



Workshop Manual Audi A4 1995 ➤

6-cylinder engine, 2.7 ltr. 5-valve turbo (RS 4),
mechanics

Engine ID	ASJ	AZR	APB						
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Edition 03.2019



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List of Workshop Manual Repair Groups

Repair Group

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



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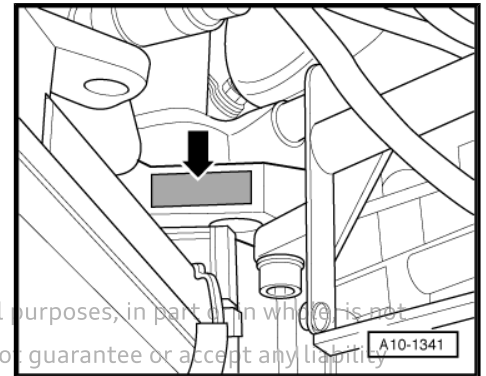
00 – Technical data

1 Technical data

(ARL006293; Edition 03.2019)

1.1 Engine number

- ◆ The engine number ("engine code" and "serial number") is stamped on the right inner side of the cylinder block between the cylinder head and power steering pump -arrow-.
- ◆ The engine code is also to be found on the vehicle data sticker.



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1.2 Engine data

Code letters		ASJ	AZR	APB
Capacity	ltr.	2.671	2.671	2.671
Power output	kW at rpm	280/6100	280/6100	287/5800
Torque	Nm at rpm	440/2500 ... 6000	440/2500 ... 6000	350/1800
Bore	Ø 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
Exhaust gas temperature control	yes		yes	yes
Turbocharging/supercharging		yes	yes	yes
Catalytic converter		yes	yes	yes
Knock control		yes	yes	yes
Lambda control		2 probes	4 probes	4 probes
Variable valve timing		yes	yes	yes
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.				



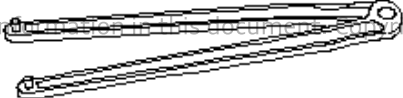
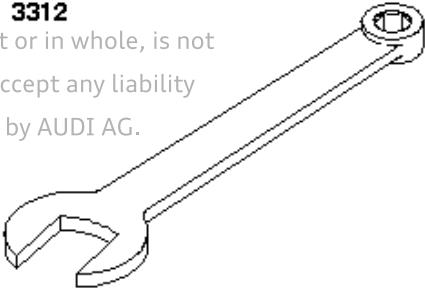
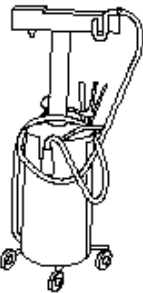
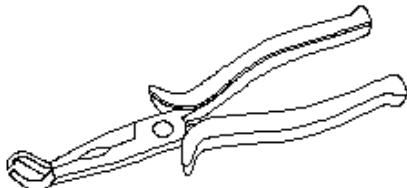
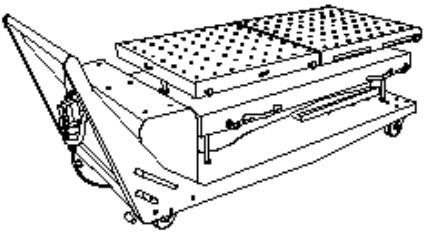
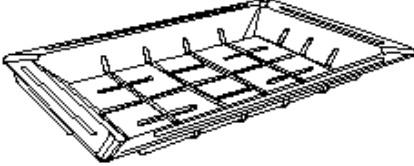
10 – Removing and installing engine

1 Removing and installing engine

1.1 Removing engine

Special tools and workshop equipment required

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3212 	3312 
V.A.G 1782 	V.A.G 1922 
VAS 6131 	VAS 6208  G10-10013

- ◆ Pin wrench - 3212-
- ◆ Open-end spanner - 3312-
- ◆ Used oil collection and extraction unit - V.A.G 1782-
- ◆ Spark plug connector pliers - V.A.G 1922-
- ◆ Scissor-type assembly platform - VAS 6131-
- ◆ Support set for Audi - VAS 6131/10-
- ◆ Drip tray for workshop hoist - VAS 6208-

**Note**

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If the engine is to be separated from the gearbox (after the entire assembly is removed), you will additionally need plate - VAS 6131/10-1- as well as supplementary set - VAS 6131/11- and - VAS 6131/12-.

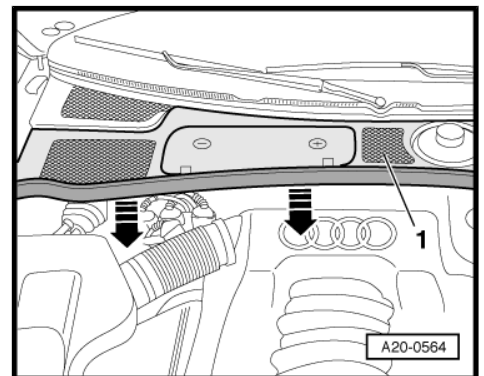
Procedure**Note**

- ◆ *The engine is removed from underneath together with the gearbox and subframe (with lock carrier detached).*
- ◆ *Collect drained coolant in a clean container for re-use or disposal.*
- ◆ *All heat insulation sleeves which are removed must be fitted in the same position when installing.*
- ◆ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*
- Discharge the refrigerant system ⇒ Air conditioner system - with refrigerant R134a .

**Caution**

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

- Detach rubber seal from plenum chamber cover in direction of -arrow-.
- Detach plenum chamber cover -1- towards front.

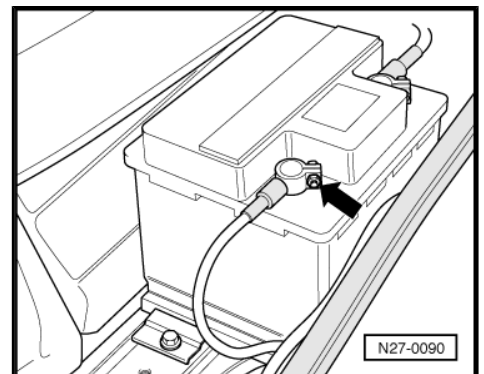


- With ignition switched off, disconnect battery earth cable -arrow-.

**WARNING**

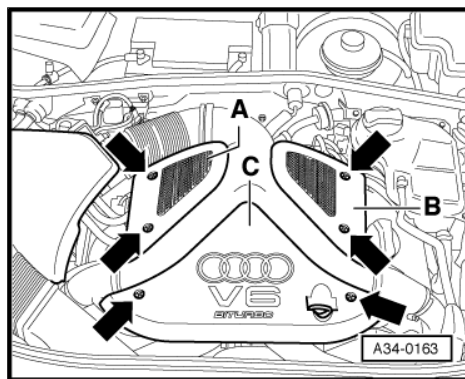
Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

- Open filler cap on coolant expansion tank.

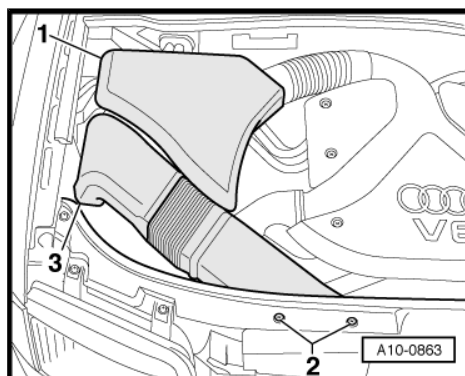




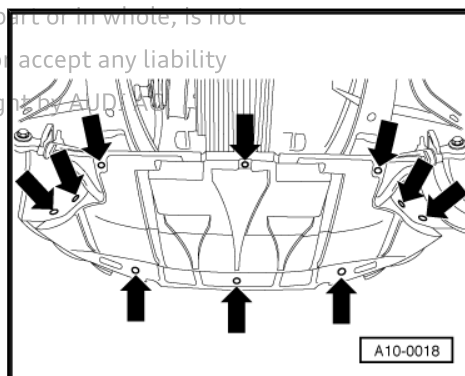
- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.



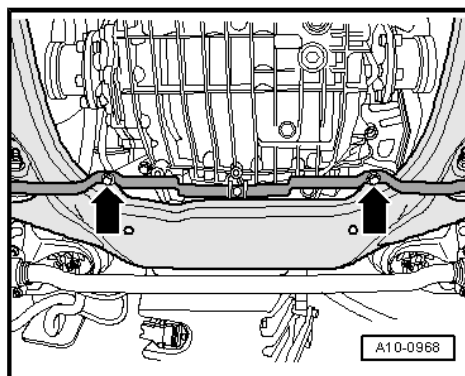
- Remove cover -1- on right side of engine compartment.
- Unscrew bolts -2- and detach air duct from air cleaner housing -3-.



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



- Unbolt bracket for noise insulation -arrows-.



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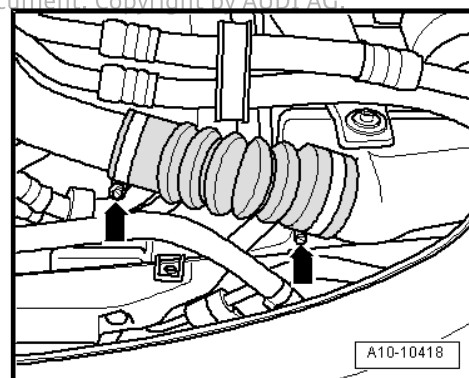
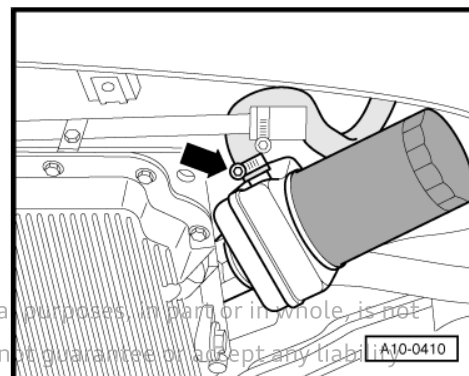
- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Disconnect coolant hose from oil cooler -arrow-, and drain off remaining coolant.



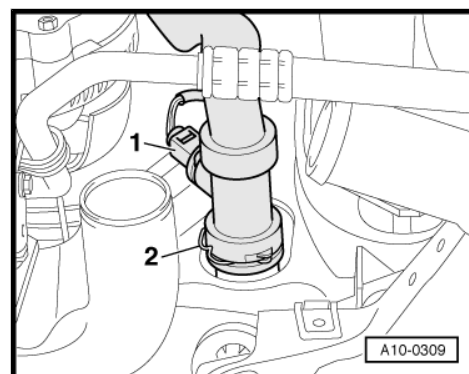
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- Remove air intake hose going to charge air cooler (right-side) -arrows-.



- Unplug electrical connector -1- at radiator fan thermal switch - F18- .
- Disconnect coolant hose (bottom right) -2- at radiator and drain off remaining coolant.

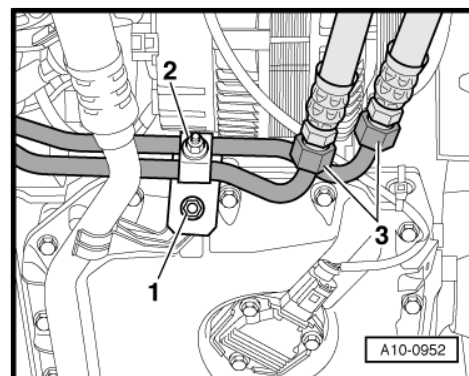


- Place used oil collection and extraction unit - V.A.G 1782- under connection.
- Unscrew union nuts -3- and disconnect gear oil pipes.



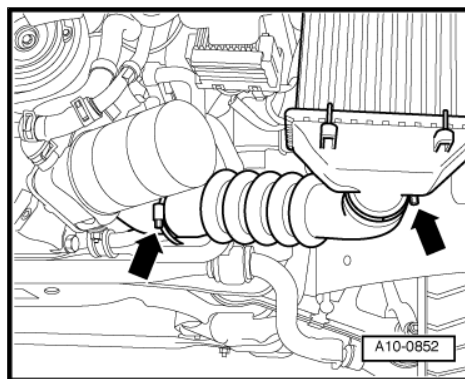
Note

Disregard items marked -1- and -2-.

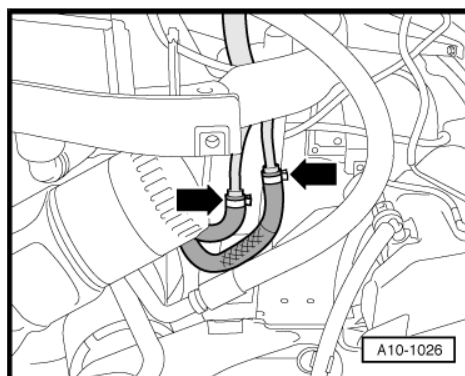




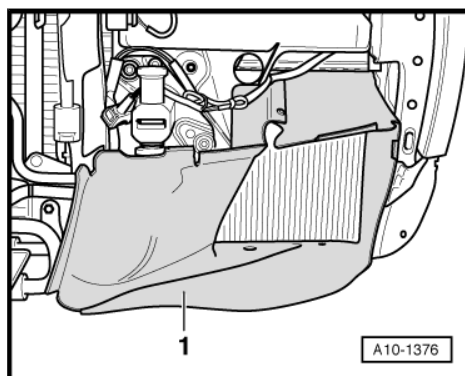
- Remove air hose leading to charge air cooler (left-side) -arrows-.



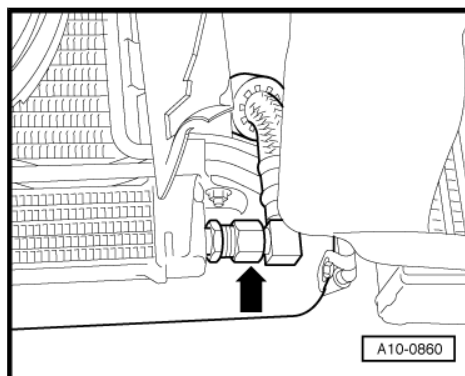
- Place used oil collection and extraction unit - V.A.G 1782- under connection.
- Detach hydraulic pipes going to cooling pipes at rear of lock carrier -arrows-.



- Remove front bumper ⇒ Rep. gr. 63 .
- Move electrical wiring harness on air duct (left and right) clear to one side.
- Remove air duct -1- in front of charge air coolers (left and right).



- Place used oil collection and extraction unit - V.A.G 1782- under connection.
- Unscrew union nut (left and right) -arrow- and disconnect oil line on auxiliary oil cooler.



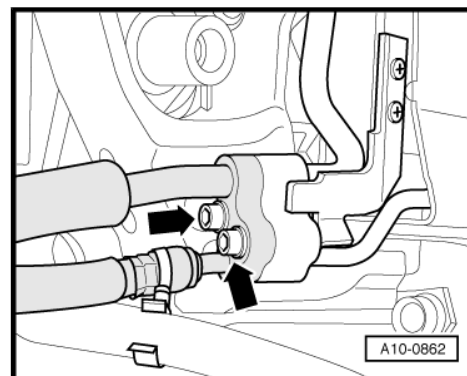
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Note

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

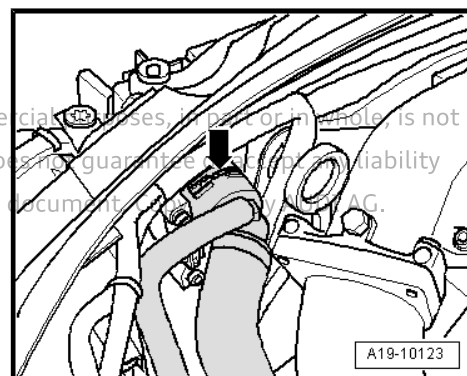
- Remove bolts -arrows- and detach refrigerant lines from condenser.



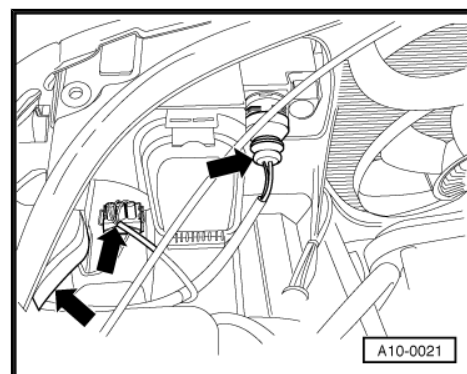
- Detach top left coolant hose from radiator -arrow-.



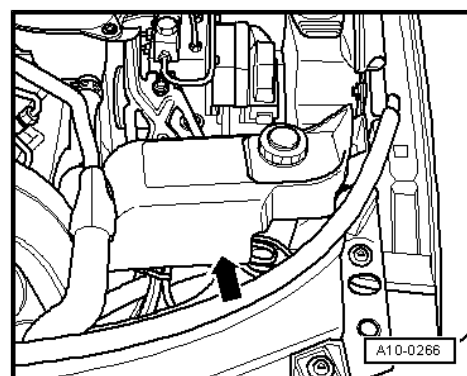
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- Unplug electrical connectors -arrows- for headlights (left and right).

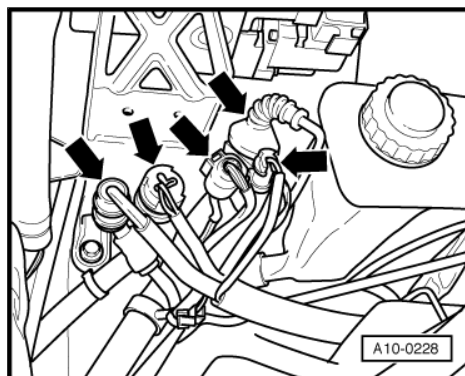


- Remove cover -arrow- at power steering fluid reservoir.

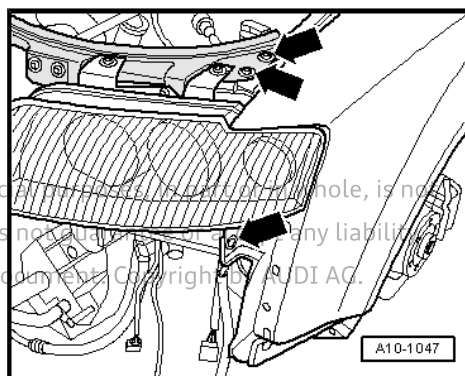




- Take electrical connectors -arrows- out of bracket.
- Unplug electrical connectors and move wiring clear.
- Detach cable for bonnet at lock carrier ⇒ Rep. gr. 55 .



- Remove bolts -arrows- on left and right sides.
- Pull bonnet seal off lock carrier and wing panels.



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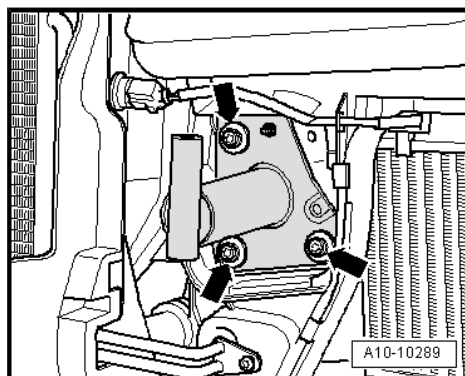
- Unscrew bolts -arrows- from impact dampers (left and right).



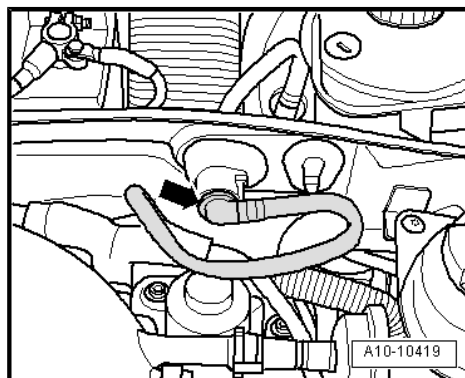
Note

A second mechanic is required for removing the lock carrier.

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

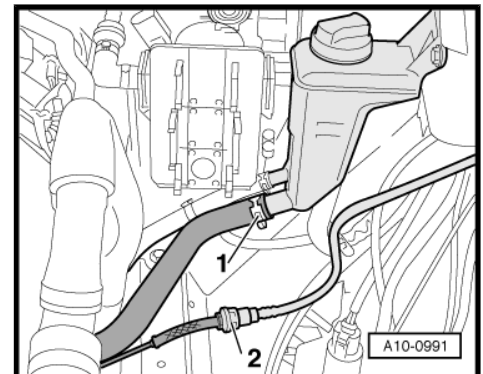
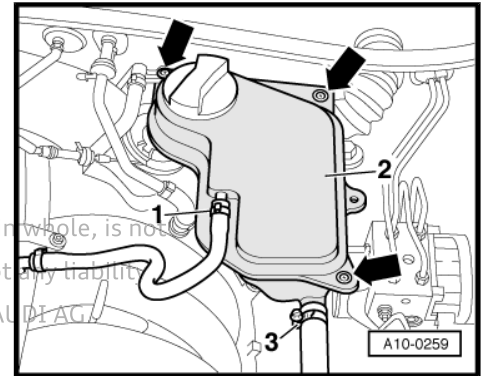


- Detach vacuum line -arrow- going to brake servo at bulkhead.





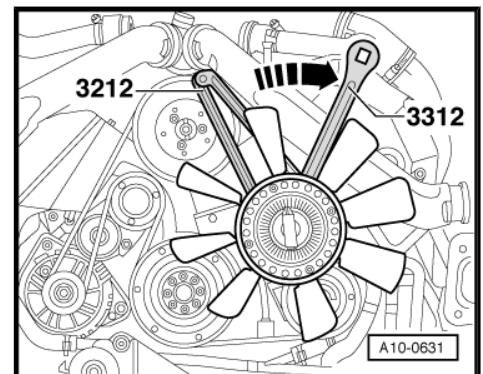
- Detach coolant hoses -1- and -3-.
- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical connector at coolant shortage indicator switch - F66- on coolant expansion tank (bottom).



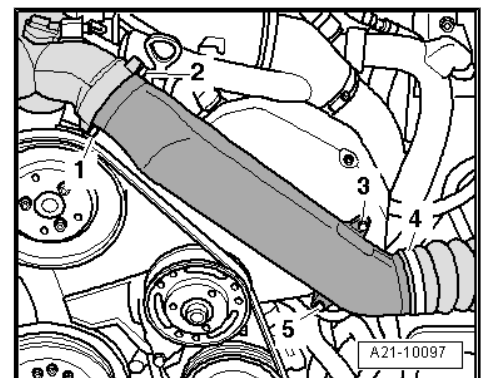
i Note

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

- Detach hose -1- at power steering reservoir.
- Disconnect vacuum hose -2- going to vacuum reservoir.
- Use open-end spanner - 3312- to unscrew viscous fan pulley in clockwise direction -arrow- (left-hand thread) while counterholding with pin wrench - 3212- .



- Disconnect air intake hose -4- from air pipe.
- Unscrew bolts -1 ... 3- and -5- and remove air pipe (left-side).

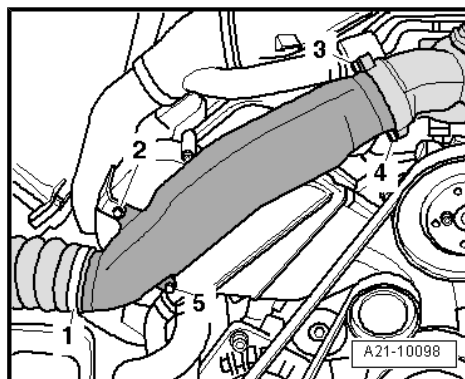




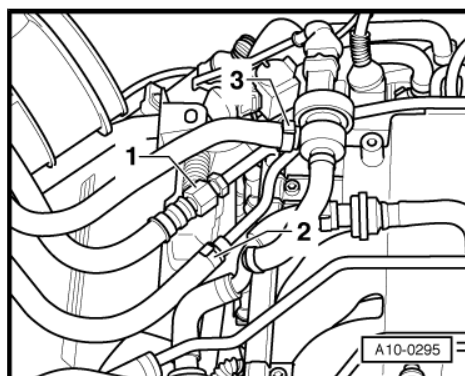
- Disconnect air intake hose -1- from air pipe.
- Remove bolts -2 ... 5- and take out air pipe (right-side).

**WARNING**

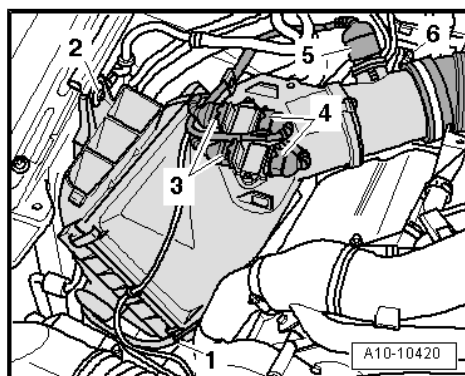
The fuel system is pressurised. Before opening the system place a clean cloth around the connection. Then carefully loosen the connection to relieve the pressure.



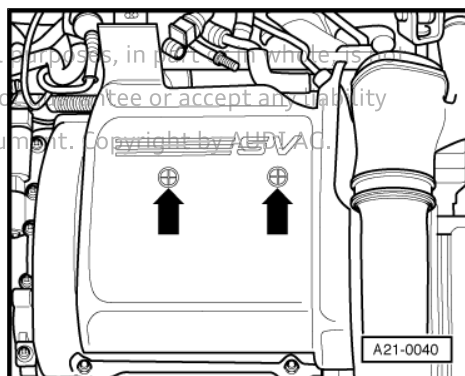
- Disconnect fuel supply line -1- and fuel return line -2-.
- Detach hose -3- from activated charcoal filter solenoid valve 1 - N80- .
- Move hose and wiring clear.



- Unplug electrical connectors at output stage - N122- -item 3- and at output stage 2 - N192- -item 4-.
- Unplug electrical connector -5- at air mass meter - G70- .
- Move wiring harness at air cleaner housing clear.
- Detach air hose -6- at air mass meter - G70- .
- Unplug vacuum hose -1-.
- Unscrew nut -2- and remove air cleaner housing with air mass meter - G70- .



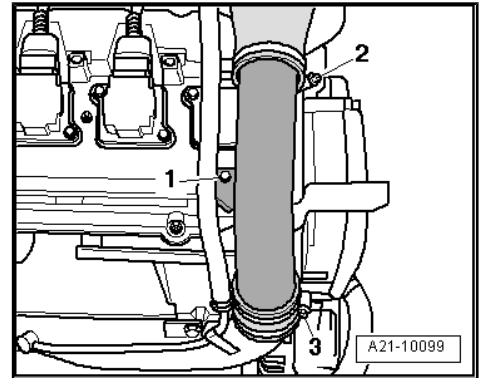
- Loosen quick release fasteners -arrows- and remove cover for cylinder head cover (right-side).



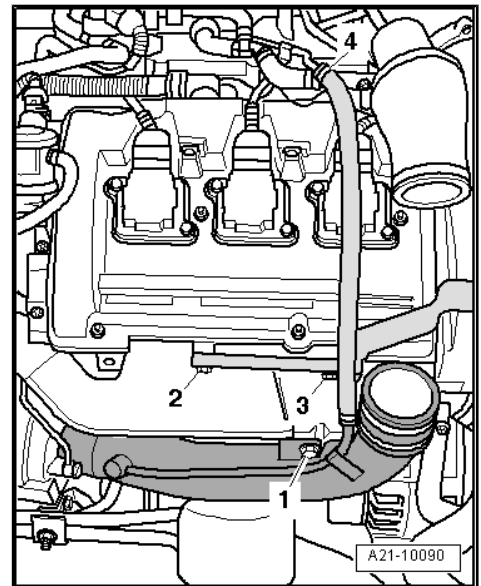
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- Remove bolt -1-.
- Remove top right air pipe; disconnect hose connections -2- and -3- for this purpose.



- Remove bolts -1 ... 3- and take out bracket for air pipe (bottom right).
- Detach vacuum hose -4-.
- Pull off air pipe (right-side) from turbocharger towards the front.

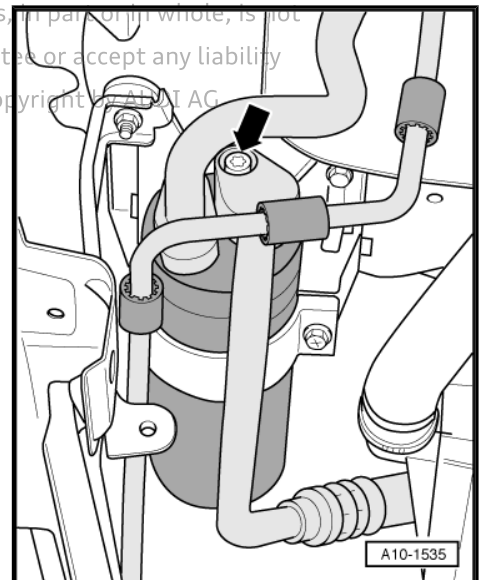


Note

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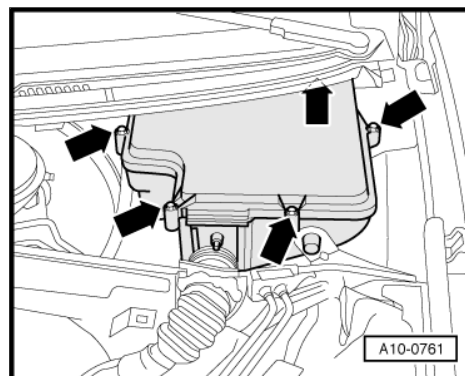
To prevent damage to the refrigerant lines, ensure that the lines and hoses are not stretched, kinked or bent.

- Remove bolt -arrow- and detach refrigerant line going to AC compressor.

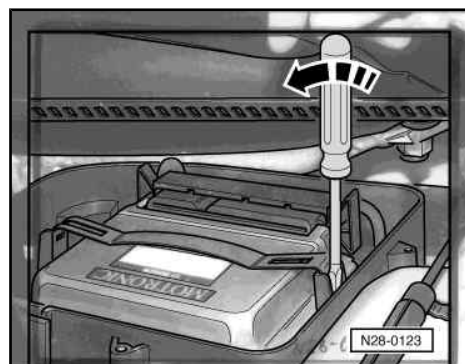




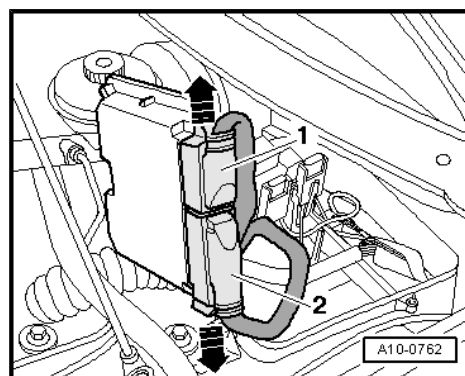
- Remove cover for electronics box in plenum chamber -arrows-.



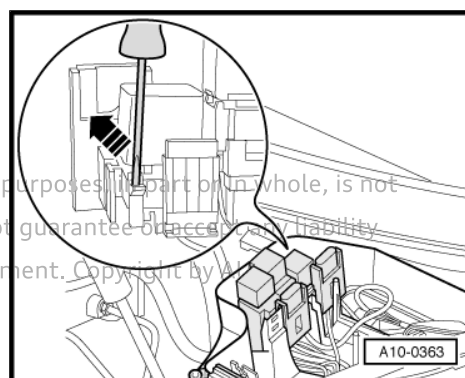
- Carefully lever off retaining strap with a screwdriver -arrow-.



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



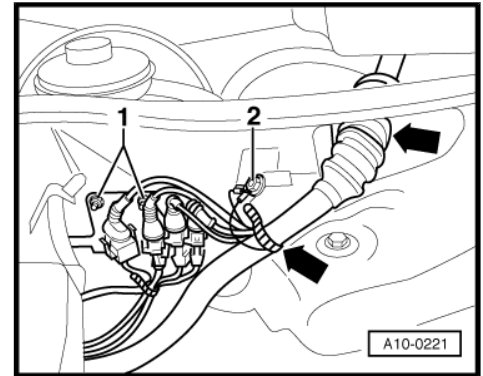
- Release retainer -arrow- and pull auxiliary relay carrier in electronics box upwards to remove.
- Disconnect electrical connectors at connector point using spark plug connector pliers - V.A.G 1922- .



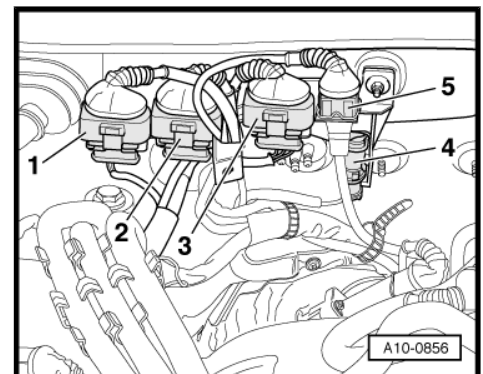
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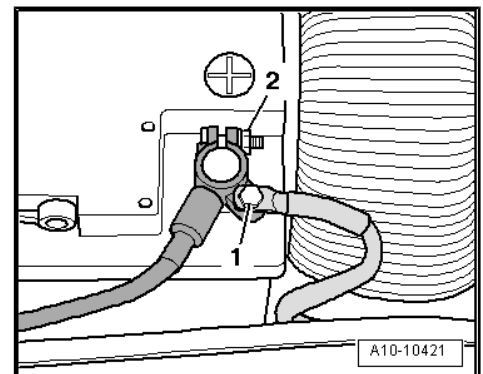
- Detach earth connection -2- and retainer -1- for electrical connectors from bulkhead.
- Disengage engine wiring harness at electronics box and bulkhead -arrows- and move clear.



- Unscrew bracket (right-side) for electrical connectors -1 ... 5- from bulkhead.



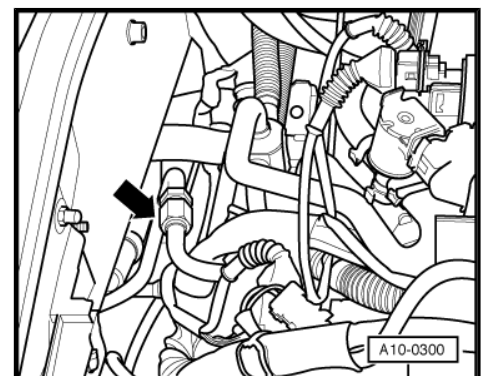
- Unscrew bolt -1- and remove positive battery terminal clamp.
- Disconnect positive cable -2- at positive battery terminal.
- Pull out positive cable forwards through bulkhead.
- Move wiring harness clear and place on top of engine.



Note

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

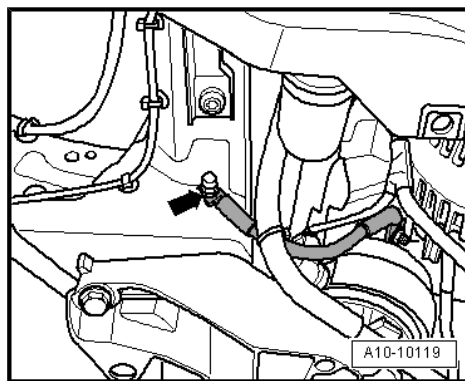
- Separate the hydraulic pressure line -arrow- for power steering pump at rear of engine.
- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Disconnect coolant hoses going to heat exchanger at rear of engine.



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- Unbolt earth cable -arrow- at longitudinal member (right-side).



Note

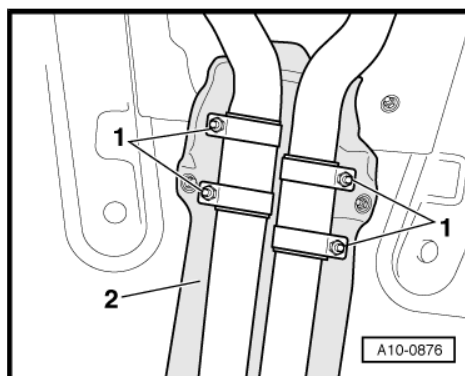
The flexible joint on the front exhaust pipe must not be bent more than 10° – otherwise it can be damaged.

- Disconnect exhaust system at clamps -1-.

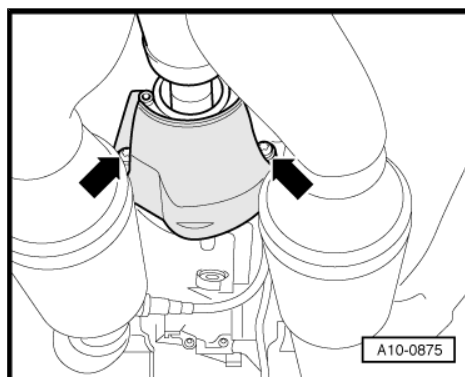


Note

Disregard -item 2-.



- Unbolt heat shield for propshaft -arrows-.
- Unbolt propshaft from flange shaft on gearbox.
- Slide propshaft together towards rear final drive; the constant velocity joints can be moved axially
- Place the propshaft onto heat shield.



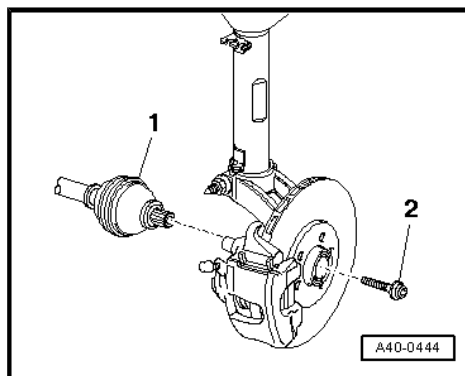
- Have a 2nd mechanic press the brake pedal.



Caution

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

- Unscrew flange bolt -2- from drive shaft -1- (left and right).



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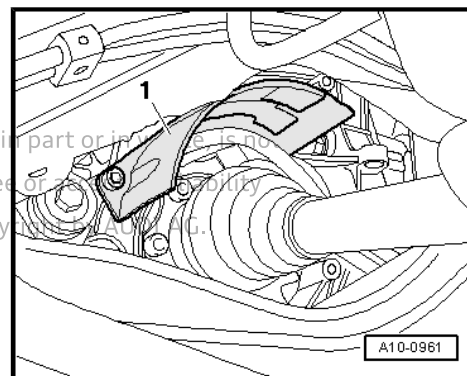


- Unbolt heat shield -1- for drive shafts (left and right).
- Unbolt drive shafts (left and right) from gearbox flange shafts.

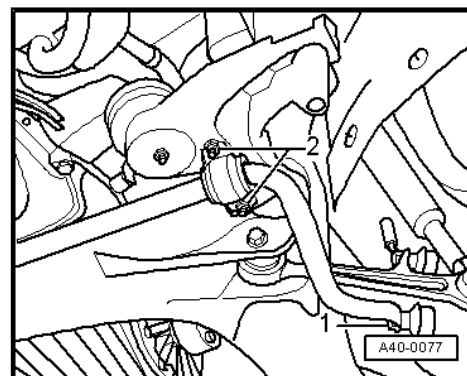
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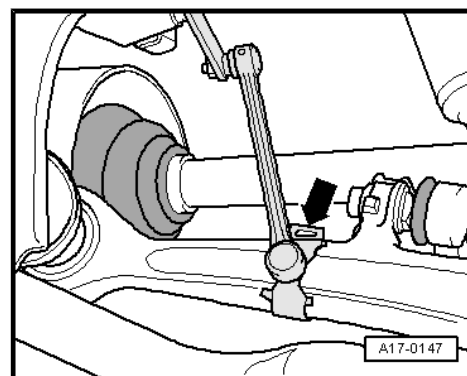
The drive shafts are removed at a later stage.



- Unscrew bolts -1- and nuts -2- on anti-roll bar evenly on both sides.
- Take out anti-roll bar.



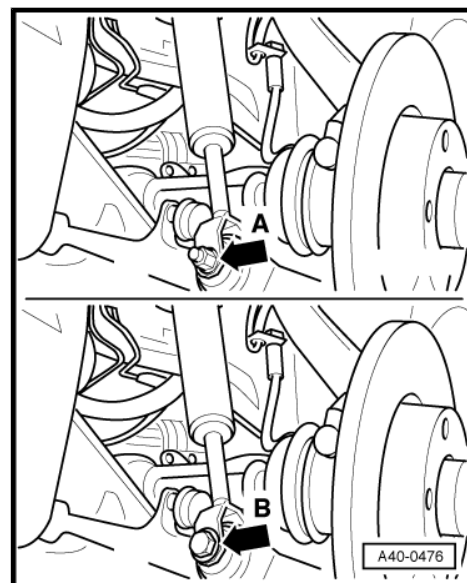
- If fitted, unclip retaining clip -arrow- on operating rod for front left vehicle level sender - G78- at track control link (bottom).



- Unbolt suspension strut from track control link.

**Note**

- ◆ *On vehicles with suspension strut bolt fitted from rear to front -arrow A- (depending on version), the bolt is removed at a later stage.*
- ◆ *On vehicles with suspension strut bolt fitted from front to rear -arrow B- (depending on version), the bolt is removed at this stage.*





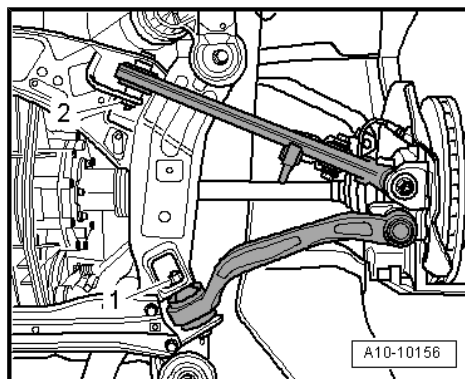
- Unscrew nuts -1- and -2- on bolted connections securing track control link and guide link.



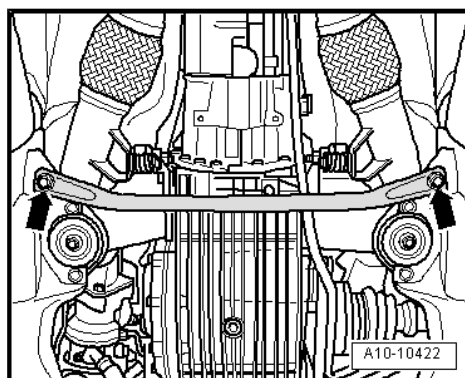
Note

The bolts are removed from the subframe at a later stage.

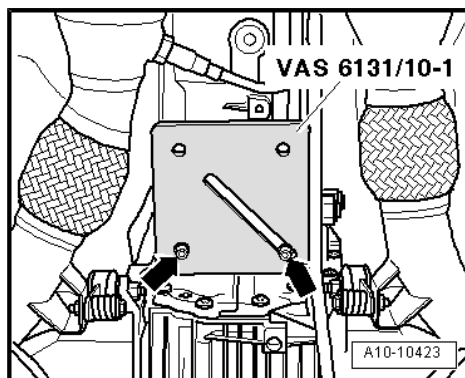
- Repeat procedure on other side of vehicle.



- Unbolt cross piece from subframe -arrows-.



- Secure plate - VAS 6131/10-1- to gearbox with two M8x20 bolts -arrows- as shown in illustration.



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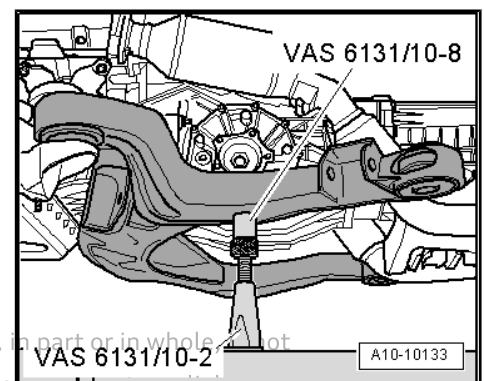
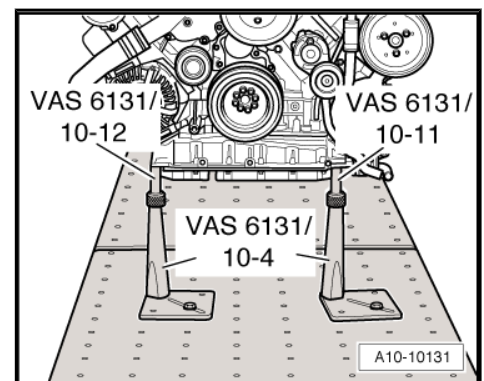
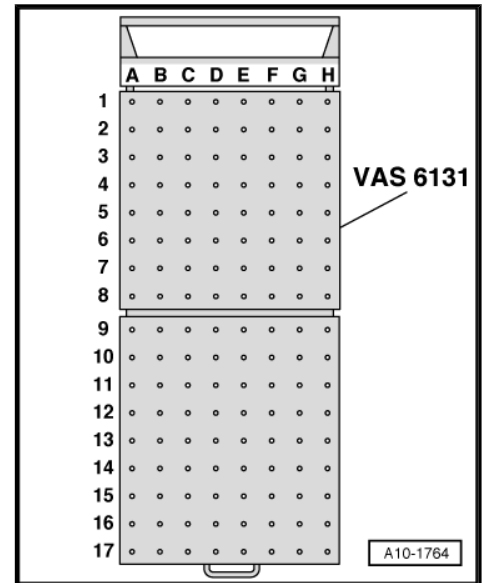


Setting up scissor-type assembly platform:

- Set up scissor-type assembly platform - VAS 6131- with support set for Audi - VAS 6131/10- as follows:

Platform coordinates	Components from support set for Audi - VAS 6131/10-			
C3	/10-1	/10-4	/10-5	/10-11
G3	/10-1	/10-4	/10-5	/10-12
B10	/10-1	/10-2	/10-5	/10-8
G10	/10-1	/10-2	/10-5	/10-8
F13	/10-1	/10-3	/10-5	/10-11
C15	/10-1	/10-4	/10-5	/10-13

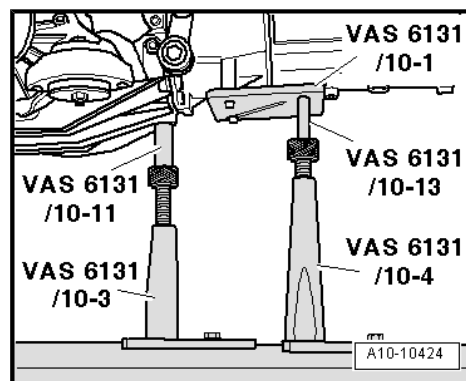
- Initially tighten support elements on assembly platform only hand-tight.
- Adjust scissor-type assembly platform - VAS 6131- so that it is horizontal.
- Take note of spirit level (bubble gauge).
- Place scissor-type assembly platform - VAS 6131- under engine/gearbox assembly.
- Position support elements at front of engine, as shown in the illustration.
- Make sure that threaded spindles are screwed in completely.
- Position support elements at left and right of subframe, as shown in the illustration.



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- Place support elements at rear of gearbox and plate - VAS 6131/10-1-, as shown in illustration.
- Turn all spindles for the support elements upwards until all locating lugs make contact with the mounting points.
- Tighten base plates for support elements to 20 Nm on scissor-type assembly platform - VAS 6131-.
- Raise scissor-type assembly platform - VAS 6131- slightly to take up weight on support elements.



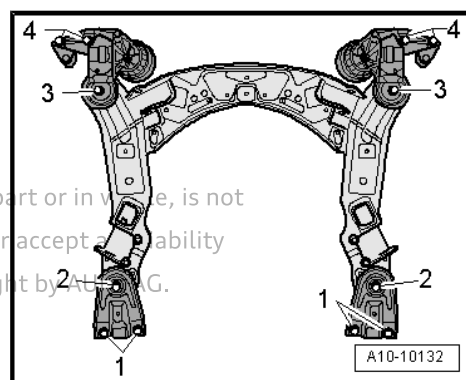
- Unscrew bolts -1-.
- Mark the installation position of the subframe and the two consoles for engine mountings on the longitudinal members with felt-tip pen.

- Unscrew bolts -2-, -3- and -4- in a diagonal sequence and in stages

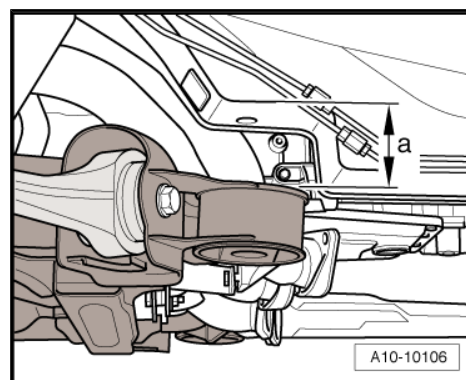
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**Note**

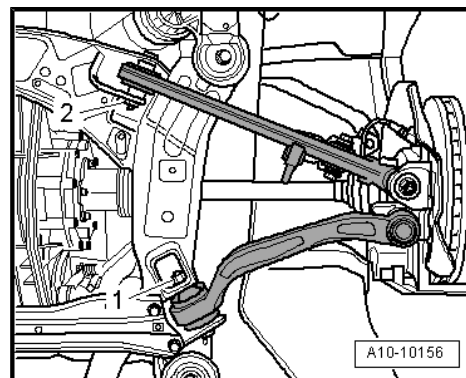
- ◆ Check that all hoses and wiring connections between engine, gearbox, subframe and body have been detached.
- ◆ Carefully guide out engine/gearbox assembly with subframe from engine compartment when lowering to avoid damage.



- Lower engine/gearbox assembly using scissor-type assembly platform - VAS 6131- initially only as far as distance -a-.
- Distance -a- = max. 30 mm.

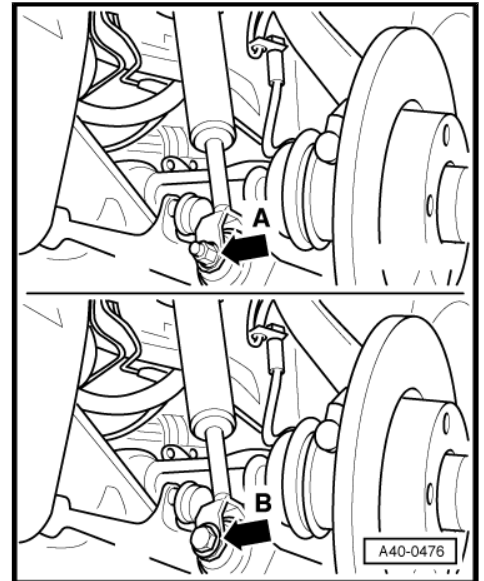


- Remove bolts for guide link -1- and track control link -2- from subframe.





- On vehicles with suspension strut bolt fitted from rear to front -arrow A- (depending on version), the bolt is removed at this stage.

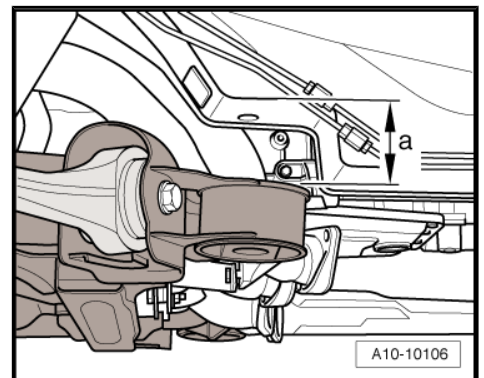
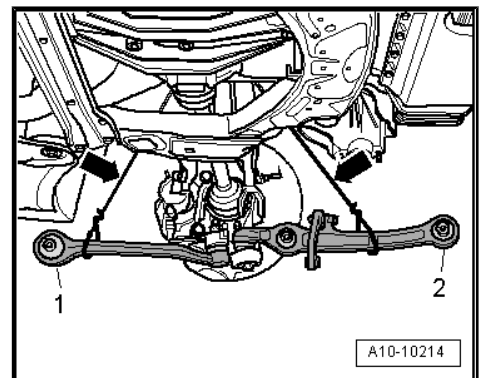


- Pivot guide link -1- and track control link -2- outwards.

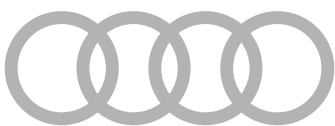
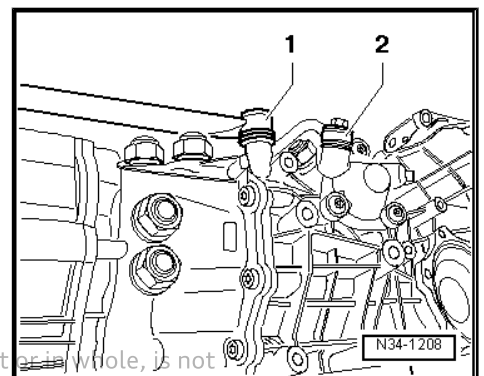
**Caution**

The guide link and track control link must not be allowed to hang down without support. Tie up both links to wheel bearing housing as illustrated -arrows-.

- Pivot wheel bearing housing outwards and remove drive shaft.
- Repeat procedure on other side of vehicle.
- Lower engine/gearbox assembly further using scissor-type assembly platform - VAS 6131- .
- Distance -a- = max. 60 mm.



- Unscrew connecting rod -2- of selector rod.
- Unscrew hexagon socket head bolt for push rod -1-.



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- Unscrew nut -arrow- and pull selector shaft lever off selector shaft.



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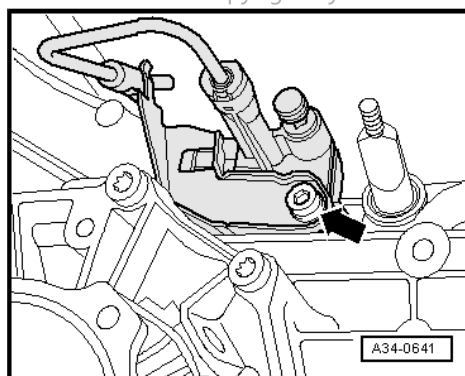
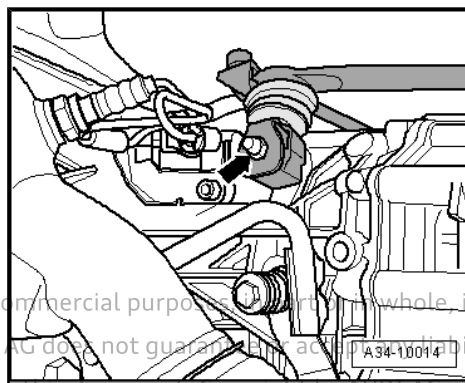
- Remove clutch slave cylinder -arrow- (do not open hose/pipe circuit).
- Tie up clutch slave cylinder together with selector linkage.



Caution

Do not press clutch pedal after removing slave cylinder. The slave cylinder will be irreparably damaged if a force of more than approx. 300 N is applied to the clutch pedal.

- Lower engine/gearbox assembly.
- Pull out scissor-type assembly platform - VAS 6131- with engine/gearbox assembly from beneath vehicle.



1.2 Separating engine and gearbox

Special tools and workshop equipment required

- ◆ Support set for Audi - VAS 6131/10- , plate - VAS 6131/10-1- , and supplementary sets - VAS 6131/11- and -VAS 6131/12-

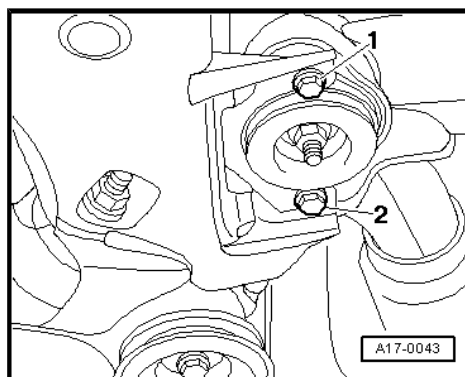
Procedure

- Engine/gearbox assembly removed and secured to scissor-type assembly platform - VAS 6131-



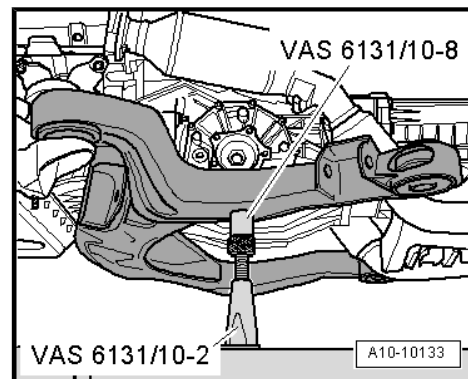
Note

- ◆ *All heat insulation sleeves which are removed must be fitted in the same position when installing.*
- ◆ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*
- Unscrew bolts -1- and -2- for gearbox mounting (left and right).





- Screw down spindles of the support elements (left and right) at subframe as far as possible.
- Remove locating lugs from spindles.
- Remove subframe to the side.
- Unscrew the two base plates for support elements (for subframe) on scissor-type assembly platform - VAS 6131- .

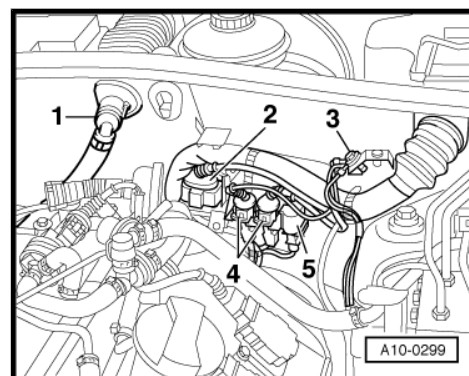


- Take electrical connector -2- for Lambda probe 2 - G108- out of bracket (left-side) and unplug it.
- Remove heat insulation sleeve at wiring harness and move the wiring clear.



Note

Illustration shows electrical connectors when installed.

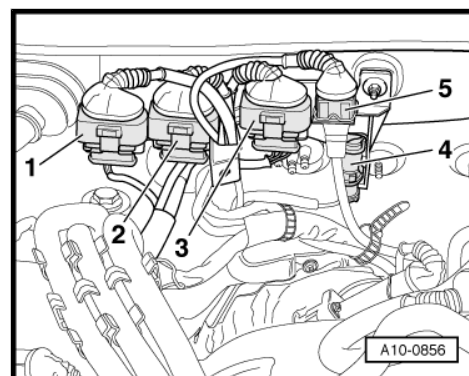


- Take electrical connector -2- for Lambda probe 2 after catalytic converter - G131- out of bracket (right-side) and unplug it.
- Remove heat insulation sleeve at wiring harness and move the wiring clear.



Note

Illustration shows electrical connectors when installed.

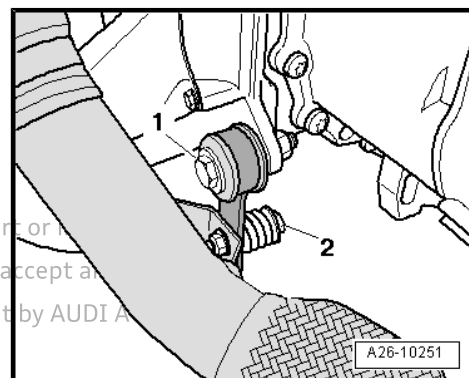


- Unscrew bolt -2- at bracket for front exhaust pipe (left-side).



Note

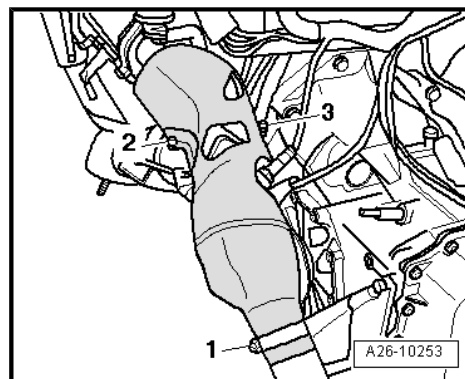
Disregard -item 1-.



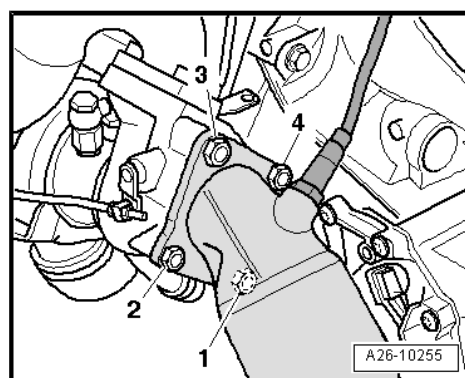
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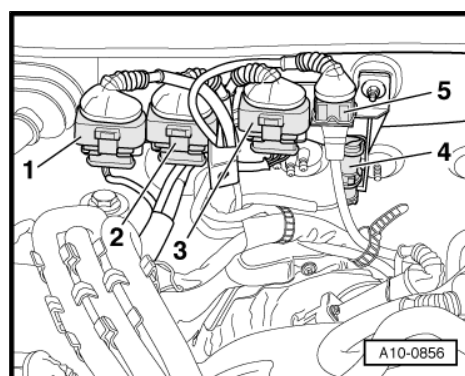
- Slacken clip -1-.
- Unscrew bolts -2- and -3- and remove heat shield from front exhaust pipe (left-side).



- Unscrew nuts -1 ... 4- securing front exhaust pipe to turbo-charger (left-side).
- Take out front exhaust pipe with starter and main catalytic converter.



- Take electrical connectors -1- and -3- for Lambda probe - G39- and Lambda probe after catalytic converter - G130- out of bracket (right-side) and unplug.
- Move wiring clear.



Note

Illustration shows electrical connectors when installed.

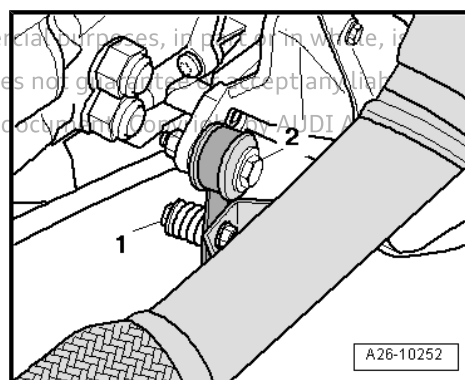


- Unscrew bolt -1- at bracket for front exhaust pipe (right-side).



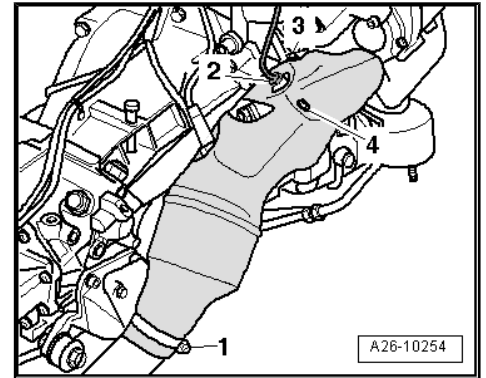
Note

Disregard -item 1-.

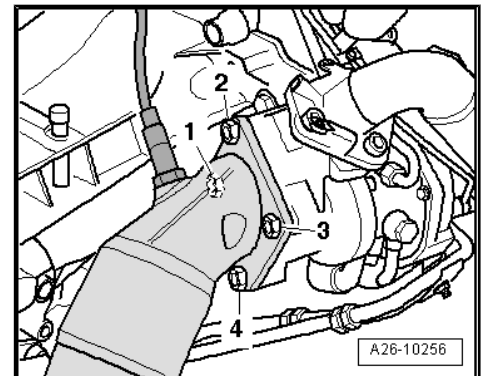




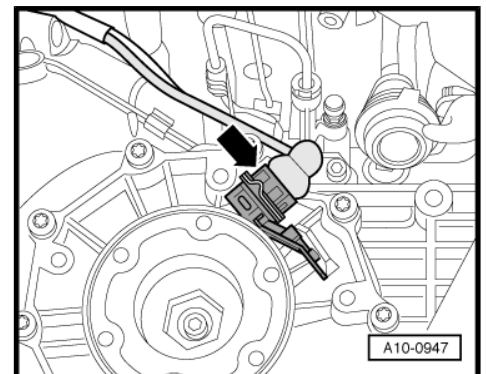
- Unbolt exhaust gas temperature sender 1 - G235- -item 2- from turbocharger.
- Slacken clip -1-.
- Unscrew bolts -3- and -4- and remove heat shield from front exhaust pipe (right-side).



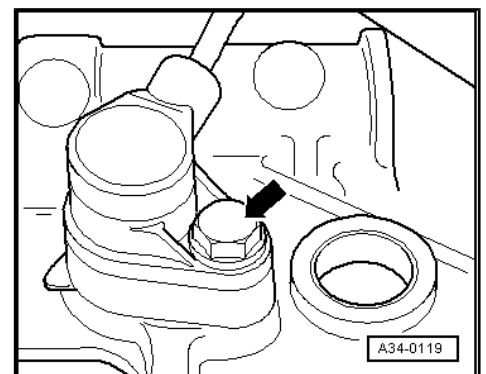
- Unscrew nuts -1 ... 4- securing front exhaust pipe to turbocharger (left-side).
- Take out front exhaust pipe with starter and main catalytic converter.



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



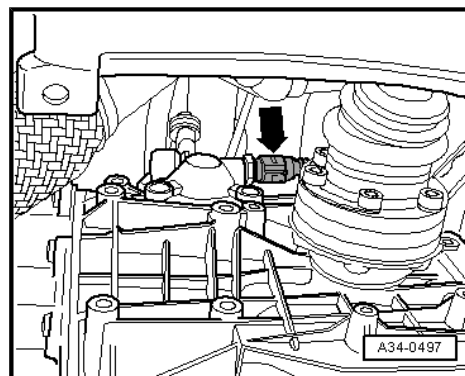
- Unbolt engine speed sender - G28- from gearbox -arrow-.



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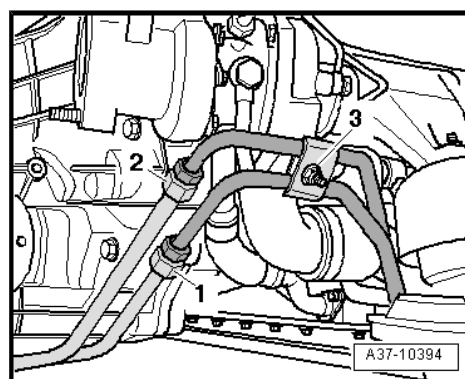


- Unplug electrical connector -arrow- at reversing light switch - F4- and move wiring clear.

**Note**

Lay a cloth under the separating point to catch any escaping gear oil.

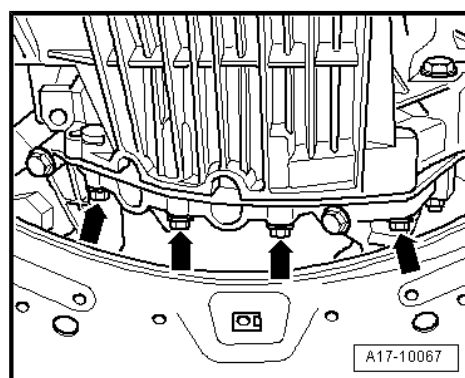
- Loosen union nuts -1- and -2-.
- Remove bracket for gear oil pipes by unscrewing nut -3-.
- Set up scissor-type assembly platform - VAS 6131- with support set for Audi - VAS 6131/10- , and supplementary sets - VAS 6131/11- and -VAS 6131/12- as follows:



Platform coordinates	Parts from support set for Audi - VAS 6131/10- , - VAS 6131/11- and -VAS 6131/12-			
C3	/10-1	/10-4	/10-5	/10-11
G3 ¹⁾	/10-1	/10-4	/10-5	/10-12
C7	/10-1	/10-4	/10-5	/12-1
F7	/10-1	/10-4	/10-5	/11-2
C10	/10-1	/10-4	/10-5	/12-1
F10	/10-1	/10-3	/10-5	/11-3
F13	/10-1	/10-3	/10-5	/10-11
C15	/10-1	/10-4	/10-5	/10-13

• ¹⁾ Support elements remain unchanged

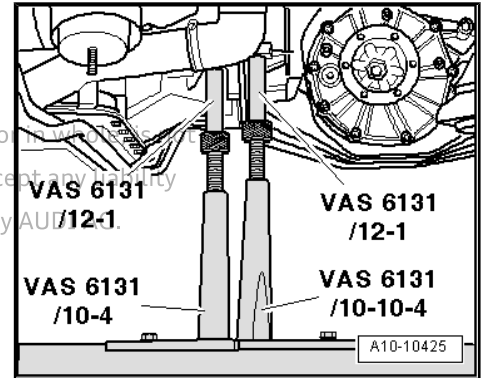
- Remove bottom engine/gearbox securing bolts -arrows-.



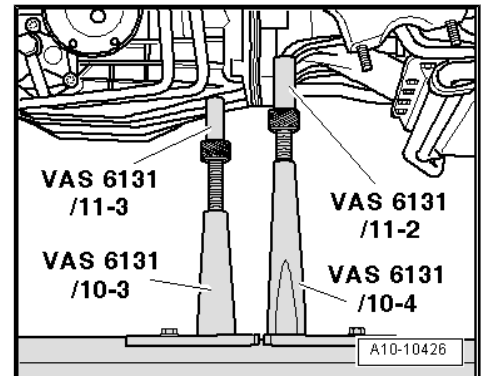


- Position support elements from -VAS 6131/10- and -VAS 6131/12- on left side of engine/gearbox assembly, as shown in illustration.

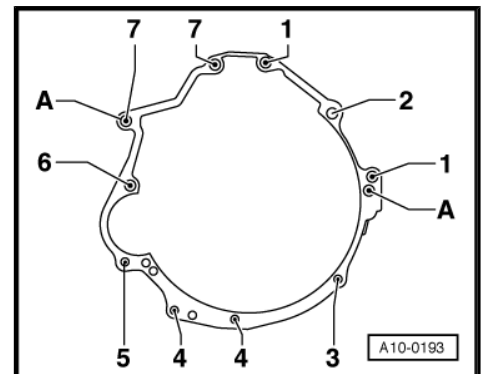
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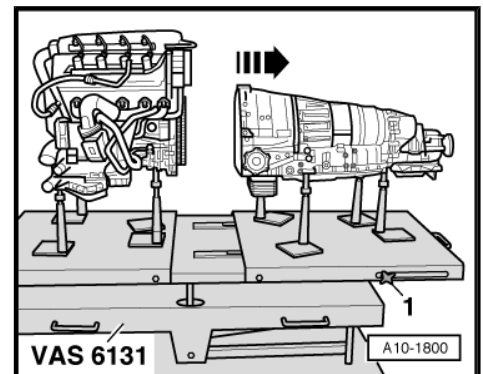
- Position support elements from -VAS 6131/10- and -VAS 6131/11- on right side of engine/gearbox assembly, as shown in illustration.
- Turn spindles for the support elements upwards until all locating lugs make contact with the mounting points.
- Tighten base plates for support elements to 20 Nm on scissor-type assembly platform - VAS 6131- .



- Remove engine/gearbox securing bolts -1 ... 4- and -7-.



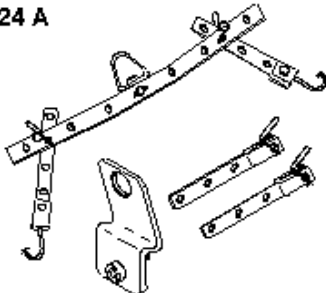
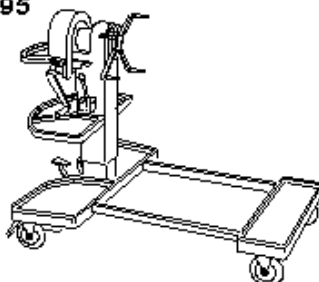
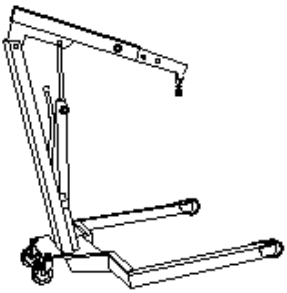
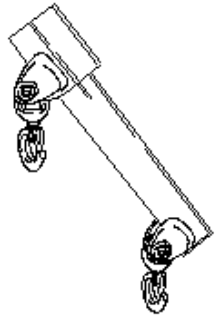
- Loosen clamping bolts -1- on sides of scissor-type assembly platform - VAS 6131- and pull rear section of platform together with gearbox towards rear -arrow-.



1.3 Securing engine to assembly stand



Special tools and workshop equipment required

2024 A 	VAS 6095 
VAS 6100 	VAS 6101 
	G10-10028

- ◆ Lifting tackle - 2024 A-
- ◆ Engine and gearbox support - VAS 6095-
- ◆ Workshop hoist - VAS 6100-
- ◆ Lift arm extension/workshop hoist - VAS 6101-



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Procedure

- Engine separated from gearbox ➔ [page 20](#) .
- Attach lifting tackle - 2024 A- to engine and workshop hoist - VAS 6100- with lift arm extension (workshop hoist) - VAS 6101- , as shown in illustration.



Note

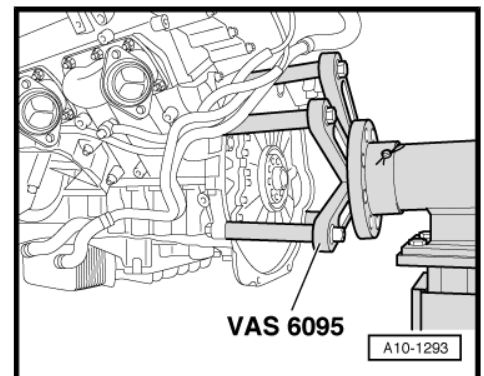
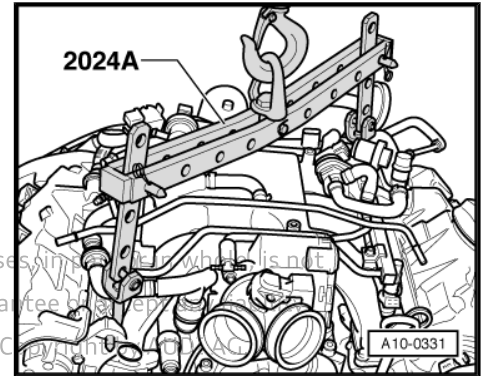
To adjust to the centre of gravity of the assembly, the perforated rails of the support hooks must be positioned as shown.



WARNING

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

- Lift engine off support elements on scissor-type assembly platform - VAS 6131- .
- Secure engine to engine and gearbox support - VAS 6095- , as shown in illustration.



1.4 Installing engine



Note

- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals, gaskets and O-rings.*
- ◆ *Hose connections and charge air system 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) ➔ Parts catalogue .*
- ◆ *Fit all heat insulation sleeves in the original position when installing.*
- ◆ *Fit all cable ties in the original positions when installing.*
- 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**

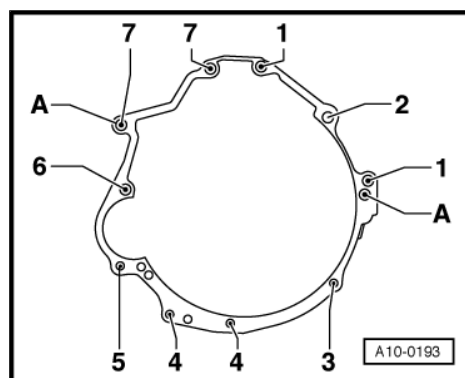
- ◆ *If the clutch plate is not being replaced, it is not necessary to reset the adjuster ring.*
- ◆ *New SAC pressure plates are already pre-set accordingly, and do not have to be reset.*
- Clean input shaft splines and (in the case of used clutch plates) hub splines. Remove corrosion and apply only a very thin coating of grease for clutch plate splines G 000 100 to the splines. Do not lubricate guide sleeve.
- Check that clutch plate is correctly centred.
- Check clutch release bearing for wear and make sure that plastic ring is securely seated ⇒ Rep. gr. 30 .
- Check whether dowel sleeves for centring the engine/gearbox assembly are fitted in the cylinder block; install dowel sleeves if necessary.
- Push intermediate plate between engine and gearbox onto dowel sleeves.
- Bolt gearbox to 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%.*

Securing engine to gearbox

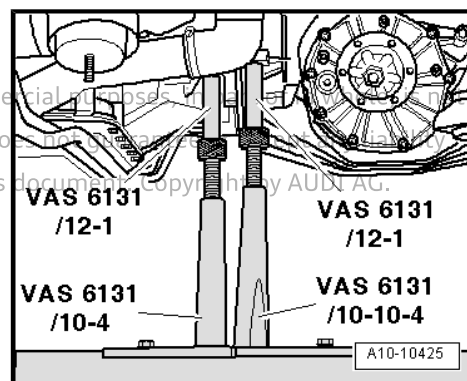
Item	Bolt	Nm
1, 9 ... 11	M10x60	45
2	M10x150 ¹⁾	65
3	M12x130	65
4, 5	M12x75	65
6, 8	M12x90	65
7	M12x95	65
A	Dowel sleeves for centralising	
• ¹⁾ Property class 10.9.		



- Secure gear oil pipes ⇒ Rep. gr. 34 .
- Install front exhaust pipes with starter and main catalytic converter: left-side ⇒ [page 234](#) , right-side ⇒ [page 241](#) .
- The threaded holes in the flange shaft for the propshaft on the gearbox must be cleaned of remaining locking fluid with a thread tap before assembling.



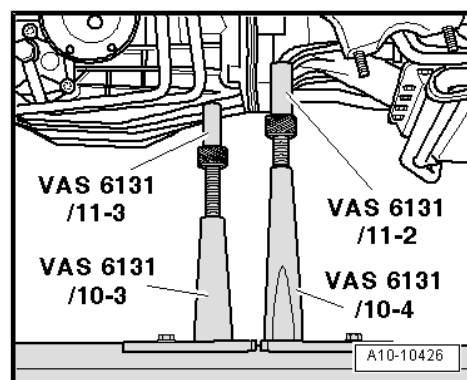
- Screw down spindles of support elements on left side of engine/gearbox assembly.
- Unscrew base plates for support elements (left-side) at scissor-type assembly platform - VAS 6131-



- Screw down spindles of support elements on right side of engine/gearbox assembly.
- Screw spindle for support element (right-side) at engine downwards.
- Unscrew base plates for support elements (right-side) at scissor-type assembly platform - VAS 6131- .

**Note**

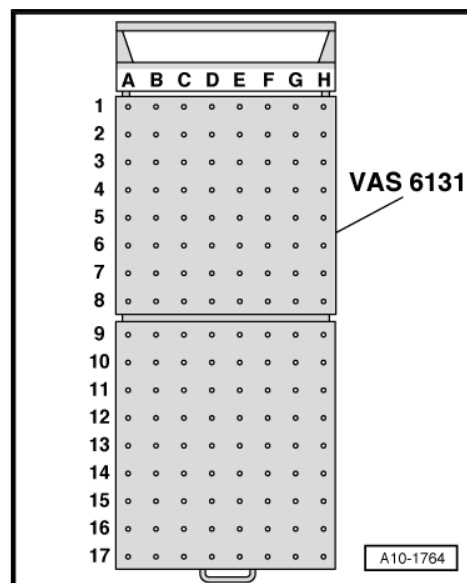
The mounting points for engine (front) and gearbox (rear) remain unchanged.



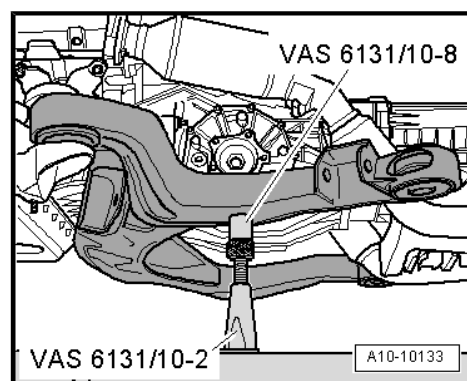
- Set up scissor-type assembly platform - VAS 6131- with support set for Audi - VAS 6131/10- as follows:

Platform coordinates	Components from support set for Audi - VAS 6131/10-			
C3 ¹⁾	/10-1	/10-4	/10-5	/10-11
G3 ¹⁾	/10-1	/10-4	/10-5	/10-12
B10	/10-1	/10-2	/10-5	/10-8 ²⁾
G10	/10-1	/10-2	/10-5	/10-8 ²⁾
F13 ¹⁾	/10-1	/10-3	/10-5	/10-11
C15 ¹⁾	/10-1	/10-4	/10-5	/10-13

- ¹⁾ Support elements remain unchanged.
- ²⁾ Secure support elements only after installing the subframe.

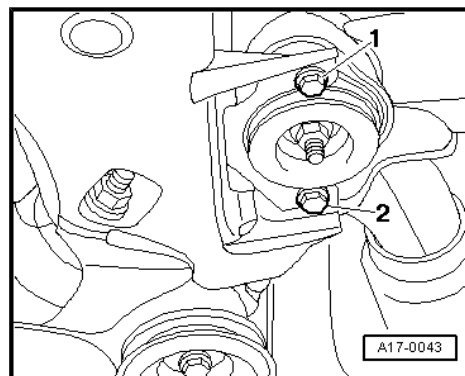


- Fit subframe onto the two support elements -VAS 6131/10-8- .
- Screw spindles for support elements upwards on both sides.

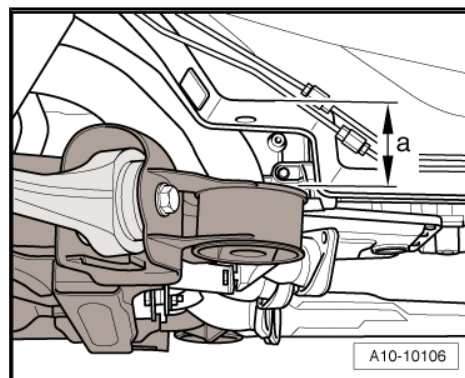




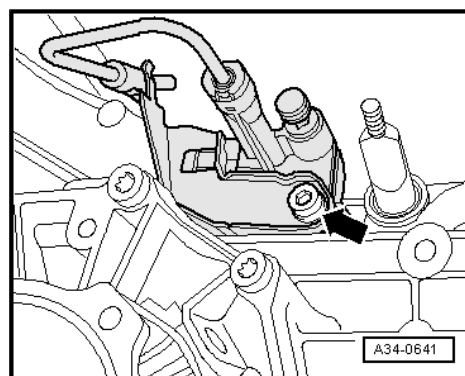
- Tighten bolts -1- and -2- for gearbox mountings on subframe.
- Slowly guide engine/gearbox assembly together with sub-frame into body from below using scissor-type assembly platform - VAS 6131- .



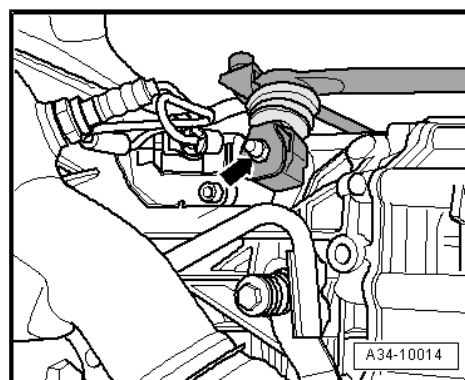
- Raise engine/gearbox assembly using scissor-type assembly platform - VAS 6131- until distance -a- is reached.
- Distance -a- = max. 60 mm.



- Secure clutch slave cylinder with new bolt -arrow-; for procedure, refer to ⇒ Rep. gr. 30 .



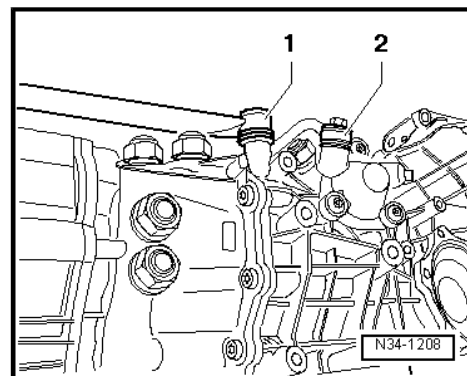
- Install selector shaft lever -arrow-.



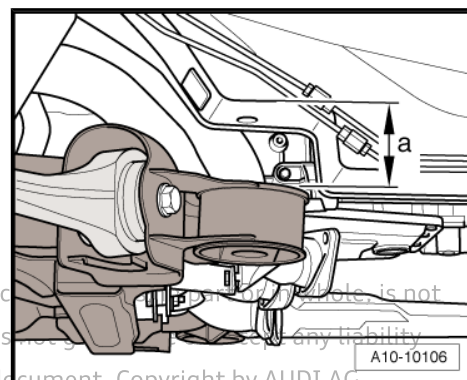
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- Secure connecting rod -2- of selector rod.
- Secure hexagon socket head bolt for push rod -1-.



- Raise engine/gearbox assembly using scissor-type assembly platform - VAS 6131- until distance -a- is reached.
- Distance -a- = max. 30 mm.
- Insert drive shafts in splines of wheel bearing housing (left and right).

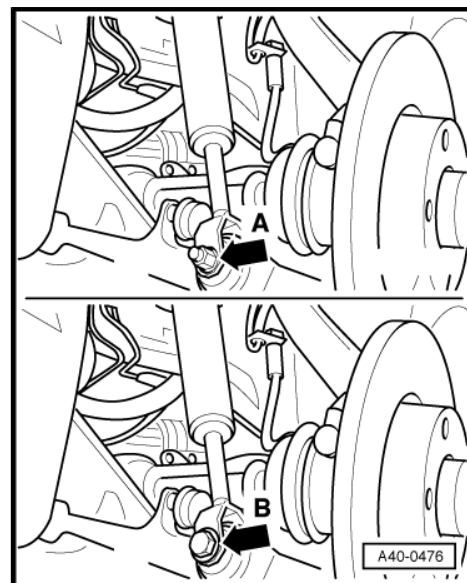


- On vehicles with suspension strut bolt fitted from rear to front -arrow A- (depending on version), the bolt is fitted at this stage.



Note

Wait until vehicle is standing on ground before tightening bolts to final setting.

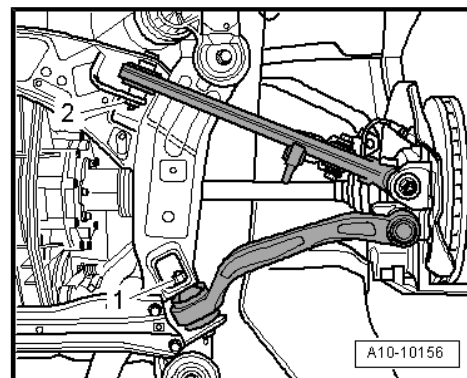


- Bolt guide link -1- and track control link -2- loosely onto sub-frame.



Note

Wait until vehicle is standing on ground before tightening bolts to final setting.





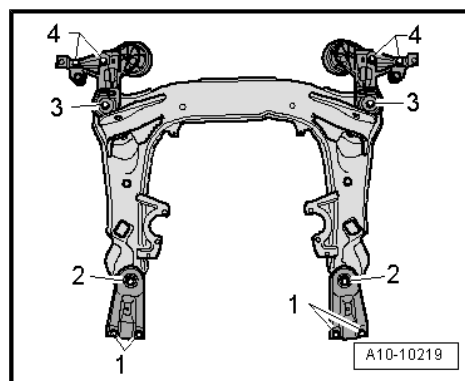
- Adjust the subframe and consoles for engine mountings according to the markings made on the longitudinal members during removal.
- Tighten bolts for subframe and consoles for engine mountings only to specified torque (do not turn further); the bolts are only fully tightened after performing the wheel alignment check.

- 1 - 32 Nm
- 2 - 115 Nm
- 3 - 115 Nm
- 4 - 75 Nm



WARNING

The vehicle must not be driven at this stage.



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

- Secure cross piece to subframe ⇒ Rep. gr. 40 .
- Install propshaft ⇒ Rep. gr. 39 .
- Align exhaust system so it is free of stress ⇒ [page 249](#) .
- Install drive shafts ⇒ Rep. gr. 40 .
- Install guide links, track control links, anti-roll bar and suspension struts ⇒ Rep. gr. 40 .
- Install refrigerant lines ⇒ Rep. gr. 87 .
- Install viscous fan ⇒ [page 186](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install gear oil pipes ⇒ Rep. gr. 34 .
- Install front bumper ⇒ Rep. gr. 63 .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Observe notes on procedures required after connecting battery ⇒ Rep. gr. 27 .



Caution

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

- Fill up with engine oil and check oil level ⇒ [page 155](#) .
- Before starting engine, top up hydraulic fluid in power steering reservoir ⇒ Rep. gr. 48 .



Note

The power steering pump must not be run when dry.

- Fill cooling system ⇒ [page 160](#) .



Note

◆ *Drained-off coolant may only be used again if the original cylinder head and cylinder block are re-installed.*

◆ *Contaminated or dirty coolant must not be used again.*

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– Charge the refrigerant system ➔ Air conditioner system with refrigerant R134a .

– Adjust subframe and the two consoles for engine mountings
⇒ Rep. gr. 40 .

– Perform wheel alignment check ⇒ Rep. gr. 44 .



WARNING

Tighten bolts for subframe to final setting after performing wheel alignment check ⇒ Rep. gr. 40 .

– Check oil level in manual gearbox ⇒ Rep. gr. 34 .

Tightening torques



Note

◆ *Tightening torques apply only to lightly greased, oiled, phosphated or black-finished nuts and bolts.*

◆ *Additional lubricant such as engine oil or gearbox oil may be used, but do not use lubricant containing graphite.*

◆ *Do not use degreased parts.*

◆ *Tolerance for tightening torques: ± 15 %.*

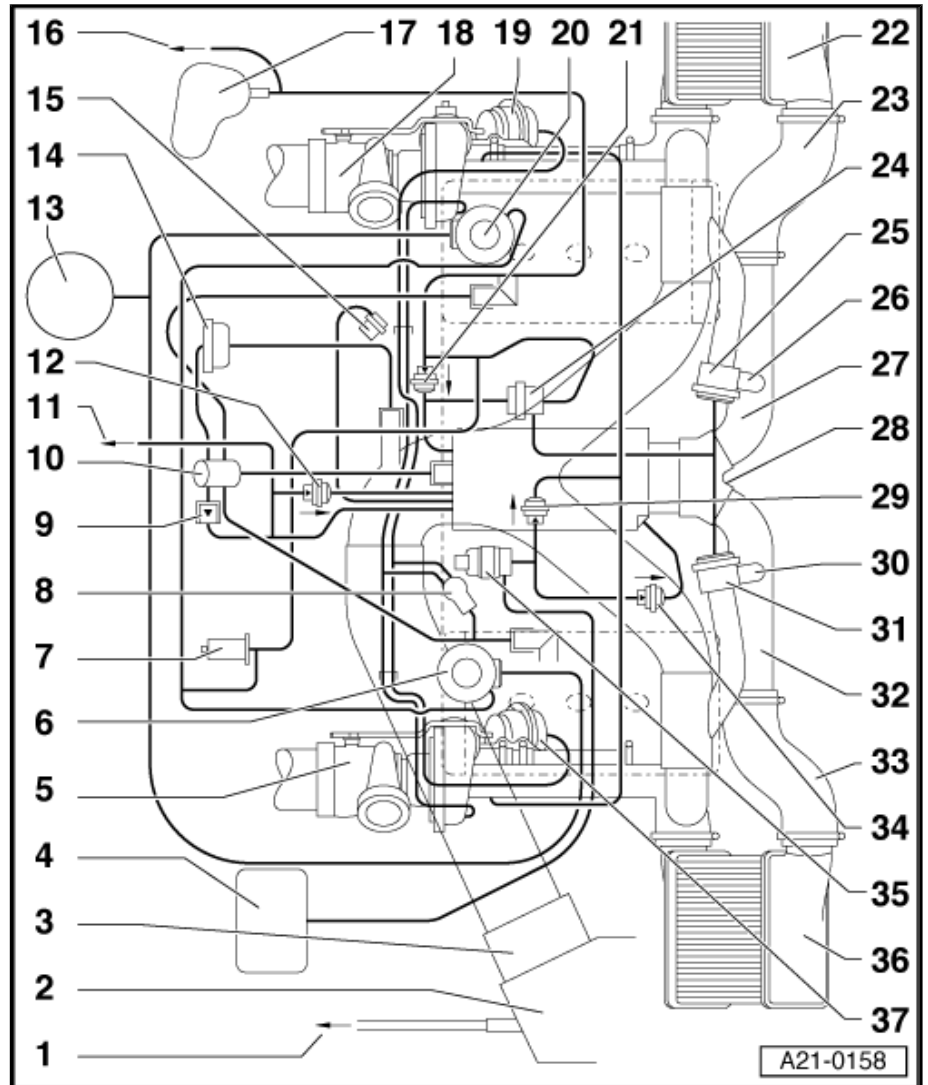


Component		Nm
Bolts/nuts	M6	9
	M8	20
	M10	40
	M12	65
Except for the following:		
Clutch slave cylinder to gearbox		23 ¹⁾
Selector shaft lever to gearbox		23
Push rod to gearbox		40
Connecting rod for selector rod to gearbox		23
Drive shaft heat shield to gearbox		23
Hydraulic pressure line for power steering (union nut)		40
Air pipe to:	Bracket	22
	Cylinder head cover	10
Fuel supply line to fuel rail		22
Oil line to auxiliary air cooler		38
Hose clips (9 mm wide)		3
Hose clips (13 mm wide)		5.5
• ¹⁾ Renew bolt.		

1.5 Vacuum hoses - overview



- 1 - To acoustic container
 - ☐ Beneath wheel housing liner (front right)
- 2 - Air cleaner
- 3 - Air mass meter - G70-
- 4 - Activated charcoal filter
- 5 - Turbocharger, bank 1
- 6 - Combination valve for secondary air system
- 7 - Secondary air inlet valve - N112-
- 8 - Charge pressure control solenoid valve - N75-
- 9 - Non-return valve
 - ☐ -Arrow- on non-return valve indicates direction of flow
- 10 - Distributor piece for crankcase breather system
- 11 - To brake servo
- 12 - Non-return valve
 - ☐ -Arrow- on non-return valve indicates direction of flow
- 13 - Secondary air pump motor - V101-
- 14 - Vacuum limiting valve
- 15 - Fuel pressure regulator
- 16 - To fuel system diagnostic pump - V144-



- 17 - Vacuum reservoir
- 18 - Turbocharger, bank 2
- 19 - Vacuum unit for charge pressure control
- 20 - Combination valve for secondary air system
- 21 - Non-return valve
 - ☐ -Arrow- on non-return valve indicates direction of flow
- 22 - Charge air cooler, bank 2
- 23 - Pressure hose, bank 2
- 24 - Turbocharger air recirculation valve - N249-
- 25 - Cut-off valve, bank 2
 - ☐ Mechanical air recirculation valve
- 26 - Connecting hose
- 27 - Pressure pipe, bank 2
- 28 - Connecting hose
 - ☐ For both charge air coolers
- 29 - Non-return valve
 - ☐ For crankcase breather

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- ☐ -Arrow- on non-return valve indicates direction of flow

30 - Connecting hose

31 - Cut-off valve, bank 1

- ☐ Mechanical air recirculation valve

32 - Pressure pipe, bank 1

33 - Pressure hose, bank 1

34 - Non-return valve

- ☐ -Arrow- on non-return valve indicates direction of flow

35 - Activated charcoal filter solenoid valve 1 - N80-

36 - Charge air cooler, bank 1

37 - Vacuum unit for charge pressure control

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13 – Crankshaft group

1 Servicing work on pulley end

1.1 Exploded view - poly V-belt drive

1 - 11 Nm

2 - Fan wheel for viscous fan

- ☐ Removing and installing
⇒ [page 186](#)

3 - Poly V-belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ☐ Removing and installing
⇒ [page 38](#)

4 - 22 Nm

5 - Alternator

- ☐ Removing and installing
⇒ Rep. gr. 27

6 - 45 Nm

7 - 22 Nm

8 - Bracket for alternator

9 - 45 Nm

10 - Not fitted

11 - 55 Nm

12 - 22 Nm

13 - Pulley for power steering pump

- ☐ To remove and install: counterhold with pin wrench - 3212-
⇒ [page 38](#)
- ☐ Marked "Vorne/Front"

14 - Pressure line

- ☐ To power-assisted steering

15 - Banjo bolt, 47 Nm

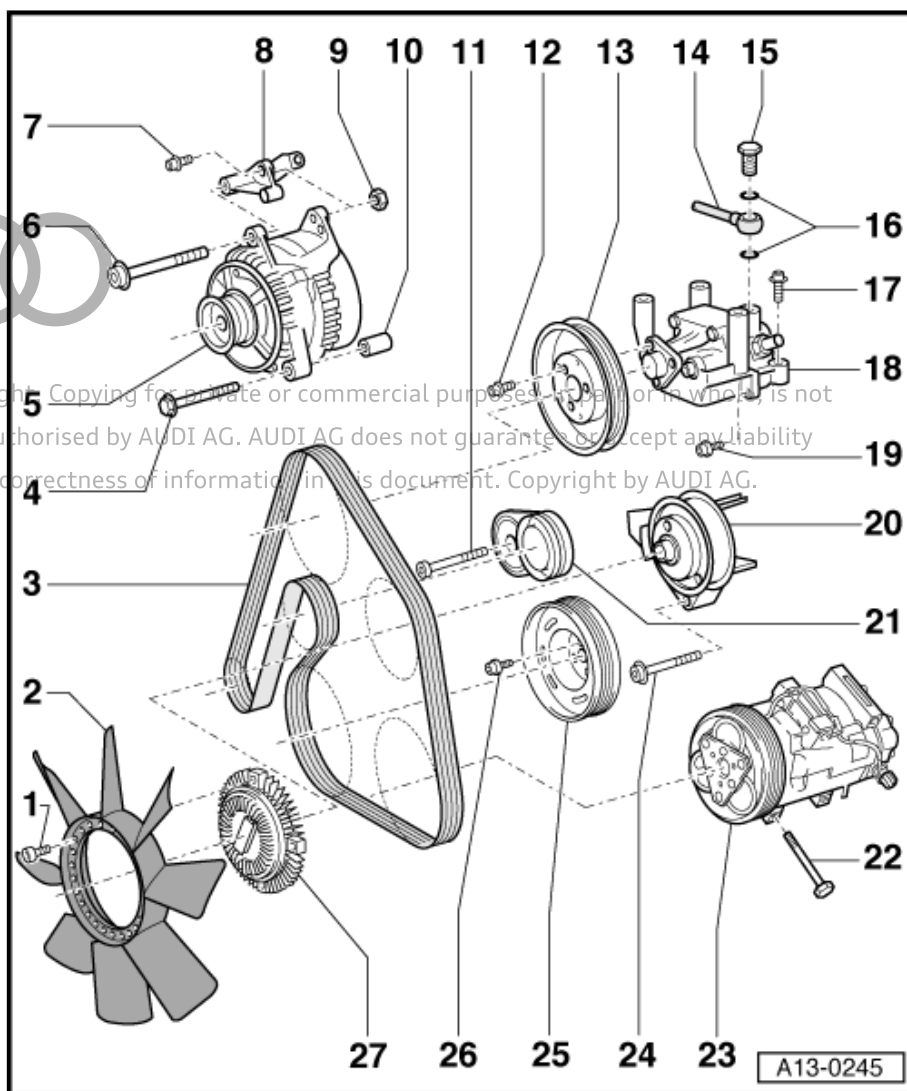
16 - Seal

- ☐ Renew

17 - 22 Nm

18 - Power steering pump with bracket

- ☐ Removing and installing ⇒ Rep. gr. 48





19 - 22 Nm

20 - Pulley for viscous fan

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

21 - Tensioner for poly V-belt

22 - 25 Nm

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.

24 - M6: 10 Nm; M8: 22 Nm

25 - Vibration damper

- ❑ Removing and installing ⇒ [page 39](#)

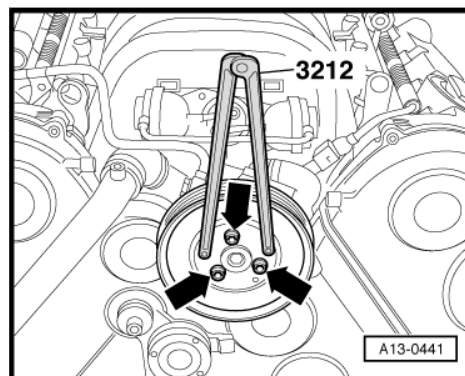
26 - 22 Nm

27 - Viscous fan coupling

- ❑ Removing and installing ⇒ [page 186](#)

Removing and installing power steering pump pulley

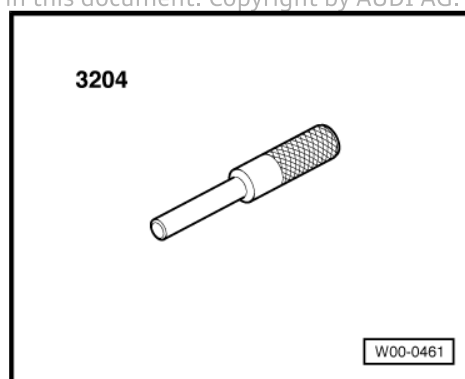
- Poly V-belt must be removed ⇒ [page 38](#) .
- Use pin wrench - 3212- to counterhold when slackening and tightening bolts -arrows-.
- Installation position: marking "Vorne/Front" faces in direction of travel.
- Tightening torque: 22 Nm



1.2 Removing and installing poly V-belt

Special tools and workshop equipment required

- ◆ Locking pin - 3204-





Removing

- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .

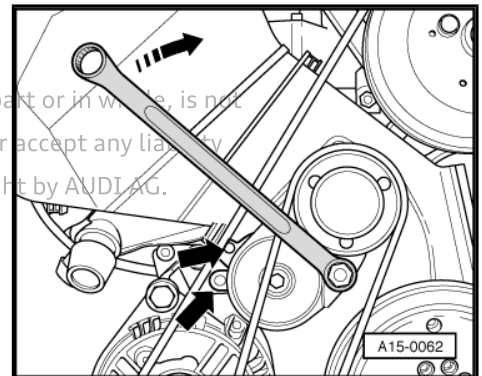
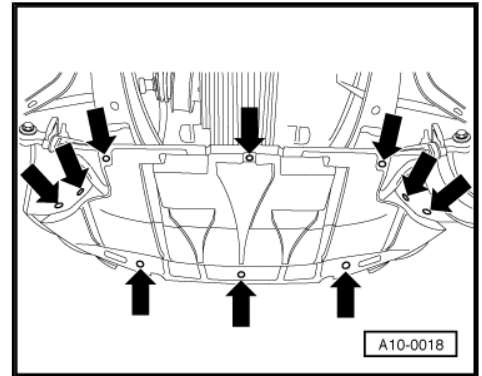


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Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Turn the tensioner in the direction of the -arrow- using a 17 mm ring spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrows-.
- Guide poly V-belt over viscous fan and detach belt.

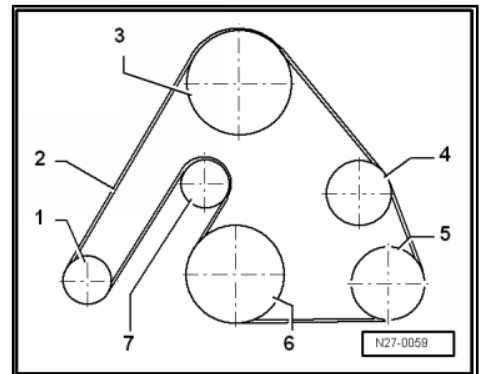


Installing

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 - Tensioning roller



Note

When installing poly V-belt, make sure it is properly seated on pulleys.

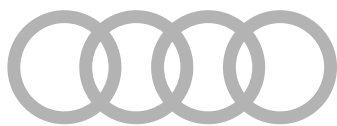
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .
- Start engine and check that belt runs properly.

1.3 Removing and installing vibration damper

Special tools and workshop equipment required



♦ Locking pin - 3204-

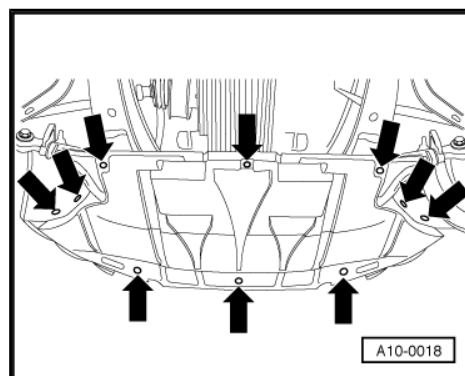


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Removing

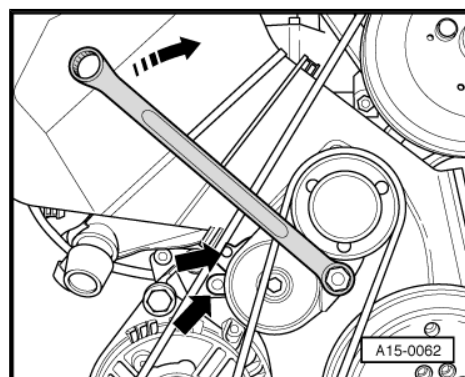
- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .



Note

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

- Turn the tensioner in the direction of the -arrow- using a 17 mm ring spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrows-.
- Guide poly V-belt over viscous fan and detach belt.



Note

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

- Unscrew vibration damper and remove.



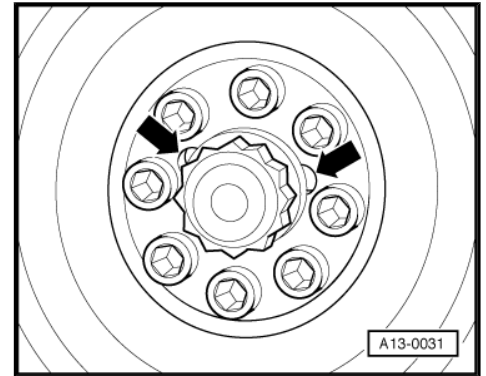
Installing

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 38](#) .
- Install lock carrier with attachments ➔ Rep. gr. 50 .
- Install front bumper ➔ Rep. gr. 63 .

Tightening torque

Component	Nm
Vibration damper to crankshaft sprocket	22



1.4 Exploded view - toothed belt drive

1 - 10 Nm

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

2 - 10 Nm

3 - Washer

4 - 22 Nm

5 - Tensioning lever with bearing bush

6 - O-ring

- ☐ Renew if damaged
- ☐ Locates ➔ [Item 3 \(page 41\)](#) , ➔ [Item 4 \(page 41\)](#) and ➔ [Item 5 \(page 41\)](#) when assembled

7 - 22 Nm

8 - 55 Nm

9 - Washer

10 - Locating plate

- ☐ Side labelled "rear/hint-en" faces rear

11 - Camshaft sprocket (right-side)

- ☐ Removing and installing ➔ ["1.5 Removing and installing toothed belt", page 43](#)
- ☐ Remove using puller - T40001-

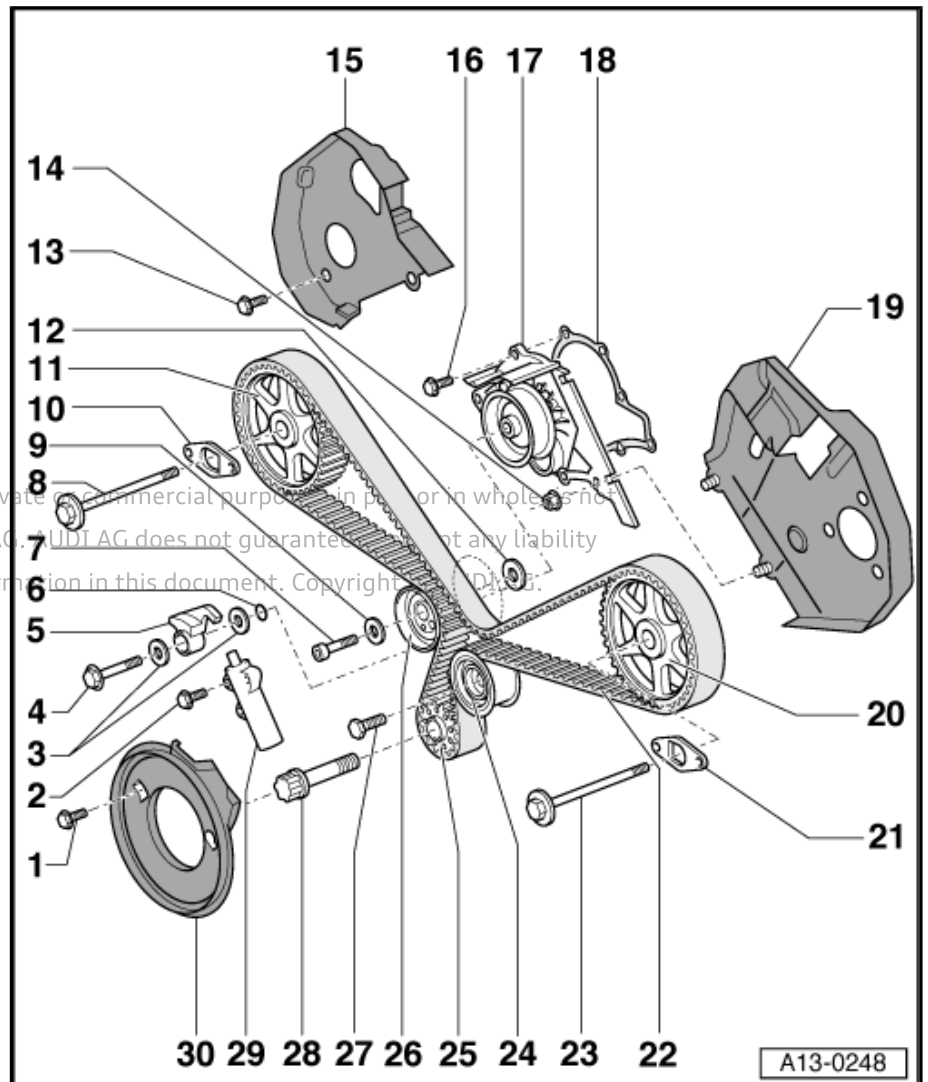
12 - Shim

13 - 10 Nm

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

14 - 10 Nm

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





15 - Toothed belt cover (rear right)

16 - 10 Nm

17 - Coolant pump

- ☐ Removing and installing ⇒ [page 164](#)

18 - Gasket

- ☐ Renew

19 - Toothed belt cover (rear left)

20 - Camshaft sprocket (left-side)

- ☐ Removing and installing ⇒ ["1.5 Removing and installing toothed belt", page 43](#)
- ☐ 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. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ☐ Check for wear
- ☐ Removing ⇒ [page 43](#)
- ☐ Installing (adjusting valve timing) ⇒ [page 50](#)

23 - 55 Nm

24 - Idler roller

25 - Crankshaft sprocket

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

26 - Tensioning roller with bearing bush

27 - 43 Nm

28 - 200 Nm + 180° (1/2 turn) further

- ☐ Renew
- ☐ Do not additionally lubricate
- ☐ Use locking pin - 3242- when loosening and tightening

29 - Tensioner

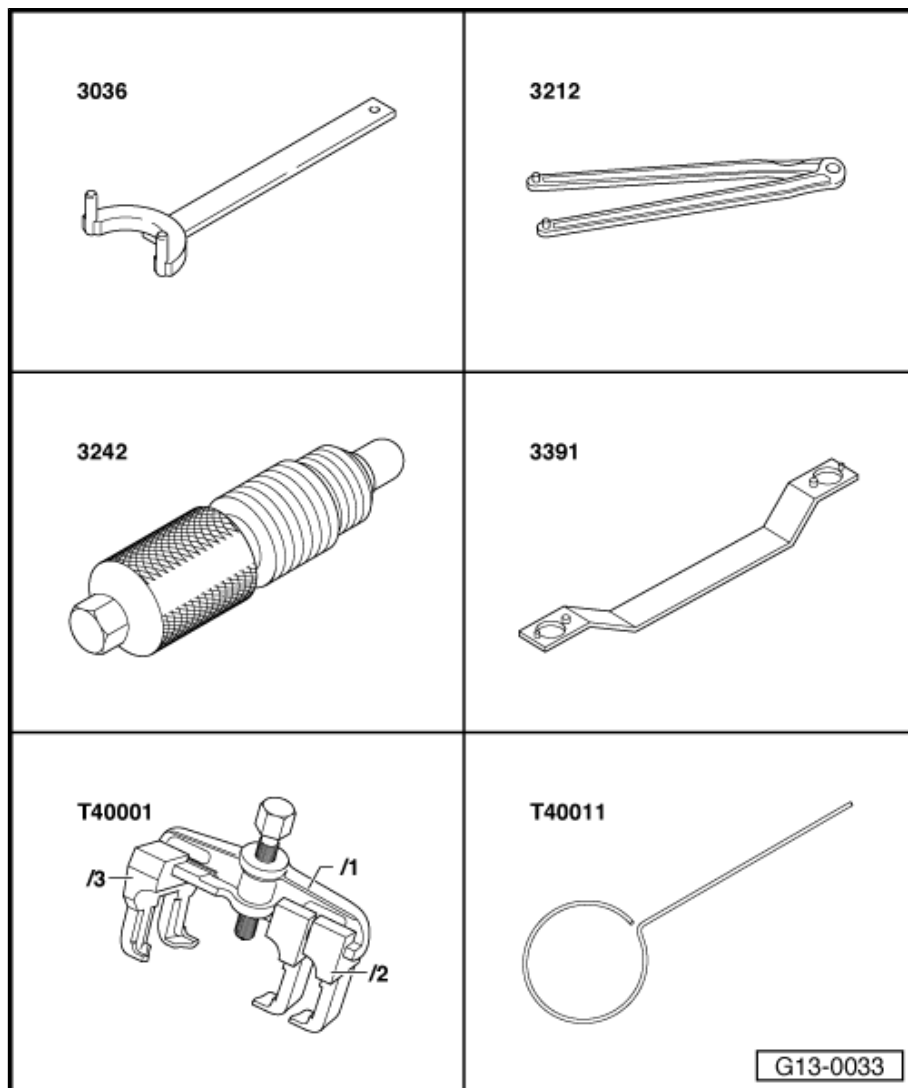
30 - Toothed belt cover (bottom)

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1.5 Removing and installing toothed belt

Special tools and workshop equipment required

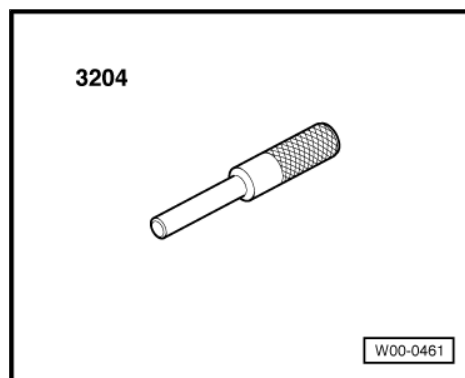


- ◆ Counterhold tool - 3036-
- ◆ Pin wrench - 3212-
- ◆ Locking pin - 3242-
- ◆ Camshaft clamp - 3391-
- ◆ Two-arm puller - T40001- with claws - T40001/2-
- ◆ Locking pin - T40011-

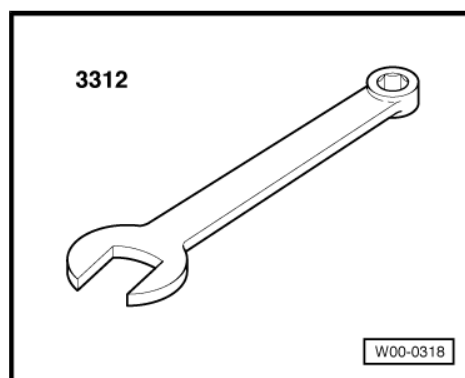
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◆ Locking pin - 3204-



◆ Open-end spanner - 3312-



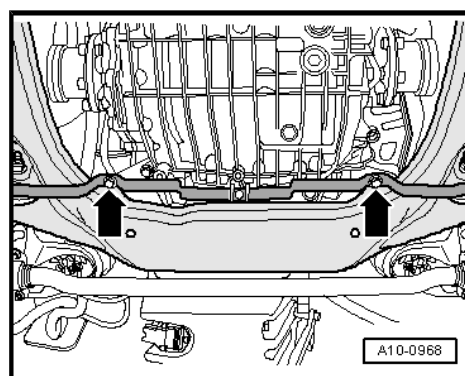
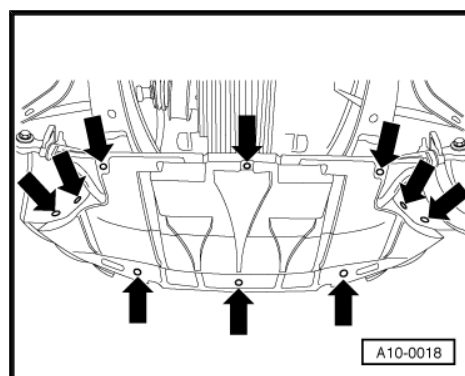
Removing



Note

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

- Remove noise insulation -arrows-.
- Unbolt bracket for noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .



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- Use open-end spanner - 3312- to unscrew viscous fan pulley in clockwise direction -arrow- (left-hand thread) while counterholding with pin wrench - 3212- .



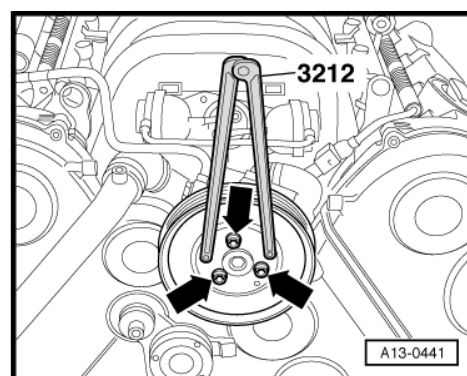
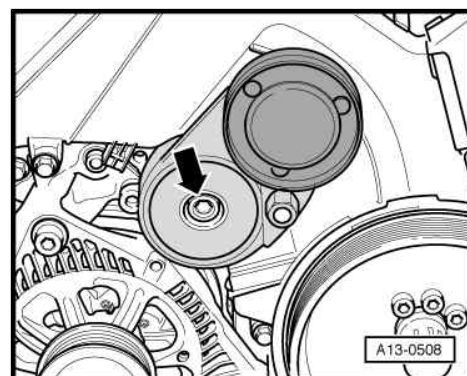
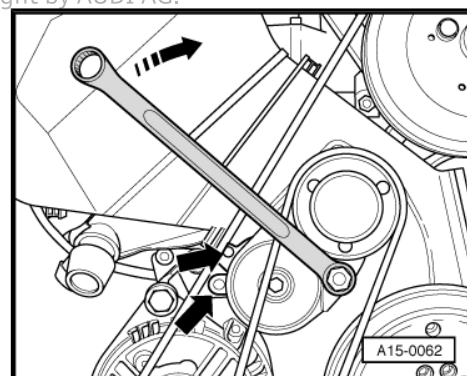
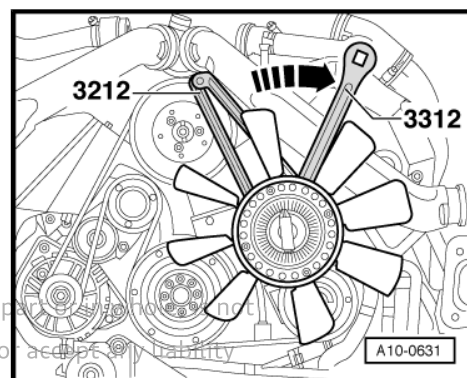
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Note

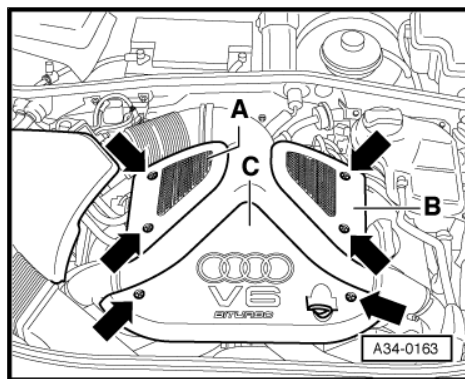
Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Turn the tensioner in the direction of the -arrow- using a 17 mm ring spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrows-.
- Take off poly V-belt.
- Unscrew bolt -arrow- and remove tensioner for poly V-belt.
- Unbolt power steering pump pulley -arrows- (counterhold with pin wrench - 3212-).

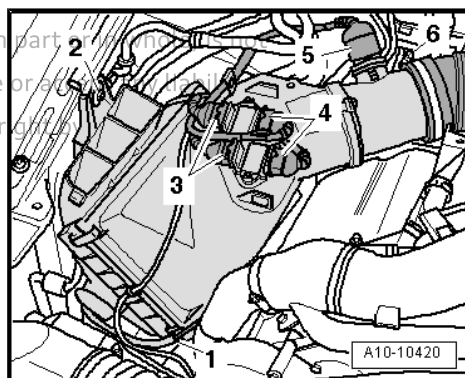




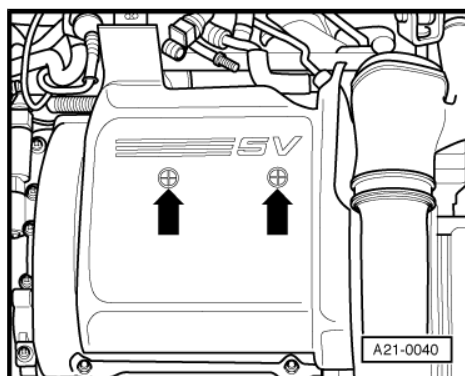
- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.



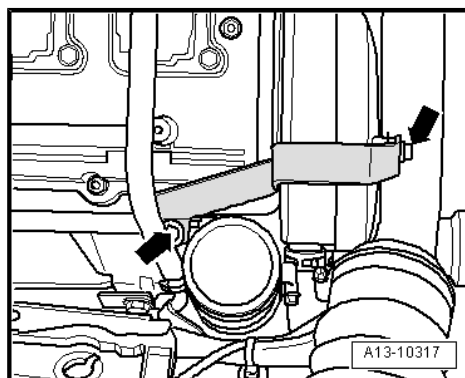
- Unplug electrical connectors at output stage - N122- -item 3- and at output stage 2 - N192- -item 4-.
- Unplug electrical connector -5- at air mass meter - G70- .
- Move wiring harness at air cleaner housing clear.
- Detach air hose -6- at air mass meter - G70- .
- Unplug vacuum hose -1-.
- Unscrew nut -2- and remove air cleaner housing with air mass meter - G70- .



- Loosen quick release fasteners -arrows- and remove cover for cylinder head cover (right-side).



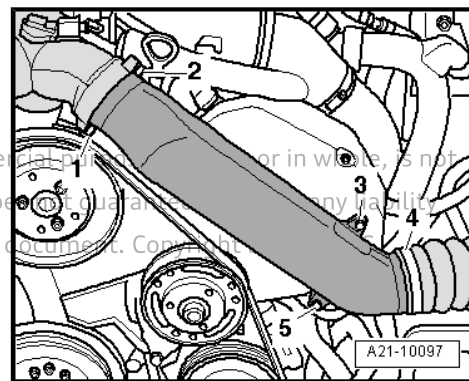
- Unscrew bolts -arrows- and remove bracket.



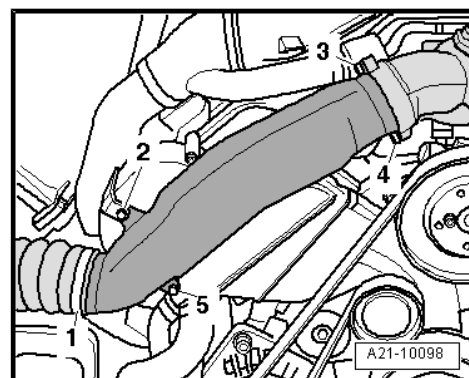


- Disconnect air intake hose -4- from air pipe (left-side).
- Unscrew bolts -1 ... 3- and -5- and remove air pipe (left-side).

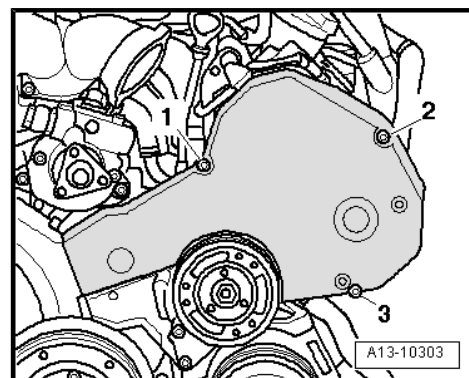
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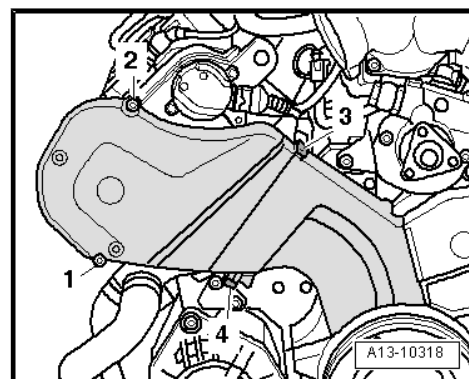
- Disconnect air intake hose -1- from air pipe (right-side).
- Remove bolts -2 ... 5- and take out air pipe (right-side).



- 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).

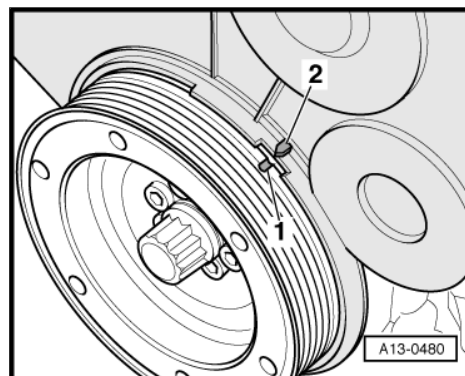


Caution

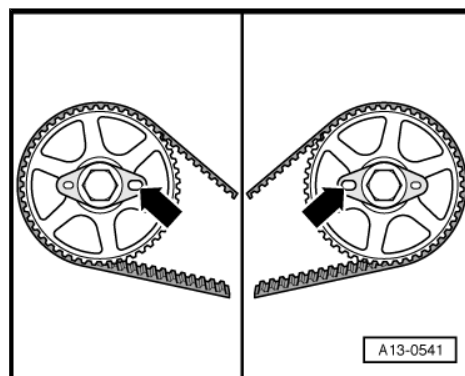
Engine must only be turned in direction of rotation (clockwise) via crankshaft.



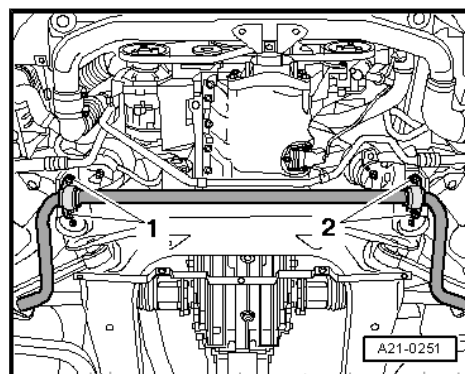
- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark.
- Notch -1- should align with marking -2-.



- 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 bolted connections -1- and -2- for anti-roll bar (left and right) and move anti-roll bar downwards.



- Unscrew plug for TDC marking from cylinder block.



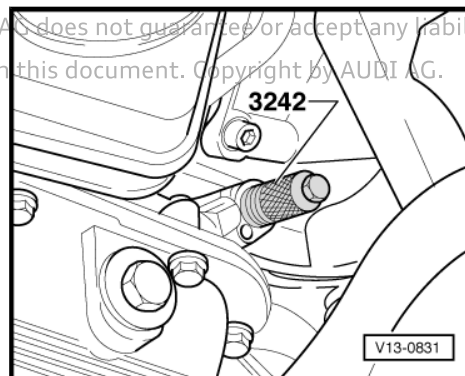
Note

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



WARNING

To avoid any risk of injury, do not rotate the crankshaft while feeling for the TDC hole with your finger.



- Screw locking pin - 3242- into bore (tightening torque: 20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.

**Note**

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

- Remove bolts and take off vibration damper.

**Note**

Disregard -arrows-.

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



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

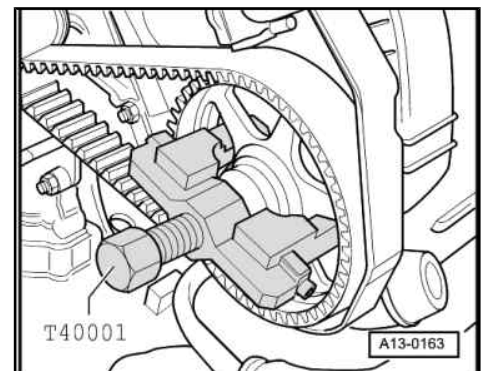
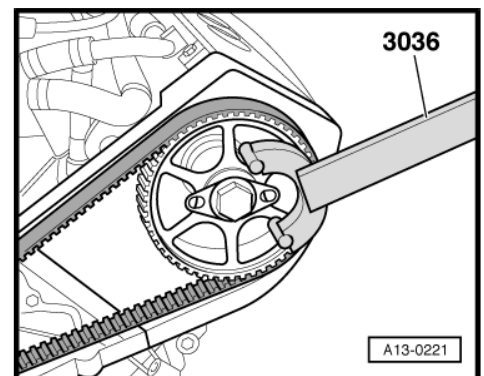
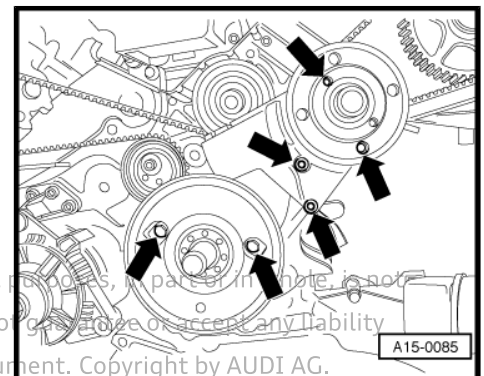
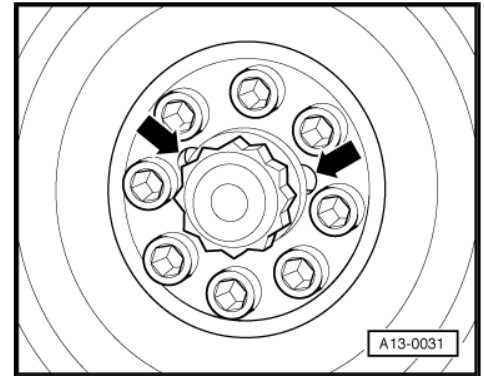
**Note**

Leave bolts screwed in loosely.

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

**Note**

- ◆ *Before removing, mark rotation direction of toothed belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*
- ◆ *The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.*

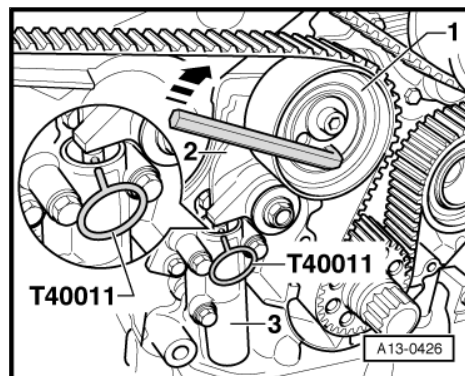




- Turn toothed belt tensioning roller -1- clockwise in direction of -arrow- using an 8 mm Allen key until tensioning lever -2- compresses tensioner -3- far enough for pressure piston to be locked with locking pin - T40011- .
- Release pressure from toothed belt tensioning roller.
- Remove toothed belt.

Installing (adjusting valve timing)

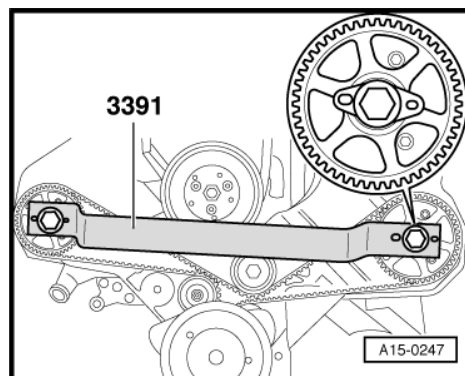
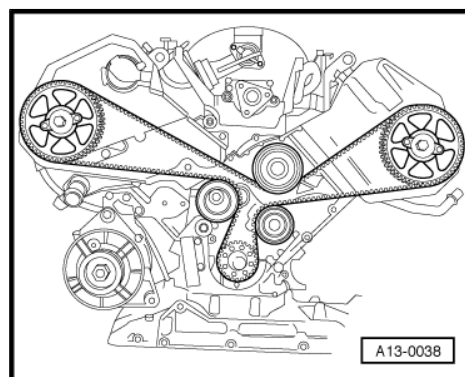
- Crankshaft locked in position with locking pin - 3242- .
- Camshaft sprockets free to turn.



Note

- ◆ *The crankshaft must not be at TDC at any cylinder when the camshaft is turned. Otherwise, there is a risk of damage to valves and piston crowns.*
 - ◆ *The valve timing must be adjusted as described below, even when the toothed belt has only been removed from the camshaft sprocket.*
 - ◆ *Renew O-rings.*
 - ◆ *Hose connections and charge air system 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) → Parts catalogue*
 - ◆ *Fit all cable ties in the original positions when installing.*
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- 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.

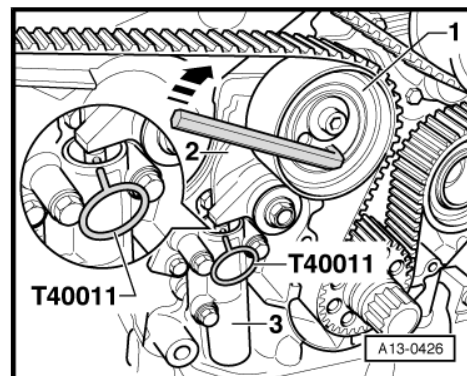




- Using an 8 mm Allen key, turn toothed belt tensioning roller -1- clockwise in direction of -arrow- until locking pin - T40011- can be removed.

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- .
- Screw plug for TDC marking into cylinder block with new O-ring.
- Install anti-roll bar ⇒ Rep. gr. 40 .
- Install vibration damper ⇒ [page 39](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Install viscous fan ⇒ [page 186](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .



Tightening torques

Component		Nm
Camshaft sprocket to camshaft		55
Viscous fan bracket to cylinder block	M6	10
	M8	22
Toothed belt cover to engine		10 ¹⁾
Pulley to power steering pump		23
Tensioner for poly V-belt to cylinder block		55
Sealing plug in cylinder block		10
Hose clips (9 mm wide)		3
Hose clips (13 mm wide)		5.5
• ¹⁾ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .		



2 Removing and installing sealing flanges and dual-mass flywheel

2.1 Exploded view - sealing flanges and dual-mass flywheel



Note

Servicing clutch ➔ Rep. gr. 30

1 - M6: 10 Nm; M8: 30 Nm

- ☐ Apply locking fluid to M8 bolt; locking fluid ➔ Parts catalogue .

2 - Crankshaft oil seal

- ☐ Renewing ➔ [page 53](#)

3 - 40 Nm

4 - Stop for torque reaction support

5 - 28 Nm

6 - Torque reaction support

7 - Sump (top section)

- ☐ Removing and installing ➔ [page 139](#)

8 - 45 Nm

9 - M7: 16 Nm; M8: 22 Nm

10 - O-ring

- ☐ Renew

11 - Dual-mass flywheel

- ☐ Removing and installing ➔ [page 61](#)

12 - 60 Nm + 180° (1/2 turn) further

- ☐ Renew

13 - Needle bearing

- ☐ Extracting and driving in ➔ [page 63](#)

14 - Sealing flange (rear) with oil seal

- ☐ Lubricate sealing lip of oil seal lightly
- ☐ Use assembly sleeve - T20097- to install

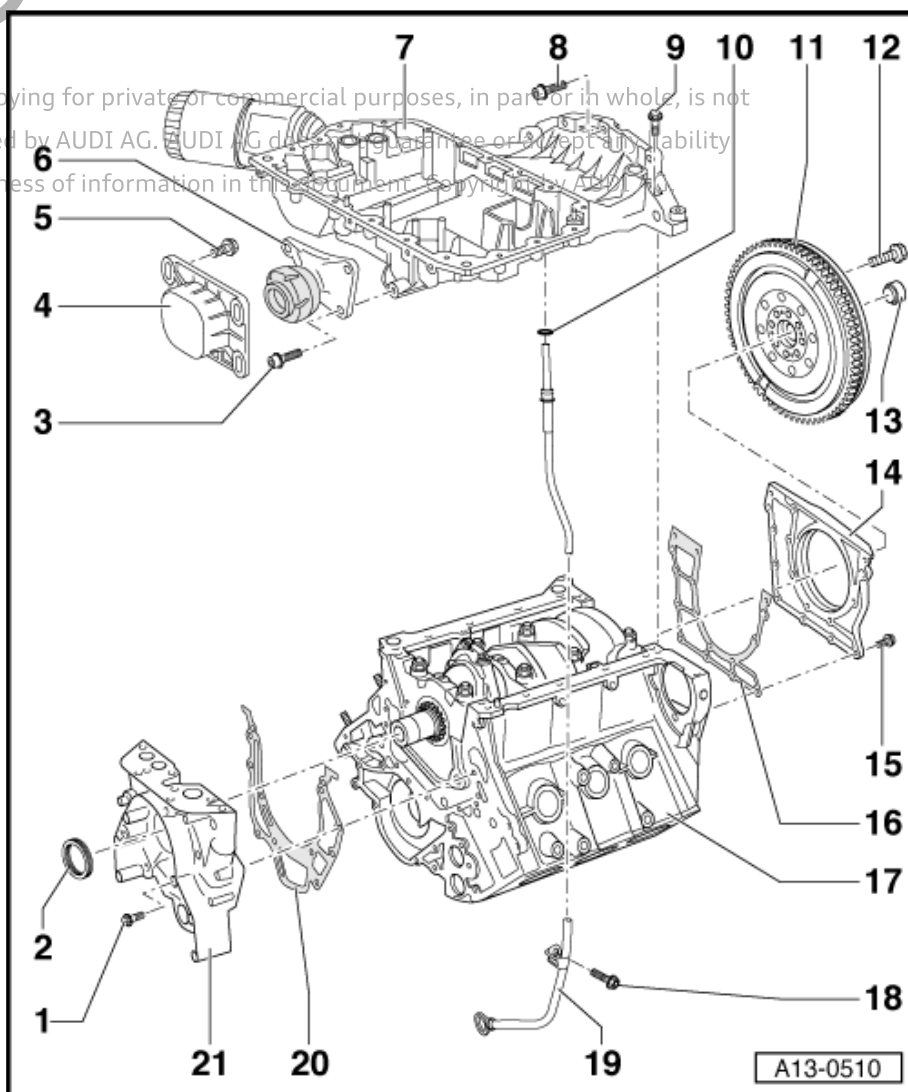
15 - 10 Nm

16 - Gasket

- ☐ Renew

17 - Cylinder block

- ☐ Removing and installing crankshaft ➔ [page 65](#)
- ☐ Dismantling and assembling pistons and conrods ➔ [page 69](#)





18 - 20 Nm

19 - Dipstick guide tube

20 - Gasket

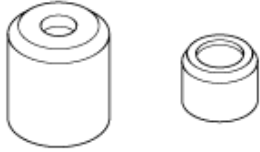
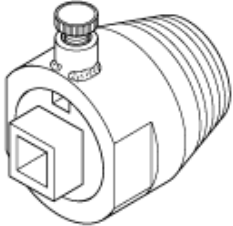
☐ Renew

21 - Sealing flange (front)

☐ Removing and installing ⇒ [page 55](#)

2.2 Renewing crankshaft oil seal (pulley end)

Special tools and workshop
equipment required

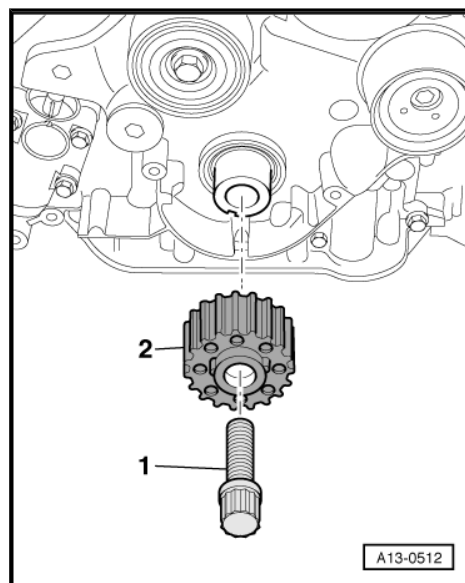
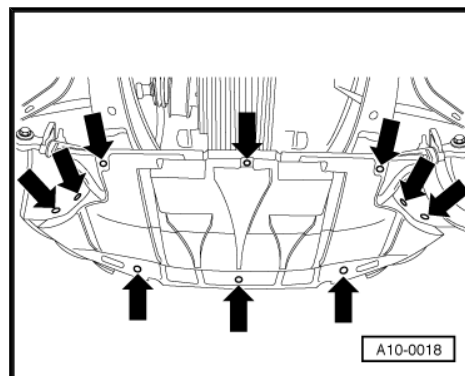
3202 	3203 
3265 	
	G13-0006

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- ◆ Oil seal extractor **3203** unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability
- ◆ Fitting sleeve **3265** respect to the correctness of information in this document. Copyright by AUDI AG.

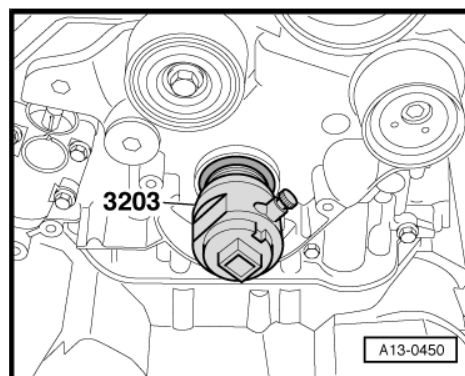


Procedure

- Remove noise insulation -arrows-.
 - Remove front bumper ⇒ Rep. gr. 63 .
 - Move lock carrier to service position ⇒ Rep. gr. 50 .
 - Remove toothed belt ⇒ [page 43](#) .
-
- Unscrew central bolt -1- for toothed belt sprocket -2- on crankshaft and remove 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 exerting firm pressure screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice.
- Remove oil seal with pliers.
- Clean running surface and sealing surface.



Note

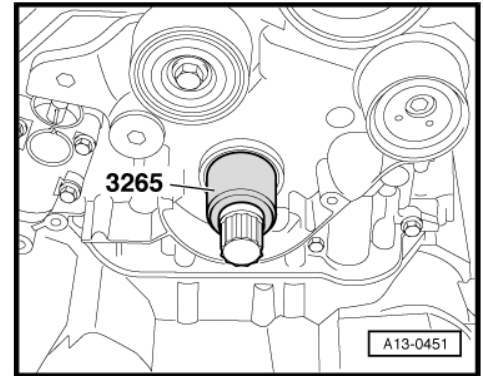
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Do not lubricate sealing lip and outer rim of oil seal before pressing in.

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



- Press oil seal on as far as stop using fitting sleeve - 3265- and central bolt.



- Fit crankshaft toothed belt sprocket -2- with new central bolt -1-.



Note

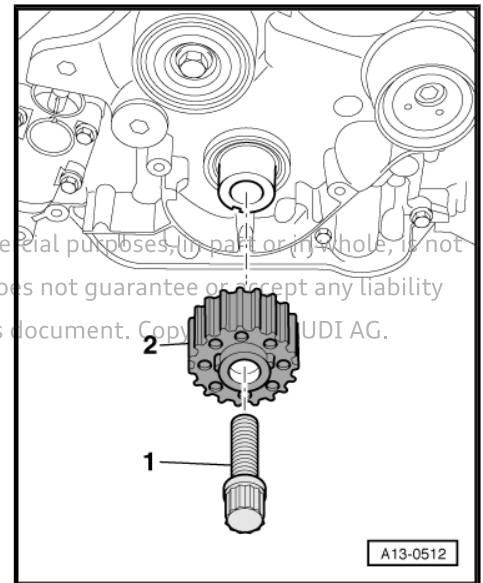


- ◆ *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- ◆ *Do not additionally lubricate bolt for crankshaft toothed belt sprocket.*

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

- Install toothed belt (adjust valve timing) ⇒ [page 50](#) .
- Install vibration damper ⇒ [page 39](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Install viscous fan ⇒ [page 186](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .



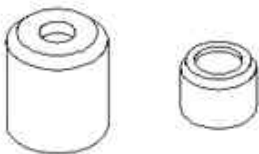
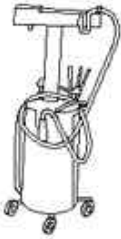
Tightening torque

Component	Nm
Toothed belt sprocket to crankshaft	200 + 180° ¹⁾²⁾
• ¹⁾ Renew bolt. • ²⁾ 180° = one half turn.	

2.3 Removing and installing sealing flange (front)



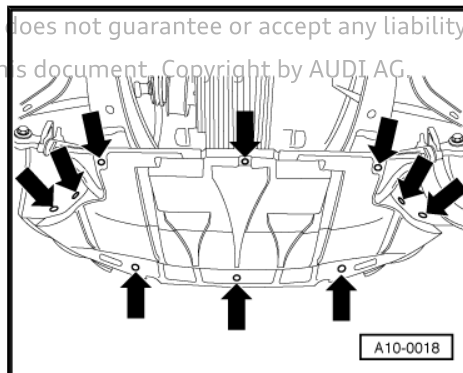
Special tools and workshop equipment required

3202 	3265 
V.A.G 1782 	
	G13-0085

- ◆ 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 ⇒ [Parts catalogue](#)

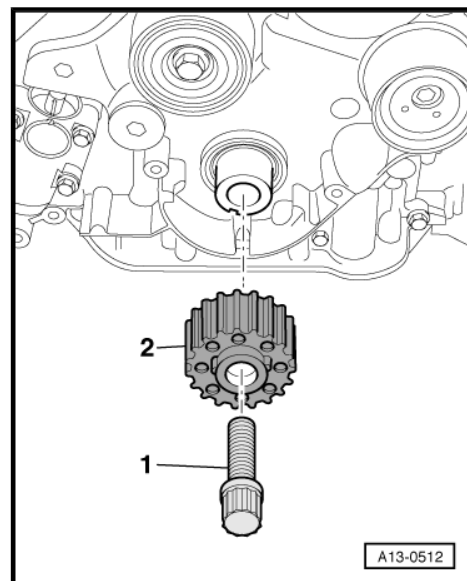
Removing

- Remove noise insulation -arrows-
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove toothed belt ⇒ [page 43](#) .

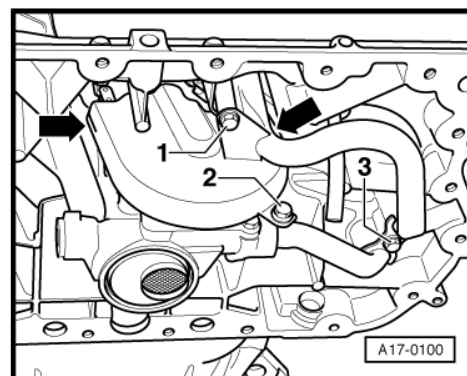




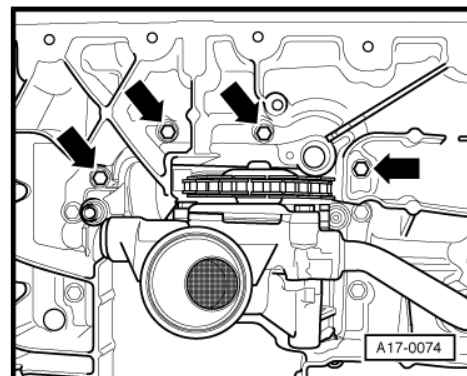
- Unscrew central bolt -1- for toothed belt sprocket -2- on crankshaft and remove toothed belt sprocket.
- Remove sump (bottom section) ⇒ [page 133](#) .



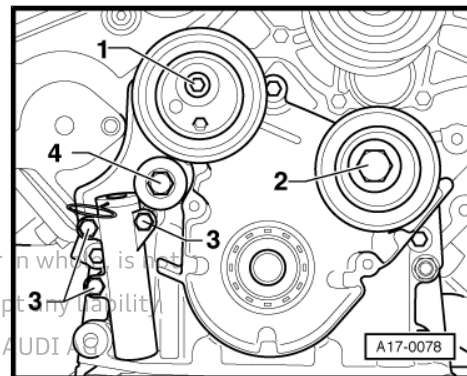
- Place used oil collection and extraction unit - V.A.G 1782- beneath engine.
- Remove bolt -2- (counterhold at welded-on nut).
- Detach cover plate at the points indicated by -arrows-.
- Remove bolts -1- and -3-.
- Pull off the longer of the two oil pipes.



- Unscrew 4 bolts -arrows- from sump (top section).



- Remove idler roller -2-, tensioning roller -1-, tensioning lever -4- and tensioner -3-.



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- Remove bolts -1- and -2- and detach front sealing flange.
- Drive out oil seal with sealing flange removed.

Installing

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



Note

Renew O-rings.

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



WARNING

Put on safety goggles.

- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (nozzle approx. 2 mm Ø).



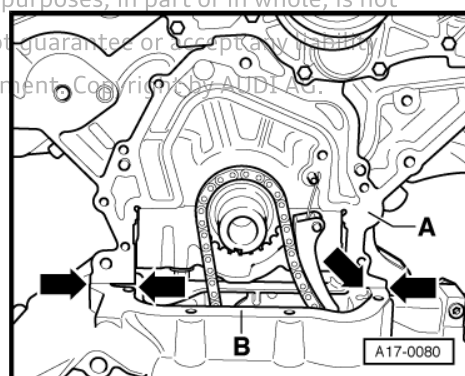
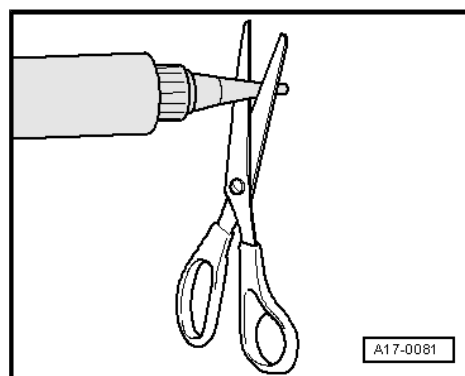
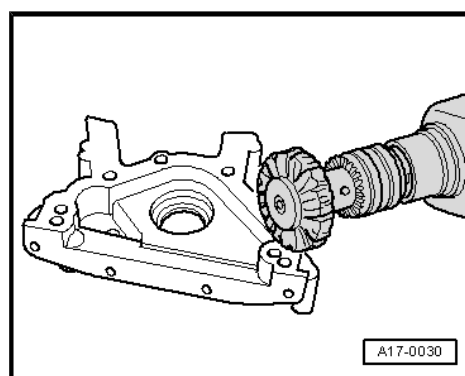
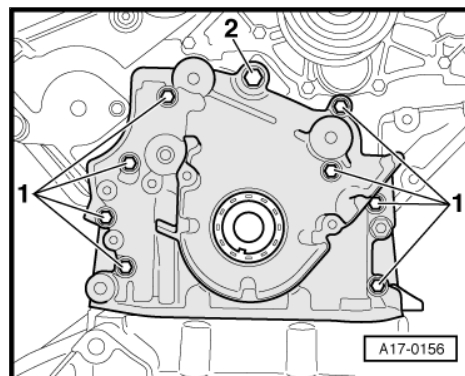
- Attach gasket to dowel pins on sealing surface -A-



Note

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

- After fitting gasket, apply a small sealant bead in each case to edges between -left arrows- and -right arrows-.

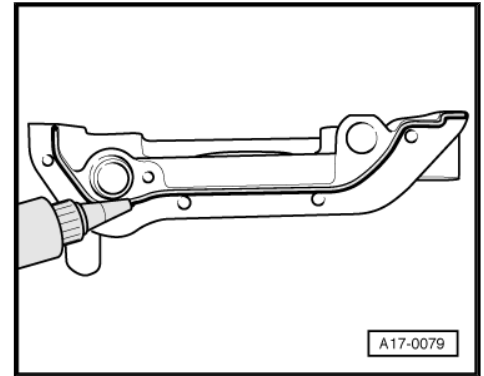




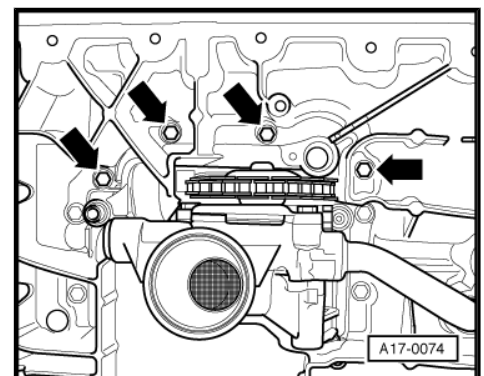
- Apply sealant bead to clean sealing surface of sealing flange, as shown in illustration.
- Thickness of sealant bead: 2 ... 3 mm.

**Note**

- ◆ *The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.*
- ◆ *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.*

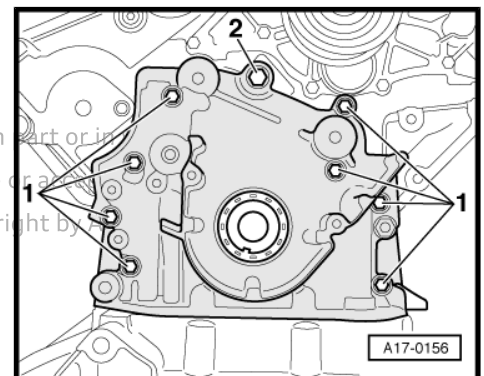


- Hand-tighten the 4 bolts -arrows-.

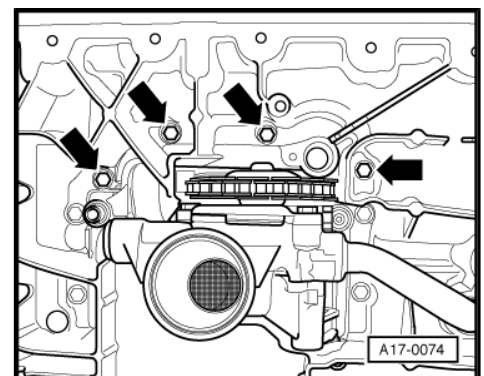


- Insert bolt -2- with locking fluid; Locking fluid ⇒ Parts catalogue.
- Tighten bolts -1- to 10 Nm and bolt -2- to 30 Nm.

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- Tighten the 4 bolts -arrows- fully.
- M6 - 10 Nm
- M7 - 16 Nm
- Install sump (bottom section) ⇒ [page 135](#).





Note

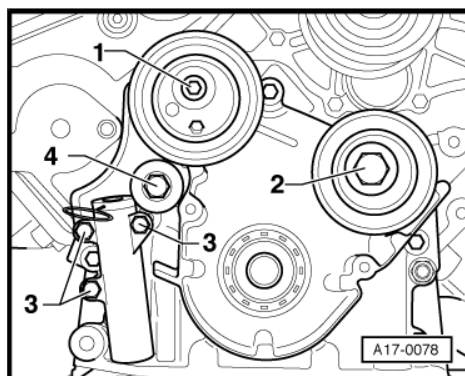
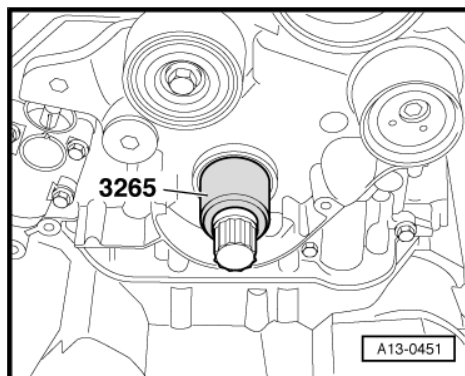
Do not lubricate sealing lip and outer rim of oil seal before pressing in.

- Push on oil seal using fitting sleeve - 3202/1- .
- Press in oil seal until flush using centre bolt and fitting sleeve - 3265- .

- Install components in the specified sequence:

- 1 - Toothed belt tensioner -item 3-
- 2 - Tensioning lever -item 4-
- 3 - Toothed belt tensioning roller -item 1-
- 4 - Idler roller -item 2-

- Pay attention to shims beneath tensioning roller and tensioning lever.



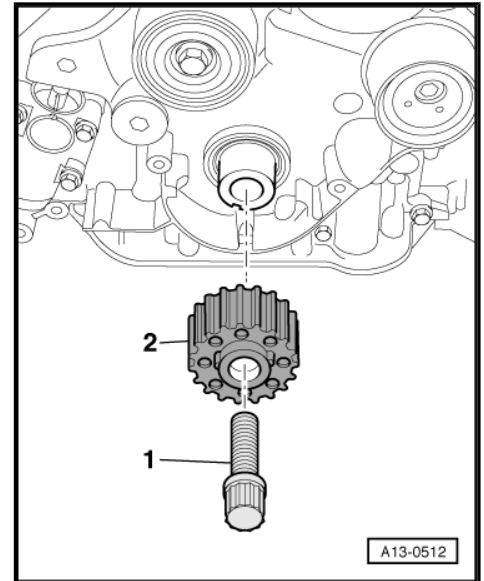
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- Fit crankshaft toothed belt sprocket -2- with new central bolt -1-.

Note

- ◆ *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- ◆ *Do not additionally lubricate bolt for crankshaft toothed belt sprocket.*
- Install toothed belt (adjust valve timing) ➤ [page 50](#) .
- Install vibration damper ➤ [page 39](#) .
- Install poly V-belt ➤ [page 38](#) .
- Install viscous fan ➤ [page 186](#) .
- Install lock carrier with attachments ➤ Rep. gr. 50 .
- Install front bumper ➤ Rep. gr. 63 .



Tightening torques

Component		Nm
Brackets for oil pipes to sump (top section)		10
Cover plate to rear cover plate		10
Front sealing flange to cylinder block	M6	10
	M8	30 ¹⁾
Sealing flange (front) to sump (top section)	M6	10
	M7	16
Toothed belt sprocket to crankshaft		200 + 180° 2)3)
Toothed belt tensioning roller to sealing flange (front)		42
Tensioner to sealing flange (front)		10
Tensioning lever to sealing flange (front)		22
Tensioning roller to sealing flange (front)		22
Idler roller to sealing flange (front)		43
• 1) Install using locking fluid; for locking fluid refer to ➤ Parts catalogue . • 2) Renew bolt. • 3) 180° = one half turn.		

2.4 Removing and installing dual-mass fly-wheel

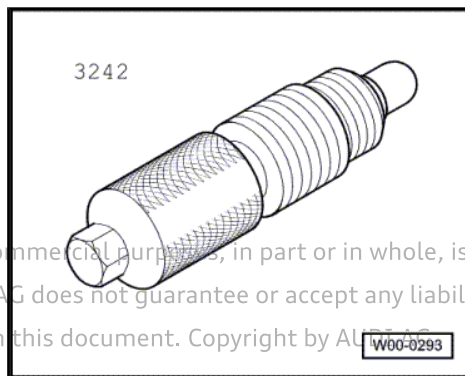
Special tools and workshop equipment required



◆ Locking pin - 3242-



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Removing

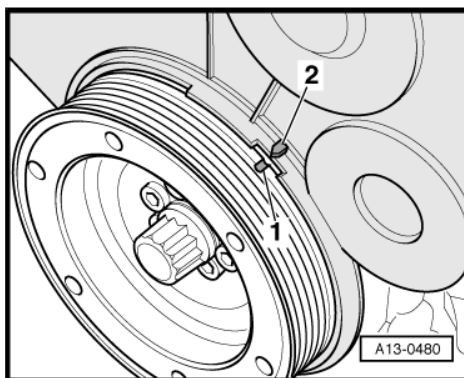
- Engine or gearbox removed.



Caution

Engine must only be turned in direction of rotation (clockwise) via crankshaft.

- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark.
- Notch -1- should align with marking -2-.





- Unscrew plug for TDC marking from cylinder block.

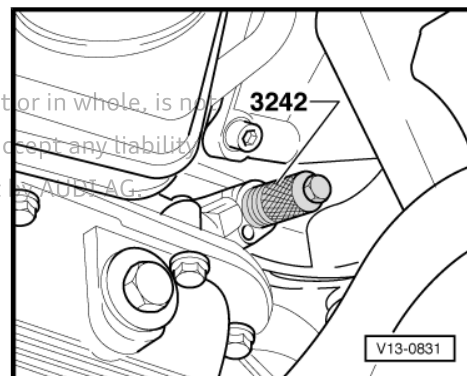
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There is a TDC drilling in the crankshaft directly behind the sealing plug (it is possible to feel the hole).

**WARNING**

To avoid any risk of injury, do not rotate the crankshaft while feeling for the TDC hole with your finger.



- Screw locking pin - 3242- into bore (tightening torque: 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 on crankshaft.
- Unbolt dual-mass flywheel.

Installing

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

- Use new securing bolts.

**Note**

A needle bearing is fitted in the dual-mass flywheel; knock in the needle bearing when fitting a new flywheel ⇒ [page 63](#) .

- Remove locking pin - 3242- .
- Screw plug for TDC marking into cylinder block with new O-ring.

Tightening torques

Component	Nm
Dual-mass flywheel to crankshaft	60 + 180° ¹⁾²⁾
Sealing plug in cylinder block	10
• ¹⁾ Renew bolts. • ²⁾ 180° = one half turn.	

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

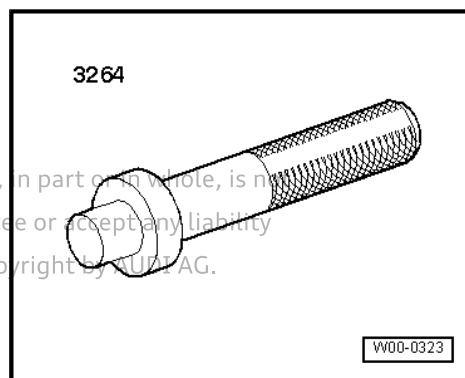
Special tools and workshop equipment required



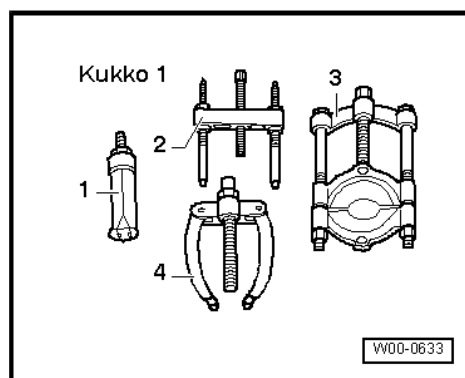
◆ Punch - 3264-



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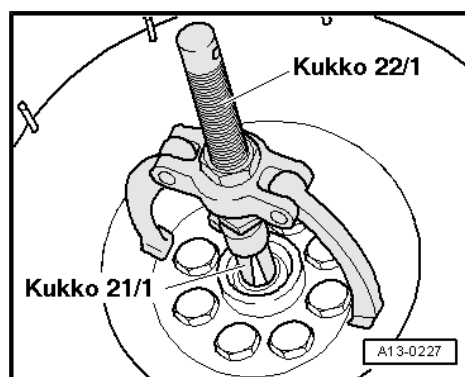
◆ -1- Internal puller - Kukko 21/1-



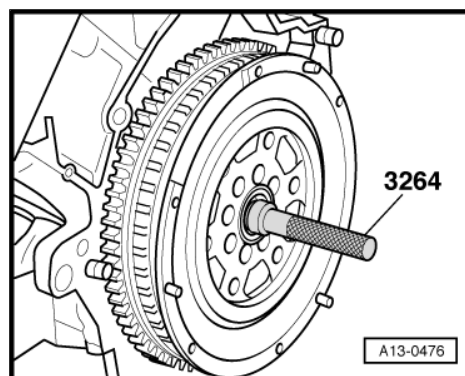
◆ -4- Counter-support - Kukko 22/1-

Procedure

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



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





3 Removing and installing crankshaft

3.1 Exploded view - crankshaft



Note

Secure engine to assembly stand with engine and gearbox support - VAS 6095- prior to performing assembly work ➔ [page 25](#).

1 - Dowel sleeve

- ☐ Insert in cylinder block

2 - Drive chain sprocket

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

3 - Crankshaft

- ☐ Measuring axial clearance ➔ [page 66](#)
- ☐ Measuring radial clearance ➔ [page 67](#)
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Crankshaft dimensions ➔ [page 66](#)

4 - Bearing cap bolts

- ☐ Renew
- ☐ Tightening sequence ➔ [page 66](#)

5 - Bearing caps

- ☐ Note marking ➔ [page 66](#)
- ☐ Installing ➔ [page 66](#)

6 - Thrust washer

- ☐ Only fitted on 4th crankshaft bearing
- ☐ Oil grooves face outwards
- ☐ Note location
- ☐ Measuring axial clearance of crankshaft ➔ [page 66](#)

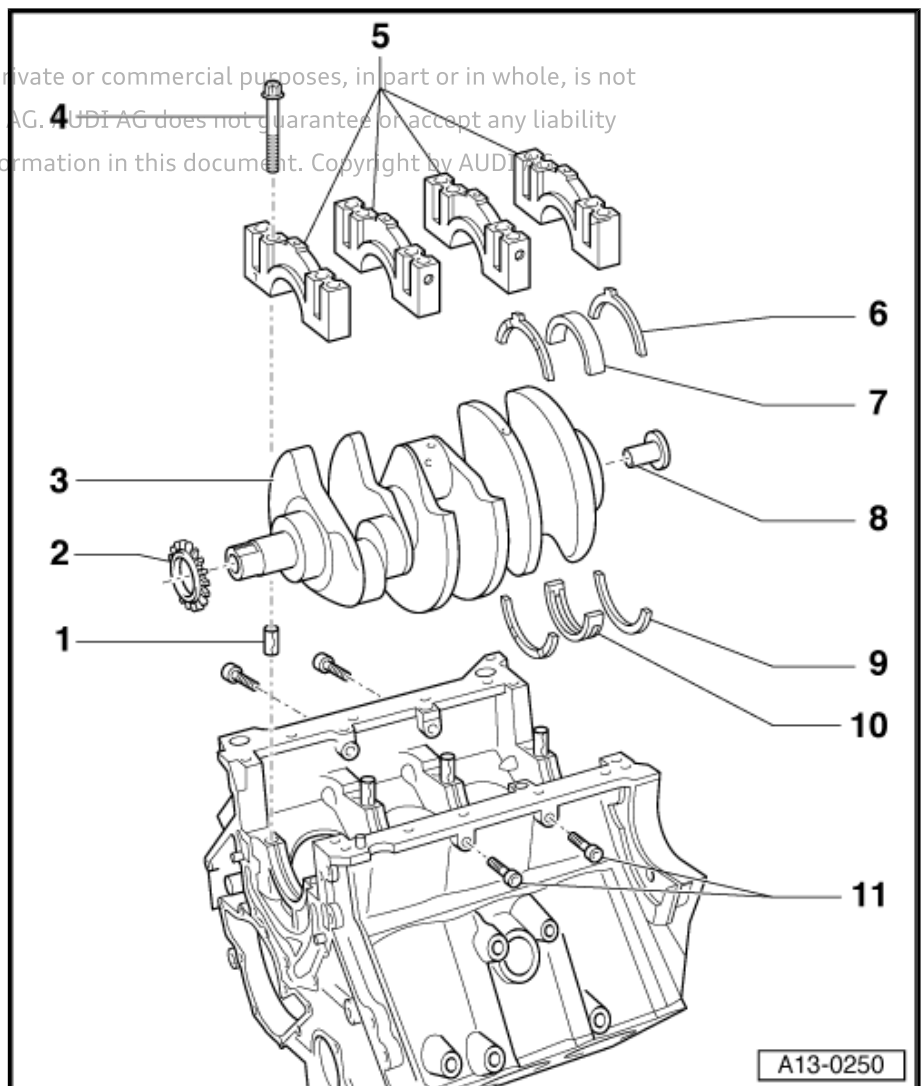
7 - Bearing shell for bearing cap

- ☐ Without oil groove
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ New bearing shells for bearing caps are only available with colour coding "yellow"

8 - Not fitted

9 - Thrust washer

- ☐ Only fitted on 4th crankshaft bearing
- ☐ Oil grooves face outwards
- ☐ Measuring axial clearance of crankshaft ➔ [page 66](#)





10 - Bearing shell for cylinder block

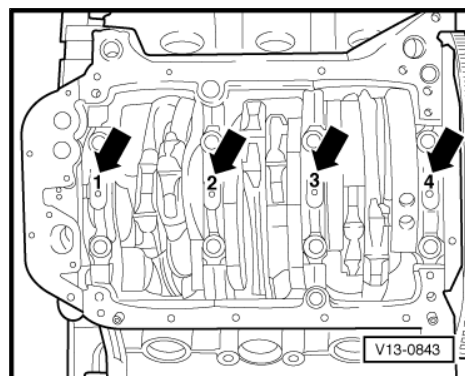
- ☐ With oil groove
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ New bearing shells for cylinder block are only available with colour coding "yellow"

11 - Bearing cap bolts

- ☐ Tightening sequence ⇒ [page 66](#)

Markings on crankshaft bearing caps

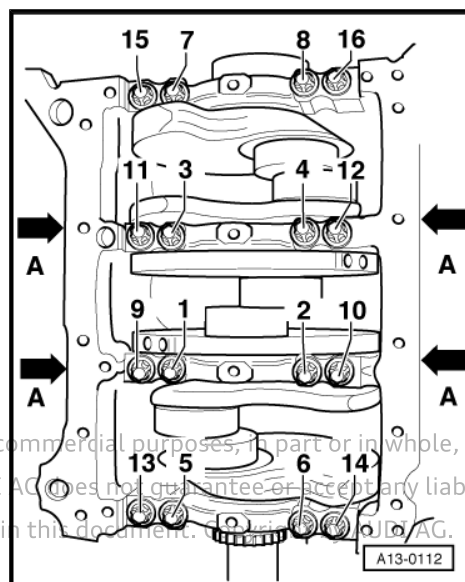
- ◆ Bearing -1- is on pulley end.
- ◆ Bearing -4- is on flywheel end



Installing crankshaft bearing caps

Crankshaft bearing cap "1" is located at toothed belt end, crankshaft bearing cap "4" on flywheel end.

- Renew bolts -1 ... 16-.
- Insert dowel sleeves in cylinder block.
- Tighten bearing cap bolts in following sequence:
 1. Screw in bolts -A- hand-tight.
 2. Tighten bolts -1 ... 16- to 30 Nm with torque wrench.
 3. Tighten bolts -1 ... 16- to 60 Nm with torque wrench.
 4. Turn bolts -1 ... 16- 90° further ($\frac{1}{4}$ turn) using a rigid wrench.
 5. Tighten bolts -A- to 25 Nm with torque wrench.



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3.2 Crankshaft dimensions

Honing dimension (in mm)	Crankshaft main bearing journal Ø	Crankshaft 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
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

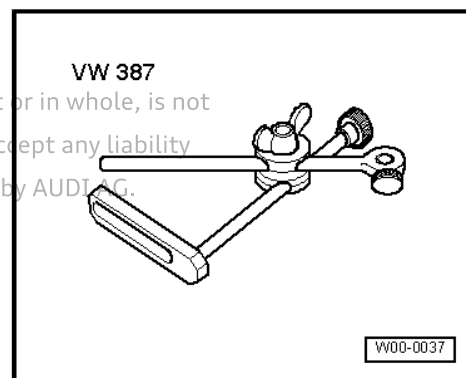
3.3 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

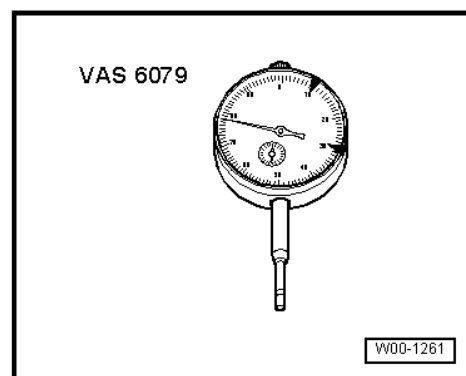


◆ Universal dial gauge bracket - VW 387-

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◆ Dial gauge - VAS 6079-

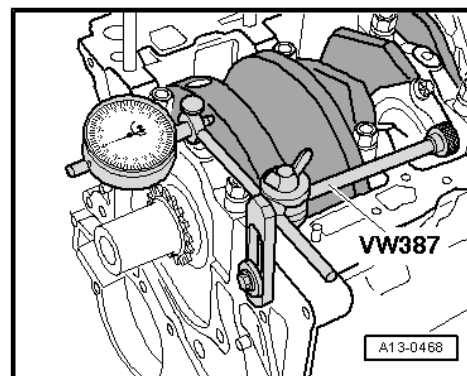


Procedure

- Bolt dial gauge with universal dial gauge bracket - VW 387- onto cylinder block and apply gauge against crank web.
- Push 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

Do not interchange used bearings.

- Remove crankshaft bearing cap and clean bearing cap and journal.
- Place a length of Plastigauge corresponding to the width of the bearing on the bearing journal or bearing shell.
- The Plastigauge must be positioned in the centre of the bearing shell



- Fit crankshaft bearing caps and tighten to 30 Nm. Do not rotate crankshaft.
- Remove crankshaft bearing cap again.
- Compare width of Plastigauge with measurement scale:

Radial clearance:

- New: 0.018 ... 0.045 mm.
- Wear limit: 0.10 mm.

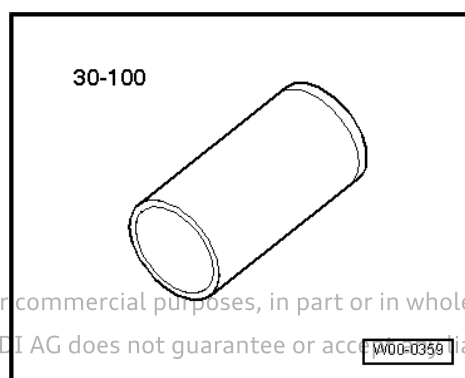
3.5 Removing and installing drive chain sprocket

Special tools and workshop equipment required

- ◆ Drift sleeve - 30-100-



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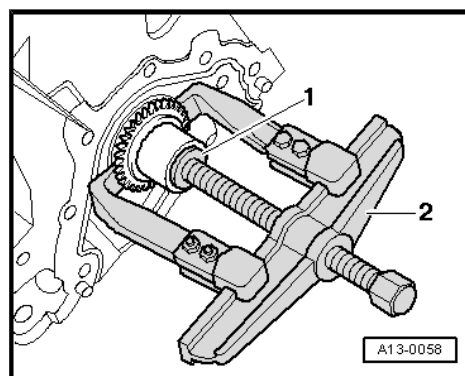
Removing

- Remove chain for oil pump ⇒ [page 138](#)
- 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:

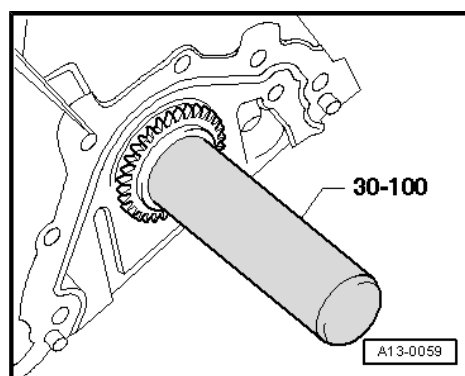
- Installation position: lettering on drive chain sprocket must be visible.
- Heat drive chain sprocket in oven for approx. 15 minutes to 220 °C.



WARNING

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- .





4 Dismantling and assembling pistons and conrods

4.1 Exploded view - pistons and conrods



Note

Oil spray jet for piston cooling ➔ [page 72](#)

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

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

2 - Conrod bearing cap

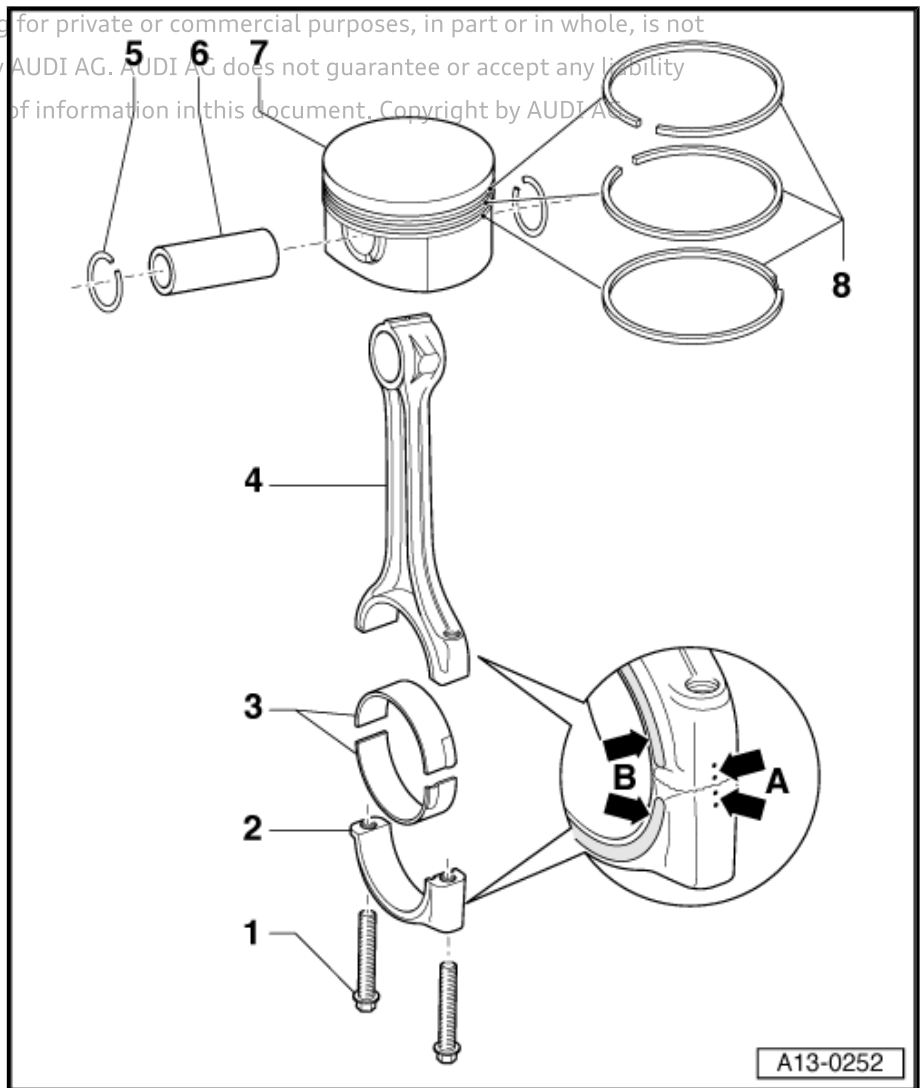
- ☐ Note installation position: split contact surfaces on side of conrod must be in alignment -B-

3 - Bearing shell

- ☐ Note installation position
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Note type: upper bearing shell (closest to piston) is made of more wear-resistant material. Distinguishing feature on new bearing shells: black marking on contact surface near separating point
- ☐ Check that it is securely seated
- ☐ Measuring radial clearance ➔ [page 72](#)
- ☐ To measure radial clearance, tighten bolts ➔ [Item 1 \(page 69\)](#) to 30 Nm but do not turn further

4 - Conrod

- ☐ Only renew as a complete set
- ☐ Mark cylinder allocation -A- ➔ [page 71](#)
- ☐ Note when fitting bearing cap: split contact surfaces on side of conrod must be in alignment -B-
- ☐ Installation position of conrod pairs ➔ [page 72](#)





5 - Circlip

6 - Piston pin

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

7 - Piston

- ☐ Mark installation position and cylinder number ⇒ [page 71](#)
- ☐ Arrow on piston crown points to pulley end
- ☐ Checking ⇒ [page 71](#)
- ☐ Install using piston ring clamp
- ☐ Piston and cylinder dimensions ⇒ [page 72](#)
- ☐ Checking cylinder bore ⇒ [page 71](#)

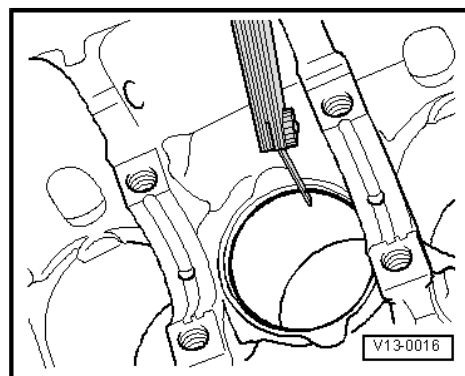
8 - Piston rings

- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ "TOP" must face towards piston crown
- ☐ Checking ring gap ⇒ [page 70](#)
- ☐ Checking ring-to-groove clearance ⇒ [page 70](#)

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.

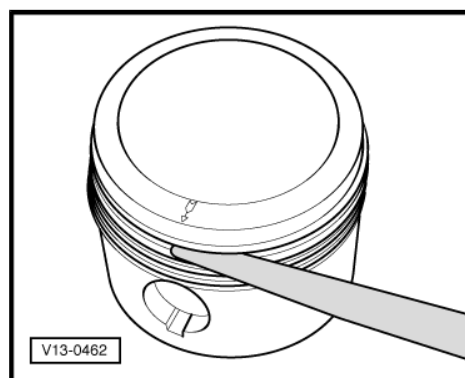
Piston ring (in mm)	New	Wear limit
1st compression ring	0.35 ... 0.50	1.0
2nd compression ring	0.50 ... 0.70	1.4
Oil scraper ring	0.25 ... 0.50	0.8



Checking ring-to-groove clearance

- Clean groove in piston before checking clearance.

Piston ring (in mm)	New	Wear limit
Compression rings	0.02 ... 0.08	0.10
Oil scraper ring	0.02 ... 0.08	0.10



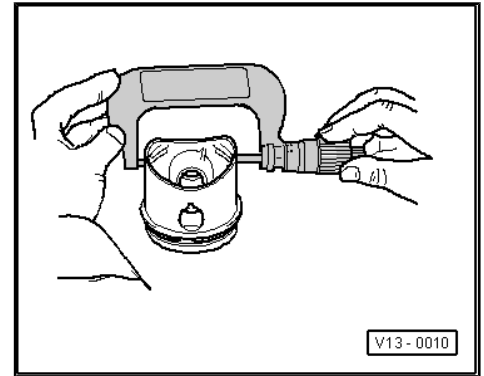


Checking piston

- Using a micrometer (75 ... 100 mm), measure approx. 10 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 72

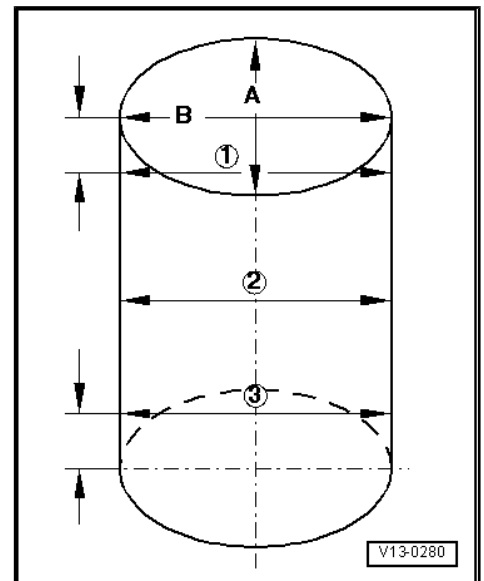


Checking cylinder bore

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

Nominal dimension

⇒ "4.2 Piston and cylinder dimensions", page 72



Piston installation position and piston/cylinder allocation

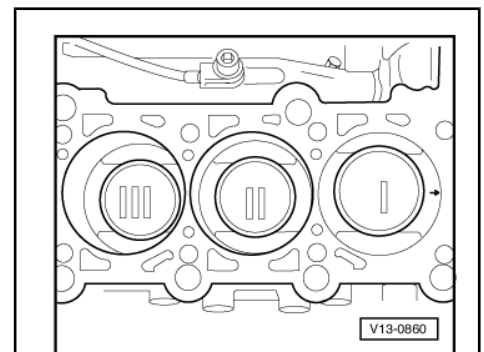
- Use chalk or waterproof felt-tip pen to mark installation position and cylinder allocation on piston crown.



Note

Do not use a centre punch or scribe, as this would damage the coating of the piston crown.

- Installation position: Arrow on piston crown points to pulley end.



Marking conrods

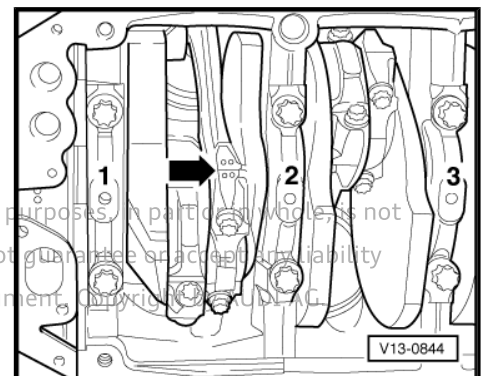


Note



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

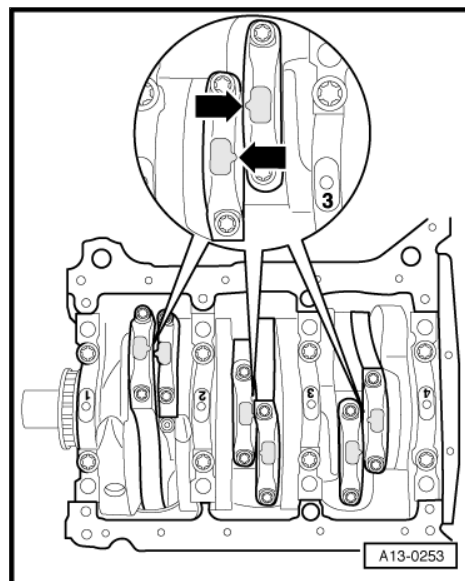
- Before removing, mark mating positions of conrods and conrod bearing caps with coloured pen -arrow-.





Installation position of conrod pairs

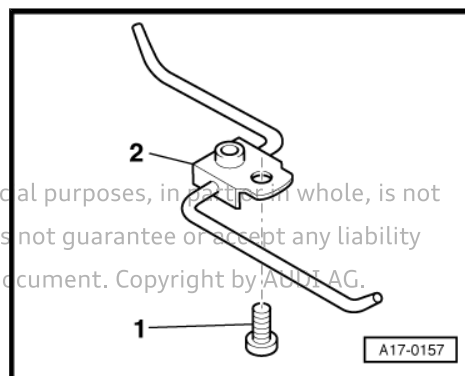
- The cast lugs -arrows- on the ground surfaces of the conrod pairs 1 and 2, 3 and 4, and 5 and 6 must face one another.



Oil spray jet for piston cooling

- 1 - Bolt, 10 Nm
- 2 - Oil spray jet for piston cooling

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4.2 Piston and cylinder dimensions

Honing dimension (in mm)	Piston Ø mm	Cylinder bore Ø mm
Basic dimension	80.95	81.01



Note

Replacement pistons are only available with basic dimension.

4.3 Checking radial clearance of conrod bearings

Special tools and workshop equipment required

- ◆ Plastigauge

Test sequence

- Remove conrod bearing caps.
- Clean bearing caps and bearing journals.
- Place Plastigauge onto bearing journal or into bearing shells corresponding to width of bearing.
- The Plastigauge must be positioned in the centre of the bearing shell



- Fit conrod bearing cap and tighten to 30 Nm. Do not rotate crankshaft.
- Remove conrod bearing caps once more.
- Compare width of Plastigauge with measurement scale:

Radial clearance:

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



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15 – Cylinder head, valve gear

1 Removing and installing cylinder head

1.1 Exploded view - cylinder head



Note

Illustration shows left-side cylinder head.

1 - Cylinder head gasket

- ☐ Renewing
⇒ ["1.4 Removing and installing cylinder head"](#),
[page 83](#)
- ☐ Installation position:
Part No. towards cylinder head
- ☐ If renewed, refill system
with fresh coolant

2 - Cylinder head

- ☐ Removing and installing
⇒ [page 83](#)
- ☐ Checking for distortion
⇒ [page 75](#)
- ☐ Machining limit
⇒ [page 76](#)
- ☐ Driving sealing cap into
cylinder head
⇒ [page 76](#)
- ☐ If renewed, refill system
with fresh coolant

3 - Lifting eye

4 - 25 Nm

5 - Cylinder head bolt

- ☐ Renew
- ☐ Note correct sequence
when loosening
⇒ [page 86](#)
- ☐ Note correct sequence
when tightening
⇒ [page 88](#)

6 - Intake manifold gasket

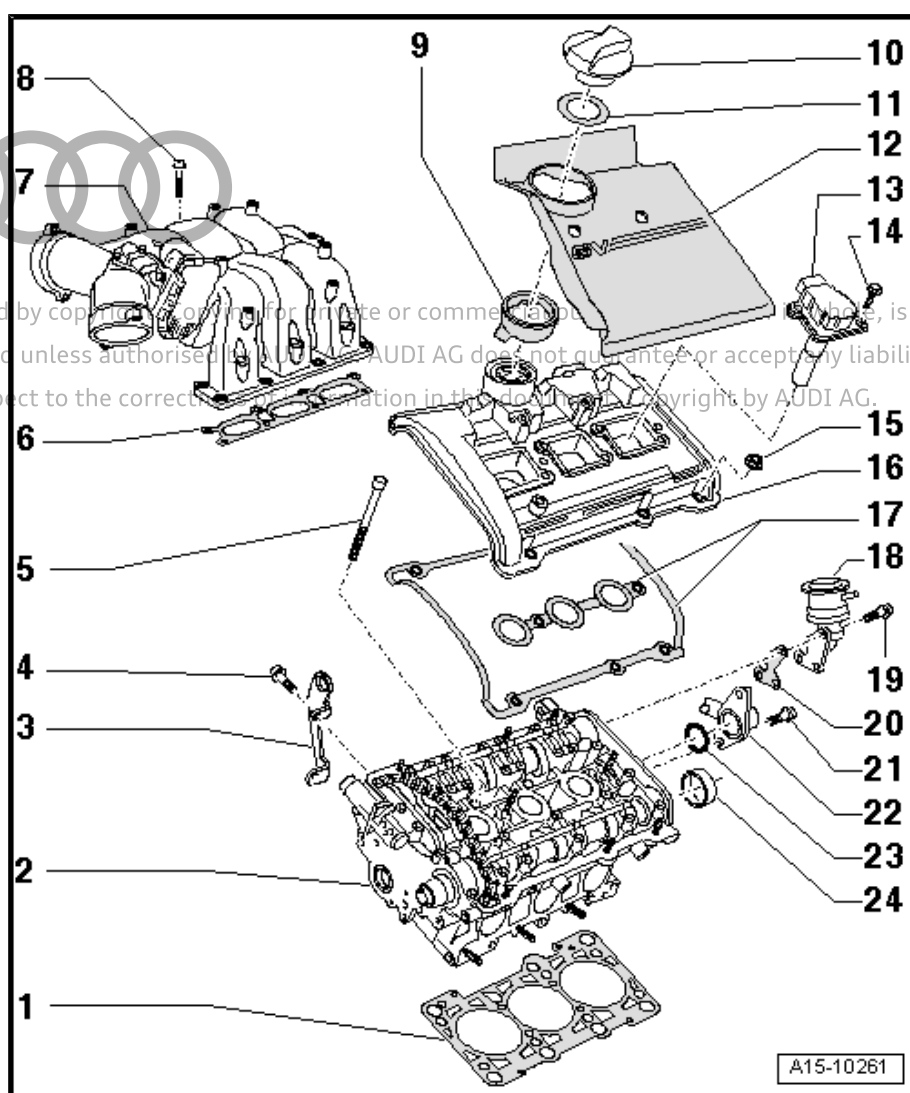
- ☐ Renew

7 - Intake manifold

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

8 - 10 Nm

- ☐ Tighten in stages and in diagonal sequence





9 - Rubber ring

10 - Filler cap

11 - Seal

- ☐ Renew if damaged or leaking

12 - Cover panel for cylinder head cover

13 - Ignition coil

14 - 10 Nm

15 - 10 Nm

- ☐ Note correct sequence when tightening ⇒ [page 79](#) or ⇒ [page 83](#)

16 - Cylinder head cover

- ☐ Removing and installing: left-side ⇒ [page 77](#) , right-side ⇒ [page 80](#)

17 - Gaskets for cylinder head cover

- ☐ Renew if damaged or leaking
- ☐ Apply sealant at sealing points before installing ⇒ [page 76](#) ; Sealant ⇒ Parts catalogue

18 - Combination valve for secondary air system

- ☐ Removing and installing: left-side ⇒ [page 282](#) , right-side ⇒ [page 284](#)

19 - 10 Nm

20 - Gasket

- ☐ Renew

21 - 10 Nm

22 - Coolant pipe (rear)

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

23 - O-ring

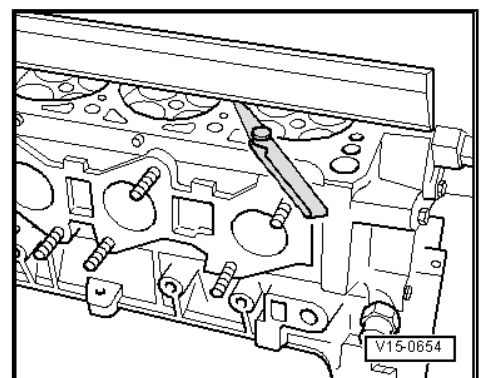
- ☐ Renew

24 - Filler cap

- ☐ Driving sealing cap into cylinder head ⇒ [page 105](#)

Checking cylinder head for distortion

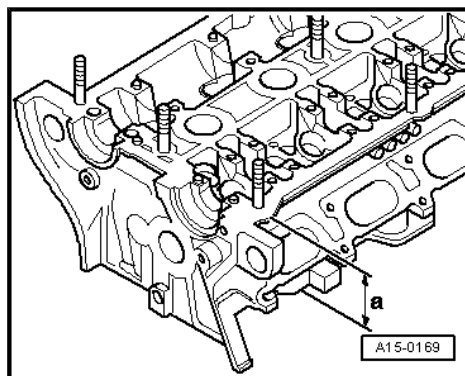
- Use straight edge and feeler gauge to measure for distortion at several points.
- Max. permissible distortion: 0.1 mm





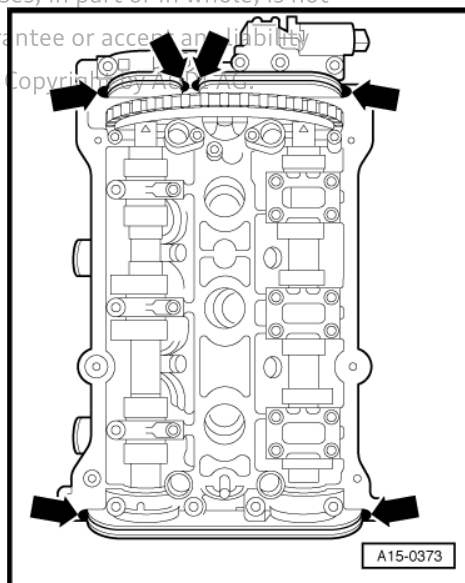
Cylinder head machining limit

- Machining of the cylinder head (surface grinding) is only permissible down to the minimum dimension -a-.
- Minimum dimension: -a- = 139.25 mm



Sealing points for bearing caps on cylinder head

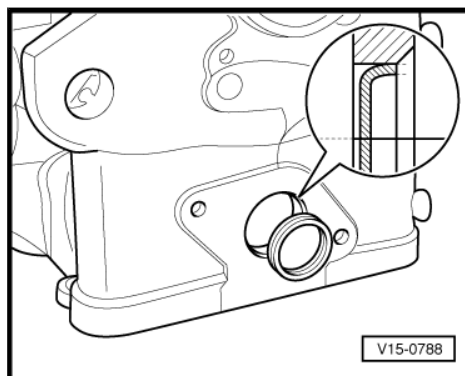
- Apply small quantity of sealant to sealing points -arrows- on top sealing surface of cylinder head; for sealant refer to ➔ Parts catalogue .



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; sealant ➔ Parts catalogue .
- Drive in sealing cap with drift - VW 295- until outer rim of sealing cap is flush with end of chamfer in cylinder head.





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

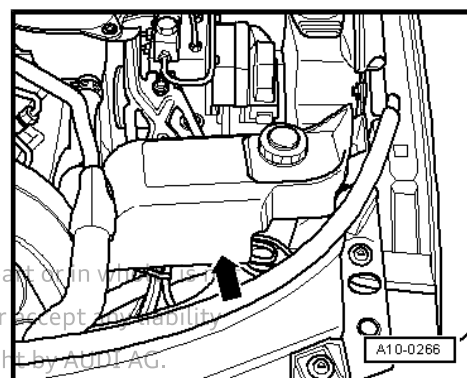
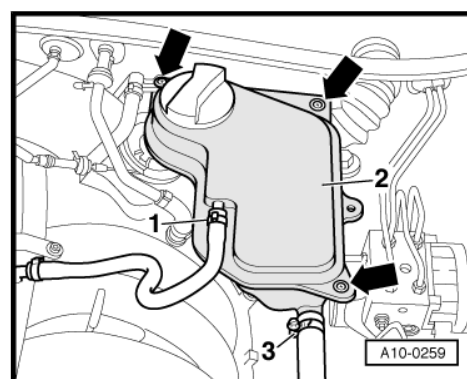
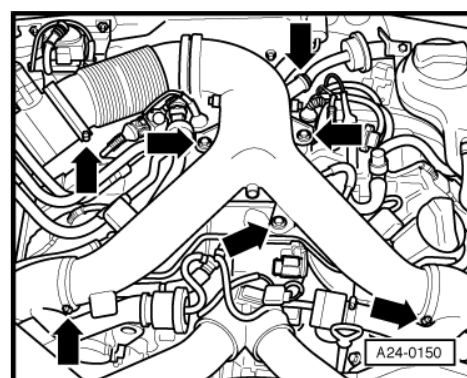
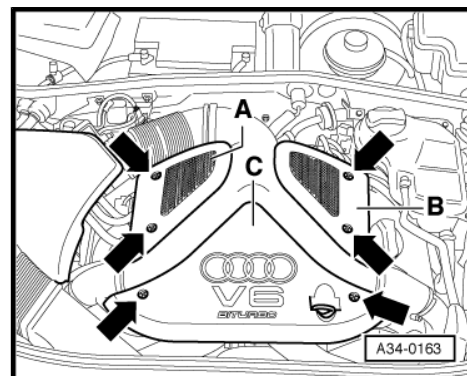
Removing



Note

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

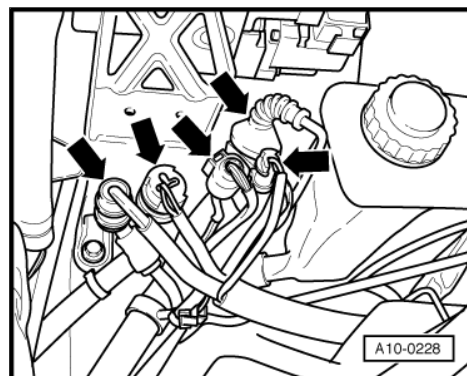
- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.
- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.
- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical wire for coolant shortage indicator switch - F66- at bottom of expansion tank and move expansion tank to one side with coolant hoses -1- and -3- attached.
- Remove cover -arrow- at power steering fluid reservoir.



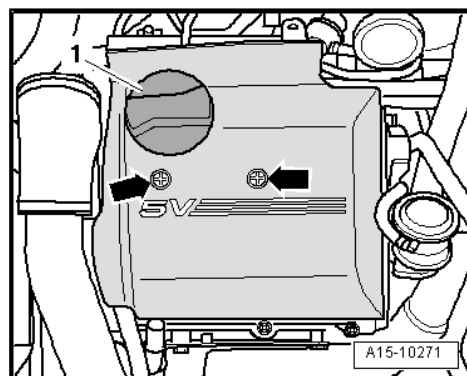
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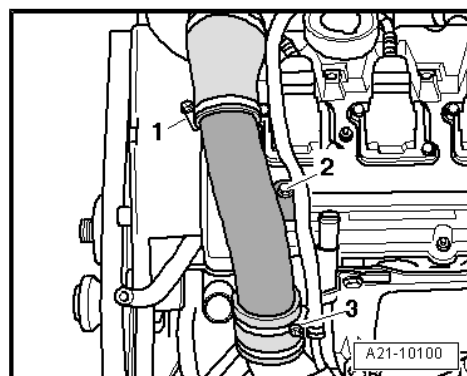
- Unclip all electrical connectors from bracket -arrows-.
- Remove bracket.



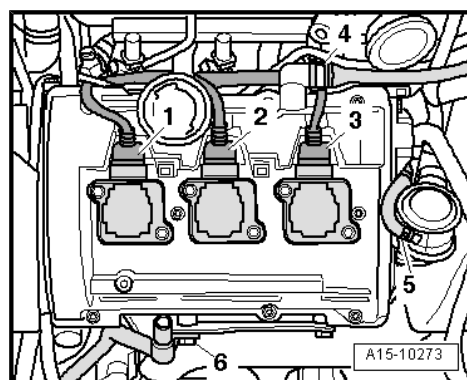
- Unscrew sealing cap -1-.
- Loosen quick release fasteners -arrows- and remove cover panel for cylinder head cover (left-side).



- Remove bolt -2-.
- Remove air pipe (left-side); disconnect hose connections -1- and -3- for this purpose.



- Unplug electrical connectors -1 ... 3-.
- Remove ignition coils.
- Unfasten cable tie and move wiring clear.
- Disconnect crankcase breather hose -4- at cylinder head cover.
- Detach vacuum hose -5- from combination valve for secondary air system.
- Remove bolt -6-.



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- Unscrew nuts -1- and -2- and remove cylinder head cover.

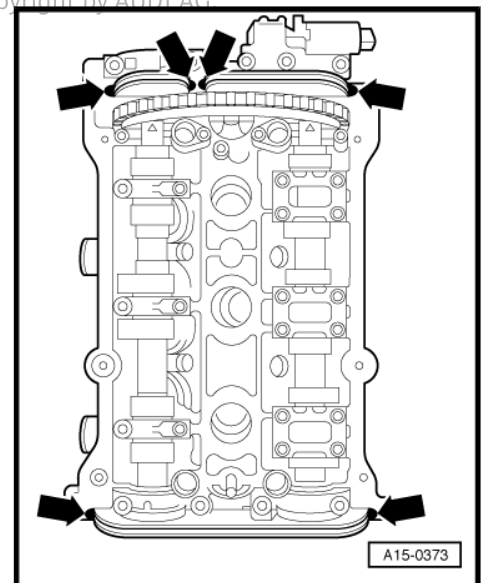
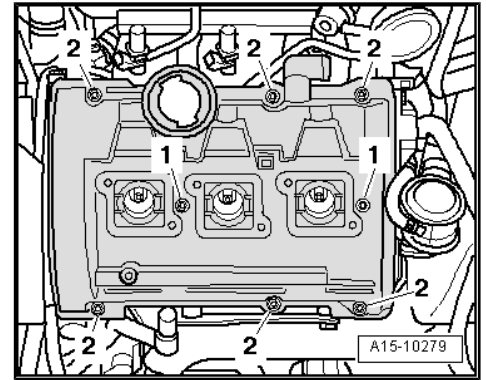
Installing

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



Note

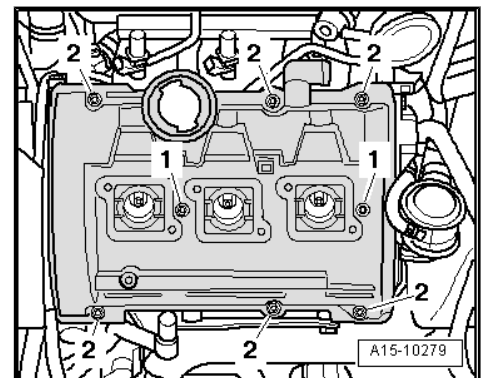
- ◆ *Renew cylinder head cover gaskets if damaged.*
 - ◆ *Hose connections and charge air system hoses must be free of oil and grease prior to fitting.*
 - ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue .*
 - ◆ *Fit all cable ties in the original positions when installing.*
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- Apply small quantity of sealant to sealing points -arrows- on top sealing surface of cylinder head; for sealant refer to ⇒ Parts catalogue .



- Tighten inner nuts -1- for cylinder head cover.
- Then tighten outer nuts -2- in stages and in diagonal sequence.

Tightening torques

Component	Nm
Cylinder head cover to cylinder head	10
Ignition coils to cylinder head cover	10
Bracket to cylinder head	22
Air pipe to cylinder head	10
Air duct to intake manifold	10
Hose clips (9 mm wide)	3
Hose clips (13 mm wide)	5.5





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

Removing



Note

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

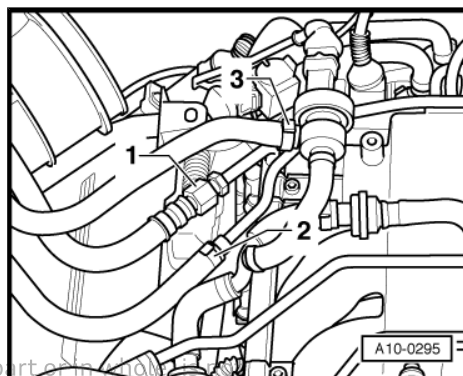
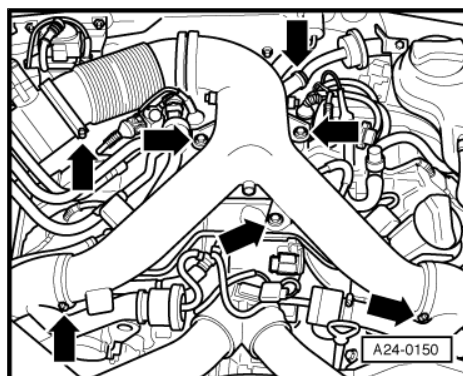
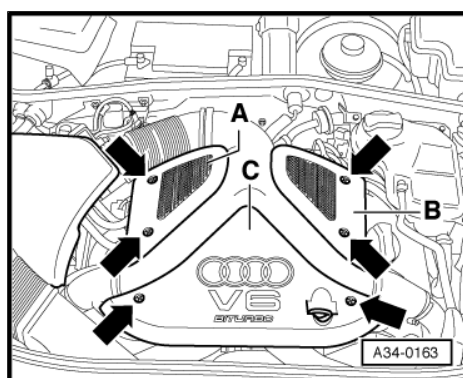
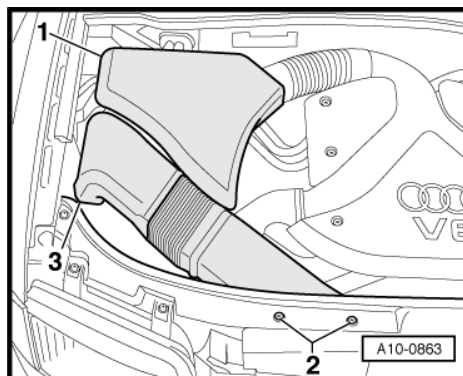
- Remove cover -1- on right side of engine compartment.
- Unscrew bolts -2- and detach air duct from air cleaner housing -3-.
- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.
- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.



WARNING

The fuel system is pressurised. Before opening the system place a clean cloth around the connection. Then carefully loosen the connection to relieve the pressure.

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



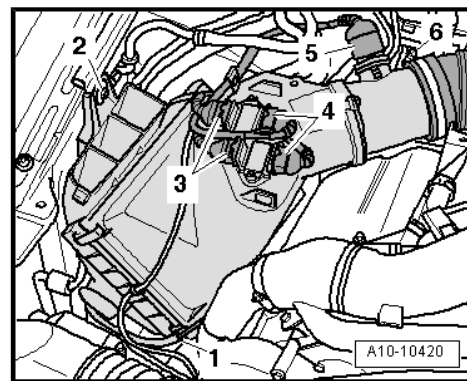
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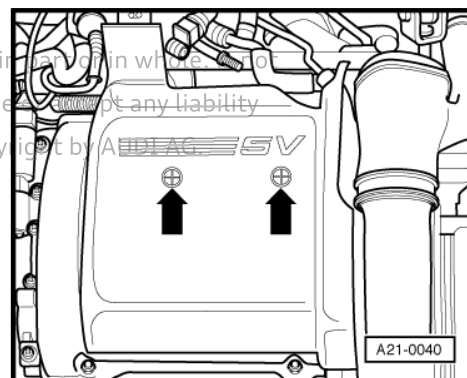
- Unplug electrical connectors at output stage - N122- -item 3- and at output stage 2 - N192- -item 4-.
- Unplug electrical connector -5- at air mass meter - G70- .
- Move wiring harness at air cleaner housing clear.
- Unplug vacuum hose -1-.
- Unscrew nut -2- and remove air cleaner housing with air mass meter - G70- .

**Note**

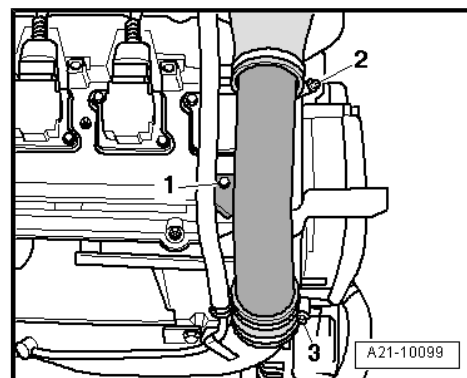
Disregard -item 6-.



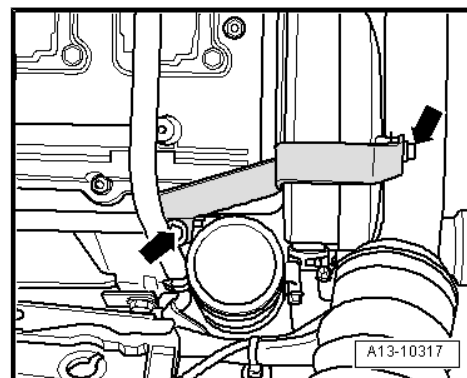
- Loosen quick release fasteners -arrows- and remove cover for cylinder head cover (right-side).



- Remove bolt -1-.
- Remove top right air pipe; disconnect hose connections -2- and -3- for this purpose.

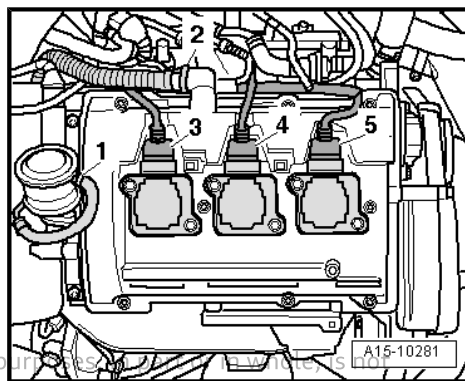


- Unscrew bolts -arrows- and remove bracket.

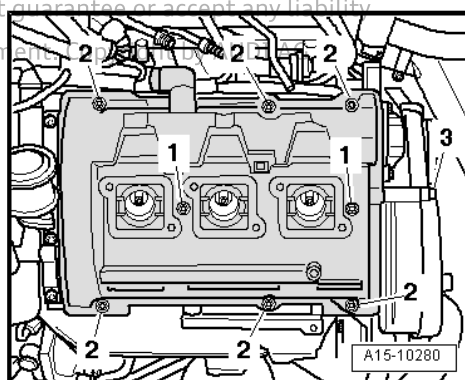




- Unplug electrical connectors -3 ... 5-.
- Remove ignition coils.
- Unfasten cable tie and move wiring clear.
- Disconnect crankcase breather hose -2- at cylinder head cover.
- Detach vacuum hose -1- from combination valve for secondary air system.



- Unscrew bolt -3- at toothed belt cover (right-side).
- Unscrew nuts -1- and -2- and remove cylinder head cover.



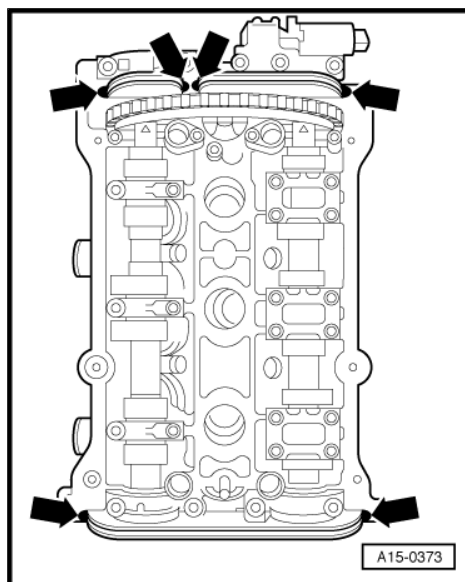
Installing

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



Note

- ◆ *Renew cylinder head cover gaskets if damaged.*
 - ◆ *Hose connections and charge air system 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) ⇒ Parts catalogue .*
 - ◆ *Fit all cable ties in the original positions when installing.*
- Apply small quantity of sealant to sealing points -arrows- on top sealing surface of cylinder head; for sealant refer to ⇒ Parts catalogue .

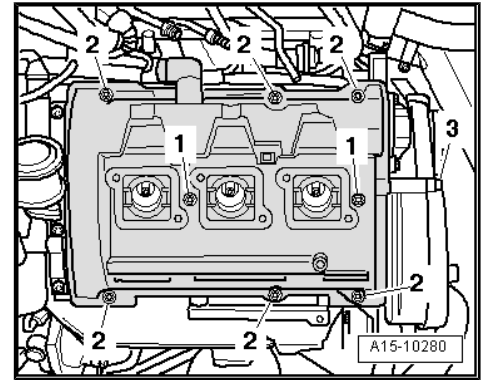




- Tighten inner nuts -1- for cylinder head cover.
- Then tighten outer nuts -2- in stages and in diagonal sequence.
- Tighten bolt -3-.

Tightening torques

Component	Nm
Cylinder head cover to cylinder head	10
Toothed belt cover to cylinder head cover	10
Ignition coils to cylinder head cover	10
Bracket to: Toothed belt cover	10
Bracket	10
Air pipe to cylinder head cover	10
Fuel supply line to fuel rail	22
Air duct to intake manifold	10
Hose clips (9 mm wide)	3
Hose clips (13 mm wide)	5.5

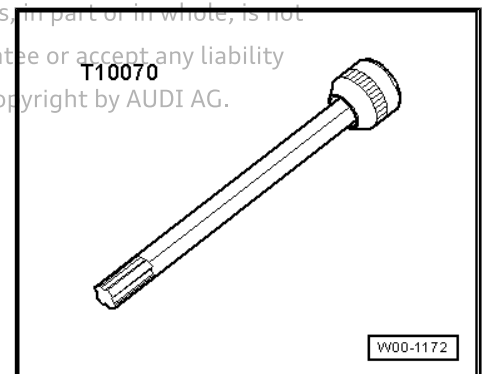


1.4 Removing and installing cylinder head

Special tools and workshop equipment required

- ◆ Socket - T10070-

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Removing



Note

- ◆ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*
- ◆ *The following description shows the removal and installation of the cylinder head (left-side). The procedure for the right-side cylinder head is the same.*
- Remove engine ⇒ [page 2](#) .
- Leave engine on scissor-type assembly platform - VAS 6131- with gearbox attached.
- Remove secondary air pump ⇒ [page 280](#) .
- Remove intake manifold ⇒ [page 90](#) .



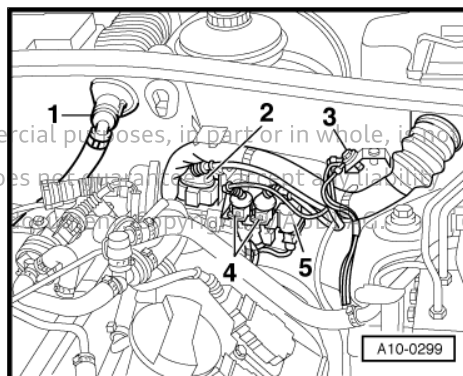
- Take electrical connector -2- for Lambda probe 2 - G108- out of bracket (left-side) and unplug it.
- Remove heat insulation sleeve at wiring harness and move wiring clear.



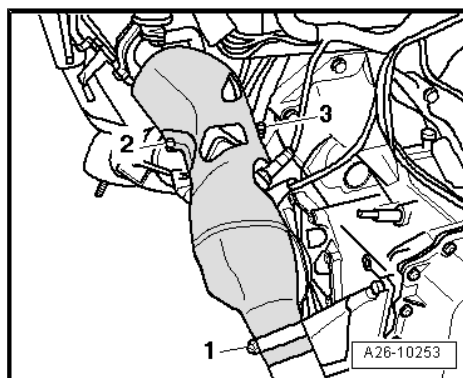
Note

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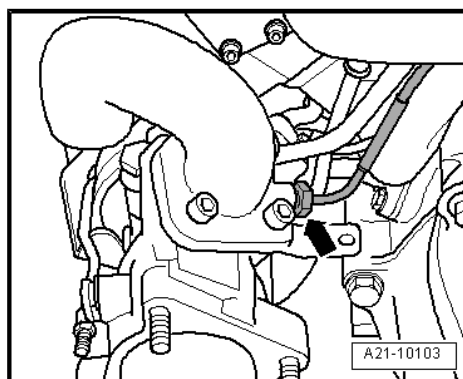
Illustration shows electrical connectors when installed.



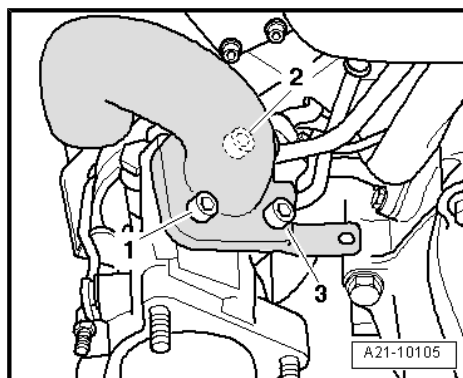
- Slacken clip -1-.
- Unscrew bolts -2- and -3- and remove heat shield from front exhaust pipe (left-side).



- Unscrew exhaust gas temperature sender 1 for cylinder bank 2 - G236- -arrow- from exhaust manifold flange.



- Remove bolts -1 ... 3-.





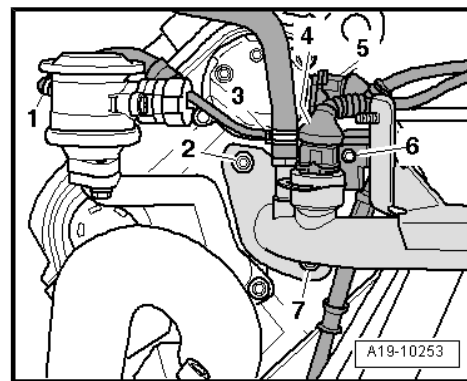
- Unplug electrical connector -5- at Hall sender 2 - G163- .
- Detach vacuum hose -1- from combination valve for secondary air system.
- Remove coolant hose -3-, if fitted.
- Unscrew bolts -2-, -6- and -7-.



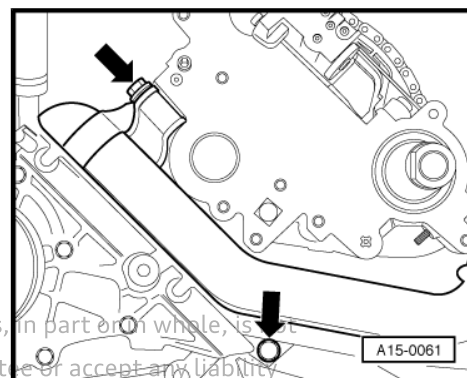
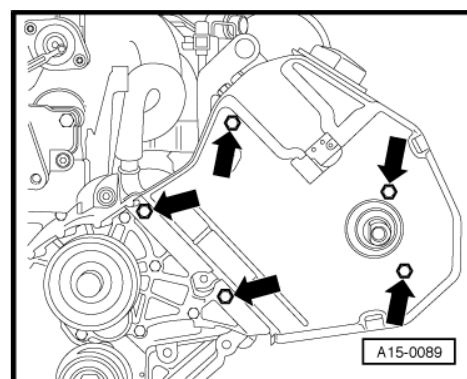
Note

- ◆ The rear coolant pipe remains installed.
- ◆ Disregard -item 4-.

- Remove toothed belt ⇒ [page 43](#) .
- Take off camshaft sprocket.
- Unscrew toothed belt cover (rear left) -arrows-.
- Unplug electrical connector at camshaft control valve 2 - N208- .

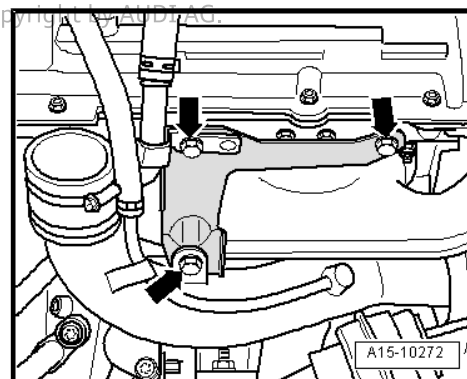


- Unbolt front coolant pipe from cylinder head -arrows-.



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- Unscrew bolts -arrows- and remove bracket for air pipe.





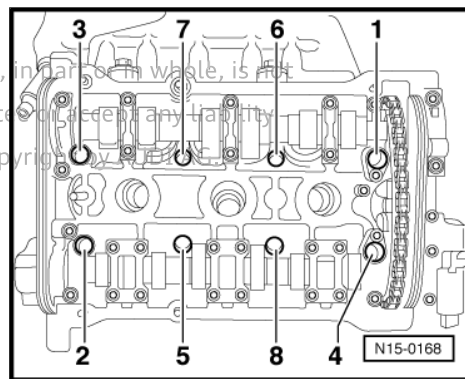
- Remove cylinder head cover (left-side) ⇒ [page 77](#) .
- Loosen cylinder head bolts in sequence 1 .. 8- using special wrench, long reach - T10070- .
- Remove cylinder head bolts and carefully detach cylinder head.

Installing



Note

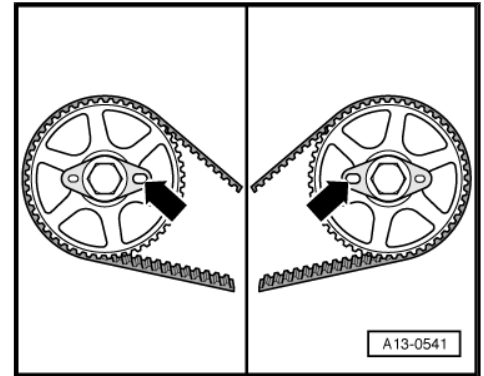
- ◆ Renew the cylinder head bolts.
- ◆ Renew self-locking nuts and bolts when performing assembly work.
- ◆ Renew bolts which are tightened to a specified angle as well as oil seals, gaskets and O-rings.
- ◆ If repairing, carefully remove any remaining gasket material from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.
- ◆ Carefully remove any remaining emery and abrasive material.
- ◆ No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.
- ◆ Do not remove new cylinder head gasket from packaging until it is ready to be fitted.
- ◆ Handle gasket very carefully. Damage to the silicone coating or the indented area will lead to leaks.
- ◆ Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.
- ◆ When installing an exchange cylinder head with fitted camshafts, the contact surfaces between the bucket tappets and cams must be oiled after installing the cylinder head.
- ◆ The plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.
- ◆ 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 76](#) .
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ *Parts catalogue* .
- ◆ Fit all cable ties in the original positions when installing.
- ◆ After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.
- ◆ When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.



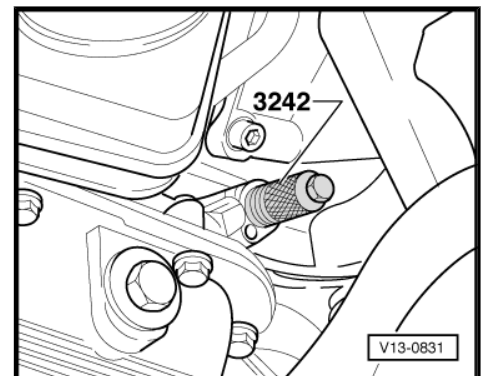


Installation is carried out in reverse order; note the following:

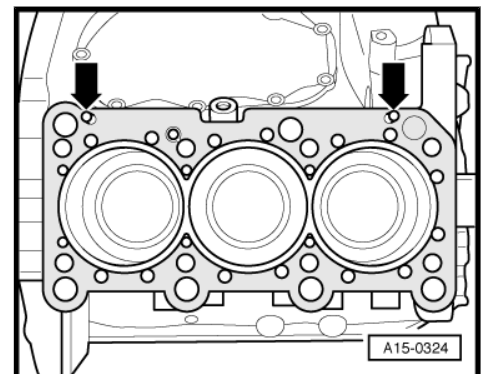
- Before installing cylinder head, set crankshaft and camshafts to TDC:
- Large holes -arrows- in locating plates at camshaft sprockets must be opposite one another on inside.



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



- Fit cylinder head gasket.
- 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.
- Insert new cylinder head bolts and tighten hand-tight.



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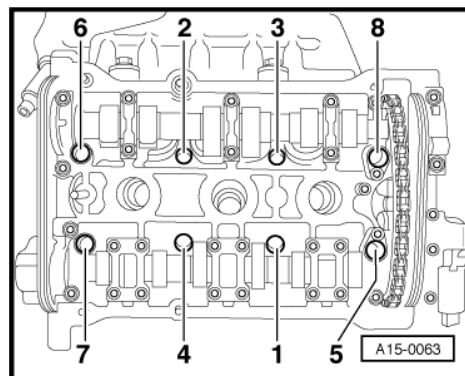


– Tighten cylinder head bolts in 3 stages in the sequence indicated:

1. Tighten with torque wrench to 60 Nm.
2. Turn 90° (1/4 turn) further using a rigid wrench.
3. Turn 90° (1/4 turn) further using a rigid wrench.

**Note**

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



- Connect vacuum hoses ⇒ [page 34](#) .
- Install cylinder head cover: left-side ⇒ [page 77](#) , right-side ⇒ [page 80](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 50](#) .
- Install vibration damper ⇒ [page 39](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Install viscous fan ⇒ [page 186](#) .
- Install intake manifold ⇒ [page 90](#) .
- Install secondary air pump ⇒ [page 280](#) .
- Install engine ⇒ [page 27](#) .

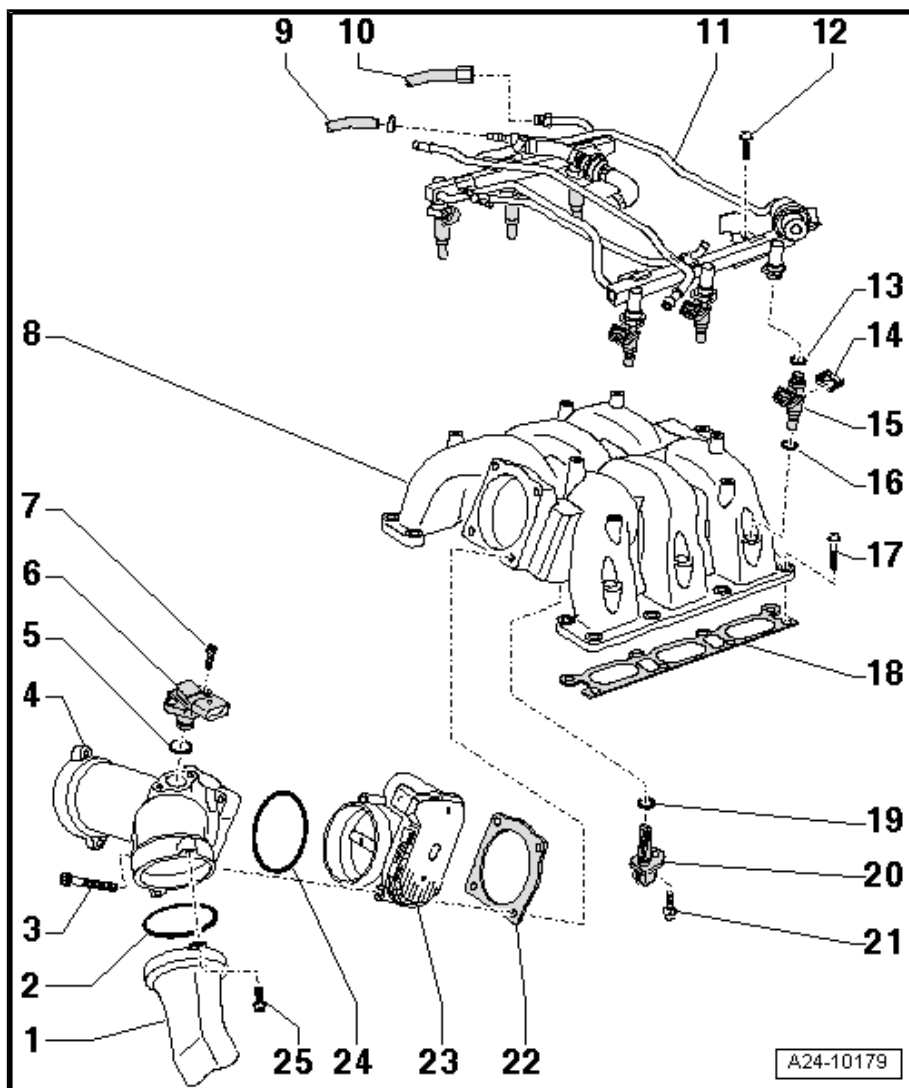
Tightening torques

Component		Nm
Bracket for air pipe to:	Cylinder head	22
	Air pipe	22
Front coolant pipe to cylinder head	M6	10
	M8	22
Rear toothed belt cover to cylinder head		10 ¹⁾
Coolant pipe (rear) to cylinder head		10
Turbocharger to exhaust manifold		60 2)3)
Exhaust gas temperature sender 1 for bank 2 - G236- to exhaust manifold		27
• 1) Install bolts using locking fluid; locking fluid ⇒ Parts catalogue . • 2) Renew bolts. • 3) Coat threads and contact surface of bolt heads with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .		

1.5 Exploded view - intake manifold



- 1 - Air pipe
- 2 - O-ring
 - ☐ Renew
- 3 - 10 Nm
- 4 - Intake manifold connection
- 5 - O-ring
 - ☐ Renew
- 6 - Charge pressure sender - G31-
- 7 - 10 Nm
- 8 - Intake manifold
 - ☐ Removing and installing
⇒ [page 90](#)
- 9 - Fuel return line
- 10 - Fuel supply line
 - ☐ Tighten union nut to 22 Nm
- 11 - Fuel rail
- 12 - 10 Nm
- 13 - O-ring
 - ☐ Renew
- 14 - Retaining clip
- 15 - Injector
- Removing and installing ⇒
Rep. gr. 24
- 16 - O-ring
 - ☐ Renew
- 17 - 10 Nm
 - ☐ Tighten in stages and in diagonal sequence
- 18 - Gasket
 - ☐ Renew
- 19 - O-ring
 - ☐ Renew
- 20 - Intake air temperature sender - G42-
- 21 - 10 Nm
- 22 - Gasket
 - ☐ Renew
- 23 - Throttle valve module - J338-
- 24 - O-ring
 - ☐ Renew
- 25 - 10 Nm



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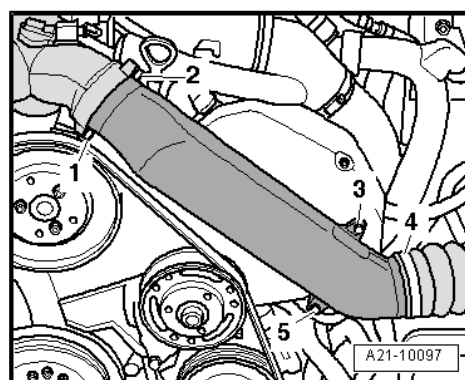
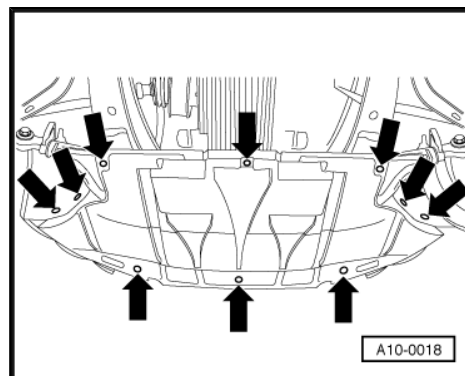
1.6 Removing and installing intake manifold

Removing

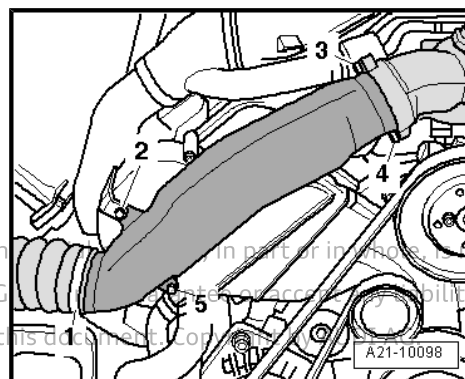


Note

- ◆ All heat insulation sleeves which are removed must be fitted in the same position when installing.
- ◆ All cable ties which are released or cut open when removing must be fitted in the same position when installing.
- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Disconnect air intake hose -4- from air pipe (left-side).
- Unscrew bolts -1 ... 3- and -5- and remove air pipe (left-side).



- Disconnect air intake hose -1- from air pipe (right-side).
- Remove bolts -2 ... 5- and take out air pipe (right-side).
- Remove secondary air pump ⇒ [page 280](#) .

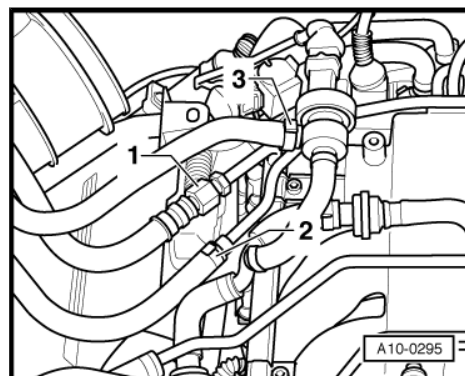


- Detach hose -3- from activated charcoal filter solenoid valve 1 - N80- .



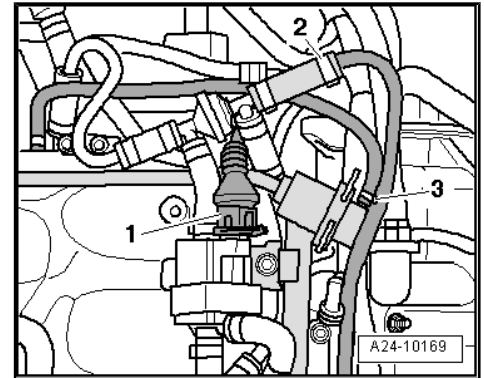
Note

The fuel supply line -1- and fuel return line -2- remain connected.

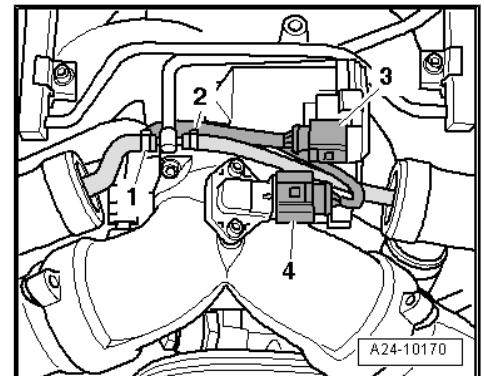




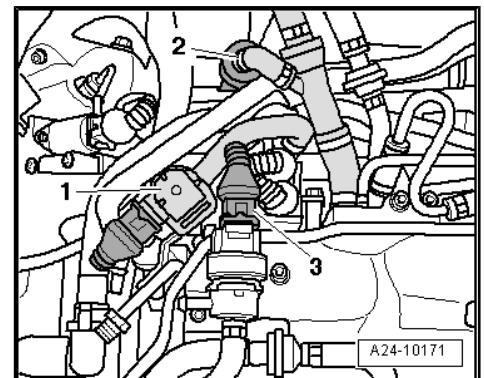
- Unplug electrical connector -1- at turbocharger air recirculation valve - N249- .
- Disconnect vacuum hoses -2- and -3-.



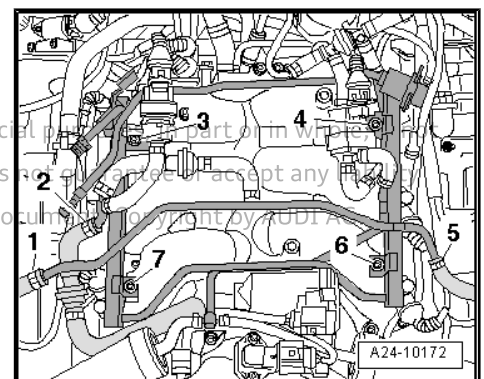
- Unplug electrical connector at throttle valve module - J338- -item 3- and at charge pressure sender - G31- -item 4-.
- Disconnect vacuum hoses -1- and -2-.



- Unplug electrical connector -3- at activated charcoal filter solenoid valve 1 - N80- .
- Disconnect charge pressure control solenoid valve - N75- -item 1- from retainer; leave electrical connector attached.
- Detach vacuum pipe -2-.



- Disconnect hoses -1- and -5- from line going to turbocharger.
- Detach vacuum hose -2- from Y-piece.
- Unplug electrical connectors at injectors.
- Unscrew bolts -3-, -4-, -6- and -7-.
- Detach fuel rail by pulling it off upwards together with injectors (injectors remain fitted).
- Lay aside fuel rail with injectors fitted.



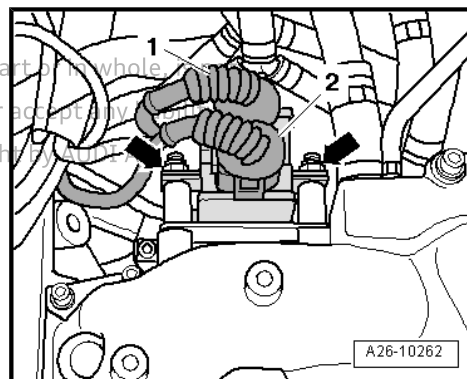


- Unplug electrical connectors -1- and -2-.

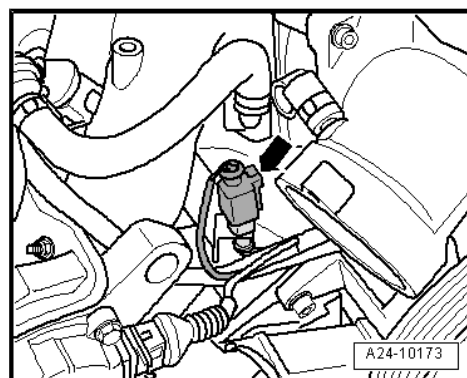
Unplug electrical connectors -1- and -2-.

Unplug electrical connectors -1- and -2-.

- Detach bracket for secondary air inlet valve - N112- from intake manifold; leave electrical connector attached.



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





- Unscrew and remove intake manifold -1-.



Note

Seal intake ports on cylinder heads with clean cloths.

Installing

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



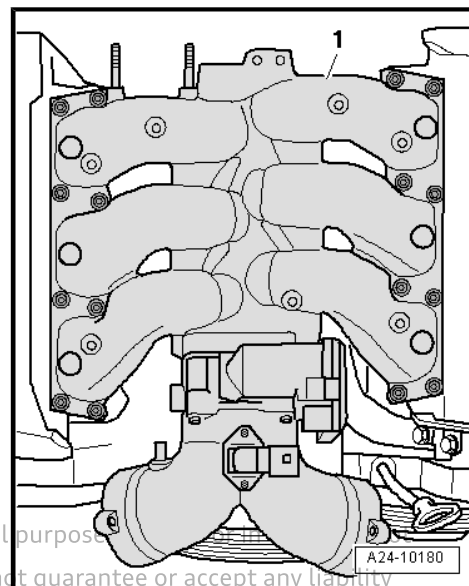
Note

- ◆ Renew self-locking nuts, gaskets, seals and O-rings.
- ◆ Hose connections and charge air system 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) ⇒ *Parts catalogue*.
- ◆ Fit all heat insulation sleeves in the original position when installing.
- ◆ Fit all cable ties in the original positions when installing.

- Tighten intake manifold bolts diagonally and in stages.
- Install secondary air pump ⇒ [page 280](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .

Tightening torques

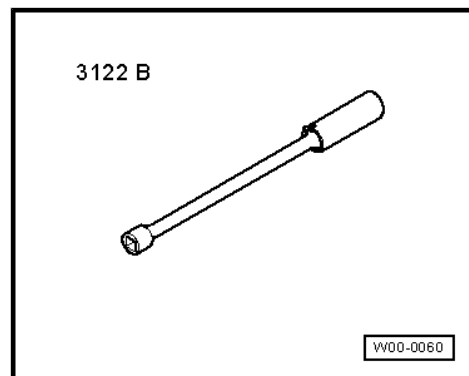
Component	Nm
Intake manifold to cylinder head	10
Control units for exhaust gas temperature sender to intake manifold	8 ¹⁾
Fuel rail to intake manifold	10
Fuel supply line to fuel rail	22
Air pipe to intake manifold	10
• ¹⁾ Renew self-locking nuts.	



1.7 Checking compression

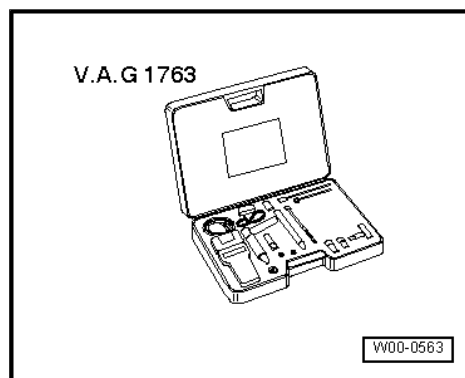
Special tools and workshop equipment required

- ◆ Spark plug spanner - 3122 B-





◆ Compression tester - V.A.G 1763-



Procedure

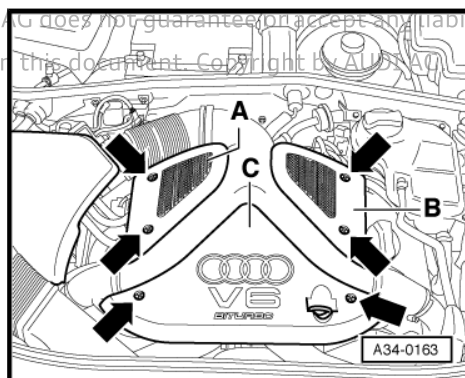
- Engine oil temperature at least 30 °C
- Battery voltage at least 12.5 V.



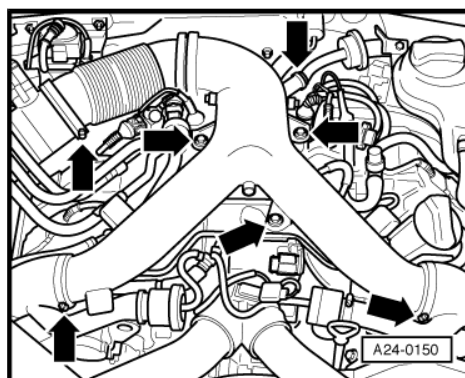
Note

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

- Switch off ignition.
- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.

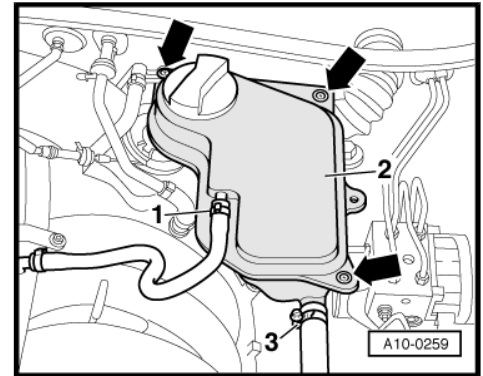


- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.

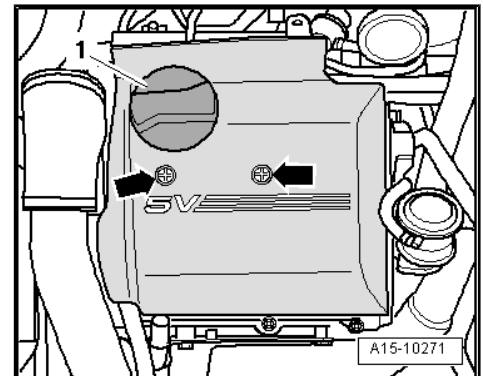




- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical wire for coolant shortage indicator switch - F66- at bottom of expansion tank and move expansion tank to one side with coolant hoses -1- and -3- attached.



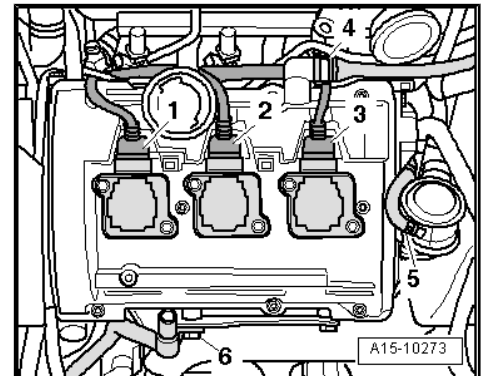
- Unscrew sealing cap -1-.
- Loosen quick release fasteners -arrows- and remove cover panel for cylinder head cover (left-side).



- Unplug electrical connectors -1 ... 3-.
- Remove ignition coils.



Disregard -items 4 ... 6-.

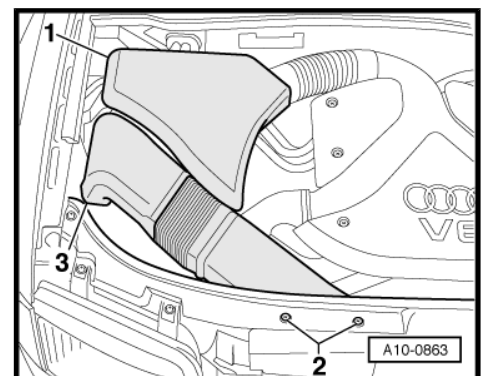


- Remove cover -1- on right side of engine compartment.
- Unscrew bolts -2- and detach air duct from air cleaner housing -3-.



WARNING

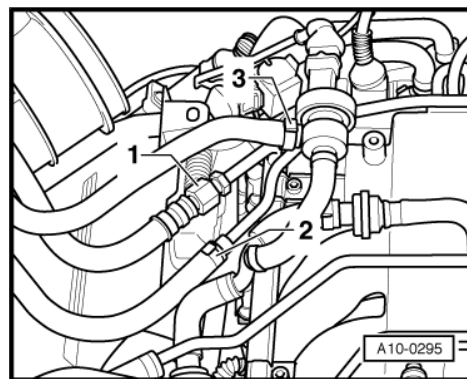
The fuel system is pressurised. Before opening the system place a clean cloth around the connection. Then carefully loosen the connection to relieve the pressure.



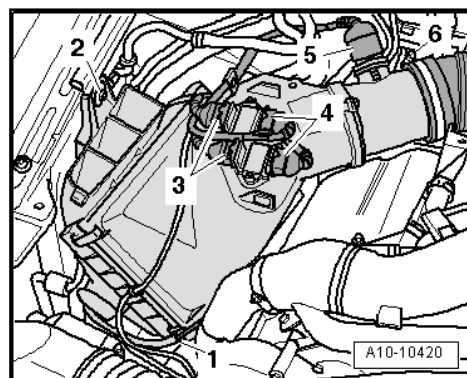
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- Disconnect fuel supply line -1- and fuel return line -2-.
- Detach hose -3- from activated charcoal filter solenoid valve 1 - N80- .
- Move hose and wiring clear.



- Unplug electrical connectors at output stage - N122- -item 3- and at output stage 2 - N192- -item 4-.
- Unplug electrical connector -5- at air mass meter - G70- .
- Move wiring harness at air cleaner housing clear.
- Unplug vacuum hose -1-.
- Unscrew nut -2- and remove air cleaner housing with air mass meter - G70- .



Note

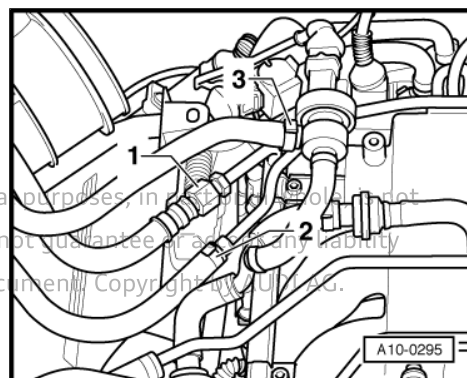
Disregard -item 6-.

- Connect fuel supply line -1- and fuel return line -2-.



WARNING

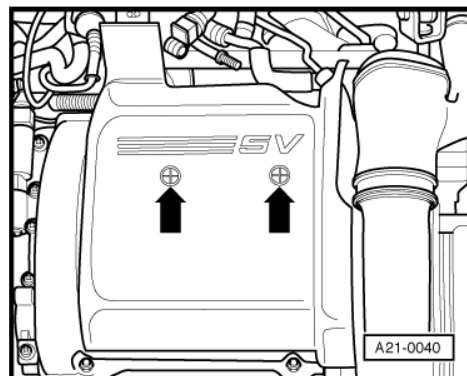
The electrical fuel pump starts up during the compression pressure test - make sure the fuel pipes remain attached.



Note

Disregard -item 3-.

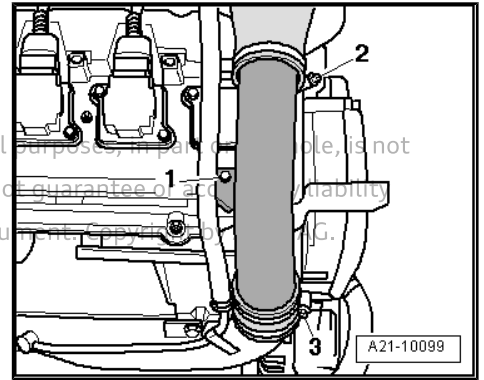
- Loosen quick release fasteners -arrows- and remove cover for cylinder head cover (right-side).





- Remove bolt -1-.
- Remove top right air pipe; disconnect hose connections -2- and -3- for this purpose.

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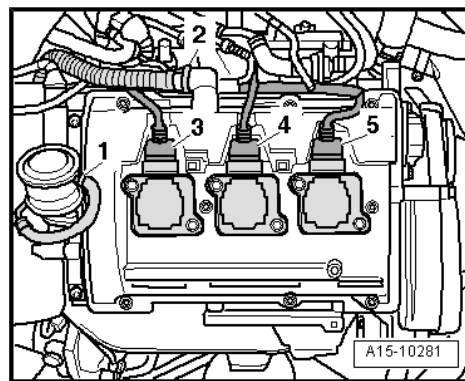


- Unplug electrical connectors -3 ... 5-.

**Note**

Disregard items marked -1- and -2-.

- Remove ignition coils.
- Remove spark plugs with spark plug socket - 3122 B- .
- Unplug electrical connectors at all injectors.
- Test compression pressure with compression tester - V.A.G 1763- .

**Note**

Using the compression tester ⇒ operating instructions .

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

Compression pressure	bar
When new	9.0 ... 13.0
Wear limit	7.0
Difference between cylinders	3.0 (maximum)

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

**Note**

- ◆ *Hose connections and charge air system 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) ⇒ Parts catalogue .*
- ◆ *Fit all cable ties in the original positions when installing.*
- Install spark plugs ⇒ Rep. gr. 28 .
- Interrogate and erase fault memory for engine control unit after testing compression pressure, as faults will have been stored when connectors are unplugged ⇒ Vehicle diagnostic tester.

Tightening torques

Component	Nm
Ignition coil to cylinder head cover	10
Air pipe to cylinder head cover	10
Fuel supply line to fuel rail	22
Air duct to intake manifold	10
Hose clips (9 mm wide)	3
Hose clips (13 mm wide)	5.5



2 Servicing valve gear



Note

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

2.1 Exploded view - valve gear



Note

Illustration shows cylinder head, bank 1 (right-side).

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**1 - Double bearing cap**

- ☐ Before installing, coat contact surfaces of bearing caps at front and rear with a small quantity of sealant
⇒ [page 102](#)

2 - 10 Nm**3 - Bearing cap on exhaust camshaft**

- ☐ Watch position of dowel sleeve
- ☐ Note installation position and allocation
⇒ [page 110](#)
- ☐ Prior to installation, apply thin coat of sealant to bearing cap next to chain ⇒ [page 102](#)

4 - Exhaust camshaft

- ☐ Checking axial clearance ⇒ [page 102](#)
- ☐ Removing and installing ⇒ [page 108](#)
- ☐ Check radial clearance with Plastigauge (bucket tappets removed)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Runout: max. 0.01 mm

5 - Sealing cap

- ☐ Renewing ⇒ [page 105](#)
- ☐ 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 110](#)

7 - Inlet camshaft

- ☐ Checking axial clearance ⇒ [page 102](#)
- ☐ Removing and installing ⇒ [page 108](#)
- ☐ Check radial clearance with Plastigauge (bucket tappets removed)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Runout: max. 0.01 mm

8 - Drive chain

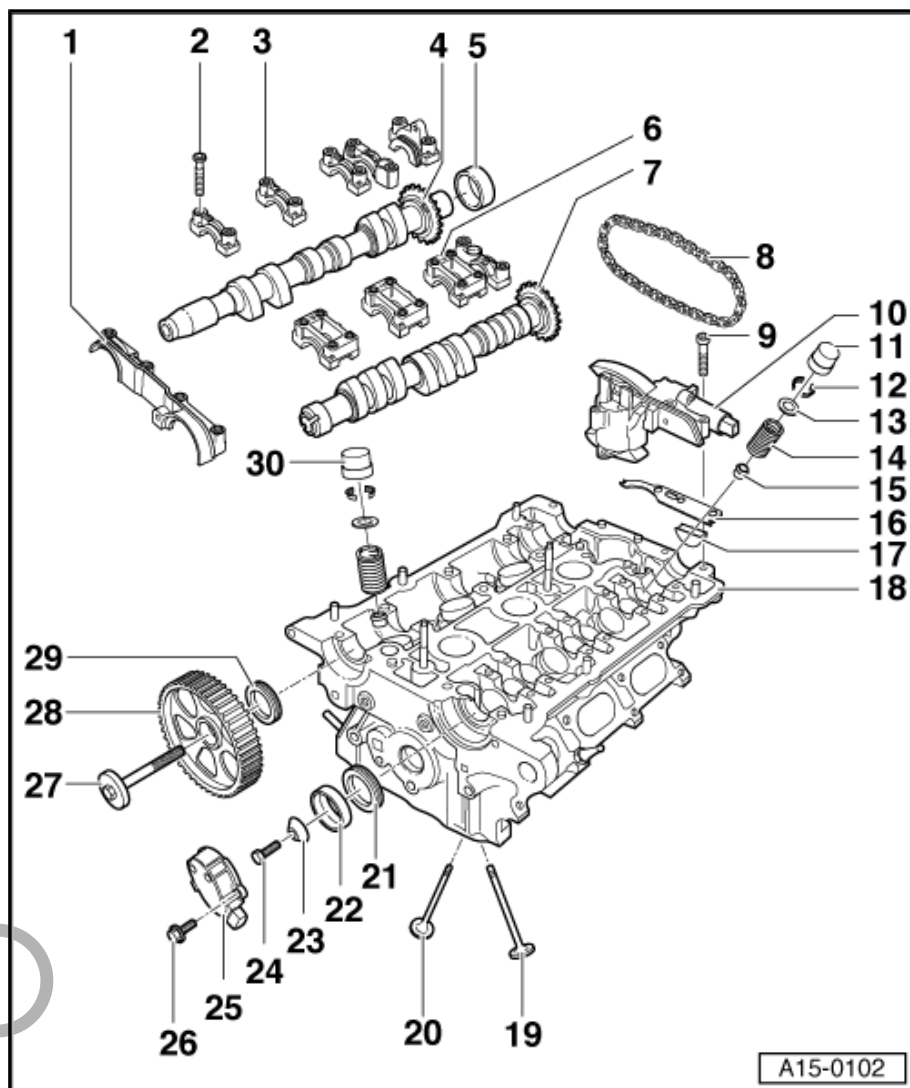
- ☐ Installing ⇒ [page 110](#)

9 - 10 Nm**10 - Mechanical camshaft adjuster**

- ☐ With camshaft control valve 1 - N205-
- ☐ Before removing, lock in position with chain tensioner retainer - 3366- ⇒ [page 108](#)

11 - Hydraulic bucket tappet (inlet valve)

- ☐ Checking ⇒ [page 113](#)
- ☐ Removing and installing ⇒ ["2.6 Removing and installing camshafts and camshaft adjuster", page 108](#)



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- ☐ Do not interchange
- ☐ Place down with contact surface facing downwards
- ☐ Check axial clearance of camshaft before installing ⇒ [page 102](#)
- ☐ Lubricate contact surface

12 - Valve cotters

13 - Valve spring plate

14 - Valve spring

15 - Valve stem oil seal

- ☐ Renewing ⇒ [page 114](#)

16 - Rubber/metal gasket

- ☐ Renew

17 - Seal

- ☐ Renew

18 - Cylinder head

- ☐ See note ⇒ [page 99](#)
- ☐ Checking valve guides, grinding-in valve seats ⇒ [page 119](#)
- ☐ Machining valve seats ⇒ [page 120](#)

19 - Exhaust valve

- ☐ Do not machine, only grinding-in is permitted
- ☐ Valve dimensions ⇒ [page 119](#)
- ☐ Checking valve guides, grinding-in valve seats ⇒ [page 119](#)

20 - Inlet valve

- ☐ Do not machine, only grinding-in is permitted
- ☐ Valve dimensions ⇒ [page 119](#)
- ☐ Checking valve guides, grinding-in valve seats ⇒ [page 119](#)

21 - Oil seal

- ☐ Note direction of rotation
- ☐ Renewing ⇒ [page 105](#) and ⇒ [page 105](#)

22 - Rotor for Hall sender

- ☐ Note fitting position (notch on camshaft)

23 - Washer

- ☐ Conical

24 - 25 Nm

25 - Hall sender

26 - 10 Nm

27 - 55 Nm

28 - Camshaft sprocket

29 - Oil seal

- ☐ Note direction of rotation
- ☐ Renewing ⇒ [page 103](#)

30 - Hydraulic bucket tappet (exhaust valve)

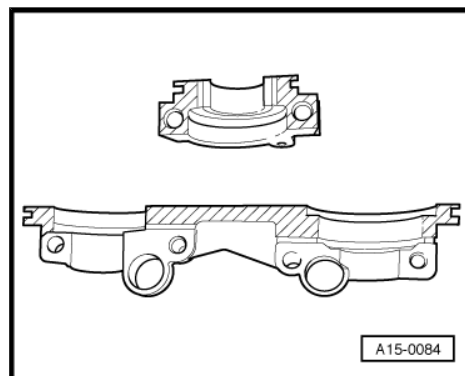
- ☐ Checking ⇒ [page 113](#)
- ☐ Removing and installing ⇒ [“2.6 Removing and installing camshafts and camshaft adjuster”, page 108](#)
- ☐ Do not interchange
- ☐ Place down with contact surface facing downwards
- ☐ Check axial clearance of camshaft before installing ⇒ [page 102](#)



- ❑ Lubricate contact surface

Applying sealant to bearing cap

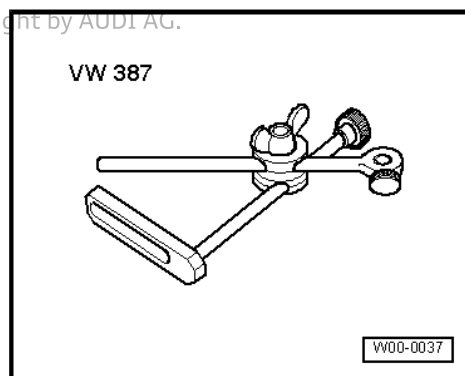
- Coat -hatched areas- of bearing caps at front and rear on inlet camshaft with a small quantity of sealant and fit bearing caps (pay attention to dowel sleeves); sealant ⇒ Parts catalogue .



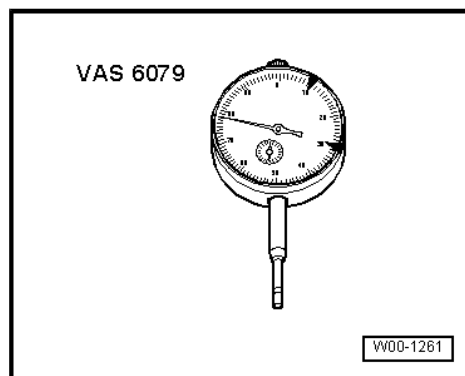
2.2 Checking axial clearance of camshafts

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket - VW 387-



- ◆ Dial gauge - VAS 6079-



Test sequence

- Remove camshafts ⇒ [page 108](#) .



Note

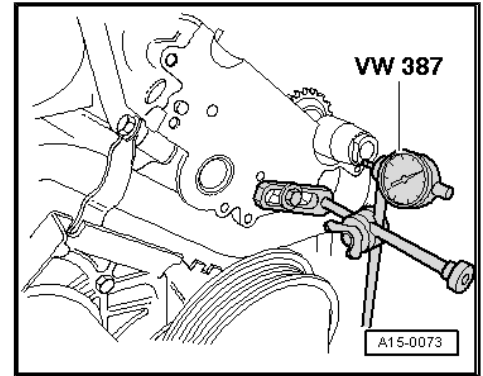
- ◆ *Take care not to interchange bucket tappets.*
- ◆ *Use waterproof felt-tip pen to mark assignment of bucket tappets on back of tappets.*
- Take bucket tappets out of guides and set them down with contact surface facing downwards.
- Fit camshafts in cylinder head without drive chain and secure with bearing caps 2 and 4.



- Secure dial gauge - VAS 6079- with universal dial gauge bracket - VW 387- to cylinder head as shown in illustration.
- Press camshaft against dial gauge by hand.
- Set dial gauge to "0".
- Press camshaft away from dial gauge and read off value.

Axial clearance:

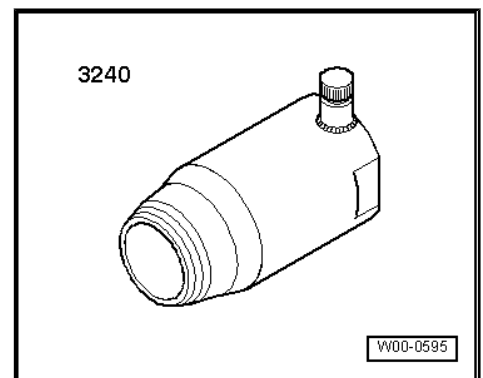
- New: 0.05 ... 0.15 mm.
- Wear limit: 0.20 mm.



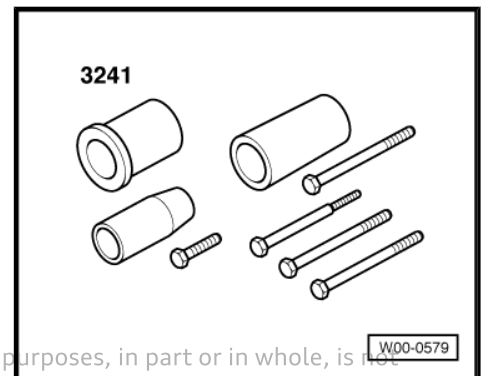
2.3 Renewing camshaft oil seals

Special tools and workshop equipment required

- ◆ Oil seal extractor - 3240-



- ◆ Fitting sleeves - 3241-

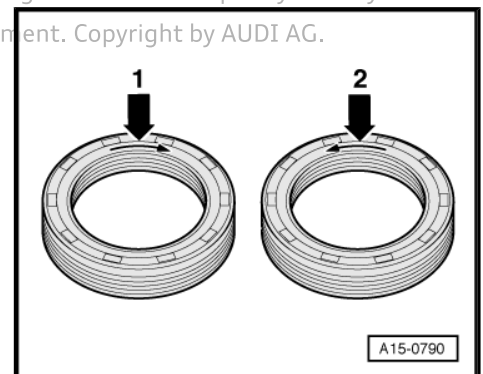


Procedure



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-.

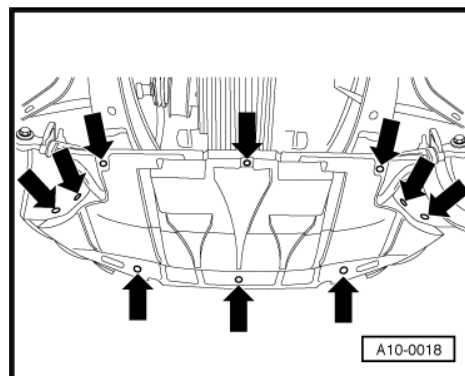




- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove toothed belt ⇒ [page 43](#) .
- Remove camshaft sprockets.

**Note**

If one of the oil seals is leaking, renew seals on both cylinder heads.



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

Cylinder head (left-side):

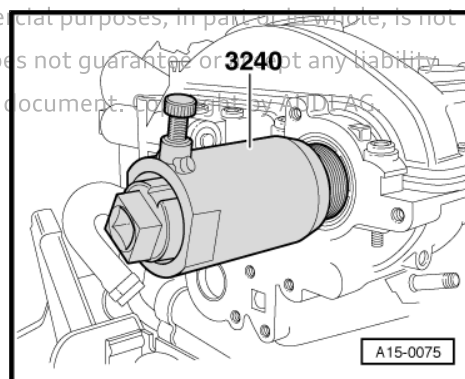
- Unscrew inner section of oil seal extractor 5 turns and lock with knurled screw.

Cylinder head (right-side):

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

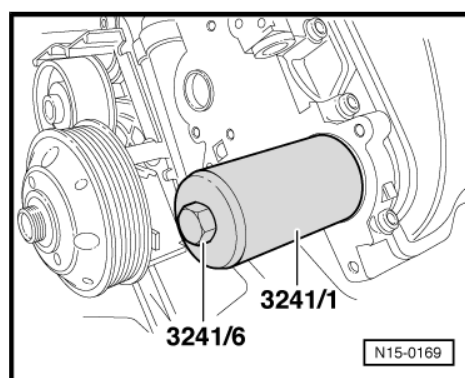
Both sides (continued):

- 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.
- Remove oil seal with pliers.
- Clean running surface and sealing surface.
- Check that oil seal is correctly matched to direction of rotation before installing.
 - Direction of shaft rotation “clockwise” (arrow on oil seal).
- Slip oil seal over camshaft taper.
- Press in oil seal until flush using fitting sleeve - 3241/1- and hexagon bolt - 3241/6- .



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

- Install toothed belt (adjust valve timing) ⇒ [page 50](#) .
- Install vibration damper ⇒ [page 39](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Install viscous fan ⇒ [page 186](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .





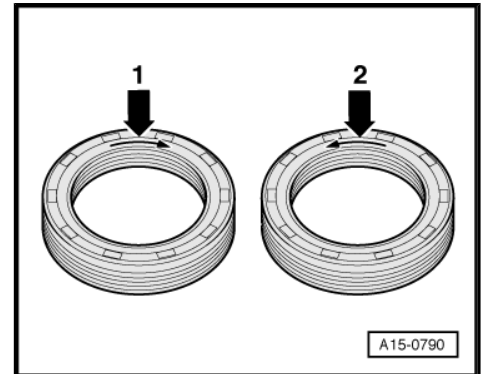
2.4 Renewing oil seal for Hall sender and sealing cap - cylinder head (left-side)

Procedure

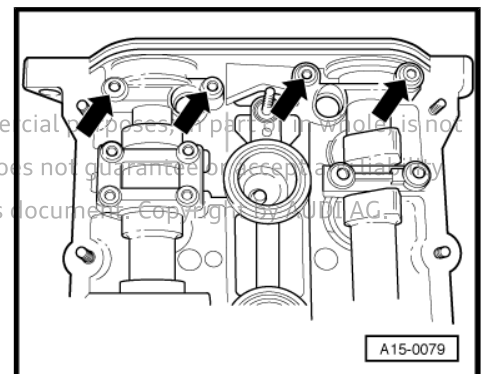


Note

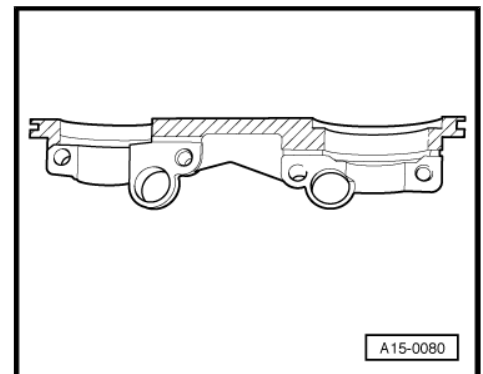
- ◆ PTFE oil seals are matched to the direction of shaft rotation (see arrow on oil seal). Incorrect allocation to direction of rotation will result in oil leaks.
- ◆ The direction of rotation of the oil seals at the front of the engine is "clockwise" -arrow 1-. The direction of rotation of the oil seals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



- Remove cylinder head cover (left-side) ➔ [page 77](#) .
- Remove Hall sender ➔ [Item 25 \(page 101\)](#) and Hall sender rotor ➔ [Item 22 \(page 101\)](#) .
- Unscrew double bearing cap -arrows-.
- Take out oil seal and sealing cap.



- Clean running and sealing surfaces as well as contact surfaces of double bearing cap.
- Apply a small quantity of sealant to -hatched area- on double bearing cap; for sealant refer to ➔ Parts catalogue .
- Check that oil seal is correctly matched to direction of rotation before installing.
 - Direction of shaft rotation "anti-clockwise" (arrow on oil seal)
- Fit oil seal and install double bearing cap.
- Use assembly lever to press in sealing cap.



Note

The bearing cap can remain installed after removing engine when renewing oil seal and sealing cap. Procedure ➔ [page 105](#)

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

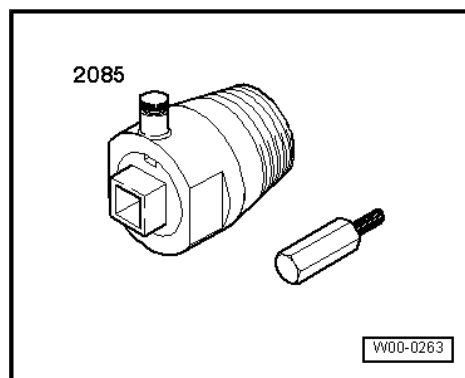
- Install Hall sender rotor ring ➔ [Item 22 \(page 101\)](#) and washer ➔ [Item 23 \(page 101\)](#) .
- Install Hall sender ➔ [Item 25 \(page 101\)](#) .
- Install cylinder head cover (left-side) ➔ [page 77](#) .

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

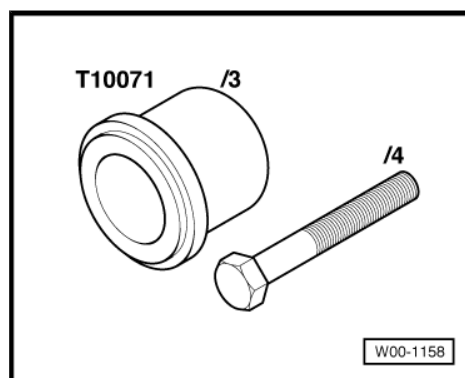
Special tools and workshop equipment required



◆ Oil seal extractor - 2085-



◆ Assembly tool - T10071-



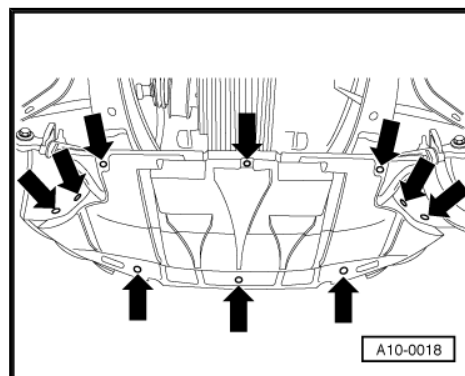
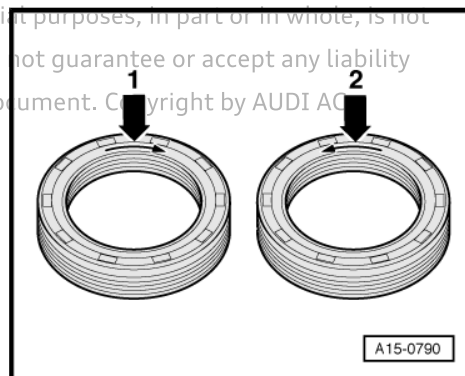
◆ M8x50 bolt

◆ 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-.

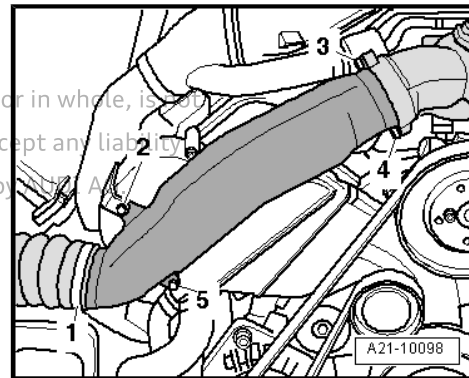
- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .



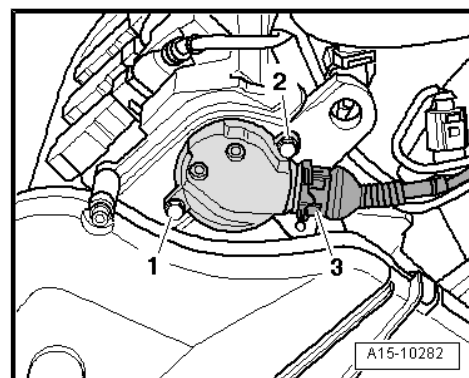


- Disconnect air intake hose -1- from air pipe (right-side).
- Remove bolts -2 ... 5- and take out air pipe (right-side).

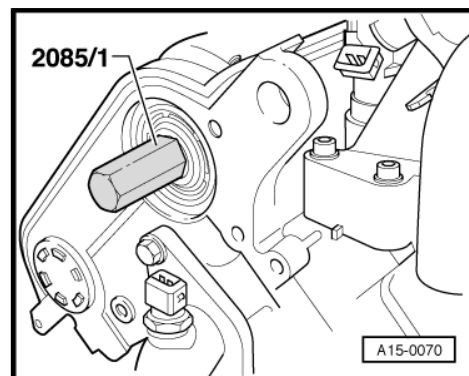
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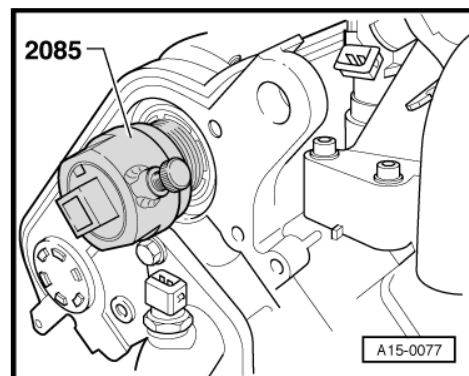
- Unplug electrical connector -3- at Hall sender - G40- .
- Unscrew bolts -1- and -2- and remove Hall sender.
- Remove rotor for Hall sender ⇒ [Item 22 \(page 101\)](#) and washer ⇒ [Item 23 \(page 101\)](#) .



- 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, place it in position and screw it into oil seal as far as possible (applying firm pressure).
- Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice.
- Remove oil seal with pliers.
- Unscrew bolt - 2085/1- for oil seal extractor - 2085- .





- Clean running surface and sealing surface.
- Fit guide sleeve - T10071/5- onto camshaft journal and secure with M8x50 bolt.
- Check that oil seal is correctly matched to direction of rotation before installing.
- Direction of shaft rotation “clockwise” (arrow on oil seal).
- Slide oil seal over guide sleeve onto camshaft journal.
- Detach guide sleeve.

- Press in oil seal as far as stop using fitting 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 charge air system 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) ⇒ Parts catalogue .*

- Install Hall sender ⇒ [Item 25 \(page 101\)](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .

Tightening torques

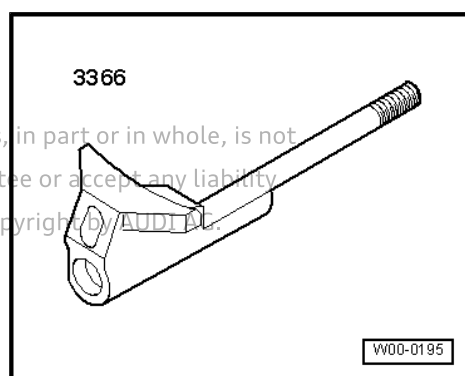
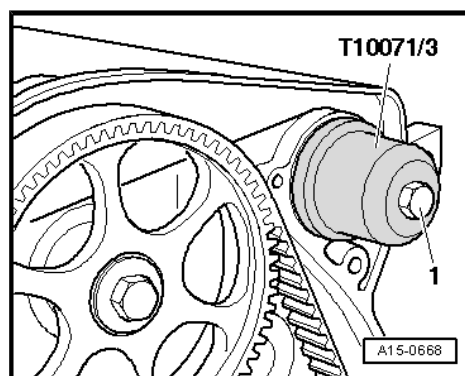
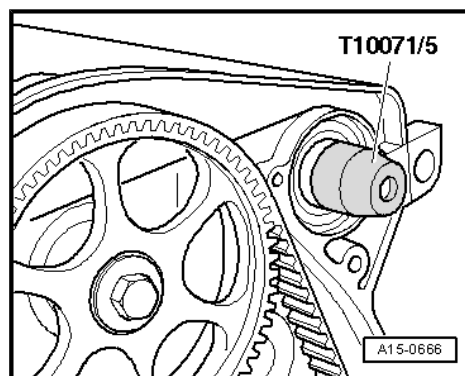
Component	Nm
Hall sender rotor to camshaft	25
Hall sender housing to cylinder head	10
Air pipe to: Cylinder head cover	10
Intake manifold	10
Hose clips (9 mm wide)	3
Hose clips (13 mm wide)	5.5

2.6 Removing and installing camshafts and camshaft adjuster

Special tools and workshop equipment required

- ◆ Chain tensioner retainer - 3366-

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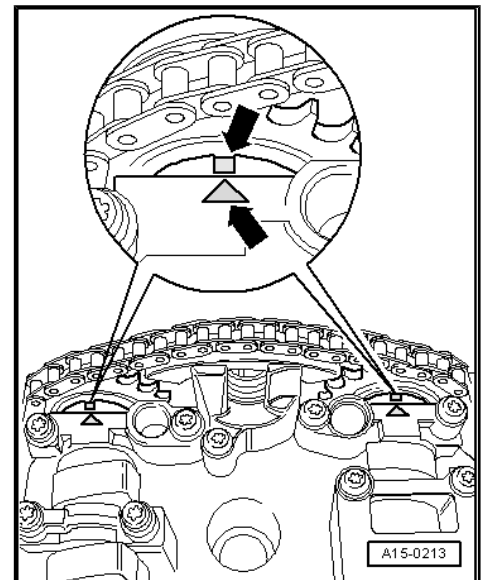
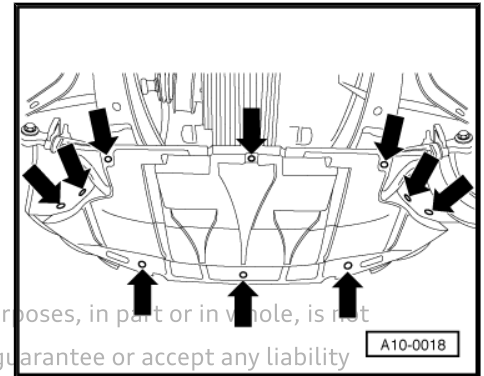




◆ Sealant ⇒ Parts catalogue

Removing

- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove toothed belt ⇒ [page 43](#) .
- Take off camshaft sprocket.
- Unscrew toothed belt cover (rear).
- Remove cylinder head cover: left-side ⇒ [page 77](#) , right-side ⇒ [page 80](#) .
- Unplug electrical connector at camshaft adjuster.
- Remove Hall sender ⇒ [Item 25 \(page 101\)](#) and Hall sender rotor ⇒ [Item 22 \(page 101\)](#) .
- Turn the crankshaft approx. 45° anti-clockwise at the toothed belt sprocket bolt 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-.



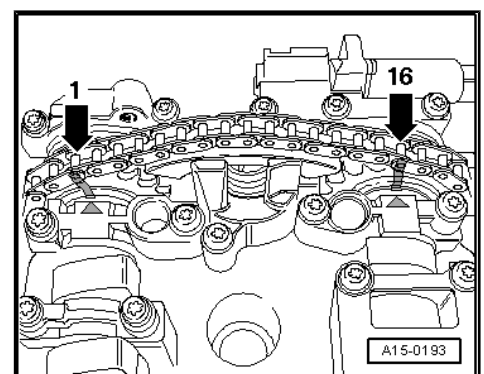
If old drive chain is to be reused:

- 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:**

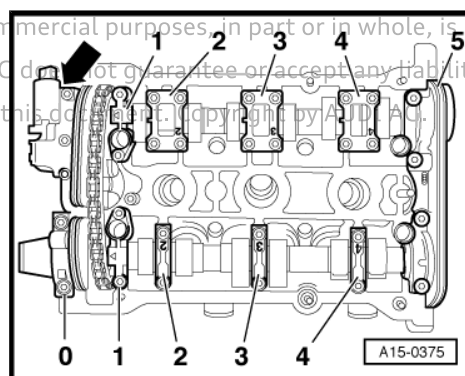
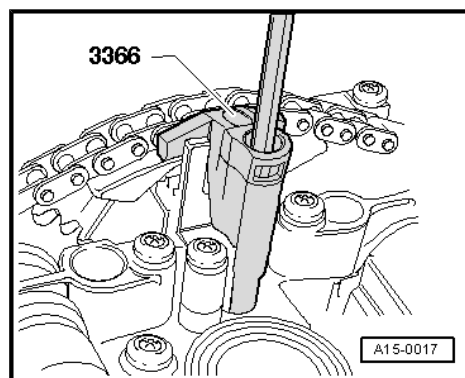
- Hold camshaft adjuster in position with chain tensioner retainer - 3366- .

**Note**

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

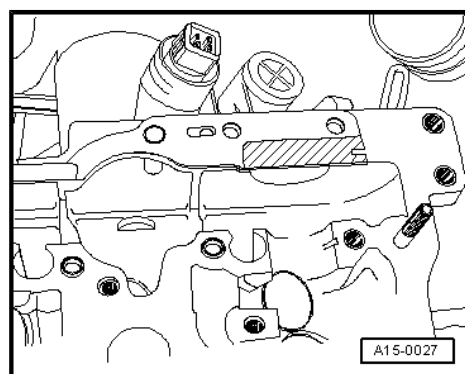


- Mark the sequence and installation positions of all bearing caps, as shown, regardless of any existing markings on the bearing caps.
- Unscrew bolts securing camshaft adjuster -arrow-.
- Remove bearing cap -0-.
- Remove bearing caps -1-, -3- and -5- and place them in the correct order on a clean surface.
- Slacken off bearing caps -2- and -4- of inlet and exhaust camshafts alternately and diagonally, and remove.
- Lift out both camshafts with camshaft adjuster.

**Installing**

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

- Renew the semi-circular sealing plug.
- Renew rubber/metal gasket for camshaft adjuster and apply a thin coat of sealant to -hatched area-; Sealant ⇒ Parts catalogue .



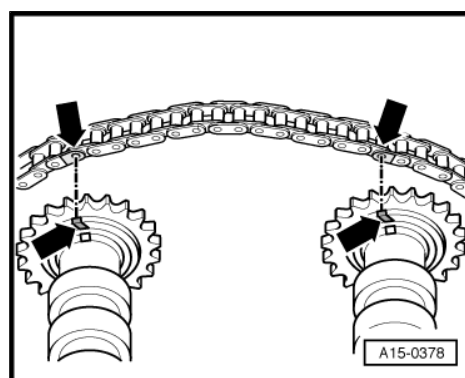
- Position drive chain on camshaft chain sprockets as follows:

If old drive chain is to be reused:

- Adjust the colour markings -arrows- so they are aligned.

If new drive chain is being used:**Caution**

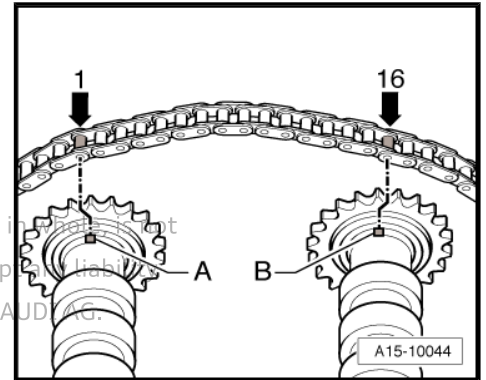
- ◆ *The stated number of rollers merely provides assistance for fitting the drive chain onto the camshafts.*
- ◆ *Make sure that the arrows on the bearing caps and the notches on the camshafts align when installing camshafts (with drive chain) in cylinder head ⇒ [page 112](#) .*





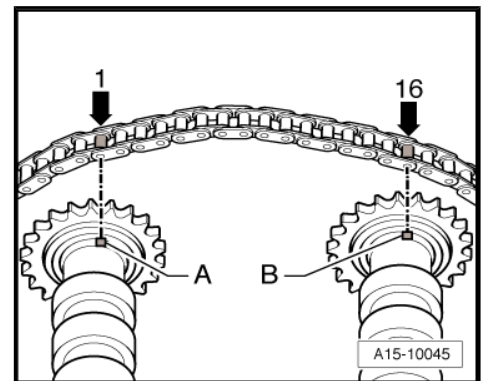
Cylinder head (left-side):

- 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 $\frac{1}{2}$ tooth outwards in relation to notches -A- and -B-



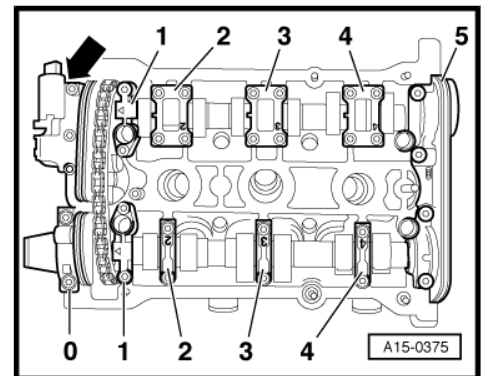
Cylinder head (right-side):

- 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).
- Insert camshafts with drive chain and camshaft adjuster into cylinder head.
- Lubricate running surfaces of camshafts.
- Dowel sleeves for bearing caps and camshaft adjuster must be positioned in cylinder head
- Secure camshaft adjuster -arrow- (watch position of dowel sleeves).
- Install bearing caps -2- and -4- as per marking.
- Tighten bearing caps -2- and -4- of inlet camshaft and exhaust camshaft alternately in diagonal sequence.
- Install the two bearing caps -1- next to the chain sprockets on the inlet and exhaust camshafts.
- Remove chain tensioner retainer - 3366- .



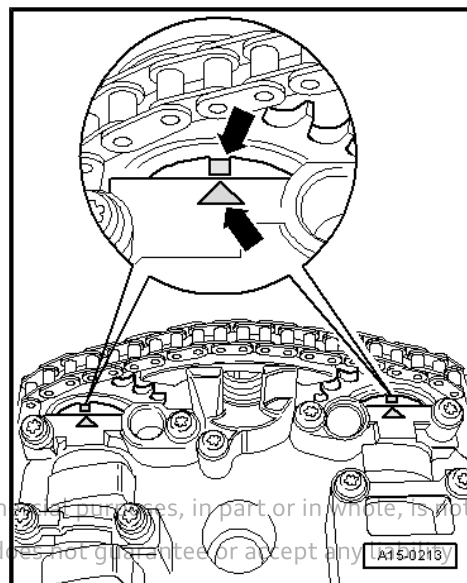


- Check correct setting of camshafts:
- The two marks on the camshafts must be opposite the two arrows on the bearing caps -arrows-.



Note

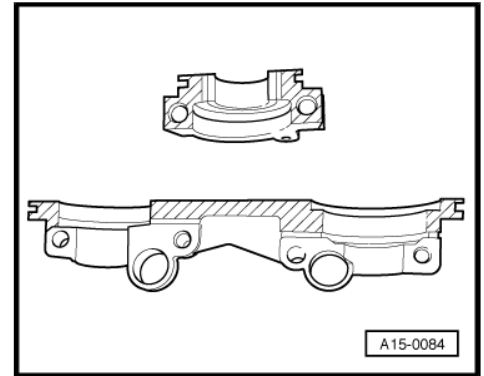
If necessary, turn camshaft slightly backwards or forwards so that the two marks coincide.



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- 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 ⇒ Parts catalogue .
- Install bearing cap (pay attention to dowel sleeves).
- Install remaining bearing caps (pay attention to dowel sleeves).
- Renew oil seals for inlet and exhaust camshaft ⇒ [page 103](#) , ⇒ [page 105](#) or ⇒ [page 105](#) .
- Torque down remaining bearing caps.
- Turn the crankshaft approx. 45° clockwise back to TDC at the toothed belt sprocket bolt and secure crankshaft with locking pin.
- Install cylinder head cover: left-side ⇒ [page 77](#) , right-side ⇒ [page 80](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 50](#) .
- Install vibration damper ⇒ [page 39](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Install viscous fan ⇒ [page 186](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .



Note

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

Tightening torques

Component	Nm
Bearing cap to cylinder head	10
Camshaft adjuster to cylinder head	10
Hall sender rotor to camshaft	25
Hall sender housing to cylinder head	10
Toothed belt cover (rear) to cylinder head/ cylinder block	10 ¹⁾
• ¹⁾ Install bolts using locking fluid; locking fluid ⇒ Parts catalogue .	

2.7 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
- ◆ Wooden/plastic wedge

Procedure

- Start engine and leave it running until coolant temperature has reached approx. 80 °C.
- Increase engine speed to about 2500 rpm for approx. 2 minutes; perform test drive if necessary.



Note

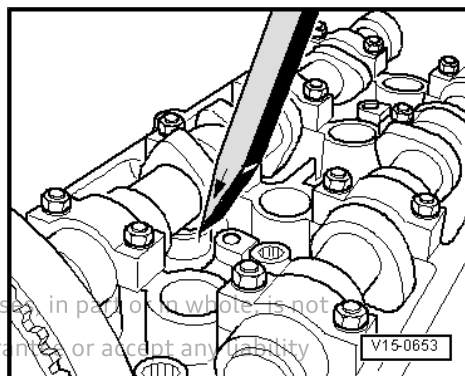
*If irregular valve noise disappears but repeatedly re-occurs when travelling short distances, renew oil retention valves. Fitting location of oil retention valves: beneath cover on intake manifold
⇒ [page 149](#).*

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

- Remove cylinder head cover: left-side ⇒ [page 77](#) , right-side ⇒ [page 80](#) .
- Turn crankshaft until cams of the cylinder to be checked are at the top (push vehicle in direction of travel with fourth gear engaged and ignition switched off).
- Push bucket tappet down with a wooden or plastic wedge to determine play between cam and bucket tappet.

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

- Renew bucket tappet
⇒ [“2.6 Removing and installing camshafts and camshaft adjuster”, page 108](#) .

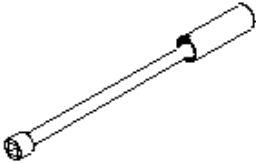
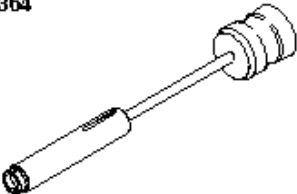
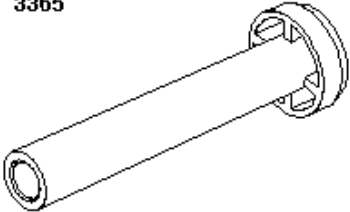


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2.8 Renewing valve stem oil seals



Special tools and workshop equipment required

VW 653/3 	3122 B 
3364 	3365 
VAS 5161 	G15-0029

- ◆ 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

- Cylinder head installed
- Remove camshafts and camshaft adjuster ⇒ [page 108](#).

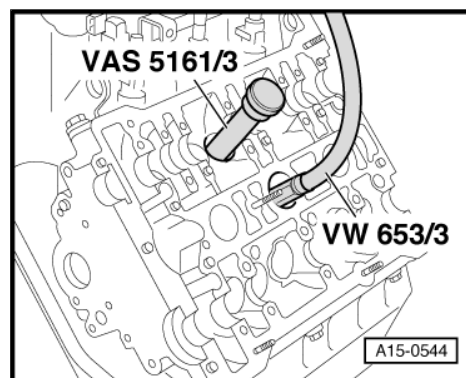


Note

Use waterproof felt-tip pen to mark assignment of bucket tappets on back to ensure that the tappets are not interchanged.

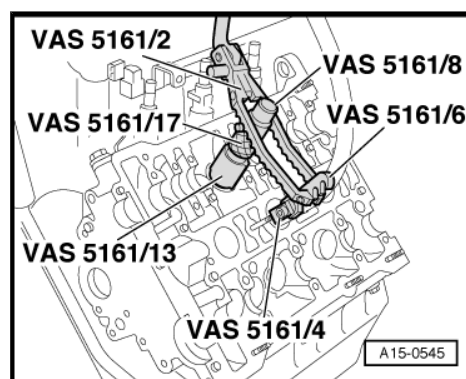


- Remove the bucket tappets from the guides and put them down with the contact surface downwards.
- Remove spark plugs with spark plug socket - 3122 B- .
- Set piston of the respective cylinder to “bottom dead centre”.
- Connect pressure hose - VW 653/3- to compressed air supply.
 - Minimum pressure: 6 bar
- Insert punch - VAS 5161/3- into bucket tappet guide.
- Knock valve cotters on all five valves loose using a plastic hammer.



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 into guide bush.
- Attach pressure fork - VAS 5161/2- to snap-in device - VAS 5161/6- and push assembly cartridge downwards.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
- Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the cartridge.
- Release pressure fork.
- Take off assembly cartridge with knurled spacer ring.
- Remove guide bush, valve spring plate and valve spring.

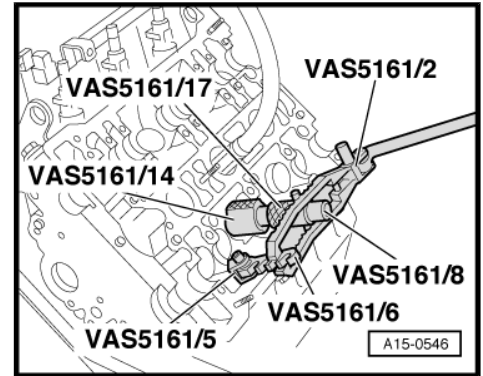


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Exhaust side:

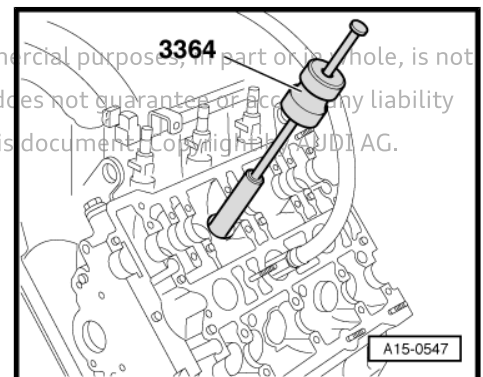
- Screw snap-in device - VAS 5161/6- with engaging fork - VAS 5161/5- into threaded hole on cylinder head.
- Push guide bush - VAS 5161/14- as far as it will go into bucket tappet guide on valve to be removed.
- Installation position: knurled surfaces face perpendicular to direction of travel.
- Slide knurled spacer ring - VAS 5161/17- onto assembly cartridge - VAS 5161/8- .
- Insert assembly cartridge into guide bush.
- Attach pressure fork - VAS 5161/2- to snap-in device - VAS 5161/6- and push assembly cartridge downwards.
- At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
- Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the cartridge.
- Release pressure fork.
- Take off assembly cartridge with knurled spacer ring.
- Remove guide bush, valve spring plate and valve spring.



Both sides (continued):

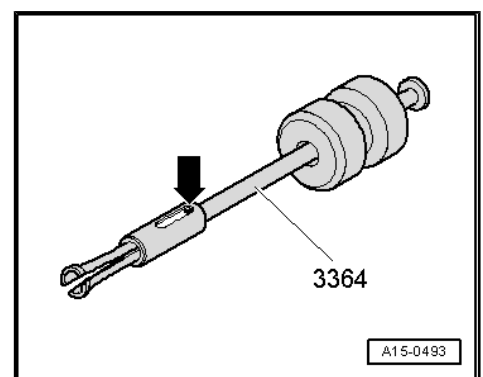
- Remove valve stem oil seal using valve stem seal puller - 3364- .

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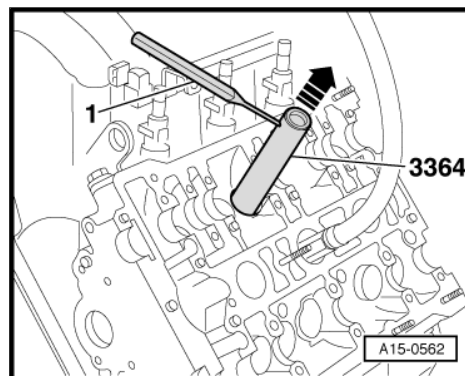
If the valve stem seal puller - 3364- cannot be used on some of the valve stem oil seals due to the confined space, proceed as follows:

- Knock pin -arrow- of valve stem seal puller - 3364- out using a punch and remove extractor attachment.





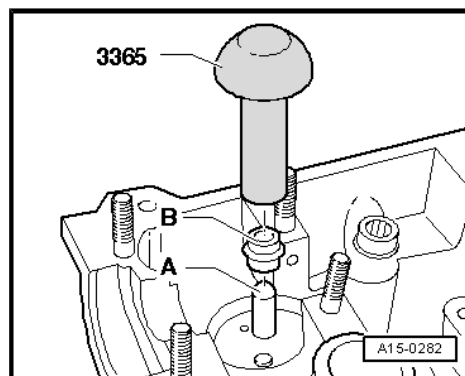
- Apply lower part of valve stem seal puller - 3364- to valve stem oil seal.
- Secure valve stem seal puller - 3364- with a punch -1- or other suitable tool, as shown in illustration.
- Apply an assembly lever to valve stem seal puller - 3364- and pull out valve stem oil seal -arrow-.



Note

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

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

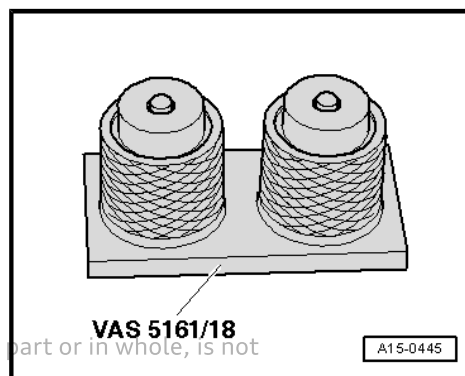


Note

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 valve insertion device from above and take up valve cotters.
- Insert guide bush - VAS 5161/13- or -VAS 5161/14- , valve spring and valve spring plate.



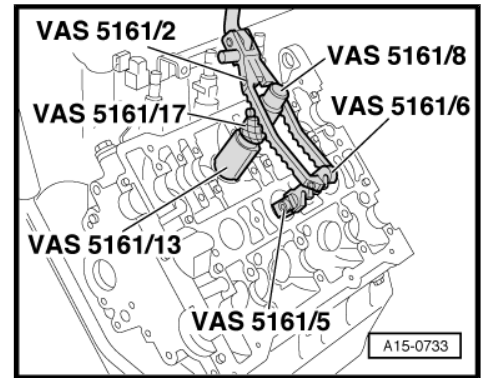
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- Re-insert cartridge into guide bush.
- Push pressure fork down and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotters.
- Release pressure fork with knurled screw still in pulled position.

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

- Insert bucket tappets.
- Install spark plugs ⇒ Rep. gr. 28 .
- Install camshafts and camshaft adjuster ⇒ [page 108](#) .



Note

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

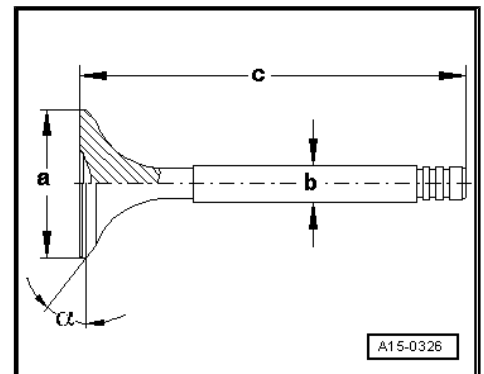
2.9 Valve dimensions



Note

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

Dimension		Inlet valve	Exhaust valve
Ø a	mm	26.80 ... 27.00	29.80 ... 30.00
Ø b	mm	5.960 ... 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.
- ◆ The valves must be sawn in two with a metal saw between the centre of the stem and valve head. When doing so, the valves must not come into contact with water. After preparing the valves, throw a maximum of ten into a bucket of water. Then step away immediately, since a chemical reaction will occur in which the sodium filling burns.
- ◆ After performing these steps the valves can be disposed of in the normal way.

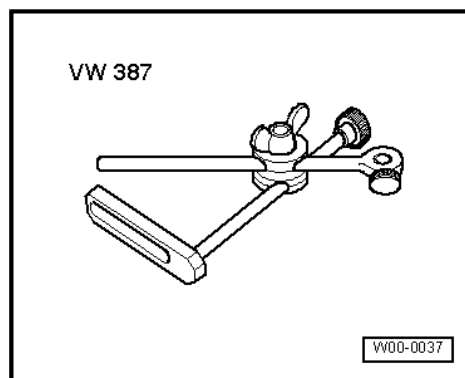
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2.10 Checking valve guides

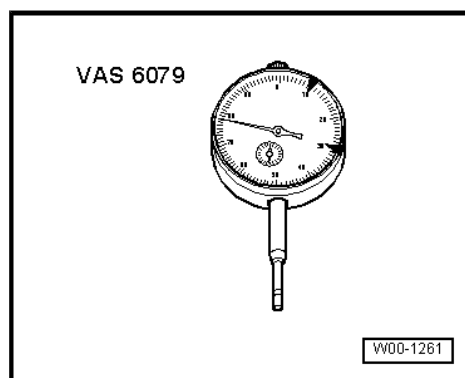
Special tools and workshop equipment required



- ◆ Universal dial gauge bracket - VW 387-



- ◆ Dial gauge - VAS 6079-



Procedure

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



Note

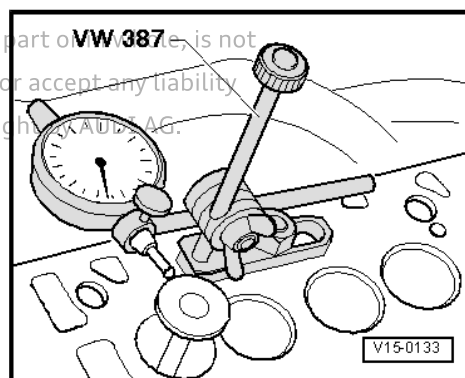
Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.

- Determine amount of sideways play.
- Wear limit: 0.80 mm.



Note

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



2.11 Machining valve seats

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

Special tools and workshop equipment required

- ◆ Depth gauge
- ◆ Valve seat machining tool

**Note**

- ◆ When servicing engines with leaking valves, it is not sufficient to machine (reface) the valve seats and renew the valves. The valve guides must also be checked for wear. This is particularly important on high-mileage engines ⇒ [page 119](#).
- ◆ Valve seats should only be machined to the extent required to give a proper seating pattern.
- ◆ Calculate the maximum permissible machining dimension before machining.
- ◆ If the maximum machining dimension is exceeded, the hydraulic valve clearance compensation will not work properly and the cylinder head will have to be renewed.

Calculating maximum permissible machining dimension

- Insert valve and press firmly against valve seat.

**Note**

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

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

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

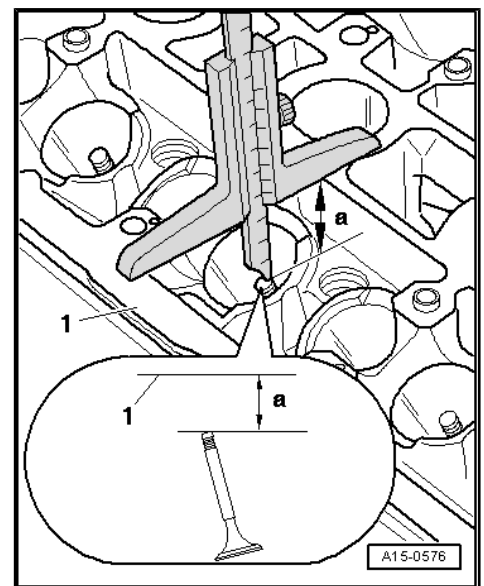
Measured distance minus minimum dimension = max. permissible machining dimension.

Example for inlet valve (outer):

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

**Note**

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





Machining valve seats

Inlet valve seat:

a - $\varnothing$ 26.2 mm

b - 1.5...1.8 mm

Z - Bottom surface of cylinder head

α - 45° valve seat angle

β - 30° upper correction angle

γ - 60° lower correction angle

Exhaust valve seat:

a - $\varnothing$ 29.0 mm

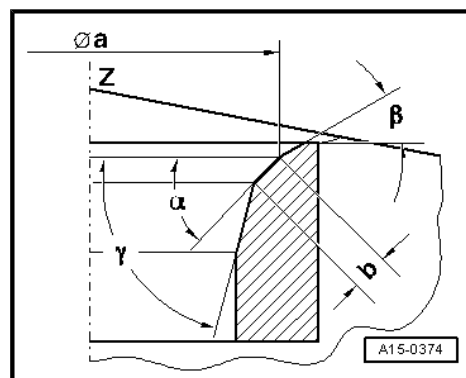
b - approx. 1.8 mm

Z - Bottom surface of cylinder head

α - 45° valve seat angle

β - 30° upper correction angle

γ - 60° lower correction angle



2.12 Checking valves

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

If scoring is clearly visible:

- Renew the relevant valve.



3 Checking variable valve timing

The timing of the inlet camshaft is controlled according to engine load and engine speed. Oil pressure is fed to the mechanical camshaft adjuster via the electrical camshaft control valve (solenoid valve).

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 5051-



Procedure

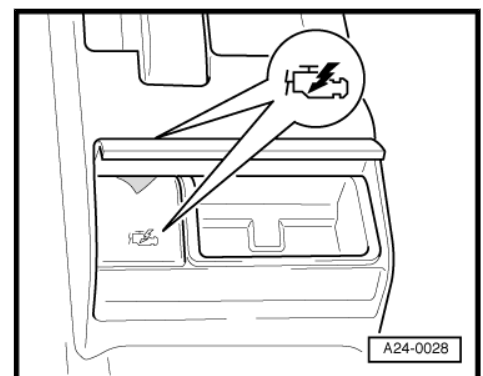
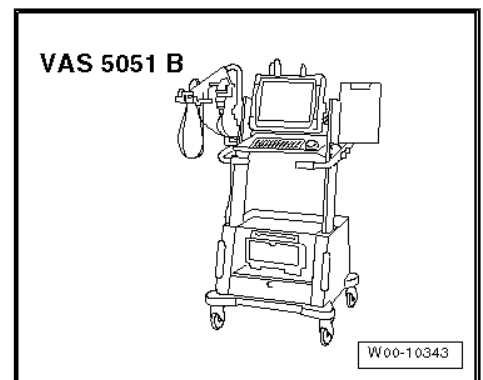
- Coolant temperature at least 80 °C.



WARNING

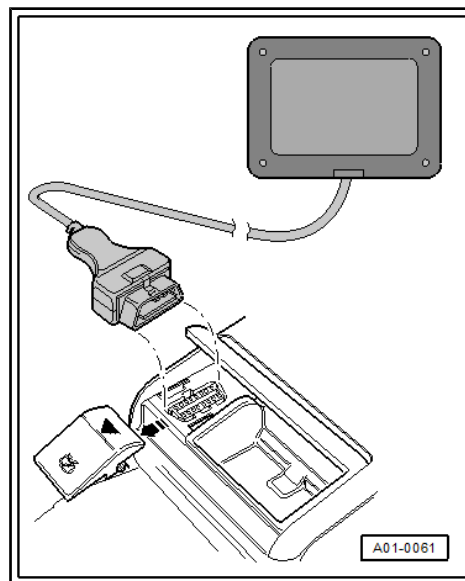
- ◆ **Test equipment must always be secured on the rear seat and operated from that position by a second person.**
- ◆ **If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, the person sitting in this seat could be seriously injured when the airbag is triggered.**

- Open rear ashtray and remove cover for diagnostic connector.





- Connect up vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1- , press vehicle self-diagnosis button and select vehicle system “01 - Engine electronics”. Engine must be idling.



Display on -VAS 5051- :

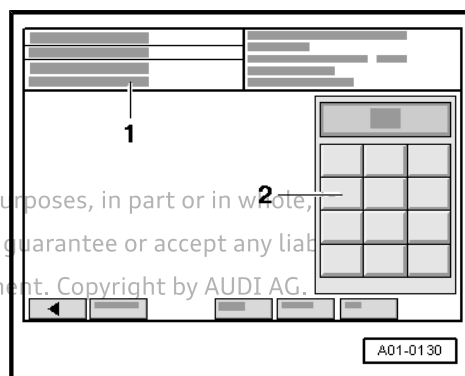
- From the list -1- select diagnostic function “08 - Read measured value block”.



Display on -VAS 5051- :

1 - Enter display group.

- Enter “90” for “Display group number 090” on keypad -2- and confirm by pressing Q key.



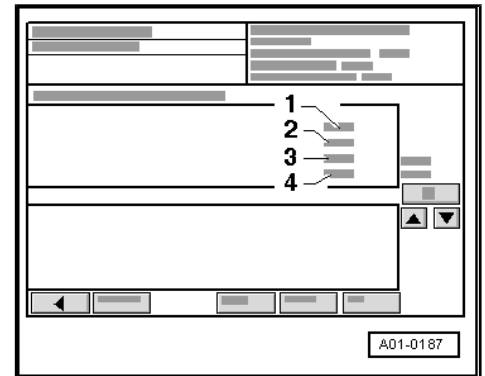
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Display on -VAS 5051- :

- Engine running at idling speed.
- Check display in zones -2-, -3- and -4-.

Display zones	Explanatory notes
2	Variable valve timing • Specification: "CS-ctrl.OFF"
3	Variable valve timing bank 1 (cylinder bank, right-side) • Specification: -3 ... 6 CA
4	Variable valve timing bank 2 (cylinder bank, left-side) • Specification: -3 ... 6 CA



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

Display zones	Explanatory notes
2	Variable valve timing • Specification: "CS-ctrl.ON"
3	Variable valve timing bank 1 (cylinder bank, right-side) • Specification: 16 ... 25 CA ¹⁾
4	Variable valve timing bank 2 (cylinder bank, left-side) • Specification: 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 the camshaft control valve 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).	

- Exit function "08 - Read measured value block" by pressing key.

If the specifications are not obtained:

- Check camshaft control valves → [page 125](#) .

If the specifications are obtained:

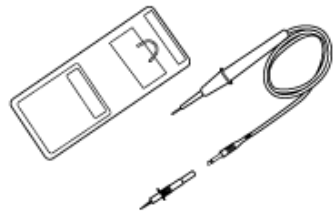
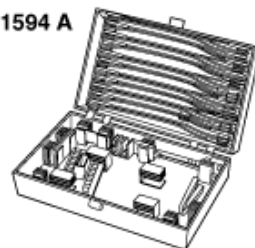
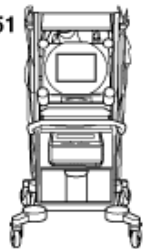
- Select "06 - End output".
- Switch off ignition and unplug diagnostic connector.

3.2 Checking camshaft control valves (solenoid valves)

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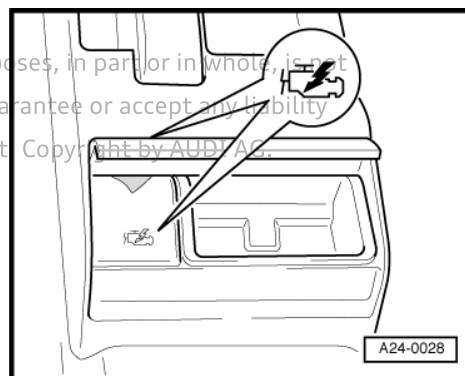
Special tools and workshop equipment required

V.A.G 1526 A 	V.A.G 1527 B 
V.A.G 1594 A 	V.A.G 1598/31 
VAS 5051 	 G24-0023

- ◆ Hand-held multimeter - V.A.G 1526 C- or -V.A.G 1526 A-
- ◆ Voltage tester - V.A.G 1527 B-
- ◆ Auxiliary measuring set - V.A.G 1594 C- or -V.A.G 1594 A-
- ◆ Adapter cable - V.A.G 1598/31- (test box)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1-

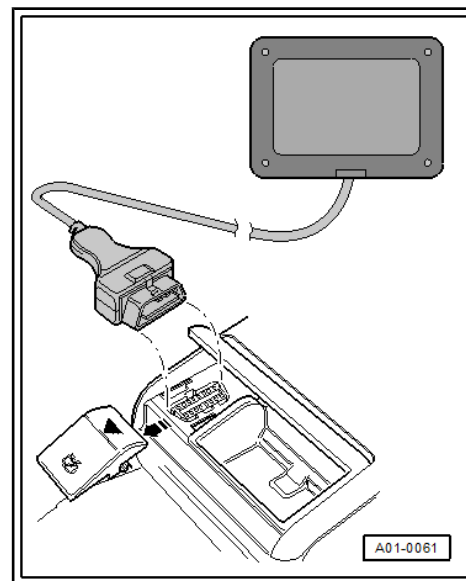
Procedure

- Open rear ashtray and remove cover for diagnostic connector.



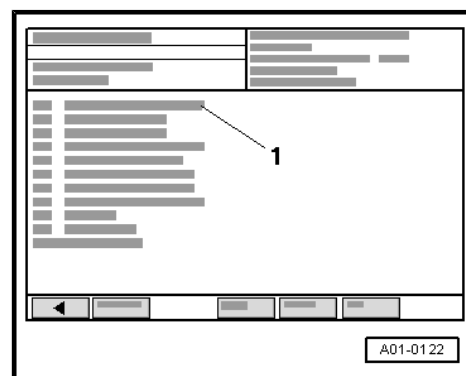


- Connect up vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1- , press vehicle self-diagnosis button and select vehicle system "01 - Engine electronics". When doing this, the ignition must be switched on.



Display on -VAS 5051- :

- From the menu -1- select the diagnostic function "03 - Final control diagnosis".



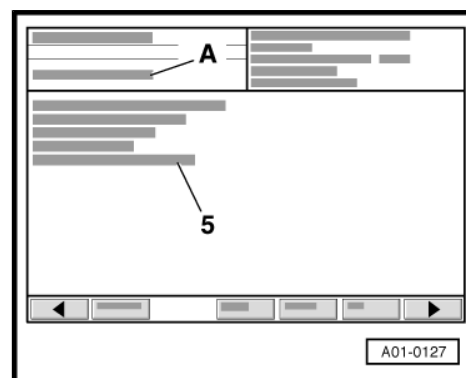
- Press key repeatedly until the following display appears:

Display on -VAS 5051- :

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 5051- :

7 - Camshaft control valve 1 - N205-

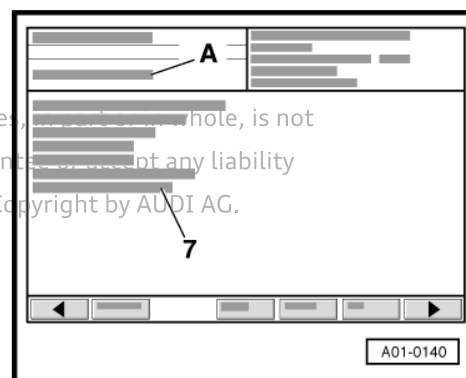
A - Actuator is running; continued switching is allowed

- The valve should click.

- Press key to exit "03 - Final control diagnosis" function.

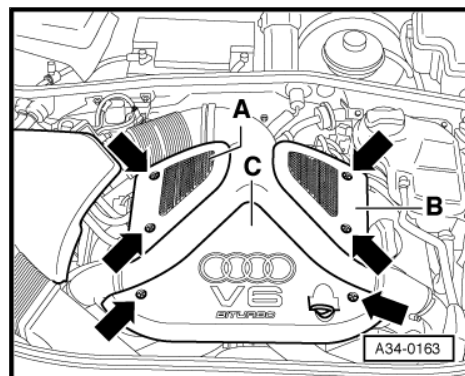
- Press function "06 - End output" and switch off ignition.

If one of the valves does not click:



**Checking internal resistance**

- Unfasten screw connections -arrows- and detach engine cover panels -A- (right-side) and -C- (front).

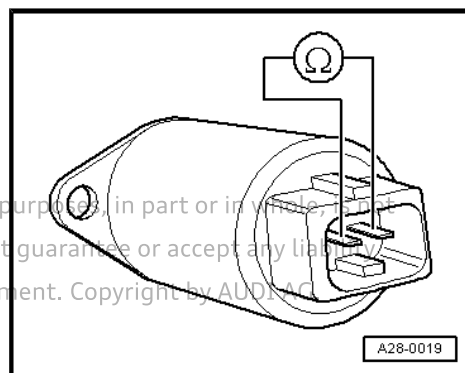


- Unplug electrical connector at camshaft control valve 1 - N205- / camshaft control valve 2 - N208- .
- Connect hand-held multimeter - V.A.G 1526 C- to contacts of camshaft control valve 1 - N205- / camshaft control valve 2 - N208- to measure resistance.

- Specification: 10 ... 18 Ω

If specification is not obtained:

- Renew relevant camshaft control valve.

**Checking voltage supply**

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

**Note**

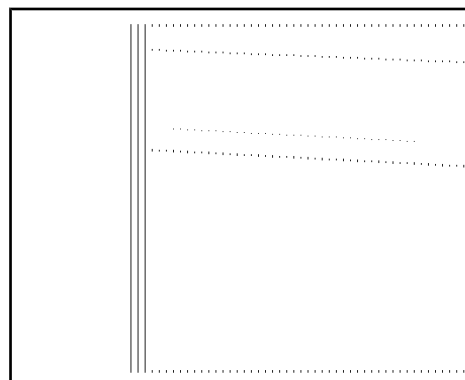
Camshaft control valve 1 - N205- / camshaft control valve 2 - N208- is supplied with power via fuel pump relay - J17- .

- Connect voltage tester - V.A.G 1527 B- between contact -1- of electrical connector for camshaft control valve 1 - N205- / camshaft control valve 2 - N208- and earth.
- Operate starter briefly.
- The LED should light up.

If LED does not light up:

- Check for open circuit in wiring from contact -1- of connector via fuse to fuel pump relay $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- Repair wiring connection if necessary.

If the LED lights up:



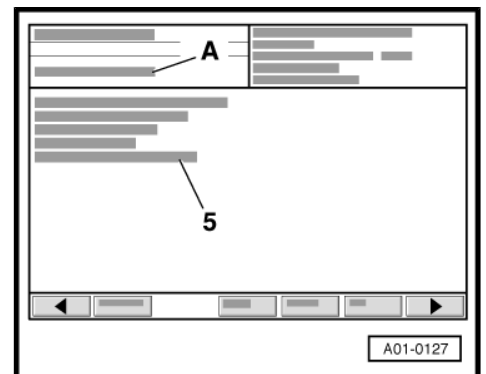
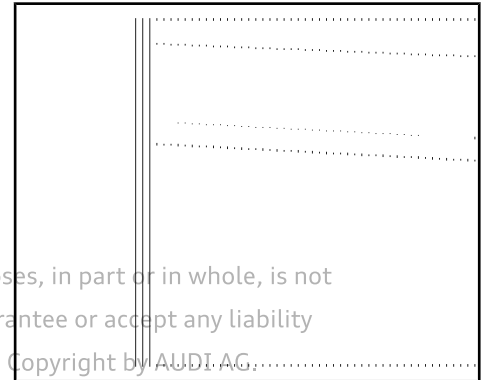


Checking activation

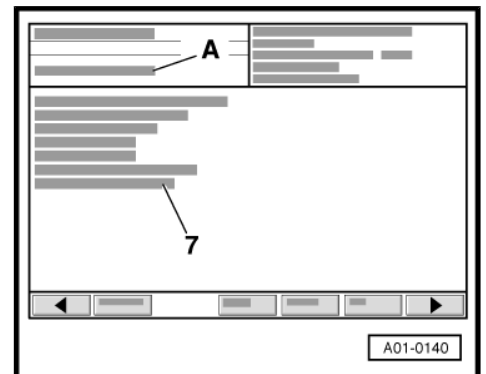
- Connect voltage tester - V.A.G 1527 B- between contacts -1- and -2- of electrical connector for camshaft control valve 1 - N205- / camshaft control valve 2 - N208- .
- Switch on ignition and select vehicle system "01 - Engine electronics".

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- Repeat function "03 - Final control diagnosis".
- Press  key repeatedly until the following display appears:
Display on -VAS 5051- :
5 - Camshaft control valve 2 - N208-
A - Actuator is running; continued switching is allowed
- The LED should flash.

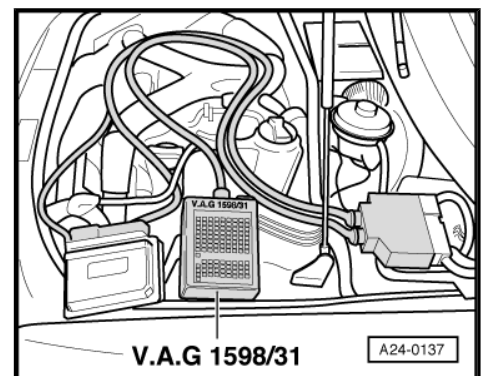


- Press  key repeatedly until the following display appears:
Display on -VAS 5051- :
7 - Camshaft control valve 1 - N205-
A - Actuator is running; continued switching is allowed
- The LED should flash.
- Press  key to exit "03 - Final control diagnosis" function.
- Press function "06 - End output".
- 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).





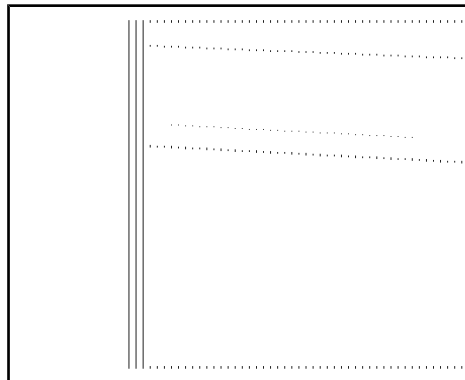
- Check for open circuit and short to earth/positive in the following wiring from camshaft control valve 1 - N205- / camshaft control valve 2 - N208- :

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
⇒ [“2.6 Removing and installing camshafts and camshaft adjuster”, page 108](#) .



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17 – Lubrication

1 Removing and installing parts of lubrication system



Note

- ◆ *If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages, oil lines and hoses must be cleaned carefully, and the two oil coolers must be renewed in order to prevent further damage occurring later.*
- ◆ *The oil level must not be above max. mark on dipstick – danger of damage to catalytic converter.*
- ◆ *Oil spray jet for piston cooling ⇒ [page 133](#)*

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 802

Oil capacities ⇒ Maintenance tables

1.1 Exploded view - lubrication system



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1 - 22 Nm

2 - Dipstick guide tube

3 - Sump (top section)

- ☐ Removing and installing
⇒ [page 139](#)

4 - M8: 22 Nm

5 - M6: 10 Nm; M7: 16 Nm

6 - M8: 22 Nm

7 - 10 Nm

8 - O-ring

- ☐ Renew

9 - Gasket

- ☐ Replaced with liquid gasket
⇒ "1.2 Removing and installing sump (bottom section)", [page 133](#)

10 - Oil drain plug, 30 Nm

11 - Seal

- ☐ Renew

12 - 10 Nm

13 - Sump (bottom section)

- ☐ Removing and installing
⇒ [page 133](#)

14 - 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-ring

- ☐ Renew

19 - Seal

- ☐ Renew
- ☐ Engage in lugs on oil cooler

20 - Oil filter

- ☐ Observe change intervals ⇒ Maintenance ; Booklet 802

☐ Loosen with oil filter wrench - 3417 - or commercial purposes, in part or in whole, is not permitted unless authorized by Audi AG. Audi AG does not guarantee or accept any liability with respect to this technical service information document. Copyright by Audi AG.

- ☐ Installing ⇒ Maintenance ; Booklet 802

- ☐ 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

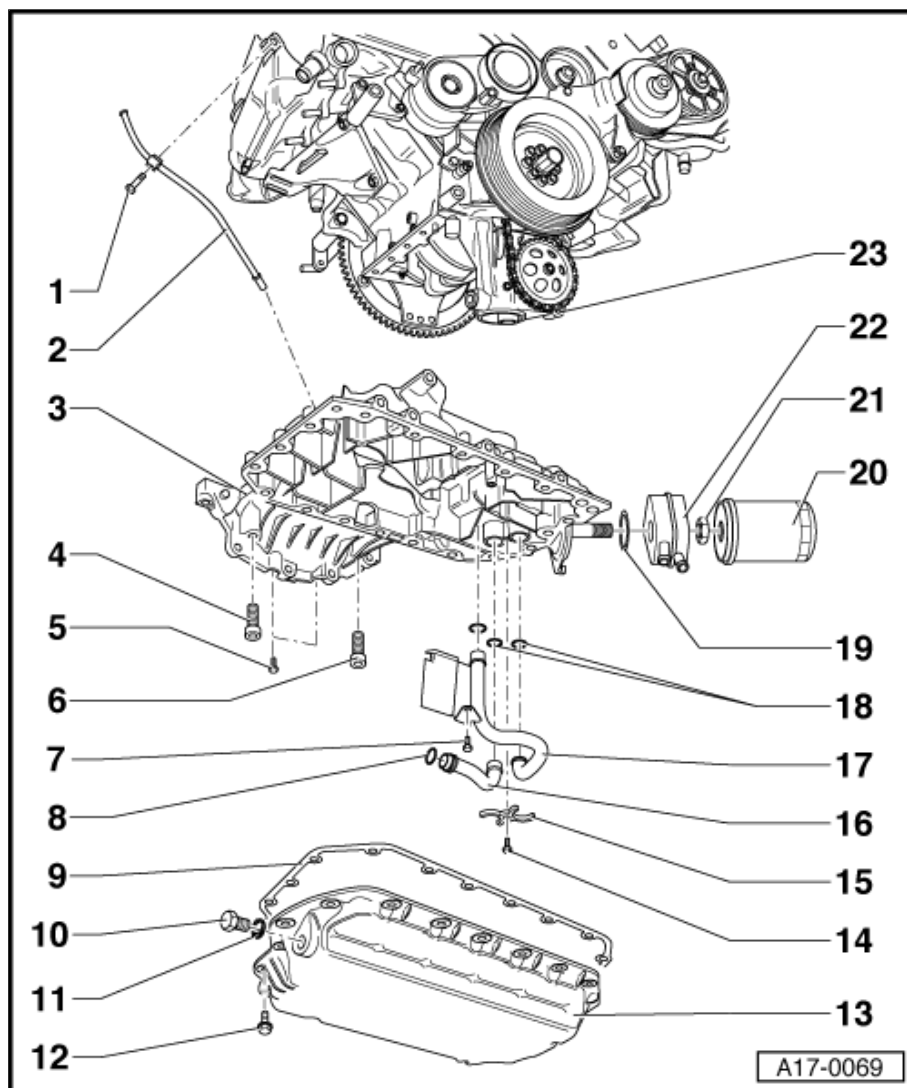
21 - 30 Nm

22 - Oil cooler

- ☐ See note ⇒ [page 131](#)

23 - Oil pump

- ☐ Chain-driven off crankshaft

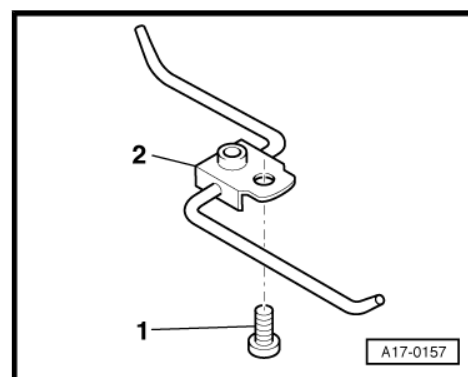




❑ Removing and installing ⇒ [page 136](#)

Oil spray jet

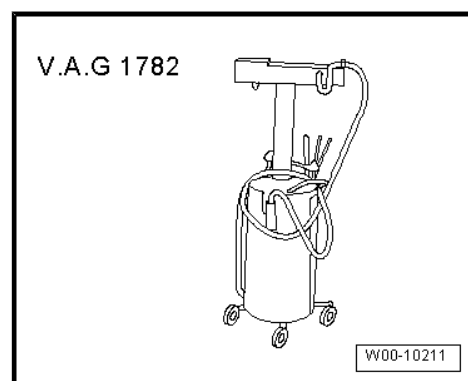
- 1 - Bolt, 10 Nm
- 2 - Oil spray jet for piston cooling



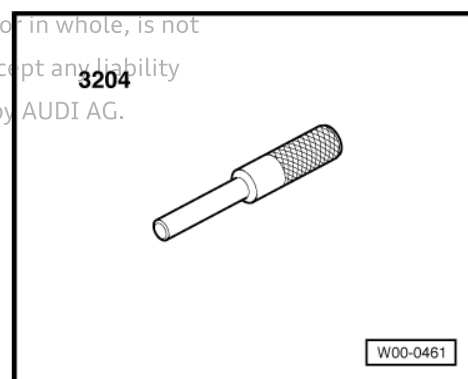
1.2 Removing and installing sump (bottom section)

Special tools and workshop equipment required

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



◆ Locking pin - 3204-
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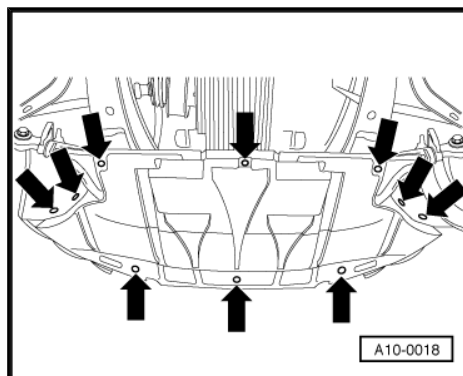


- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Parts catalogue



Removing

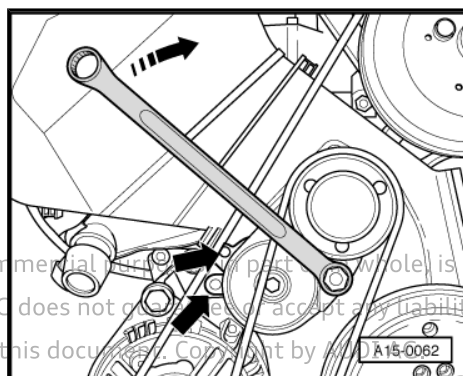
- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Place used oil collection and extraction unit - V.A.G 1782- beneath engine.
- Drain off engine oil.



Note

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

- Turn the tensioner in the direction of the -arrow- using a 17 mm ring spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrows-.
- Guide poly V-belt over viscous fan and detach belt.



WARNING

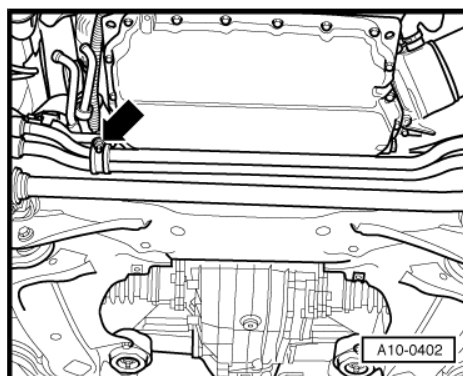
The air conditioner refrigerant circuit must not be opened.



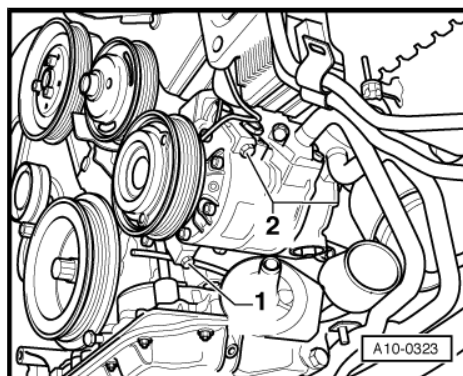
Note

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

- Unbolt refrigerant pipe from sump -arrow-.



- Remove AC compressor by unscrewing bolts -1- and -2-.
- Position AC compressor onto oil cooler (refrigerant pipes/hoses remain connected).



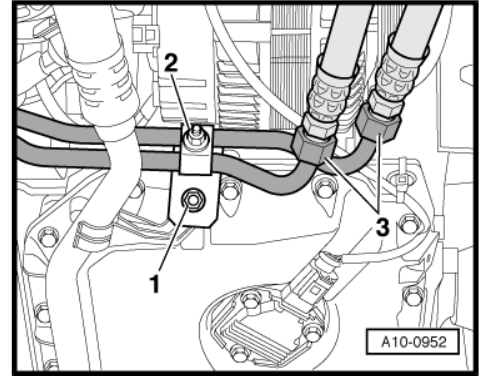


- Remove bracket for gear oil pipes (unscrew nuts -1- and -2-).

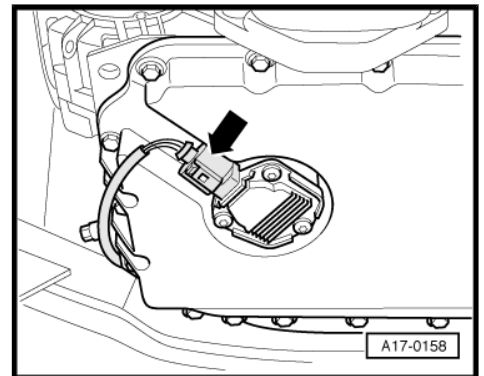


Note

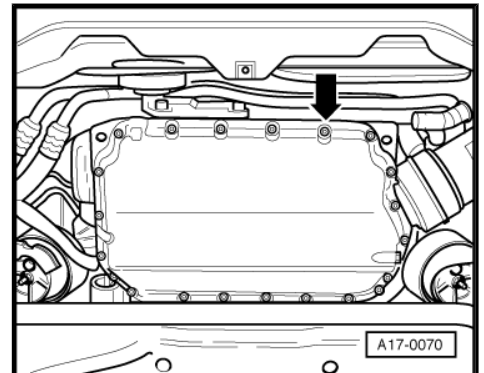
Disregard -item 3-.



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



- Unbolt sump (bottom section) -arrow- and pry off carefully.



Installing

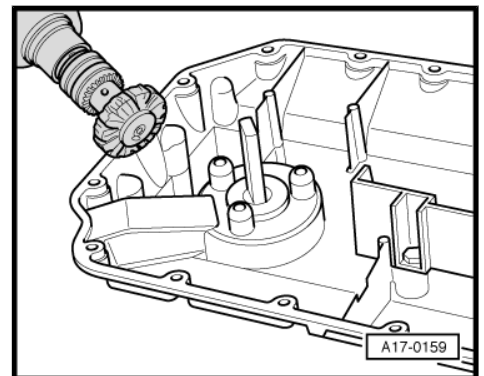
Installation is carried out in reverse order; note the following:



Note

Renew seals and self-locking nuts.

- Remove sealant residue from bottom and top sections of sump with rotating plastic brush or similar.



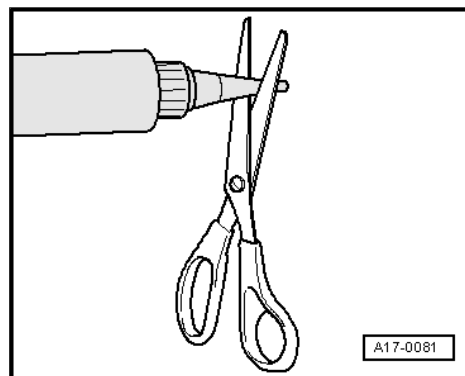
WARNING

Put on safety goggles.

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- Cut off tube nozzle at front marking (nozzle approx. 1 mm Ø).

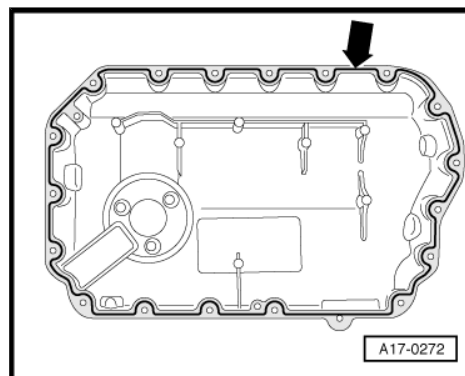


- Apply bead of sealant -arrows- onto clean sealing surface of sump (bottom section) as illustrated.
- The bead of sealant should be approx. 1.5 mm wide -arrow-.



Note

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



- Fit sump (bottom section) and tighten all bolts initially to 5 Nm in diagonal sequence.
- Tighten bolts on sump (bottom section) in diagonal sequence.
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install poly V-belt ⇒ [page 38](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .
- Fill up with engine oil and check oil level ⇒ [page 155](#) .

Tightening torques

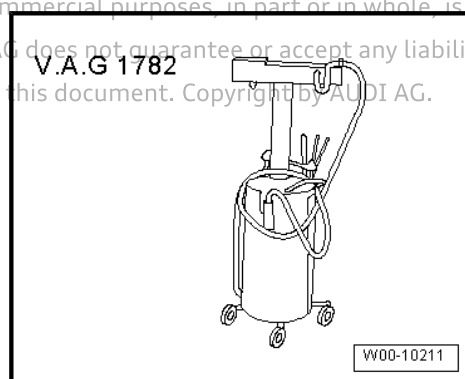
Component	Nm
Sump (bottom section) to sump (top section)	10
Oil drain plug	30

1.3 Removing and installing oil pump

Special tools and workshop equipment required

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

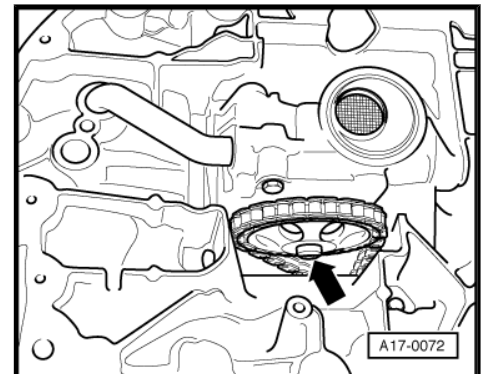
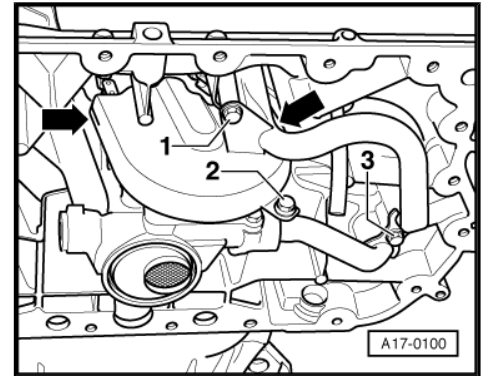
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Removing

- Remove sump (bottom section) ⇒ [page 133](#) .
- Place used oil collection and extraction unit - V.A.G 1782- beneath engine.
- Remove bolt -2- (counterhold at welded-on nut).
- Detach cover plate at the points indicated by -arrows-.
- Remove bolts -1- and -3-.
- Pull off the longer of the two oil pipes.
- Unscrew bolt -arrow- and detach chain sprocket from oil pump.



- Remove oil pump together with short oil pipe -arrows-.

Installing

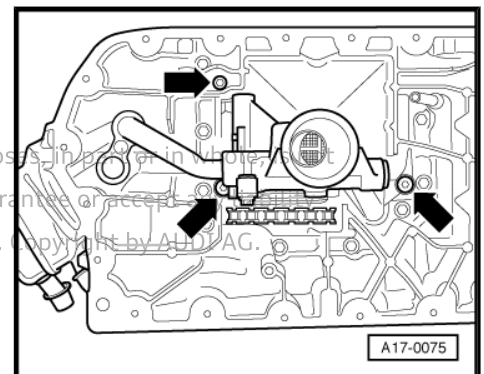
Installation is carried out in reverse order; note the following:



Note

Renew O-rings.

- Chain sprocket can only be fitted in one position on oil pump shaft.
- Checking chain tensioner for oil pump ⇒ [page 138](#) .
- Install sump (bottom section) ⇒ [page 135](#) .



Tightening torques

Component	Nm
Oil pump to cylinder block	22
Chain sprocket to oil pump shaft	25
Bracket to sump (top section)	10
Cover plate to rear cover plate	10



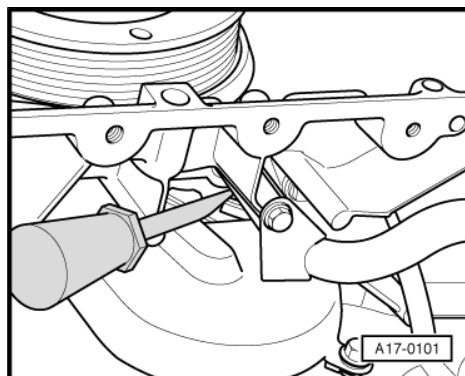
1.4 Checking chain tensioner for oil pump

Procedure

- Remove sump (bottom section) ⇒ [page 133](#) .
- Insert screwdriver between chain and chain tensioner and lever screwdriver against tensioner.

If spring tension is not felt and chain is not tensioned:

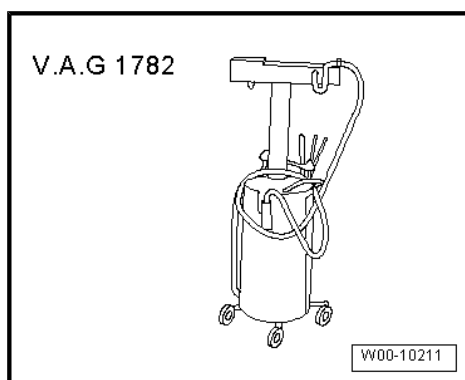
- Renew chain tensioner for oil pump ⇒ [page 138](#) .
- Install sump (bottom section) ⇒ [page 135](#) .



1.5 Removing and installing drive chain and chain tensioner for oil pump

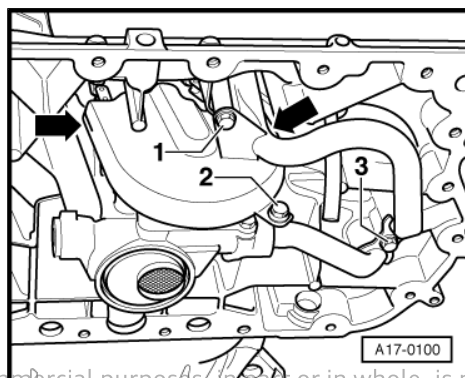
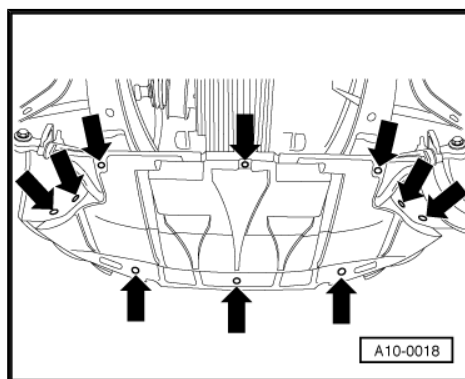
Special tools and workshop equipment required

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



Removing

- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove toothed belt ⇒ [page 43](#) .
- Remove sump (bottom section) ⇒ [page 133](#) .
- Remove sealing flange (front) ⇒ [page 55](#) .
- Place used oil collection and extraction unit - V.A.G 1782- beneath engine.
- Remove bolt -2- (counterhold at welded-on nut).
- Detach cover plate at the points indicated by -arrows-.
- Remove bolts -1- and -3-.
- Pull off the longer of the two oil pipes.



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- Unscrew bolt -arrow- and detach chain sprocket from oil pump.
- Take chain sprocket out of chain.
- Pull off chain tensioner.
- Lift off chain.

Installing

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



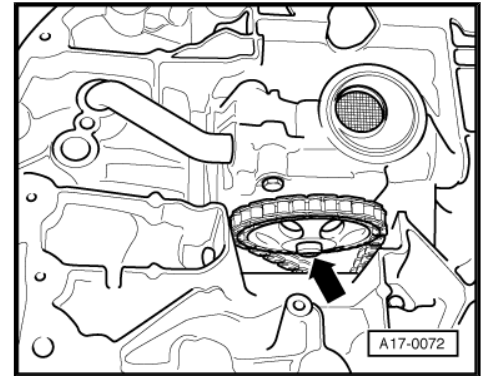
Note

Renew O-rings.

- Chain sprocket can only be fitted in one position on oil pump shaft.
- Install sealing flange (front) ⇒ [page 55](#) .
- Install sump (bottom section) ⇒ [page 135](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 50](#) .
- Install vibration damper ⇒ [page 39](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Install viscous fan ⇒ [page 186](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .

Tightening torques

Component	Nm
Chain sprocket to oil pump shaft	25
Bracket to sump (top section)	10
Cover plate to rear cover plate	10

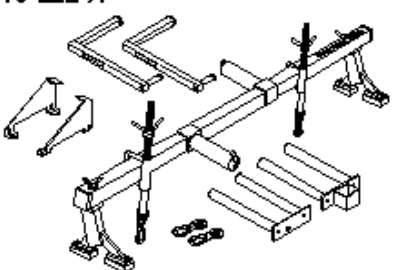
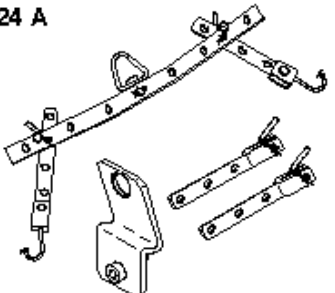
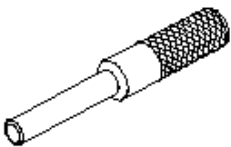
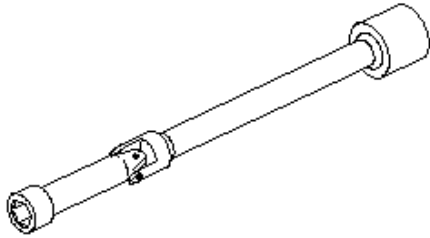
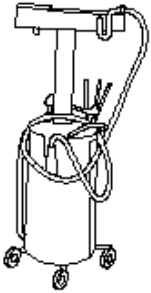
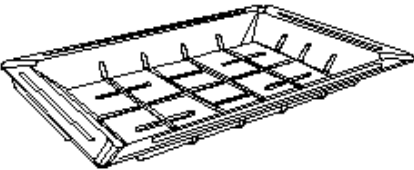


1.6 Removing and installing sump (top section)



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**Special tools and workshop equipment required**

10-222 A 	2024 A 
3204 	3220 
V.A.G 1782 	VAS 6208 

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- ◆ Support bracket - 10-222 A-
- ◆ Lifting tackle - 2024 A-
- ◆ Locking pin - 3204-
- ◆ Articulated wrench, 10 mm - 3220-
- ◆ 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 ⇒ Parts catalogue

Removing**Note**

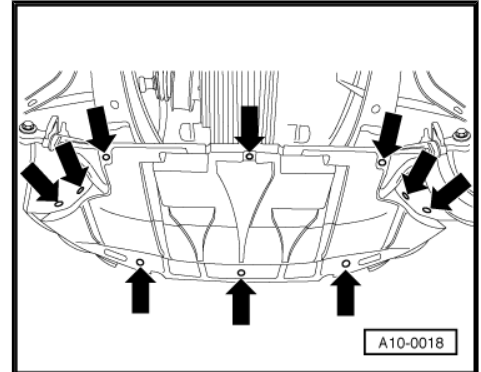
All cable ties which are released or cut open when removing must be refitted in the same position when installing.



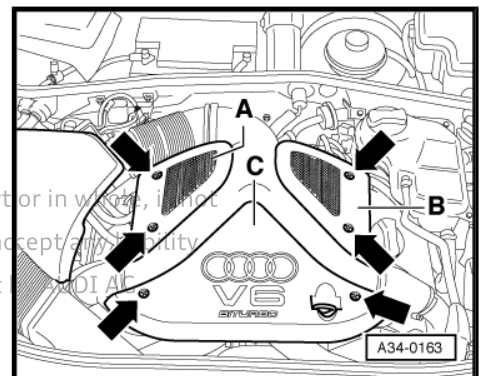
Caution

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

- With ignition switched off, disconnect earth strap at battery.
- Drain off coolant ➔ [page 158](#).
- Remove noise insulation -arrows-.
- Remove front bumper ➔ Rep. gr. 63.
- Move lock carrier to service position ➔ Rep. gr. 50.

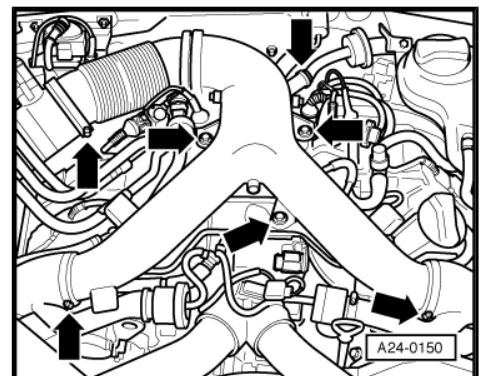


- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.

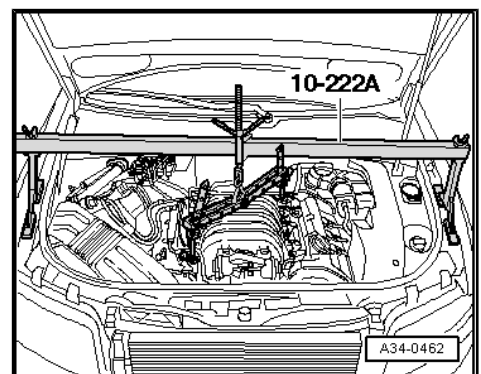


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- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.



- Pull off bonnet seal at wing mounting flanges.
- Set up support bracket - 10-222 A- on wing panel flanges.



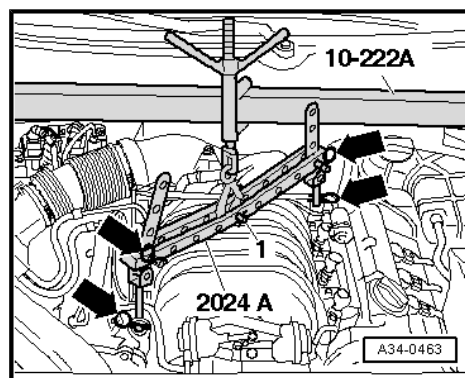


- Remove eyelet of lifting tackle - 2024 A- .
- Re-insert pin -1- in centre hole of lifting tackle and secure with split pin.
- Hook pin of lifting tackle - 2024 A- onto spindle of support bracket - 10-222 A- .
- Engage lifting tackle - 2024 A- in front and rear lifting eyes on engine.



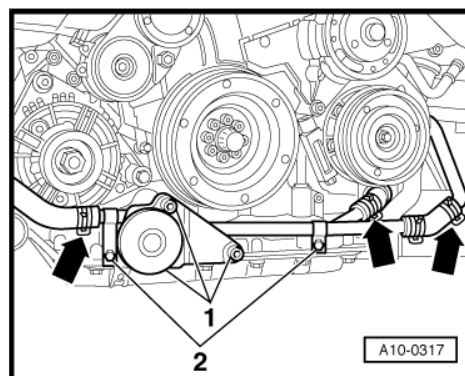
WARNING

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

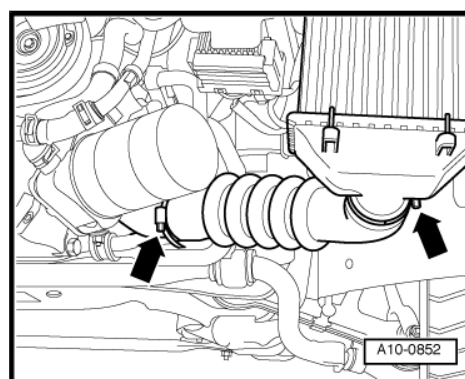


- Take up weight of engine using spindle of support bracket.
- Pull oil dipstick out of guide tube.

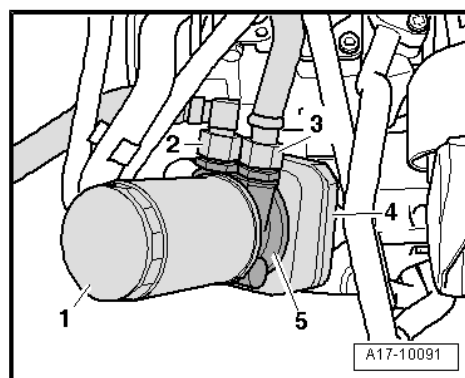
- Unscrew bolts -1- and remove torque reaction support.
- Unscrew bolts -2-.
- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Detach coolant pipe from coolant hoses -arrows-.



- Remove air hose leading to charge air cooler (left-side) -arrows-.



- Place used oil collection and extraction unit - V.A.G 1782- beneath engine.
- Drain off engine oil.
- Remove oil filter -1-.
- Unscrew intermediate flange -5- but do not disconnect from oil lines -2- and-3-.
- Remove oil cooler -4-.





- Unplug electrical connector at oil pressure switch - F1-
-arrow-.



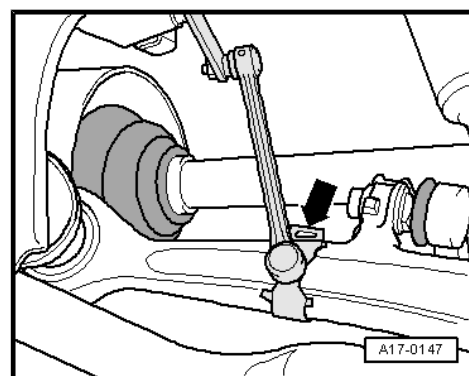
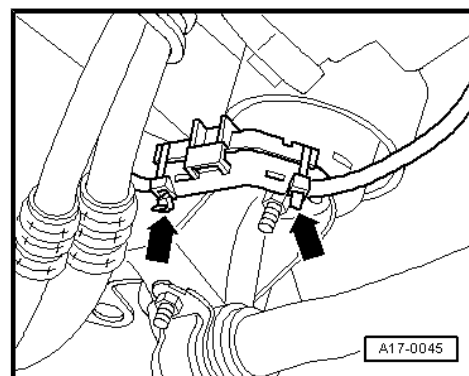
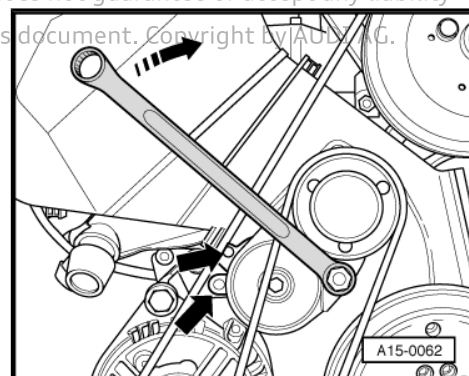
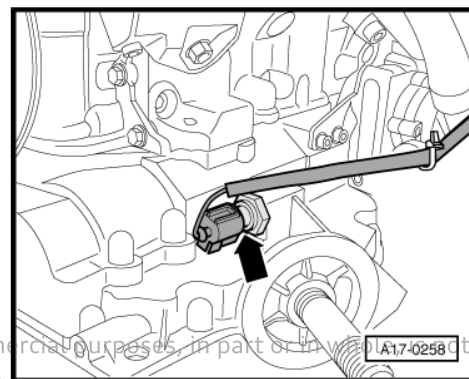
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Note

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

- Turn the tensioner in the direction of the -arrow- using a 17 mm ring spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrows-.
- Guide poly V-belt over viscous fan and detach belt.
- Remove alternator ⇒ Rep. gr. 27 .
- Remove starter ⇒ Rep. gr. 27 .
- Cut through cable ties -arrows-. Open retainer for starter wiring and take out wiring.
- If fitted, unclip retaining clip -arrow- on operating rod for front left vehicle level sender - G78- at track control link (bottom).





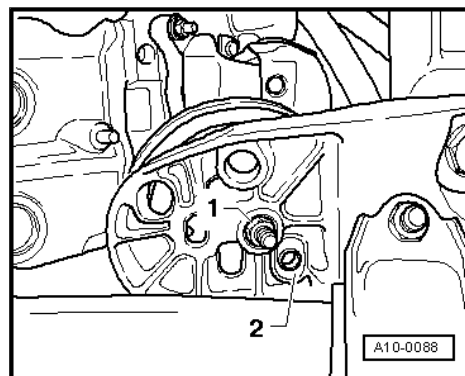
- Mark positions of bolted connections -1- and locating sleeves -2- on bottom of engine mountings (left and right).



Note

Different mounting holes are provided for the different engine versions.

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



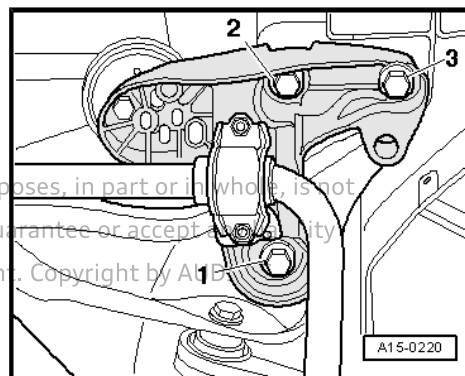
- First unscrew front bolts -2- and -3- for subframe (left and right). Then remove bolts -1-.



Note

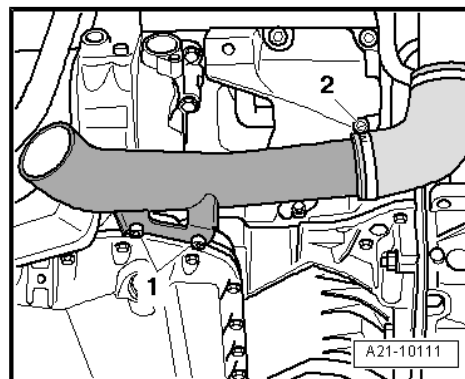
To avoid having to check and adjust wheel alignment, only loosen the front subframe mountings and lower the subframe at the front.

- Lower subframe at the front.
- Remove sump (bottom section) ⇒ [page 133](#) .
- Remove oil pump ⇒ [page 136](#) .
- Unscrew bolts -1-.
- Remove air pipe (left-side); disconnect hose connection -2- for this purpose.



WARNING

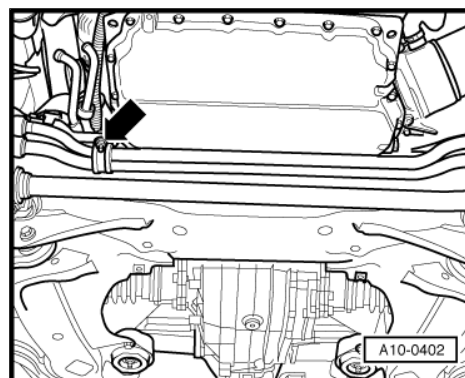
The air conditioner refrigerant circuit must not be opened.



Note

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

- Unbolt refrigerant pipe from sump -arrow-.

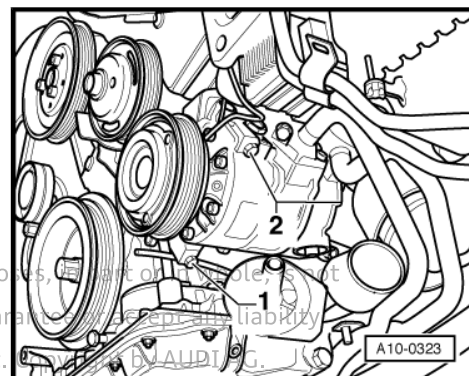




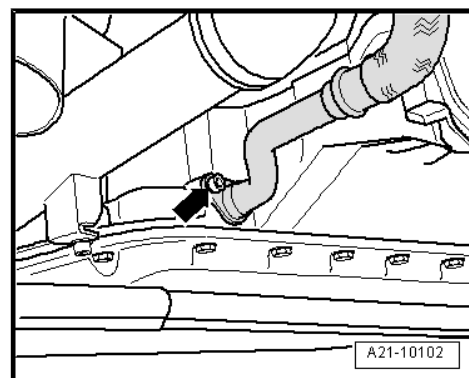
- Remove AC compressor by unscrewing bolts -1- and -2-.
- Tie up air conditioner compressor to vehicle, with lines attached.



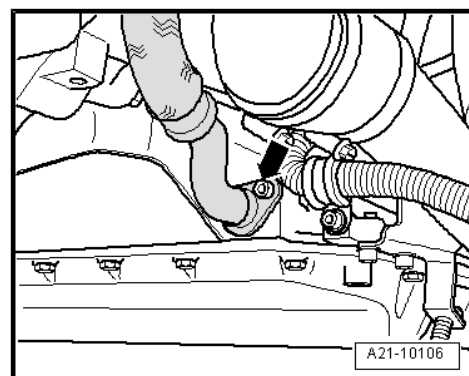
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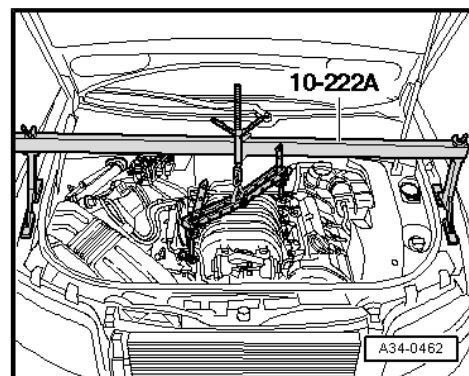
- Unscrew bolt -arrow- and detach left-side oil return line from top section of sump.



- Unscrew bolt -arrow- and detach right side oil return line from top section of sump.

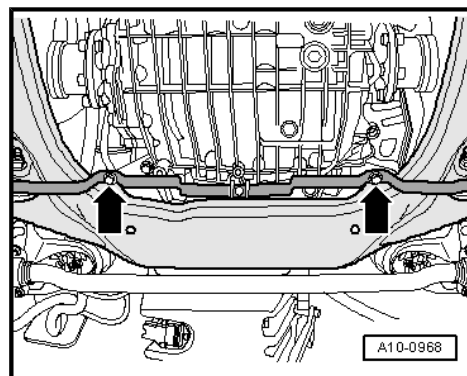


- Lift engine slightly with spindle of support bracket - 10-222 A- .

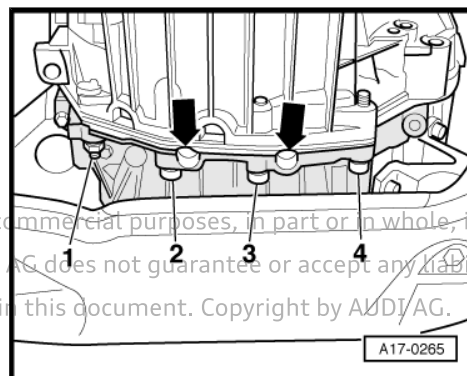




- Unbolt bracket for noise insulation -arrows-.



- Remove bolts -1 ... 4- between sump (top section) and gear-box.
- Check whether U/J extension and socket, 10 mm - 3220- can be inserted through assembly opening -arrows-. Widen out assembly opening if necessary.



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- Unscrew bolts -1- and -2- for sump (top section).
- Press sump (top section) off dowel pins on cylinder block.

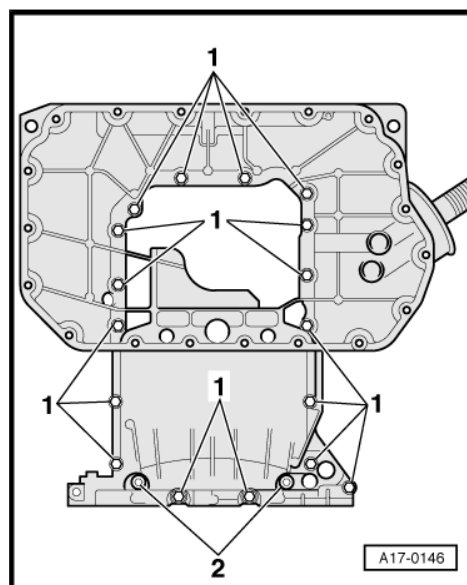
Installing

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



Note

- ◆ *Renew gaskets, seals, O-rings and self-locking nuts.*
- ◆ *Hose connections and charge air system 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) ⇒ Parts catalogue .*
- ◆ *Fit all cable ties in the original positions when installing.*



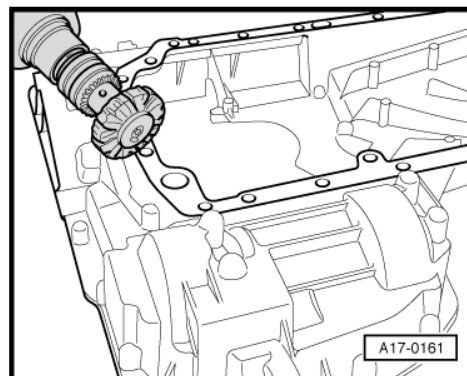
- Remove sealant residue from sump (top section) and cylinder block with rotating plastic brush or similar.



WARNING

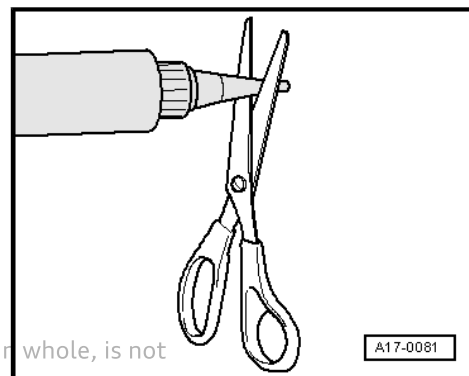
Put on safety goggles.

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





- Cut off tube nozzle at front marking (nozzle approx. 1 mm Ø).



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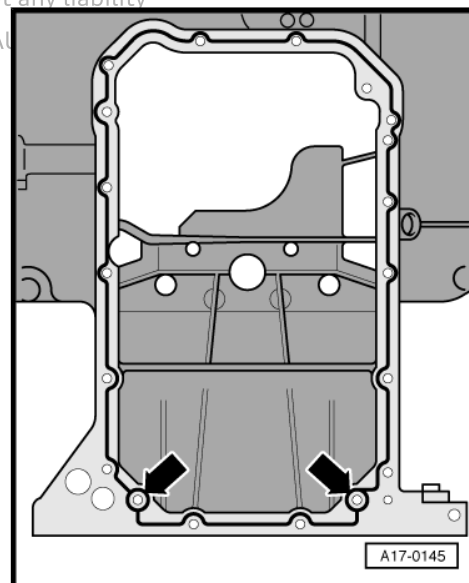
- Apply sealant bead to clean sealing surface of top section of sump, as shown in illustration.

- Bead of sealant should be approx 1.5 mm wide -arrows-.



Note

- ◆ *The sealant bead must not be thicker than specified, otherwise excess sealant could enter the sump and clog the strainer in the oil pump.*
- ◆ *Apply sealant with particular care around sealing flange -arrows- in cylinder block.*
- ◆ *The sump (top section) must be installed within 5 minutes after applying sealant.*
- Renew O-ring on guide tube for oil dipstick and insert guide tube into hole in top section of sump.

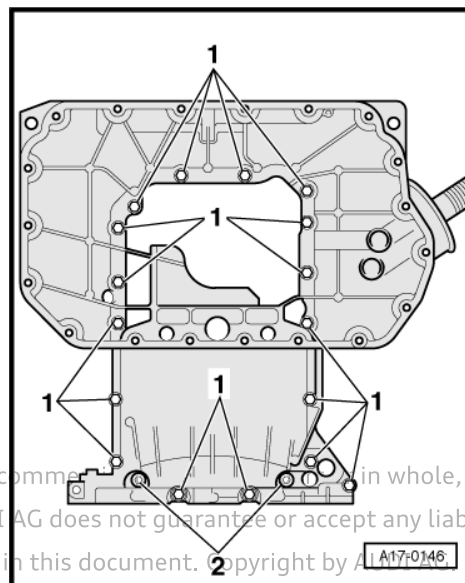




- Fit top section of sump in position (2nd mechanic required) and pre-tighten bolts -1- and -2- securing top section of sump to cylinder block diagonally to 5 Nm.
- Tighten bolts securing sump (top section) to gearbox.
- Tighten bolts securing sump (top section) to cylinder block diagonally to final setting.

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

- Install oil pump ⇒ [page 136](#).
- Install sump (bottom section) ⇒ [page 135](#).
- Install air conditioner compressor ⇒ Rep. gr. 87.
- Install oil filter ⇒ Maintenance ; Booklet 802.
- Install subframe ⇒ Rep. gr. 40.
- Install starter ⇒ Rep. gr. 27.
- Install alternator ⇒ Rep. gr. 27.
- Install poly V-belt ⇒ [page 38](#).
- Install lock carrier with attachments ⇒ Rep. gr. 50.
- Install front bumper ⇒ Rep. gr. 63.
- Fill up with engine oil and check oil level ⇒ [page 155](#).
- Observe notes on procedures required after connecting battery ⇒ Rep. gr. 27.
- Fill cooling system ⇒ [page 160](#).



Note

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

Tightening torques

Component		Nm
Sump (top section) to cylinder block and sealing flanges	M6	10
	M7	16
	M8	22
Sump (top section) to gearbox		45
Oil return line to sump (top section)		10
Air pipe to sump (top section)		10
Engine mounting to subframe		23
Oil cooler to sump (top section)		30
Intermediate flange to oil cooler		30
Oil lines to intermediate flange		38
Air duct to intake manifold		10
Hose clips (9 mm wide)		3
Hose clips (13 mm wide)		5.5



1.7 Renewing oil retention valves

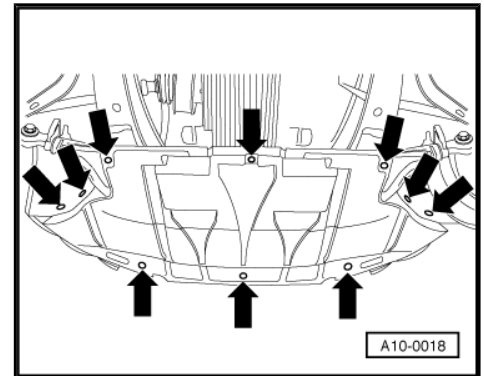


Note

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 noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Drain off coolant ⇒ [page 158](#) .
- Remove toothed belt ⇒ [page 43](#) .
- Remove coolant pump ⇒ [page 164](#) .
- Remove secondary air pump ⇒ [page 280](#) .
- Remove intake manifold ⇒ [page 90](#) .
- Remove coolant pipe (front) ⇒ [page 175](#) .
- Unscrew cover beneath intake manifold.

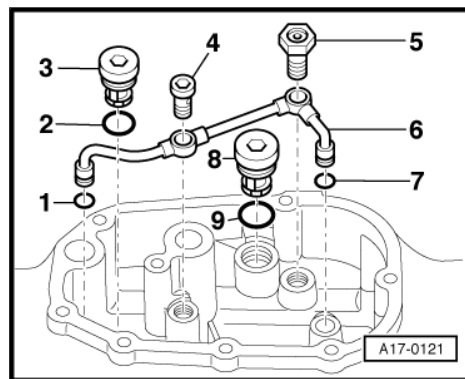


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Exploded view:

- 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 gaskets and seals.

- Install coolant pipe (front) ⇒ [page 175](#) .
- Install intake manifold ⇒ [page 90](#) .
- Install secondary air pump ⇒ [page 280](#) .
- Install coolant pump ⇒ [page 164](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 50](#) .
- Install vibration damper ⇒ [page 39](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Install viscous fan ⇒ [page 186](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .
- Fill cooling system ⇒ [page 160](#) .

Tightening torque

Component	Nm
Cover to cylinder block	10

1.8 Removing and installing auxiliary oil cooler on lock carrier

Special tools and workshop equipment required



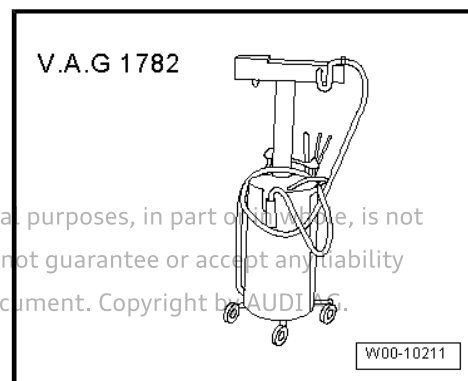
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◆ Used oil collection and extraction unit - V.A.G 1782-



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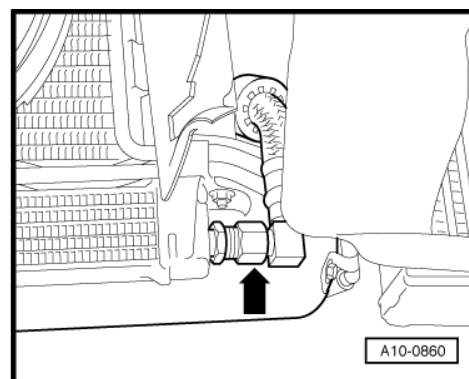
Removing

- Remove radiator ⇒ [page 180](#) .
- Place used oil collection and extraction unit - V.A.G 1782- under connection.
- Unscrew union nut -arrow- on left and right of oil cooler and disconnect engine oil pipes.
- Remove oil cooler from lock carrier.

Installing

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

- Install radiator ⇒ [page 180](#) .
- Check oil level ⇒ [page 155](#) .



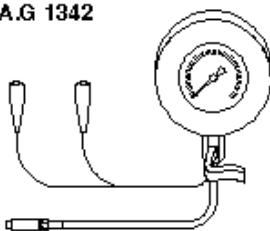
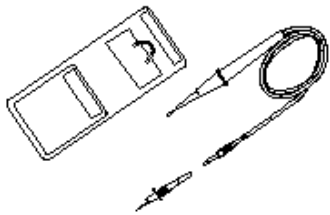
Tightening torque

Component	Nm
Union nut to oil cooler	38

1.9 Checking oil pressure and oil pressure switch - F1-



Special tools and workshop equipment required

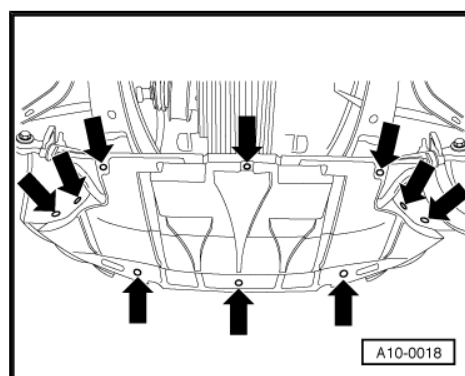
V.A.G 1342 	V.A.G 1527 B 
V.A.G 1594 C 	
	G17-0023

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

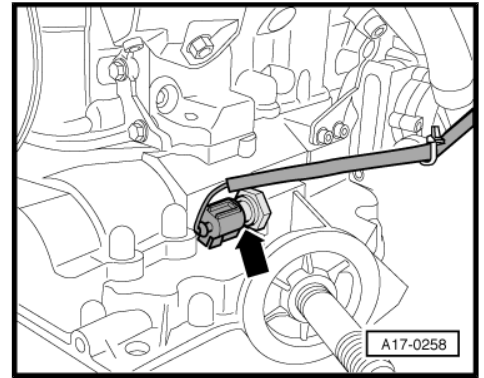
Procedure

- Oil level OK
- Engine oil temperature approx. 80 °C
- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .





- Unplug electrical connector at oil pressure switch - F1-
-arrow-.
- Unscrew oil pressure switch.



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- Connect oil pressure tester - V.A.G 1342- at threaded hole for oil pressure switch.
- Screw oil pressure switch -2- into oil pressure tester - V.A.G 1342- .
- Connect brown wire -1- of oil pressure tester to earth “(-)”.

Checking oil pressure switch

- Connect voltage tester - V.A.G 1527 B- with test leads from auxiliary measuring set - V.A.G 1594 C- to oil pressure switch and battery positive (+).
- LED should not light up.

If the LED lights up:

- Renew oil pressure switch.
- Start engine.



Note

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

- LED should light up at 1.2 ... 1.6 bar.

If LED does not light up:

- Renew oil pressure switch.

Checking oil pressure

- Start engine.
- Minimum oil pressure at idling speed: 1.5 bar.
- Minimum oil pressure at 2000 rpm: 2.5 bar.

The pressure relief valve or oil pump is defective if the specifications are not attained.

- Renew oil pump ⇒ [page 136](#) .

Assembling

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



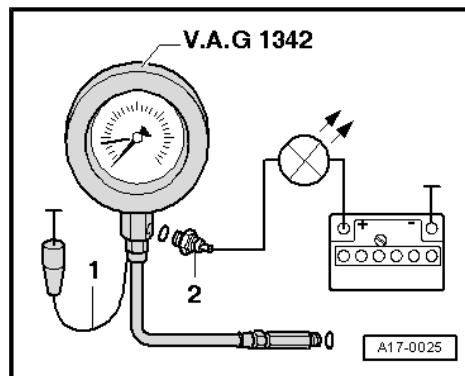
Note

Renew seal when installing oil pressure switch.

- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .

Tightening torque

Component	Nm
Oil pressure switch - F1- to sump (top section)	20



1.10 Engine oil

Viscosity grades and oil specifications ⇒ Maintenance , Booklet 802

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1.11 Checking oil level

Procedure

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

Markings on oil dipstick:

a - Oil must not be topped up.

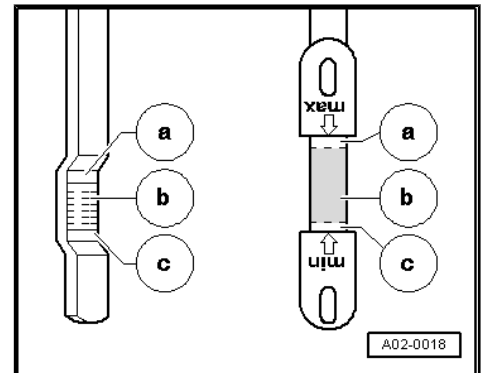
b - Oil can be topped up.

c - Oil must be topped up. The oil level is sufficient if it is in area -b- (grooved area) after topping up.



Note

The oil level must not be above marking -a- on the dipstick or below marking -c-.



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19 – Cooling

1 Removing and installing parts of cooling system



WARNING

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



Note

- ◆ *The cooling system is under pressure when the engine is hot. If necessary, relieve pressure before commencing repair work.*
- ◆ *Renew gaskets, seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue .*
- ◆ *The arrow markings on coolant pipes and on ends of coolant hoses must align.*
- ◆ *The O-rings fitted at the quick-release connections must be renewed if damaged or leaking.*

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1.1 Connection diagram - coolant hoses



1 - Coolant hose (bottom)

- ☐ From radiator to engine

2 - Cylinder head/cylinder block

3 - Turbocharger (right-side)

4 - Continued coolant circulation pump - V51-

- ☐ Removing and installing
⇒ [page 172](#)

5 - Heat exchanger

- ☐ If renewed, refill system with fresh coolant

6 - Coolant hose

- ☐ To heat exchanger

7 - Turbocharger (left-side)

8 - Coolant pipe (rear)

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

9 - Filler cap

- ☐ Checking pressure relief valve in filler cap
⇒ [page 190](#)

10 - Coolant expansion tank

11 - Oil cooler

- ☐ If renewed, refill system with fresh coolant

12 - Radiator

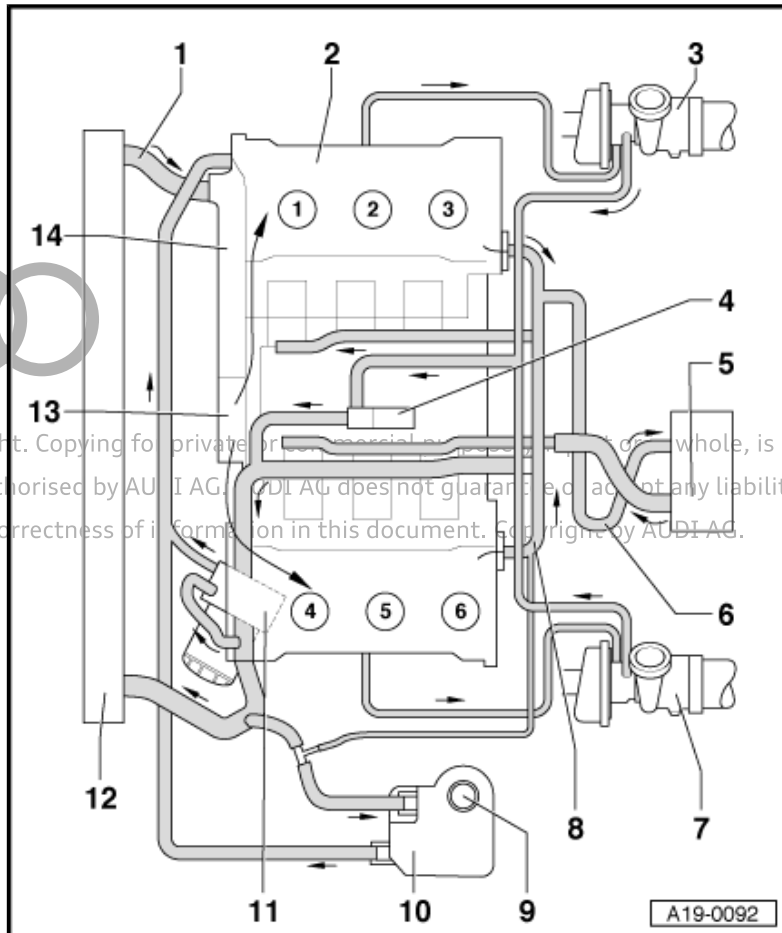
- ☐ Removing and installing
⇒ [page 180](#)
- ☐ If renewed, refill system with fresh coolant

13 - Coolant pump

- ☐ Removing and installing
⇒ [page 164](#)

14 - Thermostat

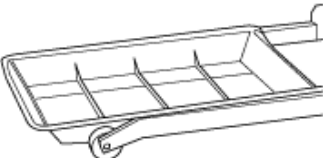
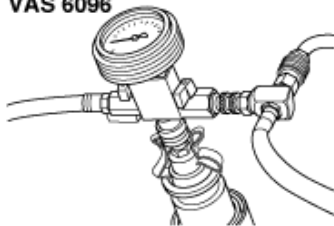
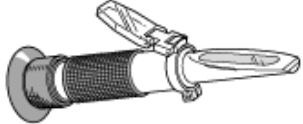
- ☐ Removing and installing
⇒ [page 165](#)
- ☐ Checking ⇒ [page 172](#)





1.2 Draining and filling cooling system

Special tools and workshop equipment required

V.A.G 1274/8 	V.A.G 1274/10 
V.A.G 1306 	V.A.G 1921 
VAS 6096 	T10007  G19-0015

- ◆ Adapter for cooling system tester - V.A.G 1274/8-
- ◆ Pipe for cooling system tester - V.A.G 1274/10-
- ◆ Drip tray for workshop hoist - VAS 6208- or -V.A.G 1306-
- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Cooling system charge unit - VAS 6096-
- ◆ Refractometer - T10007-

Draining



Note

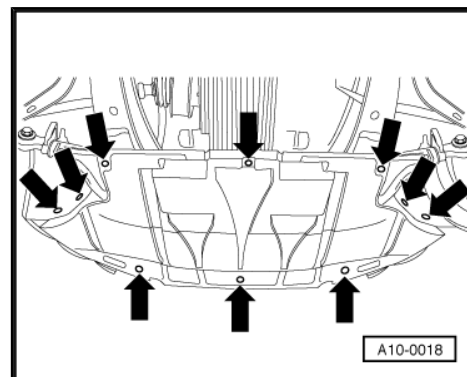
Collect drained coolant in a clean container for re-use or disposal.



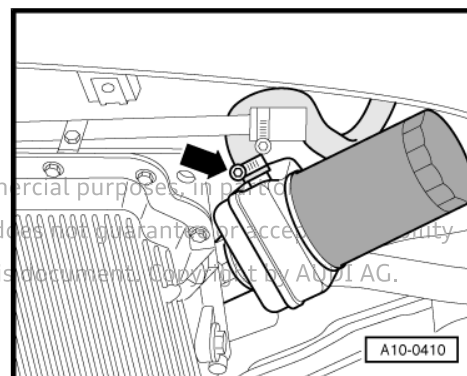
WARNING

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

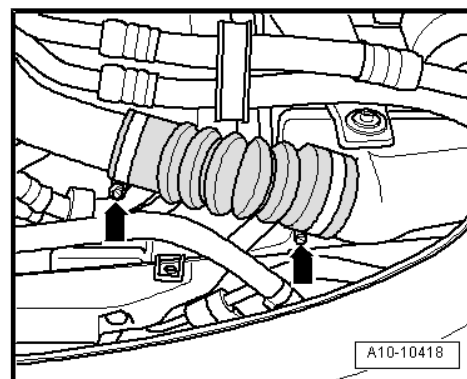
- Open filler cap on coolant expansion tank.
- Remove noise insulation -arrows-.
- Place drip tray for workshop hoist - VAS 6208- beneath engine.



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



- Remove air intake hose going to charge air cooler (right-side) -arrows-.



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- Disconnect coolant hose (bottom right) -2- at radiator and drain off remaining coolant.



Note

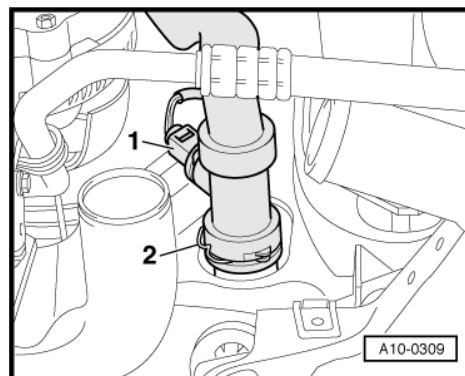
Disregard -item 1-.

Filling



Note

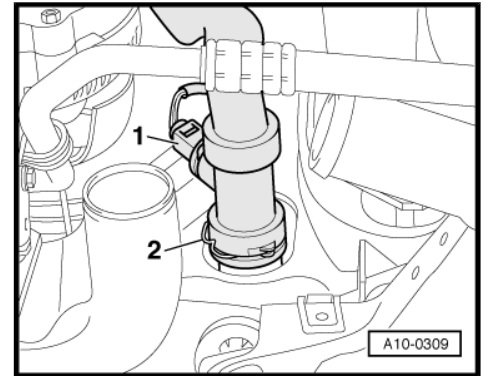
- ◆ The cooling system is filled all year round with a mixture of water and radiator anti-freeze/corrosion protection agent.
- ◆ It is important to use only coolant additive Plus - G 012 A8F A1- (also designated as »G12+«) meeting specification TL VW 774 F. If you use other coolant additives, this can 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.
- ◆ Coolant additive »G12+« may be mixed with additives »G11« and »G12«.
- ◆ »G12+« and coolant additives marked "Conforming with specification TL VW 774 F" prevent frost and corrosion damage and stop scale from forming. Such additives also raise the boiling point of the coolant. 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 amount of »G12+« can be increased, but only up to 60 % (this gives frost protection to about -40 °C). If antifreeze concentration exceeds 60 %, frost protection decreases again and cooling efficiency is also impaired.
- ◆ Use only clean tap water for mixing coolant.
- ◆ If radiator, heat exchanger, cylinder head, cylinder head gasket or cylinder block have been renewed, do not re-use old coolant.
- ◆ Contaminated or dirty coolant must not be used again.
- ◆ To check anti-freeze protection in cooling system, use refractometer - T10007- for coolant additive »G12+«.



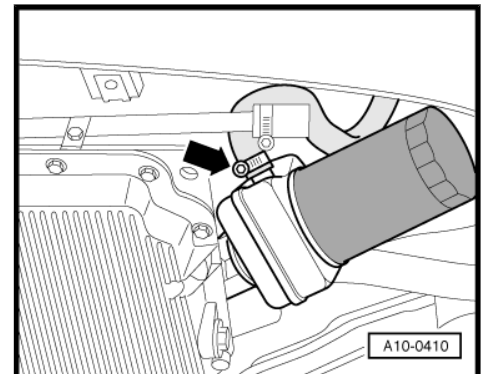
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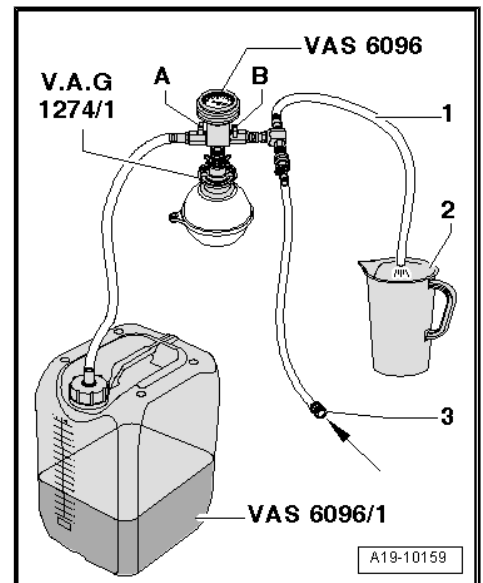
- Connect coolant hose (bottom right) to radiator; retaining clip -2- on connection should engage audibly.



- Connect coolant hose to oil cooler -arrow-.



- Fill reservoir - VAS 6096/1- with at least 10 litres of premixed coolant (according to recommended ratio).
 - »G12+« (40 %) and water (60 %) for frost protection to -25 °C
 - »G12+« (50 %) and water (50 %) for frost protection to -35 °C
 - »G12+« (60 %) and water (40 %) for frost protection to -40 °C
- Screw adapter for cooling system tester - V.A.G 1274/1- onto coolant expansion tank.
- Attach cooling system charge unit - VAS 6096- onto adapter - V.A.G 1274/1- .
- Run vent hose -1- into a small container -2-. (The vented air draws along a small amount of coolant, which should be collected.)
- Close the two valves -A- and -B- by setting lever at right angle to direction of flow.
- Connect hose -3- to compressed air.
- Pressure: 6 ... 10 bar



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

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

- The needle on the gauge should move into the green zone.
- Also briefly open valve -A- (turn lever in direction of flow) so that hose on reservoir - VAS 6096/1- can fill with coolant.
- Close valve -A- again.
- Leave valve -B- open for another 2 minutes.
- The suction jet pump will continue generating a vacuum in the cooling system.
- The needle on the gauge should remain in the green zone.
- Close valve -B-.
- The needle on the gauge should stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.

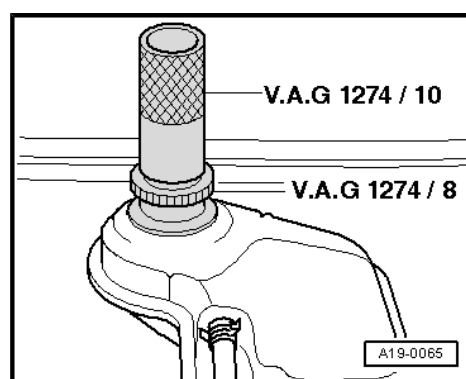
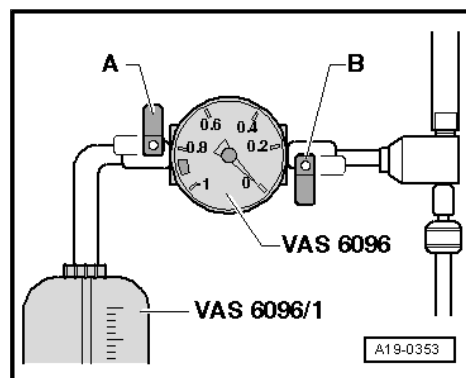
If the needle does not reach the green zone, repeat the process.

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

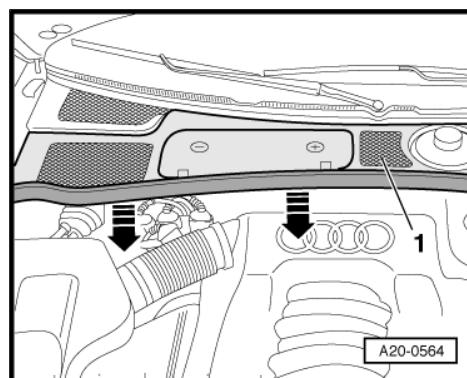
- Detach compressed air hose.
- Open valve -A-.

The partial vacuum in the cooling system causes the coolant to be drawn up out of the reservoir - VAS 6096/1- ; the cooling system is then filled.

- 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.



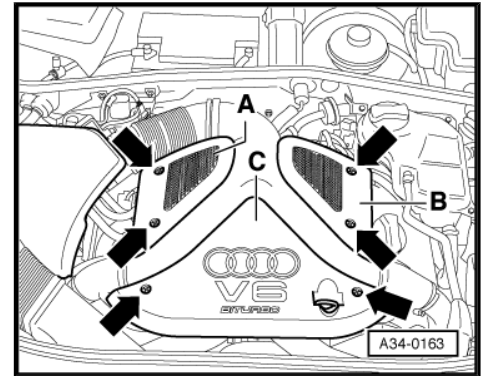
- Detach rubber seal from plenum chamber cover in direction of -arrow-.
- Detach plenum chamber cover -1- towards front.



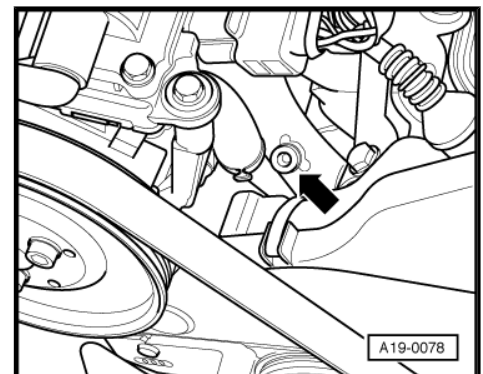
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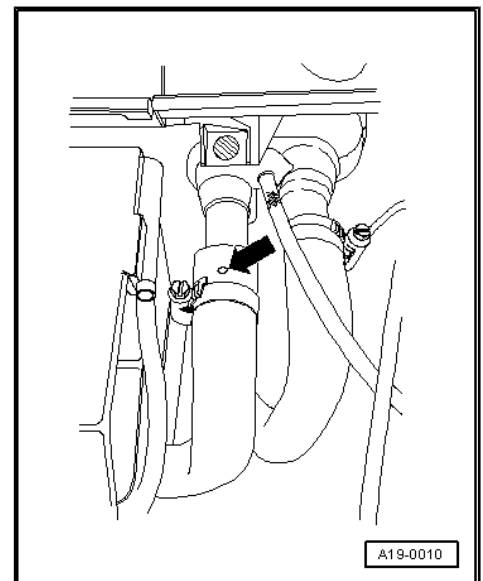
- Unfasten screw connections -front arrows- and detach engine cover panel -C-. The engine cover panels -A- and -B- remain installed.



- Open bleed screw -arrow- at front coolant pipe between power steering pump and cylinder head (left-side).
- Fill up with coolant until it emerges at bleeder hole.
- Renew seal and tighten bleed screw -arrow-.

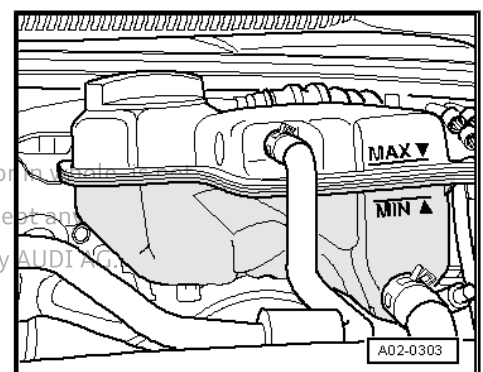


- Push back protective cover for coolant hoses on connection for heat exchanger.
- Release coolant hose going to heat exchanger and pull back hose until bleeder hole in hose -arrow- is no longer blocked by the connection.
- Fill up with coolant until it flows out at bleeder hole in coolant hose.
- Push coolant hose onto connection and secure with hose clip.
- Tighten filler cap on expansion tank.
- Start engine.
- Set heater/air conditioner to "HI".
- Run the engine for 3 minutes at 2000 rpm.
- Allow the engine to run at idling speed until the two large coolant hoses at main radiator become warm.
- Run the engine for 1 minute at 2000 rpm.
- Switch engine off.
- Check coolant level.
- The coolant level can be above the MAX marking when the engine is warm.



Tightening torques

Component	Nm
Bleeder screw to coolant pipe	15
Hose clips (9 mm wide)	3
Hose clips (13 mm wide)	5.5





1.3 Exploded view - coolant pump and thermostat

1 - Thermostat

- ☐ Removing and installing
⇒ [page 165](#)
- ☐ Checking ⇒ [page 172](#)

2 - Seal

- ☐ Renew

3 - Thermostat housing

4 - 10 Nm

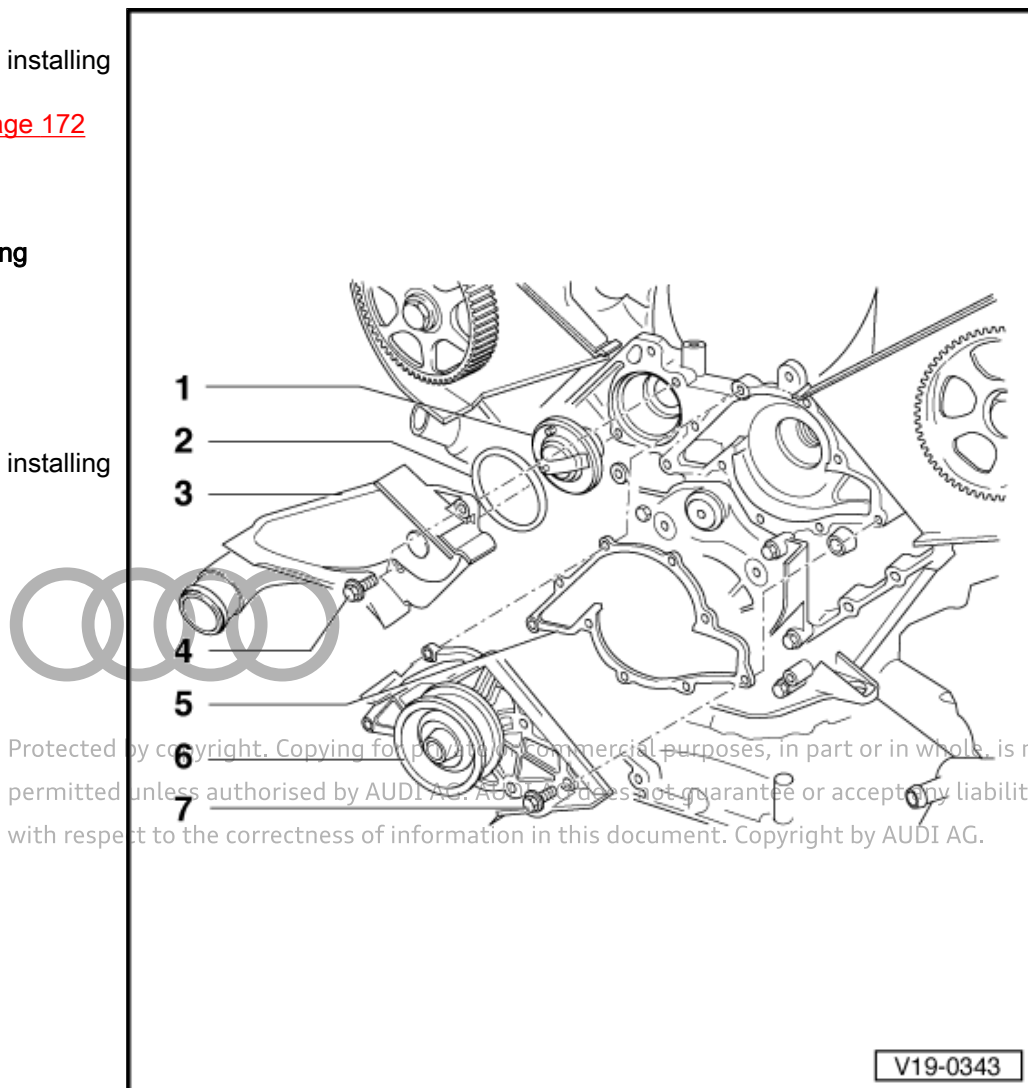
5 - Gasket

- ☐ Renew

6 - Coolant pump

- ☐ Removing and installing
⇒ [page 164](#)

7 - 10 Nm



1.4 Removing and installing coolant pump

Removing

- Drain off coolant ⇒ [page 158](#) .
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove toothed belt ⇒ [page 43](#) .
- Remove tensioning roller for toothed belt.



- Unscrew nuts -2- securing toothed belt cover (rear left).
- Unscrew bolts -1- securing coolant pump and detach coolant pump.

Installing

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



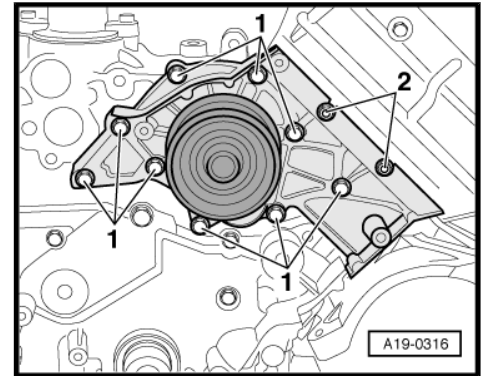
Note

Renew gaskets and O-rings.

- Clean sealing surfaces; they must be free of oil and grease.
- Note shim at rear when installing toothed belt tensioning roller
⇒ [Item 12 \(page 41\)](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 50](#) .
- Install vibration damper ⇒ [page 39](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Install viscous fan ⇒ [page 186](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .
- Fill cooling system ⇒ [page 160](#) .

Tightening torques

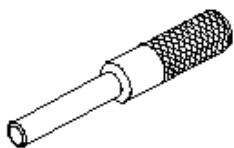
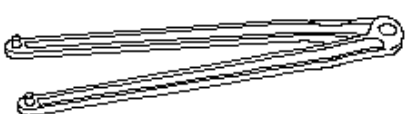
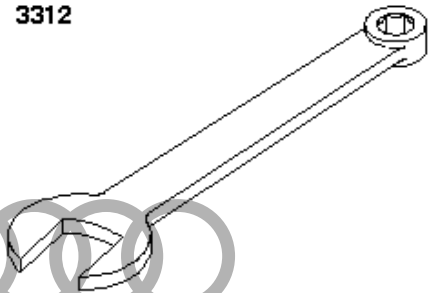
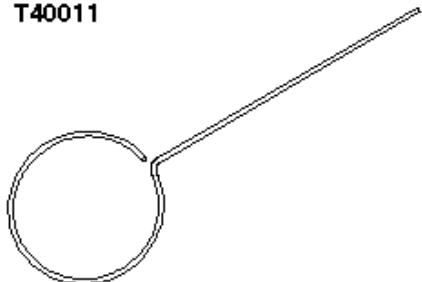
Component	Nm
Coolant pump to cylinder block	10
Toothed belt cover (rear) to coolant pump	10
Toothed belt tensioning roller to oil pump/front sealing flange	22



1.5 Removing and installing thermostat

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**Special tools and workshop equipment required**

3204 	3212 
3312 	T40011 
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G19-10008	

- ◆ Locking pin - 3204-
- ◆ Pin wrench - 3212-
- ◆ Open-end spanner - 3312-
- ◆ Locking pin - T40011-

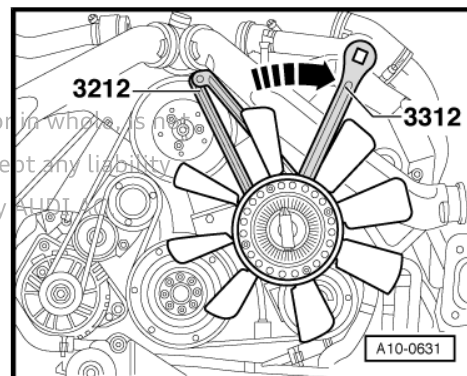
Removing

- Drain off coolant ⇒ [page 158](#) .
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .



- Use open-end spanner - 3312- to unscrew viscous fan pulley in clockwise direction -arrow- (left-hand thread) while counterholding with pin wrench - 3212- .

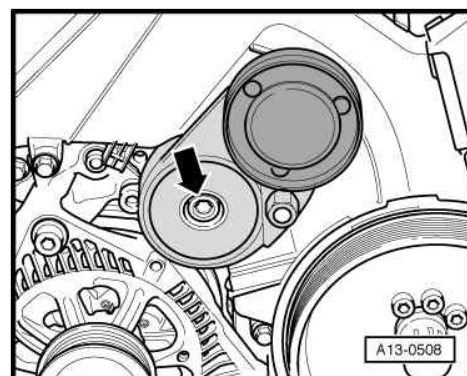
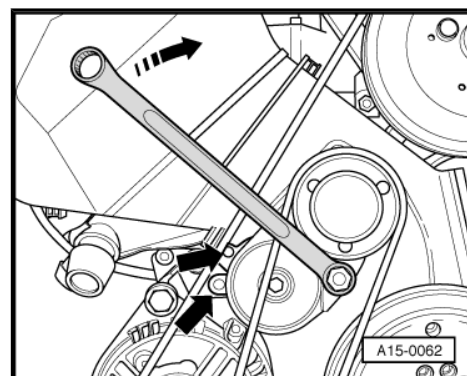
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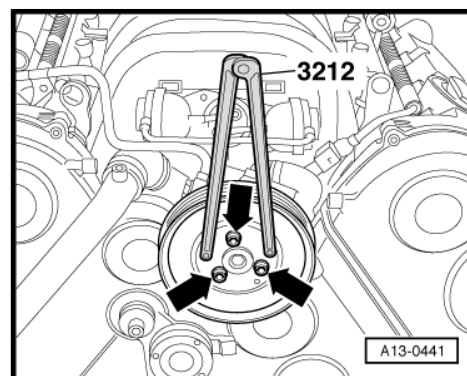
Note

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

- Turn the tensioner in the direction of the -arrow- using a 17 mm ring spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrows-.
- Take off poly V-belt.
- Unscrew bolt -arrow- and remove tensioner for poly V-belt.

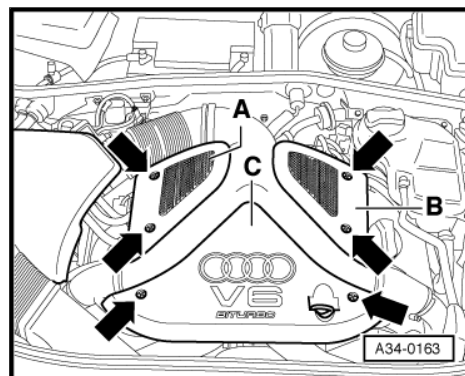


- Unbolt power steering pump pulley -arrows- (counterhold with pin wrench - 3212-).

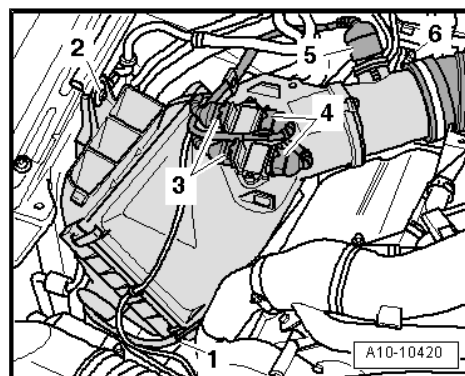




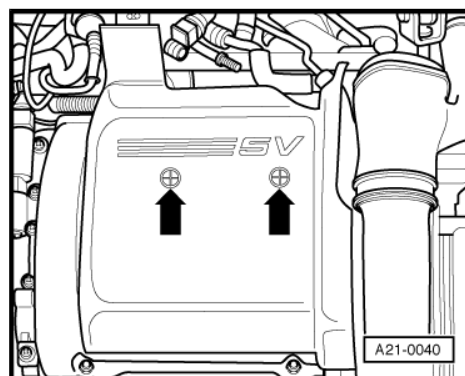
- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.



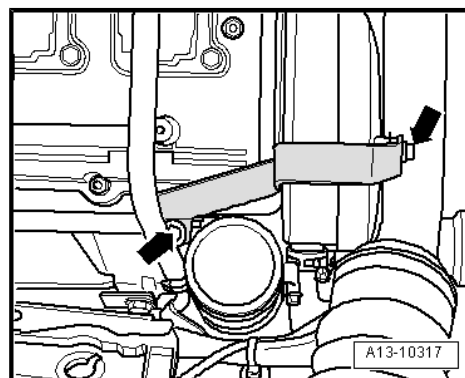
- Unplug electrical connectors at output stage - N122- -item 3- and at output stage 2 - N192- -item 4-.
- Unplug electrical connector -5- at air mass meter - G70- .
- Move wiring harness at air cleaner housing clear.
- Detach air hose -6- at air mass meter - G70- .
- Unplug vacuum hose -1-.
- Unscrew nut -2- and remove air cleaner housing with air mass meter - G70- .



- Loosen quick release fasteners -arrows- and remove cover for cylinder head cover (right-side).



- Unscrew bolts -arrows- and remove bracket.

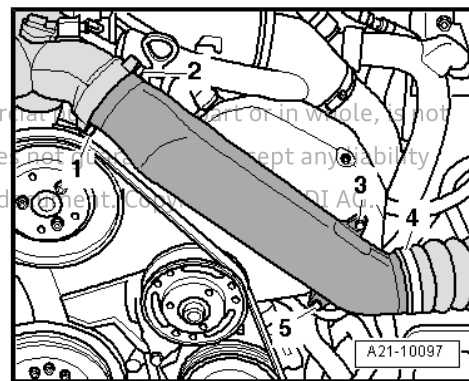


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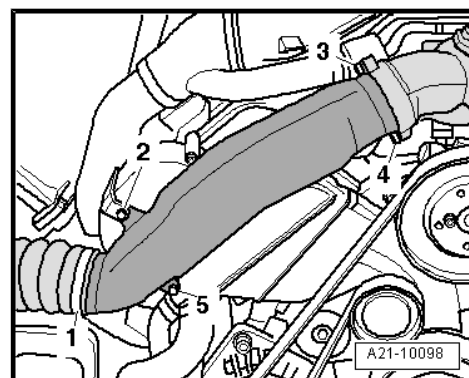


- Disconnect air intake hose -4- from air pipe.
- Unscrew bolts -1 ... 3- and -5- and remove air pipe (left-side).

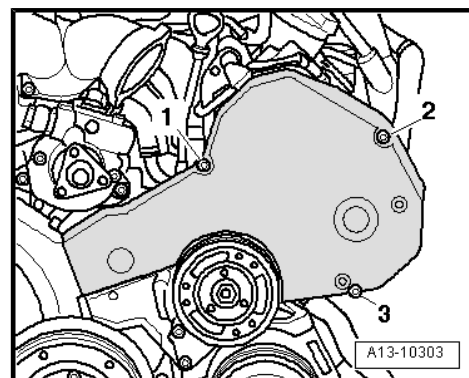
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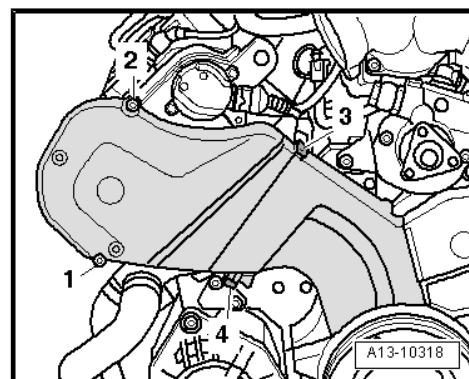
- Disconnect air intake hose -1- from air pipe.
- Remove bolts -2 ... 5- and take out air pipe (right-side).



- 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**

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

- Remove bolts and take off vibration damper.

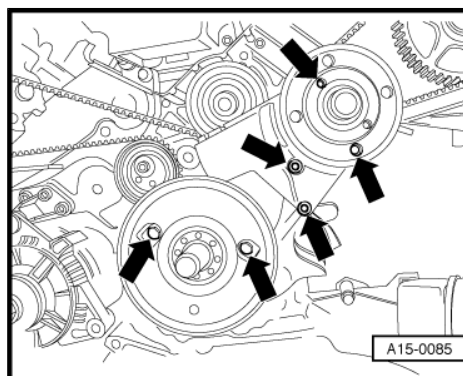
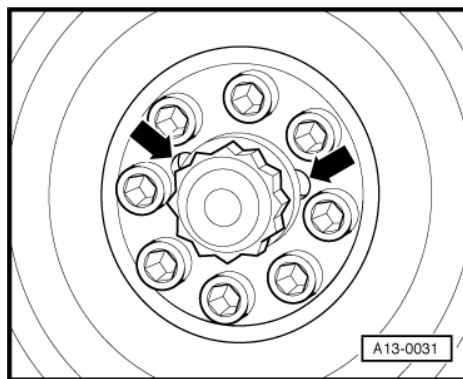
**Note**

Disregard -arrows-.

- Unbolt bottom section of toothed belt cover -bottom arrows-.

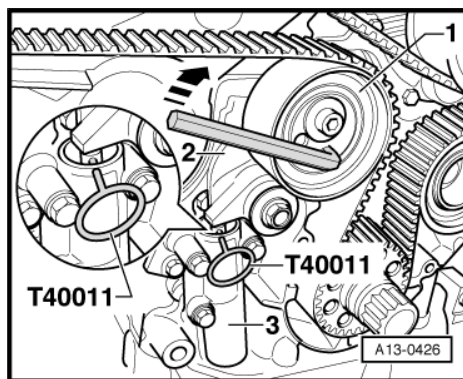
**Note**

Do not remove poly V-belt pulley for viscous fan.

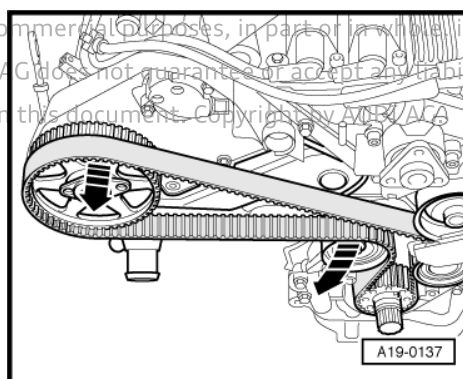
**Note**

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 43](#) .



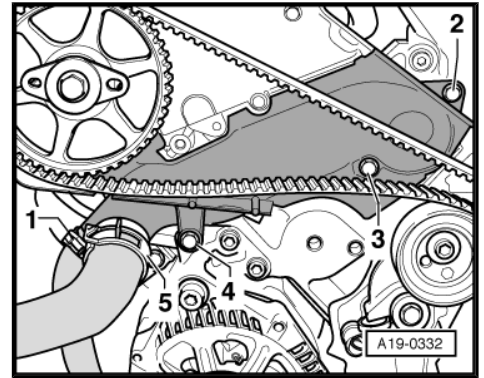
- Detach coolant hoses -1- and -5- from thermostat housing.
- Unscrew bolts -2-, -3- and -4- and detach thermostat housing.
- Remove O-ring and thermostat.

Installing

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

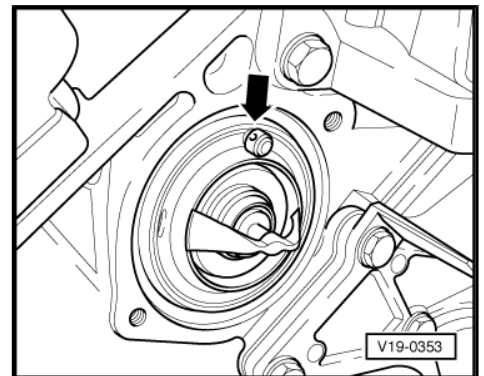
Note

- ◆ *Renew O-ring.*
- ◆ *Hose connections and charge air system 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) ⇒ Parts catalogue .*
- Clean and smoothen sealing surface for O-ring as required.
- 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 43](#) .



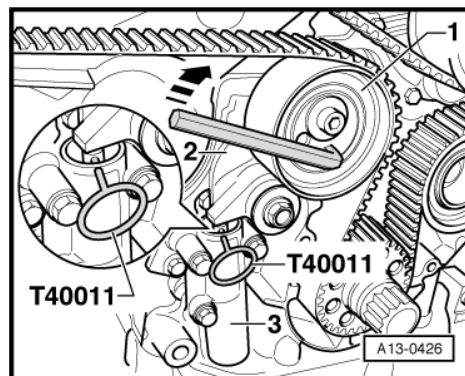
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- Using an 8 mm Allen key, turn toothed belt tensioning roller -1- clockwise in direction of -arrow- until locking pin - T40011- can be removed.

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 39](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Install viscous fan ⇒ [page 186](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .
- Fill cooling system ⇒ [page 160](#) .



Tightening torques

Component	Nm
Thermostat housing to cylinder block	10
Toothed belt cover to engine	10 ¹⁾
Pulley to power steering pump	23
Tensioner for poly V-belt to cylinder block	55
• 1) Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .	

1.6 Checking thermostat

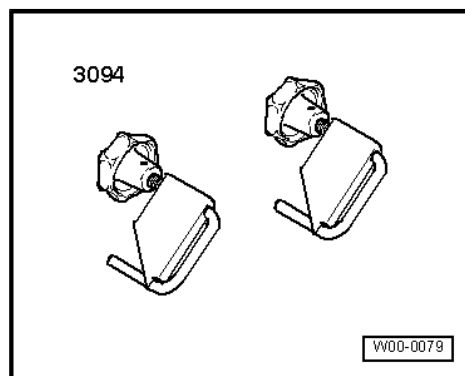
- Heat up the removed thermostat in hot water.

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

1.7 Removing and installing continued coolant circulation pump - V51-

Special tools and workshop equipment required

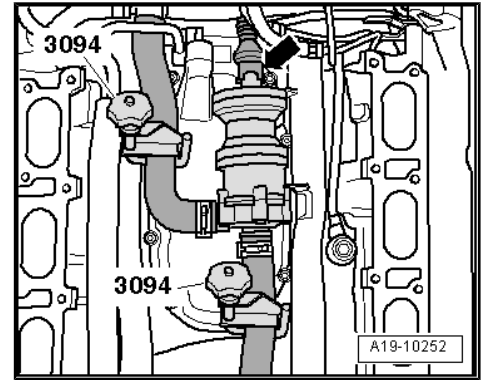
- ◆ Hose clamps up to Ø 25 mm - 3094-





Removing

- Remove secondary air pump ➔ [page 280](#) .
- Remove intake manifold ➔ [page 90](#) .
- 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) ➔ Parts catalogue .

- Install intake manifold ➔ [page 90](#) .
- Install secondary air pump ➔ [page 280](#) .
- Check coolant level ➔ [page 163](#) .

1.8 Exploded view - coolant pipes



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**1 - To coolant hose (front)****2 - Coolant pipe (front)**

- ❑ Removing and installing
⇒ [page 175](#)

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 172](#)

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 178](#)

13 - 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 (right-side)**

- ❑ From cylinder block to turbocharger

18 - From heat exchanger**19 - To coolant hose (front)****20 - Coolant pipe (small)**

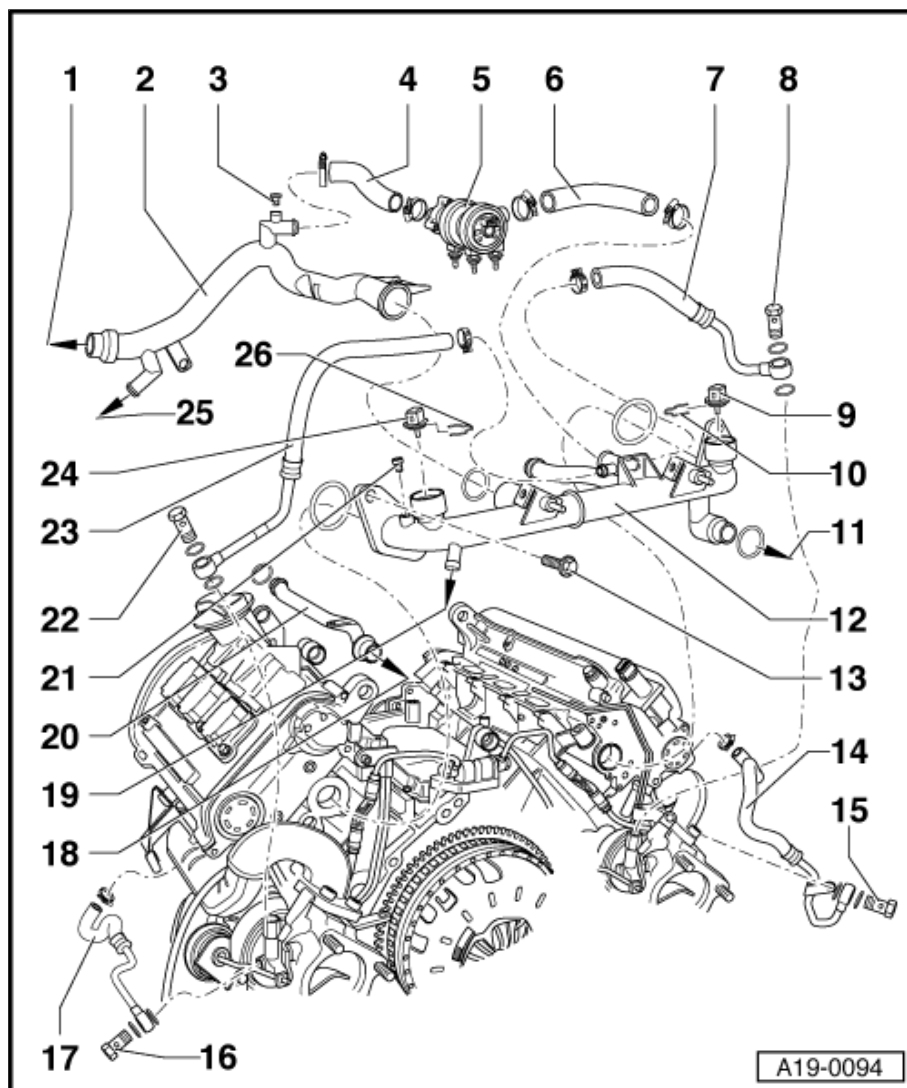
- ❑ Removing and installing ⇒ [page 177](#)

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

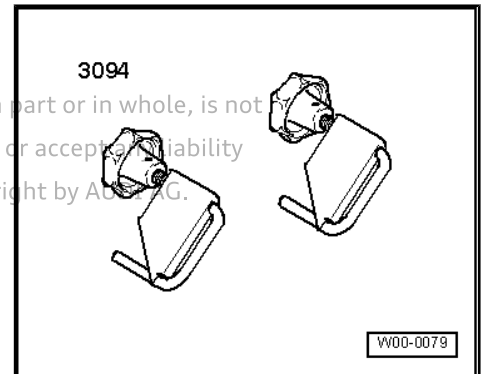
- Check for firm attachment

1.9 Removing and installing coolant pipe (front)

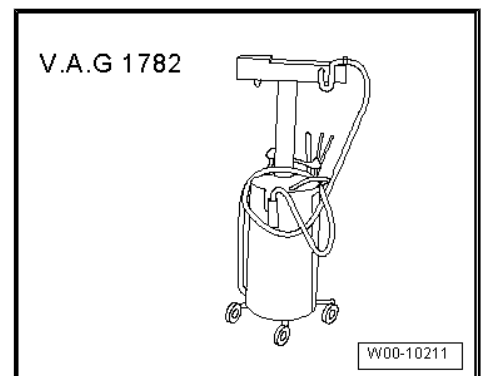
Special tools and workshop equipment required

- ◆ Hose clamps up to Ø 25 mm - 3094-

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



Removing



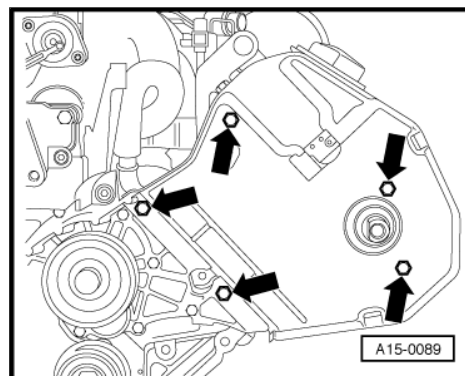
Note

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

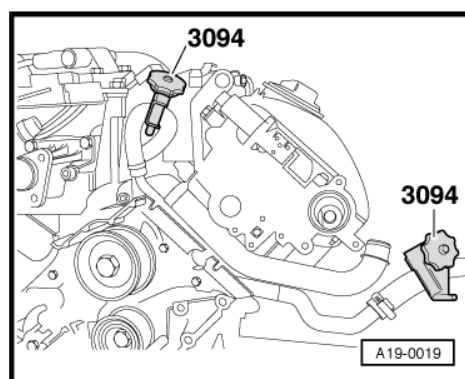
- Drain off coolant ⇒ [page 158](#) .
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .
- Remove secondary air pump ⇒ [page 280](#) .
- Remove intake manifold ⇒ [page 90](#) .
- Remove toothed belt ⇒ [page 43](#) .
- Take off camshaft sprocket (left-side).
- Remove coolant pump ⇒ [page 164](#) .



- Unscrew toothed belt cover (rear left) -arrows-.



- Place used oil collection and extraction unit - V.A.G 1782- beneath engine.
- 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).



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- Remove bolts -arrows-.
- Move wiring clear at coolant pipe.
- Pull off coolant pipe towards the front.

Installing

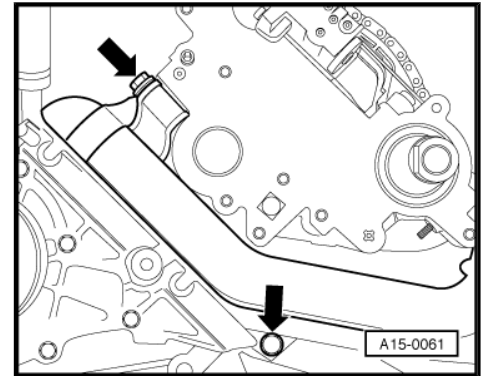
Installation is carried out in reverse order; note the following:



Note

- ◆ *Renew O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue .*
- ◆ *Fit all cable ties in the original positions when installing.*

- Clean and smoothen sealing surface for O-ring as required.
- Lubricate new O-ring with »G12+« and slide onto coolant pipe.
- Push coolant pipe into aperture on rear coolant pipe.
- Install coolant pump ⇒ [page 164](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 50](#) .



- Install vibration damper ⇒ [page 39](#) .
- Install viscous fan ⇒ [page 186](#) .
- Install poly V-belt ⇒ [page 38](#) .
- Install intake manifold ⇒ [page 90](#) .
- Install secondary air pump ⇒ [page 280](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .
- Fill cooling system ⇒ [page 160](#) .
- Top up power steering fluid and bleed steering system ⇒ Rep. gr. 48 .

Tightening torques

Component		Nm
Front coolant pipe to cylinder head	M6	10
	M8	22
Rear toothed belt cover to cylinder head		10 ¹⁾
• ¹⁾ Install bolts using locking fluid; locking fluid ⇒ Parts catalogue .		

1.10 Removing and installing coolant pipe (small)

Removing

- Remove coolant pipe (front) ⇒ [page 175](#) .
- 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

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



Note

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

- Clean and smoothen sealing surface for O-ring as required.
- Lubricate new O-rings with »G12« and slide onto coolant pipe.
- Push coolant pipe into bore on cylinder block.
- Install coolant pipe (front) ⇒ [page 175](#) .
- Fill cooling system ⇒ [page 160](#) .

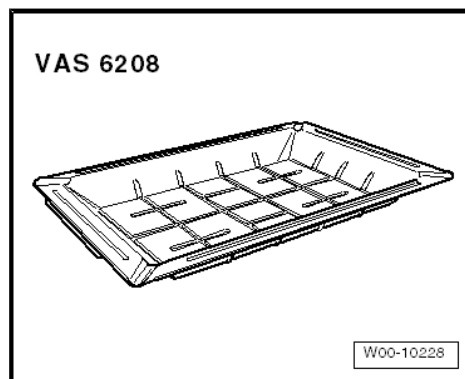
Tightening torque

Component	Nm
Coolant pipe (small) to cylinder block	10

1.11 Removing and installing coolant pipe (rear)

Special tools and workshop equipment required

- ◆ Drip tray for workshop hoist - VAS 6208-



Removing



Note

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

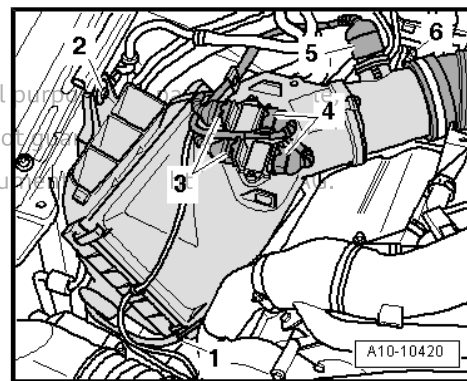
- Drain off coolant ⇒ [page 158](#) .
- Remove secondary air pump ⇒ [page 280](#) .
- Remove intake manifold ⇒ [page 90](#) .



- Unplug electrical connectors at output stage - N122- -item 3- and at output stage 2 - N192- -item 4-.
- Unplug electrical connector -5- at air mass meter - G70-.
- Move wiring harness at air cleaner housing clear.
- Unplug vacuum hose -1-.
- Unscrew nut -2- and remove air cleaner housing with air mass meter - G70- .

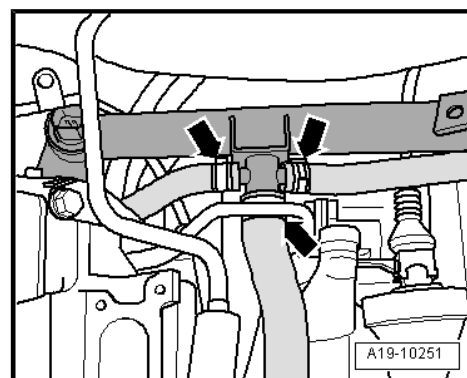
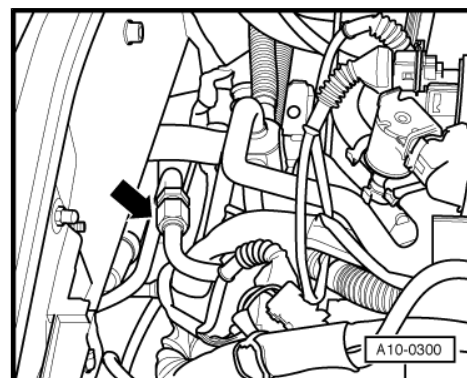
**Note**

Disregard -item 6-.

**Note**

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

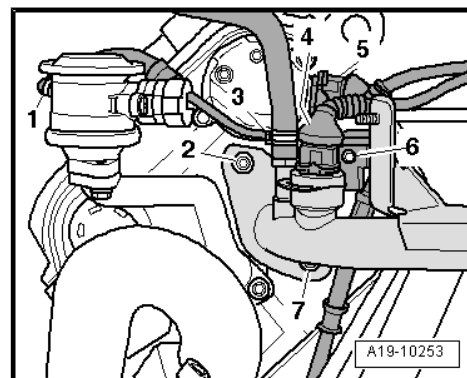
- Separate the hydraulic pressure line -arrow- for power steering pump at rear of engine.
- Remove crankcase breather hoses.
- Unscrew retaining clamps for wiring harness at coolant pipe (rear).
- Move engine wiring harness clear.
- Detach coolant hoses -arrows- from coolant pipe (rear).



- 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**

- ◆ *Illustration shows engine removed.*
- ◆ *Disregard -items 1, 5, 6-.*



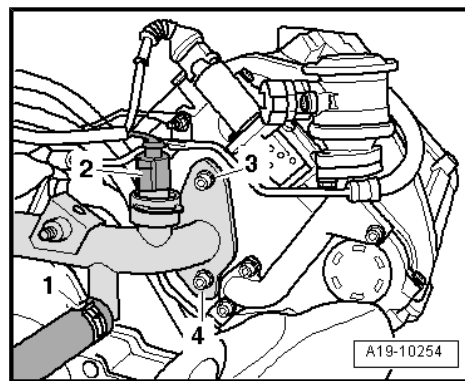


- Unplug electrical connector -2- at coolant temperature display sender - G2- / coolant temperature sender - G62- .
- Disconnect coolant hose -1- (leading to heat exchanger) from coolant pipe (rear).
- Remove bolts -3- and -4-.
- Pull coolant pipe (rear) out of cylinder block.



Note

Illustration shows 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) ⇒ 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 »G12+« and slide onto coolant pipe.
- Install intake manifold ⇒ [page 90](#) .
- Install secondary air pump ⇒ [page 280](#) .
- Fill cooling system ⇒ [page 160](#) .

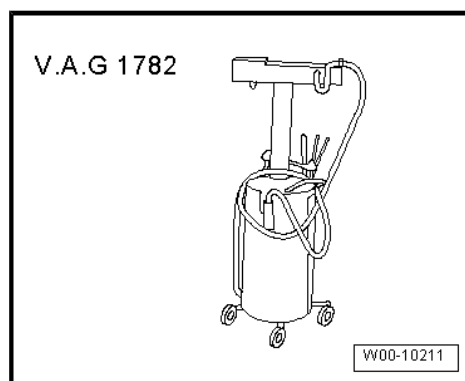
Tightening torques

Component	Nm
Coolant pipe (rear) to cylinder head	10
Hydraulic pressure line to power steering pump	40

1.12 Removing and installing radiator

Special tools and workshop equipment required

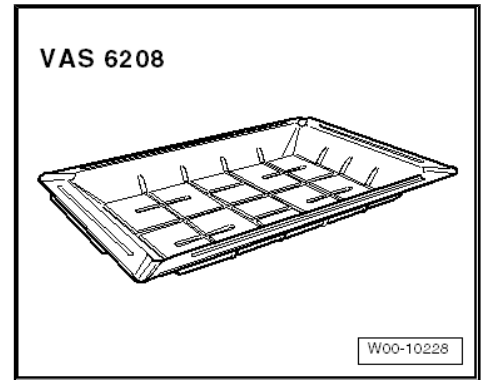
- ◆ Used oil collection and extraction unit - V.A.G 1782-



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- ◆ Drip tray for workshop hoist - VAS 6208-



Removing

- Remove front bumper ⇒ Rep. gr. 63 .



Note

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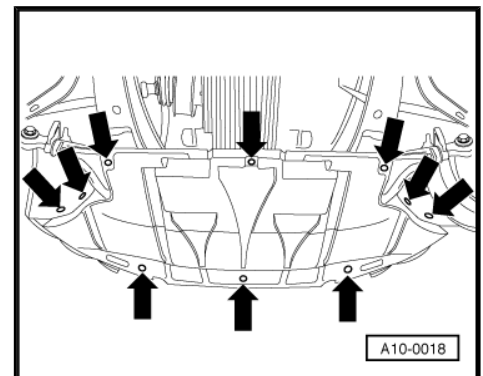
- ◆ *Collect drained coolant in a clean container for re-use or disposal.*
- ◆ *The coolant must be drained off completely if the radiator is renewed.*



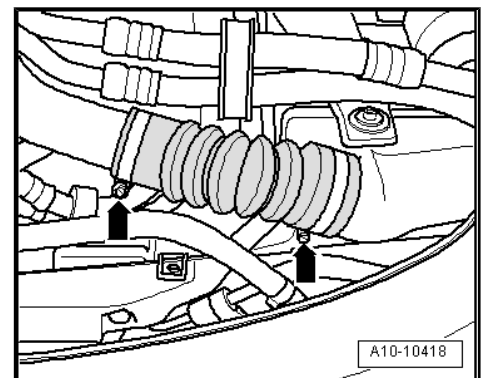
WARNING

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

- Open filler cap on coolant expansion tank.
- Remove noise insulation -arrows-.



- Remove air intake hose going to charge air cooler (right-side) -arrows-.





- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Disconnect coolant hose (bottom right) -2- at radiator and drain off coolant.



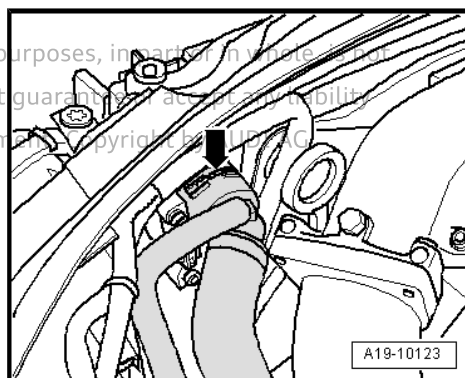
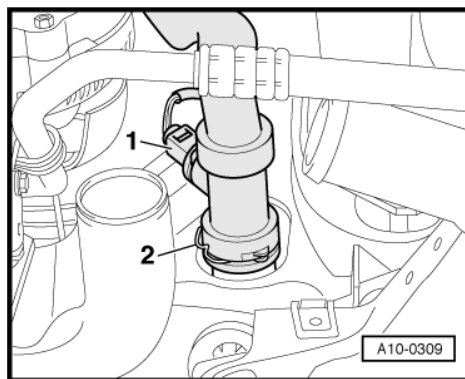
Note

Disregard -item 1-.

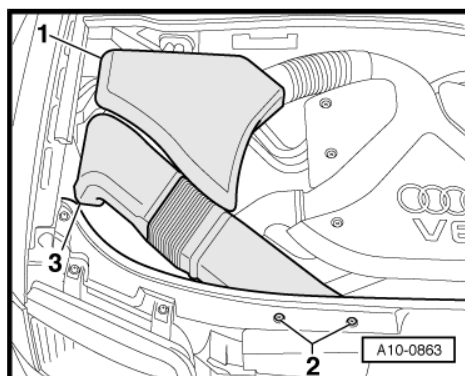


- Detach top left coolant hose from radiator -arrow-.

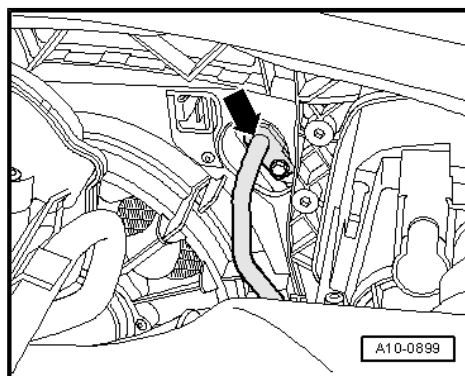
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- Remove cover -1- on right side of engine compartment.
- Unscrew bolts -2- and detach air duct from air cleaner housing -3-.

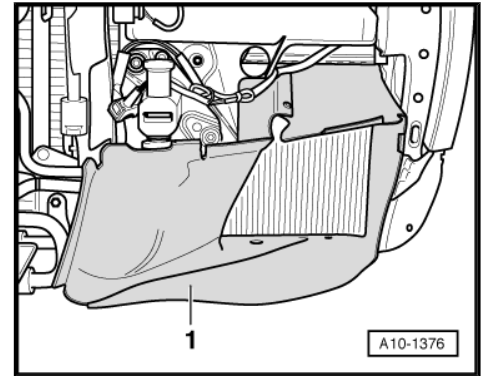


- Place used oil collection and extraction unit - V.A.G 1782- beneath engine.
- Detach gear oil pipes (top -arrow- and bottom) from radiator ⇒ Rep. gr. 34 .
- Tie gear oil pipes up onto longitudinal member to prevent fluid escaping.





- Move electrical wiring harness on air duct (left and right) clear to one side.
- Remove air duct -1- in front of charge air coolers (left and right).

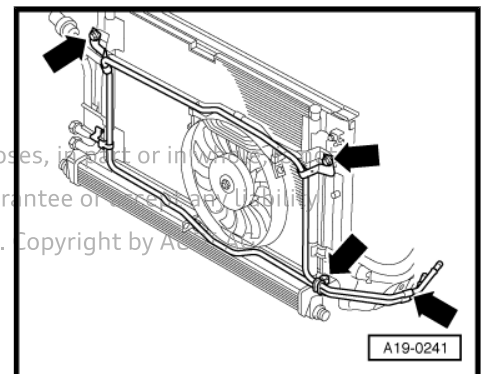


- Unbolt pressurising fan and cooling pipe for hydraulic fluid for power steering -arrows-.

**WARNING**

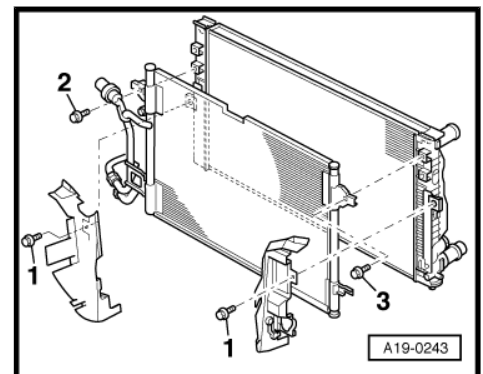
The air conditioner refrigerant circuit must not be opened.

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**Note**

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

- Unbolt air ducts (left and right) at radiator -1-.
- Remove bolts -2- and -3- at condenser.
- Unplug electrical connector at air conditioning system pressure switch - F129- .
- Pull condenser upwards and out of bracket.
- Move condenser to side and tie onto right front wheel with wire.





- Release two retaining pins for radiator and pull out upwards -arrows-.
- Swivel radiator forwards by its top edge and remove upwards.

Installing

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



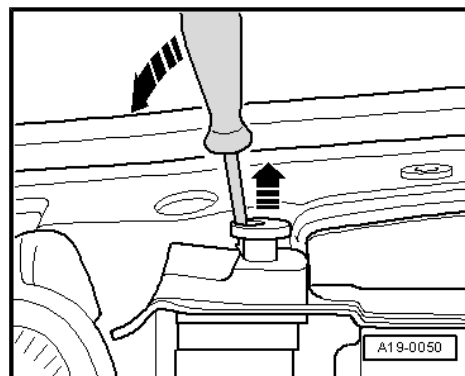
Note

- ◆ *Hose connections and charge air system 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) ⇒ Parts catalogue .*

- Install front bumper ⇒ Rep. gr. 63 .
- Fill cooling system ⇒ [page 160](#) .
- Secure gear oil pipes to gear oil cooler ⇒ Rep. gr. 34 .
- Check gear oil level in manual gearbox ⇒ Rep. gr. 34 .

Tightening torques

Component	Nm
Condenser to radiator	5
Cooling pipe to radiator	5
Pressurising fan to radiator	5
Gear oil pipe to radiator	5



1.13 Removing and installing radiator fan - V7- (right-side)

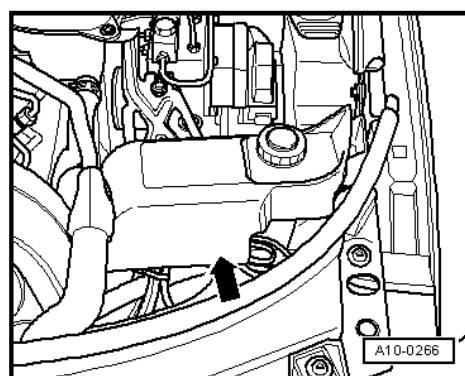
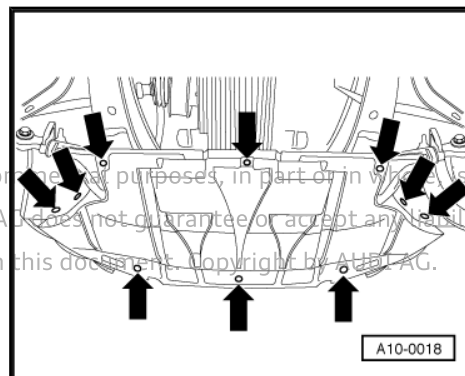
Removing



Note

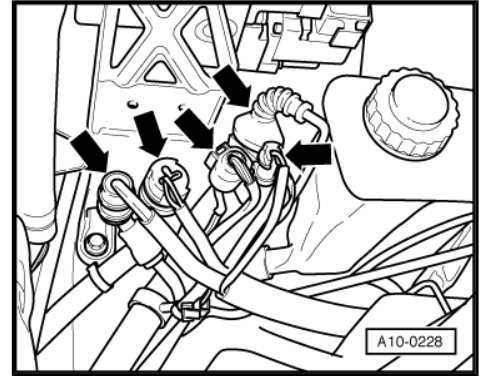
All cable ties which are released or cut open when removing must be fitted in the same position when installing.

- Remove noise insulation -arrows-.
- 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 black connector and move wiring to radiator fan - V7- clear.



- Remove bolt -1-.
- Turn radiator fan in direction of -arrow- and remove.

Installing

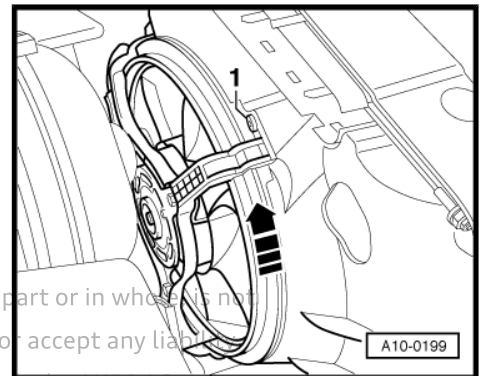
Installation is carried out in reverse order; note the following:



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 .



Tightening torque

Component	Nm
Radiator fan - V7- to lock carrier	5

1.14 Removing and installing radiator fan 2 - V177- (front)

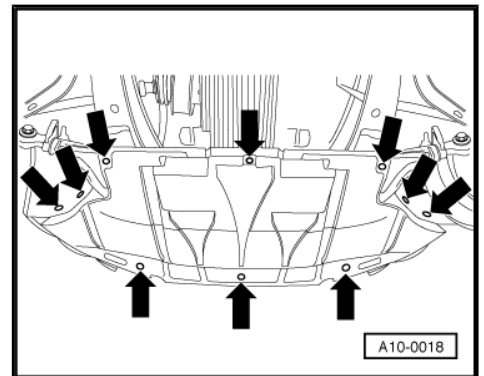
Removing



Note

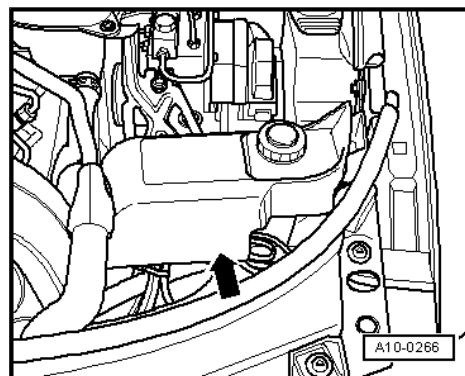
All cable ties which are released or cut open when removing must be fitted in the same position when installing.

- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .

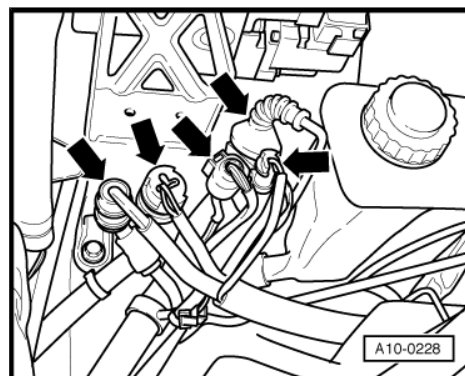




- Remove cover -arrow- at power steering fluid reservoir.



- 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

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



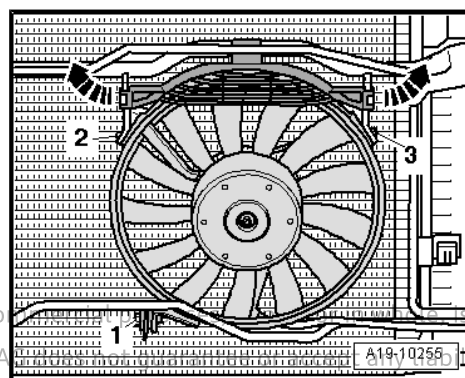
Note

Fit all cable ties in the original positions when installing.

- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .

Tightening torque

Component	Nm
Radiator fan 2 - V177- to bracket	5

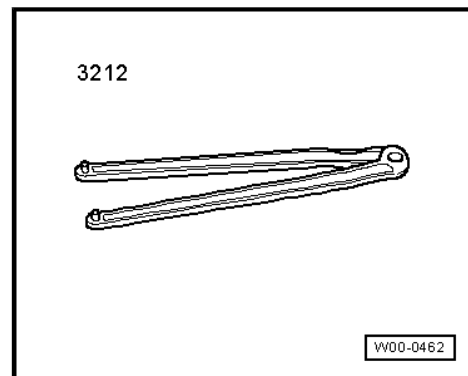


1.15 Removing and installing viscous fan

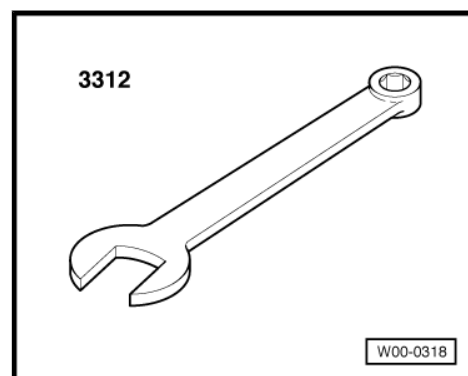
Special tools and workshop equipment required



◆ Pin wrench - 3212-

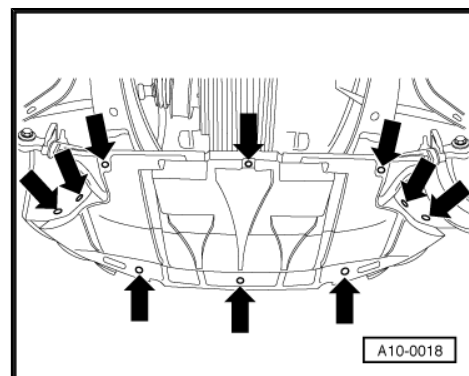


◆ Open-end spanner - 3312-

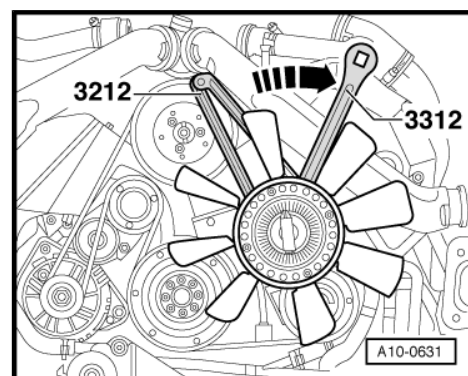


Removing

- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Move lock carrier to service position ⇒ Rep. gr. 50 .



- Use open-end spanner - 3312- to unscrew viscous fan pulley in clockwise direction -arrow- (left-hand thread) while counterholding with pin wrench - 3212- .
- Lift out viscous fan.



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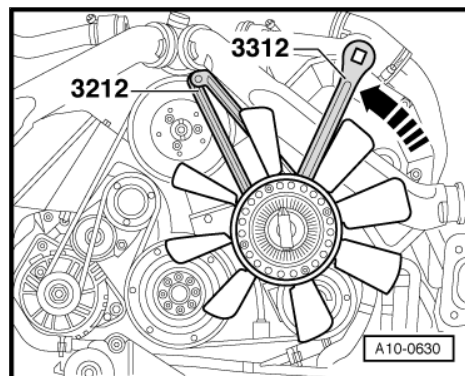
Installing

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

- Use open-end spanner - 3312- to secure viscous fan pulley in anti-clockwise direction -arrow- (left-hand thread) while counterholding with pin wrench - 3212- .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install front bumper ⇒ Rep. gr. 63 .

Tightening torque

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



1.16 Removing and installing pulley for viscous fan

Removing

- Remove poly V-belt ⇒ [page 38](#) .
- Unscrew bolts -1 ... 4-.



Note

Bolts -3- and -4- cannot be detached.

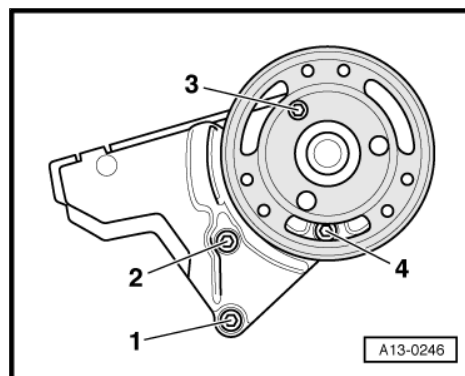
Installing

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

- Install poly V-belt ⇒ [page 38](#) .

Tightening torques

Component		Nm
Viscous fan pulley to cylinder block	M6	10
	M8	22



1.17 Checking radiator fan - V7-

Special tools and workshop equipment required

- ◆ Auxiliary measuring set - V.A.G 1594 C-



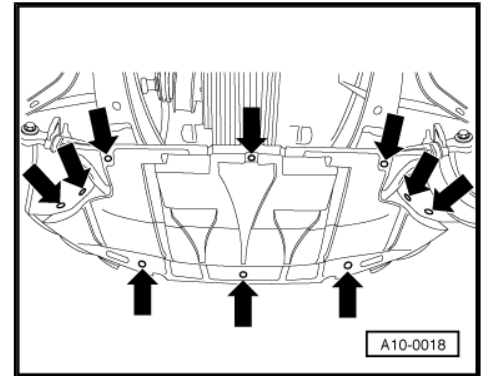
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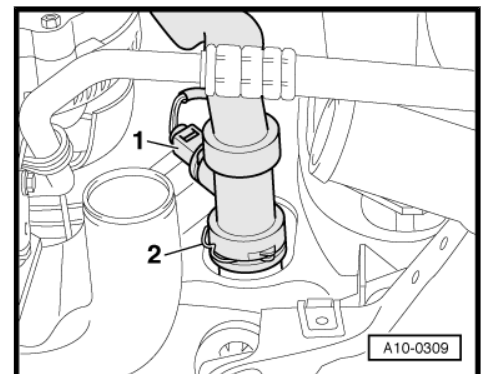


Procedure

- Fuse for radiator fan - V7- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations
- Radiator fan thermal switch - F18- OK
- Remove noise insulation -arrows-.



- Unplug electrical connector -1- at radiator fan thermal switch - F18- in bottom coolant hose -2- on right side of radiator.



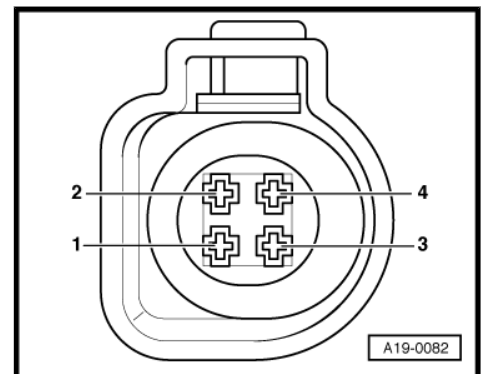
- Switch on ignition.
- Bridge contact -1- and contact -2- of connector with test leads from auxiliary measuring set - V.A.G 1594 C- .
- Stage 1 of radiator fan - V7- should start up.
- Bridge contact -1- and contact -3- of connector with test leads from auxiliary measuring set - V.A.G 1594 C- .
- Stage 2 of radiator fan - V7- should start up.

If stage 1 or 2 of radiator fan does not start up:

- Repair wiring connection if necessary.

If no fault is found in wiring:

- Renew radiator fan - V7- .



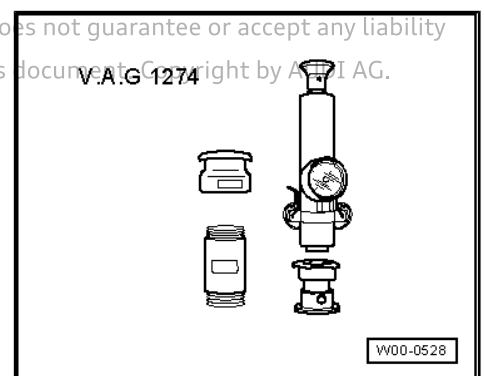
1.18 Checking cooling system for leaks

Special tools and workshop equipment required

- ♦ Cooling system tester V.A.G 1274 with V.A.G 1274/8



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Procedure

- Engine must be warm.



WARNING

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

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

If the pressure drops:

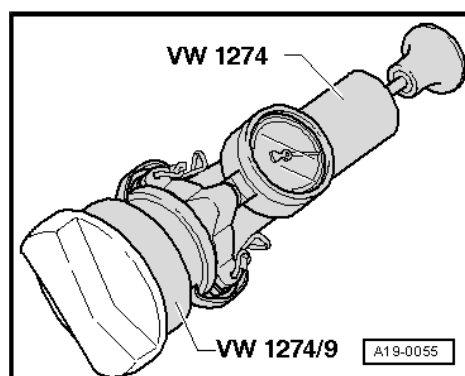
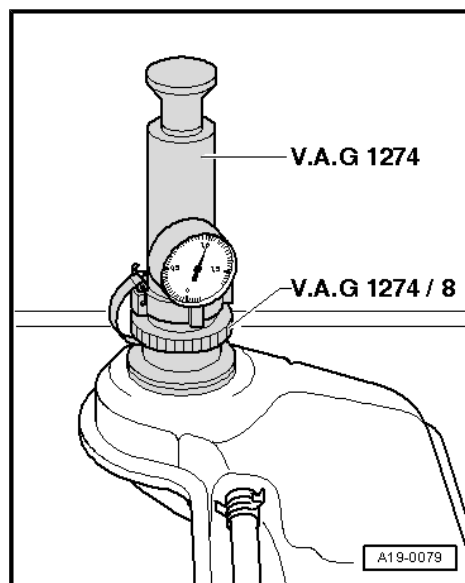
- Trace leak and repair.

Checking pressure relief valve in filler cap

- Attach cooling system tester - V.A.G 1274- with adapter - V.A.G 1274/9- to filler cap.
- Use hand pump on cooling system tester to create pressure.
- The pressure relief valve should open at a pressure of 1.2 ... 1.5 bar.

If the pressure relief valve does not open as described:

- Renew filler cap.



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21 – Turbocharging/supercharging

1 Checking charge air system with turbochargers



Note

- ◆ Observe rules for cleanliness ⇒ [page 215](#).
- ◆ Hose connections and charge air system hoses must be free of oil and grease prior to fitting. DO NOT use lubricant.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.
- ◆ 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 Safety precautions

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



WARNING

- ◆ Test equipment must always be secured on the rear seat and operated from that position by a second person.
- ◆ If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, the person sitting in this seat could be seriously injured when the airbag is triggered.

1.2 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).

1.3 Connection diagram for charge pressure control and overrun air recirculation control

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

- ☐ Bank 1 (right-side)

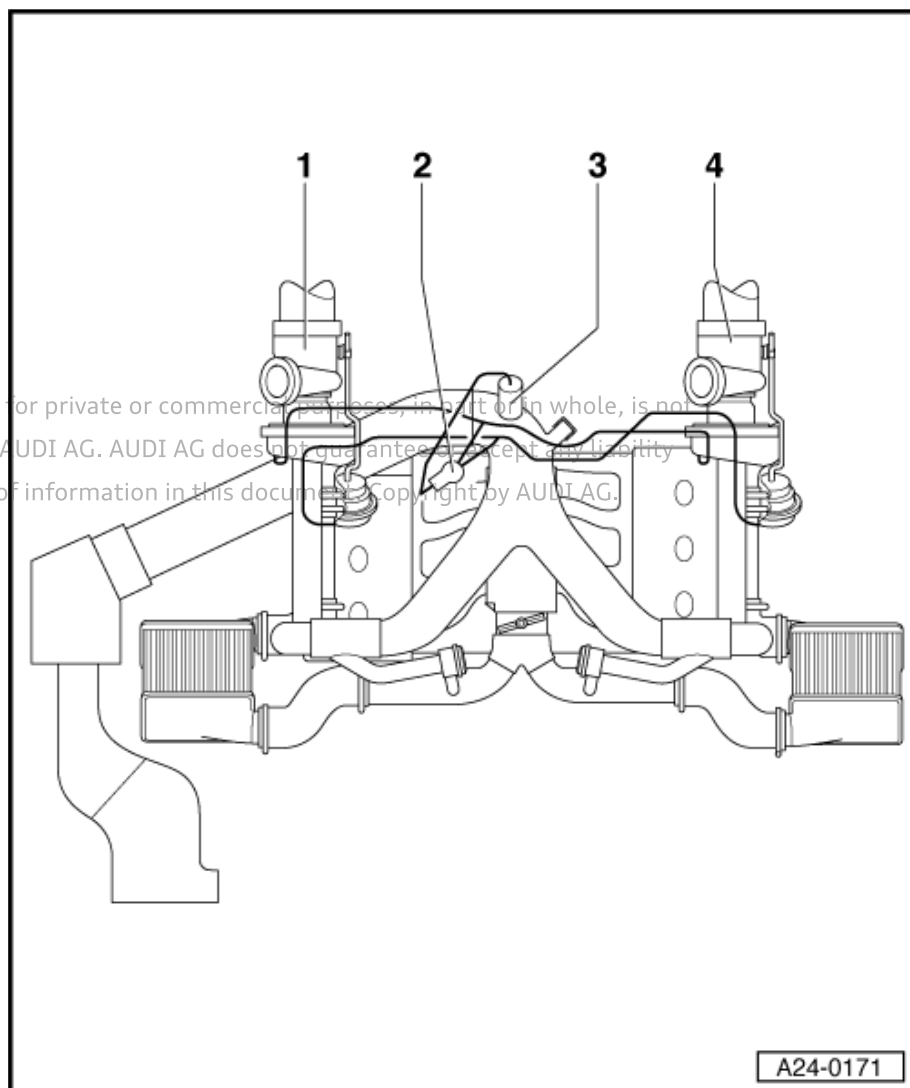
2 - Charge pressure control solenoid valve - N75-

3 - Connecting piece

- ☐ For crankcase breather

4 - Turbocharger

- ☐ Bank 2 (left-side)



Overrun air recirculation control



1 - Turbocharger air recirculation valve - N249-

❑ Checking ⇒ [page 209](#)

2 - Non-return valve

❑ Installation position: arrow points in through-flow direction

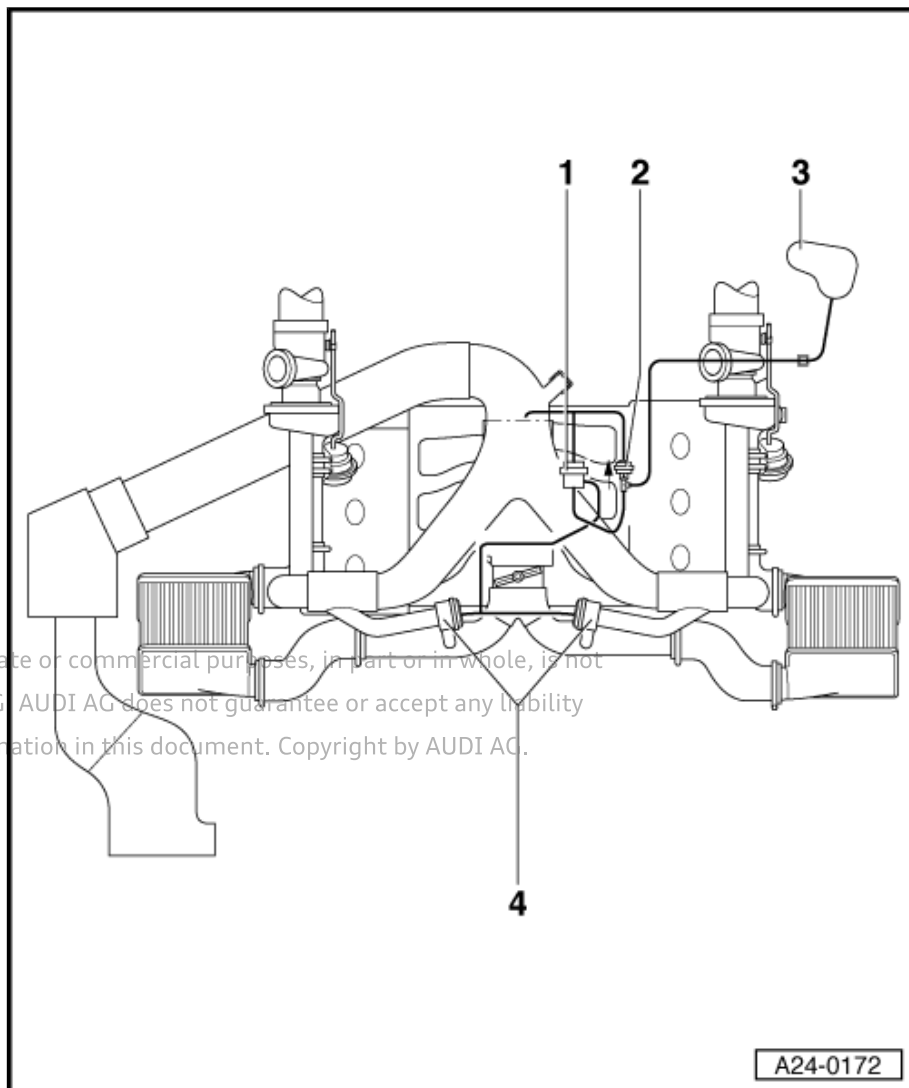
3 - Vacuum reservoir

4 - Mechanical air recirculation valves

❑ Checking ⇒ [page 213](#)



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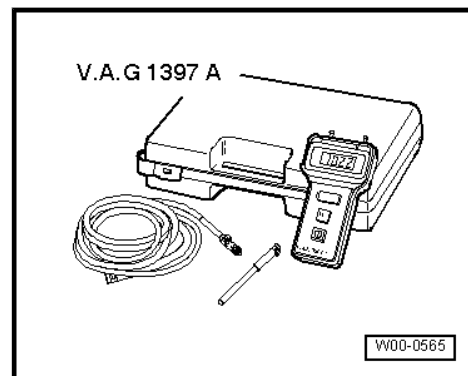


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1.4 Checking turbochargers and charge pressure control

Special tools and workshop equipment required

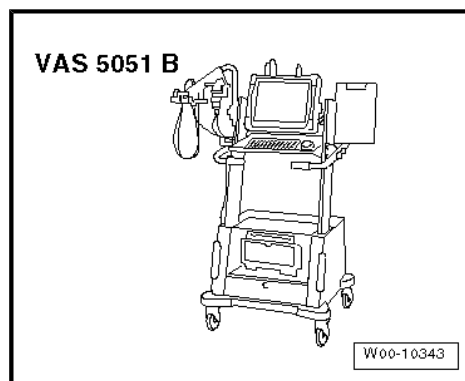
- ◆ Turbocharger tester - V.A.G 1397 A-



W00-0565

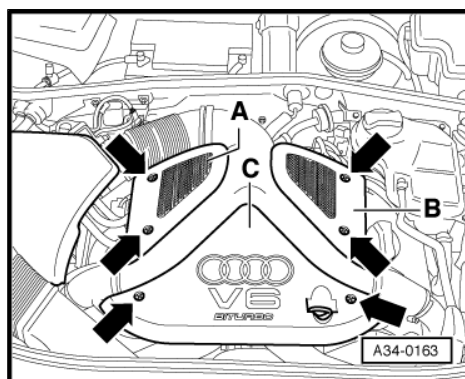


◆ Vehicle diagnosis, testing and information system - VAS 5051-

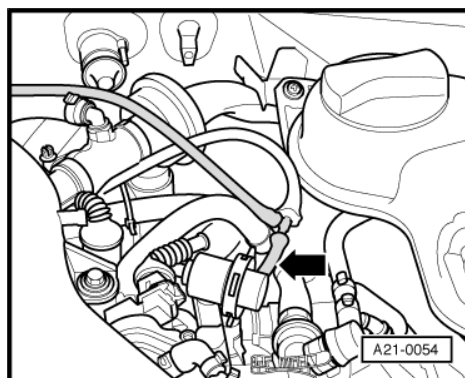


Procedure

- Unfasten screw connections -top right arrows- and detach engine cover panel (left-side)-B-.



- Connect T-piece with test hose of turbocharger tester - V.A.G 1397 A- to fuel pressure regulator -arrow-.
- Route test hose under rear edge of bonnet and through right window into passenger compartment.



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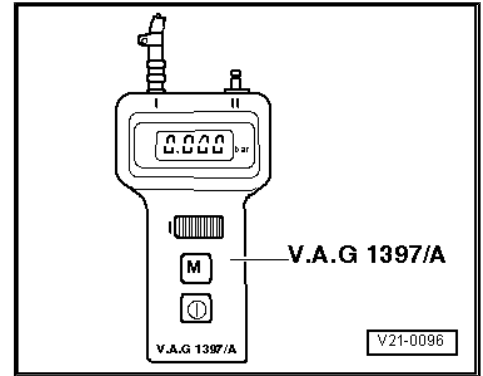


- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Attach test hose to connection -I-.



Note

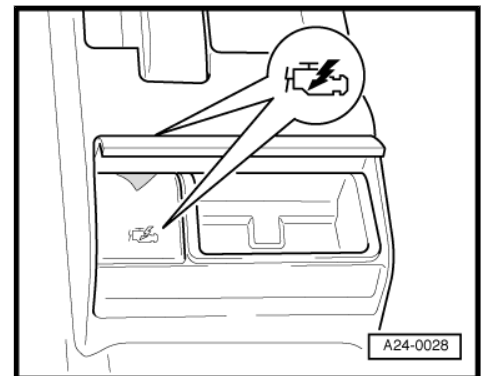
- ◆ *Hose connections must be completely airtight, otherwise measurement errors may occur.*
- ◆ *Take care not to trap test hose at bonnet and side window.*
- ◆ *Pressing memory button -M- on turbocharger tester causes last measured value to be stored until memory button -M- is pressed again or tester 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

To avoid accident risks when road testing the vehicle with test equipment, always observe the relevant safety precautions ⇒ page 191.

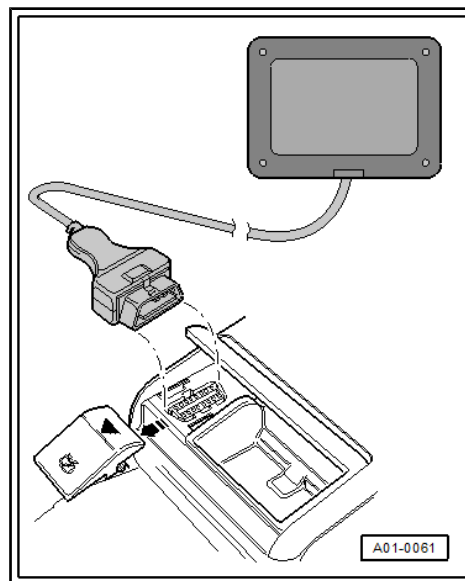
- Open rear ashtray and remove cover for diagnostic connector.



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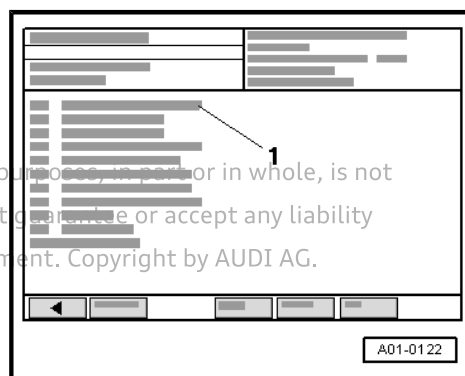
- Connect up vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1- , press vehicle self-diagnosis button and select vehicle system “01 - Engine electronics”. Engine must be idling.



Display on -VAS 5051- :

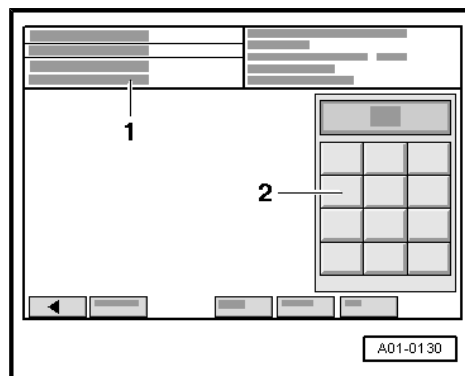
- From the list -1- select diagnostic function “08 - Read measured value block”.

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Display on -VAS 5051- :

- Use keypad -2- to enter “115” for “Display group number 115” and confirm by pressing the Q key.
- 1 - Enter display group.
- 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 5051- and memory key -M- on -V.A.G 1397 A- simultaneously at approx. 3000 rpm.

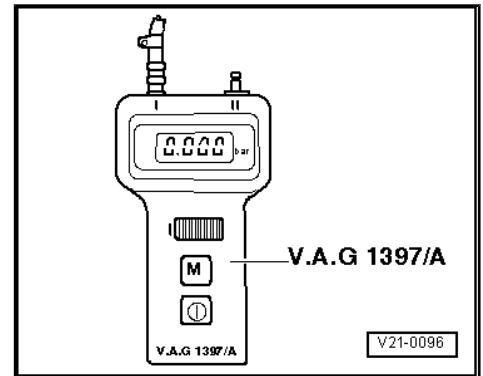


Note

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



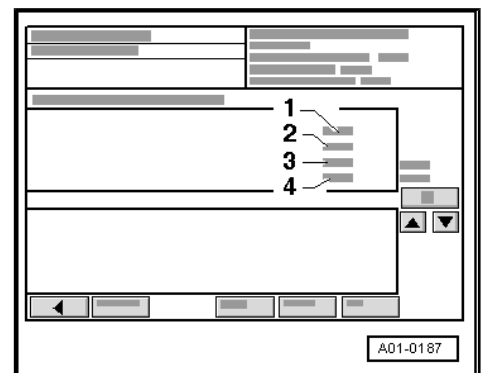
- Specification on -V.A.G 1397 A- : 1.870 ... 1.980 bar



- Specification on -VAS 5051- in display zone -4-: 1870 ... 1980 mbar
- Exit function "08 - Read measured value block" by pressing key.

If specification is not obtained:

- Check charge pressure control [⇒ page 197](#) .
- 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 191 ◆ Charge pressure control solenoid valve - N75- defective. Checking ⇒ page 200 ◆ Charge pressure regulating valve in turbocharger stuck in open position. Renewing turbocharger: left-side ⇒ page 217 ; right-side ⇒ page 223 . ◆ Leak between turbocharger and intake manifold (air intake hoses and vacuum hoses) ◆ Mechanical air recirculation valve defective. Checking ⇒ page 213 ◆ Turbocharger air recirculation valve - N249- defective. Checking ⇒ page 209 ◆ Turbocharger defective. Renewing turbocharger: left-side ⇒ page 217 ; 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 191 ◆ Vacuum unit for charge pressure regulating valve defective. Renewing turbocharger: left-side ⇒ page 217 ; right-side ⇒ page 223 . ◆ Charge pressure regulating valve in turbocharger sticking in closed position. Renewing turbocharger: left-side ⇒ page 217 ; right-side ⇒ page 223 .

If specification is obtained:

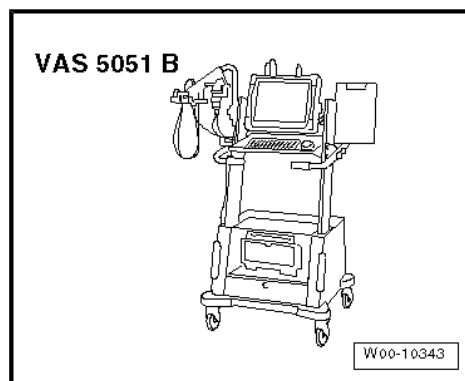
- Press function "06 - End output".
- Switch off ignition and unplug diagnostic connector.

1.5 Checking charge pressure control

Special tools and workshop equipment required



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



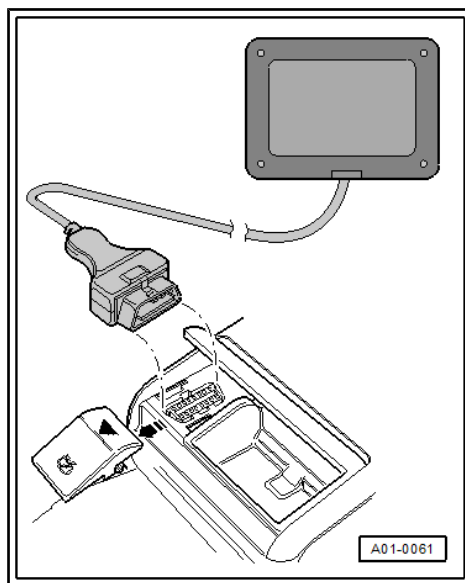
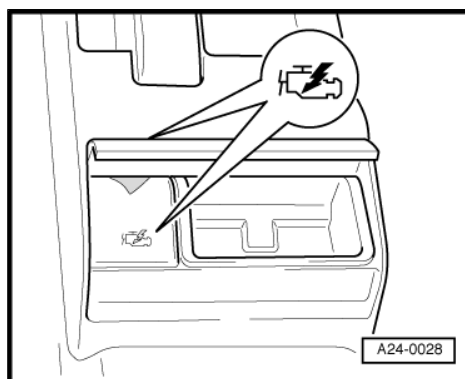
Procedure



WARNING

*To avoid accident risks when road testing the vehicle with test equipment, always observe the relevant safety precautions
⇒ [page 191](#).*

- Open rear ashtray and remove cover for diagnostic connector.
- Connect up vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1- , press vehicle self-diagnosis button and select vehicle system "01 - Engine electronics". Engine must be idling.

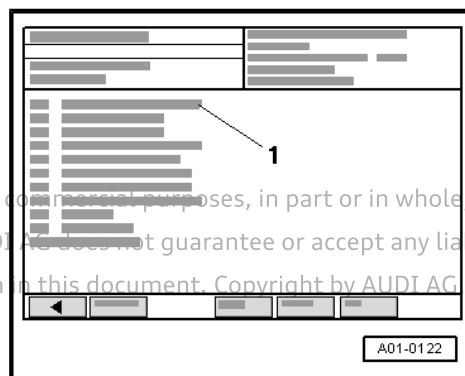


Display on -VAS 5051- :

- From the list -1- select diagnostic function "08 - Read measured value block".



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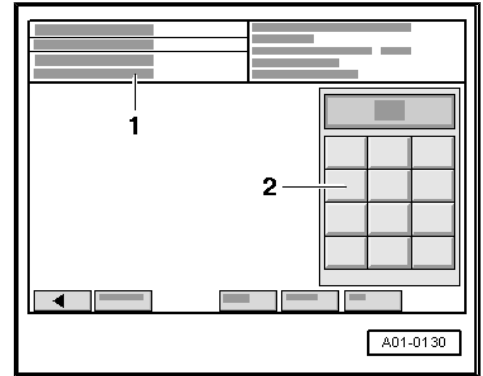




Display on -VAS 5051- :

- Use keypad -2- to enter “115” for “Display group number 115” and confirm by pressing the key.

1 - Enter display group.



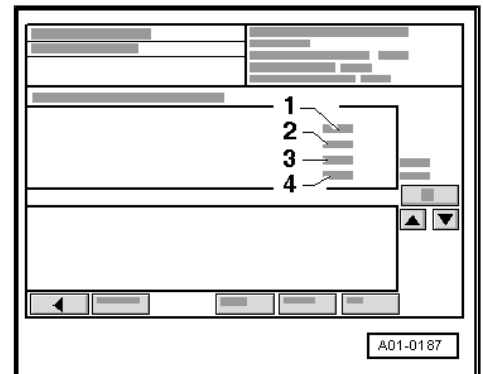
Display on -VAS 5051- :

- 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.
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Display on -VAS 5051- :

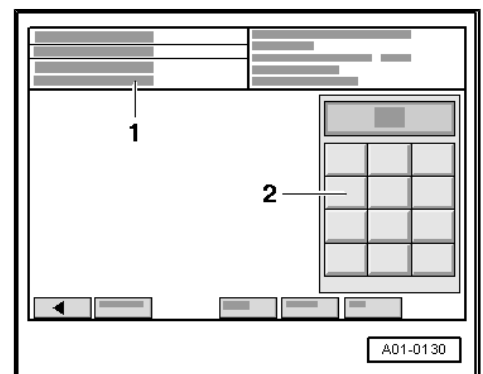
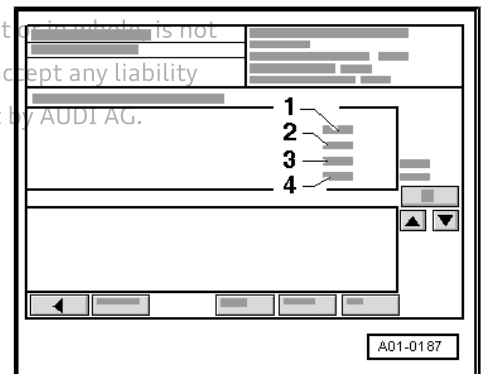
- Continue road test at full throttle and have a second mechanic check “display at full throttle” in zones -1 ... 3-.

- Max. discrepancy $\pm 5 \%$
- Exit function “08 - Read measured value block” by pressing key.
- Press function “06 - End output”.
- Terminate road test and switch off ignition.
- Switch on ignition and select vehicle system “01 - Engine electronics”.
- Repeat function “08 - Reading measured value block”.

Display on -VAS 5051- :

- Use keypad -2- to enter “116” for “Display group number 116” and confirm by pressing the key.

1 - Enter display group.





Display on -VAS 5051- :

- 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 5051- :

- 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 .

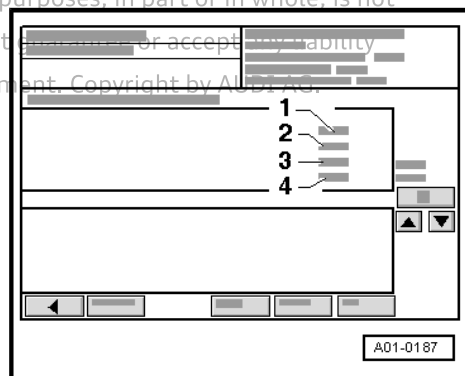
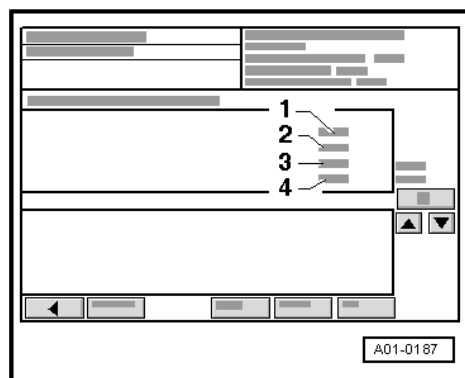
- Exit function "08 - Read measured value block" by pressing key.

If readings do not match specifications in measured value blocks:

- Check charge pressure sender - G31- ⇒ [page 205](#) .

If the specifications are obtained:

- Press function "06 - End output".
- Switch off ignition and unplug diagnostic connector.

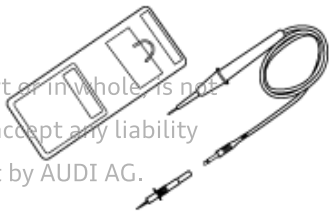
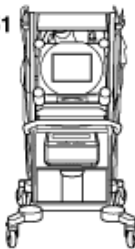


1.6 Checking charge pressure control solenoid valve - N75-



Special tools and workshop equipment required

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V.A.G 1526 A 	V.A.G 1527 B 
V.A.G 1594 A 	V.A.G 1598/31 
VAS 5051 	G24-0023

- ◆ Hand-held multimeter - V.A.G 1526 C- or -V.A.G 1526 A-
- ◆ Voltage tester - V.A.G 1527 B-
- ◆ Auxiliary measuring set - V.A.G 1594 C- or -V.A.G 1594 A-
- ◆ Adapter cable - V.A.G 1598/31- (test box)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1-

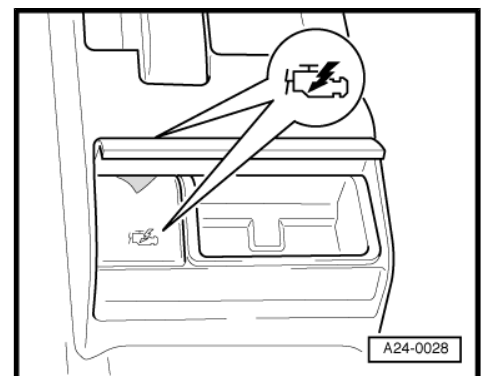
Procedure



Note

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

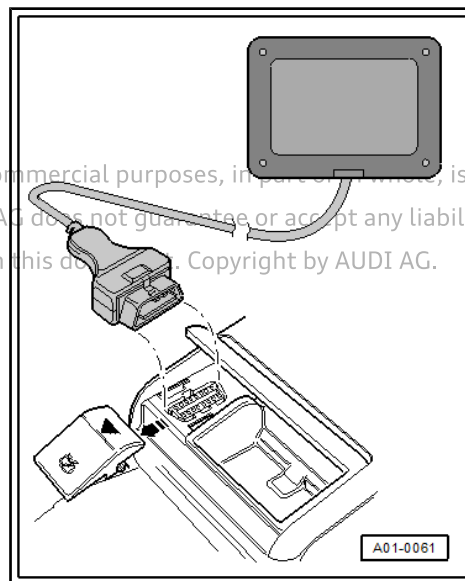
- Open rear ashtray and remove cover for diagnostic connector.





- Connect up vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1- , press vehicle self-diagnosis button and select vehicle system "01 - Engine electronics". When doing this, the engine must be running at idling speed.

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Display on -VAS 5051- :

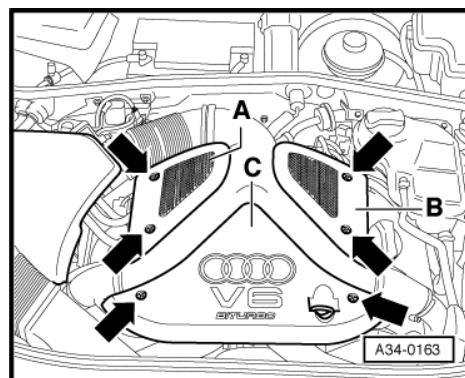
- From list -1-, select diagnosis function "02 - Interrogate fault memory".

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

- Terminate function "02 - Interrogate fault memory" by pressing  key.
- Press function "06 - End output" and switch off ignition.



- Unfasten screw connections -top left arrows- and detach engine cover panel (right-side) -A-.

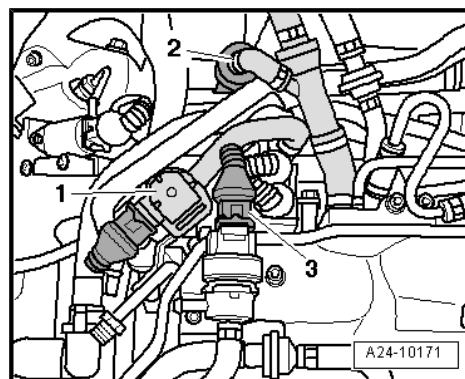


- Disconnect hoses from charge pressure control solenoid valve - N75- item 1-; leave electrical connector attached.



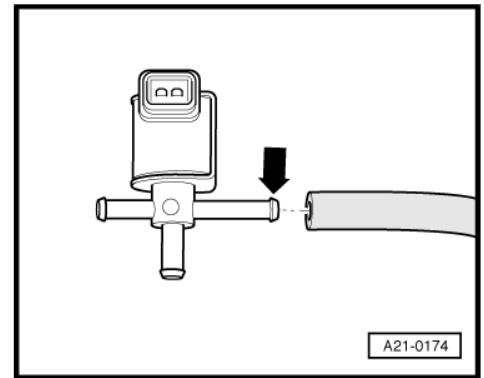
Note

Disregard items marked -2- and -3-.





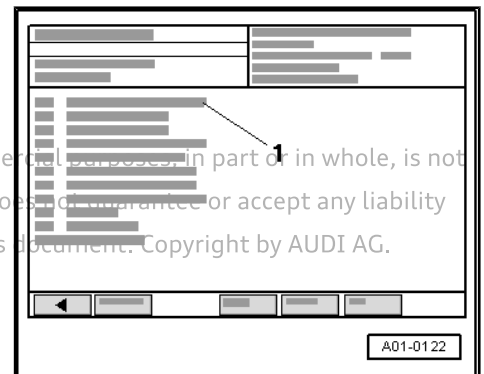
- Connect test hose to long hose connection -arrow- on charge pressure control solenoid valve - N75- .



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

Display on -VAS 5051- :

- From the menu -1- select the diagnostic function “03 - Final control diagnosis”.



- Press key repeatedly until the following display appears:

Display on -VAS 5051- :

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).

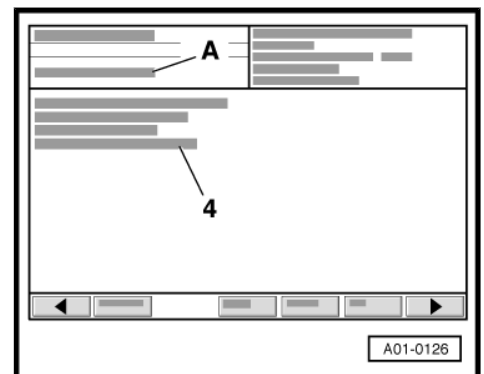
- Press key to exit “03 - Final control diagnosis” function.

- Press function “06 - 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 1526 C- to measure resistance between contacts of charge pressure control solenoid valve - N75- .

- Specification: 25 ... 35 Ω

If the 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 1527 B- between contact -1- of connector for charge pressure control solenoid valve - N75- and engine earth.
- Operate starter briefly.
- The LED should light up.

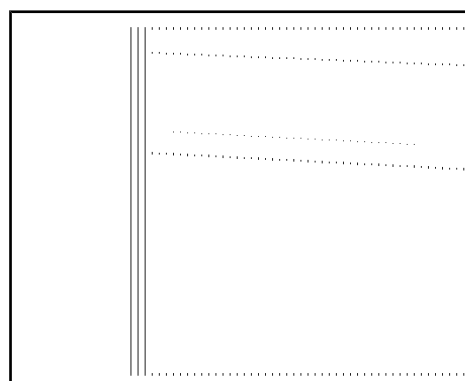
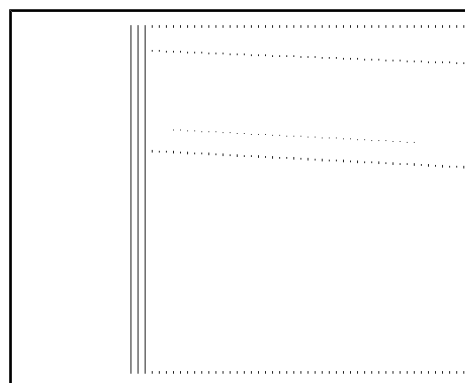
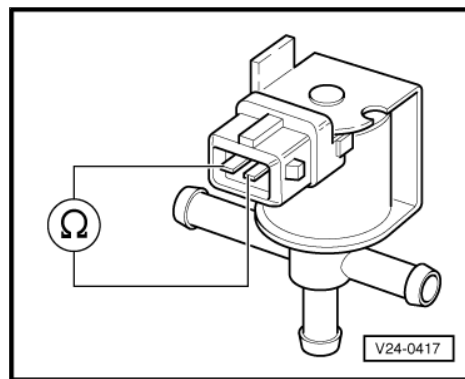
If LED does not light up:

- 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 1527 B- between contact -1- and -2- of connector for charge pressure control solenoid valve - N75- .
- Switch on ignition and select vehicle system "01 - Engine electronics".





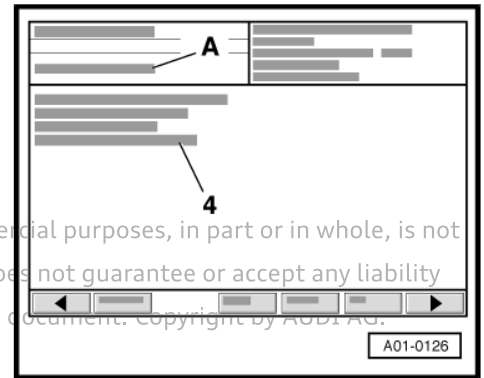
- Repeat function “03 - Final control diagnosis”.
- Press key repeatedly until the following display appears:

Display on -VAS 5051- :

4 - Charge pressure control solenoid valve - N75-

A - Actuator is running; continued switching is allowed

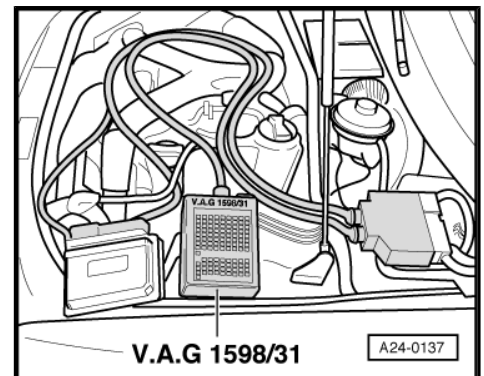
- The LED should flash.
- Press key to exit “03 - Final control diagnosis” function.
- Press function “06 - End output”.
- Switch off ignition and unplug diagnostic connector.



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).

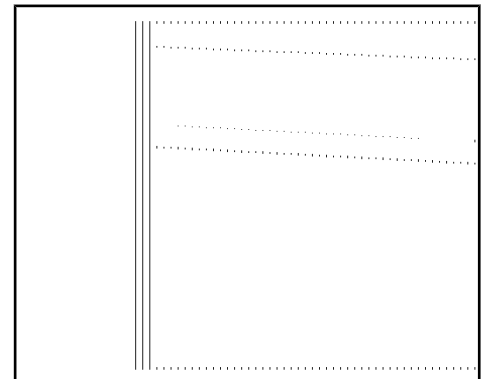
Caution
To prevent damage to electronic components, select appropriate measuring range before connecting measuring leads and observe test requirements.



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

Connector Contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-2-	104

- Repair wiring connection if necessary.



1.7 Checking charge pressure sender - G31-



Special tools and workshop equipment required

V.A.G 1526 A



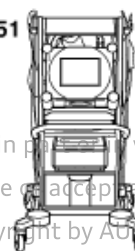
V.A.G 1594 A



V.A.G 1598/31



VAS 5051



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G24-0021

- ◆ Hand-held multimeter - V.A.G 1526 C- or -V.A.G 1526 A-
- ◆ Auxiliary measuring set - V.A.G 1594 C- or -V.A.G 1594 A-
- ◆ Adapter cable - V.A.G 1598/31- (test box)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1-

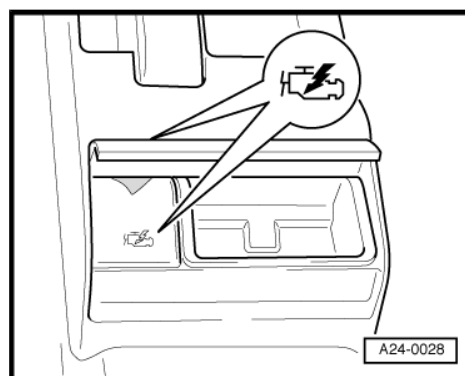
Procedure



Note

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

- Open rear ashtray and remove cover for diagnostic connector.



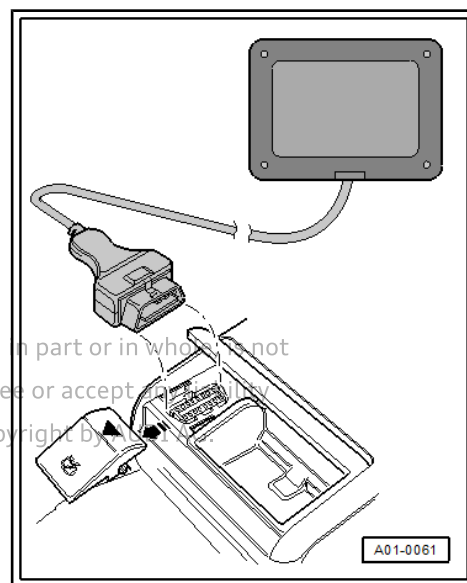
A24-0028



- Connect up vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1- , press Vehicle self-diagnosis button and select vehicle system "01 - Engine electronics". When doing this, the engine must be running at idling speed.



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Display on -VAS 5051- :

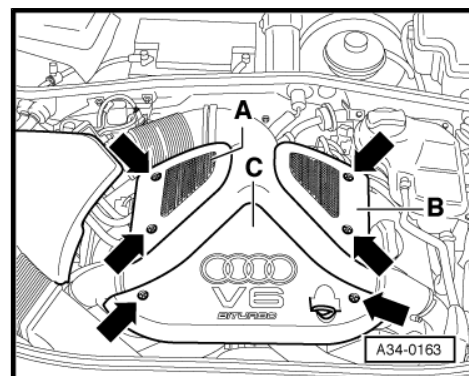
- From list -1-, select diagnosis function "02 - Interrogate fault memory".

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

- Terminate function "02 - Interrogate fault memory" by pressing key.
- Press function "06 - End output".
- Switch off ignition and unplug diagnostic connector.



- Unfasten screw connections -bottom arrows- and detach front engine cover panel -C-.

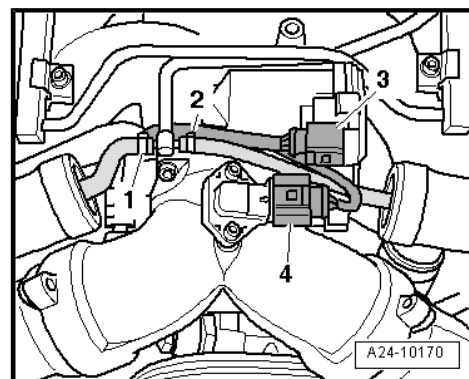


- Unplug electrical connector at charge pressure sender - G31- -item 4-.



Note

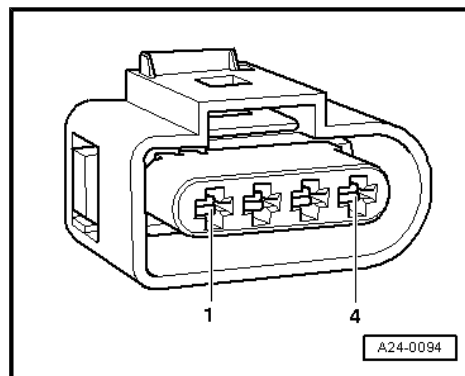
Disregard -items 1 ... 3-.





Checking voltage supply

- Connect hand-held multimeter - V.A.G 1526 C- to measure voltage between contacts -1- and -3- of connector for charge pressure sender - G31- .
- Switch on ignition.
- Specification: approx. 5 V



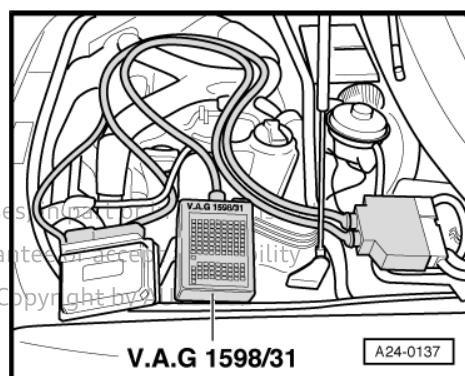
If specification is not obtained:

- 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

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:

Connector Contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-1-	108
-3-	98

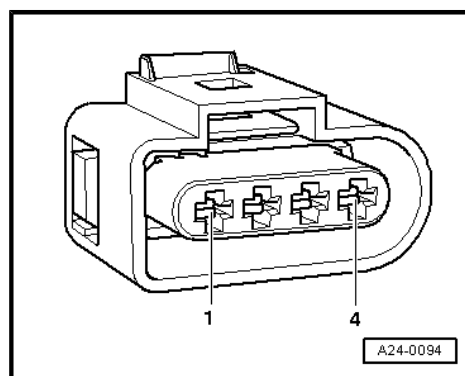
- Repair wiring connection if necessary.

If specification is obtained:

Checking signal wire

- Plug in connector at charge pressure sender - G31- .
- Connect hand-held multimeter - V.A.G 1526 C- (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:





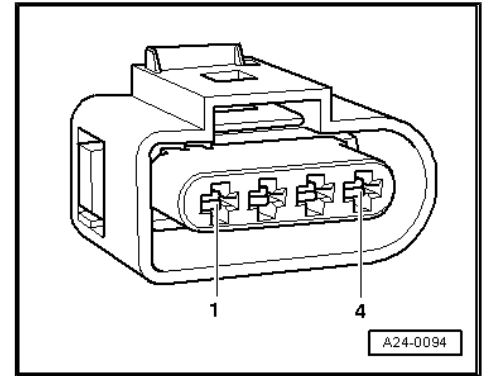
- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-4-	101

- Repair wiring connection if necessary.

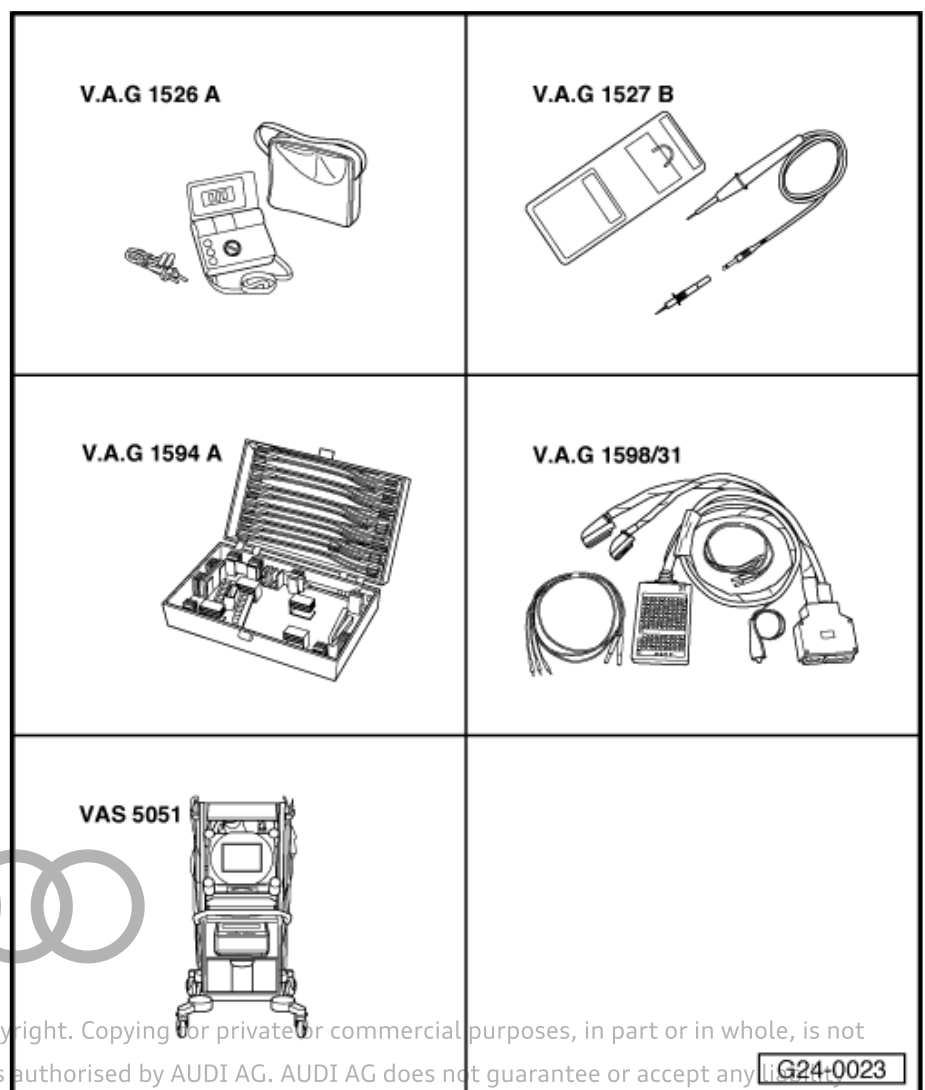
If wiring is OK:

- Renew charge pressure sender - G31- .



1.8 Checking turbocharger air recirculation valve - N249-

Special tools and workshop equipment required



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G24-0023

- ◆ Hand-held multimeter - V.A.G 1526 C- or -V.A.G 1526 A-
- ◆ Voltage tester - V.A.G 1527 B-
- ◆ Auxiliary measuring set - V.A.G 1594 C- or -V.A.G 1594 A-
- ◆ Adapter cable - V.A.G 1598/31- (test box)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1-



Procedure



Note

Turbocharger air recirculation valve - N249- and its wiring are monitored by the engine control unit.

- Open rear ashtray and remove cover for diagnostic connector.
- Connect up vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1- , press vehicle self-diagnosis button and select vehicle system "01 - Engine electronics". When doing this, the engine must be running at idling speed.

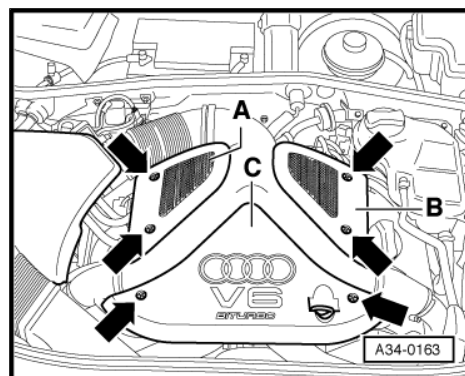
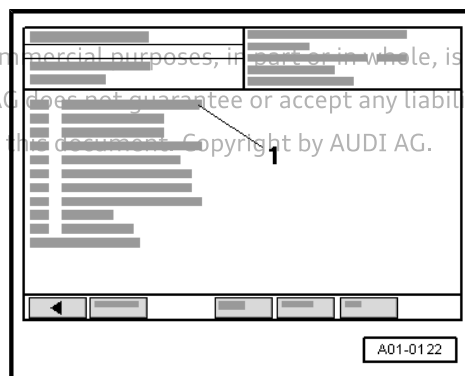
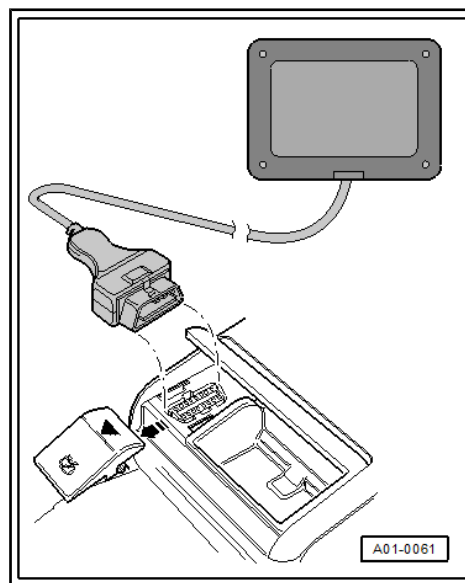
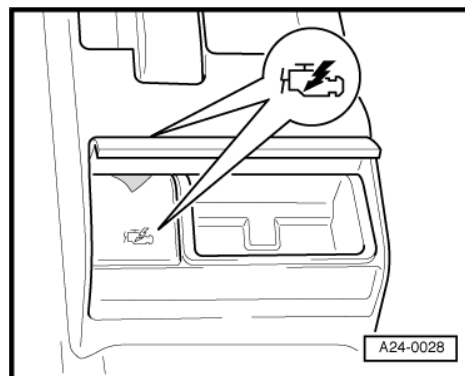


Display on -VAS 5051- :

- From list -1-, select diagnosis function "02 - Interrogate fault memory".

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

- Terminate function "02 - Interrogate fault memory" by pressing key.
- Press function "06 - End output" and switch off ignition.
- Unfasten screw connections -top right arrows- and detach engine cover panel (right-side) -B-.



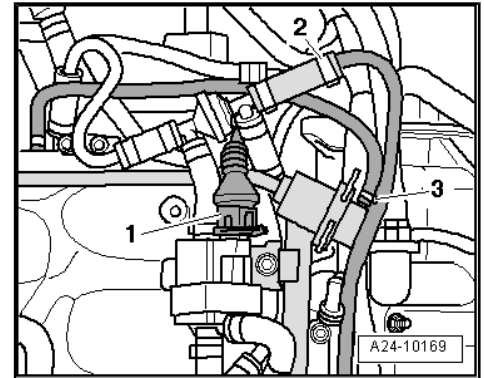


- Disconnect hoses from turbocharger air recirculation valve - N249- -item 1-; leave electrical connector attached.

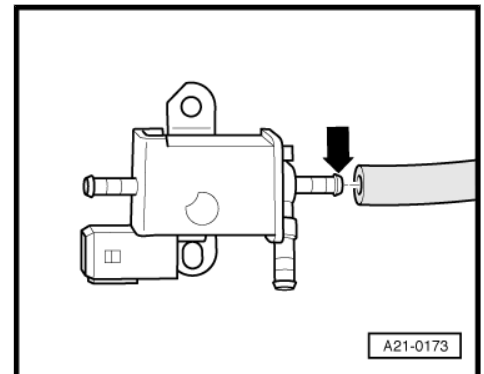


Note

Disregard items marked -2- and -3-.



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



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

Display on -VAS 5051- :

- From the menu -1- select the diagnostic function "03 - Final control diagnosis".



- Press key repeatedly until the following display appears:

Display on -VAS 5051- :

6 - Turbocharger air recirculation valve - N249-

A - Actuator is running; continued switching is allowed

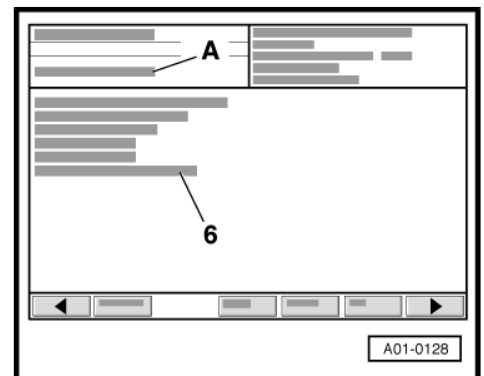
- The valve should click and open and close (check by blowing into the test hose).

- Press key to exit "03 - Final control diagnosis" function.

- Press function "06 - End output" and switch off ignition.

If valve clicks but does not open or close correctly:

- Renew turbocharger air recirculation valve - N249- .



If valve does not click:

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Checking internal resistance

- Unplug electrical connector at turbocharger air recirculation valve - N249- .
- Connect hand-held multimeter - V.A.G 1526 C- for resistance measurement between contacts on turbocharger air recirculation valve - N249- .

- Specification: 27 ... 30 Ω

If the specification is not obtained:

- Renew turbocharger air recirculation valve - N249- .

If specification is obtained:

Checking voltage supply

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



Note

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

- Connect voltage tester - V.A.G 1527 B- between contact -1- of connector for turbocharger air recirculation valve - N249- and engine earth.
- Operate starter briefly.
- The LED should light up.

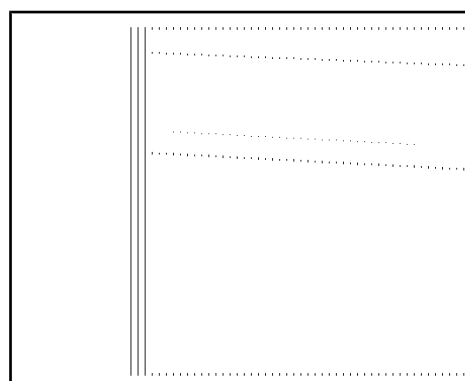
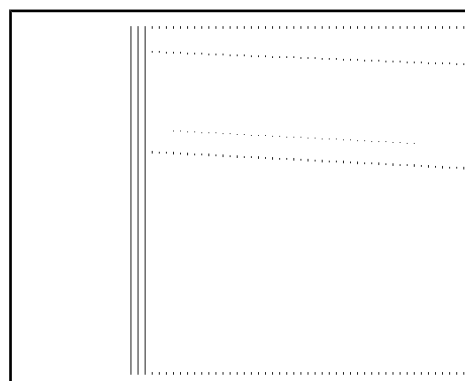
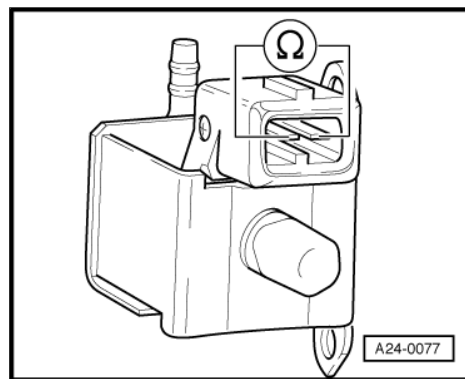
If LED does not light up:

- 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:

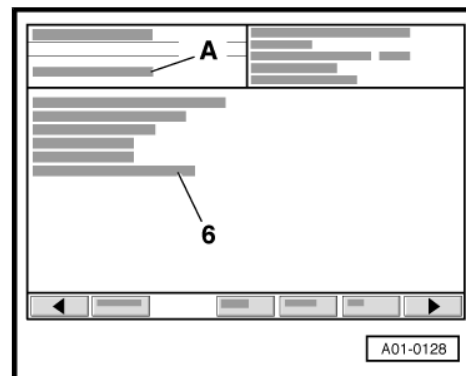
Checking activation

- Connect voltage tester - V.A.G 1527 B- between contact -1- and -2- of connector for turbocharger air recirculation valve - N249- .
- Switch on ignition and select vehicle system "01 - Engine electronics".



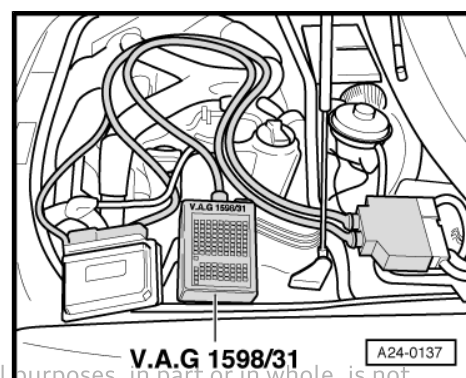


- Repeat function “03 - Final control diagnosis”.
- Press key repeatedly until the following display appears:
Display on -VAS 5051- :
6 - Turbocharger air recirculation valve - N249-
A - Actuator is running; continued switching is allowed
- The LED should flash.
- Press key to exit “03 - Final control diagnosis” function.
- Press function “06 - 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).

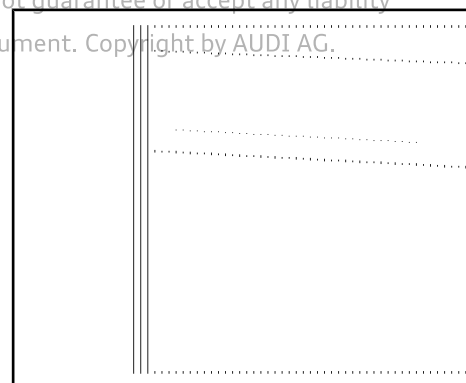


Caution
To prevent damage to electronic components, select appropriate measuring range before connecting measuring leads and observe test requirements.

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

Connector Contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-2-	9

- Repair wiring connection if necessary.



1.9 Checking mechanical air recirculation valves

Note

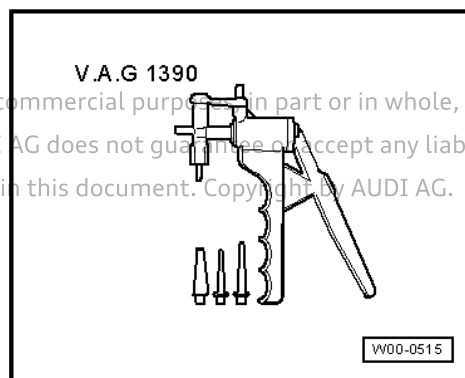
- ◆ *The mechanical air recirculation valves are located upstream of the turbochargers. They are opened by vacuum from the turbocharger air recirculation valve - N249- when the engine is on overrun or under part load or when idling. This dissipates the charge pressure upstream of the throttle valve and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

Special tools and workshop equipment required



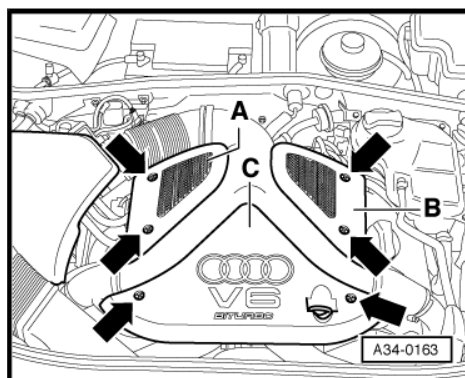
◆ Hand vacuum pump with attachments - V.A.G 1390-

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Procedure

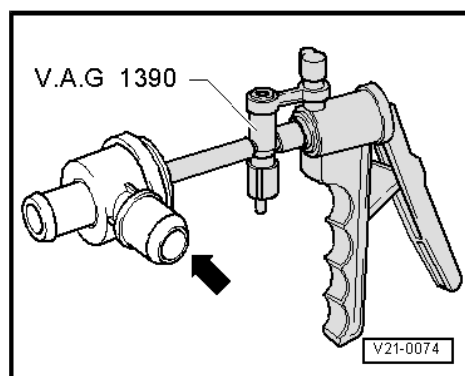
- Unfasten screw connections -bottom arrows- and detach front engine cover panel -C-.
- Remove mechanical air recirculation valves
⇒ [Item 4 \(page 193\)](#) .



- 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) ⇒ *Parts catalogue* .



2 Servicing charge air system with turbochargers

2.1 Rules for cleanliness

When working on the turbocharger, pay careful attention to the following "5 rules":

- ◆ Thoroughly clean all joints and connections and the surrounding areas before disconnecting.
- ◆ After removal, place parts on a clean surface and cover them. Only use lint-free cloths.
- ◆ Carefully cover or seal open components if repairs cannot be carried out immediately.
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use any parts that have been unpacked previously and stored away loosely (e.g. in a tool box).
- ◆ When the system is open: Do not work with compressed air if this can be avoided. If possible, do not move vehicle.

2.2 Exploded view - turbocharger

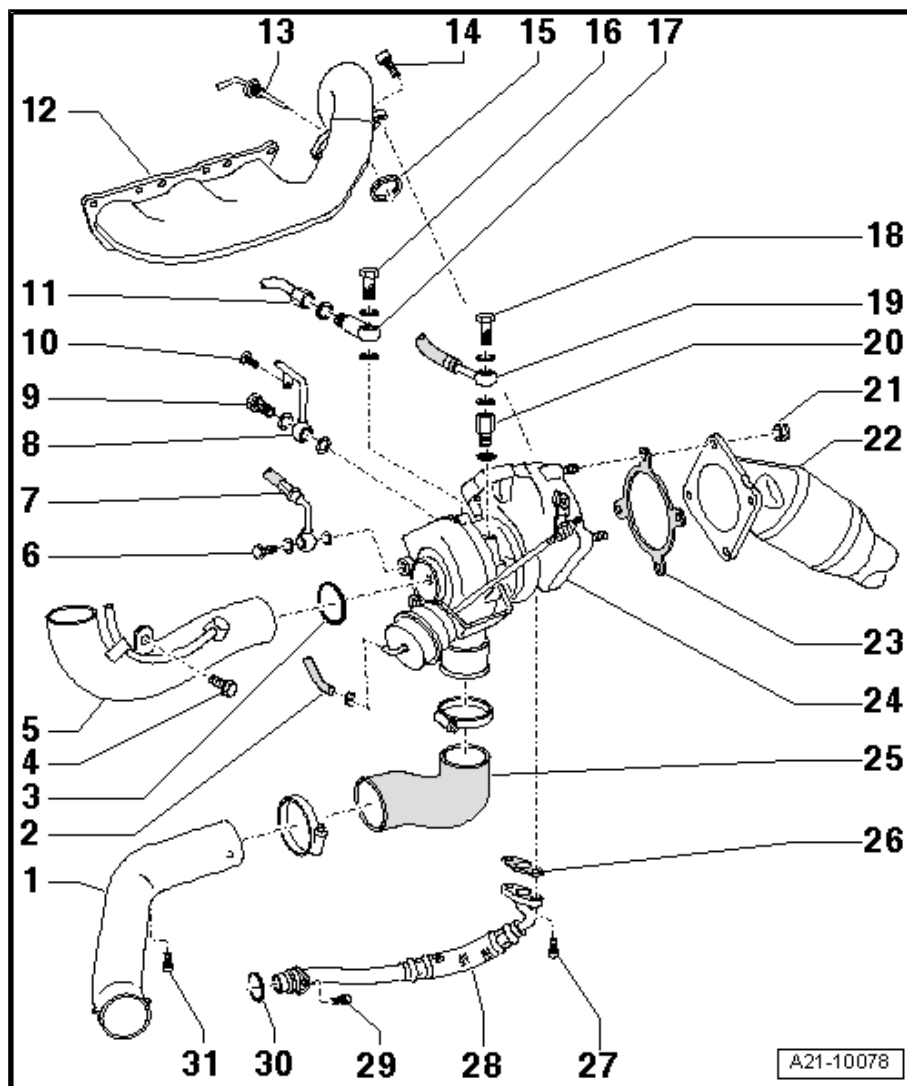


Note

Illustration shows turbocharger of 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 - 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 - 10 Nm
- 11 - Oil supply line
 - ☐ From cylinder block
 - ☐ Tighten union nut to 30 Nm
- 12 - Exhaust manifold
 - ☐ Removing and installing: left-side ⇒ [page 247](#) ; right-side ⇒ [page 248](#)



- 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 259](#) , right-side ⇒ [page 257](#)
- 14 - 60 Nm
 - ☐ Renew
 - ☐ Coat thread and contact surface of bolt head with high-temperature paste; ⇒ [Parts catalogue](#)
- 15 - Seal
 - ☐ Renew
- 16 - Banjo bolt, 30 Nm
- 17 - Connection piece
- 18 - Banjo bolt, 35 Nm
- 19 - Coolant pipe
- 20 - Threaded connection
 - ☐ Tighten to 35 Nm
- 21 - 30 Nm
 - ☐ Renew



22 - Front exhaust pipe

- ☐ Removing and installing: left-side ➔ [page 234](#) ; right-side ➔ [page 241](#)

23 - Gasket

- ☐ Renew

24 - Turbocharger

- ☐ Removing and installing: left-side ➔ [page 217](#) ; right-side ➔ [page 223](#)

25 - Air hose

- ☐ Must be free of oil and grease when installing

26 - Gasket

- ☐ Renew

27 - 10 Nm

28 - Oil return line

- ☐ To sump (top section)

29 - 10 Nm

30 - O-ring

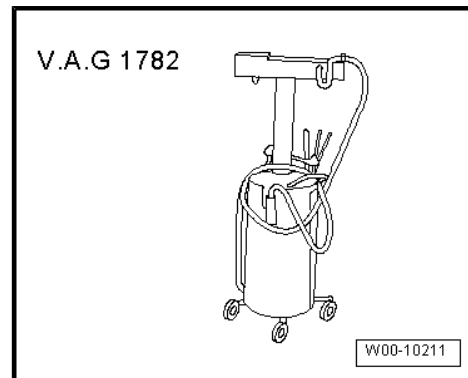
- ☐ Renew

31 - 10 Nm

2.3 Removing and installing turbocharger (left-side)

Special tools and workshop equipment required

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



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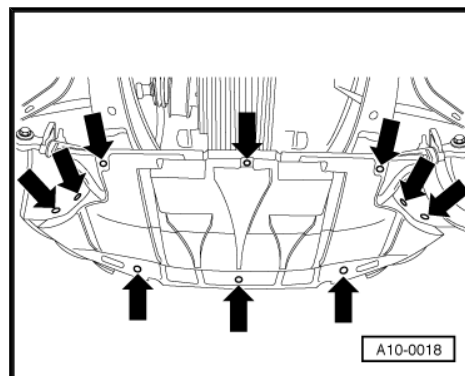
Removing



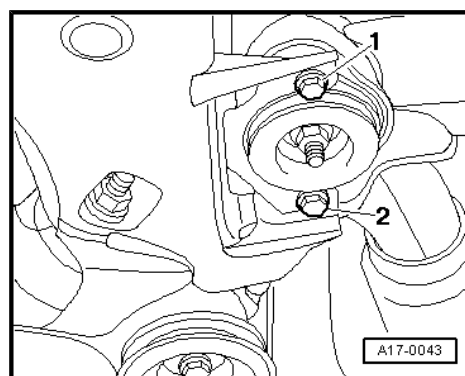
Note

- ♦ All heat insulation sleeves which are removed must be fitted in the same position when installing.
- ♦ All cable ties which are released or cut open when removing must be fitted in the same position when installing.

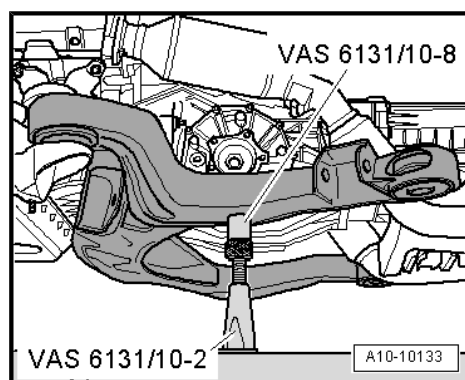
- Remove noise insulation -arrows-.
- Place used oil collection and extraction unit - V.A.G 1782- beneath engine.
- Drain off engine oil.
- Remove engine [page 2](#).
- Leave engine on scissor-type assembly platform - VAS 6131- with gearbox attached.
- Unscrew bolts -1- and -2- for gearbox mounting (left and right).



- Screw down spindles of the support elements (left and right) at subframe as far as possible.
- Remove locating lugs from spindles.
- Remove subframe to the side.

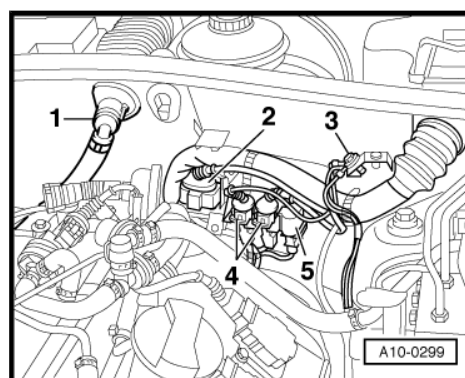


- Take electrical connector -2- for Lambda probe 2 - G108- out of bracket (left-side) and unplug it.
- Remove heat insulation sleeve at wiring harness and move wiring clear.



Note

Illustration shows electrical connectors when installed.





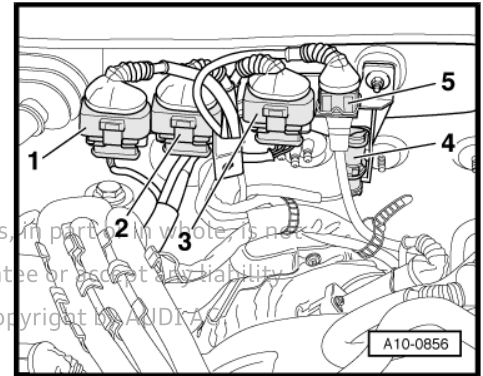
- Take electrical connector -2- for Lambda probe 2 after catalytic converter - G131- out of bracket (right-side) and unplug it.
- Remove heat insulation sleeve at wiring harness and move wiring clear.



Note

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Illustration shows electrical connectors when installed.

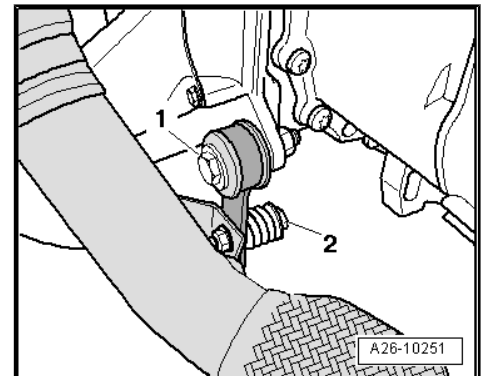


- Unscrew bolt -2- at bracket for front exhaust pipe (left-side).

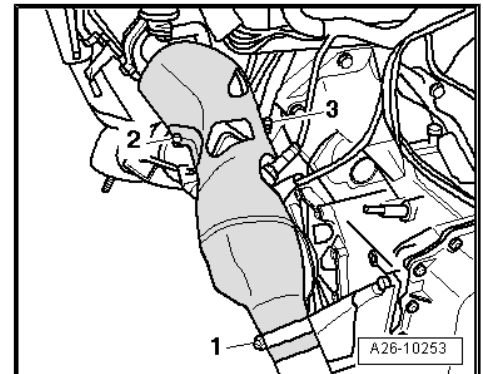


Note

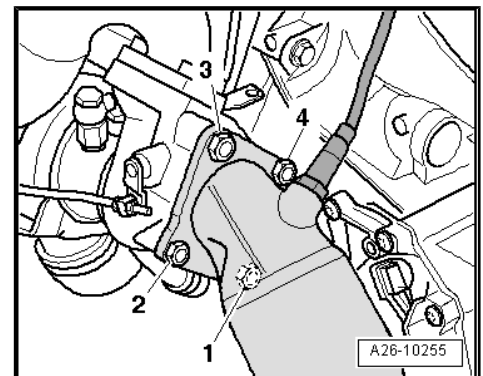
Disregard -item 1-.



- Slacken clip -1-.
- Unscrew bolts -2- and -3- and remove heat shield from front exhaust pipe (left-side).

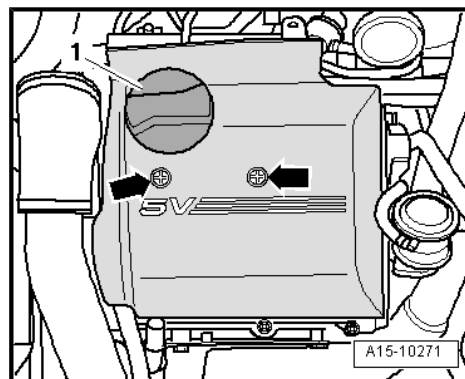


- Unscrew nuts -1 ... 4- securing front exhaust pipe to turbo-charger (left-side).
- Take out front exhaust pipe with starter and main catalytic converter.



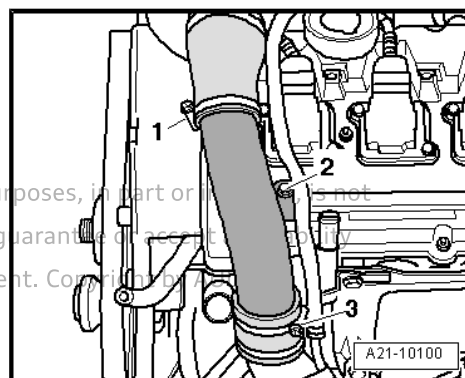


- Unscrew sealing cap -1-.
- Loosen quick release fasteners -arrows- and remove cover panel for cylinder head cover (left-side).

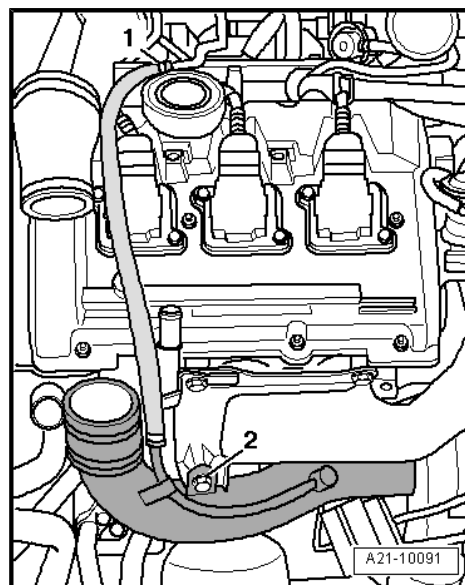


- Remove bolt -2-.
- Remove air pipe (left-side); disconnect hose connections -1- and -3- for this purpose.

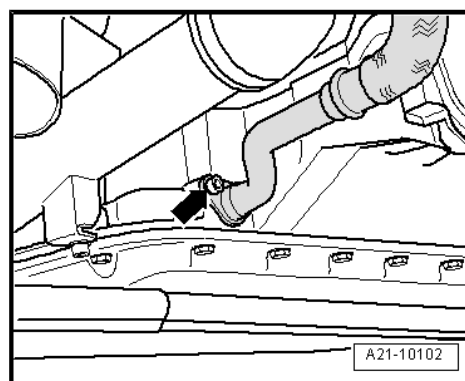
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- Detach vacuum hose -1-.
- Unscrew bolt -2- and detach air pipe (left-side) from turbo-charger towards the front.



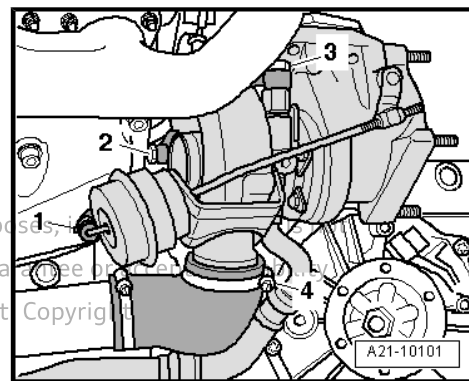
- Unscrew bolt -arrow- and detach oil return line from top section of sump.



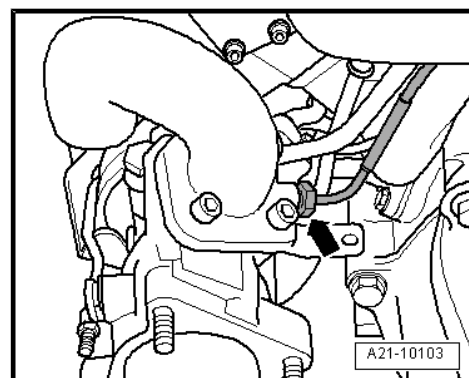


- Detach vacuum hose -1-.
- Unscrew banjo bolt -2- for pressure pipe.
- Place drip tray below turbocharger.
- Unscrew banjo bolt -3- for coolant pipe.
- Slacken hose clip -4-.

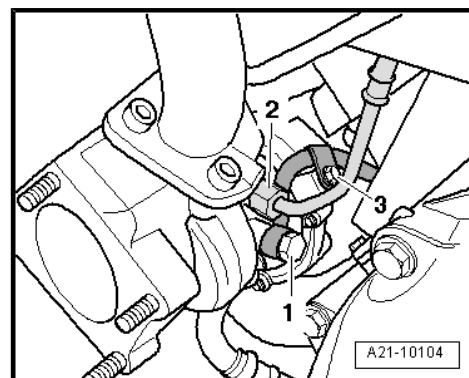
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- Unscrew exhaust gas temperature sender 1 for cylinder bank 2 - G236- -arrow- from exhaust manifold flange.



- 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.

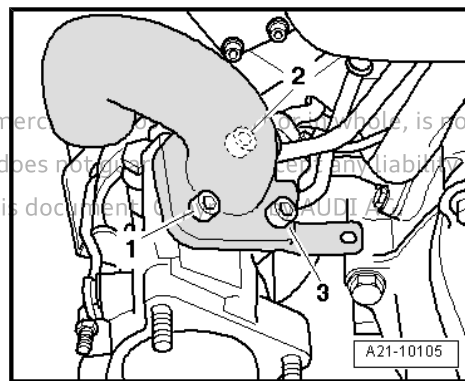
Installing

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



Note

- ◆ *Renew gaskets, seals, O-rings and self-locking nuts.*
- ◆ *Fill turbocharger with engine oil at connection for oil supply line.*
- ◆ *Hose connections and charge air system 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) ⇒ [Parts catalogue](#) .*
- ◆ *Charge air system must be free of leaks.*
- ◆ *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 259](#) .
- Install front exhaust pipe (left-side) with starter and main catalytic converter ⇒ [page 234](#) .
- Install engine ⇒ [page 27](#) .
- Fill up with engine oil and check oil level ⇒ [page 155](#) .



Note

After installing turbocharger, allow engine to idle for approx. 1 minute and do not rev up immediately to ensure turbocharger is supplied with oil.

Tightening torques

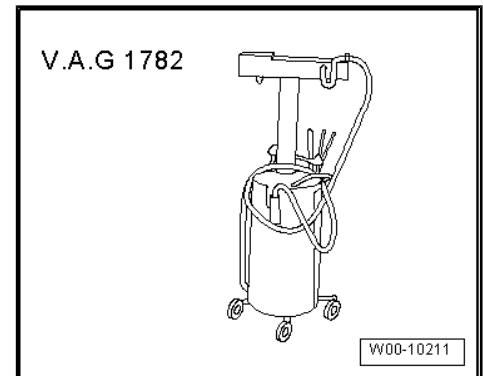
Component	Nm
Turbocharger to exhaust manifold	60 ¹⁾²⁾
Coolant line to turbocharger	35
Oil supply line to turbocharger	30
Pressure line to turbocharger	9
Oil return line to sump (top section)	10
Air pipe (left-side) to bracket	22
Air pipe to cylinder head cover	10
Hose clips (9 mm wide)	3
Hose clips (13 mm wide)	5.5
• ¹⁾ Renew bolts. • ²⁾ Coat threads and contact surface of bolt heads with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .	



2.4 Removing and installing turbocharger (right-side)

Special tools and workshop equipment required

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

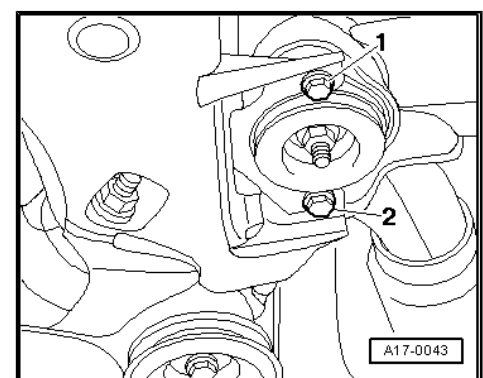
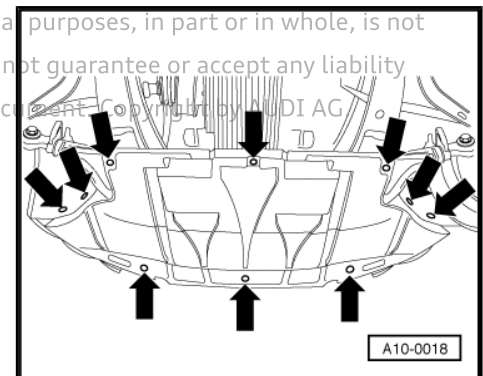


Removing



Note

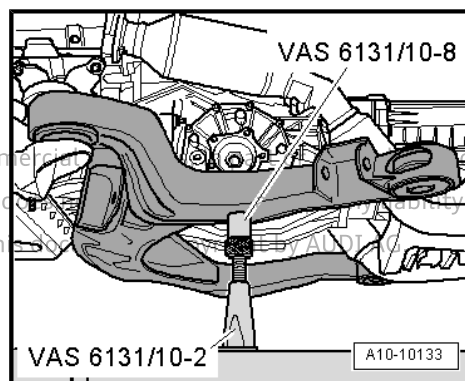
- ◆ *All heat insulation sleeves which are removed must be fitted in the same position when installing.*
- ◆ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*
- Remove noise insulation -arrows-.
- Place used oil collection and extraction unit - V.A.G 1782- beneath engine.
- Drain off engine oil.
- Remove engine ➔ [page 2](#) .
- Leave engine on scissor-type assembly platform - VAS 6131- with gearbox attached.
- Unscrew bolts -1- and -2- for gearbox mounting (left and right).





- Screw down spindles of the support elements (left and right) at subframe as far as possible.
- Remove locating lugs from spindles.
- Remove subframe to the side.

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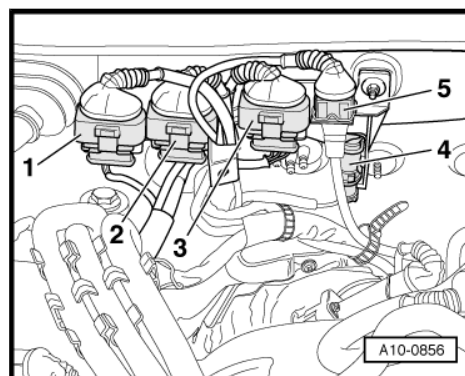


- Take electrical connectors for Lambda probe after catalytic converter - G130- -item 1- and Lambda probe - G39- -item 3- out of bracket (right-side) and unplug.
- Remove heat insulation sleeve at wiring harness and move the wiring clear.



Note

Illustration shows electrical connectors when installed.

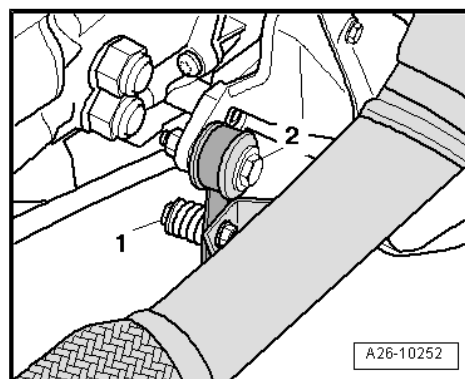


- Unscrew bolt -1- at bracket for front exhaust pipe (right-side).

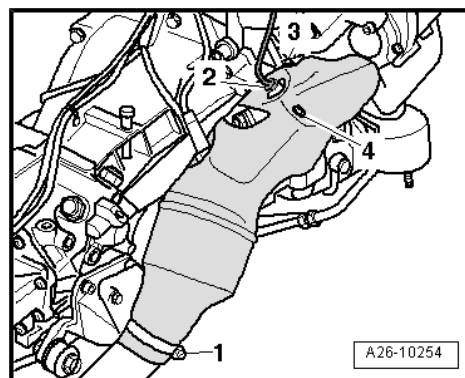


Note

Disregard -item 2-.

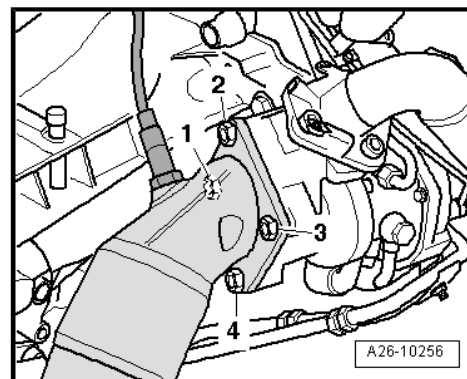


- Unbolt exhaust gas temperature sender 1 - G235- -item 2- from turbocharger.
- Slacken clip -1-.
- Unscrew bolts -3- and -4- and remove heat shield from front exhaust pipe (right-side).





- Unscrew nuts -1 ... 4- securing front exhaust pipe to turbo-charger (right-side).
- Take out front exhaust pipe with starter and main catalytic converter.



- Remove gear oil pipes from bracket by unscrewing nut -2-.

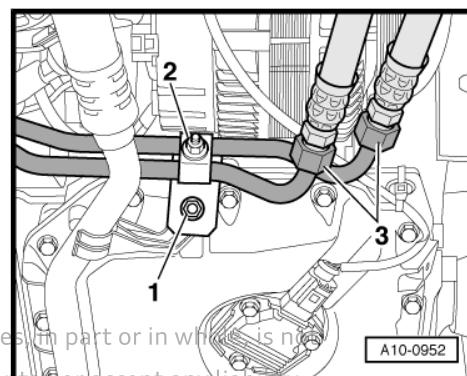


Note

Disregard items marked -1- and -3-.



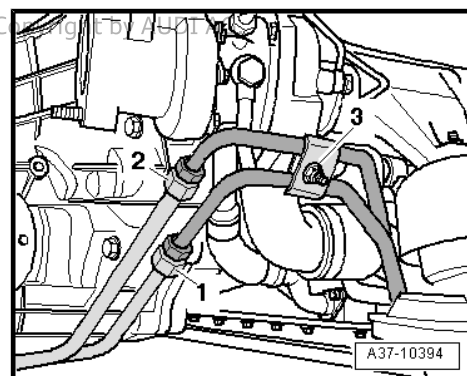
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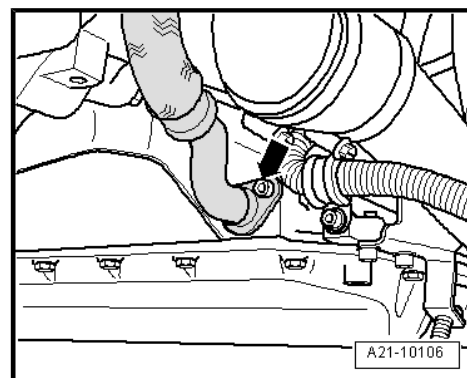
Note

Lay a cloth under the separating point to catch any escaping gear oil.

- Loosen union nuts -1- and -2-.
- Remove bracket for gear oil pipes by unscrewing nut -3-.
- Remove gear oil pipes.

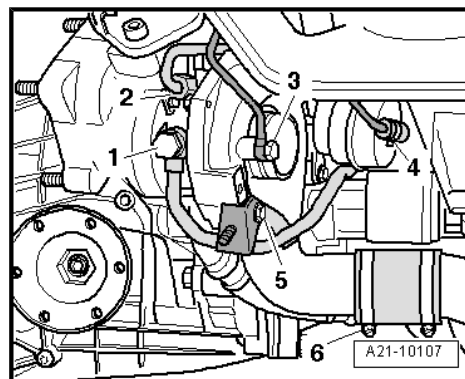


- Unscrew bolt -arrow- and detach oil return line from top section of sump.

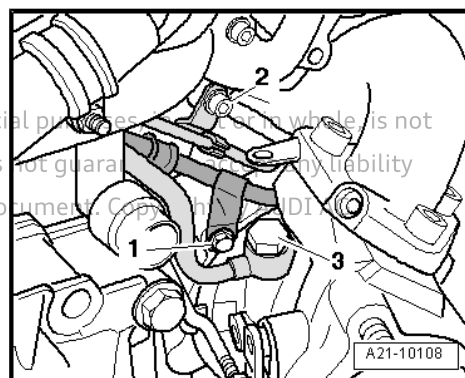




- Detach vacuum hose -4-.
- Unscrew banjo bolt -3- for pressure pipe.
- Unscrew banjo bolt -2- for oil supply line.
- Place drip tray below turbocharger.
- Unscrew banjo bolt -1- for coolant pipe.
- Unscrew retaining tab -5- for coolant pipe.



- Unscrew retaining tab -2- for pressure pipe.
- Unscrew banjo bolt -3- for coolant pipe.
- Unscrew retaining tab -1- for oil supply line.



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- Remove bolts -1 ... 3- and take out turbocharger.

Installing

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



Note

- ◆ *Renew gaskets, seals, O-rings and self-locking nuts.*
- ◆ *Fill turbocharger with engine oil at connection for oil supply line.*
- ◆ *Hose connections and charge air system 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) ⇒ Parts catalogue .*
- ◆ *Charge air system must be free of leaks.*
- ◆ *Fit all heat insulation sleeves in the original position when installing.*
- ◆ *Fit all cable ties in the original positions when installing.*

- Install exhaust gas temperature sender 1 - G235-
⇒ [page 257](#) .
- Install front exhaust pipe (right-side) with starter and main catalytic converter ⇒ [page 241](#) .
- Install gear oil pipes ⇒ Rep. gr. 34 .
- Install engine ⇒ [page 27](#) .
- Fill up with engine oil and check oil level ⇒ [page 155](#) .

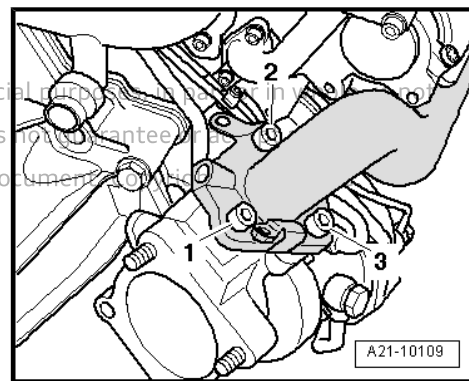


Note

After installing turbocharger, allow engine to idle for approx. 1 minute and do not rev up immediately to ensure turbocharger is supplied with oil.

Tightening torques

Component	Nm
Turbocharger to exhaust manifold	60 ¹⁾²⁾
Oil supply line to turbocharger	30
Coolant line to turbocharger	35
Pressure line to turbocharger	9
Oil return line to sump (top section)	10
Hose clips (9 mm wide)	3
Hose clips (13 mm wide)	5.5
• ¹⁾ Renew bolts. • ²⁾ Coat threads and contact surface of bolt heads with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .	



2.5 Charge air cooling - air flow



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)

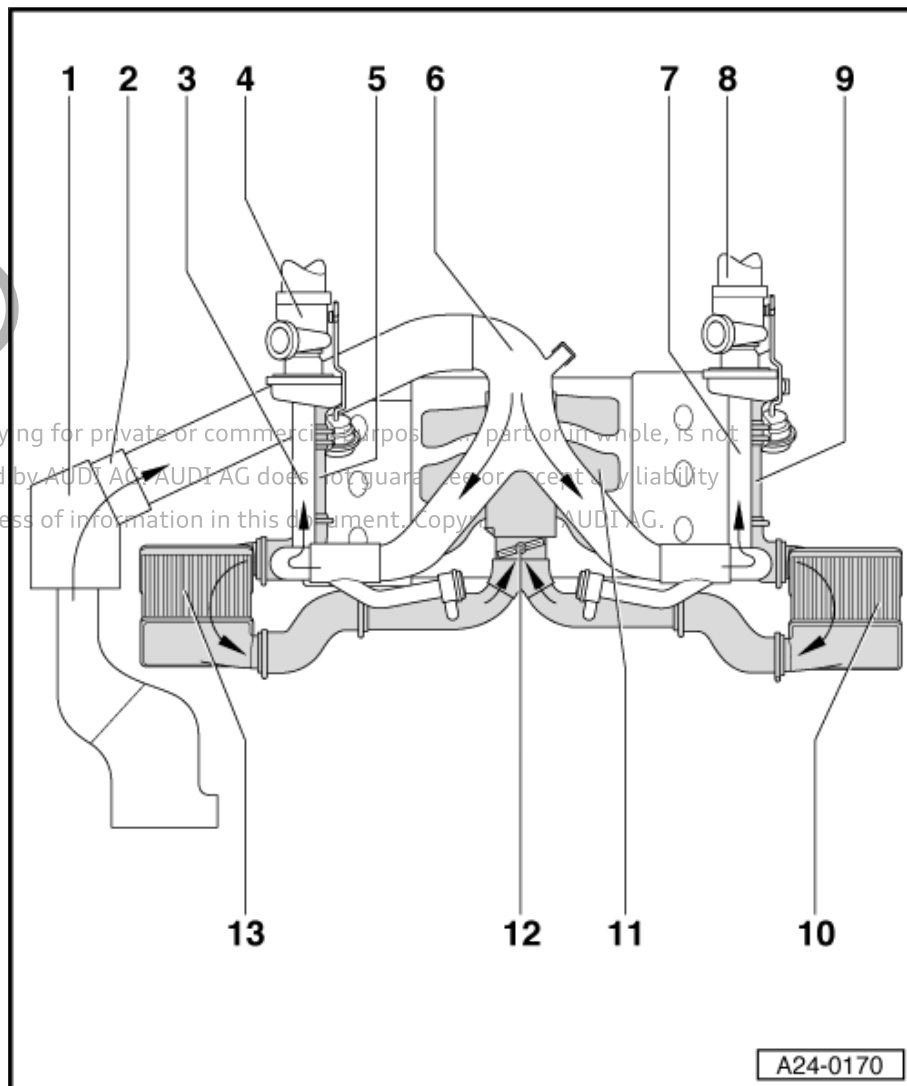
9 - Pressure side of turbocharger (left-side)

10 - Charge air cooler (left-side)

11 - Intake manifold

12 - Throttle valve module - J338-

13 - Charge air cooler (right-side)





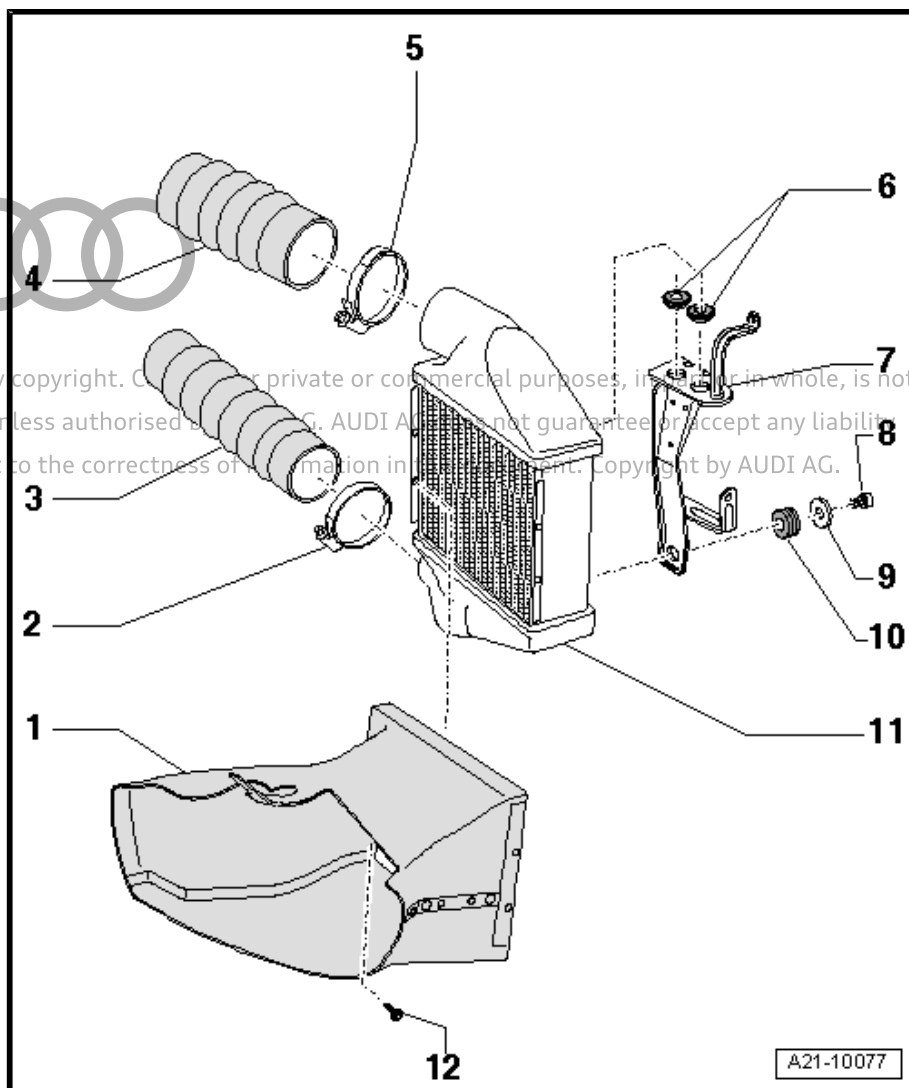
2.6 Exploded view - charge air cooling



Note

Illustration shows left-side charge air cooler.

- 1 - Front air duct
- 2 - Retaining clip, 5.5 Nm
 - ☐ Reinforced
- 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 - Retaining clip, 5.5 Nm
 - ☐ Reinforced
- 6 - Mounting for charge air cooler
 - ☐ 2x
- 7 - Bracket
- 8 - 10 Nm
- 9 - Washer
- 10 - Rubber grommet
- 11 - Charge air cooler
 - ☐ Removing and installing
⇒ [page 230](#)
- 12 - Panel bolt



A21-10077



2.7 Removing and installing charge air cooler

Removing



Note

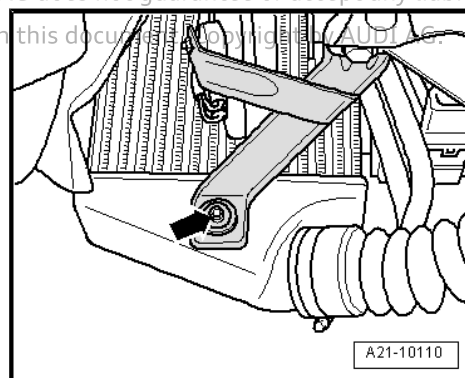
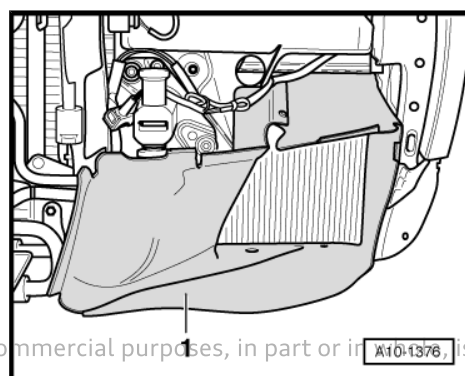
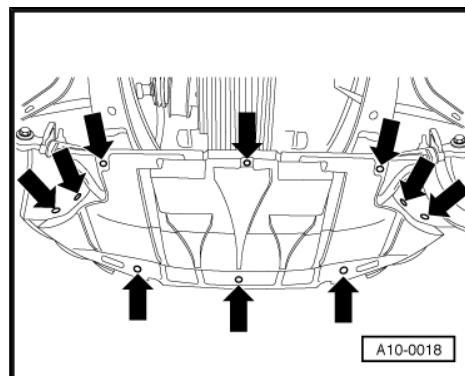
The following description shows the removal and installation of the left-side charge air cooler. The procedure is the same on both sides.

- Remove noise insulation -arrows-.
- Remove front bumper ⇒ Rep. gr. 63 .
- Remove left headlight ⇒ Rep. gr. 94 .
- Move electrical wiring harness on air cowl clear to one side.
- Remove air cowl -1- at front of charge air cooler.



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- Remove bolt -arrow- on bracket for charge air cooler.





- Remove air intake hoses -arrows-.
- Detach charge air cooler by pulling upwards.



Note

Shown in illustration with lock carrier removed.

Installing

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



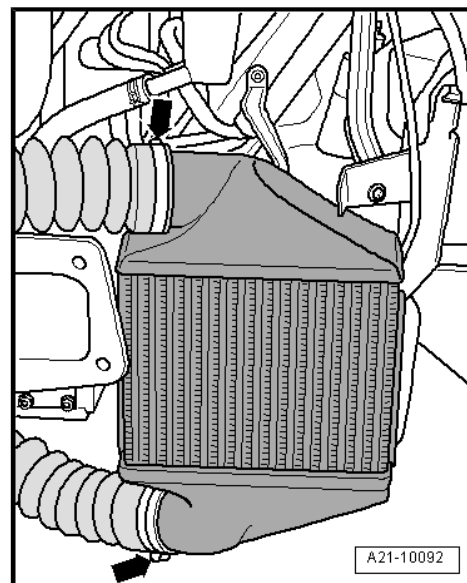
Note

- ◆ *Hose connections and charge air system 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) ⇒ Parts catalogue .*

- Install left headlight ⇒ Rep. gr. 94 .
- Install front bumper ⇒ Rep. gr. 63 .
- Check headlight adjustment ⇒ Maintenance ; Booklet 802 .

Tightening torques

Component	Nm
Charge air cooler to bracket	10
Hose clips (9 mm wide)	3
Hose clips (13 mm wide)	5.5



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26 – Exhaust system

1 Removing and installing parts of exhaust system



Note

- ◆ Renew gaskets and self-locking nuts.
- ◆ After working on the exhaust system, ensure that the system is not under stress and that it has sufficient clearance from the body. If necessary, loosen clamps and align silencers and exhaust pipes so that sufficient clearance is maintained to the body at all points and the mountings are evenly loaded.

1.1 Exploded view - exhaust system

1 - Front exhaust pipe with starter catalytic converter and main catalytic converter

- ☐ For right side of vehicle
- ☐ 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 241](#)
- ☐ Mounting components ⇒ [page 234](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 249](#)

2 - 30 Nm

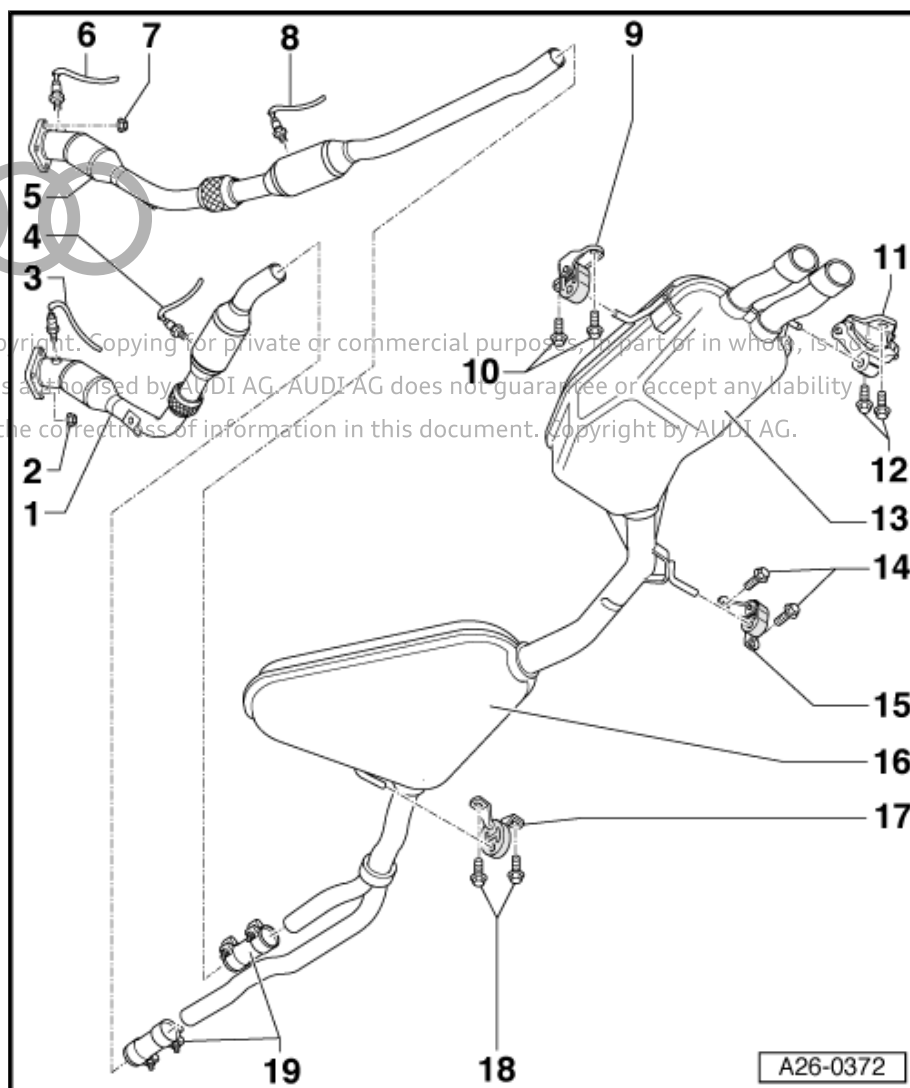
- ☐ Renew

3 - Lambda probe - G39- (before catalytic converter)

- ☐ For right side of vehicle
- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste.
- ☐ The assembly paste/ high-temperature paste must not get into the slots on the probe body.
- ☐ Tighten to 55 Nm

4 - Lambda probe after catalytic converter - G130-

- ☐ For right side of vehicle





- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ➔ Parts catalogue for high-temperature paste.
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Tighten to 55 Nm

5 - Front exhaust pipe with starter catalytic converter and main catalytic converter

- ☐ For left side of vehicle
- ☐ 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 234](#)
- ☐ Mounting components ➔ [page 234](#)
- ☐ Align exhaust system so it is free of stress ➔ [page 249](#)

6 - Lambda probe 2 - G108- (before catalytic converter)

- ☐ For left side of vehicle
- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ➔ Parts catalogue for high-temperature paste.
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Tighten to 55 Nm

7 - 30 Nm

- ☐ Renew

8 - Lambda probe 2 after catalytic converter - G131-

- ☐ For left side of vehicle
- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ➔ Parts catalogue for high-temperature paste.
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Tighten to 55 Nm

9 - Mounting

- ☐ Renew if damaged

10 - 25 Nm

11 - Mounting

- ☐ Renew if damaged

12 - 25 Nm

13 - Rear silencer

- ☐ Align exhaust system so it is free of stress ➔ [page 249](#)

14 - 25 Nm

15 - Mounting

- ☐ Renew if damaged

16 - Centre silencer

- ☐ Align exhaust system so it is free of stress ➔ [page 249](#)

17 - Mounting

- ☐ Renew if damaged

18 - 25 Nm

19 - Clamps

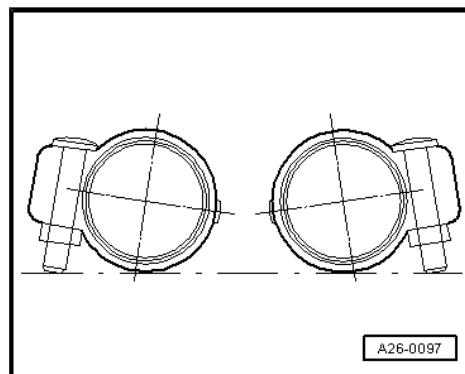
- ☐ Before tightening, align exhaust system so it is free of stress ➔ [page 249](#)
- ☐ Installation position ➔ [page 234](#)



- ❑ Tighten bolted connections evenly to 40 Nm

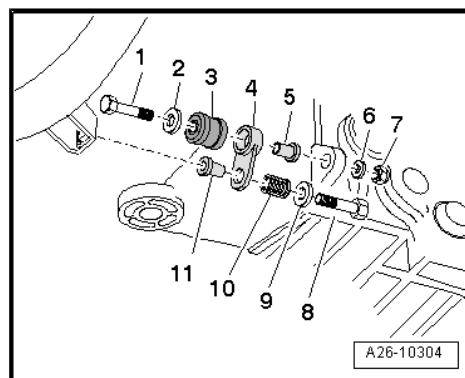
Installation position of clamps

- When fitting clamps, make sure ends of bolts do not project below bottom of clamps -arrows-.
- Bolted connections face outwards.



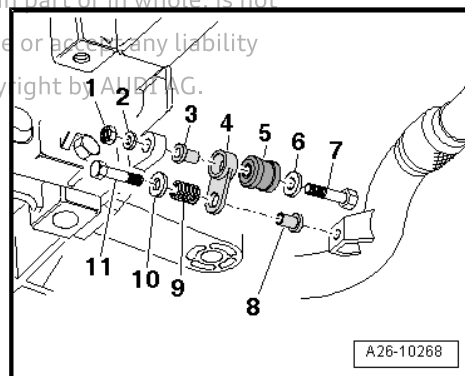
Components of exhaust pipe mountings (left-side)

- 1 - Bolt
- 2 - Washer
- 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)

- 1 - Nut, self-locking, 25 Nm
- 2 - Washer
- 3 - Spacer sleeve
- 4 - Bracket
- 5 - Buffer
- 6 - Washer
- 7 - Bolt
- 8 - Spacer sleeve
- 9 - Compression spring
- 10 - Washer
- 11 - Bolt, 25 Nm

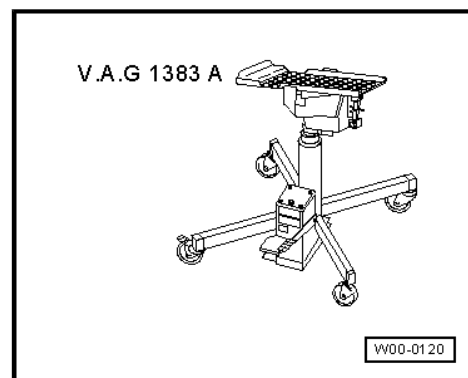


1.2 Removing and installing front exhaust pipe (left-side) with starter catalytic converter and main catalytic converter

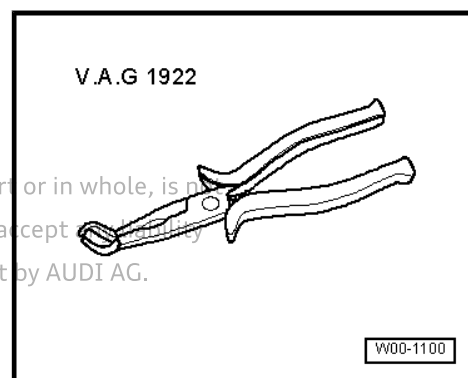
Special tools and workshop equipment required



- ◆ Engine and gearbox jack - V.A.G 1383 A-



- ◆ Spark plug connector pliers - V.A.G 1922-



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Removing



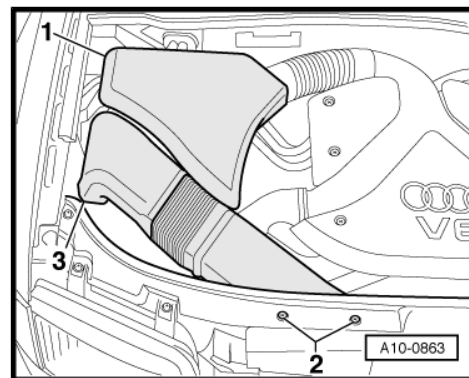
Note

- ◆ *Fit all heat insulation sleeves in the original position when installing.*
 - ◆ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*
- Remove cover -1- on right side of engine compartment.



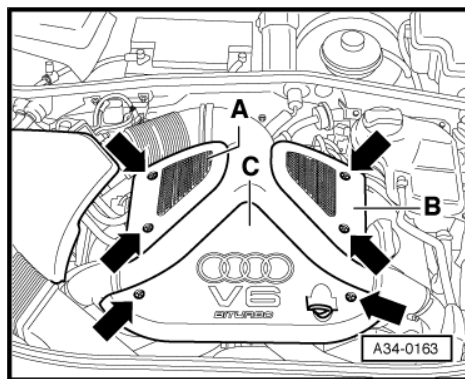
Note

Disregard items marked -2- and -3-.

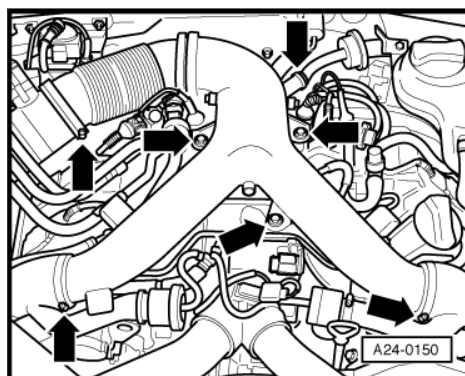




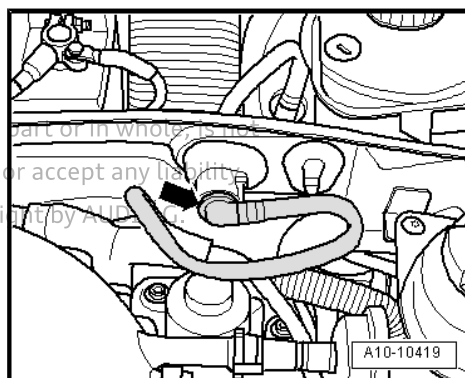
- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.



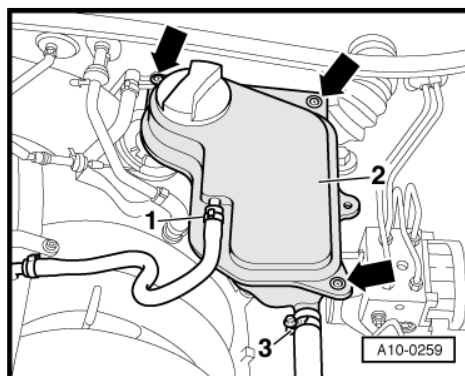
- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.



- Detach vacuum line -arrow- going to brake servo at bulkhead.



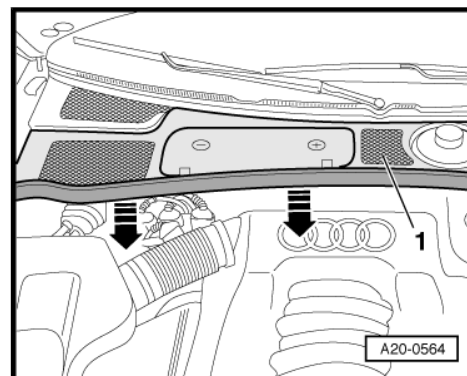
- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical wire for coolant shortage indicator switch - F66- at bottom of expansion tank and move expansion tank to one side with coolant hoses -1- and -3- attached.



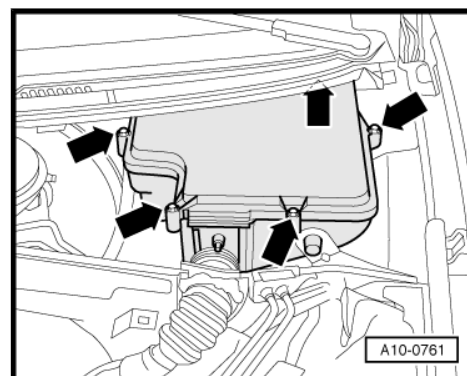
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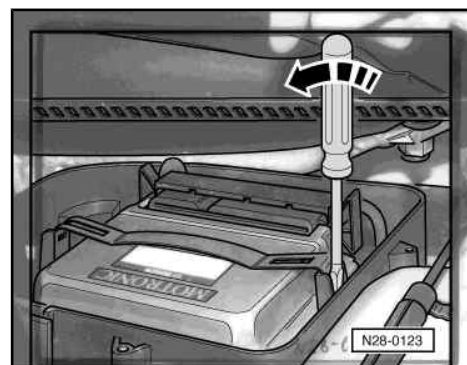
- Detach rubber seal from plenum chamber cover in direction of -arrow-.
- Detach plenum chamber cover -1- towards front.



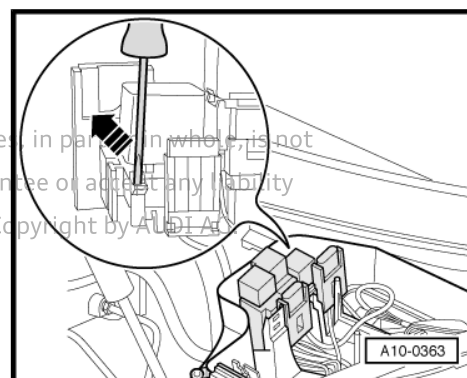
- Remove cover for electronics box in plenum chamber -arrows-.



- Carefully lever off retaining strap with a screwdriver -arrow-.
- Lay aside engine control unit with electrical connectors attached.



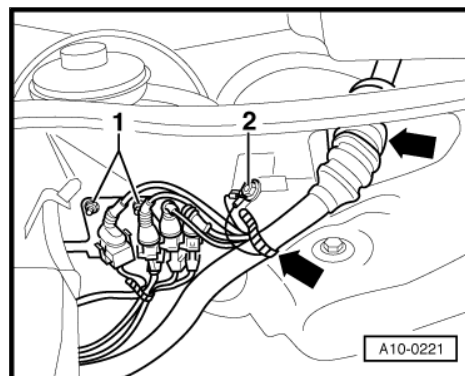
- Release retainer -arrow- and pull auxiliary relay carrier in electronics box upwards to remove.
- Disconnect electrical connectors at connector point using spark plug connector pliers - V.A.G 1922-.



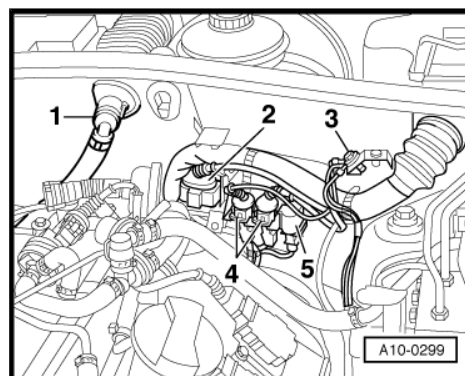
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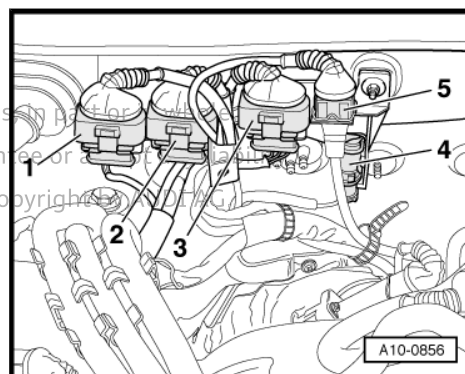
- Detach earth connection -2- and retainer -1- for electrical connectors from bulkhead.
- Disengage engine wiring harness at electronics box and bulkhead -arrows- and move clear.



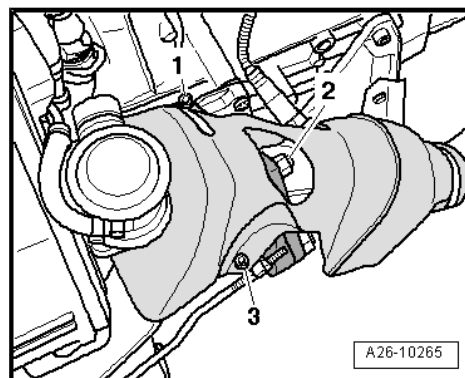
- Take electrical connector -2- for Lambda probe 2 - G108- out of bracket (left-side) at bulkhead and unplug.
- Remove heat insulation sleeve at wiring harness and move wire to Lambda probe clear.



- 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.

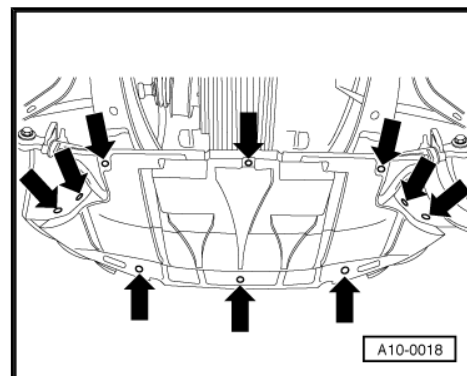


- Unscrew bolts -1- and -3- for heat shield.
- Unscrew top nut -2- securing front exhaust pipe to turbocharger.





- Remove noise insulation -arrows-.



- Unbolt heat shield -1- for drive shaft (left-side).
- Detach drive shaft (left-side) from flange shaft of gearbox.



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Note

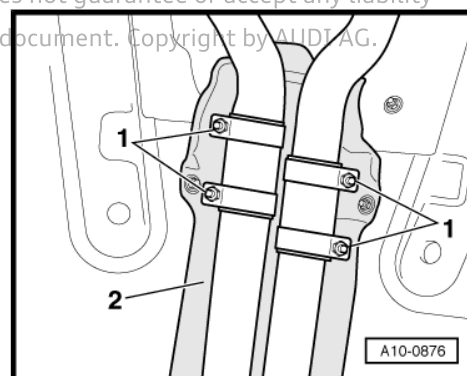
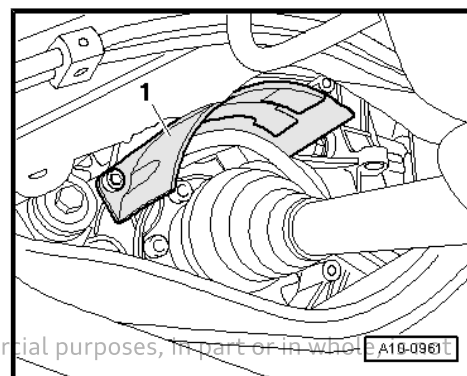
The flexible joint on the front exhaust pipe must not be bent more than 10° – otherwise it can be damaged.

- Disconnect exhaust system at clamps -1-.

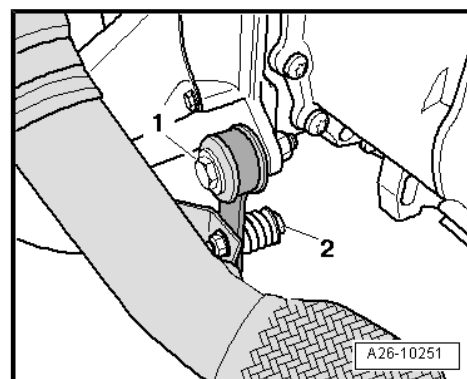


Note

Disregard -item 2-.



- Unscrew bolts -1- and -2- and remove mounting for front exhaust pipe (left-side).



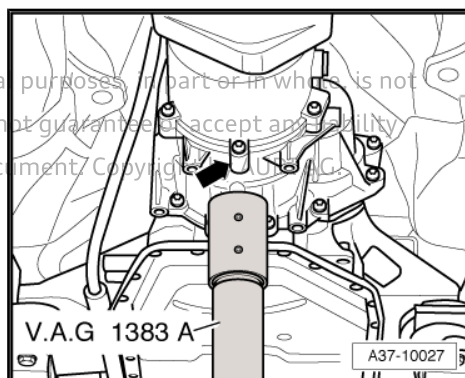
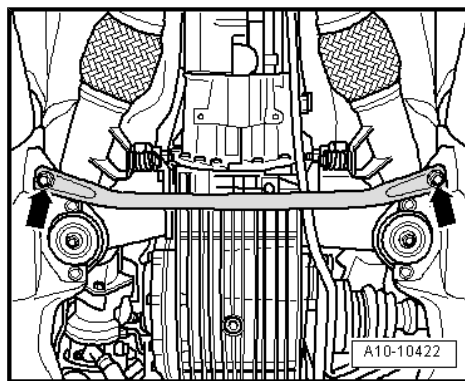


- Unbolt cross piece from subframe -arrows-.



- Apply lifting column of engine/gearbox jack - V.A.G 1383 A- at centre of gearbox housing casting -arrow- and support gearbox from below.

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Note

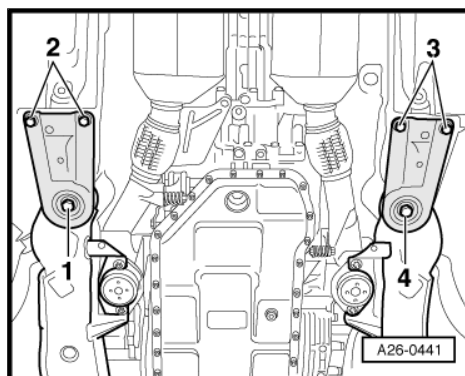
The lock carrier must be installed.

- 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- .

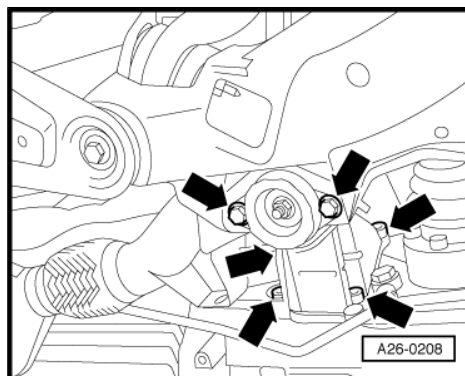


Note

Make sure that the propshaft joint is not damaged when lowering gearbox.



- Remove heat shield for gearbox support (left-side) -arrows-.
- Remove bolts and take off 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

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) ⇒ 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 subframe ⇒ Rep. gr. 40 .



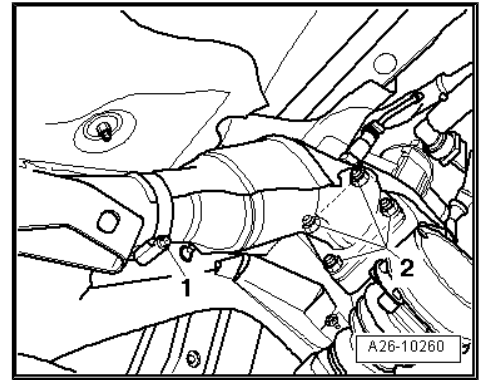
Note

*Mounting components for exhaust system on gearbox
⇒ [page 234](#)*

- Align exhaust system so it is free of stress ⇒ [page 249](#) .

Tightening torques

Component	Nm
Front exhaust pipe with Turbocharger	30 ¹⁾
starter catalytic converter and main catalytic converter to: Mounting plate	25
Mounting bracket to gearbox support	25
Drive shaft heat shield to gearbox	23
Heat shield for front exhaust pipe	10
Air duct to intake manifold	10
• ¹⁾ Renew nuts.	



1.3 Removing and installing front exhaust pipe (right-side) with starter catalytic converter and main catalytic converter

Special tools and workshop equipment required

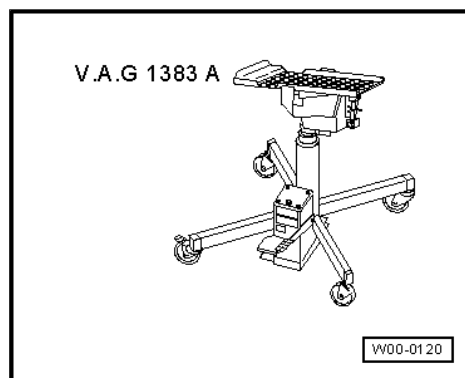


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♦ Engine and gearbox jack - V.A.G 1383 A-



Removing



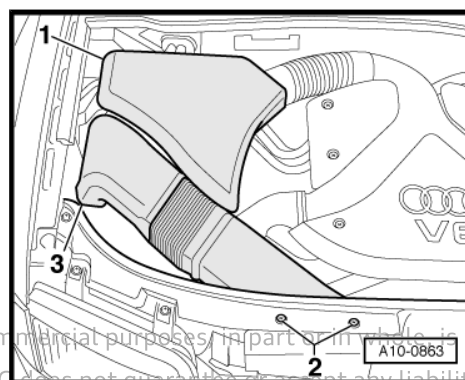
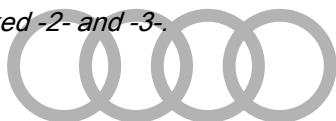
Note

- ♦ *Fit all heat insulation sleeves in the original position when installing.*
- ♦ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*
- Remove cover -1- on right side of engine compartment.

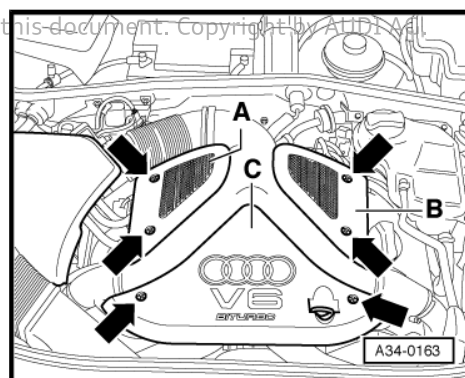


Note

Disregard items marked -2- and -3-.



- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.



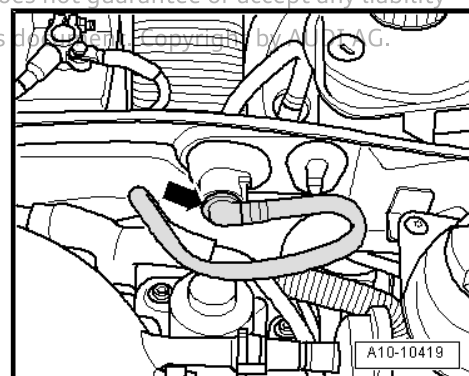
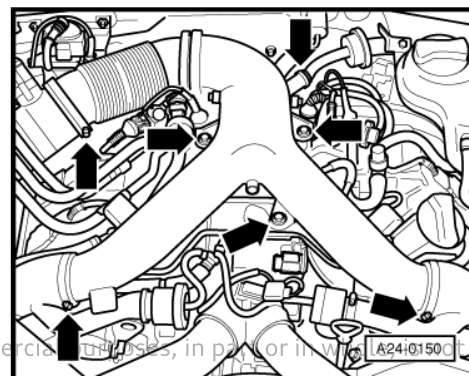


- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.

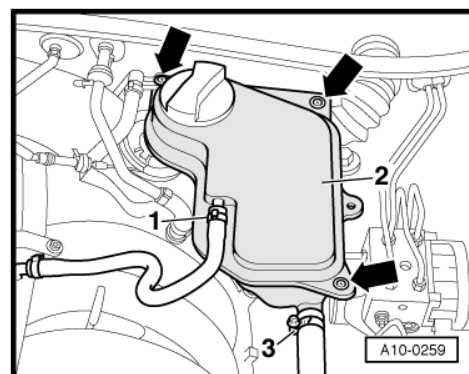


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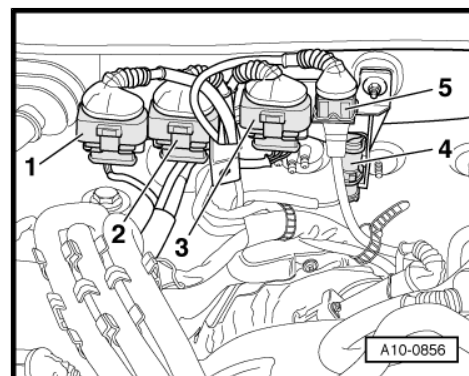
- Detach vacuum line -arrow- going to brake servo at bulkhead.



- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical wire for coolant shortage indicator switch - F66- at bottom of expansion tank and move expansion tank to one side with coolant hoses -1- and -3- attached.

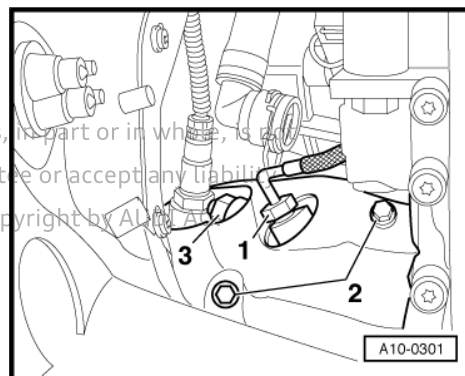


- Take electrical connectors for Lambda probe after catalytic converter - G130- -item 1- and Lambda probe - G39- -item 3- out of bracket (right-side) on bulkhead and unplug.
- Remove heat insulation sleeve at wiring harness and move wiring to Lambda probes clear.

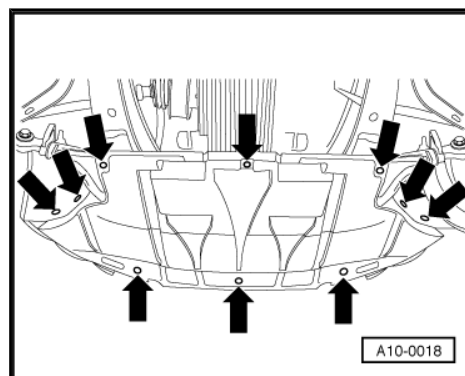




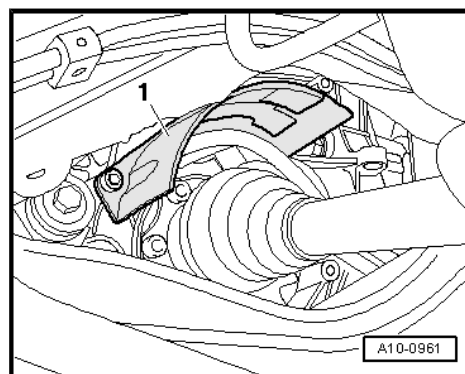
- Unbolt exhaust gas temperature sender 1 - G235- -item 1- from turbocharger.
- Unscrew bolts -2- for heat shield.
- Unscrew top nut -3- securing front exhaust pipe to turbocharger.



- Remove noise insulation -arrows-.



- Unbolt heat shield -1- for drive shaft (right-side).
- Unbolt drive shaft (right-side) from flange shaft on gearbox.



Note

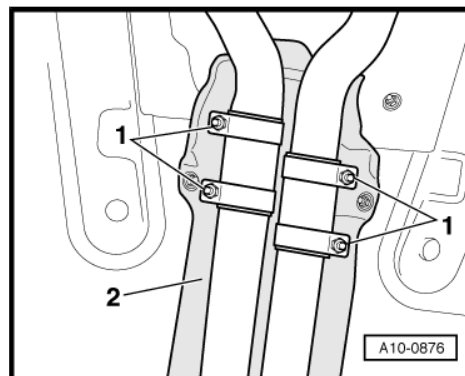
The flexible joint on the front exhaust pipe must not be bent more than 10° – otherwise it can be damaged.

- Disconnect exhaust system at clamps -1-.



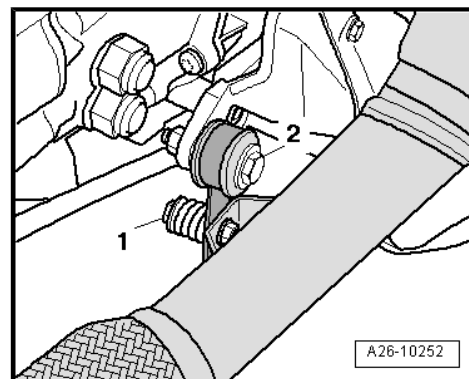
Note

Disregard -item 2-.

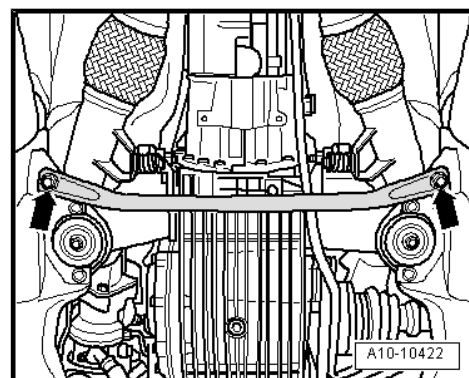




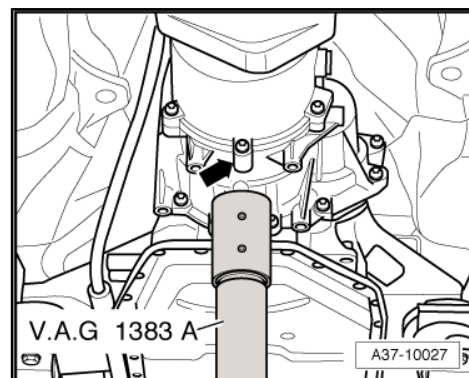
- Unscrew bolts -1- and -2- and remove mounting for front exhaust pipe (right-side).



- 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.



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Note

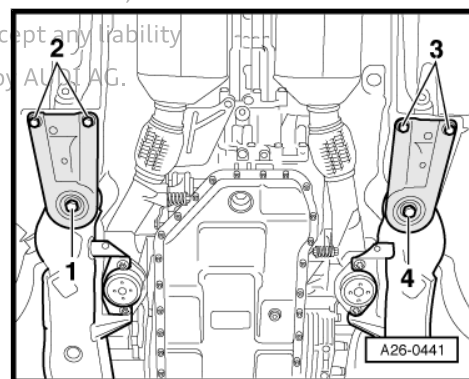
The lock carrier must be installed.

- 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- .



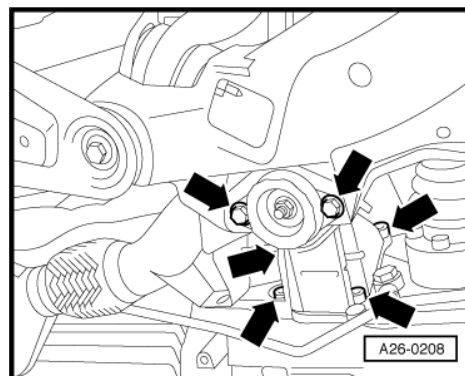
Note

Make sure that the propshaft joint is not damaged when lowering gearbox.

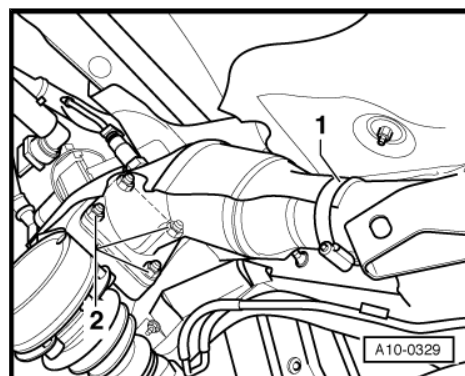




- Remove heat shield for gearbox support (right-side) -arrows-.
- Remove bolts and take off gearbox support with gearbox mounting.
- Move Lambda probe wires clear.



- 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

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) ⇒ Parts catalogue .*
- ◆ *Fit all heat insulation sleeves in the original position when installing.*
- ◆ *Fit all cable ties in the original positions when installing.*
- Install exhaust gas temperature sender 1 - G235-
⇒ [page 257](#) .
- Install gearbox support with gearbox mounting ⇒ Rep. gr. 34 .
- Install subframe ⇒ Rep. gr. 40 .



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Mounting components for exhaust system on gearbox
⇒ [page 234](#) with respect to the correctness of information in this document. Copyright by AUDI AG.

- Align exhaust system so it is free of stress ⇒ [page 249](#) .

Tightening torques

Component	Nm
Front exhaust pipe with Turbocharger	30 ¹⁾
starter catalytic converter Mounting plate	25
and main catalytic converter to:	
Mounting bracket to gearbox support	25
Heat shield for front exhaust pipe	10
Drive shaft heat shield to gearbox	23
Air duct to intake manifold	10
• 1) Renew nuts.	



1.4 Removing and installing exhaust manifold (left-side)

Special tools and workshop equipment required

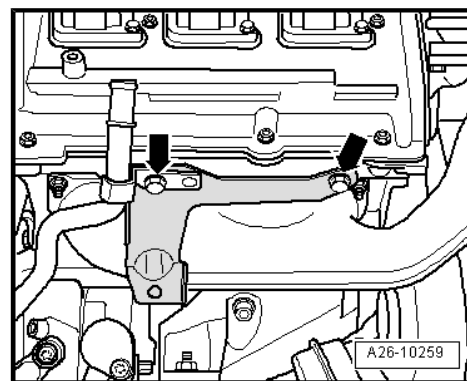
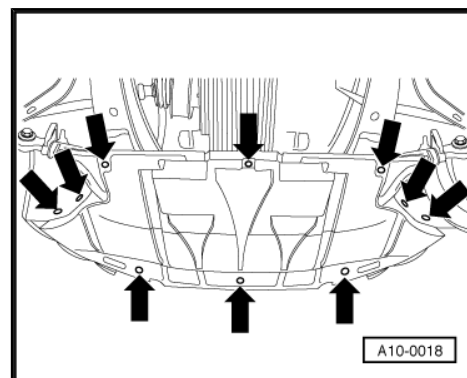
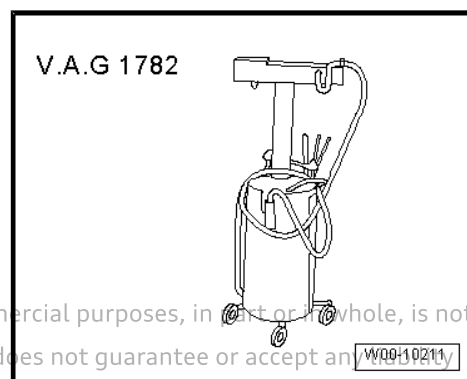
- ◆ Used oil collection and extraction unit - V.A.G 1782-



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Removing

- Remove noise insulation -arrows-.
- Place used oil collection and extraction unit - V.A.G 1782- beneath engine.
- Drain off engine oil.
- Remove engine ⇒ [page 2](#) .
- Leave engine on scissor-type assembly platform - VAS 6131- with gearbox attached.
- Remove turbocharger (left-side) ⇒ [page 217](#) .
- Unscrew bolts -arrows- and remove bracket for air pipe.





- Unscrew nuts -1 ... 9- and remove exhaust manifold (left-side).

Installing

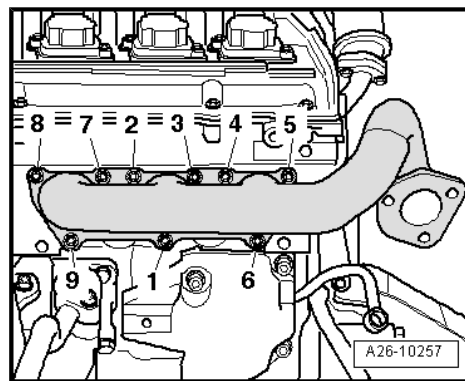
Installation is carried out in reverse order; note the following:



Note

Renew gaskets, seals and self-locking nuts.

- Tighten exhaust manifold in 2 stages in the sequence shown:
 1. Initially tighten to 15 Nm.
 2. Tighten to 25 Nm.
- Install turbocharger (left-side) ⇒ [page 217](#) .
- Install front exhaust pipe (left-side) with starter and main catalytic converter ⇒ [page 234](#) .
- Install engine ⇒ [page 27](#) .
- Fill up with engine oil and check oil level ⇒ [page 155](#) .



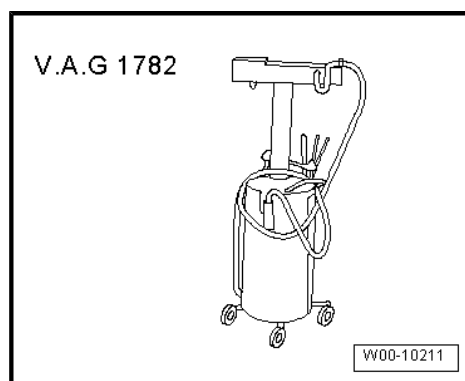
Tightening torque

Component	Nm
Exhaust manifold to cylinder head	25 ¹⁾²⁾
Bracket for air pipe to cylinder head	22
Oil drain plug	35
• ¹⁾ Renew nuts. • ²⁾ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue	

1.5 Removing and installing exhaust manifold (right-side)

Special tools and workshop equipment required

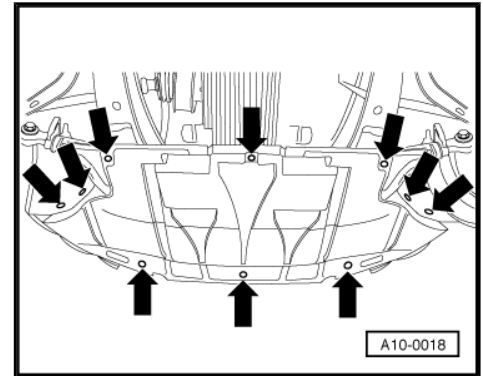
- ◆ Used oil collection and extraction unit - V.A.G 1782-





Removing

- Remove noise insulation -arrows-.
- Place used oil collection and extraction unit - V.A.G 1782- beneath engine.
- Drain off engine oil.
- Remove engine ⇒ [page 2](#) .
- Leave engine on scissor-type assembly platform - VAS 6131- with gearbox attached.
- Remove turbocharger (right-side) ⇒ [page 223](#) .



- Unscrew nuts -1 ... 9- and remove exhaust manifold (right-side).

Installing

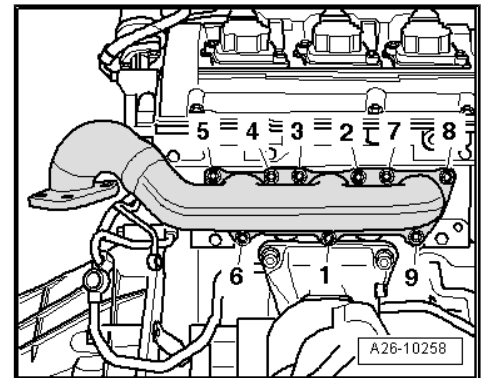
Installation is carried out in reverse order; note the following:



Note

Renew gaskets, seals and self-locking nuts.

- Tighten exhaust manifold in 2 stages in the sequence shown:
 1. Initially tighten to 15 Nm.
 2. Tighten to 25 Nm.
- Install turbocharger (right-side) ⇒ [page 223](#) .
- Install front exhaust pipe (right-side) with starter and main catalytic converter ⇒ [page 241](#) .
- Install engine ⇒ [page 27](#) .
- Fill up with engine oil and check oil level ⇒ [page 155](#) .



Tightening torques

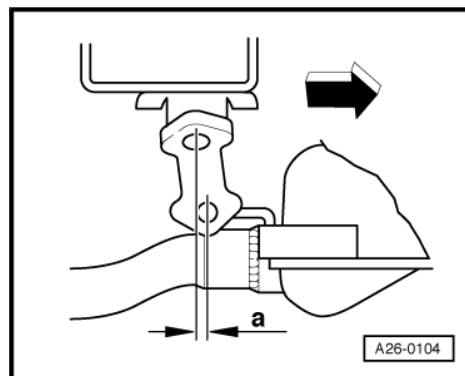
Component	Nm
Exhaust manifold to cylinder head	25 ¹⁾²⁾
Oil drain plug	35
• ¹⁾ Renew nuts. • ²⁾ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue	

1.6 Stress-free alignment of exhaust system

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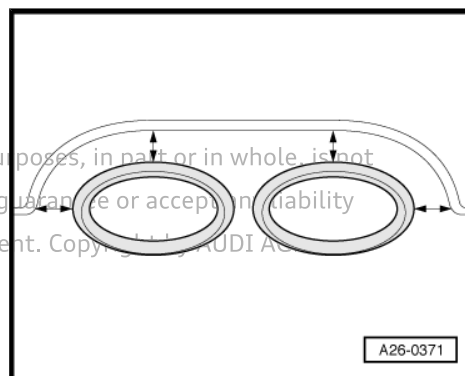


- Loosen bolts for clamps.
- Push exhaust system towards front of vehicle -arrow-, so that rubber mounting for rear silencer is preloaded by dimension -a- = 9 ... 11 mm.
- Tighten bolts on clamps evenly to 40 Nm.
- Align tailpipes ⇒ [page 250](#) .



Aligning tailpipes

- Check clearance between tailpipes and bumper on both sides and above tailpipes:
- The clearance must be the same on all sides.



1.7 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Seal off tailpipes for duration of leak test with cloths or plugs, etc.
- Listen at joints between cylinder head/exhaust manifold, exhaust manifold/turbocharger, turbocharger/front exhaust pipe etc. to check for leaks.
- Repair any leaks that are found.



2 Exhaust gas temperature monitoring

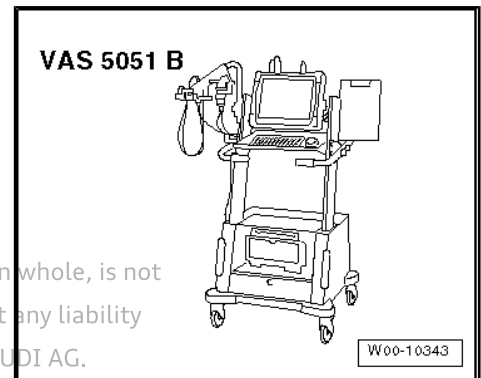
2.1 Checking function of exhaust gas temperature monitoring

Special tools and workshop equipment required

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



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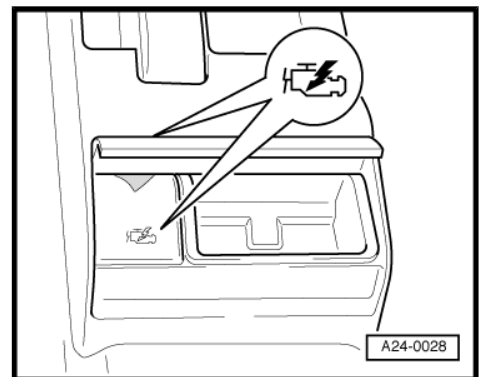
Procedure



WARNING

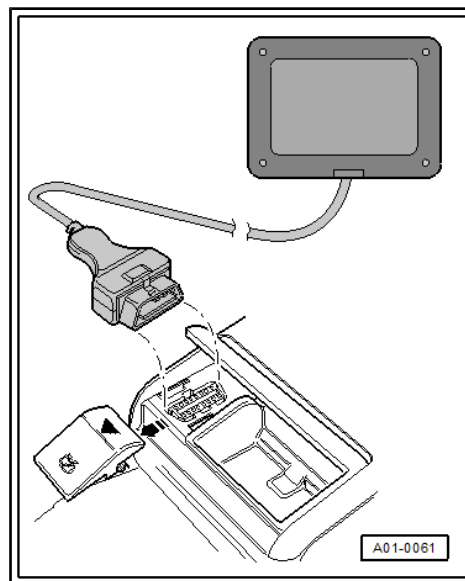
- ◆ *Test equipment must always be secured on the rear seat and operated from that position by a second person.*
- ◆ *If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, the person sitting in this seat could be seriously injured when the airbag is triggered.*

- Coolant temperature at least 80 °C.
- Open rear ashtray and remove cover for diagnostic connector.



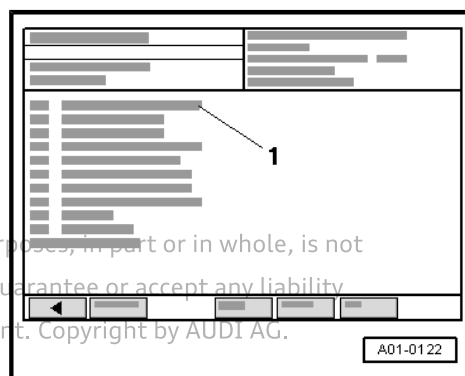


- Connect up vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1- , press vehicle self-diagnosis button and select vehicle system “01 - Engine electronics”. Engine must be idling.



Display on -VAS 5051- :

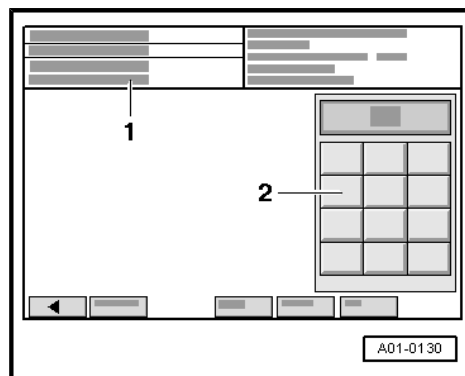
- From the list -1- select diagnostic function “08 - Read measured value block”.



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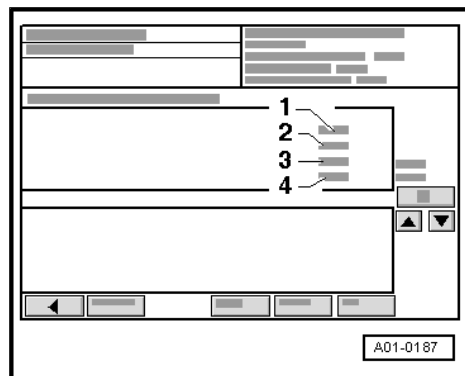
Display on -VAS 5051- :

- 1 - Enter display group.
- Enter “112” for “Display group number 112” on keypad -2- and confirm by pressing Q key.



Display on -VAS 5051- :

- 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-





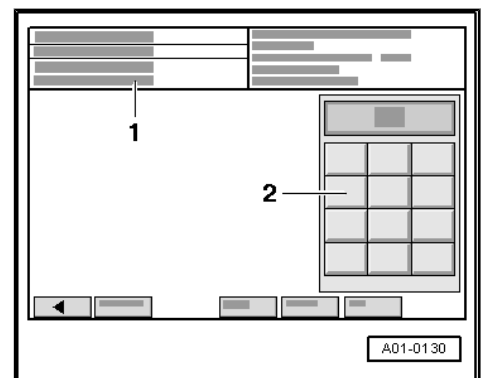
Display zones		Explanatory notes
1	... °C	Exhaust gas temperature bank 1 (cylinder bank right-side) • Specification 980 °C ¹⁾²⁾³⁾
2	... %	Enrichment factor Sensor Bank 1 (cylinder bank right-side) • Specification: 20 ± 5 % ⁴⁾
3	... °C	Exhaust gas temperature bank 2 (cylinder bank left-side) • Specification 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 5051- :

1 - Enter display group.

– Enter "220" for "Display group number 220" on keypad -2- and confirm by pressing key.



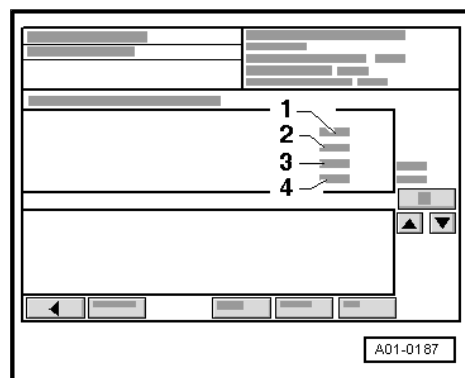
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Display on -VAS 5051- :

- 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

- Exit function “08 - Read measured value block” by pressing key.
- Select “06 - End output”.
- Terminate road test, switch off ignition and unplug diagnostic connector.

If the specifications are not obtained:

- Check exhaust gas temperature sender [⇒ page 254](#) .

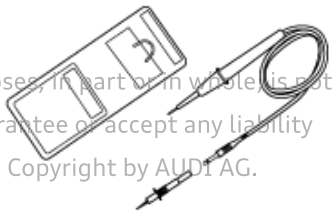
2.2 Checking exhaust gas temperature sender



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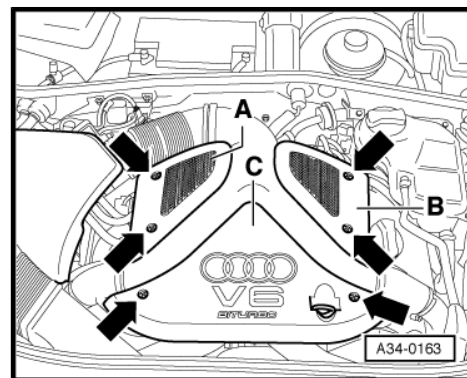
Special tools and workshop equipment required

V.A.G 1526 A 	V.A.G 1527 B 
V.A.G 1594 A 	V.A.G 1598/31 
	G24-0022

- ◆ Hand-held multimeter - V.A.G 1526 C- or -V.A.G 1526 A-
- ◆ Voltage tester - V.A.G 1527 B-
- ◆ Auxiliary measuring set - V.A.G 1594 C- or -V.A.G 1594 A-
- ◆ Adapter cable - V.A.G 1598/31- (test box)

Procedure

- Switch off ignition.
- Unfasten screw connections -top left arrows- and detach engine cover panel -A-.





- Unplug electrical connector on control unit of relevant exhaust gas temperature sender.
- 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 1527 B- 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.

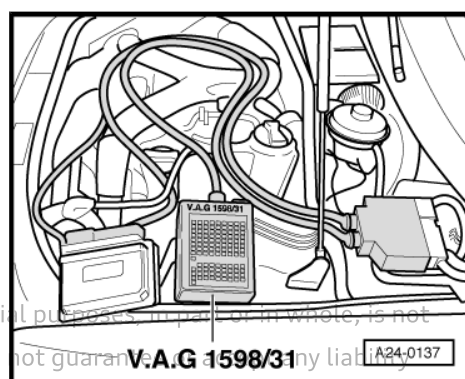
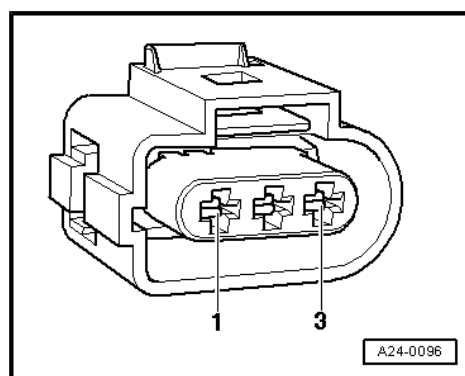
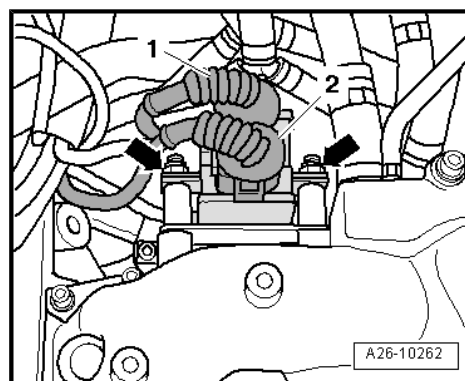
If the LED lights up:

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**

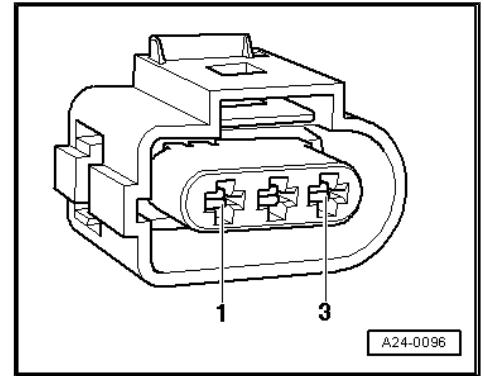
To prevent damage to electronic components, select appropriate measuring range before connecting measuring leads and observe test requirements.





- 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)	62
Exhaust gas temperature sender 1 for bank 2 - G236- , bank 2 (left-side)	-1- (signal)	20
	-2- (earth)	62



- Repair wiring connection if necessary.

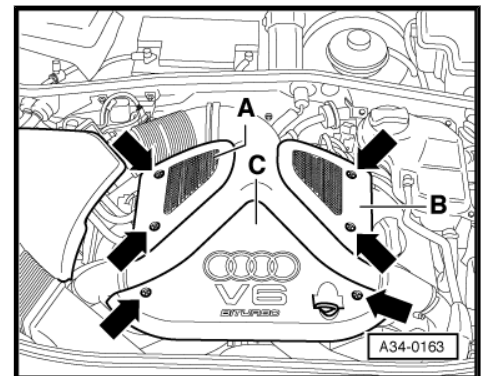
If wiring is OK:

- Renew exhaust gas temperature sender: left-side
⇒ [page 259](#) , right-side ⇒ [page 257](#) .

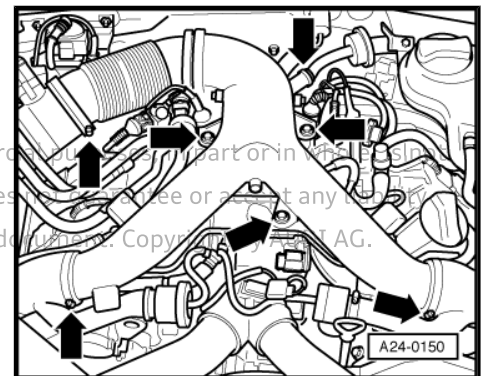
2.3 Removing and installing exhaust gas temperature sender 1 - G235-

Removing

- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.



- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.



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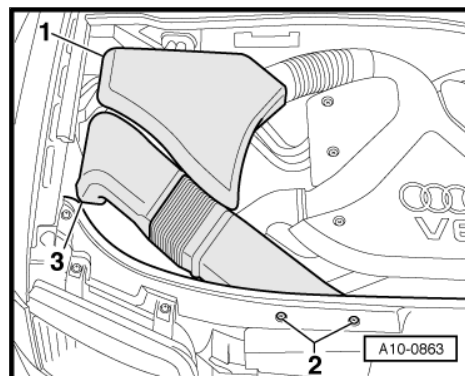


- Remove cover -1- on right side of engine compartment.



Note

Disregard items marked -2- and -3-.

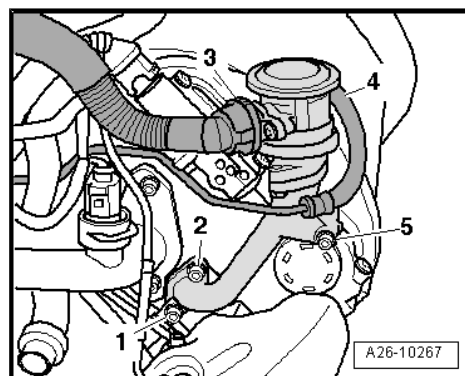


- Detach air intake hose -3- from combination valve for secondary air system.

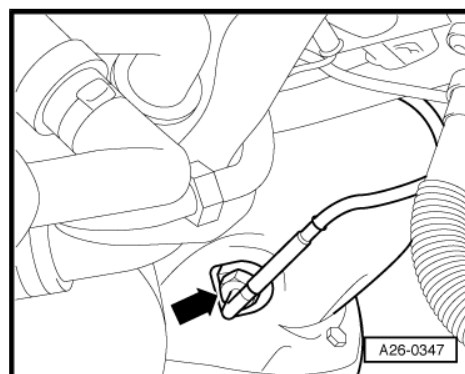


Note

- ◆ *Disregard -items 1, 2, 4, 5-.*
- ◆ *Shown from rear for illustration purposes.*



- Unbolt exhaust gas temperature sender 1 - G235- -arrow- from turbocharger.
- Move electrical wire to control unit for exhaust gas temperature sender clear.



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- Unplug electrical connectors -1- and -2-.
- Unbolt the control units for exhaust gas temperature senders from intake manifold -arrows-.
- Remove exhaust gas temperature sender 1 - G235- with control unit (brown connector).

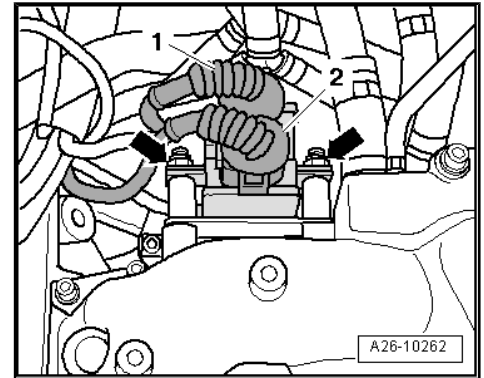
Installing

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



Note

Fit all cable ties in the original positions when installing.



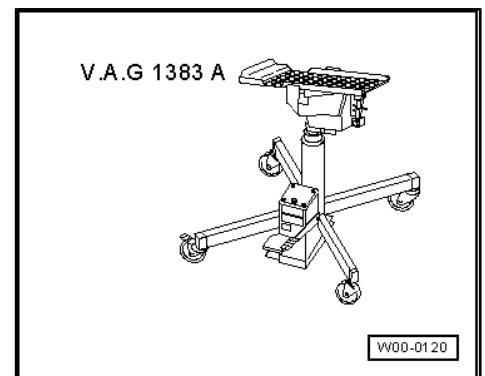
Tightening torques

Component	Nm
Exhaust gas temperature sender - G235- to turbocharger	27
Control unit for exhaust gas temperature sender to intake manifold	8 ¹⁾
Air duct to intake manifold	10
• ¹⁾ Renew self-locking nuts.	

2.4 Removing and installing exhaust gas temperature sender 1 for bank 2 - G236-

Special tools and workshop equipment required

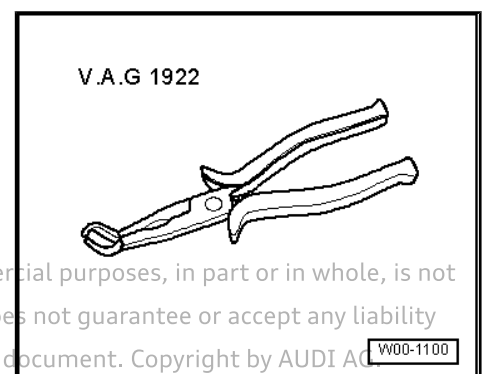
- ◆ Engine and gearbox jack - V.A.G 1383 A-



- ◆ Spark plug connector pliers - V.A.G 1922-



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Removing



Note

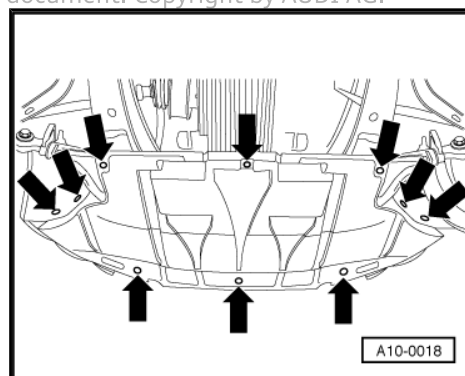


- ♦ *Fit all heat insulation sleeves in the original position when installing.*

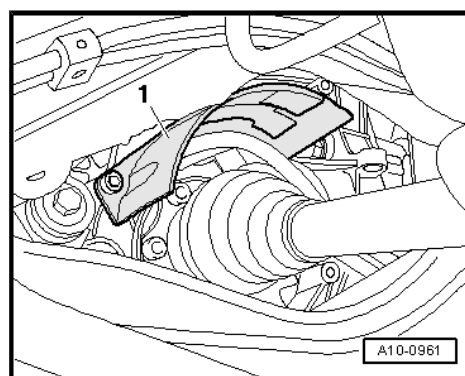
- ♦ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*

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- Remove noise insulation -arrows-.



- Unbolt heat shield -1- for drive shaft (left-side).
- Detach drive shaft (left-side) from flange shaft of gearbox.

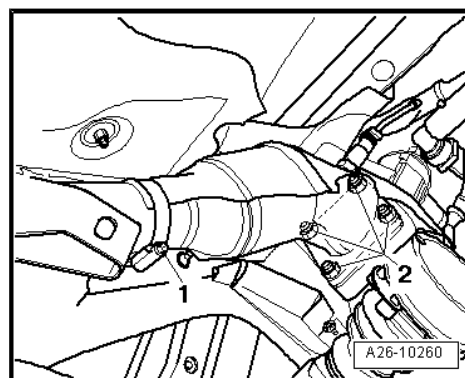


- Slacken hose clip -1- on heat shield for front exhaust pipe



Note

Disregard -item 2-.



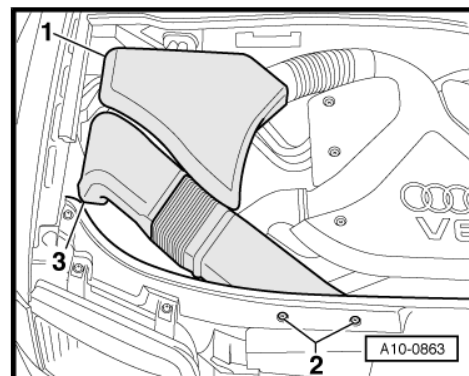


- Remove cover -1- on right side of engine compartment.

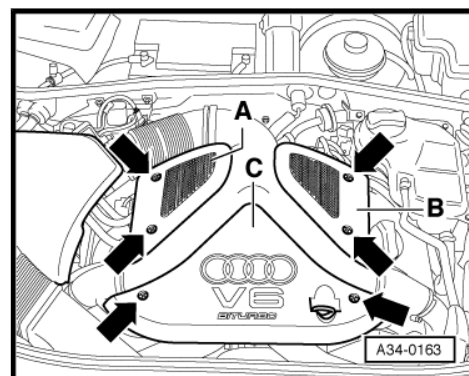


Note

Disregard items marked -2- and -3-.



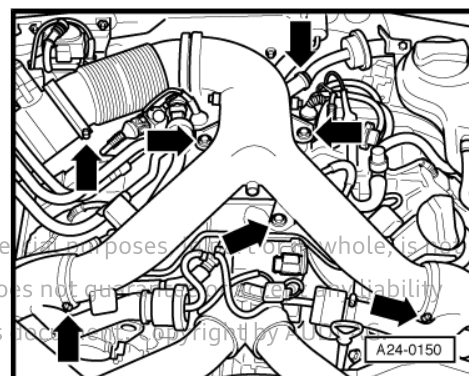
- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.



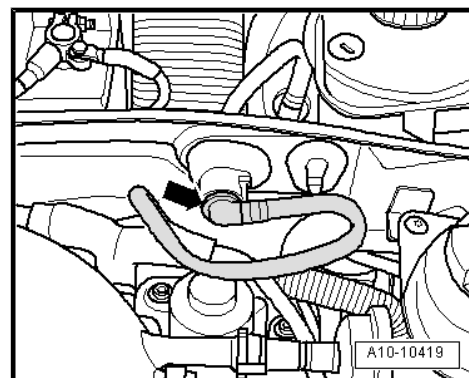
- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.



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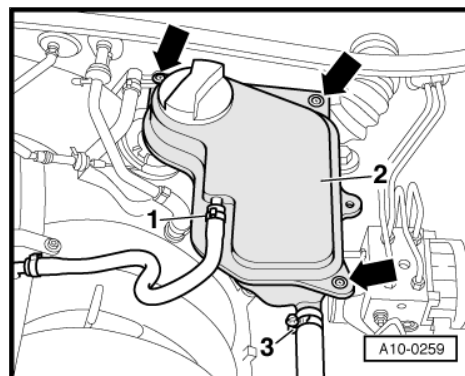


- Detach vacuum line -arrow- going to brake servo at bulkhead.

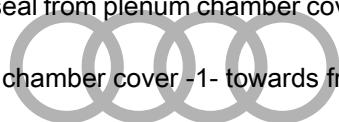




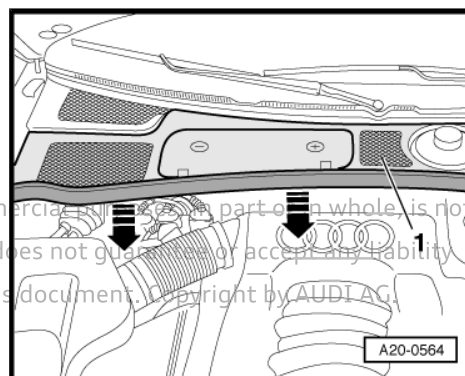
- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical wire for coolant shortage indicator switch - F66- at bottom of expansion tank and move expansion tank to one side with coolant hoses -1- and -3- attached.



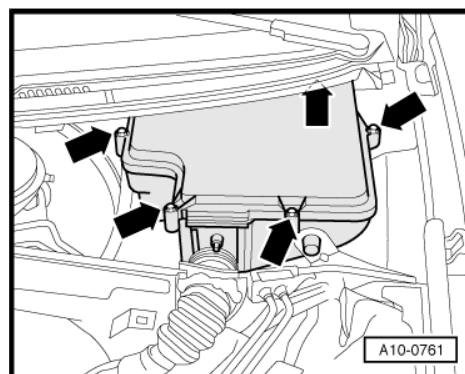
- Detach rubber seal from plenum chamber cover in direction of -arrow-.
- Detach plenum chamber cover -1- towards front.



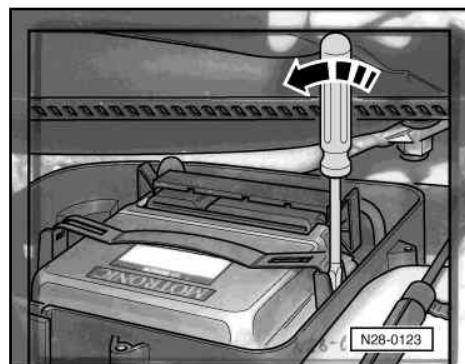
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- Remove cover for electronics box in plenum chamber -arrows-.



- Carefully lever off retaining strap with a screwdriver -arrow-.
- Lay aside engine control unit with electrical connectors attached.



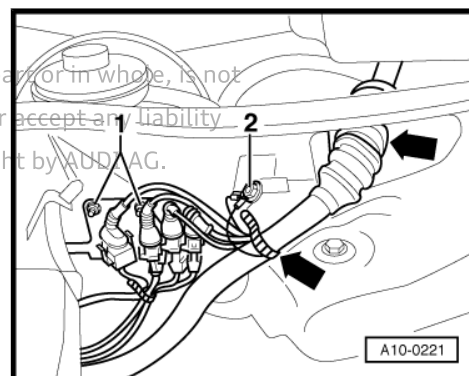
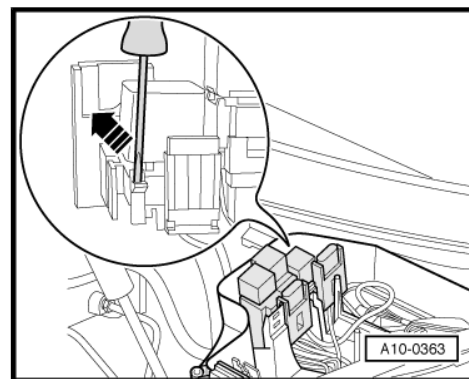


- Release retainer -arrow- and pull auxiliary relay carrier in electronics box upwards to remove.
- Disconnect electrical connectors at connector point using spark plug connector pliers - V.A.G 1922- .

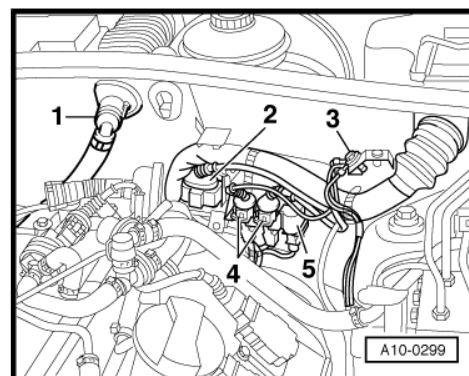


- Detach earth connection -2- and retainer -1- for electrical connectors from bulkhead.
- Disengage engine wiring harness at electronics box and bulkhead -arrows- and move clear.

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- 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.



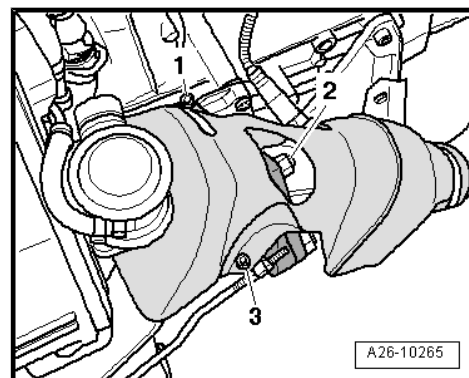
- Unscrew bolts -1- and -3- for heat shield.



Note

Disregard -item 2-.

- Unscrew Lambda probe from front exhaust pipe (left-side).
- Bend heat shield for front exhaust pipe to the side.





- Unscrew exhaust gas temperature sender 1 for cylinder bank 2 - G236- -arrow- from exhaust manifold flange.
- Move electrical wire to control unit for exhaust gas temperature sender clear.



- Unplug electrical connectors -1- and -2-.
- Unbolt the 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

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

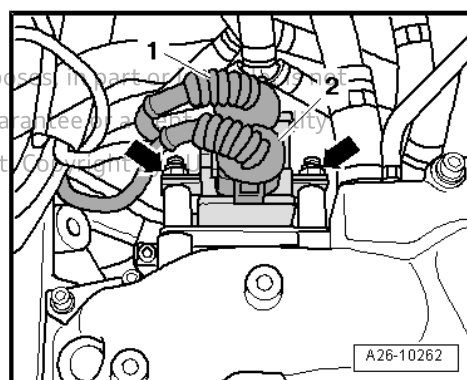
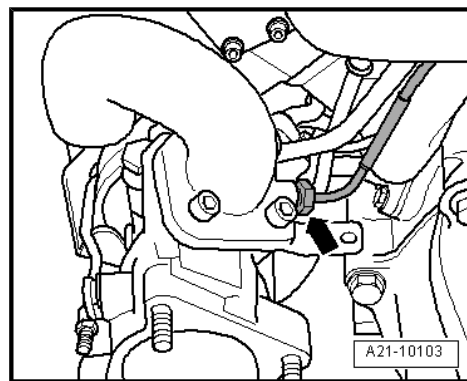


Note

- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue .*
- ◆ *Fit all heat insulation sleeves in the original position when installing.*
- ◆ *Fit all cable ties in the original positions when 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⁾
Lambda probe to front exhaust pipe	55
Heat shield for front exhaust pipe	10
Air duct to intake manifold	10
Drive shaft heat shield to gearbox	23
• 1) Renew self-locking nuts.	





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 oxidation 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.



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**1 - Secondary air pump relay - J299-**

- ☐ Fitting location
⇒ [page 267](#)
- ☐ Checking ⇒ [page 271](#)

2 - Motronic control unit - J220-**3 - Combination valve for secondary air system (right-side)**

- ☐ Fitting location
⇒ [page 266](#)
- ☐ Checking ⇒ [page 277](#)
- ☐ Removing and installing
⇒ [page 284](#)

4 - Secondary air inlet valve - N112-

- ☐ Fitting location
⇒ [page 266](#)
- ☐ Checking ⇒ [page 267](#)

5 - Secondary air pump motor - V101-

- ☐ Fitting location
⇒ [page 266](#)
- ☐ Removing and installing
⇒ [page 280](#)

6 - Non-return valve

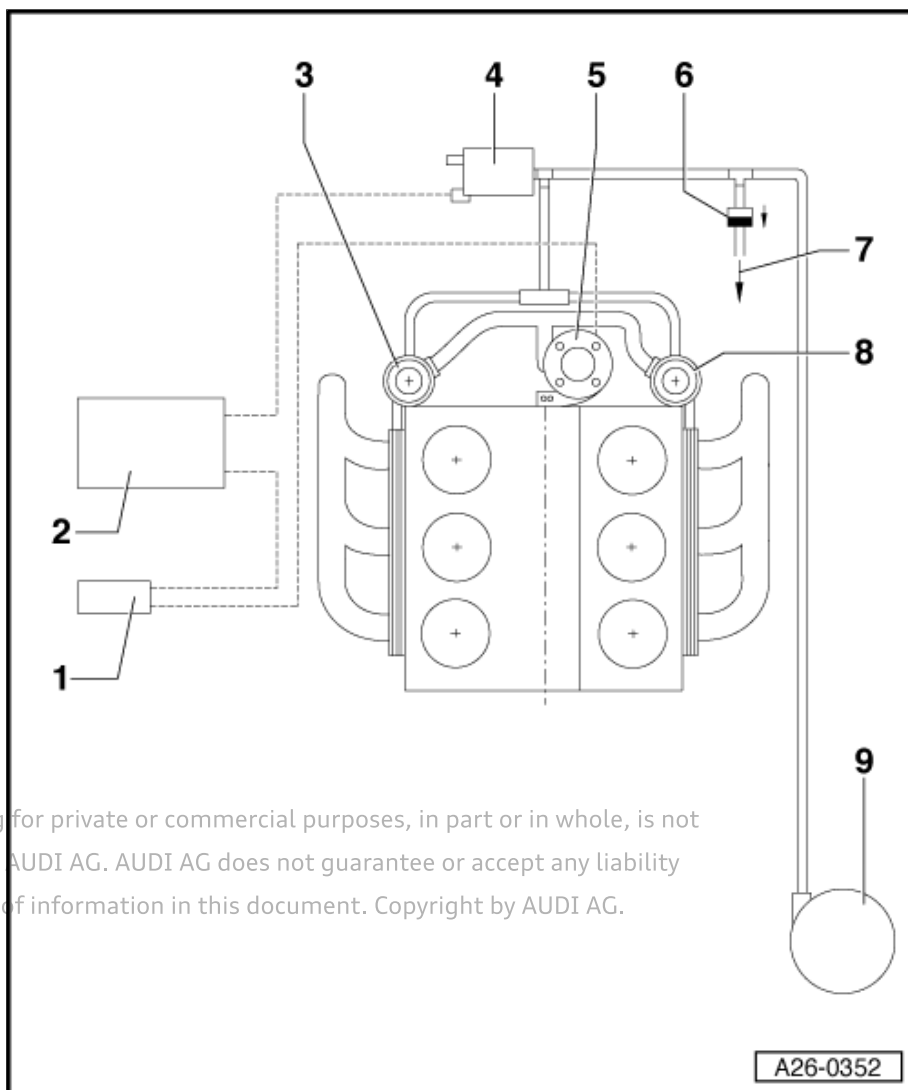
- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

7 - To intake manifold**8 - Combination valve for secondary air system (left-side)**

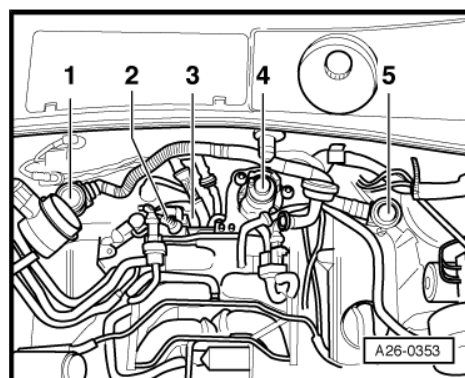
- ☐ Fitting location ⇒ [page 266](#)
- ☐ Checking ⇒ [page 277](#)
- ☐ Removing and installing ⇒ [page 282](#)

9 - Vacuum reservoir

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

**Fitting locations in engine compartment**

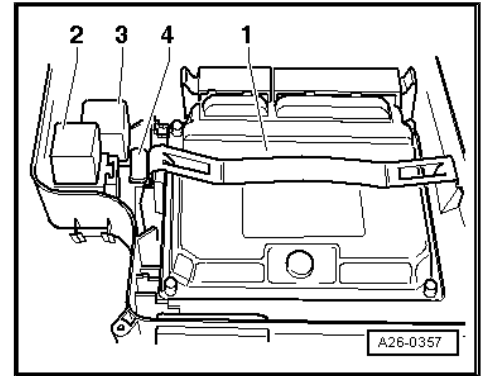
- 1 - Combination valve for secondary air system (right-side)
- 2 - (Ignore)
- 3 - Secondary air inlet valve - N112- (located below control units for exhaust gas temperature -item 2-).
- 4 - Secondary air pump motor - V101-
- 5 - Combination valve for secondary air system (left-side)





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

V.A.G 1526 A	V.A.G 1527 B
V.A.G 1594 A	V.A.G 1598/31
VAS 5051	G24-0023



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



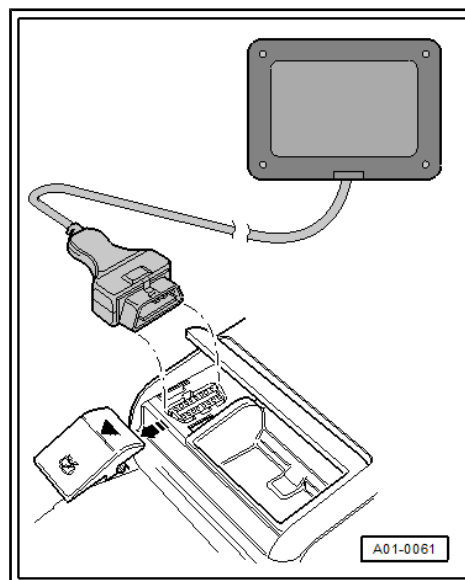
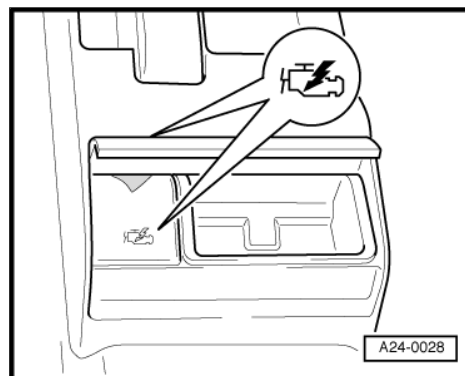
Procedure



Note

The secondary air inlet valve - N112- and the wiring connections are monitored by the engine control unit.

- Open rear ashtray and remove cover for diagnostic connector.
- Connect up vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1- , press vehicle self-diagnosis button and select vehicle system "01 - Engine electronics". When doing this, the engine must be running at idling speed.



Display on -VAS 5051- :

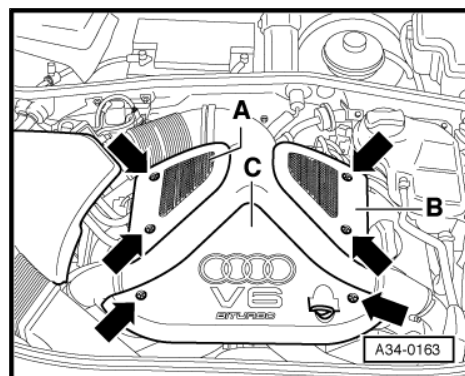
- From list -1-, select diagnosis function "02 - Interrogate fault memory".

If a fault relating to secondary air inlet valve - N112- is displayed:

- Terminate function "02 - Interrogate fault memory" by pressing key.
- Press function "06 - End output" and switch off ignition.



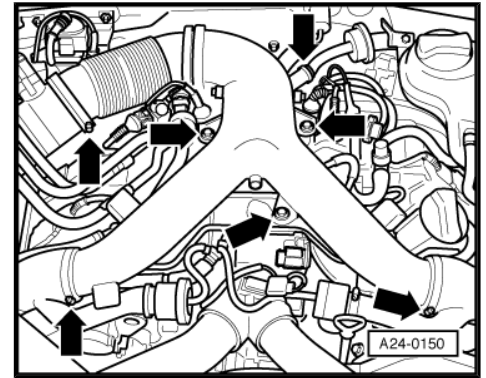
- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.



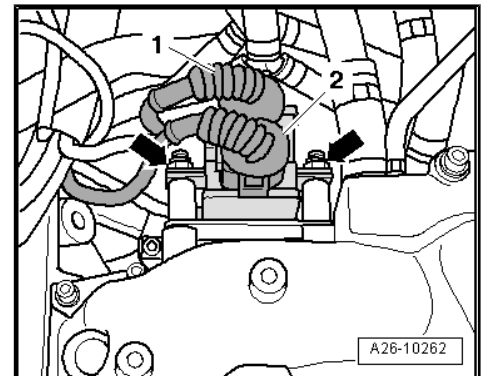
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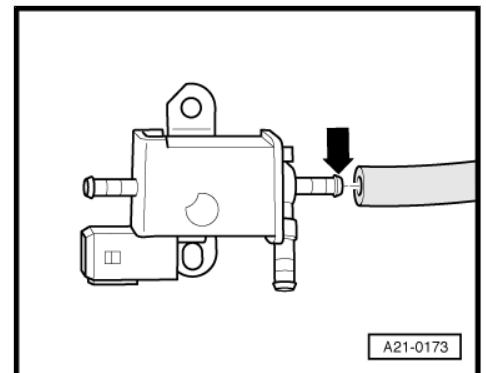
- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.



- 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- .



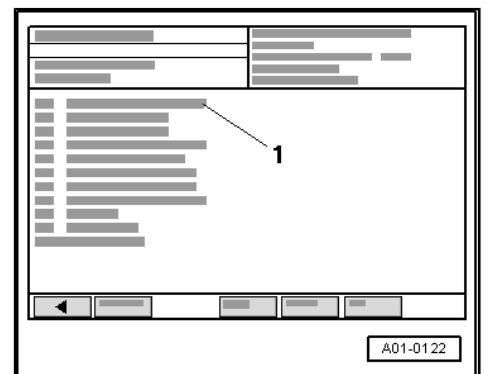
- Connect test hose to secondary air inlet valve - N112- connector marked with an -arrow-.



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

Display on -VAS 5051- :

- From the menu -1- select the diagnostic function “03 - Final control diagnosis”.





- Press  key repeatedly until the following display appears:

Display on -VAS 5051- :

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).

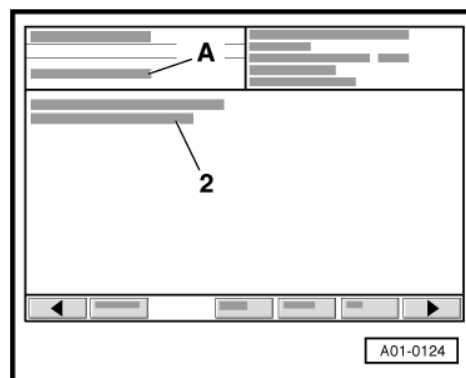
- Press  key to exit “03 - Final control diagnosis” function.

- Press function “06 - 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:



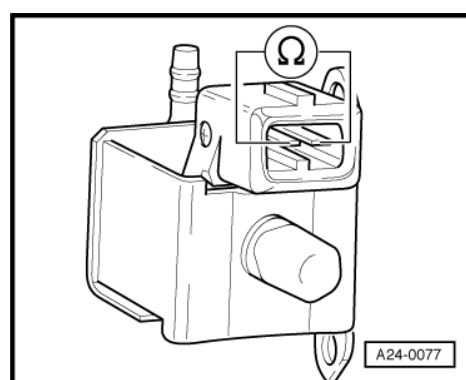
Checking internal resistance

- Unplug electrical connector at secondary air inlet valve - N112- .
- Connect hand-held multimeter - V.A.G 1526 C- 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 $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay - J17- OK $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.



Note

The secondary air inlet valve - N112- is supplied with power via the fuel pump relay - J17- .

- Connect voltage tester - V.A.G 1527 B- between contact -1- of connector for secondary air inlet valve - N112- and engine earth.

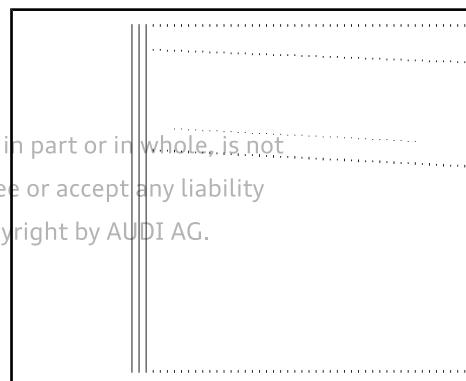
- Operate starter briefly.

- 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).

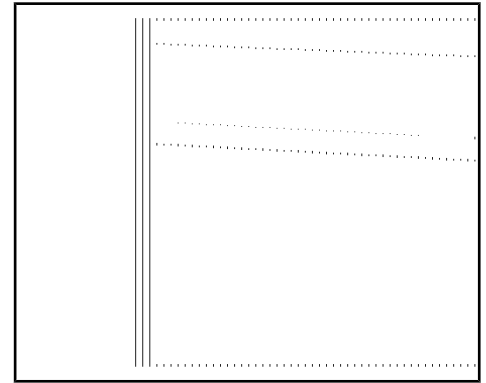
If the LED lights up:





Checking activation

- Connect voltage tester - V.A.G 1527 B- between contact -1- and -2- of connector for secondary air inlet valve - N112- .
- Switch on ignition and select vehicle system “01 - Engine electronics”.



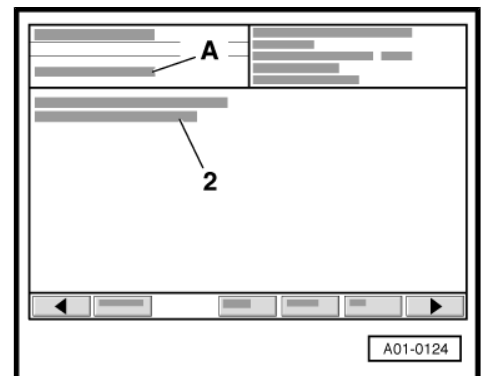
- Repeat function “03 - Final control diagnosis”.
- Press key repeatedly until the following display appears:

Display on -VAS 5051- :

2 - Secondary air inlet valve - N112-

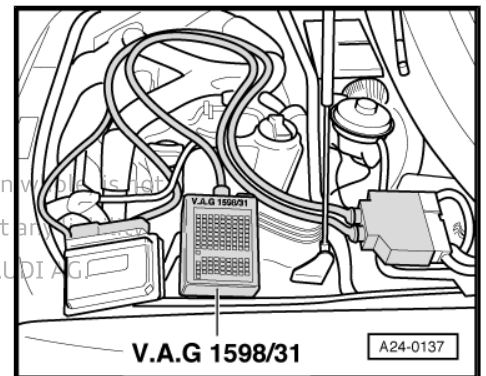
A - Actuator is running; continued switching is allowed

- The LED should flash.
- Press key to exit “03 - Final control diagnosis” function.
- Press function “06 - 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).



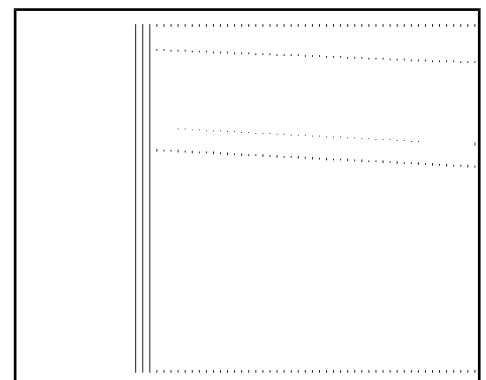
Caution

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:

Connector Contact	Adapter cable - V.A.G 1598/31- (test box) Socket
-2-	44

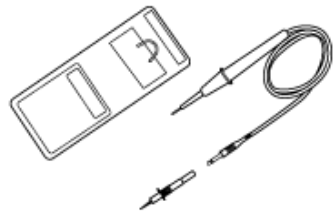
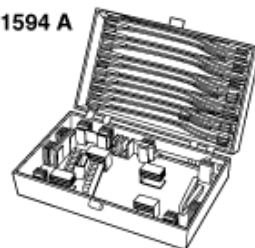
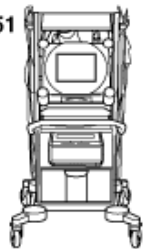
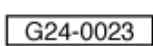
- Repair wiring connection if necessary.



3.3 Checking secondary air pump relay - J299- and activation



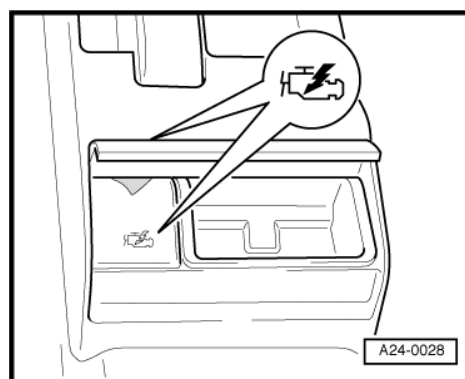
Special tools and workshop equipment required

V.A.G 1526 A 	V.A.G 1527 B 
V.A.G 1594 A 	V.A.G 1598/31 
VAS 5051 	

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

Procedure

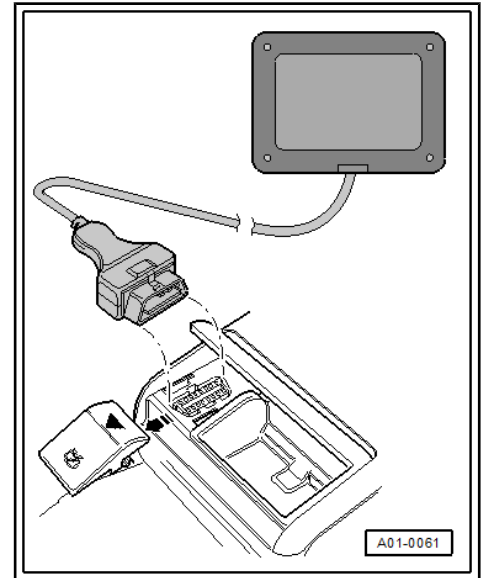
- Open rear ashtray and remove cover for diagnostic connector.



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- Connect up vehicle diagnostic, testing and information system - VAS 5051- with diagnostic cable - VAS 5051/1- , press ve-
hicle self-diagnosis button and select vehicle system "01
- Engine electronics". When doing this, the engine must be
running at idling speed.

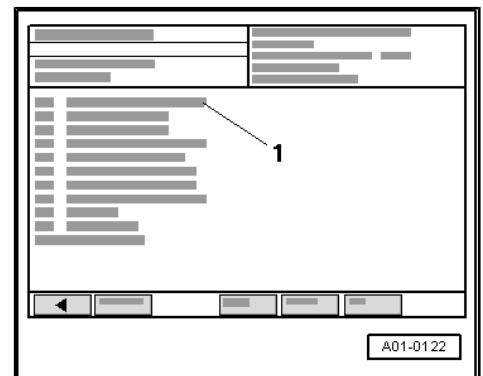


Display on -VAS 5051- :

- From list -1-, select diagnosis function "02 - Interrogate fault memory".

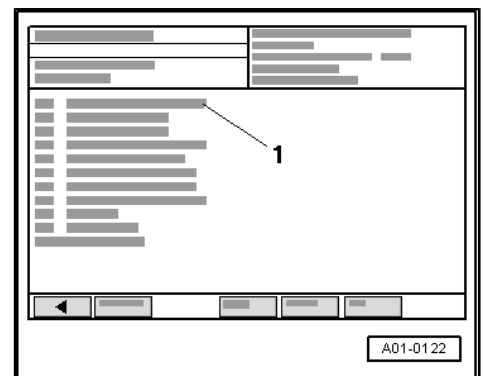
If the display shows a fault relating to secondary air pump relay - J299- :

- Terminate function "02 - Interrogate fault memory" by pressing key.



Display on -VAS 5051- :

- From the menu -1- select the diagnostic function "03 - Final control diagnosis".

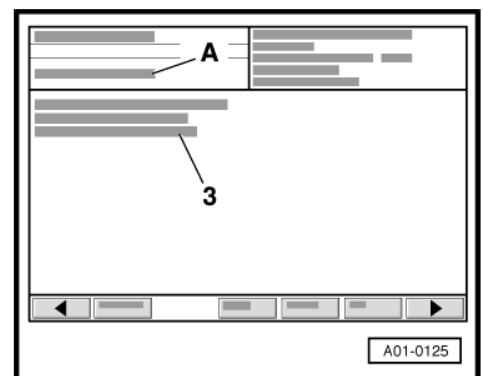


- Press key repeatedly until the following display appears:

Display on -VAS 5051- :

3 - Secondary air pump relay - J299-

A - Actuator is running; continued switching is allowed



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- 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 “03 - Final control diagnosis” function.
- Press function “06 - end output” and switch off the ignition.

A - If the relay does not pick up:

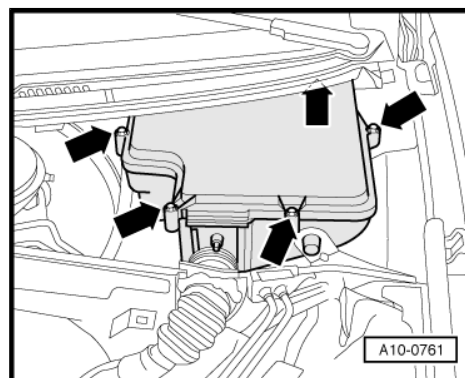
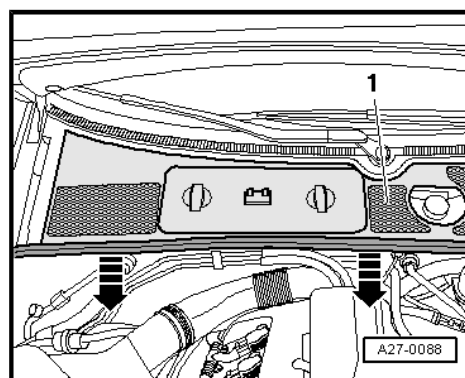
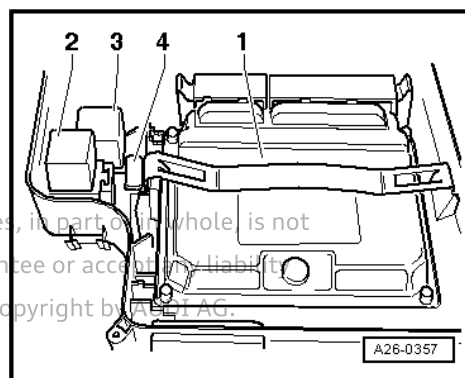
- Check voltage supply of secondary air pump relay - J299-
⇒ [page 274](#).
- Check activation of secondary air pump relay - J299-
⇒ [page 275](#).

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 276](#).

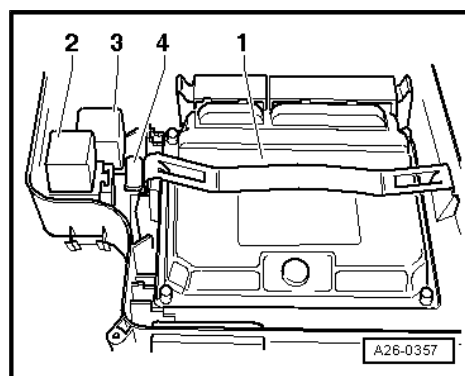
Checking voltage supply of secondary air pump relay - J299-

- Run windscreen wipers to the vertical position.
- Detach rubber seal from plenum chamber cover in direction of -arrow-.
- Detach plenum chamber cover -1- towards front.



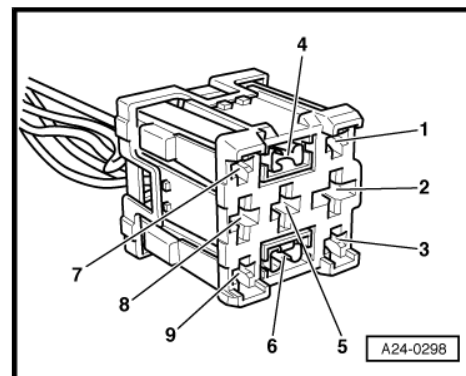
- Remove cover for electronics box in plenum chamber -arrows-.

- Disconnect secondary air pump relay - J299- -item 2-.



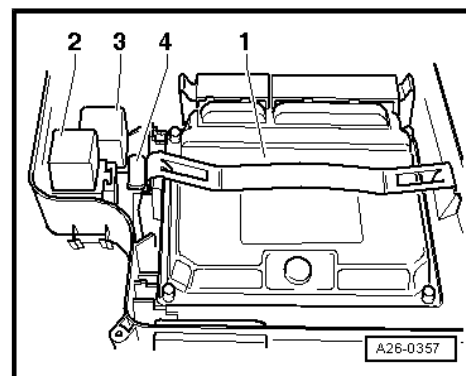


- Connect hand-held multimeter - V.A.G 1526 C- (voltage measuring range) between relay socket contact -8- and earth.
- Specification: approx. battery voltage



If specification is not obtained:

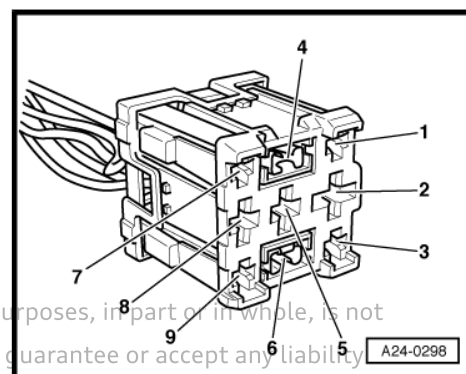
- Check secondary air pump fuse - S130- -item 4-.
- Check for open circuit in wiring from battery "+" (terminal 30), via secondary air pump fuse - S130- -item 4- to secondary air pump relay - J299- -item 2-.



- Connect hand-held multimeter - V.A.G 1526 C- (voltage measuring range) between relay socket contact -4- and earth.
- Operate starter briefly.
- Specification: approx. battery voltage

If specification is not obtained:

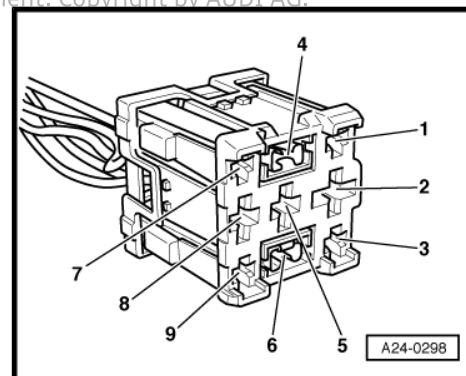
- Repair wiring harness according to current flow diagram.



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Checking activation of secondary air pump relay - J299-

- Switch off ignition.
- Disconnect secondary air pump relay - J299- .
- Connect up voltage tester - V.A.G 1527 B- between relay socket contact -6- and battery positive.
- Switch on ignition and select vehicle system "01 - Engine electronics".





- Repeat function “03 - Final control diagnosis”.
- Press key repeatedly until the following display appears:

Display on -VAS 5051- :

3 - Secondary air pump relay - J299-

A - Actuator is running; continued switching is allowed

- The LED should flash.
- Press key to exit “03 - Final control diagnosis” function.
- Press function “06 - End output” and switch off ignition.

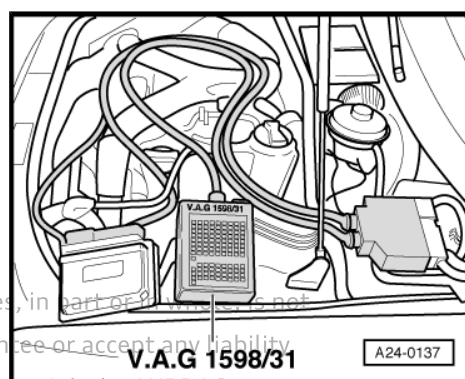
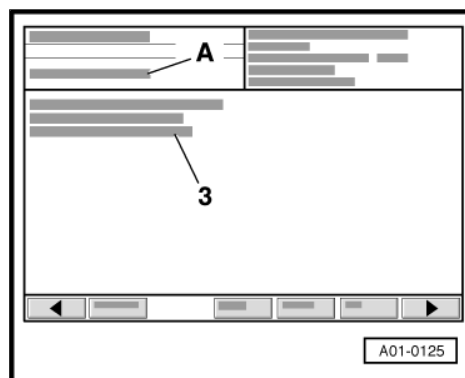
If the LED does not flash:

- 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

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:

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- .

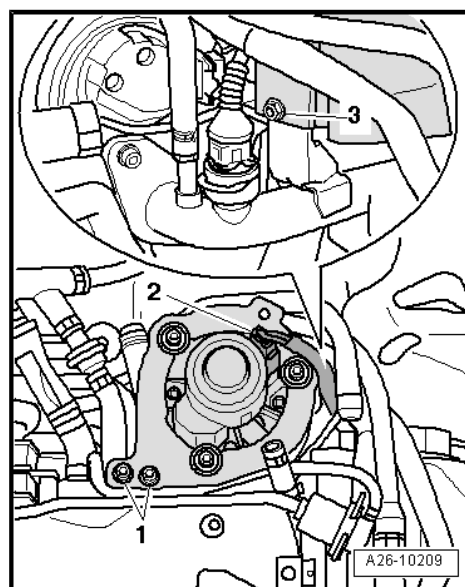
Checking voltage supply for secondary air pump motor - V101-

- Unplug electrical connector -2- at secondary air pump motor - V101- .



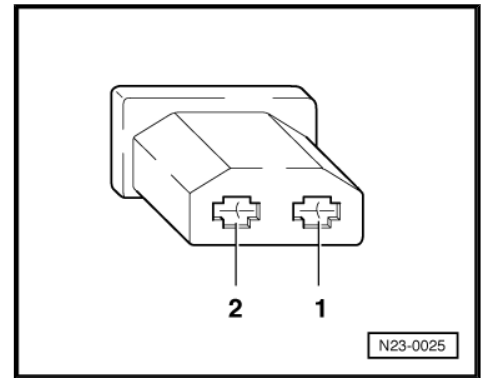
Note

Disregard items marked -1- and -3-.





- Connect voltage tester - V.A.G 1527 B- between contact -1- and -2- of connector for secondary air pump motor - V101- .
- Switch on ignition and select vehicle system "01 - Engine electronics".



- Repeat function "03 - Final control diagnosis".
- Press key repeatedly until the following display appears:

Display on -VAS 5051- :

3 - Secondary air pump relay - J299-

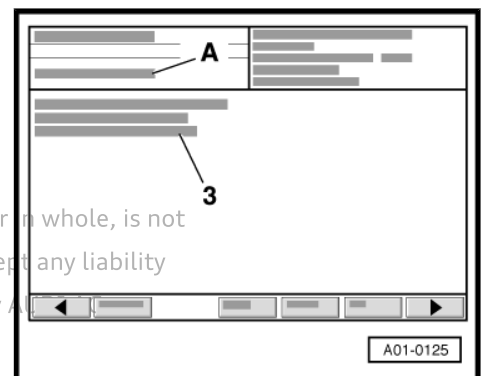
A - Actuator is running; continued switching is allowed

- The LED should flash.

- Press key to exit "03 - Final control diagnosis" function.

- Press function "06 - End output".

- Switch off ignition and unplug diagnostic connector.

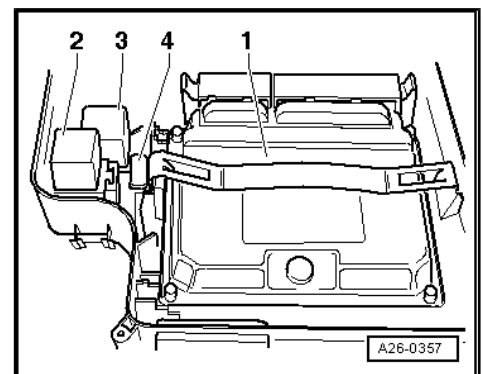


If the LED does not flash:

- 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:

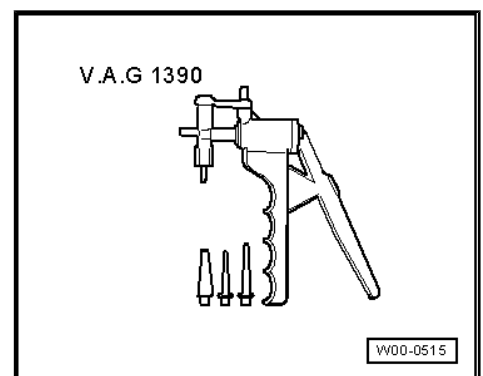
- Renew secondary air pump.



3.4 Checking combination valves for secondary air system for correct operation and leakage

Special tools and workshop equipment required

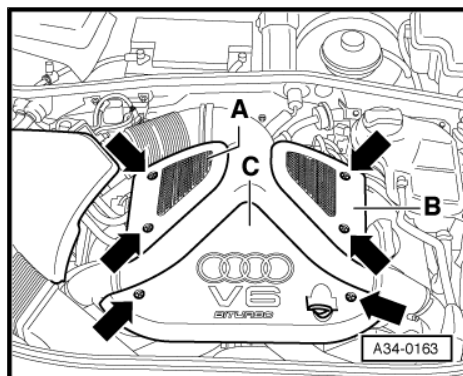
- ◆ Hand vacuum pump with attachments - V.A.G 1390-



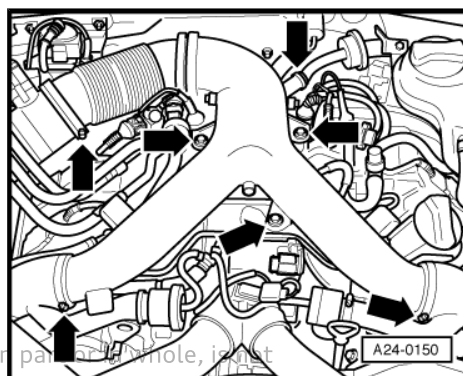


Procedure

- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.



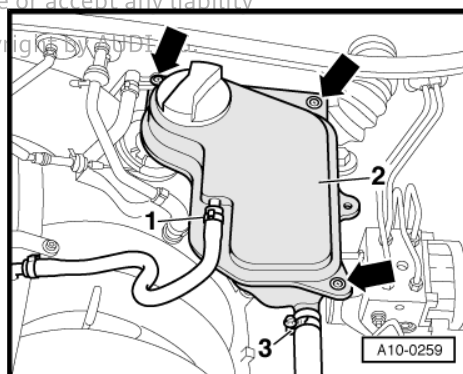
- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.



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Combination valve for secondary air (left-side):

- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical wire for coolant shortage indicator switch - F66- at bottom of expansion tank and move expansion tank to one side with coolant hoses -1- and -3- attached.



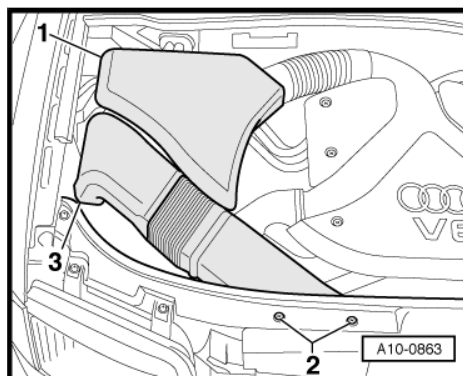
Combination valve for secondary air (right-side):

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



Note

Disregard items marked -2- and -3-.





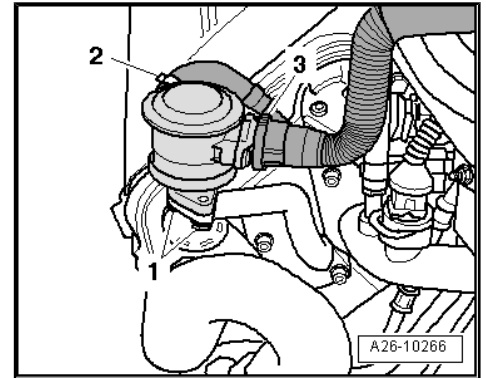
Continued for both combination valves for secondary air system:

- Detach air intake hose -3- and vacuum hose -2- from relevant combination valve for secondary air system.



Note

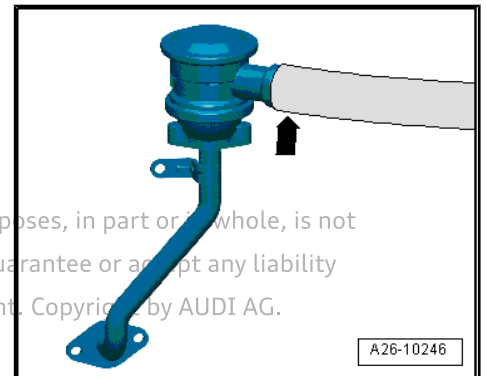
Disregard -item 1-.



- Connect suitable hose -arrow- to air intake hose connection on combination valve for secondary air.



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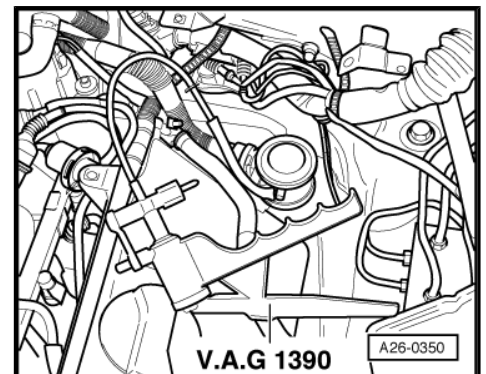


- Connect hand vacuum pump - V.A.G 1390- to vacuum connection of combination valve for secondary air.
- Blow gently into hose (do not use compressed air).
- The combination valve for secondary air system should be closed; it should not be possible to blow through the hose.
- Use hand vacuum pump to generate 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 282](#) , on right-side ⇒ [page 284](#) .

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) ⇒ Parts catalogue .

Tightening torque

Component	Nm
Air duct to intake manifold	10

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 280](#)

- 6 - Air hose
- ❑ To combination valves for secondary air inlet

7 - 10 Nm

8 - 10 Nm

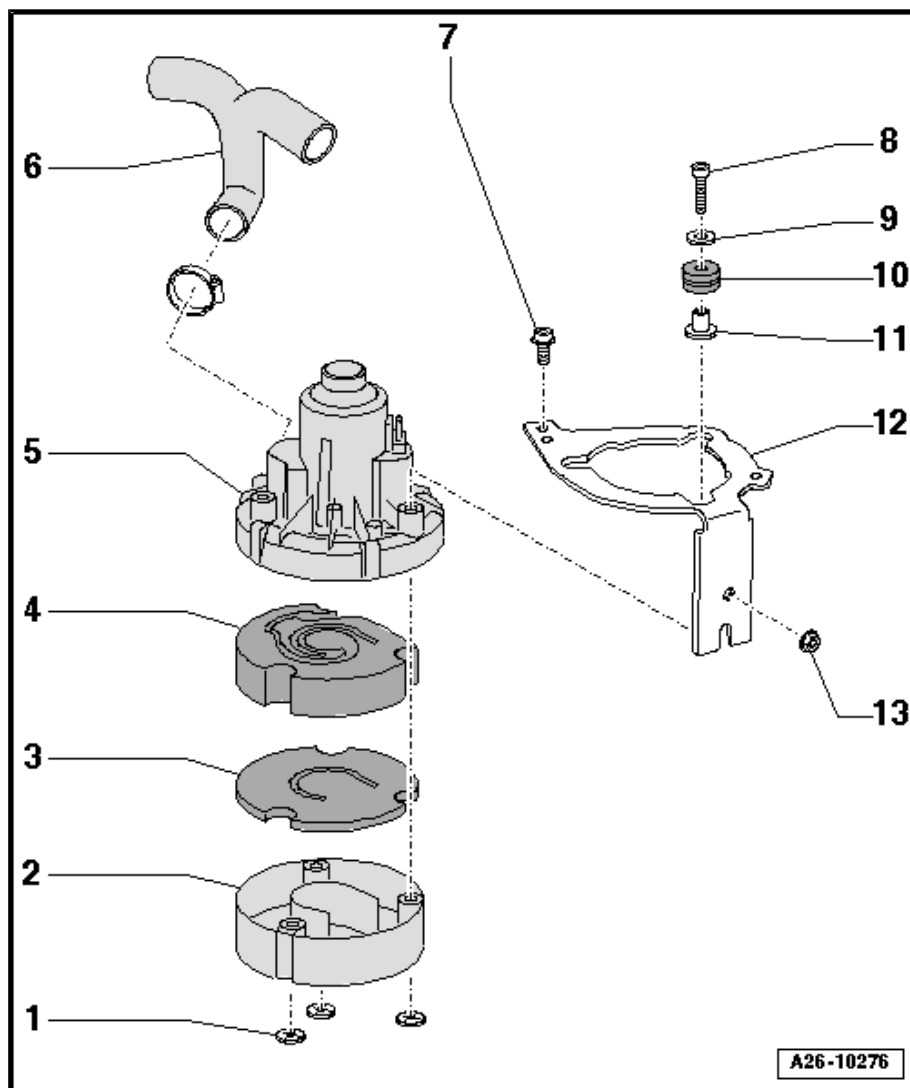
9 - Washer

10 - Grommet

11 - Spacer sleeve

12 - Bracket

13 - 10 Nm

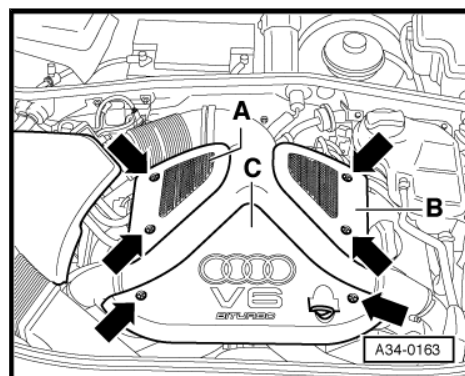


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3.6 Removing and installing secondary air pump

Removing

- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.

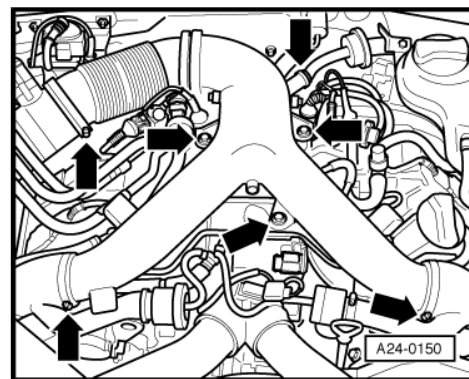


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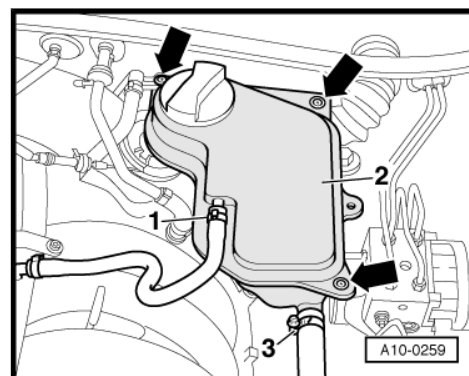
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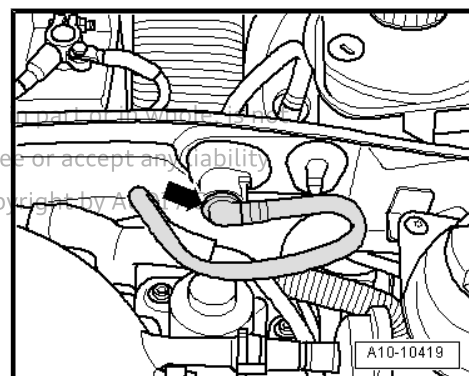
- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.



- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical wire for coolant shortage indicator switch - F66- at bottom of expansion tank and move expansion tank to one side with coolant hoses -1- and -3- attached.

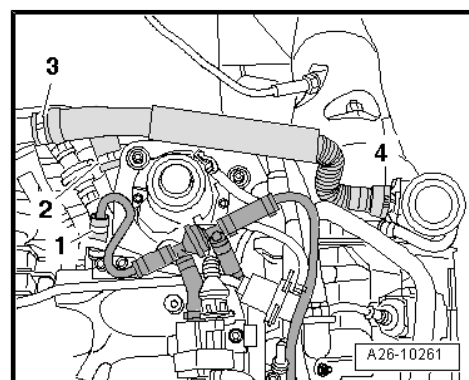


- Detach vacuum line -arrow- going to brake servo at bulkhead.



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- Detach vacuum pipe -1-.
- Detach connecting hose leading to combination valves for secondary air at the point indicated -2 ... 4-.





- Unplug electrical connector -2-.
- Unscrew bolts -1-.
- Slacken nut -3- a few turns.
- Lift out secondary air pump.

Installing

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

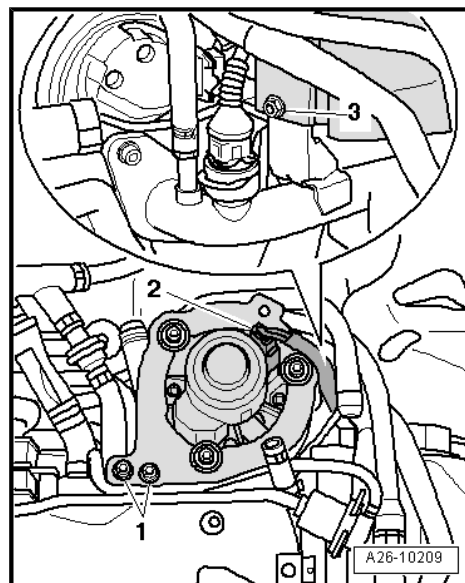


Note

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

Tightening torques

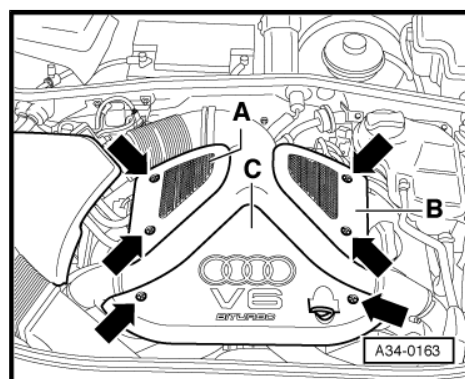
Component		Nm
Secondary air pump to:	Intake manifold	10
	Coolant pipe	10
Air duct to intake manifold		10



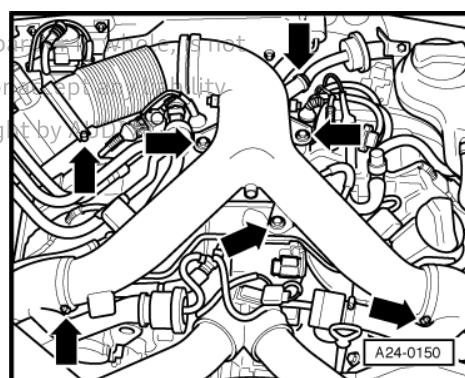
3.7 Removing and installing combination valve for secondary air system (left-side)

Removing

- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.

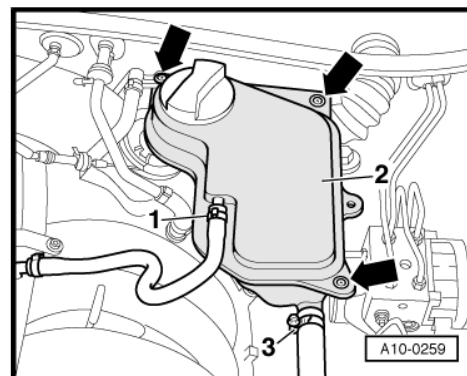


- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.
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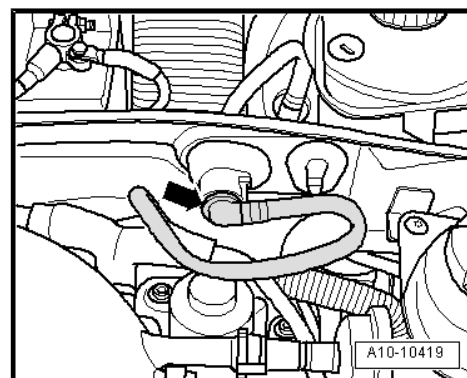




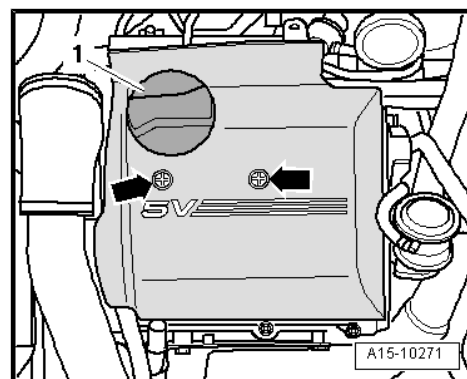
- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical wire for coolant shortage indicator switch - F66- at bottom of expansion tank and move expansion tank to one side with coolant hoses -1- and -3- attached.



- Detach vacuum line -arrow- going to brake servo at bulkhead.



- Unscrew sealing cap -1-.
- Loosen quick release fasteners -arrows- and remove cover panel for cylinder head cover (left-side).



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- 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

Shown from rear for illustration purposes.

Installing

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

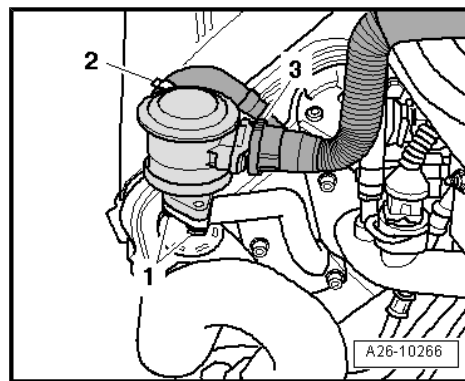


Note

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

Tightening torques

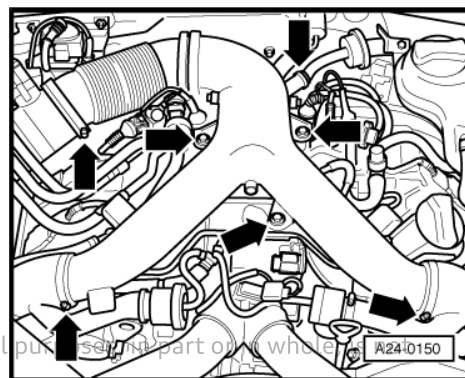
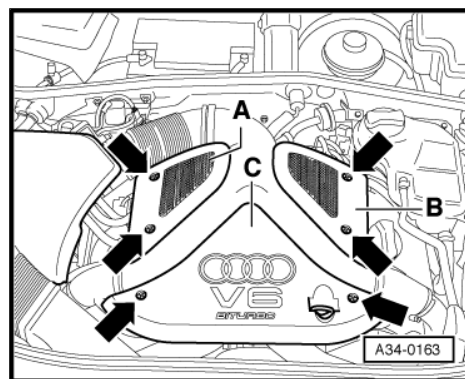
Component	Nm
Combination valve for secondary air to connection	10
Air duct to intake manifold	10



3.8 Removing and installing combination valve for secondary air system (right-side)

Removing

- Unfasten screw connections -arrows- and detach engine cover panels -A ... C-.
- Unscrew hose connections and bolted connections on the air duct at the points indicated by -arrows- and remove the air duct.



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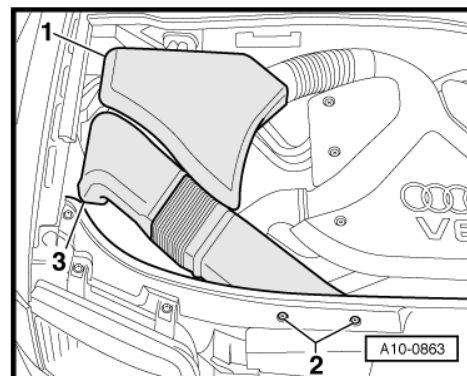


- Remove cover -1- on right side of engine compartment.

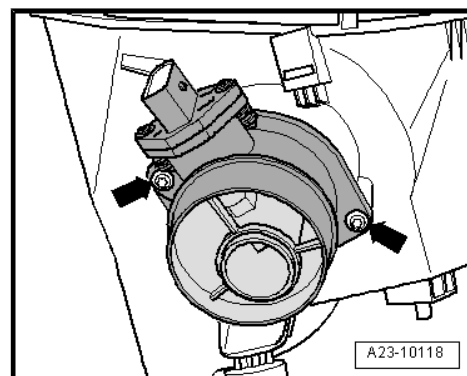


Note

Disregard items marked -2- and -3-.



- Unplug electrical connector at air mass meter - G70- .
- Remove air mass meter - G70- -arrows-.

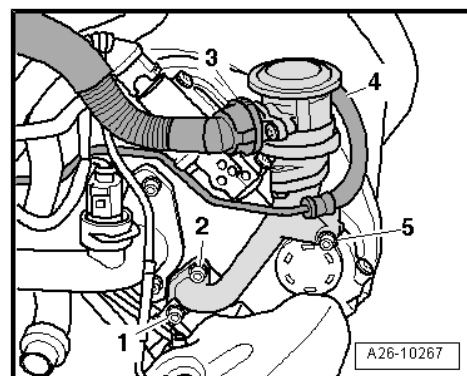


- Detach air hose -3- and vacuum hose -4- from combination valve for secondary air system.
- Unscrew bolts -1-, -2- and -5- and remove combination valve for secondary air system.



Note

Shown from rear for illustration purposes.



Installing

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



Note

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

Tightening torques

Component	Nm
Combination valve for secondary air to connection	10
Connection to cylinder head	10
Air duct to intake manifold	10

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