



Workshop Manual

Audi A6 2005 ➤

Audi A6 Avant 2005 ➤

4-cylinder TDI engine (2.0 ltr. 4-valve common rail),
mechanics

Engine ID	CAG B	CAH A	CAH B						
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Edition 08.2019



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



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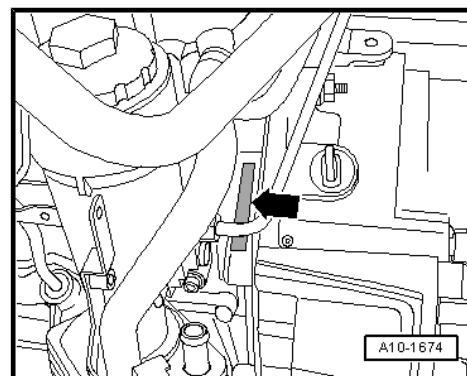
00 – Technical data

1 Engine number/engine data

(ARL006576; Edition 08.2019)

Engine number

- ◆ The engine number ("engine code" and "serial number") -arrow- can be found on the left side (seen in the direction of travel) at 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 (certain countries only), vehicle data sticker and engine control unit.*
- ◆ *Fitting locations of the type plate (certain countries only) and the vehicle data sticker ⇒ Maintenance ; Booklet 405*

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

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2 Safety precautions

Overview

- ◆ ⇒ [“2.1 Working on the fuel system”, page 2](#)
- ◆ ⇒ [“2.5 Safety precautions when working on the cooling system”, page 3](#)
- ◆ ⇒ [“2.2 Safety precautions when working on vehicles with start/stop system”, page 2](#)
- ◆ ⇒ [“2.3 Safety precautions when using testers and measuring instruments during a road test”, page 3](#)
- ◆ ⇒ [“2.6 Safety precautions when working on the exhaust system”, page 4](#)

2.1 Working on the fuel system

When working on the fuel system note the following warnings:

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.

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

Please note the following when working on vehicles with start/stop system:

Risk of injury - engine may start unexpectedly

The engine can start unexpectedly if the vehicle's start/stop system is activated. A message in the instrument cluster indicates whether the start/stop system is activated.

- To deactivate the start/stop system, switch off the ignition.

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2.3 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.

2.4 Safety precautions when working on the subframe

Please note the following warnings when working on the subframe:



Caution

Risk of damage to running gear components.

- ◆ ***The vehicle must NOT be lowered onto its wheels if the engine/gearbox mountings, steering rack or subframe cross brace are not properly installed.***
- ◆ ***The vehicle must NOT be supported by applying a trolley jack or similar to the subframe or subframe cross brace.***

2.5 Safety precautions when working on the cooling system

When working on the cooling system note the following warnings:

Risk of scalding as hot coolant can escape

The cooling system is under pressure when the engine is hot. Risk of scalding due to hot steam and hot coolant.

- Put on protective gloves.
- Put on safety goggles.
- Cover filler cap on expansion tank with a cloth and open carefully to release pressure.



Caution

Overheating can occur if the filler cap is not fitted properly.

- ◆ *The filler cap must engage positively and audibly when it is closed.*

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2.6 Safety precautions when working on the exhaust system

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Do not dismantle exhaust gas temperature sender - risk of injury.

Risk of injury when disconnecting the exhaust system

There is a risk of eye irritation caused by soot particles in the air.

- Put on safety goggles.

Danger from toxic exhaust gases

The auxiliary/supplementary heater produces toxic exhaust gases during operation. There is a risk of poisoning and of damage to the respiratory tract.

- In enclosed spaces, only switch on the auxiliary/supplementary heater if there is an exhaust extraction system.
- In enclosed spaces without an exhaust extraction system, switch off the auxiliary/supplementary heater.

Risk of damage to flexible joint

The flexible joint can be damaged or develop leaks if it is handled incorrectly.

- Do not bend flexible joint more than 10°.
- Install flexible joint so that it is not under tension.



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 Nuts, bolts”, page 7](#)

⇒ [“3.5 Identification plates”, page 7](#)

⇒ [“3.6 Use of impact wrenches”, page 7](#)

⇒ [“3.7 Foreign particles in engine”, page 8](#)

⇒ [“3.8 Contact corrosion”, page 8](#)

⇒ [“3.9 Routing and attachment of pipes, hoses and wiring”, page 8](#)

⇒ [“3.10 Installing radiators and condensers”, page 8](#)

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. Only use lint-free cloths.
- ◆ Carefully cover or seal open components if repairs cannot be carried out immediately.
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use 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

Fuel supply/injection

- ◆ 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.

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- ◆ 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.
- ◆ 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 two seconds in order to build up pressure in the fuel system.

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.***

- ◆ 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.

3.4 Nuts, bolts

- ◆ Loosen bolts in reverse sequence to specified tightening sequence.
- ◆ Bolts and nuts used to secure covers and housings must be tightened in steps according to the specified tightening sequence and method.
- ◆ Bolts and nuts which secure covers and housings should be loosened and tightened in diagonal sequence and in stages if no tightening sequence is specified.
- ◆ Always renew self-locking bolts and nuts.
- ◆ Unless otherwise specified, use a wire brush to clean the threads of bolts which are secured with locking fluid. Then install bolts with locking fluid; for locking fluid refer to ⇒ Electronic parts catalogue .
- ◆ Threaded holes which take self-locking bolts or bolts coated with locking fluid must be cleaned using a thread tap or similar. Otherwise there is a danger of the bolts shearing off the next time they are removed.
- ◆ The tightening torques stated apply to non-oiled nuts and bolts.

3.5 Identification plates

When renewing vehicle components, the identification plates on the old parts that have a replacement part number (see ⇒ Electronic parts catalogue) must be attached to the new parts due to approval regulations.

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3.6 Use of impact wrenches

In general, it is permitted to use an impact wrench to unscrew bolts and nuts. An exception to this is when work is performed inside an open high-voltage battery. For this work, it is not permitted to use an impact wrench.

An impact wrench may be used to screw in bolts and nuts when performing repair work if the following requirements are observed. In general, electric and compressed-air impact wrenches should be used.

Requirements:

- Only screw in bolts with locking fluid or self-locking nuts at low speed.
- Use a suitable impact wrench with variable speed and adjustable torque range.
- Use suitable bits when working in the vicinity of sensitive surfaces, e.g. plastic-coated bits for aluminium rims.
- When working in the vicinity of natural gas systems, observe the information in the Workshop Manual "Natural gas engines - General information".

Use:

- Fit bolts/nuts by hand.



- Only use an impact wrench to screw in bolts/nuts until the head of the bolt/nut makes contact and then continue tightening with a torque wrench.
- Clean threaded pins before unscrewing the bolt/nut.

3.7 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 202](#)

3.8 Contact corrosion

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

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

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

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

Please note:

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

3.9 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.
- ◆ Because of the limited space in the engine compartment, it is important to ensure that there is adequate clearance to any moving or hot components to avoid damage to lines and wiring.

3.10 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.

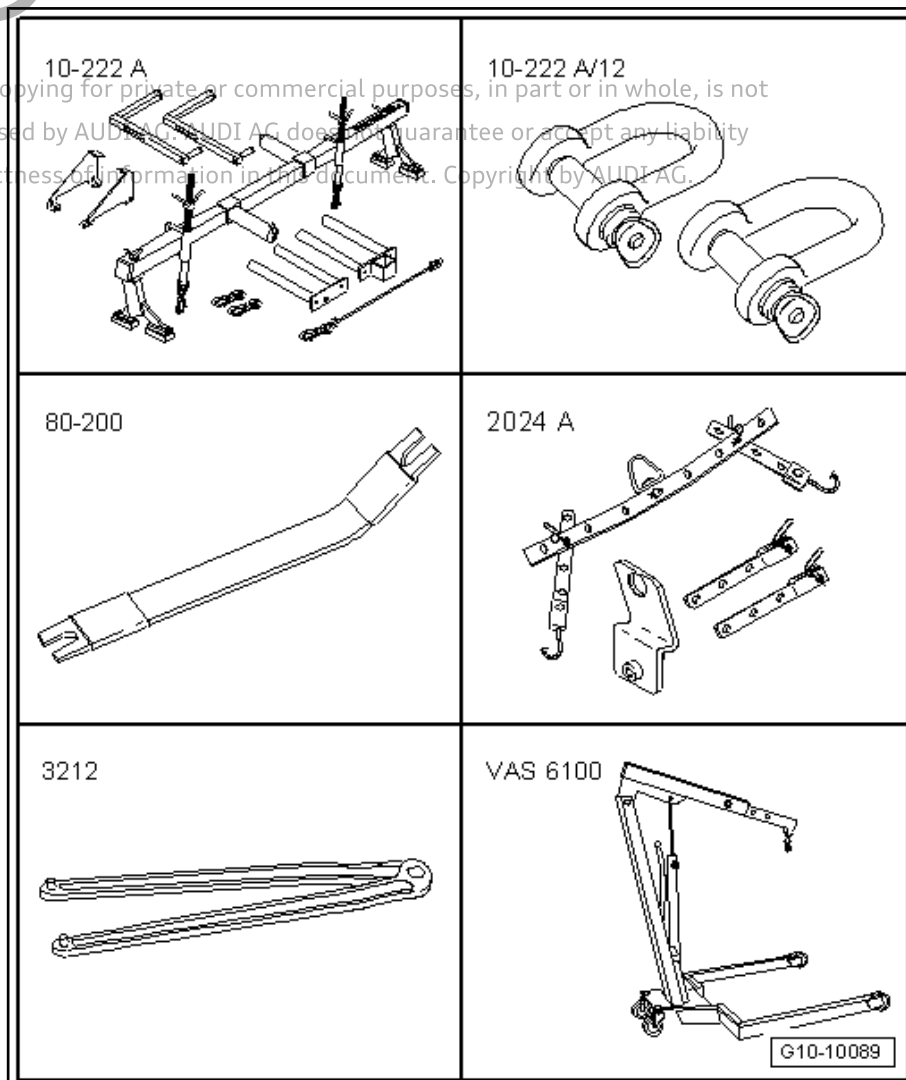


10 – Removing and installing engine

1 Removing engine

Special tools and workshop equipment required

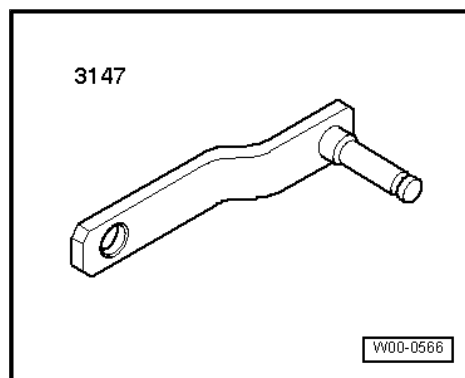
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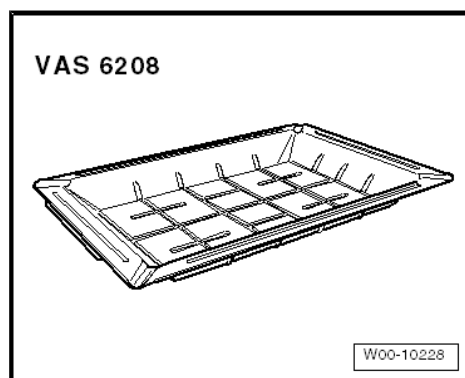
- ◆ Support bracket - 10 - 222 A-
- ◆ Shackle - 10 - 222 A /12-
- ◆ Removal lever - 80 - 200-
- ◆ Lifting tackle - 2024 A-
- ◆ Pin wrench - 3212- or strap wrench
- ◆ Workshop hoist - VAS 6100-



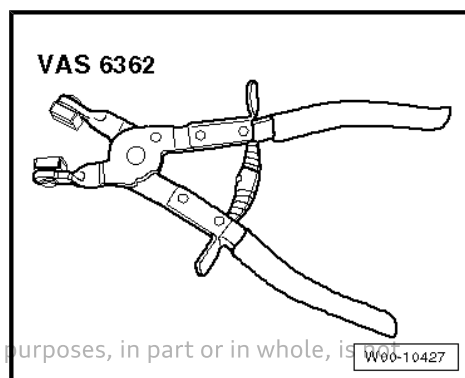
◆ Gearbox support - 3147-



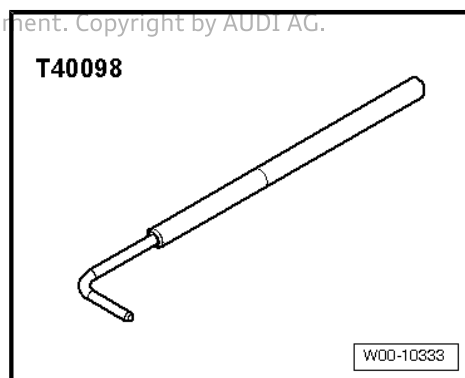
◆ Drip tray for workshop hoist - VAS 6208-



◆ Hose clip pliers - VAS 6362-



◆ Locking tool - T40098-



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Procedure



Note

- ◆ The engine is removed upwards without gearbox.
- ◆ Collect drained coolant in a container for disposal.
- ◆ Fit cable ties in the original positions when installing.

- Switch off ignition and remove ignition key.



Caution

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

- ◆ Observe notes on procedure for disconnecting the battery.

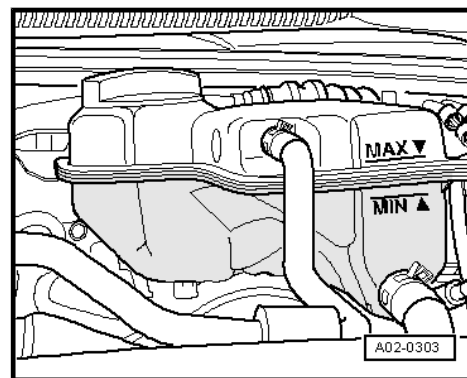
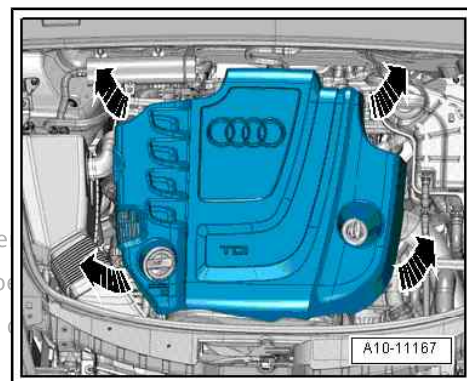
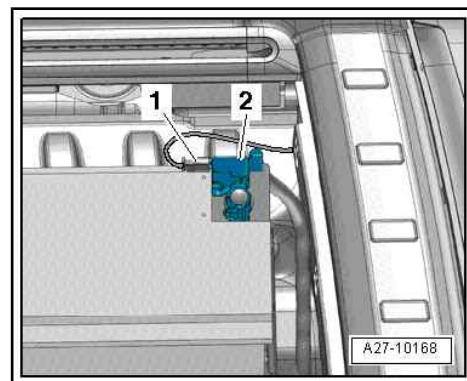
- Disconnect earth cable from battery terminal ⇒ Electrical system; Rep. gr. 27 .

- Remove engine cover panel -arrows-.



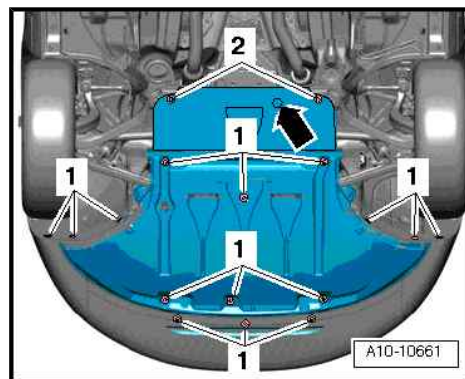
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- Open filler cap on coolant expansion tank.





- Remove noise insulation panels ⇒ Rep. gr. 50 .

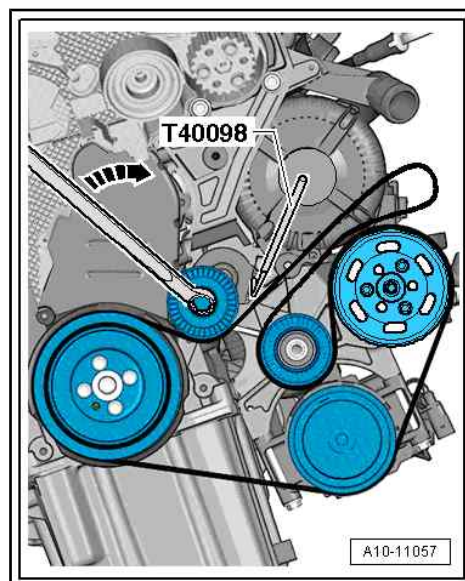


Caution

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

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

- Swivel tensioner in clockwise direction -arrow-, detach poly V-belt from pulley for air conditioner compressor and lock tensioner using locking tool - T40098- .
- Take off poly V-belt.

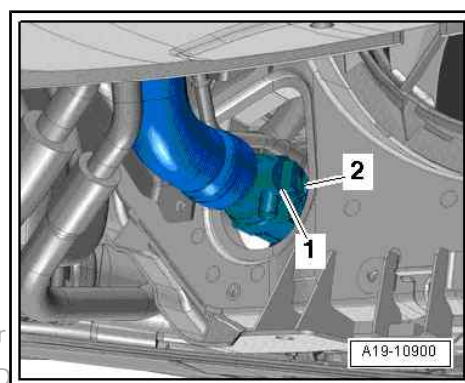


WARNING

Risk of scalding due to hot steam and hot coolant.

- ◆ *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.*

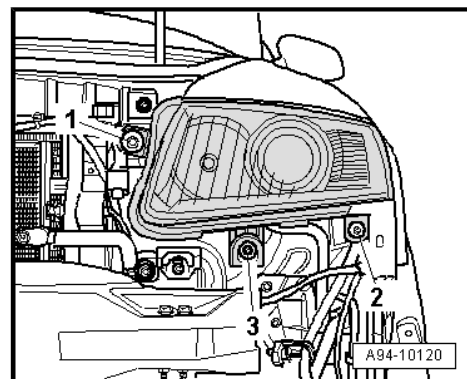
- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Open radiator drain tap -1- at connection and drain off coolant; then detach connection -2- from radiator (lift retaining clip).
- Remove bumper cover (front) ⇒ Rep. gr. 63 .



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- Remove headlight (left and right) ⇒ Electrical system; Rep. gr. 94 .

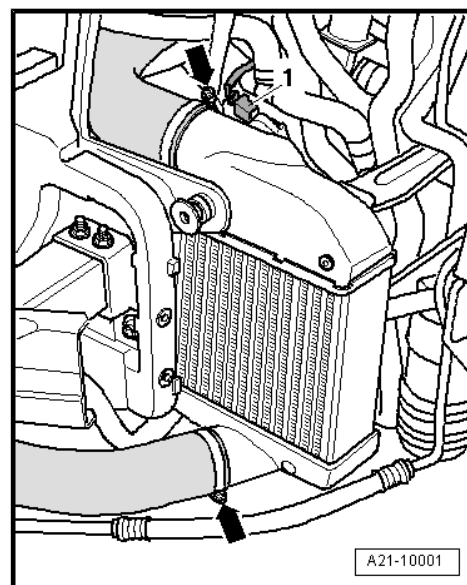


- Unplug electrical connector -1- on charge pressure sender - G31- / intake air temperature sender - G42- and move clear electrical wiring.
- Release hose clip -bottom arrow- and detach air hose from charge air cooler (left and right).



Note

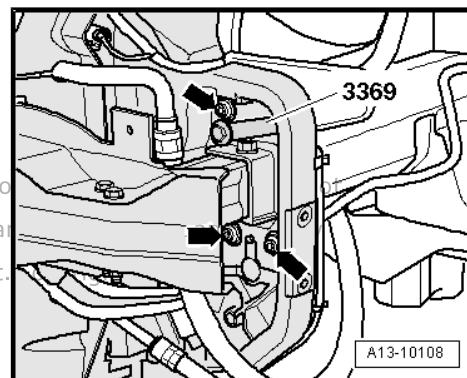
Disregard -top arrow-.



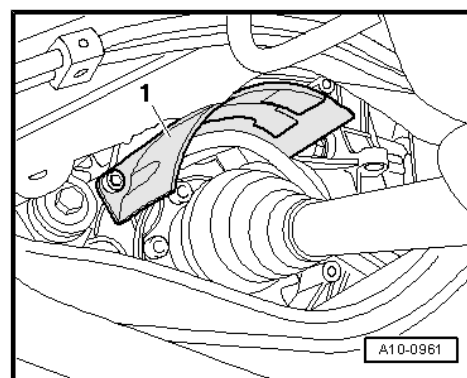
- Move lock carrier into service position ⇒ Rep. gr. 50 .



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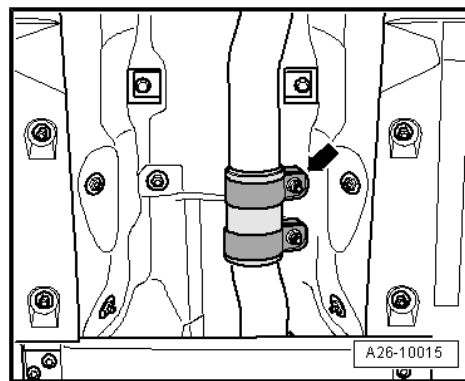


- Remove bolts and detach heat shield -1- for drive shaft (right-side).

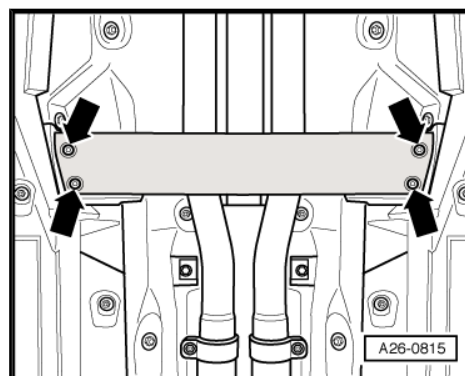




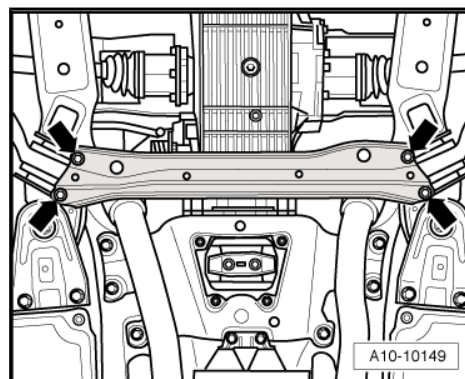
- Loosen bolt connections and push clamp -arrow- towards rear to disconnect exhaust system.



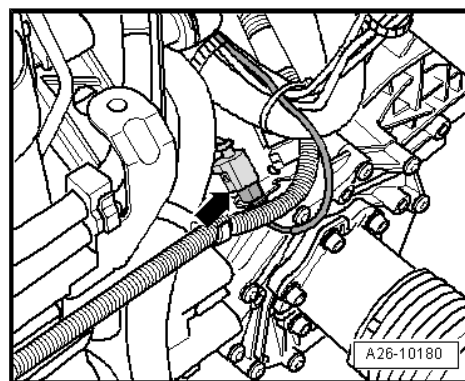
- Remove bolts -arrows- and detach front cross piece.



- Remove bolts -arrows- and detach cross piece from subframe.



- Take electrical connector -arrow- for exhaust gas temperature sender 4 - G648- out of bracket and unplug.
- Move electrical wiring clear.



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Vehicles with manual gearbox:

- Remove bolts -arrows-.



Note

Disregard -item 1-.



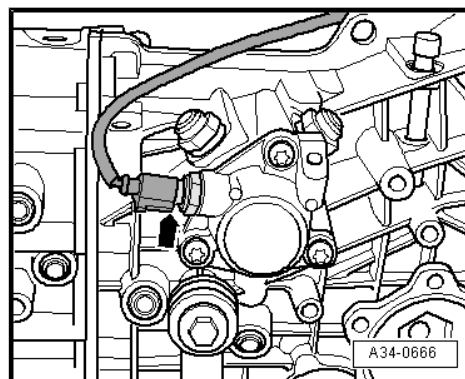
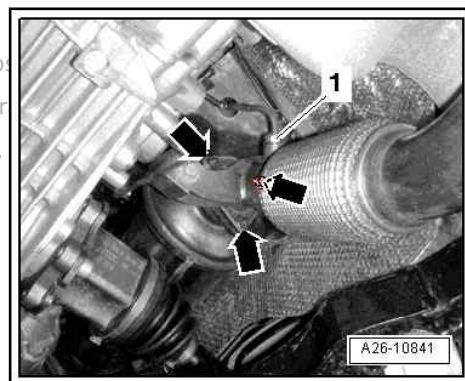
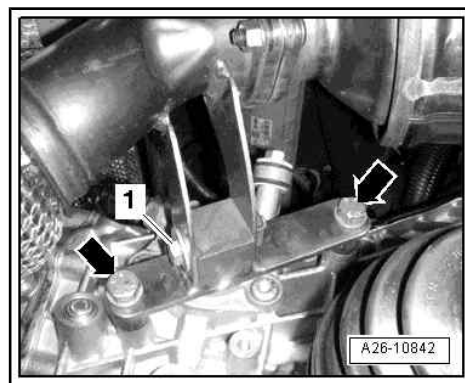
- Remove nuts -arrows- and detach front exhaust pipe.



Note

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Disregard -item 1-.

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





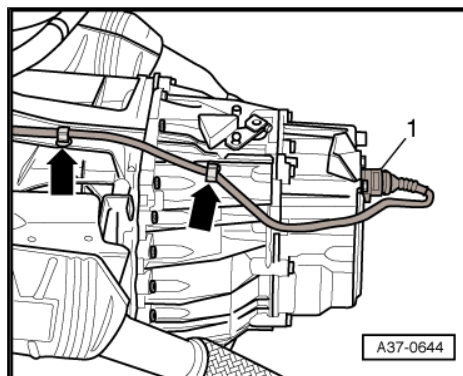
Vehicles with multitronic gearbox:



Caution

Risk of irreparable damage to gearbox control unit (mechanic unit) because of static discharge.

- ◆ **Before unplugging or plugging in electrical connector, mechanic must discharge static electricity. To do so, touch vehicle earth, heater radiator, or lifting platform, with your hand.**
- ◆ **Do NOT touch connector contacts in gearbox connector with your hands.**



- Release electrical connector -1- and detach from gearbox.
- Move clear engine wiring harness -arrows-.



Note

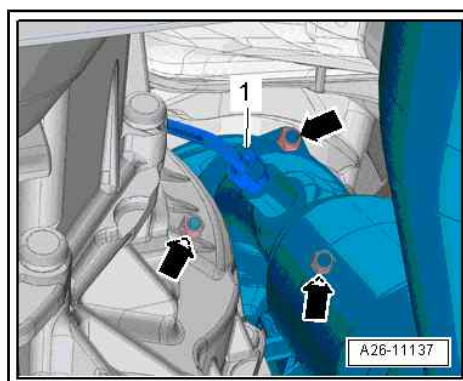
For illustration purposes, the installation position is shown with the gearbox removed.

- Remove nuts -arrows- and detach front exhaust pipe.



Note

Disregard -item 1-.

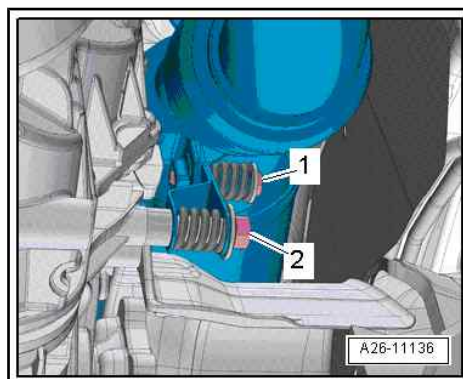


- Remove bolt -1- at bracket for particulate filter.



Note

Disregard -item 2-.



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All vehicles (continued):

- Unplug electrical connector -1- for magnetic clutch on air conditioner compressor.



WARNING

Risk of injury caused by refrigerant.

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

- Remove bolts -arrows- for air conditioner compressor.



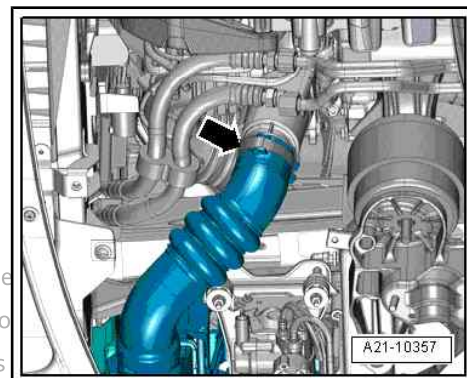
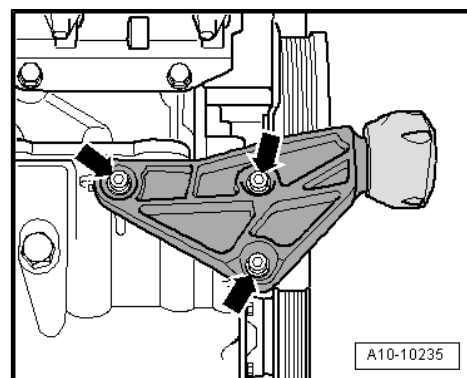
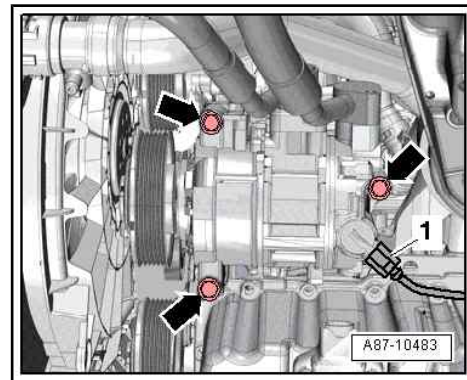
Caution

Risk of damage to refrigerant lines and hoses.

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

- Tie up air conditioner compressor together with lines to one side (lines remain connected).
- Remove bolts -arrows- and detach torque reaction support.

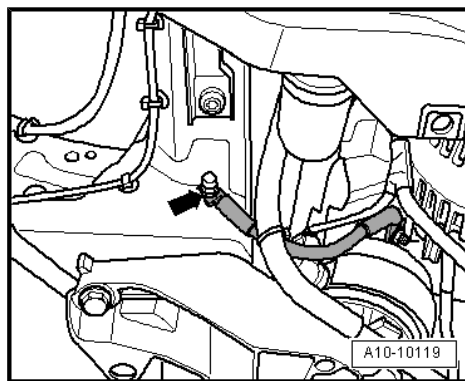
- Release hose clip -arrow- and detach air hose from turbo-charger.



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- Unscrew nut -arrow- on longitudinal member (right-side) and move earth cable clear.



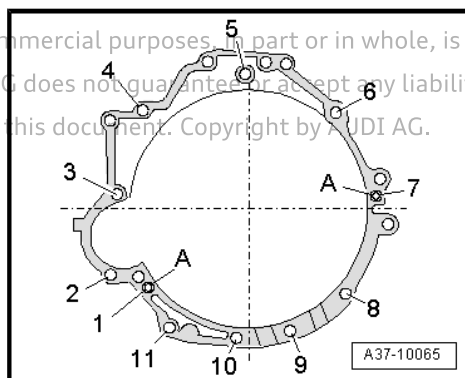
- Remove bolts -1 ... 11- securing gearbox to engine.



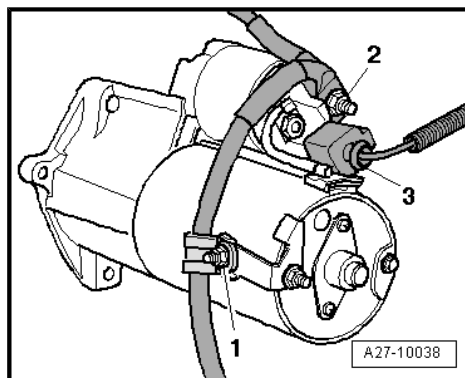
Note

Disregard -item A-.

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- Detach starter and swivel to one side.
- Unplug electrical connector -3-.
- Remove nut -1- for clamp.
- Remove nut -2- and move electrical wiring clear.
- Detach starter.



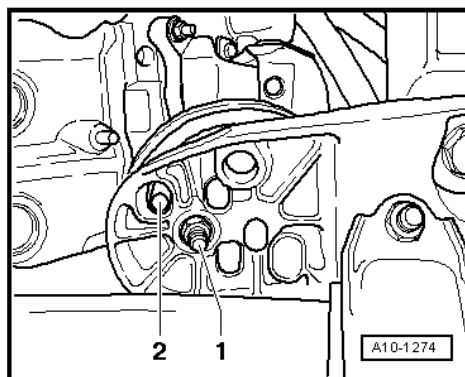
- Mark position of nuts -1- and locating sleeves -2- on bottom of engine mountings (left and right).



Note

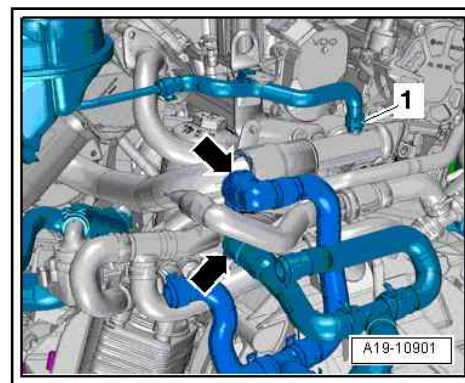
Different mounting holes are provided for the different engine versions.

- Remove nut -1- (bottom) for engine mounting on both sides.



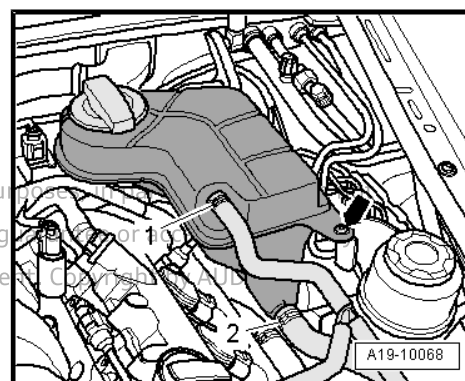


- Release hose clip -1-, lift retaining clips -arrows- and detach coolant hoses.
- Move coolant hoses clear.



- Remove bolt -arrow-.
- Unplug electrical connector at coolant shortage indicator switch - F66- and move expansion tank to one side with coolant hoses -1- and -2- attached.

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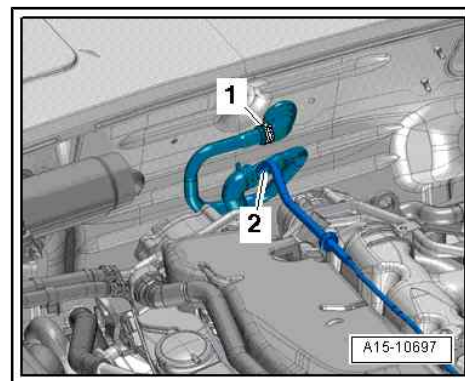


- Detach vacuum hose -1- going to brake servo.

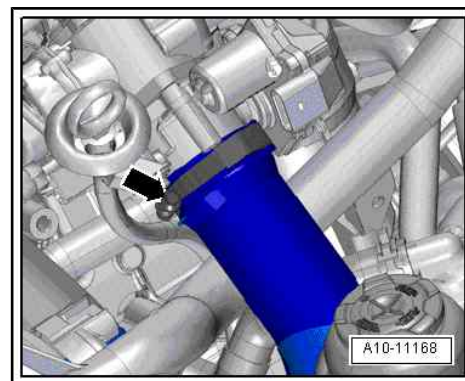


Note

Disregard -item 2-.



- Release hose clip -arrow- and disconnect air hose from intake manifold flap motor - V157- .



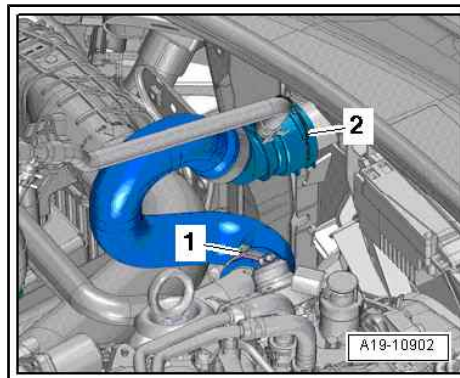


- Release hose clip -1- and detach coolant hose.

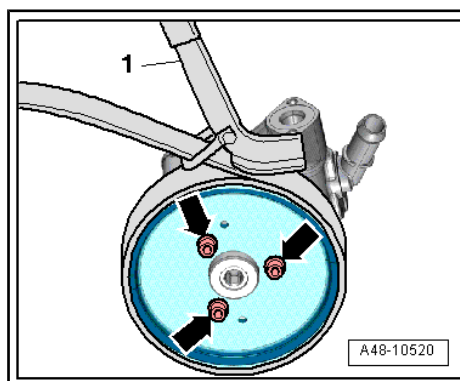


Note

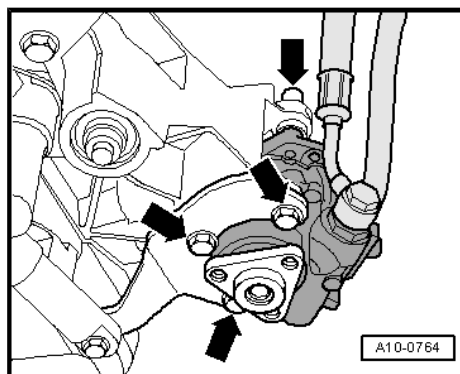
Disregard -item 2-.



- Remove bolts -arrow- for poly V-belt pulley for power steering pump (counterhold with strap wrench -1- or pin wrench -3212-).

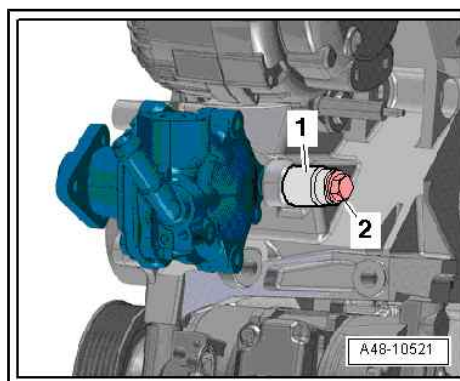


- Remove bolts -arrows- and tie power steering pump up to one side (hydraulic lines remain attached).



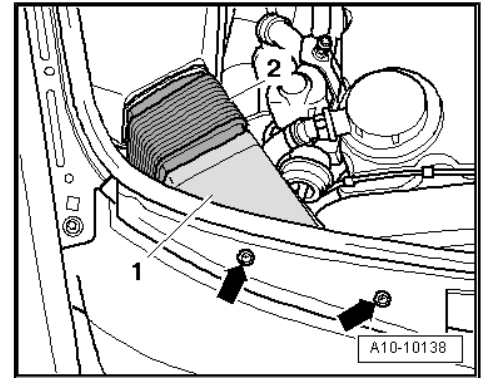
Note

- ♦ Apply 1/2" socket insert (AF 18) -item 1- to sliding bush if power steering pump is stuck in bracket.
- ♦ Fit M8x70 bolt -item 2- in power steering pump and press sliding bush out of bracket for ancillaries by screwing in bolt.

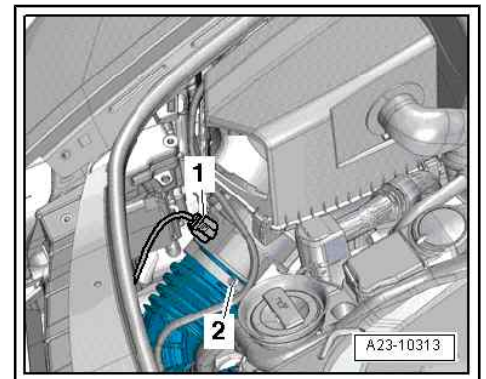




- Unscrew bolts -arrows- and detach air ducts -1- and -2-



- Unplug electrical connector -1- at air mass meter - G70- .
- Release hose clip -2- and detach air hose.
- Disengage air cleaner (bottom section) from retaining pin and remove.

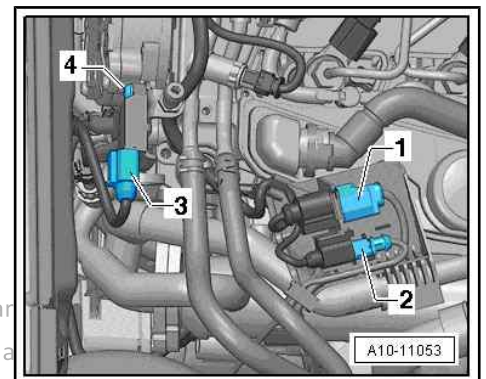
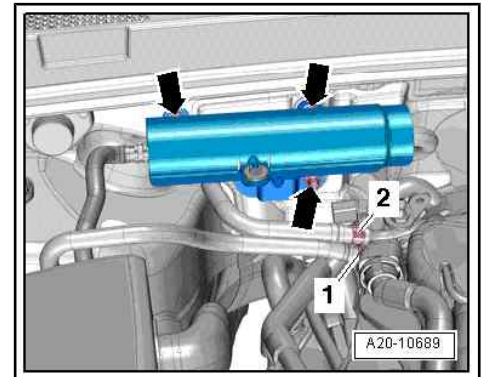


Caution

Protect fuel system against contamination.

- ◆ **Rules for cleanliness when working on the injection system ⇒ page 5 .**

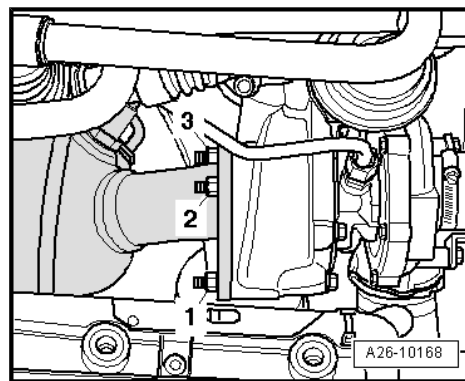
- Release hose clips and detach return hose -1- and supply hose -2- from fuel filter.
- Unscrew nuts -arrows- and move bracket with fuel filter to one side.
- Seal off open pipes/lines and connections with clean plugs from engine bung set - VAS 6122- .
- Unplug electrical connector -1- for Lambda probe - G39- and electrical connector -2- for exhaust gas temperature sender 3 - G495- and move electrical wiring clear.
- Unplug electrical connector -3-, remove bolt -4- and move exhaust gas pressure sensor 1 - G450- clear.



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- Remove nuts -1, 2, 3- at turbocharger and move particulate filter to rear.

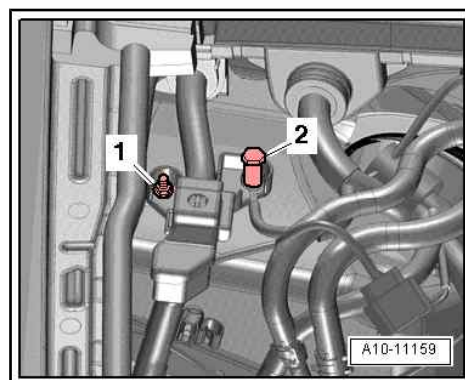


- Unscrew earth stud -2- on suspension turret (right-side) and move earth wire clear.



Note

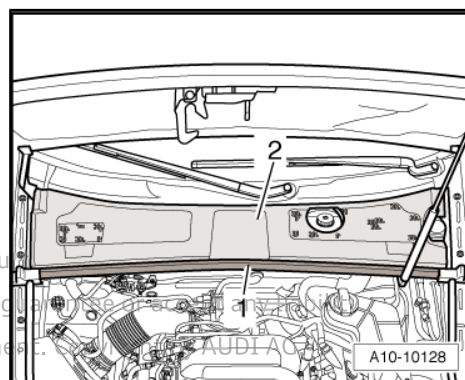
Disregard -item 1-.



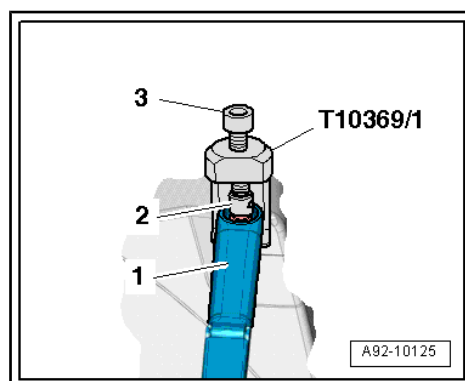
- Pull off seal -1- and remove plenum chamber cover -2-.



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- Remove wiper arms ⇒ Electrical system; Rep. gr. 92 .



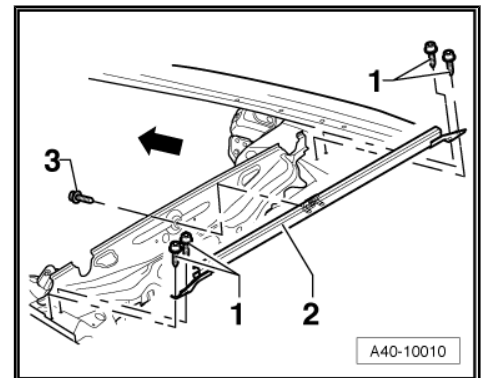
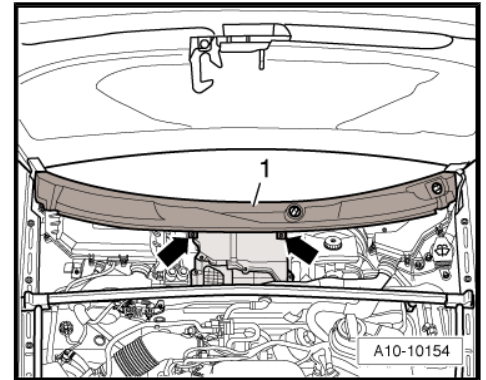


Caution

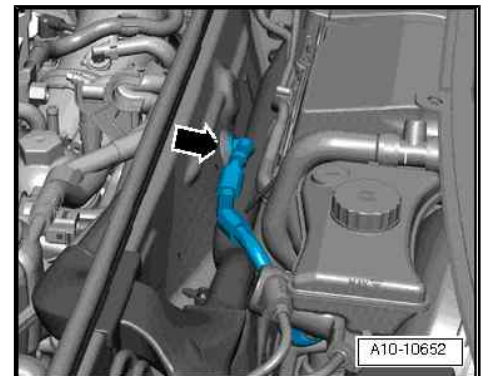
Risk of damage to cowl panel trim.

- ◆ *To avoid cracking the cowl panel trim -1- during removal, apply a small amount of soap solution to the joint between the windscreen and the cowl panel trim and pull the trim vertically up out of the windscreen surround, starting from the edge of the windscreen.*

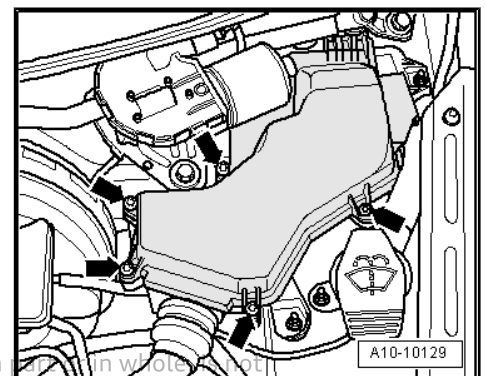
- Unscrew bolts -arrows- and pull cowl panel trim off windscreen.
- If fitted, remove bolts -1- and -3- and detach body brace -2-.



- Detach vacuum line -arrow- going to brake servo at plenum chamber partition panel.



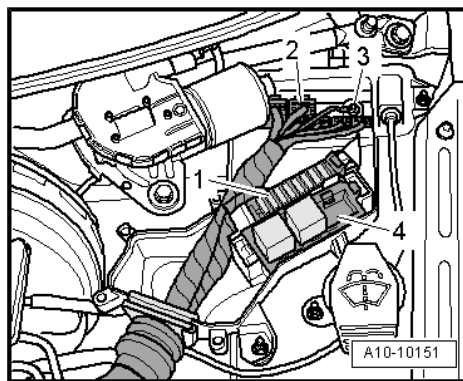
- Remove bolts -arrows- and detach cover for electronics box in engine compartment (left-side).



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- Release fasteners, pull off fuse holder -1- and then 3-position relay carrier -4- upwards.
- Unscrew wiring -3-.
- Unplug three front electrical connectors -2- at rear of connector console.
- Disengage engine wiring harness at electronics box and move clear.

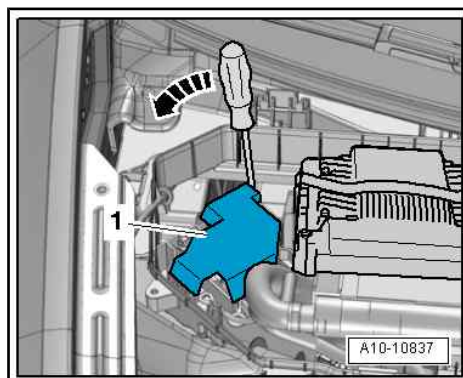
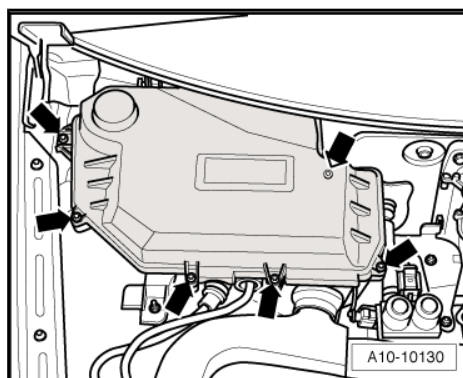


WARNING

Risk of burns at the pump valve unit for the heating system (left-side in front of electronics box).

- ◆ *Wear protective gloves when working near the pump valve unit for the heating system.*

- Remove bolts -arrows- and detach cover for electronics box in engine compartment (right-side).
- Open cover -1- with screwdriver -arrow- and detach.



- Use screwdriver -arrows 1, 2- to carefully lever off retaining strap -3- and remove engine control unit from electronics box.



Note

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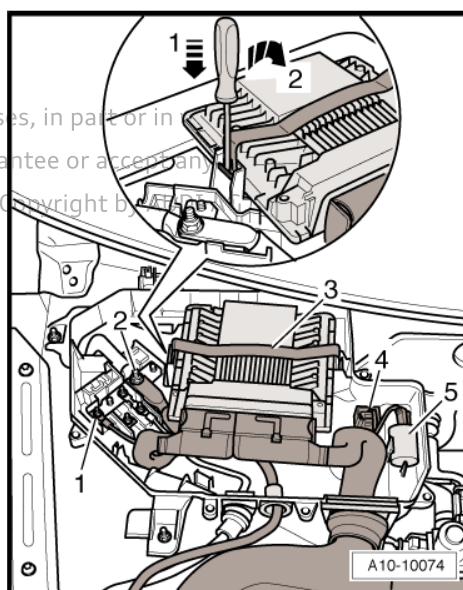
The engine control unit remains connected to the wiring harness.

- Unclip suppressor capacitor -5- and take out of retainer in electronics box.
- Unplug electrical connector -4- at rear of connector console.
- Unscrew wiring -1-.



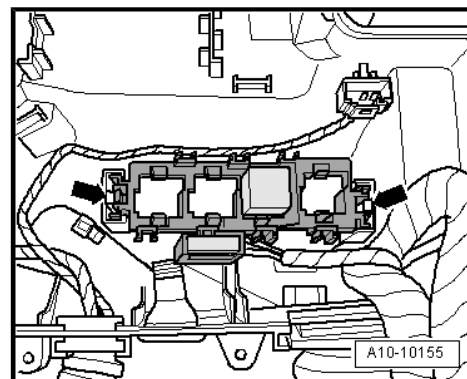
Note

Disregard -item 2-.

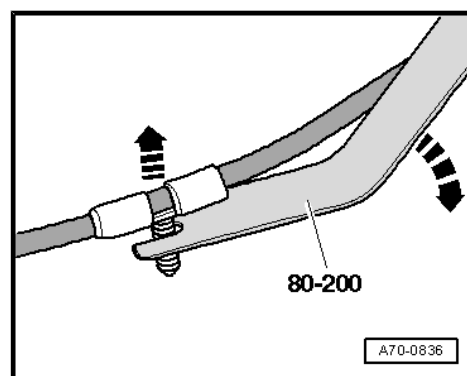




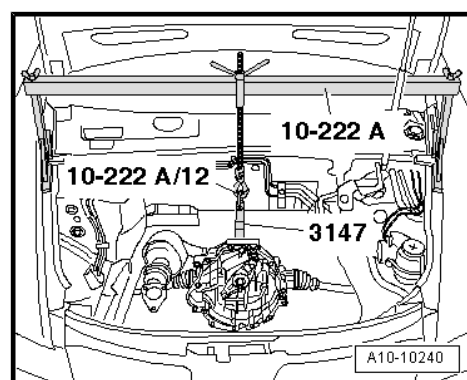
- Release catches -arrows- and detach relay carrier from electronics box in engine compartment (right-side).



- Release electrical wiring for alternator using removal lever - 80 - 200- .
- Place both wiring harnesses on engine and secure engine control unit to prevent it from dropping.



- Position support bracket - 10 - 222 A- behind gas-filled strut on wing mounting flanges.
- The spindle is located at the front.
- Engage gearbox support - 3147- in bolt hole at top of gearbox housing, as shown in illustration.
- Connect gearbox support - 3147- to support bracket - 10 - 222 A- using shackle - 10 - 222 A /12- .



i Note

For illustration purposes, the procedure is shown with the engine removed.



Caution

Risk of damage to wing mounting flanges.

- ◆ **Do not apply tension to spindle of support bracket - 10 - 222 A- .**

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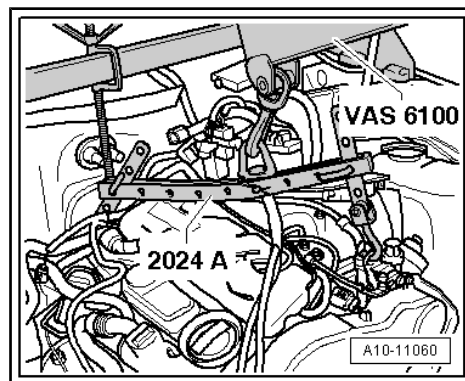
- Remove lifting eye of lifting tackle - 2024 A- (pull out split pin and press out pin).
- Reinsert lifting eye in 4th hole from front on lifting tackle.
- Secure pin with split pin again.
- Attach lifting tackle - 2024 A- to engine and workshop hoist - VAS 6100- as shown in illustration.



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.**



- Raise engine until engine mountings are clear.
- Tighten spindle of support bracket - 10 - 222 A- further.



Caution

Danger of damage to hoses, pipes and wiring connections and to engine compartment.

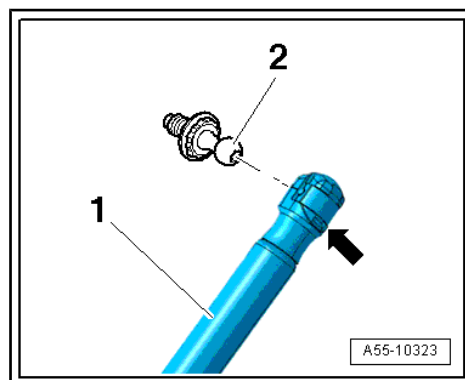
- ◆ **Check that all hoses and wiring connections between engine, gearbox, subframe and body have been detached.**
- ◆ **Carefully guide engine out of engine compartment when lifting out.**



Note

A second mechanic is required to carefully open bonnet as much as possible when lifting engine out.

- Use small screwdriver to slightly lift retaining clip -arrow- at both ends and detach gas strut -1- from ball stud -2- at top.
- Separate engine from gearbox and lift engine out of engine compartment.
- Press gas struts back onto ball studs.



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2 Securing engine to engine and gearbox support

Special tools and workshop equipment required

- ◆ Engine and gearbox support - VAS 6095-



- ◆ Workshop hoist - VAS 6100-



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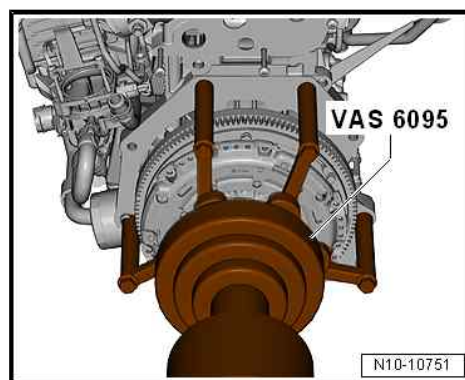
- ◆ Lift arm extension/workshop hoist - VAS 6101-
- ◆ Lifting tackle - 2024 A-





Procedure

- Secure engine to engine and gearbox support - VAS 6095-
using universal support - VAS 6095/1- .



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3 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 gearbox oil may be used, but do not use lubricants containing graphite.*
- ◆ *Do not use de-greased parts.*
- ◆ *Tolerance for tightening torques: $\pm 15\%$*

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

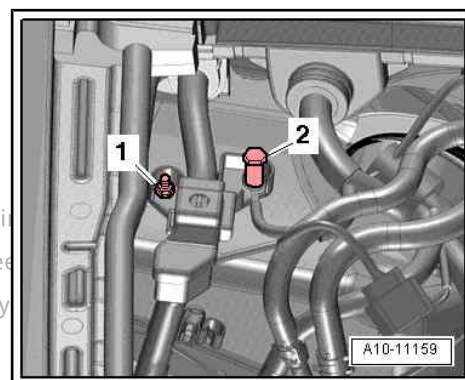
Assembly mountings

⇒ "4.1 Exploded view - assembly mountings", page 35

Earth stud

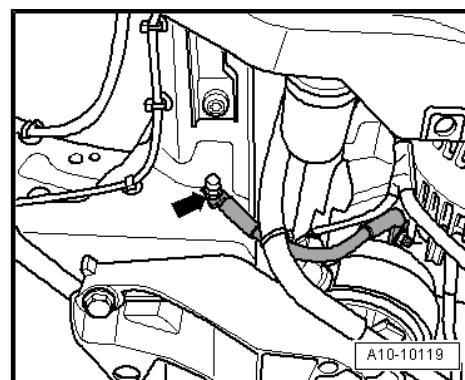
- Tighten earth stud -2- to 9 Nm.

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Earth connection on longitudinal member (right-side)

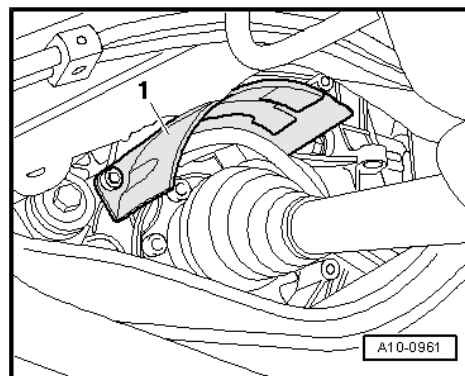
- Tighten nut -arrow- to 15 Nm.





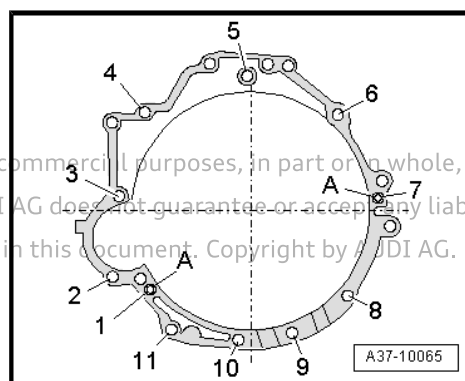
Heat shield for drive shaft

- Tighten bolts securing heat shield -1- to 23 Nm.



Engine to manual gearbox

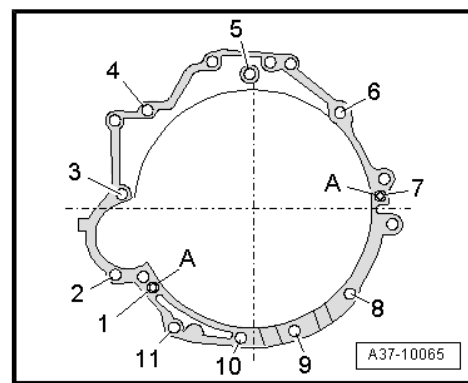
Item	Bolt	Nm
1, 6	M12x105	65
2, 4	M12x80	65
3	M12x90	65
5, 7	M12x95	65
8	M10x50	45
9, 10, 11	M10x45	45
A	Dowel sleeves for centralising	





Engine to multitronic gearbox

Item	Bolt 1)	Nm
1	M12x67	65
2 ²⁾	M10x60	45
3 ²⁾ , 4, 5, 7	M12x75	65
6	M12x100	65
8 ³⁾	M10x50	45
9, 10, 11	M10x45	45
A	Dowel sleeves for centralising	
• 1) Renew bolts for securing engine/gearbox. • 2) Bolted connection for gearbox/starter • 3) Bolt with nut		



Procedure



Note

- ◆ Renew 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.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) → Electronic parts catalogue .
- ◆ Fit all cable ties in the original positions when installing.

Vehicles with manual gearbox:

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



Note

- ◆ If the clutch plate is not being replaced, it is not necessary to reset the adjuster ring.
- ◆ New self-adjusting pressure plates are already pre-set accordingly, and do not have to be reset.
- Clean input shaft splines and (in the case of used clutch plates) the hub splines. Remove corrosion and apply only a very thin coating of grease for clutch plate splines - G 000 100- to the splines. Do not lubricate guide sleeve.
- Make sure that clutch plate is properly centred (if necessary).
- Check clutch release bearing for wear and make sure that plastic ring is securely seated; renew clutch release bearing if necessary ⇒ Rep. gr. 30 .
- A needle bearing must be fitted in the crankshaft; install needle bearing if missing ⇒ [page 72](#) .

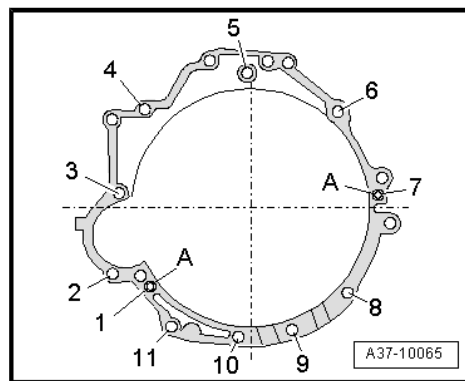


Vehicles with multitronic gearbox:

- Clean input shaft splines and splines of damper unit on fly-wheel; remove corrosion and apply only a very thin coating of grease for clutch plate splines - G 000 100- to the splines. Remove any excess grease.
- No needle bearing must be fitted in the crankshaft; remove needle bearing if necessary ➔ [page 72](#) .

All vehicles (continued):

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



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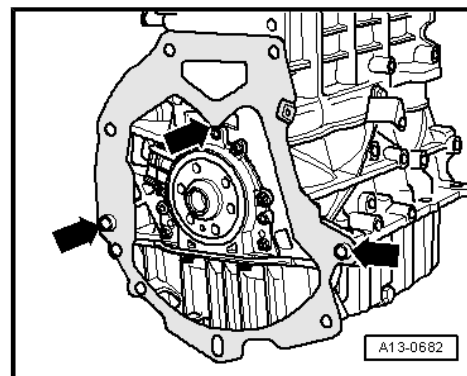
- Install intermediate plate ⇒ [page 60](#) .
- Bring engine into position on gearbox and screw in one bolt by hand until it makes contact.



Caution

Risk of damage to wing mounting flanges.

- ◆ *Release support bracket - 10 - 222 A- before lowering engine.*



- Lower workshop hoist and place engine/gearbox assembly onto engine mountings.
- Install engine mountings ⇒ [page 35](#) .
- Detach workshop hoist and lifting tackle - 2024 A- .
- Tighten bolts securing engine to gearbox.

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

- Install starter ⇒ Electrical system; Rep. gr. 27 .
- Install particulate filter:
- ◆ Vehicles with manual gearbox ⇒ [page 221](#)
- ◆ Vehicles with multitronic gearbox ⇒ [page 224](#)
- Install front exhaust pipe:
- ◆ Vehicles with manual gearbox ⇒ [page 227](#)
- ◆ Vehicles with multitronic gearbox ⇒ [page 229](#)
- Align the exhaust system so it is free of stress ⇒ [page 234](#) .
- Install front cross piece and cross member ⇒ Rep. gr. 50 .
- Install heat shield for drive shaft ⇒ [page 30](#) .
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install power steering pump ⇒ Rep. gr. 48 .
- Install poly V-belt ⇒ [page 47](#) .
- Install lock carrier with attachments ⇒ Rep. gr. 50 .
- Install torque reaction support ⇒ [page 44](#) .
- Install headlights ⇒ Electrical system; Rep. gr. 94 .
- Install bumper cover (front) ⇒ Rep. gr. 63 .
- Electrical connections and routing ⇒ [page 29](#) , ⇒ [page 29](#) .
- Install engine control unit ⇒ Rep. gr. 23 .
- Install electrical wiring, terminal 30 wiring junction 2 - TV22- and cover for electronics box in engine compartment ⇒ Electrical system; Rep. gr. 97 .
- Install and adjust wiper arms ⇒ Electrical system; Rep. gr. 92 .
- Install body brace ⇒ Rep. gr. 40 .
- Observe notes on procedure for connecting the battery ⇒ Electrical system; Rep. gr. 27 .

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Caution

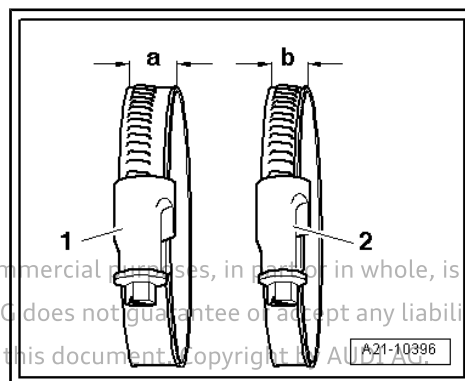
Risk of irreparable damage to control units because of excessive voltage.

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

- Install fuel filter ⇒ Rep. gr. 20 .
- Install air ducts and air cleaner housing ⇒ Rep. gr. 23 .
- Install air hoses with screw-type clips ⇒ [page 210](#) .
- Check oil level ⇒ Maintenance ; Booklet 405 .



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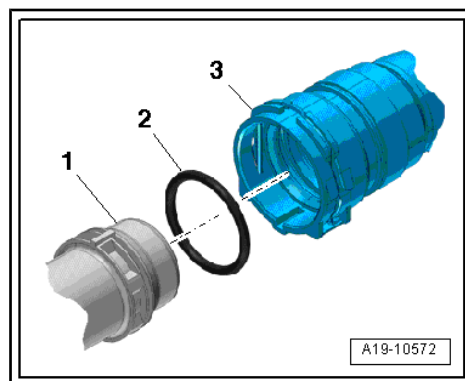


- Connect coolant hoses with plug-in connector ⇒ [page 194](#) .
- Fill up with coolant ⇒ [page 172](#) .



Note

- ◆ ***Drained-off coolant may only be used again if the original cylinder head and cylinder block are re-installed.***
- ◆ ***Contaminated or dirty coolant must not be used again.***
- Install wheel housing liners and noise insulation panels ⇒ Rep. gr. 66 .





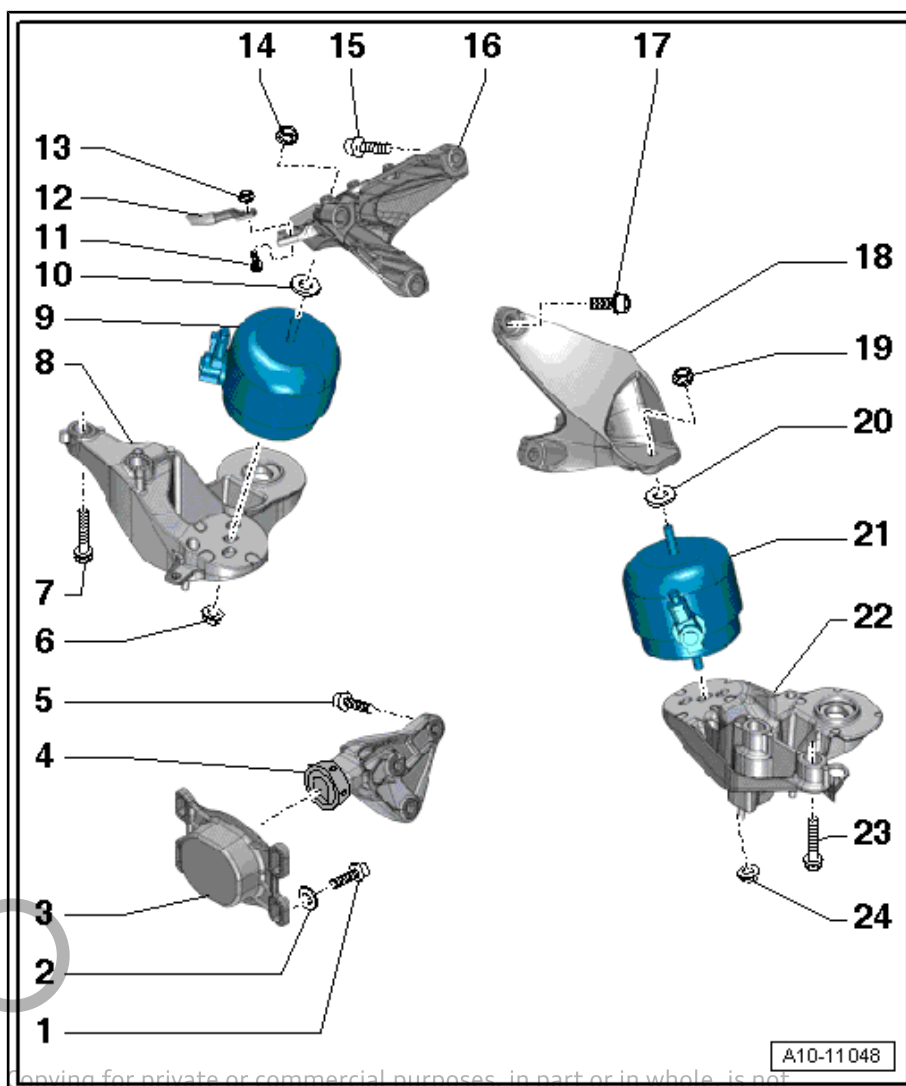
4 Assembly mountings

Overview

- ◆ ⇒ "4.1 Exploded view - assembly mountings", page 35
- ◆ ⇒ "4.2 Removing and installing engine mounting (left-side)", page 36
- ◆ ⇒ "4.3 Removing and installing engine mounting (right-side)", page 40
- ◆ ⇒ "4.4 Removing and installing torque reaction support and stop for torque reaction support", page 44

4.1 Exploded view - assembly mountings

- 1 - Bolt
 - 23 Nm
- 2 - Washer
- 3 - Stop for torque reaction support
 - Removing and installing
⇒ page 44
- 4 - Torque reaction support
 - Removing and installing
⇒ page 44
- 5 - Bolt
 - Renew
 - 20 Nm + 90°
- 6 - Nut
 - 40 Nm
- 7 - Bolt
 - Tightening torque ⇒
Rep. gr. 40
- 8 - Console for engine mounting (right-side)
- 9 - Engine mounting (right-side)
 - Removing and installing
⇒ page 40
- 10 - Washer
- 11 - Bolt
- 12 - Earth wire
- 13 - Nut
 - 23 Nm
- 14 - Nut
 - 40 Nm
- 15 - Bolt
 - 40 Nm



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16 - Engine support (right-side)

17 - Bolt

- 40 Nm

18 - Console for engine mounting (right-side)

19 - Nut

- 40 Nm

20 - Washer

21 - Engine mounting (left-side)

- Removing and installing ⇒ [page 36](#)

22 - Engine support (left-side)

23 - Bolt

- Tightening torque ⇒ Rep. gr. 40

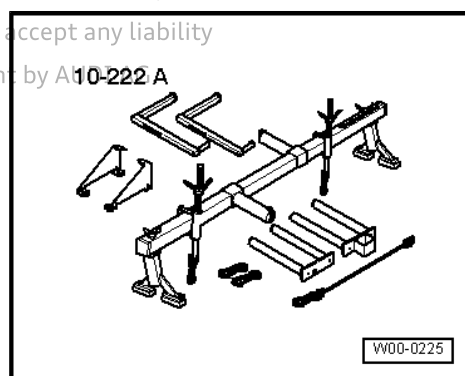
24 - Nut

- 40 Nm

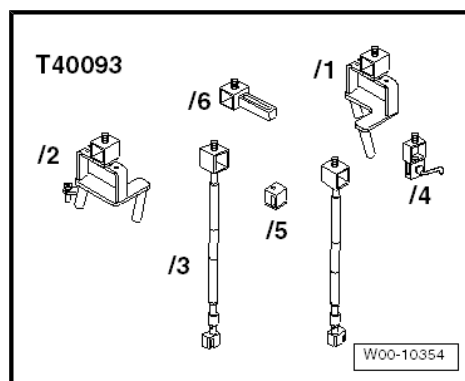
4.2 Removing and installing engine mounting (left-side)

Special tools and workshop equipment required

- ◆ Support bracket - 10 - 222 A



- ◆ Engine support bracket (supplementary set) - T40093-





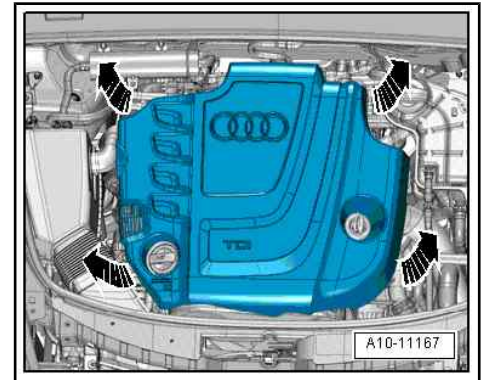
Removing



Note

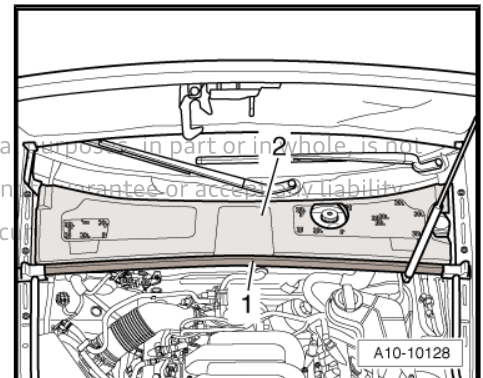
Fit all cable ties in the original positions when installing.

- Remove engine cover panel -arrows-.

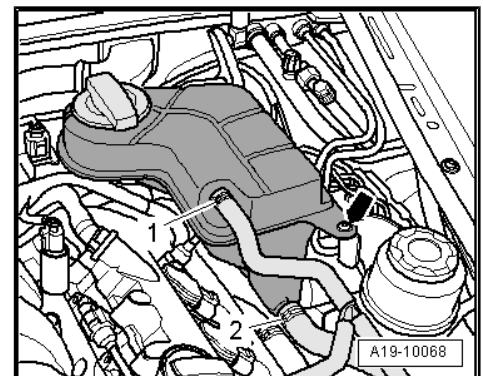


- Pull off seal -1- and remove plenum chamber cover -2-.

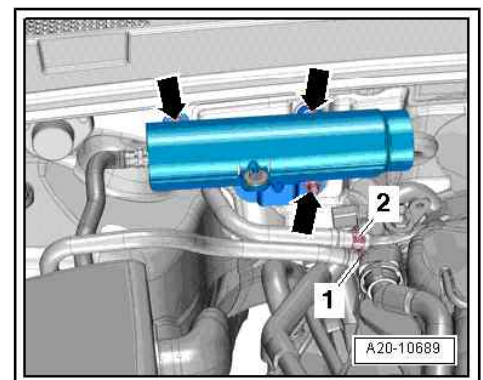
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- Remove bolt -arrow-.
- Unplug electrical connector at coolant shortage indicator switch - F66- and move expansion tank to one side with coolant hoses -1- and -2- attached.



- Remove nuts -arrows- and move fuel filter bracket clear to one side (fuel hoses -1- and -2- remain connected).



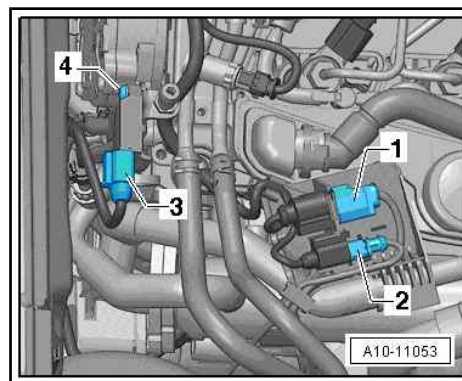


- Unplug electrical connector -3-, remove bolt -4- and push exhaust gas pressure sensor 1 - G450- to side.

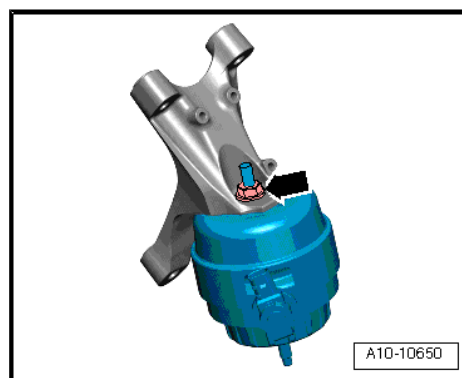


Note

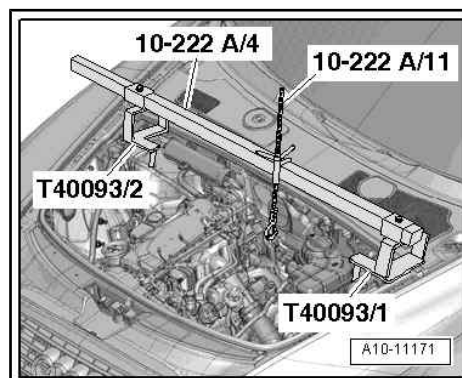
Disregard items -1 and 2-.



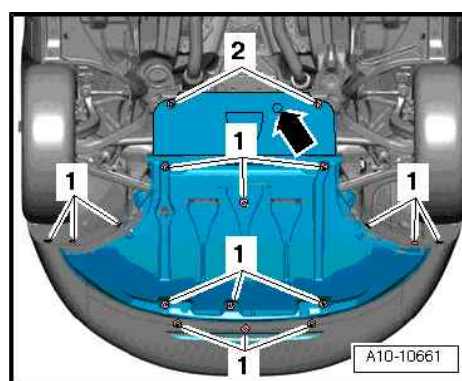
- Remove nut -arrow- on left engine mounting.



- Set up adapter - 10 - 222 A /4- with spindle - 10 - 222 A /11- and supports -T40093/1- and -T40093/2- on suspension turners as shown in illustration.
- Supports are marked for left and right side of vehicle.
- Attach spindle - 10 - 222 A /11- to engine lifting eye (rear left).
- Take up weight of engine with spindle.



- Remove noise insulation panels ⇒ Rep. gr. 50 .

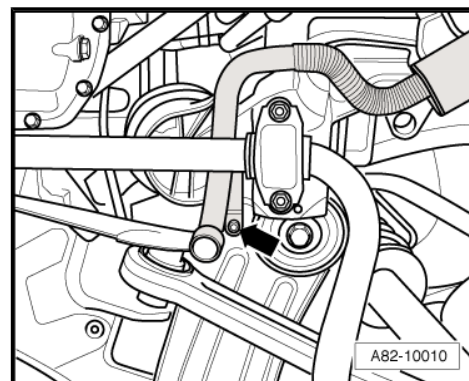


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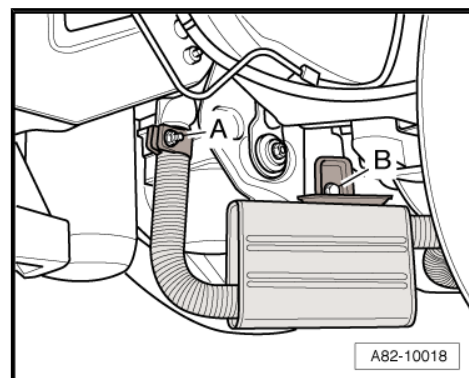


Vehicles with auxiliary heater:

- Remove front left wheel housing liner ⇒ Rep. gr. 66 .
- Remove bolt -arrow- for corrugated exhaust pipe.

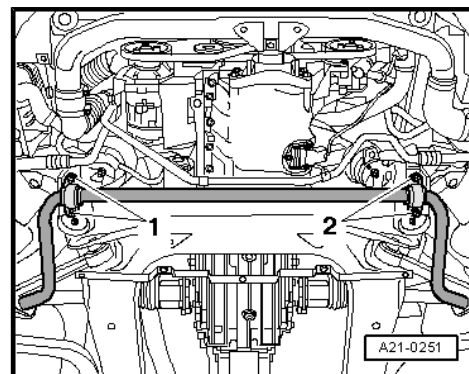


- Slacken nut -A- on clamp for corrugated exhaust pipe.
- Remove bolt -B- and detach silencer with corrugated exhaust pipes.

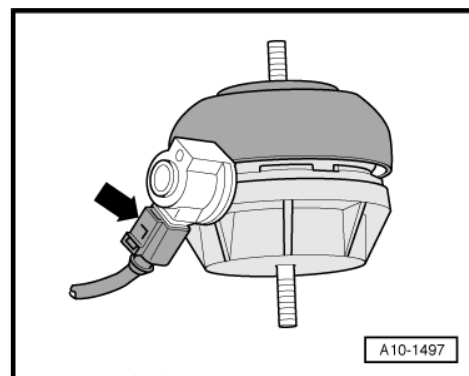


All vehicles (continued):

- Remove bolts -1- and -2- for anti-roll bar mounting on both sides and slightly lower anti-roll bar.



- Unplug electrical connector -arrow- on left electrohydraulic engine mounting solenoid valve - N144- .



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- Move B+ wire clear at console for engine mounting.
- Unscrew nut -3-.
- Remove bolts -1, 4, 5- and detach console for engine mounting -2- and engine mounting (left-side).

Installing

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

Tightening torques

- ♦ ⇒ [“4.1 Exploded view - assembly mountings”, page 35](#)



Note

Renew the bolts tightened with specified tightening angle.

- Install subframe and anti-roll bar ⇒ Rep. gr. 40 .
- On vehicles with auxiliary heater: install exhaust silencer with corrugated exhaust pipes ⇒ Rep. gr. 82 .
- Install noise insulation panels ⇒ Rep. gr. 50 .
- Secure exhaust gas pressure sensor 1 - G450- ⇒ Rep. gr. 23 .
- Install fuel filter ⇒ Rep. gr. 20 .

4.3 Removing and installing engine mounting (right-side)

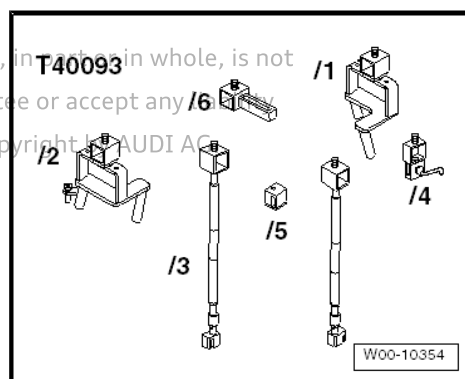
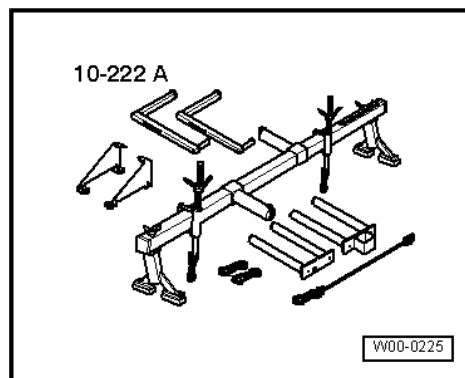
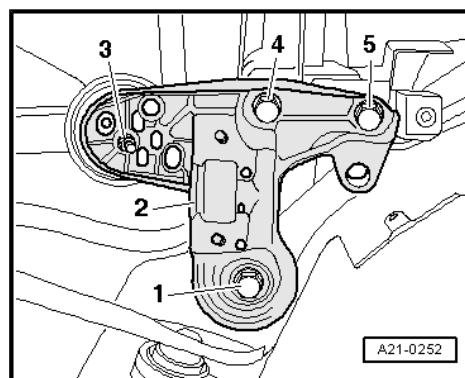
Special tools and workshop equipment required

- ♦ Support bracket - 10 - 222 A-



- ♦ Engine support bracket (supplementary set) - T40093-

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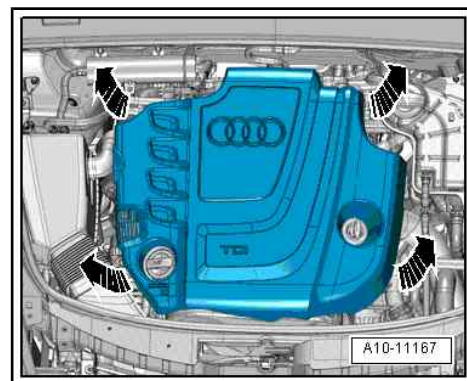
Removing



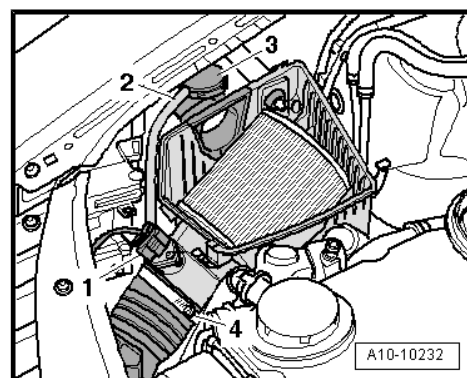
Note

Fit all cable ties in the original positions when installing.

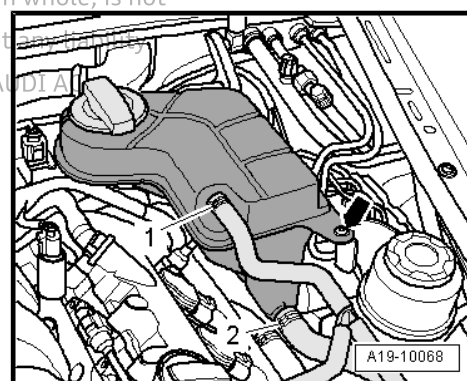
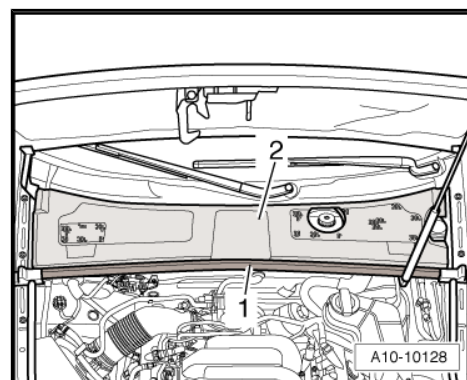
- Remove engine cover panel -arrows-.



- Remove air cleaner housing ⇒ Rep. gr. 23 .



- Pull off seal -1- and remove plenum chamber cover -2-.



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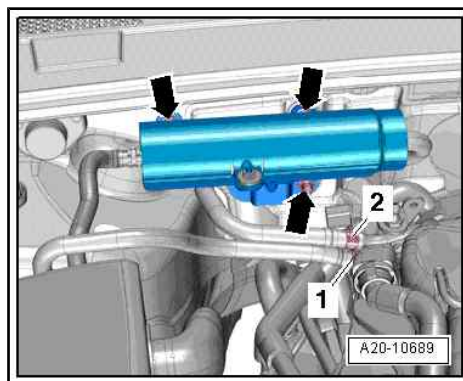
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- Remove bolt -arrow-.
- Unplug electrical connector at coolant shortage indicator switch - F66- and move expansion tank to one side with coolant hoses -1- and -2- attached.



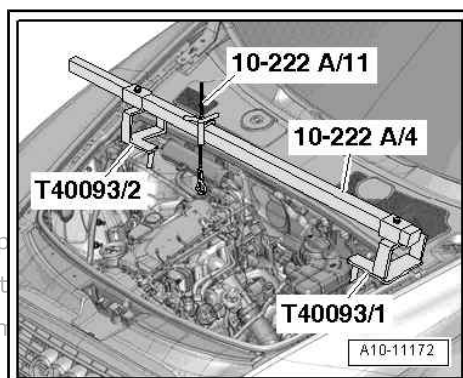
- Remove nuts -arrows- and move fuel filter bracket clear to one side (fuel hoses -1- and -2- remain connected).



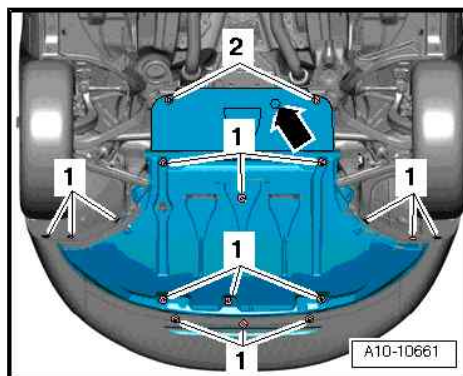
- Set up adapter - 10 - 222 A /4- with spindle - 10 - 222 A /11- and supports -T40093/1- and -T40093/2- on suspension turrets as shown in illustration.

- Supports are marked for left and right side of vehicle.
- Attach spindle - 10 - 222 A /11- to engine lifting eye (rear right).
- Take up weight of engine with spindle.

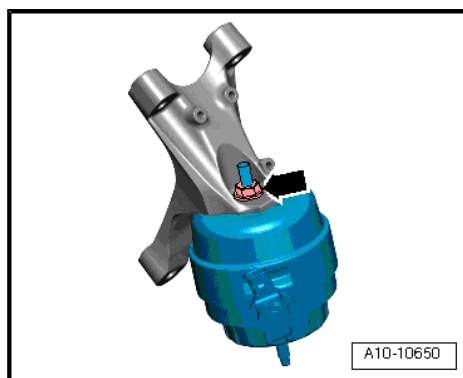
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- Remove noise insulation panels ⇒ Rep. gr. 50 .



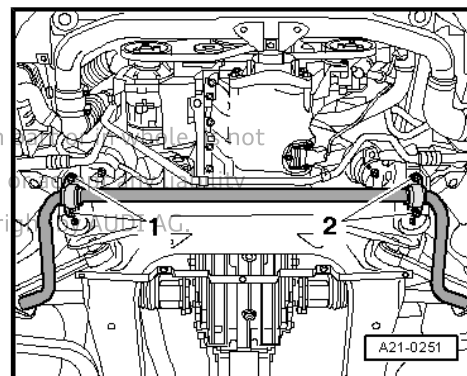
- Remove nut -arrow- on right engine mounting.



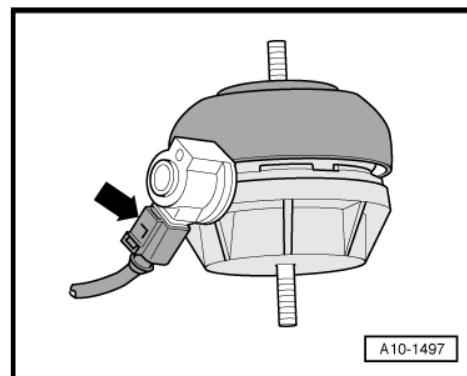


- Remove bolts -1- and -2- for anti-roll bar mounting on both sides and slightly lower anti-roll bar.

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- Unplug electrical connector -arrow- on right electrohydraulic engine mounting solenoid valve - N145- .



- Unscrew nut -3-.
- Remove bolts -1- and -2- and take off console for engine mounting and engine mounting (right-side).

Installing

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

Tightening torques

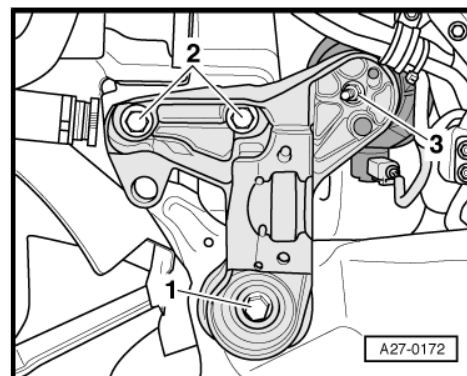
- ◆ ⇒ [“4.1 Exploded view - assembly mountings”, page 35](#)



Note

Renew the bolts tightened with specified tightening angle.

- Install subframe and anti-roll bar ⇒ Rep. gr. 40 .
- Install noise insulation panels ⇒ Rep. gr. 50 .
- Install fuel filter ⇒ Rep. gr. 20 .
- Install air cleaner housing ⇒ Rep. gr. 23 .

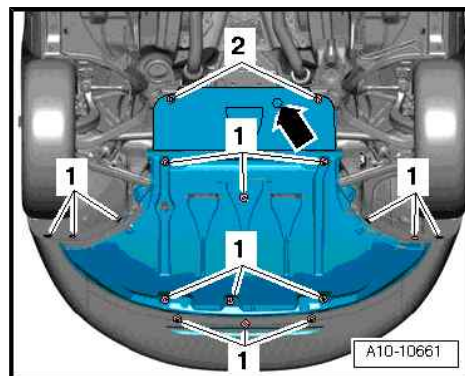




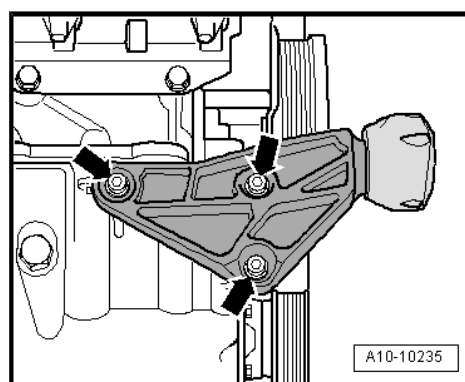
4.4 Removing and installing torque reaction support and stop for torque reaction support

Removing

- Remove noise insulation panels ⇒ Rep. gr. 50 .



- Remove bolts -arrows- and detach torque reaction support.

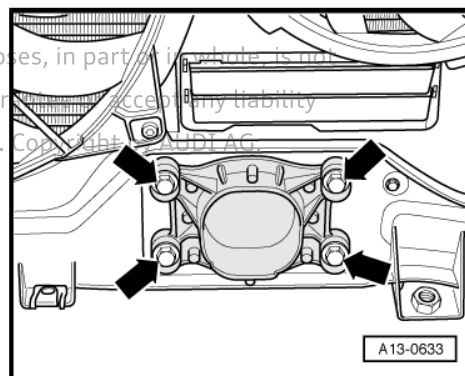


Installing

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

Tightening torques

- ♦ ⇒ [“4.1 Exploded view - assembly mountings”, page 35](#)
- Slacken bolts -arrows- on stop for torque reaction support.
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight, and tighten bolts.
- Install noise insulation panels ⇒ Rep. gr. 50 .





13 – Crankshaft group

1 Cylinder block (pulley end)

Overview

- ◆ ⇒ [“1.1 Exploded view - poly V-belt drive”, page 45](#)
- ◆ ⇒ [“1.2 Removing and installing poly V-belts”, page 47](#)
- ◆ ⇒ [“1.3 Removing and installing tensioner for poly V-belt”, page 48](#)
- ◆ ⇒ [“1.4 Removing and installing vibration damper”, page 50](#)
- ◆ ⇒ [“1.5 Removing and installing bracket for ancillaries”, page 50](#)
- ◆ ⇒ [“1.6 Exploded view - sealing flange \(pulley end\)”, page 52](#)
- ◆ ⇒ [“1.7 Renewing crankshaft oil seal \(pulley end\)”, page 53](#)
- ◆ ⇒ [“1.8 Removing and installing sealing flange \(pulley end\)”, page 55](#)

1.1 Exploded view - poly V-belt drive

1 - Poly V-belt

- ☐ Check for wear
- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen
- ☐ Removing and installing
⇒ [page 47](#)
- ☐ When installing, make sure it is properly seated on pulleys

2 - Vibration damper with poly V-belt pulley

- ☐ Can only be installed in one position
- ☐ Removing and installing
⇒ [page 50](#)

3 - Cover cap for vibration damper

4 - Bolt

- ☐ Renew
- ☐ 10 Nm +90°

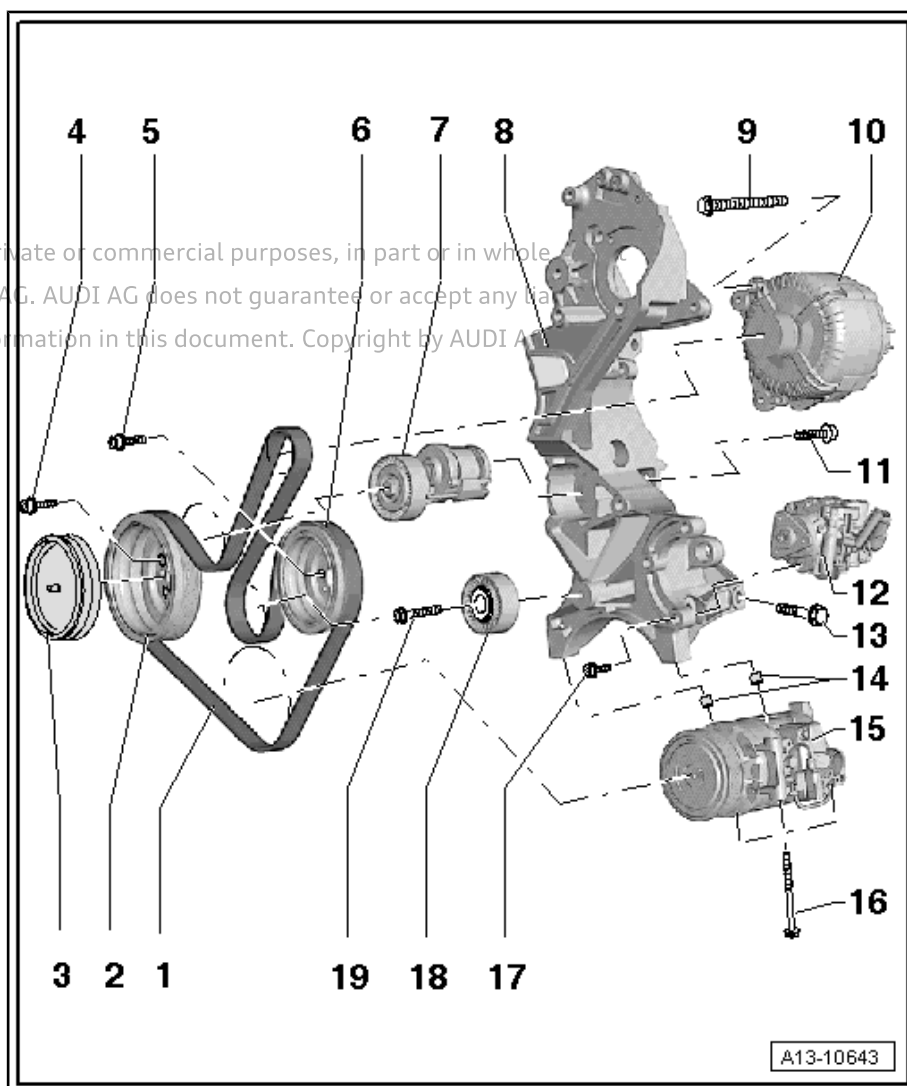
5 - Bolt

- ☐ Tightening torque ⇒ Rep. gr. 48

6 - Poly V-belt pulley for power steering pump

7 - Poly V-belt tensioner

- ☐ Use locking tool - T40098- to lock tensioner.
- ☐ Removing and installing
⇒ [page 48](#)





8 - Bracket for ancillaries

- ☐ Removing and installing ⇒ [page 50](#)

9 - Bolt

- ☐ Tightening torque ⇒ Electrical system; Rep. gr. 27

10 - Alternator

- ☐ Removing and installing ⇒ Electrical system; Rep. gr. 27

11 - Bolt

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

12 - Power steering pump

- ☐ Removing and installing ⇒ Rep. gr. 48

13 - Bolt

- ☐ Renew
- ☐ Tightening torque and sequence ⇒ [page 46](#)

14 - Dowel sleeve

- ☐ Ensure correct seating in bracket

15 - Air conditioner compressor

- ☐ Do not unscrew or disconnect refrigerant hoses or pipes.
- ☐ Removing and installing ⇒ Rep. gr. 87
- ☐ Pay attention to dowel sleeves ⇒ [Item 14 \(page 46\)](#) when installing

16 - Bolt

- ☐ Tightening torque ⇒ Rep. gr. 87

17 - Bolt

- ☐ Tightening torque ⇒ Rep. gr. 48

18 - Idler roller for poly V-belt

- ☐ Note installation position

19 - Bolt

- ☐ Renew
- ☐ 20 Nm + 90°

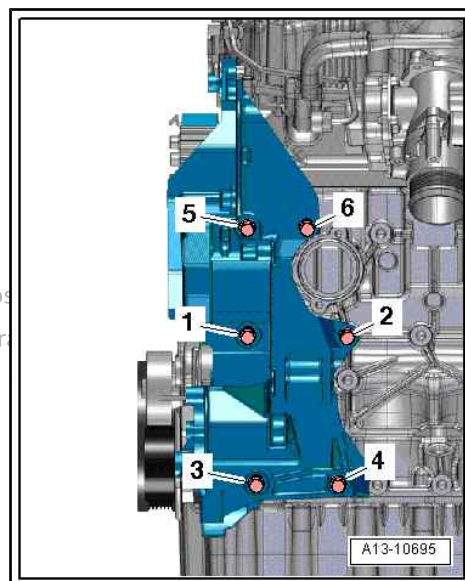
Bracket for ancillaries - tightening torque and tightening sequence

- Renew bolts for bracket for ancillaries and fit as follows:

- ◆ Bolts -1, 5, 6- M10x60.
- ◆ Bolt -2- M10x40
- ◆ Bolts -3, 4- M10x155.

- Tighten bolts for bracket for ancillaries in the sequence -1 ... 6- in 5 stages as follows:

1. Screw in all bolts by hand until they make contact.
2. Tighten all bolts to 40 Nm.
3. Turn bolts -1- and -2- 60° further.
4. Turn bolts -3- and -4- 180° further.
5. Turn bolts -5- and -6- 60° further.

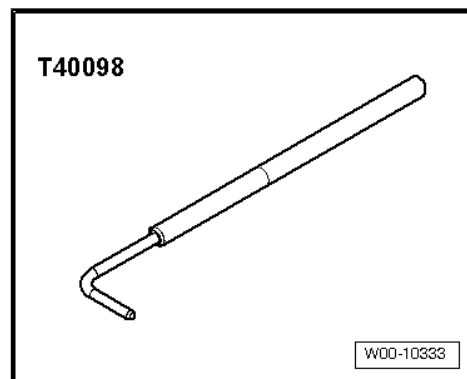




1.2 Removing and installing poly V-belts

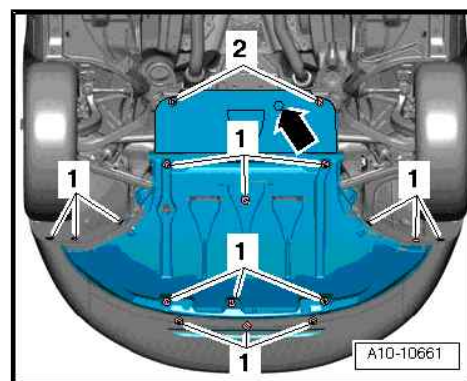
Special tools and workshop equipment required

- ◆ Locking tool - T40098-

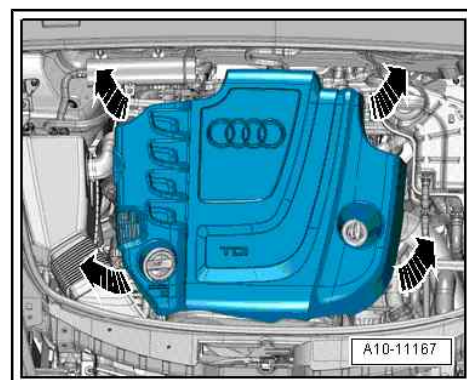


Removing

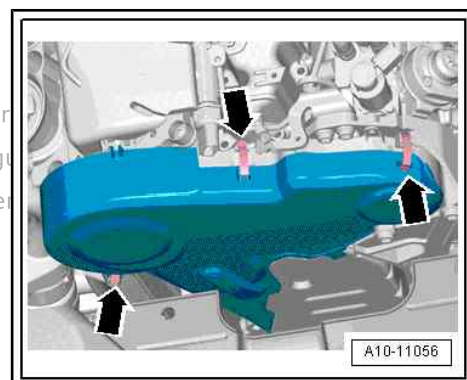
- Remove noise insulation panels ⇒ Rep. gr. 66 .



- Remove engine cover panel -arrows-.



- Open clips -arrows- and remove toothed belt cover.



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- Swivel tensioner in clockwise direction -arrow-, detach poly V-belt from pulley for air conditioner compressor and lock tensioner using locking tool - T40098- .

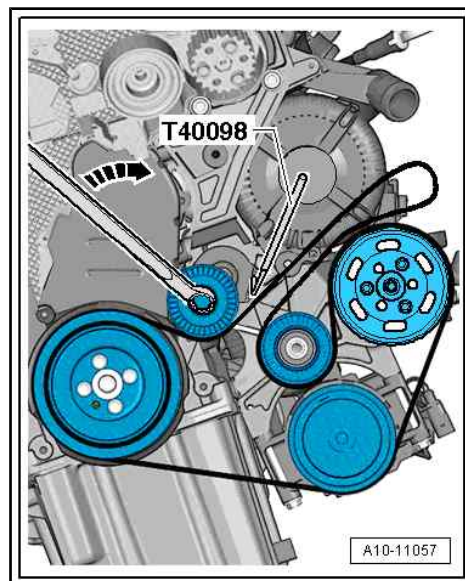


Caution

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

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

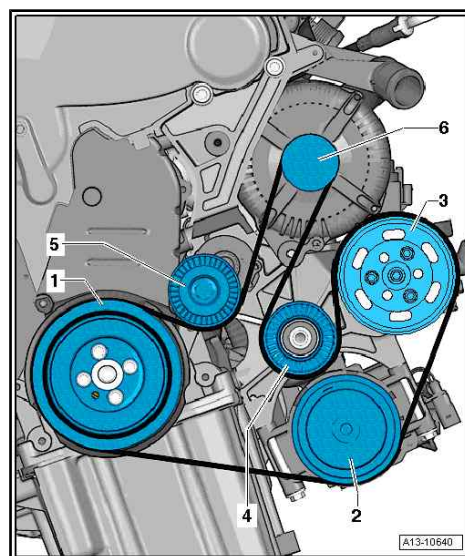
- Take off poly V-belt.



Installing

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

- Fit poly V-belt on poly V-belt pulleys:
 - 1 - Vibration damper
 - 2 - Air conditioner compressor
 - 3 - Power steering pump
 - 4 - Idler roller
 - 5 - Poly V-belt tensioner
 - 6 - Alternator
- Hold tensioner and pull out locking tool - T40098- .
- Check that poly V-belt is in correct position.
- Start engine and check that poly V-belt(s) run properly.
- Install noise insulation panels ⇒ Rep. gr. 50 .



1.3 Removing and installing tensioner for poly V-belt

Special tools and workshop equipment required

- ◆ Ratchet wrench 13 mm - T10384-

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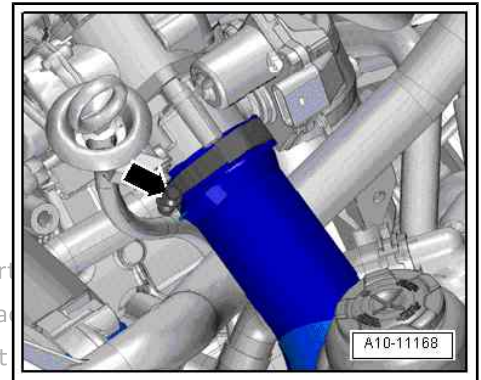


Removing

- Remove poly V-belt ⇒ [page 47](#) .
- Open hose clip -arrow- and press air hose to side.



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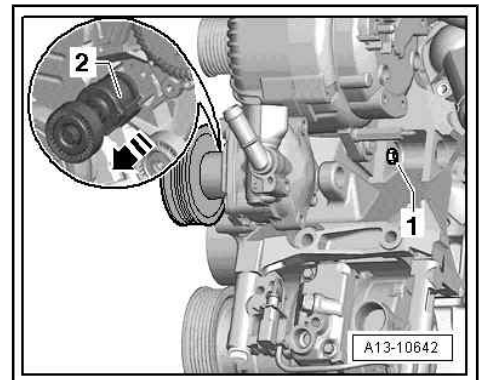


- Remove bolt -1- and detach poly V-belt tensioner -2-.



Note

- ◆ If bolt -1- 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

Tightening torques

- ◆ ⇒ [“1.1 Exploded view - poly V-belt drive”, page 45](#)

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



Note

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

- Install poly V-belt ⇒ [page 47](#) .



1.4 Removing and installing vibration damper

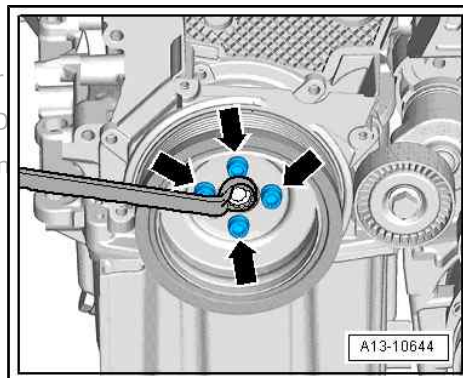
Removing

- Remove poly V-belt ⇒ [page 47](#) .
- Detach cover cap for vibration damper.
- Counterhold by applying ring spanner to bolt for crankshaft sprocket and slacken bolts -arrows-.



Note

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



- Remove bolts and take off vibration damper.

Installing

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

Tightening torques

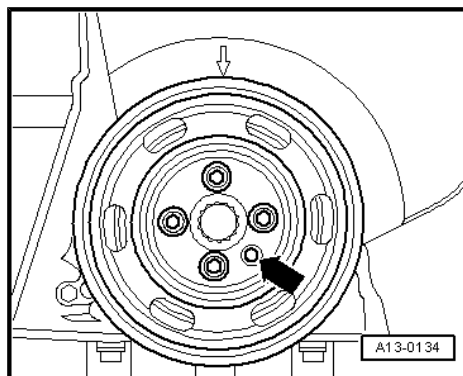
- ♦ ⇒ [“1.1 Exploded view - poly V-belt drive”, page 45](#)



Note

Renew bolts tightened with specified tightening angle.

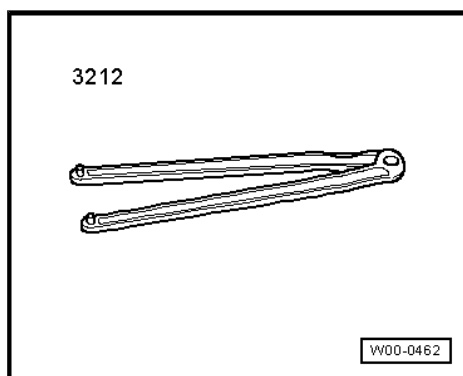
- The vibration damper can only be installed in one position. The hole in the vibration damper must be located over the projection on the toothed belt sprocket -arrow-.
- Install poly V-belt ⇒ [page 47](#) .
- Install noise insulation panels ⇒ Rep. gr. 50 .



1.5 Removing and installing bracket for ancillaries

Special tools and workshop equipment required

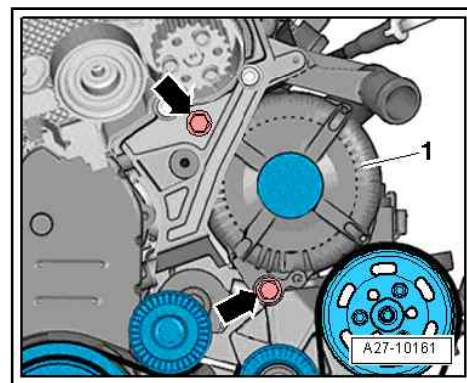
- ♦ Pin wrench - 3212- or strap wrench



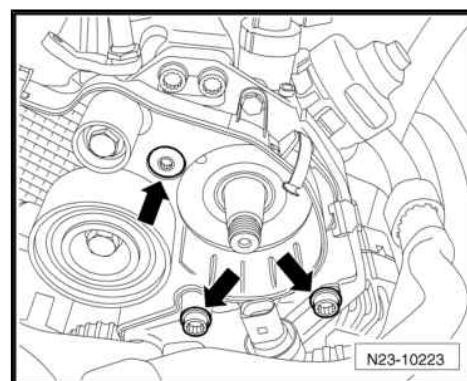


Removing

- Remove alternator ⇒ Electrical system; Rep. gr. 27 .



- Remove high-pressure pump ⇒ Rep. gr. 23 .
- Remove thermostat ⇒ [page 180](#) .



- Unplug electrical connector -1- for magnetic clutch on air conditioner compressor.

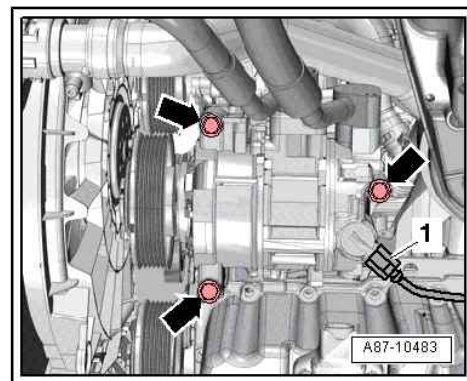


WARNING

Risk of injury caused by refrigerant.

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

- Remove bolts -arrows- for air conditioner compressor.

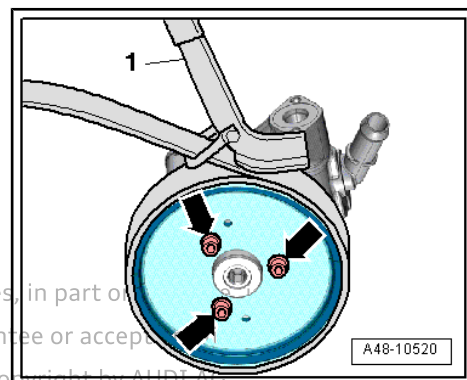


Caution

Risk of damage to refrigerant lines and hoses.

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

- Tie up air conditioner compressor together with lines to one side (lines remain connected).
- Remove bolts -arrow- for poly V-belt pulley for power steering pump (counterhold with strap wrench -1- or pin wrench -3212-).

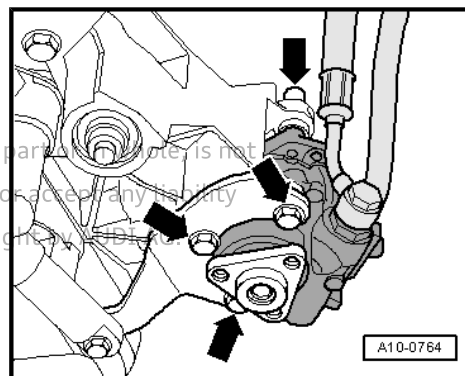


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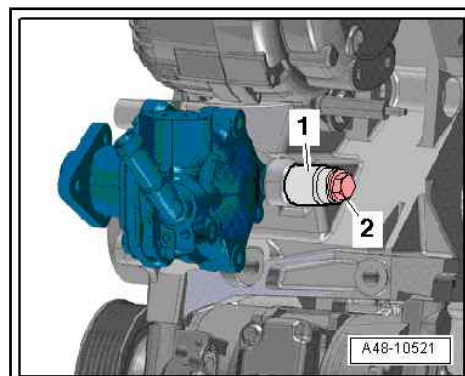


- Remove bolts -arrows- and tie power steering pump up to one side (hydraulic lines remain attached).

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**Note**

- ♦ Apply 1/2" socket insert (AF 18) -item 1- to sliding bush if power steering pump is stuck in bracket.
- ♦ Fit M8x70 bolt -item 2- in power steering pump and press sliding bush out of bracket for power steering pump by screwing in bolt.



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

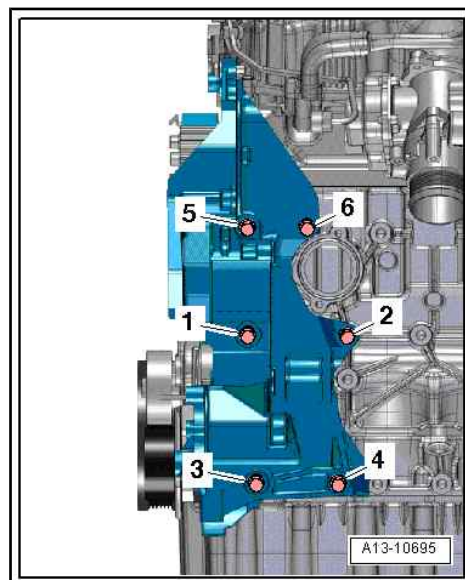
Installing

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

**Note**

Renew 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 46](#) .
- Install power steering pump ⇒ Rep. gr. 48 .
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install thermostat ⇒ [page 180](#) .
- Install high-pressure pump ⇒ Rep. gr. 23 .
- Install alternator ⇒ Electrical system; Rep. gr. 27 .



1.6 Exploded view - sealing flange (pulley end)



1 - Bolt

- ☐ Tightening torque
⇒ [Item 27 \(page 86\)](#)

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 53](#)
- ☐ Do not lubricate with oil

4 - Sealing flange (pulley end)

- ☐ Should be positioned on dowel pins
- ☐ Removing and installing
⇒ [page 55](#)

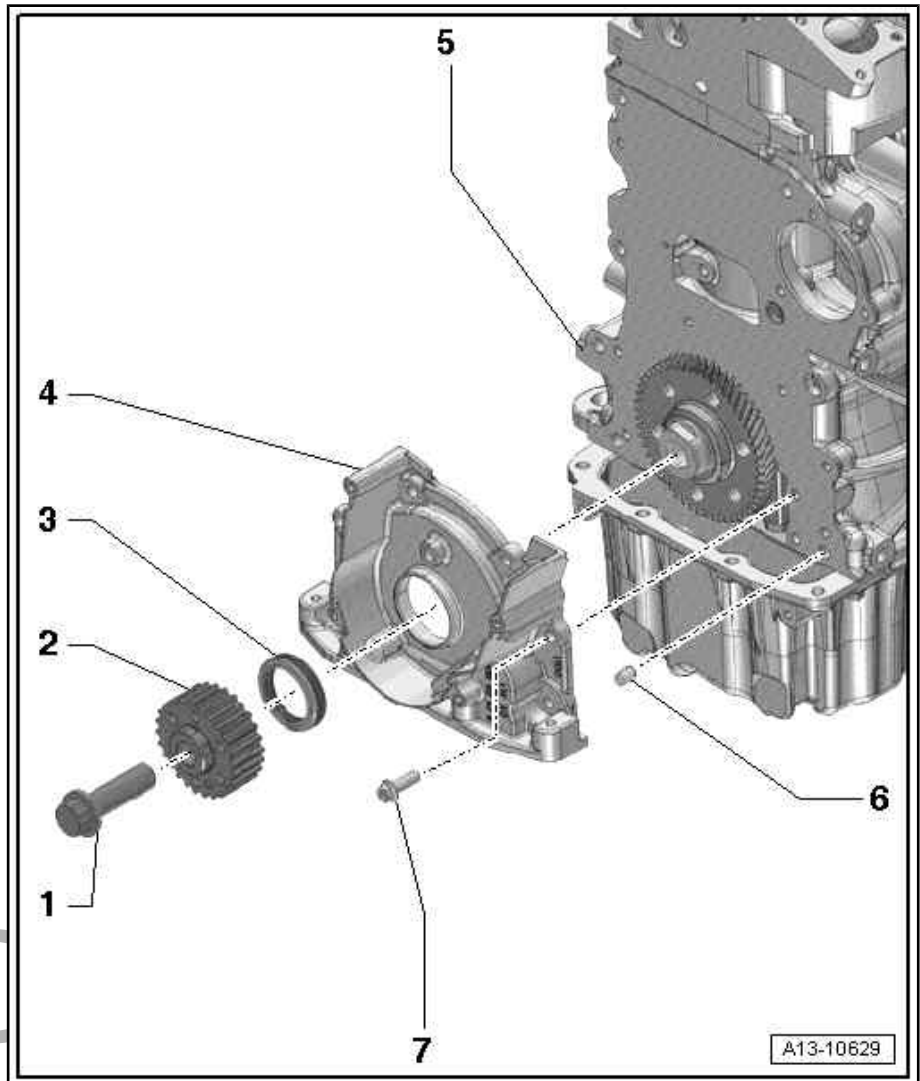
5 - Cylinder block

6 - Dowel pin

- ☐ 2x

7 - Bolt

- ☐ Tightening torque and sequence ⇒ [page 53](#)

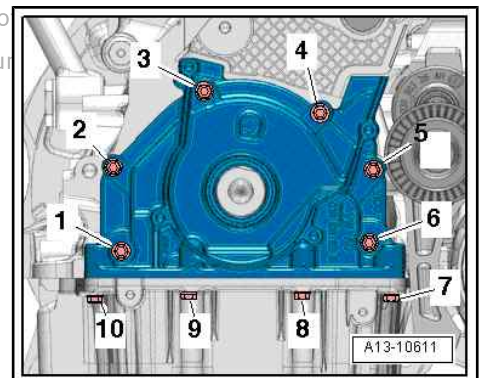


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Sealing flange (pulley end) – tightening torque and sequence

– 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

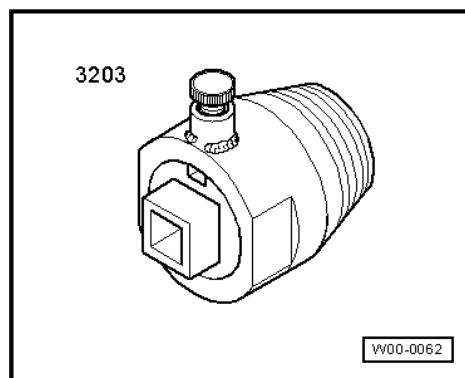


1.7 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required



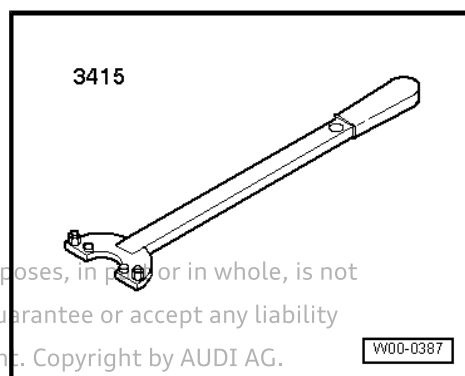
◆ Oil seal extractor - 3203-



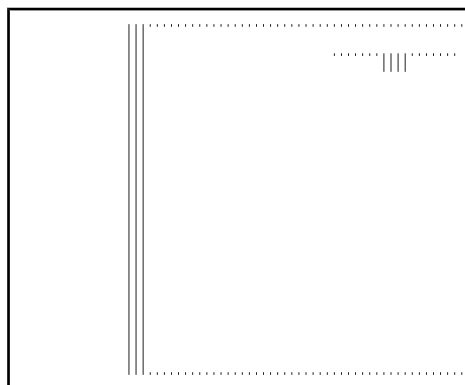
◆ Counterhold tool - 3415-



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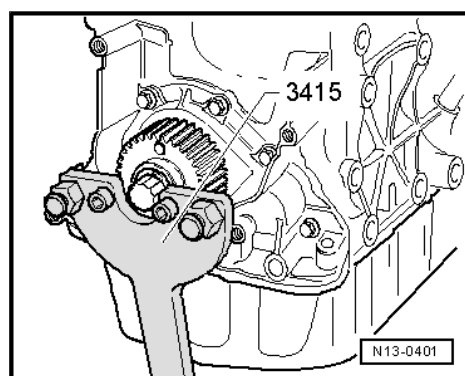


◆ Assembly tool - T10053-



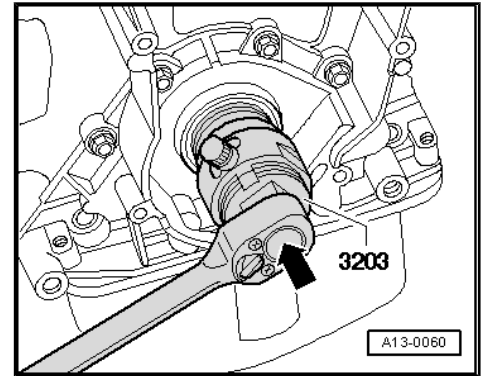
Procedure

- Remove toothed belt ➔ [page 87](#) .
- Loosen bolt for crankshaft sprocket using counterhold tool - 3415- .
- Remove bolt and detach crankshaft sprocket.





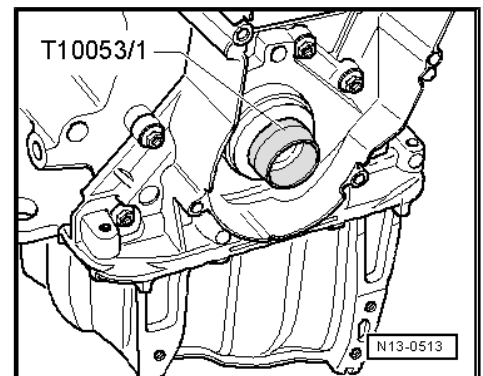
- Adjust inner section of oil seal extractor -3203- so it is flush with the outer section and lock in position with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).
- Loosen knurled screw and turn 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.



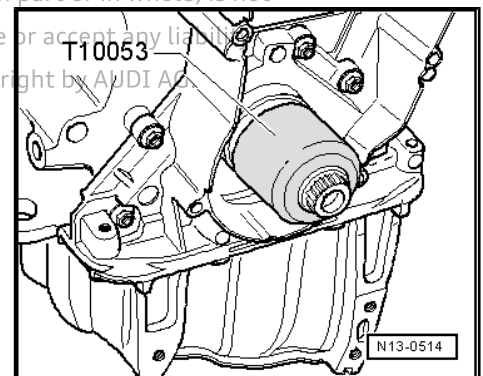
i Note

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 85](#) .
- Install toothed belt (adjust valve timing) ➔ [page 91](#) .

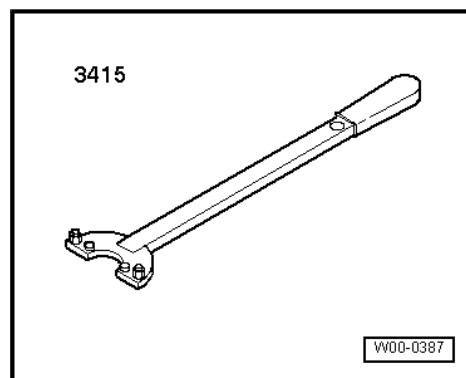


1.8 Removing and installing sealing flange (pulley end)

Special tools and workshop equipment required



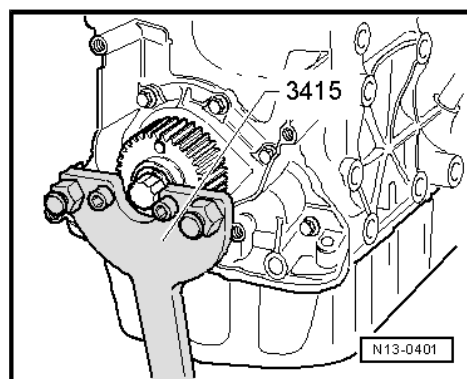
- ◆ Counterhold tool - 3415-



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

Removing

- Remove toothed belt ⇒ [page 87](#) .
- Loosen bolt for crankshaft sprocket using counterhold tool - 3415- .
- Remove bolt and detach crankshaft sprocket.



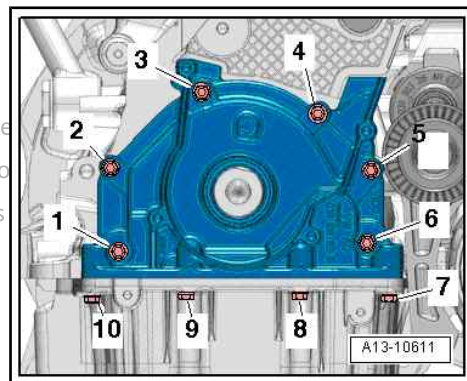
- Remove bolts -1 ... 10- and carefully release sealing flange from bonded joint.
- Drive out oil seal with sealing flange removed.

Installing

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

Tightening torques

- ◆ ⇒ [Fig. "Sealing flange \(pulley end\) - tightening torque and sequence"](#) , [page 53](#)
- ◆ ⇒ [Item 27 \(page 86\)](#)



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.

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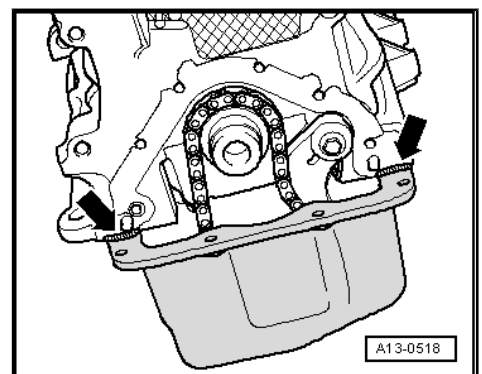
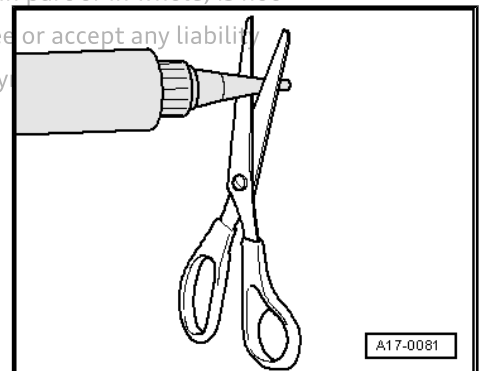
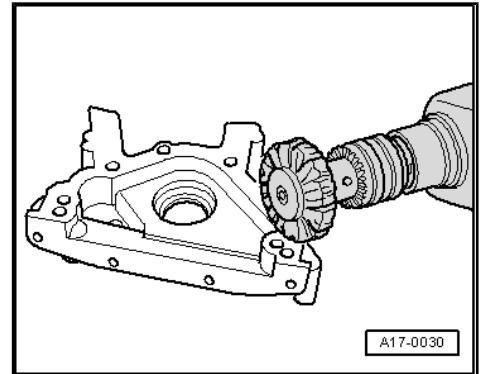


Note

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Note the use-by date of the sealant.

- Cut off nozzle of tube at front marking (nozzle Ø approx. 2 mm).
- Apply a thin bead of sealant at the edge of the joint between the cylinder block and the sump -arrows-.

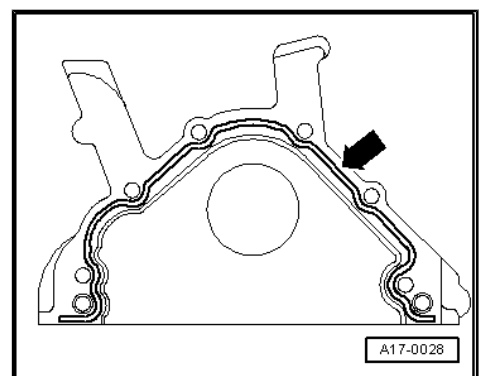


Caution

Make sure lubrication system is not clogged by excess sealant.

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

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





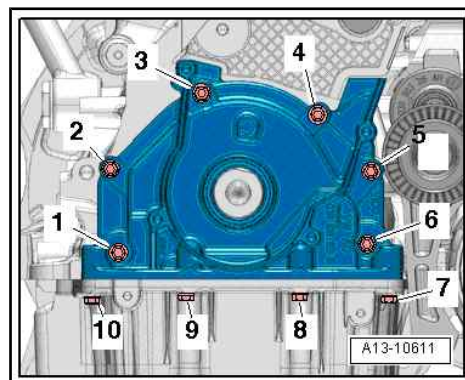
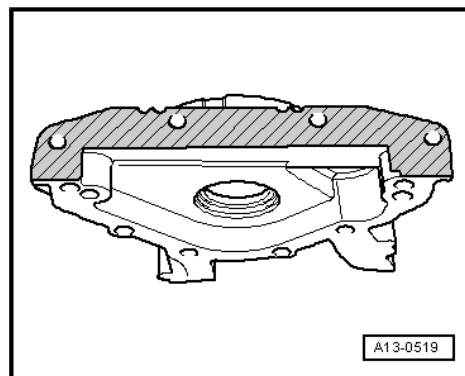
- Apply a thin coat of sealant to bottom sealing surface -shaded- on sealing flange.



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 53](#) .
- Install crankshaft oil seal (pulley end) ⇒ [page 53](#) .



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2 Cylinder block (gearbox end)

Overview

- ◆ ⇒ [“2.1 Exploded view - dual-mass flywheel and sealing flange \(gearbox end\)”, page 59](#)
- ◆ ⇒ [“2.2 Removing and installing dual-mass flywheel”, page 60](#)
- ◆ ⇒ [“2.3 Renewing sealing flange \(gearbox end\)”, page 61](#)

2.1 Exploded view - dual-mass flywheel and sealing flange (gearbox end)

1 - Bolt

- ☐ Renew
- ☐ 60 Nm + turn 90° further

2 - Dual-mass flywheel

- ☐ Removing and installing
⇒ [page 60](#)
- ☐ Can only be installed in one position

3 - Sender wheel

- ☐ For engine speed sender - G28-
- ☐ Removing and installing
⇒ [“2.3 Renewing sealing flange \(gearbox end\)”, page 61](#)

4 - Engine speed sender - G28-

- ☐ Removing and installing
⇒ Rep. gr. 28

5 - Bolt

- ☐ Tightening torque ⇒ Rep. gr. 28

6 - Dowel pin

- ☐ 2x

7 - Intermediate plate

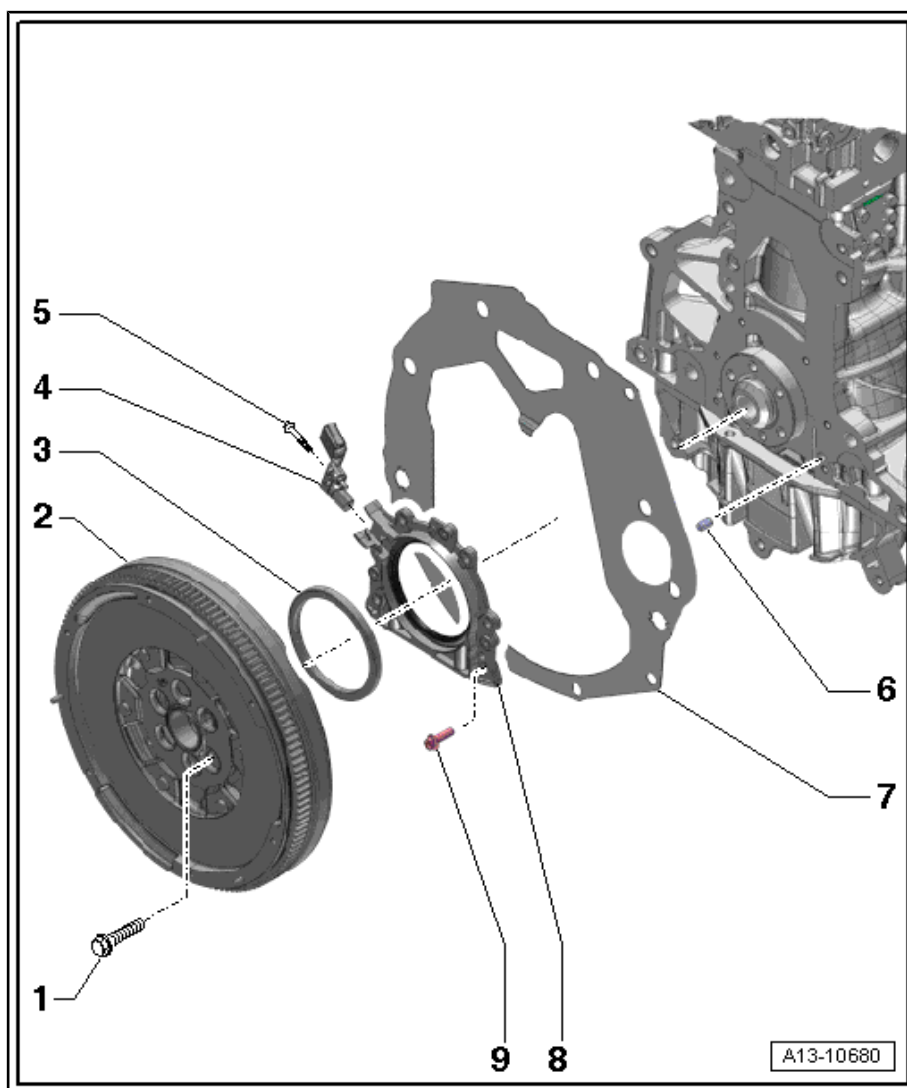
- ☐ Do not damage or bend
- ☐ Installing ⇒ [page 60](#)

8 - Sealing flange (gearbox end)

- ☐ With oil seal
- ☐ Renewing ⇒ [page 61](#)

9 - Bolt

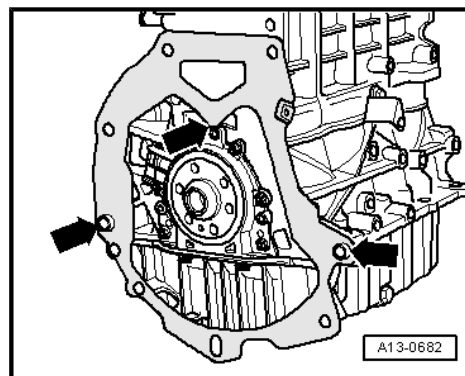
- ☐ Tightening torque and sequence ⇒ [page 60](#)





Installing intermediate plate

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



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Sealing flange (gearbox end) - tightening torque and sequence

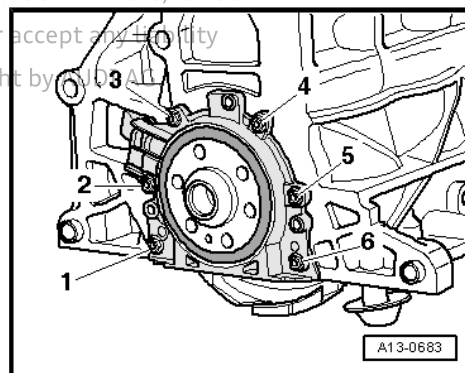
- Tighten bolts -1-...-6- in 2 stages as follows:

1. Screw in by hand until contact is made.
2. Tighten in stages and in diagonal sequence; final torque 15 Nm.



Note

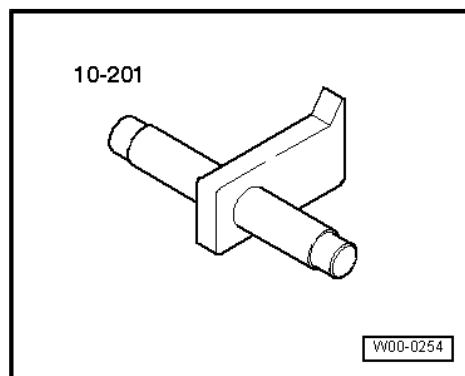
Disregard items -7 and 8-.



2.2 Removing and installing dual-mass fly-wheel

Special tools and workshop equipment required

- ♦ Counterhold tool - 10 - 201-



Removing

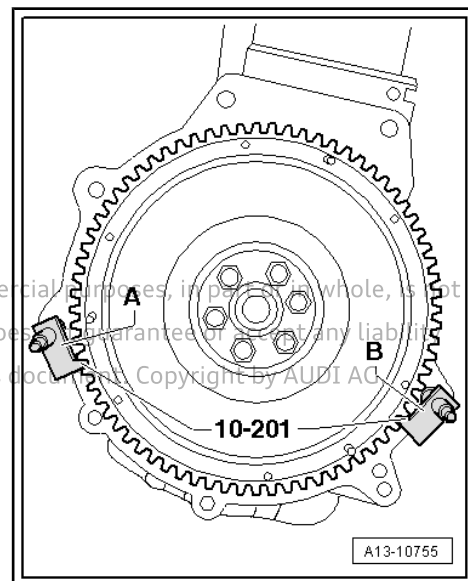
- Engine or gearbox removed.
- Remove clutch pressure plate ⇒ Rep. gr. 30 .



- Insert counterhold tool - 10 - 201- in hole on cylinder block -item B-, slacken bolts for dual-mass flywheel.



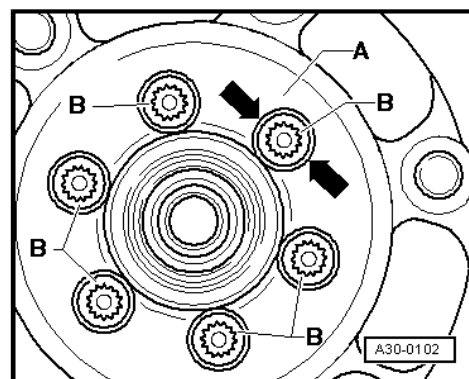
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Note

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

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



Installing

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

Tightening torques

- ◆ ⇒ [“2.1 Exploded view - dual-mass flywheel and sealing flange \(gearbox end\)”, page 59](#)



Note

Renew bolts tightened with specified tightening angle.

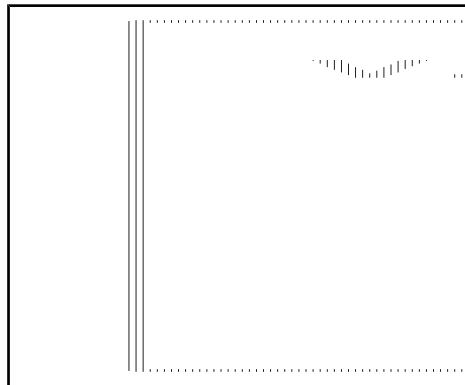
- Install clutch pressure plate ⇒ Rep. gr. 30 .

2.3 Renewing sealing flange (gearbox end)

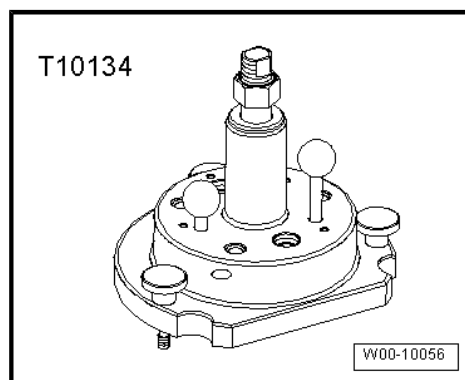
Special tools and workshop equipment required



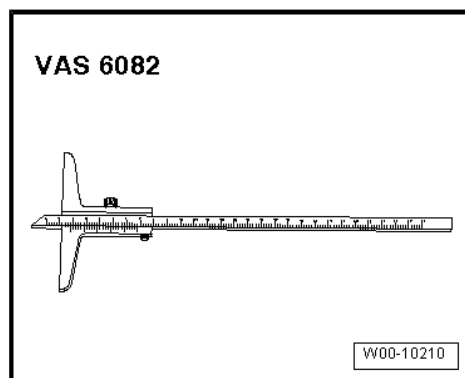
- ◆ Open end spanner insert, AF 24 - V.A.G 1332/11-



- ◆ Assembly tool - T10134-



- ◆ Depth gauge - VAS 6082-

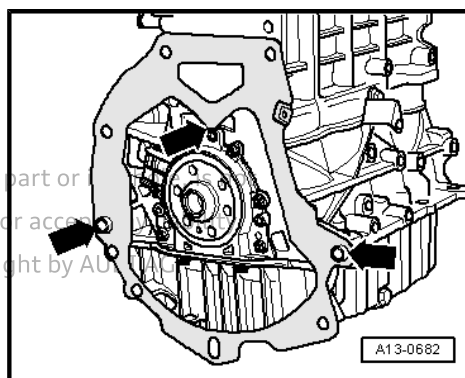


- ◆ Bolt, M6x35 (3x)

- ◆ Bolt, M7x35 (2x)

Pressing out sealing flange with sender wheel

- Gearbox removed
- Remove dual-mass flywheel ⇒ [page 60](#) .
- Pull intermediate plate off dowel sleeves -bottom arrows- and detach from sealing flange -top arrow-





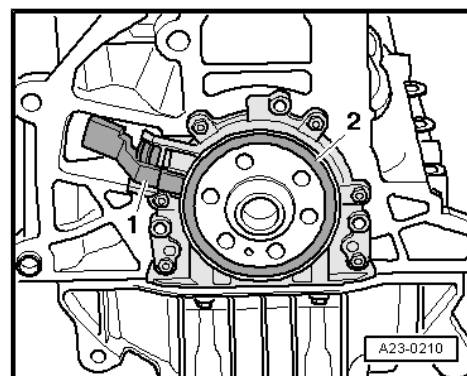
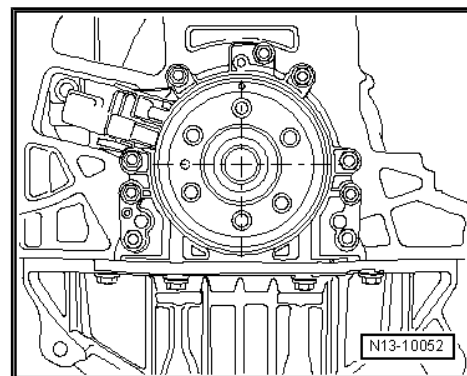
- Rotate crankshaft by turning bolt for toothed belt sprocket until crankshaft is positioned at "TDC", as shown in illustration.
- Remove sump ⇒ [page 144](#) .



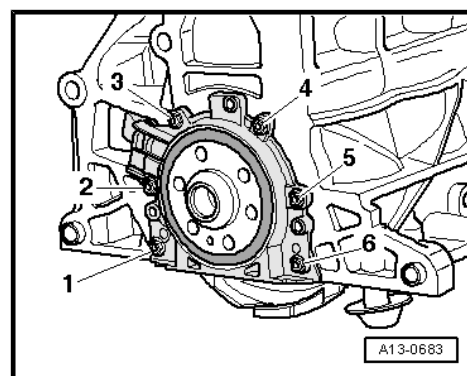
Note

For illustration purposes, the following procedure is shown with the engine removed.

- Remove engine speed sender - G28- -item 1- ⇒ Rep. gr. 28 .



- Remove bolts -1 ... 6- for sealing flange.



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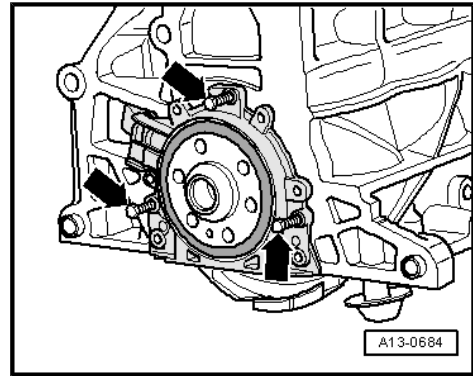
**Note**

The sealing flange is pressed off the crankshaft together with the sender wheel.

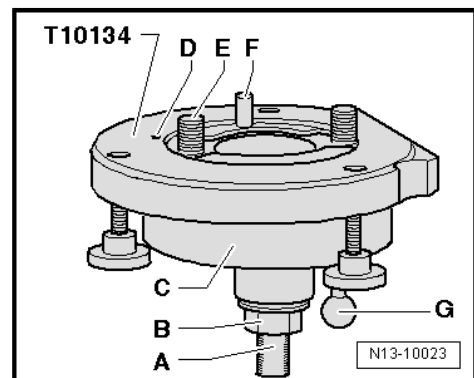
- To press off, screw 3 bolts M6x35 -arrows- alternately into sealing flange not more than $\frac{1}{2}$ turn at a time.
- Take off sealing flange with sender wheel.

Pressing in sealing flange with sender wheel**Note**

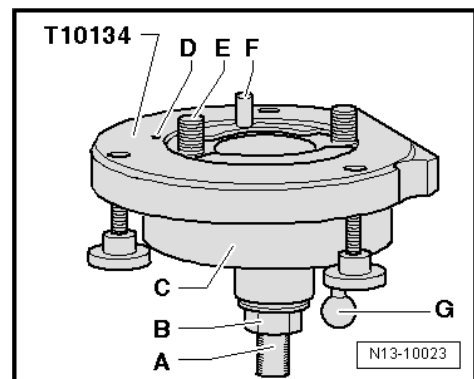
- ♦ *The sealing flange with PTFE oil seal is fitted with a sealing lip support ring. This support ring acts as an assembly sleeve and must not be removed before installation.*
- ♦ *Sealing flange and sender wheel must not be separated or rotated out of position after removal from packaging.*
- ♦ *The 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 must always 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 - Hexagon nut
- C - Assembly housing
- D - Locating pin
- E - Hexagon socket-head bolt
- F - Guide pin for diesel engines (black handle)
- G - Guide pin for petrol engines (red handle)

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

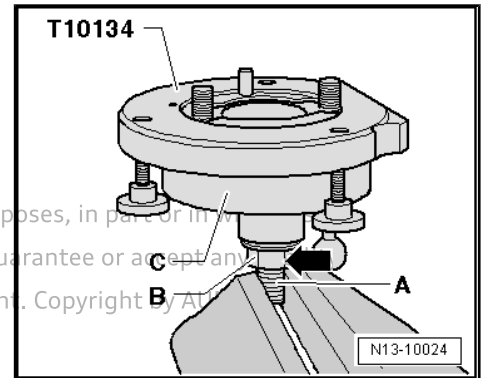
- Turn hexagon nut -B- onto threaded spindle until it is just in front of tightening flats -A-.





- Clamp assembly tool - T10134- in a vice on tightening flats -A- of threaded spindle.
- Press assembly housing -C- downwards so that it lies on hexagon nut -B- -arrow-.
- Inner part of assembly device and assembly housing must align (be level) with each other.

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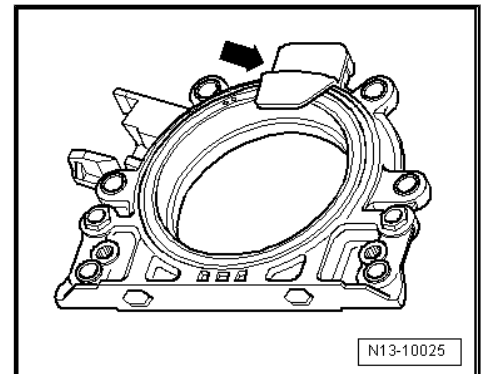


- Remove the securing clip -arrow- from new sealing flange.

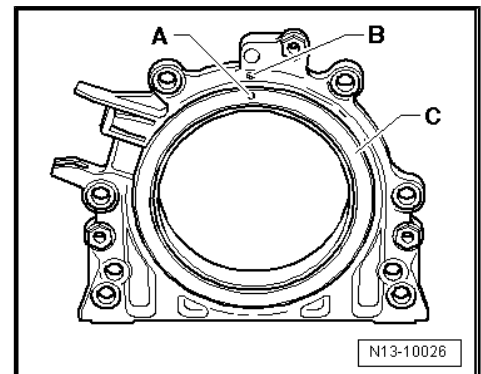


Note

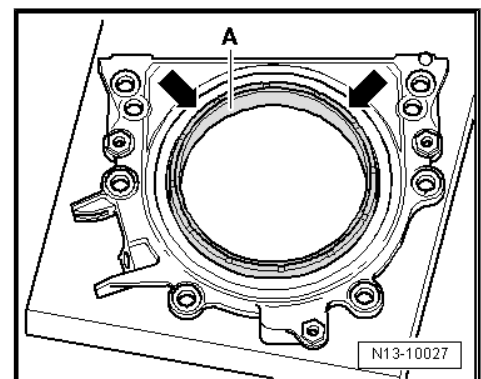
The sender wheel must not be taken out of the sealing flange or rotated out of position.



- The locating hole -A- on the sender wheel -C- must align with the marking -B- on the sealing flange.
- Place sealing flange (with front side downwards) on a clean flat surface.

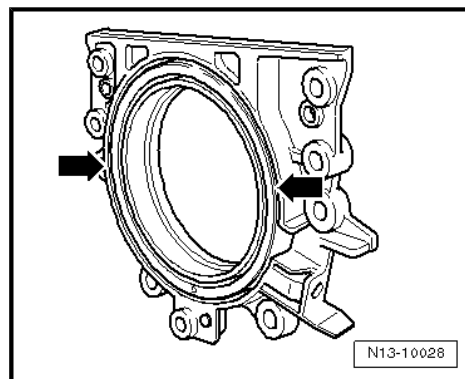


- Press the sealing lip support ring -A- downwards in direction of -arrows- until it lies against the flat surface.

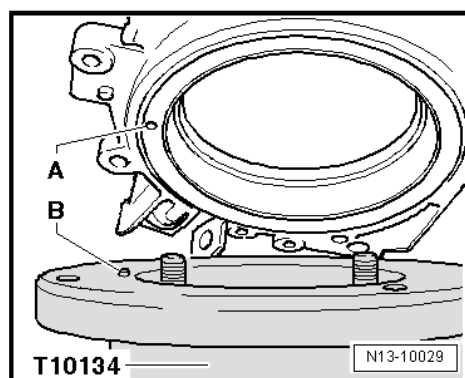




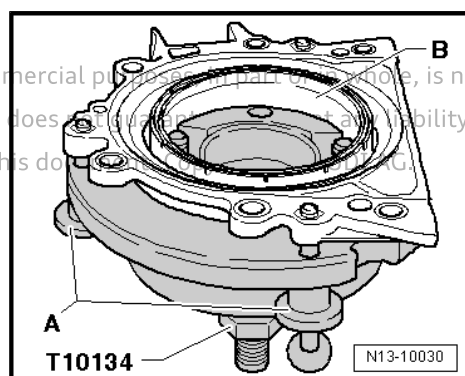
- The upper edge of the sender wheel and the front edge of the sealing flange must align -arrows-.



- Place front side of sealing flange on assembly tool - T10134- , so that locating pin -B- can be inserted in hole -A- in sender wheel.
- Ensure that sealing flange lies flat on assembly tool.

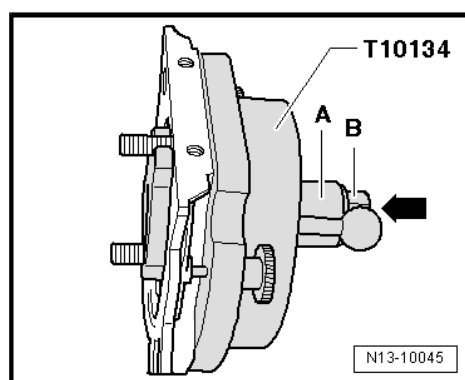


- Press the sealing flange and sealing lip support ring -B- onto the surface of the assembly tool - T10134- while tightening the 3 knurled screws -A- so that the locating pin will not slip out of the hole in the sender wheel.
- Ensure that the sender wheel remains fixed on the assembly tool when installing the sealing flange.



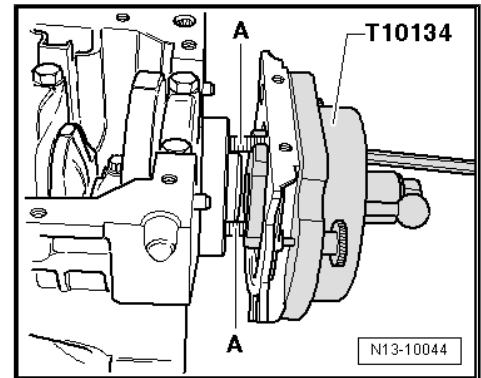
B - Installing assembly tool - T10134- with sealing flange on crankshaft flange:

- Crankshaft flange must be free of oil and grease.
- Engine is at "TDC" position.
- Screw hexagon nut -B- to end of threaded spindle.
- Press the threaded spindle of assembly tool - T10134- in direction of -arrow- until the hexagon nut -B- lies on the assembly housing -A-.

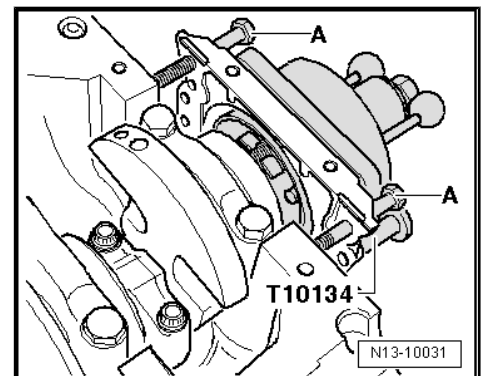




- Position flat edge of assembly housing towards sealing surface for sump on cylinder block.
- Secure assembly tool - T10134- to crankshaft flange by screwing hexagon socket head bolts -A- approx. 5 threads into crankshaft flange.



- Screw two bolts M7×35 mm -item A- into cylinder block to guide sealing flange.



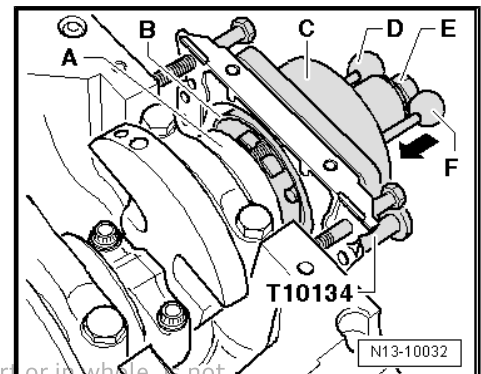
C - Securing assembly tool - T10134- onto crankshaft flange:

- Press the assembly housing -C- by hand in the direction of the -arrow- until the sealing lip support ring -B- lies on the surface of the crankshaft flange -A-.

Caution

Do not interchange components.

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



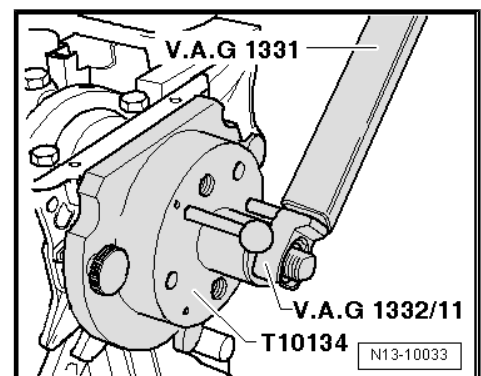
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- Push guide pin for diesel engine (black handle) -D- into hole in crankshaft. This brings the sender wheel into its final installation position.

- Tighten the two hexagon socket head bolts on assembly tool hand-tight.
- Screw hexagon nut -E- onto threaded spindle by hand until it lies against the assembly housing -C-.

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

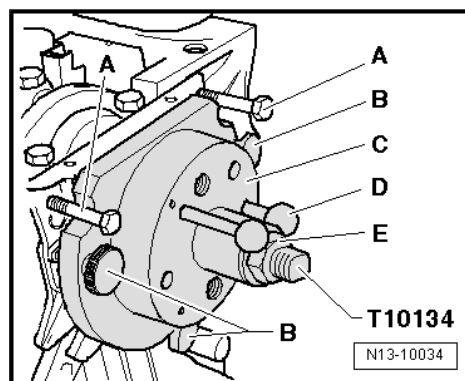
- Tighten hexagon nut on assembly tool - T10134- to 35 Nm.
- A small air gap must be present between cylinder block and sealing flange after tightening hexagon nut to 35 Nm.



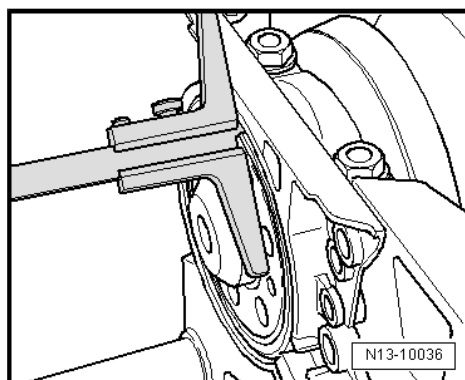


E - Checking installation position of sender wheel on crankshaft:

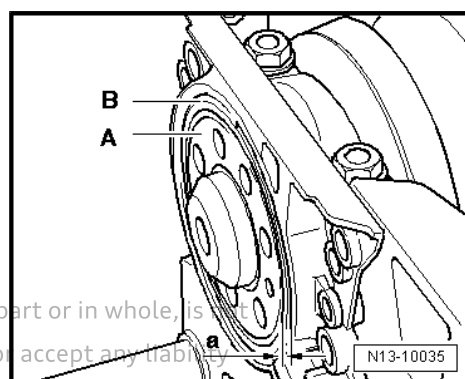
- Screw hexagon nut -E- to end of threaded spindle.
- Remove bolts -A- from cylinder block.
- Unscrew knurled screws -B- from sealing flange.
- Detach assembly tool - T10134- .
- Detach sealing lip support ring.



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



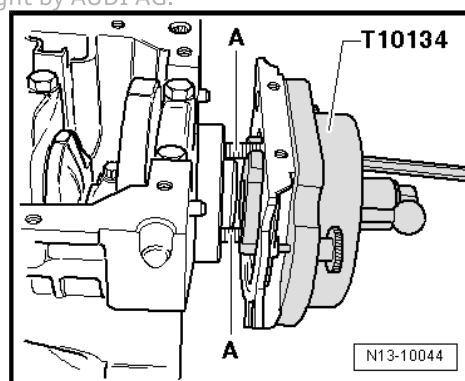
- Measure distance between crankshaft flange -A- and sender wheel -B-.
- Specification: Distance -a- = 0.5 mm.
- Press sender wheel in further if distance -a- is too small
⇒ [page 68](#) .
- If reading matches specification, continue with assembly
⇒ [page 69](#) .



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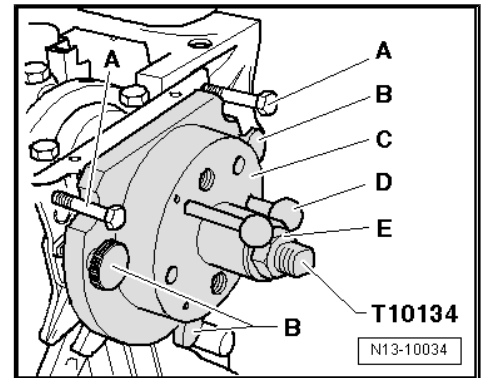
F - Pressing sender wheel in further:

- Secure assembly tool - T10134- -item A- to crankshaft flange by tightening hexagon socket head bolts hand-tight.
- Press assembly tool onto sealing flange by hand.

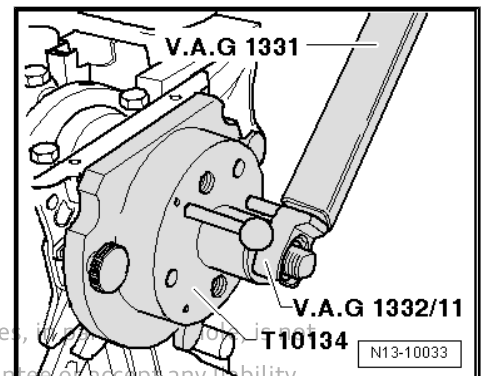




- Screw hexagon nut -E- onto threaded spindle by hand until it lies against the assembly housing -C-.



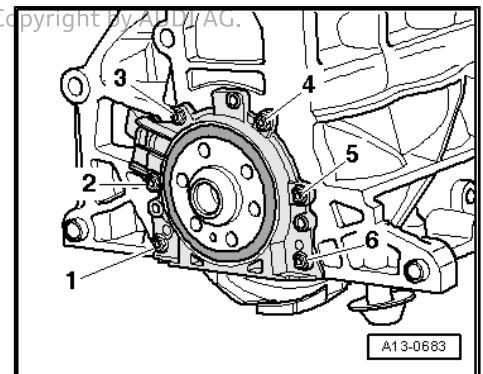
- Tighten hexagon nut on assembly tool - T10134- to 40 Nm.
- Check installation position of sender wheel on crankshaft again ⇒ [page 68](#) .
- If distance “a” is still too small, tighten hexagon nut on assembly tool - T10134- to 45 Nm.
- Check installation position of sender wheel on crankshaft again ⇒ [page 68](#) .



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Assembling: respect to the correctness of information in this document. Copyright by AUDI AG.

- Tighten sealing flange bolts ⇒ [page 60](#) .



- Install engine speed sender - G28- -item 1-.

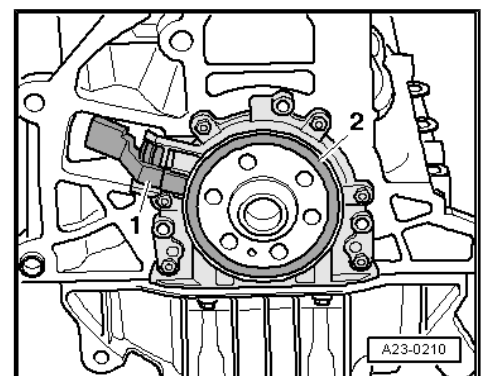


Note

Disregard -item 2-.

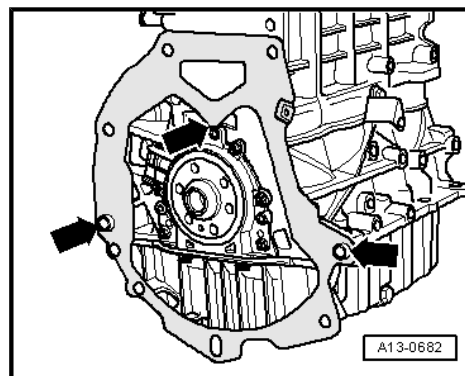
Installation is carried out in the reverse order; note the following:

- Install sump ⇒ [page 144](#) .





- Install intermediate plate ⇒ [page 60](#) .
- Install dual-mass flywheel ⇒ [page 60](#) .



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3 Crankshaft

Overview

- ◆ ⇒ [“3.1 Exploded view - crankshaft”, page 71](#)
- ◆ ⇒ [“3.2 Extracting and driving in needle bearing for crankshaft”, page 72](#)
- ◆ ⇒ [“3.3 Crankshaft dimensions”, page 73](#)
- ◆ ⇒ [“3.4 Measuring axial clearance of crankshaft”, page 73](#)
- ◆ ⇒ [“3.5 Measuring radial clearance of crankshaft”, page 74](#)
- ◆ ⇒ [“3.6 Pulling spur gear off crankshaft and shrink-fitting new spur gear”, page 74](#)

3.1 Exploded view - crankshaft



Note

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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.

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 74](#)

3 - Bearing shell

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

4 - Thrust washer

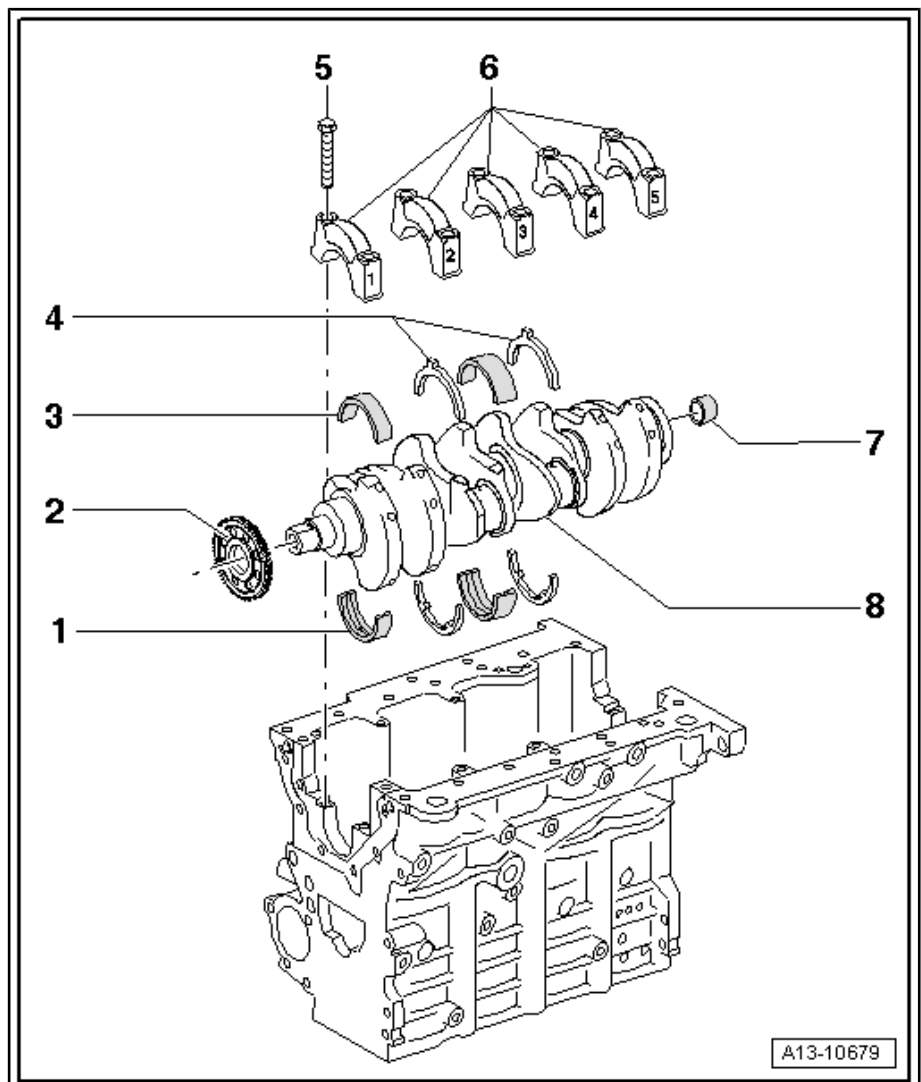
- ☐ For bearing No. 3
- ☐ Different types for cylinder block and bearing cap
- ☐ Note location

5 - Bolt

- ☐ 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

7 - Needle bearing

- ☐ For vehicles with manual gearbox
- ☐ Extracting and driving in [⇒ page 72](#)

8 - Crankshaft

- ☐ A needle bearing must be fitted in the crankshaft on vehicles with manual gearbox; install needle bearing if not yet fitted [⇒ page 72](#) .
- ☐ There should be no needle bearing fitted in the crankshaft on vehicles with multitronic gearbox; remove needle bearing if necessary [⇒ page 72](#) .
- ☐ Measuring axial clearance [⇒ page 73](#)
- ☐ Measuring radial clearance [⇒ page 74](#)
- ☐ Crankshaft dimensions [⇒ page 73](#)

3.2 Extracting and driving in needle bearing for crankshaft

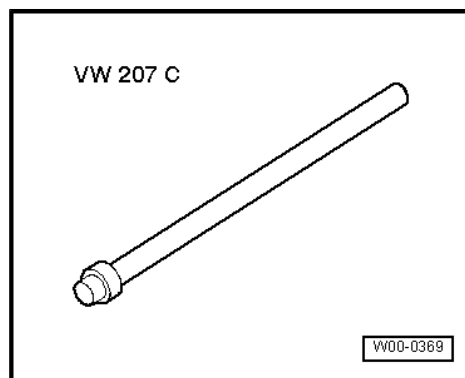


Note

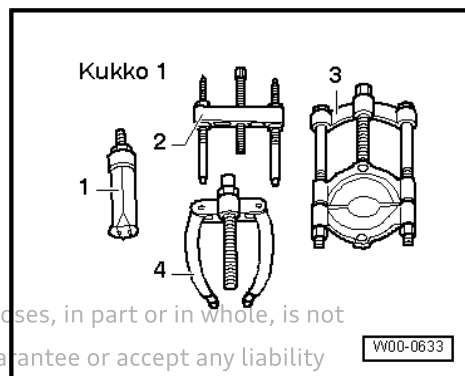
- ◆ *A needle bearing must be fitted in the crankshaft on vehicles with manual gearbox ⇒ Electronic parts catalogue .*
- ◆ *There should be no needle bearing fitted in the crankshaft on vehicles with multitronic gearbox.*

Special tools and workshop equipment required

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



- ◆ -1- Internal puller - Kukko 21/1-



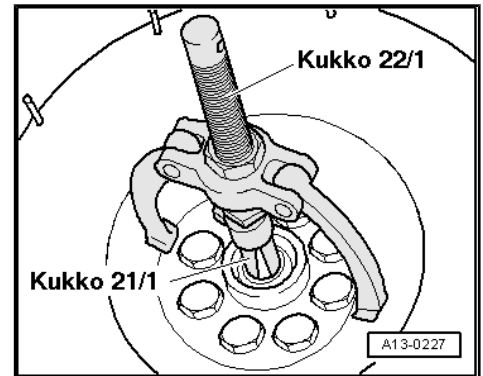
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- ◆ -4- Counter-support - Kukko 22/1-



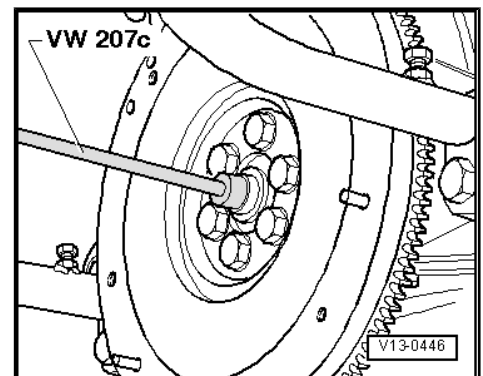
Pulling out

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



Driving in

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



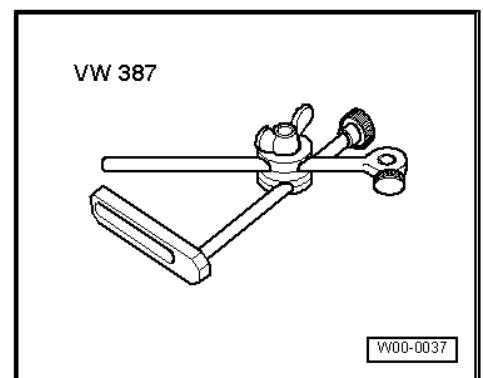
3.3 Crankshaft dimensions

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

3.4 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

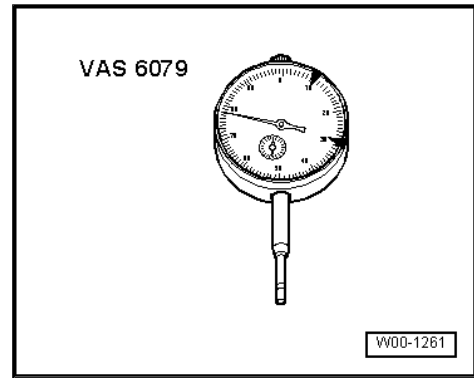
- ◆ Universal dial gauge bracket - VW 387-



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◆ Dial gauge - VAS 6079-

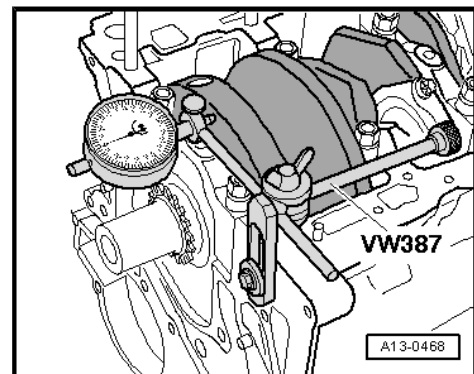


Procedure

- Bolt dial gauge - 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

- 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.

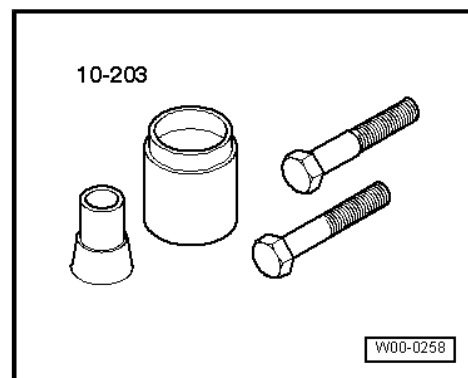
Radial clearance:

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

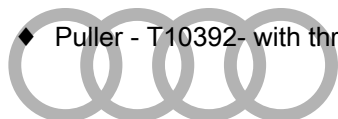
3.6 Pulling spur gear off crankshaft and shrink-fitting new spur gear



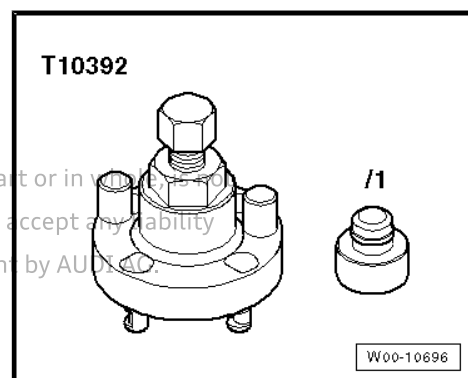
- ◆ Fitting tool - 10 - 203-



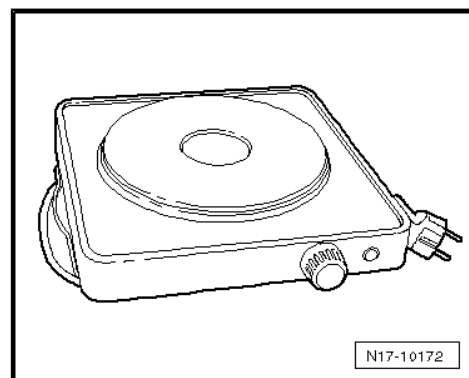
- ◆ Puller - T10392- with thrust piece -T10392/1-



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- ◆ Temperature gauge - VAS 6519-
- ◆ Hotplate (commercially available)



Procedure

- Remove sealing flange (pulley end) ⇒ [page 55](#) .
- Remove sump ⇒ [page 144](#) .



Note

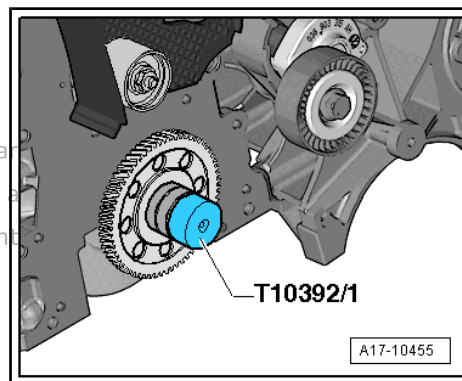
- ◆ *If the balance shaft assembly does not have to be renewed, it is sufficient just to remove the idler gear.*
- ◆ *If the bolt for the idler gear for the balance shaft assembly has been slackened or the spur gear on the crankshaft or the crankshaft itself have been renewed, you must install a new idler gear with the appropriate coating. Procedure for installation ⇒ “1.6 Installing a new balance shaft assembly”, [page 154](#) .*
- Remove idler gear ⇒ [Item 13 \(page 141\)](#) for balance shaft assembly or remove balance shaft assembly ⇒ [page 152](#) .



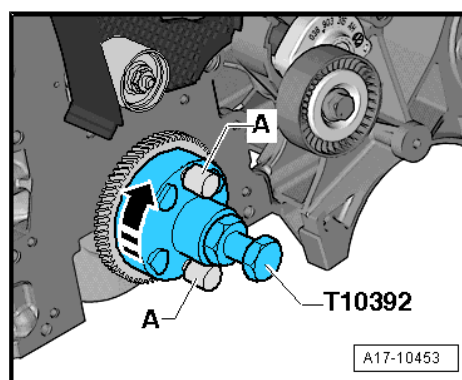
Pulling off spur gear

- 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-.



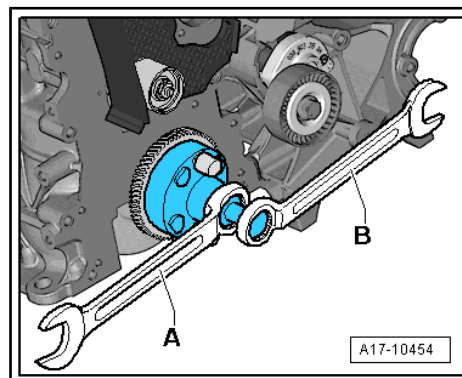
- Counterhold crankshaft with ring spanner -A- and pull spur gear off end of crankshaft by screwing in spindle with ring spanner -B-.

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.



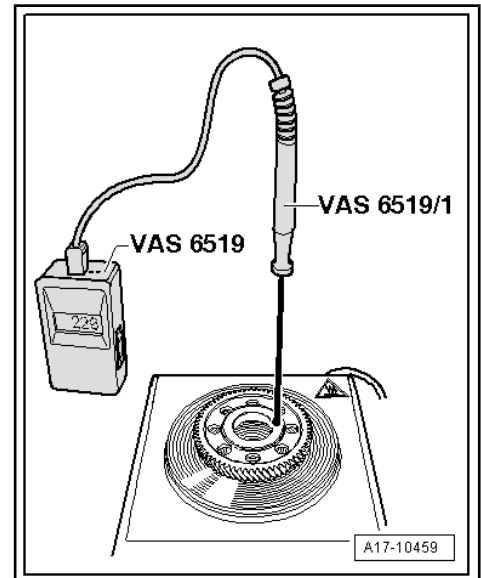
Caution

Risk of damage on account of excessive temperatures.

- ◆ The temperature must not rise above 240 °C, to prevent distortion or discolouration of the spur gear.



- 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.

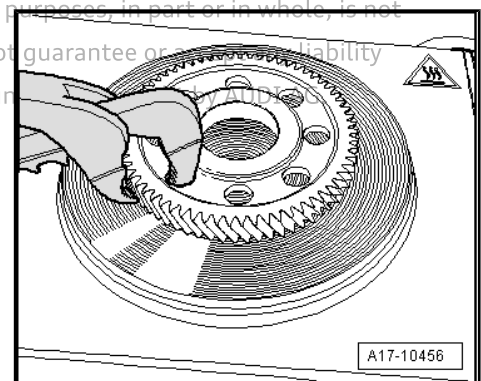
- ◆ *Use suitable protective gloves for the following steps.*

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



Note

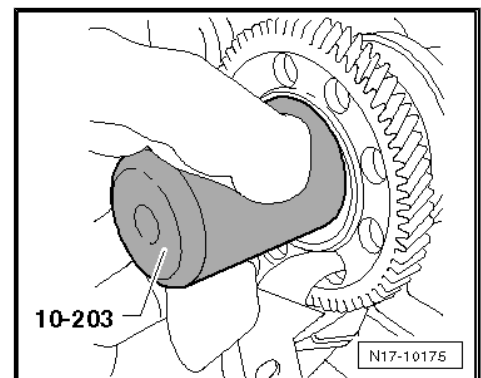
Take care not to damage the teeth of the spur gear.



- 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
⇒ [“1.6 Installing a new balance shaft assembly”, page 154](#) .

Or

- Install idler gear for balance shaft assembly
⇒ [“1.6 Installing a new balance shaft assembly”, page 154](#) .





4 Pistons and conrods

Overview

- ◆ ⇒ [“4.1 Exploded view - pistons and conrods”, page 78](#)
- ◆ ⇒ [“4.2 Measuring piston projection at TDC”, page 82](#)
- ◆ ⇒ [“4.3 Piston and cylinder dimensions”, page 83](#)
- ◆ ⇒ [“4.4 Measuring radial clearance of conrods”, page 83](#)

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Oil spray jet and pressure relief valve ⇒ [page 81](#)

4.1 Exploded view - pistons and conrods

1 - Bolt

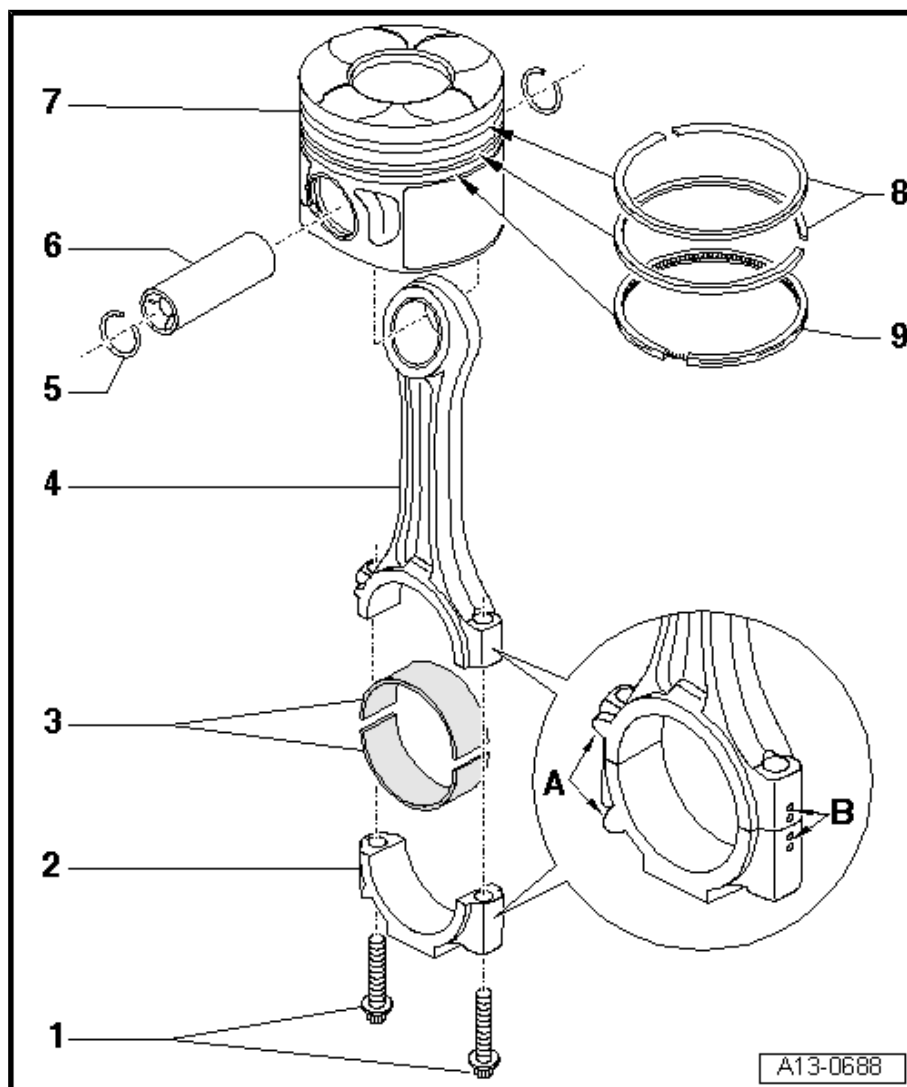
- ☐ Renew
- ☐ Lubricate threads and contact surface
- ☐ 30 Nm + 90°
- ☐ When measuring radial clearance, tighten used bolt to 30 Nm and turn 90° further

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 allocation in colour -B-
- ☐ Installation position: Markings -A- face 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. Distinguishing feature on new bearing shells: black marking on bearing surface near joint
- ☐ Check that it is securely seated
- ☐ Axial clearance: wear limit: 0.37 mm
- ☐ Measuring radial clearance ⇒ [page 83](#)





4 - Conrod

- ☐ Only renew as a complete set
- ☐ With industrially cracked conrod bearing cap
- ☐ Separating parts of new conrod ⇒ [page 81](#)
- ☐ Mark cylinder allocation in colour -B-
- ☐ Installation position: Markings -A- face towards pulley end

5 - Circlip

- ☐ Renew

6 - Piston pin

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

7 - Piston

- ☐ With combustion chamber
- ☐ Version fitted in vehicle may differ from illustration
- ☐ Mark installation position and cylinder number ⇒ [page 80](#)
- ☐ Checking ⇒ [page 80](#)
- ☐ Install using piston ring clamp
- ☐ Piston and cylinder dimensions ⇒ [page 83](#)
- ☐ Measuring cylinder bore ⇒ [page 80](#)
- ☐ Measuring piston projection at "TDC" ⇒ [page 82](#)

8 - Piston rings

- ☐ Compression rings
- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ Installation position: marking "TOP" or side with lettering faces towards piston crown
- ☐ Measuring ring gap ⇒ [page 79](#)
- ☐ Measuring ring-to-groove clearance ⇒ [page 80](#)

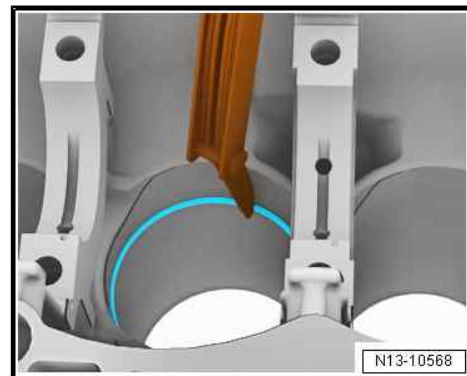
9 - Piston ring

- ☐ Oil scraper ring
- ☐ Offset gap 120° from bottom compression ring
- ☐ Use piston ring pliers to remove and install
- ☐ Measuring ring gap ⇒ [page 79](#)
- ☐ Measuring ring-to-groove clearance ⇒ [page 80](#)

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.

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

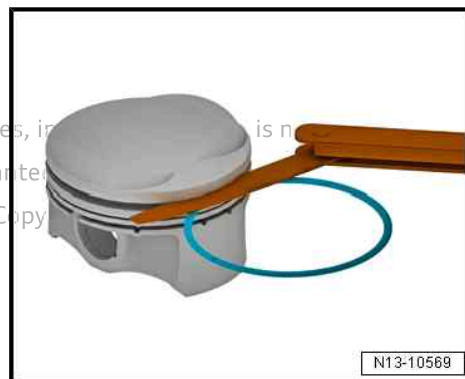




Measuring ring-to-groove clearance

- 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



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.

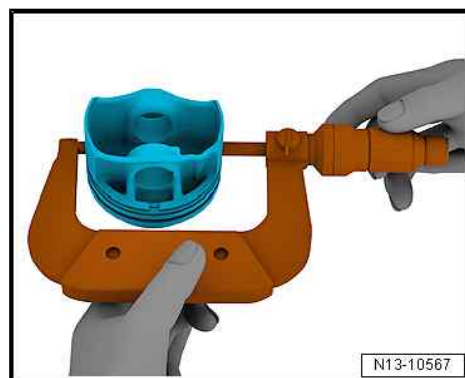
Nominal dimension

⇒ "4.3 Piston and cylinder dimensions", page 83 .



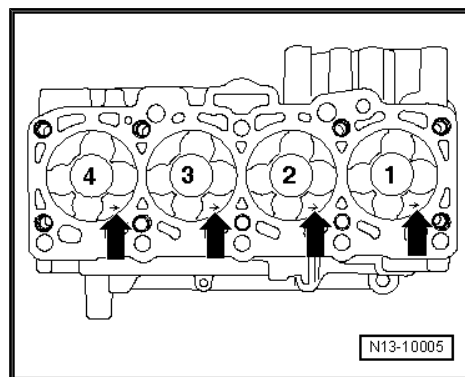
Note

Renew piston if cracking is visible on piston skirt.



Installation position of pistons and allocation of piston/cylinder

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

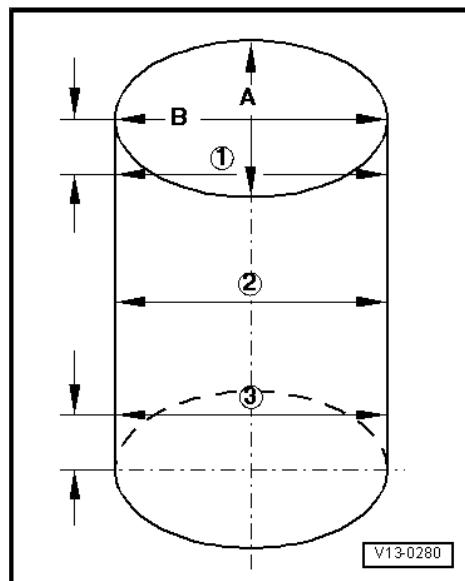


Measuring cylinder bore

- 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.

Nominal dimension

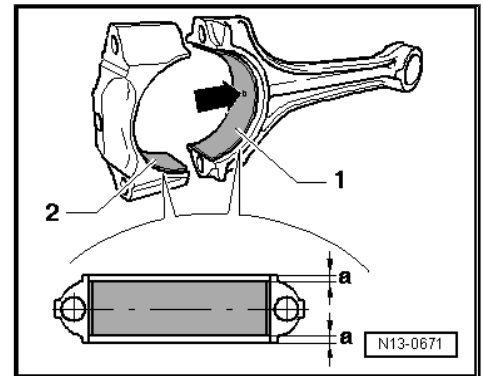
⇒ "4.3 Piston and cylinder dimensions", page 83 .





Installation position of bearing shells in conrods

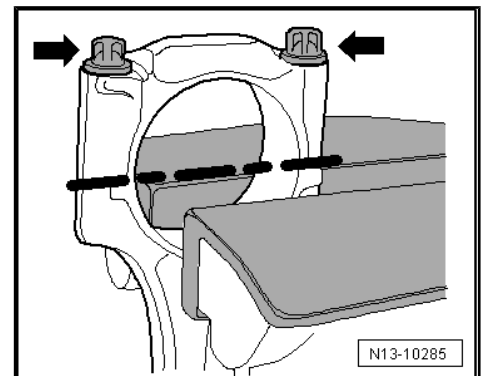
- 1 - Bearing shell with oil drilling -arrow- for conrod.
 - 2 - Bearing shell without oil drilling for conrod bearing cap.
- Insert bearing shells centrally in conrod/conrod bearing cap.
 - Distance -a- is the same on both sides.



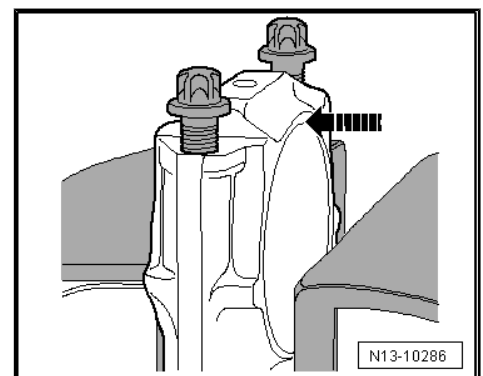
Separating parts of new conrod

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-.



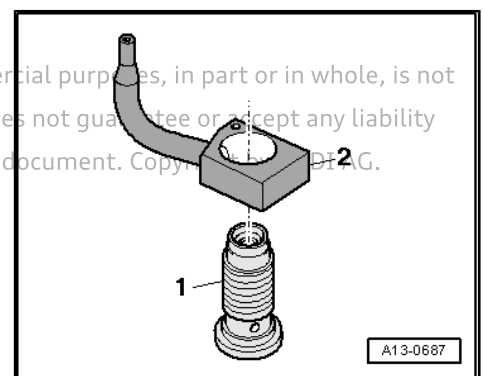
Oil spray jet and pressure relief valve

- 1 - Bolt with pressure relief valve, 27 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 Measuring piston projection at "TDC"



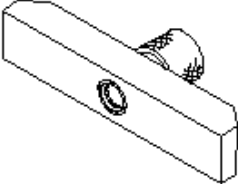
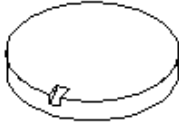
Note

- ◆ *Piston projection at "TDC" must be measured when installing new pistons or a short engine.*
- ◆ *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 upon piston projection, install the corresponding cylinder head gasket according to the table below.*

Special tools and workshop equipment required



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VW 382/7 	VW 385/17 
VAS 6079 	
	G13-0064

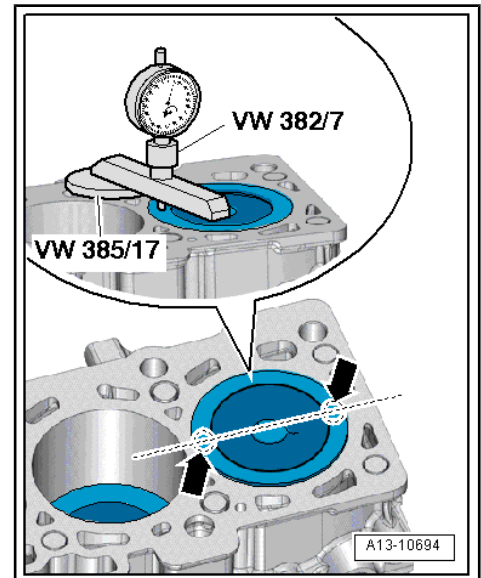
- ◆ Measuring bridge -VW 382/7- from measuring tool - VW 382-
- ◆ Measuring plate -VW 385/17- from universal measuring tool - VW 385-
- ◆ Dial gauge - VAS 6079-



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 piston projection at two points marked with -arrows- for each piston.

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



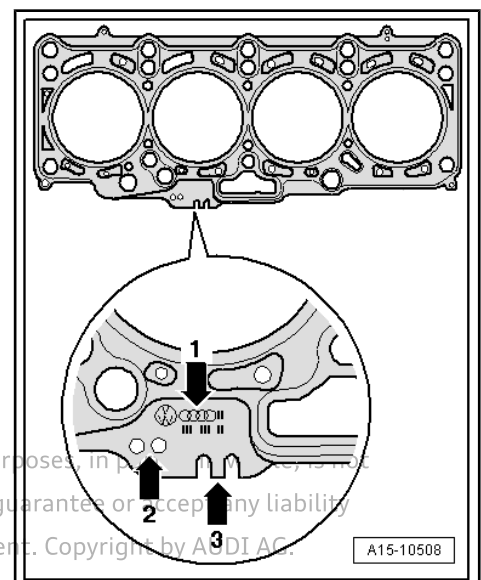
Identification of cylinder head gasket

- 1 - Part number
- 2 - Holes
- 3 - Ignore



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.



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4.3 Piston and cylinder dimensions

Honing dimension	Piston Ø mm	Cylinder bore Ø mm
Basic dimension	80.96 ¹⁾	81.01
• ¹⁾ Dimensions including coating (thickness 0.02 mm). The coating will wear down in service.		

4.4 Measuring radial clearance of conrods

Special tools and workshop equipment required

- ◆ Plastigauge

Procedure

- Remove conrod bearing cap. Clean bearing cap and bearing journal.
- Place a length of Plastigauge corresponding to the width of the bearing on the bearing journal or in the bearing shell.



- Fit conrod bearing cap and secure with old bolts
⇒ [Item 1 \(page 78\)](#) without rotating crankshaft.
- Remove conrod bearing cap again.
- Compare width of Plastigauge with measurement scale.

Radial clearance:

- Wear limit: 0.08 mm.
- Renew conrod bolts.



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15 – Cylinder head, valve gear

1 Toothed belt drive

Overview

- ◆ ⇒ [“1.1 Exploded view - toothed belt”, page 85](#)
- ◆ ⇒ [“1.2 Removing and installing toothed belt”, page 87](#)

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 87](#)
- ☐ Installing (adjusting valve timing)
⇒ [page 91](#)

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

7 - Stud

- ☐ 15 Nm

8 - Bolt

- ☐ 20 Nm

9 - Idler roller

10 - Bolt

- ☐ Renew
- ☐ 20 Nm +45°

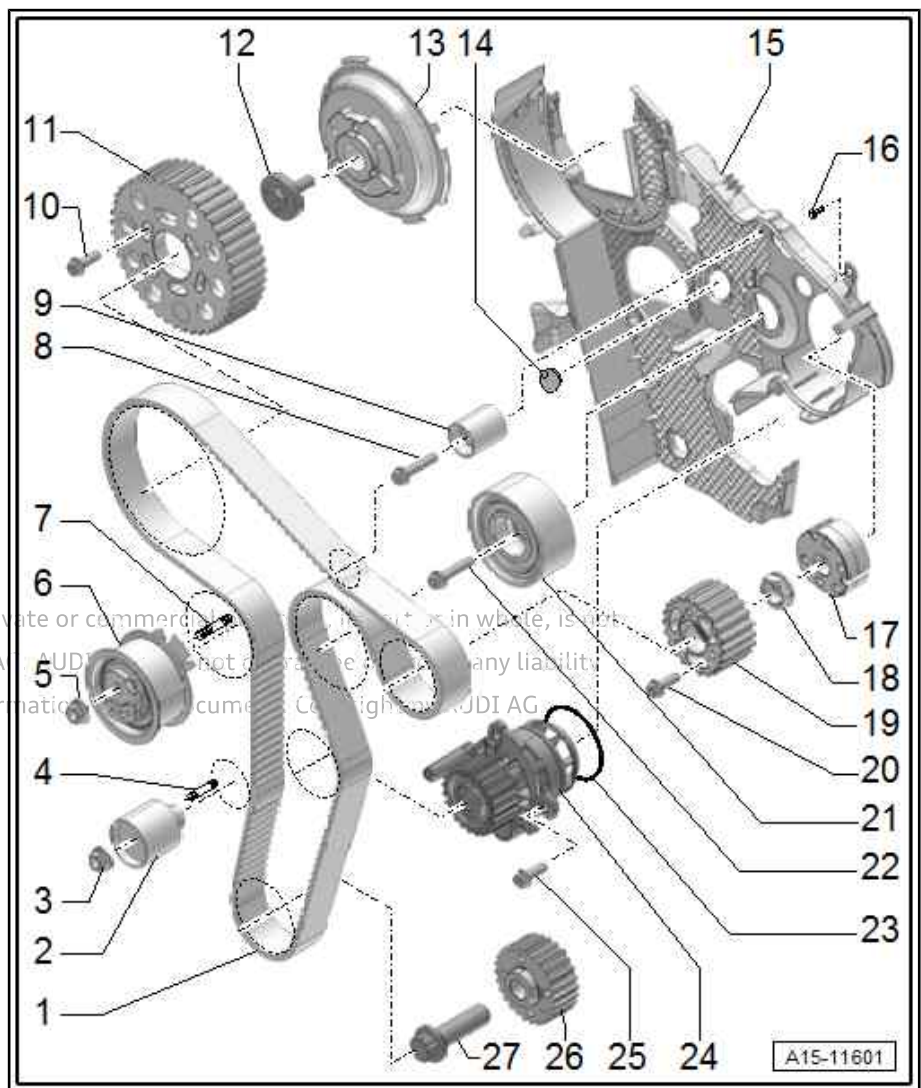
11 - Camshaft sprocket

12 - Bolt

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

13 - Camshaft hub

- ☐ Removing and installing ⇒ [“3.5 Removing and installing camshafts”, page 123](#)





14 - Plug

15 - Cover (rear) for toothed belt

16 - Bolt

- ☐ 9 Nm

17 - High-pressure pump hub

- ☐ Removing and installing ⇒ Rep. gr. 23

18 - Nut

- ☐ Tightening torque ⇒ Rep. gr. 23

19 - High-pressure pump sprocket

20 - Bolt

- ☐ Tightening torque ⇒ Rep. gr. 23

21 - Idler roller

22 - Bolt

- ☐ Renew
- ☐ 50 Nm + 90°

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23 - O-ring

- ☐ Renew

24 - Coolant pump

- ☐ Removing and installing ⇒ [page 179](#)

25 - Bolt

- ☐ Tightening torque ⇒ [Item 1 \(page 179\)](#)

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

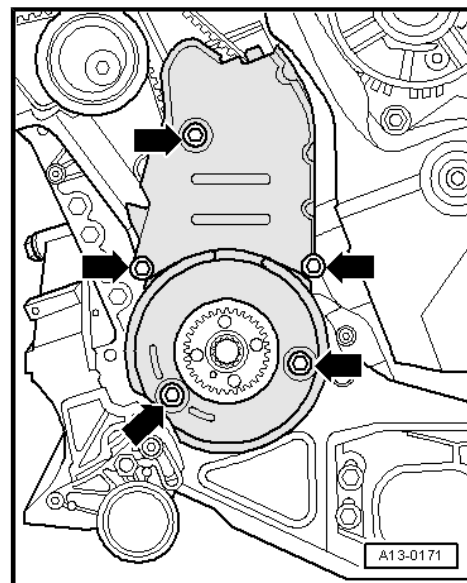
Tighten in three stages as follows:

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



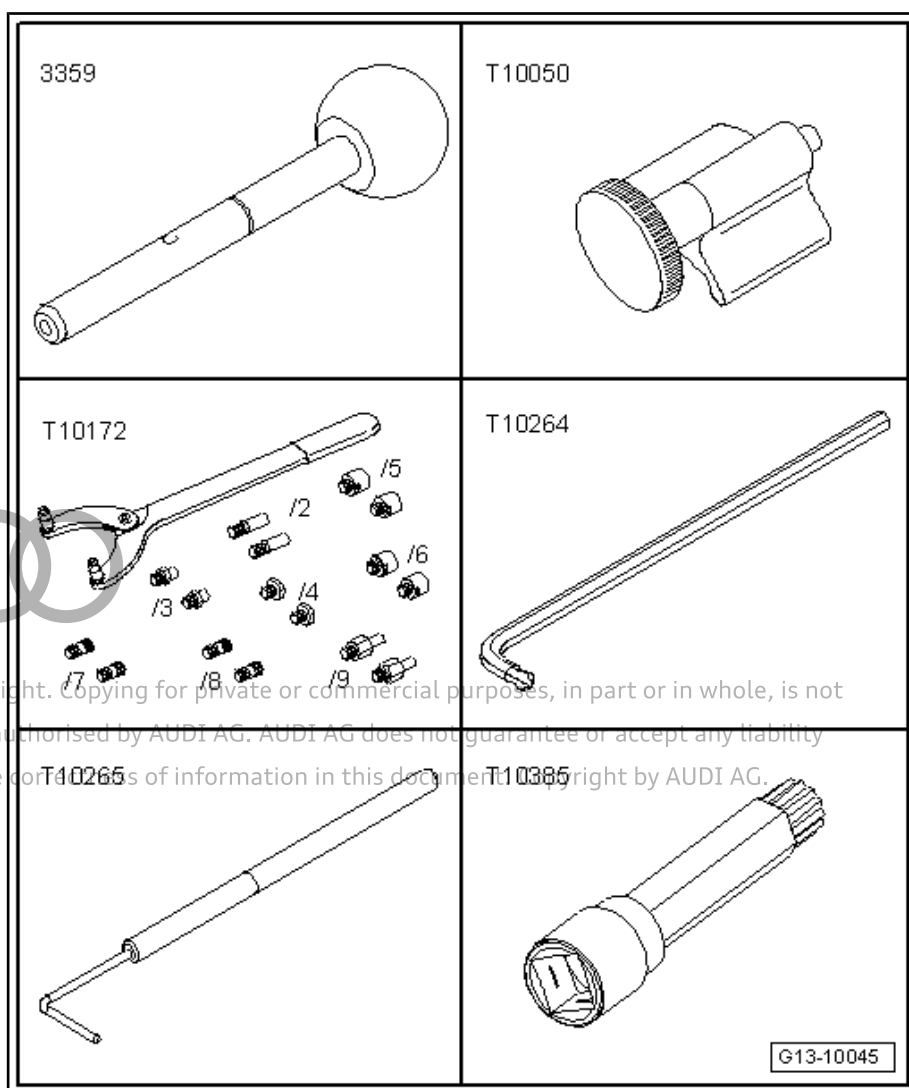
Cover for toothed belt (bottom and centre) - tightening torque

- Tighten bolts -arrows- to 9 Nm.



1.2 Removing and installing toothed belt

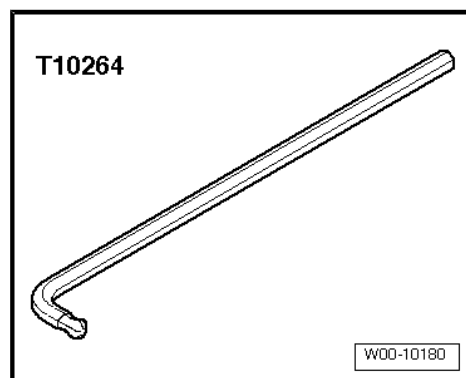
Special tools and workshop equipment required



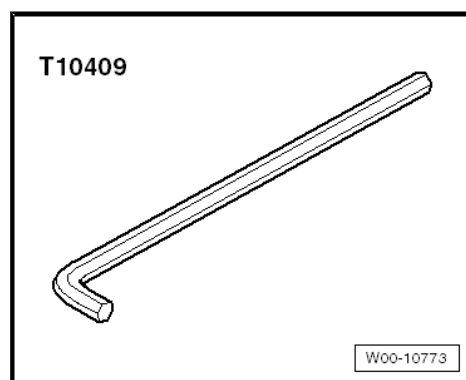
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- ◆ 2x diesel injection pump locking pin - 3359- or commercially available M6x50 bolt
- ◆ Crankshaft stop - T10050-
- ◆ Counterhold tool - T10172- with pins -T10172/4-
- ◆ Offset screwdriver - T10264-
- ◆ Locking tool - T10265-
- ◆ Bit XZN 10 - T10385- or bit M10
- ◆ Offset screwdriver - T10264- for tensioning roller A



- ◆ Offset screwdriver, 8 mm - T10409- for tensioning roller B



Differences between tensioning roller versions



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Two different tensioning roller versions are installed. It is possible to switch between them. When making adjustments, first check which tensioning roller version is installed.



Note different directions of rotation when tensioning

Features of tensioning roller A:

- ◆ Locking tool - T10265- is required for installation
- ◆ Make sure tensioning roller is positioned correctly in toothed belt cover
- ◆ Toothed belt is tensioned by turning eccentric adjuster on tensioning roller clockwise

Features of tensioning roller B:

- ◆ No locking tool required
- ◆ Tensioning roller is not located in toothed belt cover
- ◆ Toothed belt is tensioned by turning eccentric adjuster on tensioning roller anti-clockwise

Removing



Note

Perform adjustments on toothed belt only when engine is cold; position of tensioner varies according to temperature of engine.

- Remove engine cover panel -arrows-.

The following step is only required on vehicles with adaptive cruise control (ACC)

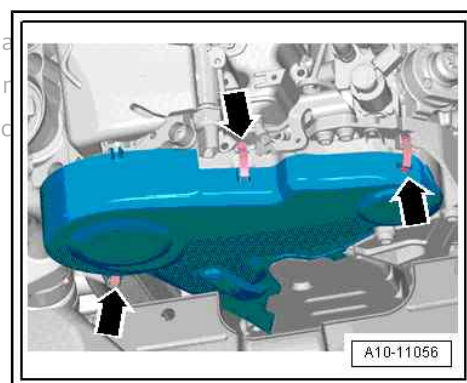
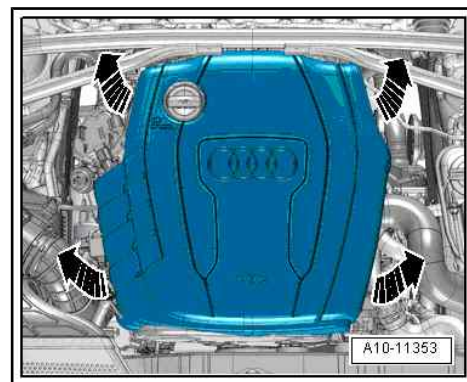
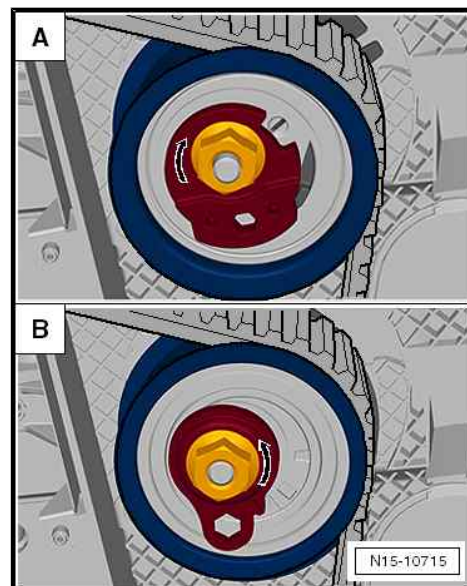
- Remove radiator cowl ⇒ [page 198](#) .

The following step is only required on vehicles without adaptive cruise control (ACC)

- Move lock carrier into service position ⇒ General body repairs, exterior; Rep. gr. 50 ; Body - front; Lock carrier service position .

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

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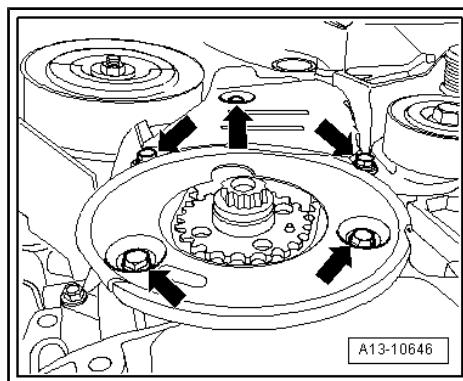
- Remove bolts -arrows- and detach toothed belt cover (bottom and centre).



Caution

Irreparable damage can be caused if the toothed belt slips.

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

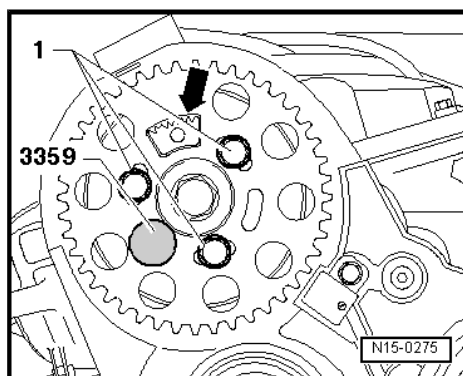


- Rotate crankshaft by turning bolt on crankshaft sprocket until camshaft sprocket is positioned at "TDC".
- The toothed segment -arrow- must face upwards.
- Lock camshaft hub with diesel injection pump locking pin - 3359- or an M6x50 bolt (commercially available).



Note

- ◆ *If it is not possible to push the diesel injection pump locking pin - 3359- in (lack of space), use an M6x50 bolt (commercially available).*
- ◆ *Disregard -item 1-.*

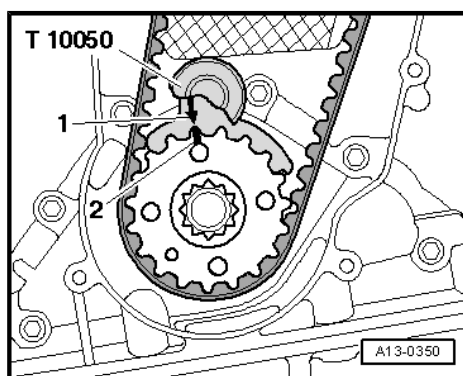


- Lock crankshaft sprocket in position with crankshaft stop - T10050- .
- The markings on the sprocket -2- and the crankshaft stop -1- must align -arrow-. The pin of the crankshaft stop must engage in the aperture in the sealing flange.

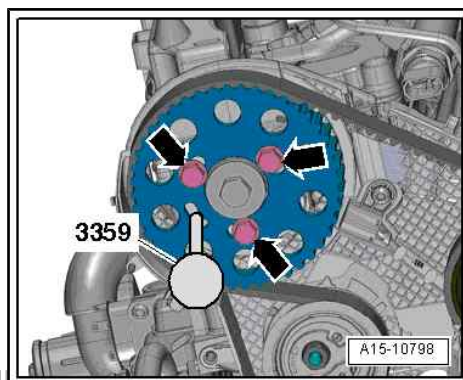


Note

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



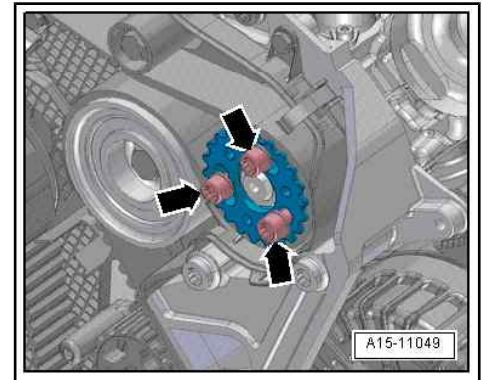
- Slacken bolts -arrows- for camshaft sprocket approx. 90°.



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- Using an M10 bit , loosen bolts -arrows- for toothed belt sprocket on high-pressure pump by approx. 90°.

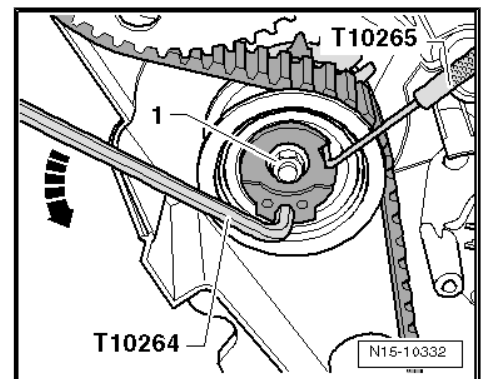


- Slacken nut -1- for tensioning roller.
- Turn eccentric adjuster of tensioning roller with offset screwdriver - T10264- anti-clockwise -arrow- until tensioning roller can be secured with locking tool - T10265- .

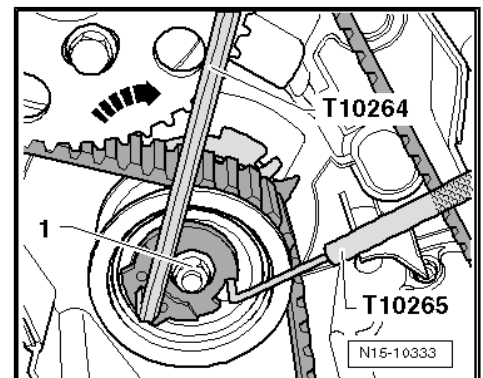


Note

- ◆ *Different tensioning roller versions: Not all tensioning rollers can be locked with the locking tool - T10265- .*
- ◆ *Tensioning rollers which cannot be locked must be loosened with the offset screwdriver - T10264- without being locked.*



- 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 85](#)



Caution

Risk of damage to valves and piston crowns.

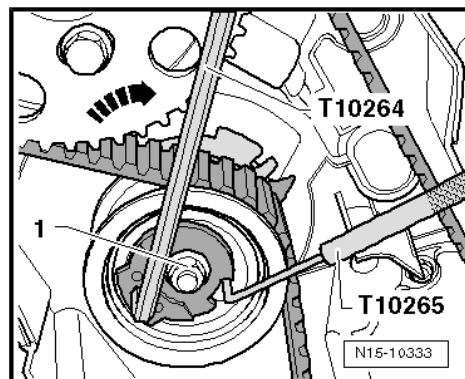
- ◆ *The crankshaft must not be at "TDC" at any cylinder when the camshaft is turned.*

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Requirements:

- Different tensioning roller versions: Not all tensioning rollers can be locked with the locking tool - T10265- .
- Tensioning roller is locked with locking tool - T10265- and secured at right stop with nut -1-.

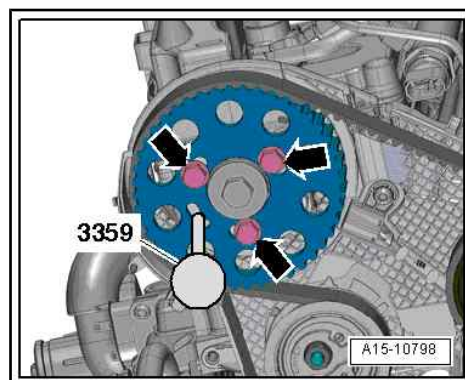


- Lock camshaft hub with diesel injection pump locking pin - 3359- or an M6x50 bolt.
- Bolts -arrows- are fitted but not tightened.
- It should just be possible to turn the sprocket on the camshaft without axial movement.

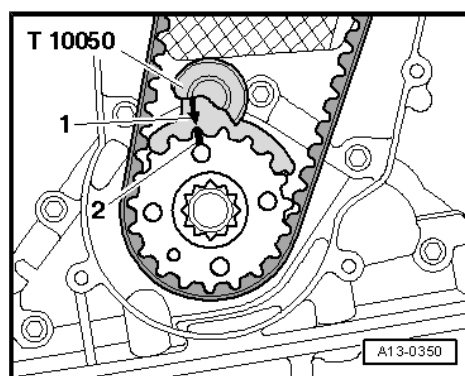


Note

- ♦ If it is not possible to push the diesel injection pump locking pin - 3359- in (lack of space), use an M6x50 bolt (commercially available).
- ♦ Disregard -arrows-.

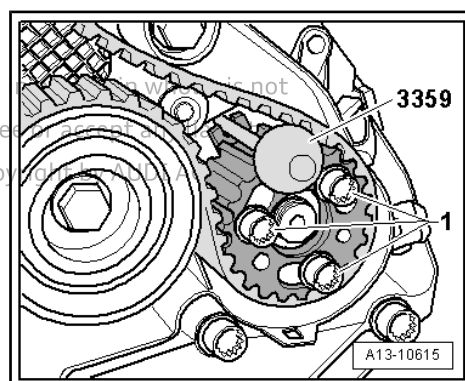


- Crankshaft is locked in position with crankshaft stop - T10050- .



- 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

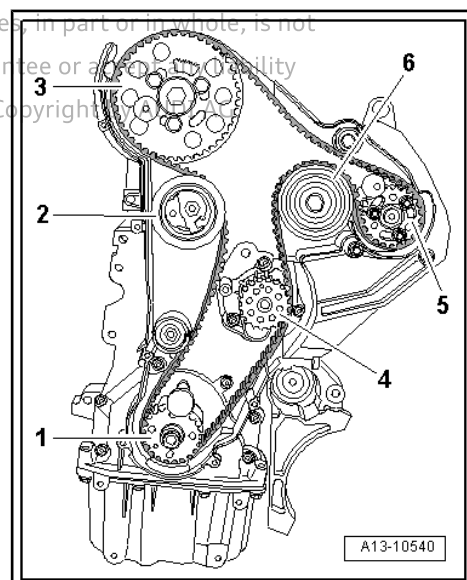
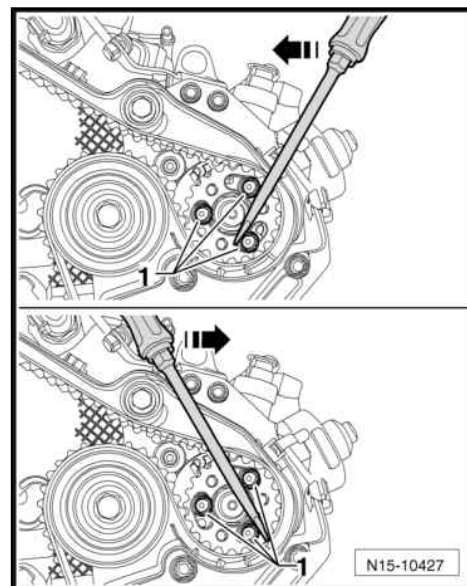
If necessary, apply a screwdriver -arrows- to bolt heads -1- and turn the high-pressure pump hub until it can be locked with the locking pin.



- 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

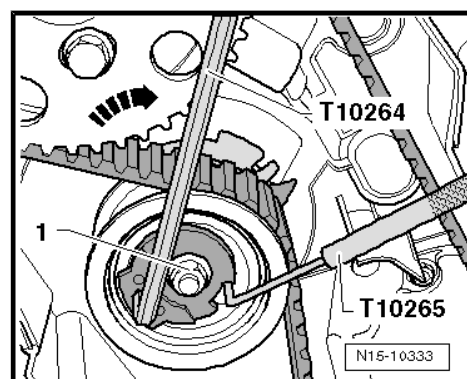


- Loosen nut -1- for tensioning roller and detach locking tool - T10265- .



Note

- ◆ *This applies if locking tool - T10265- is attached.*
- ◆ *Disregard -arrow-.*



**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.

Tightening torque

- ◆ 20 Nm

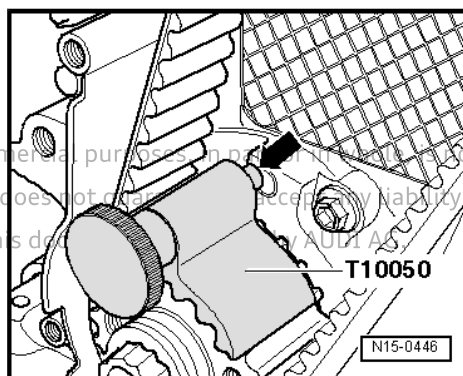
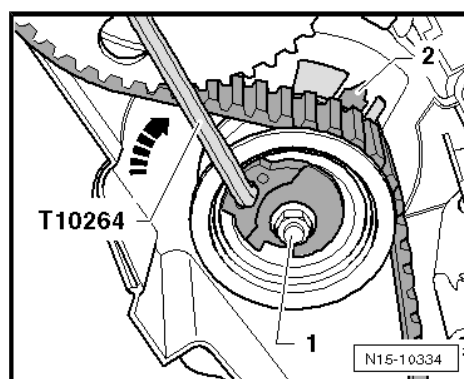
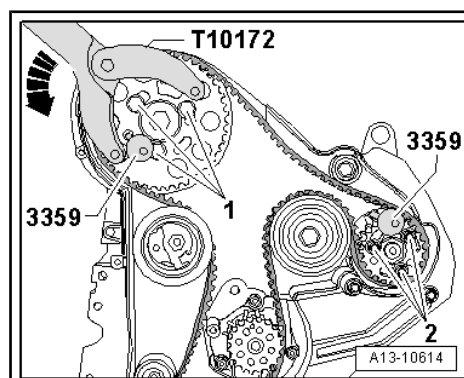
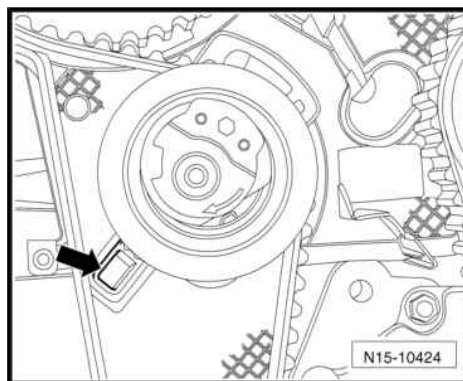
- Carefully turn eccentric adjuster of tensioning roller clockwise -arrow- using offset screwdriver - T10264- until pointer -2- aligns with centre of slot on base plate.
- Nut -1- must not turn.
- Hold tensioning roller in this position and tighten nut.
- Remove diesel injection pump locking pin - 3359- or M6x50 bolt 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.



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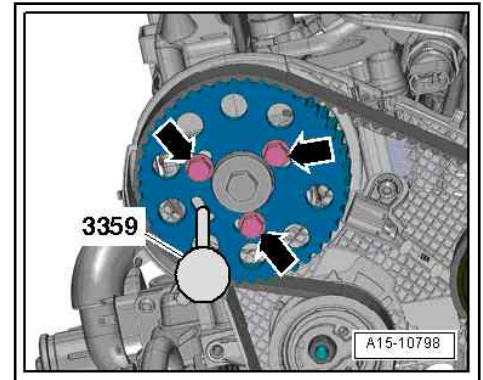


- Lock camshaft hub with diesel injection pump locking pin - 3359- or an M6x50 bolt.

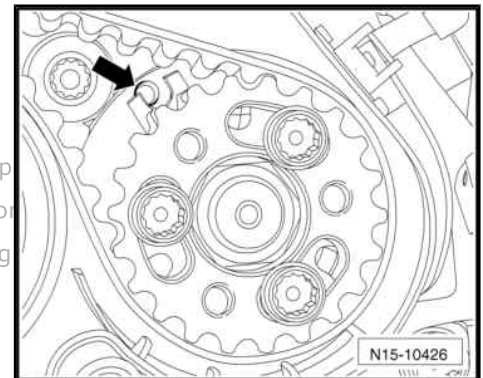


Note

Disregard -arrows-.



- 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.



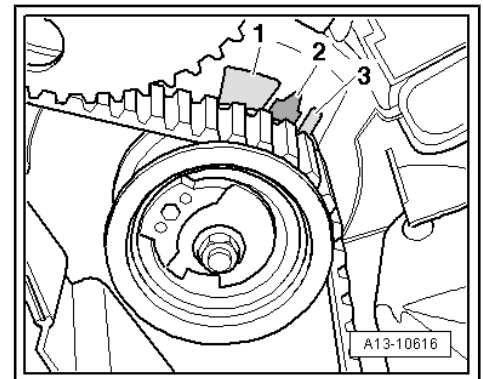
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- Pointer -2- on tensioner roller must be centred between tabs -1- and -3- on base plate.



Note

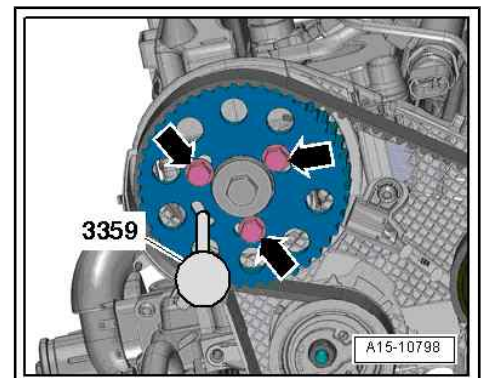
The maximum permissible sideways deviation from the specified position is 5 mm.



- ◆ Re-adjust valve timing if requirements are not met
⇒ [page 95](#) .
- ◆ If requirements are met, continue with procedure after adjusting valve timing correctly as described below ⇒ [page 96](#) .

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".
- Now turn crankshaft slowly in direction of engine rotation until it is possible to lock camshaft hub with diesel injection pump locking pin - 3359- or M6x50 bolt.
- Loosen bolts for camshaft sprocket after locking hub.



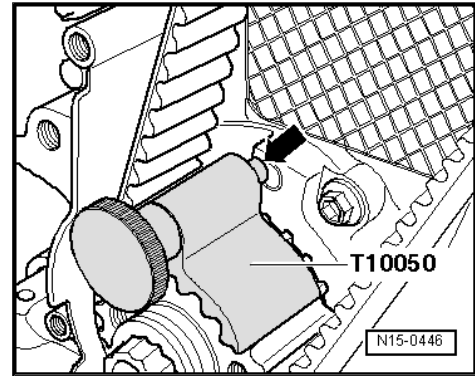


A - If pin of crankshaft stop - T10050- is on left side of bore:

- Turn crankshaft in direction of engine rotation until pin of 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:

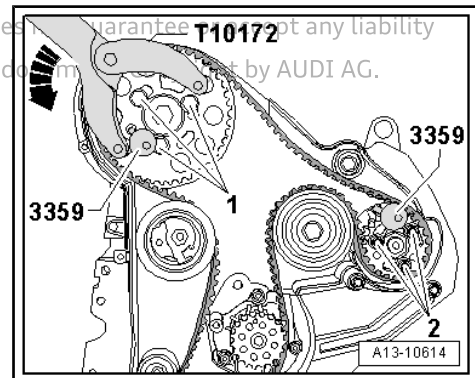
- Remove diesel injection pump locking pin - 3359- or M6x50 bolt and crankshaft stop - T10050-.
- Turn crankshaft two rotations in direction of engine rotation by turning bolt for crankshaft sprocket until crankshaft is just before "TDC".
- Check valve timing once again ⇒ [page 94](#) .
- If camshaft hub can now be locked, tighten camshaft sprocket bolts -1- to final torque ⇒ [Item 10 \(page 85\)](#) .
- Tighten bolts -2- for high-pressure pump sprocket to final torque ⇒ Rep. gr. 23 .
- Check valve timing once again ⇒ [page 94](#) .

The following step is only required on vehicles with adaptive cruise control (ACC)

- Install radiator cowl ⇒ [page 198](#) .

The following step is only required on vehicles without adaptive cruise control (ACC)

- Reset service position ⇒ General body repairs, exterior; Rep. gr. 50 ; Body - front; Lock carrier service position .
- Install engine cover panel.





2 Cylinder head

Overview

- ◆ ⇒ [“2.1 Exploded view - cylinder head cover”, page 97](#)
- ◆ ⇒ [“2.2 Removing and installing cylinder head cover”, page 98](#)
- ◆ ⇒ [“2.3 Exploded view - cylinder head”, page 99](#)
- ◆ ⇒ [“2.4 Removing and installing cylinder head”, page 101](#)
- ◆ ⇒ [“2.5 Checking compression”, page 115](#)

2.1 Exploded view - cylinder head cover

1 - Fuel rail

- ☐ With injector pipes
- ☐ Do not attempt to bend injector pipes to a different shape

2 - Bolt

- ☐ 22 Nm

3 - Injector (piezo injectors)

- ☐ Removing and installing
⇒ Rep. gr. 23

4 - Bolt

- ☐ Tightening torque ⇒
Rep. gr. 23

5 - Retaining clip

6 - Cylinder head cover

- ☐ Removing and installing
⇒ [page 98](#)

7 - Bolt

- ☐ 10 Nm

8 - Fuel lines

9 - Gasket

- ☐ Renew if damaged or
leaking

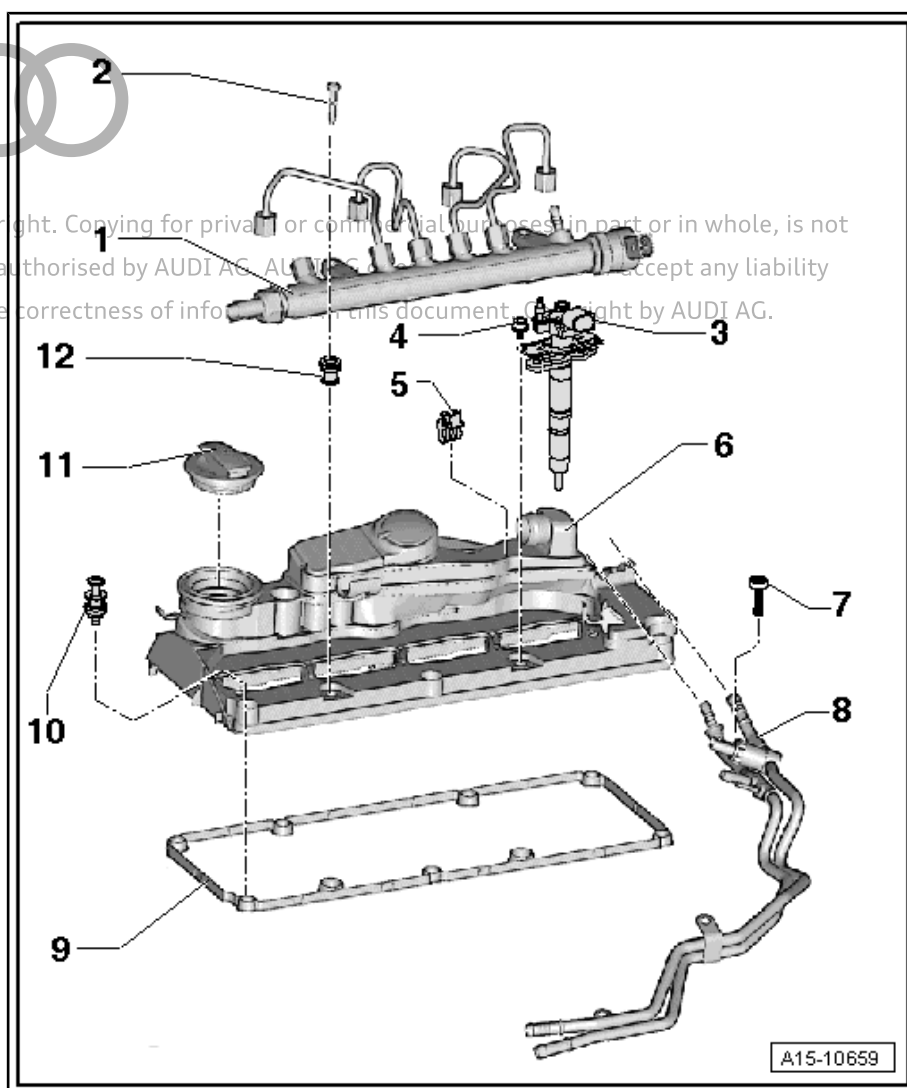
10 - Bolt

- ☐ Tightening torque and
sequence ⇒ [page 98](#)

11 - Filler cap

12 - Bush

- ☐ For securing fuel rail
- ☐ Renew if damaged





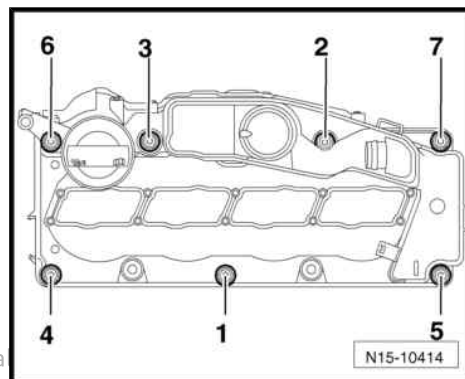
Cylinder head cover - tightening torque and sequence

- Tighten bolts for cylinder head cover in the sequence -1 ... 7- to 9 Nm.



Note

Take care to keep cylinder head cover straight.



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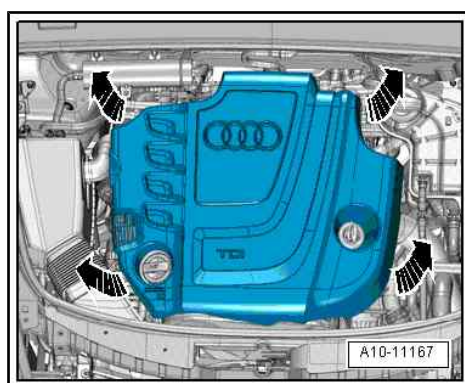
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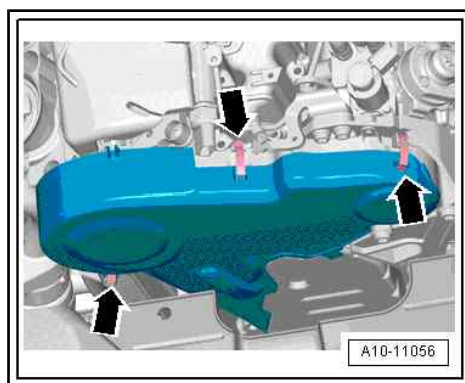
2.2 Removing and installing cylinder head cover

Removing

- Remove engine cover panel -arrows-.
- Take out noise insulation at injectors.
- Remove injectors and fuel rail ⇒ Rep. gr. 23 .



- Open clips -arrows- and remove toothed belt cover.

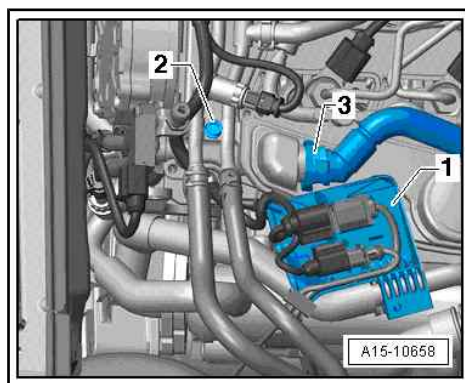


- Detach bracket -1- with wiring for Lambda probe - G39- and exhaust gas temperature sender 3 - G495- from cylinder head cover.
- Press release tabs, disconnect crankcase breather hose -3- and move clear.



Note

Disregard -item 2-.



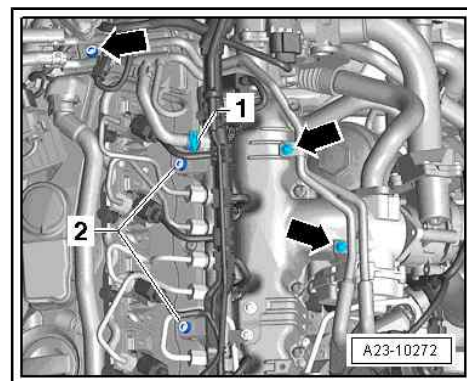


- Remove bolts -arrows- for fuel lines.



Note

Disregard items -1 and 2-.



- Slacken cylinder head cover bolts in the sequence -7 ... 1-.
- Remove bolts and take off cylinder head cover.

Installing

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

Tightening torque

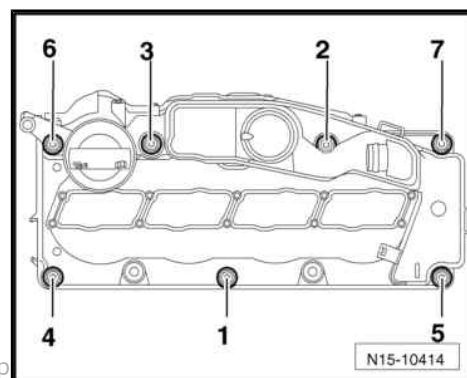
- ♦ ⇒ [“2.1 Exploded view - cylinder head cover”, page 97](#)



Note

- ♦ *Renew gasket for cylinder head cover if damaged.*
- ♦ *Renew bolts for cylinder head cover if seals on bolts are damaged.*

- Tighten cylinder head cover bolts ⇒ [page 98](#) .
- Install fuel rail and injectors ⇒ Rep. gr. 23 .



2.3 Exploded view - cylinder head



1 - Cylinder head

- ☐ Removing and installing
⇒ [page 101](#)
- ☐ Checking for distortion
⇒ [page 101](#)
- ☐ Must not be machined
- ☐ If renewed, change
coolant and engine oil

2 - Washer

- ☐ For cylinder head bolt

3 - Bolt

- ☐ Correct sequence when
slackening ⇒ [page 111](#)
- ☐ Tightening torque and
sequence ⇒ [page 101](#)
- ☐ Prior to installation, in-
sert washer in cylinder
head
⇒ [Item 2 \(page 100\)](#)

4 - Bolt

- ☐ 20 Nm

5 - Lifting eye

6 - Gasket

- ☐ Renew

7 - Vacuum pump

8 - Bolt

- ☐ Tightening torque ⇒
Rep. gr. 47

9 - Coolant hose connection

10 - Bolts

- ☐ Tightening torque ⇒ [Item 10 \(page 184\)](#)

11 - Gasket

- ☐ Renew

12 - Bolt

- ☐ 20 Nm

13 - Lifting eye

14 - Cylinder head gasket

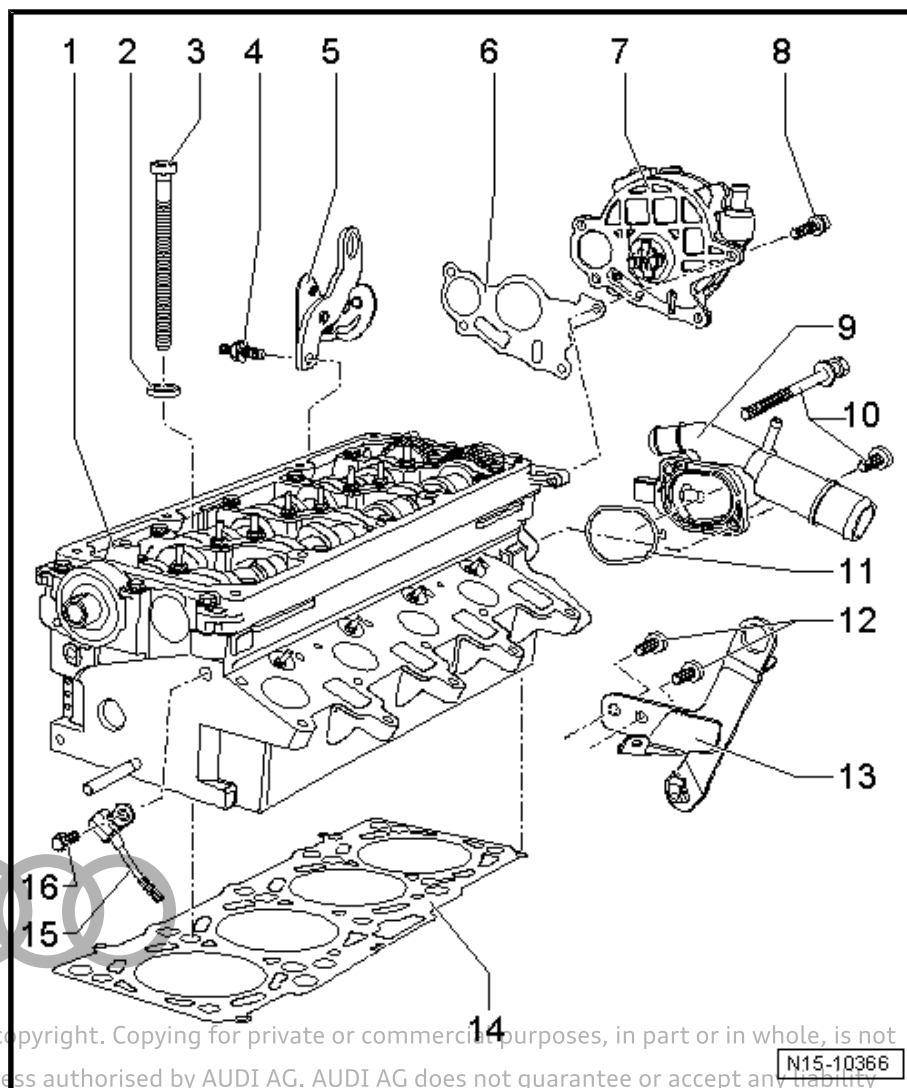
- ☐ Renew
- ☐ Note marking ⇒ [page 101](#)
- ☐ If renewed, change coolant in entire system

15 - Hall sender - G40-

- ☐ For camshaft position
- ☐ To remove and install, detach toothed belt from camshaft sprockets and loosen idler roller.

16 - Bolt

- ☐ 10 Nm





Cylinder head - tightening torque and sequence

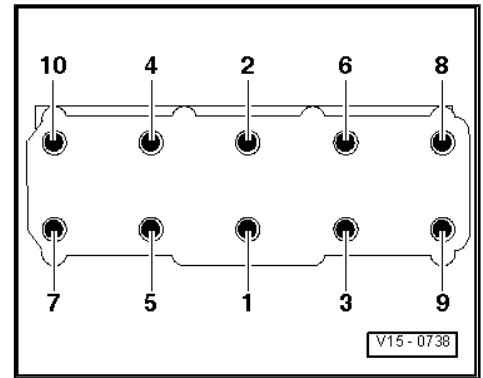


Note

Renew bolts tightened with specified tightening angle.

– 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



Note

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

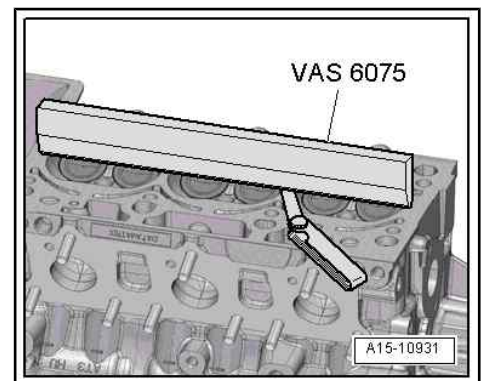
Checking cylinder head for distortion

- 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.



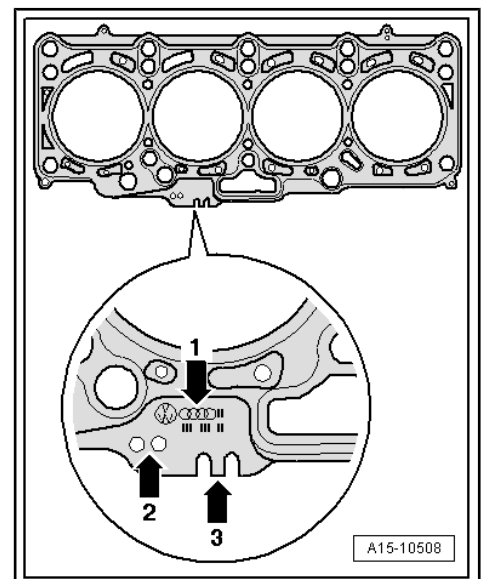
Cylinder head gasket identification

- 1 - Part number
- 2 - Holes
- 3 - Ignore



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.
- ♦ Cylinder head gaskets of different thicknesses are fitted depending on piston projection. When replacing the cylinder head gasket, install a new gasket with the same identification -arrow 2-.

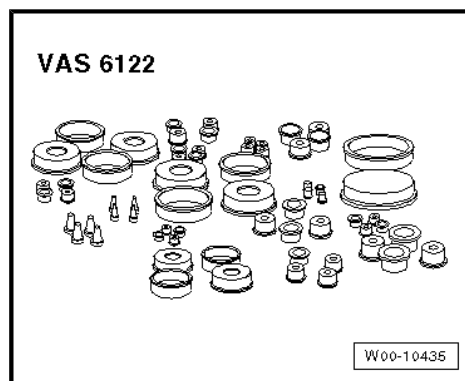


2.4 Removing and installing cylinder head

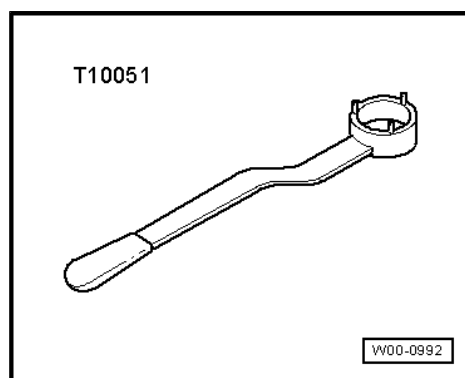
Special tools and workshop equipment required



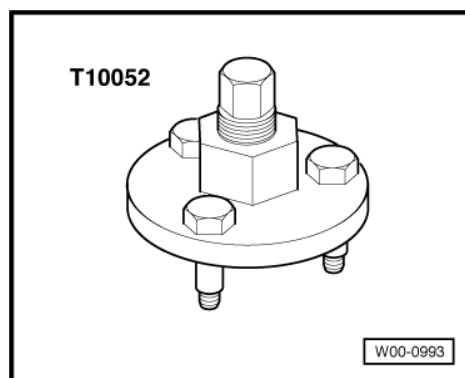
◆ Engine bung set - VAS 6122-



◆ Counterhold tool - T10051-



◆ Puller - T10052-



Removing



Caution

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

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

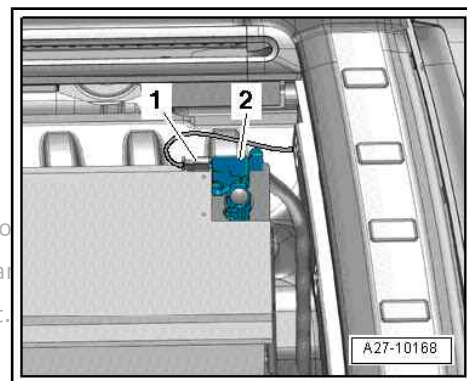
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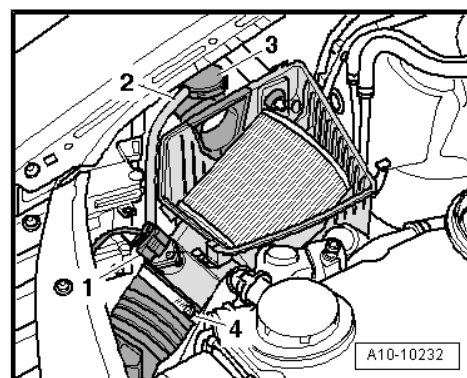
- Disconnect earth cable from battery terminal ⇒ Electrical system; Rep. gr. 27 .



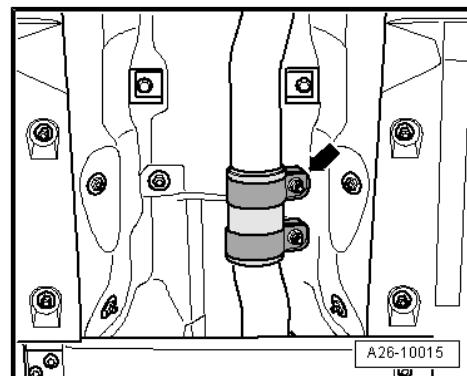
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- Remove air cleaner housing ⇒ Rep. gr. 23 .
- Drain coolant ⇒ [page 171](#) .



- Loosen bolt connections and push clamp -arrow- towards rear to disconnect exhaust system.



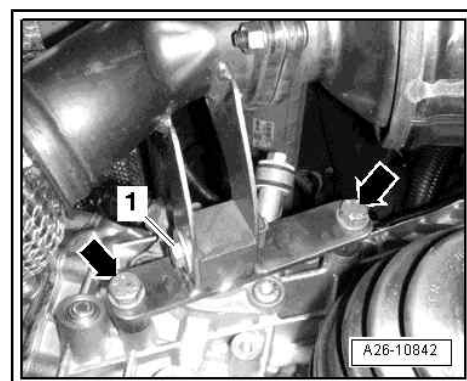
Vehicles with manual gearbox:

- Remove bolts -arrows-.



Note

Disregard -item 1-.





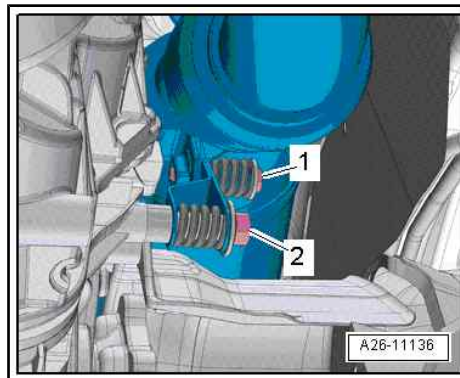
Vehicles with multitronic gearbox:

- Remove bolt -2- at bracket for particulate filter.



Note

Disregard -item 1-.

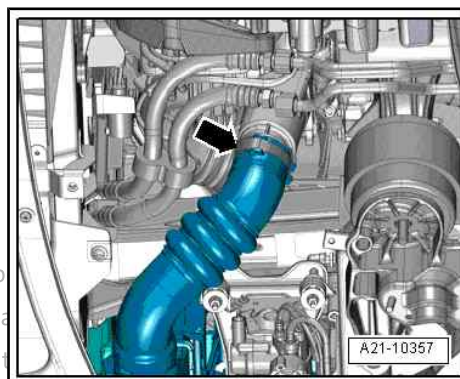


All vehicles (continued):

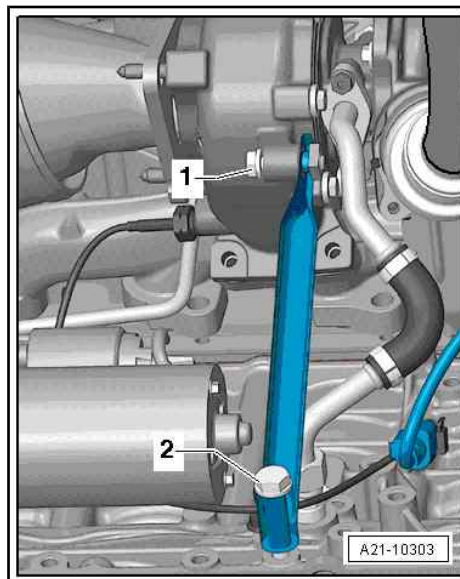
- Release hose clip -arrow- and detach air hose from turbocharger.



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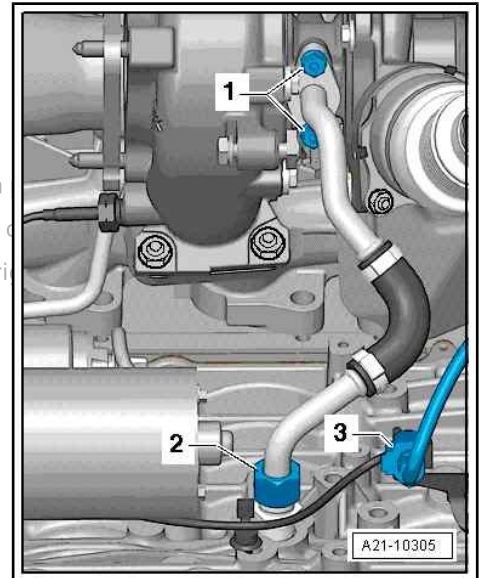
- Unscrew bolts -1- and -2- and remove support for turbocharger.



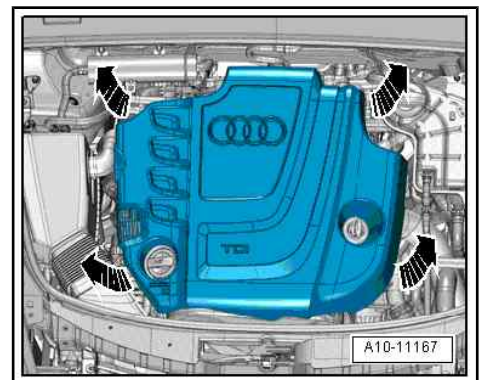


- Unscrew bolts -1- and union nut -2- and remove oil return line.
- Unplug electrical connector -3- for exhaust gas temperature sender 1 - G235- and move clear.

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- Remove engine cover panel -arrows-.

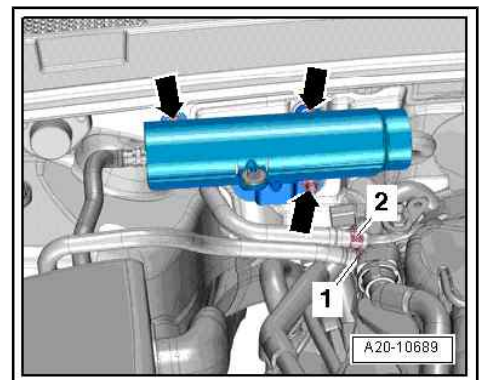


Caution

Protect fuel system against contamination.

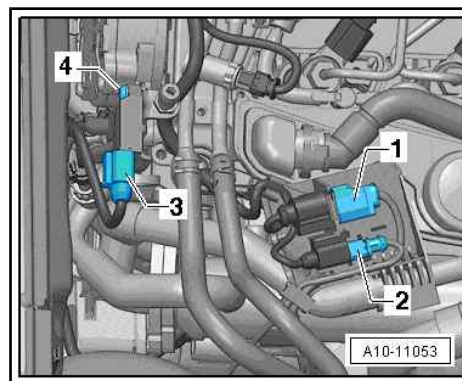
- ◆ **Rules for cleanliness when working on the injection system ⇒ page 5 .**

- Release hose clips and detach return hose -1- and supply hose -2- from fuel filter.
- Unscrew nuts -arrows- and move bracket with fuel filter to one side.
- Seal off open pipes/lines and connections with clean plugs from engine bung set - VAS 6122- .





- Unplug electrical connector -1- for Lambda probe - G39- and electrical connector -2- for exhaust gas temperature sender 3 - G495- and move electrical wiring clear.
- Unplug electrical connector -3-, remove bolt -4- and move exhaust gas pressure sensor 1 - G450- clear.

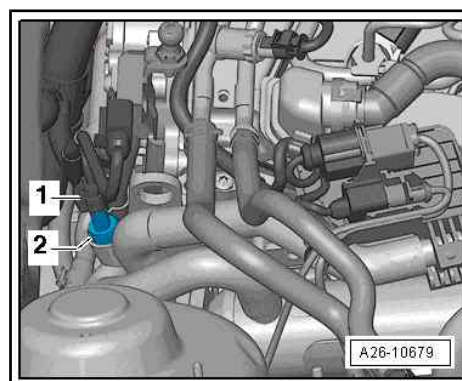


- Unplug electrical connector -1- at radiator outlet coolant temperature sender - G83- .



Note

Disregard -item 2-.

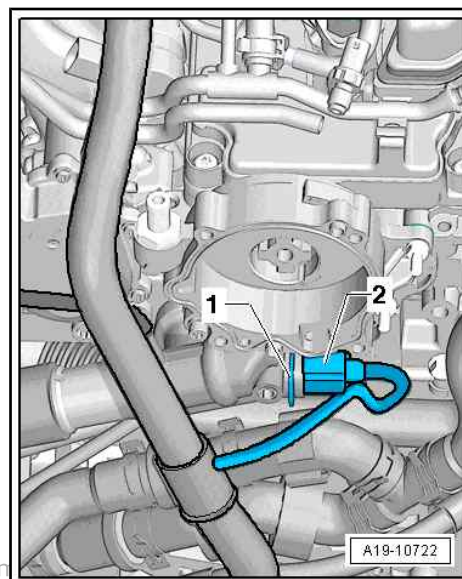


- Unplug electrical connector -2- at coolant temperature sender - G62- .



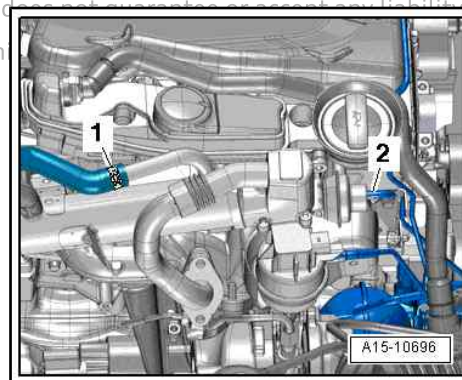
Note

Disregard -item 1-.



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- Release hose clip -1- and detach coolant hose.
- Disconnect vacuum hose -2-.



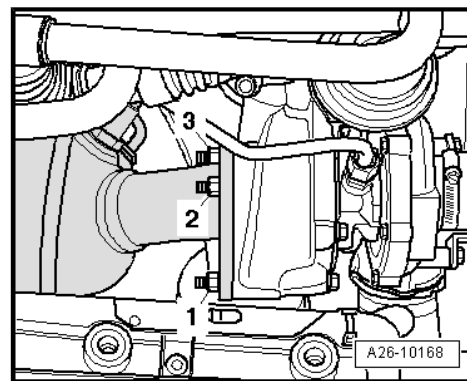


- Remove nuts -1, 2, 3- at turbocharger and press particulate filter off turbocharger.



Note

Nut -1- is accessible from below on vehicles with auxiliary heater.

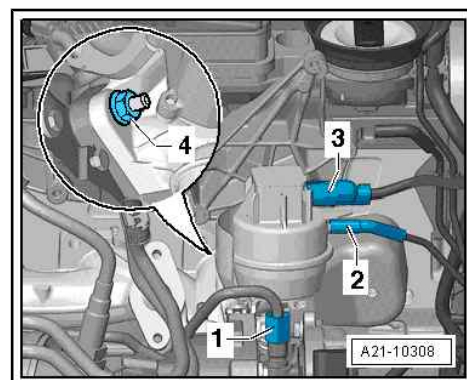


- Remove union nut -1-.
- Disconnect vacuum hose -2-.
- Unplug electrical connector -3- at position sender for charge pressure positioner - G581- .

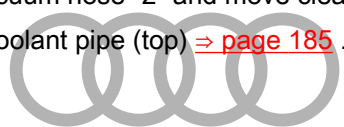


Note

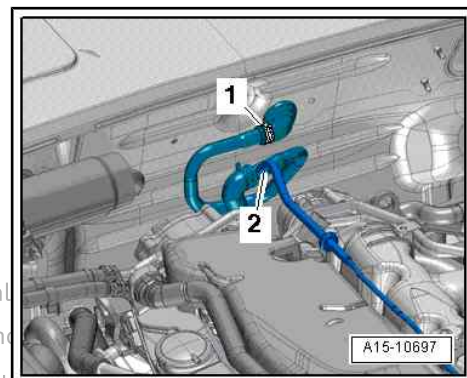
Disregard -item 4-.



- Release hose clip -1- and detach vacuum hose for brake servo.
- Detach vacuum hose -2- and move clear.
- Remove coolant pipe (top) ⇒ [page 185](#) .



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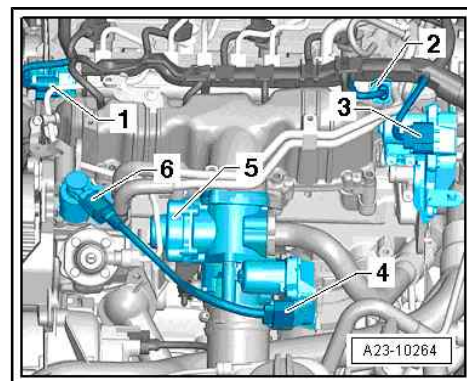


- Unplug electrical connectors:
- 3 - On variable intake manifold motor - V183-
- 4 - On intake manifold flap motor - V157-
- 5 - On exhaust gas recirculation valve - N18-



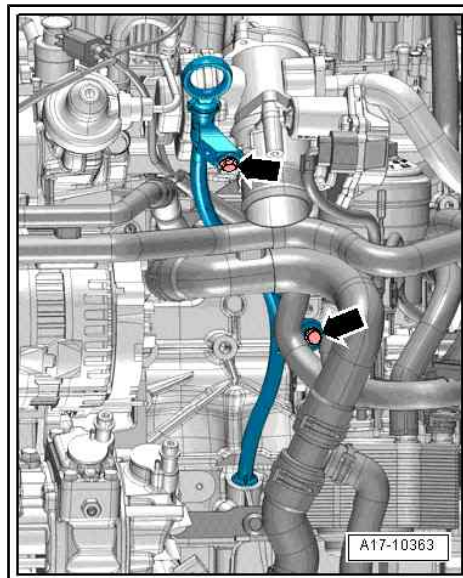
Note

Disregard -items 1, 2, 6-.





- Pull oil dipstick out slightly and remove bolts -arrows-.
- Pull guide tube for oil dipstick upwards out of cylinder block and push to one side.

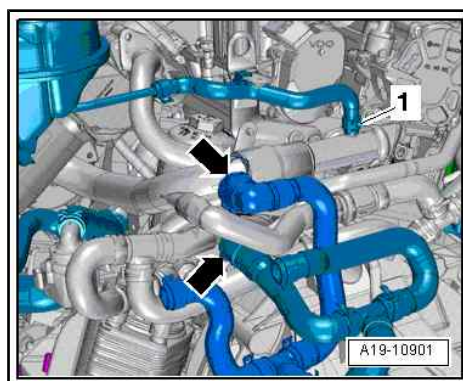


- Release hose clip -1- and detach coolant hose.



Note

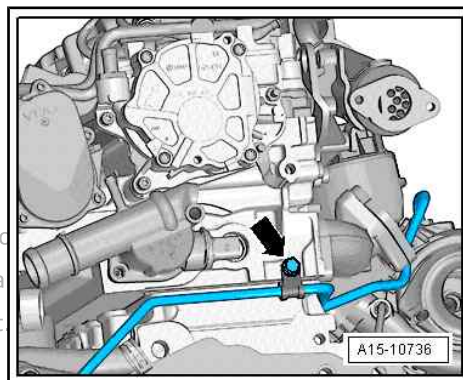
Disregard -arrows-.



- Remove bolt -arrow- for oil supply line going to turbocharger on cylinder head.



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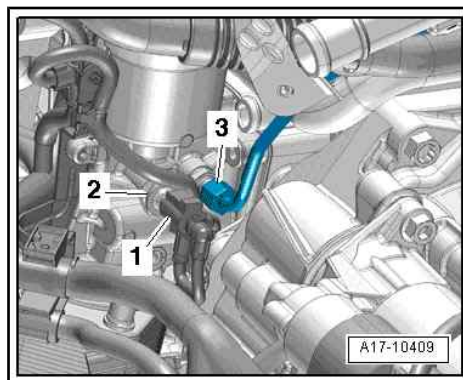


- Disconnect oil supply line from connection on oil filter bracket. To do so, counterhold at hexagon flats with an open-end spanner and loosen union nut -3-.



Note

Disregard items -1 and 2-.





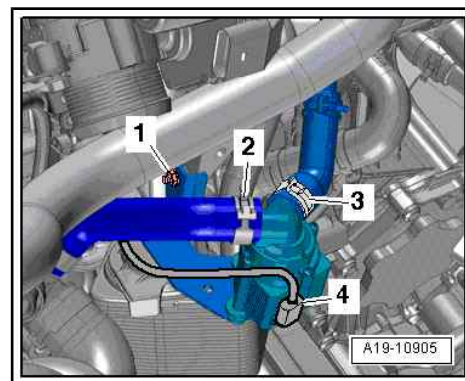
- Release hose clip -3- and detach coolant hose.



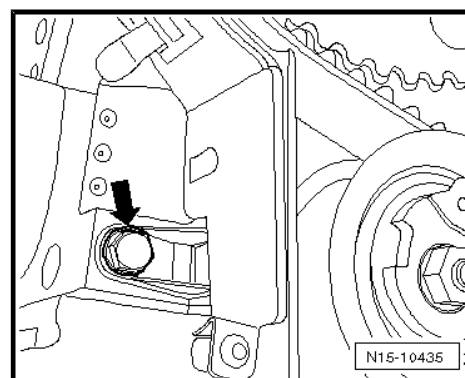
Note

Disregard -items 1, 2, 4-.

- Remove toothed belt ⇒ [page 87](#) .



- Remove bolt -arrow- securing rear cover for toothed belt.

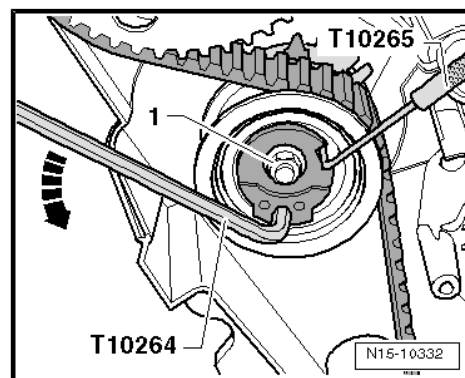


- Remove locking tool - T10265- .
- Remove nut -1- and detach tensioning roller.

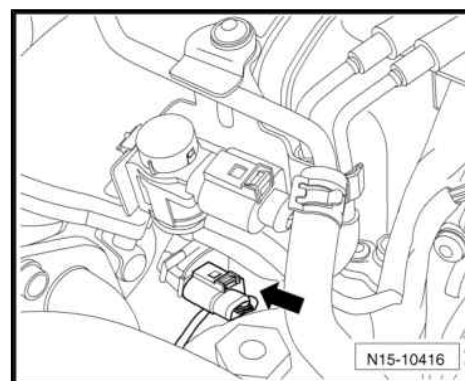


Note

Disregard -arrow-.



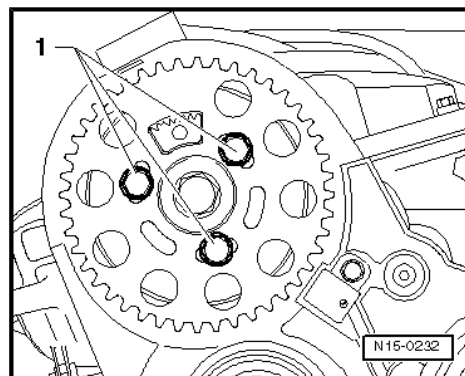
- Unplug electrical connector -arrow- at Hall sender - G40- .
- Remove cylinder head cover ⇒ [page 98](#) .
- Unplug electrical connectors on glow plugs.



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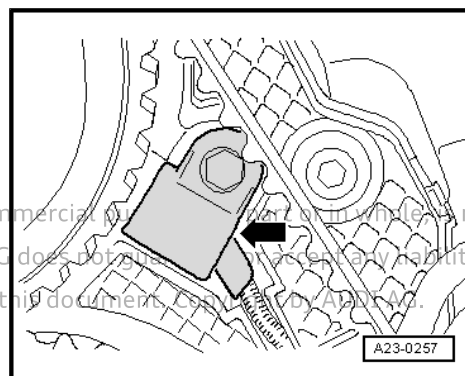
- Remove bolts -1- and detach camshaft sprocket.



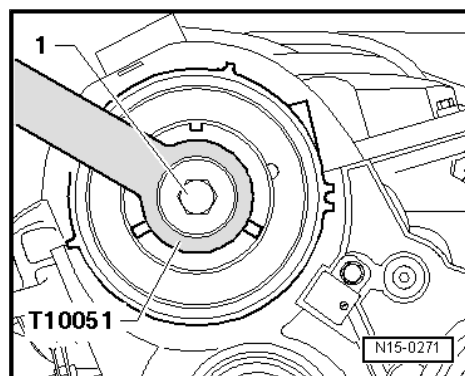
- Remove bolt -arrow- and place Hall sender - G40- to one side.



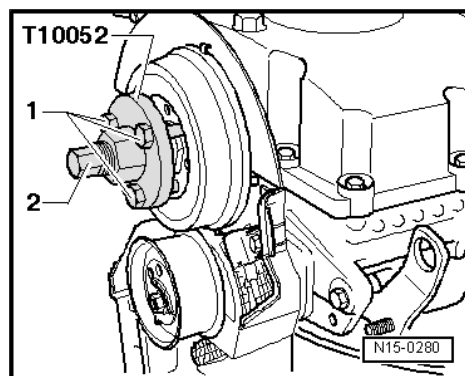
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- Counterhold using counterhold tool - T10051- and loosen bolt -1- for camshaft hub.
- Unscrew bolt approx. 2 turns.



- 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.





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



Note

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

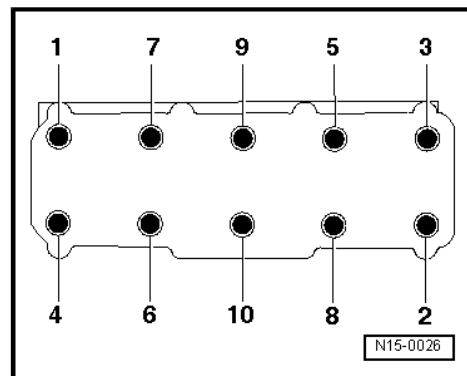
- Lift cylinder head at gearbox end first and guide out of toothed belt cover. Take care not to bend oil supply line.



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

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

Tightening torques

- ◆ ⇒ [“2.3 Exploded view - cylinder head”, page 99](#)
- ◆ ⇒ [“1.1 Exploded view - toothed belt”, page 85](#)
- ◆ ⇒ [“1.1 Exploded view - turbocharger”, page 201](#)
- ◆ ⇒ [“1.1 Exploded view - silencers”, page 217](#)



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Note

- ◆ *Use of impermissible abrasive materials can lead to subsequent damage to the turbocharger, conrod bearings or similar.*
- ◆ *Do NOT use abrasive materials (sandpaper, sanding discs, sanding pads, abrasive web, wire wool, etc.).*
- ◆ *Sealing surface (see photo) must not be raised.*
- ◆ *Dark discolouration (see photo) does not have to be removed.*
- ◆ *When removing sealant residue, make sure none of the residue enters the open channels of the engine.*
- ◆ *Ensure that nearby workspaces are kept clean and that the abrasive materials listed above are not being used there.*



- Remove sealant residue from cylinder head and cylinder block using a commercially available blade scraper (blade width at least 40 mm).
- Sealing surfaces must NOT be damaged.
- No oil or coolant must be allowed to remain in the blind holes for the bolts.
- Do not remove new cylinder head gasket from packaging until it is ready to be fitted.
- If a new cylinder head is installed, the contact surfaces between the roller rocker fingers and the running surface of the cam must be lubricated.
- Handle the cylinder head gasket very carefully to prevent damage to the silicone coating or the indented area of the gasket.
- Turn the crankshaft carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.
- After fitting a new cylinder head or cylinder head gasket, change the engine oil and the coolant in the entire cooling system.
- Remove loose residue with a lint-free cloth.
- Before fitting cylinder head, remove crankshaft stop - T10050- and turn crankshaft against direction of engine rotation until all pistons are almost evenly positioned below TDC.

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

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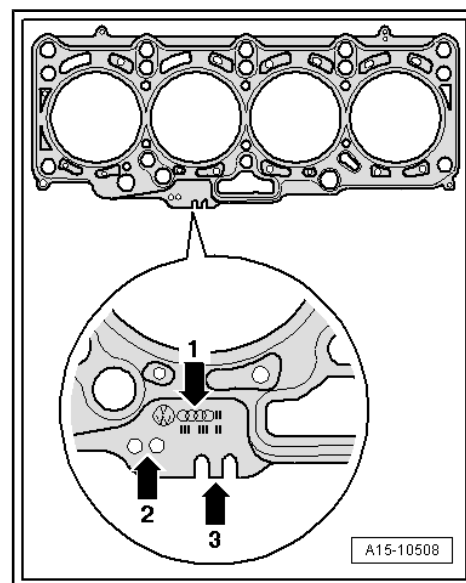
– Note cylinder head gasket identification:

- 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 82](#).



- 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.

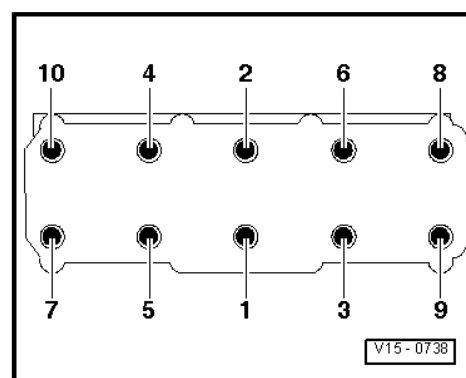
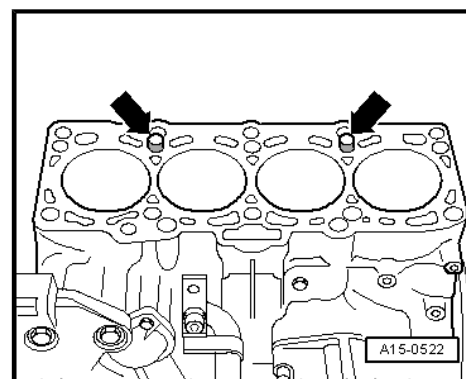


Note

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.
- Fit cylinder head.
- Screw in cylinder head bolts by hand until they make contact.
- Tighten cylinder head bolts ⇒ [page 101](#).



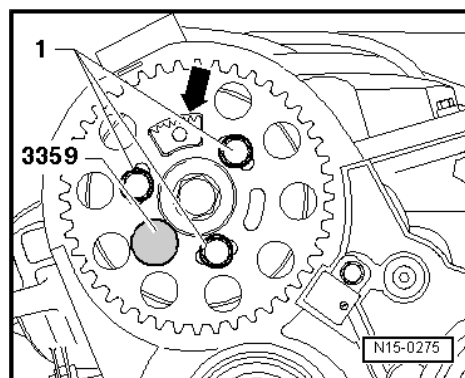


- Lock camshaft hub with diesel injection pump locking pin - 3359- .



Note

Disregard -item 1- and -arrow-.



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



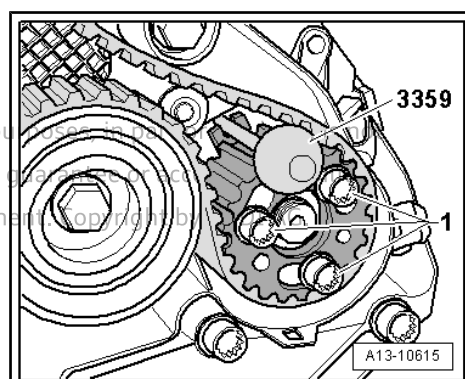
Note

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Disregard -item 1-.

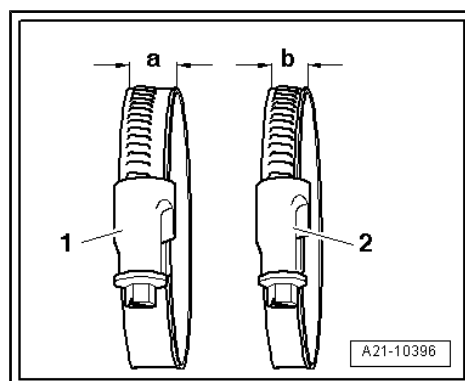
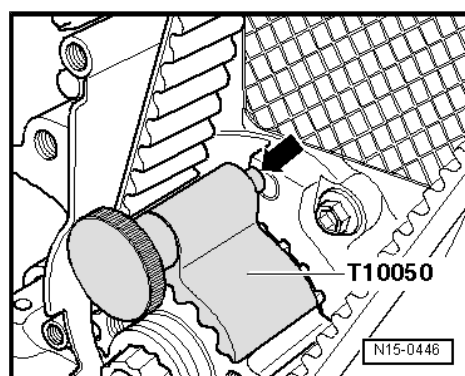
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- Turn crankshaft in direction of engine rotation until pin -arrow- on crankshaft stop engages in sealing flange as crankshaft rotates.
- Install toothed belt (adjust valve timing) ⇒ [page 91](#) .

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

- Install cylinder head cover ⇒ [page 98](#) .
- Install oil supply line ⇒ [Item 6 \(page 160\)](#) .
- Install dipstick guide tube ⇒ [page 250](#) .
- Install coolant pipe (top) ⇒ [page 185](#) .
- Secure exhaust gas pressure sensor 1 - G450- ⇒ Rep. gr. 23 .
- Install fuel filter ⇒ Rep. gr. 20 .
- Install air cleaner housing ⇒ Rep. gr. 23 .
- Install air hoses with screw-type clips ⇒ [page 210](#) .
- Observe notes on procedure for connecting the battery ⇒ Electrical system; Rep. gr. 27 .
- Change engine oil ⇒ Maintenance ; Booklet 405 .
- Fill cooling system with fresh coolant ⇒ [page 172](#) .

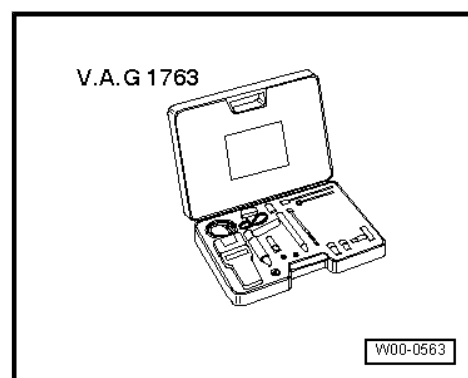
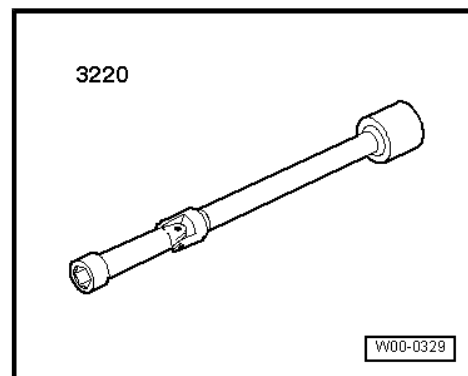




2.5 Checking compression

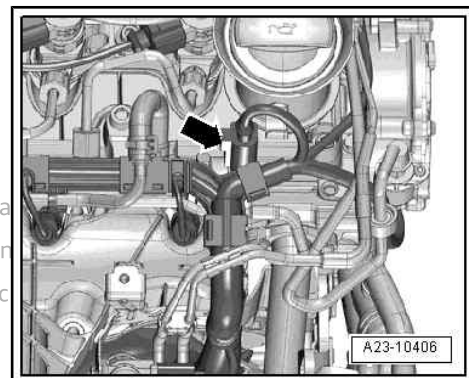
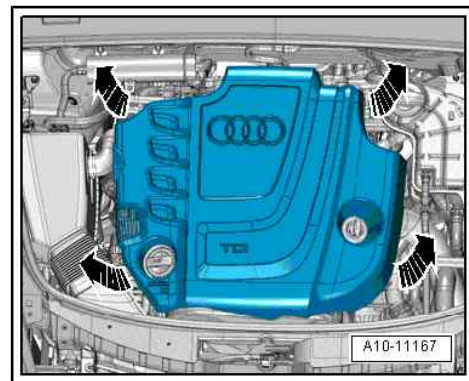
Special tools and workshop equipment required

- ◆ Jointed spanner - 3220-
- ◆ Compression tester - V.A.G 1763- with adapter - V.A.G 1763/8-



Procedure

- Engine oil temperature at least 30 °C
- Battery voltage at least 12.5 V
- Remove engine cover panel -arrows-.
- Unplug electrical connector -arrow- for fuel pressure regulating valve - N276- at fuel rail.
- Briefly start engine to relieve fuel pressure in fuel rail.
- Remove all glow plugs ⇒ Rep. gr. 28 .



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- 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 .

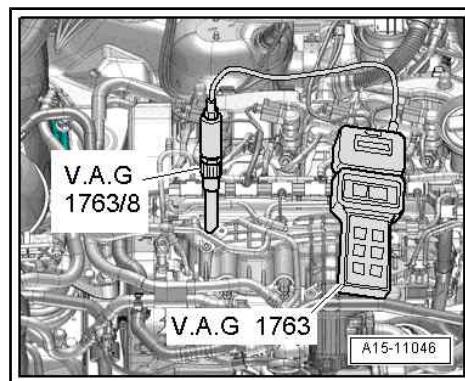
- Have a second mechanic operate starter until tester shows no further pressure increase.
- Repeat procedure on each cylinder.

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

Assembling

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

- Install glow plugs ⇒ Rep. gr. 28 .
- Entries are stored in event memory of engine control unit because electrical connectors were unplugged and the engine was started: Interrogate event memory in Vehicle self-diagnosis ⇒ Vehicle diagnostic tester.



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3 Valve gear

Overview

- ◆ ⇒ [“3.1 Exploded view - valve gear”, page 117](#)
- ◆ ⇒ [“3.2 Measuring axial clearance of camshafts”, page 119](#)
- ◆ ⇒ [“3.3 Measuring radial clearance of camshafts”, page 120](#)
- ◆ ⇒ [“3.4 Removing and installing camshaft oil seal”, page 121](#)
- ◆ ⇒ [“3.5 Removing and installing camshafts”, page 123](#)
- ◆ ⇒ [“3.6 Checking hydraulic compensation elements”, page 130](#)
- ◆ ⇒ [“3.7 Renewing valve stem oil seals with cylinder head installed”, page 131](#)
- ◆ ⇒ [“3.8 Renewing valve stem oil seals with cylinder head removed”, page 134](#)
- ◆ ⇒ [“3.9 Valve dimensions”, page 138](#)
- ◆ ⇒ [“3.10 Machining valve seats”, page 138](#)
- ◆ ⇒ [“3.11 Checking valve guides”, page 138](#)
- ◆ ⇒ [“3.12 Checking valves”, page 139](#)

3.1 Exploded view - valve gear



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1 - Oil seal

- ☐ Removing and installing
⇒ [page 121](#)

2 - Bolt

- ☐ Correct sequence when
slackening ⇒ [page 126](#)
- ☐ Tightening torque and
sequence ⇒ [page 119](#)

3 - Nut

- ☐ Correct sequence when
slackening ⇒ [page 126](#)
- ☐ Tightening torque and
sequence ⇒ [page 119](#)

4 - Retaining frame

- ☐ With integrated cam-
shaft bearings
- ☐ Removing and installing
⇒ ["3.5 Removing and in-
stalling camshafts",
page 123](#)

5 - Exhaust camshaft

- ☐ Removing and installing
⇒ [page 123](#)
- ☐ Measuring axial clear-
ance ⇒ [page 119](#)
- ☐ Measuring radial clear-
ance ⇒ [page 120](#)

6 - Inlet camshaft

- ☐ Removing and installing
⇒ [page 123](#)
- ☐ Measuring axial clear-
ance ⇒ [page 119](#)
- ☐ Measuring radial clear-
ance ⇒ [page 120](#)

7 - Roller rocker finger

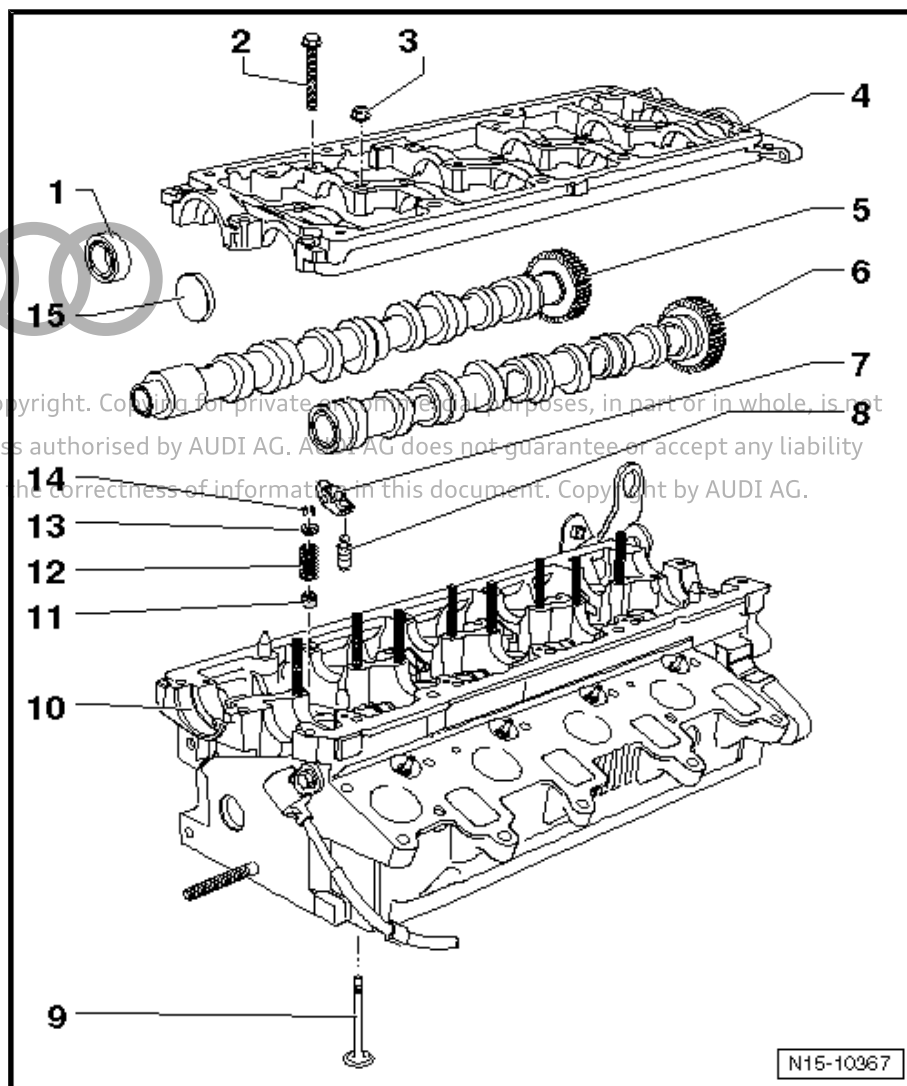
- ☐ Removing and installing ⇒ ["3.5 Removing and installing camshafts", page 123](#)
- ☐ Mark installation position for re-installation
- ☐ Check roller bearings for ease of movement
- ☐ Lubricate contact surfaces before installing

8 - Hydraulic compensation element

- ☐ With retaining clip
- ☐ Checking ⇒ [page 130](#)
- ☐ Mark installation position for re-installation
- ☐ Lubricate contact surfaces before installing

9 - Valve

- ☐ Must not be machined; only grinding-in is permissible
- ☐ Mark installation position for re-installation
- ☐ Checking ⇒ [page 139](#)
- ☐ Valve dimensions ⇒ [page 138](#)
- ☐ Checking valve guides ⇒ [page 138](#)





10 - Cylinder head

11 - Valve stem oil seal

- ❑ Renewing: with cylinder head installed → [page 131](#) , with cylinder head removed → [page 134](#)

12 - Valve spring

13 - Valve spring plate

14 - Valve cotter

15 - 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

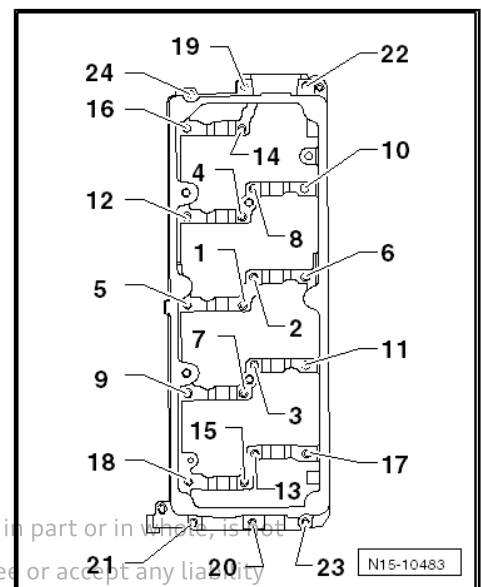
Retaining frame - tightening torque and sequence

- Tighten bolts and nuts in 2 stages in the sequence shown:

Stage	Bolts/nuts	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



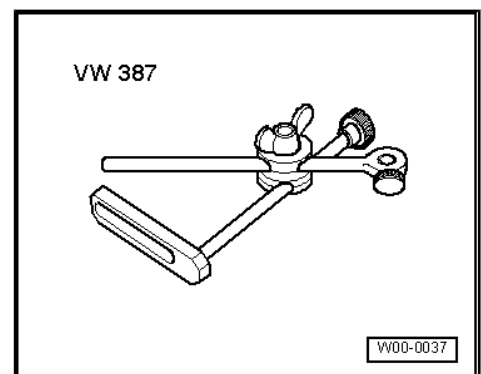
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3.2 Measuring axial clearance of camshafts

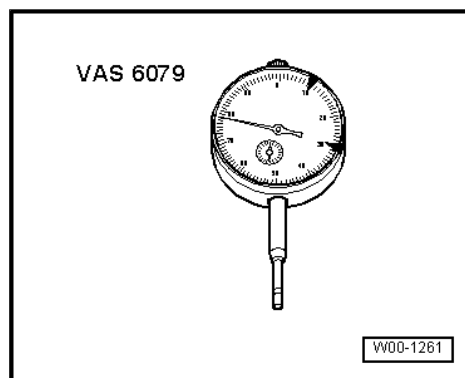
Special tools and workshop equipment required

- ◆ Universal dial gauge bracket - VW 387-





◆ Dial gauge - VAS 6079-

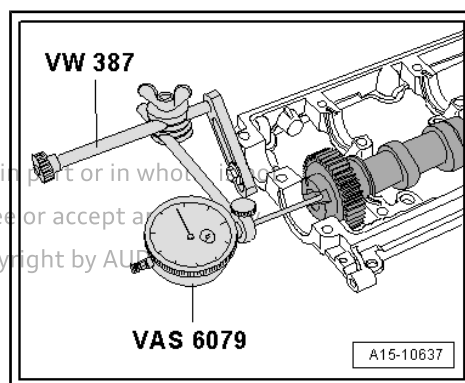


Procedure

- Remove retaining frame
⇒ ["3.5 Removing and installing camshafts", page 123](#) .
- Secure dial gauge - VAS 6079- to cylinder head with universal dial gauge bracket - VW 387- as shown in illustration.
- Press camshaft against dial gauge by hand.
- 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 camshafts

Special tools and workshop equipment required

- ◆ Plastigauge

Procedure

- Remove roller rocker fingers
⇒ ["3.5 Removing and installing camshafts", page 123](#) .
- 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 119](#) .
- 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

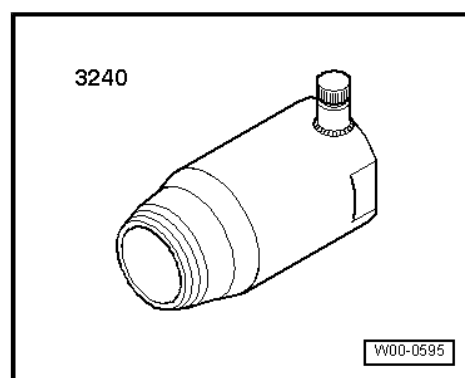
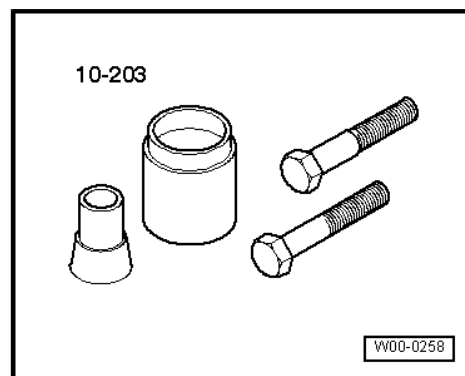
- ◆ A modified oil seal is being phased in.
- ◆ The "old" version oil seal -item A- forms a continuous surface between the camshaft and the cylinder head.
- ◆ The "new" version oil seal -item B- has a shoulder between the camshaft and the cylinder head.

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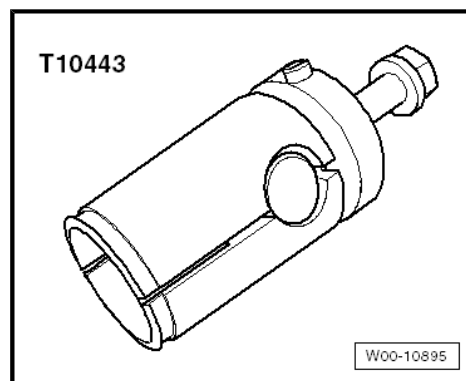
Special tools and workshop equipment required

- ◆ Fitting tool - 10 - 203-
- ◆ Oil seal extractor - 3240- with thrust piece -3240/1- for "old" version oil seal





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



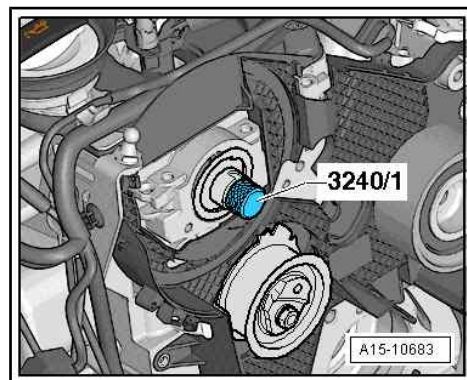
- ◆ Bolt M12x1.5x75

Procedure

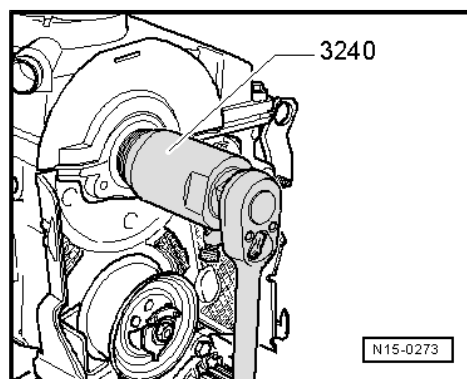
- Remove camshaft sprocket and hub
⇒ [“3.5 Removing and installing camshafts”, page 123](#) .

“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 -3240- , 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.



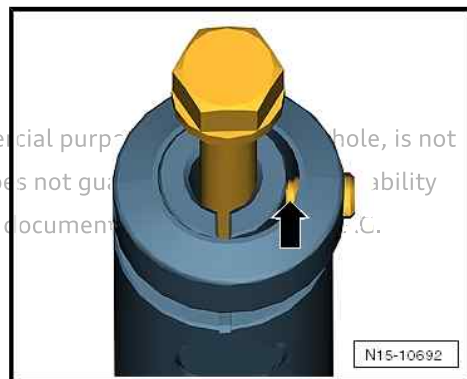
“New” version oil seal:



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.

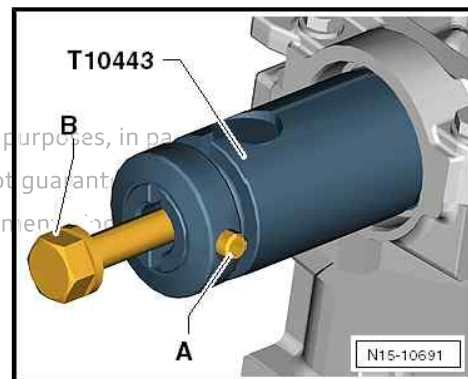
All types of oil seal (continued):

- Clean contact surface and sealing surface.

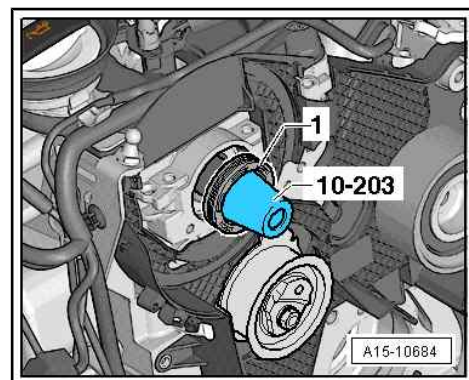


Note

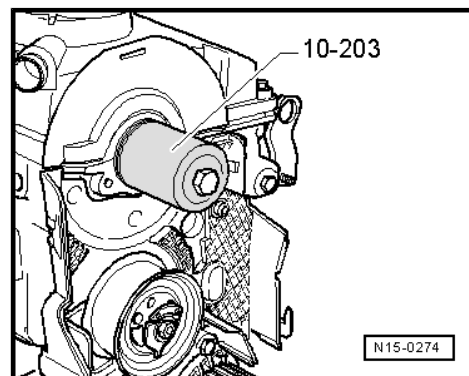
The sealing lip of the oil seal must not be additionally oiled or greased.



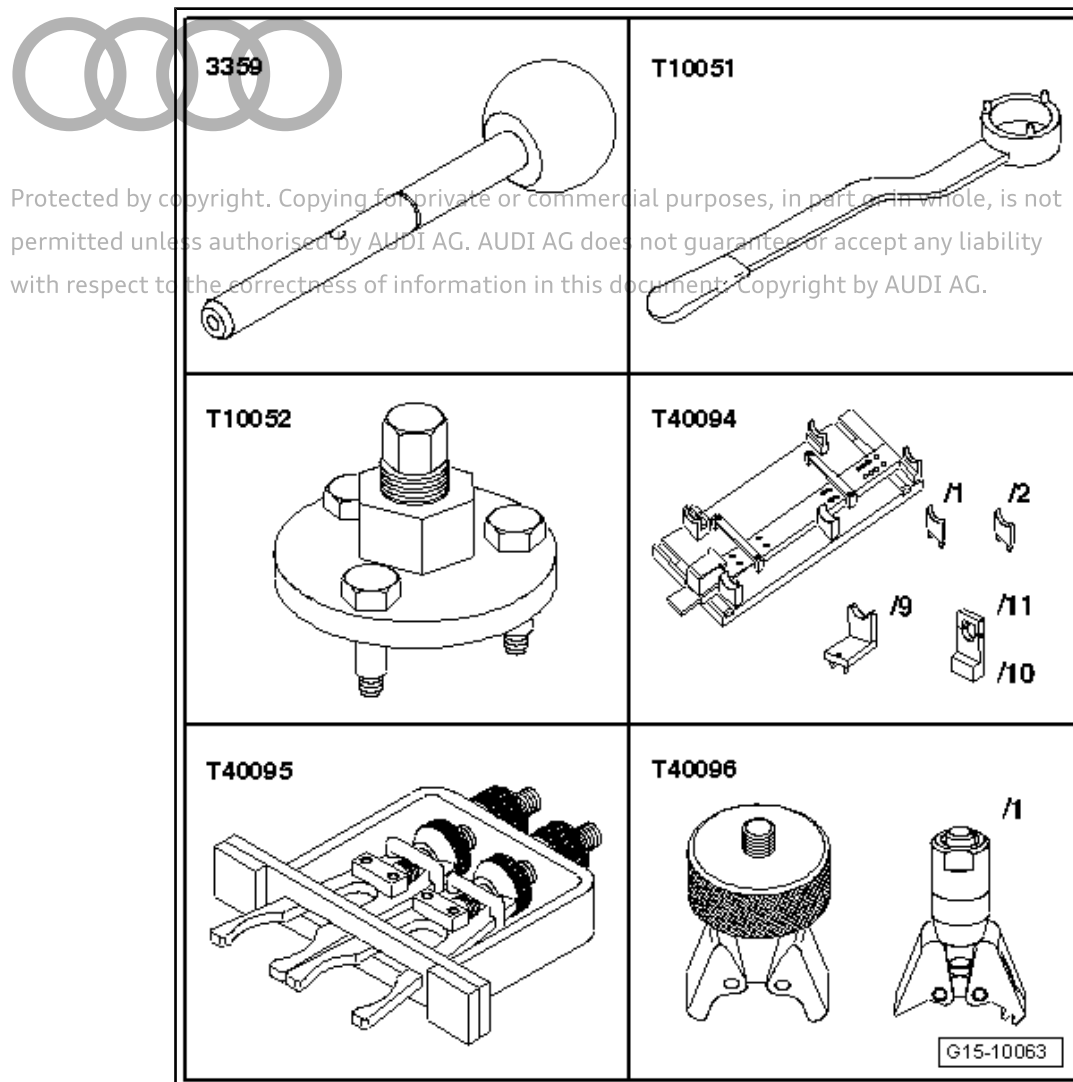
- Apply guide sleeve of fitting tool - 10 - 203- to camshaft as shown in illustration.
- Carefully push oil seal -1- over guide sleeve and onto camshaft.



- 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 camshafts”, page 123](#) .



3.5 Removing and installing camshafts

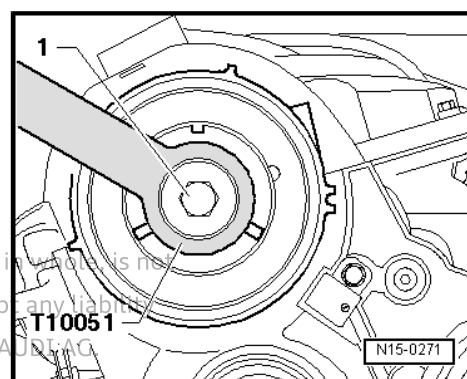
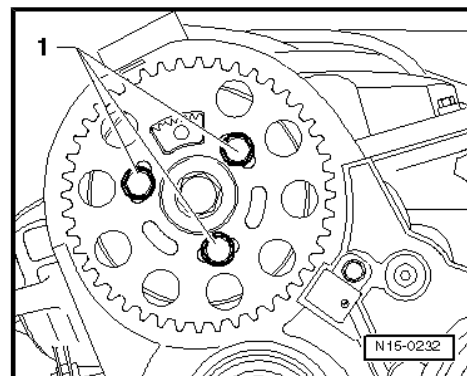


- ◆ Diesel injection pump locking pin - 3359-
- ◆ Counterhold tool - T10051-
- ◆ Puller - T10052-
- ◆ Camshaft fitting tool - T40094-
- ◆ Camshaft fitting tool - T40095-
- ◆ Clamping tool -T40096/1- for vehicles with two-piece camshaft gear
- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Electronic parts catalogue

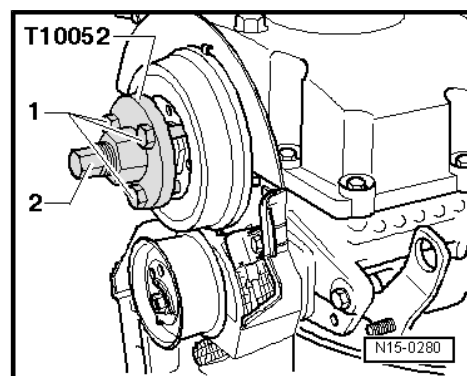


Removing

- Remove cylinder head cover ⇒ [page 98](#) .
- Take toothed belt off camshaft sprocket and high-pressure pump sprocket ⇒ [page 87](#) .
- Remove bolts -1- and detach camshaft sprocket.
- Detach camshaft sprocket from hub.
- 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.
- Remove vacuum pump ⇒ Rep. gr. 47 .

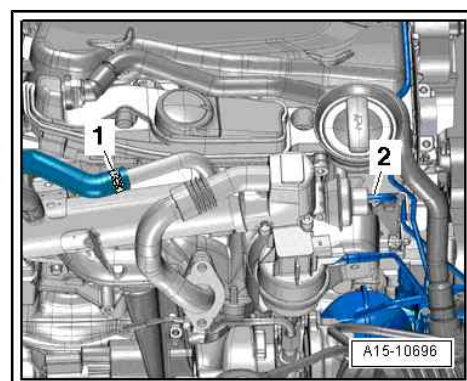


- Disconnect vacuum hose -2-.



Note

Disregard -item 1-.



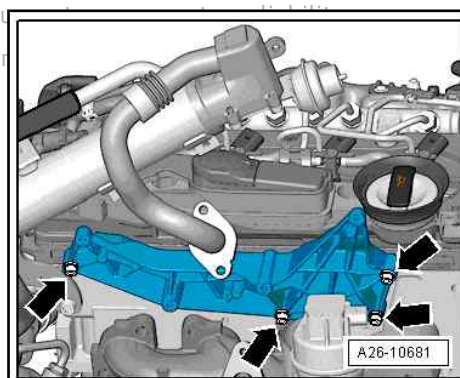
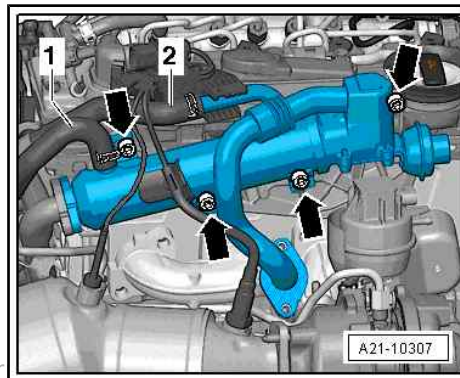


- Remove bolts -arrows-.
- Tie up exhaust gas recirculation cooler (coolant hoses -1- and -2- remain attached).



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- Unfasten bolts -arrows- and remove bracket for exhaust gas recirculation cooler.



- 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

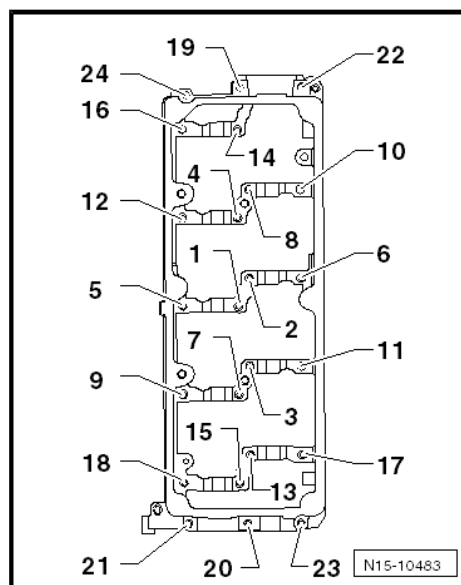
Tightening torques

- ◆ ⇒ [“3.1 Exploded view - valve gear”, page 117](#)
- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation cooler”, page 245](#)



Note

Use adhesive sealant to seal sealing surface between retaining frame and cylinder head.



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.

Protect lubrication system and bearings against contamination.

- ◆ Cover exposed parts of the engine.



WARNING

Risk of eye injury.

◆ *Put on safety goggles.*

- 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.

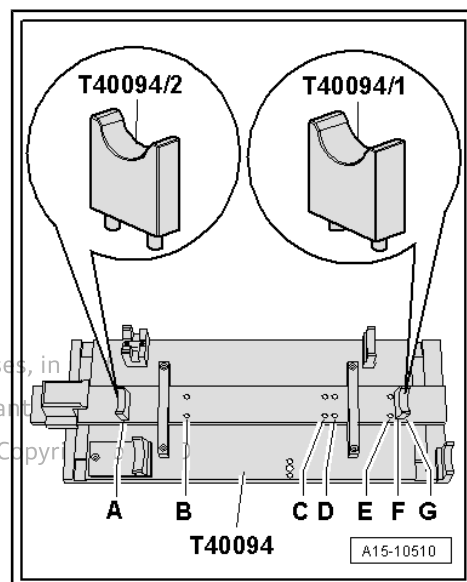
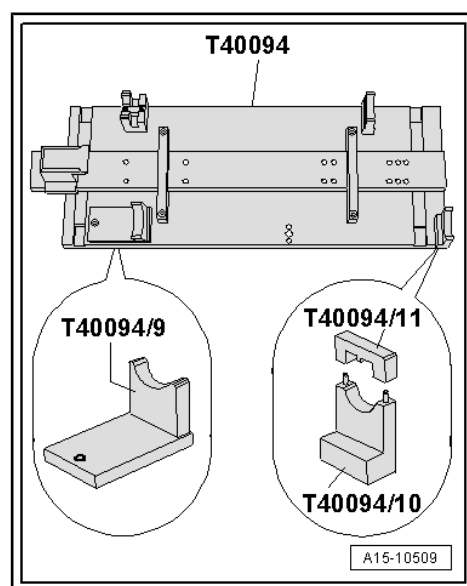
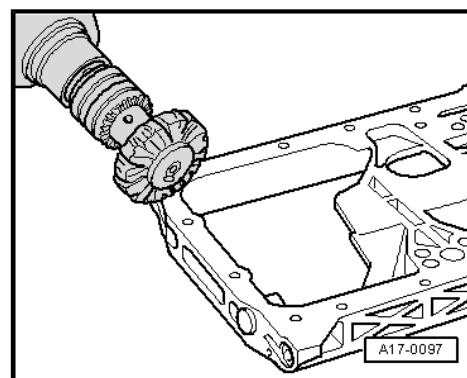
Set up camshaft fitting tool - T40094- as follows:

- 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-.



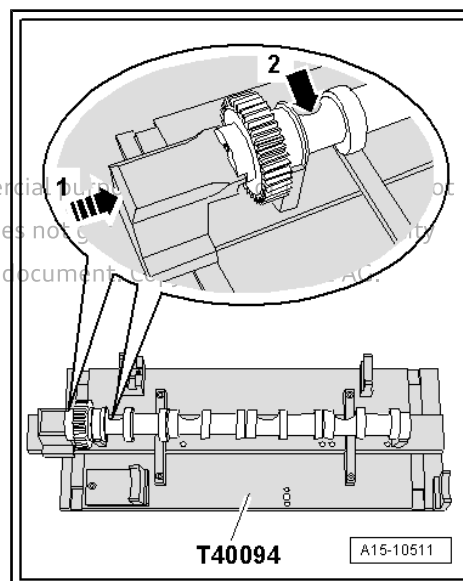
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- Place inlet camshaft in supports -T40094/1- and -T40094/2- .
- Turn inlet camshaft in such a way that it can be locked in “TDC” position using locking device -arrow 1-.
- Recess -arrow 2- for cylinder head bolt must face outwards.

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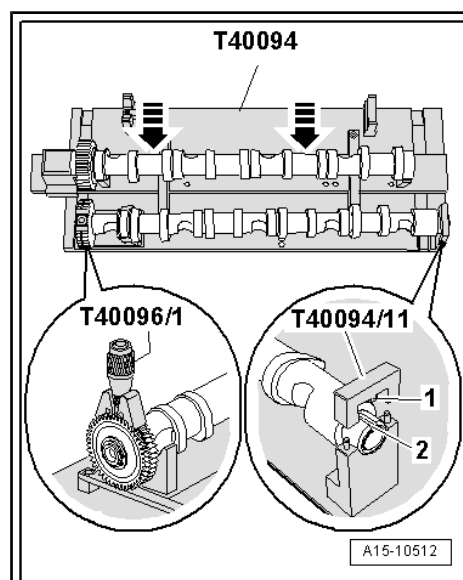
- Place exhaust camshaft in supports -T40094/9- and -T40094/11- .
- Lock exhaust camshaft with top section -T40094/11- .
- The lug -1- on the top section must engage in the slot -2- in the camshaft,

Vehicles with two-piece camshaft gear:

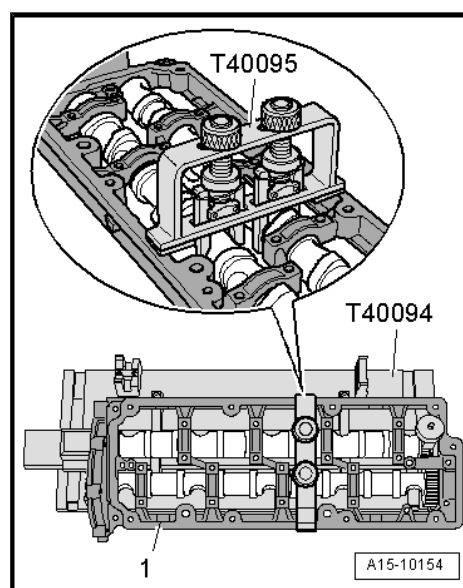
- Place clamping tool -T40096/1- on teeth of exhaust camshaft in such a way that the two arms of the tool engage in the two halves of the gear.
- The wider arm must engage in the wider half of the gear.
- Tighten the clamping tool using the knurled wheel so that the faces of the gear teeth are in alignment.

All vehicles (continued):

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



- Fit retaining frame -1- 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- .

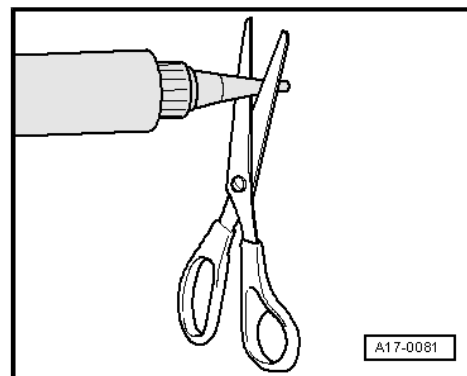




Note

Note the use-by date of the sealant.

- Cut off nozzle of tube at front marking (nozzle $\varnothing$ approx. 2 mm).



Caution

Make sure excess sealant does not contaminate camshaft bearings.

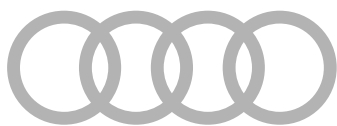
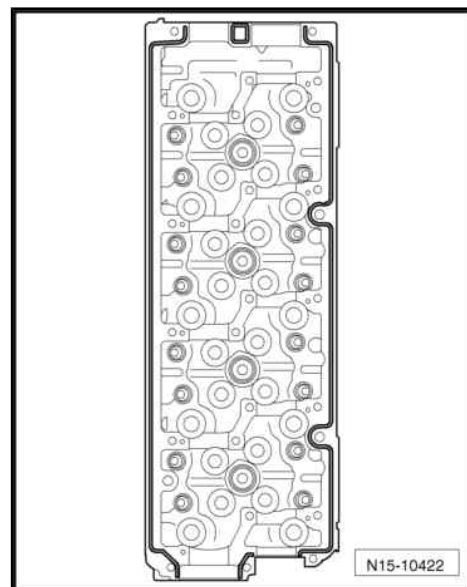
◆ ***The sealant beads must not be thicker than specified.***

- 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 and nuts 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 and nuts ➔ [page 119](#).
- Remove camshaft fitting tool - T40095- and, if necessary, clamping tool - T40096/1- .

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

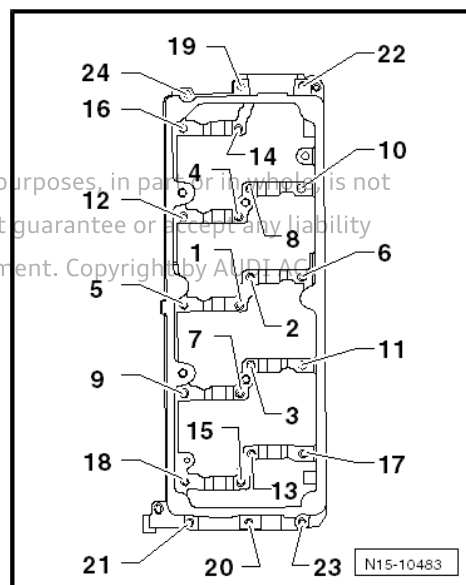
- Install camshaft oil seal ➔ [page 121](#) .
- Drive new sealing cap ➔ [Item 15 \(page 119\)](#) into cylinder head to a depth of approx. 1 ... 2 mm using suitable thrust piece.
- Install vacuum pump ➔ Rep. gr. 47 .
- Install cylinder head cover ➔ [page 98](#) .



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

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

Special tools and workshop equipment required

- ◆ Feeler gauge 0.20 mm

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 3 \(page 160\)](#) .

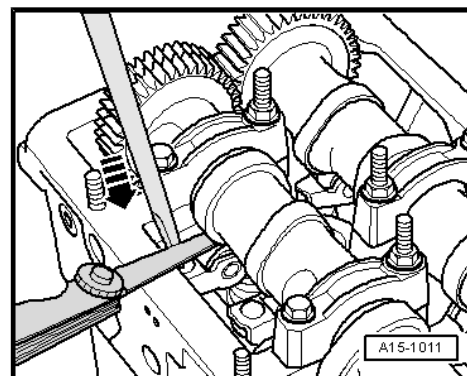
- If the compensation elements are still noisy, locate the defective compensation element as follows:
- Remove cylinder head cover ➔ [page 98](#) .



- 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 camshafts", page 123](#) .

Additional steps required

- Install cylinder head cover ⇒ [page 98](#) .



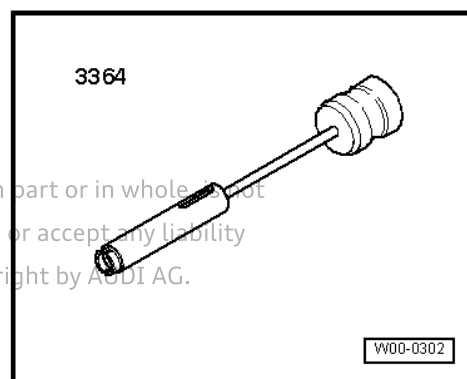
3.7 Renewing valve stem oil seals with cylinder head installed

Special tools and workshop equipment required

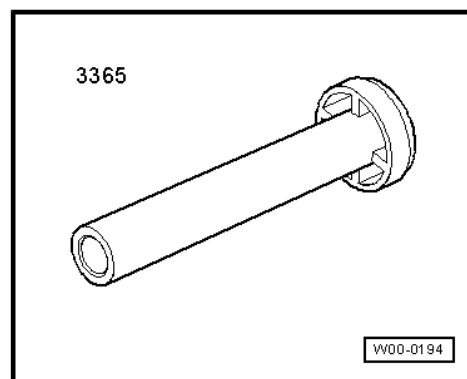
- ◆ Valve stem seal puller - 3364-



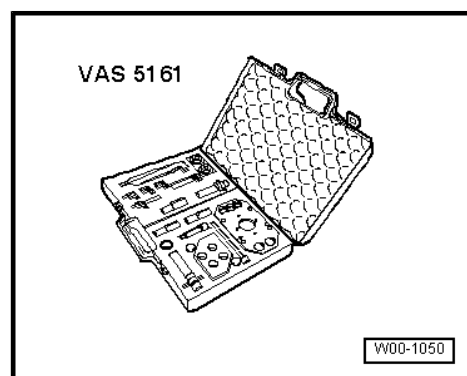
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- ◆ Valve stem oil seal fitting tool - 3365-



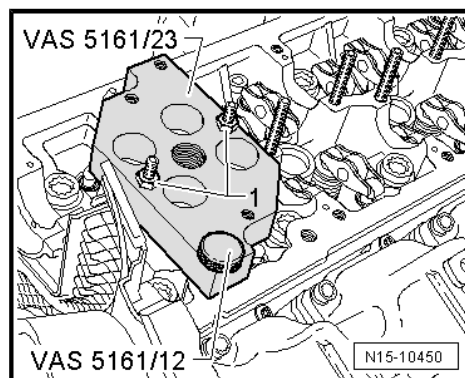
- ◆ Removal and installation device for valve cotters - VAS 5161- with guide plate for 3.0 ltr. TDI engine - VAS 5161/23- and sleeve -VAS 5161/23-1-



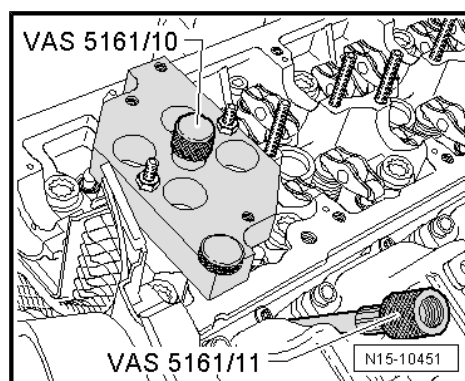


Procedure

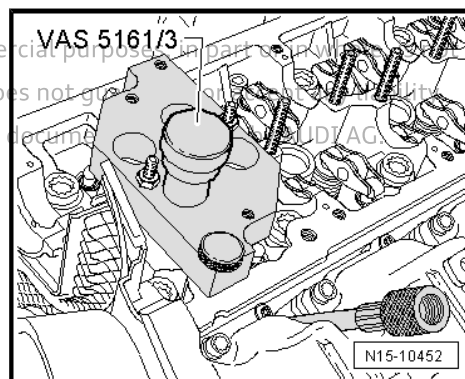
- Remove all glow plugs ⇒ Rep. gr. 28 .
- Remove camshafts ⇒ [page 123](#) .
- Mark original positions of roller rocker fingers and hydraulic compensation elements for re-installation.
- Remove roller rocker fingers together with hydraulic compensation elements and put down on a clean surface.
- Set 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 at studs by screwing on 2 M6 nuts without shoulder 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.

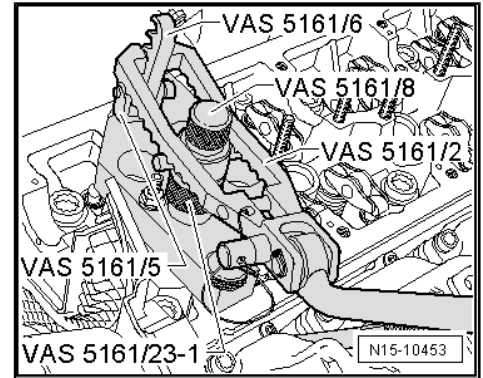


- Insert drift -VAS 5161/3- into guide plate and use plastic-headed hammer to release sticking valve cotter.

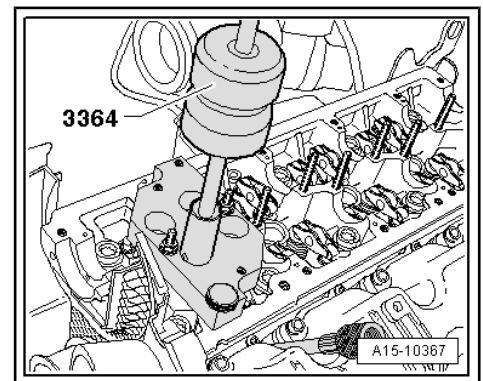
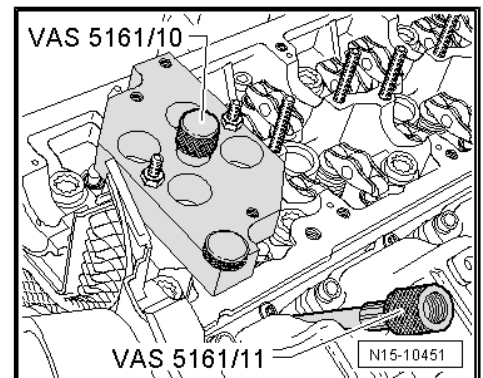




- Screw snap-in device -VAS 5161/6- with engaging fork -VAS 5161/5- into guide plate.
- Slide sleeve -VAS 5161/23-1- onto assembly cartridge -VAS 5161/8- .



- Connect adapter -VAS 5161/11- 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.
- 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- .

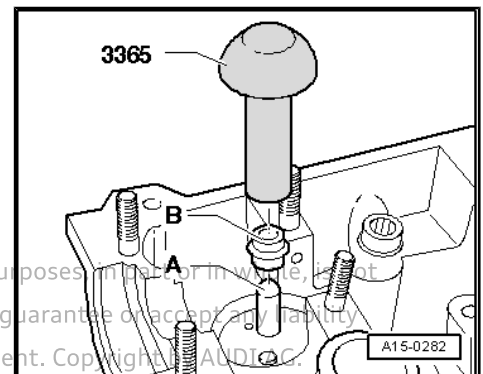


Caution

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.***

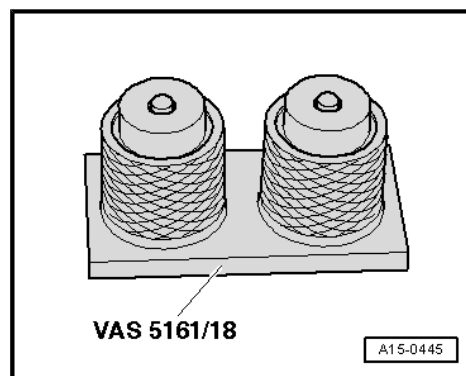
- Lightly oil sealing lip of valve stem oil seal.
- Slide valve stem oil seal onto plastic sleeve.
- Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool - 3365- .
- Take off plastic sleeve.





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.

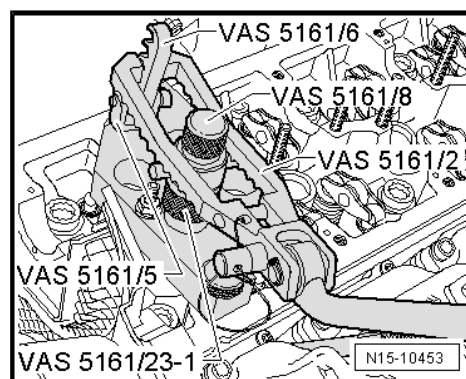


- Insert assembly cartridge in guide plate for 3.0 ltr. TDI engine - VAS 5161/23- again.
- Press down pressure fork and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotters.
- Release pressure fork with knurled screw still in pulled position.
- Repeat procedure for each valve.

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 123](#) .
- Install glow plugs ➔ Rep. gr. 28 .



3.8

Renewing valve stem oil seals with cylinder head removed

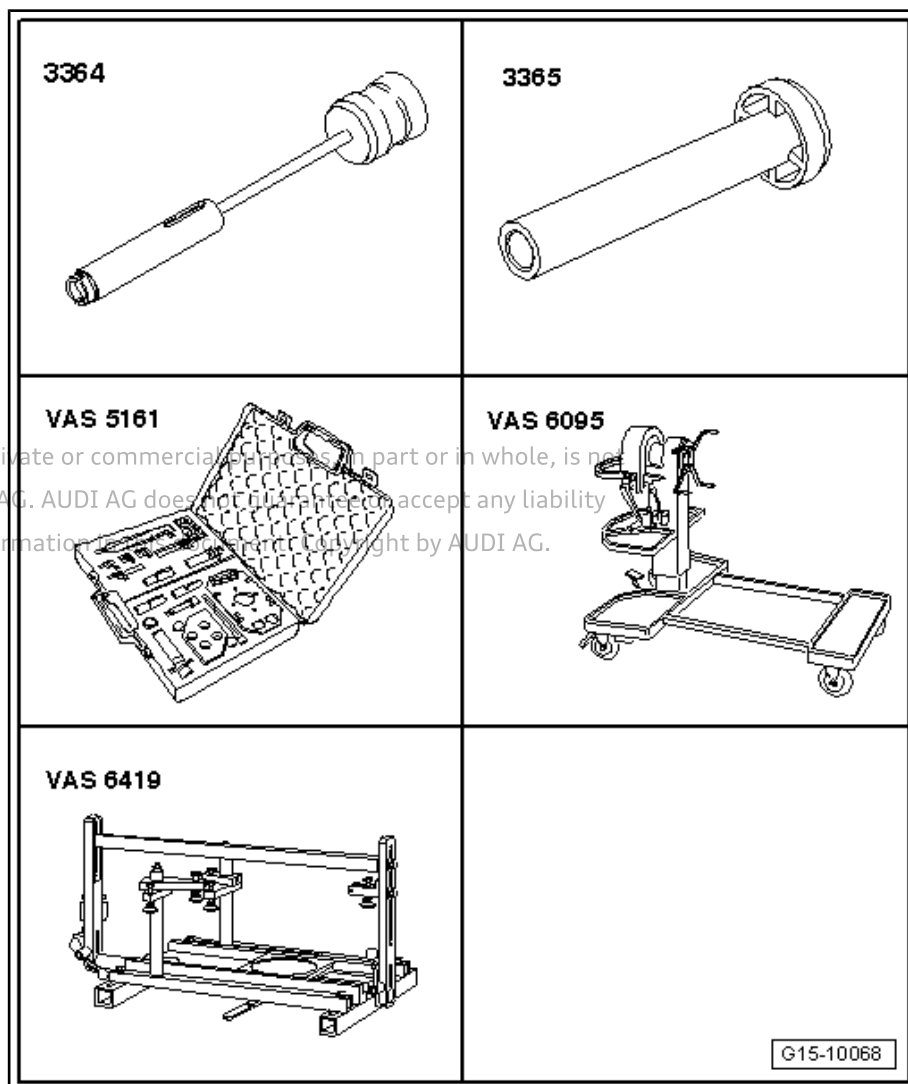
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Special tools and workshop equipment required



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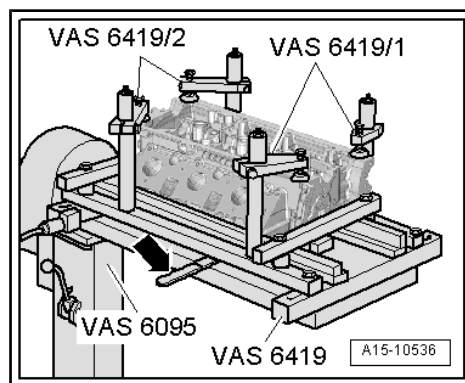
- ◆ Valve stem seal puller - 3364-
- ◆ Valve stem oil seal fitting tool - 3365-
- ◆ Removal and installation device for valve cotters - VAS 5161-
with guide plate for 3.0 ltr. TDI engine - VAS 5161/23- and
sleeve -VAS 5161/23-1-
- ◆ Engine and gearbox support - VAS 6095-
- ◆ Cylinder head tensioning device - VAS 6419-
- ◆ M6 nut without collar (2x)

Procedure

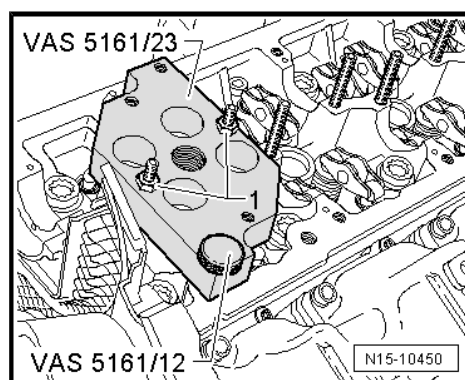
- Remove camshafts ⇒ [page 123](#) .
- Mark original positions of roller rocker fingers and hydraulic compensation elements for re-installation.
- Remove roller rocker fingers together with hydraulic compensation elements and put down on a clean surface.
- Insert cylinder head tensioning device - VAS 6419- into engine and gearbox support - VAS 6095- .



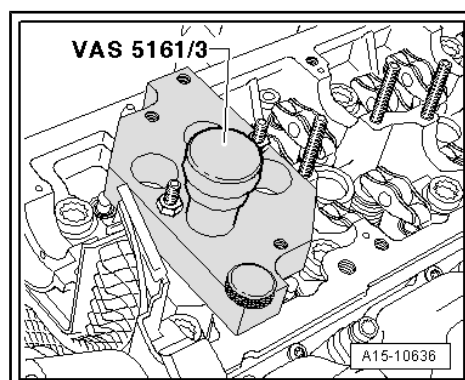
- Secure cylinder head in cylinder head tensioning device, as shown in illustration.
- Connect cylinder head tensioning device to compressed air supply.
- Using lever -arrow-, slide air pad under combustion chamber where valve stem oil seal is to be removed.
- Apply just enough compressed air to bring air pad into contact with valve heads.



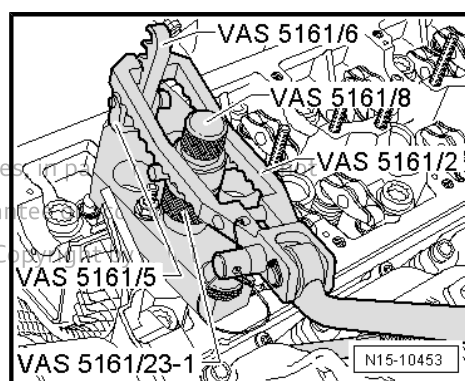
- Fit guide plate for 3.0 ltr. TDI engine - VAS 5161/23- onto cylinder head.
- Secure guide plate on intake manifold side with knurled screw -VAS 5161/12- and at studs by screwing on 2 M6 nuts without shoulder by hand until they make contact.



- 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- .

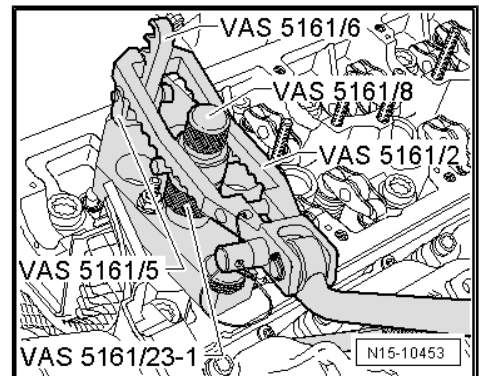
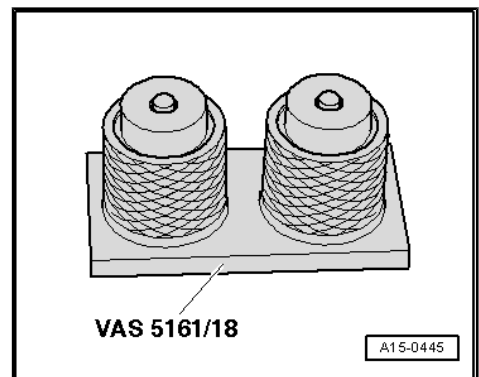
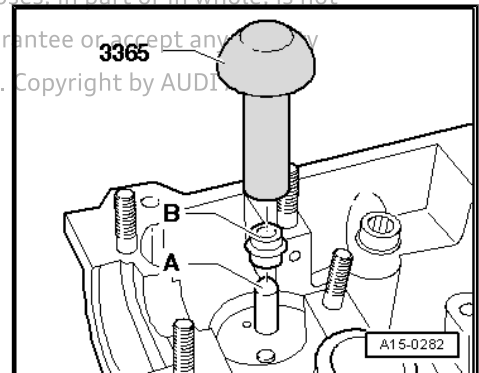
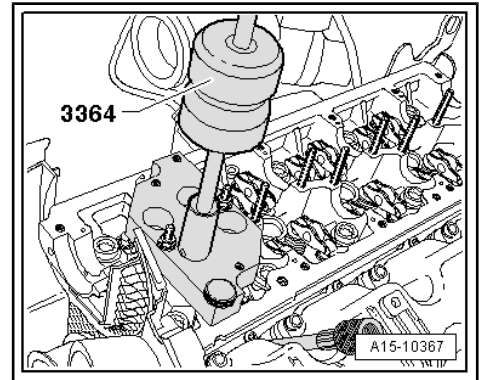
- Larger diameter of valve cotters faces upwards.
- Insert valve spring and valve spring plate.
- Press assembly cartridge onto insertion device from above and take up valve cotters.

- 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 123](#) .





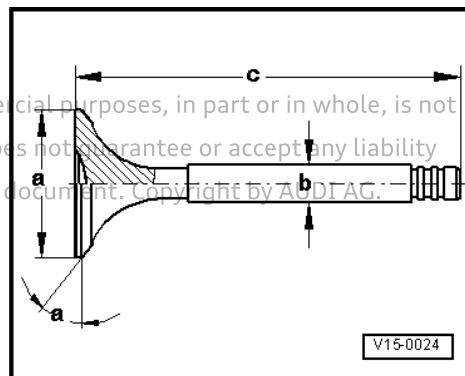
3.9 Valve dimensions



Note

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

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



3.10 Machining valve seats



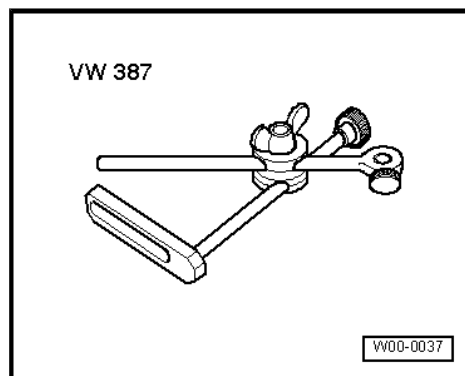
Note

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

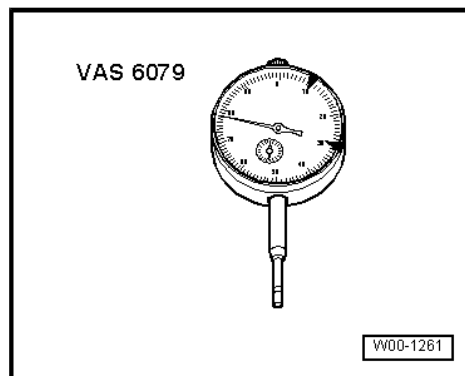
3.11 Checking valve guides

Special tools and workshop equipment required

- ♦ Universal dial gauge bracket - VW 387-



- ♦ Dial gauge - VAS 6079-



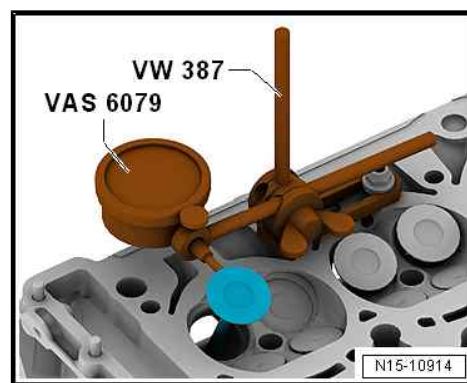


Procedure



Note

- ◆ *If the valve has to be renewed as part of a repair, use a new valve for the measurement.*
- ◆ *Only insert inlet valve into inlet 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.

3.12 Checking valves

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



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17 – Lubrication

1 Sump, oil pump, balance shaft assembly

Overview

- ◆ ⇒ [“1.1 Exploded view - sump, oil pump, balance shaft assembly”, page 140](#)
- ◆ ⇒ [“1.2 Removing and installing oil level and oil temperature sender G266”, page 144](#)
- ◆ ⇒ [“1.3 Removing and installing sump”, page 144](#)
- ◆ ⇒ [“1.4 Removing and installing oil pump”, page 151](#)
- ◆ ⇒ [“1.5 Removing balance shaft assembly”, page 152](#)
- ◆ ⇒ [“1.6 Installing a new balance shaft assembly”, page 154](#)
- ◆ ⇒ [“1.7 Re-installing a used balance shaft assembly”, page 157](#)

1.1 Exploded view - sump, oil pump, balance shaft assembly

1 - Seal

- ☐ Renew

2 - Oil drain plug

- ☐ 30 Nm

3 - Sump

- ☐ Removing and installing
⇒ [page 144](#)

4 - O-ring

- ☐ Renew

5 - Suction pipe

- ☐ Clean strainer if dirty

6 - Bolt

- ☐ 9 Nm

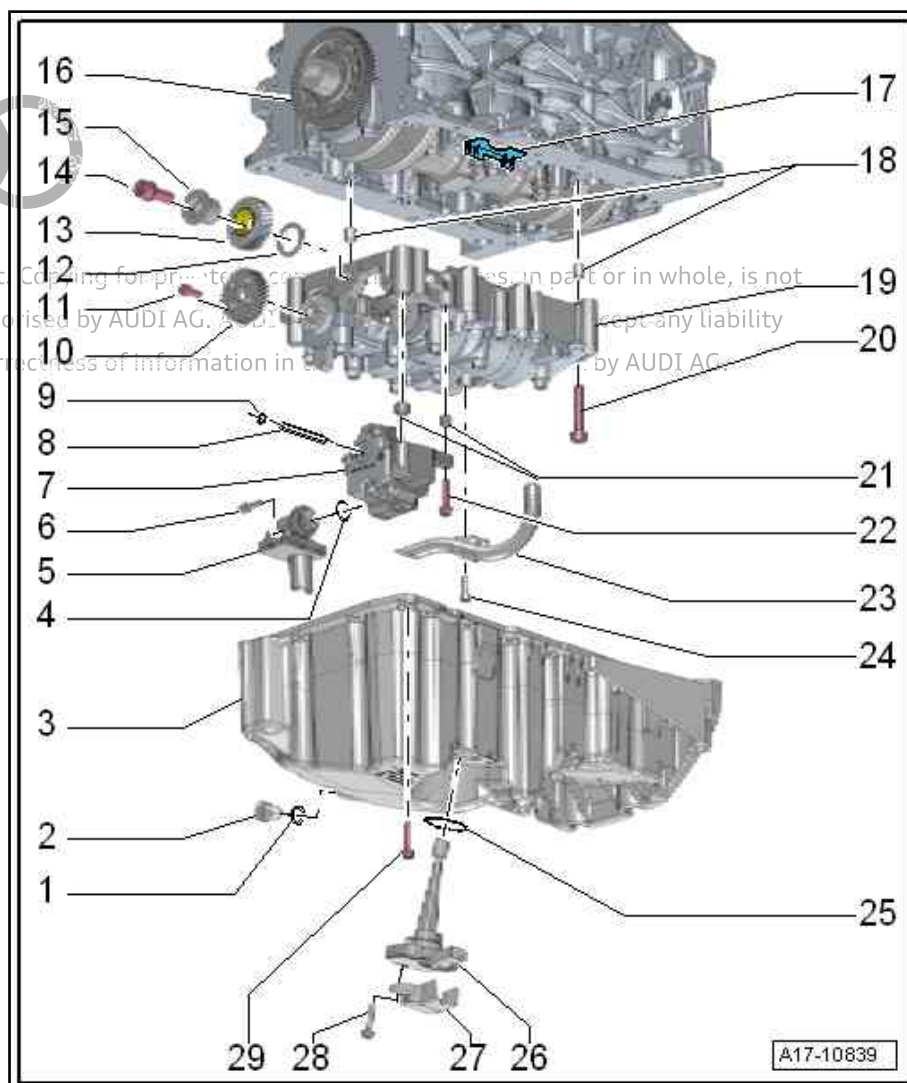
7 - Oil pump

- ☐ Removing and installing
⇒ [page 151](#)
- ☐ Before installing, check that the two dowel sleeves for centring oil pump are fitted onto balance shaft assembly.

8 - Oil pump drive shaft

9 - Circlip

- ☐ Must fit securely in groove
- ☐ Renew circlip if damaged or stretched





10 - Spur gear for balance shaft

11 - Bolt

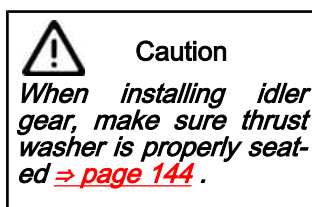
- ☐ Renew
- ☐ 20 Nm +90°

12 - Thrust washer

- ☐ For idler gear
- ☐ Only for balance shaft assembly with eight attachment points
- ☐ Renew
- ☐ Note installation position ⇒ [page 144](#)
- ☐ If necessary, apply grease and attach to housing to install idler gear

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 ⇒ ["1.6 Installing a new balance shaft assembly", page 154](#)
- ☐ To achieve the correct backlash a suitably thick coating is already applied to the new idler gear. The required clearance is achieved when the coating is worn



- ☐ Installation position: Part No. must be visible.

14 - Bolt

- ☐ 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 ⇒ ["1.6 Installing a new balance shaft assembly", page 154](#)
- ☐ 90 Nm +90°

15 - Hub

- ☐ For idler gear
- ☐ Renew

16 - Crankshaft gear

17 - Cover

- ☐ Installation position for cover of oil level and oil temperature sender - G266- ⇒ [page 142](#)

18 - Dowel sleeves

- ☐ For centring balance shaft assembly on cylinder block

19 - Balance shaft assembly

- ☐ Removing ⇒ [page 152](#)
- ☐ Before installing, check that the two dowel sleeves for centring balance shaft assembly are fitted in cylinder block.
- ☐ Installing new balance shaft assembly ⇒ [page 154](#)
- ☐ Re-installing "old" balance shaft assembly ⇒ [page 157](#)

20 - Bolt

- ☐ Renew
- ☐ Tightening torque and sequence for balance shaft assembly with eight attachment points ⇒ [page 143](#)
- ☐ Tightening torque and sequence for balance shaft assembly with six attachment points ⇒ [page 144](#)



21 - Dowel sleeves

22 - Bolt

- ☐ 9 Nm

23 - Oil intake pipe

24 - Bolt

- ☐ 9 Nm

25 - Seal

- ☐ Renew

26 - Oil level and oil temperature sender - G266-

- ☐ Removing and installing ⇒ [page 144](#)

27 - Cover

- ☐ For oil level and oil temperature sender - G266-

28 - Bolt

- ☐ Self-locking
- ☐ Renew
- ☐ 9 Nm

29 - Bolt

- ☐ Tightening torque and sequence ⇒ [page 143](#)

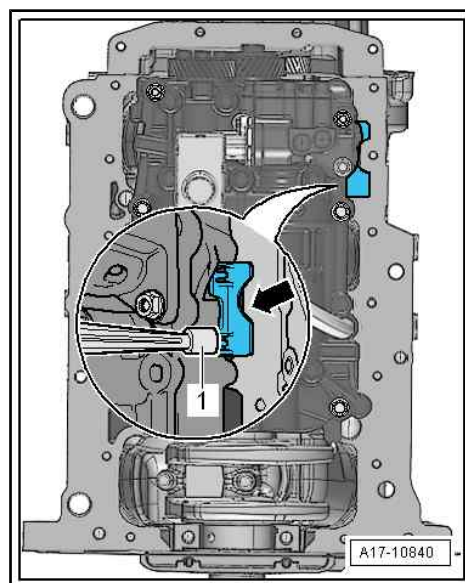
Installation position for cover of oil level and oil temperature sender

- Clip in cover for oil level and oil temperature sender -arrow-, as shown in illustration.



Note

For greater clarity, item -1- shows oil level and oil temperature sender .

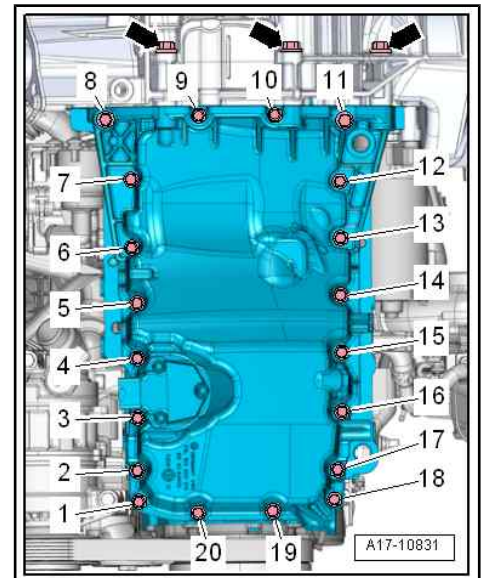




Sump - tightening torque and sequence

– Tighten bolts in stages:

Stage	Bolts	Tightening torque
1.	-1 to 20-	5 Nm in diagonal sequence
2.	-Arrows-	15 Nm + turn 90° further (renew bolts)
3.	-1 to 7-, -9 and 10-, -12 to 20-	Tighten in stages and in diagonal sequence; final torque 13 Nm
4.	-8 and 11-	23 Nm



Tightening sequence - balance shaft assembly with eight attachment points

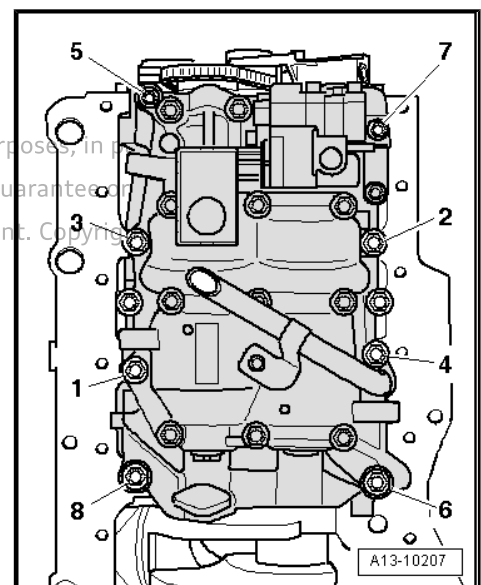


Note

Renew bolts tightened with specified tightening angle.

– Tighten bolts securing balance shaft assembly as follows:

Stage	Bolts	Tightening torque/angle specification
1.	-1 to 8-	Screw in hand-tight in this sequence
2.	-1 to 8-	Pre-tighten in this sequence to 6 Nm
3.	-1 to 4-	Tighten to 20 Nm
4.	-5-	Tighten to 13 Nm
5.	-6-	Tighten to 20 Nm
6.	-7-	Tighten to 13 Nm
7.	-8-	Tighten to 20 Nm
8.	-1 to 8-	Use rigid wrench to turn 90° further in this sequence

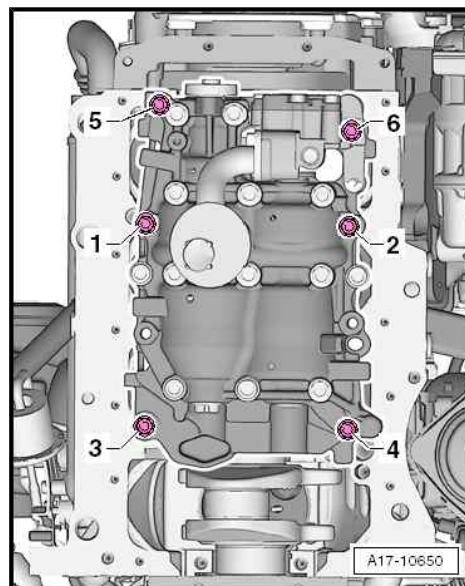


**Tightening sequence - balance shaft assembly with six attachment points****Note**

Renew bolts tightened with specified tightening angle.

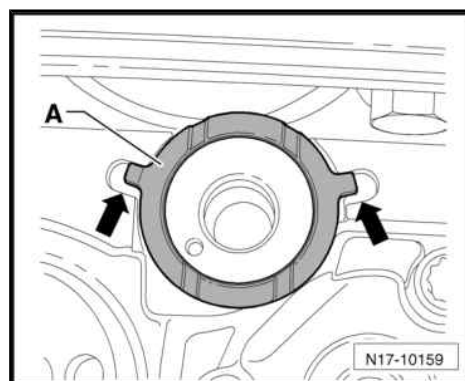
- Tighten bolts securing balance shaft assembly as follows:

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

**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.*



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

Removing

- Drain off engine oil ⇒ Maintenance ; Booklet 405 .
- Unplug electrical connector -3-.
- Remove bolts -1- and detach oil level and oil temperature sender - G266- -item 4-.

Installing

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

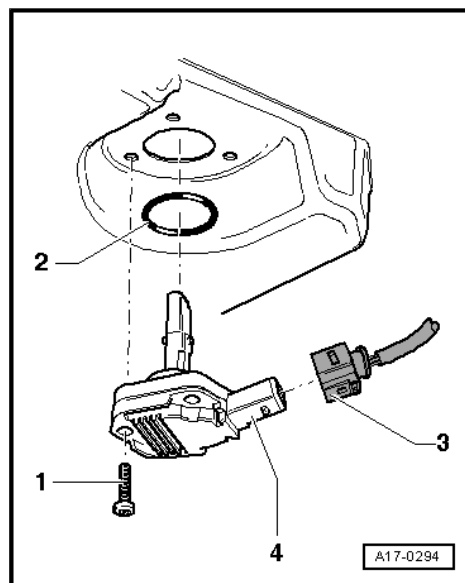
Tightening torques

- ◆ ⇒ [“1.1 Exploded view - sump, oil pump, balance shaft assembly”, page 140](#)

**Note**

Renew seal -2- and self-locking bolts -1-.

- Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .



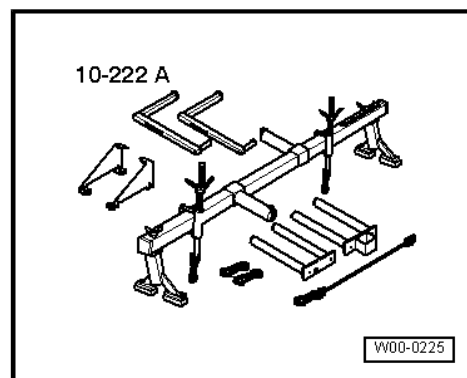
1.3 Removing and installing sump

Special tools and workshop equipment required

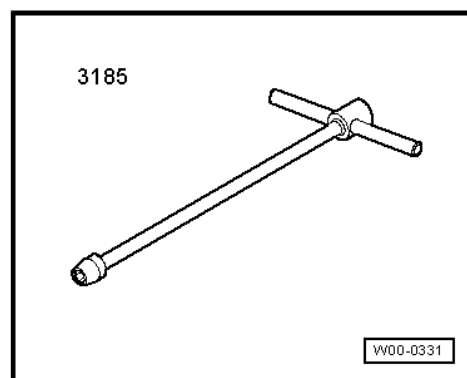
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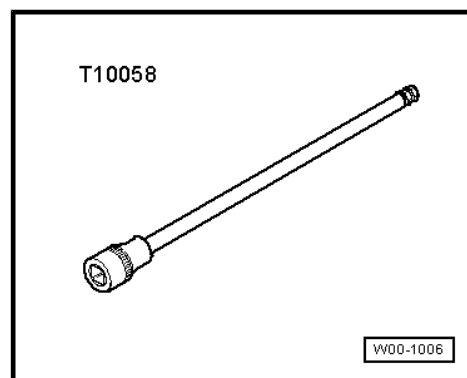
- ◆ Support bracket - 10 - 222 A-



- ◆ Articulated wrench, 10 mm - 3185-



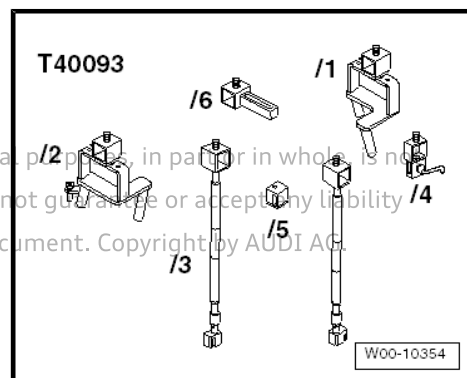
- ◆ Socket - T10058-



- ◆ Engine support bracket (supplementary set) - T40093-



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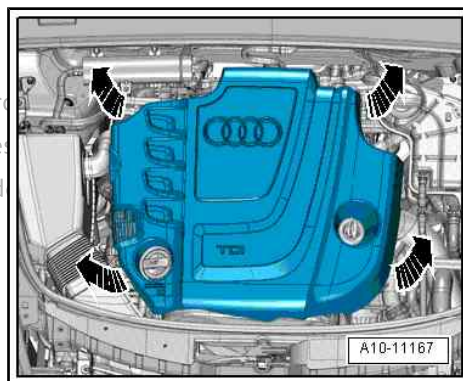




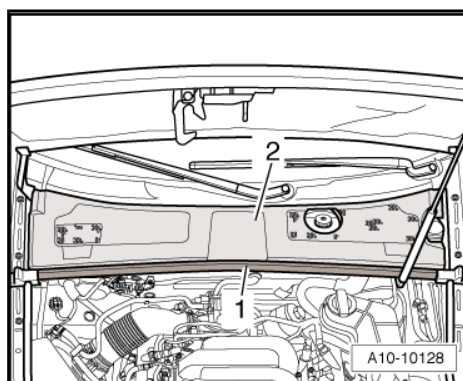
Removing

- Remove engine cover panel -arrows-.

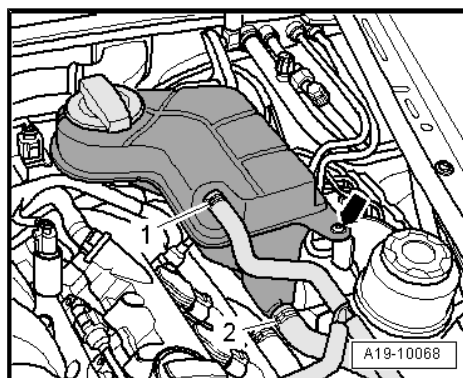
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- Pull off seal -1- and remove plenum chamber cover -2-.



- Remove bolt -arrow-.
- Unplug electrical connector at coolant shortage indicator switch - F66- and move expansion tank to one side with coolant hoses -1- and -2- attached.

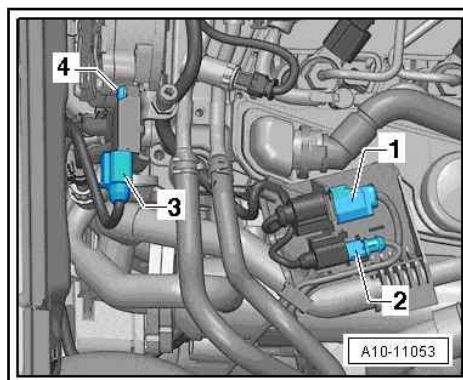


- Unplug electrical connector -3-, remove bolt -4- and push exhaust gas pressure sensor 1 - G450- to side.



Note

Disregard items -1 and 2-.



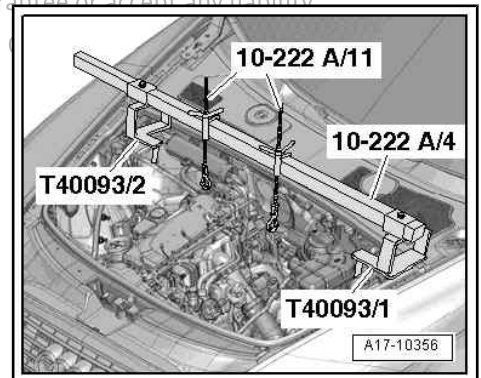
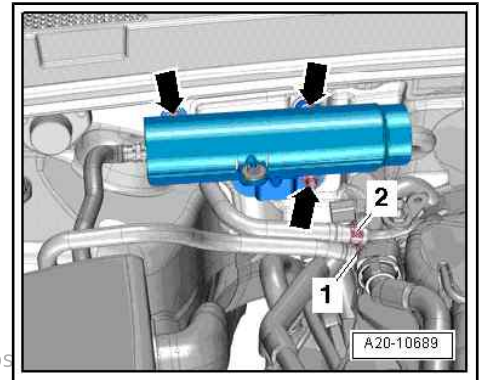


- Remove nuts -arrows- and move fuel filter bracket clear to one side (fuel hoses -1- and -2- remain connected).



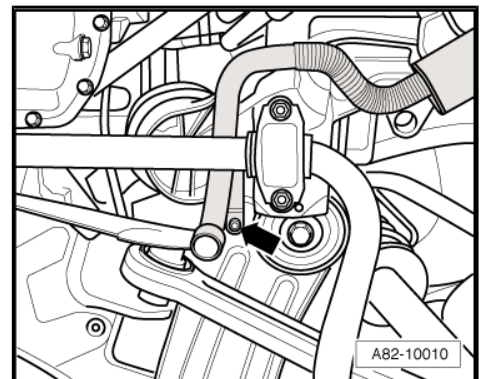
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- Set up adapter - 10 - 222 A /4- with spindles -10 - 222 A /11- and supports T40093/1 and T40093/2 on suspension turners as shown in illustration.
- Supports are marked for left and right side of vehicle.
- Engage spindles -10 - 222 A /11- at rear engine lifting eye (left and right).
- Partly take up weight of engine with spindles.
- Drain off engine oil ⇒ Maintenance ; Booklet 405 .

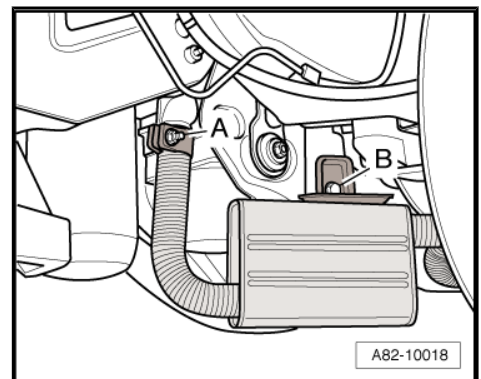


Vehicles with auxiliary heater:

- Remove front left wheel housing liner ⇒ Rep. gr. 66 .
- Remove bolt -arrow- for corrugated exhaust pipe.



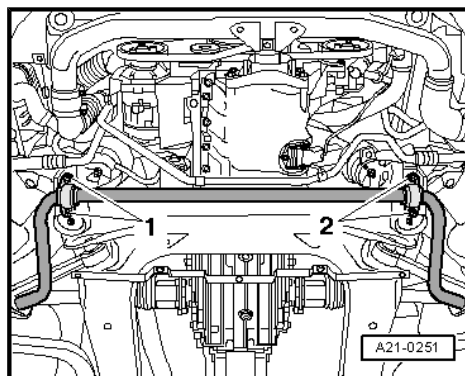
- Slacken nut -A- on clamp for corrugated exhaust pipe.
- Remove bolt -B- and detach silencer with corrugated exhaust pipes.



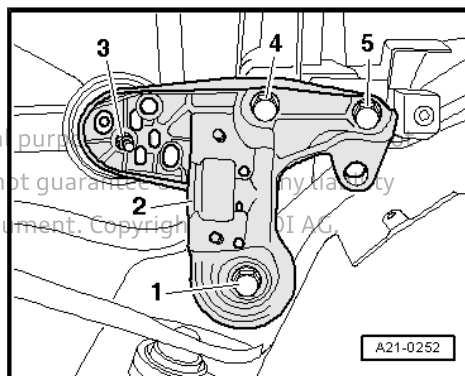


All vehicles (continued):

- Remove bolts -1- and -2- for anti-roll bar mounting on both sides and slightly lower anti-roll bar.

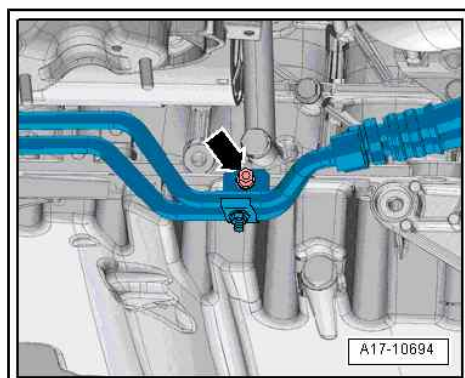


- Unscrew nut -3-.
- Remove bolts -1, 4, 5- and detach console for engine mounting -2- and engine mounting (left-side).
- Perform the same work steps on the other side of the vehicle.
- Lower subframe at the front.
- Remove torque reaction support [⇒ page 44](#).



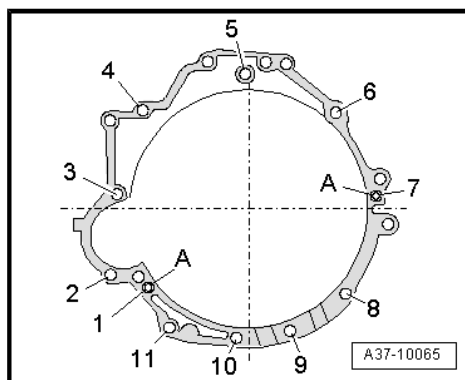
Vehicles with multitronic gearbox:

- Remove bolt -arrow- on bracket for ATF lines.



All vehicles (continued):

- Remove bolts -8 ... 11- securing sump to gearbox.





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



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



Note

- ◆ Bolts -17- and -18- can only be unscrewed using socket - T10058- .
- ◆ When unscrewing bolts -17- and -18- they come into contact with flywheel. However, this does not damage bolts and tapped holes.

- Carefully release sump from bonded joint.

Installing



Caution

Protect lubrication system and bearings against contamination.

- ◆ Cover exposed parts of the engine.

- Remove sealant remaining on cylinder block with flat scraper.

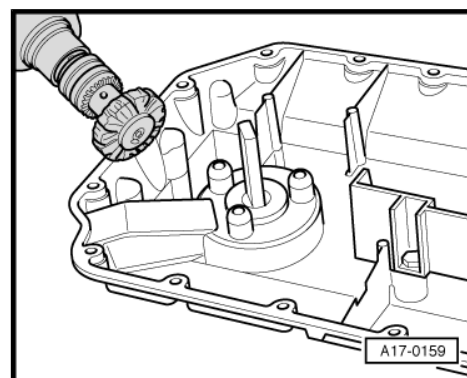
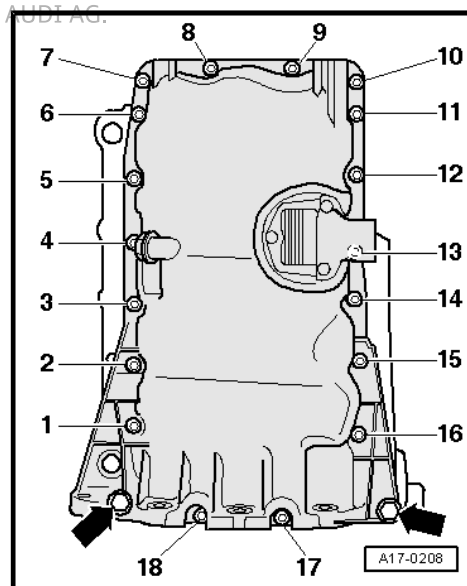
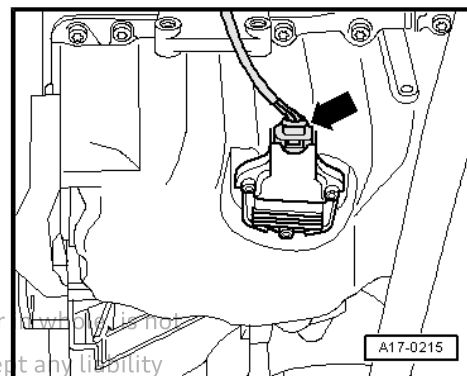


WARNING

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.

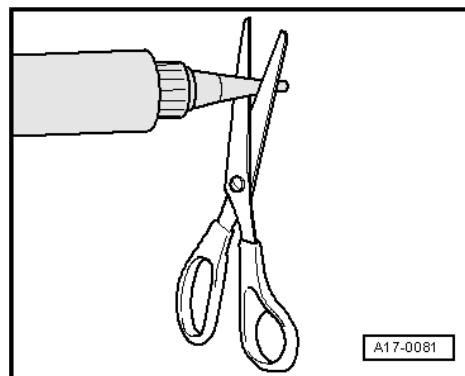




Note

Note the use-by date of the sealant.

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



Caution

Make sure lubrication system is not clogged by excess sealant.

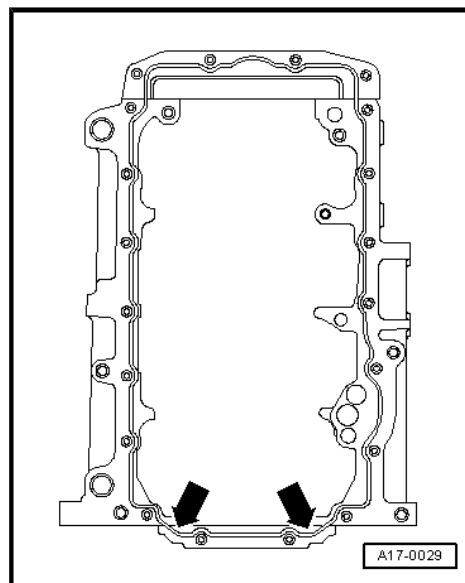
◆ ***The sealant bead must not be thicker than specified.***

- Apply sealant bead onto clean sealing surface of sump as illustrated.
- Thickness of sealant bead: 2 ... 3 mm.
- The bead of sealant must pass round the inside of the bolt holes as shown in the illustration.



Note

- ◆ *The illustration shows the position of the bead of sealant on the cylinder block.*
- ◆ *Take particular care when applying sealant bead in area of sealing flange (gearbox end) -arrows-.*
- ◆ *The sump must be installed within 5 minutes after applying the sealant.*



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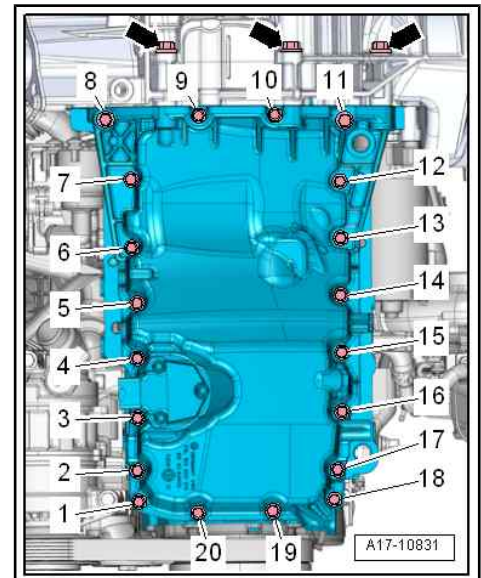


- Fit sump and tighten bolts ⇒ [page 143](#) .
- The sump must make flush contact with intermediate plate/ gearbox flange.



Note

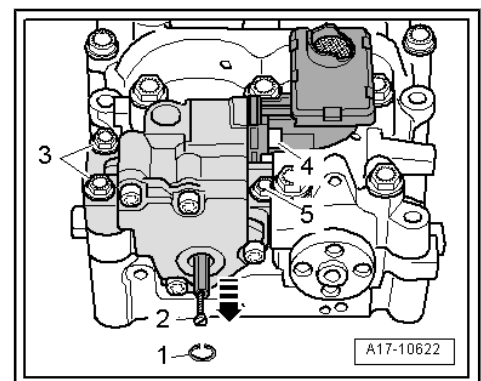
- ◆ *When installing sump with engine removed from vehicle, ensure that sump is positioned flush with cylinder block at fly-wheel end.*
- ◆ *After fitting sump, sealant must dry for approx. 30 minutes. Then (and only then) fill the engine with engine oil.*
- Tighten bolts ⇒ [page 143](#) .
- Vehicles with multitronic gearbox: secure ATF lines ⇒ Rep. gr. 37 .
- Install torque reaction support ⇒ [page 44](#) .
- Install subframe and anti-roll bar ⇒ Rep. gr. 40 .
- Install consoles for engine mountings with engine mountings ⇒ [page 35](#) .
- On vehicles with auxiliary heater: install exhaust silencer with corrugated exhaust pipes ⇒ Rep. gr. 82 .
- Secure exhaust gas pressure sensor 1 - G450- ⇒ Rep. gr. 23 .
- Install fuel filter ⇒ Rep. gr. 20 .
- Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 405 .



1.4 Removing and installing oil pump

Removing

- Remove sump ⇒ [page 144](#) .
- Remove bolt -4- and detach intake connecting pipe from oil pump.
- Remove circlip -1- using circlip pliers.
- If there is a thread in the drive shaft, screw an M3 bolt -2- into drive shaft and pull drive shaft out of oil pump -arrow-.



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Note

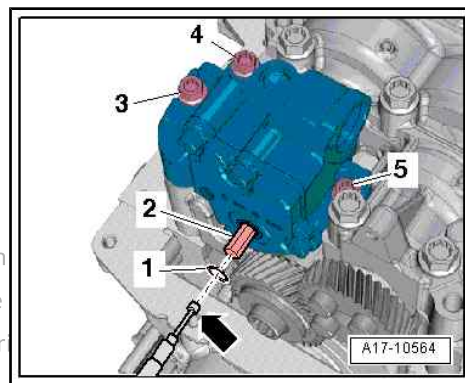
- ♦ If there is no thread in the drive shaft, use a magnet -arrow- and pull the drive shaft out of the oil pump.
- ♦ Pull drive shaft -2- out of oil pump using a magnet -arrow-.

- 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 reverse order; note the following:

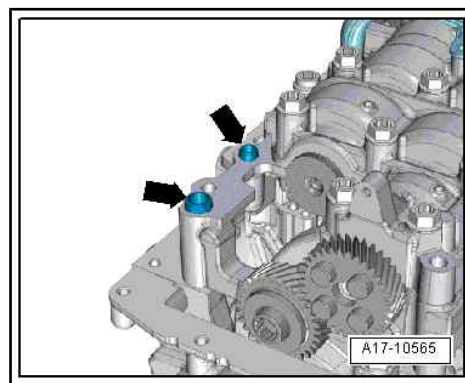
Tightening torques

- ♦ ⇒ ["1.1 Exploded view - sump, oil pump, balance shaft assembly", page 140](#)



Note

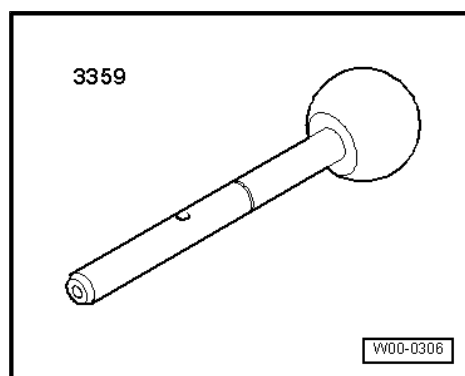
- ♦ Renew O-ring.
- ♦ Renew circlip if damaged or stretched.
- ♦ Circlip must fit securely in groove.
- Insert dowel sleeves -arrows- in oil pump, if not fitted.
- If no dowel sleeves for centring the oil pump are fitted in the balance shaft assembly, install missing dowel sleeves.
- Install sump ⇒ [page 144](#) .



1.5 Removing balance shaft assembly

Special tools and workshop equipment required

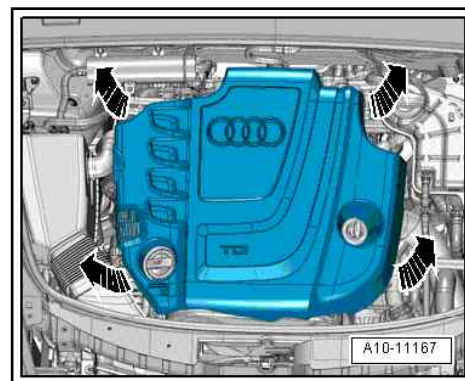
- ♦ Diesel injection pump locking pin - 3359-



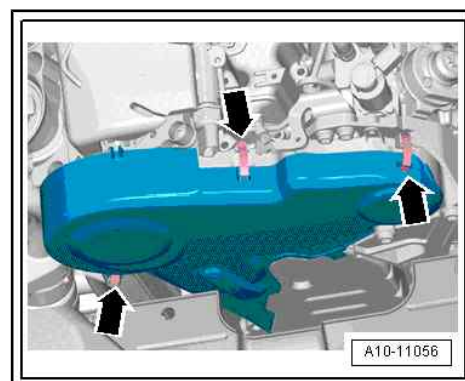


Procedure

- Remove engine cover panel -arrows-.



- Open clips -arrows- and remove toothed belt cover.



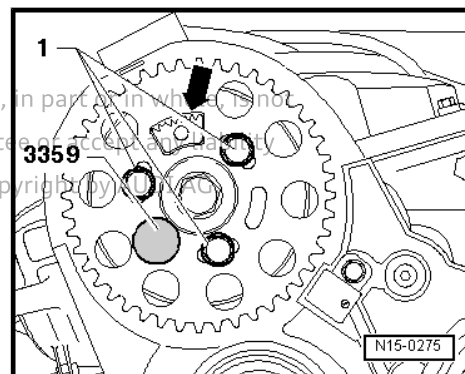
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Irreparable damage can be caused if the toothed belt slips.

◆ **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- .
- The toothed segment -arrow- must face upwards.



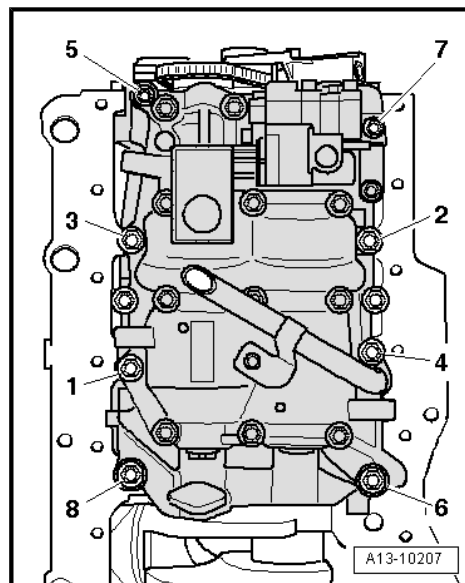
Note

Disregard -item 1-.

- Remove sump ⇒ [page 144](#) .



- Balance shaft assembly with eight attachment points: Loosen bolts in the sequence -8 ... 1-.

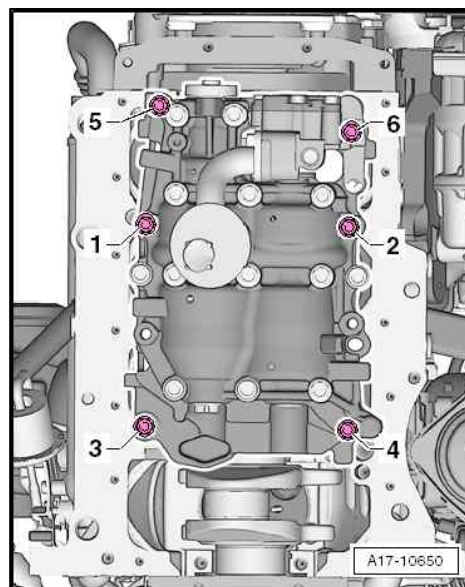


- Balance shaft assembly with six attachment points: Loosen bolts in the sequence -6 ... 1-.



Note

- ♦ ➔ [“1.6 Installing a new balance shaft assembly”, page 154](#)
- ♦ ➔ [“1.7 Re-installing a used balance shaft assembly”, page 157](#)



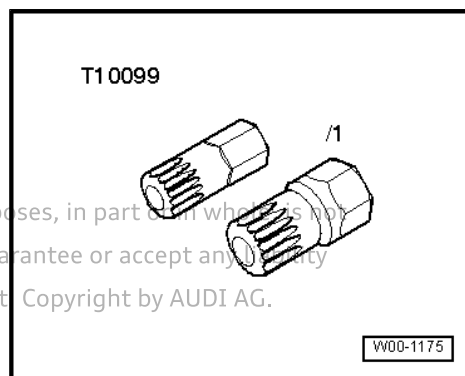
1.6 Installing a new balance shaft assembly

Special tools and workshop equipment required

- ♦ Bits - T10099-

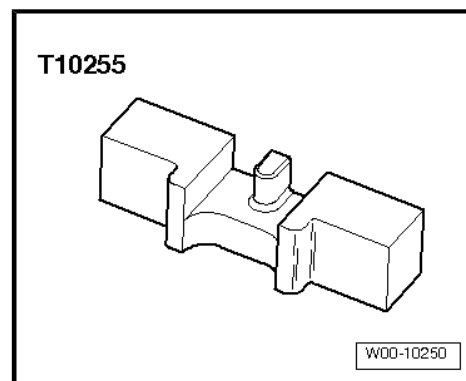


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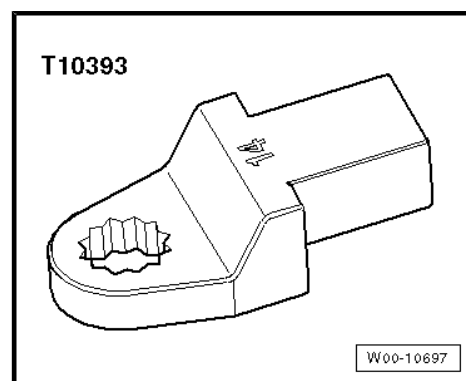




- ◆ Locking tool - T10255-



- ◆ Insert tool, 14 mm - T10393-



Procedure

Tightening torques

- ⇒ ["1.1 Exploded view - sump, oil pump, balance shaft assembly", page 140](#)



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 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](#)**

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- 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 for centring balance shaft assembly ⇒ [Item 18 \(page 141\)](#) in cylinder block.



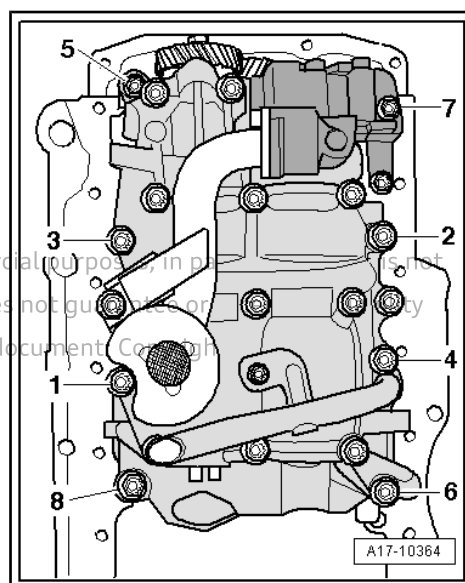
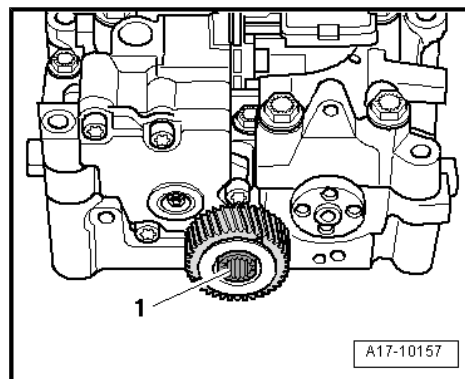
Note

Take care not to damage coating on idler gear.

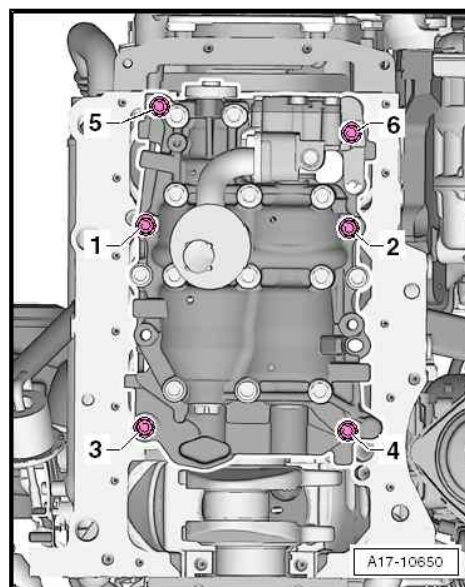
- Attach balance shaft assembly to cylinder block.
- Balance shaft assembly with eight attachment points: Tighten bolts for balance shaft assembly ⇒ [page 143](#) .



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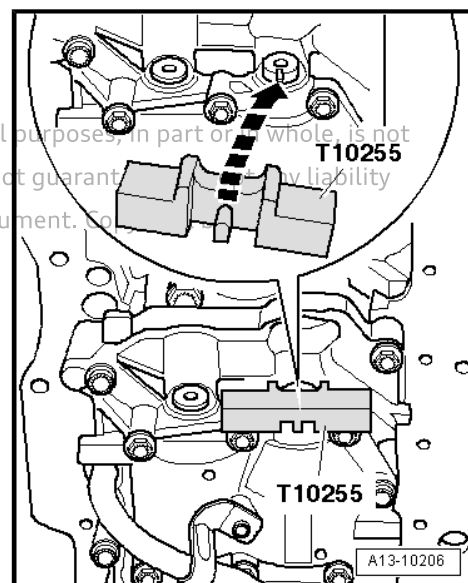
- Balance shaft assembly with six attachment points: Tighten bolts for balance shaft assembly ⇒ [page 144](#) .





- Lock balance shaft with locking tool - T10255- ; turn balance shaft to do so, if necessary.
- The lug of the locking tool must engage in the groove of the balance shaft.

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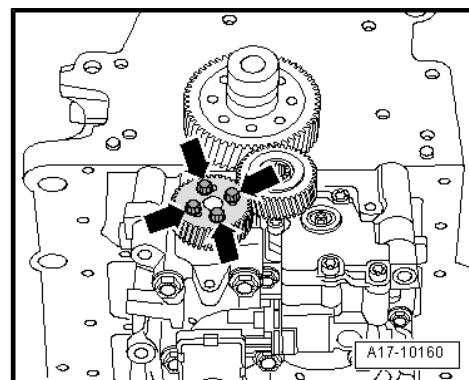
- Carefully fit balance shaft gear onto balance shaft; to do so, push idler gear slightly to one side.



Note

- ◆ Check whether threaded holes of balance shaft align centrally with elongated holes of balance shaft gear.
- ◆ 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.

- Secure balance shaft gear -arrows-.
- Detach locking tool - T10255- .



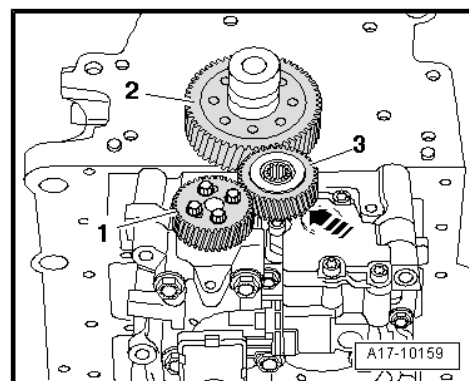
The following three steps have to be performed simultaneously (a second mechanic is therefore required):

- 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.
- Turn balance shaft gear slightly anti-clockwise when doing this.
- Tighten new bolt for idler gear ⇒ [Item 14 \(page 141\)](#) .



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:

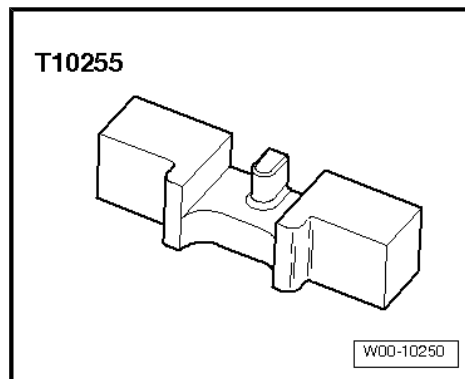
- Install sump ⇒ [page 144](#) .
- Install vibration damper ⇒ [page 50](#) .

1.7 Re-installing a used balance shaft assembly

Special tools and workshop equipment required



- ◆ Locking tool - T10255-



Procedure

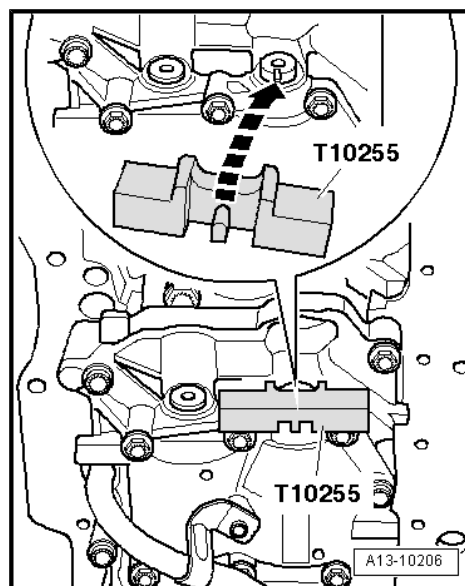
Tightening torques

- ⇒ [“1.1 Exploded view - sump, oil pump, balance shaft assembly”, page 140](#)



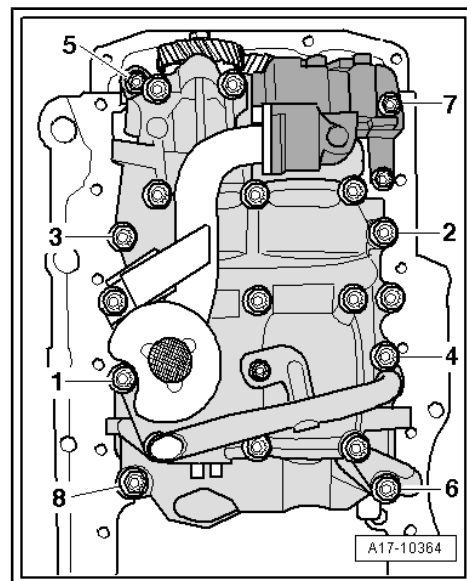
Note

- ◆ *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 ⇒ [“1.6 Installing a new balance shaft assembly”, page 154](#)*
- ◆ *Renew 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 for centring balance shaft assembly ⇒ [Item 18 \(page 141\)](#) in cylinder block.
- 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.





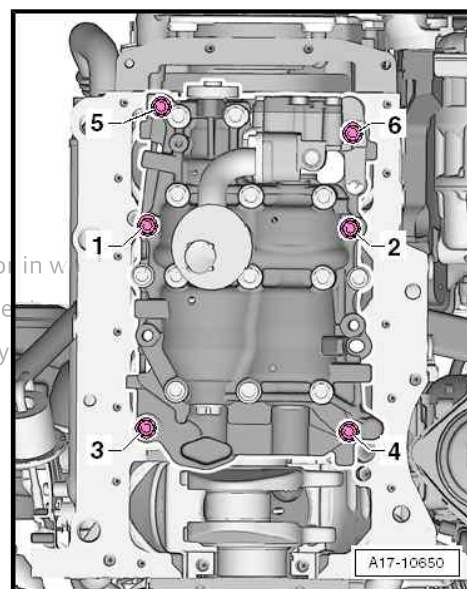
- Balance shaft assembly with eight attachment points: Tighten bolts for balance shaft assembly ➔ [page 143](#) .



- Balance shaft assembly with six attachment points: Tighten bolts for balance shaft assembly ➔ [page 144](#) .

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

- Install sump ➔ [page 144](#) .
- Install vibration damper ➔ [page 50](#) .



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2 Oil filter housing, engine oil cooler and oil supply line

Overview

- ◆ ⇒ [“2.1 Exploded view - oil filter housing and engine oil cooler”, page 160](#)
- ◆ ⇒ [“2.2 Removing and installing oil filter housing with engine oil cooler”, page 162](#)
- ◆ ⇒ [“2.3 Removing and installing engine oil cooler”, page 163](#)
- ◆ ⇒ [“2.5 Removing and installing oil pressure switch F1”, page 166](#)
- ◆ ⇒ [“2.6 Checking oil pressure”, page 167](#)
- ◆ ⇒ [“2.7 Engine oil”, page 168](#)
- ◆ ⇒ [“2.8 Checking oil level”, page 168](#)

2.1 Exploded view - oil filter housing and engine oil cooler

1 - Gasket

- ☐ Renew

2 - Bolt

- ☐ Renew
- ☐ Tightening torque and sequence ⇒ [page 161](#)

3 - Oil filter housing

- ☐ With oil retention valve
- ☐ Removing and installing ⇒ [page 162](#)

4 - Seal

- ☐ Renew

5 - Connection

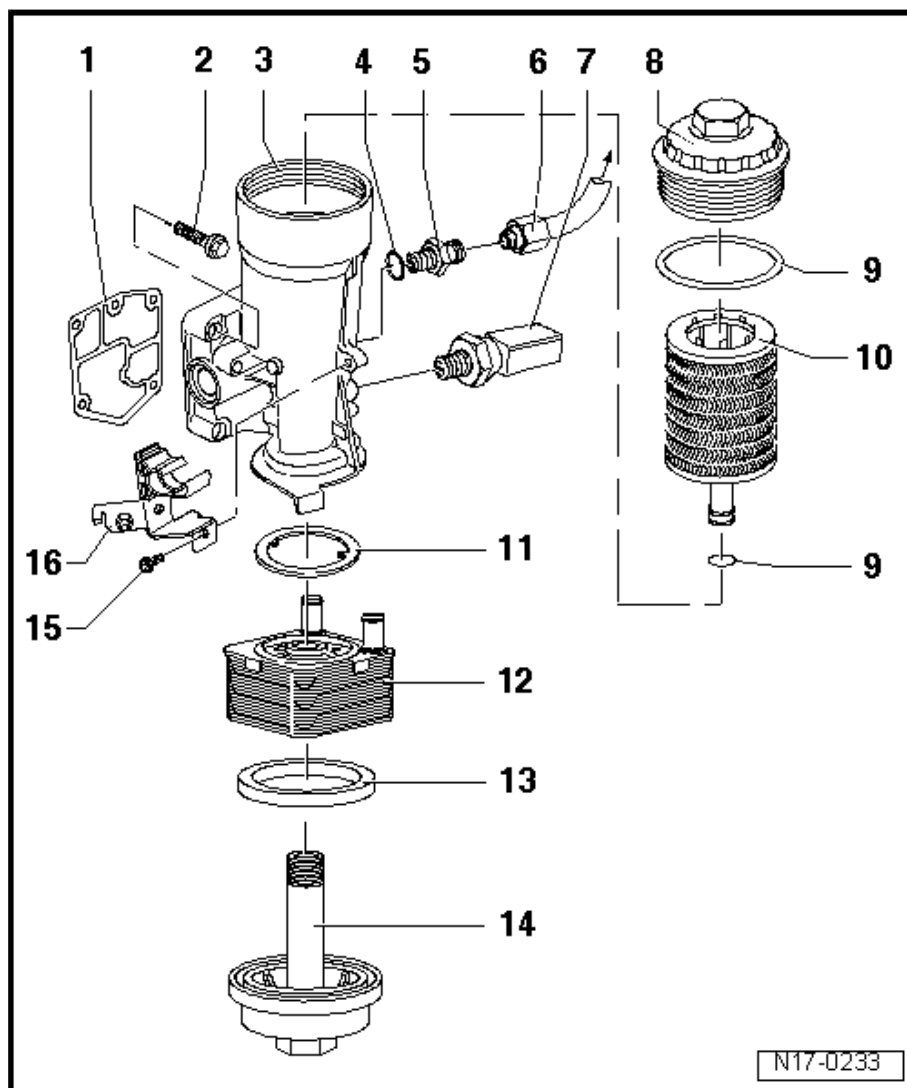
- ☐ 33 Nm

6 - Oil supply line

- ☐ To turbocharger
- ☐ Installation sequence:
 - Screw in union nuts by hand until they make contact.
 - Tighten union nuts to 22 Nm.
 - Secure bracket.

7 - Oil pressure switch - F1-

- ☐ With seal
- ☐ Renew seal.
- ☐ Opening/closing pressure 0.7 bar
- ☐ Brown insulation
- ☐ Removing and installing ⇒ [page 166](#)
- ☐ 20 Nm





- ☐ ⇒ [“2.4 Removing and installing oil supply line”, page 165](#)

8 - Sealing cap

- ☐ 25 Nm

9 - O-ring

- ☐ Renew

10 - Oil filter element

- ☐ Removing and installing ⇒ [Maintenance ; Booklet 405](#)

11 - Gasket

- ☐ Renew
- ☐ Installation position ⇒ [page 162](#)

12 - Engine oil cooler

- ☐ See note ⇒ [page 71](#)
- ☐ Connection diagram - coolant hoses ⇒ [page 169](#)
- ☐ Removing and installing
⇒ [“2.2 Removing and installing oil filter housing with engine oil cooler”, page 162](#)

13 - Seal

- ☐ Renew

14 - Plug

- ☐ 25 Nm

15 - Bolt

- ☐ 9 Nm

16 - Bracket

- ☐ For wiring harness

Oil filter housing - tightening torque and sequence

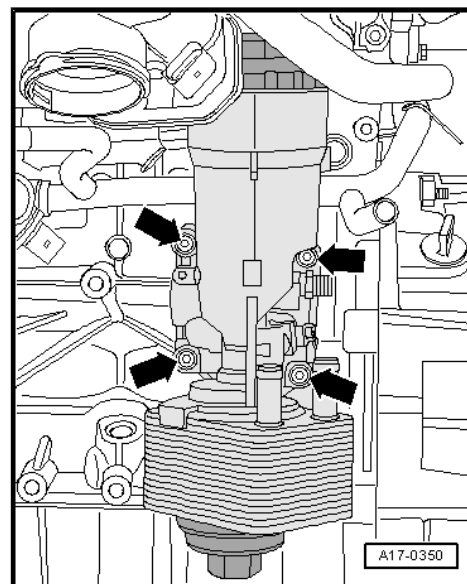


Note

Renew bolts tightened with specified tightening angle.

- Fit bolts at top left and bottom right first.
- Tighten bolts in 2 stages as follows:

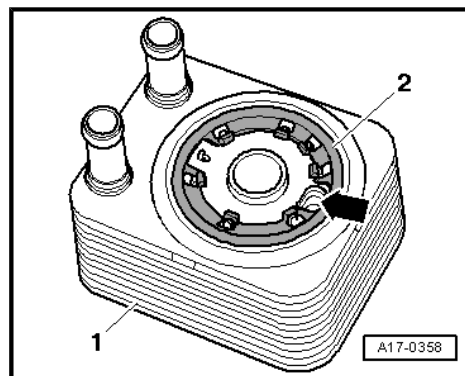
Stage	Bolts	Tightening torque/angle specification
1.	-Arrows-	14 Nm in diagonal sequence
2.	-Arrows-	Turn 90° further in diagonal sequence





Installation position of seal for engine oil cooler

- Fit seal -2- so it can be attached to all tabs on engine oil cooler -1-.
- The oil drilling -arrow- must not be covered by the seal.



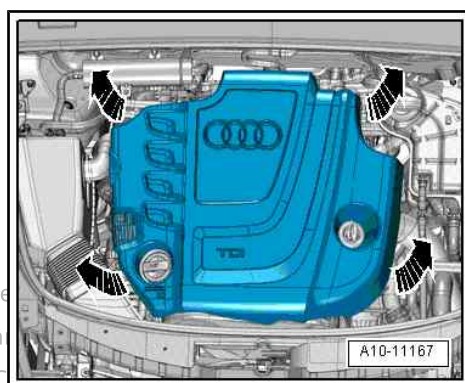
2.2 Removing and installing oil filter housing with engine oil cooler

Removing

- Remove engine cover panel -arrows-.
- Remove coolant pipe (top) ➔ [page 185](#) .



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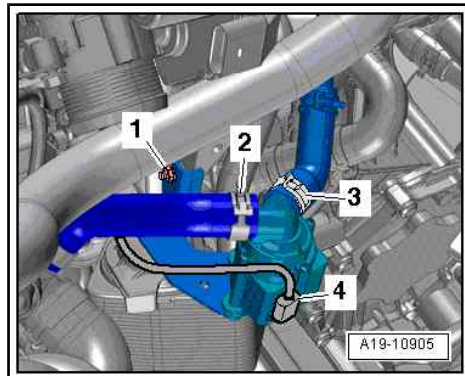
- Remove nut -1- and move pump for exhaust gas recirculation cooler - V400- clear to one side (coolant hoses -2- and -3- remain connected).



Note

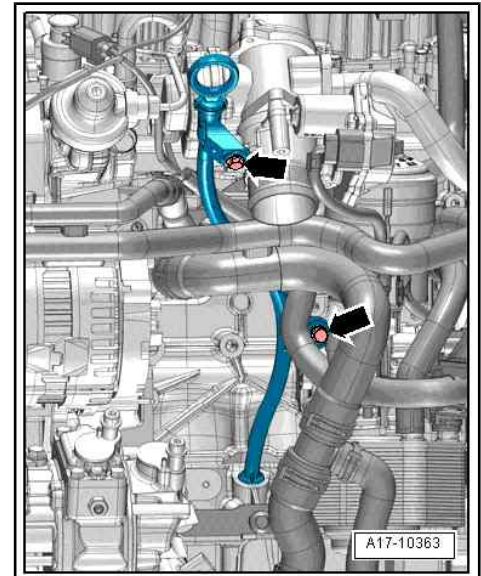
Disregard -item 4-.

- Drain coolant ➔ [page 171](#) .

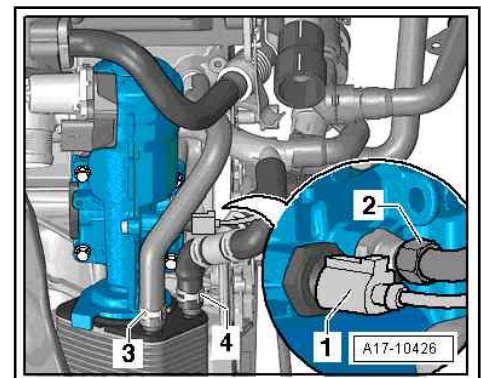




- Pull oil dipstick out slightly and remove bolts -arrows-.
- Pull guide tube for oil dipstick upwards out of cylinder block and push to one side.
- Remove oil filter element ⇒ Maintenance ; Booklet 405 .



- Unplug electrical connector -1-.
- Disconnect oil supply line -2-.
- Detach coolant hoses -3- and -4-; release hose clips to do so.



- Unscrew bolts -arrows- and remove oil filter housing.

Installing

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

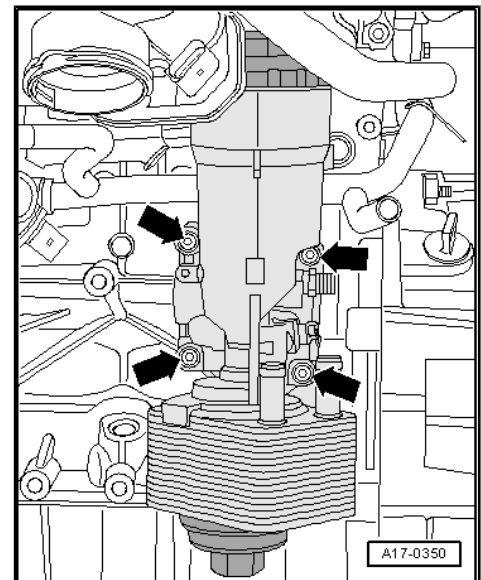


Note

Renew bolts tightened with specified tightening angle.

Tightening torques

- ◆ ⇒ [“2.1 Exploded view - oil filter housing and engine oil cooler”, page 160](#)
- ◆ ⇒ [“1.10 Exploded view - coolant pipes, coolant temperature senders, coolant circulation pump”, page 183](#)
- Install dipstick guide tube ⇒ [page 250](#) .
- Install coolant pipe (top) ⇒ [page 185](#) .
- Install oil filter element ⇒ Maintenance ; Booklet 405 .



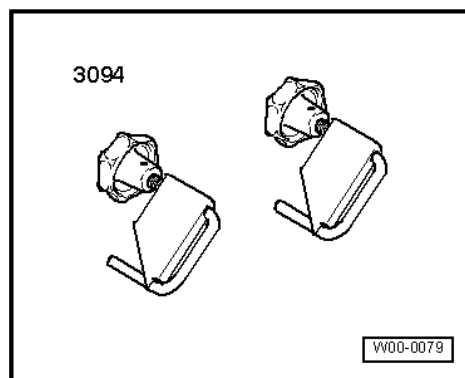
2.3 Removing and installing engine oil cooler

Special tools and workshop equipment required

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- ◆ Hose clamps up to 25 mm - 3094-



Removing

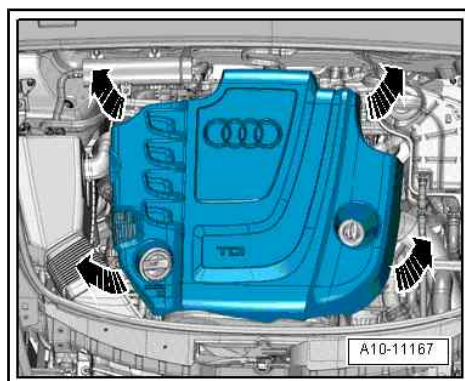
- Remove engine cover panel -arrows-.
- Remove oil filter element ⇒ Maintenance ; Booklet 405 .



WARNING

Risk of scalding due to hot steam and hot coolant.

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



- Open filler cap on coolant expansion tank.
- Clamp off coolant hoses with hose clamps up to 25 mm - 3094- as shown in illustration.



Note

Place a cloth underneath the connection to catch escaping coolant.

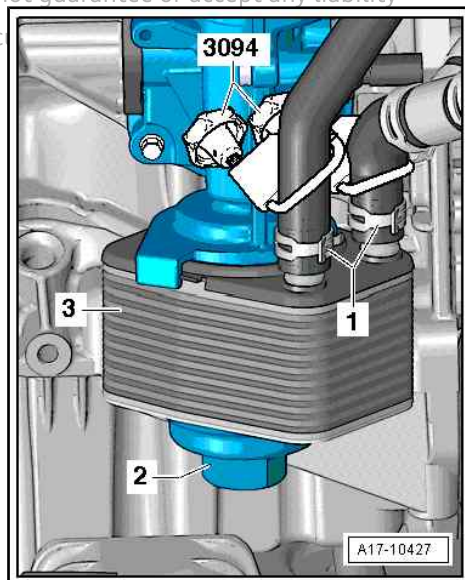
- Release hose clips -1- and detach coolant hoses.
- Unscrew sealing cap -2- and take out engine oil cooler -3-.

Installing

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

Tightening torques

- ◆ Tightening torques
⇒ ["2.1 Exploded view - oil filter housing and engine oil cooler", page 160](#)

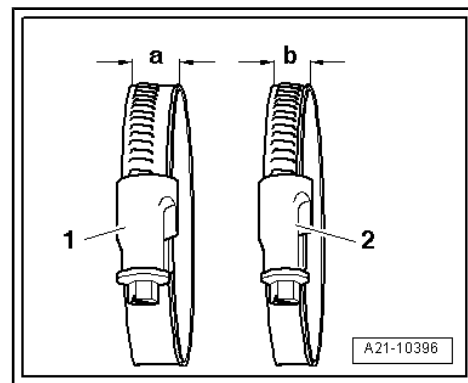


Note

- ◆ *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 .*



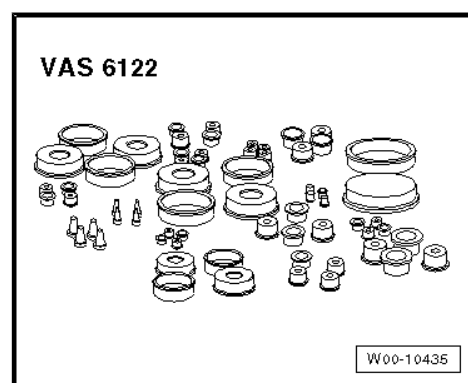
- Install air hoses with screw-type clips ⇒ [page 210](#) .
- Fill up with coolant ⇒ [page 172](#) .
- Install oil filter element ⇒ Maintenance ; Booklet 405 .



2.4 Removing and installing oil supply line

Special tools and workshop equipment required

- ♦ Engine bung set - VAS 6122-



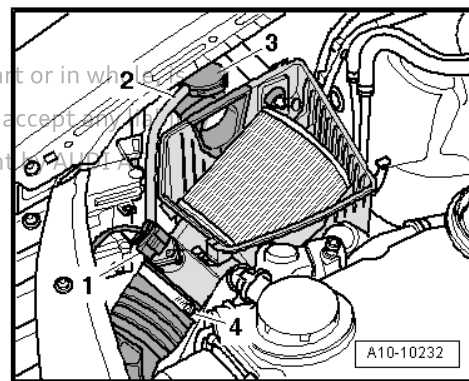
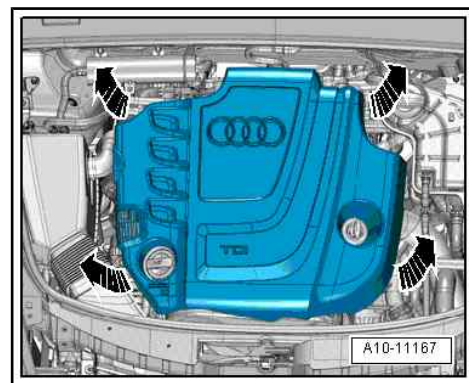
Removing

- Remove engine cover panel -arrows-.



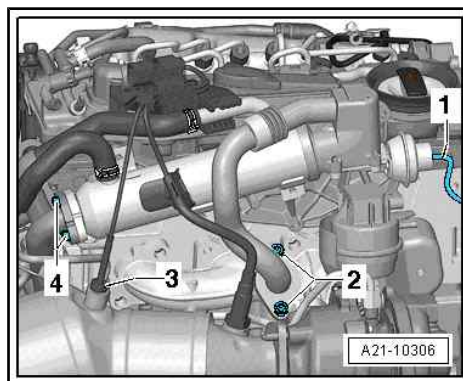
- Remove air cleaner housing ⇒ Rep. gr. 23 .

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- Disconnect vacuum hose -1-.
- Remove bolts -2- and -4-.



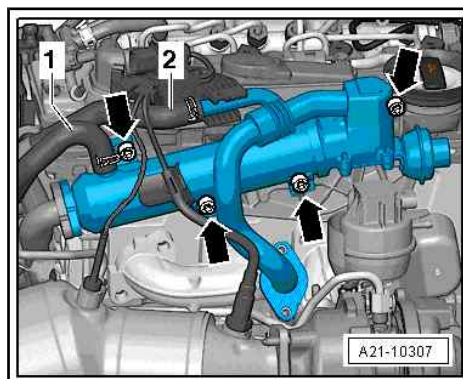
- Remove bolts -arrows- from exhaust gas recirculation cooler and place cooler to one side.



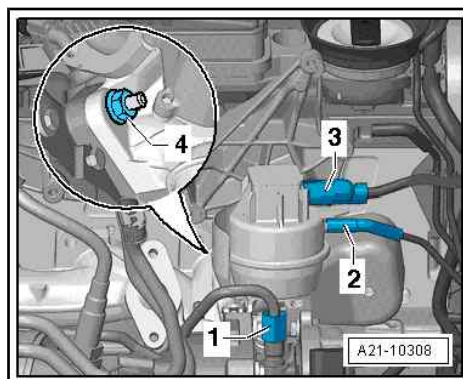
Note

Coolant hoses -1- and -2- must not be detached.

- Unfasten oil supply line from fluid connection and cylinder head (rear).



- Remove union nut -1- from turbocharger.



- Remove oil supply line -2- from oil filter flange and lift oil supply line out.

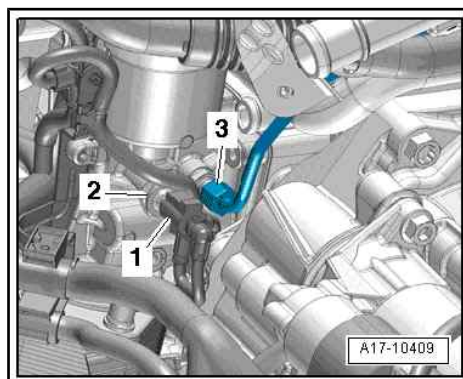
Installing

Installation is carried out in reverse sequence.

Check oil level ⇒ Maintenance ; Booklet 405 .

Tightening torques

- ♦ ⇒ ["2.1 Exploded view - oil filter housing and engine oil cooler", page 160](#)



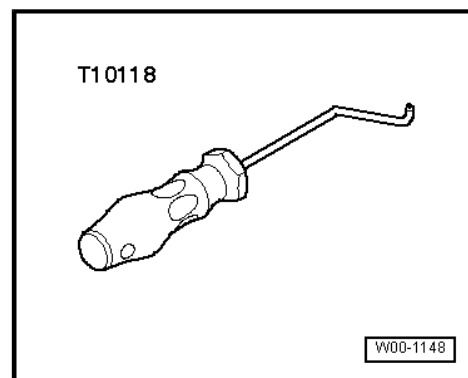
2.5 Removing and installing oil pressure switch - F1-

Special tools and workshop equipment required

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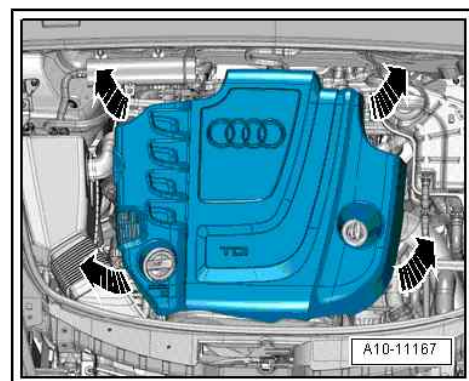


- ◆ Assembly tool - T10118-



Removing

- Remove engine cover panel -arrows-.



- Unplug electrical connector -1- at oil pressure switch - F1- using assembly tool - T10118- .
- Remove oil pressure switch - F1- -item 2-.



Note

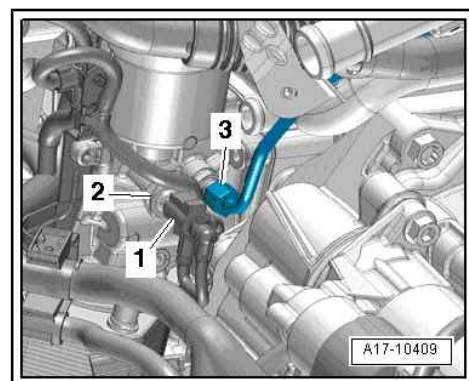
Disregard -item 3-.

Installing

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

Tightening torques

- ◆ ⇒ [“2.1 Exploded view - oil filter housing and engine oil cooler”, page 160](#)



Note

Renew seal.



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2.6 Checking oil pressure

Special tools and workshop equipment required



◆ Oil pressure tester - V.A.G 1342-

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Procedure

- Oil level OK
- Remove oil pressure switch - F1- ➔ [page 166](#) .
- 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 0.8 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 151](#) .

If specification is obtained, let engine warm up.

- Oil pressure specification at operating temperature and 2000 rpm: at least 2.0 bar.

Assembling

- Install oil pressure switch - F1- ➔ [page 166](#) .

2.7 Engine oil

Oil capacities, oil specifications and viscosity grades ➔ Maintenance tables .

2.8 Checking oil level

Check oil level ➔ Maintenance ; Booklet 405 .



19 – Cooling

1 Parts of cooling system (on engine)

Overview

- ◆ ⇒ [“1.1 General notes”, page 169](#)
- ◆ ⇒ [“1.2 Connection diagram - coolant hoses”, page 169](#)
- ◆ ⇒ [“1.3 Draining and filling cooling system”, page 171](#)
- ◆ ⇒ [“1.4 Checking cooling system for leaks”, page 177](#)
- ◆ ⇒ [“1.5 Exploded view - coolant pump, thermostat, 4/2-way valve with thermostat”, page 178](#)
- ◆ ⇒ [“1.6 Removing and installing coolant pump”, page 179](#)
- ◆ ⇒ [“1.7 Removing and installing thermostat”, page 180](#)
- ◆ ⇒ [“1.9 Checking thermostat”, page 183](#)
- ◆ ⇒ [“1.10 Exploded view - coolant pipes, coolant temperature senders, coolant circulation pump”, page 183](#)
- ◆ ⇒ [“1.11 Removing and installing coolant pipe \(top\)”, page 185](#)
- ◆ ⇒ [“1.12 Removing and installing coolant pipe \(rear\)”, page 186](#)
- ◆ ⇒ [“1.13 Removing and installing coolant pipe \(bottom\)”, page 187](#)
- ◆ ⇒ [“1.14 Removing and installing pump for exhaust gas recirculation cooler V400”, page 188](#)
- ◆ ⇒ [“1.15 Removing and installing coolant temperature sender G62”, page 190](#)
- ◆ ⇒ [“1.16 Removing and installing radiator outlet coolant temperature sender G83”, page 191](#)

1.1 General notes



WARNING

Risk of scalding due to hot steam and hot coolant.

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



Note

- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- ◆ *The arrow markings on coolant pipes and on ends of hoses must align.*

1.2 Connection diagram - coolant hoses



1 - Radiator

- ☐ If renewed, refill system with fresh coolant

2 - Engine oil cooler

3 - Exhaust gas recirculation cooler

4 - Radiator outlet coolant temperature sender - G83-

5 - Coolant temperature sender - G62-

6 - Bypass

- ☐ Not always fitted
- ☐ Depending on production period and version of vehicle

7 - Coolant shut-off valve

- ☐ Not fitted on all versions
- ☐ Vehicles with auxiliary heater ⇒ Rep. gr. 82

8 - Bleeder screw

9 - Heat exchanger for heater

- ☐ Removing and installing ⇒ Rep. gr. 87
- ☐ If renewed, refill system with fresh coolant

10 - Hose thermostat

11 - Non-return valve

12 - Coolant expansion tank

- ☐ With filler cap
- ☐ Checking cooling system for leaks ⇒ [page 177](#)

13 - Pump for exhaust gas recirculation cooler - V400-

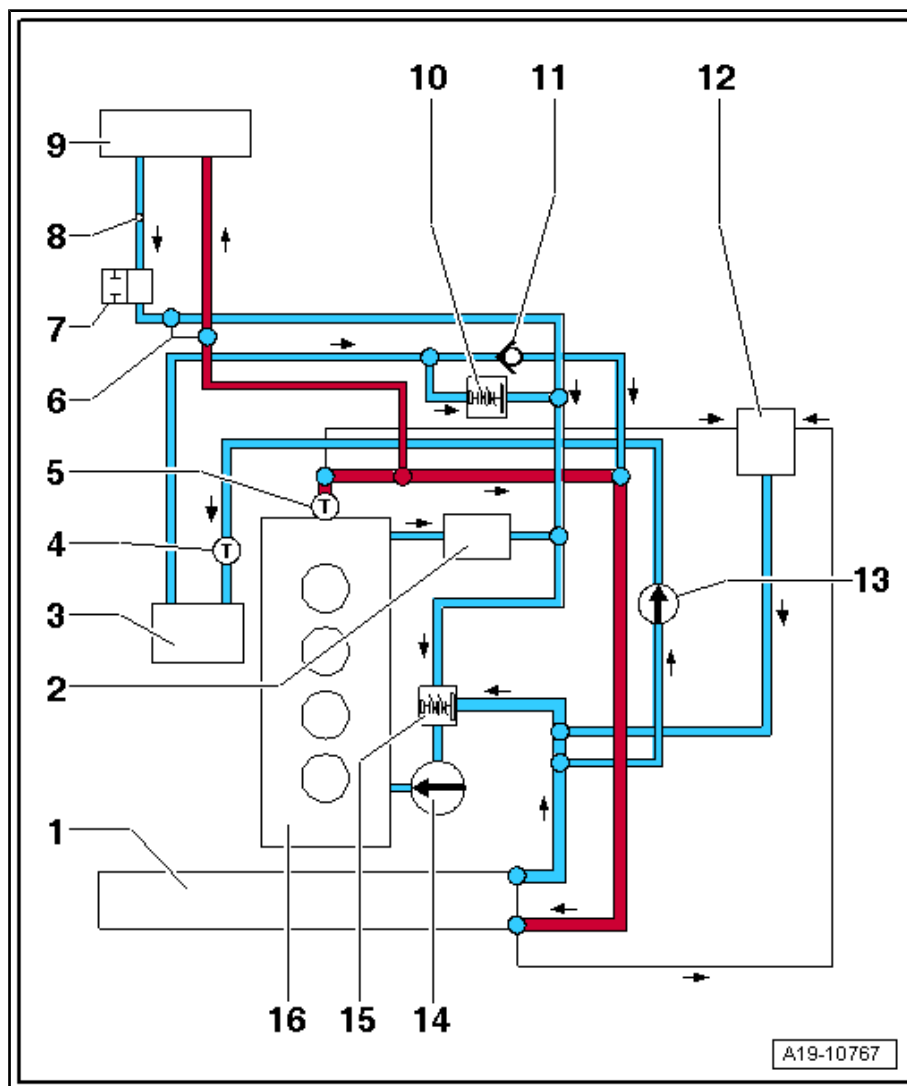
14 - Coolant pump

- ☐ Removing and installing ⇒ [page 179](#)

15 - Thermostat

16 - Cylinder head/cylinder block

- ☐ If renewed, refill system with fresh coolant

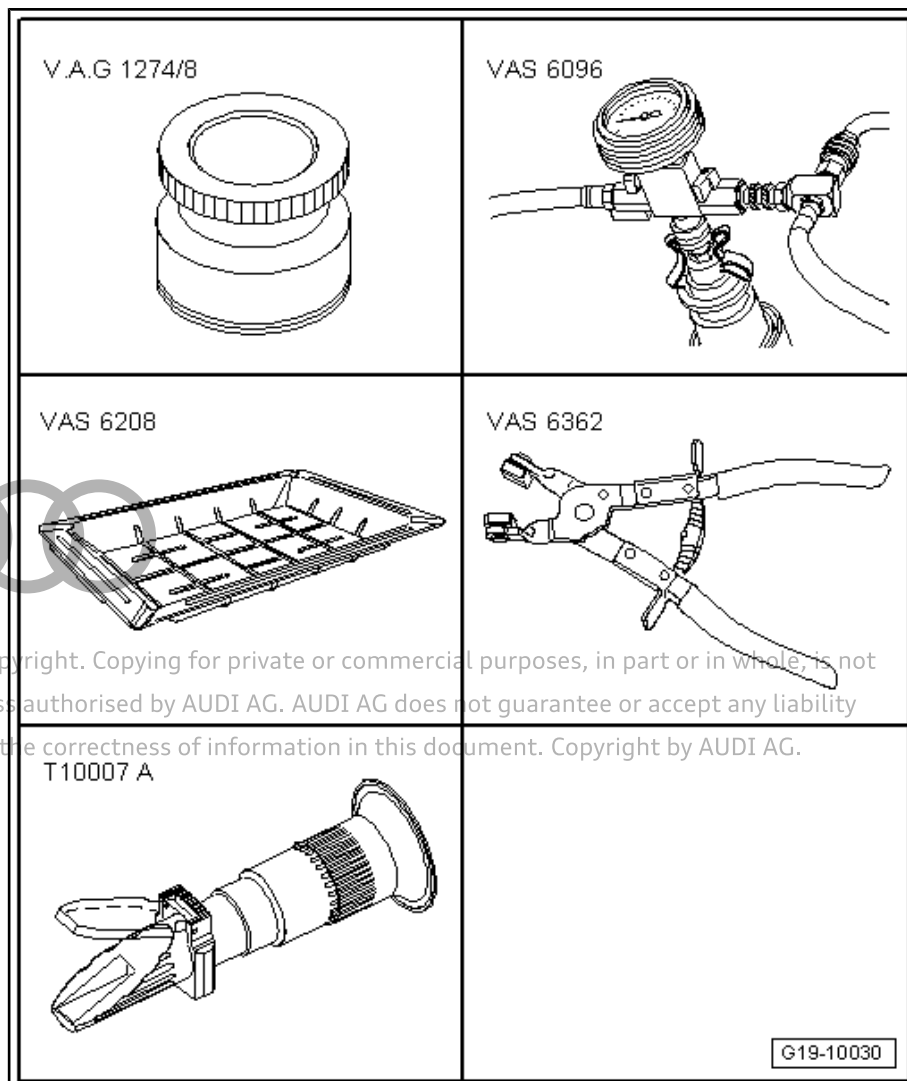


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1.3 Draining and filling cooling system

Special tools and workshop equipment required



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- ◆ Adapter for cooling system tester - V.A.G 1274/8-
- ◆ Drip tray for workshop hoist - VAS 6208-
- ◆ Cooling system charge unit - VAS 6096-
- ◆ Hose clip pliers - VAS 6362-
- ◆ Refractometer - T10007 A-

Draining



WARNING

Risk of scalding due to hot steam and hot coolant.

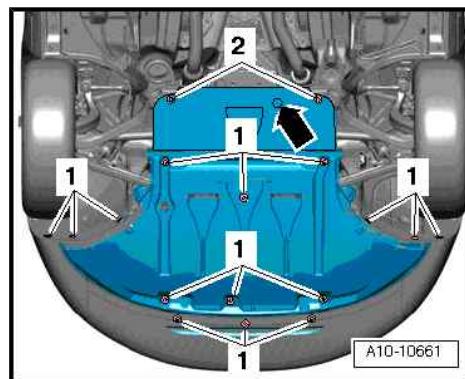
The cooling system is under pressure when the engine is hot.

Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.

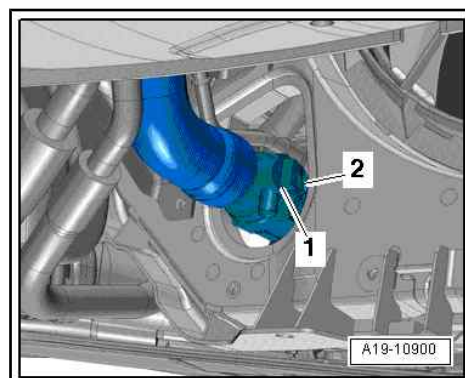
- Open filler cap on coolant expansion tank.



- Remove noise insulation panels ⇒ Rep. gr. 50 .



- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Remove drain plug -1- and drain off coolant.



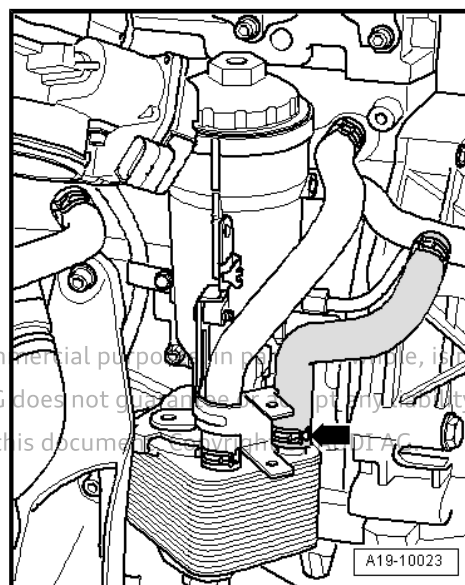
- Release hose clip -arrow-, disconnect rear coolant hose from engine oil cooler and drain off remaining coolant.

Filling



Caution

To ensure optimal corrosion protection, only distilled water may be mixed with coolant additives.

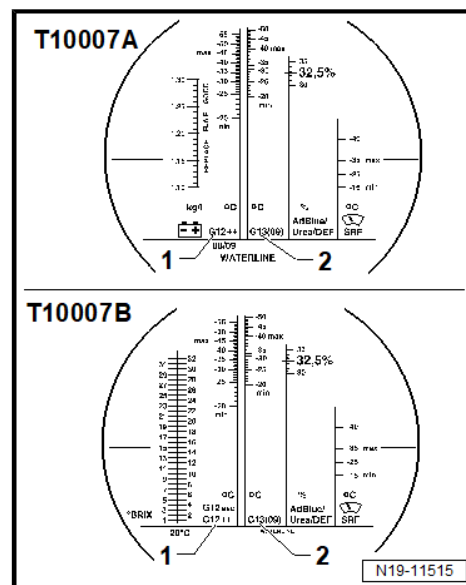


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Note

- ◆ 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.
- ◆ Refractometer - T10007A- or refractometer - T10007B- MUST be used to determine the current level of frost protection.
- ◆ Scale -1- on the refractometer applies to coolant additives G12 ++ and G12evo.
- ◆ Scale -2- on the refractometer applies to coolant additive G13.
- ◆ If more than one type of coolant additive has been used. Always use the scale for G13 to determine the anti-freeze 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.
- ◆ The temperature indicated on the refractometer 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.



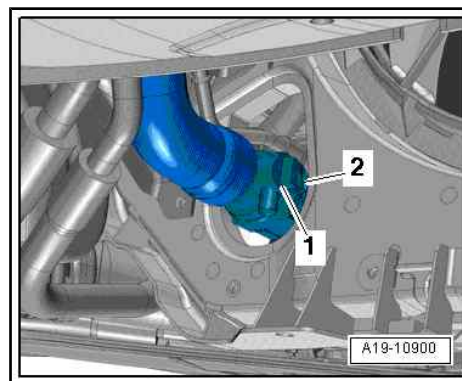
Recommended mixture ratio for coolant

- Coolant (40 %) and distilled water (60 %) for frost protection to -25 °C
- Coolant (50 %) and distilled water (50 %) for frost protection to -36 °C
- Coolant additive ⇒ Electronic parts catalogue (ETKA)

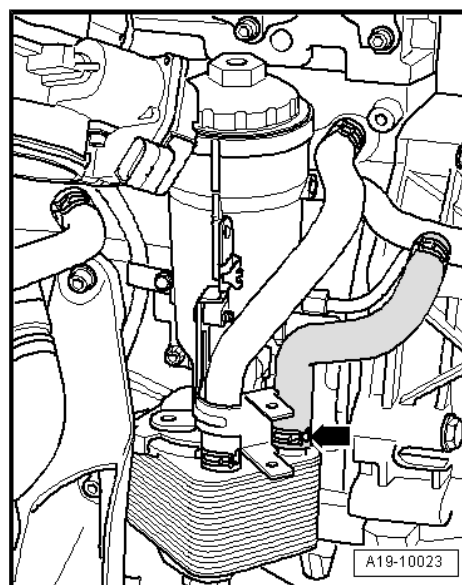


Procedure

- Close drain plug -1-.



- Connect rear coolant hose to engine oil cooler -arrow-.



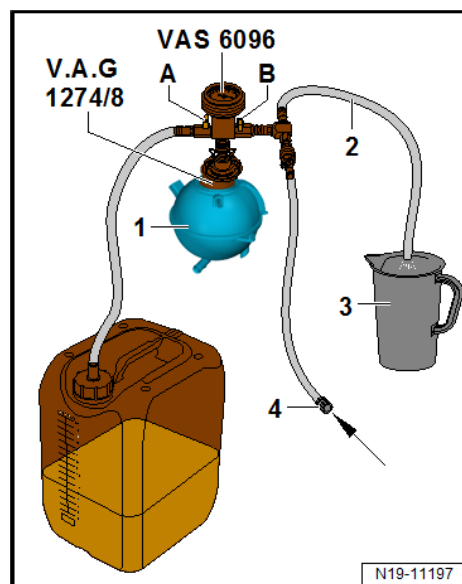
- Fill reservoir of -VAS 6096- with at least 8 litres of premixed coolant (according to recommended ratio):
- Fit adapter for cooling system tester - V.A.G 1274/8- onto coolant expansion tank.
- Attach cooling system charge unit - VAS 6096- to adapter - V.A.G 1274/8- .
- Run vent hose -2- into a small container -3-.



Note

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

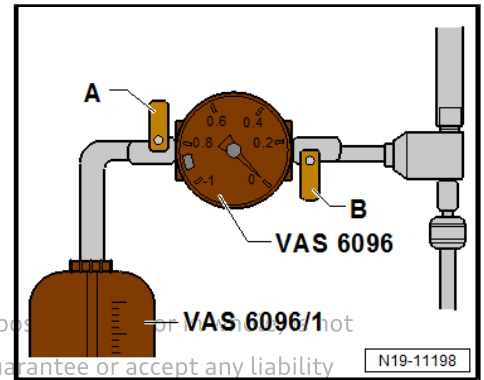
- Close both valves -A- and -B- (turn lever at right angles to direction of flow).
- Connect hose -4- to compressed air supply.
- Pressure: 7 ... 10 bar.



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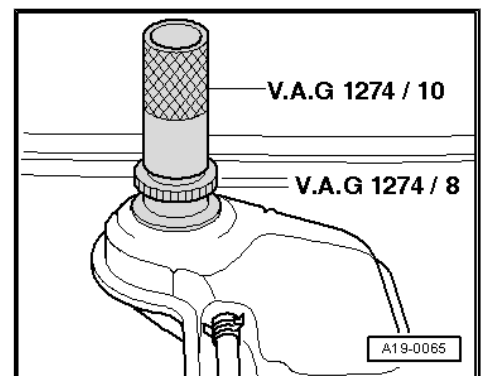


- Open valve -B- by setting lever in direction of flow.
- The suction jet pump generates a partial vacuum in the cooling system; the needle on the gauge should move into the green zone.
- Also briefly open valve -A- (turn lever in direction of flow) so that hose on reservoir of -VAS 6096- can fill with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



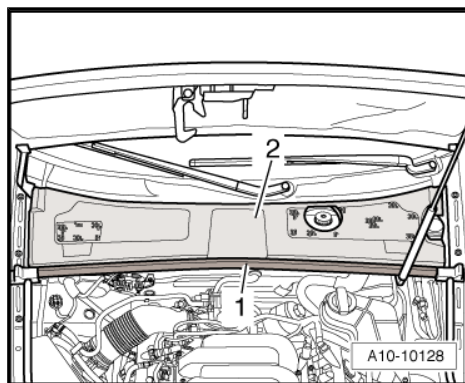
i Note

- ◆ *If the needle does not reach the green zone, repeat the process.*
- ◆ *Check cooling system for leaks if the vacuum is not maintained.*
- Detach compressed air hose.
- Open valve -A-.
- The vacuum in the cooling system causes the coolant to be drawn out of the reservoir of -VAS 6096- ; the cooling system is then filled.
- Detach cooling system charge unit - VAS 6096- from adapter -V.A.G 1274/8- on coolant expansion tank.
- Fit pipe for cooling system tester - V.A.G 1274/10- onto adapter for cooling system tester - V.A.G 1274/8- .
- Fill up pipe for cooling system tester - V.A.G 1274/10- with coolant.

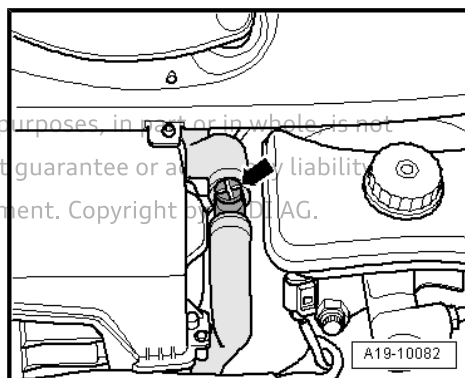




- Pull off seal -1- and remove plenum chamber cover -2-.



- Open bleeder screw -arrow- until coolant flows out at bleeder hole in coolant hose.
- Close bleeder screw.
- Fill up with coolant until it comes out at bleeder hole in coolant hose.
- Push coolant hose back onto connection and secure with spring-type hose clip.
- Detach pipe for cooling system tester - V.A.G 1274/10- and close filler cap on coolant expansion tank.
- Start engine.
- Set temperature to "HI" for all zones and select lowest possible blower speed (= 0).
- Switch off air conditioner compressor (press **AC** button).
- LED in button should not light up.
- Set fresh air blower to lowest setting.
- Run engine for 3 minutes at 2000 rpm.
- Allow engine to run at idling speed until both large coolant hoses at radiator become warm.
- Run engine for 1 minute at 2000 rpm.
- Switch off ignition and allow engine to cool down.
- Install noise insulation panels ⇒ Rep. gr. 50 .



WARNING

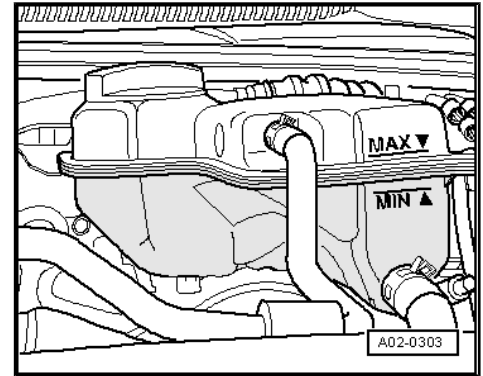
Risk of scalding due to hot steam and hot coolant.

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.



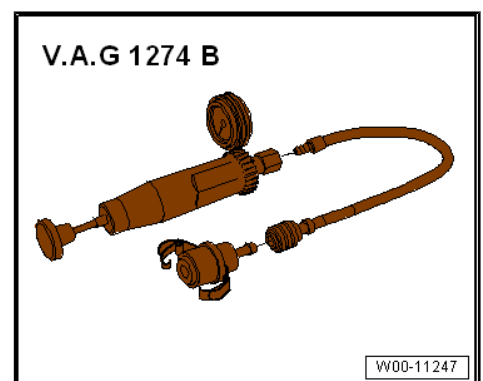
- Check coolant level.
- The coolant level must be at the “MAX” marking when the engine is cold.
- The coolant level can be above the “MAX” marking when the engine is warm.
- Top up with coolant again if necessary.



1.4 Checking cooling system for leaks

Special tools and workshop equipment required

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



- ◆ Adapter for cooling system tester - V.A.G 1274/8-



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



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Procedure

- Engine must be warm.



WARNING

*The cooling system is under pressure when the engine is hot.
Risk of scalding due to hot steam and hot coolant.*

Danger of scalding skin and other parts of the body.

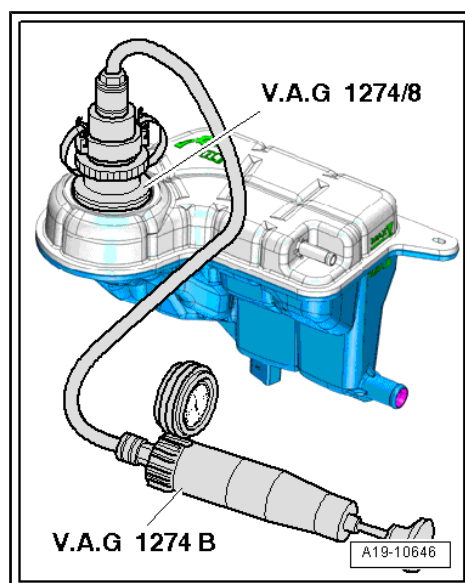
- ◆ *Put on protective gloves.*
- ◆ *Put on safety goggles.*
- ◆ *Cover filler cap on expansion tank with a cloth and open carefully to release pressure.*

- 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.



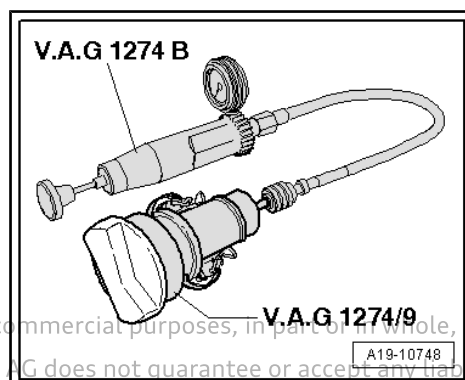
Note

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

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



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1.5 Exploded view - coolant pump, thermostat, 4/2-way valve with thermostat



1 - Bolt

- ☐ 15 Nm

2 - Coolant pump

- ☐ Removing and installing
⇒ [page 179](#)

3 - O-ring

- ☐ Renew

4 - O-ring

- ☐ Renew

5 - 4/2-way valve with thermostat

- ☐ Installed according to version
- ☐ Removing and installing
⇒ [page 182](#)
- ☐ The thermostat is located in the interior of the 4/2-way valve and cannot be renewed separately

6 - Bolt

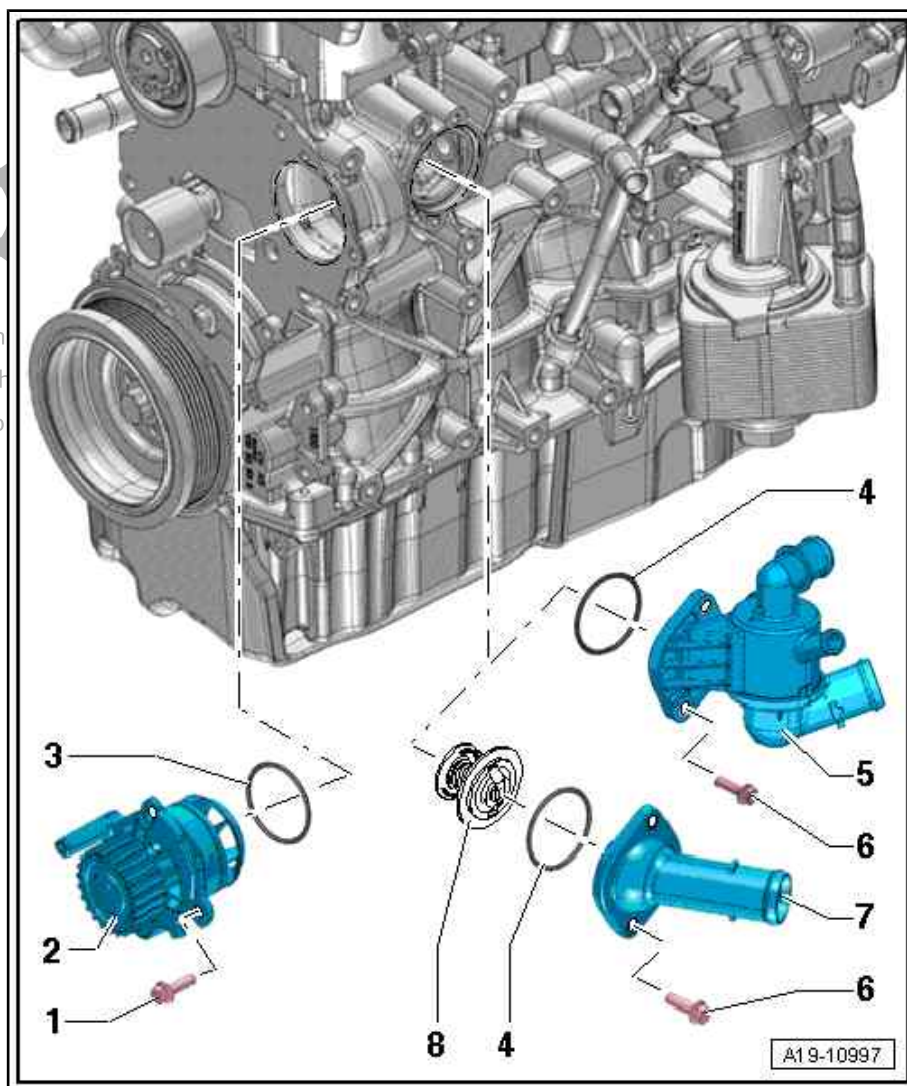
- ☐ 15 Nm

7 - Connection

- ☐ Installed according to version

8 - Thermostat

- ☐ Removing and installing
⇒ [page 180](#)
- ☐ Only fitted on version with connection -7-



1.6 Removing and installing coolant pump

Removing

- Drain coolant ⇒ [page 171](#) .
- Remove toothed belt ⇒ [page 87](#) .



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

Installing

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

Tightening torques

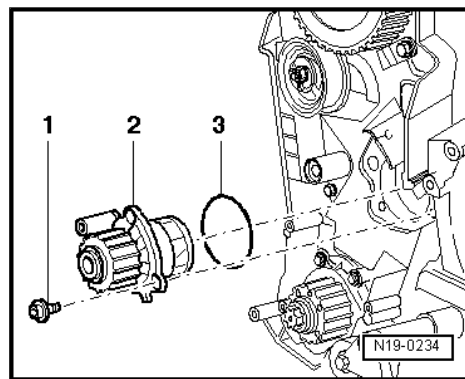
- ♦ ⇒ [“1.5 Exploded view - coolant pump, thermostat, 4/2-way valve with thermostat”, page 178](#)



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 91](#) .
- Fill up with coolant ⇒ [page 172](#) .



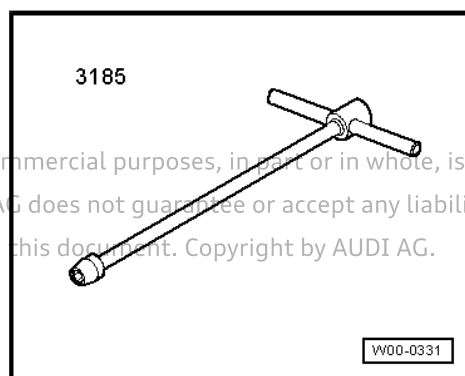
1.7 Removing and installing thermostat

Special tools and workshop equipment required

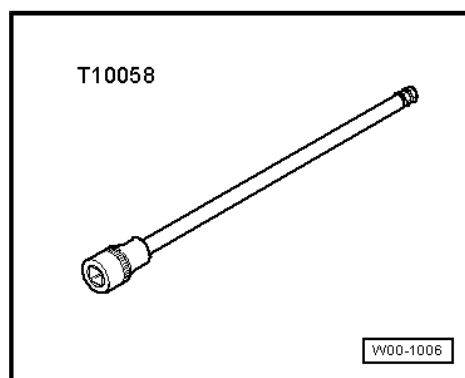
- ♦ Articulated wrench, 10 mm - 3185-



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- ♦ Socket - T10058-

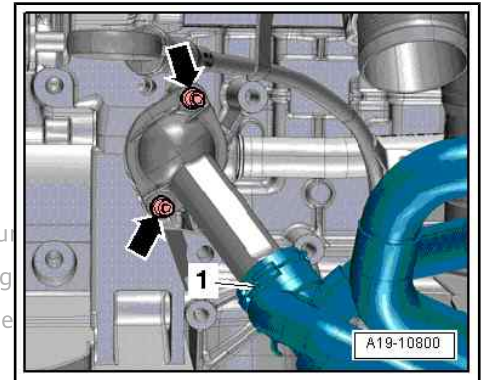




Removing

- Drain coolant ➔ [page 171](#) .
- Lift retaining clip -1- and detach coolant hose from connection.
- Use articulated wrench, 10 mm - 3185- and socket - T10058- to remove bolts -arrows-, then detach connection with coolant thermostat.

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- Turn thermostat -2- approx. 90° anti-clockwise -arrow- and take thermostat out of connection.
- Detach O-ring -1-.

Installing

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

Tightening torques

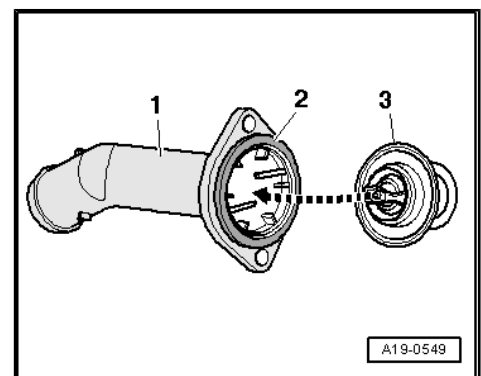
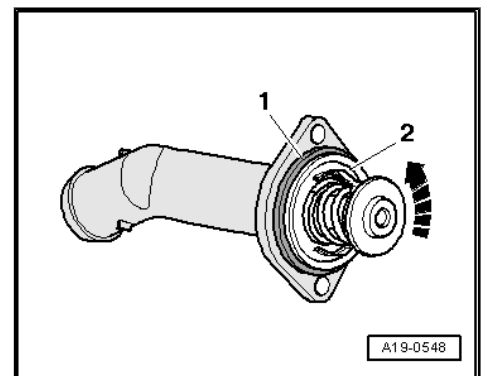
- ➔ ["1.5 Exploded view - coolant pump, thermostat, 4/2-way valve with thermostat", page 178](#)



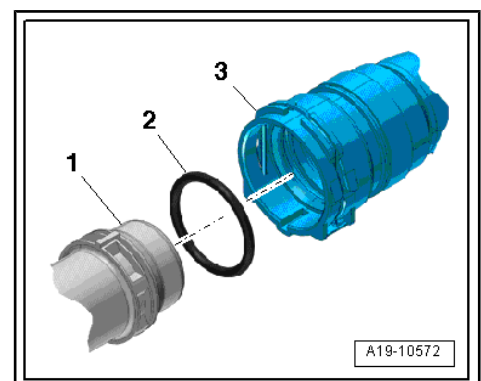
Note

Fit new O-ring.

- Clean and smoothen sealing surface for O-ring.
- Fit thermostat -3- with O-ring -2- into connection -1- and turn approx. 90° in clockwise direction.
- Installation position: cross-piece on thermostat must be in a vertical position.
- Lubricate O-ring with coolant.



- Connect coolant hose with plug-in connector to coolant pipe ➔ [page 194](#) .
- Fill up with coolant ➔ [page 172](#) .

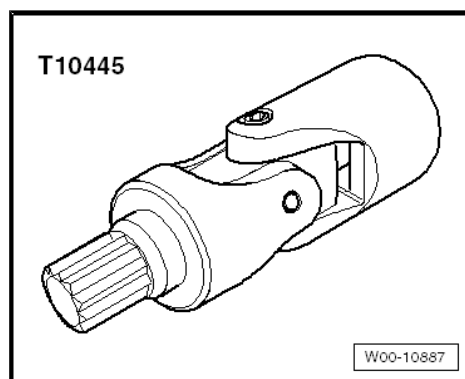




1.8 Removing and installing 4/2-way valve with thermostat

Special tools and workshop equipment required

- ◆ Multi-point bit XZN 8 - T10445-



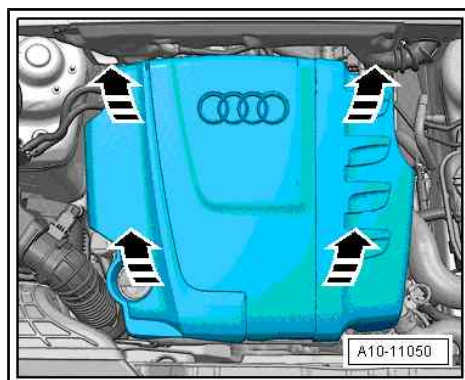
Removing



Note

The thermostat is located in the interior of the 4/2-way valve and cannot be renewed separately.

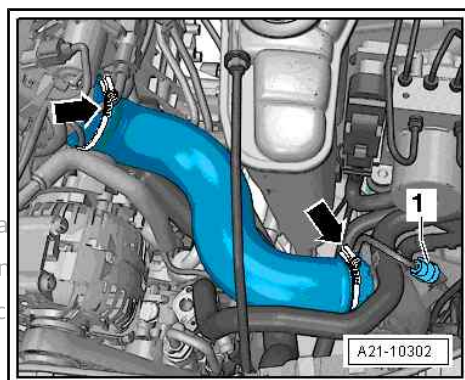
- Remove engine cover panel -arrows-.



- Release hose clips -arrows- and detach air hose.

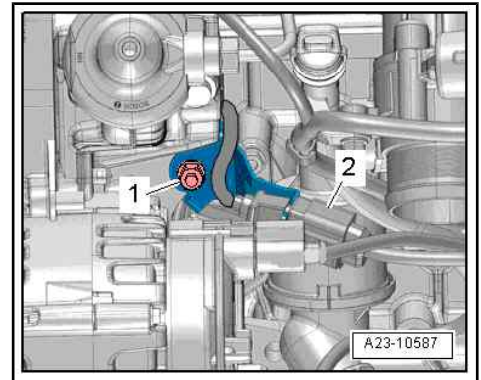


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- Unplug electrical connector -2-.
- Remove nut -1- and move bracket with electrical connector to one side.
- Drain coolant ⇒ [page 171](#) .



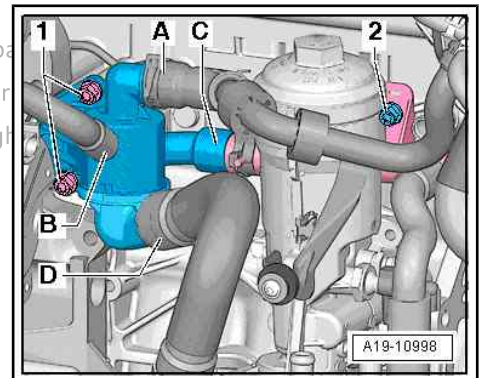
- Detach coolant hoses from connections -A, B and D-.
- Remove bolt -2- with multi-point bit XZN 8 - T10445- .
- Remove bolts -1-.
- Pull valve out of cylinder block and detach connection -C- from coolant pipe to the left.

Installing

Tightening torques

- ◆ ⇒ "1.5 Exploded view - coolant pump, thermostat, 4/2-way valve with thermostat", [page 178](#)

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



Note

Fit new O-ring.

1.9 Checking thermostat

- Remove thermostat and heat it in a water bath.

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

1.10 Exploded view - coolant pipes, coolant temperature senders, coolant circulation pump

**1 - Bracket**

- ☐ For pump for exhaust gas recirculation cooler - V400-

2 - Nut

- ☐ 9 Nm

3 - Pump for exhaust gas recirculation cooler - V400-

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

4 - O-ring

- ☐ Renew

5 - Centre hex stud

- ☐ 9 Nm

6 - Coolant pipe (top)

- ☐ Removing and installing [⇒ page 185](#)
- ☐ Connecting coolant hose [⇒ page 194](#)

7 - Bolt

- ☐ 9 Nm

8 - Gasket

- ☐ Renew

9 - Connection**10 - Bolt**

- ☐ 9 Nm

11 - Coolant temperature sender - G62-

- ☐ Removing and installing [⇒ page 190](#)

12 - Retaining clip**13 - O-ring**

- ☐ Renew

14 - Centre hex stud

- ☐ 9 Nm

15 - Radiator outlet coolant temperature sender - G83-

- ☐ Removing and installing [⇒ page 191](#)

16 - O-rings

- ☐ Renew

17 - Nut

- ☐ 9 Nm

18 - Coolant pipe (rear)

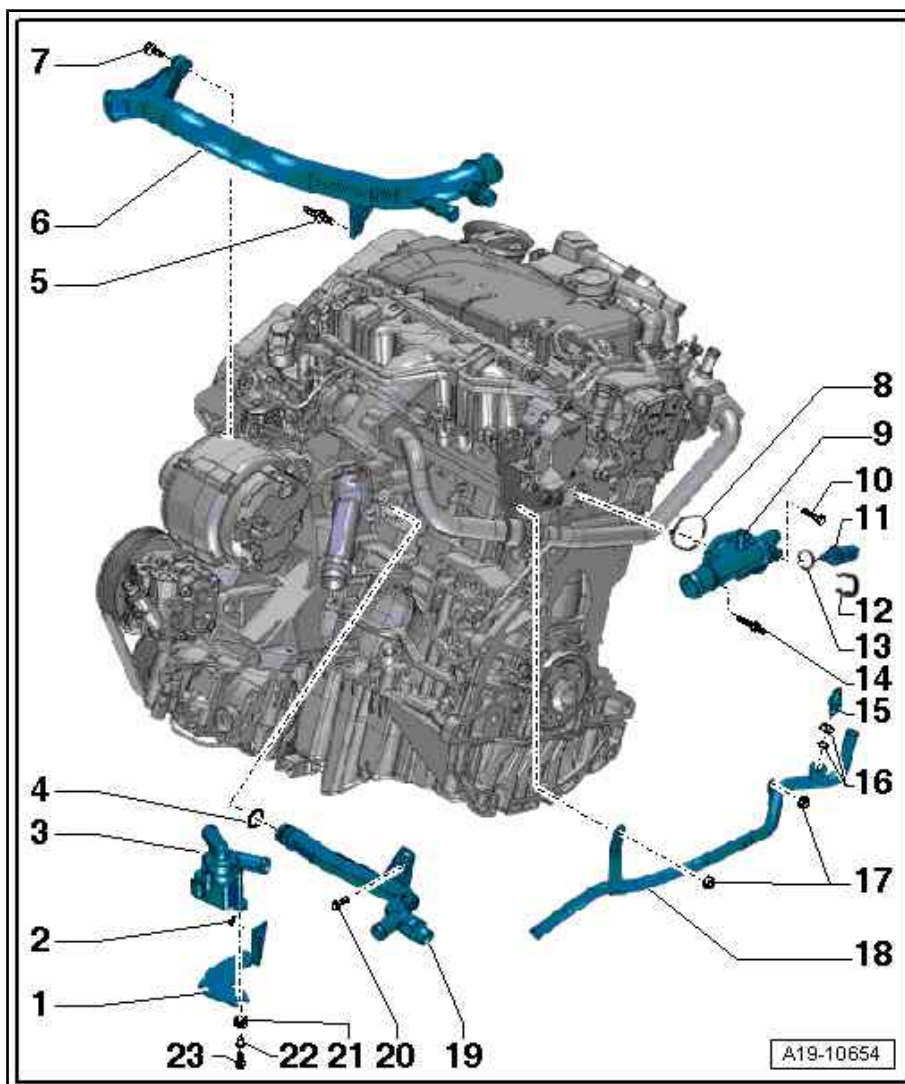
- ☐ Removing and installing [⇒ page 186](#)

19 - Coolant pipe (bottom)

- ☐ Removing and installing [⇒ page 187](#)
- ☐ Connecting coolant hose [⇒ page 194](#)

20 - Bolt

- ☐ 9 Nm



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21 - Grommet

- ☐ Not available as separate part

22 - Sleeve

- ☐ Not available as separate part

23 - Bolt

- ☐ 2.7 Nm

1.11 Removing and installing coolant pipe (top)

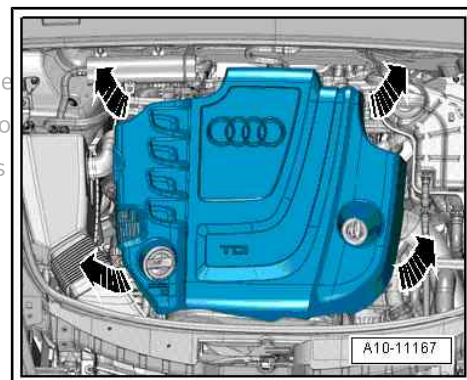
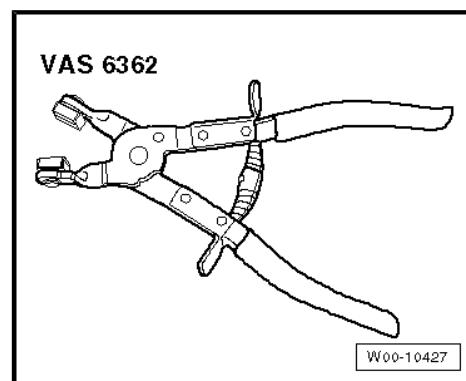
Special tools and workshop equipment required

- ◆ Hose clip pliers - VAS 6362-

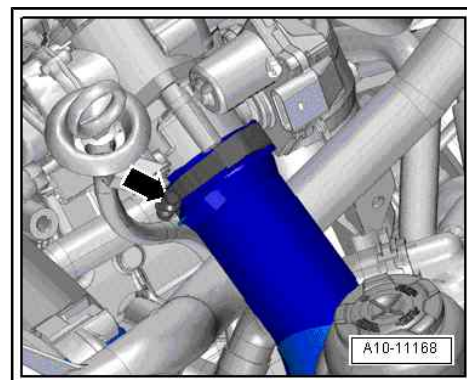


Removing

- Remove engine cover panel -arrows-
 - Drain coolant ⇒ [page 171](#)
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- Release hose clip -arrow- and disconnect air hose from intake manifold flap motor - V157- .



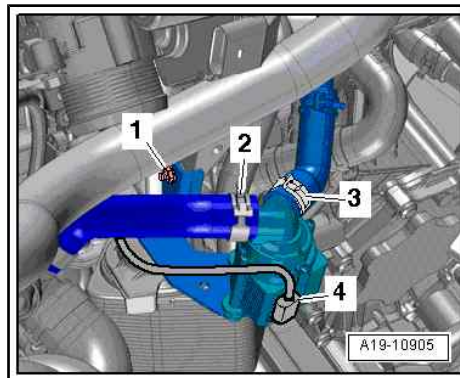


- Remove nut -1- and move pump for exhaust gas recirculation cooler - V400- clear to one side (coolant hoses -2- and -3- remain connected).



Note

Disregard -item 4-.



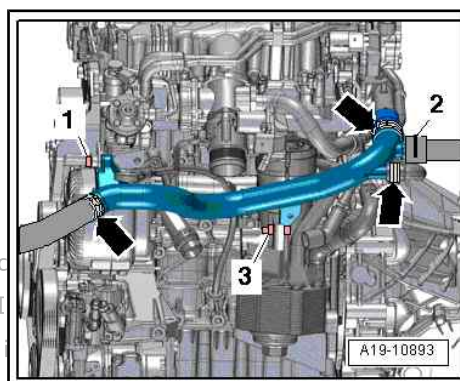
- Remove bolt -1- and centre hex stud -3-.
- Release hose clips -arrows-, lift retaining clip -2- and detach coolant pipe (top) from coolant hoses.

Installing

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

Tightening torques

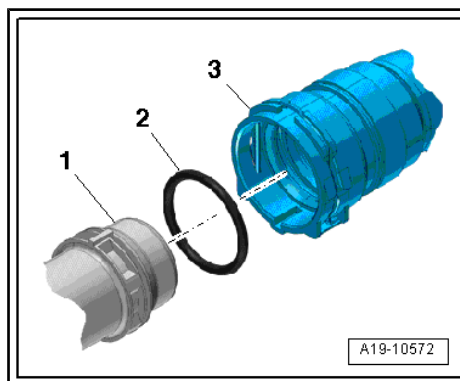
- ♦ ⇒ ["1.10 Exploded view - coolant pipes, coolant temperature senders, coolant circulation pump" page 183](#)



Note

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

- Connect coolant hose with plug-in connector to coolant pipe ⇒ [page 194](#) .
- Fill up with coolant ⇒ [page 172](#) .

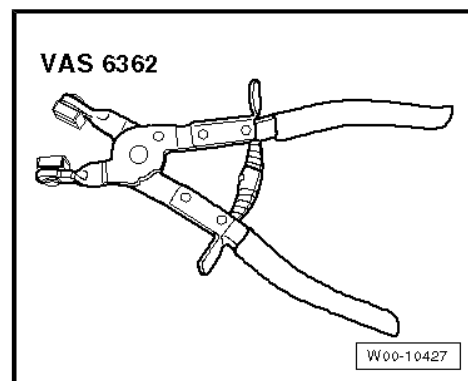


1.12 Removing and installing coolant pipe (rear)

Special tools and workshop equipment required

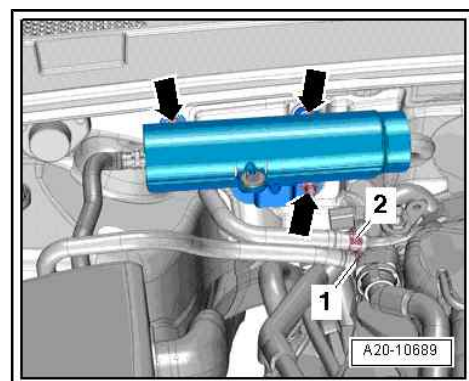


- ◆ Hose clip pliers - VAS 6362-



Removing

- Remove coolant pipe (top) ⇒ [page 185](#) .
- Remove nuts -arrows- and move fuel filter bracket clear to one side (fuel hoses -1- and -2- remain connected).



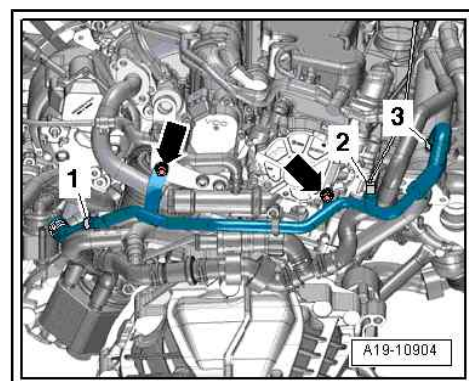
- Unplug electrical connector -2-.
- Release hose clips -1- and -3- and disconnect coolant hoses.
- Remove nuts -arrows- and detach coolant pipe.

Installing

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

Tightening torques

- ⇒ [“1.10 Exploded view - coolant pipes, coolant temperature senders, coolant circulation pump”, page 183](#)
- Install fuel filter ⇒ Rep. gr. 20 .



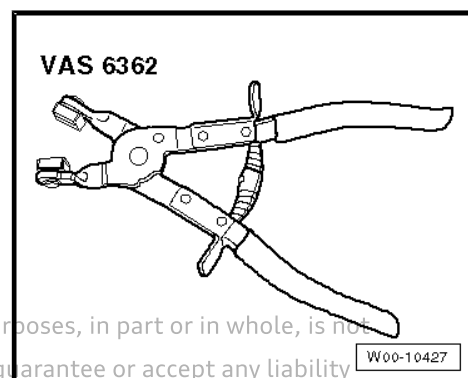
1.13 Removing and installing coolant pipe (bottom)

Special tools and workshop equipment required

- ◆ Hose clip pliers - VAS 6362-



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Removing

- Remove coolant pipe (top) ⇒ [page 185](#) .



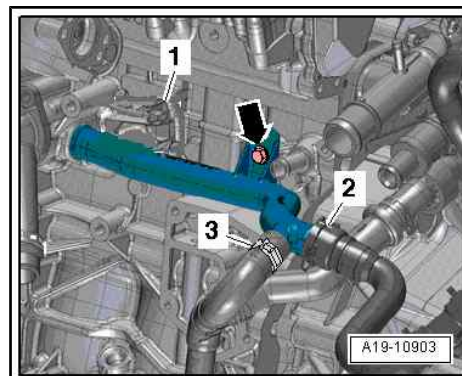
- Remove coolant pipe (rear) ⇒ [page 186](#) .
- Remove oil filter bracket ⇒ [page 162](#) .
- Unplug electrical connector -1- for Hall sender - G40- .
- Unclip bracket for electrical connector from coolant pipe (bottom).
- Release hose clip -3-, lift retaining clip -2- and detach coolant hoses.
- Remove bolt -arrow- and pull off coolant pipe from cylinder block towards rear.

Installing

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

Tightening torques

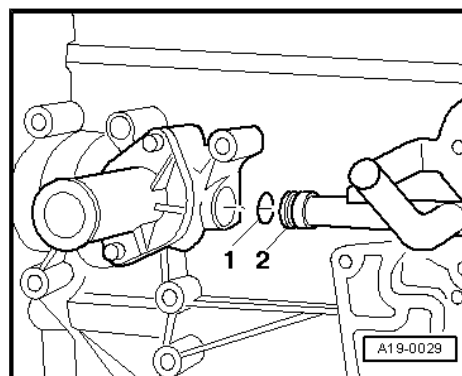
- ♦ ⇒ ["1.10 Exploded view - coolant pipes, coolant temperature senders, coolant circulation pump", page 183](#)
- ♦ ⇒ ["2.1 Exploded view - oil filter housing and engine oil cooler", page 160](#)



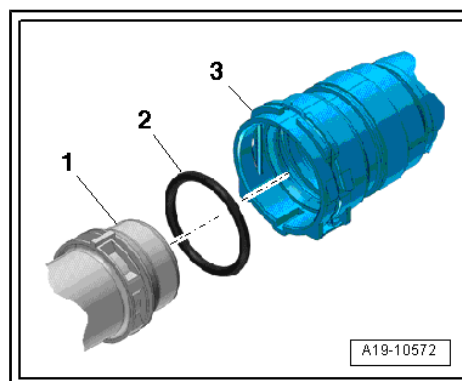
Note

Renew gaskets, seals and O-rings.

- Clean or smoothen sealing surface for seal.
- Lubricate seal -1- with coolant additive and push onto coolant pipe -2-.
- Slide coolant pipe into bore in cylinder block.



- Connect coolant hose with plug-in connector to coolant pipe ⇒ [page 194](#) .
- Fill up with coolant ⇒ [page 172](#) .



1.14 Removing and installing pump for exhaust gas recirculation cooler - V400-

Special tools and workshop equipment required

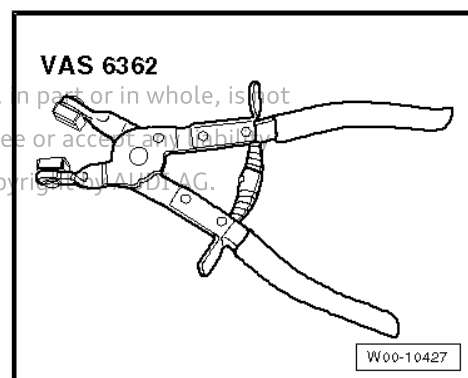
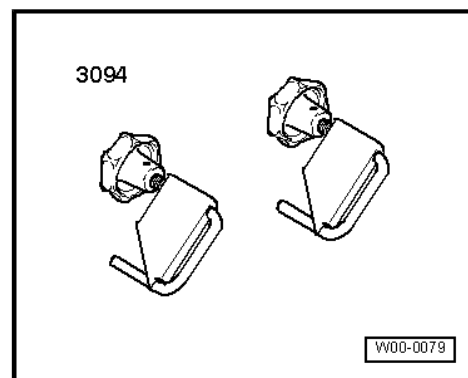


- ◆ Hose clamps up to 25 mm - 3094-



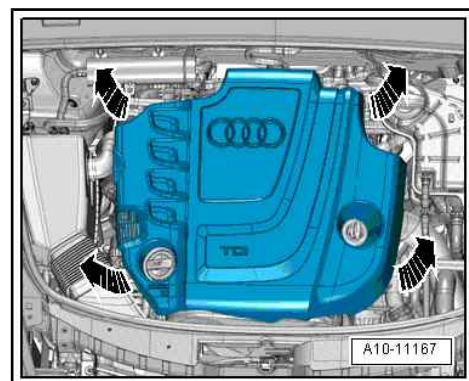
- ◆ Hose clip pliers - VAS 6362-

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Removing

- Remove engine cover panel -arrows-.



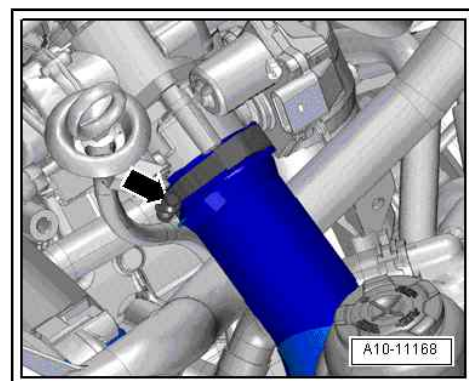
- Release hose clip -arrow- and disconnect air hose from intake manifold flap motor - V157- .



WARNING

Risk of scalding due to hot steam and hot coolant.

- ◆ ***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.***





- Clamp off coolant hoses -2- and -3- using hose clamps for hoses up to 25 mm - 3094- and disconnect hoses.
- Unplug electrical connector -4-.
- Unscrew nut -1- and remove pump for exhaust gas recirculation cooler - V400- with bracket.
- Detach pump for exhaust gas recirculation cooler from bracket.

Installing

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

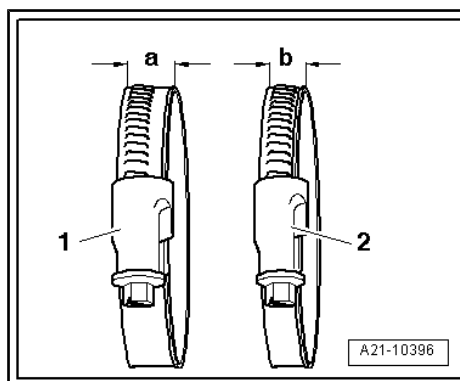
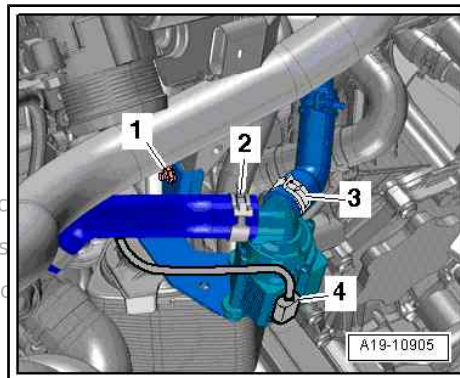
Tightening torques

- ♦ ⇒ [“1.10 Exploded view - coolant pipes, coolant temperature senders, coolant circulation pump”, page 183](#)



Note

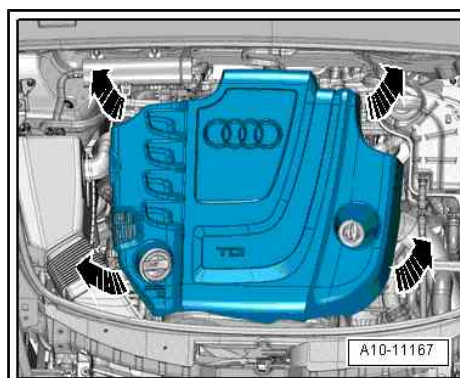
- ♦ *Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.*
- ♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Electronic parts catalogue](#) .*
- Install air hoses with screw-type clips ⇒ [page 210](#) .
- Fill up with coolant ⇒ [page 172](#) .



1.15 Removing and installing coolant temperature sender - G62-

Removing

- Engine cold.
- Remove engine cover panel -arrows-.
- Remove vacuum pump ⇒ Rep. gr. 47 .
- Open filler cap on coolant expansion tank briefly to allow residual pressure in cooling system to dissipate and close cap (make sure it engages).





- Unplug electrical connector -2- at coolant temperature sender - G62- .

i Note

Place a cloth underneath to catch escaping coolant.

- Pull off retaining clip -1- and pull out coolant temperature sender - G62- .

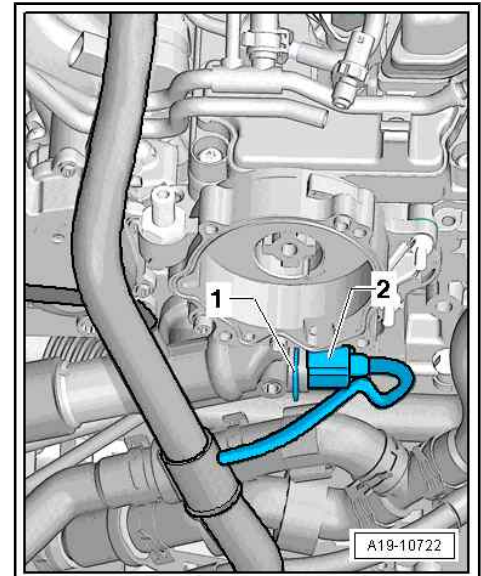
Installing

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

i Note

- ◆ *Fit new O-ring.*
- ◆ *Insert new coolant temperature sender - G62- immediately into connection to avoid loss of coolant.*

- Check coolant level ⇒ [page 177](#) .

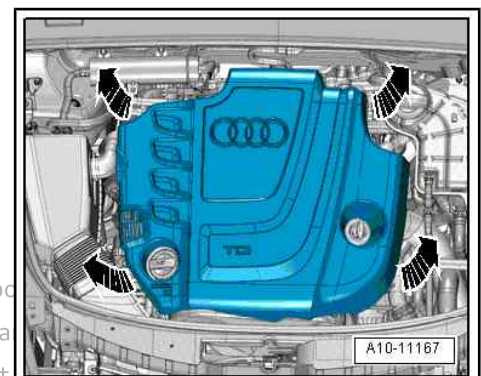


1.16 Removing and installing radiator outlet coolant temperature sender - G83-

Removing

- Engine cold.
- Remove engine cover panel -arrows-.
- Open filler cap on coolant expansion tank briefly to allow residual pressure in cooling system to dissipate and close cap (make sure it engages).

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i Note

Place a cloth underneath to catch escaping coolant.

- Unplug electrical connector -1- and unscrew radiator outlet coolant temperature sender - G83- -2-.

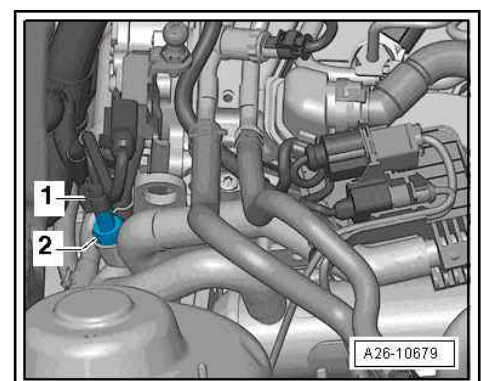
Installing

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

i Note

- ◆ *Fit new O-rings.*
- ◆ *Screw radiator outlet coolant temperature sender - G83- immediately into threaded hole to avoid loss of coolant.*

- Check coolant level ⇒ [page 177](#) .





2 Parts of cooling system (on body)

Overview

- ◆ ⇒ [“2.1 General notes”, page 192](#)
- ◆ ⇒ [“2.2 Exploded view - radiator and radiator fans”, page 192](#)
- ◆ ⇒ [“2.3 Removing and installing radiator”, page 194](#)
- ◆ ⇒ [“2.4 Removing and installing radiator cowl”, page 198](#)
- ◆ ⇒ [“2.5 Removing and installing radiator fan V7 and radiator fan 2 V177”, page 200](#)

2.1 General notes



WARNING

Risk of scalding due to hot steam and hot coolant.

- ◆ *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.*



WARNING

Risk of injury as the radiator fans may start up automatically.

- ◆ *Unplug electrical connectors before working in vicinity of radiator cowl.*



Note

- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Parts catalogue](#) .*
- ◆ *The arrow markings on coolant pipes and on ends of hoses must align.*

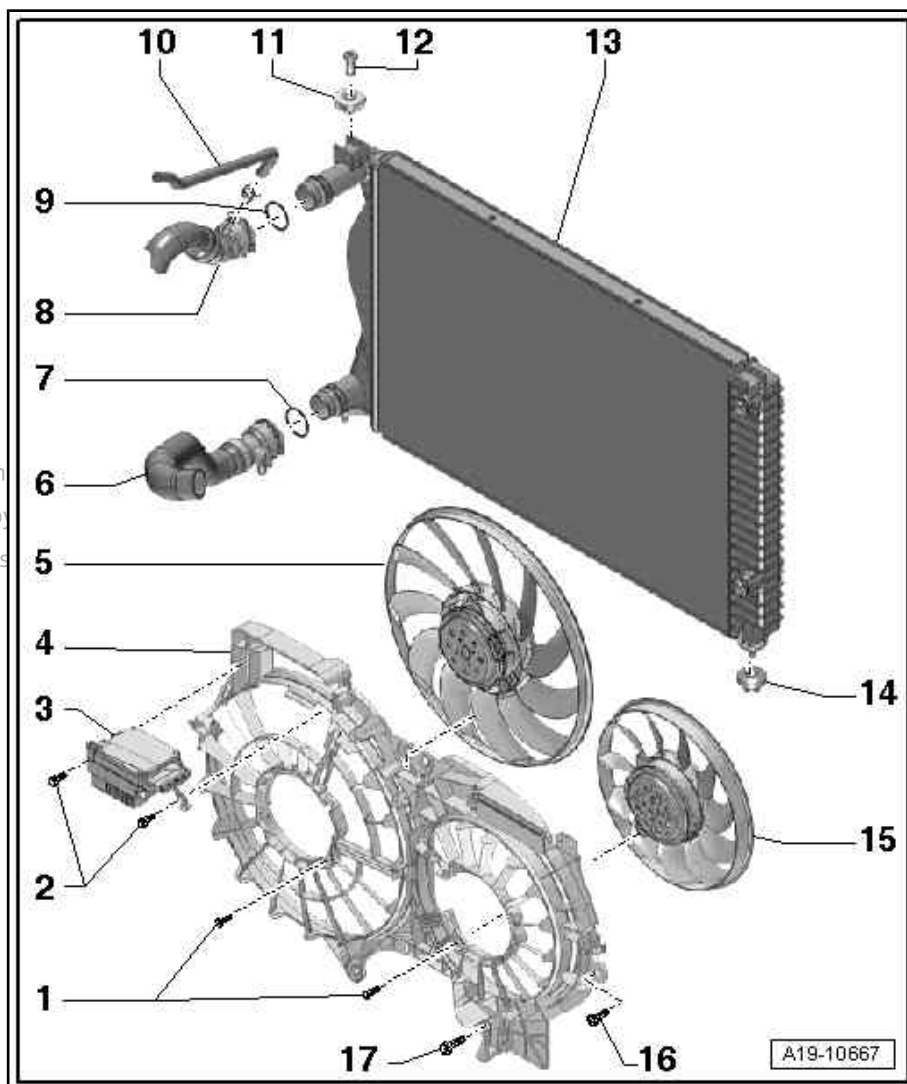
2.2 Exploded view - radiator and radiator fans



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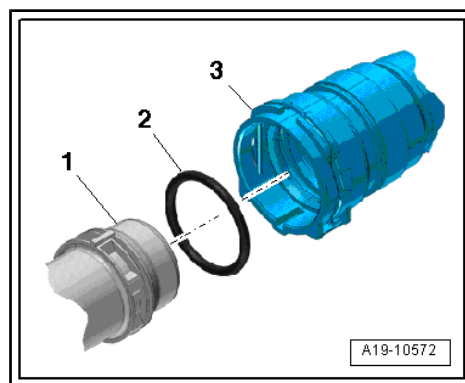
- 1 - Bolt
 - ☐ 5 Nm
- 2 - Bolt
 - ☐ 2.1 Nm
- 3 - Radiator fan control unit - J293-
- 4 - Radiator cowl
 - ☐ Removing and installing
⇒ [page 198](#)
- 5 - Radiator fan - V7-
 - ☐ Removing and installing
⇒ [page 200](#)
- 6 - Coolant hose
 - ☐ Lift retaining clip to detach
 - ☐ Connecting to radiator
⇒ [page 194](#)
- 7 - O-ring
 - ☐ Renew
- 8 - Coolant hose
 - ☐ Lift retaining clip to detach
 - ☐ Connecting to radiator
⇒ [page 194](#)
- 9 - O-ring
 - ☐ Renew
- 10 - Coolant hose
- 11 - Rubber bush (top)
- 12 - Retaining pin
- 13 - Radiator
 - ☐ Removing and installing ⇒ [page 194](#)
 - ☐ If renewed, change coolant in entire system
- 14 - Rubber bush (bottom)
- 15 - Radiator fan 2 - V177-
 - ☐ Removing and installing ⇒ [page 200](#)
- 16 - Bolt
 - ☐ 2.1 Nm
- 17 - Bolt
 - ☐ 11 Nm





Connecting coolant hose with plug-in connector

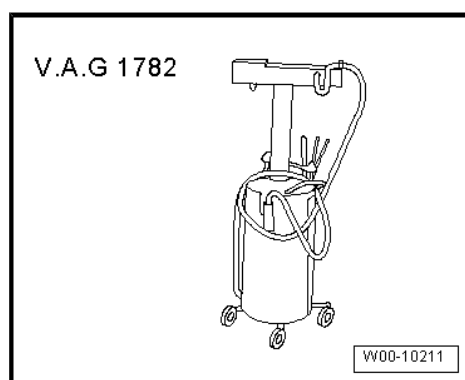
- Remove old O-ring -2- from coolant hose -3-.
- Lightly lubricate new O-ring with coolant and fit O-ring in coolant hose.
- Press coolant hose onto connection -1- until it engages audibly.
- Press coolant hose in again and then pull to check that plug-in connector is correctly engaged.



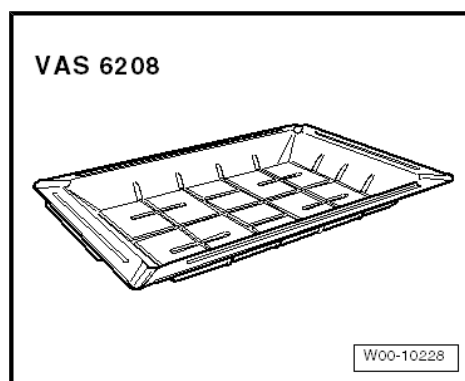
2.3 Removing and installing radiator

Special tools and workshop equipment required

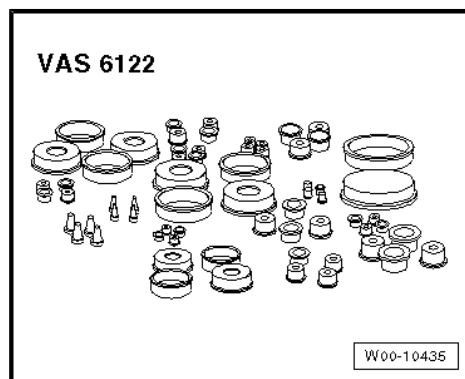
- ◆ Used oil collection and extraction unit - V.A.G 1782-



- ◆ Drip tray for workshop hoist - VAS 6208-



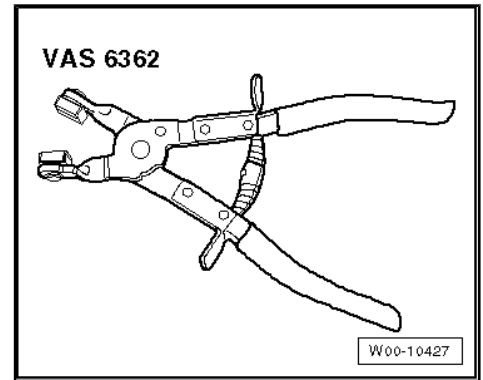
- ◆ Engine bung set - VAS 6122-



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- ◆ Hose clip pliers - VAS 6362-



Removing

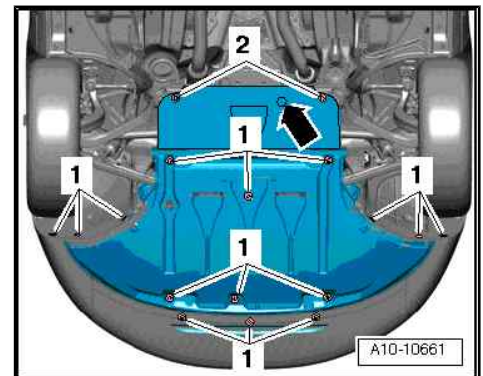


WARNING

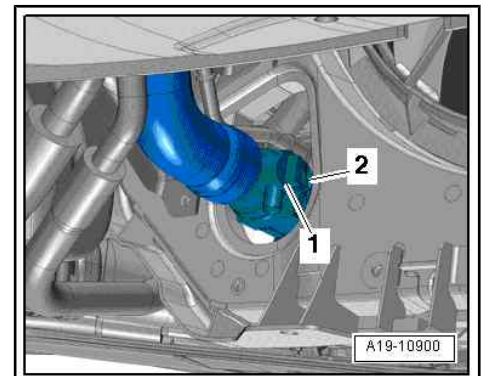
Risk of scalding due to hot steam and hot coolant.

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

- Open filler cap on coolant expansion tank.
- Remove noise insulation panels ⇒ Rep. gr. 50 .
- Remove bumper cover (front) ⇒ Rep. gr. 63 .



- Place drip tray for workshop hoist - VAS 6208- beneath engine.
- Open drain plug -1- and drain off coolant.
- Lift retaining clip -2- and disconnect coolant hose (bottom left) from radiator.



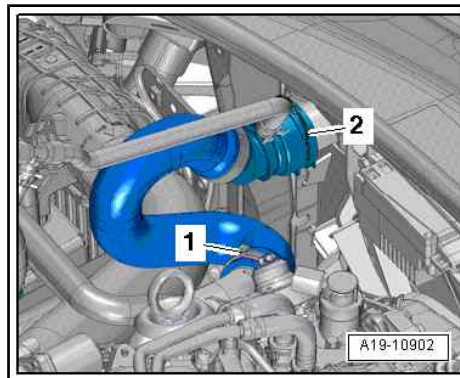


- Lift retaining clip -2- and disconnect coolant hose (top left) from radiator.



Note

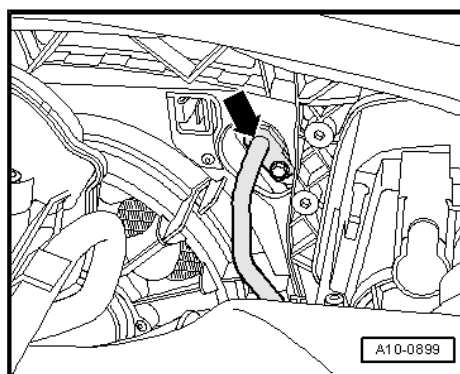
Disregard -item 1-.



Note

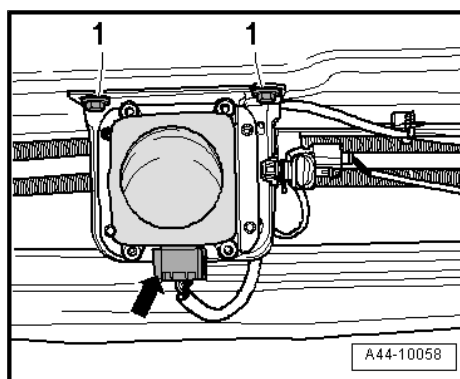
Observe rules for cleanliness when working on multitronic gear-box ⇒ Rep. gr. 00 .

- Place used oil collection and extraction unit - V.A.G 1782- underneath.
- Unscrew bolts and detach ATF line (top) -arrow- and ATF line (bottom) from radiator.
- Tie ATF lines up onto longitudinal member.
- Seal off open pipes/lines and connections with clean plugs from engine bung set - VAS 6122- .
- On vehicles with adaptive cruise control, unplug electrical connector -arrow- at adaptive cruise control unit - J428- .

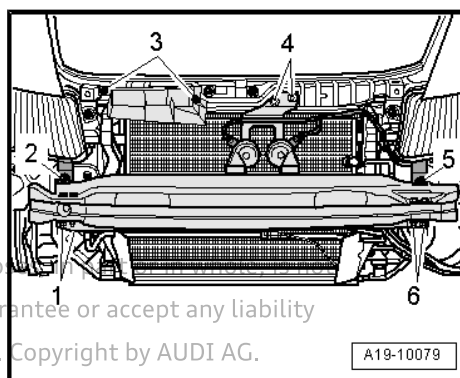


Note

Disregard -item 1-.



- Unscrew bolts -3- and remove air duct.
- Unscrew bolts -4- and detach bracket for horns; the wiring remains connected.
- Unscrew bolts -2- and -5- and remove brackets for headlights.
- Remove nuts -1- and -6- and detach bumper.



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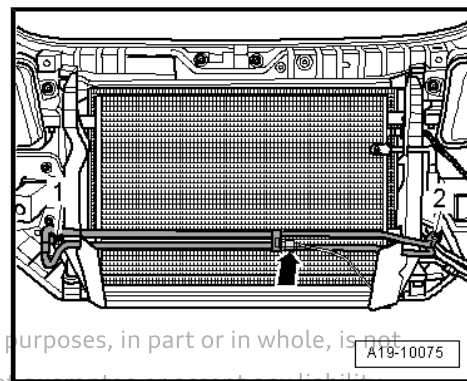
- Unclip ambient temperature sensor - G17- -arrow- from bracket.
- Unscrew bolts -1- and -2- for power steering cooling pipe; the hydraulic hoses remain attached.
- Unbolt air ducts on left and right sides of radiator.



WARNING

Risk of injury caused by refrigerant.

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



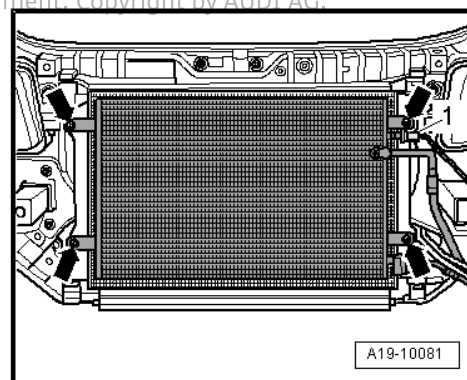
- Unplug electrical connector -1-.
- Remove bolts -arrows-.



Caution

Risk of damage to condenser and refrigerant pipes/hoses.

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



- Pivot condenser downwards with pipes/hoses attached.
- Release two retaining pins for radiator and pull out upwards -arrows-.
- Swivel radiator forwards and lift off.

Installing

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

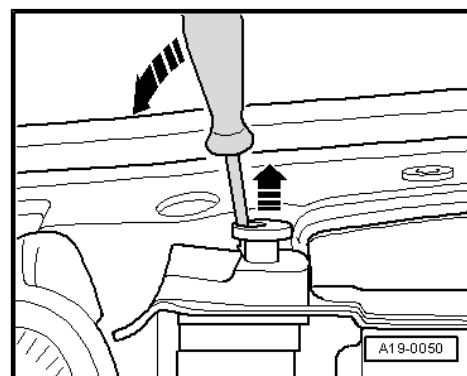
Tightening torques

- ◆ ⇒ [“2.2 Exploded view - radiator and radiator fans”, page 192](#)



Note

- ◆ *If there are slight impressions on the fins, refer to ⇒ [“3.10 Installing radiators and condensers”, page 8](#).*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Electronic parts catalogue](#).*
- Install condenser ⇒ Rep. gr. 87.
- Install cooling pipe for power steering ⇒ Rep. gr. 48.
- Install bracket for horns ⇒ Rep. gr. 96.
- Install front bumper ⇒ Rep. gr. 63.





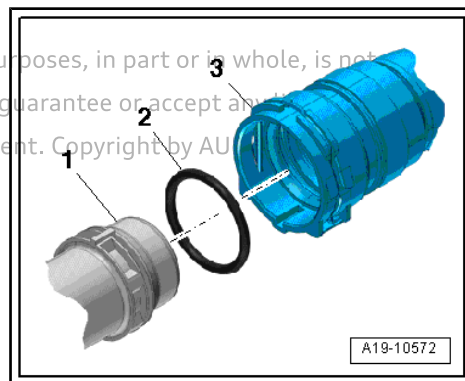
- Connect coolant hoses with plug-in connector ➤ [page 194](#) .
- Fill up with coolant ➤ [page 172](#) .



Note

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

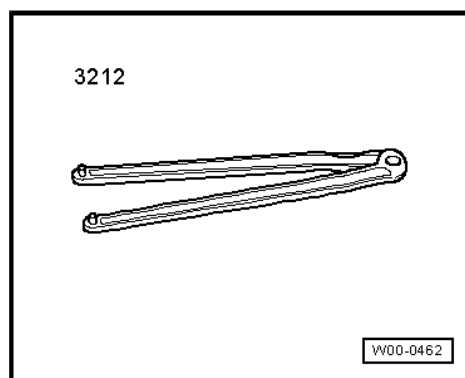
- Adjustment must be performed in “Guided Functions” after removing and installing adaptive cruise control unit - J428- ➤ Rep. gr. 44 and ➤ Vehicle diagnostic tester.



2.4 Removing and installing radiator cowl

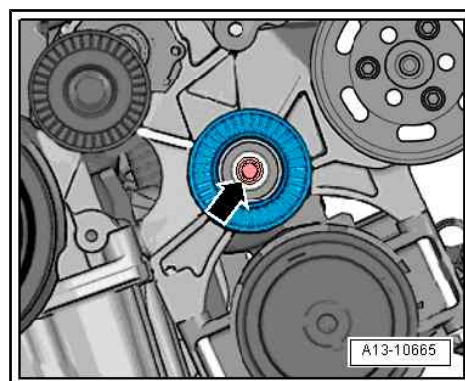
Special tools and workshop equipment required

- ♦ Pin wrench - 3212- or strap wrench



Removing

- Remove vibration damper ➤ [page 50](#) .
- Remove poly V-belt tensioner ➤ [page 48](#) .
- Remove torque reaction support ➤ [page 44](#) .
- Remove bolt -arrow- and take off idler roller for poly-V-belt.





- Unplug electrical connector -1- for magnetic clutch on air conditioner compressor.



WARNING

Risk of injury caused by refrigerant.

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

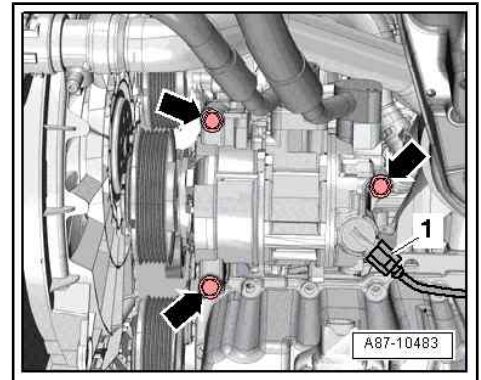
- Remove bolts -arrows- for air conditioner compressor.



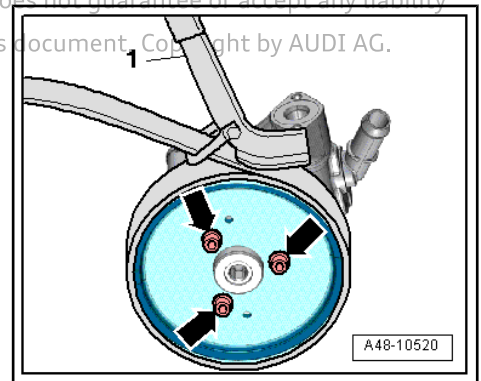
Caution

Risk of damage to refrigerant lines and hoses.

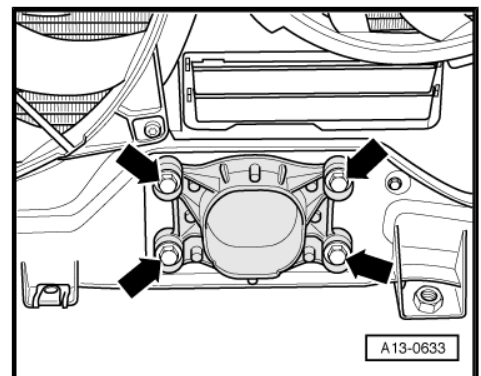
- ◆ *Do NOT stretch, kink or bend refrigerant lines and hoses.*



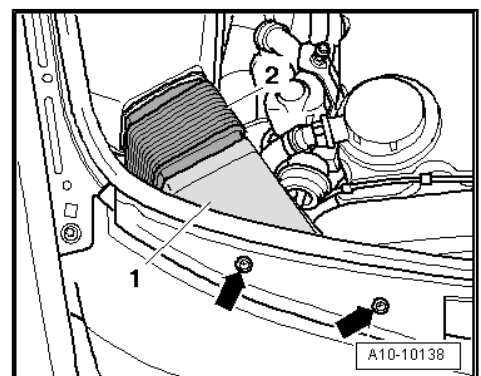
- Tie up air conditioner compressor together with lines to one side (lines remain connected).
- Remove bolts -arrow- for poly V-belt pulley for power steering pump (counterhold with strap wrench -1- or pin wrench -3212-).



- Remove bolts -arrows- and detach stop for torque reaction support.



- Unscrew bolts -arrows- and detach air ducts -1- and -2-





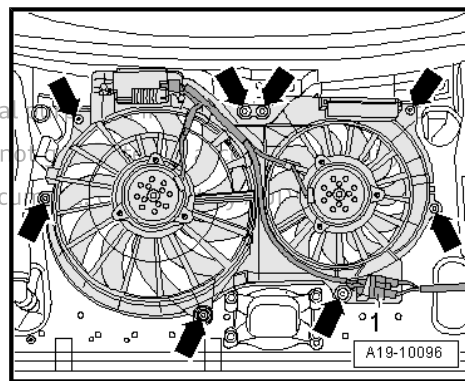
- Unplug electrical connector -1- for radiator fan.



WARNING

Risk of injury as the radiator fans may start up automatically.

- ◆ **Unplug electrical connectors before working in vicinity of radiator cowl.**



- Remove bolts -arrows- and take out radiator cowl from below.

Installing

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

Tightening torques

- ◆ ⇒ [“2.2 Exploded view - radiator and radiator fans”, page 192](#)
- ◆ ⇒ [“1.1 Exploded view - poly V-belt drive”, page 45](#)



Note

Hose connections and air pipes/hoses must be free of oil and grease prior to fitting.

- Install air ducts ⇒ Rep. gr. 23 .
- Install poly V-belt pulley for power steering pump ⇒ Rep. gr. 48 .
- Install air conditioner compressor ⇒ Rep. gr. 87 .
- Install torque reaction support ⇒ [page 44](#) .

2.5 Removing and installing radiator fan - V7- and radiator fan 2 - V177-

Removing



Note

Fit all cable ties in the original positions when installing.

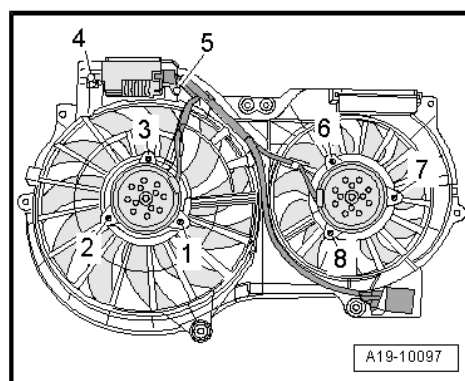
- Remove radiator cowl ⇒ [page 198](#) .
- Move electrical wiring clear.
- Unscrew bolts -1 ... 8- and remove radiator fans.

Installing

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

Tightening torques

- ◆ ⇒ [“2.2 Exploded view - radiator and radiator fans”, page 192](#)
- Install radiator cowl ⇒ [page 198](#) .





21 – Turbocharging/supercharging

1 Turbocharger

Overview

- ◆ ⇒ [“1.1 Exploded view - turbocharger”, page 201](#)
- ◆ ⇒ [“1.2 Removing and installing turbocharger”, page 202](#)

1.1 Exploded view - turbocharger

- Observe rules for cleanliness ⇒ [page 5](#) .

1 - Seal

- ☐ Renew

2 - Connection

- ☐ 40 Nm

3 - Oil return line

- ☐ To cylinder block
- ☐ Tighten union nut to 20 Nm

4 - Bolt

- ☐ 15 Nm
- ☐ Property class 10.9; use only genuine bolts (same as original equipment) ⇒ Electronic parts catalogue

5 - Gasket

- ☐ Renew

6 - Bolt

- ☐ 20 Nm

7 - Gasket

- ☐ Renew

8 - Nut

- ☐ Renew
- ☐ 23 Nm

9 - Particulate filter with catalytic converter

- ☐ Removing and installing ⇒ [page 221](#)

10 - Exhaust gas temperature sender 1 - G235-

- ☐ Removing and installing ⇒ [page 239](#)

11 - Seal

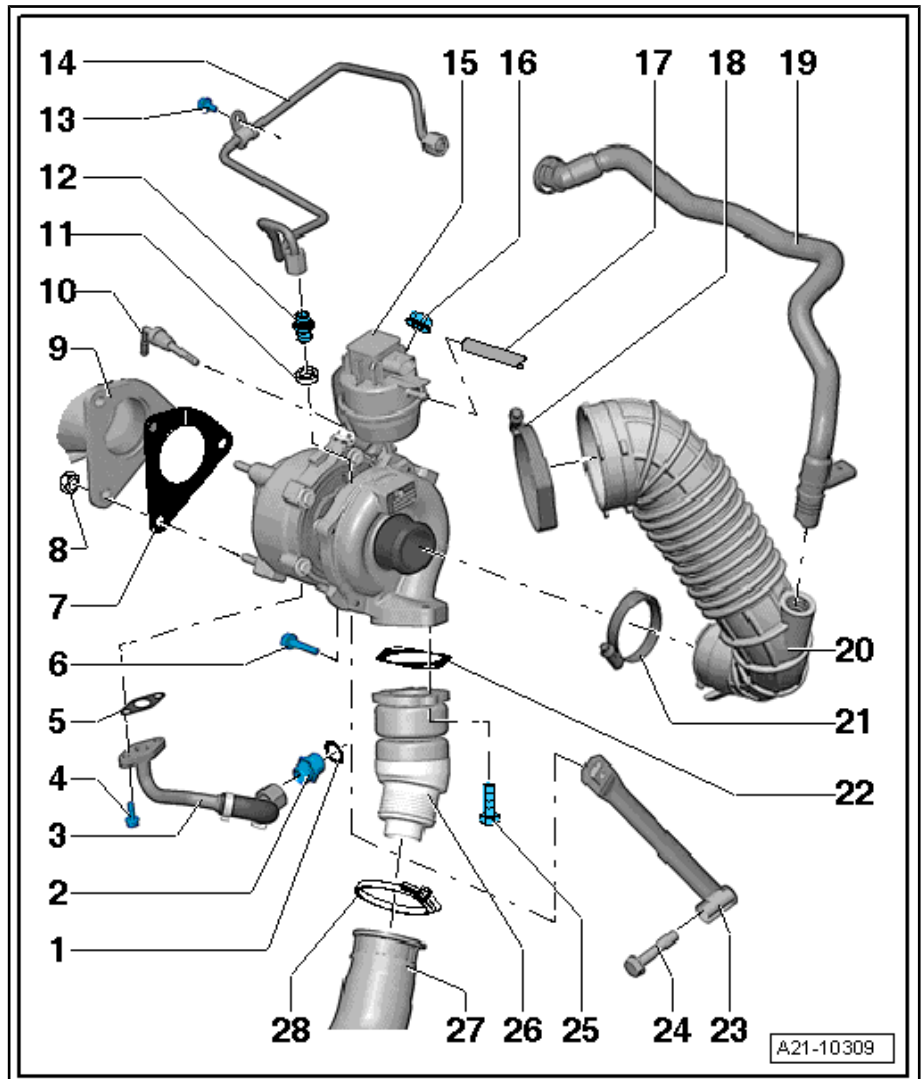
- ☐ Renew

12 - Connection

- ☐ 30 Nm

13 - Bolt

- ☐ 10 Nm





14 - Oil supply line

- ☐ Tighten union nuts to 22 Nm

15 - Turbocharger

- ☐ Removing and installing ⇒ [page 202](#)

16 - Nut

- ☐ 25 Nm
- ☐ Securing turbocharger to exhaust manifold
- ☐ Renew
- ☐ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue

17 - Vacuum hose

- ☐ From charge pressure control solenoid valve - N75-

18 - Hose clip

- ☐ Tightening torque ⇒ [page 210](#)

19 - Crankcase breather hose

20 - Air hose

21 - Hose clip

- ☐ Tightening torque ⇒ [page 210](#)

22 - Gasket

- ☐ Renew if damaged or leaking

23 - Support

24 - Bolt

- ☐ 40 Nm

25 - Bolt

- ☐ 10 Nm

26 - Connection

27 - Air hose to charge air cooler

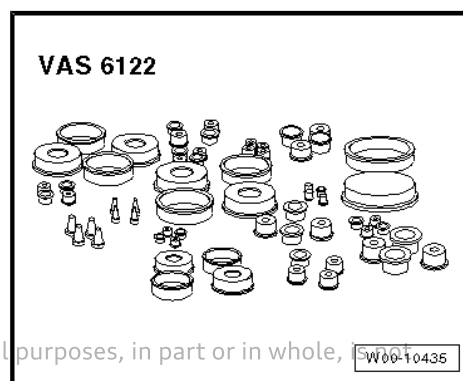
28 - Hose clip

- ☐ Tightening torque ⇒ [page 210](#)

1.2 Removing and installing turbocharger

Special tools and workshop equipment required

- ♦ Engine bung set - VAS 6122-



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Removing



Caution

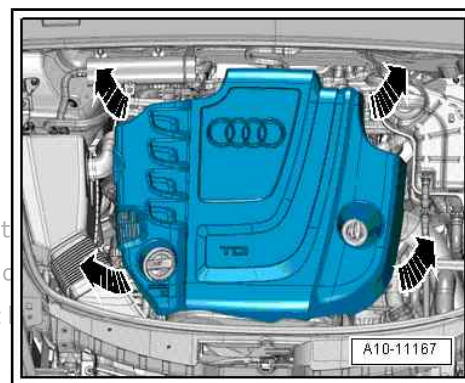
If the turbocharger has suffered mechanical damage (e.g. damaged compressor wheel), it is not sufficient merely to fit a new turbocharger. The following work must be performed in order to avoid further damage:

- ◆ *Check air cleaner housing, air filter element and air hoses for dirt and foreign particles.*
- ◆ *Check the entire charge air system (including the charge air cooler) for foreign matter.*
- ◆ *If foreign matter is found in the charge air system, clean all relevant ducts and hoses and renew charge air cooler if necessary.*

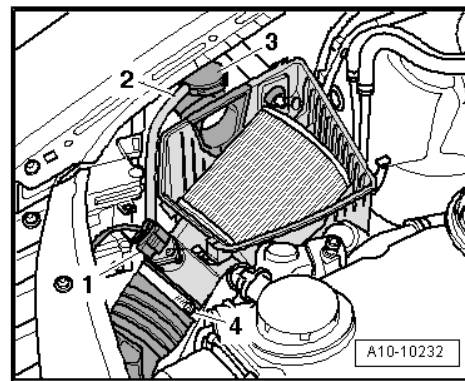
- Remove engine cover panel -arrows-.



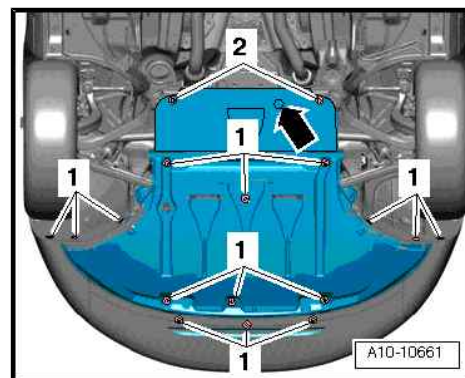
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- Remove air cleaner housing ⇒ Rep. gr. 23 .

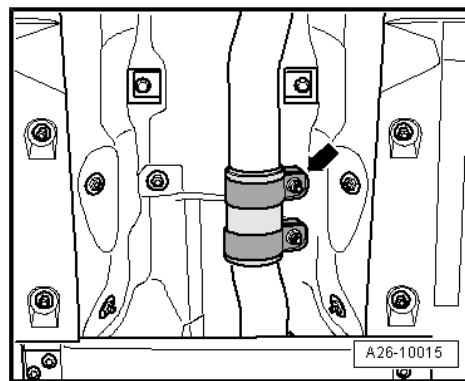


- Remove noise insulation panels ⇒ Rep. gr. 50 .





- Loosen bolt connections and push clamp -arrow- towards rear to disconnect exhaust system.



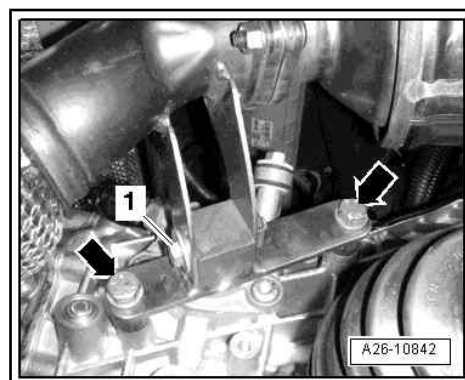
Vehicles with manual gearbox:

- Remove bolts -arrows-.



Note

Disregard -item 1-.



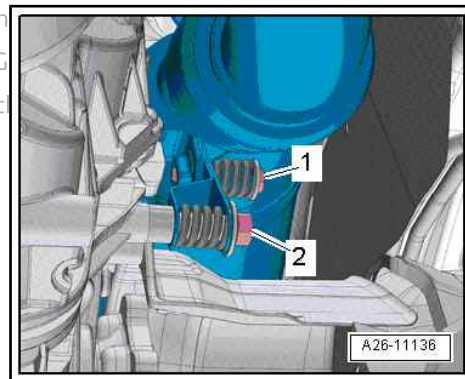
Vehicles with multitronic gearbox:

- Remove bolt -2- at bracket for particulate filter.



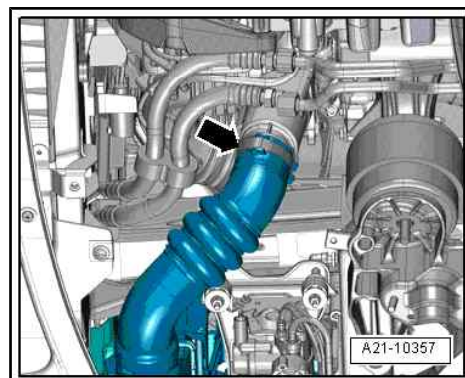
Note

Disregard -item 1-.



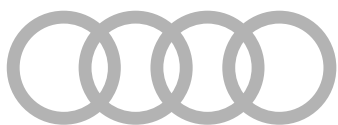
All vehicles (continued):

- Release hose clip -arrow- and detach air hose from turbo-charger.

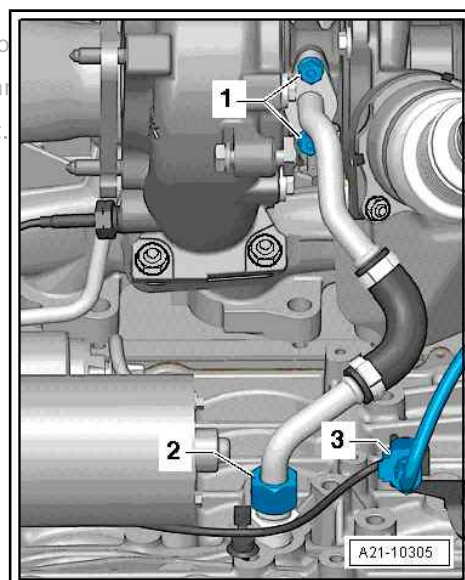
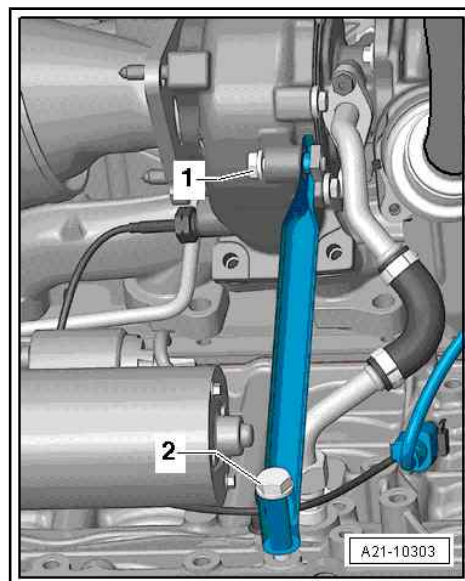




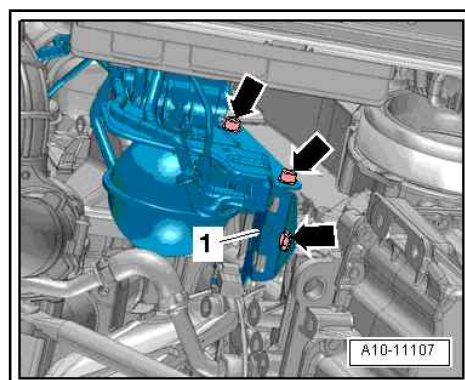
- Unscrew bolts -1- and -2- and remove support for turbocharger.



- Remove bolts -1-.
 - Unplug electrical connector -3- for exhaust gas temperature sender 1 - G235- and move clear.
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- Remove bolts -arrows- and place bracket -1- to one side.



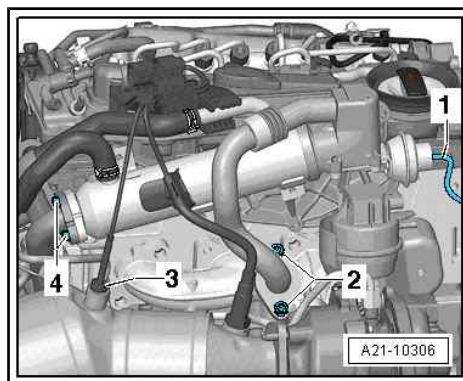


- Disconnect vacuum hose -1-.
- Remove bolts -2- and -4-.

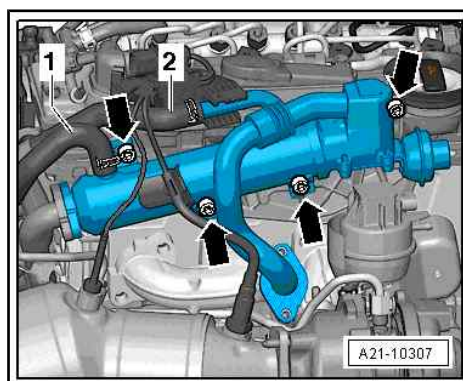


Note

Disregard -item 3-.



- Remove bolts -arrows-.
- Tie up exhaust gas recirculation cooler (coolant hoses -1- and -2- remain attached).

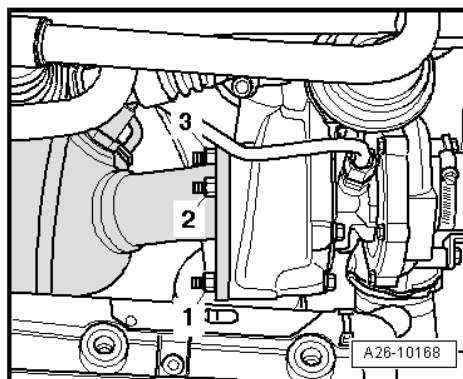


- Remove nuts -1- and -2- on turbocharger.

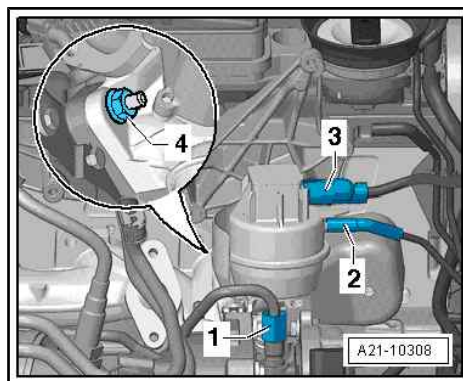


Note

- ♦ *Nut -3- is removed later.*
- ♦ *Nut -1- is accessible from below on vehicles with auxiliary heater.*



- Remove union nut -1-.
- Disconnect vacuum hose -2-.
- Unplug electrical connector -3- for position sender for charge pressure positioner - G581- .
- Remove nut -4- securing turbocharger to exhaust manifold and detach turbocharger.



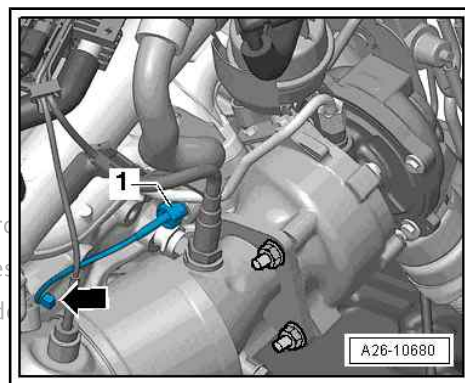
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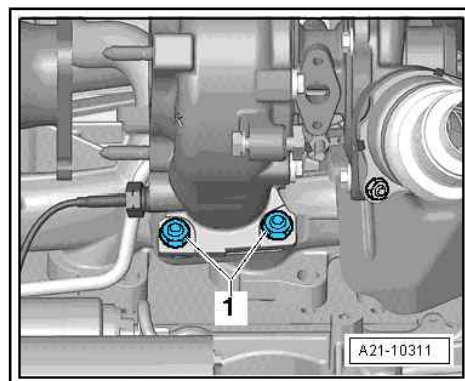
- Move clear electrical wiring for exhaust gas temperature sender 1 - G235- -item 1- on cylinder block -arrow-.



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- Remove nuts -1-, pull turbocharger and particulate filter off studs and swivel to side as far as possible.





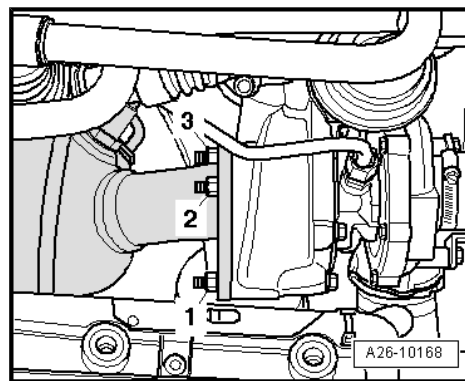
- Remove nut -3- and disconnect turbocharger from particulate filter.
- Seal off open pipes/lines and connections with clean plugs from engine bung set - VAS 6122- .



Caution

Risk of damage to oil return line.

- ◆ **After removing the turbocharger, do not put it down so it rests on the upper section of the oil return line.**



Installing

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

Tightening torques

- ◆ ⇒ [“1.1 Exploded view - turbocharger”, page 201](#)
- ◆ ⇒ [“1.1 Exploded view - silencers”, page 217](#)
- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation cooler”, page 245](#)

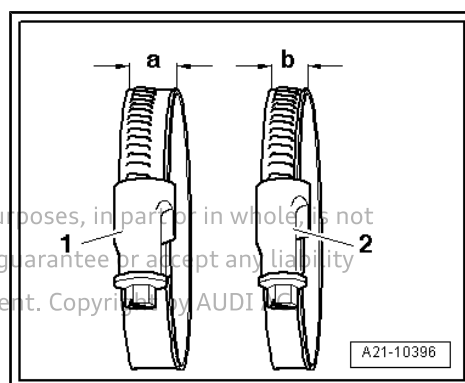


Note

- ◆ *Renew gaskets, seals and O-rings.*
- ◆ *Fill turbocharger with engine oil at connection for oil supply line.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease prior to fitting.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Electronic parts catalogue](#) .*
- ◆ *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.*
- Install noise insulation panels ⇒ Rep. gr. 50 .
- Install air cleaner housing ⇒ Rep. gr. 23 .
- Install air hoses with screw-type clips ⇒ [page 210](#) .



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2 Charge air cooling

Overview

- ◆ ⇒ [“2.1 Exploded view - charge air cooling”, page 209](#)
- ◆ ⇒ [“2.2 Removing and installing charge air cooler”, page 210](#)
- ◆ ⇒ [“2.3 Removing and installing charge pressure sender G31 - vehicles without auxiliary heater”, page 212](#)
- ◆ ⇒ [“2.4 Removing and installing charge pressure sender G31 - vehicles with auxiliary heater”, page 212](#)
- ◆ ⇒ [“2.5 Checking charge air system for leaks”, page 213](#)

2.1 Exploded view - charge air cooling

- Observe rules for cleanliness ⇒ [page 5](#) .

1 - Air duct

2 - Air hose

- ☐ To charge air cooler
- ☐ Must be free of oil and grease when installing

3 - Front air pipe

- ☐ Must be free of oil and grease when installing

4 - Bolts

- ☐ 9 Nm

5 - Charge air cooler

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

6 - Air hose

- ☐ To intake manifold
- ☐ Must be free of oil and grease when installing

7 - O-ring

- ☐ Renew

8 - Charge pressure sender - G31-

- ☐ Removing and installing: vehicles without auxiliary heater
⇒ [page 212](#) , vehicles with auxiliary heater
⇒ [page 212](#) .

9 - Bolts

- ☐ 5 Nm

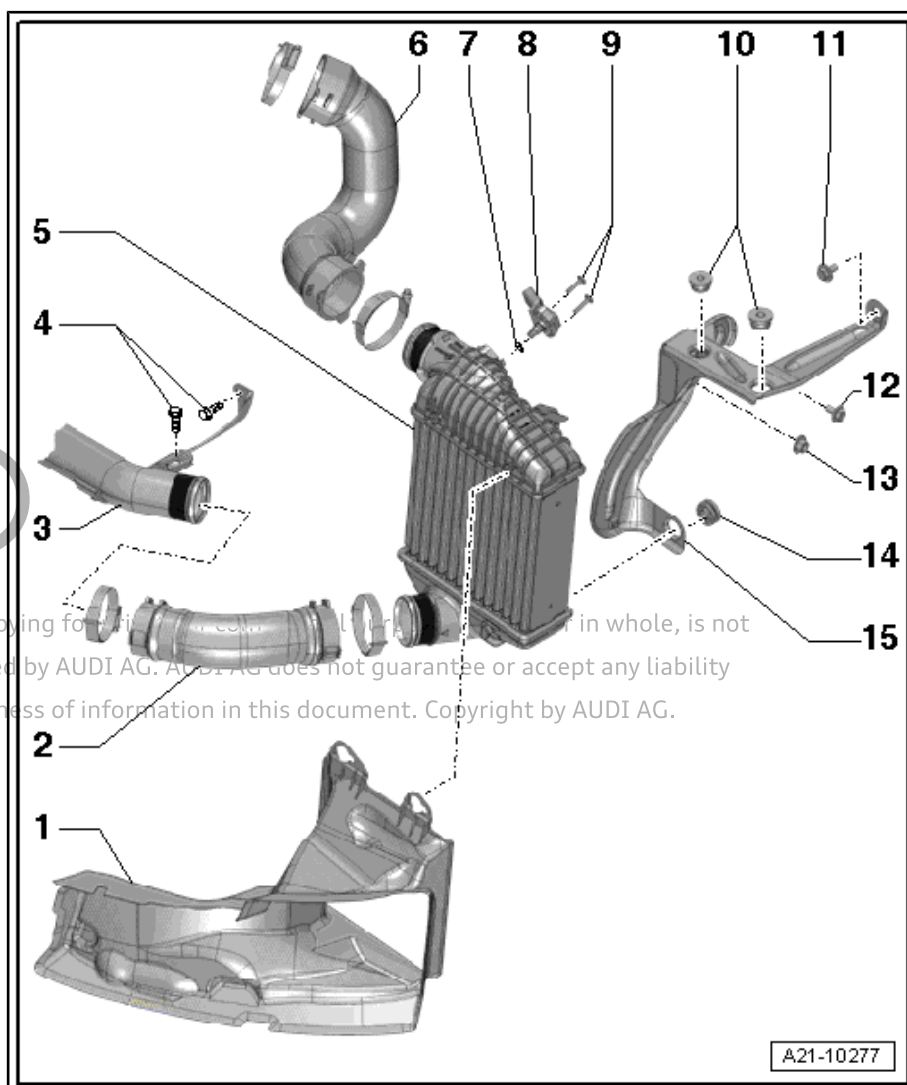
10 - Mounting

11 - Bolt

- ☐ 22 Nm

12 - Bolt

- ☐ 22 Nm





13 - Nut

□ 22 Nm

14 - Grommet

15 - Bracket

Installing air hoses with screw-type clips



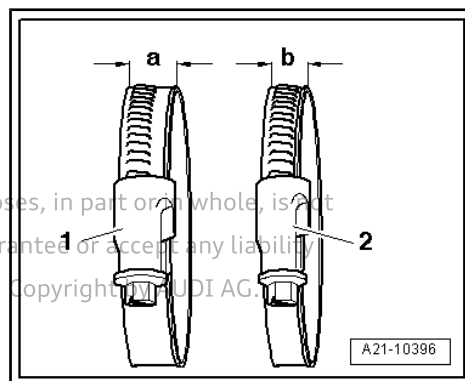
Note

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

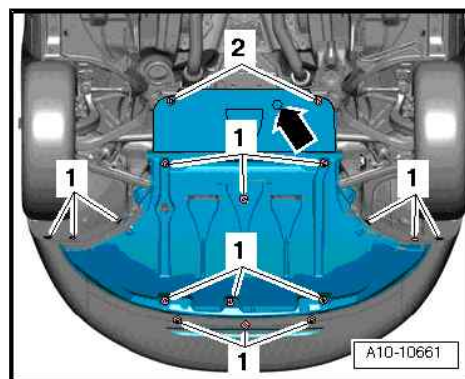
Removing



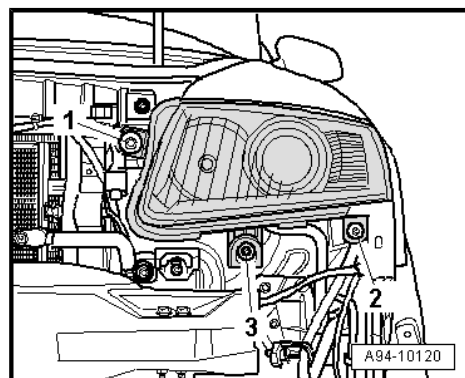
Note

The following description shows the removal and installation of the left-side charge air cooler.

- Remove noise insulation panels ⇒ Rep. gr. 50 .
- Remove front left wheel housing liner ⇒ Rep. gr. 66 .

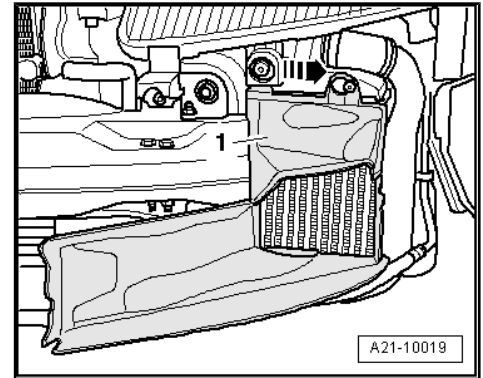


- Remove headlight (left-side) ⇒ Rep. gr. 94 .

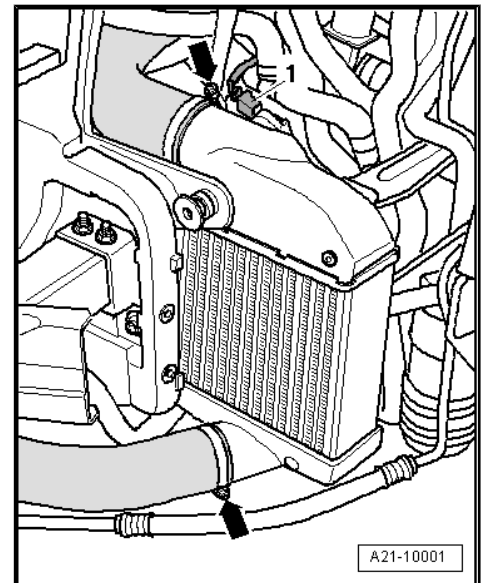




- Remove air duct -1- for charge air cooler -arrow-.



- Unplug electrical connector -1- for charge pressure sender - G31- .
- Release hose clips -arrows- and detach air hoses.
- Grasp bottom edge of charge air cooler, pull it forwards and disengage upwards.



Installing

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

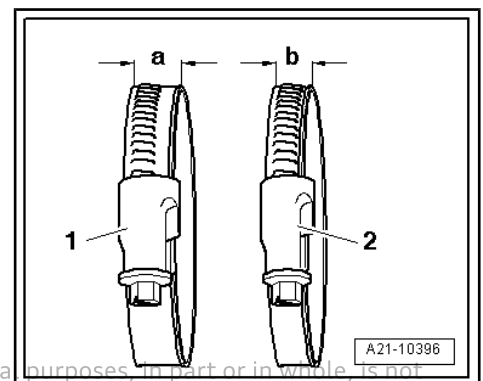
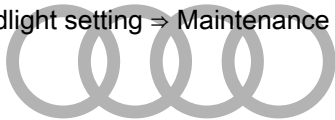
- Tightening torque
⇒ ["2.1 Exploded view - charge air cooling", page 209](#)



Note

- ◆ If there are slight impressions on the fins, refer to
⇒ ["3.10 Installing radiators and condensers", page 8](#) .
- ◆ 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 air hoses with screw-type clips ⇒ [page 210](#) .
- Install headlights ⇒ Rep. gr. 94 .
- Install front wheel housing liner ⇒ Rep. gr. 66 .
- Install noise insulation panels ⇒ Rep. gr. 50 .
- Check headlight setting ⇒ Maintenance ; Booklet 405



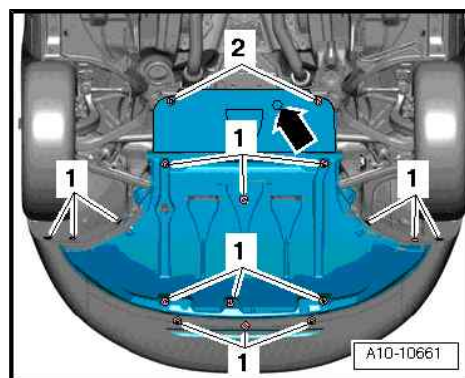
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2.3 Removing and installing charge pressure sender - G31- - vehicles without auxiliary heater

Removing

- Remove noise insulation panels ⇒ Rep. gr. 50 .
- Remove front left wheel housing liner ⇒ Rep. gr. 66 .



- Unplug electrical connector -2-.
- Remove bolts -1- and pull charge pressure sender - G31- out of charge air cooler.

Installing

Tightening torques

- ♦ ⇒ [“2.1 Exploded view - charge air cooling”, page 209](#)

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

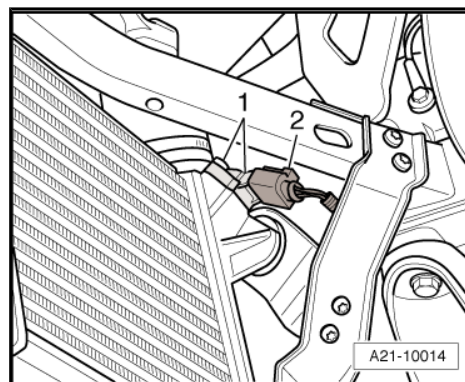


Note

Fit new O-ring.

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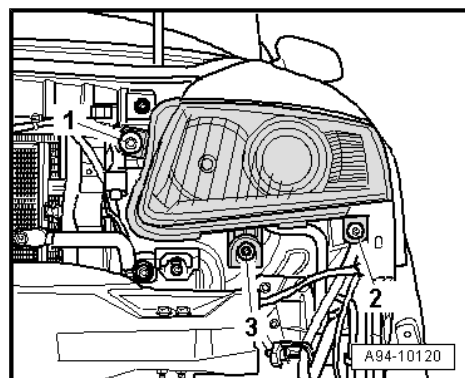
- Install front wheel housing liner ⇒ Rep. gr. 66 .
- Install noise insulation panels ⇒ Rep. gr. 50 .



2.4 Removing and installing charge pressure sender - G31- - vehicles with auxiliary heater

Removing

- Remove headlight (left-side) ⇒ Rep. gr. 94 .





- Unplug electrical connector -1-.
- Remove bolts -2- and pull charge pressure sender - G31- out of charge air cooler.

Installing

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

Tightening torques

- ◆ ⇒ ["2.1 Exploded view - charge air cooling", page 209](#)



Note

Fit new O-ring.

- Install headlights ⇒ Rep. gr. 94 .
- Check headlight setting ⇒ Maintenance ; Booklet 405

2.5 Checking charge air system for leaks

Special tools and workshop equipment required

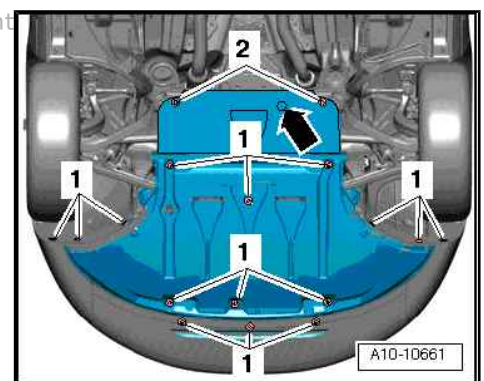
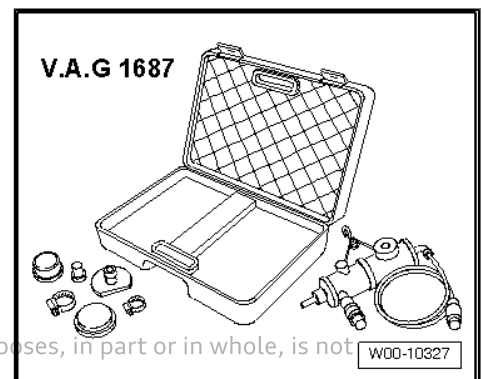
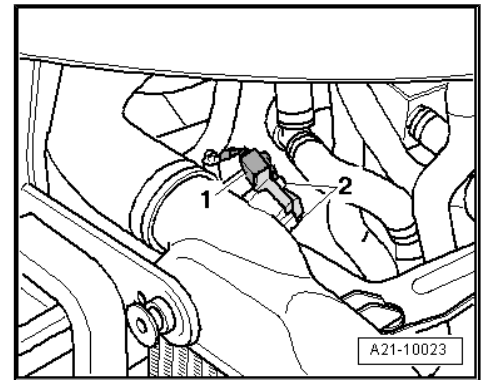
- ◆ Charge air system tester - V.A.G 1687-



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Procedure

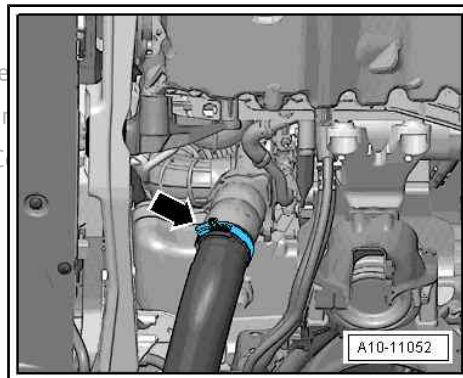
- Remove noise insulation panels ⇒ Rep. gr. 50 .



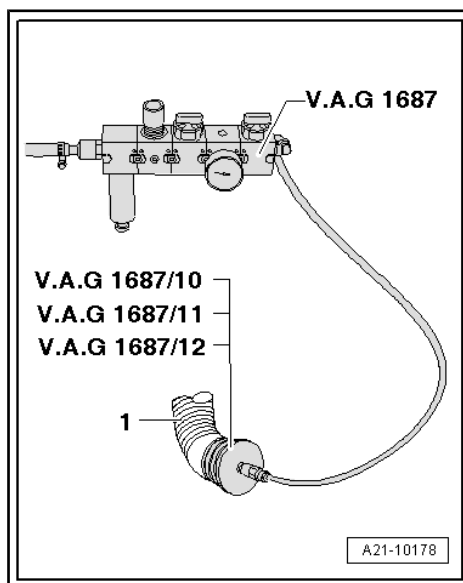


- Open hose clip -arrow-, detach air hose and swivel to side.

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- Depending on hose diameter, insert adapter - 1687/10- , -1687/11- or -1687/12- into air hose -1- and secure with hose clip.
- Connect charge air system tester - V.A.G 1687- as shown on illustration.





Prepare charge air system tester - V.A.G 1687- as follows:

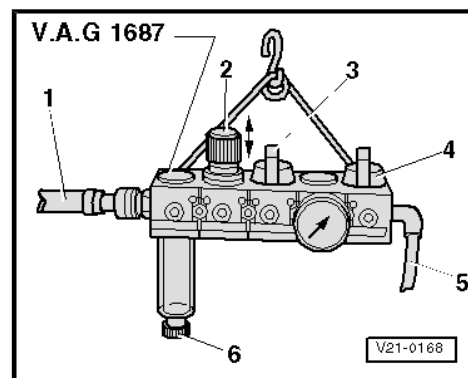
- Unscrew pressure control valve -2- completely and close valves -3- and -4-.



Note

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.

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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 detection 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.*
- ◆ *Operation of ultrasonic tester - V.A.G 1842- ⇒ Operating instructions .*

Assembling

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

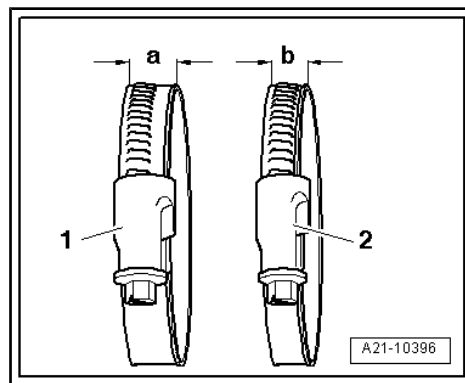


Note

- ◆ *Release pressure in test circuit by detaching coupling from adapter before removing adapter.*
- ◆ *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 air hoses with screw-type clips ⇒ [page 210](#) .
- Install noise insulation panels ⇒ Rep. gr. 50 .



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26 – Exhaust system

1 Silencers

Overview

- ◆ ⇒ [“1.1 Exploded view - silencers”, page 217](#)
- ◆ ⇒ [“1.2 Removing and installing particulate filter - vehicles with manual gearbox”, page 221](#)
- ◆ ⇒ [“1.3 Removing and installing particulate filter - vehicles with multitronic gearbox”, page 224](#)
- ◆ ⇒ [“1.4 Removing and installing front exhaust pipe - vehicles with manual gearbox”, page 227](#)
- ◆ ⇒ [“1.5 Removing and installing front exhaust pipe - vehicles with multitronic gearbox”, page 229](#)
- ◆ ⇒ [“1.6 Separating Y-pipe and rear silencers”, page 232](#)
- ◆ ⇒ [“1.7 Renewing tailpipes”, page 233](#)
- ◆ ⇒ [“1.8 Stress-free alignment of exhaust system”, page 234](#)
- ◆ ⇒ [“1.9 Aligning tailpipes”, page 235](#)
- ◆ ⇒ [“1.10 Checking exhaust system for leaks”, page 235](#)

1.1 Exploded view - silencers

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1 - Bolt

- ☐ 20 Nm

2 - Mounting

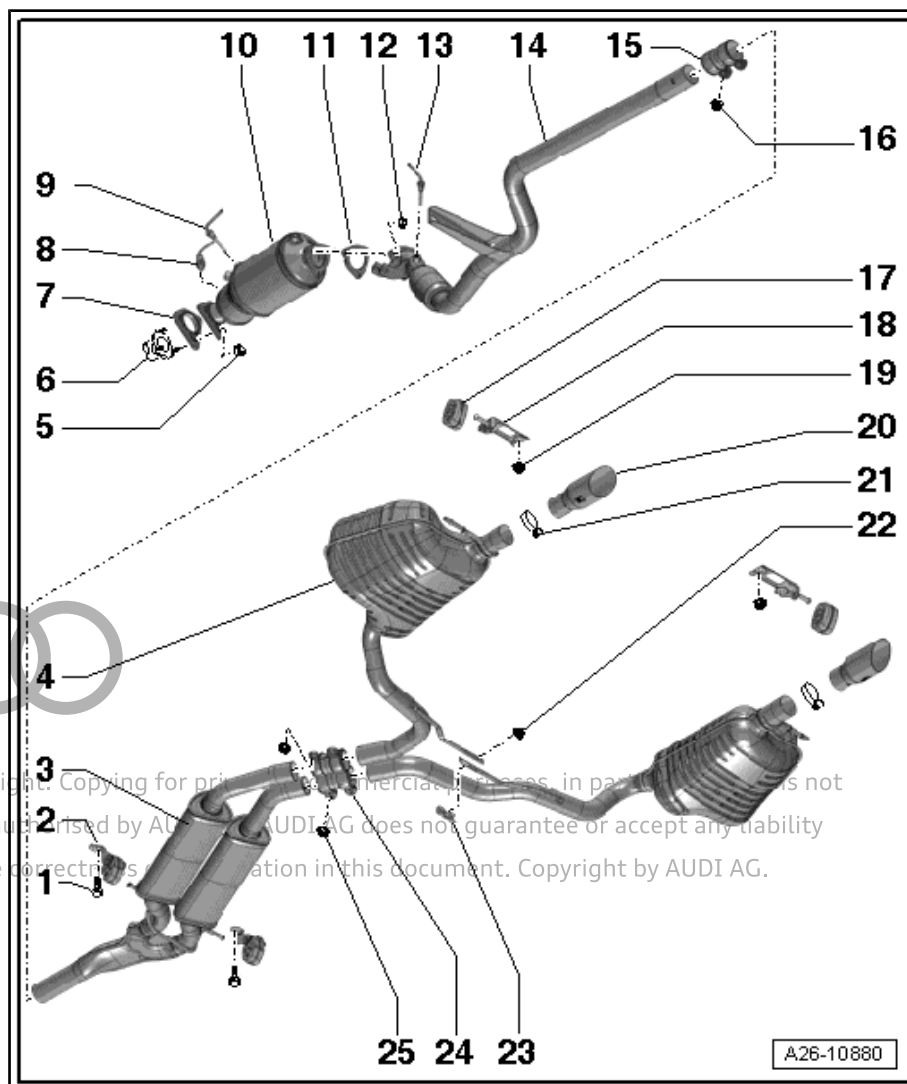
- ☐ Renew if damaged
- ☐ Check preload
⇒ ["1.8 Stress-free alignment of exhaust system", page 234](#)

3 - Y-pipe

- ☐ With centre silencers
- ☐ Combined in one unit with rear silencers as original equipment. Can be renewed separately for repair purposes
- ☐ Cutting point
⇒ [page 232](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 234](#)

4 - Rear silencer

- ☐ Combined with Y-pipe in one unit as original equipment. Can be renewed separately for repair purposes
- ☐ Cutting point: Y-pipe / rear silencer
⇒ [page 232](#)
- ☐ Renewing tailpipes
⇒ [page 233](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 234](#)



5 - Nut

- ☐ Renew
- ☐ 23 Nm

6 - Turbocharger

7 - Gasket

- ☐ Renew

8 - Lambda probe - G39-

- ☐ Removing and installing ⇒ Rep. gr. 23

9 - Exhaust gas temperature sender 3 - G495-

- ☐ Exploded view ⇒ [page 238](#)

10 - Particulate filter

- ☐ With catalytic converter
- ☐ With pressure line for exhaust gas pressure sensor 1 - G450-
- ☐ Removing and installing:

- ◆ Vehicles with manual gearbox ⇒ [page 221](#)

- ◆ Vehicles with multitronic gearbox ⇒ [page 224](#)

- ☐ Mounting components:

- ◆ Vehicles with manual gearbox ⇒ [page 220](#)



◆ Vehicles with multitronic gearbox ⇒ [page 221](#)

- ☐ After renewing, perform **Adaption** in **Guided Functions** ⇒ Vehicle diagnostic tester

11 - Gasket

- ☐ Renew

12 - Nut

- ☐ Renew
- ☐ 23 Nm

13 - Exhaust gas temperature sender 4 - G648-

- ☐ Exploded view ⇒ [page 238](#)

14 - Front exhaust pipe

- ☐ With flexible joint; do not bend flexible joint more than 10° – otherwise it can be damaged
- ☐ Protect against knocks and impact
- ☐ Removing and installing:

◆ Vehicles with manual gearbox ⇒ [page 227](#)

◆ Vehicles with multitronic gearbox ⇒ [page 229](#)

- ☐ Align exhaust system so it is free of stress ⇒ [page 234](#)

15 - Clamp (front)

- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 234](#)
- ☐ Installation position ⇒ [page 220](#)
- ☐ Tighten bolted connections evenly

16 - Nut

- ☐ 23 Nm

17 - Rubber mounting

- ☐ Renew if damaged
- ☐ Check preload ⇒ [“1.8 Stress-free alignment of exhaust system”, page 234](#)

18 - Mounting

- ☐ Renew if damaged
- ☐ Check preload ⇒ [“1.8 Stress-free alignment of exhaust system”, page 234](#)

19 - Nut

- ☐ 23 Nm

20 - Tailpipes

- ☐ Can be renewed separately for repair purposes ⇒ [page 233](#)
- ☐ Cutting point between rear silencer and tailpipes ⇒ [page 233](#)

21 - Clamp

- ☐ Tighten to 23 Nm

22 - Nut

- ☐ 23 Nm

23 - Bracket

24 - Clamp (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 234](#)
- ☐ Installation position ⇒ [page 220](#)
- ☐ Tighten bolted connections evenly

25 - Nut

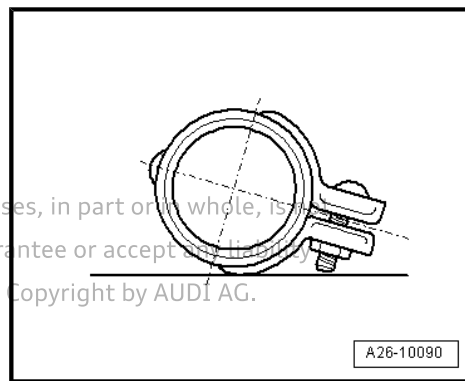
- ☐ 23 Nm



Installation position of front clamp

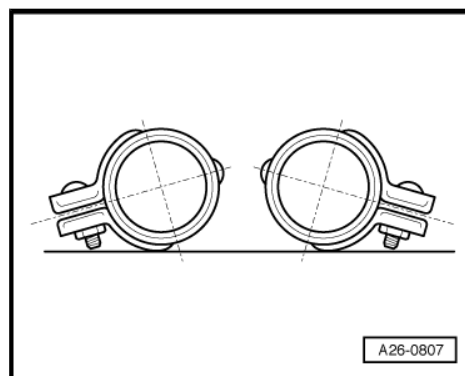
- Install clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces to right.

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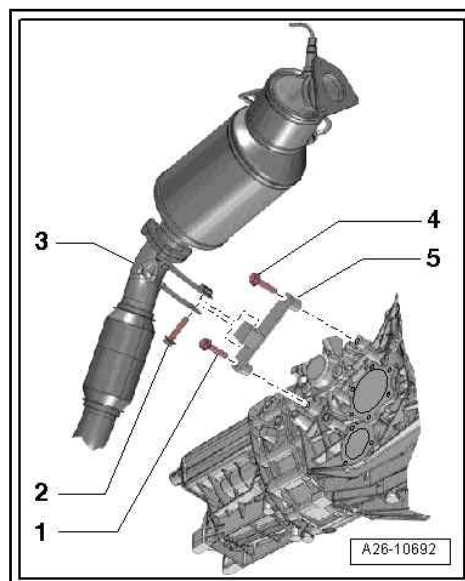
Installation position of rear clamps

- Install clamps so that the bolt ends do not protrude beyond bottom of clamp.
- Bolt connections face outwards.



Components of mountings for particulate filter - vehicles with manual gearbox

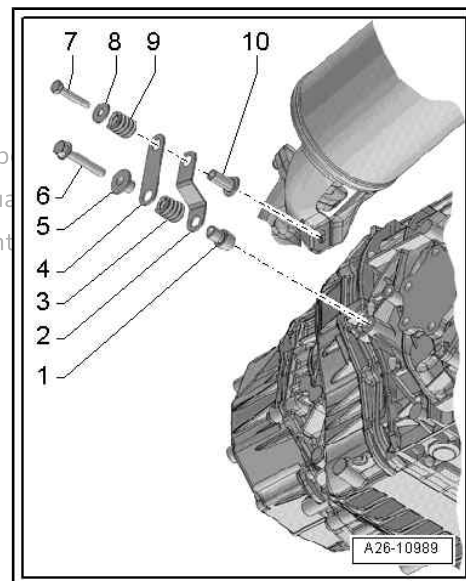
- 1 - Bolt, 40 Nm
- 2 - Bolt, 23 Nm
- 3 - Front exhaust pipe
- 4 - Bolt, 40 Nm
- 5 - Bracket





Components of mountings for particulate filter - vehicles with multitrronic gearbox

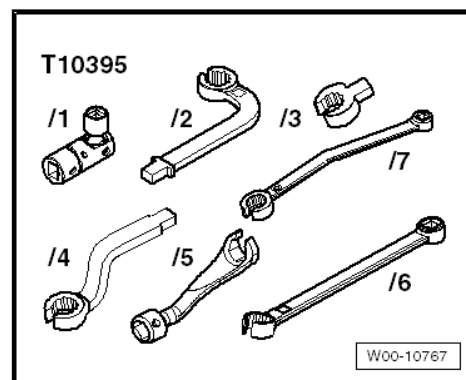
- 1 - Spacer sleeve
- 2 - Bracket
- 3 - Compression spring
- 4 - Bracket
- 5 - Spacer sleeve
- 6 - Bolt, 23 Nm
- 7 - Bolt, 23 Nm
- 8 - Washer
- 9 - Compression spring
- 10 - Spacer sleeve



1.2 Removing and installing particulate filter - vehicles with manual gearbox

Special tools and workshop equipment required

- ◆ Tool set, 17 mm - T10395-



Removing

- Remove engine cover panel -arrows-.



Note

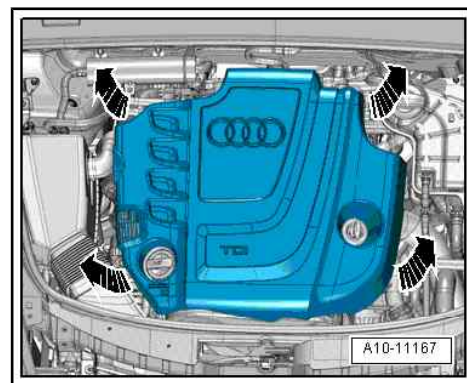
Fit all cable ties in the original positions when installing.



WARNING

When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*
⇒ "2.6 Safety precautions when working on the exhaust system", page 4 .



- Remove front exhaust pipe ⇒ [page 227](#) .



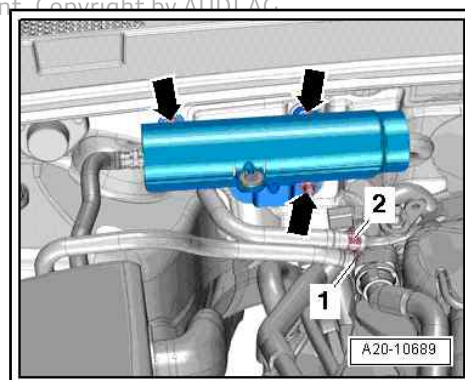
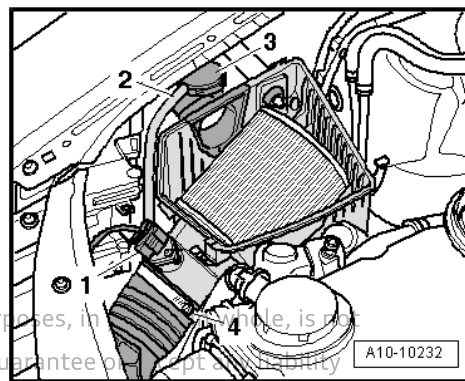
- Remove air cleaner housing ⇒ Rep. gr. 23 .
- Remove engine cover panel -arrows-.



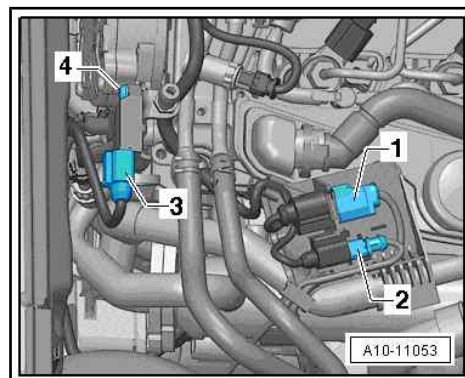
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with respect to the correctness of information in this document. Copyright by AUDI AG.

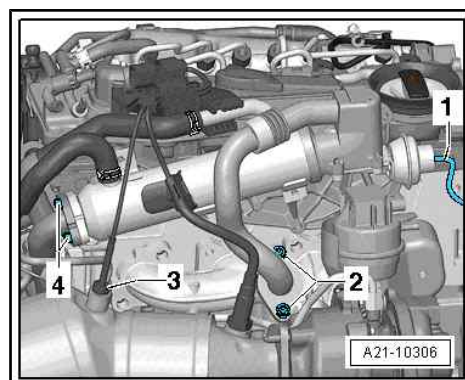
- Remove nuts -arrows- and move fuel filter bracket clear to one side (fuel hoses -1- and -2- remain connected).



- Unplug electrical connector -1- for Lambda probe - G39- and electrical connector -2- for exhaust gas temperature sender 3 - G495- and move electrical wiring clear.
- Unplug electrical connector -3-.
- Remove bolt -4- and move hoses for exhaust gas pressure sensor 1 - G450- clear.
- Unscrew pipes from particulate filter and detach with pressure sensor.

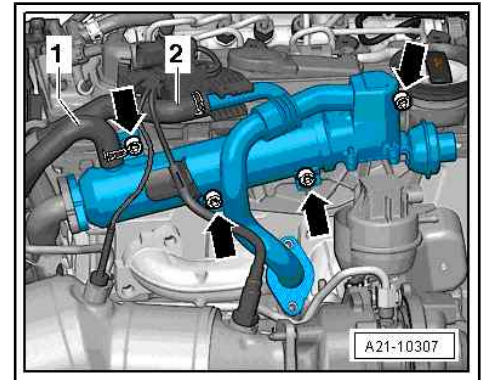


- Unscrew exhaust gas temperature sender 3 - G495- -item 3- using a tool from tool set, 17 mm - T10395- .
- Disconnect vacuum hose -1-.
- Remove bolts -2- and -4-.





- Remove bolts -arrows-.
- Tie up exhaust gas recirculation cooler (coolant hoses -1- and -2- remain attached).

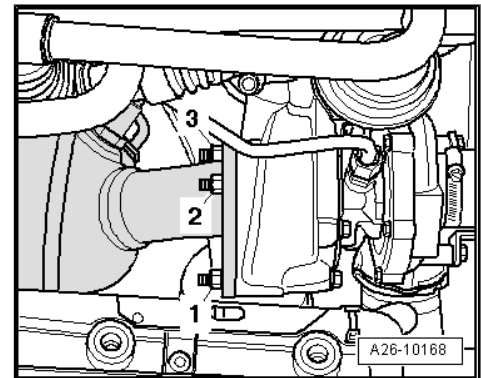


- Remove nuts -1, 2, 3- at turbocharger and press particulate filter off turbocharger.



Note

Nut -1- is accessible from below on vehicles with auxiliary heater.



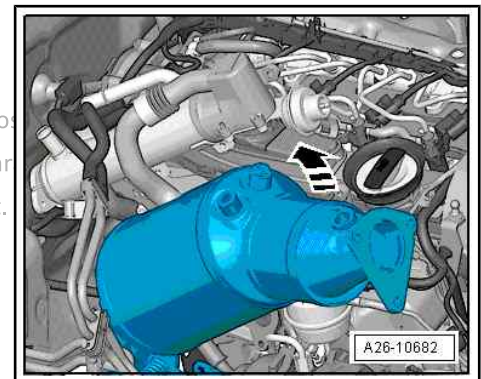
- Guide out particulate filter upwards -arrow-.

Installing

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

Tightening torques

- ◆ ⇒ [“1.1 Exploded view - silencers” page 217](#)
- ◆ ⇒ [“3.1 Exploded view - exhaust gas temperature senders”, page 238](#)
- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation cooler”, page 245](#)



Note

Renew gaskets and self-locking nuts.

- Install air cleaner housing ⇒ Rep. gr. 23 .
- Install front exhaust pipe ⇒ [page 227](#) .
- Secure exhaust gas pressure sensor 1 - G450- ⇒ Rep. gr. 23 .
- After renewing particulate filter, perform **Adaption** in **Guided Functions** ⇒ Vehicle diagnostic tester.



1.3 Removing and installing particulate filter - vehicles with multitronic gearbox

Removing

- Remove rear noise insulation ⇒ Rep. gr. 50 .



Note

Fit all cable ties in the original positions when installing.



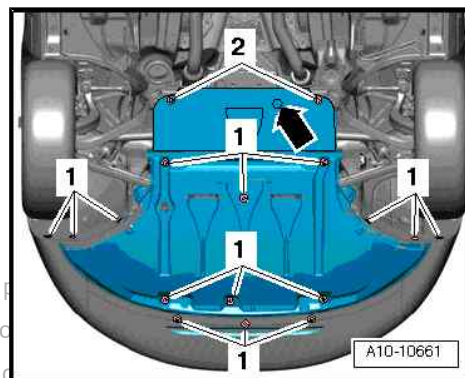
WARNING

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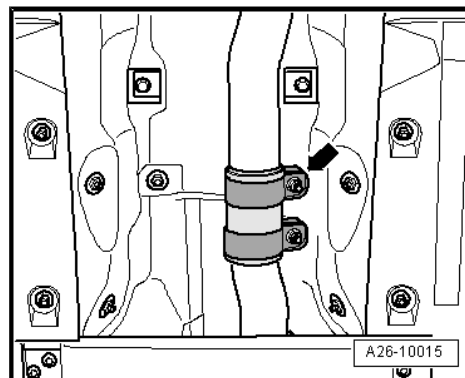
When working on all parts of the exhaust system:

◆ **Observe safety precautions when working on the exhaust system**

⇒ **"2.6 Safety precautions when working on the exhaust system", page 4 .**



- Loosen bolt connections and push clamp -arrow- towards rear to disconnect exhaust system.
- Remove front exhaust pipe ⇒ [page 227](#) .

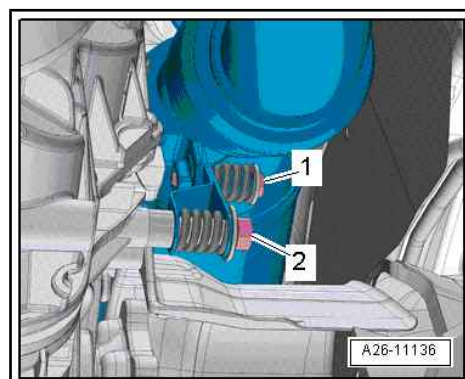


- Remove bolt -2- at bracket for particulate filter.



Note

Disregard -item 1-.

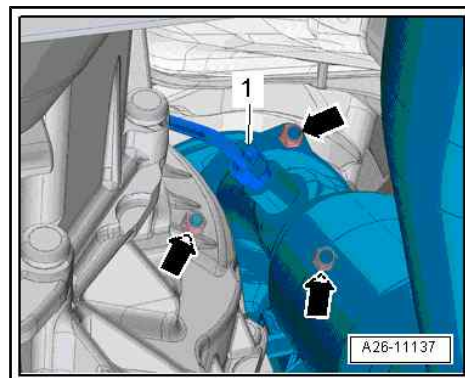


- Remove nuts -arrows- and press front exhaust pipe slightly to rear.



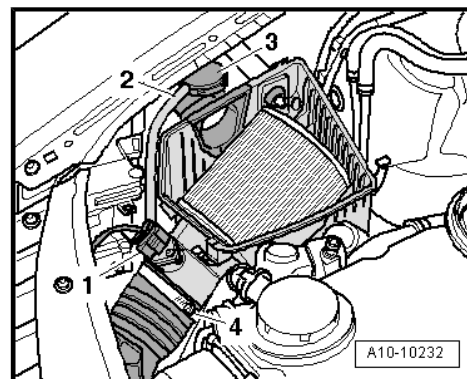
Note

Disregard -item 1-.





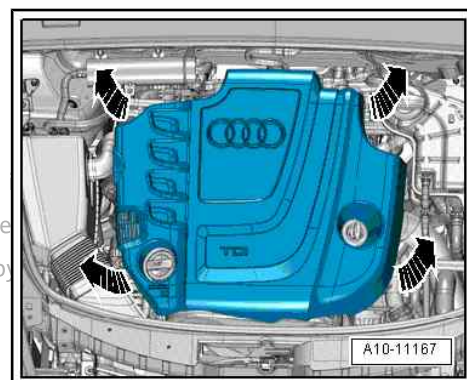
- Remove air cleaner housing ⇒ Rep. gr. 23 .



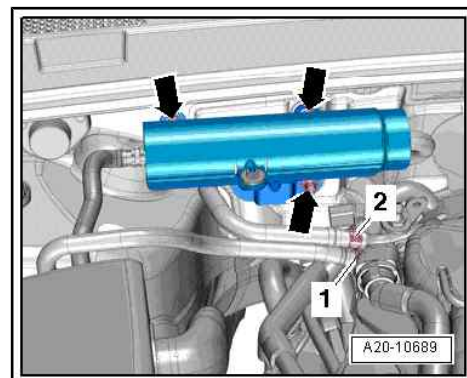
- Remove engine cover panel -arrows-.



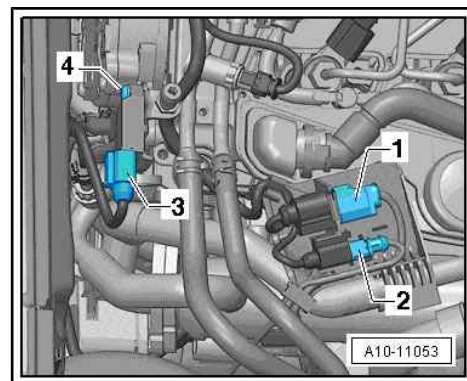
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- Remove nuts -arrows- and move fuel filter bracket clear to one side (fuel hoses -1- and -2- remain connected).



- Unplug electrical connector -1- for Lambda probe - G39- and electrical connector -2- for exhaust gas temperature sender 3 - G495- and move electrical wiring clear.
- Unplug electrical connector -3-.
- Remove bolt -4- and move hoses for exhaust gas pressure sensor 1 - G450- clear.
- Unscrew pipes from particulate filter and detach with pressure sensor.



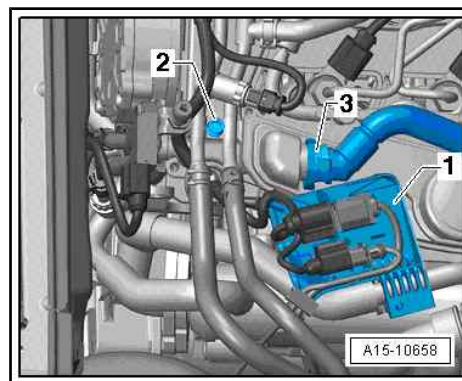


- Detach bracket -1- for Lambda probe - G39- wiring and exhaust gas temperature sender 3 - G495- from cylinder head cover.



Note

Disregard items -2 and 3-.

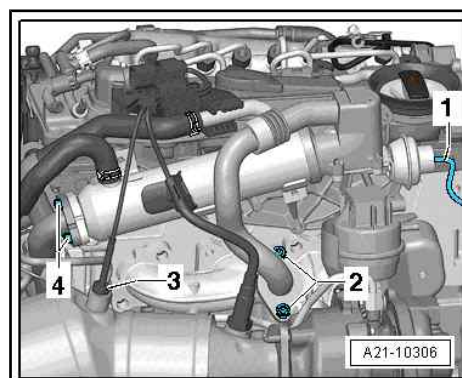


- Disconnect vacuum hose -1-.
- Remove bolts -2- and -4-.

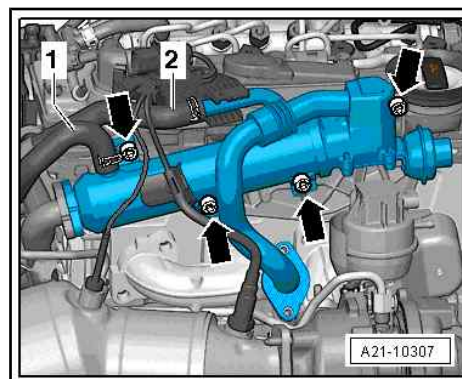


Note

Disregard -item 3-.



- Remove bolts -arrows-.
- Tie up exhaust gas recirculation cooler (coolant hoses -1- and -2- remain attached).

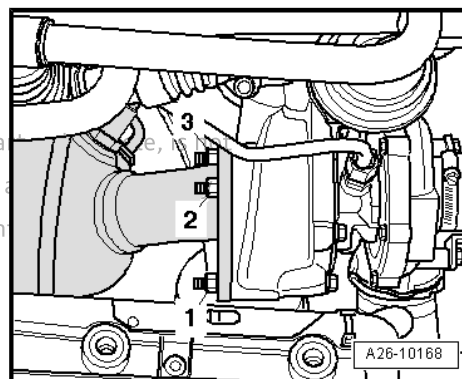


- Remove nuts -1, 2, 3- at turbocharger and press particulate filter off turbocharger.



Note

Nut -1- is accessible from below on vehicles with auxiliary heater.





- Guide out particulate filter upwards -arrow-.

Installing

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

Tightening torques

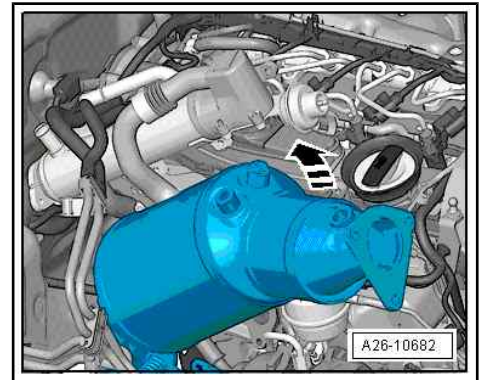
- ◆ ⇒ [“1.1 Exploded view - silencers”, page 217](#)
- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation cooler”, page 245](#)



Note

Renew gaskets and self-locking nuts.

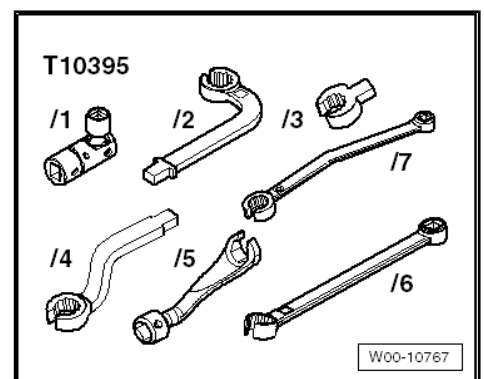
- Install air cleaner housing ⇒ Rep. gr. 23 .
- Install front exhaust pipe ⇒ [page 227](#) .
- Secure exhaust gas pressure sensor 1 - G450- ⇒ Rep. gr. 23 .
- After renewing particulate filter, perform **Adaption** in **Guided Functions** ⇒ Vehicle diagnostic tester.



1.4 Removing and installing front exhaust pipe - vehicles with manual gearbox

Special tools and workshop equipment required

- ◆ Tool set, 17 mm - T10395-



Removing



WARNING

When working on all parts of the exhaust system:

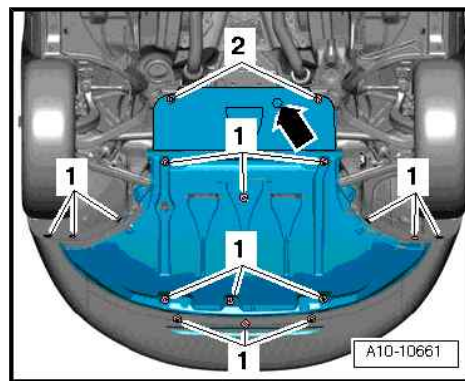
- ◆ **Observe safety precautions when working on the exhaust system**
⇒ [“2.6 Safety precautions when working on the exhaust system”, page 4](#) .



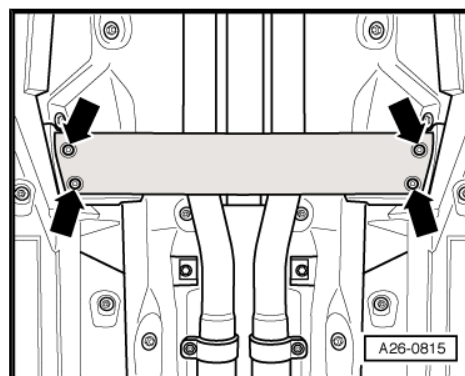
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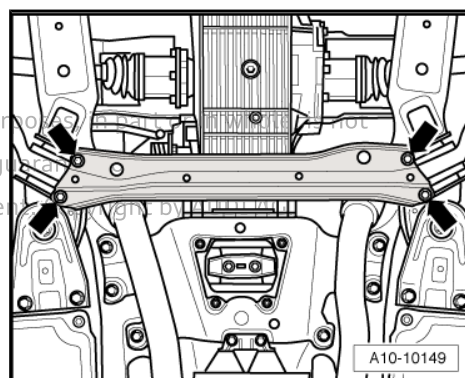
- Remove noise insulation panels ⇒ Rep. gr. 50 .



- Remove bolts -arrows- and detach front cross piece.



- Remove bolts -arrows- and detach cross piece from subframe.

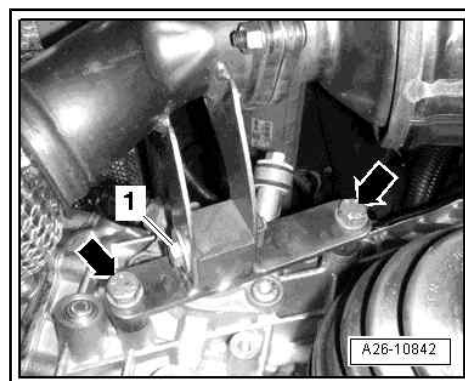


- Remove bolts -arrows-.



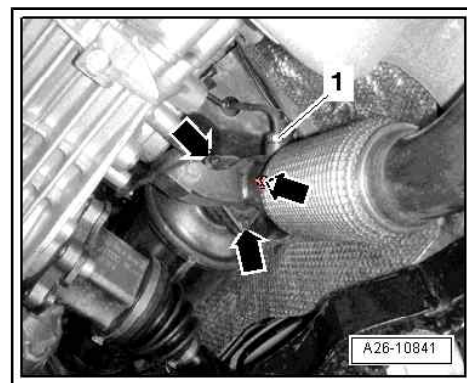
Note

Disregard -item 1-.





- Unscrew exhaust gas temperature sender 4 - G648- -item 1- using a tool from tool set, 17 mm - T10395- .
- Remove nuts -arrows-.



Caution

Risk of damage to flexible joint in front exhaust pipe.

- ◆ *Do not bend flexible joints in front exhaust pipe more than 10°.*

- Loosen bolt connections and push clamp -arrow- towards rear to disconnect exhaust system.
- Detach front exhaust pipe.

Installing

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

- Tightening torques
⇒ ["1.1 Exploded view - silencers" page 217](#)
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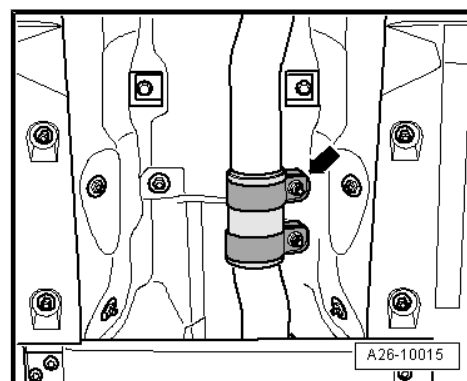
Note

Renew gaskets and self-locking nuts.

- Install exhaust gas temperature sender 4 - G648-
⇒ [page 242](#) .
- Align the exhaust system so it is free of stress ⇒ [page 234](#) .
- Install cross member and cross piece ⇒ Rep. gr. 40 .
- Install noise insulation panels ⇒ Rep. gr. 50 .

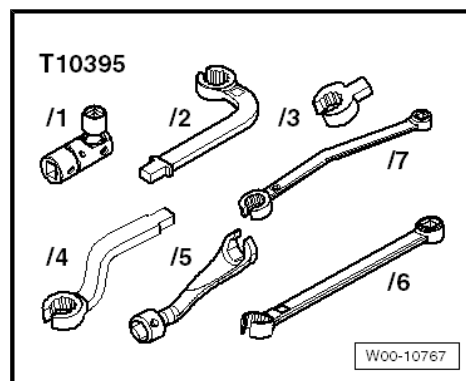
1.5 Removing and installing front exhaust pipe - vehicles with multitronic gearbox

Special tools and workshop equipment required





- ◆ Tool set, 17 mm - T10395-



Removing



WARNING

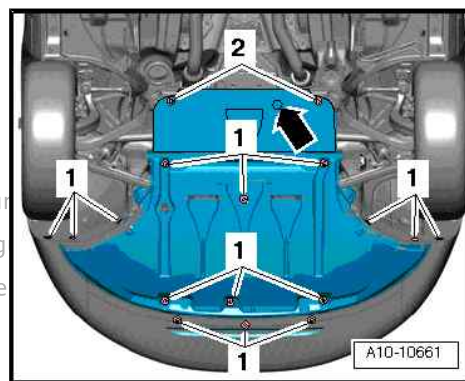
When working on all parts of the exhaust system:

- ◆ *Observe safety precautions when working on the exhaust system*
⇒ ***"2.6 Safety precautions when working on the exhaust system", page 4 .***

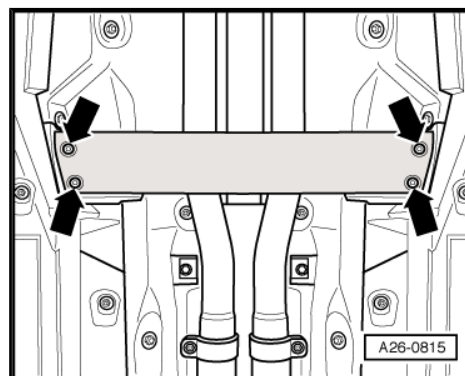
- Remove rear noise insulation ⇒ Rep. gr. 50 .



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- Remove bolts -arrows- and detach front cross piece.





- Remove bolts -arrows- and detach cross piece from subframe.



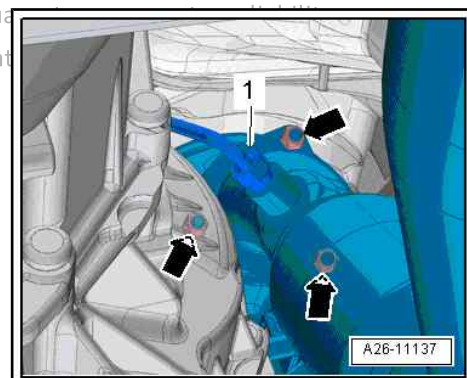
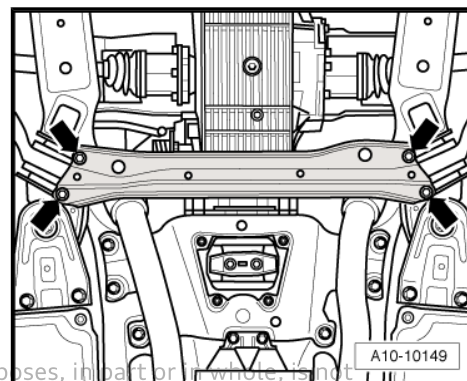
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- Remove bolts -arrows-.

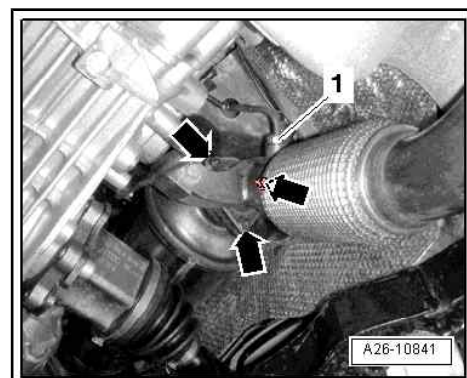


Note

Disregard -item 1-.



- Unscrew exhaust gas temperature sender 4 - G648- -item 1- using a tool from tool set, 17 mm - T10395- .
- Remove nuts -arrows-.





Caution

Risk of damage to flexible joint in front exhaust pipe.

- ◆ **Do not bend flexible joints in front exhaust pipe more than 10°.**

- Loosen bolt connections and push clamp -arrow- towards rear to disconnect exhaust system.
- Detach front exhaust pipe.

Installing

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

Tightening torques

- ◆ ⇒ ["1.1 Exploded view - silencers", page 217](#)



Note

Renew gaskets and self-locking nuts.

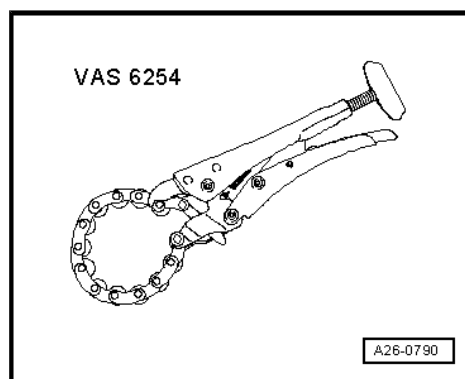
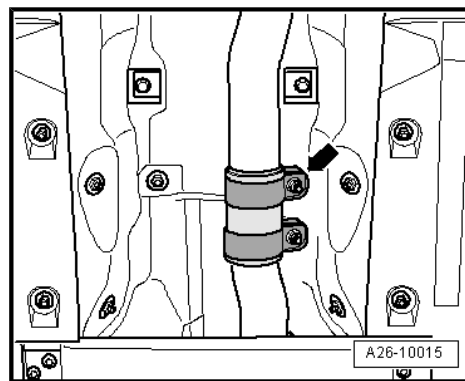
- Install exhaust gas temperature sender 4 - G648-
⇒ [page 242](#) .
- Align the exhaust system so it is free of stress ⇒ [page 234](#) .
- Install cross member and cross piece ⇒ Rep. gr. 40 .
- Install noise insulation panels ⇒ Rep. gr. 50 .

1.6 Separating Y-pipe and rear silencers

- ◆ The connecting pipe can be cut through at the point marked in order to renew the Y-pipe or rear silencer(s) separately.
- ◆ The cutting point is marked by an indentation on the circumference of the exhaust pipe.

Special tools and workshop equipment required

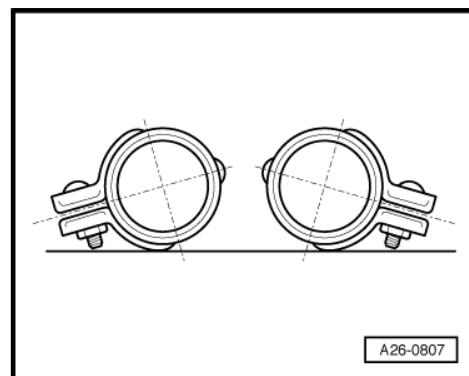
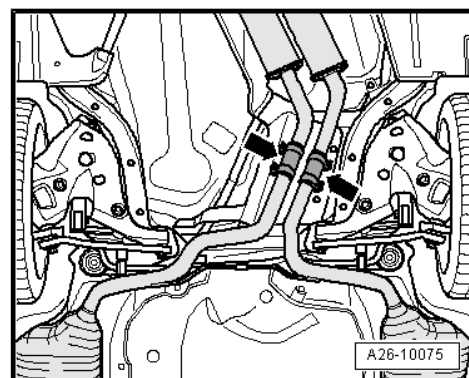
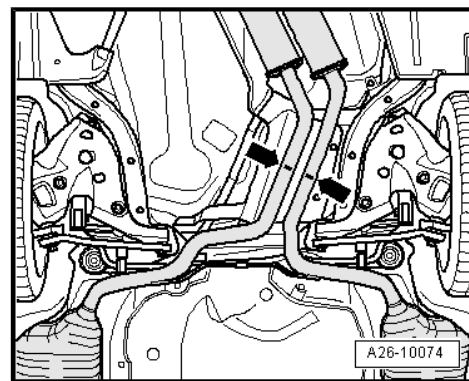
- ◆ Chain pipe cutter - VAS 6254-





Procedure

- Tightening torques
⇒ ["1.1 Exploded view - silencers", page 217](#)
- Cut through exhaust pipe at right angle at the position marked by -arrows- using chain pipe cutter - VAS 6254- .
- When installing, position centre of clamps -arrows- over cutting location.
- Install clamps so that the bolt ends do not protrude beyond bottom of clamp.
- Bolt connections face outwards.
- Align the exhaust system so it is free of stress ⇒ [page 234](#) .



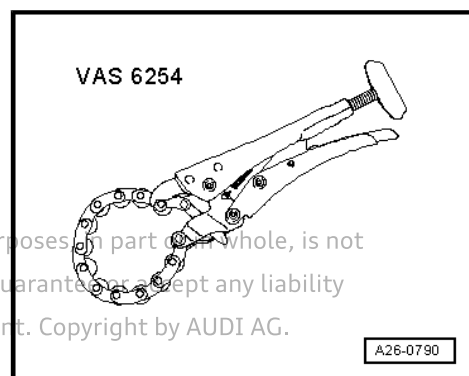
1.7 Renewing tailpipes

Special tools and workshop equipment required

- ◆ Chain pipe cutter - VAS 6254-



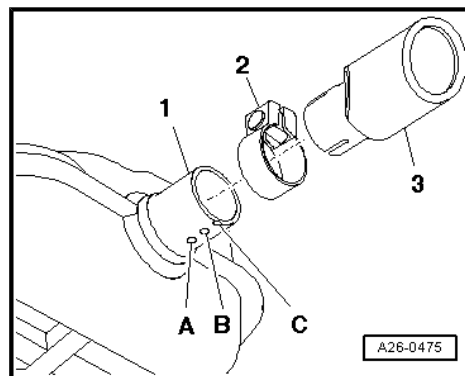
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Procedure

- Tightening torques
⇒ ["1.1 Exploded view - silencers", page 217](#)
- Cut through tailpipe -3- at a right angle at cutting point -C- using chain pipe cutter - VAS 6254- .
- Push new tailpipe onto rear silencer -1- as far as marking -A-. Slot on tailpipe should align with marking -B-.
- Fit clamp -2-.



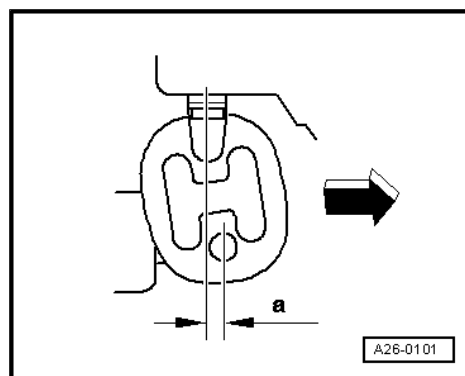
1.8 Stress-free alignment of exhaust system

Procedure

- The exhaust system must be aligned when it is cool.
- Tightening torque ⇒ [page 217](#)

Vehicles without clamps between Y-pipe and rear silencer

- Loosen bolted connections on front clamp.
- Push exhaust system towards front of vehicle -arrow- so that rear mountings for rear silencers are preloaded by -a- = 5 ... 9 mm.
- Tighten bolt connections on clamp evenly.
- Align tailpipes ⇒ [page 235](#) .



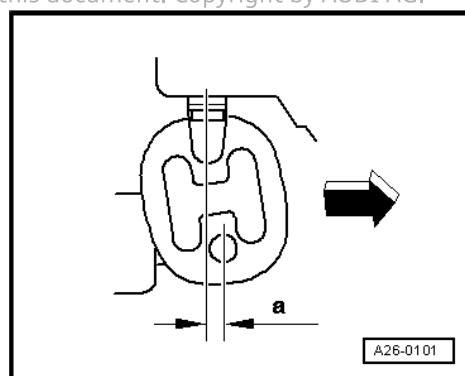
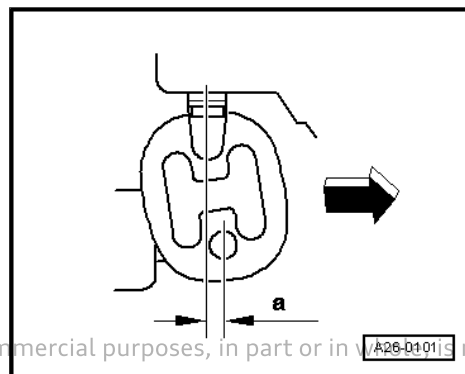
Vehicles with clamps between Y-pipe and rear silencers



Note

On a vehicle with clamps fitted between Y-pipe and rear silencers, it is also necessary to align the Y-pipe.

- Loosen bolted connections on front and rear clamps.
- Push front section of exhaust system towards front of vehicle -arrow-, so that mountings for Y-pipe are preloaded by -a- = 5 ... 9 mm.
- Tighten bolt connections on front clamp evenly.
- Push rear section of exhaust system towards front of vehicle -arrow-, so that mountings (rear) for rear silencers are preloaded by -a- = 5 ... 9 mm.
- Align rear silencer so it is horizontal.
- Tighten bolted connections on rear clamps evenly.
- Align tailpipes ⇒ [page 235](#) .



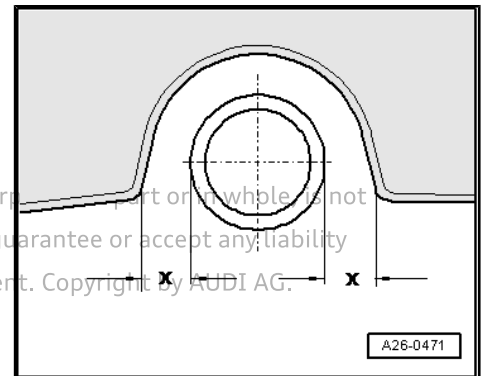


1.9 Aligning tailpipes

Procedure

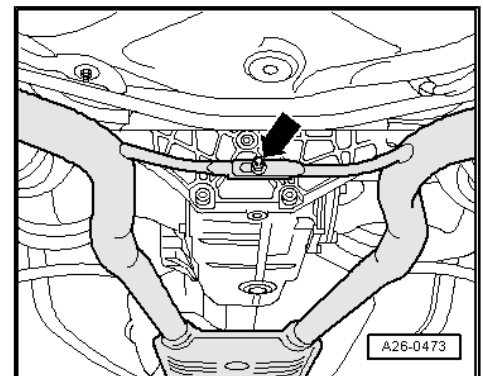
- Tightening torques ⇒ [page 217](#)
- Check clearance between tailpipes and bumper on both sides:
- Dimension -x- (left-side) = dimension -x- (right-side)

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If necessary, correct dimension -x- as follows:

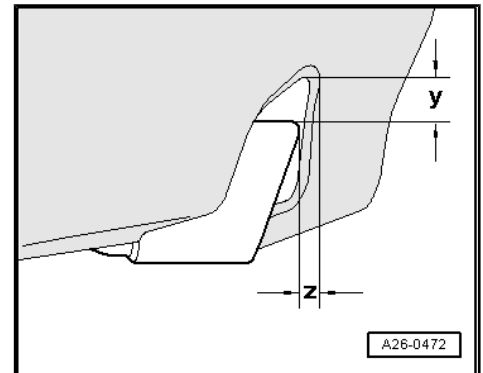
- Loosen connection -arrow- on strut between exhaust pipes.
- Adjust the distance between the rear silencers.
- Tighten connection.



- Check distances -y- and -z- between tailpipes and bumper:

Exhaust system	Exhaust system on S line models
• Dimension -y- = 23.9 ± 2.3 mm	• Dimension -y- = 23.6 ± 2.3 mm
• Dimension -z- = 15.3 ± 2.5 mm.	• Dimension -z- = 11.7 ± 2.5 mm.

- If necessary, check whether the exhaust system is aligned free of stress ⇒ [page 234](#) .



1.10 Checking exhaust system for leaks

- 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 exhaust manifold, turbocharger, particulate filter etc. to locate any leaks.
- Rectify any leaks that are found.



2 Exhaust manifold

Overview

- ◆ ⇒ [“2.1 Exploded view - exhaust manifold”, page 236](#)
- ◆ ⇒ [“2.2 Removing and installing exhaust manifold”, page 237](#)

2.1 Exploded view - exhaust manifold

1 - Gasket

- ☐ Renew

2 - Exhaust manifold

- ☐ Removing and installing
⇒ [page 237](#)

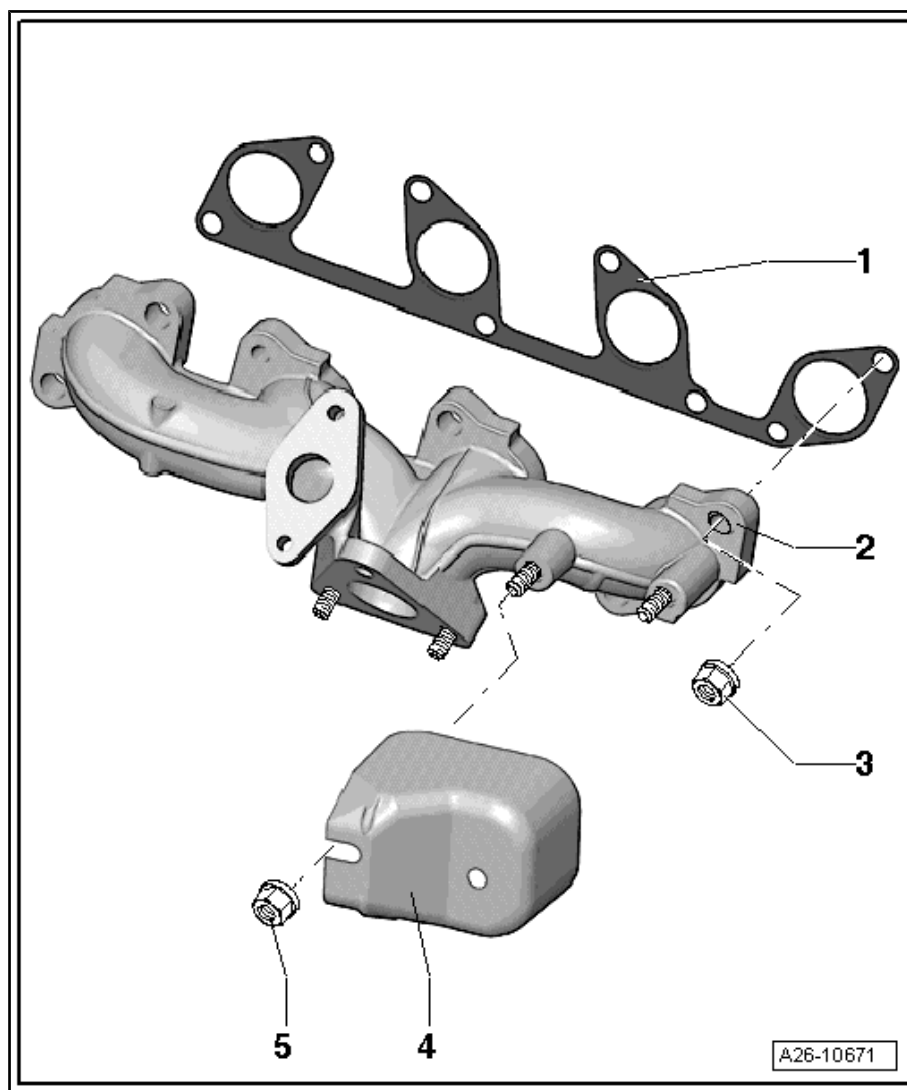
3 - Nut

- ☐ 25 Nm
- ☐ Renew
- ☐ Lubricate exhaust manifold studs with high-temperature paste
- ☐ If studs are renewed, too, tighten them to 15 Nm

4 - Heat shield

5 - Nut

- ☐ 25 Nm



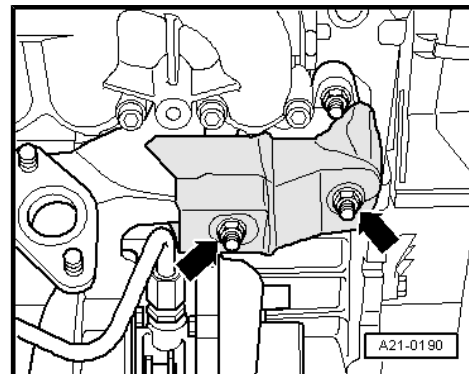
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2.2 Removing and installing exhaust manifold

Removing

- Remove turbocharger ⇒ [page 202](#) .
- Remove nuts -arrows- and detach heat shield for exhaust manifold.



- Remove nuts -arrows- and detach exhaust manifold.

Installing

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

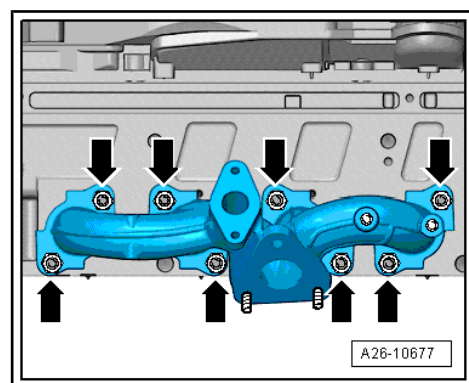


Note

Renew gaskets and self-locking nuts.

Tightening torques

- ♦ ⇒ [“2.1 Exploded view - exhaust manifold”, page 236](#)
- Install turbocharger ⇒ [page 202](#) .



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3 Exhaust gas temperature control

Overview

- ◆ ⇒ ["3.1 Exploded view - exhaust gas temperature senders", page 238](#)
- ◆ ⇒ ["3.2 Removing and installing exhaust gas temperature sender 1 G235", page 239](#)
- ◆ ⇒ ["3.3 Removing and installing exhaust gas temperature sender 3 G495", page 241](#)
- ◆ ⇒ ["3.4 Removing and installing exhaust gas temperature sender 4 G648", page 242](#)

3.1 Exploded view - exhaust gas temperature senders

1 - Particulate filter

2 - Exhaust gas temperature sender 1 - G235-

- ☐ Removing and installing ⇒ [page 239](#)
- ☐ Coat thread with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ☐ 45 Nm

3 - Turbocharger

4 - Lambda probe - G39- with Lambda probe heater - Z19-

- ☐ Removing and installing ⇒ Rep. gr. 23

5 - Exhaust gas pressure sensor 1 - G450-

- ☐ Removing and installing ⇒ Rep. gr. 23
- ☐ Pressure pipes to particulate filter: 45 Nm

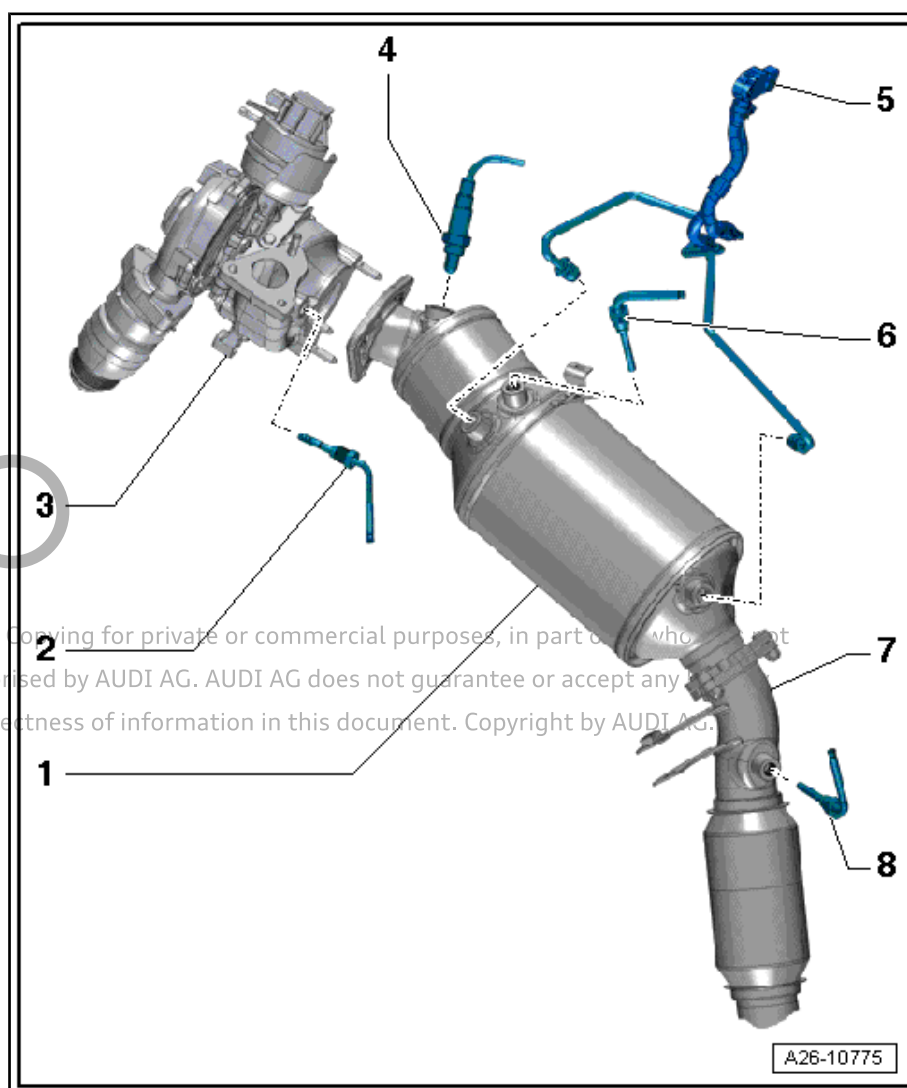
6 - Exhaust gas temperature sender 3 - G495-

- ☐ Removing and installing ⇒ [page 241](#)
- ☐ Coat thread with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ☐ 45 Nm

7 - Front exhaust pipe

8 - Exhaust gas temperature sender 4 - G648-

- ☐ Removing and installing ⇒ [page 242](#)
- ☐ 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 sender 1 - G235-

Removing

- Remove noise insulation panels ⇒ Rep. gr. 50 .



Note

Fit all cable ties in the original positions when installing.



WARNING

When working on all parts of the exhaust system:

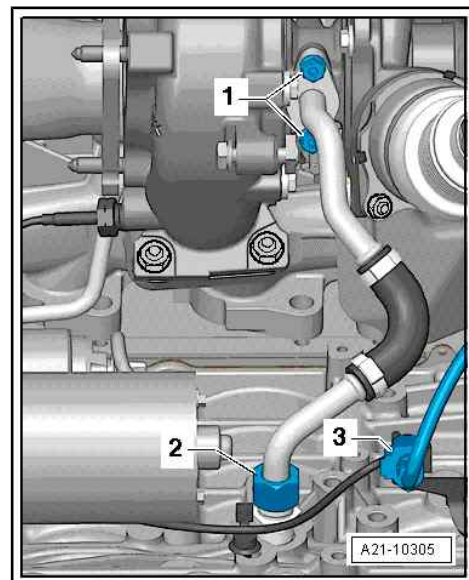
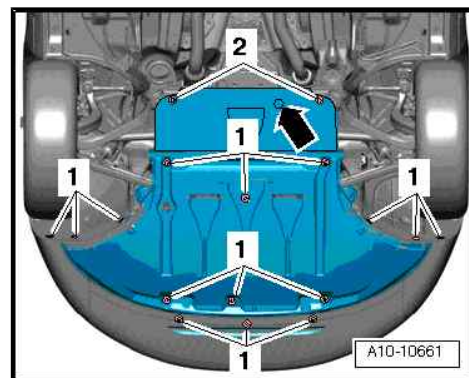
- ♦ **Observe safety precautions when working on the exhaust system**
⇒ ***"2.6 Safety precautions when working on the exhaust system", page 4 .***

- Unplug electrical connector -3- for exhaust gas temperature sender 1 - G235- and move electrical wiring clear.



Note

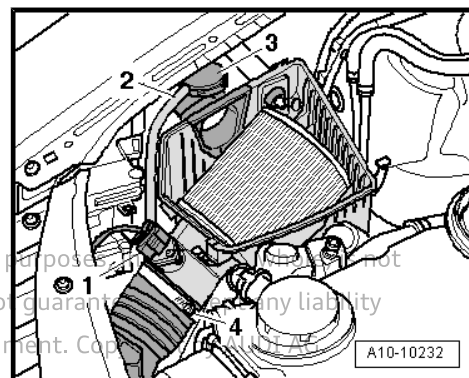
Disregard items -1 and 2-.



- Remove air cleaner housing ⇒ Rep. gr. 23 .

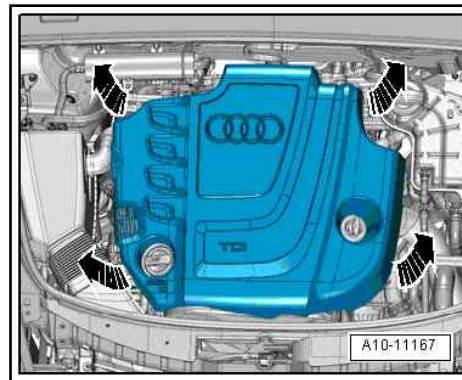


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- Remove engine cover panel -arrows-.

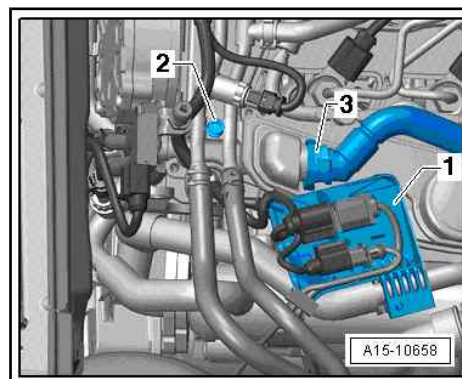


- Detach bracket -1- for Lambda probe - G39- wiring and exhaust gas temperature sender 3 - G495- from cylinder head cover.



Note

Disregard items -2 and 3-.

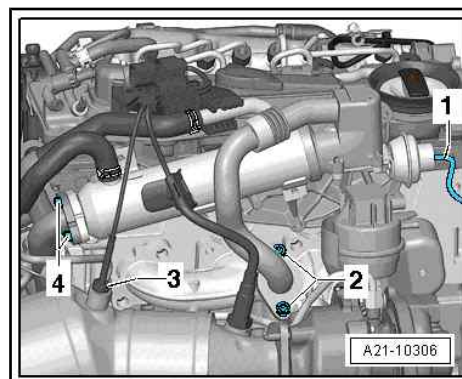


- Disconnect vacuum hose -1-.
- Remove bolts -2- and -4-.



Note

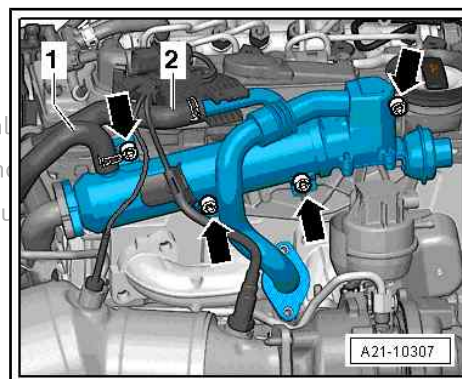
Disregard -item 3-.



- Remove bolts -arrows-.
- Tie up exhaust gas recirculation cooler (coolant hoses -1- and -2- remain attached).

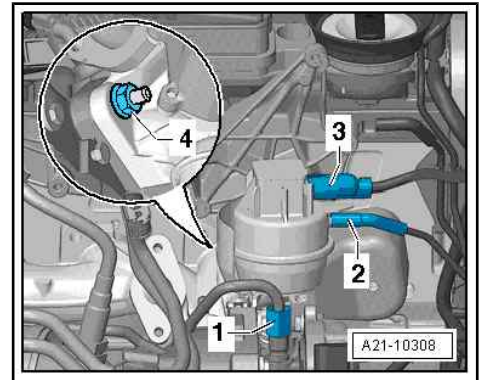


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- Remove union nut -1-.



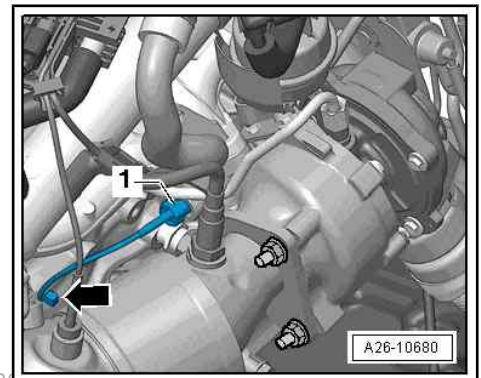
- Unscrew exhaust gas temperature sender 1 - G235- -item 1- and move electrical wiring clear -arrow-.

Installing

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

Tightening torques

- ◆ ⇒ [“3.1 Exploded view - exhaust gas temperature senders”, page 238](#)
- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation cooler”, page 245](#)

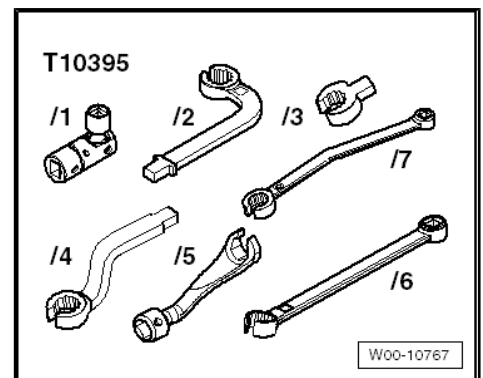


- Install noise insulation panels ➤ Rep. gr. 50
 - Install air cleaner housing ➤ Rep. gr. 23
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3.3 Removing and installing exhaust gas temperature sender 3 - G495-

Special tools and workshop equipment required

- ◆ Tool set, 17 mm - T10395-





Removing

- Remove engine cover panel -arrows-.



Note

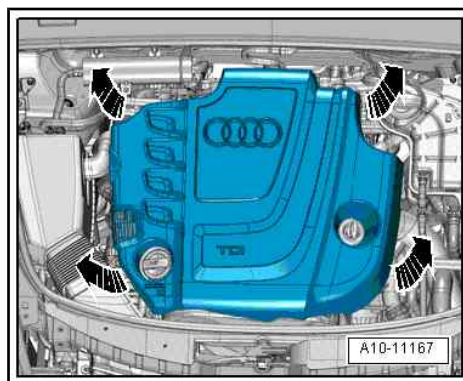
Fit all cable ties in the original positions when installing.



WARNING

When working on all parts of the exhaust system:

- ♦ Observe safety precautions when working on the exhaust system
⇒ **"2.6 Safety precautions when working on the exhaust system", page 4**.

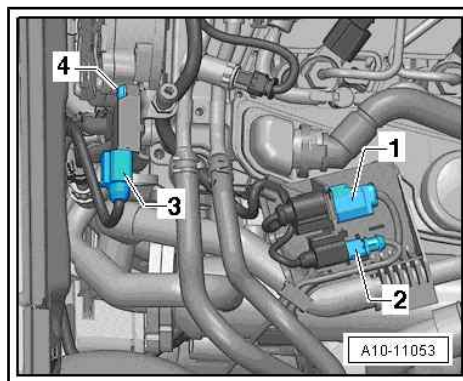


- Unplug electrical connector -2- for exhaust gas temperature sender 3 - G495- and move electrical wiring clear.



Note

Disregard -items 1, 3, 4-.

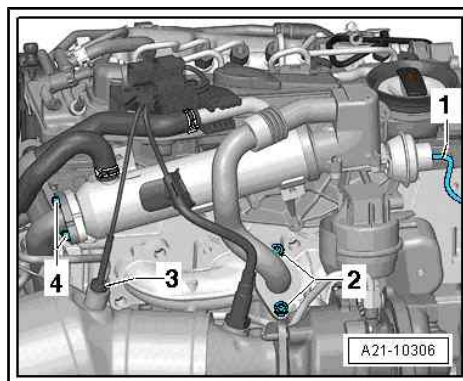


- Unscrew exhaust gas temperature sender 3 - G495- -item 3- using a tool from tool set, 17 mm - T10395- .



Note

Disregard -items 1, 2, 4-.



Installing

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

Tightening torques

- ♦ ⇒ **"3.1 Exploded view - exhaust gas temperature senders", page 238**



Note

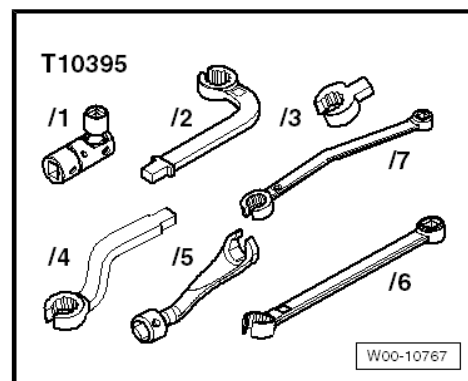
Make sure there is sufficient clearance from surrounding components.

3.4 Removing and installing exhaust gas temperature sender 4 - G648-

Special tools and workshop equipment required



- ◆ Tool set, 17 mm - T10395-



Removing

- Remove engine cover panel -arrows-.



Note

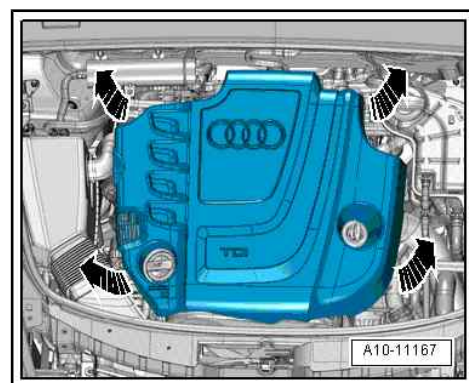
Fit all cable ties in the original positions when installing.



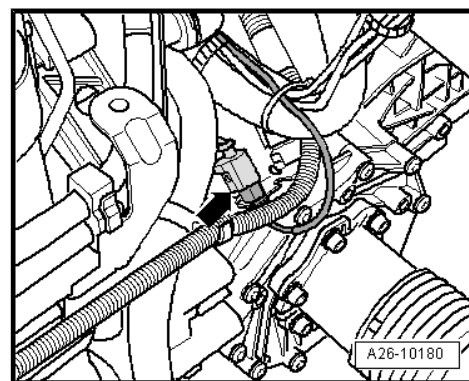
WARNING

When working on all parts of the exhaust system:

- ◆ **Observe safety precautions when working on the exhaust system**
⇒ **"2.6 Safety precautions when working on the exhaust system", page 4**.



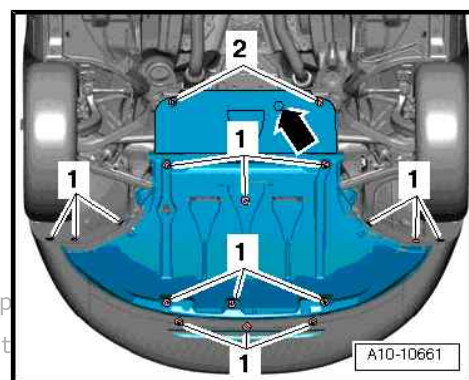
- Take electrical connector -arrow- for exhaust gas temperature sender 4 - G648- out of bracket and unplug.
- Move electrical wiring clear.



- Remove noise insulation panels ⇒ Rep. gr. 50 .



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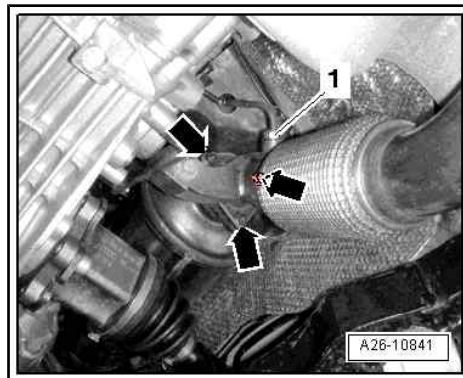
Vehicles with manual gearbox:

- Unscrew exhaust gas temperature sender 4 - G648- -item 1- using a tool from tool set, 17 mm - T10395- .



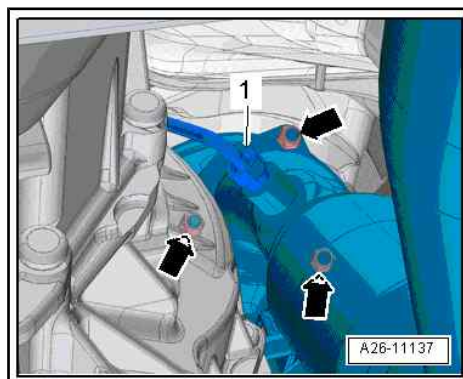
Note

Disregard -arrows-.



Vehicles with multitronic gearbox:

- Unscrew exhaust gas temperature sender 4 - G648- -item 1- using a tool from tool set, 17 mm - T10395- .



Installing

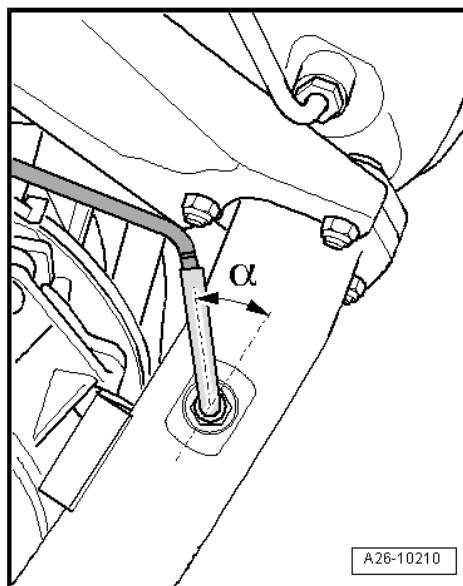
Installation is carried out in reverse order; note the following:

Tightening torques

- ♦ ⇒ [“3.1 Exploded view - exhaust gas temperature senders”, page 238](#)

Installation position of exhaust gas temperature sender -G648- :

- Angled section faces towards left side of vehicle.
- Angle α = $15 \pm 5^\circ$ to left.
- Install noise insulation panels ⇒ Rep. gr. 50 .



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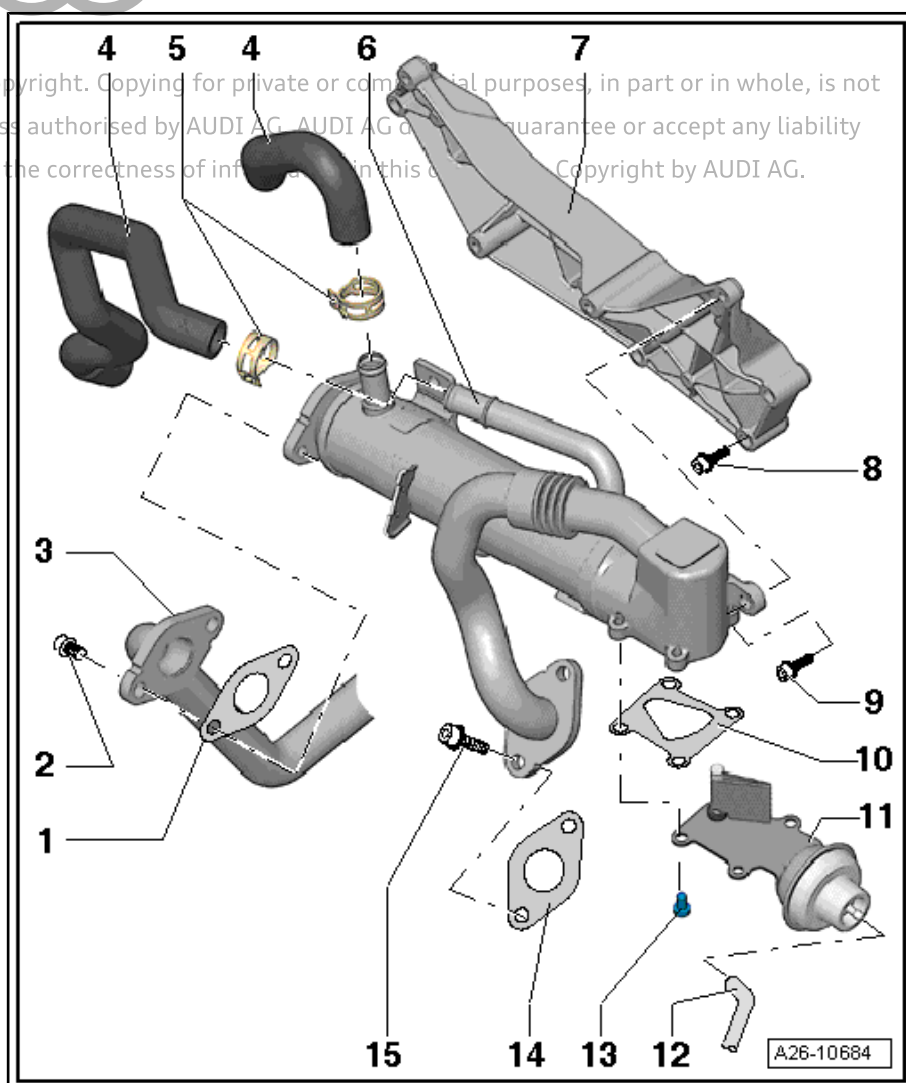
4 Exhaust gas recirculation

Overview

- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation cooler”, page 245](#)
- ◆ ⇒ [“4.2 Removing and installing exhaust gas recirculation cooler”, page 246](#)
- ◆ ⇒ [“4.3 Removing and installing vacuum unit for exhaust gas recirculation cooler”, page 248](#)
- ◆ ⇒ [“4.4 Exploded view - exhaust gas recirculation valve N18 with exhaust gas recirculation potentiometer G212”, page 250](#)
- ◆ ⇒ [“4.5 Removing and installing exhaust gas recirculation valve N18 with exhaust gas recirculation potentiometer G212”, page 251](#)
- ◆ ⇒ [“4.6 Cleaning exhaust gas recirculation system”, page 252](#)

4.1 Exploded view - exhaust gas recirculation cooler

- 1 - Gasket
 - ☐ Renew
- 2 - Bolt
 - ☐ Tightening torque and sequence ⇒ [page 246](#)
- 3 - Exhaust gas recirculation pipe
 - ☐ Tightening torque and sequence ⇒ [page 246](#)
- 4 - Coolant hoses
- 5 - Spring-type clip
- 6 - Exhaust gas recirculation cooler
 - ☐ Removing and installing ⇒ [page 246](#)
- 7 - Bracket
- 8 - Bolt
 - ☐ 9 Nm
- 9 - Bolt
 - ☐ 9 Nm
- 10 - Gasket
- 11 - Vacuum unit
- 12 - Vacuum hose
 - ☐ From exhaust gas recirculation cooler change-over valve - N345-
- 13 - Bolt
 - ☐ 7 Nm
- 14 - Gasket
 - ☐ Renew



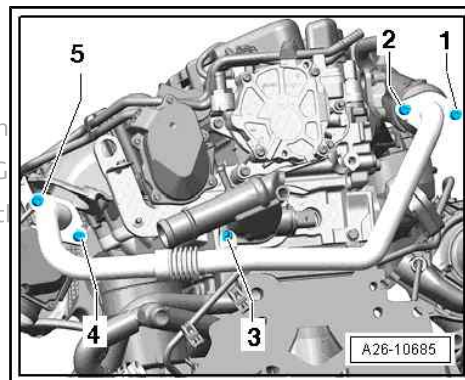


15 - Bolt

- ☐ Renew
- ☐ 25 Nm

Tightening torque and sequence

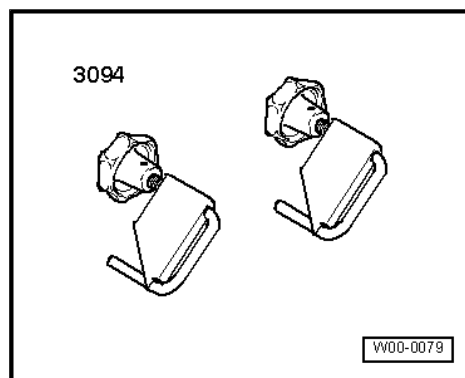
- 1 - Position bolts -4- and -5-.
- 2 - Position bolts -1- and -2-.
- 3 - Position bolt -3-.
- 4 - Tighten bolts -1- and -2- to 20 Nm.
- 5 - Tighten bolts -4- and -5- to 20 Nm.
- 6 - Tighten bolt -3- to 8 Nm.



4.2 Removing and installing exhaust gas re-circulation cooler

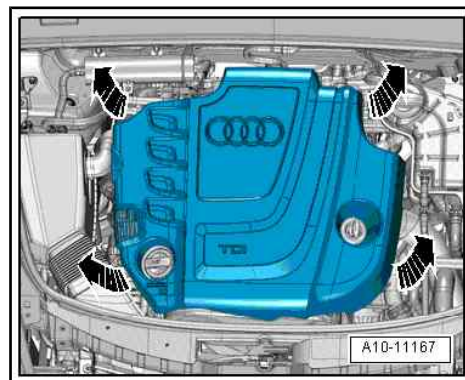
Special tools and workshop equipment required

- ◆ Hose clamps up to 25 mm - 3094-



Removing

- Remove engine cover panel -arrows-.



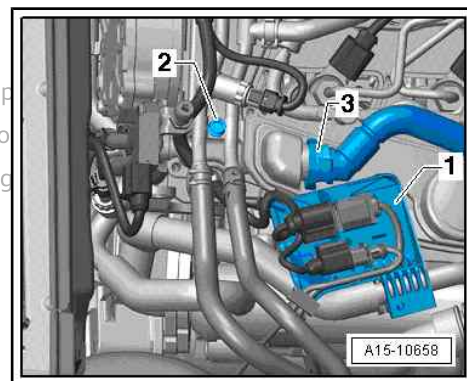


- Detach bracket -1- for Lambda probe - G39- wiring and exhaust gas temperature sender 3 - G495- from cylinder head cover.

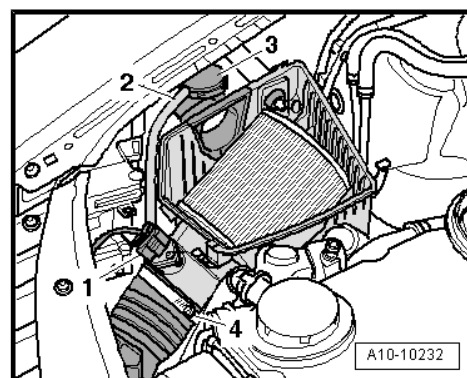
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Disregard items -2 and 3-.



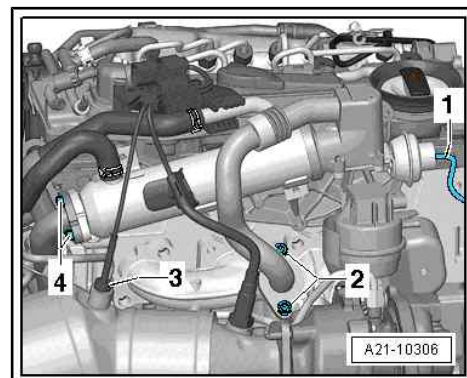
- Remove air cleaner housing ⇒ Rep. gr. 23 .



- Disconnect vacuum hose -1-.
- Remove bolts -2- and -4-.

i Note

Disregard -item 3-.





- Clamp off coolant hoses -1- and -2- using hose clamps for hoses up to 25 mm - 3094- and disconnect hoses.
- Remove bolts -arrows- and detach exhaust gas recirculation cooler.

Installing

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

Tightening torques

- ♦ ➔ [“4.1 Exploded view - exhaust gas recirculation cooler”, page 245](#)



Note

- ♦ *Renew seals and O-rings.*
- ♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ➔ [Electronic parts catalogue](#) .*
- Install air cleaner housing ➔ Rep. gr. 23 .
- Check coolant level ➔ [page 177](#) .

4.3 Removing and installing vacuum unit for exhaust gas recirculation cooler

Special tools and workshop equipment required

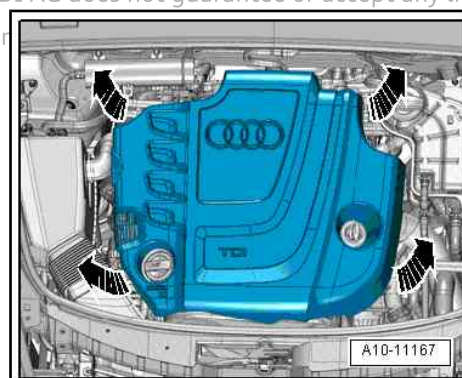
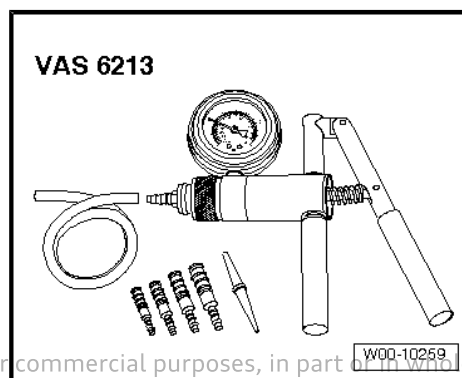
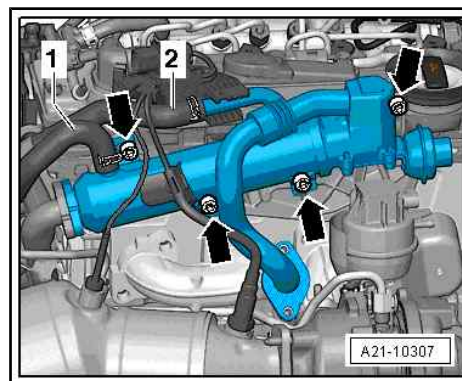
- ♦ Hand vacuum pump - VAS 6213-



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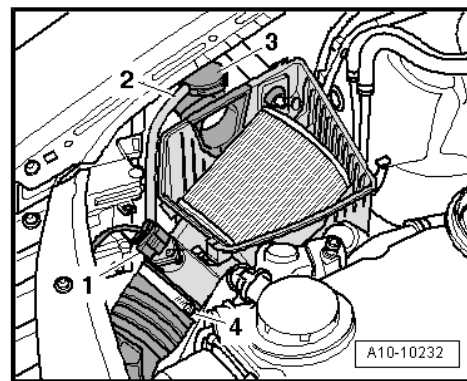
Removing

- Remove engine cover panel -arrows-.





- Remove air cleaner housing ⇒ Rep. gr. 23 .

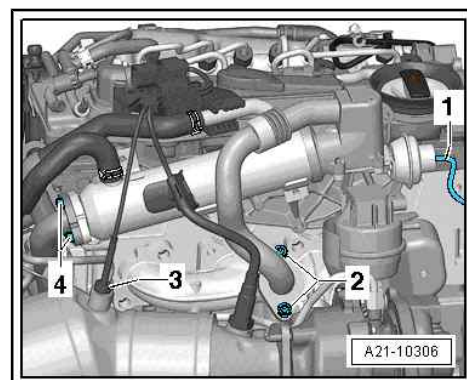


- Disconnect vacuum hose -1-.
- Remove bolts -2- and -4-.

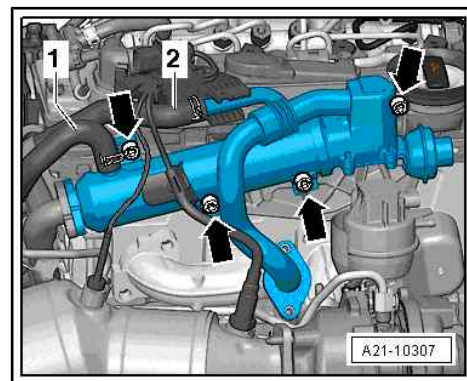


Note

Disregard -item 3-.



- Remove bolts -arrows-.
- Tie up exhaust gas recirculation cooler (coolant hoses -1- and -2- remain attached).



- Remove bolts -1 ... 4- and detach vacuum unit with gasket.



Note

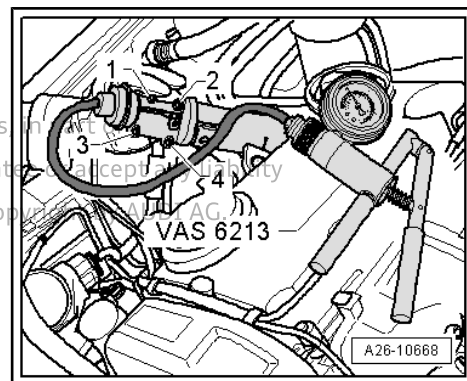
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Installing

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

Tightening torques

- ◆ ⇒ [“4.1 Exploded view - exhaust gas recirculation cooler”, page 245](#)

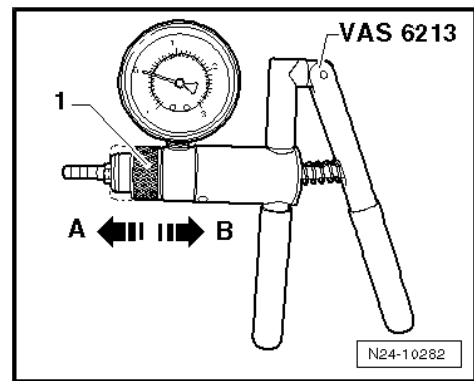


Note

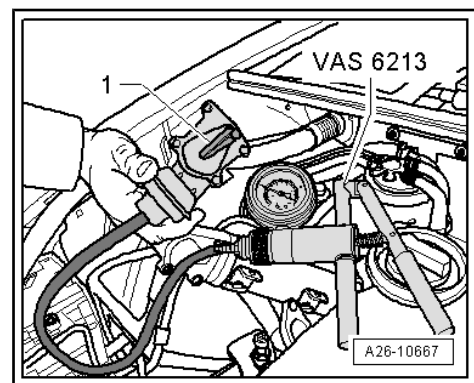
- ◆ Renew gaskets and self-locking nuts.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ *Electronic parts catalogue* .



- Set sliding ring -1- to position -A- for vacuum function.



- Set change-over flap -1- as shown in illustration using hand vacuum pump - VAS 6213- .
- Install vacuum unit with gasket and secure in position.
- Install air cleaner housing ⇒ Rep. gr. 23 .



4.4 Exploded view - exhaust gas recirculation valve - N18- with exhaust gas recirculation potentiometer - G212-

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1 - Intake manifold

- ☐ Removing and installing
⇒ Rep. gr. 23

2 - Bolt

- ☐ Tightening torque ⇒
Rep. gr. 23

3 - Gasket

- ☐ Renew

4 - Seal

- ☐ Renew

5 - Pipe

- ☐ To exhaust gas recirculation-cooler
- ☐ Tightening torque and
sequence ⇒ [page 246](#)

6 - Bolt

- ☐ Tightening torque and
sequence ⇒ [page 246](#)

7 - Gasket

- ☐ Renew

8 - Bolt

- ☐ 10 Nm

9 - Intake manifold flap motor - V157-

10 - Bolt

- ☐ Tightening torque ⇒
Rep. gr. 23

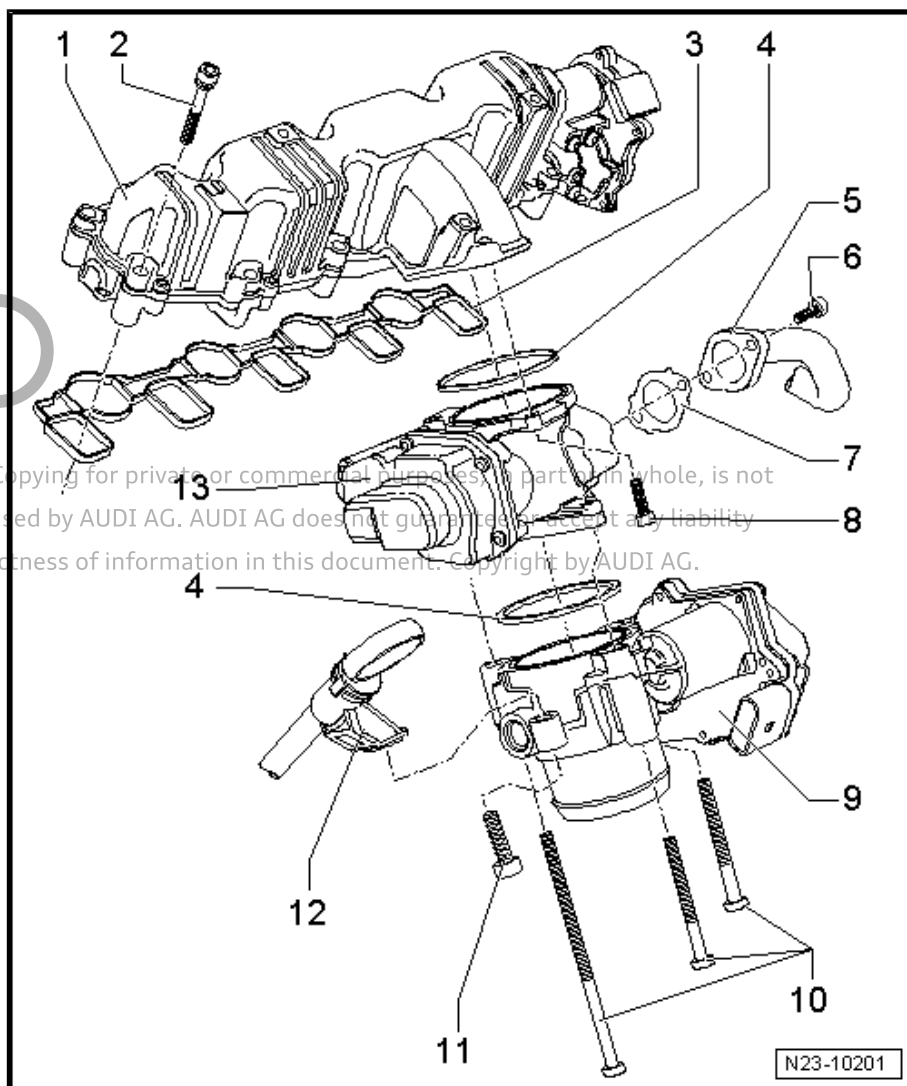
11 - Bolt

- ☐ 10 Nm

12 - Dipstick guide tube

13 - Exhaust gas recirculation valve - N18- with exhaust gas recirculation potentiometer - G212-

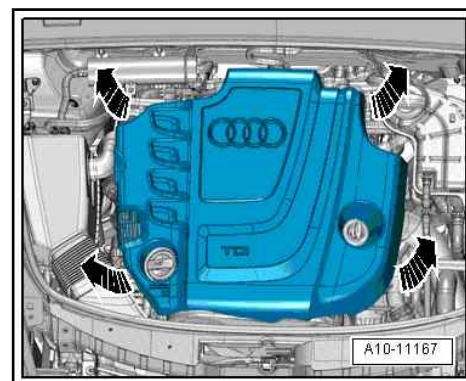
- ☐ Removing and installing ⇒ [page 251](#)



4.5 Removing and installing exhaust gas recirculation valve - N18- with exhaust gas recirculation potentiometer - G212-

Removing

- Remove engine cover panel -arrows-.
- Remove intake manifold flap motor - V157- ⇒ Rep. gr. 23 .





- Unplug electrical connector -1-.
- Remove bolts -2- and -3- and detach exhaust gas recirculation valve - N18- with exhaust gas recirculation potentiometer - G212- .

Installing

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

Tightening torques

- ♦ ⇒ ["4.1 Exploded view - exhaust gas recirculation cooler", page 245](#)



Note

Renew seals.

- Install intake manifold flap motor - V157- ⇒ Rep. gr. 23 .

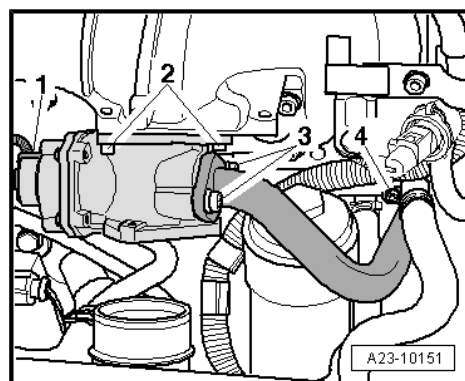
4.6 Cleaning exhaust gas recirculation system

Special tools and workshop equipment required

- ♦ Cooler rinsing system for exhaust gas recirculation - VAS 542 007-



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- ♦ Adapter - VAS 542007/4-2- , 2x
- ♦ Ultrasonic cleaning unit - VAS 6418-

Explanation:

Certain extreme driving modes (e.g. short distances) may result in varnish formation/carbon deposits inside the exhaust gas recirculation cooler. In this case, the exhaust emissions warning lamp in the instrument cluster lights up and the following code appears in the event memory:

- ♦ P401 EGR system throughput too low

In these cases, these carbon deposits can be removed by carrying out the rinsing/cleaning procedure described below.



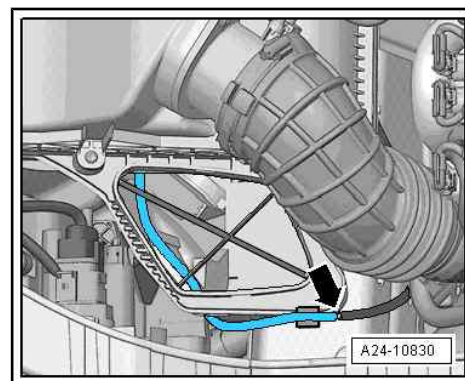
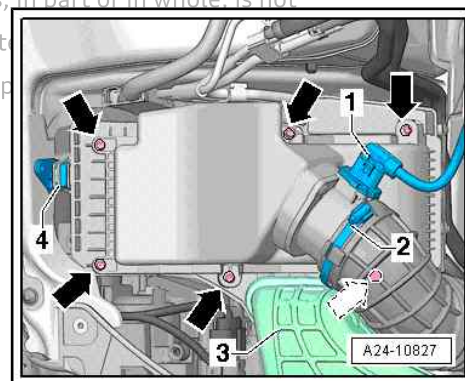
Starting cleaning procedure for exhaust gas recirculation system

- Remove engine cover panel -arrows-.
- Unplug electrical connector -1- at air mass meter - G70- .



- Open hose clip -2- on air hose leading to turbocharger and disconnect hose at air mass meter - G70- .
- Remove air duct -3-.

- Detach vacuum hose -arrow- (if fitted).

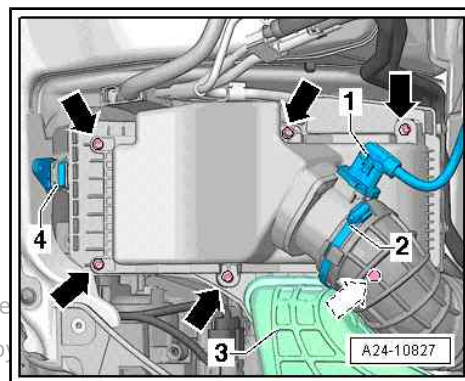




- Release retainer -4- for bottom section of air cleaner (press in rubber on left and right side and pull upwards).

**Note**

- ◆ *These components (bypass flap with variable intake manifold change-over valve - N335- -1-) are not installed on certain equipment versions or on vehicles for certain export markets.*
- ◆ *Do not use lubricants when installing retainer.*
- Disconnect electrical connector at variable intake manifold change-over valve - N335- (if fitted).



- Carefully take out complete air cleaner housing.

Cleaning exhaust gas recirculation valve - N18- :

- Remove exhaust gas recirculation valve - N18- ➔ [page 251](#) .

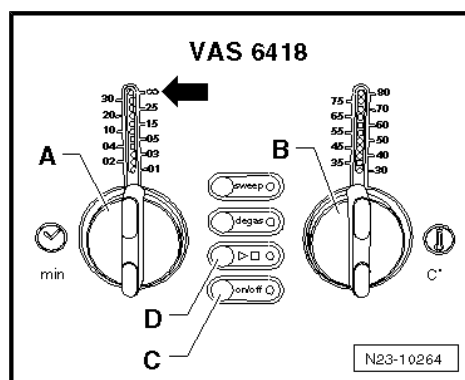
**Note**

The ultrasonic bath can be heated up more quickly by using warm tap water.

- Fill ultrasonic cleaning unit - VAS 6418- with 1800 ml of warm (approx. 40 °C) tap water and 200 ml cleaning solution D 600 200 A2.
- Switch on cleaning unit by pressing **[on/off]** button -C-.
- Turn rotary temperature control -B- until LED for heating temperature is at 40 °C.
- Set rotary control for operating time -A- to 10 -arrow-.
- Press **[]** -D- for longer than 2 seconds to start operation of unit.

**Note**

- ◆ *The temperature-controlled cleaning process is now started. While the fluid is being heated, the ultrasound is activated at intervals in order to circulate the cleaning solution. The ultrasound is activated continuously when the preselected temperature is reached.*
- ◆ *The actual cleaning process commences when the temperature reaches at least 40 °C and must last for at least 10 minutes.*
- After cleaning, rinse exhaust gas recirculation valve - N18- with clean water and blow out with compressed air.

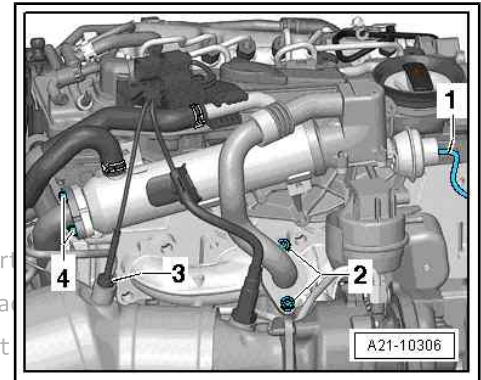
**On vehicle (continued):**



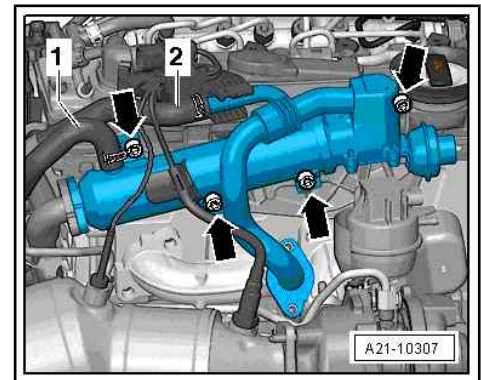
- Remove bolts -2- and -4- for connecting pipes.



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- Remove bolts -arrows- and press exhaust gas recirculation cooler to side (coolant hoses remain connected).
- Screw adapter - VAS 542 007/4-2- onto open connection of exhaust gas recirculation cooler using bolts from connecting pipe and hand-tighten. Ensure that seal on adapter is not pinched.
- Attach second adapter - VAS 542 007/4-2- to connecting pipe and hand-tighten. Ensure that seal on adapter is not pinched.
- Connect intake hose - VAS 542007/2-2- of cleaning unit to adapter - VAS 542 007/4-2- on connecting pipe.
- Connect return hose - VAS 542007/2-3- of cleaning unit to adapter - VAS 542 007/4-2- on exhaust gas recirculation cooler.
- Connect battery charger to battery.
- Connect battery clamps of pump - VAS 542007/3- to battery.



Preparing cooler rinsing system for exhaust gas recirculation - VAS 542 007- :

- Fill canister - VAS 542007/1- with 9 litres of warm (approx. 40 ° C) tap water.
- Pour 1 litre of cleaning solution - D 600 200 A2- into canister.

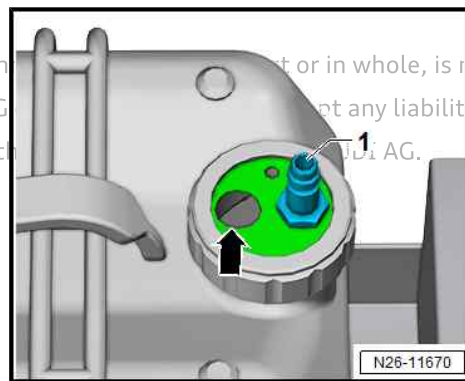


- Connect suction hose - VAS 542007/2-1- of pump to connection -1- on canister lid.
- Insert open end of return hose - VAS 542007/2-3- into opening -arrow- on canister lid to approx half height of canister.



Note

- ◆ Ensure that the bleeder screw tap on the intake hose - VAS 542007/2-2- is closed.
- ◆ Before disconnecting the intake hose - VAS 542007/2-2- , the pressure must be released by carefully opening the bleeder screw tap and escaping cleaning solution must be caught.



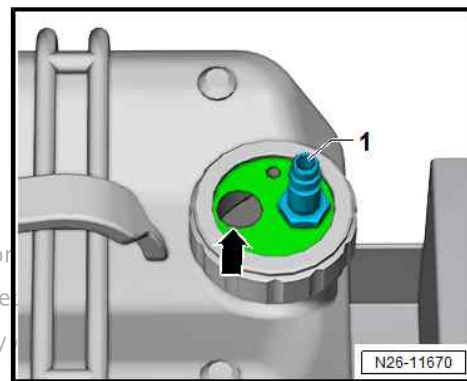
Operate pump - VAS 542007/3- as follows:

Pump - VAS 542007/3-	Time	Action
Switch on	25 minutes	Cleaning
Switch off	10 minutes	Cleaning solution taking effect
Switch on	25 minutes	Cleaning
Switch off	---	End of cleaning procedure

- Disconnect intake hose and return hose from canister.
- Empty canister (observe country-specific requirements for disposal).
- Fill canister with 10 litres of warm (approx. 40 °C – 50 °C) tap water.



- Connect intake hose - VAS 542007/2-1- of pump to connection -1- on canister lid.
- Insert open end of return hose - VAS 542 007/2-3- into a suitable container (minimum capacity of 12 litres) and fix in position.
- Connect supply hose - VAS 542007/2-2- to adapter - VAS 542 007/4-2- on connecting pipe.
- Connect compressed air adapter - VAS 542007/5- to adapter - VAS 542 007/4-2- on exhaust gas recirculation cooler.
- Connect compressed air line to compressed air adapter - VAS 542007/5- and blow all remaining water out of exhaust gas recirculation system (minimum 2 minutes).



Caution

All water must be removed from the exhaust gas recirculation system. Otherwise the engine could be damaged.

- Release and unplug compressed air adapter - VAS 542007/5- .
- Detach both adapters - VAS 542 007/4-2- from exhaust gas recirculation cooler and from connecting pipe.
- Install exhaust gas recirculation pipe with new gaskets
⇒ ["4.1 Exploded view - exhaust gas recirculation cooler", page 245](#) .
- Tighten bolts securing exhaust gas recirculation cooler.
- Install exhaust gas recirculation valve - N18-
⇒ ["4.4 Exploded view - exhaust gas recirculation valve N18 with exhaust gas recirculation potentiometer G212 ", page 250](#) .
- Install engine cover panel.
- Interrogate event memory and erase entries if necessary
⇒ Vehicle diagnostic tester.
- Perform road test.

Tightening torques:

- ◆ ⇒ ["4.1 Exploded view - exhaust gas recirculation cooler", page 245](#)