Workshop Manual

Audi Q3 2012 ➤

4-cylinder TDI engine (2.0 ltr. 4-valve common rail EA 189 - generation II)									
Engine ID	CFFA	CFFB	CFG C	CFG D	CLLB	CLJA			

Edition 11.2016

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

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00 – Technical data

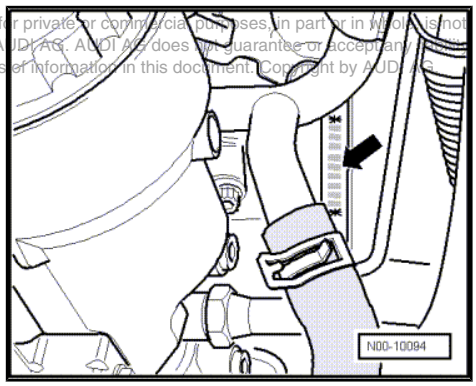
1 Identification

(ARL005020; Edition 11.2016)

⇒ “1.1 Engine identification number/engine data”, page 1

1.1 Engine identification number/engine data

Engine number



- The engine number (“engine code” and “serial number”) -arrow- can be found at the front of the joint between engine and gearbox.
- There is also a sticker with “engine code” and “serial number” attached to the toothed belt cover.
- Engine codes starting with the letter “C” have four letters (previously three letters).
- The first 3 characters of the engine code stand for the engine capacity and the mechanical construction and design. They are stamped onto the cylinder block together with the serial number.
- The 4th character indicates the power output and torque of the engine and is determined by the engine control unit.

Note

- *The four-letter engine code is found on the type plate (country specific version), vehicle data sticker and engine control unit.*
- *Fitting locations of the type plate (certain countries only) and the vehicle data sticker ⇒ Maintenance ; Booklet 820 .*

For engine data refer to ⇒ Technical data for engines; Rep. gr. 00 ; Overview of engines .

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2 Safety precautions

⇒ “2.1 Safety precautions when working on the fuel supply system”, page 2

⇒ “2.2 Safety precautions when using testers and measuring instruments during a road test”, page 3

⇒ “2.3 Safety precautions when working on vehicles with start/stop system”, page 3

⇒ “2.4 Safety precautions when working on the cooling system”, page 3

⇒ “2.5 Safety precautions when working on the exhaust system”, page 4

2.1 Safety precautions when working on the fuel supply system

When working on the fuel system note the following warnings:

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Risk of injury - fuel system operates under high pressure

The fuel system is pressurised. There is a risk of injury as fuel may spray out.

Before opening the fuel system:

– Put on safety goggles.

– Put on protective gloves.

– Release pressure (wrap a clean cloth around connection and open connection carefully).

Risk of fire due to escaping fuel

If the battery is connected, the door contact switch activates the fuel pump when the driver's door is opened. Escaping fuel may ignite, causing a fire.

– Before opening the fuel system, disconnect power supply to fuel pump.

Caution

The high-pressure pump has very close tolerances and must not be allowed to run without fuel. To prevent this and to enable the engine to start quickly after parts have been renewed, it is important to observe the following:

- *If components of the fuel system between the fuel tank and the high-pressure pump are removed or renewed, the fuel system must be bled ⇒ page 236 .*
- *If the high-pressure pump is removed or renewed, the first fuel filling operation must be performed before the engine is started for the first time ⇒ page 236 .*

Risk of irreparable damage to electronic components.

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

– Always switch off the ignition before disconnecting the battery.

– Remove fuse for fuel pump control unit - J538- in fuse holder B - SB- in electronics box in engine compartment; for identification of fuses refer to ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

2.2 Safety precautions when 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:

Risk of injury if test equipment is not secured

If an accident occurs and the front passenger's airbag is triggered, test equipment which is not secured adequately may be catapulted through the vehicle with potentially serious consequences.

– Secure test equipment on the rear seat with a strap.

Or:

– Have a second mechanic operate test equipment on the rear seat.

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2.3 Safety precautions when working on vehicles with start/stop system

When performing repairs on vehicles with start/stop system, note the following:

Risk of injury - engine may start unexpectedly

On vehicles with the start/stop system activated, the engine may start unexpectedly. A message in the instrument cluster indicates whether the start/stop system is activated.

– Deactivate start/stop system by switching off ignition.

2.4 Safety precautions when working on the cooling system

When working on the cooling system note the following:

Risk of scalding as hot coolant can escape

The cooling system is under pressure when the engine is hot. Hot steam/hot coolant can escape - risk of scalding.

– Put on protective gloves.

– Put on safety goggles.

– Cover filler cap on expansion tank with a cloth and open carefully to release pressure.

2.5 Safety precautions when working on the exhaust system

WARNING

Please note the following warnings when working on all parts of the exhaust system:

- *Wear gloves (e.g. rubber, not textile) and safety goggles to avoid contact with eyes and skin - risk of injury.*
- *Do not dismantle exhaust gas temperature sender - risk of injury.*

Caution

Risk of 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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3 Repair instructions

⇒ “3.1 Rules for cleanliness”, page 5

⇒ “3.2 General notes”, page 5

⇒ “3.3 General repair instructions”, page 6

⇒ “3.4 Foreign particles in engine”, page 6

⇒ “3.5 Contact corrosion”, page 7

⇒ “3.6 Routing and attachment of pipes, hoses and wiring”, page 7

⇒ “3.7 Installing radiators and condensers”, page 7

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3.1 Rules for cleanliness

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

- Clean connections and surrounding area thoroughly with engine cleaner or brake cleaner and dry cleaned area before loosening.
- Immediately seal open lines and connections with clean plugs, for example from engine bung set - VAS 6122- .
- After removal, place parts on a clean surface and cover them. Use lint-free cloths.
- Carefully cover or seal open components if repairs cannot be carried out immediately.
- Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have not been stored in the proper packaging (e.g. in tool boxes etc.).
- Do not work with compressed air when the system is open. If possible, do not move vehicle.
- Protect unplugged electrical connectors against dirt and moisture and make sure connections are dry when attaching.
- Also ensure that no diesel fuel comes into contact with the coolant hoses. Should this occur, the hoses must be cleaned immediately. Damaged hoses must be renewed.

3.2 General notes

- The engine control unit has a self-diagnosis capability. Before carrying out repairs and fault finding, the event memory must be interrogated. The vacuum hoses and connections must also be checked (unmetered air).
- A voltage of at least 11.5 V is required for proper operation of the electrical components.
- Do not use sealants containing silicone. Particles of silicone drawn into the engine will not be burnt in the engine and will damage the Lambda probe.
- The vehicles are fitted with a crash/fuel shut-off system. This system is designed to reduce the risk of a vehicle fire after a crash by deactivating the fuel pump via the fuel pump relay.
- At the same time, this system also improves the engine's starting performance. When the driver's door is opened, the fuel pump is activated for 2 seconds in order to build up pressure in the fuel system ⇒ page 2 .

3.3 General repair instructions

Caution

The high-pressure pump has very close tolerances and must not be allowed to run without fuel. To prevent this and to enable the engine to start quickly after parts have been renewed, it is important to observe the following:

- ***If components of the fuel system between the fuel tank and the high-pressure pump are removed or renewed, the fuel system must be filled and bled before the engine is started for the first time*** ⇒ page 236 .

- Clean tools and workbench etc. before working on the injection system.
- Before installing, check the injectors and their surroundings visually; they must be undamaged and clean. Make sure the injector bores in the cylinder head are clean. Wipe out if necessary using a clean cloth, taking care not to cause damage. Do not use sharp objects of any kind.
- If the high-pressure fuel lines are to be re-used, you must mark them before removal. High-pressure pipes must always be re-installed on the same cylinder.
- Take care not to damage the injectors when removing the old copper seals.
- Check all new O-rings for damage before installing. Lubricate O-rings with engine oil or assembly oil before installing.
- Position high-pressure pipes so they are free of stress. Tighten all unions lightly to start with before tightening to final torque.
- Never attempt to bend high-pressure fuel lines to shape.
- When working on any parts of the high-pressure fuel system, tools may only be used for loosening and tightening pipe unions. All other components must always be removed and installed by hand without using tools or other equipment.
- Press the fuel return hoses onto the injectors by hand from above so that they engage audibly on each injector (do not press in the release pins when doing this). Then press down the release pin after connecting the return line. Check that the fuel return hoses are seated securely and sealed properly by pulling them by hand from above.
- Do not dismantle individual common rail components. If there is a fault, the complete components must be renewed.
- When the engine is running, do not perform any repairs to the common rail system.
- Do not bleed the common rail system by unfastening high-pressure components after the engine has been started.
- All cable ties which are released or cut open when removing must be refitted in the same position when installing.
- Fuel hoses in engine compartment must only be secured with spring-type clips. O-type clips or screw-type clips must not be used.

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3.4 Foreign particles in engine

When performing assembly work on the engine, all open passages in the intake and exhaust systems must be sealed with suitable

plugs (e.g. from engine bung set - VAS 6122-) to prevent foreign particles from entering the engine.

Note

If the turbocharger has suffered mechanical damage
⇒ page 210

3.5 Contact corrosion

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

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

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

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

Please note:

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

3.6 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 avoid damaging pipes, hoses and wiring, ensure sufficient clearance from all moving or hot components in engine compartment (little space in engine compartment).

3.7 Installing radiators and condensers

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.

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10 – Removing and installing engine

1 Removing and installing engine

⇒ “1.1 Removing engine”, page 8

⇒ “1.2 Separating engine and gearbox”, page 26

⇒ “1.3 Securing engine to engine and gearbox support”, page 31

⇒ “1.4 Installing engine”, page 32

1.1 Removing engine

When installing a new base engine, you must check whether there is a sticker on the cylinder head cover.

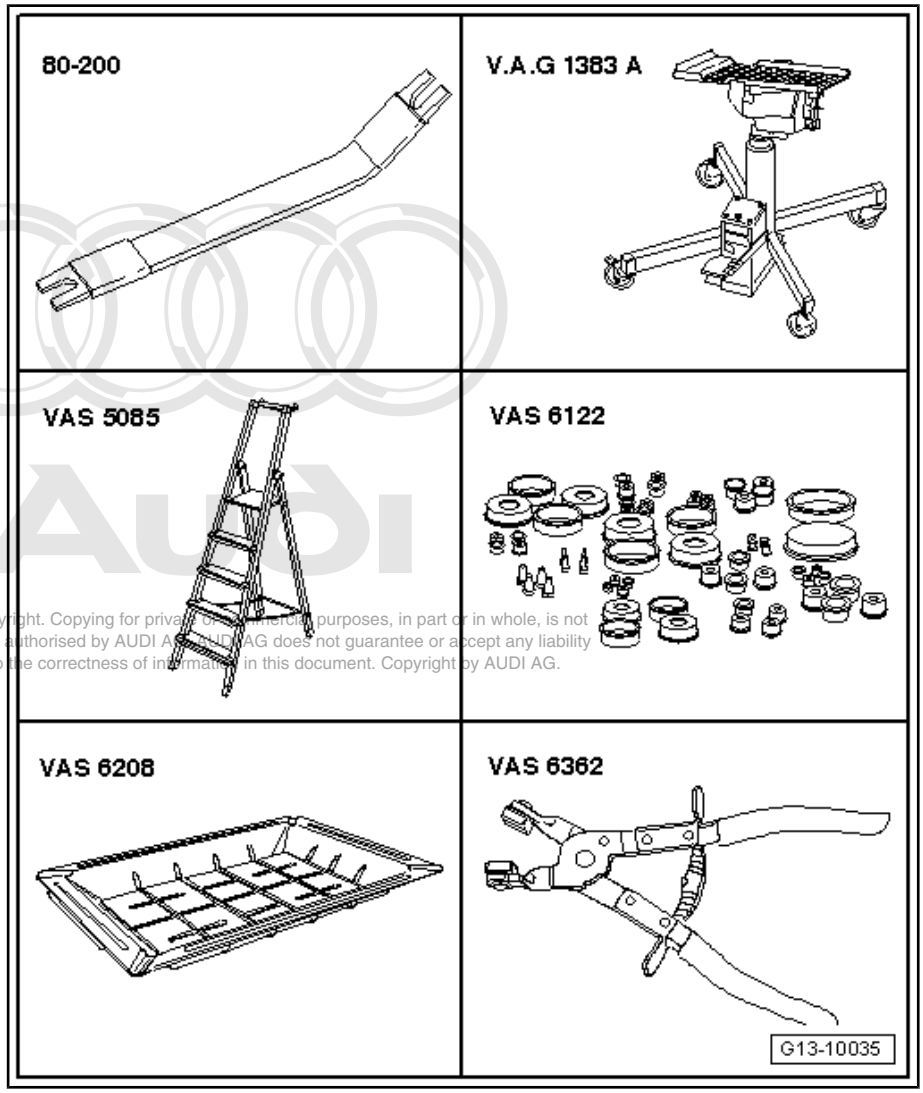
If a sticker is attached which states `Spannpratzen auf vorgeschriebenes Drehmoment angezogen` (clamping pieces tightened to specified torque), the clamping pieces have already been tightened to the specified final torque at the factory.

If no sticker is attached, it is essential that the clamping pieces for the injectors are tightened to the specified torque after installing the high-pressure pipes. If these instructions are not observed, the engine could be damaged.

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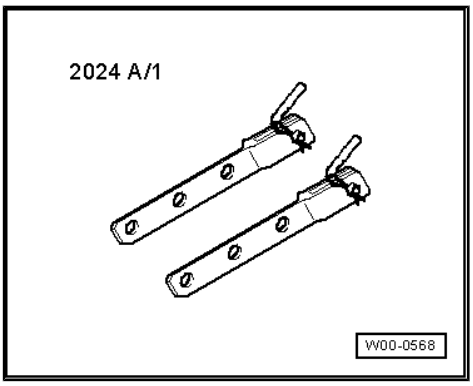
Special tools and workshop equipment required

- Removal lever - 80 - 200-
- Engine and gearbox jack - V.A.G 1383 A-
- Stepladder - VAS 5085-
- Engine bung set - VAS 6122-
- Drip tray for workshop hoist - VAS 6208-
- Hose clip pliers - VAS 6362-

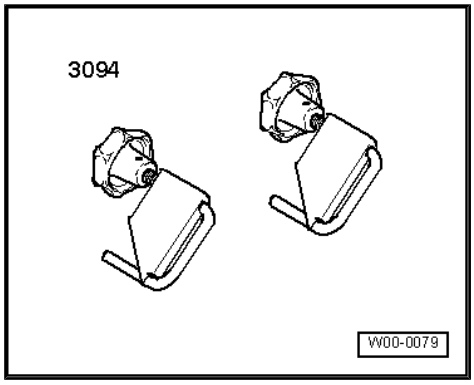


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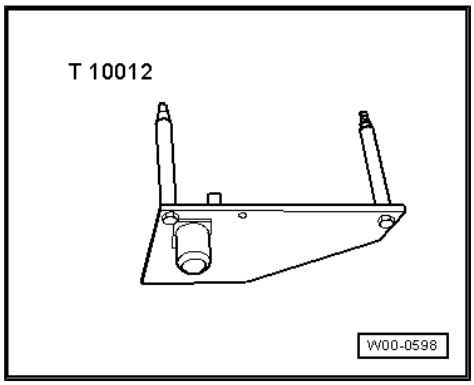
- Extension -2024 A /1- for lifting tackle - 2024 A-



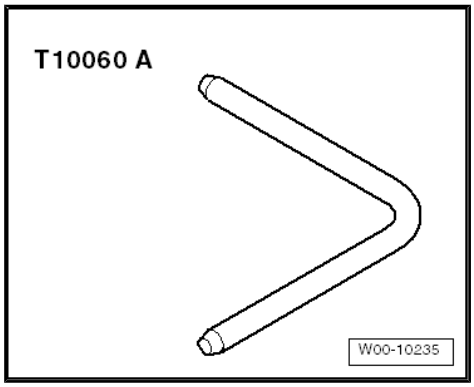
- Hose clamps, up to 25 mm - 3094-



- Engine bracket - T10012-



- Locking pin - T10060 A-



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- Safety goggles
- Protective gloves

Procedure

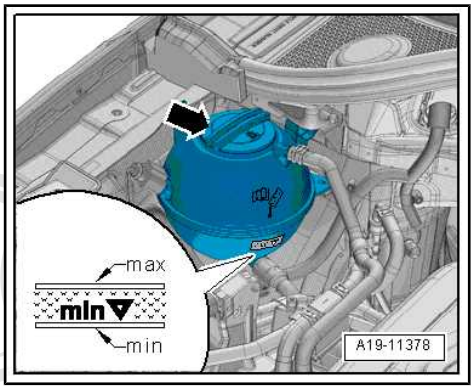
Note

- *The engine is removed from underneath together with the gearbox.*
- *Fit all cable ties in the original positions when installing.*
- *Fit heat insulation sleeves in the original positions when installing.*

WARNING

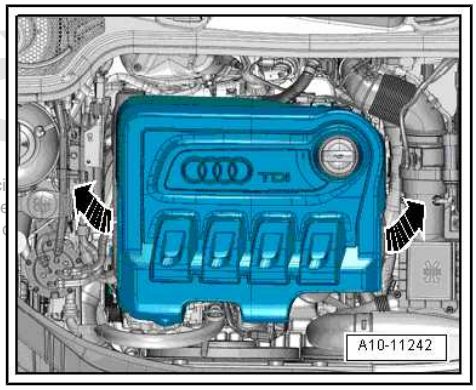
Hot steam/hot coolant can escape - risk of scalding.

- *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.*



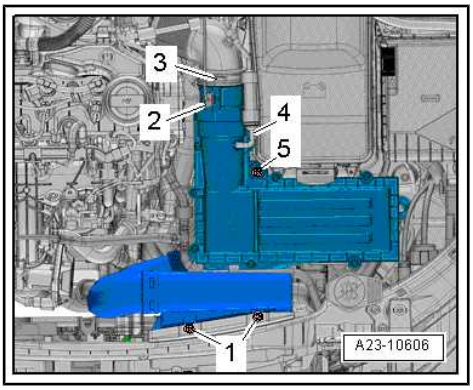
– Open filler cap -arrow- on coolant expansion tank.

– Carefully pull engine cover panel off retaining pins one after another -arrows-. Do not jerk engine cover panel away, and do not try to pull on one side only.

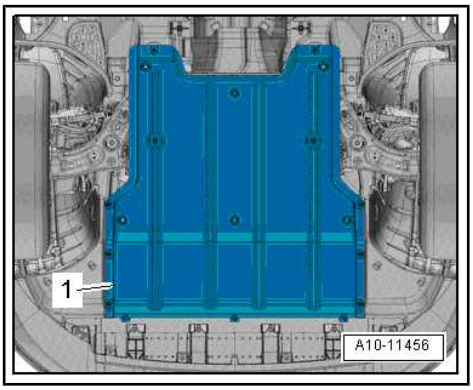


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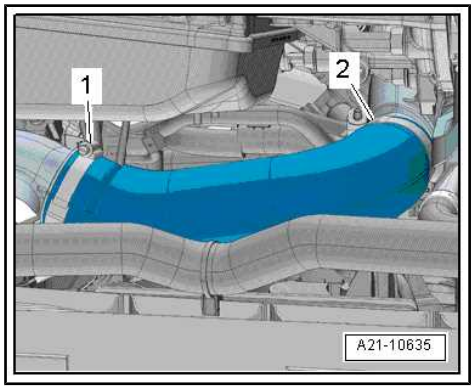
– Unplug electrical connector -2- at air mass meter - G70- .
– Detach hose -4-.
– Release hose clip -3- and detach air hose.
– Unscrew bolts -1 and 5- and detach air cleaner housing.



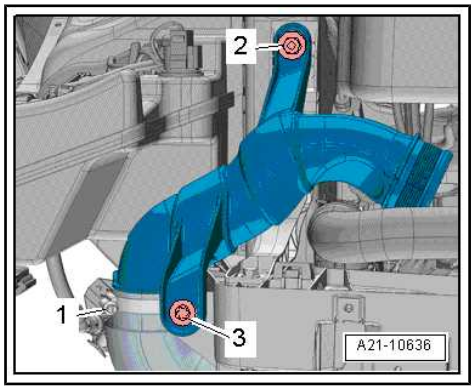
– Remove both front wheels ⇒ Running gear, axles, steering; Rep. gr. 44 ; Wheels, tyres .
– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .
– Remove wheel spoilers (front) on both sides ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liners; Exploded view - wheel housing liner (front) .



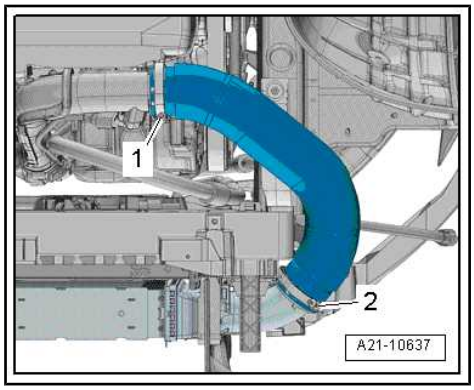
– Release hose clips -1 and 2- and remove air hose.



– Remove bolt -1- and nut -3-.
– Release hose clip -2- and detach air pipe.



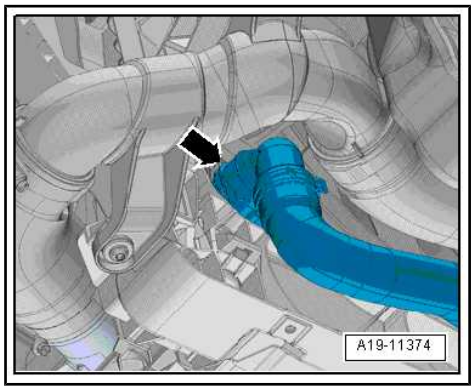
– Release hose clips -1 and 2- and remove air hose.
– Seal off open lines and connections with clean plugs from engine bung set - VAS 6122- .



Note

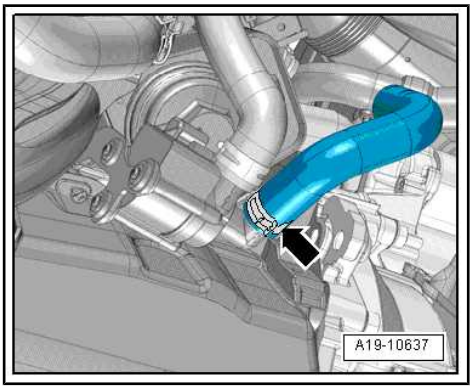
Collect drained coolant in a clean container for re-use or disposal.

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



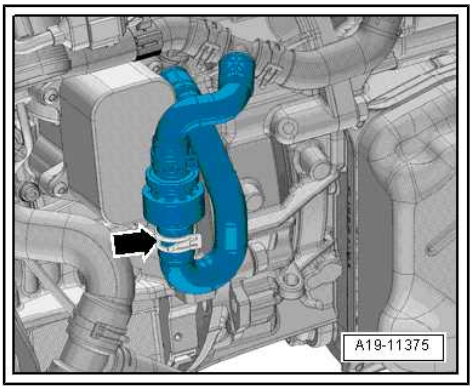
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– Open hose clip -arrow-, disconnect coolant hose (bottom) leading to pump for exhaust gas recirculation cooler - V400- and drain off coolant.

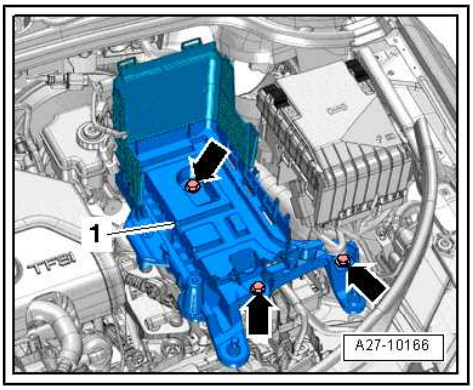


– Release hose clip -arrow-, disconnect coolant hose and drain off coolant.

– Disconnect battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Disconnecting and connecting battery .



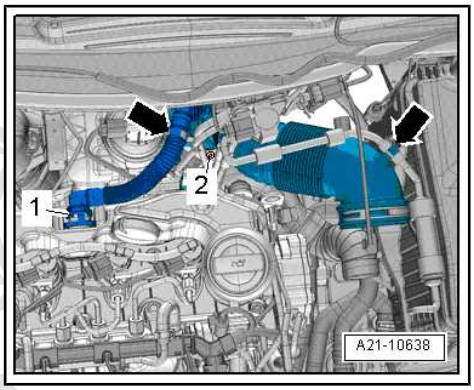
– Remove battery and battery tray ⇒ Electrical system; Rep. gr. 27 ; Battery; Removing and installing battery tray .



– Press release tabs and disconnect crankcase breather hose -1- from cylinder head cover.

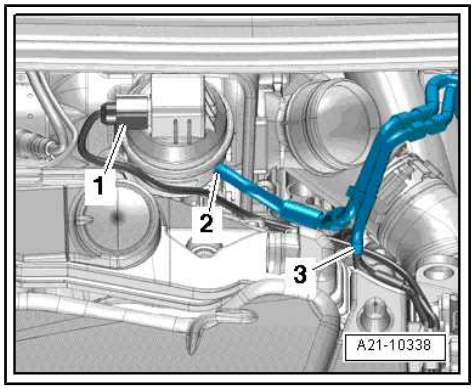
– Move clear vacuum hoses -arrows- at air pipes.

– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.



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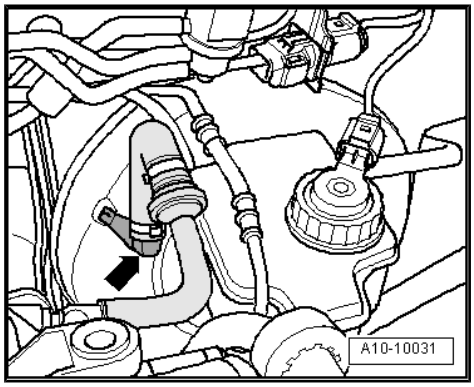
– Detach vacuum hose -2- from vacuum unit of turbocharger.
– Disconnect vacuum hose -3-.



Note

Disregard -item 1-.

– Detach vacuum hose -arrow- from brake servo.

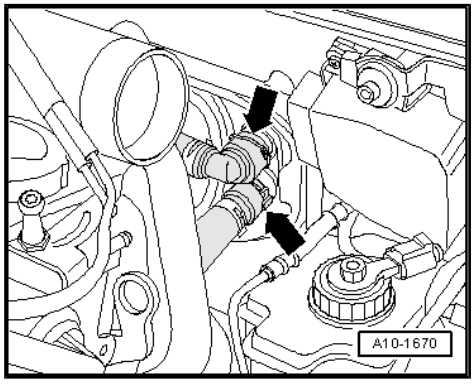


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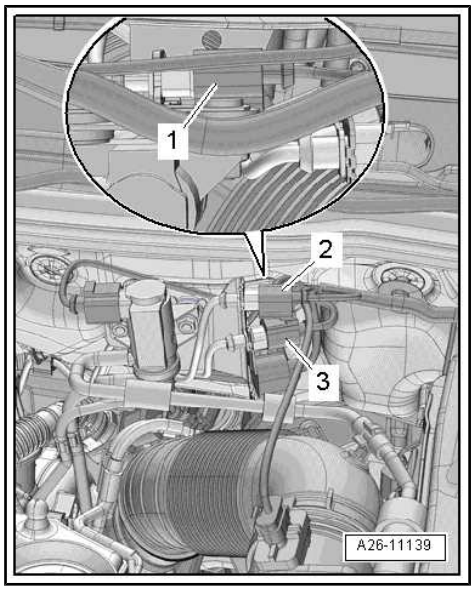
Note

Place a cloth underneath heat exchanger for heater to catch escaping coolant.

– Lift retaining clips -arrows- and disconnect coolant hoses from heat exchanger for heater.



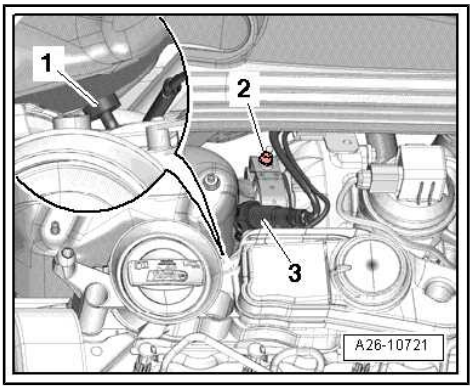
– Take electrical connector -2- out of bracket, unplug it and move electrical wiring clear.
– Move clear electrical wiring at turbocharger.



Note

Disregard items -1 and 3-.

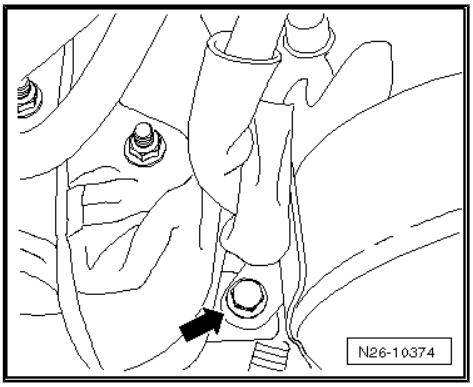
– Slacken bolt -2- and remove clamp.



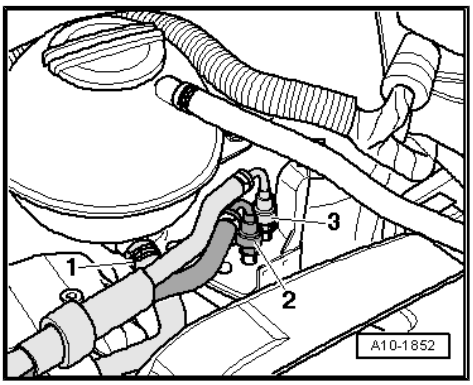
Note

Disregard items -1 and 3-.

– Remove bolt -arrow- securing top bracket for particulate filter.



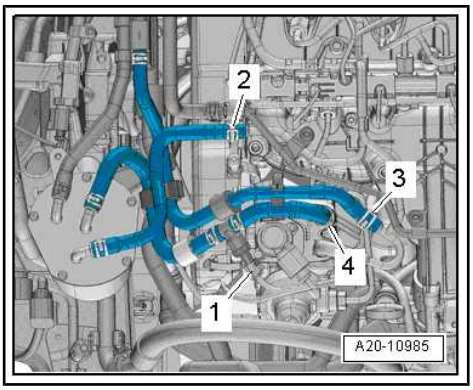
– Release hose clip -1-, detach coolant hose from coolant expansion tank and move coolant hose clear.



Note

Disregard items -2 and 3-.

– Unplug electrical connector -1- on fuel temperature sender -G81- .



WARNING

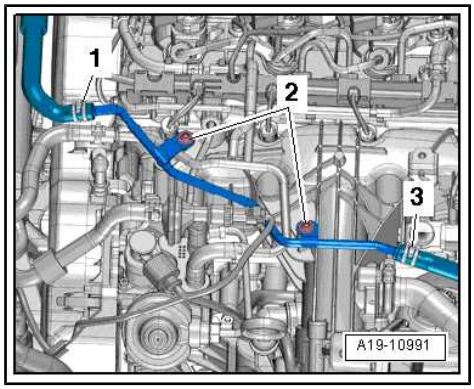
Very hot fuel - risk of burn injuries!

- ***After switching off the engine, the temperature of fuel pipes and the fuel itself can be up to 100 °C in extreme cases. Let fuel cool off before opening any connections; otherwise there is a danger of scalding!***
- ***Put on protective gloves.***
- ***Put on safety goggles.***

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– Release hose clips -2, 3, 4- and disconnect fuel supply hose and fuel return hoses.

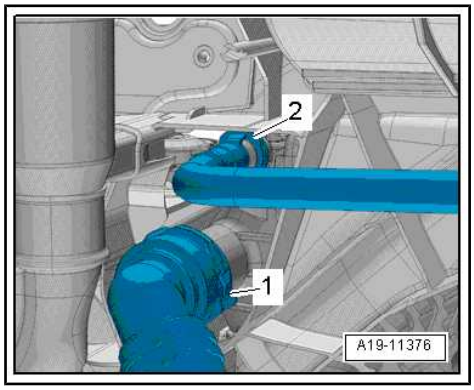
– Release hose clip -1- and detach coolant hose.



Note

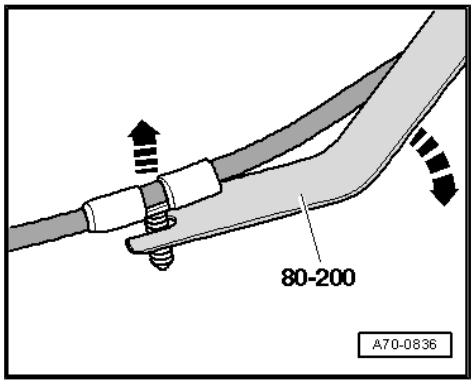
Disregard items -2 and 3-.

– Lift retaining clips -1 and 2- and disconnect coolant hoses (top left) from radiator.
– Remove engine control unit - J623- ⇒ page 284 .
– Remove throttle valve module - J338- ⇒ page 247 .

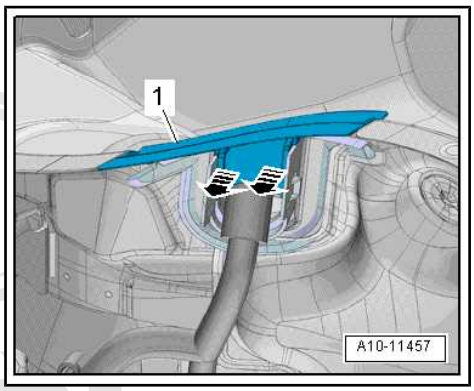


Note

Use removal lever - 80 - 200- to lever out the wiring clips when performing the next work steps.

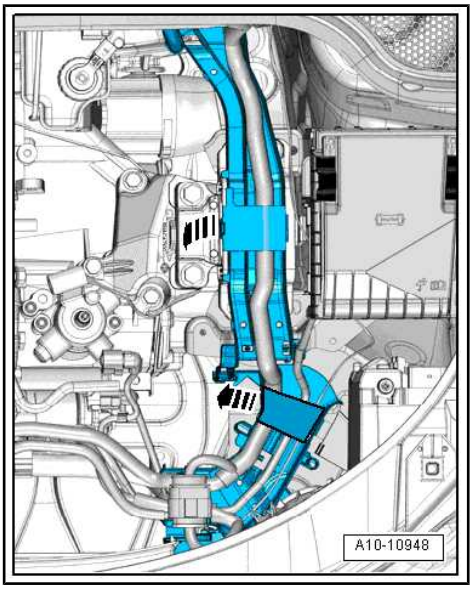


– Release wiring protector -1- for engine wiring harness -arrows- and lift off.

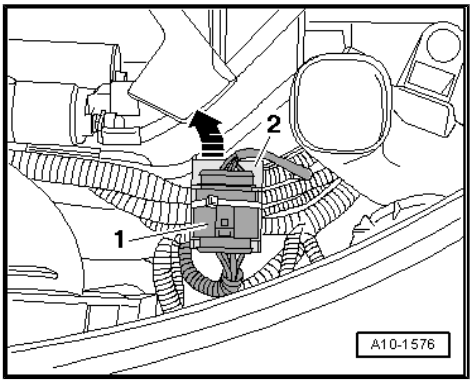


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– Open retainers for wiring duct -arrows-.



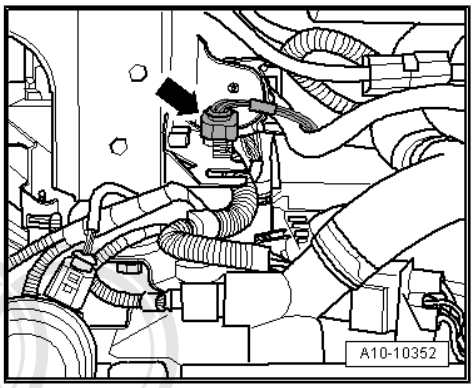
– Move clear and unplug electrical connector -1-.
– Open retainer -2- for wiring duct -arrow- (located underneath connector).
– Remove wiring harness for engine control unit from wiring duct and place on engine.



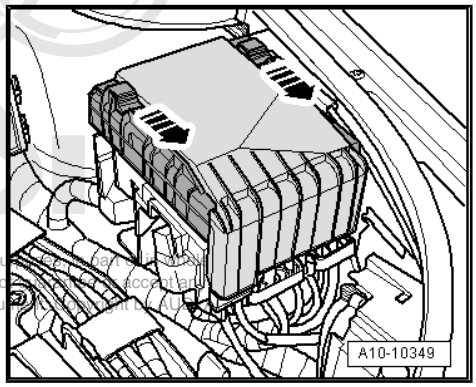
– Unplug electrical connector -arrow- at longitudinal member (bottom left).

Note

For illustration purposes, the installation position is shown from below.

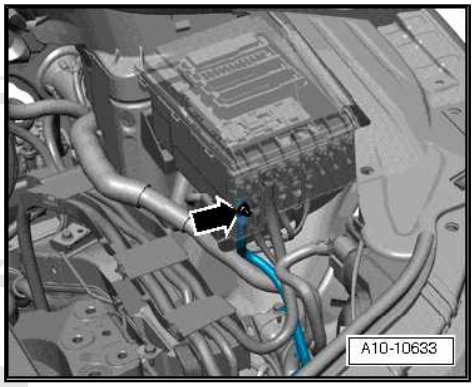


– Slide the two clips in the direction of the -arrows- and remove cover from electronics box in engine compartment.



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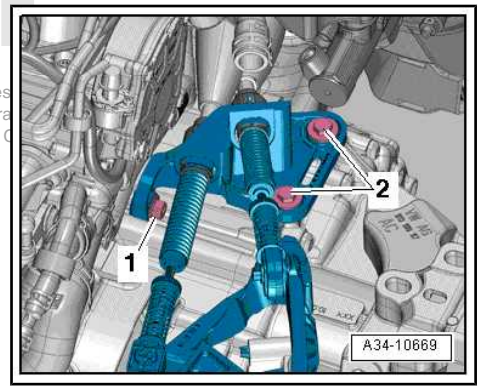
– Remove nut -arrow-, detach terminal 30 wire from electronics box in engine compartment and move it clear.



Vehicles with manual gearbox:

– Remove nut -1- and bolts -2-, detach cable support bracket and place to one side (selector cables remain fitted).

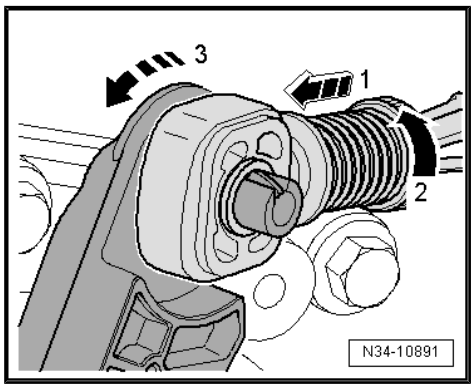
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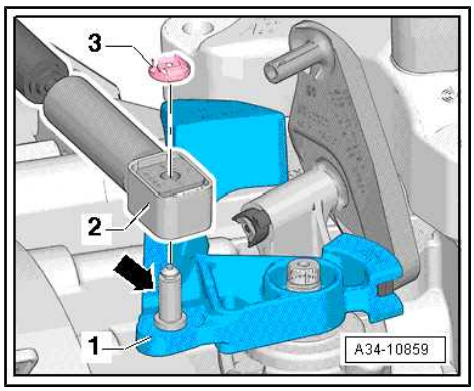
• To prevent damage to gate selector cable, cable end-piece must be detached from gate selector cable before removing.

– Pull locking device forwards onto stop -arrow 1- and lock by turning anti-clockwise -arrow 2-.

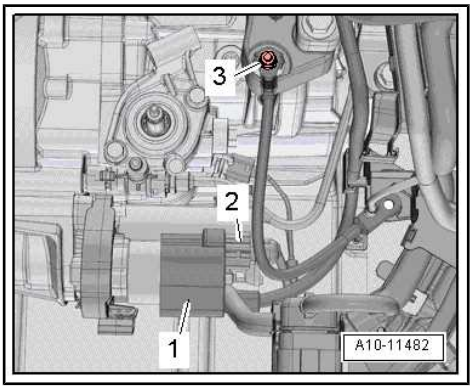
– Press gate relay lever towards front -arrow 3-, take gate selector cable out of end-piece.



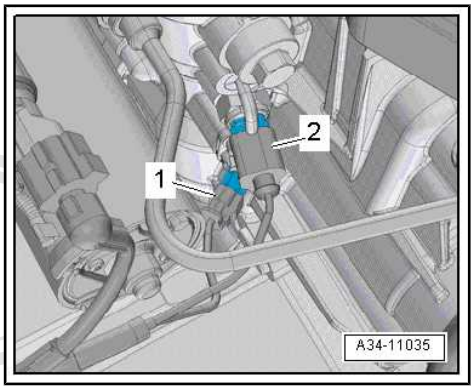
– Detach securing clip -3- for gear selector cable from gearbox selector lever -1- and pull cable -2- off pin -arrow-.



– Unplug electrical connector -2-.
– Push back cover -1- for positive battery terminal and unscrew positive wire from starter solenoid switch.
– Remove nut -3- and detach earth wire.



– Unplug electrical connectors -1, 2-.

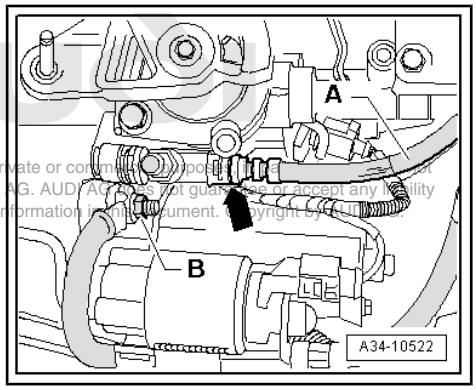


Note

Make sure brake fluid does not come into contact with longitudinal member or gearbox when performing the following operations. If it does, clean affected area thoroughly.

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– Place a lint-free cloth underneath bleeder connection.
– Pull out securing clip -arrow- as far as stop and disconnect pipe -A- from bleeder connection.



Note

Disregard -item B-.

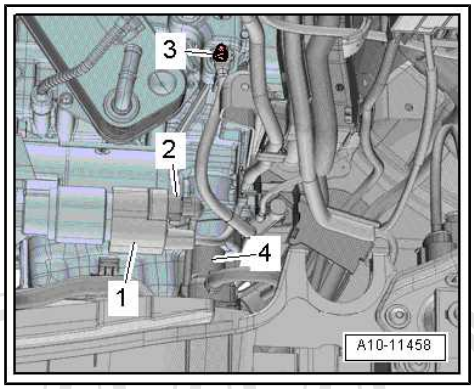
– Seal off open lines and connections with clean plugs from engine bung set - VAS 6122- .

Caution

Risk of contamination by escaping brake fluid.

- ***Do not operate clutch pedal after detaching pipe from bleeder connection on clutch slave cylinder.***

Vehicles with dual clutch gearbox:



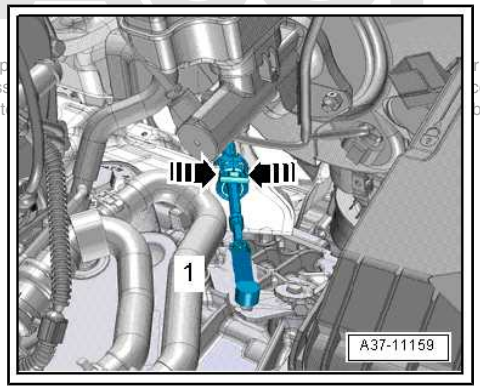
– Unplug electrical connector -2-.
– Push back cover -1- for positive battery terminal and unscrew positive wire from starter solenoid switch.
– Remove nut -3- and detach earth wire.

Caution

Risk of irreparable damage to control unit (mechatronic unit) because of electrostatic discharge.

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

– Touch vehicle earth with bare hands to eliminate any static charge.
– Turn retainer catch anti-clockwise and unplug electrical connector -4- at gearbox.



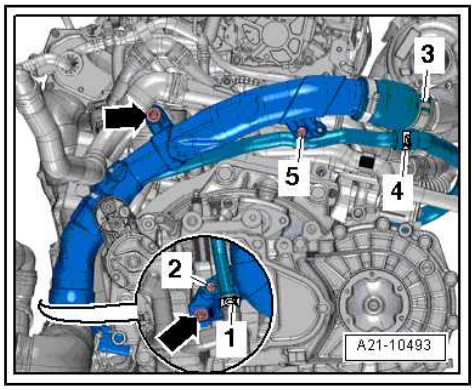
– Pry ball socket -1- of selector lever cable off parking lock lever using removal lever - 80 - 200- .
– Release fasteners -arrows- and move selector lever cable clear.

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Note

Take care not to bend or kink selector lever cable.

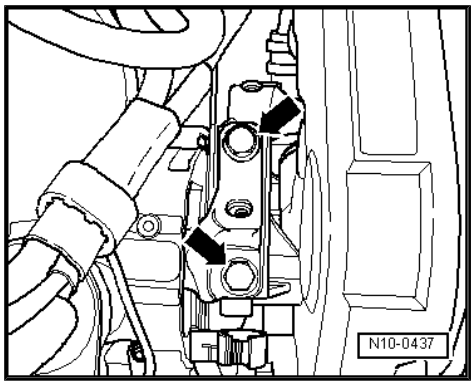
Continued for all vehicles:



– Remove bolts -2, 5- and -arrows-.
– Using removal lever - 80 - 200- , move clear electrical wiring and hoses at air pipe (left-side).
– Loosen hose clip -3- and detach air pipe (left-side) downwards.

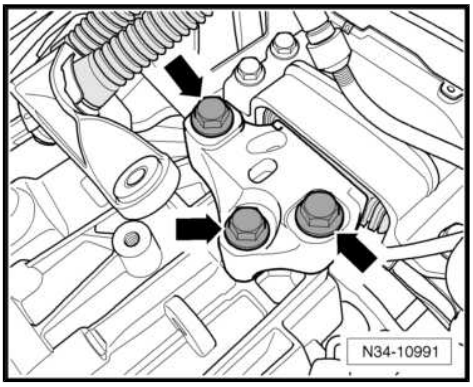
Note

Disregard items -1 and 4-.



– Unscrew bolts -arrows- at engine mounting approx. 2 turns.

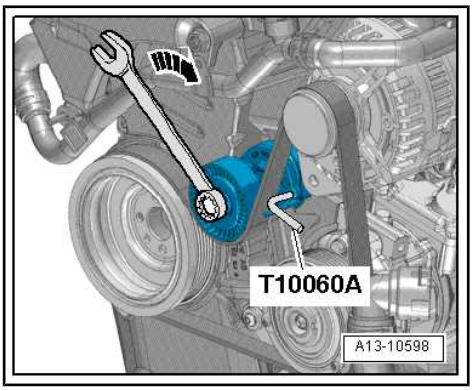
– Loosen bolts -arrows- at gearbox mounting approx. 2 turns.



Caution

Wrong direction of rotation for a used poly V-belt can lead to irreparable damage.

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



– To slacken poly V-belt, turn tensioner in clockwise direction -arrow-.

– Lock tensioner with locking pin - T10060 A- .

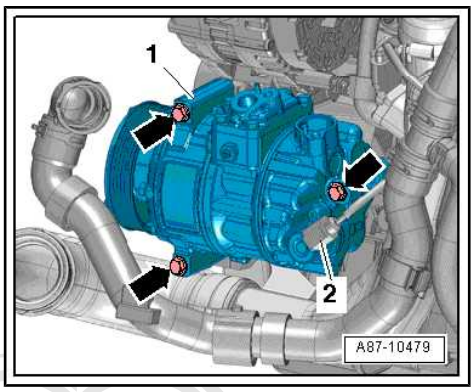
– Take off poly V-belt.

– Unplug electrical connector -2- on air conditioner compressor regulating valve - N280- .

Caution

Risk of damage to air conditioner compressor and refrigerant pipes/hoses.

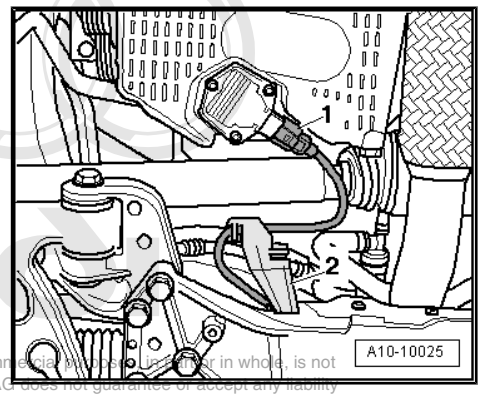
- *Do NOT stretch, kink or bend refrigerant lines and hoses.*



– Remove bolts -arrow-, detach air conditioner compressor -1- with refrigerant lines connected and tie up to front.

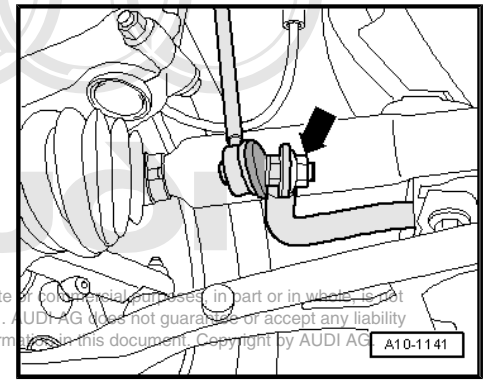
– Unplug electrical connector -1- at oil level and oil temperature sender - G266- .

– Unclip bracket -2- for wire to oil level and oil temperature sender - G266- from subframe.



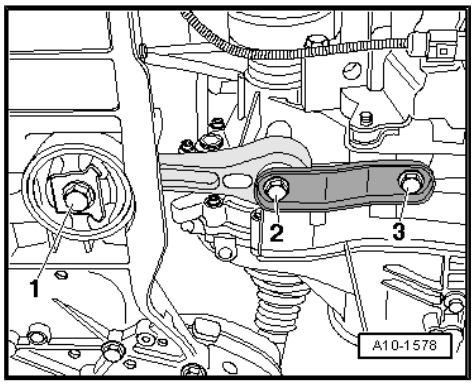
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– Remove nuts -arrow- for coupling rod on anti-roll bar on both sides.

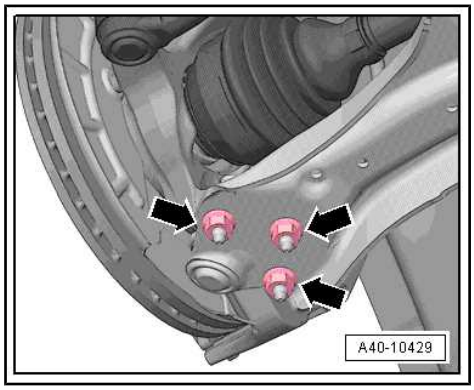


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– Remove bolts -1, 2, 3- and remove pendulum support.

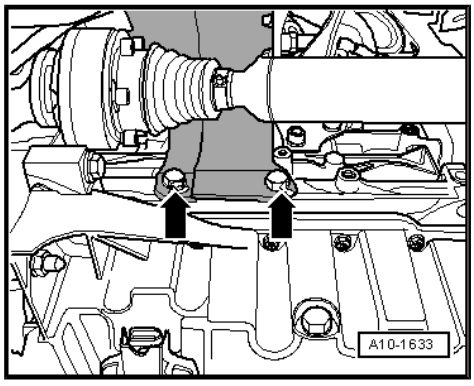


– Remove nuts -arrows- for swivel joint on both sides.
– If fitted, remove nut on bracket for front right vehicle level sender - G289- .
– Detach swivel joint from wishbone (both sides).



Vehicles with front-wheel drive:

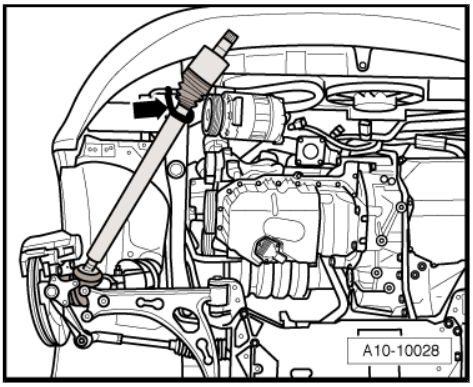
– Remove bolts -arrows- and detach heat shield for drive shaft (right-side).
– Detach drive shaft (left and right) from gearbox ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing drive shaft .
– Tie up drive shaft (left-side).



Note

Take care not to damage the surface coating of the drive shaft.

– Pivot drive shaft (right-side) forwards; to do so, push engine/gearbox assembly slightly forwards.
– Tie up drive shaft to longitudinal member -arrow-.

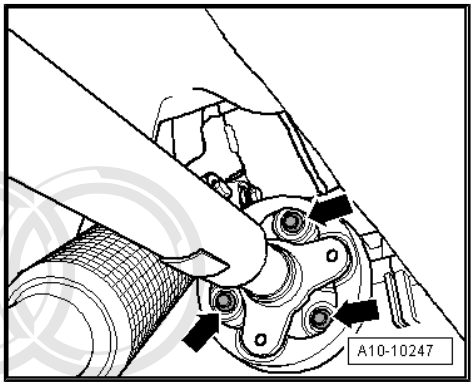


Note

Take care not to damage the surface coating of the drive shaft.

Vehicles with four-wheel drive:

– Mark position of flexible coupling and flange for bevel box in relation to each other.
– Unbolt flexible coupling for propshaft at bevel box -arrows- (counterhold using a suitable lever at the triangular flange).

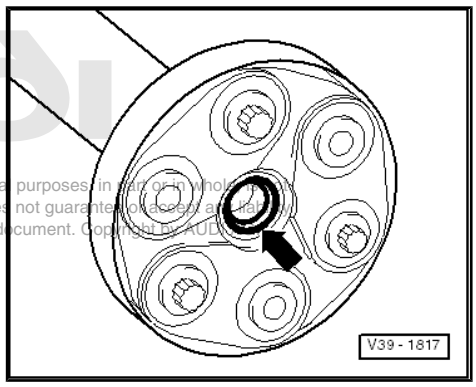


– Push engine/gearbox assembly forward slightly (towards front end) and pull propshaft off bevel box.

Caution

Make sure not to damage the oil seal -arrow- in the propshaft flange.

- ***Push the propshaft horizontally to the rear and towards the right side of vehicle as far as possible.***

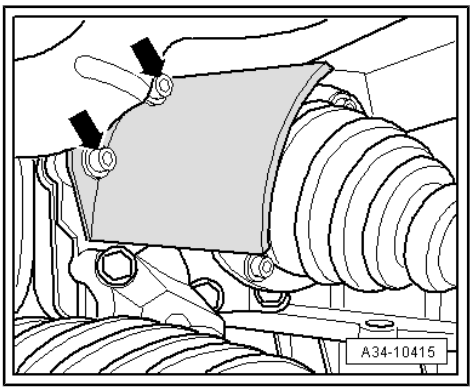


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Note

The propshaft must be renewed if the oil seal is damaged.

– If fitted, remove bolts -arrows- and detach heat shield for drive shaft (right-side).
– Detach drive shaft (left-side) from gearbox ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing drive shaft , and tie up.

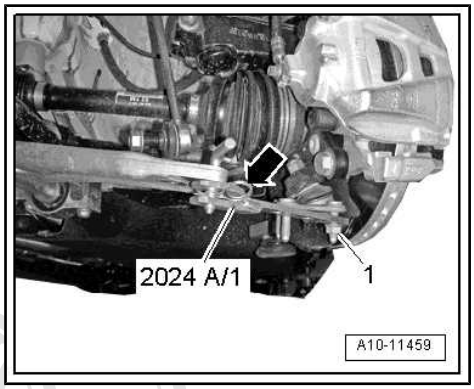


Note

Take care not to damage the surface coating of the drive shaft.

– Detach drive shaft (right-side) from bevel box ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing drive shaft .

– Swing suspension strut (right-side) outwards and support with extension -2024 A /1- as shown in illustration.



Continued for all vehicles:

– Swing suspension strut (left-side) outwards and support with extension -2024 A /1- as shown in illustration.

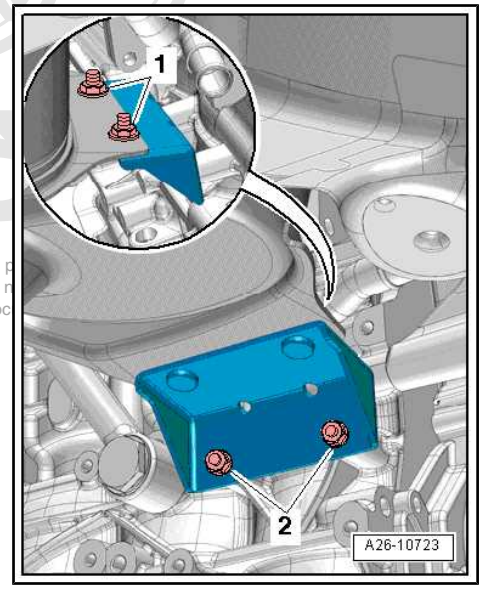
WARNING

Accident risk from loose components of support bracket.

- ***Secure retaining pin and swivel joint with locking pin -arrow- and nut -1-.***

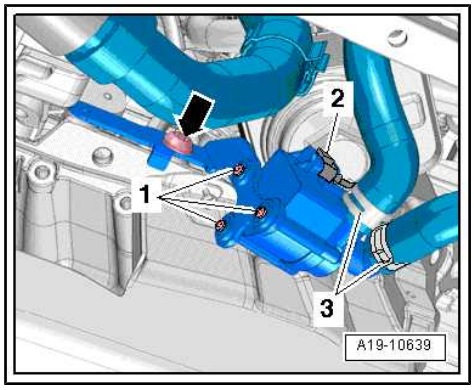
– Remove nuts -1- and -2- and detach bottom bracket for particulate filter.

– Tie up particulate filter to rear.



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– Remove bolt -arrow- and push pump for exhaust gas recirculation cooler - V400- to the side.

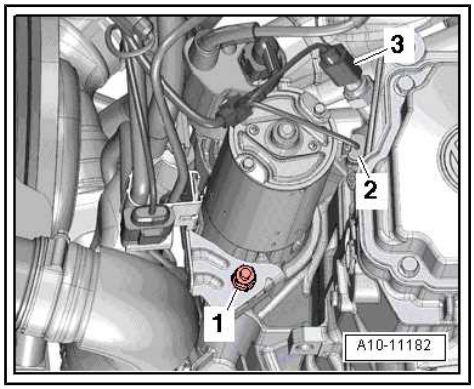


Note

Disregard -items 1, 2, 3-.

Vehicles with start/stop system:

– Unplug electrical connector -3- for gearbox neutral position sender - G701- .



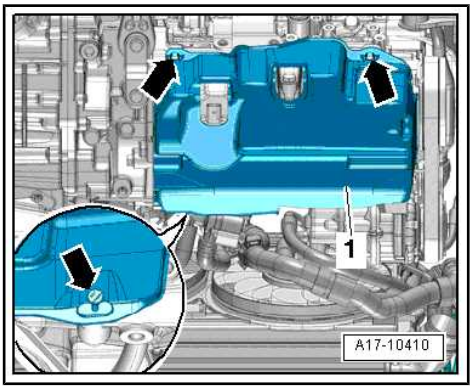
Continued for all vehicles:

– Unscrew nut -1- and detach bracket for electrical wiring.

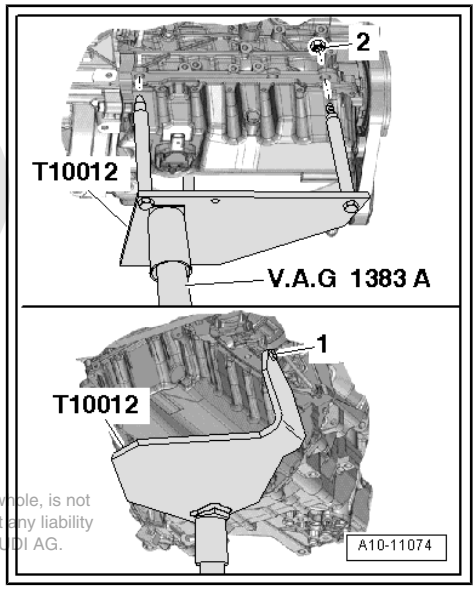
Note

Disregard -item 2-.

– Release fasteners -arrows- and remove noise insulation -1- for sump.



– Secure engine bracket - T10012- to cylinder block with bolt -1- and nut -2- (tightening torque: approx. 20 Nm).
– Insert engine and gearbox jack - V.A.G 1383 A- in engine bracket - T10012- and raise engine/gearbox assembly slightly.

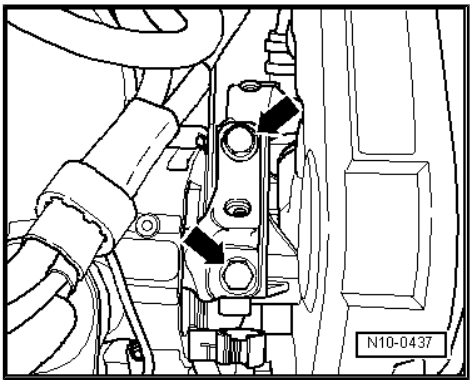


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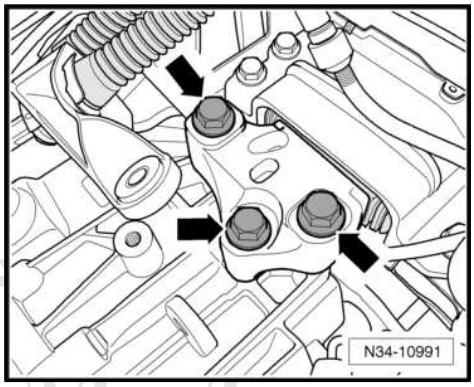
Note

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

– Remove bolts -arrows- securing engine mounting.



– Remove bolts -arrows- securing gearbox mounting.



Caution

Danger of damage to hydraulic lines, vacuum lines or electrical wiring and to engine compartment.

- *Check that all hydraulic lines, vacuum lines and electrical wiring between engine, gearbox, subframe and body have been detached.*
- *Carefully guide out engine/gearbox assembly with subframe from engine compartment when lowering.*

– First lower engine/gearbox assembly only slightly.

– Then swing gearbox end of engine/gearbox assembly forwards and only then lower further.

1.2 Separating engine and gearbox

⇒ “1.2.1 Separating engine and manual gearbox”, page 26

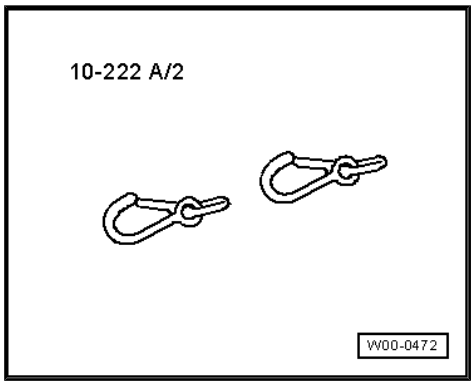
⇒ “1.2.2 Separating engine and dual clutch gearbox”, page 28

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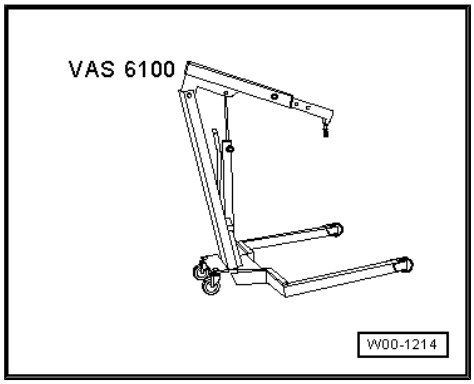
1.2.1 Separating engine and manual gearbox

Special tools and workshop equipment required

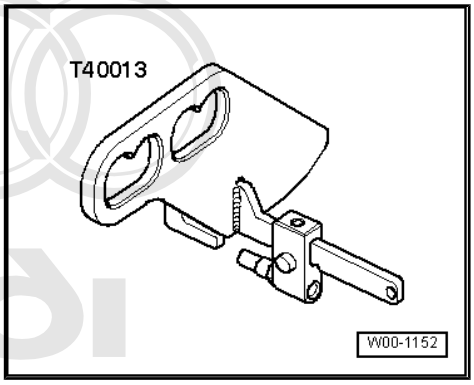
- Hooks - 10 - 222 A /2-



- Workshop hoist - VAS 6100-



♦ Lifting tackle - T40013-

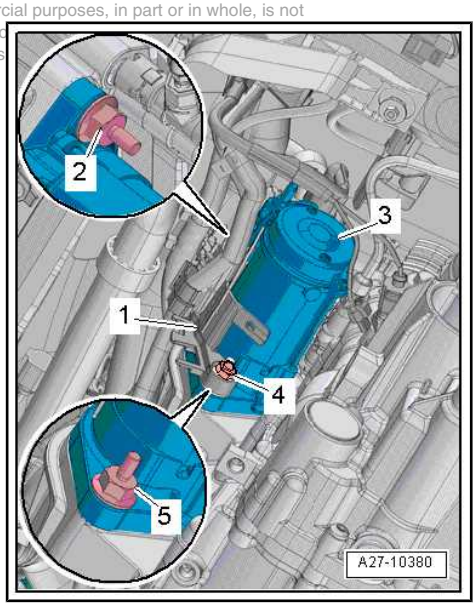


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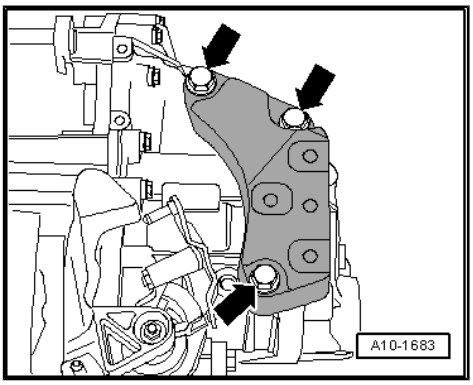
Procedure

- Engine/gearbox assembly removed and attached to engine bracket - T10012- .

– Remove starter ⇒ Electrical system; Rep. gr. 27 ; Starter; Removing and installing starter .



– Unscrew bolts -arrows- and detach gearbox support.

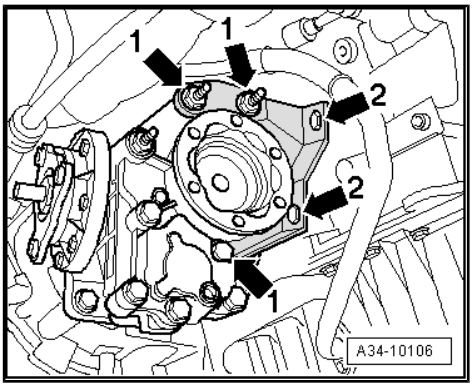


Vehicles with four-wheel drive:

– Remove bolts -arrows 1- securing bracket for bevel box.

Note

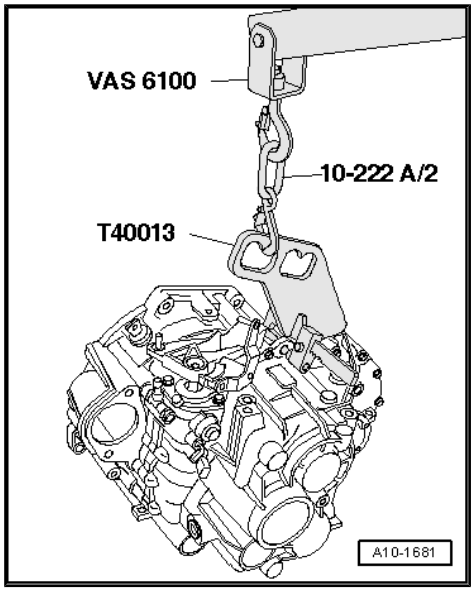
Disregard -arrows 2-.



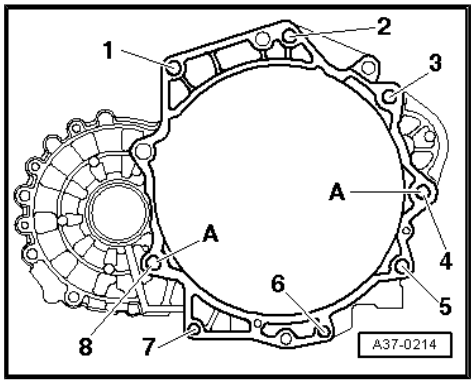
Continued for all vehicles:

– Attach lifting tackle - T40013- to gearbox and close lock.

– Attach workshop hoist - VAS 6100- with hooks - 10 - 222 A / 2- to the lifting tackle.



– Remove bolts -1, 2, 5, 6, 7, 8- securing gearbox to engine.



Note

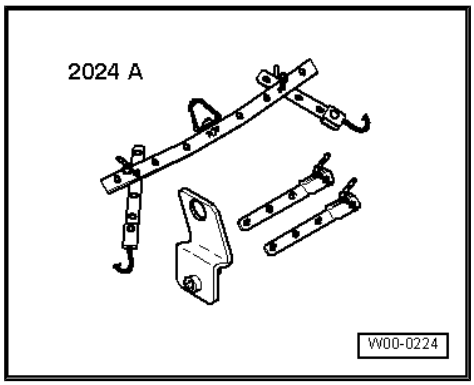
Disregard -items 3 and 4- and -A-.

– Detach gearbox from engine.

1.2.2 Separating engine and dual clutch gearbox

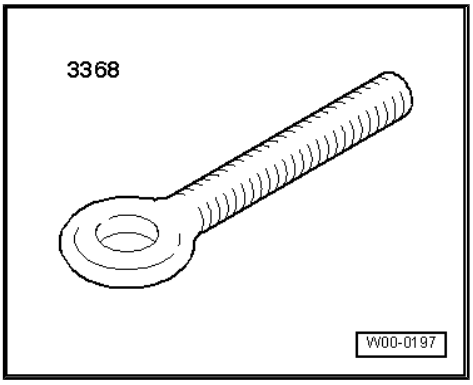
Special tools and workshop equipment required

♦ Lifting tackle - 2024 A-

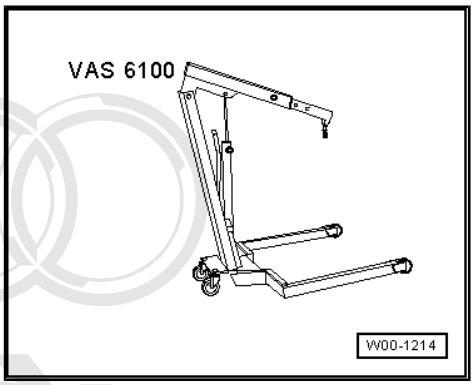


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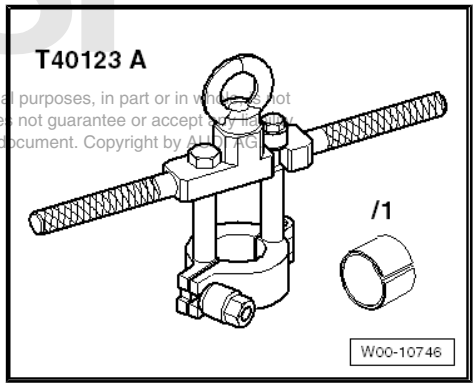
♦ Eye-head bolt - 3368-



♦ Workshop hoist - VAS 6100-



♦ Puller for ATF-supply - T40123 A-



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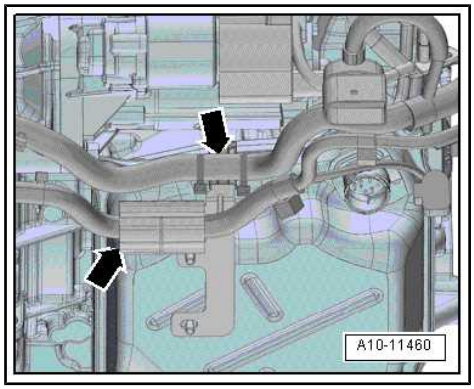
Procedure

- Engine/gearbox assembly removed and attached to engine bracket - T10012- .

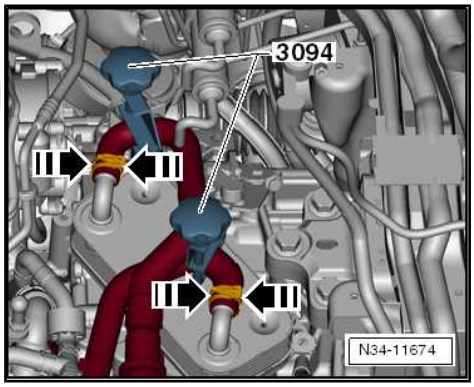
– Remove bevel box ⇒ Rep. gr. 34 ; Bevel box; Removing bevel box .

– Remove starter ⇒ Electrical system; Rep. gr. 27 ; Starter; Removing and installing starter .

– Move electrical wiring harnesses clear -arrows-.



– Slacken hose clips -arrows- and detach coolant hoses from gear oil cooler.

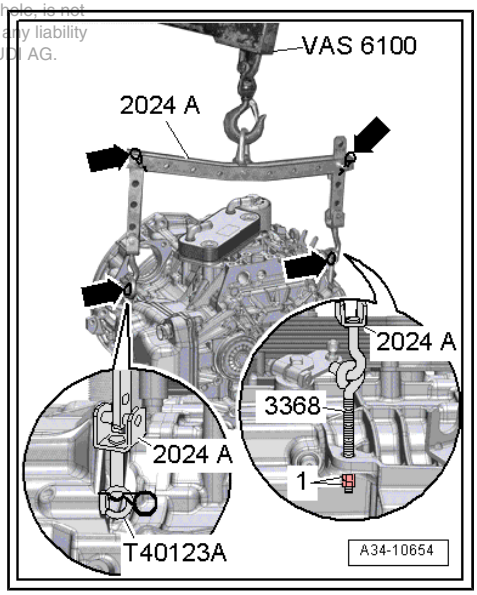


Note

Ignore -3094- .

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– Remove eye on puller for ATF-supply - T40123 A- and screw into lower threaded hole for starter bolt as far as stop.
– Secure eye-head bolt - 3368- to bore in gearbox housing with two lock nuts -1-.
– Attach lifting tackle - 2024 A- to both eyes and to workshop hoist - VAS 6100- as shown in illustration.



Note

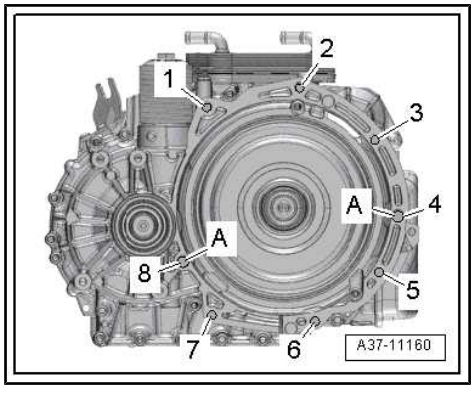
To adjust to the centre of gravity of the gearbox, the perforated rails of the support hooks must be positioned as shown.

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 bolts -1 … 8- securing gearbox to engine.
– Detach gearbox from engine.



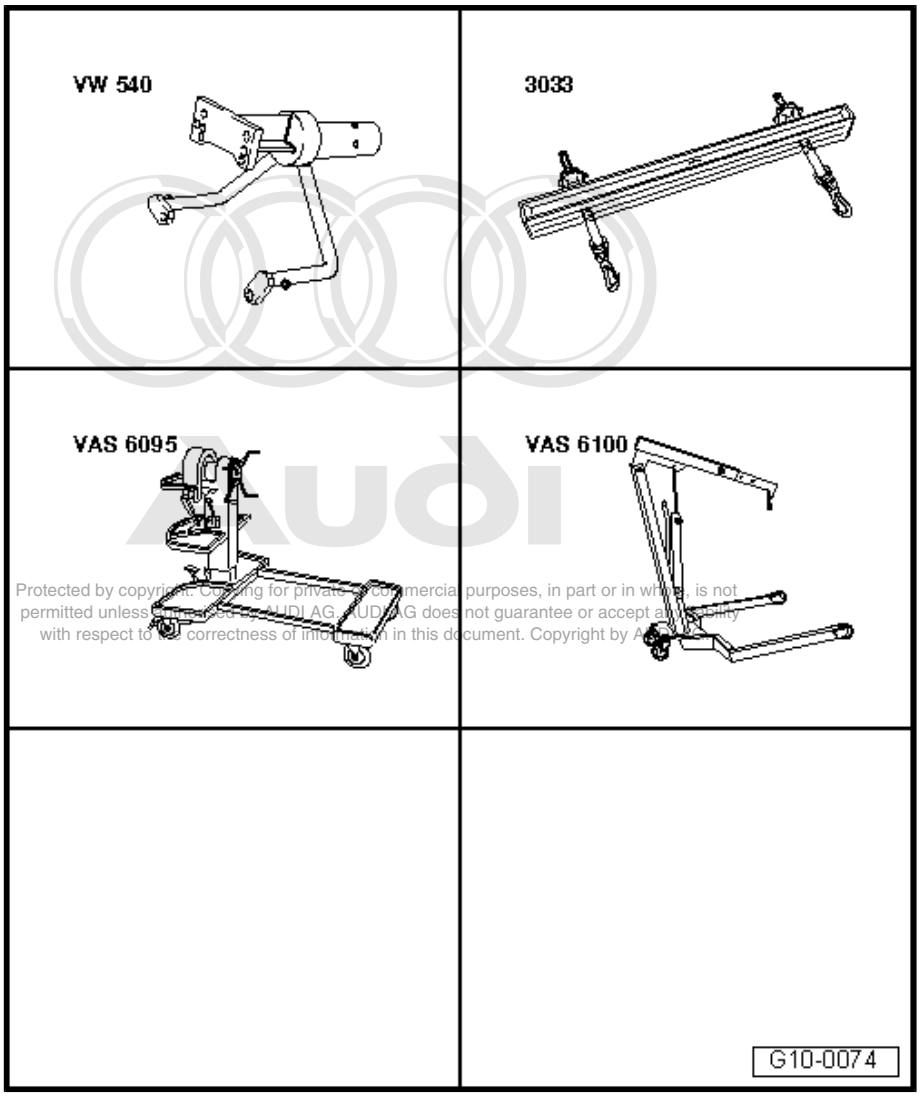
Note

Disregard -item A-.

1.3 Securing engine to engine and gearbox support

Special tools and workshop equipment required

- Engine and gearbox support - VW 540-
- Lifting tackle - 3033-
- Engine and gearbox support - VAS 6095-
- Workshop hoist - VAS 6100-



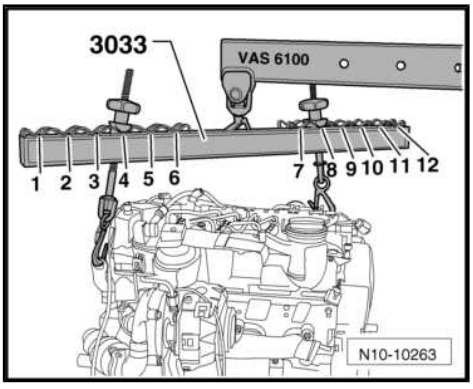
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Procedure

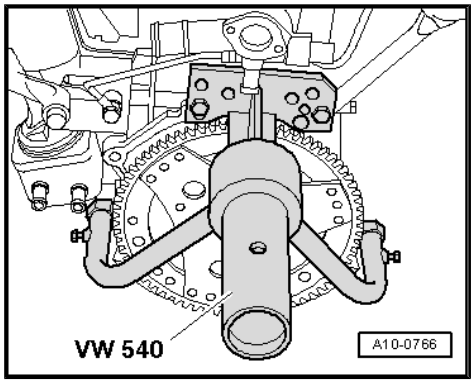
- Gearbox detached from engine ⇒ page 28 .

– Attach lifting tackle - 3033- to engine and workshop hoist - VAS 6100- as shown in illustration.

– Lift engine off engine bracket - T10012- using workshop hoist - VAS 6100- .



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



1.4 Installing engine

Tightening torques

Note

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

Component		Nm
Bolts/nuts	M6	9
	M7	15
	M8	20
	M10	40
	M12	65

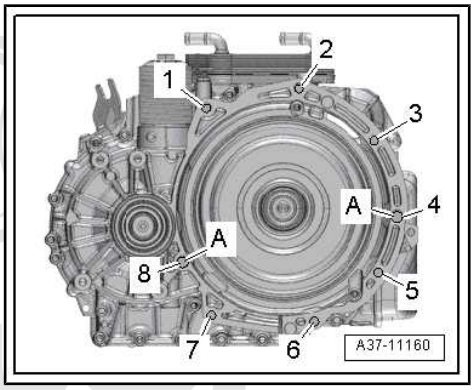
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Assembly mountings

⇒ "2.1 Exploded view - assembly mountings", page 36

Securing dual-clutch gearbox to engine

Item	Bolt	Nm
1, 2, 3	M12x55	80
4	M12x65	80
5, 6, 7	M10x50	40
8	M12x70	80
A	Dowel sleeves for centralising	



Procedure

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

- Engine/gearbox assembly attached to engine bracket - T10012- .

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Note

- *Renew the bolts tightened with specified tightening angle.*
- *Renew self-locking nuts and bolts as well as seals, gaskets and O-rings.*
- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Fit all cable ties in the original positions when installing.*

– Install intermediate plate ⇒ page 62 .

– If not already fitted, install dowel sleeves -A- for centring engine and gearbox in cylinder block.

– Install needle bearing if not fitted in crankshaft ⇒ page 72 .

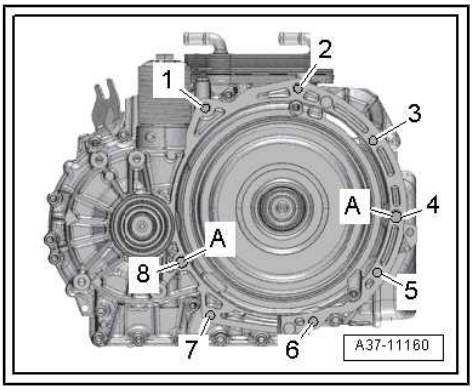
– Secure gearbox to engine.

– Install gearbox support ⇒ Rep. gr. 34 ; Removing and installing gearbox .

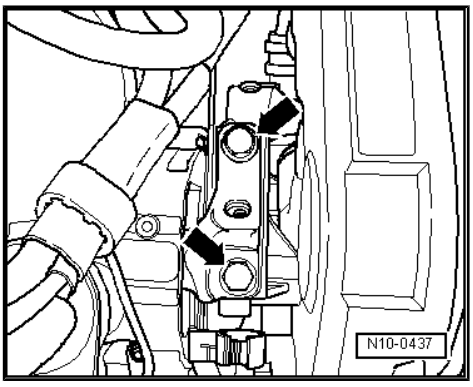
– Take up engine/gearbox assembly with engine bracket - T10012- .

– Install bracket for bevel box ⇒ Rep. gr. 34 ; Bevel box; Installing bevel box .

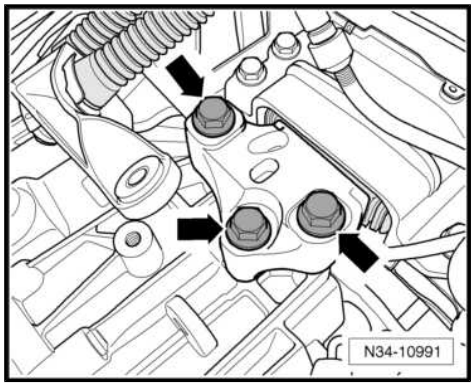
– Guide engine/gearbox assembly into body.



– Initially screw in bolts -arrows- for engine mounting by hand until they make contact.



– Initially screw in bolts -arrows- for gearbox mounting by hand until they make contact.



Note

The bolts are tightened to final torque only after adjusting the assembly mountings ⇒ page 44 .

When installing a new base engine, you must check whether there is a sticker on the cylinder head cover.

If a sticker is attached which states `Spannpratzen auf vorgeschriebenes Drehmoment angezogen` (clamping pieces tightened to specified torque), the clamping pieces have already been tightened to the specified final torque at the factory.

If no sticker is attached, it is essential that the clamping pieces for the injectors are tightened to the specified torque after installing the high-pressure pipes. If these instructions are not observed, the engine could be damaged.

– Remove engine bracket - T10012- from engine.

– Install starter ⇒ Electrical system; Rep. gr. 27 ; Starter; Removing and installing starter .

– Install pump for exhaust gas recirculation cooler - V400- ⇒ page 187 .

– Install air pipe ⇒ page 221 .

– Install air hoses with screw-type clips ⇒ page 222 .

– Install and adjust selector lever cable ⇒ Rep. gr. 34 ; Selector mechanism .

– Install particulate filter ⇒ page 294 .

– Secure propshaft with flexible coupling to bevel box flange ⇒ Rep. gr. 39 ; Propshaft; Removing and installing propshaft .

– Install drive shafts ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing drive shaft

– Install wishbone and swivel joint ⇒ Running gear, axles, steering; Rep. gr. 40 ; Lower wishbone, swivel joint; Exploded view - lower wishbone, swivel joint .

– Install coupling rod ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Exploded view - subframe .

– Install air conditioner compressor ⇒ Heating, air conditioning; Rep. gr. 87 ; Air conditioner compressor; Detaching and attaching air conditioner compressor at bracket .

– Install poly V-belt ⇒ page 51 .

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

– Install engine control unit - J623- ⇒ page 284 .

– Install throttle valve module - J338- ⇒ page 247 .

– Connect coolant hoses with plug-in connectors to heat exchanger for heater ⇒ page 200 .

– Install pendulum support ⇒ page 43 .

– Install air pipe with connection ⇒ page 208 .

– Install wheel spoilers (front) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liners; Exploded view - wheel housing liner (front) .

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– Fit front wheels ⇒ Running gear, axles, steering; Rep. gr. 44 ; Wheels, tyres .
– Adjust assembly mountings ⇒ page 44 .
– Install battery tray and battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Removing and installing battery tray .
– Connect vacuum hoses ⇒ page 238 .
– Install and adjust wiper arms ⇒ Electrical system; Rep. gr. 92 ; Windscreen wiper system; Removing and installing wiper arms .
– Install air cleaner housing ⇒ page 241 .
– Check oil level ⇒ Maintenance ; Booklet 820 .

Caution

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

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

– Fill up with coolant ⇒ page 171 .

Note

Do not reuse coolant.

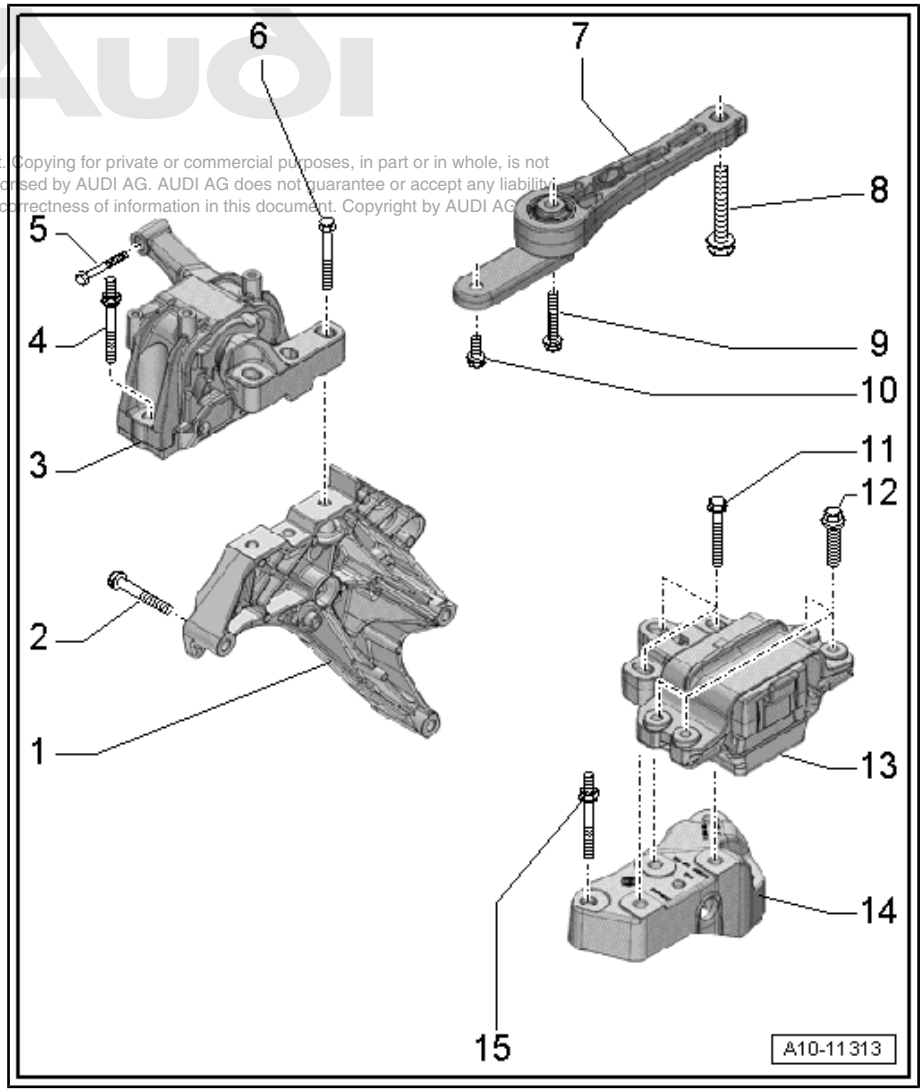
– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

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2 Assembly mountings

⇒ “2.1 Exploded view - assembly mountings”, page 36
⇒ “2.2 Removing and installing engine mountings”, page 38
⇒ “2.3 Removing and installing gearbox mounting”, page 40
⇒ “2.4 Removing and installing pendulum support”, page 43
⇒ “2.5 Adjusting assembly mountings”, page 44
⇒ “2.6 Checking adjustment of assembly mountings (engine/ gearbox mountings)”, page 46

2.1 Exploded view - assembly mountings



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1 - Engine support

2 - Bolt

- ❑ Renew
- ❑ Tightening torque and sequence ⇒ page 37

3 - Engine mounting

- ❑ With support arm
- ❑ Removing and installing ⇒ page 38

4 - Bolt

- ❑ Renew
- ❑ 40 Nm +90°

5 - Bolt

- ❑ Renew
- ❑ 20 Nm +90°

6 - Bolt

- ❑ Renew
- ❑ 60 Nm +90°

7 - Pendulum support

- ❑ Removing and installing ⇒ page 43

8 - Bolt

- ❑ Renew
- ❑ Tightening torque and sequence ⇒ page 37

9 - Bolt

- ❑ Renew
- ❑ Tightening torque and sequence ⇒ page 37

10 - Bolt

- ❑ Renew
- ❑ Tightening torque and sequence ⇒ page 37

11 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 34 ; Assembly mountings; Exploded view - assembly mountings

12 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 34 ; Assembly mountings; Exploded view - assembly mountings

13 - Gearbox mounting

- ❑ With support arm
- ❑ Removing and installing ⇒ page 40

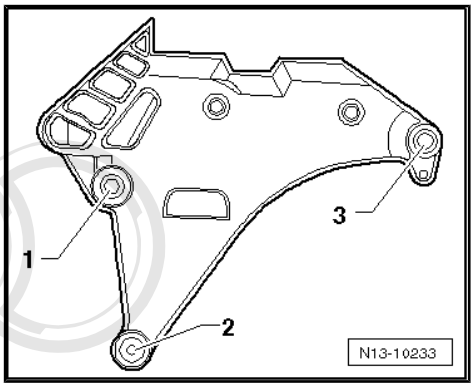
14 - Gearbox support

- ❑ Different versions; for allocation refer to ⇒ Electronic parts catalogue
- ❑ Removing and installing ⇒ Rep. gr. 34 ; Removing and installing gearbox

15 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 34 ; Assembly mountings; Exploded view - assembly mountings

Engine support - tightening torque and sequence



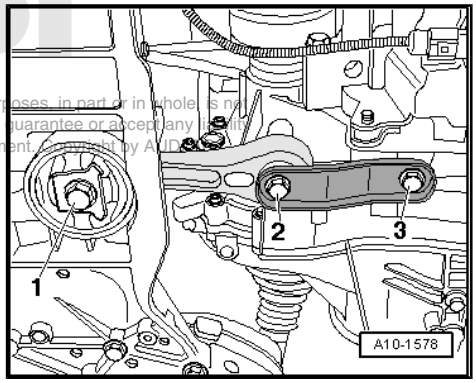
Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts in 3 stages in the sequence shown.

Stage	Bolts	Tightening torque/angle specification
1.	-1 … 3-	7 Nm
2.	-1 … 3-	40 Nm
3.	-1 … 3-	Turn 180° further

Installing pendulum support



Note

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Renew the bolts tightened with specified tightening angle.

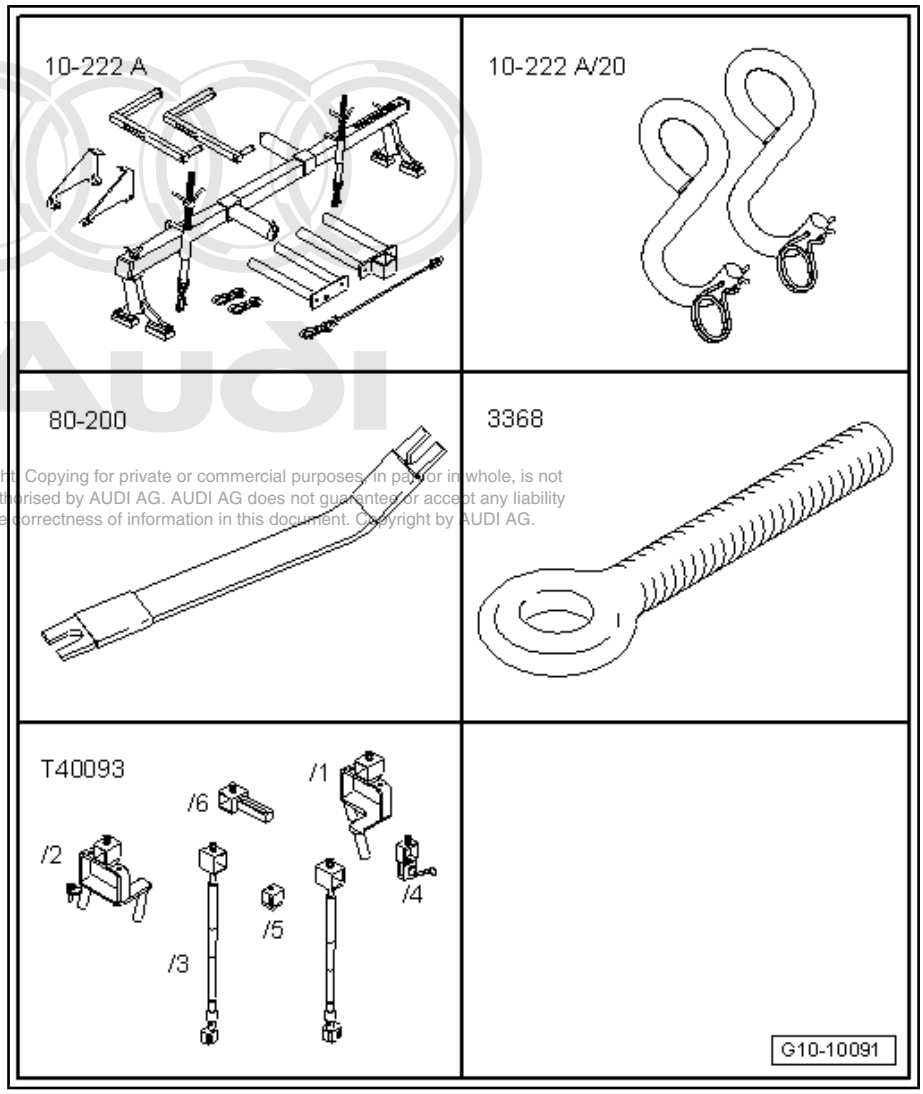
– Tighten bolts in 3 stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-2, 3-	50 Nm
2.	-1-	100 Nm
3.	-1 … 3-	Turn 90° further

2.2 Removing and installing engine mountings

Special tools and workshop equipment required

- Support bracket - 10 - 222 A-
- Adapters - 10 - 222 A /20-
- Removal lever - 80 - 200-
- Eye-head bolt - 3368-
- -T40093/6- from Engine support supplementary set - T40093-
- Flange nut M10 or nut with washer

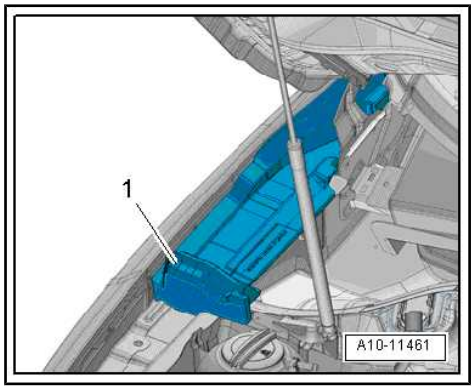


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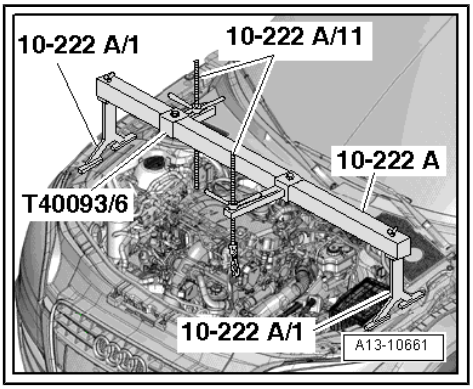
Removing

– Remove engine cover panel ⇒ page 47 .

– Unclip sealing element -1- (left and right) using removal lever - 80 - 200- .



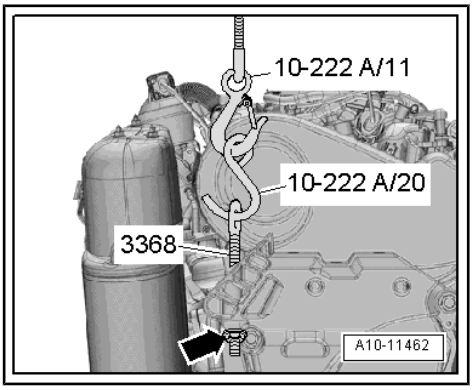
– Position support bracket - 10 - 222 A- with spindles -10 - 222 A /11- on bolted flanges of wing panels as shown in illustration.
– Attach hook of spindle to engine lifting eye (left-side).



WARNING

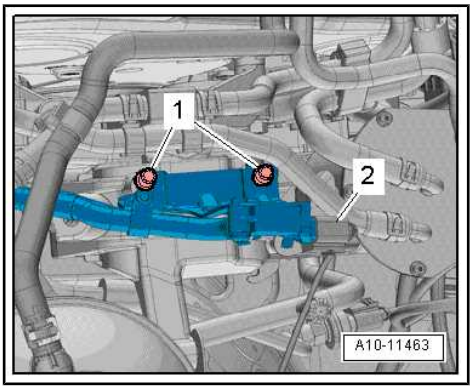
Risk of accident because of loose bolt connections.

- *Screw on flange nut or nut with washer -arrow- at least 6 turns to ensure that eye-head bolt - 3368- is properly secured.*



– Secure eye-head bolt - 3368- with flange nut M10 or nut with washer to engine support as shown in illustration.
– Hook spindle - 10 - 222 A /11- onto eye-head bolt - 10 - 222 A /20- (right-side) with adapter - 3368- .
– Take up weight of engine/gearbox assembly evenly with both spindles (do not raise assembly).

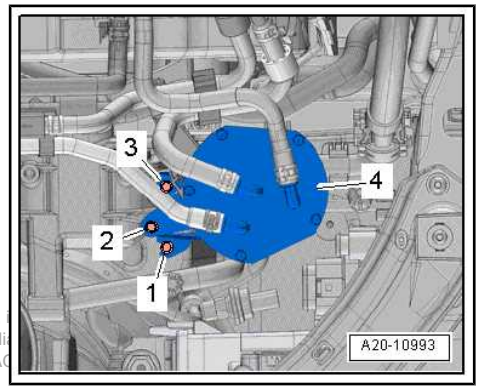
– Loosen bolt -1- and move pressure differential sender - G505- clear to one side.



Note

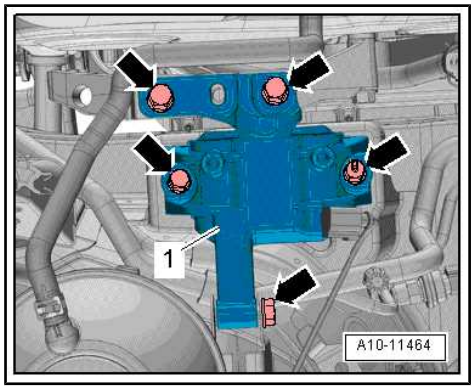
Disregard -item 2-.

– Loosen bolts -1-, remove bolt -2- and nut -3-, and move fuel filter -4- to one side.



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– Remove bolts -arrows- and detach engine mounting -1-.



Installing

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

Tightening torques

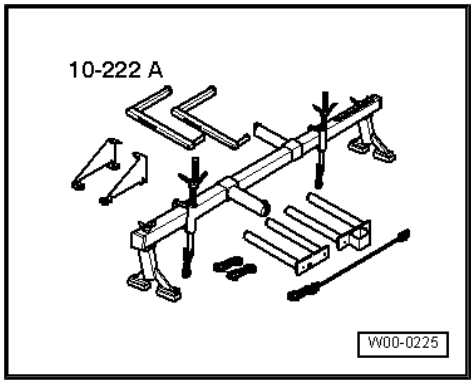
- ⇒ “2.1 Exploded view - assembly mountings”, page 36
- ⇒ Fuel supply system - diesel engines; Rep. gr. 20 ; Fuel filter; Exploded view - fuel filter
- ⇒ “8.1 Exploded view - Lambda probe”, page 280

– Check adjustment of assembly mountings (engine/gearbox mountings) ⇒ page 46 .

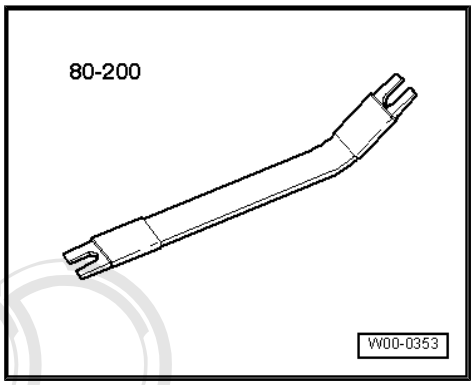
2.3 Removing and installing gearbox mounting

Special tools and workshop equipment required

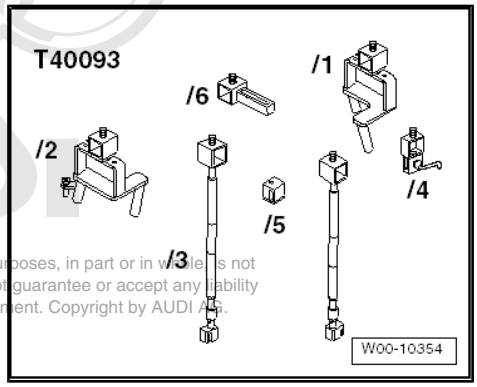
- Support bracket - 10 - 222 A-



- Removal lever - 80 - 200-



- -T40093/6- from Engine support supplementary set - T40093-



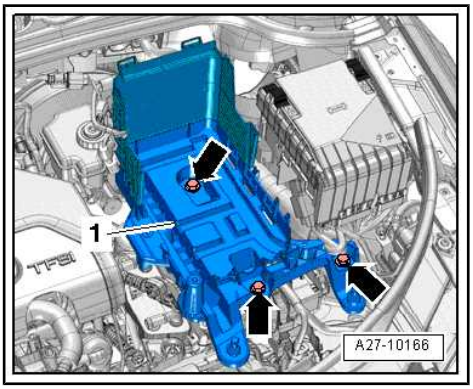
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Removing

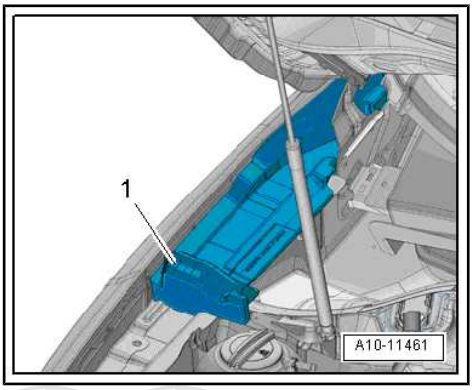
– Remove engine cover panel ⇒ page 47 .

– Disconnect battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Disconnecting and connecting battery .

– Remove battery and battery tray ⇒ Electrical system; Rep. gr. 27 ; Battery; Removing and installing battery tray .



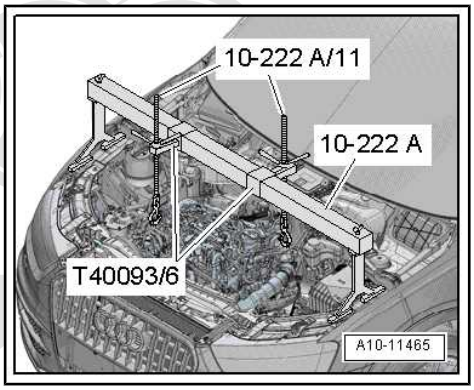
– Unclip sealing element -1- (left and right) using removal lever - 80 - 200- .



– Position support bracket - 10 - 222 A- with spindles -10 - 222 A /11- on bolted flanges of wing panels as shown in illustration.

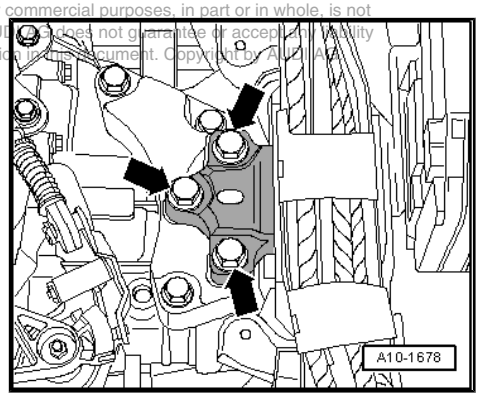
– Attach hooks of spindles to engine lifting eyes.

– Take up weight of engine/gearbox assembly evenly with both spindles (do not raise assembly).

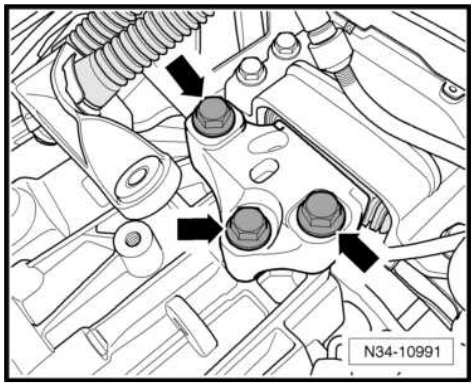


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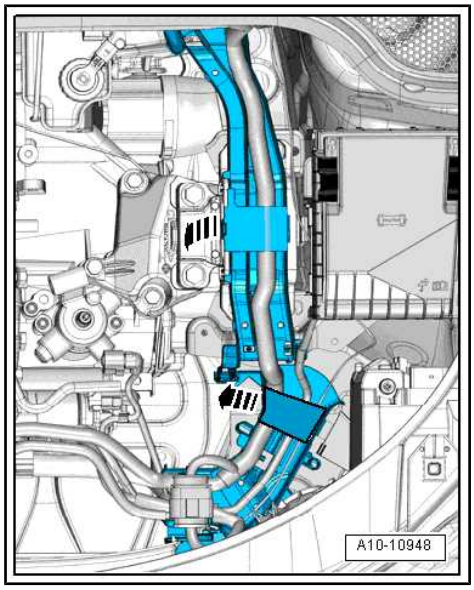
– Manual gearbox: Remove bolts -arrows- securing gearbox mounting.



– Dual clutch gearbox: Remove bolts -arrows- securing gearbox mounting.

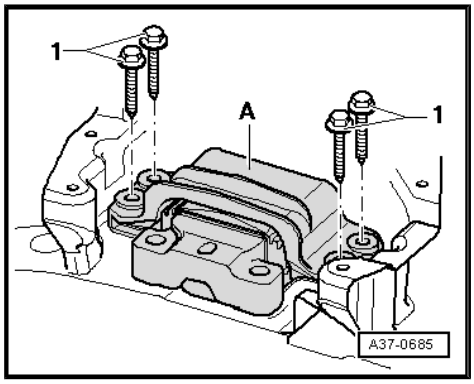


– Open retainers for wiring duct -arrows- and press electrical wiring to one side.
– Use removal lever - 80 - 200- to unclip wiring duct.



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– Unscrew bolts -1- and remove gearbox mounting -A-.



Installing

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

Tightening torques

♦ ⇒ Rep. gr. 34 ; Assembly mountings; Exploded view - assembly mountings

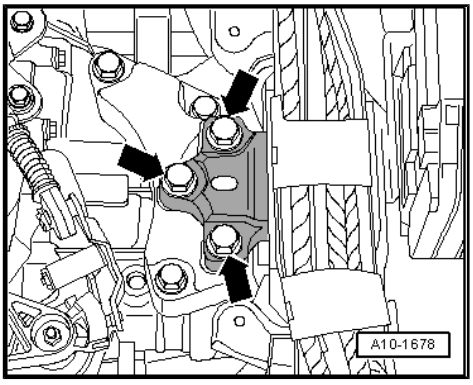
Note

Renew the bolts tightened with specified tightening angle.

– Tighten gearbox mounting -A- on longitudinal member.

Note

The illustration shows the gearbox mounting for vehicles with a manual gearbox.



Caution

Bolts must be fitted straight to avoid damage to threads in gearbox support.

- ***Gearbox support and support arm of gearbox mounting must be perfectly parallel to each other before screwing in bolts -arrows-. If necessary, lift gearbox at rear using trolley jack.***
- ***Only remove support bracket - 10 - 222 A- when bolts on assembly mounting -arrows- have been tightened to specified torque.***

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– Lift gearbox with spindle of support bracket until gearbox support makes contact with support arm of gearbox mounting.

– Check adjustment of assembly mountings (engine/gearbox mountings) ⇒ page 46

– Detach support bracket - 10 - 222 A- from engine.

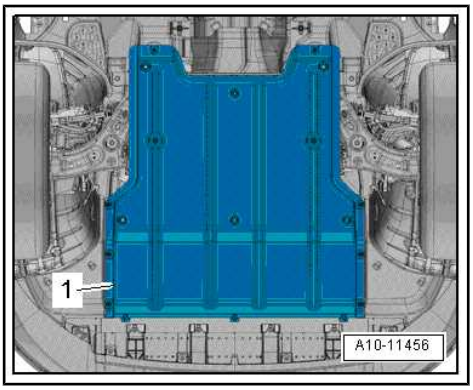
– Install battery tray and battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Removing and installing battery tray .

– Install engine cover panel ⇒ page 47 .

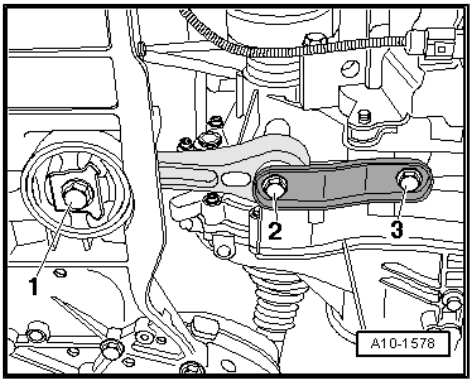
2.4 Removing and installing pendulum support

Removing

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



– Remove bolts -1, 2, 3- and remove pendulum support.



Installing

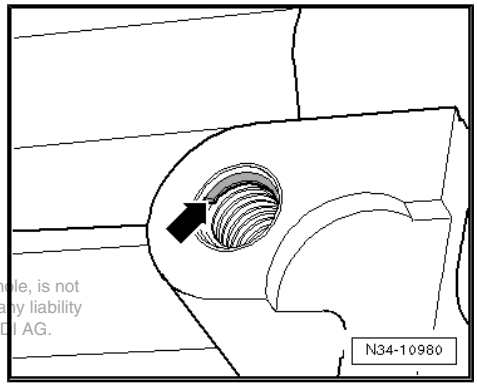
Installation is carried out in the reverse order; note the following:

Tightening torques

- ⇒ Fig. ""Installing pendulum support"" , page 37

Note

- *Bolt holes for pendulum support are fitted with thread inserts (e.g. "Heli-Coil").*
- *Identification: Shoulder on first thread -arrow-.*



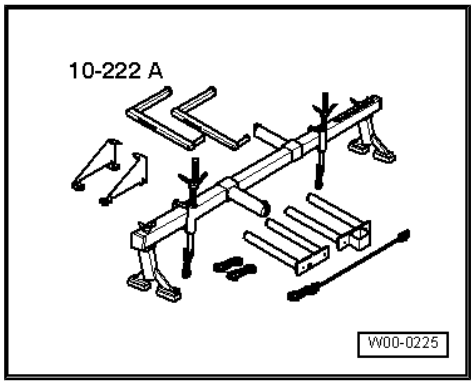
– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

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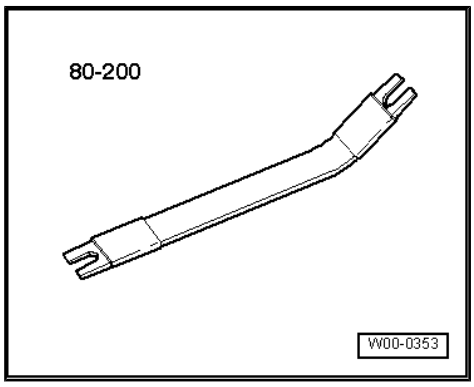
2.5 Adjusting assembly mountings

Special tools and workshop equipment required

- Support bracket - 10 - 222 A-



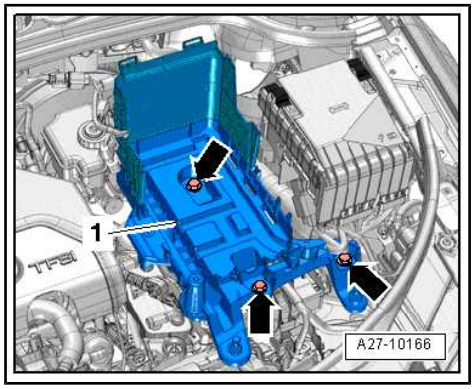
- Removal lever - 80 - 200-



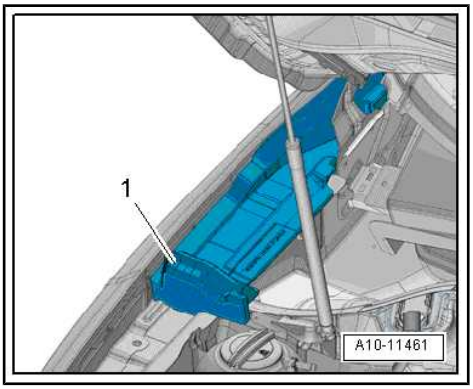
Procedure

– Remove engine cover panel ⇒ page 47 .

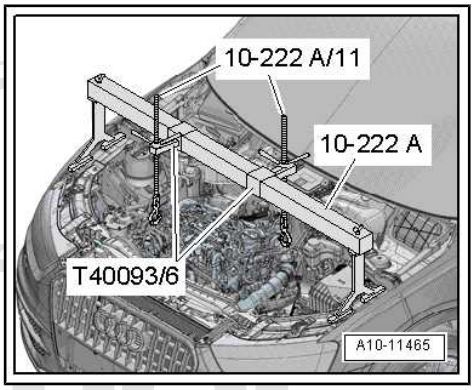
– Remove battery and battery tray ⇒ Electrical system; Rep. gr. 27 ; Battery; Removing and installing battery tray .



– Unclip sealing element -1- using removal lever - 80 - 200- .

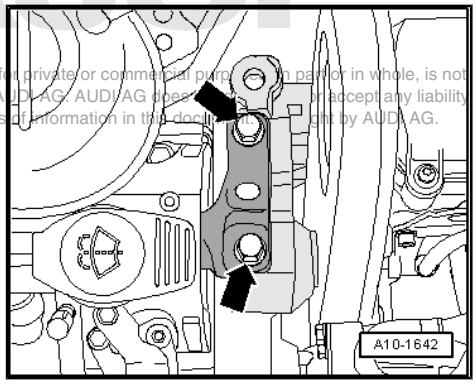


– Position support bracket - 10 - 222 A- on bolted flanges of wing panels as shown in illustration.
– Attach hooks of spindles to engine lifting eyes.
– Take up weight of engine/gearbox assembly evenly with both spindles (do not raise assembly).

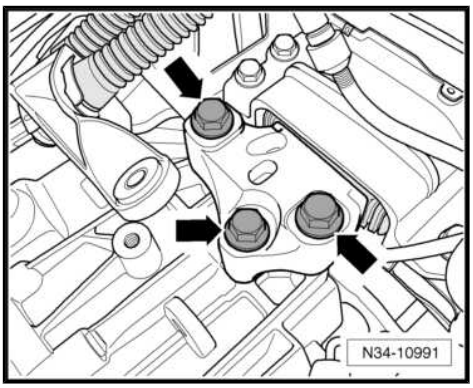


– Remove bolts -arrows- for engine mounting one by one and renew (if they were not renewed when installing engine).
– Initially fit bolts hand-tight.

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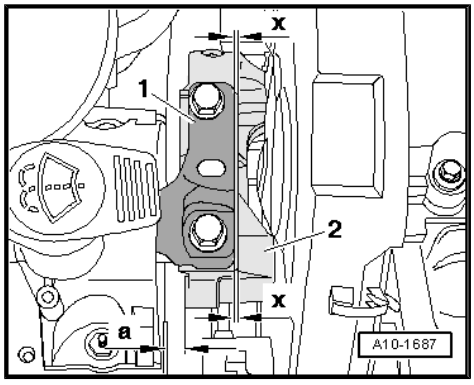


– Remove bolts -arrows- for gearbox mounting one by one and renew (if they were not renewed when installing engine).
– Initially fit bolts hand-tight.



– Using assembly lever, adjust engine/gearbox assembly between engine mounting and support arm -1- until specifications listed below are attained:

- There must be a distance of at least -a- = 13.5 mm between engine support -2- and longitudinal member (right-side).
- The side of the engine support casting -2- must be aligned parallel to the support arm -1- (distance -x- = distance -x-).



Note

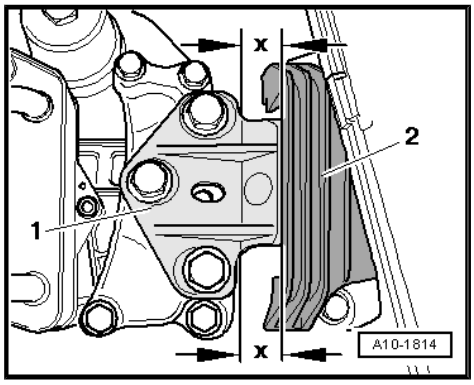
Distance -a- (at least 13.5 mm) can also be checked with a metal rod of suitable size, or similar.

– Tighten bolts for engine mounting.

– Ensure that edges of support arm (on gearbox side) -1- and gearbox mounting -2- are parallel.

- Dimension -x- = dimension -x-.

– Tighten bolts for gearbox mounting.



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

Tightening torques

◆ ⇒ “2.1 Exploded view - assembly mountings”, page 36

– Install battery tray and battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Removing and installing battery tray .

– Install engine cover panel ⇒ page 47 .

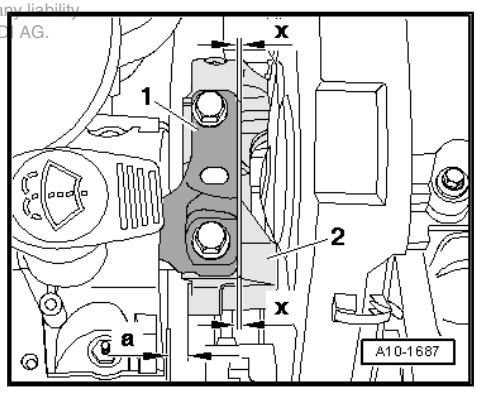
2.6 Checking adjustment of assembly mountings (engine/gearbox mountings)

Procedure

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The following specifications must be obtained:

- There must be a distance of at least -a- = 13.5 mm between engine support -2- and longitudinal member (right-side).
- The side of the engine support casting -2- must be aligned parallel to the support arm -1- (distance -x- = distance -x-).



Note

Distance -a- (at least 13.5 mm) can also be checked with a metal rod of suitable size, or similar.

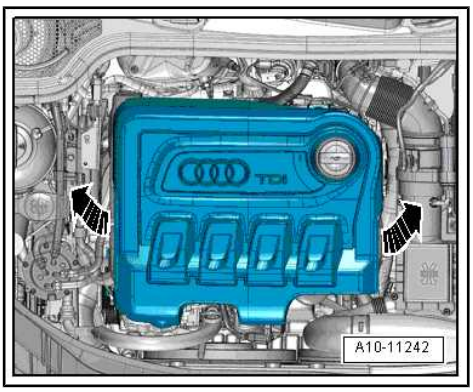
– If the distance measured is too large or small, the assembly mountings must be adjusted ⇒ page 44 .

3 Engine cover panel

⇒ “3.1 Removing and installing engine cover panel”, page 47

3.1 Removing and installing engine cover panel

Removing



– Carefully pull engine cover panel off retaining pins one after another -arrows-. Do not jerk engine cover panel away, and do not try to pull on one side only.

Installing

– To avoid damage, do not strike the engine cover panel with your fist or with any kind of tool.

– Position engine cover panel on engine, making sure it is correctly fitted on oil filler neck and oil dipstick.

– First press engine cover panel into rear rubber grommets and then into front rubber grommets with both hands.

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13 – Crankshaft group

1 Cylinder block (pulley end)

⇒ “1.1 Exploded view - cylinder block (pulley end)”, page 48

⇒ “1.2 Exploded view - sealing flange (pulley end)”, page 50

⇒ “1.3 Removing and installing poly V-belt”, page 51

⇒ “1.4 Removing and installing tensioner for poly V-belt”, page 52

⇒ “1.5 Removing and installing vibration damper”, page 53

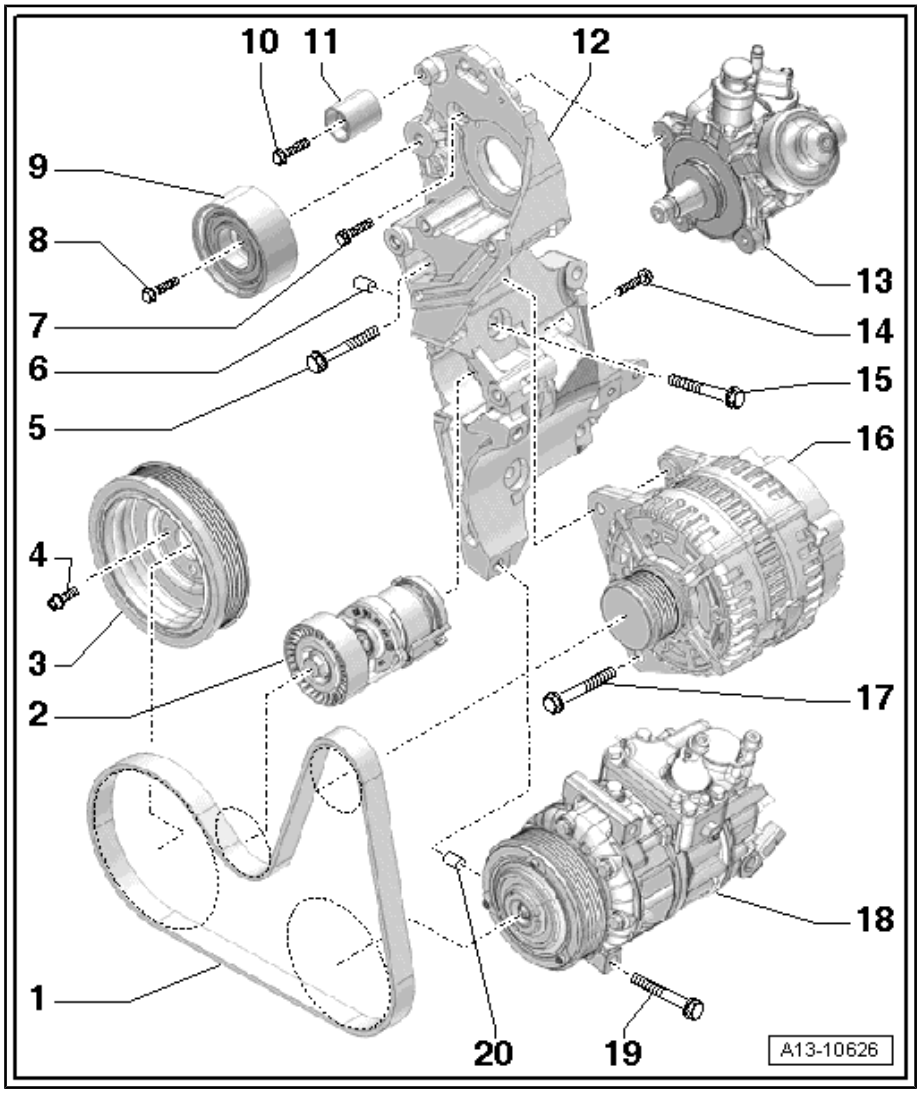
⇒ “1.6 Removing and installing bracket for ancillaries”, page 54

⇒ “1.7 Renewing crankshaft oil seal (pulley end)”, page 56

⇒ “1.8 Removing and installing sealing flange (pulley end)”, page 58

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1.1 Exploded view - cylinder block (pulley end)



1 - Poly V-belt

- ❑ Check for wear
- ❑ Before removing, mark direction of rotation with chalk or felt-tip pen
- ❑ Removing and installing ⇒ page 51
- ❑ Do not kink
- ❑ When installing, make sure it is properly seated on pulleys.

2 - Tensioner for poly V-belt

- ❑ Removing and installing ⇒ page 52

3 - Vibration damper

- ❑ With poly V-belt pulley
- ❑ Installation position: hole in vibration damper must be positioned over raised section of crankshaft sprocket
- ❑ Removing and installing ⇒ page 53

4 - Bolt

- ❑ Renew
- ❑ Use only genuine bolts ⇒ Electronic parts catalogue
- ❑ 10 Nm +90°

5 - Bolt

- ❑ Tightening torque ⇒ Electrical system; Rep. gr. 27 ; Alternator; Exploded view - alternator

6 - Dowel sleeve

- ❑ Ensure correct seating in bracket for ancillaries

7 - Bolt

- ❑ Tightening torque ⇒ Item 7 (page 249)

8 - Bolt

- ❑ Tightening torque ⇒ Item 22 (page 88)

9 - Idler roller

- ❑ For toothed belt

10 - Bolt

- ❑ Tightening torque ⇒ Item 8 (page 87)

11 - Idler roller

- ❑ For toothed belt

12 - Bracket for ancillaries

- ❑ Removing and installing ⇒ page 54

13 - High-pressure pump

- ❑ Removing and installing ⇒ page 250

14 - Bolt

- ❑ Bolt can be re-used; tightening torque for re-used bolt: 20 Nm + 90°
- ❑ New bolt: 20 Nm +180°

15 - Bolt

- ❑ Tightening torque and sequence ⇒ page 50

16 - Alternator

- ❑ Removing and installing ⇒ Electrical system; Rep. gr. 27 ; Alternator; Removing and installing alternator

17 - Bolt

- ❑ Tightening torque ⇒ Electrical system; Rep. gr. 27 ; Alternator; Exploded view - alternator

18 - Air conditioner compressor

- ❑ Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Air conditioner compressor; Removing and installing air conditioner compressor

19 - Bolt

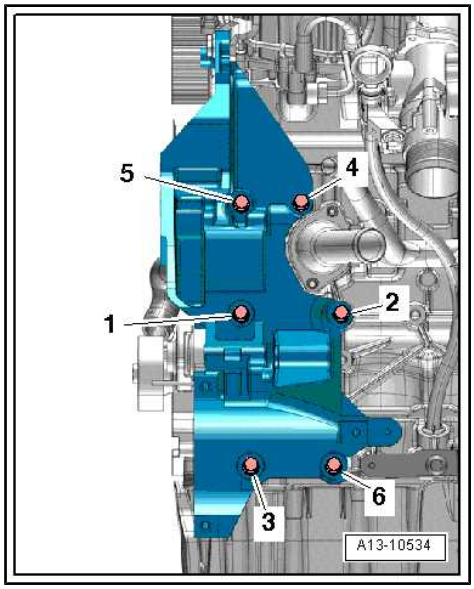
- ❑ Tightening torque ⇒ Heating, air conditioning; Rep. gr. 87 ; Air conditioner compressor; Exploded view - air conditioner compressor drive unit

20 - Dowel sleeve

- ❑ Ensure correct seating in bracket for ancillaries

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Bracket for ancillaries - tightening torque and tightening sequence



Note

Renew the bolts tightened with specified tightening angle.

– Fit bolts in the following sequence:

- Bolts -1- and -2- M10x52.
- Bolts -3- and -6- M10x30.
- Bolts -4- and -5- M10x60.

– Tighten bolts in 4 stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-1 … 6-	Screw in by hand until contact is made
2.	-1 … 6-	40 Nm
3.	-3- and -6-	Turn 45° further
4.	-1, 2, 4, 5-	Turn 90° further

1.2 Exploded view - sealing flange (pulley end)

1 - Bolt
- ❑ Tightening torque ⇒ Item 27 (page 88)

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

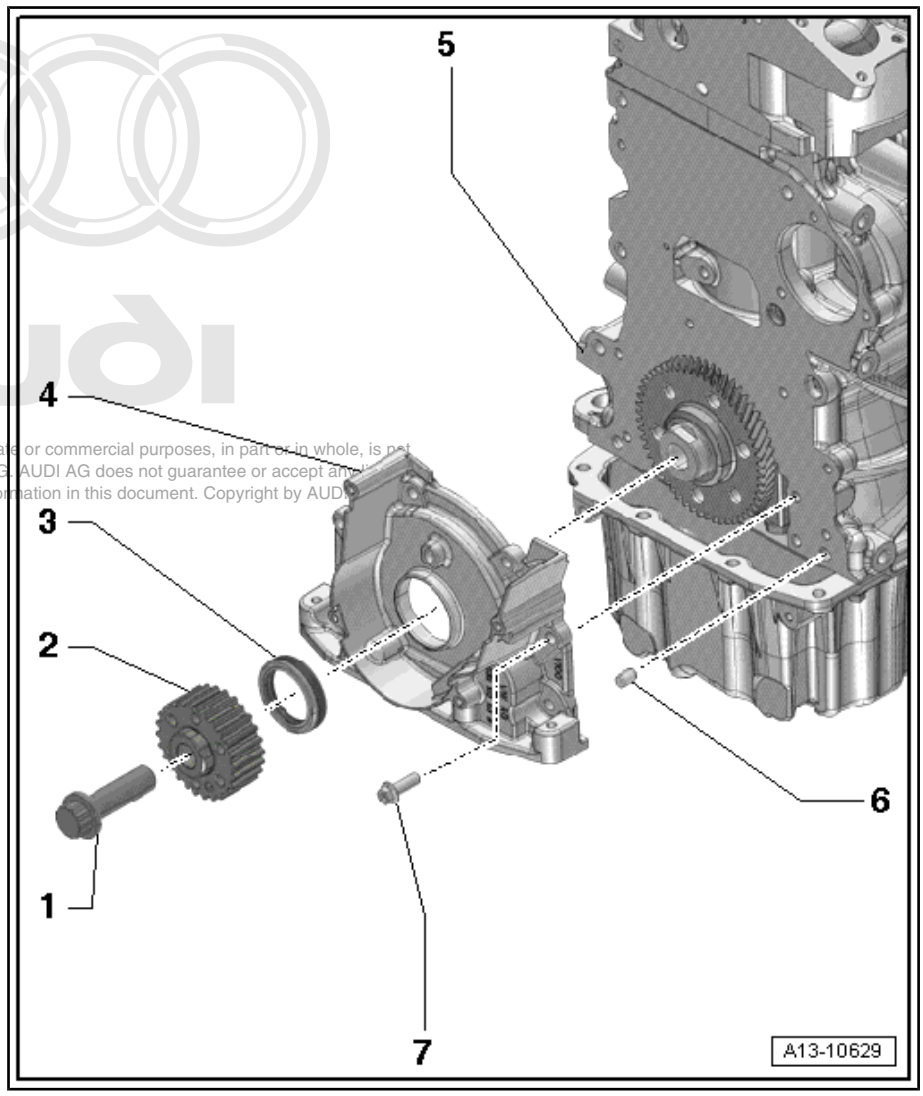
3 - Oil seal
- ❑ For crankshaft (pulley end)
- ❑ Renewing ⇒ page 56
- ❑ Do not lubricate with oil

4 - Sealing flange (pulley end)
- ❑ Should be positioned on dowel pins
- ❑ Removing and installing ⇒ page 58

5 - Cylinder block

6 - Dowel pin
- ❑ 2x

7 - Bolt
- ❑ Tightening torque and sequence ⇒ page 51

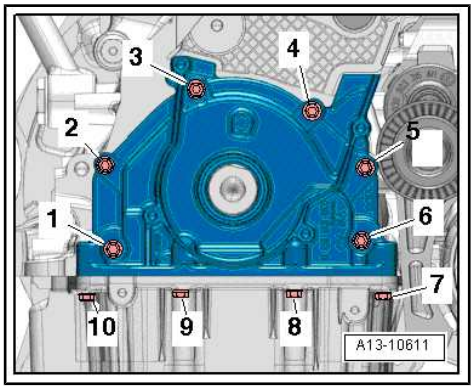


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Sealing flange (pulley end) - tightening torque and sequence

– Tighten bolts in 3 stages in the sequence shown:

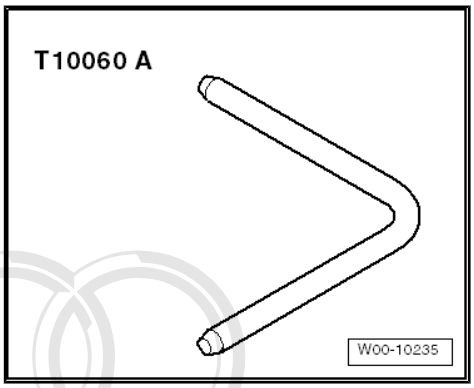
Stage	Bolts	Tightening torque
1.	-1 … 10-	Screw in by hand until contact is made
2.	-1 … 6-	Tighten in stages and in diagonal sequence; final torque 15 Nm
3.	-7 … 10-	15 Nm



1.3 Removing and installing poly V-belt

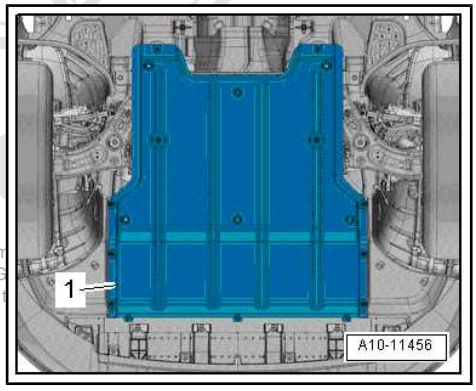
Special tools and workshop equipment required

♦ Locking pin - T10060 A-



Removing

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

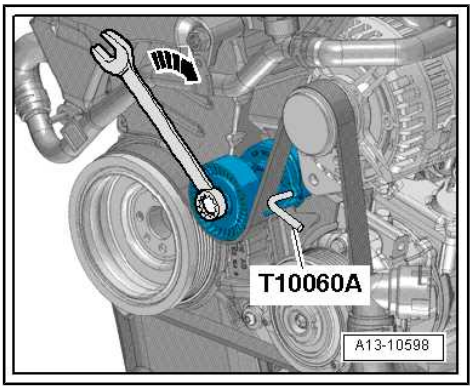


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Caution

Wrong direction of rotation for a used poly V-belt can lead to irreparable damage.

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



– To slacken poly V-belt, turn tensioner in clockwise direction -arrow-.

– Lock tensioner with locking pin - T10060 A- .

– Take off poly V-belt.

Installing

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

– Fit poly V-belt on poly V-belt pulleys:

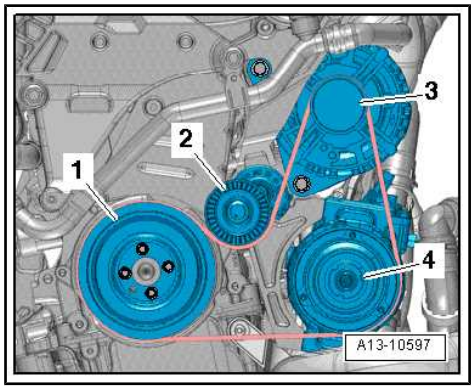
1 - Vibration damper

2 - Tensioner

3 - Alternator

4 - Air conditioner compressor

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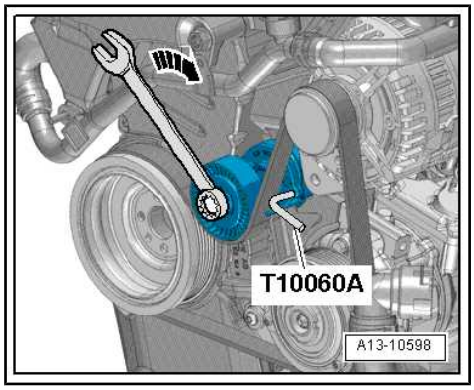
– Hold tensioner with ring spanner and remove locking pin - T10060 A- .

– Release tensioner.

– Check that poly V-belt is in correct position.

– Start engine and check that poly V-belt(s) run properly.

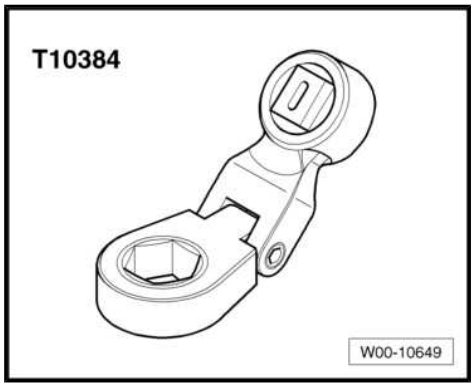
– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



1.4 Removing and installing tensioner for poly V-belt

Special tools and workshop equipment required

♦ Ratchet wrench 13 mm - T10384-



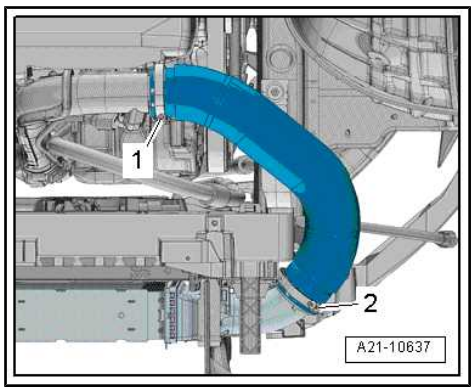
Removing

– Detach poly V-belt from tensioner ⇒ page 51 .

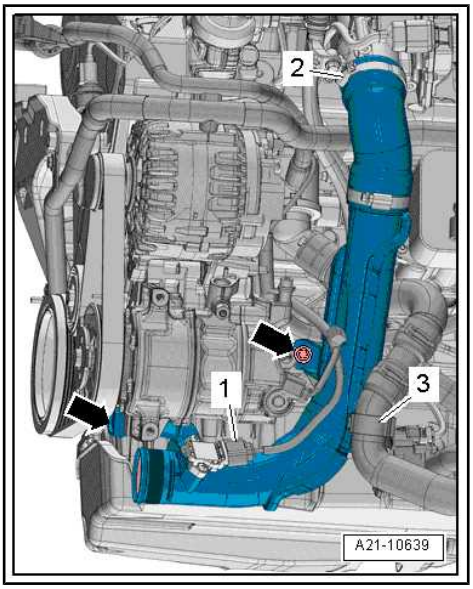
– Release hose clip -1- and detach air hose.

Note

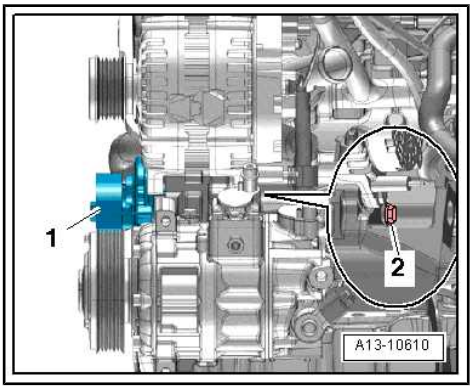
Disregard -item 2-.



– Remove bolts -arrows-.
– Move coolant hose -3- clear.
– Release hose clip -2-.
– Unplug electrical connector -1- at charge pressure sender - G31- / intake air temperature sender - G42- and detach air pipe (right-side).



– Remove bolt -2- and detach poly V-belt tensioner -1-.



Note

- *If bolt -2- makes contact with engine bracket, leave bolt in installation position.*
- *Due to lack of space, the tensioner must be guided out upwards by rotating it.*

Installing

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

Tightening torques

- ⇒ “1.1 Exploded view - cylinder block (pulley end)”, page 48
- ⇒ “2.1 Exploded view - charge air system”, page 221
- ⇒ Fig. ““Installing air hoses with screw-type clips”“ , page 222

– Install poly V-belt ⇒ page 51 .

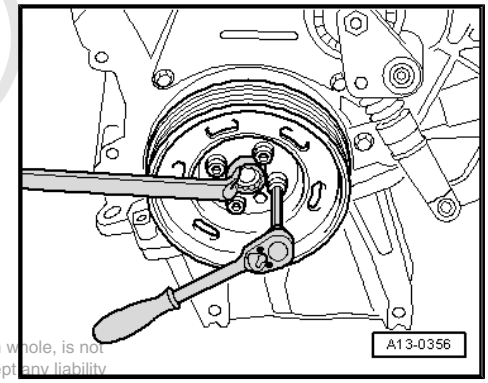
1.5 Removing and installing vibration damper

Removing

– Remove wheel spoiler (front right) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liners; Exploded view - wheel housing liner (front) .
– Remove poly V-belt ⇒ page 51 .

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– Counterhold by applying ring spanner to bolt for crankshaft sprocket and slacken bolts for vibration damper.
– Remove bolts and take off vibration damper.



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Installing

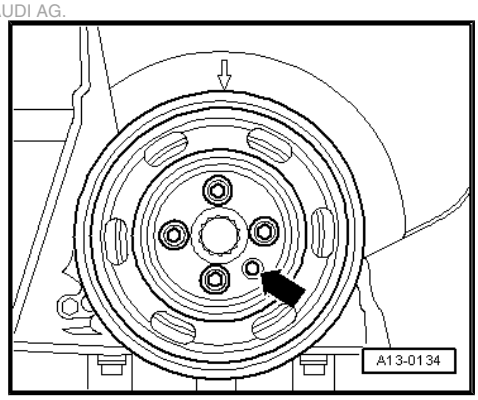
Installation is carried out in the reverse order; note the following:

Tightening torques

♦ ⇒ “1.1 Exploded view - cylinder block (pulley end)”, page 48

Note

Renew the bolts tightened with specified tightening angle.



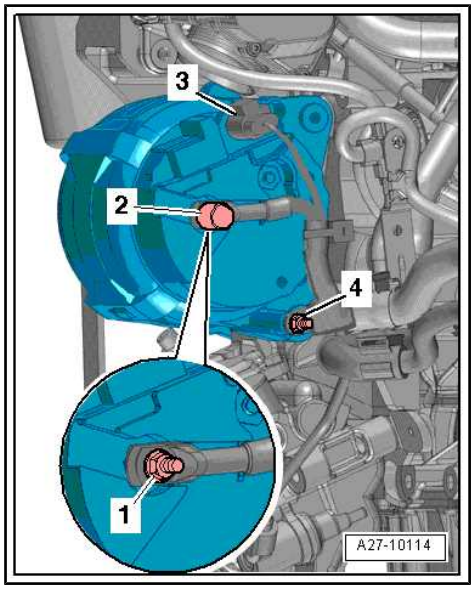
- Installation position: hole -arrow- in vibration damper must be positioned over raised section of crankshaft sprocket.

– Install poly V-belt ⇒ page 51 .
– Install wheel spoiler (front right) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liners; Exploded view - wheel housing liner (front) .

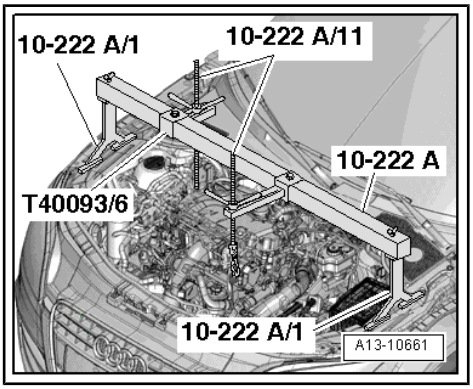
1.6 Removing and installing bracket for ancillaries

Removing

– Remove engine mounting ⇒ page 38 .
– Take poly V-belt off alternator ⇒ page 51 .
– Remove alternator ⇒ Electrical system; Rep. gr. 27 ; Alternator; Removing and installing alternator .
– Remove high-pressure pump ⇒ page 250 .



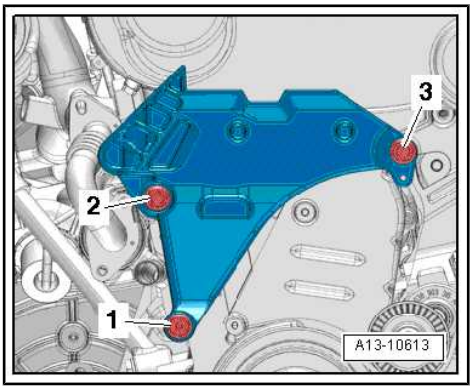
– Pull engine upwards with spindle (right-side).



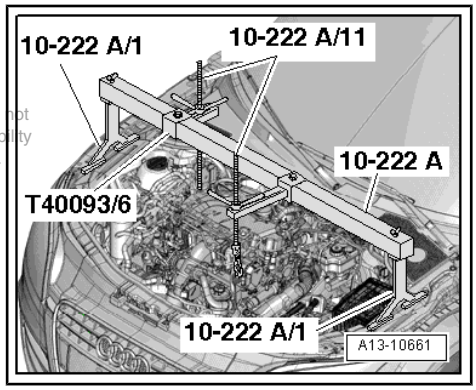
– Remove bolt -3- from engine support; insert new bolt, but do not start screwing it in.

Note

Disregard items -1 and 2-.

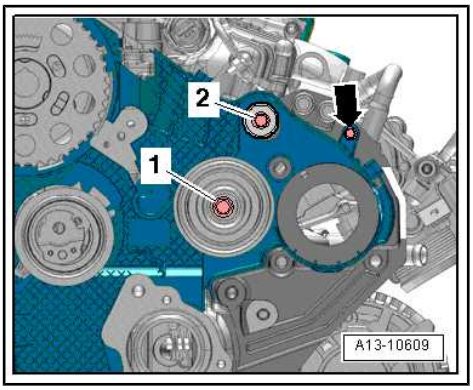


– Lower engine again with spindle (right-side).

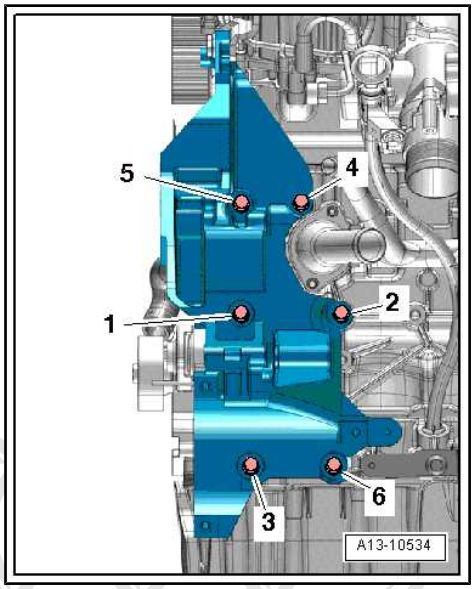


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– Remove bolt -arrow-.
– Remove bolts -1- and -2- and remove idler rollers for toothed belt.



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



Installing

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

Note

Renew the bolts tightened with specified tightening angle.

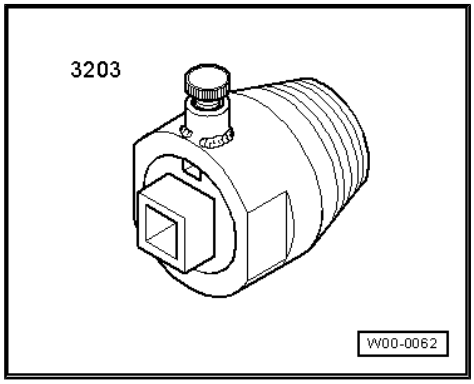
– Check that dowel sleeve at top right between bracket for ancillaries and cylinder block is fitted; insert dowel sleeve if necessary.
– Tighten bolts for bracket for ancillaries ⇒ page 50 .
– Install engine support ⇒ page 36 .
– Install high-pressure pump ⇒ page 250 .
– Install toothed belt (adjust valve timing) ⇒ page 93 .
– Install alternator ⇒ Electrical system; Rep. gr. 27 ; Alternator; Removing and installing alternator .
– Install poly V-belt ⇒ page 51 .
– Install engine mountings ⇒ page 38 .

1.7 Renewing crankshaft oil seal (pulley end)

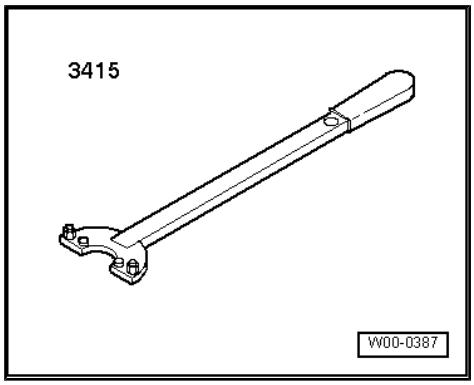
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Special tools and workshop equipment required

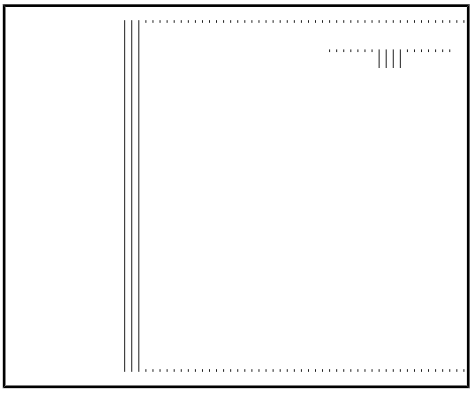
♦ Oil seal extractor - 3203-



♦ Counterhold tool - 3415-



♦ Assembly tool - T10053-

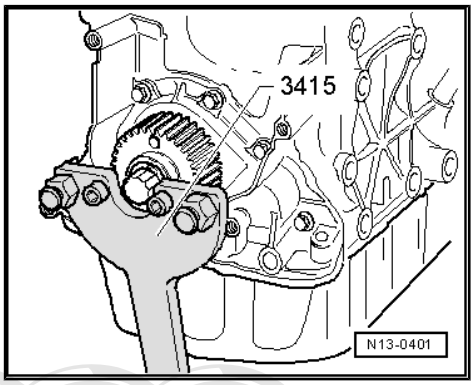


Procedure

– Remove toothed belt ⇒ page 89 .

– Loosen bolt for crankshaft sprocket using counterhold tool -3415- .

– Remove bolt and detach crankshaft sprocket.



– Adjust inner section of oil seal extractor -3203- so it is flush with the outer section and lock in position with knurled screw.

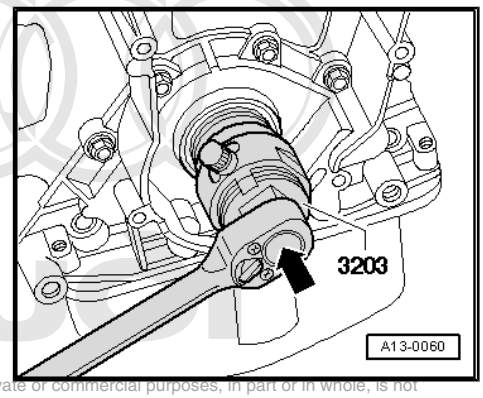
– Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).

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

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

– Clean contact surface and sealing surface for oil seal.

– Remove oil residue from crankshaft journal with a clean cloth.



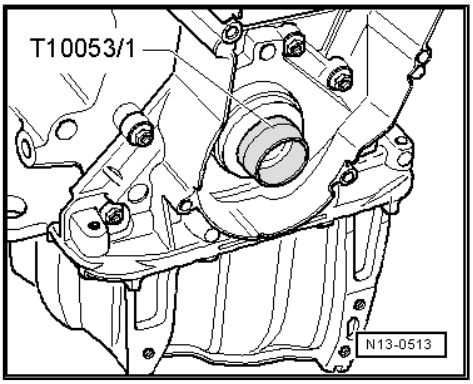
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Note

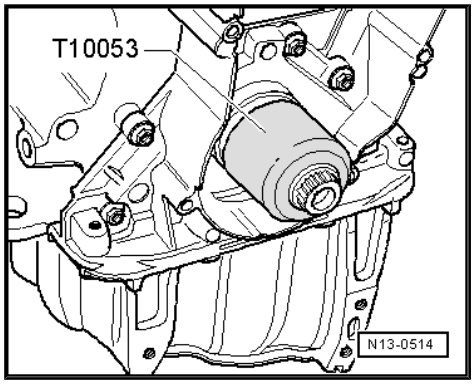
Do not lubricate sealing lip and outer rim of oil seal before pressing in.

– Fit guide sleeve -T10053/1- onto crankshaft journal.

– Push oil seal over guide sleeve onto crankshaft journal.



– Press in oil seal using bolt for crankshaft sprocket and thrust sleeve of assembly tool - T10053- until flush.
– Install crankshaft sprocket ⇒ page 87 .
– Install toothed belt (adjust valve timing) ⇒ page 93 .

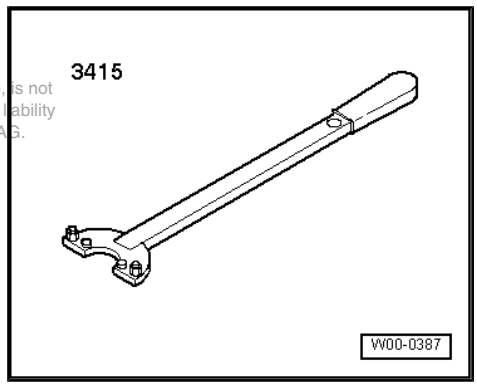


1.8 Removing and installing sealing flange (pulley end)

Special tools and workshop equipment required

♦ Counterhold tool - 3415-

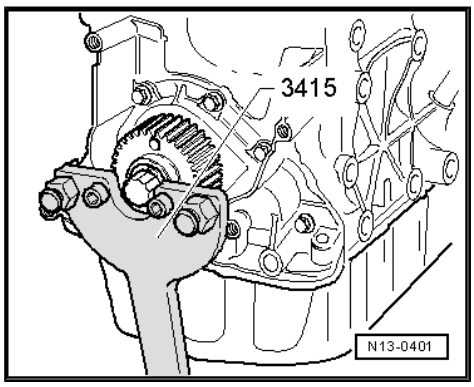
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♦ Electric drill with plastic brush attachment
♦ Safety goggles
♦ Sealant ⇒ Electronic parts catalogue

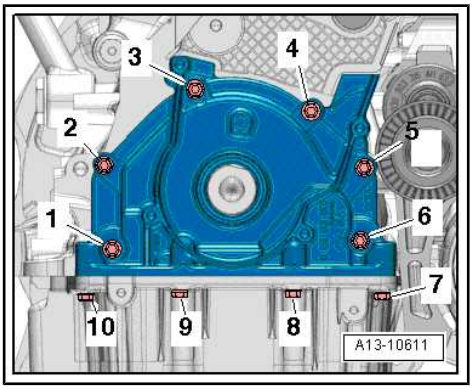
Removing

– Remove toothed belt ⇒ page 89 .
– Loosen bolt for crankshaft sprocket using counterhold tool - 3415- .
– Remove bolt and detach crankshaft sprocket.



– Remove bolts -1 ... 10- and carefully release sealing flange from bonded joint.

– Drive out oil seal with sealing flange removed.



Installing

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

Tightening torques

- ⇒ Fig. ""Sealing flange (pulley end) - tightening torque and sequence"" , page 51
- ⇒ Item 27 (page 88)

Caution

Make sure sealant residue does not enter lubrication system.

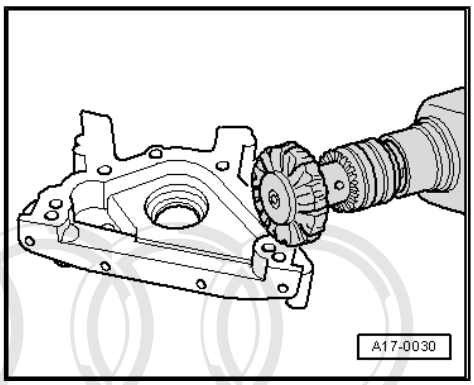
- *Place a clean cloth over the exposed section of the sump.*

– Carefully remove sealant residue on cylinder block and sump.

WARNING

Risk of eye injury.

- *Put on safety goggles.*



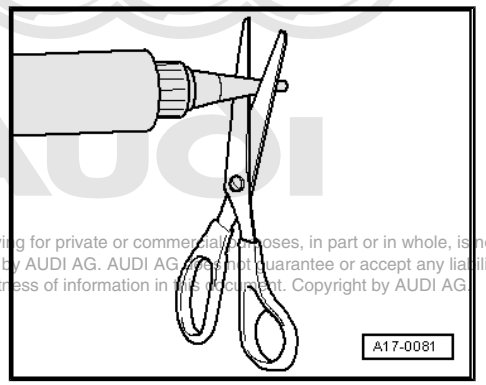
– Use e.g. rotating plastic brush to remove sealant residue on sealing flange.

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

Note

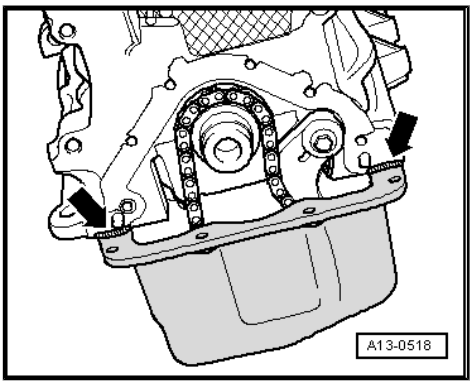
Note the use-by date of the sealant.

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



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



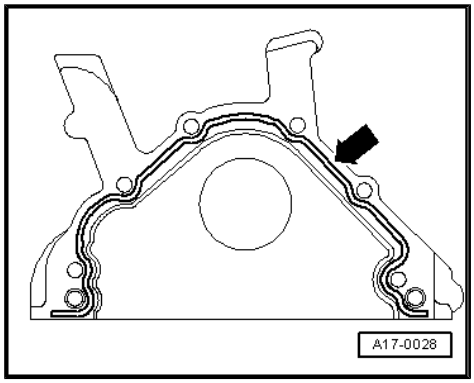
Caution

Make sure lubrication system is not clogged by excess sealant.

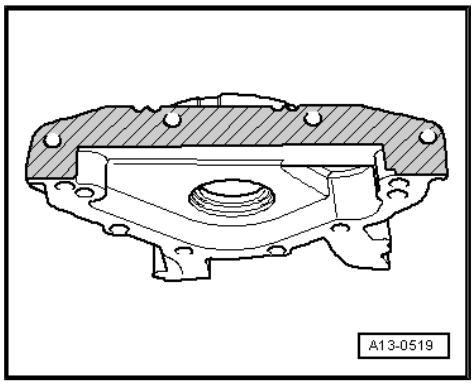
- ***The sealant bead must not be thicker than specified.***

– Apply bead of sealant -arrow- onto clean sealing surface of sealing flange as shown in illustration.

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



– Apply a thin coat of sealant to bottom sealing surface -shaded- on sealing flange.



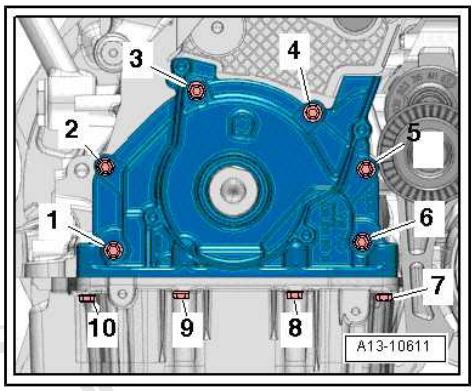
Note

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

– Carefully fit sealing flange onto dowel pins in cylinder block.

– Tighten sealing flange bolts ⇒ page 51 .

– Install crankshaft oil seal (pulley end) ⇒ page 56 .



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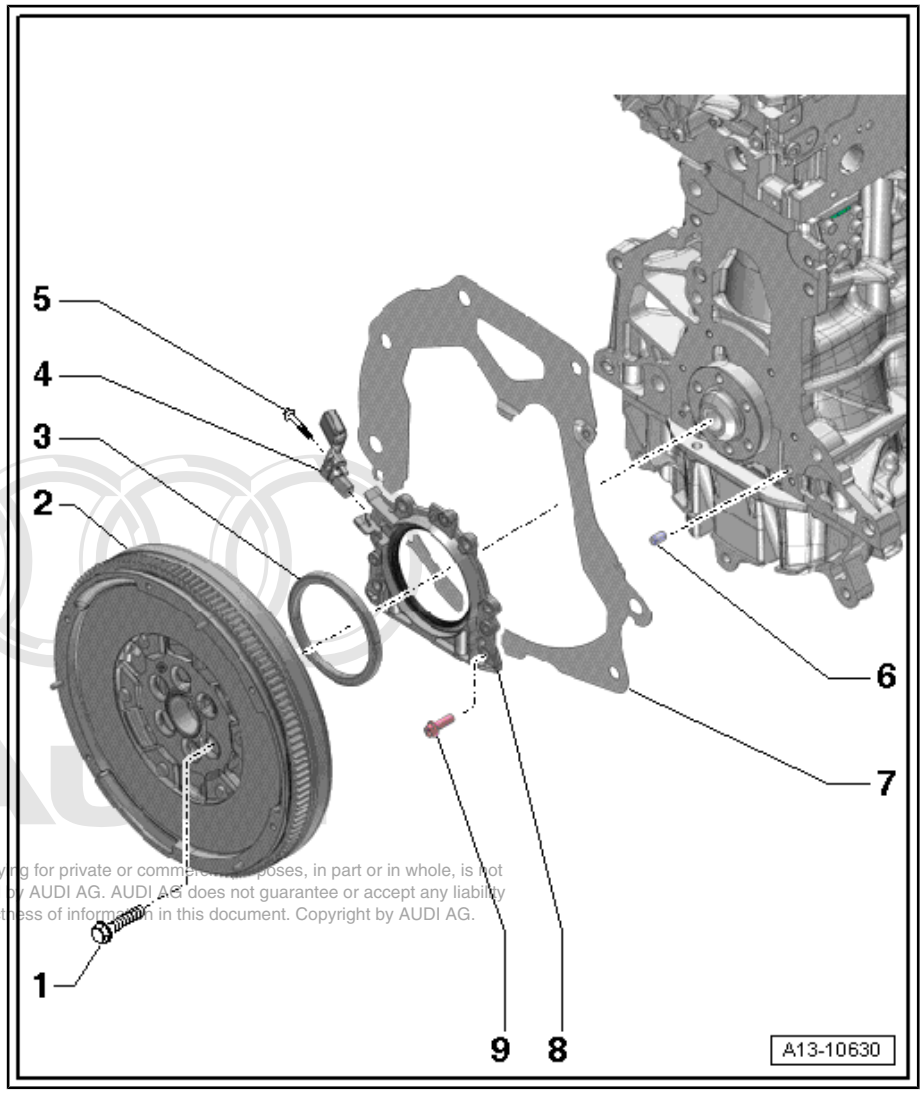
2 Cylinder block (gearbox end)

⇒ "2.1 Exploded view - cylinder block (gearbox end)", page 61

⇒ "2.2 Removing and installing flywheel", page 62

⇒ "2.3 Removing and installing sealing flange (gearbox end)", page 63

2.1 Exploded view - cylinder block (gearbox end)



1 - Bolt
- ❑ Renew
- ❑ 60 Nm +90°

2 - Dual-mass flywheel
- ❑ Removing and installing ⇒ page 62
- ❑ Can only be installed in one position

3 - Sender wheel
- ❑ For engine speed sender - G28-
- ❑ Removing and installing ⇒ "2.3 Removing and installing sealing flange (gearbox end)", page 63

4 - Engine speed sender - G28-
- ❑ Removing and installing ⇒ page 316

5 - Bolt
- ❑ 4.5 Nm

6 - Dowel pin
- ❑ 2x

7 - Intermediate plate
- ❑ Should be positioned on dowel pins
- ❑ Do not damage or bend when assembling
- ❑ Engaging on sealing flange ⇒ page 62

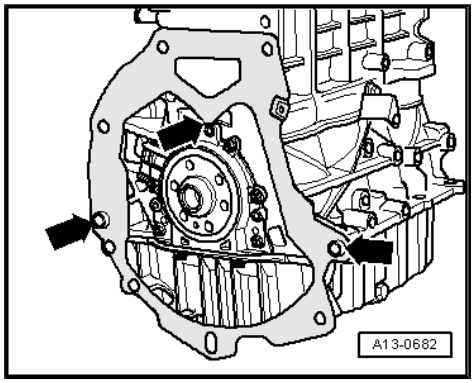
8 - Sealing flange (gearbox end)
- ❑ With oil seal
- ❑ Renewing ⇒ page 63

9 - Bolt
- ❑ Tightening torque and sequence ⇒ page 62

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Installing intermediate plate

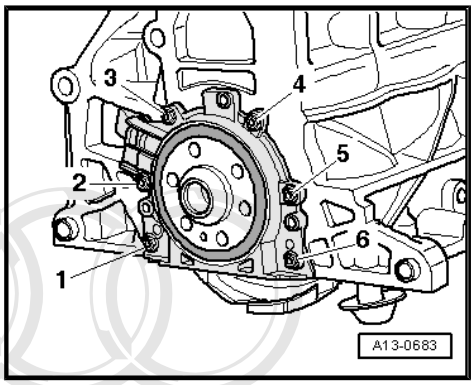
– Engage intermediate plate on sealing flange -top arrow- and push onto dowel sleeves -bottom arrows-.



Sealing flange (gearbox end) - tightening torque and sequence

– Tighten bolts in 2 stages in the sequence shown:

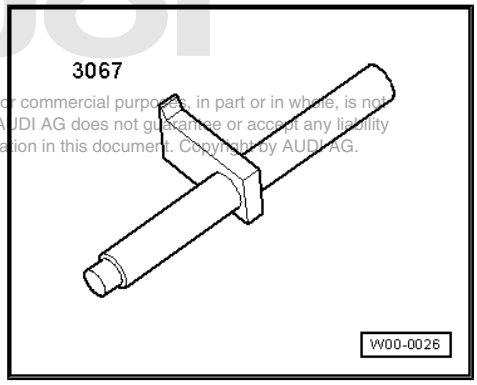
Stage	Bolts	Tightening torque
1.	-1 … 6-	Screw in by hand until contact is made
2.	-1 … 6-	Tighten in stages and in diagonal sequence; final torque 15 Nm



2.2 Removing and installing flywheel

Special tools and workshop equipment required

♦ Counterhold tool - 3067-



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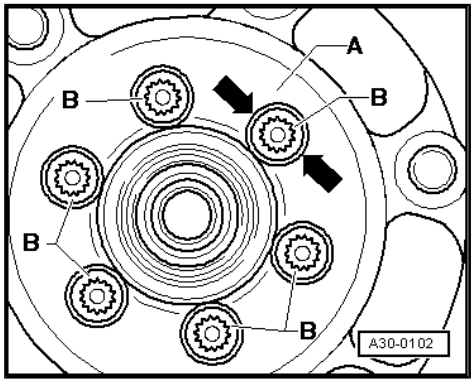
Removing

• Gearbox removed ⇒ Rep. gr. 34 ; Removing and installing gearbox; Removing gearbox

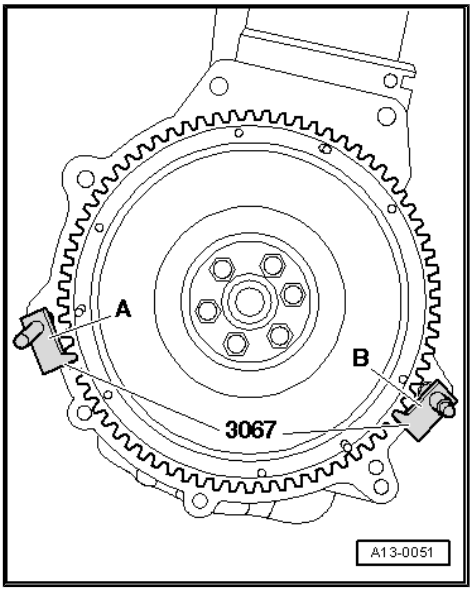
Caution

Risk of irreparable damage to dual-mass flywheel.

- *Remove bolts -B- using normal hand tools (do not use pneumatic wrench or impact driver, etc.).*
- *When removing the bolts, make sure that the bolt heads do not come into contact with the dual-mass flywheel.*
- *Rotate the dual-mass flywheel -A- so that the bolts -B- align centrally with the holes -arrows-.*



– Insert counterhold tool - 3067- in hole on cylinder block -item B-, slacken bolts for dual-mass flywheel.
– Remove bolts and take off dual-mass flywheel.



Installing

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

Tightening torques

♦ ⇒ “2.1 Exploded view - cylinder block (gearbox end)”, page 61

Note

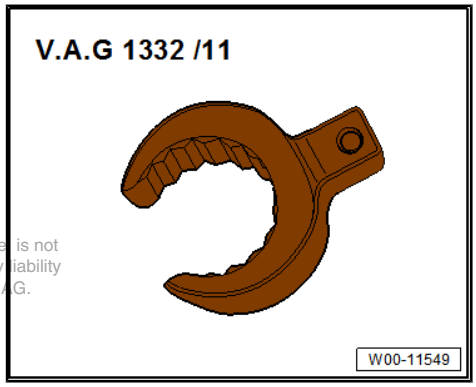
Renew the bolts tightened with specified tightening angle.

– Insert counterhold - 3067- in hole on cylinder block -item A-.

2.3 Removing and installing sealing flange (gearbox end)

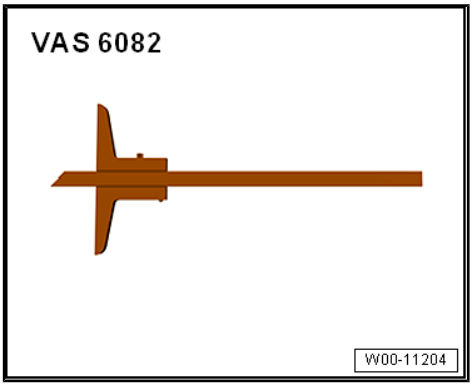
Special tools and workshop equipment required

♦ Open end spanner insert, AF 24 - V.A.G 1332/11-

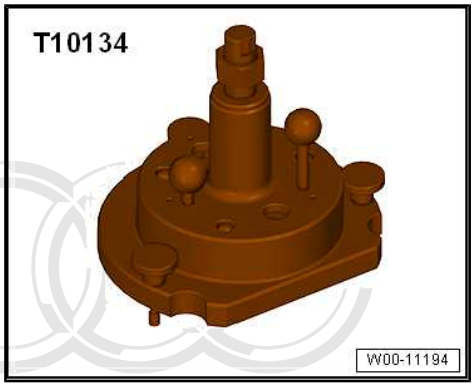


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♦ Depth gauge - VAS 6082-



♦ Assembly tool - T10134-



♦ Bolt M6x35 (3x)

♦ Bolt M7x35 (2x)

Pressing out sealing flange with sender wheel

• Gearbox removed

– Remove flywheel ⇒ page 62 .

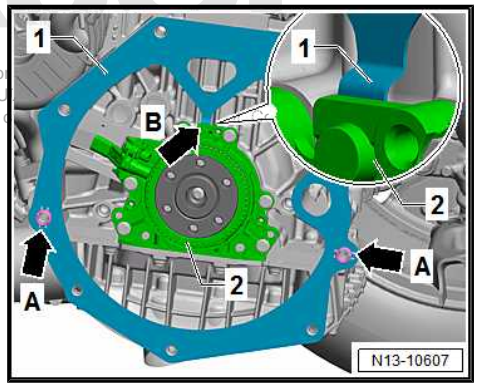
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Note

For clarity, the engine is removed in the following illustrations.

– Detach intermediate plate -1- from dowel sleeves -arrows A-.

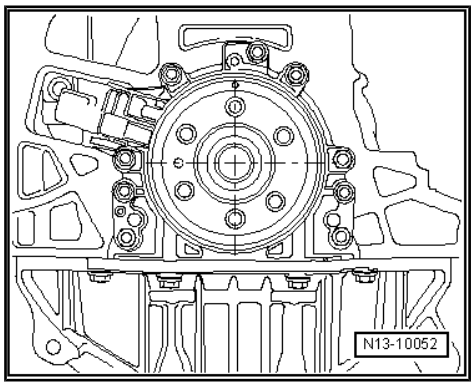
– Guide intermediate plate upwards; at the same time, pull retaining tab -arrow B- out of opening behind sealing flange -2-.



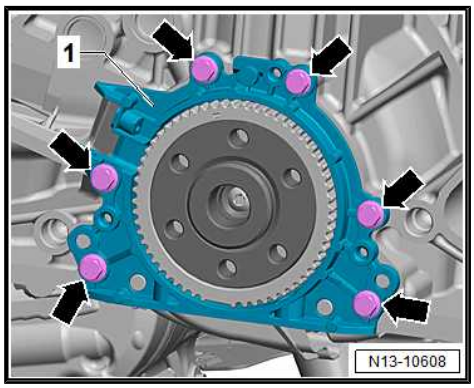
– Rotate crankshaft by turning bolt for toothed belt sprocket until crankshaft is positioned at “TDC”, as shown in illustration.

– Remove sump ⇒ page 144 .

– Remove engine speed sender - G28- ⇒ “1.5 Removing and installing engine speed sender G28 ”, page 316 .



– Remove bolts -arrows- for sealing flange -1-.

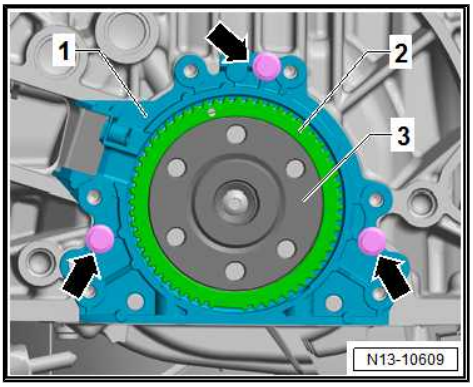


Note

The sealing flange -1- is pressed off the crankshaft -3- together with the sender wheel -2-.

– To press off, screw 3 bolts M6x35 -arrows- alternately into sealing flange not more than $^1/_2$ turn at a time.

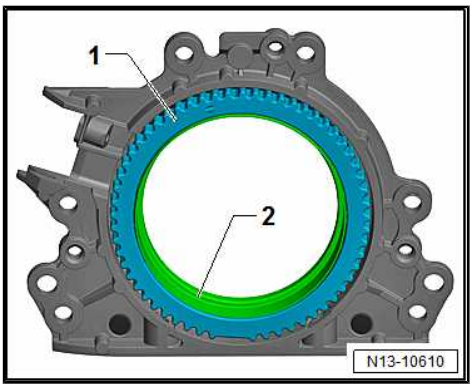
– Detach sealing flange together with sender wheel.



Pressing in sealing flange with sender wheel

Note

- *The sealing flange with PTFE oil seal is fitted with a sealing lip support ring -2-. This support ring acts as an assembly sleeve and must not be removed before installation.*
- *Sealing flange and sender wheel -1- must not be separated or rotated out of position after removal from packaging.*
- *The sender wheel is held in its installation position by a locating pin on the assembly tool - T10134- .*
- *The sealing flange and oil seal are one unit and can only be replaced together with the sender wheel.*
- *The assembly tool - T10134- is held in the correct position relative to the crankshaft by a guide pin which is inserted into a hole in the crankshaft.*



Construction of assembly tool - T10134- :

A - Tensioning flats

B - Nut

C - Assembly housing

D - Locating pin

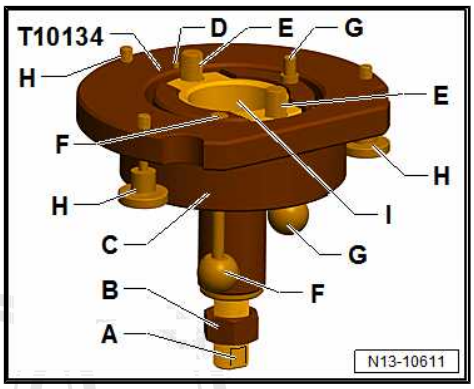
E - Hexagon socket head bolts (2x)

F - Guide pin for diesel engines (black handle)

G - Guide pin for petrol engines (red handle)

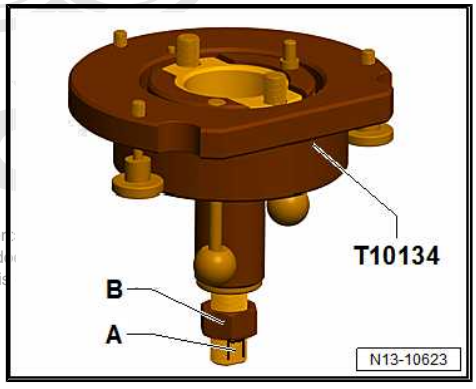
H - Knurled screws (3x)

I - Inner section



Fitting sealing flange with sender wheel onto assembly tool - T10134- :

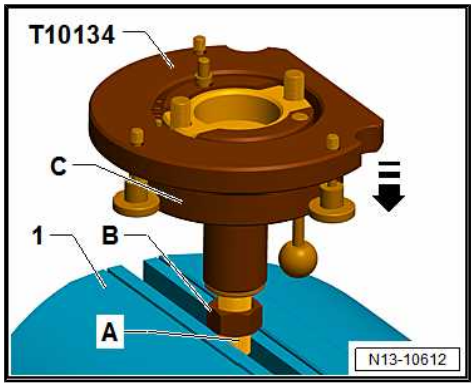
– Unscrew nut -B- until it is just in front of tightening flats -A- on threaded spindle.



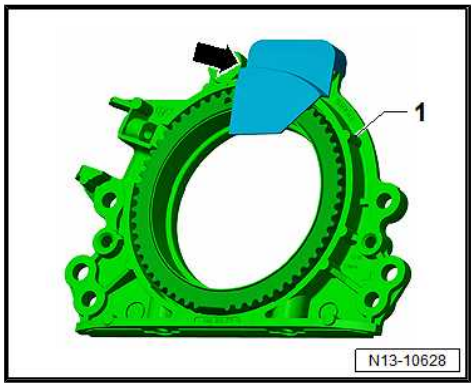
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– Clamp assembly tool - T10134- in a vice -1- on tightening flats -A- of threaded spindle.
– Press assembly housing -C- downwards -arrow- so that it rests on nut -B-.

• Inner part of assembly device and assembly housing must align (be level) with each other.



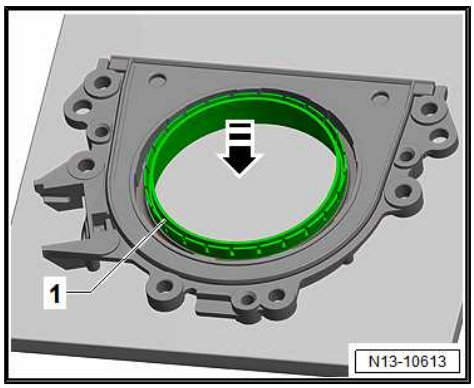
– If fitted, remove securing clip -arrow- from new sealing flange.



Note

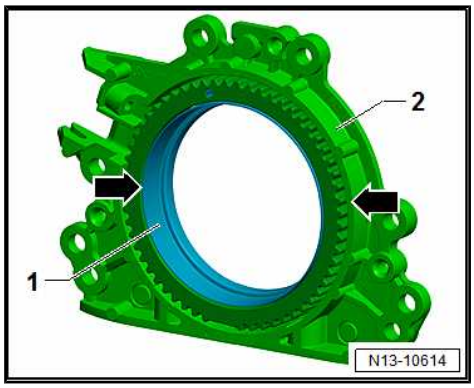
Do not take the sender wheel out of the sealing flange or rotate it out of position.

– Place sealing flange (with front side downwards) on a clean flat surface.
– Press sealing lip support ring -1- downwards in direction of -arrow- until it touches flat surface.



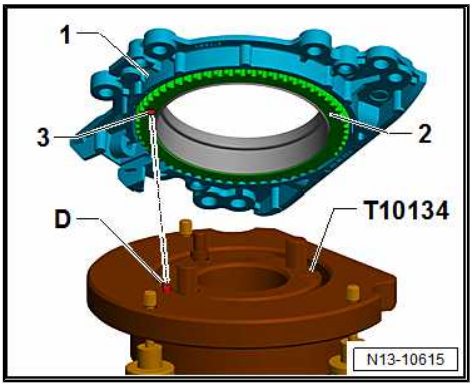
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• Upper edge of sealing lip support ring -1- must be flush -arrows- with front edge of sealing flange -2-.



– Place front side of sealing flange -1- on assembly tool - T10134- so that locating pin -D- is seated in hole -3- in sender wheel -2-.

• Ensure that sealing flange lies flat on assembly tool.

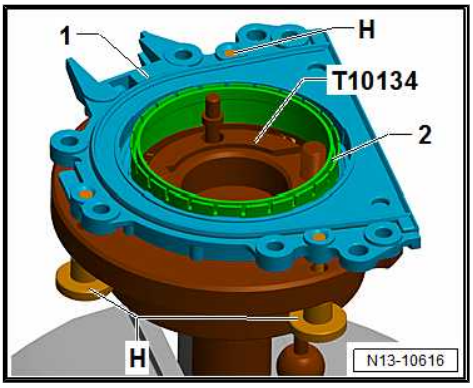


– Screw knurled screws -H- onto sealing flange -1-.

– When tightening, press sealing flange and sealing lip support ring -2- against surface of assembly tool - T10134- .

– This prevents locating pin from sliding out of hole in sender wheel.

– Ensure that sender wheel remains fixed on assembly tool when installing sealing flange.



Securing assembly tool - T10134- with sealing flange -1- on crankshaft flange:

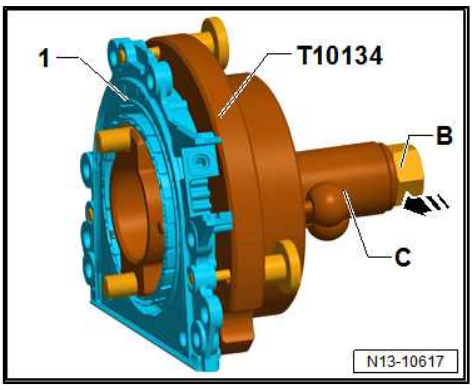
• Crankshaft flange must be free of oil and grease.

• Engine is at “TDC” position.

– Screw nut -B- to end of threaded spindle.

– Press threaded spindle of assembly tool - T10134- in direction of -arrow- until nut -B- makes contact with assembly housing -C-.

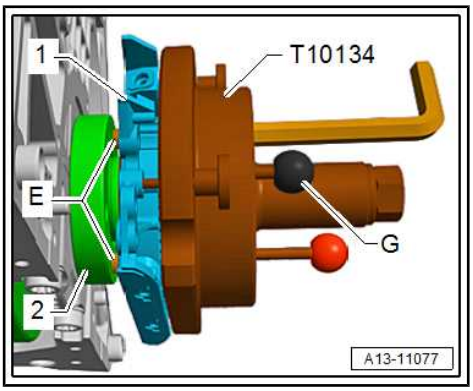
– Position flat edge of assembly housing towards sealing surface for sump on cylinder block.



– Secure assembly tool - T10134- with sealing flange -1- to crankshaft flange -2-.

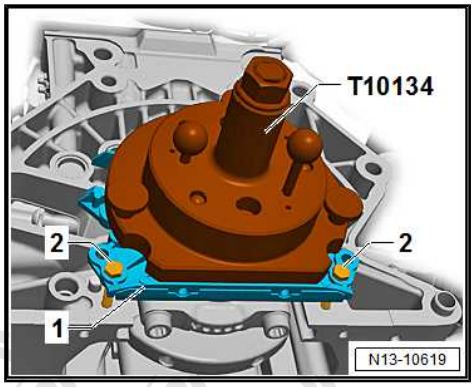
– To do so, screw hexagon socket head bolts -E- approx. 5 turns into crankshaft flange with hexagon key.

– Insert guide pin for diesel engines (black handle) -G- into crankshaft flange.



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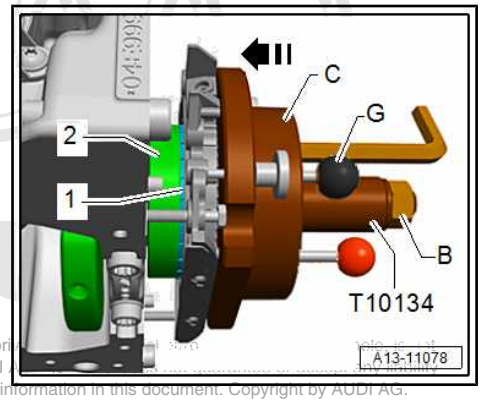
– Screw 2 bolts M6x35 -item 2- into cylinder block to guide sealing flange -1-.



Securing assembly tool - T10134- on crankshaft flange:

– Press assembly housing -C- by hand in direction of -arrow- until sealing lip support ring -1- touches surface of crankshaft flange -2-.

– Check that guide pin for diesel engines (black handle) -G- is fitted correctly in hole in crankshaft. This ensures that sender wheel reaches its final installation position.



Note

The guide pin for PETROL engines (red handle) MUST NOT be inserted into the threaded hole in the crankshaft.

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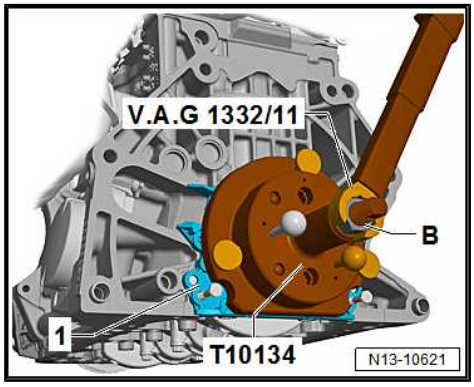
– Tighten the two hexagon socket head bolts on assembly tool hand-tight.

– Screw nut -B- onto threaded spindle by hand until it touches assembly housing -C-.

Pressing sender wheel onto crankshaft flange with assembly tool - T10134- :

– Tighten nut -B- on assembly tool - T10134- to 35 Nm.

• There must be a small gap between cylinder block and sealing flange -1- after nut has been tightened to 35 Nm.



Checking installation position of sender wheel on crankshaft:

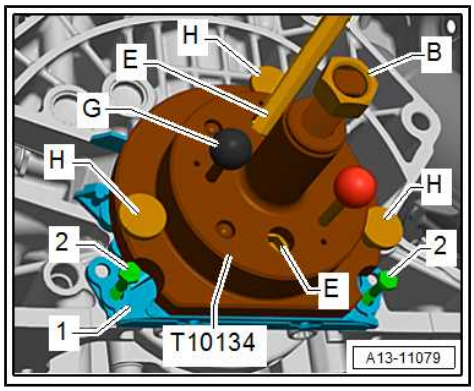
– Screw nut -B- to end of threaded spindle.

– Remove both bolts -2- from cylinder block.

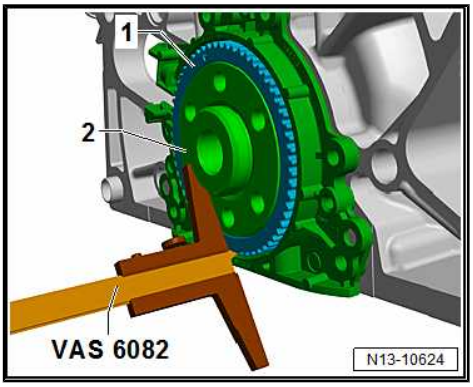
– Unscrew knurled screws -H- from sealing flange -1-.

– Unbolt assembly tool - T10134- from crankshaft flange (remove hexagon socket head bolts -E- from crankshaft flange).

– Detach sealing lip support ring.



– Apply depth gauge - VAS 6082- to crankshaft flange -2-.

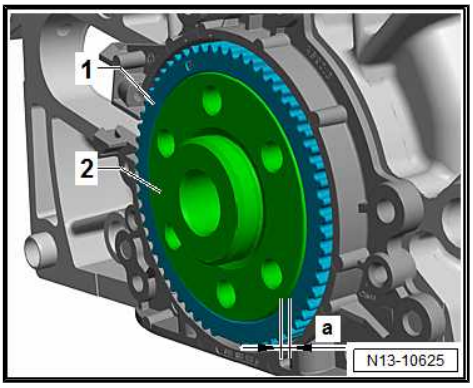


– Measure distance -a- between crankshaft flange -2- and sender wheel -1-.

• Specification: Distance -a- = 0.5 mm.

– Press sender wheel in further if measurement is too small ⇒ page 69 .

– If reading matches specification, continue with assembly ⇒ page 70 .



Pressing sender wheel in further:

– Secure assembly tool - T10134- to crankshaft flange.

– Ensure that locating pin of assembly tool - T10134- is fitted in hole in sender wheel.

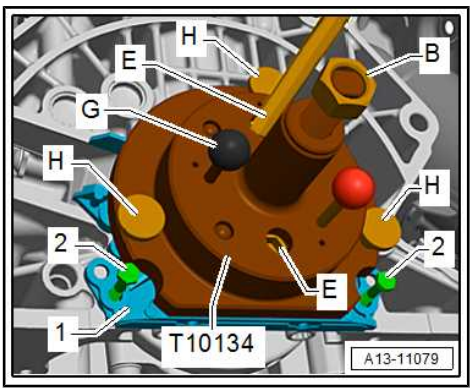
– Hand-tighten hexagon socket head bolts -E-.

– Slide assembly tool - T10134- onto sealing flange -1- by hand.

– Screw nut -B- onto threaded spindle by hand until it touches assembly tool - T10134- .

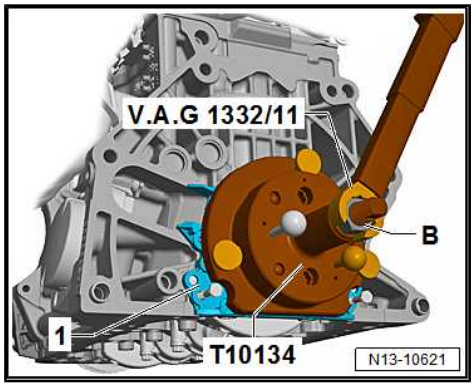
– Insert guide pin for diesel engines (black handle) -G- into crankshaft flange.

– Screw 2 bolts M6x35 -item 2- into cylinder block to guide sealing flange -1-.



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– Tighten nut -B- on assembly tool - T10134- to 40 Nm.
– Check installation position of sender wheel on crankshaft again ⇒ page 68 .
– Tighten nut on assembly tool - T10134- to 45 Nm if measurement is too small.
– Check installation position of sender wheel on crankshaft again ⇒ page 68 .



Assembling:

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

– Install sump ⇒ page 144 .
– Install intermediate plate ⇒ page 62 .
– Install flywheel ⇒ page 62 .

Tightening torques

◆ ⇒ Fig. ""Sealing flange (gearbox end) - tightening torque and sequence"" , page 62
◆ ⇒ "1.1 Exploded view - glow plug system", page 312

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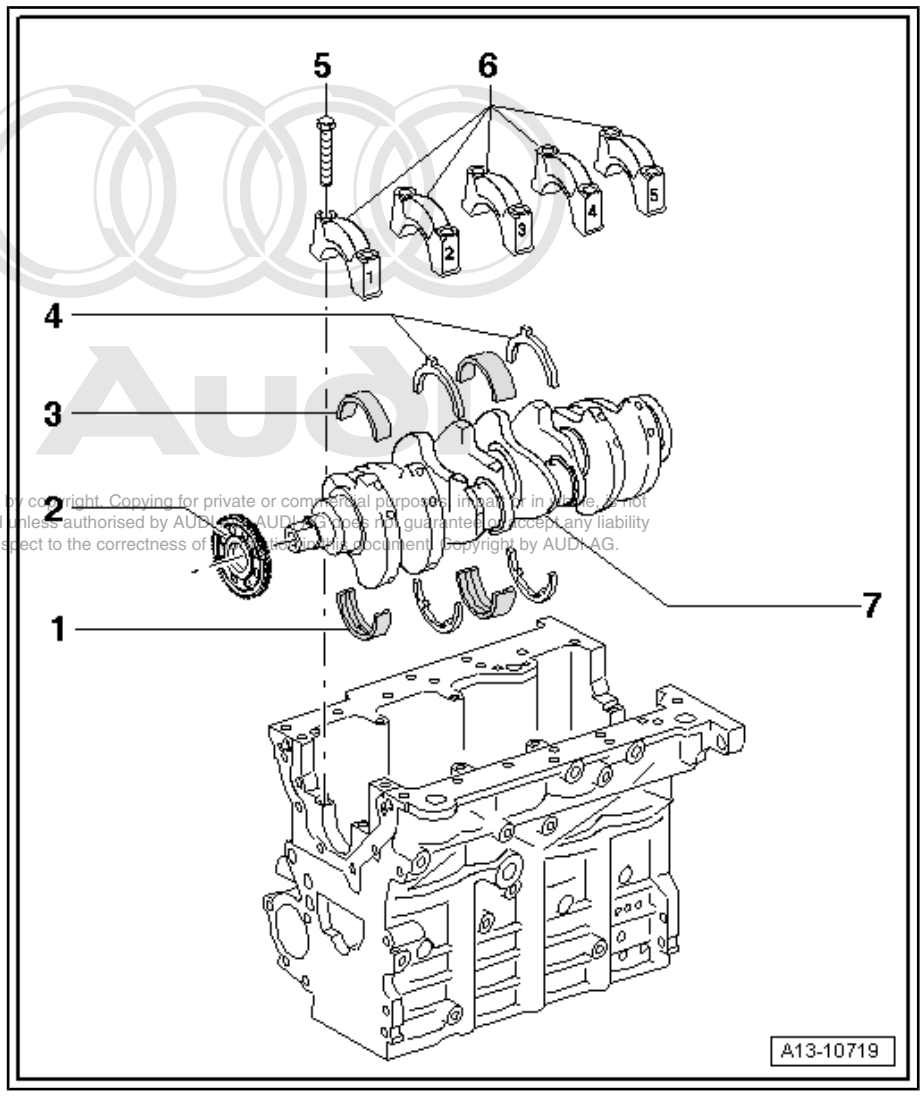
3 Crankshaft

⇒ “3.1 Exploded view - crankshaft”, page 71
⇒ “3.2 Crankshaft dimensions”, page 72
⇒ “3.3 Renewing needle bearing in crankshaft”, page 72
⇒ “3.4 Measuring axial clearance of crankshaft”, page 74
⇒ “3.5 Measuring radial clearance of crankshaft”, page 75
⇒ “3.6 Removing and installing spur gear”, page 75

3.1 Exploded view - crankshaft

Note

When performing assembly work, secure engine to engine and gearbox support ⇒ page 31 .



1 - Bearing shell

- For cylinder block (with oil groove)
- Renew used bearing shells

2 - Spur gear

- For balance shaft assembly
- Pulling spur gear off crankshaft and shrink-fitting new spur gear ⇒ page 75

3 - Bearing shell

- For bearing cap (without oil groove)
- Renew used bearing shells

4 - Thrust washers

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

5 - Bolts

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

6 - Bearing caps

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

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7 - Crankshaft

- ❑ No needle bearing must be fitted in the crankshaft; remove needle bearing if necessary ⇒ page 72
- ❑ Measuring axial clearance ⇒ page 74
- ❑ Measuring radial clearance ⇒ page 75
- ❑ Use old bolts when measuring radial clearance
- ❑ Crankshaft dimensions ⇒ page 72

3.2 Crankshaft dimensions

	Main bearing journal ∅ mm	Conrod journal ∅ mm
Basic dimension	54.00 -0.022 -0.042	50.90 -0.022 -0.042

3.3 Renewing needle bearing in crankshaft

Only fitted on vehicles with dual clutch gearbox

Special tools and workshop equipment required

- ♦ Drift - VW 207 C-

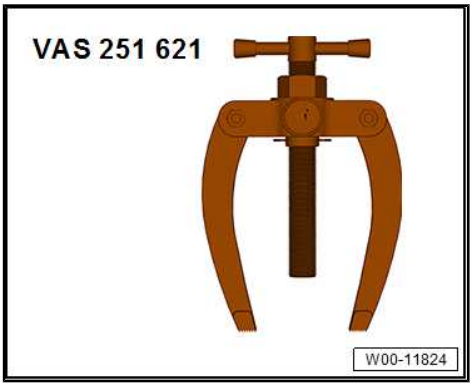


- ♦ Internal puller - VAS 251 605- (previously Kukko 21/2)



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♦ Counter-support - VAS 251 621- (previously Kukko 22/1)



Note

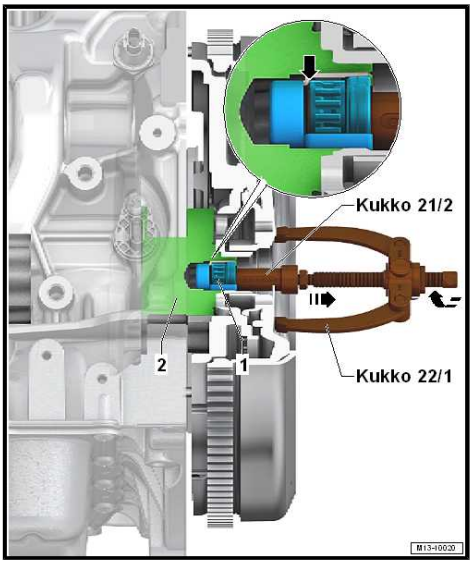
There should be no needle bearing fitted in the crankshaft on vehicles with manual gearbox.

A needle bearing must be fitted in the crankshaft on vehicles with dual clutch gearbox ⇒ Electronic parts catalogue .

Extracting needle bearing

– Remove needle bearing -1- from crankshaft -2- using internal puller and counter-support.

– Internal puller must be positioned behind needle roller -arrow-.

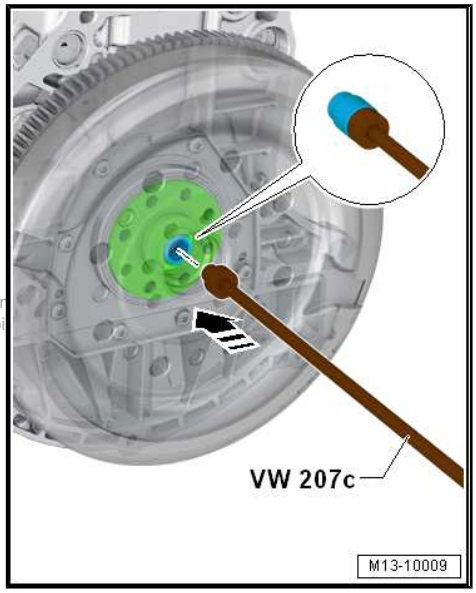


Installing

– The lettering on the needle bearing must be visible when installed.

– Clean bearing seat in crankshaft and grease lightly.

– Drive in with drift - VW 207 C- or centring mandrel - 3176- .



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Installation depth: dimension -a- = 2.0 mm

Note

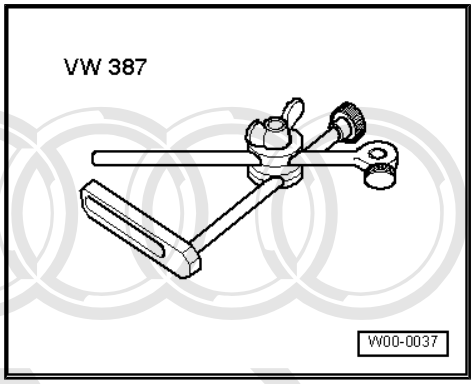
Renew needle bearing if you drive it in too far (needle bearing is damaged when it is pulled out again).



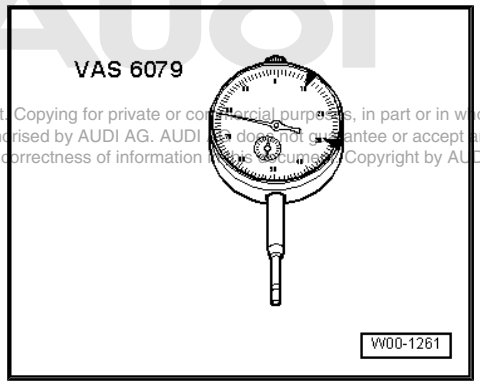
3.4 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

- Universal dial gauge bracket - VW 387-

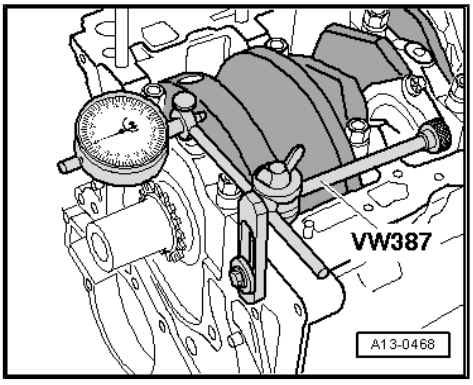


- Dial gauge - VAS 6079-



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Procedure



– Bolt dial gauge - VAS 6079- with universal dial gauge bracket - VW 387- onto cylinder block (as shown in illustration) and set it against crank web.
– Press crankshaft against dial gauge by hand.
– Set dial gauge to “0”.
– Push crankshaft away from dial gauge and read off value.

Axial clearance:

- New: 0.07 ... 0.17 mm.
- Wear limit: 0.37 mm

3.5 Measuring radial clearance of crankshaft

Special tools and workshop equipment required

♦ Plastigauge

Procedure

Note

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Use old bolts when measuring radial clearance.

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

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

– Fit bearing cap and secure with old bolts ⇒ Item 5 (page 71) without rotating crankshaft.
– Remove bearing cap again.
– Compare width of Plastigauge with measurement scale.

Radial clearance:

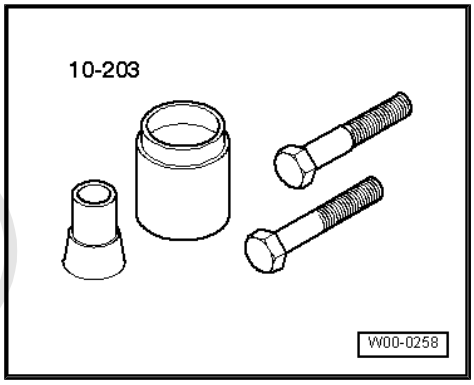
- New: 0.03 ... 0.08 mm.
- Wear limit: 0.17 mm.

– When carrying out final assembly, renew bolts.

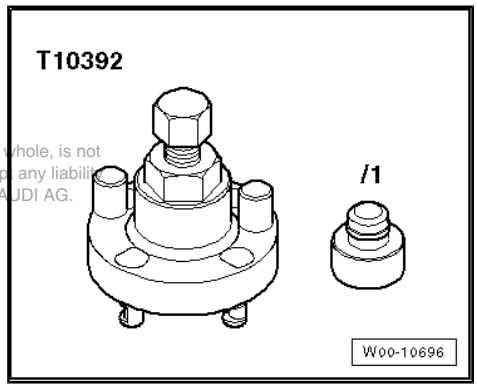
3.6 Removing and installing spur gear

♦ Temperature gauge - VAS 6519-

- Fitting tool - 10 - 203-

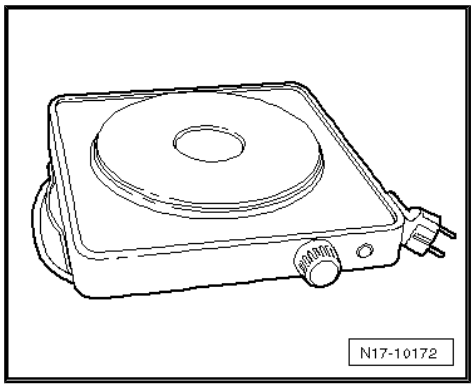


- Puller - T10392-



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- Hotplate (commercially available)



- Protective gloves

Procedure

– Remove sealing flange (pulley end) ⇒ page 58 .

– Remove sump ⇒ page 144 .

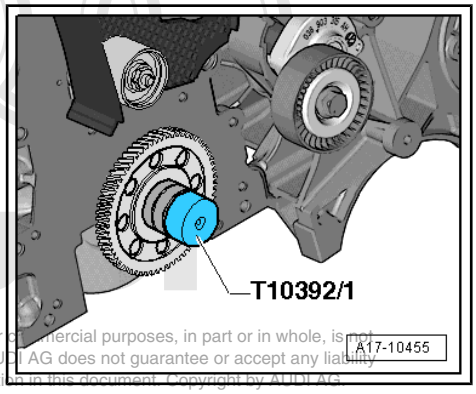
Note

- *If the balance shaft assembly does not have to be renewed, it is sufficient just to remove the idler gear.*
- *If the bolt for the idler gear for the balance shaft assembly has been slackened or the spur gear on the crankshaft or the crankshaft itself have been renewed, you must install a new idler gear with the appropriate coating. Procedure for installation*
  ⇒ "3.1.2 Installing a new balance shaft assembly", page 161 .

– Remove idler gear ⇒ Item 13 (page 142) for balance shaft assembly or remove balance shaft assembly ⇒ page 160 .

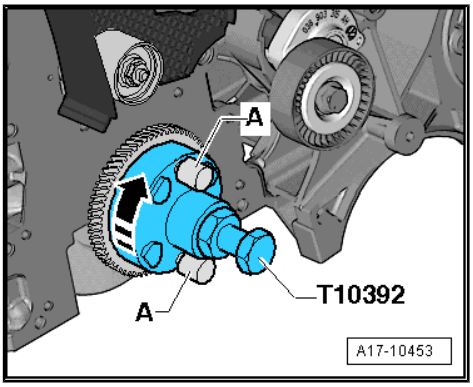
Pulling off spur gear

– Insert thrust piece -T10392/1- in end of crankshaft.



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– Insert puller - T10392- in holes in spur gear, turn clockwise -arrow- and screw in locating pins -A-.

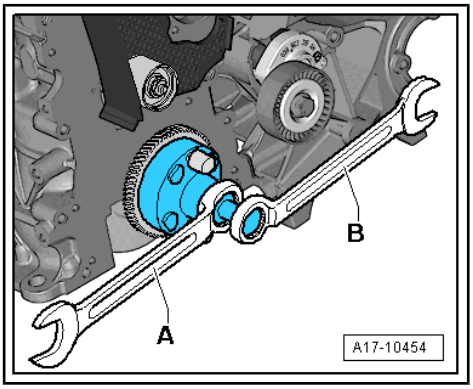


– Counterhold crankshaft with ring spanner -A- and pull spur gear off end of crankshaft by screwing in spindle with ring spanner -B-.

Shrink-fitting spur gear

Note

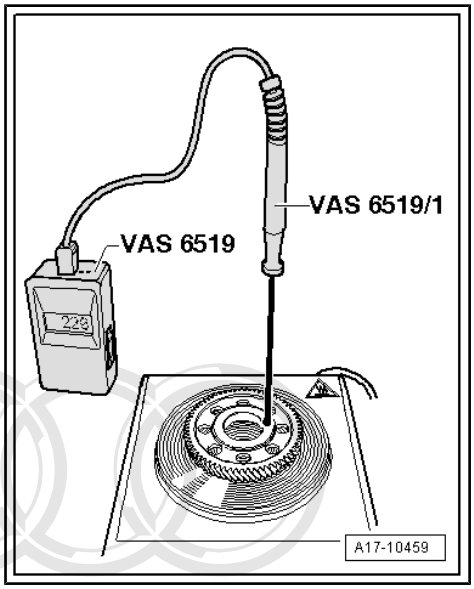
- *While heating up the new spur gear, monitor the temperature with the temperature gauge - VAS 6519- .*
- *When the temperature reaches 200 °C, you have approx. 4 seconds to fit the spur gear on the crankshaft.*
- *A higher temperature increases the amount of time available (220 °C = approx. 6 seconds).*
- *Make sure the end of the crankshaft is clean.*



Caution

Do not exceed a maximum temperature of 240 °C; otherwise the spur gear can become discoloured and distorted.

– Place the new spur gear flat on a commercially available hot-plate and heat it up to at least 200 °C, but not more than 240 ° C. Lettering faces upwards.
– Set temperature gauge - VAS 6519- to measuring range 2.
– Position temperature sensor -VAS 6519/1- on collar of spur gear (as shown) and read off temperature at temperature gauge.

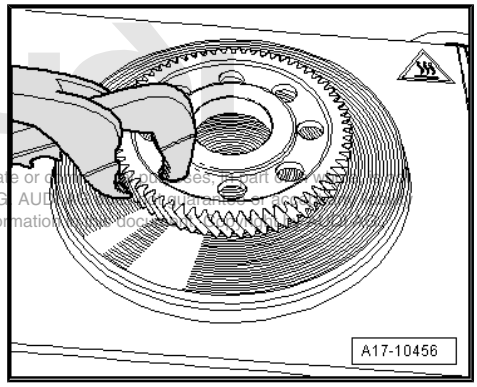


WARNING

Risk of burns.

- *Use suitable protective gloves for the following steps.*

– When the required temperature has been reached, pick up the spur gear with pliers as illustrated.

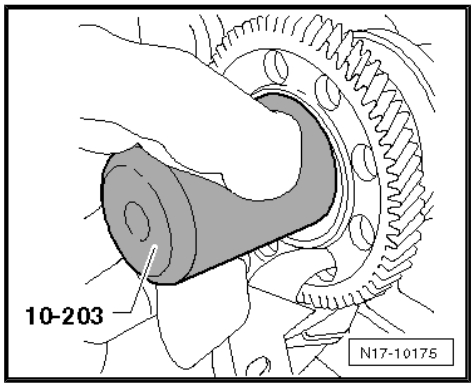


Note

Take care not to damage the teeth of the spur gear.

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– With the aid of fitting tool - 10 - 203- , slide spur gear by hand onto end of crankshaft as far as stop. This must be done without delay, taking care to keep the gear straight.
– Wait a few minutes to allow the spur gear to cool down.
– Install balance shaft assembly ⇒ “3.1.2 Installing a new balance shaft assembly”, page 161 .



Or

– Install idler gear for balance shaft assembly ⇒ “3.1.2 Installing a new balance shaft assembly”, page 161 .
– Install sealing flange (pulley end) ⇒ page 58 .

4 Pistons and conrods

⇒ “4.1 Exploded view - pistons and conrods”, page 79

⇒ “4.2 Removing and installing pistons”, page 81

⇒ “4.3 Measuring piston projection at TDC”, page 83

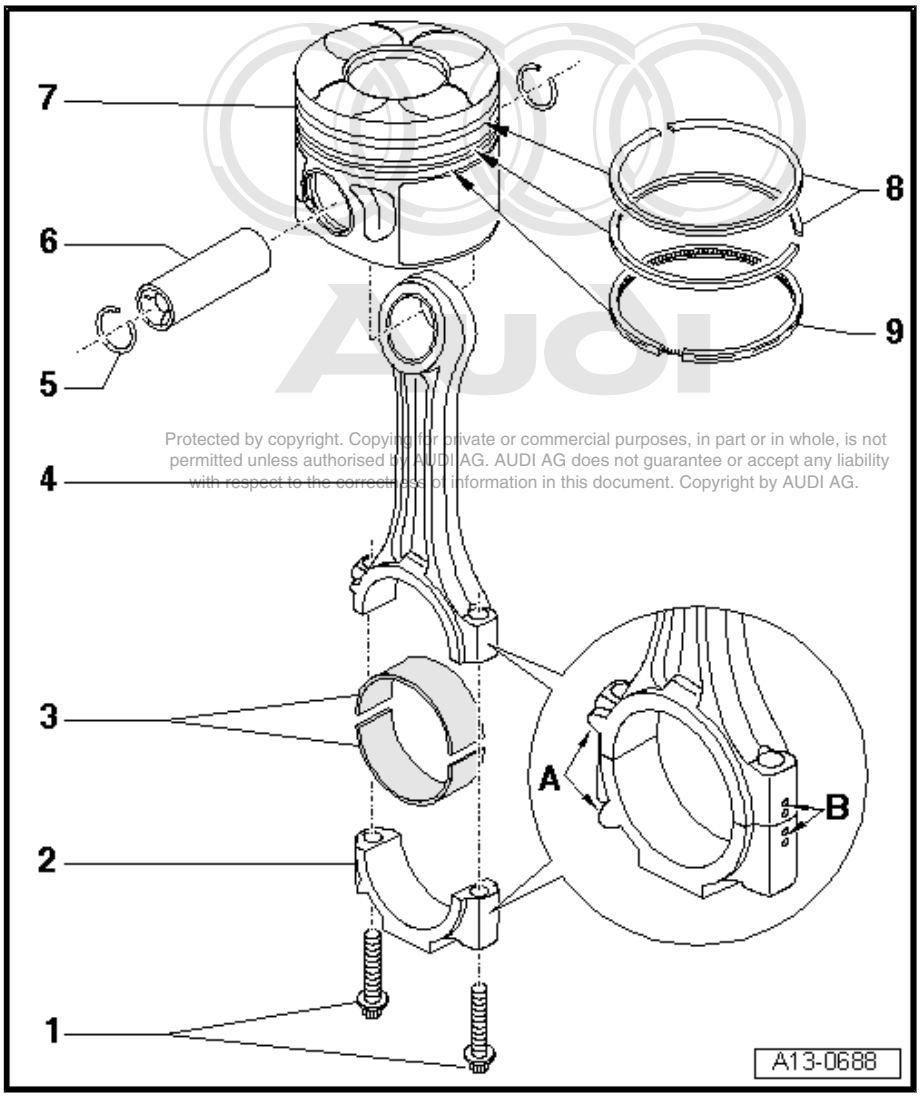
⇒ “4.4 Checking pistons and cylinder bores”, page 85

⇒ “4.5 Checking radial clearance of conrod bearings”, page 86

4.1 Exploded view - pistons and conrods

Note

Oil spray jet and pressure relief valve ⇒ page 81



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1 - Bolt

- ❑ Renew
- ❑ When measuring radial clearance, tighten used bolt to 30 Nm and turn 90° further
- ❑ Lubricate threads and contact surface
- ❑ 30 Nm +90°

2 - Conrod bearing cap

- ❑ Due to the cracking method used to separate the bearing cap from the conrod in manufacture, the caps only fit in one position and only on the appropriate conrod
- ❑ Mark cylinder and conrod allocation in colour -B-
- ❑ Installation position: Markings -A- faces towards pulley end

3 - Bearing shell

- ❑ Installation position ⇒ page 81
- ❑ Renew used bearing shells
- ❑ Note version: Upper bearing shell (closest to piston) is constructed from a more wear-resistant material; refer to ⇒ Electronic parts catalogue
- ❑ Check that it is securely seated

4 - Conrod

- ❑ Only renew as a complete set
- ❑ With industrially cracked conrod bearing cap

- ❑ Separating parts of new conrod ⇒ page 81
- ❑ Mark cylinder and conrod bearing cap allocation in colour -B-
- ❑ Installation position: Markings -A- face towards pulley end
- ❑ Axial clearance: wear limit: 0.37 mm
- ❑ Measuring radial clearance ⇒ page 86

5 - Circlip

- ❑ 2x
- ❑ Renew

6 - Piston pin

- ❑ Removing and installing ⇒ “4.2 Removing and installing pistons”, page 81

7 - Piston

- ❑ With combustion chamber
- ❑ Version fitted in vehicle may differ from illustration
- ❑ Mark installation position and cylinder number ⇒ page 80
- ❑ Removing and installing ⇒ page 81
- ❑ Measuring piston projection at “TDC” ⇒ page 83
- ❑ Checking pistons and cylinder bores ⇒ page 85

8 - Piston rings

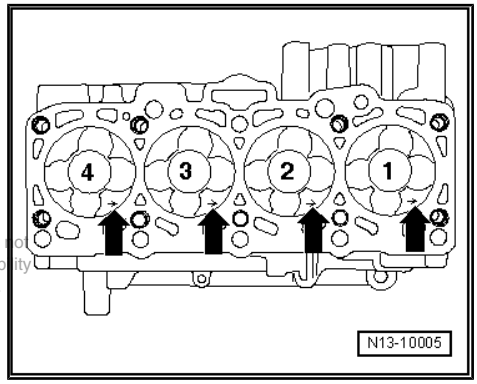
- ❑ Compression rings
- ❑ Measuring ring gap ⇒ page 85
- ❑ Measuring ring-to-groove clearance ⇒ page 86
- ❑ Use piston ring pliers (commercially available) to remove and install
- ❑ Installation position: marking “TOP” or side with lettering faces towards piston crown
- ❑ Offset gaps by 120°

9 - Piston ring

- ❑ Oil scraper ring
- ❑ Measuring ring gap ⇒ page 85
- ❑ Measuring ring-to-groove clearance ⇒ page 86
- ❑ Use piston ring pliers to remove and install
- ❑ Installation position: marking “TOP” or side with lettering faces towards piston crown
- ❑ Offset gap 120° from bottom compression ring

Installation position of pistons and allocation of piston/cylinder

- Arrow on piston crown points to pulley end -arrows-.

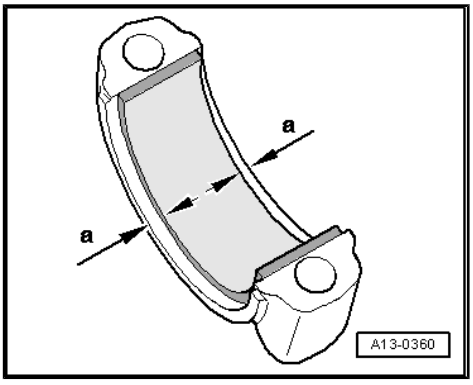


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Installation position of bearing shells in conrods

– Insert bearing shells centrally in conrod and conrod bearing cap.

• Dimension -a- = 2.5 mm



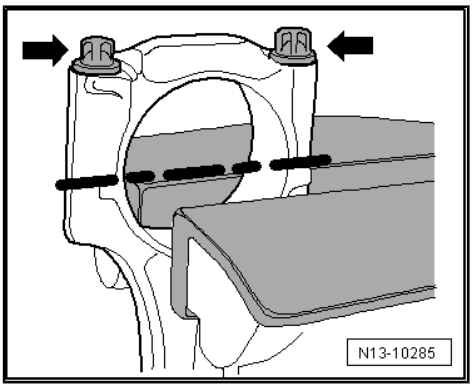
Separating parts of new conrod

It is possible that the two parts of a new conrod are not completely separated as intended. If it is not possible to take off the conrod bearing cap by hand, proceed as follows:

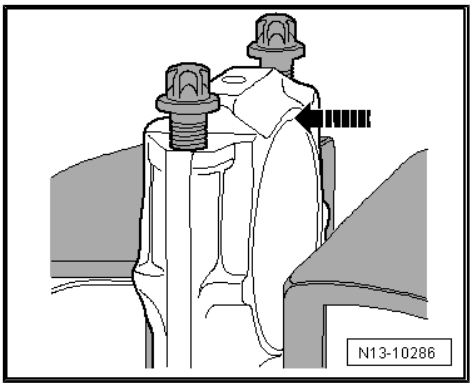
– To avoid any risk of damage, the conrod should only be clamped lightly in a vice using jaw covers as shown in illustration.

• The conrod is clamped in position below the dotted line.

– Unscrew bolts -arrows- approx. 5 turns.



– Using a plastic hammer, carefully knock conrod bearing cap loose -arrow-.



Oil spray jet and pressure relief valve

1 - Bolt with pressure relief valve, 24 Nm

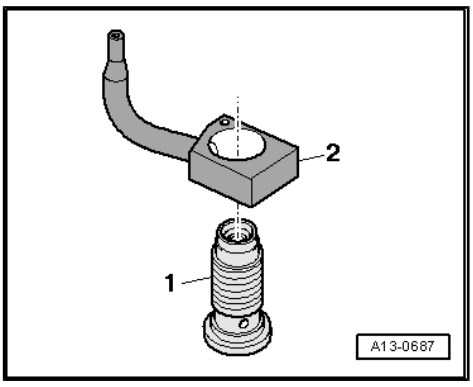
2 - Oil spray jet (for cooling of pistons)

• Installation position: align locating edge of oil spray jet with machined surface of cylinder block.

Note

♦ *Take care not to bend oil spray jets.*

♦ *Always renew bent oil spray jets.*

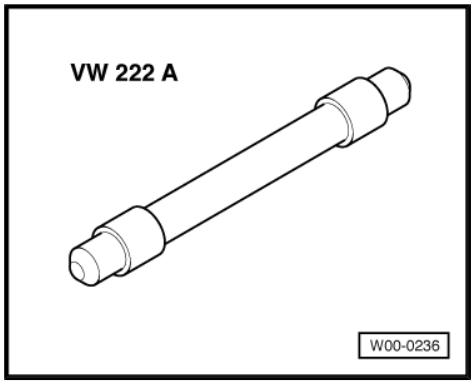


4.2 Removing and installing pistons

Special tools and workshop equipment required

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♦ Drift - VW 222 A-



♦ Piston ring clamp, commercially available

Removing

- Engine secured to engine and gearbox support ⇒ page 31 .

– Remove cylinder head ⇒ page 104 .

– Remove balance shaft assembly ⇒ page 160 .

– Mark installation position and matching of conrod bearing caps to cylinder and to conrods for re-installation ⇒ Item 2 (page 79) .

– Unbolt conrod bearing caps.

– Pull out pistons upwards with conrods.

Note

If piston pin is difficult to remove, heat piston to approx. 60 °C.

– Take circlip out of piston pin boss.

– Use drift - VW 222 A- to drive out piston pin.

Installing

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

Tightening torques

♦ ⇒ “4.1 Exploded view - pistons and conrods”, page 79

Note

Renew the bolts tightened with specified tightening angle.

– Oil running surfaces of bearing shells.

– Install pistons using piston ring clamp.

Installation position:

- Pistons ⇒ page 80
- Bearing shells in conrods ⇒ page 81

– Install conrod bearing caps according to markings.

– Install balance shaft assembly ⇒ “3.1.3 Re-installing a used balance shaft assembly”, page 164 .

– Install cylinder head ⇒ page 104 .

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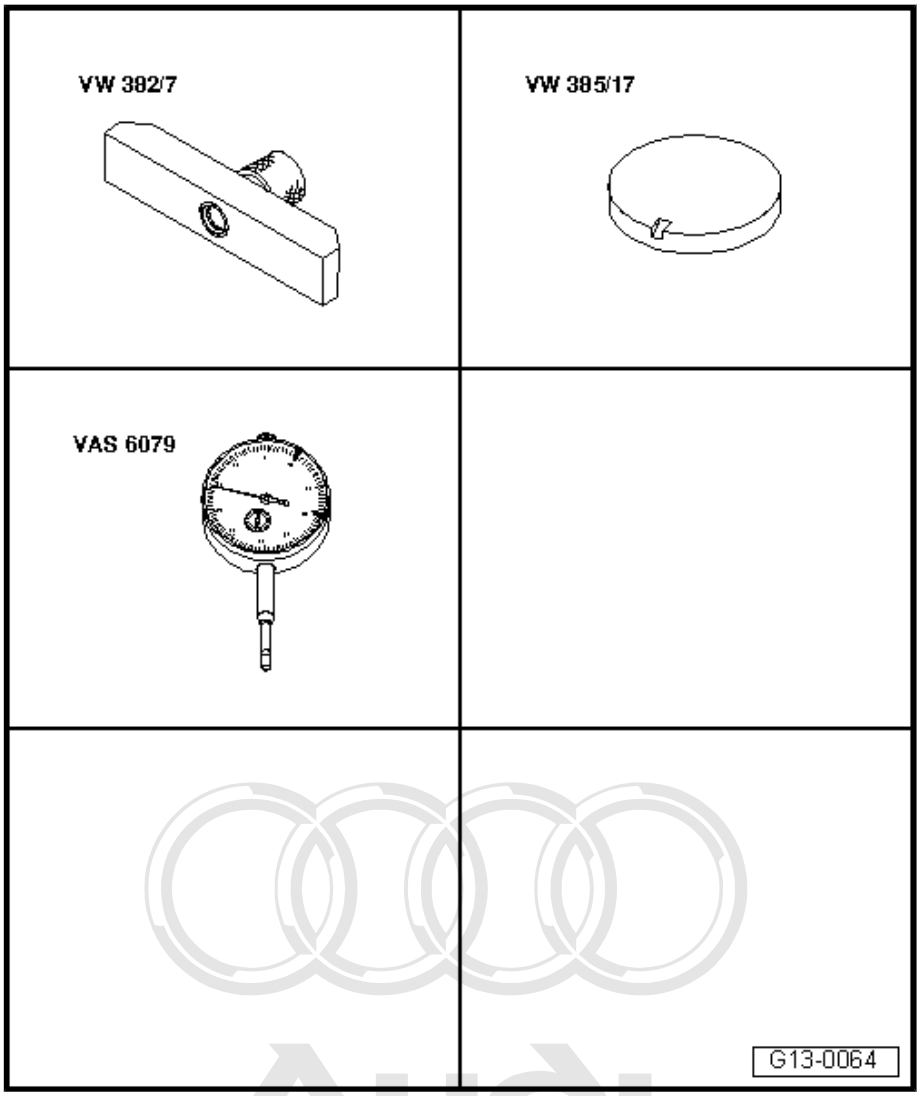
4.3 Measuring piston projection at TDC

Note

Piston projection at "TDC" must be measured when installing new pistons or a short engine.

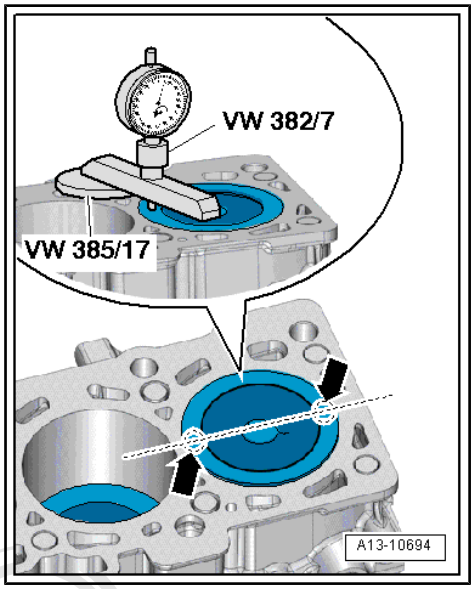
Special tools and workshop equipment required

- Measuring bridge - VW 382/7- from measuring tool - VW 382-
- Measuring plate - VW 385/17- from universal measuring tool - VW 385-
- Dial gauge - VAS 6079-



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Procedure



– Secure dial gauge - VAS 6079- with measuring bridge - VW 382/7- and measuring plate -VW 385/17- to cylinder block as shown in illustration.
– Measure projection at each piston at both locations marked with -arrows- (seen in longitudinal direction of engine: at front and rear of piston).

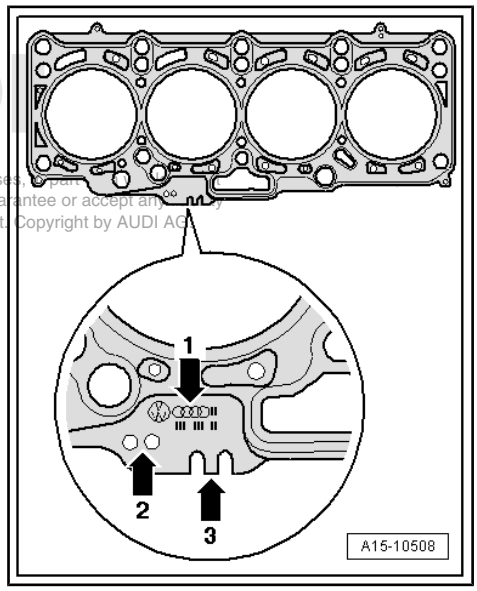
Note

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

– Depending on piston projection, install corresponding cylinder head gasket according to following table:

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

Identification of cylinder head gasket



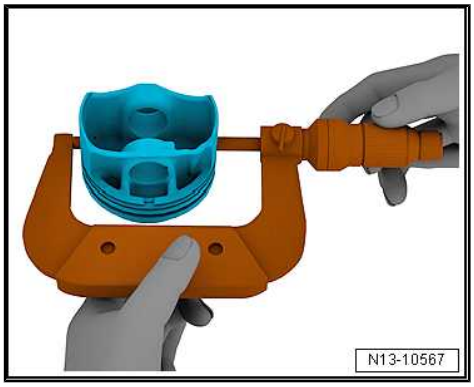
1 - Part number
2 - Holes
3 - Ignore

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Note

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

4.4 Checking pistons and cylinder bores



Checking piston

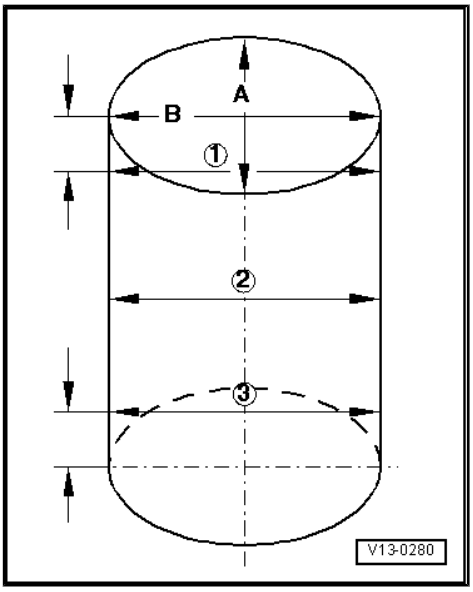
– Using a micrometer (75 ... 100 mm), measure approx. 15 mm from the lower edge, perpendicular to the piston pin axis.

• Maximum deviation from nominal dimension: 0.04 mm.

Note

Renew piston if cracking is visible on piston skirt.

Piston Ø	
Nominal dimension	80.96 mm 1)
• 1) Dimensions including coating (thickness 0.02 mm). The coating will wear down in service.	



Measuring cylinder bore

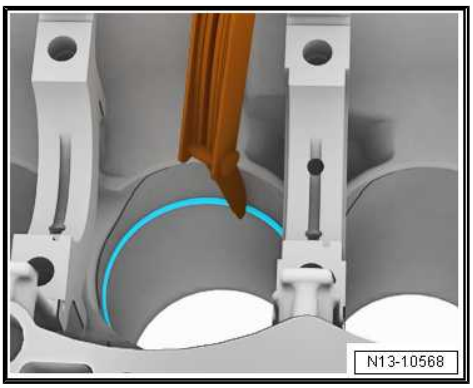
– Use a cylinder gauge - VAS 6078- to take measurements at 3 points in transverse direction -A- and in longitudinal direction -B-.

• Maximum deviation from nominal dimension: 0.10 mm.

Cylinder bore Ø	
Nominal dimension	81.01 mm

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Measuring 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.

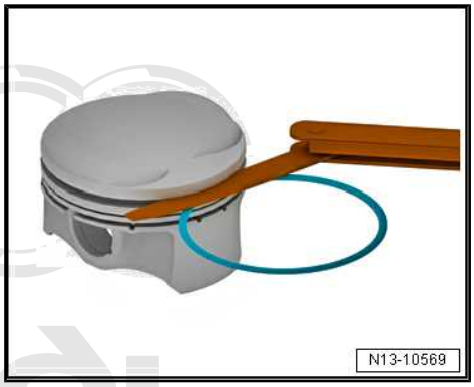
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Piston ring	new mm	Wear limit mm
1st compression ring	0.25 … 0.40	1.00
2nd compression ring	0.25 … 0.40	1.00
Oil scraper ring	0.25 … 0.50	1.00

Measuring ring-to-groove clearance

– Clean groove in piston before checking clearance.

Piston ring	new mm	Wear limit mm
1st compression ring	0.06 … 0.09	0.25
2nd compression ring	0.05 … 0.08	0.25
Oil scraper ring	0.03 … 0.06	0.15



4.5 Checking radial clearance of conrod bearings

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Special tools and workshop equipment required

♦ Plastigauge

Procedure

Note

Use old bolts when measuring radial clearance.

– Remove conrod bearing cap. Clean bearing cap and bearing journal.
– Place a length of Plastigauge corresponding to the width of the bearing on the bearing journal or in the bearing shell.
– Fit conrod bearing cap and secure with old bolts ⇒ Item 1 (page 79) without rotating crankshaft.
– Remove conrod bearing cap again.
– Compare width of Plastigauge with measurement scale.

Radial clearance:

• Wear limit: 0.08 mm.

– When carrying out final assembly, renew bolts.

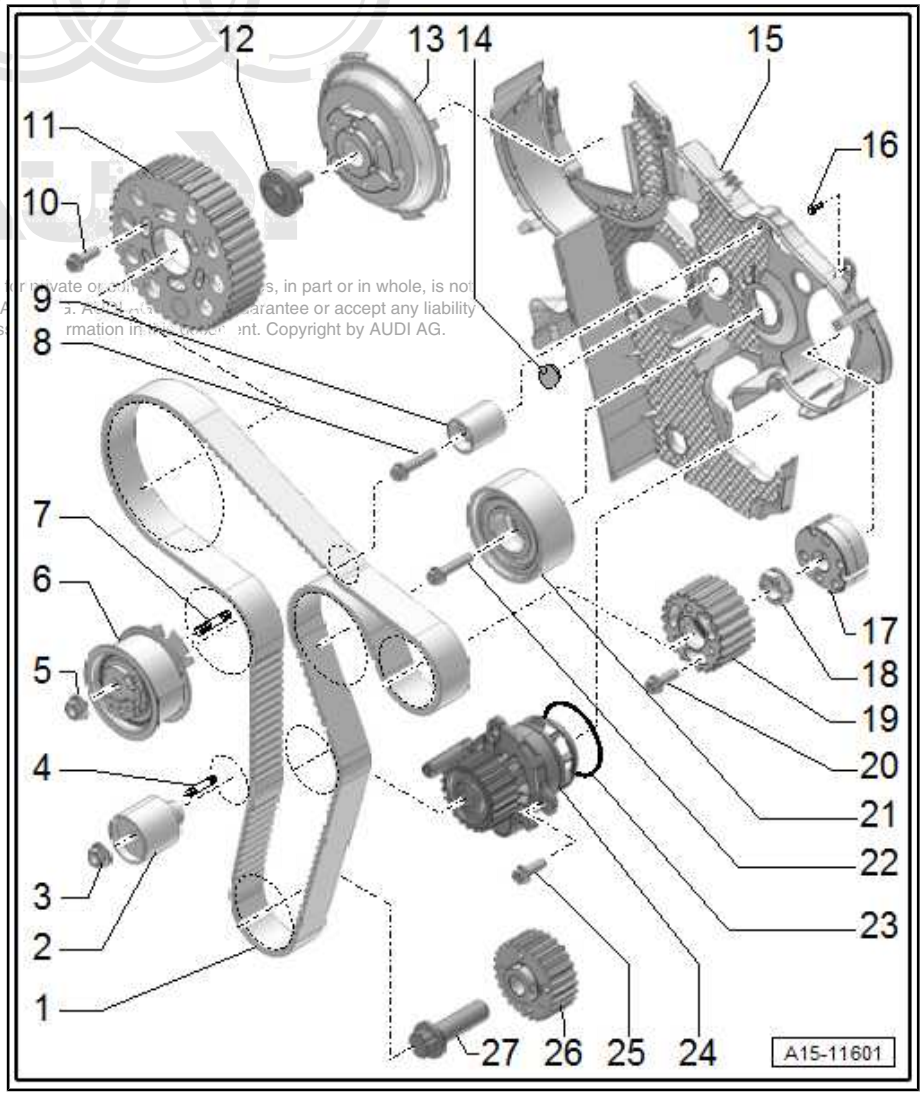
15 – Cylinder head, valve gear

1 Toothed belt drive

⇒ “1.1 Exploded view - toothed belt”, page 87

⇒ “1.2 Removing and installing toothed belt”, page 89

1.1 Exploded view - toothed belt



1 - Toothed belt

- ❑ Before removing, mark direction of rotation with chalk or felt-tip pen
- ❑ Check for wear
- ❑ Removing ⇒ page 89
- ❑ Installing (adjusting valve timing) ⇒ page 93

2 - Idler roller

3 - Nut

- ❑ Make sure that stud is fitted securely
- ❑ 20 Nm

4 - Stud

- ❑ 15 Nm

5 - Nut

- ❑ Renew nut
- ❑ Make sure that stud is fitted securely
- ❑ 20 Nm + 45°

6 - Tensioning roller

- ❑ Before renewing, toothed belt and engine support must be removed

7 - Stud

- ❑ 15 Nm

8 - Bolt

- ❑ 20 Nm

9 - Idler roller

10 - Bolt

- ❑ Renew
- ❑ 20 Nm +45°

11 - Camshaft sprocket

12 - Bolt

- ❑ Slacken and tighten with counterhold tool - T10051-
- ❑ 100 Nm

13 - Camshaft hub

- ❑ Removing and installing ⇒ “3.5 Removing and installing camshaft”, page 125

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14 - Plug

15 - Toothed belt cover (rear)

16 - Bolt

- ❑ 9 Nm

17 - High-pressure pump hub

- ❑ Removing and installing ⇒ page 249

18 - Nut

- ❑ 95 Nm

19 - High-pressure pump sprocket

20 - Bolt

- ❑ Renew
- ❑ 20 Nm

21 - Idler roller

22 - Bolt

- ❑ Renew
- ❑ 50 Nm +90°

23 - O-ring

- ❑ Renew

24 - Coolant pump

- ❑ Removing and installing ⇒ page 177

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25 - Bolt

- ❑ Tightening torque ⇒ Item 2 (page 176)

26 - Crankshaft sprocket

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

27 - Bolt

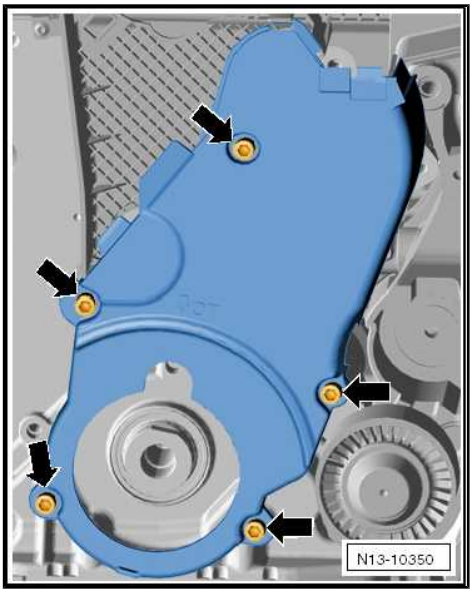
- ❑ Renew
- ❑ Slacken and tighten with counterhold tool - 3415-
- ❑ Do not additionally oil threads and shoulder

Tighten in three stages as follows:

- ♦ 1st stage: 180 Nm
- ♦ 2nd stage: Use rigid wrench to turn 90° further
- ♦ 3rd stage: Use rigid wrench to turn 45° further

Toothed belt cover (bottom) - tightening torque

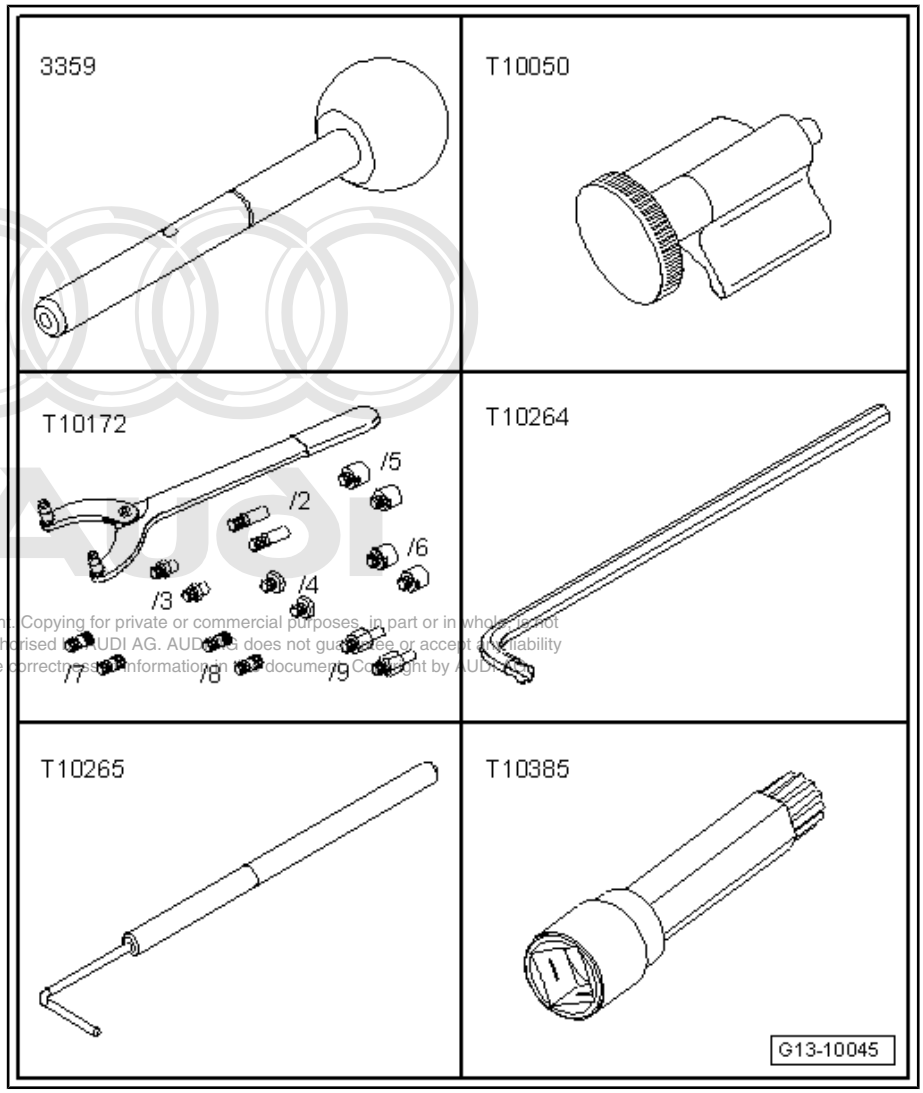
– Tighten bolts -arrows- to 9 Nm.



1.2 Removing and installing toothed belt

Special tools and workshop equipment required

- 2x diesel injection pump locking pin - 3359-
- Crankshaft stop - T10050-
- Counterhold tool - T10172-
- Offset screwdriver - T10264-
- Locking tool - T10265-
- Bit XZN 10 - T10385-



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Removing

– Remove engine cover panel ⇒ page 47 .

– Remove vibration damper ⇒ page 53 .

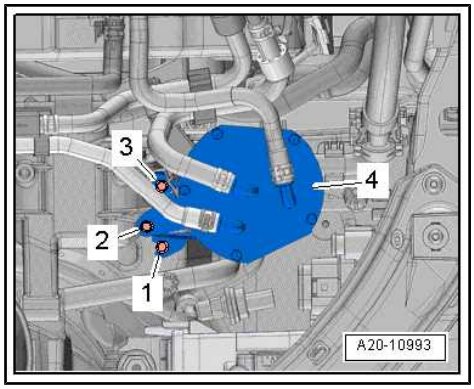
Note

The engine support must be removed if you also need to renew the tensioning roller.

– Loosen bolt -1-.

– Remove bolt -2- and nut -3-.

– Detach fuel filter -4- and move clear to one side (leave fuel hoses connected).

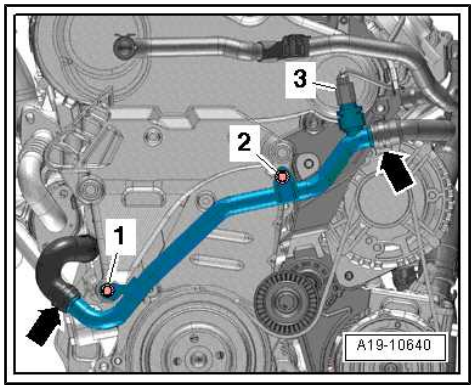


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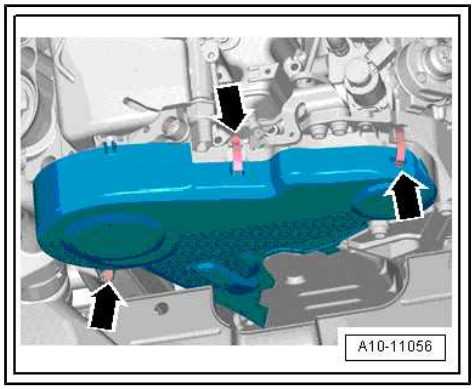
– Unplug electrical connector -3- at radiator outlet coolant temperature sender - G83- .

– Remove nut -1- and bolt -2-.

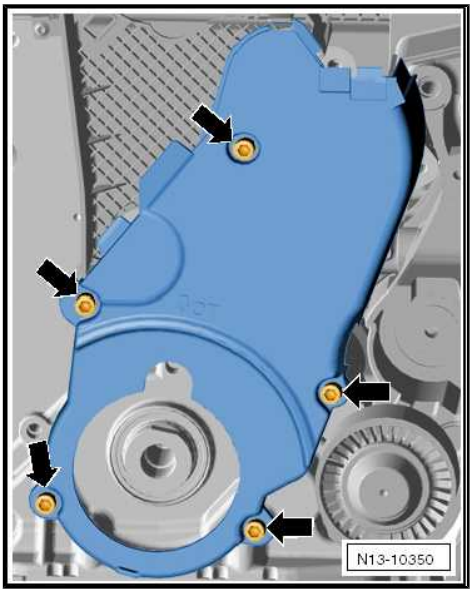
– Move coolant pipe (right-side) -arrows- to side (coolant hoses remain connected).



– Release retaining clips -arrows- and detach toothed belt cover (top).



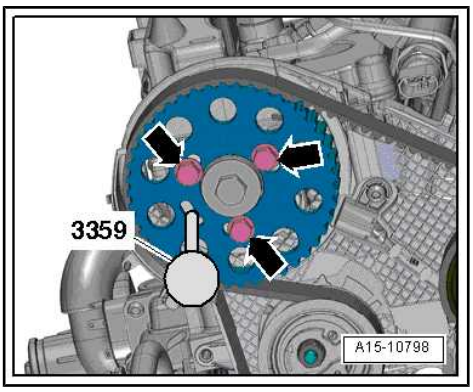
– Remove bolts -arrows-.
– Detach toothed belt cover (bottom).



Caution

Irreparable damage can be caused if the toothed belt slips.

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



– Rotate crankshaft by turning bolt on crankshaft sprocket until camshaft sprocket is positioned at “TDC”.
– Lock camshaft hub with diesel injection pump locking pin -3359- .

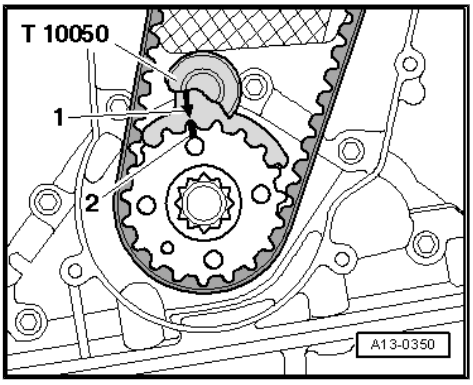
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Note

Disregard -arrows-.

– Lock crankshaft sprocket in position with crankshaft stop -T10050- .

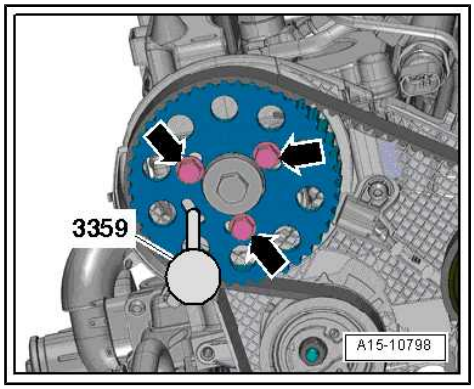
- The markings on the sprocket -2- and the crankshaft stop -1- must align -arrow-. The pin of the crankshaft stop must engage in the aperture in the sealing flange.



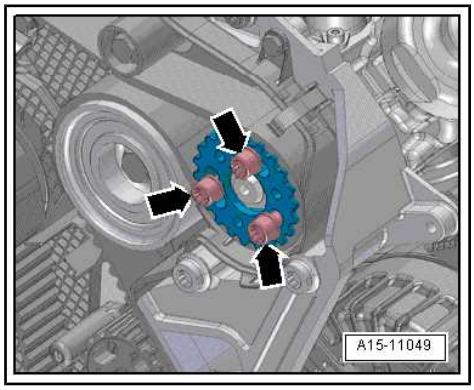
Note

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

– Slacken bolts -arrows- for camshaft sprocket approx. 90°.

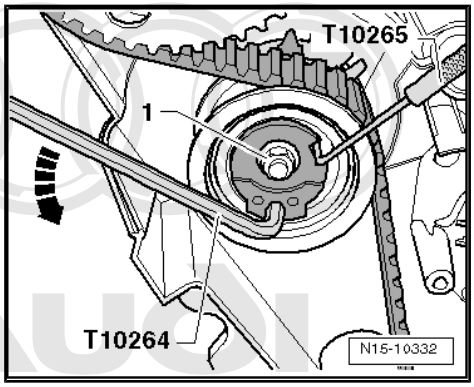


– Using bit XZN 10 - T10385- , loosen bolts -arrows- for high-pressure pump sprocket approx. 90°.



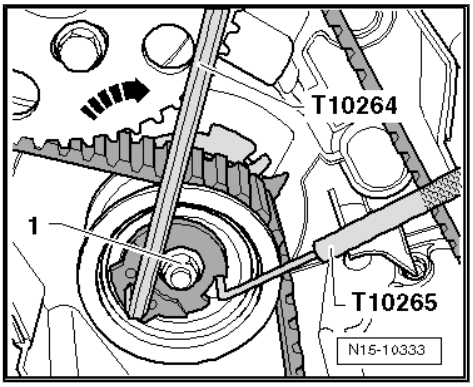
– Slacken nut -1- for tensioning roller.

– Turn eccentric adjuster of tensioning roller with offset screwdriver - T10264- anti-clockwise -arrow- until tensioning roller can be secured with locking tool - T10265- .



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– Then use offset screwdriver - T10264- to turn eccentric adjuster of tensioning roller clockwise -arrow- as far as stop and tighten nut -1- by hand.



Caution

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

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

– Take off toothed belt first from idler roller and then from remaining sprockets.

Installing (adjusting valve timing)

Note

Perform adjustments on toothed belt only when engine is cold.

Tightening torques

- ⇒ “1.1 Exploded view - toothed belt”, page 87
- ⇒ Fuel supply system - diesel engines; Rep. gr. 20 ; Fuel filter; Exploded view - fuel filter
- ⇒ “3.1 Exploded view - coolant pipes”, page 187

Caution

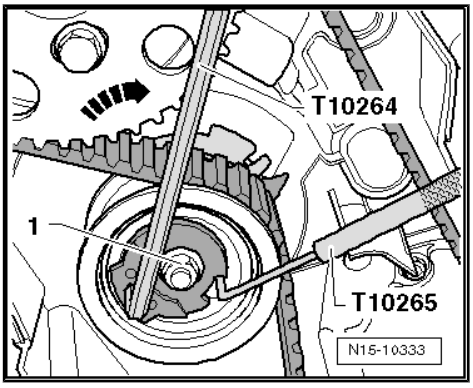
Risk of damage to valves and piston crowns.

- ***The crankshaft must not be at “TDC” at any cylinder when the camshaft is turned.***

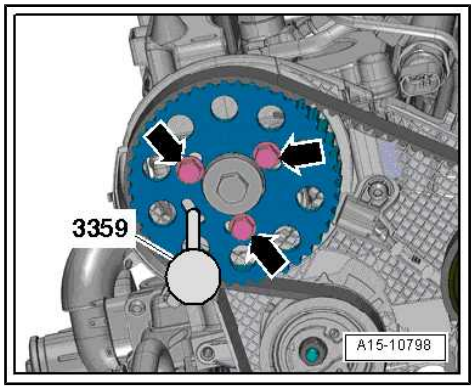
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Requirements:

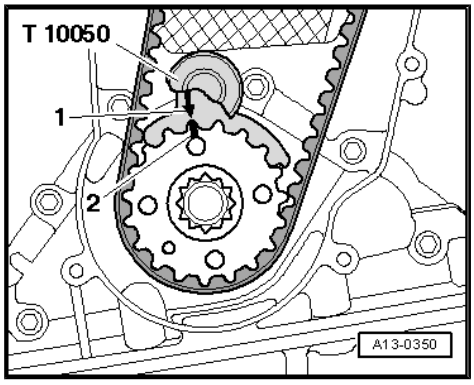
- Tensioning roller is locked with locking tool - T10265- and secured at right stop with nut -1-.



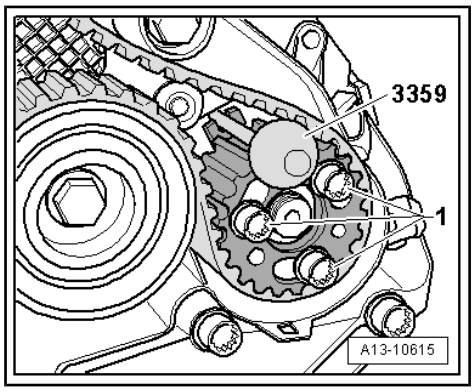
- Camshaft hub locked with diesel injection pump locking pin - 3359- .
- Bolts -arrows- are fitted but not tightened.
- It should just be possible to turn the sprocket on the camshaft without axial movement.



- Crankshaft is locked in position with crankshaft stop - T10050- .

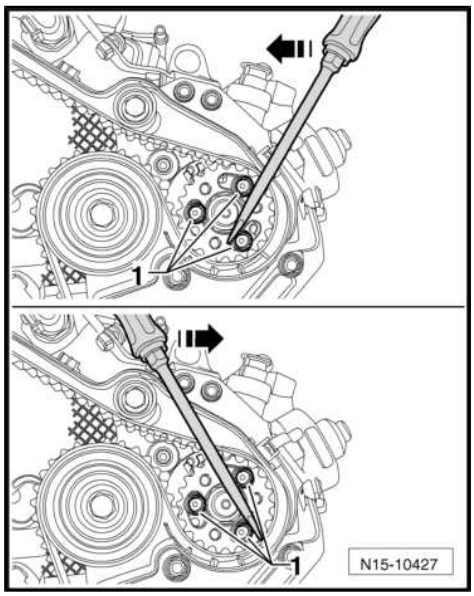


- Hub of high-pressure pump locked with diesel injection pump locking pin - 3359- .
- Bolts -1- are fitted but not tightened.
- The high-pressure pump sprocket should still just turn, but there must be no axial movement.



Note

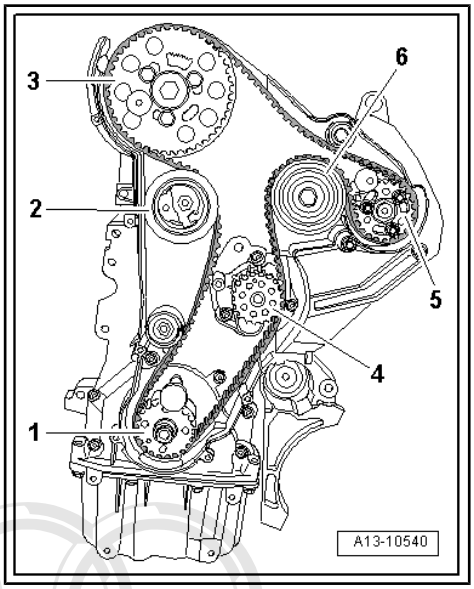
If necessary, apply a screwdriver -arrows- to bolt heads -1- and turn the high-pressure pump hub until it can be locked with the locking pin.



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– Turn the camshaft sprocket and high-pressure pump sprocket in their elongated holes clockwise as far as the stop.
– Install toothed belt in the specified sequence:

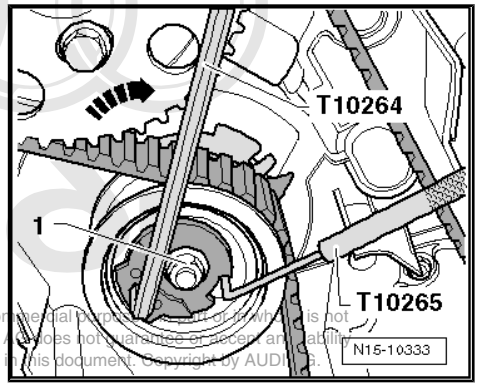
1 - Crankshaft sprocket
2 - Tensioning roller
3 - Camshaft sprocket
4 - Coolant pump sprocket
5 - High-pressure pump sprocket
6 - Idler roller



– Loosen nut -1- for tensioning roller and detach locking tool - T10265- .

Note

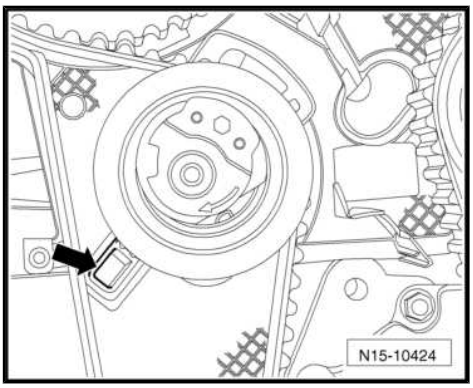
Disregard -arrow-.



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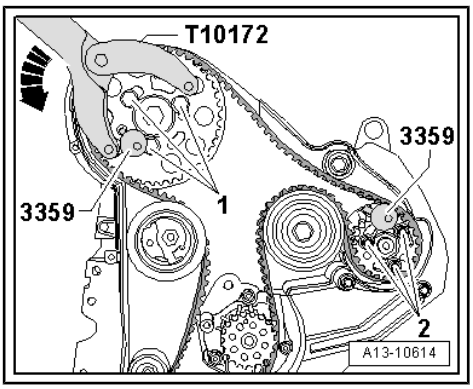
Note

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

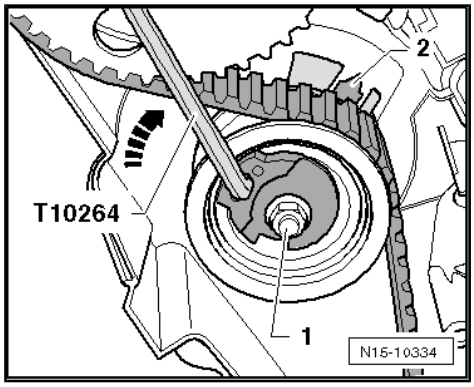


– Position counterhold tool - T10172- on camshaft sprocket as shown in illustration.
– Apply force to counterhold tool in anti-clockwise direction -arrow- and maintain tension.
– Tighten bolts -1- for camshaft sprocket and bolts -2- for high-pressure pump sprocket in this position.

♦ Initial tightening torque: 20 Nm



– Carefully turn eccentric adjuster of tensioning roller clockwise -arrow- using offset screwdriver - T10264- until pointer -2- aligns with centre of slot on base plate.



- Nut -1- must not turn.

– Hold tensioning roller in this position and tighten nut.

– Remove locking pins -3359- and crankshaft stop - T10050- .

Checking valve timing:

Caution

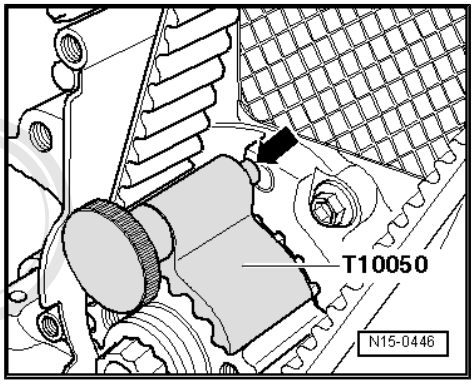
Irreparable damage can be caused if the toothed belt slips.

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

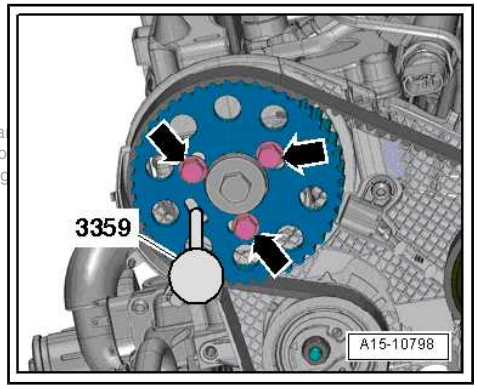
– Turn crankshaft two rotations in direction of engine rotation by turning bolt for crankshaft sprocket until crankshaft is just before “TDC”.

– Fit crankshaft stop - T10050- to crankshaft sprocket again.

– Turn crankshaft in direction of engine rotation until pin -arrow- on crankshaft stop engages in sealing flange as crankshaft rotates.



- It should now be possible to lock camshaft hub with diesel injection pump locking pin - 3359- .

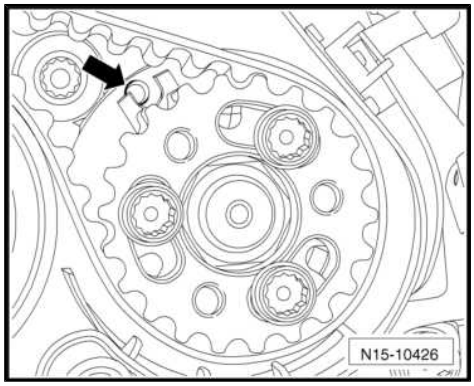


Note

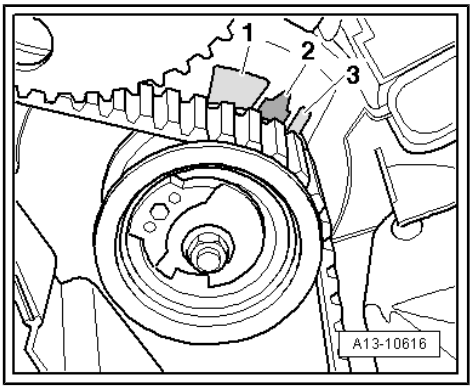
Disregard -arrows-.

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- It is very difficult to reproduce the locking position of the high-pressure pump hub. However, a slight deviation -arrow- does not influence engine operation.



- Pointer -2- on tensioner roller must be centred between tabs -1- and -3- on base plate.



Note

The maximum permissible sideways deviation from the specified position is 5 mm.

- Re-adjust valve timing if requirements are not met ⇒ page 97 .
- If requirements are met, continue with procedure after adjusting valve timing correctly as described below ⇒ page 97 .

Re-adjusting valve timing:

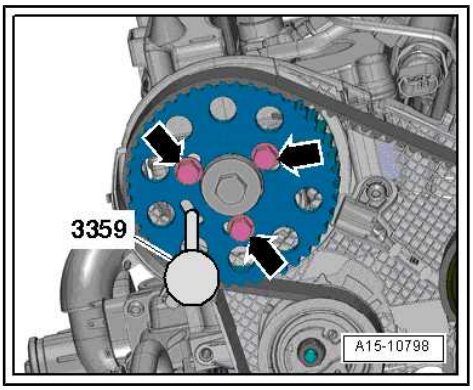
– If camshaft hub cannot be locked, withdraw crankshaft stop - T10050- until pin is clear of bore.

– Turn crankshaft in opposite direction of engine rotation slightly past “TDC”.

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– Now turn crankshaft slowly in direction of engine rotation until it is possible to lock camshaft hub with diesel injection pump locking pin - 3359- .

– Loosen bolts for camshaft sprocket after locking hub.



A - If pin of crankshaft stop - T10050- is on left side of bore:

– Turn crankshaft in direction of engine rotation until pin -arrow- on crankshaft stop engages in sealing flange as crankshaft rotates.

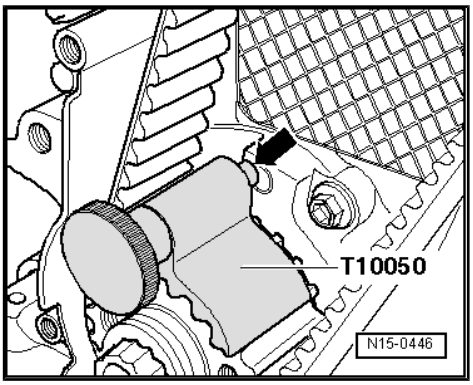
– Tighten camshaft sprocket bolts to 20 Nm initially.

B - If pin of crankshaft stop - T10050- is on right side of bore:

– Turn crankshaft slightly in opposite direction to engine rotation.

– Turn crankshaft in direction of engine rotation again until pin of crankshaft stop engages in sealing flange as crankshaft rotates.

– Tighten camshaft sprocket bolts to 20 Nm initially.



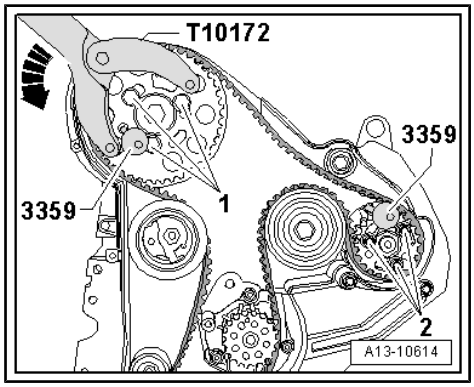
Procedure after adjusting valve timing correctly:

– Remove diesel injection pump locking pin - 3359- and crankshaft stop - T10050- .

– Turn crankshaft two rotations in direction of engine rotation by turning bolt for crankshaft sprocket until crankshaft is just before “TDC”.

– Check valve timing once again ⇒ page 96 .

– If camshaft hub can now be locked with diesel injection pump locking pin - 3359- , tighten camshaft sprocket bolts -1- to final torque ⇒ Item 10 (page 87) .
– Tighten bolts -2- for high-pressure pump sprocket to final torque ⇒ page 249 .
– Check valve timing once again ⇒ page 96 .



Assembling

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 .*

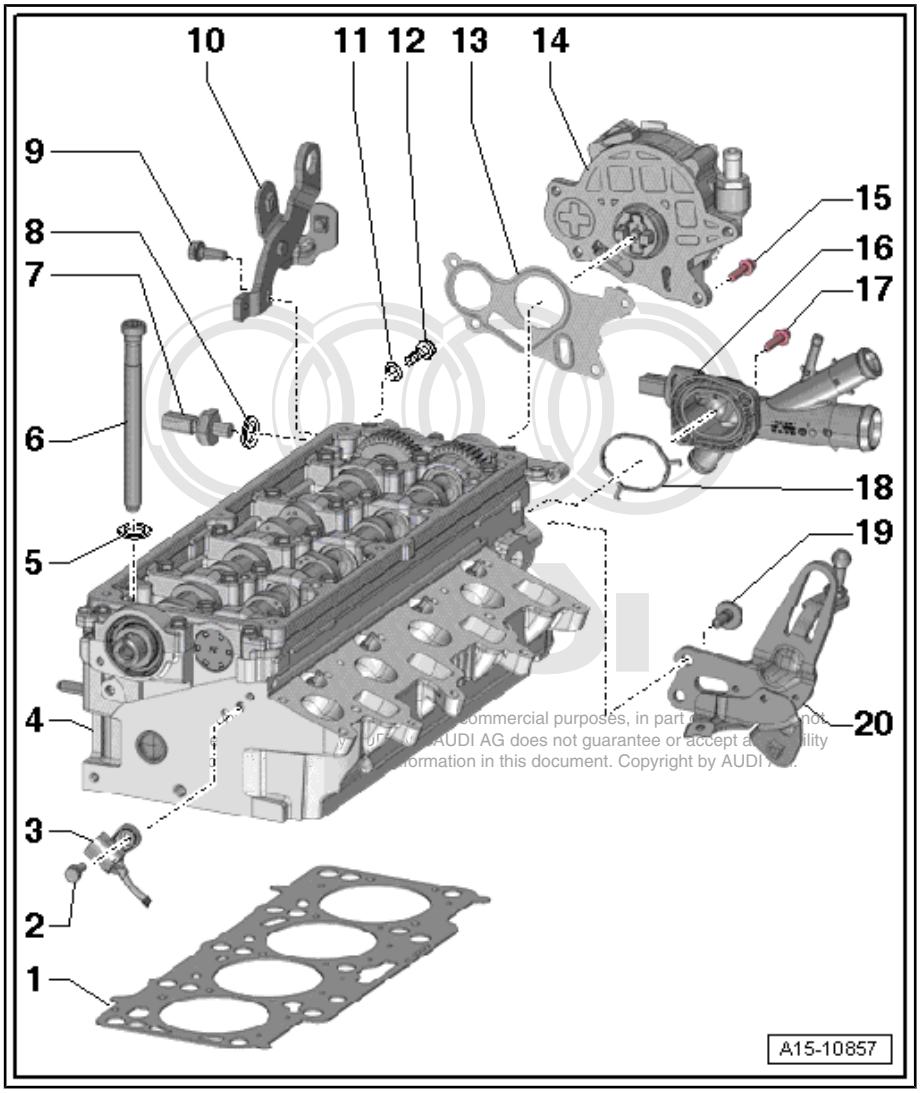
– Install vibration damper ⇒ page 53 .
– Install engine cover panel ⇒ page 47 .

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2 Cylinder head

⇒ “2.1 Exploded view - cylinder head”, page 99
⇒ “2.2 Exploded view - cylinder head cover”, page 101
⇒ “2.3 Removing and installing cylinder head”, page 104
⇒ “2.4 Removing and installing cylinder head cover”, page 114
⇒ “2.5 Removing and installing seals for injectors”, page 116
⇒ “2.6 Checking compression”, page 117

2.1 Exploded view - cylinder head



1 - Cylinder head gasket

- ❑ Renewing ⇒ “2.3 Removing and installing cylinder head”, page 104
- ❑ Identification of cylinder head gasket ⇒ page 101
- ❑ If renewed, change coolant and engine oil

2 - Bolt

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

3 - Hall sender - G40-

- ❑ For camshaft position
- ❑ Removing and installing ⇒ page 315

4 - Cylinder head

- ❑ Removing and installing ⇒ page 104
- ❑ To prevent damage to glow plugs, always place cylinder head on a soft foam surface after removal.
- ❑ Checking for distortion ⇒ page 100
- ❑ Must not be machined
- ❑ Before installing, check that the two dowel sleeves for centring cylinder head are fitted on cylinder block
- ❑ If renewed, change coolant and engine oil

5 - Washer

6 - Bolt

- ❑ Renew
- ❑ Correct sequence when slackening ⇒ page 111
- ❑ Tightening torque and sequence ⇒ page 101

7 - Oil pressure switch - F1-

- ❑ Opening/closing pressure 0.3 ... 0.6 bar
- ❑ Removing and installing ⇒ page 156
- ❑ Checking ⇒ page 156
- ❑ 20 Nm

8 - Seal

- ❑ Renew

9 - Bolt

- ❑ 20 Nm

10 - Engine lifting eye

11 - Seal

- ❑ Renew

12 - Plug

- ❑ 20 Nm

13 - Gasket

- ❑ Renew

14 - Vacuum pump

- ❑ Removing and installing ⇒ Brake system; Rep. gr. 47 ; Vacuum system; Removing and installing vacuum pump

15 - Bolt

- ❑ Tightening torque ⇒ Brake system; Rep. gr. 47 ; Vacuum system; Exploded view - vacuum pump

16 - Connection

- ❑ For coolant hoses
- ❑ with coolant temperature sender - G62-

17 - Bolt

- ❑ Tightening torque ⇒ Item 22 (page 188)

18 - Gasket

- ❑ Renew

19 - Bolt

- ❑ 20 Nm

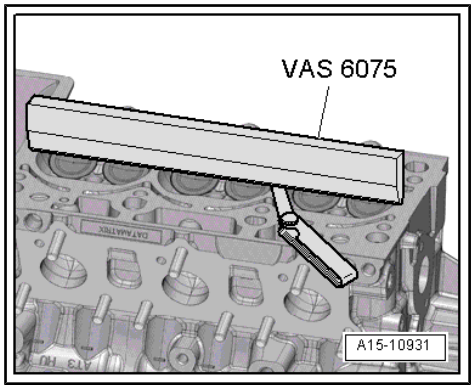
20 - Engine lifting eye

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Checking cylinder head for distortion

– Use straight edge 500 mm - VAS 6075- and feeler gauge to measure cylinder head for distortion at several points.

• Max. permissible distortion: 0.1 mm.



Note

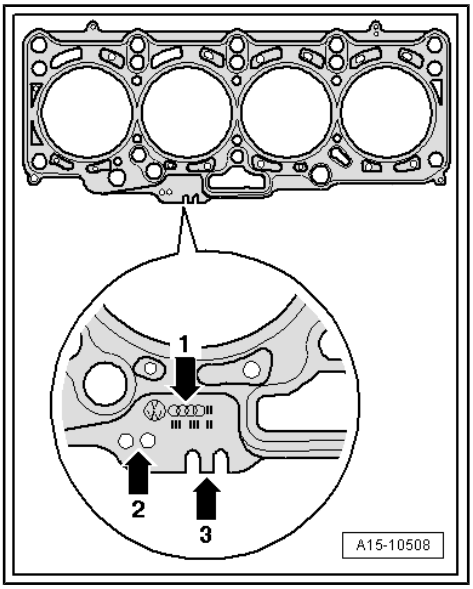
Cylinder heads must not be reworked on TDI engines.

Identification of cylinder head gasket

1 - Part number

2 - Holes

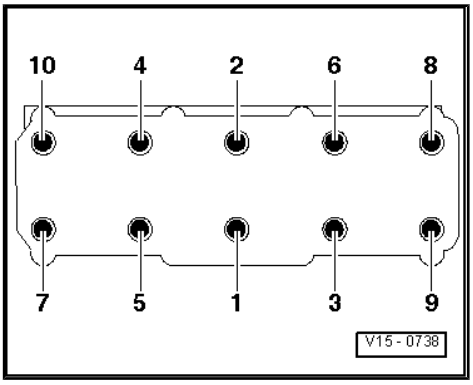
3 - Ignore



Note

Cylinder head gaskets of different thicknesses are fitted depending on the amount of piston projection ⇒ page 83 . When renewing only the cylinder head gasket, the new gasket should have the same identification as the old one.

Cylinder head - tightening torque and sequence



Note

Renew the bolts tightened with specified tightening angle.

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– Tighten bolts in 4 stages in the sequence shown.

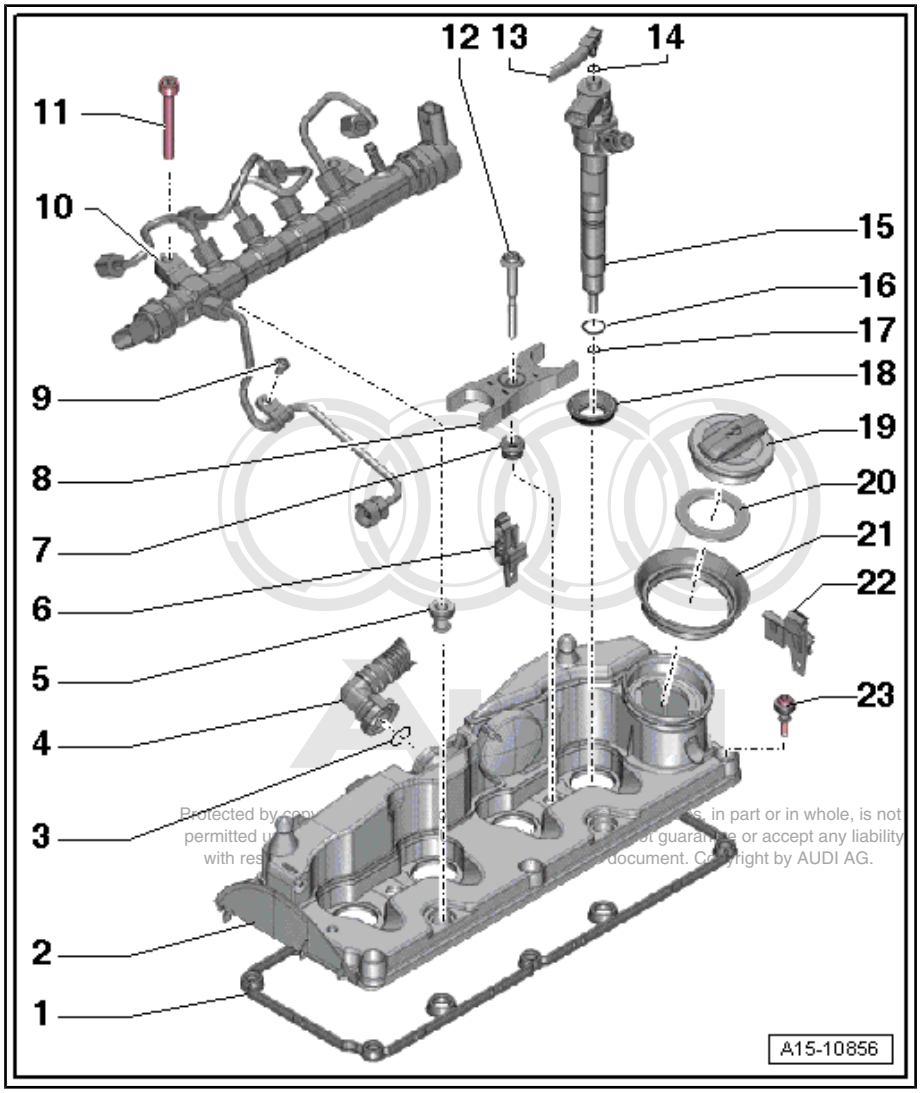
Stage	Bolts	Tightening torque/angle specification
1.	-1 … 10-	30 Nm
2.	-1 … 10-	50 Nm
3.	-1 … 10-	Turn 90° further
4.	-1 … 10-	Turn 90° further

2.2 Exploded view - cylinder head cover

When installing a new base engine, you must check whether there is a sticker on the cylinder head cover.

If a sticker is attached which states `Spannpratzen auf vorgeschriebenes Drehmoment angezogen` (clamping pieces tightened to specified torque), the clamping pieces have already been tightened to the specified final torque at the factory.

If no sticker is attached, it is essential that the clamping pieces for the injectors are tightened to the specified torque after installing the high-pressure pipes. If these instructions are not observed, the engine could be damaged.



1 - Gasket

- ❑ Renew if damaged or leaking

2 - Cylinder head cover

- ❑ Removing and installing ⇒ page 114

3 - O-ring

- ❑ Renew

4 - Hose

- ❑ For crankcase breather
- ❑ Press release tabs to detach

5 - Sealing bush

- ❑ For high-pressure reservoir (rail)
- ❑ Renew if damaged or leaking

6 - Bracket

- ❑ For electrical wiring

7 - Grommet

8 - Clamping piece

9 - Bolt

- ❑ Tightening torque ⇒ Item 16 (page 257)

10 - High-pressure reservoir (rail)

- ❑ Observe rules for cleanliness ⇒ page 5
- ❑ Do not attempt to bend high-pressure pipes to a different shape
- ❑ Installing high-pressure pipes ⇒ page 268

11 - Bolt

- ❑ Tightening torque ⇒ Item 10 (page 256)

12 - Bolt

- ❑ Tightening torque ⇒ Item 7 (page 255)

13 - Fuel return line

14 - O-ring

- ❑ Renew

15 - Injector

- ❑ Observe rules for cleanliness ⇒ page 5
- ❑ Removing and installing ⇒ page 264

16 - O-ring

- ❑ Renew

17 - Insulating seal

- ❑ Renew

18 - Seal

- ❑ For injector
- ❑ Renewing ⇒ page 116

19 - Filler cap

20 - Seal

- ❑ For filler cap

21 - Grommet

22 - Bracket

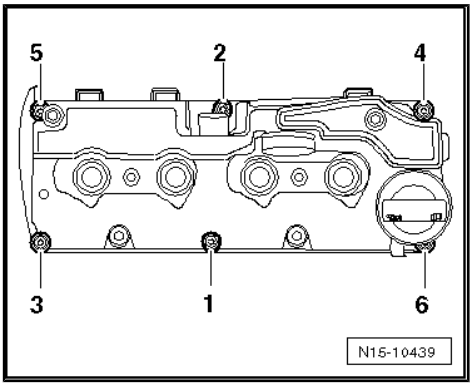
- ❑ For electrical wiring

23 - Bolt

- ❑ Renew if seal is damaged
- ❑ Tightening torque and sequence ⇒ page 103

Cylinder head cover - tightening torque and sequence

– Tighten bolts for cylinder head cover in the sequence -1 ... 6- to 9 Nm.

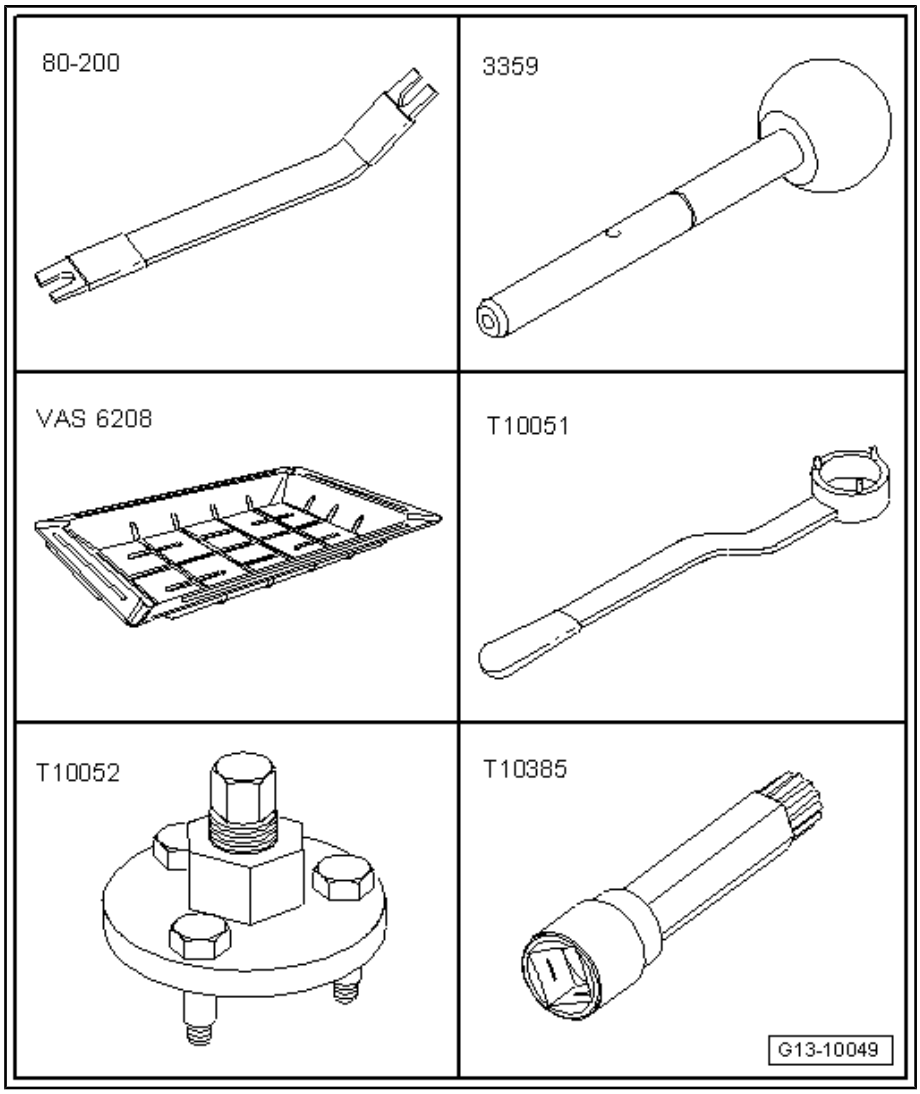


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2.3 Removing and installing cylinder head

Special tools and workshop equipment required

- Removal lever - 80 - 200-
- Diesel injection pump locking pin - 3359-
- Drip tray for workshop hoist - VAS 6208-
- Counterhold tool - T10051-
- Puller - T10052-
- Bit XZN 10 - T10385-



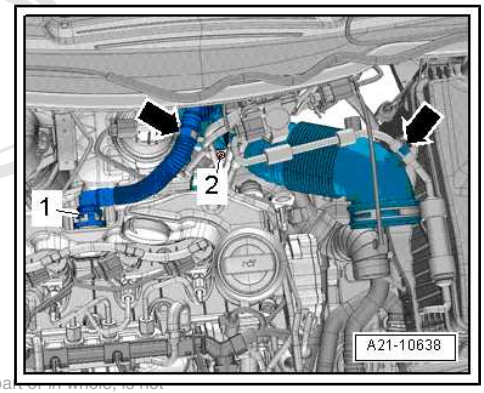
Removing

– Remove coolant pipe (top front) ⇒ page 191 .

– Press release tabs and detach crankcase breather hose -1-.

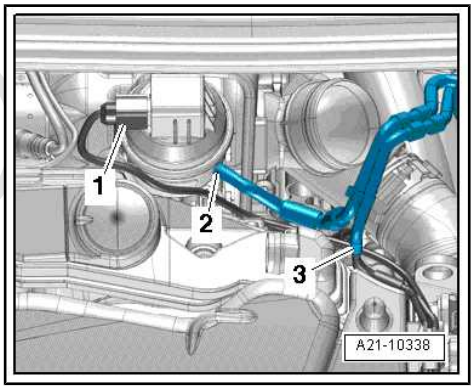
– Move clear vacuum hoses -arrows-.

– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.



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– Detach vacuum hose -2- from vacuum unit of turbocharger.
– Disconnect vacuum hose -3-.

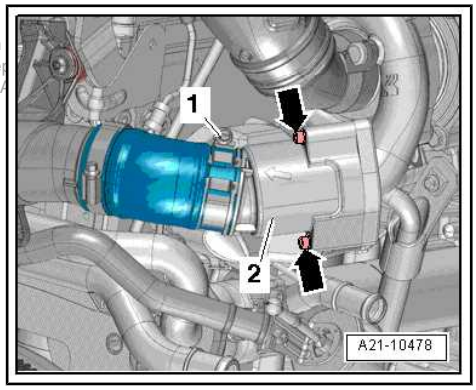


Note

Disregard -item 1-.

– Remove bolts -arrows- and detach pulsation damper -2-.

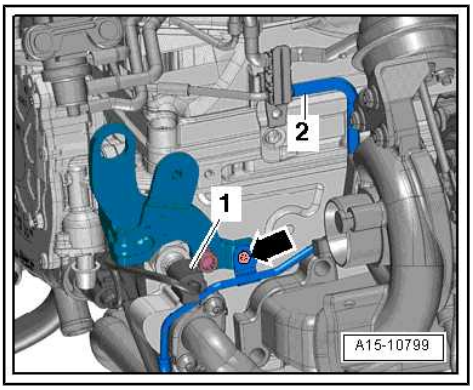
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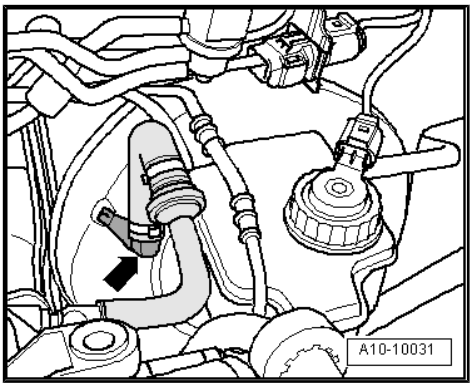
Note

Disregard -item 1-.

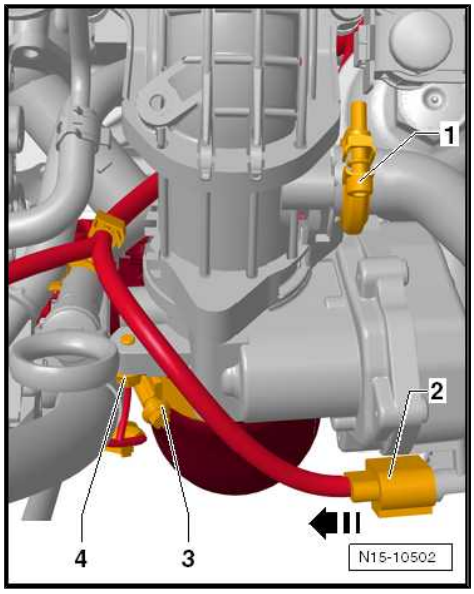
– Unplug electrical connector -1- on oil pressure switch - F1- .
– Remove bolt -arrow-.
– Disconnect vacuum hose -2-.



– Detach vacuum hose from brake servo -arrow-.



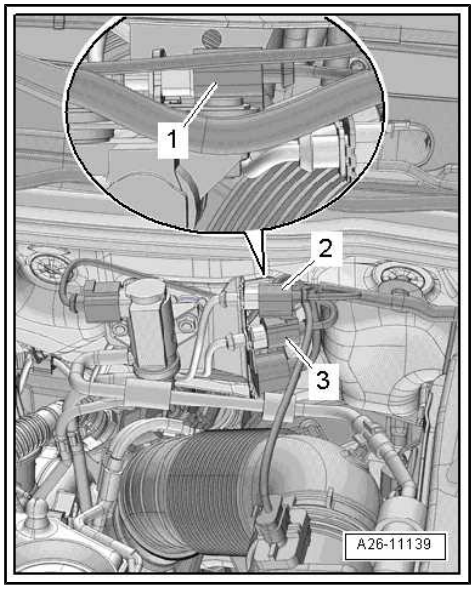
– Unplug electrical connector -2- at throttle valve module - J338- -arrow-.
– Remove bolt -4- for dipstick guide tube.



Note

Disregard items -1 and 3-.

– Detach electrical connector -3- from bracket and unplug.
– Move clear electrical wiring at turbocharger.



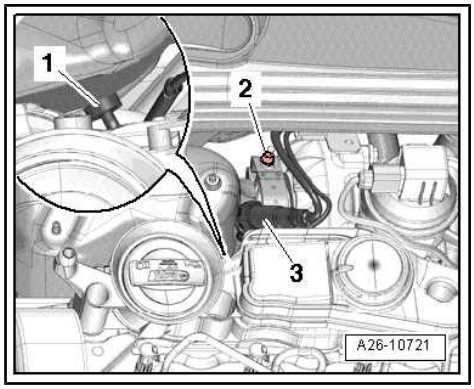
Note

Disregard items -1 and 2-.

Audi

– Slacken bolt -2- and remove clamp.

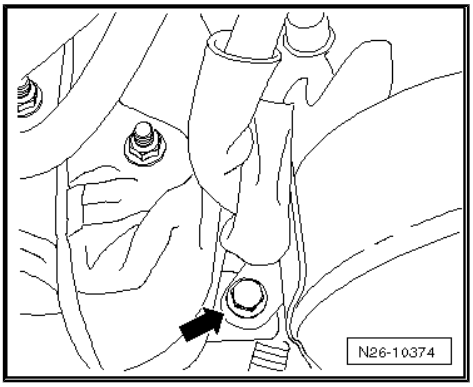
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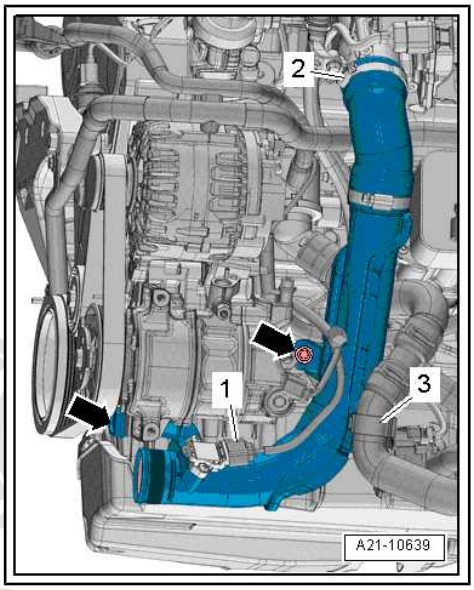
Note

Disregard items -1 and 3-.

– Remove bolt -arrow- securing top bracket for particulate filter.



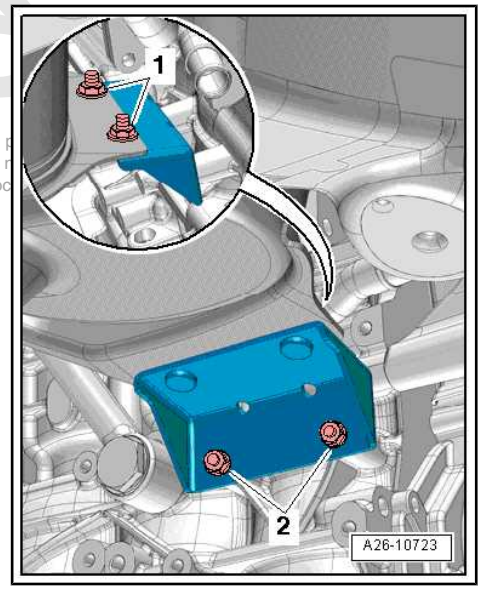
– Remove bolts -arrows-.
– Move coolant hose -3- clear.
– Release hose clip -2-.
– Unplug electrical connector -1- at charge pressure sender - G31- / intake air temperature sender - G42- and detach air pipe (right-side).



– Remove nuts -2-, tie up particulate filter to rear.

Note

Disregard -item 1-.

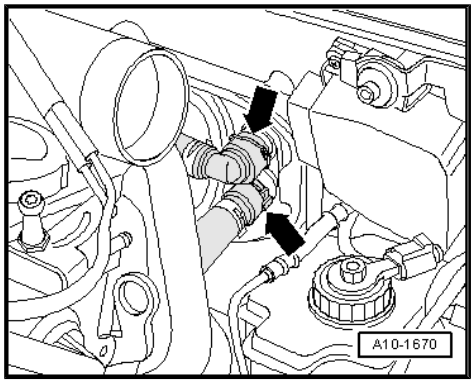


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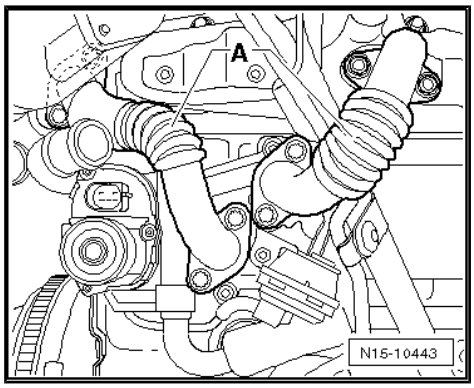
Note

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

– Place drip tray for workshop hoist - VAS 6208- under connection.
– Lift retaining clips -arrows- and disconnect coolant hoses from heat exchanger for heater.
– Guide coolant hoses downwards and drain off coolant.



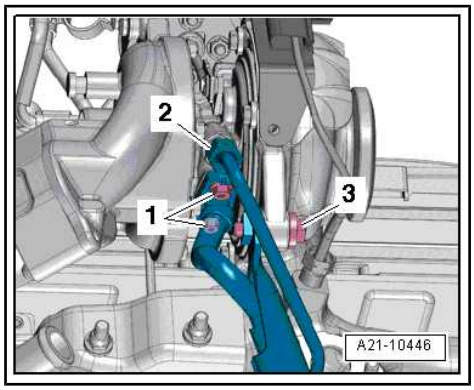
– Remove bolts and detach exhaust gas recirculation pipes -A-.



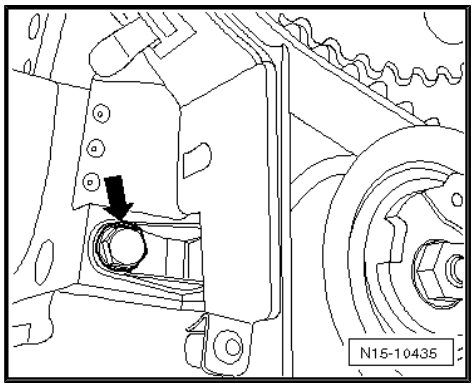
– Unscrew union nut -2- and bolt -3-.

Note

Disregard -item 1-.

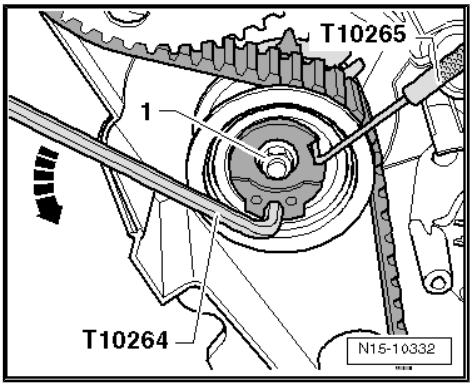


– Remove bolt -arrow- for toothed belt cover (rear).
– Take toothed belt off camshaft sprocket ⇒ page 89.



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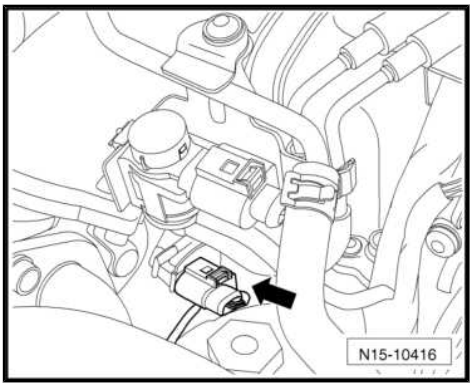
– Unscrew nut -1-.



Note

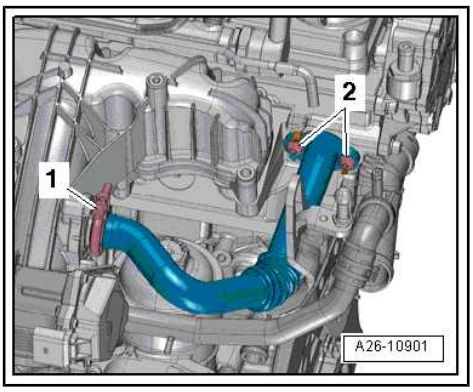
Disregard -arrow- and -T10264- .

– Unplug electrical connector -arrow- at Hall sender - G40- .
– Remove cylinder head cover ⇒ page 114 .

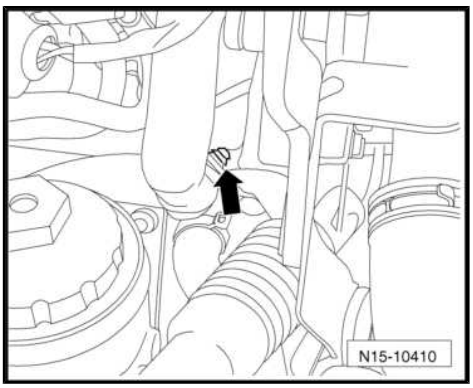


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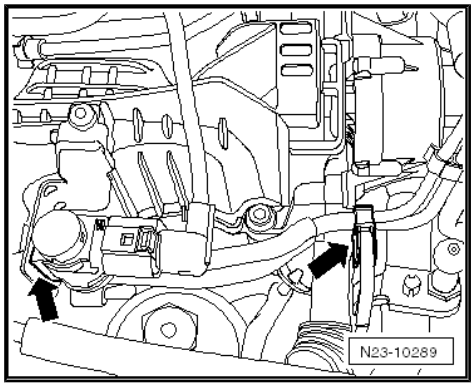
– Open clamp -1- and detach.
– Remove bolts -2- and detach exhaust gas recirculation pipe.



– Unclip electrical wiring harness from bracket -arrow- and move clear.



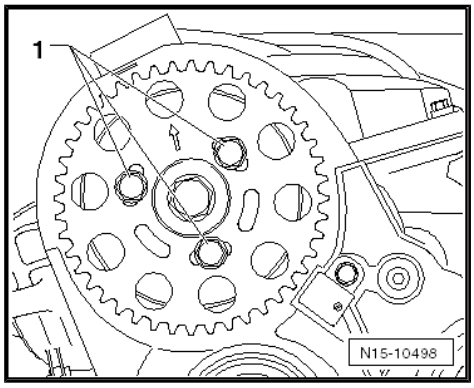
– Take exhaust gas recirculation cooler change-over valve - N345- -left arrow- out of bracket and move clear to one side.



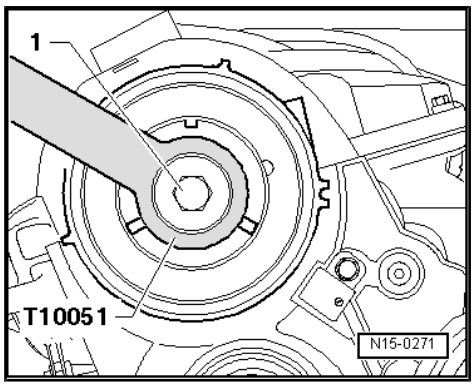
Note

Disregard -arrow- on right-side of illustration.

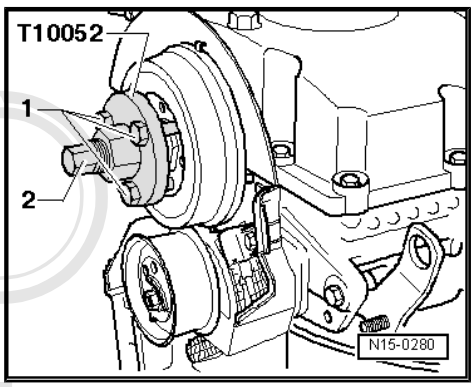
– Remove bolts -1- and detach camshaft sprocket.



– Counterhold using counterhold tool - T10051- and loosen bolt -1- for camshaft hub.
– Unscrew bolt approx. 2 turns.

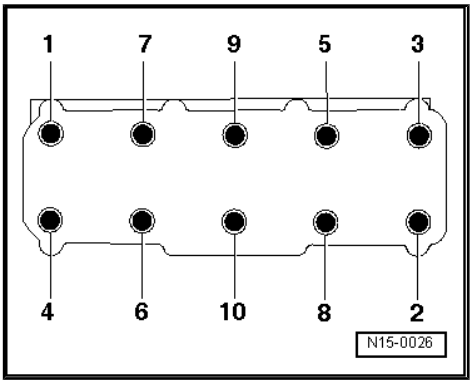


– Apply puller - T10052- to camshaft hub and screw bolts -1- into hub.
– Counterhold on hexagon flats (30 mm) of puller and screw in bolt -2- to pull off camshaft hub.
– Detach hub from taper of camshaft.



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– Slacken cylinder head bolts in the sequence -1 ... 10-.



Note

A second mechanic is required for removal of the cylinder head.

– Swivel cylinder head to left and out of rear toothed belt cover and detach tensioning roller at the same time.

– Take care not to damage oil return line for turbocharger.

– Take care to place cylinder head down without bending oil return line. If necessary, place a block of wood below exhaust manifold.

Caution

Risk of damage to glow plugs when putting down cylinder head.

- ***After removal, the cylinder head must not be put down on the gasket side with the glow plugs still installed, because the glow plugs project slightly beyond the gasket surface.***

Installing

Tightening torques

- ⇒ “2.1 Exploded view - cylinder head”, page 99
- ⇒ Fig. ““Guide tube for oil dipstick - tightening torque”“ , page 152
- ⇒ “1.1 Exploded view - turbocharger”, page 208
- ⇒ “2.1 Exploded view - charge air system”, page 221
- ⇒ Fig. ““Installing air hoses with screw-type clips”“ , page 222
- ⇒ “4.1 Exploded view - exhaust gas recirculation system”, page 307

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Caution

Risk of damage to sealing surfaces.

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

Risk of damage to cylinder block.

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

Risk of leaks at cylinder head gasket.

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

Risk of damage to open valves.

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

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

- *Turn the crankshaft carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

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Note

- *Renew the bolts tightened with specified tightening angle.*
- *Renew self-locking nuts as well as seals, gaskets and O-rings.*
- *Cylinder heads must not be reworked on TDI engines.*
- *When installing an exchange cylinder head, the contact surfaces between roller rocker fingers and cams must be oiled.*
- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *After fitting a new cylinder head or cylinder head gasket, change the engine oil and the coolant in the entire cooling system.*

– Before fitting cylinder head, remove crankshaft stop - T10050- and turn crankshaft against normal direction of rotation until all pistons are positioned approximately equally below “TDC”.

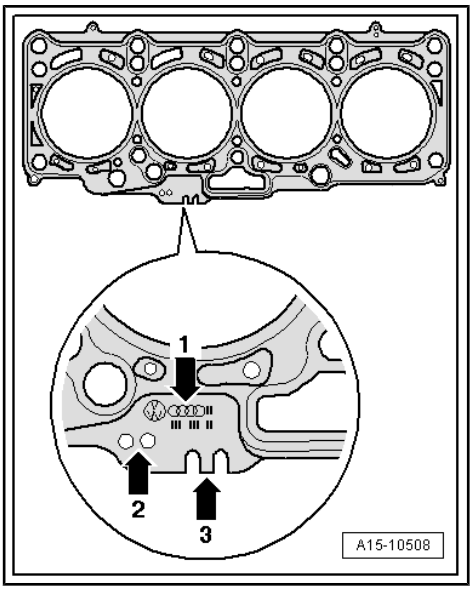
– If not already fitted, install dowel sleeves for centring cylinder block and cylinder head in cylinder block.

– Note cylinder head gasket identification:

1 - Part number

2 - Holes

3 - Ignore

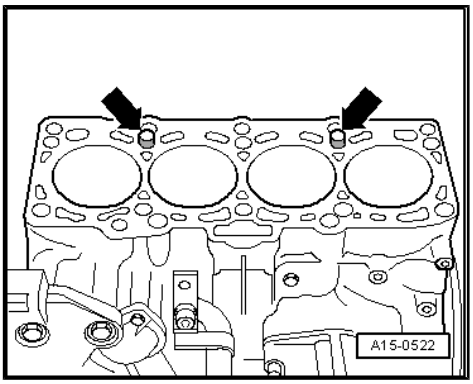


Note

- *If the cylinder head gasket or cylinder head have been replaced, select the new cylinder head gasket according to the number of holes on the old gasket.*
- *If parts of the crankshaft drive have been renewed, the new cylinder head gasket must be selected by measuring the piston projection at "TDC"* ⇒ page 83 .

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– Fit cylinder head gasket onto dowel sleeves -arrows- in cylinder block.



- Installation position of cylinder head gasket: the word "oben" (top) or the part number should face towards the cylinder head.

Note

A second mechanic is required for fitting cylinder head.

– Swivel cylinder head so that stud for toothed belt tensioning roller is inserted into aperture in toothed belt cover (rear) and attach tensioning roller at the same time.

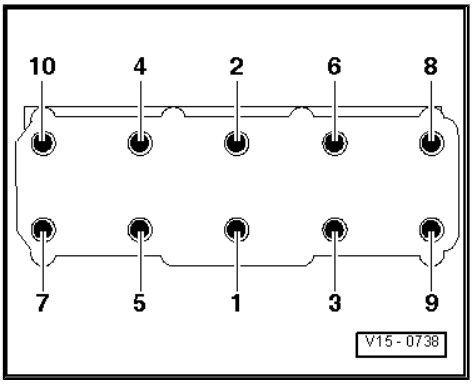
Note

Make sure that electrical wiring to Hall sender - G40- is properly routed.

– Fit cylinder head.

– Screw in cylinder head bolts by hand until they make contact.

– Tighten cylinder head bolts ⇒ page 101 .

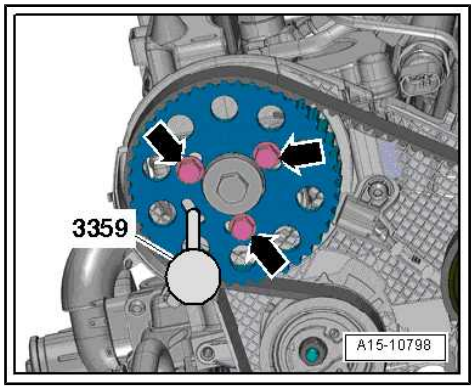


Note

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

– Install rear toothed belt cover, camshaft hub and sprocket ⇒ page 87 .

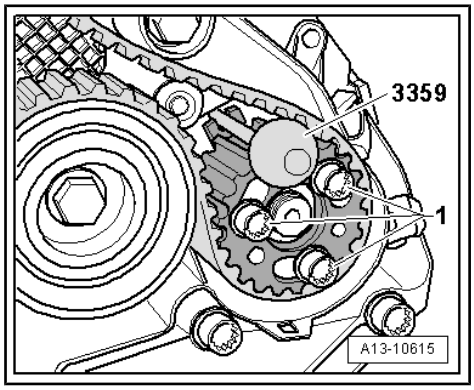
– Lock camshaft hub with diesel injection pump locking pin - 3359- .



Note

Disregard -arrows-.

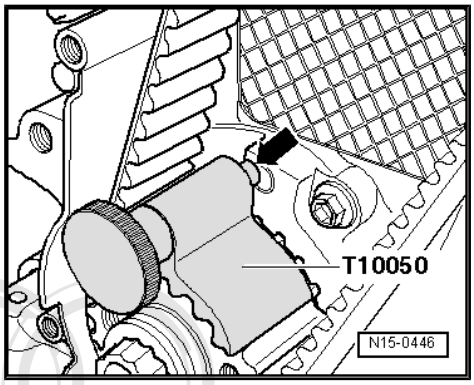
– Lock high-pressure pump hub with diesel injection pump locking pin - 3359- .



Note

Disregard -item 1-.

– Then turn crankshaft in direction of engine rotation until pin -arrow- on crankshaft stop - T10050- engages in sealing flange as crankshaft rotates.



– Install toothed belt (adjust valve timing) ⇒ page 93 .

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

– Install cylinder head cover ⇒ page 114 .
– Connect coolant hoses with plug-in connectors to heat exchanger for heater ⇒ page 200 .
– Install particulate filter ⇒ page 294 .
– Connect vacuum hoses ⇒ page 238 .
– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Change engine oil ⇒ Maintenance ; Booklet 820 .
– Fill cooling system with fresh coolant ⇒ page 171 .

2.4 Removing and installing cylinder head cover

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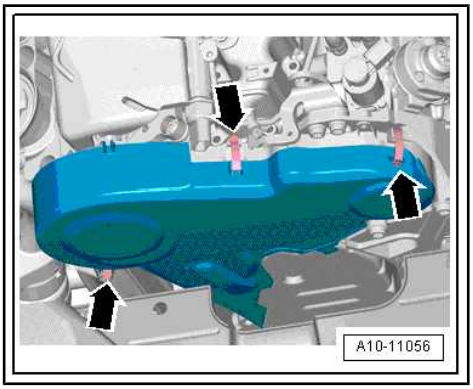
Removing

Note

Secure the heat insulation sleeve in the original position when installing.

– Remove engine cover panel ⇒ page 47 .

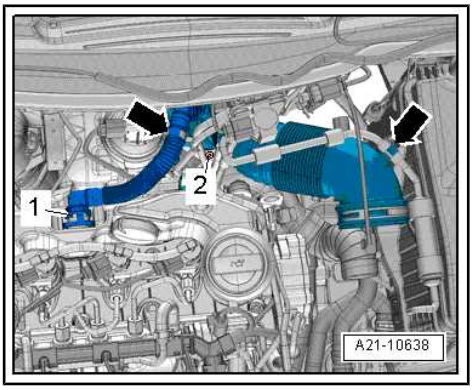
– Release retaining clips -arrows- and detach toothed belt cover (top).
– Remove injectors ⇒ page 264 .
– Remove high-pressure reservoir (rail) ⇒ page 270 .



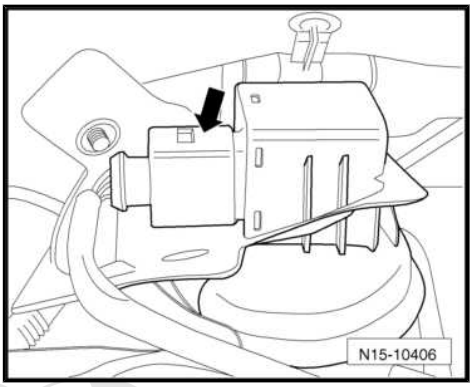
– Press release tabs and disconnect crankcase breather hose -1- from cylinder head cover.

Note

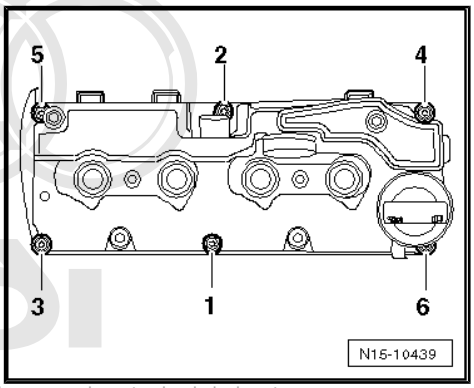
-Item 2- and -arrows- can be disregarded.



– Detach heat shield sleeve.
– Unplug electrical connector -arrow- at position sender for charge pressure positioner - G581- .
– Detach vacuum lines from bracket at cylinder head cover.



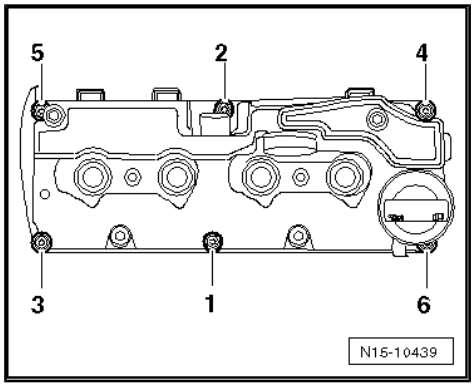
– Slacken cylinder head cover bolts in the sequence -6 ... 1- and remove.
– Detach cylinder head cover.



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Installing

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

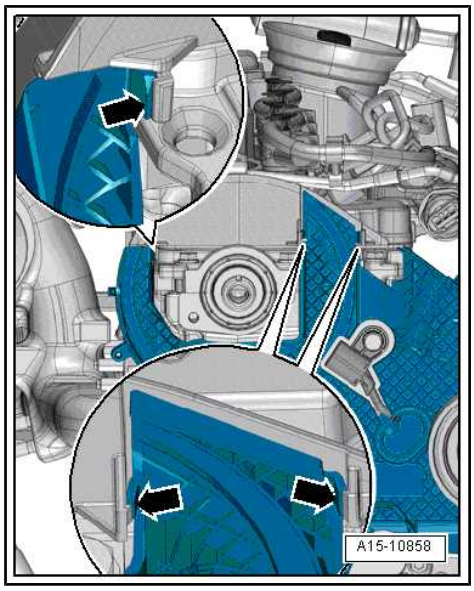


Note

- *Renew gasket for cylinder head cover and bolts for cylinder head cover if damaged or leaking.*
- *Fit new O-ring.*
- *Renew grommets and seals for injectors if damaged or leaking.*

– Tighten cylinder head cover bolts ⇒ page 103 .

– Make sure that cylinder head cover is clipped properly to toothed belt cover -arrows-.



Note

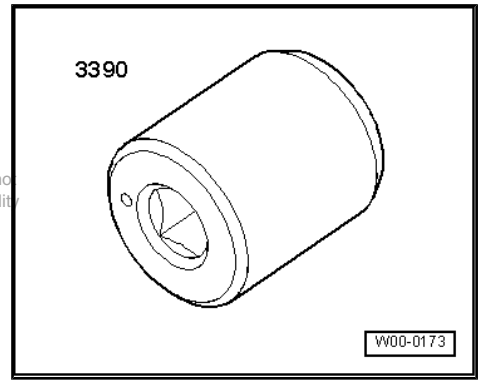
For illustration purposes, the installation position is shown with the camshaft sprocket removed.

– Make sure there is a clearance between hub and toothed belt cover.
– Install high-pressure reservoir (rail) ⇒ page 270 .
– Install injectors ⇒ page 264 .
– Install engine cover panel ⇒ page 47 .

2.5 Removing and installing seals for injectors

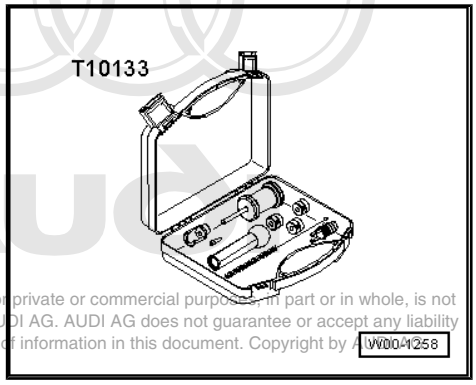
Special tools and workshop equipment required

- Carrier - 3390-



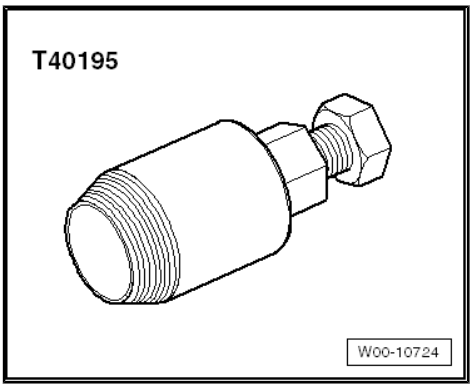
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♦ Tool set for FSI engines - T10133-



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♦ Oil seal extractor - T40195-

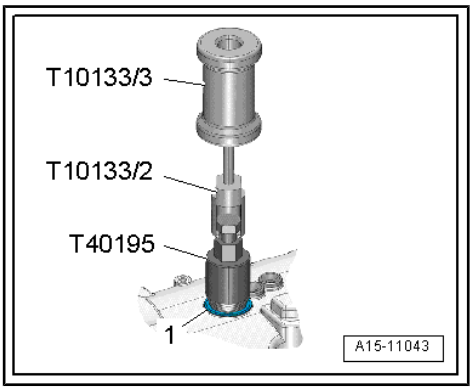


Procedure

– Remove corresponding injector ⇒ page 264 .

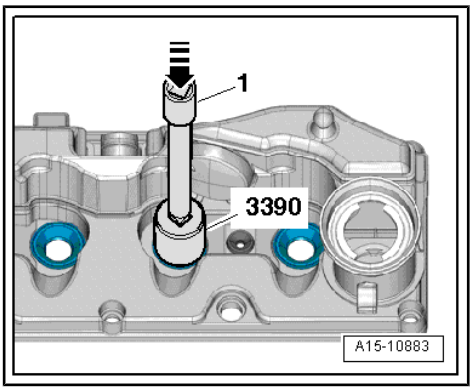
– Screw oil seal extractor - T40195- into seal -1-.

– Fit striker -T10133/3- with adapter -T10133/2- on oil seal extractor, as shown in illustration, and pull out seal upwards by tapping gently.



– Apply carrier - 3390- and short extension -1- at top and press new injector seal in as far as stop.

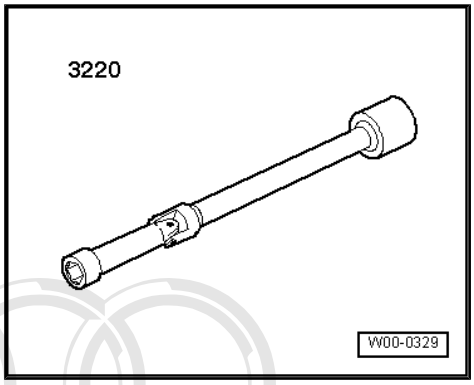
– Install injector ⇒ page 264 .



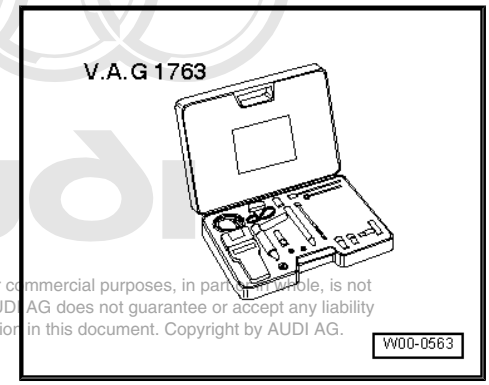
2.6 Checking compression

Special tools and workshop equipment required

♦ Jointed spanner - 3220-



♦ Compression tester - V.A.G 1763- with adapter - V.A.G 1763/8-



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Procedure

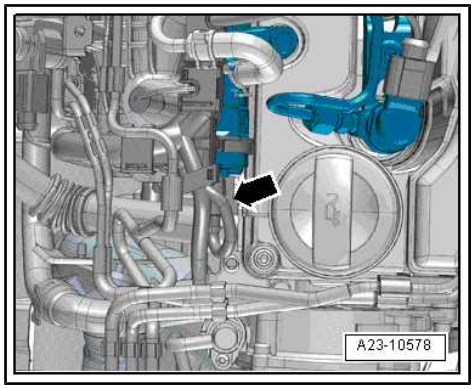
- Engine oil temperature approx. 80 °C
- Battery voltage at least 12.5 V

– Remove engine cover panel ⇒ page 47 .

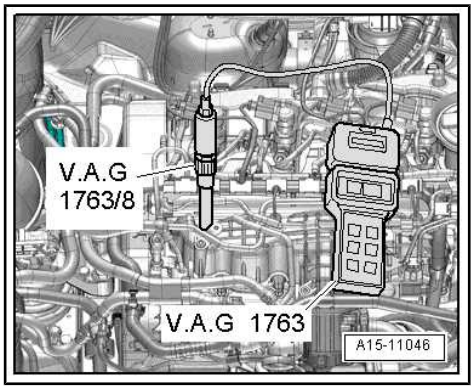
– Unplug electrical connector -arrow- for fuel pressure regulating valve - N276- at high-pressure reservoir (rail).

– Briefly start engine to relieve fuel pressure in high-pressure reservoir (rail).

– Remove all glow plugs ⇒ page 313 .



– Screw in adapter - V.A.G 1763/8- in place of corresponding glow plug and connect compression tester - V.A.G 1763- .



Note

Using the compression tester ⇒ Operating instructions .

– Have a second mechanic operate starter until tester shows no further pressure increase.

– Repeat procedure on each cylinder.

Compression pressure	bar
When new	25.0 … 31.0
Wear limit	19.0
Maximum difference between cylinders	5.0

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Assembling

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

– Install glow plugs ⇒ page 313 .

– Install engine cover panel ⇒ page 47 .

– Erase any entries in event memory resulting from testing ⇒ Vehicle diagnostic tester, `Guided Functions`, then `Interrogate event memory`.

3 Valve gear

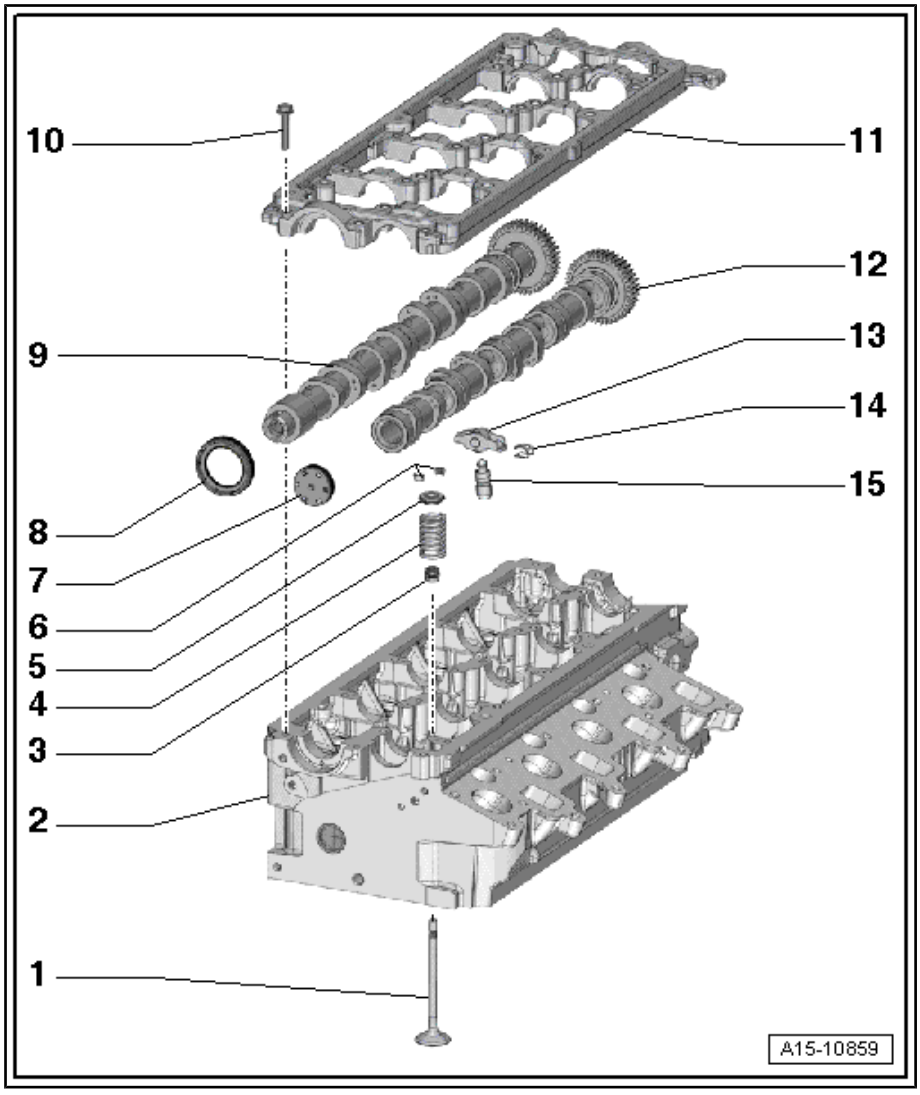
⇒ “3.1 Exploded view - valve gear”, page 120
⇒ “3.2 Measuring axial clearance of camshaft”, page 121
⇒ “3.3 Measuring radial clearance of camshaft”, page 122
⇒ “3.4 Removing and installing camshaft oil seal”, page 123
⇒ “3.5 Removing and installing camshaft”, page 125
⇒ “3.6 Checking hydraulic compensation elements”, page 131
⇒ “3.7 Removing and installing valve stem oil seals”, page 132

3.1 Exploded view - valve gear

Note

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Cylinder heads with cracks between the valve seats may be used without reducing engine life, provided the cracks are small and not more than 0.5 mm wide.



1 - Valve

- ❑ Must not be machined; only grinding-in is permissible
- ❑ Mark installation position for re-installation
- ❑ Checking ⇒ page 140
- ❑ Valve dimensions ⇒ page 140
- ❑ Checking valve guides ⇒ page 139

2 - Cylinder head

3 - Valve stem oil seal

- ❑ Renewing with cylinder head installed ⇒ page 132
- ❑ Renewing with cylinder head removed ⇒ page 135

4 - Valve spring

5 - Valve spring plate

6 - Valve cotters

7 - Sealing cap

- ❑ Renew
- ❑ Removing sealing cap with retaining frame installed: pierce on one side with an awl and pry out
- ❑ Installing: drive in without sealant using suitable thrust piece
- ❑ Installation depth 1 ... 2 mm

8 - Oil seal

- ❑ Different versions; for allocation refer to ⇒ Electronic parts catalogue
- ❑ Renewing ⇒ page 123

9 - Exhaust camshaft

- ❑ Removing and installing ⇒ page 125
- ❑ Measuring axial clearance ⇒ page 121
- ❑ Measuring radial clearance ⇒ page 122

10 - Bolt

- ❑ Correct sequence when slackening ⇒ page 127
- ❑ Tightening torque and sequence ⇒ page 121

11 - Retaining frame

- ❑ With integrated camshaft bearings
- ❑ Removing and installing ⇒ “3.5 Removing and installing camshaft”, page 125

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12 - Inlet camshaft

- ❑ Removing and installing ⇒ page 125
- ❑ Measuring axial clearance ⇒ page 121
- ❑ Measuring radial clearance ⇒ page 122

13 - Roller rocker finger

- ❑ Removing and installing ⇒ “3.5 Removing and installing camshaft”, page 125
- ❑ Mark installation position for re-installation
- ❑ Check roller bearings for ease of movement
- ❑ Lubricate contact surfaces before installing

14 - Securing clip

- ❑ For hydraulic compensation element

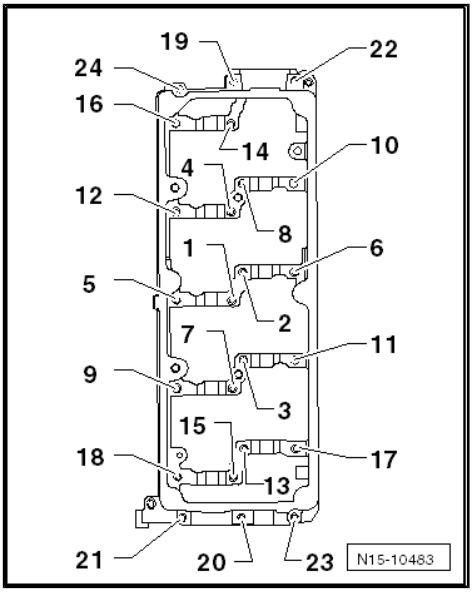
15 - Hydraulic compensation element

- ❑ Checking ⇒ page 131
- ❑ Mark installation position for re-installation
- ❑ Lubricate contact surfaces before installing

Retaining frame - tightening torque and sequence

– Tighten bolts in 2 stages in the sequence shown:

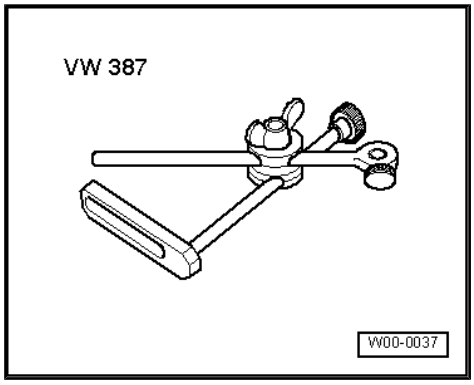
Stage	Bolts	Tightening torque
1.	-1 … 24-	Screw in by hand until contact is made • The retaining frame should make contact with the cylinder head over the full surface
2.	-1 … 24-	10 Nm



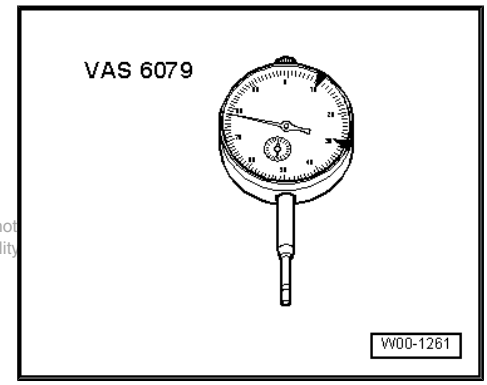
3.2 Measuring axial clearance of camshaft

Special tools and workshop equipment required

♦ Universal dial gauge bracket - VW 387-



♦ Dial gauge - VAS 6079-



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Procedure

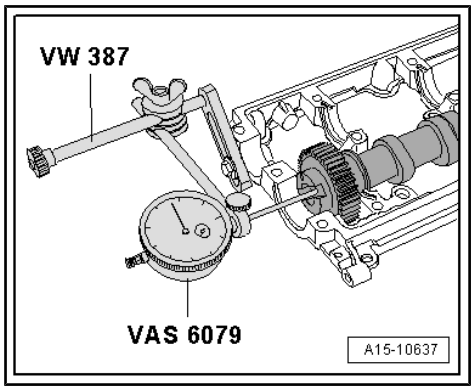
– Remove retaining frame
⇒ “3.5 Removing and installing camshaft”, page 125 .

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

– Press camshaft against dial gauge by hand.

– Set dial gauge to “0”.

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



Axial clearance on inlet camshaft and exhaust camshaft:

- Specification: 0.048 … 0.118 mm.
- Wear limit: 0.17 mm.

3.3 Measuring radial clearance of camshaft

Special tools and workshop equipment required

♦ Plastigauge

Procedure

– Remove roller rocker fingers
⇒ “3.5 Removing and installing camshaft”, page 125 .

– Clean bearings and bearing journals.

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

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

– Fit retaining frame and tighten to 10 Nm without rotating camshafts ⇒ page 121 .

– Remove retaining frame again.
– Compare width of Plastigauge with measurement scale.

• Radial clearance: 0.035 ... 0.085 mm

3.4 Removing and installing camshaft oil seal

Note

♦ *A modified oil seal is being phased in.*

♦ *The “old” version oil seal -item A- forms a continuous surface between the camshaft and the cylinder head.*

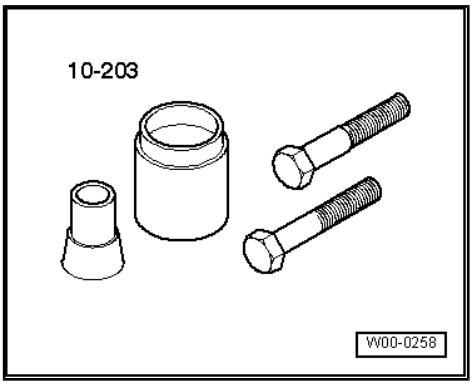
♦ *The “new” version oil seal -item B- has a shoulder between the camshaft and the cylinder head.*



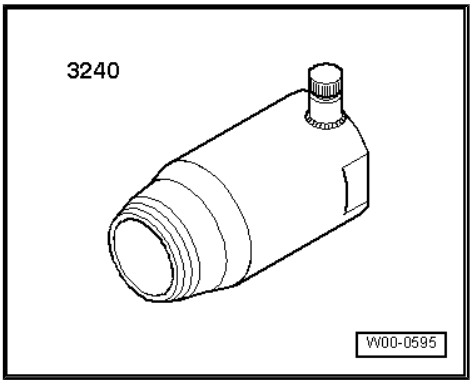
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Special tools and workshop equipment required

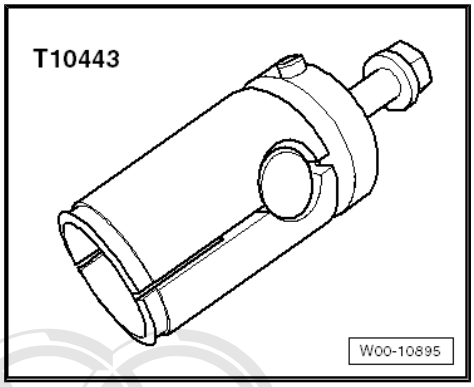
♦ Fitting tool - 10 - 203-



♦ Oil seal extractor - 3240- for “old” version oil seal



♦ Puller - T10443- for “new” version oil seal



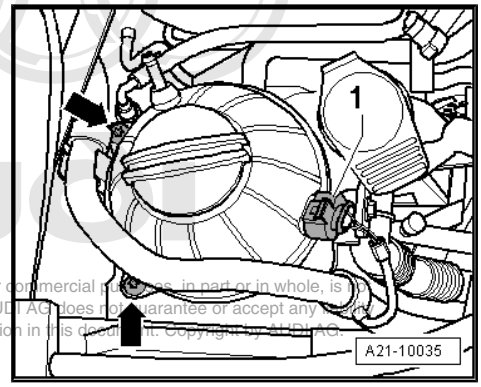
♦ Bolt M12x1.5x75

Procedure

– Remove camshaft sprocket and hub
⇒ “3.5 Removing and installing camshaft”, page 125 .

– Remove bolts -arrows-.

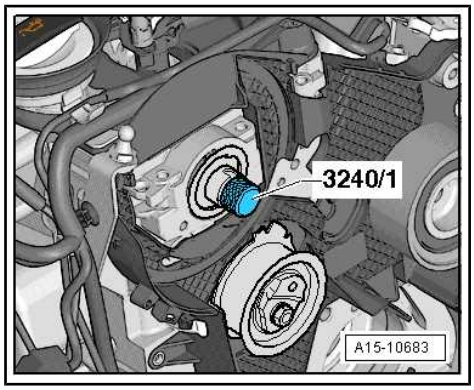
– Detach electrical connector -1- for coolant shortage indicator switch - F66- and move coolant expansion tank to side.



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“Old” version oil seal:

– Insert thrust piece -3240/1- in camshaft.

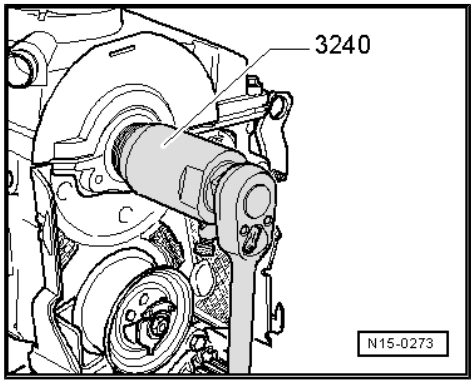


– Screw inner section of oil seal extractor -3240- two turns out of outer section (approx. 3 mm) and lock with knurled screw.

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

– Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.

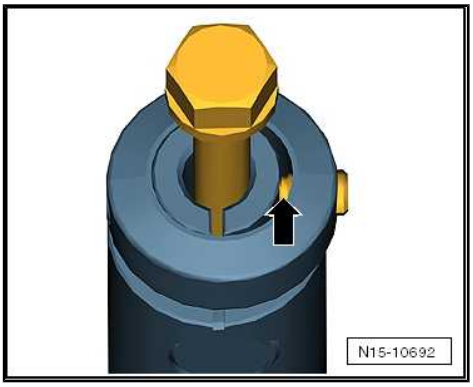
– Clamp flats of oil seal extractor in vice and use pliers to remove oil seal.



“New” version oil seal:

Caution

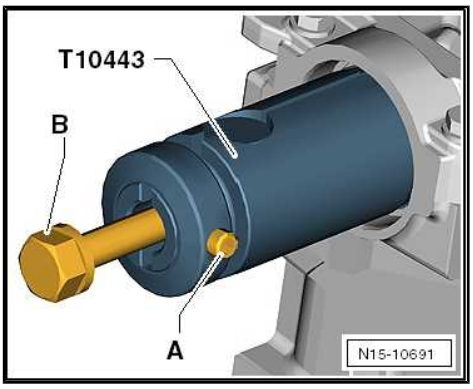
- *If the grub screw is unscrewed too far the thrust plate inside the puller -T10443- will come loose from the thrust bolt. If this happens, the thrust plate must be pushed back onto the thrust bolt.*



– Carefully unscrew grub screw -arrow- of puller -T10443- until slight resistance is felt.

– Apply puller - T10443- in a straight line, as shown in illustration, and lock by screwing in grub screw.-A-.

– Screw in thrust bolt -B- until oil seal is pulled out.



All types of oil seal (continued):

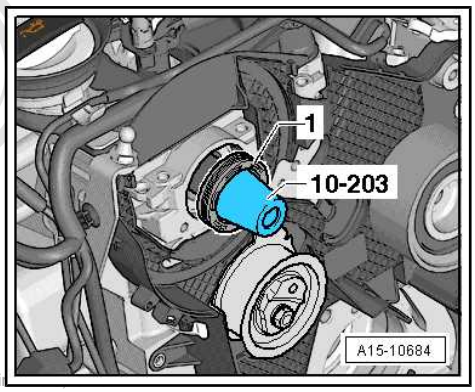
– Clean contact surface and sealing surface.

Note

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

– Apply guide sleeve of fitting tool - 10 - 203- to camshaft as shown in illustration.

– Carefully push oil seal -1- over guide sleeve and onto camshaft.

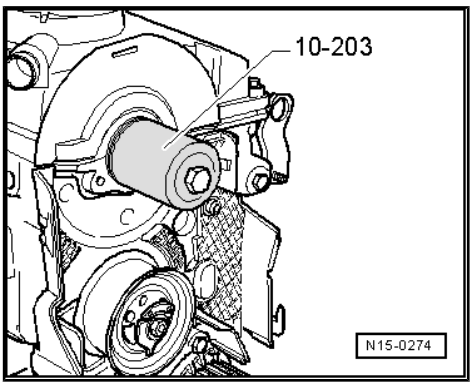


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– Press in oil seal onto stop using thrust piece of fitting tool - 10 - 203- and bolt M12×1.5×75.

– Install camshaft sprocket and hub
⇒ “3.5 Removing and installing camshaft”, page 125 .

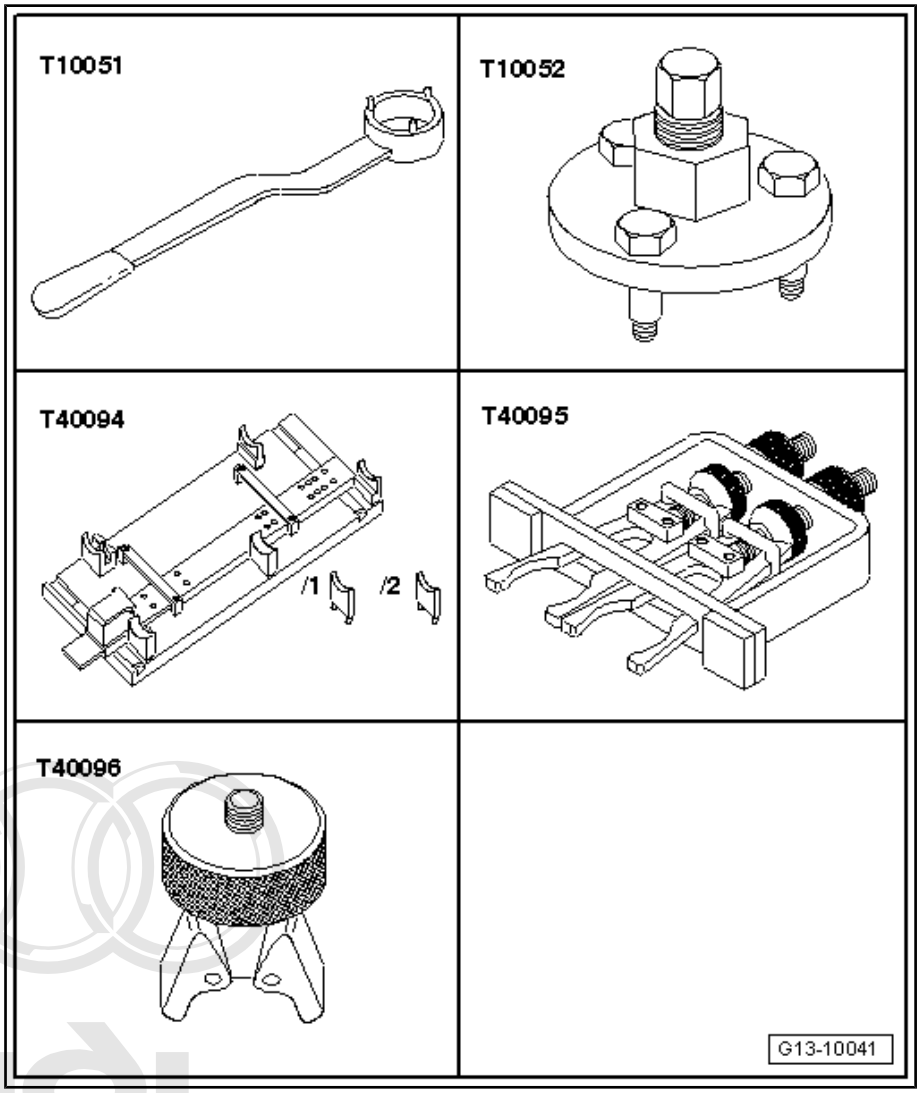
– Install toothed belt (adjust valve timing) ⇒ page 93 .



3.5 Removing and installing camshaft

Special tools and workshop equipment required

- Counterhold tool - T10051-
- Puller - T10052-
- Camshaft fitting tool - T40094-
- Camshaft fitting tool - T40095-
- Clamping tool -T40096/1- for vehicles with two-piece camshaft gear
- Electric drill with plastic brush attachment
- Safety goggles
- Sealant ⇒ Electronic parts catalogue



Removing

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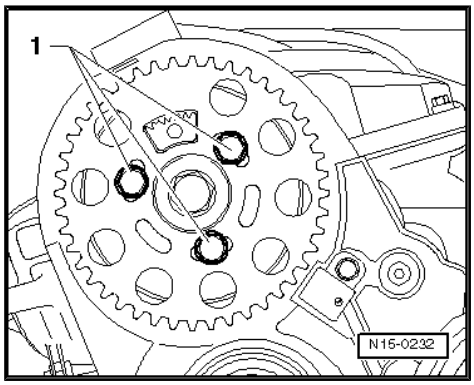
- Cylinder head installed.

– Remove engine cover panel ⇒ page 47 .

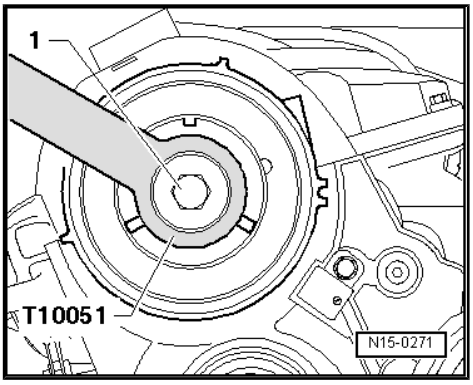
– Take toothed belt off camshaft sprocket and high-pressure pump sprocket ⇒ page 89 .

– Remove cylinder head cover ⇒ page 114 .

– Remove bolts -1- and detach camshaft sprocket.

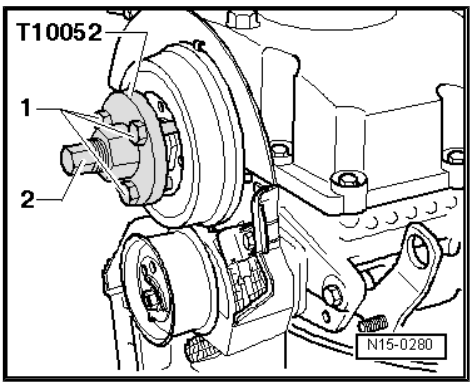


– Counterhold using counterhold tool - T10051- and loosen bolt -1- for camshaft hub.
– Unscrew bolt approx. 2 turns.

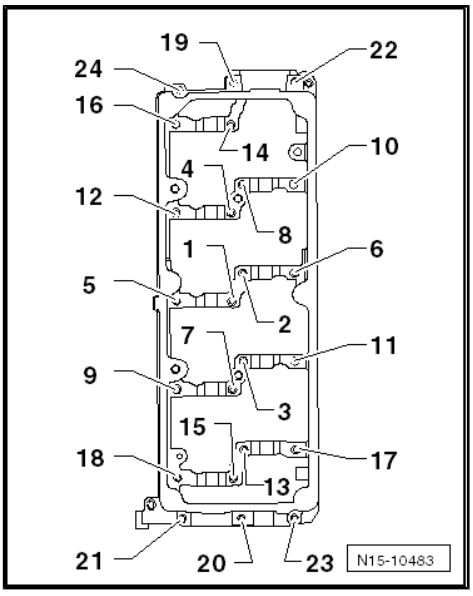


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– Apply puller - T10052- to camshaft hub and screw bolts -1- into hub.
– Counterhold on hexagon flats (30 mm) of puller and screw in bolt -2- to pull off camshaft hub.
– Detach hub from taper of camshaft.
– Remove vacuum pump ⇒ Brake system; Rep. gr. 47 ; Vacuum system; Removing and installing vacuum pump .



– Slacken retaining frame bolts in the sequence -24 ... 1-.
– Remove bolts and carefully release retaining frame from bonded joint.
– Mark fitting location of camshafts for re-installation and remove.



Installing

Tightening torques

◆ ⇒ “3.1 Exploded view - valve gear”, page 120

Caution

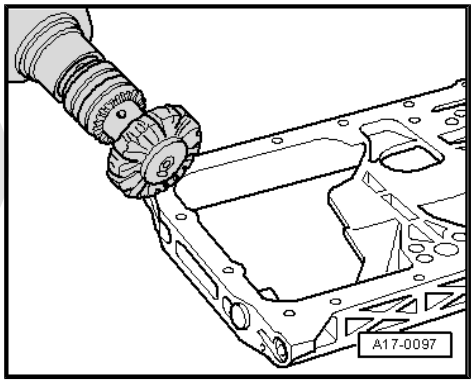
Make sure axial bearings in retaining frame are not damaged.

◆ *The camshafts MUST be installed using the camshaft fitting tool - T40094- as described in the following.*

Caution

Protect lubrication system and bearings against contamination.

- *Cover exposed parts of the engine.*



WARNING

Risk of eye injury.

- *Put on safety goggles.*

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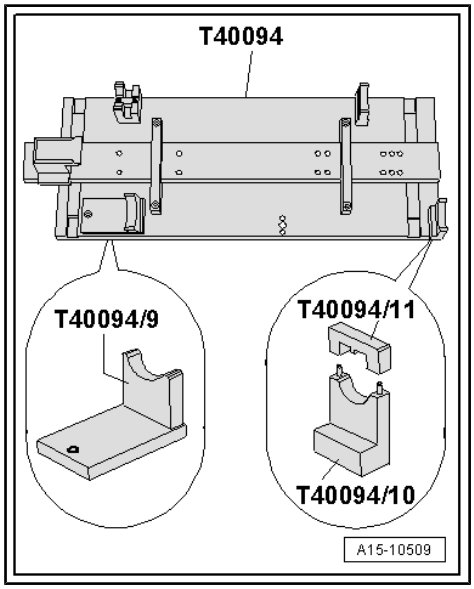
– Remove remaining sealant from cylinder head and retaining frame using rotating plastic brush or similar.

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

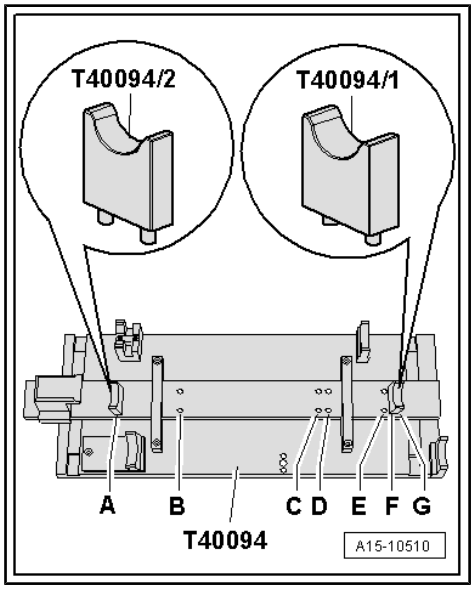
– Oil running surfaces of both camshafts.

Set up camshaft fitting tool - T40094- as follows:

– Secure supports -T40094/9- and -T40094/10- (with -T40094/11-) to base plate, as shown in illustration. If necessary, remove any supports already attached at these positions.



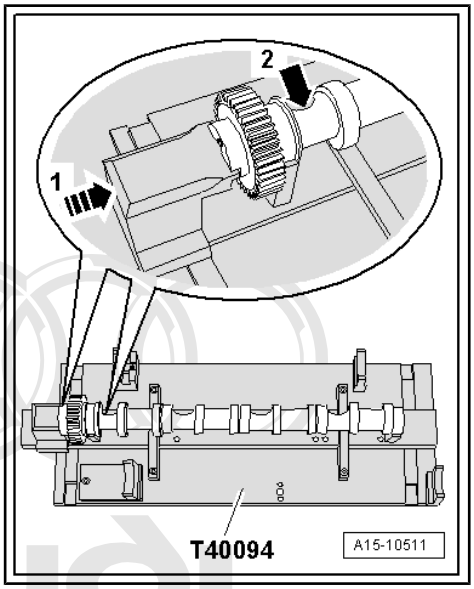
– Fit support -T40094/1- onto position -F- and support -T40094/2- onto position -A-.



– Place inlet camshaft in supports -T40094/1- and -T40094/2- .

– Turn inlet camshaft in such a way that it can be locked in “TDC” position using locking device -arrow 1-.

• Recess -arrow 2- for cylinder head bolt must face outwards.

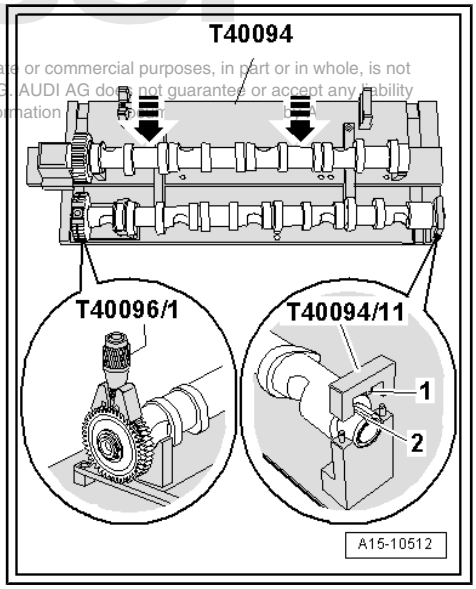


– Place exhaust camshaft in supports -T40094/9- and -T40094/10- .

– Lock exhaust camshaft with top section -T40094/11- .

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• The lug -1- on the top section must engage in the slot -2- in the camshaft,



Vehicles with two-piece camshaft gear:

– Place clamping tool -T40096/1- on teeth of exhaust camshaft in such a way that the two arms of the tool engage on the two halves of the gear (one in each half, as shown in illustration).

• The wider arm must engage in the wider half of the gear.

– Tighten the clamping tool using the knurled wheel so that the faces of the gear teeth are in alignment.

Continued for all vehicles:

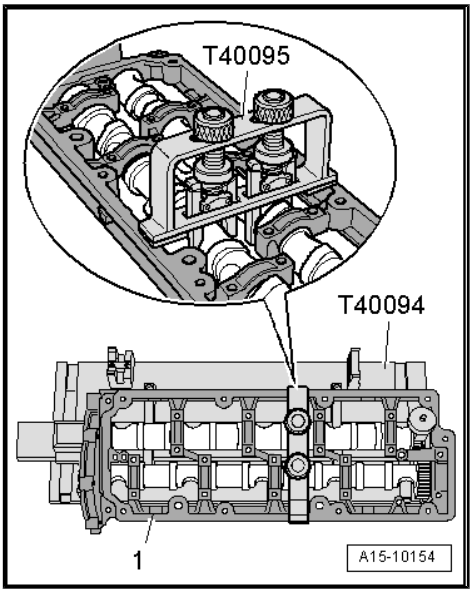
– Slide inlet camshaft towards exhaust camshaft, until gear teeth engage -arrows-.

– Fit retaining frame on camshafts.

• All camshaft bearings must be seated on the camshafts.

– Position camshaft fitting tool - T40095- and fix camshafts in position in retaining frame, as shown in illustration.

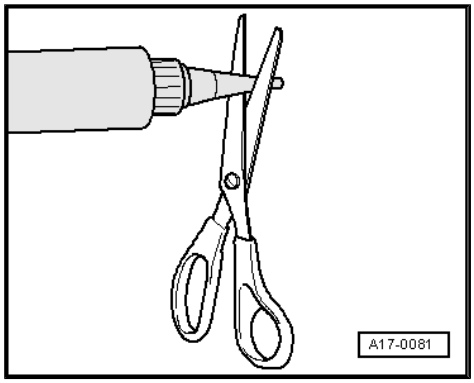
– Detach top section -T40094/11- .



Note

Note the use-by date of the sealant.

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



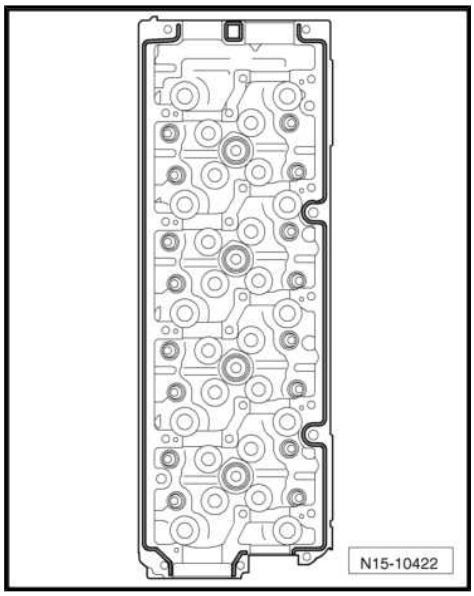
Caution

Make sure excess sealant does not contaminate camshaft bearings.

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

– Apply beads of sealant onto clean sealing surfaces of cylinder head as shown in illustration.

• Thickness of sealant beads: 2 ... 3 mm



Note

- *The retaining frame should be fitted and secured without delay, as the sealant starts hardening immediately.*
- *After installing the retaining frame, wait about 30 minutes for the sealant to dry.*

– Take camshafts together with retaining frame, camshaft fitting tool - T40095- and, if necessary, clamping tool -T40096/1- out of camshaft fitting tool - T40094- and insert components carefully into cylinder head.

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– Screw in retaining frame bolts in the sequence -1 ... 24- evenly by hand until they make contact.

• The retaining frame should make contact with the cylinder head over the full surface.

– Tighten bolts ⇒ page 121 .

– Remove camshaft fitting tool - T40095- and, if necessary, clamping tool -T40096/1- .

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

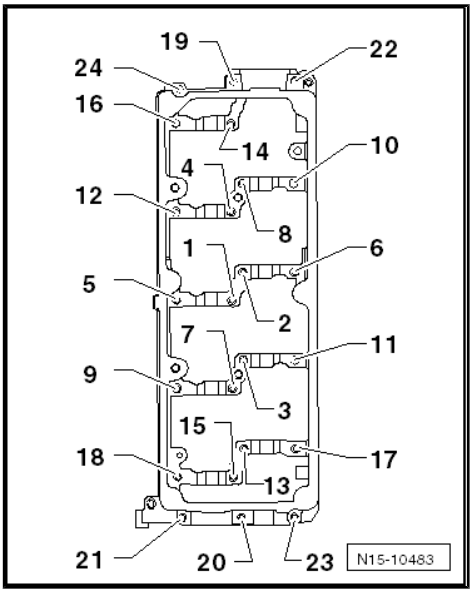
– Install camshaft oil seal ⇒ page 123 .

– Drive new sealing cap ⇒ Item 7 (page 120) into cylinder head to a depth of approx. 1 ... 2 mm using suitable thrust piece.

– Install vacuum pump ⇒ Brake system; Rep. gr. 47 ; Vacuum system; Removing and installing vacuum pump .

– Install cylinder head cover ⇒ page 114 .

– Install engine cover panel ⇒ page 47 .



Caution

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

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

3.6 Checking hydraulic compensation elements

Note

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- *The hydraulic compensation elements cannot be serviced.*
- *Irregular valve noises when starting engine are normal.*

Special tools and workshop equipment required

- Feeler gauge

Procedure

– Start engine and run until radiator fan has started up once.

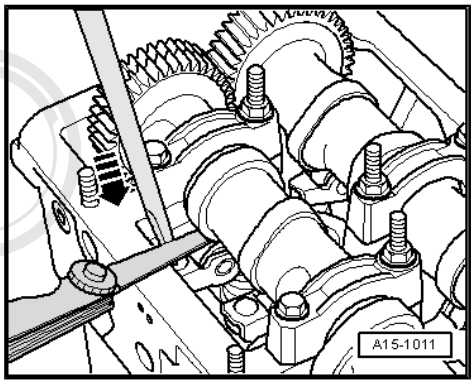
– Increase engine speed to approx. 2500 rpm for 2 minutes (perform road test if necessary).

Note

If irregular valve noise disappears but repeatedly re-occurs when travelling short distances, renew oil retention valve. The oil retention valve is located in the oil filter bracket ⇒ Item 10 (page 151) .

– If the compensation elements are still noisy, locate the defective compensation element as follows:

– Remove cylinder head cover ⇒ page 114 .
– Rotate crankshaft by turning bolt for toothed belt sprocket until cam of supporting element to be tested is facing upwards.
– Press roller rocker finger down -arrow- to determine clearance between cam and roller rocker finger.
– If it is possible to insert a feeler gauge of 0.20 mm between cam and roller rocker finger, renew hydraulic compensation element
⇒ “3.5 Removing and installing camshaft”, page 125 .



Additional steps required

– Install cylinder head cover ⇒ page 114 .

3.7 Removing and installing valve stem oil seals

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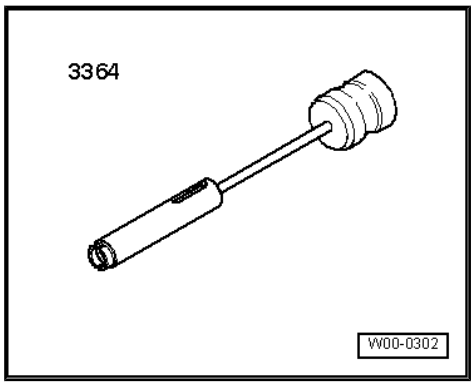
⇒ “3.7.1 Removing and installing valve stem oil seals (cylinder head installed)”, page 132

⇒ “3.7.2 Removing and installing valve stem oil seals (cylinder head removed)”, page 135

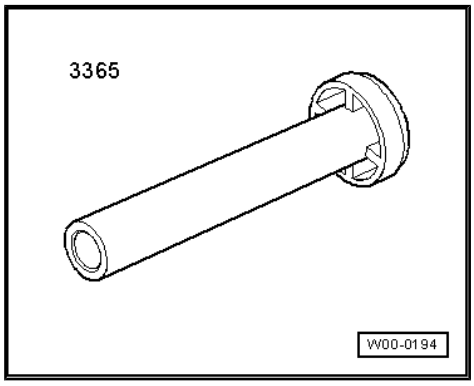
3.7.1 Removing and installing valve stem oil seals (cylinder head installed)

Special tools and workshop equipment required

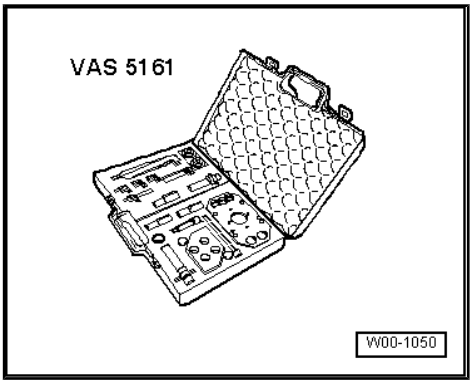
♦ Valve stem seal puller - 3364-



♦ Valve stem seal fitting tool - 3365-



- Removal and installation device for valve cotters - VAS 5161 A- with guide plate for 3.0 ltr. TDI engine - VAS 5161/23- and sleeve -VAS 5161/23-1-



- Bolt M6x30 (2x)

Procedure

– Remove all glow plugs ⇒ page 313 .

– Remove camshafts ⇒ page 125 .

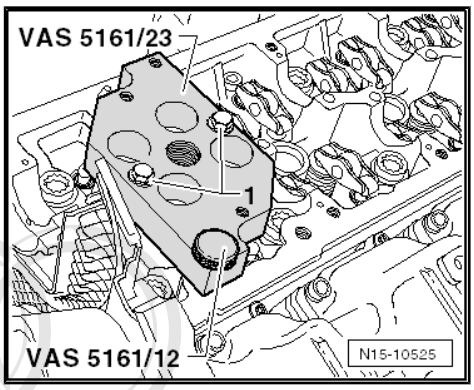
– Mark original positions of roller rocker fingers and hydraulic compensation elements for re-installation.

– Remove roller rocker fingers together with hydraulic compensation elements and put down on a clean surface.

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

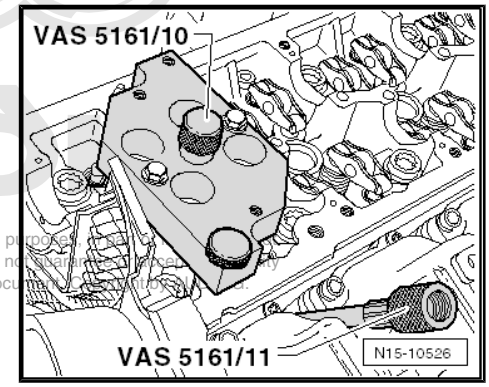
– Fit guide plate for 3.0 ltr. TDI engine - VAS 5161/23- onto cylinder head.

– Secure guide plate on intake manifold side with knurled screw -VAS 5161/12- and 2 M6x30 bolts -item 1- by hand until they make contact.



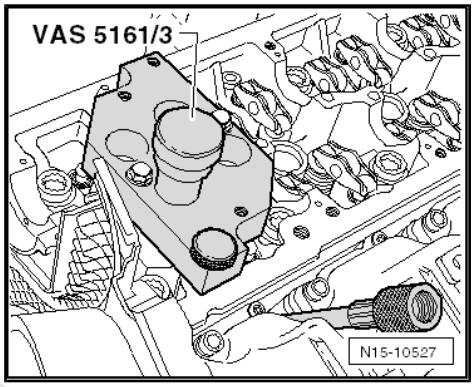
– Screw sealing pin -VAS 5161/10- into guide plate.

– Screw adapter -VAS 5161/11- hand-tight into corresponding glow plug thread.



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– Insert drift -VAS 5161/3- into guide plate and use plastic-headed hammer to release sticking valve cotters.



– Screw snap-in device -VAS 5161/6- with engaging fork -VAS 5161/5- into guide plate.

– Slide sleeve -VAS 5161/23-1- onto assembly cartridge -VAS 5161/8- .

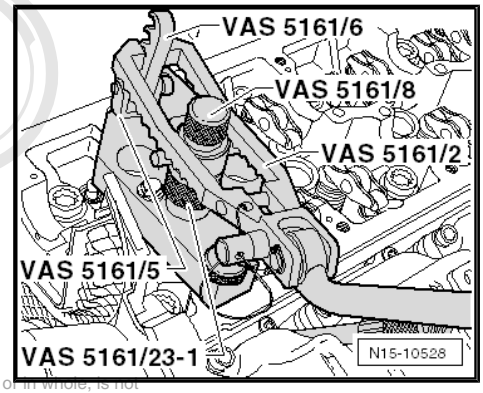
– Connect adapter to compressed air line using a commercially available connection piece, and apply constant air pressure.

• Minimum pressure: 6 bar

– Attach pressure fork -VAS 5161/2- to snap-in device and push assembly cartridge down.

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

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



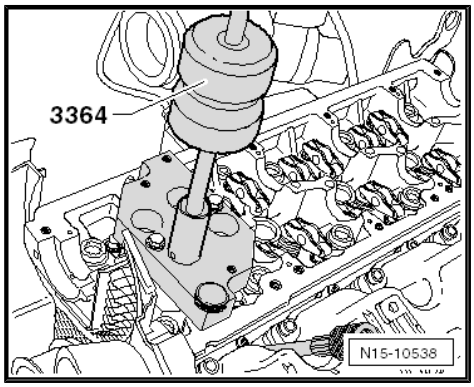
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– Release pressure fork.

– Take off assembly cartridge with sleeve.

– Detach valve spring with valve spring plate.

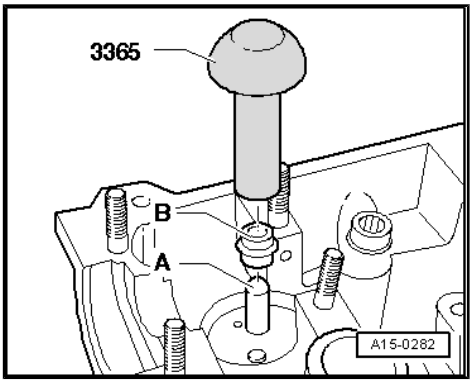
– Pull off valve stem oil seal with valve stem seal puller - 3364- .



Caution

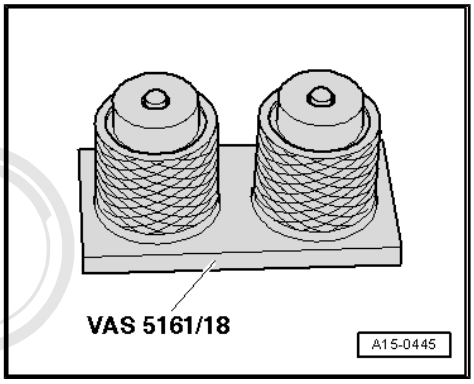
Make sure valve stem oil seals are not damaged when installing.

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

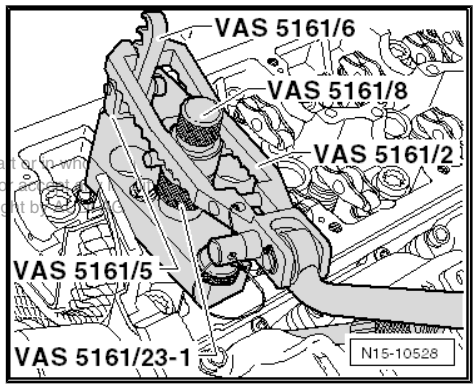


– Lightly oil sealing lip of valve stem oil seal.
– Slide valve stem oil seal onto plastic sleeve.
– Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool - 3365- .
– Take off plastic sleeve.

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



• Larger diameter of valve cotters faces upwards.
– Insert valve spring and valve spring plate.
– Press assembly cartridge onto insertion device from above and take up valve cotters.



– Insert assembly cartridge in guide plate for 3.0 ltr. TDI engine - VAS 5161/23- again.
– 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.

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Assembling

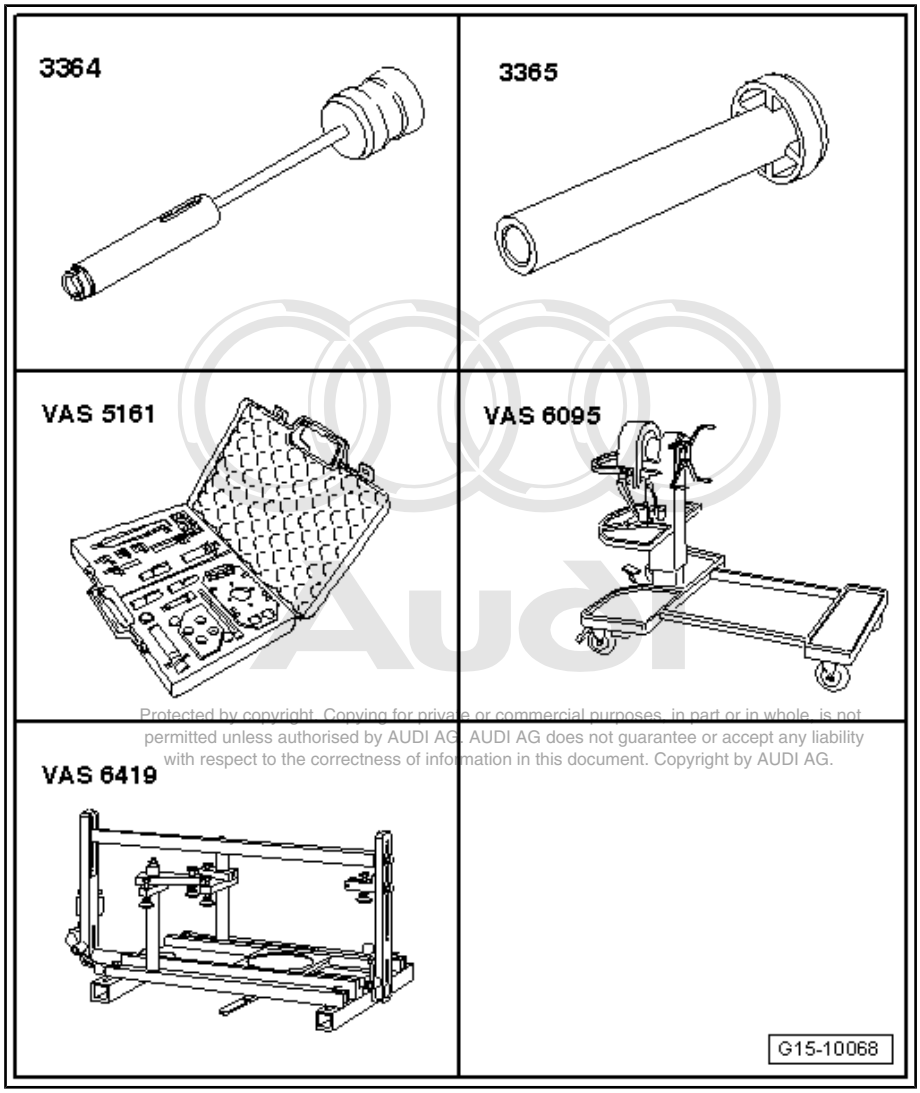
Installation is carried out in the reverse order; note the following:

– Ensure that all roller rocker fingers make contact with the ends of the valve stems correctly and are clipped onto their respective hydraulic compensation elements.
– Install camshafts ⇒ page 125 .
– Install glow plugs ⇒ page 313 .

3.7.2 Removing and installing valve stem oil seals (cylinder head removed)

Special tools and workshop equipment required

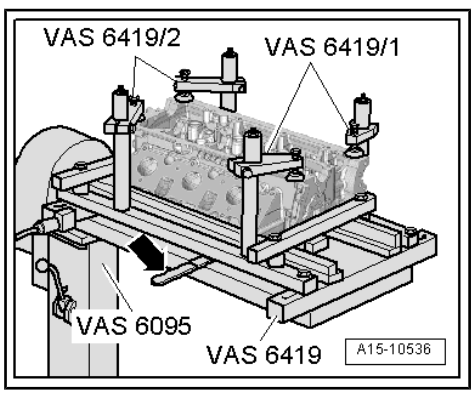
- Valve stem seal puller - 3364-
- Valve stem seal fitting tool - 3365-
- Removal and installation device for valve cotters - VAS 5161 A- with guide plate for 3.0 ltr. TDI engine - VAS 5161/23- and sleeve -VAS 5161/23-1-
- Engine and gearbox support - VAS 6095-
- Cylinder head tensioning device - VAS 6419-
- Bolt M6x30 (2x)



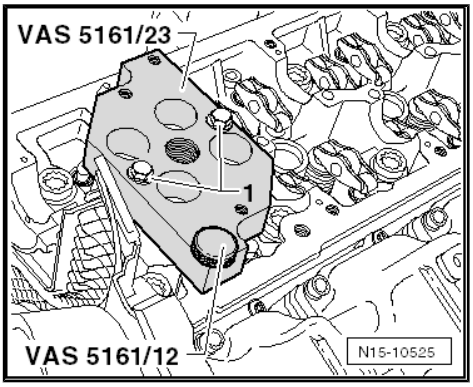
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Procedure

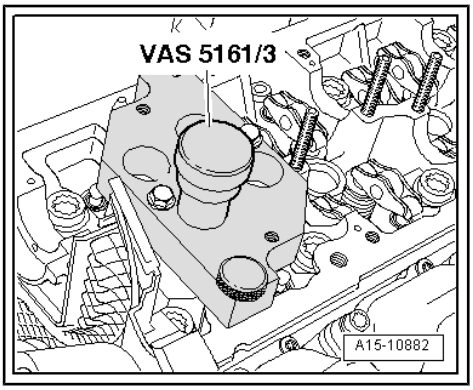
– Remove camshafts ⇒ page 125 .
– Mark original positions of roller rocker fingers and hydraulic compensation elements for re-installation.
– Remove roller rocker fingers together with hydraulic compensation elements and put down on a clean surface.
– Insert cylinder head tensioning device - VAS 6419- into engine and gearbox support - VAS 6095- .
– Secure cylinder head in cylinder head tensioning device, as shown in illustration.
– Connect cylinder head tensioning device to compressed air supply.
– 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.



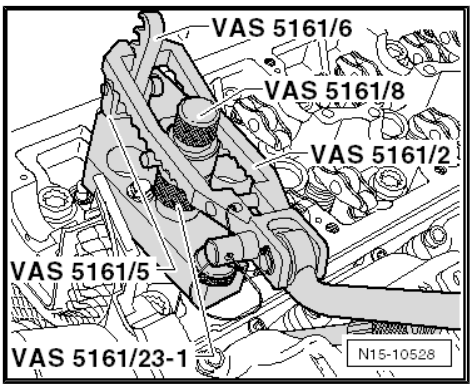
– Fit guide plate for 3.0 ltr. TDI engine - VAS 5161/23- onto cylinder head.
– Secure guide plate on intake manifold side with knurled screw -VAS 5161/12- and 2 M6x30 bolts -item 1- by hand until they make contact.



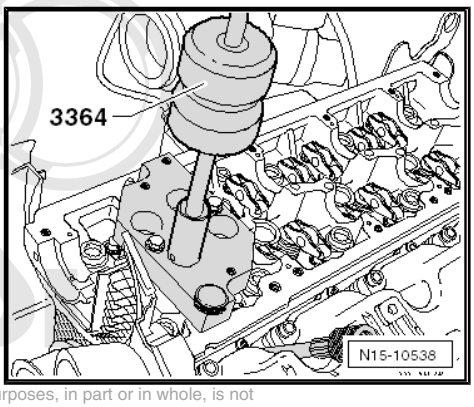
– Insert drift -VAS 5161/3- into guide plate and use plastic-headed hammer to release sticking valve cotters.



– Screw snap-in device -VAS 5161/6- with engaging fork -VAS 5161/5- into guide plate.
– Slide sleeve -VAS 5161/23-1- onto assembly cartridge -VAS 5161/8- .
– Attach pressure fork -VAS 5161/2- to snap-in device and push assembly cartridge down.
– At the same time, turn knurled screw of assembly cartridge clockwise until tips engage in valve cotters.
– Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.
– Release pressure fork.
– Take off assembly cartridge with sleeve.
– Detach valve spring with valve spring plate.



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

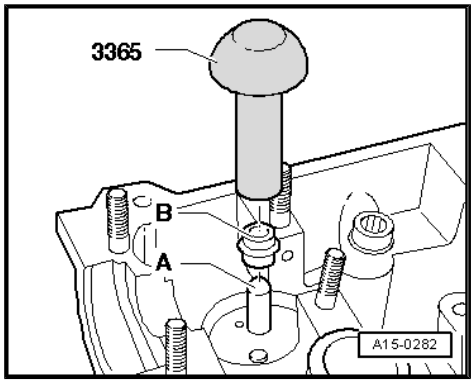


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Caution

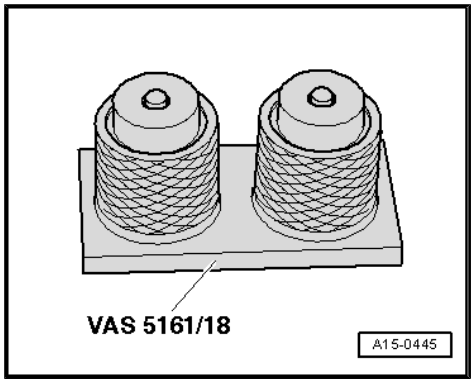
Make sure valve stem oil seals are not damaged when installing.

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

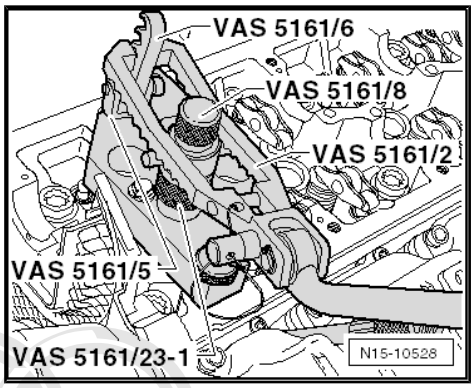


– Lightly oil sealing lip of valve stem oil seal.
– Slide valve stem oil seal onto plastic sleeve.
– Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool - 3365- .
– Take off plastic sleeve.

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



• Larger diameter of valve cotters faces upwards.
– Insert valve spring and valve spring plate.
– Press assembly cartridge onto insertion device from above and take up valve cotters.



– Insert assembly cartridge in guide plate for 3.0 ltr. TDI engine - VAS 5161/23- again.
– 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:

– Ensure that all roller rocker fingers make contact with the ends of the valve stems correctly and are clipped onto their respective hydraulic compensation elements.
– Install camshafts ⇒ page 125 .

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4 Inlet and exhaust valves

⇒ “4.1 Machining valve seats”, page 139
⇒ “4.2 Checking valve guides”, page 139
⇒ “4.3 Checking valves”, page 140
⇒ “4.4 Valve dimensions”, page 140

4.1 Machining valve seats

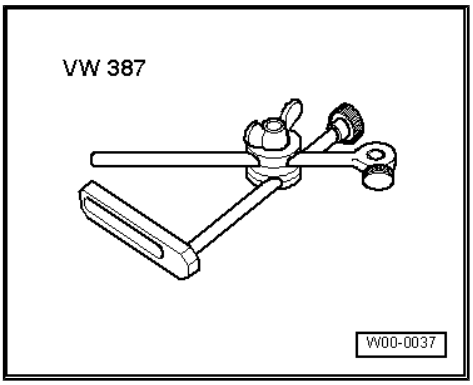
Note

Valve seats may not be machined due to the very small tolerances.

4.2 Checking valve guides

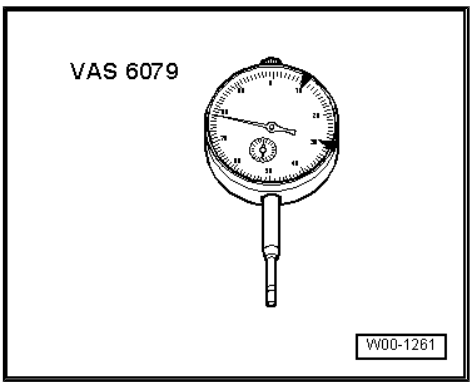
Special tools and workshop equipment required

- Universal dial gauge bracket - VW 387-



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- Dial gauge - VAS 6079-

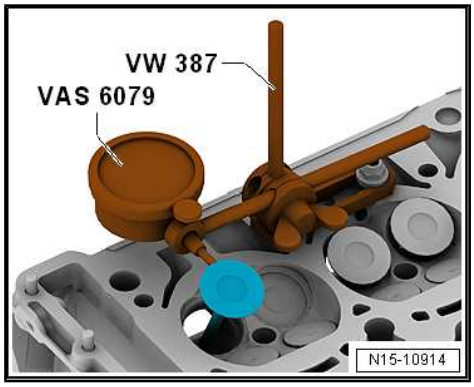


Procedure

Note

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

– Attach dial gauge - VAS 6079- with universal dial gauge bracket - VW 387- to cylinder head.
– Insert valve into guide.
• End of valve stem must be flush with guide.
– Measure the amount of sideways play.
• Wear limit: 1.0 mm.
– If the wear limit is exceeded, repeat the measurement with new valves.
– Renew cylinder head if wear limit is still exceeded.



Note

Valve guides cannot be renewed.

4.3 Checking valves

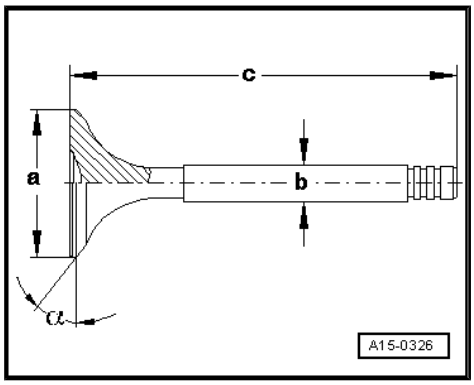
– Visually inspect for scoring on valve stems and valve seat surfaces.
– Renew valve if scoring is clearly visible.

4.4 Valve dimensions

Note

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

Dimension		Inlet valve	Exhaust valve
∅ a	mm	28.10	26.00
∅ b	mm	5.975	5.965
c	mm	99.30	99.10
α	∠°	45	45



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17 – Lubrication

1 Sump/oil pump

⇒ "1.1 Exploded view - sump/oil pump", page 141

⇒ "1.2 Engine oil", page 144

⇒ "1.3 Removing and installing sump", page 144

⇒ "1.4 Removing and installing oil pump", page 148

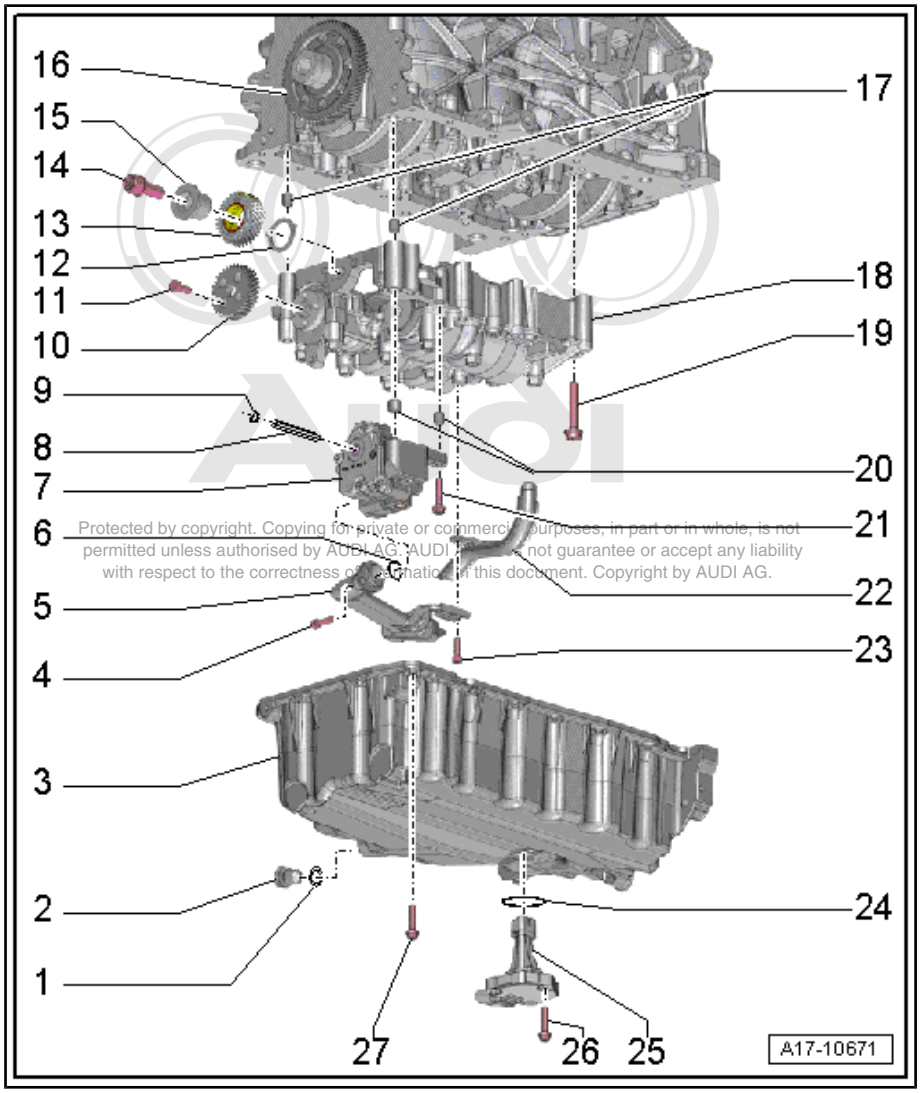
⇒ "1.5 Removing and installing oil level and oil temperature sender G266 ", page 150

1.1 Exploded view - sump/oil pump

Note

- *If large quantities of metal shavings or abrasion are found when performing engine repairs, this may be an indication of damage to the crankshaft or conrod bearings. To prevent further damage, the following steps are required after completion of repair work: clean the oil passages carefully and renew the oil spray jets, engine oil cooler and oil filter.*
- *Refer to ⇒ Maintenance tables for engine oil capacity, oil specifications and viscosity grades.*
- *Oil spray jet and pressure relief valve ⇒ page 81*

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1 - Seal

- ❑ Renew

2 - Oil drain plug

- ❑ 30 Nm

3 - Sump

- ❑ Removing and installing ⇒ page 144

4 - Bolt

- ❑ 9 Nm

5 - Suction pipe

- ❑ Clean strainer if dirty

6 - O-ring

- ❑ Renew

7 - Oil pump

- ❑ Removing and installing ⇒ page 148
- ❑ Before installing, check that the two dowel sleeves for centring oil pump are fitted onto balance shaft assembly

8 - Drive shaft

- ❑ For oil pump

9 - Circlip

- ❑ Must fit securely in groove
- ❑ Renew circlip if damaged or stretched

10 - Spur gear

- ❑ For balance shaft

11 - Bolt

- ❑ Renew
- ❑ 20 Nm +90°

12 - Thrust washer

- ❑ For idler gear
- ❑ Renew
- ❑ Installation position ⇒ page 144
- ❑ When installing idler gear, apply grease to hold washer on balance shaft assembly

13 - Idler gear

- ❑ For balance shaft assembly
- ❑ If the bolt for the idler gear has been slackened or the spur gear on the crankshaft or the crankshaft itself have been renewed, you must install a new idler gear with the appropriate coating. Procedure for installation ⇒ “3.1.2 Installing a new balance shaft assembly”, page 161
- ❑ To achieve the correct backlash a suitably thick coating is already applied to the new idler gear; the required clearance is achieved as the coating is worn down
- ❑ Installation position: Part No. must be visible.
- ❑ Make sure thrust washer is properly seated ⇒ page 144

14 - Bolt

- ❑ With washer
- ❑ Renew

- ❑ If the bolt for the idler gear has been slackened or the spur gear on the crankshaft or the crankshaft itself have been renewed, you must install a new idler gear with the appropriate coating. Procedure for installation ⇒ “3.1.2 Installing a new balance shaft assembly”, page 161
- ❑ 90 Nm +90°

15 - Hub

- ❑ For idler gear
- ❑ Renew

16 - Spur gear

- ❑ Pulling spur gear off crankshaft and shrink-fitting new spur gear ⇒ page 75

17 - Dowel sleeves

- ❑ For centring balance shaft assembly on cylinder block

18 - Balance shaft assembly

- ❑ Removing ⇒ page 160
- ❑ Before installing, check that the two dowel sleeves for centring balance shaft assembly are fitted on cylinder block
- ❑ Installing new balance shaft assembly ⇒ page 161
- ❑ Re-installing "old" balance shaft assembly ⇒ page 164

19 - Bolt

- ❑ Renew
- ❑ Tightening torque and sequence ⇒ page 144

20 - Dowel sleeves

21 - Bolt

- ❑ 9 Nm

22 - Oil intake pipe

23 - Bolt

- ❑ 9 Nm

24 - Seal

- ❑ Renew

25 - Oil level and oil temperature sender - G266-

- ❑ Removing and installing ⇒ page 150

26 - Bolt

- ❑ Self-locking
- ❑ Renew
- ❑ 9 Nm

27 - Bolt

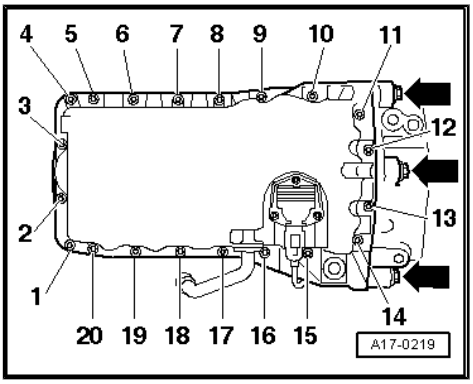
- ❑ Tightening torque and sequence ⇒ page 143

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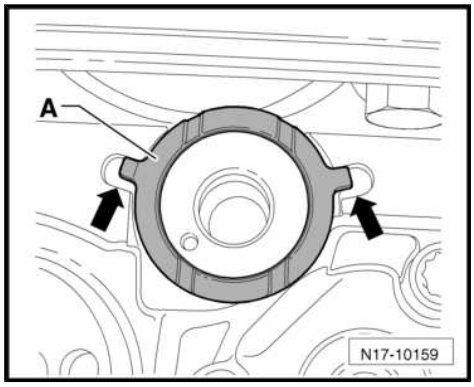
Sump - tightening torque and sequence

– Tighten bolts in stages:

Stage	Bolts	Tightening torque
1.	-1 to 20-	5 Nm in diagonal sequence
2.	-arrows-	40 Nm
3.	-1 to 20-	Tighten in stages and in diagonal sequence; final torque 13 Nm



Installation position of thrust washer

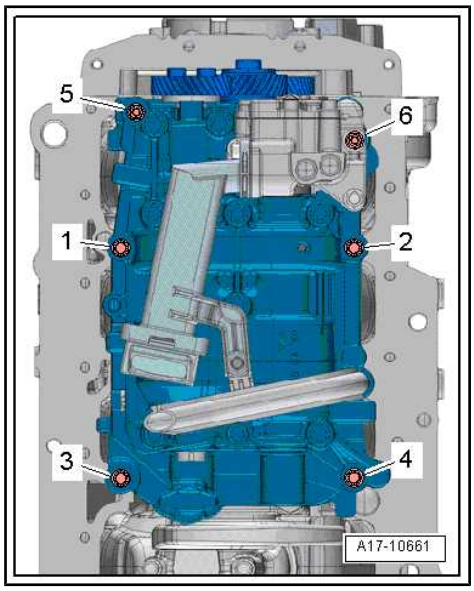


Caution

Thrust washer can slip out of position behind idler gear.

- *Make sure that thrust washer -A- does not slip out of the recesses in the balance shaft assembly -arrows- when fitting the idler gear. If this is neglected, the thrust washer can become trapped. If necessary, apply grease to hold washer on balance shaft assembly.*

Balance shaft assembly - tightening torque and sequence



Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts in 5 stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-1 to 6-	Screw in hand-tight in this sequence
2.	-1 to 6-	Pre-tighten bolts in this sequence to 6 Nm
3.	-1 to 4-	Tighten to 20 Nm
4.	-5 and 6-	Tighten to 13 Nm
5.	-1 to 6-	Use rigid wrench to turn 90° further in this sequence

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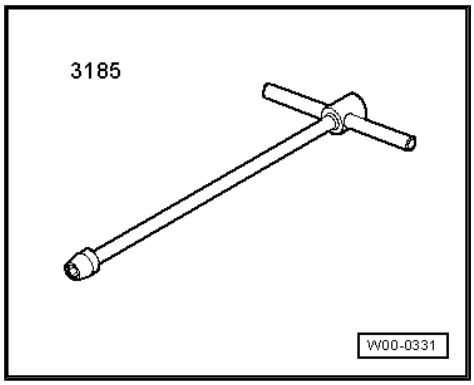
1.2 Engine oil

Oil capacities, oil specifications and viscosity grades ⇒ Maintenance tables .

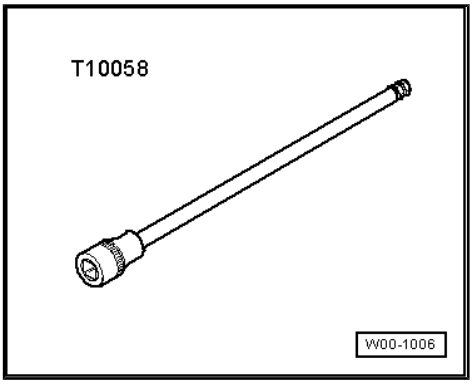
1.3 Removing and installing sump

Special tools and workshop equipment required

- Articulated wrench, 10 mm - 3185-



- Socket - T10058-

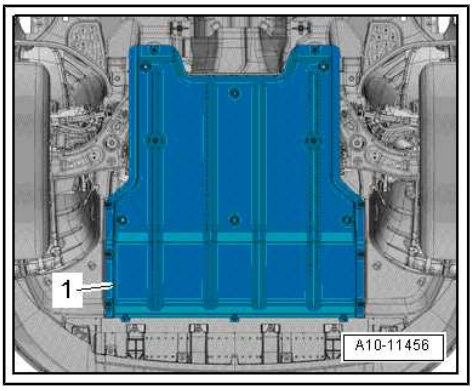


- Electric drill with plastic brush
- Sealant ⇒ Electronic parts catalogue
- Safety goggles

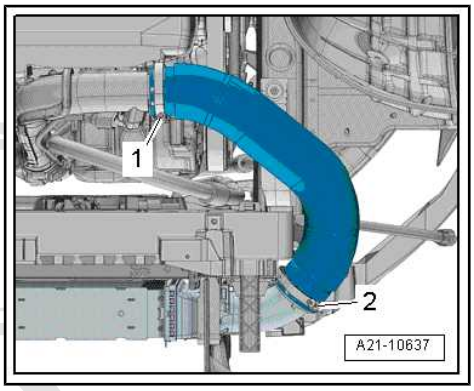
Removing

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

• Engine oil drained ⇒ Maintenance ; Booklet 820



– Release hose clip -1- and detach air hose.



Note

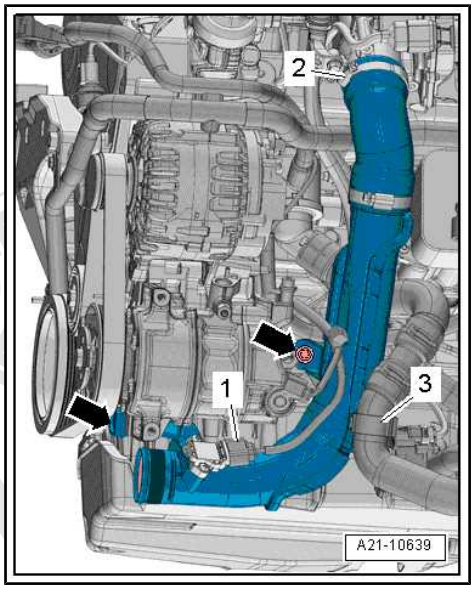
Disregard -item 2-.

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WARNING

Risk of injury as the radiator fan may start up automatically.

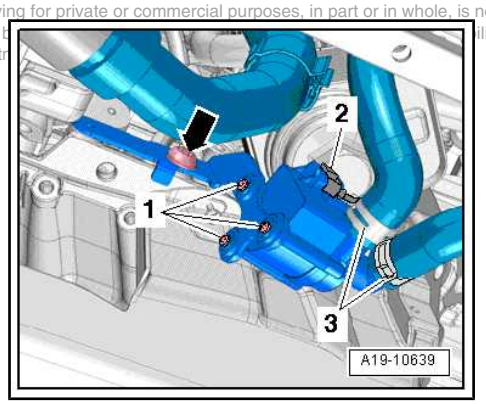
- *Even when the ignition is switched off, the radiator fan can start up without warning due to accumulated heat in the engine compartment, etc.*



– Remove bolts -arrows-.
– Move coolant hose -3- clear.
– Release hose clip -2-.
– Unplug electrical connector -1- at charge pressure sender - G31- and detach air pipe (right-side).

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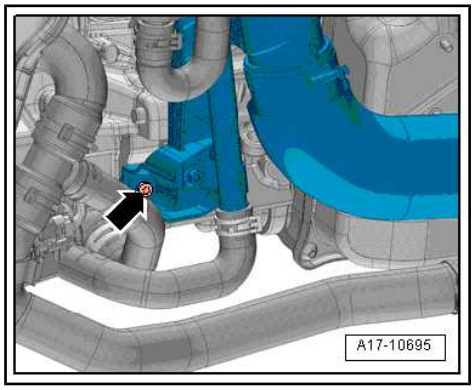
– Remove bolt -arrow- and push pump for exhaust gas recirculation cooler - V400- to the side.



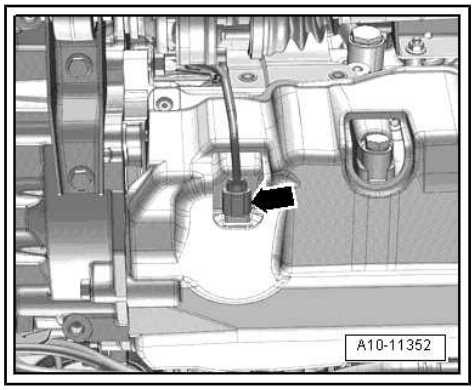
Note

Disregard -items 1, 2, 3-.

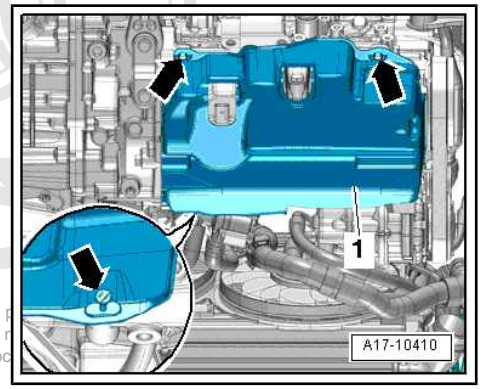
– Remove bolt -arrow- at air pipe (left-side).



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

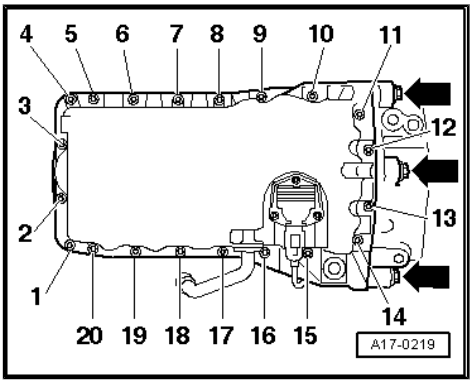


– Release fasteners -arrows- and remove noise insulation -1- for sump.



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– Remove bolts -arrows- securing sump to gearbox using Allen key, long reach - T10058- .
– Unscrew bolts -1 to 20- in diagonal sequence and remove.
– Carefully release sump from bonded joint.



Installing

Tightening torques

- ⇒ Fig. ""Sump - tightening torque and sequence"" , page 143
- ⇒ "2.1 Exploded view - charge air system", page 221
- ⇒ Fig. ""Installing air hoses with screw-type clips"" , page 222

Caution

Protect lubrication system and bearings against contamination.

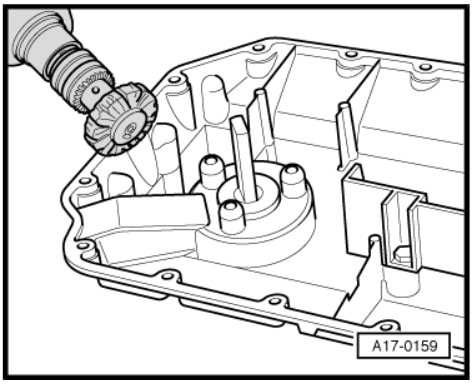
- *Cover exposed parts of the engine.*

WARNING

Risk of eye injury.

- *Put on safety goggles.*

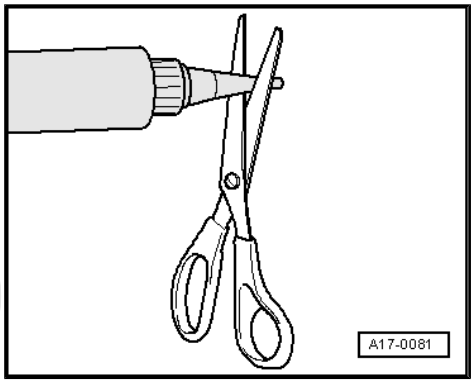
– Remove sealant residue from sump and cylinder block using rotating plastic brush or similar.
– Clean sealing surfaces; they must be free of oil and grease.



Note

Note the use-by date of the sealant.

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



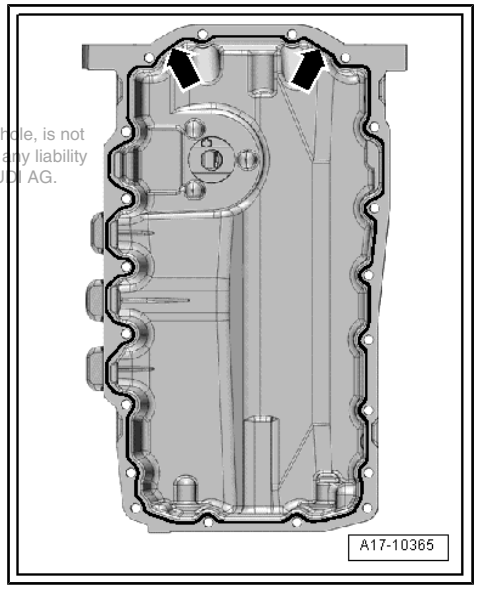
Caution

Make sure lubrication system is not clogged by excess sealant.

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

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

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



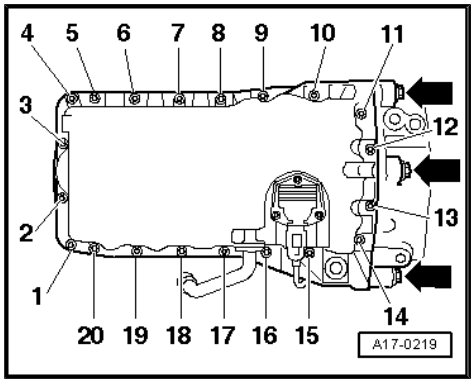
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Note

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

– Fit sump and tighten bolts ⇒ page 143 .

- The sump must make flush contact with intermediate plate/ gearbox flange.



Note

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

– Install pump for exhaust gas recirculation cooler - V400- ⇒ page 187 .

– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 820 .

1.4 Removing and installing oil pump

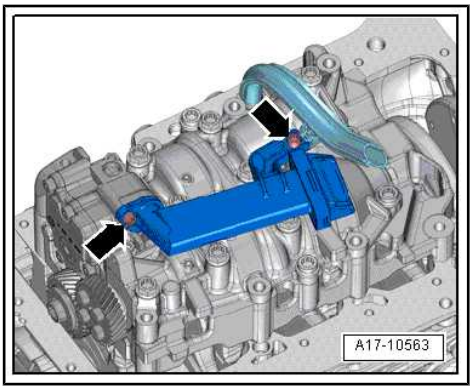
Special tools and workshop equipment required

♦ Circlip pliers (commercially available)

Removing

– Remove sump ⇒ page 144 .

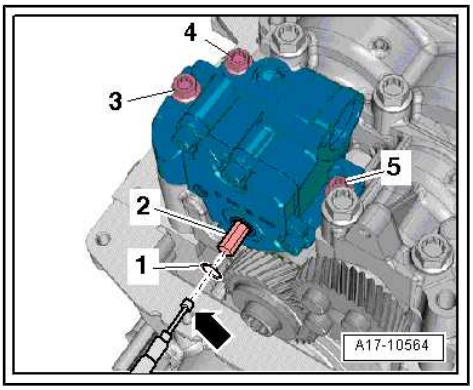
– Remove bolts -arrows- and detach suction pipe from oil pump.



– Remove circlip -1- using circlip pliers.

– Pull drive shaft -2- out of oil pump using a magnet -arrow-.

– Remove bolts -3, 4, 5- and detach oil pump.



Caution

The bolt on the idler gear must NOT be loosened.

Installing

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

Tightening torques

♦ ⇒ “1.1 Exploded view - sump/oil pump”, page 141

Note

♦ *Fit new O-ring.*

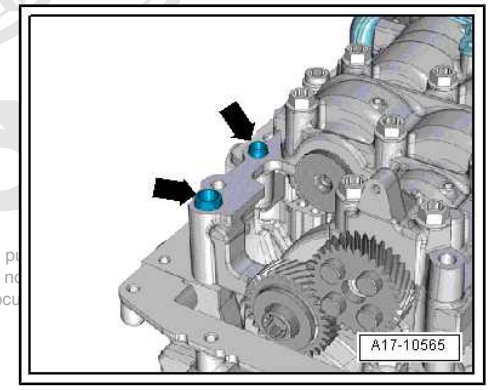
♦ *Renew circlip if damaged or stretched.*

♦ *Circlip must fit securely in groove.*

– Insert dowel sleeves -arrows- in oil pump, if not fitted.

– If no dowel sleeves for centring the oil pump are fitted in the balance shaft assembly, install missing dowel sleeves.

– Install sump ⇒ page 144 .



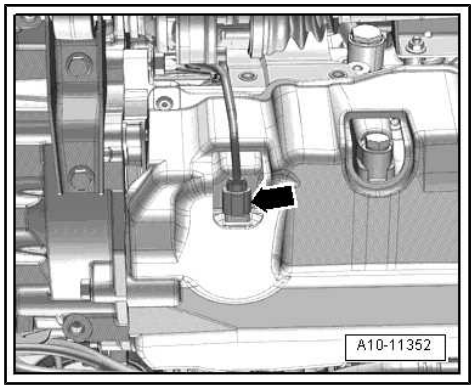
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1.5 Removing and installing oil level and oil temperature sender - G266-

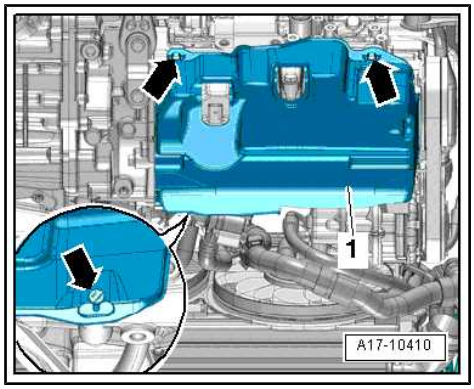
Removing

- Engine oil drained ⇒ Maintenance ; Booklet 820

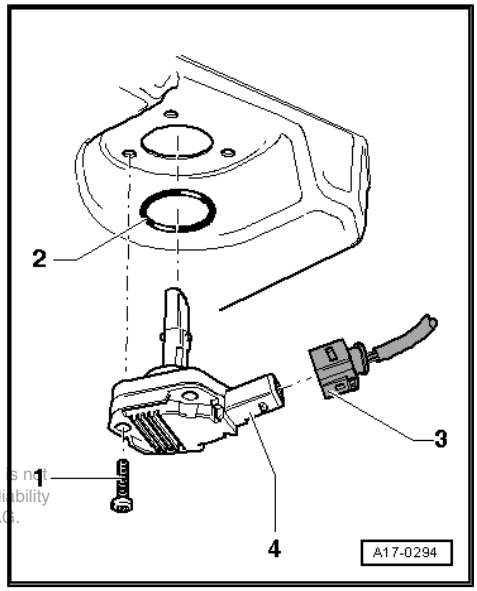
– Unplug electrical connector -arrow- at oil level and oil temperature sender - G266- .



– Release fasteners -arrows- and remove noise insulation -1- for sump.



– Remove bolts -1- and detach oil level and oil temperature sender - G266- -item 4-.



Note

Disregard -item 3-.

Installing

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

Tightening torques

♦ ⇒ “1.1 Exploded view - sump/oil pump”, page 141

Note

Renew seal -2- and self-locking bolts -1-.

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– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 820 .

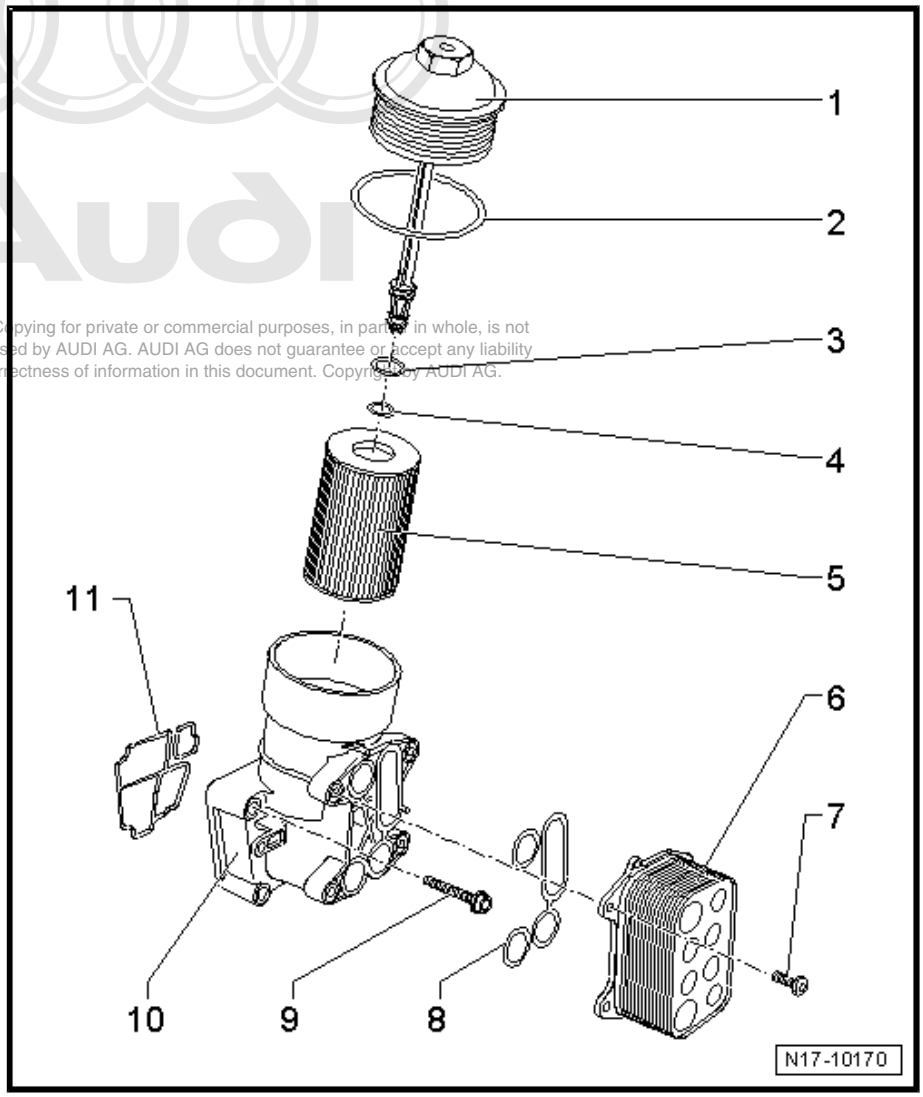
2 Oil filter/oil pressure switch

⇒ “2.1 Exploded view - oil filter housing/oil pressure switch”, page 151

⇒ “2.2 Removing and installing oil filter housing”, page 152

⇒ “2.3 Removing and installing oil pressure switch F1 ”, page 156

2.1 Exploded view - oil filter housing/oil pressure switch



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1 - Sealing cap

- ❑ 25 Nm

2 - O-ring

- ❑ Renew

3 - O-ring

- ❑ Renew

4 - O-ring

- ❑ Renew

5 - Oil filter element

- ❑ See note ⇒ page 141
- ❑ Removing and installing ⇒ Maintenance ; Booklet 820

6 - Engine oil cooler

- ❑ See note ⇒ page 141
- ❑ Connection diagram - coolant hoses ⇒ page 166
- ❑ Removing and installing ⇒ “2.2 Removing and installing oil filter housing”, page 152
- ❑ If renewed, refill system with fresh coolant

7 - Bolt

- ❑ 11 Nm

8 - Gaskets

- ❑ Renew

9 - Bolt

- ❑ Renew
- ❑ Tightening torque and sequence ⇒ page 152

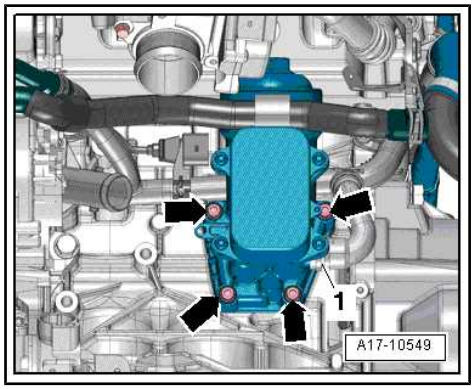
10 - Oil filter bracket

- ❑ With integrated oil retention valve
- ❑ Removing and installing ⇒ “2.2 Removing and installing oil filter housing”, page 152

11 - Gaskets

- ❑ Renew

Oil filter bracket - tightening torque and sequence



Note

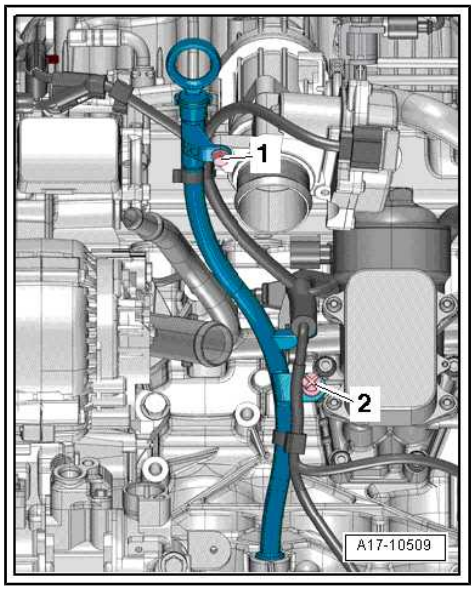
Renew the bolts tightened with specified tightening angle.

– Fit bolts at top left and bottom right first.
– Tighten bolts in 2 stages as follows:

Stage	Bolts	Tightening torque/angle specification
1.	-arrows-	14 Nm in diagonal sequence
2.	-arrows-	Turn 90° further in diagonal sequence

Guide tube for oil dipstick - tightening torque

– Tighten bolt -1- to 9 Nm.



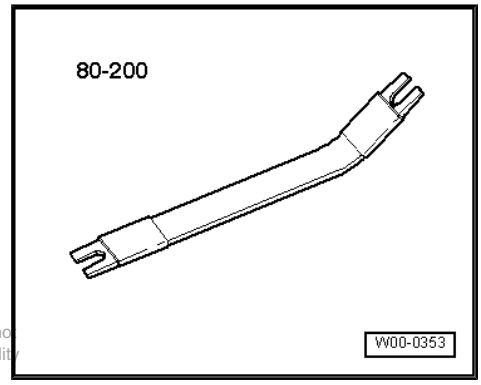
2.2 Removing and installing oil filter housing

Note

The oil filter housing is removed and installed together with the engine oil cooler.

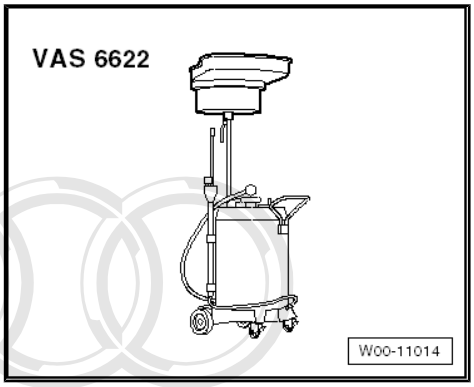
Special tools and workshop equipment required

♦ Removal lever - 80 - 200-

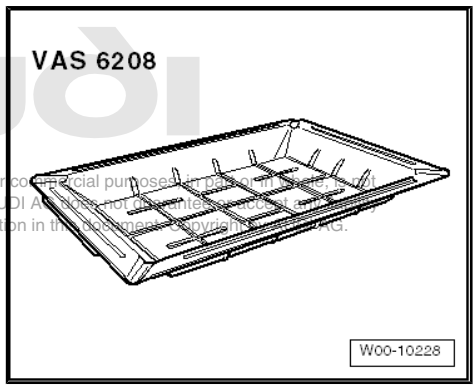


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♦ Used oil collection and extraction unit - VAS 6622-

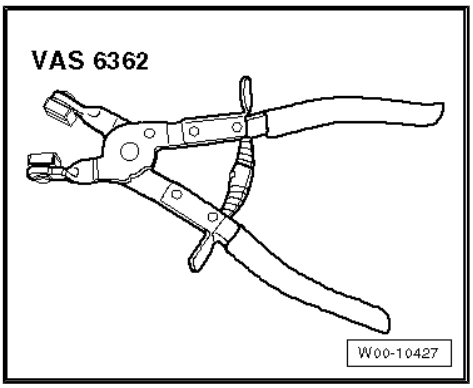


♦ Drip tray for workshop hoist - VAS 6208-



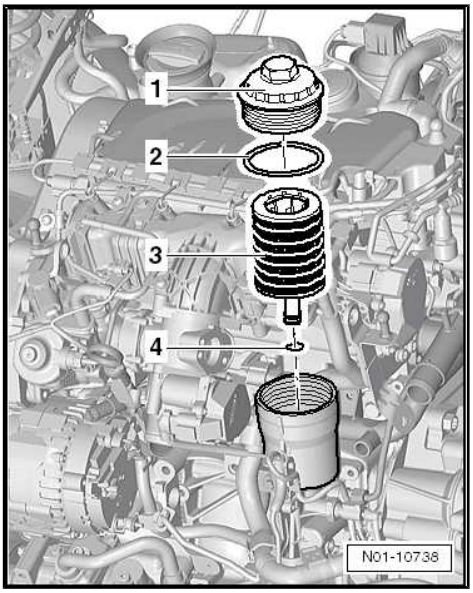
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♦ Hose clip pliers - VAS 6362-

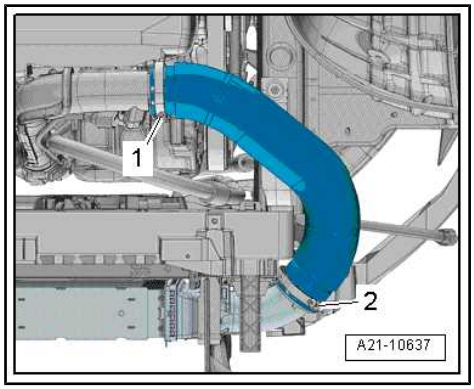


Removing

– Drain coolant ⇒ page 168 .
– Remove air cleaner housing ⇒ page 241 .
– Remove oil filter element ⇒ Maintenance ; Booklet 820 .



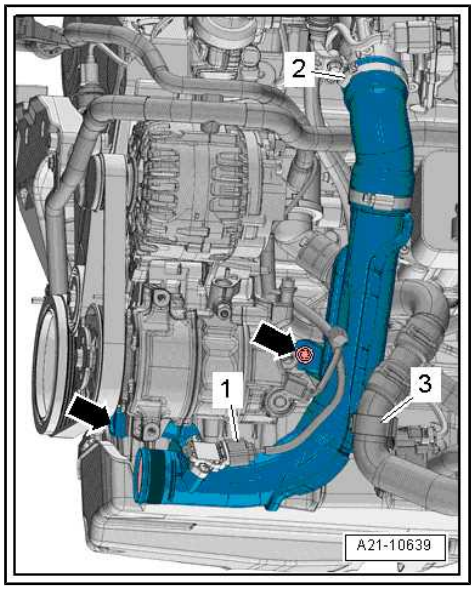
– Loosen hose clip -1- and remove air hose.



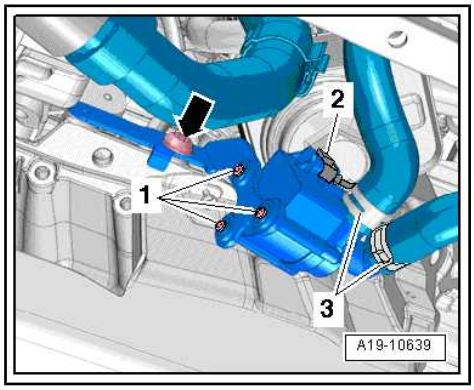
Note

Disregard -item 2-.

– Remove bolts -arrows-.
– Move coolant hose -3- clear.
– Release hose clip -2-.
– Unplug electrical connector -1- at charge pressure sender - G31- / intake air temperature sender - G42- and detach air pipe (right-side).



– Remove bolt -arrow- and push pump for exhaust gas recirculation cooler - V400- to the side.

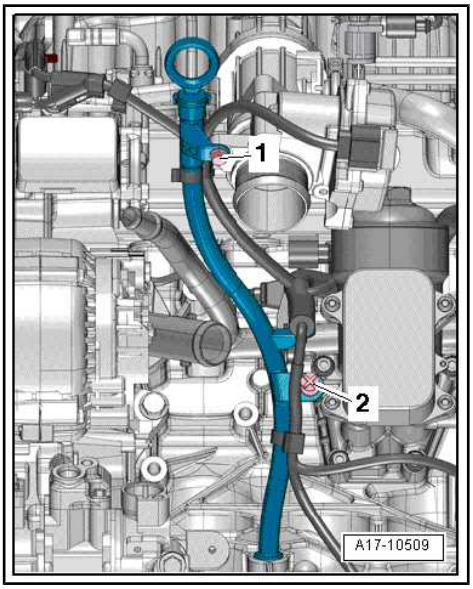


Note

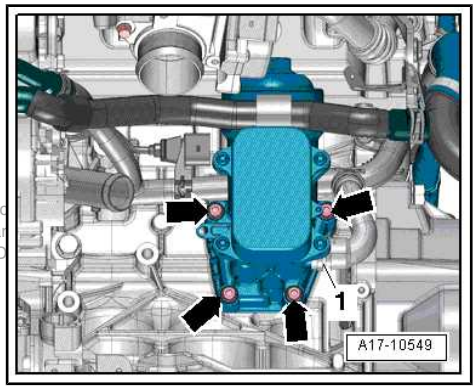
Disregard -items 1, 2, 3-.

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– Pull oil dipstick out slightly and remove bolt -1-.
– Release clip -2- with removal lever - 80 - 200- .
– Pull guide tube for oil dipstick upwards out of cylinder block and push to one side.



– Place drip tray for workshop hoist - VAS 6208- under connection.
– Release hose clip -1- and detach coolant hose.
– Position used oil collection and extraction unit - VAS 6622- below engine.
– Unscrew bolts -arrows- and remove oil filter bracket with engine oil cooler.



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Installing

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

Tightening torques

- ⇒ “2.1 Exploded view - oil filter housing/oil pressure switch”, page 151
- ⇒ Fig. ““Guide tube for oil dipstick - tightening torque”“ , page 152
- ⇒ “3.1 Exploded view - coolant pipes”, page 187
- ⇒ “2.1 Exploded view - charge air system”, page 221
- ⇒ Fig. ““Installing air hoses with screw-type clips”“ , page 222

Note

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

– Install oil filter element, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 820 .
– Install air cleaner housing ⇒ page 241 .
– Fill up cooling system (or change coolant if the engine oil cooler has been renewed) ⇒ page 171 .

2.3 Removing and installing oil pressure switch - F1-

Removing

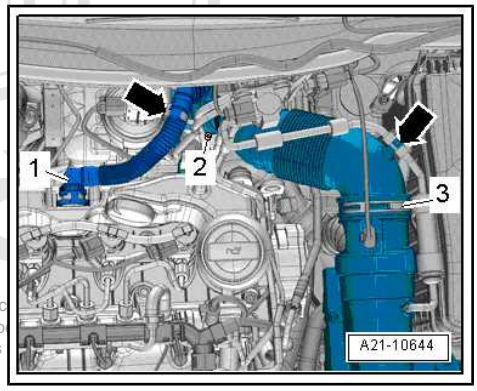
– Remove engine cover panel ⇒ page 47 .

– Press release tabs and detach crankcase breather hose -1-.

– Move clear vacuum hoses -arrows-.

– Release hose clip -3- and detach air pipe from air cleaner housing.

– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.

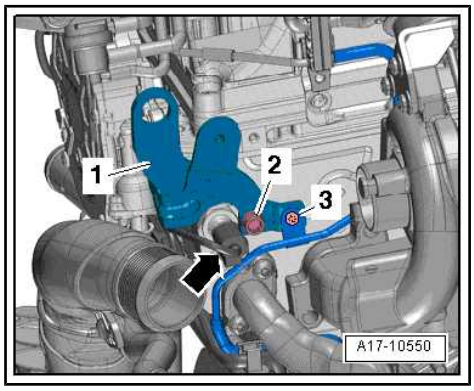


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– Remove bolts -2- and -3- and detach engine lifting eye -1-.

– Unplug electrical connector -arrow-.

– Unscrew oil pressure switch - F1- .



Installing

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

Tightening torques

- ⇒ “2.1 Exploded view - cylinder head”, page 99
- ⇒ Fig. ““Installing air hoses with screw-type clips”“ , page 222
- ⇒ “4.1 Exploded view - exhaust gas recirculation system”, page 307

Note

Renew seal.

– Install engine cover panel ⇒ page 47 .

2.4 Checking oil pressure and oil pressure switch

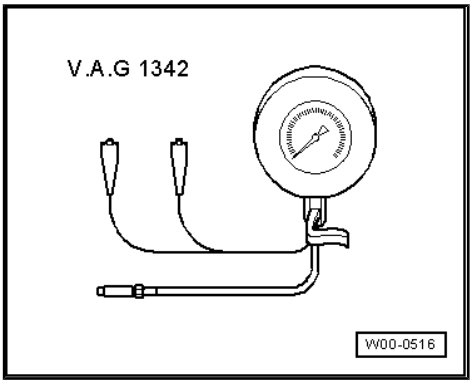
⇒ “2.4.1 Checking oil pressure switch F1 ”, page 156

⇒ “2.4.2 Checking oil pressure”, page 158

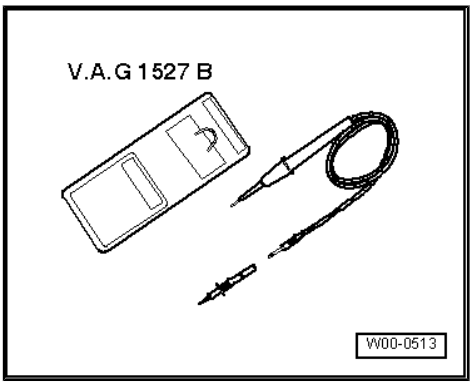
2.4.1 Checking oil pressure switch - F1-

Special tools and workshop equipment required

- Oil pressure tester - V.A.G 1342-



- Voltage tester - V.A.G 1527B-

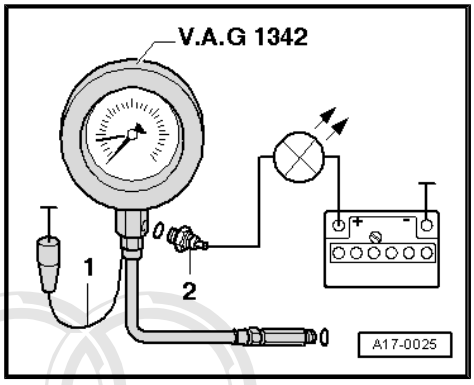


- Auxiliary measuring set - V.A.G 1594C-



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Procedure



- Oil level OK
- Engine oil temperature approx. 80 °C

– Remove oil pressure switch - F1- ⇒ page 156 .

– Connect oil pressure tester - V.A.G 1342- to bore for oil pressure switch.

– Screw oil pressure switch - F1- -item 2- into threaded hole in oil pressure tester.

– Connect brown wire -1- of oil pressure tester to earth (–).

– Connect voltage tester - V.A.G 1527B- with adapter lead from auxiliary measuring set - V.A.G 1594C- to oil pressure switch - F1- and battery positive (+).

- LED should not light up.

Note

Renew oil pressure switch - F1- if LED lights up at this stage.

– Start engine.

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Note

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

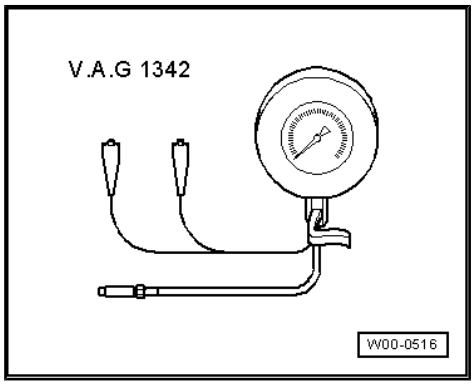
- LED should light up at 0.3 ... 0.6 bar.

– Renew oil pressure switch - F1- if LED does not light up ⇒ page 156 .

2.4.2 Checking oil pressure

Special tools and workshop equipment required

♦ Oil pressure tester - V.A.G 1342-



Procedure

- Oil level OK

– Remove oil pressure switch - F1- ⇒ page 156 .

– Connect oil pressure tester - V.A.G 1342- to threaded hole for oil pressure switch - F1- .

– Screw a used oil pressure switch into threaded hole on oil pressure tester - V.A.G 1342- to seal hole.

– Start engine.

- Oil pressure when starting and then at idling speed: at least 0.6 bar.

If specification is not obtained, switch off engine immediately and check oil pump drive; renew oil pump if necessary
⇒ “1.4 Removing and installing oil pump”, page 148 .

If specification is obtained, let engine warm up.

- Oil pressure specification at operating temperature and 2000 rpm: at least 1.0 bar.

Assembling

– Install oil pressure switch - F1- ⇒ page 156 .

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3 Balance shaft assembly

⇒ “3.1 Removing and installing balance shaft assembly”, page 160

3.1 Removing and installing balance shaft assembly

⇒ “3.1.1 Removing balance shaft assembly”, page 160

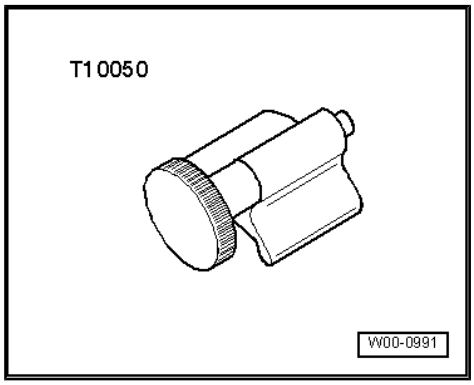
⇒ “3.1.2 Installing a new balance shaft assembly”, page 161

⇒ “3.1.3 Re-installing a used balance shaft assembly”, page 164

3.1.1 Removing balance shaft assembly

Special tools and workshop equipment required

- Crankshaft stop - T10050-



Procedure

– Pull out oil dipstick.

– Remove vibration damper ⇒ page 53 .

Caution

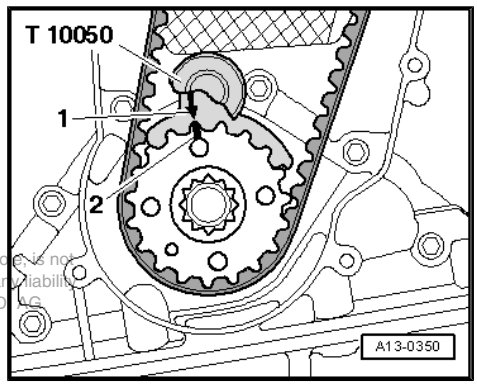
Irreparable damage can be caused if the toothed belt slips.

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

– Rotate crankshaft by turning bolt for toothed belt sprocket until crankshaft is positioned at “TDC”.

– Lock crankshaft in position with crankshaft stop - T10050- .

• The markings on the sprocket -2- and the crankshaft stop -1- must align -arrow-. The pin of the crankshaft stop must engage in the aperture in the sealing flange.



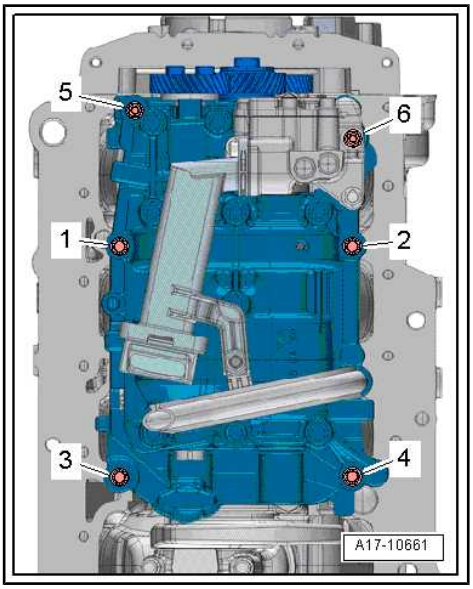
Note

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

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– Remove sump ⇒ page 144 .

– Loosen bolts in the sequence -6 ... 1-.
– Remove bolts and detach balance shaft assembly with oil pump.



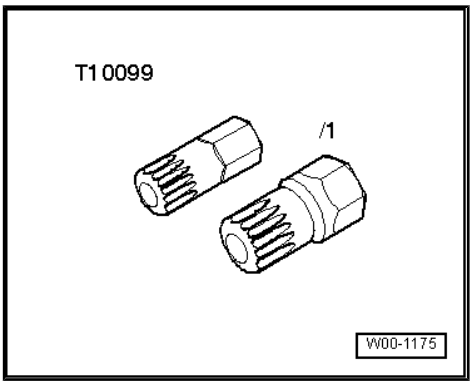
Note

- *Installing a new balance shaft assembly* ⇒ page 161 .
- *Re-installing the "old" balance shaft assembly* ⇒ page 164 .

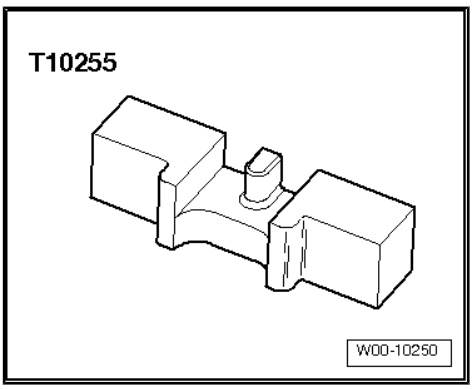
3.1.2 Installing a new balance shaft assembly

Special tools and workshop equipment required

- Bits - T10099-

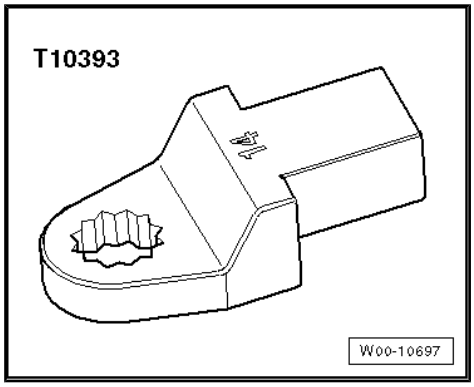


- Locking tool - T10255-



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- Insert tool, 14 mm - T10393-



Procedure

Note

- *The spur gear drive of the balance shaft assembly must be installed with a specified backlash.*
- *To achieve the correct backlash, a coating is already applied to the new idler gear.*
- *The coating is worn down rapidly and the backlash is then correct.*
- *Therefore, a new balance shaft assembly must always be installed in conjunction with a new idler gear which has the correct coating.*
- *Renew the bolts tightened with specified tightening angle.*

Caution

Thrust washer can slip out of position behind idler gear.

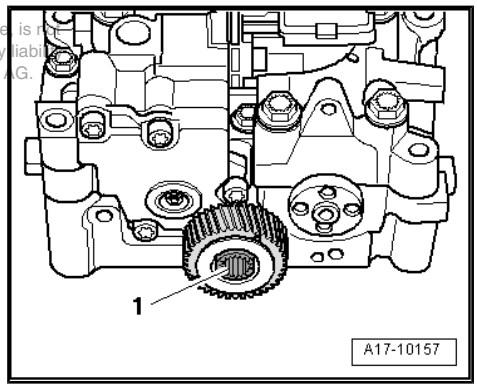
- ***Before positioning balance shaft assembly, slacken off bolt for idler gear as specified below, but not further. Installation position of thrust washer ⇒ page 144***

– Loosen bolt -1- for idler gear approx. 45° using e.g. bits - T10099- and insert tool, 14 mm - T10393-.

– If not already fitted, fit dowel sleeves ⇒ Item 17 (page 143) into cylinder block for centring balance shaft assembly.

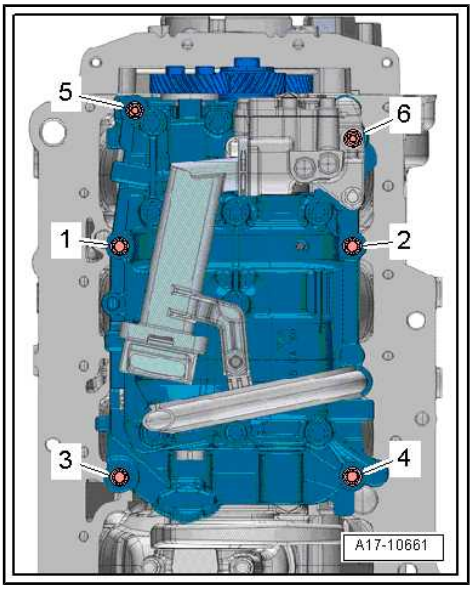
– Attach balance shaft assembly to cylinder block.

• Take care not to damage the coating of the idler gear.



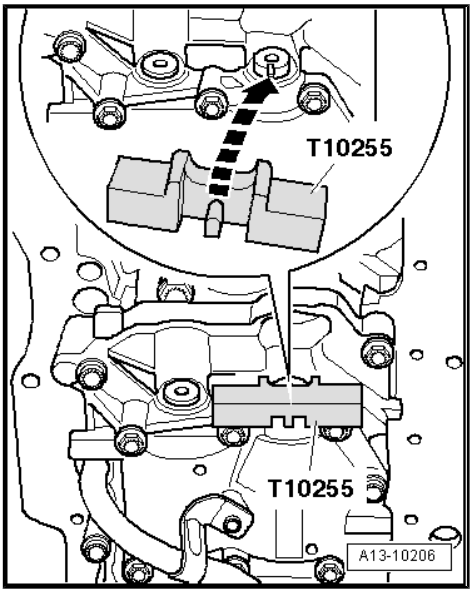
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– Tighten bolts securing balance shaft assembly ⇒ page 144 .



– Lock balance shaft with locking tool - T10255- , turning balance shaft as required.

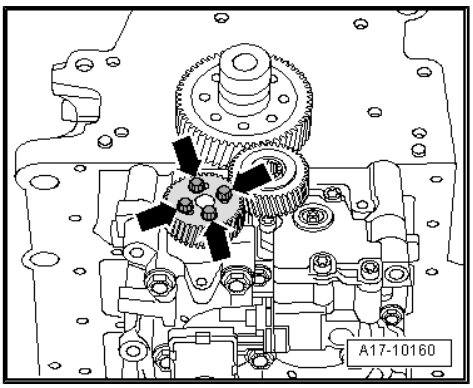
• The lug of the locking tool must engage in the groove of the balance shaft.



– Carefully fit balance shaft gear onto balance shaft; to do so, push idler gear slightly to one side.

• Take care not to damage the coating of the idler gear.

• The threaded holes in the balance shaft should be aligned as centrally as possible with the elongated holes in the balance shaft gear.



Note

If it is not possible to align the elongated holes in the balance shaft gear with the threaded holes, you must turn the gear some teeth further as required and then fit it again.

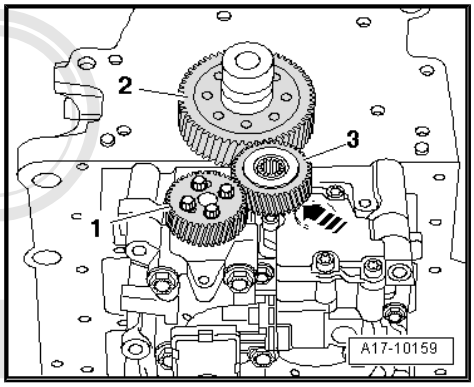
– Tighten bolts -arrows- for balance shaft gear.

– Remove locking tool - T10255- .

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Note

The following three steps have to be performed simultaneously (a second mechanic is therefore required):



- Push idler gear -3- firmly in direction of -arrow- into teeth on spur gear -2- and balance shaft gear -1-. If necessary use a wooden rod to do so.
- At the same time, turn balance shaft gear slightly anti-clockwise.
- Tighten bolt securing idler gear.
- Remove crankshaft stop - T10050- .

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Note

After installation the idler gear must have no backlash. This can be checked by exerting light pressure by hand.

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

Tightening torques

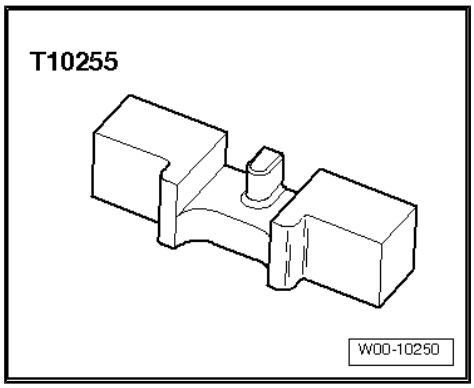
- ⇒ “1.1 Exploded view - sump/oil pump”, page 141
- ⇒ Fig. ““Balance shaft assembly - tightening torque and sequence”“ , page 144
- Crankshaft locked in position with crankshaft stop - T10050- .

- Install sump ⇒ page 144 .
- Install vibration damper ⇒ page 53 .

3.1.3 Re-installing a used balance shaft assembly

Special tools and workshop equipment required

- Locking tool - T10255-



Procedure

Note

- *If re-installing the "old" balance shaft assembly and neither the spur gear on the crankshaft nor the crankshaft itself have been renewed, proceed as described in the following. It is also essential that the idler gear has NOT been slackened.*
- *If the bolt for the idler gear has been slackened or the spur gear on the crankshaft or the crankshaft itself have been renewed, you must install a new idler gear with the appropriate coating. Procedure for installation ⇒ "3.1.2 Installing a new balance shaft assembly", page 161 .*
- *Renew the bolts tightened with specified tightening angle.*

– Lock balance shaft with locking tool - T10255- , turning balance shaft as required.

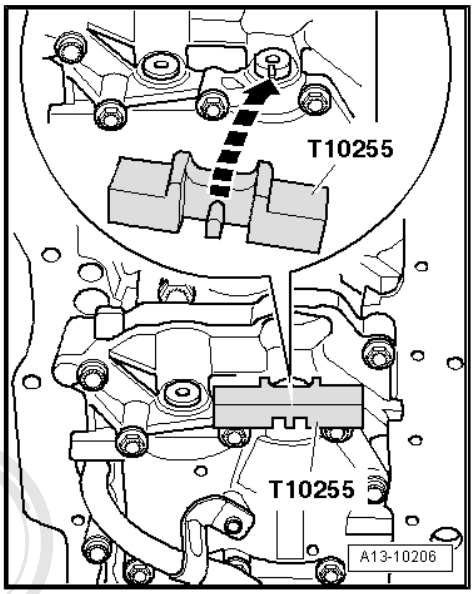
• The lug of the locking tool must engage in the groove of the balance shaft.

– If not already fitted, fit dowel sleeves ⇒ Item 17 (page 143) into cylinder block for centring balance shaft assembly.

– Attach balance shaft assembly to cylinder block.

• With the balance shaft locked in position, the idler gear must engage in the spur gear on the crankshaft.

• Idler gear must have noticeable backlash.



– Tighten bolts securing balance shaft assembly ⇒ page 144 .

– Remove crankshaft stop - T10050- .

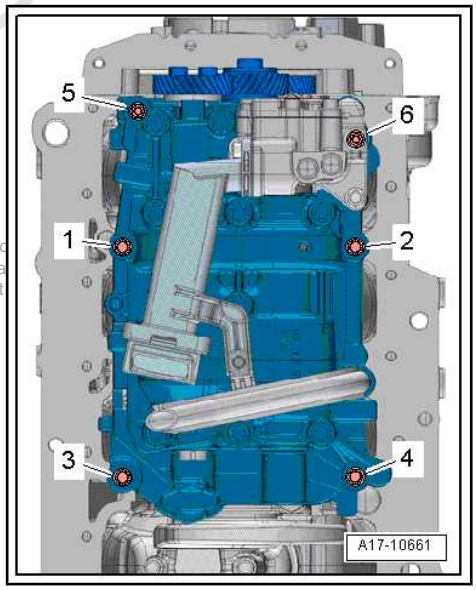
Remaining installation steps are carried out in reverse sequence; note the following:

Tightening torques

- ⇒ Fig. ""Balance shaft assembly - tightening torque and sequence"" , page 144

– Install sump ⇒ page 144 .

– Install vibration damper ⇒ page 53 .



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19 – Cooling

1 Cooling system/coolant

⇒ “1.1 Connection diagram - coolant hoses”, page 166

⇒ “1.2 Checking cooling system for leaks”, page 167

⇒ “1.3 Draining and filling cooling system”, page 168

1.1 Connection diagram - coolant hoses

Note

- *Blue = Large coolant circuit.*
- *Red = Small coolant circuit.*
- *Orange = Coolant circuit for exhaust gas recirculation.*
- *Green = Coolant circuit for gear oil cooling.*

1 - Radiator

- ❑ If renewed, refill system with fresh coolant

2 - Pump for exhaust gas recirculation cooler - V400-

3 - Thermostat

- ❑ For exhaust gas recirculation cooler

4 - 4/2-way valve

5 - Coolant pump

6 - Exhaust gas recirculation temperature sensor - G98-

7 - Coolant expansion tank

8 - Filler cap

- ❑ For coolant expansion tank
- ❑ Checking pressure relief valve ⇒ page 168

9 - Exhaust gas recirculation cooler

- ❑ If renewed, refill system with fresh coolant

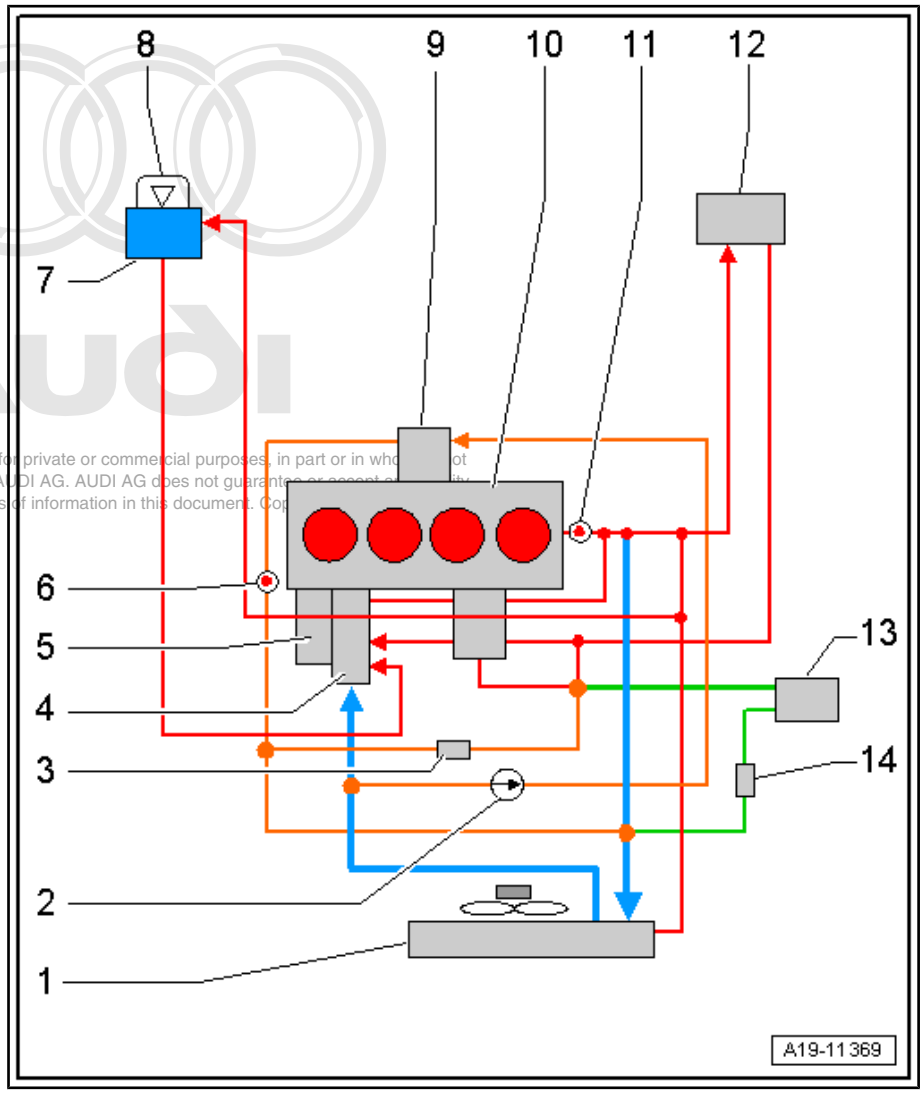
10 - Cylinder head/cylinder block

- ❑ If renewed, refill system with fresh coolant

11 - Coolant temperature sender - G62-

12 - Heat exchanger for heater

- ❑ If renewed, refill system with fresh coolant



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13 - Gear oil cooler

- ❑ Only on vehicles with dual clutch gearbox
- ❑ If renewed, refill system with fresh coolant

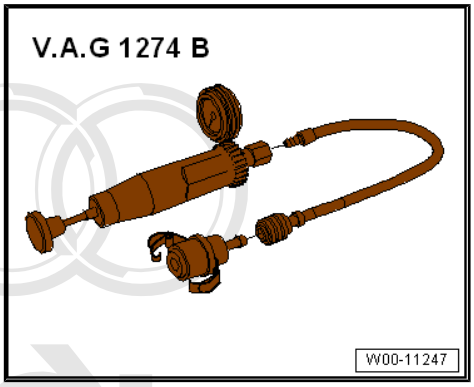
14 - Thermostat

- ❑ For gear oil cooler
- ❑ Only on vehicles with dual clutch gearbox

1.2 Checking cooling system for leaks

Special tools and workshop equipment required

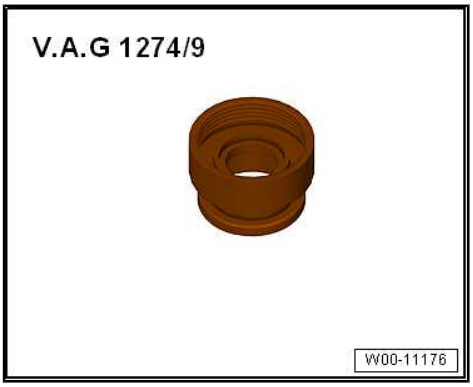
- ♦ Cooling system tester - V.A.G 1274 B-



- ♦ Adapter for cooling system tester - V.A.G 1274/8-



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



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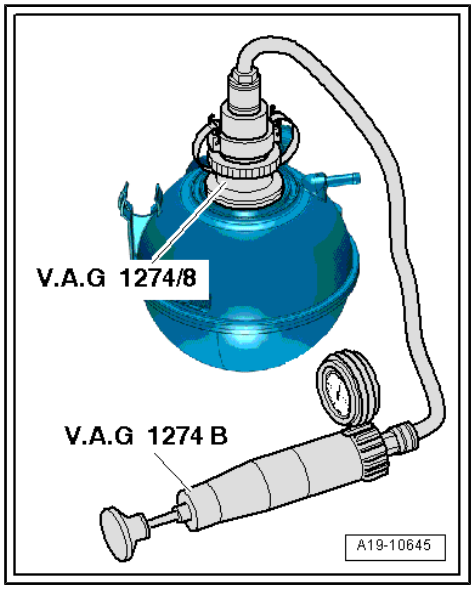
Procedure

- 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- onto coolant expansion tank.
– Using hand pump on cooling system tester, build up a pressure of approx. 1.5 bar.
- The pressure should not drop more than 0.2 bar within 10 minutes.
– If the pressure drops more than 0.2 bar, locate leak and eliminate fault.

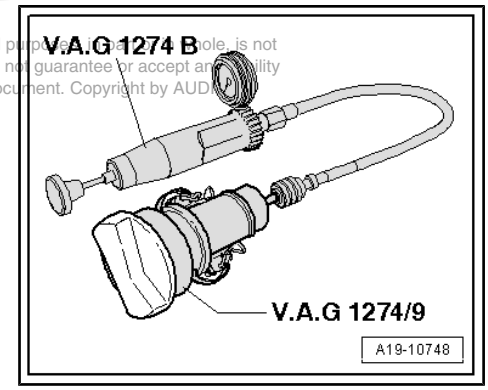
Note

The drop in pressure of 0.2 bar within 10 minutes is caused by the decrease in coolant temperature. The colder the engine is, the less the pressure will fall. If necessary, check again when the engine is cold.

Checking pressure relief valve in filler cap

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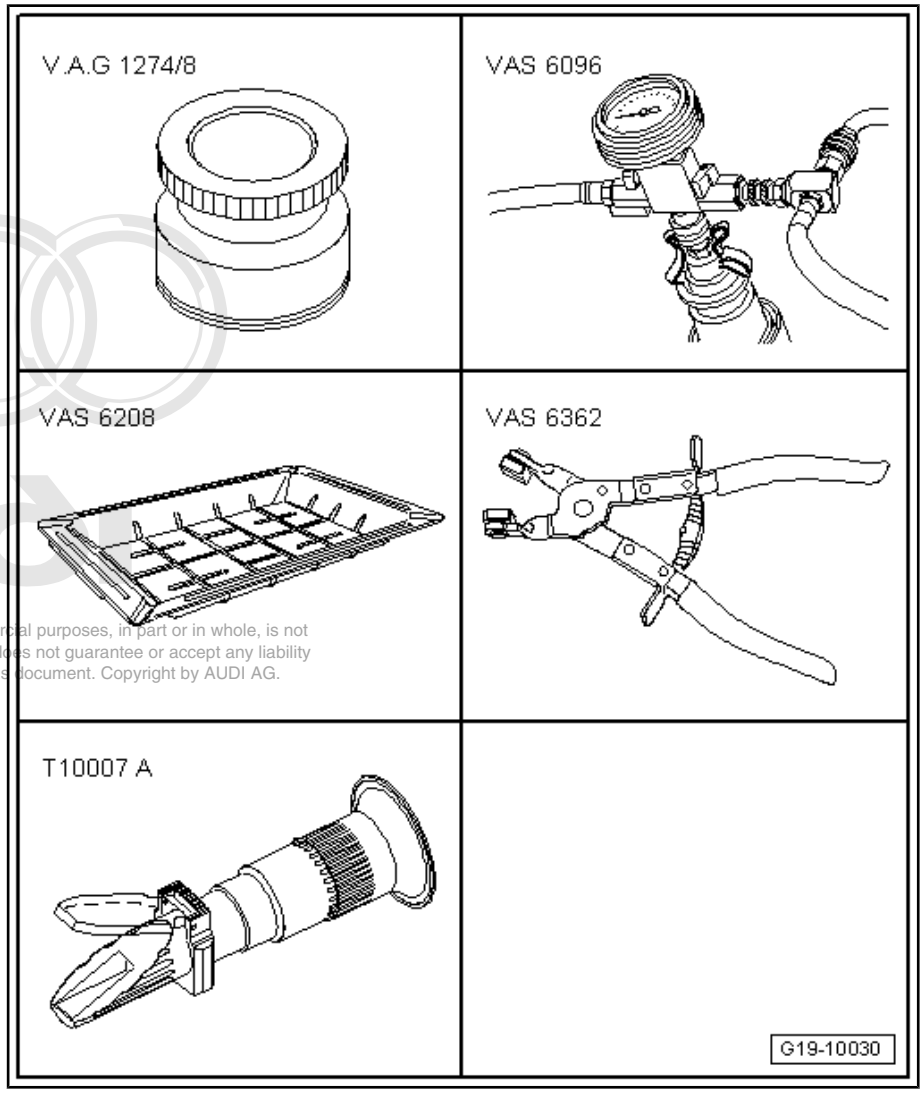
– Fit cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/9- onto filler cap.
– Build up pressure with hand pump on cooling system tester.
- The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.
– Renew filler cap if pressure relief valve does not open as described.



1.3 Draining and filling cooling system

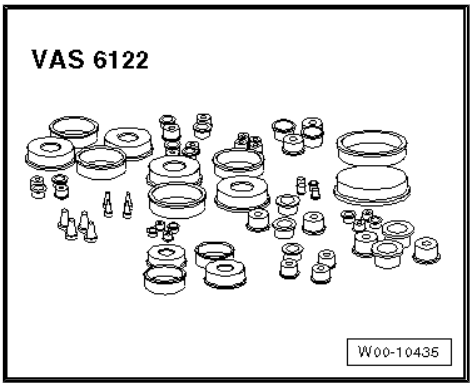
Special tools and workshop equipment required

- Adapter for cooling system tester - V.A.G 1274/8-
- Cooling system charge unit - VAS 6096-
- Drip tray for workshop hoist - VAS 6208-
- Hose clip pliers - VAS 6362-
- Refractometer - T10007 A-

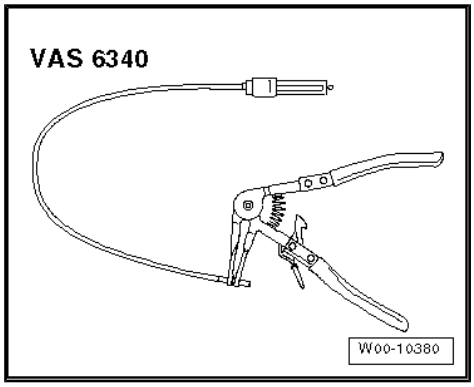


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- Engine bung set - VAS 6122-



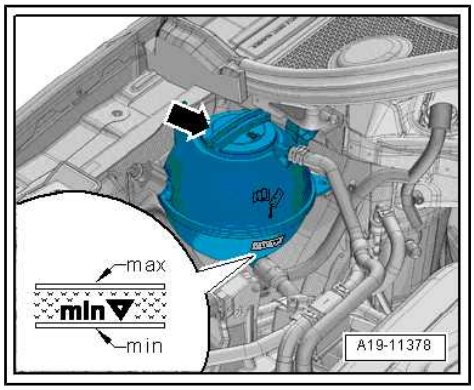
- Hose clip pliers - VAS 6340-



- Safety goggles
- Protective gloves

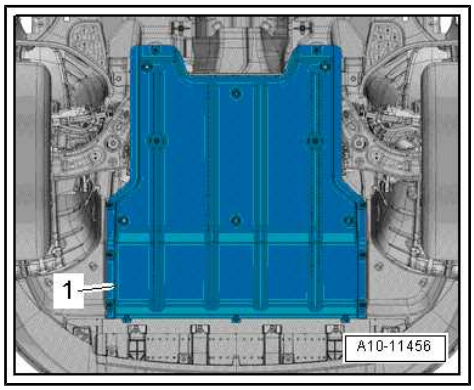
Draining

> **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 -arrow- on coolant expansion tank.

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

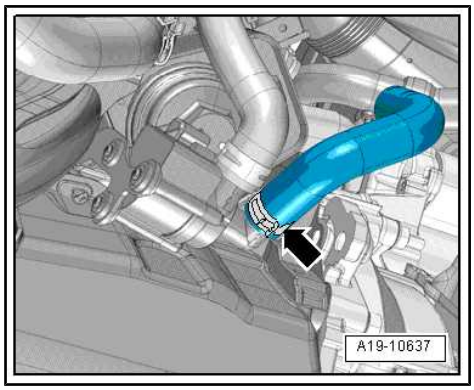


– Place drip tray for workshop hoist - VAS 6208- beneath engine.

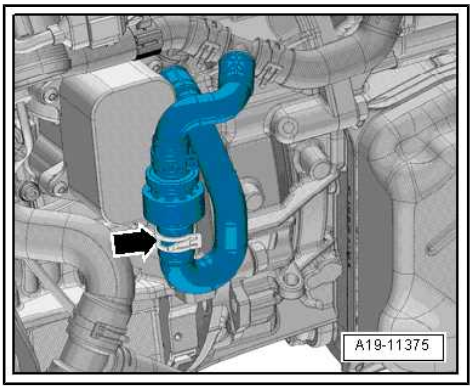
– Lift retaining clip -arrow-, disconnect coolant hose (bottom) from radiator and drain off coolant.

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– Open hose clip -arrow-, disconnect coolant hose (bottom) leading to pump for exhaust gas recirculation cooler - V400- and drain off coolant.



– Release hose clip -arrow-, disconnect coolant hose and drain off remaining coolant.



Filling

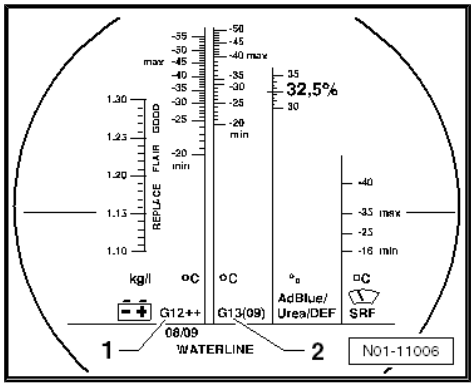
Tightening torques:

- ⇒ Fig. ""Installing air hoses with screw-type clips"" , page 222

Caution

To ensure optimal corrosion protection, only distilled water may be mixed with coolant additives.

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Note

- *The effectiveness of the coolant is greatly influenced by the quality of the water with which it is mixed. Because water may contain different substances depending on the country or even the region, the water quality to be used for cooling systems has been specified. Distilled water meets all the requirements and is therefore recommended for use when topping up or filling up with coolant.*
- *Use only coolant additives listed in the ⇒ Electronic parts catalogue (ETKA) . If you use other coolant additives, this can significantly impair in particular the corrosion protection effect. The resulting damage could lead to loss of coolant and consequently to serious engine damage.*
- *Coolant with the recommended mixture ratio prevents frost and corrosion damage and stops scaling. At the same time it raises the boiling point of the fluid in the system. For this reason 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.*
- *The refractometer - T10007A- MUST be used to determine the current level of frost protection.*
- *The mixture must guarantee frost protection down to at least -25 °C (in countries with arctic climate: down to -36 °C). The amount of antifreeze should only be increased if greater frost protection is required in very cold climates. This must only be down to -48 °C, however, as otherwise the cooling efficiency of the coolant is impaired.*
- *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. Frost protection must be provided to at least -25 °C.*
- *Read off the level of frost protection on the scale for the relevant coolant additive.*
- *The temperature indicated on the refractometer - T10007A- corresponds to the temperature at which the first ice crystals can form in the coolant.*
- *Do not reuse coolant.*
- *Only use water/coolant additive as a lubricant for coolant hoses.*

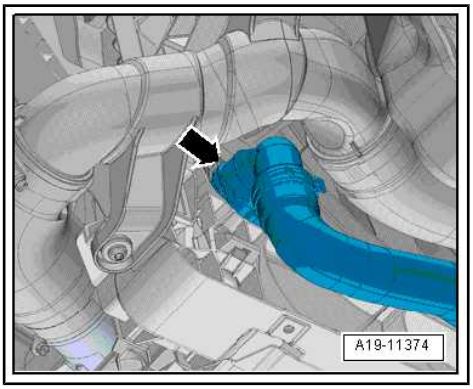
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Recommended mixture ratio for coolant

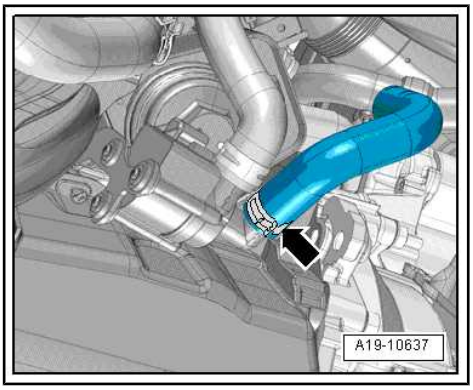
- Coolant (40 %) and distilled water (60 %) for frost protection to -25 °C
- Coolant additive (50 %) and distilled water (50 %) for frost protection to -36 °C
- Coolant additive ⇒ Electronic parts catalogue (ETKA)

Procedure

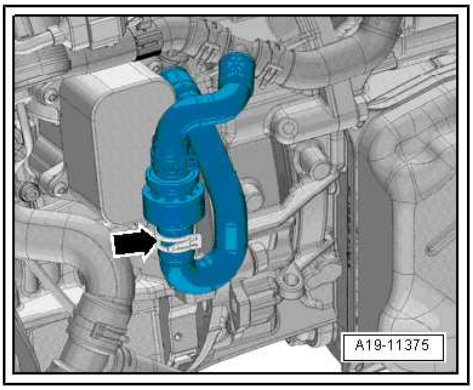
– Connect coolant hose with plug-in connector to radiator (bottom) ⇒ page 200 .



– Connect coolant hose (bottom) at pump for exhaust gas recirculation cooler - V400- -arrow-.



– Connect coolant hose -arrow-.

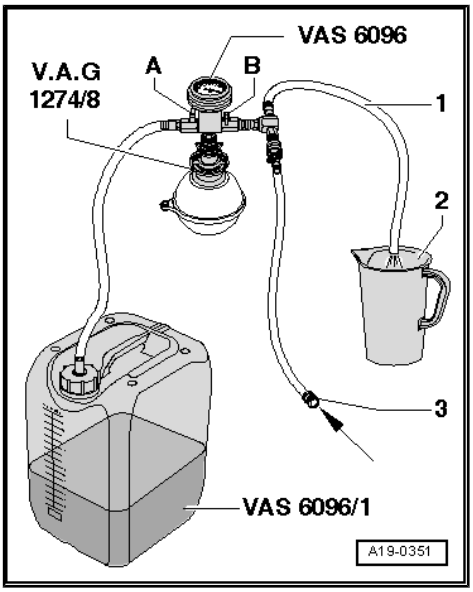


– Fill reservoir of -VAS 6096- with at least 8 litres of premixed coolant (according to recommended ratio).

– 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-.



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Note

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

– Close both valves -A- and -B- (turn lever at right angles to direction of flow).

– Connect hose -3- to compressed air supply.

• Pressure: 7 ... 10 bar.

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

• The suction jet pump generates a partial vacuum in the cooling system; the needle on the gauge should move into the green zone.

– Also briefly open valve -A- (turn lever in direction of flow) so that hose on reservoir of -VAS 6096- can fill with coolant.

– Close valve -A- again.

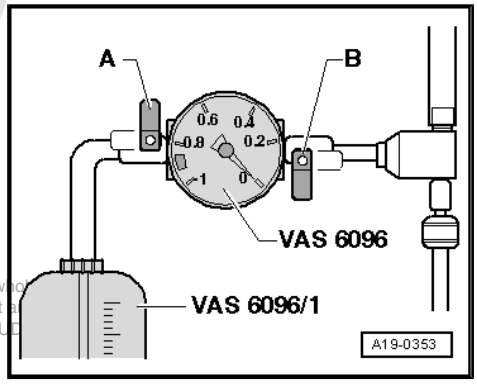
– Leave valve -B- open for another 2 minutes.

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• The suction jet pump continues to generate a partial vacuum in the cooling system; the needle on the gauge should remain in the green zone.

– Close valve -B-.

• The needle on the gauge should stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.



Note

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

♦ *Check cooling system for leaks if the vacuum is not maintained.*

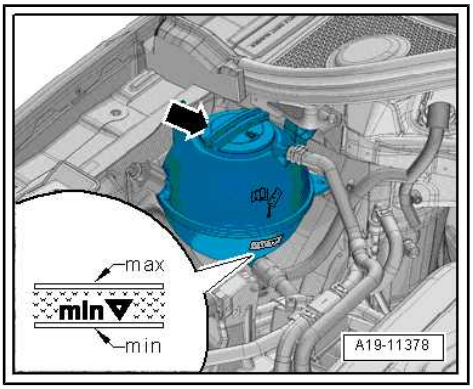
– Detach compressed air hose.

– Open valve -A-.

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

– Detach cooling system charge unit - VAS 6096- from coolant expansion tank.

– Top up coolant to “max” mark.



Note

Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.

– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

– Set temperature to “HI”.

– Switch off air conditioner compressor (press AC button).

• LED in button should not light up.

– Set fresh air blower to lowest setting.

– Start engine and run for 2 minutes (maximum) at approx. 1500 rpm.

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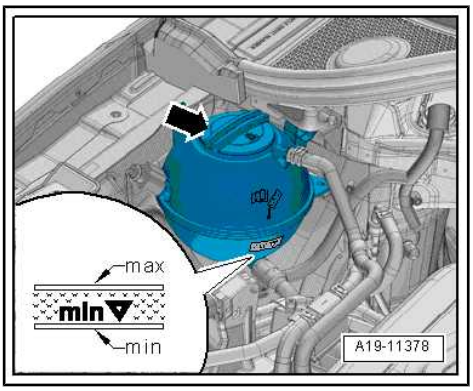
– Top up coolant to overflow hole on expansion tank with engine running.

– Close filler cap on coolant expansion tank (make sure it engages).

– Allow engine to run at idling speed until both large coolant hoses at radiator become warm.

– Switch off ignition and allow engine to cool down.

– Check coolant level.



• The coolant level must be between the “min” and “max” markings when the engine is cold.

• The coolant level can be at the “max” marking when the engine is warm.

– Top up with coolant again if necessary.

2 Coolant pump/thermostat assembly

⇒ “2.1 Exploded view - coolant pump/thermostat”, page 176

⇒ “2.2 Removing and installing coolant pump”, page 177

⇒ “2.3 Removing and installing 4/2-way valve with thermostat”, page 177

⇒ “2.4 Removing and installing electric coolant pump”, page 181

⇒ “2.5 Removing and installing coolant temperature sender G62 ”, page 183

⇒ “2.6 Removing and installing radiator outlet coolant temperature sender G83 ”, page 185

2.1 Exploded view - coolant pump/thermostat

1 - Coolant pump

- ❑ Removing and installing ⇒ page 177

2 - Bolt

- ❑ 15 Nm

3 - O-ring

- ❑ Renew

4 - O-ring

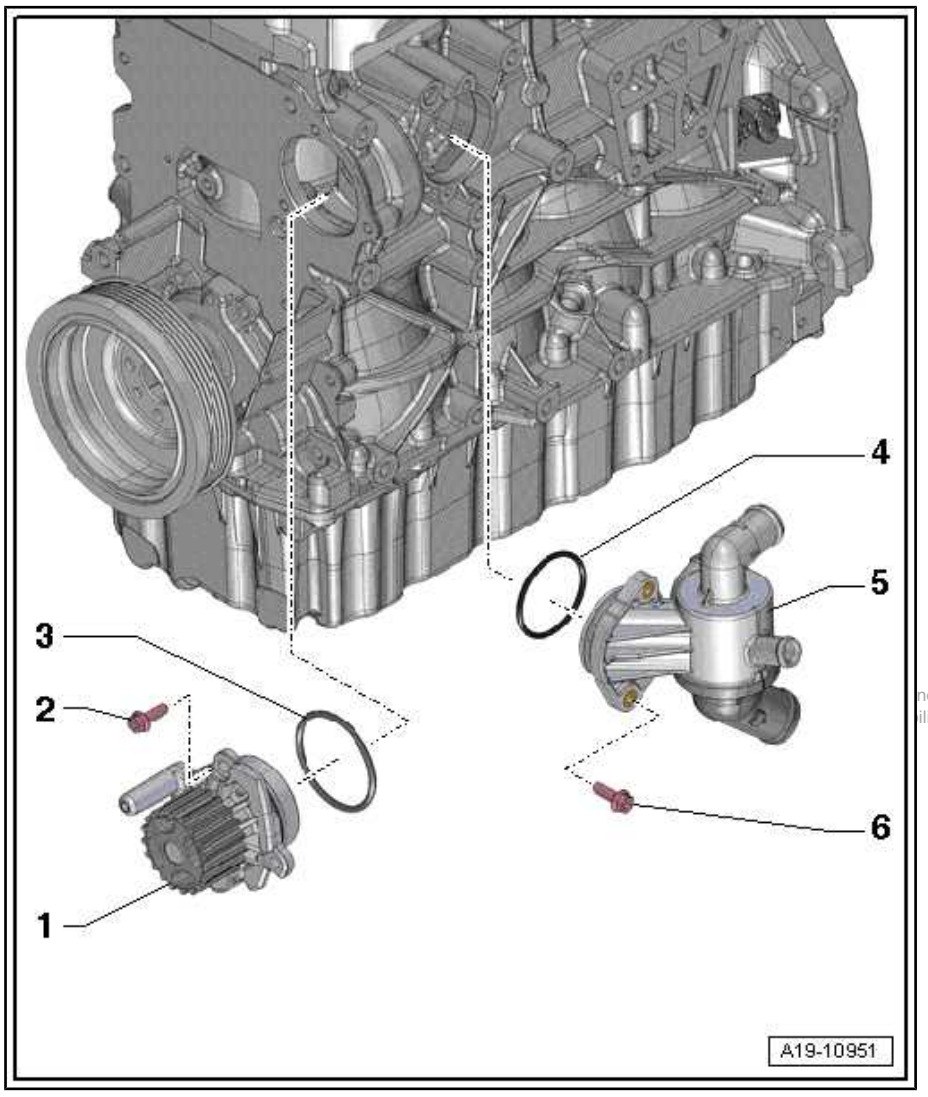
- ❑ Renew

5 - 4/2-way valve

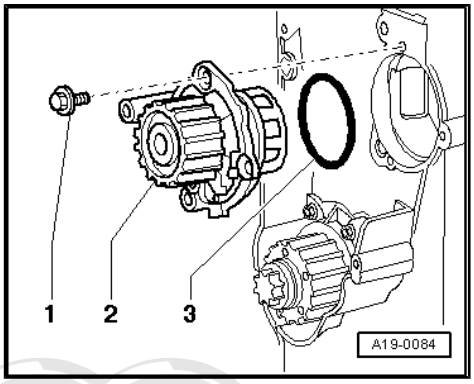
- ❑ The thermostat is located in the interior of the 4/2-way valve and cannot be renewed separately
- ❑ Removing and installing ⇒ page 177

6 - Bolt

- ❑ 15 Nm



2.2 Removing and installing coolant pump



Removing

– Drain coolant ⇒ page 168 .
– Remove toothed belt ⇒ page 89 .
– Unscrew bolts -1- and remove coolant pump -2-.
– Detach O-ring -3-.

Installing

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

Tightening torques

♦ ⇒ “2.1 Exploded view - coolant pump/thermostat”, page 176

Note

Fit new O-ring.

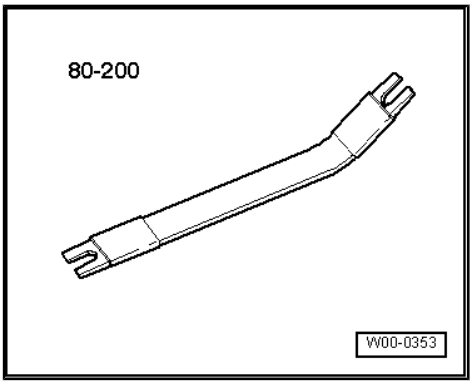
– Clean and smoothen sealing surface for O-ring.
– Lightly lubricate O-ring -3- with coolant.
– Fit coolant pump -2-.
• Installation position: Sealing plug in housing faces downwards.
– Install toothed belt (adjust valve timing) ⇒ page 93 .
– Fill up with coolant ⇒ page 171 .

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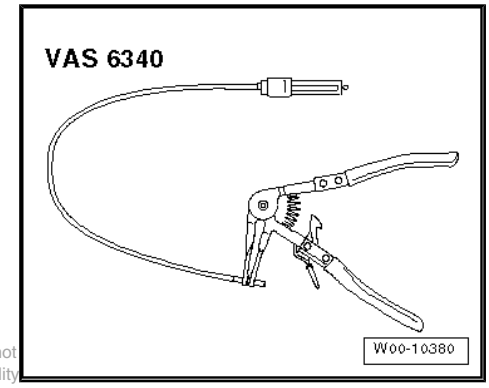
2.3 Removing and installing 4/2-way valve with thermostat

Special tools and workshop equipment required

♦ Removal lever - 80 - 200-

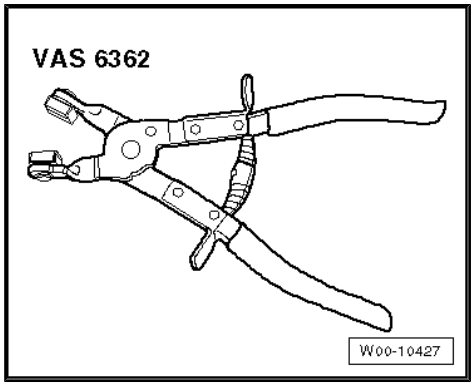


- Hose clip pliers - VAS 6340-



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- Hose clip pliers - VAS 6362-



Removing

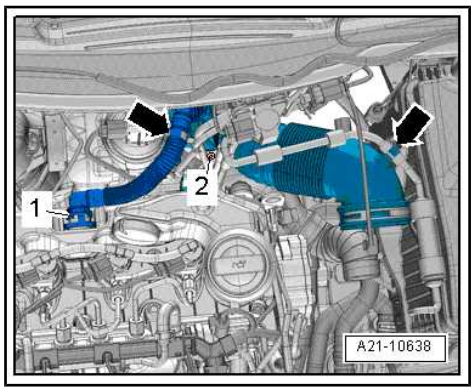
– Drain coolant ⇒ page 168 .

– Remove air cleaner housing ⇒ page 241 .

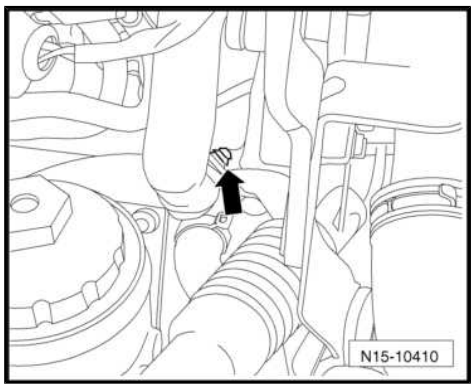
– Press release tabs and disconnect crankcase breather hose -1- from cylinder head cover.

– Move clear vacuum hoses -arrows- at air pipe.

– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.



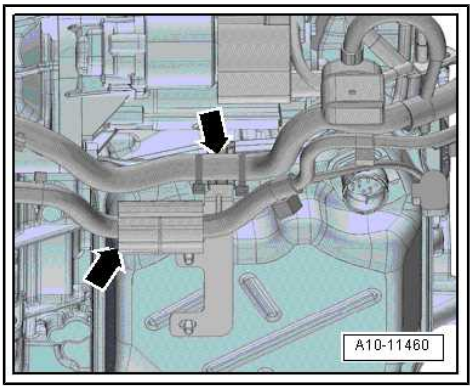
– Unclip wiring harness from retainer -arrow-.



WARNING

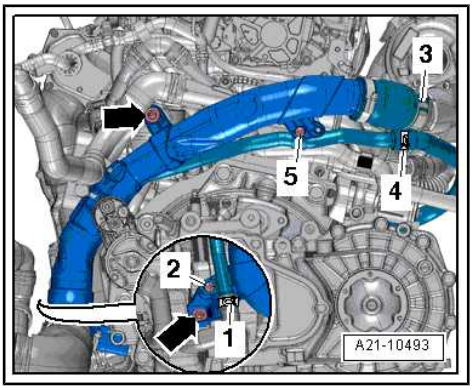
Risk of injury as the radiator fan may start up automatically.

- ***Even when the ignition is switched off, the radiator fan can start up without warning due to accumulated heat in the engine compartment, etc.***



– Move clear wiring harnesses at bracket -arrows-.

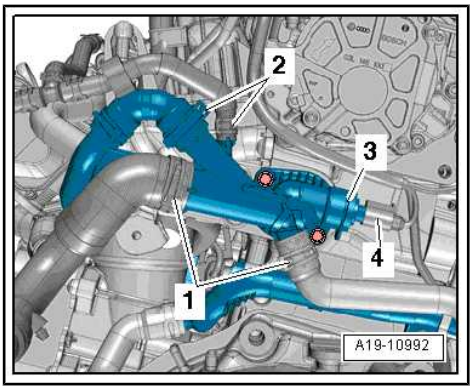
– Remove bolts -2, 5- and -arrows-.
– Using removal lever - 80 - 200- , move clear electrical wiring and hoses at air pipe (left-side).
– Loosen hose clip -3- and detach air pipe (left-side) downwards.



Note

Disregard items -1 and 4-.

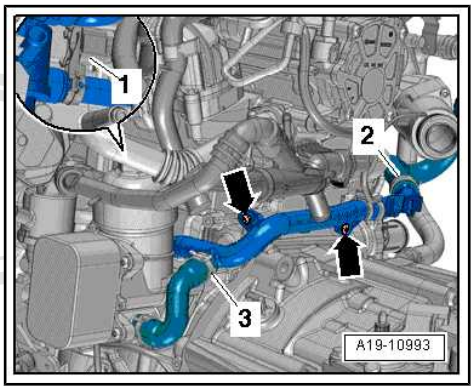
– Release hose clips -1- and detach coolant hoses.



Note

Disregard -items 2, 3, 4-.

– Take electrical connector -1- for Hall sender - G40- out of retainer.
– Remove bolts -arrows-, pull off coolant pipe (front) from 4/2-way valve to left side and leave in installation position.

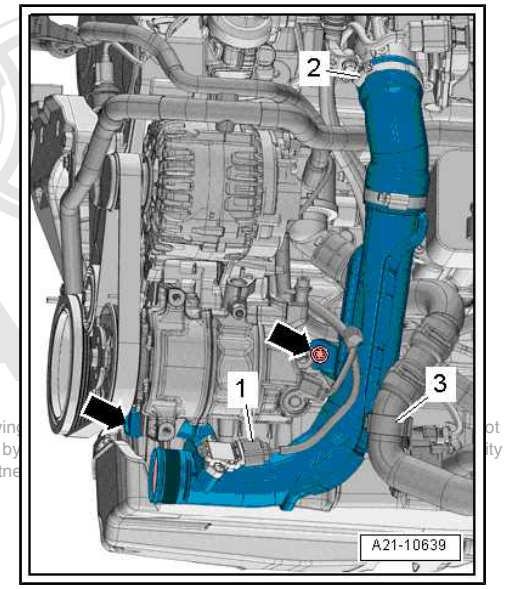


Note

Disregard items -2 and 3-.

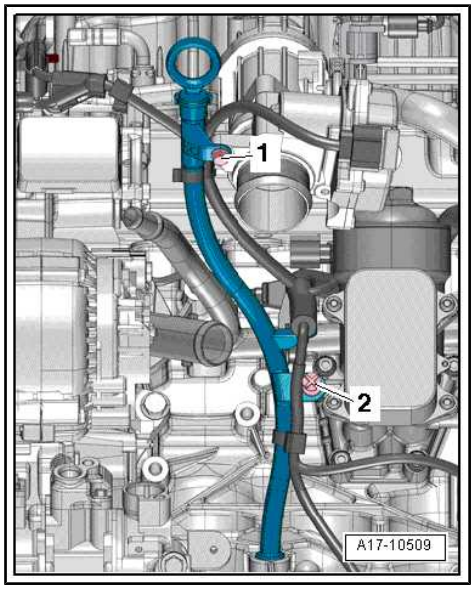
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– Remove bolts -arrows-.
– Move coolant hose -3- clear.
– Release hose clip -2-.
– Unplug electrical connector -1- at charge pressure sender - G31- / intake air temperature sender - G42- and detach air pipe (right-side).



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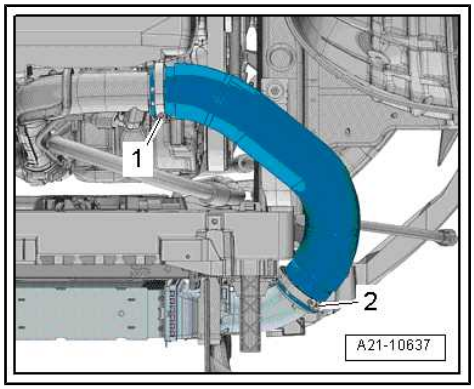
– Pull oil dipstick out slightly and remove bolt -1-.
– Release clip -2- with removal lever - 80 - 200- .
– Pull guide tube for oil dipstick upwards out of cylinder block and push to one side.



– Release hose clip -1- and detach air hose.

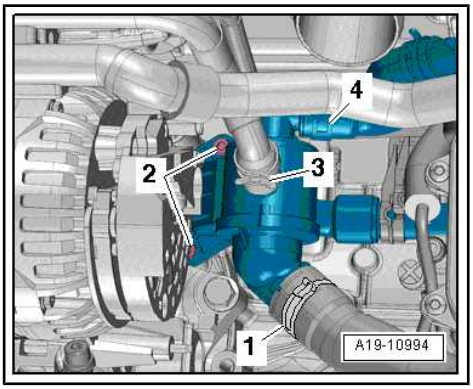
Note

Disregard -item 2-.



– Remove bolts -2-.

– Loosen hose clips -1, 3, 4-, detach coolant hoses and remove 4/2-way valve.



Installing

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

Tightening torques

- ⇒ Fig. ""Guide tube for oil dipstick - tightening torque"" , page 152
- ⇒ "2.1 Exploded view - coolant pump/thermostat", page 176
- ⇒ "2.1 Exploded view - charge air system", page 221
- ⇒ Fig. ""Installing air hoses with screw-type clips"" , page 222

– Install coolant pipe (front) ⇒ page 188 .

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

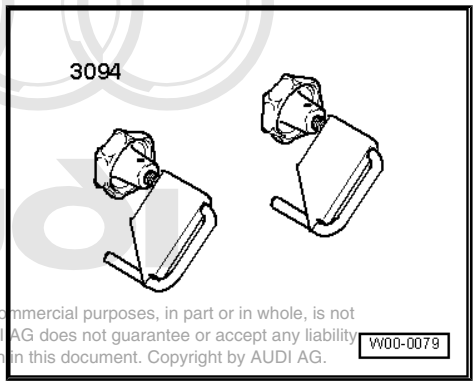
– Install air cleaner housing ⇒ page 241 .

– Fill up with coolant ⇒ page 171 .

2.4 Removing and installing electric coolant pump

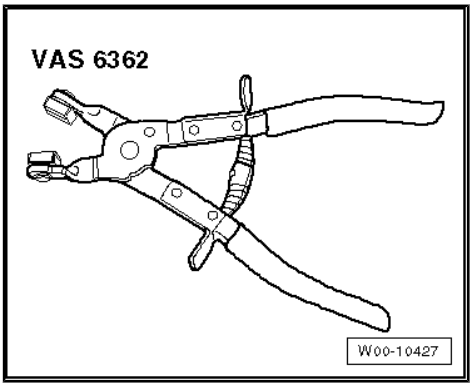
Special tools and workshop equipment required

- Hose clamps, up to 25 mm - 3094-



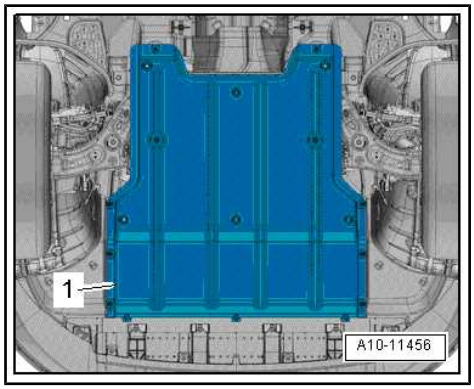
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- Hose clip pliers - VAS 6362-

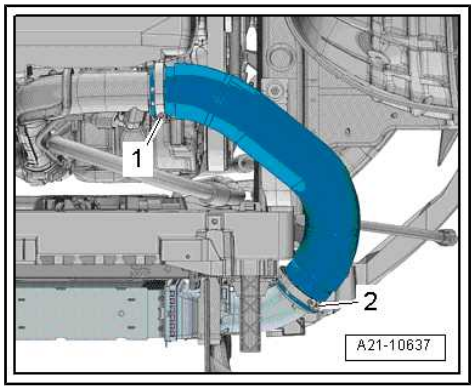


Removing

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



– Release hose clip -1- and detach air hose.



Note

Disregard -item 2-.

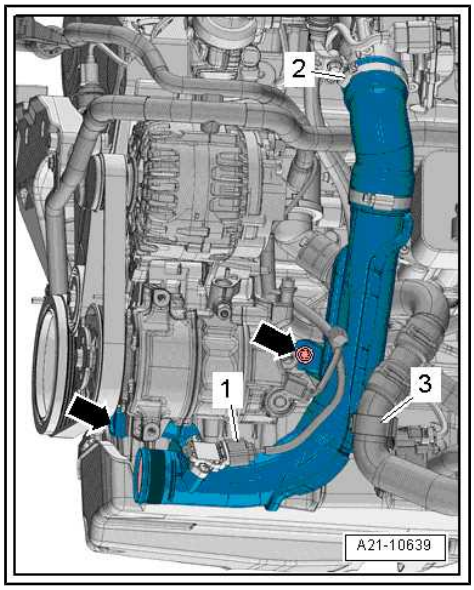
WARNING

Risk of injury as the radiator fan may start up automatically.

- ***Even when the ignition is switched off, the radiator fan can start up without warning due to accumulated heat in the engine compartment, etc.***

– Remove bolts -arrows-.

– Release hose clip -2- and push right air pipe towards the right.



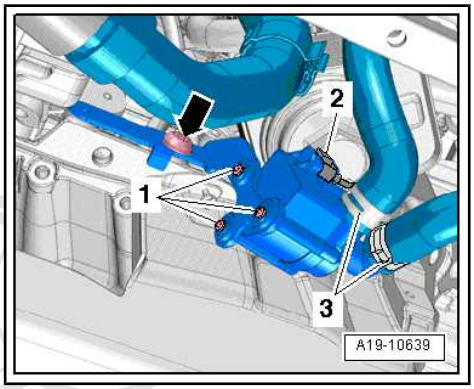
Note

Disregard items -1 and 3-.

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Note

Place a cloth underneath pump for exhaust gas recirculation cooler - V400- to catch escaping coolant.



- Clamp off coolant hoses with hose clamps up to 25 mm - 3094- .
- Release hose clips -3- und disconnect hoses from pump.
- Unplug electrical connector -2-.
- Unscrew bolts -1- and remove pump for exhaust gas recirculation cooler - V400- .

Note

Disregard -arrow-.

Installing

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

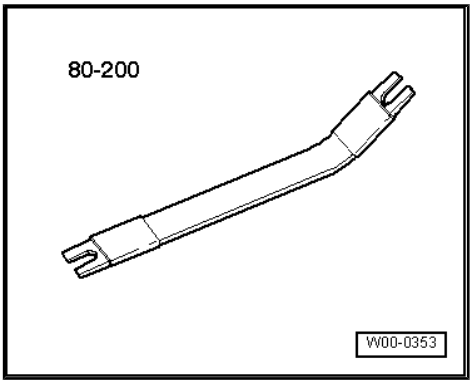
Tightening torques

- ⇒ “3.1 Exploded view - coolant pipes”, page 187
- ⇒ “2.1 Exploded view - charge air system”, page 221
- ⇒ Fig. ““Installing air hoses with screw-type clips”“ , page 222
- Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .
- Check coolant level ⇒ page 175 .

2.5 Removing and installing coolant temperature sender - G62-

Special tools and workshop equipment required

- Removal lever - 80 - 200-

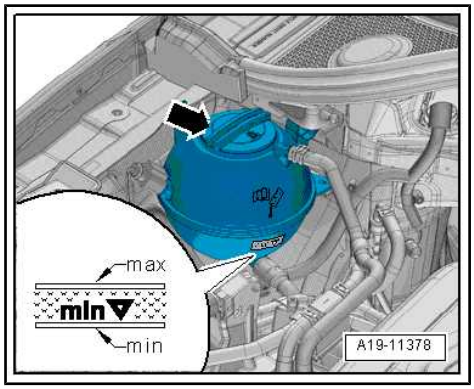


Removing

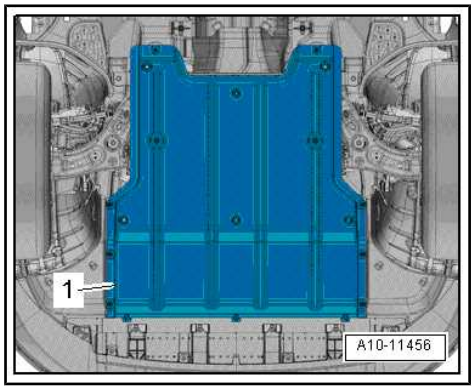
- Engine cold.

– Open filler cap -arrow- on coolant expansion tank briefly to relieve residual pressure in cooling system.

– Remove air cleaner housing ⇒ page 241 .



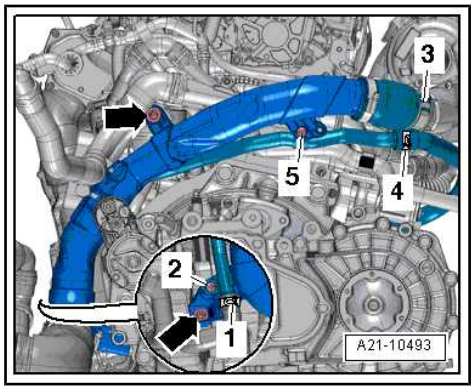
– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



– Remove bolts -arrows-.

– Using removal lever - 80 - 200- , move clear electrical wiring and hoses at air pipe (left-side).

– Release hose clip -3- and push air pipe (left-side) with coolant pipe towards the left.

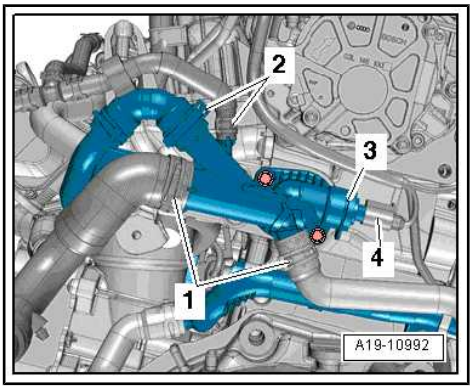


Note

Disregard -items 1, 2, 4, 5-.

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– Unplug electrical connector -4- at coolant temperature sender - G62- .



Note

Place a cloth underneath the connection to catch escaping coolant.

– Pull off retaining clip -3- and pull coolant temperature sender - G62- out of connection.

Note

Disregard items -1 and 2-.

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Installing

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

Tightening torques

♦ ⇒ “2.1 Exploded view - charge air system”, page 221

Note

♦ *Fit new O-ring.*

♦ *To avoid loss of coolant, insert new coolant temperature sender - G62- immediately into connection.*

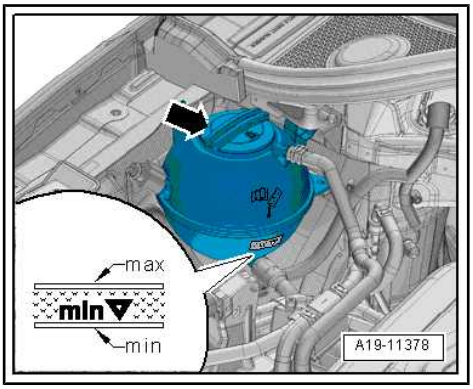
– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

– Install air cleaner housing ⇒ page 241 .

– Check coolant level ⇒ page 175 .

2.6 Removing and installing radiator outlet coolant temperature sender - G83-

Removing

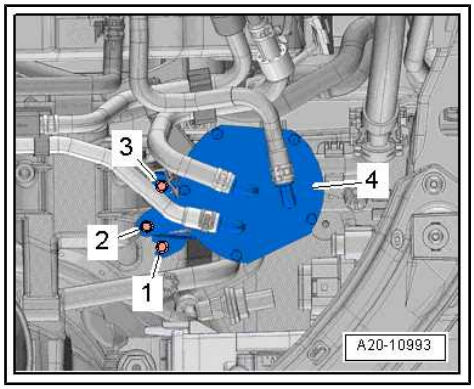


• Engine cold.

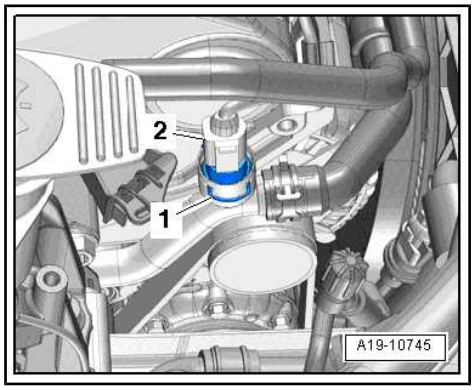
– Open filler cap -arrow- on coolant expansion tank briefly to relieve residual pressure in cooling system.

– Remove engine cover panel ⇒ page 47 .

– Loosen bolt -1-.
– Remove bolt -2- and nut -3-.
– Move fuel filter -4- clear to one side (fuel hoses remain connected).



– Unplug electrical connector -2- at radiator outlet coolant temperature sender - G83- .



Note

Place a cloth underneath to catch escaping coolant.

– Pull off retaining clip -1- and pull radiator outlet coolant temperature sender - G83- out of connection on coolant pipe.

Installing

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

Tightening torques

♦ ⇒ Fuel supply system - diesel engines; Rep. gr. 20 ; Fuel filter; Exploded view - fuel filter

Note

♦ *Fit new O-ring.*
♦ *To avoid loss of coolant, fit new radiator outlet coolant temperature sender - G83- into coolant pipe immediately.*

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– Check coolant level ⇒ page 175 .
– Install engine cover panel ⇒ page 47 .

3 Coolant pipes

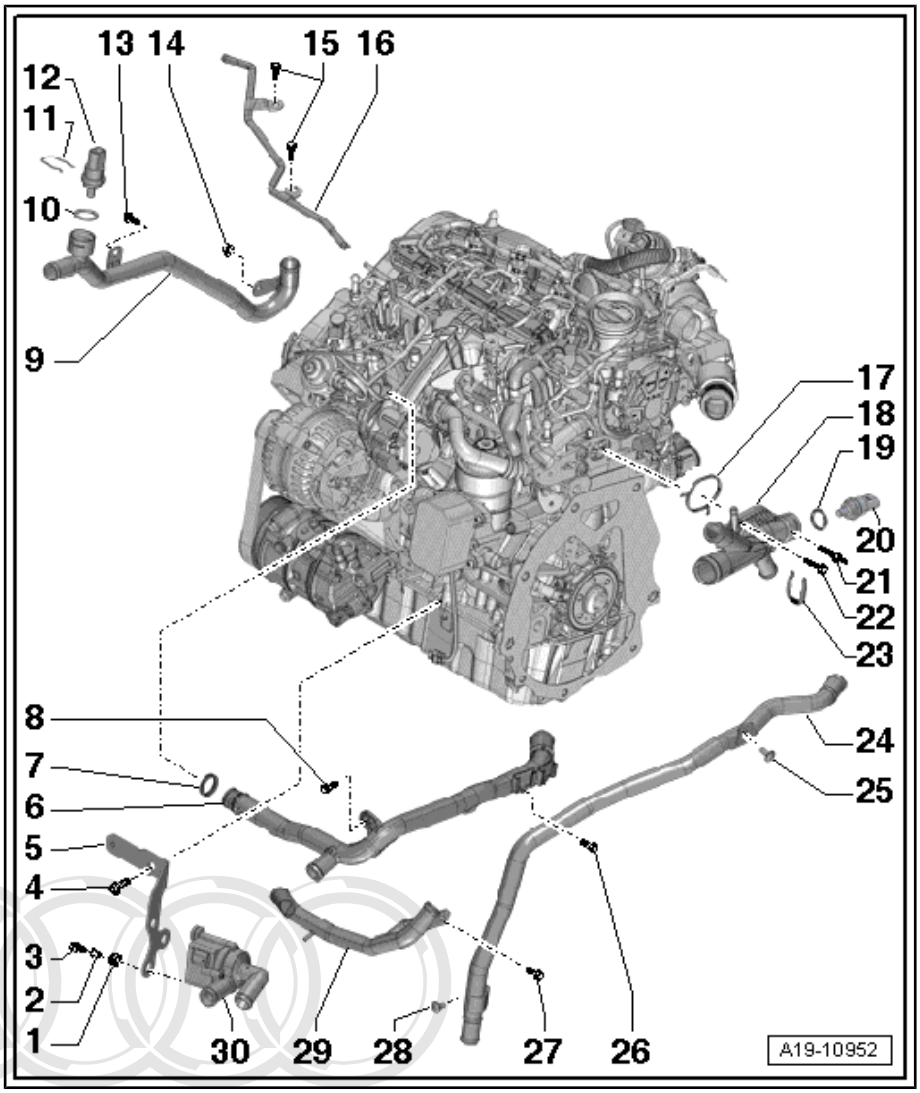
⇒ “3.1 Exploded view - coolant pipes”, page 187

⇒ “3.2 Removing and installing coolant pipes (top)”, page 188

3.1 Exploded view - coolant pipes

Note

The arrow markings on coolant pipes and on ends of hoses must align.



1 - Grommet
- ❑ Not supplied separately

2 - Sleeve
- ❑ Not supplied separately

3 - Bolt
- ❑ 2.7 Nm

4 - Bolt
- ❑ 40 Nm

5 - Bracket
- ❑ For pump for exhaust gas recirculation cooler - V400-

6 - Coolant pipe (front)
- ❑ Removing and installing ⇒ page 188

7 - O-ring
- ❑ Renew

8 - Bolt
- ❑ 9 Nm

9 - Coolant pipe (right-side)
- ❑ Removing and installing ⇒ page 196

10 - O-ring
- ❑ Renew

11 - Retaining clip

12 - Radiator outlet coolant temperature sender - G83-
- ❑ Removing and installing ⇒ page 185

13 - Bolt
- ❑ 9 Nm

14 - Nut
- ❑ 9 Nm

15 - Bolts
- ❑ 9 Nm

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16 - Coolant pipe

17 - Gasket

- ❑ Renew

18 - Connection

- ❑ For coolant hoses

19 - O-ring

- ❑ Renew

20 - Coolant temperature sender - G62-

- ❑ Removing and installing ⇒ page 183

21 - Centre hex stud

- ❑ 9 Nm

22 - Bolt

- ❑ 9 Nm

23 - Retaining clip

24 - Coolant pipe (left-side)

- ❑ Removing and installing ⇒ page 193

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25 - Nut

- ❑ 9 Nm

26 - Bolt

- ❑ 9 Nm

27 - Bolt

- ❑ 9 Nm

28 - Nut

- ❑ 9 Nm

29 - Coolant pipe (top front)

- ❑ Removing and installing ⇒ page 191

30 - Pump for exhaust gas recirculation cooler - V400-

- ❑ Removing and installing ⇒ page 181

3.2 Removing and installing coolant pipes (top)

⇒ “3.2.1 Removing and installing coolant pipe (front)”, page 188

⇒ “3.2.2 Removing and installing coolant pipe (top front)”, page 191

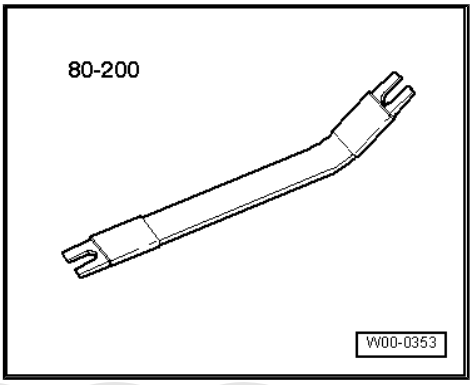
⇒ “3.2.3 Removing and installing coolant pipe (left-side)”, page 193

⇒ “3.2.4 Removing and installing coolant pipe (right-side)”, page 196

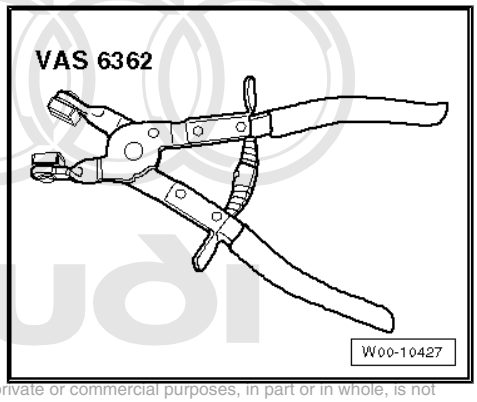
3.2.1 Removing and installing coolant pipe (front)

Special tools and workshop equipment required

♦ Removal lever - 80 - 200-



♦ Hose clip pliers - VAS 6362-



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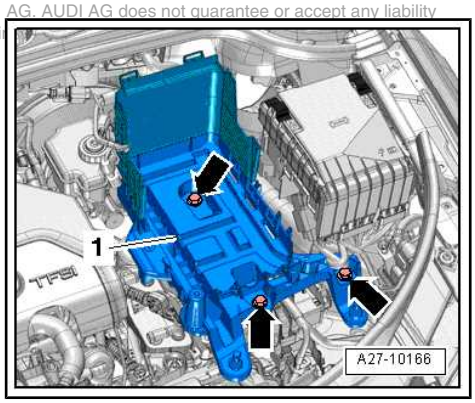
Removing

– Drain coolant ⇒ page 168 .

– Remove air cleaner housing ⇒ page 241 .

– Disconnect battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Disconnecting and connecting battery .

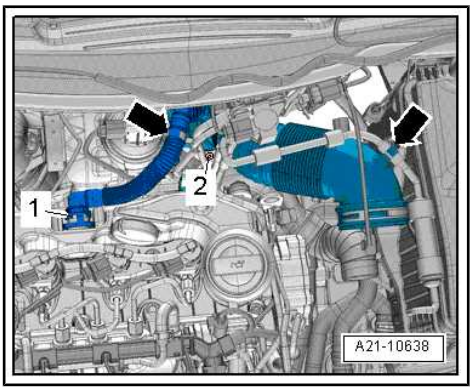
– Remove battery and battery tray ⇒ Electrical system; Rep. gr. 27 ; Battery; Removing and installing battery tray .



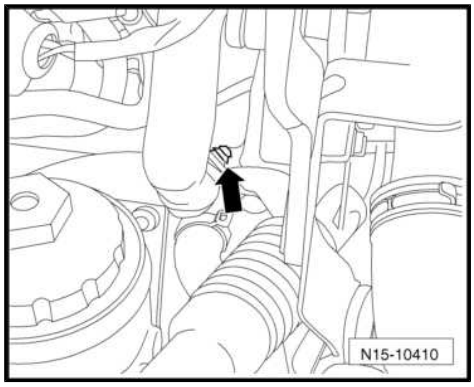
– Press release tabs and disconnect crankcase breather hose -1- from cylinder head cover.

– Move clear vacuum hoses -arrows- at air pipe.

– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.



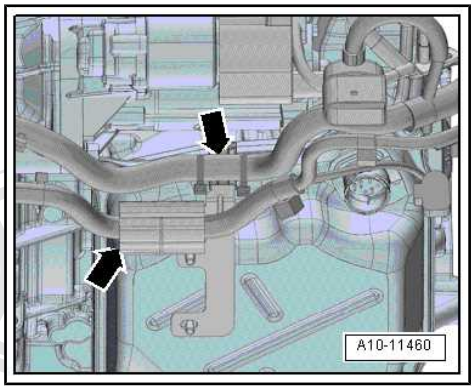
– Unclip wiring harness from retainer -arrow-.



WARNING

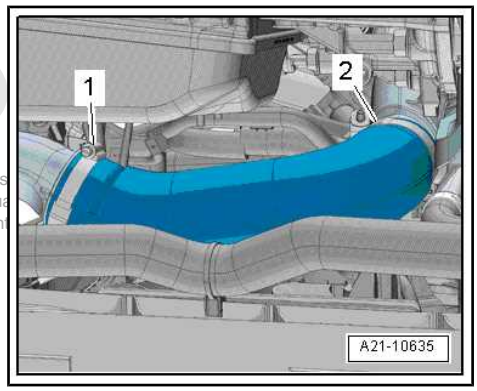
Risk of injury as the radiator fan may start up automatically.

- *Even when the ignition is switched off, the radiator fan can start up without warning due to accumulated heat in the engine compartment, etc.*



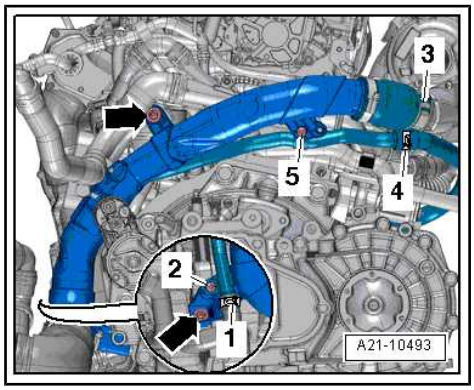
– Move clear wiring harnesses at bracket -arrows-.

– Release hose clips -1- and -2- and remove air hose.



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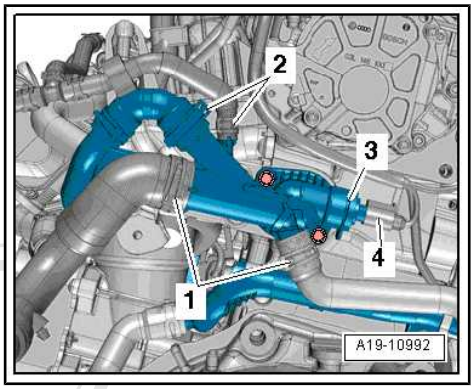
– Remove bolts -2, 5- and -arrows-.
– Using removal lever - 80 - 200- , move clear electrical wiring and hoses at air pipe (left-side).
– Loosen hose clip -3- and detach air pipe (left-side) downwards.



Note

Disregard items -1 and 4-.

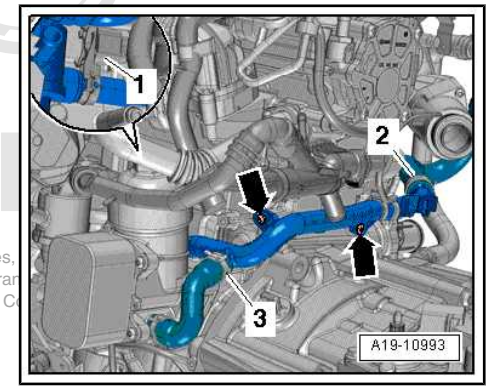
– Release hose clips -1- and detach coolant hoses.



Note

Disregard -items 2, 3, 4-.

– Take electrical connector -1- for Hall sender - G40- out of retainer.



– Detach bracket from coolant pipe (front).
– Release hose clips -2- and -3- and disconnect coolant hoses.
– Remove bolts -arrows- and detach coolant pipe (front) from 4/2-way valve to left side.

Installing

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

Tightening torques

- ⇒ “3.1 Exploded view - coolant pipes”, page 187
- ⇒ “1.1 Exploded view - turbocharger”, page 208
- ⇒ “2.1 Exploded view - charge air system”, page 221
- ⇒ Fig. ““Installing air hoses with screw-type clips”“ , page 222

Note

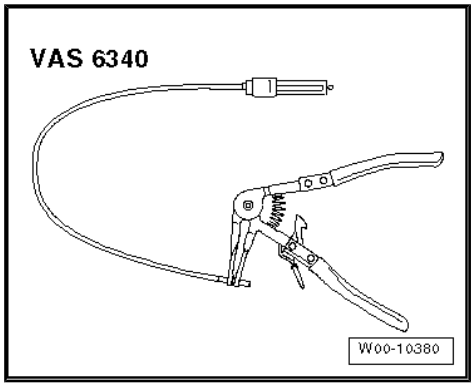
- *Renew gaskets, seals and O-rings.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Clean and smoothen sealing surface for O-ring.
– Lightly lubricate O-ring with coolant and slide O-ring onto coolant pipe (front).
– Push coolant pipe (front) into 4/2-way valve.
– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Install battery tray and battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Removing and installing battery tray .
– Install air cleaner housing ⇒ page 241 .
– Fill up with coolant ⇒ page 171 .

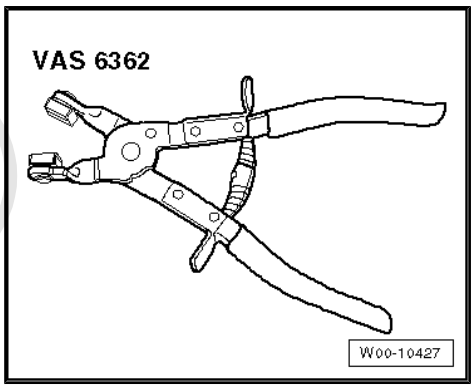
3.2.2 Removing and installing coolant pipe (top front)

Special tools and workshop equipment required

♦ Hose clip pliers - VAS 6340-



♦ Hose clip pliers - VAS 6362-

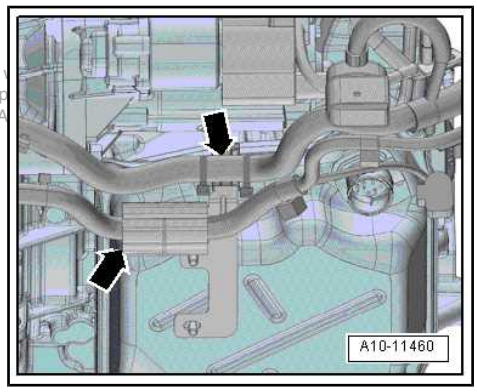


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Removing

– Drain coolant ⇒ page 168.

– Remove air cleaner housing ⇒ page 241.



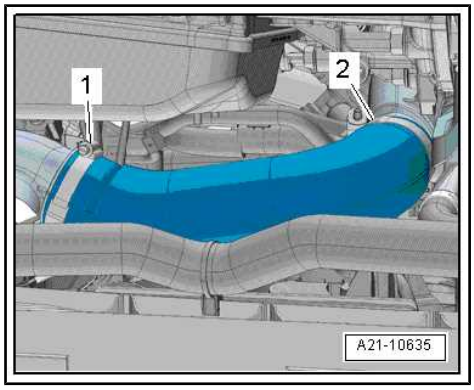
WARNING

Risk of injury as the radiator fan may start up automatically.

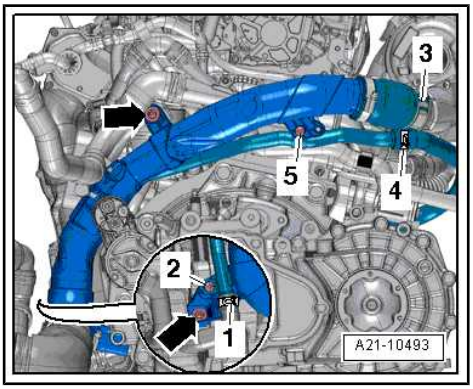
- ***Even when the ignition is switched off, the radiator fan can start up without warning due to accumulated heat in the engine compartment, etc.***

– Move clear wiring harnesses at bracket -arrows-.

– Release hose clips -1- and -2- and remove air hose.



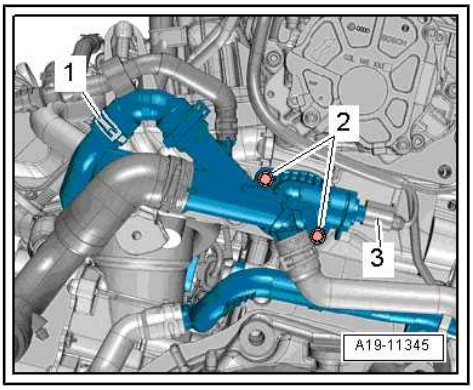
– Remove bolts -2, 5- and -arrows-.
– Using removal lever - 80 - 200- , move clear electrical wiring and hoses at air pipe (left-side).
– Loosen hose clip -3- and detach air pipe (left-side) downwards.



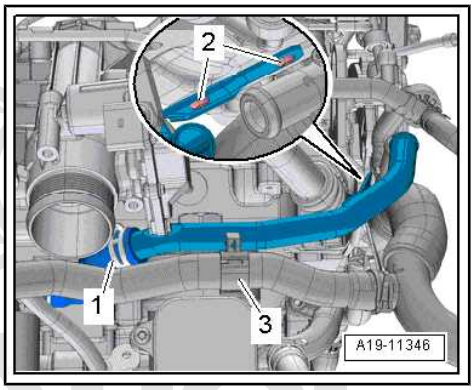
Note

Disregard items -1 and 4-.

– Unplug electrical connector -3-.
– Place drip tray for workshop hoist - VAS 6208- beneath engine.
– Remove bolts -2-.
– Release hose clip -1- and detach coolant hose, push connection to one side.



– Move coolant hose -3- clear.
– Remove bolts -2-.
– Loosen hose clip -1- and detach front coolant pipe upwards.



Installing

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

Tightening torques

- ⇒ “3.1 Exploded view - coolant pipes”, page 187
- ⇒ “2.1 Exploded view - charge air system”, page 221
- ⇒ Fig. ““Installing air hoses with screw-type clips”“ , page 222

Note

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

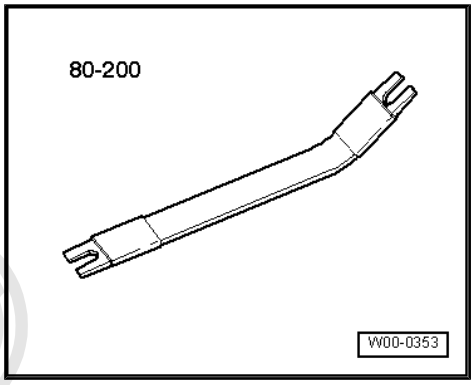
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– Install air cleaner housing ⇒ page 241 .
– Fill up with coolant ⇒ page 171 .

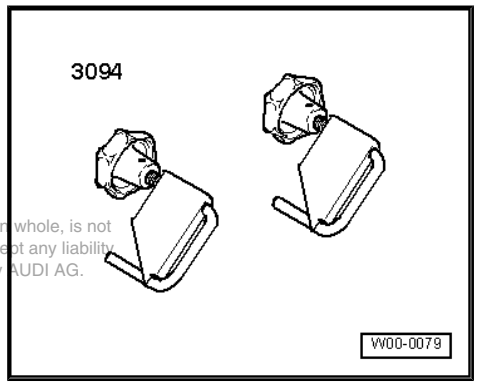
3.2.3 Removing and installing coolant pipe (left-side)

Special tools and workshop equipment required

- Removal lever - 80 - 200-

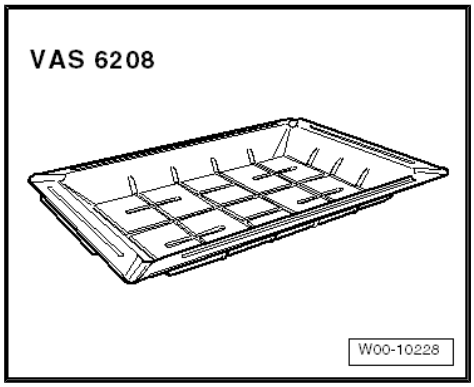


- Hose clamps, up to 25 mm - 3094-

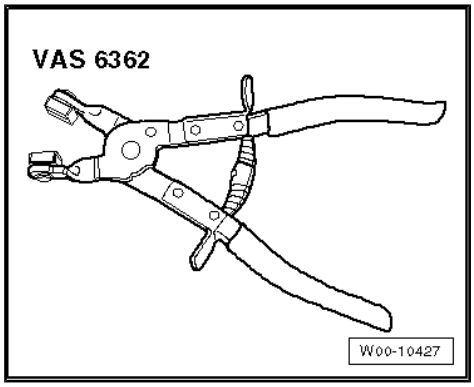


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- Drip tray for workshop hoist - VAS 6208-



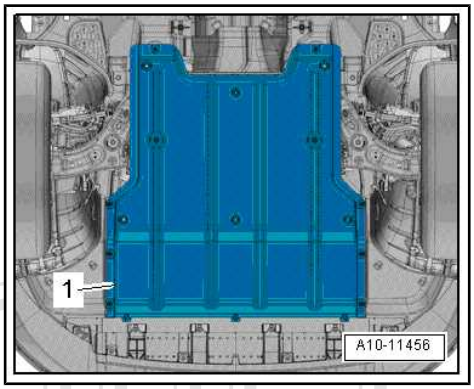
- Hose clip pliers - VAS 6362-



Removing

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

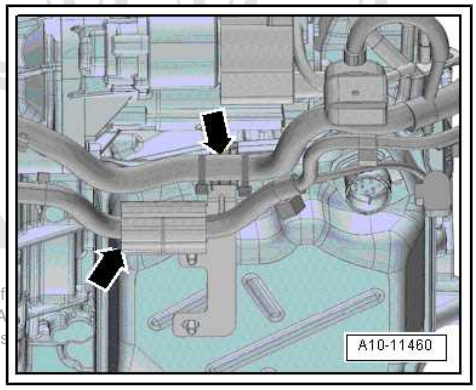
– Remove air cleaner housing ⇒ page 241 .



WARNING

Risk of injury as the radiator fan may start up automatically.

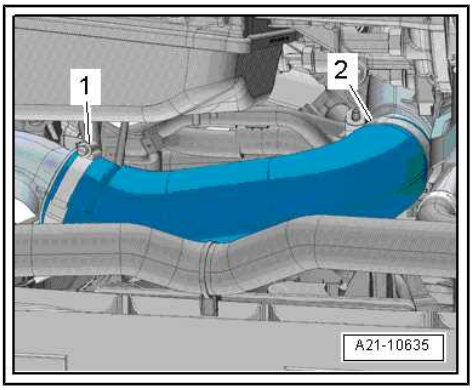
- ***Even when the ignition is switched off, the radiator fan can start up without warning due to accumulated heat in the engine compartment, etc.***



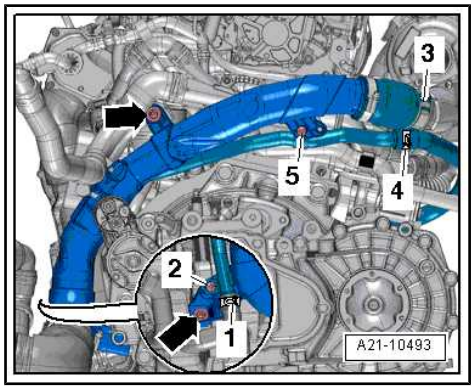
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– Move clear wiring harnesses at bracket -arrows-.

– Release hose clips -1- and -2- and remove air hose.



– Remove bolts -2, 5- and -arrows-.
– Using removal lever - 80 - 200- , move clear electrical wiring and hoses at air pipe (left-side).
– Loosen hose clip -3- and detach air pipe (left-side) downwards.
– Place drip tray for workshop hoist - VAS 6208- beneath engine.
– Clamp off coolant hoses using hose clamps up to 25 mm - 3094- , release hose clips -1- and -4- and disconnect coolant hoses from coolant pipe (left-side).
– Detach coolant pipe (left-side).



Installing

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

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Tightening torques

- ⇒ “3.1 Exploded view - coolant pipes”, page 187
- ⇒ “2.1 Exploded view - charge air system”, page 221
- ⇒ Fig. ““Installing air hoses with screw-type clips”“ , page 222

Note

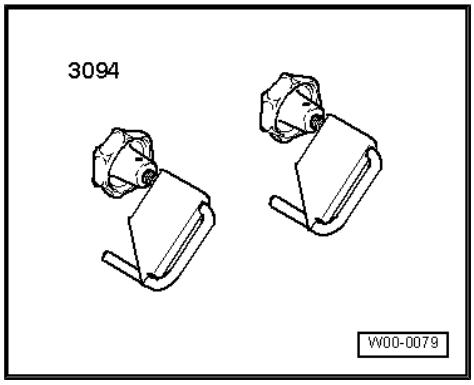
Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .

– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Install air cleaner housing ⇒ page 241 .
– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .
– Fill up with coolant ⇒ page 171 .

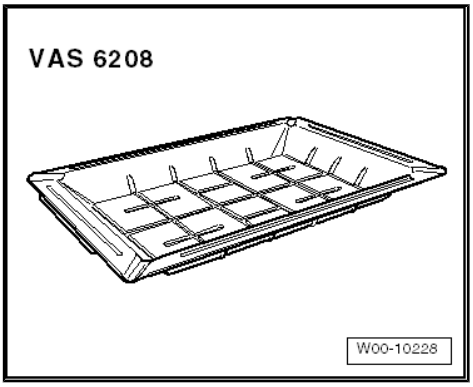
3.2.4 Removing and installing coolant pipe (right-side)

Special tools and workshop equipment required

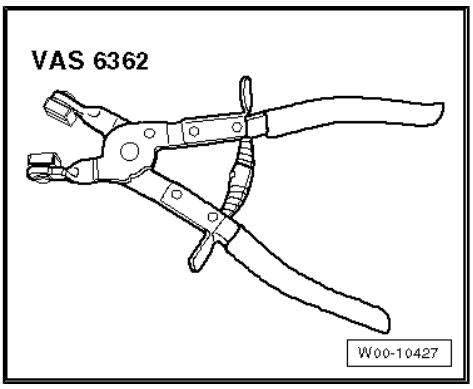
- Hose clamps, up to 25 mm - 3094-



♦ Drip tray for workshop hoist - VAS 6208-



♦ Hose clip pliers - VAS 6362-



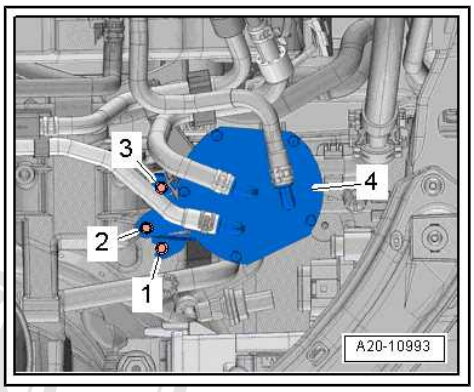
Removing

– Remove engine cover panel ⇒ page 47 .

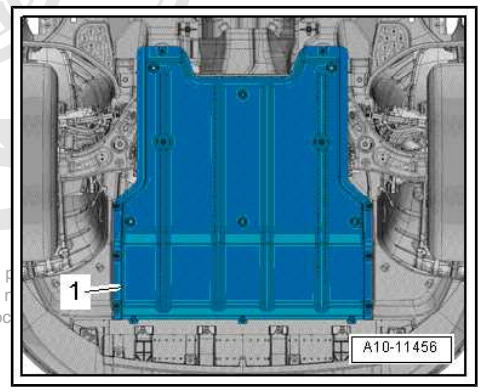
– Loosen bolt -1-.

– Remove nut -2- and bolt -3-.

– Move fuel filter -4- clear to one side (fuel hoses remain connected).

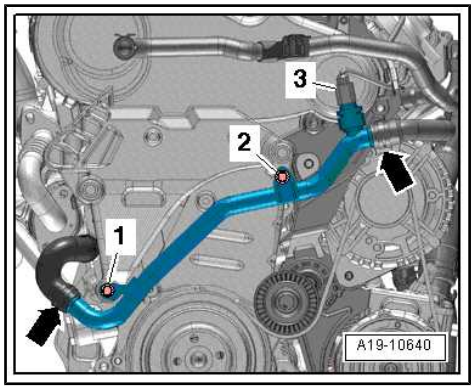


– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



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– Place drip tray for workshop hoist - VAS 6208- beneath engine.
– Unplug electrical connector -3- at radiator outlet coolant temperature sender - G83- .
– Clamp off coolant hoses using hose clamps up to 25 mm - 3094- , release hose clips -arrows- and disconnect coolant hoses from coolant pipe (right-side).
– Remove nut -1- and bolt -2- and take off coolant pipe (right-side).



Installing

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

Tightening torques

- ⇒ “3.1 Exploded view - coolant pipes”, page 187
- ⇒ Fuel supply system - diesel engines; Rep. gr. 20 ; Fuel filter; Exploded view - fuel filter

Note

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

– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .
– Check coolant level ⇒ page 175 .
– Install engine cover panel ⇒ page 47 .

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4 Radiator/radiator fan

⇒ “4.1 Exploded view - radiator/radiator fan”, page 199

⇒ “4.2 Removing and installing radiator”, page 201

⇒ “4.3 Removing and installing radiator cowl”, page 204

⇒ “4.4.1 Removing and installing radiator fan V7 ”, page 206

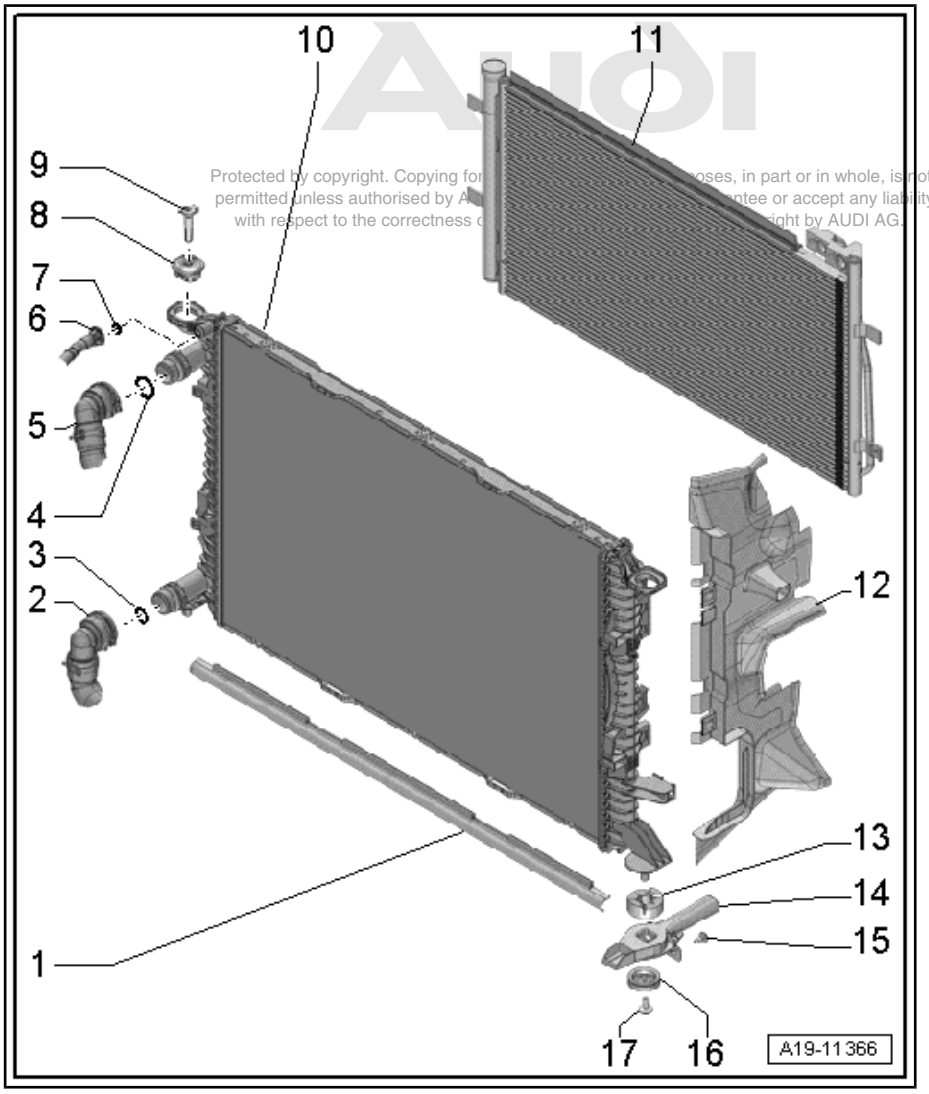
⇒ “4.4.2 Removing and installing radiator fan control unit J293 ”, page 206

4.1 Exploded view - radiator/radiator fan

⇒ “4.1.1 Exploded view - radiator/radiator fan (radiator for engine coolant)”, page 199

⇒ “4.1.2 Exploded view - radiator/radiator fan (radiator cowl and radiator fan)”, page 201

4.1.1 Exploded view - radiator/radiator fan (radiator for engine coolant)



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1 - Air duct

2 - Coolant hose (bottom)

- ❑ Lift retaining clip to detach
- ❑ Connecting to radiator ⇒ page 200

3 - O-ring

- ❑ Renew

4 - O-ring

- ❑ Renew

5 - Coolant hose (top)

- ❑ Lift retaining clip to detach
- ❑ Connecting to radiator ⇒ page 200

6 - Coolant hose

- ❑ To coolant expansion tank

7 - O-ring

- ❑ Renew

8 - Rubber mounting

- ❑ For radiator

9 - Retaining pin

- ❑ Use screwdriver to release and pull off

10 - Radiator

- ❑ Remove and install together with radiator cowl ⇒ page 201
- ❑ If renewed, refill system with fresh coolant

11 - Condenser

- ❑ Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Refrigerant circuit; Removing and installing condenser

12 - Air duct

13 - Rubber mounting

- ❑ For radiator

14 - Radiator bracket

15 - Bolt

- ❑ 5 Nm

16 - Washer

17 - Bolt

- ❑ 4.5 Nm

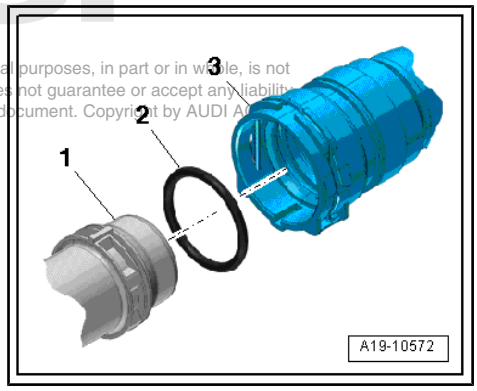
Connecting coolant hose with plug-in connector

– 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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4.1.2 Exploded view - radiator/radiator fan (radiator cowl and radiator fan)

1 - Radiator fan control unit - J293-

- ❑ Removing and installing ⇒ page 206

2 - Bolt

- ❑ 4.5 Nm

3 - Bolt

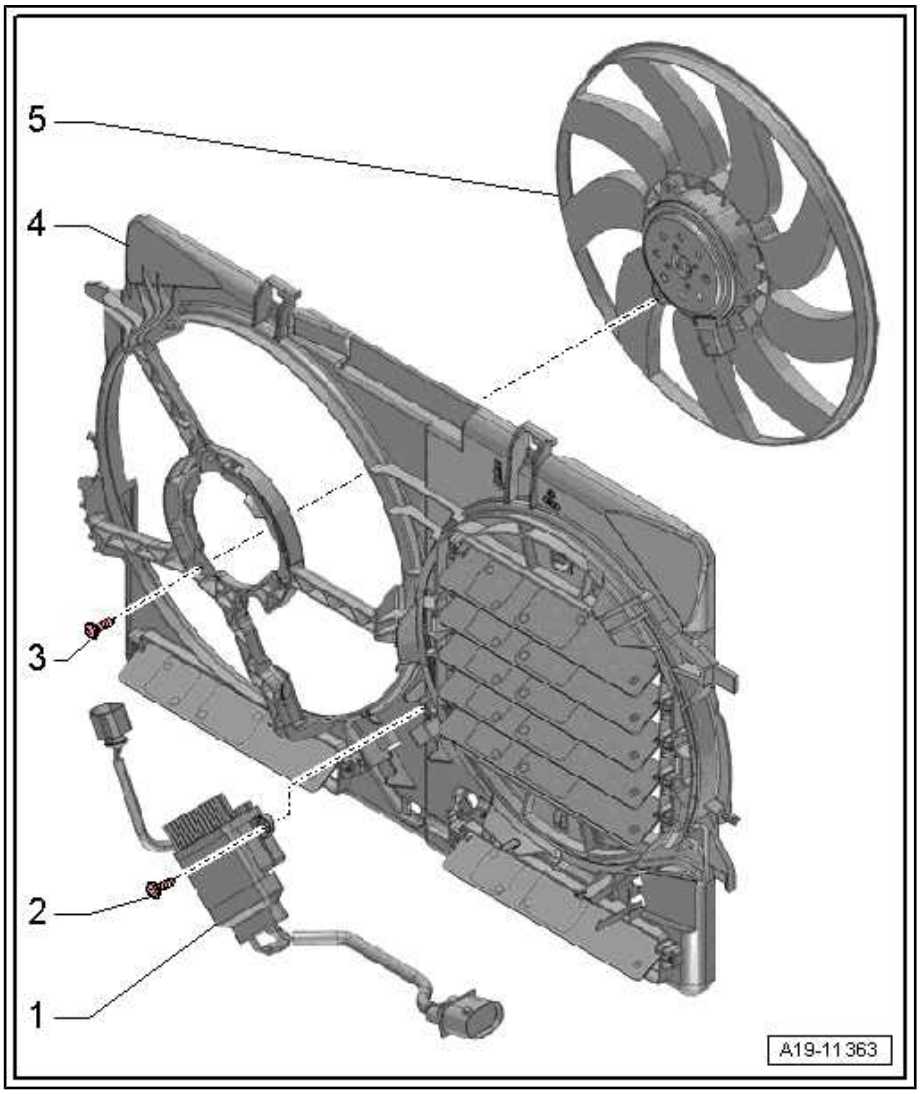
- ❑ 5 Nm

4 - Radiator cowl

- ❑ Removing and installing ⇒ page 204

5 - Radiator fan - V7-

- ❑ Removing and installing ⇒ page 206



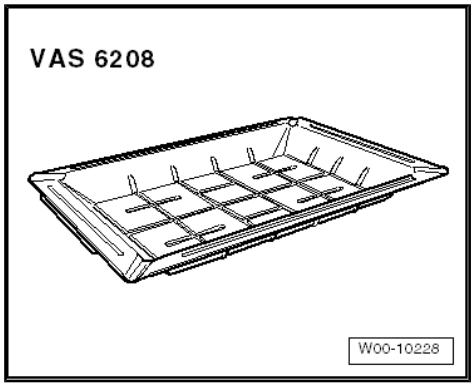
4.2 Removing and installing radiator

Note

The radiator and radiator cowl can only be removed and installed together as one unit.

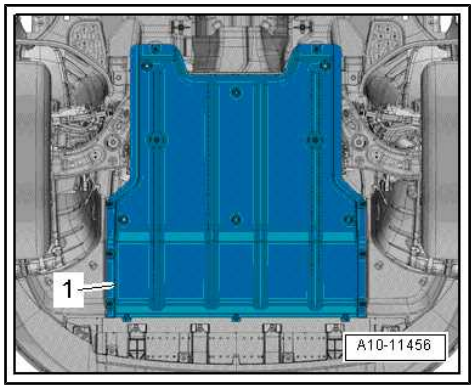
Special tools and workshop equipment required

♦ Drip tray for workshop hoist - VAS 6208-



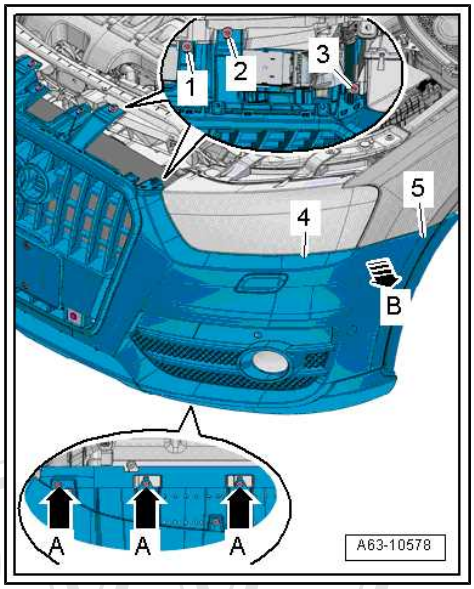
Removing

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



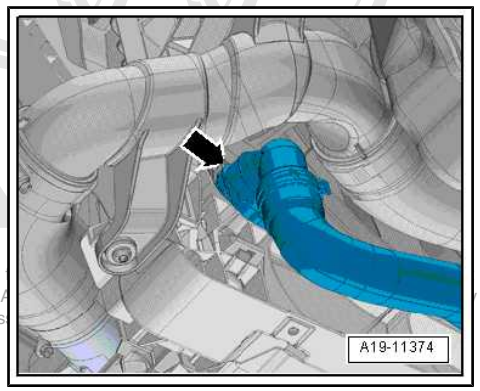
– Remove bumper cover -4- ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Removing and installing bumper cover .

– Remove charge air cooler ⇒ page 222 .



– Place drip tray for workshop hoist - VAS 6208- beneath engine.

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

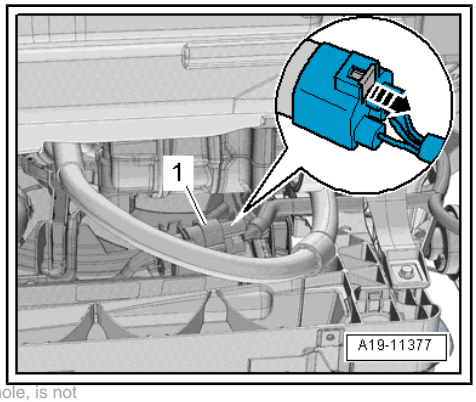


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WARNING

Risk of injury as the radiator fan may start up automatically.

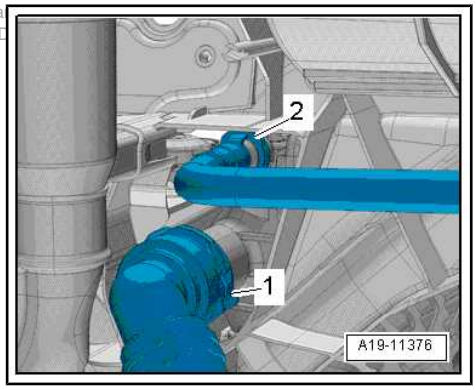
- *Unplug electrical connectors before starting to work in the area of radiator cowl.*



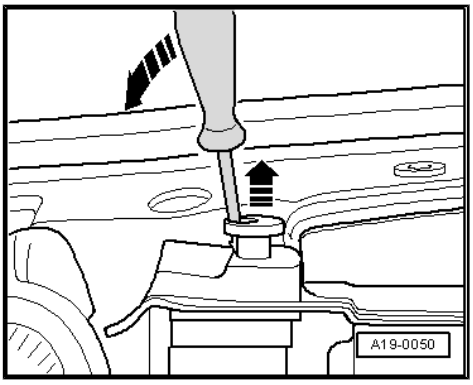
– Unplug electrical connector -1- for radiator fan (push retainer to the rear -arrow- and press down release catch).

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– Lift retaining clips -1- and -2- and detach connection from radiator.



– Release retaining pins for radiator on both sides and pull out upwards -arrows-.

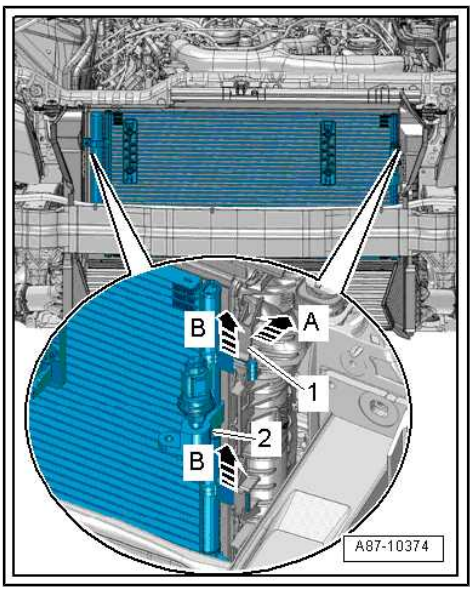


– Have a second mechanic release retaining clips -1- in direction of -arrow A- and lift condenser -2- out of mountings on radiator -arrows B-.

Caution

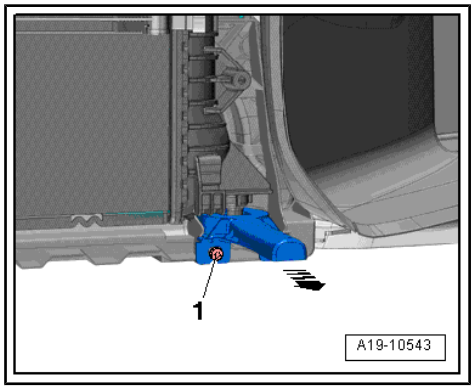
Risk of damage to condenser, refrigerant lines and refrigerant hoses.

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



– Pivot condenser forwards with pipes/hoses attached.

– Remove bolts -1- on both sides and detach radiator bracket with radiator from lock carrier -arrow-.
– Detach radiator downwards.



– Press locking tabs on left and right sides of radiator cowl -arrow- and at the same time lift radiator cowl off radiator.

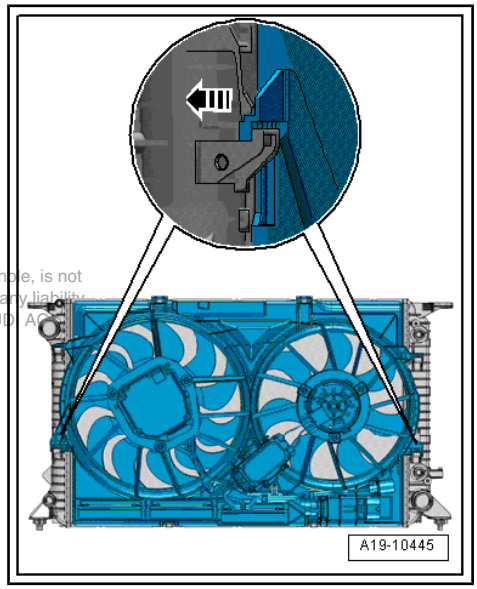
Installing

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

Tightening torques

◆ ⇒ “4.1.1 Exploded view - radiator/radiator fan (radiator for engine coolant)”, page 199

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Note

If there are slight impressions on the fins, refer to ⇒ page 7 .

– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Connect coolant hose with plug-in connector ⇒ page 200 .
– Install charge air cooler ⇒ page 222 .
– Install bumper cover ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Removing and installing bumper cover .
– Fill up with coolant ⇒ page 175 .

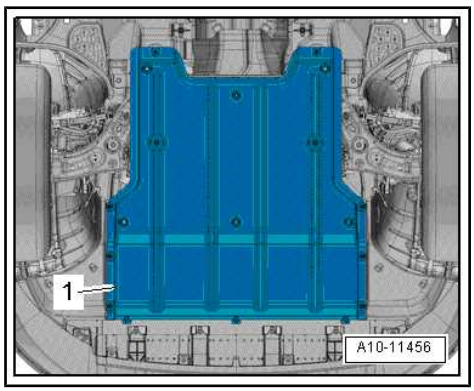
Note

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

4.3 Removing and installing radiator cowl

Removing

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .
– Remove charge air cooler ⇒ page 222 .

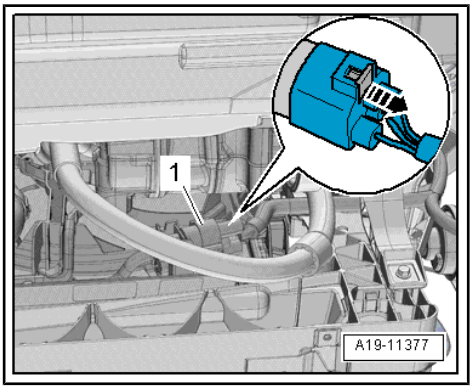


WARNING

Risk of injury as the radiator fan may start up automatically.

- ***Unplug electrical connectors before starting to work in the area of radiator cowl.***

– Unplug electrical connector -1- for radiator fan (push retainer to the rear -arrow- and press down release catch).

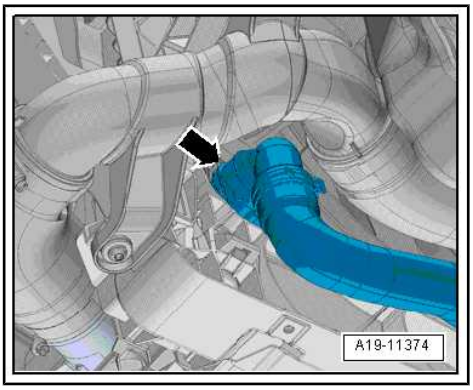


Note

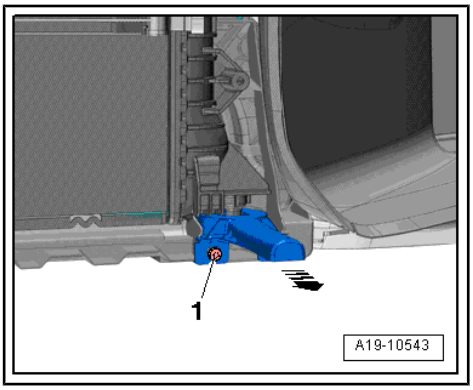
Collect drained coolant in a clean container for re-use or disposal.

– Place drip tray for workshop hoist - VAS 6208- beneath engine.

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

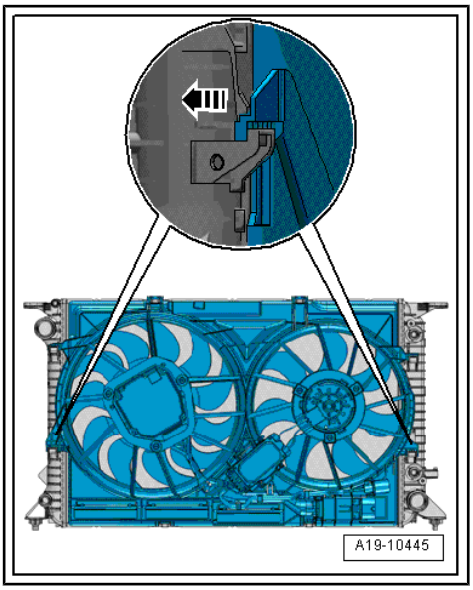


– Remove bolts -1- on both sides and detach radiator bracket with radiator from lock carrier -arrow-.



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– Press locking tabs on left and right sides of radiator cowl simultaneously -arrow- and detach radiator cowl downwards from radiator.



Installing

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

Tightening torques

- ⇒ “4.1.2 Exploded view - radiator/radiator fan (radiator cowl and radiator fan)”, page 201

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

– Connect coolant hose with plug-in connector ⇒ page 200 .

– Install charge air cooler ⇒ page 222 .

– Fill up with coolant ⇒ page 175 .

4.4 Removing and installing radiator fan

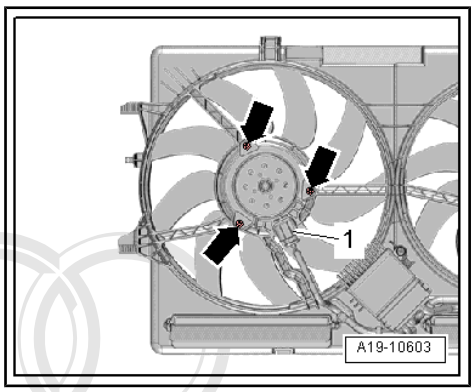
4.4.1 Removing and installing radiator fan - V7-

Removing

Note

Fit all cable ties in the original positions when installing.

– Remove radiator cowl ⇒ page 204 .
– Unplug electrical connector -1-.
– Unscrew bolts -arrows- and remove radiator fan - V7- .



Installing

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

Tightening torques

◆ ⇒ “4.1.2 Exploded view - radiator/radiator fan (radiator cowl and radiator fan)”, page 201

Note

Fit all cable ties in the original positions when installing.

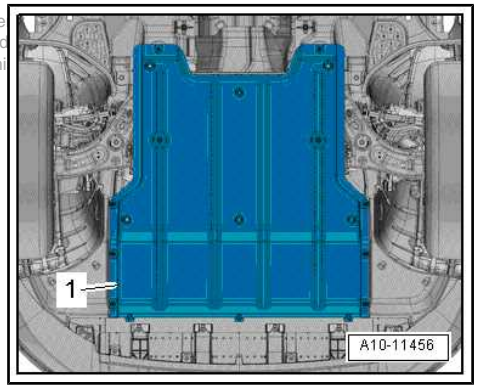
– Install radiator cowl ⇒ page 204 .

4.4.2 Removing and installing radiator fan control unit - J293-

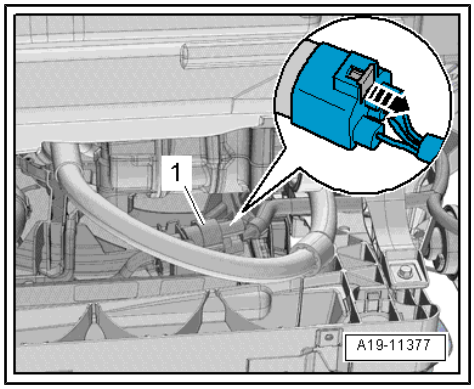
Removing

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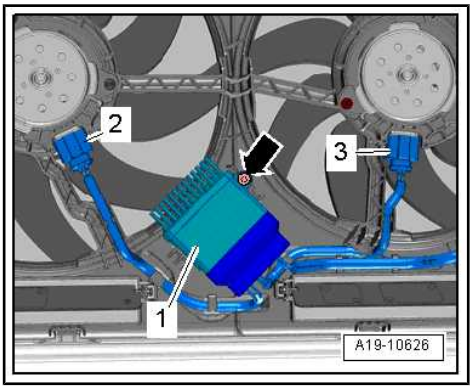
– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



– Take electrical connector -1- for radiator fan out of bracket and unplug connector (push retainer to the rear -arrow- and press down release catch).
– Move electrical wiring harness going to radiator fan control unit clear.



– Unplug electrical connector -2-.
– Unscrew bolt -arrow- and remove radiator fan control unit -1-.



Note

Disregard -item 3-.

Installing

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

Tightening torques

◆ ⇒ “4.1.2 Exploded view - radiator/radiator fan (radiator cowl and radiator fan)”, page 201

– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

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21 – Turbocharging/supercharging

1 Turbocharger

⇒ “1.1 Exploded view - turbocharger”, page 208

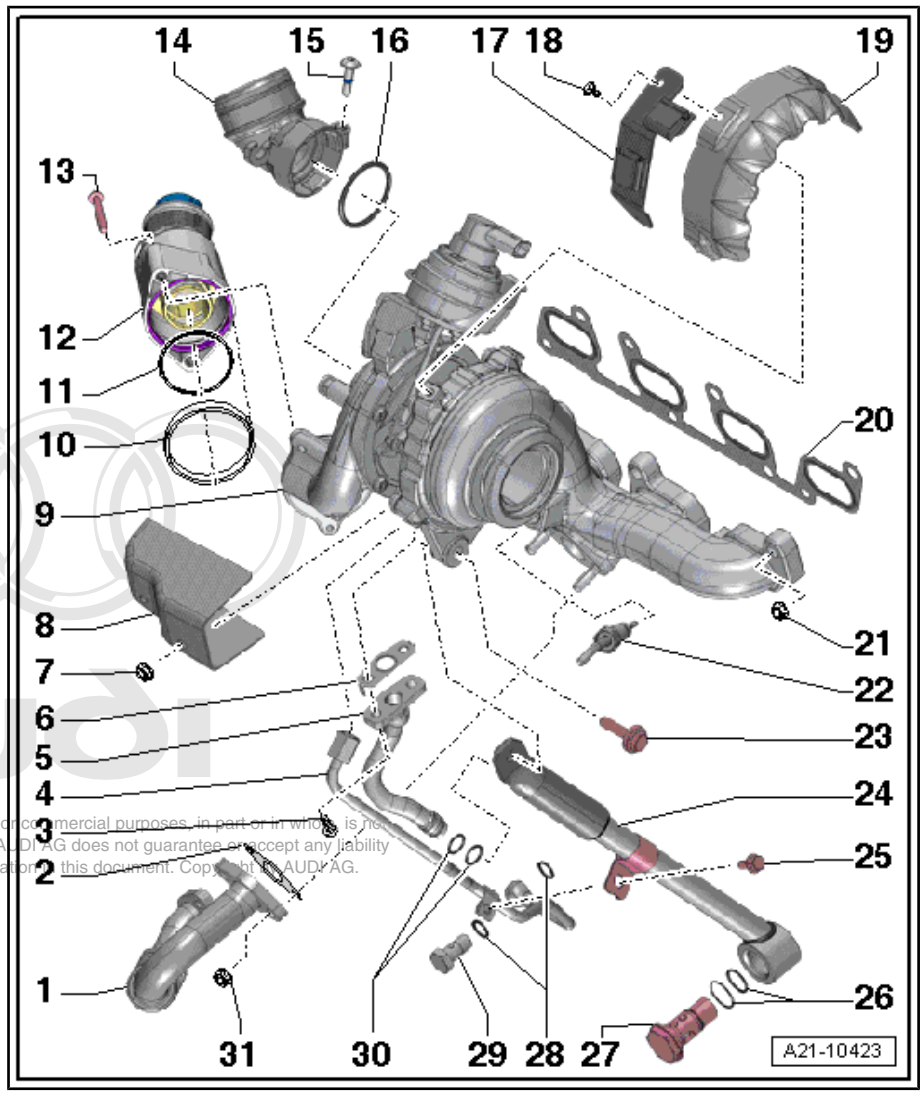
⇒ “1.2 Removing and installing turbocharger”, page 210

⇒ “1.3 Renewing vacuum unit for turbocharger”, page 215

1.1 Exploded view - turbocharger

Note

Observe rules for cleanliness ⇒ page 5 .



1 - Pipe for exhaust gas recirculation

- ❑ With flexible joint; do not bend joint - risk of cracking

2 - Gasket

- ❑ Renew

3 - Ribbed bolt

- ❑ Renew
- ❑ 17 Nm

4 - Oil supply line

- ❑ Version fitted in vehicle may differ from illustration
- ❑ Check for obstructions
- ❑ Before installing, fill turbocharger with engine oil at connection for oil supply line
- ❑ Tighten union nuts to 22 Nm
- ❑ Different connection points on turbocharger

5 - Oil return line

6 - Gasket

- ❑ Renew

7 - Nut

- ❑ 24 Nm

8 - Heat shield

9 - Turbocharger

- ❑ Can only be renewed together with exhaust manifold and vacuum unit as one unit
- ❑ Adaption must be performed after renewing this component
- ❑ Select `01 - Engine electronics, functions` and perform Guided Function `01 - Adaption after replacing positioner`
- ❑ Removing and installing ⇒ page 210

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10 - Retaining ring

- ❑ Can only be installed in one position

11 - O-ring

- ❑ Renew

12 - Pulsation damper

13 - Bolt

- ❑ 9 Nm

14 - Intake connecting pipe

15 - Bolt

- ❑ 9 Nm
- ❑ Captive in intake connecting pipe

16 - O-ring

- ❑ Renew

17 - Bracket

- ❑ For electrical wiring

18 - Bolt

- ❑ 15 Nm

19 - Heat shield

20 - Gasket

- ❑ Renew

21 - Nut

- ❑ Renew
- ❑ 24 Nm

22 - Exhaust gas temperature sender 1 - G235-

- ❑ Exploded view ⇒ page 301

23 - Bolt

- ❑ 20 Nm

24 - Support

- ❑ For turbocharger

25 - Bolt

- ❑ 9 Nm

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26 - O-rings

- ❑ Different diameters
- ❑ Renew

27 - Banjo bolt

- ❑ Renew
- ❑ 60 Nm
- ❑ Tighten banjo bolt using a commercially available open-end spanner insert, 27 mm and a suitable torque wrench

28 - O-rings

- ❑ Renew

29 - Banjo bolt

- ❑ 30 Nm

30 - Seals

- ❑ Renew

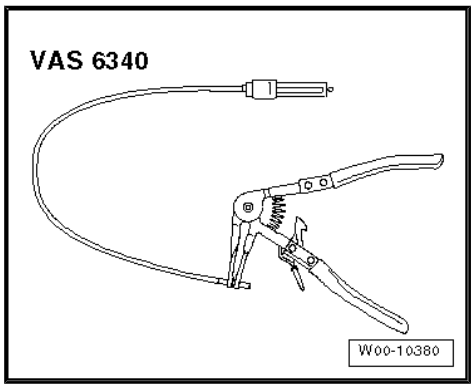
31 - Nut

- ❑ 24 Nm

1.2 Removing and installing turbocharger

Special tools and workshop equipment required

- ♦ Hose clip pliers - VAS 6340-



Removing

Note

Secure the heat insulation sleeve in the original position when installing.

– Observe rules for cleanliness ⇒ page 5 .

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Caution

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

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

– Remove engine cover panel ⇒ page 47 .

– Remove air cleaner housing ⇒ page 241 .

Vehicles with four-wheel drive and dual clutch gearbox:

– Unbolt drive shaft (right-side) from bevel box ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing drive shaft .

Vehicles with four-wheel drive and manual gearbox:

– Unbolt drive shaft (right-side) from bevel box ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing drive shaft .

– Remove flange shaft (right-side) ⇒ Rep. gr. 39 ; Differential; Removing and installing flange shaft (right-side) .

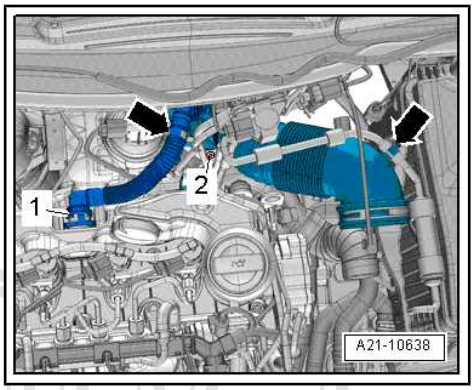
All vehicles:

– Press release tabs and disconnect crankcase breather hose -1- from cylinder head cover.

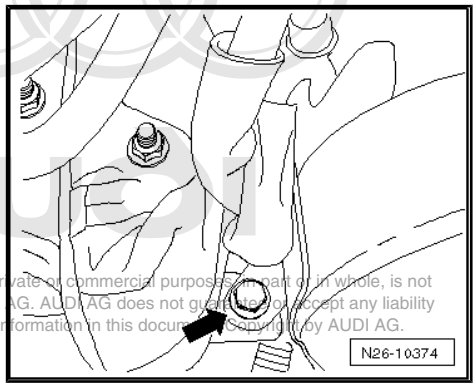
– Move clear vacuum hoses -arrows-.

– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.

– Disconnect battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Disconnecting and connecting battery .

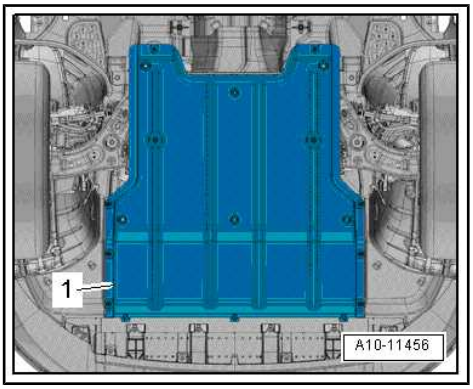


– Remove bolt -arrow- securing top bracket for particulate filter.

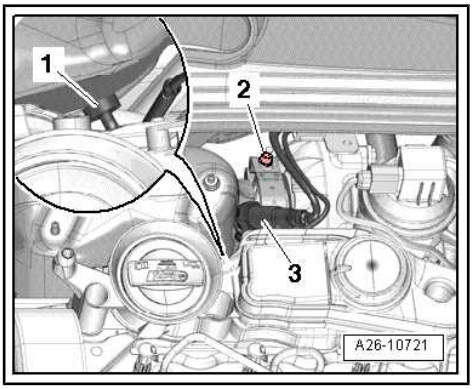


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– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

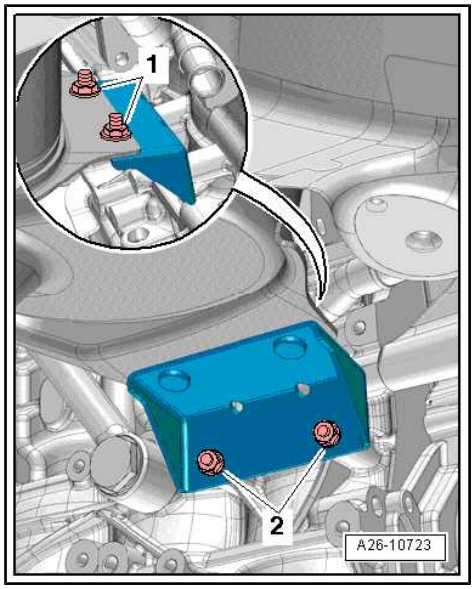


– Slacken bolt -2- and remove clamp.



– Remove nuts -1- and then nuts -2-, and detach bracket for particulate filter.

– Securely clamp or tie up particulate filter as far towards the rear as possible.



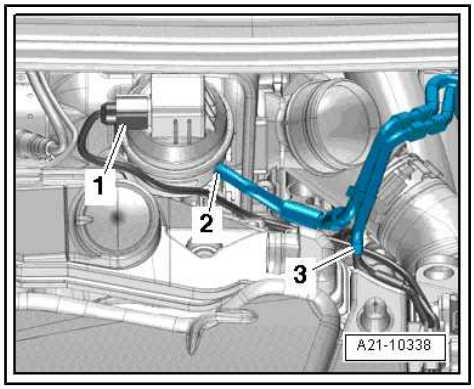
– Detach heat shield sleeve.

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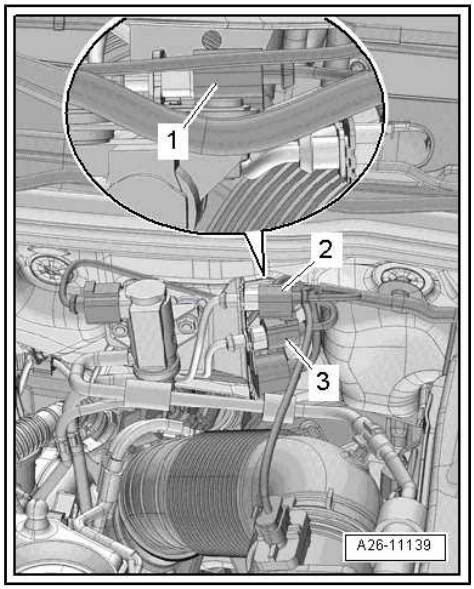
– Detach vacuum hose -2- from vacuum unit of turbocharger.

– Disconnect vacuum hose -3-.

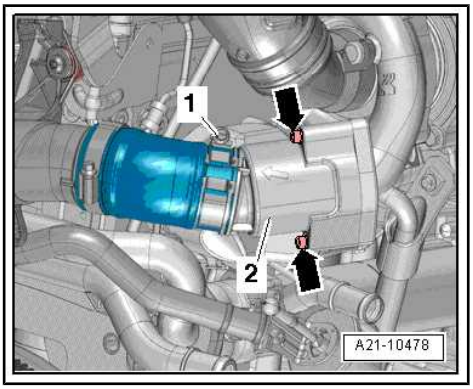
– Unplug electrical connector -1- at position sender for charge pressure positioner - G581- .



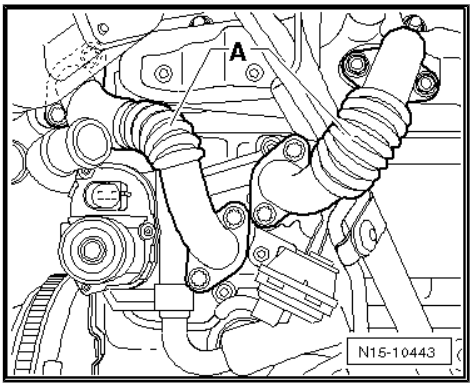
– Move clear electrical connector -2- for exhaust gas temperature sender 1 - G235- and electrical wiring at turbocharger.



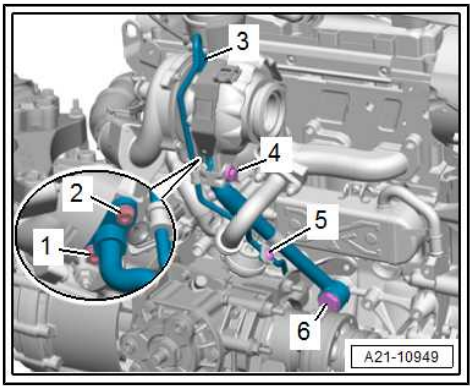
– Remove bolts -arrows-.
– Release hose clip -1- (or the other hose clip) and detach pulsation damper -2-.



– Remove bolts and detach both exhaust gas recirculation pipes -A-.



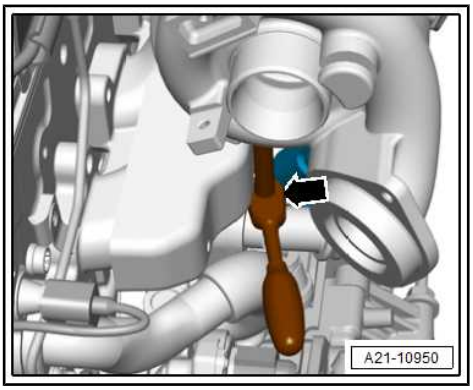
– Unscrew union nut -3- and remove bolts -4 and 5-.
– Remove bolts -1, 2 and 6- and detach oil return line.



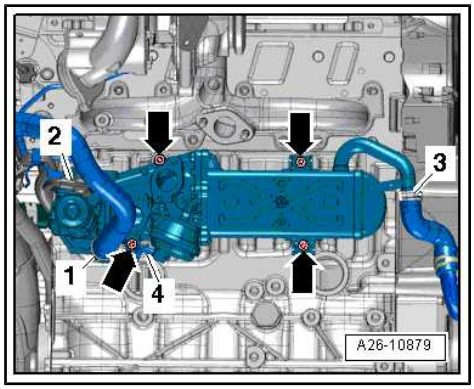
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Note

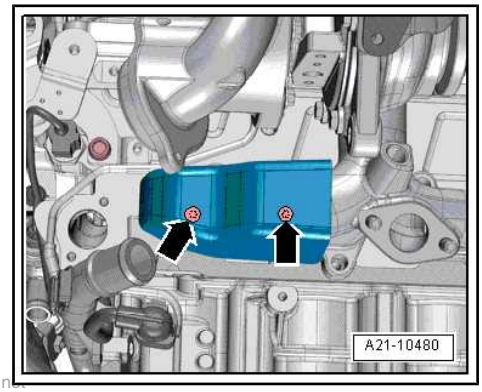
On four-wheel drive vehicles, bolt -1- for the oil return line is accessible from above. Use a small ratchet -arrow- to unscrew it.



– Remove bolts -arrows- and move exhaust gas recirculation cooler towards rear.

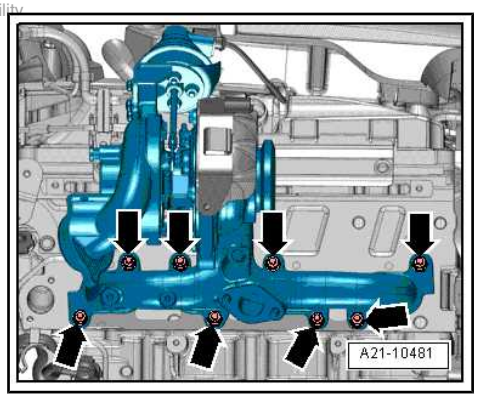


– Remove bolts -arrows- and detach heat shield.



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– Remove nuts -arrows-, detach turbocharger with exhaust manifold from cylinder head and lift out.



Note

The turbocharger is removed upwards. Make sure that the heat shield on the bulkhead is not damaged.

Installing

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

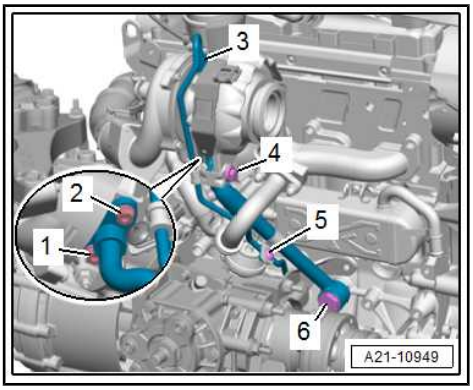
Tightening torques

- ⇒ “1.1 Exploded view - turbocharger”, page 208
- ⇒ Fig. ““Installing air hoses with screw-type clips”“ , page 222
- ⇒ “4.1 Exploded view - exhaust gas recirculation system”, page 307

Note

- *Renew seals, gaskets, O-rings and self-locking nuts.*
- *Fill turbocharger with engine oil at connection for oil supply line.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *After installing the turbocharger, allow the engine to idle for approx. 1 minute without pressing the accelerator to ensure that the turbocharger is supplied with oil.*

– Carefully fit and tighten union nut -3- for oil supply line while guiding in turbocharger.



Note

Do not bend the oil supply line and oil return line when installing them.

– Connect vacuum hoses ⇒ page 238 .
– Install particulate filter ⇒ page 294 .
– If previously removed: Install flange shaft (right-side) ⇒ Rep. gr. 39 ; Differential; Removing and installing flange shaft (right-side) .
– If previously removed: Secure drive shaft (right-side) ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing drive shaft .
– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .
– Install air cleaner housing ⇒ page 241 .
– Install engine cover panel ⇒ page 47 .
– Adaption must be performed after renewing this component:
– Connect ⇒ Vehicle diagnostic tester.
– Select `Diagnosis` mode and then `Start diagnosis`.
– Choose `Select own test` tab and select following options one after the other:

♦ `Drive train`
♦ `Select engine code and engine`
♦ `01 - Self-diagnosis compatible systems`
♦ `01 - Engine electronics`
♦ `01 - Engine electronics, functions`
♦ `01 - Adaption after replacing positioner`

1.3 Renewing vacuum unit for turbocharger

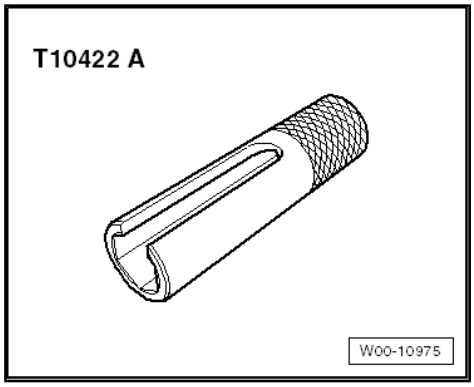
Note

♦ *Replacement part kit is available for renewing vacuum unit with position sender for charge pressure positioner - G581- ⇒ Electronic parts catalogue .*
♦ *Renewing vacuum unit with position sender for charge pressure positioner - G581- is only possible with certain engine codes. Refer to ⇒ Electronic parts catalogue for correct replacement part kit and for information on its availability.*
♦ *Socket, AF 10 mm - T10422 A- replaces socket, AF 10 mm - T10422- . If your workshop still has T10422 sockets, these can continue to be used.*

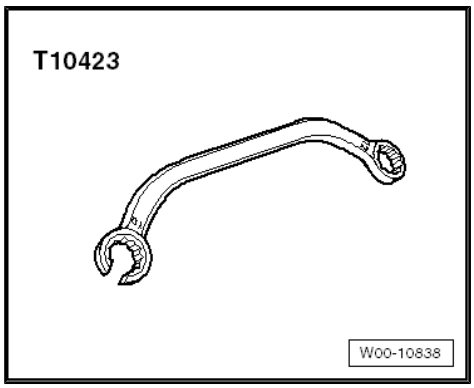
Special tools and workshop equipment required

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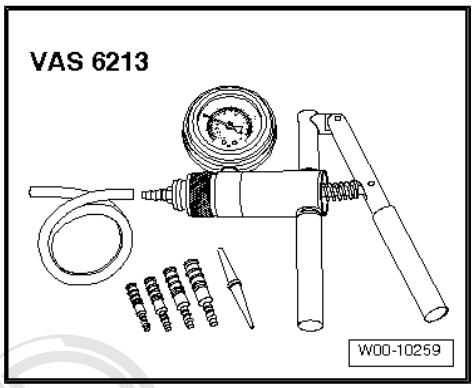
- Socket AF 10 mm - T10422 A-



- Ring spanner - T10423-



- Hand vacuum pump - VAS 6213-



- Vehicle diagnostic tester

Caution

The special tools listed, in particular the socket, AF 10 mm - T10422- / socket, AF 10 mm - T10422 A- , are only intended for use according to the procedure described in the following; do NOT use the tools for other bolted connections. There is danger of deformation if the specified torques are exceeded.

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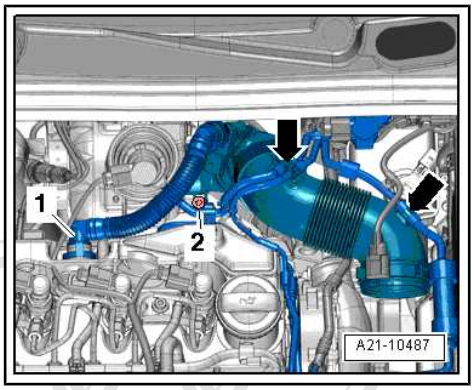
Removing

– Press release tabs and disconnect crankcase breather connecting pipe -1- from cylinder head cover.

– Move clear vacuum hoses -arrows-.

– Unscrew captive bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.

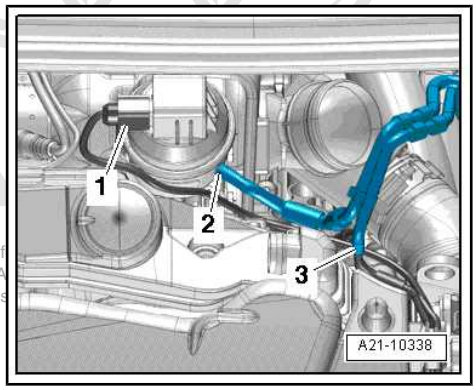
– Seal opening on turbocharger with sealing cap from replacement part kit.



– Detach heat shield sleeve around electrical connector -1-.

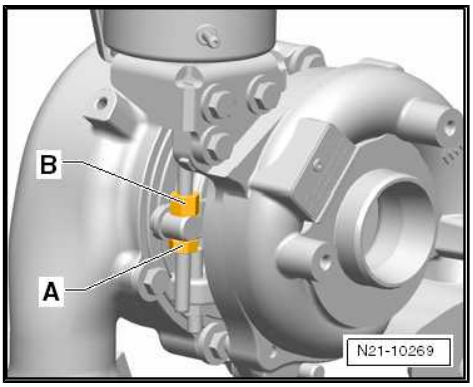
– Unplug electrical connector -1- at position sender for charge pressure positioner - G581- .

– Detach vacuum hose -2- from vacuum unit of turbocharger.

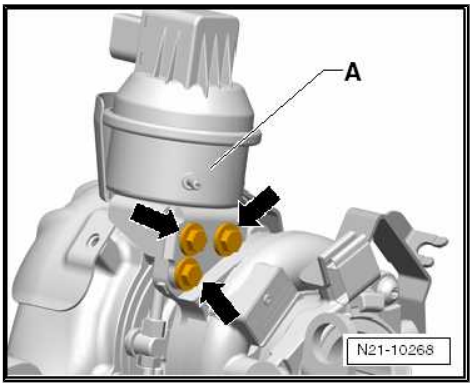


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– Counterhold lock nut -B- and remove securing nut -A- from control rod using socket, AF 10 mm - T10422- / socket, AF 10 mm - T10422 A- .



– Unscrew bolts -arrows- securing vacuum unit and detach vacuum unit with position sender for charge pressure positioner - G581- -A-.

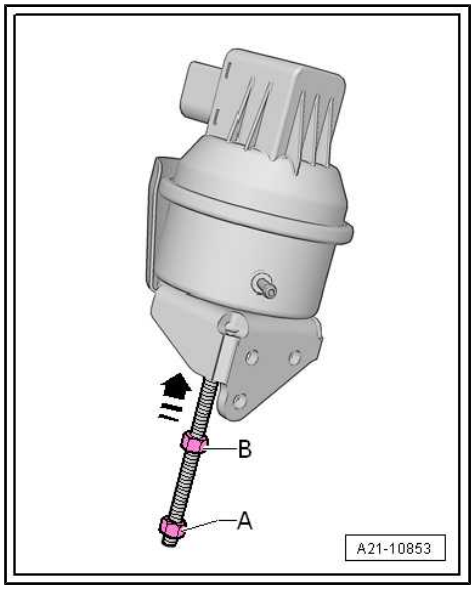


Installing

Caution

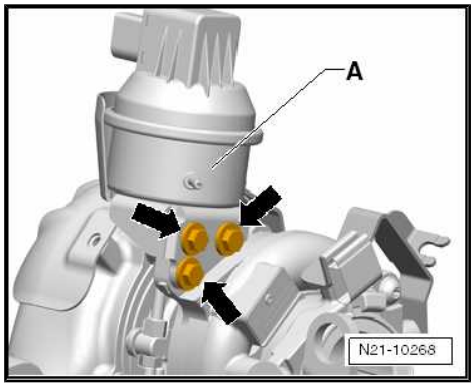
Only use new bolts and nuts from replacement part kit.

– If necessary, remove bottom nut -A- securing control rod from new vacuum unit.
– Screw lock nut -B- onto control rod by hand as far as stop in direction of -arrow-.



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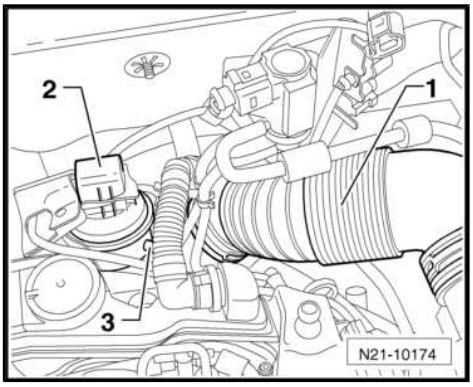
– Guide control rod through adjusting lever on turbocharger, fit vacuum unit -A- and secure bolts -arrows-.
– Tighten securing bolts -arrows- to 8 Nm.



Note

Please ensure that guide can be moved easily on control rod.

– Plug in connector -2- at position sender for charge pressure positioner - G581- and fasten heat shield sleeve.
– Connect vehicle diagnostic tester .



Selecting operating mode:

– On touch screen, press button for “Vehicle self-diagnosis”.

Selecting vehicle system:

– On touch screen, press button for “01 - Engine electronics”.

The display will show the identification and coding of the engine control unit.

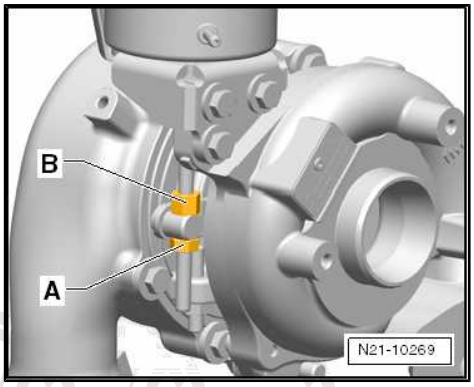
Selecting diagnostic function:

– On touch screen, press button for “Measured values”.
– Select “Actuator for turbocharger high-pressure, actual value raw voltage” and continue until the measured value is shown on the display.
– Connect hand vacuum pump - VAS 6213- to vacuum unit.
– Create voltage of 760 mV by generating a maximum vacuum of 0.65 bar (observe measured value shown).

Caution

During the following adjustment procedure for the control rod, the vacuum and the voltage of 0.760 V must be maintained.

– Slowly screw lock nut -B- for control rod downwards by hand. Adjusting lever is on bottom stop.
– Counterhold lock nut -B- and screw securing nut -A- on control rod against adjusting lever. Tighten slightly using ring spanner - T10423- .
– Release vacuum pressure from vacuum unit.
– Observe measured value shown; a value of 3000 ... 3400 mV should be displayed (unpressurised).
– Fit socket, AF 10 mm - T10422- / socket, AF 10 mm - T10422 A- , counterhold lock nut -B- and tighten securing nut -A-.



Caution

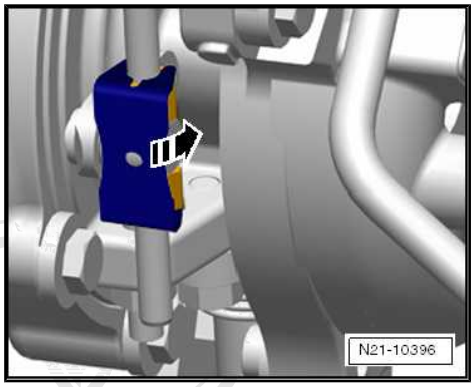
Create vacuum of 0.65 ± 0.05 bar for vacuum unit to ensure that adjusting lever is positioned at stop. A voltage of 760 mV should build up.

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Voltage value OK

– Press locking plate onto control rod by hand and, if possible, turn by 90° in direction of -arrow-.

– Seal connection between control rod and securing nut with sealing paint from replacement part kit.

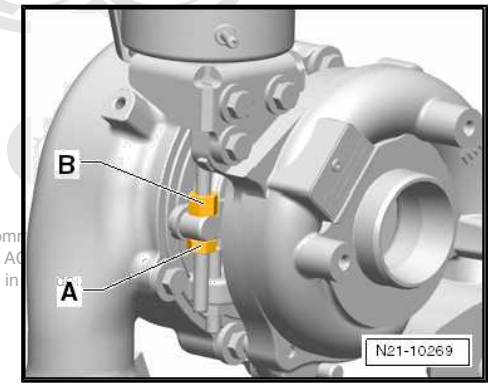


Voltage value not OK

– Counterhold lock nut -B-, loosen securing nut -A- on control rod and adjust value by turning lock nut -B-.

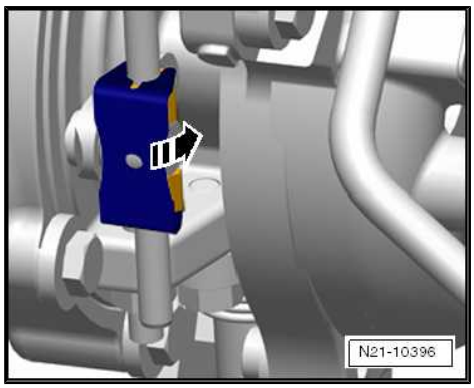
– Counterhold lock nut -B-, screw securing nut -A- in other direction and tighten using socket, AF 10 mm - T10422- / socket, AF 10 mm - T10422 A- .

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– Press locking plate onto control rod by hand and, if possible, turn by 90° in direction of -arrow-.

– Seal connection between control rod and securing nut with sealing paint from replacement part kit.



Continued

– Remove sealing cap from turbocharger.

– Fully assemble engine components.

– Start engine and erase event memory ⇒ Vehicle diagnostic tester.

– Check adjustment as follows:

Selecting diagnostic function:

– On touch screen, press button for “Basic setting”.

– Select “Adaption of turbocharger” from list.

– On bottom right of touch screen, press button for “Measured values”.

– Select “Actuator for turbocharger high-pressure, actual value raw voltage” from list.

– On bottom right of touch screen, press button for “Start”.

– Observe value on bottom part of display: value should fluctuate between 650 ... 850 mV and 3000 ... 3400 mV (vacuum unit is moved to both limit stops alternately).

Voltage values OK:

– Exit basic setting.

2 Charge air system

⇒ “2.1 Exploded view - charge air system”, page 221

⇒ “2.1 Connection diagram - vacuum system”, page 238

⇒ “2.2 Removing and installing charge air cooler”, page 222

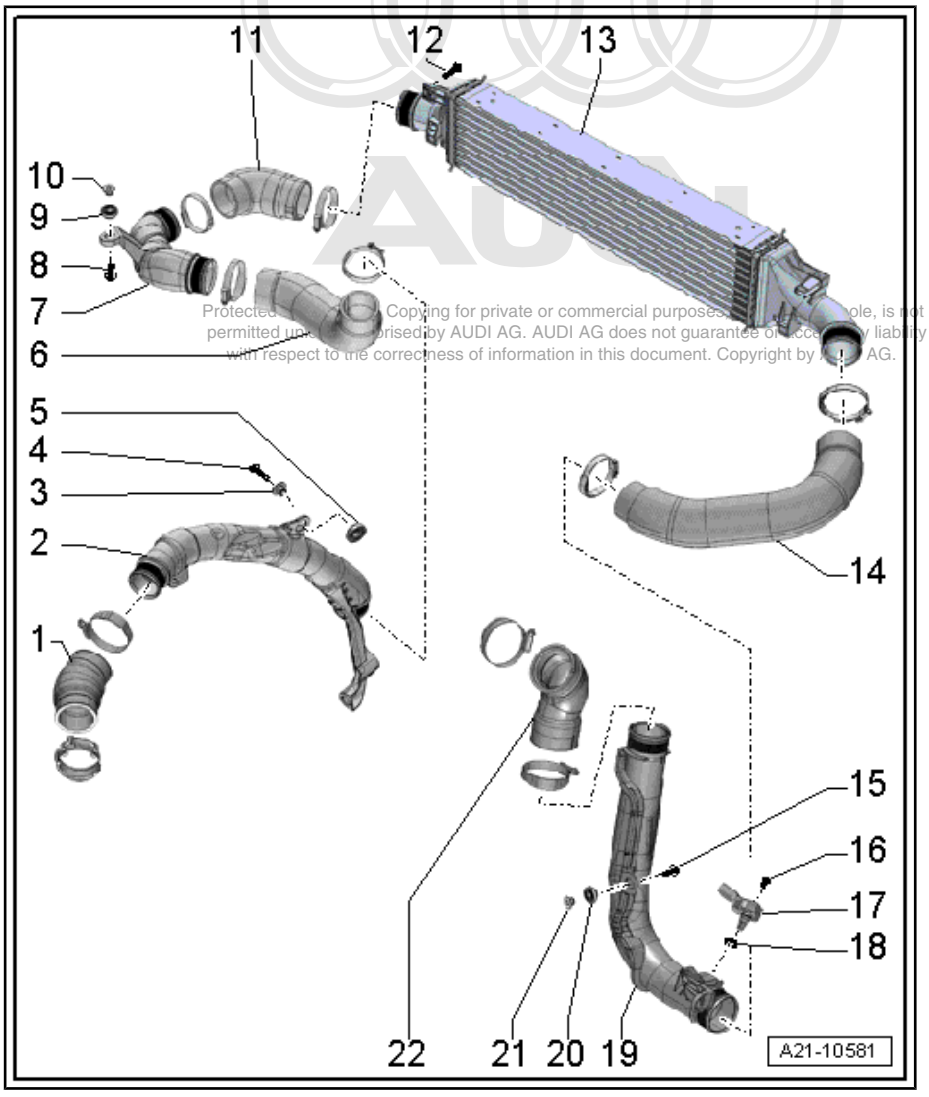
⇒ “2.3 Removing and installing charge pressure sender G31 / intake air temperature sender G42 ”, page 224

⇒ “2.4 Checking charge air system for leaks”, page 225

2.1 Exploded view - charge air system

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.*
- *Observe rules for cleanliness ⇒ page 5 .*



1 - Air hose

2 - Air pipe (rear left)

3 - Spacer sleeve

4 - Bolt

❑ 9 Nm

5 - Grommet

❑ Renew if damaged

6 - Air hose

7 - Air pipe (front left)

8 - Bolt

❑ 9 Nm

9 - Grommet

❑ Renew if damaged

10 - Spacer sleeve

11 - Air hose

12 - Bolt

❑ 7 Nm

13 - Charge air cooler

❑ Removing and installing ⇒ page 222

14 - Air hose

15 - Bolt

❑ 9 Nm

16 - Bolt

❑ 5 Nm

17 - Charge pressure sender - G31- / intake air temperature sender - G42-

❑ Removing and installing ⇒ page 224

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18 - O-ring

- ❑ Renew

19 - Air pipe (right-side)

20 - Grommet

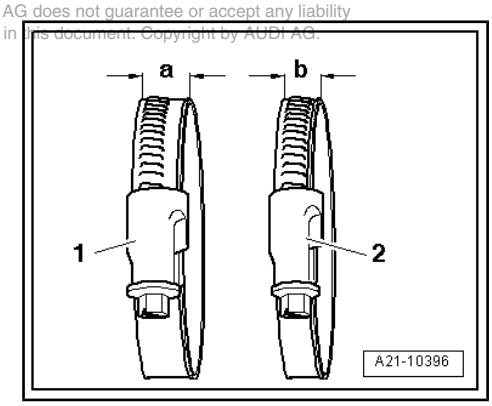
- ❑ Renew if damaged

21 - Spacer sleeve

22 - Air hose

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Installing air hoses with screw-type clips



Note

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

Tightening torque for

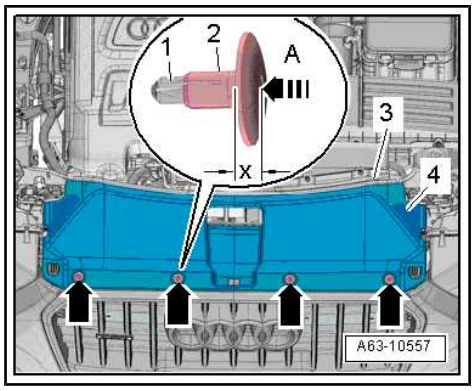
1 - Hose clip with width -a- = 13 mm: 5.5 Nm

2 - Hose clip with width -b- = 9 mm: 3 Nm

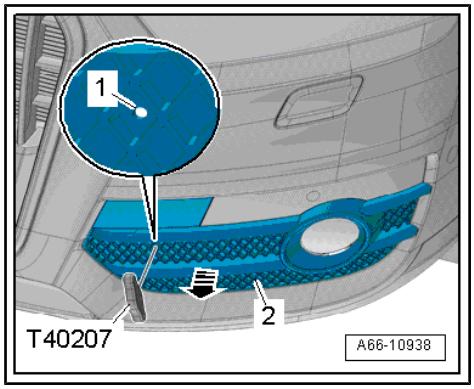
2.2 Removing and installing charge air cooler

Removing

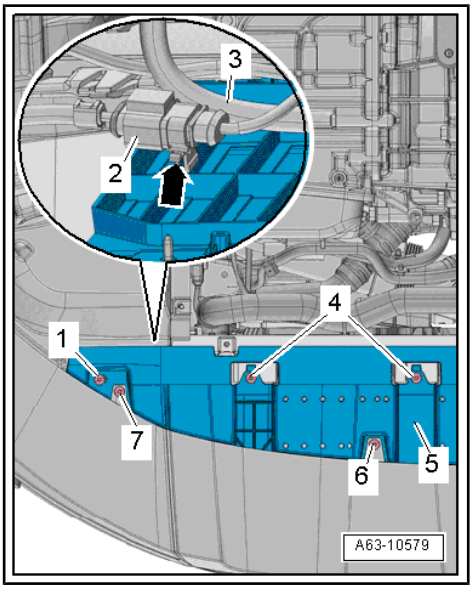
– Remove lock carrier cover -4- ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Exploded view - bumper cover .



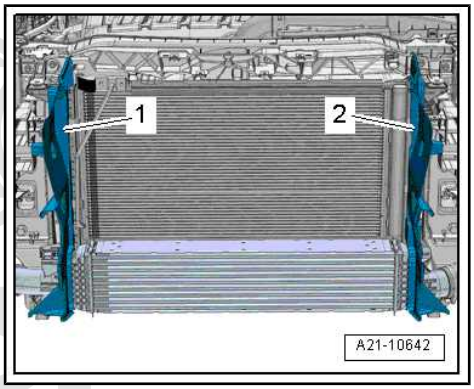
– Remove air intake grille -2- on both sides ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Exploded view - bumper cover .



– Remove closure plate for bumper cover -5- ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Exploded view - bumper cover .

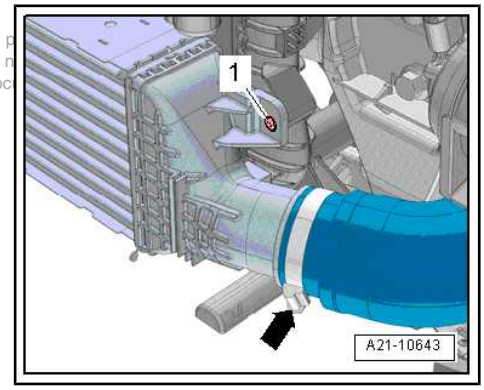


– Unclip air ducts -1 and 2-.



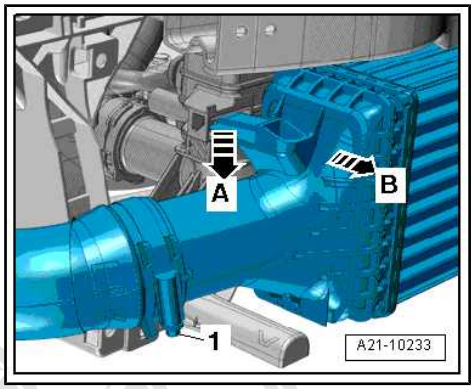
– Release hose clip -arrow- and detach air hose from charge air cooler.

– Remove bolt -1-.



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– Release hose clip -1- and detach air hose from charge air cooler.
– Push catch down -arrow A- and move top of charge air cooler slightly in direction of -arrow B-.
– Disengage and detach charge air cooler upwards.



Installing

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

Tightening torques:

- ⇒ “2.1 Exploded view - charge air system”, page 221
- ⇒ Fig. ““Installing air hoses with screw-type clips”“ , page 222

Note

If there are slight impressions on the fins, refer to ⇒ page 7 .

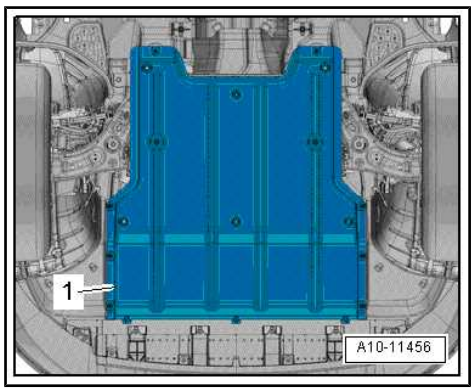
– Install closure plate for bumper cover, air intake grille and lock carrier cover ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Exploded view - bumper cover .

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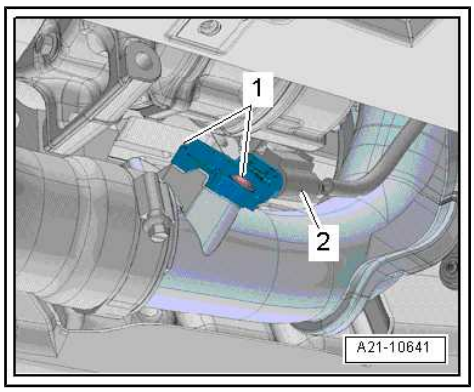
2.3 Removing and installing charge pressure sender - G31- / intake air temperature sender - G42-

Removing

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



– Unplug electrical connector -2-.
– Remove bolts -1- and pull charge pressure sender - G31- / intake air temperature sender - G42- out of air pipe.



Installing

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

- Tightening torque
⇒ “2.1 Exploded view - charge air system”, page 221

Note

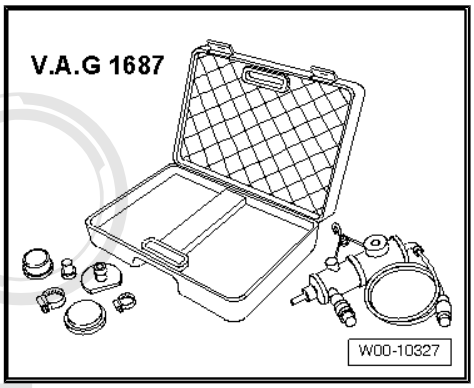
Fit new O-ring.

– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

2.4 Checking charge air system for leaks

Special tools and workshop equipment required

- Charge air system tester - V.A.G 1687- with adapters -V.A.G 1687/11- and -V.A.G 1687/16-



Procedure

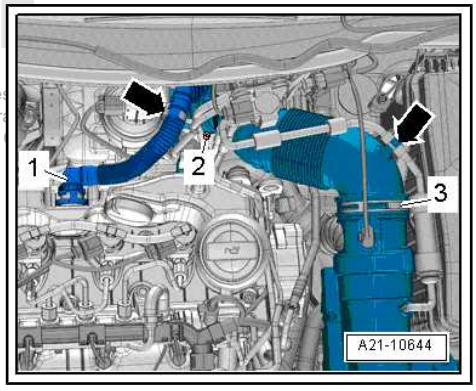
– Remove engine cover panel ⇒ page 47 .

– Press release tabs and detach crankcase breather hose -1-.

– Move clear vacuum hoses -arrows-.

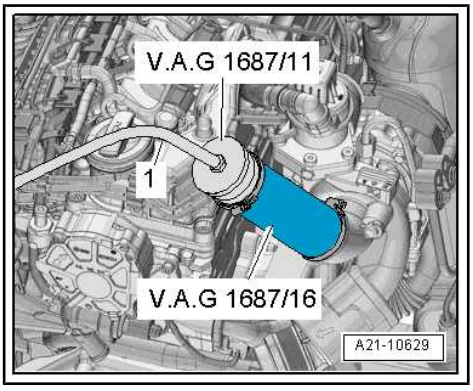
– Release hose clip -3- and detach air pipe from air cleaner housing.

– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.



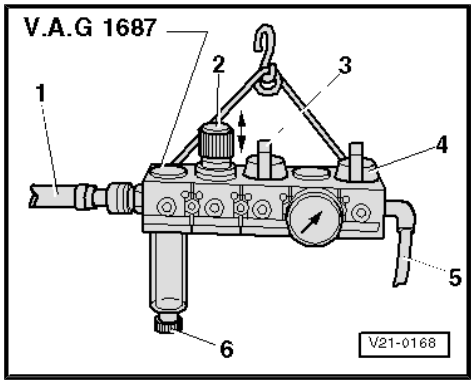
– Connect adapter - V.A.G 1687/11- with -V.A.G 1687/16- to turbocharger.

– Connect hose -1- of charge air system tester -V.A.G 1687- to adapter.



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Prepare charge air system tester - V.A.G 1687- as follows:



– Unscrew pressure control valve -2- completely and close valves -3- and -4-.

• Make sure knob is pulled out before turning pressure control valve -2-.

– Using a commercially available connection piece, connect charge air system tester - V.A.G 1687- to compressed air -1-.

Note

If there is water in sight glass, remove drain plug -6- and drain water.

– Open valve -3-.

Caution

Risk of damage if pressure is set too high.

- ***The pressure must not exceed 0.5 bar.***

– Adjust pressure to 0.5 bar via pressure control valve -2-.

– Open valve -4- and wait until test system is pressurised. If necessary, adjust pressure to 0.5 bar again.

– Check charge air system for audible leaks or leaks that can be felt with the hand; apply commercially available leak detecting spray or use ultrasonic tester - V.A.G 1842- .

Note

- *A small amount of air escapes through the valves and enters the engine. Therefore it is not possible to perform a pressure retention test.*
- *For operation of ultrasonic tester -V.A.G 1842- , refer to ⇒ Operating instructions .*
- *Release pressure in test circuit by detaching hose coupling from adapter before removing adapter.*

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Assembling

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

Tightening torques:

• ⇒ “1.1 Exploded view - turbocharger”, page 208
• ⇒ Fig. ““Installing air hoses with screw-type clips”“ , page 222

Note

- *Renew gasket and O-rings.*
- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Install engine cover panel ⇒ page 47 .

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23 – Mixture preparation - injection

1 Injection system

⇒ “1.1 Overview of fitting locations - injection system”, page 228

⇒ “1.2 Overview - fuel system”, page 235

⇒ “1.3 Filling and bleeding fuel system”, page 236

⇒ “1.4 Checking fuel system for leaks”, page 237

1.1 Overview of fitting locations - injection system

Components “A” to “I” are not shown in the illustration.

1 - Pressure differential sender - G505-

- ❑ Exploded view ⇒ page 280
- ❑ If renewed, learnt values must be reset

2 - Hall sender - G40-

- ❑ Fitting location ⇒ page 233
- ❑ Exploded view ⇒ page 312

3 - Injectors

- ❑ Exploded view ⇒ page 254

4 - Lambda probe - G39- with Lambda probe heater - Z19-

- ❑ Fitting location ⇒ page 234
- ❑ Exploded view ⇒ page 280

5 - Position sender for charge pressure positioner - G581-

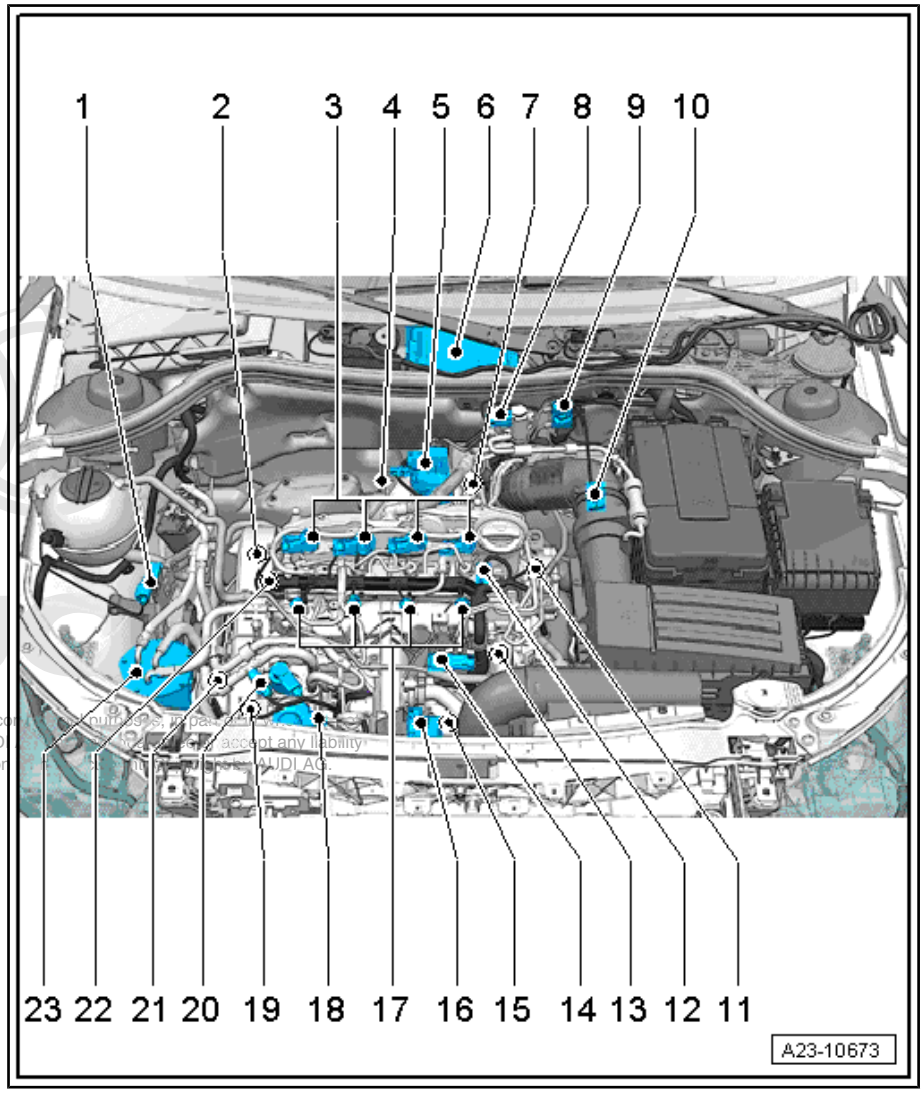
- ❑ Fitting location ⇒ page 234

6 - Engine control unit - J623-

- ❑ Removing and installing ⇒ page 284

7 - Exhaust gas recirculation control motor - V338- with exhaust gas recirculation potentiometer - G212-

- ❑ Fitting location



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⇒ page 232

- ❑ Exploded view ⇒ page 307

8 - Charge pressure control solenoid valve - N75-

- ❑ Fitting location ⇒ page 232
- ❑ Diagram of vacuum connections ⇒ page 238

9 - Electrical connectors

- ❑ For exhaust gas temperature sender 4 - G648-
- ❑ For exhaust gas temperature sender 1 - G235-
- ❑ For Lambda probe - G39-
- ❑ Fitting location ⇒ page 232

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10 - Air mass meter - G70-

- ❑ Exploded view ⇒ page 240

11 - Coolant temperature sender - G62-

- ❑ Fitting location ⇒ page 234

12 - Fuel pressure regulating valve - N276-

- ❑ Exploded view ⇒ page 254
- ❑ Checking ⇒ page 273

13 - Engine speed sender - G28-

- ❑ Fitting location ⇒ page 234
- ❑ Exploded view ⇒ page 312

14 - Exhaust gas recirculation cooler change-over valve - N345-

- ❑ Diagram of vacuum connections ⇒ page 238

15 - Pump for exhaust gas recirculation cooler - V400-

- ❑ Fitting location ⇒ page 233

16 - Throttle valve module - J338- with throttle valve potentiometer - G69-

- ❑ Exploded view

17 - Glow plugs

- ❑ Glow plug 1 - Q10-
- ❑ Glow plug 2 - Q11-
- ❑ Glow plug 3 - Q12-
- ❑ Glow plug 4 - Q13-
- ❑ Exploded view ⇒ page 312

18 - High-pressure fuel pump with fuel metering valve - N290-

- ❑ Fitting location ⇒ page 233
- ❑ Exploded view ⇒ page 249
- ❑ Do not open fuel metering valve - N290-
- ❑ After renewing, first fuel filling operation MUST be performed (it is important not to allow pump to run while it is still empty) ⇒ page 236

19 - Charge pressure sender - G31- with intake air temperature sender - G42-

- ❑ Fitting location ⇒ page 232

20 - Fuel temperature sender - G81-

- ❑ In fuel supply line
- ❑ Fitting location ⇒ page 233

21 - Radiator outlet coolant temperature sender - G83-

- ❑ Fitting location ⇒ page 234

22 - Fuel pressure sender - G247-

- ❑ Exploded view ⇒ page 254

23 - Fuel filter

- ❑ Exploded view ⇒ Fuel supply system, diesel engines; Rep. gr. 20 ; Fuel filter; Exploded view - fuel filter

A - Low heat output relay - J359- and high heat output relay - J360-

- ❑ Fitting location ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

B - Brake light switch - F- and brake pedal switch - F47-

- ❑ Fitting location ⇒ page 231

C - Clutch position sender - G476-

- ❑ Fitting location ⇒ page 231
- ❑ Only fitted on vehicles with manual gearbox

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D - Accelerator position sender - G79- and accelerator position sender 2 - G185-

- ❑ Fitting location ⇒ page 230

E - Exhaust gas temperature sender 1 - G235-

- ❑ Exploded view ⇒ page 280

F - Exhaust gas temperature sender 3 - G495-

- ❑ Fitting location ⇒ page 234
- ❑ Exploded view ⇒ page 280

G - Exhaust gas temperature sender 4 - G648-

- ❑ Exploded view ⇒ page 280

H - Particulate filter

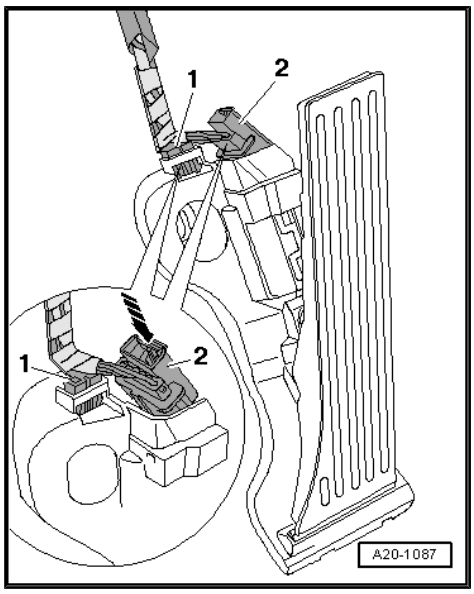
- ❑ Combined with catalytic converter
- ❑ Exploded view ⇒ page 293

I - Radiator fan control unit - J293-

- ❑ Fitting location ⇒ page 233

Fitting location: accelerator position sender - G79- and accelerator position sender 2 - G185-

- ♦ Combined with accelerator pedal module

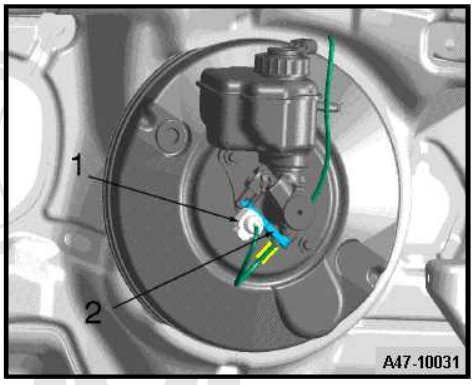


Note

The illustration shows the set-up for left-hand drive vehicles.

Removing and installing accelerator pedal module ⇒ Fuel supply system, diesel engines; Rep. gr. 20 ; Accelerator mechanism; Removing and installing accelerator pedal module with accelerator position sender -G79- / -G185- .

Fitting location of brake light switch - F- and brake pedal switch - F47-

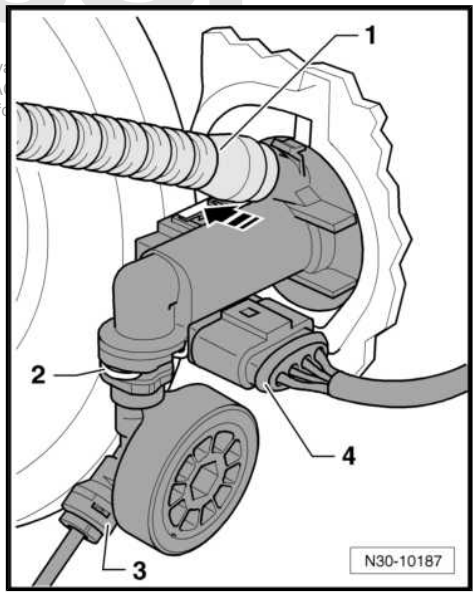


1 - Brake light switch - F- and brake pedal switch - F47-

- On brake master cylinder

Removing and installing ⇒ Brake system; Rep. gr. 47 ; Brake servo/brake master cylinder; Removing and installing brake light switch

Fitting location of clutch position sender - G476-



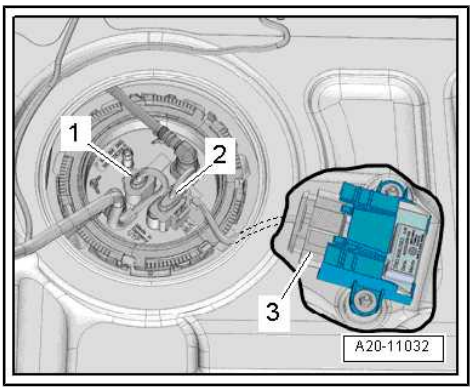
- On clutch master cylinder -4-

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Removing and installing ⇒ Rep. gr. 30 ; Clutch mechanism; Removing and installing clutch position sender - G476-

Integrated functions: clutch pedal switch for engine start - F194- and clutch pedal switch - F36- (manual gearbox only)

Fitting location of fuel pump control unit - J538- -3-



1 - Electrical connector for fuel gauge sender - G-

2 - Electrical connector for fuel system pressurisation pump - G6-

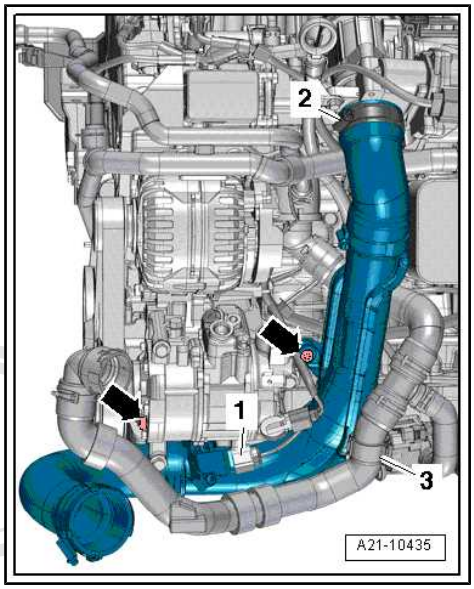
3 - Fuel pump control unit - J538-

Removing and installing ⇒ Fuel supply system - diesel engines; Rep. gr. 20 ; Fuel pump; Removing and installing fuel pump control unit -J538-

Fitting location of charge pressure sender - G31- with intake air temperature sender - G42-

1 - Charge pressure sender - G31- with intake air temperature sender - G42-

Removing and installing ⇒ page 224

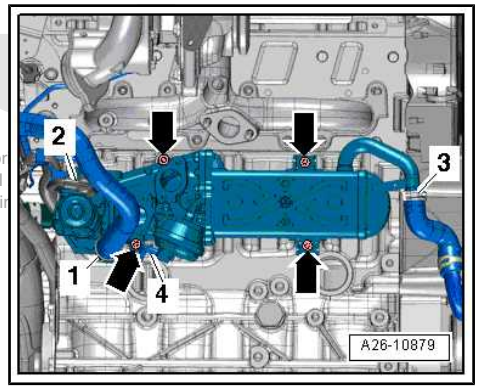


Components at rear of engine

2 - Exhaust gas recirculation control motor - V338- with exhaust gas recirculation potentiometer - G212-

4 - Vacuum unit for exhaust gas recirculation cooling system

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Electrical connectors

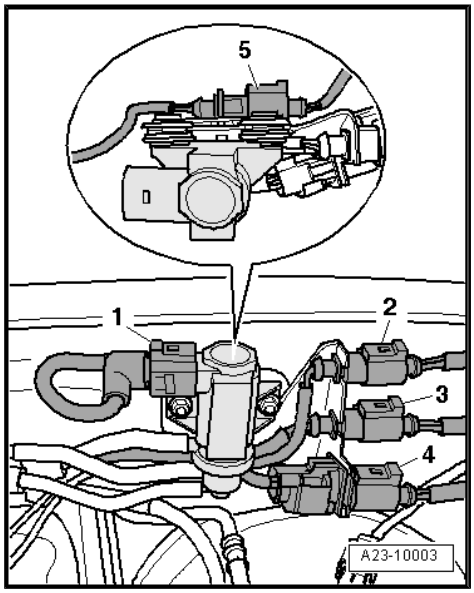
1 - For charge pressure control solenoid valve - N75-

2 - For exhaust gas temperature sender 4 - G648- (orange)

3 - For exhaust gas temperature sender 1 - G235- (black)

4 - For Lambda probe - G39-

5 - For exhaust gas temperature sender 3 - G495- (brown)

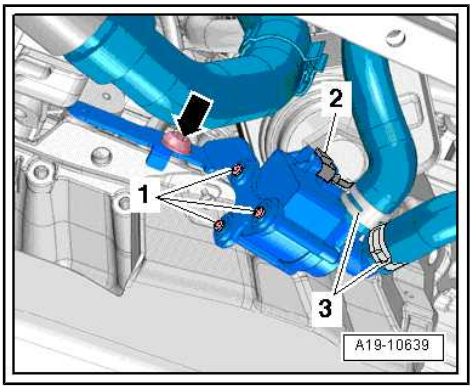


Fitting location of pump for exhaust gas recirculation cooler - V400-

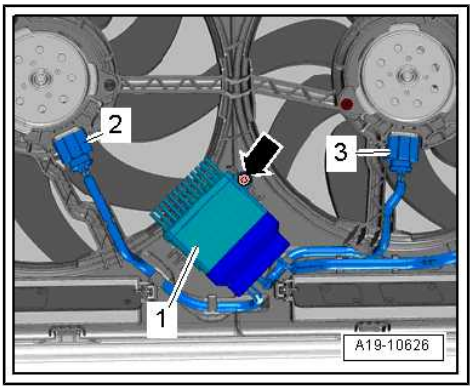
2 - Pump for exhaust gas recirculation cooler - V400-

- At front of engine

Removing and installing ⇒ page 181



Radiator fan control unit - J293- -1-



Fitting locations at high-pressure fuel pump

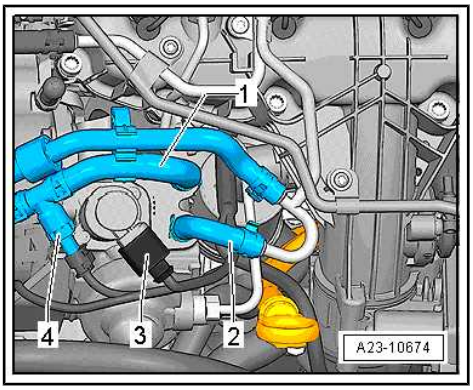
1 - Fuel supply line

2 - Fuel return line

3 - Fuel metering valve - N290-

4 - Fuel temperature sender - G81-

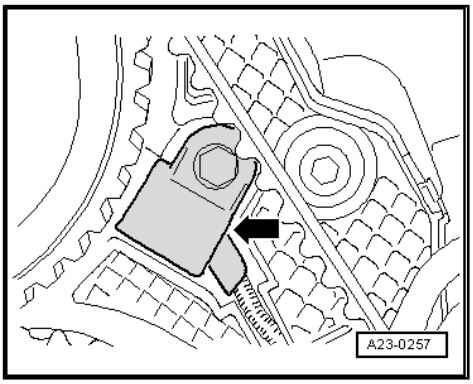
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Fitting location of Hall sender - G40-

- Next to camshaft sprocket -arrow-

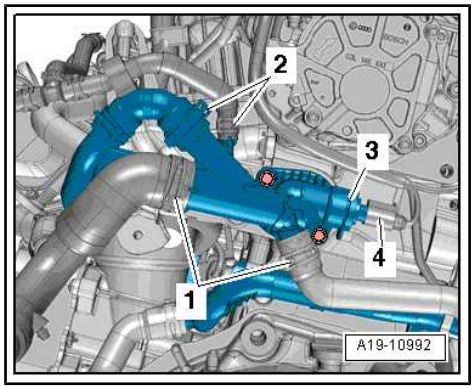
Removing and installing ⇒ page 315



Fitting location of coolant temperature sender - G62-

4 - Coolant temperature sender - G62-

Removing and installing ⇒ page 183

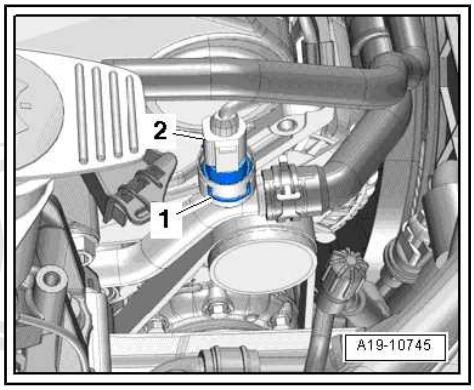


Fitting location of radiator outlet coolant temperature sender - G83-

2 - Radiator outlet coolant temperature sender - G83-

♦ In coolant pipe (right-side) above alternator

Removing and installing ⇒ page 185



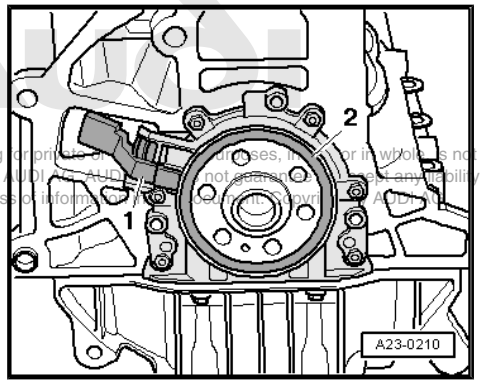
Fitting location of engine speed sender - G28-

1 - Engine speed sender - G28-

2 - Sender wheel

♦ On flywheel side of engine

Removing and installing ⇒ page 316



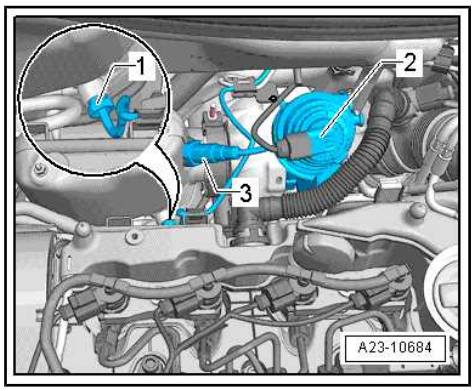
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Lambda probe

1 - Exhaust gas temperature sender 3 - G495-

2 - Position sender for charge pressure positioner - G581-

3 - Lambda probe - G39-



1.2 Overview - fuel system

WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 6 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

Caution

The high-pressure pump has very close tolerances and must not be allowed to run without fuel. To prevent this and to enable the engine to start quickly after parts have been renewed, it is important to observe the following:

- *If components of the fuel system between the fuel tank and the high-pressure pump are removed or renewed, the fuel system must be bled ⇒ page 236 .*
- *If the high-pressure pump is removed or renewed, the first fuel filling operation must be performed before the engine is started for the first time ⇒ page 236 .*

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Note

The high-pressure pump will be damaged if the first fuel filling operation is not performed.

1 - Fuel tank

- ❑ With fuel system pressurisation pump - G6-

2 - Fuel filter

3 - Not fitted

4 - Filter strainer

5 - Fuel temperature sender - G81-

6 - High-pressure fuel pump

- ❑ Exploded view ⇒ page 249

7 - Fuel metering valve - N290-

- ❑ Do not unscrew

8 - Fuel pressure regulating valve - N276-

- ❑ Exploded view ⇒ page 254

9 - High-pressure reservoir (rail)

- ❑ Exploded view ⇒ page 254

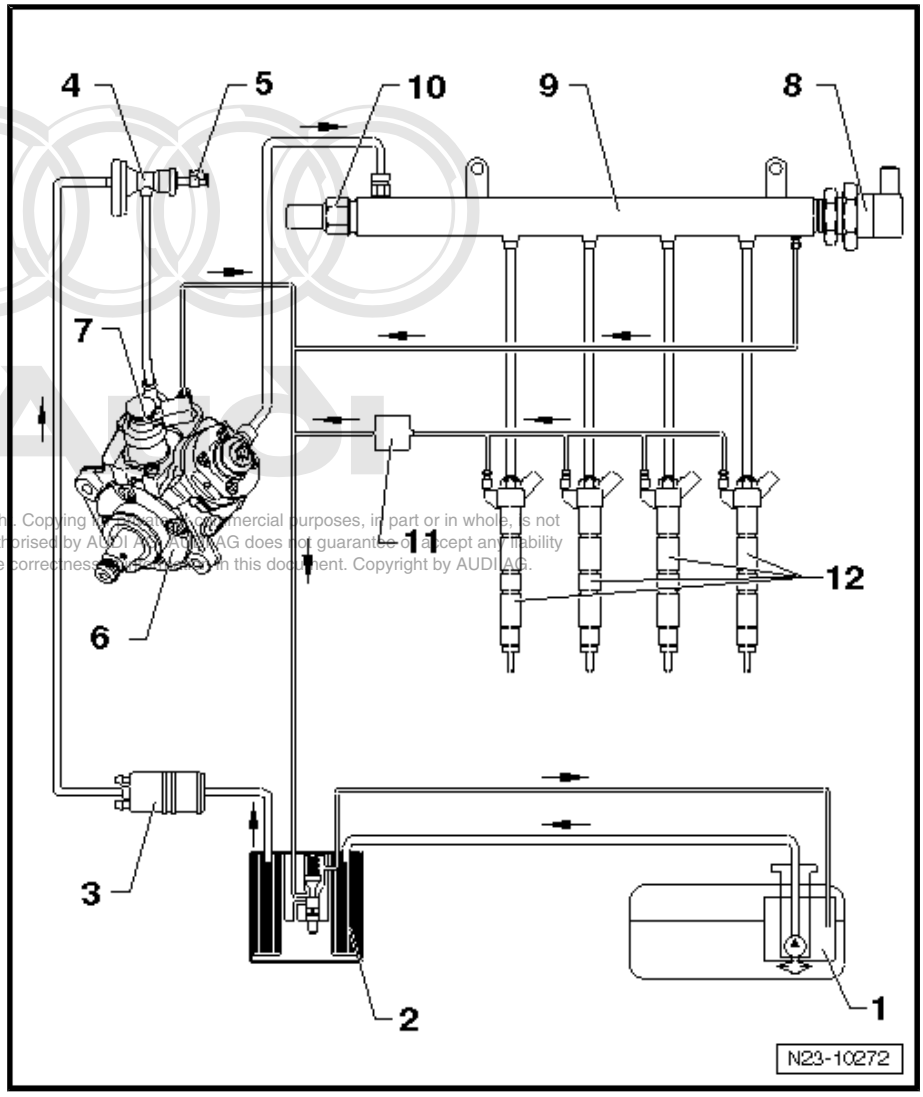
10 - Fuel pressure sender - G247-

- ❑ Exploded view ⇒ page 254

11 - Restrictor

12 - Injector

- ❑ Exploded view ⇒ page 254



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1.3 Filling and bleeding fuel system

Special tools and workshop equipment required

♦ Vehicle diagnostic tester

If components of the fuel system between the fuel tank and the high-pressure pump are removed or renewed, the fuel system must be bled.

Risk of irreparable damage to fuel pump

After working on the fuel system, the fuel pump may be irreparably damaged if it is allowed to run while empty.

– Never allow fuel pump to run while it is empty.

– Fill/bleed fuel pump.

Proceed as follows to fill high-pressure pump with fuel.

- Check fuel gauge in instrument cluster; fuel gauge needle must indicate that fuel is above reserve level.

– Connect ⇒ Vehicle diagnostic tester.
– Select `Diagnosis` mode and then `Start diagnosis`.
– Choose `Select own test` tab and select following options one after the other:

♦ `Drive train`
♦ `Select engine code and engine`
♦ `01 - Self-diagnosis compatible systems`
♦ `01 - Engine electronics`
♦ `01 - Engine electronics, functions`
♦ `Activate fuel pump`
♦ Press `Carry out check`

– The fuel pump starts running.
– The fuel pump must run for approx. 3 minutes to ensure that the fuel system is filled sufficiently with fuel.
– Start engine after filling fuel system.
– Run engine at moderate speed for several minutes and then switch off.
– Check fuel system for leaks.
– Road-test vehicle and accelerate with full throttle at least once.
– Then inspect high-pressure section again for leaks.

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1.4 Checking fuel system for leaks

Procedure

WARNING

The fuel system operates at high pressure - risk of injuries!

♦ ***The fuel system is self-bleeding; do not open the high-pressure connections.***

– Allow engine to run for several minutes at moderate rpm.
– Switch off ignition.
– Check the complete fuel system including all 4 return line connections for leaks.
– If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
– Road-test vehicle and accelerate with full throttle at least once.
– Then inspect high-pressure section of fuel system again for leaks.

Note

If there is any air left in the fuel system, the engine may switch to the backup mode ('emergency running' mode) during the road test. Switch off the engine and erase the event memory. Then continue the road test.

2 Vacuum system

⇒ “2.1 Connection diagram - vacuum system”, page 238

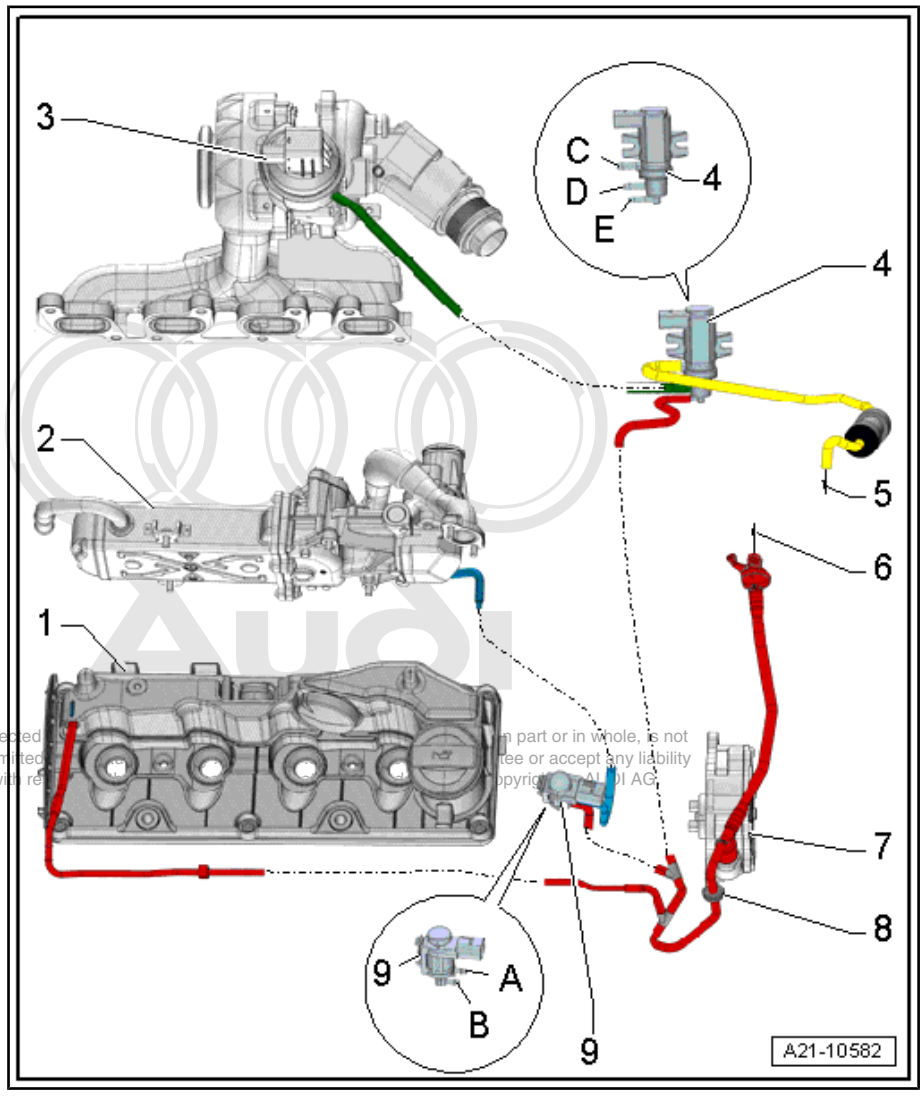
⇒ “2.2 Checking vacuum system”, page 238

2.1 Connection diagram - vacuum system

Caution

Risk of engine malfunctions

- *When routing vacuum lines, make sure they are not kinked, twisted or crushed.*



1 - Cylinder head cover

- ❑ With vacuum reservoir

2 - Exhaust gas recirculation cooler

- ❑ With vacuum unit for EGR cooler change-over function

3 - Vacuum unit

- ❑ On turbocharger
- ❑ With position sender for charge pressure positioner - G581-

4 - Charge pressure control solenoid valve - N75-

- ♦ C - Connection for vented air to air cleaner
- ♦ D - Connection to vacuum unit on turbocharger
- ♦ E - Connection to vacuum supply

5 - To air cleaner housing

6 - To brake servo

7 - Vacuum pump

8 - Non-return valve

- ❑ Note installation position

9 - Exhaust gas recirculation cooler change-over valve - N345-

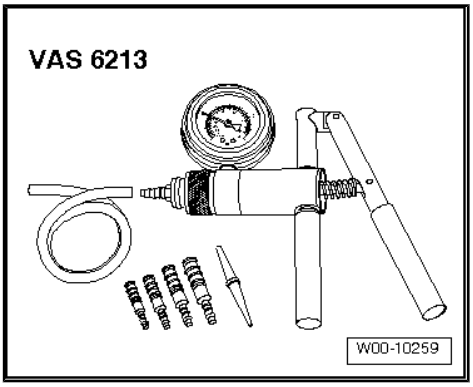
- ❑ Checking change-over function ⇒ page 310

- ♦ A - Connection to vacuum unit for exhaust gas recirculation cooler
- ♦ B - Connection to vacuum supply

2.2 Checking vacuum system

Special tools and workshop equipment required

- Hand vacuum pump - VAS 6213-



Procedure

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

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

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

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

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

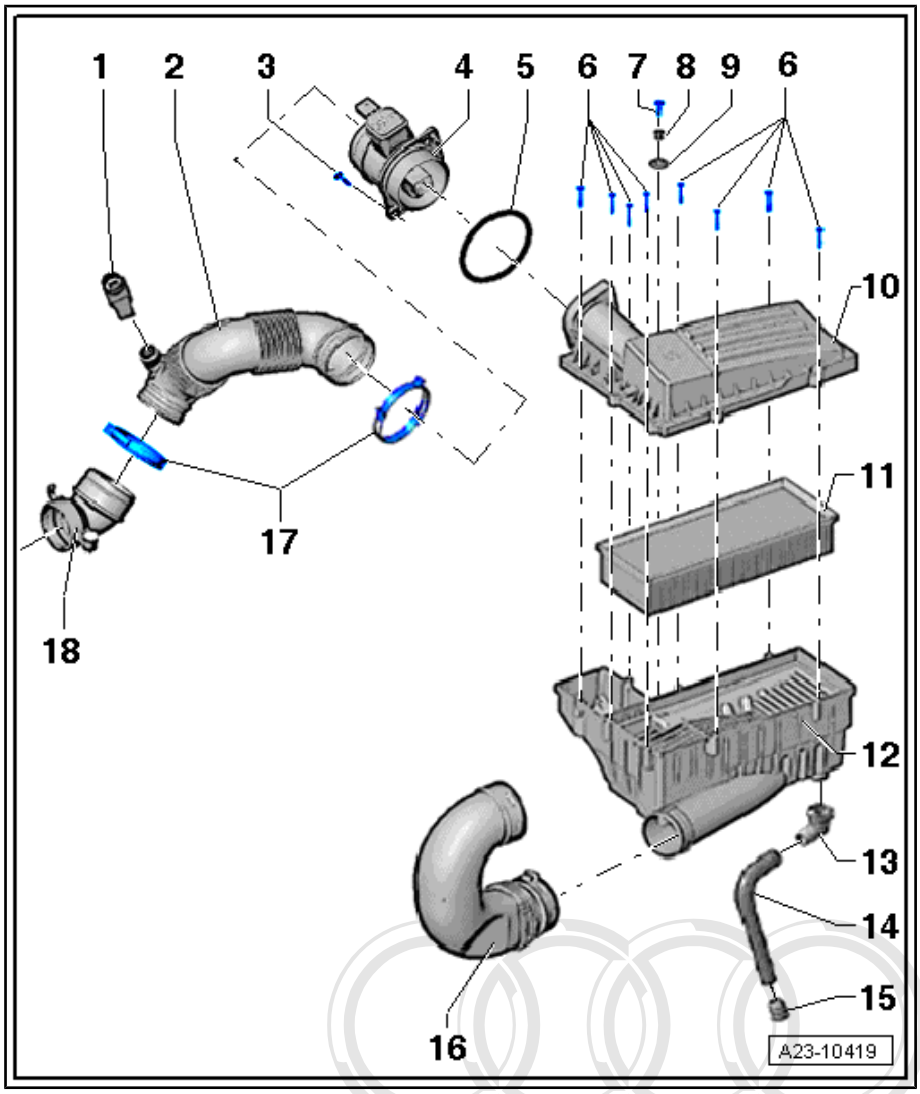
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3 Air cleaner

⇒ “3.1 Exploded view - air cleaner housing”, page 240

⇒ “3.2 Removing and installing air cleaner housing”, page 241

3.1 Exploded view - air cleaner housing



1 - Hose connection

2 - Air hose

- ❑ To turbocharger
- ❑ Check for dirt and accumulated leaves, etc.

3 - Bolt

- ❑ 2x
- ❑ 1.5 Nm

4 - Air mass meter - G70-

- ❑ Removing and installing ⇒ page 279

5 - O-ring

- ❑ Renew
- ❑ Use silicone-free lubricant when installing

6 - Bolts

- ❑ For air cleaner (top section)
- ❑ 1.5 Nm

7 - Bolt

- ❑ For air cleaner (bottom section)
- ❑ 8 Nm

8 - Sleeve

9 - Washer

10 - Air cleaner (top section)

- ❑ Remove any salt residue, dirt and leaves

11 - Air filter element

- ❑ Always use genuine part for air filter element
- ❑ Removing and installing ⇒ Maintenance ; Booklet 820
- ❑ Change intervals ⇒ Maintenance tables

12 - Air cleaner (bottom section)

- ❑ Remove any salt residue, dirt and leaves
- ❑ On vehicles for cold climates, air cleaner (bottom section) with hot air intake is installed
- ❑ Country-specific version with snow screen

13 - Connection for water drain hose

- ❑ Clean

14 - Water drain hose

- ❑ Clean

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15 - Flutter valve

- ❑ Clean and re-install

16 - Intake air duct

- ❑ To lock carrier
- ❑ Remove any salt residue, dirt and leaves

17 - Spring-type clips

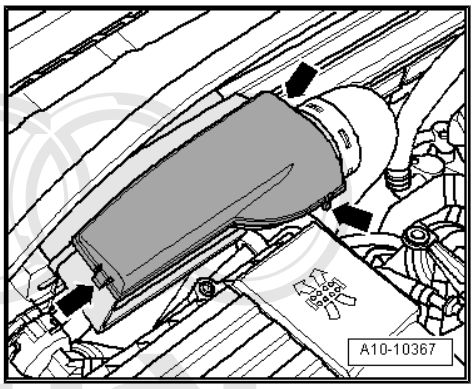
18 - Connecting hose

- ❑ To turbocharger

3.2 Removing and installing air cleaner housing

Removing

– Pull cover off air duct (release clips on sides) -arrows-.

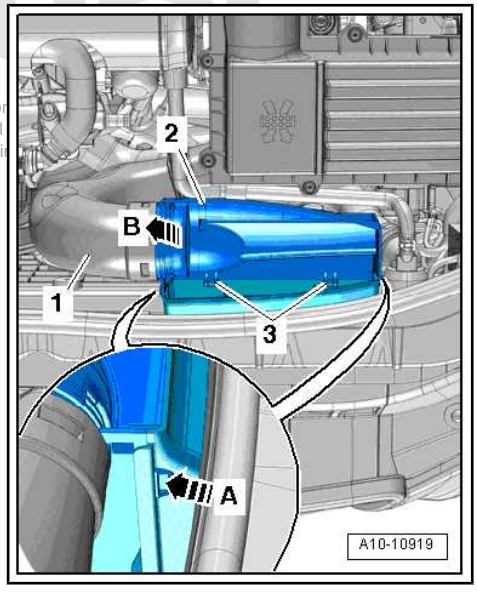


– Release clips on left and right -arrow A- and unclip air duct at bottom -2-.

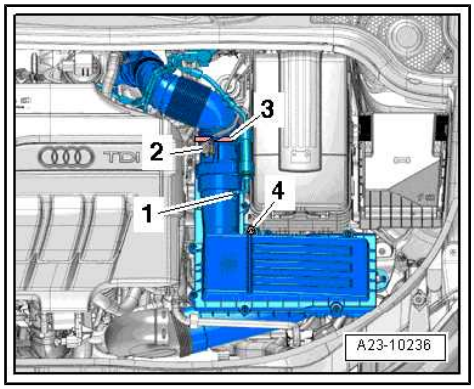
– Swivel air duct (bottom) slightly to the rear and detach air duct (bottom) from retainers -3-.

– Detach air pipe -1- from air duct (bottom) -arrow B-.

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– Unplug electrical connector -2- at air mass meter - G70- .
– Detach hose -1-.
– Release hose clip -3- and detach air hose.
– Unscrew bolt -4- and remove air cleaner housing.



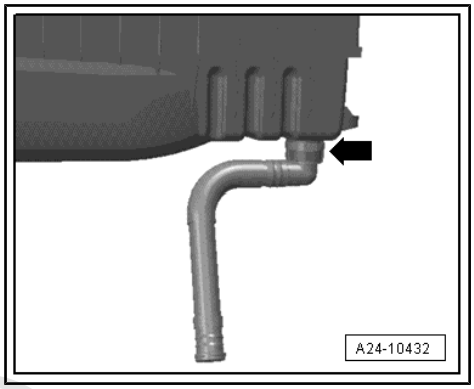
Installing

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

Note

- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Use silicone-free lubricant when installing air hose.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Disconnect water drain hose -arrow- from air cleaner (bottom section) and clean any dirt or leaves out of connection and hose.



Tightening torques

- ⇒ “3.1 Exploded view - air cleaner housing”, page 240

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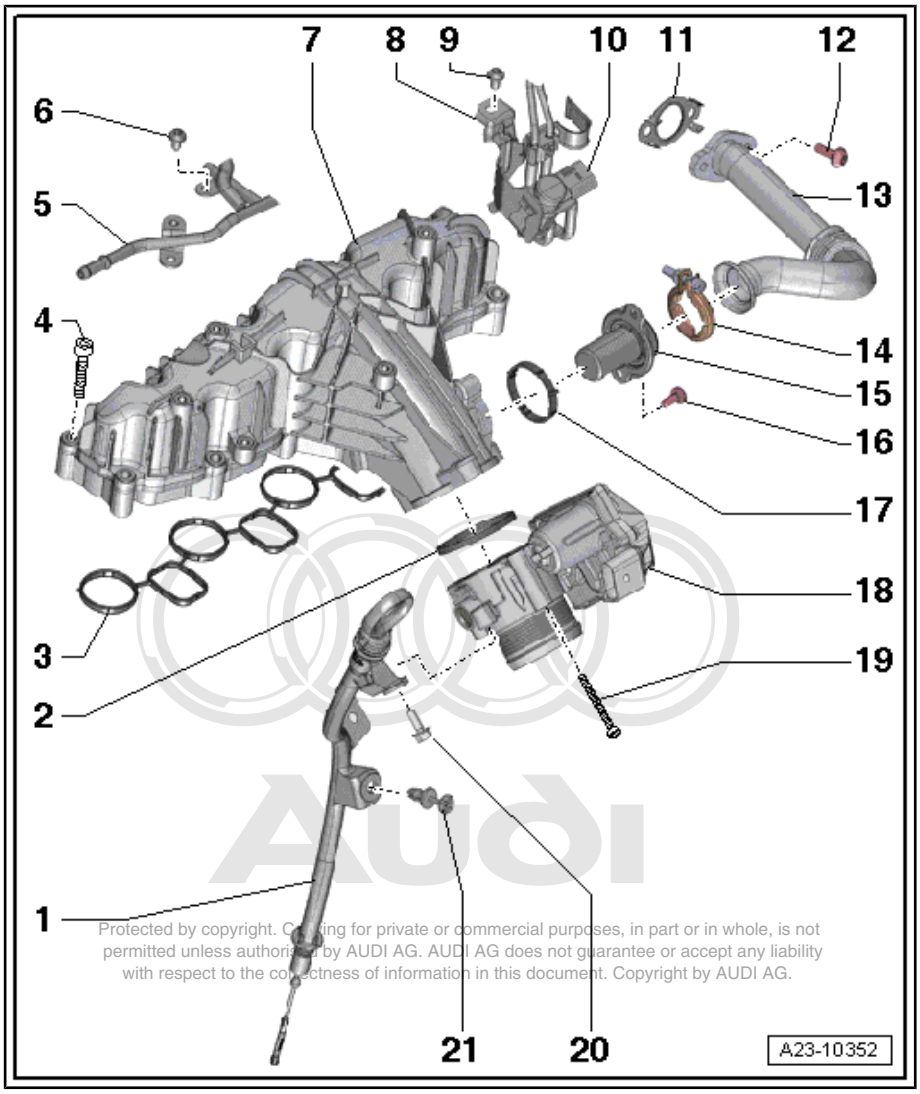
4 Intake manifold

⇒ “4.1 Exploded view - intake manifold”, page 243

⇒ “4.2 Removing and installing intake manifold”, page 244

⇒ “4.3 Removing and installing throttle valve module J338 ”, page 247

4.1 Exploded view - intake manifold



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1 - Guide tube
- ❑ For oil dipstick

2 - Seal
- ❑ Renew

3 - Gasket
- ❑ Renew

4 - Bolt
- ❑ 8 Nm

5 - Fuel return line

6 - Bolt
- ❑ 9 Nm

7 - Intake manifold
- ❑ With intake manifold flap motor - V157- and intake manifold flap potentiometer - G336-
- ❑ Must not be dismantled
- ❑ Removing and installing ⇒ page 244

8 - Bracket
- ❑ For exhaust gas recirculation cooler change-over valve - N345-

9 - Bolt
- ❑ 9 Nm

10 - Exhaust gas recirculation cooler change-over valve - N345-

11 - Gasket
- ❑ Renew

12 - Bolt
- ❑ 20 Nm

13 - Connecting pipe
- ❑ To exhaust gas recirculation cooler

14 - Clamp
- ❑ Renew
- ❑ 5 Nm

15 - Connection
- ❑ For exhaust gas recirculation

16 - Bolt

- ❑ 8 Nm

17 - Seal

- ❑ Renew

18 - Throttle valve module - J338-

- ❑ With throttle valve potentiometer - G69-
- ❑ Removing and installing ⇒ page 247

19 - Bolt

- ❑ 8 Nm

20 - Bolt

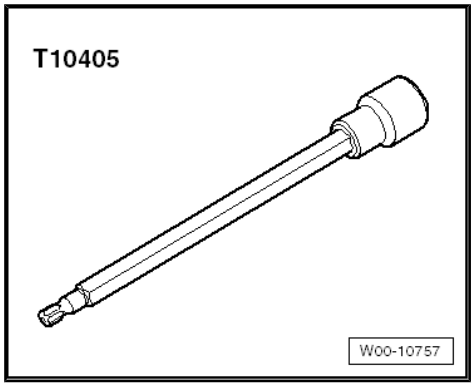
- ❑ 9 Nm

21 - Clip

4.2 Removing and installing intake manifold

Special tools and workshop equipment required

- ♦ Socket Torx T30 - T10405-



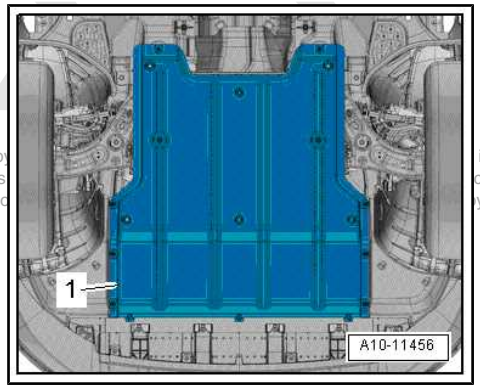
Removing

WARNING

- ♦ *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 6 .*
- ♦ *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

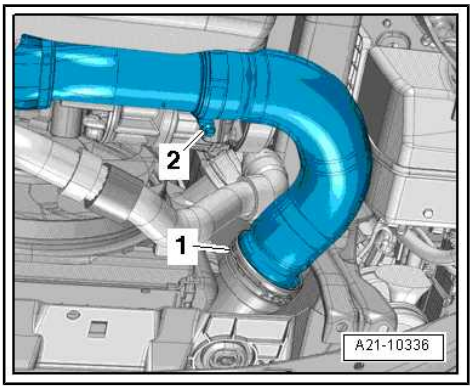
– Remove engine cover panel ⇒ page 47 .

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



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– Loosen hose clip -2- and remove air hose.



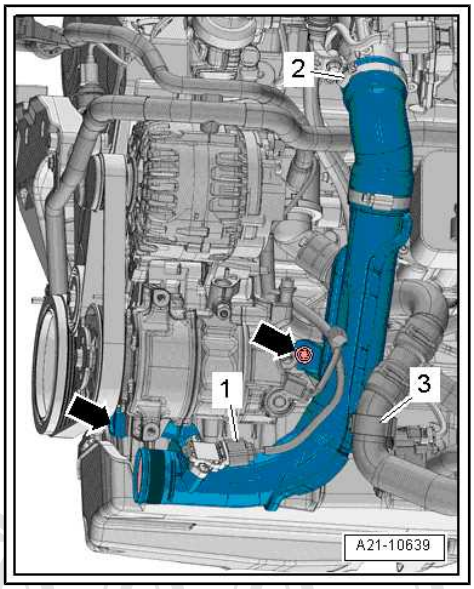
Note

Disregard -item 1-.

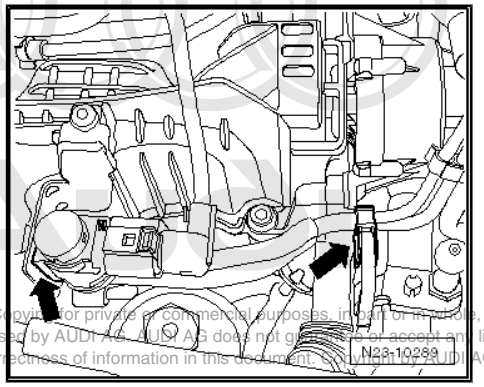
– Unplug electrical connector at charge pressure sender - G31- -1-.

– Remove bolts -arrows-.

– Loosen hose clip -2- at throttle valve module - J338- , detach air pipe, but leave in position.



– Take exhaust gas recirculation cooler change-over valve - N345- -left arrow- out of bracket and move clear to one side.



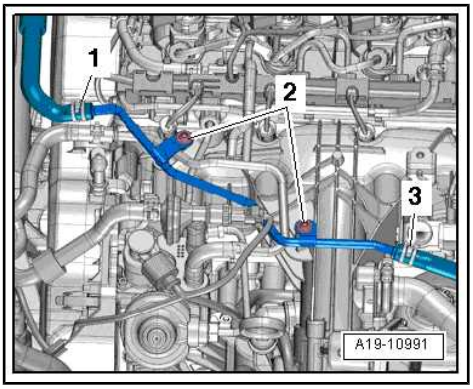
Note

Disregard right -arrow-.

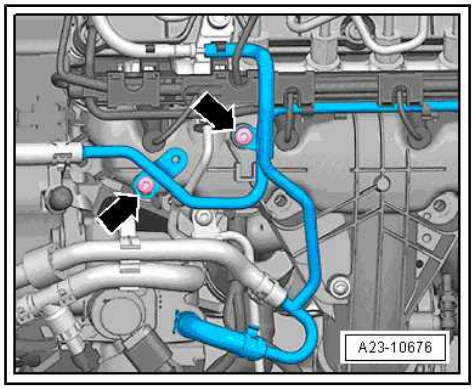
– Detach electrical connectors at glow plugs ⇒ page 313 .

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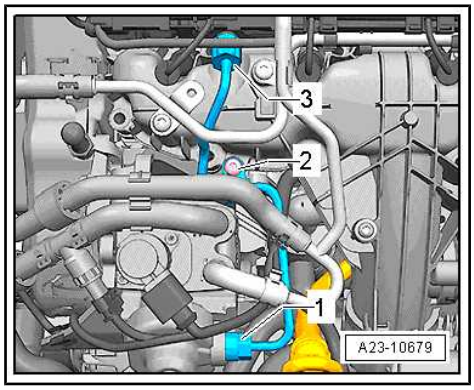
– Remove bolts -2- and place coolant return line to one side.



– Remove bolts -arrows- and place fuel return line to one side.



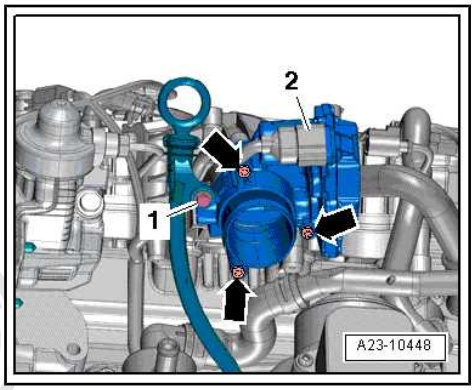
– Remove bolt -2- and union nuts -1 and 3- and detach high-pressure pipe.
– Remove high-pressure reservoir (rail) ⇒ page 270 .



– Unplug electrical connector -2- at throttle valve module - J338- .
– Remove bolt -1- for dipstick guide tube.

Note

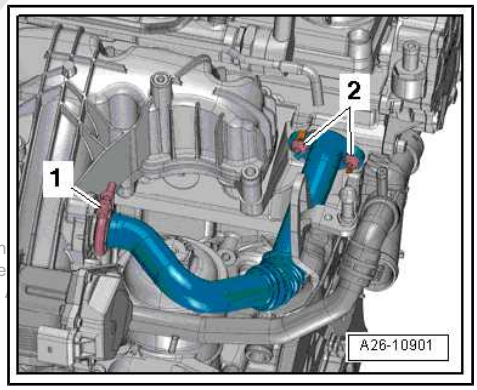
Disregard -arrows-.



– Open clamp -1- and detach.

Note

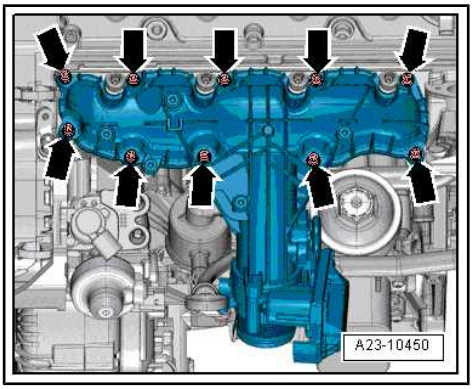
Disregard -item 2-.



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– Unscrew intake manifold bolts -arrows- in diagonal sequence starting from outside and working inwards using socket Torx T30 - T10405- .

– Carefully take out intake manifold.



Installing

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

Note

Renew seals and/or gaskets.

– Tighten intake manifold bolts in diagonal sequence, working from inside to outside.

– Install high-pressure reservoir (rail) ⇒ page 270 .

– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

– Check fuel system for leaks ⇒ page 237 .

Tightening torques

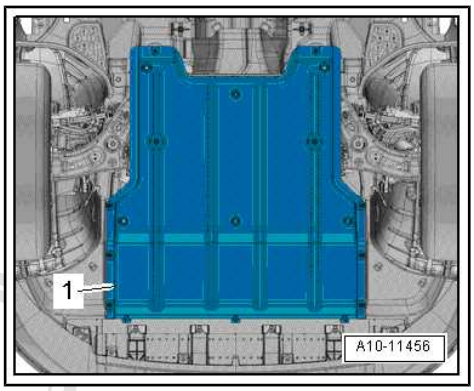
- ⇒ “2.1 Exploded view - charge air system”, page 221
- ⇒ “4.1 Exploded view - intake manifold”, page 243

4.3 Removing and installing throttle valve module - J338-

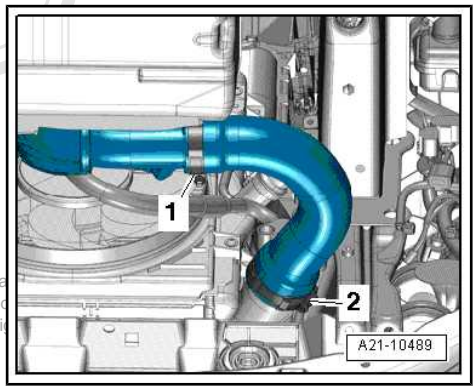
Removing

– Remove engine cover panel ⇒ page 47 .

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

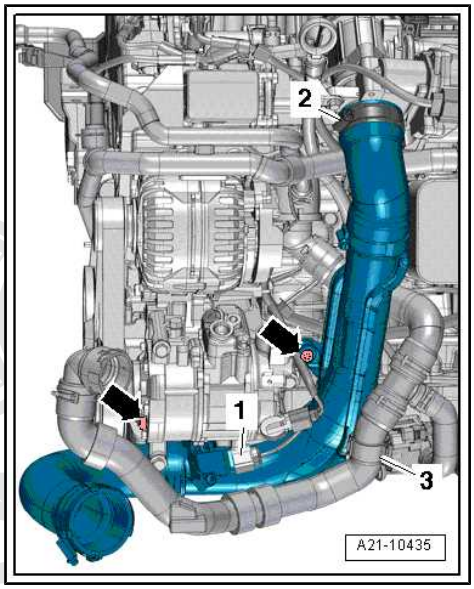


– Release hose clips -1- and -2- and remove air hose.

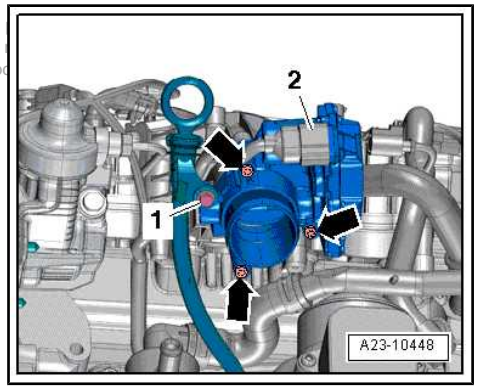


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– Remove bolts -arrows-.
– Move coolant hose -3- clear.
– Release hose clip -2-.
– Unplug electrical connector -1- at charge pressure sender - G31- and detach air pipe.



– Unplug electrical connector -2-.
– Remove bolt -1- for dipstick guide tube.
– Remove bolts -arrows- and detach throttle valve module - J338- .



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Installing

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

Note

Fit new O-ring.

– Install engine cover panel ⇒ page 47 .

Tightening torques

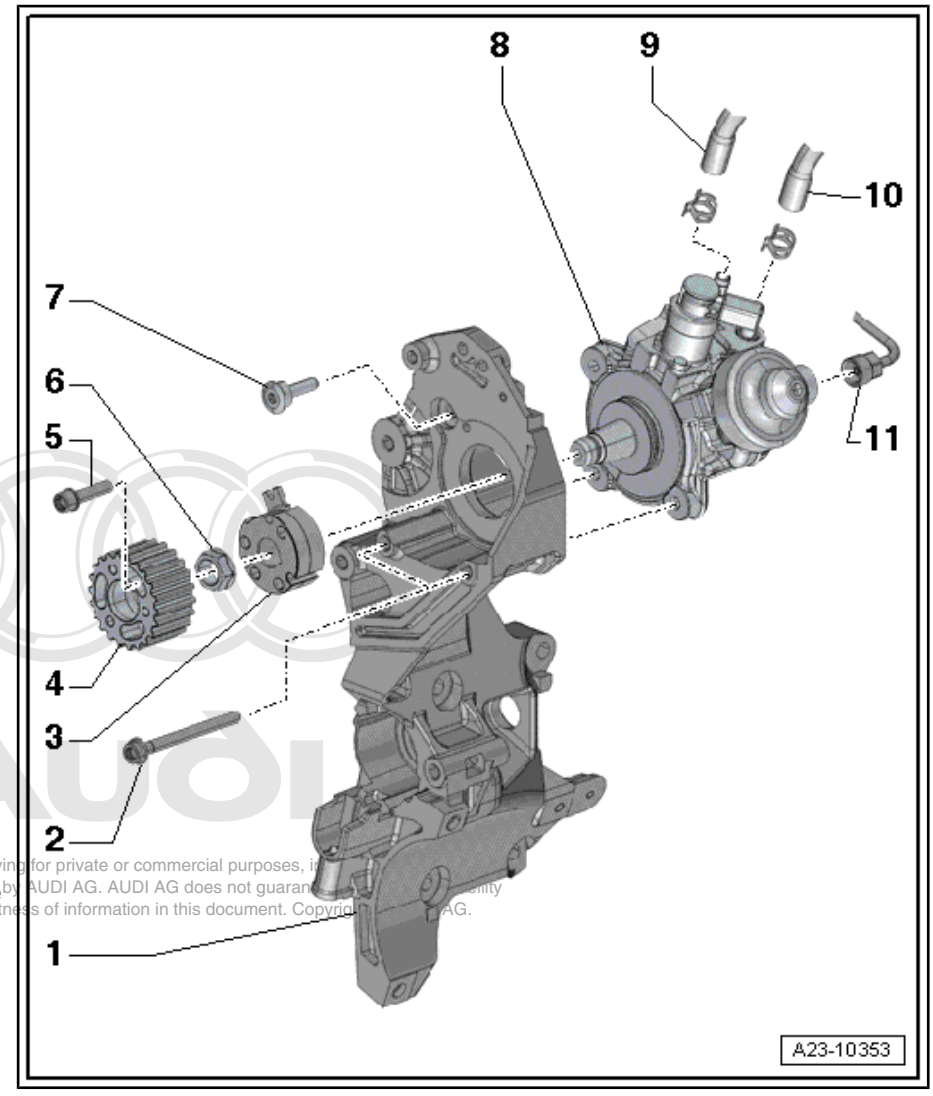
♦ ⇒ “4.1 Exploded view - intake manifold”, page 243

5 High-pressure pump

⇒ “5.1 Exploded view - high-pressure pump”, page 249

⇒ “5.2 Removing and installing high-pressure pump”, page 250

5.1 Exploded view - high-pressure pump



1 - Bracket for ancillaries

- ❑ Removing and installing ⇒ page 54

2 - Bolt

- ❑ 2x
- ❑ Renew
- ❑ 20 Nm +180°

3 - Hub

- ❑ Use counterhold tool - T10051- when loosening and tightening
- ❑ To remove, use puller - T40064-

4 - High-pressure pump

5 - Bolt

- ❑ Renew
- ❑ 20 Nm

6 - Nut

- ❑ 95 Nm

7 - Bolt

- ❑ Renew
- ❑ 20 Nm +45°

8 - High-pressure pump

- ❑ With fuel metering valve - N290- (do not open)
- ❑ After renewing, first fuel filling operation MUST be performed (it is important not to allow pump to run while it is still empty) ⇒ page 236
- ❑ After renewing high-pressure pump or fuel pressure regulating valve - N276- , learnt values must be re-adapted; see “Guided Functions” in ⇒ Vehicle diagnostic tester
- ❑ Removing and installing ⇒ page 250

9 - Fuel supply hose

10 - Fuel return hose

11 - High-pressure pipes

- ❑ Between high-pressure pump and high-pressure reservoir (rail)
- ❑ Do not interchange

Note

- ♦ *Note identification marks for cylinder allocation when re-installing high-pressure pipes.*

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- *The high-pressure pipes can be re-used after performing the following checks:*
- *Check taper seats of high-pressure pipes for deformation and cracks.*
- *The bore of the pipe must not be distorted, restricted or otherwise damaged.*
- *Corroded pipes must not be used again.*

❑ Install free of stress
❑ 25 Nm

5.2 Removing and installing high-pressure pump

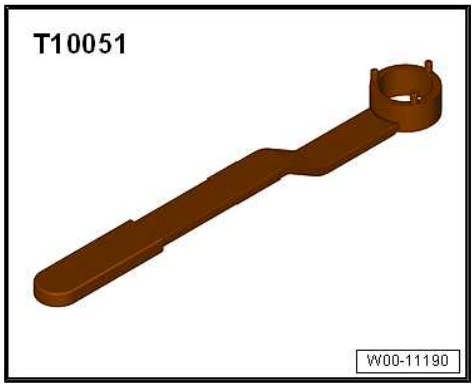
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Special tools and workshop equipment required

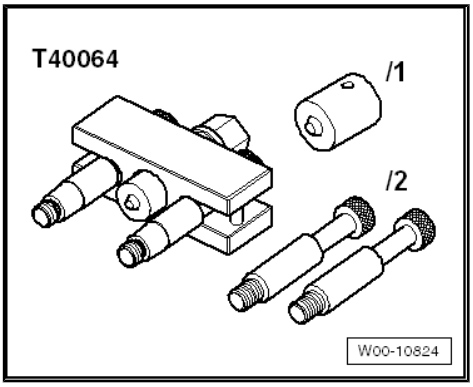
- Counterhold tool - T10172A-



- Counterhold tool - T10051-



- Puller - T40064/1-2-



Removing

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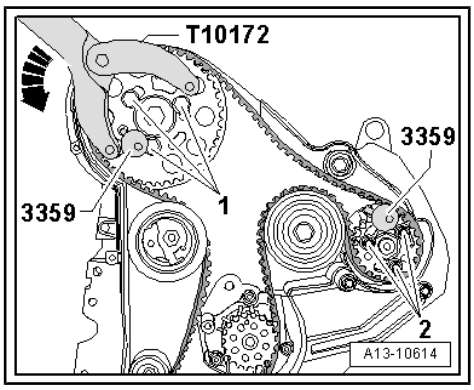
Caution

- *Always observe rules for cleanliness and instructions for working on fuel system ⇒ page 6 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

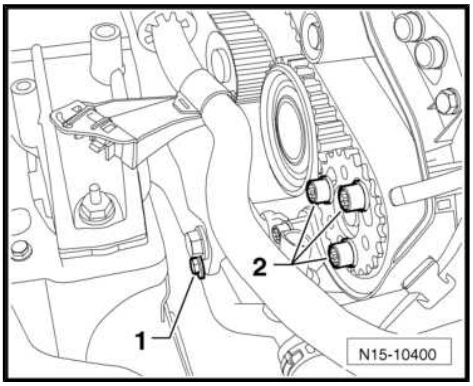
Running when dry causes irreparable damage to high-pressure pump.

- *The high-pressure pump must first be filled with fuel before the engine is started. The high-pressure pump must not be allowed to run while still empty. First fuel filling ⇒ page 236*

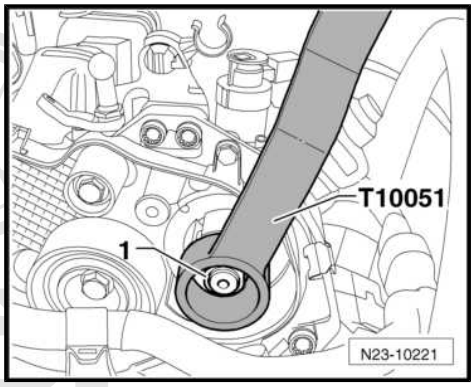
– Remove toothed belt from camshaft and high-pressure pump ⇒ page 89 .



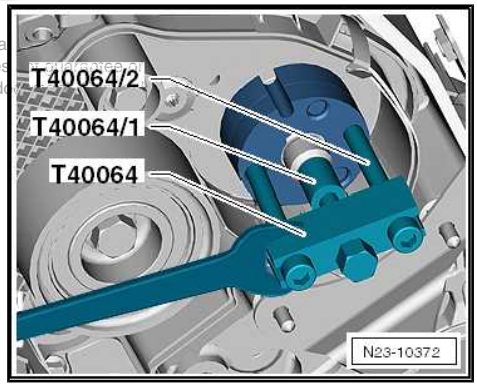
– Remove bolts -2- and detach toothed belt sprocket from high-pressure pump.



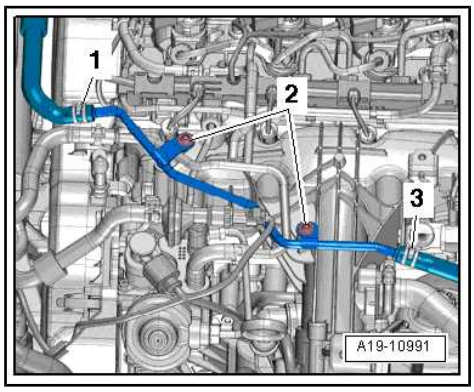
– Counterhold using counterhold tool - T10051- and remove nut -1- at hub of high-pressure pump.



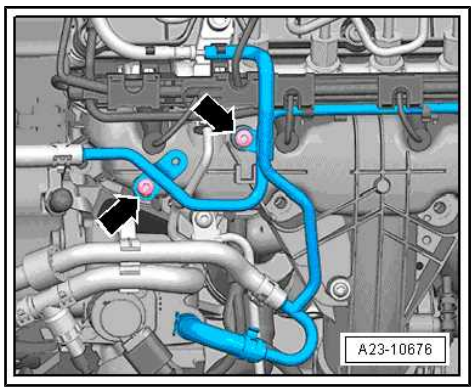
– Apply puller - T40064- with thrust piece - T40064/1- and pin - T40064/2- as shown in illustration and pull hub off high-pressure pump. If necessary, counterhold using an open-end spanner (24 mm).



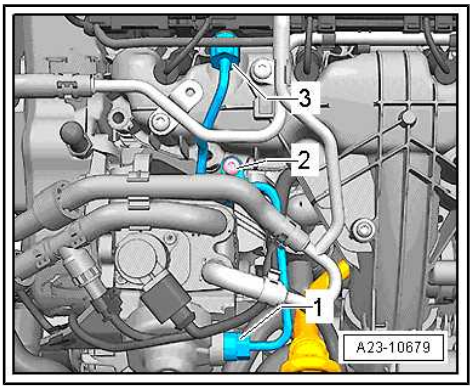
– Remove bolts -2- and place coolant return line to one side.



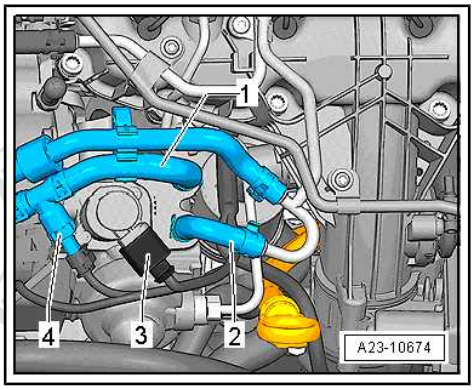
– Remove bolts -arrows- and place fuel return line to one side.



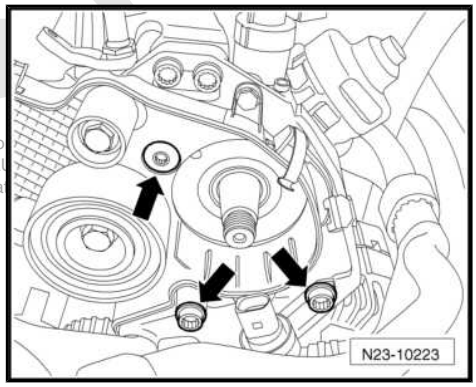
– Remove bolt -2- and union nuts -1 and 3- and detach high-pressure pipe.



– Unplug electrical connectors -3- and -4-.
– Detach fuel supply hose -1- and fuel return hose -2- from high-pressure pump.



– Remove bolts -arrows- for high-pressure pump.
– Carefully take out high-pressure pump.



Installing

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

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– Install toothed belt (adjust valve timing) ⇒ page 93 .
– Install high-pressure pipe ⇒ page 268 .

Caution

Running when dry causes irreparable damage to high-pressure pump.

- ***The high-pressure pump must first be filled with fuel before the engine is started. The high-pressure pump must not be allowed to run while still empty. First fuel filling ⇒ page 236***

After renewing high-pressure pump and/or fuel pressure regulating valve - N276- , adaption must be performed. The adaption procedure is described in the Guided Fault Finding or Guided Functions; use ⇒ Vehicle diagnostic tester.

Tightening torques

- ⇒ “5.1 Exploded view - high-pressure pump”, page 249

6 Injectors/high-pressure reservoir (rail)

⇒ “6.1 Exploded view - injectors”, page 254

⇒ “6.2 Checking injectors”, page 257

⇒ “6.3 Performing adaption of correction values for injectors”, page 257

⇒ “6.4 Checking for injectors sticking open”, page 258

⇒ “6.5 Checking return flow rate of injectors with engine running”, page 260

⇒ “6.6 Checking return flow rate of injectors at starter cranking speed”, page 262

⇒ “6.7 Removing and installing injectors”, page 264

⇒ “6.8 Removing and installing high-pressure pipes”, page 268

⇒ “6.9 Removing and installing high-pressure reservoir (rail)”, page 270

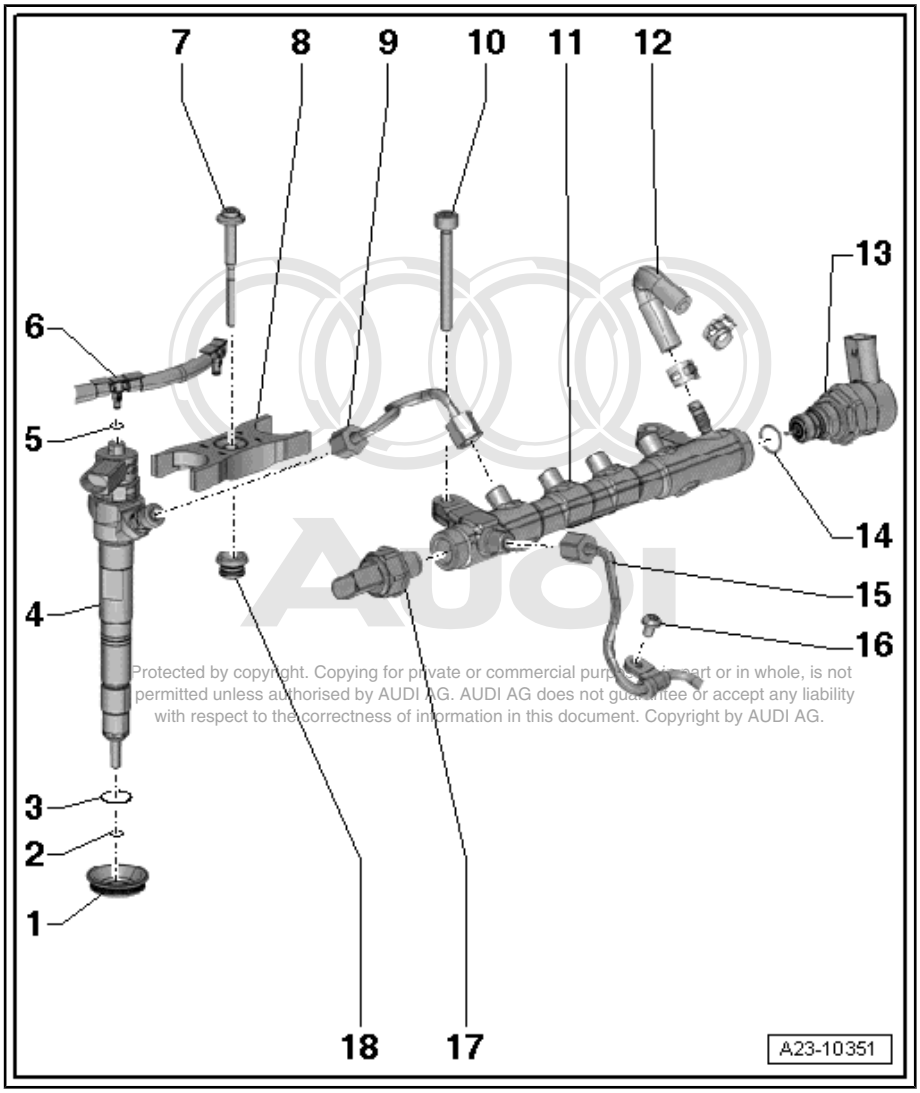
6.1 Exploded view - injectors

When installing a new base engine, you must check whether there is a sticker on the cylinder head cover.

If a sticker is attached which states `Spannpratzen auf vorgeschriebenes Drehmoment angezogen` (clamping pieces tightened to specified torque), the clamping pieces have already been tightened to the specified final torque at the factory.

If no sticker is attached, it is essential that the clamping pieces for the injectors are tightened to the specified torque after installing the high-pressure pipes. If these instructions are not observed, the engine could be damaged.

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1 - Seal

- ❑ For injector
- ❑ In cylinder head cover
- ❑ Renew if leaking ⇒ page 116

2 - Copper seal

- ❑ Always renew copper seal when removing and installing

3 - O-ring

- ❑ Renew

4 - Injector

- ❑ Use a coloured pen to mark allocation of injectors to corresponding clamping piece and high-pressure pipe, and to corresponding cylinder for re-installation; pay attention to markings when installing
- ❑ Always renew copper seal when removing and installing
- ❑ To remove carbon deposits from the injector sealing surface, clean the injector bore in the cylinder head with cleaning kit - VAS 6811- (it is important to do this to avoid leaks)
- ❑ Removing and installing ⇒ page 264

5 - O-ring

- ❑ Renew

6 - Fuel return line

- ❑ To fuel tank
- ❑ Must not be kinked, damaged or clogged
- ❑ Do not dismantle
- ❑ After replacement, engine must be run at idling speed for approx. 2 minutes to bleed fuel system; then check fuel return line for leaks

7 - Bolt

- ❑ Renew
- ❑ Tighten initially to 2 Nm, then screw on union nuts for high-pressure pipes hand-tight and align injectors
- ❑ 8 Nm + 270° (3x 90° further)
- ❑ Note warning instructions for clamping piece ⇒ Item 8 (page 255)

8 - Clamping piece

- ❑ Use a coloured pen to mark injectors and corresponding clamping piece and cylinder for re-installation; pay attention to markings when installing
- ❑ The clamping pieces can be re-used when installing new injectors
- ❑ Each clamping piece secures two injectors
- ❑ Installation position ⇒ page 257

9 - High-pressure pipe

- ❑ Between high-pressure reservoir (rail) and injectors

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Note

- *Note identification marks for cylinder allocation when re-installing high-pressure pipes.*
- *The high-pressure pipes can be re-used after performing the following checks:*
- *Check taper seats of high-pressure pipes for deformation and cracks.*
- *The bore of the pipe must not be distorted, restricted or otherwise damaged.*
- *Corroded pipes must not be used again.*

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- ❑ Install free of stress
- ❑ 25 Nm

10 - Bolt

- ❑ 22 Nm

11 - Fuel rail

- ❑ Removing and installing ⇒ page 270

12 - Fuel return hose

13 - Fuel pressure regulating valve - N276-

- ❑ Always renew after removing
- ❑ Removing and installing ⇒ page 274
- ❑ 80 Nm
- ❑ After renewing high-pressure pump or fuel pressure regulating valve - N276- , learnt values must be re-adapted; see “Guided Functions” in ⇒ Vehicle diagnostic tester

14 - O-ring

- ❑ Renew

15 - High-pressure pipe

- ❑ Between high-pressure pump and high-pressure reservoir (rail)

Note

- *Note identification marks for cylinder allocation when re-installing high-pressure pipes.*
- *The high-pressure pipes can be re-used after performing the following checks:*
- *Check taper seats of high-pressure pipes for deformation and cracks.*
- *The bore of the pipe must not be distorted, restricted or otherwise damaged.*
- *Corroded pipes must not be used again.*

- ❑ 25 Nm

16 - Bolt

- ❑ 8 Nm

17 - Fuel pressure sender - G247-

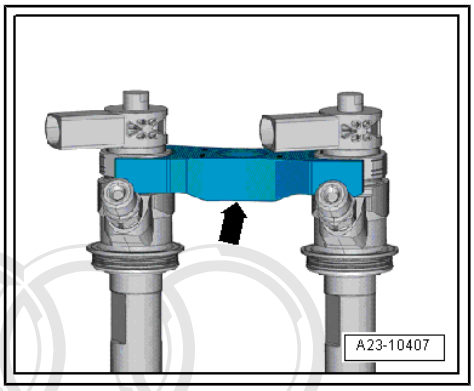
- ❑ Always renew after removing
- ❑ Removing and installing ⇒ page 276
- ❑ 100 Nm

18 - Grommet

- ❑ In cylinder head cover

Installation position of clamping piece

- Each clamping piece secures two injectors.
- The bulge -arrow- of the clamping piece should point downwards.



6.2 Checking injectors

There are four different tests for checking the operation of the injectors.

- ⇒ “6.3 Performing adaption of correction values for injectors”, page 257
- ⇒ “6.4 Checking for injectors sticking open”, page 258
- ⇒ “6.5 Checking return flow rate of injectors with engine running”, page 260
- ⇒ “6.6 Checking return flow rate of injectors at starter cranking speed”, page 262

Perform the following tests first if the engine does not start at all:

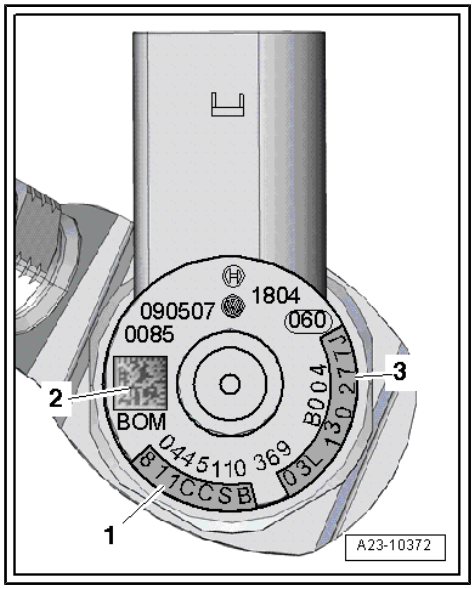
- ⇒ “6.4 Checking for injectors sticking open”, page 258
- ⇒ “6.6 Checking return flow rate of injectors at starter cranking speed”, page 262
- ⇒ “7.1 Checking fuel pressure regulating valve N276 ”, page 273

6.3 Performing adaption of correction values for injectors

The “Injector delivery calibration values” function serves to correct the injection rates for each cylinder of a common rail system individually across the entire operating range.

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The 7-digit adaption values -1- (details in illustration are only an example) are marked separately on each injector. The values may consist of letters and/or numbers.



Injector (view from above)

1 - Checksum

2 - Data matrix code

3 - Part number

When a new injector is installed, the adaption value must be written into the engine control unit.

When a new engine control unit is installed, the “Adaption values for injectors” must be written into the new control unit.

Additionally, check that the “injector delivery calibration values” are correctly entered for all the other injectors. Do NOT attempt to re-enter these values if the correct values are already stored in the engine control unit.

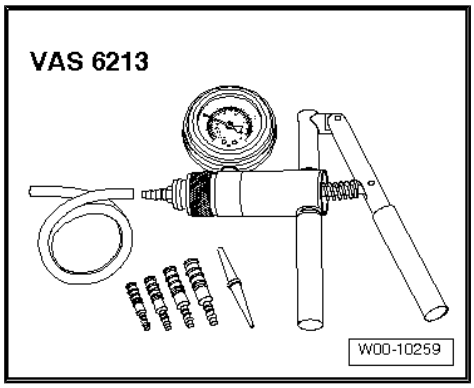
The adaption procedure is described in the “Guided Fault Finding”. (The procedure is also described under “Guided Functions”.) Use ⇒ Vehicle diagnostic tester

6.4 Checking for injectors sticking open

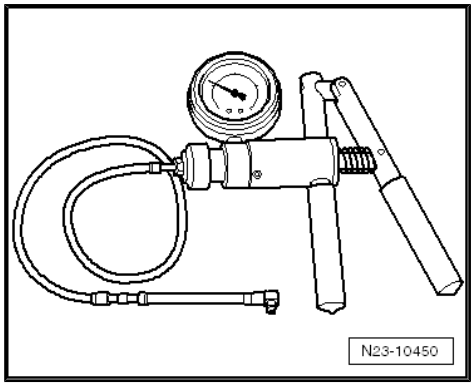
If one of the injectors is sticking open, this means that the injector needle is not closing fully and fuel escapes into the cylinder.

Special tools and workshop equipment required

- Hand vacuum pump - VAS 6213-



- Use a return line to make an -adapter-.



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WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 6 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

– Remove engine cover panel ⇒ page 47 .

– Clean all connections (with commercial cleaning solution or similar) before removing.

Note

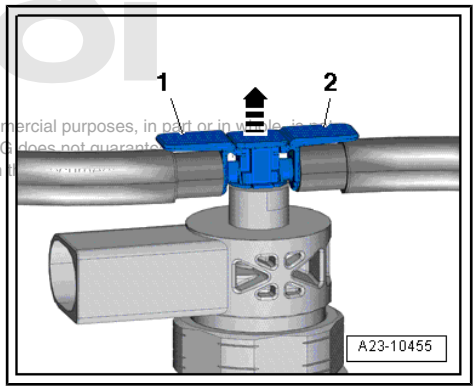
- *Make sure all parts are clean; no dirt must be allowed to enter the fuel system.*
- *Check all cylinders in turn.*

– Dry all components after cleaning.

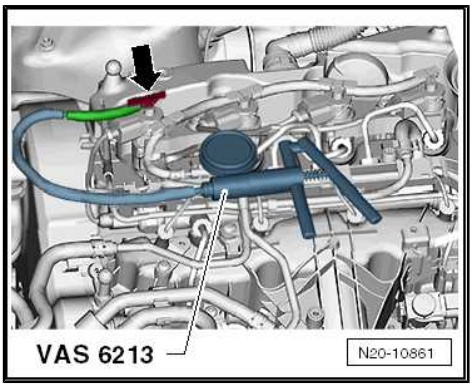
Start with cylinder No. 1.

– Pull return line connections off injectors; to do so, press tabs -1- and -2- down and at the same time pull release pin upwards -arrow-.

– Connect adapter to return line connection of injector to be tested after adapter has been cleaned and blown out.



– Generate a vacuum of -500 mbar using the hand vacuum pump - VAS 6213- .



If the vacuum reading remains the same for 30 seconds, the injector is OK.

If the injector is faulty, the vacuum reading will fall back to 0 bar within 2 to 3 seconds.

Repeat test if necessary; note drop in vacuum reading on hand vacuum pump - VAS 6213- .

– Renew faulty injectors ⇒ page 264 .

Checking fuel system for leaks

– Run engine at idling speed for several minutes (do not press accelerator) and then switch off. Fuel system will bleed itself automatically.

– Check the entire fuel system for leaks.

Renew the affected component if leakage occurs.

– After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.

– Install engine cover panel ⇒ page 47 .

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6.5 Checking return flow rate of injectors with engine running

Checking return flow rate of all injectors

Special tools and workshop equipment required

- Fuel-resistant measuring container

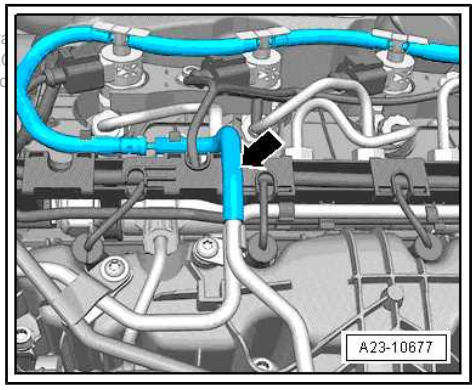
WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 6 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

– Remove engine cover panel ⇒ page 47 .

– Disconnect hose connection -arrow-.

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– Seal off open return line connection with plug -1-.

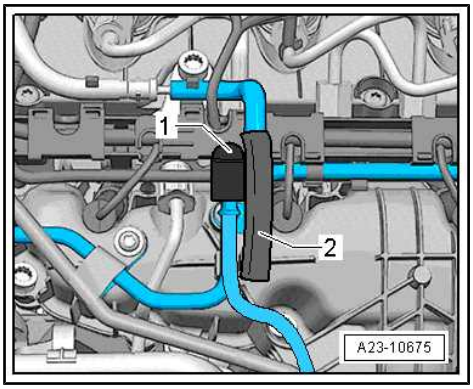
– Hold end of fuel return hose (lengthen with hose -2- if necessary) in a measuring container to measure the total return flow rate.

– Start engine and let it idle for 2 minutes.

• Specification for 2 minutes: 0 ml to 50 ml

– If specification is attained, increase engine speed to 2000 ... 2500 rpm for approx. 2 minutes and then check return flow rate again.

• Specification for 2 minutes: less than 250 ml



Note

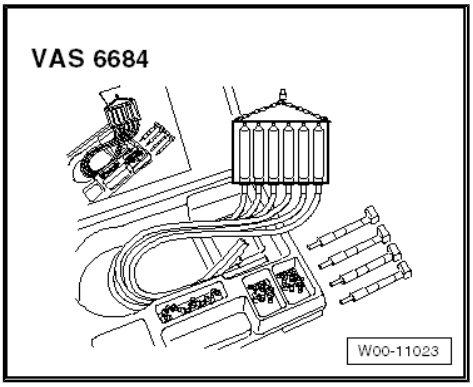
1000 ml = 1 litre

If specification is exceeded, this indicates that one or more injectors are defective. Check return flow rate from each injector individually.

Checking return flow rate of individual injectors

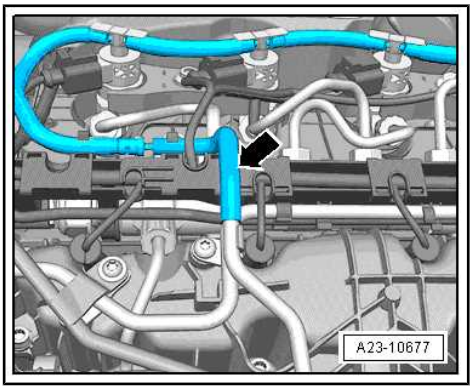
Special tools and workshop equipment required

♦ Return flow meter - VAS 6684-

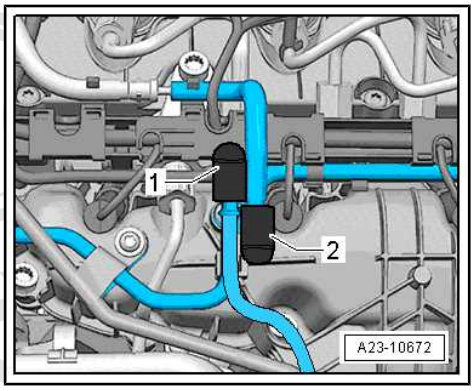


Each injector normally has a relatively low fuel return flow rate. If the return flow rate at one injector is relatively high compared to the other injectors, that injector is probably defective.

– Remove engine cover panel ⇒ page 47 .
– Clean all return line connections (e.g. with commercial cleaning solution etc.) before removing.
– Dry all components after cleaning.
– Disconnect hose connection -arrow-.

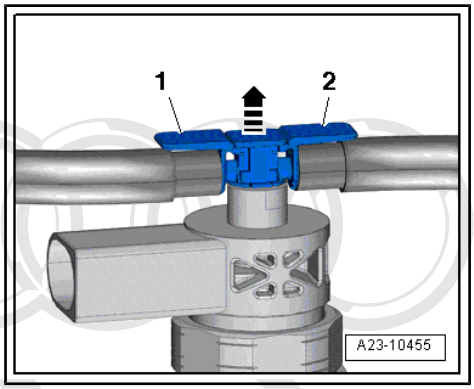


– Seal off open connections with a plug -1 and 2-.



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– Pull return line connections off injectors; to do so, press tabs -1- and -2- down and at the same time pull release pin upwards -arrow-.



Note

No dirt must be allowed to get into the disconnected return lines or the open connections on the injectors.

– Connect hoses of return flow meter - VAS 6684- to return line connections of all four injectors.

Caution

Risk of damage to injectors when return lines are disconnected.

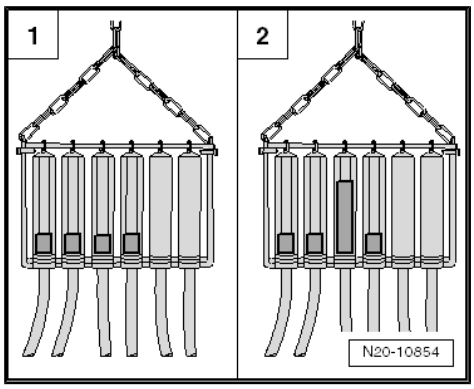
- ***Do NOT press the accelerator during this test; the engine must only run at idling speed.***

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– Start engine and let it idle for several minutes.

– When the engine is warm and running at idling speed, the return flow rates at each of the 4 return lines must not differ by more than a small amount (example -1-).

– If one injector has a significantly higher return flow rate than the others (example -2-), it must be renewed ⇒ page 264 .



Installing fuel return lines

– Check O-ring for fuel return line connection for damage and deformation.

If O-ring is damaged or deformed, renew O-ring.

Note

Lubricate all seals with engine oil or assembly oil before installing.

– Push return line connections carefully onto injectors. The catch should engage audibly. Then press release pin down carefully.

Checking fuel system for leaks

– Run engine at idling speed for several minutes (do not press accelerator) and then switch off. Fuel system will bleed itself automatically.

– Check the entire fuel system for leaks.

Renew the affected component if leakage occurs.

– After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.

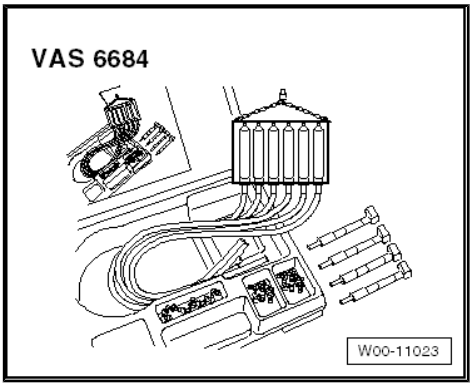
– Install engine cover panel ⇒ page 47 .

6.6 Checking return flow rate of injectors at starter cranking speed

Only perform this test if the engine does not start at all.

Special tools and workshop equipment required

- Return flow meter - VAS 6684-



WARNING

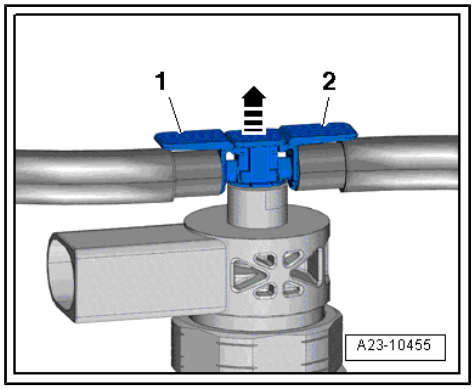
- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 6 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

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Each injector normally has a relatively low fuel return flow rate. If the return flow rate at one injector is relatively high compared to the other injectors, that injector is probably defective.

– Remove engine cover panel ⇒ page 47 .
– Remove noise insulation from injectors.
– Clean all return line connections (with commercial cleaning solution or similar) before removing.
– Dry all components after cleaning.

– Pull return line connections off injectors; to do so, press tabs -1- and -2- down and at the same time pull release pin upwards -arrow-.



– Connect hoses of return flow meter - VAS 6684- to return line connections of all four injectors.

– Operate starter three times (wait approx. 20 seconds each time after operating starter to prevent it from overheating).

• Specification of return flow rate: 0 ml

– If fuel comes out of an injector, that injector must be renewed.

Installing fuel return lines

– Check O-ring for fuel return line connection for damage and deformation.

Note

Lubricate all seals with engine oil or assembly oil before installing.

– Push return line connections carefully onto injectors. The catch should engage audibly. Then press release pin down carefully.

Checking fuel system for leaks

– Run engine at idling speed for several minutes (do not press accelerator) and then switch off. Fuel system will bleed itself automatically.

– Check the entire fuel system for leaks.

Renew the affected component if leakage occurs.

– After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.

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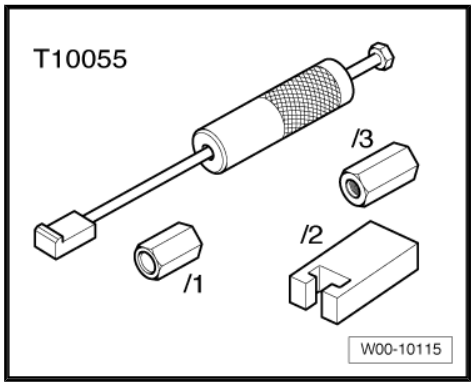
– Install engine cover panel ⇒ page 47 .

6.7 Removing and installing injectors

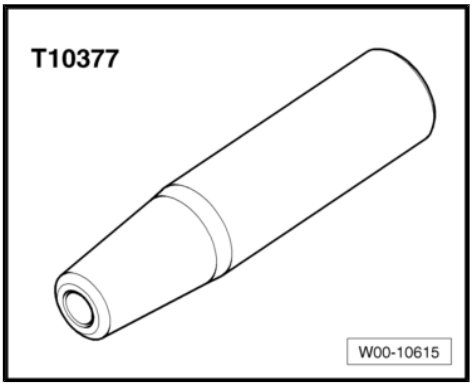
Special tools and workshop equipment required

♦ Cleaning kit - VAS 6811-

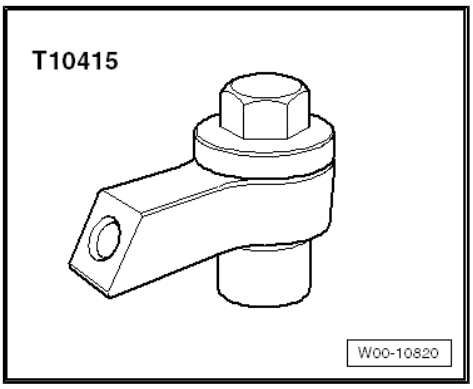
♦ Puller - T10055-



- Assembly sleeve - T10377-



- Puller - T10415-



Removing

WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 6 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

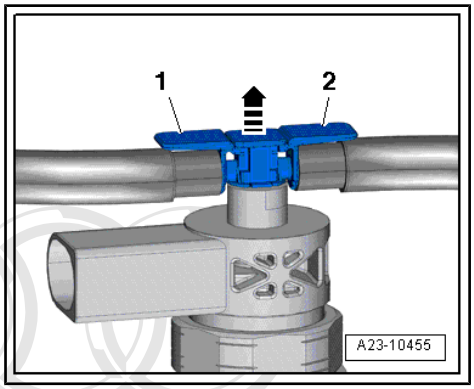
– Remove engine cover panel ⇒ page 47 .

Caution

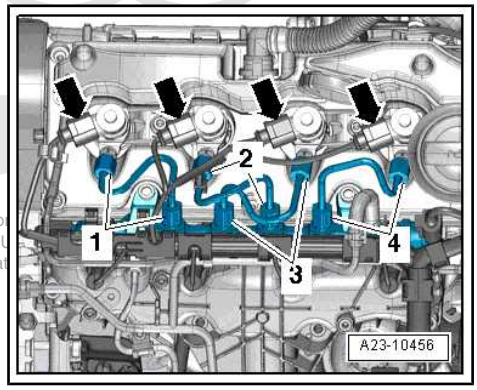
- *Mark cylinder numbers on injector units. They must always be re-installed on the same cylinders.*
- *Observe rules for cleanliness when working on the injection system.*
- *Plug open connections with suitable sealing caps immediately.*

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– Pull return line connections off injectors; to do so, press tabs -1- and -2- down and at the same time pull release pin upwards -arrow-.

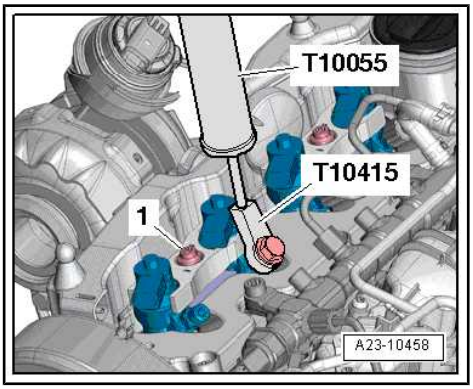


– Unplug electrical connectors -arrows- at injectors.
– Unscrew union nuts on corresponding high-pressure pipe (-1 to 4-) and detach corresponding high-pressure pipe.
– Unscrew bolt -1- for clamping piece.



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– Apply puller - T10055- with puller -T10415- as shown in illustration, and pull out injectors upwards.



Note

To avoid damaging the sealing lip, rotate the injector while pulling it out.

– After removal, lay injectors on a clean cloth.

Important instructions for installing injectors:

When installing injectors, the following components must be renewed:

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- Bolt for clamping piece
- Copper seal
- O-ring for injector bore
- O-ring for fuel return line connection

Note

- *Note identification marks for cylinder allocation when re-installing high-pressure pipes.*
- *The high-pressure pipes can be re-used after performing the following checks:*
- *Check taper seats of high-pressure pipes for deformation and cracks.*
- *The bore of the pipe must not be distorted, restricted or otherwise damaged.*
- *Corroded pipes must not be used again.*

If a used injector is being re-installed:

– Spray tip of injector nozzle with rust-releasing spray. Wait approx. 5 minutes and wipe off soot particles and oil with a cloth.

– To remove the old copper seal from the injector, clamp the seal carefully in a vice so that it is just held between the jaws without turning. Then carefully pull and twist the injector out of the copper seal by hand.

– Clean off deposits under the copper seal using a suitable scraper.

Continued (same procedure for used and new injectors):

Caution

Risk of damage to injector sealing surface.

- ***To remove carbon deposits from the injector sealing surface, clean the injector bore in the cylinder head with cleaning kit - VAS 6811- .***

– Fit new copper seal.

– Renew O-ring for injector bore using assembly sleeve - T10377- .

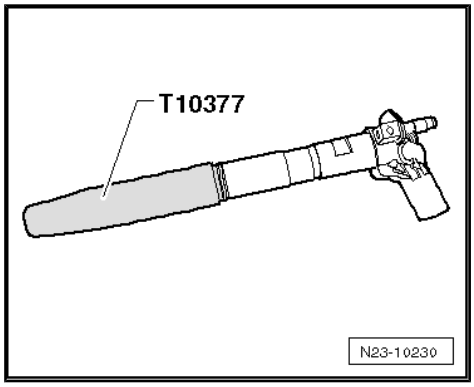
– Install injectors.

– Slide clamping piece onto injectors; observe installation position.

– Always insert 2 injectors with clamping piece carefully into bores in cylinder head.

– Hand-tighten union nuts on high-pressure pipes. Make sure that connections are not under tension.

– Tighten clamping piece to specified torque.



Tightening torques

♦ ⇒ “6.1 Exploded view - injectors”, page 254

– Press return line connections carefully over seals and onto injectors (check seal for damage before connecting return line). The catch should engage audibly. Then press release pin down carefully.

– Install engine cover panel ⇒ page 47 .

When one or more injectors have been renewed, the “Injector delivery calibration values” for the new injectors must be programmed in the engine control unit.

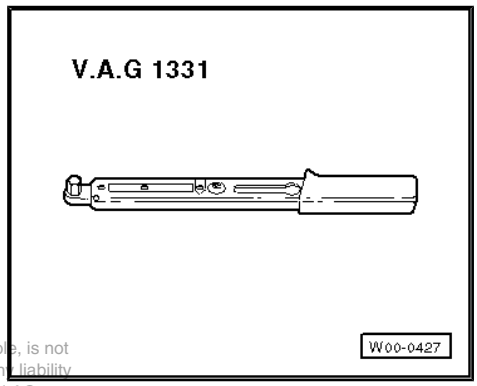
Additionally, check that the “Injector delivery calibration values” are correctly entered for all the other injectors. Do NOT attempt to re-enter these values if the correct values are already stored in the engine control unit.

– Check fuel system for leaks ⇒ page 237 .

6.8 Removing and installing high-pressure pipes

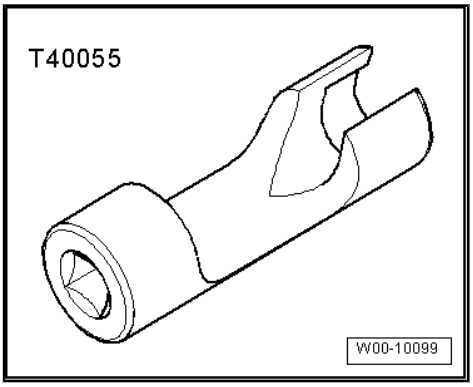
Special tools and workshop equipment required

♦ Torque wrench - V.A.G 1331-



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- Socket - T40055-



Procedure

Note

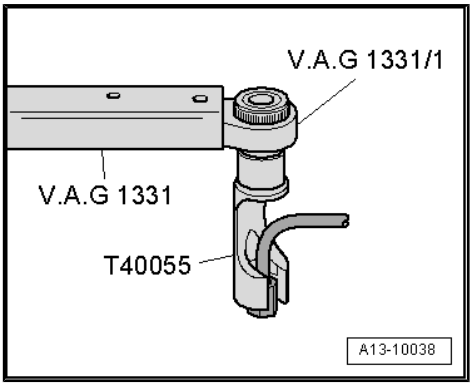
- *Note identification marks for cylinder allocation when re-installing high-pressure pipes.*
- *The high-pressure pipes can be re-used after performing the following checks:*
- *Check taper seats of high-pressure pipes for deformation and cracks.*
- *The bore of the pipe must not be distorted, restricted or otherwise damaged.*
- *Corroded pipes must not be used again.*

Caution

The high-pressure reservoir (rail) and the clamping pieces can be slackened so that the injector pipes are not installed under tension. If necessary, move the high-pressure reservoir (rail) slightly and turn the corresponding injector slightly. Never bend the pipes or subject them to tension. Bending the pipes would ultimately cause them to fracture.

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– Use vacuum cleaner to remove dirt from taper seat at high-pressure reservoir (rail).
– Clean fuel pipe and end of pipe using cleaning solution and dry with compressed air.
– Lubricate threads of union nuts with fuel.
– Hand-tighten union nuts on high-pressure pipes (ensure that pipes are not under tension).
– To tighten unions of high-pressure pipes to high-pressure reservoir (rail) and injectors, use torque wrench - V.A.G 1331- with socket - T40055- .
– Check fuel system for leaks ⇒ page 237 .



Tightening torques

- ⇒ “6.1 Exploded view - injectors”, page 254

6.9 Removing and installing high-pressure reservoir (rail)

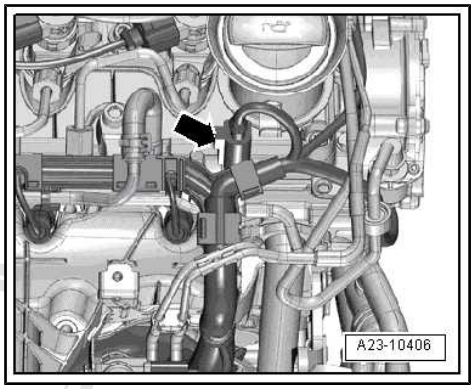
Removing

WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 6 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

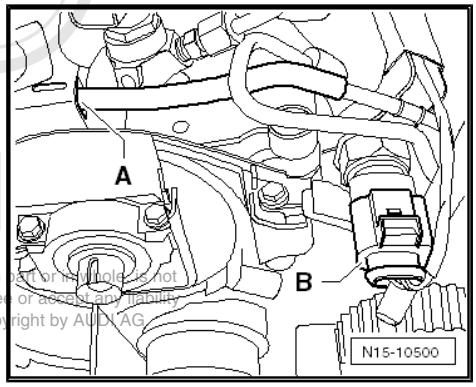
– Remove engine cover panel ⇒ page 47 .

– Unplug electrical connector -arrow- at fuel pressure regulating valve - N276- .



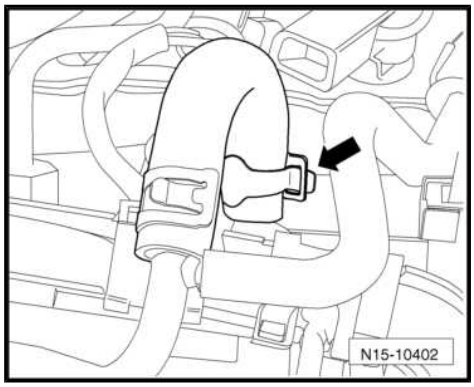
– Unplug electrical connector -B- at fuel pressure sender - G247- .

– Disconnect vacuum hose -A- from cylinder head cover.

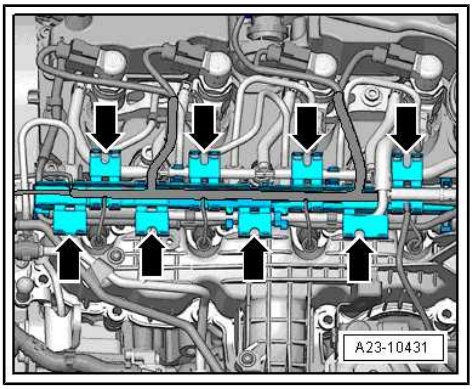


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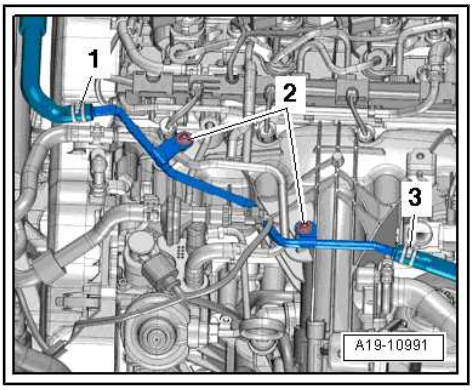
– Release hose clip -arrow- and detach fuel return hose from high-pressure reservoir (rail).



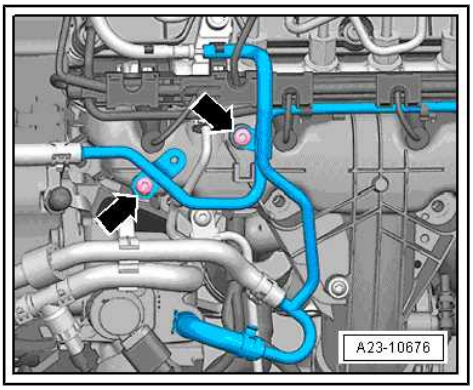
– Release retaining clips -arrows- at wiring harness and detach electrical connectors from glow plugs.



– Remove bolts -2- and place coolant return line to one side.

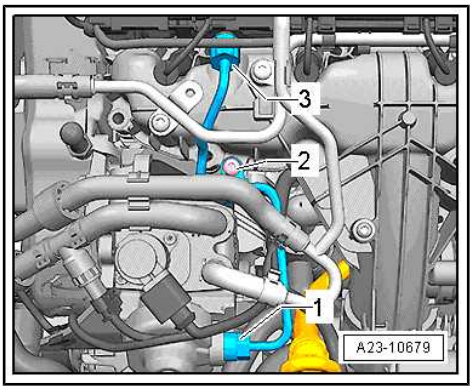


– Remove bolts -arrows- and place fuel return line to one side.



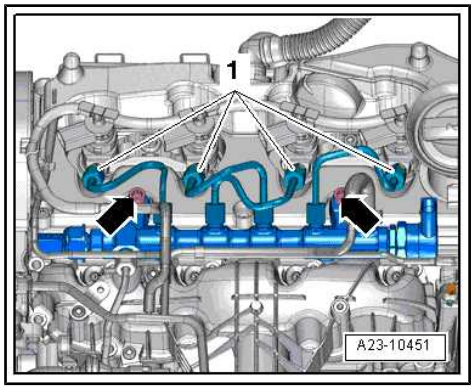
– Remove bolt -2- and union nuts -1 and 3- and detach high-pressure pipe.

– Disconnect wiring guide from high-pressure reservoir (rail) and move clear to one side.



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– Loosen union nuts on the 4 high-pressure pipes -1-.
– After removal, lay high-pressure pipes on a clean cloth.
– Unscrew the two bolts -arrows- and remove high-pressure reservoir (rail).



Installing

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

– Install high-pressure pipes so they are free of tension ⇒ page 268 .

Note

- *Note identification marks for cylinder allocation when re-installing high-pressure pipes.*
- *The high-pressure pipes can be re-used after performing the following checks:*
- *Check taper seats of high-pressure pipes for deformation and cracks.*
- *The bore of the pipe must not be distorted, restricted or otherwise damaged.*
- *Corroded pipes must not be used again.*

– Install engine cover panel ⇒ page 47 .
– Check fuel system for leaks ⇒ page 237 .

Tightening torques

- ⇒ “6.1 Exploded view - injectors”, page 254

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7 Senders and sensors

⇒ “7.1 Checking fuel pressure regulating valve N276 ”, page 273

⇒ “7.2 Removing and installing fuel pressure regulating valve N276 ”, page 274

⇒ “7.3 Removing and installing fuel pressure sender G247 ”, page 276

⇒ “7.4 Removing and installing air mass meter G70 ”, page 279

7.1 Checking fuel pressure regulating valve - N276-

Special tools and workshop equipment required

- Fuel-resistant measuring container

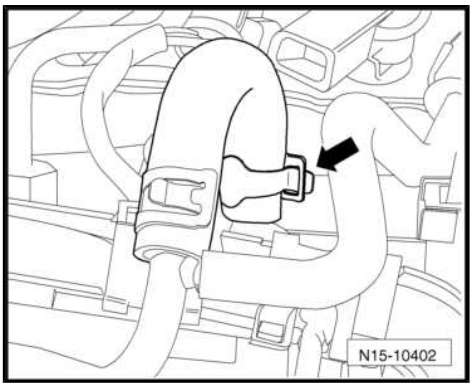
WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 6 .*
- *Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.*

– Remove engine cover panel ⇒ page 47 .

– Release hose clip -arrow- and detach fuel return hose from high-pressure reservoir (rail).

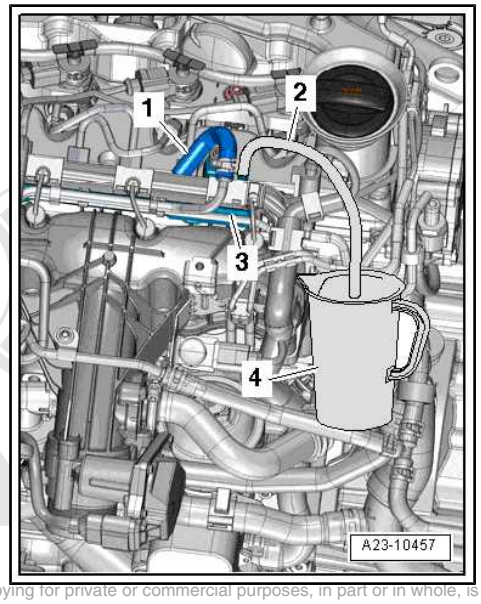
– Seal off open return line connection with a plug -1-.



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– Connect test hose -2- to return line connection of high-pressure reservoir -3-.

– Hold end of test hose into measuring container -4- to measure return flow rate.



1) Checking while engine is running

– Start the engine and run at idling speed.

- Specification: more than 75 ml in 30 seconds

If specification is not obtained, fuel pressure regulating valve - N276- is defective.

2) Checking while engine is running

If condition for 1) is met, start engine and increase engine speed to ≥ 2000 rpm.

- Fuel is still discharged in the first few seconds after the engine is started
- Specification after a few seconds: return flow rate = 0 ml
- Drip leaks are permissible

If specification is not obtained, fuel pressure regulating valve - N276- is defective.

3) If engine can no longer be started

Perform check at cranking speed.

- Specification of return flow rate: 0 ml
- Drip leaks are permissible
- If specification is not obtained, fuel pressure regulating valve - N 276- is defective.

– Install engine cover panel ⇒ page 47 .

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7.2 Removing and installing fuel pressure regulating valve - N276-

Special tools and workshop equipment required

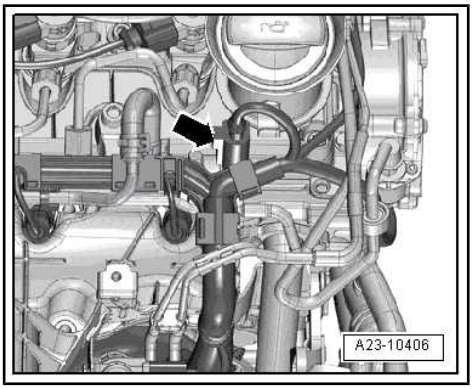
♦ Open-end spanner insert, 30 mm - T10553-

♦ Torque wrench

The fuel pressure regulating valve - N276- -2- is located in the high-pressure reservoir (rail). It maintains a constant pressure in the high-pressure reservoir (rail) and the injector pipes (high-pressure fuel circuit).

If the pressure in the high-pressure fuel circuit is too high, the regulating valve opens to allow some of the fuel to flow back from the high-pressure reservoir (rail) to the fuel tank via a return line.

If the pressure in the high-pressure fuel circuit is too low, the fuel pressure regulating valve - N276- closes and seals off the high-pressure section of the system from the low-pressure section.



Note

Fuel pressure regulating valve - N276- must always be renewed after it has been removed.

Removing

WARNING

- ***Always observe rules for cleanliness and instructions for working on fuel system ⇒ page 6 .***
- ***Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.***

– Remove high-pressure reservoir ⇒ page 270 .

– Before removal, clean area around thread for fuel pressure regulating valve - N276- using commercial cleaning solution or similar (no dirt must enter opening in high-pressure reservoir).

Note

Clean carefully; cleaning solution must not enter the electrical connector.

– Dry off fuel pressure regulating valve - N276- .

– Slacken union nut (counterhold at hexagon flats on housing). Then unscrew and remove by hand.

– Extract dirt from opening in high-pressure reservoir (thread and sealing surface) using a vacuum cleaner. Do not use metal tools, etc.

– Seal off open connection in high-pressure reservoir with clean plug.

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Installing

Note

- *The fuel pressure regulating valve - N276- has a deformable sealing lip and no separate seal; it can therefore be used only once.*
- *Check that sealing surfaces (deformable sealing lip) and threads on new fuel pressure regulating valve - N276- are not damaged.*
- *Check sealing surface at opening in high-pressure reservoir.*
- *The beginning of the thread and the deformable sealing lip of the fuel pressure regulating valve - N276- must be coated with diesel fuel.*

– Screw on union nut by hand.

– Align new regulating valve so that connecting wire is free of tension after connector is attached.

– Hold regulating valve in this position by holding hexagon flats on housing of regulating valve with open-end spanner or pliers (water pump pliers or similar).

– Tighten union nut using open-end spanner insert, 30 mm - T10553- (at the same time, counterhold at hexagon flats on housing).

Tightening torques

- ⇒ “6.1 Exploded view - injectors”, page 254

– Install high-pressure reservoir ⇒ page 270 .

After renewing high-pressure pump or fuel pressure regulating valve - N276- , learnt values must be re-adapted; see “Guided Functions” in ⇒ Vehicle diagnostic tester

– After installation, run engine at moderate speed for several minutes and then switch off.

– Check fuel system for leaks.

– Interrogate event memory.

– After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.

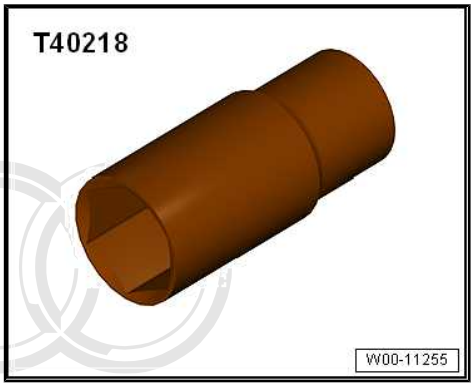
– Interrogate event memory again.

7.3 Removing and installing fuel pressure sender - G247-

Special tools and workshop equipment required

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- Bit (27 mm) - T40218- or commercially available socket (27 mm)



- Torque wrench

Note

- *The fuel pressure sender - G247- continuously measures the fuel pressure in the high-pressure system. It transmits a corresponding voltage signal to the engine control unit - J623- .*
- *Should the fuel pressure sender fail, the engine control unit will control the fuel pressure via a mapped open-loop backup function. Maximum engine speed in this mode is restricted.*
- *The fuel pressure sender - G247- has a deformable sealing lip and no separate seal; it can therefore be used only once.*

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Removing

WARNING

- ***Always read rules for cleanliness and instructions for working on fuel system ⇒ page 6 .***
- ***Follow these instructions and rules for cleanliness before starting work and while working on the fuel system.***

– Remove engine cover panel ⇒ page 47 .

– Before removal, clean area around thread for fuel pressure sender - G247- using e.g. commercial cleaning solution.

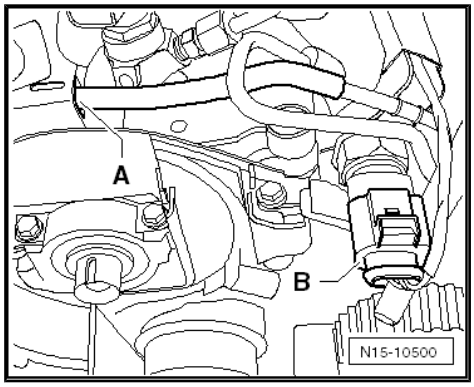
• Make sure no dirt gets into opening in high-pressure reservoir.

• Clean carefully; cleaning solution must not enter the electrical connector.

– Dry off fuel pressure sender - G247- .

– Unplug electrical connector -B- at fuel pressure sender - G247- .

– Unscrew fuel pressure sender - G247- using socket, 27 mm - T40218- .



Note

An open-end spanner must not be used for loosening or tightening.

– Extract dirt from opening in high-pressure reservoir (thread and sealing surface) using a vacuum cleaner. Do not use metal tools, etc.

– Seal off opening in high-pressure reservoir with a plug.

Installing

Note

- *Fuel pressure sender - G247- must always be renewed after it has been removed.*
- *Also check sealing surface at opening in high-pressure reservoir.*
- *Check that the deformable sealing lip and the thread on the new fuel pressure sender - G247- are not damaged.*
- *The beginning of the thread and the deformable sealing lip of the fuel pressure sender - G247- must be coated with diesel fuel.*

– Screw in fuel pressure sender - G247- by hand.

– Then tighten fuel pressure sender - G247- to specified torque.

Tightening torques

- ⇒ “6.1 Exploded view - injectors”, page 254

– Install engine cover panel ⇒ page 47 .

After installing fuel pressure sender - G247- , leave engine running at moderate speed for a few minutes when bleeding fuel system and then switch off again.

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Note

The fuel system is “self-bleeding”; do NOT open the high-pressure connections.

– Switch off ignition.

– Carefully check the entire fuel system for leaks.

Renew affected component if leakage still occurs after tightening to correct torque.

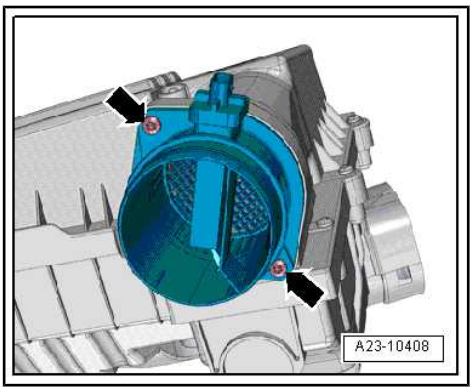
– After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.

Note

If there is any air left in the fuel system, the engine may switch to the backup mode ('emergency running' mode) during the road test. Switch off the engine and erase the event memory. Then continue the road test.

7.4 Removing and installing air mass meter - G70-

Removing



– Remove air cleaner housing ⇒ page 241 .

– Remove bolts -arrows-.

– Carefully pull air mass meter - G70- out of guide on air cleaner housing.

Installing

To ensure the proper function of the air mass meter - G70- it is important to observe the following instructions.

Note

- *If the air filter element is very dirty or wet, dirt particles or water can reach the air mass meter and falsify the detected air mass values. This will cause a loss of power, as the calculated injection quantities will be too low.*
- *Always use genuine air filter elements (same as original equipment).*
- *Always renew seal if damaged (air leaks in intake system).*
- *Use a silicone-free lubricant when installing the air hose and seal.*
- *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Check air mass meter and air hose (engine intake side) for salt residue, dirt and leaves.

– Check intake duct as far as air filter element for dirt. If necessary, clean salt residue, dirt and leaves out of air cleaner housing (top and bottom sections); wash out or use a vacuum cleaner as required.

– Install air cleaner housing ⇒ page 241 .

Tightening torques

- ⇒ “3.1 Exploded view - air cleaner housing”, page 240

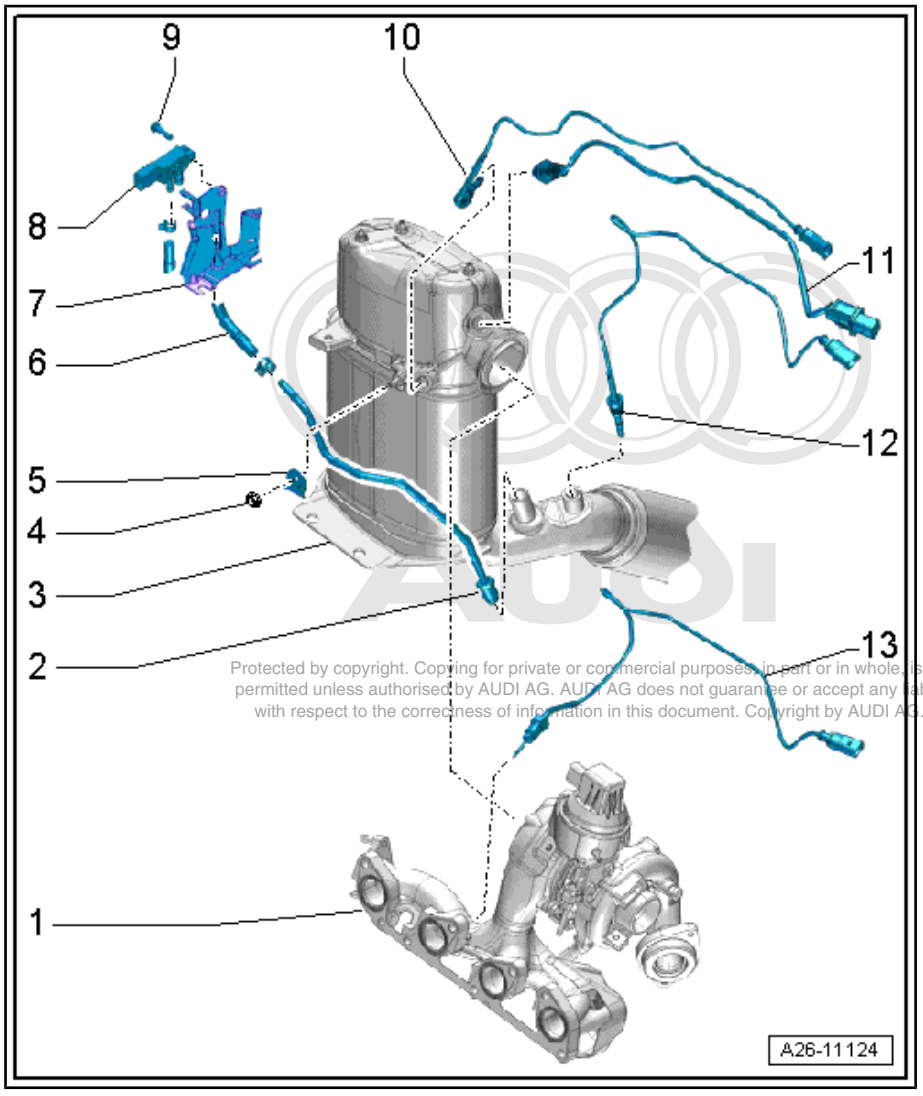
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8 Lambda probe

⇒ “8.1 Exploded view - Lambda probe”, page 280

⇒ “8.2 Removing and installing Lambda probe”, page 281

8.1 Exploded view - Lambda probe



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1 - Turbocharger

2 - Control pipe

- ❑ Tightening torque ⇒ Item 2 (page 301)

3 - Particulate filter

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ page 294
- ❑ Adaption must be performed after renewing particulate filter. Use ⇒ Vehicle diagnostic tester

4 - Nut

- ❑ 9 Nm

5 - Retainer

- ❑ Bolted to particulate filter

6 - Hose

7 - Bracket

- ❑ For pressure differential sender - G505-

8 - Pressure differential sender - G505-

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ page 299

9 - Bolt

- ❑ 8 Nm

10 - Exhaust gas temperature sender 3 - G495-

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ page 303

11 - Lambda probe - G39- with Lambda probe heater - Z19-

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ page 281
- ❑ 50 Nm

12 - Exhaust gas temperature sender 4 - G648-

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ page 305

13 - Exhaust gas temperature sender 1 - G235-

- ❑ Removing and installing ⇒ page 302

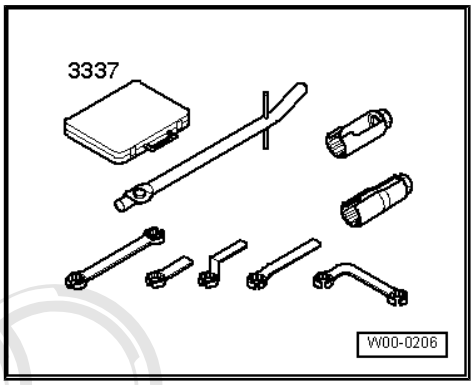
8.2 Removing and installing Lambda probe

⇒ "8.2.1 Removing and installing Lambda probe G39 ", page 281

8.2.1 Removing and installing Lambda probe - G39-

Special tools and workshop equipment required

- Lambda probe open ring spanner set - 3337-



Removing

WARNING

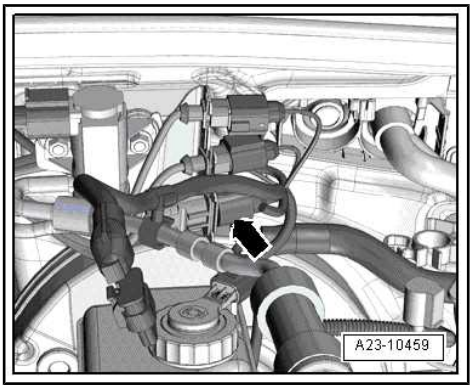
When working on all parts of the exhaust system:

- *Observe safety precautions when working on the exhaust system ⇒ "2.5 Safety precautions when working on the exhaust system", page 4 .*

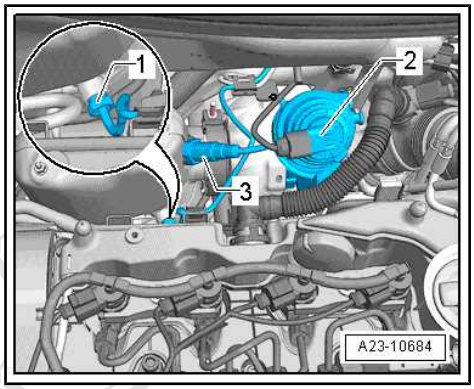
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– Remove engine cover panel ⇒ page 47 .

– Unplug electrical connector -arrow- for Lambda probe - G39- .



– Unscrew Lambda probe - G39- -3- using tool from Lambda probe open ring spanner set - 3337- .



Installing

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

Note

- *Threads of new Lambda probes are already coated with assembly paste; the paste must not get into the slots on the probe body.*
- *In the case of a used Lambda probe grease only the thread with high-temperature paste. The paste must not get into the slots on the Lambda probe body. For high-temperature paste refer to ⇒ Electronic parts catalogue*
- *When installing, the Lambda probe wiring must always be reattached at the same locations to prevent it from coming into contact with the exhaust pipe.*

– Install engine cover panel ⇒ page 47.

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Tightening torques

- ⇒ “8.1 Exploded view - Lambda probe”, page 280

9 Engine control unit

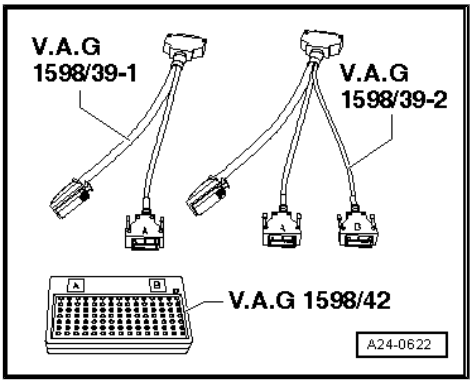
⇒ “9.1 Wiring and component check with test box 1598/42”, page 283

⇒ “9.2 Removing and installing engine control unit J623 ”, page 284

9.1 Wiring and component check with test box 1598/42

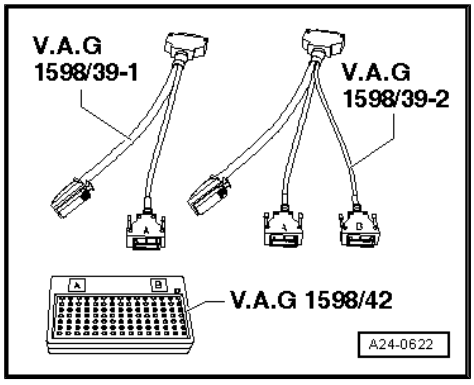
Special tools and workshop equipment required

- Adapter cable - V.A.G 1598/39-



- Test box - V.A.G 1598/42-

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Note

- *The test box has 105 sockets. The connecting cable can be disconnected from the test box. This means that only the cable (and not the test box) has to be purchased for future engine control units with different types of connectors.*
- *The smaller of the two connectors on the engine control unit has the contacts 1 to 60. The larger of the two connectors has the contacts 1 to 94.*
- *To carry out tests on the 60-pin wiring harness connector, the adapter cable - V.A.G 1598/39-1- is connected to connector -A- on the test box. For components connected to 60-pin wiring harness connector ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.*
- *To carry out tests on the 94-pin wiring harness connector, the adapter cable - V.A.G 1598/39-2- must be connected to connectors -A- and -B- on the test box. For components connected to 94-pin wiring harness connector ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.*
- *The test box - V.A.G 1598/42- is designed so it can be connected both to the wiring harness for the engine control unit and to the engine control unit itself at the same time.*
- *The advantage of this is that the electronic engine control system remains fully functional when the test box is connected (for example, for measuring signals when the engine is running).*
- *The relevant test procedure will state whether it is necessary to also connect the engine control unit to the test box.*

The engine control unit has to be removed before connectors can be unplugged from engine control unit ⇒ page 284 .

WARNING

To prevent irreparable damage to the electronic components, select appropriate measuring range before connecting the measuring cables and observe the test requirements.

– Connect the test box - V.A.G 1598/42- to wiring harness with adapter cable - V.A.G 1598/39-1- or adapter cable - V.A.G 1598/39-2- . Connect earth clip of test box to negative terminal of battery. The instructions for performing the individual tests indicate whether or not the engine control unit itself also needs to be connected to the test box.
– Carry out test as described in appropriate repair procedures.

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Installing engine control unit

Installation is performed in the reverse sequence.

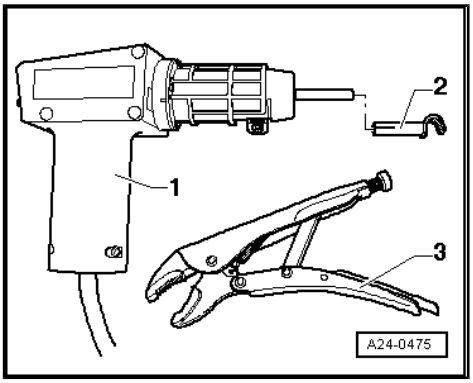
Perform the following after reconnecting engine control unit:

– Interrogate event memory and erase if necessary.

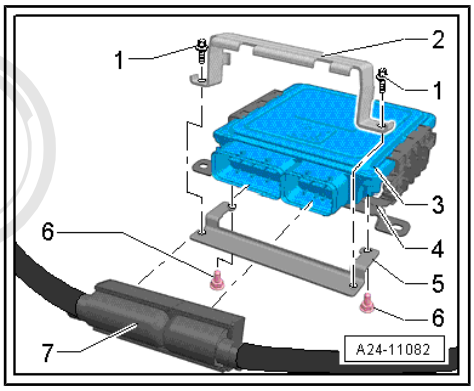
9.2 Removing and installing engine control unit - J623-

Special tools and workshop equipment required

- Hot air blower - VAS 1978/14A- -item 1- with nozzle attachment -2- from wiring harness repair set - VAS 1978 B-



- Small, commercially available mole grips -3-



Note

- *Not every engine control unit is bolted to a protective housing. Whether a protective housing is fitted depends on the engine/gearbox combination.*
- *The engine control unit -3- is bolted to the retaining bracket -2 and 5-. To make it more difficult to unscrew the shear bolts -1- for locking plate -2-, their threads have been coated with locking fluid.*
- *The protective housing has to be removed before the connectors can be unplugged from the engine control unit (e.g. to connect the test box or renew the engine control unit).*

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Removing

– Before removing the engine control unit - J623-, the adaption values of the injectors and the ash deposit mass must be read out. Use ⇒ Vehicle diagnostic tester.

The adaption values for the injectors in the old (defective) engine control unit can be read out via the Guided Fault Finding or Guided Functions mode and can be stored as an electronic file in the ⇒ Vehicle diagnostic tester.

– Store adaption values as electronic file.

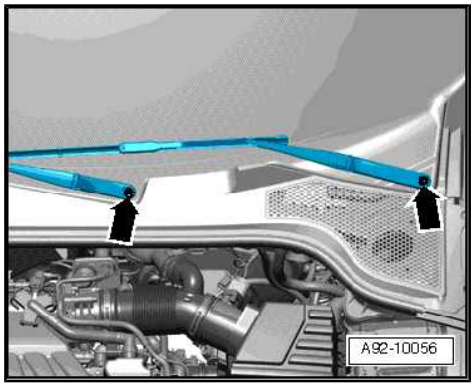
– Switch off ignition and remove ignition key after storing electronic file containing adaption values.

Note

If the adaption values of the injectors cannot be read out of the old (defective) engine control unit, the adaption values must be entered into the new engine control unit manually and the adaption procedure must be performed accordingly.

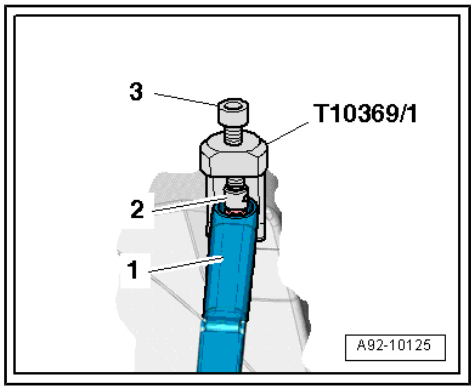
– Lever off caps on windscreen wiper arms with a screwdriver.

– Loosen hexagon nuts -arrows- several turns.
– Loosen wiper arms from wiper shafts by tilting slightly.
– Completely remove hexagon nuts and detach wiper arms from wiper shafts.

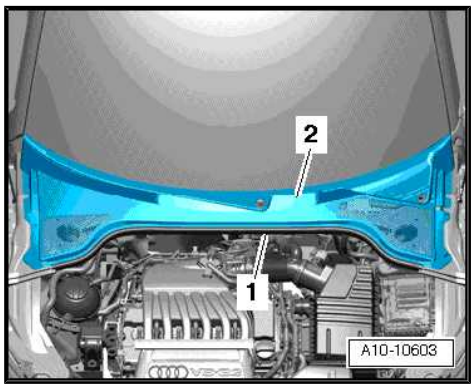


Note

If necessary, use puller - T10369- or a commercially available puller to remove wiper arms.

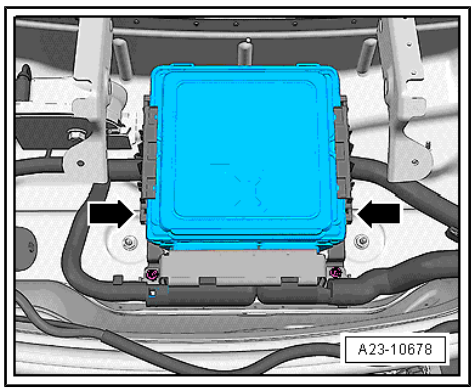


– Pull off rubber seal -1- and remove plenum chamber cover -2-.



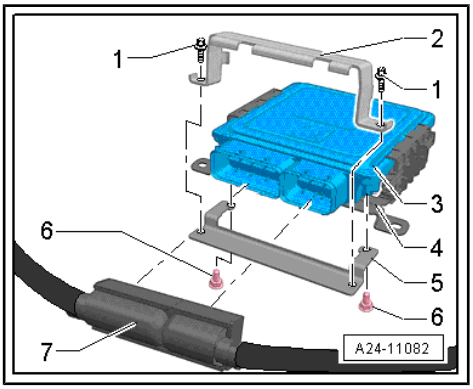
– Release clips -arrows- and pull out engine control unit - J623- towards front.

Perform the following work steps if a retaining bracket is fitted:

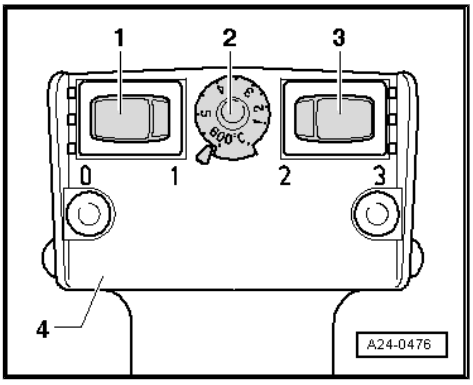


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The threads of the two shear bolts -1- which are not screwed into the engine control unit are secured with locking fluid. To unscrew these two bolts, the threads must therefore be heated with the hot air blower.



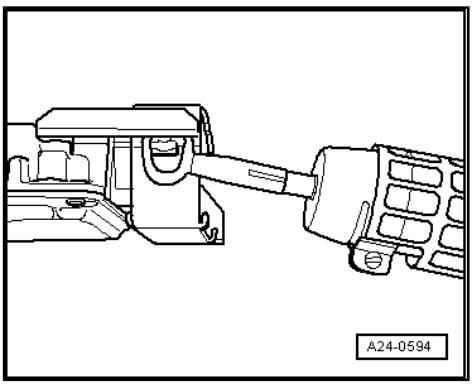
Select settings on hot air blower as shown in illustration, i.e. set temperature potentiometer -2- to maximum heat output and two-stage air flow switch -3- to position 3.



WARNING

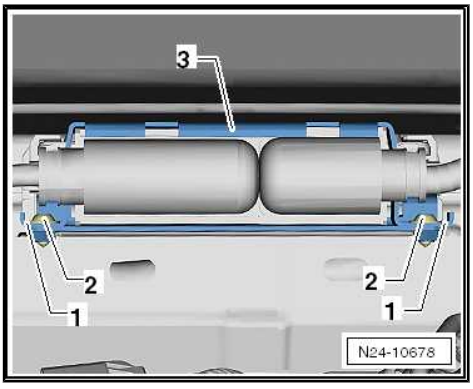
Heating the thread of the locking plate also heats up the shear bolts and parts of the retaining bracket. Take care to avoid burns. It is also important to ensure that only the thread is heated and none of the surrounding components if at all possible. These should be covered if necessary.

Switch on the hot air blower and heat the bolt for approximately 20 ... 30 seconds.

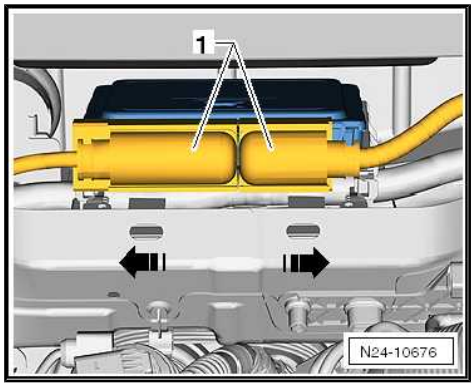


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– If necessary, bend vertical edges -1- of retaining bracket outwards.
– Remove shear bolts -2- using mole grips and detach retaining bracket -3-.



– Slide catches -1- on engine control unit in direction of -arrow- and unplug both connectors.



Installing

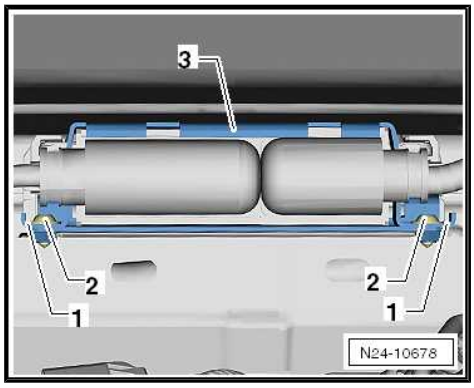
Installation is performed in the reverse sequence.

– Clean threaded holes for shear bolts to remove any residue from locking fluid. This can be done using a thread tap.

– Always use new shear bolts.

– Retaining bracket must be renewed if it has been bent outwards.

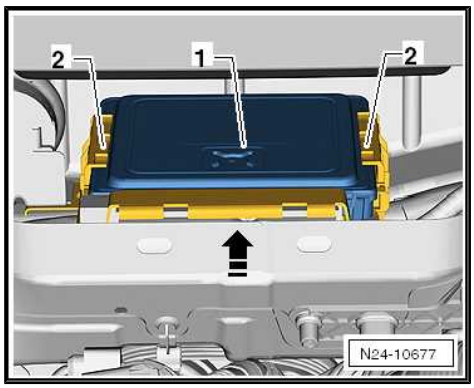
– Tighten retaining bracket -3- with new shear bolts -2- evenly until heads of bolts shear off.



Note

Disregard item -1-.

– Slide engine control unit -1- in direction of -arrow- into side guides -2-.



After installing a new engine control unit, the following operation must be performed:

– Activate engine control unit using ⇒ Vehicle diagnostic tester in “Guided Functions” mode, “Replace engine control unit”.

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26 – Exhaust system

1 Exhaust pipes/silencer

⇒ "1.1 Exploded view - silencer", page 289

⇒ "1.2 Stress-free alignment of exhaust system", page 290

⇒ "1.3 Checking exhaust system for leaks", page 291

1.1 Exploded view - silencer

Note

- *After working on the exhaust system, ensure that the system is not under stress and that it has sufficient clearance from the body. If necessary, loosen clamp and align silencers and exhaust pipe so that sufficient clearance is maintained to the body at all points and the mountings are evenly loaded.*
- *Use screwdriver to unfasten and tighten clamping washers for heat shields. Tightening torque: 2 Nm*

1 - Rear silencer

- ❑ Align exhaust system so it is free of stress ⇒ page 290

2 - Tunnel cross-piece

- ❑ Removing and installing ⇒ General body repairs, exterior; Rep. gr. 66 ; Underbody trim; Removing and installing tunnel cross-piece

3 - Nut

- ❑ Tightening torque ⇒ General body repairs, exterior; Rep. gr. 66 ; Underbody trim; Exploded view - underbody trim

4 - Mounting

- ❑ Renew if damaged

5 - Bolt

- ❑ 23 Nm

6 - Bolt

- ❑ 20 Nm

7 - Mounting

- ❑ Renew if damaged

8 - Rubber mounting

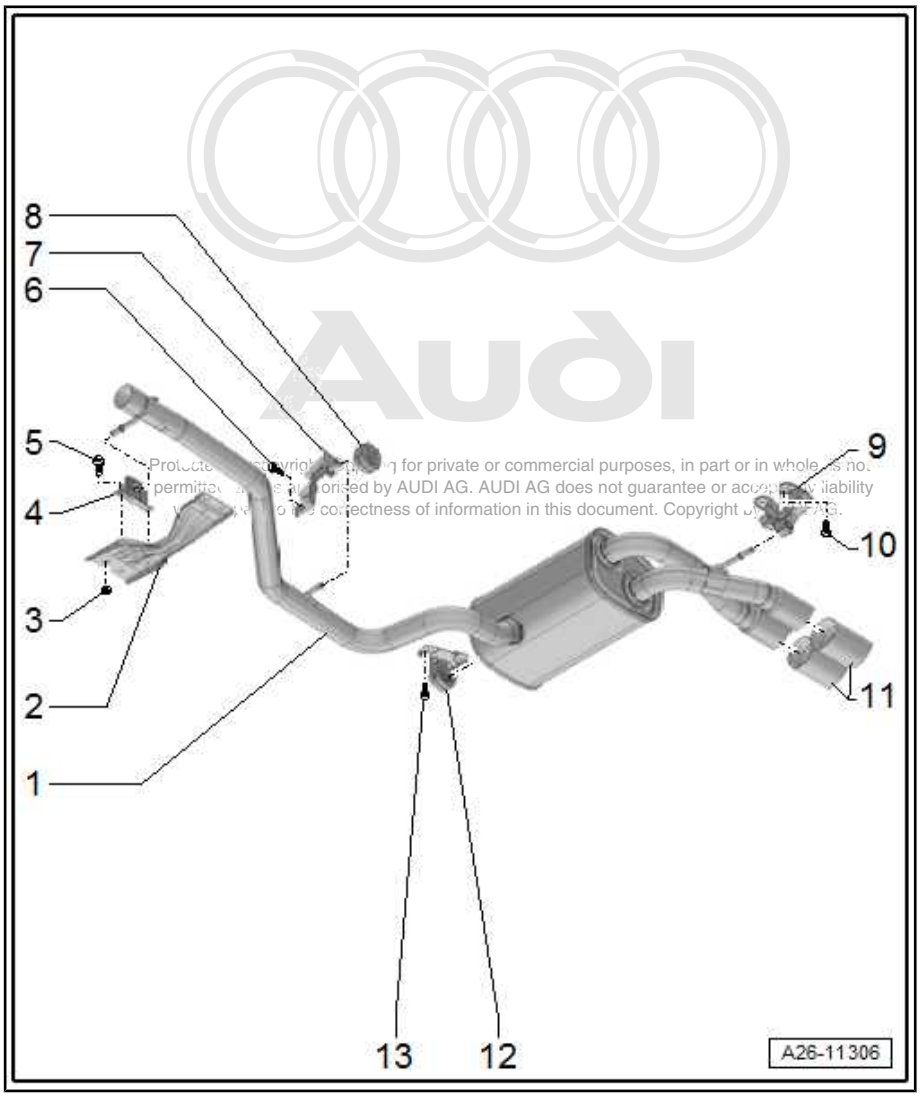
- ❑ Renew if damaged

9 - Mounting

- ❑ Renew if damaged

10 - Bolt

- ❑ 33 Nm



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11 - Tailpipes

- ❑ Aligning ⇒ page 291

12 - Mounting

- ❑ Renew if damaged

13 - Bolt

- ❑ 23 Nm

1.2 Stress-free alignment of exhaust system

⇒ "1.2.1 Stress-free alignment of exhaust system", page 290

⇒ "1.2.2 Aligning tailpipes", page 291

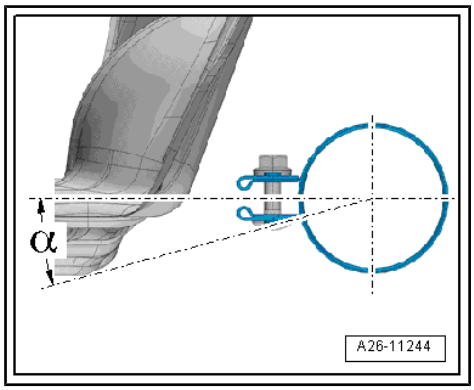
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1.2.1 Stress-free alignment of exhaust system

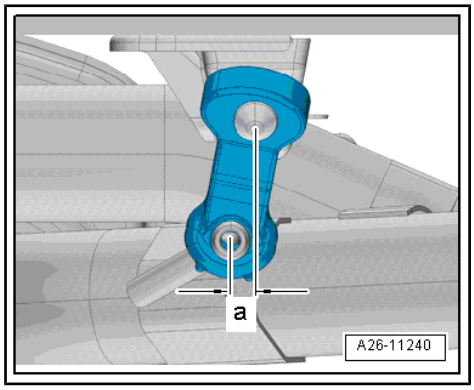
Procedure

- The exhaust system must be aligned when it is cool.
- Tightening torque ⇒ "1.1 Exploded view - silencer", page 289

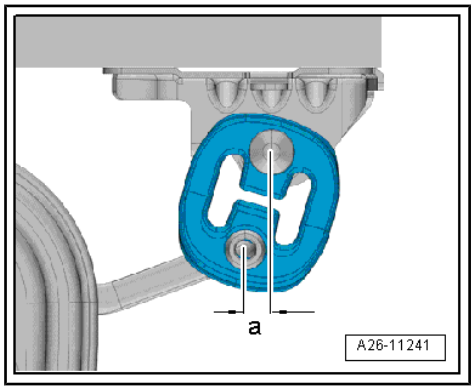
– Loosen bolt connections for clamp.



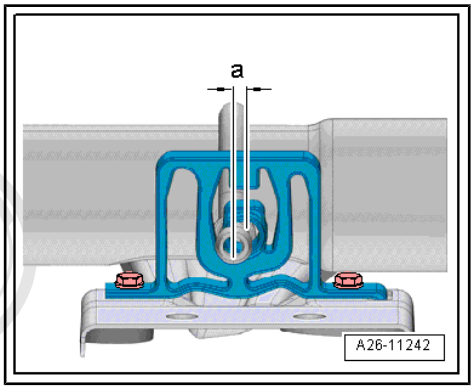
– Push exhaust system towards front of vehicle until preloading at mounting (left-side) for rear silencer -a- = 11 mm.



– Push exhaust system towards front of vehicle until preloading at mounting (right-side) for rear silencer -a- = 10.3 mm.



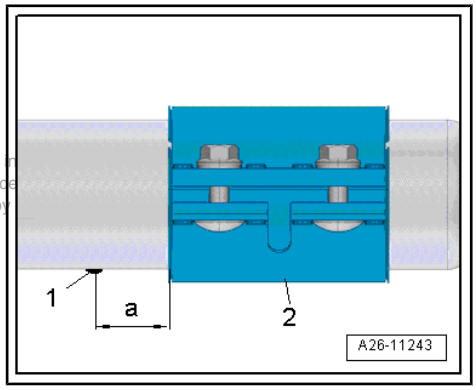
– Push exhaust system towards front of vehicle until preloading at front mounting for rear silencer -a- = 4.7 mm.



– Align clamp -2- with distance -a- according to mark -1- on particulate filter.

• Dimension -a- = 8.5 mm

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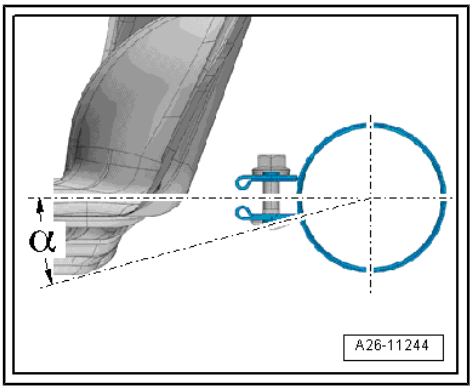
– Fit the clamp at the angle shown.

• Angle -α- = approx. 5°

• Bolt connections face to left

• Nuts facing upwards

– Tighten bolt connections on clamp evenly.

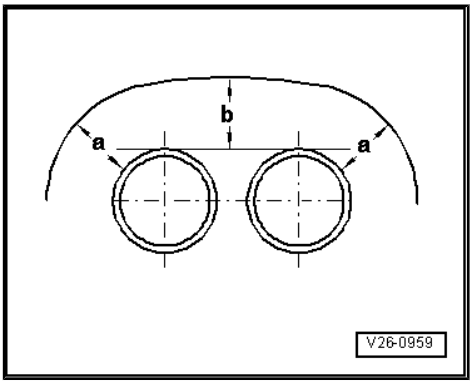


1.2.2 Aligning tailpipes

Procedure

– Align rear silencer so that there is an equal distance -a- and -b- between bumper cut-out and tailpipes.

– Unfasten rear silencer mounting to align tailpipes.



1.3 Checking exhaust system for leaks

Procedure

– Start the engine and run at idling speed.

– Plug tailpipes during leak test (e.g. with cloth or plug).

– Listen for noise at the connection points of cylinder head/exhaust manifold, turbocharger/front exhaust pipe etc. to locate any leaks.
– Rectify any leaks that are found.

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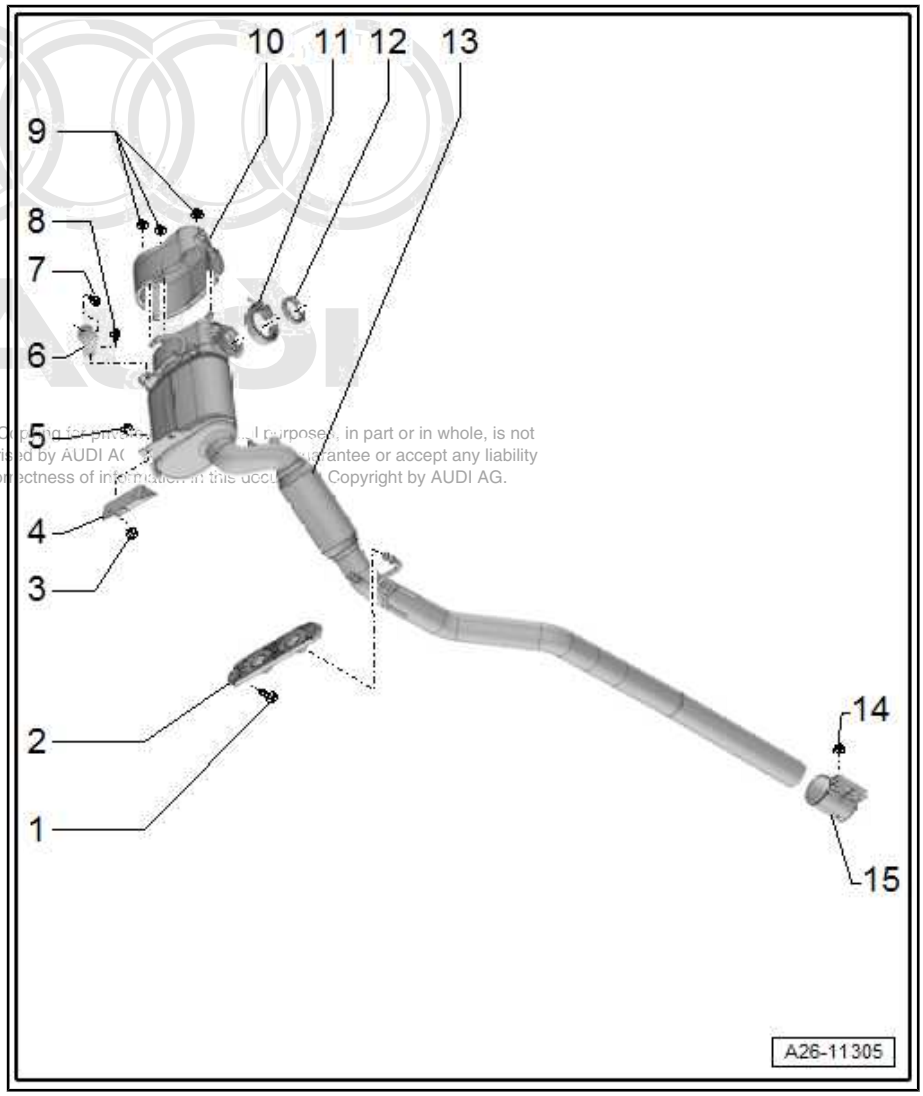
2 Emission control system

⇒ “2.1 Exploded view - emission control system”, page 293

⇒ “2.2 Removing and installing particulate filter”, page 294

⇒ “2.3 Removing and installing pressure differential sender G505 ”, page 299

2.1 Exploded view - emission control system



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1 - Bolt
- ❑ 23 Nm

2 - Bracket

3 - Nut
- ❑ 23 Nm

4 - Bracket (bottom)
- ❑ For particulate filter

5 - Nut
- ❑ 23 Nm

6 - Bracket (top)
- ❑ For particulate filter

7 - Bolt
- ❑ 23 Nm

8 - Bolt
- ❑ 23 Nm

9 - Nuts
- ❑ 9 Nm

10 - Heat shield

11 - Clamp
- ❑ For particulate filter
- ❑ Renew
- ❑ Installation position ⇒ page 294
- ❑ 7 Nm

12 - Seal
- ❑ Renew

13 - Diesel particulate filter with catalytic converter
- ❑ Removing and installing ⇒ page 294
- ❑ After renewing, perform `Adaption` in `Guided Functions` ⇒ Vehicle diagnostic tester
- ❑ Align exhaust system so it is free of stress ⇒ page 290

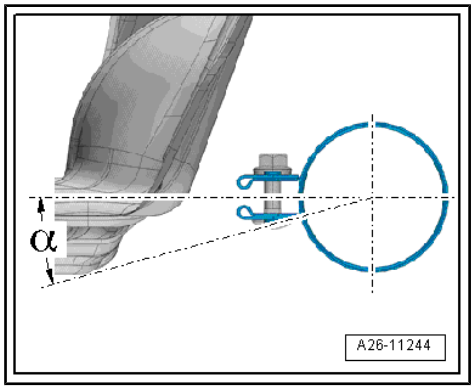
14 - Nut
- ❑ 23 Nm

15 - Clamp
- ❑ Before tightening, align exhaust system so it is free of stress ⇒ page 290
- ❑ Installation position ⇒ page 294
- ❑ Tighten bolted connections evenly

Installation position of front clamp

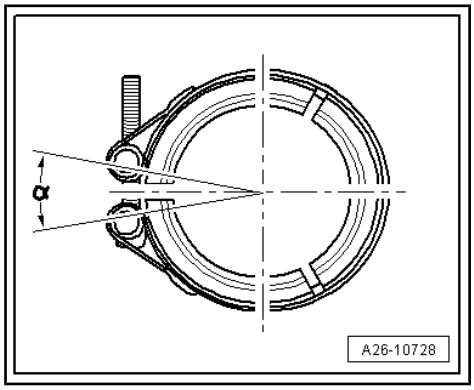
– Fit the clamp at the angle shown.

- Angle -α- = approx. 5°
- Bolt connections face to left
- Nuts facing upwards



Installation position of clamp for particulate filter

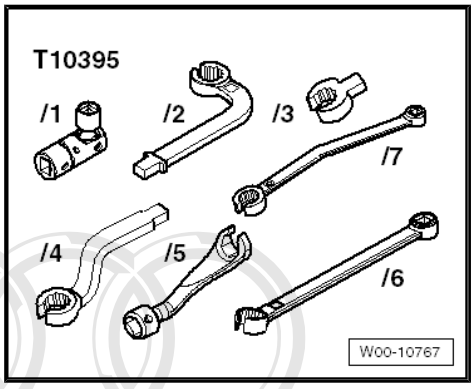
- Angle -α- = 0 ± 10°
- Bolt connection faces to rear



2.2 Removing and installing particulate filter

Special tools and workshop equipment required

♦ Tool set, 17 mm - T10395-



♦ Flange bolt M10x35

Removing

WARNING

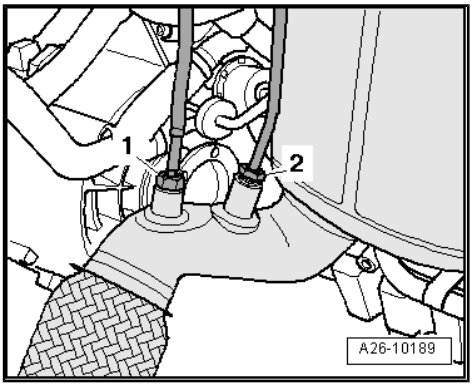
When working on all parts of the exhaust system:

♦ *Observe safety precautions when working on the exhaust system*
⇒ "2.5 Safety precautions when working on the exhaust system", page 4 .

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– Remove Lambda probe ⇒ page 281 .

– Unscrew exhaust gas temperature sender 4 - G648- -item 1- from exhaust pipe behind particulate filter using a tool from tool set, 17 mm - T10395- .

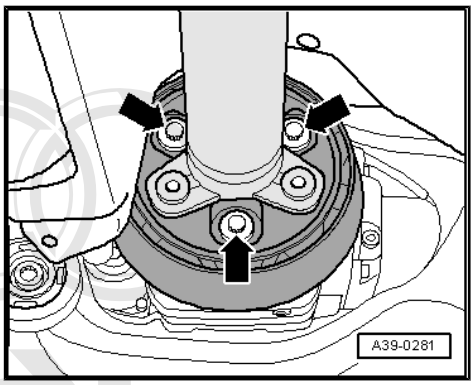


Note

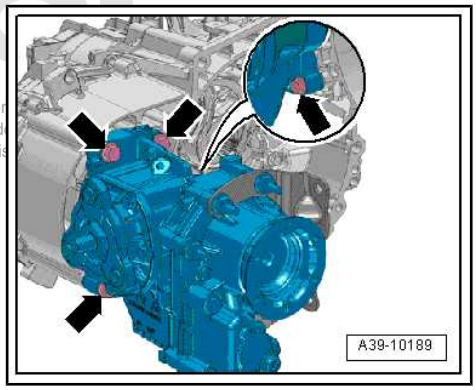
Disregard -item 2-.

Vehicles with four-wheel drive:

– Remove propshaft ⇒ Rep. gr. 39 ; Propshaft; Removing and installing propshaft .



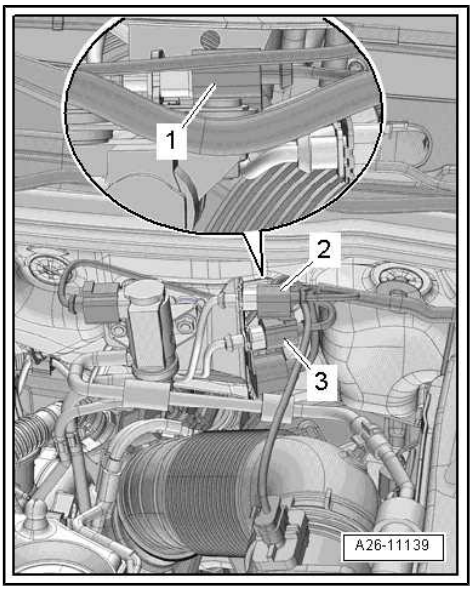
– Remove bevel box ⇒ Rep. gr. 34 ; Bevel box; Removing bevel box .



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with respect to the correctness of information in this

Continued for all vehicles:

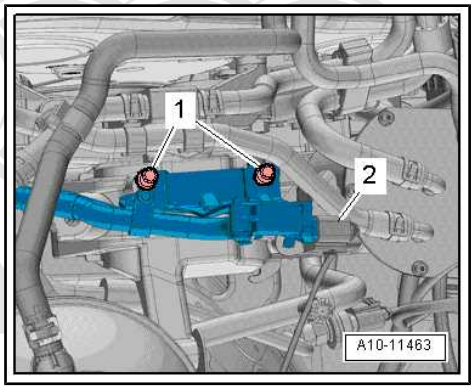
– Unplug electrical connector -1- for exhaust gas temperature sender 3 - G495- and move electrical wiring clear.



Note

Disregard items -2 and 3-.

– Unplug electrical connector -2-.
– Remove bolts -1- and detach pressure differential sender - G505- from bracket -arrow-.



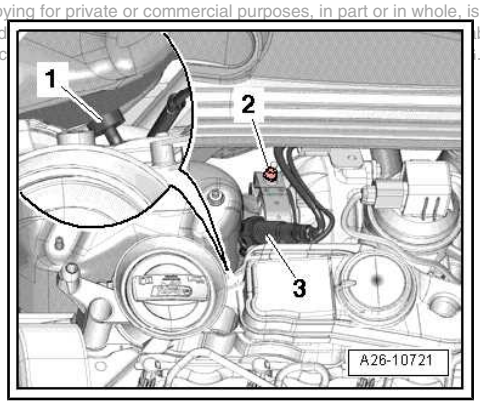
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Vehicles with front-wheel drive:

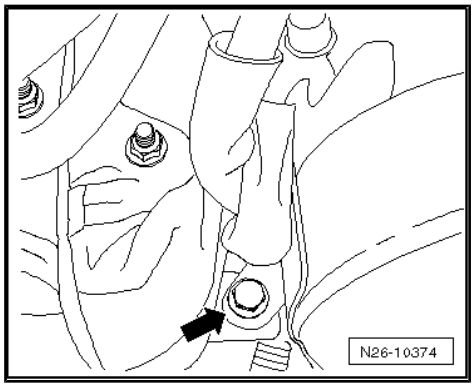
– Slacken bolt -2- and remove clamp.

Note

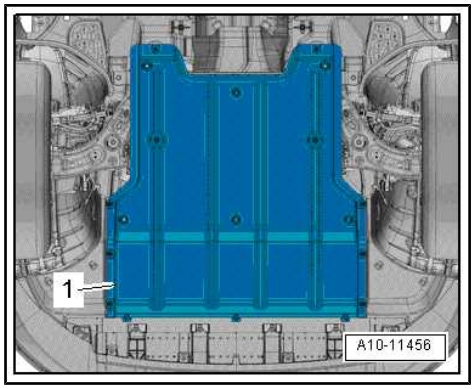
Disregard items -1 and 3-.



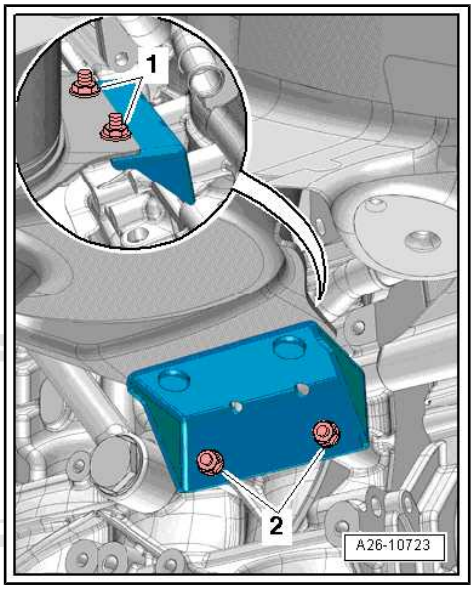
– Remove bolt -arrow- securing top bracket for particulate filter.



– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



– Remove nuts -1- and -2- and detach bottom bracket for particulate filter.

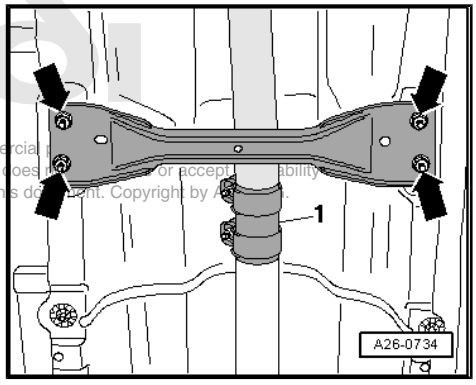


Caution

Risk of damage to flexible joint.

- *Do NOT bend flexible joint in front exhaust pipe more than 10°.*

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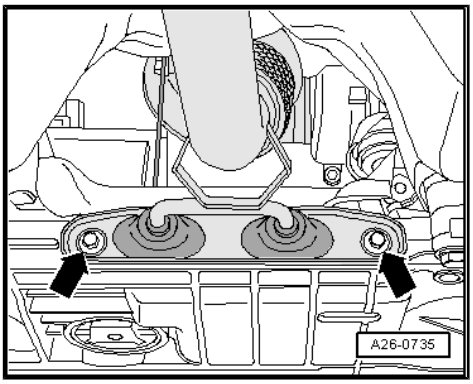


– Loosen nuts for clamp -1- and push clamp to rear.

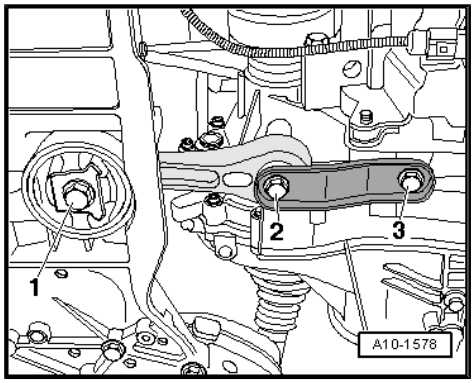
Note

Disregard -arrows-.

– Remove bolts -arrows- securing bracket for exhaust system.



– Remove bolt -1- securing pendulum support.

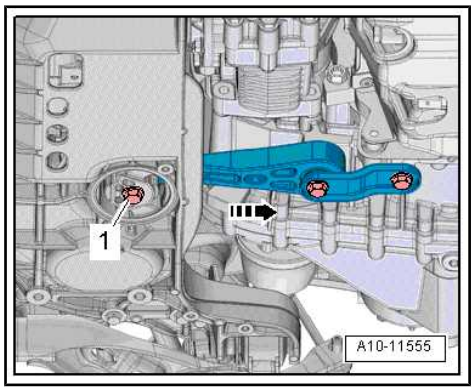


Note

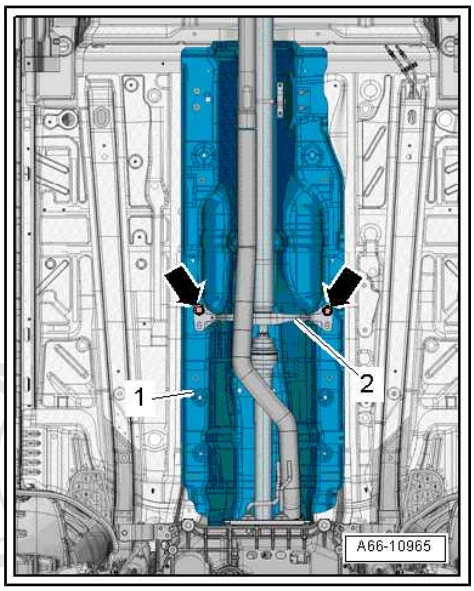
Disregard items -2 and 3-.

Continued for all vehicles:

– Press engine/gearbox assembly towards lock carrier -arrow- and screw in bolt -1- again by several turns.

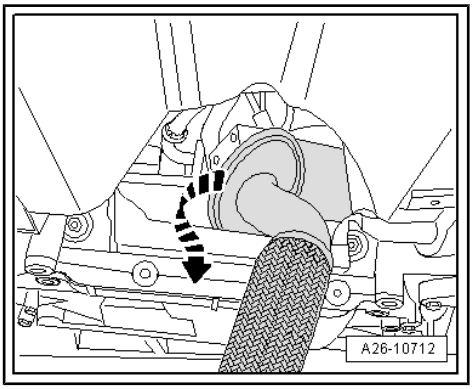


– Remove heat shield -1- for floor ⇒ General body repairs, exterior; Rep. gr. 66 ; Strips / trim panels / extensions; Removing and installing heat shield for floor .



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– Remove particulate filter by rotating through 180° around its own axis -arrow-.



Installing

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

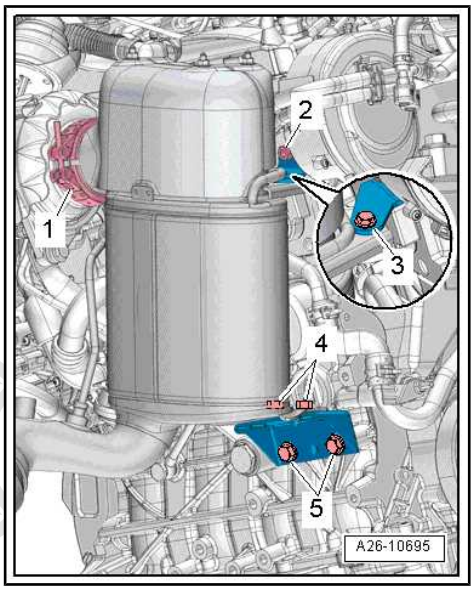
Tightening torques

- ⇒ “8.1 Exploded view - Lambda probe”, page 280
- ⇒ “1.1 Exploded view - silencer”, page 289
- ⇒ “2.1 Exploded view - emission control system”, page 293
- ⇒ “3.1 Exploded view - exhaust gas temperature control”, page 301

Note

- *Renew gaskets, self-locking nuts and clamp for particulate filter.*
- *Fit all cable ties in the original positions when installing.*

– Note sequence when installing particulate filter:



1.	Fit particulate filter to turbocharger, attach clip -1- without tightening
2.	Fit bolts -2 ... 5- by hand without tightening • It must still be possible to move particulate filter and bracket
3.	Tighten clamp -1-
4.	Tighten bolts -2- and -5-.
5.	Tighten bolts -3- and -4-.

– Install heat shield for floor ⇒ General body repairs, exterior; Rep. gr. 66 ; Strips / trim panels / extensions; Removing and installing heat shield for floor .

– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

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

– Install bevel box ⇒ Rep. gr. 34 ; Bevel box; Installing bevel box .

– Install propshaft ⇒ Rep. gr. 39 ; Propshaft; Removing and installing propshaft .

– Align the exhaust system so it is free of stress ⇒ page 290 .

– After renewing particulate filter, perform `Adaption` in `Guided Functions` ⇒ Vehicle diagnostic tester.

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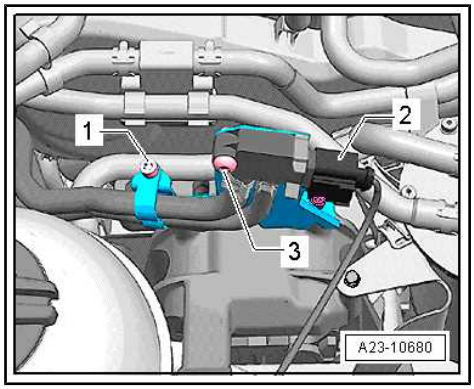
2.3 Removing and installing pressure differential sender - G505-

The pressure differential sender - G505- detects the amount of deposits in the particulate filter.

Removing

– Remove engine cover panel ⇒ page 47 .

– Unplug electrical connector -2-.
– Remove bolt -3- and detach pressure differential sender - G505- from bracket.
– Detach retaining clips -1- from both hoses.
– Before disconnecting, spray the hoses for the pressure differential sender - G505- with suitable release agent.
– Carefully disconnect the hoses from their connections (take care to keep the hoses straight: the connections on pressure sensor can break off easily).



Installing

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

Note

- *Before installing, blow out control pipes from pressure differential sender - G505- to particulate filter towards particulate filter with compressed air (pipes can become obstructed or may ice up due to condensation).*
- *Make sure that hoses are securely fitted and seal properly.*
- *If pressure pipes were loosened on particulate filter, tighten pressure pipe connections* ⇒ page 301 .
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Install engine cover panel ⇒ page 47 .
– Learnt values must be reset on engine control unit after renewing pressure differential sender - G505- . To do so, switch on ignition and select following menu options on ⇒ Vehicle diagnostic tester.

- `01 - Self-diagnosis compatible systems`
- `01 - Engine electronics`
- `Guided Functions`
- `01 - Reset learnt values`

Tightening torques

- ⇒ “8.1 Exploded view - Lambda probe”, page 280

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3 Exhaust gas temperature control

⇒ "3.1 Exploded view - exhaust gas temperature control", page 301

⇒ "3.2 Removing and installing exhaust gas temperature senders", page 302

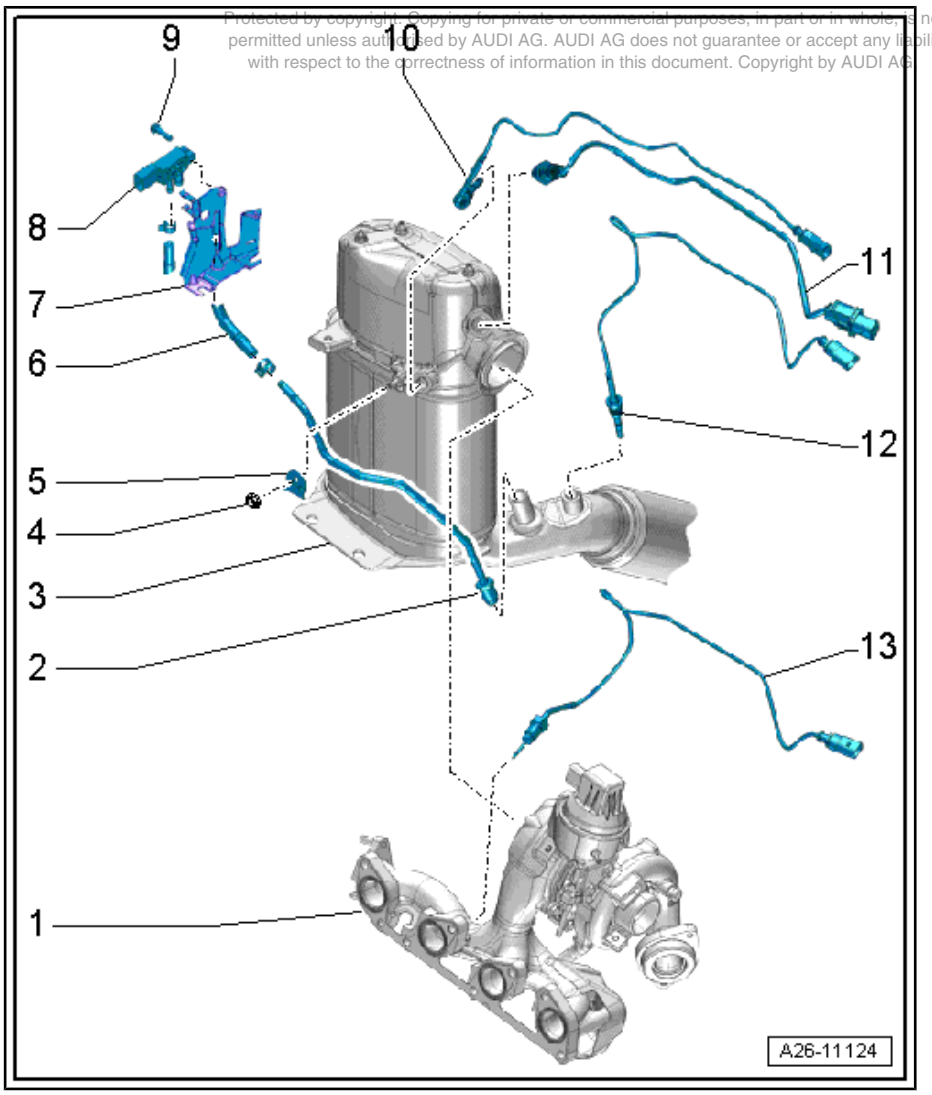
3.1 Exploded view - exhaust gas temperature control

Caution

Risk of malfunctions caused by improperly secured exhaust gas temperature senders.

- *The threads of the exhaust gas temperature senders - G495- and -G648- are coated. It is important that you do NOT coat them additionally with high-temperature paste and that you tighten them to the specified torque.*

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1 - Turbocharger

2 - Control pipe

- ❑ 45 Nm

3 - Particulate filter

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ page 294

4 - Nut

- ❑ Tightening torque ⇒ Item 4 (page 280)

5 - Bracket

- ❑ Bolted to particulate filter

6 - Hose

7 - Bracket

- ❑ For pressure differential sender - G505-

8 - Pressure differential sender - G505-

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ page 299

9 - Bolt

- ❑ Tightening torque ⇒ Item 9 (page 280)

10 - Exhaust gas temperature sender 3 - G495-

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ page 303

- ❑ The thread of the exhaust gas temperature sender is coated; it must not additionally be greased with high-temperature paste
- ❑ 60 Nm

11 - Lambda probe - G39- with Lambda probe heater - Z19-

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ page 281

12 - Exhaust gas temperature sender 4 - G648-

- ❑ May be fitted depending on emission standard
- ❑ Removing and installing ⇒ page 305
- ❑ The thread of the exhaust gas temperature sender is coated; it must not additionally be greased with high-temperature paste
- ❑ 60 Nm

13 - Exhaust gas temperature sender 1 - G235-

- ❑ Removing and installing ⇒ page 302
- ❑ Coat thread with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ❑ 45 Nm

3.2 Removing and installing exhaust gas temperature senders

⇒ "3.2.1 Removing and installing exhaust gas temperature sender 1 G235 ", page 302

⇒ "3.2.2 Removing and installing exhaust gas temperature sender 3 G495 ", page 303

⇒ "3.2.3 Removing and installing exhaust gas temperature sender 4 G648 ", page 305

3.2.1 Removing and installing exhaust gas temperature sender 1 - G235-

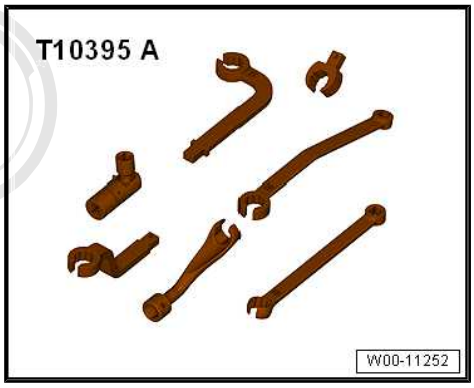
Tool set - T10395 A/B-

Removing

WARNING

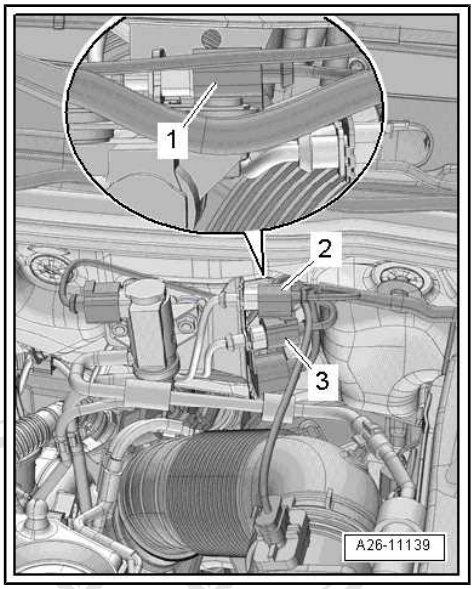
When working on all parts of the exhaust system:

- *Observe safety precautions when working on the exhaust system*
  ⇒ "2.5 Safety precautions when working on the exhaust system", page 4 .



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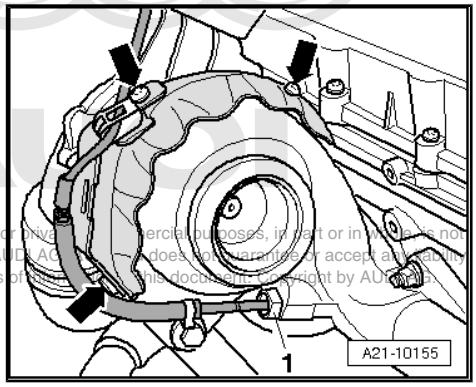
– Unplug electrical connector -2- for exhaust gas temperature sender 1 - G235- and move electrical wiring clear.



Note

The connection can be accessed from below.

– Unscrew exhaust gas temperature sender 1 - G235- -1- from exhaust manifold.



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Installing

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

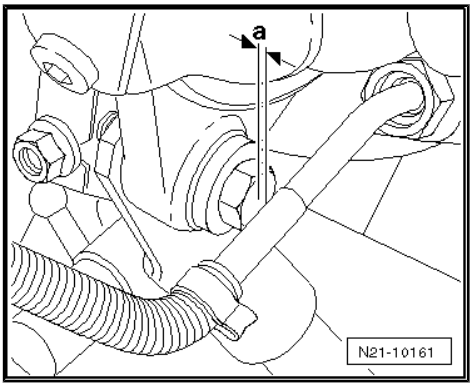
Tightening torques

◆ ⇒ "3.1 Exploded view - exhaust gas temperature control", page 301

Note

Coat threads of exhaust gas temperature sender with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue .

Installation position of exhaust gas temperature sender 1 - G235- :



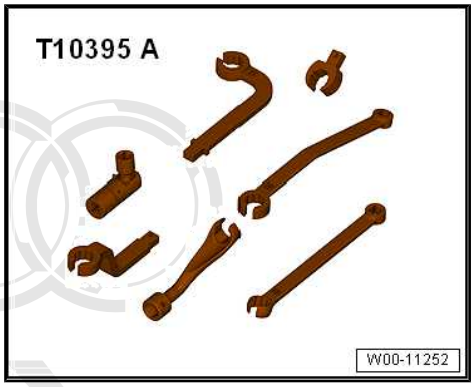
- The angled part of the pipe must have a clearance of -a- = 3 … 5 mm from the bolt on the turbocharger support.

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

3.2.2 Removing and installing exhaust gas temperature sender 3 - G495-

Special tools and workshop equipment required

- Tool set - T10395 A/B-



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Removing

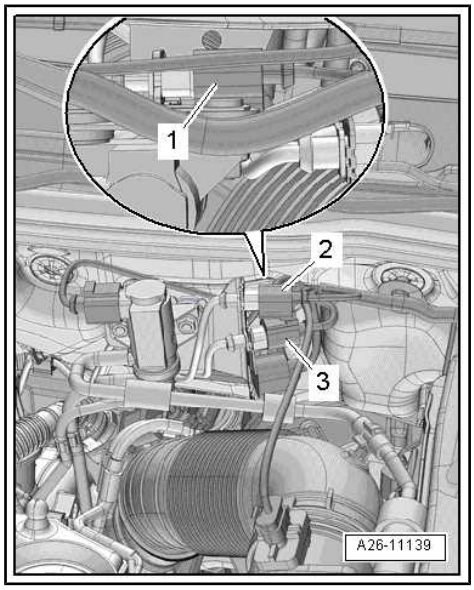
WARNING

When working on all parts of the exhaust system:

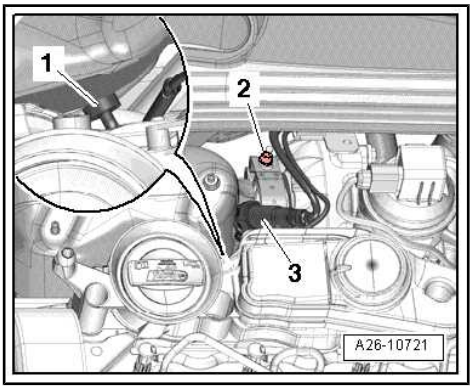
- ***Observe safety precautions when working on the exhaust system***
  ⇒ "2.5 Safety precautions when working on the exhaust system", page 4 .

– Remove Lambda probe - G39- ⇒ page 281 .

– Unplug electrical connector -1- for exhaust gas temperature sender 3 - G495- and move electrical wiring clear.



– Unscrew exhaust gas temperature sender 3 - G495- -1- using a tool from tool set, 17 mm - T10395- .



Installing

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

Tightening torques

- ⇒ "3.1 Exploded view - exhaust gas temperature control", page 301

Caution

Risk of malfunctions caused by improperly secured exhaust gas temperature senders.

- *The threads of the exhaust gas temperature senders - G495- and -G648- are coated. It is important that you do NOT coat them additionally with high-temperature paste and that you tighten them to the specified torque.*

– Align exhaust gas temperature sender 3 - G495- with as much clearance from surrounding components as possible.

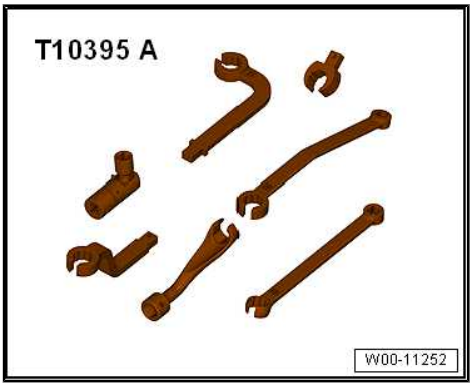
– Install Lambda probe - G39- ⇒ page 281 .

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

3.2.3 Removing and installing exhaust gas temperature sender 4 - G648-

Special tools and workshop equipment required

- Tool set - T10395 A/B-



Removing

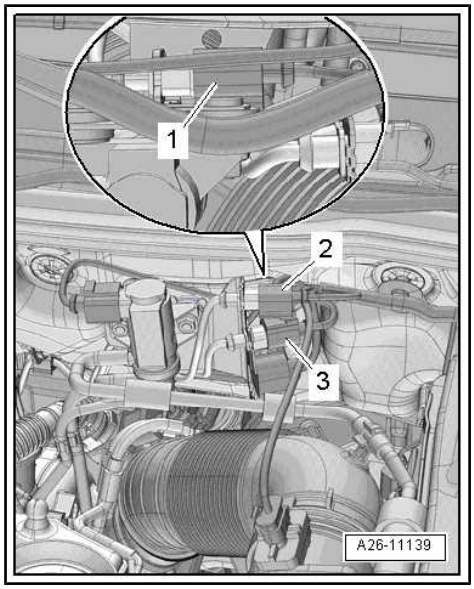
WARNING

When working on all parts of the exhaust system:

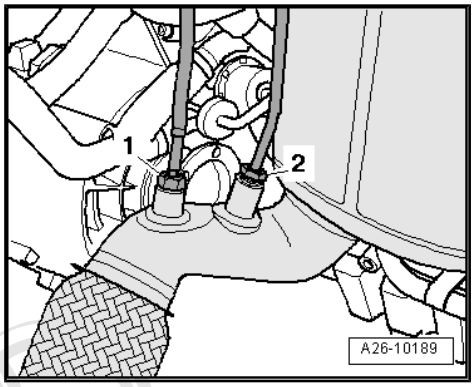
- *Observe safety precautions when working on the exhaust system*
  ⇒ "2.5 Safety precautions when working on the exhaust system", page 4 .

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– Unplug electrical connector -3- for exhaust gas temperature sender 4 - G648- and move electrical wiring clear.



– Unscrew exhaust gas temperature sender 4 - G648- -1- from exhaust pipe behind particulate filter using a tool from tool set, 17 mm - T10395- .



Installing

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

Tightening torques

- ⇒ “3.1 Exploded view - exhaust gas temperature control”, page 301

Caution

Risk of malfunctions caused by improperly secured exhaust gas temperature senders.

- ***The threads of the exhaust gas temperature senders - G495- and -G648- are coated. It is important that you do NOT coat them additionally with high-temperature paste and that you tighten them to the specified torque.***

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

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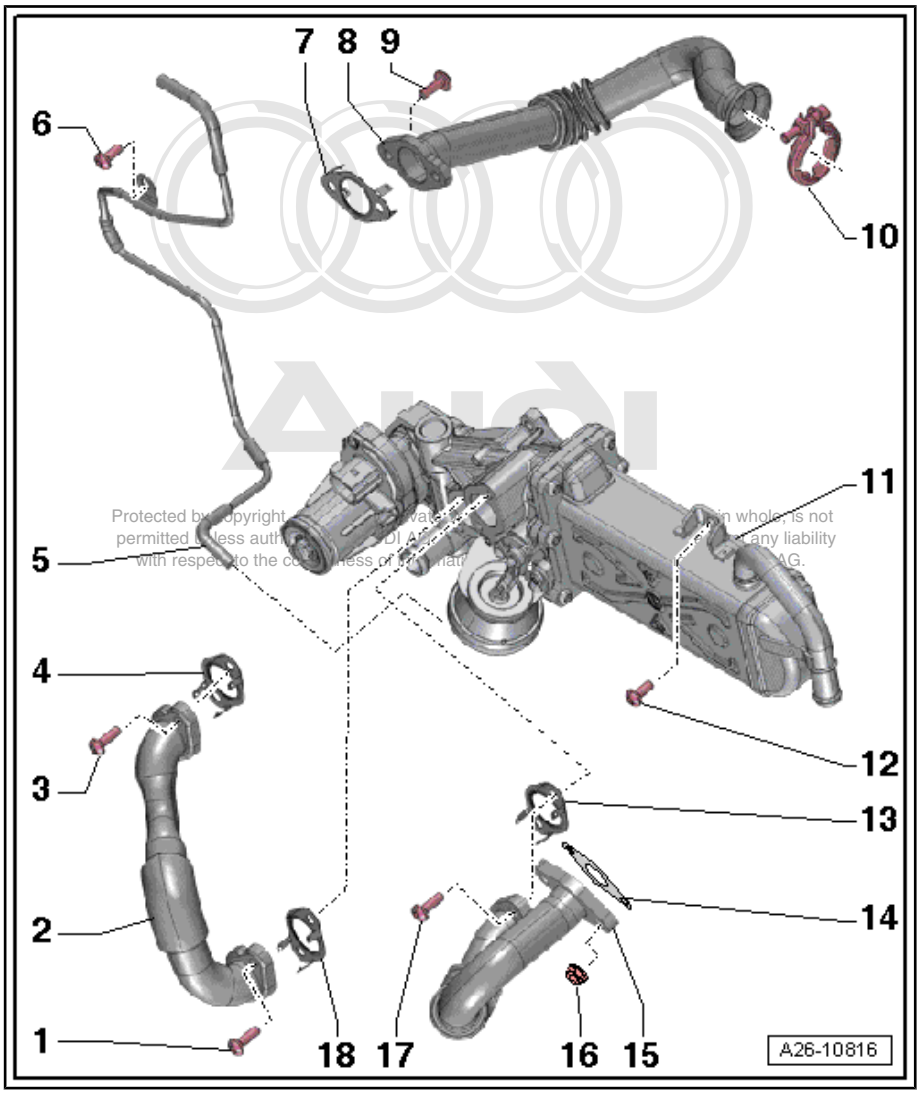
4 Exhaust gas recirculation

⇒ “4.1 Exploded view - exhaust gas recirculation system”, page 307

⇒ “4.2 Removing and installing exhaust gas recirculation cooler”, page 308

⇒ “4.3 Checking exhaust gas recirculation cooler change-over”, page 310

4.1 Exploded view - exhaust gas recirculation system



1 - Bolt
- ❑ 9 Nm

2 - Pipe for exhaust gas recirculation
- ❑ With flexible joint; do not bend joint - risk of cracking

3 - Bolt
- ❑ 9 Nm

4 - Gasket
- ❑ Renew

5 - Vacuum line
- ❑ Do not alter shape

6 - Bolt
- ❑ 9 Nm

7 - Gasket
- ❑ Renew

8 - Pipe for exhaust gas recirculation
- ❑ With flexible joint; do not bend joint - risk of cracking

9 - Bolt
- ❑ 9 Nm

10 - Clip
- ❑ 5 Nm

11 - Exhaust gas recirculation cooler
- ❑ With integrated exhaust gas recirculation control motor - V338- with exhaust gas recirculation potentiometer - G212-
- ❑ Checking change-over function ⇒ page 310
- ❑ Removing and installing ⇒ page 308
- ❑ After renewing exhaust gas recirculation control motor - V338- , learnt values must be re-adapted; see `Guided Functions` of ⇒ Vehicle diagnostic tester, `01 - Adaption elec. adjuster with checkback`

12 - Bolt
- ❑ 9 Nm

13 - Gasket
- ❑ Renew

14 - Gasket

- ❑ Renew

15 - Pipe for exhaust gas recirculation

- ❑ With flexible joint; do not bend joint - risk of cracking

16 - Nut

- ❑ 24 Nm

17 - Bolt

- ❑ 9 Nm

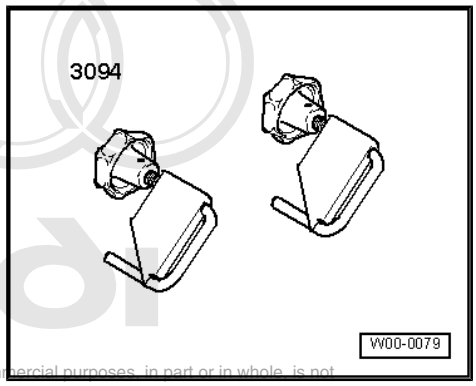
18 - Gasket

- ❑ Renew

4.2 Removing and installing exhaust gas recirculation cooler

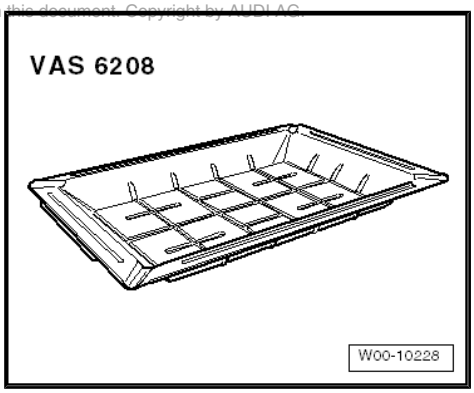
Special tools and workshop equipment required

- ♦ Hose clamps, up to 25 mm - 3094-

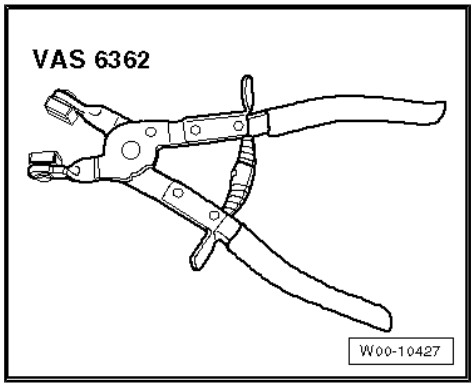


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- ♦ Drip tray for workshop hoist - VAS 6208-



- ♦ Hose clip pliers - VAS 6362-



Removing

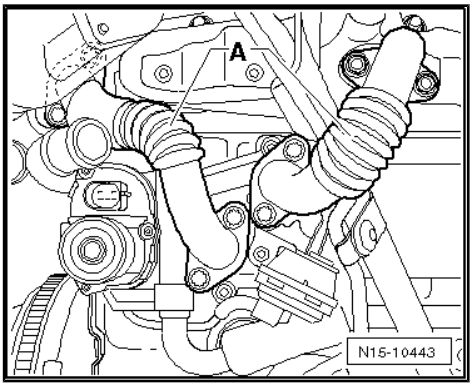
Note

Fit heat insulation sleeve in the original position when installing.

Vehicles with front-wheel drive:

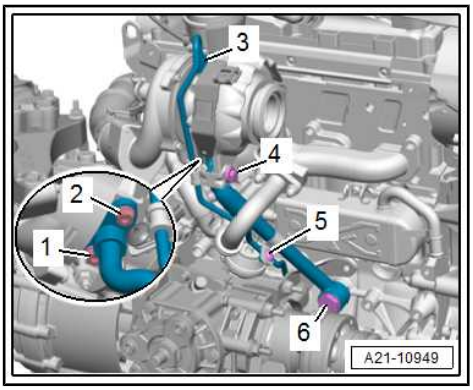
– Remove particulate filter ⇒ page 294 .

– Remove bolts and detach exhaust gas recirculation pipes -A-.



– Unscrew union nut -3- and remove bolts -4 and 5-.

– Remove bolts -1, 2 and 6- and detach oil return line.



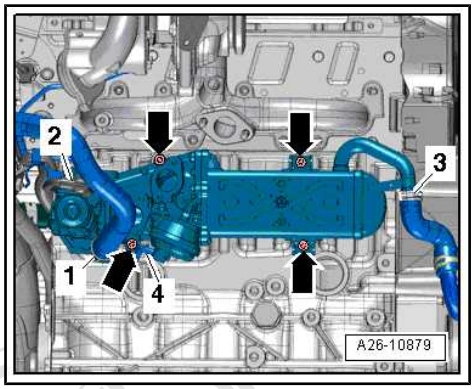
Vehicles with four-wheel drive:

– Remove bevel box ⇒ Rep. gr. 34 ; Bevel box; Removing bevel box .

Continued for all vehicles:

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– Place drip tray for workshop hoist - VAS 6208- beneath engine.
– Clamp off coolant hoses -1- and -3- using hose clamps up to 25 mm - 3094- , release hose clips and disconnect coolant hoses from exhaust gas recirculation cooler.
– Unplug electrical connector -2-.
– Detach heat insulation sleeve, disconnect vacuum hose -4- from vacuum unit and move clear.
– Remove bolts -arrows- and detach exhaust gas recirculation cooler.



Installing

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

Tightening torques

♦ ⇒ “4.1 Exploded view - exhaust gas recirculation system”, page 307

Note

♦ *Renew gaskets, seals and self-locking nuts.*
♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue*

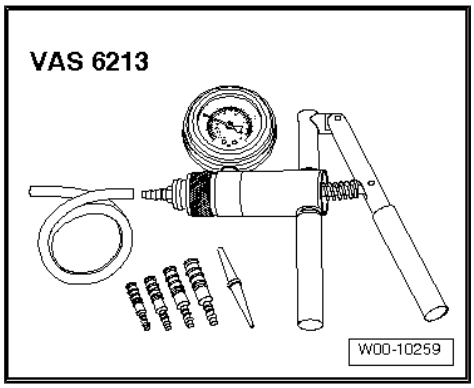
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– Vehicles with front-wheel drive: install particulate filter ⇒ page 294 .
– Vehicles with four-wheel drive: Install bevel box ⇒ Gearbox; Rep. gr. 34 ; Bevel box; Installing bevel box .
– After renewing, learnt values must be re-adapted; see `Guided Functions` of ⇒ Vehicle diagnostic tester, `01 - Adaption elec. adjuster with checkback`.

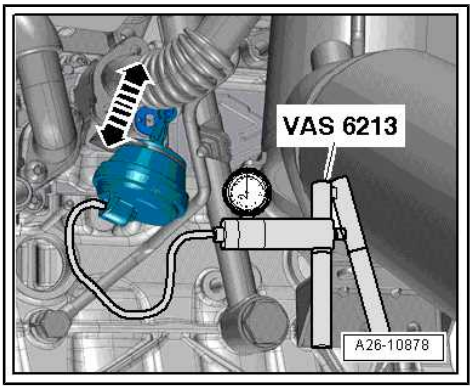
4.3 Checking exhaust gas recirculation cooler change-over

Special tools and workshop equipment required

♦ Hand vacuum pump - VAS 6213-



Procedure



– Detach heat shield sleeve.

– Disconnect vacuum hose from vacuum unit and connect hand vacuum pump - VAS 6213- in its place.

– Operate hand vacuum pump to produce a vacuum.

• The linkage of the exhaust gas recirculation cooler change-over should move -arrows-.

If the linkage does not move or only moves jerkily:

♦ The vacuum unit is defective.

♦ The change-over flap for exhaust gas recirculation is sticking.

Note

Secure the heat insulation sleeve in the original position when installing.

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28 – Glow plug system

1 Glow plug system

⇒ “1.1 Exploded view - glow plug system”, page 312

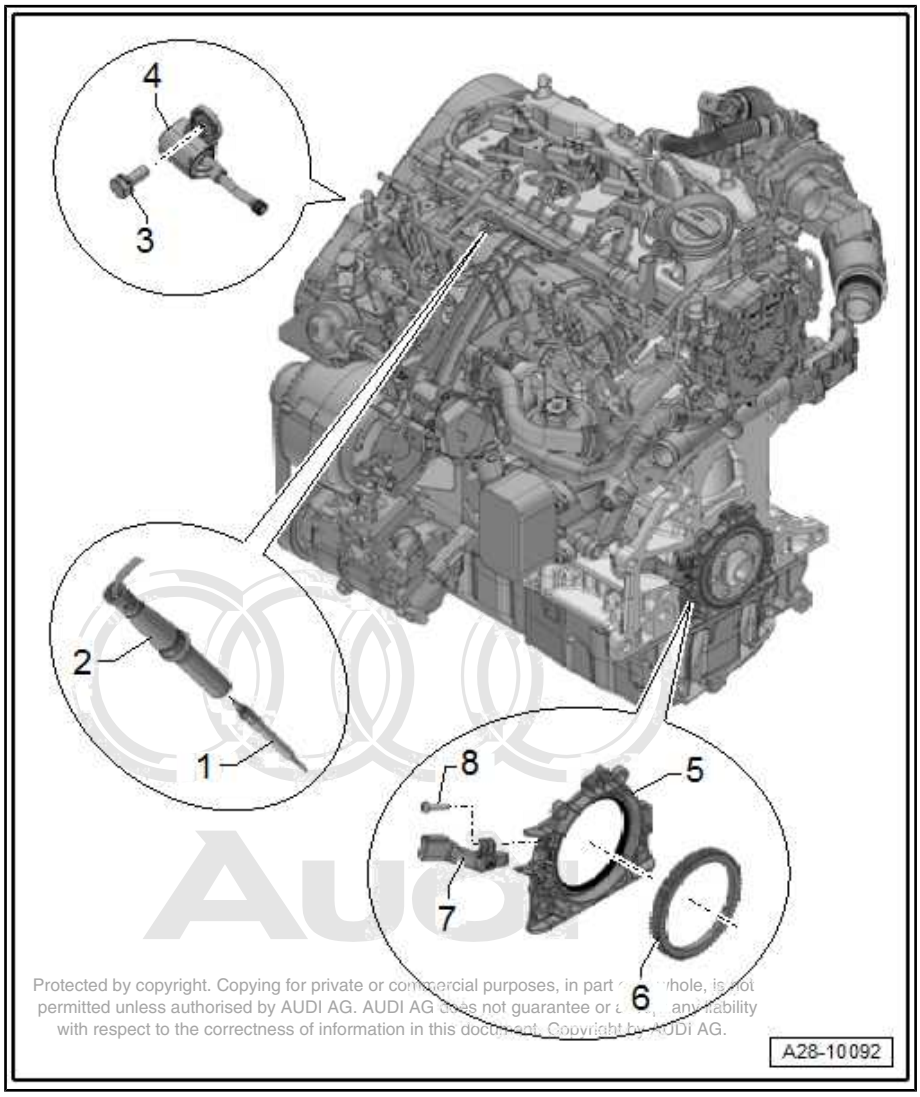
⇒ “1.2 Removing and installing glow plug”, page 313

⇒ “1.3 Removing and installing automatic glow period control unit J179 ”, page 315

⇒ “1.4 Removing and installing Hall sender G40 ”, page 315

⇒ “1.5 Removing and installing engine speed sender G28 ”, page 316

1.1 Exploded view - glow plug system



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1 - Glow plug

- ◆ Glow plug 1 - Q10-
- ◆ Glow plug 2 - Q11-
- ◆ Glow plug 3 - Q12-
- ◆ Glow plug 4 - Q13-
  - ❑ Removing and installing ⇒ page 313
  - ❑ 17 Nm

2 - Electrical connector

- ❑ For glow plug

3 - Bolt

- ❑ 10 Nm

4 - Hall sender - G40-

- ❑ Removing and installing ⇒ page 315

5 - Sealing flange (gearbox end)

- ❑ Removing and installing ⇒ page 63

6 - O-ring

7 - Sender wheel

- ❑ For engine speed sender - G28-
- ❑ Removing and installing ⇒ “2.3 Removing and installing sealing flange (gearbox end)”, page 63

8 - Engine speed sender - G28-

- ❑ Removing and installing ⇒ page 316

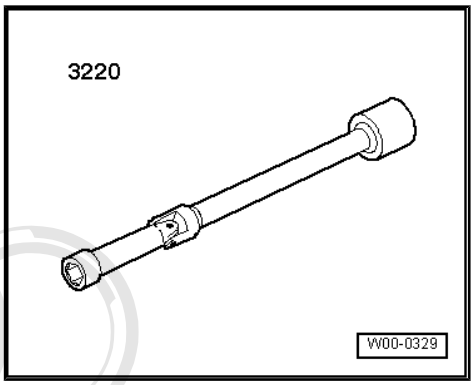
9 - Bolt

- ❑ 4.5 Nm

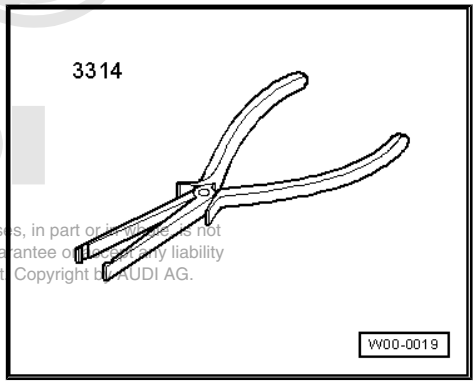
1.2 Removing and installing glow plug

Special tools and workshop equipment required

- Articulated wrench, 10 mm - 3220-



- Pliers - 3314-



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Removing

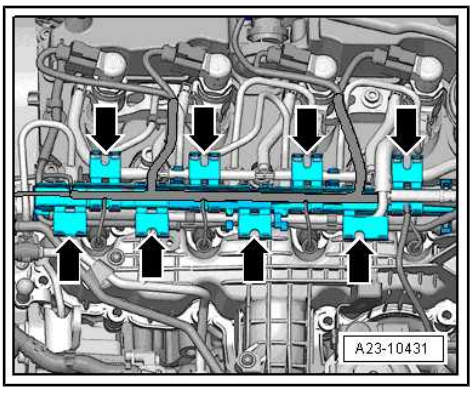
– Switch off ignition.

– Remove engine cover panel ⇒ page 47 .

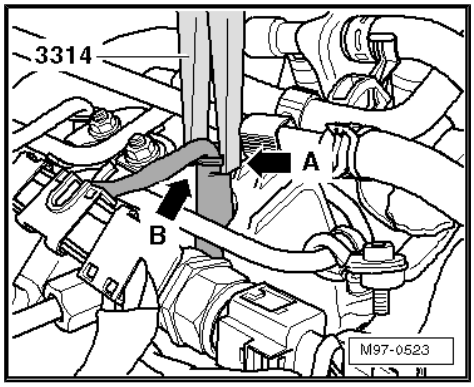
Caution

- *Make sure that no wire connection is damaged when unplugging the glow plug connectors; otherwise the entire wiring harness must be renewed.*
- *When unplugging the glow plug connectors, do not compress the pliers - 3314- with too much force so that the support sleeve is not damaged.*

– Release retaining clips -arrows- at wiring harness and detach electrical connectors from glow plugs.



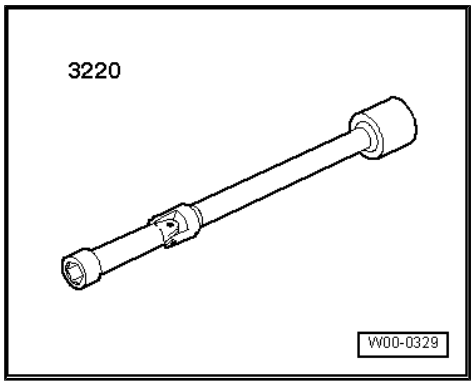
– Apply groove -arrow A- of pliers - 3314- to collar of support sleeve -arrow B- and pull glow plug connectors off glow plugs.
– Clean glow plug openings in cylinder head; make sure no dirt gets into cylinder.



Note

- *Cleaning procedure:*
- *Use a vacuum cleaner to remove coarse dirt.*
- *Spray brake cleaner or suitable cleaning agent into glow plug openings, let it work in briefly, and blow out with compressed air.*
- *Then clean the glow plug openings using a cloth moistened with oil.*

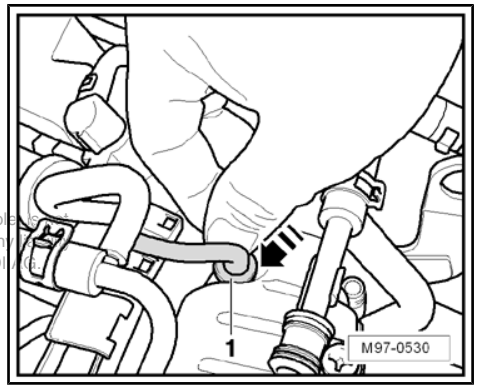
– To slacken the glow plugs use special tool U/J extension and socket, 10 mm - 3220- .



Installing

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

– Fit glow plug connectors -1- back onto glow plugs -arrow-.



Note

Check that glow plug connectors are securely seated.

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– Install engine cover panel ⇒ page 47 .

Tightening torques

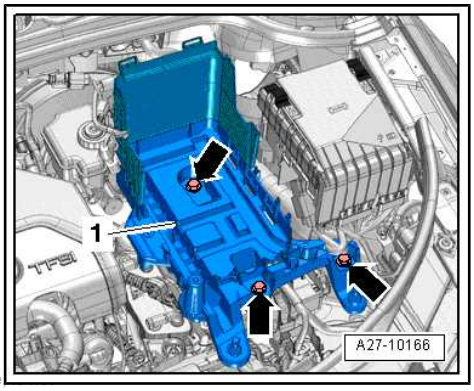
- ⇒ “1.1 Exploded view - glow plug system”, page 312

1.3 Removing and installing automatic glow period control unit - J179-

Removing

– Disconnect battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Disconnecting and connecting battery .

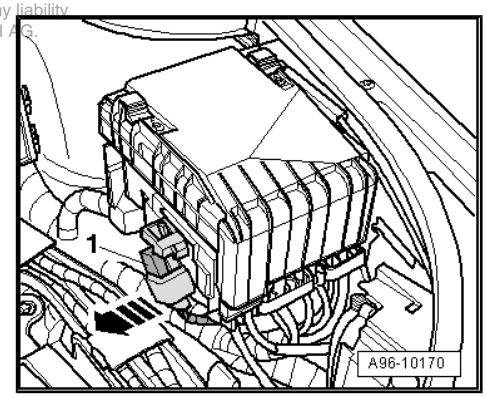
– Remove battery and battery tray ⇒ Electrical system; Rep. gr. 27 ; Battery; Removing and installing battery tray .



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– Pull out the relay carrier from under the electronics box in engine compartment -arrow-.

– Pull automatic glow period control unit - J179- -item 1- out of relay carrier below electronics box in engine compartment.



Installing

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

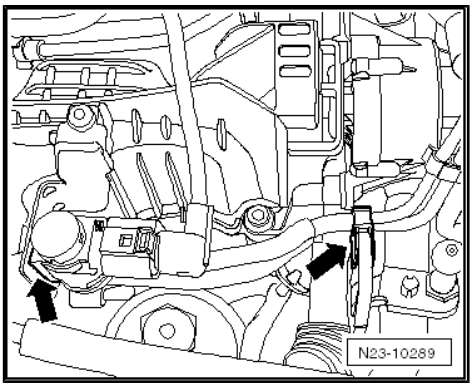
– Install battery tray and battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Removing and installing battery tray .

1.4 Removing and installing Hall sender - G40-

Removing

– Remove toothed belt ⇒ page 89 .

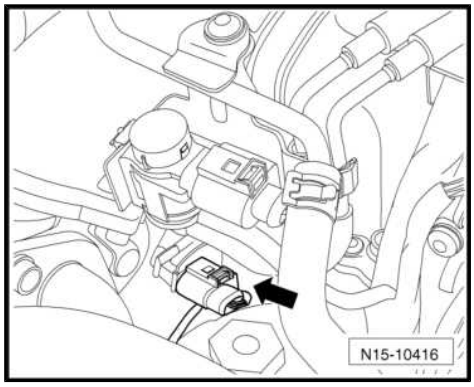
– Take exhaust gas recirculation cooler change-over valve - N345- -left arrow- out of bracket and move clear to one side.



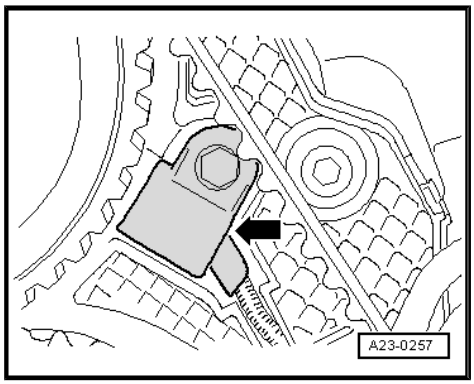
Note

Disregard right -arrow-.

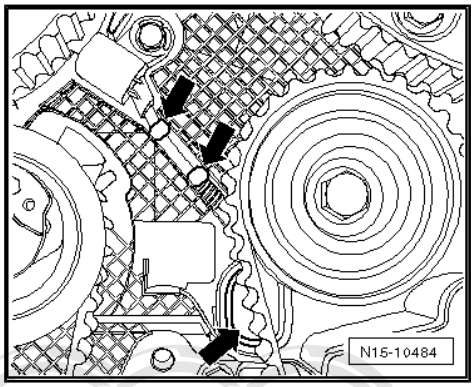
– Unplug electrical connector -arrow- from Hall sender - G40- and detach connector from retainer.



– Unbolt Hall sender - G40- -arrow-.



– Using a screwdriver, remove projections and take out cover for repair opening -arrows-.
– Take Hall sender - G40- off cylinder head and guide its connector through repair opening in toothed belt cover.



Installing

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

– Seal repair opening in toothed belt cover with rubber plug; for rubber plug refer to ⇒ Electronic parts catalogue .
– Install toothed belt (adjust valve timing) ⇒ page 93 .

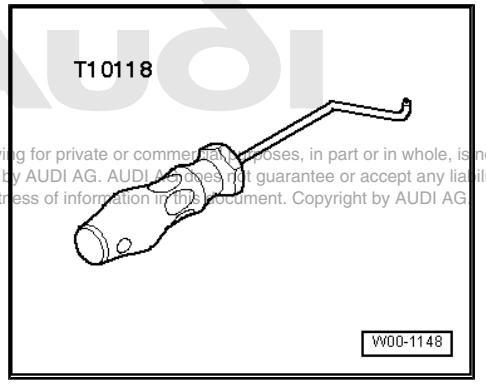
Tightening torques

♦ ⇒ “1.1 Exploded view - glow plug system”, page 312

1.5 Removing and installing engine speed sender - G28-

Special tools and workshop equipment required

♦ Assembly tool - T10118-

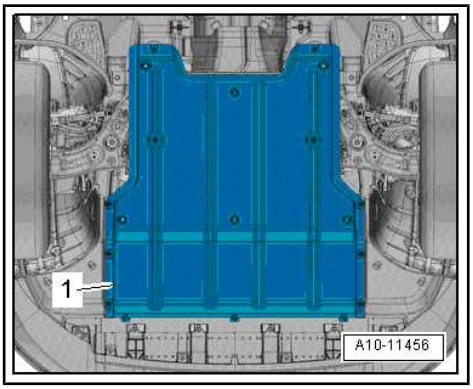


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Removing

– Remove noise insulation -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

– Loosen hose clip -2- and remove air hose.



Note

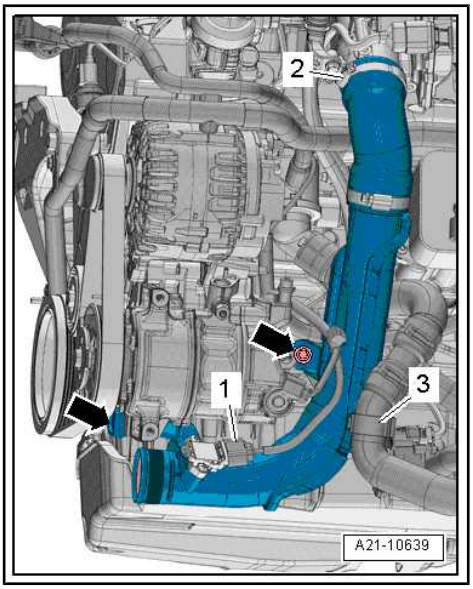
Disregard -item 1-.

– Unplug electrical connector -1- at charge pressure sender - G31- .

– Remove bolts -arrows-.

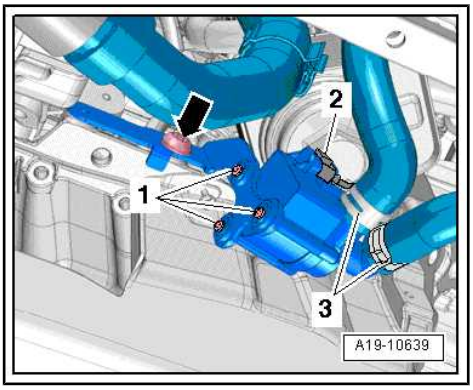
– Release retaining clip -3- and move coolant hose clear.

– Loosen hose clip -2- at throttle valve module - J338- and remove air pipe downwards.



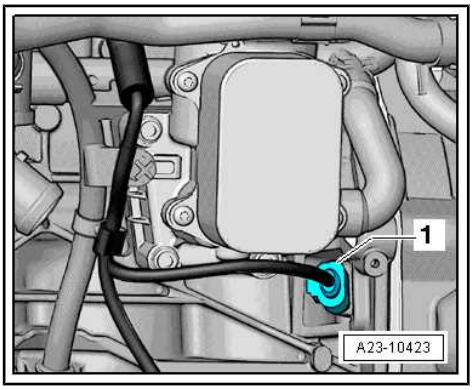
– Unplug electrical connector -2-.

– Remove bolt -arrow- and move pump for exhaust gas recirculation cooler - V400- to one side with hoses connected.



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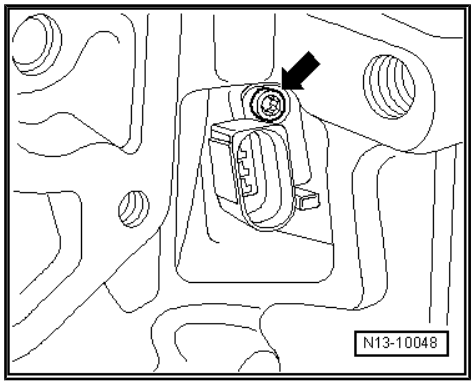
– Unplug electrical connector -1- at engine speed sender - G28- using assembly tool - T10118- .



Note

To release electrical connector without assembly tool - T10118- , press connector on engine speed sender in with a screwdriver and at the same time lift release tab with a thin wire hook.

– Remove bolt -arrow- for engine speed sender - G28- .



Installing

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

– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

Tightening torques

- ⇒ “3.1 Exploded view - coolant pipes”, page 187
- ⇒ “2.1 Exploded view - charge air system”, page 221
- ⇒ “1.1 Exploded view - glow plug system”, page 312

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