

Workshop Manual Audi A4 1995 ➤

4-cylinder engine (1.8 ltr. 5-valve turbo), mechanics

Engine ID	AEB	AJL	ANB	APU	ARK	ATW			
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Edition 06.2013



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List of Workshop Manual Repair Groups

Repair Group

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- 17 - Lubrication
- 19 - Cooling
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- 26 - Exhaust system

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

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Audi A4 1995 ►

4-cylinder engine (1.8 ltr. 5-valve turbo), mechanics - Edition 06.2013



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00 – Technical data

1 Engine number

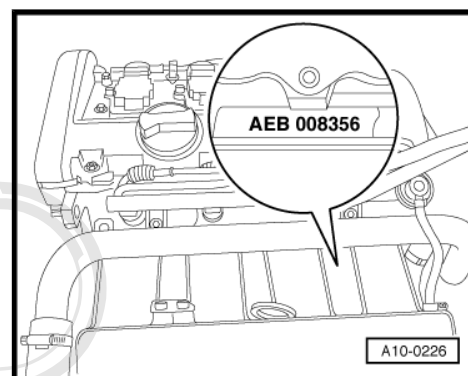
(ARL003413; Edition 06.2013)

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



Note

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



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2 Engine data

Code letters		AEB	AJL	ANB
Capacity	ltr.	1.781	1.781	1.781
Power output	kW at rpm	110/5700	132/6200	110/5700
Torque	Nm at rpm	210/1750 ... 4600	235/2000 ... 4600	210/1750 ... 4600
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		95 ¹⁾	98 ²⁾	95 ¹⁾
Injection/ignition system		Bosch Motronic	Bosch Motronic	Bosch Motronic
Exhaust gas recirculation		no	no	no
Turbocharging/supercharging		yes	yes	yes
Self-diagnosis		yes	yes	yes
Knock control		yes	yes	yes
Catalytic converter		yes	yes	yes
Lambda control		yes	yes	yes
Variable valve timing		no	no	no
Intake manifold change-over		no	no	no
Secondary air system		no	no	yes
Valves per cylinder		5	5	5

- ¹⁾ Unleaded regular grade petrol (RON 91) can also be used, but this will result in a loss of power
- ²⁾ Unleaded premium RON 95 can also be used, but results in reduced power

Code letters		APU	ARK	ATW
Capacity	ltr.	1.781	1.781	1.781
Power output	kW at rpm	110/5700	110/5700	110/5700
Torque	Nm at rpm	210/1750 ... 4600	210/1750 ... 4600	210/1750 ... 4600
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		95 ¹⁾	95 ¹⁾	95 ¹⁾
Injection/ignition system		Bosch Motronic	Bosch Motronic	Bosch Motronic
Exhaust gas recirculation		no	no	no
Turbocharging/supercharging		yes	yes	yes
Self-diagnosis		yes	yes	yes
Knock control		yes	yes	yes
Catalytic converter		yes	yes	yes
Lambda control		yes	yes	yes
Variable valve timing		no	no	no
Intake manifold change-over		no	no	no
Secondary air system		yes	no	yes
Valves per cylinder		5	5	5

- ¹⁾ Unleaded regular grade petrol (RON 91) can also be used, but this will result in a loss of power



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3 Safety precautions

3.1 Working on the fuel system

When working on the fuel system note the following warnings:



WARNING

Risk of injury - fuel system operates under high pressure.

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

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

- ◆ Always switch off the ignition before connecting or disconnecting electrical wiring for the injection or ignition system or tester cables.
- ◆ Always switch off ignition before washing engine.
- ◆ Faults are stored in engine control unit(s) if electrical connectors were unplugged and engine was started: "Generate readiness code" in "Guided Functions" ⇒ Vehicle diagnostic tester.



Caution

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

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

– Disconnect battery ⇒ Rep. gr. 27 .

3.2 Working on the cooling system

When working on the cooling system note the following warnings:



WARNING

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

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

3.3 Using testers and measuring instruments during a road test

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



WARNING

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

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

- *The use of test equipment while driving causes distraction.*
- *There is an increased risk of injury if test equipment is not secured.*
- ◆ *Test equipment must always be secured on the rear seat with a strap and operated from the rear seat by a second person.*

3.4 Working on the exhaust system

When working on the exhaust system please note the following:



Caution

Avoid damage to flexible joint.

- ◆ *Do not bend flexible joint more than 10°.*
- ◆ *Install flexible joint so that it is not under tension.*
- ◆ *Take care not to damage wire mesh on flexible joint.*

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4 General repair instructions

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

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

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

4.2 Checking for leaks in the fuel system

- Allow engine to run for several minutes at moderate rpm.
- Switch off ignition.
- Check complete fuel system for leaks.
- If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
- Road-test vehicle and accelerate with full throttle at least once.
- Then check high-pressure part of fuel system again for leakage.

4.3 Foreign particles in engine

- ◆ When working on the engine, all open inlet and exhaust ports must be sealed with suitable plugs (e.g. from engine bung set - VAS 6122-) to prevent foreign particles from entering the engine.

4.4 Contact corrosion!

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

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

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

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

Note the following:

- ◆ We recommend using only genuine replacement parts; these have been tested and are compatible with aluminium.
- ◆ We recommend the use of Audi accessories.
- ◆ Damage caused by contact corrosion is not covered under warranty.

4.5 Routing and attachment of pipes, hoses and wiring

- ◆ Mark fuel lines, hydraulic lines, vacuum lines, lines for activated charcoal filter and electrical wiring etc. before removal so they can be re-installed in the original positions and correctly connected. Make sketches or take photographs if necessary.
- ◆ To prevent damaging pipes, hoses and wiring, ensure sufficient clearance from all moving or hot components in engine compartment (little space in engine compartment).

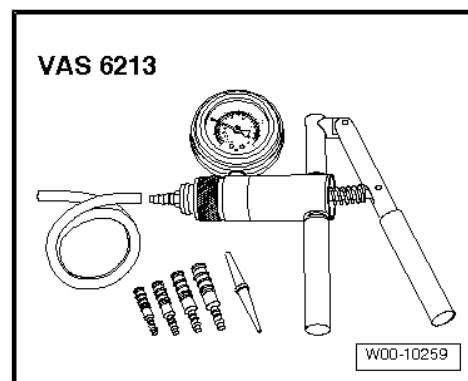
4.6 Installing radiators, condensers and charge air coolers

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

4.7 Checking vacuum system

Special tools and workshop equipment required

- ◆ Hand vacuum pump - VAS 6213-



Procedure

- Check all vacuum lines in the complete vacuum system for:
 - ◆ Cracks
 - ◆ Traces of animal bites
 - ◆ Kinked or crushed lines
 - ◆ Lines porous or leaking
- Check vacuum line to solenoid valve and from solenoid valve to corresponding component.
- If a fault is stored in the memory, check the vacuum lines leading to the corresponding component and also check the remaining vacuum lines in the system.



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



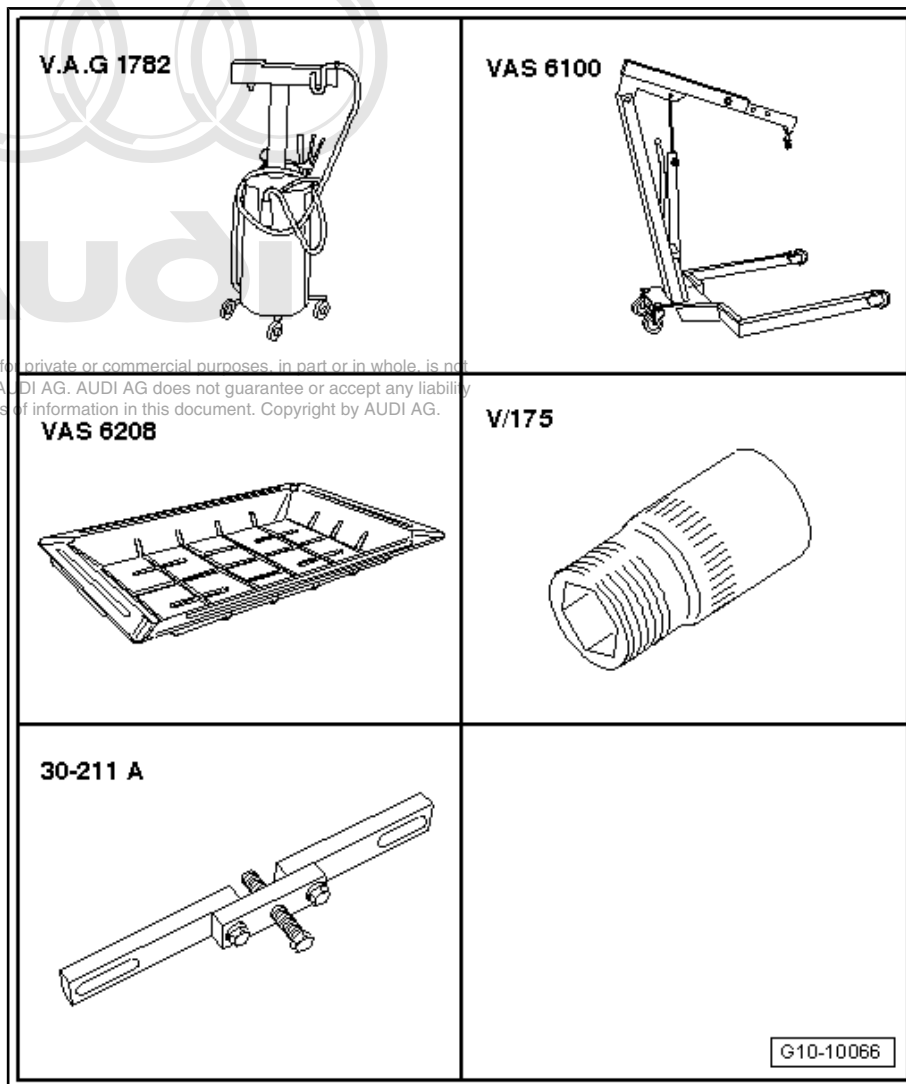
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10 – Removing and installing engine

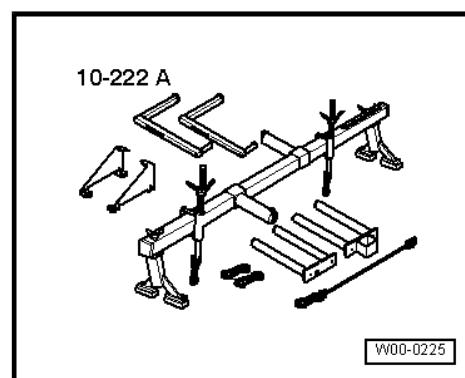
1 Removing engine - engine codes AEB, AJL

Special tools and workshop equipment required

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

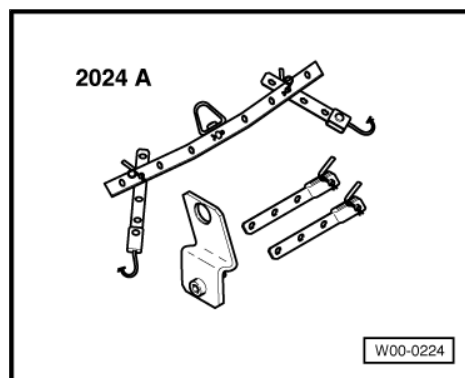


- ◆ Support bracket - 10 - 222 A-

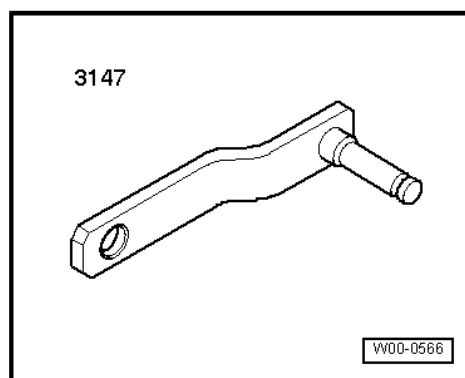




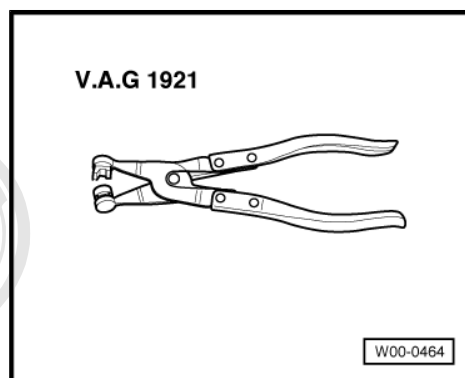
◆ Lifting tackle - 2024 A-



◆ Gearbox support - 3147-



◆ Hose clip pliers - V.A.G 1921-



Procedure



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

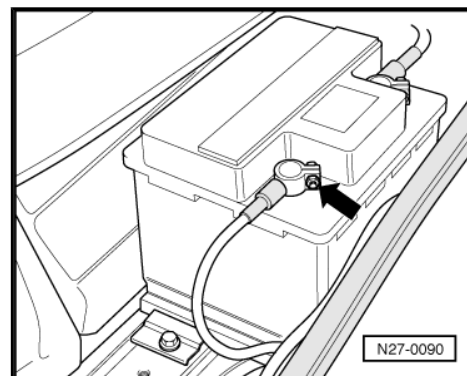


Caution

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

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

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

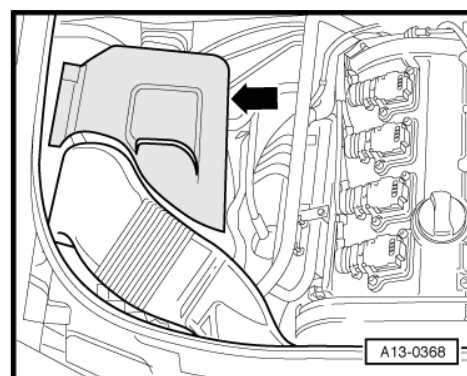
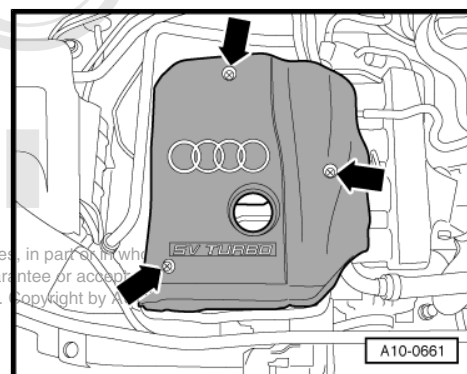
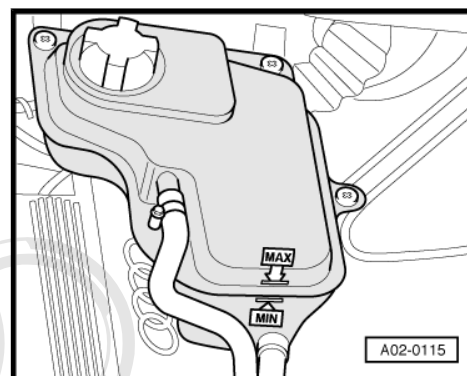


WARNING

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

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

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

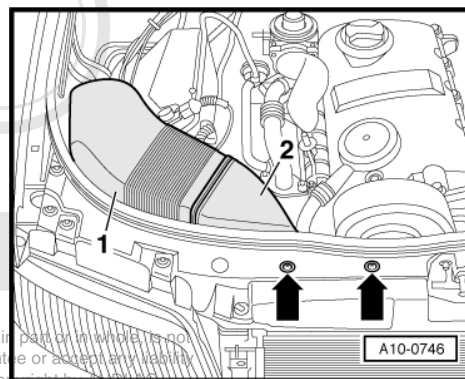


- Detach air cleaner cover -arrow-.

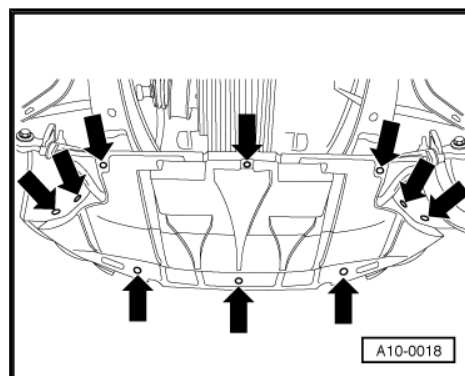
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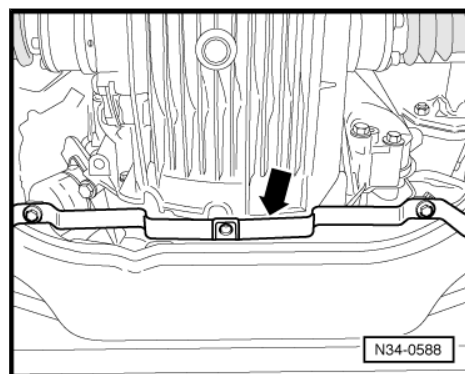
- Remove bolts -arrows-.
- Remove air duct -1- and -2-.
- Remove front bumper ⇒ Rep. gr. 63 .



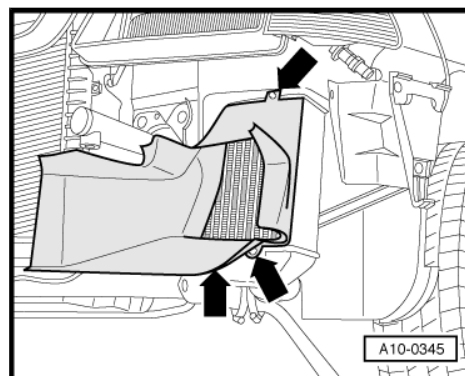
- Release fasteners -arrows- and remove noise insulation.



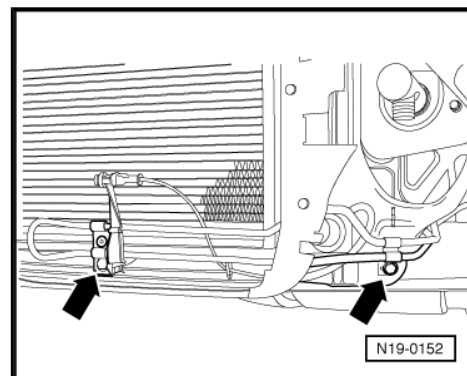
- Unbolt bracket for noise insulation -arrow-.



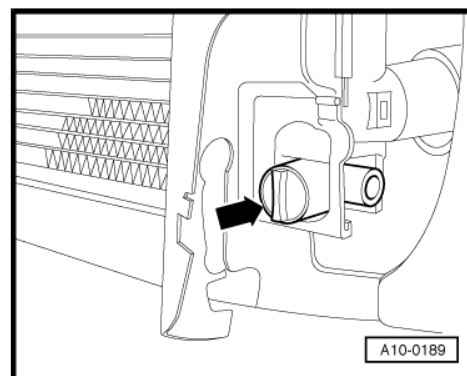
- Remove air duct in front of charge air cooler -arrows-.



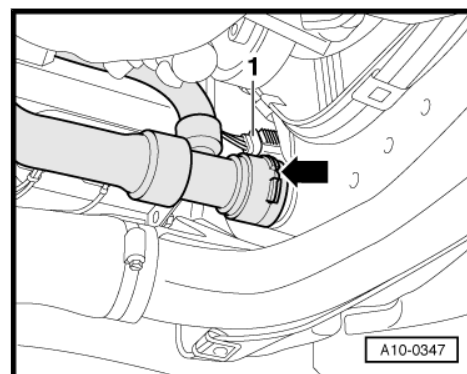
- Detach cooling pipe for power steering hydraulic fluid -arrows- and move clear; do not open hydraulic fluid circuit.
- Tighten bracket for outside temperature sensor back on finger-tight.



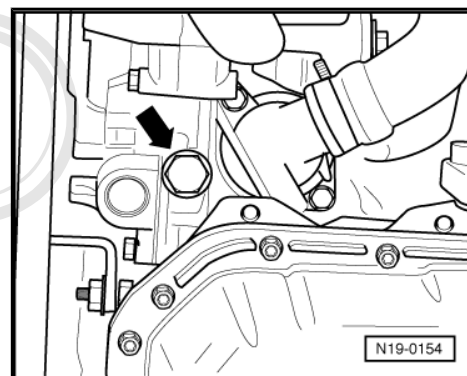
- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



- Lift retaining clip and disconnect coolant hose (bottom) from radiator -arrow-.
- Unplug electrical connector -1- at radiator fan thermal switch - F18/F54- at radiator (bottom left) and move wiring clear.

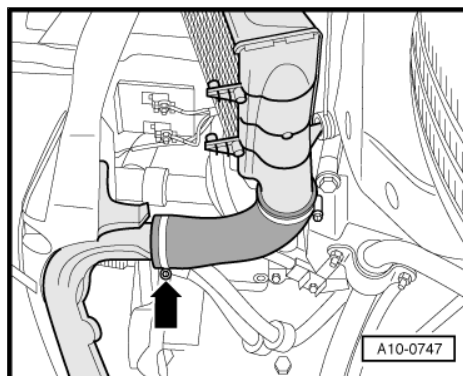


- Also open drain plug -arrow- on coolant pump bearing housing.
- Remove coolant hose from hose connection at thermostat.



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



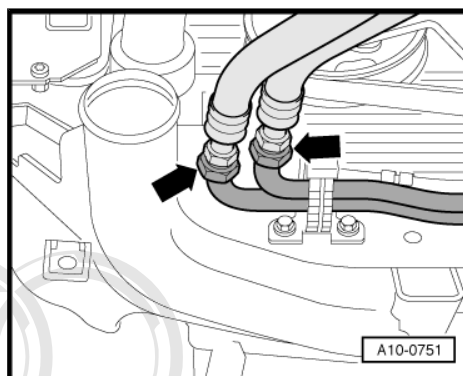
Vehicles with automatic gearbox:



Note

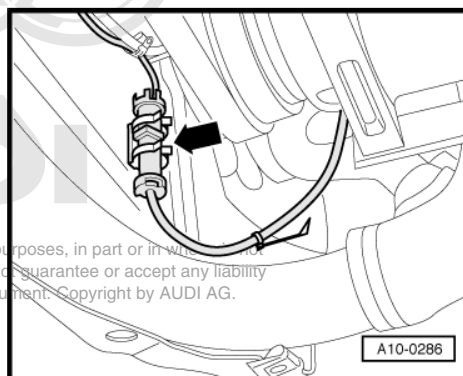
Observe rules for cleanliness when working on automatic gearbox ⇒ Rep. gr. 37.

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



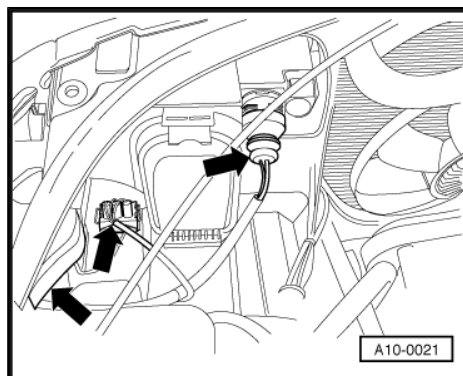
Vehicles with air conditioning:

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



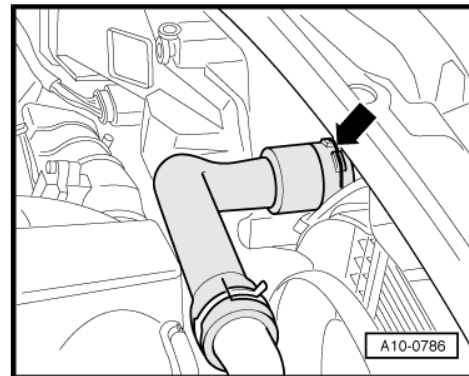
All vehicles (continued):

- Unplug connectors for headlights and headlight adjustment -arrows-.
- Turn bulb holders for turn signals anti-clockwise and remove from turn signal housing -left arrow- (both sides of vehicle).

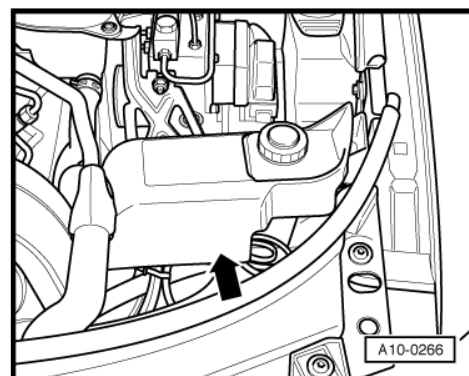


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- Lift retaining clip -arrow- and disconnect coolant hose (top left) from radiator.
- Detach cable for bonnet at lock carrier ⇒ Rep. gr. 55 .

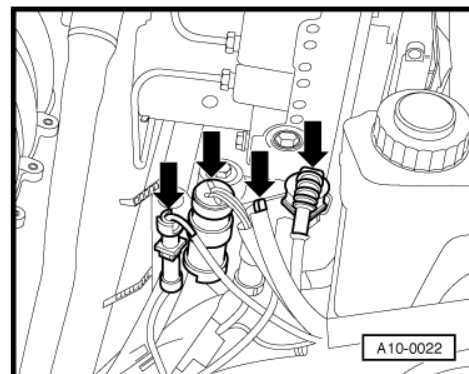


- Remove cover -arrow- at power steering fluid reservoir.



- Unplug electrical connectors -arrows-.
- Move electrical wiring clear.
- Unplug connector for anti-theft alarm on lock carrier (top left) and move wiring clear.

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

Vehicles with air conditioning:



WARNING

Risk of injury caused by refrigerant.

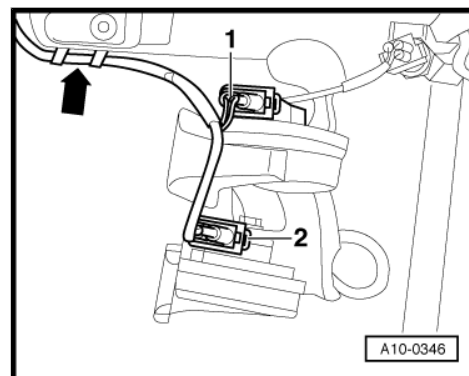
- ◆ *The air conditioner refrigerant circuit must not be opened.*



Caution

Risk of damage to condenser, refrigerant lines and refrigerant hoses.

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

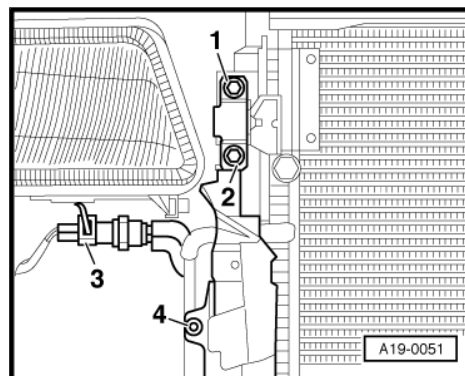


- Remove bolts -4- (left and right) for air cowls from radiator.
- Remove bolts -1 and 2- for condenser.
- Unplug electrical connector -3- at air conditioner pressure switch - F129- .
- Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.



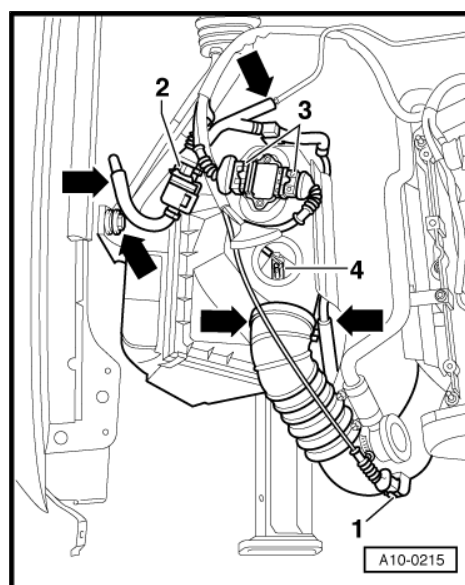
Note

Protect side panel (front) from damage.



All vehicles (continued):

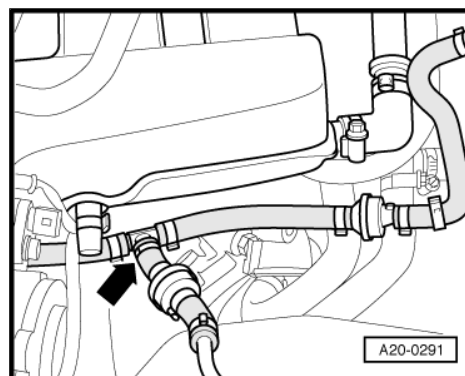
- Unbolt and remove lock carrier. Place clear of vehicle and ensure that it cannot tip over.
- Unplug electrical connectors:
 - 1 - On charge pressure control solenoid valve - N75-
 - 2 - On activated charcoal filter solenoid valve 1 - N80-
 - 3 - On output stage - N122-
 - 4 - On air mass meter - G70-
- Move wiring harness clear and lay on top of engine.
- Detach hose connections and remove air cleaner housing -arrows-.



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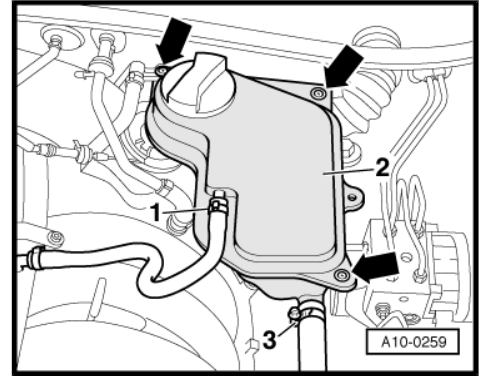
USA models:

- Disconnect vacuum line leading to fuel system diagnostic pump - V144- -arrow-.



All vehicles (continued):

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

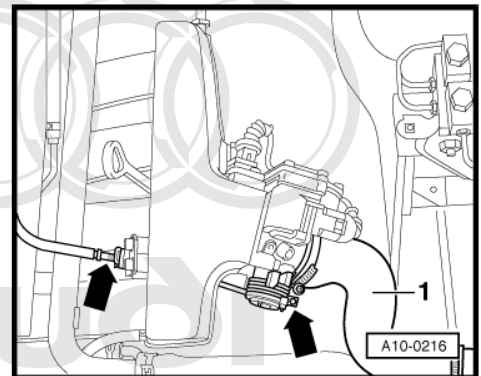


Vehicles with cruise control system:

- Disengage operating rod at throttle valve module - J338- .
- Detach vacuum hose at vacuum unit.

All vehicles (continued):

- Detach throttle cable from throttle valve module - J338- and from support bracket -arrows- (do not remove retainer). Move throttle cable clear to the side.
- Remove air hose -1-.



WARNING

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

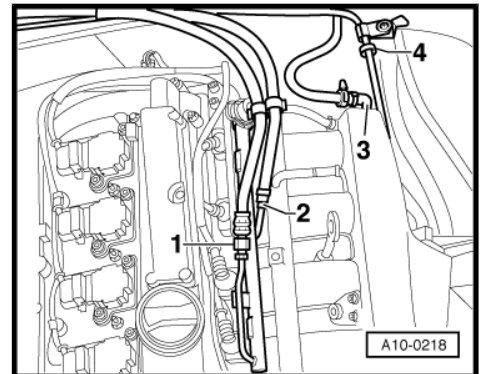
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- Disconnect fuel supply line -1- and fuel return line -2- and move clear.
- Disconnect vacuum hoses:
- 3 - To brake servo
- 4 - To activated charcoal filter solenoid valve 1 - N80-

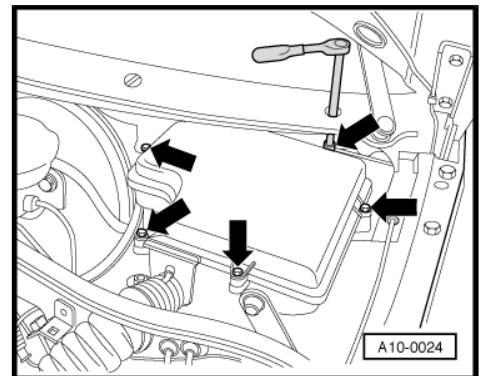


Note

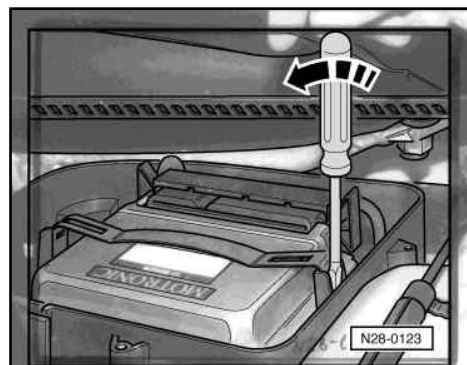
On vehicles with automatic gearbox, disconnect vacuum hose -3- behind suction-jet pump.



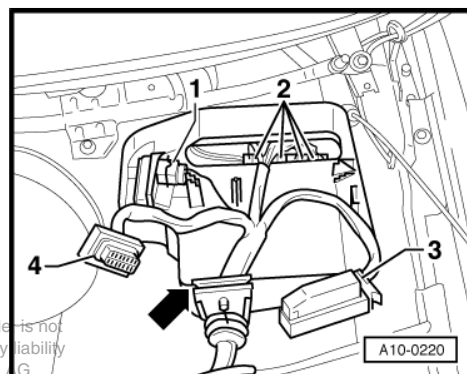
- Remove cover for electronics box in plenum chamber -arrows-.



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



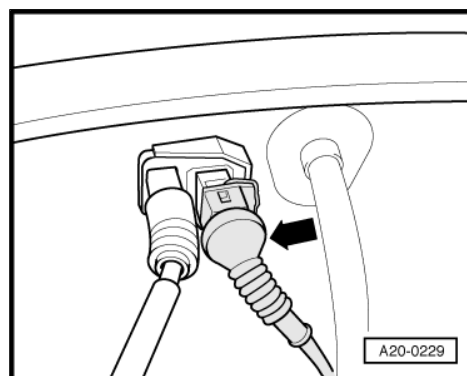
- Release retainer catches and unplug electrical connectors -3 and 4- from engine control unit.
- Unplug electrical connectors at altitude sender - F96- -1- and at connector point -2-.
- Unhook wiring harness -arrow- and move it clear.



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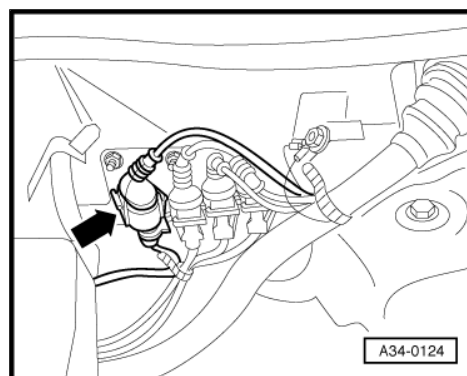
Vehicles with automatic gearbox:

- Unplug electrical connector at kickdown switch -arrow-.



All vehicles (continued):

- Detach electrical connector -arrow- for Lambda probe from bracket, unplug and move wiring clear.



- Unscrew earth wire -2-.
- Unbolt bracket for connectors -1- from plenum chamber.
- Disengage wiring harness -arrows- and move it clear.
- Unplug electrical connector from speedometer sender - G22- on left of gearbox, and move wire clear.

Vehicles with manual gearbox:

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

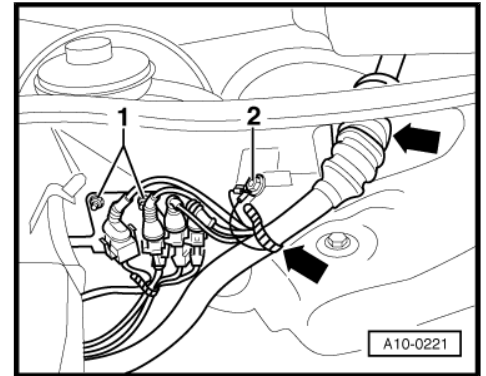
All vehicles (continued):



Caution

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

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



Vehicles with air conditioning:

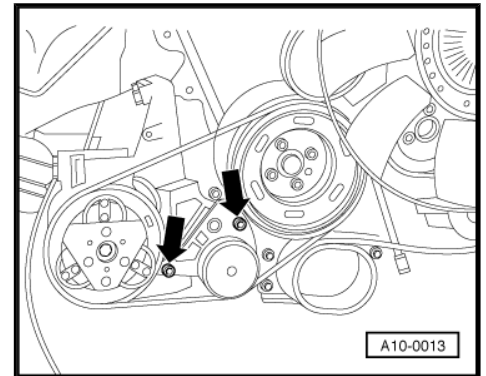
- Loosen bolts on tensioner for poly V-belt for air conditioner compressor -arrows-, slacken belt and remove.



WARNING

Risk of injury caused by refrigerant.

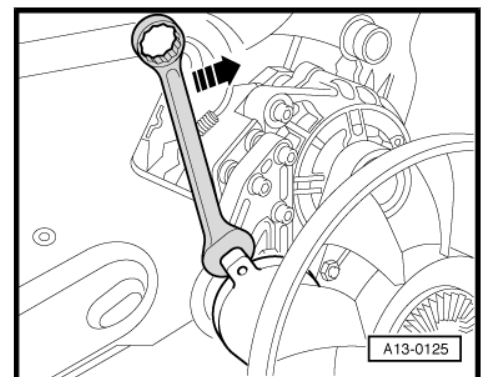
- ◆ *The air conditioner refrigerant circuit must not be opened.*



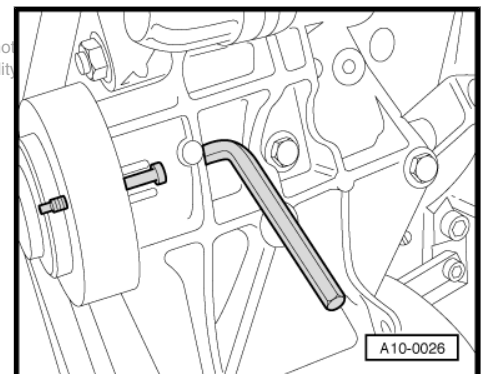
- Detach air conditioner compressor from bracket and secure to body with wire.

All vehicles (continued):

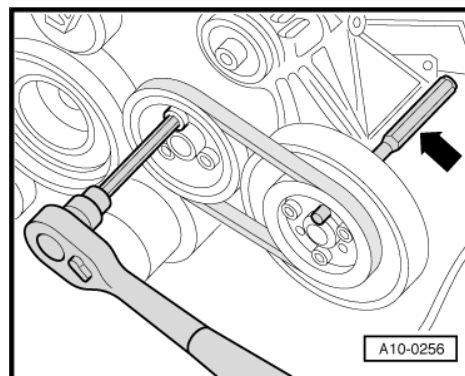
- To slacken poly V-belt turn tensioner in direction of -arrow-.
- Remove poly V-belt from pulley on alternator.



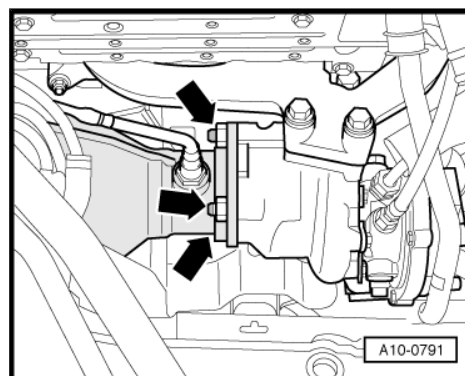
- Use M5x60 mm bolt to lock poly V-belt pulley for viscous fan and unscrew using hexagon key.
- Take off poly V-belt.



- Remove V-belt pulley for coolant pump; apply drift -arrow- at power steering pump pulley.
- Detach V-belt.
- Remove poly V-belt pulley for power steering pump.
- Unbolt power steering pump and tie up to one side; the hydraulic fluid hoses/pipes remain connected.



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



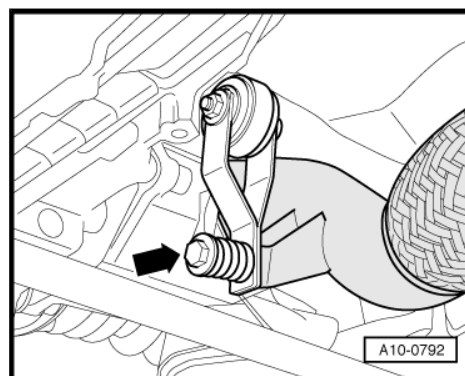
- Unbolt bracket for exhaust system -arrow-.



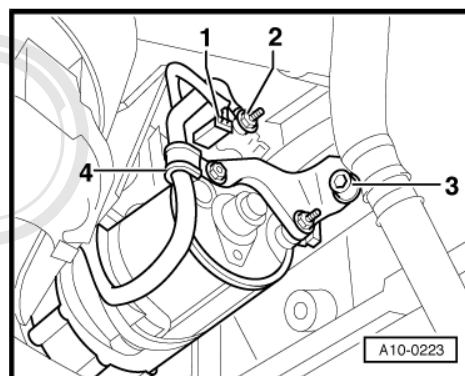
Caution

Avoid damage to flexible joint.

- ◆ *Do not bend flexible joint more than 10°.*
- ◆ *Install flexible joint so that it is not under tension.*
- ◆ *Take care not to damage wire mesh on flexible joint.*



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



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Vehicles with automatic gearbox:

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



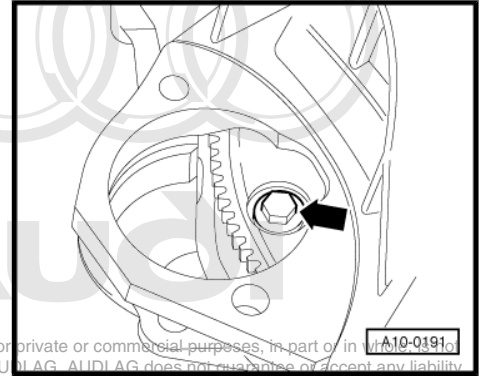
Note

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

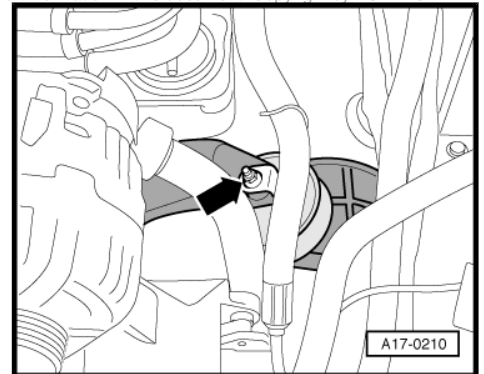
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All vehicles (continued):

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



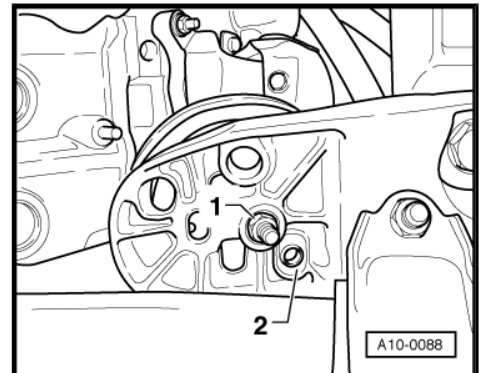
- Mark position of nuts -1- and locating sleeves -2- on bottom of engine mountings (right and left).



Note

Different mounting holes are provided for the different engine versions.

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



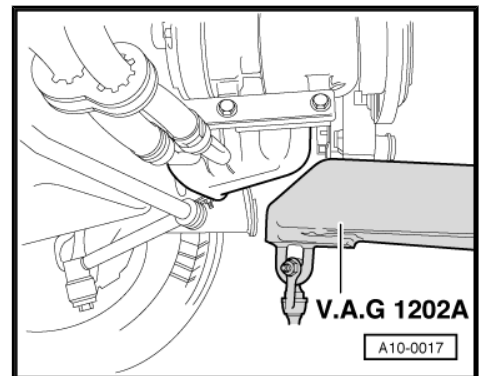
- Raise engine and gearbox using workshop hoist.



WARNING

Injury risk.

◆ *Ensure adequate support.*



Note

Make sure no wires/pipes are damaged at the top on the bulkhead.

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

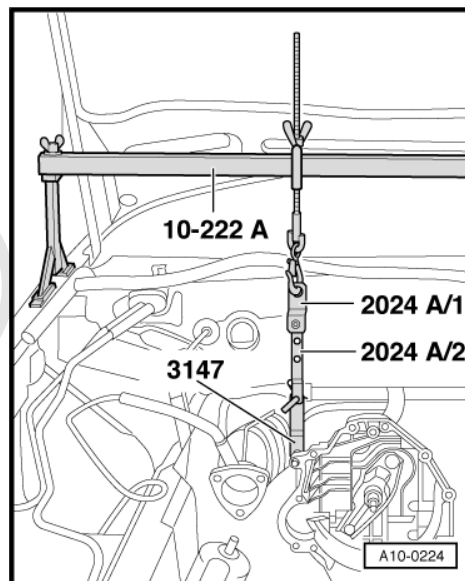
- Position support bracket - 10 - 222 A- behind gas-filled strut on bolted flanges of wing panels. The spindle must be at the front.
- Insert gearbox support - 3147- into bolt hole in gearbox bell housing.
- Connect gearbox support - 3147- to support bracket - 10 - 222 A- using hooks - 10 - 222 A /2-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



Note

Shown in illustration with engine removed.

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

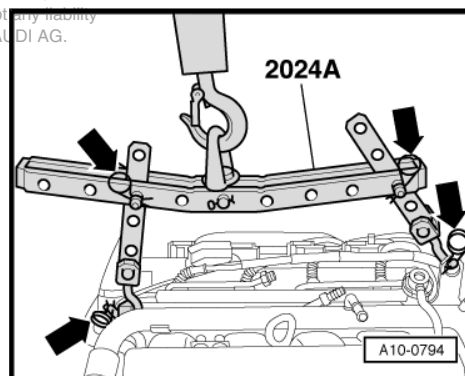


- Engage lifting tackle - 2024 A- on engine and workshop hoist.



Note

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



WARNING

Accident risk from loose components of lifting tackle.

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

- Remove remaining bolt securing engine to gearbox.



Note

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

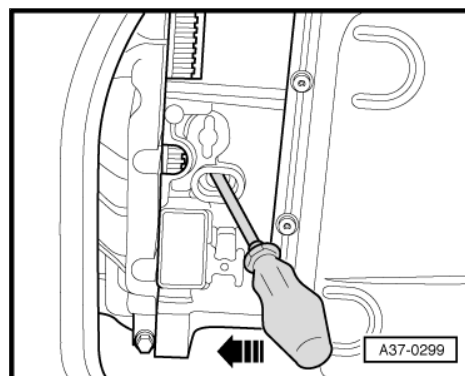
- Raise engine with workshop hoist until the studs of the engine mountings are clear.
- Tighten spindle of support bracket - 10 - 222 A- further.

Vehicles with automatic gearbox:

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

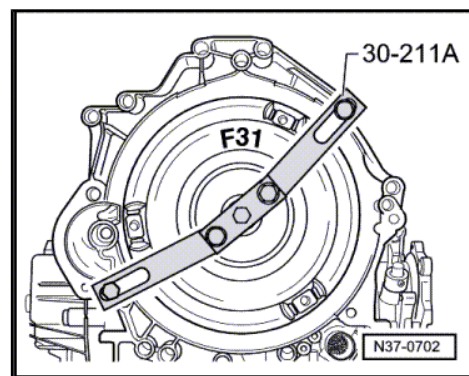
All vehicles (continued):

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



Vehicles with automatic gearbox:

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

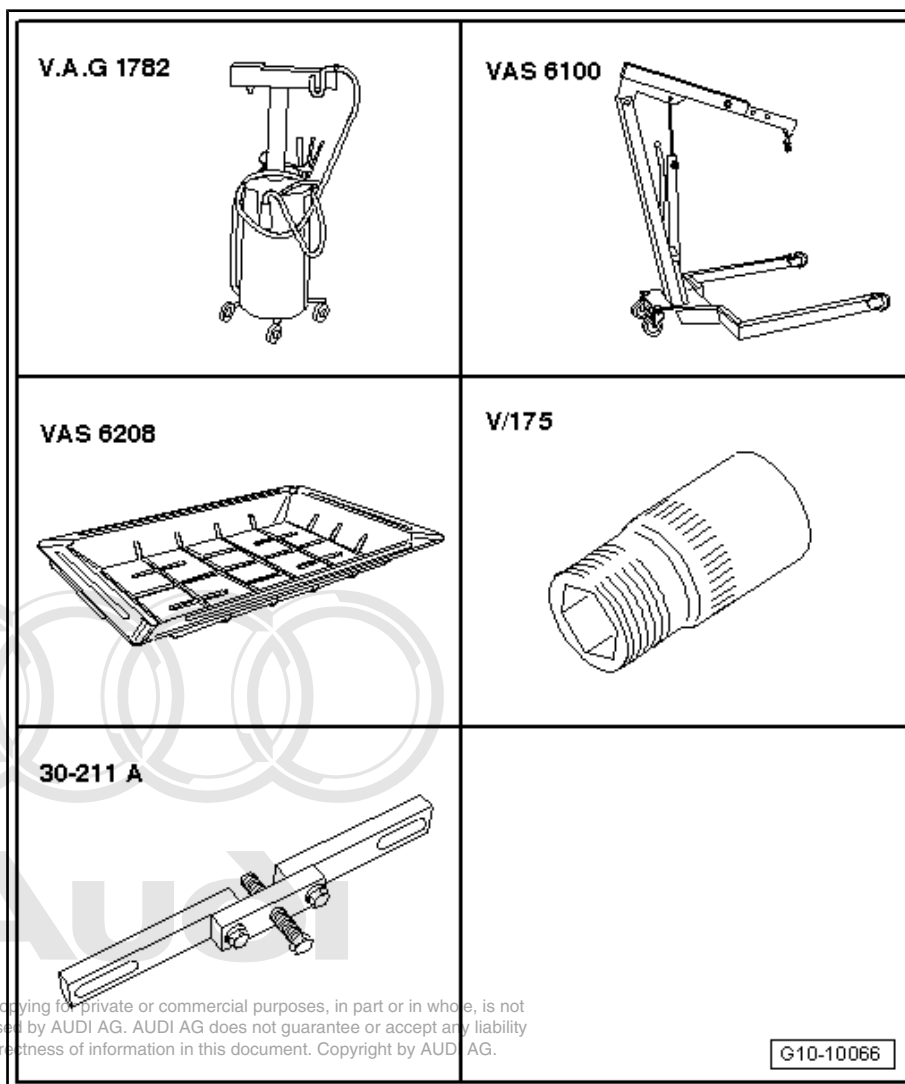


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2 Removing engine - engine codes ANB, APU, ARK, ATW

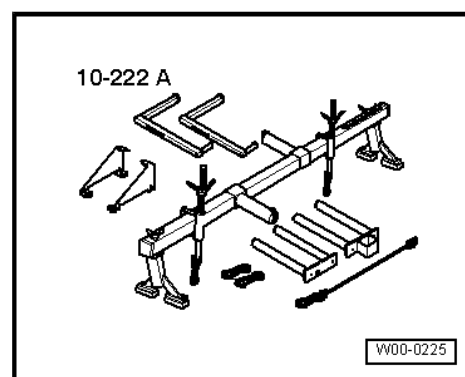
Special tools and workshop equipment required

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

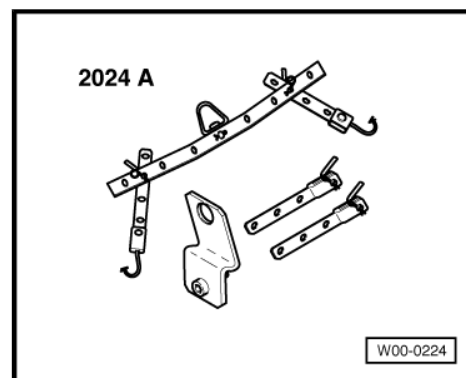


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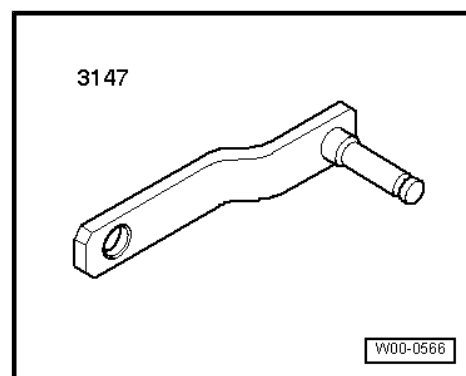
- ◆ Support bracket - 10 - 222 A-



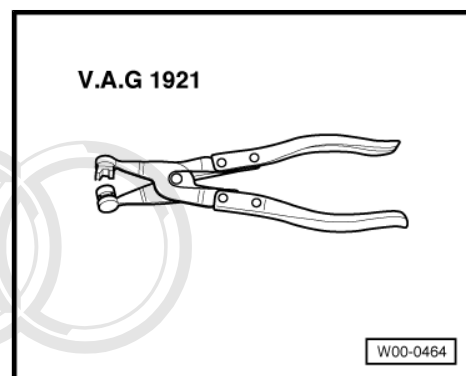
◆ Lifting tackle - 2024 A-



◆ Gearbox support - 3147-



◆ Hose clip pliers - V.A.G 1921-



Procedure



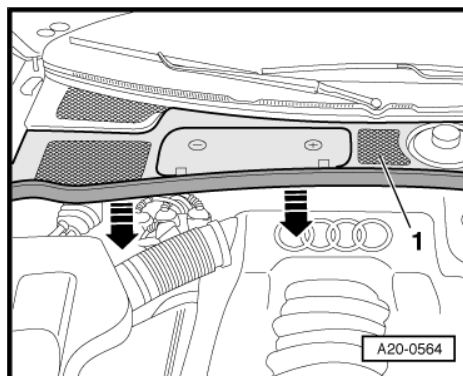
Note

- ◆ *The engine is removed from the front without the gearbox after removing the lock carrier.*

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- ◆ *Fit all cable ties in the original positions when installing.*
- ◆ *Collect drained coolant in a clean container for re-use or disposal.*
- Move selector lever to position "N" on vehicles with automatic gearbox.

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

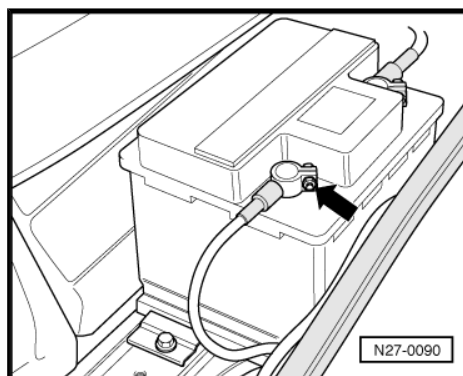


Caution

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

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

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

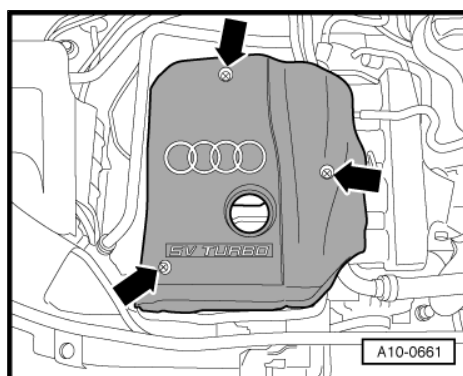
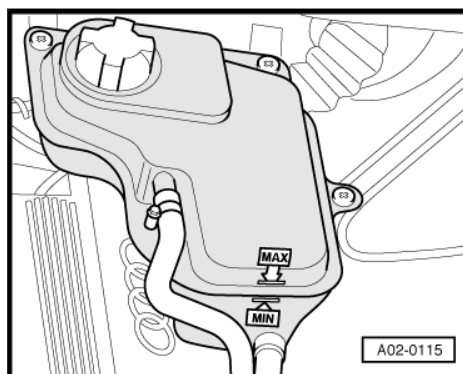


WARNING

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

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

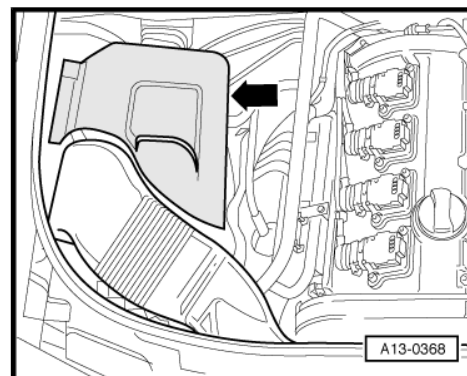
- Open filler cap on coolant expansion tank.
- Release quick-release fasteners and remove engine cover panel -arrows-.



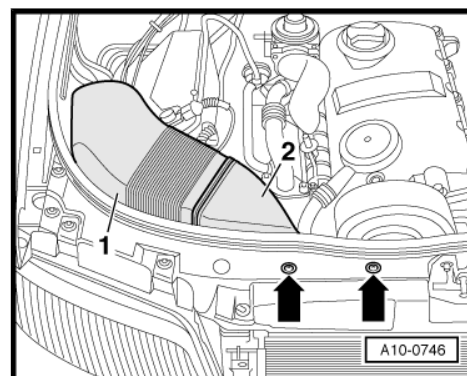
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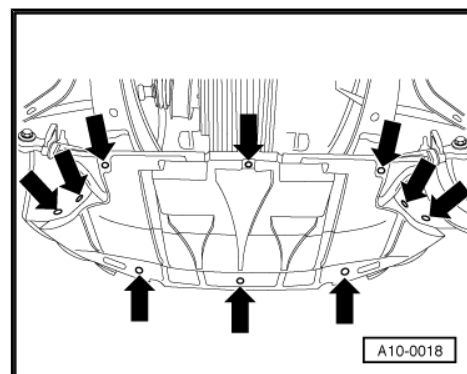
- Detach air cleaner cover -arrow-.



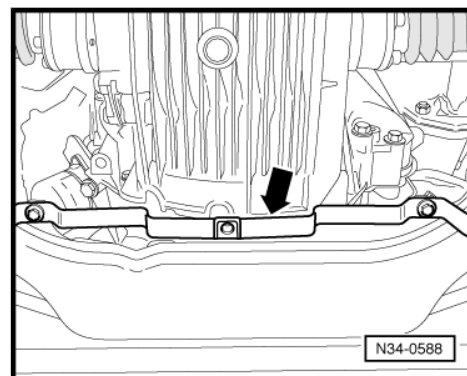
- Remove bolts -arrows-.
- Remove air duct -1- and -2-.
- Remove front bumper ⇒ Rep. gr. 63 .



- Release fasteners -arrows- and remove noise insulation.

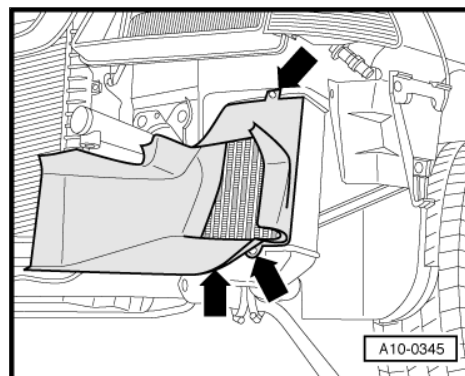


- Unbolt bracket for noise insulation -arrow-.

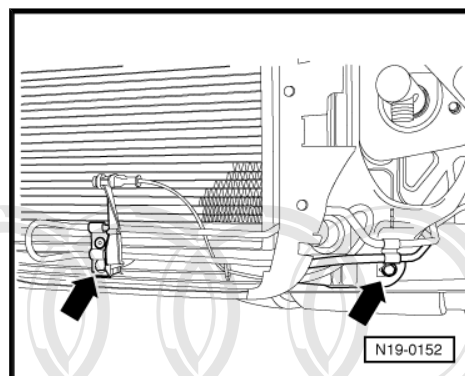


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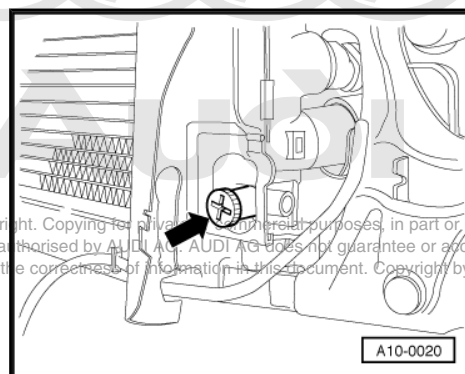
- Remove air duct in front of charge air cooler -arrows-.
- Unclip ambient temperature sensor - G17- from bracket.



- Detach cooling pipe for power steering hydraulic fluid -arrows- and move clear; do not open hydraulic fluid circuit.

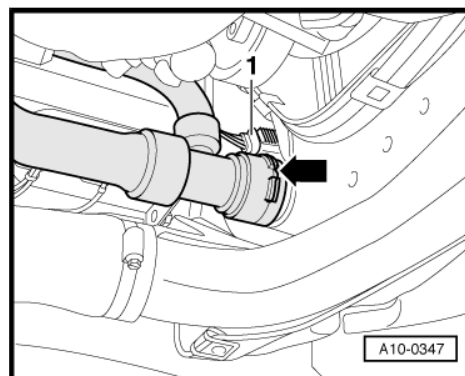


- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.

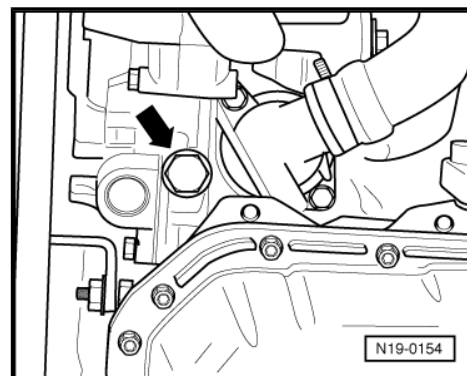


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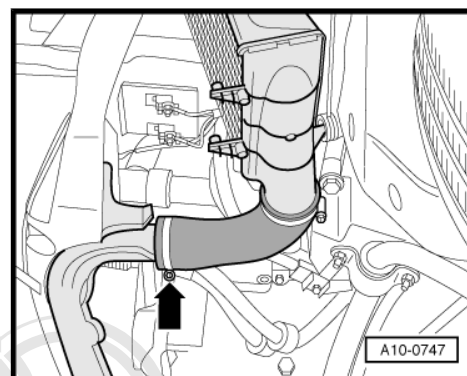
- Lift retaining clip and disconnect coolant hose (bottom) from radiator -arrow-.
- Unplug electrical connector -1- at radiator fan thermal switch - F18/F54- at radiator (bottom left) and move wiring clear.



- Also open drain plug -arrow- on coolant pump bearing housing.
- Remove coolant hose from hose connection at thermostat.



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



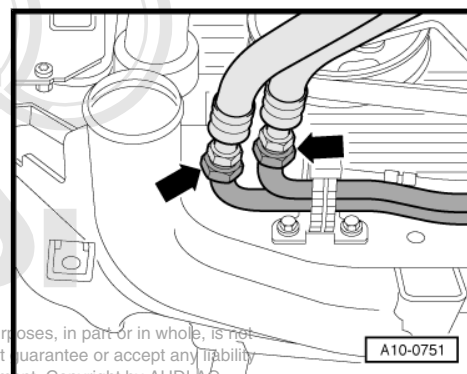
Vehicles with automatic gearbox:



Note

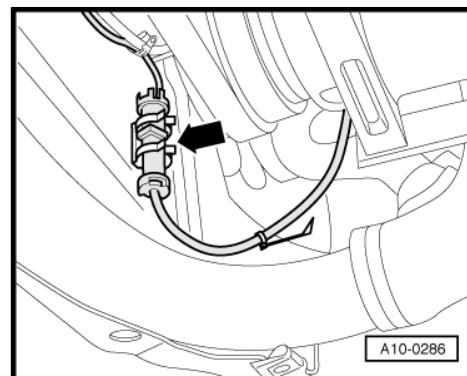
Observe rules for cleanliness when working on automatic gearbox ⇒ Rep. gr. 37.

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



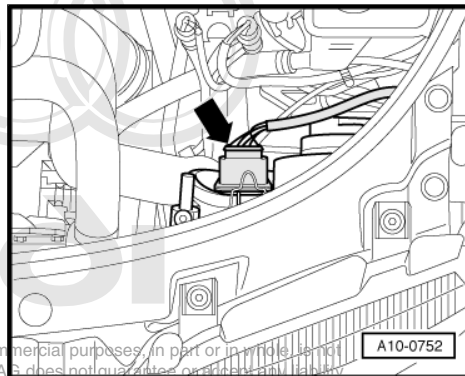
Vehicles with air conditioning:

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

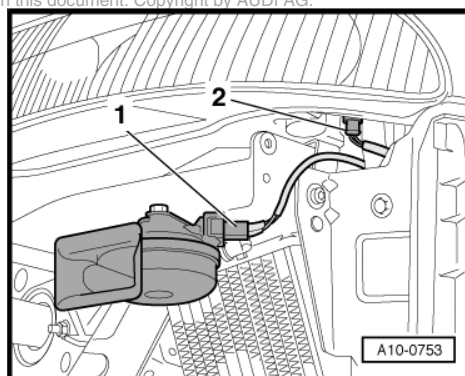


All vehicles (continued):

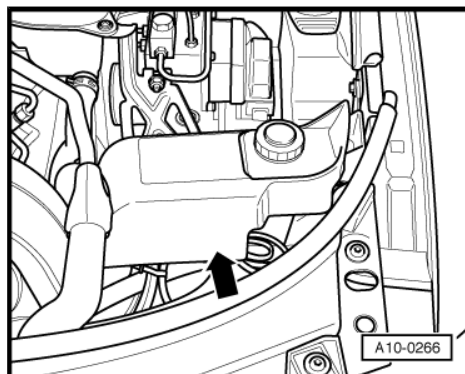
- Unplug electrical connector (left and right) -arrow- for head-lights.



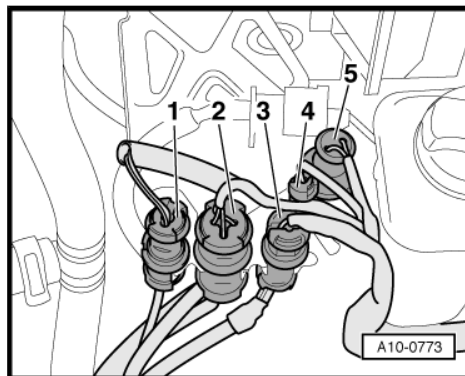
- Unplug electrical connector (left and right) -2- for turn signal indicator.
- Unplug electrical connector -1- at both horns and move wiring clear.
- Detach cable for bonnet at lock carrier ⇒ Rep. gr. 55 .



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



- Unplug electrical connectors -1 ... 5-.
- Move electrical wiring clear.



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

Vehicles with air conditioning:



WARNING

Risk of injury caused by refrigerant.

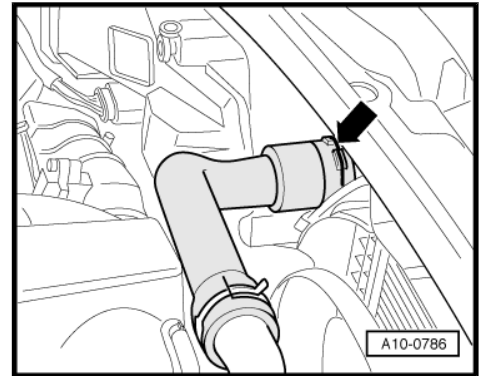
- ◆ *The air conditioner refrigerant circuit must not be opened.*



Caution

Risk of damage to condenser, refrigerant lines and refrigerant hoses.

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

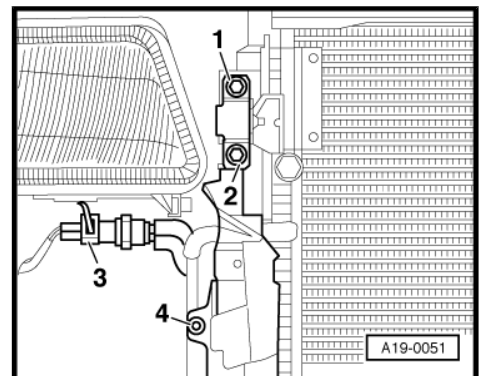


- Remove bolts -4- (left and right) for air cowls from radiator.
- Remove bolts -1 and 2- for condenser.
- Unplug electrical connector -3- at air conditioner pressure switch - F129- .
- Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.



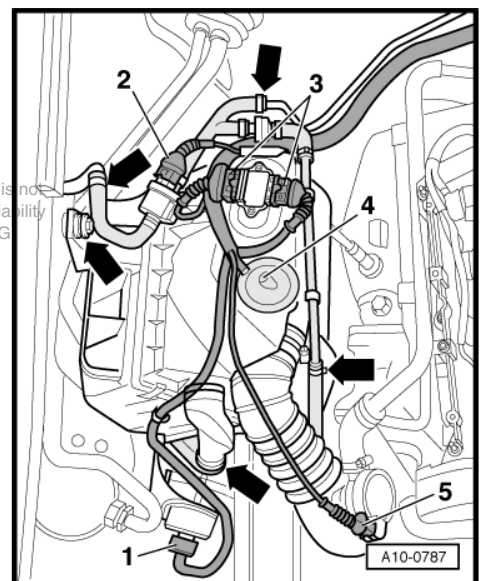
Note

Protect side panel (front) from damage.



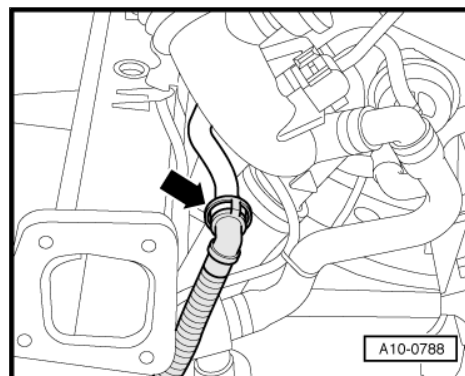
All vehicles (continued):

- Unbolt and remove lock carrier. Place clear of vehicle and ensure that it cannot tip over.
- Unplug electrical connectors:
 - 1 - On secondary air pump motor - V101- (vehicles with secondary air system)
 - 2 - On activated charcoal filter solenoid valve 1 - N80-
 - 3 - On output stage - N122-
 - 4 - On air mass meter - G70-
 - 5 - On charge pressure control solenoid valve - N75-
- Move wiring harness clear and lay on top of engine.
- Detach hose connections and remove air cleaner housing -arrows-.



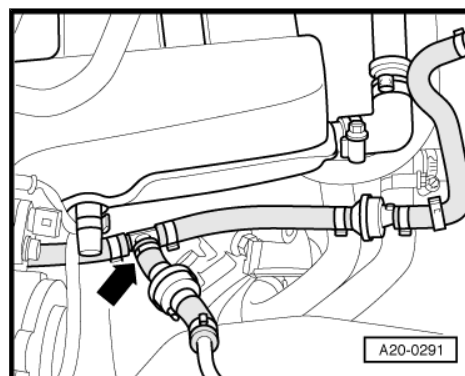
Vehicles with secondary air system:

- Detach hose -arrow- from pipe at combination valve for secondary air.



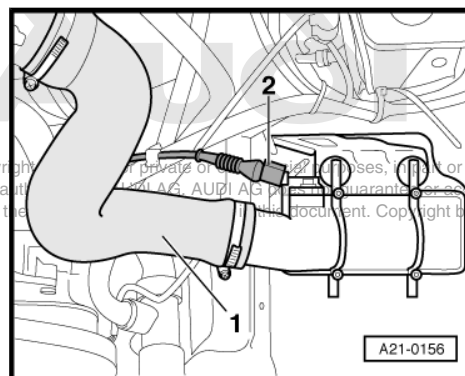
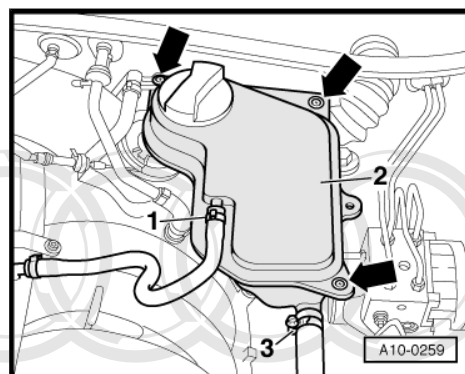
USA models:

- Disconnect vacuum line leading to fuel system diagnostic pump - V144- -arrow-.



All vehicles (continued):

- Detach coolant hoses -1- and -3-.
- Remove bolts -arrows-.
- Unplug electrical connector at coolant shortage indicator switch - F66- and detach coolant expansion tank -2-.
- Detach coolant hose (left-side) going to heat exchanger from coolant pipe (bottom) on engine.
- Disconnect coolant hose (right-side) going to heat exchanger at cylinder head connection.
- Remove air hose -1-.
- Unplug electrical connector -2- at charge pressure sender - G31- .



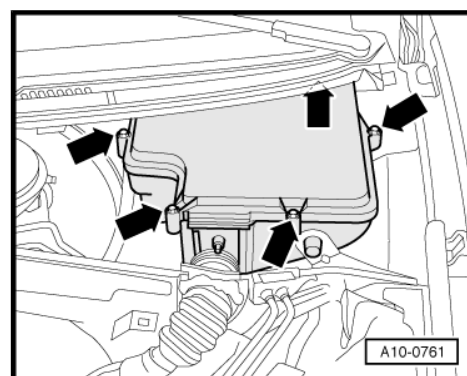
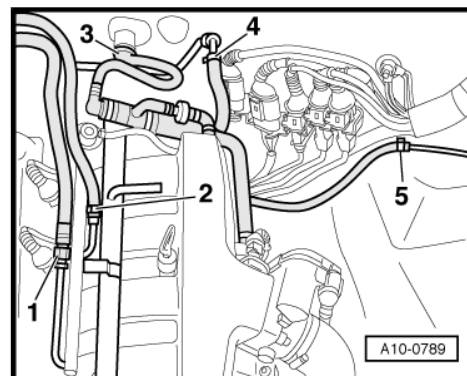
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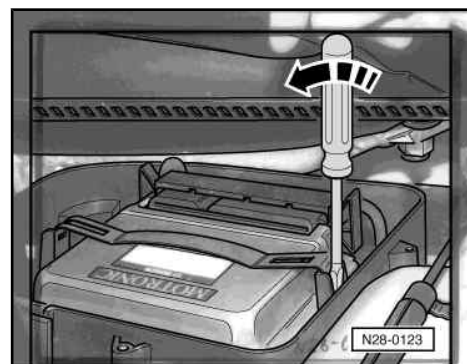
WARNING

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

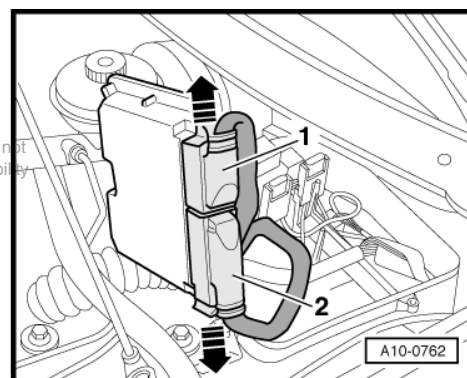
- Disconnect fuel supply line -1- and fuel return line -2- and move clear.
- Disconnect vacuum hoses:
 - 3 - To brake servo
 - 4 - To activated charcoal filter solenoid valve 1 - N80-
 - 5 - To vacuum reservoir
- Remove cover for electronics box in plenum chamber -arrows-.



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

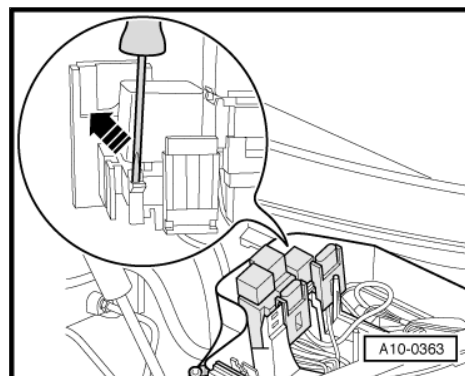


- Release retainer catches -arrows- and unplug electrical connectors -1 and 2- from engine control unit.

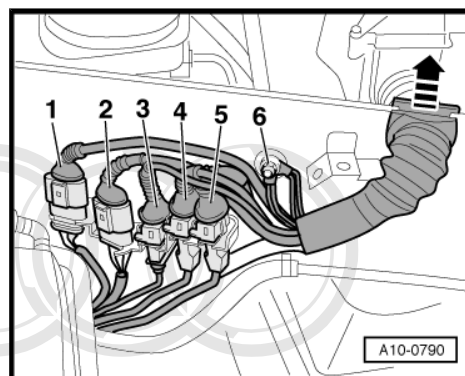


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- Release retainer -arrow- and pull auxiliary relay carrier in electronics box upwards to remove.
- Unplug electrical connectors at rear of connector console.



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



Vehicles with manual gearbox:

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

All vehicles (continued):



Caution

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

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

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Vehicles with air conditioning:

- Loosen bolts on tensioner for poly V-belt for air conditioner compressor -arrows-, slacken belt and remove.

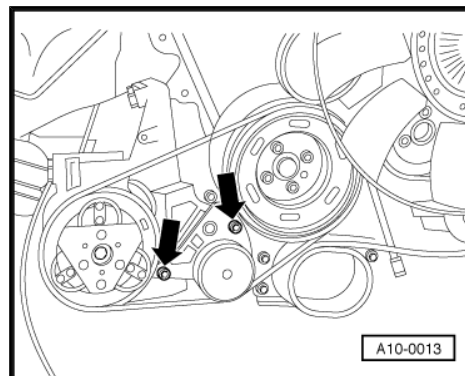


WARNING

Risk of injury caused by refrigerant.

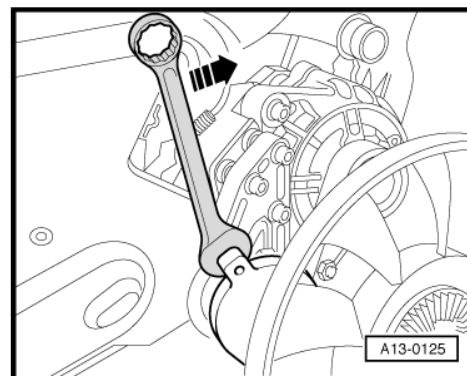
- ◆ *The air conditioner refrigerant circuit must not be opened.*

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

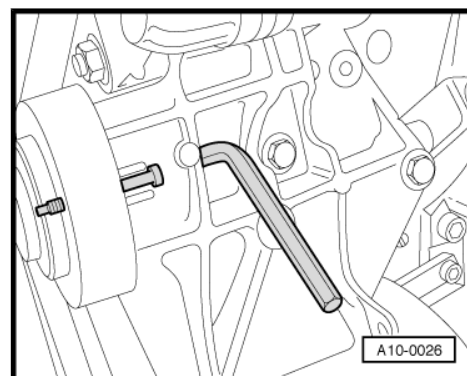


All vehicles (continued):

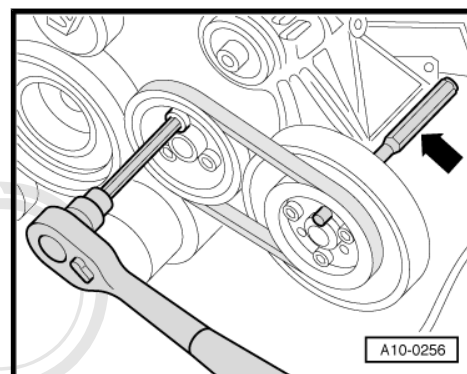
- To slacken poly V-belt turn tensioner in direction of -arrow-.
- Remove poly V-belt from pulley on alternator.



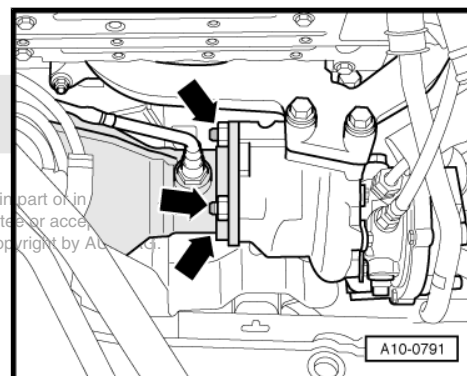
- Use M5x60 mm bolt to lock poly V-belt pulley for viscous fan and unscrew using hexagon key.
- Take off poly V-belt.



- Remove V-belt pulley for coolant pump; apply drift -arrow- at power steering pump pulley.
- Detach V-belt.
- Remove poly V-belt pulley for power steering pump.
- Unbolt power steering pump and tie up to one side; the hydraulic fluid hoses/pipes remain connected.



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



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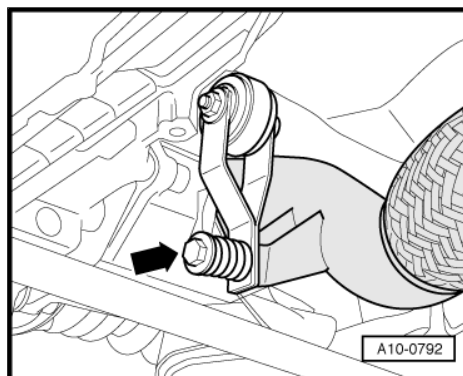
- Unbolt bracket for exhaust system -arrow-.



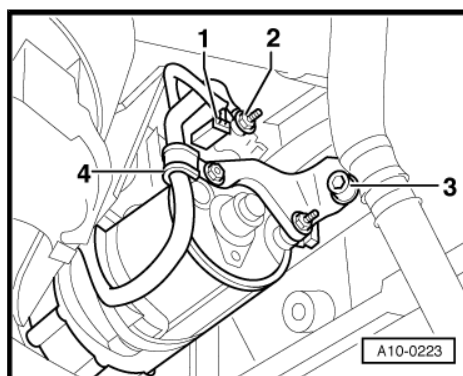
Caution

Avoid damage to flexible joint.

- ◆ *Do not bend flexible joint more than 10°.*
- ◆ *Install flexible joint so that it is not under tension.*
- ◆ *Take care not to damage wire mesh on flexible joint.*



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



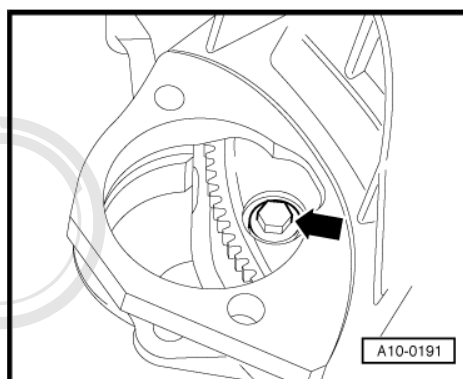
Vehicles with automatic gearbox:

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



Note

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



All vehicles (continued):

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

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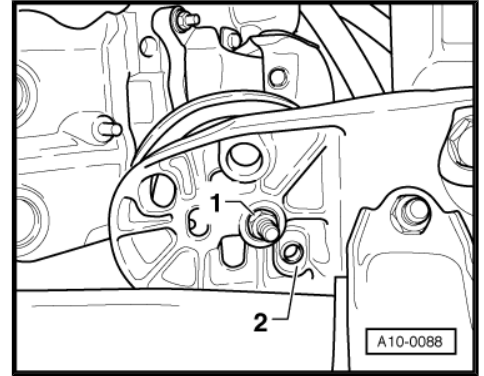


- Mark position of nuts -1- and locating sleeves -2- on bottom of engine mountings (right and left).

 Note

Different mounting holes are provided for the different engine versions.

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



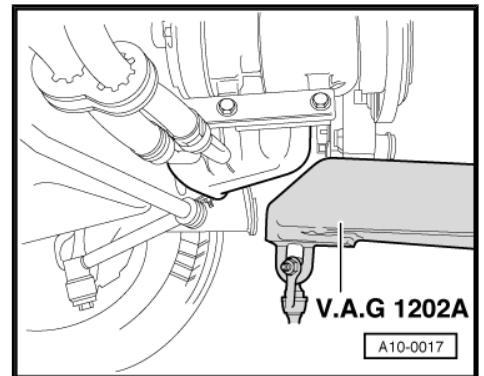
- Raise engine and gearbox using workshop hoist.



WARNING

Injury risk.

◆ *Ensure adequate support.*



 Note

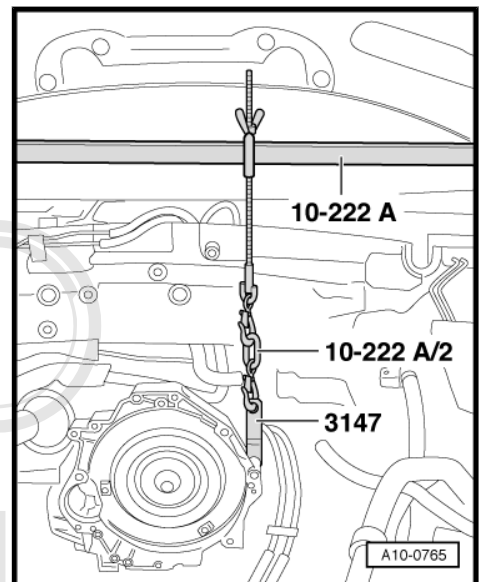
Make sure no wires/pipes are damaged at the top on the bulk-head.

- Remove bolts (accessible from below) securing engine to gearbox.
- Lower engine again.
- Position support bracket - 10 - 222 A- behind gas-filled strut on bolted flanges of wing panels. The spindle must be at the front.
- Insert gearbox support - 3147- into bolt hole in gearbox bell housing.
- Connect gearbox support - 3147- to support bracket - 10 - 222 A- using hooks - 10 - 222 A /2- .

 Note

Shown in illustration with engine removed.

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



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



Note

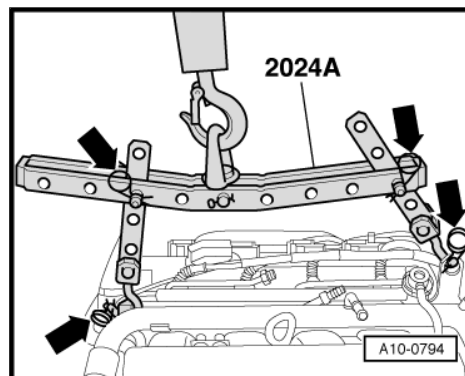
To adjust to the centre of gravity of the assembly, the perforated rails of the support hooks must be positioned as shown.



WARNING

Accident risk from loose components of lifting tackle.

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



- Remove remaining bolt securing engine to gearbox.



Note

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

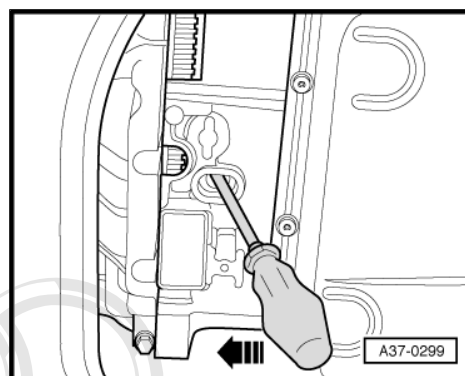
- Raise engine with workshop hoist until the studs of the engine mountings are clear.
- Tighten spindle of support bracket - 10 - 222 A- further.

Vehicles with automatic gearbox:

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

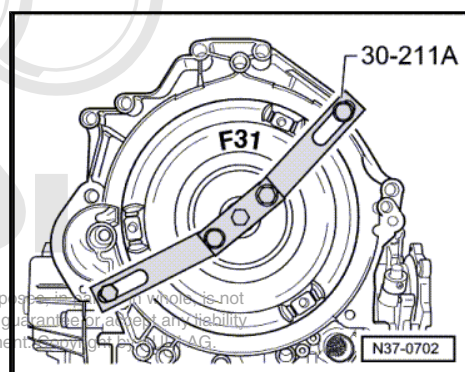
All vehicles (continued):

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



Vehicles with automatic gearbox:

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



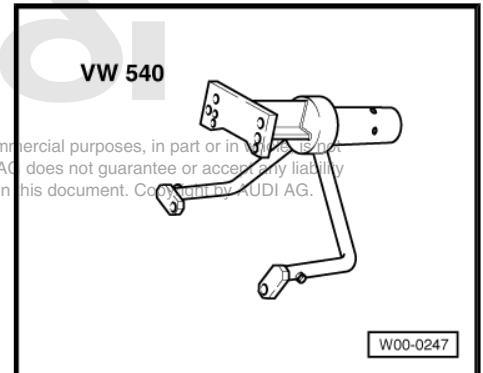
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3 Securing engine to engine and gear-box support

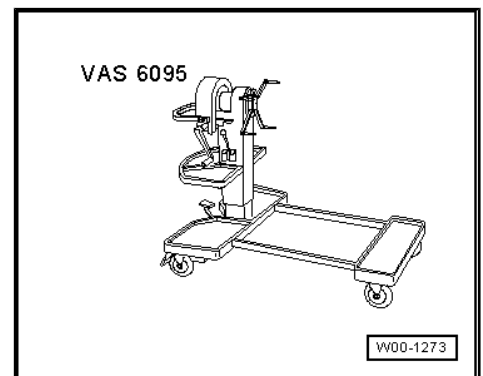
Special tools and workshop equipment required

- ◆ Engine and gearbox support - VW 540-

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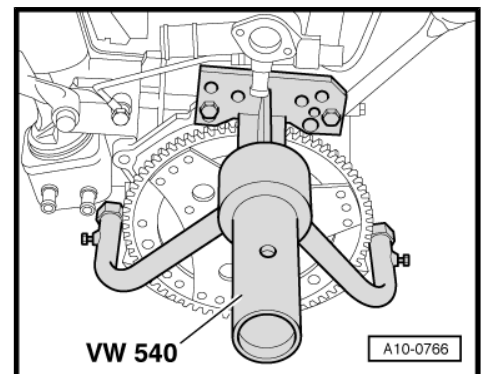


- ◆ Engine and gearbox support - VAS 6095-



Procedure

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



4 Installing engine

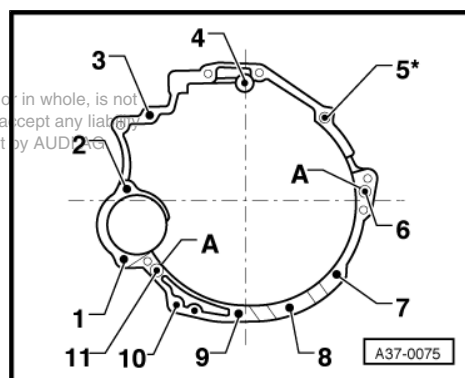
Procedure



Note

- ◆ *Renew self-locking nuts and bolts.*
- ◆ *Renew bolts which are tightened to a specified angle as well as oil seals, gaskets and O-rings.*
- ◆ *Hose connections and air pipes and hoses must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- ◆ *Fit all cable ties in the original positions when installing.*
- Check whether dowel sleeves -A- for centring engine and gearbox are fitted in cylinder block; install missing dowel sleeves.

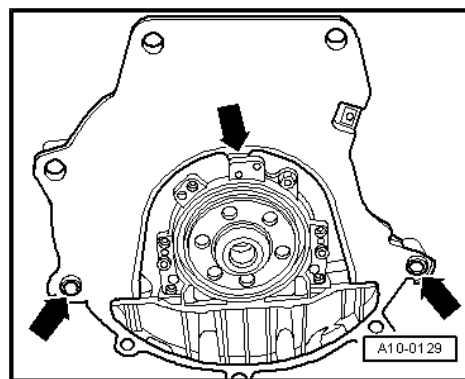
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- Ensure that the intermediate plate is engaged on the sealing flange and pushed onto the dowel sleeves -arrows-.

Vehicles with manual gearbox:

- Make sure that clutch plate is properly centred ⇒ Rep. gr. 30 .
- Check clutch release bearing for wear; renew if necessary.
- Clean input shaft splines and (in the case of used clutch plates) the hub splines. Remove corrosion and apply only a very thin coating of grease for clutch plate splines - G 000 100- to the splines. Then move clutch plate back and forth on input shaft until the hub moves smoothly on the shaft. Remove any excess grease. Do not lubricate guide sleeve ⇒ Rep. gr. 30 .
- A needle bearing must be fitted in the crankshaft on vehicles with manual gearbox; install needle bearing if not already fitted ⇒ [page 67](#) .



Vehicles with automatic gearbox:

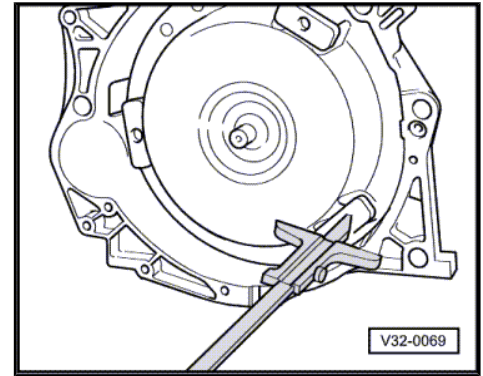
- In vehicles with automatic gearbox, the needle bearing must NOT be fitted in the crankshaft; remove needle bearing if fitted ⇒ [page 67](#) .

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

**Caution**

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

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

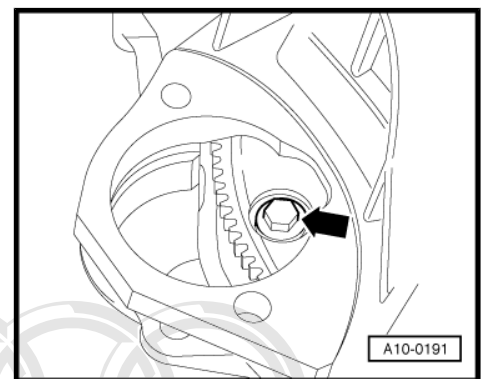


- Before bringing engine and gearbox together, turn torque converter and drive plate on engine so that the holes for one securing bolt are in line with the opening for the starter motor -arrow-.
- To secure torque converter on drive plate, use only new bolts (same as original equipment); refer to ⇒ Electronic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

**Caution**

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

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

**All vehicles (continued):**

- Join engine onto gearbox and screw in one securing bolt (tighten hand-tight).
- Slacken spindle of support bracket - 10 222 A -
- Lower engine, inserting studs of engine mountings into consoles for engine mountings.
- Install engine mountings free of stress. To do so, shake engine before tightening engine mountings.
- Install starter ⇒ Rep. gr. 27
- Install catalytic converter ⇒ [page 207](#) .
- Install V-belt ⇒ [page 51](#) .
- Install viscous fan ⇒ [page 168](#) .
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install power steering pump ⇒ Rep. gr. 48 .
- Install poly V-belt ⇒ [page 49](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .

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- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight, and tighten bolts.

Vehicles with automatic gearbox:

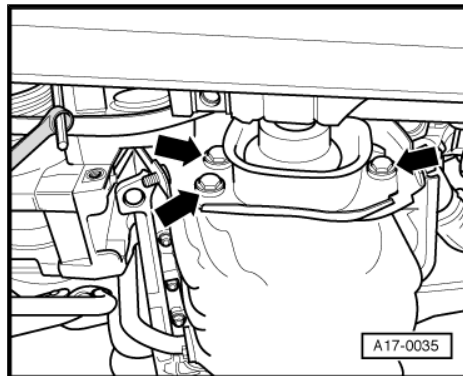
- Secure ATF lines ⇒ Rep. gr. 37 .

Vehicles with throttle cable:

- Adjust throttle cable ⇒ Rep. gr. 20 .

All vehicles (continued):

- Install front bumper ⇒ Rep. gr. 63 .
- Align the exhaust system so it is free of stress ⇒ [page 211](#) .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.



Caution

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

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

- Observe notes on procedure for connecting the battery ⇒ Rep. gr. 27 .
- Check engine oil level ⇒ Maintenance ; Booklet 802 .
- Install coolant hoses and air hoses with screw-type clips ⇒ [page 43](#) .
- Fit drain plug with new seal on coolant pump bearing housing and tighten ⇒ [page 161](#) .
- Connect coolant hose with plug-in connector ⇒ [page 44](#) .
- Fill up with coolant ⇒ [page 158](#) .



Note

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

Vehicles with automatic gearbox:

- Check ATF level ⇒ Rep. gr. 37 .

Tightening torques



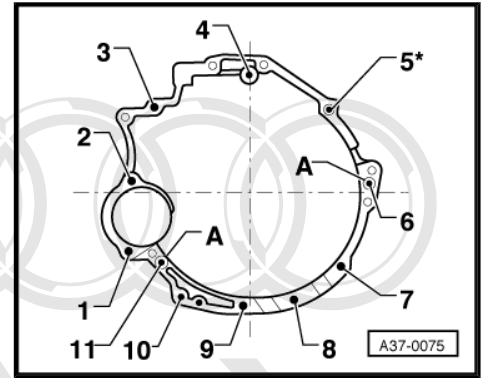
Note

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



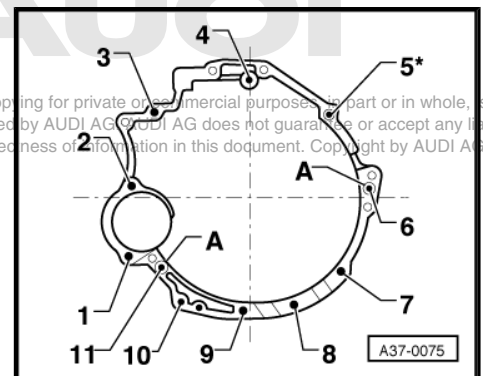
Engine/gearbox connecting bolts (manual gearbox)

Item	Bolt	Nm
1, 3, 4	M12x67	65
2, 6	M12x90	65
5, 11	M12x110	65
7, 8 ¹⁾ , 9, 10	M10x45	45
A	Dowel sleeves for centralising	
¹⁾ Vehicles up to approx. 07.96: M8 bolt; tightening torque: 25 Nm.		



Engine/gearbox connecting bolts (automatic gearbox)

Item	Bolt	Nm
1, 8, 9, 10	M10x45	45
2, 3, 4, 11	M12x67	65
5	M12x110	65
6	M12x90	65
7	M10x60	45
A	Dowel sleeves for centralising	



Component	Nm	
Bolts/nuts	M6	10
	M7	15
	M8	20
	M10	45
	M12	65
Except for the following:		
Engine mounting to subframe		25
Engine support to engine mounting		25
Stop for torque reaction support to bracket for torque reaction support		28
Torque converter to drive plate		85

Installing coolant hoses and air hoses with screw-type clips

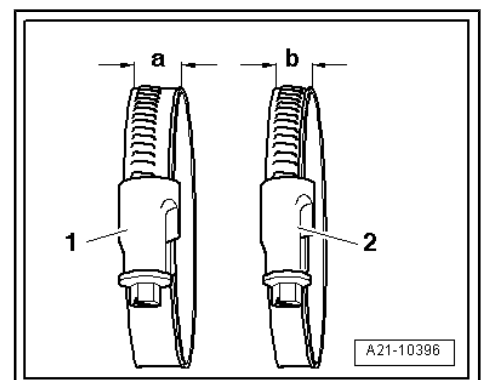


Note

To ensure that the air hoses can be properly secured at their connections, spray rust remover onto the worm thread of used hose clips before installing.

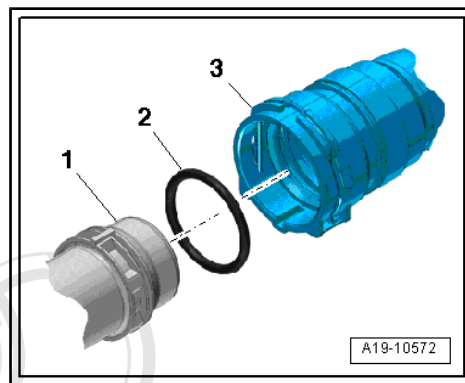
Tightening torque for

- 1 - Hose clip -a- for air hoses: 3.5 Nm
- 2 - Hose clip -b- for coolant hoses: 2 Nm



Connecting coolant hose with plug-in connector

- Remove old O-ring -2- from coolant hose -3-.
- Lightly lubricate new O-ring with coolant and fit O-ring in coolant hose.
- Press coolant hose onto connection -1- until it engages audibly.
- Press coolant hose in again and then pull to check that plug-in connector is correctly engaged.



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13 – Crankshaft group

1 Cylinder block (pulley end)

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



Caution

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

1 - Bolt

- ☐ 10 Nm

2 - Fan wheel for viscous fan

- ☐ Removing and installing
⇒ ["2.2 Removing and installing viscous fan", page 168](#)

3 - Bolt

- ☐ Tightening torque
⇒ [Item 13 \(page 162\)](#)

4 - V-belt pulley

- ☐ For coolant pump
- ☐ Installation position:
straight half of pulley to
coolant pump

5 - Poly V-belt

- ☐ Check for wear
- ☐ Do not kink
- ☐ Before removing, mark
direction of rotation with
chalk or felt-tip pen
- ☐ Removing and installing
⇒ [page 49](#)
- ☐ When installing, make
sure it is properly seated
on pulleys

6 - Bolt

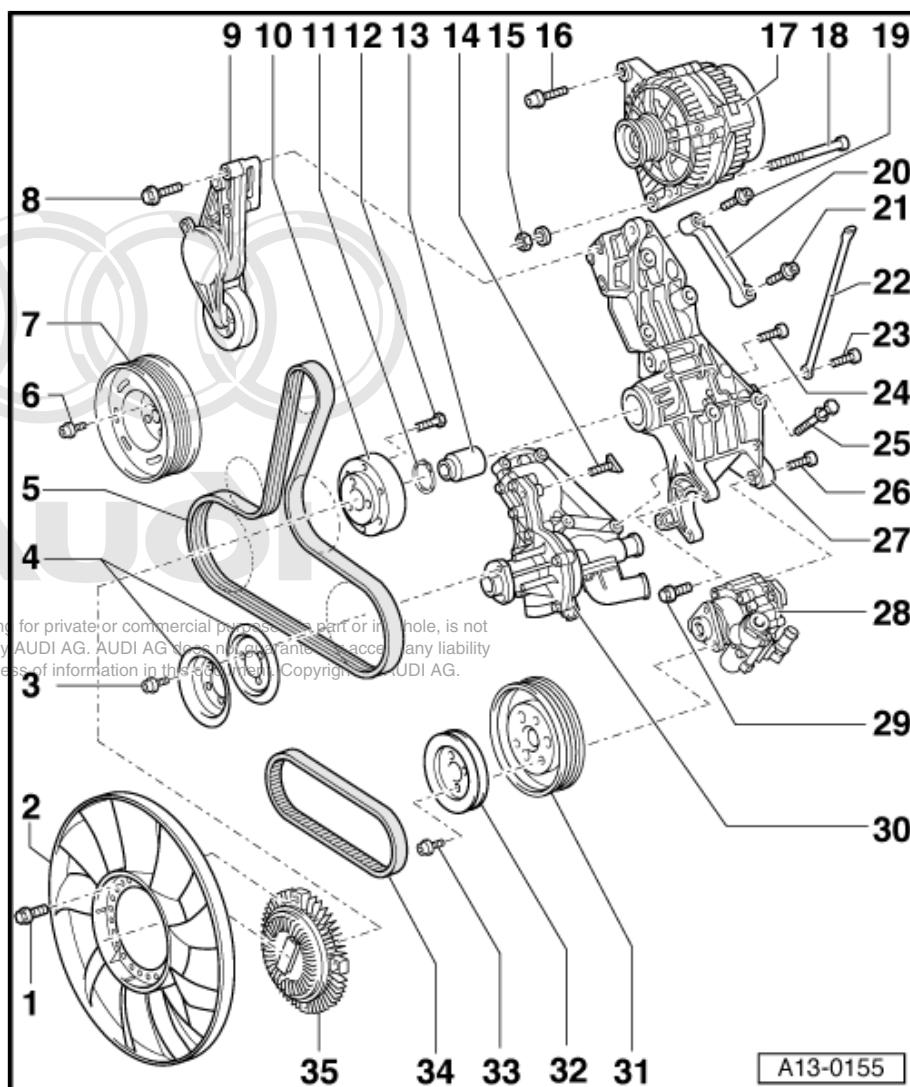
- ☐ 40 Nm
- ☐ Use only genuine bolts
⇒ [Electronic parts catalogue](#)

7 - Vibration damper with poly V-belt pulley

- ☐ Can only be installed in one position
- ☐ Removing and installing ⇒ [page 55](#)

8 - Bolt

- ☐ 25 Nm





9 - Tensioner for poly V-belt

10 - Poly V-belt pulley for viscous fan

- ☐ Removing and installing ⇒ ["2.2 Removing and installing viscous fan", page 168](#)

11 - Circlip

- ☐ For viscous fan bearing

12 - Bolt

- ☐ 10 Nm

13 - Bearing for viscous fan

- ☐ Removing and installing ⇒ [page 169](#)

14 - T-head bolt

- ☐ Insert before installing bracket for ancillaries

15 - Nut

- ☐ Tightening torque ⇒ Rep. gr. 27

16 - Bolt

- ☐ Tightening torque ⇒ Rep. gr. 27

17 - Alternator

- ☐ Removing and installing ⇒ Rep. gr. 27

18 - Bolt

19 - Bolt

- ☐ 40 Nm

20 - Support

- ☐ To cylinder block

21 - Bolt

- ☐ 25 Nm

22 - Support for intake manifold

23 - Bolt

- ☐ 20 Nm

24 - Bolt

- ☐ 45 Nm

25 - Bolt

- ☐ Different lengths
- ☐ Tightening torque and sequence ⇒ [page 47](#)

26 - Bolt

- ☐ Tightening torque ⇒ Rep. gr. 48

27 - Bracket for ancillaries

- ☐ Removing and installing ⇒ [page 52](#)

28 - Power steering pump

- ☐ Removing and installing ⇒ Rep. gr. 48

29 - Bolt

- ☐ Tightening torque ⇒ Rep. gr. 48

30 - Coolant pump

- ☐ With thermostat
- ☐ Removing and installing ⇒ [page 163](#)

31 - Poly V-belt pulley for power steering pump

- ☐ Installation position: shoulder faces to front of vehicle

32 - V-belt pulley for power steering pump

33 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 48

34 - V-belt

- ❑ For coolant pump
- ❑ Removing and installing ⇒ [page 51](#)

35 - Viscous coupling

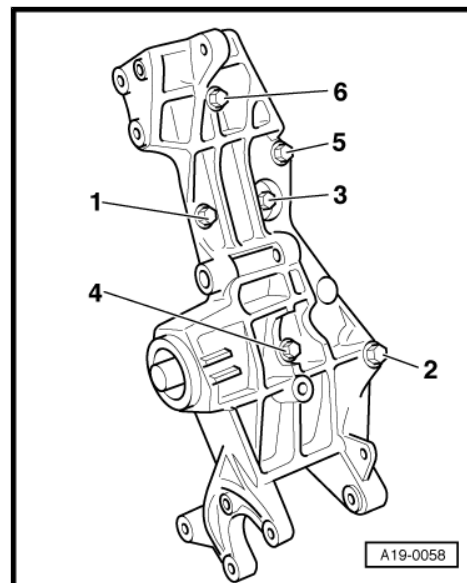
- ❑ Removing and installing ⇒ ["2.2 Removing and installing viscous fan", page 168](#)

Bracket for ancillaries - tightening torque and tightening sequence

- Fit bolts for bracket for ancillaries as follows:

- 1 - M8x70
- 2 - M8x110
- 3 - M8x50
- 4 - M8x90
- 5 - M8x70
- 6 - M8x100

- Tighten bolts -1 ... 6- to 25 Nm in the sequence shown.



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

1 - Bolt

- ☐ Tightening torque ⇒ Rep. gr. 87

2 - Refrigerant lines

- ☐ Do not unscrew or disconnect

3 - Dowel sleeve

- ☐ Check for correct seating in bracket

4 - Bolt

- ☐ 25 Nm

5 - Bracket

- ☐ For air conditioner compressor

6 - Tensioner for poly V-belt

7 - Washer

8 - Bolt

- ☐ 20 Nm

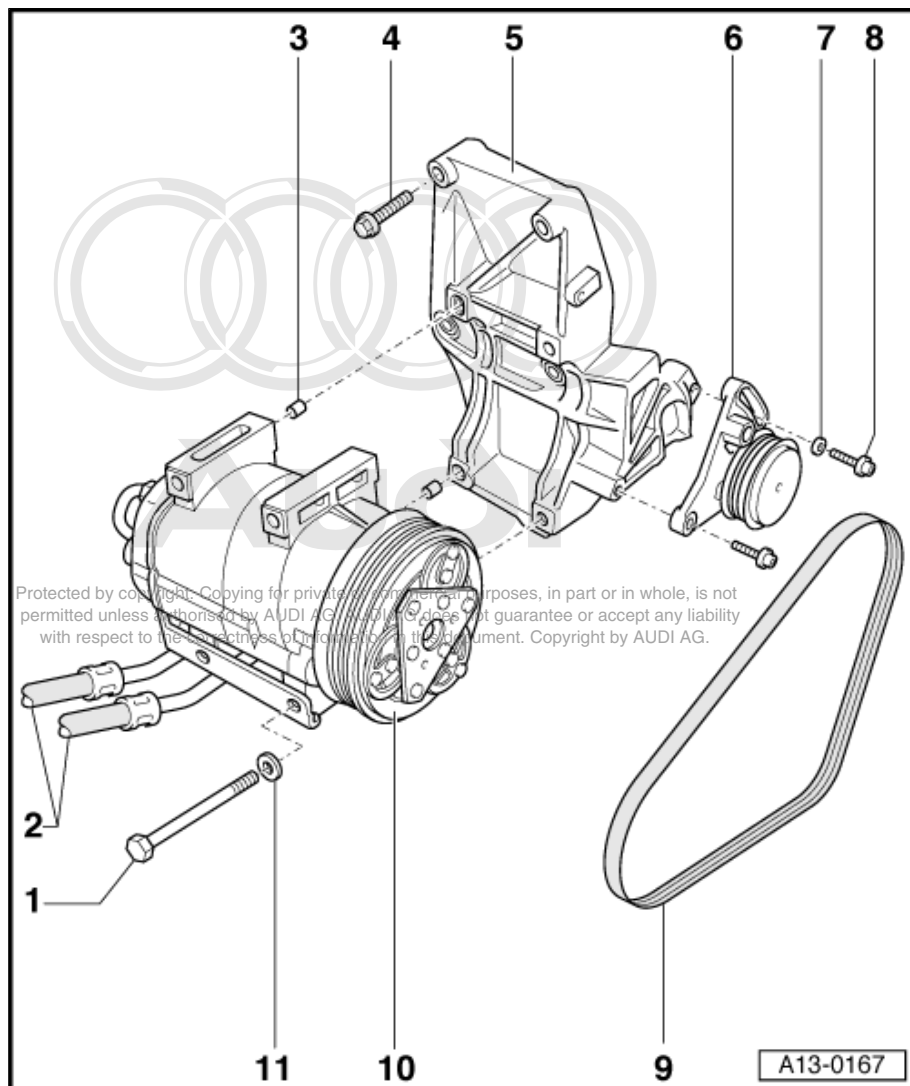
9 - Poly V-belt

- ☐ Check for wear
- ☐ Do not kink
- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen
- ☐ Removing and installing ⇒ [page 49](#)
- ☐ When installing, make sure it is properly seated on pulleys

10 - Air conditioner compressor

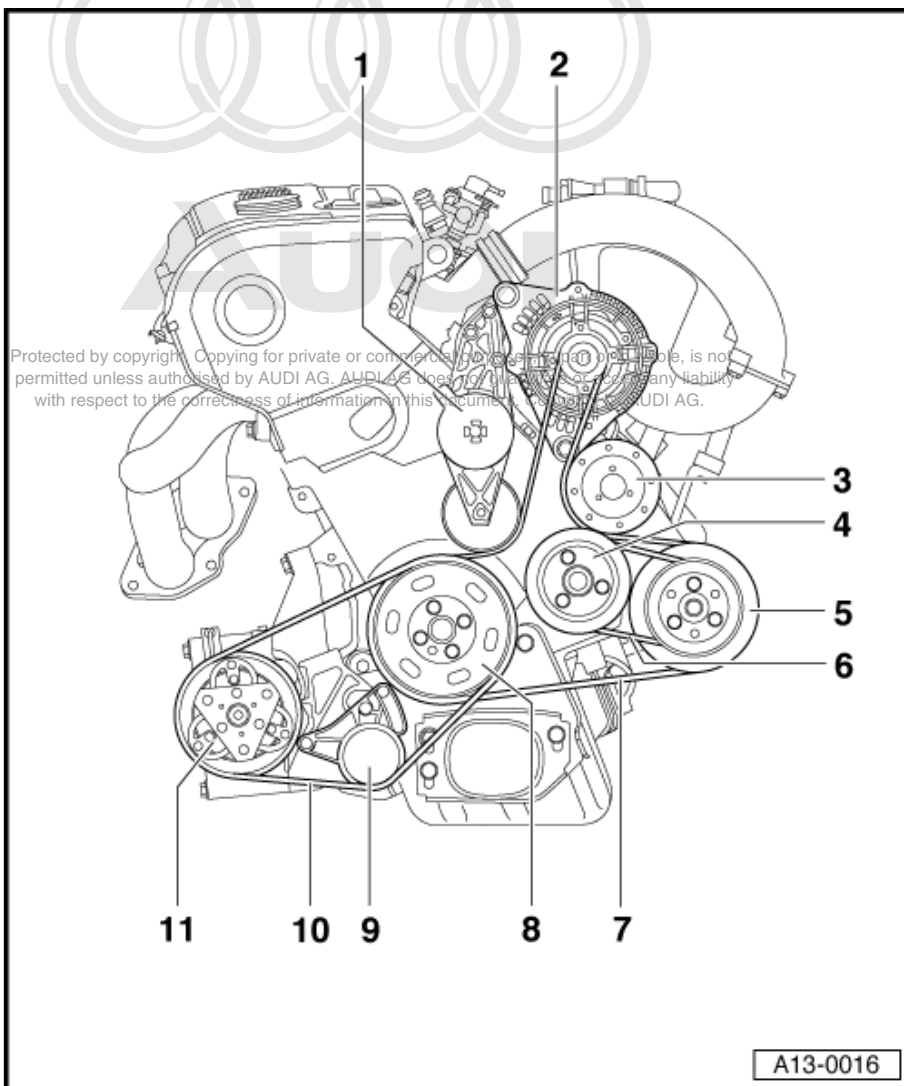
- ☐ Do not unscrew or disconnect refrigerant hoses or pipes.
- ☐ After removing compressor from mountings, secure it to longitudinal member with wire or similar. Do not leave it suspended from refrigerant pipes.

11 - Washer



1.3 Routing of V-belt and poly V-belt

- 1 - Tensioner for poly V-belt
- 2 - Alternator
- 3 - Viscous coupling
- 4 - Coolant pump
- 5 - Power steering pump
- 6 - V-belt
 - ☐ For coolant pump
 - ☐ Removing and installing
⇒ [page 51](#)
- 7 - Poly V-belt
 - ☐ For alternator, power steering pump and viscous fan
 - ☐ Removing and installing
⇒ [page 49](#)
- 8 - Vibration damper
- 9 - Tensioner for poly V-belt
 - ☐ For air conditioner compressor
- 10 - Poly V-belt
 - ☐ For air conditioner compressor
 - ☐ Removing and installing
⇒ [page 49](#)
- 11 - Air conditioner compressor

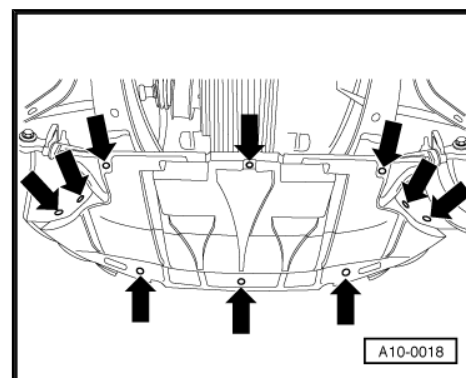


1.4 Removing and installing poly V-belts

Removing

Vehicles with air conditioning:

- Release fasteners -arrows- and remove noise insulation.





Caution

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

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

- Loosen bolts on tensioner for poly V-belt for air conditioner compressor -arrows-, slacken belt and remove.

All vehicles (continued):

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

Installing

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



Note

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

- Position poly V-belt on pulleys of crankshaft and power steering pump; pull upwards with suitable tool if necessary.
- Turn tensioner in direction of -arrow-.
- Then position poly V-belt on alternator pulley and release tensioner.
- Check that poly V-belt is properly seated.
- Routing of poly V-belt ⇒ [page 49](#)

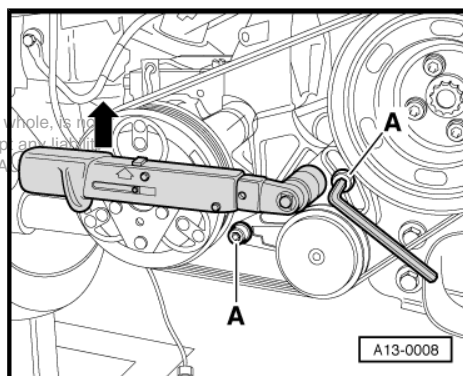
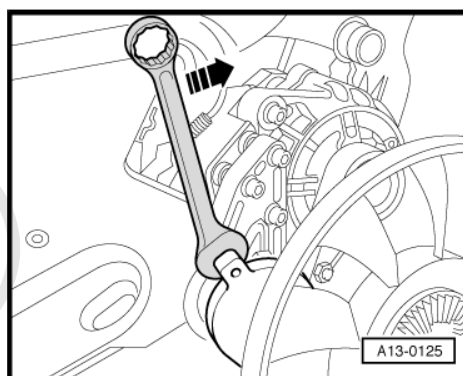
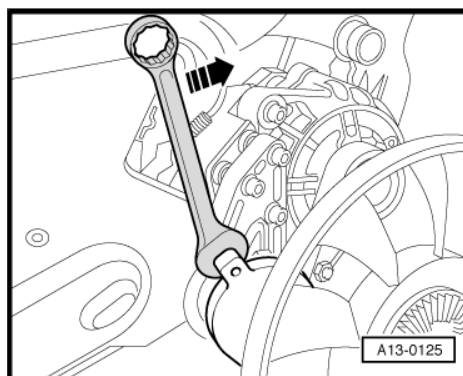
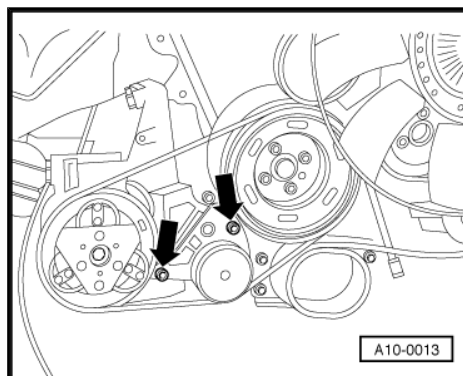
Vehicles with air conditioning:

- Install poly V-belt for air conditioner compressor.
- Routing of poly V-belt ⇒ [page 49](#)
- Apply torque wrench to hexagon on tensioner as shown.
- Pre-tension tensioner to 25 Nm and at the same time tighten bolts -A-.

All vehicles (continued):

- Start engine and check that belts run properly.

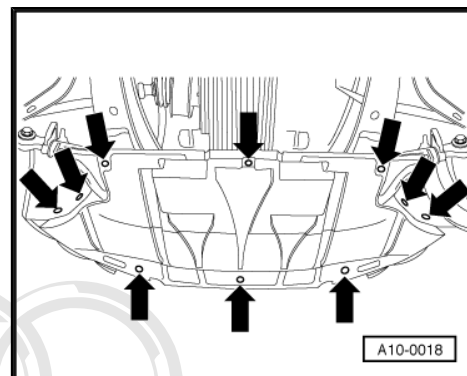
Tightening torque ⇒ [page 48](#)



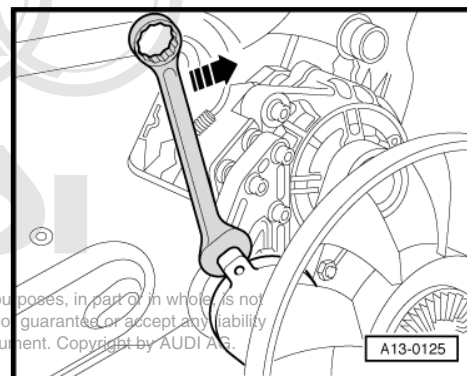
1.5 Removing and installing V-belt

Removing

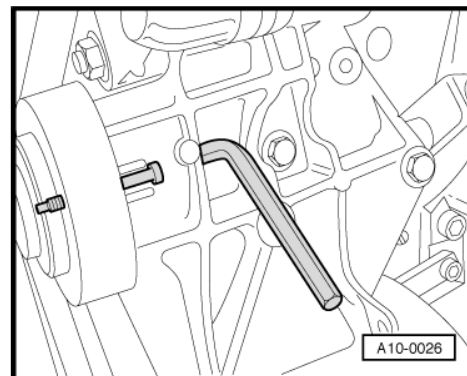
- Lock carrier must be in service position ⇒ Rep. gr. 50 .
- Release fasteners -arrows- and remove noise insulation.



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



- Use M5x60 mm bolt to lock poly V-belt pulley for viscous fan and unscrew using hexagon key.

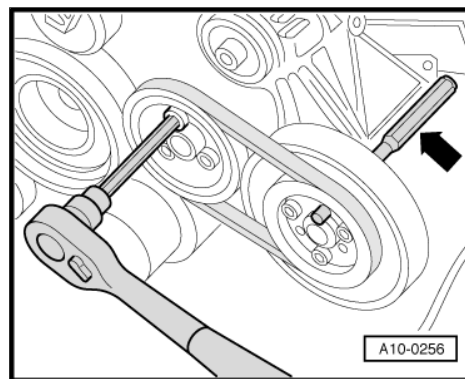


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- Remove V-belt pulley for coolant pump; apply drift -arrow- at power steering pump pulley.
- Detach V-belt.

Installing

- Installation is carried out in the reverse order; note the following:
- Fit V-belt and secure the two pulley halves loosely to the coolant pump.
- Tighten the two pulley halves in stages (continue to rotate coolant pump).
- Whilst tightening, V-belt must move outwards as far as possible to actual resting surface.



Note

It is not possible to adjust belt tension on coolant pump pulley.

- Fit poly V-belt, slacken off tensioner.
- Install viscous fan ⇒ [page 168](#) .
- Start engine and check that belts run properly.
- Check tightening torque of coolant pump pulley bolts again.

Tightening torque ⇒ [page 161](#)

1.6 Removing and installing bracket for ancillaries

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Removing

- Lock carrier must be in service position ⇒ Rep. gr. 50 .

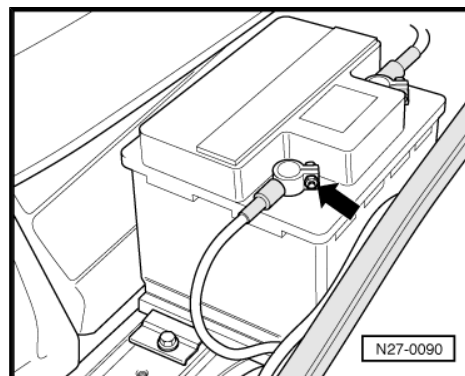


Caution

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

- ◆ Observe notes on procedure for disconnecting the battery.

- Disconnect earth wire -arrow- from battery terminal ⇒ Rep. gr. 27 .
- Remove poly V-belt and tensioner for poly V-belt ⇒ [page 49](#) .



Note

The air conditioner poly V-belt remains fitted.

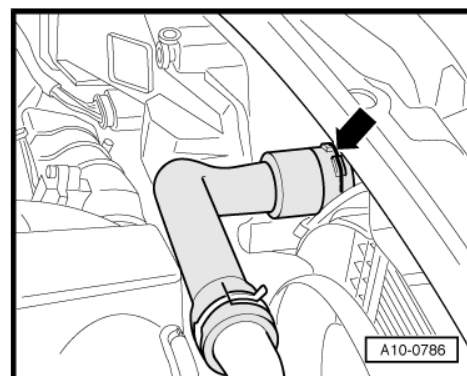
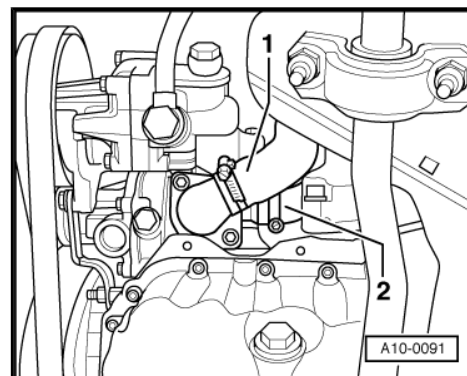
- Remove viscous fan with poly V-belt pulley ⇒ [page 168](#) .
- Remove V-belt ⇒ [page 51](#) .
- Remove poly V-belt pulley for power steering pump.
- Unbolt power steering pump and tie up to one side; the hydraulic fluid hoses/pipes remain connected.
- Drain coolant ⇒ [page 156](#) .

- Detach coolant hoses -1- and -2-; release hose clips to do so.



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

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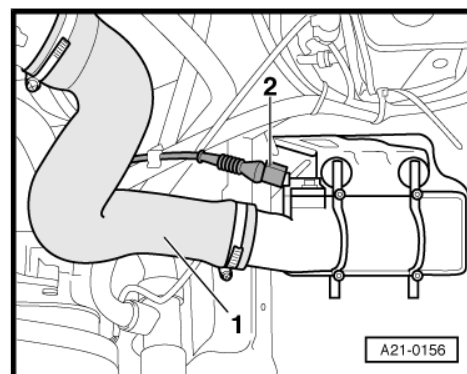


- Remove air hose -1-.

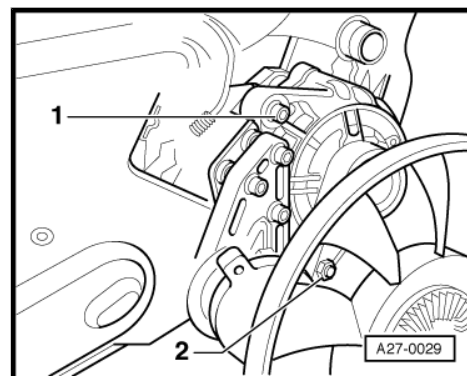


Note

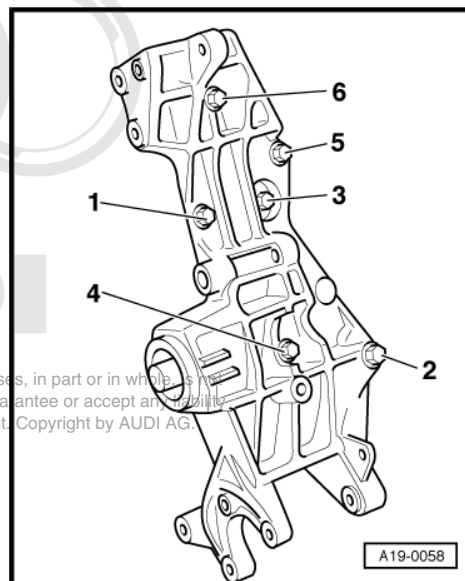
Disregard -item 2-.



- Unscrew hexagon socket head bolt -1-.
- Remove nut -2-.
- Pivot alternator slightly to side and pull out bottom bolt.
- Detach alternator towards front and unbolt electrical wiring.
- Unbolt the following supports and struts from bracket for ancillaries:
 - ◆ Support for intake manifold
 - ◆ Support to torque reaction support bracket
 - ◆ Strut to cylinder block (remove completely)



- Remove bolts -1 ... 6- and detach bracket for ancillaries.
- Detach coolant hoses from coolant pump and thermostat housing.



- Remove nut -arrow- and detach coolant pump.



Note

Coolant pump is bolted to bracket for ancillaries.

Installing

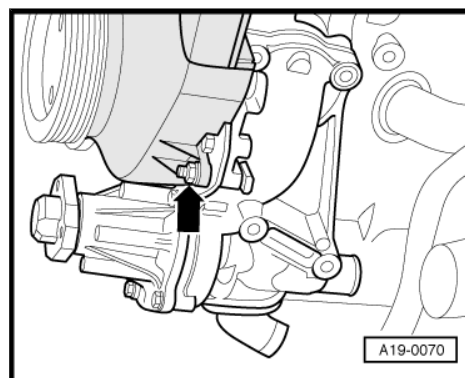
Installation is carried out in the reverse order; note the following:



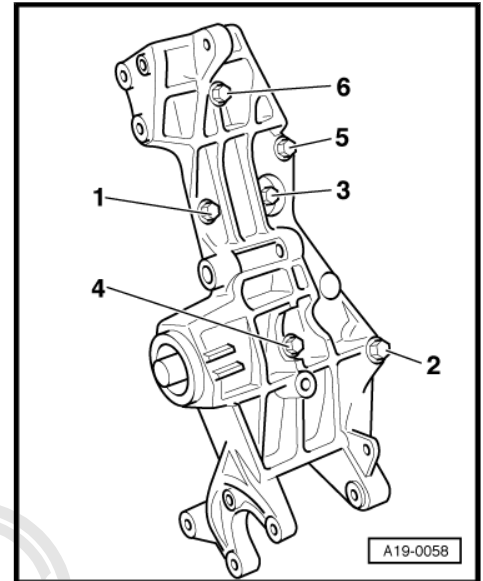
Note

Fit new O-ring for coolant pump.

- Clean sealing surfaces at cylinder block and coolant pump.
- Insert T-head bolt into hole on coolant pump.



- Position bracket for ancillaries with coolant pump on cylinder block, insert bolts and tighten ⇒ [page 47](#) .
- To facilitate attachment of alternator, knock back bushes for securing bolts slightly.
- Install power steering pump ⇒ Rep. gr. 48 .
- Install alternator ⇒ Rep. gr. 27 .
- Install V-belt ⇒ [page 51](#) .
- Bolt coolant pump housing to toothed belt cover and install poly V-belt pulley for coolant pump ⇒ [page 161](#) .
- Install viscous fan ⇒ [page 168](#) .
- Install coolant hoses and air hoses with screw-type clips ⇒ [page 43](#) .
- Install poly V-belt ⇒ [page 51](#) .
- Fill up with coolant ⇒ [page 158](#) .
- Observe notes on procedure for connecting the battery ⇒ Rep. gr. 27 .



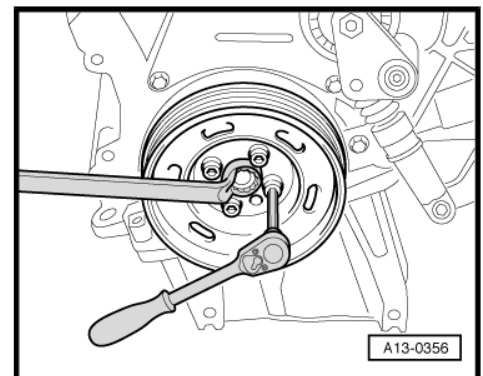
Tightening torques

Component		Nm
Strut for cylinder block	to cylinder block	25
	to bracket for ancillaries	40
Strut for torque reaction support bracket	to torque reaction support	25
	to bracket for ancillaries	20
Support for intake manifold	to intake manifold	20
	to bracket for ancillaries	20

1.7 Removing and installing vibration damper

Removing

- Lock carrier must be in service position ⇒ Rep. gr. 50 .
- Remove poly V-belt ⇒ [page 49](#) .
- Counterhold by applying ring spanner to bolt for toothed belt sprocket and unbolt vibration damper.



Installing

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

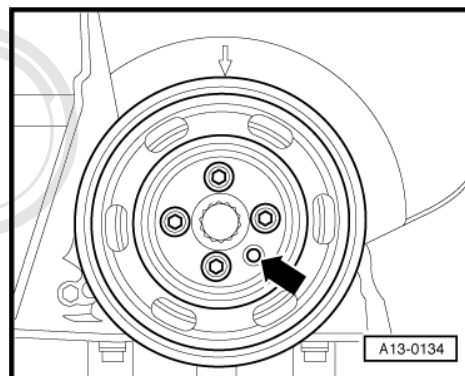


Note

- ◆ *Use only genuine bolts ⇒ Electronic parts catalogue .*
- ◆ *The vibration damper can only be installed in one position. The hole -arrow- in the vibration damper must be located over the projection on the toothed belt sprocket.*

- Install poly V-belt ⇒ [page 49](#) .

Tightening torques ⇒ [page 45](#)



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



Servicing clutch ⇒ Rep. gr. 30

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

1 - Oil seal

- ☐ To renew, remove intermediate shaft sealing flange -item 15-
- ☐ Install using fitting tool - 10 - 203-

2 - Woodruff key

- ☐ Check for firm attachment

3 - Bolt

- ☐ 25 Nm

4 - Sealing flange (pulley end)

- ☐ Remove sump in order to remove and install
⇒ [page 138](#)

5 - Gasket

- ☐ Renew

6 - Cylinder block

7 - Bolt

- ☐ Renew
- ☐ For dual-mass flywheel:
60 Nm + turn 180° further
- ☐ For drive plate: 60 Nm +
turn 90° further

8 - Dual-mass flywheel/drive plate

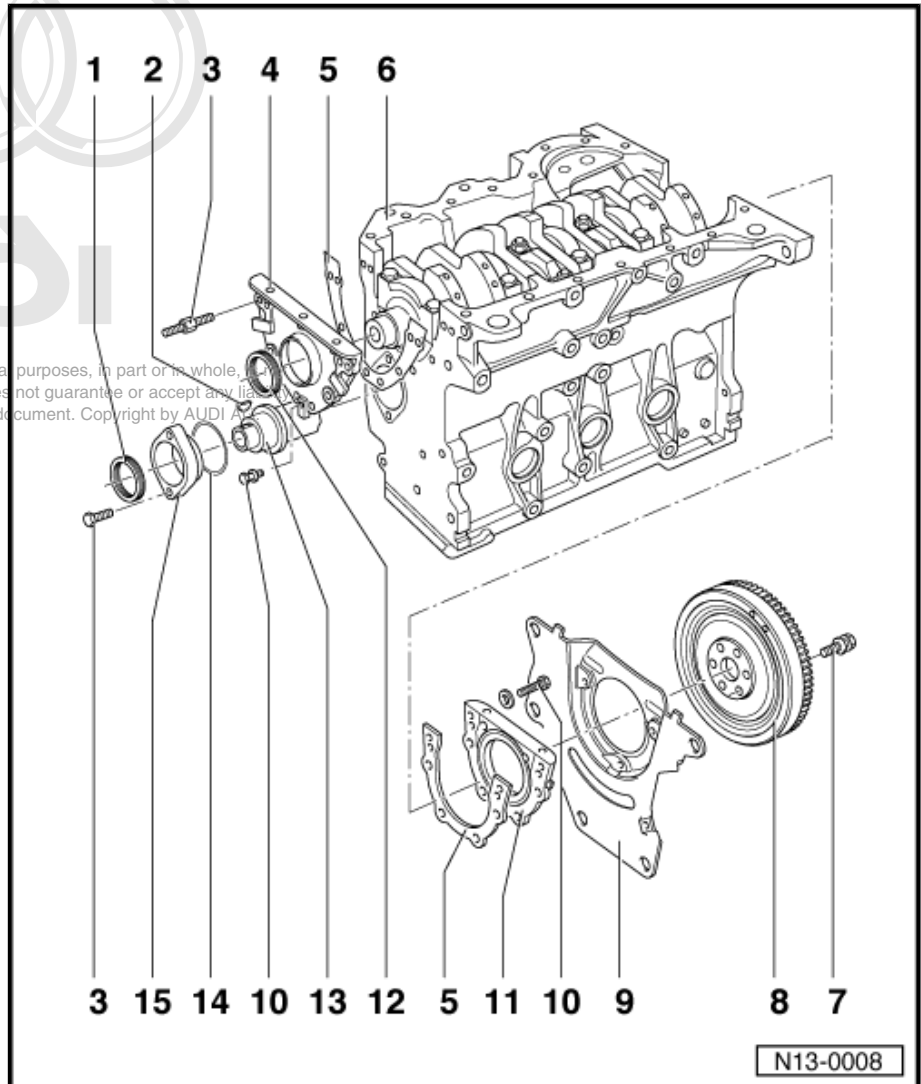
- ☐ Removing and installing dual-mass flywheel on vehicles with manual gearbox ⇒ [page 61](#)
- ☐ Removing and installing drive plate on vehicles with automatic gearbox ⇒ [page 62](#)

9 - Intermediate plate

- ☐ Must be positioned on dowel sleeves
- ☐ Do not damage/bend when assembling
- ☐ Is fitted onto sealing flange ⇒ [page 58](#)

10 - Bolt

- ☐ Install with spring washer
- ☐ 10 Nm



11 - Sealing flange (gearbox end)

- ☐ With oil seal
- ☐ Remove sump in order to remove and install ⇒ [page 138](#)
- ☐ Renew
- ☐ Before installing, remove oil residue from crankshaft journal with a clean cloth
- ☐ Do not lubricate/grease sealing lip of oil seal
- ☐ Take care not to fold over or damage sealing lip of oil seal when fitting

12 - Oil seal

- ☐ Renewing ⇒ [page 59](#)

13 - Intermediate shaft

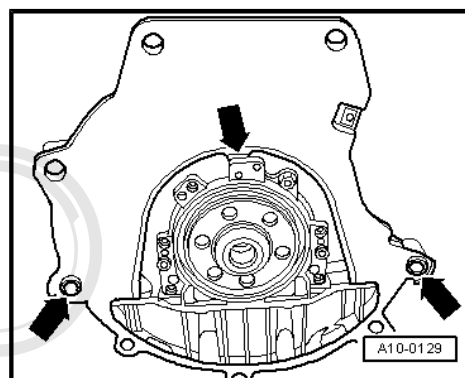
- ☐ Axial clearance: max. 0.25 mm

14 - O-ring

- ☐ Renew

15 - Intermediate shaft sealing flange**Installing intermediate plate**

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



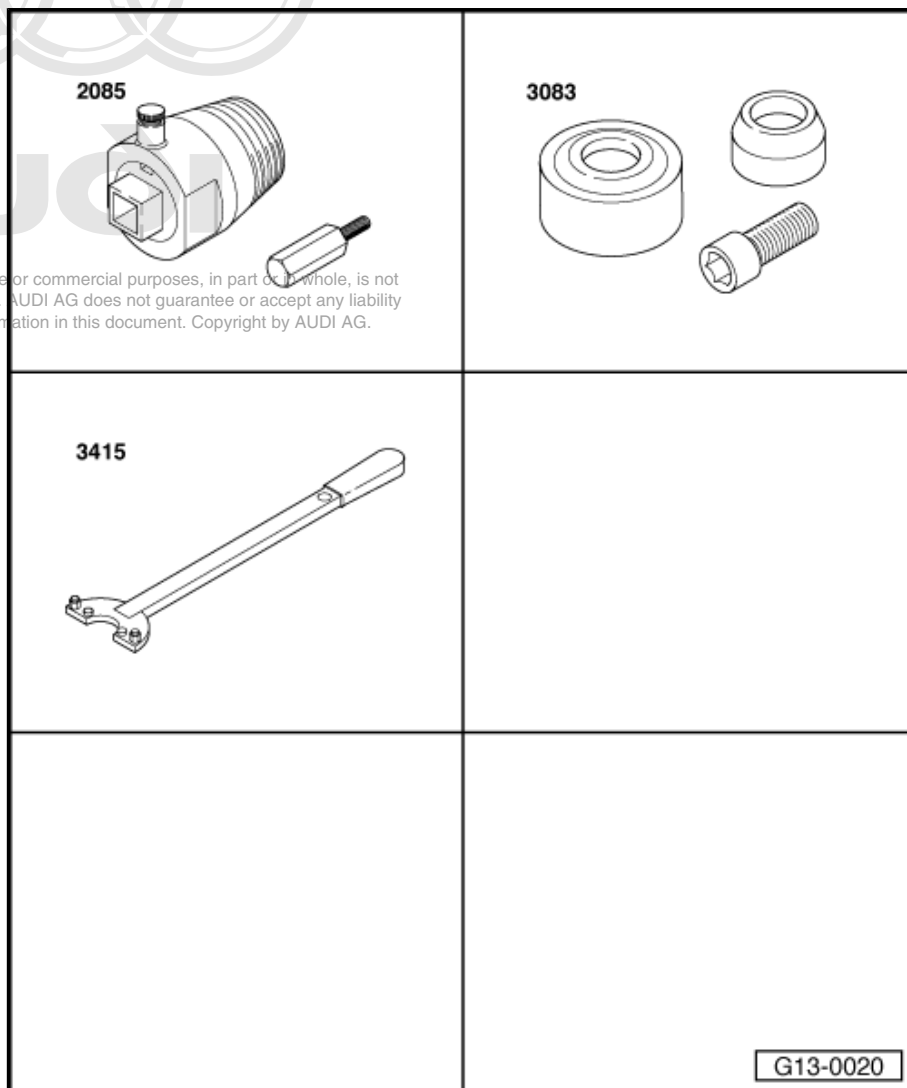
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2.2 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

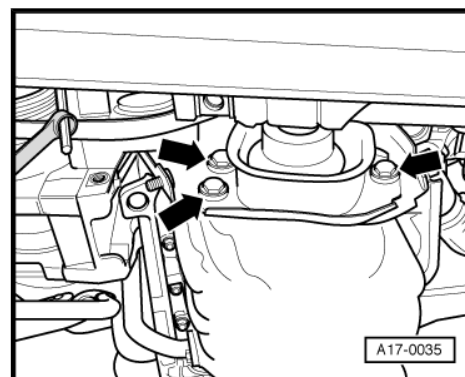
- ◆ Oil seal extractor - 2085-
- ◆ Oil seal fitting tool - 3083-
- ◆ Counterhold tool - 3415-

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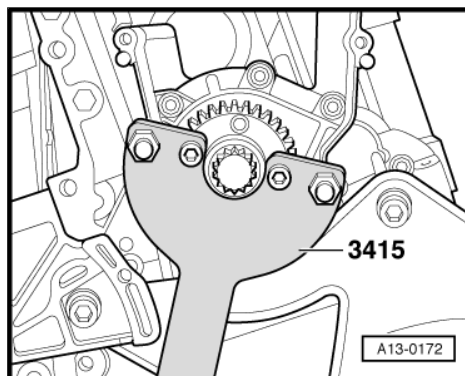


Procedure

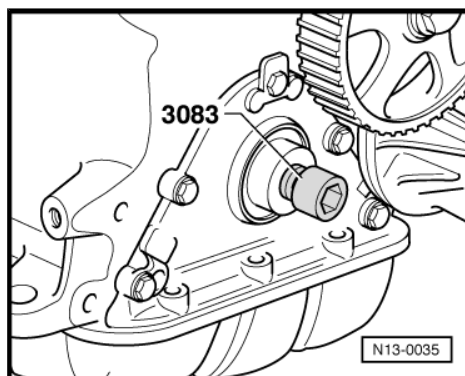
- Lock carrier must be in service position ⇒ Rep. gr. 50 .
- Remove toothed belt ⇒ [page 74](#) .
- Remove stop for torque reaction support -arrows-.



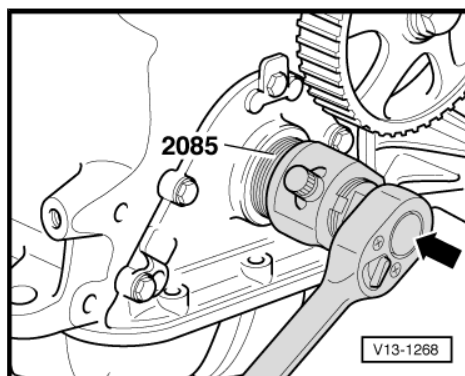
- Remove crankshaft sprocket using counterhold tool - 3415- .



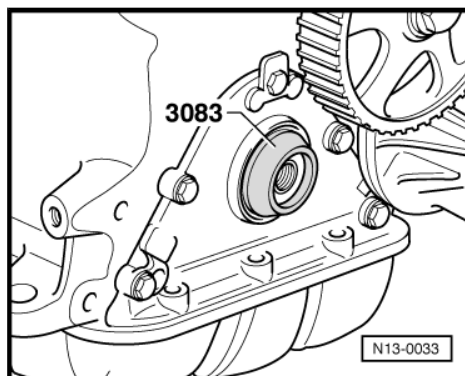
- To guide oil seal extractor, screw socket head bolt from oil seal fitting tool - 3083- for toothed belt sprocket into crankshaft onto stop by hand.
- Screw inner section of oil seal extractor -2085- two turns out of outer section (approx. 3 mm) and lock with knurled screw.



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



- Position guide sleeve from oil seal fitting tool - 3083- on crankshaft journal.



Note

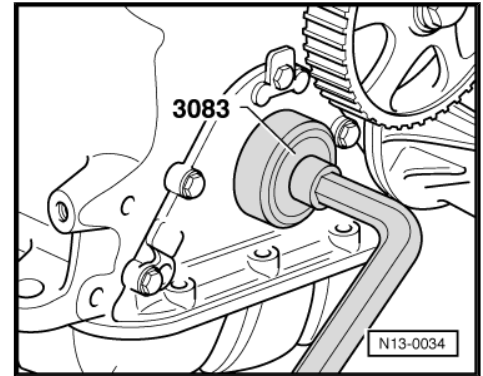
Do not lubricate sealing lip and outer rim of oil seal before pressing in.

- Push oil seal over guide sleeve onto crankshaft journal.

- Press in oil seal as far as stop using fitting sleeve and bolt from oil seal fitting tool - 3083- .

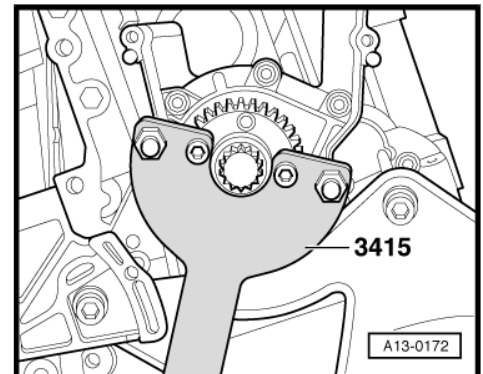
 Note

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



- Install crankshaft sprocket using counterhold tool - 3415- .
- Install toothed belt (adjust valve timing): vehicles up to 05.1999 ⇒ [page 76](#) , vehicles from 06.1999 onwards ⇒ [page 81](#) .
- Install poly V-belt and tensioner for poly V-belt ⇒ [page 49](#) .

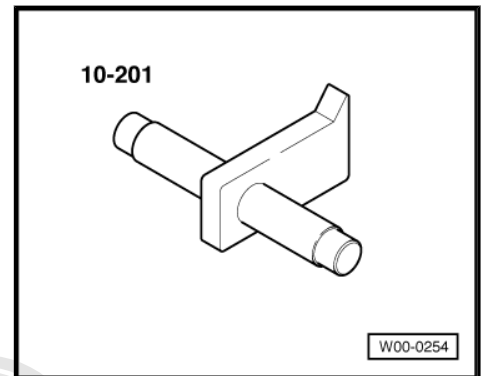
For tightening torques refer to ⇒ [page 73](#) or ⇒ [page 78](#) .



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

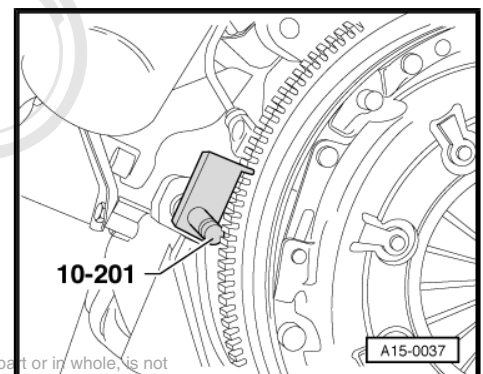
Special tools and workshop equipment required

- ◆ Counterhold tool - 10 - 201-



Removing

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



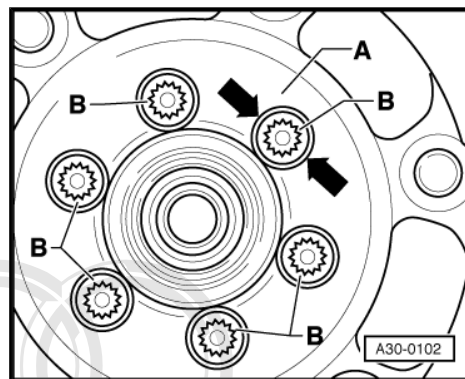
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Note

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

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



Installing

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



Note

Renew bolts for dual-mass flywheel.

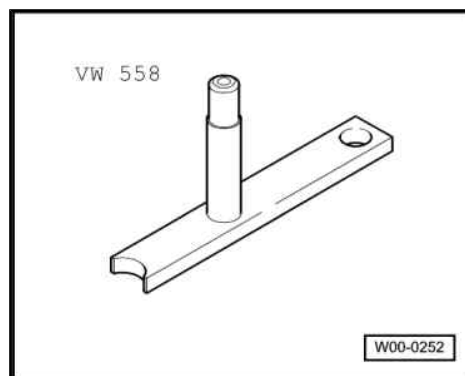
- Fit counterhold tool - 10 - 201- the other way round to tighten bolts.
- Install clutch pressure plate ⇒ Rep. gr. 30 .

Tightening torque ⇒ [page 57](#)

2.3.1 Removing and installing drive plate - vehicles with automatic gearbox

Special tools and workshop equipment required

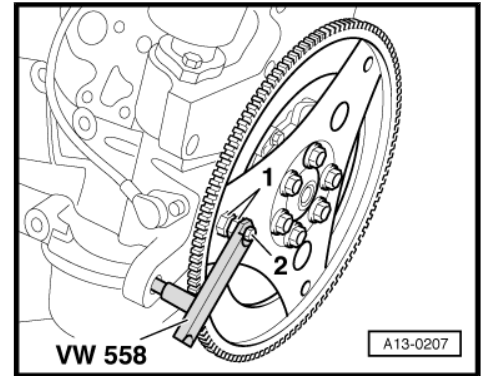
- ◆ Clutch counterhold tool - VW 558-



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

Removing

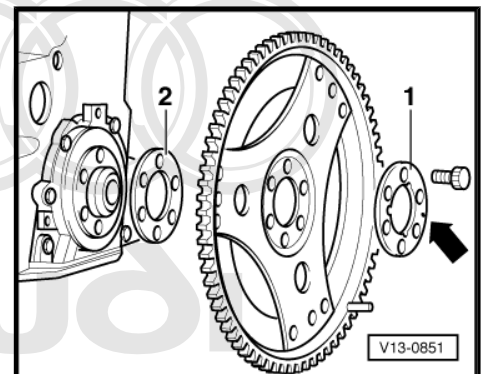
- Engine or gearbox removed.
- Secure clutch counterhold tool - VW 558- to drive plate using M8x45 bolt -item 2-. Fit two M10 nuts -1- between counterhold tool and drive plate.
- Mark position of drive plate in relation to crankshaft.
- Remove drive plate.
- Remove shim located behind.



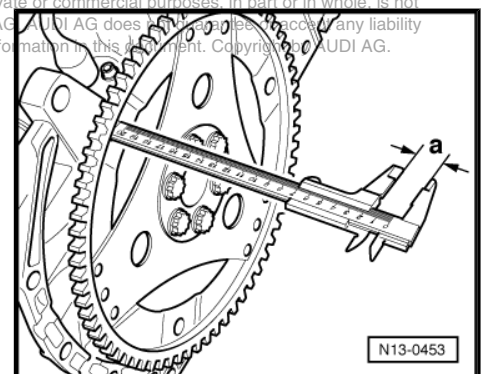
Installing

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

- Fit shim -2- on crankshaft.
- Install drive plate with washer -1-.
- Lug -arrow- must face torque converter.



- Insert at least 3 old bolts and tighten to 30 Nm.
- Measure distance through torque converter securing hole using depth gauge.
- Specification: Distance -a- = 18.9 ... 20.5 mm.



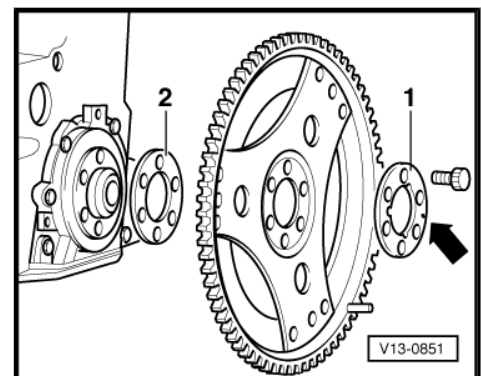
- If specification is not attained, remove drive plate and remove or add shim -2-.
- Repeat measurement (tighten bolts on drive plate to 30 Nm).



Note

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

Tightening torque ➔ [page 57](#)



3 Crankshaft



Note

- ◆ When carrying out repairs, secure engine with engine and gearbox support - VW 540- to engine and gearbox support - VAS 6095- ➔ [page 39](#).
- ◆ If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully, and the oil cooler must be renewed in order to prevent further damage occurring later.
- ◆ All bearing and running surfaces must be oiled before assembling.

3.1 Crankshaft - exploded view

1 - Bearing shells 1, 2, 4 and 5

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

2 - Bolt

- ☐ Renew
- ☐ 65 Nm + 90°
- ☐ When measuring radial clearance, tighten used bolt to 65 Nm and turn 90° further

3 - Bearing caps

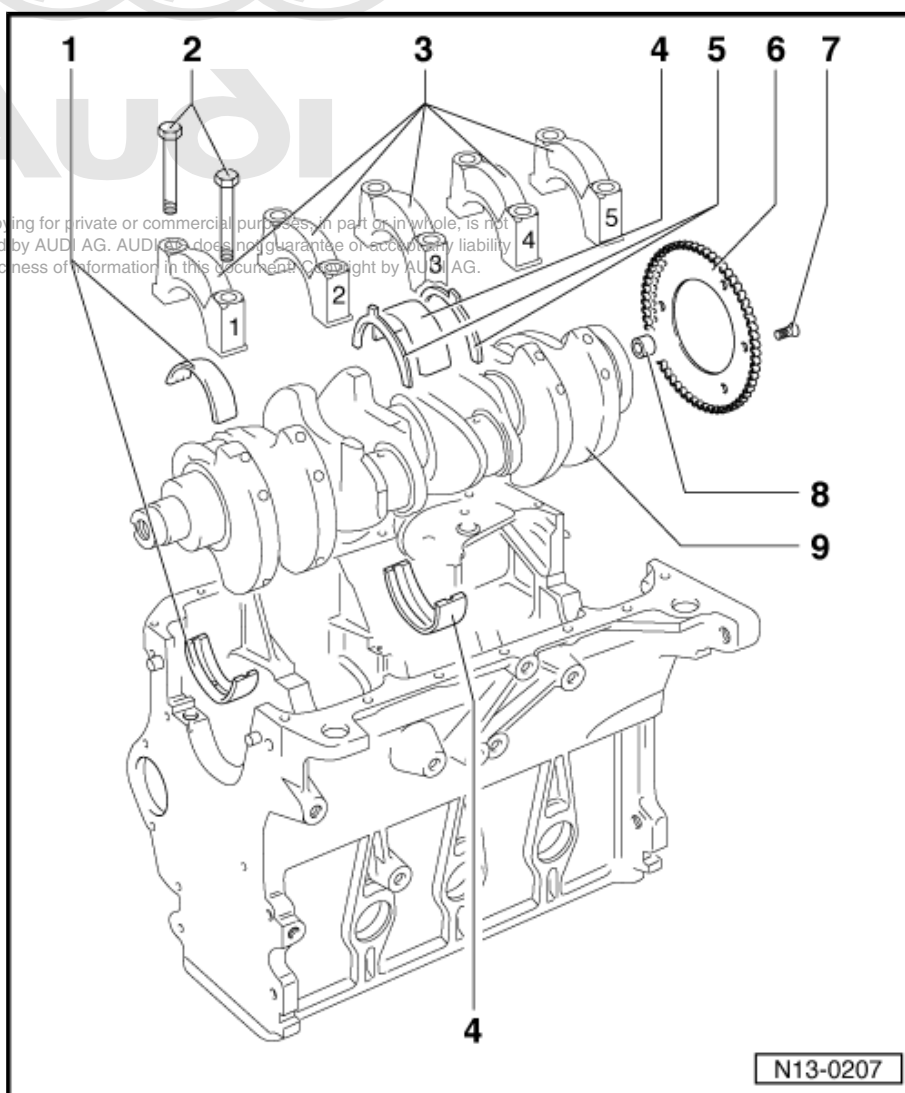
- ☐ Bearing cap 1: Pulley end
- ☐ Installation position: retaining lugs on bearing shells in cylinder block and bearing caps must be on the same side

4 - Bearing shell 3

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

5 - Thrust washers

- ☐ For bearing cap, bearing 3



- ☐ Note location

6 - Sender wheel

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

7 - Bolt

- ☐ Renew
- ☐ 10 Nm + 90°
- ☐ Sender wheel must be renewed if bolts are loosened [⇒ page 65](#)

8 - Needle bearing

- ☐ For vehicles with manual gearbox
- ☐ Extracting and driving in [⇒ page 67](#)

9 - Crankshaft

- ☐ Measuring axial clearance [⇒ page 65](#)
- ☐ Measuring radial clearance [⇒ page 66](#)
- ☐ Crankshaft dimensions [⇒ page 68](#)

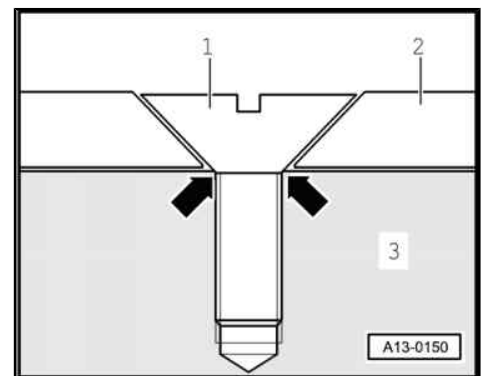
Removing and installing sender wheel

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



Note

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

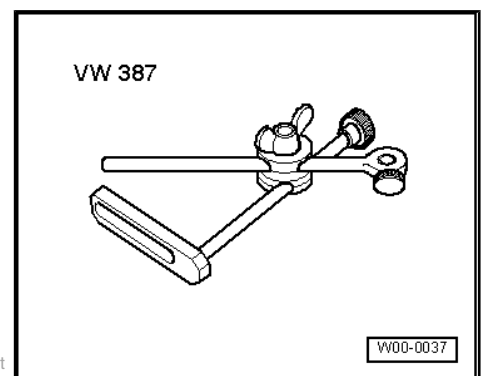


Tightening torque [⇒ page 64](#)

3.2 Measuring axial clearance of crankshaft

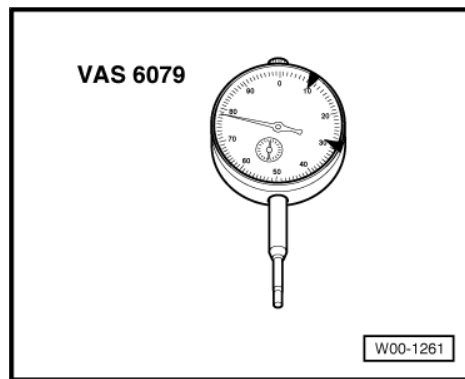
Special tools and workshop equipment required

- ◆ Universal dial gauge bracket - VW 387-



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◆ Dial gauge - VAS 6079-



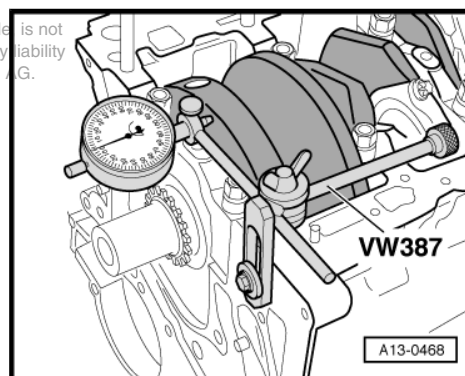
Procedure

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- Secure dial gauge VAS 6079- with universal dial gauge bracket - VW 387- to cylinder block as shown in illustration.
- Set dial gauge against crank web.
- Press crankshaft against dial gauge by hand and set gauge to "0".
- Push crankshaft away from dial gauge and read off value.

Axial clearance:

- New: 0.07 ... 0.23 mm.
- Wear limit: 0.30 mm.



3.3 Measuring radial clearance of crankshaft

Special tools and workshop equipment required

- ◆ Plastigage

Procedure



Note

- ◆ *Mark used bearing shells for re-installation (but do not mark bearing surface).*
- ◆ *Bearing shells worn down to the base layer must be renewed.*
- Remove bearing cap.
- Clean bearing cap and bearing journal.
- Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or in the bearing shell.
- The Plastigage must be positioned in the centre of the bearing shell.
- Fit bearing cap and secure with old bolts ⇒ [Item 2 \(page 64\)](#) without rotating crankshaft.
- Remove bearing cap again.
- Compare width of Plastigage with measurement scale.

Radial clearance:

- New: 0.02 ... 0.04 mm.
- Wear limit: 0.15 mm.

3.4 Extracting and driving in needle bearing for crankshaft

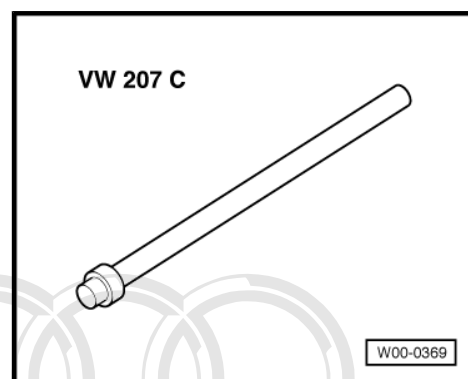


Note

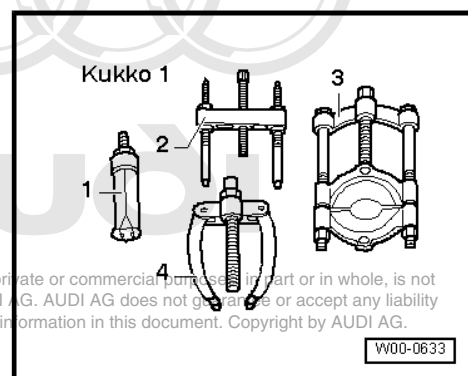
- ◆ A needle bearing must be fitted in the crankshaft on vehicles with manual gearbox; insert needle bearing if not yet fitted.
- ◆ In vehicles with automatic gearbox, the needle bearing must NOT be fitted in the crankshaft; remove needle bearing if fitted.

Special tools and workshop equipment required

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



- ◆ -1- Internal puller Kukko 21/1



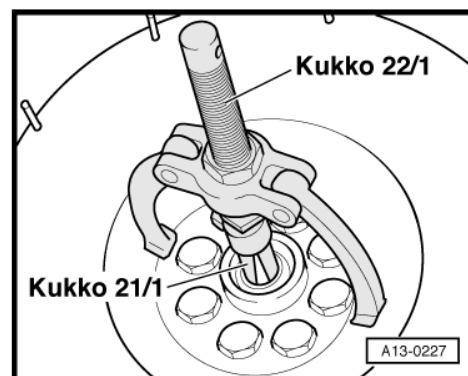
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- ◆ -4- Counter-support Kukko 22/1

- ◆ Depth gauge

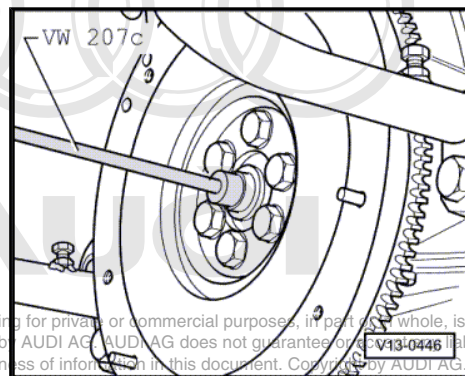
Pulling out

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



Driving in

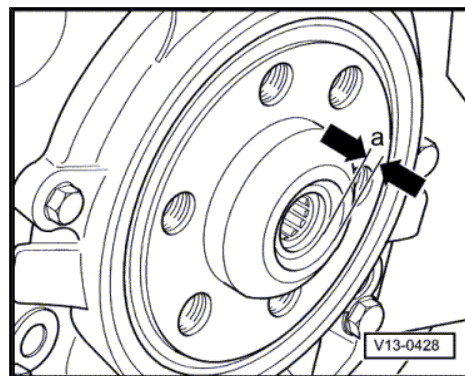
- Drive in needle bearing with drift - VW 207 C- or centring mandrel - 3176- .
- The lettering on the needle bearing must be visible when installed.



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Installation depth of needle bearing

- Distance -a- = 1.5 mm



3.5 Crankshaft dimensions

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

4 Pistons and conrods



Note

- ◆ If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully, and the oil cooler must be renewed in order to prevent further damage occurring later.
- ◆ All bearing and running surfaces must be oiled before assembling.

4.1 Pistons and conrods - exploded view

1 - Nut

- ☐ Renew conrod bolt -item 13-
- ☐ Lubricate threads and contact surface
- ☐ 30 Nm $\pm$ 90°
- ☐ When measuring radial clearance, tighten used bolts and nuts to 30 Nm and turn 90° further

2 - Pressure relief valve

- ☐ Opens at: 2.5 ... 3.2 bar
- ☐ 27 Nm

3 - Oil spray jet

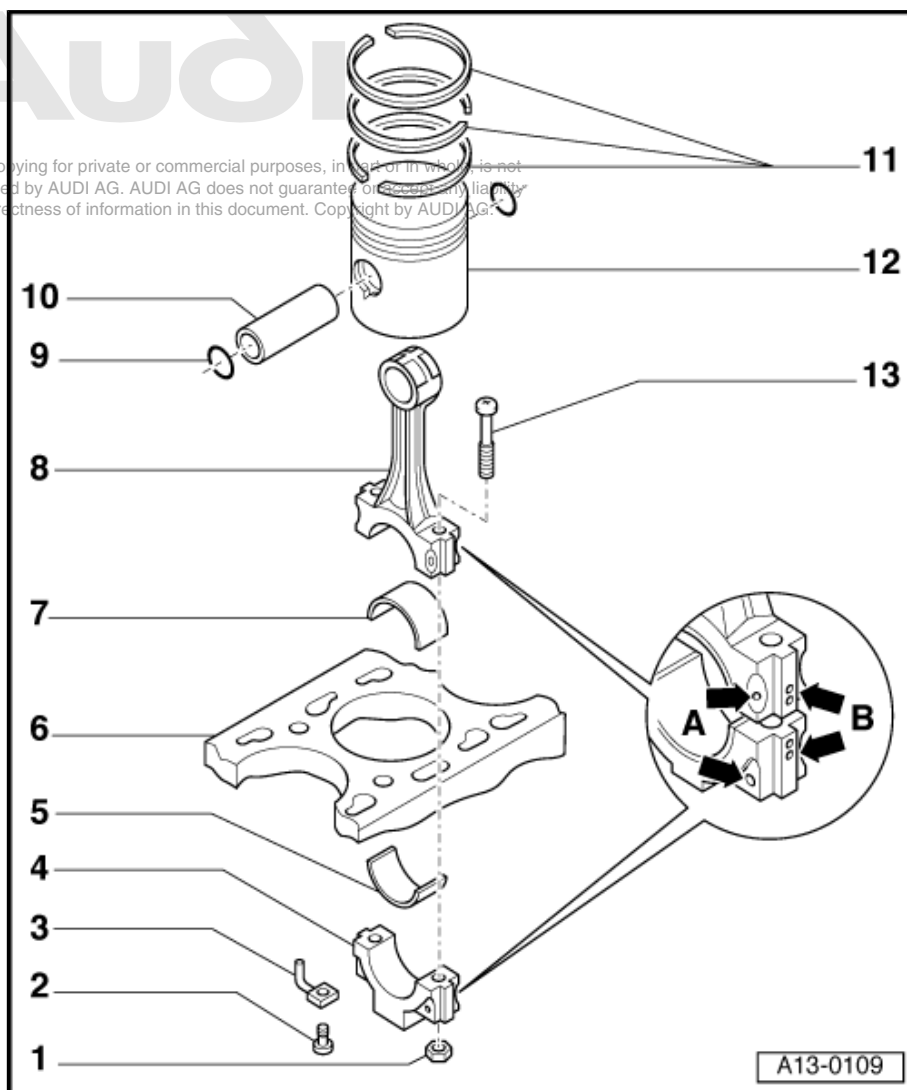
- ☐ For piston cooling

4 - Conrod bearing cap

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

5 - Bearing shell

- ☐ Mark used bearing shells for re-installation but not on bearing surface
- ☐ Bearing shells worn down to base layer must be renewed
- ☐ Note installation position
- ☐ Ensure tight fit in retaining lugs



6 - Cylinder block

- ☐ Checking cylinder bore [⇒ page 71](#)
- ☐ Piston and cylinder dimensions [⇒ page 72](#)

7 - Bearing shell

- ☐ With oil drilling for piston pin lubrication
- ☐ Mark used bearing shells for re-installation but not on bearing surface
- ☐ Bearing shells worn down to base layer must be renewed

- ☐ Note installation position

8 - Conrod

- ☐ With oil drilling for piston pin lubrication
- ☐ Only renew as a complete set
- ☐ Mark cylinder allocation in colour -B-
- ☐ Installation position: Markings -A- face towards pulley end
- ☐ Axial clearance (new): 0.10 ... 0.35 mm
- ☐ Axial clearance (wear limit): 0.40 mm
- ☐ Measuring radial clearance ⇒ [page 71](#)

9 - Circlip

- ☐ Renew

10 - Piston pin

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

11 - Piston rings

- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ "TOP" must face towards piston crown
- ☐ Measuring ring gap ⇒ [page 70](#)
- ☐ Measuring ring-to-groove clearance ⇒ [page 71](#)

12 - Piston

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

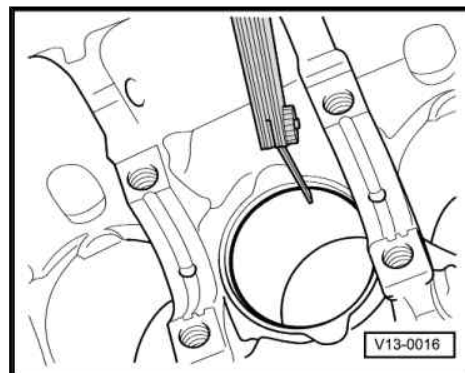
13 - Bolt

- ☐ Renew
- ☐ When measuring radial clearance, tighten used bolts and nuts to 30 Nm and turn 90° further

Checking piston ring gap

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

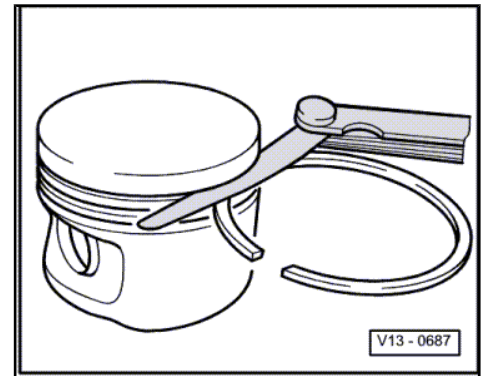
Piston ring	new mm	Wear limit mm
1st compression ring	0.20 ... 0.40	0.8
2nd compression ring	0.20 ... 0.40	0.8
Oil scraper ring	0.25 ... 0.50	0.8



Checking ring-to-groove clearance

- Clean annular groove of piston.
- Check gap using feeler gauge.

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

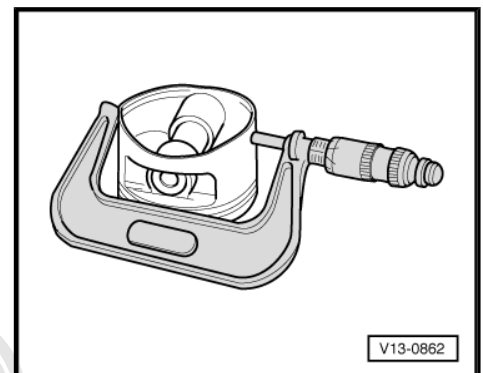


Checking piston

- 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

⇒ ["4.3 Piston and cylinder dimensions", page 72](#).

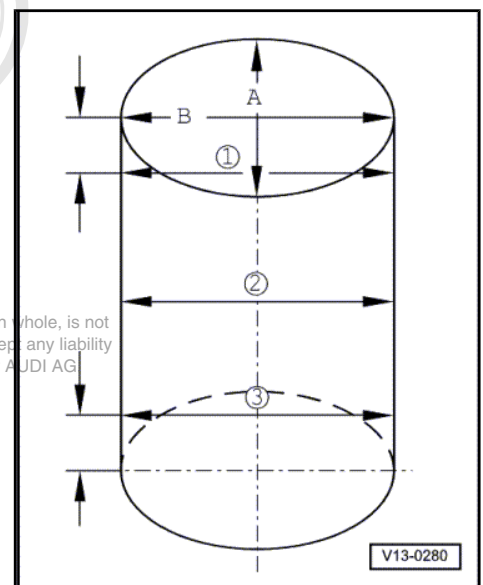


Checking cylinder bore

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

Nominal dimension

⇒ ["4.3 Piston and cylinder dimensions", page 72](#).



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4.2 Measuring radial clearance of conrods

Special tools and workshop equipment required

- ◆ Plastigage

Procedure

- Remove conrod bearing cap. Clean bearing cap and bearing journal.
- Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or in the bearing shell.
- The Plastigage must be positioned in the centre of the bearing shell.
- Fit conrod bearing cap and secure with old bolts and nuts
⇒ [Item 1 \(page 69\)](#) without rotating crankshaft.



- Remove conrod bearing cap again.
- Compare width of Plastigage with measurement scale.

Radial clearance:

- New: 0.01 ... 0.05 mm.
- Wear limit: 0.12 mm.
- Renew conrod bolts.

4.3 Piston and cylinder dimensions

Honing dimension (in mm)	Piston Ø	Cylinder bore Ø
Basic dimension	80.975 ¹⁾	81.010
Repair oversize	81.475 ¹⁾	81.510
• ¹⁾ Dimensions not including coating (thickness 0.02 mm). The coating will wear down in service.		



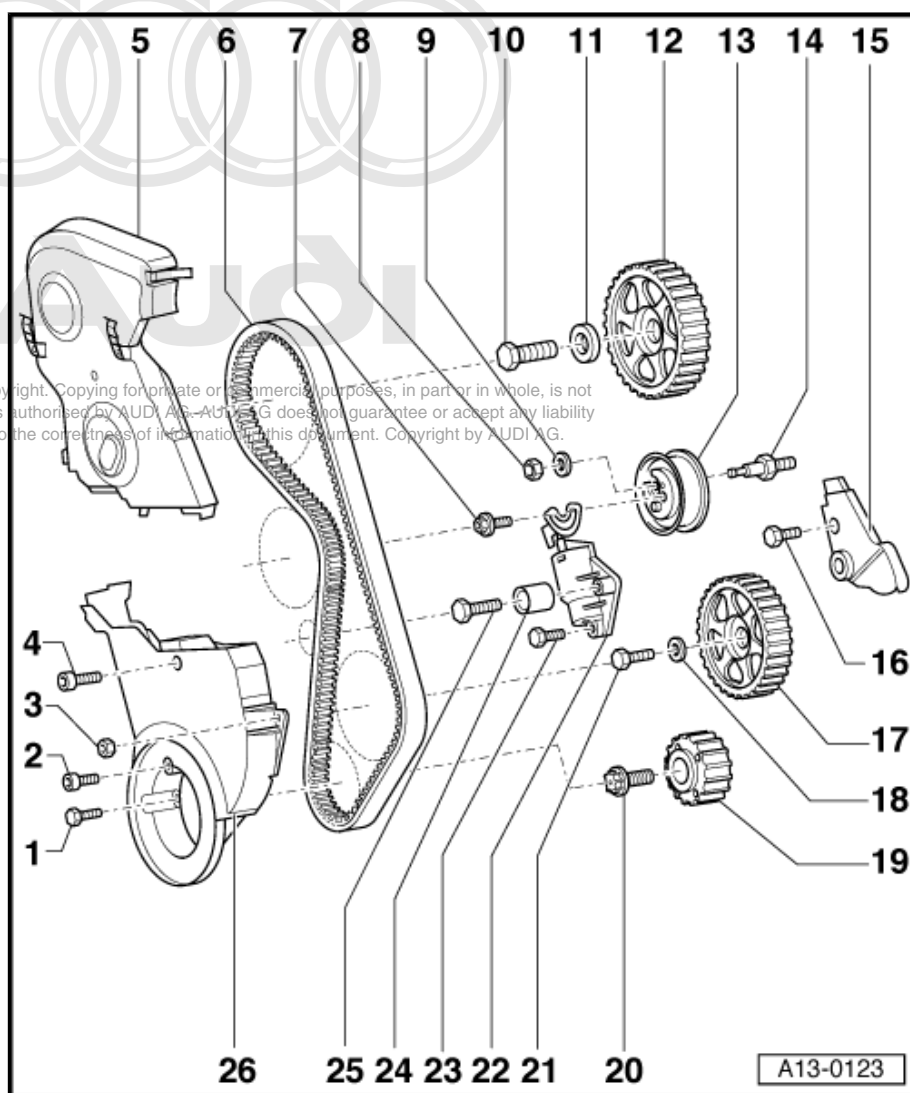
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15 – Cylinder head, valve gear

1 Toothed belt drive up to 05.1999

1.1 Toothed belt drive - exploded view

- 1 - Bolt
☐ 10 Nm
- 2 - Bolt
☐ 10 Nm
- 3 - Nut
☐ 10 Nm
- 4 - Bolt
☐ 20 Nm
- 5 - Toothed belt cover (top)
- 6 - Toothed belt
☐ Check for wear
☐ Do not kink
☐ Before removing, mark direction of rotation with chalk or felt-tip pen
☐ Removing ⇒ [page 74](#)
☐ Installing (adjusting valve timing) ⇒ [page 76](#)
- 7 - Bolt
☐ 25 Nm
- 8 - Nut
☐ 10 Nm
- 9 - Washer
- 10 - Bolt
☐ Use counterhold tool - 3036- when loosening and tightening
☐ Tightening torque ⇒ [Item 1 \(page 106\)](#)
- 11 - Washer
- 12 - Camshaft sprocket
☐ For exhaust camshaft
☐ Remove toothed belt prior to removing and installing ⇒ [page 74](#)
- 13 - Tensioning roller
- 14 - Fitted bolt
☐ For tensioning roller
☐ 25 Nm





15 - Toothed belt cover (rear)

16 - Bolt

- ☐ 20 Nm

17 - Intermediate shaft sprocket

18 - Washer

19 - Crankshaft sprocket

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

20 - Bolt

- ☐ Renew
- ☐ Do not lubricate with oil
- ☐ Use counterhold tool - 3415- to loosen and tighten
- ☐ 90 Nm + 90°

21 - Bolt

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

22 - Tensioner for toothed belt

23 - Bolt

- ☐ 10 Nm

24 - Idler roller

25 - Bolt

- ☐ 25 Nm

26 - Toothed belt cover (bottom)

- ☐ Unbolt vibration damper prior to removing

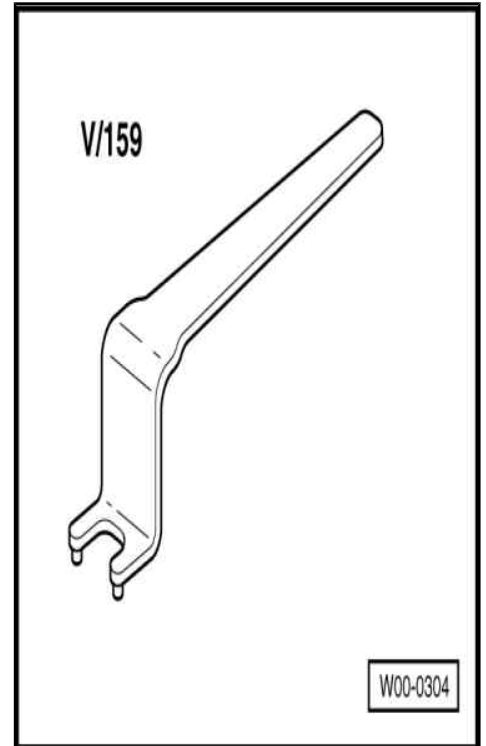
1.2 Removing and installing toothed belt

Special tools and workshop equipment required



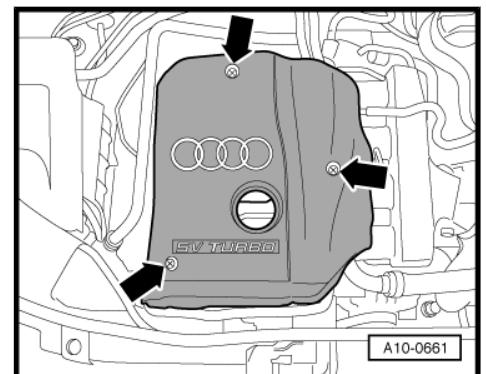
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◆ Pin wrench Matra V/159



Removing

- Lock carrier must be in service position ➔ Rep. gr. 50 .
- Release quick-release fasteners and remove engine cover panel -arrows-.
- Remove poly V-belt and tensioner for poly V-belt ➔ [page 49](#) .
- Remove viscous fan ➔ [page 168](#) .



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– Remove toothed belt cover (top section)

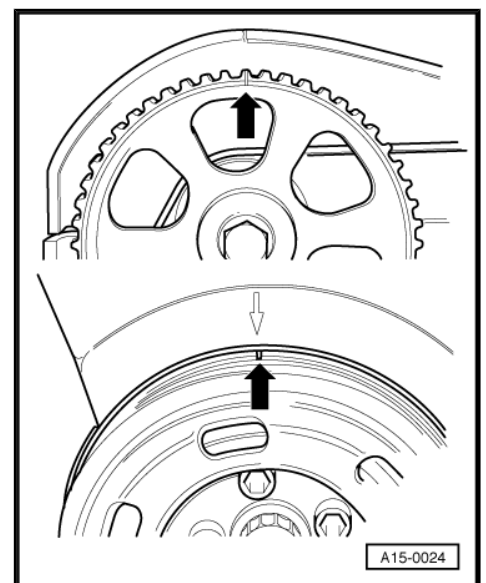


Caution

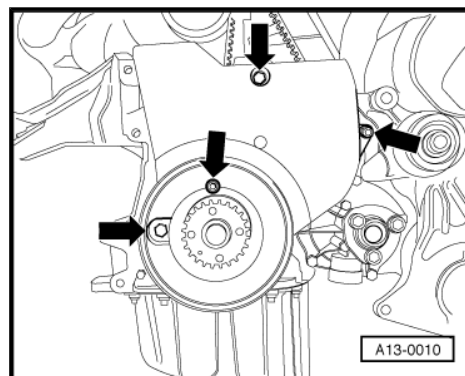
Irreparable damage can be caused if the toothed belt slips.

- ◆ *Turn crankshaft only in direction of engine rotation (in clockwise direction).*

- Rotate crankshaft to "TDC" by turning bolt for toothed belt sprocket.
- Marking on camshaft sprocket and marking on crankshaft must be aligned to "TDC" -arrows-.
- Remove vibration damper ➔ [page 55](#) .



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



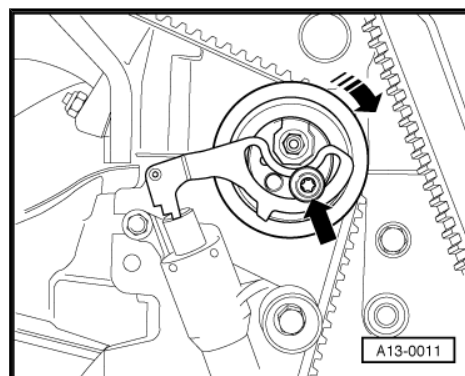
- Loosen TORX bolt -bottom arrow- and press toothed belt tensioner down.
- Mark rotation direction of toothed belt with chalk or felt-tip pen and remove toothed belt.

Installing (adjusting valve timing)

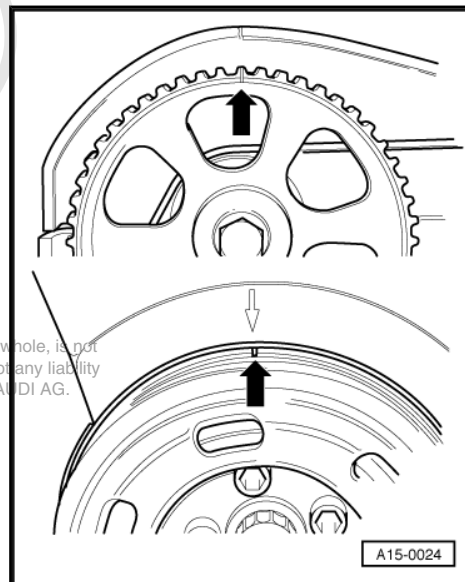


Note

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

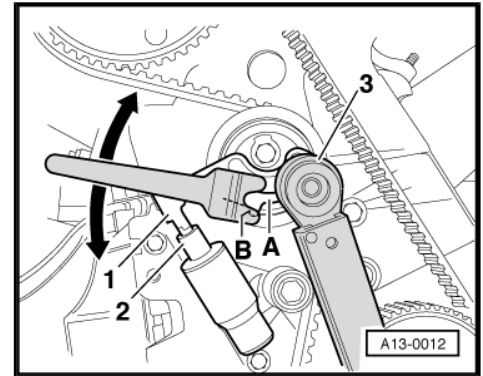


- Align markings on camshaft sprocket/cylinder head cover -top arrow-.
- Fit toothed belt on crankshaft sprocket (note rotation direction).
- Install toothed belt cover (bottom section).
- Secure vibration damper with one bolt (note fixing arrangement).
- Rotate crankshaft to "TDC" -bottom arrow- by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



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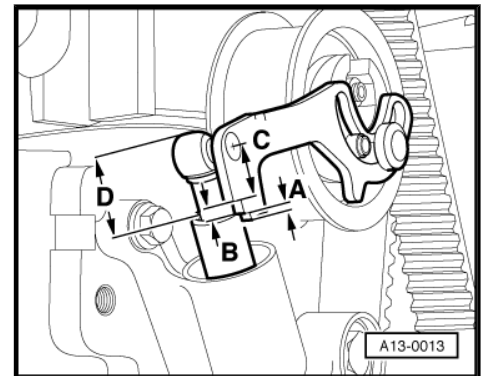
- Tension toothed belt; to do so, turn tensioner -A- clockwise using pin wrench -B- (e.g. Matra V/159):
- The piston -1- must be fully extended.
- Piston of tensioner -2- must lift off by approx. 1 mm.
- Screw in bolt -3- by hand until it makes contact.
- Turn crankshaft two rotations by turning bolt for toothed belt sprocket.



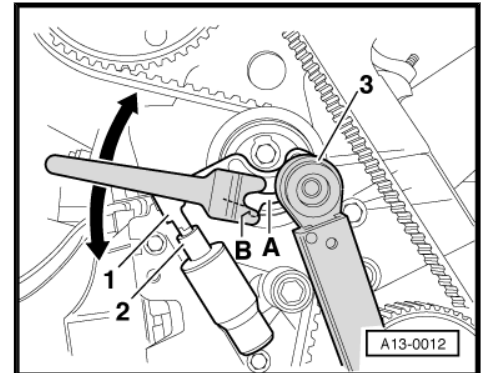
- Check whether area -A- aligns with top edge of piston -2- (⇒ illustration A13-0012); adjust if necessary.
- ◆ Area -A-: adjustment OK
- ◆ Area -B-: wear area
- ◆ Area -C-: re-adjust/check belt drive including tensioning roller for wear

 Note

If edge of piston is in area -A-, this corresponds to a dimension -D- of 25 ... 29 mm.



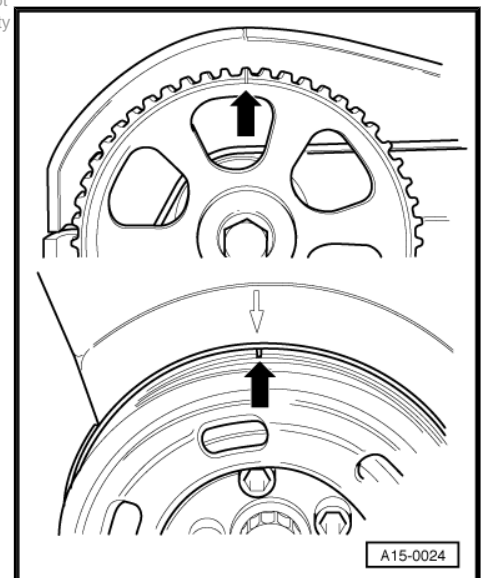
- Use pin wrench -B- to counterhold toothed belt tensioner and tighten bolt -3-.



- Turn crankshaft two rotations by turning bolt for toothed belt sprocket until crankshaft is at TDC again.

- Marking on camshaft sprocket and marking on crankshaft must be aligned to "TDC" -arrows-.
- Install vibration damper ⇒ [page 55](#) .
- Install toothed belt cover (top section).
- Install viscous fan ⇒ [page 168](#) .
- Install poly V-belt and tensioner for poly V-belt ⇒ [page 49](#) .

Tightening torques ⇒ [page 73](#)



2 Toothed belt drive from 06.1999 onwards

2.1 Toothed belt drive - exploded view

1 - Bolt

- ☐ 10 Nm

2 - Bolt

- ☐ 10 Nm

3 - Nut

- ☐ 10 Nm

4 - Bolt

- ☐ 20 Nm

5 - Toothed belt cover (bottom)

- ☐ Unbolt vibration damper prior to removing

6 - Toothed belt cover (top)

- ☐ Engage carefully in toothed belt cover (bottom) when installing

7 - Toothed belt

- ☐ Check for wear
- ☐ Do not kink
- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen
- ☐ Removing ⇒ [page 79](#)
- ☐ Installing (adjusting valve timing)
⇒ [page 81](#)

8 - Bolt

- ☐ 40 Nm

9 - Washer

10 - Lever

11 - Bolt

- ☐ Use counterhold tool - 3036- when loosening and tightening
- ☐ Tightening torque ⇒ [Item 1 \(page 106\)](#)

12 - Camshaft sprocket

- ☐ For exhaust camshaft
- ☐ Remove toothed belt prior to removing and installing ⇒ [page 79](#)

13 - Tensioning roller

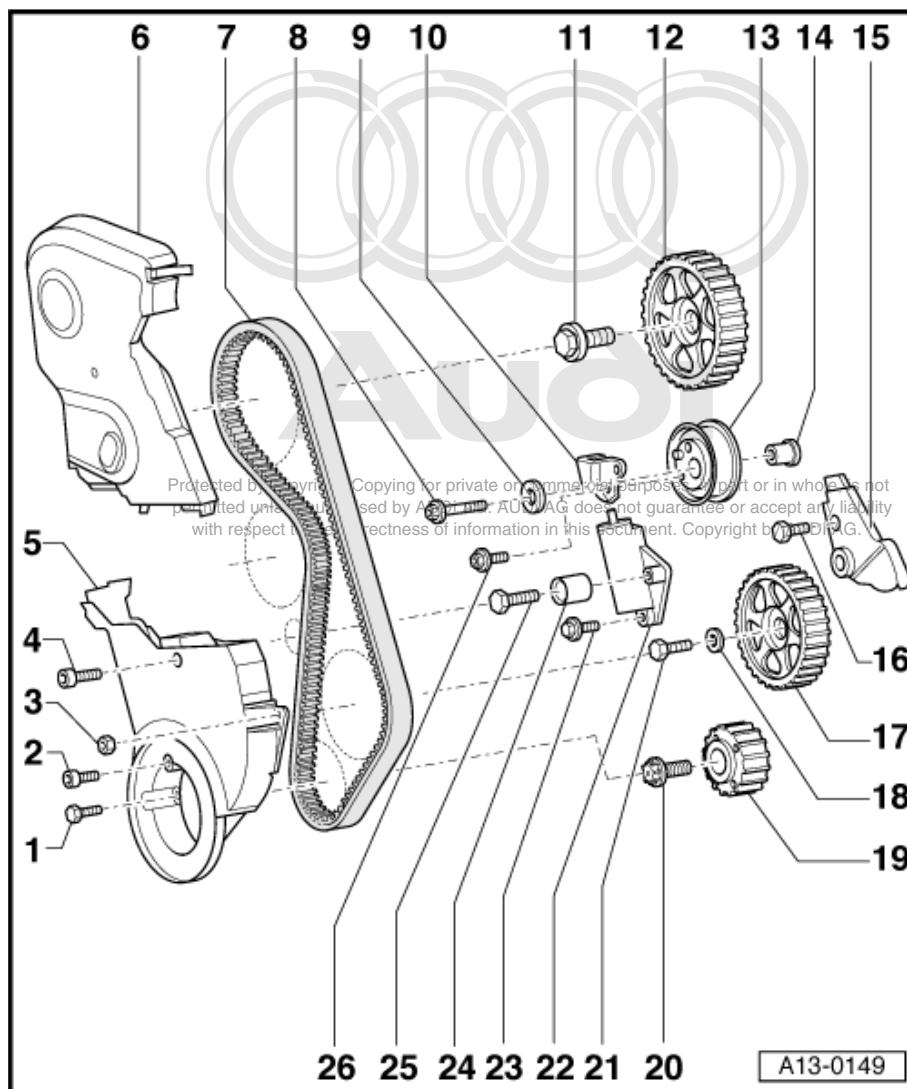
14 - Mounting bush

- ☐ For tensioning roller

15 - Toothed belt cover (rear)

16 - Bolt

- ☐ 20 Nm



17 - Intermediate shaft sprocket

18 - Washer

19 - Crankshaft sprocket

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

20 - Bolt

- ☐ Renew
- ☐ Do not lubricate with oil
- ☐ Use counterhold tool - 3415- to loosen and tighten
- ☐ 90 Nm + 90°

21 - Bolt

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

22 - Tensioner for toothed belt

23 - Bolt

- ☐ 10 Nm

24 - Idler roller

25 - Bolt

- ☐ 25 Nm

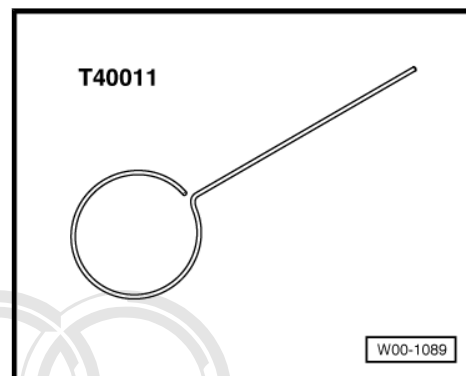
26 - Bolt

- ☐ 10 Nm

2.2 Removing and installing toothed belt

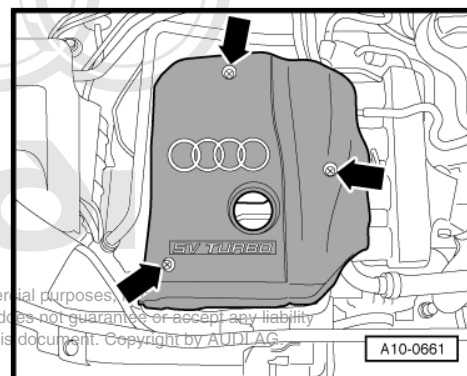
Special tools and workshop equipment required

- ◆ Locking pin - T40011-



Removing

- Lock carrier must be in service position ⇒ Rep. gr. 50 .
- Release quick-release fasteners and remove engine cover panel -arrows-.
- Remove poly V-belt and tensioner for poly V-belt ⇒ [page 49](#) .
- Remove viscous fan ⇒ [page 168](#) .



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- Remove toothed belt cover (top section)



Caution

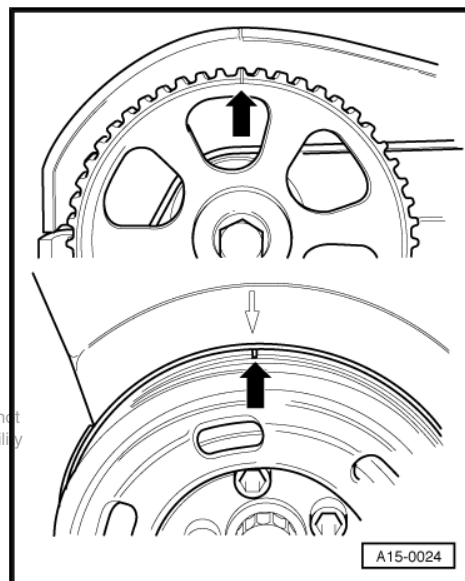
Irreparable damage can be caused if the toothed belt slips.

- ◆ Turn crankshaft only in direction of engine rotation (in clockwise direction).

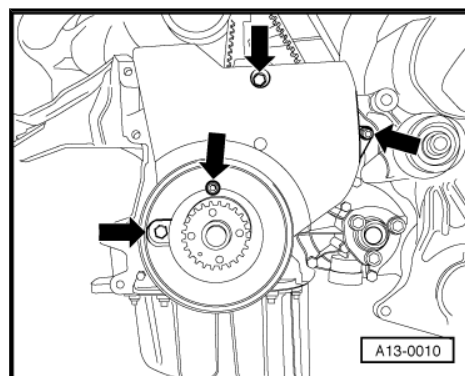
- Rotate crankshaft to “TDC” by turning bolt for toothed belt sprocket.

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

- Remove vibration damper → [page 55](#)



- Remove toothed belt cover (bottom section) -arrows-



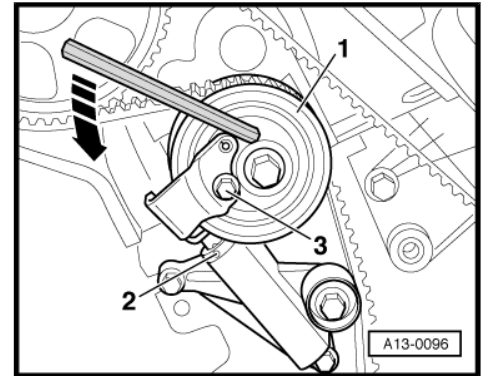


Caution

Risk of damage to toothed belt tensioner.

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

- Applying constant and moderate force, apply hexagon key through opening -2- to press toothed belt tensioning roller -1- anti-clockwise -arrow- until piston can be locked with locking pin - T40011- .
- Insert locking pin - T40011- and make sure that it remains in place.
- Mark rotation direction of toothed belt with chalk or felt-tip pen and remove toothed belt.



Note

Bolt -3- must not be slackened.

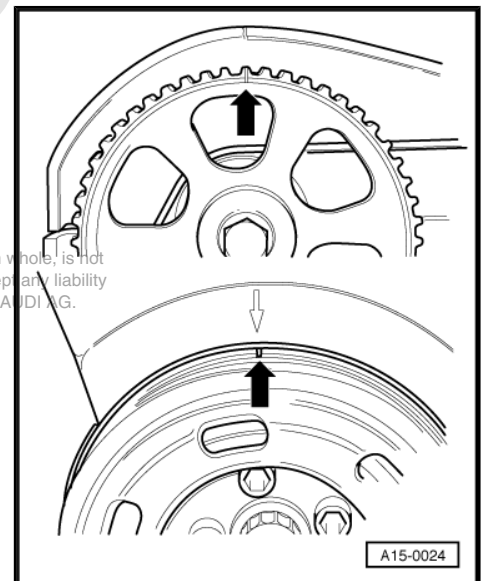
Installing (adjusting valve timing)



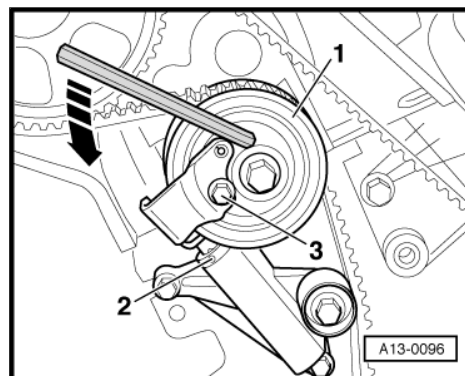
Note

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

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

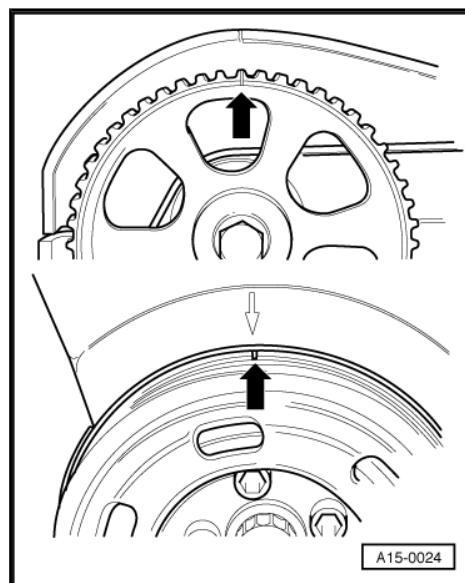


- Applying constant and moderate force, apply hexagon key to press toothed belt tensioning roller -1- anti-clockwise -arrow- until locking pin - T40011- can be pulled out.



- Turn crankshaft two rotations by turning bolt for toothed belt sprocket until crankshaft is at “TDC” again.
- Marking on camshaft sprocket and marking on crankshaft must be aligned to “TDC” -arrows-.
- Install vibration damper ⇒ [page 55](#) .
- Install toothed belt cover (top section).
- Install viscous fan ⇒ [page 168](#) .
- Install poly V-belt and tensioner for poly V-belt ⇒ [page 49](#) .

Tightening torques ⇒ [page 78](#)

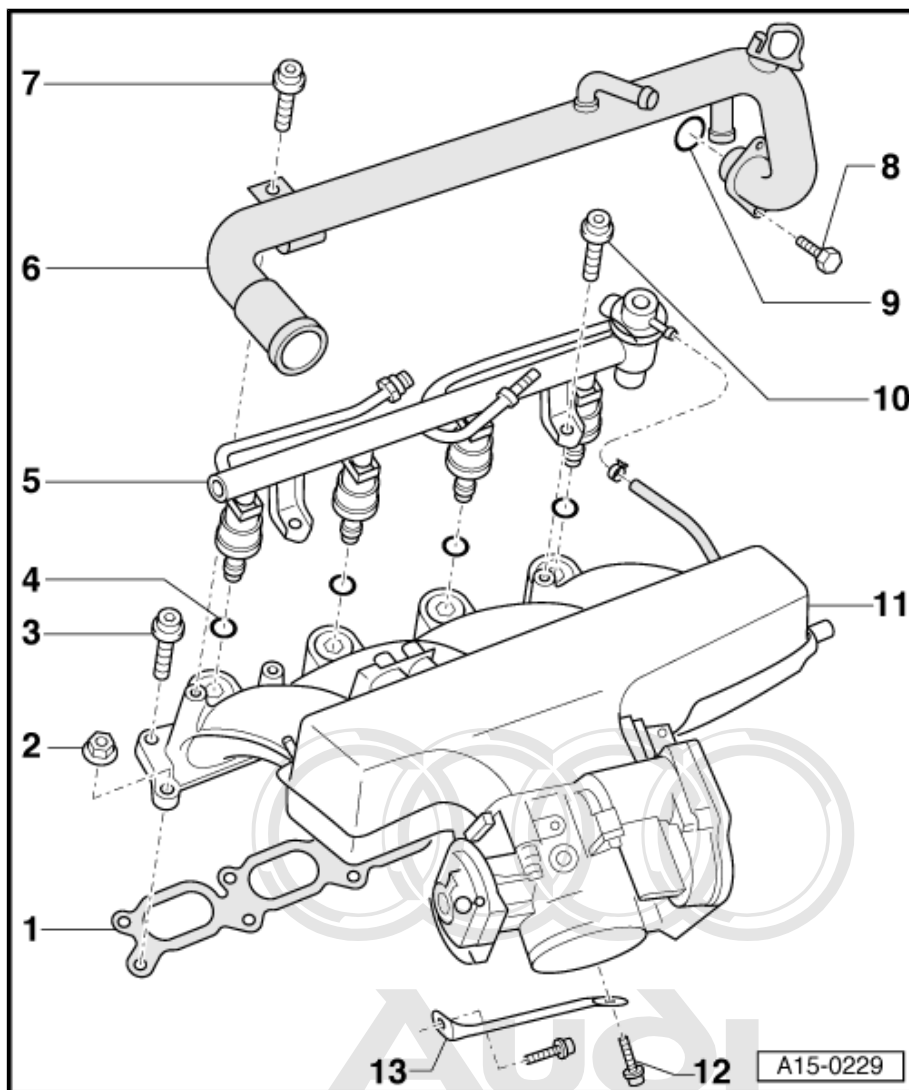


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3 Cylinder head

3.1 Intake manifold - exploded view

- 1 - Gasket**
☐ Renew
- 2 - Nut**
☐ 10 Nm
- 3 - Bolt**
☐ 10 Nm
- 4 - O-ring**
☐ Renew
- 5 - Fuel rail**
☐ With injectors
- 6 - Coolant pipe (top)**
- 7 - Bolt**
☐ 10 Nm
- 8 - Bolt**
☐ 10 Nm
- 9 - O-ring**
☐ Renew
- 10 - Bolt**
☐ 10 Nm
- 11 - Intake manifold**
☐ Removing and installing:
♦ Engine codes AEB, AJL ⇒ [page 84](#)
♦ Engine codes ANB, APU, ARK, ATW ⇒ [page 86](#)
- 12 - Bolt**
☐ 20 Nm
- 13 - Support**
☐ For intake manifold



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3.2 Removing and installing intake manifold - engine codes AEB, AJL

Removing



Note

Fit all cable ties in the original positions when installing.

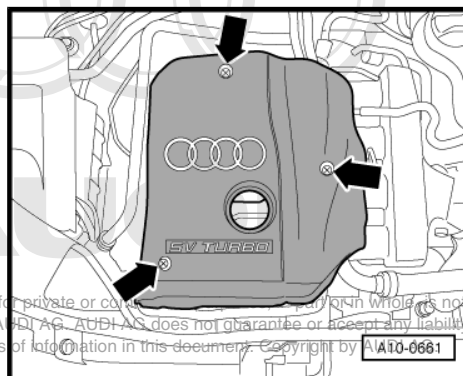
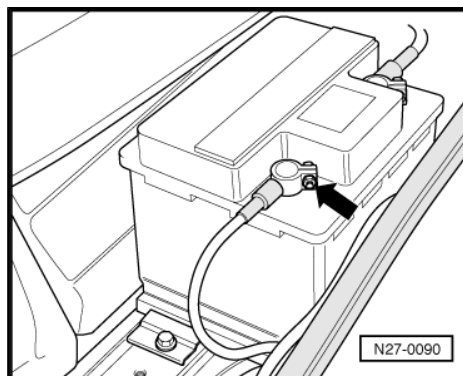


Caution

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

- ◆ Observe notes on procedure for disconnecting the battery.

- Disconnect earth wire -arrow- from battery terminal ⇒ Rep. gr. 27 .
- Release quick-release fasteners and remove engine cover panel -arrows-.
- Drain coolant ⇒ [page 156](#) .



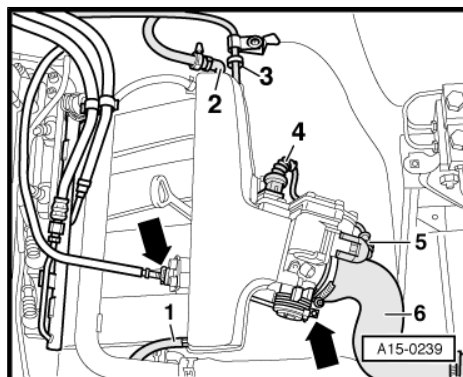
- Detach throttle cable from throttle valve module - J338- and from support bracket -arrows- (do not remove retainer).
- Disconnect vacuum hoses -1 ... 3-.



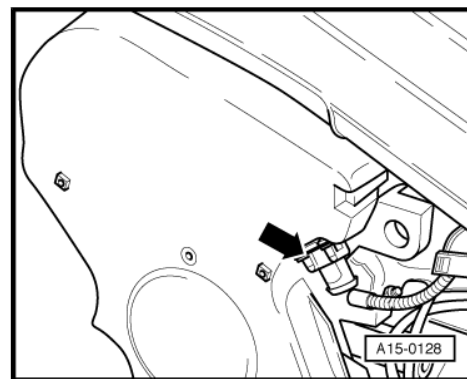
Note

On vehicles with automatic gearbox, disconnect vacuum hose -2- behind suction-jet pump.

- Unplug electrical connectors:
- 4 - For intake air temperature sender - G42-
- 5 - For throttle valve module - J338-
- Detach air intake hose -6-.



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

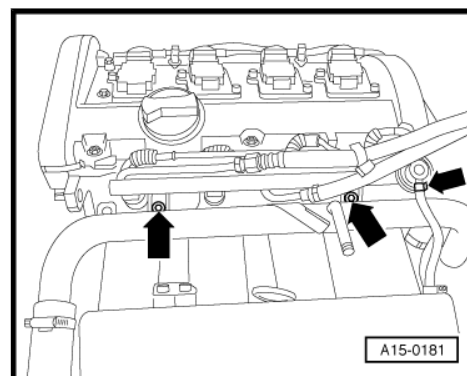


- Remove bolts for fuel rail and disconnect vacuum line from fuel pressure regulator -arrows-.
- Pull fuel rail together with injectors off intake manifold and set it aside on a clean cloth in rear of engine compartment.

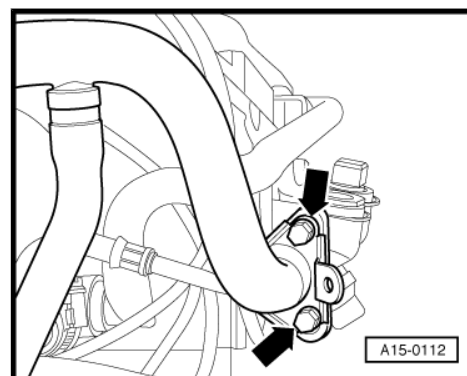


Note

Make sure the removed injectors do not become soiled.



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



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- Disconnect crankcase breather hose -1- from intake manifold.
- Remove support for intake manifold -arrows-.
- Pull out oil dipstick.
- Unbolt intake manifold from cylinder head and remove.



Note

Block off intake ports in cylinder head with clean rags.

Installing

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



Note

- ◆ Renew gaskets and O-rings.
- ◆ Hose connections and air pipes and hoses must be free of oil and grease before assembly.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ *Electronic parts catalogue*.
- Adjust throttle cable ⇒ Rep. gr. 20.
- Install coolant hoses and air hoses with screw-type clips ⇒ [page 43](#).
- Observe notes on procedure for connecting the battery ⇒ Rep. gr. 27.
- Fill up with coolant ⇒ [page 158](#).

Tightening torques ⇒ [page 83](#)

3.3 Removing and installing intake manifold - engine codes ANB, APU, ARK, ATW

Removing



Note

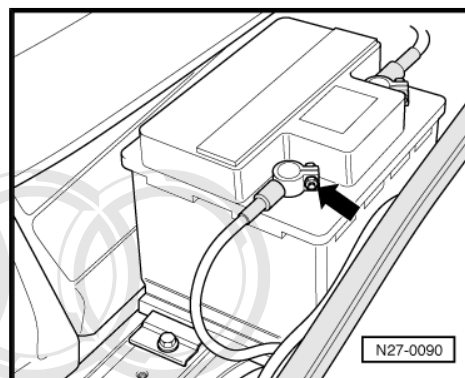
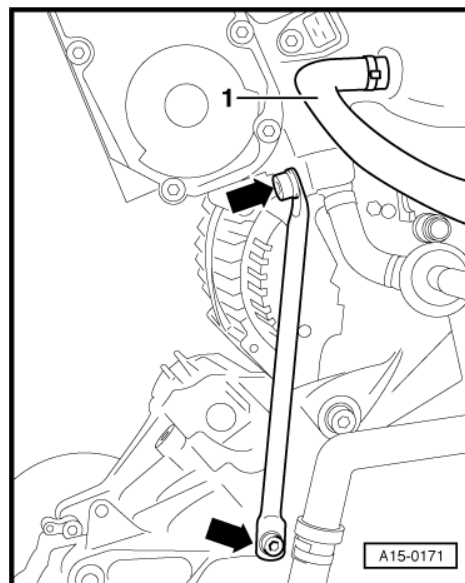
Fit all cable ties in the original positions when installing.



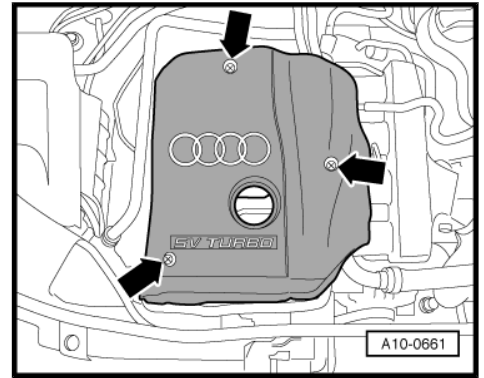
Caution

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

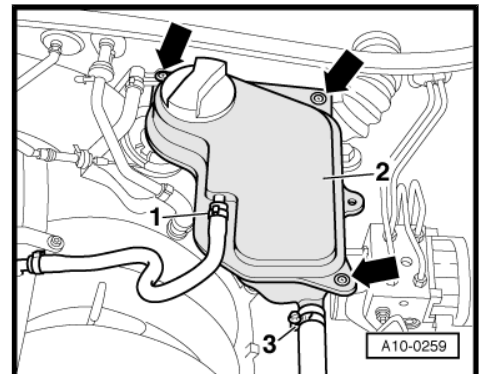
- ◆ Observe notes on procedure for disconnecting the battery.



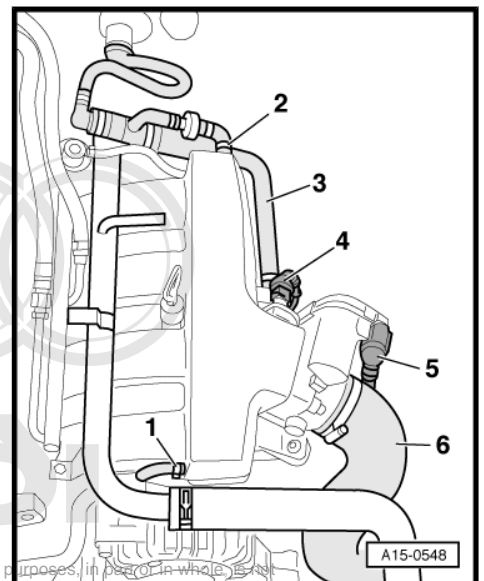
- Disconnect earth wire -arrow- from battery terminal ⇒ Rep. gr. 27 .
- Release quick-release fasteners and remove engine cover panel -arrows-.



- Drain coolant ⇒ [page 156](#) .
- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical wiring for coolant shortage indicator switch - F66- at bottom of coolant expansion tank and move coolant expansion tank to one side with coolant hoses -1- and -3- attached.
- Drain coolant ⇒ [page 156](#) .



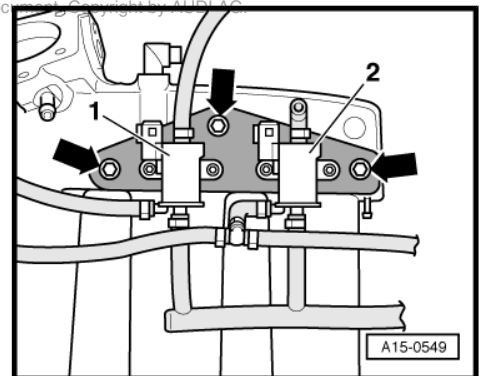
- Disconnect vacuum hoses -1 ... 3-.
- Unplug electrical connectors:
- 4 - For intake air temperature sender - G42-
- 5 - For throttle valve module - J338-
- Detach air intake hose -6-.



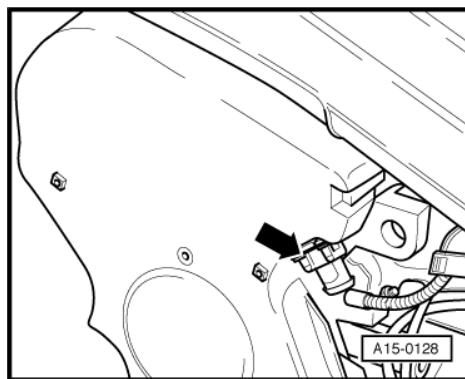
- Unbolt retaining plate for solenoid valves -arrows- located below intake manifold.

 Note

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



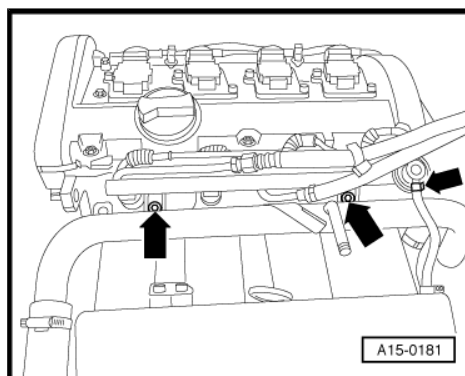
- Unplug electrical connector -arrow- at Hall sender - G40- .



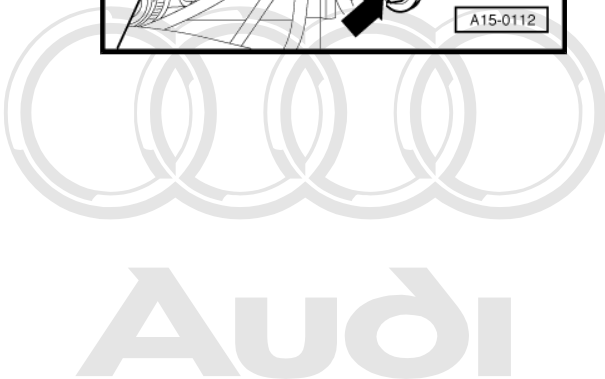
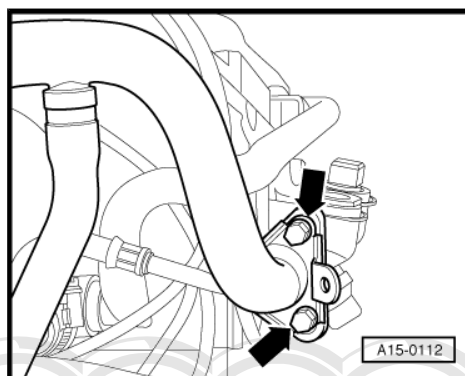
- Remove bolts for fuel rail and disconnect vacuum line from fuel pressure regulator -arrows-.
- Pull fuel rail together with injectors off intake manifold and set it aside on a clean cloth in rear of engine compartment.

**Note**

Make sure the removed injectors do not become soiled.



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



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- Remove support for intake manifold -arrows-.
- Pull out oil dipstick.
- Unbolt intake manifold from cylinder head and remove.



Note

Block off intake ports in cylinder head with clean rags.

Installing

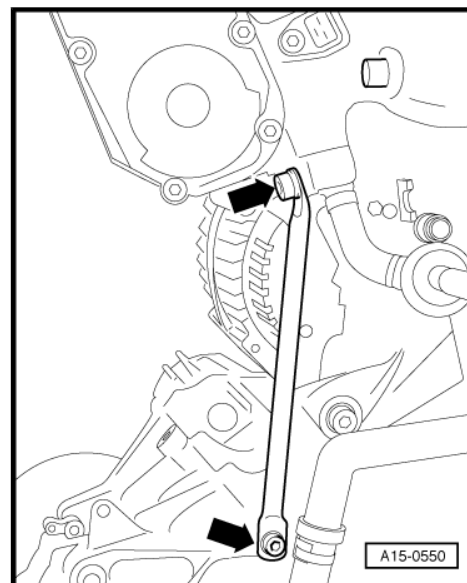
Installation is carried out in the reverse order; note the following:



Note

- ◆ *Renew gaskets and O-rings.*
- ◆ *Hose connections and air pipes and hoses must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- Install coolant hoses and air hoses with screw-type clips
⇒ [page 43](#) .
- Observe notes on procedure for connecting the battery ⇒ [Rep. gr. 27](#) .
- Fill up with coolant ⇒ [page 158](#) .

Tightening torques ⇒ [page 83](#)



3.4 Cylinder head - exploded view

1 - Cylinder head gasket

- ☐ Renewing:

♦ Engine codes AEB, AJL
⇒ [page 94](#)

♦ Engine codes ANB, APU, ARK, ATW ⇒ [page 97](#)

- ☐ Installation position:
Part No. towards cylinder head
- ☐ If renewed, change coolant and engine oil

2 - Cylinder head

- ☐ Removing:

♦ Engine codes AEB, AJL
⇒ [page 94](#)

♦ Engine codes ANB, APU, ARK, ATW ⇒ [page 97](#)

- ☐ Installing ⇒ [page 101](#)
- ☐ Checking for distortion ⇒ [page 91](#)
- ☐ Machining limit ⇒ [page 91](#)
- ☐ If renewed, change coolant and engine oil

3 - Oil deflector

- ☐ Note installation position: Above inlet camshaft between cylinders 1 and 2

4 - Bolt

- ☐ Renew
- ☐ Note correct sequence when loosening ⇒ [page 97](#) and ⇒ [page 100](#)
- ☐ Tightening torque and sequence ⇒ [page 91](#)

5 - Gasket

- ☐ Renew if damaged or leaking

6 - Ignition coil

7 - Bolt

- ☐ 10 Nm

8 - Filler cap

9 - Seal

- ☐ Renew if damaged or leaking

10 - Nut

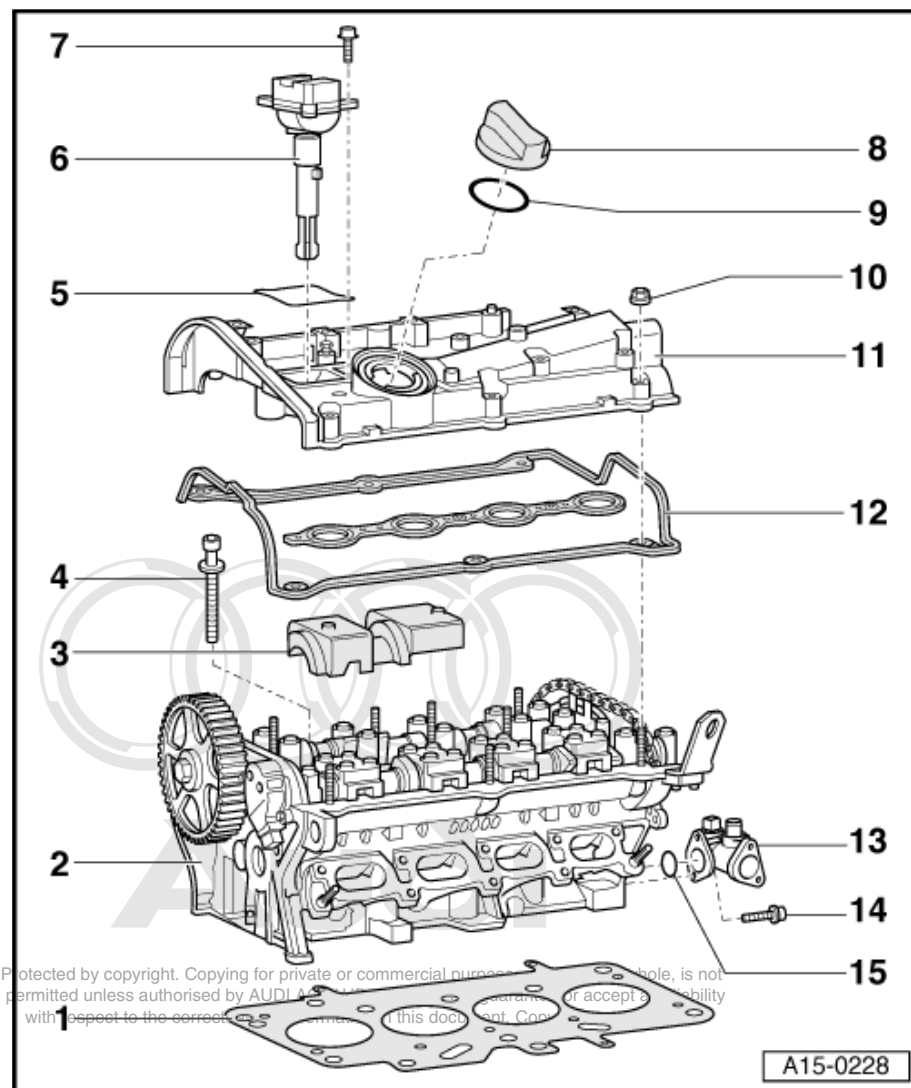
- ☐ Tighten inner nuts first
- ☐ Tighten outer nuts in diagonal sequence
- ☐ 10 Nm

11 - Cylinder head cover

- ☐ Removing and installing ⇒ [page 92](#)

12 - Gaskets for cylinder head cover

- ☐ Renew if damaged or leaking



- ☐ Before fitting, apply sealant at sealing points ⇒ [page 92](#)

13 - Coolant flange

- ☐ With coolant temperature sender

14 - Bolt

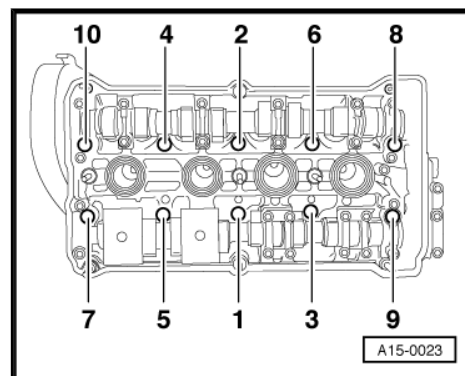
- ☐ 10 Nm

15 - O-ring

- ☐ Renew

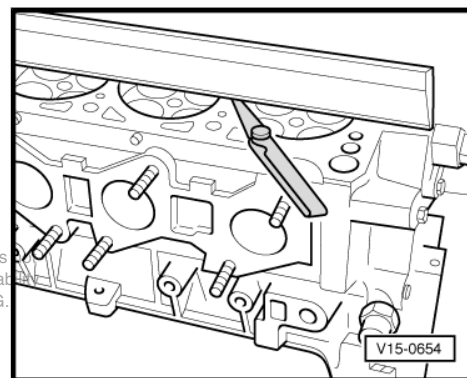
Cylinder head - tightening torque and sequence

- Tighten cylinder head bolts in 3 stages and in sequence shown as follows:
 1. Tighten to 60 Nm.
 2. Turn 90° further.
 3. Turn 90° further.



Checking cylinder head for distortion

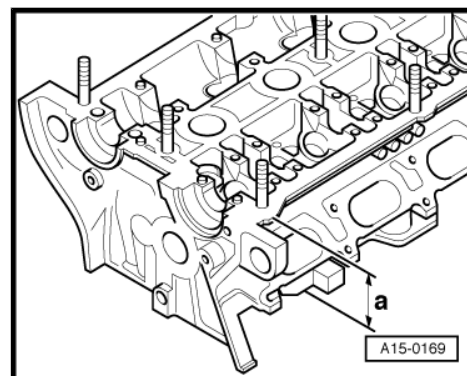
- Use straight edge and feeler gauge to measure cylinder head for distortion at several points.
- Max. permissible distortion: 0.1 mm.



Cylinder head machining limit

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

- Minimum dimension: -a- = 139.25 mm

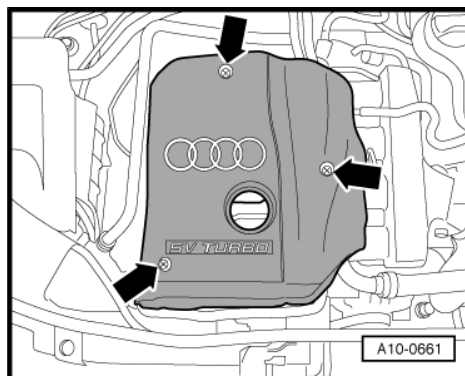


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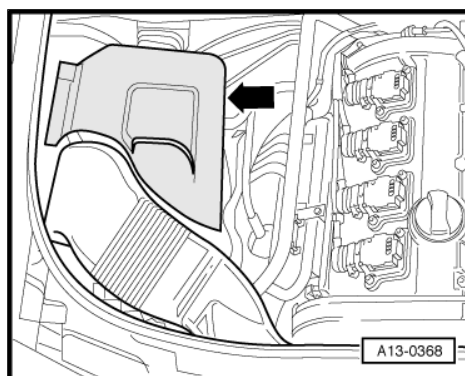
3.5 Removing and installing cylinder head cover

Removing

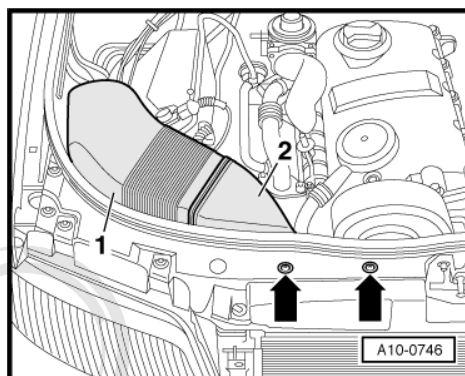
- Release quick-release fasteners and remove engine cover panel -arrows-.



- Detach air cleaner cover -arrow-.



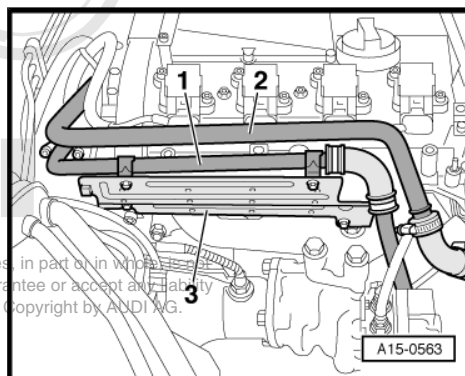
- Remove bolts -arrows-.
- Remove air duct -1- and -2-.



- Remove crankcase breather pipe -2- from cylinder head cover and pivot slightly to the side.

Vehicles with secondary air system:

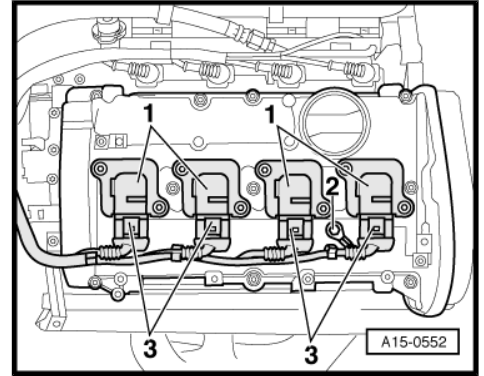
- Detach pipe -1- on combination valve for secondary air from cylinder head cover and heat shield -3-.
- Pivot secondary air pipe slightly to the side.



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All vehicles (continued):

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



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

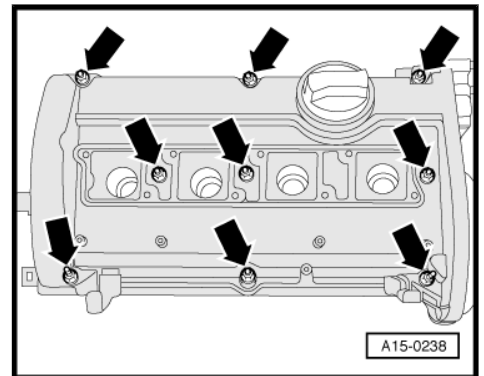
Installing

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

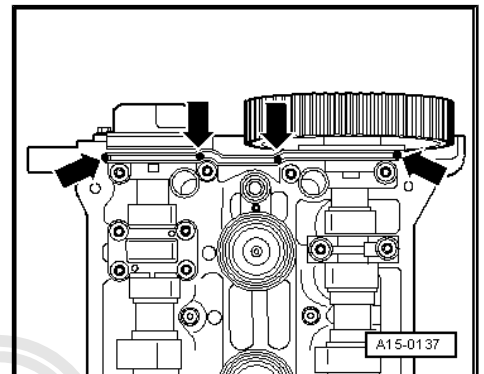


Note

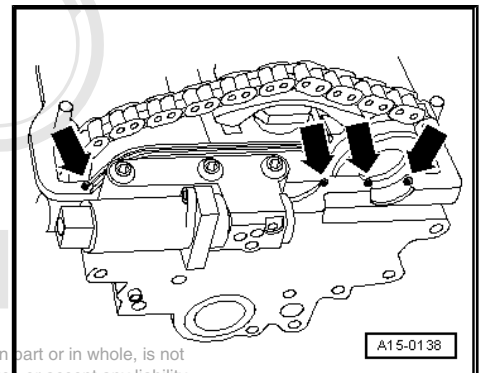
- ◆ *Renew all seals and gaskets.*
- ◆ *Renew gaskets for cylinder head cover if damaged.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*



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



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

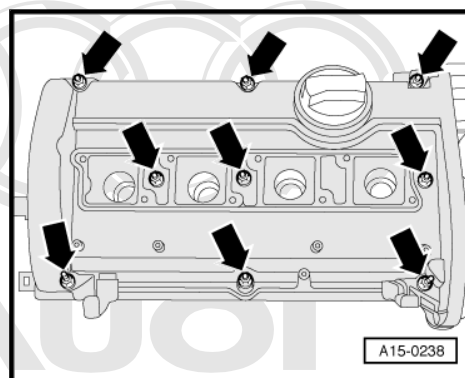


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- First tighten inner nuts for cylinder head cover and then outer nuts in diagonal sequence.
- Make sure toothed belt cover (top) is seated correctly.
- Install air hoses with screw-type clips ➔ [page 43](#) .

Tightening torques ➔ [page 89](#) , ➔ [page 197](#)

Component	Nm
Secondary air pipe to cylinder head cover	10
Secondary air pipe to combination valve for secondary air	10

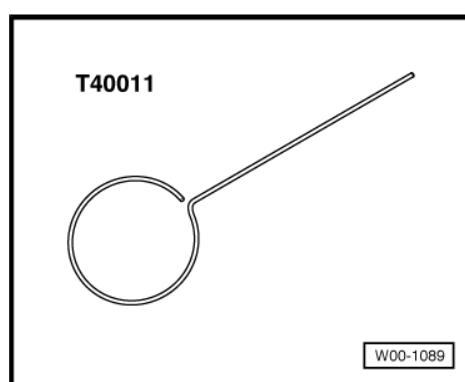


3.6 Removing cylinder head - engine codes AEB, AJL

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Special tools and workshop equipment required

- ♦ Locking pin - T40011- for vehicles from 06.1999 onwards



Procedure

- Lock carrier must be in service position ➔ Rep. gr. 50 .



Note

Fit all cable ties in the original positions when installing.

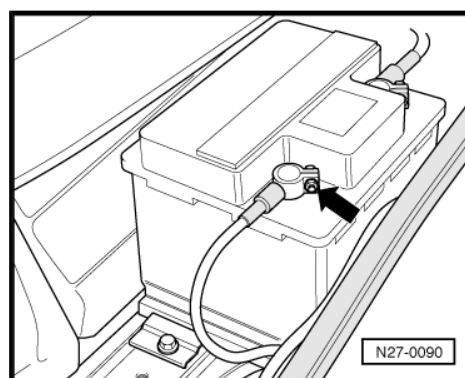


Caution

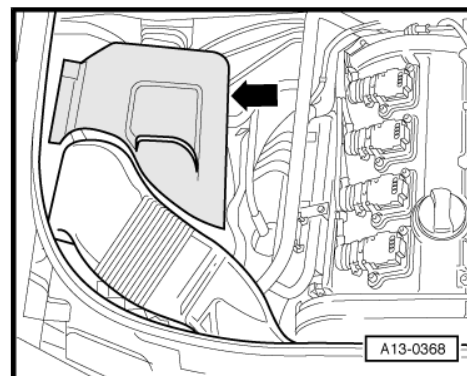
To prevent irreparable damage to the electronic components when disconnecting the battery:

- ♦ Observe notes on procedure for disconnecting the battery.

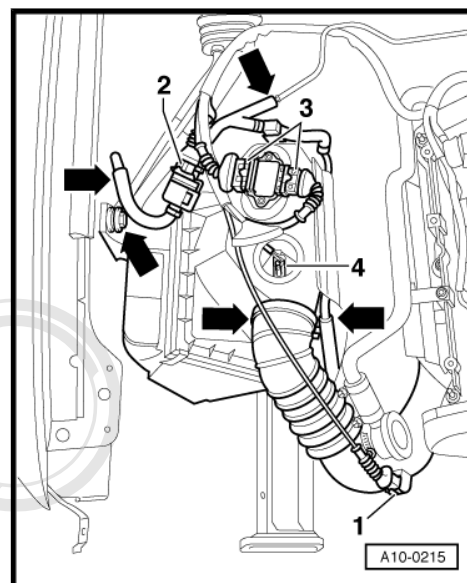
- Disconnect earth wire -arrow- from battery terminal ➔ Rep. gr. 27 .
- Drain coolant ➔ [page 156](#) .
- Remove intake manifold ➔ [page 84](#) .
- Remove poly V-belt and tensioner for poly V-belt ➔ [page 49](#) .



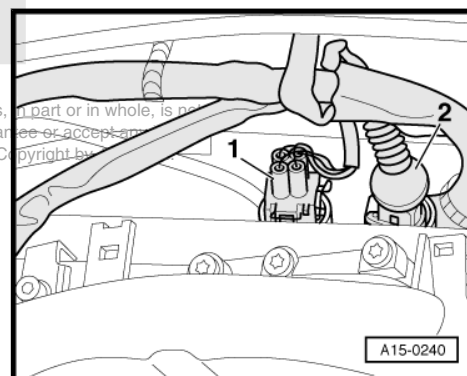
- Detach air cleaner cover -arrow-.



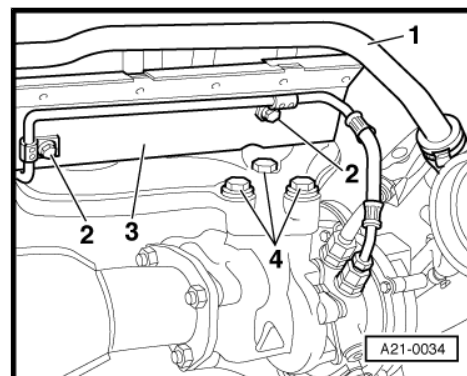
- Unplug electrical connectors:
 - 1 - On charge pressure control solenoid valve - N75-
 - 2 - On activated charcoal filter solenoid valve 1 - N80-
 - 3 - On output stage - N122-
 - 4 - On air mass meter - G70-
- Move wiring harness clear and lay on top of engine.
- Detach hose connections and remove air cleaner housing -arrows-.



- Unplug electrical connector -1- at coolant temperature display sender - G2- / coolant temperature sender - G62- .
- If fitted, unplug electrical connector -2- at temperature sender - G18- .
- Unclip/release all electrical wires on the cylinder head and move clear.



- Remove crankcase breather pipe -1-.
- Remove bolts -2- for oil supply line.
- Remove heat shield -3-.
- Remove bolts -4- for turbocharger.
- Detach coolant hose for heat exchanger at rear of cylinder head (release retaining clip on connecting flange).



- Remove toothed belt cover (top section)

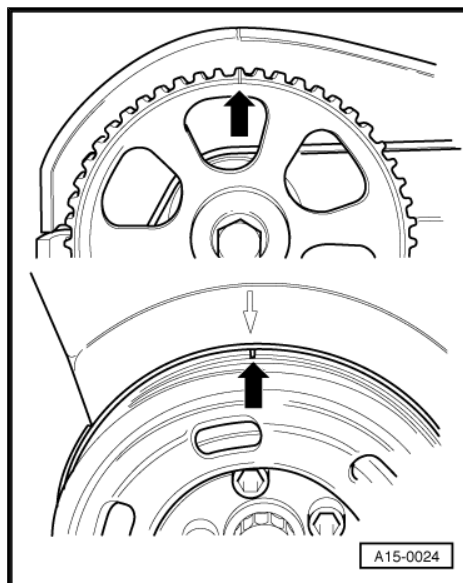


Caution

Irreparable damage can be caused if the toothed belt slips.

- ◆ *Turn crankshaft only in direction of engine rotation (in clockwise direction).*

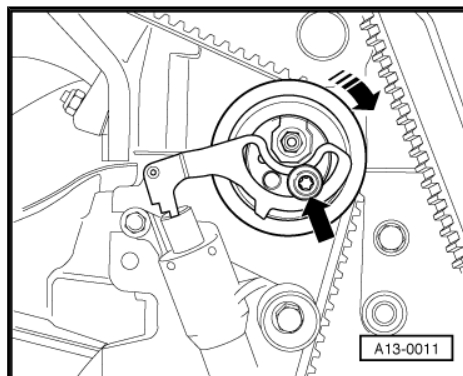
- Rotate crankshaft to "TDC" by turning bolt for toothed belt sprocket.
- Marking on camshaft sprocket and marking on crankshaft must be aligned to "TDC" -arrows-.



A15-0024

Vehicles up to 05.1999:

- Loosen TORX bolt -bottom arrow- and press toothed belt tensioner down.
- Remove toothed belt from camshaft sprocket.
- Remove TORX bolt and swivel bracket of tensioner towards front.



A13-0011

Vehicles from 06.1999 onwards:

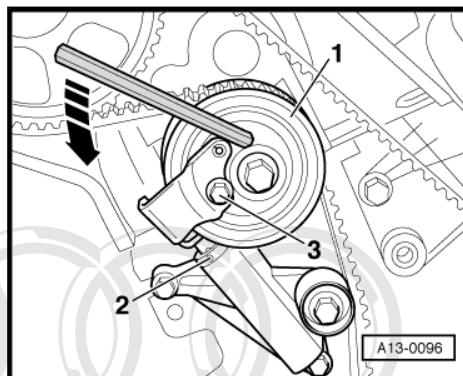


Caution

Risk of damage to toothed belt tensioner.

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

- Applying constant and moderate force, apply hexagon key through opening -2- to press toothed belt tensioning roller -1- anti-clockwise -arrow- until piston can be locked with locking pin - T40011- .
- Insert locking pin - T40011- and make sure that it remains in place.



A13-0096



Note

Bolt -3- must not be slackened.

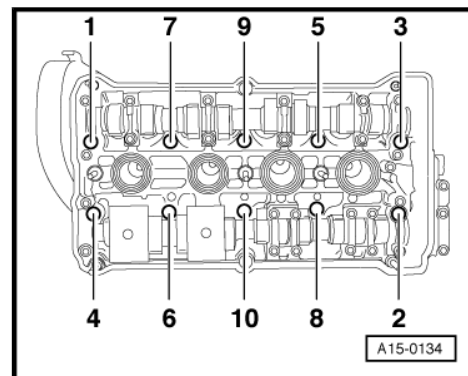
- Remove toothed belt from camshaft sprocket.

All vehicles (continued):

- Remove cylinder head cover ➔ [page 92](#) .

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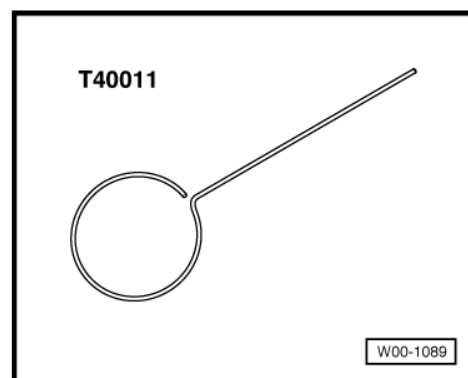
- Remove cylinder head bolts in the sequence: -1 ... 10-.
- Take off cylinder head.



3.7 Removing cylinder head - engine codes ANB, APU, ARK, ATW

Special tools and workshop equipment required

- ◆ Locking pin - T40011-



Procedure

- Lock carrier must be in service position ⇒ Rep. gr. 50 .



Note

Fit all cable ties in the original positions when installing.

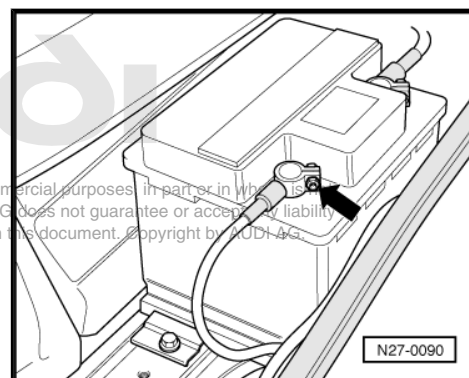


Caution

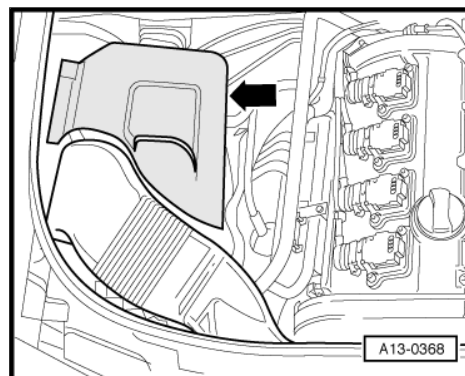
To prevent irreparable damage to the electronic components when disconnecting the battery:

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

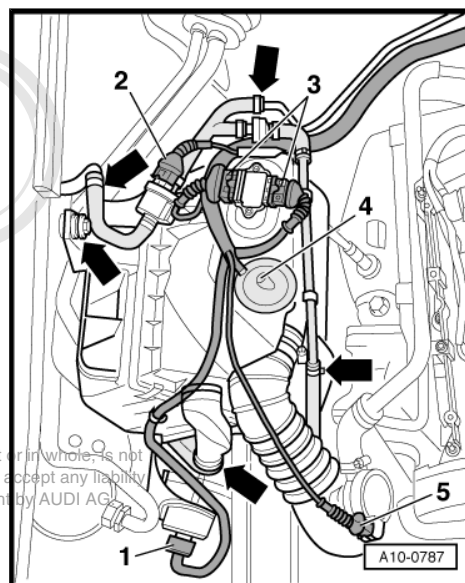
- Disconnect earth wire -arrow- from battery terminal ⇒ Rep. gr. 27 .
- Drain coolant ⇒ [page 156](#) .
- Remove intake manifold ⇒ [page 84](#) .
- Remove poly V-belt and tensioner for poly V-belt ⇒ [page 49](#) .



- Detach air cleaner cover -arrow-.



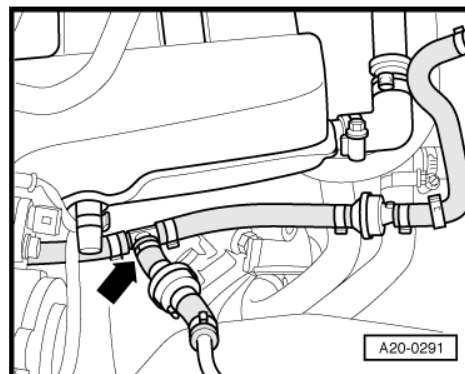
- Unplug electrical connectors:
- 1 - On secondary air pump motor - V101- (vehicles with secondary air system)
- 2 - On activated charcoal filter solenoid valve 1 - N80-
- 3 - On output stage - N122-
- 4 - On air mass meter - G70-
- 5 - On charge pressure control solenoid valve - N75-
- Move wiring harness clear and lay on top of engine.
- Detach hose connections and remove air cleaner housing -arrows-.



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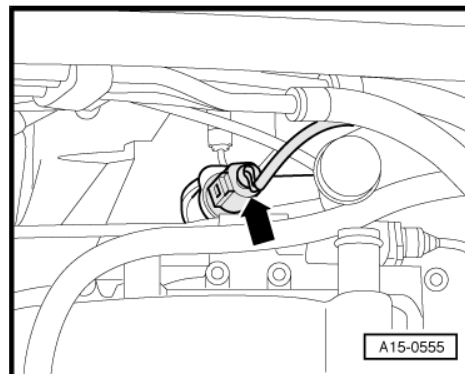
USA models:

- Disconnect vacuum line leading to fuel system diagnostic pump - V144- -arrow-.

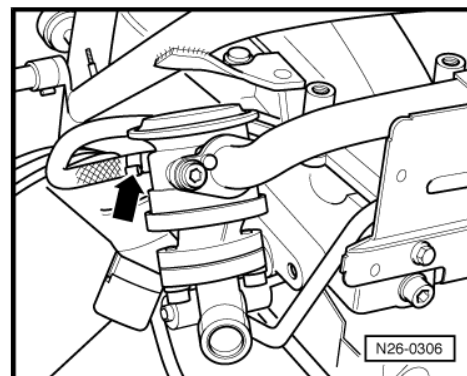


All vehicles (continued):

- Unplug electrical connector -1- at coolant temperature display sender - G2- / coolant temperature sender - G62- .



- Remove vacuum hose at combination valve for secondary air -arrow-.
- Unclip/release all electrical wires on the cylinder head and move clear.



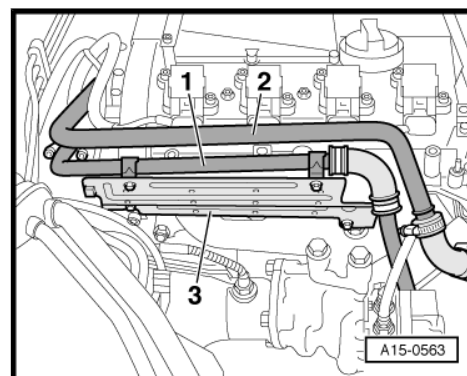
- Remove crankcase breather pipe -2-.

Vehicles with secondary air system:

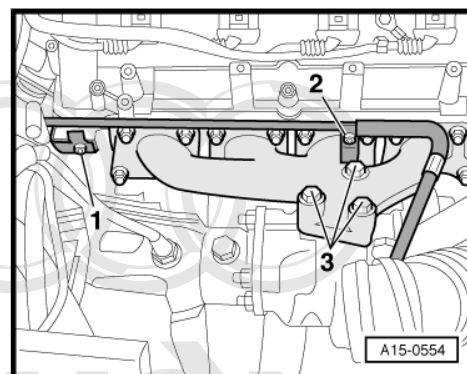
- Detach pipe -1- on combination valve for secondary air from cylinder head cover and heat shield -3-.

All vehicles (continued):

- Remove heat shield -3-.



- Unscrew bolts -1- and -2- for oil supply line.
- Remove bolts -3- for turbocharger.
- Detach coolant hose for heat exchanger at rear of cylinder head (release retaining clip on connecting flange).



- Remove toothed belt cover (top section)



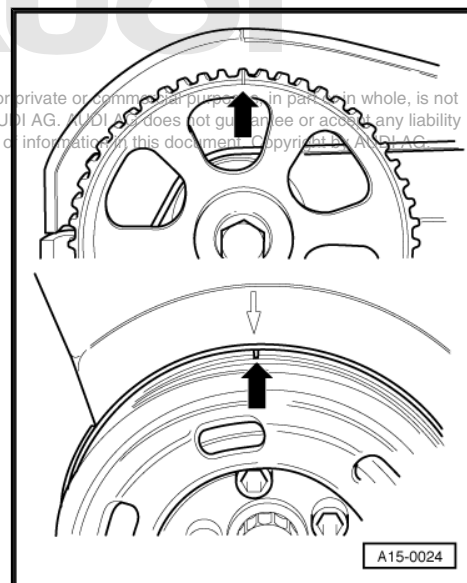
Caution

Irreparable damage can be caused if the toothed belt slips.

- ◆ **Turn crankshaft only in direction of engine rotation (in clockwise direction).**

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



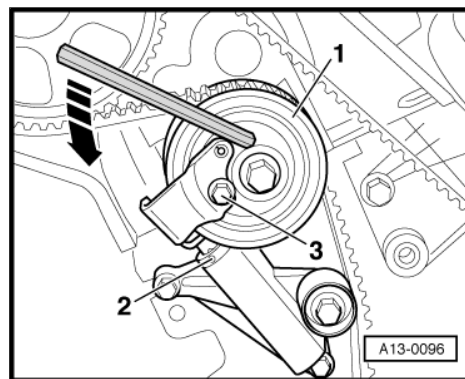


Caution

Risk of damage to toothed belt tensioner.

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

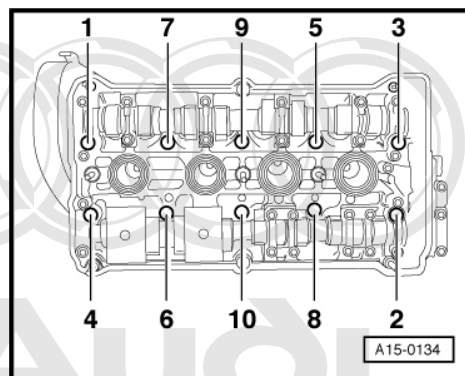
- Applying constant and moderate force, apply hexagon key through opening -2- to press toothed belt tensioning roller -1- anti-clockwise -arrow- until piston can be locked with locking pin - T40011- .
- Insert locking pin - T40011- and make sure that it remains in place.
- Mark rotation direction of toothed belt with chalk or felt-tip pen and remove toothed belt.



Note

Bolt -3- must not be slackened.

- Remove toothed belt from camshaft sprocket.
- Remove cylinder head cover ⇒ [page 92](#) .
- Remove cylinder head bolts in the sequence: -1 ... 10-.
- Take off cylinder head.



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3.8 Installing cylinder head



Caution

Avoid damage to sealing surfaces.

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

Avoid damage to cylinder block.

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

Risk of leaks at cylinder head gasket.

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

Avoid damage to open valves.

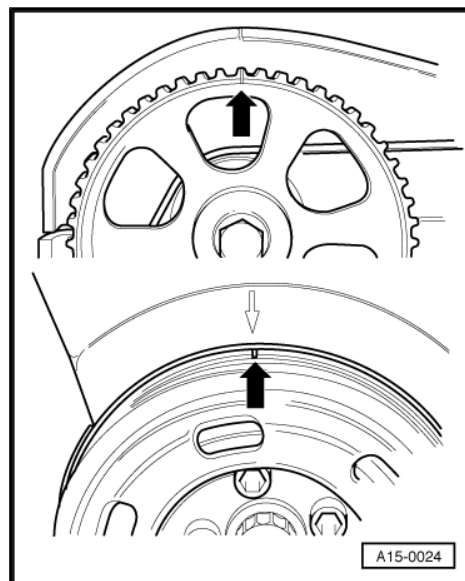
- ◆ *When installing an exchange cylinder head, the plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*



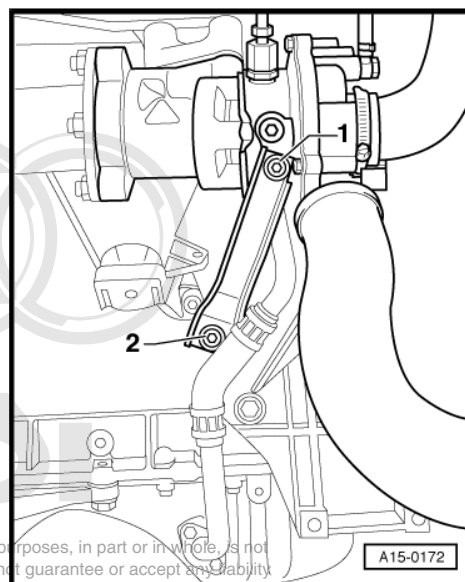
Note

- ◆ *Renew the bolts tightened with specified tightening angle.*
- ◆ *Renew self-locking nuts as well as seals, gaskets and O-rings.*
- ◆ *When installing an exchange cylinder head, the contact surfaces between the hydraulic compensation elements, roller rocker fingers and cams must be oiled before installing the cylinder head.*
- ◆ *Hose connections and air pipes and hoses must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- ◆ *After fitting a new cylinder head or cylinder head gasket, change the engine oil and the coolant in the entire cooling system.*

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

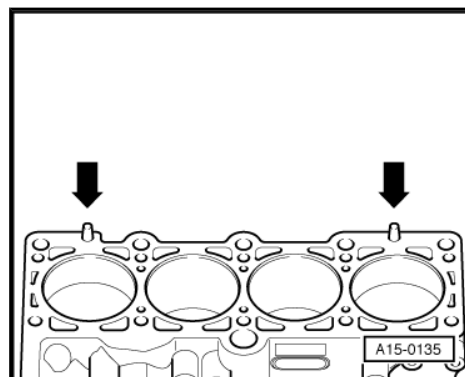


- Slacken bolts -1- and -2- on support for turbocharger (about 2 full turns each) so that components remain free of stress when installing cylinder head.



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



- Tighten cylinder head bolts ⇒ [page 91](#) .



Note

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

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

- Secure turbocharger with new gasket to exhaust manifold and secure bracket to cylinder block ⇒ [page 197](#) .
- Install cylinder head cover ⇒ [page 92](#) .
- Install toothed belt (adjust valve timing): vehicles up to 05.1999 ⇒ [page 76](#) , vehicles from 06.1999 onwards ⇒ [page 81](#) .
- Install poly V-belt and tensioner for poly V-belt ⇒ [page 49](#) .
- Install intake manifold ⇒ [page 84](#) .
- Install coolant hoses and air hoses with screw-type clips ⇒ [page 43](#) .
- Connect coolant hose with plug-in connector ⇒ [page 44](#) .

Vehicles with throttle cable:

- Adjust throttle cable ⇒ Rep. gr. 20 .

All vehicles (continued):

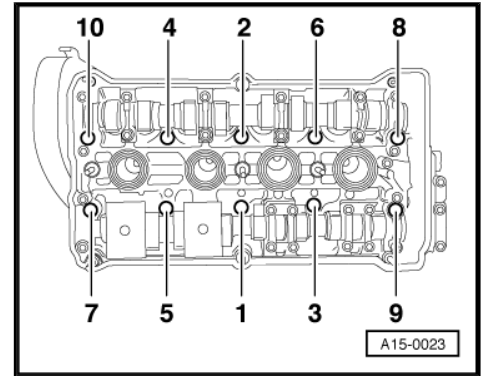
- Observe notes on procedure for connecting the battery ⇒ Rep. gr. 27 .
- Change engine oil ⇒ Maintenance ; Booklet 802 .
- Fill cooling system with fresh coolant ⇒ [page 158](#) .

Tightening torques ⇒ [page 89](#) , ⇒ [page 197](#)

3.9 Checking compression

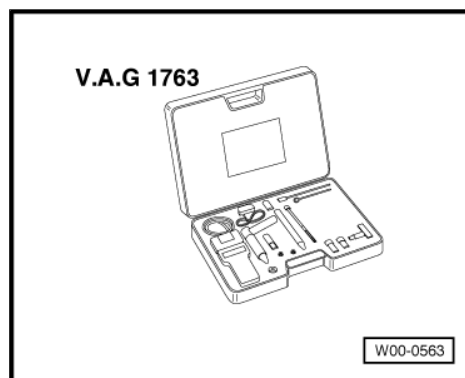
Special tools and workshop equipment required

- ◆ Spark plug socket and extension - 3122 B-



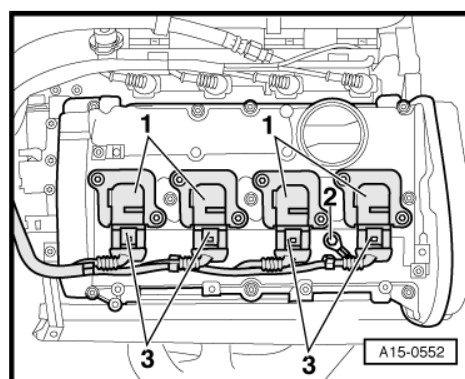
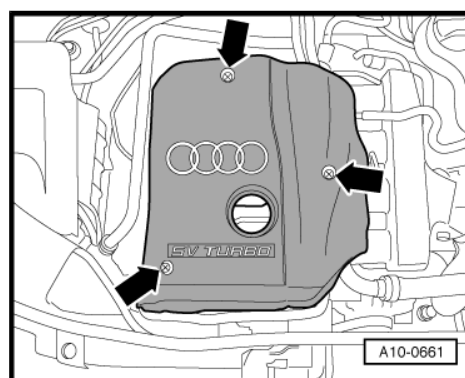
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◆ Compression tester - V.A.G 1763-



Procedure

- Engine oil temperature at least 30 °C
- Battery voltage at least 12.5 V
- Release quick-release fasteners and remove engine cover panel -arrows-.
- Unplug electrical connectors -3-.
- Remove ignition coils -1-.
- Remove spark plugs with spark plug socket and extension - 3122 B- .
- Unplug electrical connectors at injectors.
- Check compression pressure with compression tester - V.A.G 1763- (see ⇒ operating instructions for details of how to use tester).
- Have a 2nd mechanic press down the accelerator pedal completely and at the same time operate the starter until the pressure on the tester display no longer increases.
- Repeat procedure on each cylinder.



Compression pressure	bar
When new	10.0 ... 13.0
Wear limit	7.0
Maximum difference between cylinders	3.0

Assembling

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

- Install spark plugs ⇒ Maintenance ; Booklet 802 .
- Faults are stored in engine control unit because electrical connectors were unplugged and engine was started: "Generate readiness code" in "Guided Functions" ⇒ Vehicle diagnostic tester.

Tightening torque ⇒ [page 89](#)

4 Valve gear



Caution

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

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



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.

4.1 Valve gear - exploded view



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1 - Bolt

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

2 - Camshaft sprocket

- ☐ For exhaust camshaft
- ☐ Note installation position: The camshaft sprocket is installed with the smaller web facing out and the "TDC" marking is visible from the front ⇒ [page 113](#)

3 - Exhaust camshaft oil seal

- ☐ Renewing ⇒ [page 109](#)

4 - Cylinder head

- ☐ See note ⇒ [page 105](#)
- ☐ Checking valve guides ⇒ [page 131](#)
- ☐ Machining valve seats ⇒ [page 132](#)
- ☐ Dowel sleeves for bearing caps must be positioned in cylinder head

5 - Valve guide

- ☐ Checking ⇒ [page 131](#)

6 - Valve stem oil seal

- ☐ Renewing with cylinder head installed ⇒ [page 123](#)
- ☐ Renewing with cylinder head removed ⇒ [page 127](#)

7 - Valve spring

- ☐ Removing and installing ⇒ [page 123](#) or ⇒ [page 127](#)

8 - Valve spring plate

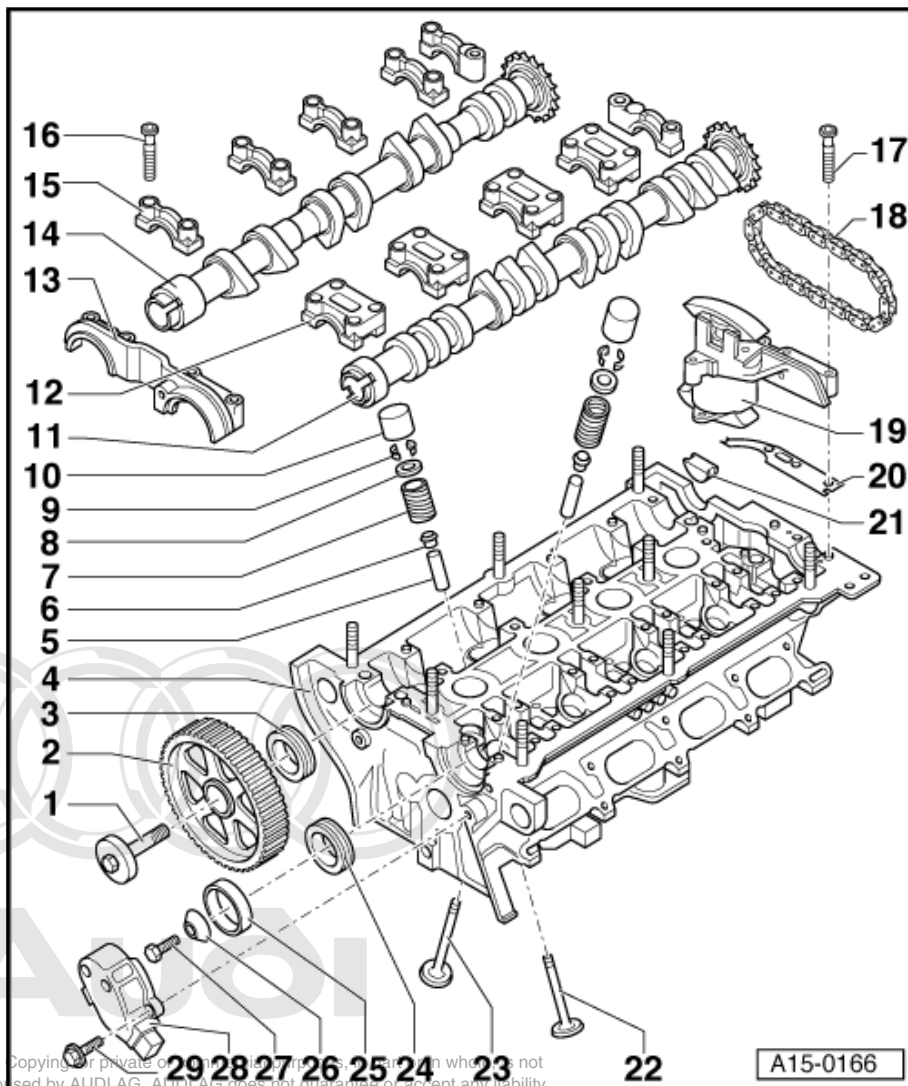
9 - Valve cotters

10 - Hydraulic bucket tappet

- ☐ Checking ⇒ [page 122](#)
- ☐ Removing and installing ⇒ [page 123](#)
- ☐ Do not interchange
- ☐ Place down with contact surface facing downwards
- ☐ Before installing, check camshaft axial clearance ⇒ [page 108](#)
- ☐ Lubricate contact surface

11 - Inlet camshaft

- ☐ Removing and installing ⇒ [page 115](#)
- ☐ Measuring axial clearance ⇒ [page 108](#)
- ☐ Check radial clearance with Plastigage (bucket tappets removed)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Runout: max. 0.01 mm



12 - Bearing cap for inlet camshaft

- ☐ Must be positioned on dowel sleeves
- ☐ Dowel sleeves must be positioned in cylinder head
- ☐ Note installation position
- ☐ Installation sequence ➔ [page 121](#)

13 - Double bearing cap

- ☐ Must be positioned on dowel sleeves
- ☐ Dowel sleeves must be positioned in cylinder head
- ☐ Before installing, apply small quantity of sealant to sealing surface
- ☐ Applying sealant to sealing points between double bearing cap and cylinder head

14 - Exhaust camshaft

- ☐ Removing and installing ➔ [page 115](#)
- ☐ Measuring axial clearance ➔ [page 108](#)
- ☐ Check radial clearance with Plastigage (bucket tappets removed)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Runout: max. 0.01 mm

15 - Bearing cap for exhaust camshaft

- ☐ Must be positioned on dowel sleeves
- ☐ Dowel sleeves must be positioned in cylinder head
- ☐ Note installation position
- ☐ Installation sequence ➔ [page 121](#)

16 - Bolt

- ☐ 10 Nm

17 - Bolt

- ☐ 10 Nm

18 - Drive chain

- ☐ Check for wear
- ☐ Removing and installing
➔ ["4.5 Removing and installing camshafts and hydraulic chain tensioner", page 115](#)
- ☐ Mark installation position prior to removal if old drive chain is to be reused ➔ [page 119](#)

19 - Hydraulic chain tensioner

- ☐ Before removing, lock in position with chain tensioner retainer - 3366-
- ☐ Removing and installing ➔ [page 115](#)
- ☐ Apply sealant to transition points between hydraulic chain tensioner and cylinder head

20 - Rubber/metal gasket

- ☐ Renew

21 - Seal

- ☐ Renew

22 - Exhaust valve

- ☐ With sodium filling
- ☐ Note safety requirements when disposing of valves with sodium filling ➔ [page 130](#)
- ☐ Must not be machined; only grinding-in is permissible
- ☐ Valve dimensions ➔ [page 130](#)
- ☐ Checking valve guides ➔ [page 131](#)
- ☐ Machining valve seats ➔ [page 132](#)

23 - Inlet valve

- ☐ Must not be machined; only grinding-in is permissible
- ☐ Valve dimensions ➔ [page 130](#)

- ☐ Checking valve guides ⇒ [page 131](#)
- ☐ Machining valve seats ⇒ [page 132](#)

24 - Inlet camshaft oil seal

- ☐ Renewing ⇒ [page 113](#)

25 - Rotor for Hall sender

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

26 - Washer

- ☐ With taper
- ☐ Note installation position

27 - Bolt

- ☐ 25 Nm

28 - Hall sender - G40- housing**29 - Bolt**

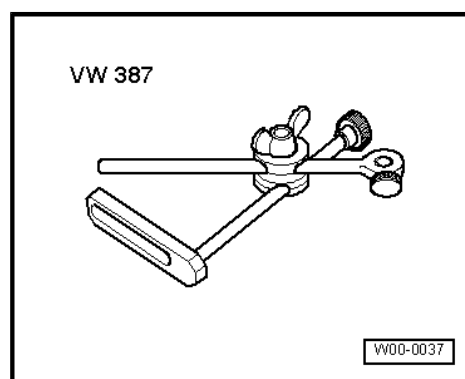
- ☐ 10 Nm

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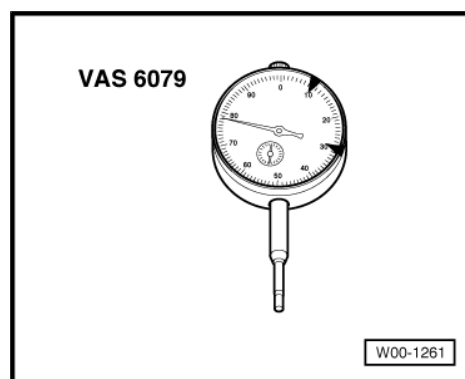
4.2 Checking axial clearance of camshafts

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket - VW 387-

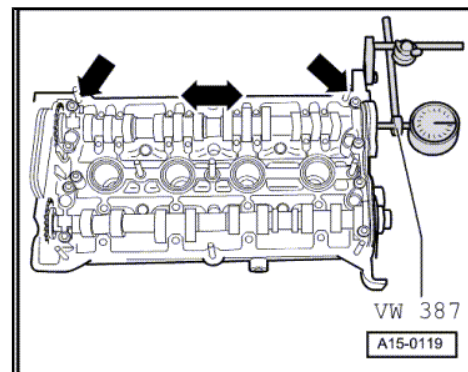


- ◆ Dial gauge - VAS 6079-

**Procedure**

- Remove camshafts ⇒ [page 115](#) .
- Mark allocation of bucket tappets for re-installation.
- Remove bucket tappets from guides and put them down on a clean surface with contact surface facing downwards.
- Insert camshafts in cylinder head and fit bearing cap at chain sprocket end and fit double bearing cap.

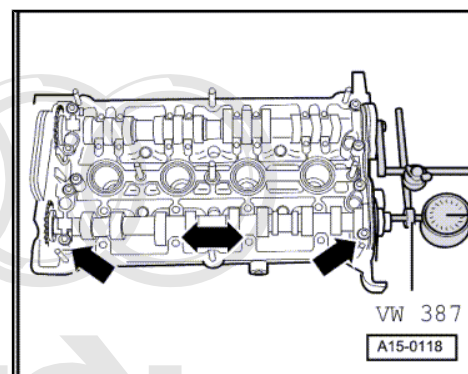
- Secure dial gauge - VAS 6079- with universal dial gauge bracket - VW 387- to retaining frame as shown in illustrations.
- Measure axial clearance of inlet camshaft -arrows-.



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

Axial clearance

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

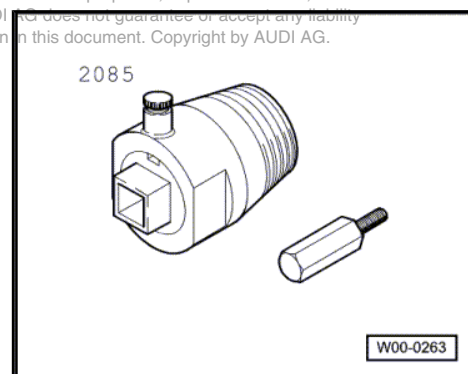


4.3 Renewing exhaust camshaft oil seal

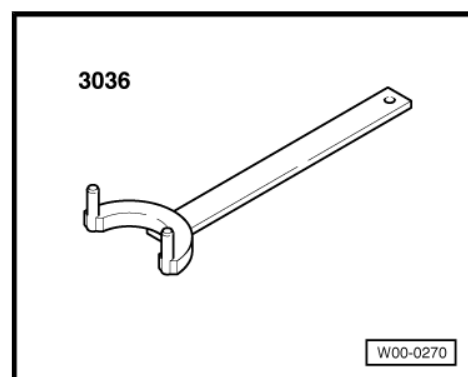
Special tools and workshop equipment required

- ◆ Oil seal extractor - 2085-

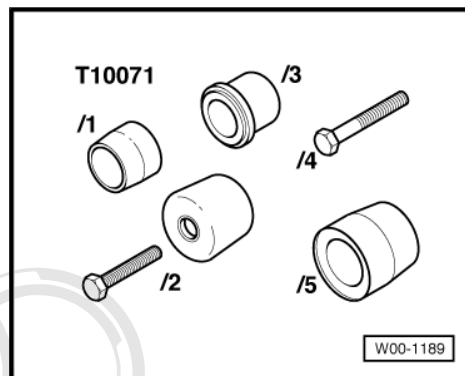
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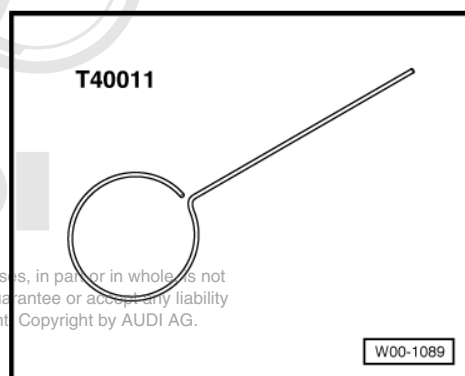
- ◆ Counterhold tool - 3036-



◆ Assembly tool - T10071-



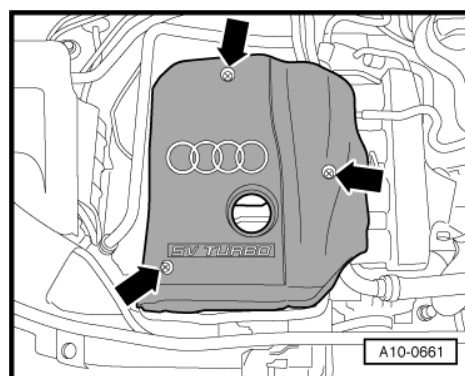
◆ Locking pin - T40011- for vehicles from 06.1999 onwards



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Procedure

- Lock carrier must be in service position ⇒ Rep. gr. 50 .
- Release quick-release fasteners and remove engine cover panel -arrows-.
- Remove poly V-belt and tensioner for poly V-belt ⇒ [page 49](#) .



- Remove toothed belt cover (top section)

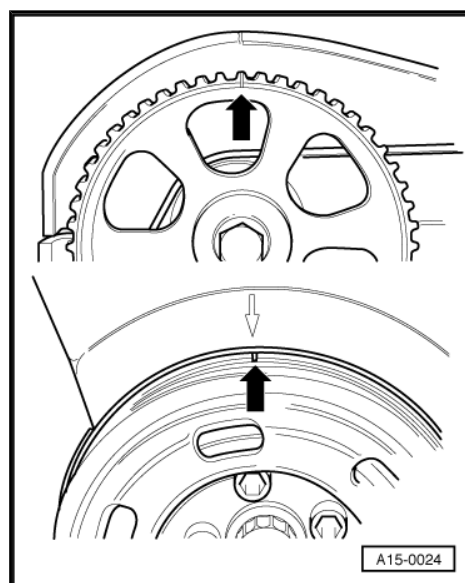


Caution

Irreparable damage can be caused if the toothed belt slips.

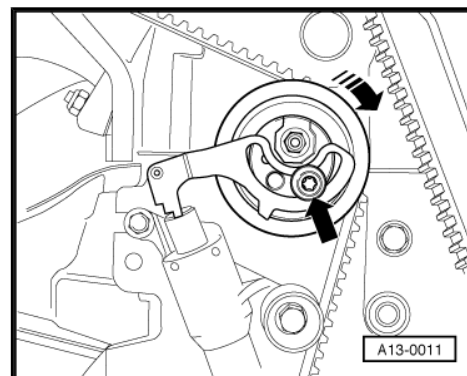
- ◆ *Turn crankshaft only in direction of engine rotation (in clockwise direction).*

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



Vehicles up to 05.1999:

- Loosen TORX bolt -bottom arrow- and press toothed belt tensioner down.
- Remove toothed belt from camshaft sprocket.



Vehicles from 06.1999 onwards:

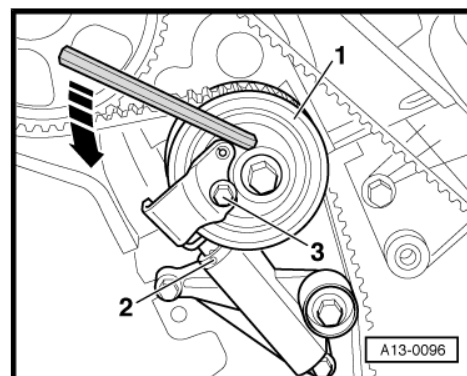


Caution

Risk of damage to toothed belt tensioner.

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

- Applying constant and moderate force, apply hexagon key through opening -2- to press toothed belt tensioning roller -1- anti-clockwise -arrow- until piston can be locked with locking pin - T40011- .
- Insert locking pin - T40011- and make sure that it remains in place.



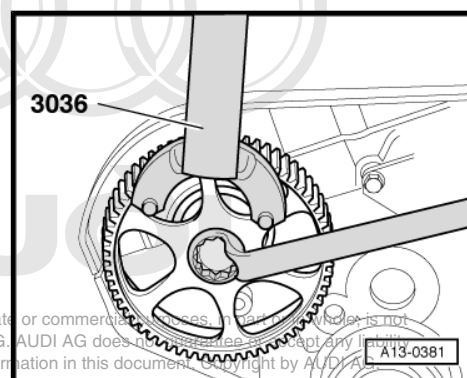
Note

Bolt -3- must not be slackened.

- Remove toothed belt from camshaft sprocket.

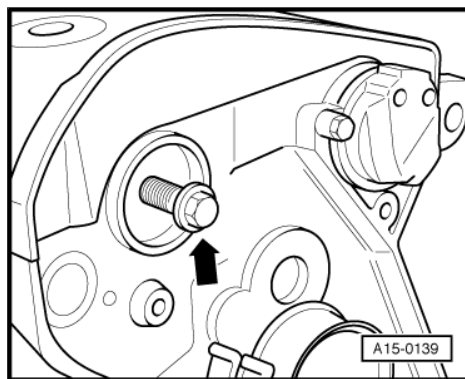
All vehicles (continued):

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

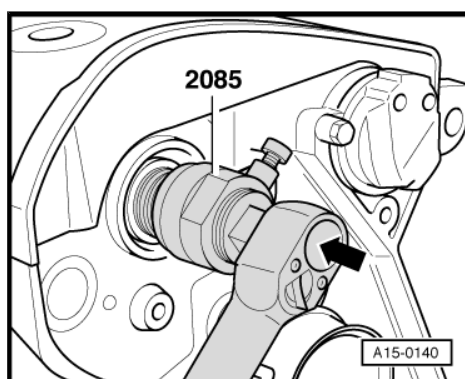


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- To guide oil seal extractor, screw camshaft sprocket bolt -arrow- into camshaft as far as it will go by hand.
- Unscrew inner section of oil seal extractor -2085- two turns (approx. 3 mm) out of outer section and lock inner section with knurled screw.



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



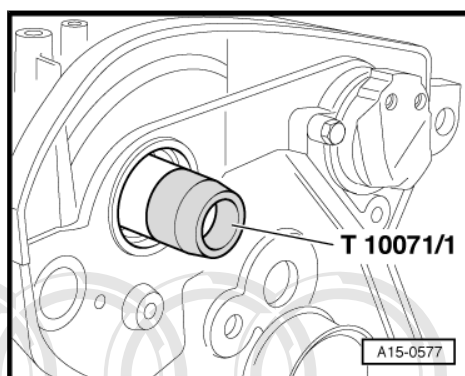
- Fit guide sleeve -T10071/1- onto camshaft journal.



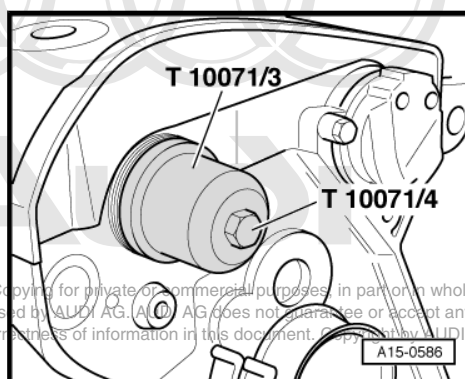
Note

Do not lubricate sealing lip of oil seal.

- Push oil seal over guide sleeve onto shaft journal.
- Take off guide sleeve.



- Press oil seal in onto stop using press sleeve -T10071/3- and bolt -T10071/4- .



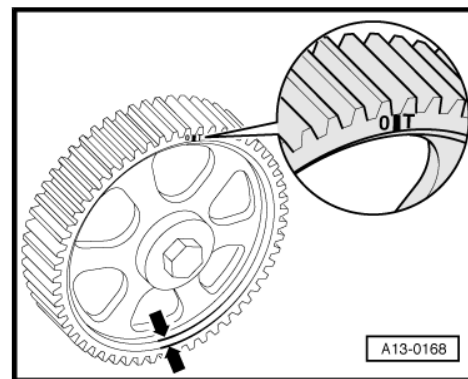
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- Install camshaft sprocket.
- Installation position: The thinner web of the camshaft sprocket faces outwards -arrows- and the marking for “TDC” is visible.



Caution

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



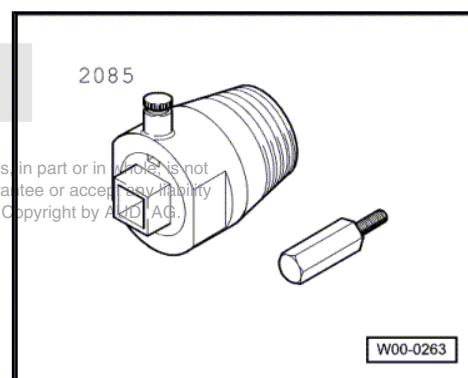
- Tighten camshaft sprocket bolt using counterhold tool - 3036- .
- Install toothed belt (adjust valve timing): vehicles up to 05.1999 ⇒ [page 76](#) , vehicles from 06.1999 onwards ⇒ [page 81](#) .
- Install poly V-belt and tensioner for poly V-belt ⇒ [page 49](#) .

Tightening torque ⇒ [page 105](#)

4.4 Renewing inlet camshaft oil seal

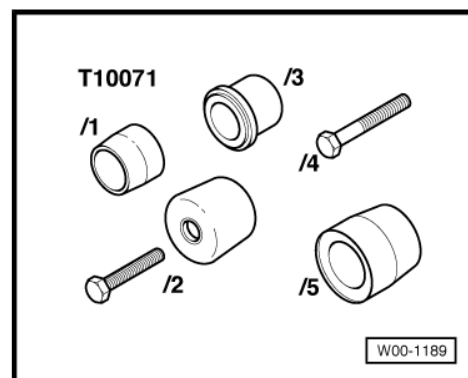
Special tools and workshop equipment required

- ◆ Oil seal extractor - 2085-



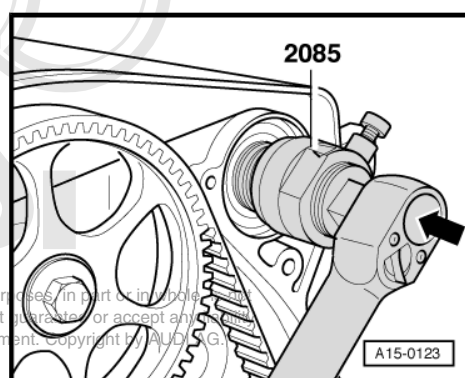
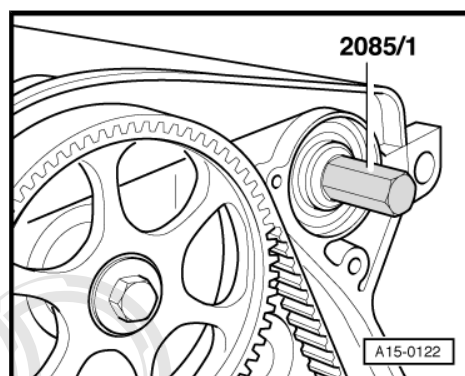
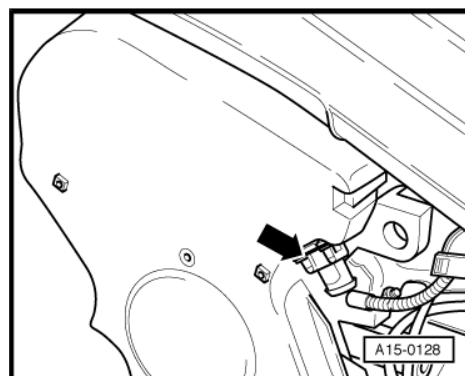
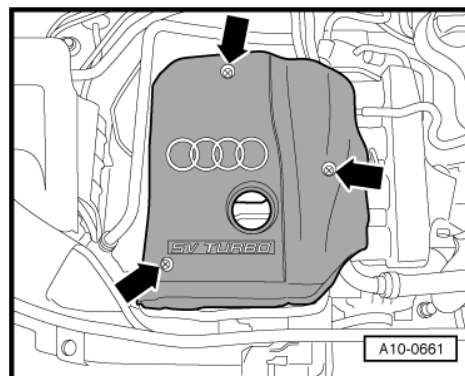
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- ◆ Assembly tool - T10071-



Procedure

- Lock carrier must be in service position ⇒ Rep. gr. 50 .
- Release quick-release fasteners and remove engine cover panel -arrows-.
- Unplug electrical connector -arrow- at Hall sender - G40- .
- Remove toothed belt cover (top section)
- Remove Hall sender ⇒ [Item 25 \(page 108\)](#) ,
⇒ [Item 26 \(page 108\)](#) and ⇒ [Item 28 \(page 108\)](#) .
- To guide oil seal extractor, screw bolt -2085/1- by hand into camshaft as far as it will go.
- Unscrew inner section of oil seal extractor -2085- two turns (approx. 3 mm) out of outer section and lock inner section with knurled screw.
- Lubricate threaded head of oil seal extractor -2085- , place it in position and screw it into oil seal as far as possible (applying firm pressure).
- Loosen knurled screw and turn inner section of oil seal extractor against camshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice and use pliers to remove oil seal.
- Clean contact surface and sealing surface.



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

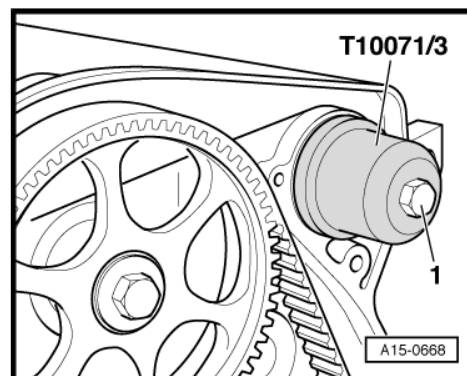
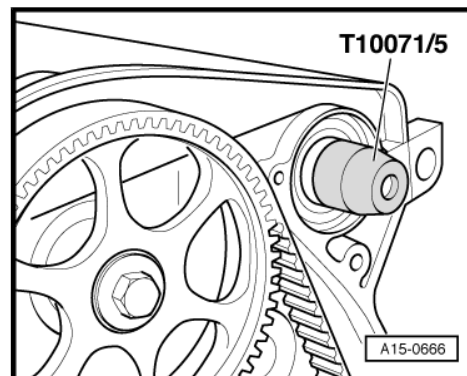


Note

Do not lubricate sealing lip of oil seal.

- Push oil seal over guide sleeve onto shaft journal.
- Take off guide sleeve.
- Press oil seal in onto stop using press sleeve -T10071/3- and M8x60 bolt.
- Install Hall sender ⇒ [Item 25 \(page 108\)](#) ,
⇒ [Item 26 \(page 108\)](#) and ⇒ [Item 28 \(page 108\)](#) .
- Install toothed belt cover (top section).

Tightening torques ⇒ [page 105](#)



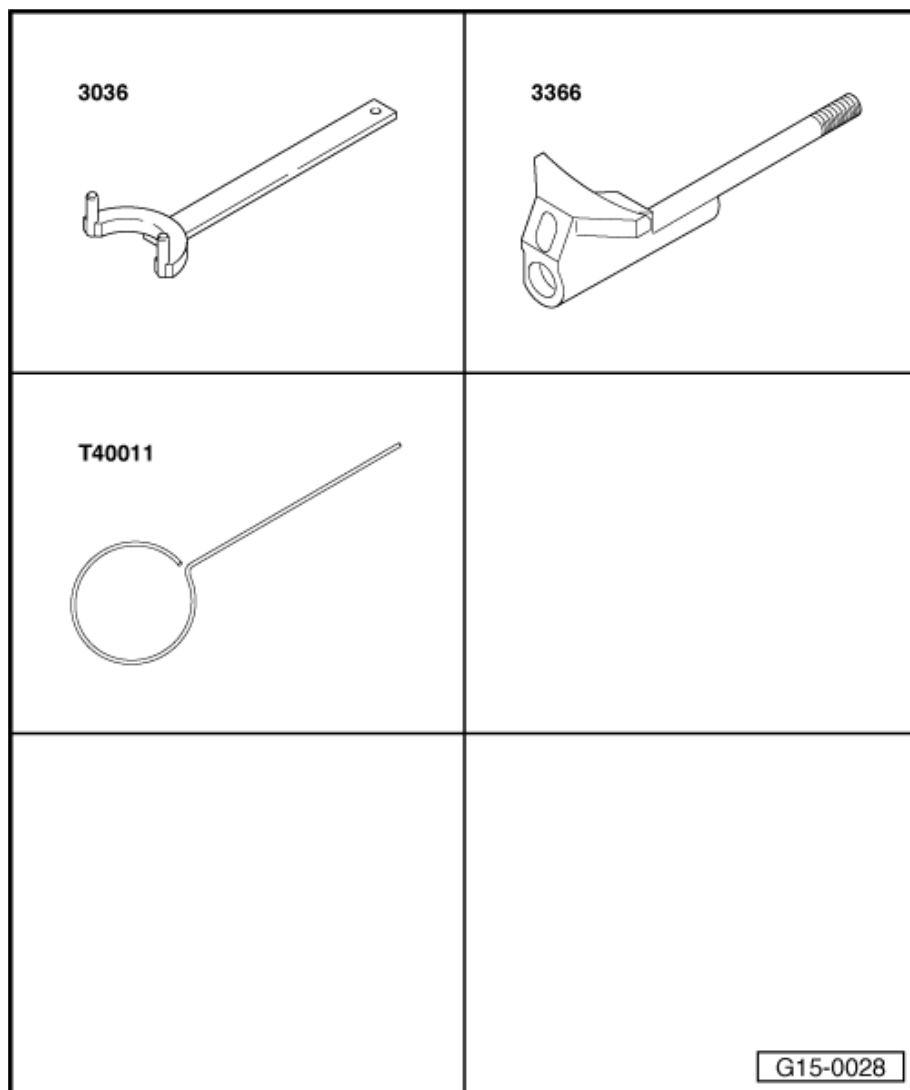
4.5 Removing and installing camshafts and hydraulic chain tensioner



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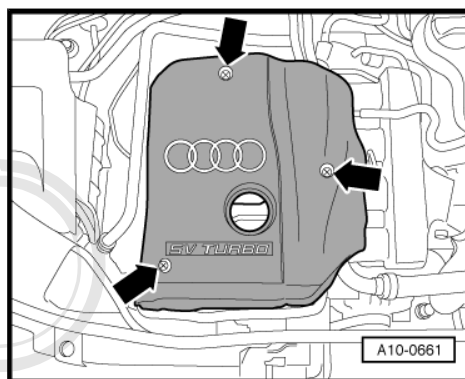
Special tools and workshop equipment required

- ◆ Counterhold tool - 3036-
- ◆ Chain tensioner retainer - 3366-
- ◆ Locking pin - T40011- for vehicles from 06.1999 onwards



Removing

- Lock carrier must be in service position ⇒ Rep. gr. 50 .
- Release quick-release fasteners and remove engine cover panel -arrows-.
- Remove poly V-belt and tensioner for poly V-belt ⇒ [page 49](#) .



- Remove toothed belt cover (top section)



Caution

Irreparable damage can be caused if the toothed belt slips.

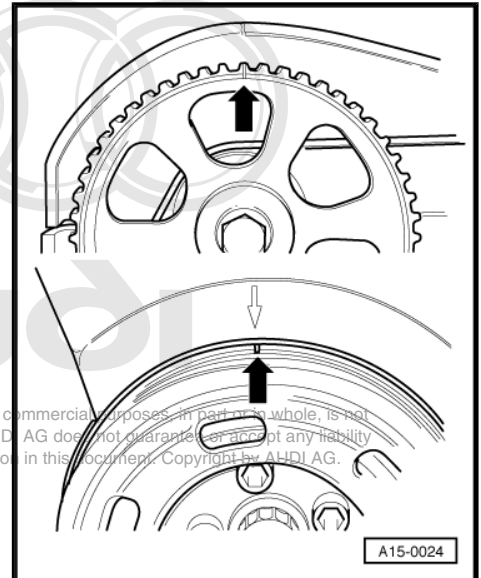
- ◆ *Turn crankshaft only in direction of engine rotation (in clockwise direction).*

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

- Marking on camshaft sprocket and marking on crankshaft must be aligned to "TDC" -arrows-

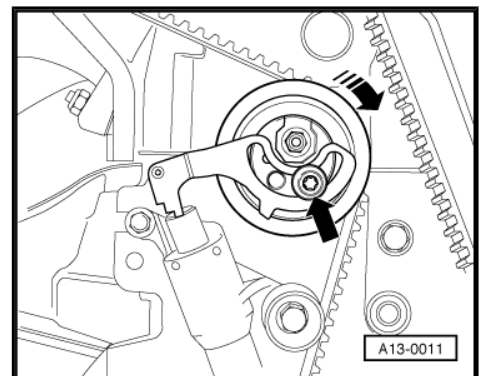
- Remove cylinder head cover ⇒ [page 92](#)

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Vehicles up to 05.1999:

- Loosen TORX bolt -bottom arrow- and press toothed belt tensioner down.
- Remove toothed belt from camshaft sprocket.



Vehicles from 06.1999 onwards:

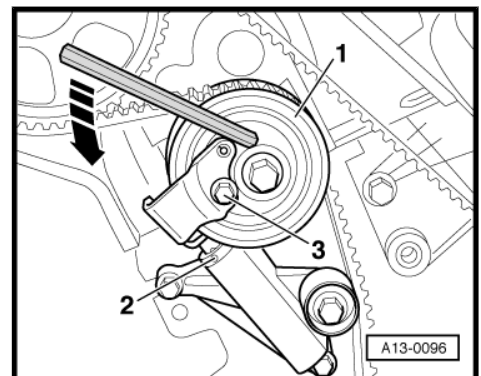


Caution

Risk of damage to toothed belt tensioner.

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

- Applying constant and moderate force, apply hexagon key through opening -2- to press toothed belt tensioning roller -1- anti-clockwise -arrow- until piston can be locked with locking pin - T40011- .
- Insert locking pin - T40011- and make sure that it remains in place.



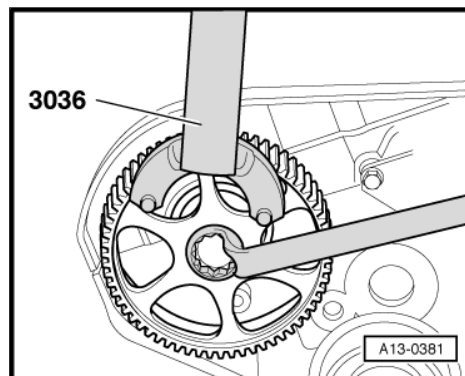
Note

Bolt -3- must not be slackened.

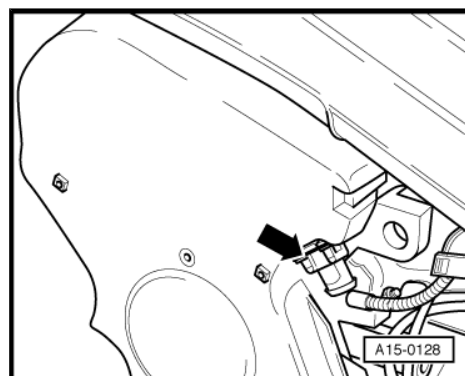
- Remove toothed belt from camshaft sprocket.

All vehicles (continued):

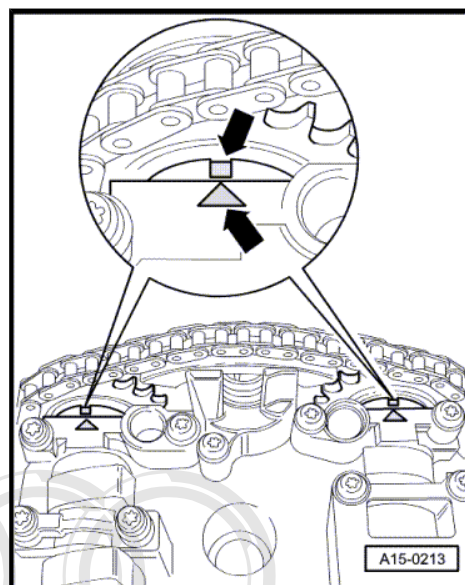
- Turn crankshaft approx. 45° anti-clockwise at bolt for toothed belt sprocket so that all pistons are clear of "TDC" position.
- Loosen camshaft sprocket bolt using counterhold tool - 3036- .
- Pull off camshaft sprocket.
- Remove cylinder head cover ⇒ [page 92](#) .
- Detach oil deflector.



- Unplug electrical connector -arrow- at Hall sender - G40- .
- Remove Hall sender ⇒ [Item 25 \(page 108\)](#) ,
⇒ [Item 26 \(page 108\)](#) and ⇒ [Item 28 \(page 108\)](#) .



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



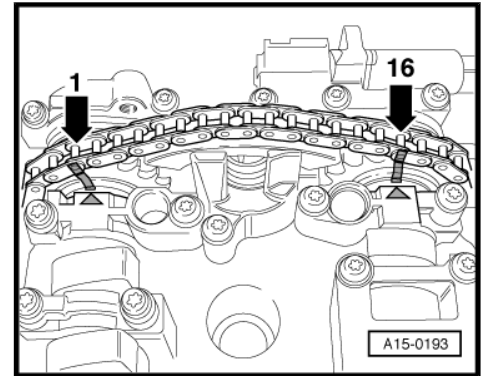
If old drive chain is to be reused:

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



Note

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



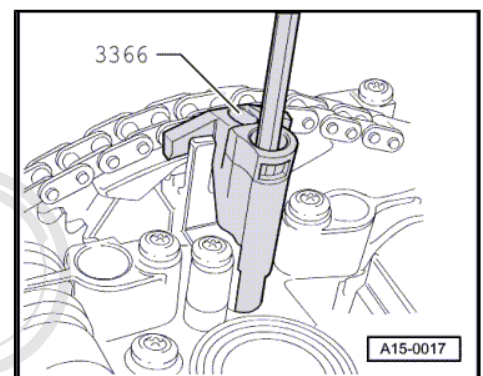
Continued for all drive chains:

- Secure hydraulic chain tensioner with chain tensioner retainer - 3366- .

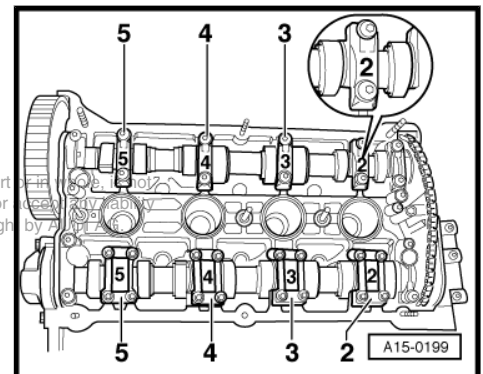


Note

Over-tightening the chain tensioner retainer can damage the hydraulic chain tensioner.

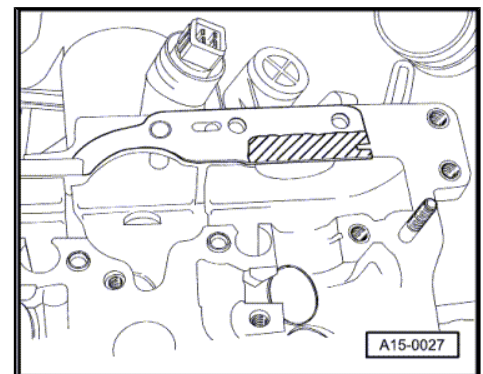


- First remove bearing caps -3 and 5- on inlet and exhaust camshafts.
- Remove double bearing cap.
- Remove both bearing caps next to chain sprockets on inlet and exhaust camshafts.
- Remove bolts for hydraulic chain tensioner.
- Slacken off bearing caps -2 and 4- on inlet and exhaust camshafts alternately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



Installing

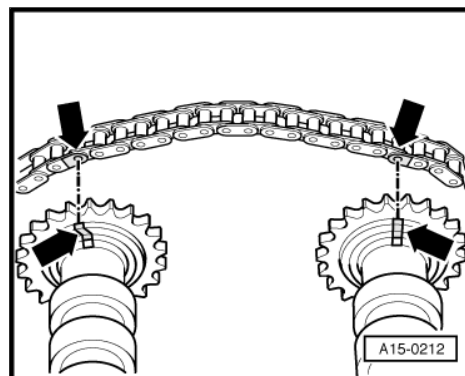
- Pistons must not be at TDC.
- Renew rubber/metal gasket for hydraulic chain tensioner and apply a thin coat of sealant to hatched area; for sealant refer to ⇒ Electronic parts catalogue .



- Position drive chain as follows on camshaft chain sprockets:

If old drive chain is to be reused:

- Align coloured marks -arrows-.

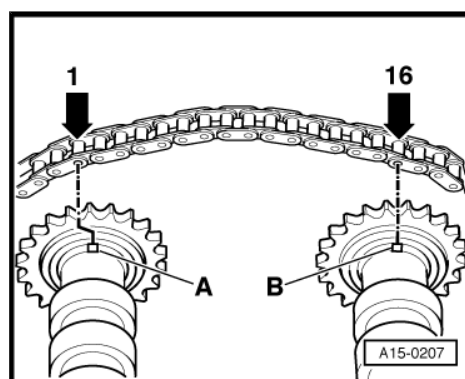


If new drive chain is being used:



Caution

- ◆ *The stated number of rollers merely provides assistance for fitting the drive chain onto the camshafts.*
- ◆ *Make sure that the arrows on the bearing caps and the notches on the camshafts align when installing camshafts (with drive chain) in cylinder head ⇒ [page 121](#) .*



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

Continued for all drive chains:

- Insert hydraulic chain tensioner inside drive chain (2nd mechanic required).
- Place camshafts with drive chain and hydraulic chain tensioner in cylinder head.
- Oil running surfaces of both camshafts.
- Dowel sleeves for bearing caps and hydraulic chain tensioner must be located in cylinder head.



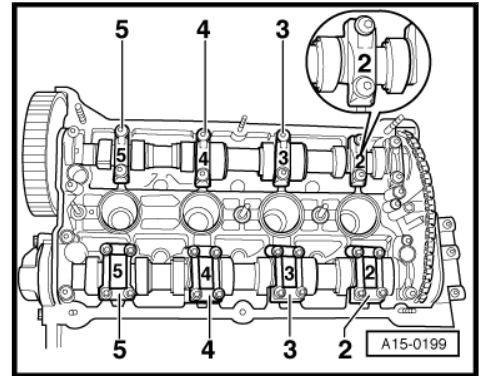
Note

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

- Secure hydraulic chain tensioner (pay attention to dowel sleeves).

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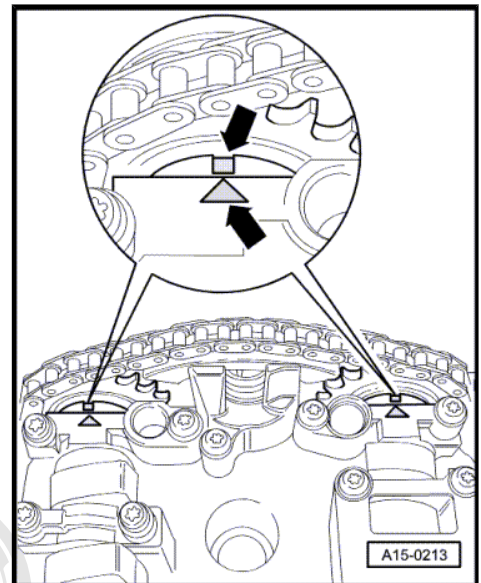
- Tighten bearing caps -2 and 4- on inlet and exhaust camshafts alternately and in diagonal sequence (pay attention to dowel sleeves).
- Install both bearing caps next to chain sprockets on inlet and exhaust camshaft.
- Remove chain tensioner retainer - 3366- .



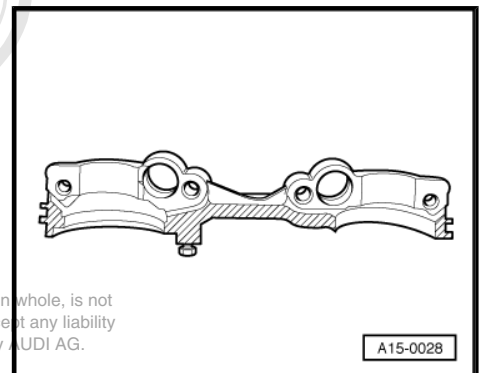
- Check that camshafts are positioned correctly:
 - The two marks on the camshafts must be opposite the two arrows on the bearing caps -arrows-.

**Note**

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

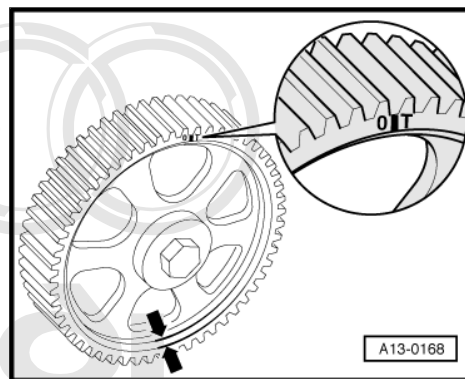


- Apply a small quantity of sealant to hatched area on double bearing cap and on outer bearing cap adjacent to chain tensioner; for sealant refer to ⇒ Electronic parts catalogue .
- Install remaining bearing caps (pay attention to dowel sleeves).
- Renewing camshaft oil seals:
 - ⇒ [“4.3 Renewing exhaust camshaft oil seal”, page 109](#) or
 - ⇒ [“4.4 Renewing inlet camshaft oil seal”, page 113](#) .
- Secure remaining bearing caps.



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- Install camshaft sprocket.
- Installation position: The thinner web of the camshaft sprocket faces outwards -arrows- and the marking for “TDC” is visible.
- Tighten camshaft sprocket bolt using counterhold tool - 3036- .
- Install Hall sender ⇒ [Item 25 \(page 108\)](#) ,
⇒ [Item 26 \(page 108\)](#) and ⇒ [Item 28 \(page 108\)](#) .
- Install cylinder head cover ⇒ [page 92](#) .
- Turn crankshaft approx. 45° clockwise to “TDC” position via toothed belt sprocket bolt.
- Install toothed belt (adjust valve timing): vehicles up to 05.1999 ⇒ [page 76](#) , vehicles from 06.1999 onwards ⇒ [page 81](#) .
- Install poly V-belt ⇒ [page 49](#) .



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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.*

Tightening torques ⇒ [page 105](#)

4.6 Checking hydraulic bucket tappets

Special tools and workshop equipment required

- ◆ Feeler gauge
- ◆ Wooden/plastic wedge

Procedure



Note

- ◆ *Hydraulic bucket tappets cannot be serviced.*
- ◆ *Irregular valve noises when starting engine are normal.*
- Start engine and run until radiator fan has started up once.
- Increase engine speed to approx. 2500 rpm for 2 minutes (perform road test if necessary).



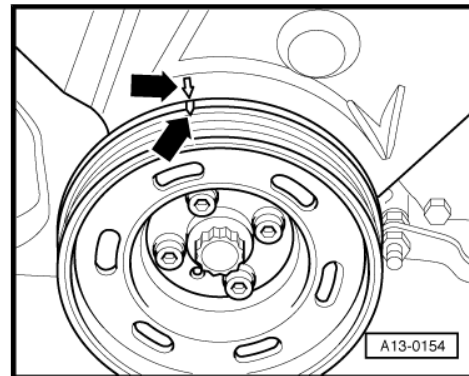
Note

If the irregular valve noises stop but recur repeatedly during short trips, renew the oil retention valve. The oil retention valve is located in the oil filter bracket ⇒ [Item 1 \(page 150\)](#) .

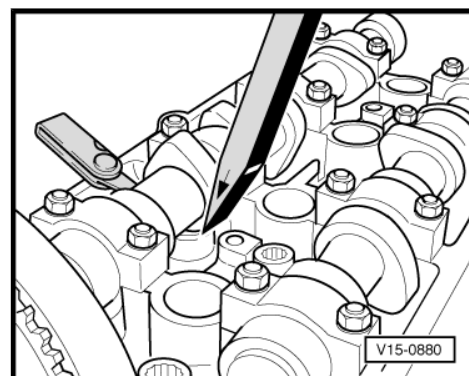
If the hydraulic tappets are still noisy, locate defective tappet as follows:

- Remove cylinder head cover ⇒ [page 92](#) .
- Turn crankshaft until cams of bucket tappets to be tested are at top:

- ◆ On vehicles with manual gearbox: push vehicle in direction of travel with fourth gear engaged and ignition switched off until "TDC" marking on vibration damper aligns with marking on bottom section of toothed belt cover -arrows-.
- ◆ On vehicles with automatic gearbox: rotate crankshaft to "TDC" by turning toothed belt sprocket bolt in direction of engine rotation.



- Push bucket tappet down with a wooden or plastic wedge to determine play between cam and bucket tappet.
- If an 0.20 mm feeler gauge can be inserted between camshaft and tappet, renew tappet
⇒ ["4.5 Removing and installing camshafts and hydraulic chain tensioner", page 115](#).

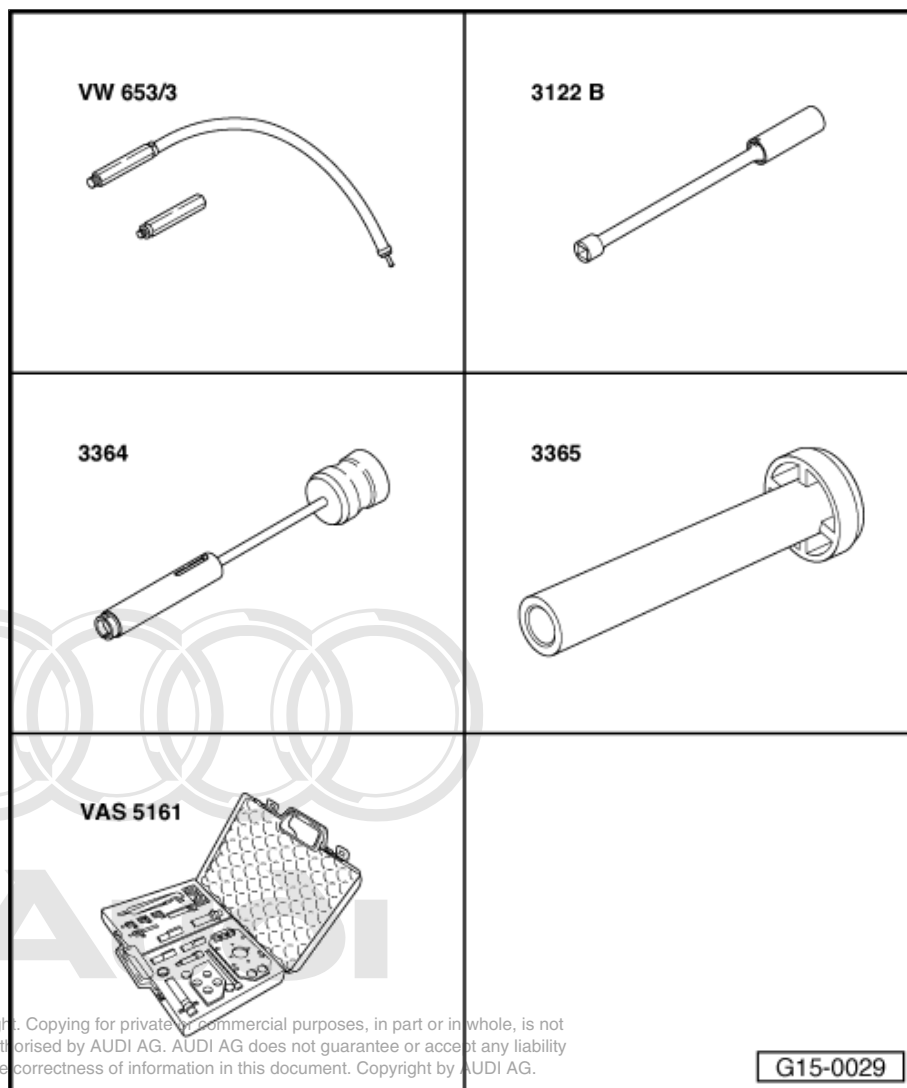


4.7 Renewing valve stem oil seals with cylinder head installed

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Special tools and workshop equipment required

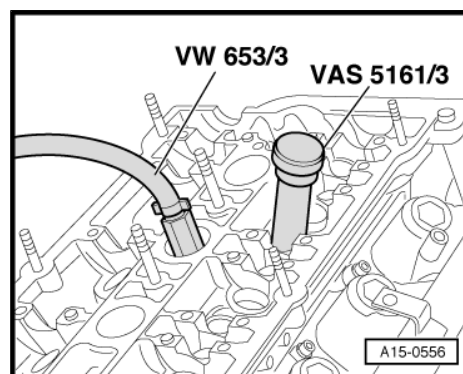
- ◆ Pressure hose - VW 653/3-
- ◆ Spark plug socket and extension - 3122 B-
- ◆ Valve stem seal puller - 3364-
- ◆ Valve stem seal fitting tool - 3365-
- ◆ Removal and installation device for valve cotters - VAS 5161-



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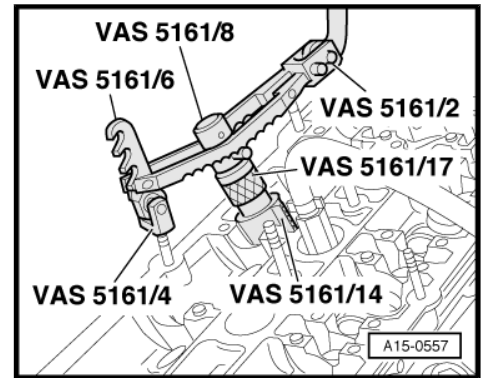
Procedure

- Remove camshafts and camshaft adjuster ⇒ [page 115](#) .
- Mark allocation of bucket tappets for re-installation.
- Remove the bucket tappets from the guides and put them down with the contact surface downwards.
- Remove spark plugs with spark plug socket and extension - 3122 B- .
- Set piston of appropriate cylinder to “bottom dead centre”.
- Screw pressure hose - VW 653/3- into spark plug thread.
- Connect hose to compressed air and apply a steady pressure.
 - Minimum pressure: 6 bar.
- Apply drift -VAS 5161/3- to valve spring plate and use plastic-headed hammer to release sticking valve cotters.
- Use plastic-headed hammer to release sticking valve cotters on all five valves.



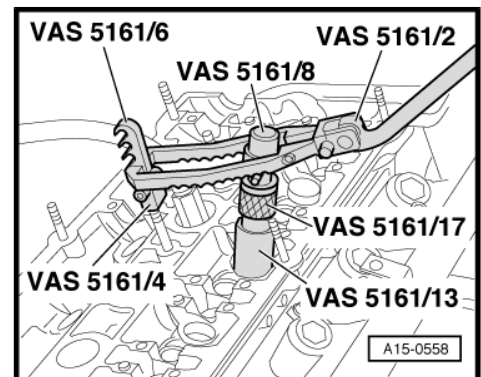
Exhaust side:

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



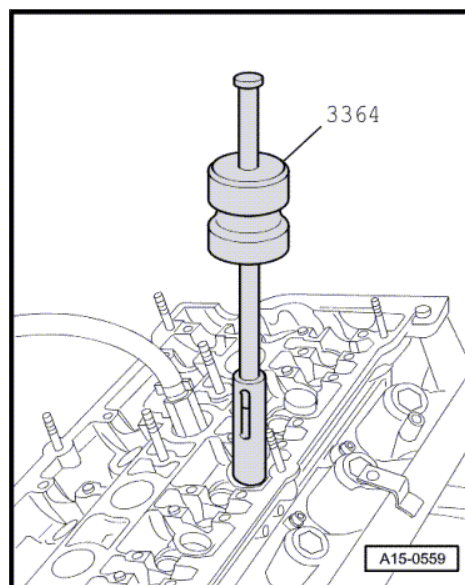
Inlet side:

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



Continuation for both sides:

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

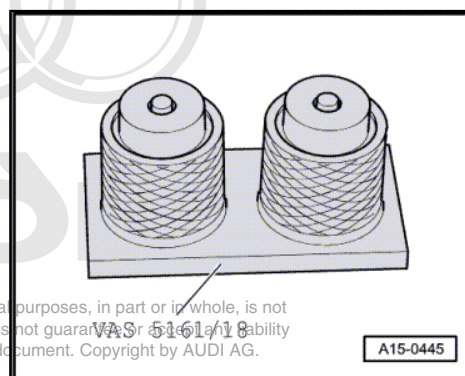
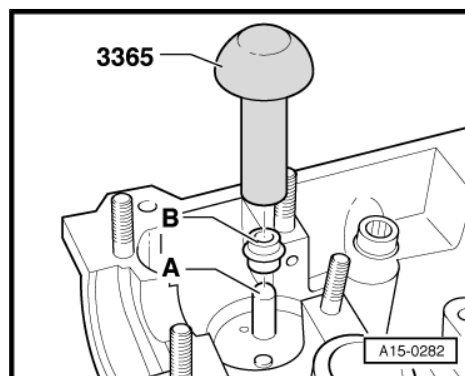


Caution

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

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

- Lightly oil sealing lip of valve stem oil seal.
- Slide valve stem oil seal onto plastic sleeve.
- Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool - 3365- .
- Remove plastic sleeve.
- If valve cotters have been removed from assembly cartridge, they need to be put into insertion device for valve cotters - VAS 5161/18- first.
- Larger diameter of valve cotters faces upwards.
- Press assembly cartridge -VAS 5161/8- onto insertion device from above and take up valve cotters.



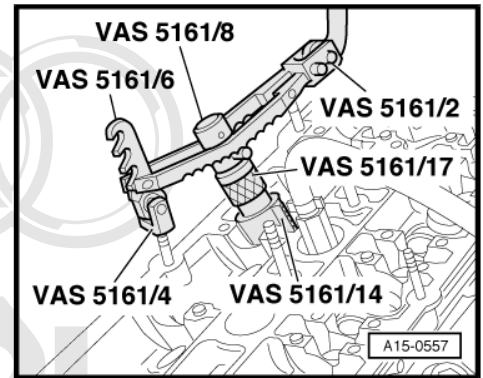
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- Insert assembly cartridge in guide bush -VAS 5161/13- or -VAS 5161/14- .
- Press down pressure fork and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotters.
- Release pressure fork with knurled screw still in pulled position.
- Repeat procedure for each valve.

Assembling

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

- Install bucket tappets.
- Install camshafts and camshaft adjuster [⇒ page 115](#).

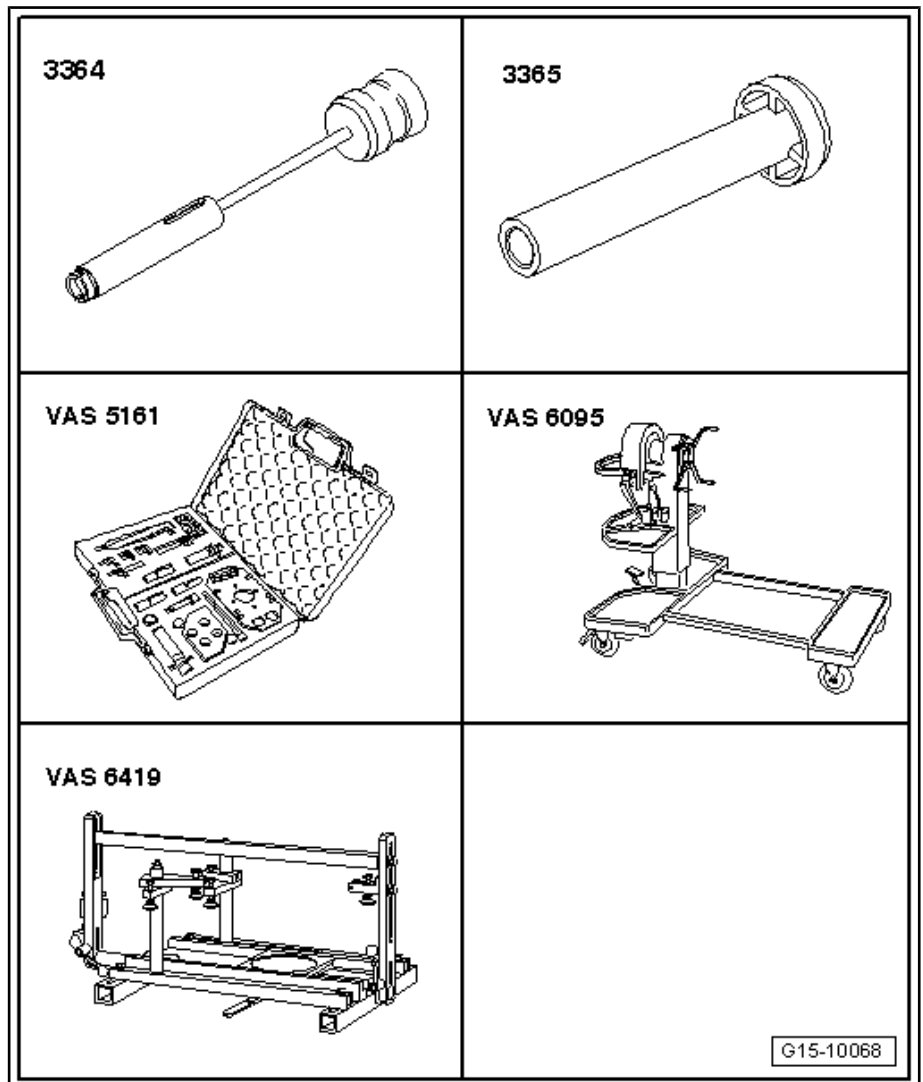


Shank of camshaft adjuster is not to be used for repair or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.

4.8 Renewing valve stem oil seals with cylinder head removed

Special tools and workshop equipment required

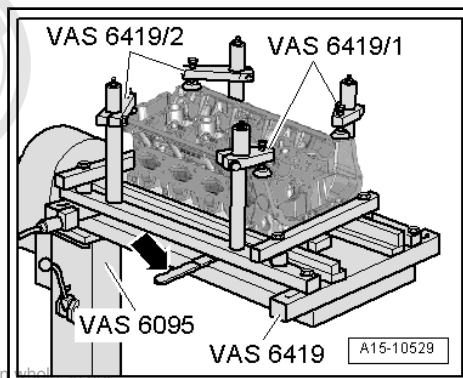
- ◆ Valve stem seal puller - 3364-
- ◆ Valve stem seal fitting tool - 3365-
- ◆ Removal and installation device for valve cotters - VAS 5161-
- ◆ Engine and gearbox support - VAS 6095-
- ◆ Cylinder head tensioning device - VAS 6419-



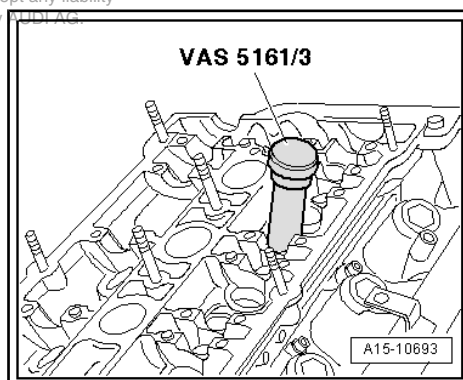
Procedure

- Remove camshafts and camshaft adjuster [⇒ page 115](#) .
- Mark allocation of bucket tappets for re-installation.

- Remove the bucket tappets from the guides and put them down with the contact surface downwards.
- Attach tensioning device -VAS 6419- to engine and gearbox support - VAS 6095- .
- Secure cylinder head in tensioning device -VAS 6419- as illustrated.
- Connect compressed air line to tensioning device -VAS 6419- .
- Using lever -arrow-, slide air pad under combustion chamber where valve stem oil seal is to be removed.
- Apply just enough compressed air to bring air pad into contact with valve heads.

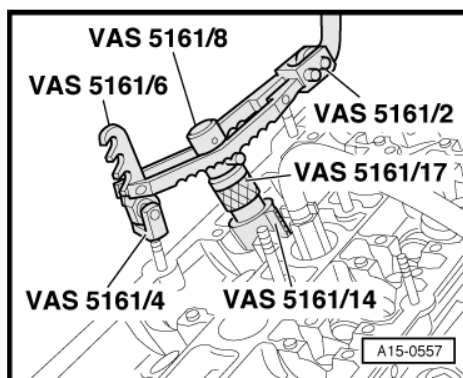


- Apply drift -VAS 5161/3- to valve spring plate and use plastic-headed hammer to release sticking valve cotters.



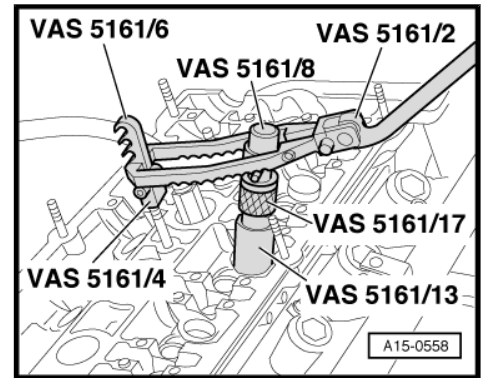
Exhaust side:

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



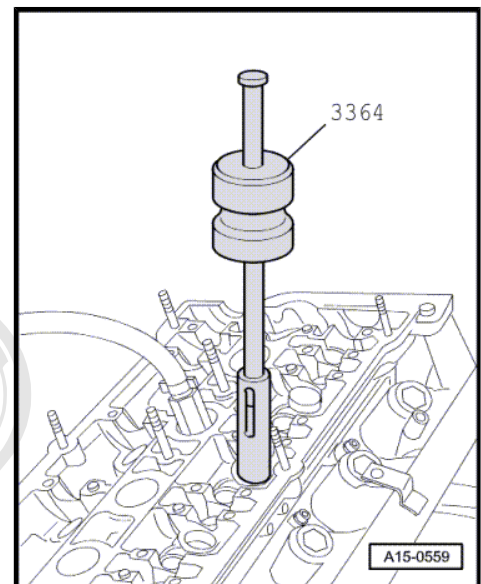
Inlet side:

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



Continuation for both sides:

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



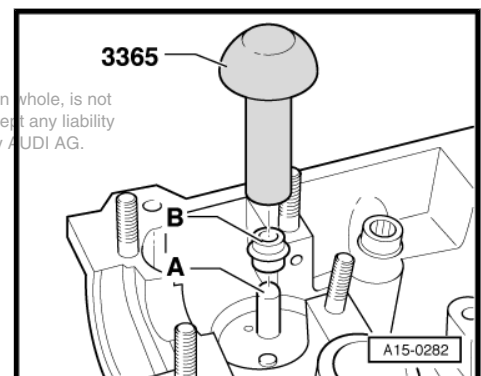
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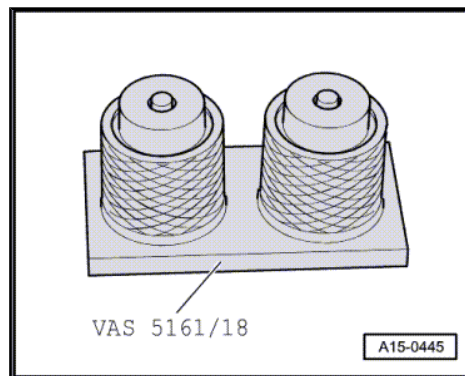
Make sure valve stem oil seals are not damaged when installing.

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

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



- If valve cotters have been removed from assembly cartridge, they need to be put into insertion device for valve cotters - VAS 5161/18- first.
- Larger diameter of valve cotters faces upwards.
- Press assembly cartridge -VAS 5161/8- onto insertion device from above and take up valve cotters.

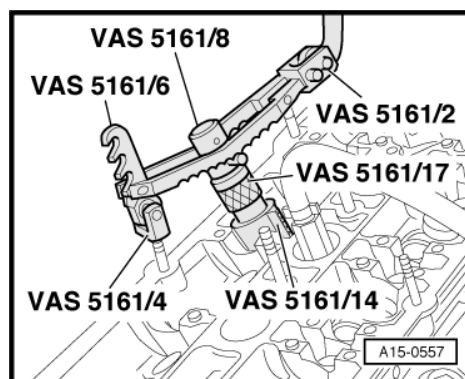


- Insert assembly cartridge in guide bush -VAS 5161/13- or -VAS 5161/14- .
- Press down pressure fork and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotters.
- Release pressure fork with knurled screw still in pulled position.
- Repeat procedure for each valve.

Assembling

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

- Install bucket tappets.
- Install camshafts and camshaft adjuster → [page 115](#) .



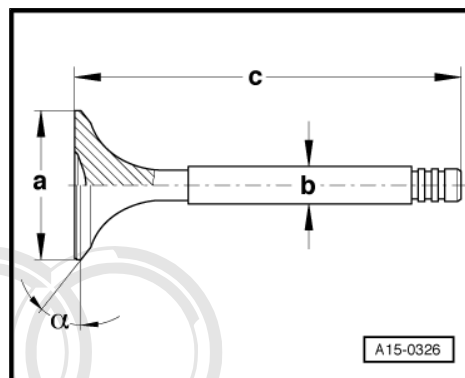
4.9 Valve dimensions



Note

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

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



WARNING

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

4.10 Checking valves

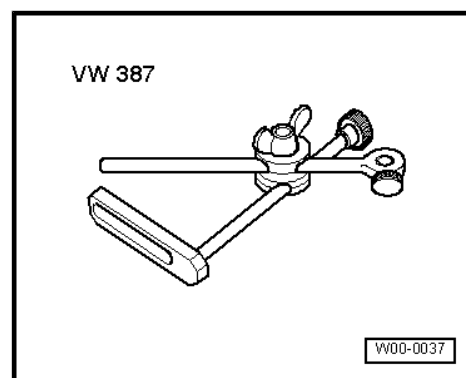
Procedure

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

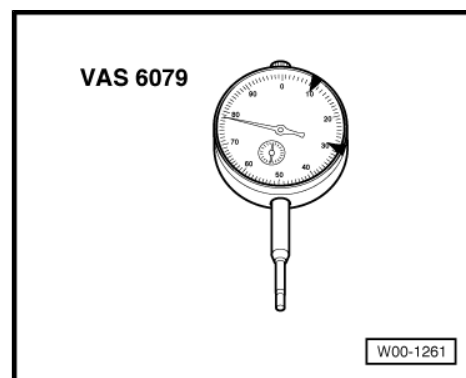
4.11 Checking valve guides

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket - VW 387-



- ◆ Dial gauge - VAS 6079-



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Procedure



Note

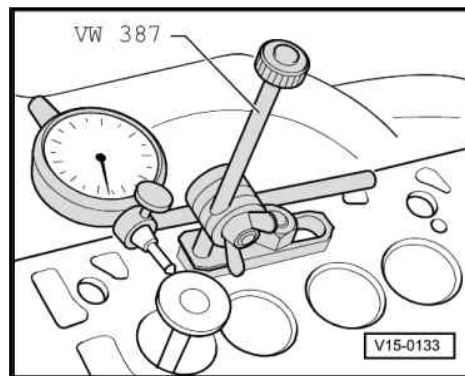
- ◆ *If the valve has to be renewed as part of a repair, use a new valve for the measurement.*
- ◆ *Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.*
- Insert valve into guide.
- End of valve stem must be flush with valve guide.

- Determine amount of sideways play.
- Wear limit: 0.8 mm.
- Renew cylinder head if wear limit is still exceeded.



Note

Valve guides cannot be renewed.



4.12 Machining valve seats

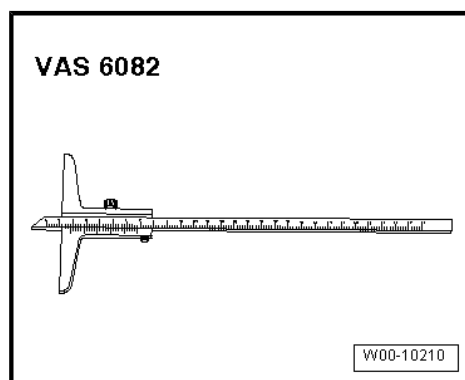


Note

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 - VAS 6082-



- ◆ 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 131](#).
- ◆ Valve seats should only be machined to the extent required to give a proper seating pattern.
- ◆ The maximum permissible machining dimension must be calculated before starting work.
- ◆ If the machining dimension is exceeded, the function of the hydraulic valve clearance compensation can no longer be ensured and the cylinder head must be renewed.

Calculating maximum permissible machining dimension

- Insert valve and press firmly against valve seat.



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

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

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

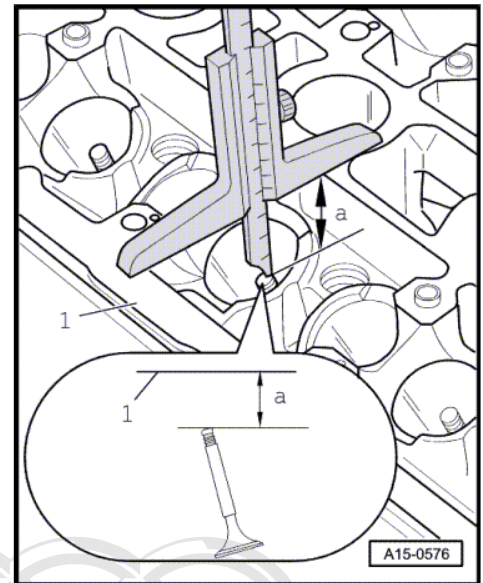
Measured distance minus minimum dimension = max. permissible machining dimension.

Example for inlet valve (outer):

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



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



Machining inlet valve seat

a - $\varnothing$ 26.2 mm

b - 1.5 ... 1.8 mm

Z - Bottom surface of cylinder head

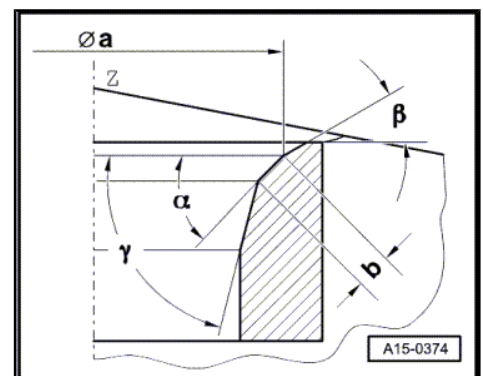
α - 45° valve seat angle

β - 30° upper correction angle

γ - 60° lower correction angle



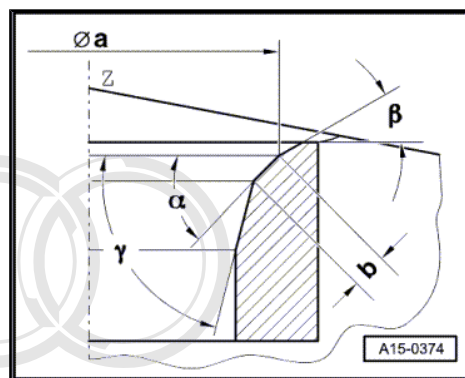
Calculating maximum permissible machining dimension
⇒ [page 133](#).



Machining exhaust valve seata - $\varnothing$ 29.0 mm

b - 1.8 mm

Z - Bottom surface of cylinder head

 α - 45° valve seat angle β - 30° upper correction angle γ - 60° lower correction angle**Note***Calculating maximum permissible machining dimension**⇒ [page 133](#).*

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17 – Lubrication

1 Sump and oil pump



Caution

Risk of damage to catalytic converter.

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



Note

- ◆ *If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully, and the oil cooler must be renewed in order to prevent further damage occurring later.*
- ◆ *Oil spray jet and pressure relief valve ⇒ [page 69](#)*
- ◆ *Refer to ⇒ Maintenance tables for engine oil capacity, oil specifications and viscosity grades.*

1.1 Sump, oil pump - exploded view

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1 - Bolt

- ☐ M6: 10 Nm
- ☐ M7: 15 Nm

2 - Gasket

- ☐ Renewing moulded gasket ⇒ [page 145](#)
- ☐ Renewing liquid gasket ⇒ [page 146](#)

3 - O-ring

- ☐ Renew

4 - Suction pipe

- ☐ Clean strainer if dirty

5 - Bolt

- ☐ 10 Nm

6 - Baffle plate
7 - Nut

- ☐ 25 Nm

8 - Longitudinal strut
9 - Bolt

- ☐ 25 Nm

10 - Stop for torque reaction support

- ☐ Adjusting:
- ☐ Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight, and tighten bolts to 28 Nm.

11 - Bolt

- ☐ 25 Nm

12 - Nut

- ☐ 25 Nm

13 - Bracket for torque reaction support
14 - Support
15 - Nut

- ☐ 25 Nm

16 - Longitudinal strut
17 - Bolt

- ☐ 20 Nm

18 - Oil pump housing

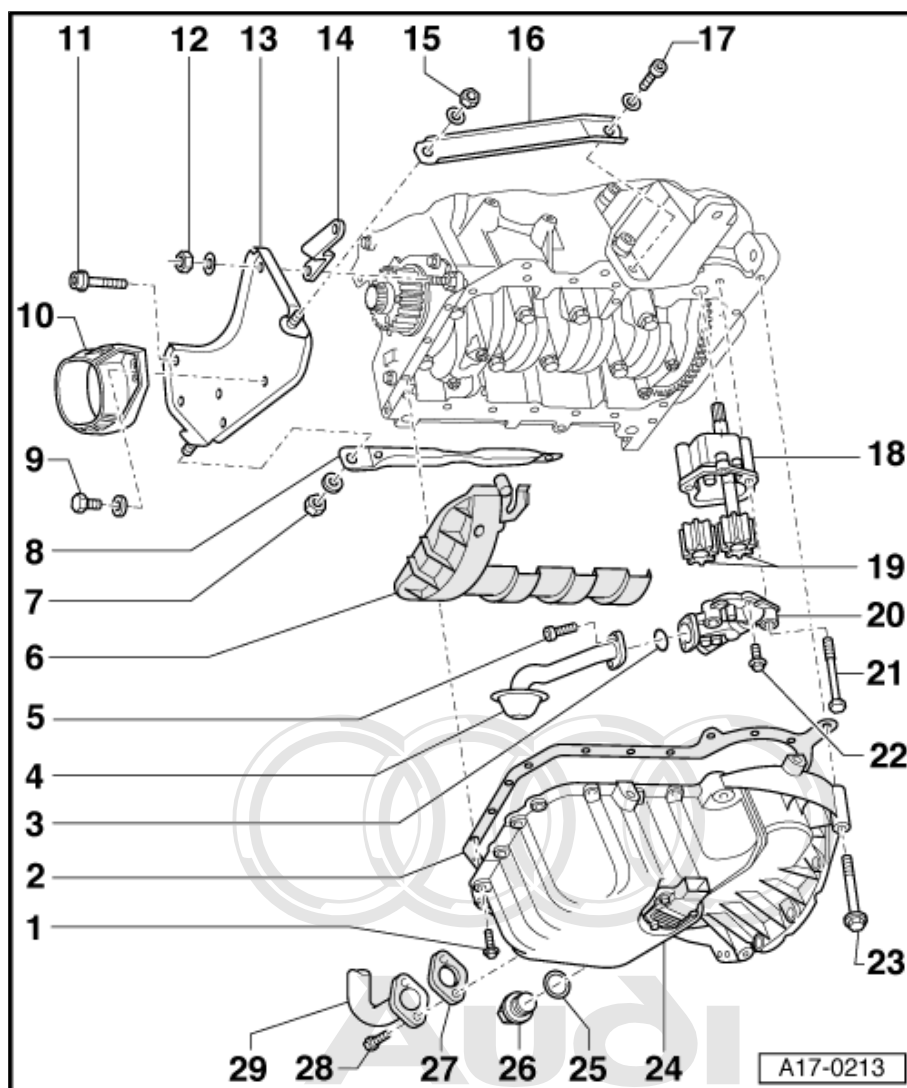
- ☐ Removing and installing oil pump ⇒ [page 149](#)

19 - Gears

- ☐ Checking backlash ⇒ [page 137](#)
- ☐ Checking axial clearance ⇒ [page 137](#)

20 - Oil pump cover with pressure relief valve

- ☐ Opening pressure: 5.7 ... 6.7 bar



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21 - Bolt

- ☐ 25 Nm

22 - Bolt

- ☐ 10 Nm

23 - Bolt

- ☐ 45 Nm

24 - Sump

- ☐ With oil level and oil temperature sender - G266-
- ☐ Removing and installing oil level and oil temperature sender - G266- [⇒ page 138](#)
- ☐ Removing sump [⇒ page 138](#)
- ☐ Installing sump with moulded gasket [⇒ page 145](#)
- ☐ Installing sump with liquid gasket [⇒ page 146](#)

25 - Seal

- ☐ Renew

26 - Oil drain plug

- ☐ 50 Nm

27 - Gasket

- ☐ Renew

28 - Bolt

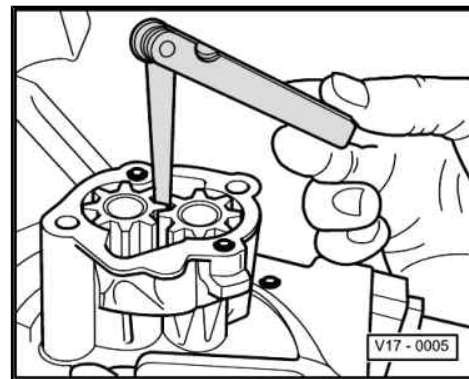
- ☐ 10 Nm

29 - Oil return line

- ☐ From turbocharger

Checking backlash of oil pump

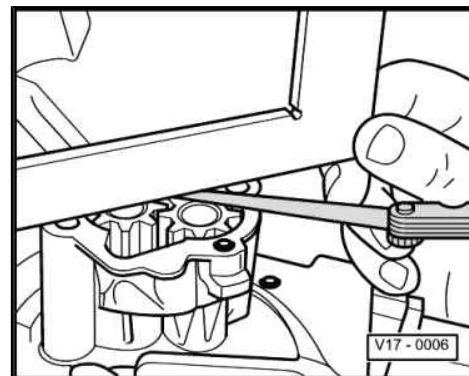
- New: 0.05 mm.
- Wear limit: 0.20 mm.



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Checking axial clearance of oil pump

- Wear limit: 0.15 mm



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

Removing

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

Installing

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



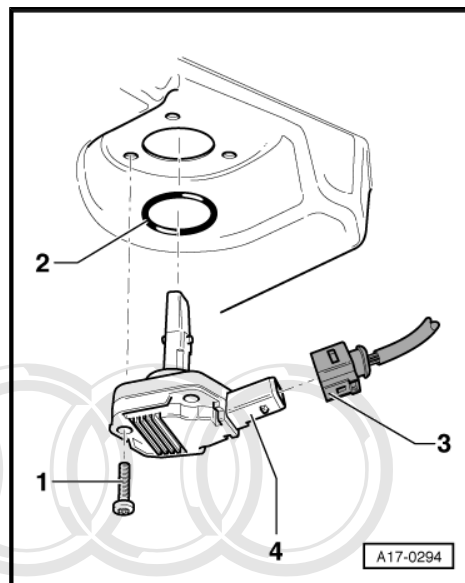
Note

Renew seal -2-.

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

Tightening torque

Component	Nm
Oil level and oil temperature sender - G266- to sump	10

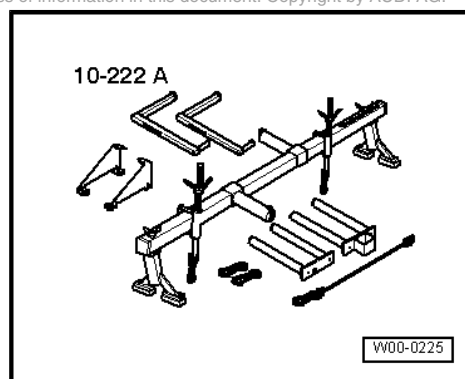


1.3 Removing sump

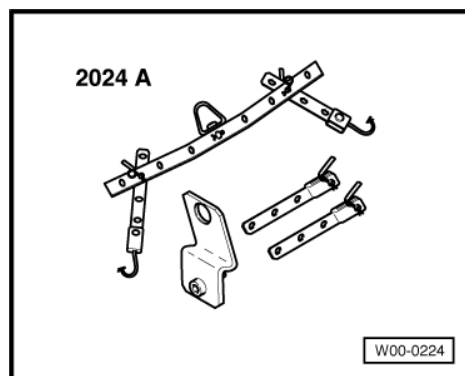
Special tools and workshop equipment required

- ◆ Support bracket - 10 - 222 A-

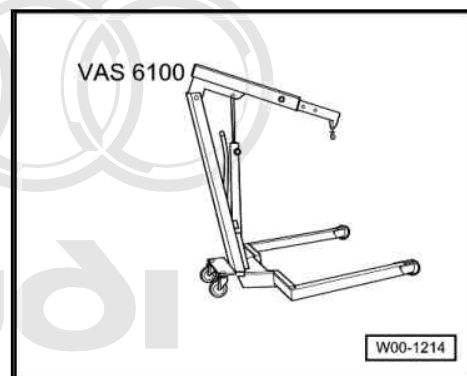
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- ◆ Lifting tackle - 2024 A-

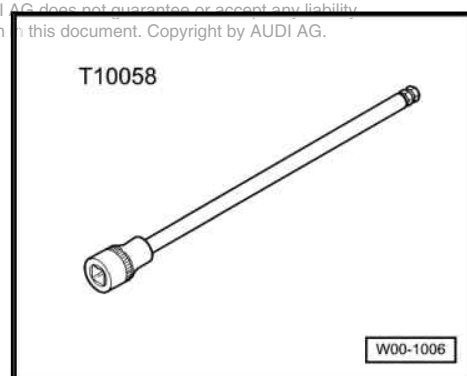


- ◆ Workshop hoist - VAS 6100-



- ◆ Allen key, long reach - T10058-

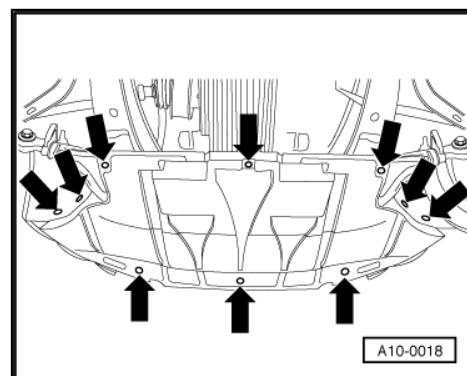
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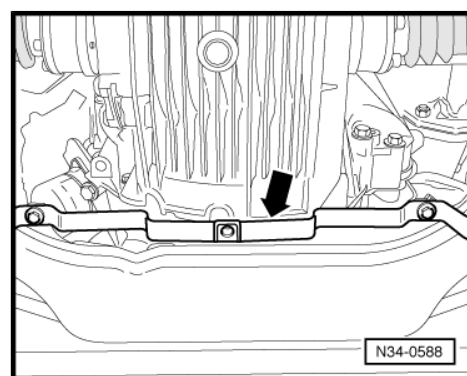
- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Electronic parts catalogue

Procedure

- Engine in vehicle.
- Release fasteners -arrows- and remove noise insulation.
- Drain off engine oil ⇒ Maintenance ; Booklet 802 .



- Unbolt bracket for noise insulation -arrow-.



Vehicles with air conditioning:



Caution

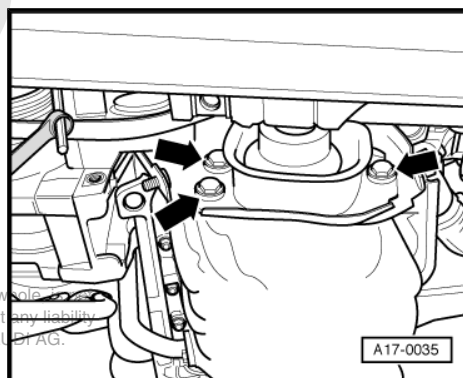
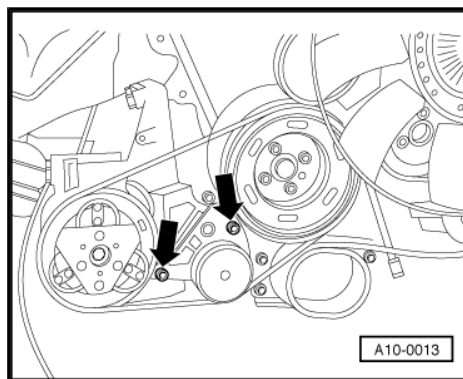
If a used belt runs in the opposite direction when it is refitted, this can cause breakage.

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

- Loosen bolts on tensioner for poly V-belt for air conditioner compressor -arrows-, slacken belt and remove.
- Remove tensioner.

All vehicles (continued):

- Remove stop for torque reaction support -arrows-.

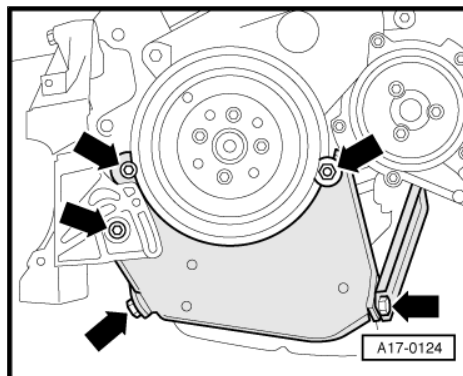


- Remove longitudinal strut (left and right) and torque reaction support bracket -arrows-.

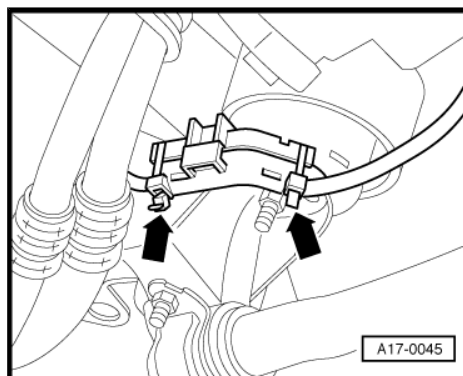


Note

Shown in illustration with engine removed.



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



Vehicles with automatic gearbox:



Note

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

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



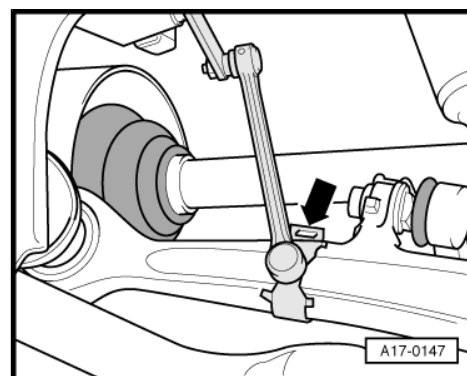
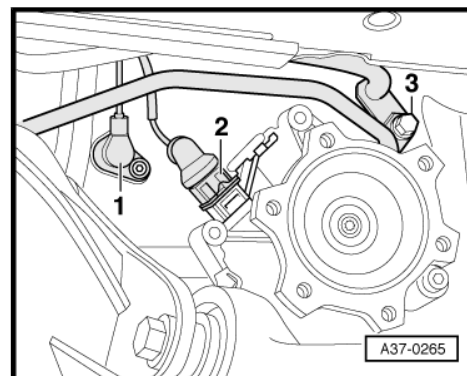
Note

Disregard -items 1, 2-.

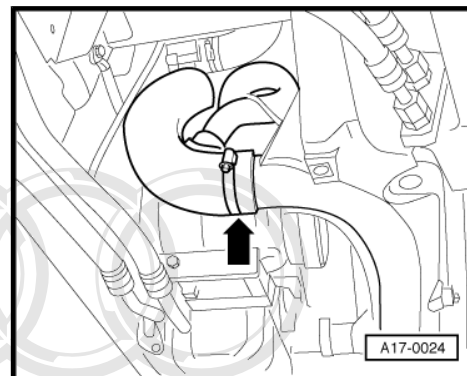
- Detach bracket for ATF line from engine.
- Move ATF lines clear to side.

All vehicles (continued):

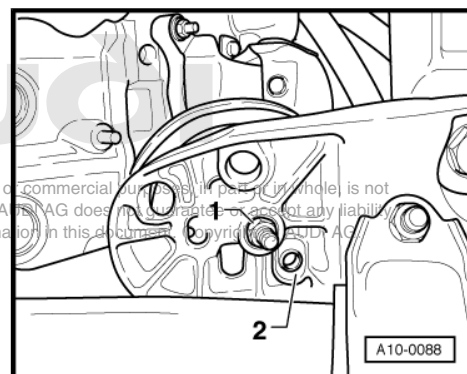
- If fitted, unclip actuator rod for vehicle level sender at bottom transverse link -arrow-.



- Detach air hose from air pipe in lock carrier -arrow-.



- Mark position of nuts -1- and locating sleeves -2- on bottom of engine mountings (right and left).
- Remove nut for engine mounting -1- on both sides.



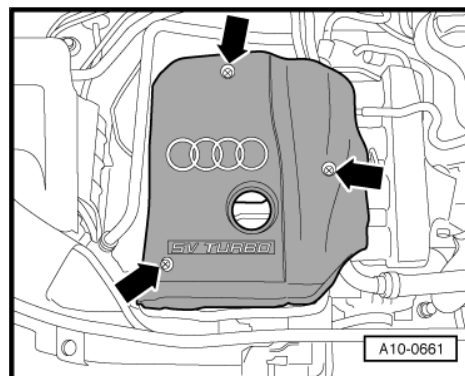
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- Release quick-release fasteners and remove engine cover panel -arrows-.

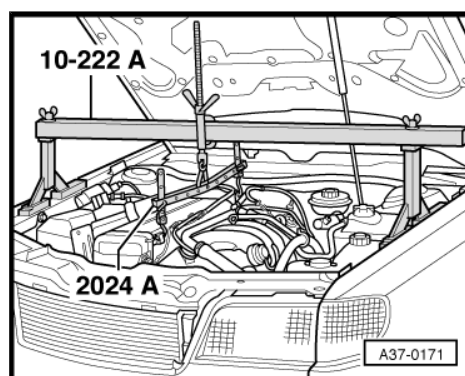


Note

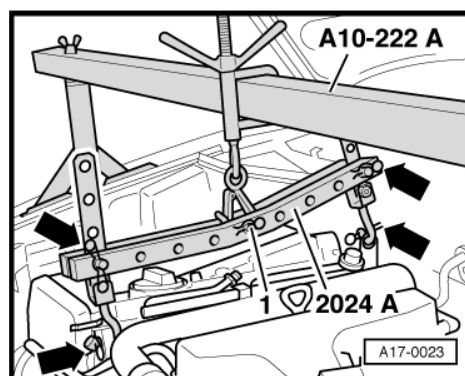
Different mounting holes are provided for the different engine versions.



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



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



WARNING

Accident risk from loose components of lifting tackle.

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

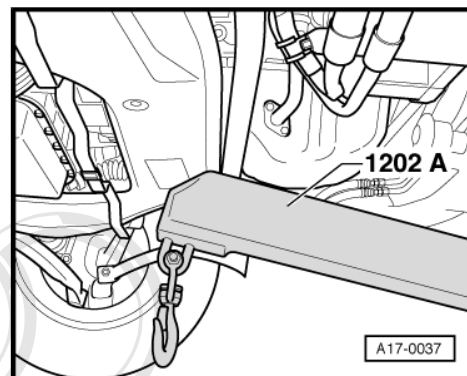
- Raise engine as far as possible with spindle of support bracket.



Note

Do not lift engine to such an extent that pipes or coolant hoses are damaged or strained. Make sure viscous fan does not become trapped. If necessary, remove viscous fan ⇒ [page 168](#) and place it towards front into radiator cowl.

- Support subframe with workshop hoist.



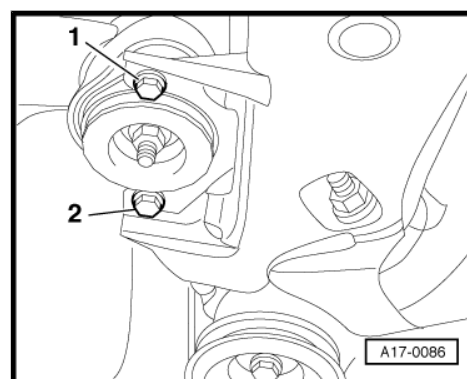
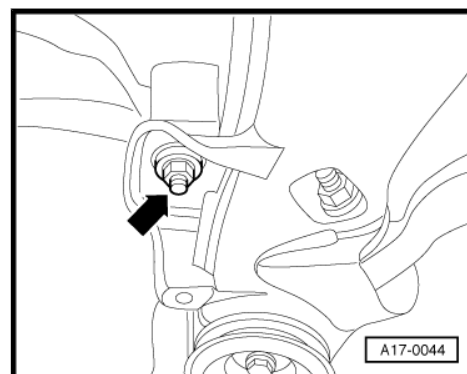
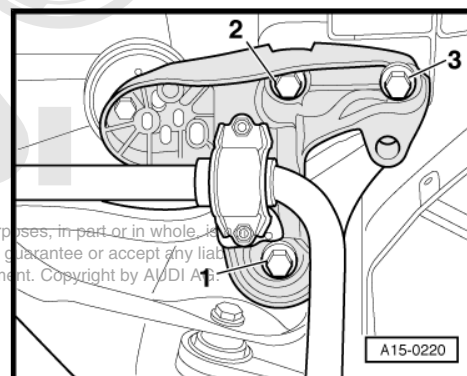
Caution

Risk of misalignment of wheels.

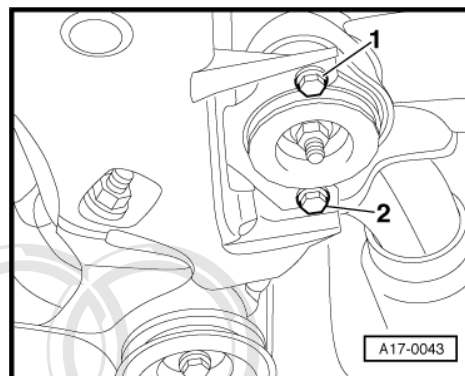
- ◆ **The subframe should only be unfastened and lowered at the front, as otherwise wheel alignment has to be performed.**

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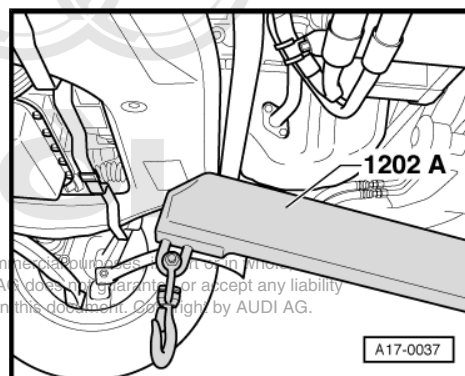
- First remove bolts (front) -2- and -3- for subframe (left and right). Then remove bolts -1-.
- Vehicles with manual gearbox: loosen nut -arrow- for gearbox mounting (left-side) until it is flush with lower end of bolt (turn approx. 4 threads).
- Loosen nut -arrow- for gearbox mounting (left-side) until it is flush with lower end of bolt (turn approx. 4 threads).
- Vehicles with automatic gearbox: slacken rear bolt -2- for gearbox mounting (left-side) several turns; remove front bolt -1- for gearbox mounting (left-side).



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

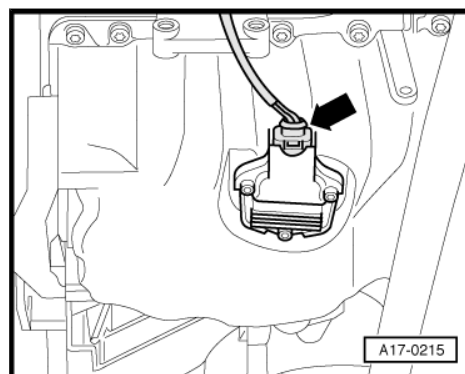


- Lower subframe slowly using workshop hoist.
- Run out workshop hoist; pivot anti-roll bar downwards.
- Disconnect oil return line for turbocharger from sump.

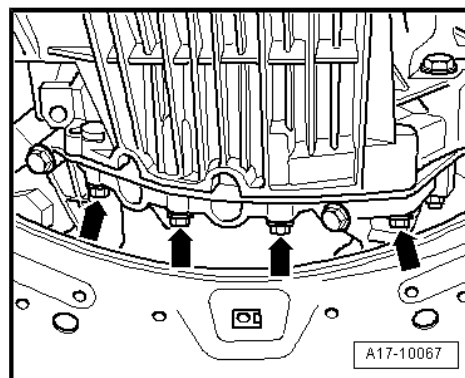


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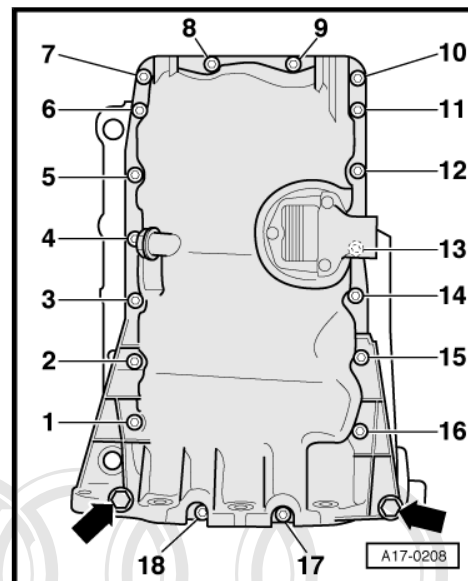
- Unplug electrical connector -arrow- at oil level and oil temperature sender - G266- .



- Remove bolts securing sump to gearbox -arrows-.



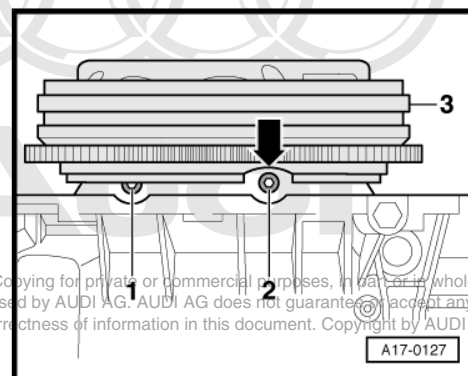
- Remove M10 bolts -arrows-.
- Slacken bolts -1 ... 18- in diagonal sequence and remove.



Note

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

- Engines with moulded gasket: take off sump; if necessary loosen it by striking it lightly with a rubber hammer.
- Engines with liquid gasket: carefully release sump from bonded joint.



1.4 Installing sump - engines with moulded gasket

Procedure

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



Caution

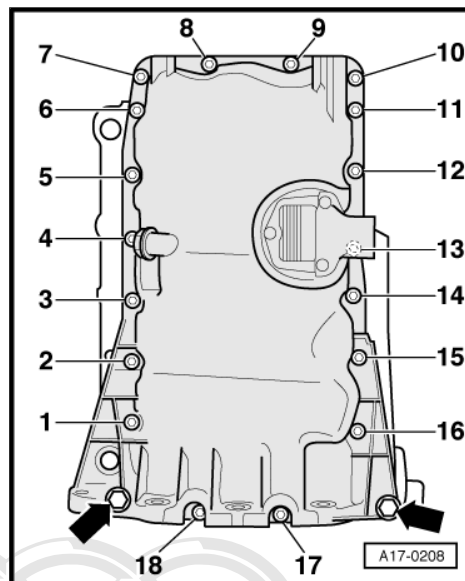
It is essential to use a moulded gasket again if sump was previously fitted with such a gasket.



Note

Renew all seals and gaskets.

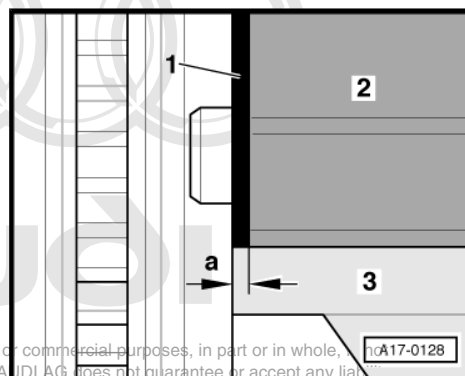
- Fit sump and tighten bolts in the sequence shown.
- 1. Pre-tighten bolts -1 ... 18- to 5 Nm in diagonal sequence.
- 2. Tighten bolts securing sump to gearbox.
- 3. Tighten M10 bolts -arrows-.
- 4. Tighten bolts -1 ... 18- in diagonal sequence.



Note

When installing the sump -3- with the engine removed from the vehicle, make sure that it is positioned flush with the intermediate plate -1- at the flywheel end. In other words, the sump should protrude by 0.8 mm (distance -a-) from cylinder block -2-.

- Install subframe ⇒ Rep. gr. 40 .
- Vehicles with automatic gearbox: secure ATF lines ⇒ Rep. gr. 37 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight, and tighten bolts.
- Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 802 .
- Vehicles with automatic gearbox: check ATF level ⇒ Rep. gr. 37 .



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Tightening torques ⇒ [page 135](#)

1.5 Installing sump - engines with liquid gas-ket

Procedure

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



Note

Renew all seals and gaskets.



Caution

Protect lubrication system against contamination.

◆ Cover exposed parts of the engine.

- Carefully remove sealant residues from cylinder block. For this purpose, remove baffle plate.

**WARNING**

Risk of eye injury.

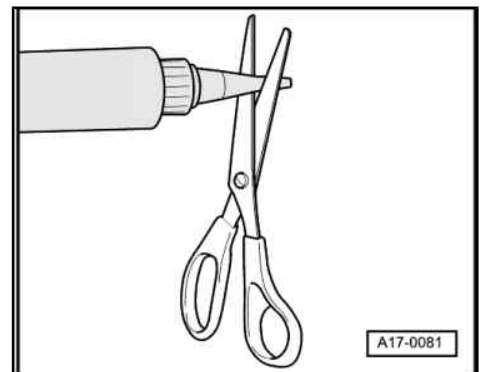
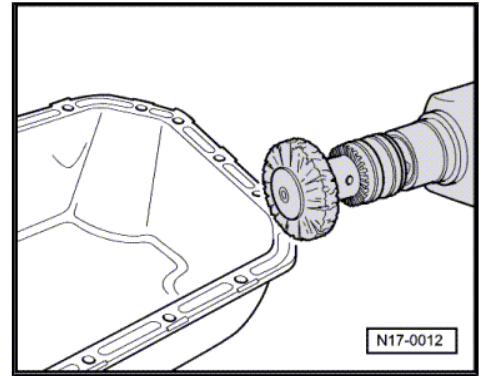
- ◆ *Wear safety goggles.*

- Remove remaining sealant from sump (with rotating plastic brush or similar).
- Clean sealing surfaces; they must be free of oil and grease.

**Note**

Note the use-by date of the sealant.

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

**Caution**

Make sure lubrication system is not clogged by excess sealant.

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

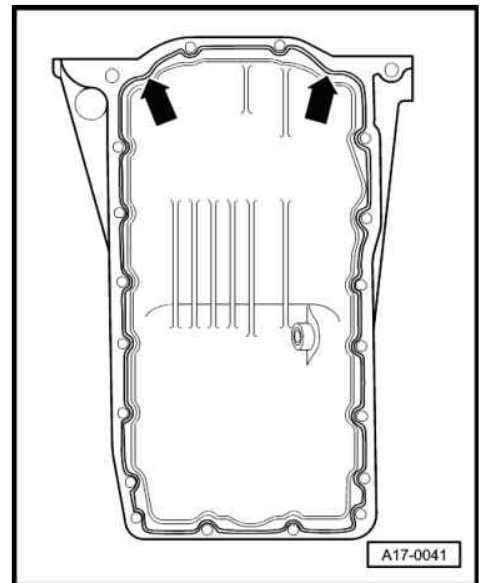
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- Apply sealant onto clean sealing surface of sump as shown in illustration.

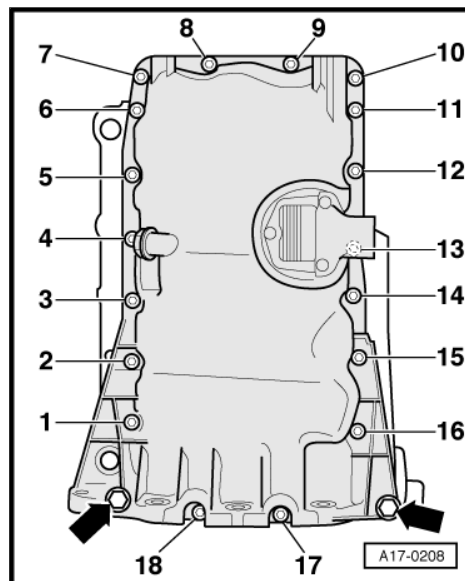
- Thickness of sealant bead: 2 ... 3 mm

**Note**

- ◆ *Take particular care when applying sealant bead in area of rear sealing flange -arrows-.*
- ◆ *The sump must be installed within 5 minutes after applying sealant.*

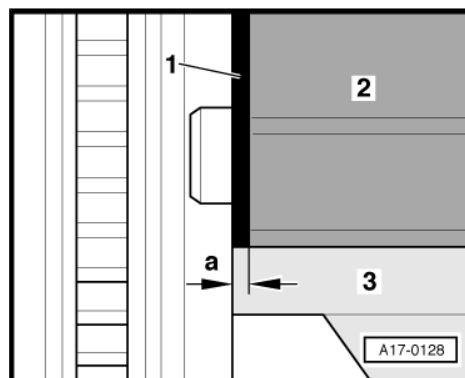


- Fit sump and tighten bolts in the sequence shown.
- 1. Pre-tighten bolts -1 ... 18- to 5 Nm in diagonal sequence.
- 2. Tighten bolts securing sump to gearbox.
- 3. Tighten M10 bolts -arrows-.
- 4. Tighten bolts -1 ... 18- in diagonal sequence.



Note

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



- Install subframe ⇒ Rep. gr. 40 .
- Vehicles with automatic gearbox: secure ATF lines ⇒ Rep. gr. 37 .
- Install subframe ⇒ Rep. gr. 40 .
- Vehicles with automatic gearbox: secure ATF lines ⇒ Rep. gr. 37 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight, and tighten bolts.
- Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 802 .
- Vehicles with automatic gearbox: check ATF level ⇒ Rep. gr. 37 .

Tightening torques ⇒ [page 135](#)

1.6 Removing and installing oil pump

Removing

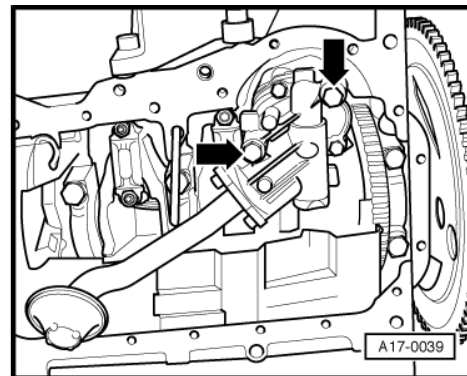
- Remove sump ⇒ [page 138](#) .
- Detach and remove baffle plate.
- Remove bolts -arrows-.
- Press subframe downwards and detach oil pump.

Installing

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

- Install sump
⇒ [“1.4 Installing sump - engines with moulded gasket”,
page 145](#) /
⇒ [“1.5 Installing sump - engines with liquid gasket”,
page 146](#) .

Tightening torques ⇒ [page 135](#)



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2 Oil filter and oil cooler

2.1 Oil filter and oil cooler - exploded view

1 - Oil filter bracket

- ☐ With pressure relief valve, approx. 4 bar

2 - Gasket

- ☐ Renew

3 - Oil retention valve

- ☐ Tighten to 8 Nm

4 - Seal

- ☐ Renew

5 - Threaded connection

- ☐ 25 Nm

6 - Oil supply line

- ☐ To turbocharger
- ☐ Tighten union nut to 25 Nm

7 - Bolt

- ☐ 20 Nm

8 - Coolant pipe (bottom)

- ☐ Removing and installing
⇒ [page 163](#)

9 - Seal

- ☐ If seal is leaking, cut open and renew

10 - Oil pressure switch - F1-

- ☐ Opening/closing pressure 1.4 bar
- ☐ Black insulation
- ☐ Checking ⇒ [page 152](#)
- ☐ 20 Nm

11 - Oil temperature sender - G8-

- ☐ 10 Nm

12 - Seal

- ☐ If seal is leaking, cut open and renew

13 - Gasket

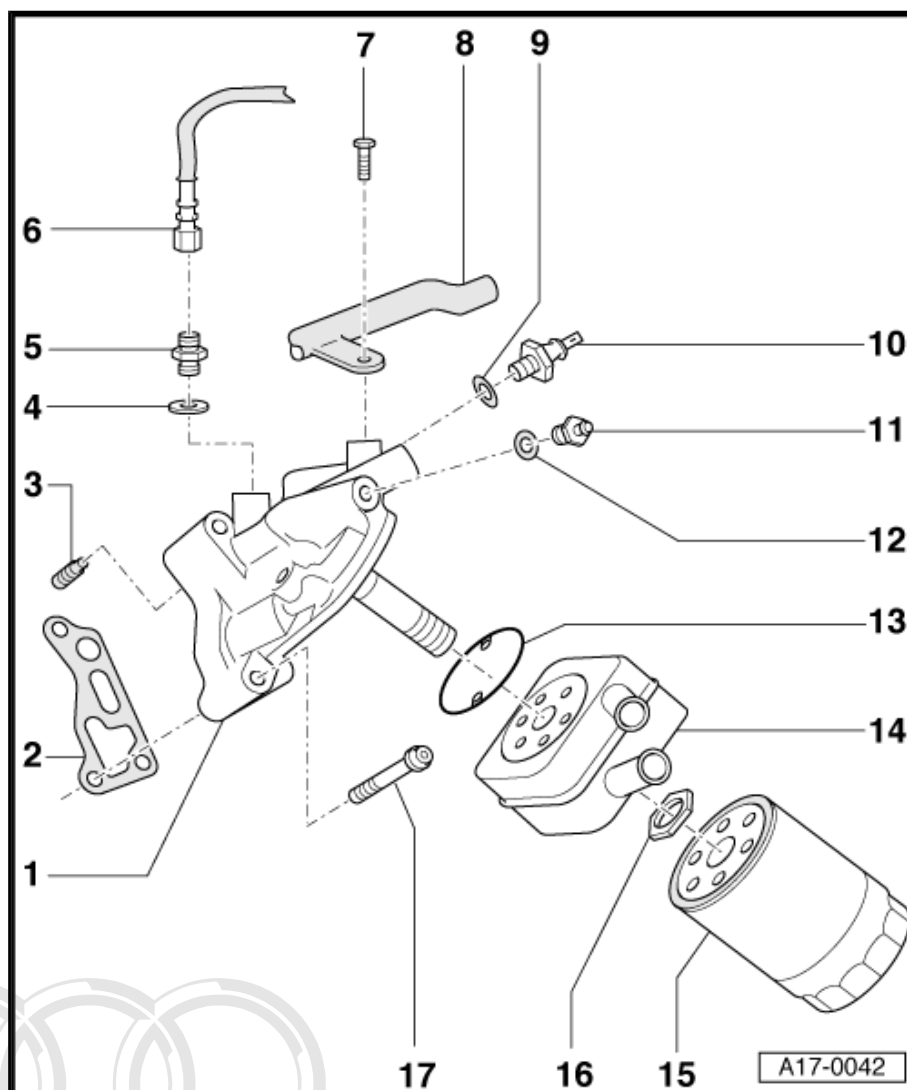
- ☐ Renew
- ☐ Engage in lugs on oil cooler

14 - Oil cooler

- ☐ See note ⇒ [page 135](#)
- ☐ Ensure clearance from surrounding components
- ☐ Diagram of coolant hose connections ⇒ [page 154](#)

15 - Oil filter

- ☐ Removing and installing ⇒ Maintenance ; Booklet 802



16 - Nut

- 25 Nm

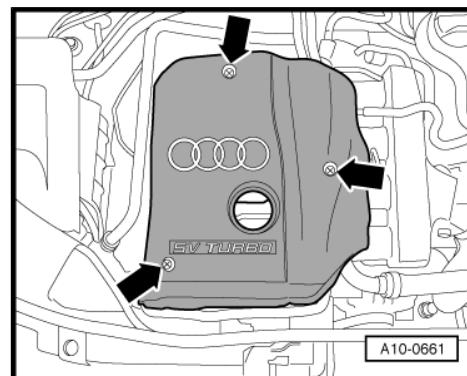
17 - Bolt

- 25 Nm

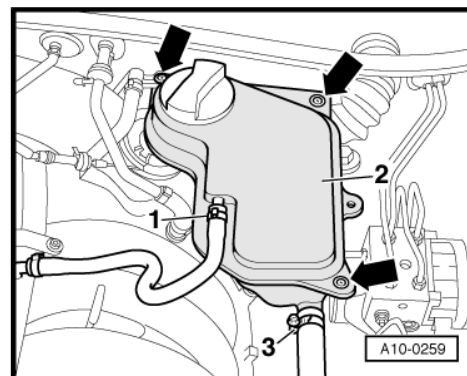
2.2 Removing and installing oil pressure switch - F1-

Removing

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



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



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

Installing

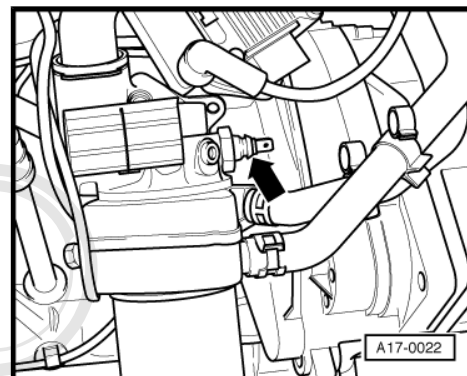
Installation is carried out in the reverse order; note the following:



Note

Renew seal.

Tightening torque ⇒ [page 150](#)



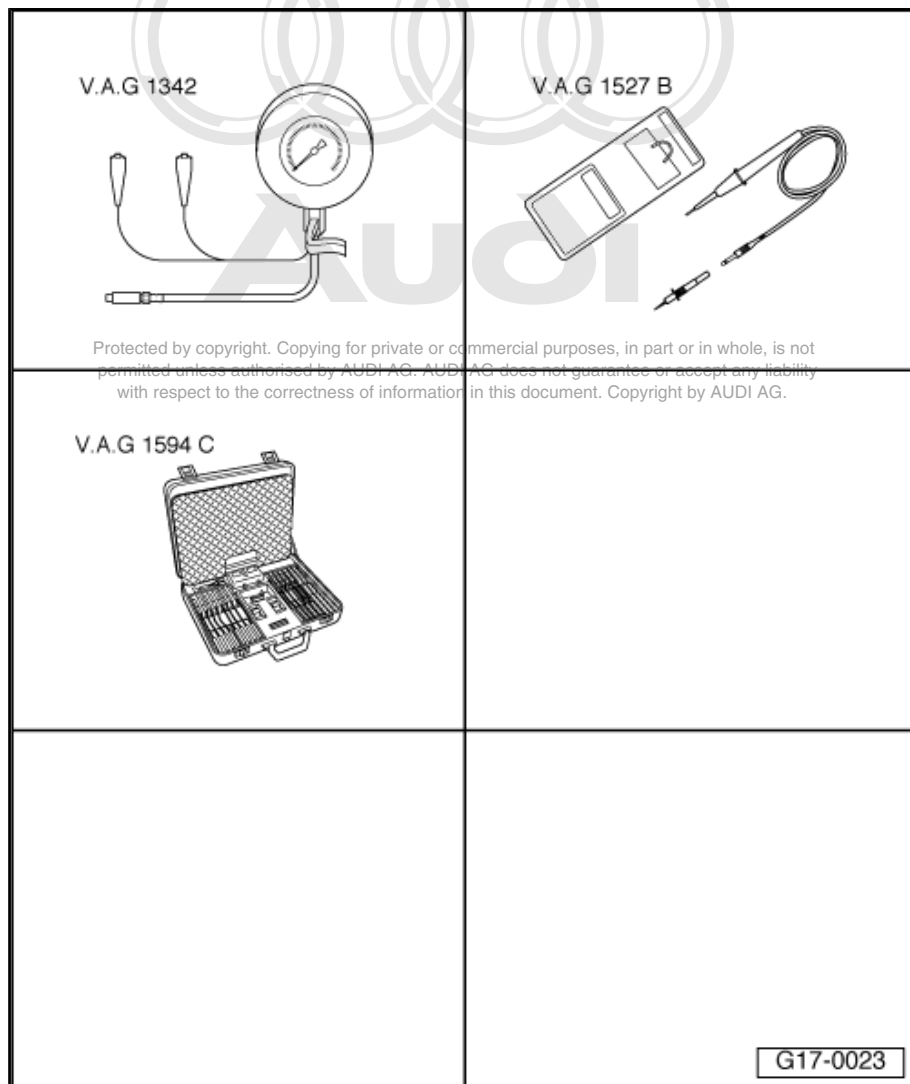
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2.3 Checking oil pressure and oil pressure switch - F1-

Special tools and workshop equipment required

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



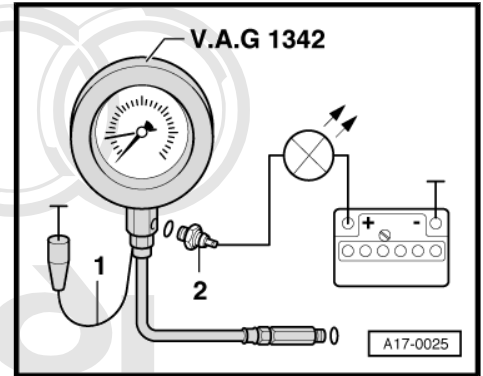
Procedure

- Oil level OK
- On vehicles with auto-check system, the "OK" display must light up (select symbol).
- Engine oil temperature approx. 80 °C.
- Remove oil pressure switch - F1- ⇒ [page 151](#) .

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

Checking oil pressure switch

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



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Note

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

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

Checking oil pressure

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

Assembling

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

- Install oil pressure switch - F1- ⇒ [page 151](#) .

2.4 Engine oil

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

2.5 Checking oil level

Check oil level ⇒ Maintenance ; Booklet 802 .

19 – Cooling

1 Cooling system



WARNING

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

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



Note

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

1.1 Diagram of coolant hose connections



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1 - Heat exchanger

- ☐ If renewed, refill system with fresh coolant

2 - Coolant pipe (bottom)

3 - Coolant expansion tank

- ☐ With filler cap
- ☐ Checking pressure relief valve in filler cap
⇒ [page 172](#)

4 - Oil cooler

- ☐ If renewed, refill system with fresh coolant

5 - Intake manifold

6 - Coolant hose (bottom)

7 - Coolant hose (top)

8 - Radiator

- ☐ Removing and installing
⇒ [page 165](#)
- ☐ If renewed, refill system with fresh coolant

9 - Coolant pipe (top)

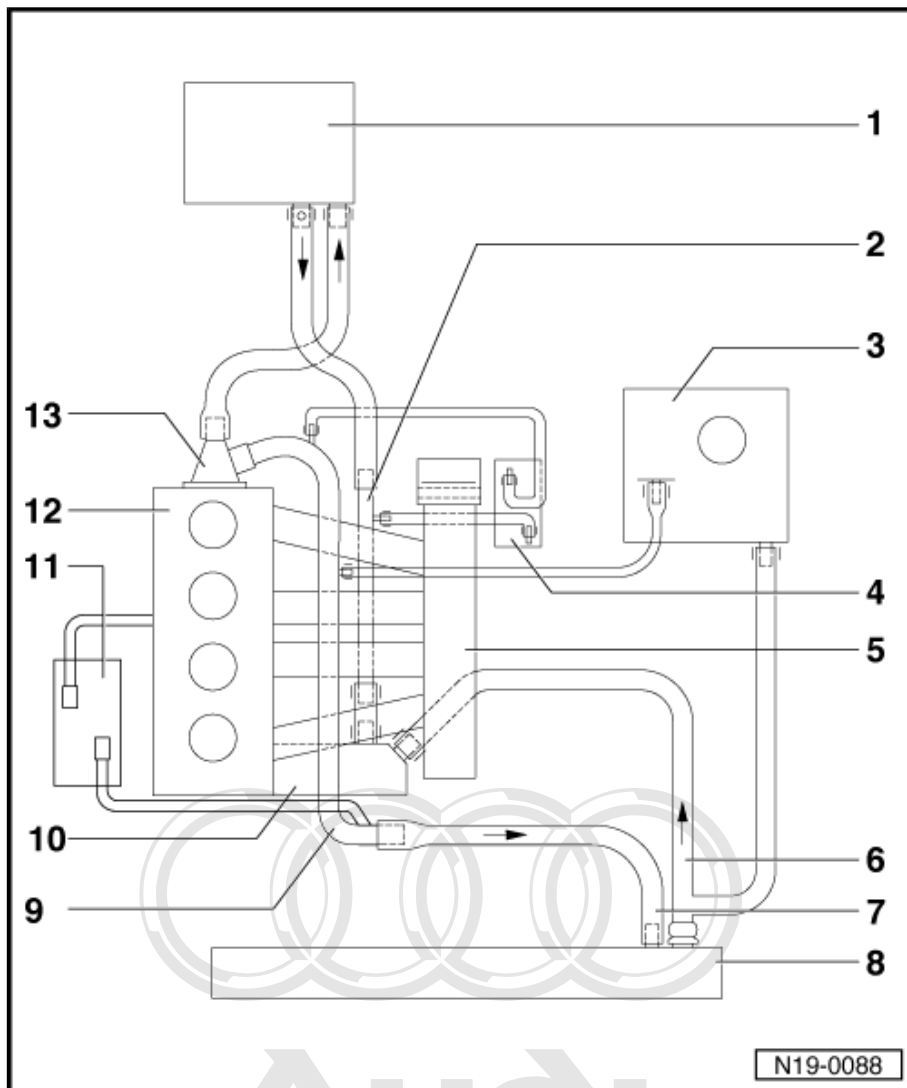
10 - Coolant pump/thermostat

11 - Turbocharger

12 - Cylinder head/cylinder block

- ☐ If renewed, refill system with fresh coolant

13 - Connection



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1.2 Draining and filling cooling system

Special tools and workshop equipment required

- ◆ Adapter for cooling system tester - V.A.G 1274/8- (for vehicles with large filler cap) or -V.A.G 1274/1- (for vehicles with small filler cap)
- ◆ Pipe for cooling system tester - V.A.G 1274/10-
- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Cooling system charge unit - VAS 6096-
- ◆ Drip tray for workshop hoist - VAS 6208-
- ◆ Refractometer - T10007-

V.A.G 1274/8 	V.A.G 1274/10
V.A.G 1921 	VAS 6096
VAS 6208 	T10007

Draining



Note

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

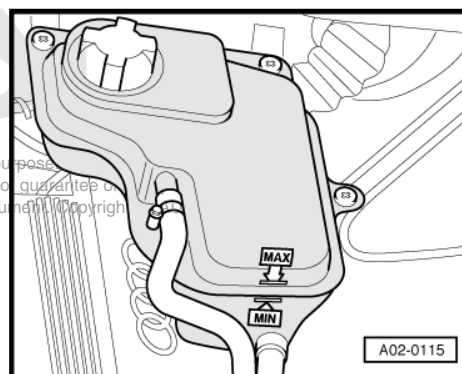


WARNING

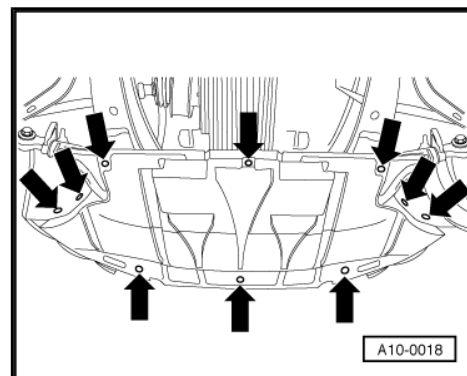
Hot steam/hot coolant can escape - risk of scalding.

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

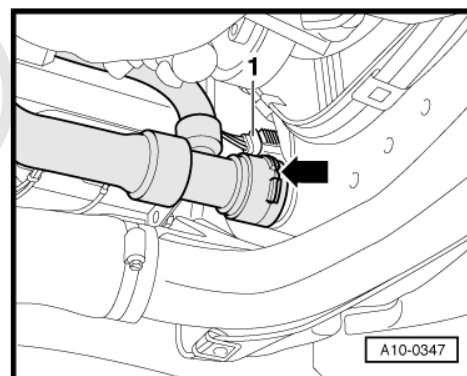
- Open filler cap on coolant expansion tank.



- Release fasteners -arrows- and remove noise insulation.



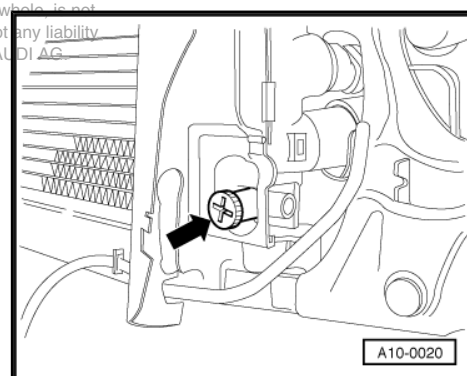
- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Lift retaining clip and disconnect coolant hose (bottom) from radiator -arrow-.



Note

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

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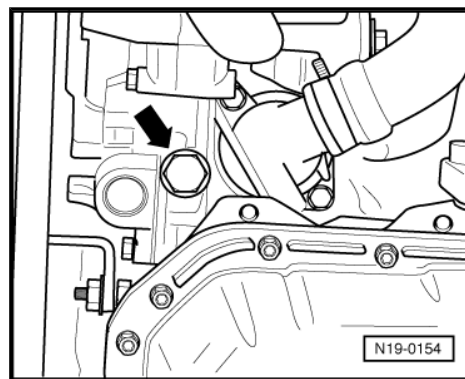
- Remove drain plug -arrow- from coolant pump.

Filling

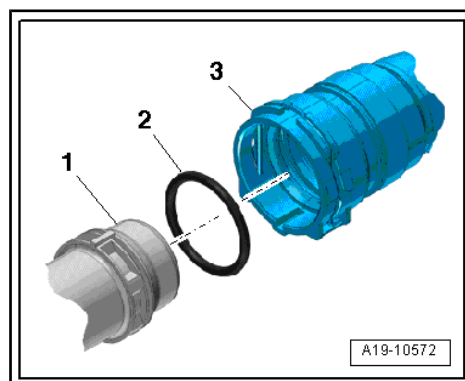


Note

- ◆ The cooling system is filled all year round with a mixture of water and radiator antifreeze/anti-corrosion agent.
- ◆ Use only the radiator antifreeze/anti-corrosion agent approved for this engine ⇒ *Electronic parts catalogue*. Other coolant additives could seriously impair in particular the anti-corrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.
- ◆ Coolant additive prevents frost and corrosion damage and stops scaling. Such additives also raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct coolant additive.
- ◆ Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.
- ◆ Frost protection is required down to about -25°C (in countries with arctic climate: down to about -35°C).
- ◆ The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The antifreeze concentration must be at least 40 %.
- ◆ If greater frost protection is required in very cold climates, the concentration of radiator antifreeze/anti-corrosion agent can be increased, but only up to 60% (this gives frost protection to about -40°C). If the concentration exceeds 60%, frost protection decreases again and cooling efficiency is also impaired.
- ◆ Use only clean tap water for mixing coolant.
- ◆ Do not use drained coolant again if:
- ◆ radiator, heat exchanger for heater, cylinder head and cylinder head gasket or cylinder block have been renewed.
- ◆ the coolant is contaminated or dirty.
- ◆ Contaminated or dirty coolant must not be used again.
- ◆ For checking anti-freeze protection in cooling system, use refractometer - T10007-.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ *Electronic parts catalogue*.



- Connect coolant hose with plug-in connector to radiator (bottom) ⇒ [page 44](#).

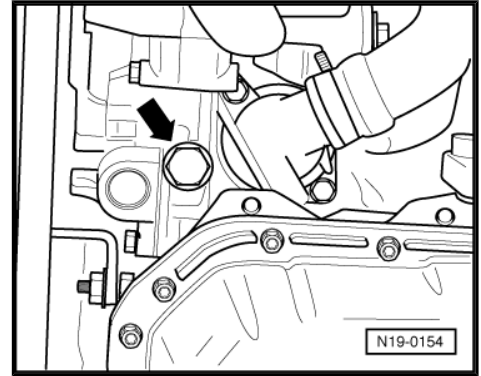


- Tighten drain plug -arrow- on coolant pump with new seal.

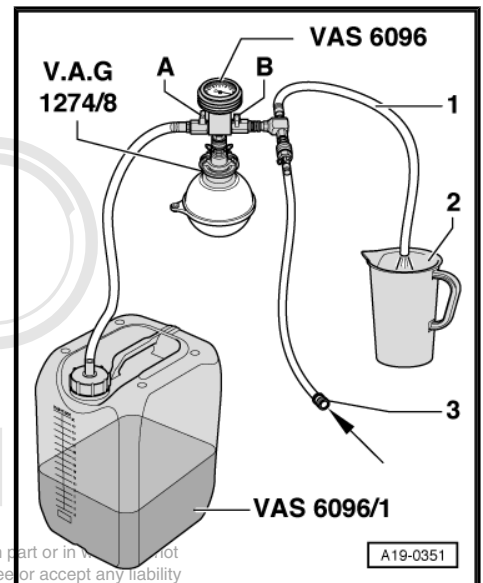


Note

Close coolant drain plug at bottom of radiator if it has been opened.



- Fill reservoir of cooling system charge unit -VAS 6096- with at least 7 litres of premixed coolant (according to recommended ratio):
 - Coolant additive (40 %) and water (60 %) for frost protection to – 25 °C
 - Coolant additive (50 %) and water (50 %) for frost protection to – 35 °C
 - Coolant additive (60 %) and water (40 %) for frost protection to – 40 °C
 - Coolant additive ⇒ Electronic parts catalogue
- Fit adapter for cooling system tester - V.A.G 1274/8- onto coolant expansion tank.
- Attach cooling system charge unit - VAS 6096- to adapter - V.A.G 1274/8- .
- Run vent hose -1- into a small container -2-.



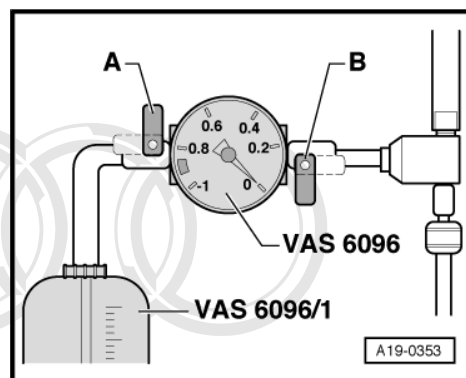
Note

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

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

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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 of -VAS 6096- can fill with coolant.
- Close valve -A- again.
- Leave valve -B- open for another 2 minutes.
- The suction jet pump continues to generate a partial vacuum in the cooling system; the needle on the gauge should remain in the green zone.
- Close valve -B-.
- The needle on the gauge should stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.



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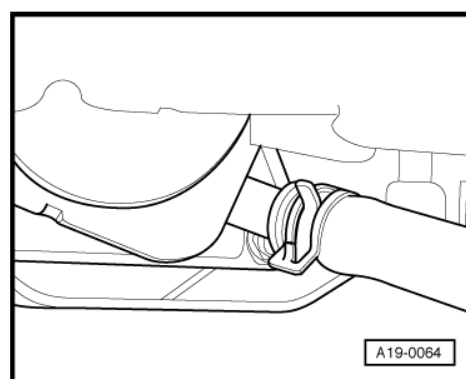


Note

- ◆ *If the needle does not reach the green zone, repeat the process.*
- ◆ *Check cooling system for leaks if the vacuum is not maintained.*
- Detach compressed air hose.
- Open valve -A-.
- The vacuum in the cooling system causes the coolant to be drawn out of the reservoir of -VAS 6096- ; the cooling system is then filled.
- Detach cooling system charge unit - VAS 6096- from adapter on coolant expansion tank.

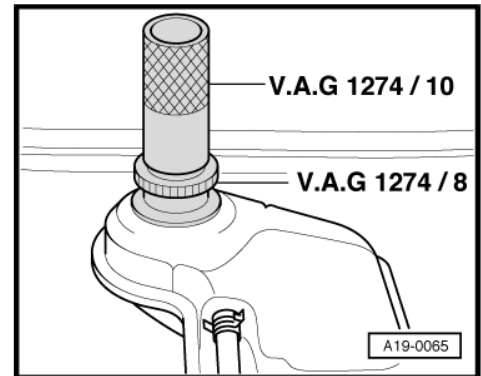
Vehicles with small filler cap:

- Fit pipe for cooling system tester - V.A.G 1274/10- onto adapter -V.A.G 1274/1- .



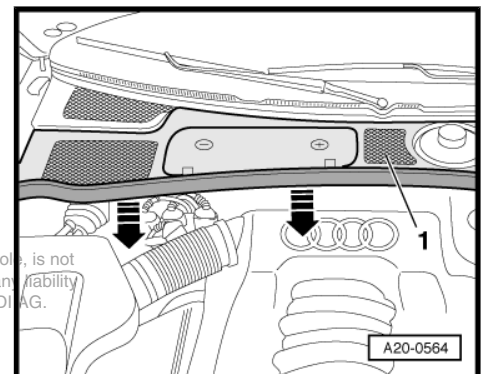
Vehicles with large filler cap:

- Fit pipe for cooling system tester - V.A.G 1274/10- onto adapter -V.A.G 1274/8- .



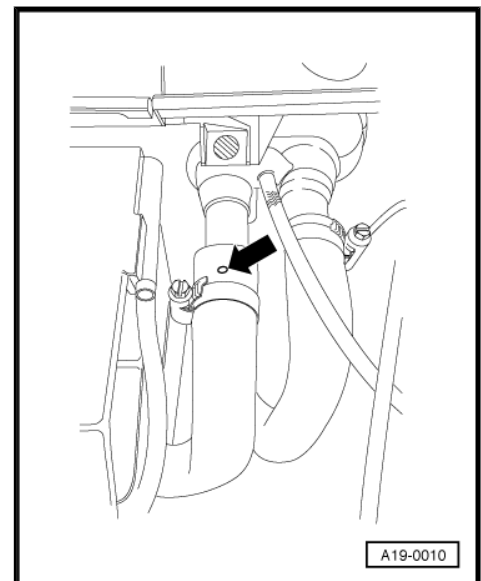
All vehicles (continued):

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



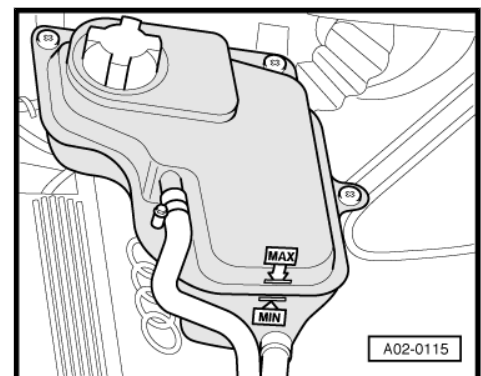
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- Release coolant hose going to heat exchanger and pull back hose until bleeder hole in hose -arrow- is no longer blocked by the connection.
- Fill up with coolant until it flows out at bleeder hole in coolant hose.
- Push coolant hose back onto connection and secure.
- Close filler cap on coolant expansion tank (make sure it engages).
- Start engine.
- Run engine for 3 minutes at 2000 rpm.
- Then allow engine to idle until bottom coolant hose at radiator becomes hot.
- Switch off ignition and allow engine to cool down.



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

Tightening torque ⇒ [page 161](#)



1.3 Coolant pump and thermostat - exploded view

1 - Bolt

- ☐ Tightening torque
⇒ [Item 4 \(page 73\)](#) or
⇒ [Item 4 \(page 78\)](#)

2 - Toothed belt cover (bottom)

- ☐ Version fitted in vehicle may differ from illustration

3 - Nut

- ☐ Tightening torque
⇒ [Item 3 \(page 73\)](#) or
⇒ [Item 3 \(page 78\)](#)

4 - Coolant pump

- ☐ Removing and installing
⇒ [page 163](#)

5 - Gasket

- ☐ Renew

6 - O-ring

- ☐ Renew

7 - T-head bolt

- ☐ Insert before installing

8 - Thermostat

- ☐ Removing and installing
⇒ [page 163](#)
- ☐ Checking ⇒ [page 163](#)

9 - Connection

10 - Drain plug

- ☐ 30 Nm

11 - Seal

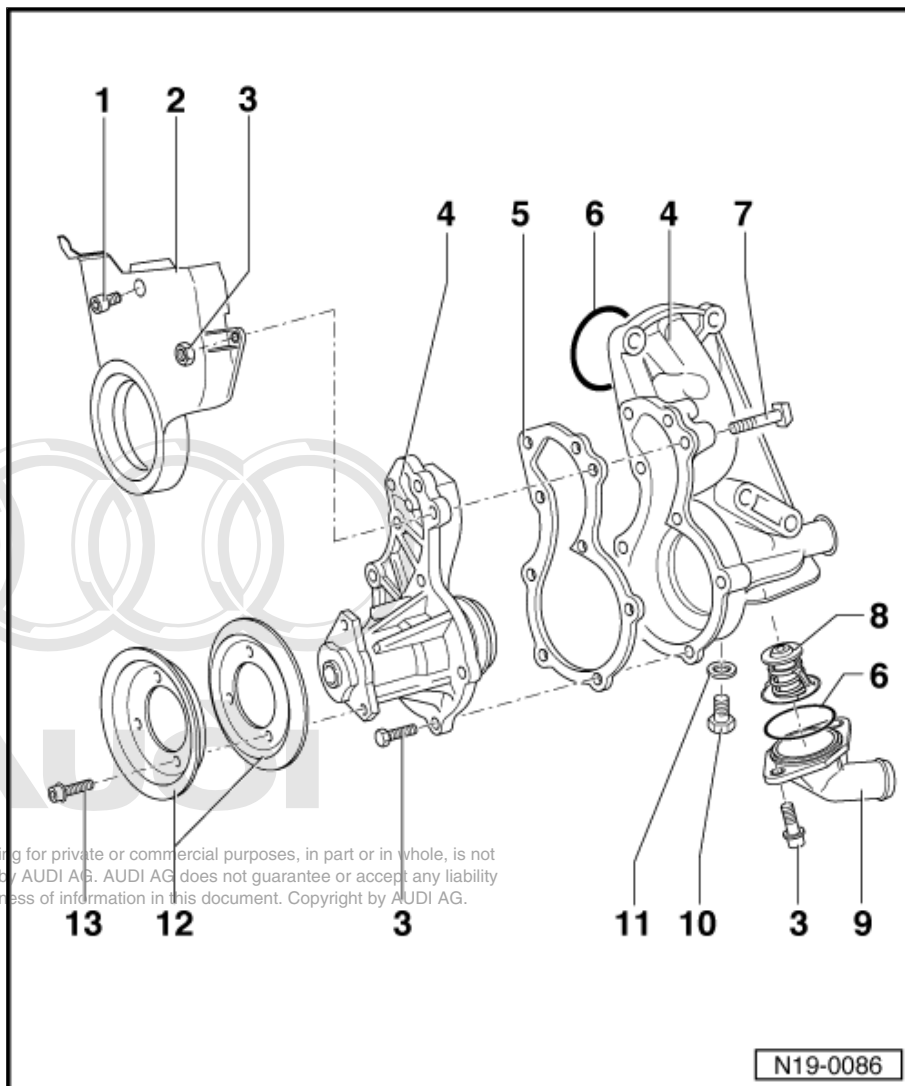
- ☐ Renew

12 - V-belt pulley

- ☐ Installation position: straight half of pulley to coolant pump

13 - Bolt

- ☐ 25 Nm



1.4 Removing and installing coolant pump

Removing

- Remove bracket for ancillaries ⇒ [page 52](#) .
- Remove bearing housing -1- from pump housing -4-.

Installing

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

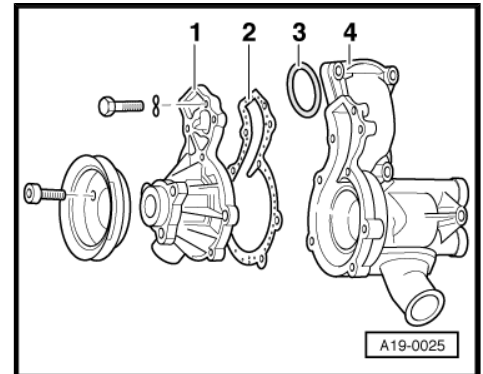


Note

Renew gasket and O-ring.

- Clean sealing surfaces on both sections of housing.
- Install bracket for ancillaries ⇒ [page 52](#) .

Tightening torques ⇒ [page 161](#)



1.5 Removing and installing thermostat

Removing

- Drain coolant ⇒ [page 156](#) .
- Remove bolts -4- and detach connection -3-, O-ring -2- and thermostat -1-.

Installing

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

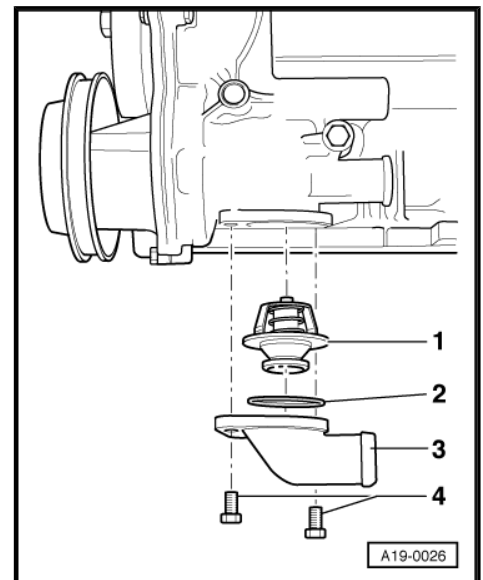


Note

Fit new O-ring.

- Fill up with coolant ⇒ [page 158](#) .

Tightening torque ⇒ [page 161](#)



1.6 Checking thermostat

- Heat removed thermostat in water bath.

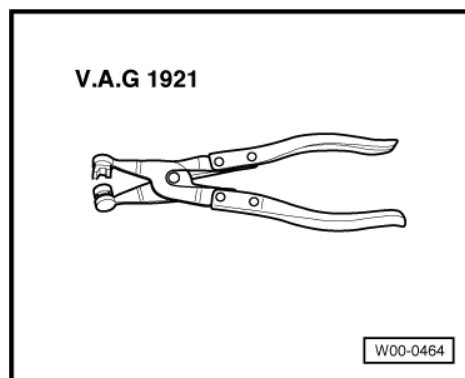
Starts to open	Fully open	Opening travel
approx. 87 °C	approx. 102 °C ¹⁾	at least 8 mm
• ¹⁾ Cannot be tested.		

1.7 Removing and installing coolant pipe (bottom)

Special tools and workshop equipment required

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◆ Hose clip pliers - V.A.G 1921-



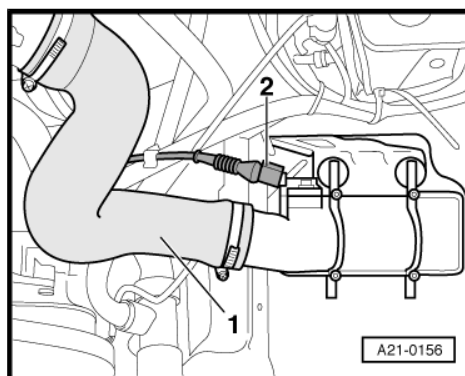
Removing

- Drain coolant ⇒ [page 156](#) .
- Remove air hose -1-.

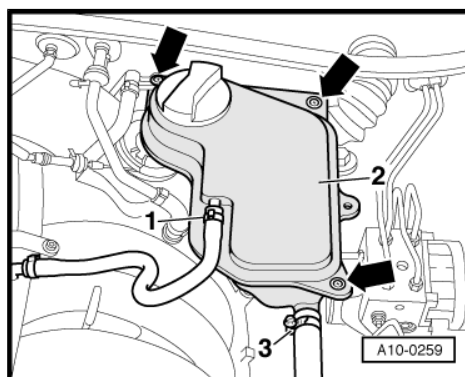


Note

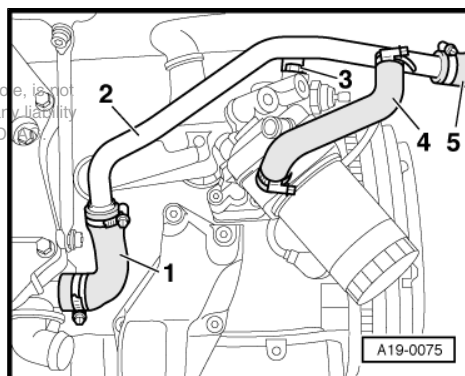
Disregard -item 2-.



- Detach coolant hoses -1- and -3-.
- Remove bolts -arrows-.
- Unplug electrical connector at coolant shortage indicator switch -F66- and detach coolant expansion tank -2-.



- Detach coolant hose -4- from coolant pipe (bottom) -2-.
- Detach coolant hose -5- going to heat exchanger from coolant pipe (bottom).
- Remove coolant pipe (bottom) from oil filter bracket -3-.
- Detach coolant pipe (bottom) from coolant hose -1-.



Installing

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



Note

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

- Install coolant hoses and air hoses with screw-type clips ⇒ [page 43](#) .
- Fill up with coolant ⇒ [page 158](#) .

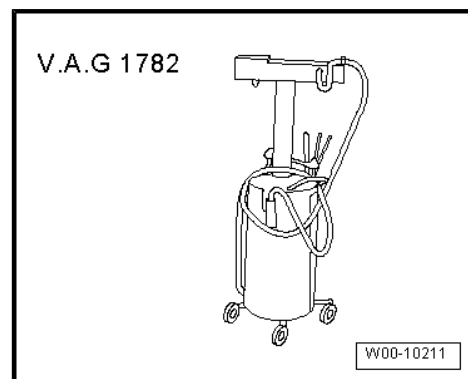
Tightening torque ⇒ [page 150](#)

2 Radiator and viscous fan

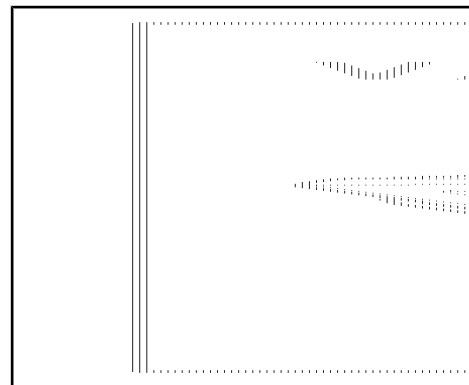
2.1 Removing and installing radiator

Special tools and workshop equipment required

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



- ◆ ~~Drip tray for workshop hoist - VAS 6208-~~



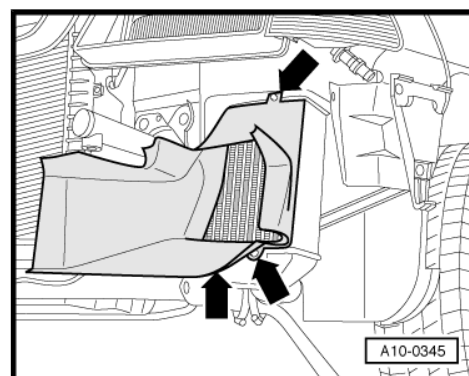
Removing



Note

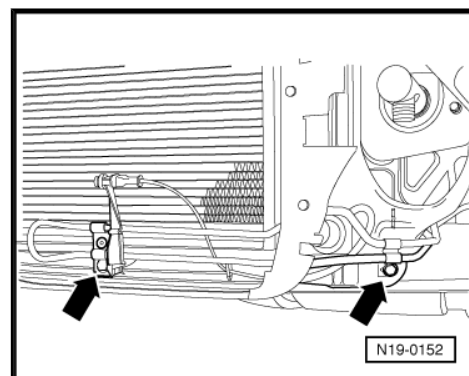
If there are slight impressions on the fins, refer to [⇒ page 7](#).

- Remove front bumper ⇒ Rep. gr. 63 .
- Remove air duct in front of charge air cooler -arrows-.
- Detach cooling pipe for power steering hydraulic fluid -arrows- and move clear; do not open hydraulic fluid circuit.



Note

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

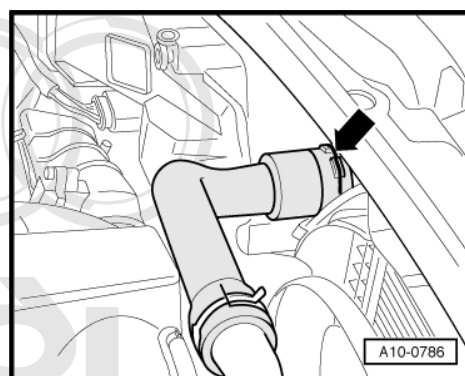
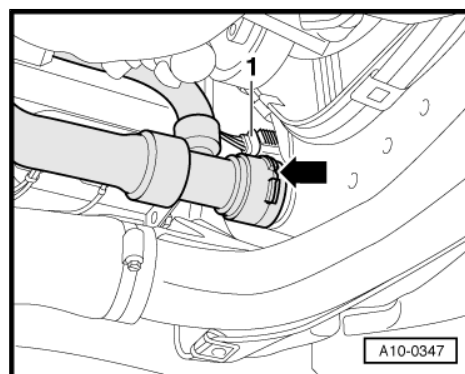
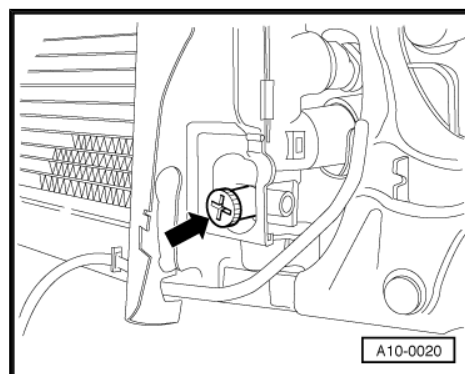
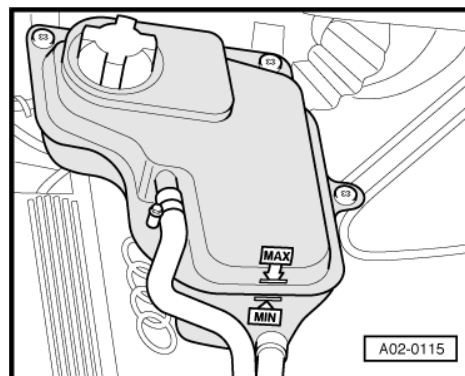



WARNING

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

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

- Open filler cap on coolant expansion tank.
- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Open drain plug -arrow- on radiator, if necessary fit drain hose to connection.
- Lift retaining clip and disconnect coolant hose (bottom) from radiator -arrow-.
- Unplug electrical connector -1- at radiator fan thermal switch - F18/F54- at radiator (bottom left) and move wiring clear.
- Lift retaining clip -arrow- and disconnect coolant hose (top left) from radiator.



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Vehicles with automatic gearbox:

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



Note

Observe rules for cleanliness when working on automatic gear-box ⇒ Rep. gr. 37.

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

Vehicles with air conditioning:



WARNING

Risk of injury caused by refrigerant.

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



Caution

Risk of damage to condenser, refrigerant lines and refrigerant hoses.

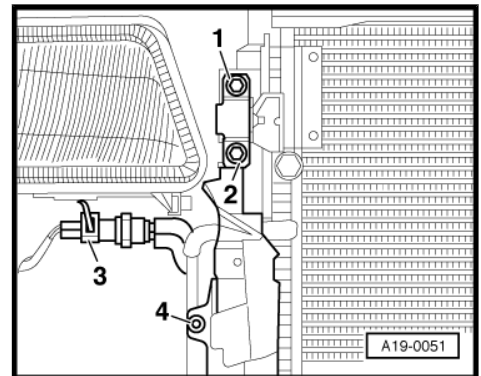
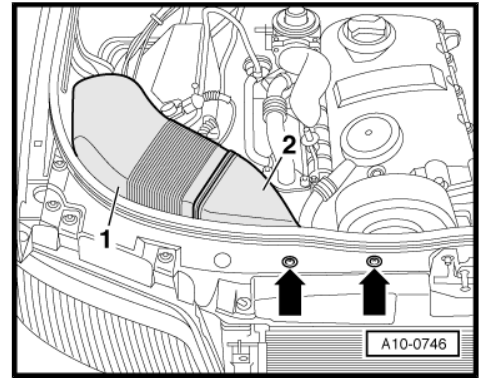
- ◆ **Do NOT stretch, kink or bend refrigerant lines and hoses.**

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



Note

Protect side panel (front) from damage.



All vehicles (continued):

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

Installing

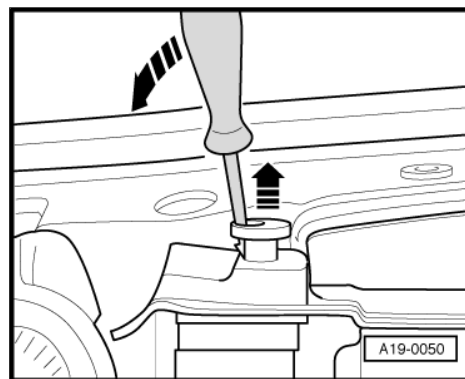
Installation is carried out in the reverse order; note the following:

Vehicles with automatic gearbox:

- Secure ATF lines ⇒ Rep. gr. 37 .

All vehicles (continued):

- Install front bumper ⇒ Rep. gr. 63 .
- Connect coolant hoses with plug-in connector ⇒ [page 44](#) .
- Install coolant hoses with screw-type clips ⇒ [page 43](#) .
- Fill up with coolant ⇒ [page 158](#) .



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

Vehicles with automatic gearbox:

- Check ATF level ⇒ Rep. gr. 37 .

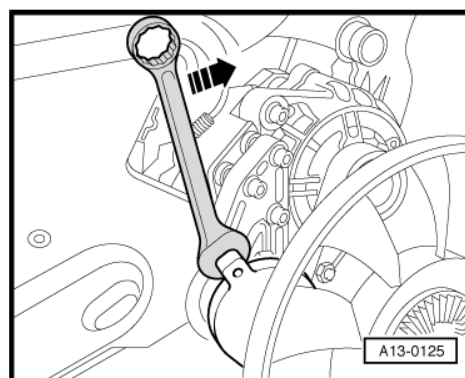
Tightening torques

Component	Nm
Condenser to radiator	10
Cooling pipe for power steering hydraulic fluid to radiator	10

2.2 Removing and installing viscous fan

Removing

- Lock carrier must be in service position ⇒ Rep. gr. 50 .
- To slacken poly V-belt turn tensioner in direction of -arrow-.
- Remove poly V-belt from alternator pulley and release tensioner.



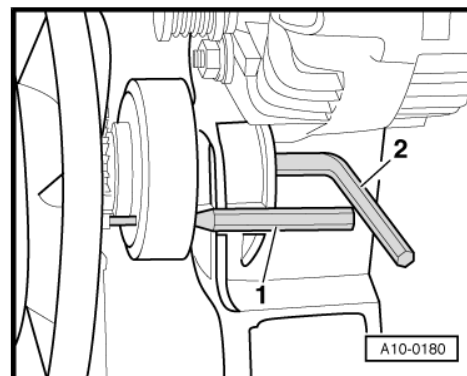
- Lock pulley for viscous fan with roll-pin drift -1- and unscrew using hexagon key -2-.
- Detach viscous fan.

Installing

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

- Install poly V-belt ⇒ [page 49](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .

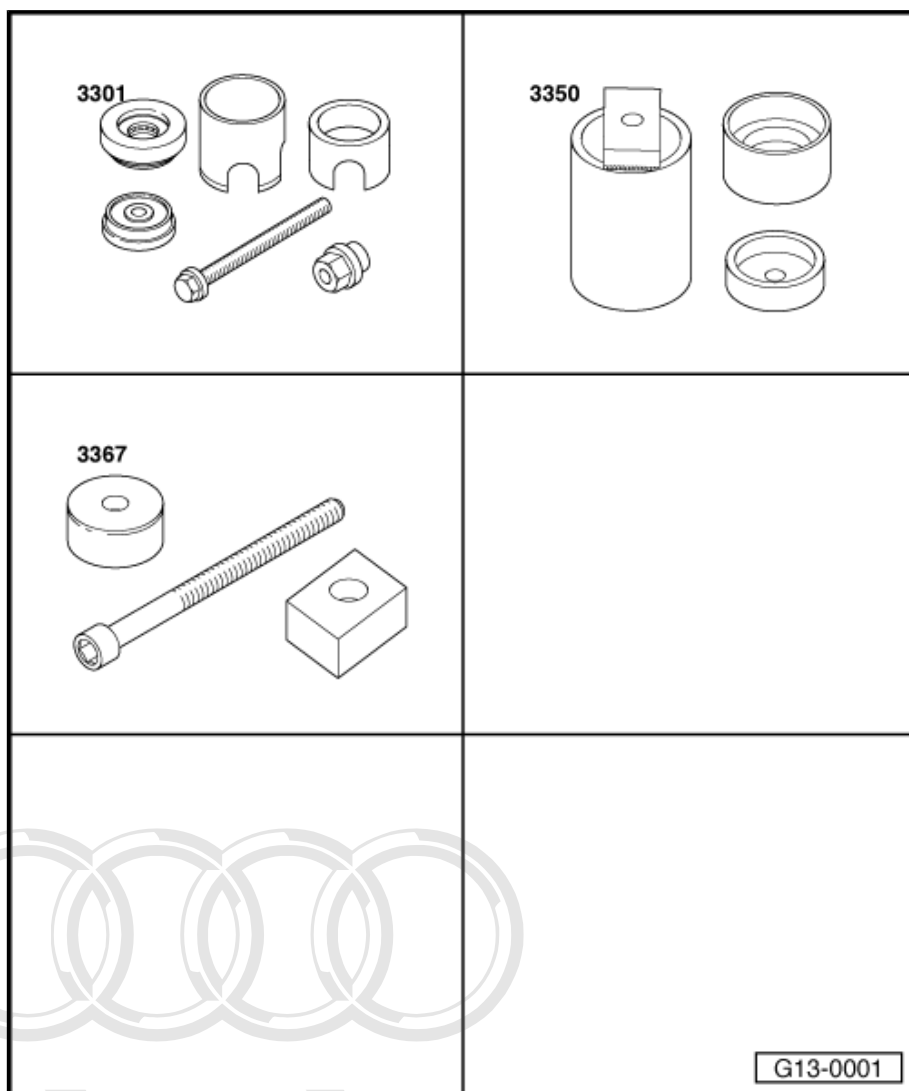
Tightening torque ⇒ [page 45](#)



2.3 Removing and installing viscous fan bearing

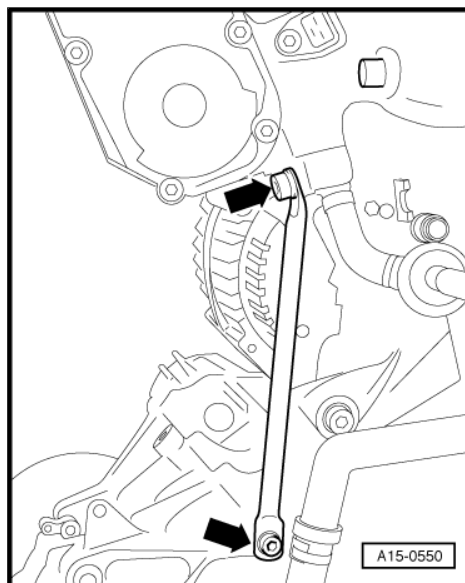
Special tools and workshop equipment required

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

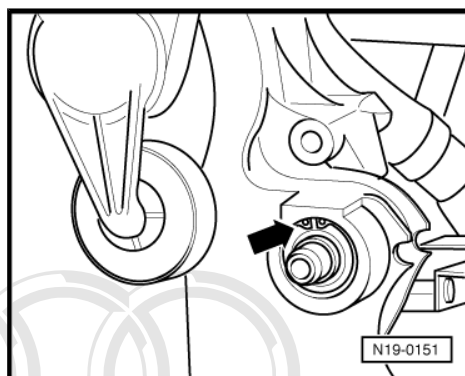


Removing

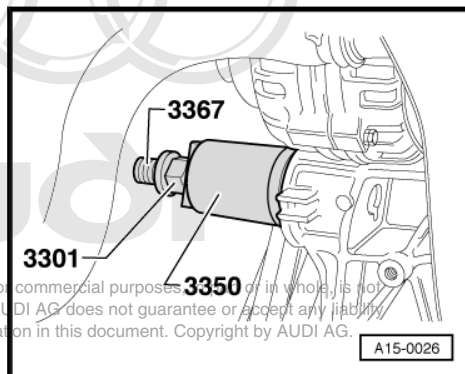
- Lock carrier must be in service position ⇒ Rep. gr. 50 .
- Remove viscous fan ⇒ [page 168](#) .
- Remove support for intake manifold -arrows-.



- Remove circlip -arrow- from bearing bush.



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



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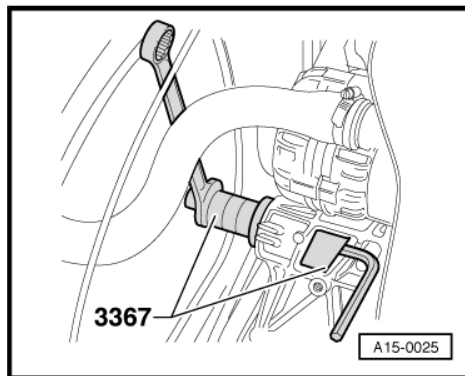
Installing

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

- Press in viscous fan bearing, using viscous fan fitting tool - 3367- and nut from -3301- .
- Fit circlip into bracket for ancillaries.
- Install viscous fan ⇒ [page 168](#) .

Tightening torques

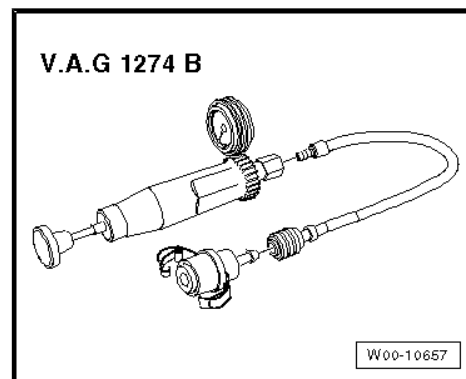
Component		Nm
Support for intake manifold to:	Bracket for ancillaries	20
	Intake manifold	20



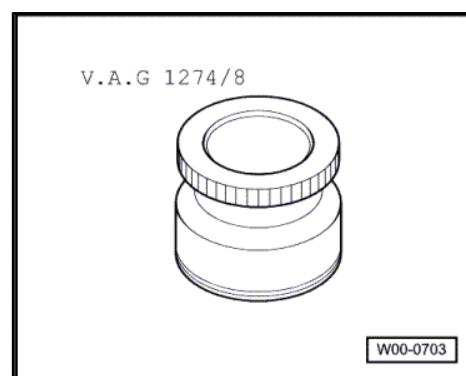
2.4 Checking cooling system for leaks

Special tools and workshop equipment required

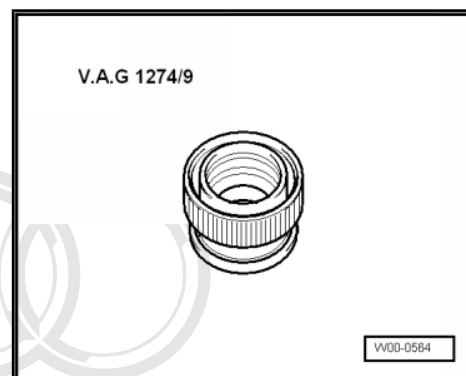
- ◆ Cooling system tester - V.A.G 1274 B-



- ◆ Adapter for cooling system tester - V.A.G 1274/8- (for vehicles with large filler cap) or -V.A.G 1274/1- (for vehicles with small filler cap)



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



Procedure

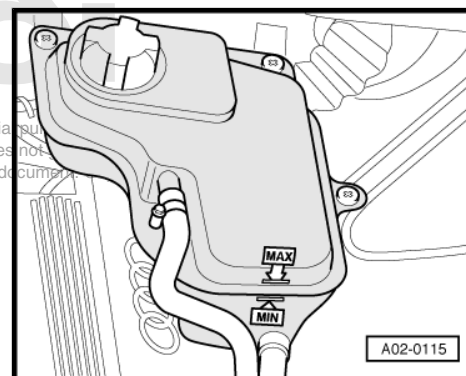
- Engine must be warm.



WARNING

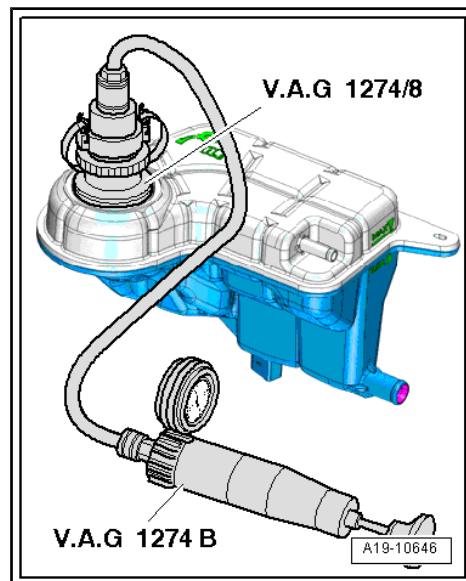
Hot steam/hot coolant can escape - risk of scalding.

- ◆ The cooling system is under pressure when the engine is hot.
- ◆ Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.



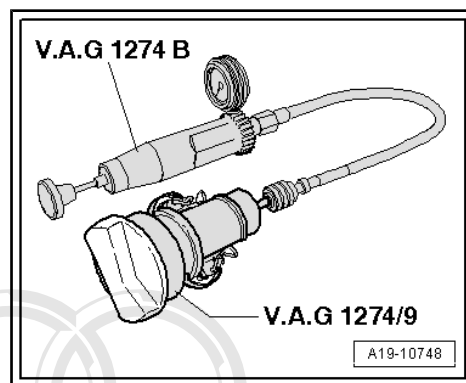
- Open filler cap on coolant expansion tank.

- Fit cooling system tester - V.A.G 1274 B- with adapter -V.A.G 1274/8- (for vehicles with large filler cap) or -V.A.G 1274/1- (for vehicles with small filler cap) onto coolant expansion tank.
- Using hand pump on cooling system tester, build up a pressure of approx. 1.0 bar.
- If this pressure is not maintained, locate and rectify leaks.



Checking pressure relief valve in filler cap

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



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21 – Turbocharging/supercharging

1 Charge air system with turbocharger

Note

Check that all air pipes and hoses and vacuum lines are correctly fitted and that there are no leaks before carrying out tests or repairs.

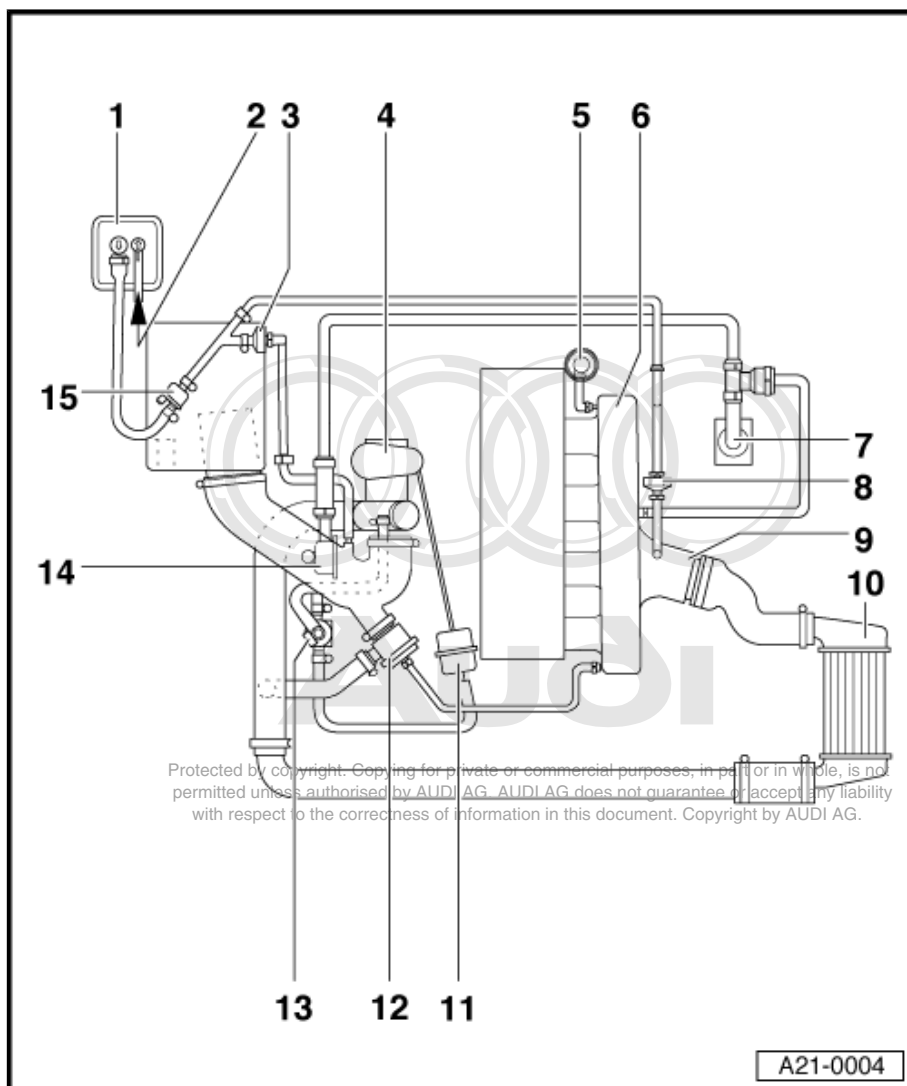
1.1 Diagram of connections for charge pressure control system and vacuum system

Engine codes AEB, AJL

Note

Illustration shows diagram of connections for vehicles with manual gearbox.

- 1 - Activated charcoal filter
- 2 - Breather line
 - ☐ From fuel tank
- 3 - Non-return valve
 - ☐ For activated charcoal filter
- 4 - Turbocharger
- 5 - Fuel pressure regulator
- 6 - Intake manifold
- 7 - Crankcase breather
- 8 - Non-return valve
 - ☐ For activated charcoal filter
- 9 - Throttle valve module - J338-
- 10 - Charge air cooler
- 11 - Vacuum unit for charge pressure regulating valve
- 12 - Mechanical air recirculation valve
 - ☐ Checking ⇒ [page 183](#)
- 13 - Charge pressure control solenoid valve - N75-
 - ☐ Checking ⇒ [page 188](#)
- 14 - Pressure control valve for crankcase breather system
- 15 - Activated charcoal filter solenoid valve 1 - N80-



Engine codes ANB, APU, ARK, ATW

1 - Activated charcoal filter

2 - Activated charcoal filter solenoid valve 1 - N80-

3 - Non-return valve

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

4 - Air cleaner

- ☐ With air mass meter - G70-

5 - Turbocharger

- ☐ Checking ⇒ [page 176](#)

6 - Combination valve for secondary air system

- ☐ Only for engines with secondary air system

7 - Fuel pressure regulator

8 - To brake servo

9 - Non-return valve

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

10 - Suction-jet pump

11 - Non-return valve

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

12 - Vacuum reservoir

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

13 - Secondary air inlet valve - N112-

- ☐ Engine codes ANB and ATW only
- ☐ Fitting location: below intake manifold

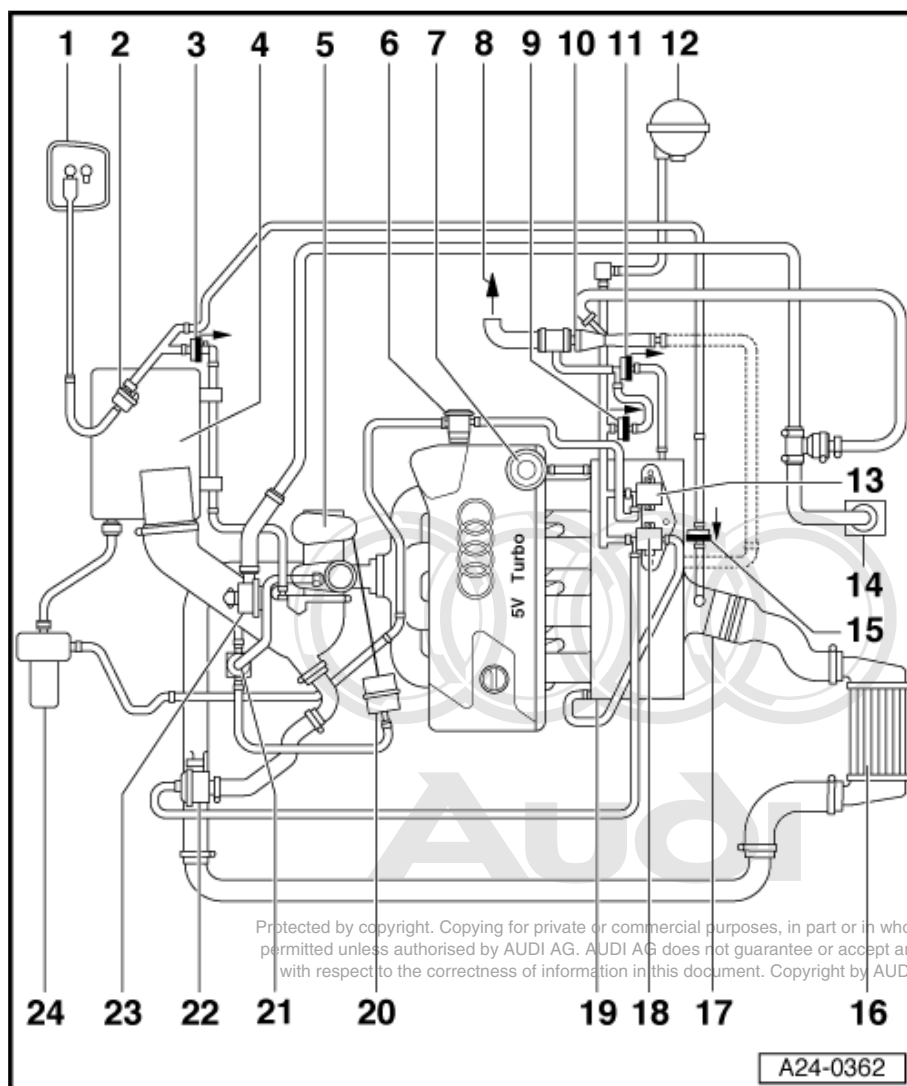
14 - Crankcase breather

15 - Non-return valve

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

16 - Charge air cooler

- ☐ With charge pressure sender - G31-
- ☐ Checking charge pressure sender - G31- ⇒ [page 193](#)



17 - Throttle valve module - J338-

18 - Turbocharger air recirculation valve - N249-

- ☐ Fitting location: below intake manifold
- ☐ Checking ⇒ [page 184](#)

19 - Intake manifold

- ☐ With intake air temperature sender - G42-

20 - Vacuum unit for charge pressure regulating valve

21 - Charge pressure control solenoid valve - N75-

- ☐ Checking ⇒ [page 188](#)

22 - Mechanical air recirculation valve

- ☐ Checking ⇒ [page 183](#)

23 - Pressure control valve for crankcase breather system

24 - Secondary air pump motor - V101-

1.2 Effects of leaks in charge air system

A - Leaks downstream of air mass meter

Possible causes of trouble:

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

Effect:

- Loss of power

B - Leaks downstream of turbocharger (intake side)

Possible causes of trouble:

- 1 - Air intake hoses and pipes between turbocharger and charge air cooler
- 2 - Air intake hoses and pipes between charge air cooler and intake manifold
- 3 - Charge air cooler
- 4 - Seal underneath charge pressure sender - G31-
- 5 - Seal between throttle valve module and intake manifold
- 6 - Gasket between intake manifold and cylinder head

Effect:

- Inadequate charge pressure

C - Leaks downstream of turbocharger (exhaust side)

Possible causes of trouble:

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

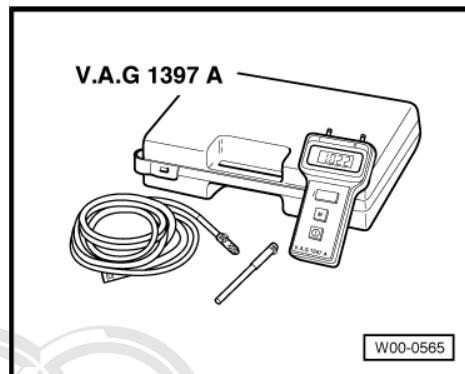
Effect:

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

1.3 Checking turbocharger and charge pressure regulating valve - engine codes AEB, AJL

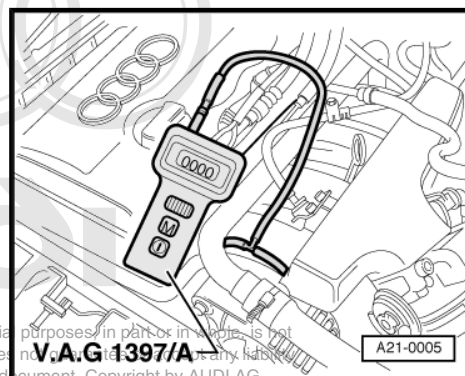
Special tools and workshop equipment required

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



Procedure

- All hoses and pipes securely fitted and free of leaks.
- Fault memory interrogated, final control diagnosis performed
⇒ Vehicle diagnostic tester.
- Connect T-piece with hose of turbocharger tester - V.A.G 1397A- to intake manifold (front).
- Route test hose under rear edge of bonnet and through right window into passenger compartment.

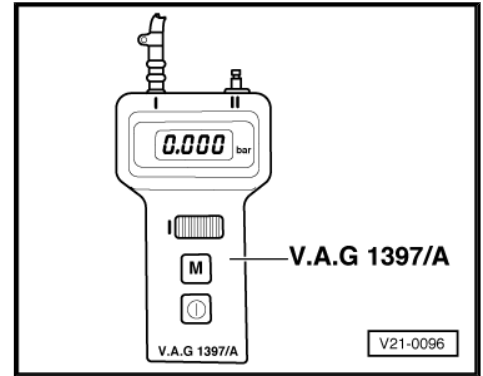


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- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Fit test hose to connection -I-.

 Note

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



WARNING

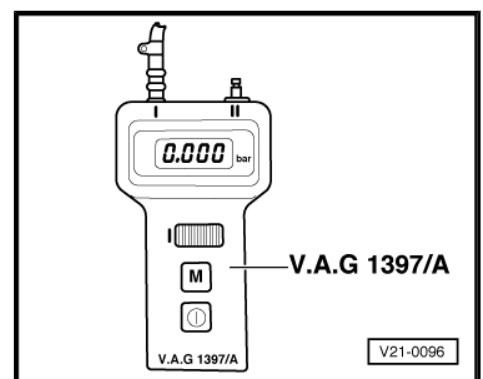
Accidents can be caused if the driver is distracted by test equipment while road-testing, or if test equipment is not properly secured.

- ◆ *Observe safety precautions ⇒ [page 4](#).*

- Charge pressure is measured under full load while driving or on a roller dynamometer.
- Test duration per measurement: max. 10 seconds
- Engine running.

Vehicles with engine code AEB:

- Accelerate vehicle in 3rd gear (or position 2) from 2000 rpm at full throttle while a second mechanic observes the rev counter.
- Second mechanic should press memory button -M- on - V.A.G 1397A- at approx. 3000 rpm.
- Specification: 1.370 ... 1.470 bar.





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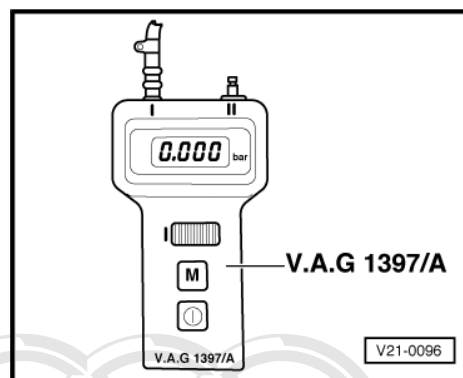
Vehicles with engine code AJL:

- Accelerate vehicle in 3rd gear (or position 2) from 2000 rpm at full throttle while a second mechanic observes the rev counter.
- Second mechanic should press memory button -M- on - V.A.G 1397A- at approx. 2500 rpm.

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

- Specification: 1.800 ... 1.900 bar.

All vehicles (continued):



If specification is not obtained:

Fault	Possible causes
Charge pressure below specification	◆ Hose connections to charge pressure control solenoid valve - N75- defective. Connection diagram ⇒ page 173 ◆ Charge pressure control solenoid valve - N75- defective. Checking ⇒ page 188 ◆ Charge pressure regulating valve in turbocharger stuck in open position. Renew turbocharger ⇒ page 200 ◆ Leaks between turbocharger and intake manifold (air intake hoses and vacuum hoses). Effects ⇒ page 175 ◆ Mechanical air recirculation valve defective. Checking ⇒ page 183 ◆ Turbocharger defective. Renewing ⇒ page 200
Charge pressure above specification ¹⁾	◆ Air leaks in hoses or connections to pressure unit for charge pressure control (via -N75-). Connection diagram ⇒ page 173 ◆ Vacuum unit for charge pressure regulating valve defective. Renew turbocharger ⇒ page 200 ◆ Charge pressure regulating valve in turbocharger sticking in closed position. Renew turbocharger ⇒ page 200
• ¹⁾ If the charge pressure is too high the fuel supply will be shut off in order to protect the engine. Misfiring will then occur at high engine speeds.	

Checking load signal in order to test charge pressure control function



Note

On vehicles with automatic gearbox the charge pressure test is not always a reliable indication of the proper function of the charge pressure control system. Therefore, if the pressure value is close to the lower tolerance limit, check the load signal in order to test the charge pressure control function.



WARNING

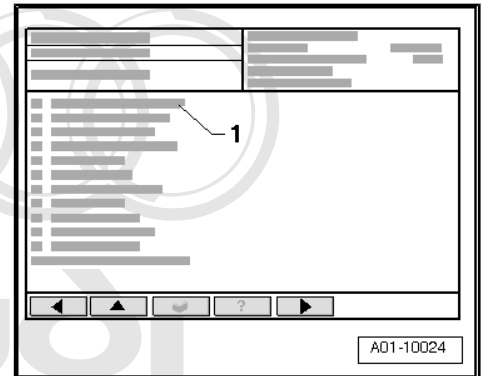
Accidents can be caused if the driver is distracted by test equipment while road-testing, or if test equipment is not properly secured.

- ◆ **Observe safety precautions ⇒ [page 4](#) .**

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

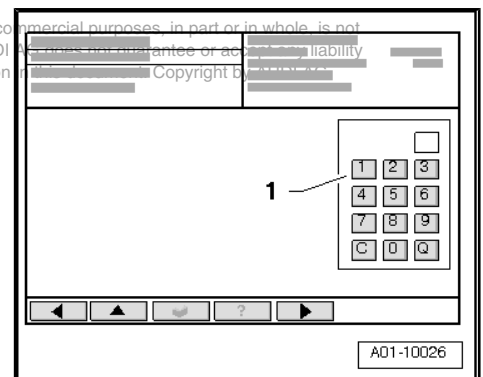
Display on -VAS 5051B- :

- From menu -1-, select diagnostic function "Measured values" and press  key to continue.



Display on -VAS 5051B- :

- Press keys   on keypad -1- to select "Display group 025" and confirm entry by pressing  key.



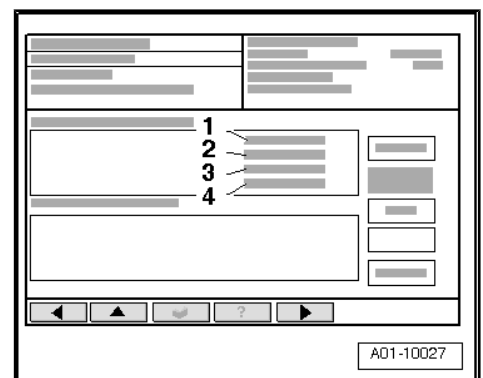
Display on -VAS 5051B- :

- Accelerate vehicle at a constant rate and check display in display zones -2- and -3-.
- Specification: maximum difference between indicated values: 0.3 ms.



Note

If the self-diagnosis function of the engine control unit detects a fault in the charge pressure control system, the duty cycle in display zone -4- is set to 5% (constant).

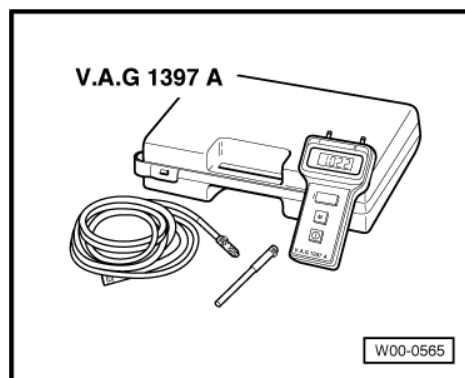


If the specification is not attained ⇒ [page 178](#) .

1.4 Checking turbocharger and charge pressure regulating valve - engine codes ANB, APU, ARK, ATW

Special tools and workshop equipment required

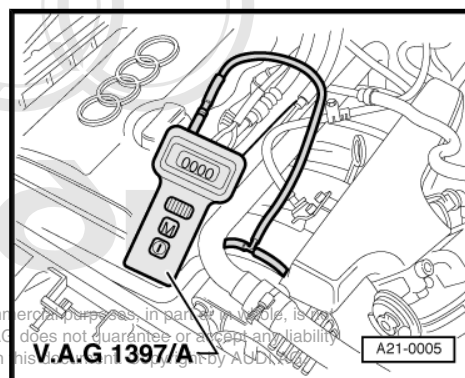
◆ Turbocharger tester - V.A.G 1397A-



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

Procedure

- All hoses and pipes securely fitted and free of leaks.
- Fault memory interrogated, final control diagnosis performed
⇒ Vehicle diagnostic tester.
- Connect T-piece with hose of turbocharger tester - V.A.G 1397A- to intake manifold (front).
- Route test hose under rear edge of bonnet and through right window into passenger compartment.

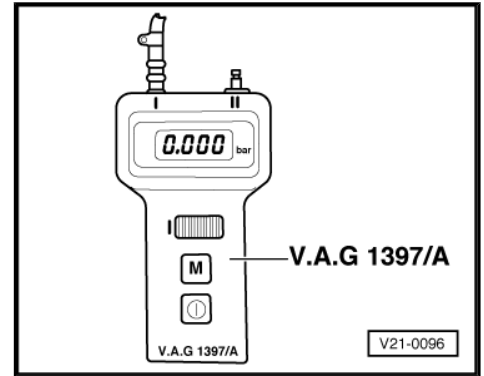


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- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Fit test hose to connection -I-.

 Note

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



WARNING

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

- ◆ *Observe safety precautions ⇒ [page 4](#) .*

- Charge pressure is measured under full load while driving or on a roller dynamometer.
- Test duration per measurement: max. 10 seconds
- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

Display on -VAS 5051B- :

- From menu -1-, select diagnostic function "Measured values" and press  key to continue.



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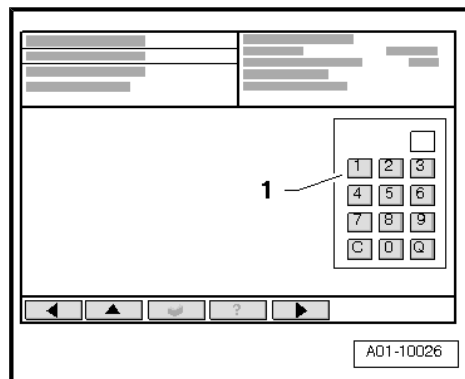
Display on -VAS 5051B- :

- Press keys **1** **1** **5** on keypad -1- to select “Display group 115” and confirm entry by pressing **Q** key.
- Accelerate vehicle in 3rd gear (or position 2) from 2000 rpm at full throttle while a second mechanic observes the rev counter.
- Have the second mechanic press **PRINT** key on -VAS 5051B- and memory key -M- on -V.A.G 1397A- simultaneously at approx. 2500 rpm.



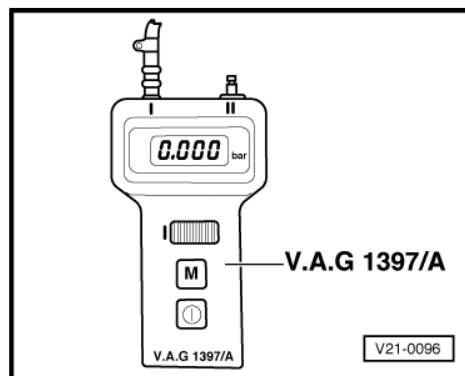
Note

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



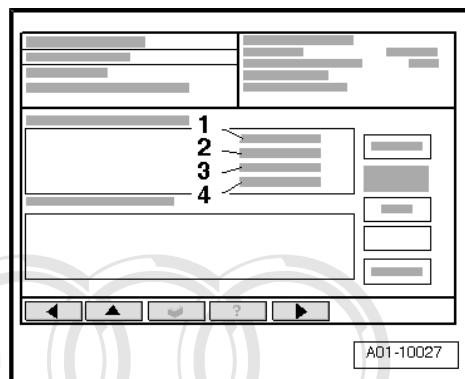
Display on -V.A.G 1397 A- :

- Specification: 1.500 ... 1.600 bar.



Display on -VAS 5051B- :

- Check display in display zone -4-.
- Specification: 1500 ... 1600 mbar.



If the specification is not attained:

Fault	Possible causes
Charge pressure below specification	◆ Hose connections to charge pressure control solenoid valve - N75- defective. Connection diagram ⇒ page 173 ◆ Charge pressure control solenoid valve - N75- defective. Checking ⇒ page 188 ◆ Charge pressure regulating valve in turbocharger stuck in open position. Renew turbocharger ⇒ page 200 ◆ Leak between turbocharger and intake manifold. Effects ⇒ page 175 ◆ Mechanical air recirculation valve defective. Checking ⇒ page 183 ◆ Turbocharger air recirculation valve - N249- defective. Checking ⇒ page 184 ◆ Turbocharger defective. Renewing ⇒ page 200

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Fault	Possible causes
Charge pressure above specification ¹⁾	◆ Vacuum unit for charge pressure regulating valve defective. Renew turbocharger ⇒ page 200 ◆ Air leaks in hoses or connections to vacuum unit for charge pressure control (via charge pressure control solenoid valve - N75-). Connection diagram ⇒ page 173 ◆ Charge pressure regulating valve in turbocharger sticking in closed position. Renew turbocharger ⇒ page 200
• ¹⁾ If the charge pressure is too high the fuel supply will be shut off in order to protect the engine. Misfiring will then occur at high engine speeds.	

If specification is obtained:

- Select “End output”.
- Switch off ignition and unplug diagnostic connector.

1.5 Checking mechanical air recirculation valve

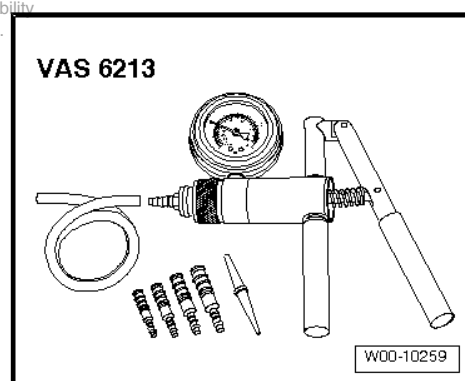


Note

- ◆ *The mechanical air recirculation valve is located upstream of the turbocharger. It is opened by vacuum during overrun, at idle and at part throttle. This dissipates the charge pressure upstream of the throttle valve and maintains a higher turbocharger speed.*
- ◆ *On vehicles with engine codes ANB, APU, ARK and ATW, the mechanical air recirculation valve is activated via the turbocharger air recirculation valve - N249- .*
- ◆ *Check air recirculation valve in the event of loss of power or load change jolts.*

Special tools and workshop equipment required

- ◆ Hand vacuum pump - VAS 6213-



Procedure

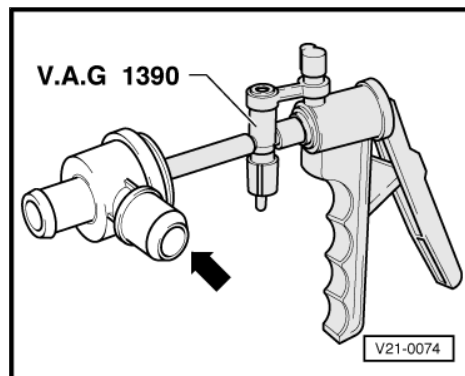
- Connect hand vacuum pump to air recirculation valve.



Note

The illustration shows the old tool (-V.A.G 1390-).

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



Note

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

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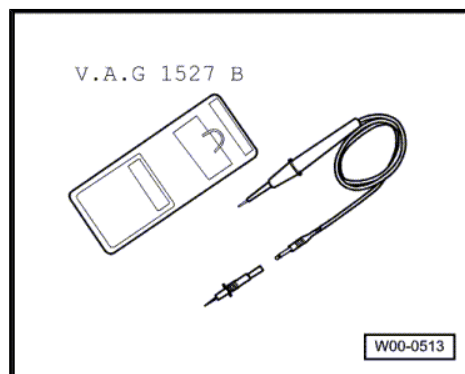
1.6 Checking turbocharger air recirculation valve - N249- - engine codes ANB, APU, ARK, ATW

Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526D-



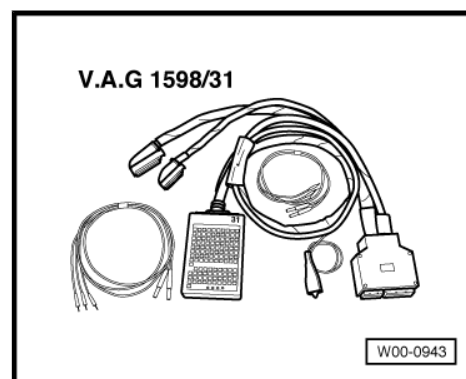
- ◆ Voltage tester - V.A.G 1527B-



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



◆ Adapter cable, 121-pin - V.A.G 1598/31-



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

Procedure



Note

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

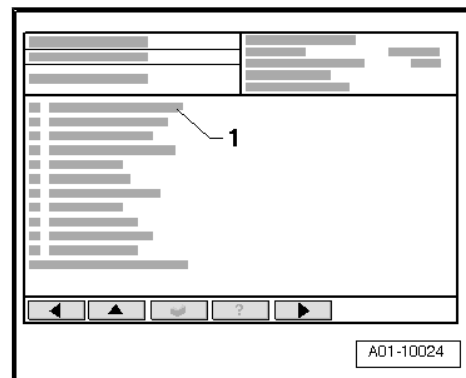
- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

Display on -VAS 5051B- :

- From menu -1-, select diagnostic function "Interrogate fault memory" and press  key to continue.

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

- Press  key to exit function "Interrogate fault memory".
- Select "End output".
- Switch off ignition.

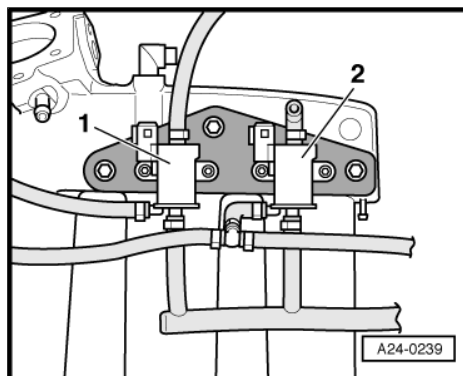


- Disconnect hoses from turbocharger air recirculation valve - N249- -item 1-; leave electrical connector attached.
- Fitting location: below intake manifold

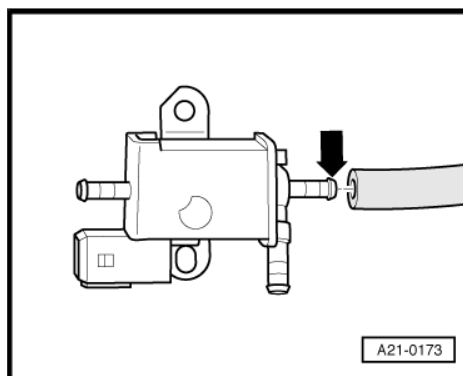


Note

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



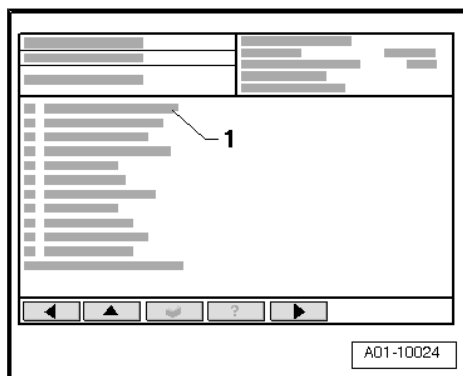
- Connect a test hose to the hose connection on the turbocharger air recirculation valve - N249- marked with an -arrow-.



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

Display on -VAS 5051B- :

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



- Press the key repeatedly until the following display appears:

Display on -VAS 5051B- :

6 - Turbocharger air recirculation valve - N249-

A - Actuator is running; continued switching is allowed

- The valve will be activated intermittently for approx. 1 minute (and should click audibly).

- The valve should open and close (check by blowing into the test hose).

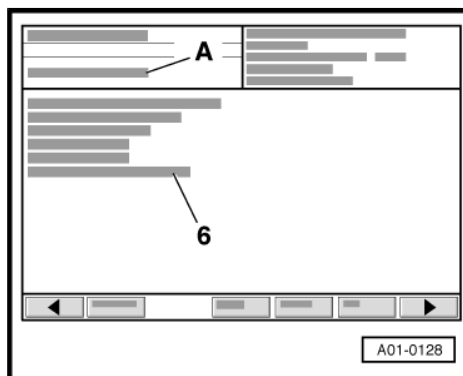
- Press key to exit diagnostic function “Final control diagnosis”.

- Select function “End output” and switch off ignition.

If valve clicks but does not open or close correctly:

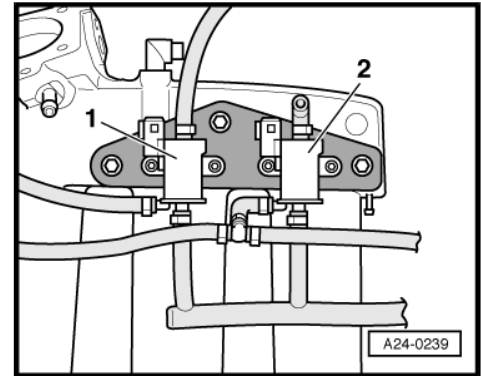
- Renew air recirculation valve for turbocharger - N249- .

If valve does not click:



Checking internal resistance

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

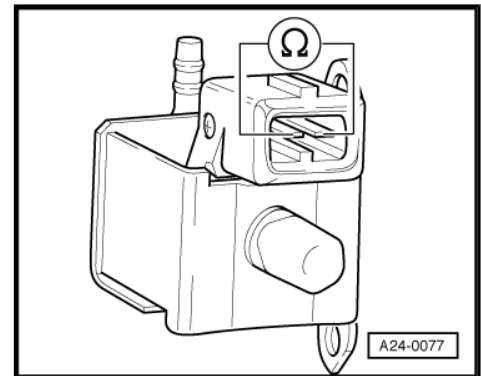


- Connect hand-held multimeter - V.A.G 1526D- to valve (resistance measurement range).
- Specification: 27 ... 30 Ω .
- If reading does not match specification, renew turbocharger air recirculation valve - N249- .

If the specification is attained:

Checking voltage supply

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



Note

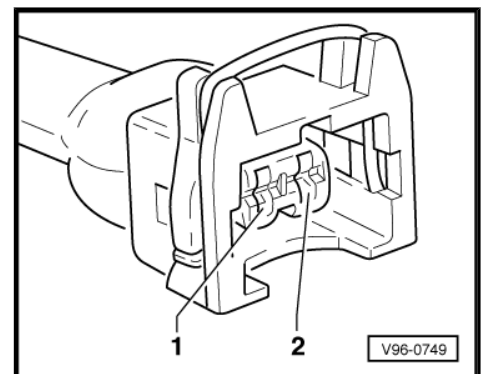
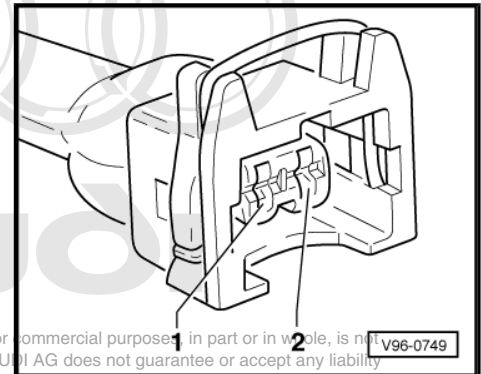
Turbocharger air recirculation valve - N249- is supplied with power via fuel pump relay - J17- .

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

If the LED lights up:

Checking activation

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



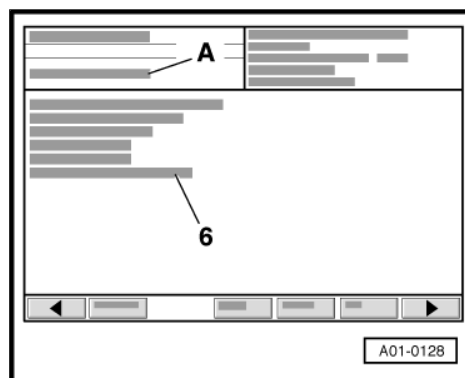
- Switch on ignition and select vehicle system “01 - Engine electronics”.
- Repeat diagnostic function “Final control diagnosis”.
- Press the key repeatedly until the following display appears:

Display on -VAS 5051B- :

6 - Turbocharger air recirculation valve - N249-

A - Actuator is running; continued switching is allowed

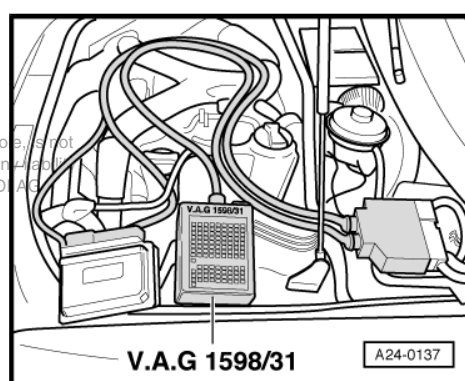
- The LED should flash.
- Press key to exit diagnostic function “Final control diagnosis”.
- Select “End output”.
- Switch off ignition and unplug diagnostic connector.
- If LED does not flash or lights up continuously, connect adapter cable, 121-pin - V.A.G 1598/31- (test box) to connectors of wiring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



Caution

Electronic components are susceptible to damage.

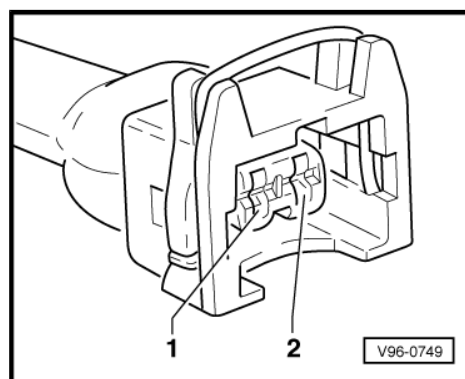
- ◆ **Select the appropriate measuring range before connecting the test leads and observe test requirements.**



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

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

- Repair wiring connection if necessary.



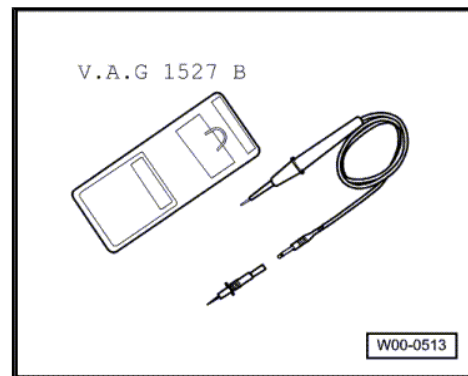
1.7 Checking charge pressure control solenoid valve - N75-

Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526D-



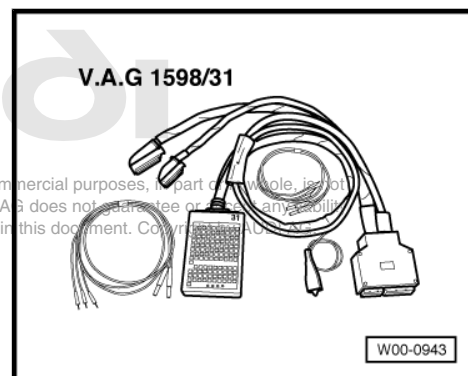
◆ Voltage tester - V.A.G 1527B-



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



◆ Adapter - V.A.G 1598/19- (engine codes AEB, AJL up to 06.96)



◆ Adapter - V.A.G 1598/22- (engine codes AEB, AJL from 07.96 onwards)

◆ Adapter cable, 121-pin - V.A.G 1598/31- (engine codes ANB, APU, ARK, ATW)

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

Procedure



Note

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

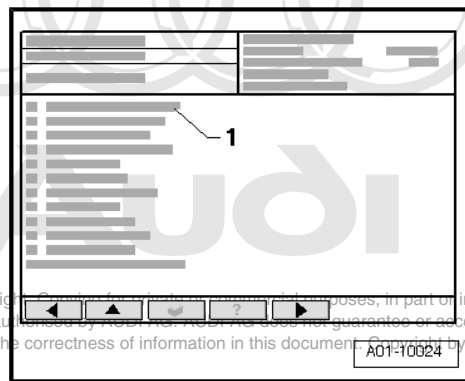
- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

Display on -VAS 5051B- :

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

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

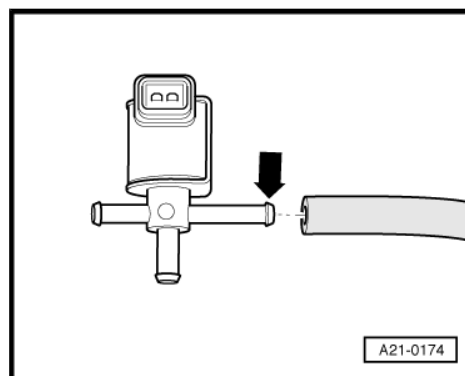
- Press key to exit function “Interrogate fault memory”.
- Select “End output”.
- Switch off ignition.



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Checking operation

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



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

Display on -VAS 5051B- :

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



- Press the key repeatedly until the following display appears:

Display on -VAS 5051B- :

4 - Charge pressure control solenoid valve - N75-

A - Actuator is running; continued switching is allowed

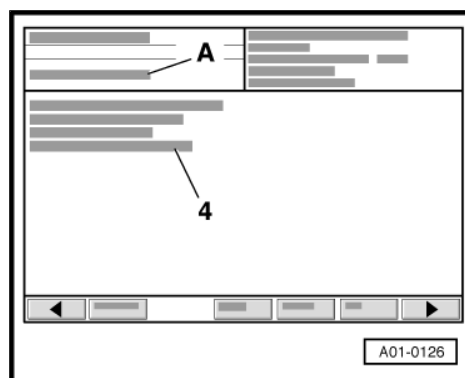
- The valve will be activated intermittently for approx. 1 minute (and should click audibly).
- The valve should open and close (check by blowing into the test hose).

- Press key to exit diagnostic function “Final control diagnosis”.
- Select function “End output” and switch off ignition.

If valve clicks but does not open or close correctly:

- Renew charge pressure control solenoid valve - N75- .

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



Checking internal resistance

- Unplug electrical connector at charge pressure control solenoid valve - N75- .
- Connect hand-held multimeter - V.A.G 1526D- to valve (resistance measurement range).
- Specification: 25 ... 35 Ω .
- If reading does not match specification, renew charge pressure control solenoid valve - N75- .

If the specification is attained:

Checking voltage supply

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



Note

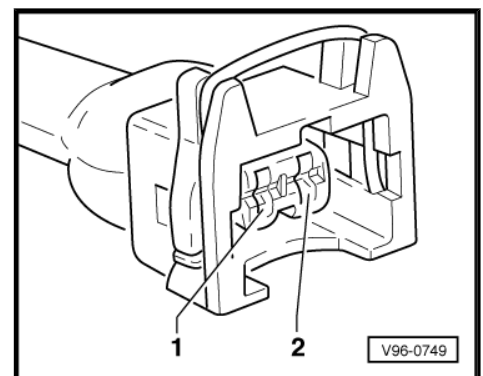
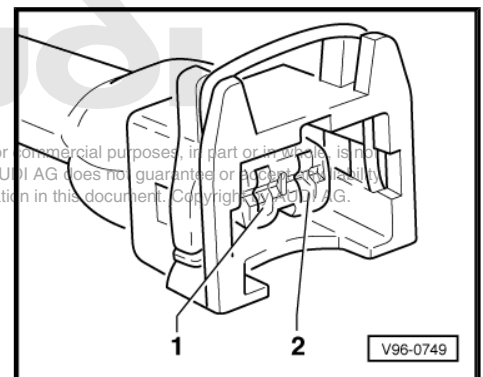
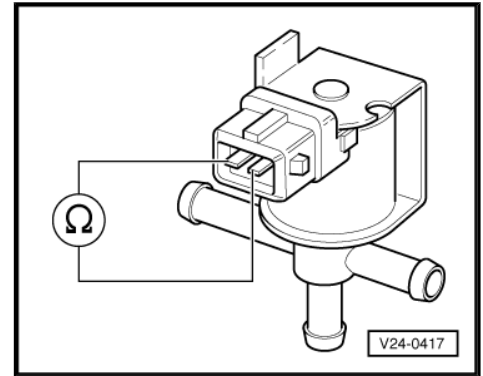
Charge pressure control solenoid valve - N75- is supplied with power via fuel pump relay - J17- .

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

If the LED lights up:

Checking activation

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



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

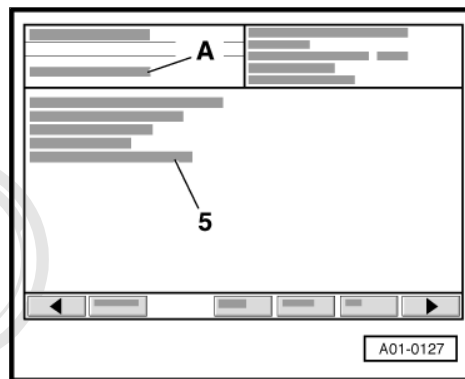
Display on -VAS 5051B- (example):

A - 5th control element being tested

5 - Charge pressure control solenoid valve - N75-

- The LED should flash.

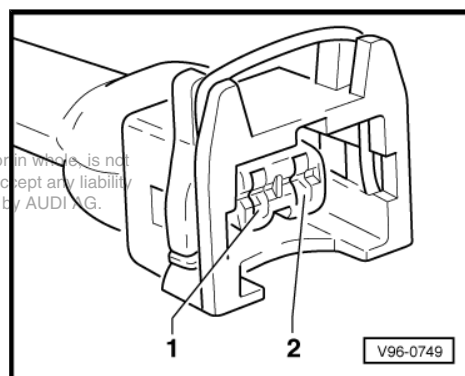
If the LED does not flash or lights up continuously:



Vehicles with engine codes AEB, AJL up to 06.96:

- Connect adapter - V.A.G 1598/19- (test box) to connectors of wiring harness; do not connect engine control unit ⇒ Rep. gr. 24 .
- Check for open circuit and short to positive or earth in the following wiring for charge pressure control solenoid valve - N75- .

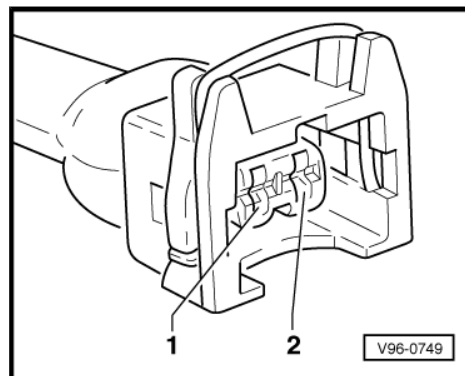
Connector Contact	-V.A.G 1598/19-Socket
-2-	D3



Vehicles with engine codes AEB, AJL from 07.96 onwards:

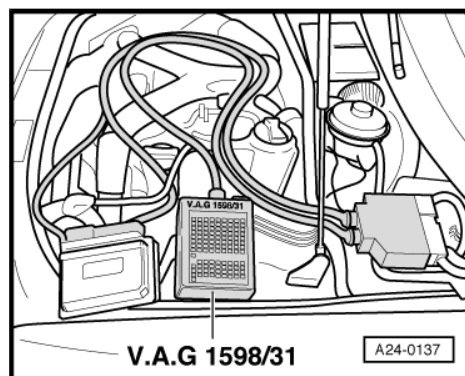
- Connect adapter - V.A.G 1598/19- (test box) to connectors of wiring harness; do not connect engine control unit ⇒ Rep. gr. 24 .
- Check for open circuit and short to positive or earth in the following wiring for charge pressure control solenoid valve - N75- .

Connector Contact	-V.A.G 1598/19-Socket
-2-	64



Vehicles with engine codes ANB, APU, ARK, ATW:

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

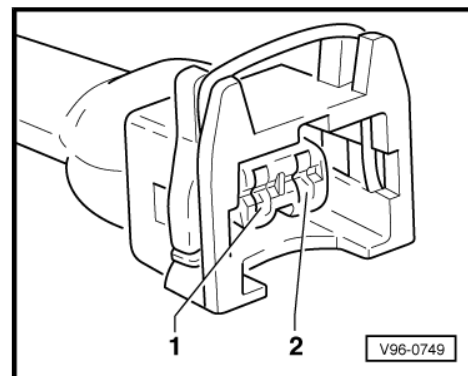


- Check for open circuit and short to positive or earth in the following wiring for charge pressure control solenoid valve - N75- .

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

All vehicles (continued):

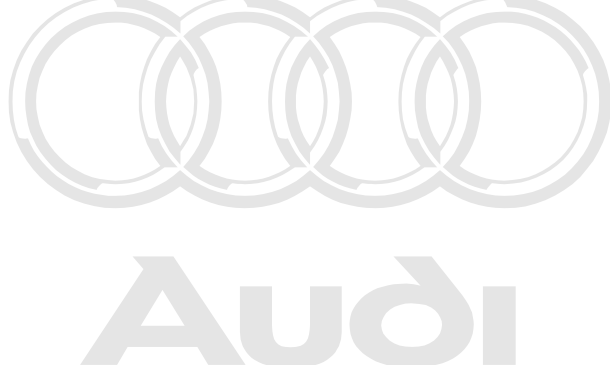
- Repair wiring connection if necessary.



1.8 Checking charge pressure sender - G31- - engine codes ANB, APU, ARK, ATW

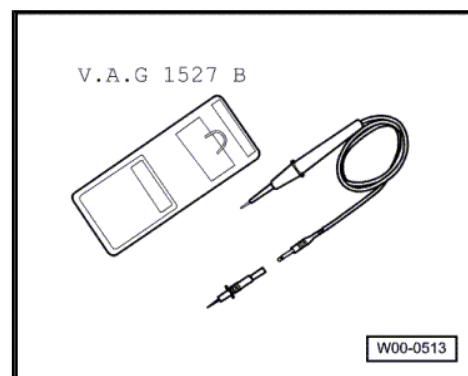
Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526D-



- ◆ Voltage tester - V.A.G 1527B-

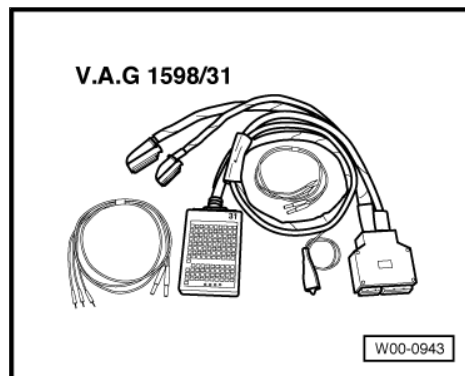
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- ◆ Auxiliary measuring set - V.A.G 1594C-



- ◆ Adapter cable, 121-pin - V.A.G 1598/31-



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

Procedure



Note

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

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

Display on -VAS 5051B- :

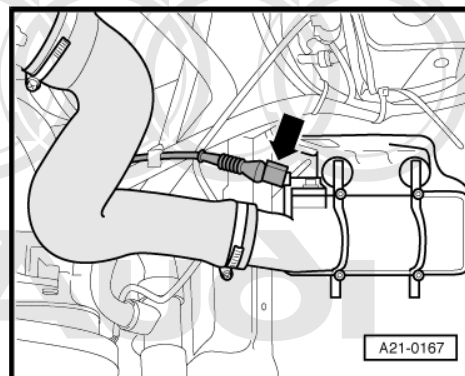
- From menu -1-, select diagnostic function "Interrogate fault memory" and press key to continue.

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

- Press key to exit function "Interrogate fault memory".
- Select "End output".
- Switch off ignition.



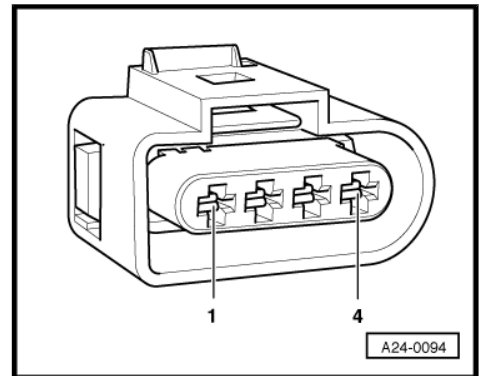
- Unplug electrical connector -arrow- at charge pressure sender - G31- .



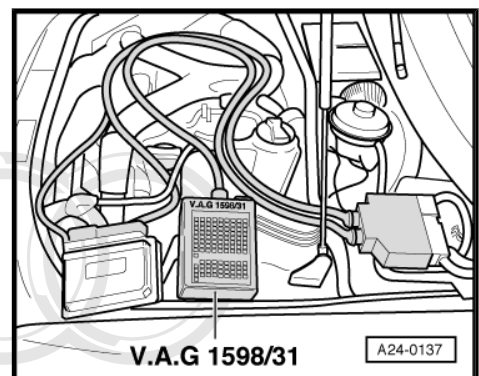
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Checking voltage supply

- Connect hand-held multimeter - V.A.G 1526D- to measure voltage between contacts -1- and -3- of electrical connector for charge pressure sender - G31- .
- Switch on ignition.
- Specification: approx. 5 V.



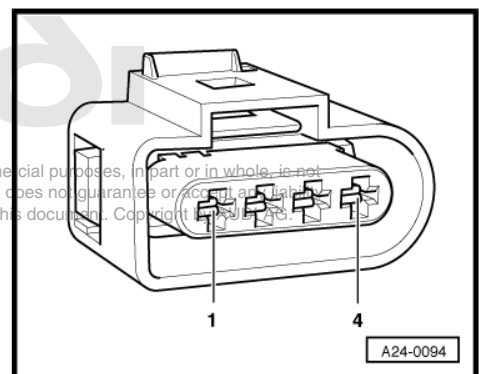
- If specification is not attained, connect adapter cable, 121-pin - V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth → Rep. gr. 24 .



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

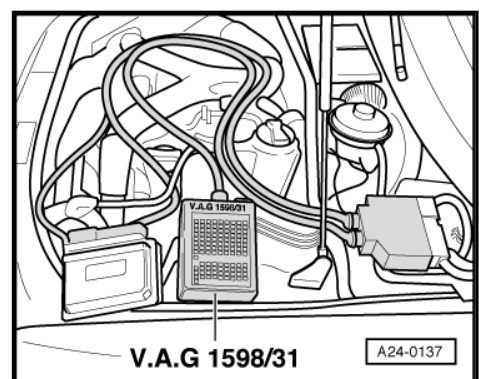
Connector Contact	-V.A.G 1598/31- Socket
-1-	108
-3-	98

- Repair wiring connection if necessary.



Checking signal wire

- Connect electrical connector to charge pressure sender - G31- .
- Connect multimeter (voltage measurement range) between socket "101" and socket "108" of adapter cable, 121-pin - V.A.G 1598/31- .
- Start the engine and run at idling speed.
- Specification: approx. 1.90 V.
- Increase engine speed by operating throttle quickly.
- Specification: 2.00 ... 3.00 V.

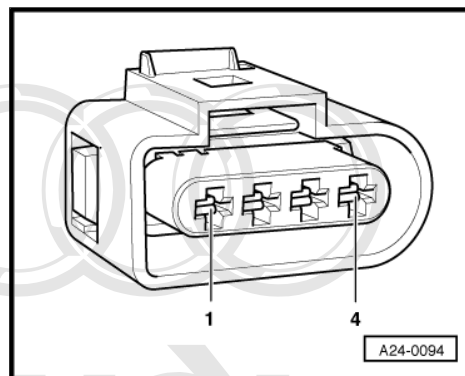




- If specifications are not attained, check for open circuit and short to positive or earth in the following wiring for charge pressure sender - G31- :

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

- Repair wiring connection if necessary.



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2 Turbocharger and charge air cooler

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

2.1 Turbocharger - exploded view

Turbocharger, oil lines

1 - Bolt

- ☐ Use only genuine bolt ⇒ Electronic parts catalogue
- ☐ 40 Nm

2 - Gasket

- ☐ Renew

3 - Catalytic converter

- ☐ Removing and installing ⇒ [page 219](#)

4 - Nut

- ☐ Renew
- ☐ 30 Nm

5 - Threaded connection

- ☐ 30 Nm

6 - Threaded connection

- ☐ 35 Nm

7 - Bolt

- ☐ 20 Nm

8 - Oil supply line

- ☐ Tighten union nut to 25 Nm
- ☐ From oil filter bracket ⇒ [Item 1 \(page 150\)](#)

9 - Heat shield

10 - Exhaust manifold

- ☐ Removing and installing ⇒ [page 221](#)

11 - Bolt

- ☐ Renew
- ☐ Coat threads and contact surface of bolt head with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ☐ 35 Nm

12 - Bolt

- ☐ 10 Nm

13 - Gasket

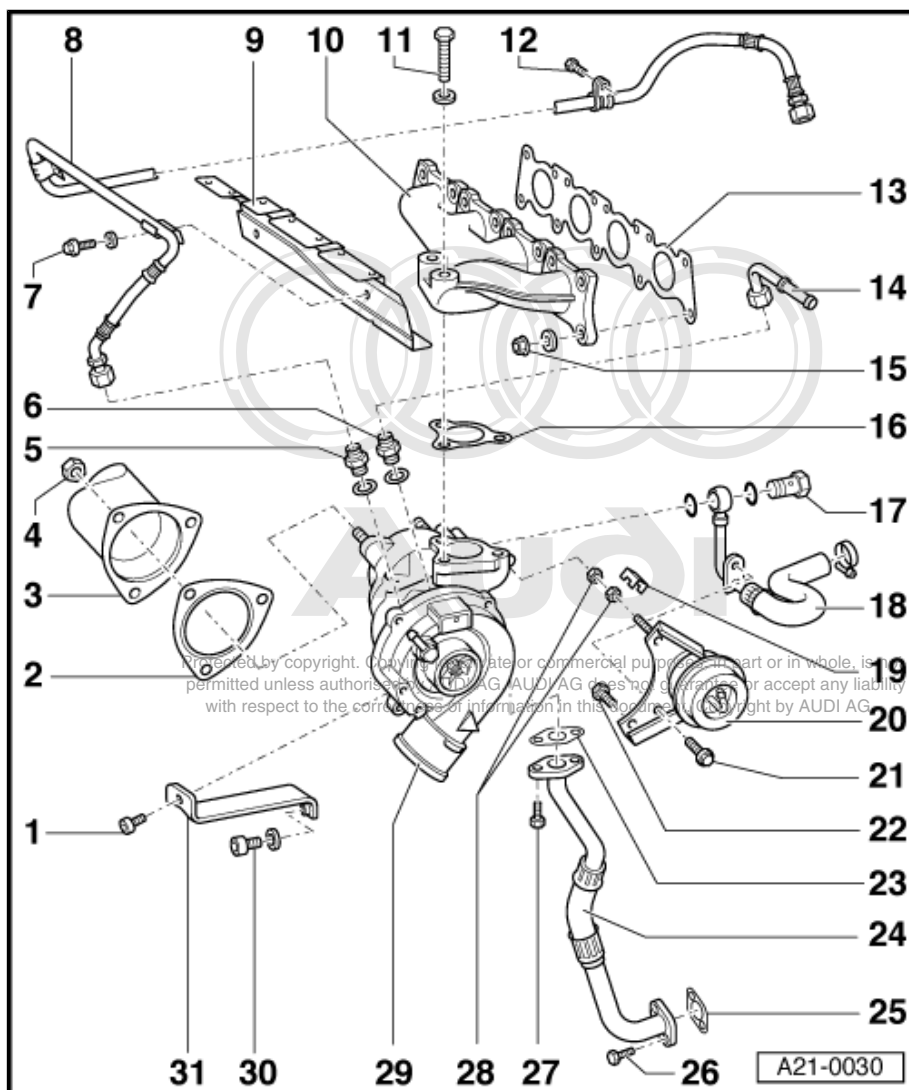
- ☐ Renew
- ☐ Note installation position

14 - Coolant return hose/pipe

- ☐ Tighten union nut to 30 Nm

15 - Nut

- ☐ Renew





- ☐ 25 Nm

16 - Gasket

- ☐ Renew
- ☐ Note installation position

17 - Banjo bolt

- ☐ 35 Nm

18 - Coolant supply line

19 - Locking element

20 - Vacuum unit for charge pressure regulating valve

21 - Bolt

- ☐ 10 Nm

22 - Bolt

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

23 - Gasket

- ☐ Renew

24 - Oil return line

- ☐ To sump

25 - Gasket

- ☐ Renew

26 - Bolt

- ☐ 10 Nm

27 - Bolt

- ☐ 10 Nm

28 - Nut

- ☐ Do not alter setting
- ☐ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue
- ☐ 10 Nm

29 - Turbocharger

- ☐ Checking: engine codes AEB, AJL ⇒ [page 176](#)
- ☐ Checking: engine codes ANB, APU, ARK, ATW ⇒ [page 179](#)
- ☐ Removing and installing ⇒ [page 200](#)

30 - Bolt

- ☐ 45 Nm

31 - Support

- ☐ For turbocharger

Air hoses, solenoid valves



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1 - Vacuum hose

- ☐ To intake manifold

2 - Mechanical air recirculation valve

- ☐ Checking ⇒ [page 183](#)

3 - Hose

- ☐ To turbocharger air recirculation valve

4 - Air hose

- ☐ To turbocharger
- ☐ Must be free of oil or grease when installing

5 - Hose

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

6 - Crankcase breather pipe

7 - Bolt

- ☐ 10 Nm

8 - Panel bolt

9 - Hose

- ☐ To crankcase breather pipe

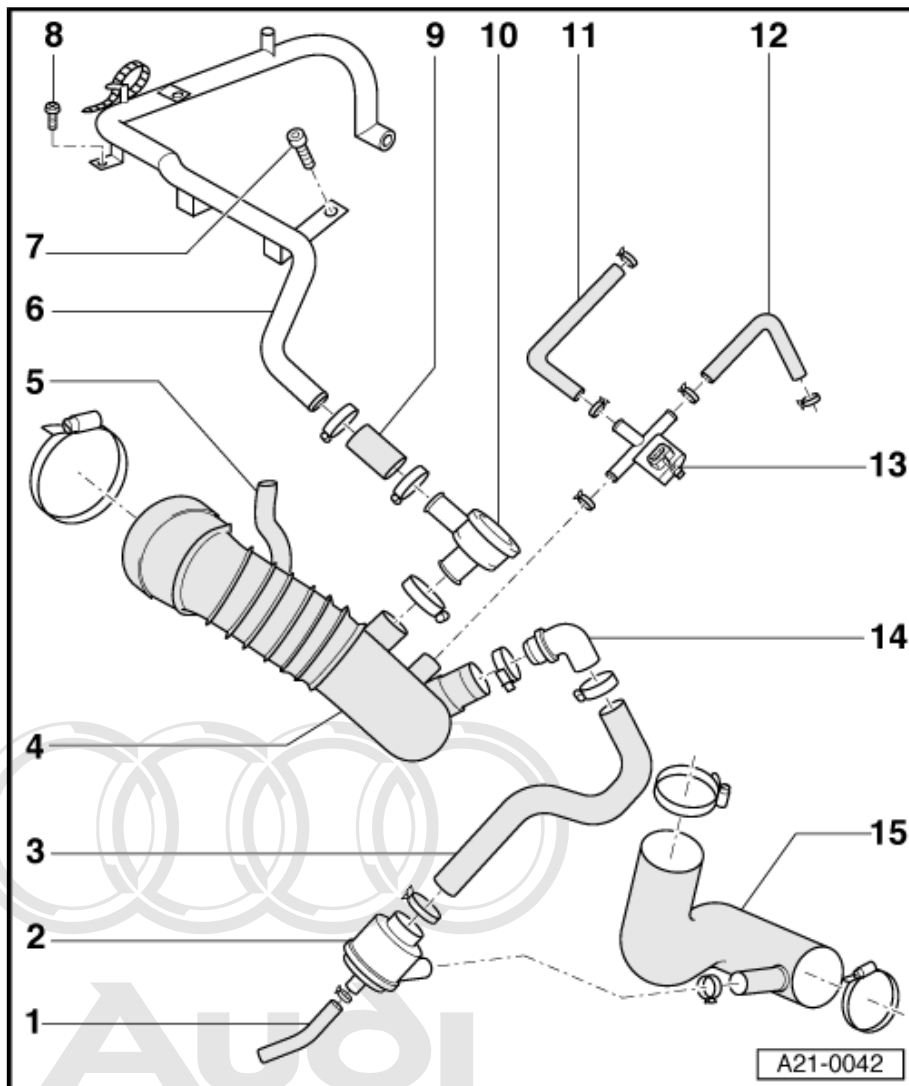
10 - Pressure control valve for crankcase breather system

11 - Hose

- ☐ To turbocharger

12 - Hose

- ☐ To vacuum unit for charge pressure regulating valve



13 - Charge pressure control solenoid valve - N75-

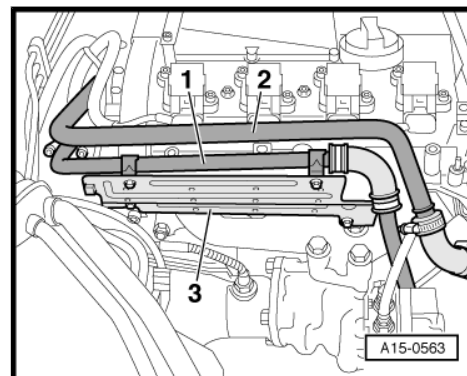
14 - Elbow

15 - Air hose

- ☐ From turbocharger
- ☐ Must be free of oil or grease when installing

Heat shield - tightening torque

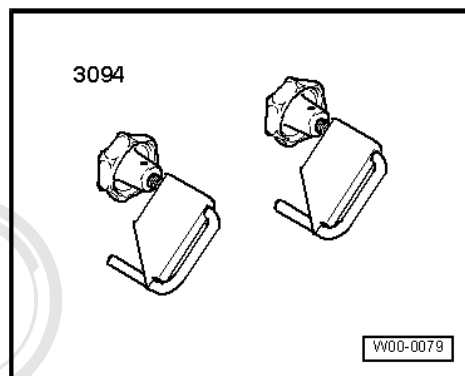
- Tighten bolts securing heat shield -3 - to 5 Nm.



2.2 Removing and installing turbocharger

Special tools and workshop equipment required

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



Removing

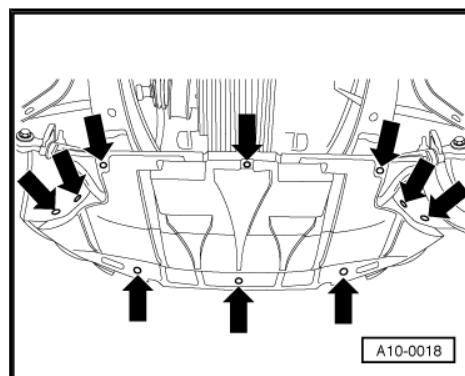


Caution

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

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

- Release fasteners -arrows- and remove noise insulation.



Vehicles with air conditioning:

- Loosen bolts on tensioner for poly V-belt for air conditioner compressor -arrows-, slacken belt and remove.

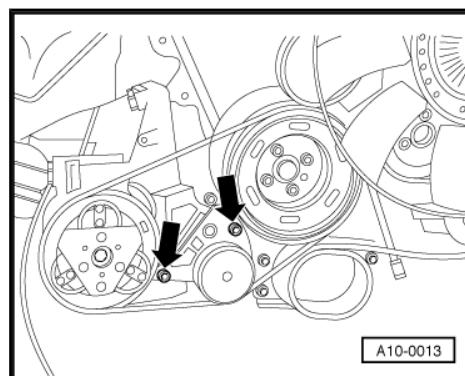


WARNING

Risk of injury caused by refrigerant.

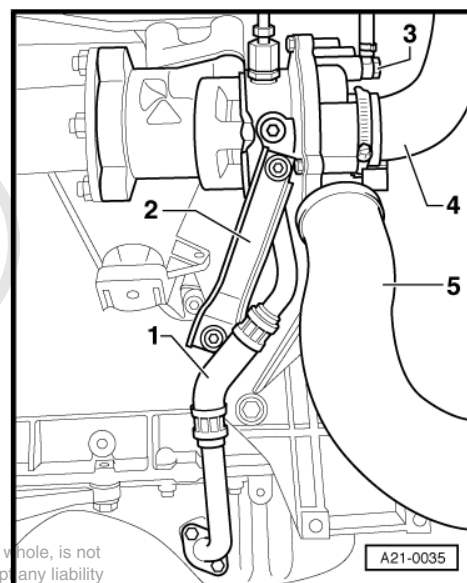
- ◆ ***The air conditioner refrigerant circuit must not be opened.***

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



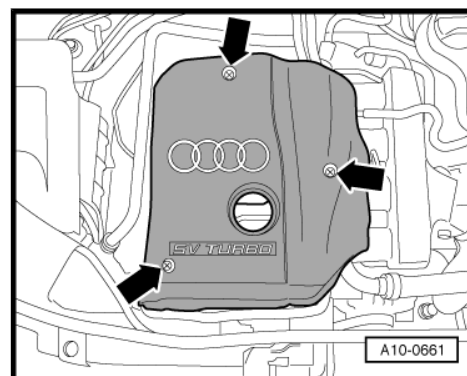
All vehicles (continued):

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

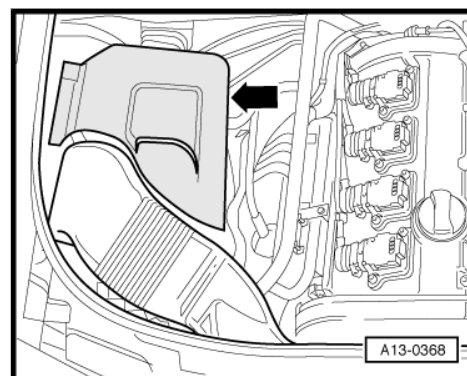


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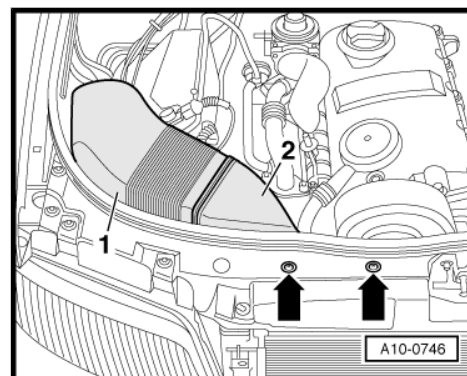
- Release quick-release fasteners and remove engine cover panel -arrows-.



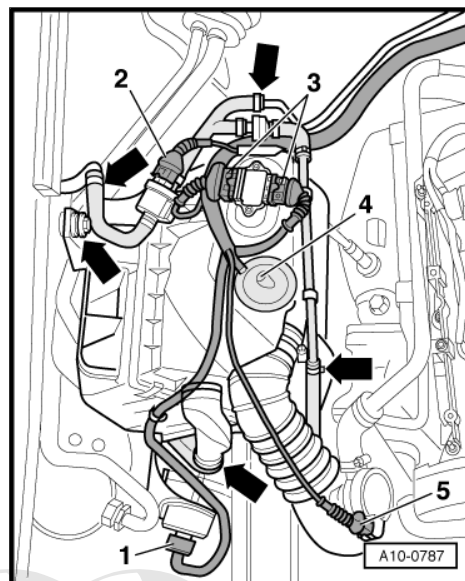
- Detach air cleaner cover -arrow-.



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

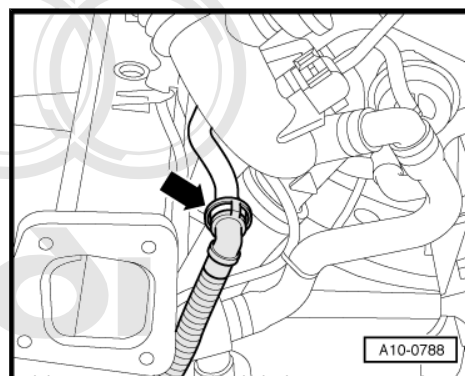


- Unplug electrical connectors:
- 1 - On secondary air pump motor - V101- (vehicles with secondary air system)
- 2 - On activated charcoal filter solenoid valve 1 - N80-
- 3 - On output stage - N122-
- 4 - On air mass meter - G70-
- 5 - On charge pressure control solenoid valve - N75-
- Move wiring harness clear and lay on top of engine.
- Detach hose connections and remove air cleaner housing -arrows-.

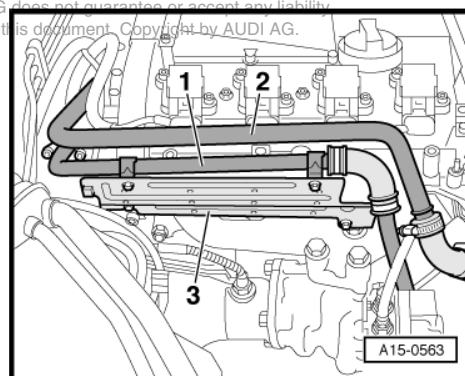


Vehicles with secondary air system:

- Remove bracket for secondary air pipe from turbocharger.
- Detach hose -arrow- from pipe at combination valve for secondary air.



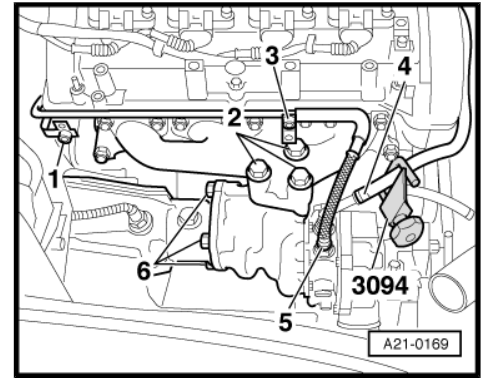
- Remove heat shield -3- from secondary air pipe -1- and from cylinder head.



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All vehicles (continued):

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



Caution

Avoid damage to flexible joint.

- ◆ *Do not bend flexible joint more than 10°.*
- ◆ *Install flexible joint so that it is not under tension.*
- ◆ *Take care not to damage wire mesh on flexible joint.*

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

Installing

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



Note

- ◆ *Renew seals, gaskets and self-locking nuts.*
- ◆ *Hose connections and air pipes and hoses must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- ◆ *Fit all heat insulation sleeves in the original position when installing.*

Perform the following operations before securing the turbocharger:

- Fit coolant supply line together with bracket loosely at vacuum unit for charge pressure regulating valve.
- First tighten banjo bolt and then bolt securing bracket for coolant supply line.



Note

Fill turbocharger with engine oil at connection for oil supply line.

- Install coolant hoses and air hoses with screw-type clips
⇒ [page 43](#) .
- Install poly V-belt for air conditioner compressor ⇒ [page 49](#) .



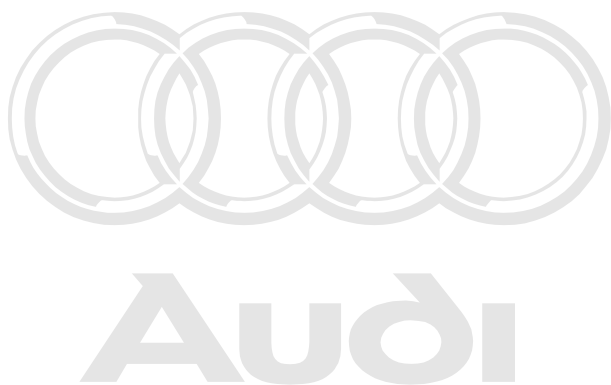
- Check oil level ⇒ Maintenance ; Booklet 802 .
- Fill up with coolant ⇒ [page 158](#) .



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 ⇒ [page 197](#) , ⇒ [page 207](#) and ⇒ [page 213](#)



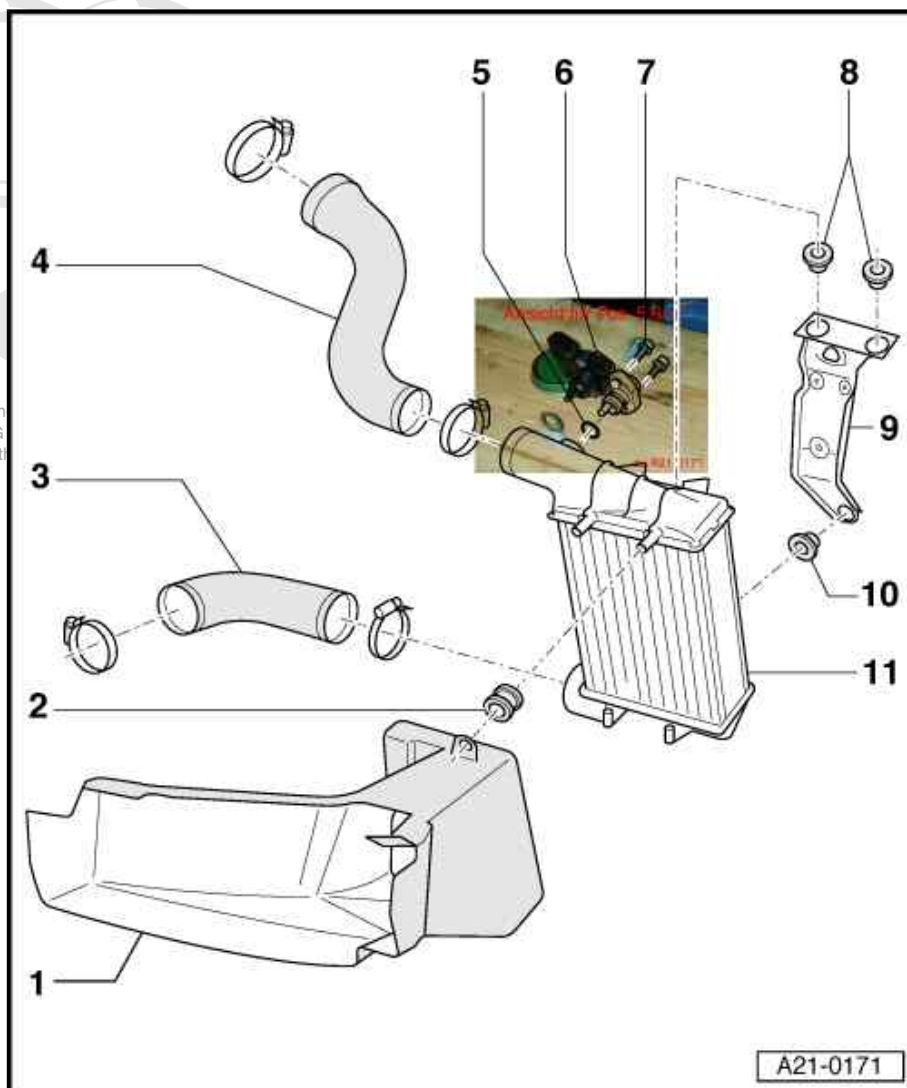
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3 Charge air cooling

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

3.1 Charge air cooler - exploded view

- 1 - Air duct
 - ☐ For charge air cooler
- 2 - Rubber grommet
- 3 - Air hose
 - ☐ From lock carrier
 - ☐ Must be free of oil or grease when installing
- 4 - Air hose
 - ☐ To intake manifold
 - ☐ Must be free of oil or grease when installing
- 5 - O-ring
 - ☐ Renew
- 6 - Charge pressure sender - G31-
- 7 - Bolt
 - ☐ 3 Nm
- 8 - Rubber grommet
- 9 - Bracket for charge air cooler
 - ☐ Riveted to body
- 10 - Rubber grommet
- 11 - Charge air cooler
 - ☐ Removing and installing ⇒ [page 205](#)



3.2 Removing and installing charge air cooler

Removing

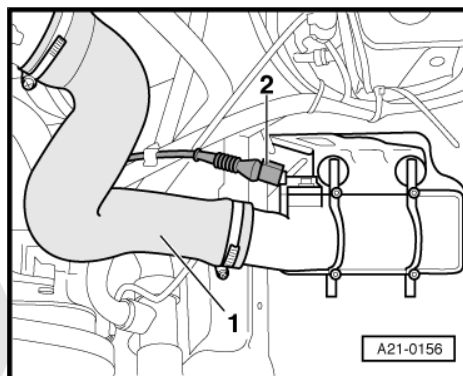
- Lock carrier must be in service position ⇒ Rep. gr. 50 .



Note

If there are slight impressions on the fins, refer to ⇒ [page 7](#) .

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



- Remove air duct for charge air cooler -arrows-.
- Remove bottom air hose going to charge air cooler.
- Take out charge air cooler from underneath.

Installing

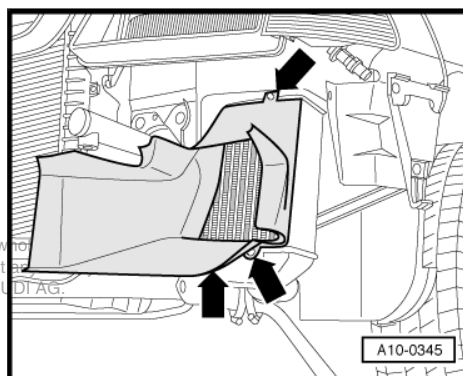
Installation is carried out in the reverse order; note the following:



Note

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- ◆ *Hose connections and air pipes and hoses must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- Install air hoses with screw-type clips ⇒ [page 43](#) .



26 – Exhaust system

1 Exhaust system on vehicles with front-wheel drive

1.1 Silencers - exploded view

1 - Nut

- ☐ 40 Nm

2 - Clamp (front)

- ☐ Before tightening, align exhaust system so it is free of stress
⇒ [page 211](#)
- ☐ Installation position
⇒ [page 209](#)
- ☐ Tighten bolt connections evenly

3 - Nut

- ☐ 40 Nm

4 - Clamp (rear)

- ☐ For separate replacement of centre or rear silencer
- ☐ Before tightening, align exhaust system so it is free of stress
⇒ [page 211](#)
- ☐ Installation position
⇒ [page 209](#)
- ☐ Tighten bolt connections evenly

5 - Bolt

- ☐ 25 Nm

6 - Mounting

- ☐ Renew if damaged
- ☐ Check preload
⇒ "1.3 Stress-free alignment of exhaust system", [page 211](#)

7 - Gasket

- ☐ Renew

8 - Nut

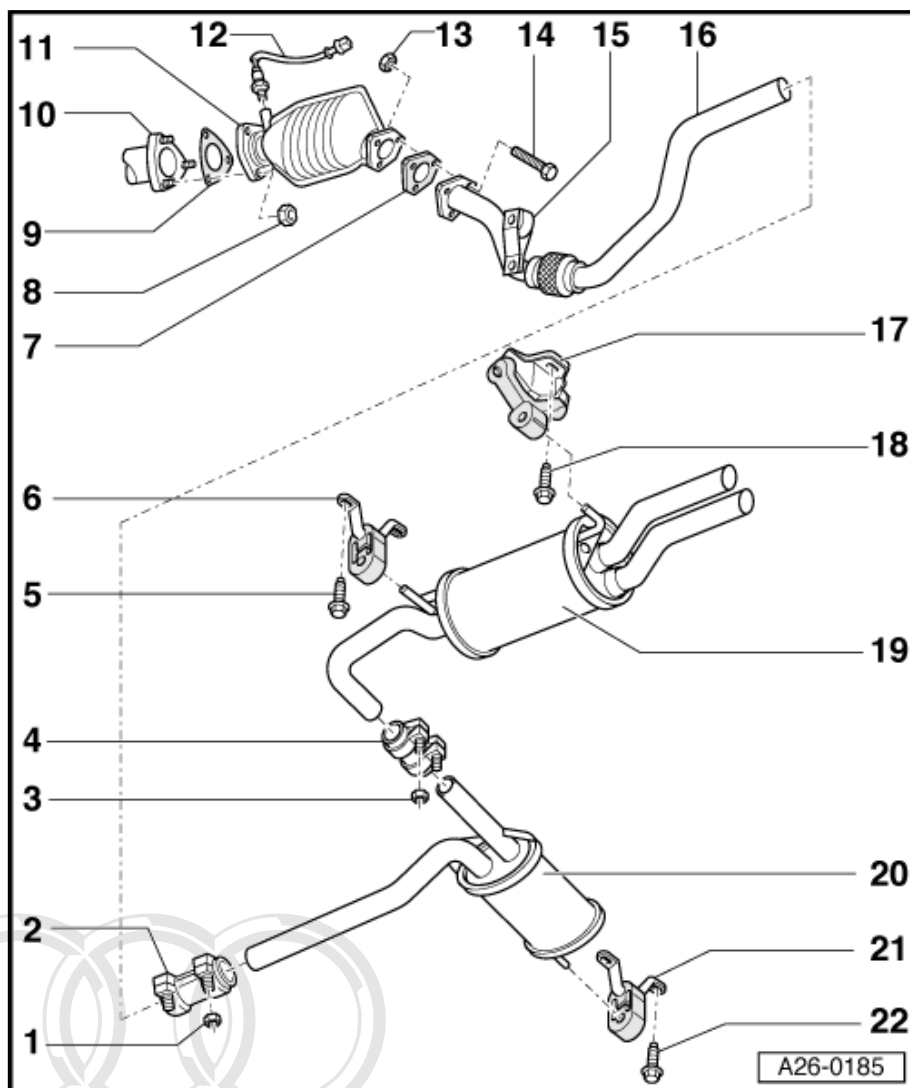
- ☐ 30 Nm
- ☐ Renew

9 - Gasket

- ☐ Renew

10 - Turbocharger

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



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11 - Catalytic converter

- ☐ Protect against knocks and impact
- ☐ Removing and installing ⇒ [page 219](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 211](#)

12 - Lambda probe

- ☐ Removing and installing Lambda probe ⇒ Rep. gr. 24

13 - Nut

- ☐ 25 Nm
- ☐ Renew

14 - Bolt

- ☐ 25 Nm

15 - Mounting

- ☐ Mounting components on vehicles with manual gearbox ⇒ [page 209](#)
- ☐ Mounting components on vehicles with automatic gearbox ⇒ [page 210](#)

16 - Front exhaust pipe

- ☐ With flexible joint
- ☐ Do not bend flexible joint more than 10° – otherwise it can be damaged
- ☐ Align exhaust system so it is free of stress ⇒ [page 211](#)

17 - Mounting

- ☐ Renew if damaged
- ☐ Check preload ⇒ [“1.3 Stress-free alignment of exhaust system”, page 211](#)

18 - Bolt

- ☐ 25 Nm

19 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 210](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 211](#)

20 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 210](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 211](#)

21 - Mounting

- ☐ Renew if damaged
- ☐ Check preload ⇒ [“1.3 Stress-free alignment of exhaust system”, page 211](#)

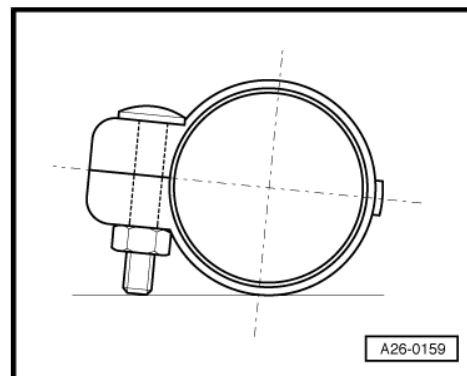
22 - Bolt

- ☐ 25 Nm

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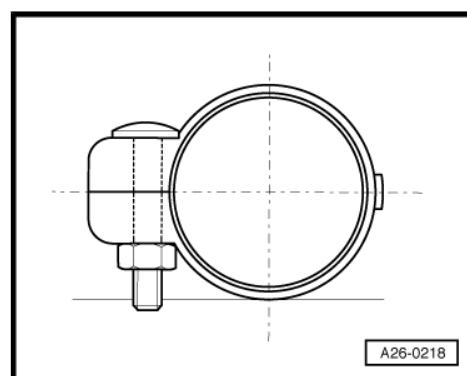
Installation position of front clamp

- Install clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces to left.



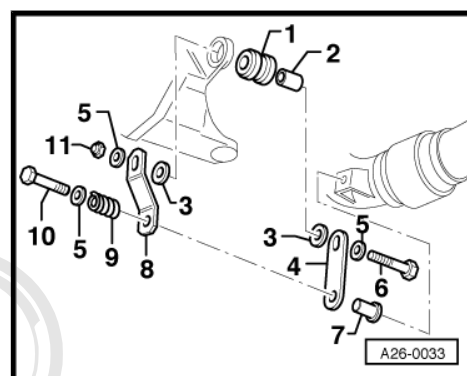
Installation position of rear clamp

- Fit clamp in horizontal position.
- Bolt connection faces to left.



Components of exhaust pipe mountings (vehicles with manual gearbox)

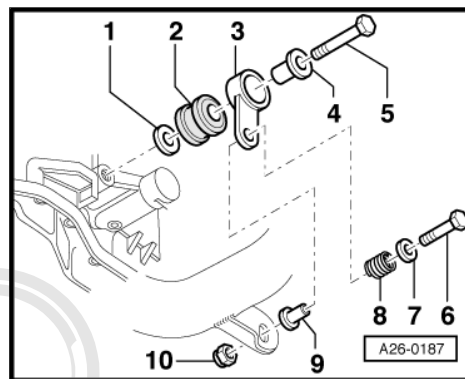
- 1 - Buffer
- 2 - Spacer
- 3 - Washer
- 4 - Bracket (right-side)
- 5 - Washer
- 6 - Bolt, 25 Nm
- 7 - Spacer sleeve
- 8 - Bracket (left-side)
- 9 - Compression spring
- 10 - Bolt, 25 Nm
- 11 - Nut, self-locking, 25 Nm



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Components of exhaust pipe mountings (vehicles with automatic gearbox)

- 1 - Washer
- 2 - Buffer
- 3 - Bracket
- 4 - Spacer sleeve
- 5 - Bolt, 25 Nm
- 6 - Bolt
- 7 - Washer
- 8 - Compression spring
- 9 - Spacer sleeve
- 10 - Nut, self-locking, 25 Nm



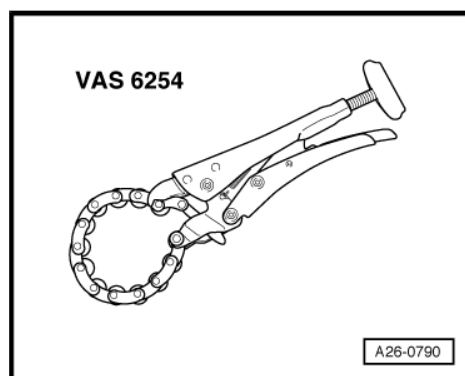
1.2 Separating centre and rear silencers

- ◆ The connecting pipe can be cut through at the cutting point in order to renew the centre and rear silencers separately.
- ◆ The cutting point is marked by an indentation on the circumference of the exhaust pipe.

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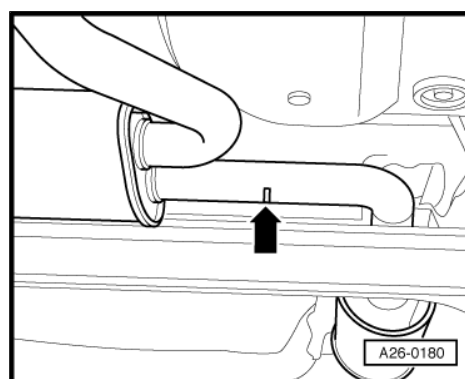
Special tools and workshop equipment required

- ◆ Chain pipe cutter - VAS 6254-

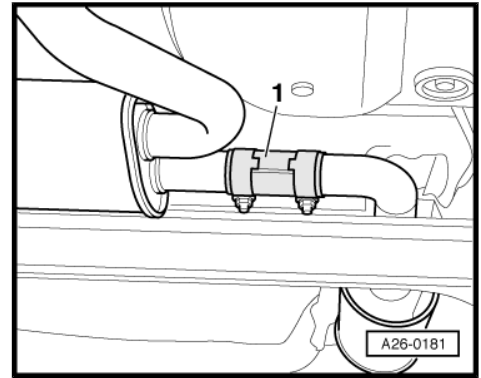


Procedure

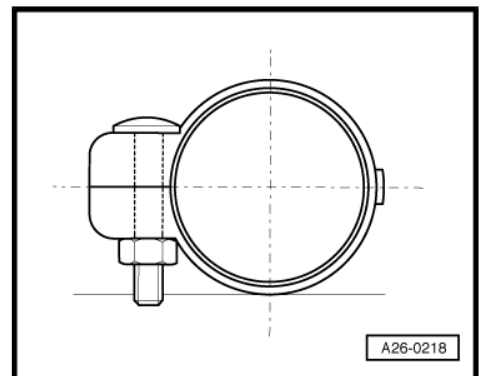
- Cut through exhaust pipe at right angles at the position marked -arrow- using chain-type pipe cutter - VAS 6254-



- When installing, position centre of clamp -1- over cutting point.



- Fit clamp in horizontal position.
- Bolt connection faces to left.
- Align the exhaust system so it is free of stress ⇒ [page 211](#) .

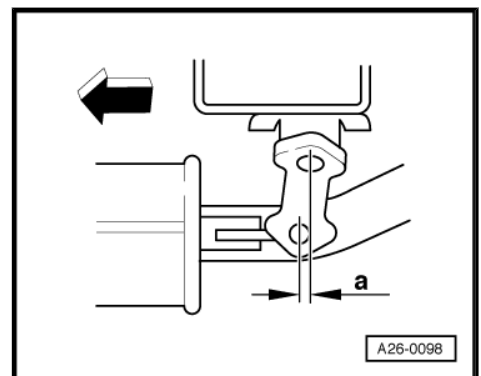


1.3 Stress-free alignment of exhaust system

- The exhaust system must be aligned when it is cool.

Vehicles without clamp between centre silencer and rear silencer

- Loosen bolts on front clamp ⇒ [Item 2 \(page 207\)](#) .
- Push exhaust system towards front of vehicle -arrow-, so that rear mounting for rear silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolt connections on clamp evenly.
- Align tailpipes ⇒ [page 212](#) .



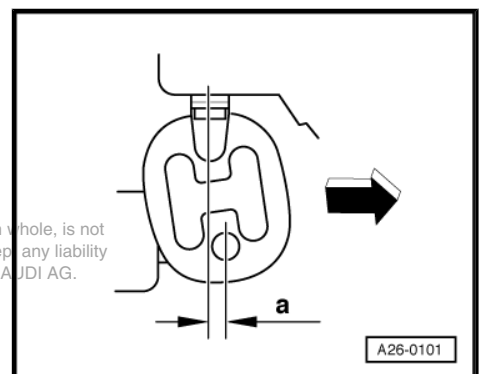
Vehicles with clamp between centre silencer and rear silencer



Note

On vehicles with clamp fitted between centre silencer and rear silencer, it is also necessary to align the centre silencer.

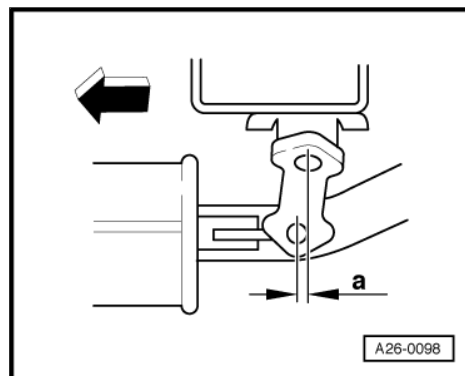
- Loosen bolts on front clamp ⇒ [Item 2 \(page 207\)](#) and rear clamp ⇒ [Item 4 \(page 207\)](#) .
- Push front section of exhaust system towards front of vehicle -arrow-, so that rubber mounting (right-side) for centre silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolt connections on front clamp evenly ⇒ [Item 2 \(page 207\)](#) .



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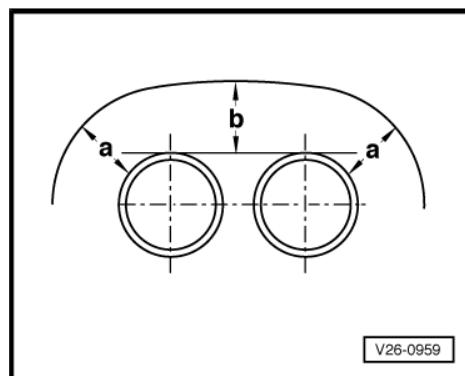
- Push rear section of exhaust system towards front of vehicle -arrow- until rear mounting for rear silencer is preloaded by -a- = 7 ... 11 mm.
- Tighten bolt connections on rear clamp evenly
⇒ [Item 4 \(page 207\)](#) .
- Align tailpipes ⇒ [page 212](#) .

Tightening torque ⇒ [page 207](#)



Aligning tailpipes

- Align tailpipes as follows:
- Distance -a- is the same on both sides.
- Distance -b- from bumper cut-out to top of tailpipes should be at least 24 mm.



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2 Exhaust system on vehicles with four-wheel drive

2.1 Silencers - exploded view

1 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point
⇒ [page 216](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 217](#)

2 - Gasket

- ☐ Renew

3 - Nut

- ☐ Renew
- ☐ 30 Nm

4 - Gasket

- ☐ Renew

5 - Turbocharger

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

6 - Catalytic converter

- ☐ Protect against knocks and impact
- ☐ Removing and installing
⇒ [page 219](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 217](#)

7 - Lambda probe

- ☐ Removing and installing Lambda probe ⇒ Rep. gr. 24

8 - Nut

- ☐ Renew
- ☐ 25 Nm

9 - Bolt

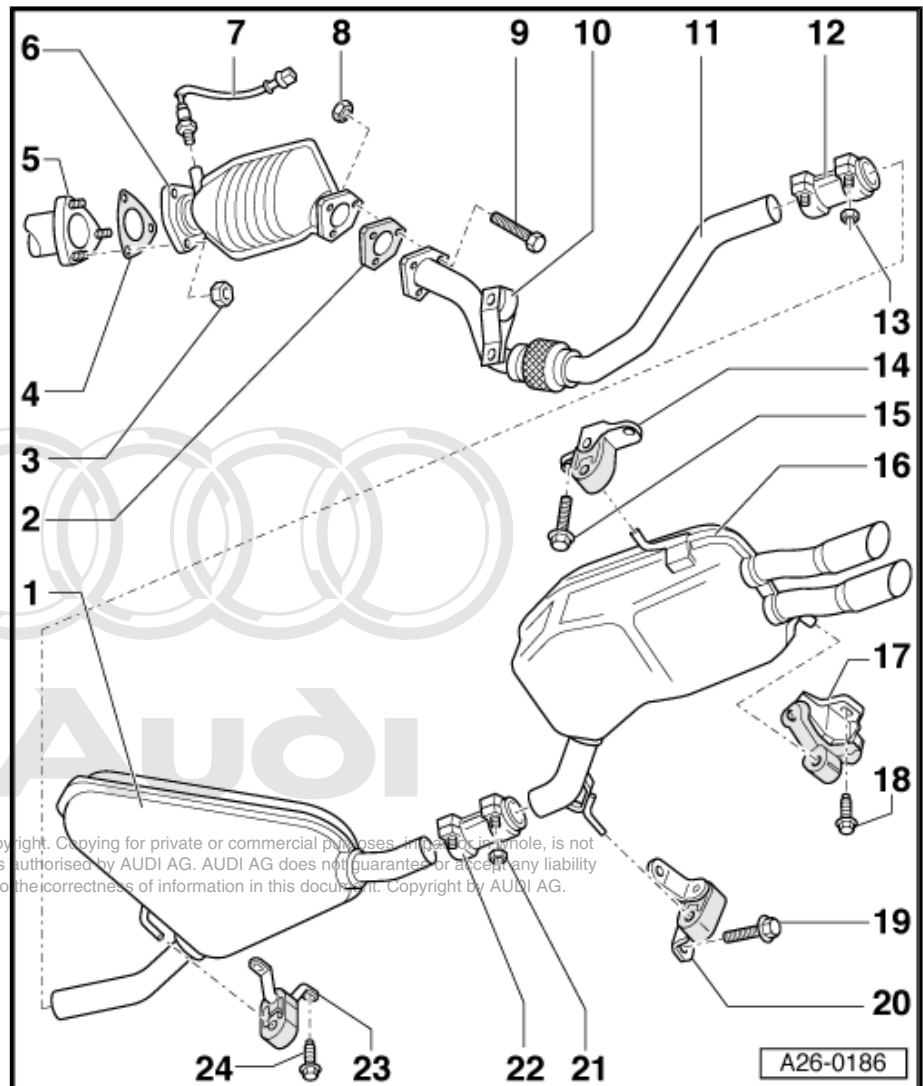
- ☐ 25 Nm

10 - Mounting

- ☐ Components of exhaust pipe mountings (vehicles with manual gearbox) ⇒ [page 215](#)
- ☐ Components of exhaust pipe mountings (vehicles with automatic gearbox) ⇒ [page 216](#)

11 - Front exhaust pipe

- ☐ With flexible joint
- ☐ Do not bend flexible joint more than 10° – otherwise it can be damaged
- ☐ Align exhaust system so it is free of stress ⇒ [page 217](#)





12 - Clamp (front)

- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 217](#)
- ☐ Installation position ⇒ [page 215](#)
- ☐ Tighten bolt connections evenly

13 - Nut

- ☐ 40 Nm

14 - Mounting

- ☐ Renew if damaged
- ☐ Check preload ⇒ ["2.3 Stress-free alignment of exhaust system", page 217](#)

15 - Bolt

- ☐ 25 Nm

16 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 216](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 217](#)

17 - Mounting

- ☐ Renew if damaged
- ☐ Check preload ⇒ ["2.3 Stress-free alignment of exhaust system", page 217](#)

18 - Bolt

- ☐ 25 Nm

19 - Bolt

- ☐ 25 Nm

20 - Mounting

- ☐ Renew if damaged
- ☐ Check preload ⇒ ["2.3 Stress-free alignment of exhaust system", page 217](#)

21 - Clamp (rear)

- ☐ For individual replacement of centre silencer and the two rear silencers
- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 217](#)
- ☐ Installation position ⇒ [page 215](#)
- ☐ Tighten bolt connections evenly

22 - Nut

- ☐ 40 Nm

23 - Mounting

- ☐ Renew if damaged
- ☐ Check preload ⇒ ["2.3 Stress-free alignment of exhaust system", page 217](#)

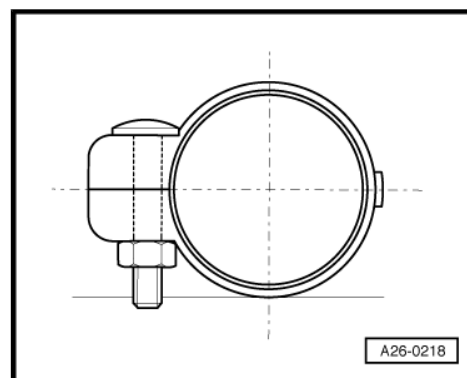
24 - Bolt

- ☐ 25 Nm

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Installation position of front clamp

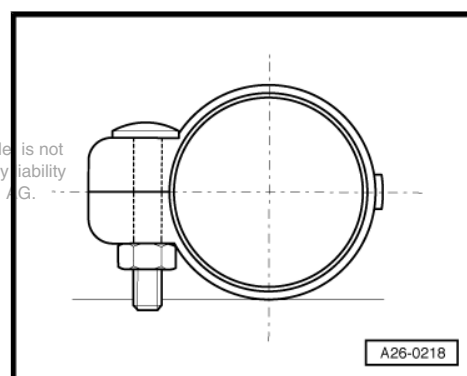
- Fit clamp in horizontal position.
- Bolt connection faces to left.



Installation position of rear clamp

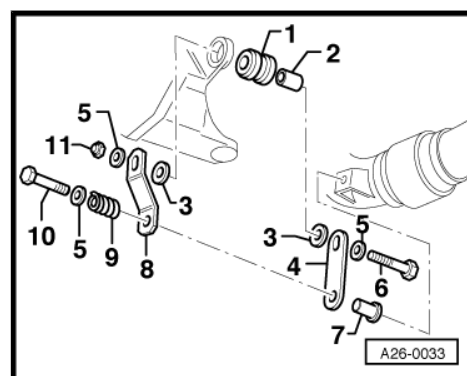
- Fit clamp in horizontal position.
- Bolt connection faces to left.

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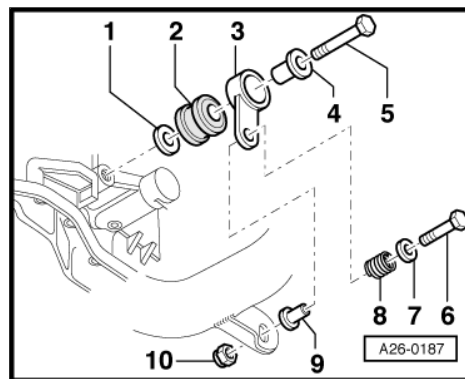
Components of exhaust pipe mountings (vehicles with manual gearbox)

- 1 - Buffer
- 2 - Spacer
- 3 - Washer
- 4 - Bracket (right-side)
- 5 - Washer
- 6 - Bolt, 25 Nm
- 7 - Spacer sleeve
- 8 - Bracket (left-side)
- 9 - Compression spring
- 10 - Bolt, 25 Nm
- 11 - Nut, self-locking, 25 Nm



Components of exhaust pipe mountings (vehicles with automatic gearbox)

- 1 - Washer
- 2 - Buffer
- 3 - Bracket
- 4 - Spacer sleeve
- 5 - Bolt, 25 Nm
- 6 - Bolt
- 7 - Washer
- 8 - Compression spring
- 9 - Spacer sleeve
- 10 - Nut, self-locking, 25 Nm

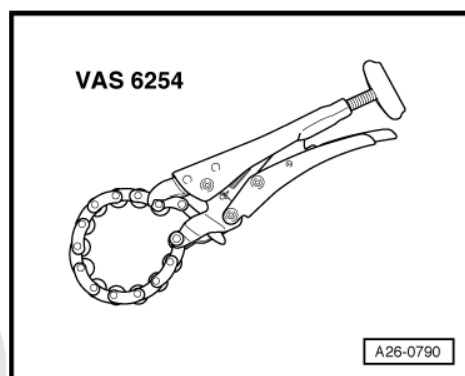


2.2 Separating centre and rear silencers

- ◆ The connecting pipe can be cut through at the cutting point in order to renew the centre and rear silencers separately.
- ◆ The cutting point is marked by an indentation on the outside of the exhaust pipe.

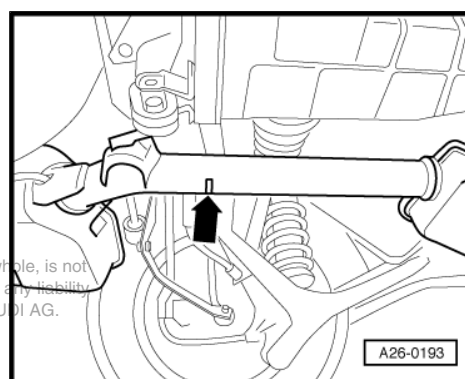
Special tools and workshop equipment required

- ◆ Chain pipe cutter - VAS 6254-



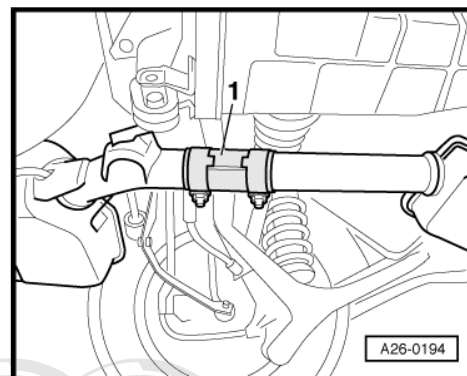
Procedure

- Cut through exhaust pipe at right angles at the position marked -arrow- using chain-type pipe cutter - VAS 6254-

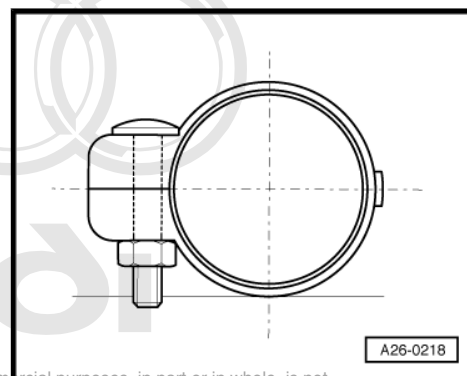


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- When installing, position centre of clamp -1- over cutting point.



- Fit clamp in horizontal position.
- Bolt connection faces to left.
- Align the exhaust system so it is free of stress ⇒ [page 217](#).



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2.3 Stress-free alignment of exhaust system

- The exhaust system must be aligned when it is cool.

Vehicles without clamp between centre silencer and rear silencer

- Loosen bolts on front clamp ⇒ [Item 12 \(page 214\)](#).
- Push exhaust system towards front of vehicle -arrow- so that mounting (rear right) for rear silencer is preloaded by -a- = 7 ... 11 mm.
- Tighten bolt connections on clamp evenly.
- Align tailpipes ⇒ [page 218](#).

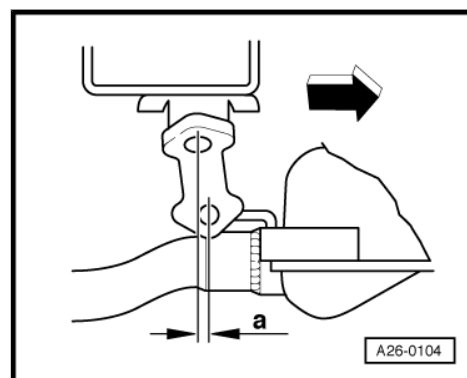
Vehicles with clamp between centre silencer and rear silencer



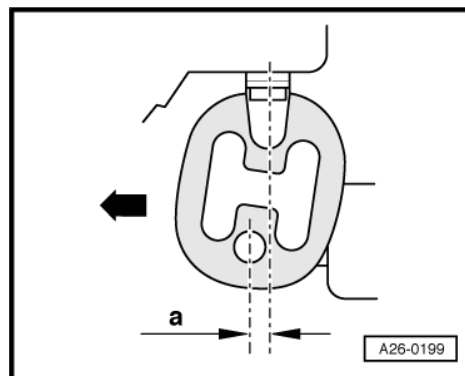
Note

On vehicles with clamp fitted between centre silencer and rear silencer, it is also necessary to align the centre silencer.

- Loosen bolts on front clamp ⇒ [Item 12 \(page 214\)](#) and rear clamp ⇒ [Item 21 \(page 214\)](#).



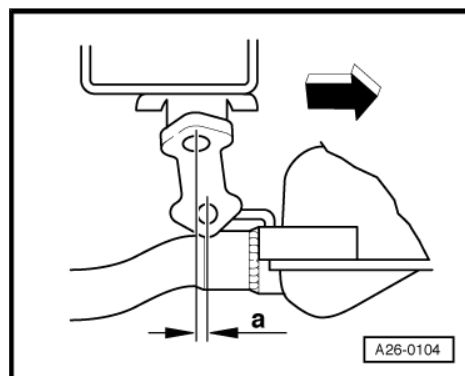
- Push front section of exhaust system towards front of vehicle -arrow-, so that mounting for centre silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolt connections on front clamp evenly
⇒ [Item 12 \(page 214\)](#) .



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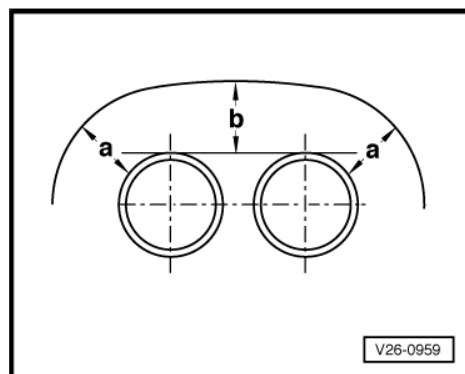
- Push rear silencer towards front of vehicle -arrow- until mounting (rear right) on rear silencer is preloaded by -a- = 7 ... 11 mm.
- Tighten bolt connections on rear clamp evenly
⇒ [Item 21 \(page 214\)](#) .
- Align tailpipes ⇒ [page 218](#) .

Tightening torque ⇒ [page 213](#)



Aligning tailpipes

- Align tailpipes as follows:
 - Distance -a- is the same on both sides.
 - Distance -b- from bumper cut-out to top of tailpipes should be at least 24 mm.



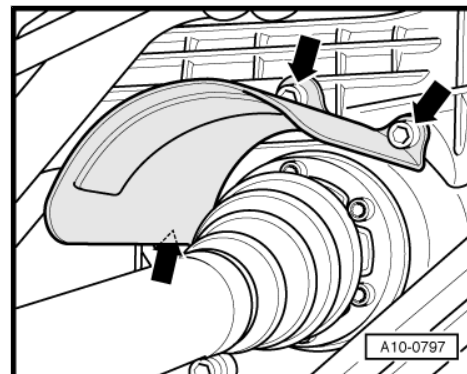
3 Catalytic converter, exhaust manifold

3.1 Removing and installing catalytic converter

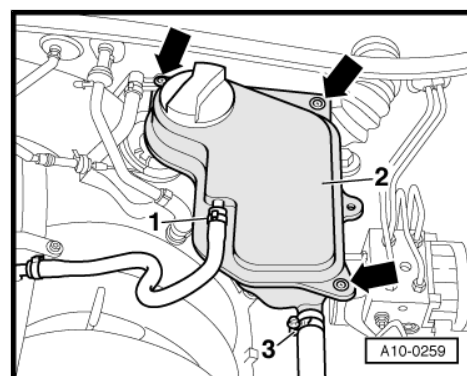
Removing

- Remove heat shield for drive shaft (right-side) -arrows-.

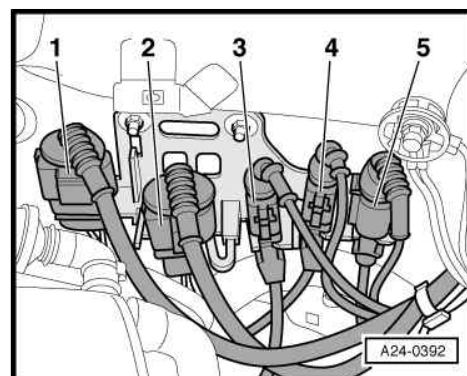
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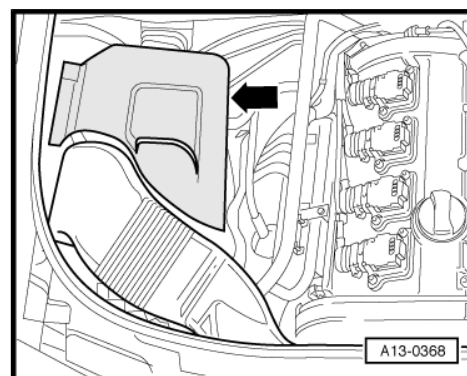
- Unbolt coolant expansion tank -2- -arrows-.
- Unplug electrical wiring for coolant shortage indicator switch - F66- at bottom of coolant expansion tank and move coolant expansion tank to one side with coolant hoses -1- and -3- attached.



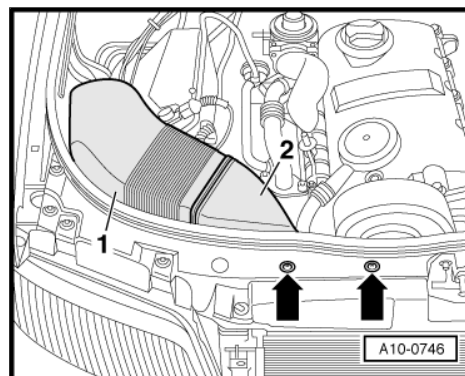
- Unplug electrical connectors and move electrical wiring clear.
- 1 - For Lambda probe after catalytic converter - G130- (brown, vehicles with 2 Lambda probes)
- 2 - For Lambda probe - G39- (before catalytic converter; black)



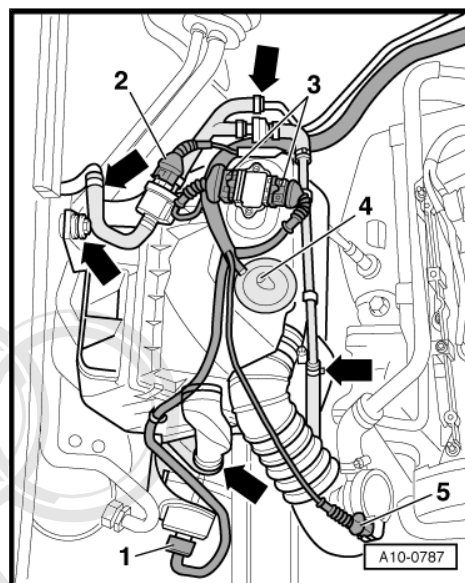
- Detach air cleaner cover -arrow-.



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



- Unplug electrical connectors:
- 1 - On secondary air pump motor - V101- (vehicles with secondary air system)
- 2 - On activated charcoal filter solenoid valve 1 - N80-
- 3 - On output stage - N122-
- 4 - On air mass meter - G70-
- 5 - On charge pressure control solenoid valve - N75-
- Move wiring harness clear and lay on top of engine.
- Detach hose connections and remove air cleaner housing -arrows-.
- Remove bolts securing front exhaust pipe to catalytic converter that are accessible from above.

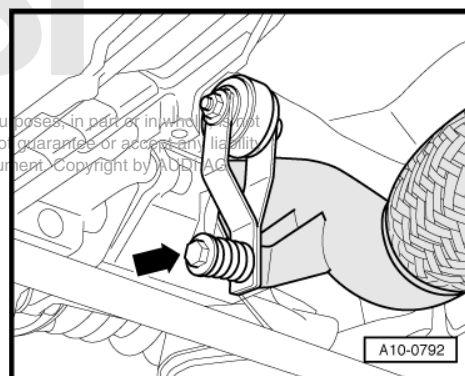


Caution

Avoid damage to flexible joint.

- ◆ Do not bend flexible joint more than 10°.
- ◆ Install flexible joint so that it is not under tension.
- ◆ Take care not to damage wire mesh on flexible joint.

- Unbolt bracket for exhaust system -arrow-.



- Remove bolts securing front exhaust pipe to catalytic converter that are accessible from below.
- Remove nuts -arrows- securing turbocharger to catalytic converter.
- Lift out catalytic converter.

Installing

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



Renew gaskets and self-locking nuts.

- Install air hoses with screw-type clips ⇒ [page 43](#) .
- Align exhaust system so it is free of stress: vehicles with front-wheel drive ⇒ [page 211](#) , vehicles with four-wheel drive ⇒ [page 217](#) .

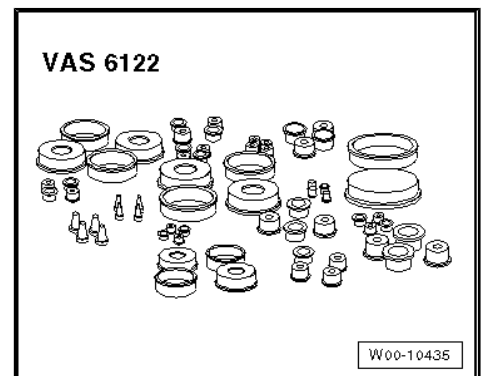
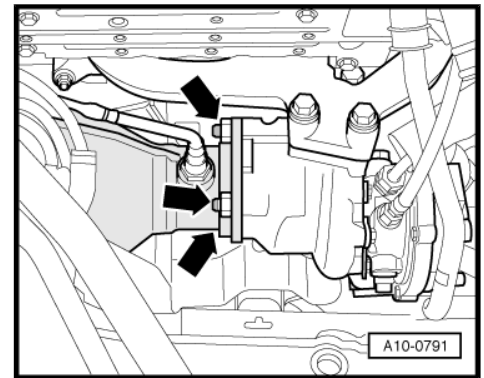
Tightening torques ⇒ [page 207](#) , ⇒ [page 213](#)

Component	Nm
Heat shield to gearbox	23

3.2 Removing and installing exhaust manifold

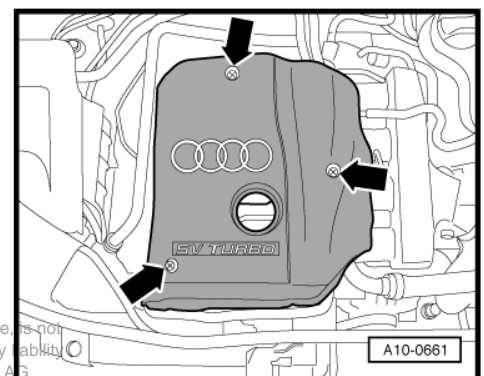
Special tools and workshop equipment required

- ♦ Engine bung set - VAS 6122-



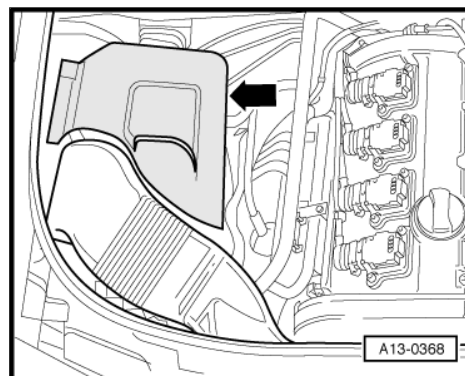
Removing

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

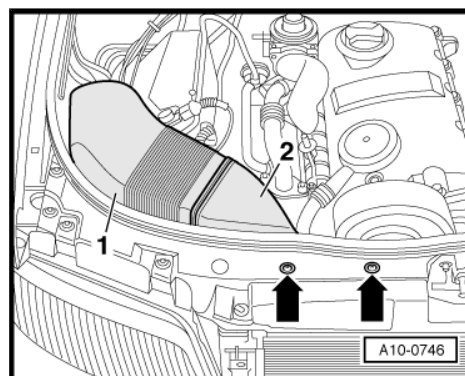


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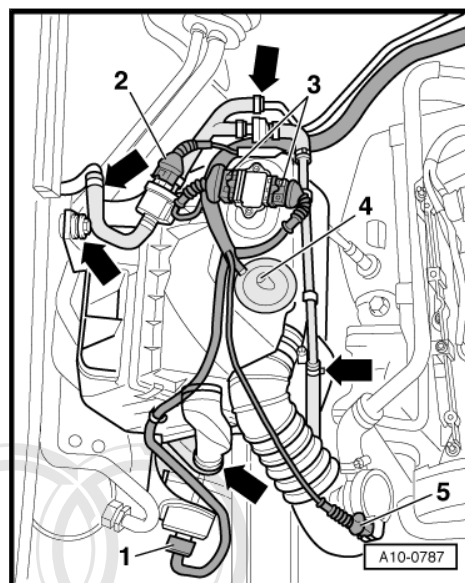
- Detach air cleaner cover -arrow-.



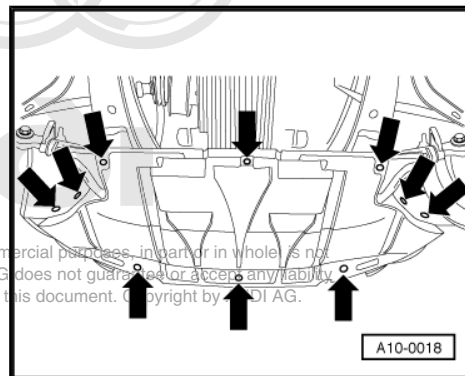
- Remove bolts -arrows-.
- Remove air duct -1 and 2-.



- Unplug electrical connectors:
 - 1 - On secondary air pump motor - V101- (vehicles with secondary air system)
 - 2 - On activated charcoal filter solenoid valve 1 - N80-
 - 3 - On output stage - N122-
 - 4 - On air mass meter - G70-
 - 5 - On charge pressure control solenoid valve - N75-
- Move wiring harness clear and lay on top of engine.
- Detach hose connections and remove air cleaner housing -arrows-.

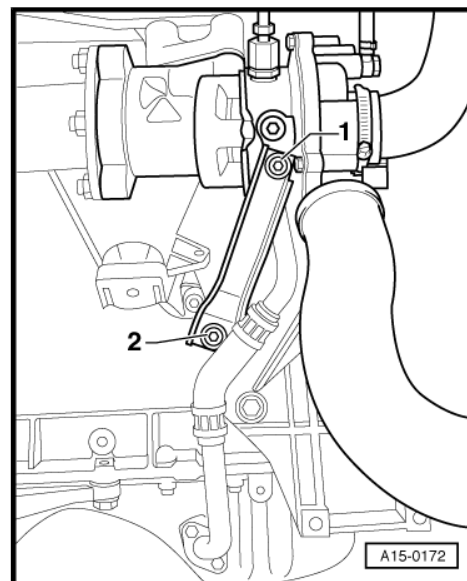


- Release fasteners -arrows- and remove noise insulation.



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- Loosen bolts -1- and -2- on support for turbocharger several turns.



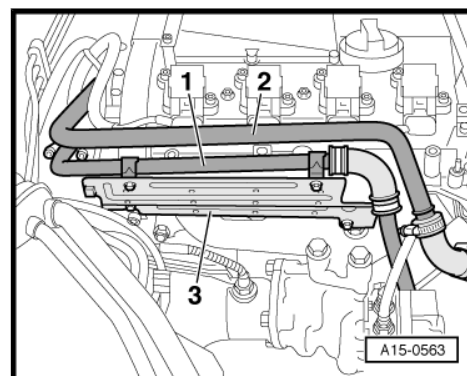
- Remove front hose from crankcase breather pipe -2-.

Vehicles with secondary air system:

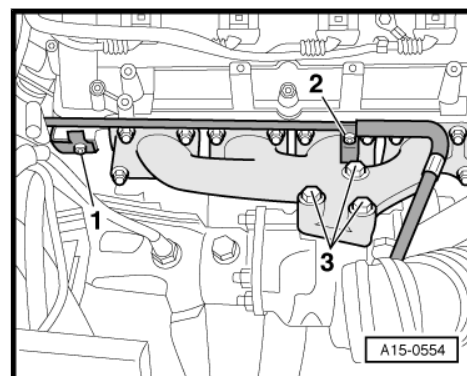
- Remove front hose from secondary air pipe -1-.

All vehicles (continued):

- Remove heat shield -3-.



- Unscrew bolts -1- and -2- for oil supply line.
- Remove bolts -3- for turbocharger.
- Detach gasket between turbocharger and exhaust manifold.
- Seal openings on turbocharger and all relevant ducts and hoses of the charge air system with plugs from engine bung set - VAS 6122- .



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- Remove nuts -arrows-.
- Detach washers and exhaust manifold.

Installing



Note

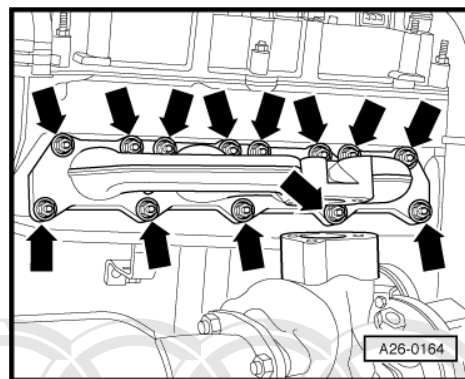
Renew gaskets and self-locking nuts.

- Fit exhaust manifold to cylinder head.
- Fit turbocharger to exhaust manifold.
- Fit bracket for turbocharger to cylinder block
- Fit bracket for turbocharger to turbocharger.

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

- Install air hoses with screw-type clips ⇒ [page 43](#) .

Tightening torques ⇒ [page 213](#)



3.3 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug tailpipes during leak test (e.g. with cloth or plug).
- Listen for leaks at connection points between cylinder head/exhaust manifold, exhaust manifold/turbocharger and turbocharger/catalytic converter etc.
- Rectify any leaks that are found.

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4 Secondary air system - engine codes ANB, ATW

The secondary air system is designed to enable the catalytic converter to heat up and reach its operating temperature more quickly after a cold start.

Principle

Because of the over-enrichment of the mixture in the cold start phase, the proportion of unburned hydrocarbons in the exhaust gas is higher. The secondary air system improves the afterburning (oxidation) process in the catalytic converter, and thus reduces toxic emissions. The heat generated by oxidation accelerates the "light off" of the catalytic converter and significantly improves exhaust gas quality during warm-up.

How the system works

- ◆ In the warm-up phase, the engine control unit activates the secondary air pump via the secondary air pump relay. Air is routed to the secondary air combination valve.
- ◆ In parallel to this, the secondary air inlet valve is activated and allows vacuum to pass to the secondary air combination valve. In this way, the combination valve opens a passage for the secondary air system to supply air to the exhaust ports in the cylinder head.

4.1 Secondary air system - overview



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1 - Secondary air pump motor - V101-

- ☐ Fitting location
⇒ [page 227](#)
- ☐ Checking voltage supply
⇒ [page 237](#)

2 - Air cleaner

3 - Combination valve for secondary air system

- ☐ Fitting location
⇒ [page 227](#)
- ☐ Checking for correct operation and leakage
⇒ [page 227](#)

4 - Non-return valve

- ☐ Installation position: as shown in illustration, the arrow points in direction of flow

5 - Secondary air pump relay - J299-

- ☐ Fitting location
⇒ [page 227](#)
- ☐ Checking ⇒ [page 233](#)

6 - Motronic control unit - J220-

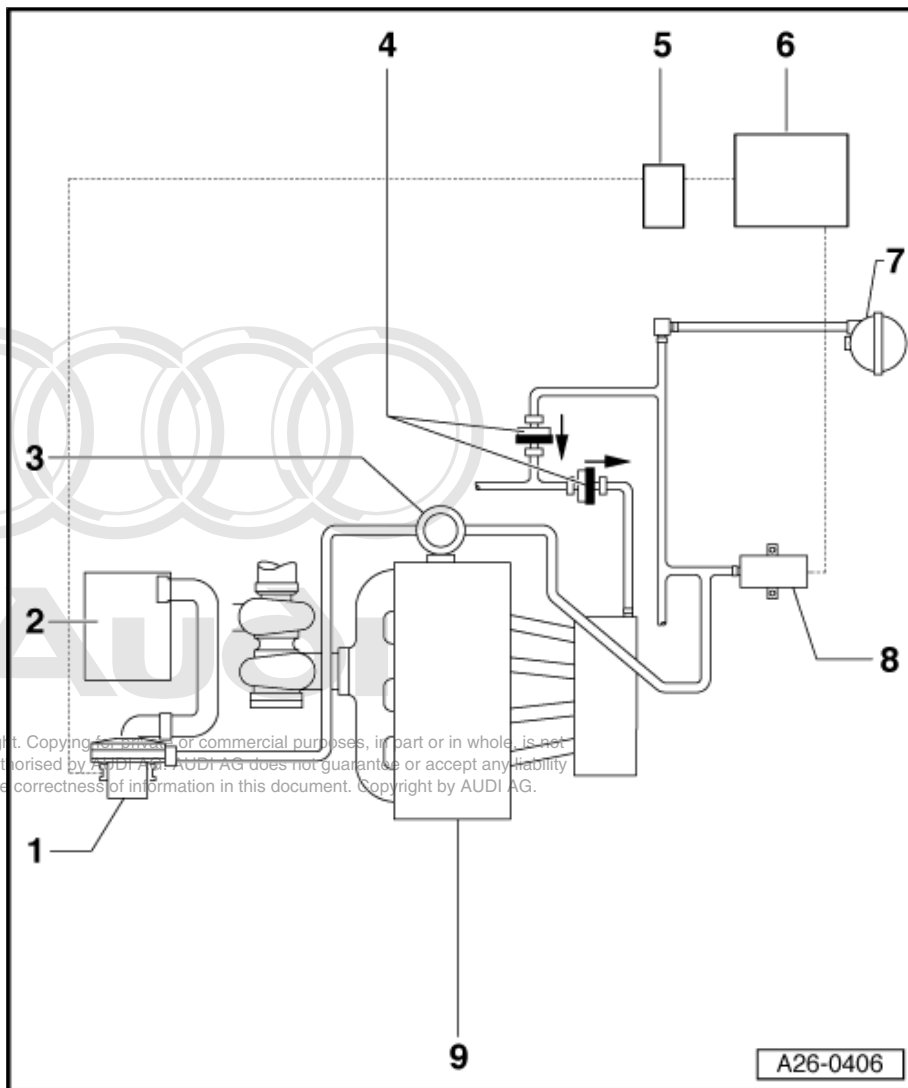
7 - Vacuum reservoir

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

8 - Secondary air inlet valve - N112-

- ☐ Fitting location
⇒ [page 226](#)
- ☐ Checking ⇒ [page 228](#)

9 - Cylinder head



Fitting location of secondary air inlet valve - N112-

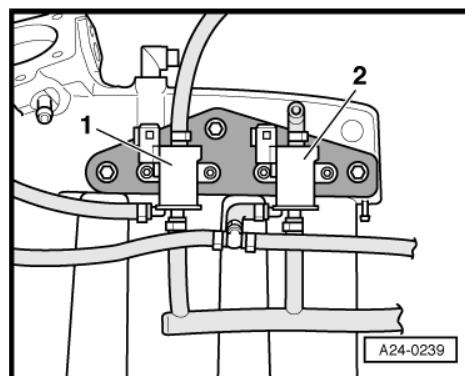
- ◆ Below intake manifold

- 1 - Turbocharger air recirculation valve - N249- (green connector)
- 2 - Secondary air inlet valve - N112- (brown connector)



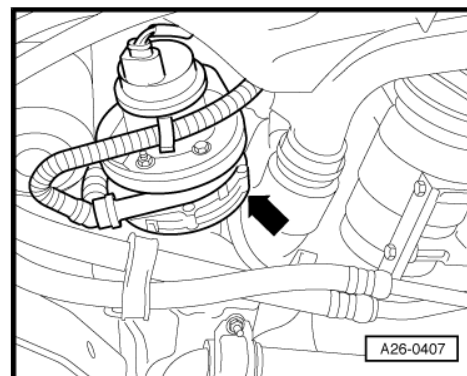
Note

For illustration purposes, the installation position is shown from the bottom and with the intake manifold removed.



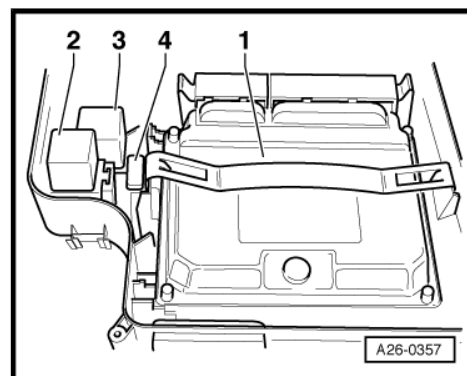
Fitting location of secondary air pump motor - V101-

- ◆ At front right of engine compartment, below longitudinal member.



Fitting location of secondary air pump relay - J299-

- ◆ In electronics box (plenum chamber)
- 1 - Motronic control unit - J220-
- 2 - Secondary air pump relay - J299-
- 3 - Motronic current supply relay - J271-
- 4 - Secondary air pump fuse - S130-



Fitting location of combination valve for secondary air system

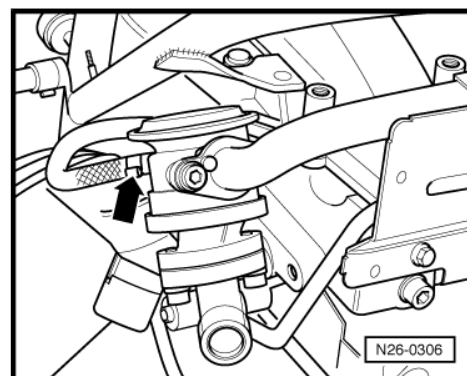
- ◆ On rear right of cylinder head.



Note

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

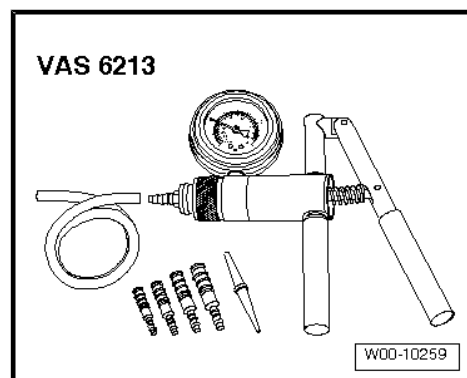
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4.2 Checking combination valve for secondary air system for proper operation and leakage

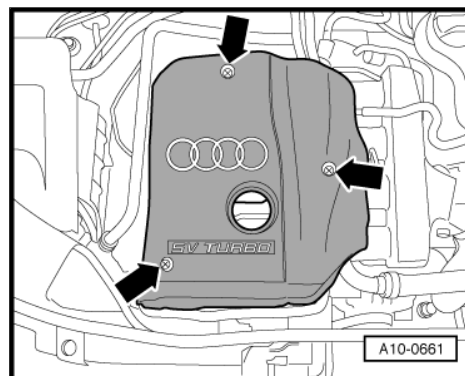
Special tools and workshop equipment required

- ◆ Hand vacuum pump - VAS 6213-



Procedure

- Vacuum hoses and hose connections do not leak.
- Vacuum hoses are not clogged.
- Release quick-release fasteners and remove engine cover panel -arrows-.



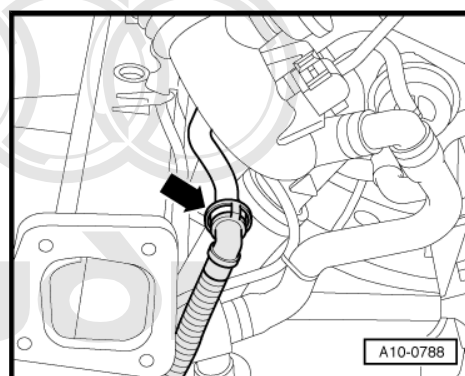
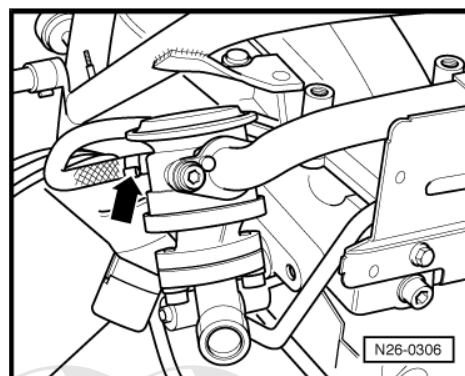
- Remove vacuum hose at combination valve for secondary air -arrow-.



Note

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

- Connect hand-operated vacuum pump to vacuum connection on combination valve for secondary air system.
- Disconnect hose -arrow- at pipe leading to combination valve for secondary air and attach test hose.
- Blow gently into pipe (do not use compressed air).
- The combination valve for secondary air system should be closed; it should not be possible to blow through the hose.
- Operate hand vacuum pump to produce a vacuum.
- The combination valve should open; it should now be possible to blow through the hose.



If the combination valve does not open:

- Renewing combination valve ⇒ [page 239](#)

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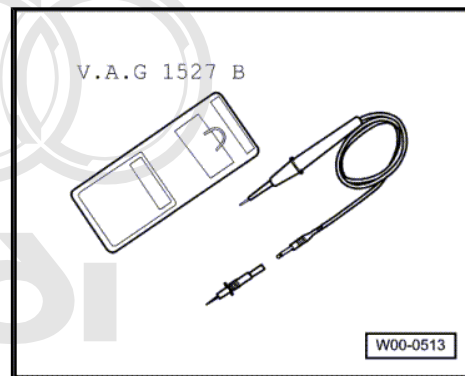
4.3 Checking secondary air inlet valve - N112-

Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526D-



◆ Voltage tester - V.A.G 1527B-



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

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◆ Adapter cable, 121-pin - V.A.G 1598/31-



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

Procedure



Note

The secondary air inlet valve - N112- and the wiring connections are monitored by the engine control unit.

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

Display on -VAS 5051B- :

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

If a fault relating to secondary air inlet valve - N112- is displayed:

- Press key to exit function “Interrogate fault memory”.
- Select “End output”.
- Switch off ignition.



- Disconnect hoses from secondary air inlet valve - N112- -item 2-; leave electrical connector attached.

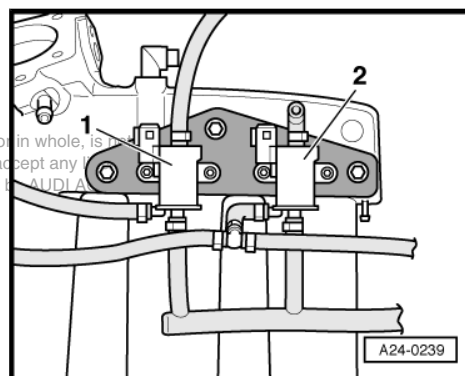
- Fitting location: below intake manifold.



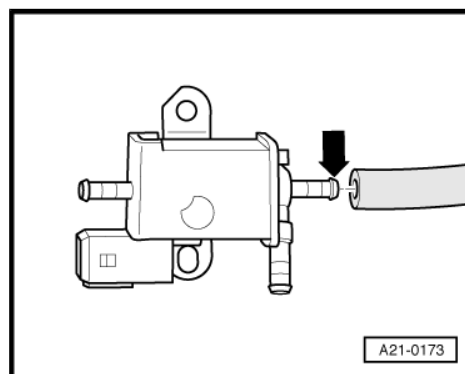
Note

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For illustration purposes, the installation position is shown from the bottom and with the intake manifold removed.



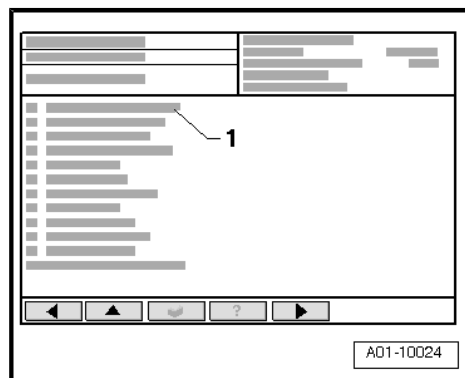
- Connect test hose to hose connection on secondary air inlet valve - N112- marked with an -arrow-.



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

Display on -VAS 5051B- :

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



- Press the  key repeatedly until the following display appears:

Display on -VAS 5051B- :

2 - Secondary air inlet valve - N112-

A - Actuator is running; continued switching is allowed

- The valve will be activated intermittently for approx. 1 minute (and should click audibly).
- The valve should open and close (check by blowing into the test hose).

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

- Select function “End output” and switch off ignition.

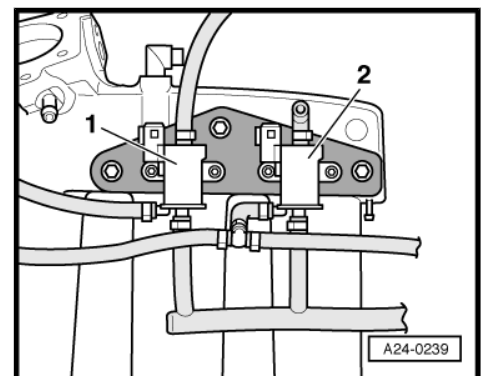
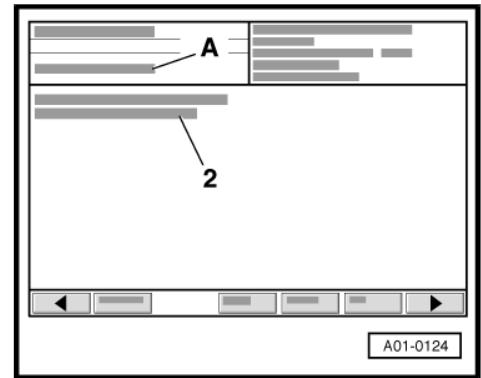
If valve clicks but does not open or close correctly:

- Check secondary air inlet valve - N112- .

If valve does not click:

Checking internal resistance

- Unplug electrical connector at secondary air inlet valve - N112- -item 2-.



- Connect hand-held multimeter - V.A.G 1526D- to measure resistance between contacts on secondary air inlet valve - N112- .

- Specification: 27 ... 30 Ω .

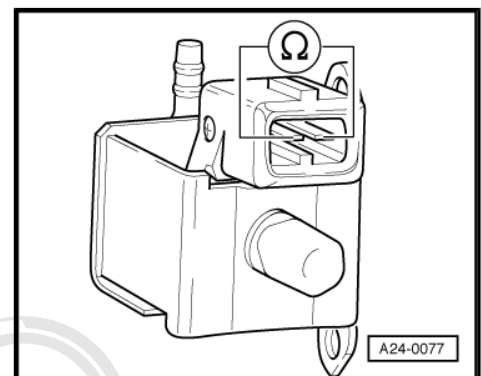
If the specification is not attained:

- Check 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; checking $\Rightarrow$ Rep. gr. 24



Note

The secondary air inlet valve - N112- is supplied with power via the fuel pump relay - J17- .

- Connect voltage tester - V.A.G 1527B- between contact -1- of connector for secondary air inlet valve - N112- and earth “-”.
- Briefly operate starter.
- The LED should light up.

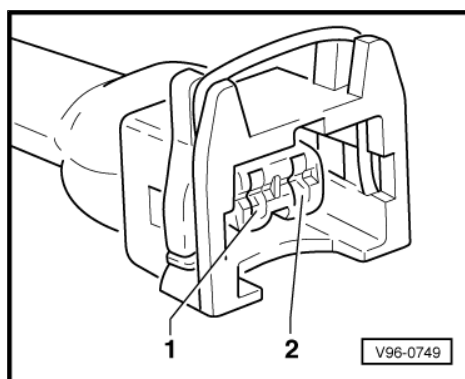
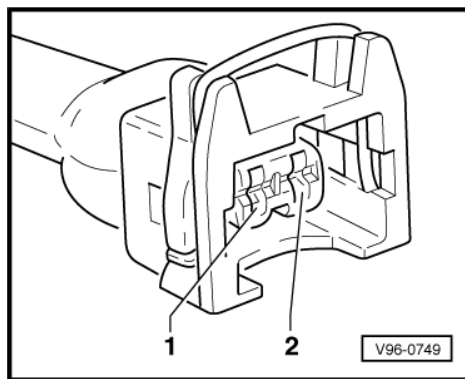
If LED does not light up:

- Check for open circuit in wiring from contact -1- of electrical connector for secondary air inlet valve - N112- via fuse to fuel pump relay - J17- ⇒ 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 1527B- between contacts -1- and -2- of connector for secondary air inlet valve - N112- .



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

Display on -VAS 5051B- :

- From menu -1-, select diagnostic function “Final control diagnosis” and press key to continue.
- Press the key repeatedly until the following display appears:

Display on -VAS 5051B- :

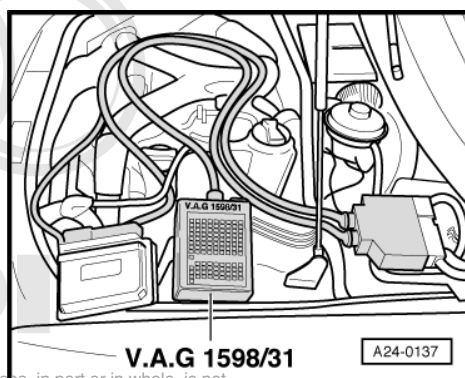
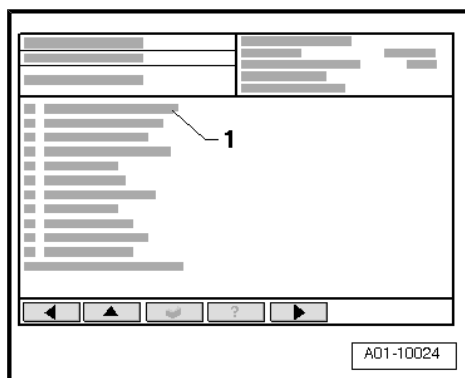
2 - Secondary air inlet valve - N112-

A - Actuator is running; continued switching is allowed

- The LED should flash.

If the LED does not flash or lights up continuously:

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

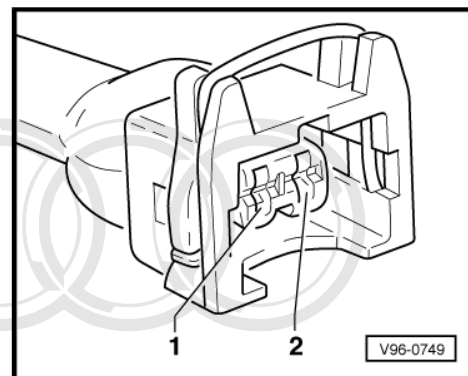


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- Check for open circuit and short to positive or earth in the following wiring for secondary air inlet valve - N112- .

Connector Contact	-V.A.G 1598/31- Socket
-2-	44

- Repair wiring connection if necessary.



4.4 Checking secondary air pump relay - J299- and secondary air pump motor - V101-

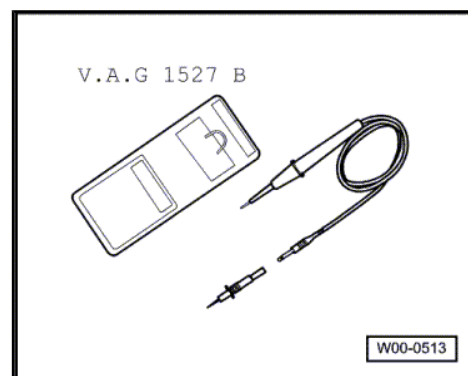
Special tools and workshop equipment required

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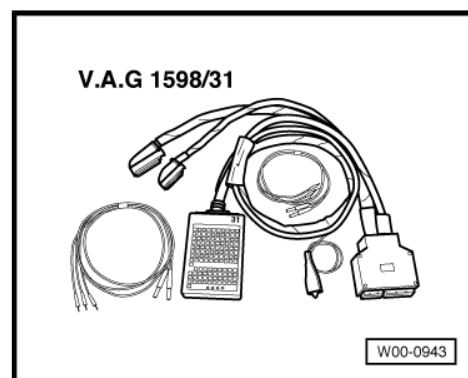
- ◆ Hand-held multimeter - V.A.G 1526D-



- ◆ Voltage tester - V.A.G 1527B-



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



- ◆ Adapter cable, 121-pin - V.A.G 1598/31-



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

Procedure

- Vehicle diagnostic, testing and information system - VAS 5051B- connected.
- Engine running.
- Vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

Display on -VAS 5051B- :

- From menu -1-, select diagnostic function "Interrogate fault memory" and press key to continue.

If the display shows a fault relating to secondary air pump relay - J299- :

- Press key to exit function "Interrogate fault memory".
- Switch off engine, then switch on ignition again.
- From menu -1- select diagnostic function "Final control diagnosis".

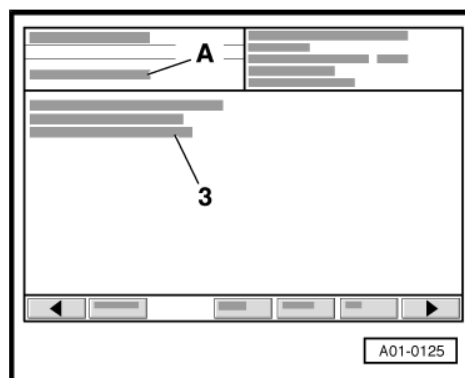


- Press the key repeatedly until the following display appears:

Display on -VAS 5051B- :

3 - Secondary air pump relay - J299-

A - Actuator is running; continued switching is allowed



- The secondary air pump relay - J299- -item 2- (located in electronics box in plenum chamber) should pick up and the secondary air pump motor - V101- should start up intermittently.
- Press  key to exit diagnostic function “Final control diagnosis”.
- Select function “End output” and switch off ignition.

A - If the relay does not pick up:

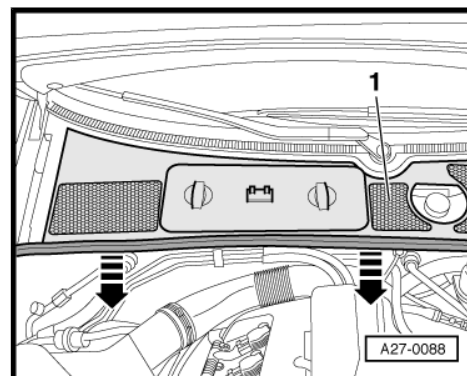
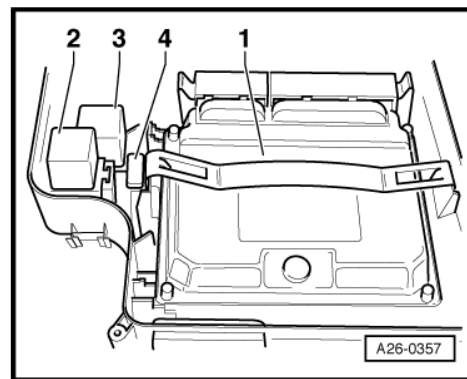
- Checking voltage supply of secondary air pump relay - J299-
⇒ [page 235](#) .
- Check activation of secondary air pump relay - J299-
⇒ [page 236](#) .

B - If the relay picks up but the secondary air pump motor - V101- does not run:

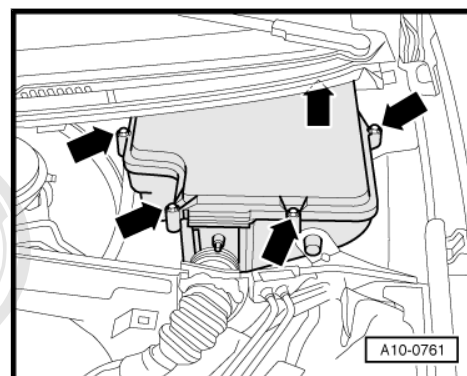
- Check voltage supply of secondary air pump motor - V101-
⇒ [page 237](#) .

Checking voltage supply for secondary air pump relay - J299-

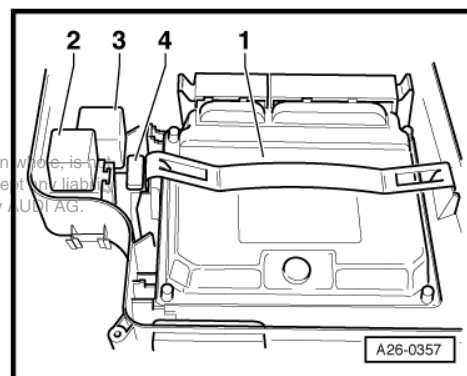
- Remove seal -arrows-.
- Pull off plenum chamber cover -1- towards front of vehicle.



- Remove bolts -arrows- and detach cover for electronics box in plenum chamber.

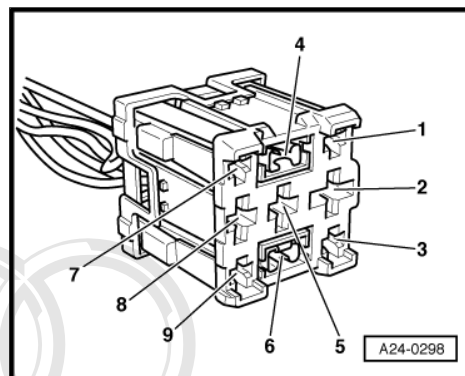


- Detach relay for secondary air pump - J299- -item 2-.

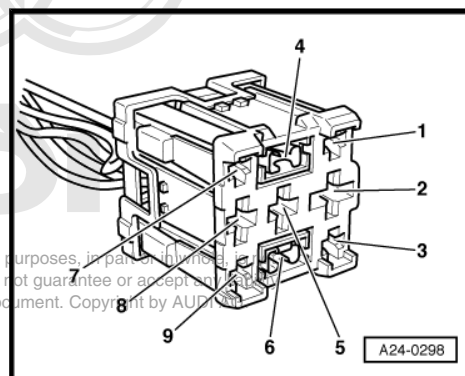


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- Connect hand-held multimeter - V.A.G 1526D- (voltage measuring range) between relay socket, contact -8- and earth.
- Specification: approx. battery voltage.
- If specification is not attained, check for open circuit in wiring between secondary air pump relay - J299- via secondary air pump fuse - S130- to battery + (terminal 30) ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

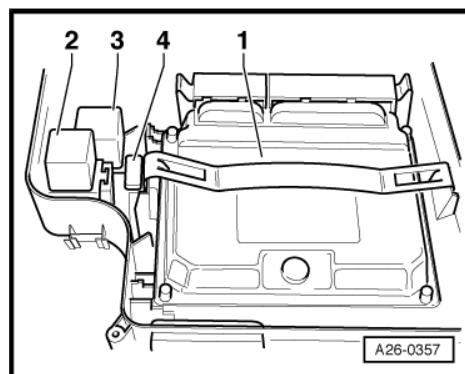


- Connect hand-held multimeter - V.A.G 1526D- (voltage measuring range) between relay socket, contact -4- and earth.
- Briefly operate starter.
- Specification: approx. battery voltage.
- If specification is not attained, check for open circuit in wiring between secondary air pump relay - J299- via fuse in fuse holder - S234- to fuel pump relay - J17- ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

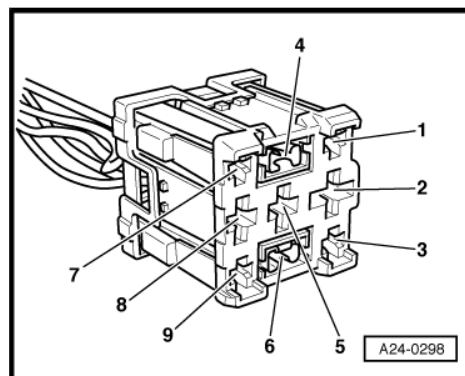


Checking activation of secondary air pump relay - J299-

- Switch off ignition.
- Detach relay for secondary air pump - J299- -item 2-.



- Connect voltage tester - V.A.G 1527B- between contact -6- of relay socket at position "2" in 3-position relay carrier in electronics box in plenum chamber and earth "-".



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

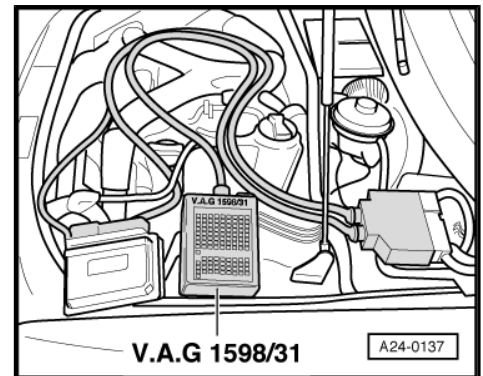
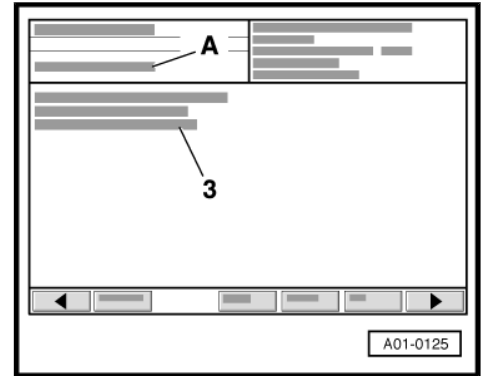
- Press the  key repeatedly until the following display appears:

Display on -VAS 5051B- :

3 - Secondary air pump relay - J299-

A - Actuator is running; continued switching is allowed

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



- Check for open circuit and short to positive or earth in the following wiring for secondary air pump relay - J299- .

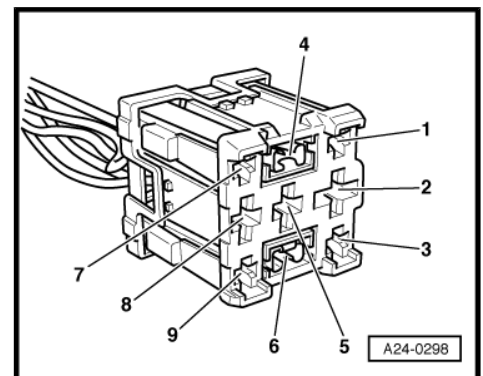
Connector Contact	-V.A.G 1598/31- Socket
-6-	66

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Repair wiring connection if necessary.

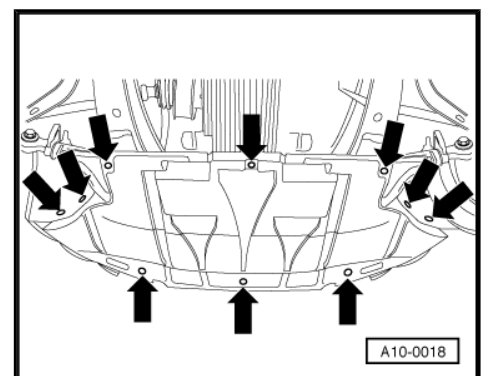
If no fault is found:

- Renew secondary air pump relay - J299- .

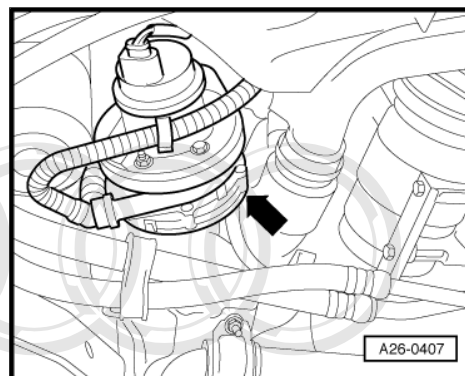


Checking voltage supply for secondary air pump motor - V101-

- Release fasteners -arrows- and remove noise insulation.

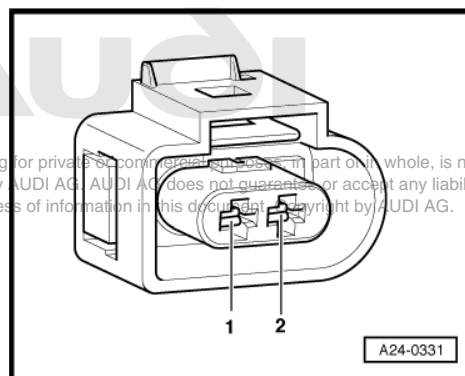


- Unplug electrical connector -arrow- at secondary air pump motor - V101- at front right of engine compartment below air cleaner housing.



- Connect voltage tester - V.A.G 1527B- between contacts -1- and -2- of connector for secondary air pump motor - V101- .
- Switch on ignition and select vehicle system "01 - Engine electronics".

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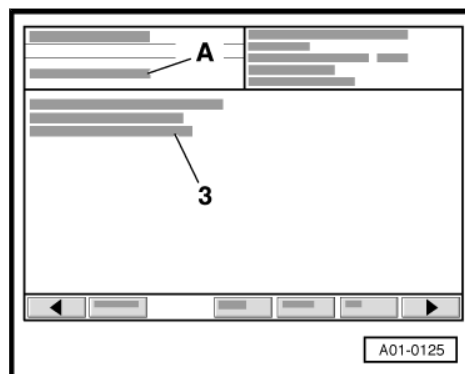
- Repeat diagnostic function "Final control diagnosis".
- Press the key repeatedly until the following display appears:

Display on -VAS 5051B- :

3 - Secondary air pump relay - J299-

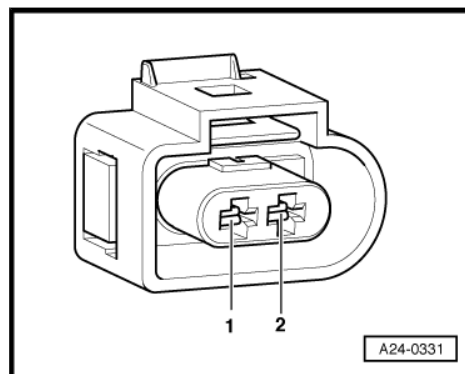
A - Actuator is running; continued switching is allowed

- The LED should flash.
- Press key to exit diagnostic function "Final control diagnosis".
- Select function "End output" and switch off ignition.



If the LED does not flash:

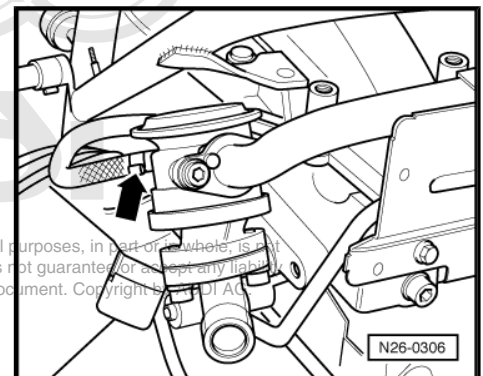
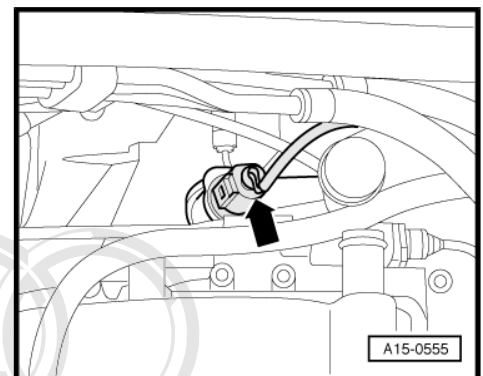
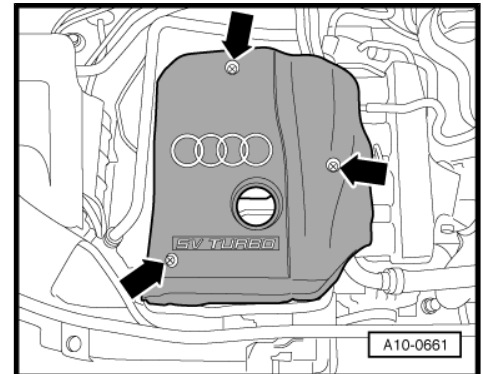
- Check for open circuit in wiring from contact -1- of connector to secondary air pump relay - J299- (on 3-position relay carrier in electronics box in plenum chamber, position "2") ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Check for open circuit in wiring from contact -2- of connector to earth ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- If no fault is found, renew secondary air pump motor - V101- .



4.5 Removing and installing combination valve for secondary air system

Removing

- Release quick-release fasteners and remove engine cover panel -arrows-.
- Unplug electrical connector -1- at coolant temperature display sender - G2- / coolant temperature sender - G62- .
- Move clear electrical wiring harness at bulkhead.
- Detach vacuum hose -arrow- from combination valve for secondary air system.



Note

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

- Remove 4 bolts and detach combination valve for secondary air system.

Installing

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

Note

- ◆ Renew seals and/or gaskets.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .

Tightening torques

Component	Nm
Combination valve for secondary air system to cylinder head	10
Secondary air pipe to cylinder head cover	10
Secondary air pipe to combination valve for secondary air	10