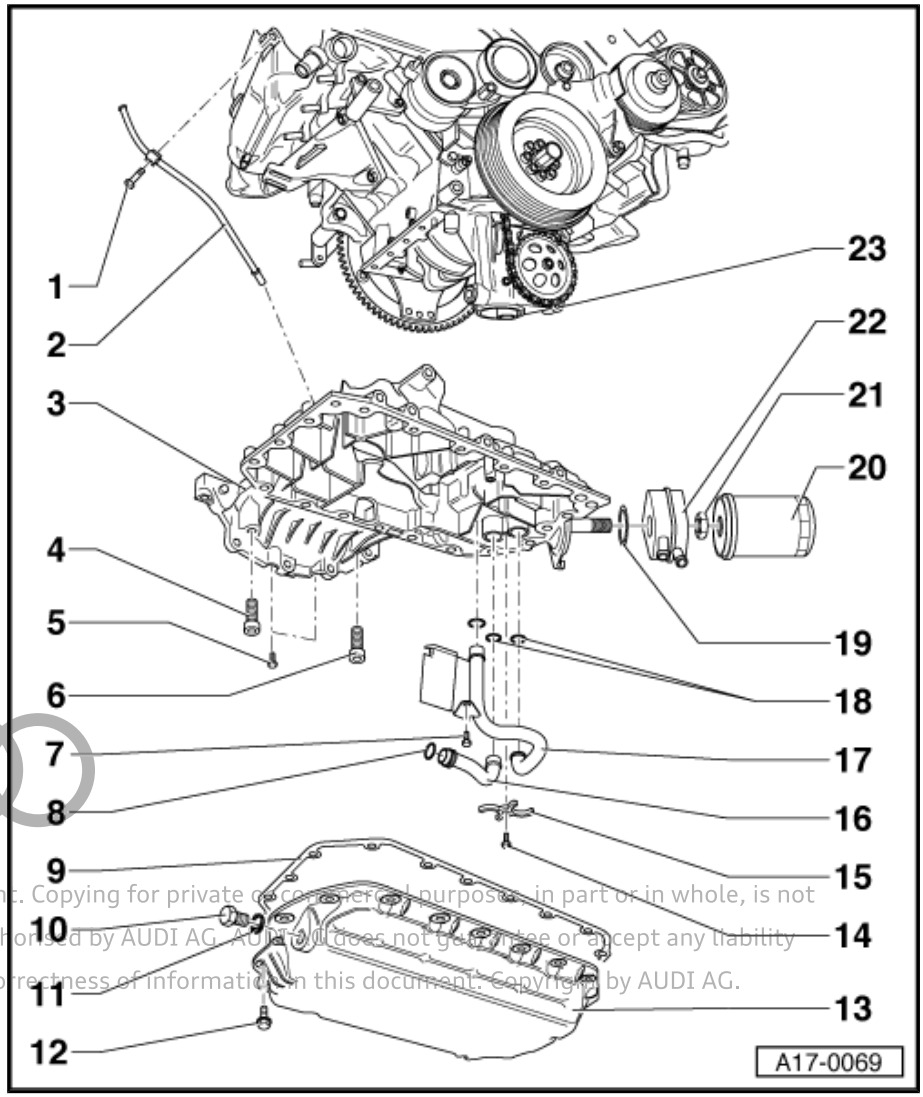
Risk of damage to catalytic converter.

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

Note

If large quantities of metal shavings or abrasion are found when performing engine repairs, this may be an indication of damage to the crankshaft or conrod bearings. To prevent further damage, the following steps are required after completion of repair work: thoroughly clean the oil passages, oil lines and oil hoses and renew the oil cooler and oil filter.

1.1 Exploded view - sump, oil pump, oil filter, oil cooler



1 - Bolt
- ❑ 20 Nm

2 - Dipstick guide tube
- ❑ Renew O-ring

3 - Sump (top section)
- ❑ Removing and installing ⇒ page 149

4 - Bolt
- ❑ Tightening torque and sequence ⇒ page 142

5 - Bolt
- ❑ Tightening torque and sequence ⇒ page 142

6 - Bolt
- ❑ Tightening torque and sequence ⇒ page 142

7 - Bolt
- ❑ 10 Nm

8 - O-ring
- ❑ Renew

9 - Gasket
- ❑ Moulded gasket (up to approx. 02.1999)
- ❑ Renewing ⇒ “1.4 Installing sump (bottom section) - engines with moulded gasket”, page 145
- ❑ Liquid gasket (from approx. 03.1999 onwards)
- ❑ Renewing ⇒ “1.5 Installing sump (bottom section) - engines with liquid gasket”, page 145

10 - Oil drain plug
- ❑ 35 Nm

11 - Seal
- ❑ Renew

12 - Bolt
- ❑ Tightening torque and sequence ⇒ page 141

13 - Sump (bottom section)
- ❑ With oil level and oil temperature sender - G266-
- ❑ Removing and installing sump (bottom section) ⇒ page 144
- ❑ Removing and installing oil level and oil temperature sender - G266- ⇒ page 143

14 - Bolt
- ❑ 10 Nm

15 - Bracket for oil pipes

16 - Oil pipe
- ❑ From oil pump to oil filter

17 - Oil pipe
- ❑ From oil filter to engine oil circuit

18 - O-rings

- ❑ Renew

19 - Seal

- ❑ Renew
- ❑ Engage in lugs on oil cooler

20 - Oil filter

- ❑ Removing and installing ⇒ Maintenance ; Booklet 402
- ❑ After installing new oil filter, check clearance of hoses from oil cooler with respect to adjacent components and correct position of oil cooler if necessary
- ❑ See note ⇒ page 139

21 - Nut

- ❑ 30 Nm
- ❑ Threaded pipe for oil cooler and oil filter: tightening torque 20 Nm

22 - Oil cooler

- ❑ See note ⇒ page 139
- ❑ When installing, ensure O-ring is correctly seated

23 - Oil pump

- ❑ Chain-driven off crankshaft
- ❑ Removing and installing ⇒ page 146

- Tightening torques ⇒ page 142 , ⇒ page 142 and ⇒ page 142

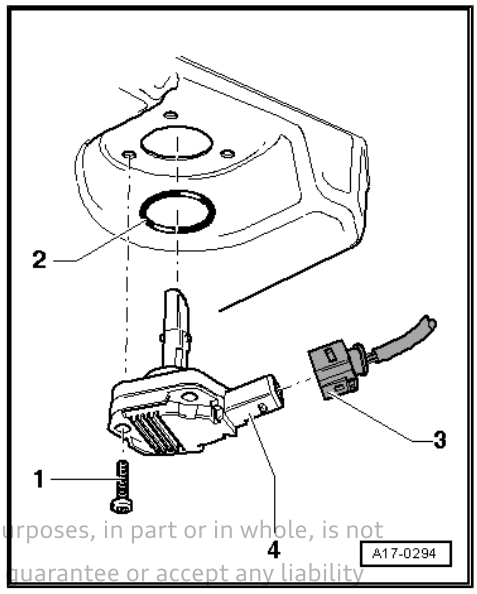
Oil level and oil temperature sender - G266- - tightening torque

Note

Renew seal -2- for oil level and oil temperature sender - G266- -item 4-.

– Tighten bolts -1- to 10 Nm.

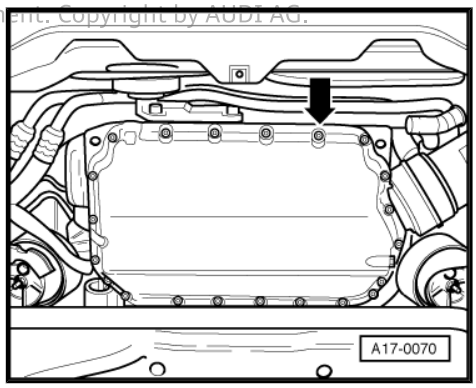
– Plug in electrical connector -3-.



Sump (bottom section) - tightening torque and sequence

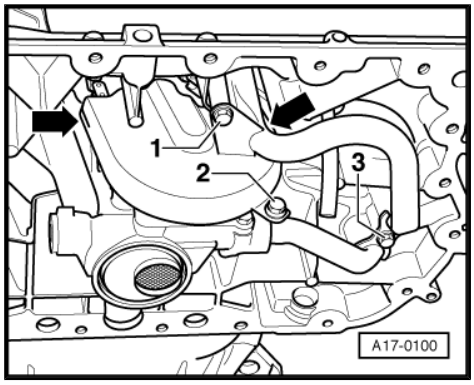
– Tighten bolts -arrow- for sump (bottom section) in diagonal sequence and in 2 stages as follows:

1. Initially tighten to 5 Nm.
2. Tighten to 10 Nm.



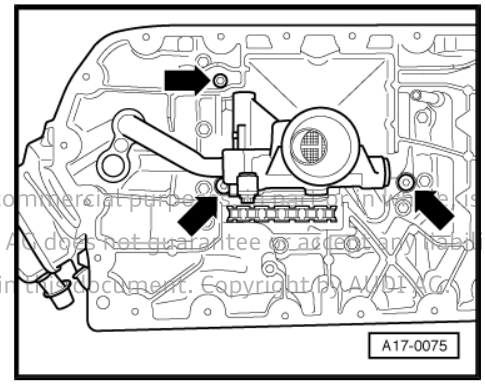
Cover plate to rear cover plate - tightening torque

– Tighten bolt -2- to 10 Nm.



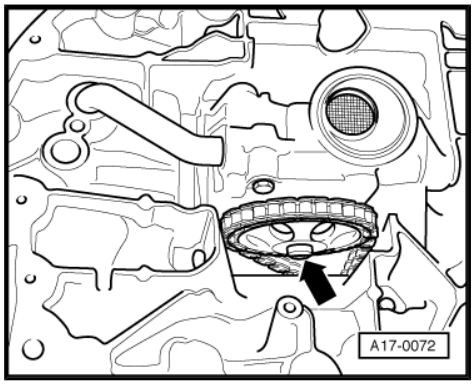
Oil pump to cylinder block - tightening torque

– Tighten bolts -arrows- for oil pump to 22 Nm.



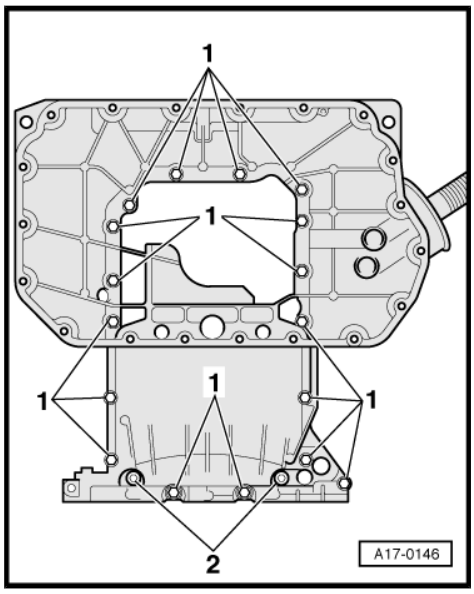
Chain sprocket for oil pump - tightening torque

– Tighten bolt -arrow- for chain sprocket to 25 Nm.



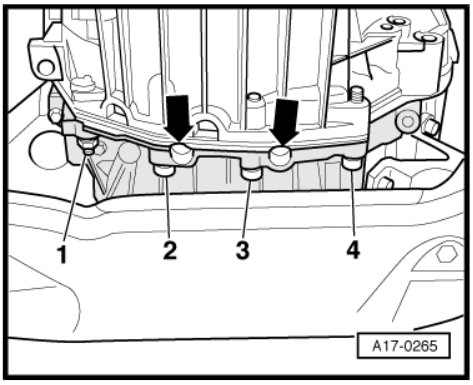
Sump (top section) - tightening torques and sequence

– Tighten bolts -1- and -2- securing sump (top section) to cylinder block in diagonal sequence initially to 5 Nm.



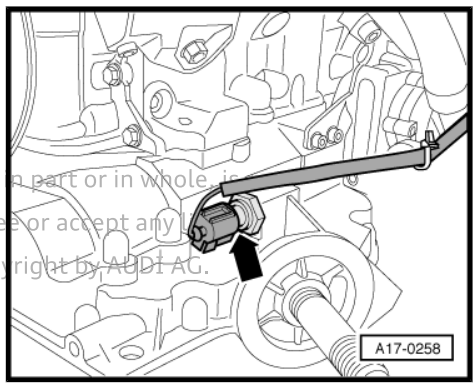
– Tighten bolts -1 ... 4- securing sump (top section) to gearbox to 45 Nm.
– Tighten bolts securing sump (top section) to cylinder block in diagonal sequence. Tightening torques:

- M6: 10 Nm
- M7: 16 Nm
- M8: 22 Nm



Oil pressure switch - F1- - tightening torque

– Tighten oil pressure switch - F1- to 20 Nm.



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

Removing

– Drain off engine oil ⇒ Maintenance ; Booklet 402 .
– Unplug electrical connector -3-.
– Remove bolts -1- and detach oil level and oil temperature sender - G266- -item 4-.

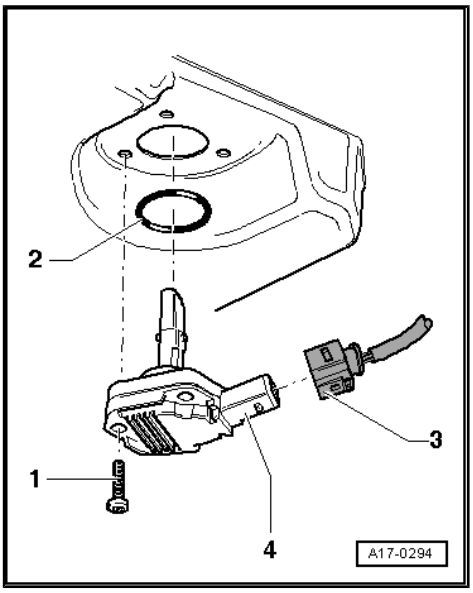
Installing

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

Note

Renew seal -2-.

– Tighten bolts ⇒ page 141 .
– Fill up with engine oil and check engine oil level ⇒ Maintenance ; Booklet 402 .

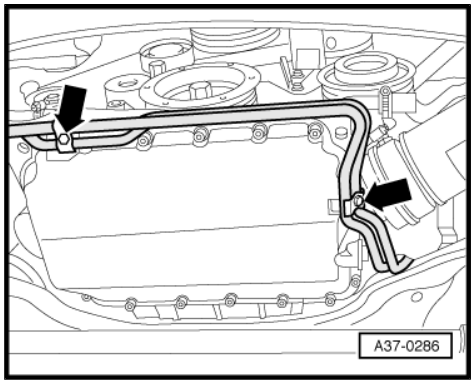


1.3 Removing sump (bottom section)

Procedure

– Remove poly V-belt ⇒ page 41 .

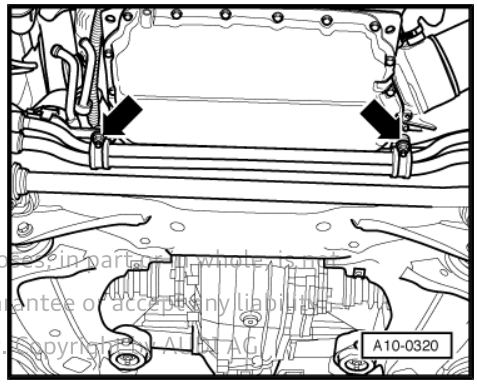
– Remove bracket for gear oil pipes/ATF lines from oil sump (bottom section) -arrows-.



WARNING

Risk of injury caused by refrigerant.

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



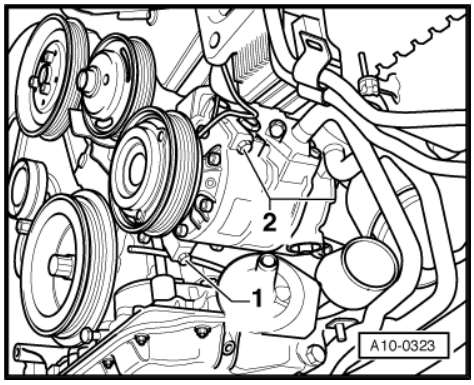
– Unbolt refrigerant pipe bracket -arrows- from sump (bottom section).

– Remove bolts -1- and -2-.

Caution

Risk of damage to refrigerant lines and hoses

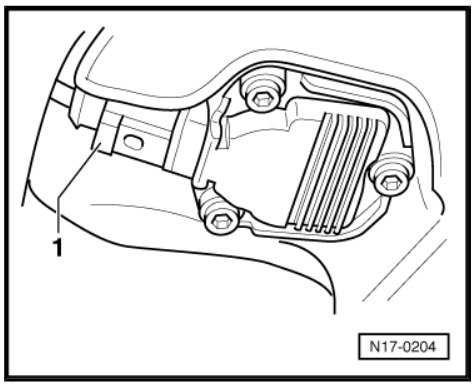
- *Do NOT stretch, kink or bend refrigerant lines and hoses.*



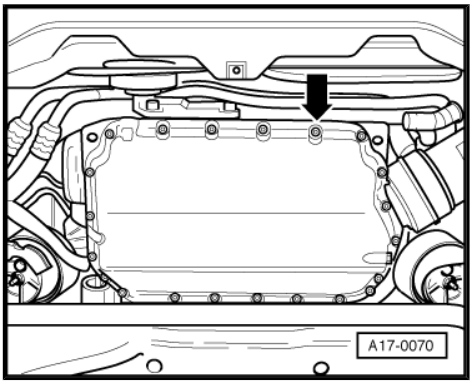
– Tie up air conditioner compressor to side at body (refrigerant lines remain connected).

– Drain off engine oil ⇒ Maintenance ; Booklet 402 .

– Unplug electrical connector -1- at oil level and oil temperature sender - G266- .



– Loosen bolts -arrow- for sump (bottom section) in diagonal sequence and remove.
– On vehicles with liquid gasket, carefully release sump (bottom section) from bonded joint.



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

Procedure

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

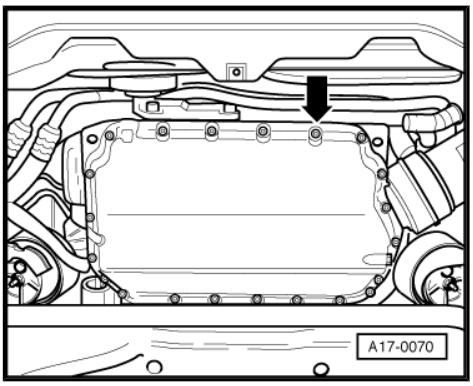
Note

Renew all seals and gaskets.

Caution

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

– Clean sealing surfaces.
– Fit sump (bottom section) and tighten bolts ⇒ page 141 .
– Install air conditioner compressor ⇒ Rep. gr. 87 .
– Install gear oil pipes ⇒ Rep. gr. 34 /ATF lines ⇒ Rep. gr. 37 .
– Fill up with engine oil and check engine oil level ⇒ Maintenance ; Booklet 402 .



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

Special tools and workshop equipment required

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

Procedure

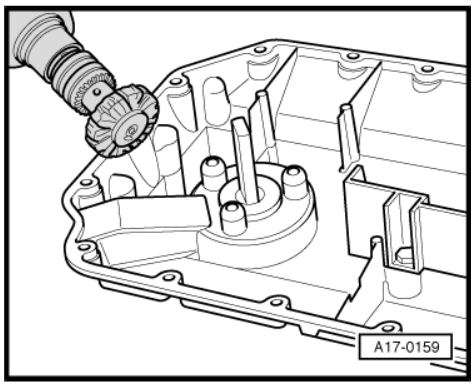
Note

Renew seals.

Caution

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

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



WARNING

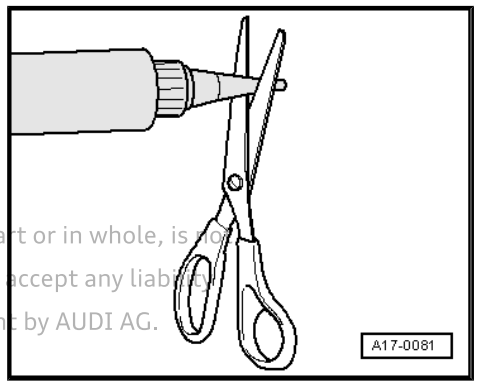
Put on safety goggles.

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

Note

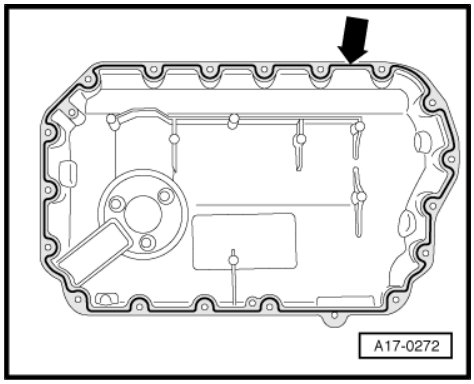
Note the use-by date of the sealant.

– Cut off nozzle of tube at front marking (nozzle ∅ approx. 1 mm).



– Apply bead of sealant -arrow- onto clean sealing surface of sump (bottom section) as illustrated.

• The bead of sealant should be approx. 1.5 mm wide.



Note

- *The sump (bottom section) must be installed within 5 minutes after applying sealant.*
- *The sealant bead must not be thicker than specified, otherwise excess sealant could enter the sump and clog the strainer in the oil pump.*

– Fit sump (bottom section) and tighten bolts ⇒ page 141 .

– Install air conditioner compressor ⇒ Rep. gr. 87 .

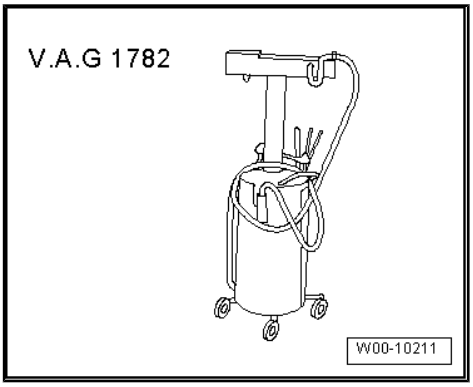
– Install gear oil pipes ⇒ Rep. gr. 34 /ATF lines ⇒ Rep. gr. 37 .

– Fill up with engine oil and check engine oil level ⇒ Maintenance ; Booklet 402 .

1.6 Removing and installing oil pump

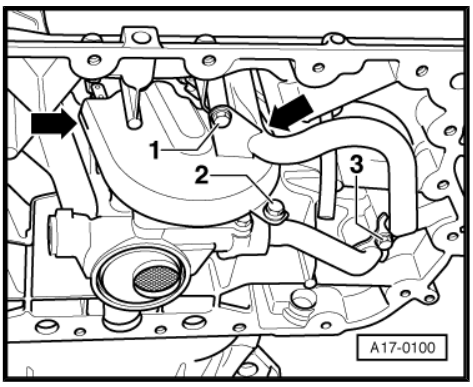
Special tools and workshop equipment required

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

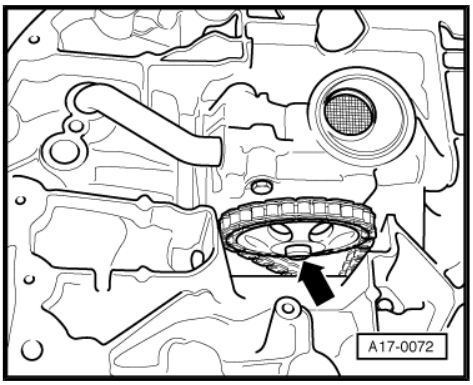


Removing

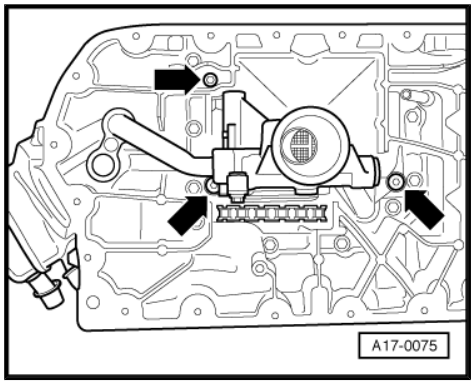
– Remove sump (bottom section) ⇒ page 144 .
– Place used oil collection and extraction unit - V.A.G 1782- below engine.
– Remove bolt -2- (counterhold at welded-on nut).
– Disengage cover plate -arrows-.
– Remove bolts -1- and -3-.
– Pull off the longer of the two oil pipes.



– Remove bolt -arrow- and detach chain sprocket from oil pump.



– Remove bolts -arrows- and remove oil pump together with short oil supply pipe.



Installing

- Tightening torques ⇒ page 142 , ⇒ page 142 and ⇒ page 142

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

Note

Fit new O-rings.

- Chain sprocket can only be fitted in one position on oil pump shaft.

– Check chain tensioner for oil pump ⇒ page 148 .

– Install sump (bottom section) ⇒ “1.4 Installing sump (bottom section) - engines with moulded gasket”, page 145 or ⇒ “1.5 Installing sump (bottom section) - engines with liquid gasket”, page 145 .

1.7 Checking chain tensioner for oil pump

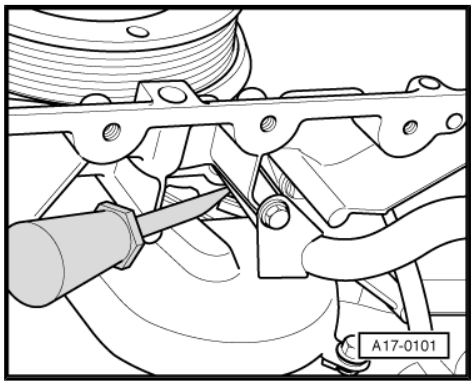
Procedure

– Remove sump (bottom section) ⇒ page 144 .

– Insert screwdriver between chain and chain tensioner and lever screwdriver against tensioner.

– If no spring tension can be felt and chain is not tensioned, renew chain tensioner for oil pump ⇒ page 148

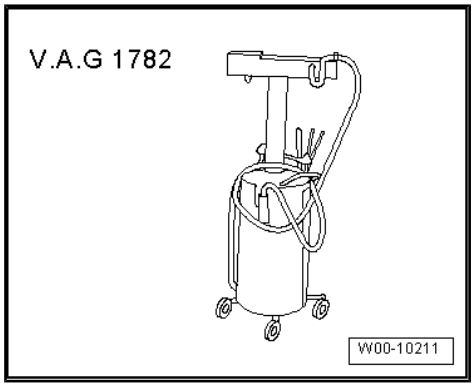
– Install sump (bottom section) ⇒ “1.4 Installing sump (bottom section) - engines with moulded gasket”, page 145 or ⇒ “1.5 Installing sump (bottom section) - engines with liquid gasket”, page 145 .



1.8 Removing and installing drive chain or chain tensioner for oil pump

Special tools and workshop equipment required

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

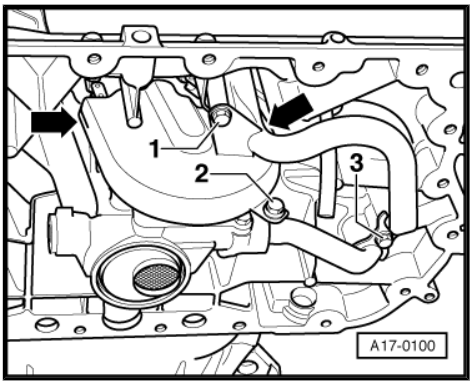


Removing

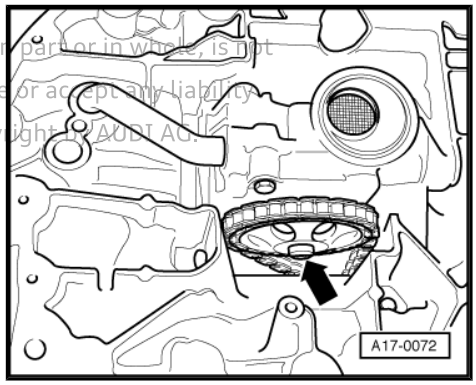
– Remove toothed belt ⇒ page 46 .

– Remove sump (bottom section) ⇒ page 144 .

– Remove sealing flange (pulley end) ⇒ page 56 .
– Place used oil collection and extraction unit - V.A.G 1782- below engine.
– Remove bolt -2- (counterhold at welded-on nut).
– Disengage cover plate -arrows-.
– Remove bolts -1- and -3-.
– Pull off the longer of the two oil pipes.



– Remove bolt -arrow- and detach chain sprocket from oil pump.
– Take chain sprocket out of chain.
– Detach chain tensioner.
– Lift off chain.



Installing

• Tightening torques ⇒ page 139

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

Note

Fit new O-rings.

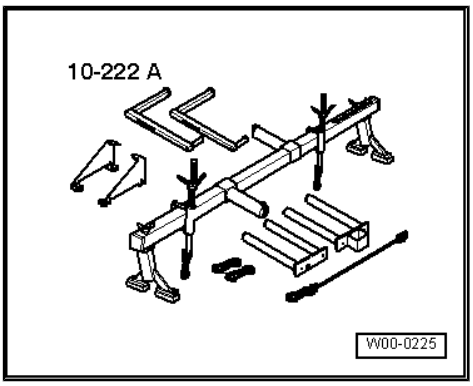
• Chain sprocket can only be fitted in one position on oil pump shaft.

– Install sealing flange (pulley end) ⇒ page 56 .
– Install sump (bottom section)
⇒ “1.4 Installing sump (bottom section) - engines with moulded gasket”, page 145 or
⇒ “1.5 Installing sump (bottom section) - engines with liquid gasket”, page 145 .
– Install toothed belt (adjust valve timing) ⇒ page 50 .

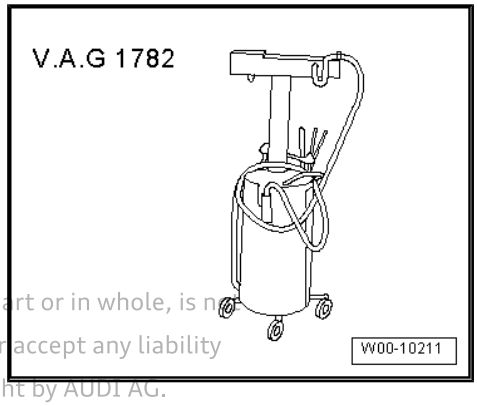
1.9 Removing and installing sump (top section)

Special tools and workshop equipment required

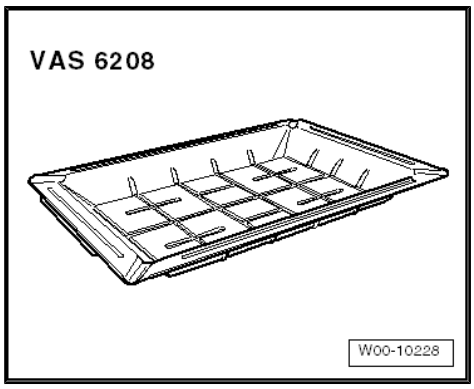
♦ Support bracket - 10 - 222 A-



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



- Drip tray for workshop hoist - VAS 6208-



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

Removing

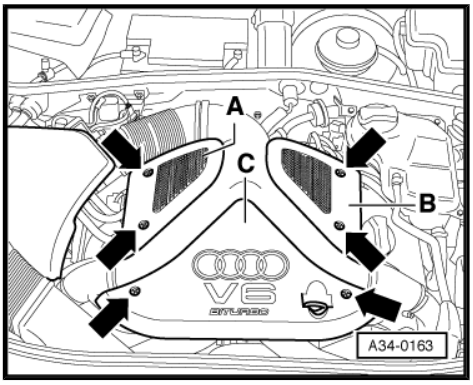
Caution

When disconnecting the battery there is a risk of irreparable damage to electronic components.

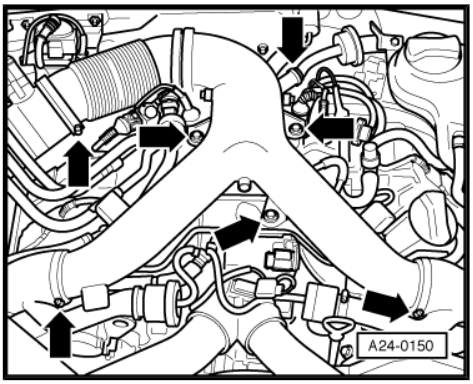
- ***Observe the notes on the procedure for disconnecting the battery.***

– Disconnect earth wire at battery with ignition switched off ⇒ Rep. gr. 27 .
– Drain coolant ⇒ page 163 .
– Remove front bumper ⇒ Rep. gr. 63 .
– Move lock carrier to service position ⇒ Rep. gr. 50 .
– Pull out oil dipstick.
– Unbolt dipstick guide tube from cylinder head (front right), and pull guide tube up and out of sump (top section).

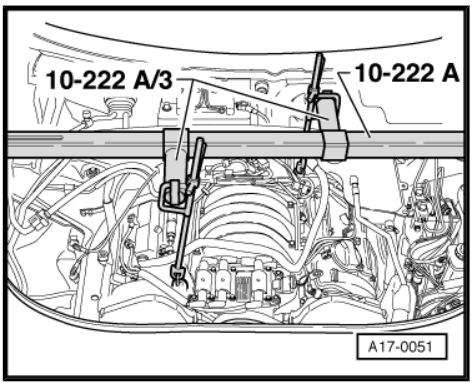
– Detach engine cover panels -A ... C- by removing bolts -arrows-.



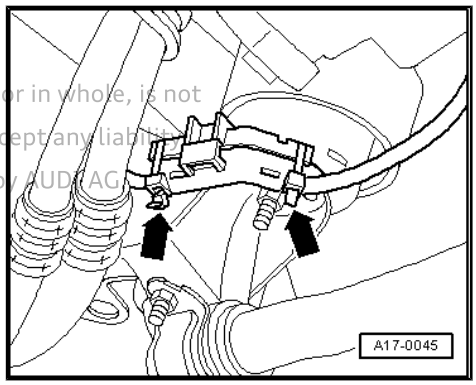
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



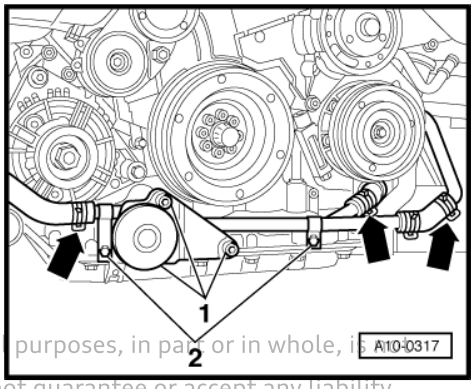
– Position support bracket - 10 - 222 A- on bolted flanges of wing panels as shown in illustration.
– Connect support bracket to front and rear lifting eyes on engine.
– Raise engine as far as possible with spindles of support bracket.



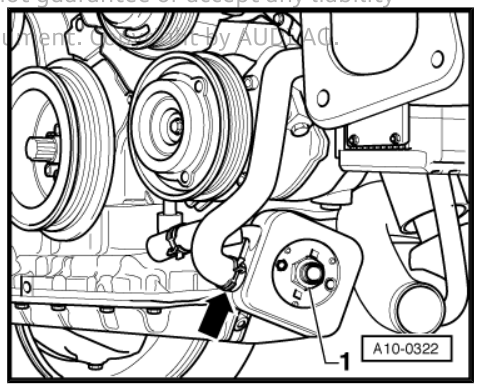
– Cut through cable ties -arrows-, open retainer for starter cable and take out cable.



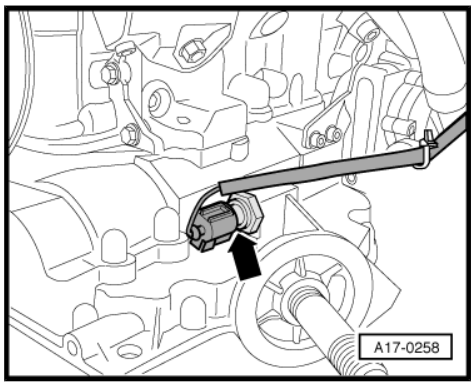
– Unscrew bolts -1- and remove torque reaction support.
– Remove bolts -2-.
– Place drip tray for workshop hoist - VAS 6208- beneath engine.
– Detach coolant pipe (bottom) from coolant hoses -arrows-.
– Drain engine oil and remove oil filter ⇒ Maintenance ; Booklet 402 .



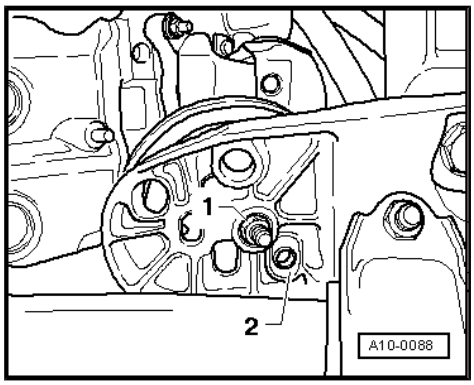
– Release hose clip -arrow-.
– Remove oil cooler -1-.



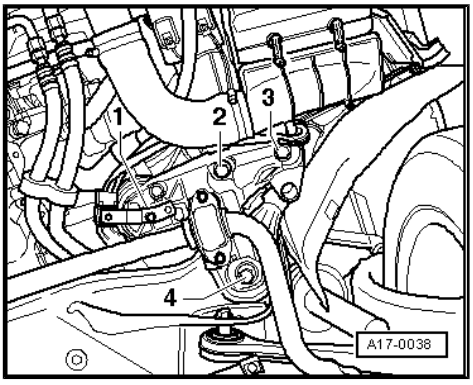
– Unplug electrical connector at oil pressure switch - F1- -arrow-.



– Remove nuts -1- (bottom) for engine mounting on both sides.
– Mark installation position of nut -1- and locating sleeves -2- on bottom of engine mountings (right and left).



– First remove bolts (front) -2- and -3- for subframe (left and right). Then remove bolts -4-.
– Pivot anti-roll bar downwards.

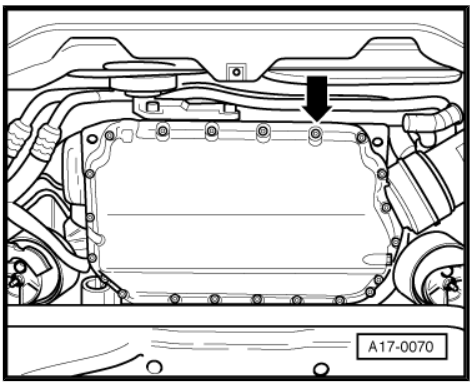


Note

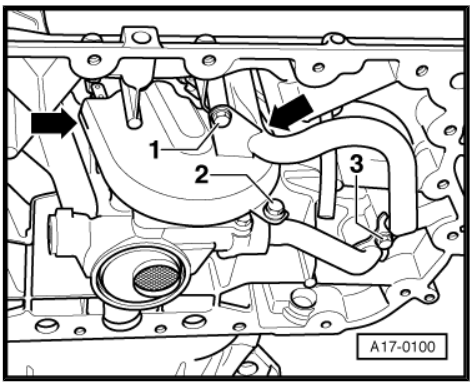
Disregard -item 1-.

– Remove charge air cooler ⇒ page 230 .
– Remove poly V-belt ⇒ page 41 .
– Remove alternator and starter ⇒ Rep. gr. 27 .

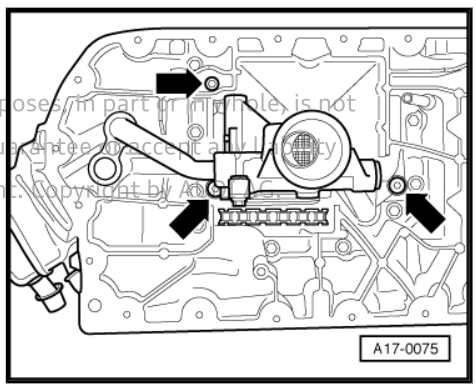
– Loosen bolts -arrow- for sump (bottom section) in diagonal sequence and remove.
– On vehicles with liquid gasket, carefully release sump (bottom section) from bonded joint.
– Place used oil collection and extraction unit - V.A.G 1782- below engine.
– Detach oil return lines for turbocharger from sump (top section).



– Remove bolt -2- (counterhold at welded-on nut).
– Disengage cover plate -arrows-.
– Remove bolts -1- and -3-.
– Pull off the longer of the two oil pipes.



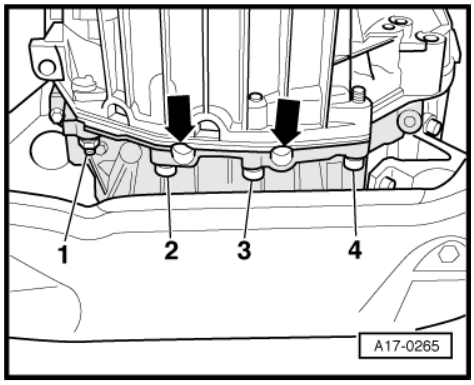
– Remove bolts -arrows- for oil pump and pull off short oil supply pipe.



Note

Oil pump remains in installation position.

– Remove bolts -1 … 4- between sump (top section) and gearbox.
– Check whether U/J extension and socket, 10 mm - 3220- can be inserted through assembly opening -arrows-. Widen out assembly opening if necessary.



– Unscrew bolts -1- and -2- for sump (top section).
– Carefully release sump (top section) from bonded joint and pry sump off dowel pins on cylinder block.

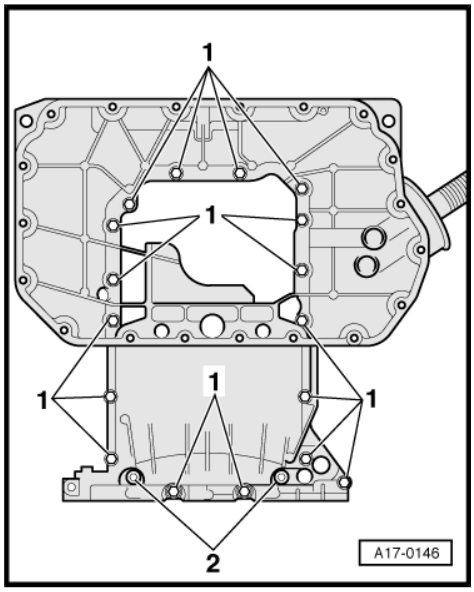
Installing

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

Caution

Protect lubrication system against contamination.

- *Cover exposed parts of the engine.*

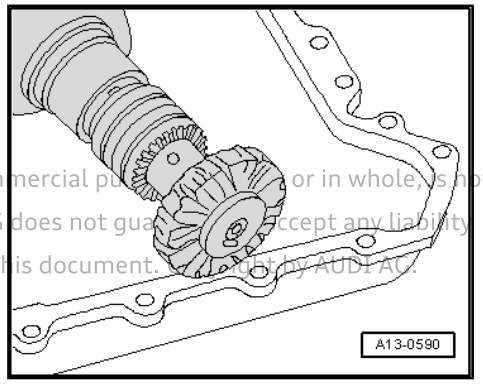


WARNING

Risk of eye injury.

- *Put on safety goggles.*

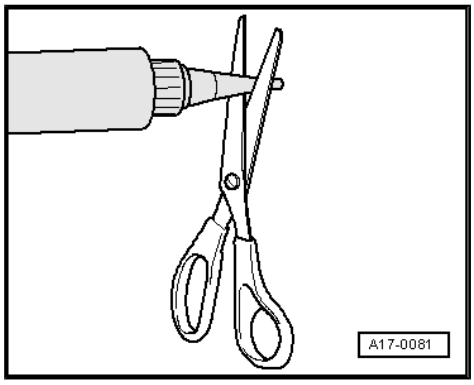
– Remove sealant residue from sump (top section) and cylinder block using rotating plastic brush or similar.
– Clean sealing surfaces; they must be free of oil and grease.



Note

Note the use-by date of the sealant.

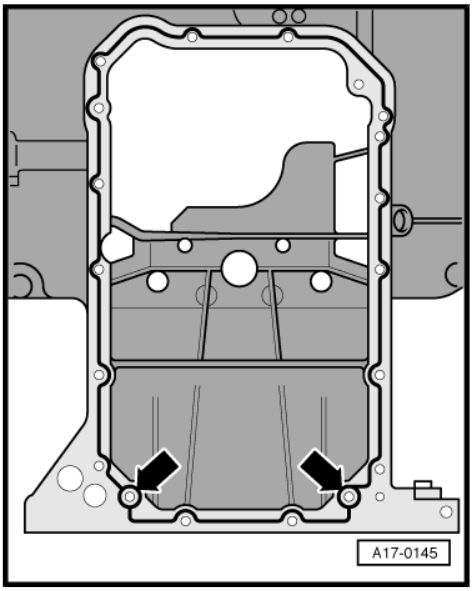
– Cut off nozzle of tube at front marking (nozzle ∅ approx. 2 mm).



Caution

Make sure lubrication system is not clogged by excess sealant.

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



– Apply bead of sealant to clean sealing surface of sump (top section) as illustrated.

• Thickness of sealant bead: 2 ... 3 mm.

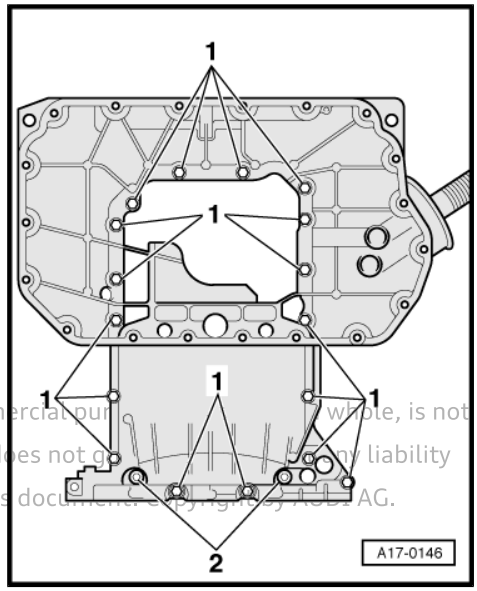
– Take particular care when applying sealant bead in area of rear sealing flange -arrows-.

Note

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

– Renew O-ring on guide tube for oil dipstick and insert guide tube into hole in top section of sump.

– Position sump (top section) with the assistance of a second mechanic and tighten bolts ⇒ page 142 .



Note

When installing sump (top section) with engine removed from vehicle, ensure that sump is positioned flush with cylinder block at flywheel end.

– Install oil pump ⇒ page 146 .
– Install sump (bottom section)
⇒ “1.4 Installing sump (bottom section) - engines with moulded gasket”, page 145 or
⇒ “1.5 Installing sump (bottom section) - engines with liquid gasket”, page 145 .
– Install starter and alternator ⇒ Rep. gr. 27 .
– Install poly V-belt ⇒ page 41 .
– Install charge air cooler ⇒ page 230 .
– Install anti-roll bar and subframe ⇒ Rep. gr. 40 .
– Install engine mountings ⇒ page 39 .
– Install oil cooler ⇒ page 139 .
– Install coolant pipe (bottom) ⇒ page 178 .
– Install torque reaction support ⇒ page 39 .
– Install air duct ⇒ page 29 .
– Install lock carrier with attachments ⇒ Rep. gr. 50 .
– Install front bumper ⇒ Rep. gr. 63 .
– Install oil filter, fill up with engine oil and check engine oil level ⇒ Maintenance ; Booklet 402 .
– Observe notes on procedures required after connecting battery ⇒ Rep. gr. 27 .
– Fill up with coolant ⇒ page 165 .

1.10 Renewing oil retention valves

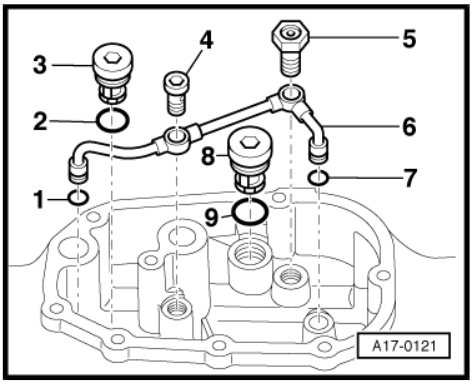
Note

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

Removing

– Remove front bumper ⇒ Rep. gr. 63 .
– Move lock carrier to service position ⇒ Rep. gr. 50 .
– Drain coolant ⇒ page 163 .
– Remove toothed belt ⇒ page 46 .
– Remove coolant pipe (front) ⇒ page 179 .
– Unscrew cover beneath intake manifold.

Exploded view:



1 - O-ring; renew
2 - O-ring; renew
3 - Oil retention valve for cylinder head (left-side), 20 Nm
4 - Banjo bolt, 15 Nm
5 - Spray nozzle valve for piston cooling nozzles, 25 Nm
6 - Oil line
7 - O-ring; renew
8 - Oil retention valve for cylinder head (right-side), 20 Nm
9 - O-ring; renew

Installing

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

Note

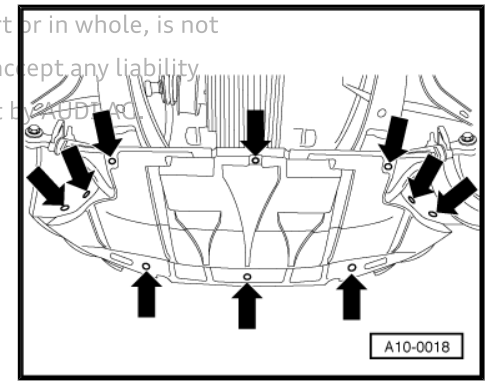
Renew seals and O-rings.

– Install coolant pipe (front) ⇒ page 178 .
– Install toothed belt (adjust valve timing) ⇒ page 50 .
– Install lock carrier with attachments ⇒ Rep. gr. 50 .
– Install front bumper ⇒ Rep. gr. 63 .
– Fill up with coolant ⇒ page 165 .

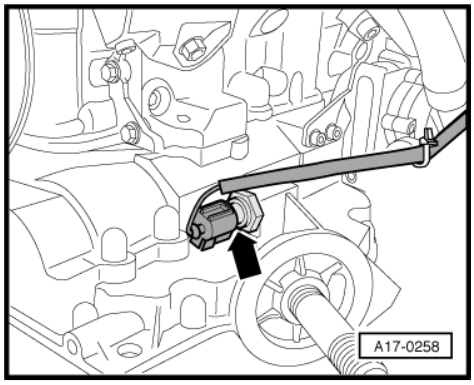
1.11 Removing and installing oil pressure switch - F1-

Removing

– Release fasteners -arrows- and remove noise insulation.
– Remove front bumper ⇒ Rep. gr. 63 .
– Move lock carrier to service position ⇒ Rep. gr. 50 .



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



Note

Place a cloth underneath to catch escaping engine oil.

– Unscrew oil pressure switch.

Installing

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

Note

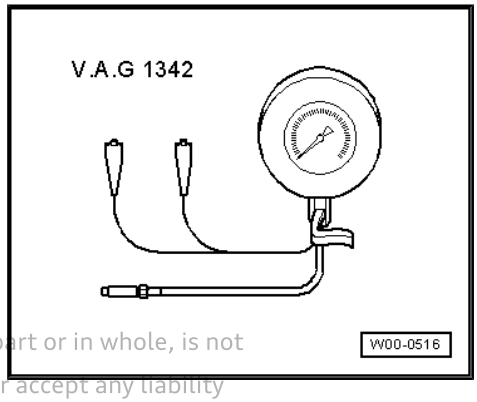
Renew seal.

– Secure oil pressure switch - F1- ⇒ page 143 .
– Install lock carrier with attachments ⇒ Rep. gr. 50 .
– Install front bumper ⇒ Rep. gr. 63 .
– Check engine oil level ⇒ Maintenance ; Booklet 402 .

1.12 Checking oil pressure

Special tools and workshop equipment required

♦ Oil pressure tester - V.A.G 1342-

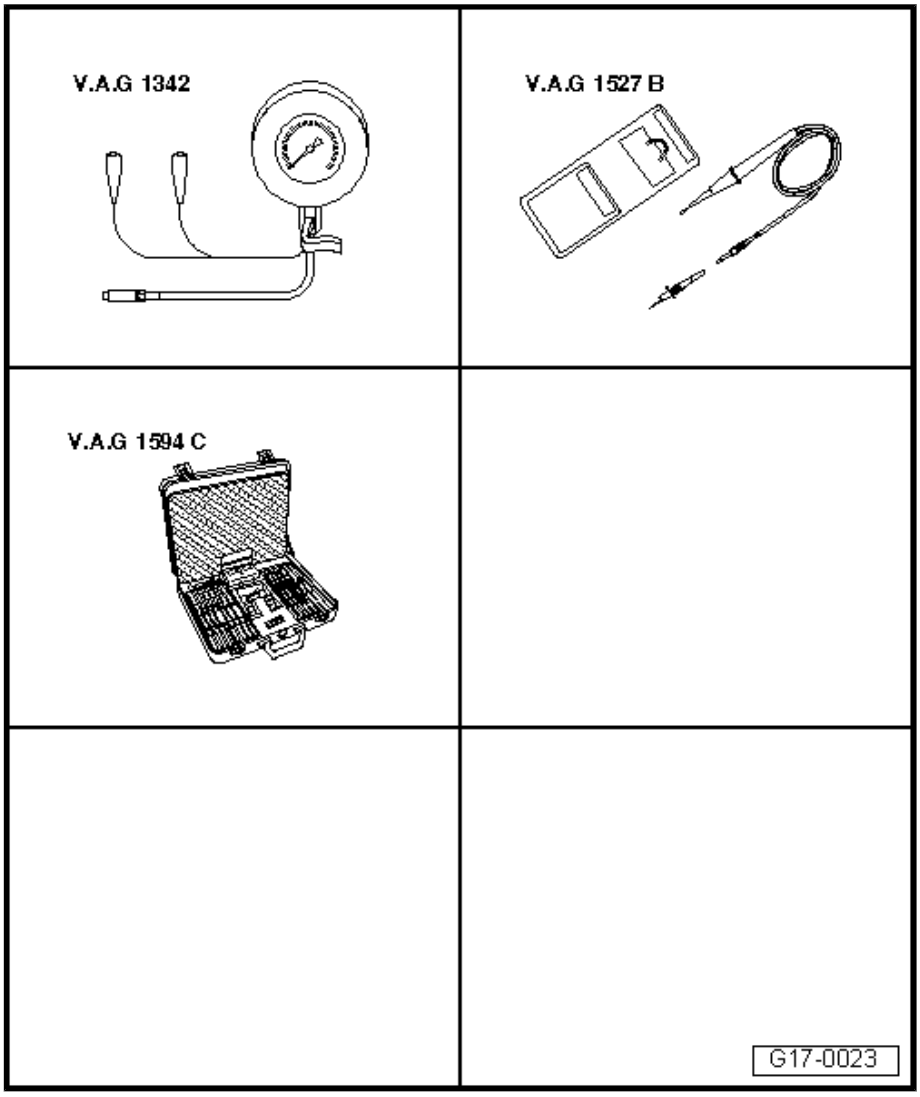


Procedure

• Oil level OK
• Engine oil temperature approx. 80 °C
– Remove oil pressure switch - F1- ⇒ page 157 .
– Connect oil pressure tester - V.A.G 1342- to bore for oil pressure switch.
– Screw oil pressure switch - F1- into oil pressure tester - V.A.G 1342- .
– Start engine.
• Oil pressure at idling speed: at least 1.5 bar.
• Oil pressure at 2000 rpm: at least 2.5 bar.
– Install oil pressure switch - F1- ⇒ page 157 .

1.13 Checking oil pressure switch - F1-

Special tools and workshop equipment required



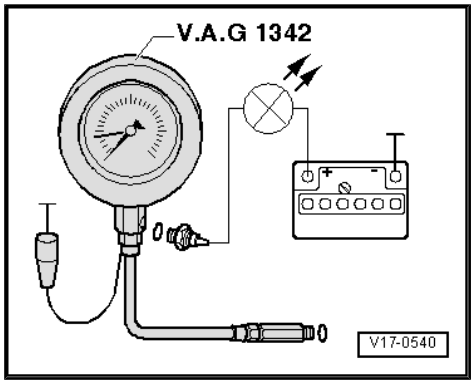
- Oil pressure tester - V.A.G 1342-
- Voltage tester - V.A.G 1527B-
- Auxiliary measuring set - V.A.G 1594C-

Procedure

- Engine oil level OK.
- Engine oil temperature approx. 80 °C

– Remove oil pressure switch - F1- ⇒ page 157 .

– Connect oil pressure tester - V.A.G 1342- to bore for oil pressure switch.
– Screw oil pressure switch - F1- into oil pressure tester - V.A.G 1342- .
– Connect brown wire of oil pressure tester to earth “–”.
– Connect voltage tester - V.A.G 1527B- with adapter leads from auxiliary measuring set - V.A.G 1594C- to oil pressure switch and battery positive (“+”).
• LED should not light up.



Note

Renew oil pressure switch if LED lights up at this stage.

– Start engine.

Note

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

• LED should light up at 1.2 ... 1.6 bar.
– Renew oil pressure switch if LED does not light up.
– Install oil pressure switch - F1- ⇒ page 157 .

1.14 Engine oil

Oil capacities, oil specifications and viscosity grades ⇒ Maintenance tables .

1.15 Checking engine oil level

Check engine oil level ⇒ Maintenance ; Booklet 402 .

19 – Cooling

1 Cooling system

WARNING

Risk of scalding due to hot steam and hot coolant.

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

Note

- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue.*
- *The arrow markings on coolant pipes and on ends of hoses must align.*

1.1 Connection diagram - coolant hoses

1 - Coolant hose (bottom)

- ❑ From radiator to engine

2 - Cylinder block with cylinder heads

3 - Turbocharger (right-side)

4 - Continued coolant circulation pump - V51-

- ❑ Removing and installing ⇒ page 178

5 - Heat exchanger for heater

6 - Coolant hose

- ❑ To heat exchanger for heater

7 - Turbocharger (left-side)

8 - Coolant pipe (rear)

9 - Filler cap

- ❑ Checking pressure relief valve ⇒ page 195

10 - Coolant expansion tank

11 - Oil cooler

- ❑ If renewed, refill system with fresh coolant

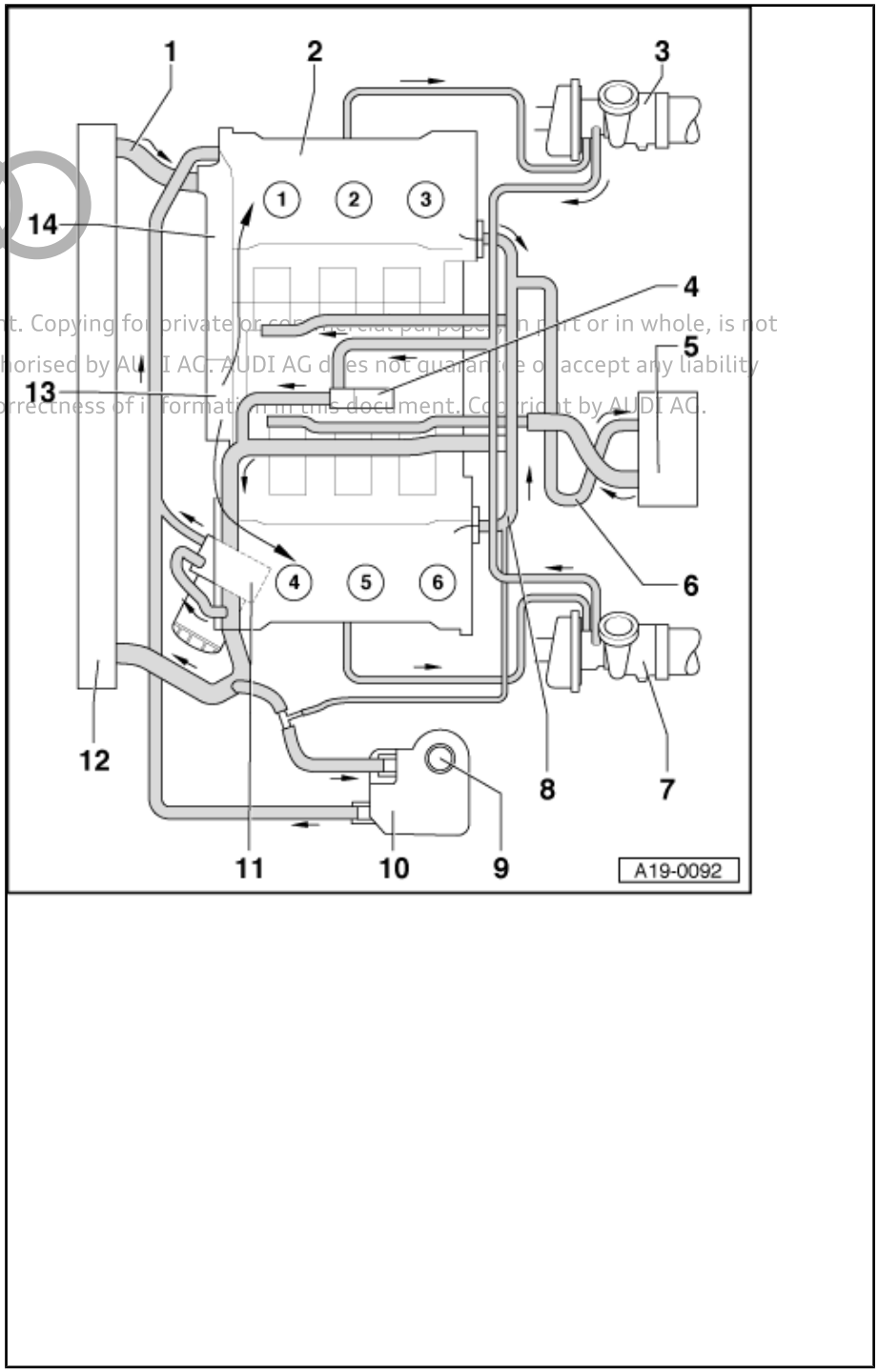
12 - Radiator

- ❑ Removing and installing ⇒ page 186
- ❑ If renewed, refill system with fresh coolant

13 - Coolant pump

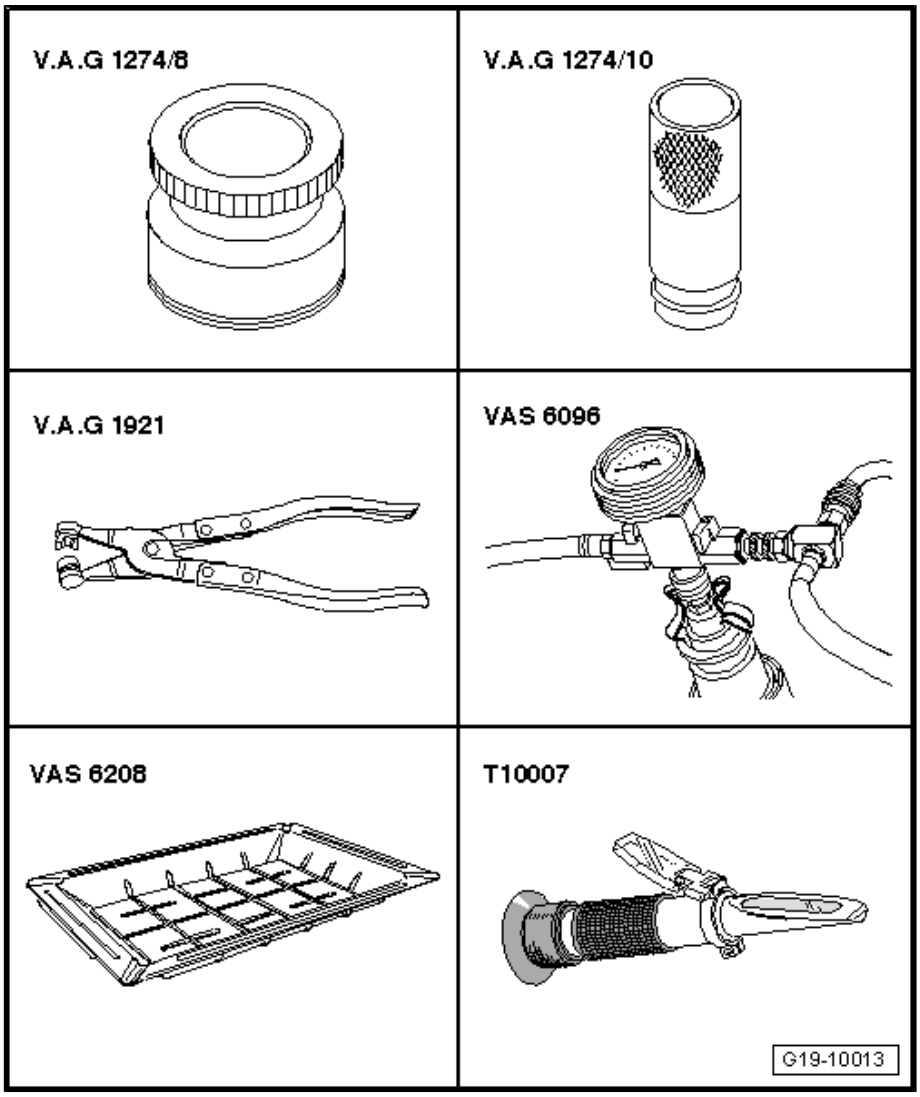
14 - Connection

- ❑ For thermostat



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-

Draining

Note

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

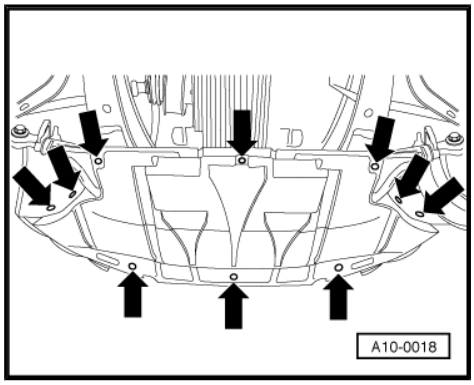
WARNING

Risk of scalding due to hot steam and hot coolant.

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

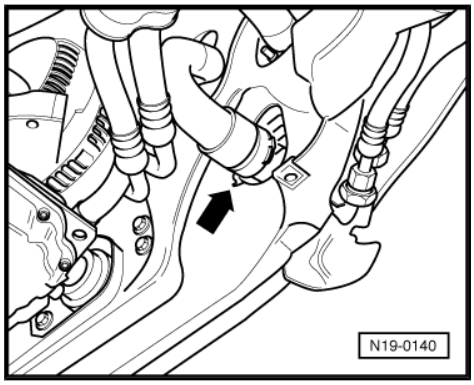
– Open filler cap on coolant expansion tank.

– Release fasteners -arrows- and remove noise insulation.

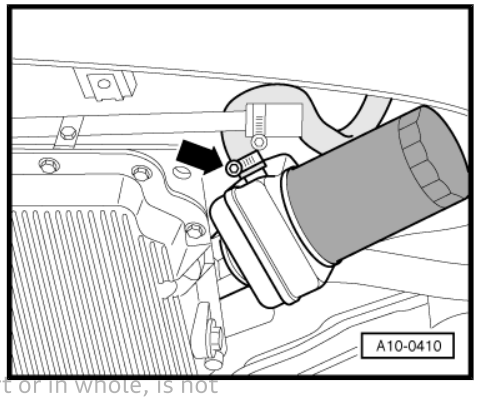


– Place drip tray for workshop hoist - VAS 6208- beneath engine.

– Lift retaining clip -arrow- and disconnect coolant hose (bottom right) from radiator.



– Also disconnect coolant hose at oil cooler -arrow-, and drain off remaining coolant.

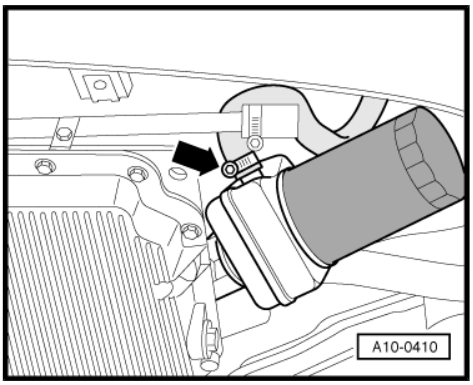


Filling

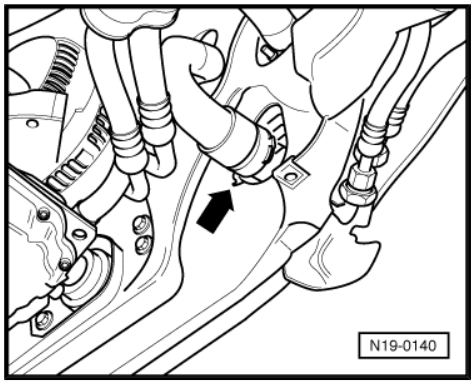
Note

- *The cooling system is filled all year round with a mixture of water and radiator anti-freeze/corrosion protection agent.*
- *Use only the radiator antifreeze/anti-corrosion agent approved for this engine ⇒ Electronic parts catalogue . If you use other coolant additives, this can significantly impair in particular the corrosion protection effect. The resulting damage could lead to loss of coolant and consequently to serious damage to the power unit.*
- *The specified radiator antifreeze/anti-corrosion agent prevents frost and corrosion damage and stops scaling. Such additives also raise the boiling point of the coolant. It is therefore essential to use the correct radiator anti-freeze and corrosion protection additive in the cooling system all year round.*
- *Because of its high boiling point, the coolant improves power unit 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 coolant additive concentration must be at least 40 %.*
- *If greater frost protection is required in very cold climates, the concentration of radiator antifreeze/anti-corrosion agent can be increased, but only up to 60% (this gives frost protection to about –40 °C). If the concentration exceeds 60%, frost protection decreases again and cooling efficiency is also impaired.*
- *Use only clean tap water for mixing coolant.*
- *Do not use drained coolant again if:*
- *the radiator, heat exchanger for heater, cylinder head, cylinder head gasket or cylinder block have been renewed.*
- *the coolant is contaminated or dirty.*
- *For checking anti-freeze protection in cooling system, use refractometer - T10007- .*

– Connect coolant hose to oil cooler -arrow-.



– Connect coolant hose -arrow- with plug-in connector to radiator ⇒ page 186 .



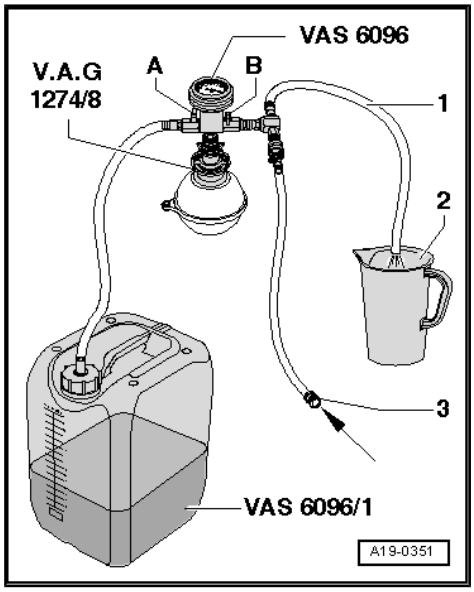
– Fill reservoir of cooling system charge unit -VAS 6096- with at least 10 litres of premixed coolant (according to recommended ratio):

- Radiator antifreeze/anti-corrosion agent (40 %) and water (60 %) for frost protection to –25 °C.
- Radiator antifreeze/anti-corrosion agent (50 %) and water (50 %) for frost protection to -35 °C.
- Radiator antifreeze/anti-corrosion agent (60 %) and water (40 %) for frost protection to -40 °C.
- Radiator antifreeze/anti-corrosion agent ⇒ Electronic parts catalogue

– Fit adapter for cooling system tester - V.A.G 1274/8- onto coolant expansion tank.

– Attach cooling system charge unit - VAS 6096- to adapter - V.A.G 1274/8- .

– Run vent hose -1- into a small container -2-.



Note

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

– Close both valves -A- and -B- (turn lever at right angles to direction of flow).

– Connect hose -3- to compressed air supply.

- Pressure: 6 ... 10 bar

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

• The suction jet pump generates a partial vacuum in the cooling system; the needle on the gauge should move into the green zone.

– Also briefly open valve -A- (turn lever in direction of flow) so that hose on reservoir of -VAS 6096- can fill with coolant.

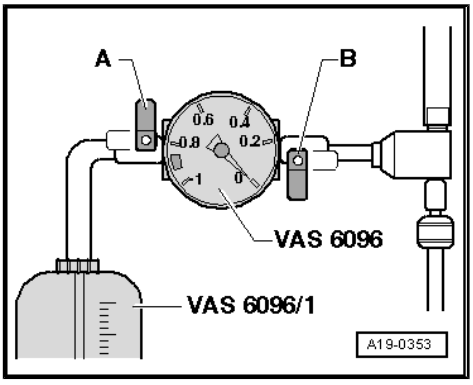
– Close valve -A- again.

– Leave valve -B- open for another 2 minutes.

• The suction jet pump continues to generate a partial vacuum in the cooling system; the needle on the gauge should remain in the green zone.

– Close valve -B-.

• The needle on the gauge should stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.



Note

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

♦ *Check cooling system for leaks if the vacuum is not maintained.*

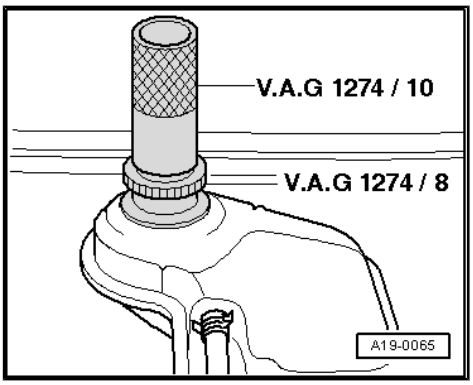
– Detach compressed air hose.

– Open valve -A-.

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

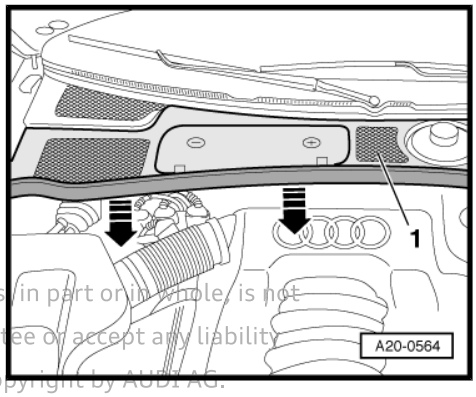
– Detach cooling system charge unit - VAS 6096- from adapter - V.A.G 1274/8- on coolant expansion tank.

– Fit pipe for cooling system tester - V.A.G 1274/10- onto adapter.

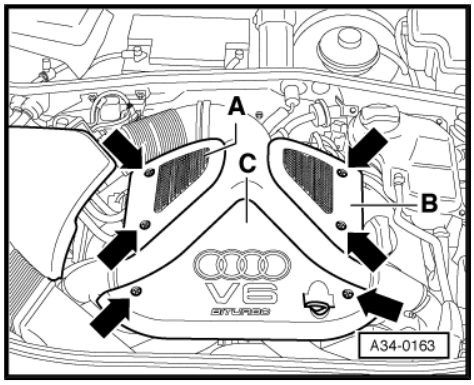


– Remove seal -arrows-.

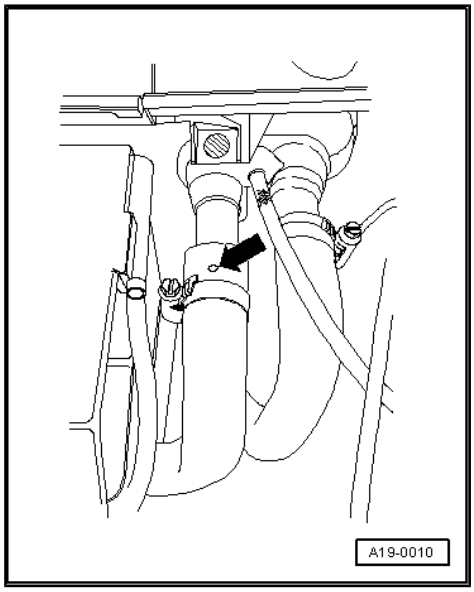
– Pull off plenum chamber cover -1- towards front of vehicle.



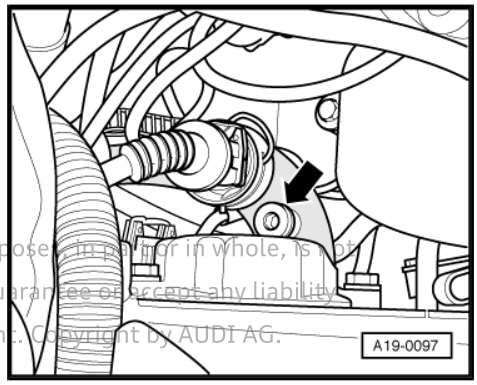
– Detach engine cover panel -C- by removing bolts -arrows-.



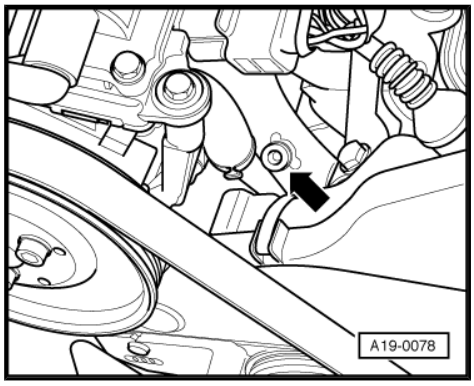
– Push back protective sleeve for coolant hoses on connection for heat exchanger.
– Release coolant hose going to heat exchanger and pull back hose until bleeder hole in hose -arrow- is no longer blocked by connection.
– Fill up with coolant until it flows out at bleeder hole in coolant hose.
– Push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

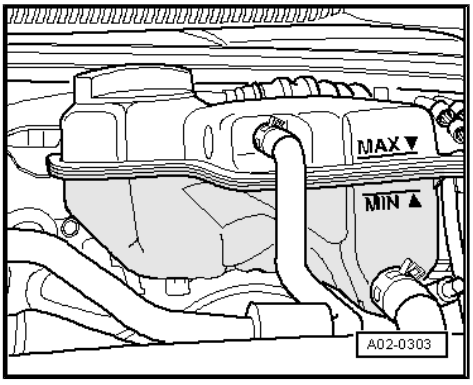


– Open bleeder valve -arrow- on coolant pipe (rear) below coolant expansion tank.
– Fill up with coolant until it comes out at bleeder valve.
– Close bleeder screw.



– Open bleeder valve -arrow- at coolant pipe (front) between power steering pump and cylinder head (left-side).
– Fill up with coolant until it comes out at bleeder valve.
– Close bleeder screw.





– Top up coolant to -MAX- mark.
– On vehicles with auxiliary heater, switch heater on (for about 30 seconds) and then off again.
– Close filler cap on expansion tank.
– Start engine.
– Set temperature to “HI”.
– Switch off air conditioner compressor (press ECON button).
– Run engine for 3 minutes at 2000 rpm.
– Allow engine to run at idling speed until both large coolant hoses at radiator become warm.
– Run engine for 1 minute at 2000 rpm.
– Switch off ignition and allow engine to cool down.
– Install noise insulation ⇒ Rep. gr. 50 .
– 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.

2 Coolant pump and thermostat

2.1 Exploded view - coolant pump and thermostat

1 - Thermostat
- ❑ Removing and installing ⇒ page 171
- ❑ Checking ⇒ page 176

2 - Seal
- ❑ Renew

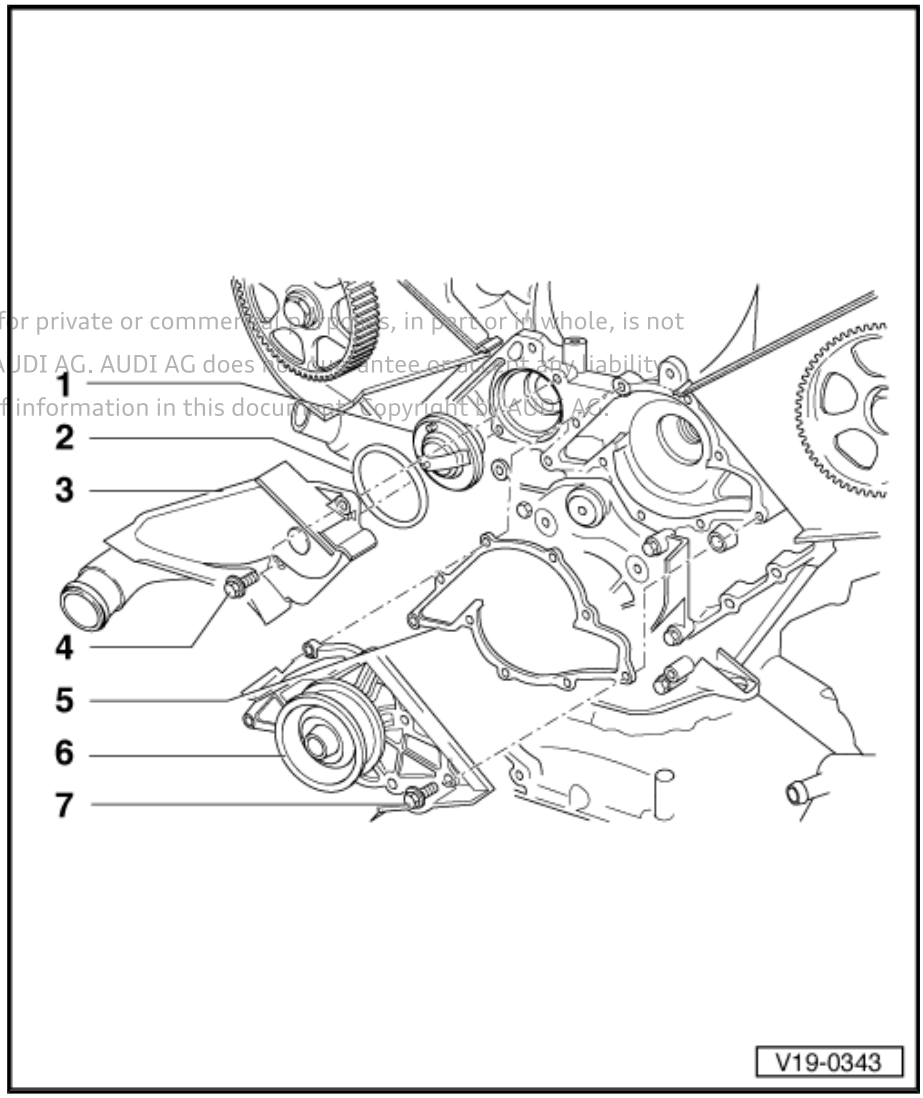
3 - Thermostat housing

4 - Bolt
- ❑ 10 Nm

5 - Gasket
- ❑ Renew

6 - Coolant pump
- ❑ Removing and installing ⇒ page 170

7 - Bolt
- ❑ 10 Nm



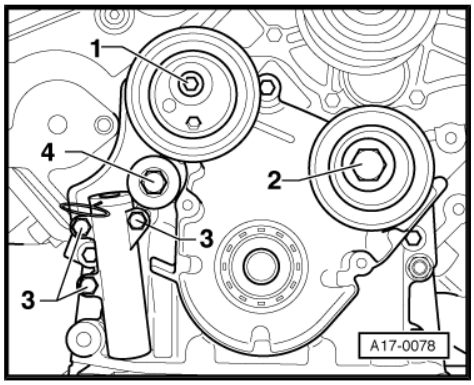
2.2 Removing and installing coolant pump

Removing

– Drain coolant ⇒ page 163 .

– Remove toothed belt ⇒ page 46 .

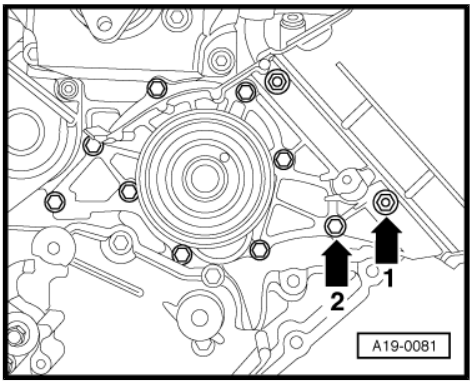
– Remove bolt -2- for idler roller and bolt -1- for toothed belt tensioning roller and detach corresponding component.



Note

Disregard items -3 and 4-.

– Remove 2 nuts -arrow 1- for toothed belt cover (rear).



Note

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

– Remove 9 bolts -arrow 2- and detach coolant pump.

Installing

• Tightening torque ⇒ page 170

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

Note

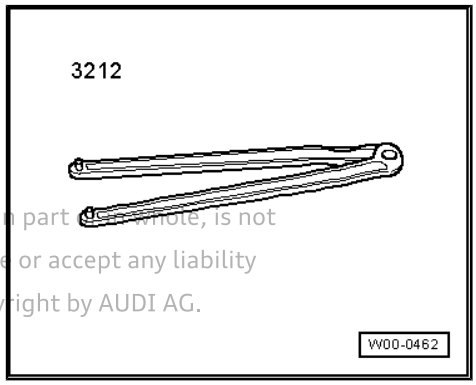
Renew seals and O-rings.

– Remove sealant residues on sealing surfaces of coolant pump and cylinder block.
– Clean sealing surfaces; they must be free of oil and grease.
– Install toothed belt cover (rear) ⇒ page 44 .
– Install tensioner, tensioning lever, toothed belt tensioning roller and idler roller ⇒ page 46 .
– Install toothed belt (adjust valve timing) ⇒ page 50 .
– Fill up with coolant ⇒ page 165 .

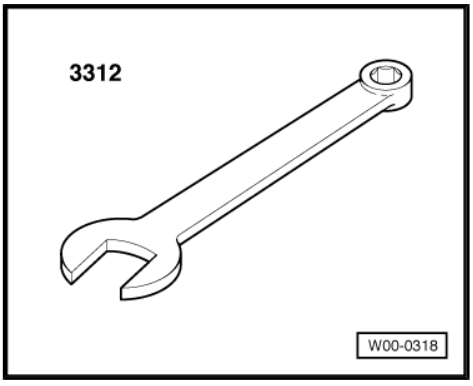
2.3 Removing and installing thermostat

Special tools and workshop equipment required

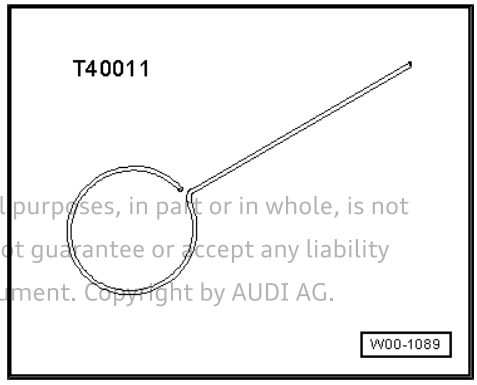
♦ Pin wrench - 3212-



♦ Open-end spanner - 3312-



- Locking pin - T40011-



Removing

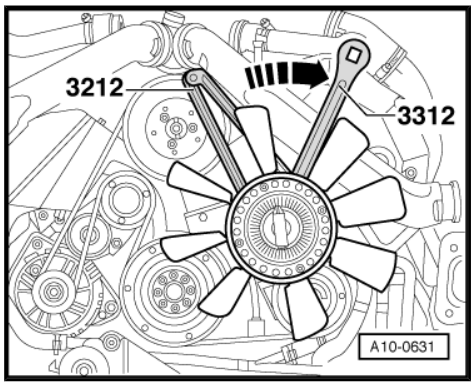
– Drain coolant ⇒ page 163 .

– Remove poly V-belt tensioner ⇒ page 43 .

Caution

Risk of damage to thread.

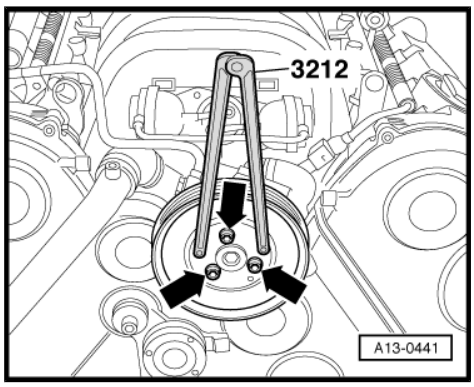
- *The viscous fan has a left-hand thread.*



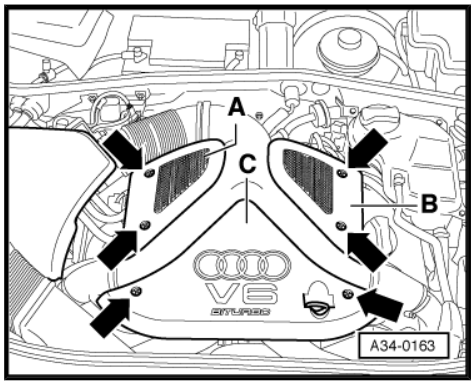
– Use pin wrench - 3212- to counterhold and unscrew viscous fan with open-end spanner - 3312- -arrow- in clockwise direction.

– Carefully lift out viscous fan.

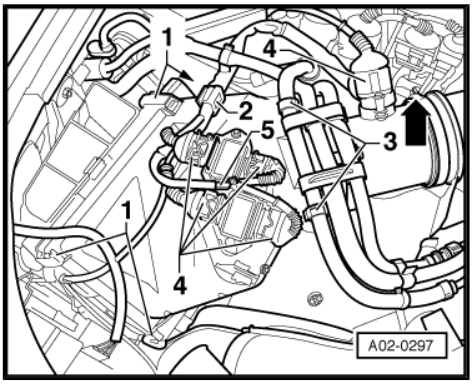
– Unbolt poly V-belt pulley for power steering pump -arrows- using pin wrench - 3212- as a counterhold.



– Detach engine cover panels -A ... C- by removing bolts -arrows-.



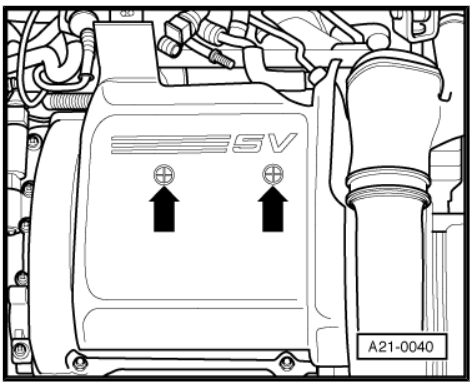
– Unplug electrical connector -4- at air mass meter - G70- .
– On vehicles with separate output stages, unplug remaining connectors -4-, cut through cable tie -5- and detach wiring harness from clip -2-. Then put down wiring harness next to intake opening of air cleaner.
– Open retaining clips -3- for fuel lines.
– Release hose clip -arrow-.
– Remove bolts and take off air filter housing.



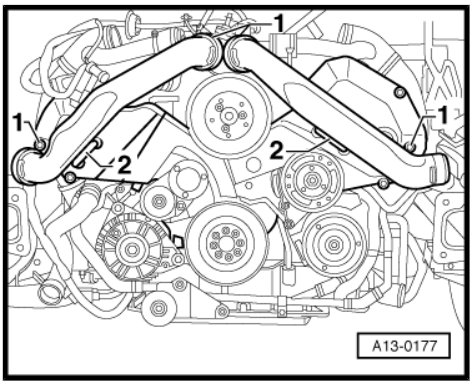
Note

Disregard -item 1-.

– Open quick-release fasteners -arrows- and detach cover for cylinder head cover (right-side).



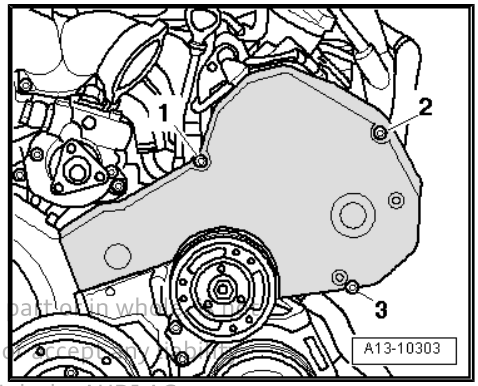
– Remove bolts -1- and detach air pipes.



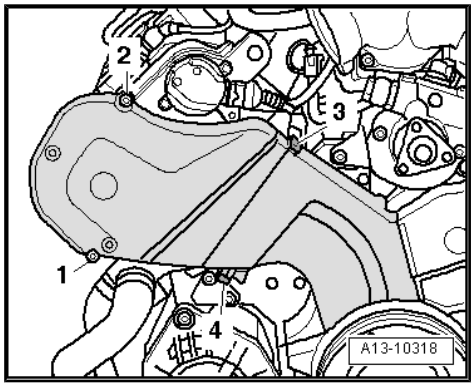
Note

Pay attention to retaining strips -2-.

– Remove bolts -1 … 3- and take out toothed belt cover (left-side).



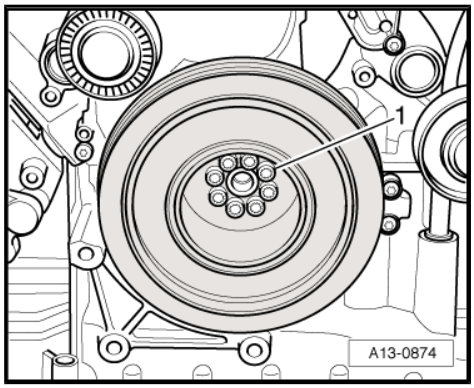
– Remove bolts -1- and -2- and take off toothed belt cover (top right).
– Release retaining tabs -3- and -4- and detach toothed belt cover (bottom right).



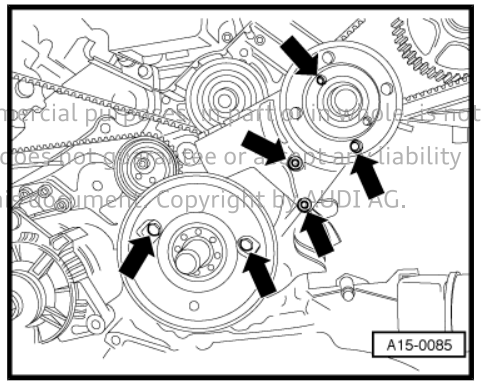
Note

It is not necessary to unscrew bolt for crankshaft sprocket to remove vibration damper.

– Unscrew bolts -1- and remove vibration damper.



– Unbolt bottom section of toothed belt cover -bottom arrows-.



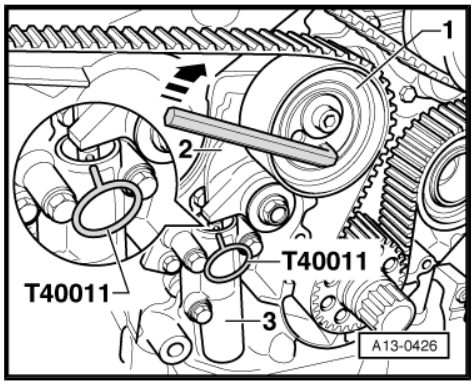
Note

Do not remove poly V-belt pulley for viscous fan.

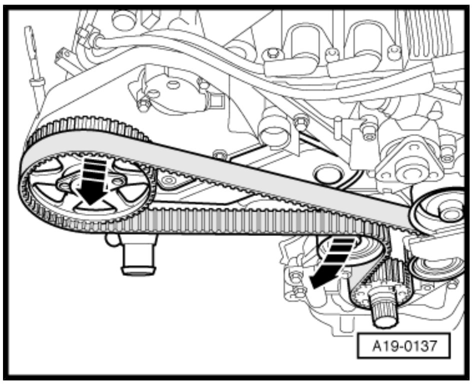
Note

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

– Turn toothed belt tensioning roller -1- clockwise in direction of -arrow- using an 8 mm Allen key until tensioning lever -2- compresses tensioner -3- far enough for pressure piston to be locked with locking pin - T40011- .
– Release pressure from toothed belt tensioning roller.



– Pull toothed belt forwards slightly on tensioning roller and right camshaft sprocket -arrows-, but do not pull off completely.

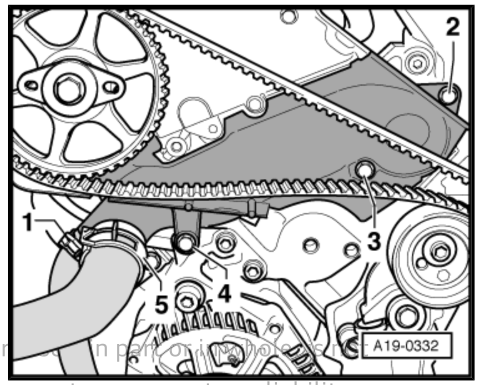


> **Caution**
>
> *Timing must be re-adjusted if toothed belt has slipped off tensioning roller* *⇒ page 50* *. Follow all instructions for removing and installing toothed belt* *⇒ page 46* *.*

– Detach coolant hoses -1- and -5- from thermostat housing.

– Unscrew bolts -2-, -3- and -4- and detach thermostat housing.

– Remove O-ring and thermostat.



Installing

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

Note

- *Fit new O-rings.*
- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*

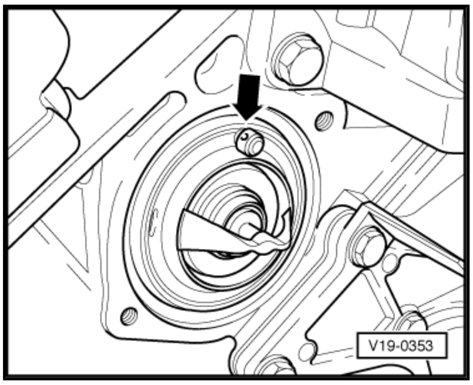
– Clean and smoothen sealing surface for O-ring.

– Install thermostat.

• Installation position: Vent valve -arrow- faces upwards.

• Seal facing housing

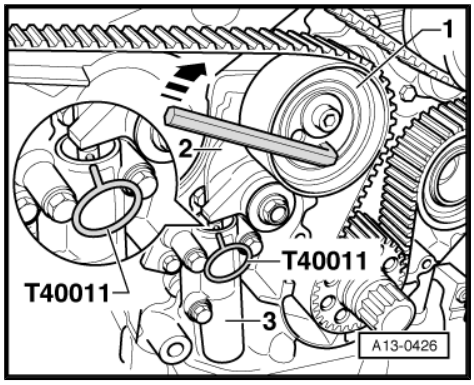
– Install thermostat housing.



> **Caution**
>
> *Timing must be re-adjusted if toothed belt has slipped off tensioning roller* *⇒ page 50* *. Follow all instructions for removing and installing toothed belt* *⇒ page 46* *.*

– Push back toothed belt on tensioning roller and on right camshaft toothed belt sprocket.

– Using an 8 mm Allen key, turn toothed belt tensioning roller -1- clockwise in direction of -arrow- until locking pin - T40011- can be removed.



Proceed as follows to pre-tension tensioning roller before first starting engine:

– Apply torque wrench to hexagon socket of tensioning roller.
– Pre-tension tensioning roller by applying a torque of 15 Nm.
– Install vibration damper ⇒ page 43 .
– Install viscous fan ⇒ page 189 .
– Install lock carrier with attachments ⇒ Rep. gr. 50 .
– Fill up with coolant ⇒ page 165 .

2.4 Checking thermostat

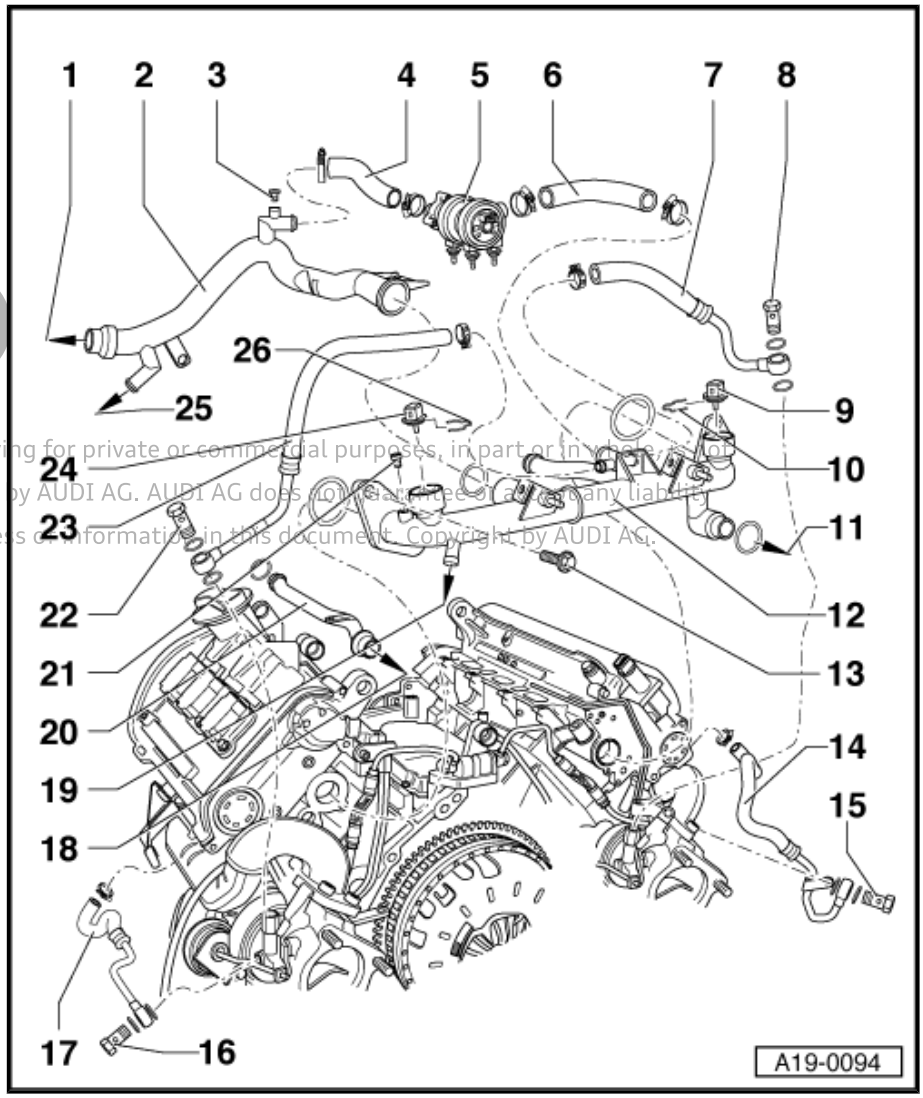
– Remove thermostat and heat it in a water bath.

Starts to open	Fully open	Opening travel
approx. 87 °C	approx. 102 °C[1)]	at least 8 mm

• [1)] Cannot be tested.

3 Coolant pipes

3.1 Exploded view - coolant pipes



1 - To coolant hose (front)

2 - Coolant pipe (front)

- ❑ Removing and installing ⇒ page 179
- ❑ Tightening torque ⇒ page 178

3 - Bleeder screw

- ❑ 15 Nm

4 - Coolant hose

- ❑ From continued circulation coolant pump to front coolant pipe

5 - Continued coolant circulation pump - V51-

- ❑ Removing and installing ⇒ page 178

6 - Coolant hose

- ❑ From rear coolant pipe to continued circulation coolant pump

7 - Coolant pipe (right-side)

- ❑ From turbocharger to rear coolant pipe

8 - Banjo bolt

- ❑ 35 Nm

9 - Coolant temperature display sender - G2- / coolant temperature sender - G62-

10 - Retaining clip

- ❑ Check for firm attachment

11 - To heat exchanger

12 - Coolant pipe (rear)

- ❑ Removing and installing ⇒ page 182

13 - Bolt

- ❑ 10 Nm

14 - Coolant pipe (right-side)

- ❑ From cylinder block to turbocharger

15 - Banjo bolt

- ❑ 35 Nm

16 - Banjo bolt

- ❑ 35 Nm

17 - Coolant pipe (left-side)

- ❑ From cylinder block to turbocharger

18 - From heat exchanger

19 - To coolant hose (front)

20 - Coolant pipe (small)

- ❑ Removing and installing ⇒ page 181

21 - Bleeder screw or connection

- ❑ Tighten bleeder screw to 15 Nm

22 - Banjo bolt

- ❑ 35 Nm

23 - Coolant pipe (left-side)

- ❑ From turbocharger to rear coolant pipe

24 - Thermal switch for continued circulation of coolant - F95-

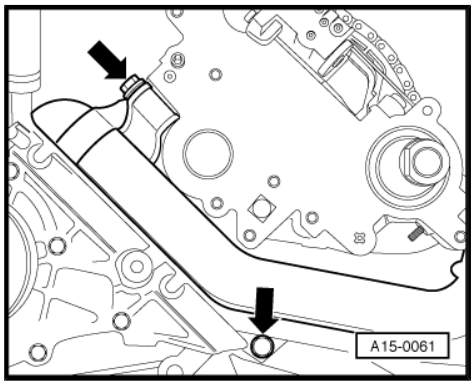
25 - To oil cooler

26 - Retaining clip

- ❑ Check for firm attachment

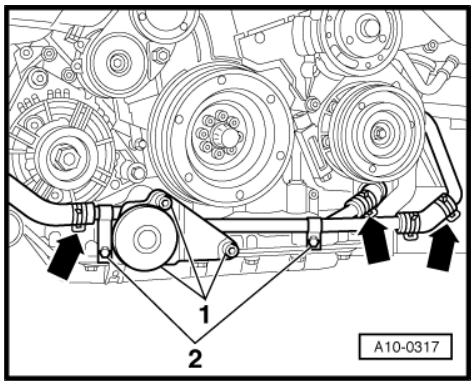
Coolant pipe (front) - tightening torque

– Tighten bolts -2- to 9 Nm.



Coolant pipe (bottom) - tightening torque

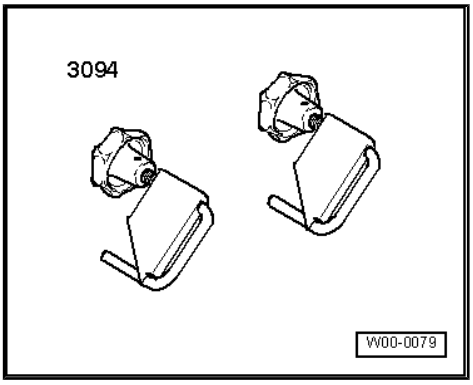
– Tighten bolts -2- to 25 Nm.



3.2 Removing and installing continued coolant circulation pump - V51-

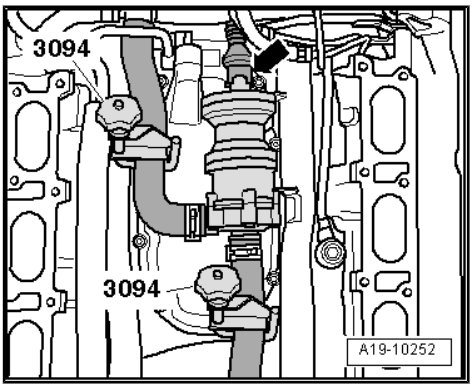
Special tools and workshop equipment required

♦ Hose clamps, up to 25 mm - 3094-



Removing

– If fitted, remove secondary air pump ⇒ page 287 .
– Remove intake manifold ⇒ Rep. gr. 24 .
– Unplug electrical connector -arrow-.
– Clamp off coolant hoses with hose clamps - 3094- .
– Disconnect coolant hoses from continued coolant circulation pump - V51- .
– Disengage continued circulation coolant pump - V51- from retainers.



Installing

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

Note

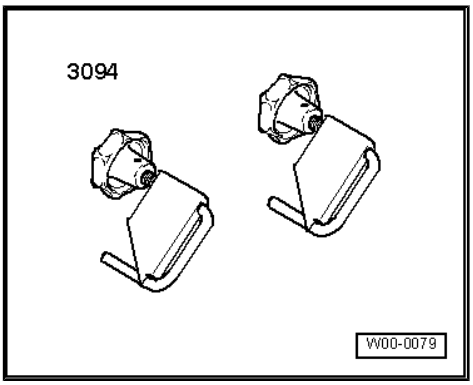
Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .

– Install intake manifold ⇒ Rep. gr. 24.
– Install secondary air pump ⇒ page 287.
– Check coolant level ⇒ page 169 .

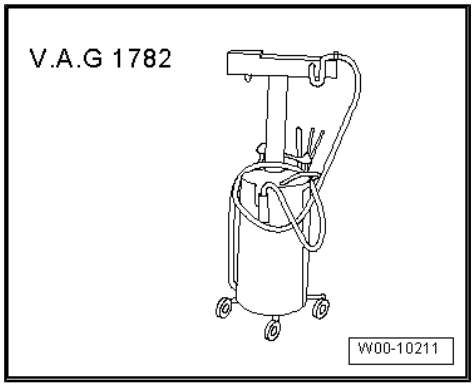
3.3 Removing and installing coolant pipe (front)

Special tools and workshop equipment required

♦ Hose clamps up to Ø 25 mm - 3094-

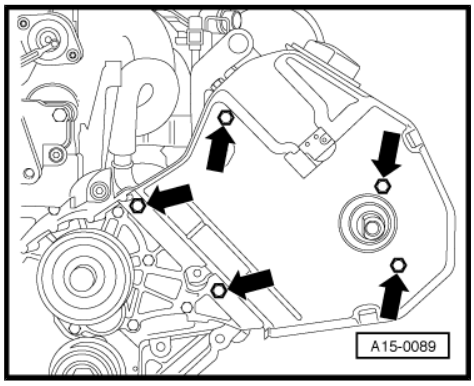


♦ Used oil collection and extraction unit - V.A.G 1782-

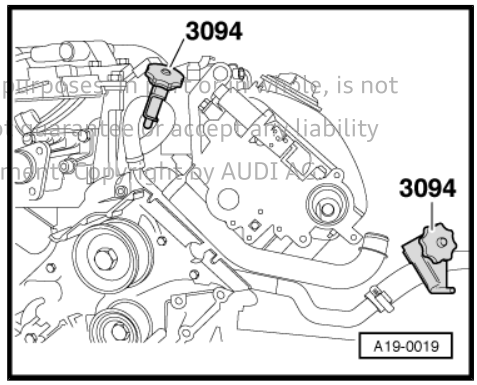


Removing

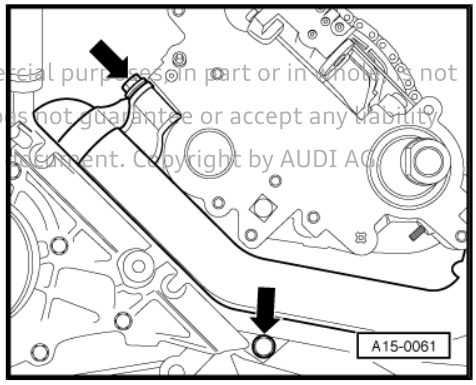
– If fitted, remove secondary air pump ⇒ page 287 .
– Remove intake manifold ⇒ Rep. gr. 24 .
– Remove coolant pump ⇒ page 170 .
– Take off camshaft sprocket (left-side).
– Unscrew toothed belt cover (rear left) -arrows-.



– Position used oil collection and extraction unit - V.A.G 1782- below connection point.
– Clamp off both hoses at supply pipe for hydraulic fluid using hose clamps - 3094- .
– Disconnect both hydraulic hoses from supply pipe.
– Detach coolant hose from coolant pipe (front).



– Remove bolts -arrows-.



– Move wiring clear at coolant pipe.
– Pull off coolant pipe towards the front.

Installing

• Tightening torque ⇒ page 177

Note

♦ *Fit new O-rings.*

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

♦ *Fit all cable ties in the original positions when installing.*

– Clean and smoothen sealing surface for O-ring.
– Lubricate new O-ring with coolant and slide onto coolant pipe.
– Push coolant pipe into aperture on rear coolant pipe.

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

– Install coolant pump ⇒ page 170 .
– Install intake manifold ⇒ Rep. gr. 24 .
– Install secondary air pump ⇒ page 287 .
– Fill up with coolant ⇒ page 165 .
– Install toothed belt cover (rear) ⇒ page 44 .
– Install hydraulic fluid hoses for power steering ⇒ Rep. gr. 48 .

3.4 Removing and installing coolant pipe (small)

Removing

– Remove coolant pipe (front) ⇒ page 179 .
– Disconnect rear coolant hose from coolant pipe (small).
– Unscrew securing bolt.
– Pull off small coolant pipe to rear.
– Take out coolant pipe from the top.

Installing

• Tightening torque ⇒ page 177

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

Note

♦ *Fit new O-rings.*

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

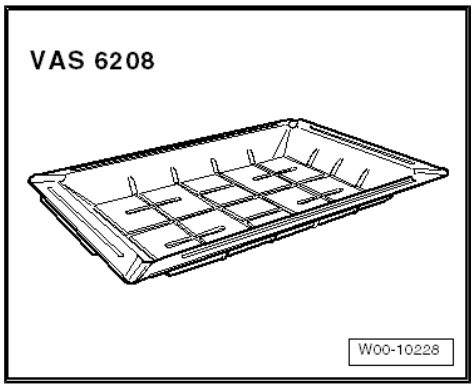
– Clean or smoothen sealing surfaces for O-rings.
– Lubricate new O-rings with coolant and slide onto coolant pipe.

– Push coolant pipe into bore on cylinder block.
– Install coolant pipe (front) ⇒ page 178 .
– Fill up with coolant ⇒ page 165 .

3.5 Removing and installing coolant pipe (rear)

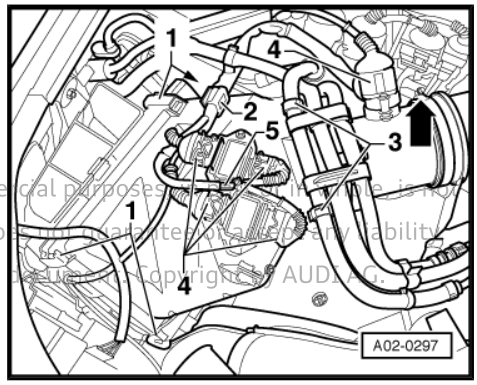
Special tools and workshop equipment required

♦ Drip tray for workshop hoist - VAS 6208-



Removing

– Drain coolant ⇒ page 163 .
– If fitted, remove secondary air pump ⇒ page 287 .
– Remove intake manifold ⇒ Rep. gr. 24 .
– Unplug electrical connector -4- at air mass meter - G70- .
– On vehicles with separate output stages, unplug remaining connectors -4-, cut through cable tie -5- and detach wiring harness from clip -2-. Then put down wiring harness next to intake opening of air cleaner.
– Open retaining clips -3- for fuel lines.
– Release hose clip -arrow-.
– Remove bolts and take off air filter housing.



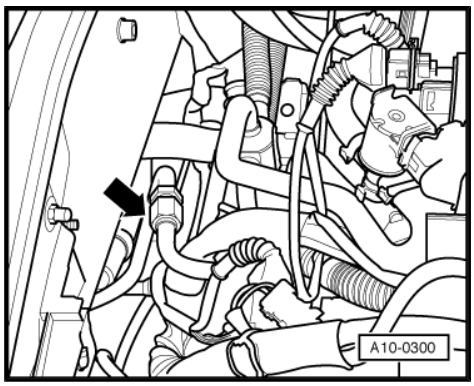
Note

Disregard -item 1-.

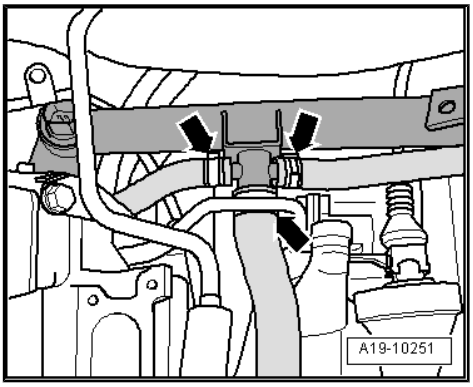
Note

Lay a cloth under the separating point to catch escaping hydraulic fluid.

– Separate the hydraulic pressure line -arrow- for power steering pump at rear of engine.
– Remove crankcase breather hoses.
– Unscrew retaining clamps for wiring harness at coolant pipe (rear).
– Move engine wiring harness clear.



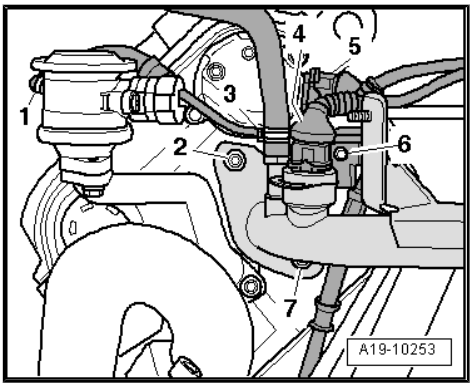
– Detach coolant hoses -arrows- from coolant pipe (rear).



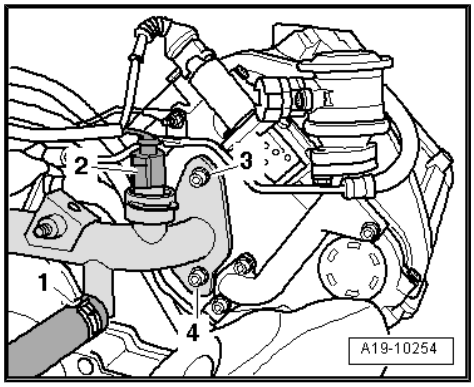
– Unplug electrical connector -4- at thermal switch for continued circulation of coolant - F95- .
– Remove coolant hose -3-, if fitted.
– Remove bolts -2- and -7-.

Note

- *For illustration purposes, the installation position is shown with the engine removed.*
- *Disregard -items 1, 5, 6-.*



– Unplug electrical connector -2- at coolant temperature display sender - G2- / coolant temperature sender - G62- .
– Disconnect coolant hose -1- (leading to heat exchanger) from coolant pipe (rear).
– Remove bolts -3- and -4-.
– Pull coolant pipe (rear) out of cylinder block.



Note

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

Installing

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

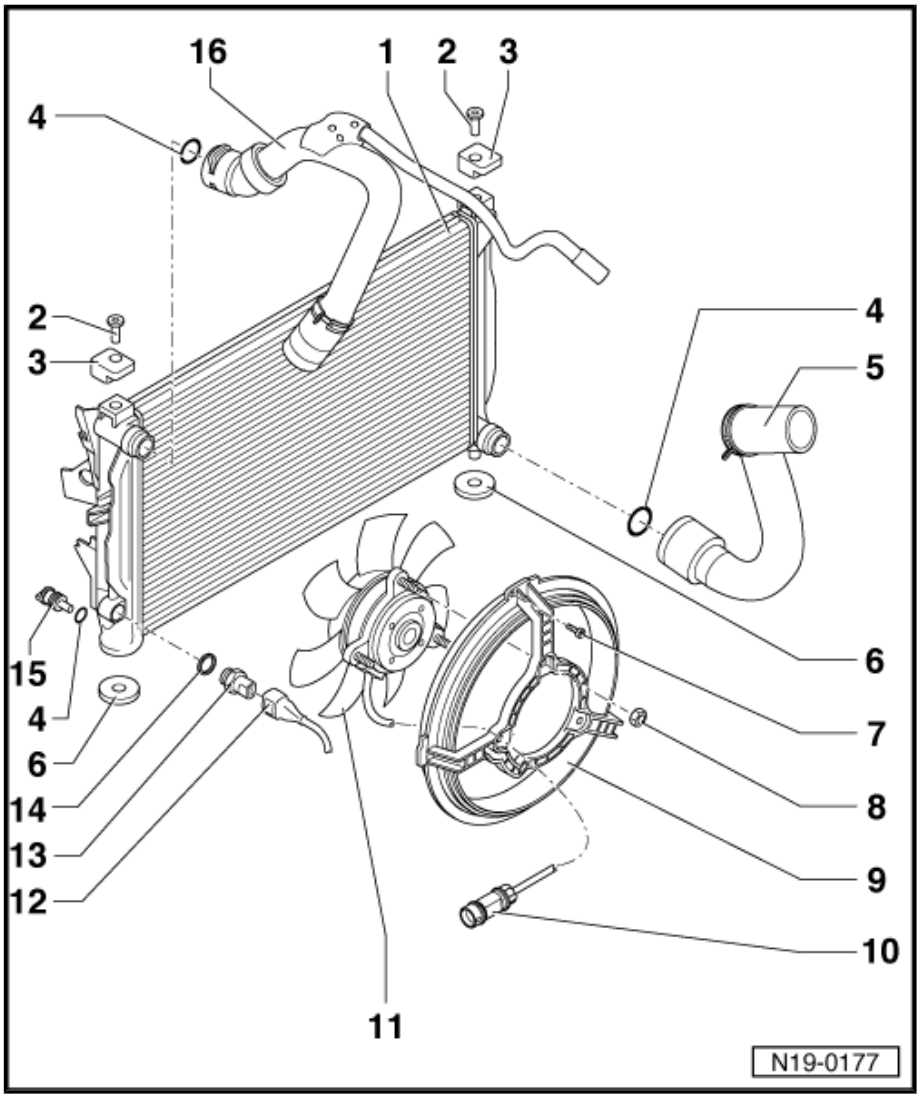
Note

- *Renew seals and O-rings.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *Fit all cable ties in the original positions when installing.*

– Clean and smoothen sealing surface for O-rings as required.
– Lubricate new O-ring with coolant and slide onto coolant pipe.
– Install hydraulic pressure line for power steering ⇒ Rep. gr. 48 .
– Install intake manifold ⇒ Rep. gr. 24 .
– Install secondary air pump ⇒ page 287 .
– Fill up with coolant ⇒ page 165 .

4 Radiator and radiator fans

4.1 Exploded view - radiator and radiator fans



1 - Radiator

- ❑ Removing and installing ⇒ page 186
- ❑ If renewed, refill system with fresh coolant

2 - Clip

3 - Rubber mounting

4 - O-ring

- ❑ Renew if damaged

5 - Coolant hose (bottom)

- ❑ Lift retaining clip to detach
- ❑ Connecting to radiator ⇒ page 186

6 - Rubber washer

7 - Bolt

8 - Nut

- ❑ 10 Nm

9 - Fan ring

- ❑ Clipped into cowling and secured with bolt -item 7-

10 - 2-pin electrical connector

11 - Radiator fan - V7-

- ❑ Checking ⇒ page 190
- ❑ Removing and installing ⇒ page 191

12 - 3-pin electrical connector

- ❑ For radiator fan thermal switch - F18-

13 - Radiator fan thermal switch - F18-

- ❑ Switching temperatures:
- ♦ Stage 1 on: 92 ... 97 °C
- ♦ Stage 1 off: 84 ... 91 °C
- ♦ Stage 2 on: 99 ... 105 °C
- ♦ Stage 2 on: 91 ... 98 °C
- ❑ 35 Nm

14 - Seal

- ❑ Renew

15 - Drain plug

- ❑ 10 Nm

16 - Coolant hose (top)

- ❑ Lift retaining clip to detach
- ❑ Connecting to radiator ⇒ page 186

17 - Bolt

- ❑ 5 Nm

18 - Mounting rod

19 - Guard plate

20 - Bolt

- ❑ 5 Nm

21 - Bolt

- ❑ 5 Nm

22 - Radiator

- ❑ Removing and installing ⇒ page 186
- ❑ If renewed, refill system with fresh coolant

23 - Nut

- ❑ 5 Nm

24 - Bracket

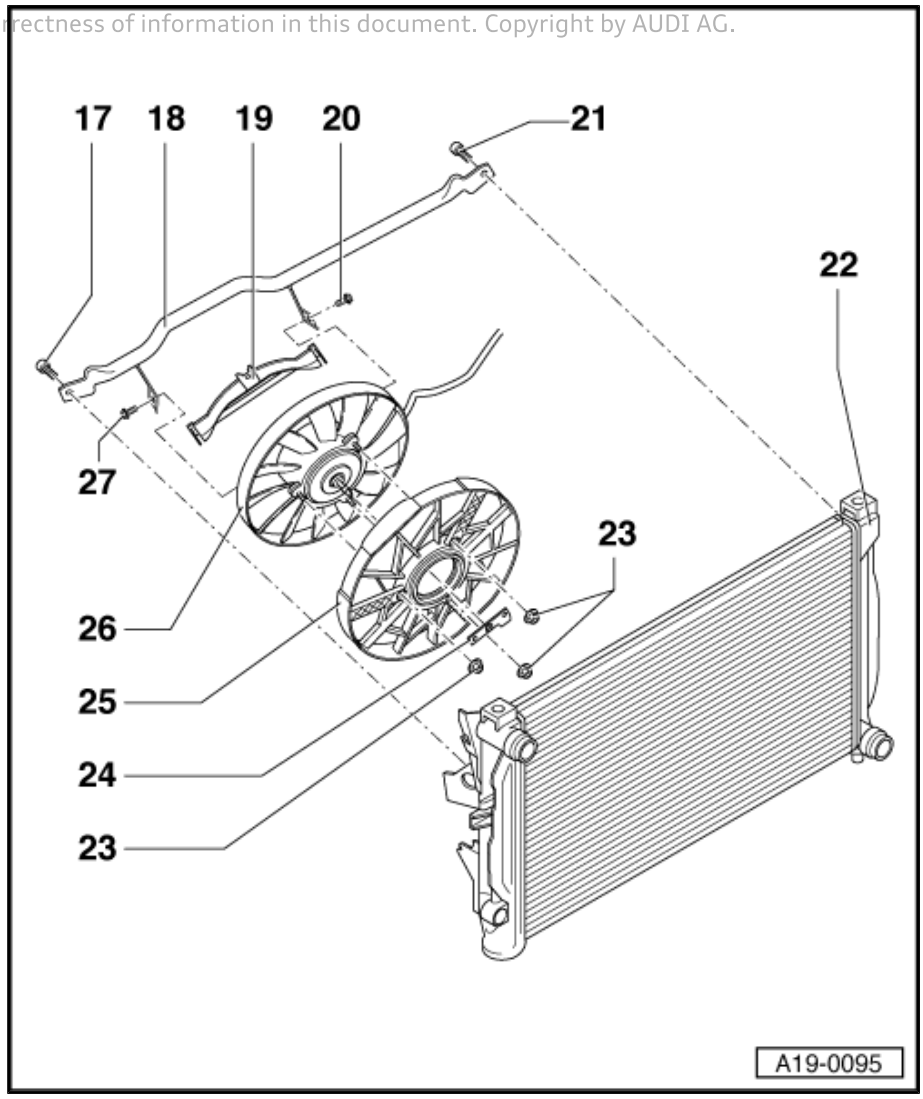
25 - Fan ring

26 - Radiator fan 2 - V177-

- ❑ Removing and installing ⇒ page 192

27 - Bolt

- ❑ 5 Nm



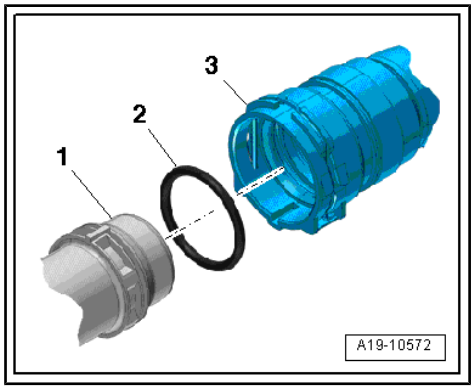
Connecting coolant hose with plug-in connector to radiator

– Remove old O-ring -2- from coolant hose -3-.

– Lubricate new O-ring with coolant additive and fit O-ring in coolant hose.

– Press coolant hose onto radiator -1- until it engages with a click.

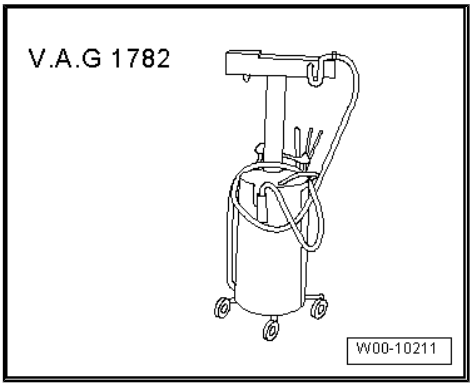
– Press coolant hose in again and then pull to check that plug-in connector is correctly engaged.



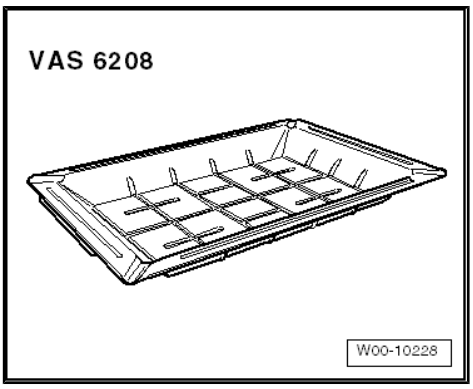
4.2 Removing and installing radiator

Special tools and workshop equipment required

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



♦ Drip tray for workshop hoist - VAS 6208-



Removing

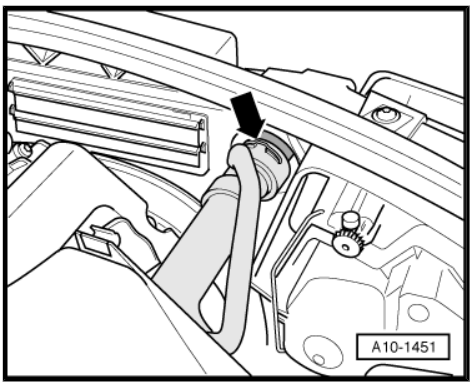
Note

If there are slight impressions on the fins, refer to ⇒ page 6 .

– Remove front bumper ⇒ Rep. gr. 63 .

– Place drip tray for workshop hoist - VAS 6208- beneath engine.

– Lift retaining clip -arrow- and disconnect coolant hose (top) from radiator.



– Unplug electrical connector at thermal switch at bottom left of radiator.

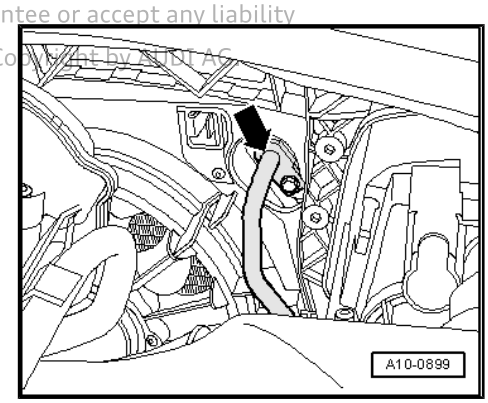
Note

Observe rules for cleanliness when working on gear oil pipes/ATF lines ⇒ Rep. gr. 00 .

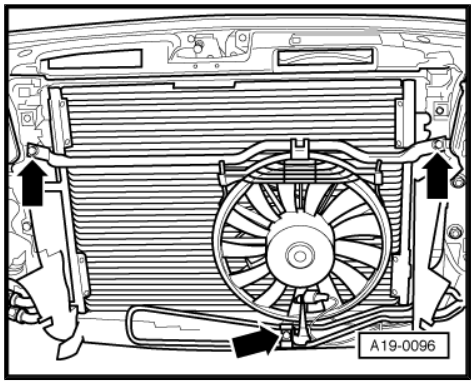
– Position used oil collection and extraction unit - V.A.G 1782- below connection point.

– Detach gear oil/ATF lines (top -arrow- and bottom) from radiator ⇒ Rep. gr. 34 /⇒ Rep. gr. 37 .

– Tie gear oil/ATF lines up onto longitudinal member to prevent fluid escaping.



– Unbolt pressurising fan and cooling pipe for hydraulic fluid for power steering -arrows-.



WARNING

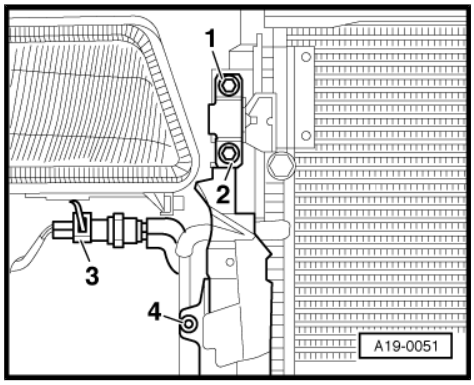
Risk of injury caused by refrigerant.

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

– Detach air ducts (left and right) from radiator -4-.

– Remove bolts -1- and -2- securing condenser.

– Unplug electrical connector -3- at air conditioner pressure switch - F129- .



WARNING

Risk of injury caused by refrigerant.

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

– Remove bolts -1- and -2- for condenser.

Caution

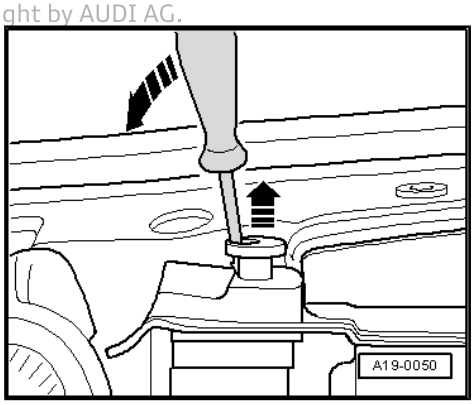
Risk of damage to refrigerant lines and hoses

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

– Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.

– Release two retaining pins for radiator and pull out upwards -arrows-.

– Swivel radiator forwards and lift off.



Installing

• Tightening torques ⇒ page 185

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

Note

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

– Install condenser ⇒ Rep. gr. 87 .

– Install cooling pipe for power steering ⇒ Rep. gr. 48 .

– Install gear oil pipes ⇒ Rep. gr. 34 /ATF lines ⇒ Rep. gr. 37 .

– Install front bumper ⇒ Rep. gr. 63 .

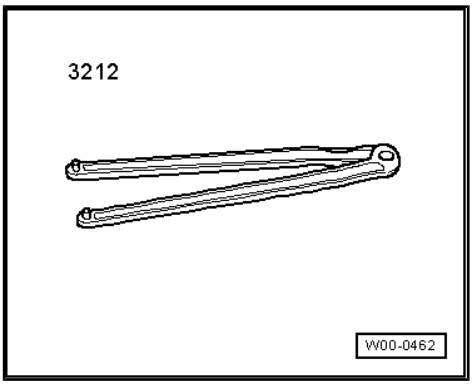
– Connect coolant hoses with plug-in connector ⇒ page 186 .

– Fill up with coolant ⇒ page 165 .

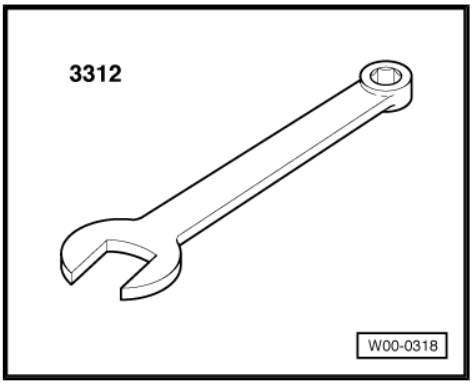
4.3 Removing and installing viscous fan

Special tools and workshop equipment required

- Pin wrench - 3212-



- Open-end spanner - 3312-

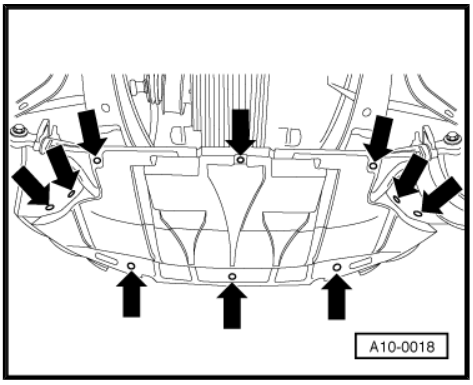


Removing

– Release fasteners -arrows- and remove noise insulation.

– Remove front bumper ⇒ Rep. gr. 63 .

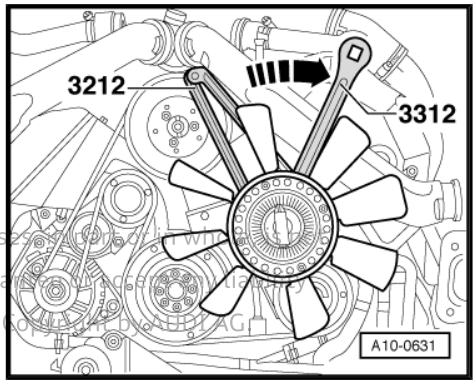
– Move lock carrier to service position ⇒ Rep. gr. 50 .



Caution

Risk of damage to thread.

- ***The viscous fan has a left-hand thread.***



– Unscrew viscous fan coupling with open-end spanner - 3312- -arrow- in clockwise direction while counterholding with pin wrench - 3212- .

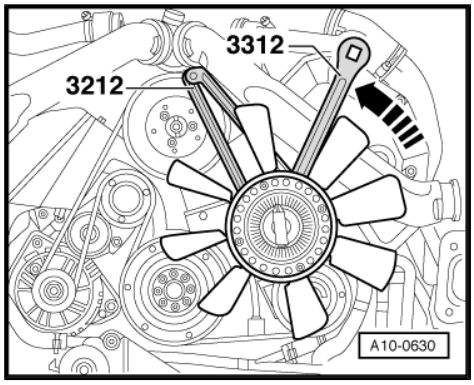
– Carefully lift out viscous fan.

Installing

Caution

Risk of damage to thread.

- *The viscous fan has a left-hand thread.*



– Use open-end spanner - 3312- to secure viscous fan coupling in anti-clockwise direction -arrow- (left-hand thread) while counterholding with pin wrench - 3212- ⇒ page 40 .

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

– Install lock carrier with attachments ⇒ Rep. gr. 50 .

– Install front bumper ⇒ Rep. gr. 63 .

– Install noise insulation ⇒ Rep. gr. 50 .

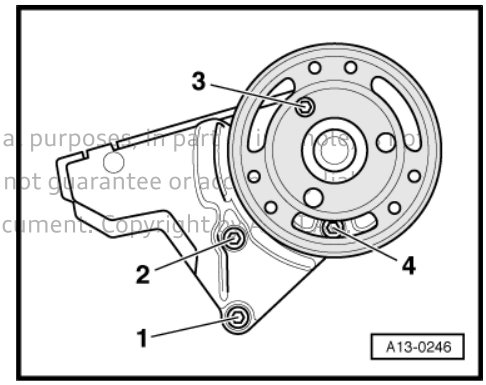
4.4 Removing and installing poly V-belt pulley for viscous fan

Removing

– Remove viscous fan ⇒ page 189 .

– Remove poly V-belt ⇒ page 41 .

– Remove bolts -1 ... 4-.



Note

Bolts -3- and -4- cannot be detached.

Installing

• Tightening torques ⇒ page 40 .

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

– Install poly V-belt ⇒ page 41 .

– Install viscous fan ⇒ page 189 .

4.5 Checking radiator fan

Special tools and workshop equipment required

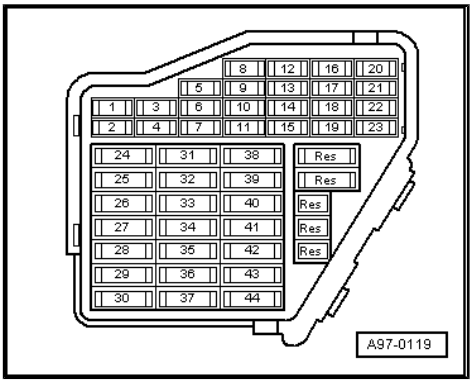
♦ Auxiliary measuring set - V.A.G 1594C-

Procedure

- Fuse in fuse holder - S234- OK
- Radiator fan thermal switch - F18- OK

– Unplug electrical connector at radiator fan thermal switch - F18- at bottom left of radiator.

– Switch on ignition.



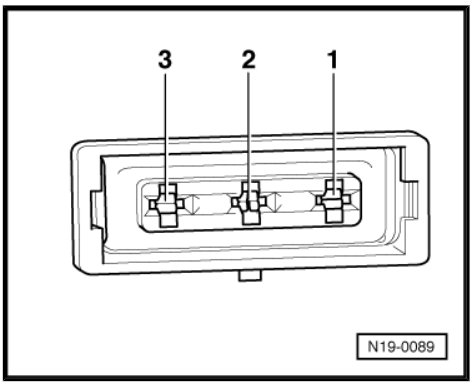
– Bridge contact -1- and contact -2- of electrical connector with test leads from auxiliary measuring set - V.A.G 1594C- :

- Stage 1 of radiator fan - V7- should start up.

– Bridge contact -1- and contact -3- of electrical connector with test leads from auxiliary measuring set - V.A.G 1594C- .

- Stage 2 of radiator fan - V7- should start up.

– If radiator fan - V7- does not react as described, check wiring ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.



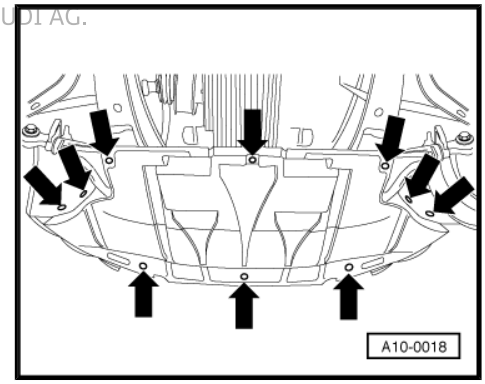
4.6 Removing and installing radiator fan - V7- (right-side)

Removing

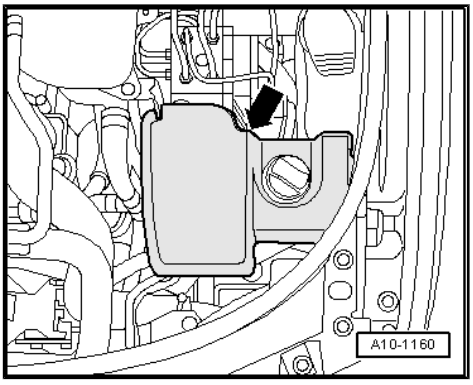
– Release fasteners -arrows- and remove noise insulation.

– Remove front bumper ⇒ Rep. gr. 63 .

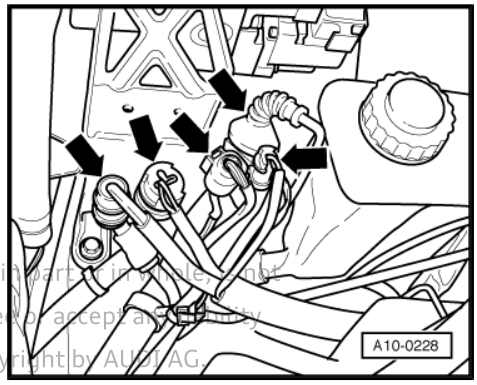
– Move lock carrier to service position ⇒ Rep. gr. 50 .



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



– Remove all electrical connectors from bracket -arrows-.



WARNING

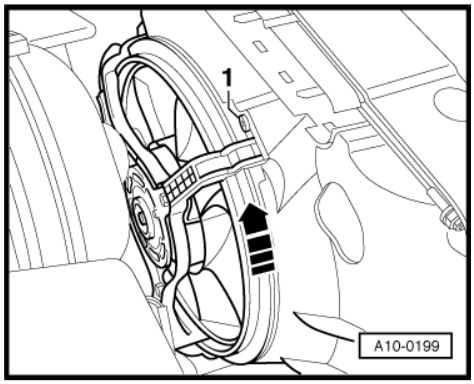
Risk of injury as the radiator fans may start up automatically.

- ***Unplug electrical connectors before working in vicinity of radiator cowl.***

– Unplug black connector and move wiring to radiator fan - V7- clear.

– Remove bolt -1-.

– Turn radiator fan in direction of -arrow- and remove.



Installing

• Tightening torque ⇒ page 185

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

Note

Fit all cable ties in the original positions when installing.

– Install lock carrier with attachments ⇒ Rep. gr. 50 .

– Install front bumper ⇒ Rep. gr. 63 .

– Install noise insulation ⇒ Rep. gr. 50 .

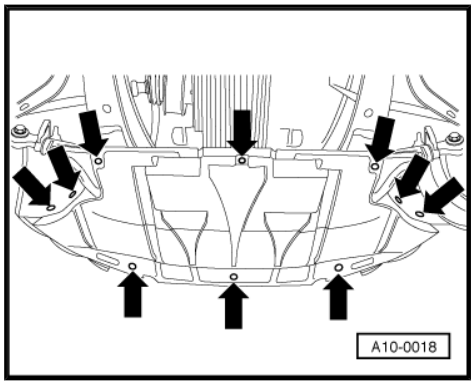
4.7 Removing and installing radiator fan 2 - V177- (front)

Removing

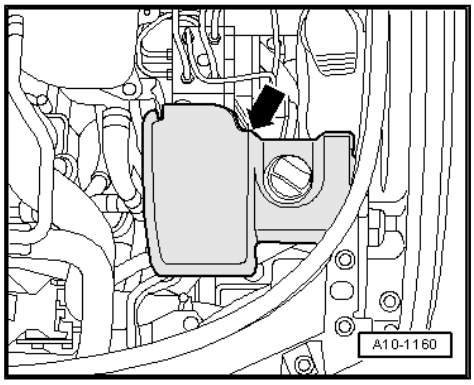
– Release fasteners -arrows- and remove noise insulation.

– Remove front bumper ⇒ Rep. gr. 63 .

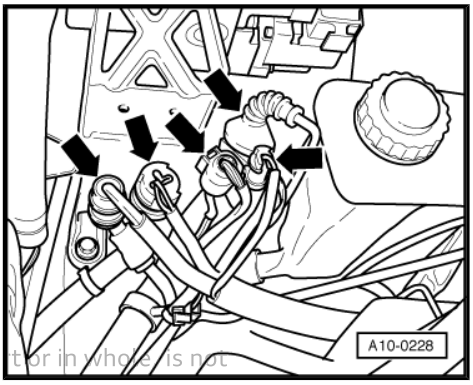
– Move lock carrier to service position ⇒ Rep. gr. 50 .



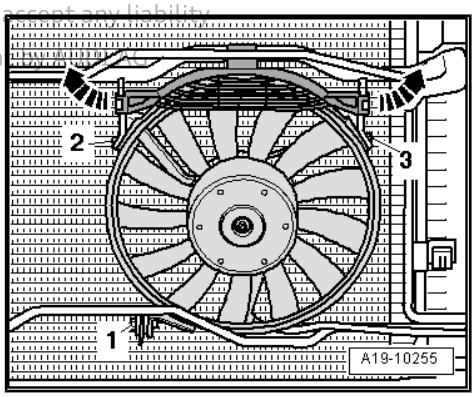
– Remove cover -arrow- at power steering fluid reservoir.



– Remove all electrical connectors from bracket -arrows-.
– Unplug brown connector and move wiring to radiator fan 2 - V177- clear.



– Unclip ambient temperature sensor - G17- .
– Unclip cover for radiator fan and lift out upwards -arrows-.
– Remove bolts -1 … 3- and take out radiator fan.



Installing

• Tightening torque ⇒ page 185

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

Note

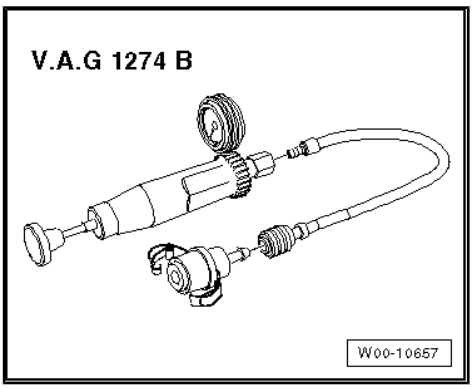
Fit all cable ties in the original positions when installing.

– Install lock carrier with attachments ⇒ Rep. gr. 50 .
– Install front bumper ⇒ Rep. gr. 63 .
– Install noise insulation ⇒ Rep. gr. 50 .

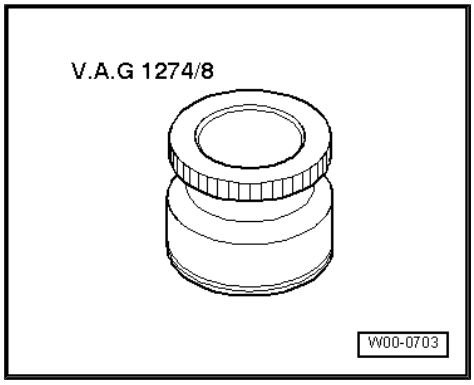
4.8 Checking cooling system for leaks

Special tools and workshop equipment required

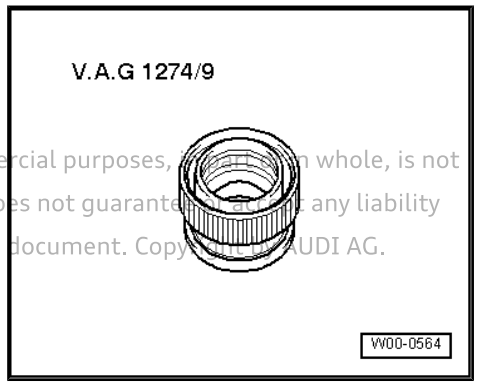
♦ Cooling system tester - V.A.G 1274 B-



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



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



Procedure

- Engine must be warm.

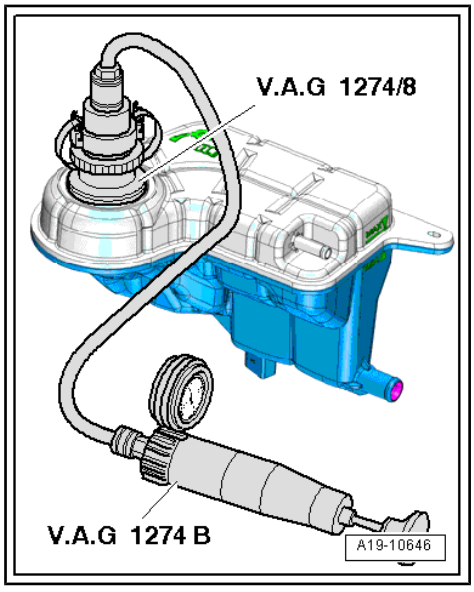
> **WARNING**
>
> *Risk of scalding due to hot steam and hot coolant.*
>
> - *The cooling system is under pressure when the power unit is hot.*
> - *To allow pressure to dissipate, cover filler cap on coolant expansion tank with cloth and open carefully.*

– Open filler cap on coolant expansion tank.

– Fit cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/8- onto coolant expansion tank.

– Using hand pump on cooling system tester, build up a pressure of approx. 1.0 bar.

– If this pressure is not maintained, locate and rectify leaks.



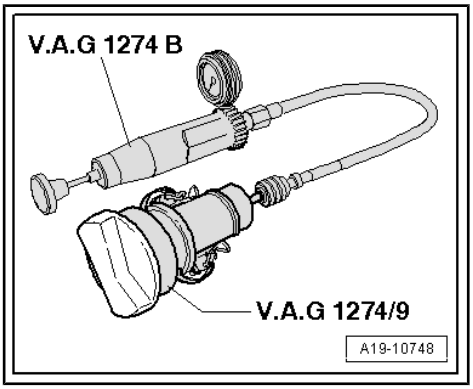
Checking pressure relief valve in filler cap

– Fit cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/9- onto filler cap.

– Build up pressure with hand pump on cooling system tester.

• The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.

– Renew filler cap if pressure relief valve does not open as described.



21 – Turbocharging/supercharging

1 Checking charge air system with turbocharger

Note

- *Observe rules for cleanliness ⇒ page 6 .*
- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*
- *Before carrying out tests or repair work, make sure that all pipes and hoses are securely connected and that there are no leaks.*

1.1 Test requirements for checking turbocharging system

- Coolant temperature at least 85 °C.
- Fault memory of engine control unit interrogated.
- No leaks in the intake and exhaust systems.
- No leaks in vacuum hoses.
- Vacuum pipe to charge pressure regulating valve not obstructed, loose or leaking.
- No faults on engine or injection system (e.g. compression pressure or injectors).

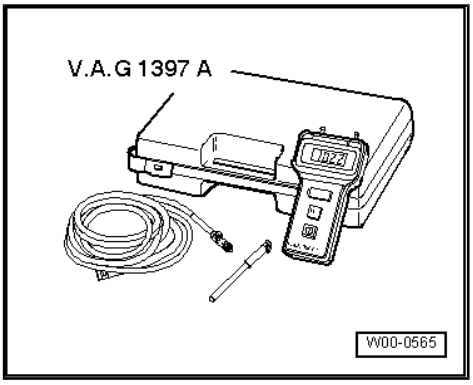
1.2 Connection diagram for charge pressure control and overrun air recirculation control

Connection diagram for charge pressure control and overrun air recirculation control ⇒ page 33 .

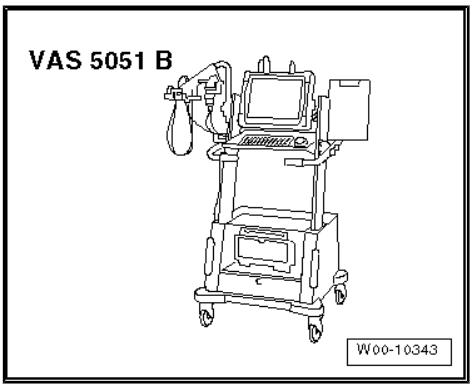
1.3 Checking turbocharger and charge pressure control

Special tools and workshop equipment required

- Turbocharger tester - V.A.G 1397A-

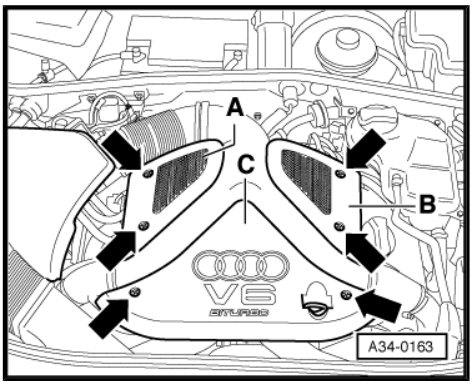


- Vehicle diagnostic, testing and information system - VAS 5051B-



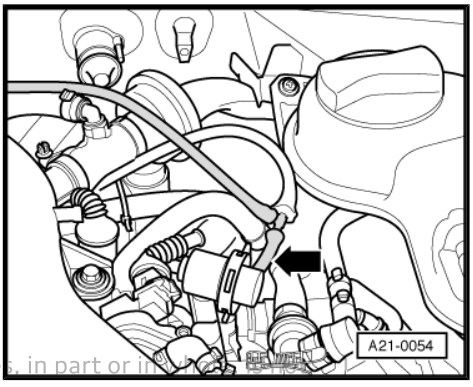
Procedure

– Detach engine cover panel -B- by removing bolts -arrows-.

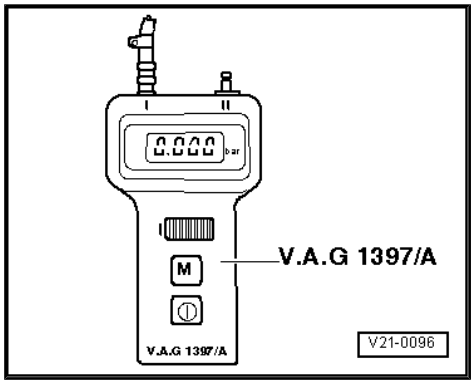


– Connect T-piece with test hose of turbocharger tester - V.A.G 1397A- to fuel pressure regulator -arrow-.

– Route test hose under rear edge of bonnet and through right window into passenger compartment.



– Switch on turbocharger tester - V.A.G 1397A- and set range switch to position -I- (absolute pressure).
– Attach test hose to connection -I-.



Note

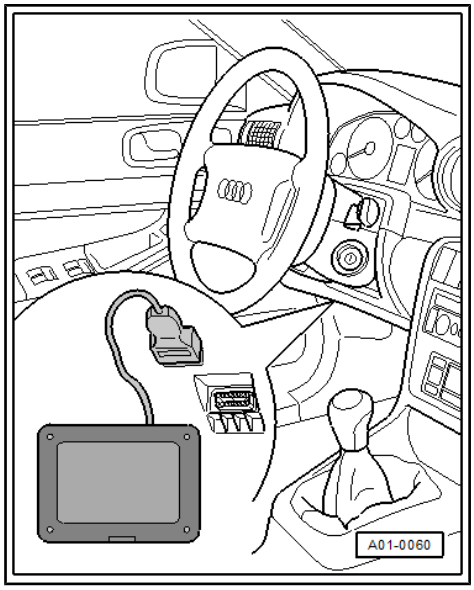
- *Hose connections must be completely airtight, otherwise measurement errors may occur.*
- *Take care not to trap test hose at bonnet and side window.*
- *Pressing memory button -M- on turbocharger tester causes last measured value to be stored until memory button -M- is pressed again or tester is switched 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).*

WARNING

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

- ***Observe safety precautions*** ***⇒ page 5*** ***.***

– Connect vehicle diagnostic, testing and information system - VAS 5051B- .
– Switch on ignition.
– Select `vehicle self-diagnosis` and vehicle system “01 - Engine electronics”.



Display on -VAS 5051B- :

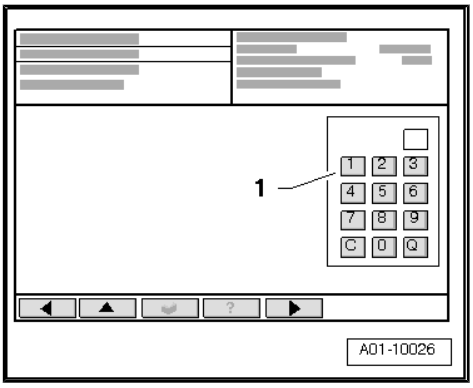
– From menu -1-, select diagnostic function “Measured values” and press ⇨ key to continue.

Display on -VAS 5051B- :

– Press keys 1 1 5 on keypad -1- to select “Display group 115” and confirm entry by pressing Q key.

– Accelerate vehicle in 4th gear from 2000 rpm at full throttle while a second mechanic observes the rev counter.

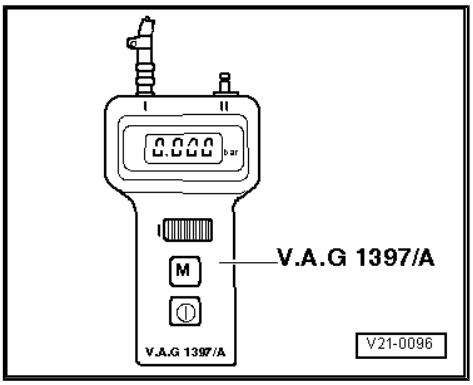
– Have the second mechanic press PRINT key on -VAS 5051B- and memory key -M- on -V.A.G 1397A- simultaneously at approx. 3000 rpm.



Note

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

• Specification on -V.A.G 1397A- : 1.390 ... 1.490 bar



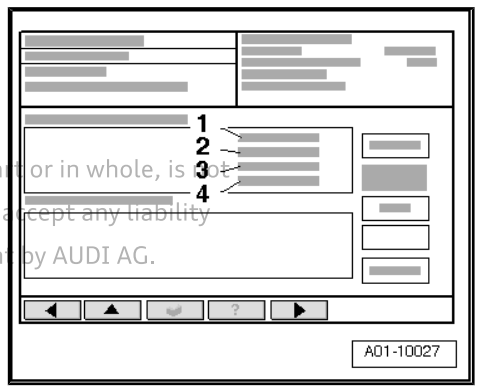
• Specification on -VAS 5051B- in display zone -4-: 1390 ... 1490 mbar

– Exit “Measured values” function by pressing ⇦ key.

If specification is not obtained:

– Check charge pressure control ⇒ page 200 .

– Find fault causes using fault table below.



Fault	Possible causes
Charge pressure below specification	♦ Hose connections to charge pressure control solenoid valve - N75- defective. Connection diagram ⇒ page 33 ♦ Charge pressure control solenoid valve - N75- defective. Checking ⇒ page 203 ♦ Charge pressure regulating valve in turbocharger stuck in open position. Renewing turbocharger: left-side ⇒ page 221 ; right-side ⇒ page 223 . ♦ Leak between turbocharger and intake manifold (air intake hoses and vacuum hoses) ♦ Mechanical air recirculation valve defective. Checking ⇒ page 216 ♦ By-pass air cut-off valve for central idling speed - N8- defective. Checking ⇒ page 212 ♦ Turbocharger defective. Renewing turbocharger: left-side ⇒ page 221 ; right-side ⇒ page 223 .
Charge pressure above specification	♦ Air leaks in hoses or connections to pressure unit for charge pressure control (via -N75-). Connection diagram ⇒ page 33 ♦ Vacuum unit for charge pressure regulating valve defective. Renewing turbocharger: left-side ⇒ page 221 ; right-side ⇒ page 223 . ♦ Charge pressure regulating valve in turbocharger sticking in closed position. Renewing turbocharger: left-side ⇒ page 221 ; right-side ⇒ page 223 .

If specification is obtained:

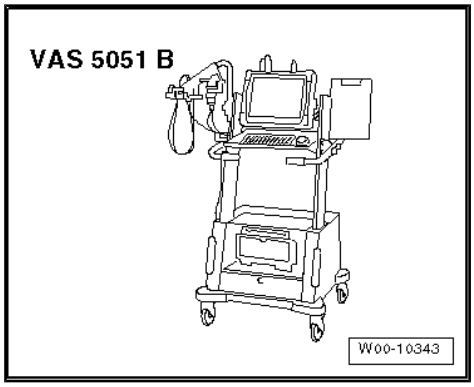
– Select “End output”.

– Switch off ignition and unplug diagnostic connector.

1.4 Checking charge pressure control

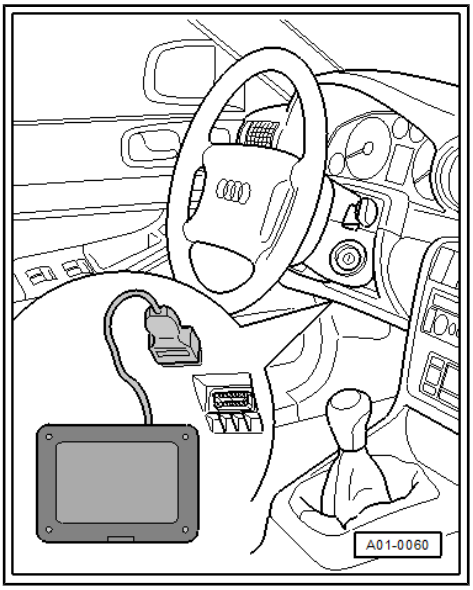
Special tools and workshop equipment required

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



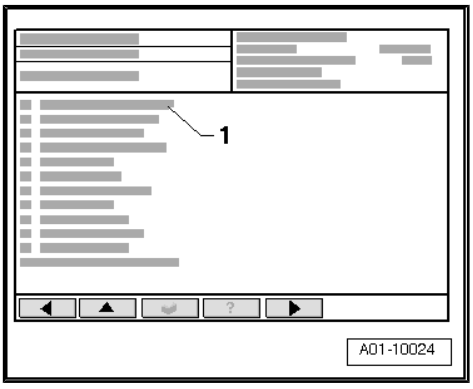
Procedure

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running
- Vehicle self-diagnosis and vehicle system “01 - Engine electronics” selected.



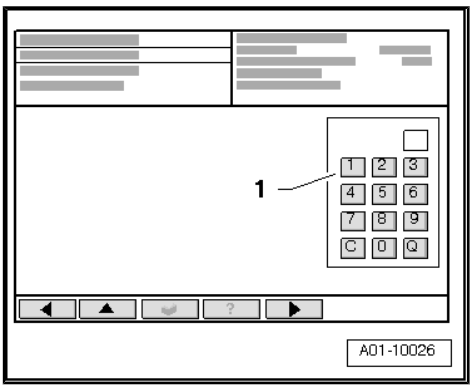
Display on -VAS 5051B- :

– From menu -1-, select diagnostic function “Measured values” and press → key to continue.



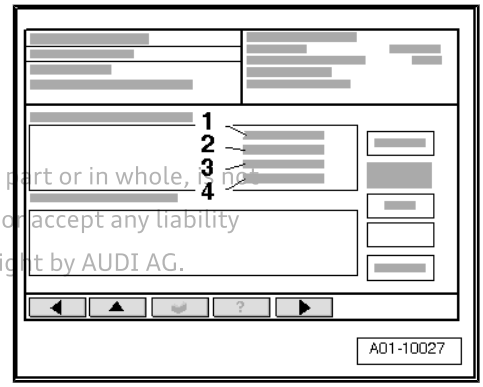
Display on -VAS 5051B- :

– Press keys 1 1 5 on keypad -1- to select “Display group 115” and confirm entry by pressing Q key.



Display on -VAS 5051B- :

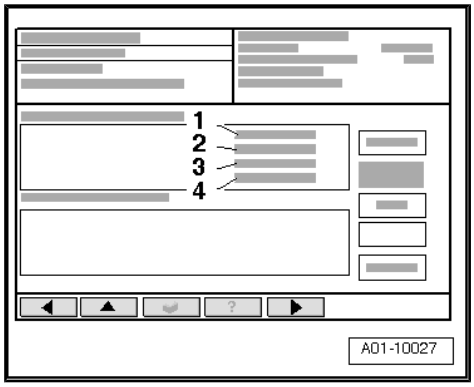
– Perform road test at full throttle and have a second mechanic check display in zones -3- and -4-.



Note

The values in display zone -3- (specified pressure) and in display zone -4- (actual pressure) must not vary more than 20 mbar.

– Switch to “display group 114” by pressing [↓] key.



Display on -VAS 5051B- :

– Continue road test at full throttle and have a second mechanic check “display at full throttle” in zones -1 ... 3-.

• Max. discrepancy ± 5 %

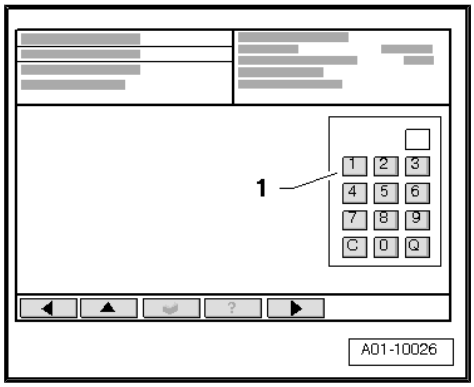
– Press [←] key to terminate diagnostic function “Measured values”.

– Select “End output”.

– Terminate road test and switch off ignition.

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

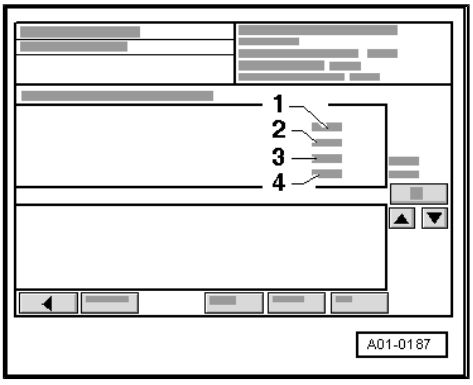
– Repeat diagnostic function “Measured values”.



Display on -VAS 5051B- :

– Press keys [1] [1] [6] on keypad -1- to select “Display group 116” and confirm entry by pressing [Q] key.

Display on -VAS 5051B- :



– Check “fuel pressure control value” in zone -2-.

• Specification: 0 %

Note

If the value displayed exceeds 0 %, the charge pressure was reduced e.g. due to fuel which does not meet specified octane rating. If applicable, fill with fuel of specified rating

– Check “coolant temperature control value” in zone -3-.

• Specification: 0 %

Note

If the value displayed exceeds 0 %, the charge pressure was reduced e.g. due to overheated coolant or if temperature signal transmits wrong value. Check cooling system and temperature signal ⇒ Rep. gr. 24 .

– Check “intake air temperature control value” in zone -4-.

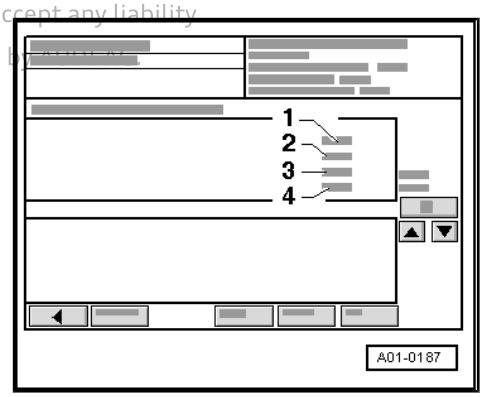
• Specification: 0 %

Note

If the value displayed exceeds 0 %, the charge pressure was reduced e.g. due to overheated intake air or if intake air temperature sender transmits wrong value. Check charge air cooler and intake air temperature sender - G42- ⇒ Rep. gr. 24 .

– Switch to “display group 117” by pressing ↑ key.

Display on -VAS 5051B- :



– Depress accelerator pedal all the way and check display in display zone -2-.

• Specification: 100 %

Note

Check accelerator position sender if the value displayed is less than 100 % ⇒ Rep. gr. 24 .

– Press ← key to terminate function “Measured values”.

If readings do not match specifications in measured value blocks:

– Check charge pressure sender - G31- ⇒ page 208 .

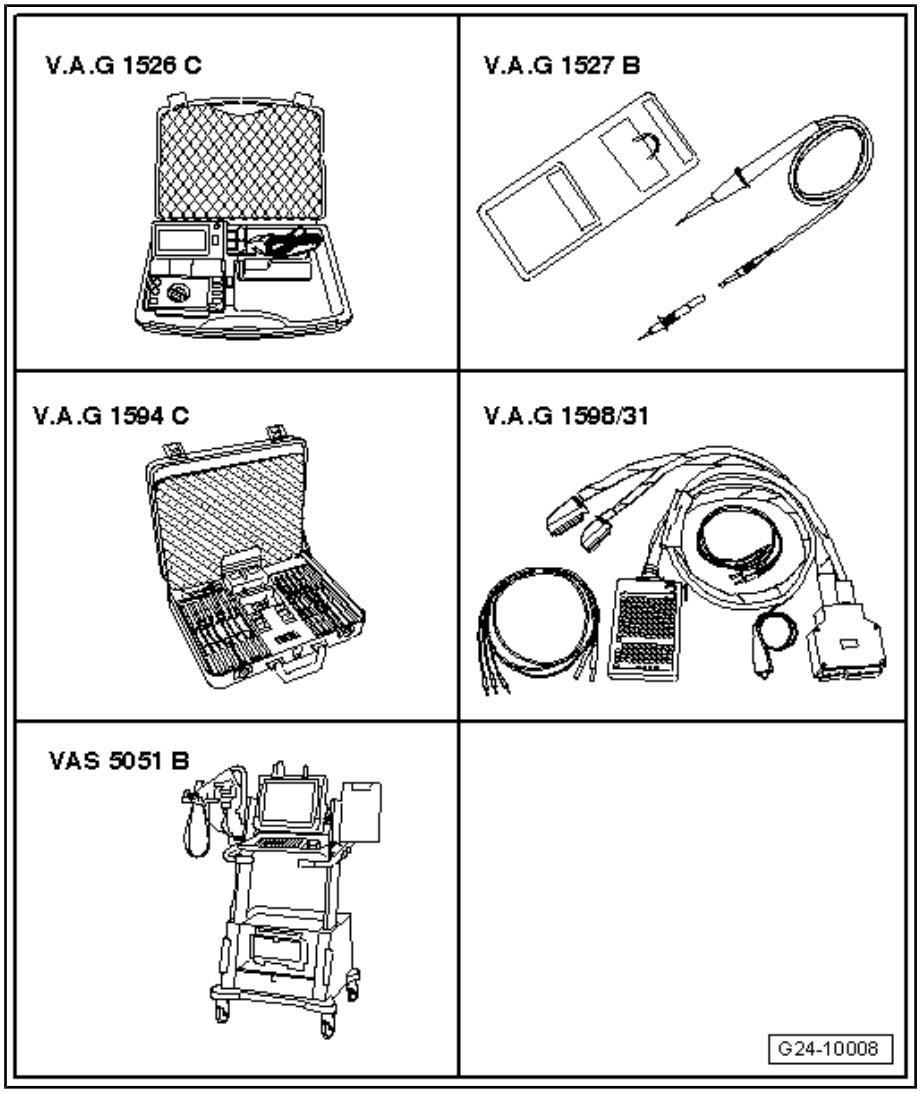
If the specifications are obtained:

– Select “End output”.

– Switch off ignition and unplug diagnostic connector.

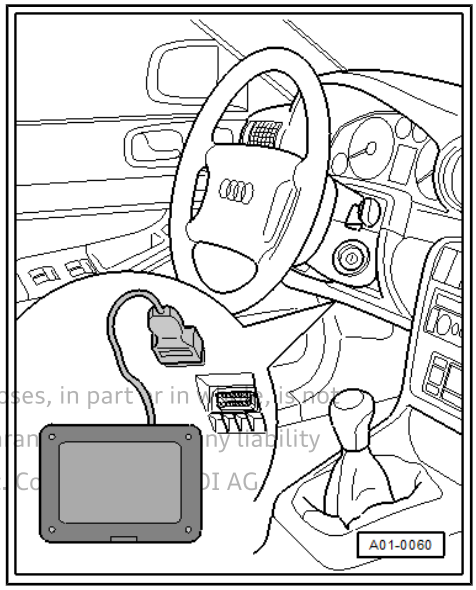
1.5 Checking charge pressure control solenoid valve - N75-

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



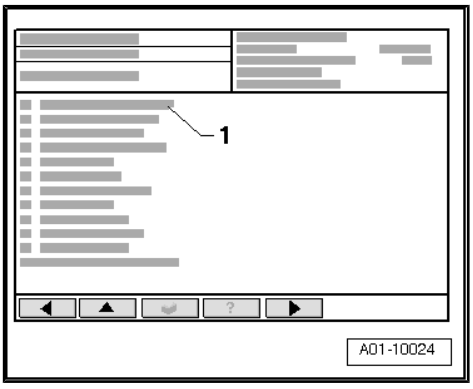
Note

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

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running
- Vehicle self-diagnosis and vehicle system “01 - Engine electronics” selected.

Display on -VAS 5051B- :

– From menu -1-, select diagnostic function “Interrogate fault memory” and press → key to continue.

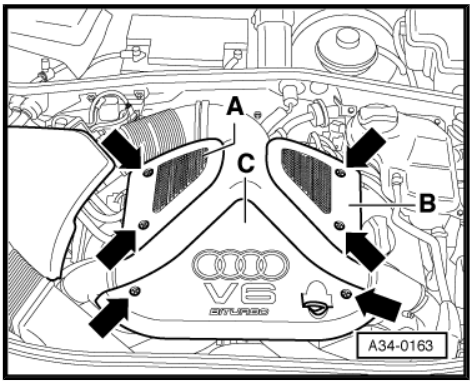


If the display shows a fault relating to charge pressure control solenoid valve - N75- :

– Press ← key to terminate function “Interrogate fault memory”.

– Select “End output”.

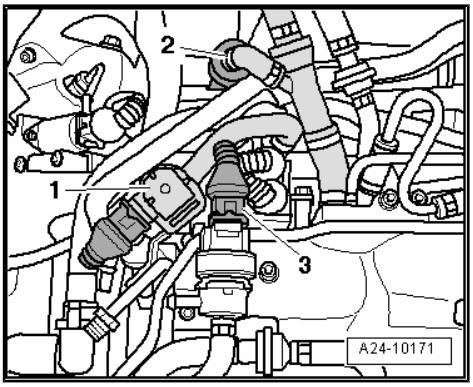
– Detach engine cover panel -A- by removing bolts -arrows-.



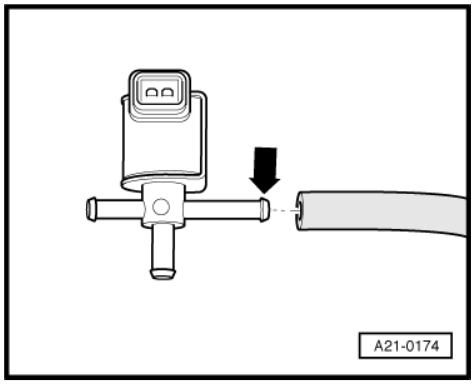
– Disconnect hoses from charge pressure control solenoid valve - N75- -item 1-; leave electrical connector attached.

Note

Disregard items -2 and 3-.



– Connect test hose to long hose connection -arrow- on charge pressure control solenoid valve - N75- .



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

Display on -VAS 5051B- :

– From menu -1-, select diagnostic function “Final control diagnosis” and press → key to continue.

– Press → key repeatedly until the following display appears:

Display on -VAS 5051B- :

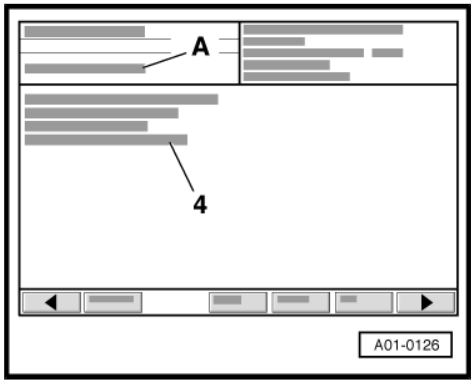
4 - Charge pressure control solenoid valve - N75-

A - Actuator is running; continued switching is allowed

- The valve should click and open and close (check by blowing into the test hose).

– Press ← key to exit diagnostic function “Final control diagnosis”.

– Select function “End output” and switch off ignition.

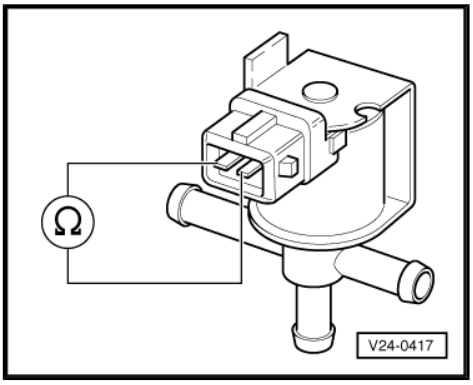


If valve clicks but does not open or close correctly:

– Renew charge pressure control solenoid valve - N75-.

If valve does not click:

Checking internal resistance



– Disconnect electrical connector at charge pressure control solenoid valve - N75- .

– Connect hand-held multimeter - V.A.G 1526C- to measure resistance between contacts of charge pressure control solenoid valve - N75- .

• Specification: 25 … 35 Ω

If specification is not obtained:

– Renew charge pressure control solenoid valve - N75- .

If specification is obtained:

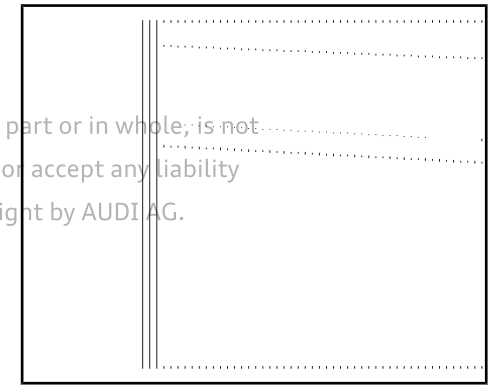
Checking voltage supply

• Fuse for charge pressure control solenoid valve - N75- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

• Fuel pump relay - J17- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

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 engine earth.

– Operate starter briefly.

• The LED should light up.

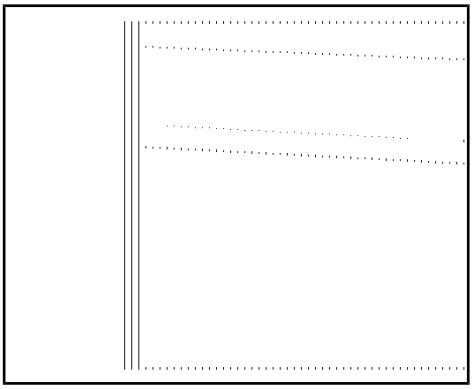
If LED does not light up:

– Refer to current flow diagram to check for open circuit in wiring from contact -1- of connector via fuse to fuel pump relay - J17- .

– Repair wiring connection if necessary.

If the LED lights up:

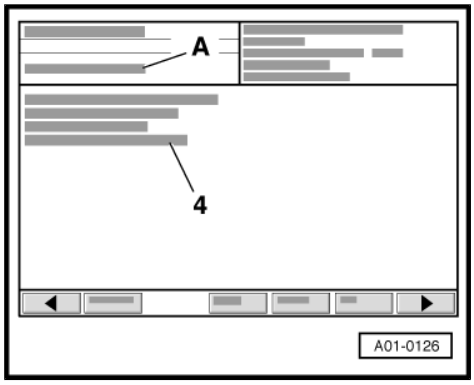
Checking activation



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

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

– Repeat diagnostic function “Final control diagnosis”.
– Press → key repeatedly until the following display appears:



Display on -VAS 5051B- :

4 - Charge pressure control solenoid valve - N75-

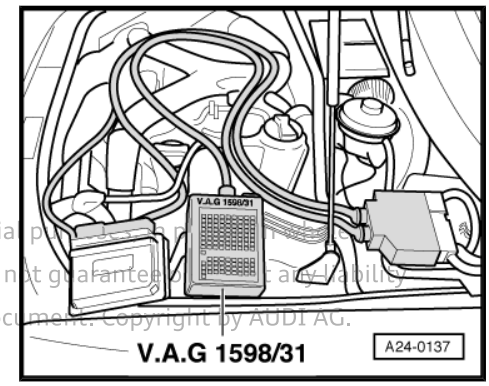
A - Actuator is running; continued switching is allowed

• The LED should flash.

– Press ← key to exit diagnostic function “Final control diagnosis”.
– Select “End output”.
– Switch off ignition and unplug diagnostic connector.

If the LED does not flash or lights up continuously:

– Connect adapter cable - 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 (not shown in illustration).

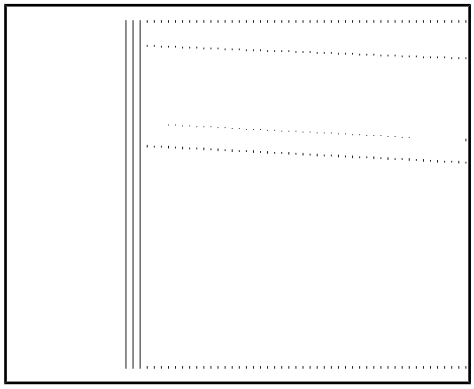


Caution

Risk of irreparable damage to electronic components.

- ***Select the appropriate measuring range before connecting the test leads and observe test requirements.***

– Check for open circuit and short to positive or earth in the following wiring:



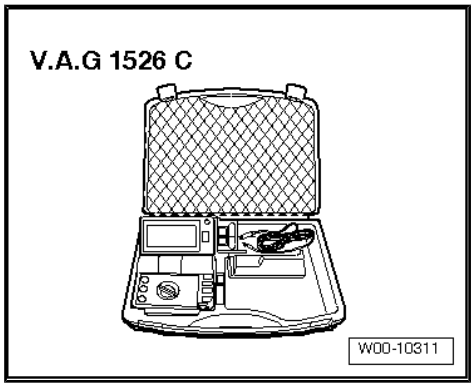
Connector Contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-2-	Engine codes AJK, ARE, AZA 104
	Engine code BES 116

– Repair wiring connection if necessary.

1.6 Checking charge pressure sender - G31-

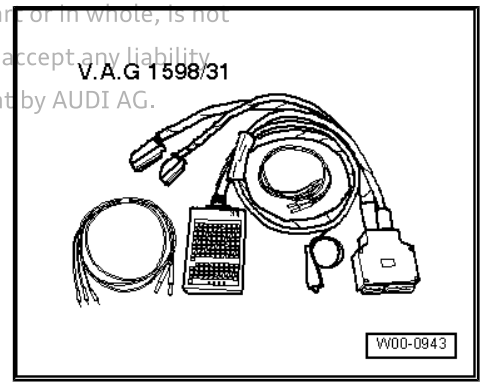
Special tools and workshop equipment required

- Hand-held multimeter - V.A.G 1526C-

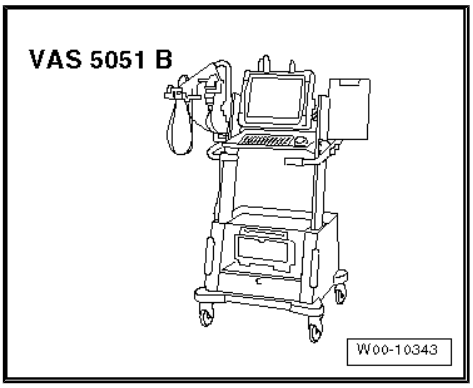


- Auxiliary measuring set - V.A.G 1594C-

- Adapter cable, 121-pin - V.A.G 1598/31- (test box)



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

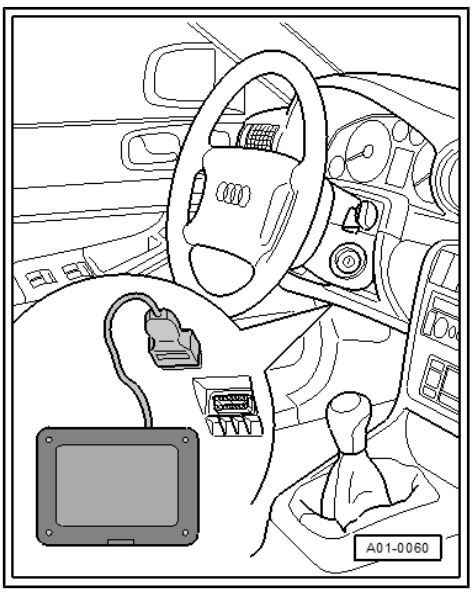


Procedure

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.
- Engine running
- Vehicle self-diagnosis and vehicle system “01 - Engine electronics” selected.



Display on -VAS 5051B- :

– From menu -1-, select diagnostic function “Interrogate fault memory” and press → key to continue.

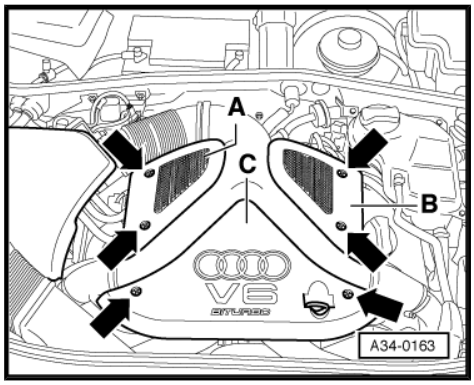
If a fault relating to charge pressure sender - G31- is displayed:

– Press ← key to terminate function “Interrogate fault memory”.

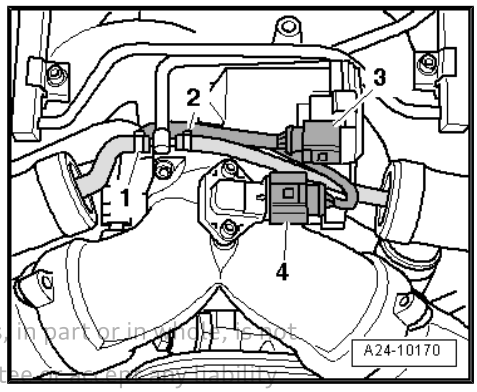
– Select “End output”.

– Switch off ignition and unplug diagnostic connector.

– Detach engine cover panel -C- by removing bolts -arrows-.



– Unplug electrical connector at charge pressure sender - G31- -item 4-.



Note

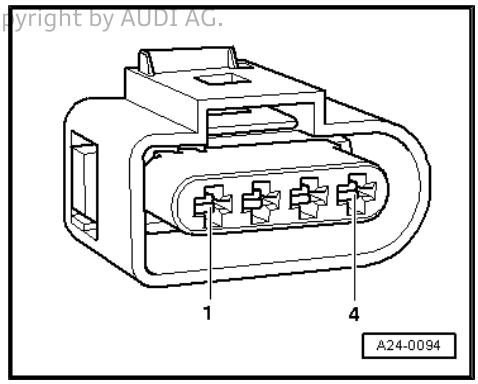
Disregard -items 1 ... 3-.

Checking voltage supply

– Connect hand-held multimeter - V.A.G 1526C- to measure voltage between contacts -1- and -3- of connector for charge pressure sender - G31- .

– Switch on ignition.

• Specification: approx. 5 V



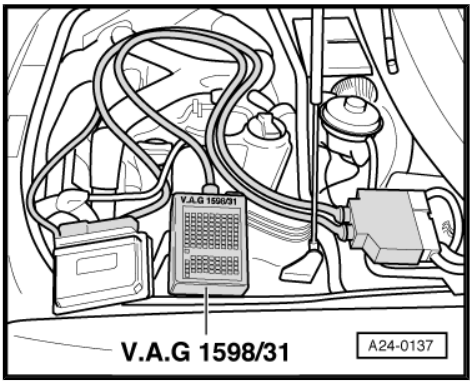
If specification is not obtained:

– Connect adapter cable - 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 (not shown in illustration).

Caution

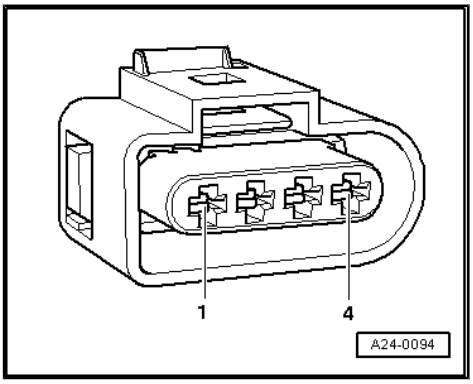
Risk of irreparable damage to electronic components.

- *Select the appropriate measuring range before connecting the test leads and observe test requirements.*



– Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-1-	108
-3-	98



– Repair wiring connection if necessary.

If specification is obtained:

Checking signal wire

– Plug in connector at charge pressure sender - G31- .

– Connect hand-held multimeter - V.A.G 1526C- (voltage measurement range) between sockets “101” and “108” on test box.

– Start engine and run at idling speed.

• Specification: approx. 1.90 V

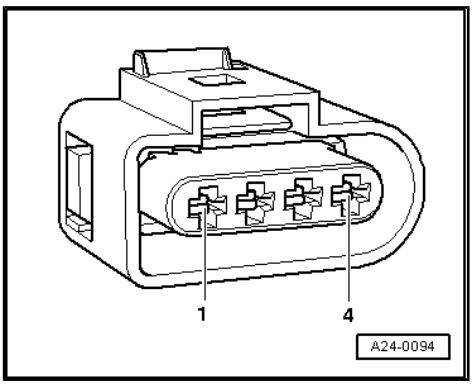
– Increase engine speed by depressing accelerator pedal briefly.

• Specification: 2.00 … 3.00 V

If the specifications are not obtained:

– Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-4-	101



– Repair wiring connection if necessary.

If wiring is OK:

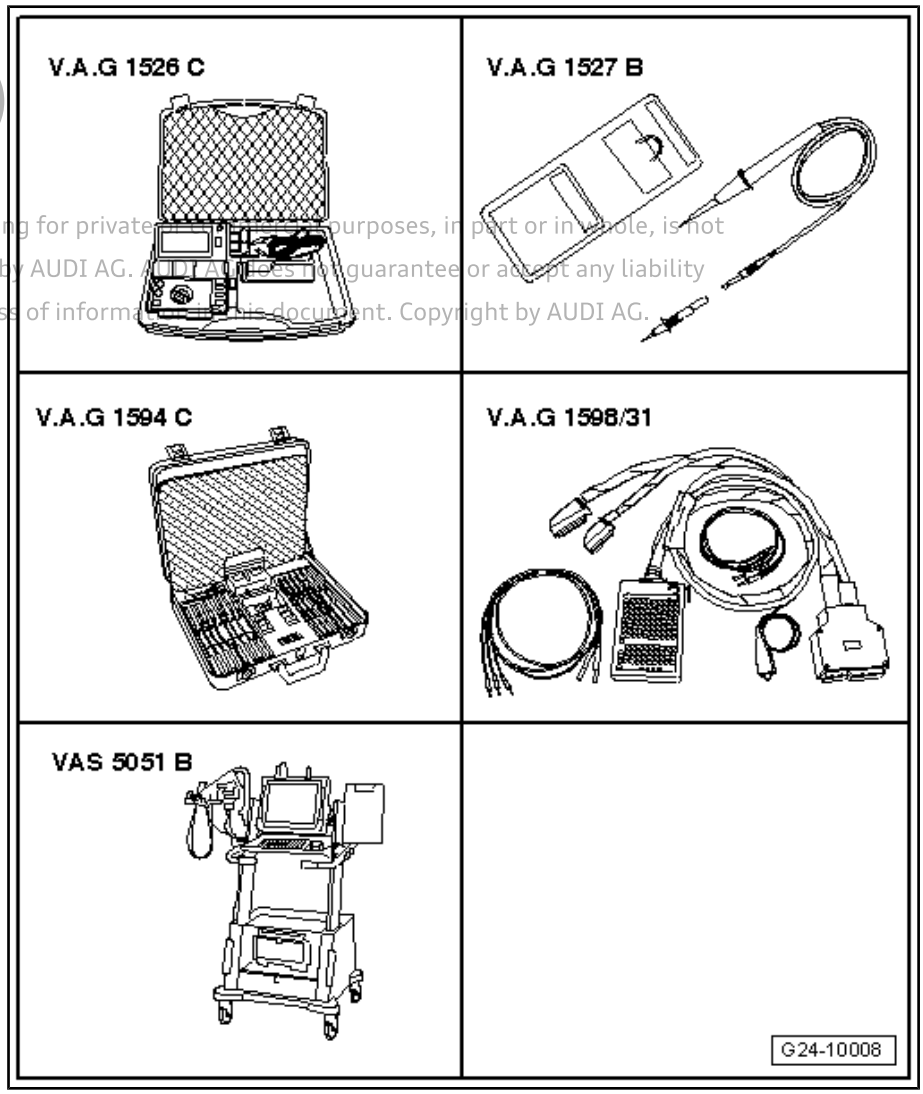
– Renew charge pressure sender - G31- .

1.7 Checking by-pass air cut-off valve for central idling speed - N8-

Note

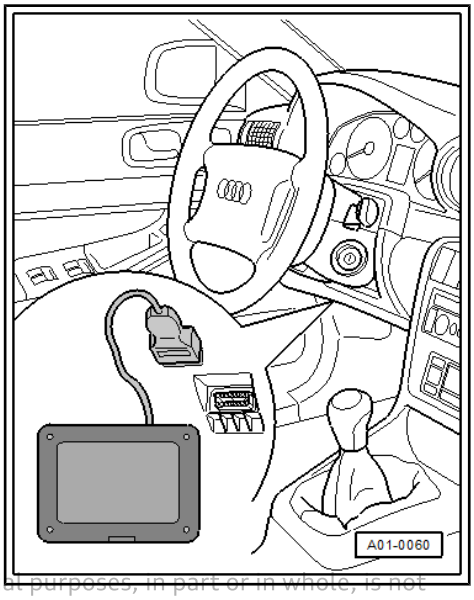
By-pass air cut-off valve for central idling speed - N8- is also referred to as turbocharger air recirculation valve - N249- on vehicles with 6-cylinder biturbo engine.

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



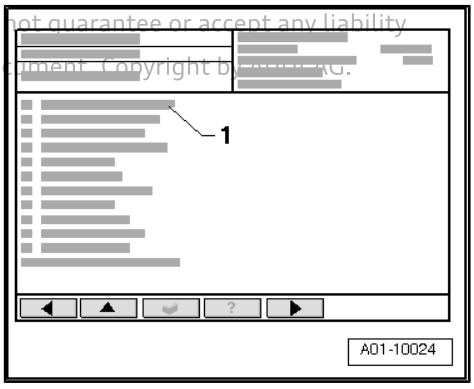
Note

The by-pass air cut-off valve for central idling speed - N8- and the wiring connections are monitored by the engine control unit.

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running
- Vehicle self-diagnosis and vehicle system “01 - Engine electronics” selected.

Display on -VAS 5051B- :

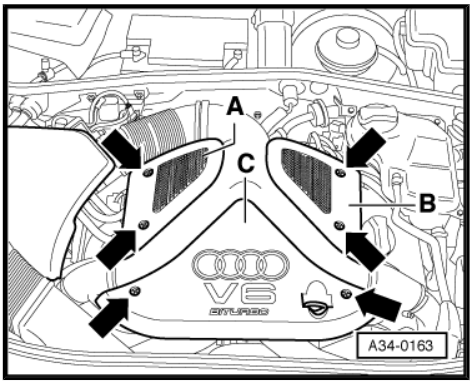
– From menu -1-, select diagnostic function “Interrogate fault memory” and press → key to continue.



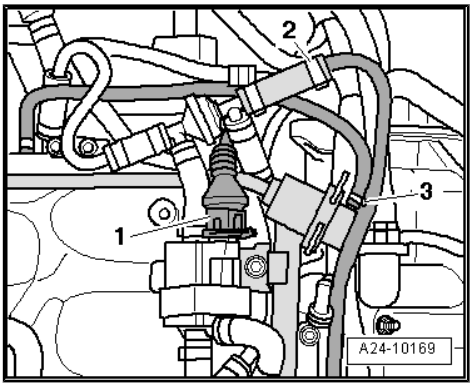
If the display shows a fault relating to by-pass air cut-off valve for central idling speed - N8- :

– Press ← key to terminate function “Interrogate fault memory”.
– Select “End output”.
– Switch off ignition and unplug diagnostic connector.

– Detach engine cover panel -B- by removing bolts -arrows-.



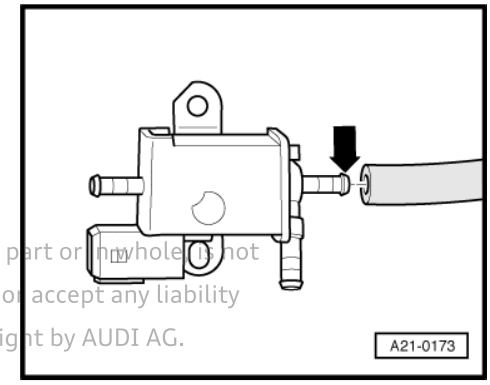
– Disconnect hoses from by-pass air cut-off valve for central idling speed - N8- -item 1-; leave electrical connector attached.



Note

Disregard items -2 and 3-.

– Connect test hose to hose connection marked with an -arrow- on by-pass air cut-off valve for central idling speed - N8- .



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

Display on -VAS 5051B- :

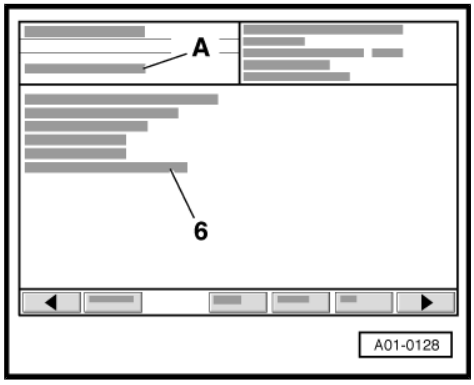
– From menu -1- select diagnostic function “Final control diagnosis”.

– Press → key repeatedly until the following display appears:

Display on -VAS 5051B- :

6 - By-pass air cut-off valve for central idling speed - N8-

A - Actuator is running; continued switching is allowed



- The valve should click and open and close (check by blowing into the test hose).

– Press ← key to exit diagnostic function “Final control diagnosis”.

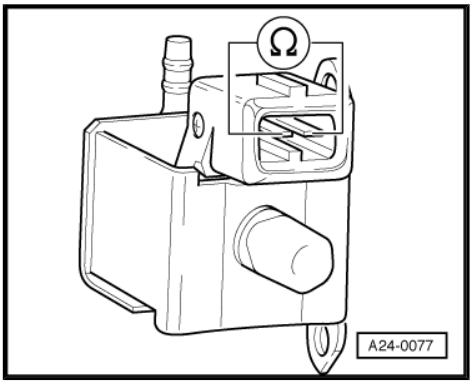
– Select function “End output” and switch off ignition.

If valve clicks but does not open or close correctly:

– Renew by-pass air cut-off valve for central idling speed - N8- .

If valve does not click:

Checking internal resistance



– Unplug electrical connector at by-pass air cut-off valve for central idling speed - N8- .

– Connect hand-held multimeter - V.A.G 1526C- for resistance measurement between contacts on by-pass air cut-off valve for central idling speed - N8- .

• Specification: 27 … 30 Ω

If the specification is not obtained:

– Renew by-pass air cut-off valve for central idling speed - N8- .

If specification is obtained:

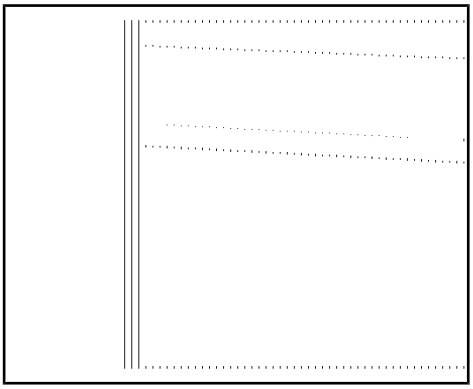
Checking voltage supply

• Fuse for by-pass air cut-off valve for central idling speed - N8- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

• Fuel pump relay - J17- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

Note

By-pass air cut-off valve for central idling speed - N8- is supplied with power via fuel pump relay - J17- .



– Connect voltage tester - V.A.G 1527B- between contact -1- of connector for by-pass air cut-off valve for central idling speed - N8- and engine earth.

– Operate starter briefly.

• The LED should light up.

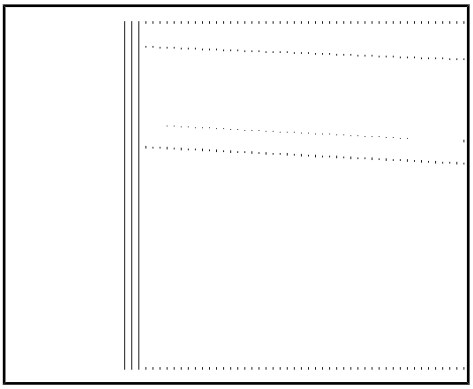
If LED does not light up:

– Refer to current flow diagram to check for open circuit in wiring from contact -1- of connector via fuse to fuel pump relay - J17- .

– Repair wiring connection if necessary.

If the LED lights up:

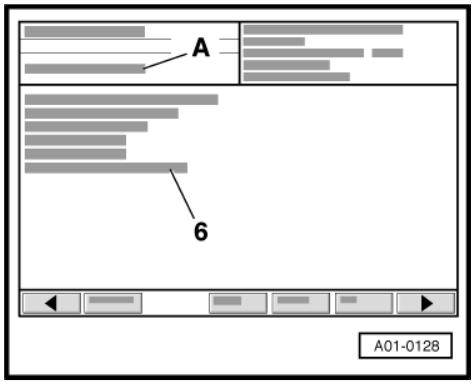
Checking activation



– Connect voltage tester - V.A.G 1527B- between contact -1- and -2- of connector for by-pass air cut-off valve for central idling speed - N8- .

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

– Repeat diagnostic function “Final control diagnosis”.
– Press → key repeatedly until the following display appears:



Display on -VAS 5051B- :

6 - By-pass air cut-off valve for central idling speed - N8-

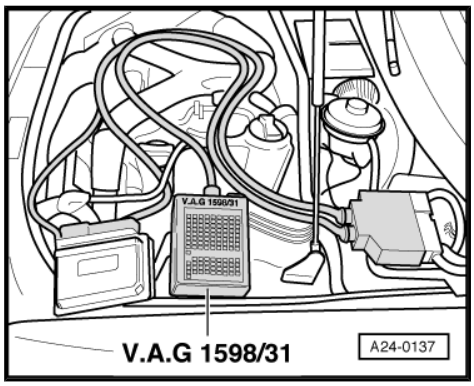
A - Actuator is running; continued switching is allowed

• The LED should flash.

– Press ← key to exit diagnostic function “Final control diagnosis”.
– Select “End output”.
– Switch off ignition and unplug diagnostic connector.

If the LED does not flash or lights up continuously:

– Connect adapter cable - 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 (not shown in illustration).

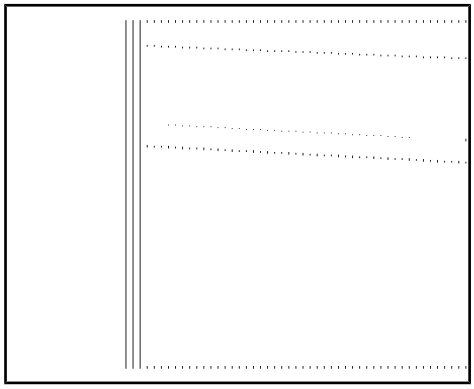


Caution

Risk of irreparable damage to electronic components.

- ***Select the appropriate measuring range before connecting the test leads and observe test requirements.***

– Check for open circuit and short to positive or earth in the following wiring:



Connector Contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-2-	9

– Repair wiring connection if necessary.

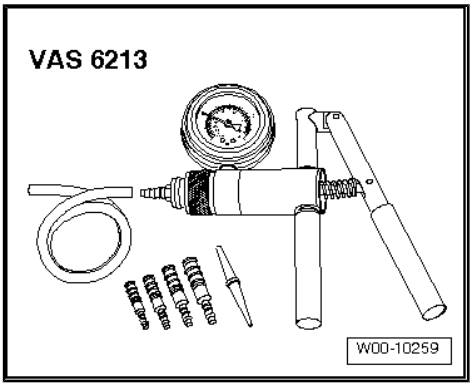
1.8 Checking mechanical air recirculation valves

Note

- *The mechanical air recirculation valves are located upstream of the turbochargers. They are opened by vacuum via the by-pass air cut-off valve for central idling speed - N8- when the engine is on overrun, 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 valves in the event of loss of power or load change jolts.*

Special tools and workshop equipment required

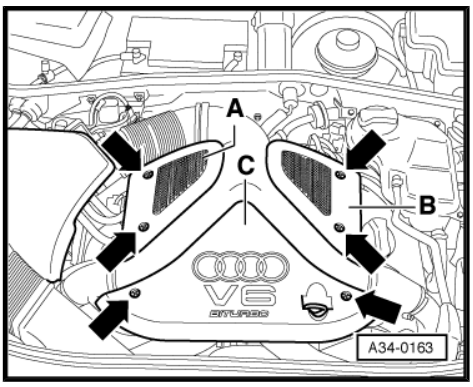
♦ Hand vacuum pump - VAS 6213-



Procedure

– Detach engine cover panel -C- by removing bolts -arrows-.

– Remove mechanical air recirculation valves ⇒ Item 4 (page 35) .



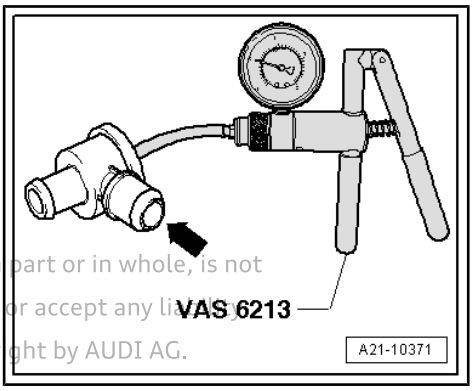
– Connect hand vacuum pump - V.A.G 1390- to air recirculation valve.

– Operate hand vacuum pump.

• Air recirculation valve should open -arrow-

– Operate vent valve on hand vacuum pump after approx. 30 seconds.

• Air recirculation valve should close -arrow-.



If air recirculation valve does not open/close or if valve plate does not provide a tight closure when air recirculation valve is closed:

– Renew air recirculation valve.

Note

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

2 Turbocharger

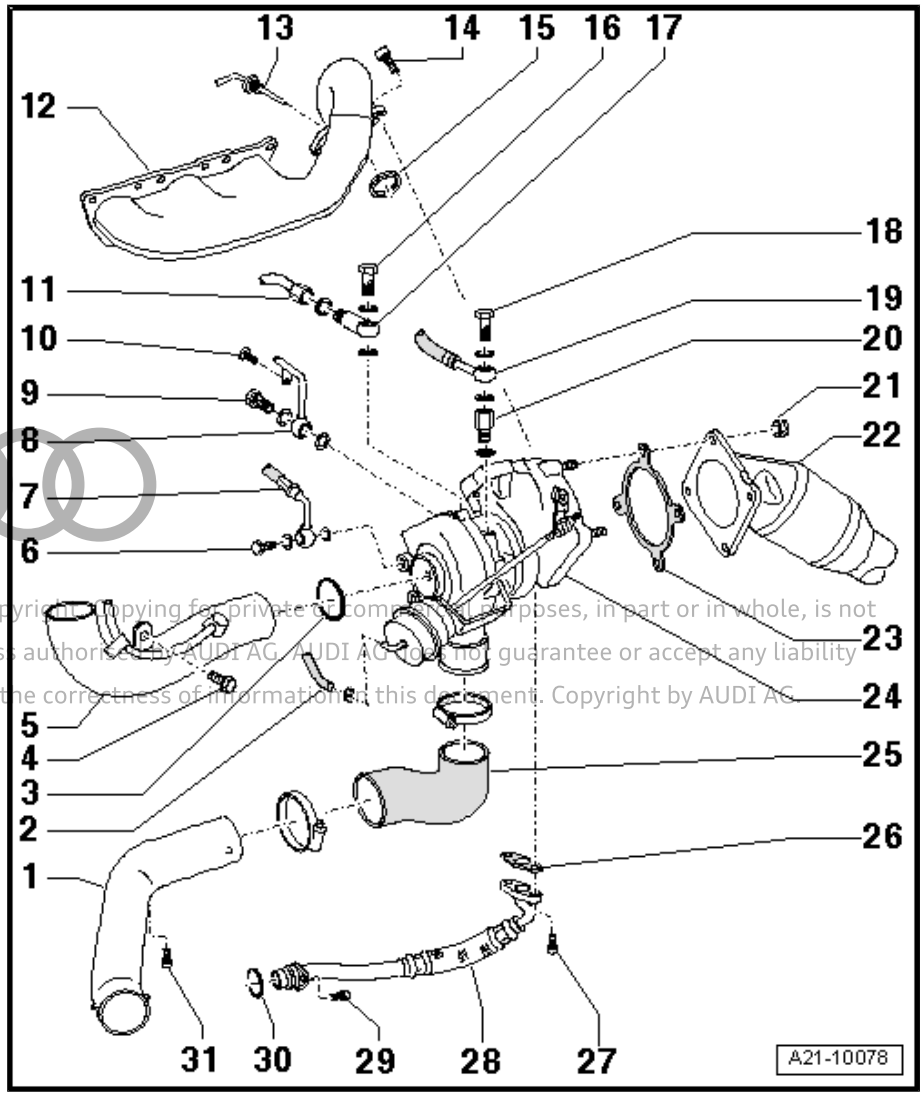
Note

- *Observe rules for cleanliness ⇒ page 6 .*
- *Check that all air pipes and hoses and vacuum lines are correctly fitted and that there are no leaks before carrying out tests or repairs.*

2.1 Exploded view - turbocharger

Note

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



1 - Air pipe
- ❑ To charge air cooler

2 - Control pipe
- ❑ From charge pressure control solenoid valve - N75-

3 - O-ring
- ❑ Renew

4 - Bolt
- ❑ 22 Nm

5 - Air pipe
- ❑ To air mass meter - G70-

6 - Banjo bolt M8
- ❑ 9 Nm

7 - Pressure line
- ❑ Control pressure supply line
- ❑ To charge pressure control solenoid valve - N75-

8 - Coolant pipe

9 - Banjo bolt M14
- ❑ 35 Nm

10 - Bolt
- ❑ 10 Nm

11 - Oil supply line
- ❑ From cylinder block
- ❑ Tighten union nut to 30 Nm

12 - Exhaust manifold
- ❑ Removing and installing: left-side ⇒ page 251 ; right-side ⇒ page 251

13 - Exhaust gas temperature sender

- ❑ Exhaust gas temperature sender 1 for bank 2 - G236- (left-side), exhaust gas temperature sender 1 - G235- (right-side)
- ❑ Removing and installing: left-side ⇒ page 265 , right-side ⇒ page 262

14 - Bolt

- ❑ Renew
- ❑ Coat threads and contact surface of bolt head with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ❑ 60 Nm

15 - Seal

- ❑ Renew

16 - Banjo bolt

- ❑ 30 Nm

17 - Connection piece

18 - Banjo bolt

- ❑ 35 Nm

19 - Coolant pipe

20 - Threaded connection

- ❑ 35 Nm

21 - Nut

- ❑ Tightening torque ⇒ page 232

22 - Front exhaust pipe

- ❑ Removing and installing: left-side ⇒ page 239 ; right-side ⇒ page 245

23 - Gasket

- ❑ Renew

24 - Turbocharger

- ❑ Removing and installing: left-side ⇒ page 221 ; right-side ⇒ page 223

25 - Air hose

- ❑ Must be free of oil and grease when installing

26 - Gasket

- ❑ Renew

27 - Bolt

- ❑ 10 Nm

28 - Oil return line

- ❑ To sump (top section)

29 - Bolt

- ❑ 10 Nm

30 - O-ring

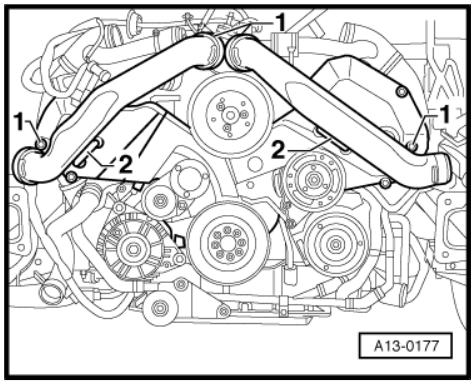
- ❑ Renew

31 - Bolt

- ❑ 10 Nm

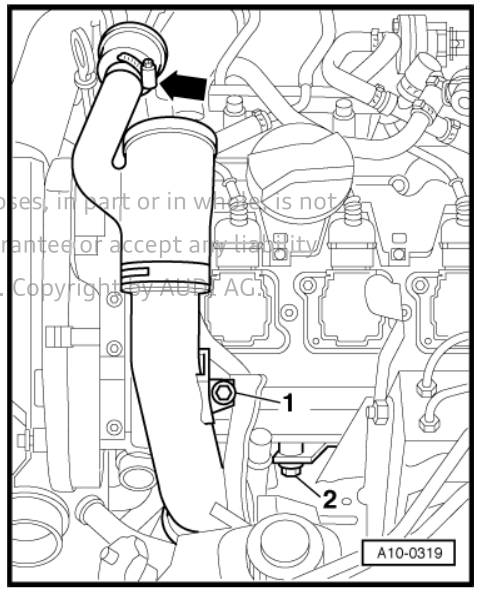
Air pipes (front) - tightening torque

– Tighten bolts -1- to 9 Nm.



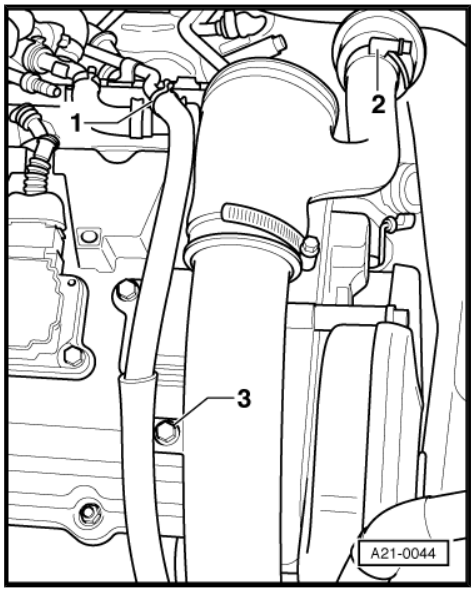
Air pipe (left-side) - tightening torque

– Tighten bolt -1- to 9 Nm.



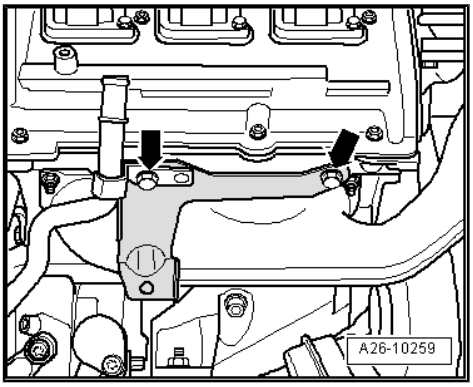
Air pipe (right-side) - tightening torque

– Tighten bolt -3- to 9 Nm.



Bracket for air pipe - tightening torque

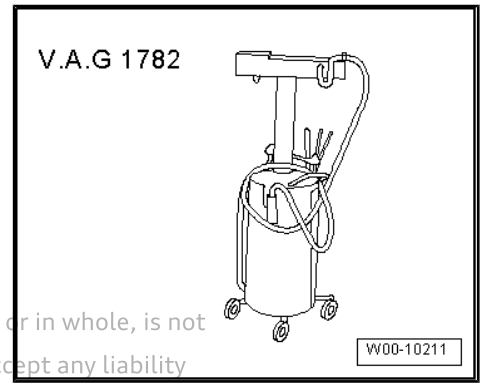
– Tighten bolts -arrows- to 22 Nm.



2.2 Removing and installing turbocharger (left-side)

Special tools and workshop equipment required

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



Removing

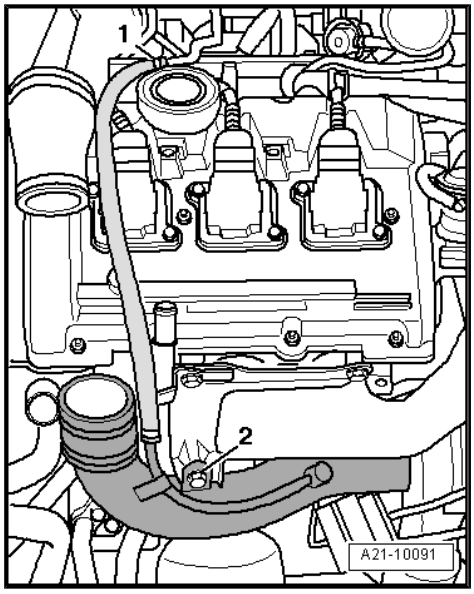
Caution

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

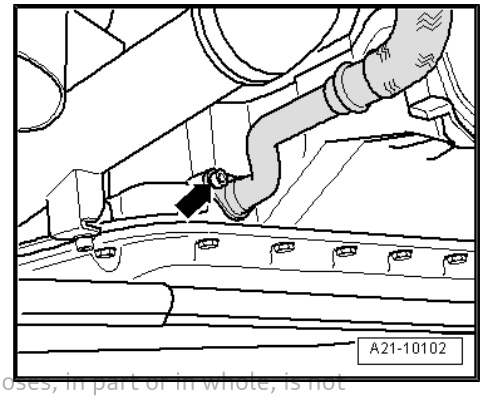
- *Check air cleaner housing, air filter element and air hoses for dirt and foreign particles.*
- *Check the entire charge air system (including the charge air cooler) for foreign matter.*
- *If foreign matter is found in the charge air system, clean all relevant ducts and hoses and renew charge air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

- Engine removed and secured to engine and gearbox support - VAS 6095- ⇒ page 28 .
- Engine oil drained ⇒ Maintenance ; Booklet 402

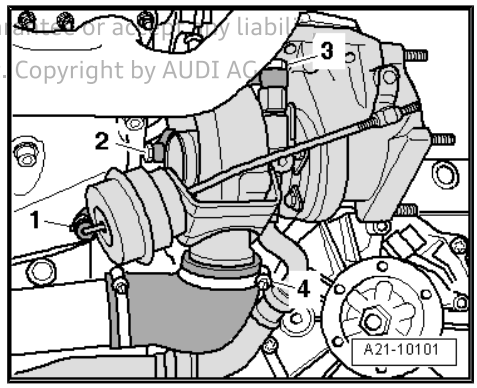
– Detach vacuum hose -1-.
– Unscrew bolt -2- and detach air pipe (left-side) from turbocharger towards the front.



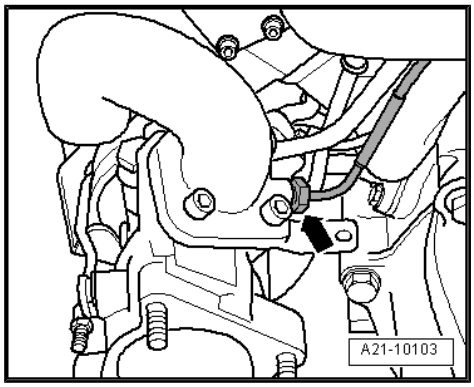
– Position used oil collection and extraction unit - V.A.G 1782- below connection point.
– Unscrew bolt -arrow- and detach oil return line from top section of sump.



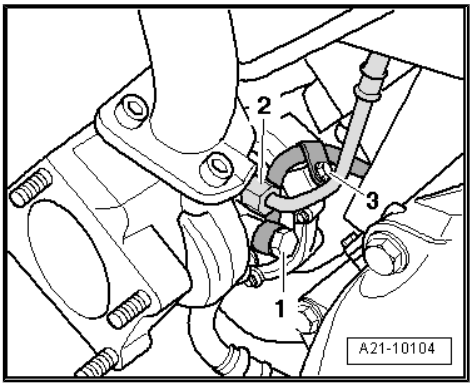
– Detach vacuum hose -1-.
– Unscrew banjo bolt -2- for pressure pipe.
– Unscrew banjo bolt -3- for coolant pipe.
– Slacken hose clip -4-.



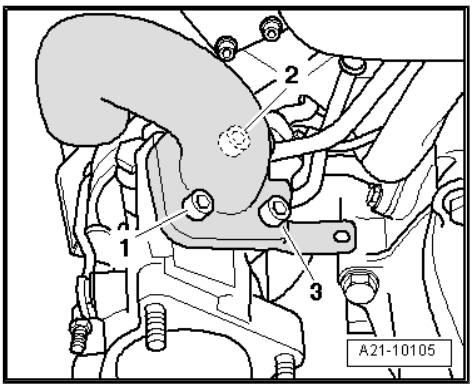
– Unscrew exhaust gas temperature sender 1 for bank 2 - G236- -arrow- from exhaust manifold flange.



– Unscrew oil supply line -2- from turbocharger.
– Unscrew banjo bolt -1- for coolant pipe.
– Unscrew retaining tab -3- for coolant pipe.



– Remove bolts -1 … 3- and take out turbocharger.



Installing

• Tightening torques ⇒ page 218

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

Note

- *Renew self-locking nuts as well as seals, gaskets and O-rings.*
- *Fill turbocharger with engine oil at connection for oil supply line.*
- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*
- *Fit all cable ties in the original positions when installing.*
- *Fit all heat insulation sleeves in the original position when installing.*

– Install exhaust gas temperature sender 1 for bank 2 - G236- ⇒ page 265 .

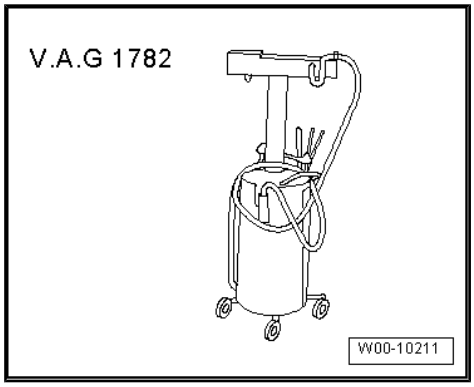
Note

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.

2.3 Removing and installing turbocharger (right-side)

Special tools and workshop equipment required

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



Removing

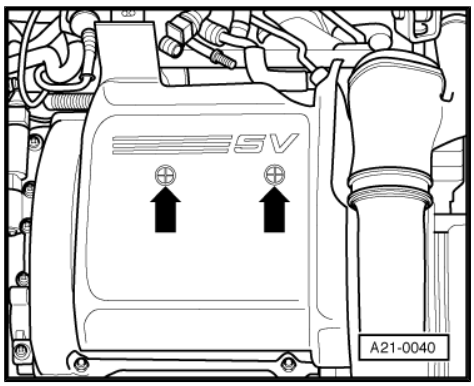
Caution

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

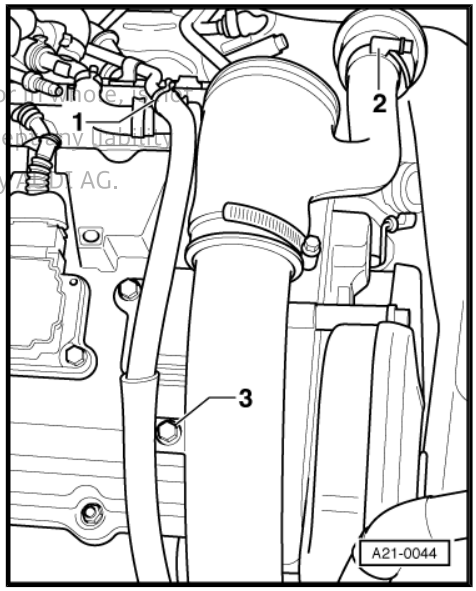
- ***Check air cleaner housing, air filter element and air hoses for dirt and foreign particles.***
- ***Check the entire charge air system (including the charge air cooler) for foreign matter.***
- ***If foreign matter is found in the charge air system, clean all relevant ducts and hoses and renew charge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

- Engine removed and secured to engine and gearbox support - VAS 6095- ⇒ page 28 .
- Engine oil drained ⇒ Maintenance ; Booklet 402

– Open quick-release fasteners -arrows- and detach cover for cylinder head cover (right-side).



– Remove bolt -3- , detach hoses -1- and -2- and remove air pipe.



Caution

Risk of irreparable damage to engine.

- ***Block off the opening of the air pipe (bottom) with a clean cloth to prevent small items from dropping into the engine through the air pipe (bottom).***

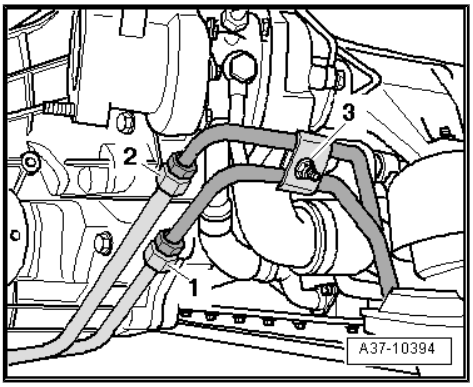
Note

- *Observe rules for cleanliness when working on gear oil pipes/ ATF lines ⇒ Rep. gr. 00 .*
- *Lay a cloth under the connection point to catch escaping gear oil.*

– Loosen union nuts -1- and -2-.

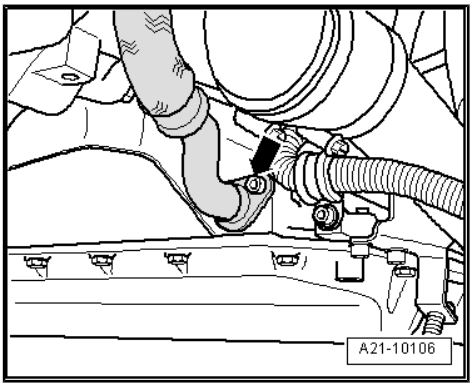
– Remove bracket for gear oil pipes/ATF lines (unscrew nut -3-).

– Detach gear oil pipes/ATF lines.



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

– Unscrew bolt -arrow- and detach oil return line from top section of sump.



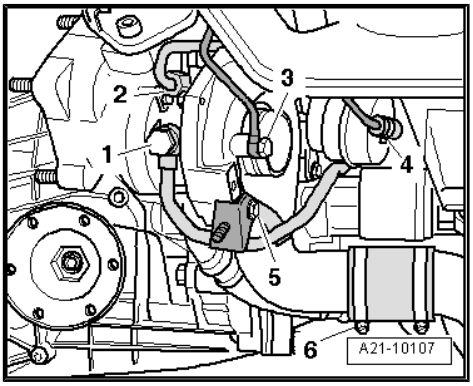
– Detach vacuum hose -4-.

– Unscrew banjo bolt -3- for pressure pipe.

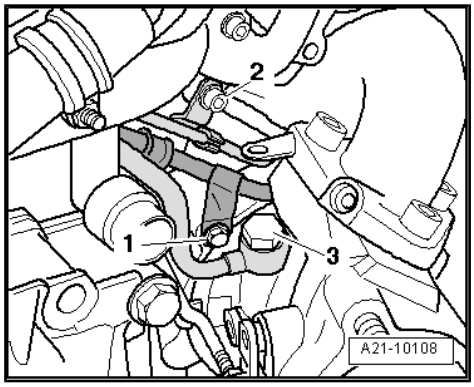
– Unscrew banjo bolt -2- for oil supply line.

– Unscrew banjo bolt -1- for coolant pipe.

– Unscrew retaining tab -5- for coolant pipe.



– Unscrew retaining tab -2- for pressure pipe.
– Unscrew banjo bolt -3- for coolant pipe.
– Unscrew retaining tab -1- for oil supply line.

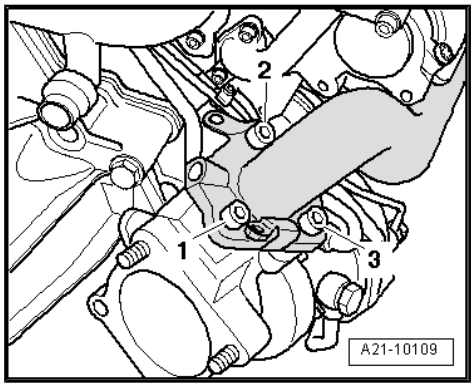


– Remove bolts -1 … 3- and take out turbocharger.

Installing

• Tightening torques ⇒ page 218

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



Note

- *Renew gaskets, seals and O-rings.*
- *Fill turbocharger with engine oil at connection for oil supply line.*
- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*
- *Fit all heat insulation sleeves in the original position when installing.*
- *Fit all cable ties in the original positions when installing.*

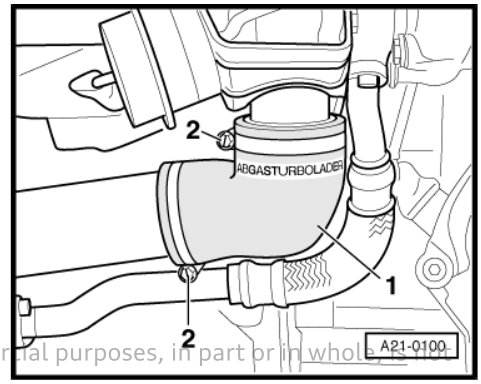
– Install gear oil pipes ⇒ Rep. gr. 34 /ATF lines ⇒ Rep. gr. 37 .
– Install air pipe ⇒ page 220 .

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.

2.4 Installing air hoses

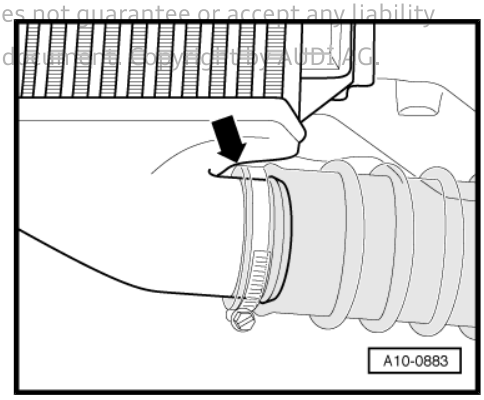
Installing air hoses for turbocharger



– Attach air hoses -1- as far as stop.

- The word “Abgasturbocharger” must be visible as shown in illustration.
- Hose clips -2- must be fitted as shown in illustration.
- Fastening screws of hose clips must be positioned at X marking on air hose.

Installing air hoses for charge air cooling



– Attach air hoses as far as stop -arrow-.

- Hose clips must be positioned directly behind bulged end of charge air cooler or air pipe when tightening.
- Fastening screws of hose clips must be positioned at X marking on air hose.
- Tightening torques:

Component	Nm
Hose clips (9 mm wide)	3
Hose clips (13 mm wide)	5.5

3 Charge air cooling

Note

- *Observe rules for cleanliness ⇒ page 6 .*
- *Check that all air pipes and hoses are fitted securely and that there are no leaks after carrying out repairs.*

3.1 Air duct

1 - Air cleaner

2 - Air mass meter - G70-

3 - Intake side of turbocharger (right-side)

4 - Turbocharger (right-side)

5 - Pressure side of turbocharger (right-side)

6 - Air duct

7 - Intake side of turbocharger (left-side)

8 - Turbocharger (left-side)

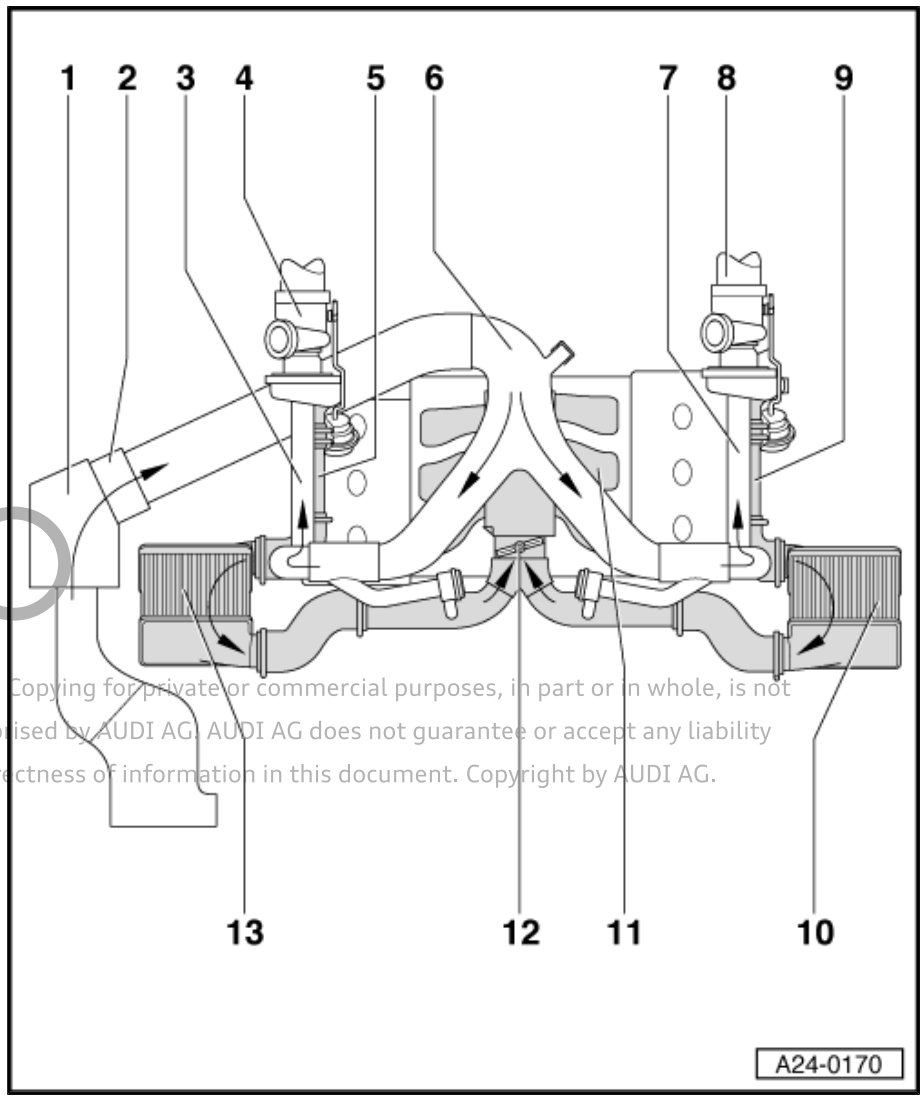
9 - Pressure side of turbocharger (left-side)

10 - Charge air cooler (left-side)

11 - Intake manifold

12 - Throttle valve module - J338-

13 - Charge air cooler (right-side)



3.2 Exploded view - charge air cooler

Note

Illustration shows left-side charge air cooler.

1 - Front air duct

2 - Rubber grommet

3 - Air hose

- ❑ Between turbocharger and charge air cooler
- ❑ Must be free of oil and grease when installing

4 - Air hose

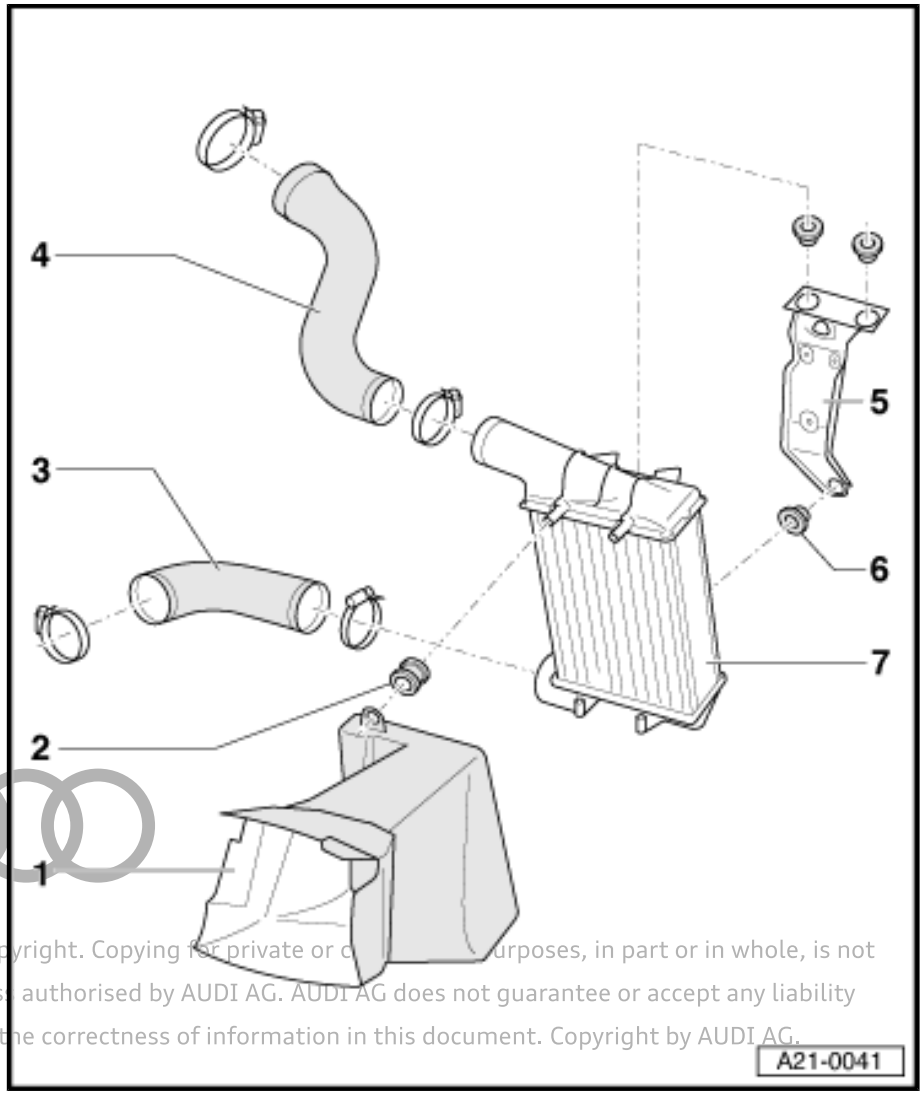
- ❑ Between charge air cooler and throttle valve module - J338-
- ❑ Must be free of oil and grease when installing

5 - Bracket

6 - Rubber grommet

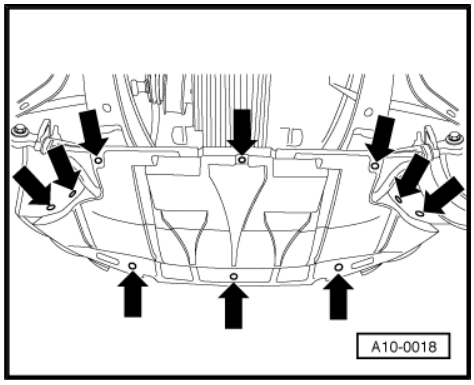
7 - Charge air cooler

- ❑ Removing and installing ⇒ page 230



3.3 Removing and installing charge air cooler

Removing



Note

- *The following description shows the removal and installation of the left-side charge air cooler. The procedure is the same on both sides.*
- *If there are slight impressions on the fins, refer to ⇒ page 6 .*

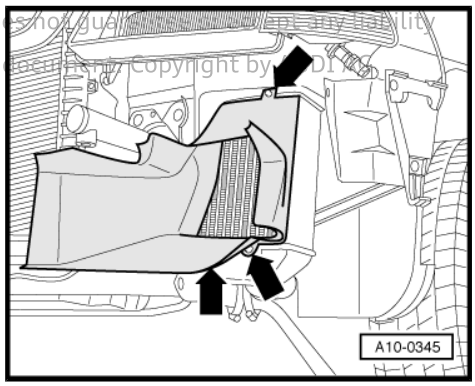
– Release fasteners -arrows- and remove noise insulation.

– Remove front bumper ⇒ Rep. gr. 63 .

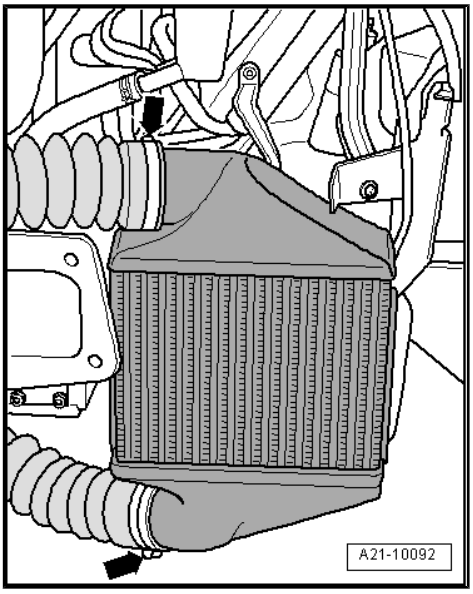
– Remove headlight (left-side) ⇒ Rep. gr. 94 .

– Move electrical wiring harness on air cowl clear to one side.

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



– Loosen hose clips -arrows- and remove air hoses.
– Grasp bottom edge of charge air cooler, pull it forwards and disengage upwards.



Note

For illustration purposes, the installation position is shown with the lock carrier removed.

Installing

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

Note

- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*

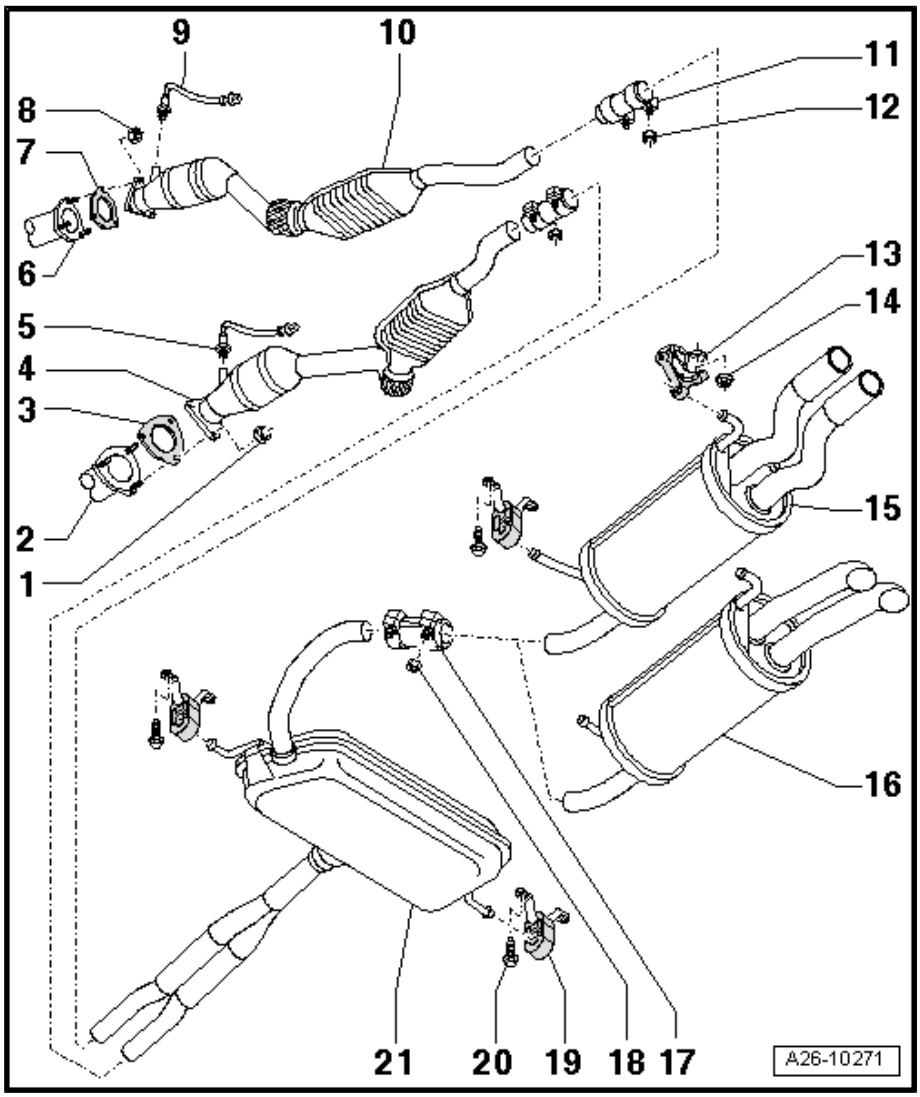
– Install air hoses ⇒ page 227 .
– Install headlight ⇒ Rep. gr. 94 .
– Install front bumper ⇒ Rep. gr. 63 .
– Install noise insulation ⇒ Rep. gr. 50 .

26 – Exhaust system

1 Silencers

1.1 Exploded view - silencers

Vehicles with front-wheel drive



1 - Nut

- ❑ Renew
- ❑ 27 Nm

2 - Turbocharger

- ❑ For cylinder bank 1 (right-side)

3 - Gasket

- ❑ Renew

4 - Front exhaust pipe with starter catalytic converter and main catalytic converter

- ❑ For cylinder bank 1 (right-side)
- ❑ With flexible joint; do not bend flexible joint more than 10° – otherwise it can be damaged
- ❑ Protect against knocks and impact
- ❑ Removing and installing ⇒ page 245
- ❑ Different versions available ⇒ Electronic parts catalogue
- ❑ Align exhaust system so it is free of stress ⇒ page 253
- ❑ Components of exhaust pipe mountings: Vehicles with manual gearbox ⇒ page 237 , vehicles with automatic gearbox ⇒ page 237

5 - Lambda probe - G39-

- ❑ For cylinder bank 1 (right-side)
- ❑ Removing and installing ⇒ Rep. gr. 24

6 - Turbocharger

- ❑ For cylinder bank 2 (left-side)

7 - Gasket

- ❑ Renew

8 - Nut

- ❑ Renew
- ❑ 27 Nm

9 - Lambda probe 2 - G108-

- For cylinder bank 2 (left-side)
- Removing and installing ⇒ Rep. gr. 24

10 - Front exhaust pipe with starter catalytic converter and main catalytic converter

- For cylinder bank 2 (left-side)
- With flexible joint; do not bend flexible joint more than 10° – otherwise it can be damaged
- Protect against knocks and impact
- Removing and installing ⇒ page 239
- Different versions available ⇒ Electronic parts catalogue
- Align exhaust system so it is free of stress ⇒ page 253
- Components of exhaust pipe mountings: Vehicles with manual gearbox ⇒ page 236 , vehicles with automatic gearbox ⇒ page 237

11 - Clamp (front)

- Before tightening, align exhaust system so it is free of stress ⇒ page 253
- Installation position ⇒ page 236
- Tighten bolted connections evenly

12 - Nut

- 40 Nm

13 - Mounting

- Renew if damaged

14 - Nut

- 25 Nm

15 - Rear silencer

- On vehicles with visible tailpipes
- Combined in one unit with centre silencer as original equipment. Can be renewed separately for repair purposes
- Cutting point ⇒ page 252
- Align exhaust system so it is free of stress ⇒ page 253

16 - Rear silencer

- On vehicles with concealed tailpipes
- Combined in one unit with centre silencer as original equipment. Can be renewed separately for repair purposes
- Cutting point ⇒ page 252
- Align exhaust system so it is free of stress ⇒ page 253

17 - Clamp (rear)

- For separate replacement of centre and rear silencers
- Before tightening, align exhaust system so it is free of stress ⇒ page 253
- Installation position ⇒ page 236
- Tighten bolted connections evenly

18 - Nut

- 40 Nm

19 - Mounting

- Renew if damaged

20 - Bolt

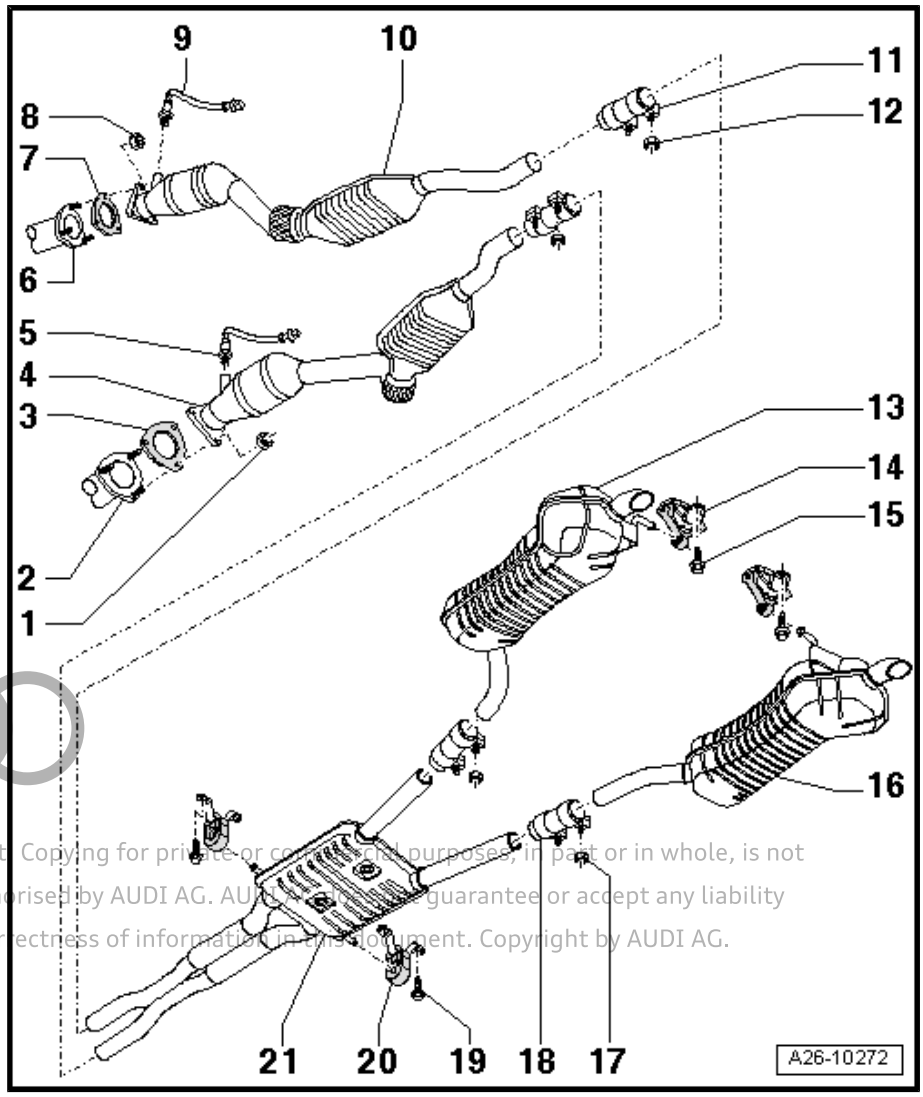
- 25 Nm

21 - Centre silencer

- Combined in one unit with rear silencer as original equipment. Can be renewed separately for repair purposes

- ❑ Cutting point ⇒ page 252
- ❑ Align exhaust system so it is free of stress ⇒ page 253

Vehicles with four-wheel drive



1 - Nut

- ❑ Renew
- ❑ 27 Nm

2 - Exhaust manifold

- ❑ For cylinder bank 1 (right-side)

3 - Gasket

- ❑ Renew

4 - Front exhaust pipe with starter catalytic converter and main catalytic converter

- ❑ For cylinder bank 1 (right-side)
- ❑ With flexible joint; do not bend flexible joint more than 10° – otherwise it can be damaged
- ❑ Protect against knocks and impact
- ❑ Removing and installing ⇒ page 245
- ❑ Different versions available ⇒ Electronic parts catalogue
- ❑ Align exhaust system so it is free of stress ⇒ page 253
- ❑ Components of exhaust pipe mountings: Vehicles with manual gearbox ⇒ page 237 , vehicles with automatic gearbox ⇒ page 237

5 - Lambda probe - G39-

- ❑ For cylinder bank 1 (right-side)
- ❑ Removing and installing ⇒ Rep. gr. 24

6 - Exhaust manifold

- ❑ For cylinder bank 2 (left-side)

7 - Gasket

- ❑ Renew

8 - Nut

- ❑ Renew
- ❑ 27 Nm

9 - Lambda probe 2 - G108-

- ❑ For cylinder bank 2 (left-side)
- ❑ Removing and installing ⇒ Rep. gr. 24

10 - Front exhaust pipe with starter catalytic converter and main catalytic converter

- ❑ For cylinder bank 2 (left-side)
- ❑ With flexible joint; do not bend flexible joint more than 10° – otherwise it can be damaged
- ❑ Protect against knocks and impact
- ❑ Removing and installing ⇒ page 239
- ❑ Different versions available ⇒ Electronic parts catalogue
- ❑ Align exhaust system so it is free of stress ⇒ page 253
- ❑ Components of exhaust pipe mountings: Vehicles with manual gearbox ⇒ page 236 , vehicles with automatic gearbox ⇒ page 237

11 - Clamp (front)

- ❑ Before tightening, align exhaust system so it is free of stress ⇒ page 253
- ❑ Installation position ⇒ page 236
- ❑ Tighten bolted connections evenly

12 - Nut

- ❑ 40 Nm

13 - Rear silencer

- ❑ Left side of vehicle
- ❑ Different versions available ⇒ Electronic parts catalogue
- ❑ Combined in one unit with centre silencer as original equipment. Can be renewed separately for repair purposes
- ❑ Cutting point ⇒ page 252
- ❑ Align exhaust system so it is free of stress ⇒ page 253

14 - Mounting

- ❑ Renew if damaged

15 - Bolt

- ❑ 25 Nm

16 - Rear silencer

- ❑ Right side of vehicle
- ❑ Different versions available ⇒ Electronic parts catalogue
- ❑ Combined in one unit with centre silencer as original equipment. Can be renewed separately for repair purposes
- ❑ Cutting point ⇒ page 252
- ❑ Align exhaust system so it is free of stress ⇒ page 253

17 - Nut

- ❑ 40 Nm

18 - Clamp (rear)

- ❑ For separate replacement of centre and rear silencers
- ❑ Before tightening, align exhaust system so it is free of stress ⇒ page 253
- ❑ Installation position ⇒ page 236
- ❑ Tighten bolted connections evenly

19 - Bolt

- ❑ 25 Nm

20 - Mounting

- ❑ Renew if damaged

21 - Centre silencer

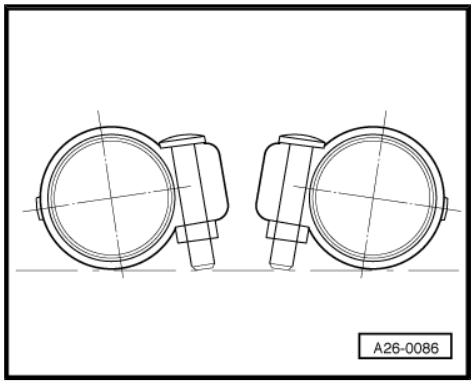
- ❑ Combined in one unit with rear silencer as original equipment. Can be renewed separately for repair purposes
- ❑ Cutting point ⇒ page 252

❑ Align exhaust system so it is free of stress ⇒ page 253

Installation position of front clamps

– Fit clamps so that ends of bolts do not protrude beyond bottom of clamp.

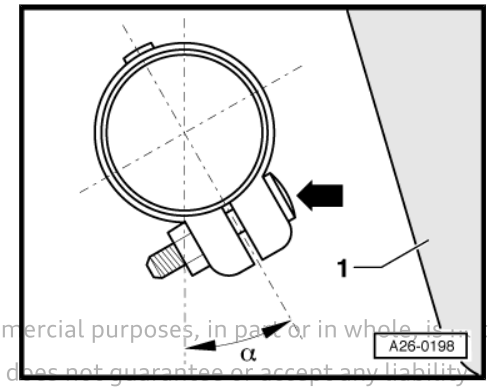
• Bolted connections face one another.



Installation position of clamp (rear) - vehicles with front-wheel drive

• Bolt heads -arrow- face fuel tank -1-.

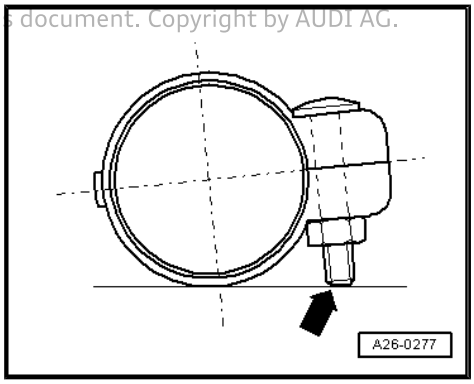
• -α- = 25° ... 35°



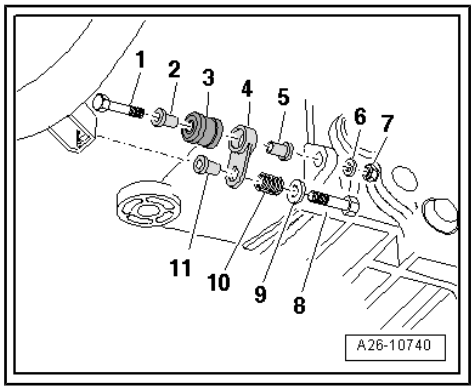
Installation position of clamps (rear) - vehicles with four-wheel drive

– When fitting clamps, make sure ends of bolts do not project below bottom of clamp -arrow-.

• Bolted connections face to right.

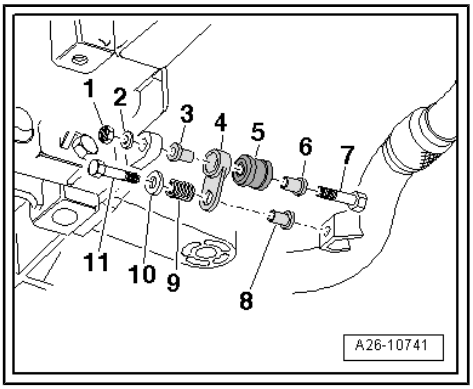


Components of exhaust pipe mountings (left-side) for vehicles with manual gearbox



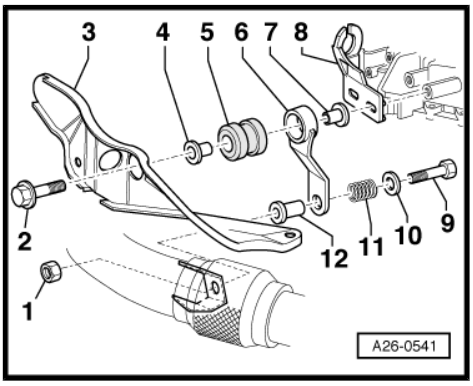
1 - Bolt
2 - Spacer sleeve
3 - Buffer
4 - Bracket
5 - Spacer sleeve
6 - Washer
7 - Nut, self-locking, 25 Nm
8 - Bolt, 25 Nm
9 - Washer
10 - Compression spring
11 - Spacer sleeve

Components of exhaust pipe mountings (right-side) for vehicles with manual gearbox



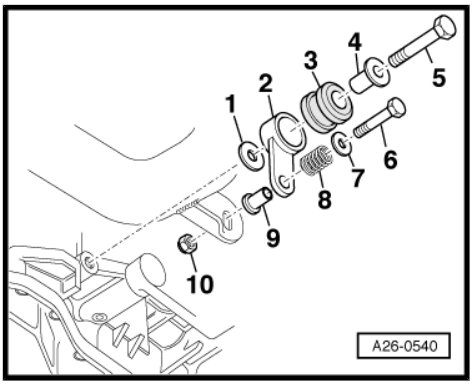
1 - Nut, self-locking, 25 Nm
2 - Washer
3 - Spacer sleeve
4 - Bracket
5 - Buffer
6 - Spacer sleeve
7 - Bolt
8 - Spacer sleeve
9 - Compression spring
10 - Washer
11 - Bolt, 25 Nm

Components of exhaust pipe mountings (left-side) for vehicles with automatic gearbox



1 - Nut, self-locking, 25 Nm
2 - Bolt, 25 Nm
3 - Heat shield for selector lever cable
4 - Spacer sleeve
5 - Buffer
6 - Bracket
7 - Spacer sleeve
8 - Support bracket
9 - Bolt
10 - Washer
11 - Compression spring
12 - Spacer sleeve

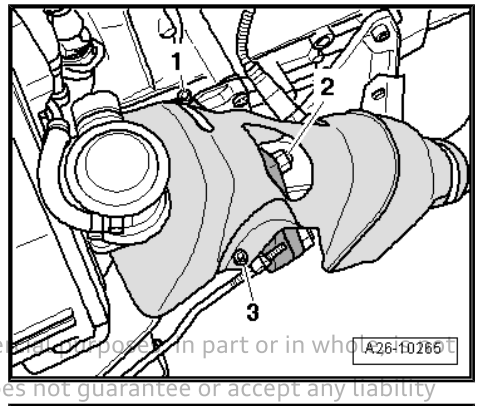
Components of exhaust pipe mountings (right-side) for vehicles with automatic gearbox



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

Heat shield for front exhaust pipe - tightening torque

– Tighten bolts -1- and -3- securing heat shield for front exhaust pipe to 10 Nm.

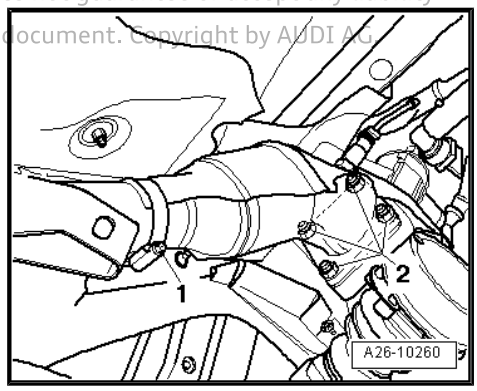


Note

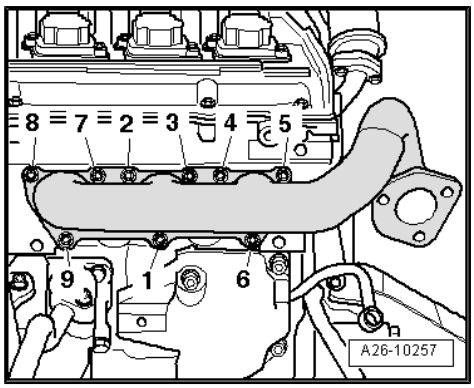
Disregard -item 2-.

Hose clip on heat shield for front exhaust pipe - tightening torque

– Tighten hose clip -1- to 5 Nm.



Exhaust manifold (left-side) - tightening torque and sequence



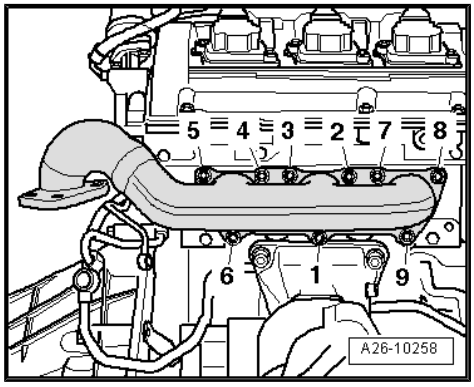
Note

- *Renew self-locking nuts.*
- *Coat nuts with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue*

– Tighten nuts for exhaust manifold in the sequence -1 ... 9- in 3 stages as follows:

1. Screw in nuts hand-tight.
2. Initially tighten to 15 Nm.
3. Tighten to 25 Nm.

Exhaust manifold (right-side) - tightening torque and sequence



Note

- *Renew self-locking nuts.*
- *Coat nuts with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue*

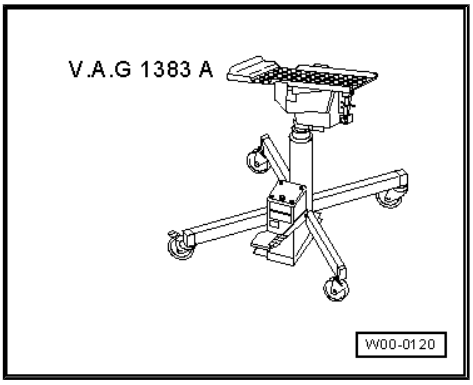
– Tighten nuts for exhaust manifold in the sequence -1 ... 9- in 3 stages as follows:

1. Screw in nuts hand-tight.
2. Initially tighten to 15 Nm.
3. Tighten to 25 Nm.

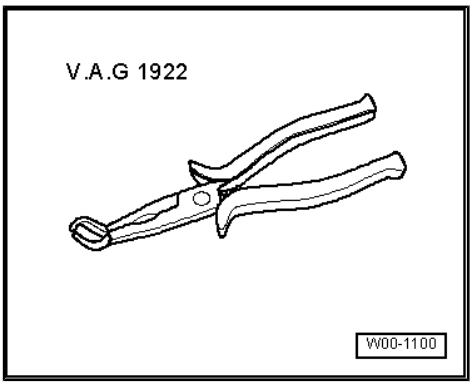
1.2 Removing and installing front exhaust pipe (left-side) with starter catalytic converter and main catalytic converter

Special tools and workshop equipment required

- Engine and gearbox jack - V.A.G 1383 A-

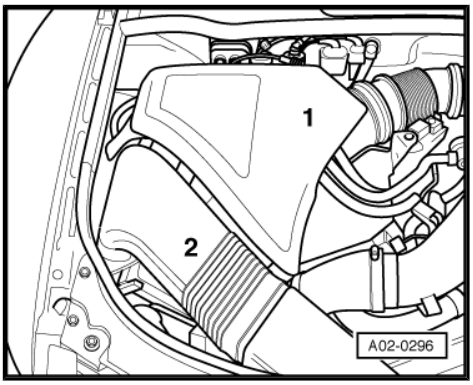


- Spark plug connector pliers - V.A.G 1922-

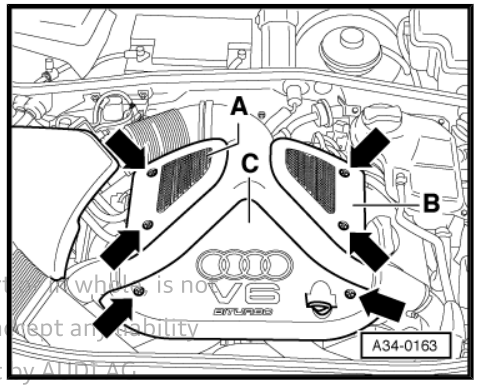


Removing

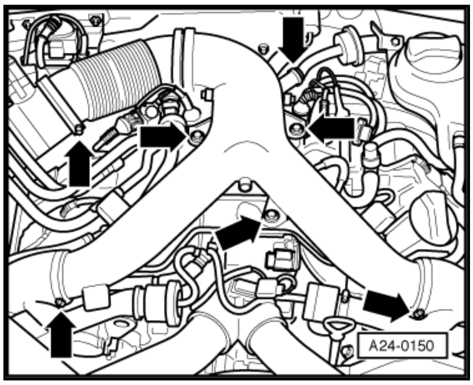
– Remove cover -1- on right side of engine compartment.



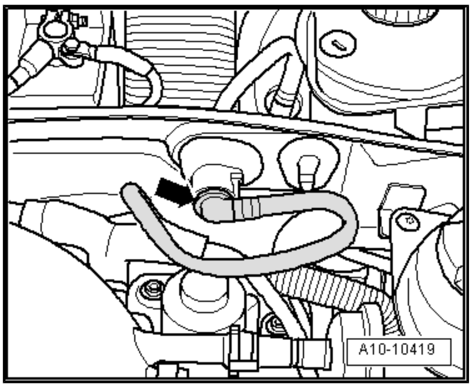
– Detach engine cover panels -A ... C- by removing bolts -arrows-.



– Unscrew hose connections and bolted connections -arrows- and remove air duct.

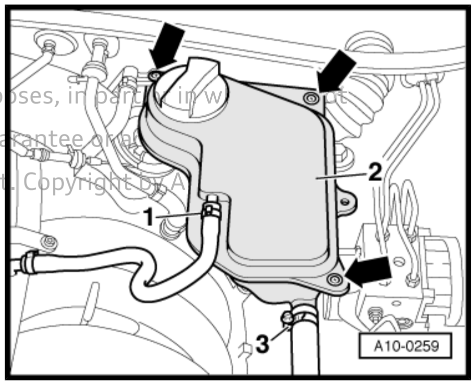


– Detach vacuum line -arrow- going to brake servo at bulkhead.



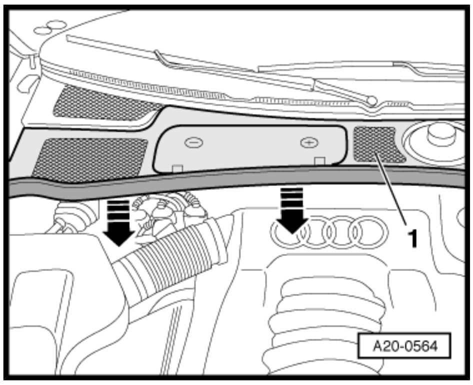
– Remove bolts -arrows-.

– Unplug electrical wiring to coolant shortage indicator switch -F66- and move coolant expansion tank -2- to one side with coolant hoses -1- and -3- attached.

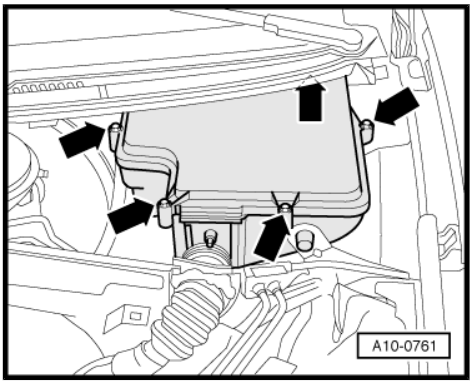


– Remove seal -arrows-.

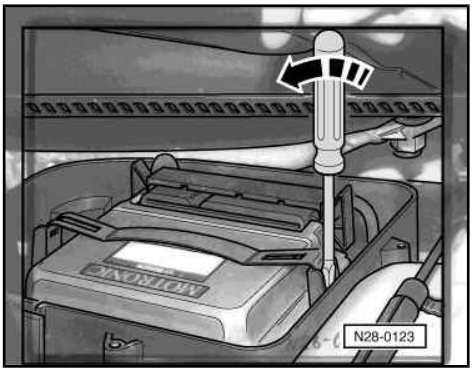
– Pull off plenum chamber cover -1- towards front of vehicle.



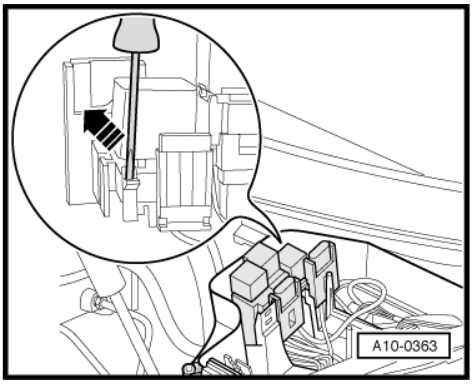
– Unscrew bolts -arrows- and take off cover for electronics box in plenum chamber.



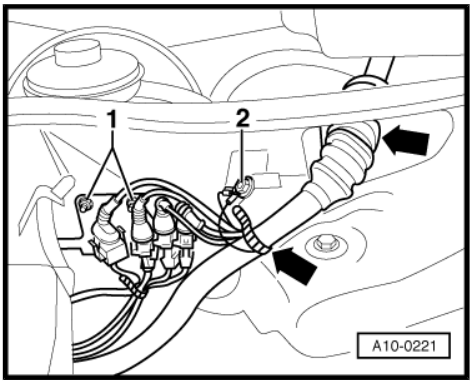
– Carefully lever off retaining strap with a screwdriver -arrow-.
– Move engine control unit to one side with electrical connectors attached.



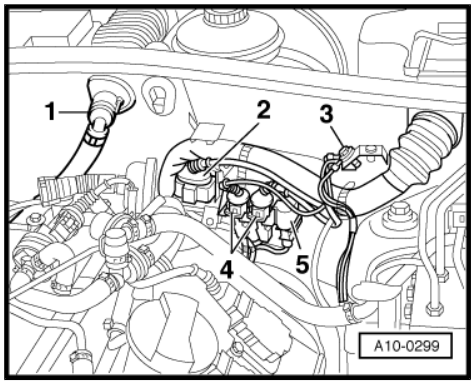
– Release retainer -arrow- and pull auxiliary relay carrier in electronics box upwards to remove.
– Disconnect electrical connectors at connector point using spark plug connector pliers - V.A.G 1922- .



– Detach earth connection -2- and retainer -1- for electrical connectors from bulkhead.
– Disengage engine wiring harness at electronics box and bulkhead -arrows- and move clear.



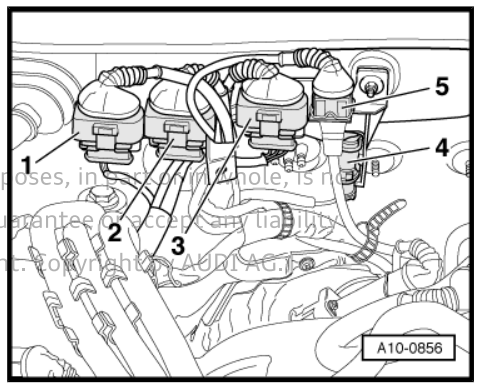
– Take electrical connector -2- for Lambda probe 2 - G108- out of bracket (left-side) at bulkhead and unplug.
– Remove heat insulation sleeve at wiring harness and move wire to Lambda probe clear.



Note

Disregard -items 1, 3, 4, 5-.

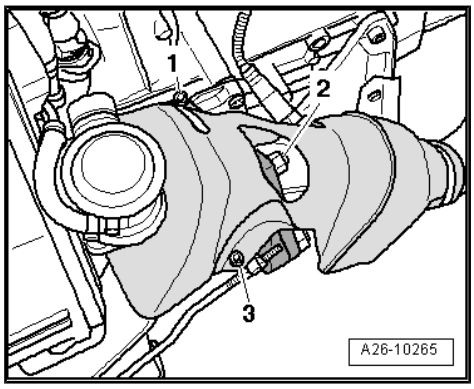
– Take electrical connector -2- for Lambda probe 2 after catalytic converter - G131- out of bracket (right-side) on bulkhead and unplug it.
– Remove heat insulation sleeve at wiring harness and move wire to Lambda probe clear.



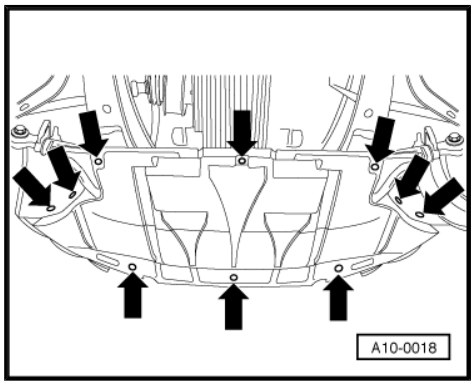
Note

Disregard -items 1, 3, 4, 5-.

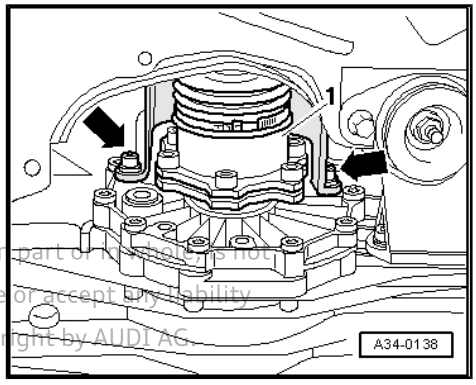
– Unscrew bolts -1- and -3- for heat shield.
– Unscrew top nut -2- securing front exhaust pipe to turbocharger.



– Release fasteners -arrows- and remove noise insulation.



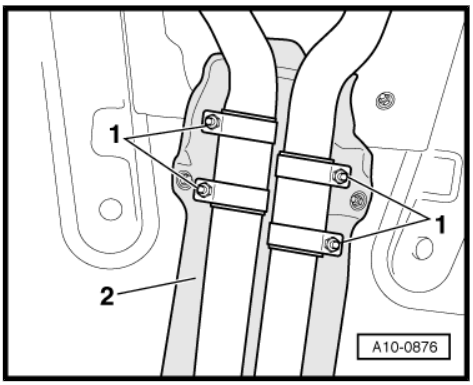
– Remove bolts -arrows- and detach heat shield for drive shaft (left-side) -1-.
– Detach drive shaft (left-side) from flange shaft of gearbox.



Caution

Risk of damage to flexible joints in front silencer.

- ***Do NOT bend the flexible joints in the front silencer more than 10°.***

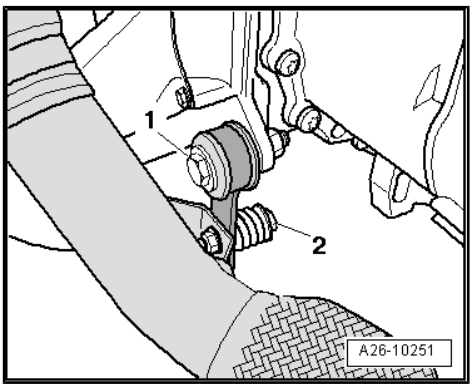


– Disconnect exhaust system at clamps -1-.

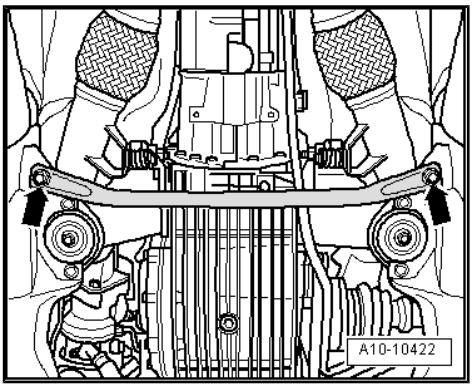
Note

Disregard -item 2-.

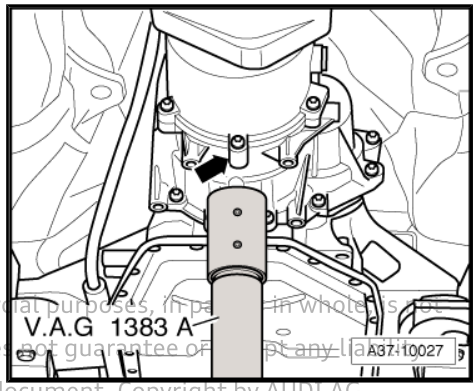
– Unscrew bolts -1- and -2- and remove mounting for front exhaust pipe (left-side).



– Unbolt cross piece from subframe -arrows-.



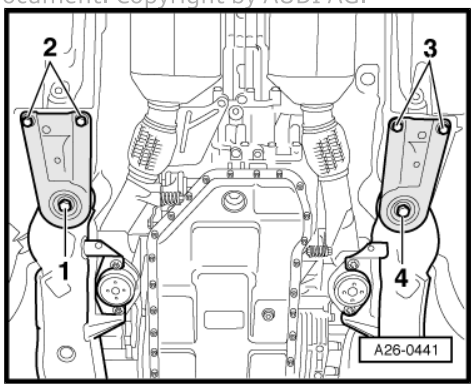
– Apply lifting column of engine/gearbox jack - V.A.G 1383 A- at centre of gearbox housing casting -arrow- and support gearbox from below.



Note

The lock carrier must be installed.

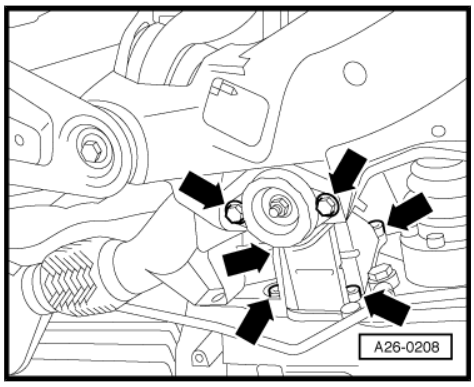
– First remove bolts -2- and -3- and then bolts -1- and -4-.
– Lower gearbox and subframe slowly using engine and gearbox jack - V.A.G 1383 A- .

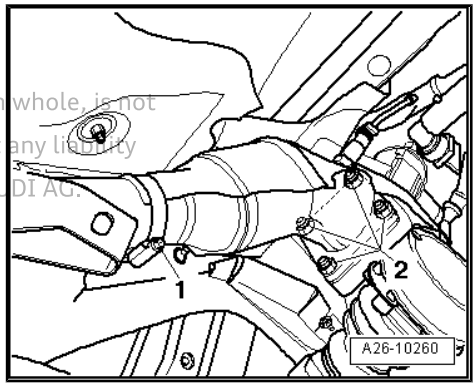


Note

Make sure that the propshaft joint is not damaged when lowering gearbox.

– Remove heat shield for gearbox support (left-side).
– Remove bolts -arrows- and detach gearbox support with gearbox mounting.
– Move Lambda probe wires clear.





– Slacken hose clip -1- on heat shield for front exhaust pipe
– Unscrew nuts -2- securing front exhaust pipe to turbocharger.
– Take out front exhaust pipe with starter and main catalytic converter.

Installing

- Tightening torques ⇒ page 232

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

Note

- *Renew gaskets and self-locking nuts.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *Fit all heat insulation sleeves in the original position when installing.*
- *Fit all cable ties in the original positions when installing.*

– Install gearbox support with gearbox mounting ⇒ Rep. gr. 34 .
– Install cover for electronics box in plenum chamber ⇒ Rep. gr. 97 .
– Install subframe and cross piece ⇒ Rep. gr. 40 .

Note

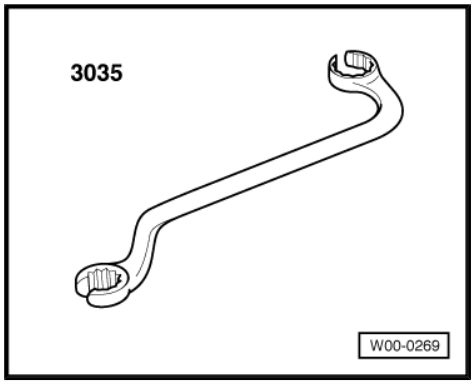
Mounting components for exhaust system on gearbox: Manual gearbox ⇒ page 236 , automatic gearbox ⇒ page 237 .

– Align exhaust system so it is free of stress ⇒ page 253 .
– Secure drive shaft to flange shaft of gearbox ⇒ Rep. gr. 40 .
– Install heat shield for drive shaft ⇒ page 29 .
– Install noise insulation ⇒ Rep. gr. 50 .
– Install heat shield for front exhaust pipe ⇒ page 238 .
– Install air duct ⇒ page 29 .

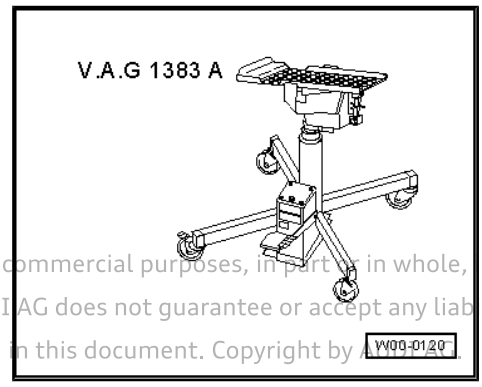
1.3 Removing and installing front exhaust pipe (right-side) with starter catalytic converter and main catalytic converter

Special tools and workshop equipment required

♦ Ring spanner - 3035-

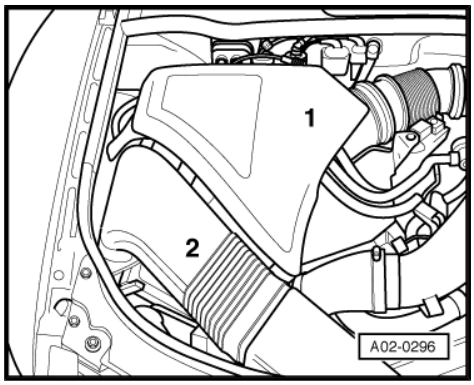


♦ Engine and gearbox jack - V.A.G 1383 A-

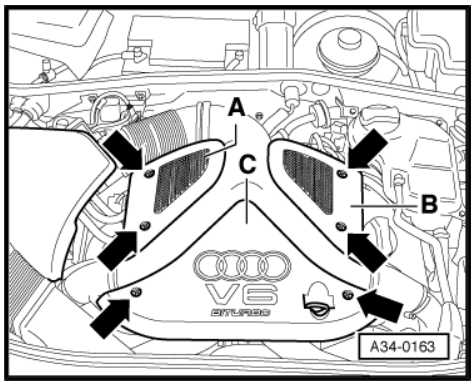


Removing

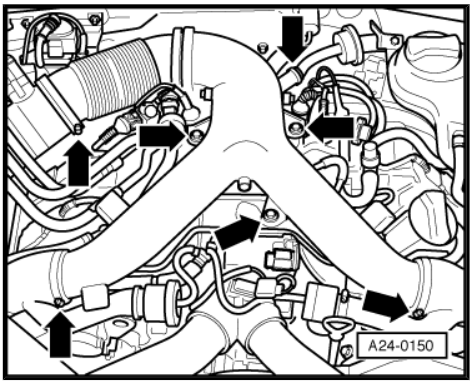
– Remove cover -1- on right side of engine compartment.



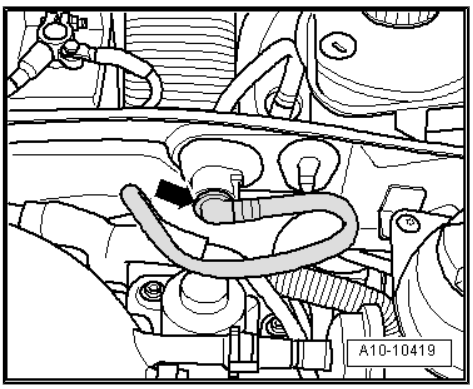
– Detach engine cover panels -A ... C- by removing bolts -arrows-.



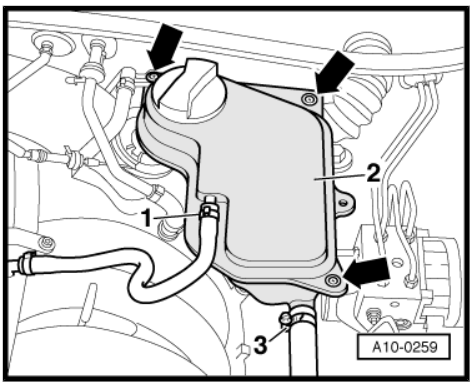
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



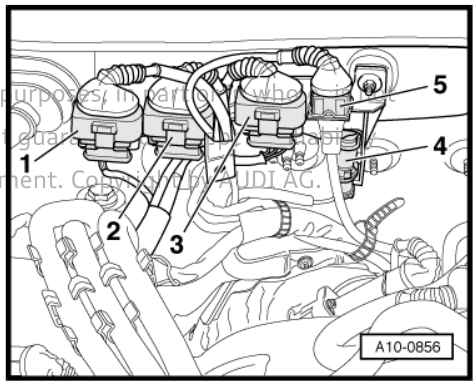
– Detach vacuum line -arrow- going to brake servo at bulkhead.



– Remove bolts -arrows-.
– Unplug electrical wiring to coolant shortage indicator switch - F66- and move coolant expansion tank -2- to one side with coolant hoses -1- and -3- attached.



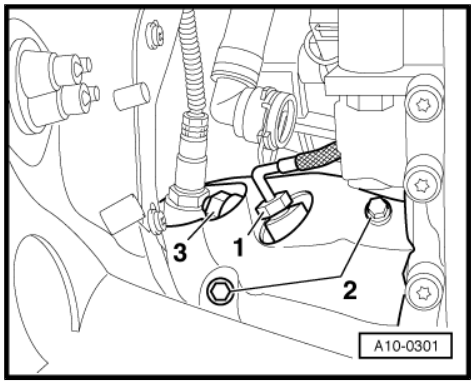
– Take electrical connectors for Lambda probe after catalytic converter - G130- -item 1- and Lambda probe - G39- -item 3- out of bracket (right-side) on bulkhead and unplug.
– Remove heat insulation sleeve at wiring harness and move wiring to Lambda probes clear.



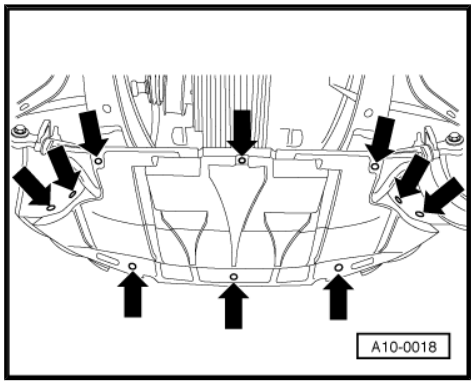
Note

Disregard -items 2, 4, 5-.

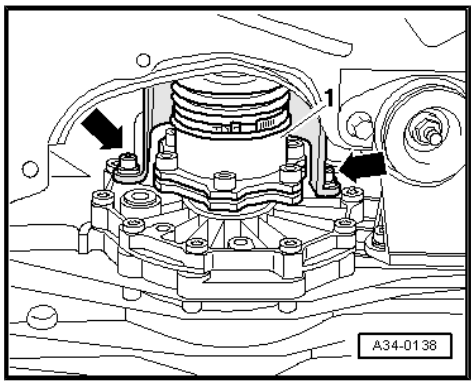
– Use ring spanner - 3035- to remove exhaust gas temperature sender 1 - G235- -item 1- from turbocharger (right-side).
– Unscrew bolts -2- for heat shield.
– Unscrew top nut -3- securing front exhaust pipe to turbocharger.



– Release fasteners -arrows- and remove noise insulation.



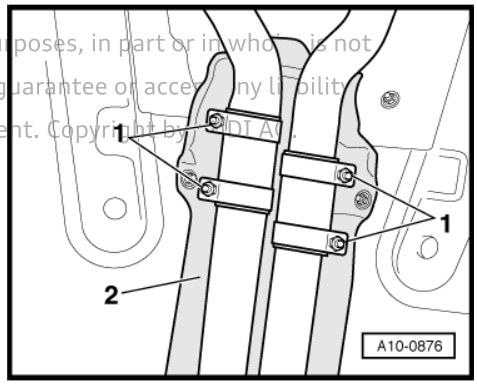
– Remove bolts -arrows- and detach heat shield for drive shaft (right-side) -1-.
– Unbolt drive shaft (right-side) from flange shaft on gearbox.



Caution

Risk of damage to flexible joints in front silencer.

- ***Do NOT bend the flexible joints in the front silencer more than 10°.***

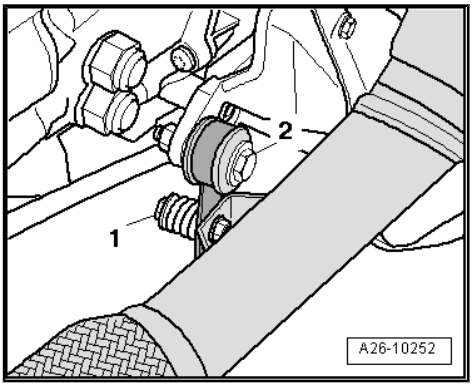


– Disconnect exhaust system at clamps -1-.

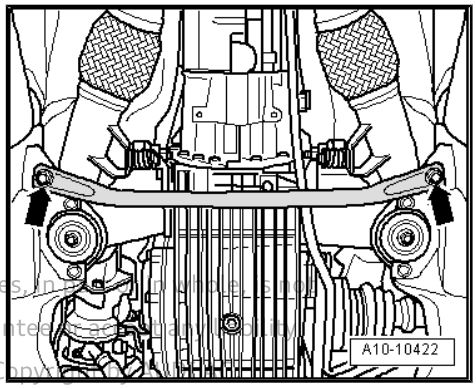
Note

Disregard -item 2-.

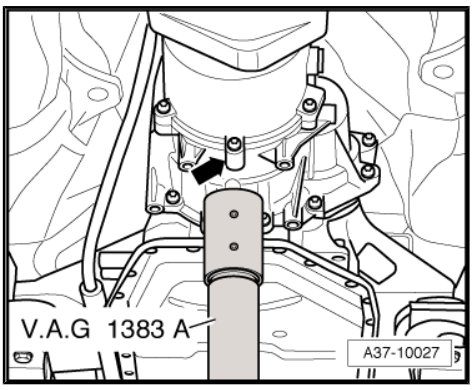
– Unscrew bolts -1- and -2- and remove mounting for front exhaust pipe (right-side).



– Unbolt cross piece from subframe -arrows-.



– Apply lifting column of engine/gearbox jack - V.A.G 1383 A- at centre of gearbox housing casting -arrow- and support gearbox from below.

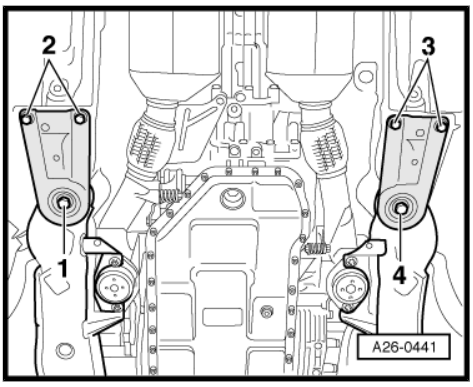


Note

The lock carrier must be installed.

– First remove bolts -2- and -3- and then bolts -1- and -4-.

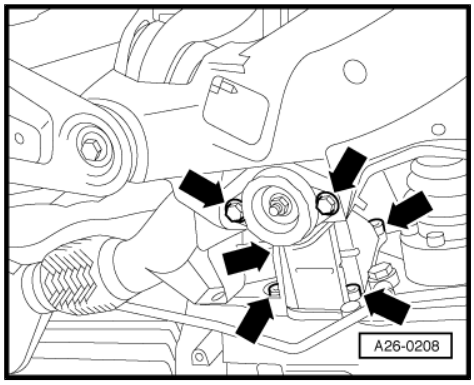
– Lower gearbox and subframe slowly using engine and gearbox jack - V.A.G 1383 A- .



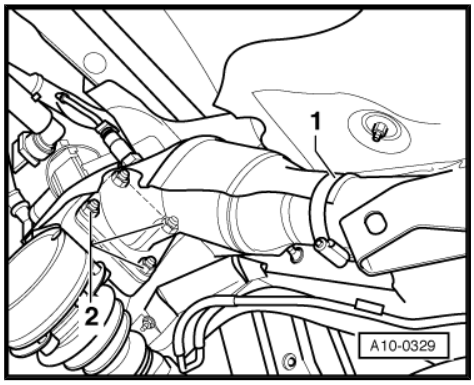
Note

Make sure that the propshaft joint is not damaged when lowering gearbox.

– Remove heat shield for gearbox support (right-side).
– Remove bolts -arrows- and detach gearbox support with gearbox mounting.
– Move Lambda probe wires clear.



– Slacken hose clip -1- on heat shield for front exhaust pipe
– Unscrew nuts -2- securing front exhaust pipe to turbocharger.
– Take out front exhaust pipe with starter and main catalytic converter.



Installing

• Tightening torques ⇒ page 232

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

Note

- *Renew gaskets and self-locking nuts.*
- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*
- *Fit all cable ties in the original positions when installing.*

– Install gearbox support with gearbox mounting ⇒ Rep. gr. 34 .
– Install cover for electronics box in plenum chamber ⇒ Rep. gr. 97 .
– Install subframe and cross piece ⇒ Rep. gr. 40 .
– Install subframe ⇒ Rep. gr. 40 .

Note

Mounting components for exhaust system on manual gearbox ⇒ page 237 and automatic gearbox ⇒ page 237 .

– Align exhaust system so it is free of stress ⇒ page 253 .
– Secure drive shaft to flange shaft of gearbox ⇒ Rep. gr. 40 .
– Install heat shield for drive shaft ⇒ page 29 .
– Install noise insulation ⇒ Rep. gr. 50 .
– Install exhaust gas temperature sender 1 - G235- ⇒ page 262 .

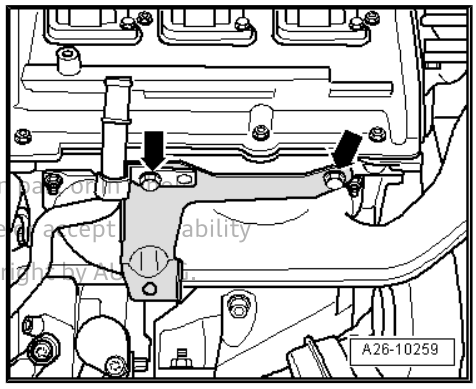
1.4 Removing and installing exhaust manifold (left-side)

Removing

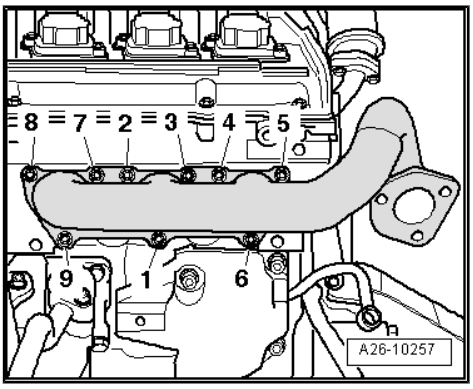
- Engine removed and secured to engine and gearbox support - VAS 6095- ⇒ page 28 .
- Engine oil drained ⇒ Maintenance ; Booklet 402

– Remove turbocharger (left-side) ⇒ page 221 .

– Unscrew bolts -arrows- and remove bracket for air pipe.



– Unscrew nuts -1 ... 9- and remove exhaust manifold (left-side).



Installing

- Tightening torque ⇒ page 221

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

Note

Renew gaskets, seals and self-locking nuts.

– Tighten nuts for exhaust manifold ⇒ page 238 .

– Install turbocharger (left-side) ⇒ page 221 .

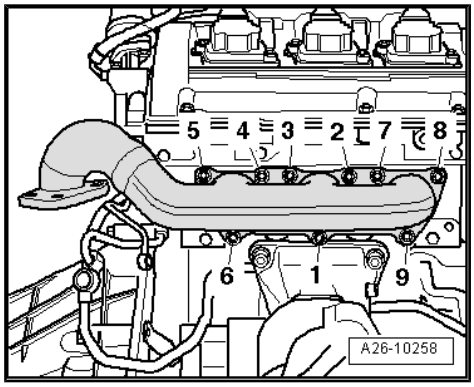
1.5 Removing and installing exhaust manifold (right-side)

Removing

- Engine removed and secured to engine and gearbox support - VAS 6095- ⇒ page 28 .
- Engine oil drained ⇒ Maintenance ; Booklet 402

– Remove turbocharger (right-side) ⇒ page 223 .

– Unscrew nuts -1 ... 9- and remove exhaust manifold (right-side).



Installing

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

Note

Renew gaskets, seals and self-locking nuts.

– Tighten nuts for exhaust manifold ⇒ page 238 .

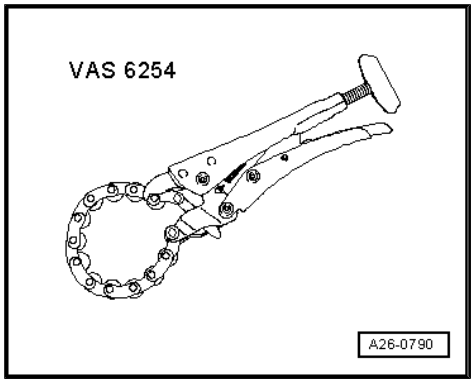
– Install turbocharger (right-side) ⇒ page 223 .

1.6 Separating centre and rear silencers

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

Special tools and workshop equipment required

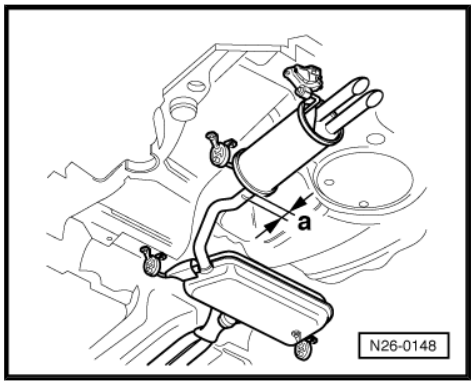
- Chain pipe cutter - VAS 6254-



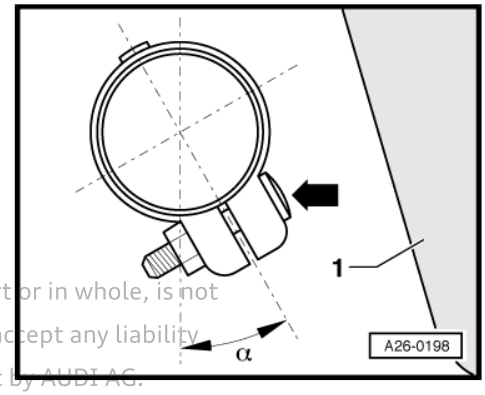
Procedure - vehicles with front-wheel drive:

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

• Dimension -a- = approx. 182 mm



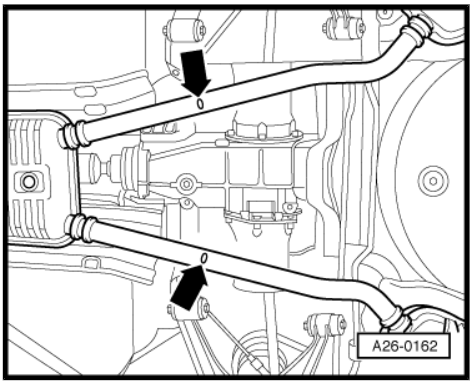
– When reassembling, position the clamp centrally over the cutting points.
– Install clamp so that bolt heads -arrow- face fuel tank -1-.



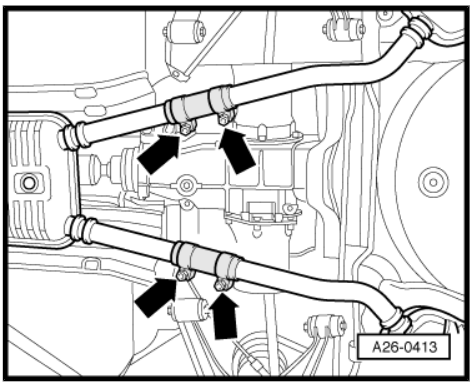
• -α- = 25° ... 35°
– Align exhaust system so it is free of stress ⇒ page 253 .

Procedure - vehicles with four-wheel drive:

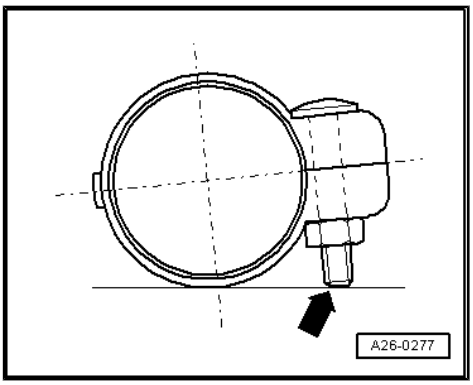
– Cut through exhaust pipe at a right angle at cutting point -arrow- using chain pipe cutter - VAS 6254- .



– When reassembling, position the clamps centrally over the cutting points.
• Bolted connections -arrows- face to right.



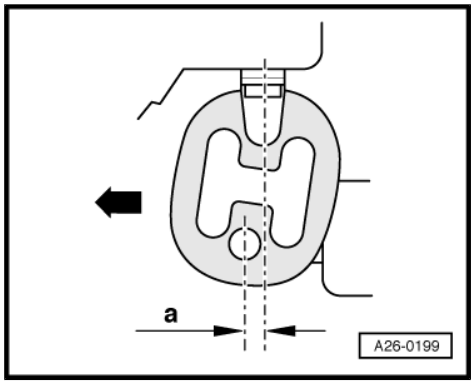
– When fitting clamps, make sure ends of bolts do not project below bottom of clamp -arrow-.
– Align exhaust system so it is free of stress ⇒ page 253 .



1.7 Stress-free alignment of exhaust system

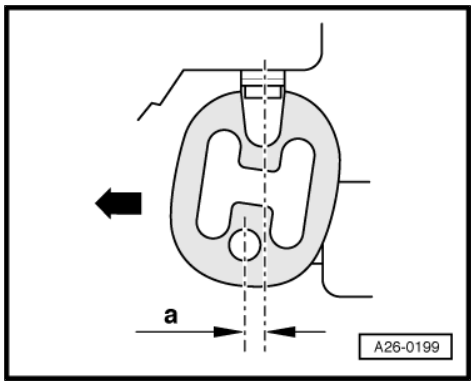
• The exhaust system must be aligned when it is cool.
• Tightening torques ⇒ page 232

Vehicles without clamp(s) between centre silencer and rear silencer



- Loosen connections on front clamps: vehicles with front-wheel drive ⇒ Item 11 (page 233) , vehicles with four-wheel drive ⇒ Item 11 (page 235) .
- Push exhaust system towards front of vehicle -arrow-, so that mounting for centre silencer is preloaded by -a- = 5 ... 9 mm.
- Tighten bolted connections on clamps evenly.
- Align tailpipes ⇒ “1.8 Aligning tailpipes - vehicles with concealed tailpipes”, page 254 or ⇒ “1.9 Aligning tailpipes - vehicles with visible tailpipes”, page 255 .

Vehicles with clamp(s) between centre silencer and rear silencer

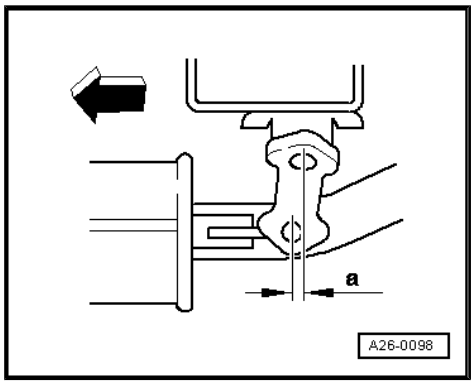


Note

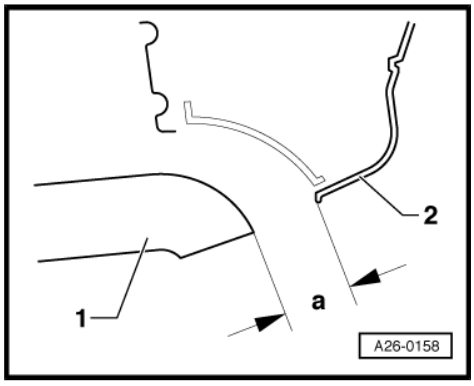
On vehicles with clamp(s) fitted between centre silencer and rear silencer, it is also necessary to align the rear silencer.

- Loosen connections on front clamps: vehicles with front-wheel drive ⇒ Item 11 (page 233) , vehicles with four-wheel drive ⇒ Item 11 (page 235) .
- Loosen connections on rear clamp(s): vehicles with front-wheel drive ⇒ Item 17 (page 233) , vehicles with four-wheel drive ⇒ Item 18 (page 235) .
- Push front section of exhaust system towards front of vehicle -arrow-, so that mounting for centre silencer is preloaded by -a- = 5 ... 9 mm.
- Tighten bolts on front clamps evenly to 40 Nm.

- Push rear section of exhaust system towards front of vehicle -arrow- until rear rubber mountings for rear silencer are preloaded by -a- = 5 ... 9 mm.
- Align rear silencer so it is horizontal.
- Tighten bolted connections on rear clamp(s) evenly.
- Align tailpipes ⇒ “1.8 Aligning tailpipes - vehicles with concealed tailpipes”, page 254 or ⇒ “1.9 Aligning tailpipes - vehicles with visible tailpipes”, page 255 .



1.8 Aligning tailpipes - vehicles with concealed tailpipes



- Check distance -a- between tailpipe -1- and bumper cover (bottom) -2-.

• Dimension -a- = approx. 40 mm.

- If necessary, check whether the exhaust system is aligned free of stress ⇒ page 253 .

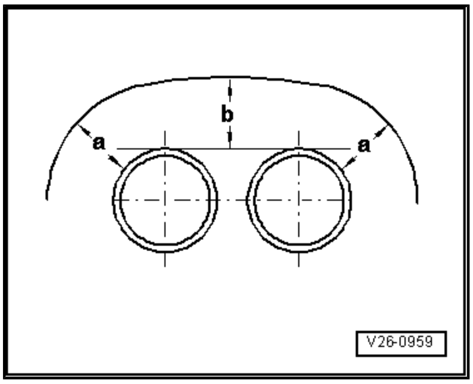
1.9 Aligning tailpipes - vehicles with visible tailpipes

Vehicles with front-wheel drive:

– Align tailpipes so that distance -a- (left-side) is the same as distance -a- (right-side).

– At the same time, distance -b- must be obtained between bumper cut-out and top of tailpipes.

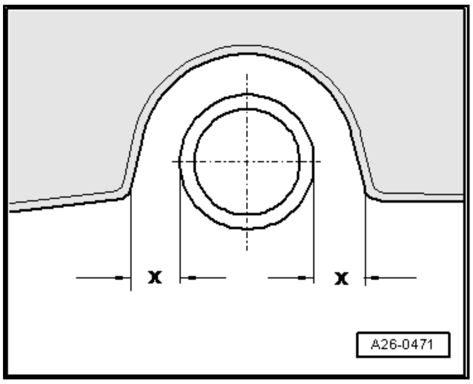
• Dimension -b- = 23 ... 31 mm.



Vehicles with four-wheel drive:

– Check clearance between tailpipes and bumper on both sides.

• Dimension -x- (left-side) = dimension -x- (right-side)



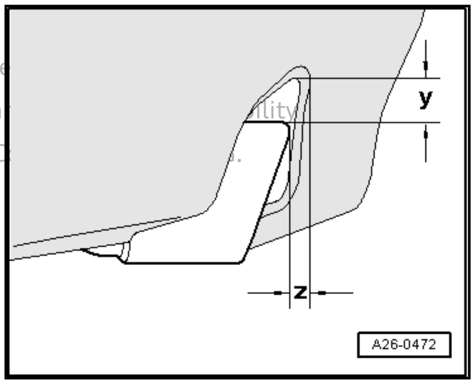
– Check distances -y- and -z- between tailpipes and bumper.

• Dimension -y- = 22 ... 30 mm.

• Dimension -z- = 9 ... 14 mm.

All vehicles (continued):

– If necessary, check whether the exhaust system is aligned free of stress ⇒ page 253 .



1.10 Checking exhaust system for leaks

Procedure

– Start engine and run at idling speed.

– Seal openings of tailpipes during leak test (e.g. with cloth or plug).

– Listen for leaks at joints between cylinder head and exhaust manifold with turbocharger, exhaust manifold/turbocharger and front exhaust pipe, etc.

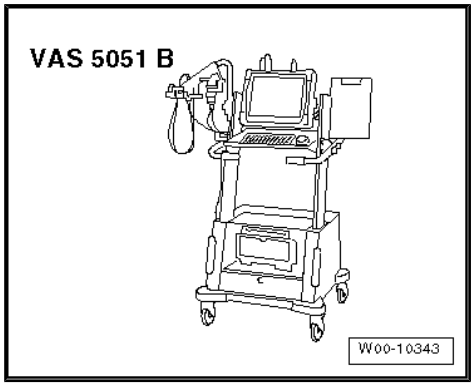
– Rectify any leaks that are found.

2 Exhaust gas temperature monitoring

2.1 Checking function of exhaust gas temperature monitoring

Special tools and workshop equipment required

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

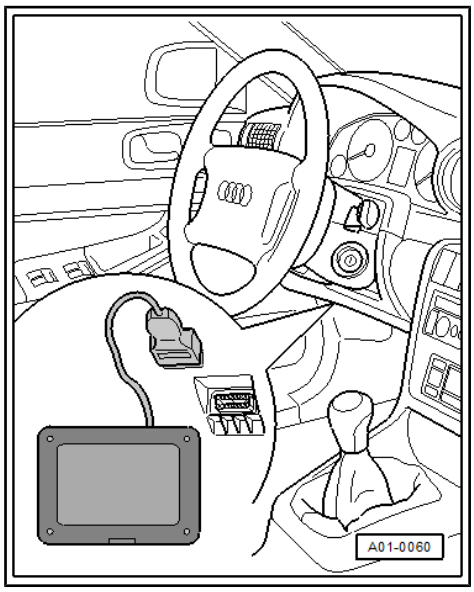


Procedure

WARNING

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

- ***Observe safety precautions ⇒ page 5 .***



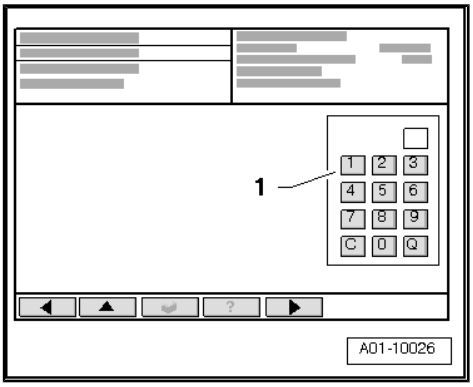
- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running
- `Vehicle self-diagnosis` and vehicle system “01 - Engine electronics” selected.

Display on -VAS 5051B- :

– From menu -1-, select diagnostic function “Measured values” and press ↵ key to continue.

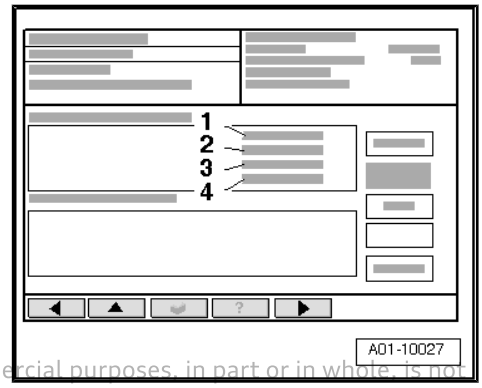
Display on -VAS 5051B- :

– Press keys 1 1 2 on keypad -1- to select “Display group 112” and confirm entry by pressing Q key.



Display on -VAS 5051B- :

– Perform road test at full throttle and at engine speeds between 5000 ... 6500 rpm and have a second mechanic check display in zones -1 ... 4-



Display zones		Explanatory notes
1	... °C	Exhaust gas temperature bank 1 (cylinder bank right-side) • Specification 980 °C 1)2)3)
2	… %	Enrichment factor Sensor Bank 1 (cylinder bank right-side) • Specification: 20 ± 5 % 4)
3	... °C	Exhaust gas temperature bank 2 (cylinder bank left-side) • Specification 980 °C 1)2)3)
4	… %	Enrichment factor Sensor Bank 2 (cylinder bank left-side) • Specification: 20 ± 5 % 4)

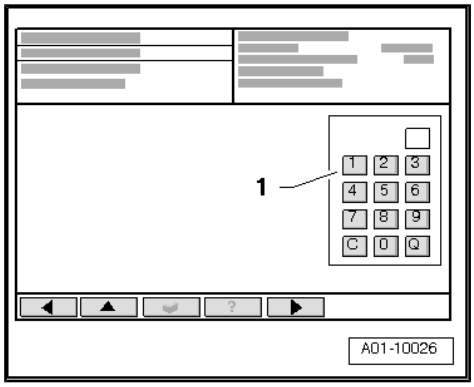
- 1) “945 °C” is displayed at an exhaust gas temperature of 945 °C or below.
- 2) The control process is activated when the exhaust gas temperature is above 980 °C.
- 3) During the start-up period, the display can rise to 1025 °C.
- 4) Possible causes of the displayed values constantly exceeding 30 % can be either low fuel pressure or that the signal transmitted by the air mass meter - G70- is too small.

– Press ↵ key.

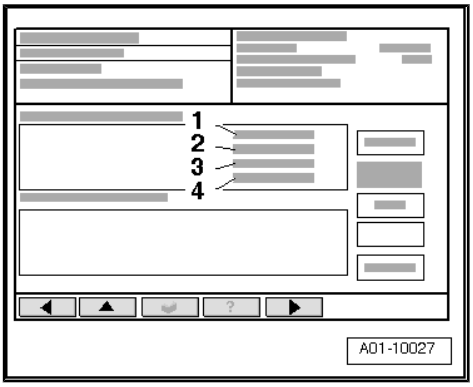
Display on -VAS 5051B- :

1 - Enter display group.

– Press keys 2 2 0 on keypad -1- to select “Display group 220” and confirm entry by pressing Q key.



Display on -VAS 5051B- :



– Continue to drive at full throttle and at engine speeds between 5000 ... 6500 rpm and have a second mechanic check display in zones -1 ... 4-.

Display zones		Explanatory notes
1	... rpm	Engine speed • Specification: above 5000 rpm
2	… %	Load • Specification: above 100 %
3	… %	Duty cycle, exhaust gas temperature sender 1 - G235- • Specification: 42 ± 10 %
4	…	Operating status, bank 1 (cylinder bank right-side) • Specification: Control ON

– Switch to “display group 221” by pressing [↑] key.

– Continue to drive at full throttle and at engine speeds between 5000 ... 6500 rpm and have a second mechanic check display in zones -1 ... 4-.

Display zones		Explanatory notes
1	... rpm	Engine speed • Specification: above 5000 rpm
2	… %	Load • Specification: Above 100 %
3	… %	Duty cycle, exhaust gas temperature sender 1 for bank 2 - G236- • Specification: 42 ± 10 %
4	…	Operating status, bank 2 (cylinder bank left-side) • Specification: Control ON

– Press [←] key to terminate diagnostic function “Measured values”.

– Select “End output”.

– Terminate road test, switch off ignition and unplug diagnostic connector.

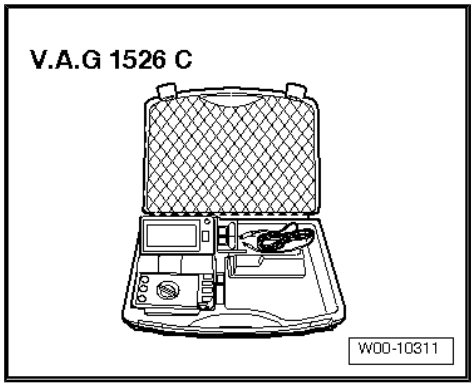
If the specifications are not obtained:

– Check exhaust gas temperature sender ⇒ page 259 .

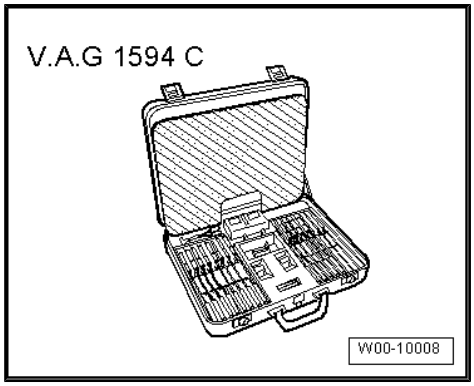
2.2 Checking exhaust gas temperature sender

Special tools and workshop equipment required

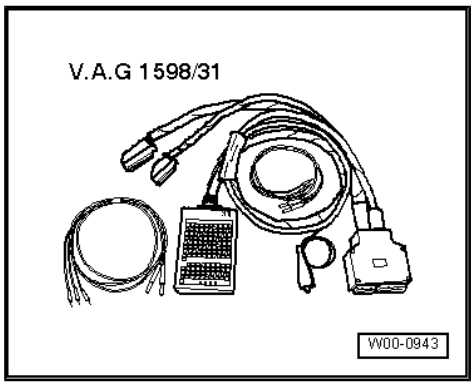
- Hand-held multimeter - V.A.G 1526C-



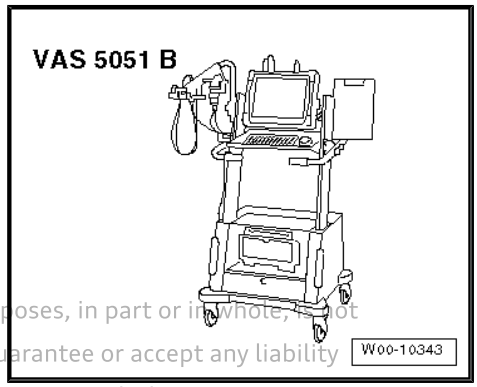
- Auxiliary measuring set - V.A.G 1594C-



- Adapter cable, 121-pin - V.A.G 1598/31- (test box)



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

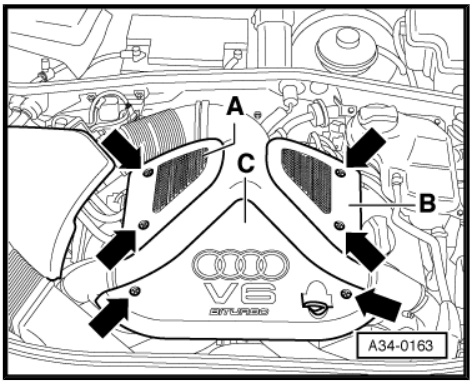


Procedure

– Switch off ignition.

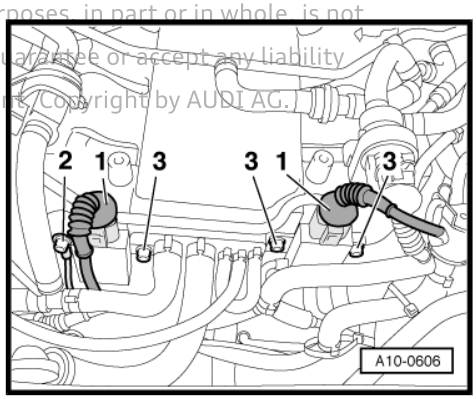
– Detach engine cover panel -A- by removing bolts -arrows-.

– Unplug electrical connector on control unit of relevant exhaust gas temperature sender.



Vehicles without secondary air system:

1 - Exhaust gas temperature sender 1 - G235- , bank 1 (brown), on intake manifold (right-side); exhaust gas temperature sender 1 for bank 2 - G236- , bank 2 (black), on intake manifold (left-side)



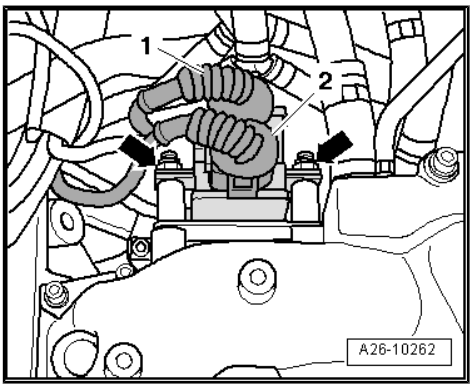
Note

Disregard items -2 and 3-.

Vehicles with secondary air system:

1 - Exhaust gas temperature sender 1 for bank 2 - G236- , bank 2 (black)

2 - Exhaust gas temperature sender 1 - G235- , bank 1 (brown)



Note

Disregard -arrows-.

Checking voltage supply

- Fuse for exhaust gas temperature sender 1 - G235- and exhaust gas temperature sender 1 for bank 2 - G236- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay - J17- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

Note

The exhaust gas temperature senders are supplied with power via the fuel pump relay - J17- .

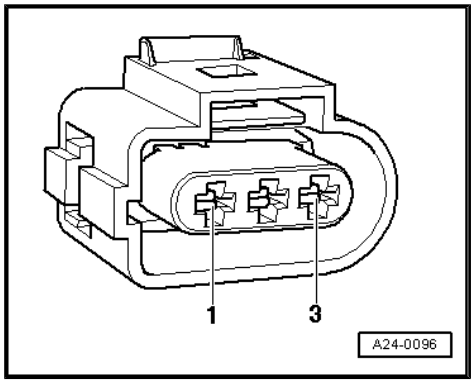
– Connect voltage tester - V.A.G 1527B- between contact -3- of electrical connector for exhaust gas temperature sender 1 - G235- or exhaust gas temperature sender 1 for bank 2 - G236- and engine earth.

– Operate starter briefly.

• The LED should light up.

– Refer to current flow diagram to check for open circuit in wiring from contact -3- of connector via fuse to fuel pump relay - J17- .

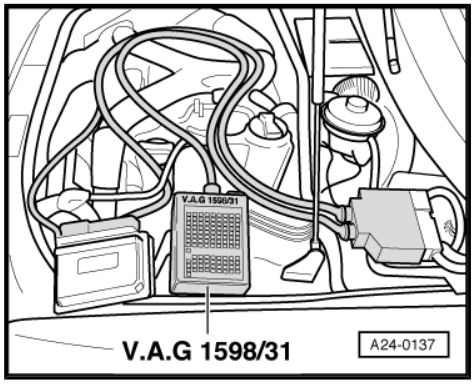
– Repair wiring connection if necessary.



If the LED lights up:

Checking wiring

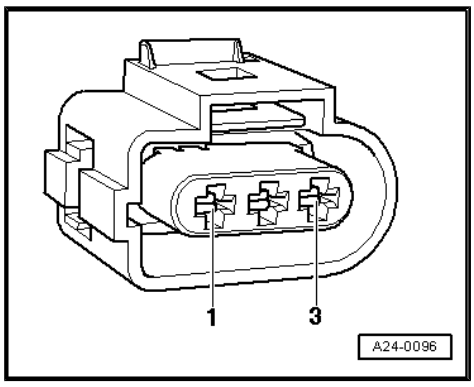
– Connect adapter cable - V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth (not shown in illustration).



Caution

To prevent damage to electronic components, select appropriate measuring range before connecting measuring leads and observe test requirements.

– Check for open circuit and short to positive or earth in the following wiring:



Component	Connector Contact	Adapter cable, 121-pin - V.A.G 1598/31- Socket
Exhaust gas temperature sender 1 - G235- , bank 1 (right-side)	-1- (signal)	61
	-2- (earth)	Engine code AJK 50
Exhaust gas temperature sender 1 for bank 2 - G236- , bank 2 (left-side)	-1- (signal)	20
	-2- (earth)	Engine codes ARE, AZA, BES 1 or 2

– Repair wiring connection if necessary.

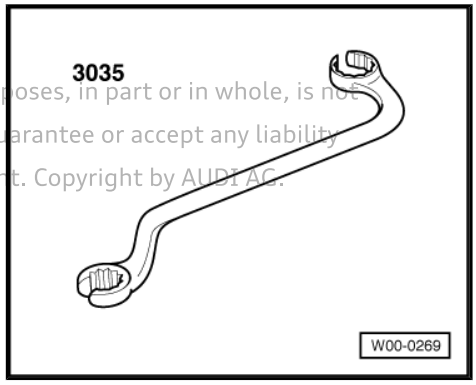
If wiring is OK:

– Renew exhaust gas temperature sender: left-side ⇒ page 265 , right-side ⇒ page 262 .

2.3 Removing and installing exhaust gas temperature sender 1 - G235-

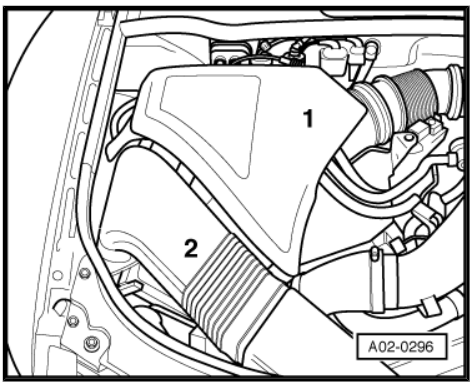
Special tools and workshop equipment required

♦ Ring spanner - 3035-

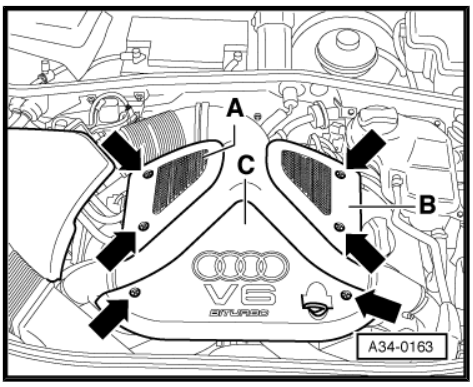


Removing

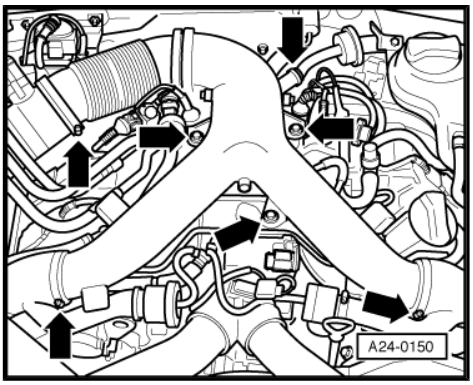
– Remove cover -1- on right side of engine compartment.



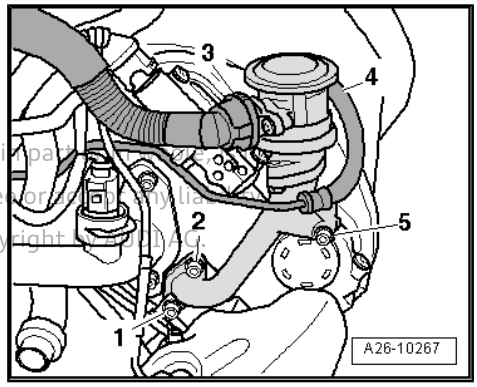
– Detach engine cover panels -A ... C- by removing bolts -arrows-.



– Unscrew hose connections and bolted connections -arrows- and remove air duct.



– Disconnect hose -3- from combination valve for secondary air system.

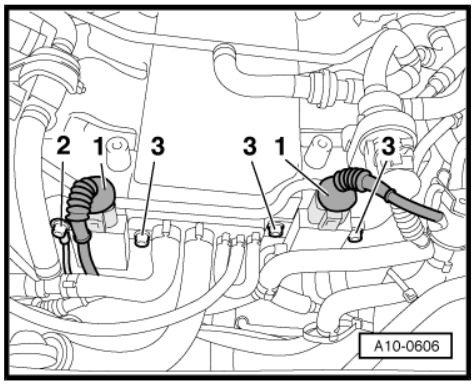


Note

- *Disregard -items 1, 2, 4, 5-.*
- *For illustration purposes, the installation position is shown from the rear.*

Vehicles without secondary air system:

– Unplug electrical connector -1- for exhaust gas temperature sender 1 - G235- , bank 1 (brown), on intake manifold (right-side).

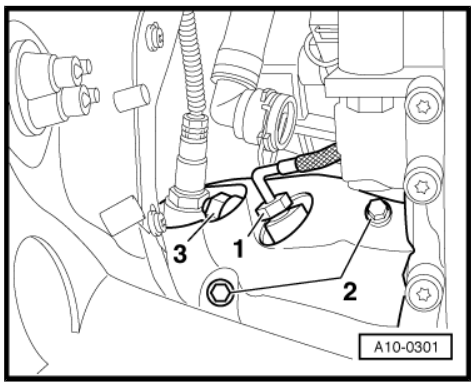


Note

Disregard items -2 and 3-.

All vehicles (continued):

– Use ring spanner - 3035- to remove exhaust gas temperature sender 1 - G235- -item 1- from turbocharger (right-side).



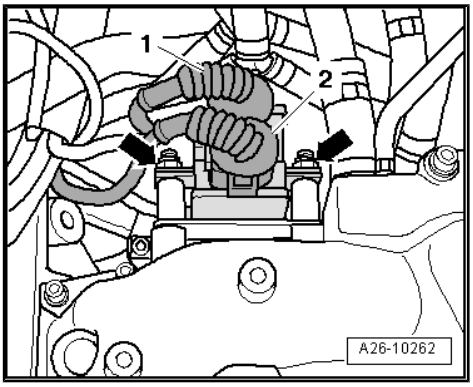
Vehicles with secondary air system:

– Move electrical wire to control unit for exhaust gas temperature sender clear.

– Unplug electrical connectors -1- and -2-.

– Unbolt control units for exhaust gas temperature senders from intake manifold -arrows-.

– Remove exhaust gas temperature sender 1 - G235- with control unit (brown connector).



Installing

• Tightening torques:

Component	Nm
Exhaust gas temperature sender 1 - G235- to turbocharger	27
Control unit for exhaust gas temperature sender to intake manifold	8[1)]
• [1)] Renew self-locking nuts.	

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

Note

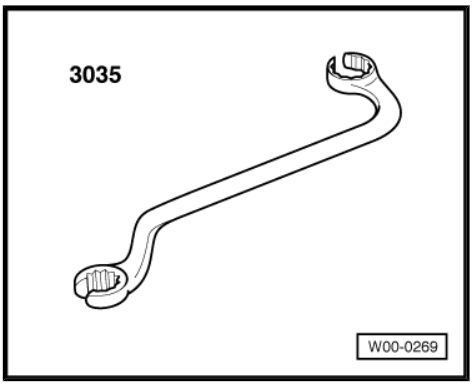
Fit all cable ties in the original positions when installing.

– Install air duct ⇒ page 29 .

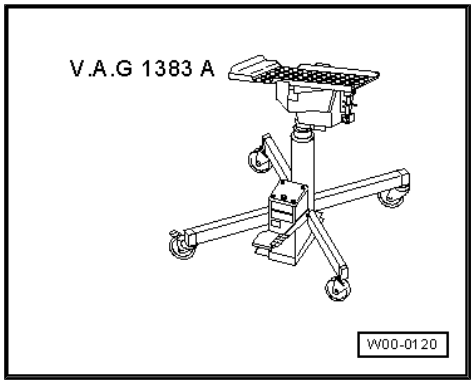
2.4 Removing and installing exhaust gas temperature sender 1 for bank 2 - G236-

Special tools and workshop equipment required

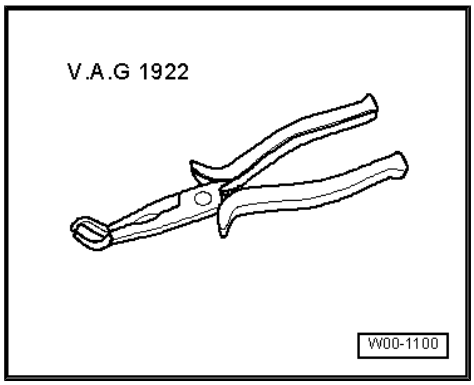
♦ Ring spanner - 3035-



♦ Engine and gearbox jack - V.A.G 1383 A-

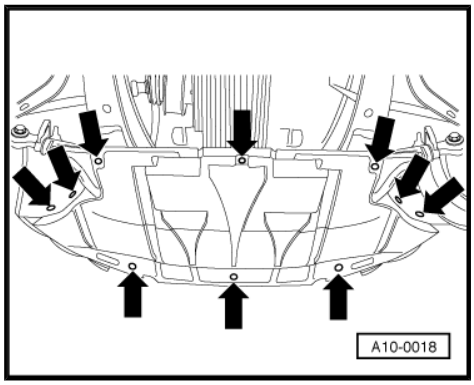


♦ Spark plug connector pliers - V.A.G 1922-

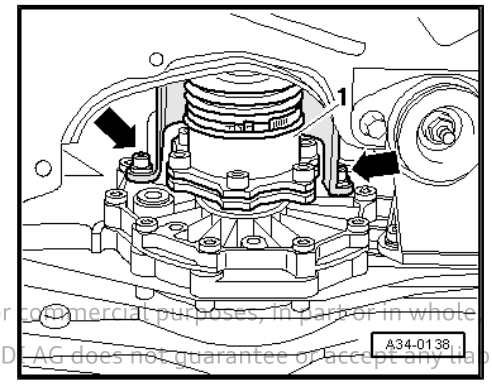


Removing

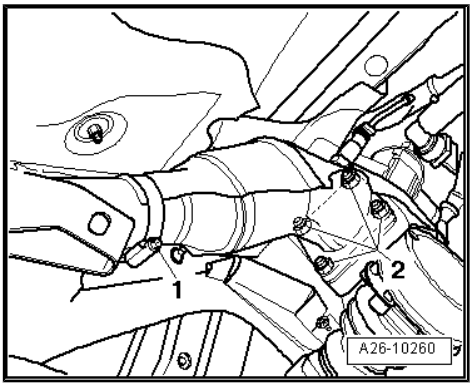
– Release fasteners -arrows- and remove noise insulation.



– Remove bolts -arrows- and detach heat shield for drive shaft (left-side) -1-.
– Detach drive shaft (left-side) from flange shaft of gearbox.



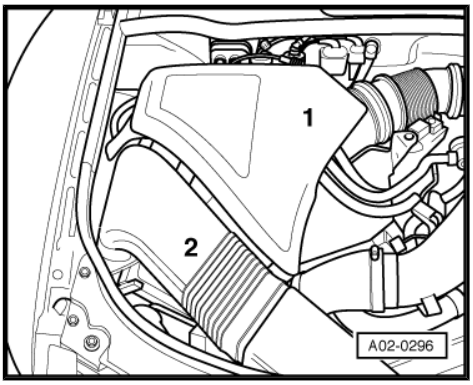
– Slacken hose clip -1- on heat shield for front exhaust pipe



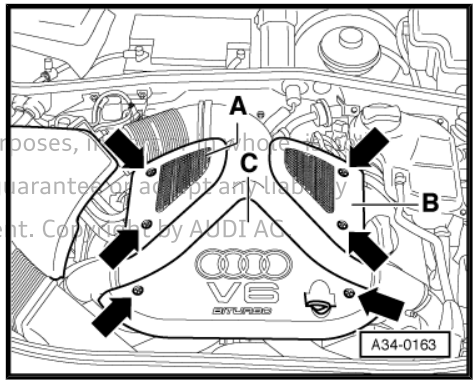
Note

Disregard -item 2-.

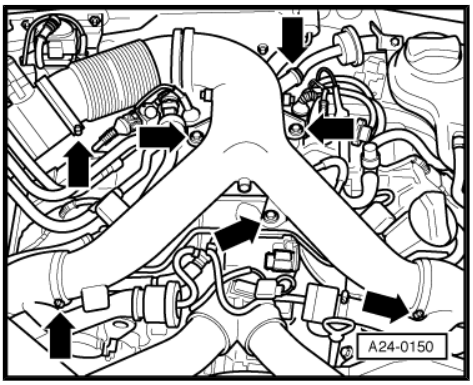
– Remove cover -1- on right side of engine compartment.



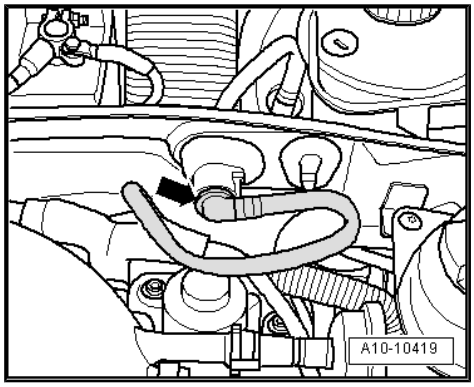
– Detach engine cover panels -A ... C- by removing bolts -arrows-.



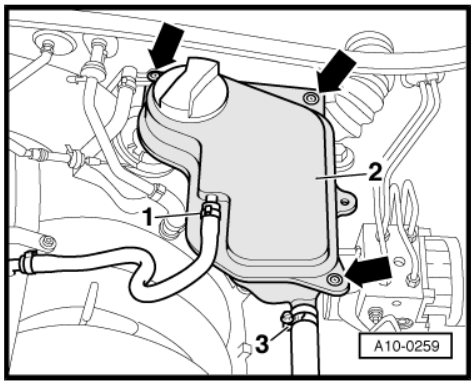
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



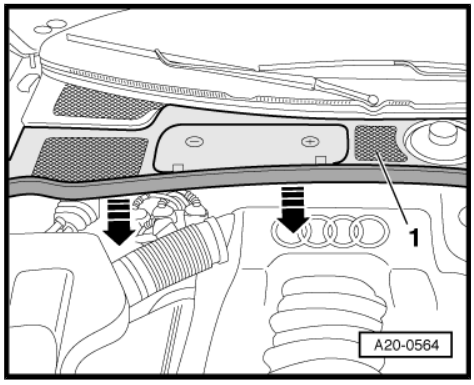
– Detach vacuum line -arrow- going to brake servo at bulkhead.



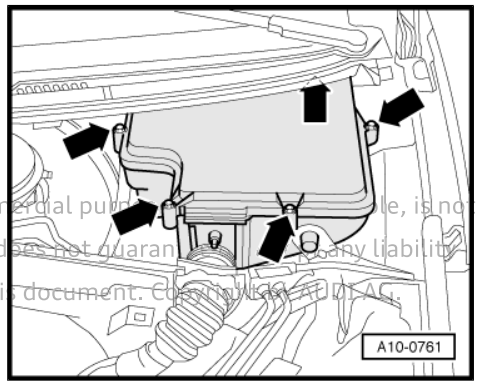
– Remove bolts -arrows-.
– Unplug electrical wiring to coolant shortage indicator switch -F66- and move coolant expansion tank -2- to one side with coolant hoses -1- and -3- attached.



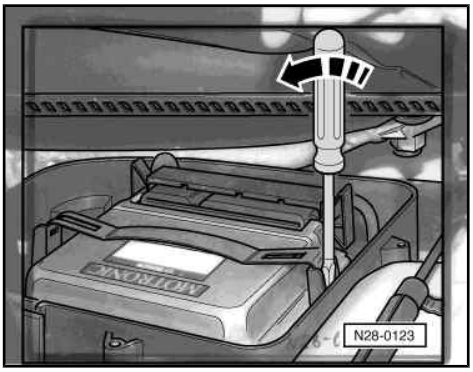
– Remove seal -arrows-.
– Pull off plenum chamber cover -1- towards front of vehicle.



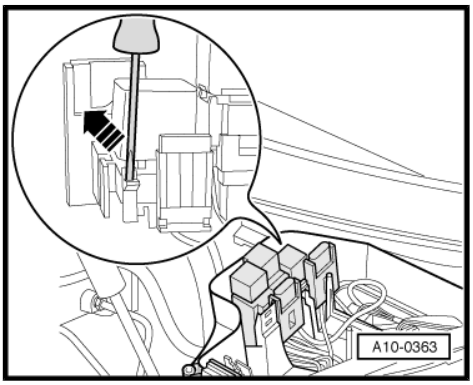
– Unscrew bolts -arrows- and take off cover for electronics box in plenum chamber.



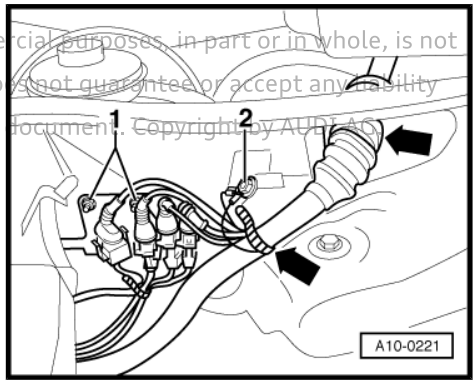
– Carefully lever off retaining strap with a screwdriver -arrow-.
– Move engine control unit to one side with electrical connectors attached.



– Release retainer -arrow- and pull auxiliary relay carrier in electronics box upwards to remove.
– Disconnect electrical connectors at connector point using spark plug connector pliers - V.A.G 1922- .



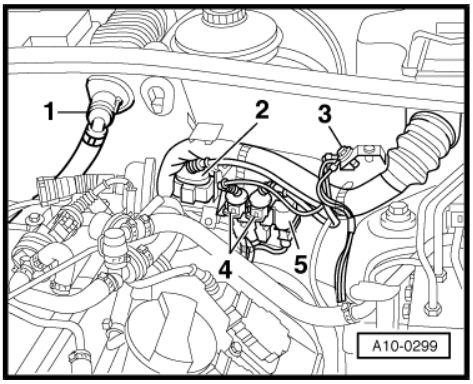
– Detach earth connection -2- and retainer -1- for electrical connectors from bulkhead.
– Disengage engine wiring harness at electronics box and bulkhead -arrows- and move clear.



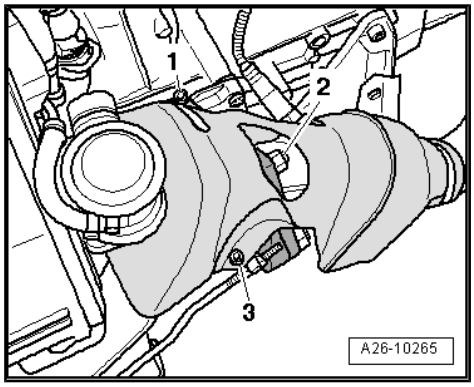
– Take electrical connectors -2-, -4- and -5- out of bracket (left-side) on bulkhead and unplug.
– Remove heat insulation sleeve at wiring harness and move wire to Lambda probe clear.

Note

Disregard items -1 and 3-.



– Unscrew bolts -1- and -3- for heat shield.



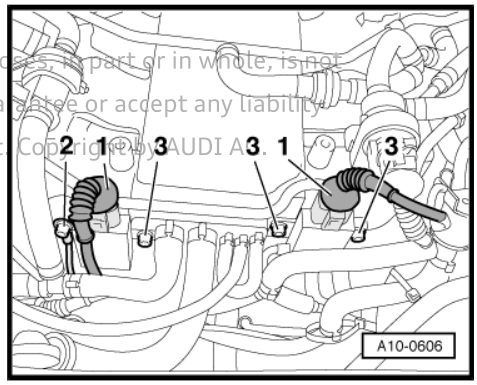
Note

Disregard -item 2-.

– Unscrew Lambda probe from front exhaust pipe (left-side).
– Bend heat shield for front exhaust pipe to the side.

Vehicles without secondary air system:

– Unplug electrical connector -1- for exhaust gas temperature sender 1 - G235- , bank 1 (brown), on intake manifold (right-side).

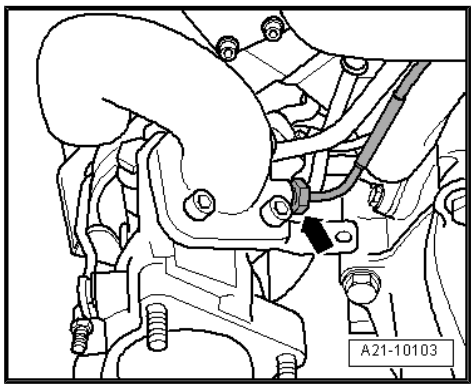


Note

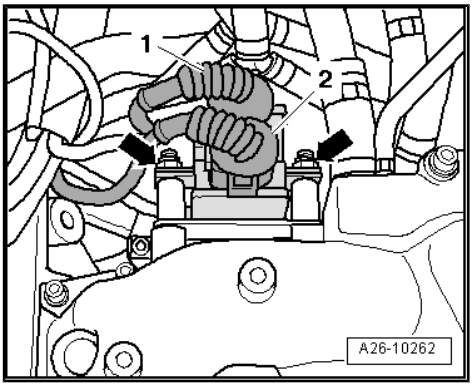
Disregard items -2 and 3-.

All vehicles (continued):

– Use ring spanner - 3035- to unscrew exhaust gas temperature sender 1 for bank 2 - G236- -arrow- from exhaust manifold flange.



Vehicles with secondary air system:



– Move electrical wire to control unit for exhaust gas temperature sender clear.
– Unplug electrical connectors -1- and -2-.
– Unbolt control units for exhaust gas temperature senders from intake manifold -arrows-.
– Remove exhaust gas temperature sender 1 for bank 2 - G236- with control unit (black connector).

Installing

- Tightening torques:

Component	Nm
Exhaust gas temperature sender 1 for bank 2 - G236- to exhaust manifold	27
Control unit for exhaust gas temperature sender to intake manifold	8[1)]
• [1)] Renew self-locking nuts.	

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

Note

- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *The screw sections of used screw-type clips must be sprayed with rust remover prior to fitting so that the air hoses can be attached securely to the hose connections.*
- *Fit all cable ties in the original positions when installing.*
- *Fit all heat insulation sleeves in the original position when installing.*

– Install Lambda probe ⇒ Rep. gr. 24 .
– Install heat shield for front exhaust pipe ⇒ page 238 .
– Install cover for electronics box in plenum chamber ⇒ Rep. gr. 97 .
– Install air duct ⇒ page 29 .
– Secure drive shaft to flange shaft of gearbox ⇒ Rep. gr. 40 .
– Install heat shield for drive shaft ⇒ page 29 .
– Install noise insulation ⇒ Rep. gr. 50 .

3 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.

3.1 Principle and function

Principle

Because of the over-enrichment of the mixture in the cold start phase, the proportion of unburned hydrocarbons in the exhaust gas is higher. The secondary air system improves the afterburning (oxidation) process in the catalytic converter, and thus reduces toxic emissions. The heat generated by oxidisation accelerates the "light off" of the catalytic converter and significantly improves exhaust gas quality during warm-up.

Function

- During the warm-up phase, the engine control unit -2- activates the secondary air pump -5- via the secondary air pump relay - J299- -1-. Air will then reach the combination valves for secondary air system -3- and -8-.
- At the same time, the secondary air inlet valve -4- is actuated, thus allowing vacuum to reach the combination valves for secondary air system -3- and -8-. In this way, the combination valve opens a passage for the secondary air system to supply air to the exhaust ports in the corresponding cylinder head.

1 - Secondary air pump relay - J299-

- ❑ Fitting location ⇒ page 274
- ❑ Checking ⇒ page 278

2 - Motronic control unit - J220-

3 - Combination valve for secondary air system (right-side)

- ❑ Fitting location ⇒ page 273
- ❑ Checking ⇒ page 284
- ❑ Removing and installing ⇒ page 291

4 - Secondary air inlet valve - N112-

- ❑ Fitting location ⇒ page 273
- ❑ Checking ⇒ page 274

5 - Secondary air pump motor - V101-

- ❑ Fitting location ⇒ page 273
- ❑ Removing and installing ⇒ page 287

6 - Non-return valve

- ❑ Installation position: as shown in illustration, the arrow points in direction of flow

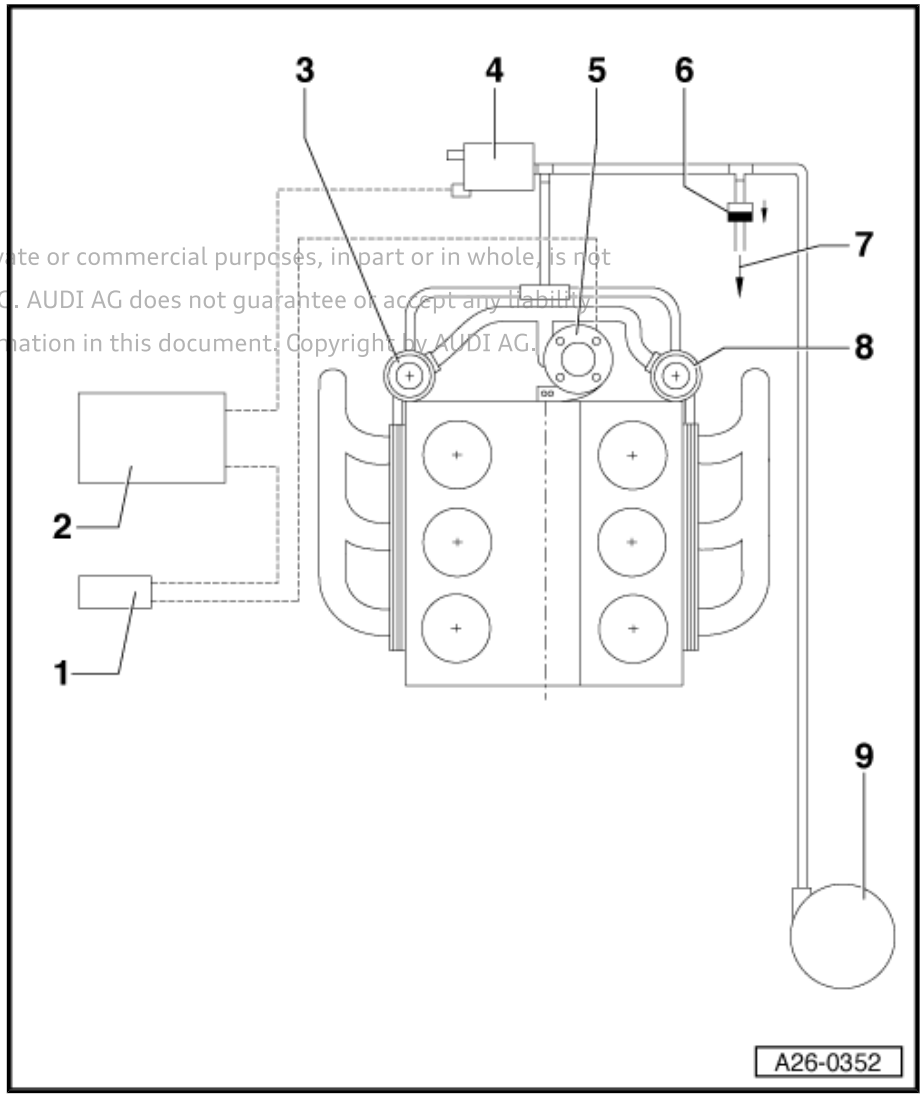
7 - To intake manifold

8 - Combination valve for secondary air system (left-side)

- ❑ Fitting location ⇒ page 273
- ❑ Checking ⇒ page 284
- ❑ Removing and installing ⇒ page 289

9 - Vacuum reservoir

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



Fitting locations in engine compartment

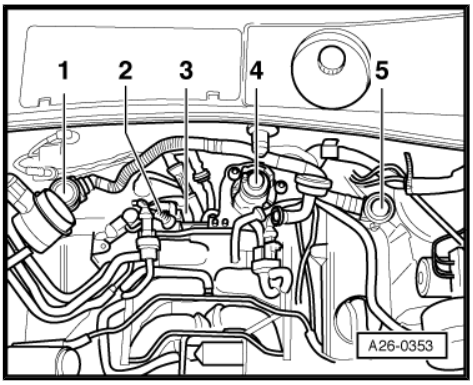
1 - Combination valve for secondary air system (right-side)

2 - (Ignore)

3 - Secondary air inlet valve - N112- (located below control units for exhaust gas temperature -item 2-).

4 - Secondary air pump motor - V101-

5 - Combination valve for secondary air system (left-side)



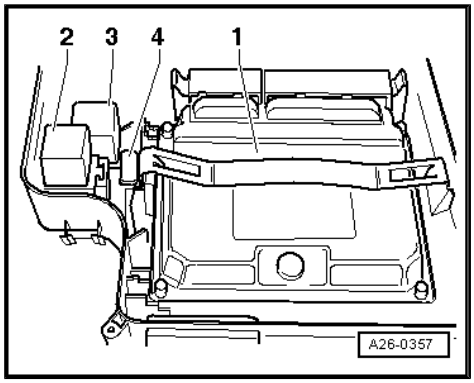
Fitting locations in electronics box (plenum chamber).

1 - Motronic control unit - J220-

2 - Secondary air pump relay - J299-

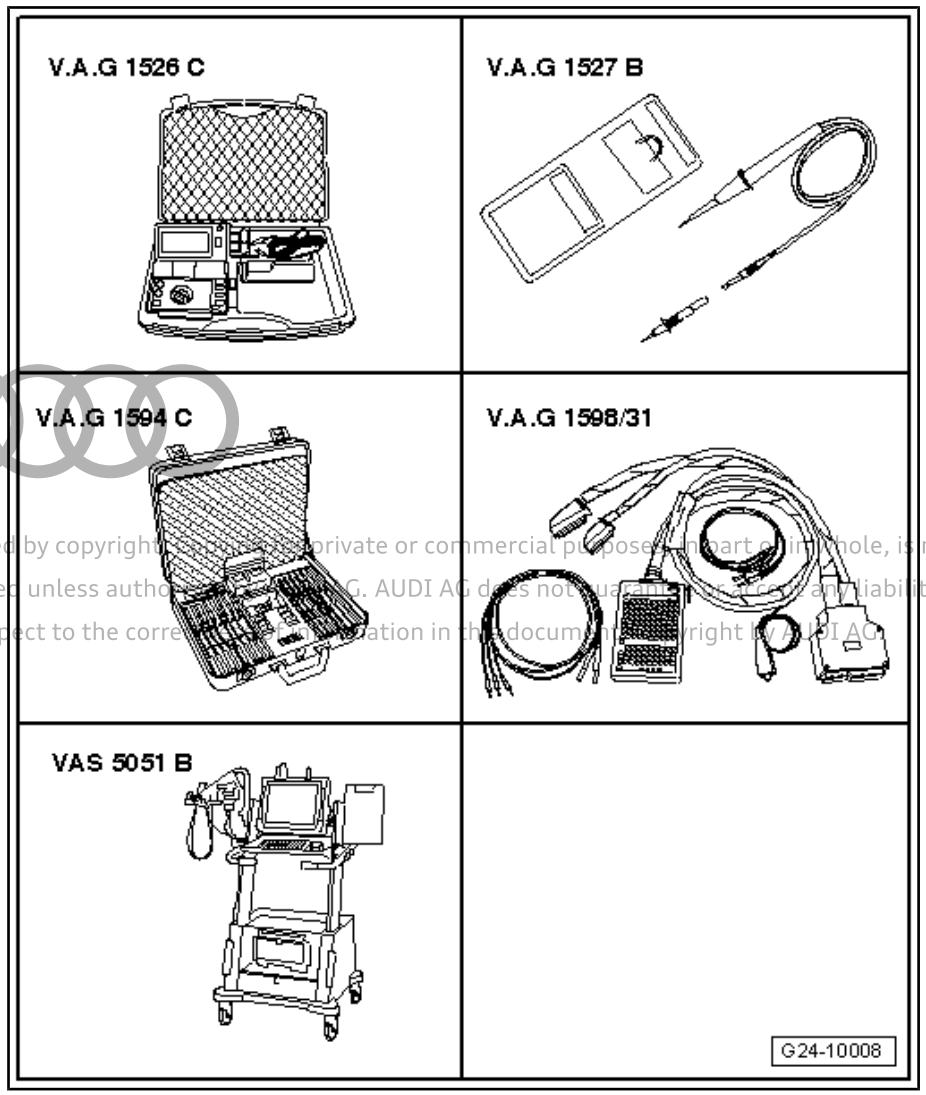
3 - (Ignore)

4 - Secondary air pump fuse - S130-



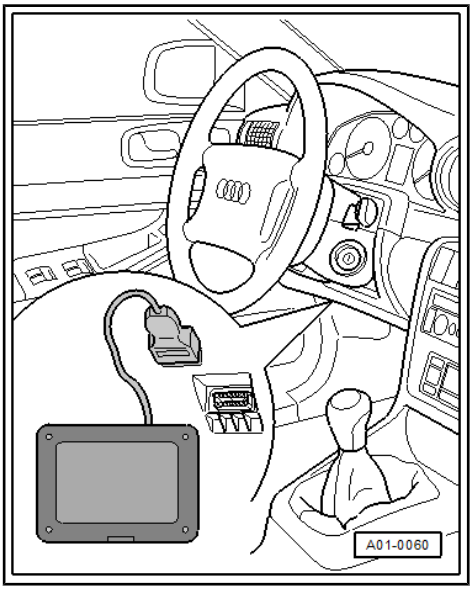
3.2 Checking secondary air inlet valve - N112-

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

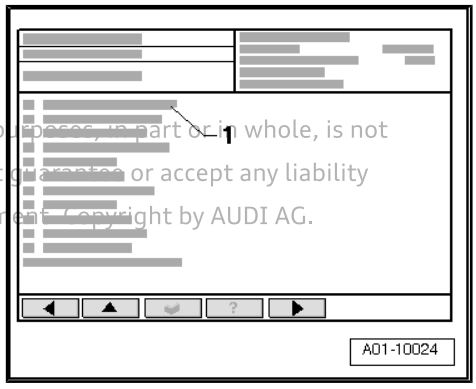


Note

The 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.
- Engine running
- Vehicle self-diagnosis and vehicle system “01 - Engine electronics” selected.

Display on -VAS 5051B- :

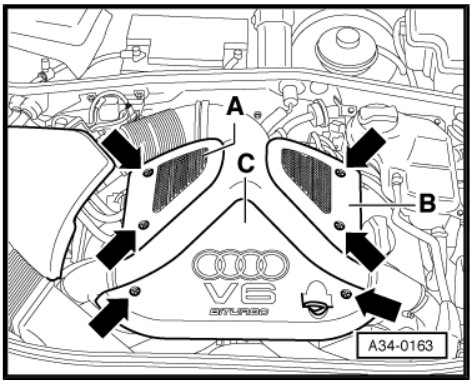


– From menu -1-, select diagnostic function “Interrogate fault memory” and press → key to continue.

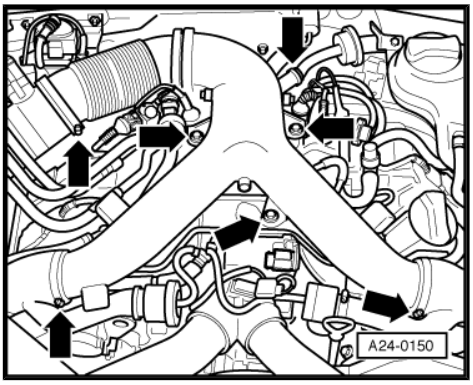
If a fault relating to secondary air inlet valve - N112- is displayed:

– Press ← key to terminate function “Interrogate fault memory”.
– Select function “End output” and switch off ignition.

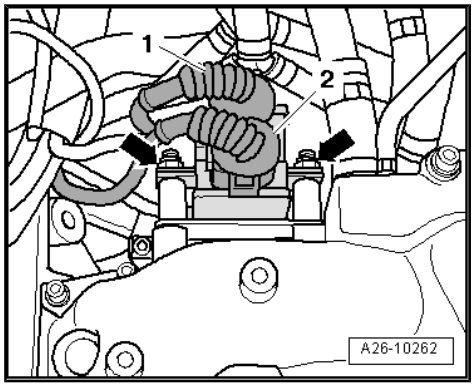
– Detach engine cover panels -A ... C- by removing bolts -arrows-.



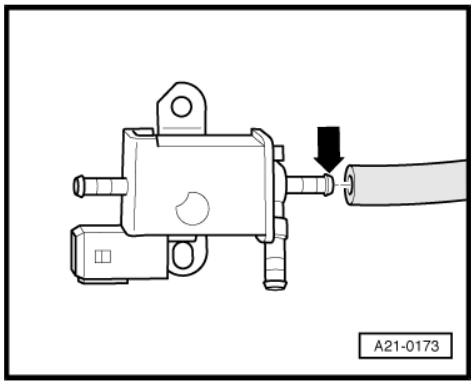
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



– Unplug electrical connectors -1- and -2-.
– Unscrew nuts -arrows- and remove control units for exhaust gas temperature sender.
– Detach bracket for secondary air inlet valve - N112- from intake manifold; leave electrical connector attached.
– Detach hoses from secondary air inlet valve - N112- .



– Connect test hose to secondary air inlet valve - N112- connector marked with an -arrow-.



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

Display on -VAS 5051B- :

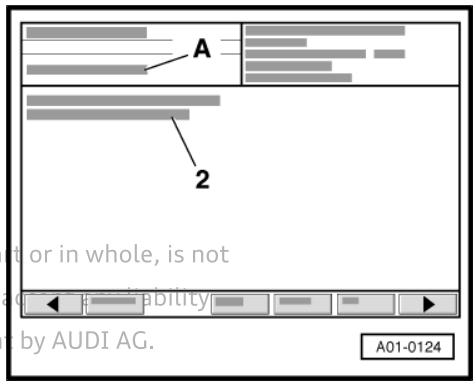
– From menu -1-, select diagnostic function “Final control diagnosis” and press → key to continue.

– Press → key repeatedly until the following display appears:

Display on -VAS 5051B- :

2 - Secondary air inlet valve - N112-

A - Actuator is running; continued switching is allowed



• The valve should click and open and close (check by blowing into the test hose).

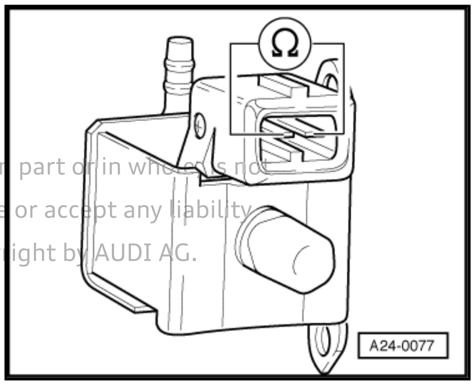
– Press ← key to exit diagnostic function “Final control diagnosis”.
– Select function “End output” and switch off ignition.

If valve clicks but does not open or close correctly:

– Renew secondary air inlet valve - N112- .

If valve does not click:

Checking internal resistance



– Unplug electrical connector at secondary air inlet valve - N112- .

– Connect hand-held multimeter - V.A.G 1526C- to measure resistance between contacts on secondary air inlet valve - N112- .

• Specification: 25 ... 35 Ω

If the specification is not obtained:

– Renew secondary air inlet valve - N112- .

If specification is obtained:

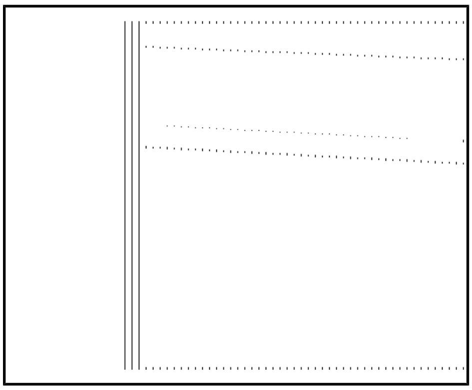
Checking voltage supply

• Fuse for secondary air inlet valve - N112- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

• Fuel pump relay - J17- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

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 engine earth.

– Operate starter briefly.

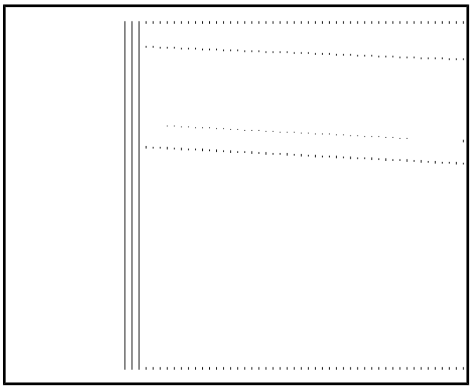
• The LED should light up.

If LED does not light up:

– Repair wiring from contact -1- of connector, via fuse, to fuel pump relay - J17- (refer to current flow diagram).

If the LED lights up:

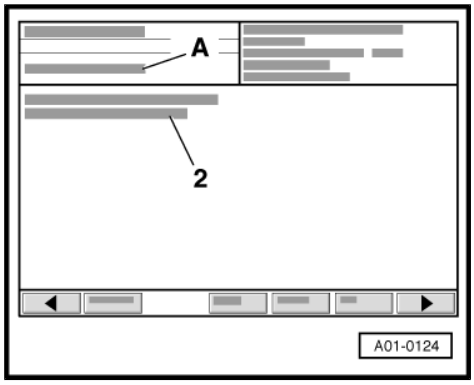
Checking activation



– Connect voltage tester - V.A.G 1527B- between contact -1- and -2- of connector for secondary air inlet valve - N112- .

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

– Repeat diagnostic function “Final control diagnosis”.
– Press → key repeatedly until the following display appears:



Display on -VAS 5051B- :

2 - Secondary air inlet valve - N112-

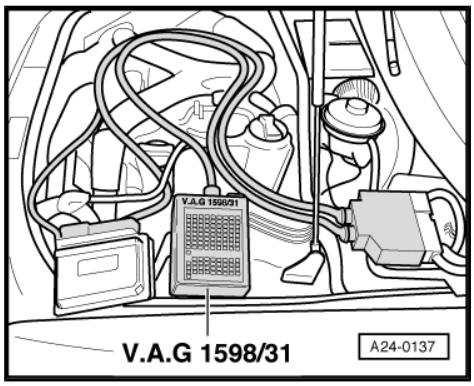
A - Actuator is running; continued switching is allowed

• The LED should flash.

– Press ← key to exit diagnostic function “Final control diagnosis”.
– Select “End output”.
– Switch off ignition and unplug diagnostic connector.

If the LED does not flash:

– Connect adapter cable - 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 (not shown in illustration).

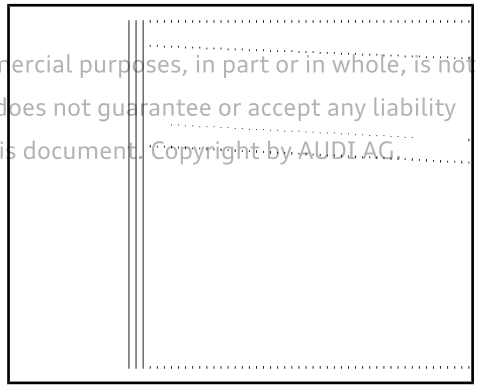


Caution

Risk of irreparable damage to electronic components.

- ***Select the appropriate measuring range before connecting the test leads and observe test requirements.***

– Check for open circuit and short to positive or earth in the following wiring:



Connector Contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-2-	44

– Repair wiring connection if necessary.

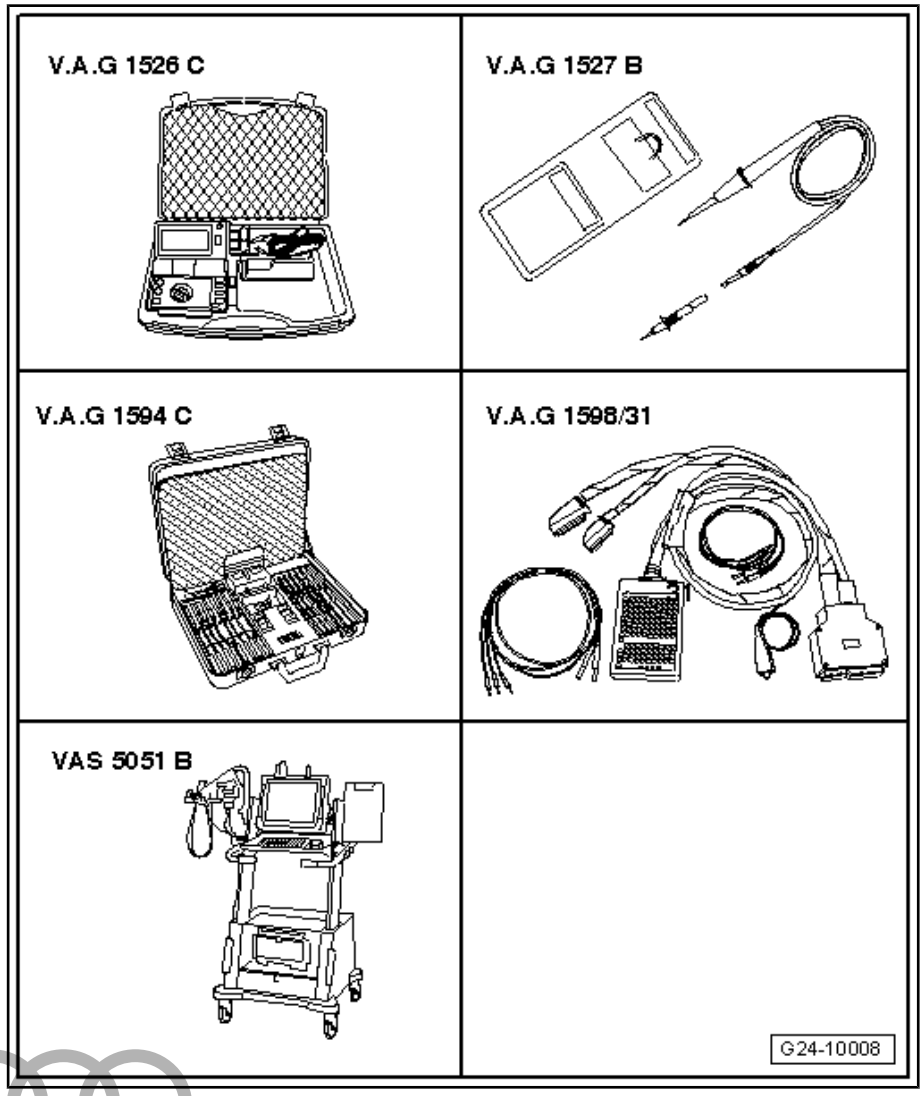
Assembling

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

– Install air duct ⇒ page 29 .

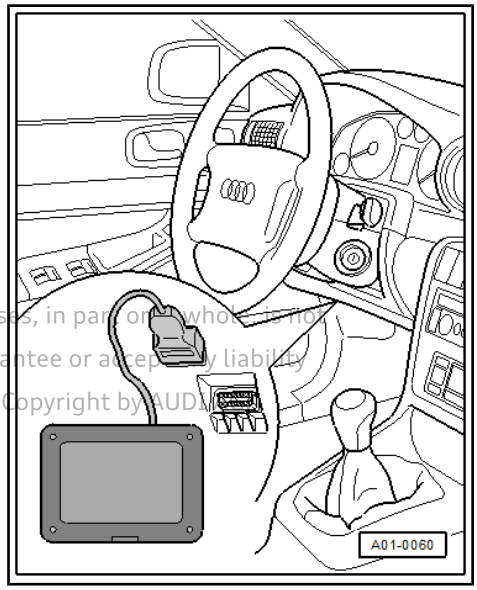
3.3 Checking secondary air pump relay - J299- and activation

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



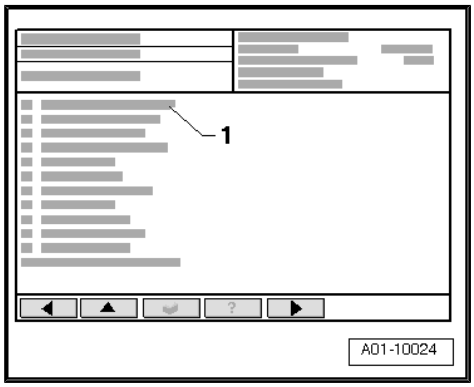
Note

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

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running
- Vehicle self-diagnosis and vehicle system “01 - Engine electronics” selected.

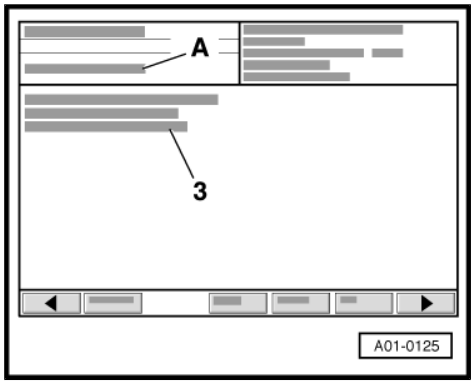
Display on -VAS 5051B- :

– From menu -1-, select diagnostic function “Interrogate fault memory” and press → key to continue.



If the display shows a fault relating to secondary air pump relay - J299- :

– Press ← key to terminate function “Interrogate fault memory”.
– Switch off engine, then switch on ignition again.
– From menu -1- select diagnostic function “Final control diagnosis”.
– Press → key repeatedly until the following display appears:

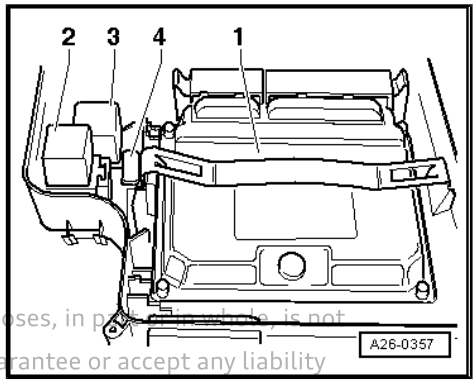


Display on -VAS 5051B- :

3 - Secondary air pump relay - J299-

A - Actuator is running; continued switching is allowed

- The secondary air pump relay - J299- -item 2- (located in electronics box in plenum chamber) should pick up and the secondary air pump motor - V101- should start up intermittently.



– Press ⌫ key to exit diagnostic function “Final control diagnosis”.
– Select function “End output” and switch off ignition.

A - If the relay does not pick up:

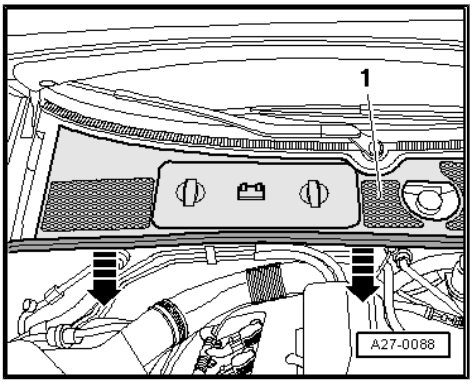
– Check voltage supply of secondary air pump relay - J299- ⇒ page 281 .
– Check activation of secondary air pump relay - J299- ⇒ page 282 .

B - If the relay picks up but the secondary air pump motor - V101- does not run:

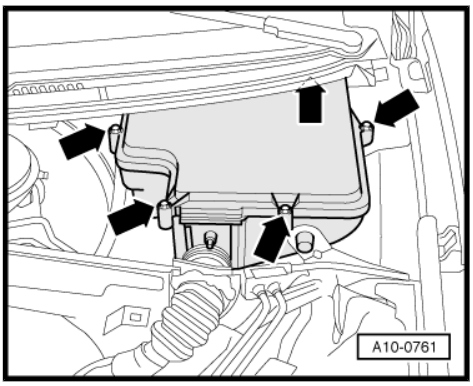
– Check voltage supply for secondary air pump motor - V101- ⇒ page 283 .

Checking voltage supply of secondary air pump relay - J299-

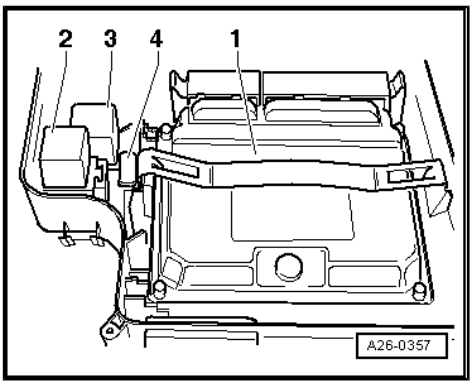
– Remove seal -arrows-.
– Pull off plenum chamber cover -1- towards front of vehicle.



– Unscrew bolts -arrows- and take off cover for electronics box in plenum chamber.

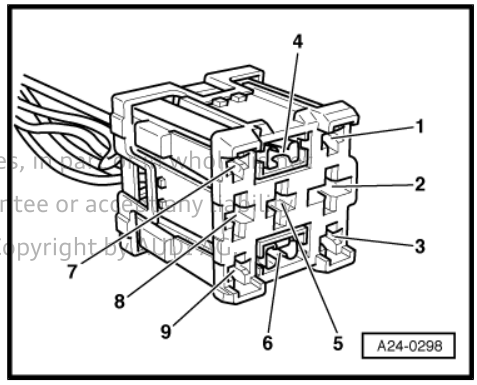


– Disconnect secondary air pump relay - J299- -item 2-.



– Connect hand-held multimeter - V.A.G 1526C- (voltage measuring range) between relay socket contact -8- and earth.

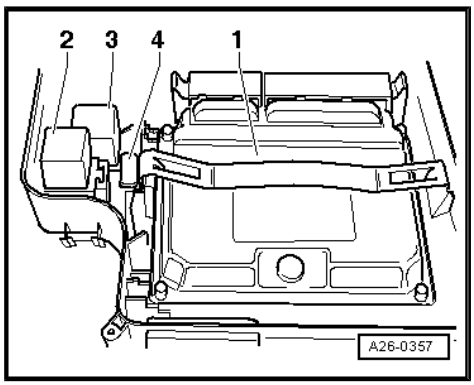
• Specification: approx. battery voltage



If specification is not obtained:

– Check secondary air pump fuse - S130- -item 4-.

– Check for open circuit in wiring from battery “+” (terminal 30), via secondary air pump fuse - S130- -item 4- to secondary air pump relay - J299- -item 2-.



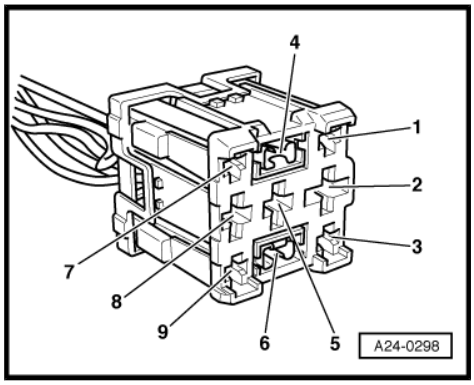
– Connect hand-held multimeter - V.A.G 1526C- (voltage measuring range) between contact -4- of relay socket and earth.

– Operate starter briefly.

• Specification: approx. battery voltage

If specification is not obtained:

– Repair wiring connection if necessary.



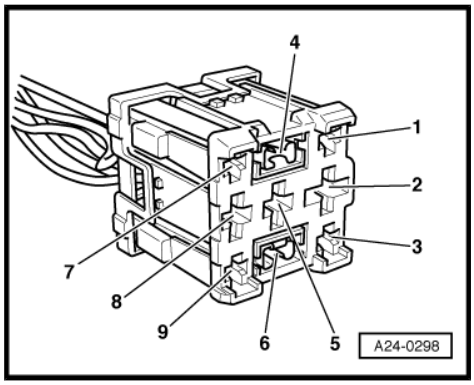
Checking activation of secondary air pump relay - J299-

– Switch off ignition.

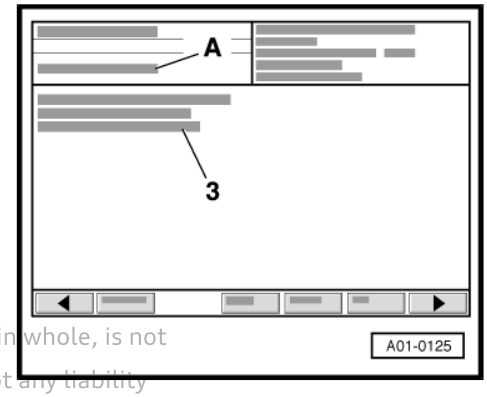
– Disconnect secondary air pump relay - J299- .

– Connect up voltage tester - V.A.G 1527B- between relay socket contact -6- and battery positive.

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



– Repeat diagnostic function “Final control diagnosis”.
– Press [→] key repeatedly until the following display appears:



Display on -VAS 5051B- :

3 - Secondary air pump relay - J299-

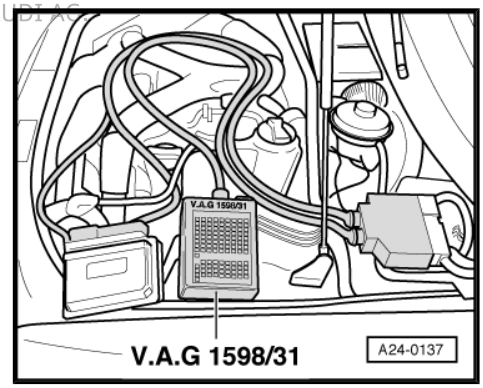
A - Actuator is running; continued switching is allowed

- The LED should flash.

– Press [←] key to exit diagnostic function “Final control diagnosis”.
– Select function “End output” and switch off ignition.

If the LED does not flash:

– Connect adapter cable - 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 (not shown in illustration).



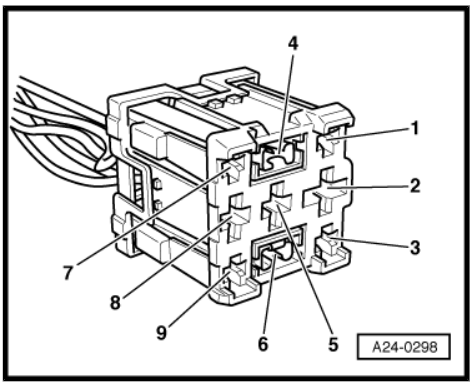
Caution

Risk of irreparable damage to electronic components.

- *Select the appropriate measuring range before connecting the test leads and observe test requirements.*

– Check for open circuit and short to positive or earth in the following wiring:

Relay socket contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-6-	46



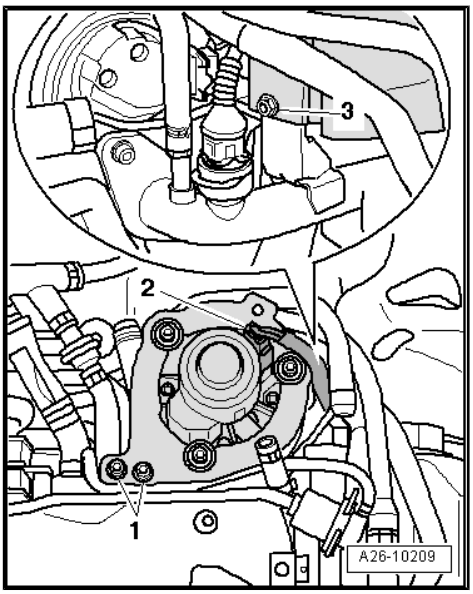
– Repair wiring connection if necessary.

If no fault is found in wiring:

– Renew secondary air pump relay - J299- .

Checking voltage supply for secondary air pump motor - V101-

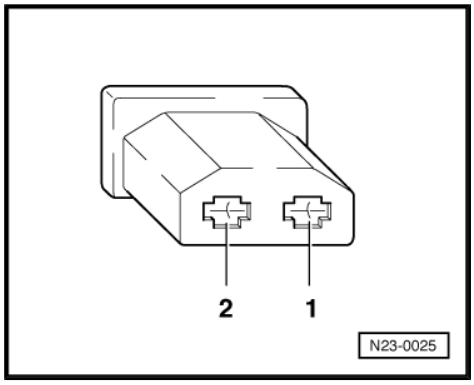
– Unplug electrical connector -2- at secondary air pump motor - V101- .



Note

Disregard items marked -1- and -3-.

– Connect voltage tester - V.A.G 1527B- between contact -1- and -2- of connector for secondary air pump motor - V101- .
– Switch on ignition and select vehicle system “01 - Engine electronics”.

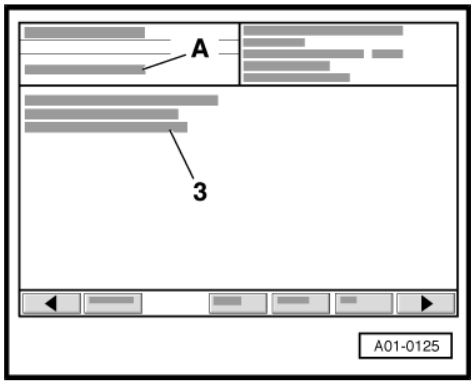


– Repeat diagnostic function “Final control diagnosis”.
– Press → key repeatedly until the following display appears:

Display on -VAS 5051B- :

3 - Secondary air pump relay - J299-

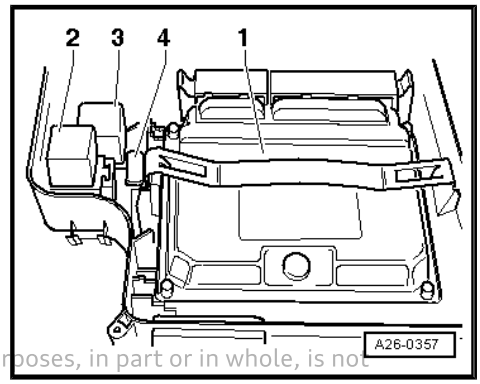
A - Actuator is running; continued switching is allowed



- The LED should flash.

– Press ← key to exit diagnostic function “Final control diagnosis”.
– Select “End output”.
– Switch off ignition and unplug diagnostic connector.

If the LED does not flash:



– Use current flow diagram to check for open circuit in wiring between connector at secondary air pump motor - V101- and secondary air pump relay - J299- -item 2- (in electronics box in plenum chamber).
– Use current flow diagram to check for open circuit in wiring between connector at secondary air pump motor - V101- and earth.

If no fault is found:

– Renew secondary air pump ⇒ page 287 .

Assembling

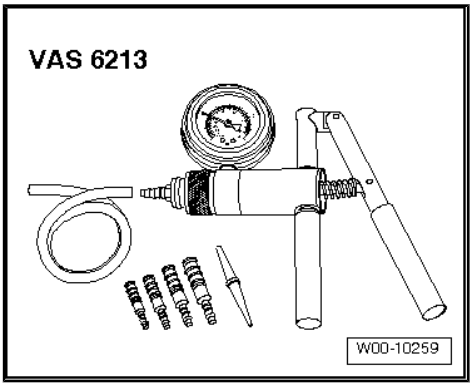
Installation is carried out in the reverse order; note the following:

– Install cover for electronics box in plenum chamber ⇒ Rep. gr. 97 .

3.4 Checking combination valves for secondary air system for correct operation and leakage

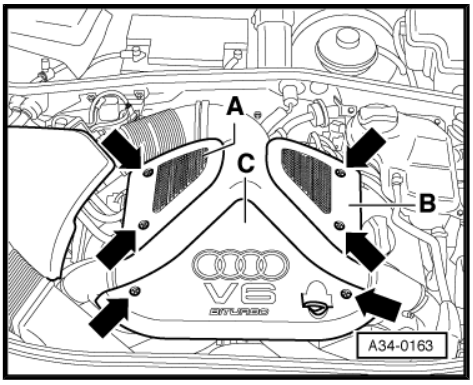
Special tools and workshop equipment required

♦ Hand vacuum pump - VAS 6213-

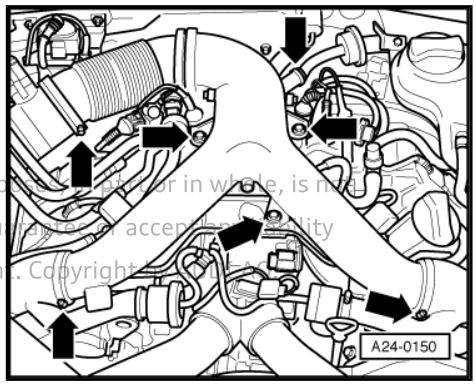


Procedure

– Detach engine cover panels -A ... C- by removing bolts -arrows-.



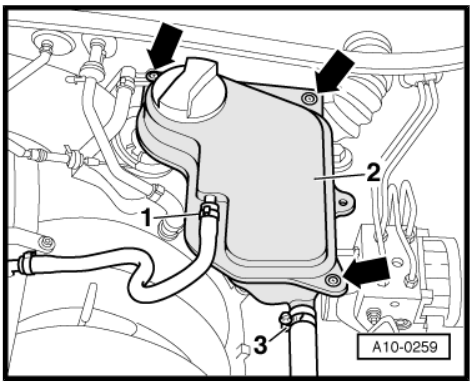
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



Combination valve for secondary air (left-side):

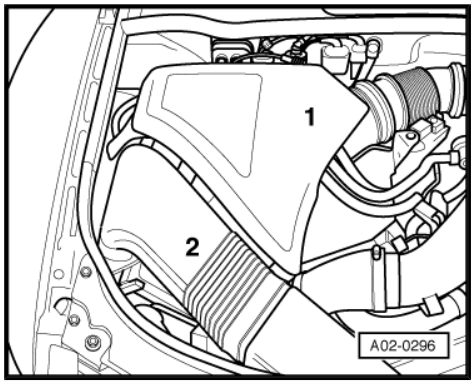
– Remove bolts -arrows-.

– Unplug electrical wiring to coolant shortage indicator switch - F66- and move coolant expansion tank -2- to one side with coolant hoses -1- and -3- attached.



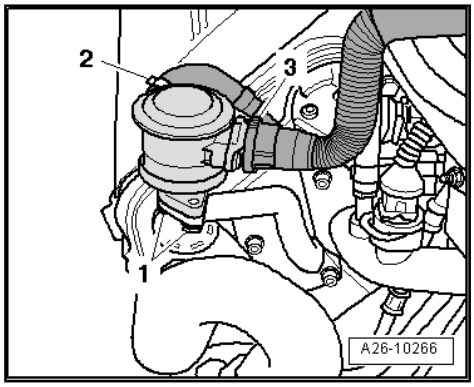
Combination valve for secondary air (right-side):

– Remove cover -1- on right side of engine compartment.



Both sides (continued):

– Detach air intake hose -3- and vacuum hose -2- from relevant combination valve for secondary air system.



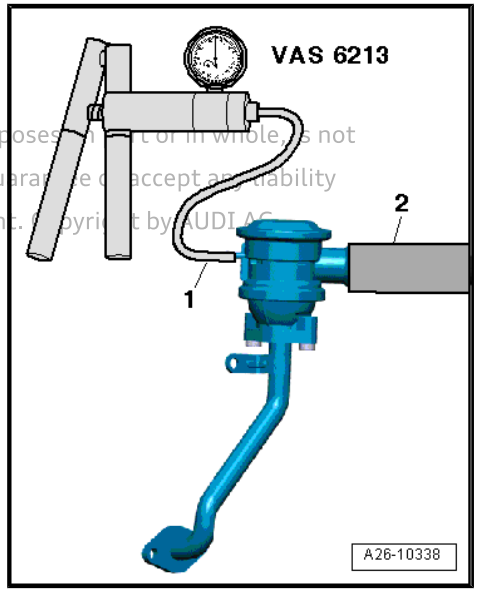
Note

Disregard -item 1-.

– Connect hand vacuum pump - VAS 6213- to vacuum connection -1- on relevant combination valve for secondary air system.

– Connect a suitable test hose -2- onto combination valve for secondary air system.

– Blow lightly into test hose with your mouth (do not use compressed air).



- The combination valve for secondary air system should be closed; it should not be possible to blow through the hose.

– Operate hand vacuum pump to produce a vacuum.

- The combination valve for secondary air system should open; it should now be possible to blow through the hose.

If combination valve for secondary air system does not react as described:

– Renew combination valve for secondary air system: on left-side ⇒ page 289 , on right-side ⇒ page 291 .

Assembling

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

Note

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

– Install air duct ⇒ page 29 .

3.5 Exploded view - secondary air pump

1 - Securing clip

2 - Housing

3 - Small filter element

4 - Large filter element

5 - Secondary air pump motor - V101-

- ❑ Removing and installing secondary air pump ⇒ page 287

6 - Air hose

- ❑ To combination valves for secondary air inlet

7 - Bolt

- ❑ 10 Nm

8 - Bolt

- ❑ 10 Nm

9 - Washer

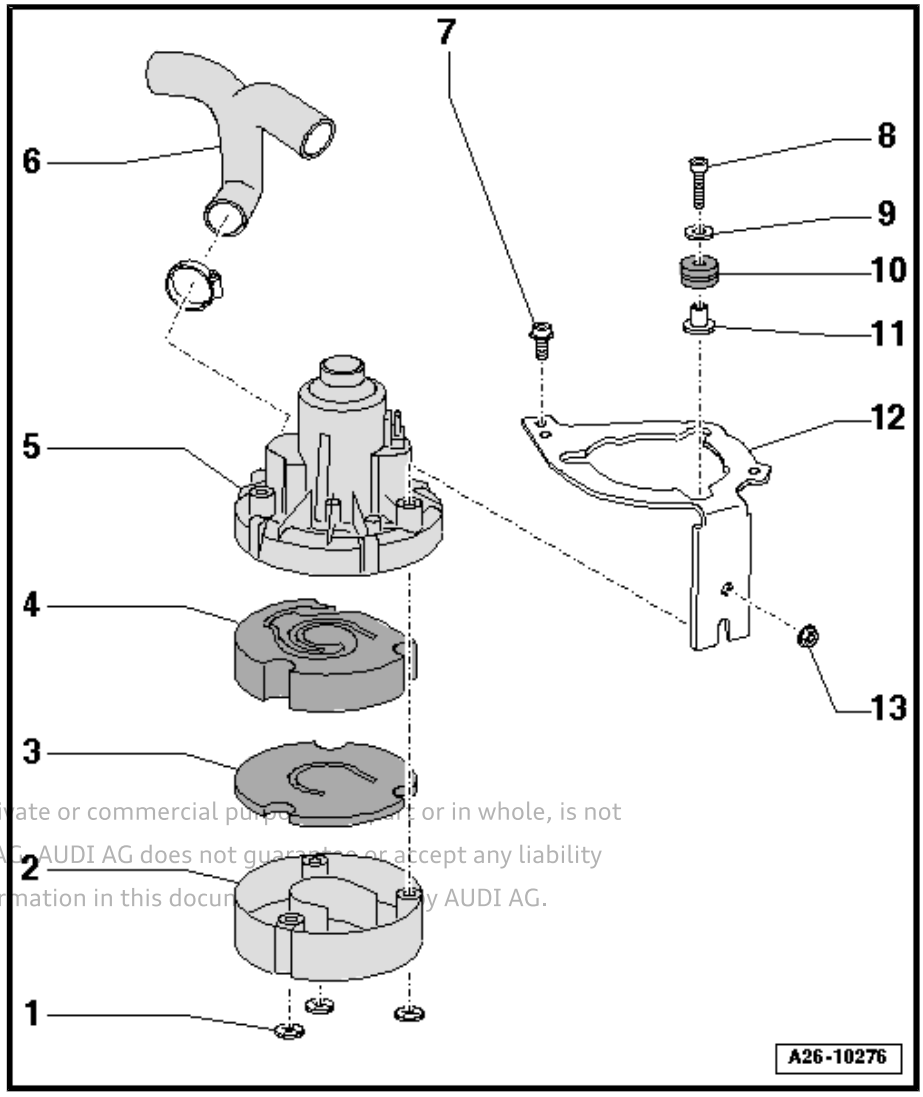
10 - Grommet

11 - Spacer sleeve

12 - Bracket

13 - Nut

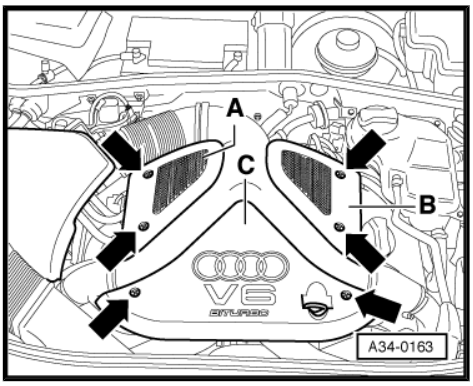
- ❑ 10 Nm



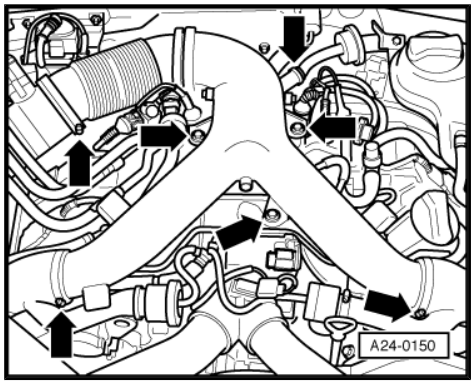
3.6 Removing and installing secondary air pump

Removing

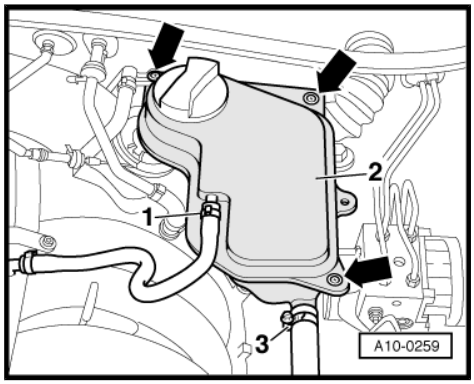
– Detach engine cover panels -A ... C- by removing bolts -arrows-.



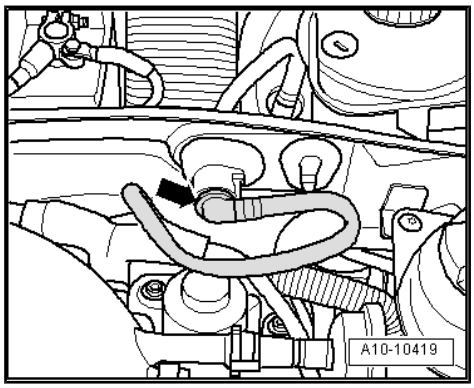
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



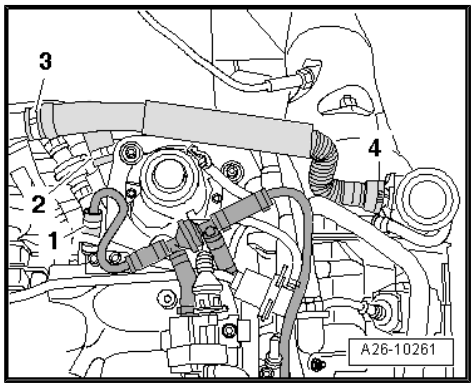
– Remove bolts -arrows-.
– Unplug electrical wiring to coolant shortage indicator switch -F66- and move coolant expansion tank -2- to one side with coolant hoses -1- and -3- attached.



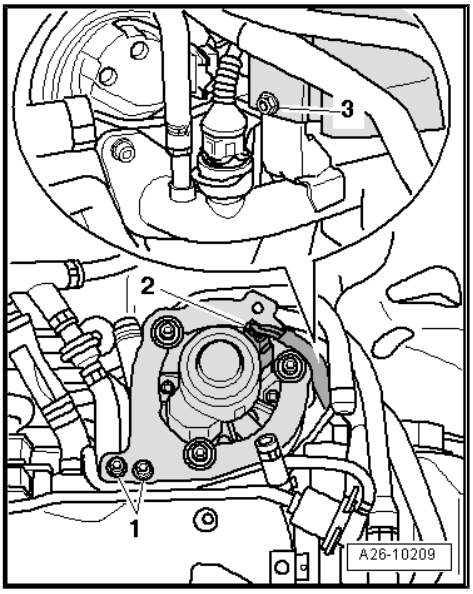
– Detach vacuum line -arrow- going to brake servo at bulkhead.



– Detach vacuum pipe -1-.
– Detach connecting hose leading to combination valves for secondary air at the point indicated -2 ... 4-.



– Unplug electrical connector -2-.
– Remove bolts -1-.
– Slacken nut -3- a few turns.
– Lift out secondary air pump.



Installing

• Tightening torques ⇒ page 286

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

Note

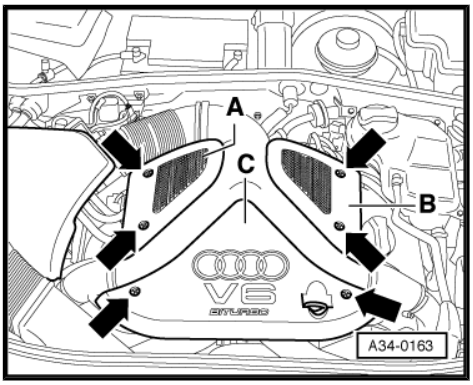
Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .

– Install air duct ⇒ page 29 .

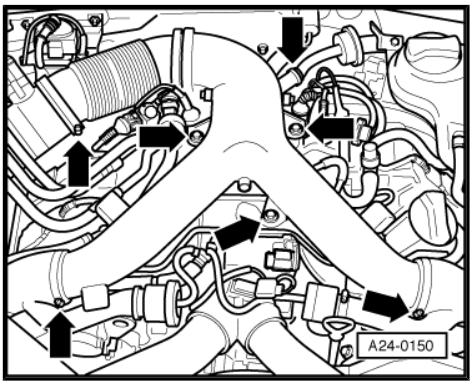
3.7 Removing and installing combination valve for secondary air system (left-side)

Removing

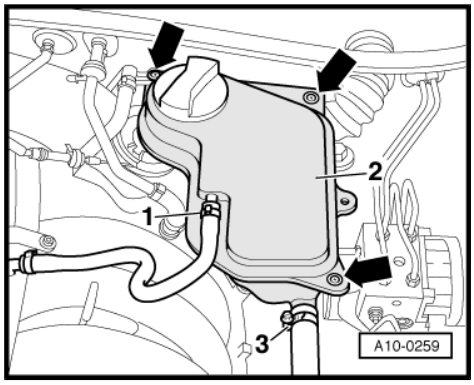
– Detach engine cover panels -A ... C- by removing bolts -arrows-.



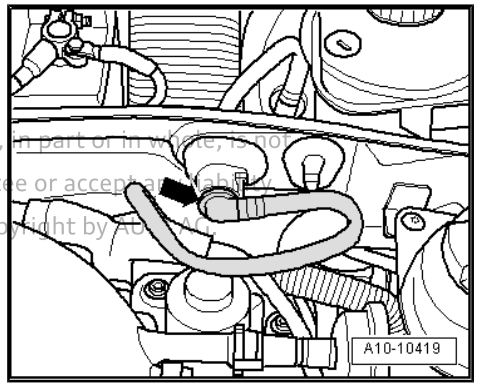
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



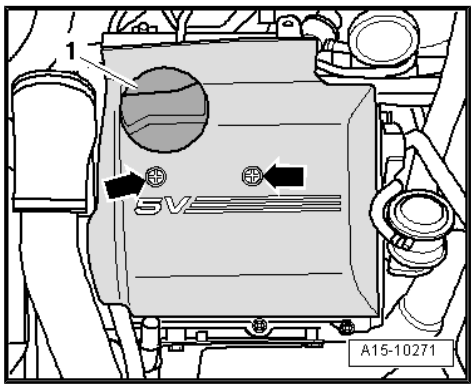
– Remove bolts -arrows-.
– Unplug electrical wiring to coolant shortage indicator switch - F66- and move coolant expansion tank -2- to one side with coolant hoses -1- and -3- attached.



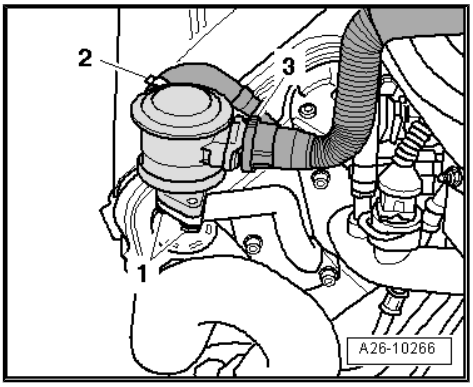
– Detach vacuum line -arrow- going to brake servo at bulkhead.



– Detach filler cap -1-.
– Open quick-release fasteners -arrows- and detach cover for cylinder head cover (left-side).



– Detach vacuum hose -2- and air intake hose -3- leading to relevant combination valve for secondary air system.
– Unscrew bolts -1- and take off combination valve for secondary air from connection.



Note

For illustration purposes, the installation position is shown from the rear.

Installing

- Tightening torques ⇒ page 77

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

Note

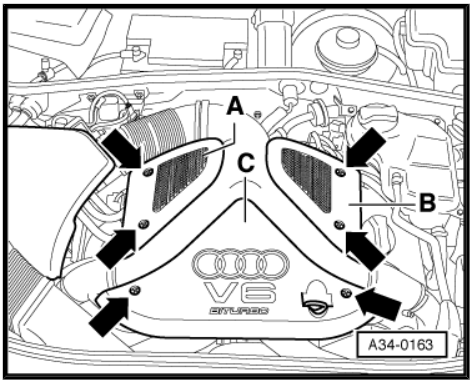
- *Renew seals and/or gaskets.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Install air duct ⇒ page 29 .

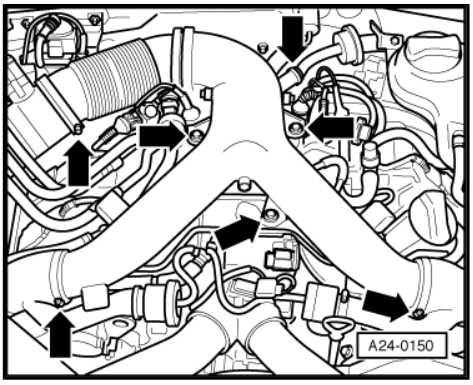
3.8 Removing and installing combination valve for secondary air system (right-side)

Removing

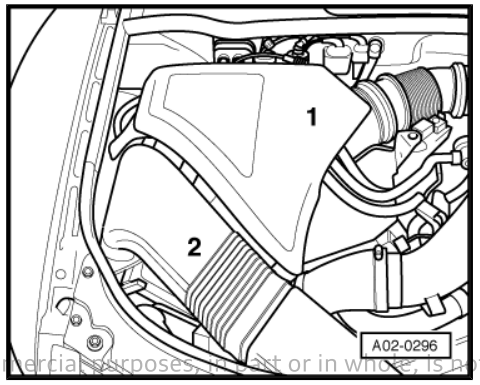
– Detach engine cover panels -A ... C- by removing bolts -arrows-.



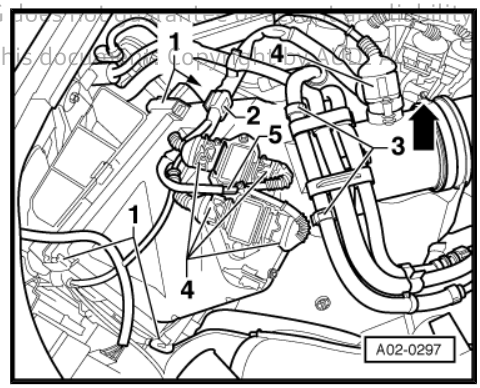
– Unscrew hose connections and bolted connections -arrows- and remove air duct.



– Remove cover -1- on right side of engine compartment.



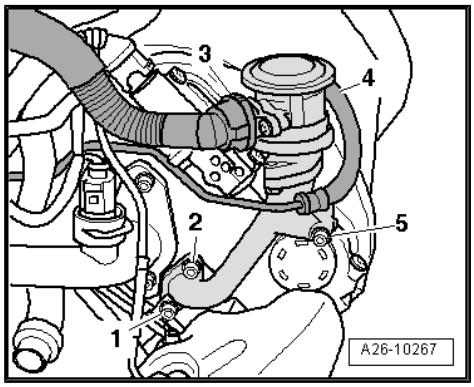
– Unplug electrical connector -4- at air mass meter - G70- .
– On vehicles with separate output stages, unplug remaining connectors -4-, cut through cable tie -5- and detach wiring harness from clip -2-. Then put down wiring harness next to intake opening of air cleaner.
– Open retaining clips -3- for fuel lines.
– Release hose clip -arrow-.
– Remove bolts and take off air filter housing.



Note

Disregard -item 1-.

– Detach hose -3- and vacuum hose -4- from combination valve for secondary air system.
– Unscrew bolts -1-, -2- and -5- and remove combination valve for secondary air system.



Note

For illustration purposes, the installation position is shown from the rear.

Installing

• Tightening torques ⇒ page 77

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

Note

♦ *Renew seals and/or gaskets.*
♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Install air duct ⇒ page 29 .