Workshop Manual

Audi A8 2010 ➤

8-cylinder direct injection engine (4.2 ltr. 4-valve)									
Engine ID	CDR A								

Edition 11.2013

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Repair Group

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

Contents

00 – Technical data

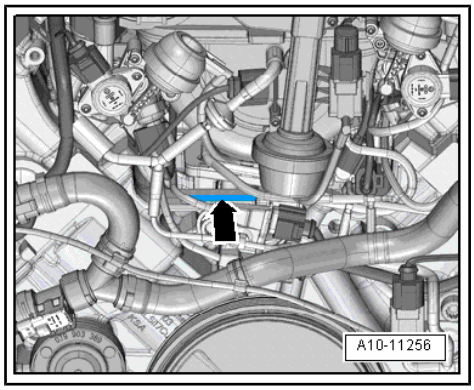
1 Identification

(ARL003627; Edition 11.2013)

⇒ “1.1 Engine identification number/engine data”, page 2

1.1 Engine identification number/engine data

Engine number



Note

The engine cover panel must be removed to make the engine number visible.

- The engine number (“engine code” and “serial number”) can be found on top of the cylinder block at the front -arrow-.
- Starting with the letter “C”, the engine codes consist of 4 letters.
- The first 3 characters of the engine code stand for the engine capacity and the mechanical construction and design. They are stamped on 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 4-character engine code can be found on the type plate (in versions for some countries only) and on the vehicle data sticker and the engine control unit.*
- *Fitting locations of the type plate (certain countries only) and the vehicle data sticker ⇒ Maintenance ; Booklet 410 .*

Engine data

Code letters		CDRA
Capacity	ltr.	4.163
Power output	kW at rpm	273/6800
Torque	Nm at rpm	445/3500
Bore	∅ in mm	84.5
Stroke	mm	92.8
Compression ratio		12.5
RON	at least	98 [1)]
Injection/ignition system		Bosch Motronic
Firing order		1-5-4-8-6-3-7-2
Turbocharging/supercharging		no
Knock control		4 sensors
Lambda control		2 probes before catalytic converter 2 probes after catalytic converter
Variable valve timing		Inlet Exhaust
Intake manifold changeover		yes
Secondary air system		yes
Valves per cylinder		4

- [1)] Unleaded premium RON 95 can also be used, but results in reduced power

2 Safety precautions

2.1 Safety precautions when working on the fuel supply system

Please note the following warnings when working on the fuel supply system:

WARNING

The fuel system operates at extremely high pressure. This can cause injury.

- *The fuel pressure in the high-pressure section of the injection system must be reduced to a residual pressure prior to opening the system. Procedure ⇒ page 255*
- *Wrap a clean cloth around the connection and carefully loosen the connection to allow the residual pressure to dissipate.*

Escaping fuel can cause a risk.

- *The power supply for the fuel system pressurisation pump - G6- must be disconnected before opening the fuel system, since -G6- will be activated briefly when the driver's door is opened with the battery still connected.*
- *Disconnect power supply by removing fuse for fuel pump control unit - J538- /fuel delivery unit ⇒ Current flow diagrams, Electrical fault finding and Fitting locations, or disconnect battery.*

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

- Always switch off the ignition before connecting or disconnecting electrical wiring for the injection or ignition system or tester cables.
- Always switch off ignition before washing engine.
- Erase any entries in event memory resulting from testing or installation ⇒ Vehicle diagnostic tester, `Interrogate event memory`, then `Generate readiness code`.

Caution

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

- *Observe notes on procedure for disconnecting the battery.*
- *Always switch off the ignition before disconnecting the battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Disconnecting and connecting battery .*

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

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

WARNING

Risk of injury due to automatic engine start on vehicles with start/stop system.

- *On vehicles with activated start/stop system (this is indicated by a message in the instrument cluster display), the engine may start automatically on demand.*
- *Therefore it is important to ensure that the start/stop system is deactivated when performing repairs (switch off ignition, if required switch on ignition again).*

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:

WARNING

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

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

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

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:

WARNING

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

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

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

- *Unplug electrical connectors before starting to work in the area of radiator cowl.*

Caution

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

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

2.6 Safety precautions when working on the ignition system

To prevent injuries to persons and/or irreparable damage to the fuel injection and ignition system, the following must be noted:

- Persons wearing a cardiac pacemaker must at all times maintain a safe distance from high-voltage components such as the ignition system and xenon headlights.
- Always switch off the ignition before connecting or disconnecting electrical wiring for the injection or ignition system or tester cables.
- Erase any entries in event memory resulting from testing or installation ⇒ Vehicle diagnostic tester, `Interrogate event memory`, then `Generate readiness code`.
- Always switch off the ignition before cleaning the engine.

- Always switch off the ignition before connecting or disconnecting the battery, otherwise the engine control unit may be damaged.
- If you want to turn over the engine at cranking speed without actually starting it (e.g. compression test), first unplug the connectors from the ignition coils. In addition, remove fuse for fuel pump control unit - J538- ; for identification of fuses refer to ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

Caution

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

- *Observe notes on procedure for disconnecting the battery.*
- *Always switch off the ignition before disconnecting the battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Disconnecting and connecting battery .*

3 Repair instructions

3.1 Rules for cleanliness

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

- Carefully clean connection points and the surrounding area with engine cleaner or brake cleaner and dry thoroughly before opening.
- Immediately seal open lines and connections with clean plugs, for example from engine bung set - VAS 6122- .
- Place parts that have been removed on a clean surface and cover them over. Use only 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 their packing (e.g. in tool boxes etc.).
- When the system is open, do not work with compressed air and do not move the vehicle.
- Make sure that no fuel runs onto the fuel hoses. Should this occur, the fuel hoses must be cleaned again immediately.
- Protect unplugged electrical connectors against dirt and moisture and make sure connections are dry when attaching.

3.2 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.
- In the event of mechanical damage to one of the cylinder banks, the intake and exhaust systems and combustion chambers of the opposite cylinder bank must always be examined for foreign particles to prevent further damage occurring later.

3.3 Contact corrosion

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

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

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

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

Note the following:

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

3.4 Routing and attachment of pipes, hoses and wiring

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

3.5 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, condenser or charge air cooler.

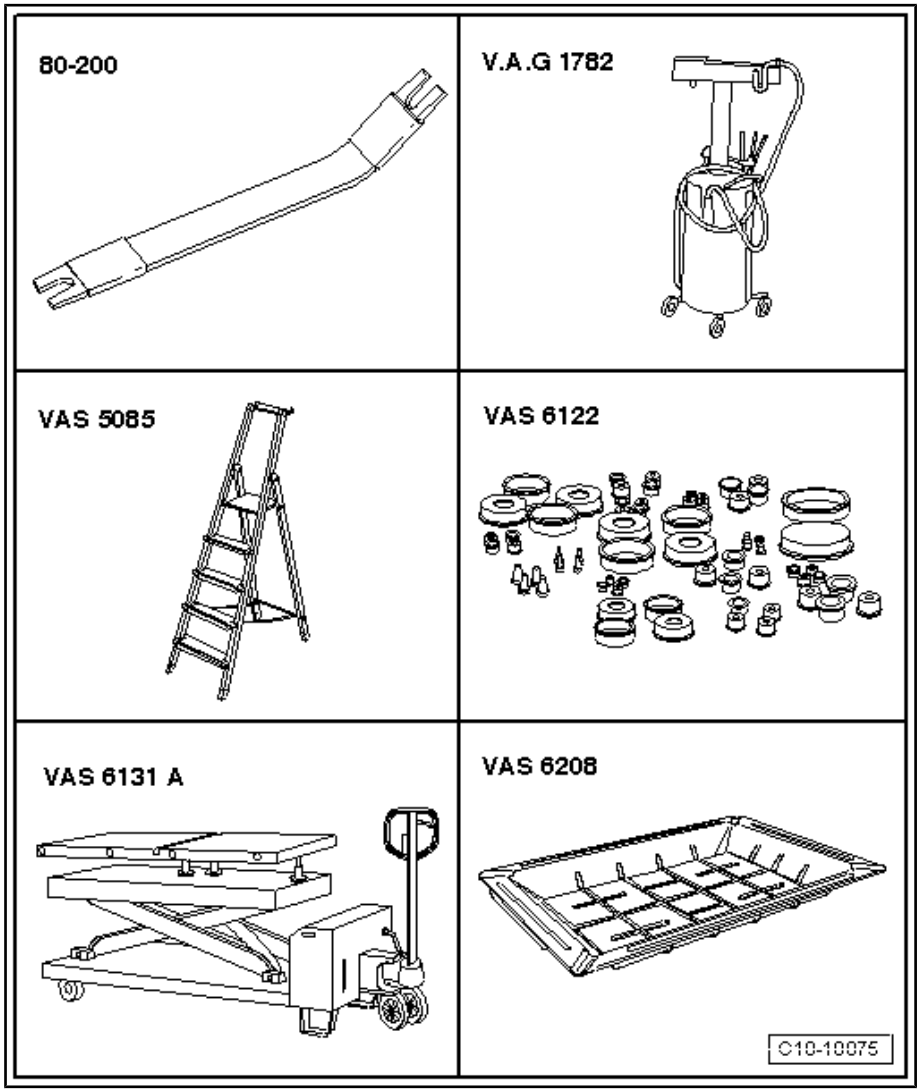
10 – Removing and installing engine

1 Removing and installing engine

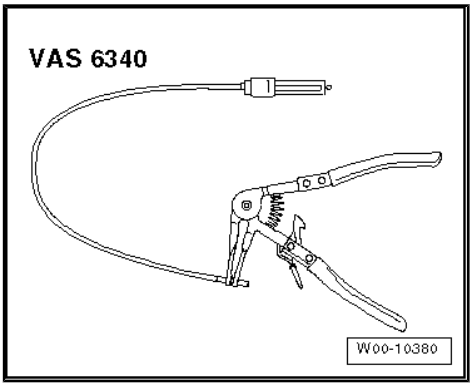
1.1 Removing engine

Special tools and workshop equipment required

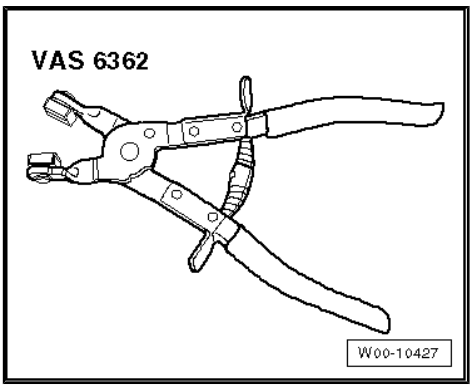
- Removal lever - 80 - 200-
- Used oil collection and extraction unit - V.A.G 1782-
- Stepladder - VAS 5085-
- Engine bung set - VAS 6122-
- Scissor-type assembly platform - VAS 6131 A- with support set for Audi - VAS 6131/10- , support set -VAS 6131/11- and supplementary set -VAS 6131/13-
- Drip tray for workshop hoist - VAS 6208-



- Hose clip pliers - VAS 6340-



- Hose clip pliers - VAS 6362-



Procedure

Note

- *The engine is removed from underneath together with the gearbox and subframe (with lock carrier installed).*
- *Fit cable ties in the original positions when installing.*

WARNING

Make sure the vehicle cannot tip over when the engine is removed.

- ***Secure the vehicle, to do so, the luggage compartment must be empty.***

The fuel system operates at extremely high pressure. This can cause injury.

- ***The fuel pressure in the high-pressure section of the injection system must be reduced to a residual pressure prior to opening the system. Procedure ⇒ page 255***
- ***Wrap a clean cloth around the connection and carefully loosen the connection to allow the residual pressure to dissipate.***

Note

Move the gearbox to position "N" and release the electromechanical parking brake before disconnecting the battery, so that the propshaft can be turned during removal.

– Set front wheels to straight-ahead position.

Caution

Electronic components are susceptible to damage.

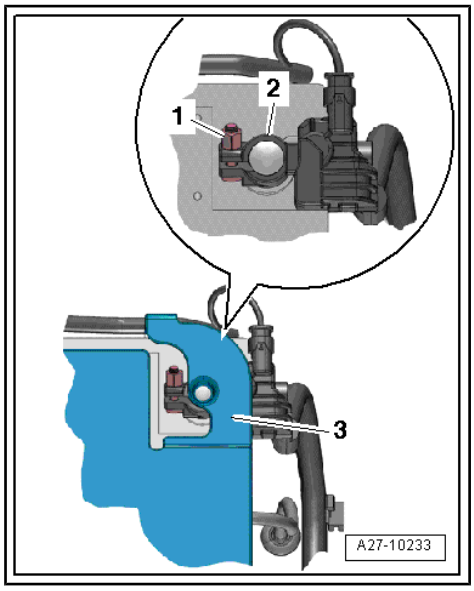
- *Observe notes on procedure for disconnecting the battery.*

– Switch off ignition and take out ignition key (if applicable).

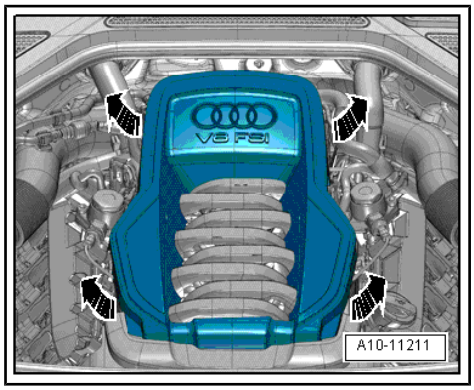
– Disconnect earth wire -2- from battery terminal ⇒ Electrical system; Rep. gr. 27 ; Battery, Disconnecting and connecting battery .

– Discharge refrigerant system ⇒ Air conditioner with refrigerant R134a .

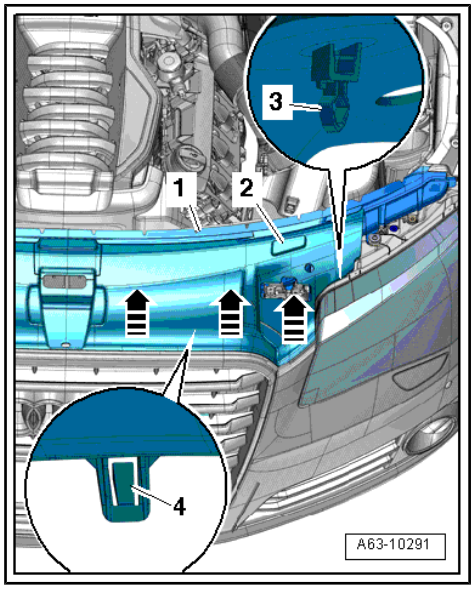
– Extract hydraulic fluid for power steering from reservoir using used oil collection and extraction unit - V.A.G 1782- .



– Remove engine cover panel -arrows-.



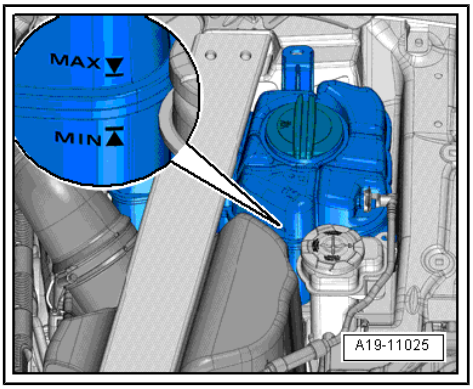
– Remove lock carrier cover -2- ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Removing and installing attachments .



WARNING

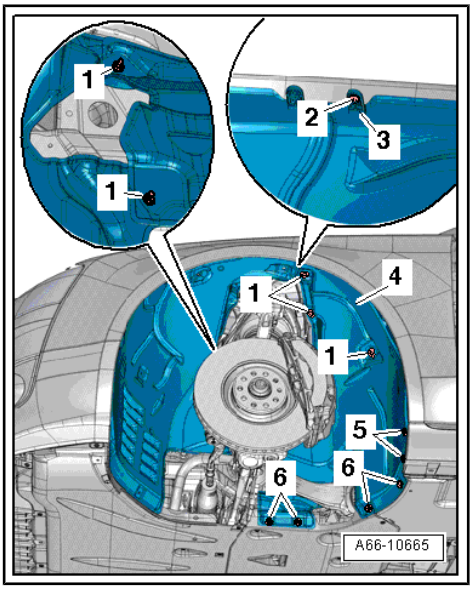
Hot steam/hot coolant can escape - risk of scalding.

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

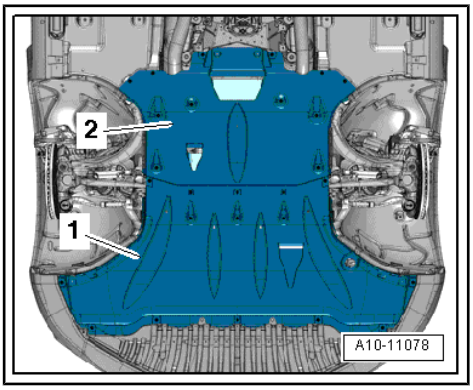


– Open filler cap on coolant expansion tank.

– Completely remove wheel housing liners (front left and front right) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Removing and installing wheel housing liner (front) .

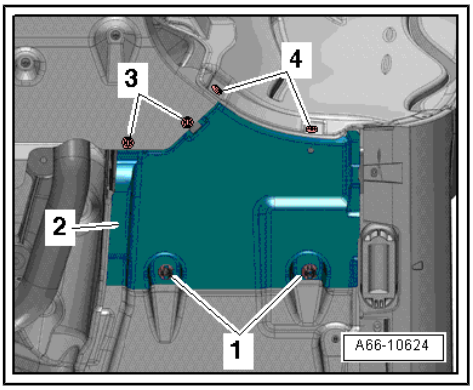


– Remove noise insulation panels -1- and -2- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

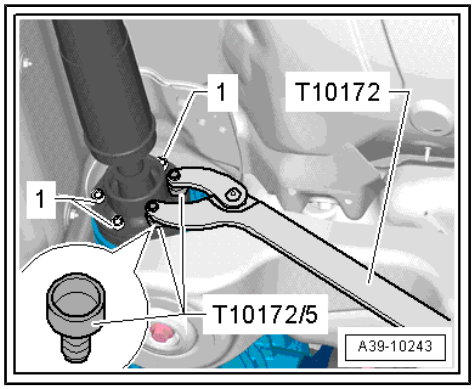


– Remove front underbody trim panels (left and right) -2- ⇒ General body repairs, exterior; Rep. gr. 66 ; Underbody trim; Removing and installing underbody trim .

– Remove longitudinal members (bottom left and right) ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier; Removing and installing lock carrier .



– Remove propshaft ⇒ Final drive; Rep. gr. 39 ; Propshaft; Removing and installing propshaft .

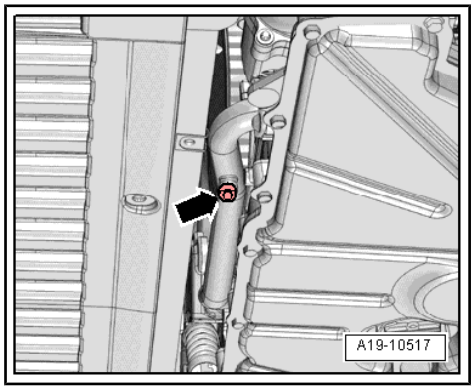


Note

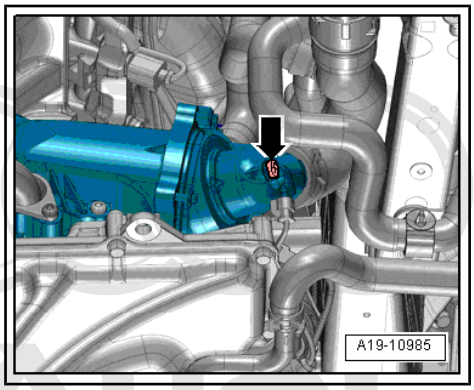
Collect drained coolant in a clean container for disposal.

– Place drip tray for workshop hoist - VAS 6208- beneath engine.

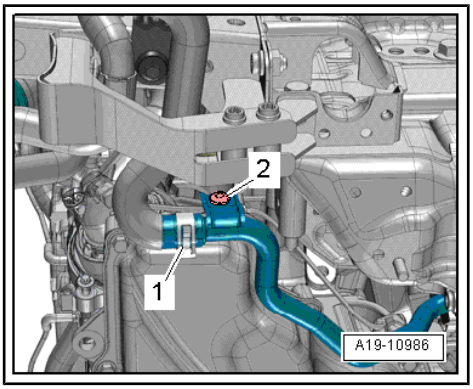
– Unscrew drain plug -arrow- on coolant pipe (front) and drain off coolant.



– Unscrew drain plug -arrow- on map-controlled engine cooling system thermostat - F265- and drain off coolant.



– Release hose clip -1- and detach coolant hose from coolant pipe (bottom left).



Note

Disregard -item 2-.

WARNING

Risk of injury caused by fuel.

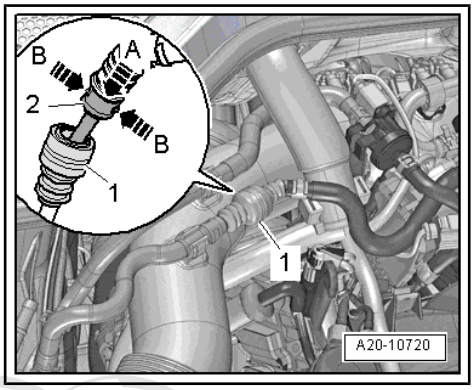
- ***To allow the fuel pressure to dissipate, wrap a clean cloth around the connection and carefully loosen the connection before opening the fuel system.***

Caution

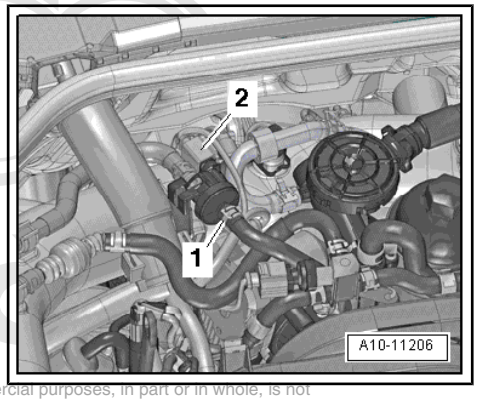
Risk of damage caused by particles of dirt.

- ***Observe rules for cleanliness when working on the fuel supply system ⇒ page 8 .***

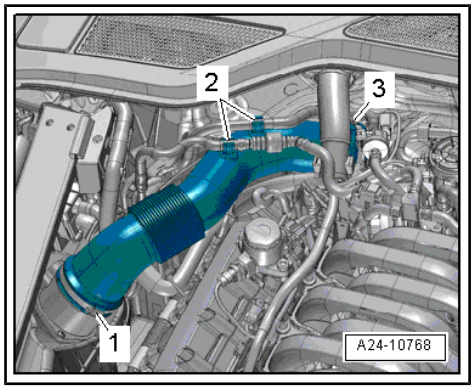
– Push down protective sleeve -1- and disconnect fuel line.
– First press hose connector -2- downwards -arrow A-, then press release tabs -arrow B-.
– Pull off hose connector, keeping release tabs depressed.



– Move clear fuel line and line going to activated charcoal filter at air pipe.
– Unplug electrical connector -2- at activated charcoal filter solenoid valve 1 - N80- and detach vacuum hose -1-.
– Detach activated charcoal filter solenoid valve 1 - N80- from bracket and move to one side with hose and fuel line still attached.



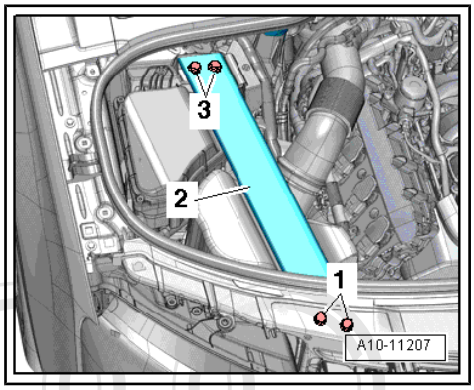
– Loosen hose clips -1, 3- and remove air pipe.



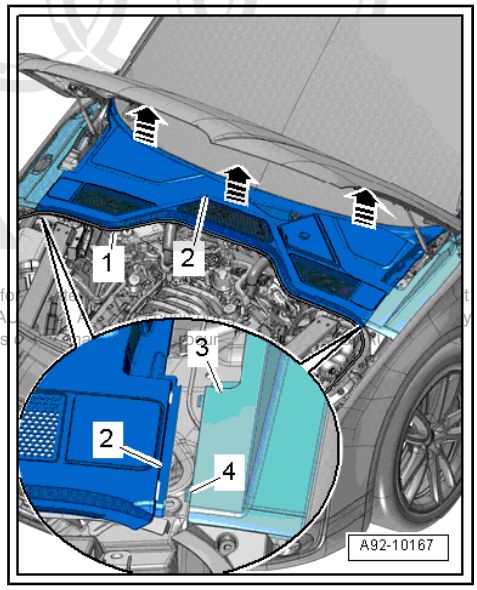
Note

Disregard -item 2-.

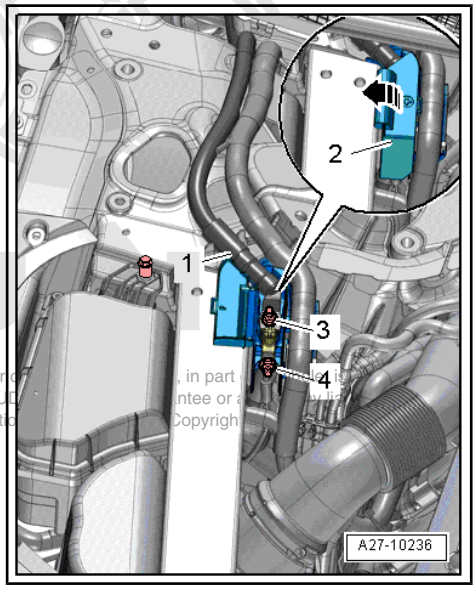
– Remove longitudinal member (top right) -2- ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier; Exploded view - lock carrier .



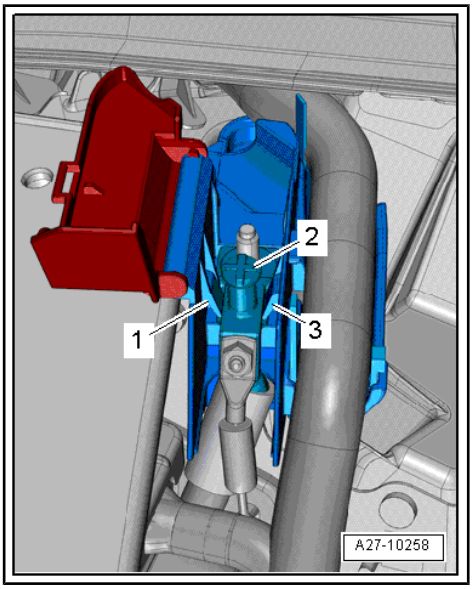
– Remove plenum chamber cover -2- ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Removing and installing plenum chamber cover .



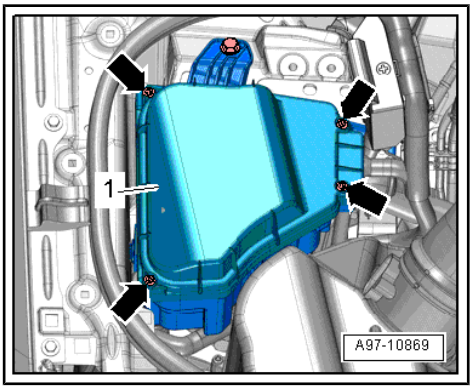
– Release cover -2- and swivel to side -arrow-.
– Remove nut -4- and move battery positive wire clear.
– Unscrew nut -3- and detach battery positive wire -1-.



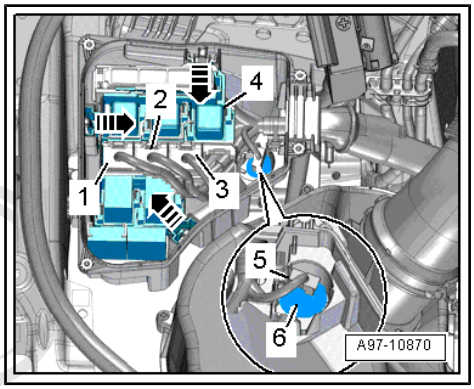
– Release retaining tabs -1, 3- and swivel positive terminal -2- out of mounting.



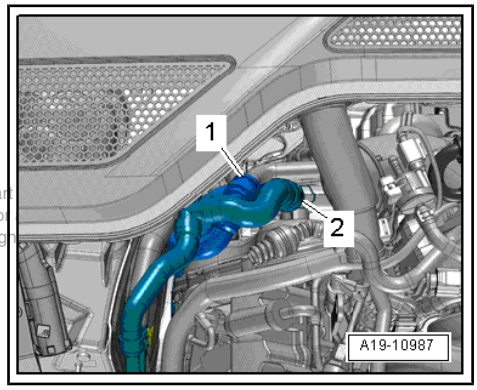
– Remove bolts -arrows- and detach cover -1- for electronics box in engine compartment.



– Unplug electrical connectors -1, 2, 3- and move electrical wiring clear.
– Release catches -arrows- and detach relay carrier with fuse holder -4-.
– Release fastener -5- and detach condenser -6-.
– Disengage engine wiring harness at electronics box in engine compartment, move clear and place onto engine.



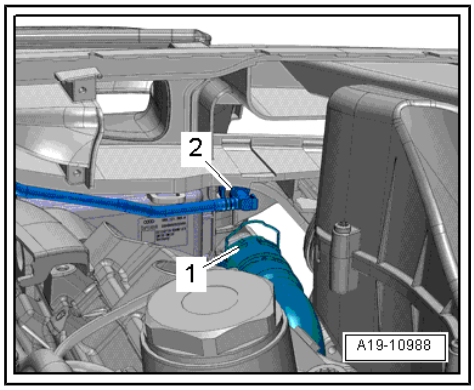
– Lift retaining clips -1- and -2- and disconnect coolant hoses.



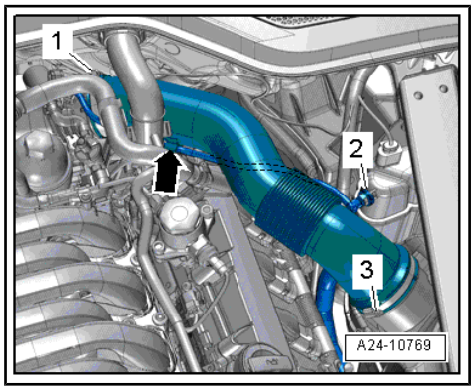
– Lift retaining clip -1- and disconnect coolant hose (top right) from radiator.

Note

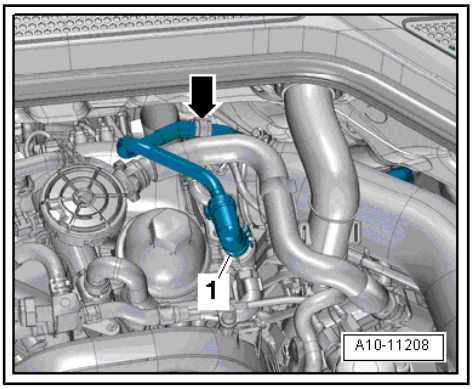
Disregard -item 2-.



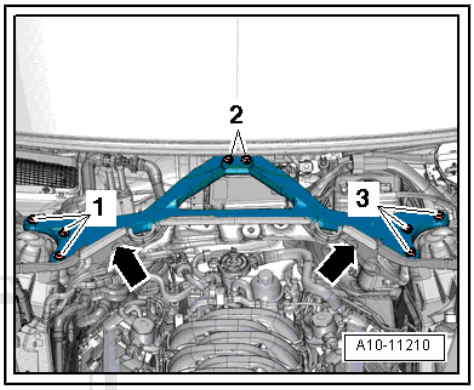
– Move coolant hose clear -arrow- and detach from coolant expansion tank (lift retaining clip -2-).
– Release hose clips -1- and -3- and remove air pipe.



– Detach vacuum hose -1- and move clear -arrow-.



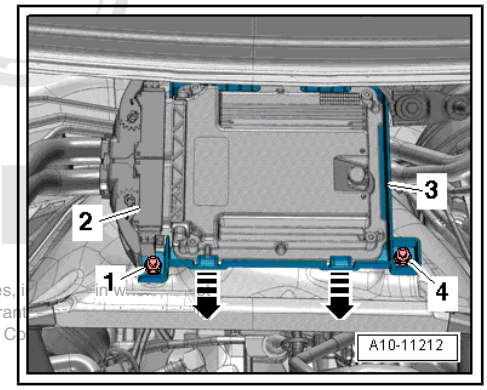
– Remove body brace ⇒ Running gear, axles, steering; Rep. gr. 40 ; Suspension strut, upper links; Removing and installing body brace .



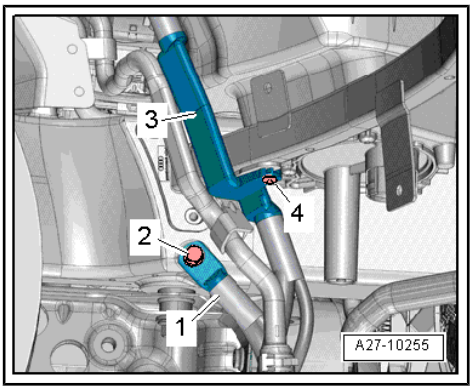
– Release clips -arrows-, take out engine control unit - J623- -item 2- and place onto engine.

Note

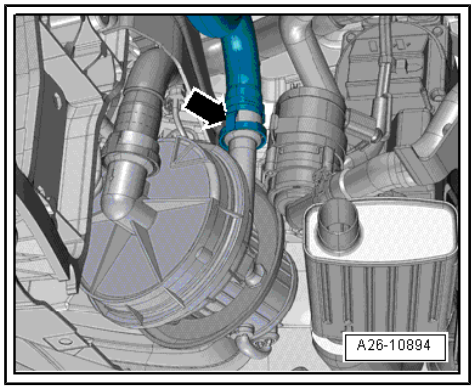
Disregard -items 1, 3, 4-.



– Remove bolt -4- for battery positive wire -3- and bolt -2- for earth wire -1- and move electrical wiring clear.



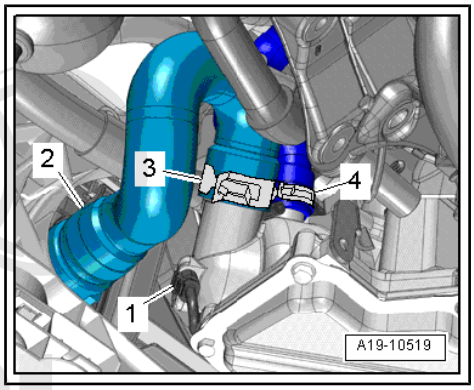
– Detach air hose -arrow- (press release tabs).



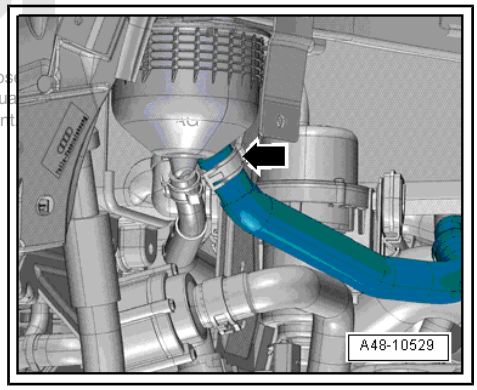
– Release hose clip -3- and detach coolant hose.

Note

Disregard -items 1, 2, 4-.



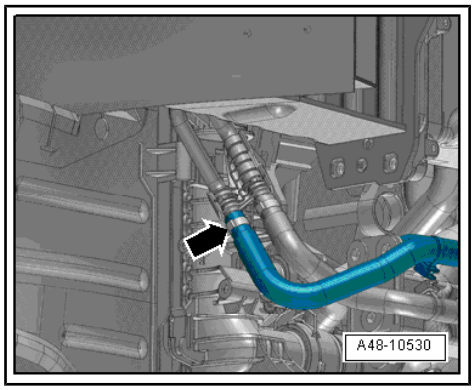
– Position used oil collection and extraction unit - V.A.G 1782- below connection point.
– Release hose clip -arrow- and detach hydraulic hose.
– Seal off open lines and connections with clean plugs from engine bung set - VAS 6122- .



Note

Lay a cloth underneath vehicle to catch escaping hydraulic fluid.

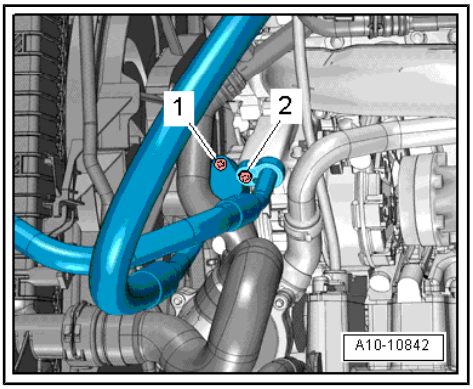
– Release hose clip -arrow- and detach hydraulic hose.
– Seal off open lines and connections with clean plugs from engine bung set - VAS 6122- .



Caution

Danger of damage to refrigerant lines and hoses.

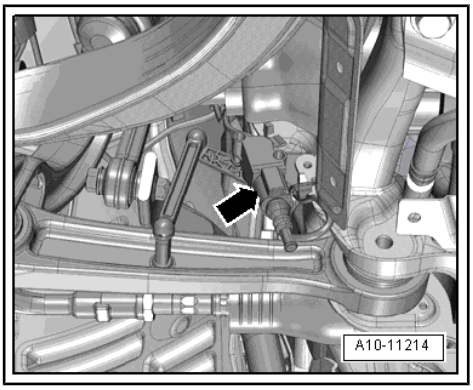
- *Do NOT stretch, kink or bend refrigerant lines and hoses.*



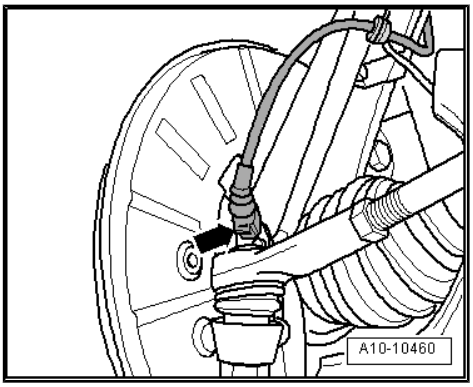
– Unscrew bolts -1, 2- and remove refrigerant lines from A/C compressor.

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

– Unplug electrical connector -arrow- on both sides at front vehicle level sender -G78- / -G289- and move electrical wiring clear.



– Unplug electrical connector -arrow- at front wheel speed sensor on both sides.

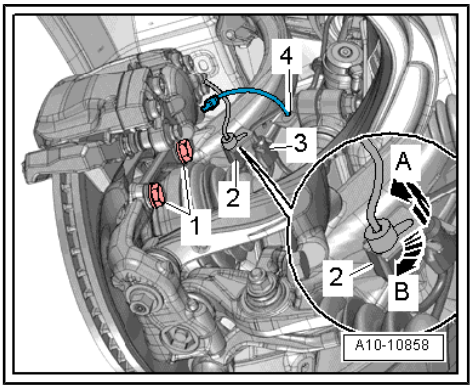


– Remove brake caliper and tie up in wheel housing with wire (brake hose remains attached) ⇒ Brake system; Rep. gr. 46 ; Front brakes; Removing and installing brake caliper .

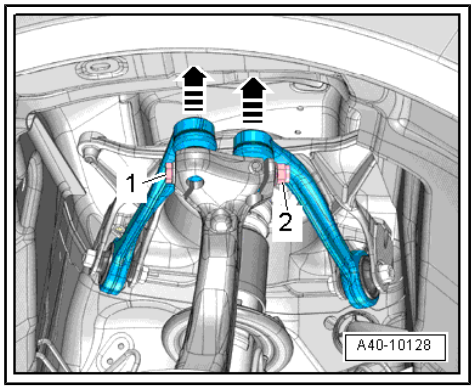
Caution

Avoid damage to brake pistons.

- *Do not operate brake pedal with brake caliper removed.*



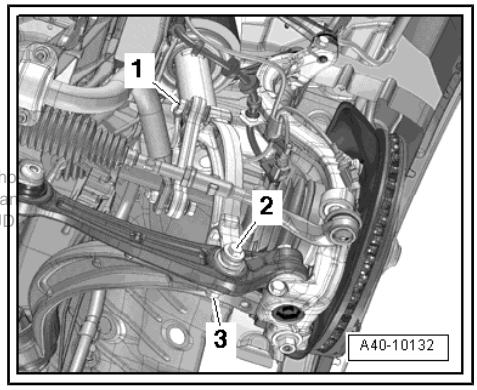
– Remove nut -2- and pull out bolt -1-.
– Pull upper suspension links upwards out of wheel bearing housing -arrows-.
– Perform the same work steps on the other side of the vehicle.



– Remove bolt -1- for anti-roll bar on both sides.
– Remove nut -3- on both sides.

Note

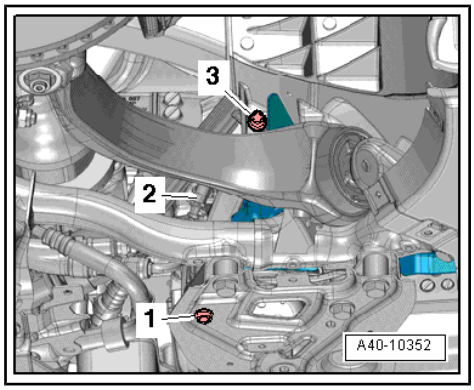
The bolt -2- is removed at a later stage.



– Remove bolt -3- on both sides.

Note

Disregard -items 1, 2-.

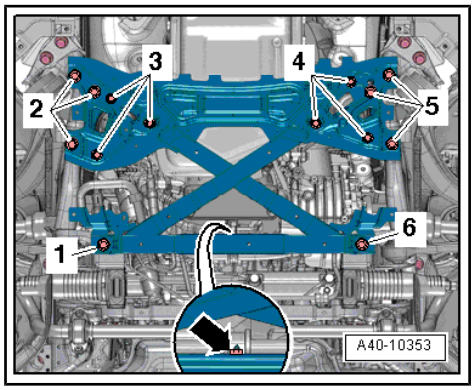


– Remove subframe cross brace ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Removing and installing subframe cross brace .

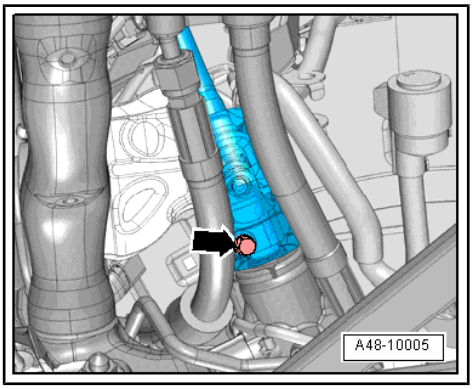
Caution

Risk of damage to running gear components.

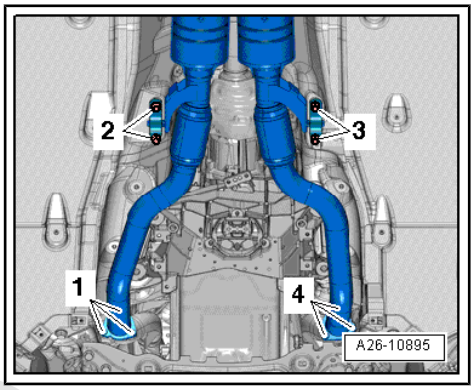
- ***The vehicle must NOT be lowered onto its wheels if the engine/gearbox mountings, steering rack or subframe cross brace are not properly installed.***



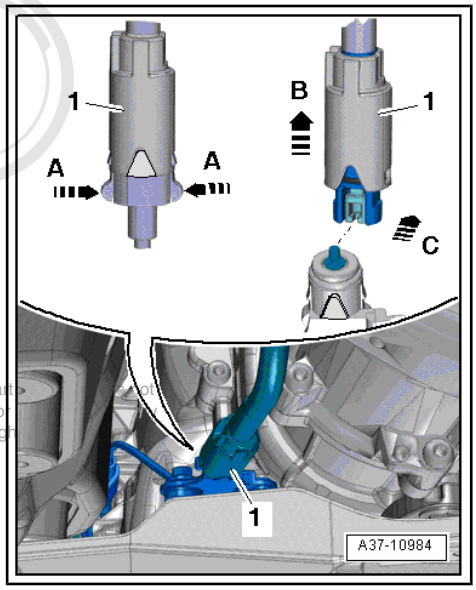
– Detach intermediate steering shaft from steering rack and move clear by telescoping upwards ⇒ Running gear, axles, steering; Rep. gr. 48 ; Steering column; Removing and installing intermediate steering shaft .



– Remove nuts -1- and bolts -2- and detach front silencer (left-side).
– Remove nuts -4- and bolts -3- and detach front silencer (right-side).



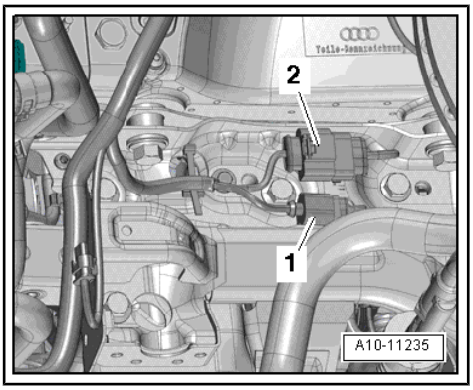
– Release catches -arrows A- and push sleeve -1- at manual release cable in direction of -arrow B-.
– Disengage rear manual release cable from front manual release cable -arrow C-.



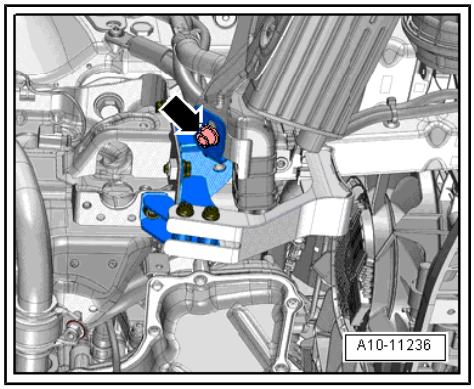
– Detach electrical connectors from bracket and unplug.

1 - For electrohydraulic engine mounting solenoid valves - N144- / -N145-

2 - For Servotronic solenoid valve - N119-



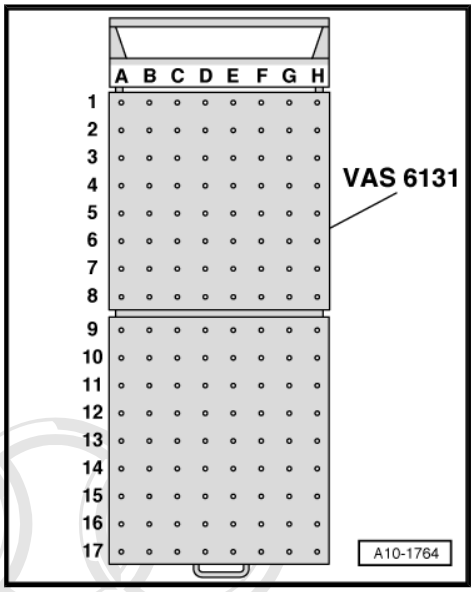
– If fitted, remove bolt -arrow- securing bracket for auxiliary heater.



Set up the scissor-type assembly platform as follows:

– Set up scissor-type assembly platform - VAS 6131 A- with support set for Audi - VAS 6131/10- , support set -VAS 6131/11- and supplementary set -VAS 6131/13- as follows:

Platform coordinates	Parts of support set for Audi - VAS 6131/10- , support set -VAS 6131/11- and supplementary set - VAS 6131/13-			
B4	/13-4	/10-4	/10-5	/13-1
G4	/13-4	/10-4	/10-5	/13-1
B6	/10-1	/10-2	/10-5	/10-11
G6	/10-1	/10-2	/10-5	/10-11
A8+C8	/13-6			/13-2
F8+H8	/13-5			/13-2
B14	/10-1	/10-4	/10-5	/10-7
G14	/10-1	/10-4	/10-5	/11-1



– Initially hand-tighten the support elements on the scissor-type assembly platform.

– Position scissor-type assembly platform - VAS 6131 A- horizontally.

• Take note of spirit level (bubble gauge).

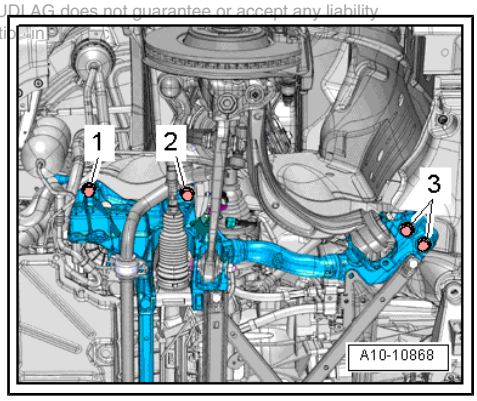
– Position scissor-type assembly platform - VAS 6131 A- below engine/gearbox assembly.

WARNING

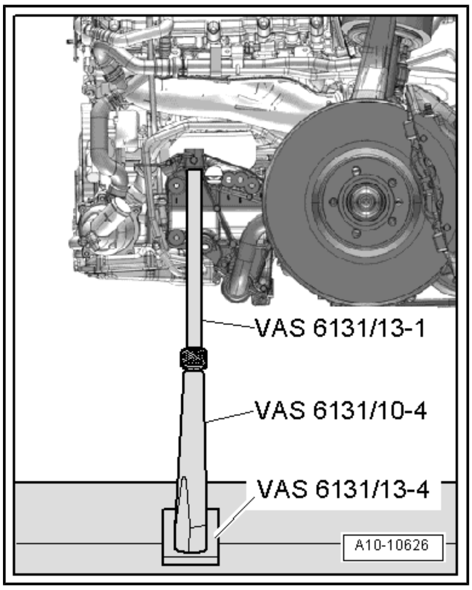
Accident risk if subframe mountings are detached.

- ***Subframe bolts -2- and -3- must not be loosened at this stage.***

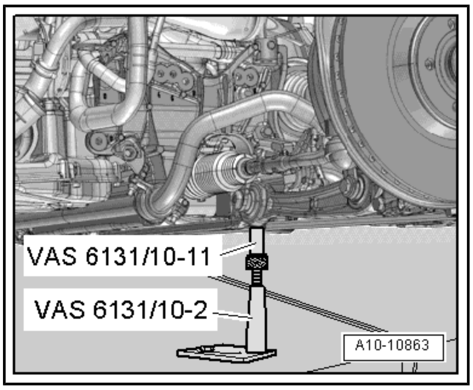
– Remove subframe bolt -1- on both sides.



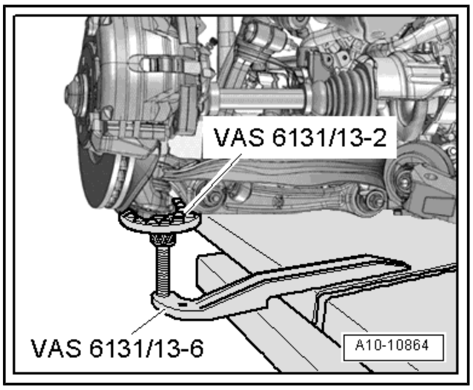
– Position support elements from -VAS 6131/10- and -VAS 6131/13- at front left and right of subframe as shown.
– Make sure that threaded spindles are screwed in completely.



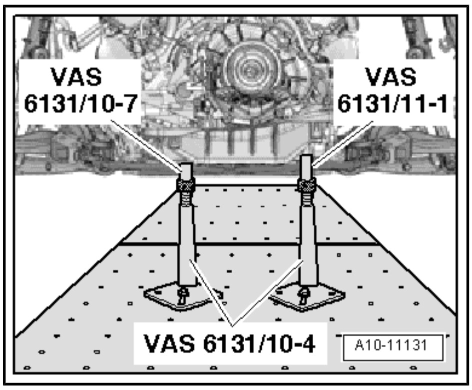
– Position support elements from -VAS 6131/10- (rear left and right) at front attachment points of subframe cross brace as shown.



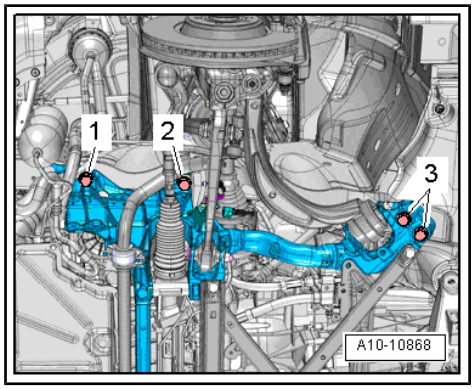
– Position support elements from -VAS 6131/13- under left and right wheel bearing housings as shown.



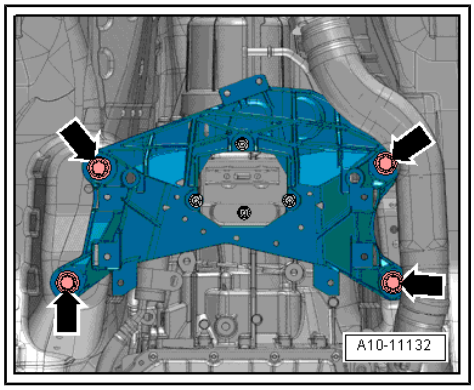
– Position support elements from -VAS 6131/10- and -VAS 6131/11- (rear left and right) at tunnel cross member as shown.
– Turn all spindles for support elements upwards until all locating lugs make contact with mounting points.
– Tighten base plates for support elements to 20 Nm on scissor-type assembly platform - VAS 6131 A- .



– Mark installation position of subframe and tunnel cross member on longitudinal members with felt-tip pen.
– Unscrew subframe bolts -2, 3- on both sides in several stages.



– Remove bolts -arrows- for tunnel cross member.

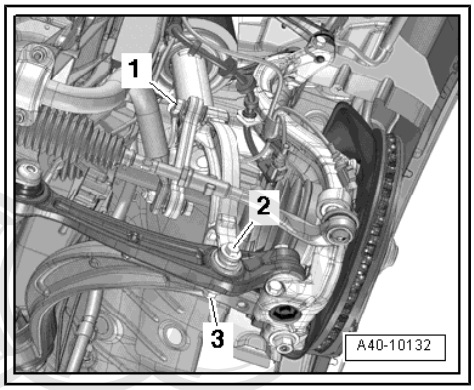


– Remove bolt -2- on both sides.

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 out engine/gearbox assembly with subframe from engine compartment when lowering.***

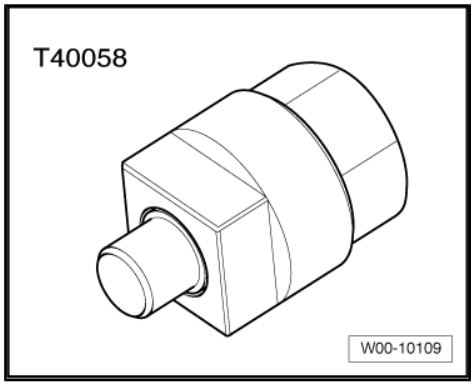


– Lower engine/gearbox assembly using scissor-type assembly platform - VAS 6131 A- .
– Pull out scissor-type assembly platform - VAS 6131 A- with engine/gearbox assembly from underneath vehicle.

1.2 Separating engine and gearbox

Special tools and workshop equipment required

- Adapter - T40058-



- Support set for Audi - VAS 6131/10- , supplementary set -VAS 6131/12- and -VAS 6131/13-
- Bolt M10x65

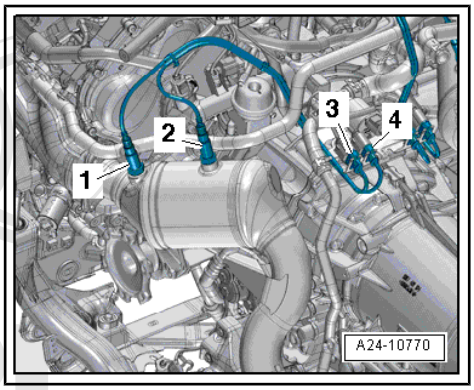
Procedure

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

– Detach electrical connectors from bracket, unplug and move electrical wires clear:

3 - For Lambda probe 2 - G108-

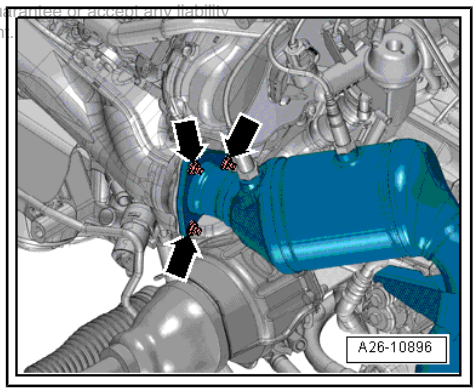
4 - For Lambda probe 2 - G131- (after catalytic converter)



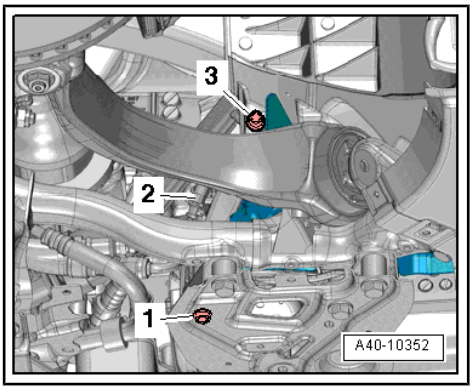
Note

Disregard -items 1, 2-.

– Unscrew nuts -arrows- and detach catalytic converter (left-side).



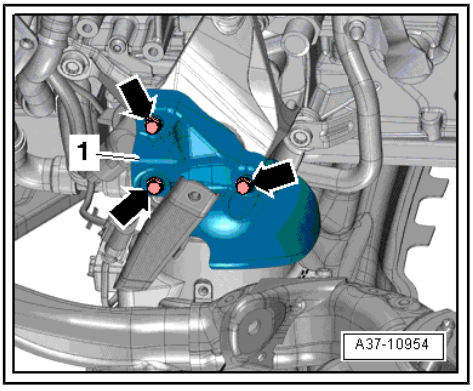
– Remove electrical connector -2- for gearbox mounting valve 2 - N263- from bracket and unplug connector.



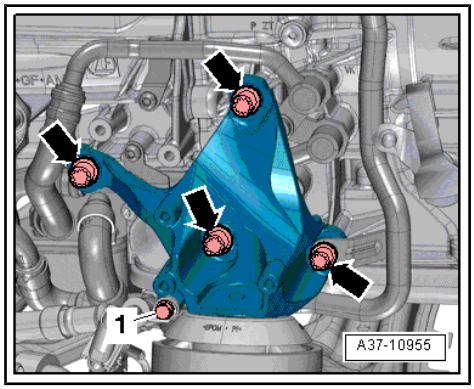
Note

Disregard -items 1, 3-.

– Remove bolts -arrows- and detach heat shield -1-.



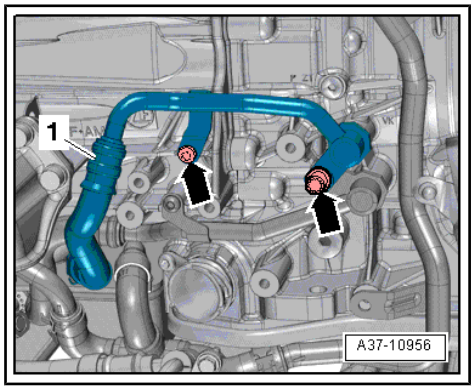
– Remove bolt -1- on bracket for hydraulic line.
– Remove bolts -arrows- and detach gearbox mounting (left-side) with gearbox support.



Note

Place a cloth underneath to catch escaping ATF.

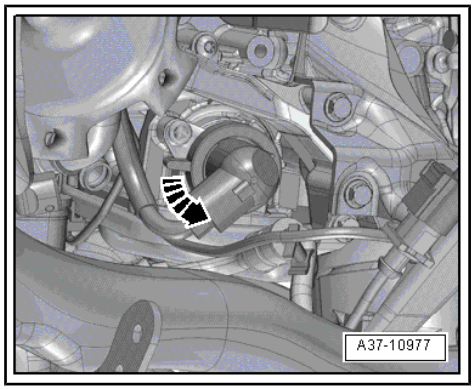
– Remove bolts -arrows- and detach ATF line -1- from gearbox.
– Seal off open lines and connections with clean plugs from engine bung set - VAS 6122- .



Caution

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

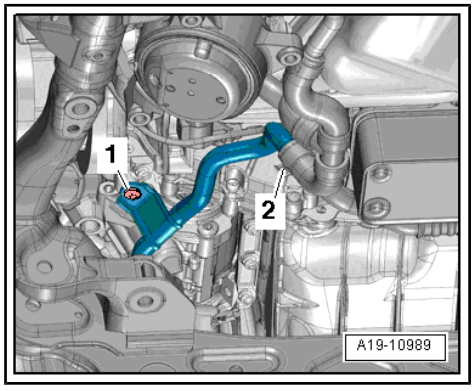
- ***Do NOT touch connector contacts in gearbox connector with your hands.***



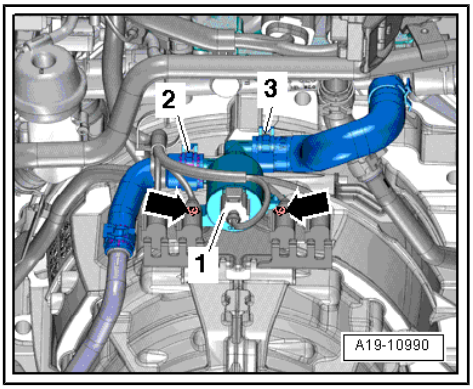
– Touch gearbox housing with your hand (without wearing gloves) to eliminate static charge.
– Turn retainer catch anti-clockwise -arrow- and unplug electrical connector at gearbox.
– Move clear electrical wiring harness at gearbox.
– Release hose clip -2- and detach coolant hose.

Note

Disregard -item 1-.



– Unplug electrical connector -1- and move wiring clear.
– Release hose clip -3- and detach coolant hose.



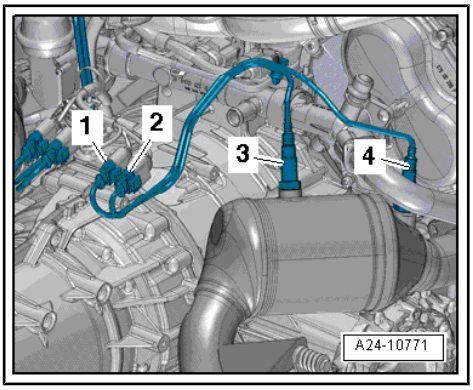
Note

Ignore items marked -2- and -arrows-.

– Detach electrical connectors from bracket, unplug connectors and move electrical wiring clear:

1 - For Lambda probe after catalytic converter - G130-

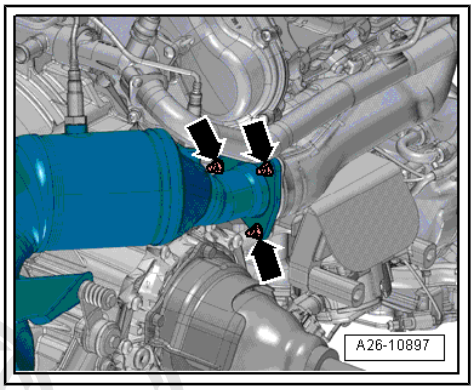
2 - For Lambda probe - G39-



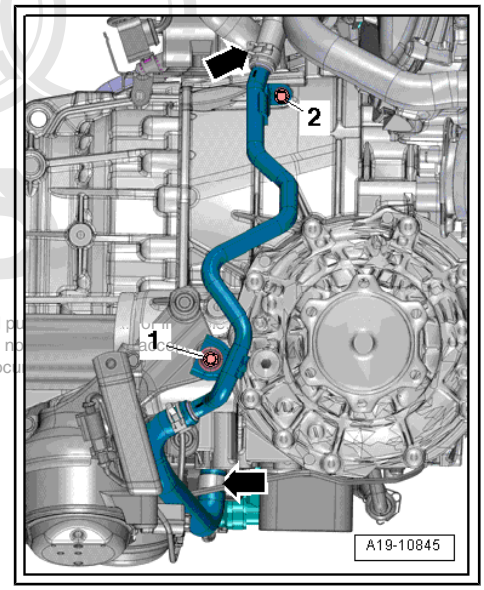
Note

Disregard -items 3, 4-.

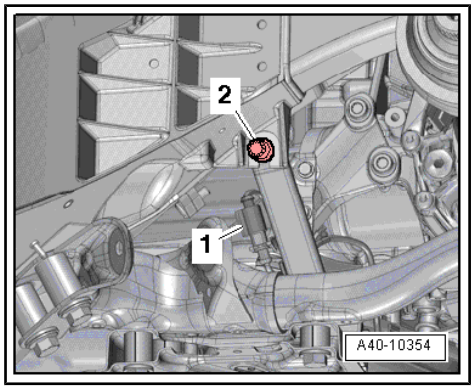
– Unscrew nuts -arrows- and detach catalytic converter (right-side).



– Remove bolts -1, 2-, release hose clips -arrows- and detach coolant pipe (right-side) at gearbox from coolant hoses.



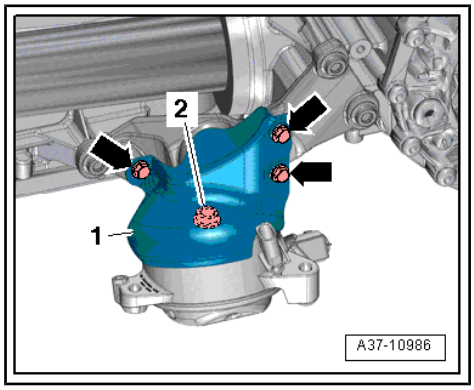
– Detach electrical connector -1- from bracket and unplug.



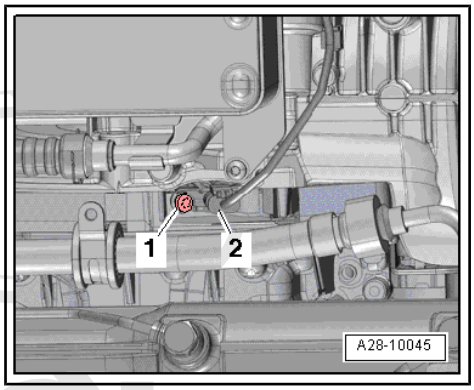
Note

Disregard -item 2-.

– Remove bolts -arrows- and detach heat shield -1-.
– Remove bolt -2- and detach gearbox mounting from gearbox support.



– Unplug electrical connector -2- at engine speed sender - G28- and move electrical wiring at gearbox clear.



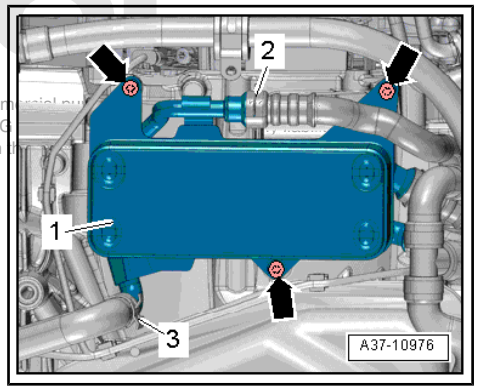
Note

Disregard -item 1-.

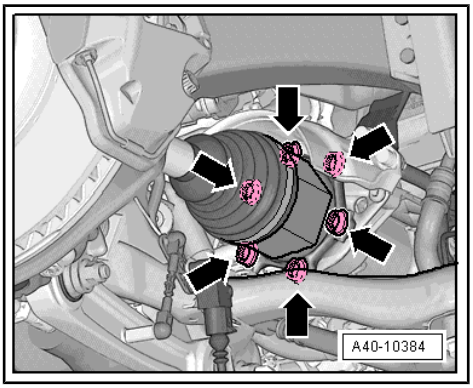
Note

Place a cloth underneath to catch escaping ATF.

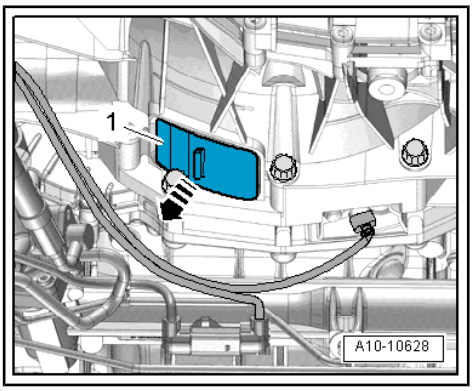
– Remove bolts -arrows- and tie up ATF cooler -1- to side with hoses -2, 3- attached.



– Unbolt drive shaft (left and right) from gearbox flange shafts ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing drive shaft .

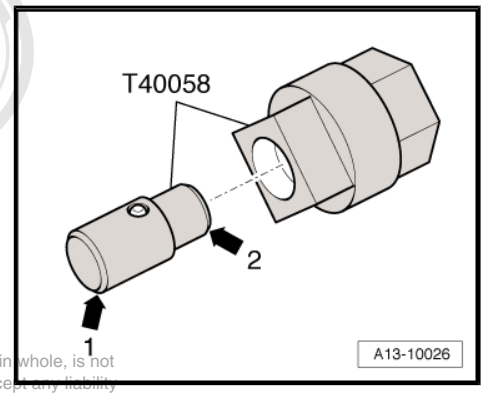


– Detach bottom cover -1- from gearbox -arrow-.

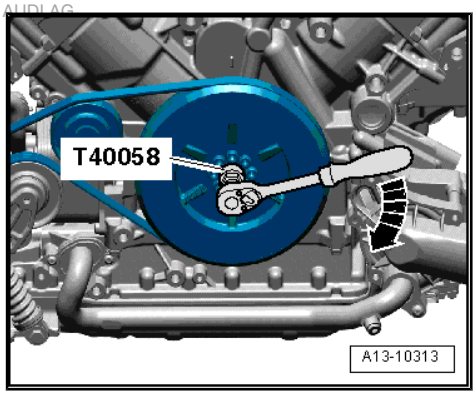


– Insert guide pin of adapter -T40058- as follows:

- The larger-diameter section -arrow 1- faces towards the engine.
- The smaller-diameter section -arrow 2- faces the adapter.



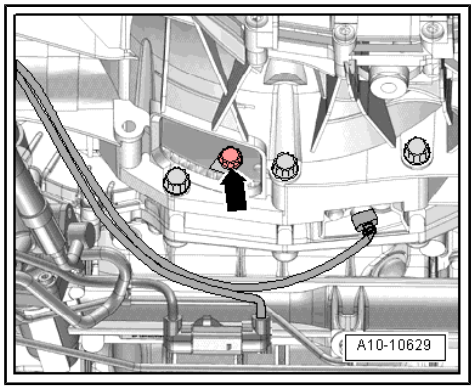
– Counterhold crankshaft using adapter - T40058- when slackening bolts for torque converter.



Note

When performing the next step, turn the crankshaft only in the normal direction of rotation -arrow-.

– Remove 6 bolts -arrow- for torque converter, turning crankshaft 60° in normal direction of rotation each time.

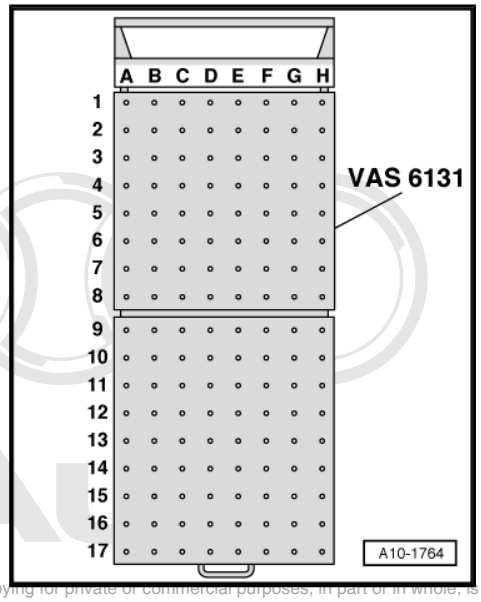


– Set up scissor-type assembly platform - VAS 6131 A- with support set for Audi - VAS 6131/10- , support set -VAS 6131/12- and supplementary set -VAS 6131/13- as follows:

Note

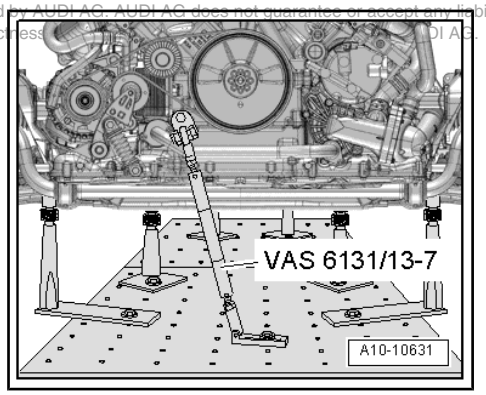
The other support elements remain unchanged.

Platform coordinates	Parts of support set for Audi - VAS 6131/10- , support set -VAS 6131/12- and supplementary set - VAS 6131/13-			
E2	/13-7			
B10	/10-1	/10-3	/10-5	/12-1
H10	/10-1	/10-3	/10-5	/12-1

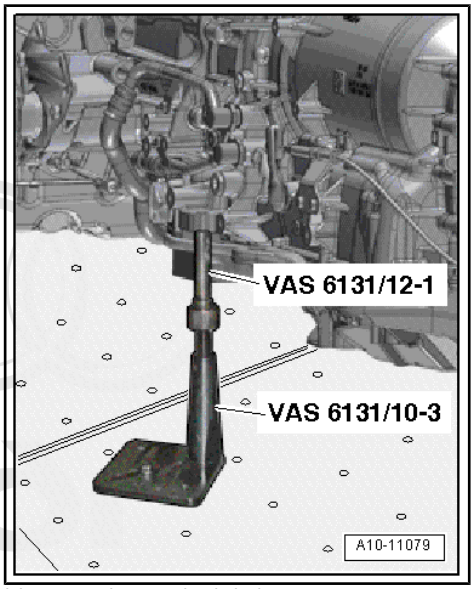


– Secure support -VAS 6131/13-7- at tapped hole at front of engine (right-side) with bolt M10x65, as illustrated.

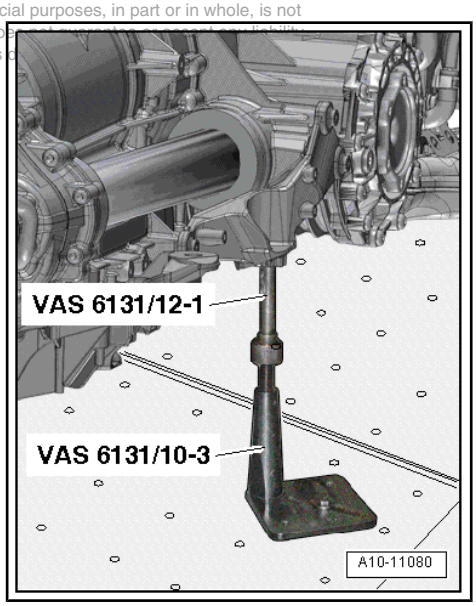
– Secure support -VAS 6131/13-7- to scissor-type assembly platform and tighten to 20 Nm.



– Position the support elements from -VAS 6131/10- and -VAS 6131/12- at left of gearbox, as shown in the illustration.



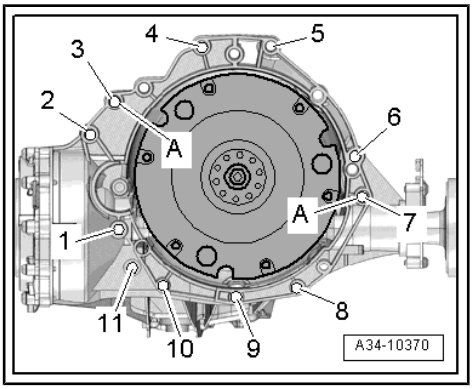
– Position the support elements from -VAS 6131/10- and -VAS 6131/12- at gearbox support (right-side), as shown in illustration.
– Turn spindles (left and right) upwards until all locating lugs make contact with mounting points.
– Tighten base plates for support elements to 20 Nm on scissor-type assembly platform - VAS 6131 A- .



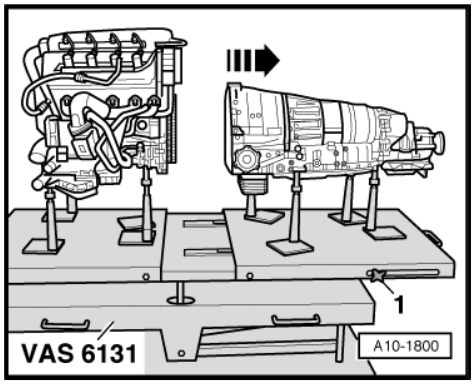
– Remove bolts -1- and -2- for starter.
– Separate starter from gearbox and leave in position.
– Unscrew remaining bolts -3 ... 11- securing engine to gearbox.

Note

Disregard -item A-.



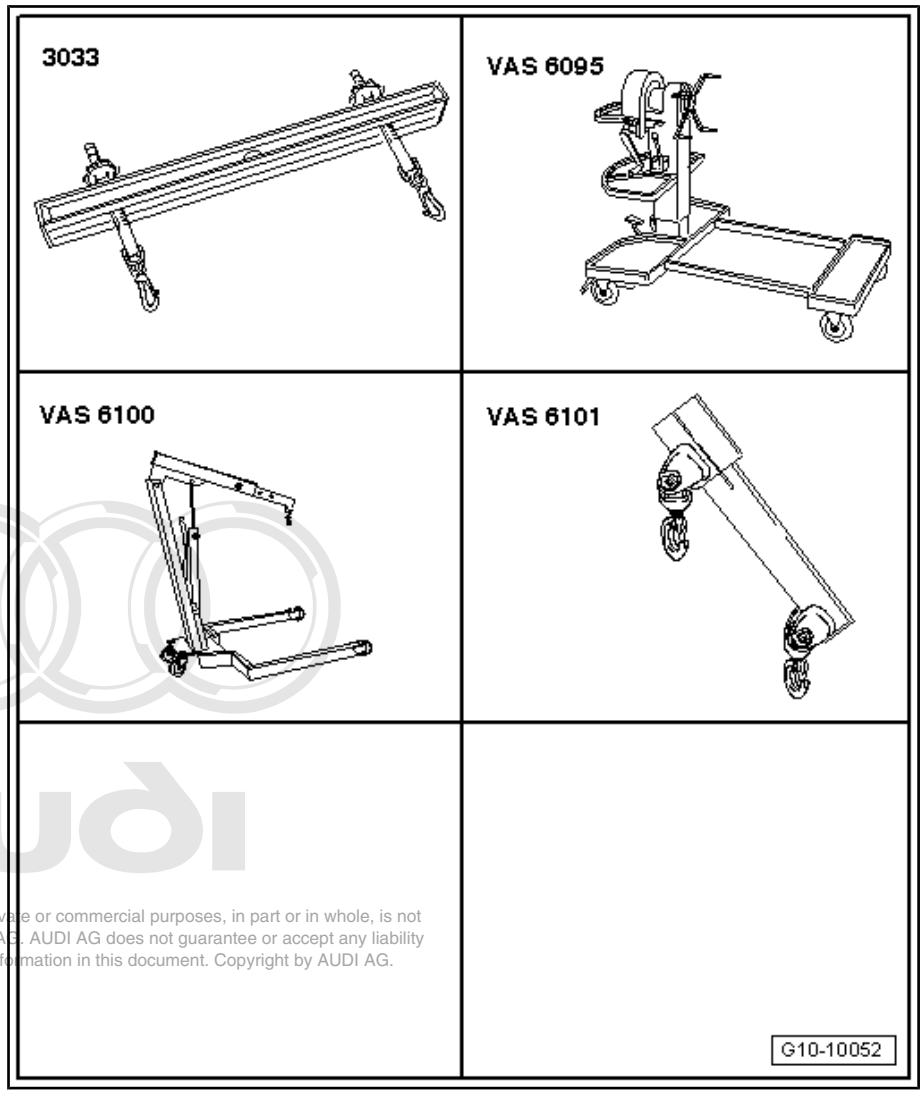
– Loosen clamping bolts -1- on sides of scissor-type assembly platform - VAS 6131 A- and pull rear section of platform together with gearbox towards rear -arrow-.



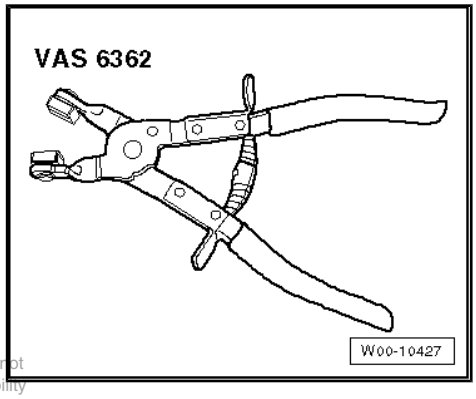
1.3 Securing engine to engine and gearbox support

Special tools and workshop equipment required

- Lifting tackle - 3033-
- Engine and gearbox support - VAS 6095- with bracket for V8 FSI engine - VAS 6095/1-6A-
- Workshop hoist - VAS 6100-
- Lift arm extension (workshop hoist) - VAS 6101-



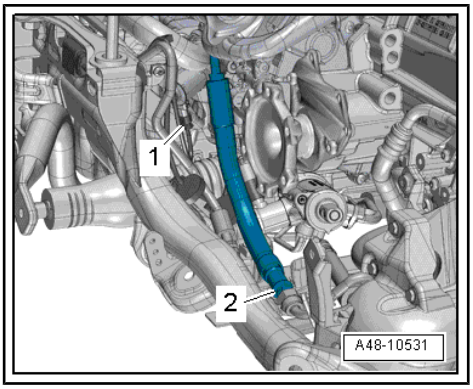
♦ Hose clip pliers - VAS 6362-



Procedure

- Engine/gearbox assembly removed; engine separated from gearbox ⇒ page 26 .
- Engine secured with support -VAS 6131/13-7- .

– Unplug electrical connector -1-.

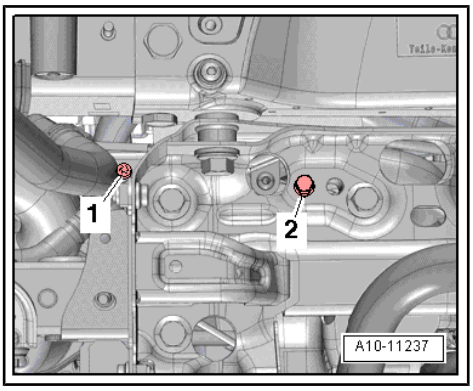


Note

Lay a cloth underneath vehicle to catch escaping hydraulic fluid.

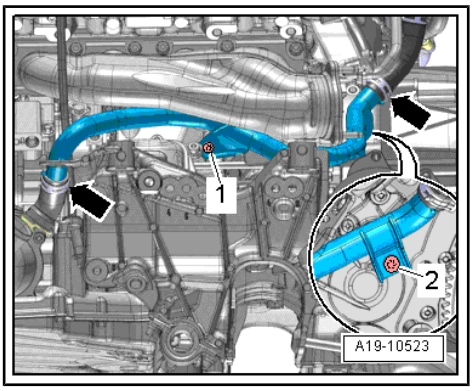
– Disconnect hydraulic line -2- for power steering.

– Remove bolts -1 and 2-.

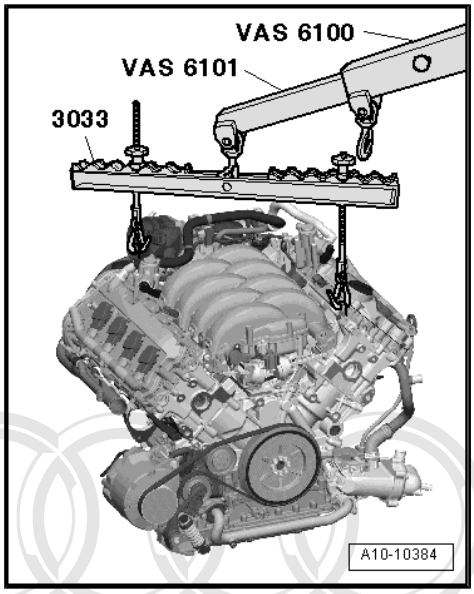


– Move clear electrical wiring at coolant pipe (centre left)

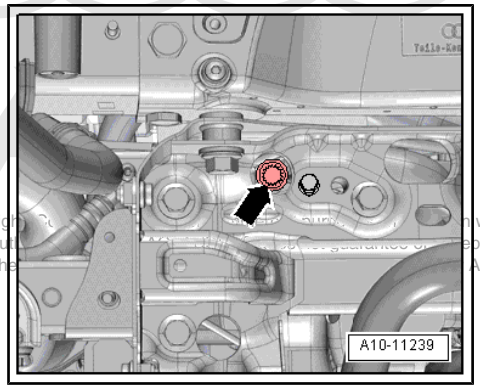
– Remove bolts -1, 2-, release hose clips -arrows- and detach coolant pipe (centre left) from coolant hoses.



– Attach lifting tackle - 3033- to engine lifting eyes and workshop hoist as shown in illustration.
– Take up weight of engine with workshop hoist, but do not lift.



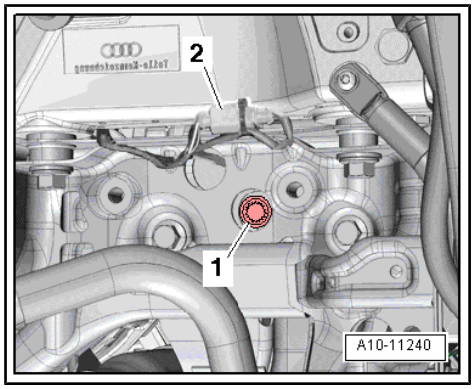
– Remove bolt -arrow- for engine mounting (left-side).



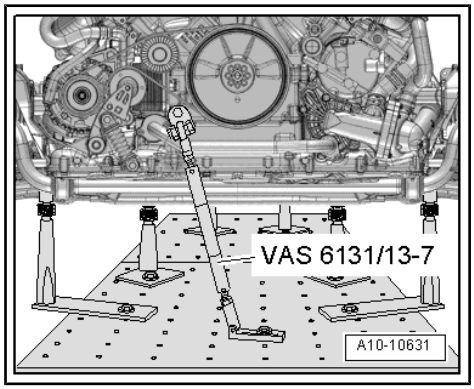
– Remove bolt -1- for engine mounting (right-side).

Note

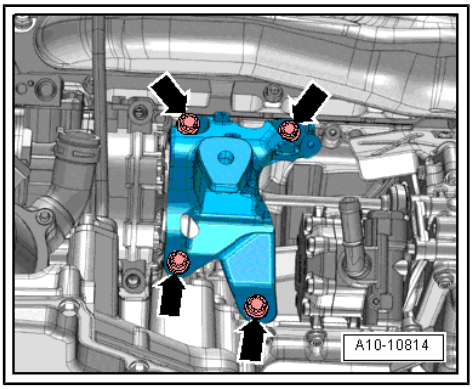
Disregard -item 2-.



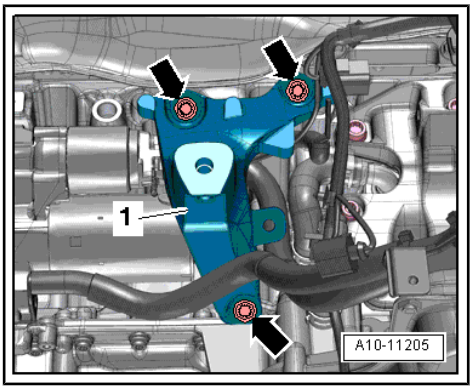
– Remove support -VAS 6131/13-7- from engine.
– Lift off engine from engine cross member.



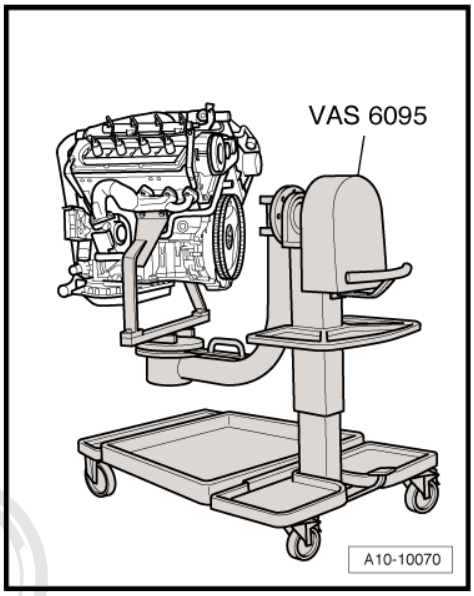
– Unscrew bolts -arrows- and remove engine support (left-side).



– Remove bolts -arrows- and detach engine support -1- (right-side).
– Tie up starter on engine.



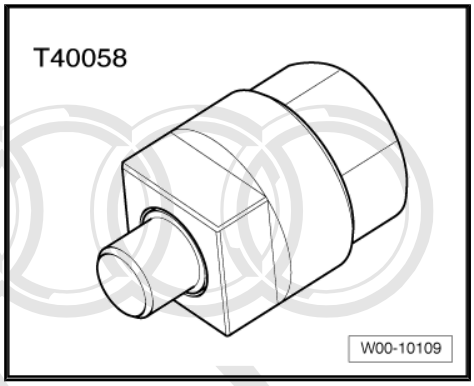
– Secure engine with support bracket for V8 FSI engine - VAS 6095/1-6A- to engine and gearbox support - VAS 6095- as shown in illustration and tighten to 55 Nm.



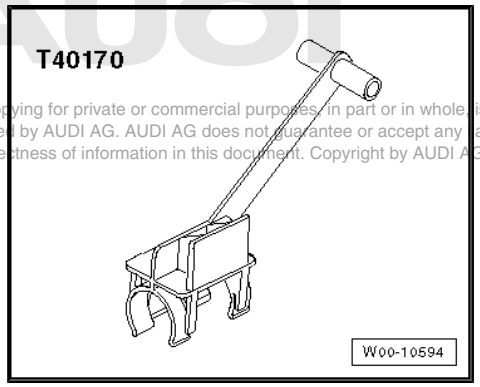
1.4 Installing engine

Special tools and workshop equipment required

- Adapter - T40058-



- Transport lock - T40170-



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: ± 15 %.*

Component		Nm
Bolts/nuts	M6	9
	M7	15
	M8	20
	M10	40
	M12	65
Except for the following:		
Earth stud to suspension turret		9

- Assembly mountings
⇒ “2.1 Exploded view - assembly mountings”, page 45
- Engine to gearbox ⇒ Rep. gr. 37 ; Removing and installing gearbox; Tightening torques for gearbox

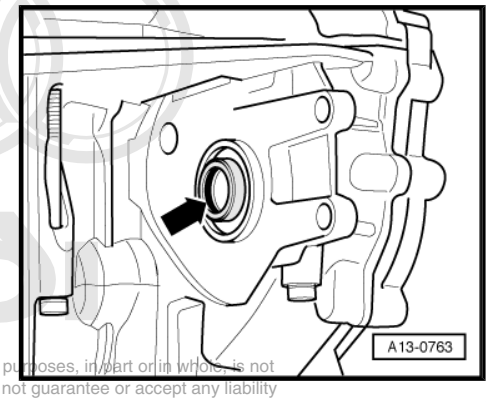
Procedure

Note

- *Renew the bolts tightened with specified tightening angle.*
- *Renew self-locking nuts and bolts as well as seals, gaskets and O-rings.*
- *Hose connections and air pipes and hoses must be free of oil and grease before assembly.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *Fit all cable ties in the original positions when installing.*

– Before installing gearbox, remove residue from threaded holes for engine/gearbox bolts in cylinder block using a thread tap.

– Before installing an exchange engine, check whether flat-section O-ring -arrow- is fitted in drive shaft of power steering pump.

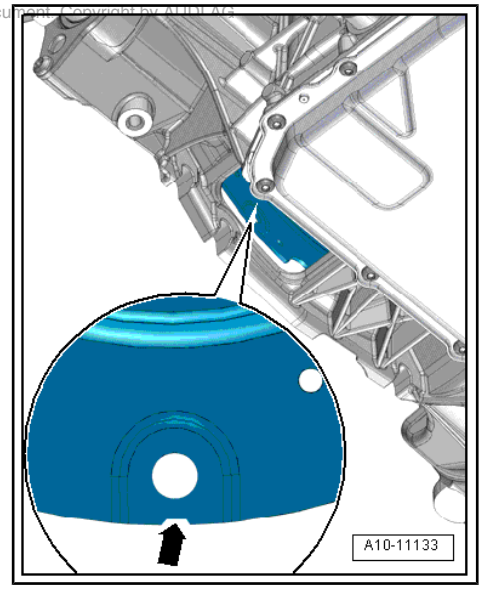


– Install engine support and engine mounting ⇒ page 45 .

– Install coolant pipe (centre left) ⇒ page 221 .

– The following preparations are required before joining engine and gearbox.

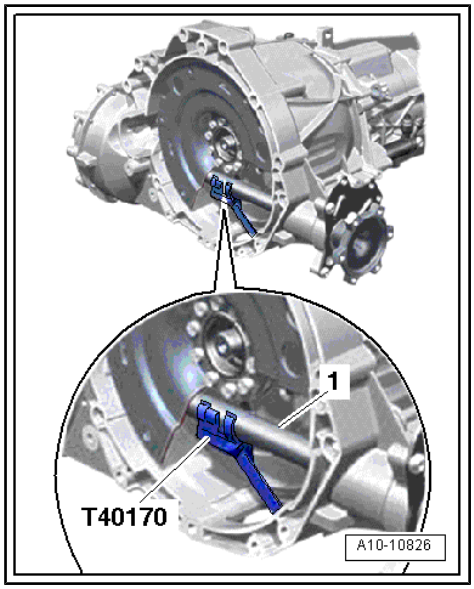
– Turn torque converter until hole is visible next to notch -arrow- in recess in bottom of gearbox housing, as shown in illustration.



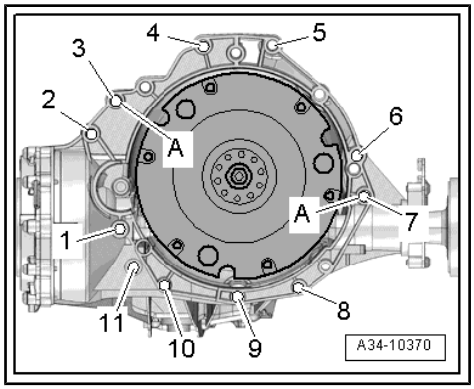
Note

There is only one notch on the circumference; turn the torque converter accordingly.

– Insert transport lock - T40170- into gearbox housing from below and clamp onto flange shaft -1-.
– Hold ATF lines in installation position when joining engine and subframe.



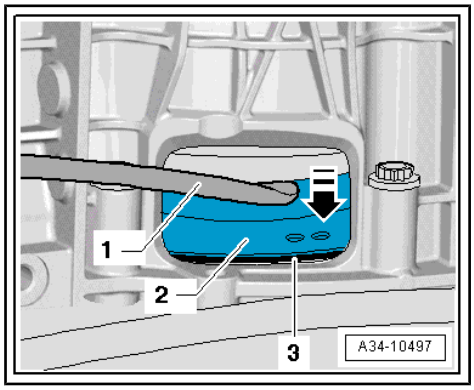
– Check whether dowel sleeves -A- for centring engine and gearbox are fitted in cylinder block; install missing dowel sleeves.
– Check whether aluminium bolts securing engine to gearbox can be reused; if so, apply marking ⇒ Rep. gr. 37 ; Removing and installing gearbox; Tightening torques for gearbox .
– Bring gearbox into position on engine (pay attention to starter).
– Tighten bolts -1 ... 11-.
– Remove transport lock - T40170-.



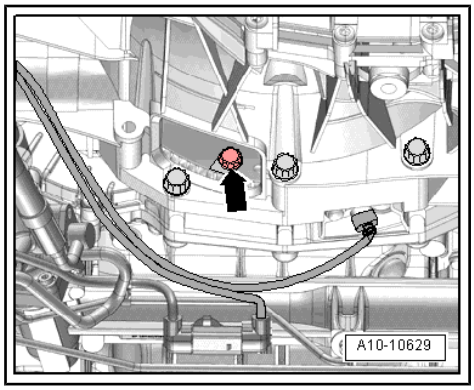
Note

The following step is necessary to ensure that the torque converter is straight and that it makes even contact with the drive plate.

– Use assembly lever -1- to press torque converter -2- slightly against drive plate -3- in direction of -arrow-.



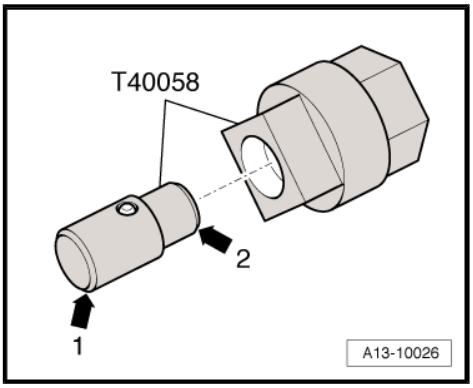
– Hand-tighten first bolt -arrow- (2 Nm).

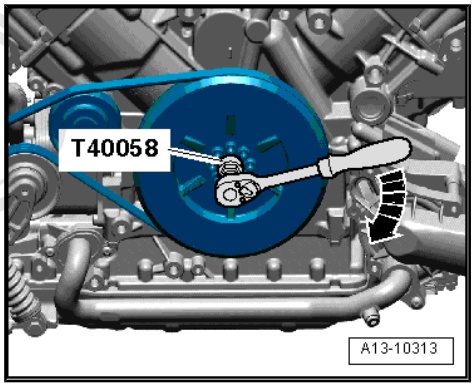


– Insert guide pin of adapter -T40058- as follows:

• The larger-diameter section -arrow 1- faces towards the engine.

• The smaller-diameter section -arrow 2- faces the adapter.





- Turn crankshaft 180° further in normal direction of engine rotation -arrow- with adapter - T40058- .
- Tighten bolt accessible in this crankshaft position to specified torque ⇒ Rep. gr. 32 ; Torque converter; Exploded view - torque converter .
- Turn crankshaft by 60° each time and tighten remaining 5 bolts to specified torque ⇒ Rep. gr. 32 ; Torque converter; Exploded view - torque converter .
- Secure drive shafts to gearbox flange shafts ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Exploded view - drive shaft .
- Install ATF cooler ⇒ Rep. gr. 37 ; ATF circuit; Removing and installing ATF cooler .
- Install coolant pipe (right-side) ⇒ page 228 .
- Install catalytic converter (right-side) ⇒ page 297 .
- Install ATF lines ⇒ Rep. gr. 37 ; ATF circuit; Removing and installing ATF lines .
- Install power steering hydraulic line ⇒ Running gear, axles, steering; Rep. gr. 48 ; Hydraulic power steering; Exploded view - hydraulic lines, reservoir .
- Install gearbox mounting with gearbox support ⇒ page 61 .
- Install catalytic converter (left-side) ⇒ page 297 .
- Raise engine/gearbox assembly using scissor-type assembly platform - VAS 6131 A- .
- Align subframe and tunnel cross member on longitudinal members according to markings made before removal.
- Tighten bolts for tunnel cross-piece ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings .
- Tighten subframe bolts only to specified torque (do not turn further); the bolts should only be fully tightened after performing the wheel alignment check ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Exploded view - subframe .

WARNING

Risk of accident because of loose bolt connections.

- ***Do NOT drive the vehicle unless the subframe bolts have been finally tightened.***

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

- Install manual release cable ⇒ Rep. gr. 37 ; Selector mechanism; Exploded view - selector mechanism .
- Install propshaft ⇒ Final drive; Rep. gr. 39 ; Propshaft; Removing and installing propshaft .
- Install front silencers ⇒ page 300 .
- Secure intermediate steering shaft to steering rack ⇒ Running gear, axles, steering; Rep. gr. 48 ; Steering column; Removing and installing intermediate steering shaft .
- Install upper suspension links and suspension strut ⇒ Running gear, axles, steering; Rep. gr. 40 ; Suspension strut, upper links; Exploded view - suspension strut, upper links .

- Install subframe cross brace and anti-roll bar ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Exploded view - subframe .
- Install struts at gearbox mountings ⇒ page 45 .
- Install brake calipers ⇒ Brake system; Rep. gr. 46 ; Front brakes; Removing and installing brake caliper .
- Install silencer for auxiliary heater ⇒ Auxiliary heater, supplementary heater; Rep. gr. 82 ; Auxiliary/supplementary heater; Removing and installing silencer with bracket .
- Install positive wires at positive terminal ⇒ Electrical system; Rep. gr. 27 ; Jump start terminal; Exploded view - jump start terminal .
- Install longitudinal members (bottom) ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier; Exploded view - lock carrier .
- Install air pipes ⇒ page 260 .
- Install electrical wiring, fuse holder and cover for electronics box in engine compartment ⇒ Electrical system; Rep. gr. 97 ; Relay carriers, fuse carriers, electronics boxes; Overview of fitting locations - relay carriers, fuse carriers, electronics boxes , and ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Install refrigerant lines ⇒ Heating, air conditioning; Rep. gr. 87 ; Refrigerant circuit; Exploded view - condenser .
- Install bumper cover (front) ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Removing and installing bumper cover .
- Observe steps required after re-connecting battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Disconnecting and connecting battery .
- Install body brace ⇒ Running gear, axles, steering; Rep. gr. 40 ; Suspension strut, upper links; Exploded view - suspension strut, upper links .
- Install upper longitudinal member ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier; Exploded view - lock carrier
- Install plenum chamber cover ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Removing and installing plenum chamber cover .

Caution

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

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

- Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 410 .
- Before starting engine, top up hydraulic fluid in power steering reservoir ⇒ Running gear, axles, steering; Rep. gr. 48 ; Hydraulic power steering; Checking power steering fluid level .

Note

- *The power steering pump must not be run when dry.*
- *Do not reuse coolant.*

– Connect coolant hoses with plug-in connector ⇒ page 237 .

– Fill up with coolant ⇒ page 196 .

– Charge refrigerant system ⇒ Air conditioner with refrigerant R134a .

– Align subframe ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Removing and installing subframe with steering rack .

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

– Check wheel alignment ⇒ Running gear, axles, steering; Rep. gr. 44 ; Wheel alignment check; Wheel alignment procedure .

WARNING

Risk of accident because of loose bolt connections.

- ***Tighten subframe bolts to final setting after performing wheel alignment check.***

– Top up ATF ⇒ Rep. gr. 37 ; ATF; Checking ATF level .

– Install noise insulation panels ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation .

2 Assembly mountings

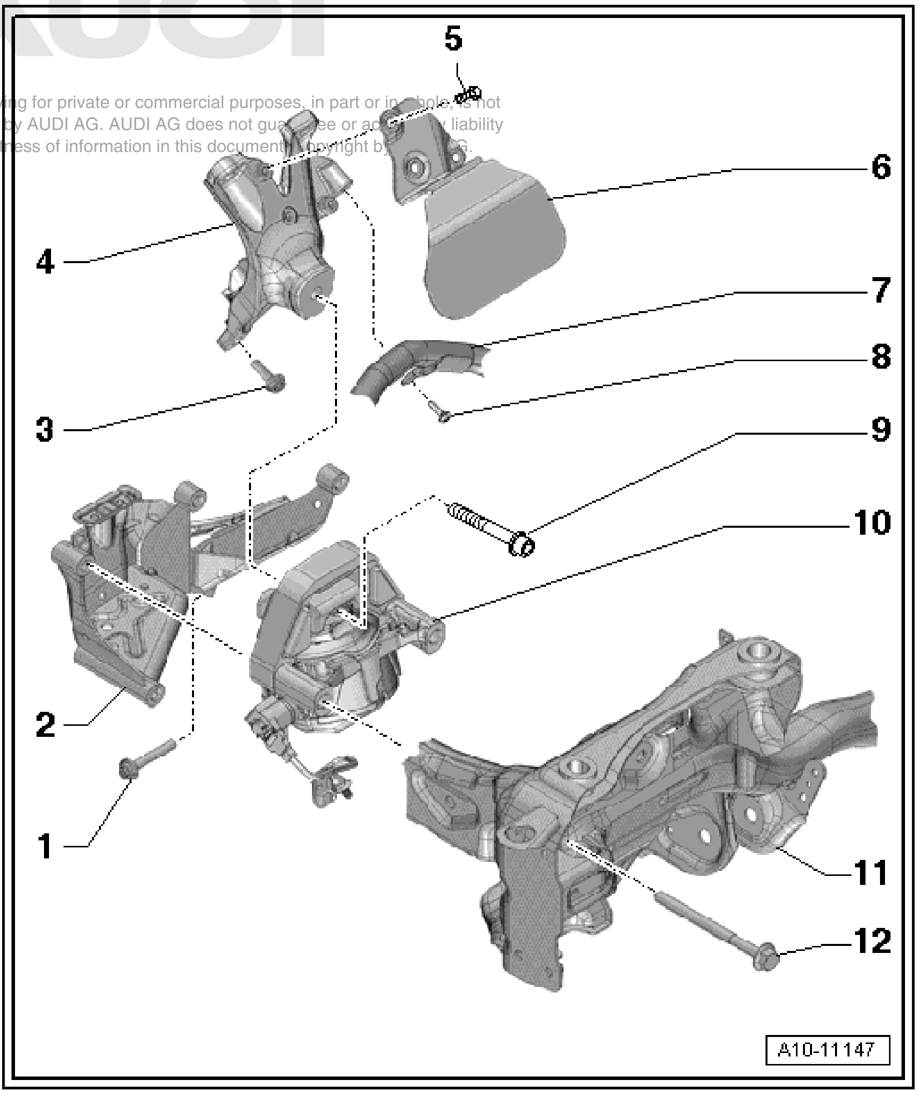
⇒ “2.1 Exploded view - assembly mountings”, page 45

⇒ “2.2 Removing and installing engine mountings”, page 47

⇒ “2.3 Removing and installing gearbox mounting”, page 58

2.1 Exploded view - assembly mountings

Engine mounting



1 - Bolt
- ❑ 20 Nm

2 - Console for engine mounting

3 - Bolt
- ❑ 40 Nm

4 - Engine support

5 - Bolt
- ❑ 10 Nm

6 - Heat shield

7 - Coolant pipe (centre left)

8 - Bolt
- ❑ Tightening torque ⇒ Item 26 (page 215)

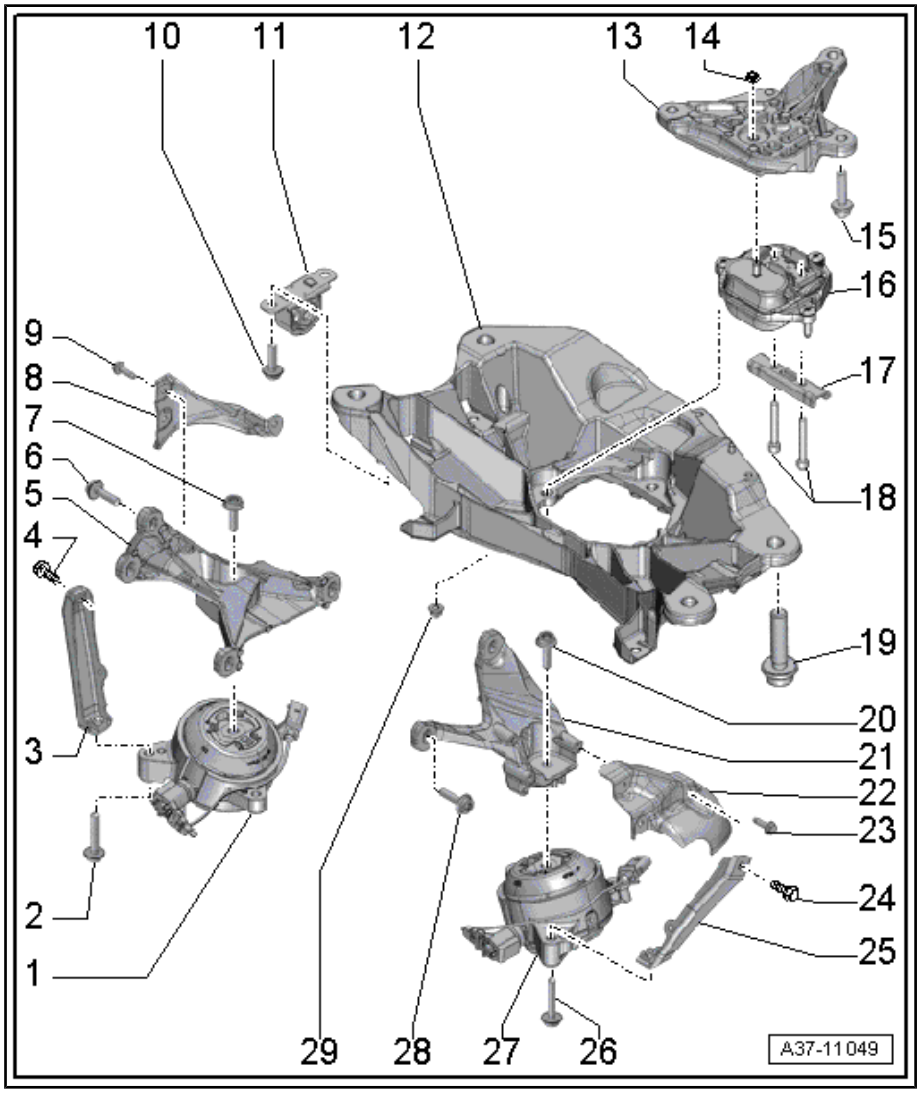
9 - Bolt
- ❑ Renew
- ❑ 90 Nm + turn 90° further

10 - Engine mounting
- ❑ Left side with left electrohydraulic engine mounting solenoid valve - N144-
- ❑ Right side with right electrohydraulic engine mounting solenoid valve - N145-
- ❑ Removing and installing ⇒ page 47

11 - Subframe

12 - Bolt
- ❑ 55 Nm

Gearbox mounting



1 - Gearbox mounting (right-side)

- ❑ With gearbox mounting valve 1 - N262-
- ❑ Removing and installing ⇒ page 60

2 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

3 - Support

4 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

5 - Gearbox support (right-side)

6 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

7 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

8 - Heat shield

9 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

10 - Not fitted

11 - Not fitted

12 - Tunnel cross-member

- ❑ Removing and installing ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

13 - Gearbox support (rear)

- ❑ Removing and installing ⇒ page 61

14 - Nut

- ❑ Only remove if detaching gearbox mounting from gearbox support
- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

15 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

16 - Gearbox mounting (rear)

- ❑ Removing and installing ⇒ page 62

17 - Stop (bottom)

- ❑ For gearbox mounting (rear)

18 - Bolts

- ❑ Only remove if detaching gearbox mounting from gearbox support
- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

19 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

20 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

21 - Gearbox support (left-side)

22 - Heat shield

23 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

24 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

25 - Support

26 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

27 - Gearbox mounting (left-side)

- ❑ With gearbox mounting valve 2 - N263-
- ❑ Removing and installing ⇒ page 58

28 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

29 - Nut

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

2.2 Removing and installing engine mountings

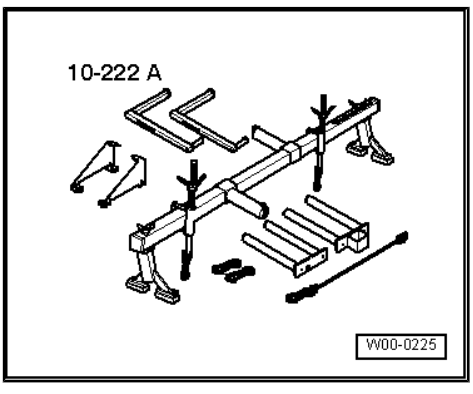
⇒ "2.2.1 Removing and installing engine mounting (left-side)", page 47

⇒ "2.2.2 Removing and installing engine mounting (right-side)", page 55

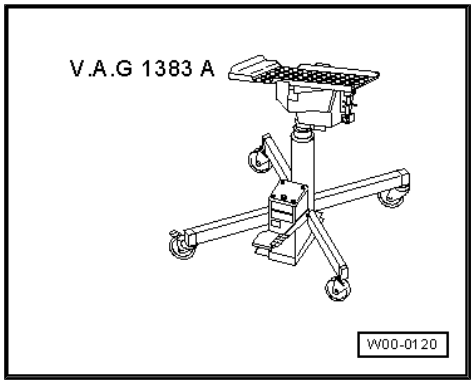
2.2.1 Removing and installing engine mounting (left-side)

Special tools and workshop equipment required

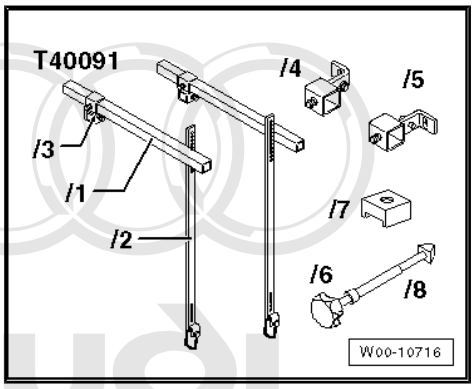
- ♦ Support bracket - 10 - 222 A-



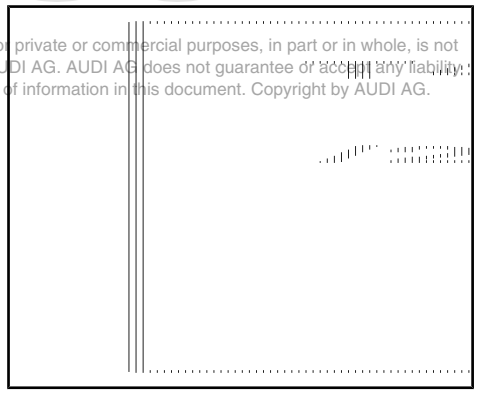
- Engine and gearbox jack - V.A.G 1383 A-



- Engine support bracket (basic set) - T40091-



- Engine support bracket (supplementary set) - T40093- with - T40093/7- and -T40093/8-



Removing

– Set front wheels to straight-ahead position.

Caution

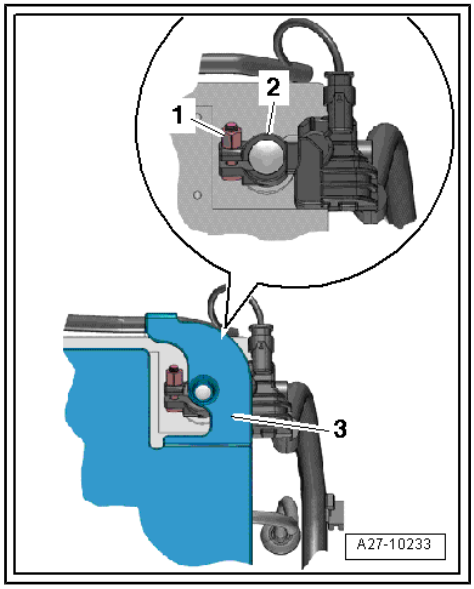
Electronic components are susceptible to damage.

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

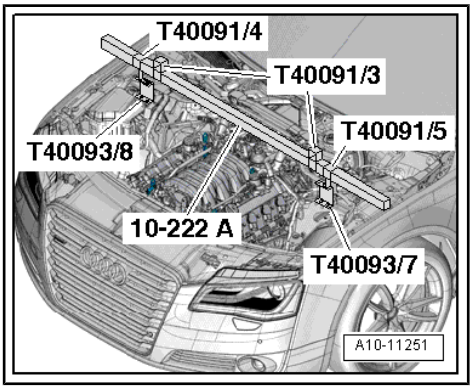
– Disconnect earth wire -2- from battery terminal ⇒ Electrical system; Rep. gr. 27 ; Battery, Disconnecting and connecting battery .

– Remove engine cover panel ⇒ page 63 .

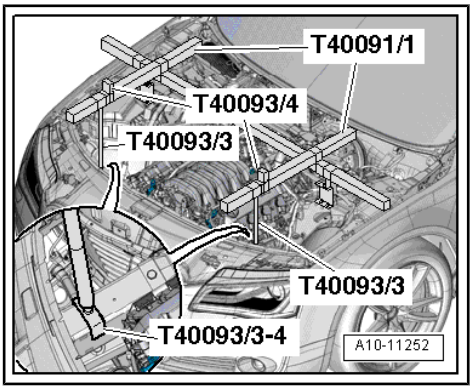
– Remove air cleaner housing (left and right) ⇒ page 261 .



– Set up support bracket - 10 - 222 A- with -T40091/3- , -T40091/4- , -T40091/5- , -T40093/7- and -T40093/8- on suspension turrets (left and right) as illustrated.

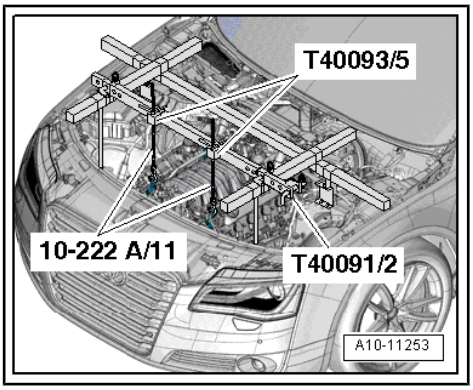


– Set up further tools -T40091/1- , -T40093/3- , -T40093/3-4- and -T40093/4- , as shown in illustration.

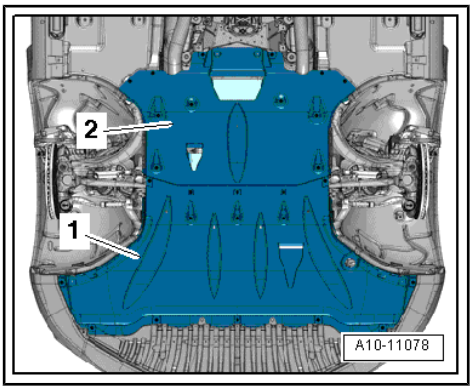


– Set up further tools -T40091/2- and -T40093/5- with spindles -10 - 222 A /11- , as shown in illustration.

– Engage spindles on engine lifting eyes and partly take up weight of engine.

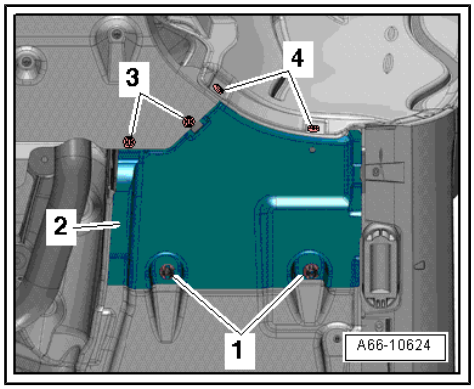


– Remove noise insulation panels -1- and -2- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

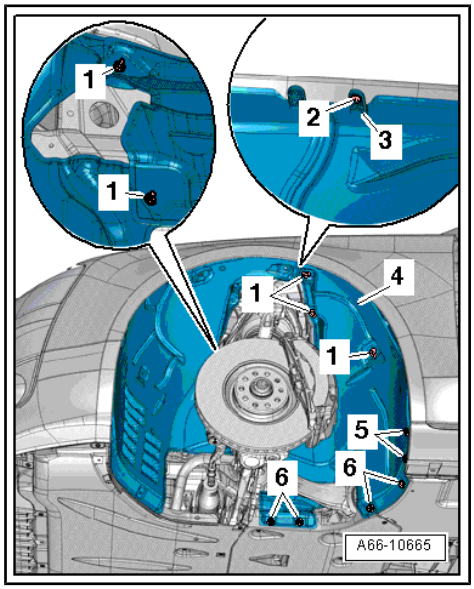


– Remove front underbody trim panels (left and right) -2- ⇒ General body repairs, exterior; Rep. gr. 66 ; Underbody trim; Removing and installing underbody trim .

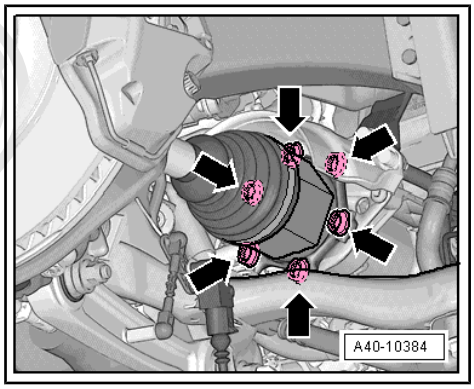
– Remove longitudinal members (bottom left and right) ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier; Removing and installing lock carrier .



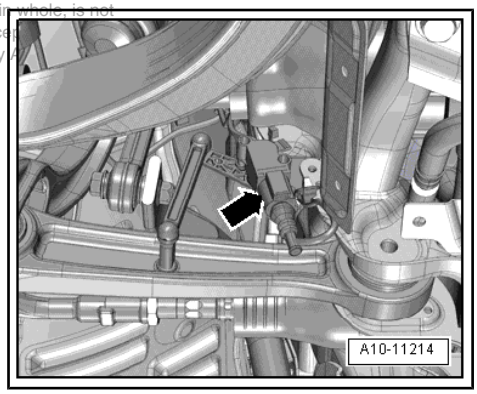
– Completely remove wheel housing liners (front left and front right) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Removing and installing wheel housing liner (front) .



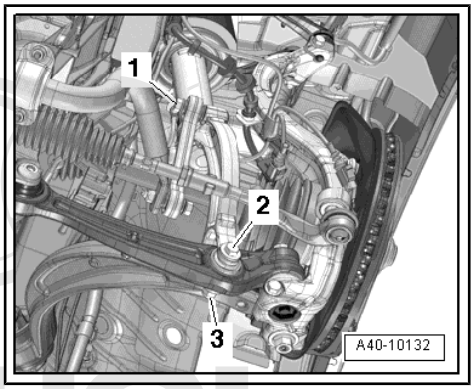
– Unbolt drive shaft (left and right) from gearbox flange shafts ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Removing and installing drive shaft .



– Unplug electrical connector -arrow- at front vehicle level sender -G78- / -G289- and move electrical wiring clear.



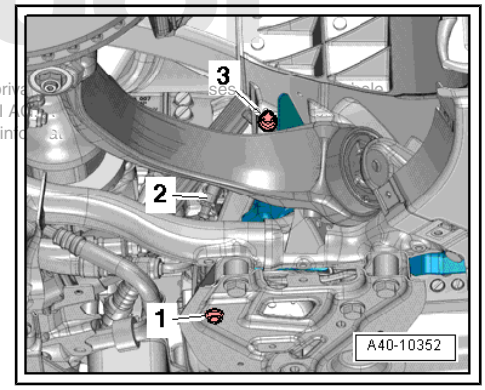
– Remove bolt -1- for anti-roll bar on both sides.



Note

Disregard -items 2 and 3-.

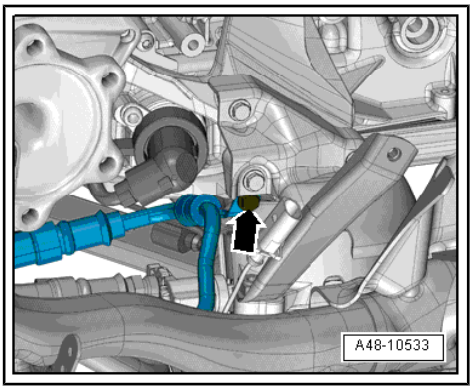
– Remove bolts -3- on both sides.



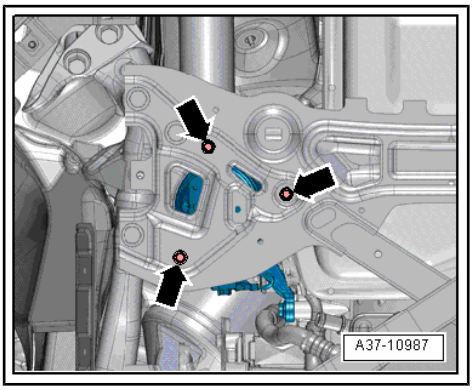
Note

Disregard -items 1, 2-.

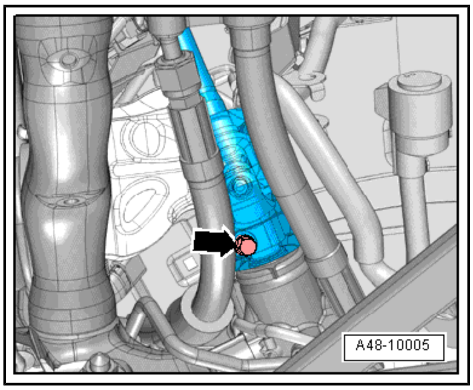
– Remove bolt -arrow- for power steering hydraulic line.



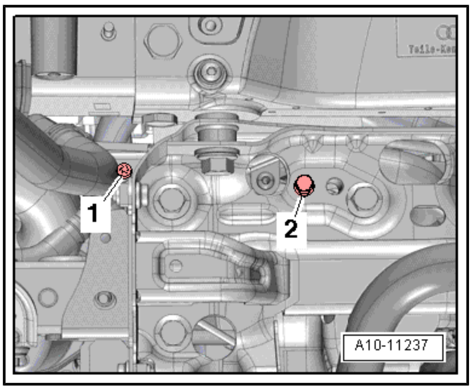
– Remove bolts for gearbox mounting -arrows- on both sides.



– Detach intermediate steering shaft from steering rack and move clear by telescoping upwards ⇒ Running gear, axles, steering; Rep. gr. 48 ; Steering column; Removing and installing intermediate steering shaft .



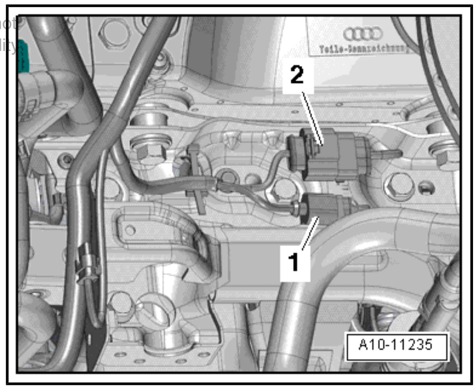
– Remove bolts -1- and -2-.



– Detach electrical connectors from bracket and unplug.

1 - For left electrohydraulic engine mounting solenoid valve - N144-

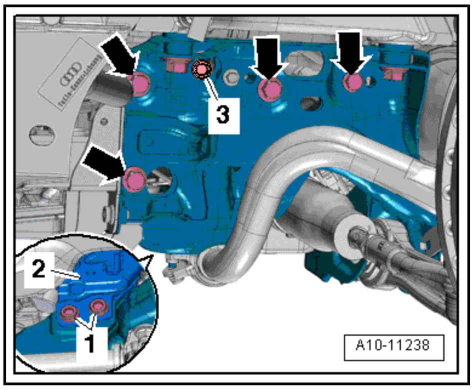
2 - For Servotronic solenoid valve - N119-



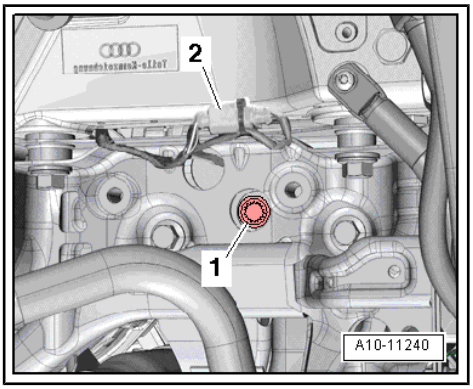
– Remove bolts -1, 3- and -arrows-.

Note

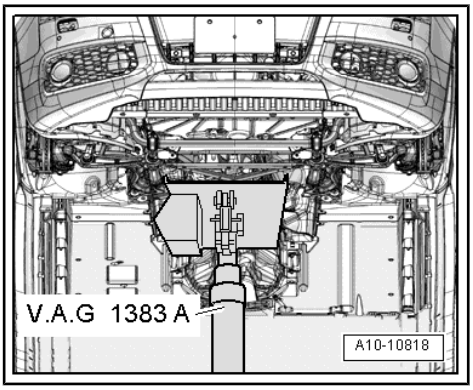
Retaining plate -2- for engine mounting (left-side) remains in installation position.



– Move clear and unplug electrical connector -2-.
– Remove bolt -1- for engine mounting (right-side).

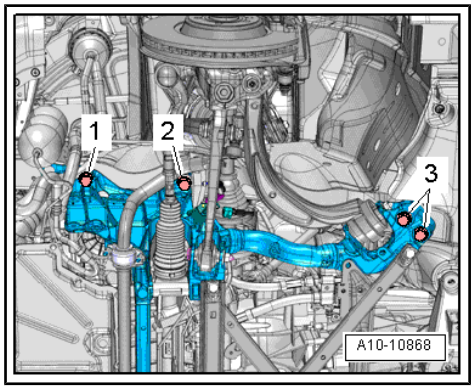


– Support subframe using engine and gearbox jack - V.A.G 1383 A- as illustrated.



– Mark installation position of subframe on longitudinal members with felt-tip pen.

– Unscrew subframe bolts -1, 2, 3- on both sides in several stages and in diagonal sequence.



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.*

– Lower subframe using engine and gearbox jack - V.A.G 1383 A- only far enough to detach engine mounting (left-side). At the same time check clearance of hydraulic fluid hoses (left-side) and electrical wiring (right-side).

– Detach engine mounting (left-side).

Installing

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

Note

- *Renew the bolts tightened with specified tightening angle.*
- *Fit all cable ties in the original positions when installing.*

– Align subframe on longitudinal members according to markings made before removal.

– Tighten subframe bolts only to specified torque (do not turn further); the bolts should only be fully tightened after performing the wheel alignment check ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Exploded view - subframe .

WARNING

Risk of accident because of loose bolt connections.

- *Do NOT drive the vehicle unless the subframe bolts have been finally tightened.*

– Install strut on gearbox mounting.

– Secure intermediate steering shaft to steering rack ⇒ Running gear, axles, steering; Rep. gr. 48 ; Steering column; Removing and installing intermediate steering shaft .

– Install silencer for auxiliary heater ⇒ Auxiliary heater, supplementary heater; Rep. gr. 82 ; Auxiliary/supplementary heater; Removing and installing silencer with bracket .

– Install ATF lines ⇒ Rep. gr. 37 ; ATF circuit; Removing and installing ATF lines .

– Install electrical wiring and terminal 30 wiring junction 2 - TV22- ⇒ Electrical system; Rep. gr. 97 ; Relay carriers, fuse carriers, electronics boxes; Overview of fitting locations - relay carriers, fuse carriers, electronics boxes , and ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

– Observe steps required after re-connecting battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Disconnecting and connecting battery .
– Install air cleaner housing ⇒ page 261 .
– Install engine cover panel ⇒ page 63 .
– Check wheel alignment ⇒ Running gear, axles, steering; Rep. gr. 44 ; Wheel alignment check; Wheel alignment procedure .

WARNING

Risk of accident because of loose bolt connections.

- *Tighten subframe bolts to final setting after performing wheel alignment check.*

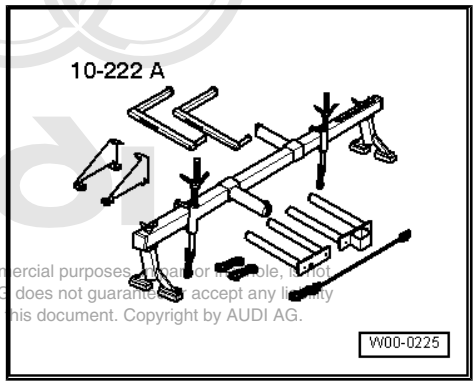
Tightening torques

- ⇒ “2.1 Exploded view - assembly mountings”, page 45
- Subframe cross brace, anti-roll bar ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Exploded view - subframe
- ⇒ Running gear, axles, steering; Rep. gr. 48 ; Hydraulic power steering; Exploded view - hydraulic lines, reservoir
- ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Exploded view - drive shaft
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Exploded view - wheel housing liner (front)
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation

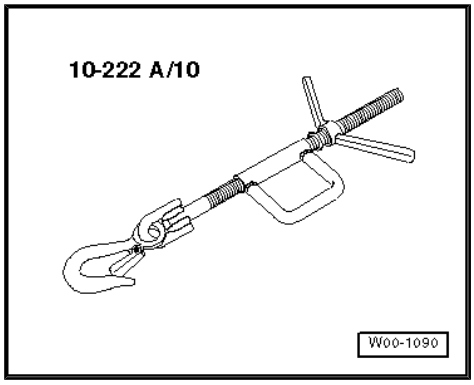
2.2.2 Removing and installing engine mounting (right-side)

Special tools and workshop equipment required

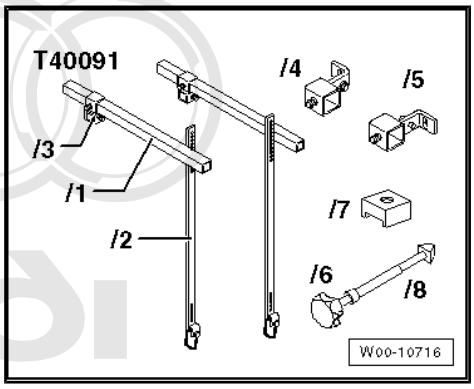
- Support bracket - 10 - 222 A-



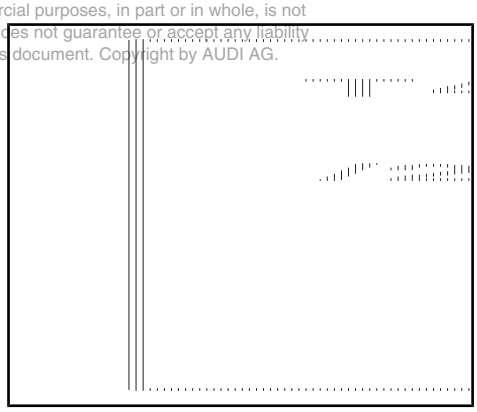
- Hook - 10 - 222 A /10-



- Engine support bracket (basic set) - T40091-



- Engine support bracket (supplementary set) - T40093- with - T40093/7- and -T40093/8-

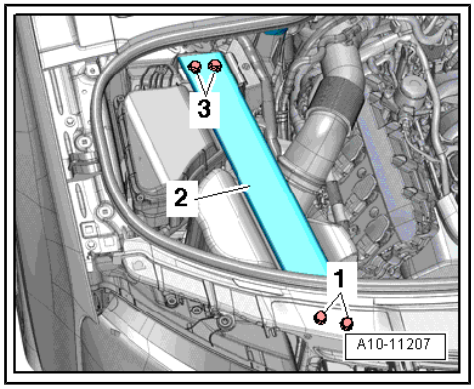


Removing

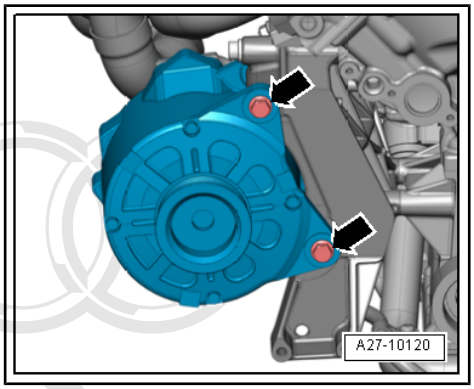
– Remove engine cover panel ⇒ page 63 .

– Remove upper longitudinal member on both sides -2- ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier; Exploded view - lock carrier .

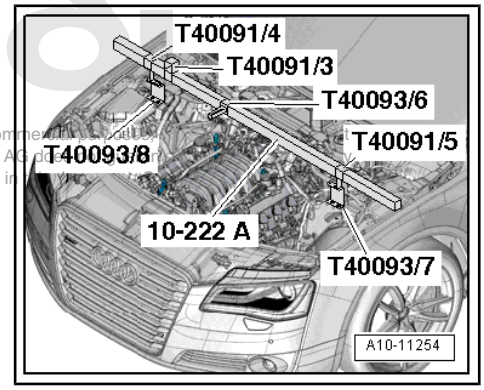
– Remove air cleaner housing (right-side) ⇒ page 261 .



– Remove alternator ⇒ Electrical system; Rep. gr. 27 ; Alternator; Removing and installing alternator .

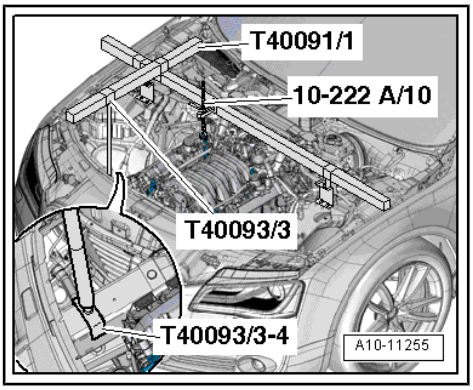


– Set up support bracket - 10 - 222 A- with -T40093/7- , -T40093/8- , -T40091/3- , -T40091/4- , -T40091/5- and -T40091/6- on suspension turrets (left and right), as shown in illustration.



– Set up further tools: hooks - 10 - 222 A /10- , -T40091/1- , -T40091/3- and -T40093/4- , as shown in illustration.

– Attach hook - 10 - 222 A /10- to engine lifting eye (right-side) and partly take up weight of engine.

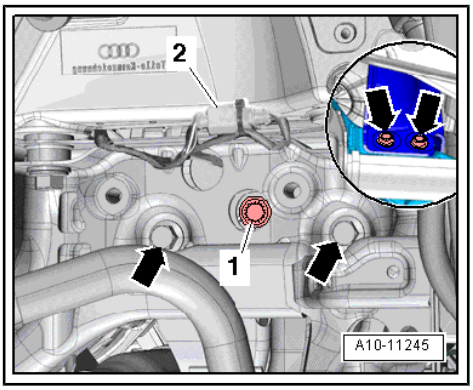


– Unplug electrical connector -2- on right electrohydraulic engine mounting solenoid valve - N145- and move electrical wiring clear.

– Remove bolts -1, 4- and -arrows- for retaining plate for engine mounting (right-side).

– Move wiring harness clear at retaining plate -3- for engine mounting (right-side).

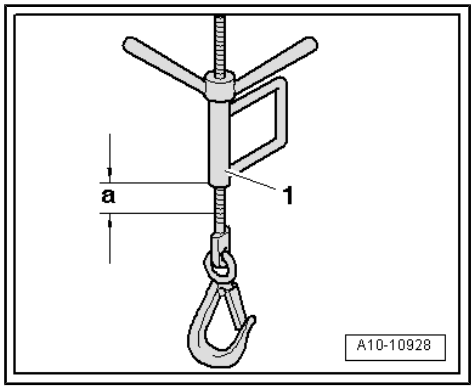
– Move retaining plate for engine mounting clear to one side.



– Using hook - 10 - 222 A /10- -item 1-, raise engine through distance -a-.

• Distance -a- = approx. 20 mm.

– Detach engine mounting (right-side).



Installing

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

Note

- *Renew the bolts tightened with specified tightening angle.*
- *Fit all cable ties in the original positions when installing.*

– Install electrical wiring ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

– Install alternator ⇒ Electrical system; Rep. gr. 27 ; Alternator; Removing and installing alternator .

– Install air cleaner housing ⇒ page 261 .

– Install engine cover panel ⇒ page 63 .

Tightening torques

- ⇒ “2.1 Exploded view - assembly mountings”, page 45
- Upper longitudinal member ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier; Exploded view - lock carrier

2.3 Removing and installing gearbox mounting

⇒ “2.3.1 Removing and installing gearbox mounting (left-side)”, page 58

⇒ “2.3.2 Removing and installing gearbox mounting (right-side)”, page 60

⇒ “2.3.3 Removing and installing gearbox support with gearbox mounting (rear)”, page 61

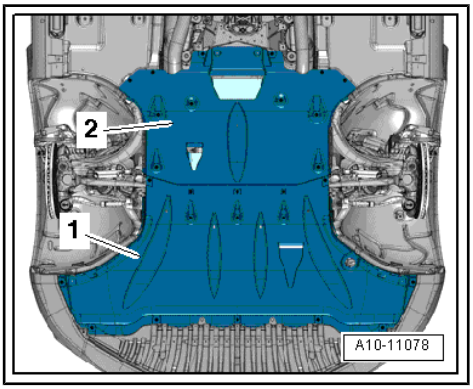
⇒ “2.3.4 Removing and installing gearbox mounting (rear)”, page 62

2.3.1 Removing and installing gearbox mounting (left-side)

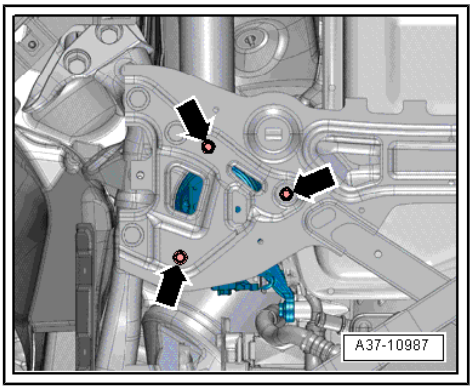
Removing

– Remove rear section of front wheel housing liner (left-side) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Removing and installing wheel housing liner (front) .

– Remove rear noise insulation -2- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

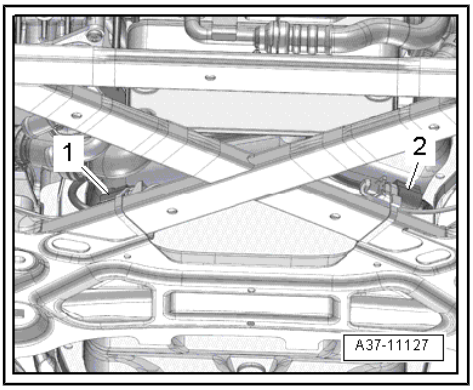


– Remove bolts -arrows-.



Gearbox mounting valve 2 - N263- , version 1:

– Unplug electrical connector -2- for gearbox mounting valve 2 - N263- .



Note

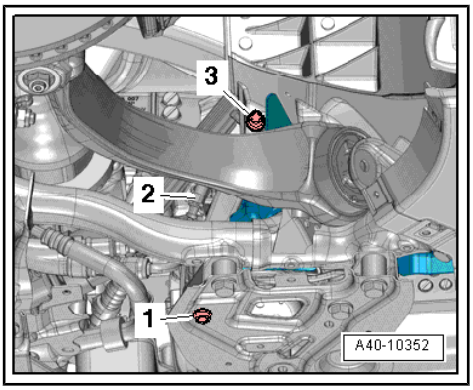
Disregard -item 1-.

Gearbox mounting valve 2 - N263- , version 2:

– Remove electrical connector -2- for gearbox mounting valve 2 - N263- from bracket and unplug connector.

All versions (continued):

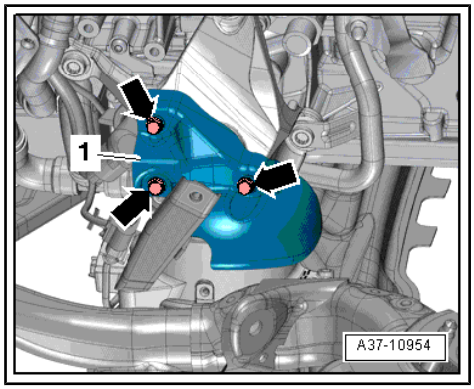
– Unscrew bolt -3- and remove strut.



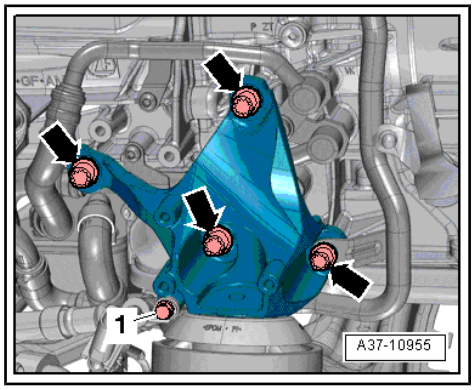
Note

Disregard -item 1-.

– Remove bolts -arrows- and detach heat shield -1-.



– Remove bolt -1- on bracket for hydraulic line.
– Remove bolts -arrows- and detach gearbox mounting (left-side) with gearbox support.



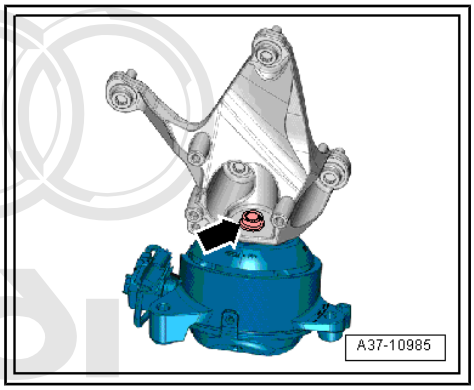
– Remove bolt -arrow- and detach gearbox mounting (left-side) from gearbox support.

Installing

Install in reverse order.

Tightening torques

- ⇒ “2.1 Exploded view - assembly mountings”, page 45
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Exploded view - wheel housing liner (front)
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation



2.3.2 Removing and installing gearbox mounting (right-side)

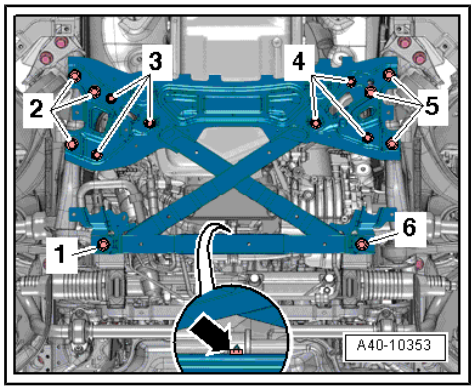
Removing

– Remove rear section of front wheel housing liner (right-side) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Removing and installing wheel housing liner (front) .
– Remove subframe cross brace ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Removing and installing subframe cross brace .

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.*

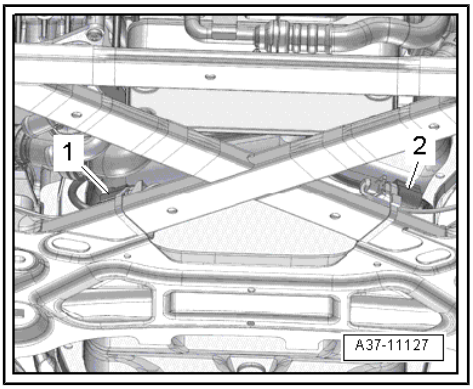


Gearbox mounting valve 1 - N262- , version 2:

– Unplug electrical connector -1- for gearbox mounting valve 1 - N262- .

Note

Disregard -item 2-.

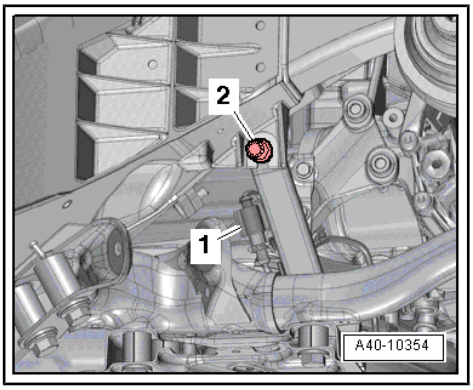


Gearbox mounting valve 1 - N262- , version 1:

– Remove electrical connector -1- for gearbox mounting valve 1 - N262- from bracket and unplug connector.

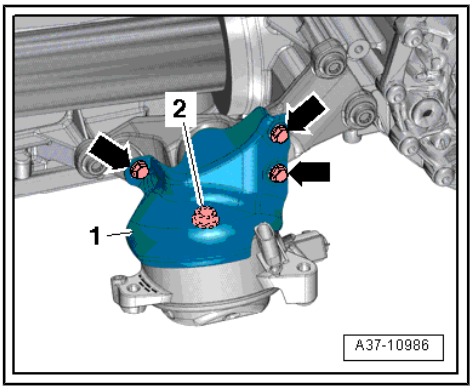
All versions (continued):

– Unscrew bolt -2- and remove strut.



– Remove bolts -arrows- and detach heat shield -1-.

– Remove bolt -2- and detach gearbox mounting from gearbox support.



Installing

Install in reverse order.

Tightening torques

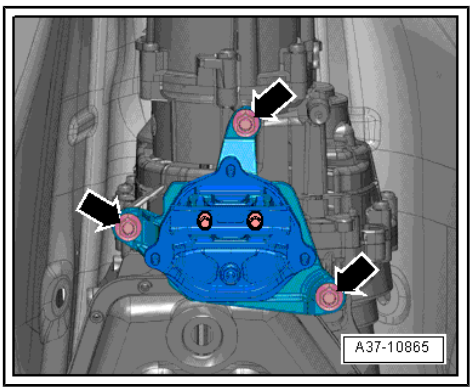
- ⇒ “2.1 Exploded view - assembly mountings”, page 45
- Subframe cross brace ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Exploded view - subframe
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Exploded view - wheel housing liner (front)

2.3.3 Removing and installing gearbox support with gearbox mounting (rear)

Removing

– Remove tunnel cross-piece ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings .

– Remove bolts -arrows- and detach gearbox support and gearbox mounting from gearbox.



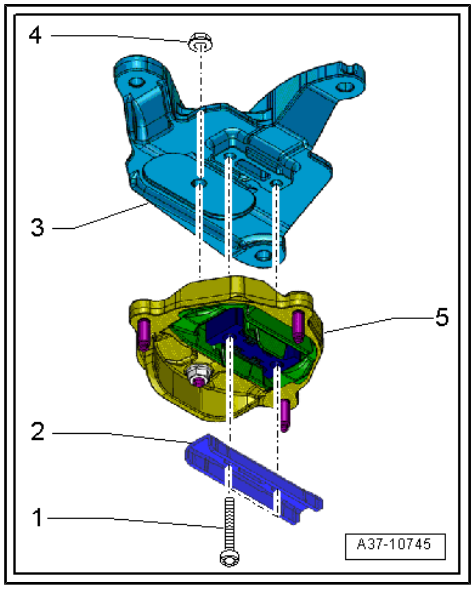
Installing

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

Tightening torques

- ⇒ “2.1 Exploded view - assembly mountings”, page 45
- Tunnel cross-piece ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

2.3.4 Removing and installing gearbox mounting (rear)



Removing

– Remove gearbox support with gearbox mounting (rear) ⇒ page 61 .

– Unscrew bolts -1- and detach stop (bottom) -2- for gearbox mounting.

– Remove nut -4- and detach gearbox mounting -5- from gearbox support.

Installing

– Position gearbox support -3- on gearbox mounting -5-.

– Hand-tighten nut -4-.

– Secure stop (bottom) -2- with bolts -1-.

– Tighten nut -4-.

– Install gearbox support with gearbox mounting (rear) ⇒ page 61 .

Tightening torques

◆ ⇒ “2.1 Exploded view - assembly mountings”, page 45

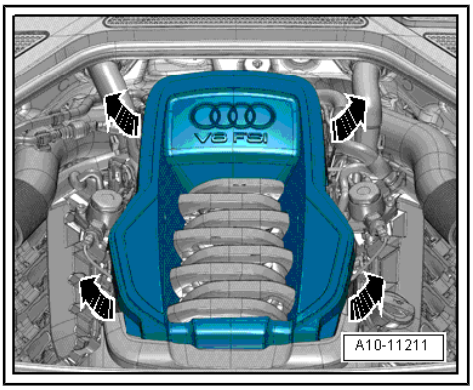
3 Engine cover panel

⇒ “3.1 Removing and installing engine cover panel”, page 63

3.1 Removing and installing engine cover panel

Removing

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



Installing

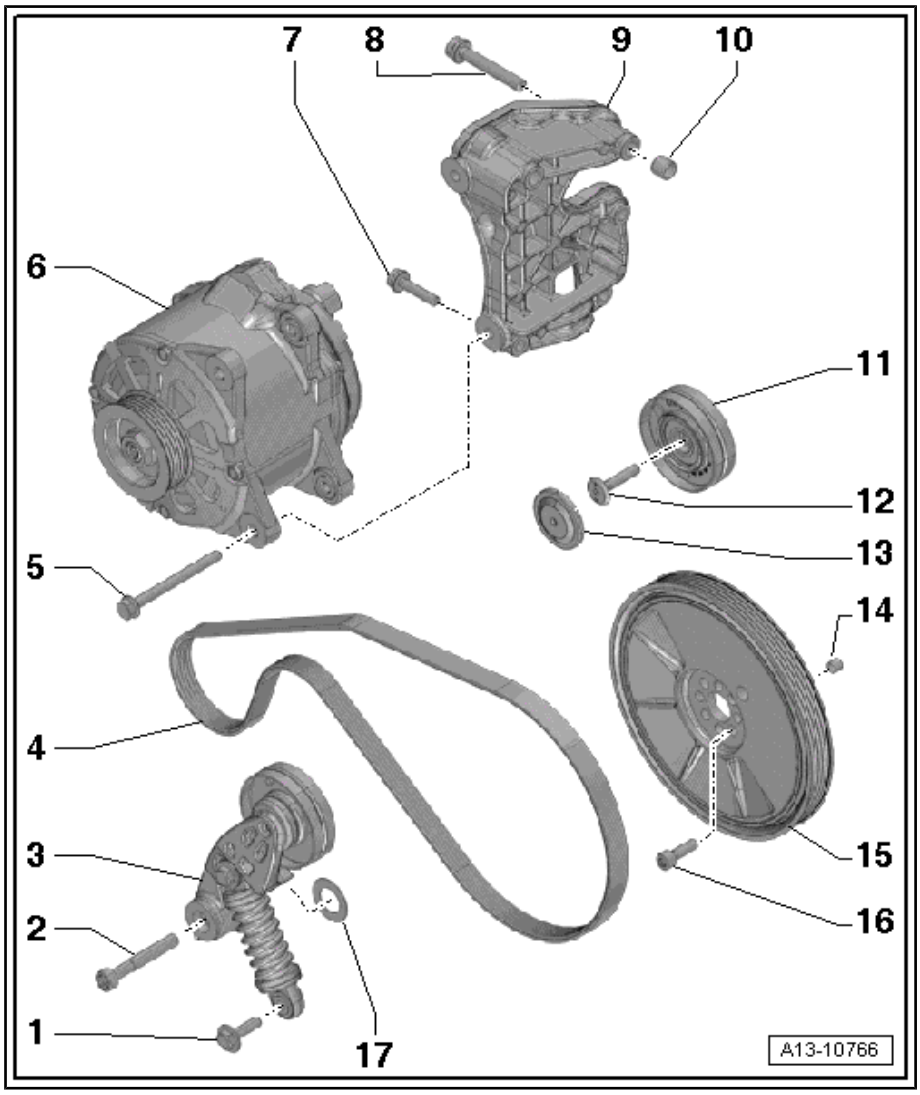
– To avoid damage, do not strike the engine cover panel with your fist or with any kind of tool.

– Press engine cover panel with both hands into the rubber grommets at the rear and then into the grommets at the front.

13 – Crankshaft group

1 Cylinder block (pulley end)

1.1 Exploded view - poly V-belt drive



1 - Bolt
- ❑ 22 Nm

2 - Bolt
- ❑ 55 Nm

3 - Tensioner
- ❑ For poly V-belt
- ❑ Removing and installing ⇒ page 66

4 - Poly V-belt
- ❑ Check for wear
- ❑ Before removing, mark direction of rotation with chalk or felt-tip pen
- ❑ Removing and installing ⇒ page 66
- ❑ Do not kink
- ❑ When installing, make sure it is properly seated on pulleys

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

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

7 - Bolt
- ❑ 22 Nm

8 - Bolt
- ❑ 46 Nm

9 - Bracket
- ❑ For alternator

- ❑ Removing and installing ⇒ page 68

10 - Dowel sleeve

- ❑ For bracket for alternator
- ❑ 2x

11 - Idler roller

- ❑ For poly V-belt
- ❑ With bolt -item 12-

12 - Bolt

- ❑ 22 Nm

13 - Cap

- ❑ For idler roller

14 - Dowel sleeve

- ❑ For bracket for alternator
- ❑ 2x

15 - Vibration damper

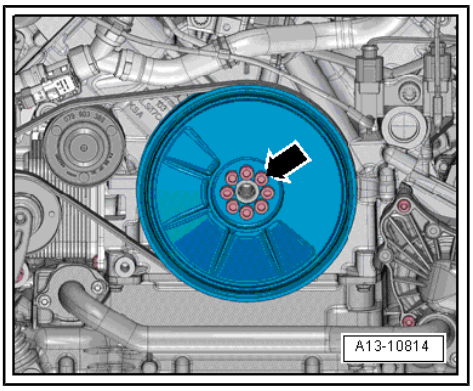
- ❑ With poly V-belt pulley
- ❑ Removing and installing ⇒ page 67

16 - Bolt

- ❑ Renew
- ❑ Threaded holes for bolts must be cleaned using a thread tap or similar
- ❑ Apply locking fluid when installing; refer to ⇒ Electronic parts catalogue
- ❑ Tightening torque and sequence ⇒ page 65

17 - Thrust washer

Vibration damper - tightening torque and sequence



Note

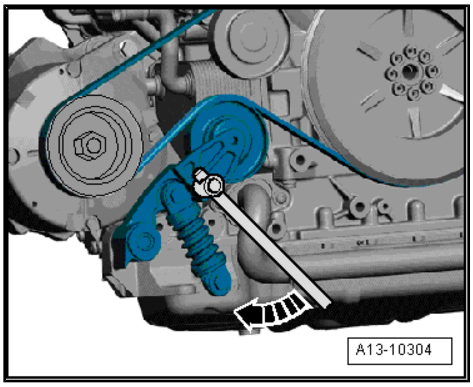
- ♦ *Renew the bolts tightened with specified tightening angle.*
- ♦ *Apply locking fluid to bolts when installing; for locking fluid refer to ⇒ Electronic parts catalogue .*
- ♦ *The threaded holes for the bolts must be cleaned using a thread tap or similar.*

– Tighten bolts in 3 stages as follows:

Stage	Bolts	Tightening torque/angle specification
1.	-arrow-	15 Nm in diagonal sequence
2.	-arrow-	22 Nm in diagonal sequence
3.	-arrow-	Turn 90° further in diagonal sequence

1.2 Removing and installing poly V-belt

Removing



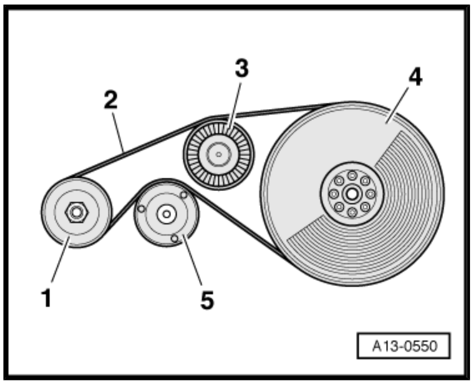
> ⚠ Caution
>
> *If a used belt runs in the opposite direction when it is refitted, this can cause breakage.*
>
> - *Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen for re-installation.*

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

– Remove poly V-belt and release tensioner.

Installing

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



ℹ Note

Secure alternator before fitting poly V-belt.

– Fit poly V-belt -2- onto pulleys in the following sequence:

1 - Alternator

3 - Idler roller

4 - Vibration damper

5 - Tensioner

ℹ Note

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

– Start engine and check that belt runs properly.

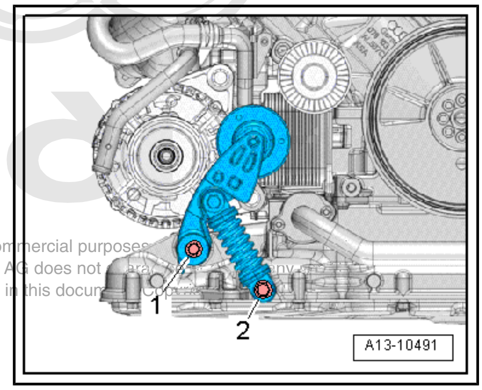
1.3 Removing and installing tensioner for poly V-belt

Removing

– Remove poly V-belt ⇒ page 66 .

– Remove bolts -1- and -2-.

– Detach poly V-belt tensioner from sump (top section)



Installing

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

– Install poly V-belt ⇒ page 66 .

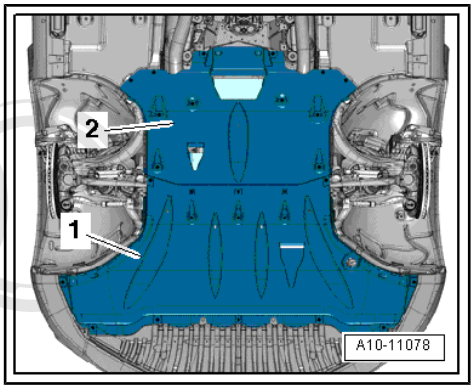
Tightening torques

- ⇒ “1.1 Exploded view - poly V-belt drive”, page 64

1.4 Removing and installing vibration damper

Removing

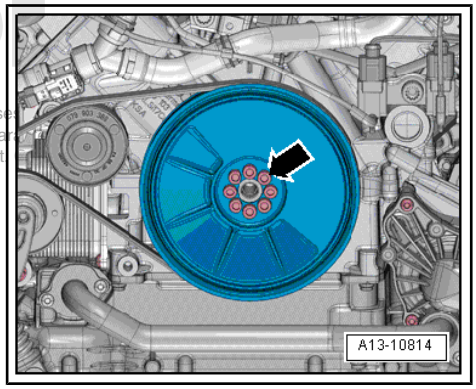
– Remove noise insulation (front) -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



– Slacken off bolts -arrow- on vibration damper several turns (counterhold with ring spanner on nut for poly V-belt pulley for alternator).

– Remove poly V-belt ⇒ page 66 .

– Unscrew bolts -arrow- and remove vibration damper.



Installing

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

Note

- *Renew the bolts tightened with specified tightening angle.*
- *Apply locking fluid to bolts when installing; for locking fluid refer to ⇒ Electronic parts catalogue .*
- *The threaded holes for the bolts must be cleaned using a thread tap or similar.*

– Observe dowel sleeve when installing vibration damper.

– Install poly V-belt ⇒ page 66 .

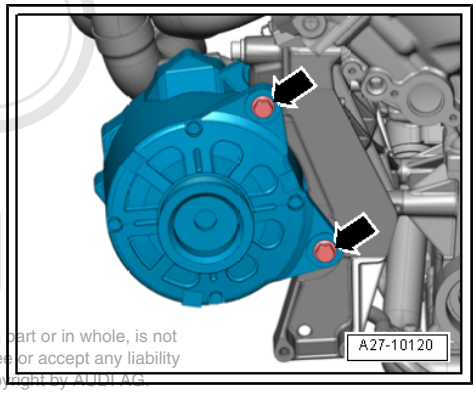
Tightening torques

- ⇒ Fig. ""Vibration damper - tightening torque and sequence"" , page 65
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation

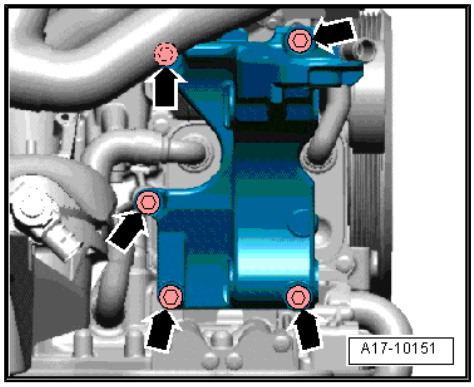
1.5 Removing and installing bracket for ancillaries

Removing

– Remove alternator ⇒ Electrical system; Rep. gr. 27 ; Alternator; Removing and installing alternator .



– Remove bolts -arrows- and detach bracket for alternator.



Installing

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

– Install alternator ⇒ Electrical system; Rep. gr. 27 ; Alternator; Removing and installing alternator .

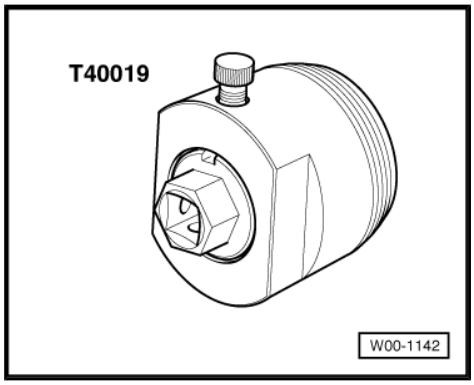
Tightening torques

♦ ⇒ “1.1 Exploded view - poly V-belt drive”, page 64

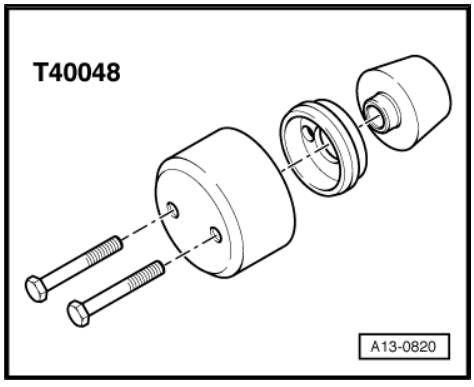
1.6 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

♦ Oil seal extractor - T40019-



♦ Assembly tool - T40048-



♦ Bolts M8x55 mm (2x)

Procedure

– Remove vibration damper ⇒ page 67 .

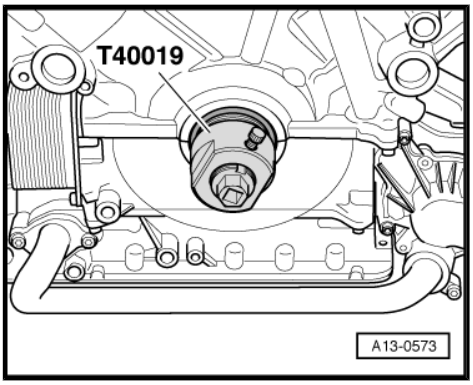
– Adjust inner part of oil seal extractor -T40019- so that it is level with the outer part and lock in position with knurled screw.

– 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.

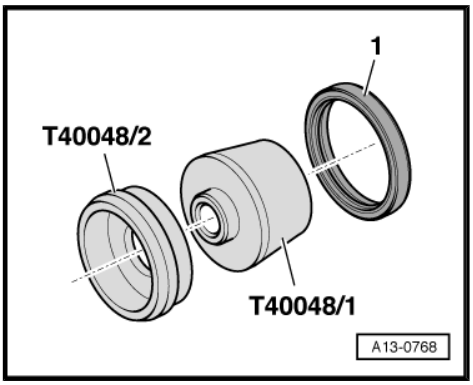
– Clamp flats of oil seal extractor in vice and use pliers to remove oil seal.

– Clean contact surface and sealing surface.



– Fit assembly aid -T40048/1- onto assembly sleeve -T40048/2- and slide oil seal -1- onto assembly sleeve.

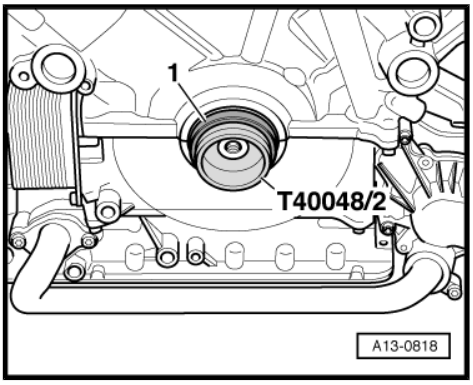
– Detach assembly aid.



– Fit assembly sleeve -T40048/2- on crankshaft and slide oil seal -1- into sealing surface in cylinder block.

Note

Leave assembly sleeve in position on crankshaft when pressing in seal.



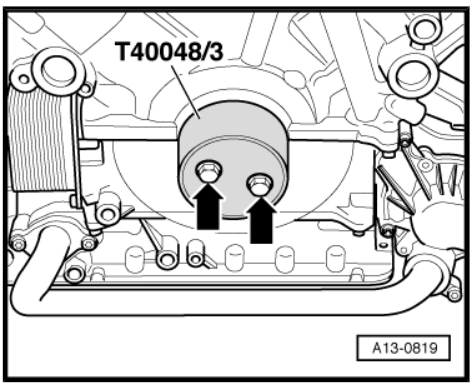
– Apply press sleeve -T40048/3- to crankshaft using two M8×55 mm bolts -arrows-.

– Initially hand-tighten bolts.

– Tighten bolts alternately, $^{1}/_{2}$ turn at a time, to press in oil seal onto stop.

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

– Install vibration damper ⇒ page 67 .

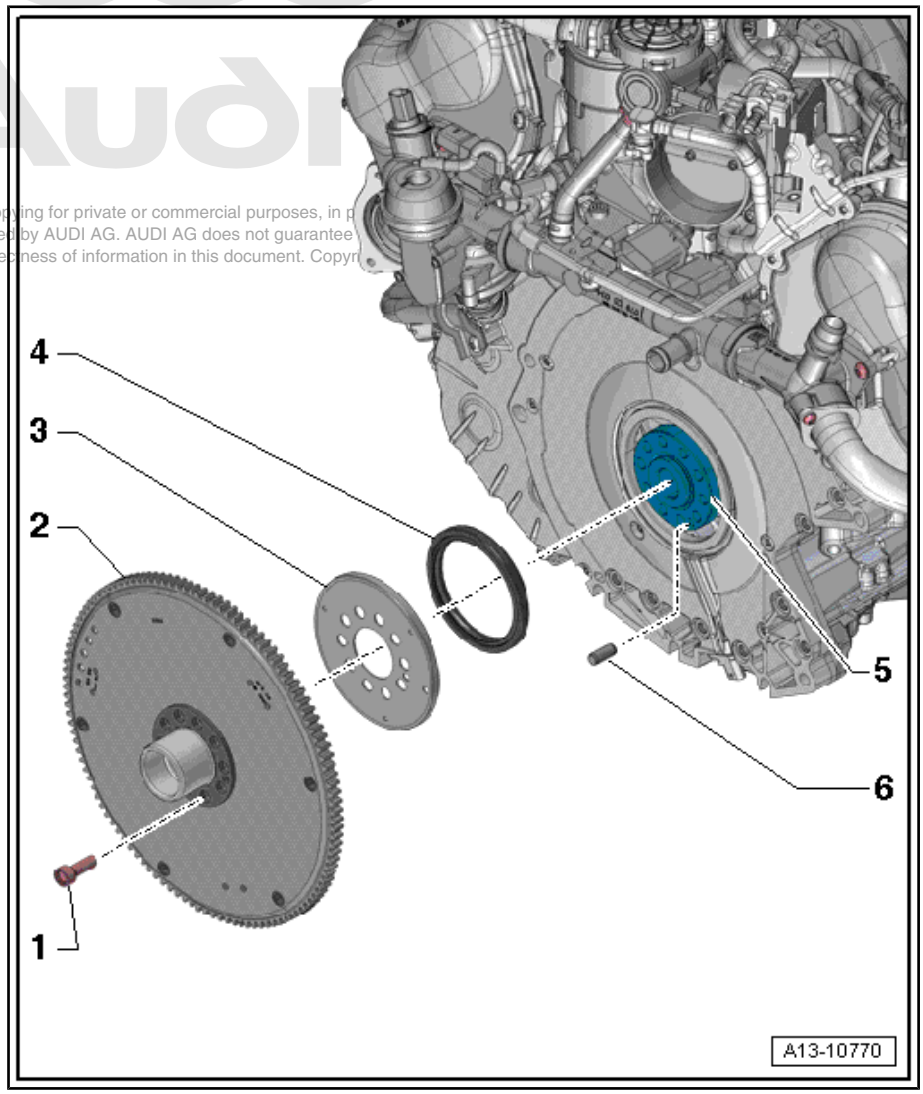


2 Cylinder block (gearbox end)

2.1 Exploded view - cylinder block (gearbox end)

Note

When carrying out repairs, secure engine to engine and gearbox support - VAS 6095- using bracket for V8 FSI engine -6095/1-6A- ⇒ page 34 .



1 - Bolt

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

2 - Drive plate

- ❑ With bearing flange
- ❑ Check running surface on bearing flange and holes for torque converter for cracks and scoring
- ❑ Removing and installing ⇒ page 71

3 - Sender wheel

- ❑ For engine speed sender - G28-
- ❑ Removing and installing ⇒ page 72

Caution

Risk of magnetic fields causing irreparable damage to sender wheel.
The encoder wheel must be kept away from magnets (e.g. base of torch, loudspeaker).

If the drive plate/flywheel or the sender wheel itself has been removed or renewed, check that the sender wheel is operating correctly before installation ⇒ page 73 .

- ❑ Checking ⇒ page 73

4 - Oil seal

- ❑ For crankshaft (gearbox end)
- ❑ Renewing ⇒ page 74

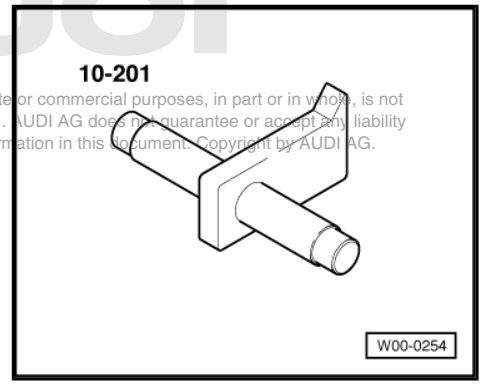
5 - Crankshaft

6 - Dowel pin

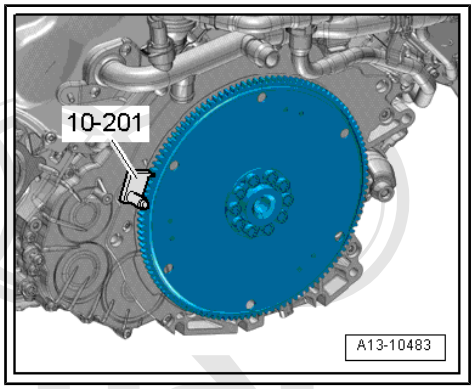
2.2 Removing and installing drive plate

Special tools and workshop equipment required

- Counterhold tool - 10 - 201-



Removing



- Engine or gearbox removed.

– Insert counterhold tool - 10 - 201- to slacken bolts.

Caution

Take care not to damage outer surface of bearing flange on drive plate.

- *Use a multi-point socket bit with a length of at least 40 mm to slacken and tighten the drive plate bolts.*

– Remove bolts and take off drive plate.

– Detach sender wheel for engine speed sender - G28- .

Installing

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

Note

Renew the bolts tightened with specified tightening angle.

Caution

Risk of magnetic fields causing irreparable damage to sender wheel.

- *The encoder wheel must be kept away from magnets (e.g. base of torch, loudspeaker).*
- *If the drive plate/flywheel or the sender wheel itself has been removed or renewed, check that the sender wheel is operating correctly before installation ⇒ page 73 .*

– Pay attention to dowel pin when installing drive plate.

– Fit counterhold tool - 10 - 201- the other way round to tighten bolts.

Tightening torques

- ⇒ “2.1 Exploded view - cylinder block (gearbox end)”, page 70

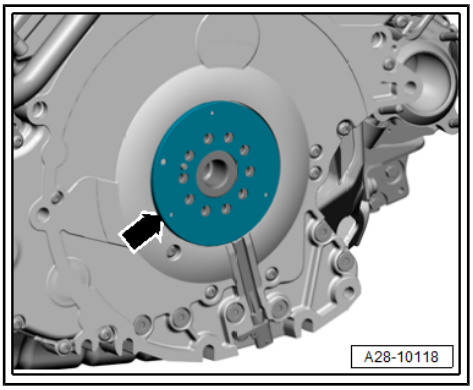
2.3 Removing and installing sender wheel

Removing

- Gearbox removed ⇒ Rep. gr. 37 ; Removing and installing gearbox; Removing gearbox .

– Remove drive plate ⇒ page 71 .

– Detach sender wheel -arrow-.



Installing

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

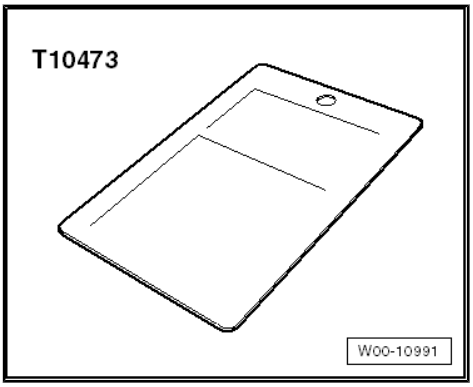
> **Caution**
>
> ***Risk of magnetic fields causing irreparable damage to sender wheel.***
>
> - ***The encoder wheel must be kept away from magnets (e.g. base of torch, loudspeaker).***
> - ***If the drive plate/flywheel or the sender wheel itself has been removed or renewed, check that the sender wheel is operating correctly before installation ⇒ page 73 .***

– Install drive plate ⇒ page 71 .

2.4 Checking sender wheel

Special tools and workshop equipment required

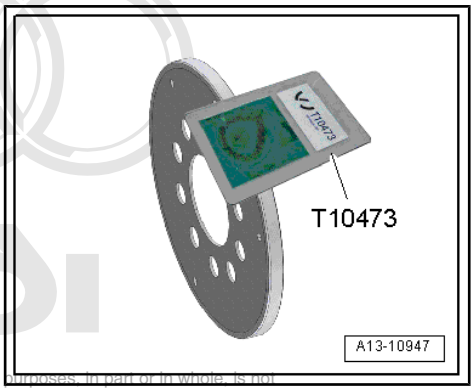
- Sensor gauge - T10473-



Procedure

- Sender wheel removed

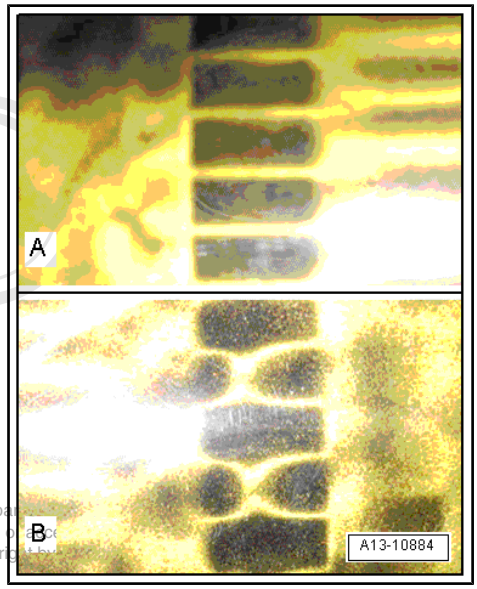
– Check entire circumference of sender wheel using sensor gauge - T10473- , as shown in illustration.



Inspection image of sender wheel

A - Sender wheel OK

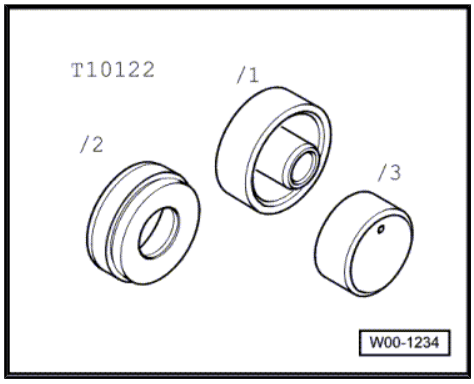
B - Sender wheel defective



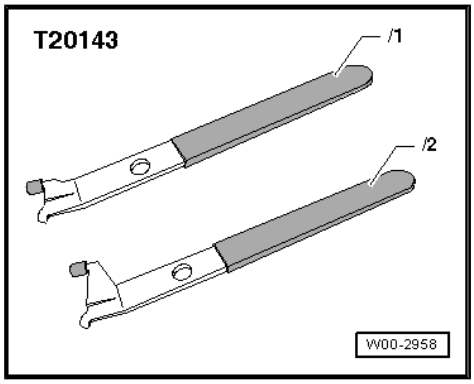
2.5 Renewing crankshaft oil seal (gearbox end)

Special tools and workshop equipment required

- Fitting tool - T10122-



- Extractor tool - T20143/2-



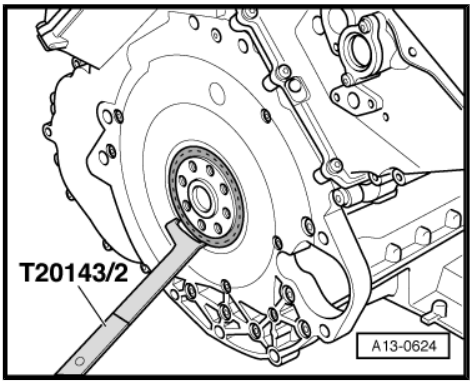
Procedure

- Engine or gearbox removed.

– Remove drive plate ⇒ page 71 .

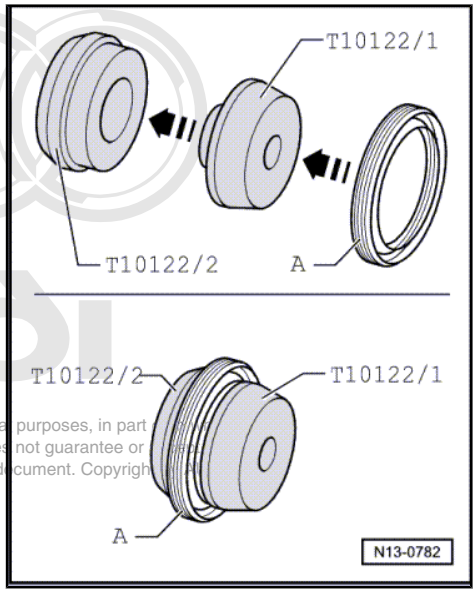
– Pry out oil seal using extractor tool -T20143/2- .

– Clean contact surface and sealing surface.

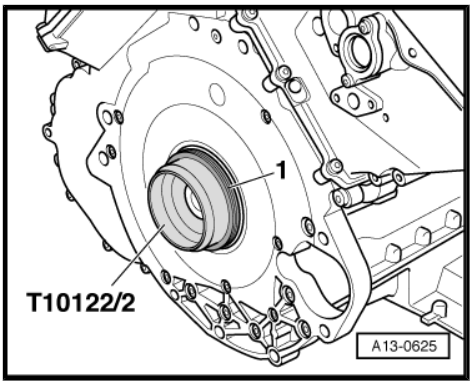


– Fit assembly aid -T10122/1- onto assembly sleeve -T10122/2- and slide oil seal -A- onto assembly sleeve.

– Detach assembly aid.

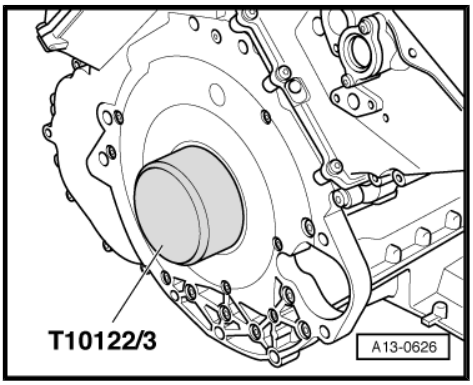


– Fit assembly sleeve -T10122/2- with oil seal -1- onto crankshaft.



– Drive in oil seal uniformly until flush all round using thrust piece -T10122/3- .

– Install drive plate ⇒ page 71 .

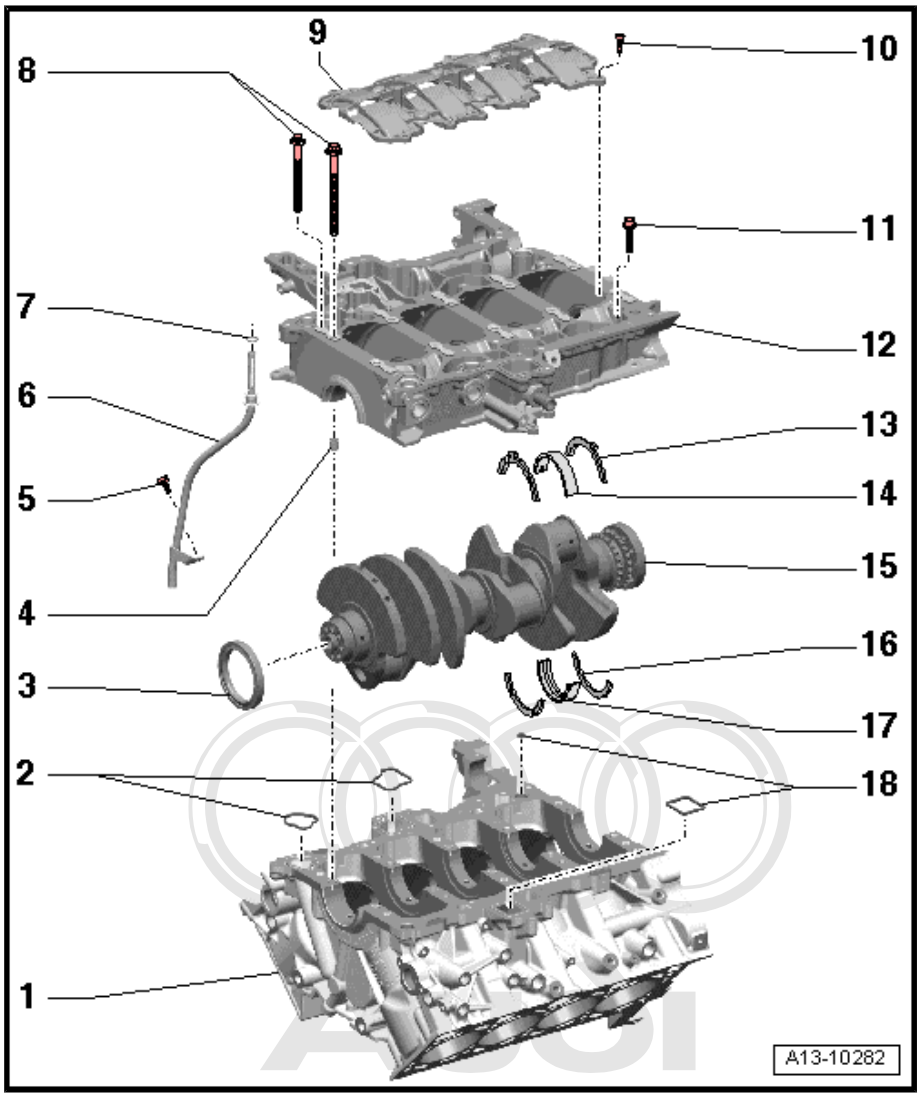


3 Crankshaft

3.1 Exploded view - crankshaft

Note

When carrying out repairs, secure engine to engine and gearbox support - VAS 6095- using bracket for V8 FSI engine -6095/1-6A- ⇒ page 34 .



1 - Cylinder block
- ❑ Matched to -item 12-
- ❑ Applying sealant onto cylinder block (for retaining frame) ⇒ page 78

2 - Gaskets
- ❑ Renew

3 - Oil seal
- ❑ For crankshaft (pulley end)
- ❑ Renewing ⇒ page 68

4 - Dowel sleeve
- ❑ 2x
- ❑ Insert in retaining frame
- ❑ Installation position ⇒ page 79

5 - Bolt
- ❑ 9 Nm

6 - Guide tube
- ❑ For oil dipstick

7 - O-ring
- ❑ Renew

8 - Bolts
- ❑ For retaining frame
- ❑ Different bolt lengths
- ❑ Renew
- ❑ Use old bolts when measuring radial clearance
- ❑ Tightening torque and sequence ⇒ page 79

9 - Baffle plate

10 - Bolt
- ❑ Renew

- ❑ Tightening torque and sequence ⇒ page 78

11 - Bolt

- ❑ For sealing surfaces: retaining frame to cylinder block
- ❑ Different bolt lengths
- ❑ Tightening sequence ⇒ page 79

12 - Retaining frame

- ❑ Matched to -item 1-
- ❑ To remove, detach guide rail ⇒ Item 1 (page 114) for drive chain for valve gear
- ❑ Apply sealant when installing (on cylinder block) ⇒ page 78 ; refer to ⇒ Electronic parts catalogue

13 - Thrust washer

- ❑ Only fitted on 4th crankshaft bearing
- ❑ Installation position: oil grooves face outwards
- ❑ Make sure it engages in retaining frame

14 - Bearing shell

- ❑ For retaining frame (without oil groove)
- ❑ Renew used bearing shells
- ❑ Fit new bearing shells for retaining frame with the correct colour coding: new crankshaft ⇒ page 80 , used and machined crankshaft ⇒ page 81
- ❑ Do not interchange crankshaft bearing shells 1 ... 4 with crankshaft bearing shell 5
- ❑ Crankshaft bearing shell 5 with offset position of locating lug

15 - Crankshaft

- ❑ Measuring axial clearance ⇒ page 81
- ❑ Measuring radial clearance ⇒ page 82
- ❑ Crankshaft dimensions ⇒ page 79

16 - Thrust washer

- ❑ Only fitted on 4th crankshaft bearing
- ❑ Installation position: oil grooves face outwards

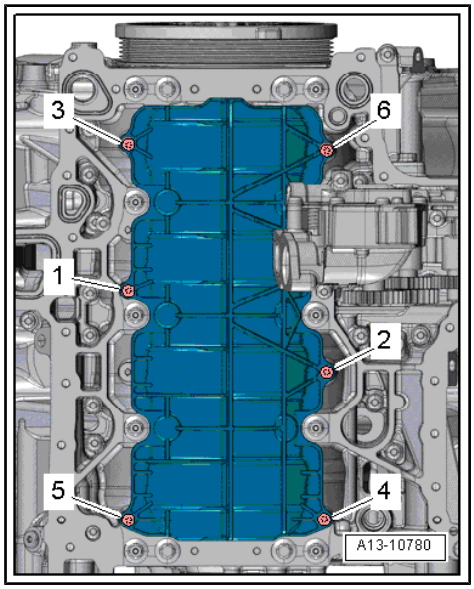
17 - Bearing shell

- ❑ For cylinder block (with oil groove)
- ❑ Renew used bearing shells
- ❑ Fit new bearing shells for cylinder block with the correct colour coding: new crankshaft ⇒ page 80 , used and machined crankshaft ⇒ page 81
- ❑ Do not interchange crankshaft bearing shells 1 ... 4 with crankshaft bearing shell 5
- ❑ Crankshaft bearing shell 5 with offset position of locating lug

18 - Gaskets

- ❑ Renew

Baffle plate - tightening torque and tightening sequence



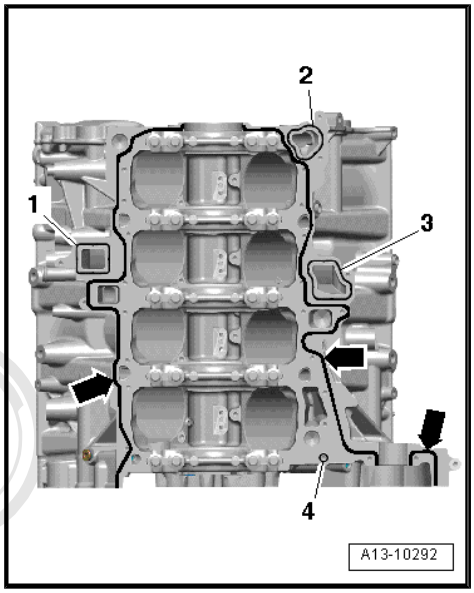
Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts in 2 stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-1 … 6-	5 Nm
2.	-1 … 6-	Turn 90° further

Applying sealant onto cylinder block (for retaining frame)



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

Caution

Make sure lubrication system is not clogged by excess sealant.

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

– Apply beads of sealant -arrows- onto clean sealing surfaces as shown in illustration.

- Width of beads of sealant: 2.0 mm.

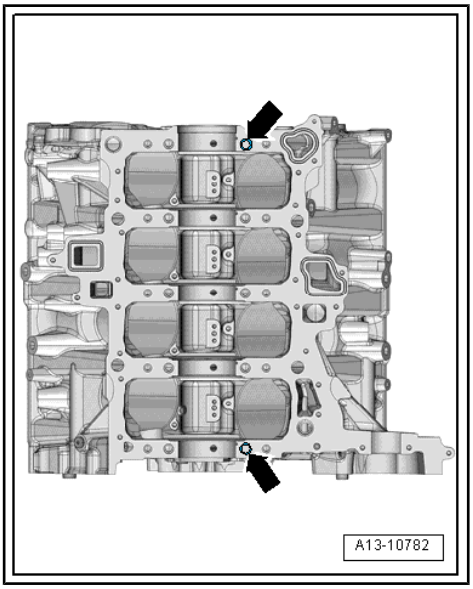
– Fit seals -1 ... 4-.

Note

The retaining frame must be installed within 5 minutes after applying the sealant.

Fitting location of dowel sleeves

– Fit dowel sleeves -arrows-, if not fitted on the cylinder block at the points marked.



Retaining frame - tightening torque and sequence

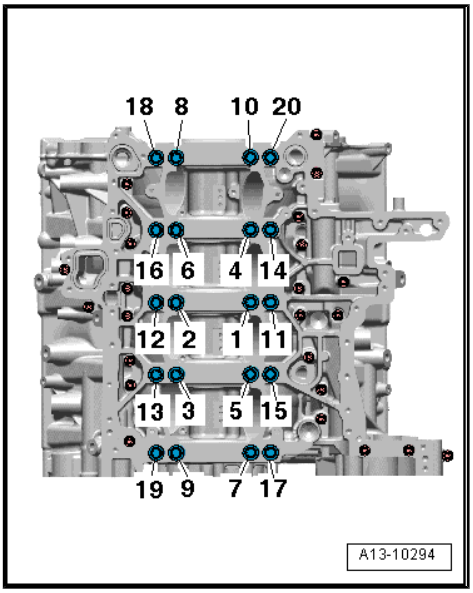
Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts in 6 stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-1 … 10-	30 Nm
2.	-11 … 20-	30 Nm
3.	-1 … 10-	50 Nm
4.	-1 … 10-	Turn 90° further
5.	-11 … 20-	50 Nm
6.	-11 … 20-	Turn 90° further

– Tighten bolts for sealing surfaces between retaining frame and cylinder block -shaded dark- to 9 Nm in diagonal sequence.



3.2 Crankshaft dimensions

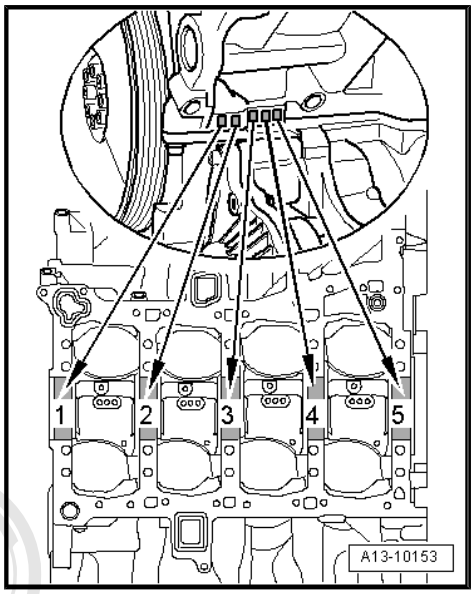
Honing dimension	Crankshaft bearing journal ∅ mm	Crankshaft conrod journal ∅ mm
Basic dimension	65.000 – 0.022 – 0.042	54.000 – 0.022 – 0.042
Repair undersize	64.750 – 0.022 – 0.042	53.750 – 0.022 – 0.042

3.3 Allocation of main bearing shells

⇒ “3.3.1 Allocation of main bearing shells on new crankshafts”, page 80

⇒ “3.3.2 Allocation of main bearing shells on used and machined crankshafts”, page 81

3.3.1 Allocation of main bearing shells on new crankshafts



Allocation of crankshaft bearing shells for cylinder block

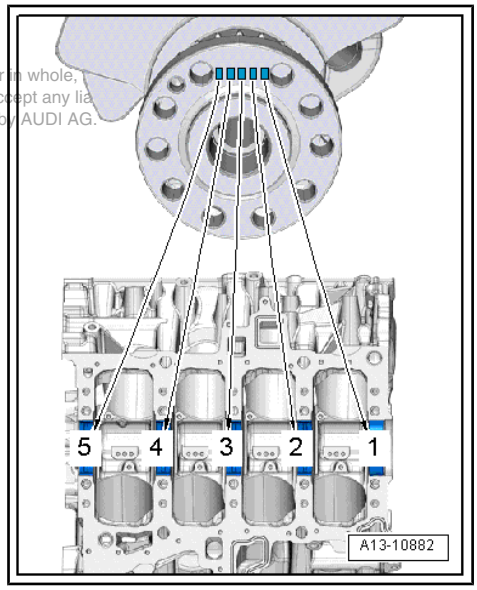
- Bearing shells of the correct thickness are matched to the bearings in the cylinder block at the factory. Coloured dots on the side of the bearing shells are used to identify the bearing shell thickness.
- The allocation of the bearing shells to the cylinder block is indicated by letters on the front left of the cylinder block (legible from outside), as shown in illustration.

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

Note

The code letters are also stamped on the retaining frame.

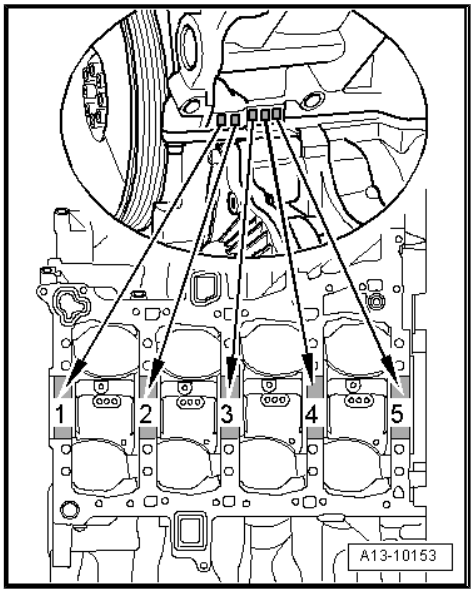
Allocation of crankshaft bearing shells for retaining frame



- Bearing shells of the correct thickness are matched to the bearings in the retaining frame at the factory. Coloured dots on the side of the bearing shells are used to identify the bearing shell thickness.
- The allocation of the bearing shells to the retaining frame is indicated by letters on the front crankshaft flange, as shown in illustration.

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

3.3.2 Allocation of main bearing shells on used and machined crankshafts



Allocation of crankshaft bearing shells for cylinder block

- Bearing shells are allocated to the cylinder block according to the colour codes stamped on the cylinder block.
- On a used and machined crankshaft, the crankshaft bearing journals must be measured in order to allocate the correct bearing shells.
- Crankshaft dimensions ⇒ page 79.

- Oversized (thicker) bearing shells are available for a machined crankshaft. However, these bearing shells have the same colour coding as the original-size bearing shells.

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

Allocation of crankshaft bearing shells for retaining frame

- On a used and machined crankshaft, the crankshaft bearing journals must be measured in order to allocate the correct bearing shells.
- Any markings still visible on a machined crankshaft are invalid.
- Allocate the bearing shells according to the measured diameter of the crankshaft bearing journals as follows:

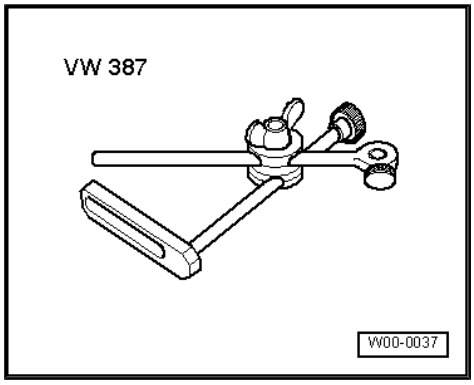
Crankshaft main bearing journal ∅	Colour code of bearing shells for retaining frame				
Dimensions (in mm)	**Red**	**Black**	**Yellow**	**Green**	**Blue**
Basic dimension 65.000	64.978 … 64.975	64.974 … 64.971	64.970 … 64.967	64.966 … 64.963	64.962 … 64.958
Repair undersize 64.750 [1)]	64.728 … 64.725	64.724 … 64.721	64.720 … 64.717	64.716 … 64.713	64.712 … 64.708

- [1)] The colour codes for the oversized (thicker) bearing shells required for a machined crankshaft are the same as those on bearing shells for a new crankshaft, in spite of the greater bearing thickness.

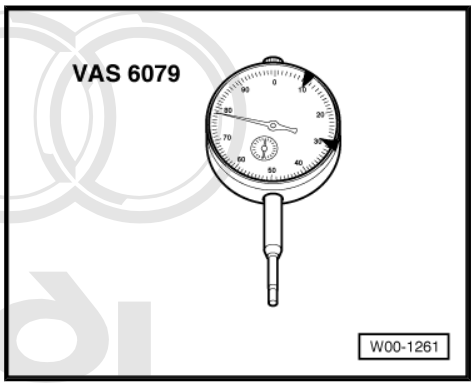
3.4 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

♦ Universal dial gauge bracket - VW 387-

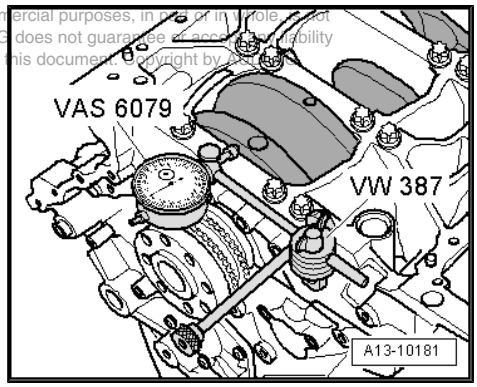


♦ Dial gauge - VAS 6079-



Procedure

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



– Apply dial gauge to crank web.

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

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

• Axial clearance: 0.090 ... 0.251 mm

3.5 Measuring radial clearance of crankshaft

Special tools and workshop equipment required

♦ Plastigage

Procedure

Note

Use old bolts when measuring radial clearance.

– Remove retaining frame and clean bearing journals.

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

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

– Fit retaining frame and secure with old bolts ⇒ page 79 without rotating crankshaft.

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

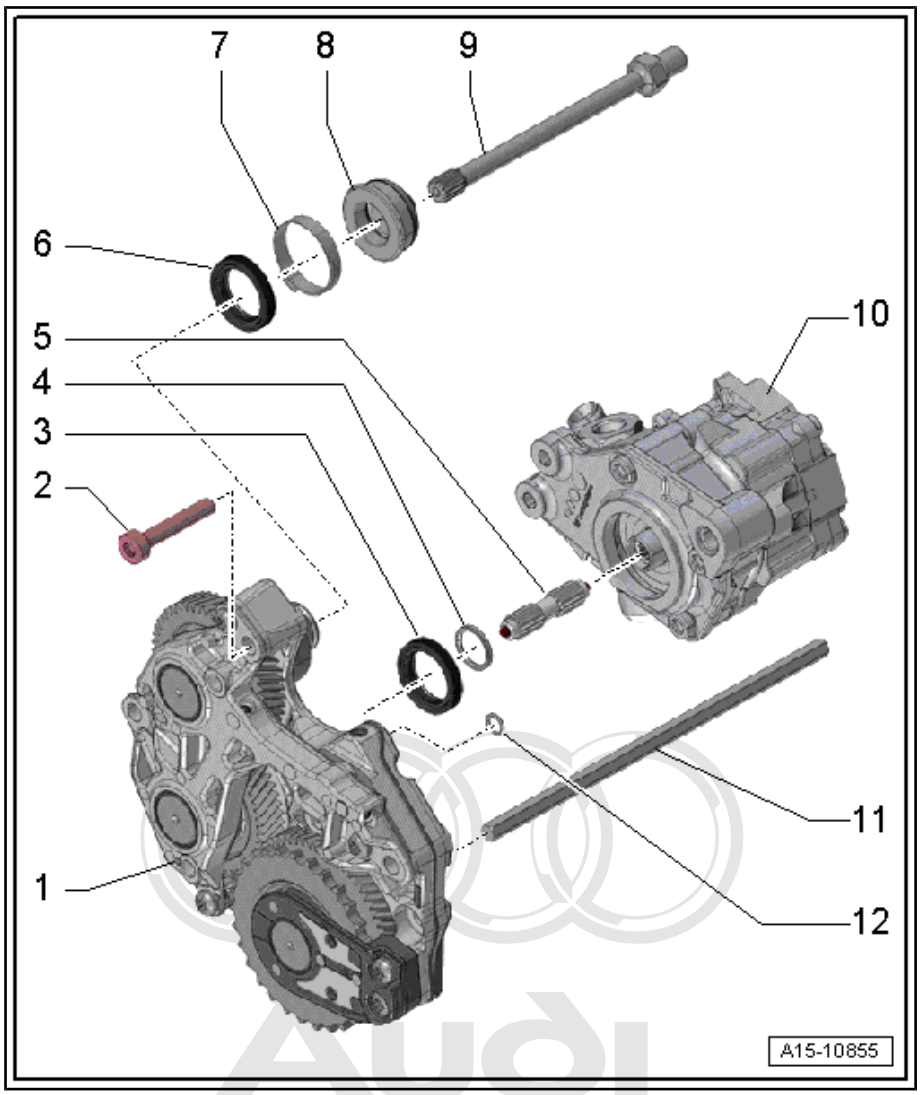
Radial clearance:

- New: 0.017 ... 0.044 mm.
- Wear limit: 0.08 mm.

– When carrying out final assembly, renew bolts.

4 Auxiliary drive

4.1 Exploded view - auxiliary drive



1 - Spur gear drive
- ❑ Do not dismantle
- ❑ Removing and installing ⇒ page 85

2 - Bolt
- ❑ Tightening torque and sequence ⇒ page 85

3 - Oil seal
- ❑ For power steering pump drive
- ❑ Renewing ⇒ page 88

4 - Flat-section O-ring
- ❑ Installation position ⇒ page 85

5 - Drive shaft
- ❑ For power steering pump
- ❑ With bonded rubber buffers

6 - Oil seal
- ❑ For AC compressor drive
- ❑ Renewing ⇒ page 89

7 - Clip

8 - Dust cap
- ❑ For AC compressor drive

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

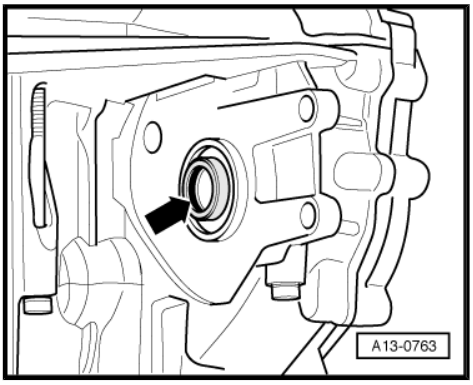
10 - Power steering pump

11 - Drive shaft
- ❑ For oil pump

12 - O-ring
- ❑ Renew

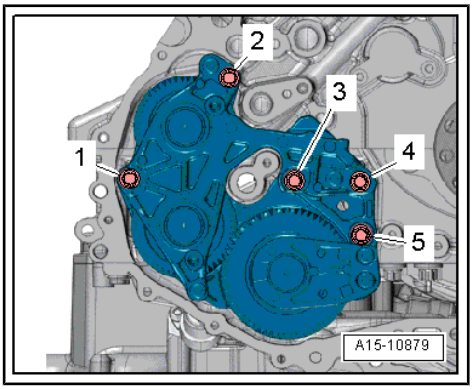
Installation position of flat-section O-ring

♦ In power steering pump drive -arrow-.



Spur gear drive - tightening torque and sequence

– Tighten bolts -1 ... 5- to 22 Nm in diagonal sequence.



4.2 Removing and installing spur gear drive

Special tools and workshop equipment required

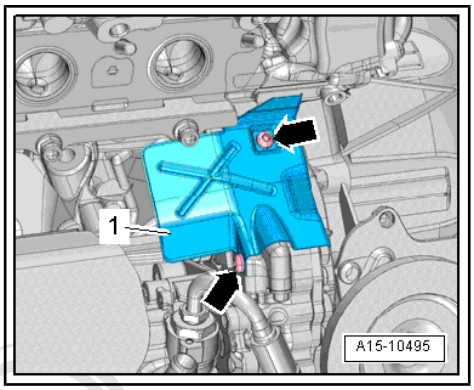
♦ Sealant ⇒ Electronic parts catalogue

Removing

• Gearbox removed ⇒ Rep. gr. 37 ; Removing and installing gearbox; Removing gearbox .

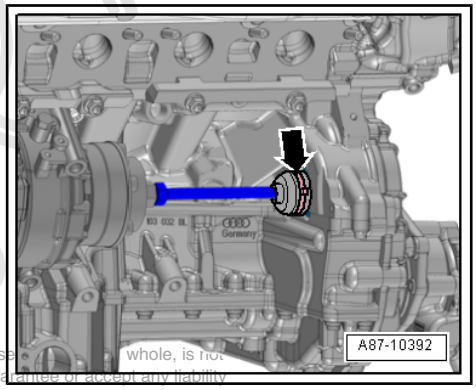
– Remove exhaust manifold (left-side) ⇒ page 316 .

– Remove bolts -arrows- and detach heat shield -1-.

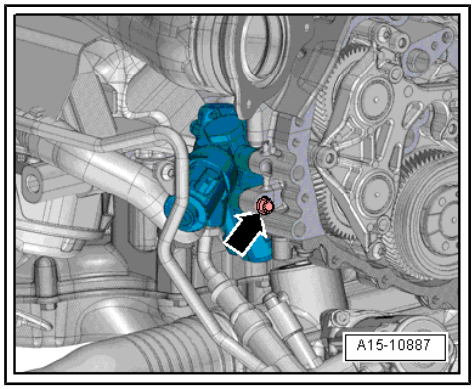


– Detach hose clip on dust cap -arrow- for air conditioner compressor drive.

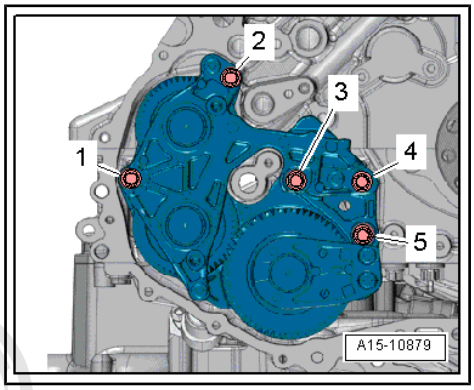
– Remove timing chain cover (bottom) ⇒ page 105 .



– Remove bolt -arrow- and detach power steering pump or steering hydraulics pump - V119- from retaining frame.
– Remove drive chain for auxiliary drives ⇒ page 127 .



– Slacken bolts -1 ... 5- in diagonal sequence and remove.
– Carefully release spur gear drive from bonded joint and detach.

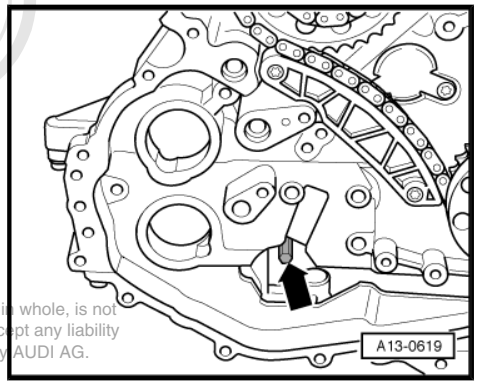


– Pull out oil pump drive shaft -arrow-.

Installing

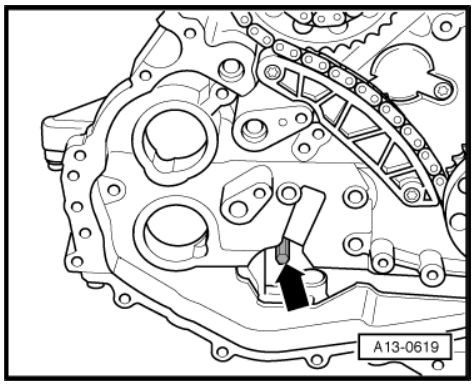
Note

Fit new O-ring.



– Renew oil seals ⇒ Item 3 (page 84) , ⇒ Item 6 (page 84) and flat-section O-ring ⇒ page 85 in power steering pump drive if damaged.
– Remove sealant residues from spur gear drive and cylinder block.
– Clean sealing surfaces; they must be free of oil and grease.

– Insert drive shaft -arrow- for oil pump into guide sleeve at oil pump.



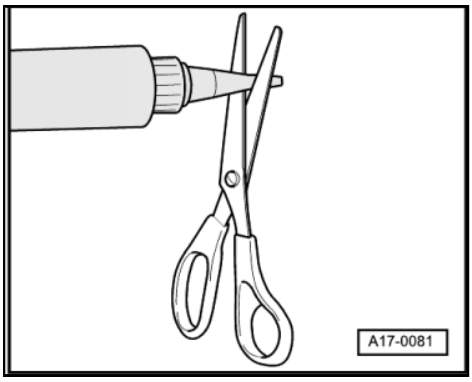
Note

To ensure that drive shaft engages correctly in oil pump, insert drive shaft separately into oil pump (NOT together with spur gear drive).

Note

Note the use-by date of the sealant.

– Cut off nozzle of tube at front marking (nozzle ∅ approx. 1.5 mm).



Caution

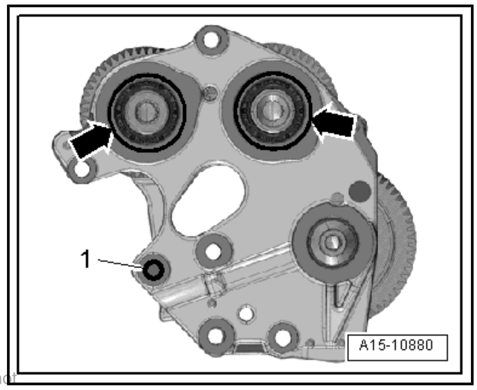
Make sure lubrication system is not clogged by excess sealant.

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

– Apply beads of sealant -arrows- onto clean sealing surfaces of spur gear drive as shown in illustration.

• Width of beads of sealant: 2.0 mm.

– Fit new O-ring -1- and secure in position with a small amount of grease.



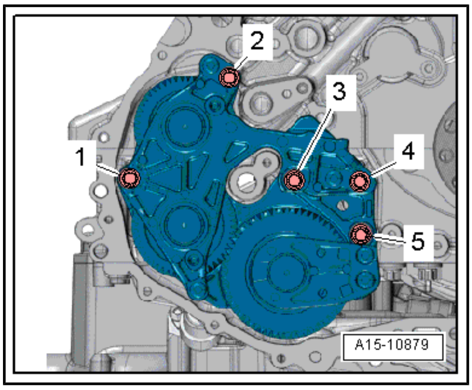
Note

The spur gear drive must be installed within 5 minutes after applying the sealant.

– Fit spur gear drive and tighten bolts ⇒ page 85 .

– Install drive chain for auxiliary drives ⇒ page 127 .

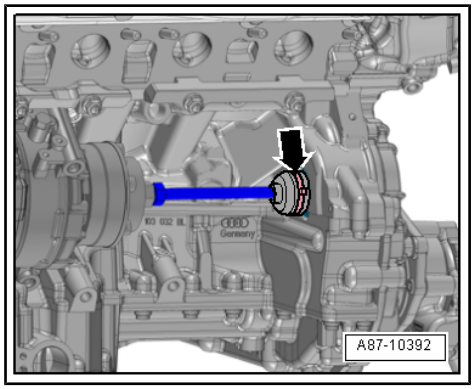
– Slide power steering pump with new O-ring onto spur gear for power steering pump drive.



Note

Secure with correct type of hose clip (same as original equipment) ⇒ Electronic parts catalogue .

– Press dust cap -arrow- with hose clip fitted onto stub shaft of spur gear for AC compressor drive.



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

– Install drive chain for auxiliary drives ⇒ page 127 .
– Install power steering pump or steering hydraulics pump - V119- ⇒ Running gear, axles, steering; Rep. gr. 48 ; Hydraulic power steering; Removing and installing power steering pump .
– Install timing chain cover (bottom) ⇒ page 105 .
– Install exhaust manifold (left-side) ⇒ page 316 .

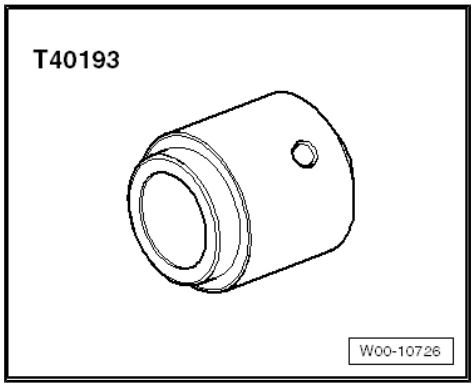
Tightening torques

♦ ⇒ Fig. ""Spur gear drive - tightening torque and sequence"" , page 85

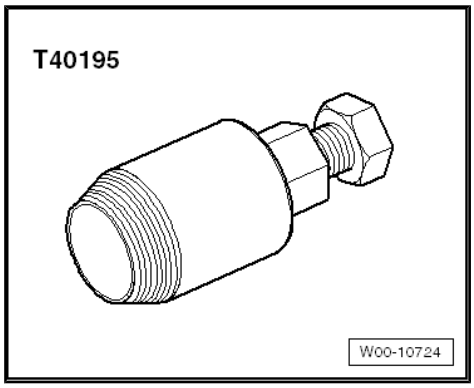
4.3 Renewing oil seal for power steering pump drive

Special tools and workshop equipment required

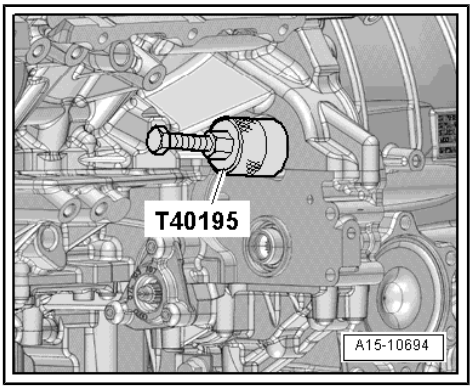
♦ Thrust piece - T40193-



♦ Oil seal extractor - T40195-



Procedure

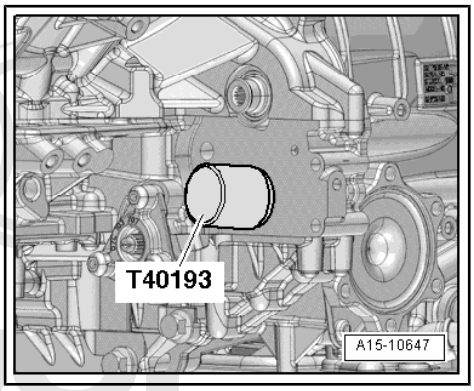


– Remove power steering pump or steering hydraulics pump - V119- ⇒ Running gear, axles, steering; Rep. gr. 48 ; Hydraulic power steering; Removing and installing power steering pump .
– Screw spindle of oil seal extractor -T40195- all the way out.
– Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).
– Turn inner part of oil seal extractor against spur gear drive until the oil seal is pulled out.

Note

If the sections of the oil seal come apart, apply oil seal extractor again and pull out remaining part of oil seal.

– Clamp hexagon flats of oil seal extractor in vice and use pliers to remove oil seal.
– Clean contact surface and sealing surface.



– Drive in oil seal for power steering pump drive as far as stop using thrust piece - T40193- .

Note

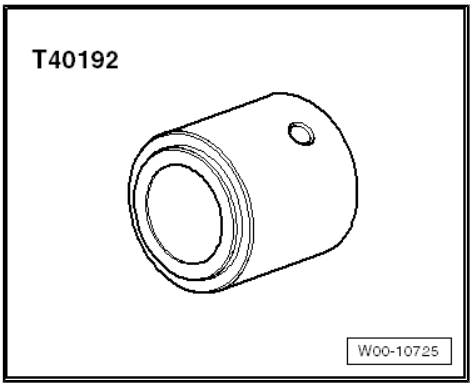
For illustration purposes, the installation position is shown with the engine removed.

– Install power steering pump or steering hydraulics pump - V119- ⇒ Running gear, axles, steering; Rep. gr. 48 ; Hydraulic power steering; Removing and installing power steering pump .

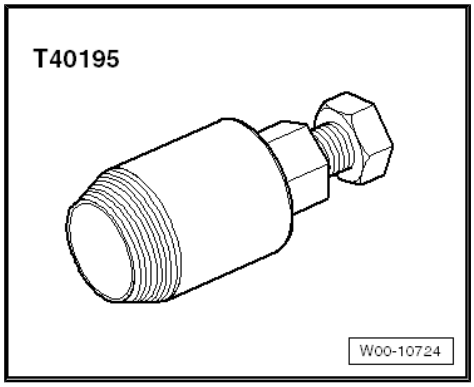
4.4 Renewing oil seal for AC compressor drive

Special tools and workshop equipment required

♦ Thrust piece - T40192-

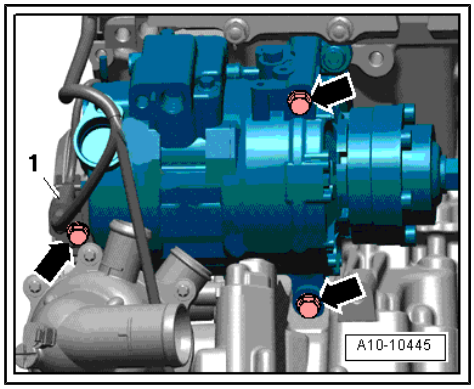


♦ Oil seal extractor - T40195-

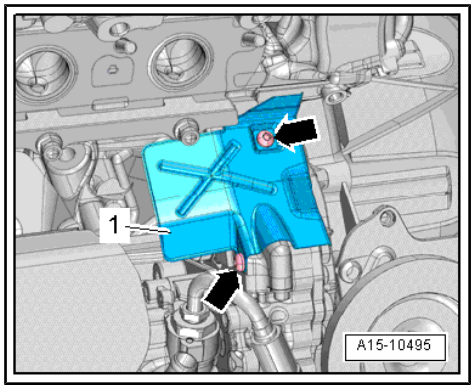


Procedure

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

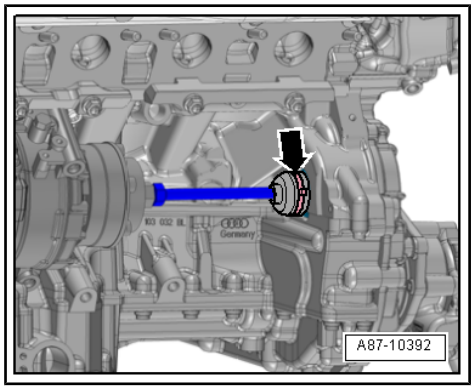


– Remove bolts -arrows- and detach heat shield -1-.

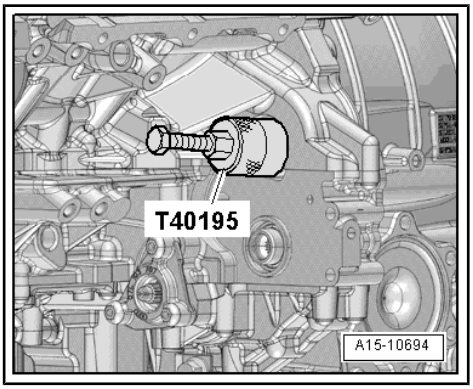


– Detach hose clip on dust cap -arrow-.

– Pull off dust cap together with drive shaft for air conditioner compressor from stub shaft of spur gear for air conditioner compressor drive.



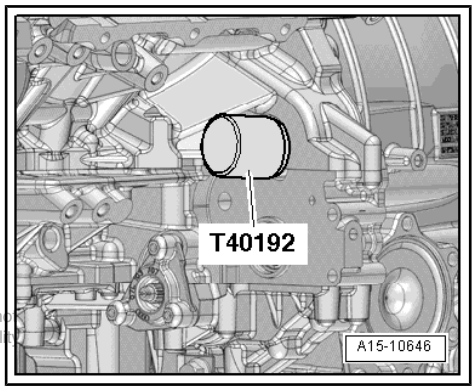
– Screw spindle of oil seal extractor -T40195- all the way out.
– Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).
– Turn inner part of oil seal extractor against spur gear drive until the oil seal is pulled out.



Note

If the sections of the oil seal come apart, apply oil seal extractor again and pull out remaining part of oil seal.

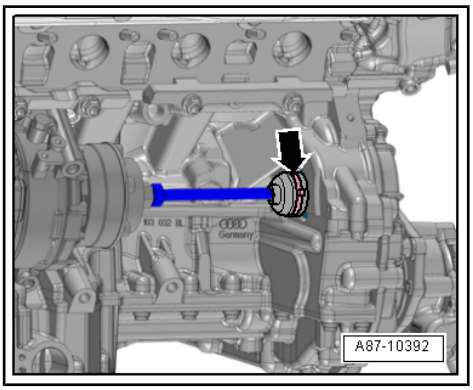
– Clamp hexagon flats of oil seal extractor in vice and use pliers to remove oil seal.
– Clean contact surface and sealing surface.
– Drive in oil seal for AC compressor drive using thrust piece -T40192- .



Note

Secure with correct type of hose clip (same as original equipment) ⇒ Electronic parts catalogue .

– Press dust cap -arrow- with hose clip fitted onto stub shaft of spur gear for AC compressor drive.
– Install air conditioner compressor ⇒ Heating, air conditioning; Rep. gr. 87 ; Air conditioner compressor; Detaching and attaching air conditioner compressor at bracket .

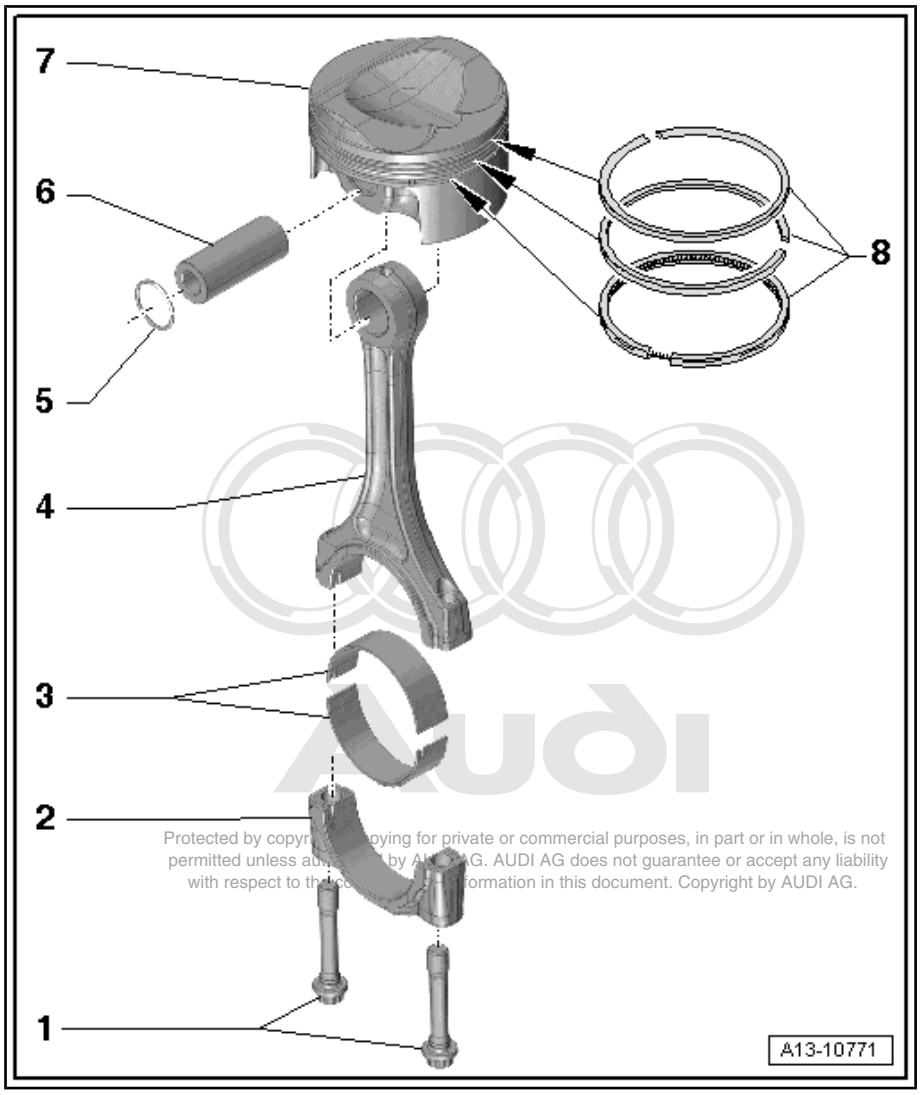


5 Pistons and conrods

5.1 Exploded view - pistons and conrods

Note

Oil spray jet for piston cooling ⇒ page 94 .



1 - Bolts

- ❑ Renew
- ❑ Use old bolts when measuring radial clearance
- ❑ Lubricate threads and contact surface
- ❑ 50 Nm + turn 90° further

2 - Conrod bearing cap

- ❑ Mark installation position for re-installation
- ❑ Mark cylinder and conrod allocation in colour ⇒ page 93
- ❑ Installation position of conrod pairs ⇒ page 93

3 - Bearing shells

- ❑ Ensure that retaining lugs are securely seated.
- ❑ Renew used bearing shells
- ❑ Oversized bearings are available for machined crankshaft conrod journals ⇒ Electronic parts catalogue

4 - Conrod

- ❑ Only renew as a complete set
- ❑ Mark cylinder and conrod bearing cap allocation in colour ⇒ page 93
- ❑ Installation position of conrod pairs ⇒ page 93
- ❑ Axial clearance for each conrod pair (when new): 0.16 … 0.40 mm
- ❑ Measuring radial clearance ⇒ page 96

5 - Circlip

- ❑ 2x

❑ Renew

6 - Piston pin

❑ Removing and installing ⇒ “5.2 Removing and installing pistons”, page 94

7 - Piston

❑ Installation position ⇒ page 93
❑ Removing and installing ⇒ page 94
❑ Renew piston if cracking is visible on piston crown or piston skirt
❑ Checking pistons and cylinder bores ⇒ page 95

8 - Piston rings

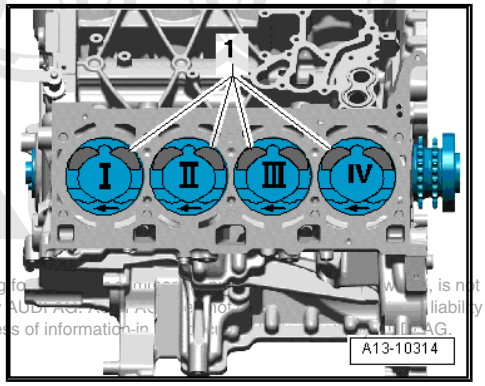
❑ Measuring ring gap ⇒ page 96
❑ Measuring ring-to-groove clearance ⇒ page 96
❑ Use piston ring pliers (commercially available) to remove and install
❑ Installation position: marking “TOP” or side with lettering faces towards piston crown
❑ Offset gaps by 120°

Installation position of pistons

Caution

Do not damage the coating of the piston crown.

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



Installation position:

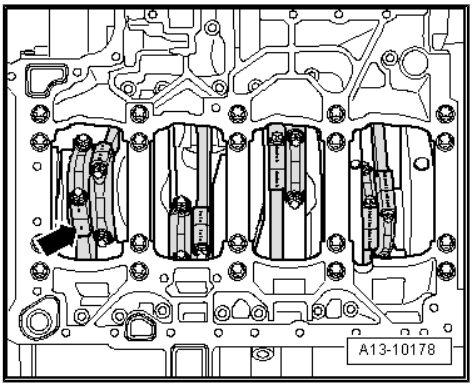
- Arrows on piston crowns point to pulley end.
- Large valve recesses -1- face centre of engine.

Marking conrods

Note

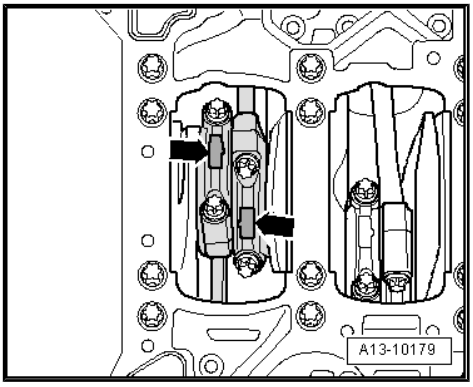
Only renew conrods as a complete set.

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

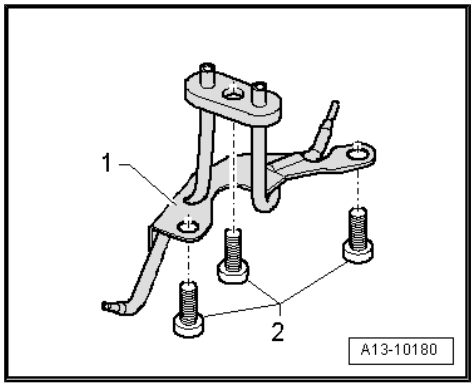


Installation position of conrods

- The cast lugs -arrows- on the ground surfaces of the conrod pairs “1 and 2”, “3 and 4”, “5 and 6” and “7 and 8” must face each other.



Oil spray jet for piston cooling



1 - Oil spray jet

2 - Apply locking fluid to bolts and tighten to 9 Nm; for locking fluid refer to ⇒ Electronic parts catalogue .

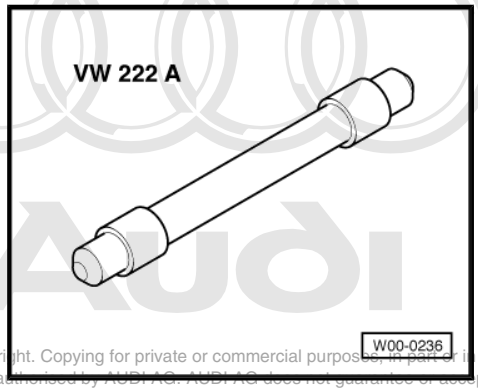
Note

- *Do not bend piston cavity oil jets.*
- *Always renew bent spray jets for pistons.*

5.2 Removing and installing pistons

Special tools and workshop equipment required

- Drift - VW 222 A-



- Piston ring clamp, commercially available

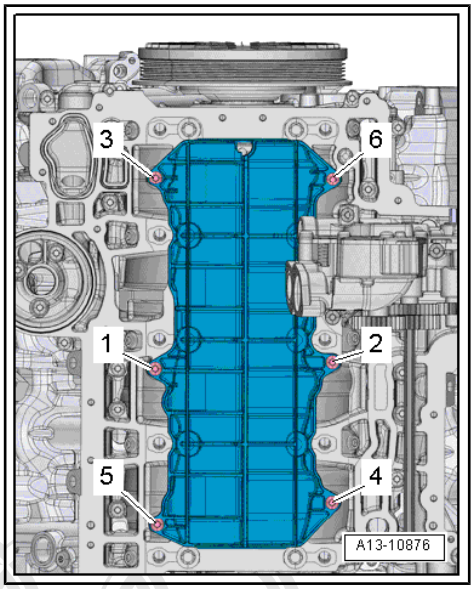
Removing

- Engine secured to engine and gearbox support - VAS 6095- ⇒ page 34 .

– Remove cylinder head ⇒ page 132 .

– Remove upper section of sump ⇒ page 173 .

– Remove bolts -1 … 6- and detach baffle plate.
– Mark installation position and matching of conrod bearing caps to cylinder and to conrods for reinstallation ⇒ page 93 .
– Unbolt conrod bearing caps.
– Pull out pistons upwards with conrods.



Note

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

– Take circlip out of piston pin boss.
– Use drift - VW 222 A- to drive out piston pin.

Installing

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

Note

Renew the bolts tightened with specified tightening angle.

– Oil running surfaces of bearing shells.
– Install pistons using commercially available piston ring clamp.

Installation position:

- Pistons ⇒ page 93
- Conrods ⇒ page 93

– Install conrod bearing caps according to markings.
– Install baffle plate ⇒ page 78 .
– Install sump (upper section) ⇒ page 173 .
– Install cylinder head ⇒ page 137 .

Tightening torques

♦ ⇒ “5.1 Exploded view - pistons and conrods”, page 92

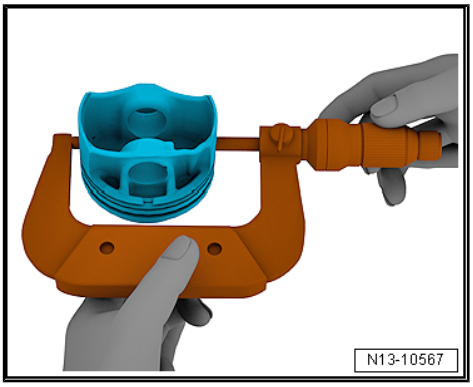
5.3 Checking pistons and cylinder bores

Checking piston

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

- Maximum deviation from nominal dimension: 0.03 mm.

There are different piston sizes specifically matched to the varying bore dimensions for the cylinder block.



Piston Ø mm	
Nominal dimension	84.490 1)
Repair oversize	84.590 1)

- 1) Dimensions including coating (thickness 0.01 mm). The coating will wear down in service.

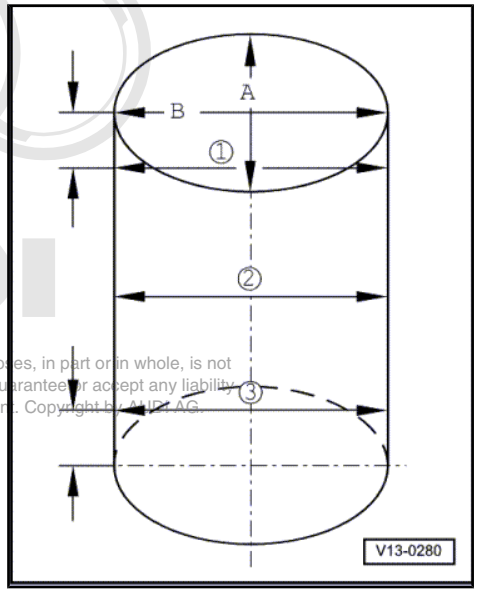
Measuring cylinder bore

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

• Maximum deviation from nominal dimension: 0.08 mm.

Cylinder bore ∅ mm	
Nominal dimension	84.510 ± 0.005 [1]
Repair oversize	84.610 ± 0.005 [1]

• [1] Measure at 50 mm into cylinder bore.

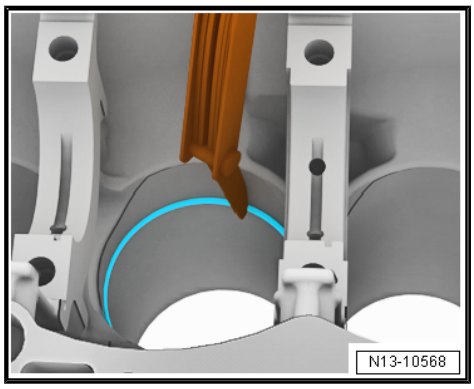


Measuring piston ring gap

– 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.

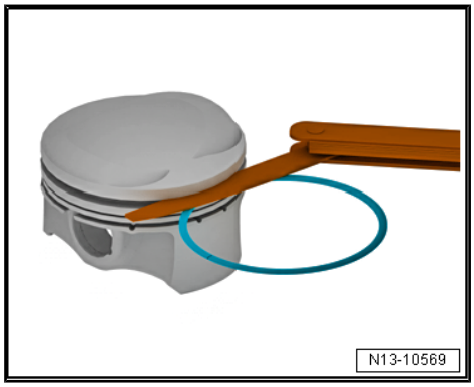
Piston ring	new mm	Wear limit mm
1st compression ring	0.20 … 0.35	0.80
2nd compression ring	0.20 … 0.40	0.80
Oil scraper ring	0.20 … 0.40	0.80



Measuring ring-to-groove clearance

– Clean groove in piston before checking clearance.

Piston ring	new mm	Wear limit mm
1st compression ring	0.020 … 0.070	0.200
2nd compression ring	0.005 … 0.045	0.150
Oil scraper ring	0.020 … 0.055	0.200



5.4 Checking radial clearance of conrod bearings

Special tools and workshop equipment required

◆ Plastigage

Procedure

Note

Use old bolts when measuring radial clearance.

– Remove conrod bearing cap.

– Clean bearing cap and bearing journal.
– Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or in the bearing shell.
– Fit conrod bearing cap and secure with old bolts ⇒ Item 1 (page 92) without rotating crankshaft.
– Remove conrod bearing cap again.
– Compare width of Plastigage with measurement scale.

Radial clearance:

• New: 0.020 ... 0.069 mm.
• Wear limit: 0.120 mm.

– When carrying out final assembly, renew bolts.

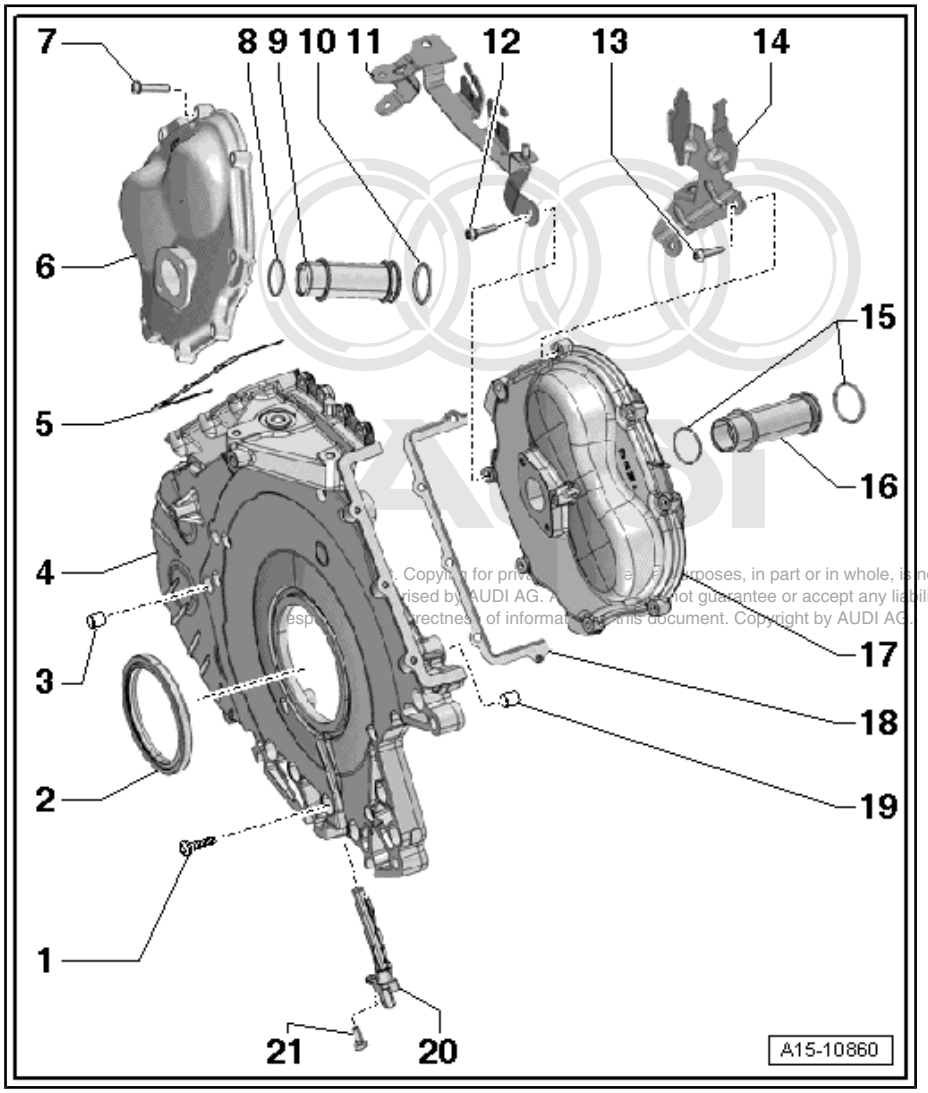
15 – Cylinder head, valve gear

1 Timing chain cover

⇒ “1.1 Exploded view - timing chain cover”, page 98

⇒ “1.2 Removing and installing timing chain cover”, page 100

1.1 Exploded view - timing chain cover



1 - Bolt

- ❑ Tightening torque and sequence ⇒ page 100

2 - Oil seal

- ❑ For crankshaft (gearbox end)
- ❑ Renewing ⇒ page 74

3 - Dowel sleeve

- ❑ 2x

4 - Timing chain cover (bottom)

- ❑ Removing and installing ⇒ page 105

5 - Cylinder head gasket (left-side)

6 - Timing chain cover (left-side)

- ❑ Removing and installing ⇒ page 100

7 - Bolt

- ❑ Tightening torque and sequence ⇒ page 99

8 - O-ring

- ❑ Renew

9 - Intermediate coolant pipe (left-side)

- ❑ Drive out with drift

10 - O-ring

- ❑ Renew

11 - Bracket

- ❑ For electrical connectors for Lambda probes (left-side)

12 - Bolt

- ❑ Tightening torque and sequence ⇒ page 99

13 - Bolt

- ❑ Tightening torque and sequence ⇒ page 99

14 - Bracket

- ❑ For electrical connectors for Lambda probes (right-side)

15 - O-rings

- ❑ Renew

16 - Intermediate coolant pipe (right-side)

- ❑ Drive out with drift

17 - Timing chain cover (right-side)

Removing and installing ⇒ page 102

18 - Cylinder head gasket (right-side)

19 - Dowel sleeve

- ❑ 2x

20 - Engine speed sender - G28-

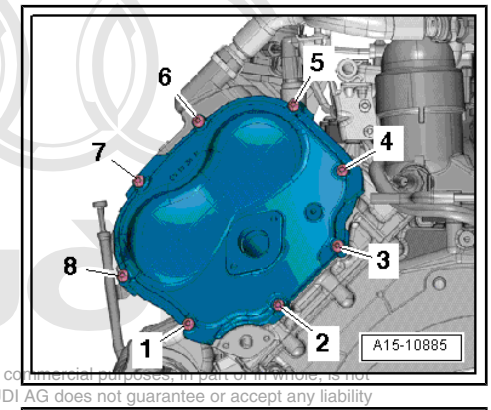
- ❑ Removing and installing ⇒ page 327

21 - Bolt

- ❑ Tightening torque ⇒ page 322

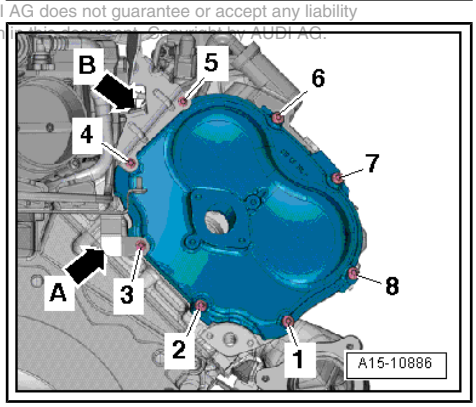
Timing chain cover (left-side) - tightening torque and sequence

– Tighten bolts in the sequence -1 ... 8- to 9 Nm.



Timing chain cover (right-side) - tightening torque and sequence

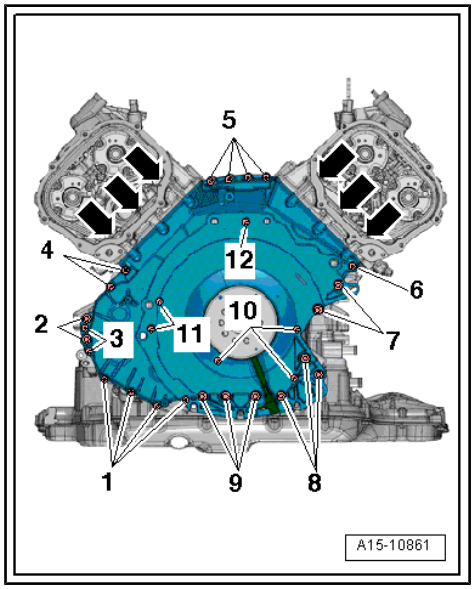
– Tighten bolts for timing chain cover (right-side) in the sequence -1 ... 8- to 9 Nm.



Note

The brackets -arrows A and B- are secured together with the timing chain cover (left-side).

Timing chain cover (bottom) - tightening torque and sequence



Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts in 6 stages as follows:

Stage	Bolts	Tightening torque/angle specification
1.	-arrows-	Apply locking fluid when installing; 5 Nm Locking fluid ⇒ Electronic parts catalogue
2.	-1 … 12-	8 Nm in diagonal sequence
3.	-arrows-	8 Nm
4.	-2, 7, 8, 9-	22 Nm in diagonal sequence
5.	-1, 3, 4, 5, 6, 10, 11, 12-	Turn 90° further in diagonal sequence
6.	-arrows-	Turn 90° further

1.2 Removing and installing timing chain cover

⇒ “1.2.1 Removing and installing timing chain cover (left-side)”, page 100

⇒ “1.2.2 Removing and installing timing chain cover (right-side)”, page 102

⇒ “1.2.3 Removing and installing timing chain cover (bottom)”, page 105

1.2.1 Removing and installing timing chain cover (left-side)

Special tools and workshop equipment required

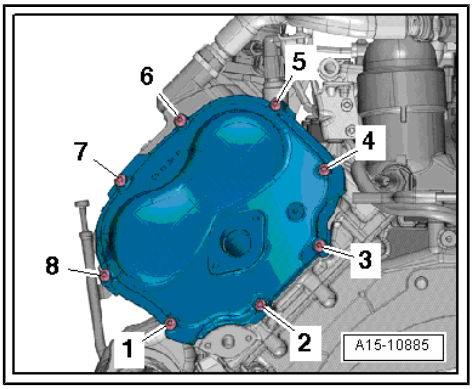
- Electric drill with plastic brush
- Safety goggles
- Sealant ⇒ Electronic parts catalogue

Removing

– Remove coolant shut-off valve ⇒ page 210 .

– Slacken and remove bolts in the sequence: -8 ... 1-.

– Carefully release timing chain cover (left-side) from bonded joint and detach.



Installing

Note

Fit new O-rings.

– Remove old sealant from grooves on timing chain cover and from sealing surfaces.

Caution

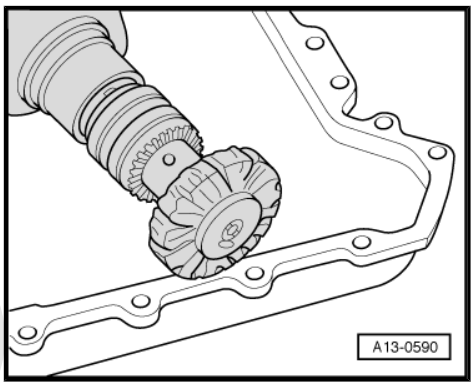
Protect lubrication system against contamination.

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

WARNING

Risk of eye injury.

- ***Wear safety goggles.***



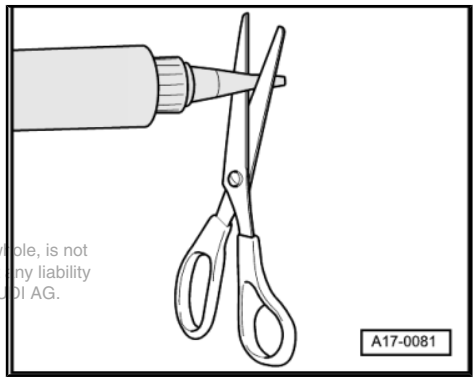
– Remove remaining sealant on timing chain cover and cylinder head using rotating plastic brush or similar.

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

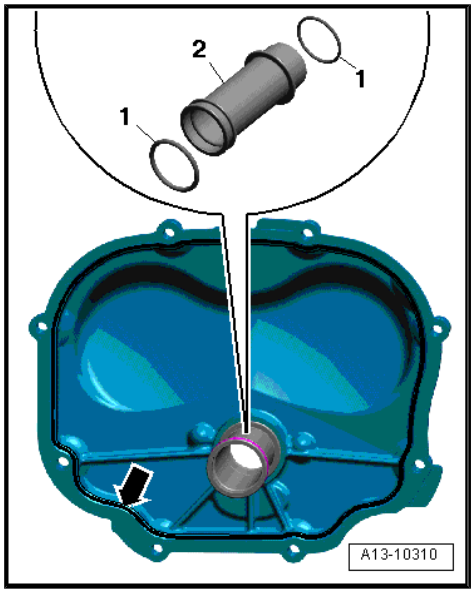
Note

Note the use-by date of the sealant.

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



– Use drift to drive intermediate coolant pipe (left-side) -2- out of timing chain cover (left-side).
– Fit O-rings -1- on intermediate coolant pipe.
– Fit intermediate coolant pipe in timing chain cover (left-side).



Caution

Make sure lubrication system is not clogged by excess sealant.

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

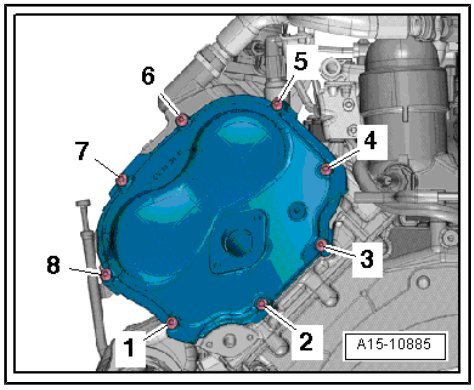
– Apply sealant bead -arrow- onto clean sealing surfaces of timing chain cover (left-side) as illustrated.

• Width of sealant bead: 2.5 mm.

Note

The timing chain cover must be installed within 5 minutes after applying the sealant.

– Install timing chain cover (left-side) and tighten bolts ⇒ page 99 .



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

– Install coolant shut-off valve ⇒ page 210 .

Tightening torques

- ⇒ Fig. ""Timing chain cover (left-side) - tightening torque and sequence"", page 99

1.2.2 Removing and installing timing chain cover (right-side)

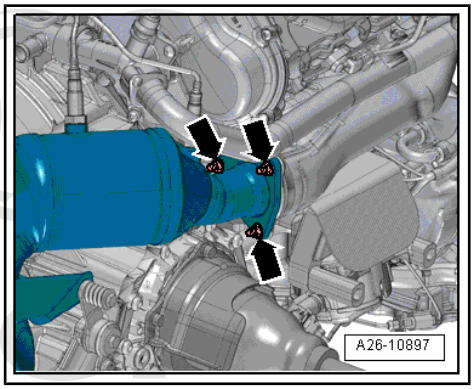
Special tools and workshop equipment required

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

Removing

– Remove front silencer (right-side) ⇒ page 300 .
– Remove coolant hose connection ⇒ page 230 .
– Remove air cleaner housing (left-side) ⇒ page 261 .
– Remove Lambda probe - G39- ⇒ page 286 .

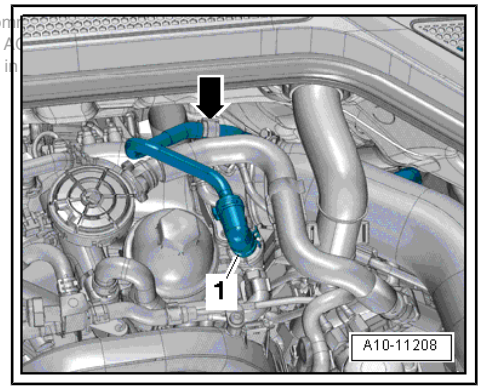
– Remove nuts -arrows-, detach catalytic converter (right-side) and move it clear to the side.



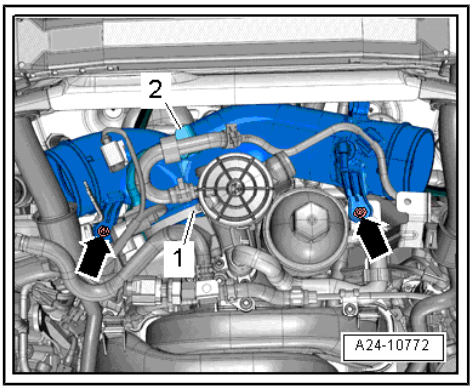
Note

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

– Detach vacuum hose -1- and move clear -arrow-.



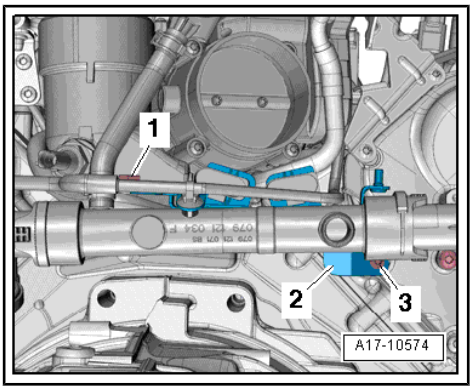
– Remove bolts -arrows-.
– Loosen clamp -1-.
– Detach air pipe and move clear to one side with crankcase breather hose -2- attached.



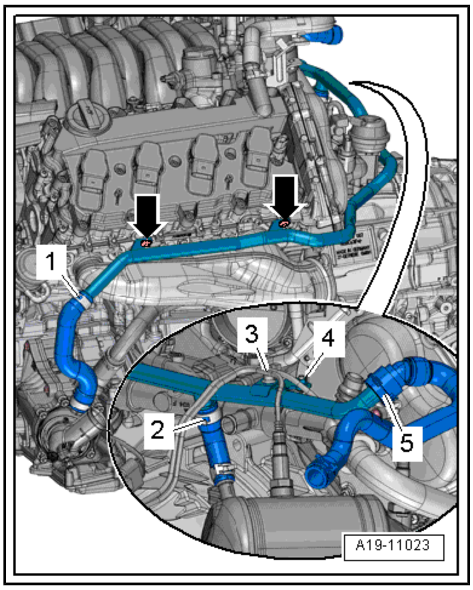
– Remove bolt -1- for bracket -2- for electrical connectors.

Note

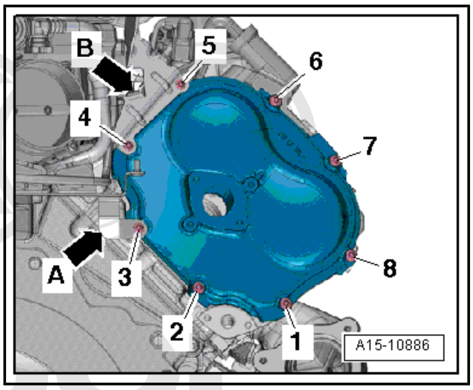
Disregard -item 3-.



– Remove bolts -arrows- and nut -4-.
– Lift retaining clip -5- and disconnect coolant hose.
– Loosen hose clips -1, 2-.
– Move clear electrical wiring harness -3-.
– Swivel coolant pipe (top left) slightly to left.



– Slacken and remove bolts in the sequence: -8 ... 1-.
– Detach bracket -arrow A- for electrical connectors.
– Push bracket -arrow B- for electrical wiring harness to one side.
– Carefully release timing chain cover (right-side) from bonded joint and detach.



Installing

Note

♦ *Fit new O-rings.*
♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

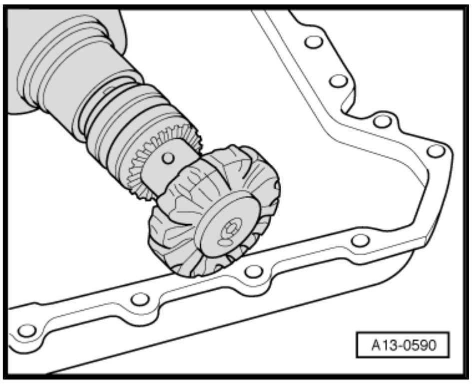
– Remove old sealant from grooves on timing chain cover and from sealing surfaces.

Caution

Protect lubrication system against contamination.
♦ *Cover exposed parts of the engine.*

WARNING

Risk of eye injury.
♦ *Wear safety goggles.*

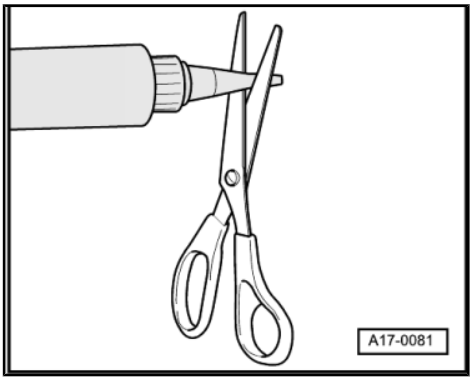


– Remove remaining sealant on timing chain cover and cylinder head using rotating plastic brush or similar.
– Clean sealing surfaces; they must be free of oil and grease.

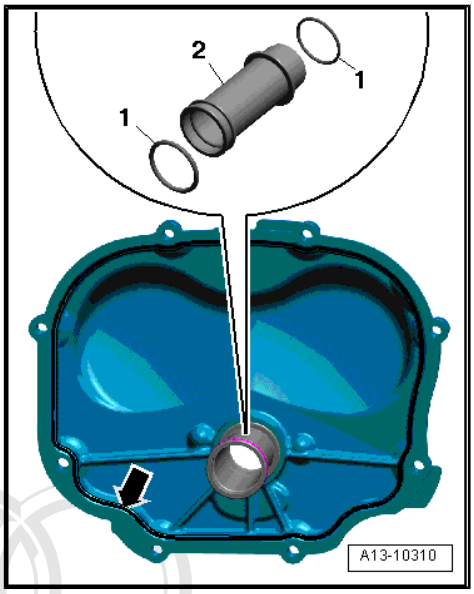
Note

Note the use-by date of the sealant.

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



– Use drift to drive intermediate coolant pipe (right-side) -2- out of timing chain cover (right-side).
– Fit O-rings -1- on intermediate coolant pipe.
– Fit intermediate coolant pipe in timing chain cover (right-side).



Caution

Make sure lubrication system is not clogged by excess sealant.

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

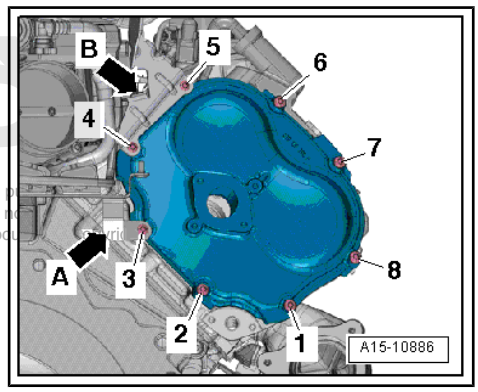
– Apply sealant bead -arrow- onto clean sealing surfaces of timing chain cover (right-side) as illustrated.

• Width of sealant bead: 2.5 mm.

Note

The timing chain cover must be installed within 5 minutes after applying the sealant.

– Fit timing chain cover (right-side) together with brackets -arrows A and B- and tighten bolts ⇒ page 99 .



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

– Install coolant pipe (top left) ⇒ page 218 .
– Install oil filter housing ⇒ page 186 .
– Install catalytic converter (right-side) ⇒ page 306 .
– Install Lambda probe - G39- ⇒ page 286
– Install air cleaner housing and air pipes ⇒ page 261 .
– Install coolant hose connection ⇒ page 230 .
– Install front silencer (right-side) ⇒ page 300 .

Tightening torques

- ⇒ Fig. ""Timing chain cover (right-side) - tightening torque and sequence"" , page 99

1.2.3 Removing and installing timing chain cover (bottom)

Special tools and workshop equipment required

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

Removing

- Gearbox removed ⇒ Rep. gr. 37 ; Removing and installing gearbox; Removing gearbox .

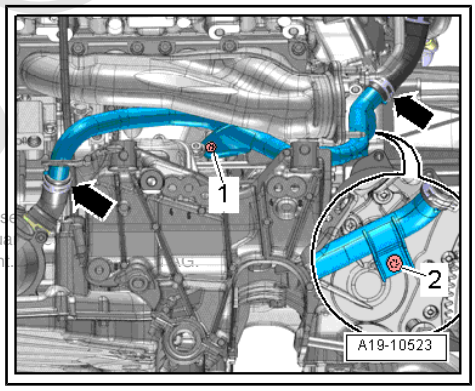
– Remove drive plate ⇒ page 71 .

– Remove timing chain cover: left-side ⇒ page 100 , right-side ⇒ page 102 .

– Remove intake manifold ⇒ page 266 .

– Remove oil filter housing ⇒ page 186 .

– Remove bolts -1- and -2- and swivel coolant pipe (centre left) to one side.



Note

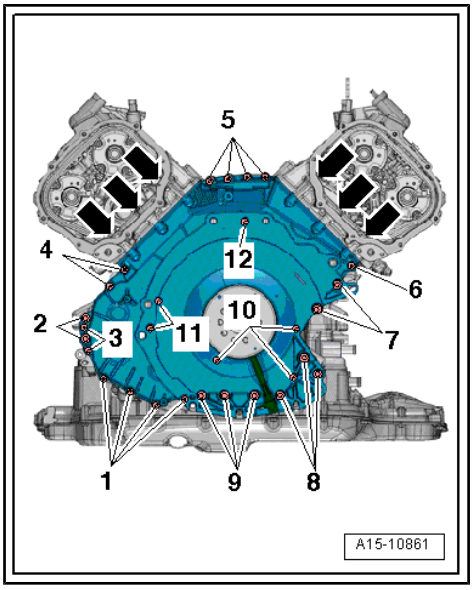
Disregard -arrows-.

– Remove bolts -arrows-.

– Slacken bolts -1 ... 12- in diagonal sequence and remove.

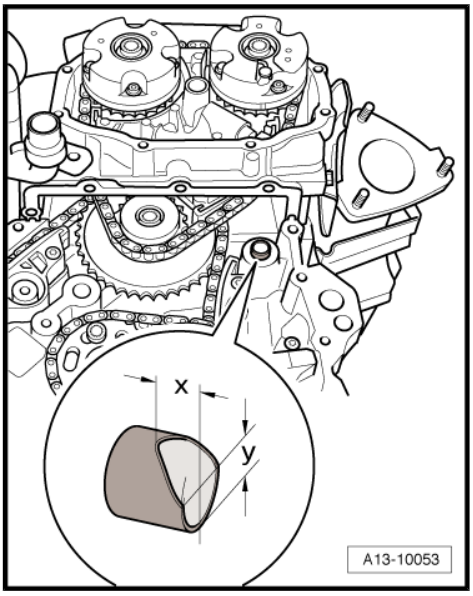
– Carefully release timing chain cover (bottom) from bonded joint and remove cover.

– Press crankshaft oil seal (gearbox end) out of timing chain cover (bottom).



Installing

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



Note

Renew the bolts tightened with specified tightening angle.

– Pull dowel sleeve at top right out of cylinder block.
– Bevel the dowel sleeve with a file, as illustrated.
• Dimension -x- = 6.5 mm.
• Dimension -y- = 8 mm.
– Fit dowel sleeve on cylinder block in such a way that the bevelled side points upwards.

Note

Bevelling the dowel sleeve makes it easier to fit the timing chain cover (bottom) with the cylinder head installed.

Caution

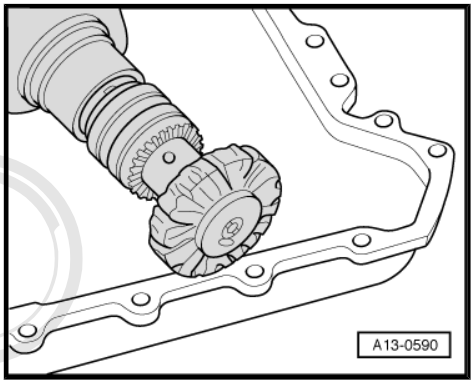
Protect lubrication system against contamination.

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

WARNING

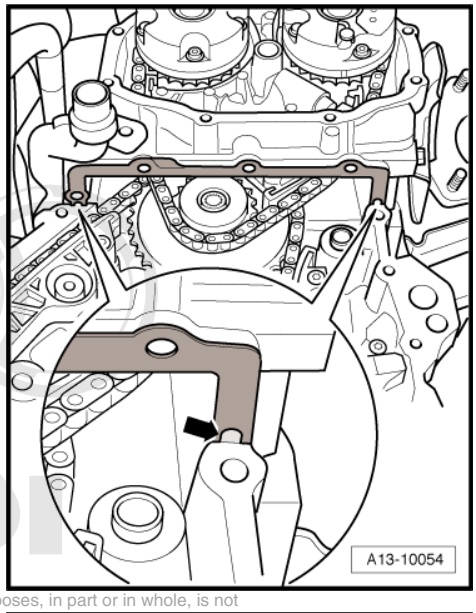
Risk of eye injury.

- ***Wear safety goggles.***



– Remove remaining sealant on timing chain cover (bottom), cylinder block and cylinder head using rotating plastic brush or similar.
– Clean sealing surfaces; they must be free of oil and grease.
– Before installing gearbox, remove residue from threaded holes for engine/gearbox bolts in cylinder block using a thread tap.

– Clean old sealant from holes -arrow- in cylinder head gaskets.



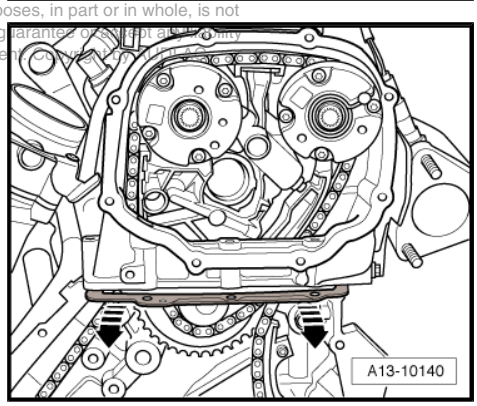
Note

With the cylinder head installed the holes in the cylinder head gasket are only half visible.

Caution

Avoid damage to cylinder head gasket.

- ***Only bend the ends of the cylinder head gaskets slightly and do not kink.***



Note

If the cylinder head gasket has been bent and kinked it must be renewed.

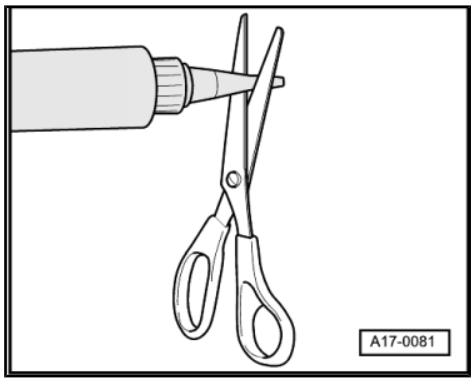
– Carefully bend the ends of the cylinder head gaskets down very slightly -arrows-, just far enough to be able to clean the upper sealing surface on the cylinder head gasket and cylinder head.

– Clean cylinder head gaskets (top and bottom); they must be free of oil and grease.

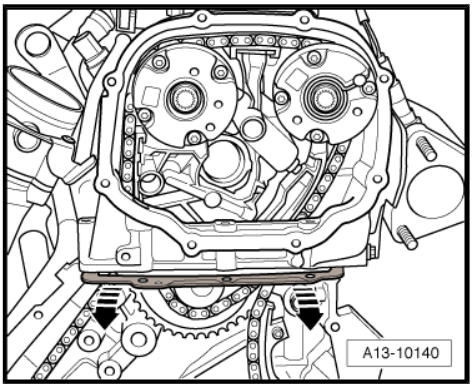
Note

Note the use-by date of the sealant.

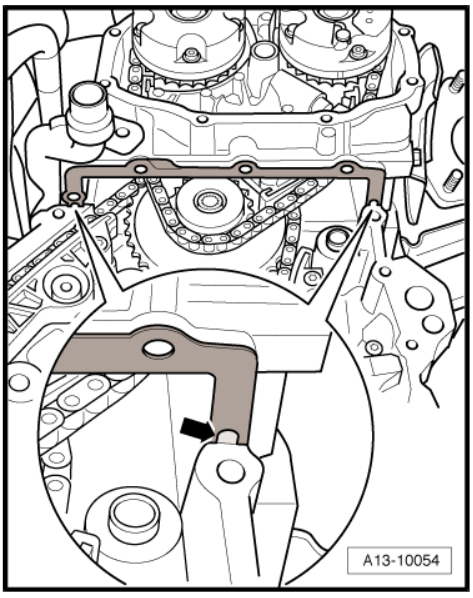
– Cut off nozzle of tube at front marking (nozzle ∅ approx. 2 mm).



– Apply a small amount of sealant to sealing surfaces of cylinder head gaskets (top and bottom). To do so, you again have to bend cylinder head gaskets down very slightly -arrows-.
– Use a flat object (e.g. a feeler gauge) to apply sealant to the area between cylinder head and gasket.



– Clean holes -arrow- in cylinder head gaskets and fill them with sealant.



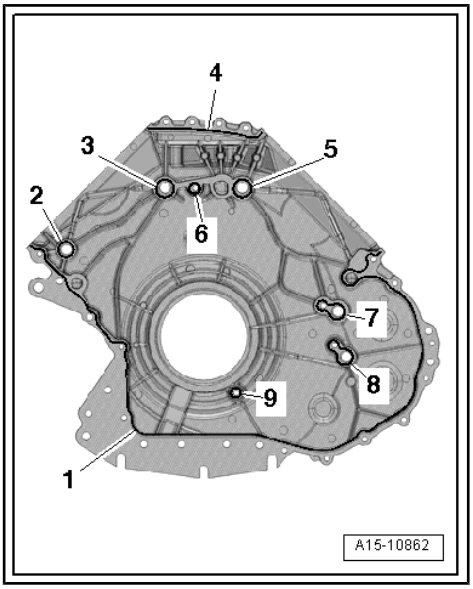
Caution

Make sure lubrication system is not clogged by excess sealant.

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

– Apply sealant beads -1 ... 9- onto the clean sealing surfaces of the timing chain cover (bottom) as illustrated.

- Width of beads of sealant: 2.5 mm.



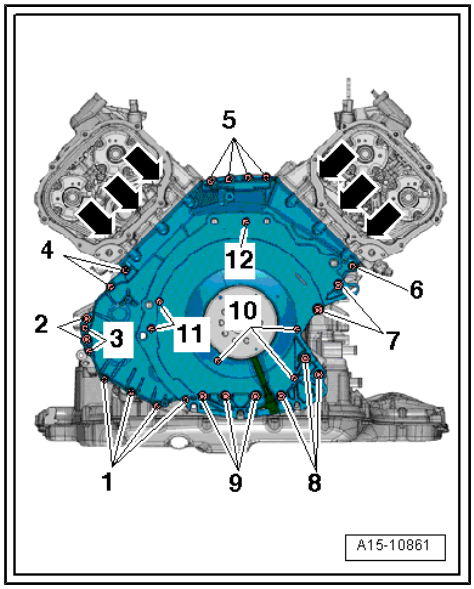
Note

The timing chain cover must be installed within 5 minutes after applying the sealant.

– Fit timing chain cover (bottom), guiding it towards the sealing surface on cylinder block and cylinder head at an angle and from below.
– Take care not to damage the cylinder head gaskets when fitting the cover.
– Tighten bolts ⇒ page 100 .

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

– Install crankshaft oil seal (gearbox end) ⇒ page 74 .
– Install coolant pipe (centre left) ⇒ page 221 .
– Install oil filter housing ⇒ page 186 .
– Install intake manifold ⇒ page 266 .
– Install timing chain cover: left-side ⇒ page 100 , right-side ⇒ page 102 .
– Install drive plate ⇒ page 71 .



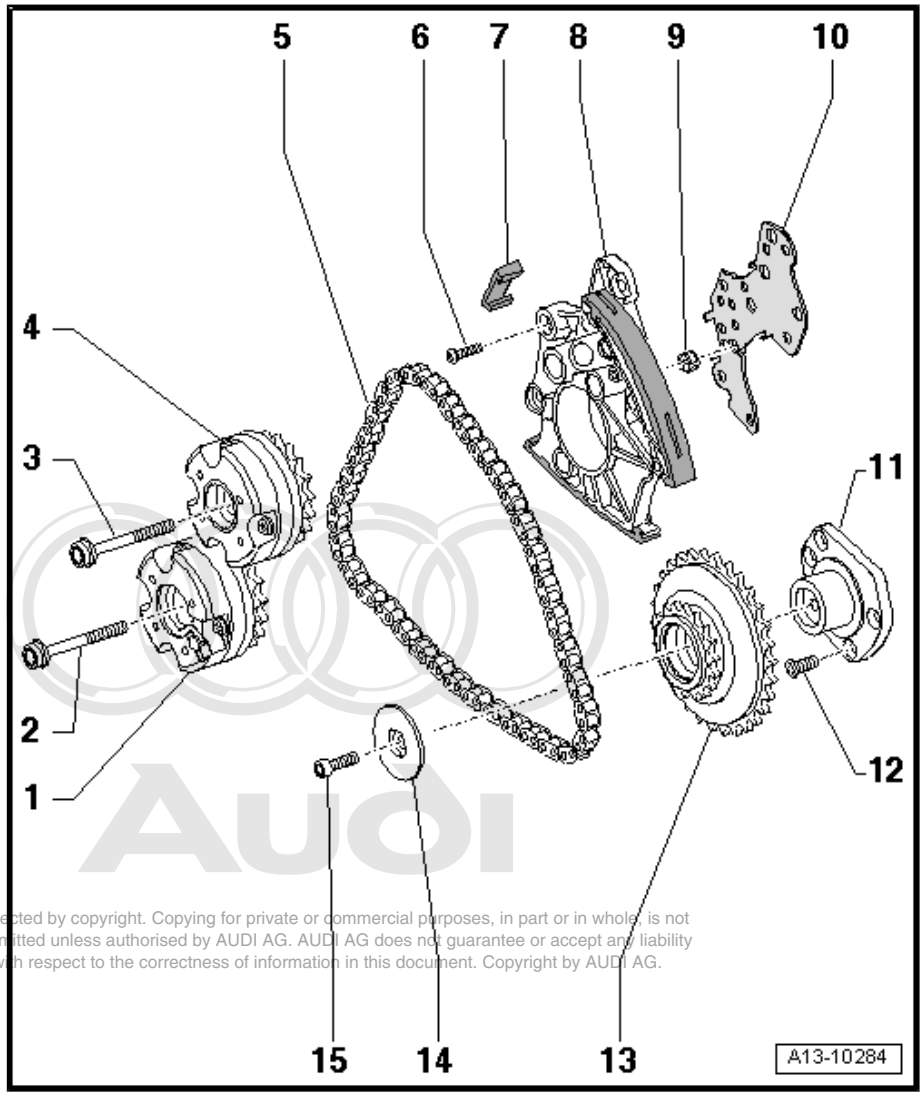
Tightening torques

◆ ⇒ Fig. ""Timing chain cover (bottom) - tightening torque and sequence"" , page 100

2 Chain drive

2.1 Exploded view - camshaft timing chains

Camshaft timing chain (left-side)



1 - Camshaft adjuster

- ❑ For exhaust camshaft
- ❑ Identification “EXHAUST”
- ❑ Removing and installing ⇒ “2.4 Removing and installing camshaft timing chain”, page 116

2 - Bolt

- ❑ Renew
- ❑ 80 Nm + turn 90° further

3 - Bolt

- ❑ Renew
- ❑ 80 Nm + turn 90° further

4 - Camshaft adjuster

- ❑ For inlet camshaft
- ❑ Identification “INTAKE”
- ❑ Removing and installing ⇒ “2.4 Removing and installing camshaft timing chain”, page 116

5 - Camshaft timing chain (left-side)

- ❑ Removing from camshafts ⇒ page 118
- ❑ Before removing, mark running direction with paint
- ❑ Removing and installing ⇒ page 116

6 - Bolt

- ❑ Renew
- ❑ 5 Nm + turn 90° further

7 - Slide

8 - Chain tensioner

- ❑ For camshaft timing chain (left-side)
- ❑ Removing and installing ⇒ “2.4 Removing and installing camshaft timing chain”, page 116

9 - Oil strainer

- ❑ Inserted in chain tensioner
- ❑ Watch position of locking lug on outer circumference

10 - Gasket

- ❑ Renew
- ❑ Clipped onto chain tensioner

11 - Bearing bracket

- ❑ For drive chain sprocket
- ❑ Version fitted in vehicle may differ from illustration

12 - Bolt

- ❑ 9 Nm

13 - Drive chain sprocket

- ❑ For camshaft timing chain (left-side)

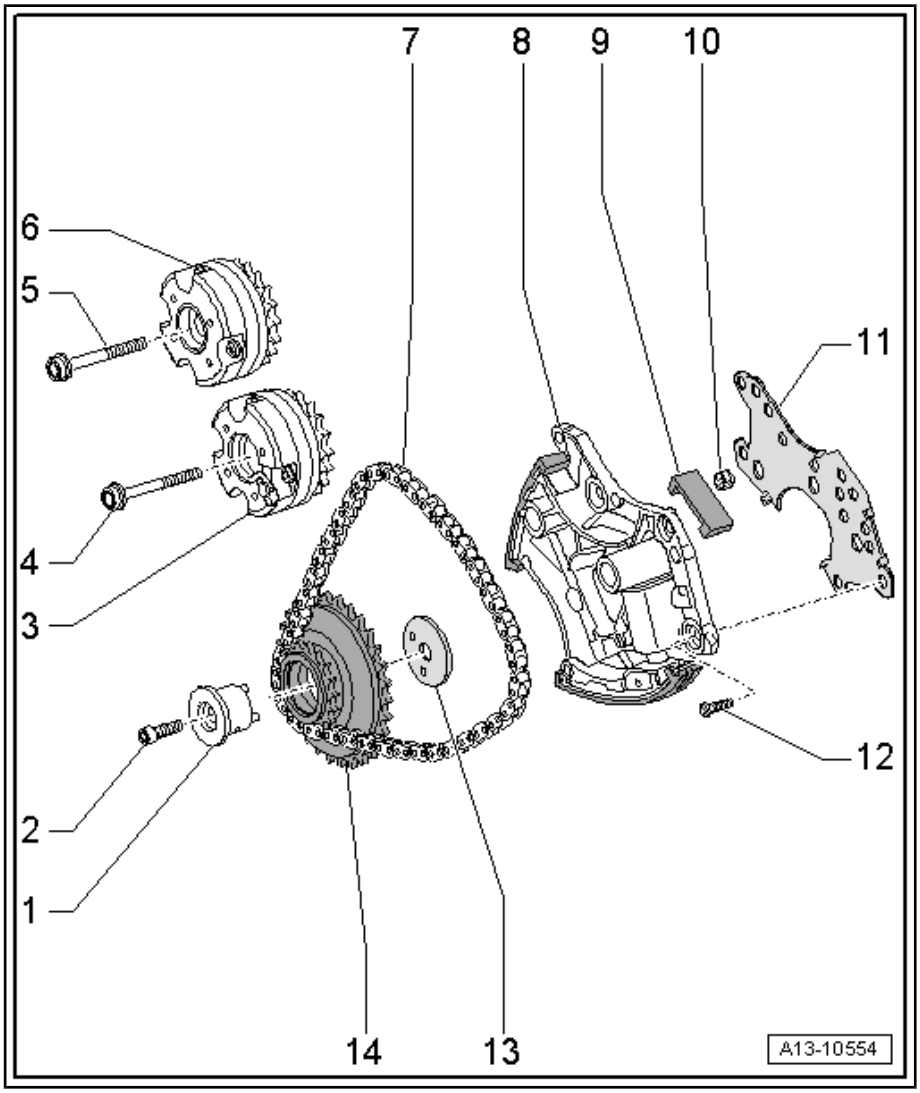
14 - Thrust washer

- ❑ For drive chain sprocket

15 - Bolt

- ❑ 22 Nm

Camshaft timing chain (right-side)



1 - Bearing mounting

- ❑ For drive chain sprocket for camshaft timing chain (right-side)
- ❑ Asymmetric version
- ❑ Installation position ⇒ page 114

2 - Bolt

- ❑ 42 Nm

3 - Camshaft adjuster

- ❑ For exhaust camshaft
- ❑ Identification “EXHAUST”
- ❑ Removing and installing ⇒ “2.4 Removing and installing camshaft timing chain”, page 116

4 - Bolt

- ❑ Renew
- ❑ 80 Nm + turn 90° further

5 - Bolt

- ❑ Renew
- ❑ 80 Nm + turn 90° further

6 - Camshaft adjuster

- ❑ For inlet camshaft
- ❑ Identification “INTAKE”
- ❑ Removing and installing ⇒ “2.4 Removing and installing camshaft timing chain”, page 116

7 - Camshaft timing chain (right-side)

- ❑ Removing from camshafts ⇒ page 118
- ❑ Before removing, mark running direction with paint
- ❑ Removing and installing ⇒ page 116

8 - Chain tensioner

- ❑ For camshaft timing chain (right-side)
- ❑ Version fitted in vehicle may differ from illustration
- ❑ Removing and installing ⇒ “2.4 Removing and installing camshaft timing chain”, page 116

9 - Slide

10 - Oil strainer

- ❑ Inserted in chain tensioner
- ❑ Installation position: note locating lug on outer circumference

11 - Gasket

- ❑ Renew
- ❑ Clipped onto chain tensioner

12 - Bolt

- ❑ Renew
- ❑ 5 Nm + turn 90° further

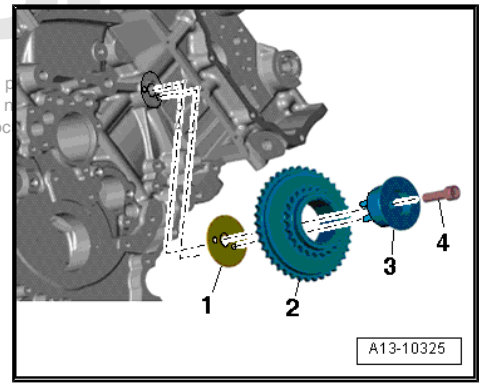
13 - Thrust washer

- ❑ For drive chain sprocket

14 - Drive chain sprocket

- ❑ For camshaft timing chain (right-side)

Installation position: bearing mounting for drive sprocket for camshaft timing chain (right-side)



- Dowel pins in bearing mounting -3- for drive sprocket for camshaft timing chain (right-side) must engage in drillings in thrust washer -1- and in cylinder block drillings.

2 - Drive sprocket for camshaft timing chain (right-side)

4 - Bolt

2.2 Exploded view - drive chain for valve gear

1 - Guide rail

2 - Bolt

- ❑ Renew
- ❑ 17 Nm + turn 90° further

3 - Bolt

- ❑ Tightening torque ⇒ Item 2 (page 113)

4 - Bolt

- ❑ Tightening torque ⇒ Item 15 (page 112)

5 - Thrust washer

- ❑ For drive chain sprocket

6 - Drive chain sprocket

- ❑ For timing chain (left-side)

7 - Bolt

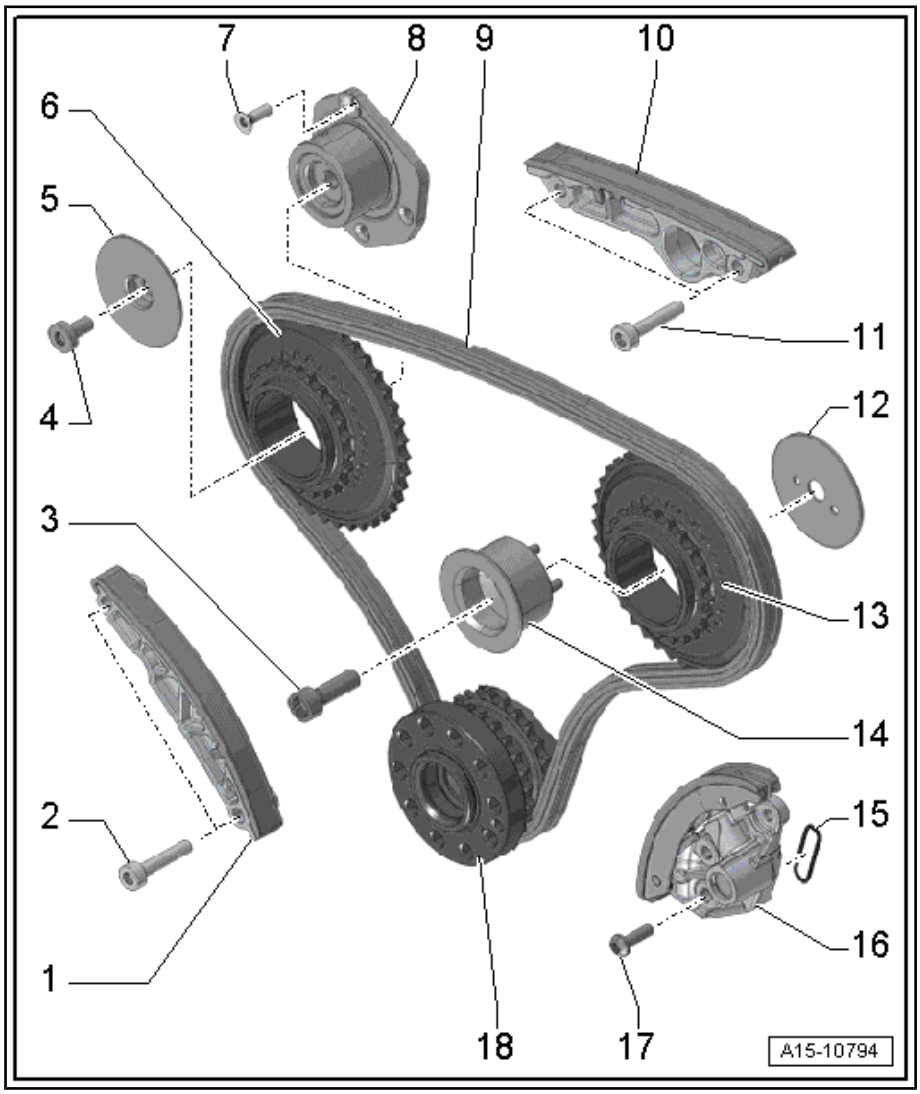
- ❑ Tightening torque ⇒ Item 12 (page 112)

8 - Bearing mounting

- ❑ For drive chain sprocket for camshaft timing chain (right-side)
- ❑ Asymmetric version
- ❑ Installation position ⇒ page 114

9 - Drive chain

- ❑ For timing drive
- ❑ Before removing, mark running direction with paint
- ❑ Removing and installing ⇒ page 126



10 - Guide rail

11 - Bolt

- ❑ Renew
- ❑ 17 Nm + turn 90° further

12 - Thrust washer

13 - Drive chain sprocket

- ❑ For timing chain (right-side)

14 - Bearing mounting

- ❑ For drive chain sprocket

15 - Seal

- ❑ Renew

16 - Chain tensioner

17 - Bolt

- ❑ Renew
- ❑ 5 Nm + turn 90° further

18 - Crankshaft

2.3 Exploded view - drive chain for auxiliary drive

1 - Bolt
- ❑ Renew
- ❑ 5 Nm + turn 90° further

2 - Chain tensioner
- ❑ With guide rail

3 - Seal
- ❑ Renew

4 - Drive chain sprocket
- ❑ For auxiliary drives
- ❑ Part of spur gear drive

5 - Bolt
- ❑ 42 Nm

6 - Bearing mounting
- ❑ For idler sprocket

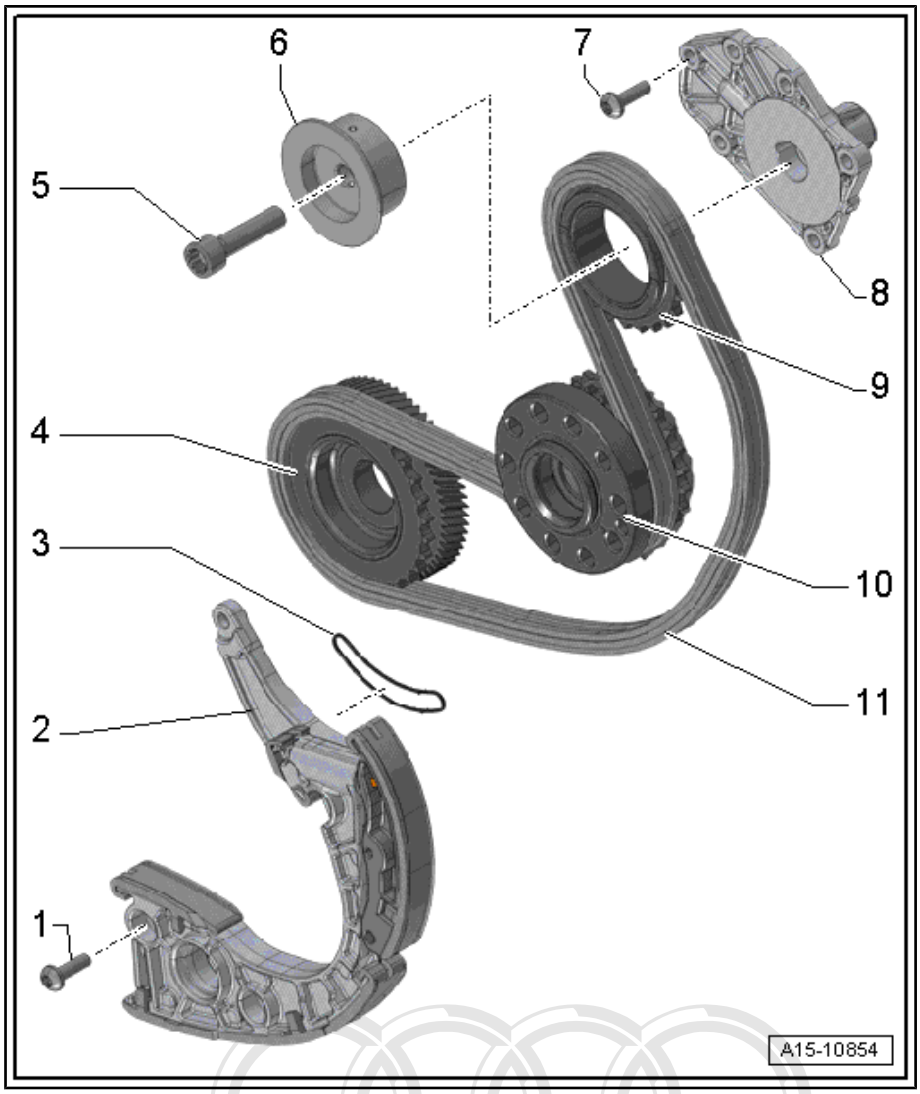
7 - Bolt
- ❑ Renew
- ❑ 5 Nm + turn 90° further

8 - Mounting bracket
- ❑ For idler sprocket

9 - Idler sprocket
- ❑ For drive chain for auxiliary drives

10 - Crankshaft

11 - Drive chain
- ❑ For auxiliary drives
- ❑ Removing and installing ⇒ page 127



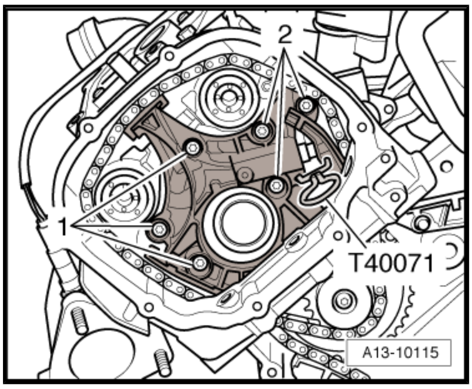
2.4 Removing and installing camshaft timing chain

Removing

- Gearbox removed ⇒ Rep. gr. 37 ; Removing and installing gearbox; Removing gearbox .

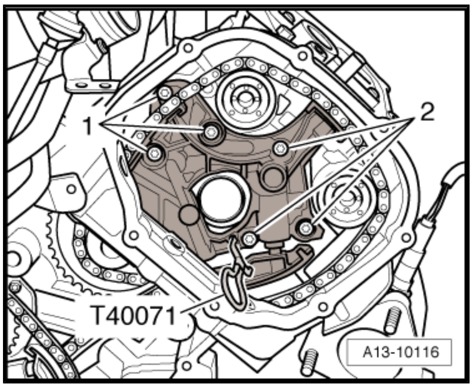
– Remove timing chain cover (bottom) ⇒ page 105 .

– Remove timing chains from camshafts ⇒ page 118 .



> ⚠ Caution
>
> *If a used timing chain rotates in the opposite direction when it is refitted, this can cause breakage.*
>
> ♦ *Mark running direction of timing chain with coloured arrows for re-installation.*

– Remove bolts -1- and -2- and take off chain tensioner (left-side) and camshaft timing chain (left-side).



– Remove bolts -1- and -2- and take off chain tensioner (right-side) and timing chain (right-side).

Installing

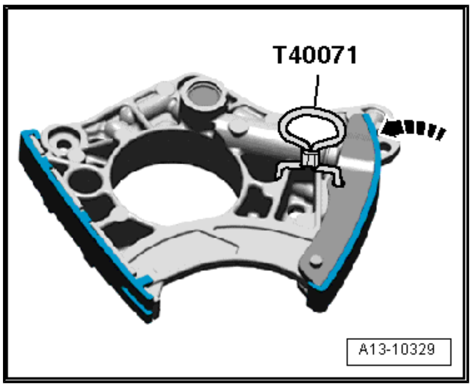
> ℹ Note

♦ *Note the correct installation position if the tensioning element has been removed from the chain tensioner: drilling in base of housing faces chain tensioner and piston faces tensioner rail.*

♦ *Renew the bolts tightened with specified tightening angle.*

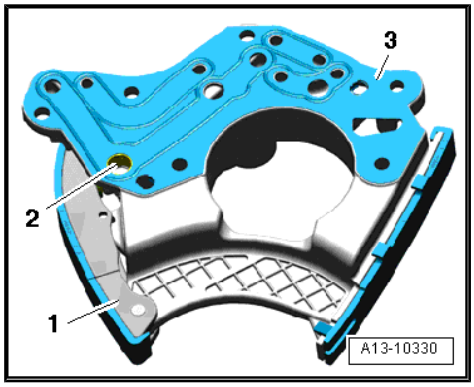
♦ *Renew seals and/or gaskets.*

> ⚠ Caution
>
> *Avoid damage to valves and piston crowns.*
>
> ♦ *The crankshaft must not be at “TDC” at any cylinder when the camshafts are turned.*

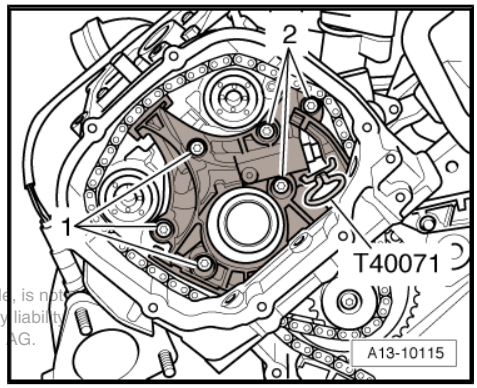


– Press guide rail of chain tensioner for camshaft timing chain (left or right) inwards -arrow- as far as the stop. Then lock chain tensioner by inserting locking pin - T40071- .

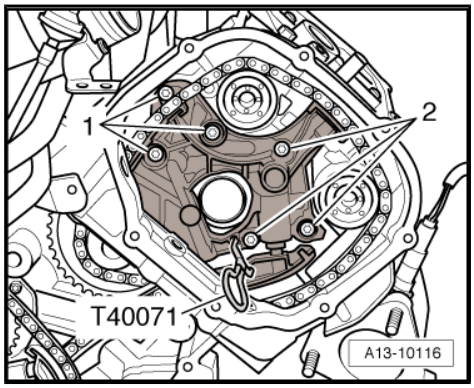
– If necessary, clean oil strainer -2- in both chain tensioners.
– Fit new gasket -3- on rear of chain tensioner -1-.



– Fit chain tensioner on cylinder head (left-side) and position timing chain as shown in the illustration (according to marks applied when removing).
– Tighten bolts -1- and -2-.



– Fit chain tensioner on cylinder head (right-side) and position timing chain as shown in the illustration (according to marks applied when removing).
– Tighten bolts -1- and -2-.



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

– Fit timing chains on camshafts ⇒ page 122 .
– Install timing chain cover (bottom) ⇒ page 105 .

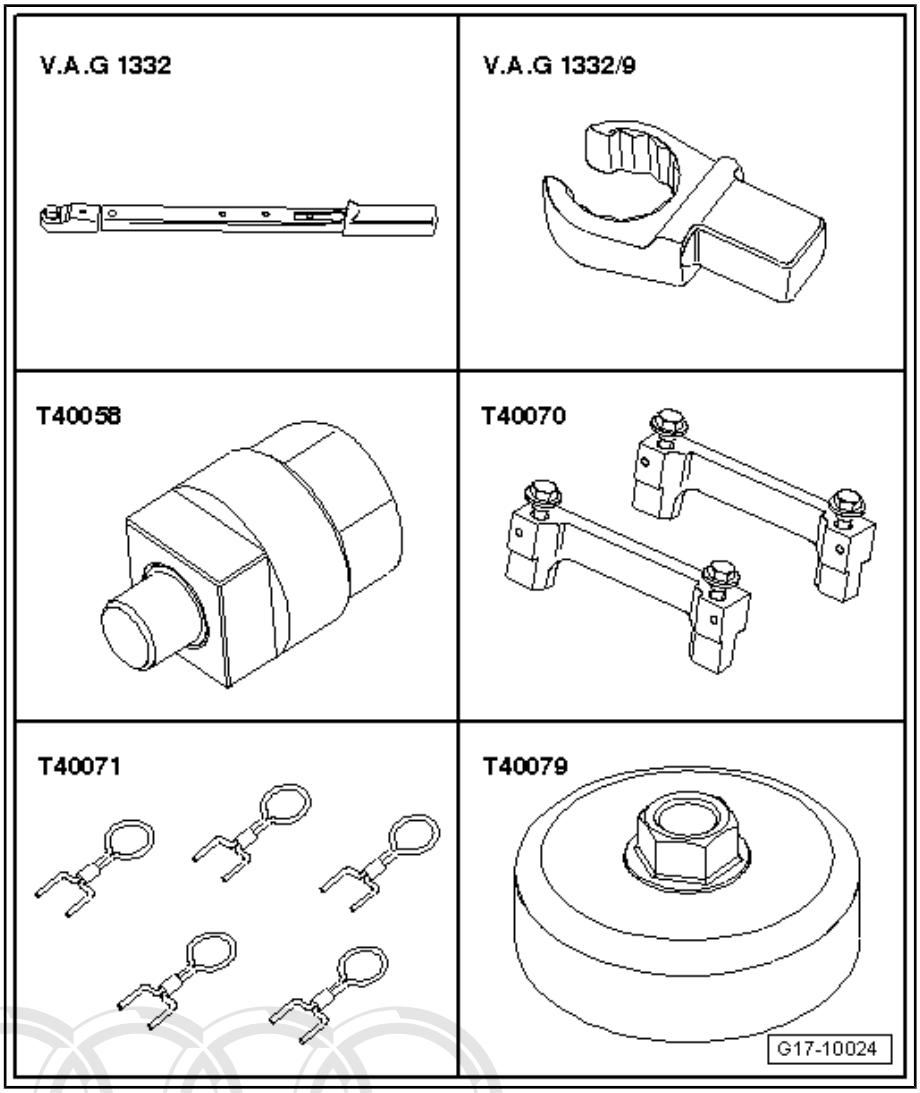
Tightening torques

◆ ⇒ “2.1 Exploded view - camshaft timing chains”, page 111

2.5 Removing camshaft timing chain from camshafts

Special tools and workshop equipment required

- Torque wrench - V.A.G 1332-
- Open ring spanner insert - V.A.G 1332/9-
- Adapter - T40058-
- 2x Camshaft clamp - T40070-
- 2x Locking pin - T40071-
- Key - T40079-



- Locking pin -T40227-

Removing

Note

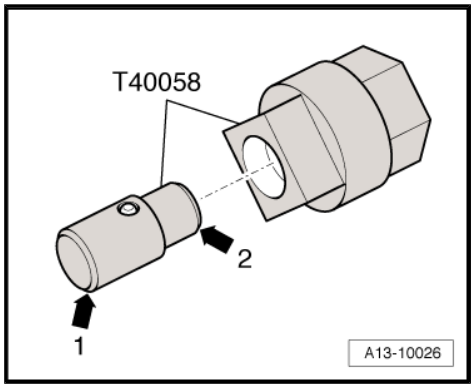
In the following procedure the camshaft timing chains remain on the engine.

– Remove corresponding cylinder head cover ⇒ page 140 .

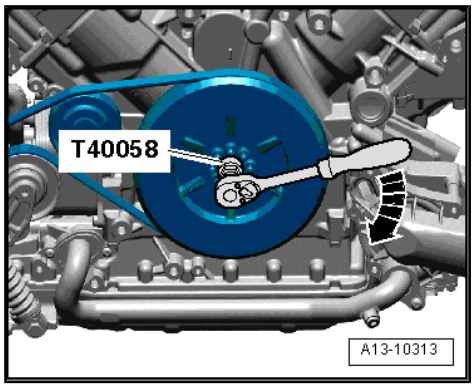
– Remove relevant timing chain cover: left-side ⇒ page 100 ; right-side ⇒ page 102 .

– Insert guide pin of adapter -T40058- as follows:

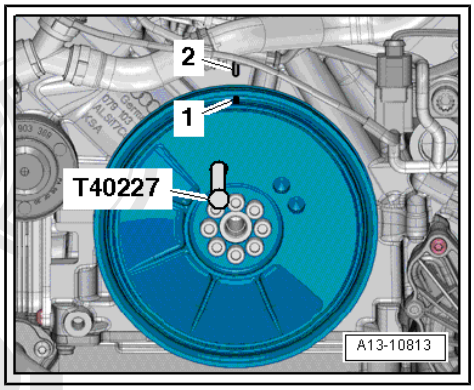
- The larger-diameter section -arrow 1- faces towards the engine.
- The smaller-diameter section -arrow 2- faces the adapter.



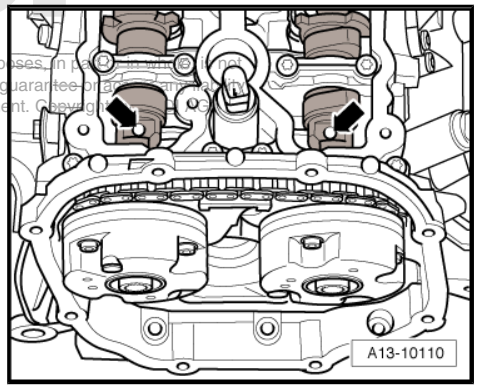
– Use adapter - T40058- to turn crankshaft in direction of engine rotation to “TDC” position.



- Marks -1- at vibration damper and -2- on cylinder block must be opposite one another.

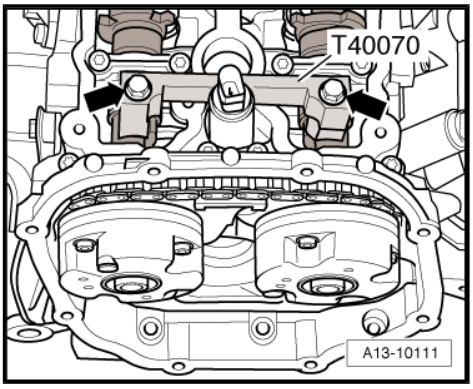


- The threaded holes -arrows- in the camshafts must face upwards.

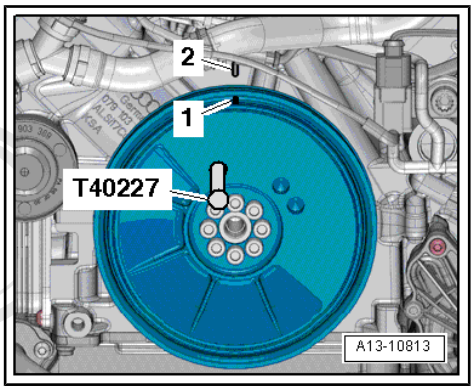


– Secure camshaft clamps - T40070- on both cylinder heads and tighten to 25 Nm -arrows-.

• The camshaft clamp - T40070- is positioned correctly if the holes for the cylinder head bolts remain free.



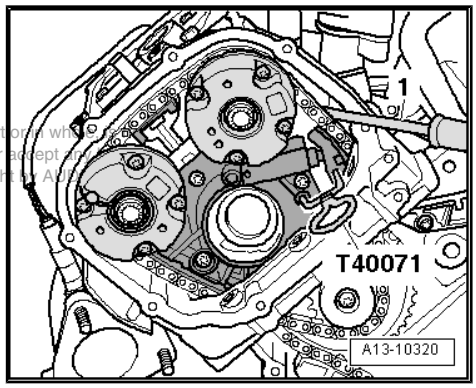
– Screw in locking pin -T40227- through bore in vibration damper into cylinder block by hand until it makes contact. If necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.



– Press guide rail of chain tensioner for camshaft timing chain (left-side) inwards as far as the stop using a screwdriver -1-. Then lock chain tensioner by inserting locking pin - T40071- .

Note

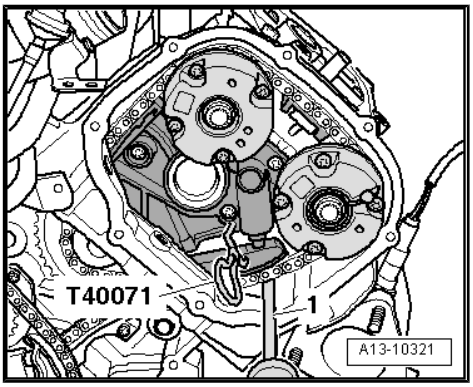
The chain tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.



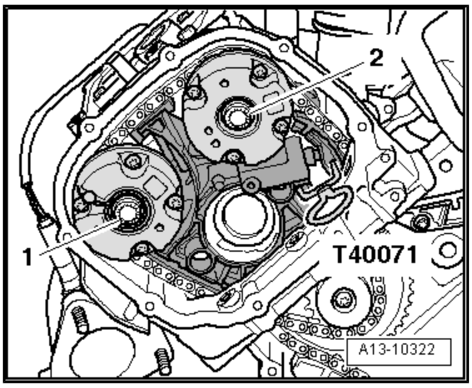
– Press guide rail of chain tensioner for camshaft timing chain (right-side) inwards as far as the stop using a screwdriver -1-. Then lock chain tensioner by inserting locking pin - T40071- .

Note

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

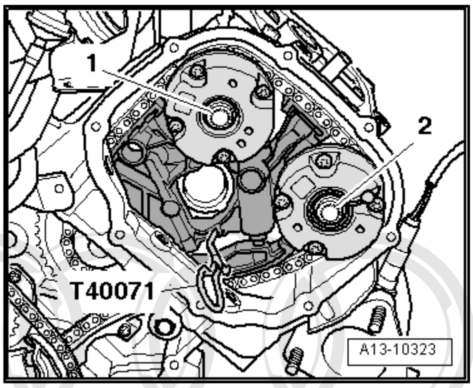


– Mark position of camshaft adjusters with paint for re-installation.



> ⚠ **Caution**
>
> *Risk of irreparable damage to engine.*
>
> ♦ *Block off the opening in the valve timing housing with a clean cloth to prevent small items from dropping into the engine.*

– Unscrew bolts -1- and -2- on cylinder head (left-side) and remove both camshaft adjusters.



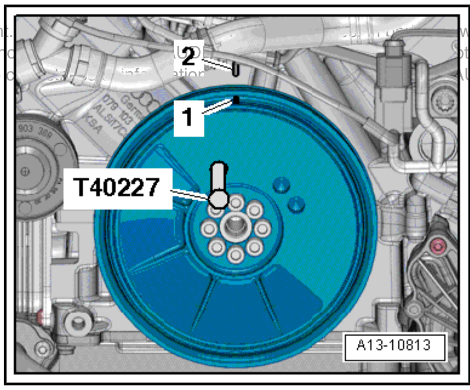
– Mark position of camshaft adjusters with paint for re-installation.

– Unscrew bolts -1- and -2- on cylinder head (right-side) and remove both camshaft adjusters.

Installing

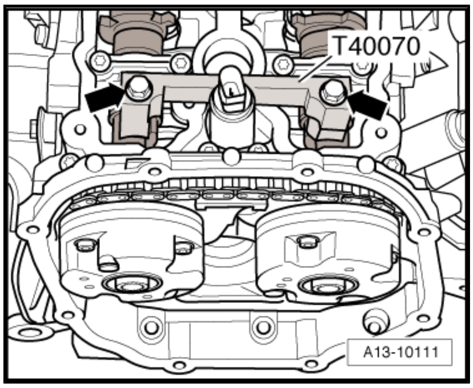
> ℹ **Note**
>
> *Renew the bolts tightened with specified tightening angle.*

> ⚠ **Caution**
>
> *Avoid damage to valves and piston crowns.*
>
> ♦ *The crankshaft must not be at "TDC" at any cylinder when the camshafts are turned.*



• Drive chain for valve gear installed ⇒ page 126

• Crankshaft locked in "TDC position" with locking pin -T40227-.



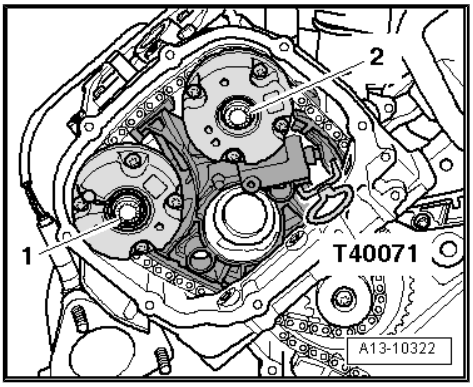
• Camshaft clamps - T40070- secured on both cylinder heads and tightened to 25 Nm -arrows-.

– Re-install camshaft adjusters on cylinder head (left-side) in the same position as before (pay attention to marks applied when removing).

– Fit timing chain onto drive chain sprocket and camshaft adjusters and fit bolts -1- and -2- without tightening.

• It should just be possible to turn both camshaft adjusters on the camshaft without axial movement.

– Remove locking pin - T40071- .

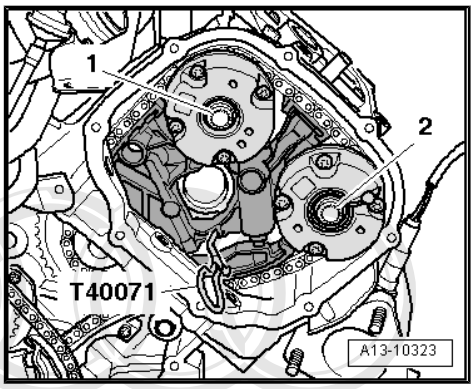


– Re-install camshaft adjusters on cylinder head (right-side) in the same position as before (pay attention to marks applied when removing).

– Fit timing chain onto drive chain sprocket and camshaft adjusters and fit bolts -1- and -2- without tightening.

• It should just be possible to turn both camshaft adjusters on the camshaft without axial movement.

– Remove locking pin - T40071- .

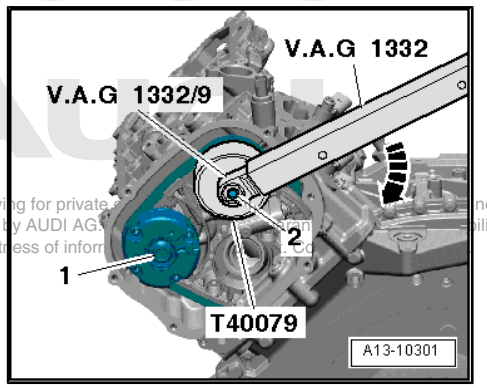


– Fit key - T40079- onto camshaft adjuster of inlet camshaft on cylinder head (left-side).

– Apply torque wrench - V.A.G 1332- with open ring spanner insert - V.A.G 1332/9- to key - T40079- .

– Have a second mechanic apply a torque of 40 Nm to camshaft adjuster in direction of -arrow-.

– Tighten bolts as follows while keeping camshaft adjuster under tension:



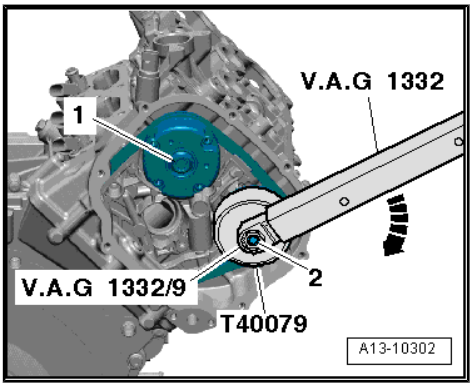
Stage	Bolt	Tightening torque
1.	-1-	on exhaust camshaft: 60 Nm
1.	-2-	on inlet camshaft: 60 Nm

– Fit key - T40079- onto camshaft adjuster of exhaust camshaft on cylinder head (right-side).

– Apply torque wrench - V.A.G 1332- with open ring spanner insert - V.A.G 1332/9- to key - T40079- .

– Have a second mechanic apply a torque of 40 Nm to camshaft adjuster in direction of -arrow-.

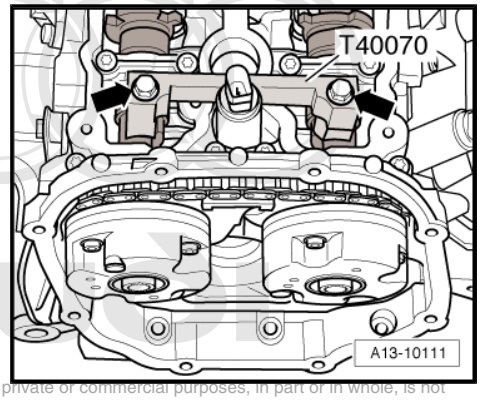
– Tighten bolts as follows while keeping camshaft adjuster under tension:



Stage	Bolt	Tightening torque
1.	-1-	on inlet camshaft: 60 Nm
1.	-2-	on exhaust camshaft: 60 Nm

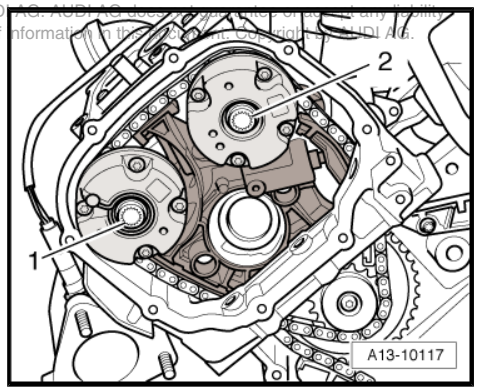
– Remove key - T40079- .

– Remove camshaft clamps - T40070- from both cylinder heads -arrows-.



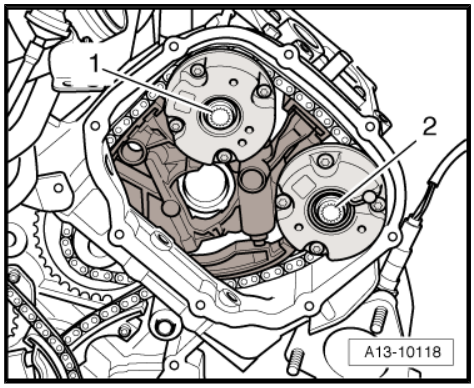
– Tighten camshaft adjuster bolts on cylinder head (left-side) as follows:

Stage	Bolt	Tightening torque
2.	-1-	Tighten on exhaust camshaft to final tightening torque ⇒ Item 2 (page 111)
2.	-2-	Tighten on inlet camshaft to final tightening torque ⇒ Item 3 (page 111)

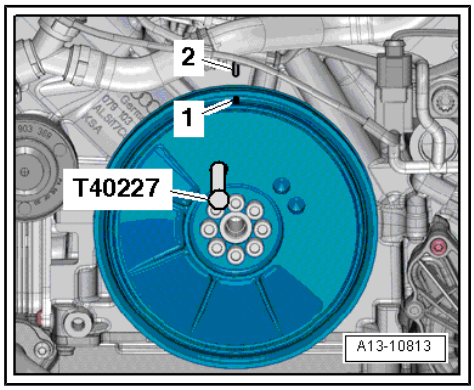


– Tighten camshaft adjuster bolts on cylinder head (right-side) as follows:

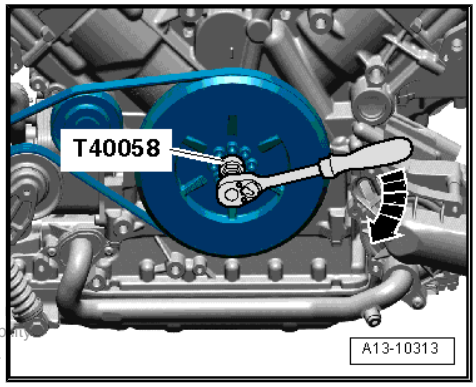
Stage	Bolt	Tightening torque
2.	-1-	Tighten on inlet camshaft to final tightening torque ⇒ Item 5 (page 113)
2.	-2-	Tighten on exhaust camshaft to final tightening torque ⇒ Item 4 (page 113)



– Remove locking pin -T40227- .



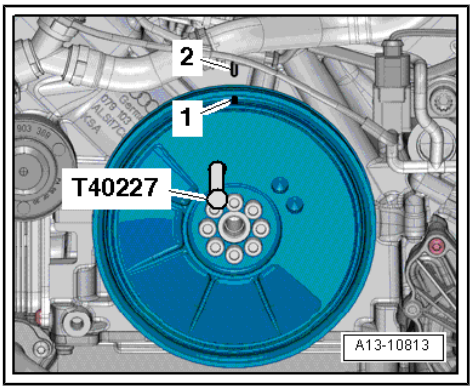
– Using adapter - T40058- , turn crankshaft 2 revolutions in normal direction of rotation -arrow- until crankshaft is at “TDC” again.



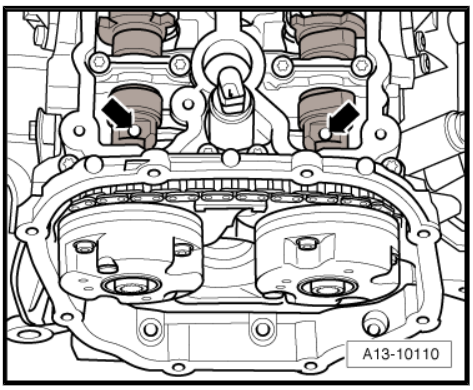
Note

If you turn the crankshaft beyond “TDC” by mistake, turn it back approx. 30° and set to “TDC” again.

- Marks -1- at vibration damper and -2- on cylinder block must be opposite one another.

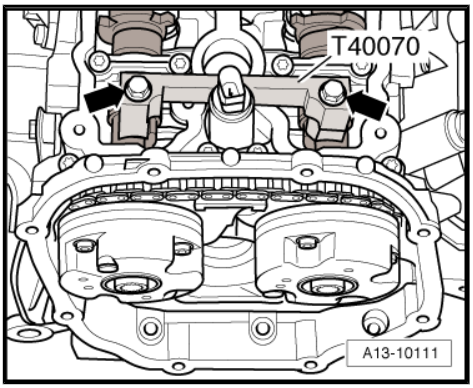


- The threaded holes -arrows- in the camshafts must face upwards.



– Secure camshaft clamps - T40070- on both cylinder heads and tighten to 25 Nm -arrows-.

- The camshaft clamp - T40070- is positioned correctly if the holes for the cylinder head bolts remain free.

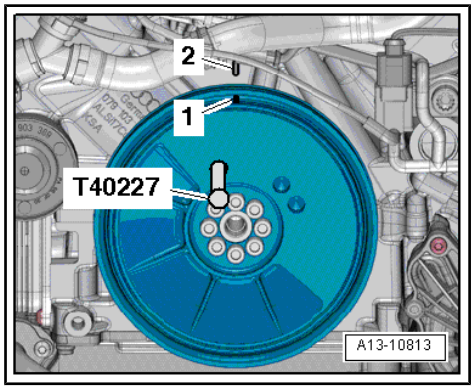


– Screw in locking pin -T40227- through bore in vibration damper into cylinder block by hand until it makes contact.

• The locking pin -T40227- must engage in the locating hole in cylinder block. If it does not, reset valve timing.

– Remove camshaft clamps from both cylinder heads.

– Remove locking pin -T40227- .



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

– Install timing chain cover: left-side ⇒ page 100 , right-side ⇒ page 102 .

– Install cylinder head cover ⇒ page 140 .

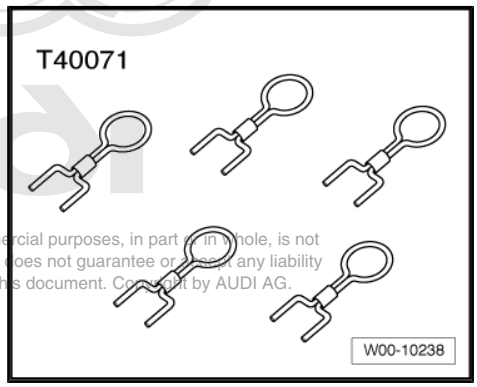
Tightening torques

♦ ⇒ “2.1 Exploded view - camshaft timing chains”, page 111

2.6 Removing and installing drive chain for valve gear

Special tools and workshop equipment required

♦ Locking pin - T40071-



Removing

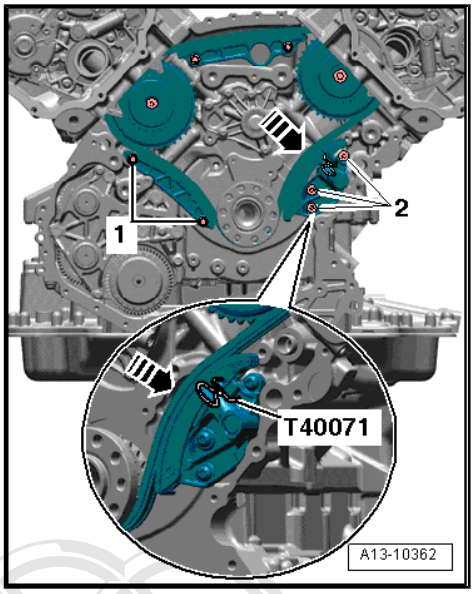
• Gearbox removed ⇒ Rep. gr. 37 ; Removing and installing gearbox; Removing gearbox .

– Remove timing chain cover (bottom) ⇒ page 105 .

– Remove timing chains from camshafts ⇒ page 118 .

– Remove drive chain for auxiliary drives ⇒ page 127 .

– Press guide rail of chain tensioner for drive chain in direction of -arrow- and lock chain tensioner by inserting locking pin - T40071- .



Caution

If a used drive chain rotates in the opposite direction when it is refitted, this can cause breakage.

- ***Mark running direction of drive chain with coloured arrows for re-installation.***

– Unscrew bolts -1- and remove guide rail.

– Remove bolts -2- and take off chain tensioner.

– Detach drive chain for valve gear.

Installing

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

Note

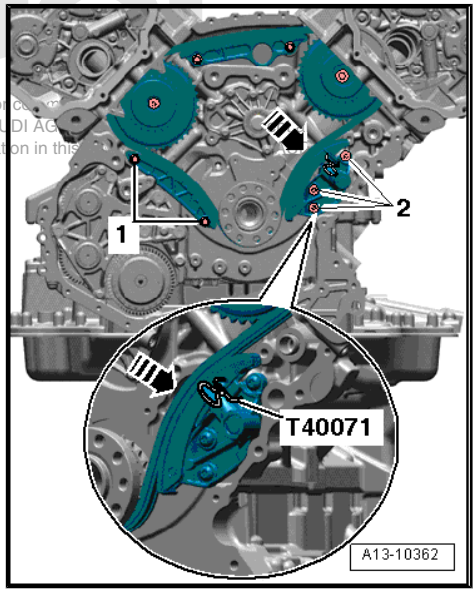
Renew the bolts tightened with specified tightening angle.

– Position drive chain for valve gear onto drive chain sprockets (according to marks applied during removal).

– Install guide rail and tighten bolts -1-.

– Install chain tensioner and tighten bolts -2-.

– Press guide rail of chain tensioner for drive chain in direction of -arrow- and pull locking pin - T40071- out of chain tensioner.



– Install drive chain for auxiliary drives ⇒ page 127 .

– Fit timing chains on camshafts ⇒ page 122 .

– Install timing chain cover (bottom) ⇒ page 105 .

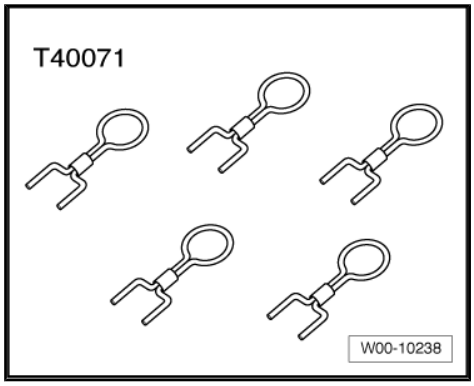
Tightening torques

♦ ⇒ “2.2 Exploded view - drive chain for valve gear”, page 114

2.7 Removing and installing drive chain for auxiliary drive

Special tools and workshop equipment required

♦ Locking pin - T40071-



Removing

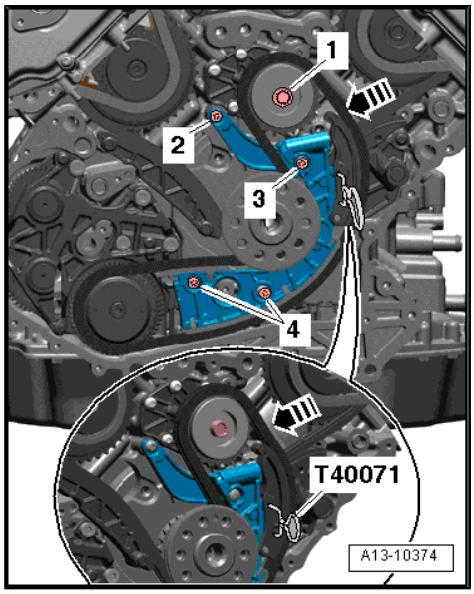
- Gearbox removed ⇒ Rep. gr. 37 ; Removing and installing gearbox; Removing gearbox .

– Remove timing chain cover (bottom) ⇒ page 105 .

Caution

If a used drive chain rotates in the opposite direction when it is refitted, this can cause breakage.

♦ ***Mark running direction of drive chain for auxiliary drives with coloured arrows for re-installation.***



– Press tensioning rail in direction of -arrow- and lock chain tensioner in place using locking pin - T40071- .

– Unscrew bolt -1- and remove idler sprocket.

– Remove bolts -2, 3, 4- and take off chain tensioner.

– Detach drive chain for auxiliary drives.

Installing

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

Note

♦ *Renew seal.*

♦ *Renew the bolts tightened with specified tightening angle.*

– Install timing chain cover (bottom) ⇒ page 105 .

Tightening torques

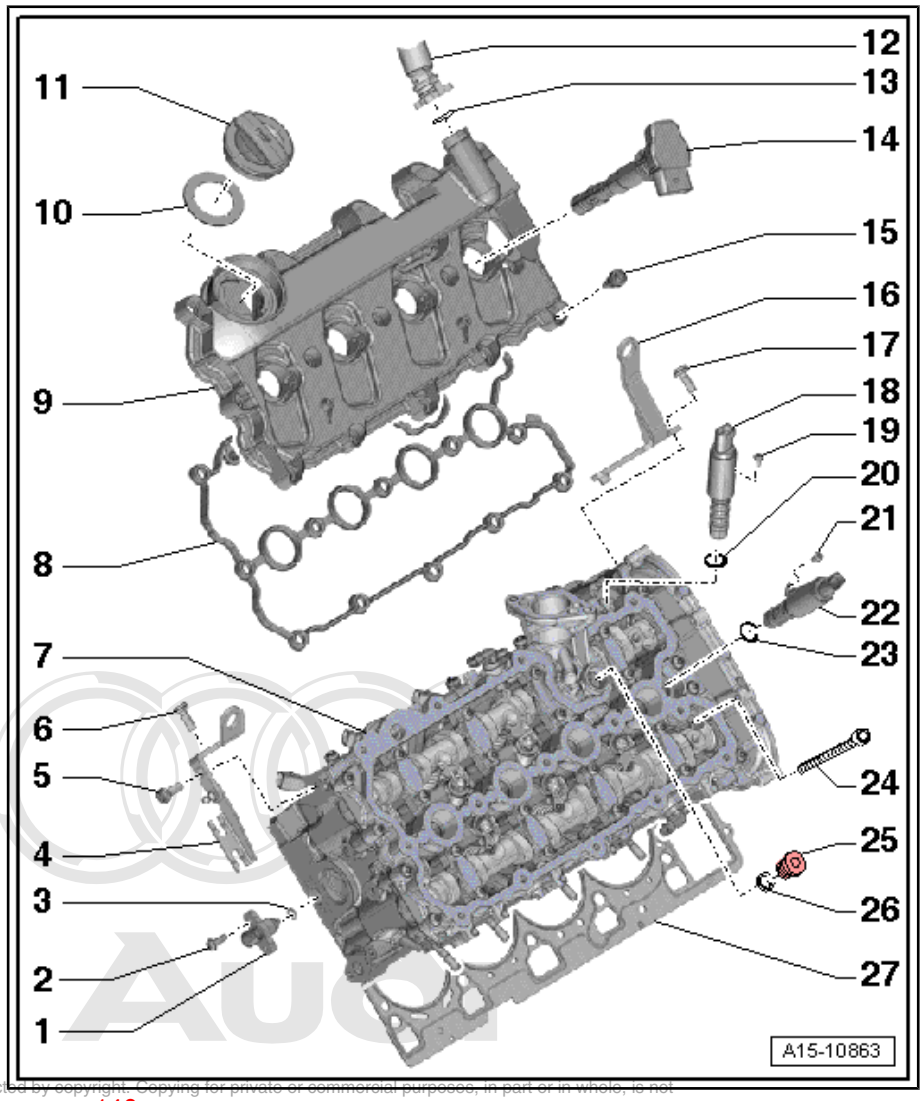
♦ ⇒ “2.3 Exploded view - drive chain for auxiliary drive”, page 116

3 Cylinder head

3.1 Exploded view - cylinder head

Note

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



1 - Temperature sender for engine temperature regulation - G694-

- ❑ Removing and installing ⇒ page 210

2 - Bolt

- ❑ 8 Nm

3 - O-ring

- ❑ Renew

4 - Engine lifting eye

- ❑ With bracket for wiring harness

5 - Bolt

- ❑ 22 Nm

6 - Bolt

- ❑ 22 Nm

7 - Cylinder head

- ❑ Removing and installing ⇒ page 132
- ❑ Checking for distortion ⇒ page 132
- ❑ Machining limit ⇒ page 132
- ❑ If renewed, change coolant and engine oil

8 - Gasket

- ❑ For cylinder head cover
- ❑ Renew if damaged or leaking

9 - Cylinder head cover

- ❑ Removing and installing ⇒ page 140

10 - Seal

- ❑ For filler cap
- ❑ Renew if damaged or leaking

11 - Filler cap

12 - Crankcase breather hose

13 - O-ring

- ❑ Renew

14 - Ignition coil

- ❑ Removing and installing ⇒ page 323

15 - Bolt

- ❑ Renew if seal is damaged
- ❑ Tightening torque and tightening sequence: cylinder head cover (left-side) ⇒ page 131 , cylinder head cover (right-side) ⇒ page 131

16 - Engine lifting eye

- ❑ With bracket for wiring harness

17 - Bolt

- ❑ 22 Nm

18 - Camshaft control valve 2 - N208-

19 - Bolt

- ❑ 2.4 Nm

20 - O-ring

- ❑ Renew

21 - Bolt

- ❑ 2.4 Nm

22 - Exhaust camshaft control valve 2 - N319-

23 - O-ring

- ❑ Renew

24 - Bolt

- ❑ Renew
- ❑ Correct sequence when slackening ⇒ page 136
- ❑ Tightening torque and sequence ⇒ page 131

25 - Screw plug

- ❑ 45 Nm

26 - Seal

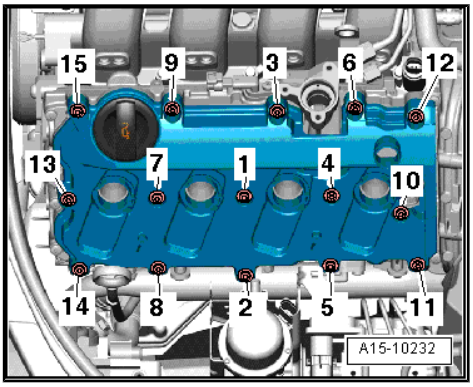
- ❑ Renew

27 - Cylinder head gasket

- ❑ Renewing ⇒ “3.2 Removing and installing cylinder head”, page 132
- ❑ Installation position: part number must face cylinder head
- ❑ If renewed, change coolant and engine oil

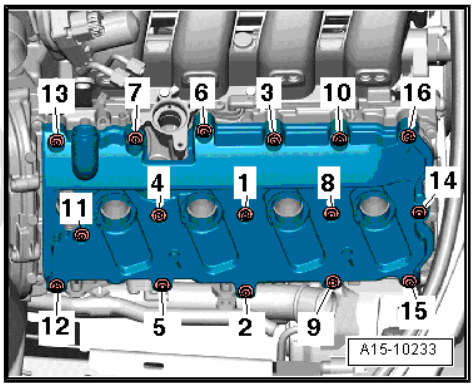
Cylinder head cover (left-side) - tightening torque and sequence

– Tighten bolts in the sequence -1 ... 15- to 9 Nm.



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

– Tighten bolts in the sequence -1 ... 16- to 9 Nm.

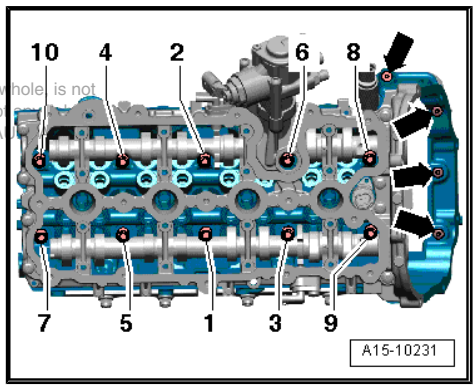


Cylinder head - tightening torque and sequence

Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts in 7 stages in the sequence shown:

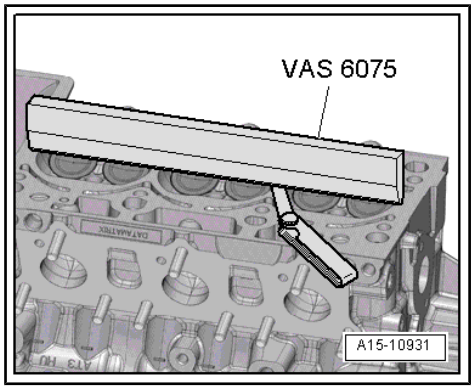


Stage	Bolts	Tightening torque/angle specification
1.	-1 … 10-	Screw in by hand until contact is made
2.	-1 … 10-	30 Nm
3.	-1 … 10-	60 Nm
4.	-1 … 10-	Turn 90° further
5.	-1 … 10-	Turn 90° further
6.	-arrows-	Apply locking fluid when installing; 8 Nm Locking fluid ⇒ Electronic parts catalogue
7.	-arrows-	Turn 90° further

Checking cylinder head for distortion

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

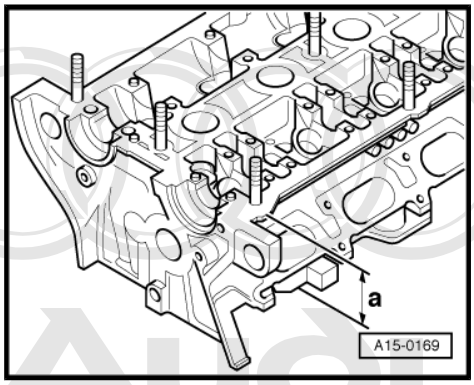
• Max. permissible distortion: 0.1 mm.



Cylinder head machining limit

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

• Minimum dimension: -a- = 139.5 mm



3.2 Removing and installing cylinder head

⇒ “3.2.1 Removing cylinder head, bank 1 (right-side)”, page 132

⇒ “3.2.2 Removing cylinder head, bank 2 (left-side)”, page 134

⇒ “3.2.3 Installing cylinder head”, page 137

3.2.1 Removing cylinder head, bank 1 (right-side)

Special tools and workshop equipment required

♦ Socket XZN M12 (at least 75 mm), commercially available

Procedure

– Remove timing chain cover (right-side) ⇒ page 102 .

– Remove timing chain (right-side) from camshafts ⇒ page 118 .

– Remove intake manifold ⇒ page 266 .

– Remove cylinder head cover ⇒ page 140 .

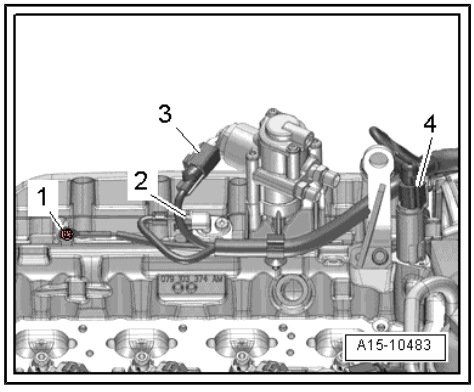
– Unplug electrical connectors:

2 - at Hall sender 4 - G301-

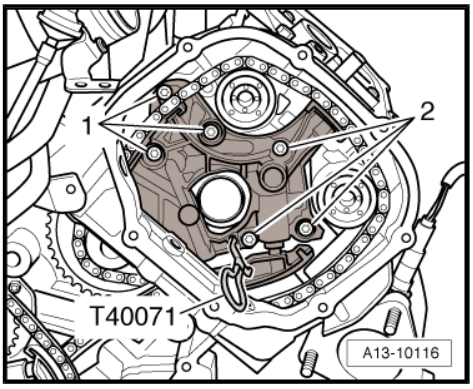
3 - at high-pressure pump (right-side)

4 - at camshaft control valve 1 - N205-

– Remove bolt -1-, detach wiring harness and move clear to one side.



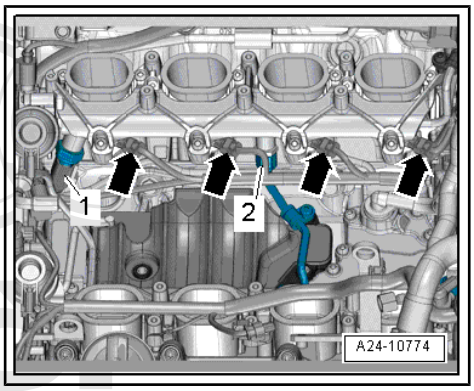
– Remove bolts -1, 2- and take off chain tensioner (right-side).



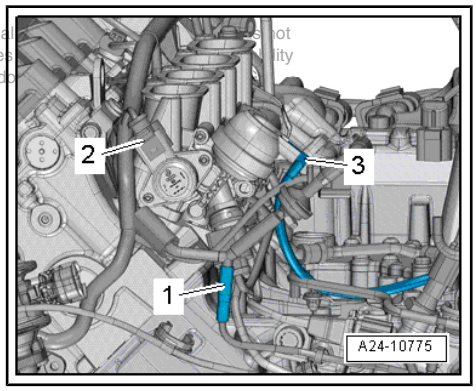
– Unplug electrical connectors -arrows- at injectors and -1- at fuel rail.
– Unscrew high-pressure pipe -2- from connection on fuel rail. To do so, counterhold at hexagon flats with an open-end spanner and loosen union nut.

Note

Do not attempt to bend high-pressure pipe to a different shape.



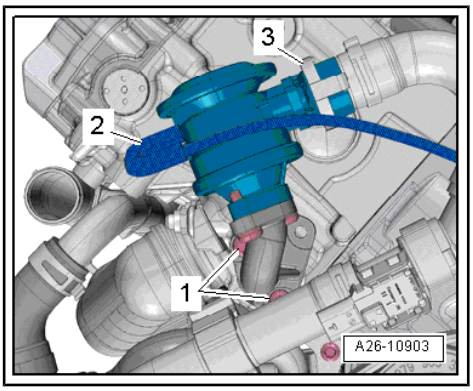
– Unplug electrical connector -2-.
– Detach vacuum hoses -1, 3- and move clear.



– Disconnect vacuum hose -2-.
– Press release tabs and disconnect secondary air hose -3-.

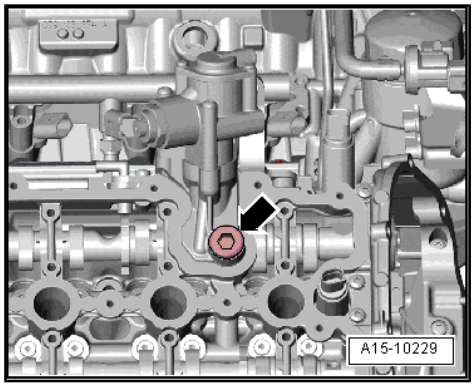
Note

Disregard -item 1-.

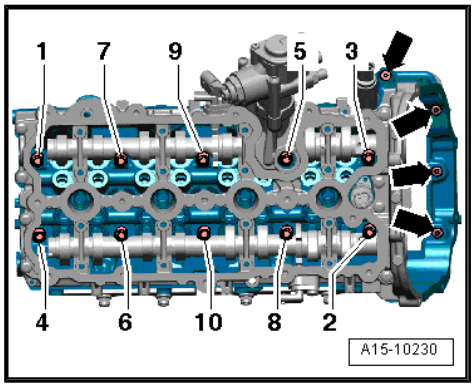


Note

The following illustrations show the left-side cylinder bank 2.



– Remove screw plug -arrow-.
– Move clear electrical wiring.



– Remove bolts -arrows-.
– Slacken cylinder head bolts in the sequence -1 ... 10-.
– Remove bolts and carefully take off cylinder head.
– Place cylinder head onto soft surface (foam plastic).

3.2.2 Removing cylinder head, bank 2 (left-side)

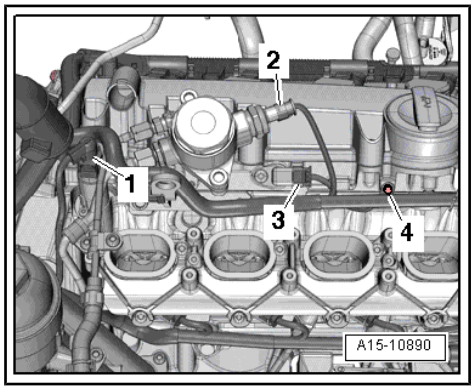
Special tools and workshop equipment required

♦ Socket XZN M12 (at least 75 mm), commercially available

Procedure

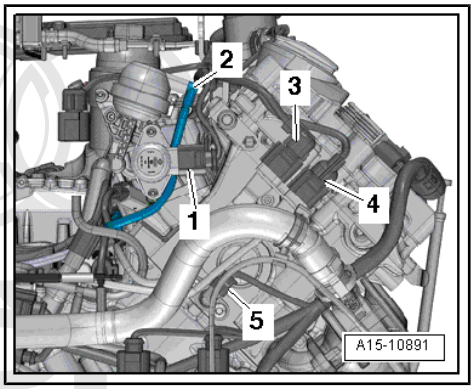
– Remove timing chain cover (left-side) ⇒ page 100 .
– Remove timing chain (left-side) from camshafts ⇒ page 118 .
– Remove intake manifold ⇒ page 266 .
– Remove cylinder head cover (left-side) ⇒ page 140 .
– Remove front silencer ⇒ page 300 .
– Unplug electrical connectors:

1 - at camshaft control valve 2 - N208-
2 - at high-pressure pump (left-side)
3 - at Hall sender 2 - G163-

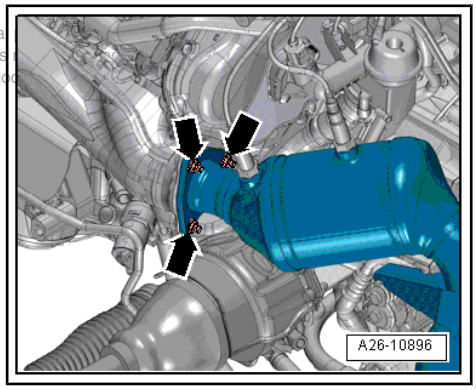


– Remove bolt -4- and move wiring harness to one side.

– Disconnect vacuum hose -2-.
– Unplug electrical connectors -1- and -5-.
– Detach electrical connectors -3- and -4- from bracket.



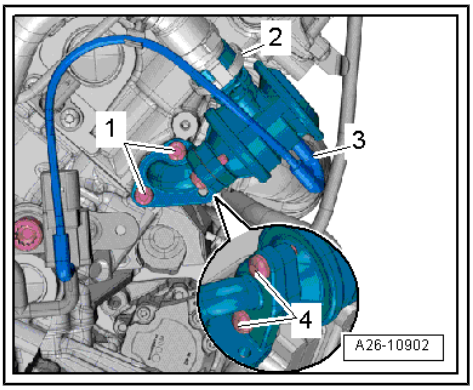
– Unscrew nuts -arrows- and move catalytic converter (left-side) to rear.



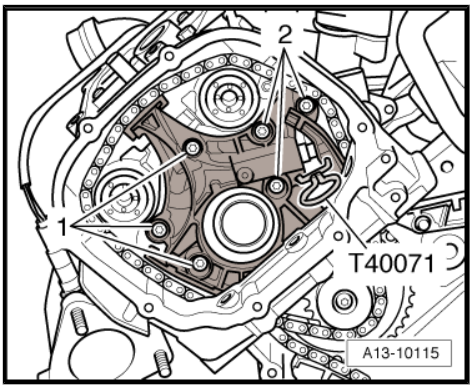
– Disconnect vacuum hose -3-.
– Press release tabs and disconnect secondary air hose -2-.

Note

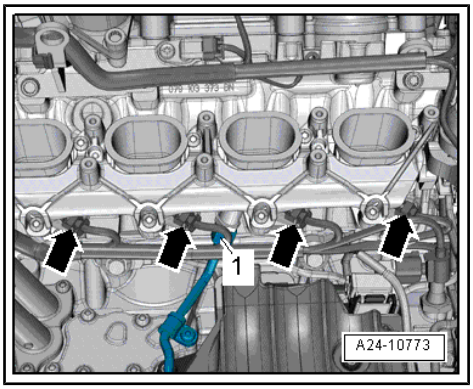
Disregard -items 1, 4-.



– Remove bolts -1, 2- and take off chain tensioner (left-side).



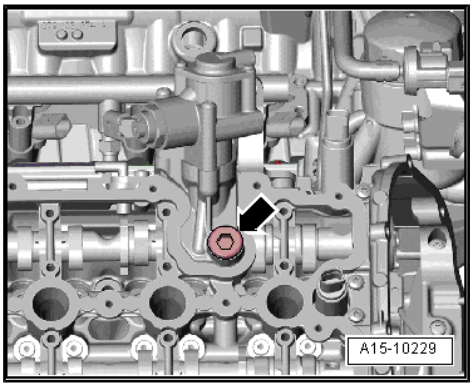
– Unplug electrical connectors -arrows- at injectors.
– Unscrew high-pressure pipe -1- from connection on fuel rail. To do so, counterhold at hexagon flats with an open-end spanner and loosen union nut.



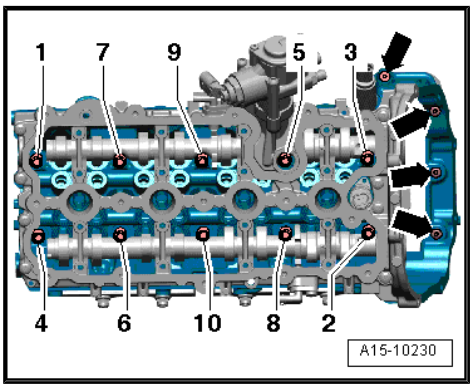
Note

Do not attempt to bend high-pressure pipes to a different shape.

– Remove screw plug -arrow-.
– Move clear electrical wiring.



– Remove bolts -arrows-.
– Slacken cylinder head bolts in the sequence -1 ... 10-.
– Remove bolts and carefully take off cylinder head.
– Place cylinder head onto soft surface (foam plastic).



3.2.3 Installing cylinder head

Procedure

Caution

Avoid damage to sealing surfaces.

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

Avoid damage to cylinder block.

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

Risk of leaks at cylinder head gasket.

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

Avoid damage to open valves.

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

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

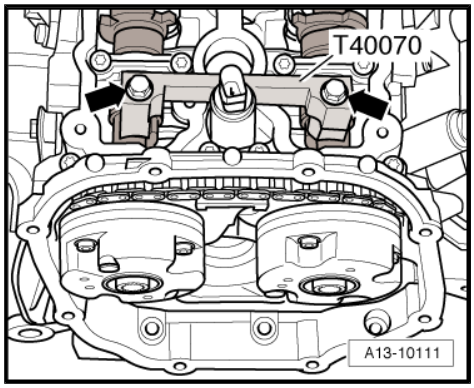
- *Turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

Note

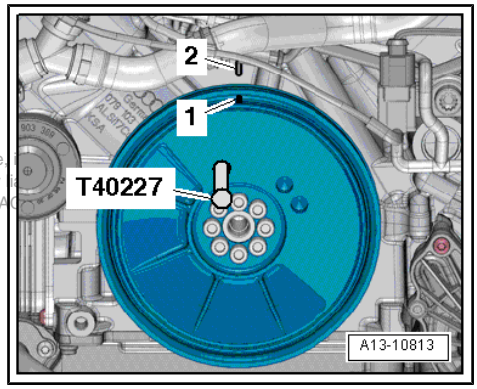
- *Renew the bolts tightened with specified tightening angle.*
- *Renew gaskets, seals and O-rings.*
- *When installing an exchange cylinder head, the contact surfaces between the hydraulic compensation elements, roller rocker fingers and cams must be oiled before installing the cylinder head cover.*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

– Check that camshafts on both cylinder heads are positioned at “TDC”.

• Camshaft clamps - T40070- secured on both cylinder heads and tightened to 25 Nm -arrows-.



• Locking pin -T40227- screwed in.



Note

The following illustrations show the left-side cylinder bank 2.

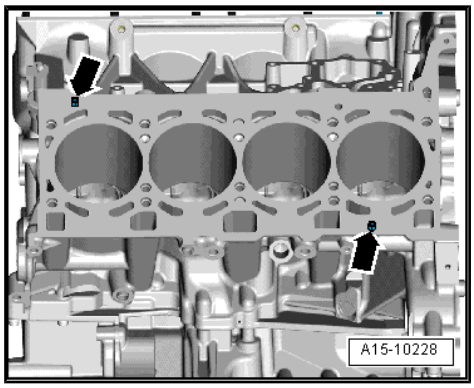
– Fit dowel sleeves -arrows-, if not fitted on the cylinder block at the points marked.

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

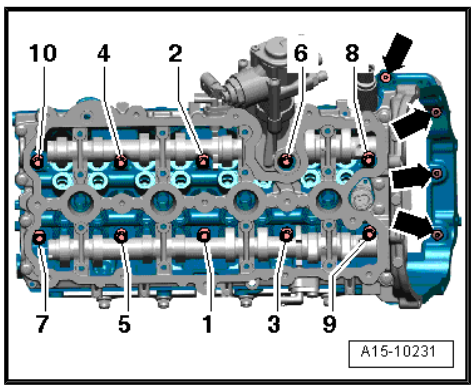
• Installation position of cylinder head gasket: the word “oben” (top) or the part number should face towards the cylinder head.

– Fit cylinder head.

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



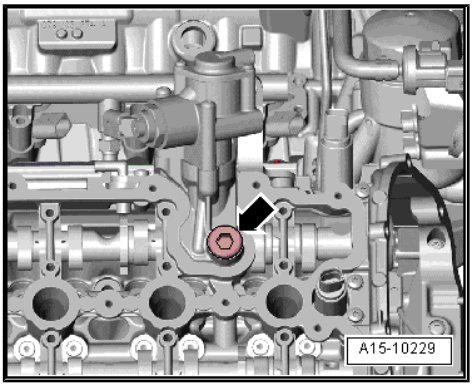
– Tighten cylinder head bolts ⇒ page 131 .



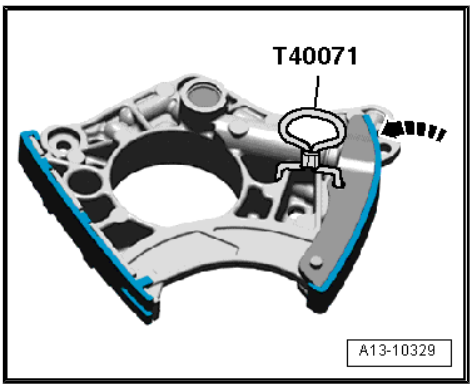
Note

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

– Tighten screw plug -arrow-.



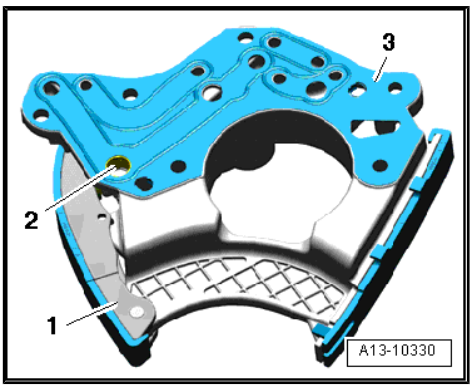
– Make sure that guide rail of chain tensioner for camshaft timing chain is locked with locking pin - T40071- .



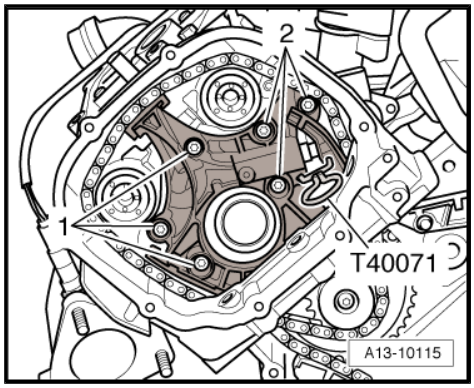
Note

- *Note the correct installation position if the tensioning element has been removed from the chain tensioner: drilling in base of housing faces chain tensioner and piston faces tensioner rail.*
- *Disregard -arrow-.*

– Clean oil strainer -2- of chain tensioner.
– Fit new gasket -3- on rear of chain tensioner -1-.



– Install chain tensioner and fit timing chain as shown in illustration.



– Tighten bolts -1- and -2-.

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

– Install cylinder head cover ⇒ page 140 .
– Install high-pressure pipe ⇒ page 283 .
– Install intake manifold ⇒ page 266 .
– Fit timing chains on camshafts ⇒ page 122 .
– Install timing chain covers: left-side ⇒ page 100 , right-side ⇒ page 102 .
– Change engine oil ⇒ Maintenance ; Booklet 410 .
– Fill cooling system with fresh coolant ⇒ page 196.

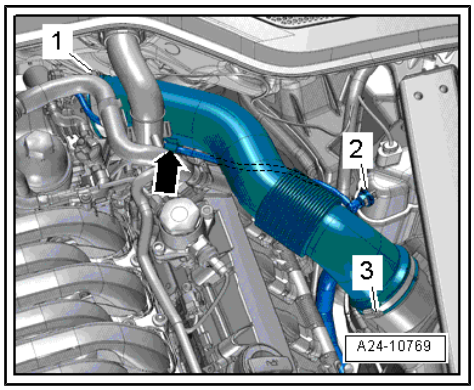
Tightening torques

- ⇒ “3.1 Exploded view - cylinder head”, page 129
- ⇒ Fig. ““Cylinder head - tightening torque and sequence”“ , page 131

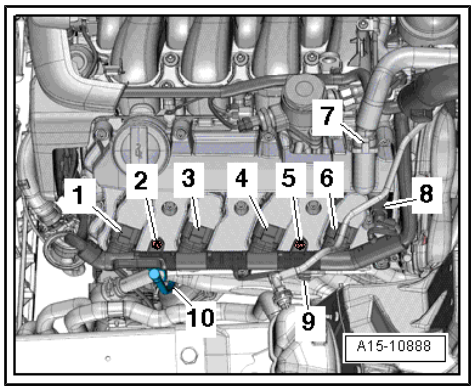
3.3 Removing and installing cylinder head cover

Removing

– Remove engine cover panel ⇒ page 63 .
– Move coolant hose -2- clear -arrow-.
– Loosen hose clips -1- and -3- and remove air pipe.



– Remove bolts -2- and -5-.
– Unplug electrical connectors -1, 3, 4, 6, 8, 9- and move wiring harness clear.



Rest-of-world vehicles:

– Cylinder head (left-side): pull oil dipstick -10- out of guide tube and detach crankcase breather hose -7- (press release tabs).

USA models:

Caution

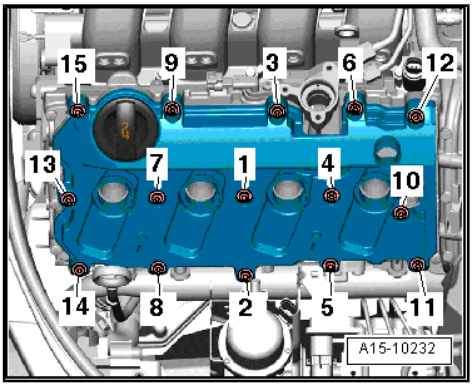
Risk of violating emission legislation applying to USA models.

- *Do NOT open hose connection -7-.*

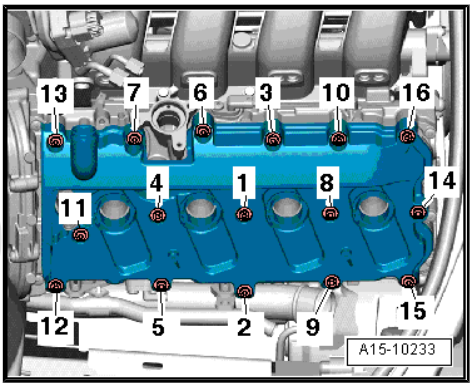
All vehicles (continued):

– Remove ignition coils ⇒ page 323 .

– Slacken bolts for cylinder head cover (left-side) in the sequence -15 ... 1-.



– Slacken bolts for cylinder head cover (right-side) in the sequence -16 ... 1-.



Rest-of-world vehicles:

– Remove bolts and take off cylinder head cover.

USA models:

– Remove bolts and move cylinder head cover to one side with crankcase breather hose connected.

Installing

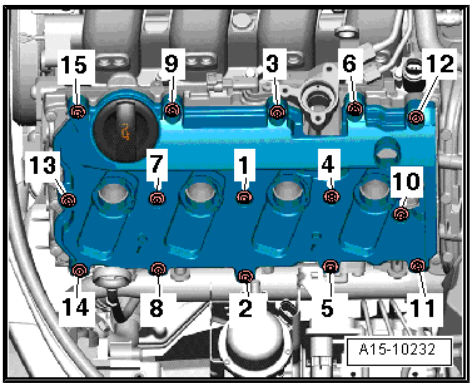
Installation is carried out in the reverse order; note the following:

Note

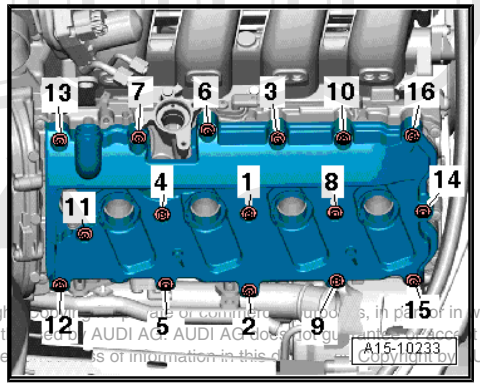
- *Fit new O-ring.*
- *Renew gasket for cylinder head cover if damaged.*
- *Renew bolts for cylinder head cover if seals on bolts are damaged.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

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

– Tighten bolts for cylinder head cover (left-side) ⇒ page 131 .



– Tighten bolts for cylinder head cover (right-side) ⇒ page 131 .
– Install ignition coils ⇒ page 323 .
– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Install air pipe ⇒ page 260 .
– Install engine cover panel ⇒ page 63 .



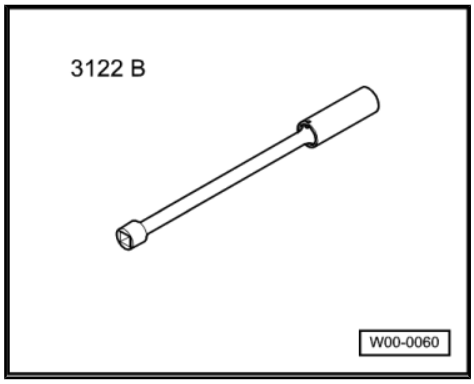
Tightening torques

♦ ⇒ Fig. ""Cylinder head cover (left-side) - tightening torque and sequence"" , page 131

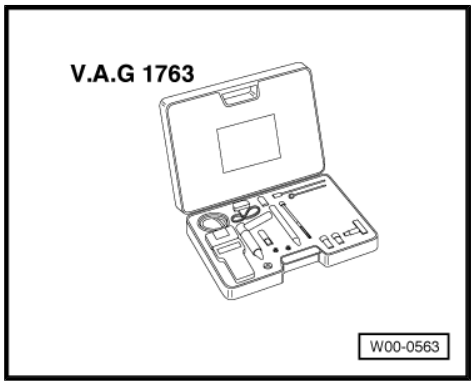
3.4 Checking compression

Special tools and workshop equipment required

♦ Spark plug socket and extension - 3122 B-



♦ Compression tester - V.A.G 1763-



Procedure

• Engine oil temperature at least 30 °C.
• Battery voltage at least 12.5 V.
– Remove ignition coils ⇒ page 323 .
– Remove spark plugs with spark plug socket and extension - 3122 B- .
– Pull out fuel pump fuse ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Check compression pressure with compression tester - V.A.G 1763- .

Note

Using the compression tester ⇒ Operating instructions .

– Have a 2nd mechanic press down the accelerator pedal completely and at the same time operate the starter until the pressure on the tester display no longer increases.

– Repeat procedure on each cylinder.

Compression pressure	bar
When new	10.0 … 14.0
Wear limit	9.0
Maximum difference between cylinders	3.0

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

– Install noise insulation (rear) ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation .

– Install spark plugs ⇒ Maintenance ; Booklet 410 .

– Install ignition coils ⇒ page 323 .

– Erase any entries in event memory resulting from testing ⇒ Vehicle diagnostic tester, `Interrogate event memory`, then `Generate readiness code`.

4 Valve gear

4.1 Exploded view - valve gear

Note

- *Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.*
- *The diagram shows the cylinder head on cylinder bank 2 (left-side).*

1 - Sealing plugs

2 - Valve stem oil seal

- ❑ Removing and installing ⇒ page 157

3 - Valve spring

- ❑ Installation position ⇒ page 146

4 - Hydraulic valve compensation element

- ❑ Clipped into roller rocker finger -item 8-
- ❑ Checking ⇒ page 155
- ❑ Mark installation position for re-installation with a coloured pen
- ❑ Lubricate contact surfaces before installing

5 - Valve spring plate

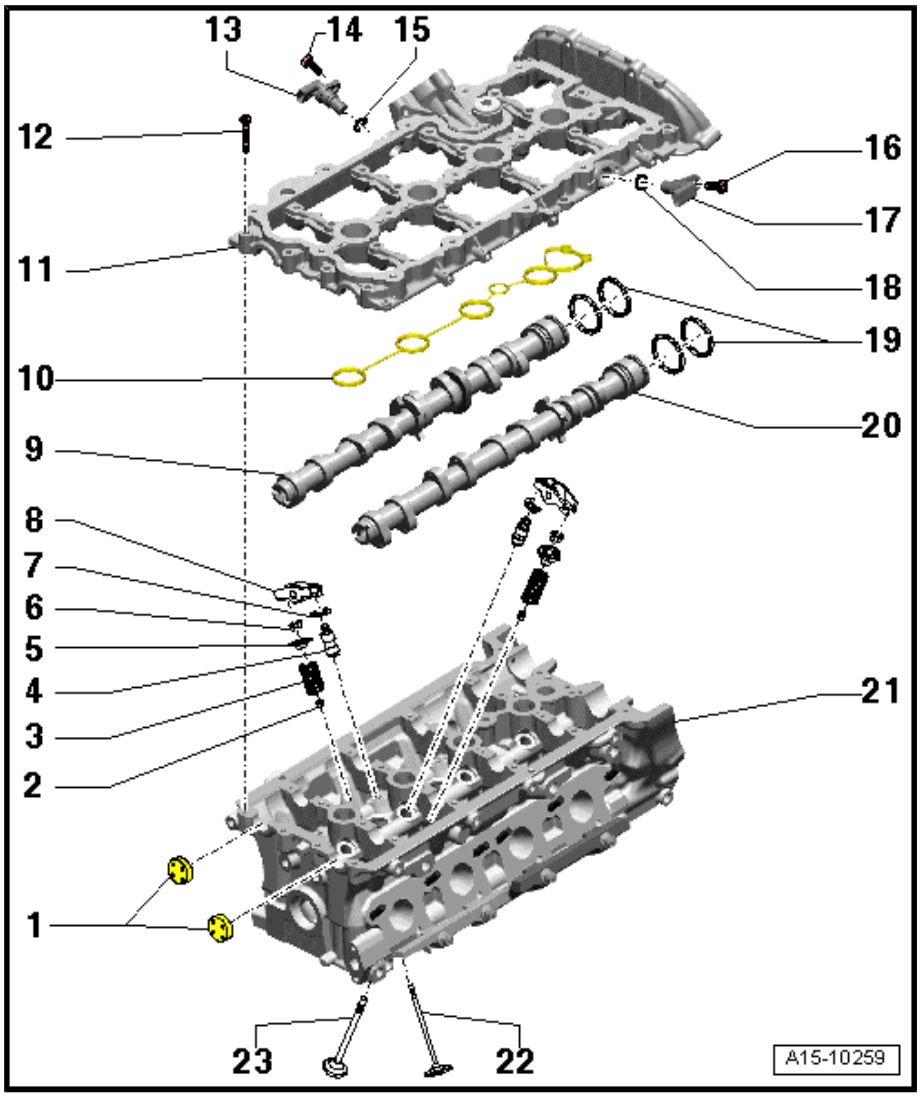
6 - Valve cotters

7 - Securing clip

- ❑ Not supplied separately
- ❑ Check for firm attachment

8 - Roller rocker finger

- ❑ Mark installation position for re-installation with a coloured pen
- ❑ Check roller bearings for ease of movement
- ❑ Lubricate contact surfaces before installing



- ❑ Attach to hydraulic compensation element -item 4- using securing clip -item 7-

9 - Inlet camshaft

- ❑ Removing and installing ⇒ page 148
- ❑ Measuring axial clearance ⇒ page 146
- ❑ Measuring radial clearance ⇒ page 147
- ❑ Runout: max. 0.04 mm

10 - Gasket

- ❑ Renew

11 - Retaining frame

- ❑ With integrated camshaft bearings
- ❑ Removing and installing ⇒ “4.4 Removing and installing camshaft”, page 148

12 - Bolt

- ❑ Renew
- ❑ Use old bolts when measuring radial clearance
- ❑ Tightening sequence ⇒ page 146

13 - Hall sender 2 - G163-

14 - Bolt

- ❑ Tightening torque ⇒ page 322

15 - O-ring

- ❑ Renew

16 - Bolt

- ❑ Tightening torque ⇒ page 322

17 - Hall sender 4 - G301-

18 - O-ring

- ❑ Renew

19 - Rectangular section seals

- ❑ For camshaft adjuster

20 - Exhaust camshaft

- ❑ Removing and installing ⇒ page 148
- ❑ Measuring axial clearance ⇒ page 146
- ❑ Measuring radial clearance ⇒ page 147
- ❑ Runout: max. 0.04 mm

21 - Cylinder head

- ❑ Checking valve guides ⇒ page 165

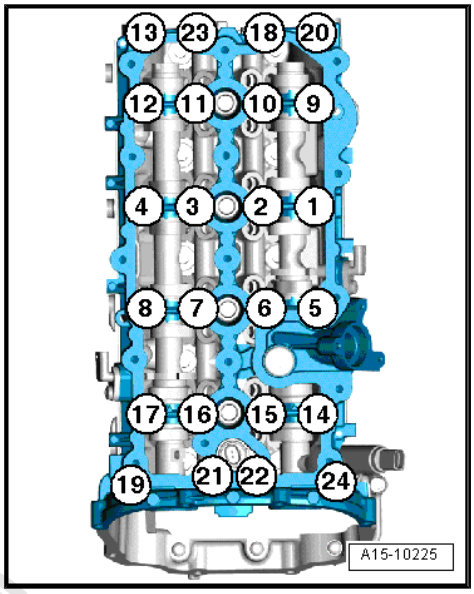
22 - Inlet valve

- ❑ Do not machine, only grinding-in is permitted
- ❑ Mark installation position for re-installation
- ❑ Valve dimensions ⇒ page 166
- ❑ Checking valve guides ⇒ page 165

23 - Exhaust valve

- ❑ Do not machine, only grinding-in is permitted
- ❑ Mark installation position for re-installation
- ❑ Valve dimensions ⇒ page 166
- ❑ Checking valve guides ⇒ page 165

Retaining frame for camshafts - tightening torque and sequence



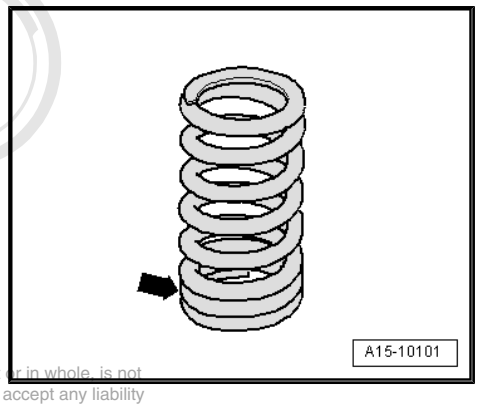
Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts in 3 stages in the sequence shown:

Stage	Bolts	Tightening torque/angle specification
1.	-1 … 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-	8 Nm
3.	-1 … 24-	Turn 90° further

Position of valve spring

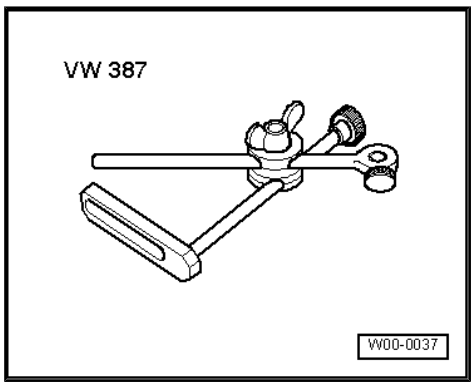


- Closely spaced spring coils -arrow- face towards cylinder head.

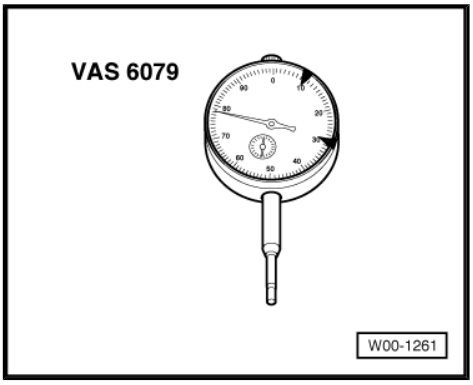
4.2 Measuring axial clearance of camshaft

Special tools and workshop equipment required

♦ Universal dial gauge bracket - VW 387-



♦ Dial gauge - VAS 6079-



Procedure

– Remove retaining frame
⇒ “4.4 Removing and installing camshaft”, page 148 .

– Fit camshaft to be tested in retaining frame.

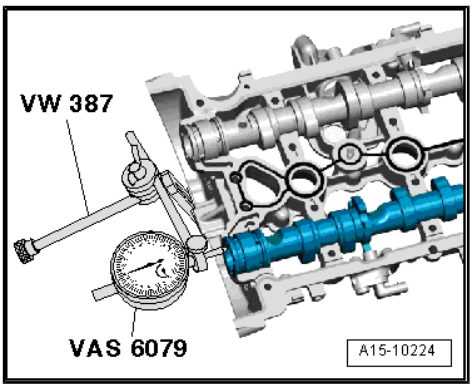
– Attach dial gauge - VAS 6079- with universal dial gauge bracket - VW 387- to retaining frame.

– Press camshaft against dial gauge by hand.

– Set dial gauge to “0”.

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

• Axial clearance: 0.100 ... 0.191 mm



4.3 Measuring radial clearance of camshaft

Special tools and workshop equipment required

♦ Plastigage

Procedure

Note

Use old bolts when measuring radial clearance.

– Remove camshafts ⇒ page 148 .

– Mark allocation of roller rocker fingers for re-installation.

– Carefully remove roller rocker fingers and place them on a clean surface.

– Clean bearings and bearing journals.

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

• The Plastigage must be positioned in the centre of the bearing.

– Re-insert camshafts, fit retaining frame and secure with old bolts without rotating camshafts ⇒ page 146 .

– Remove retaining frame and camshafts again.

– Compare width of Plastigage with measurement scale.

Radial clearance:

• 24 mm bearing diameter: 0.024 ... 0.066 mm

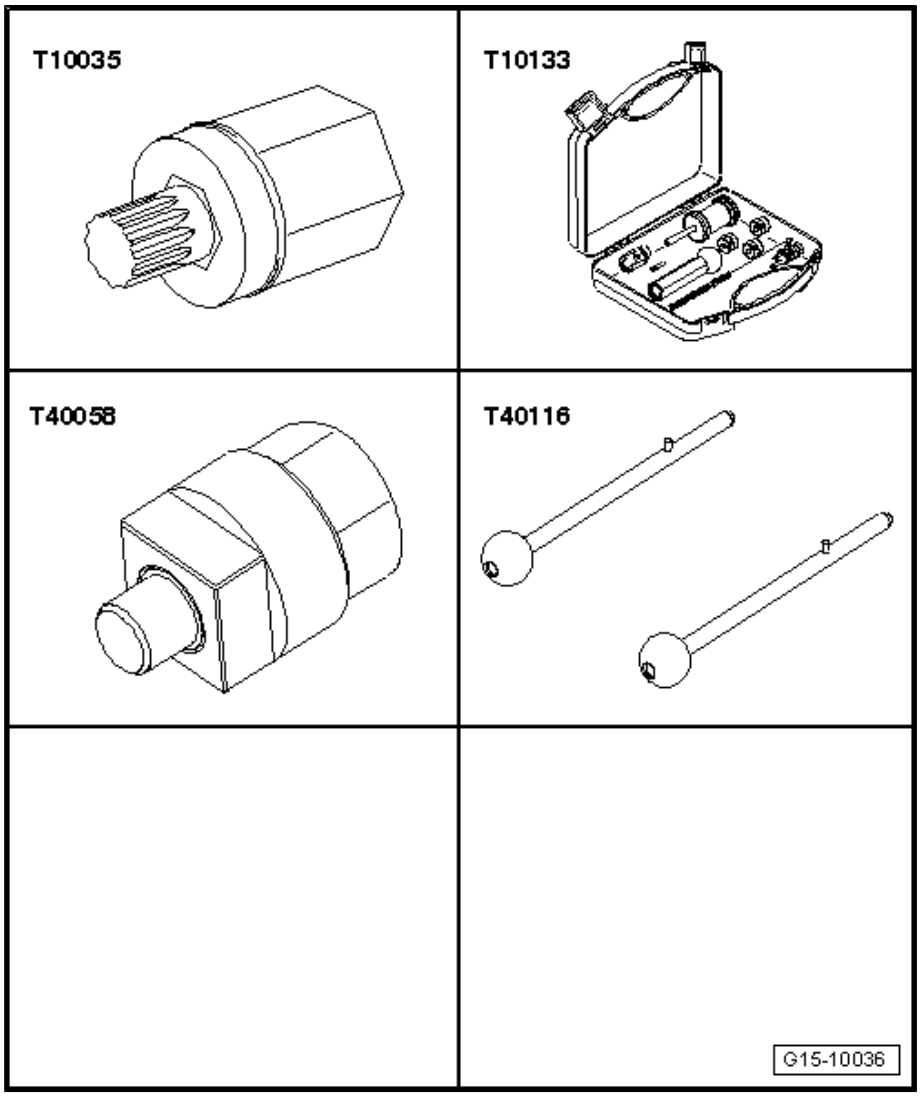
• 36 mm bearing diameter: 0.032 ... 0.078 mm

– When carrying out final assembly, renew bolts.

4.4 Removing and installing camshaft

Special tools and workshop equipment required

- Special wrench - T10035-
- Impact extractor attachment -T10133/3- from tool set for FSI engines - T10133-
- Adapter - T40058-
- Locating pins - T40116-
- Electric drill with plastic brush attachment
- Safety goggles
- Sealant ⇒ Electronic parts catalogue



Removing

Note

The following description is for removing and installing at the cylinder bank 2 (left-side).

– Remove timing chain from camshafts on relevant side ⇒ page 118 .

– Unplug electrical connectors:

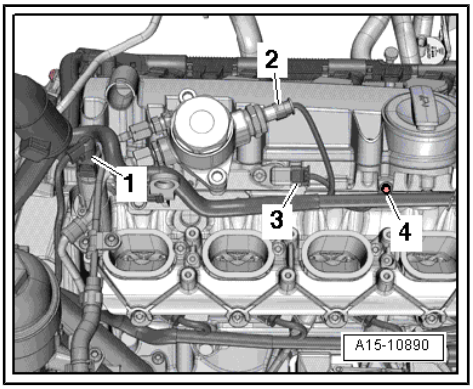
1 - at camshaft control valve 2 - N208-

2 - at high-pressure pump (left-side)

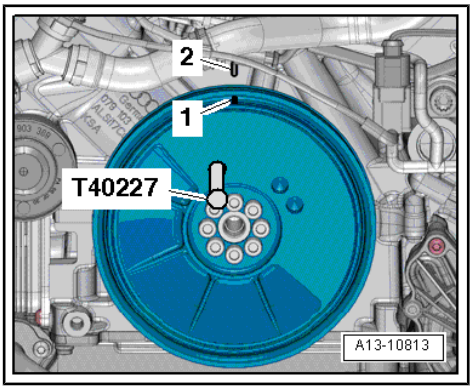
3 - at Hall sender 2 - G163-

– Remove bolt -4- and move wiring harness clear.

– Remove high-pressure pump ⇒ page 281 .

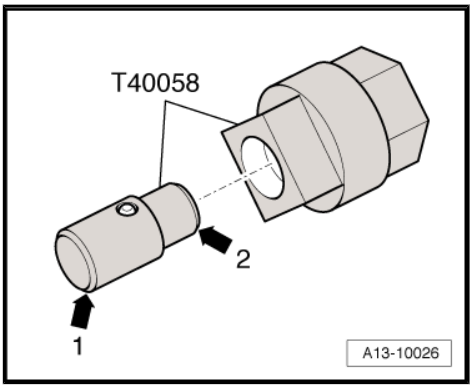


– Remove locking pin -T40227- .



– Insert guide pin of adapter -T40058- as follows:

- The larger-diameter section -arrow 1- faces towards the engine.
- The smaller-diameter section -arrow 2- faces the adapter.

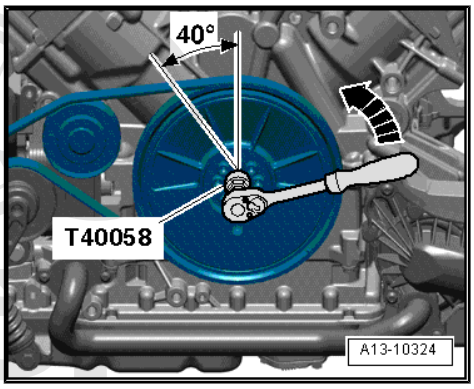


Caution

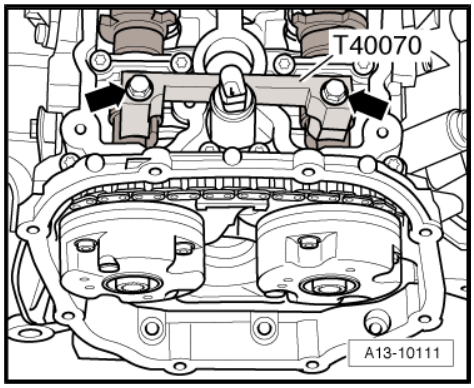
Avoid damage to valves and piston crowns.

- ***When performing the following steps, the crankshaft must not be at "TDC" position at any cylinder.***

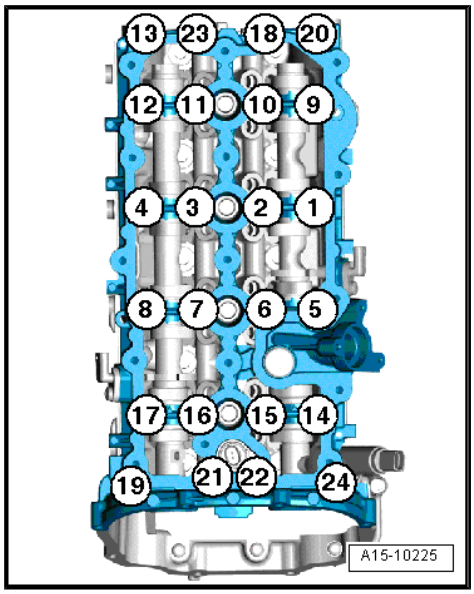
– Using adapter - T40058- , turn crankshaft back through 40° out of "TDC" position in opposite direction to normal rotation -arrow-.



– Remove camshaft clamp - T40070- -arrows-.



– Slacken and remove bolts in the sequence: -24 ... 1-.



Note

Perform the same procedure (laterally reversed) on retaining frame (right-side).

– Carefully release retaining frame from bonded joint and detach.

– Mark allocation of camshafts for re-installation.

– Carefully remove camshafts and place them on a clean surface.

Installing

Note

- *Renew all seals and gaskets.*
- *Renew the bolts tightened with specified tightening angle.*

Caution

Protect lubrication system and bearings against contamination.

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

WARNING

Risk of eye injury.

- ***Wear 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.

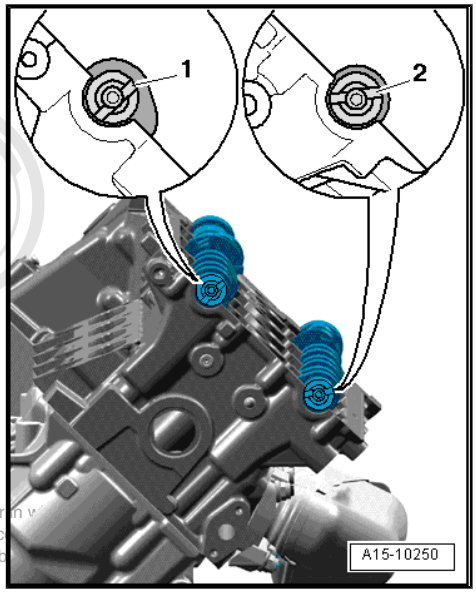
– Insert camshafts in cylinder head; note position of camshafts to make sure retaining frame is fitted free of stress.

Cylinder head (left-side):

1 - Inlet camshaft

2 - Exhaust camshaft

- The groove on the end of the shaft must be positioned as shown in the illustration.

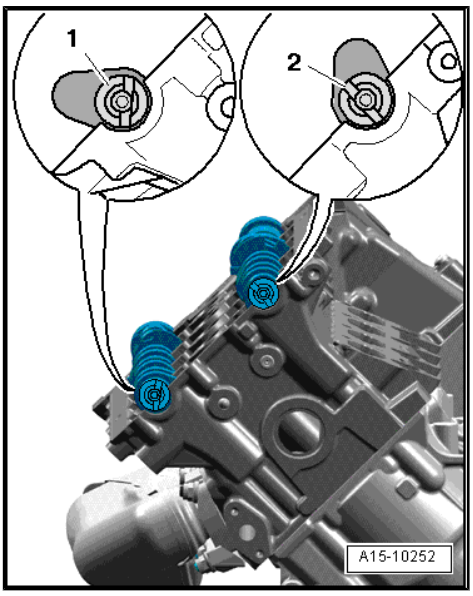


Cylinder head (right-side):

1 - Exhaust camshaft

2 - Inlet camshaft

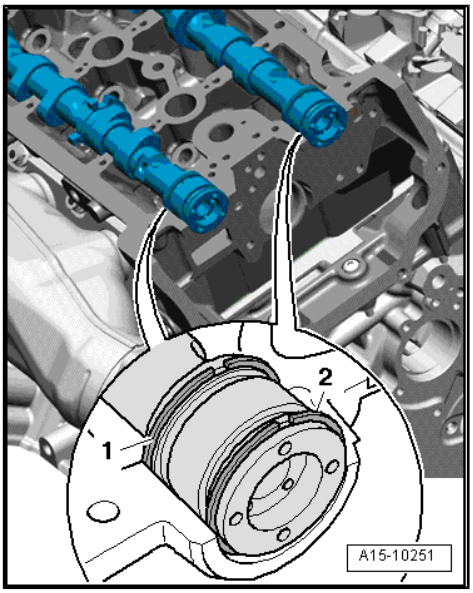
- The groove on the end of the shaft must be positioned as shown in the illustration.



Continuation for both sides:

– Check position of ends of rectangular section seals.

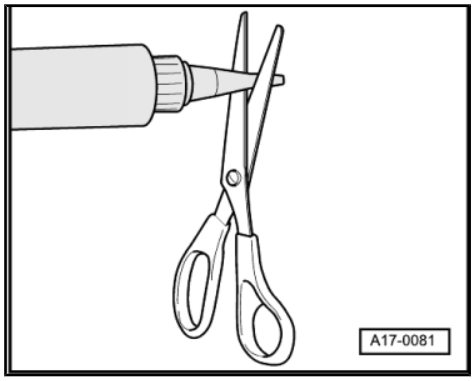
- The ends of the rectangular section seals -1 and 2- must point up or down, never to the side.



Note

Note the use-by date of the sealant.

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

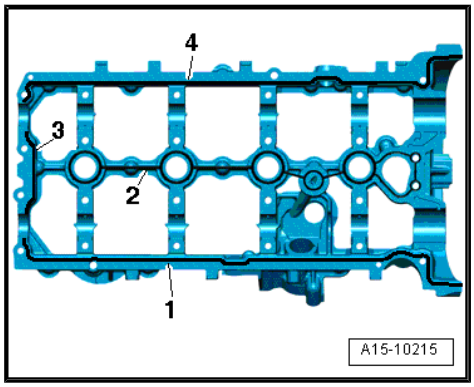


– Fit gasket -2- in grooves on retaining frame.

Caution

Make sure excess sealant does not contaminate camshaft bearings.

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



– Apply beads of sealant -1, 3, 4- onto clean sealing surfaces of retaining frame as shown in illustration.

- Width of beads of sealant: 2.5 mm.

Note

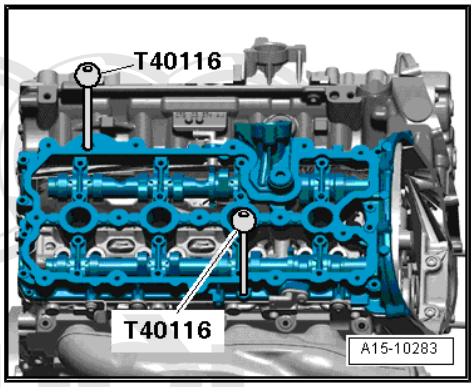
The retaining frame must be installed within 5 minutes after applying the sealant.

– Fit retaining frame onto cylinder head.

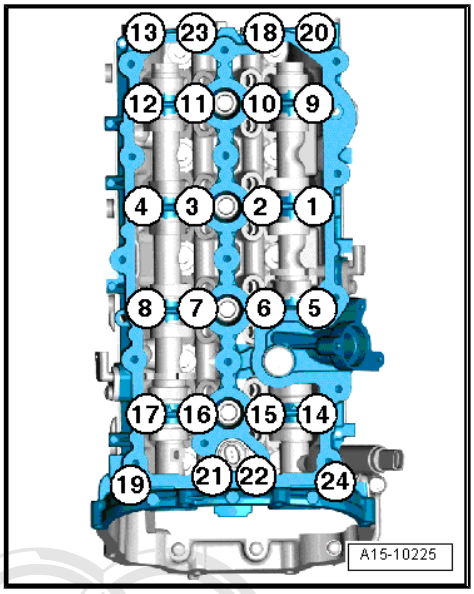
Note

Make sure that camshafts can be inserted into axial bearing of retaining frame without applying force.

– Insert locating pins - T40116- in retaining frame and cylinder head.



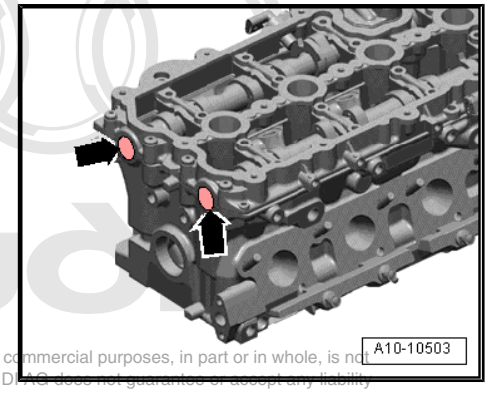
– Tighten bolts for retaining frame ⇒ page 146 .



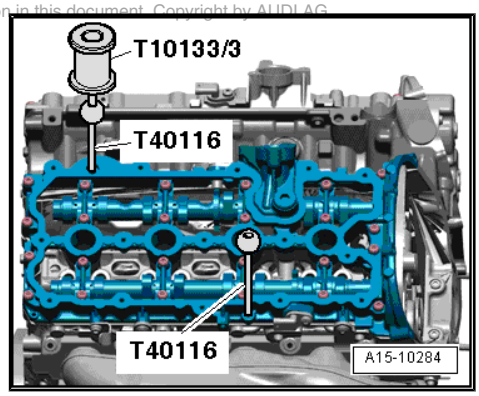
Note

After installing the retaining frame, the sealant must dry for approx. 30 minutes.

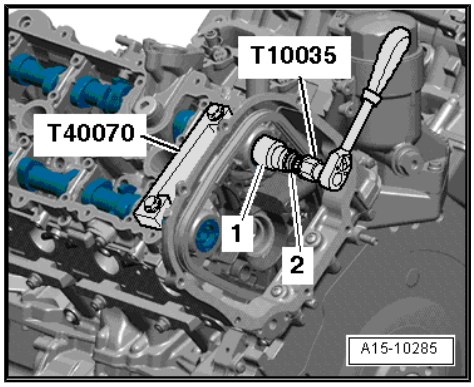
– Drive in sealing plugs -arrows- until flush.



– Use impact extractor attachment -T10133/3- to pull out locating pins - T40116- .



– Turn inlet camshaft to “TDC” position; to do so, fit a socket (24 mm) -item 1- between inlet camshaft and camshaft adjuster bolt -2- and secure camshaft adjuster bolt to camshaft as shown in illustration.



Note

Use pliers to counterhold socket when tightening bolt.

– Apply lever or ratchet with special wrench - T10035- and turn camshaft until threaded hole for camshaft clamp - T40070- points upwards.

– Initially screw bolt for camshaft clamp - T40070- only a few turns into inlet camshaft.

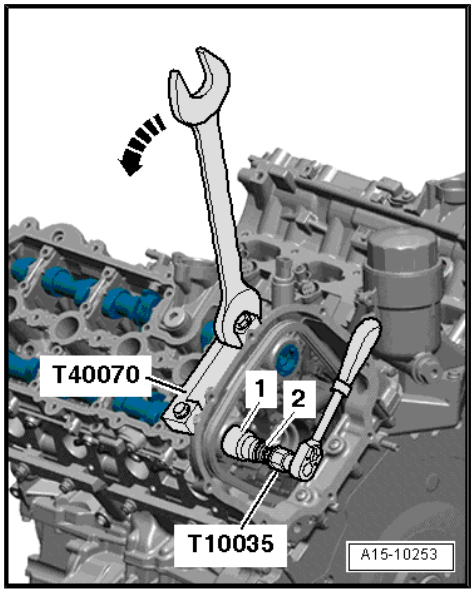
• The camshaft clamp - T40070- is positioned correctly if the holes for the cylinder head bolts remain free.

– Fit camshaft adjuster bolt -2- and socket (24 mm) -item 1- onto exhaust camshaft.

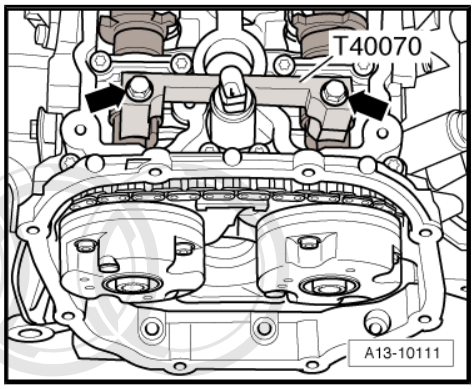
– Turn exhaust camshaft until threaded hole for camshaft clamp - T40070- points upwards.

– At the same time apply open-end spanner (24 mm) to camshaft clamp - T40070- and pivot camshaft clamp - T40070- towards exhaust camshaft -arrow- until camshaft clamp can be fastened.

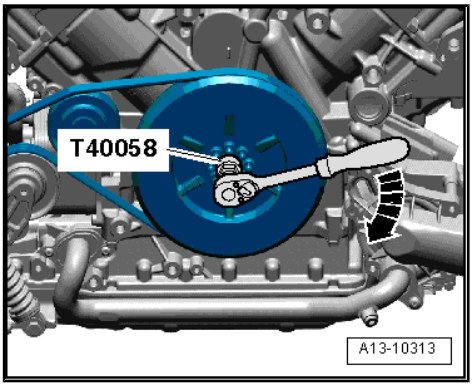
– Secure camshaft clamp - T40070- to exhaust camshaft only hand-tight, to avoid damaging the thread (assistance of second mechanic required).



– Tighten bolts on camshaft clamp - T40070- to 25 Nm -arrows-.

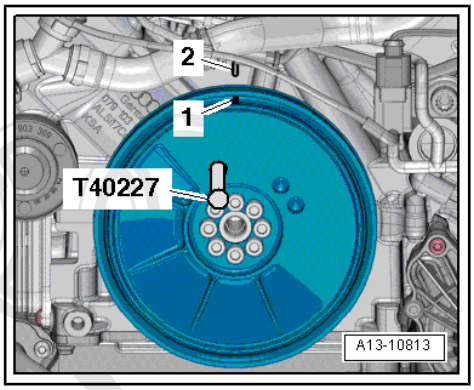


– Turn crankshaft with adapter - T40058- in normal direction of rotation -arrow- to “TDC position”.



• Marks -1- at vibration damper and -2- on cylinder block must be opposite one another.

– Screw in locking pin -T40227- through bore in vibration damper into cylinder block by hand until it makes contact. If necessary, turn crankshaft backwards and forwards slightly to fully centralise locking pin.



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

– Install high-pressure pump ⇒ page 281 .

– Fit timing chains on camshafts ⇒ page 122 .

Caution

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

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

Tightening torques

- ⇒ Fig. ““Retaining frame for camshafts - tightening torque and sequence”“ , page 146

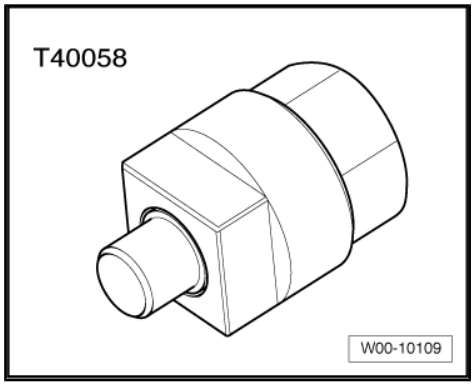
4.5 Checking hydraulic valve compensation elements

Note

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

Special tools and workshop equipment required

♦ Adapter - T40058-



♦ Feeler gauge

Procedure

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

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

Note

If irregular valve noise disappears but repeatedly re-occurs when travelling short distances, renew oil retention valve. Fitting location of oil retention valve
⇒ "1.1 Exploded view - sump/oil pump", page 167 .

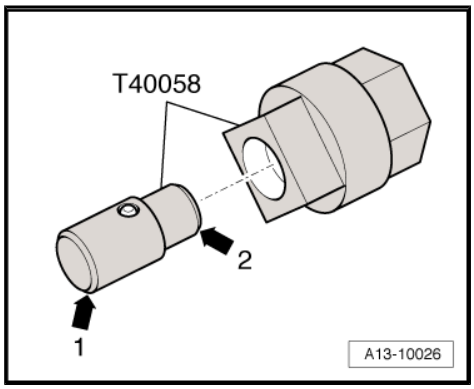
– If the compensation elements are still noisy, locate the defective compensation element as follows:

– Remove cylinder head cover ⇒ page 140 .

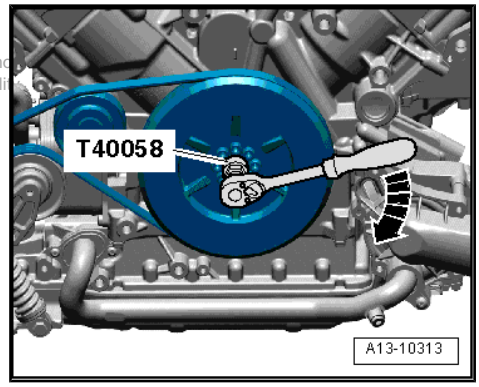
– Insert guide pin of adapter -T40058- as follows:

• The larger-diameter section -arrow 1- faces towards the engine.

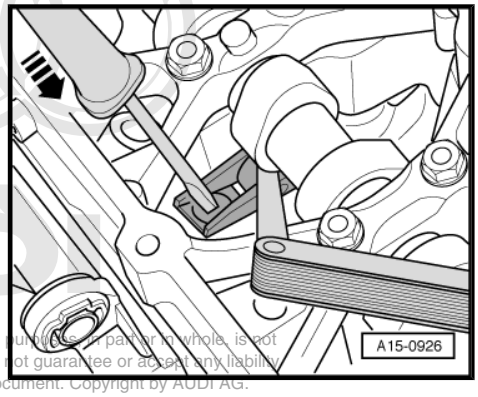
• The smaller-diameter section -arrow 2- faces the adapter.



– Turn crankshaft with adapter - T40058- in direction of engine rotation -arrow- until cam of compensation element to be tested is at top.



– 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
⇒ “4.4 Removing and installing camshaft”, page 148 .



Additional steps required

– Install cylinder head cover ⇒ page 140 .

4.6 Removing and installing valve stem oil seals

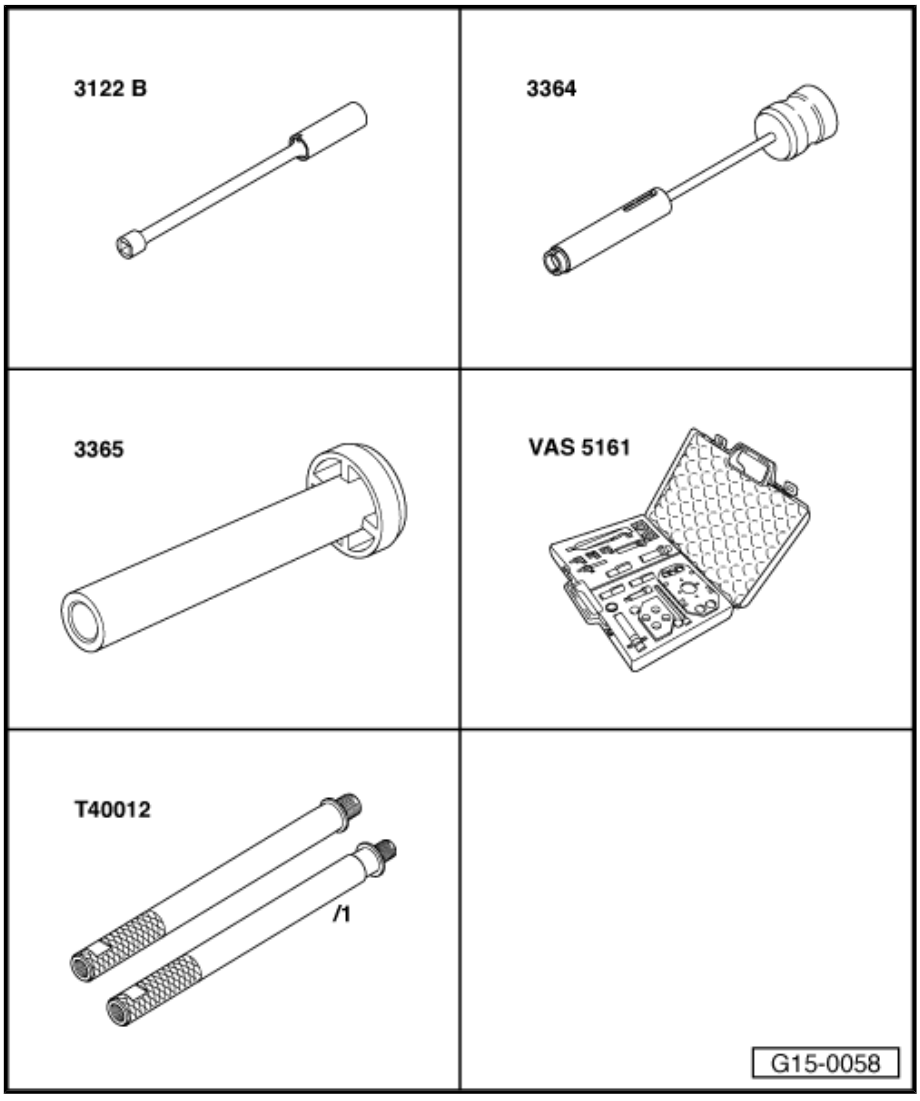
⇒ “4.6.1 Removing and installing valve stem oil seals (cylinder head installed)”, page 157

⇒ “4.6.2 Removing and installing valve stem oil seals (cylinder head removed)”, page 161

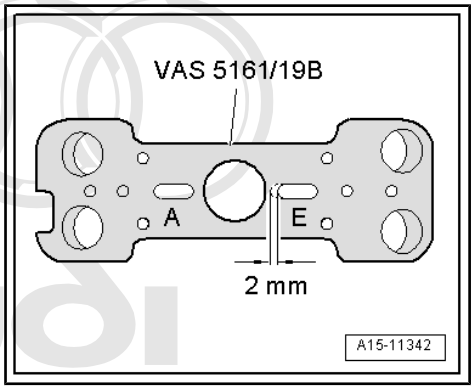
4.6.1 Removing and installing valve stem oil seals (cylinder head installed)

Special tools and workshop equipment required

- Spark plug socket and extension - 3122 B-
- Valve stem seal puller - 3364-
- Valve stem seal fitting tool - 3365-
- Removal and installation device for valve cotters - VAS 5161 A- with guide plate -VAS 5161/19C- , or substitute -VAS 5161/19B-
- Adapter - T40012-



Modifying guide plate for 2.0 ltr. and 3.0 ltr. FSI engine - VAS 5161/19B- :



Note

Guide plate for 2.0 ltr. and 3.0 ltr. FSI engine - VAS 5161/19B- may also be used instead of guide plate -VAS 5161/19C- . To do so, it must be modified as follows:

– Lengthen elongated hole by 2 mm, as shown in the illustration.

Note

In this case, the guide plate is only secured on cylinder head with one knurled screw.

Procedure

– Remove camshafts ⇒ page 148 .

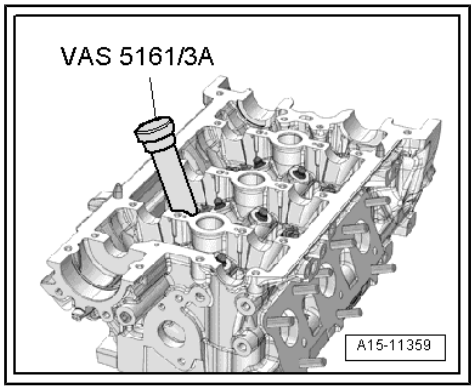
– Mark original positions of roller rocker fingers and hydraulic compensation elements for reinstallation.

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

– Remove spark plugs with spark plug socket and extension - 3122 B- .

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

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



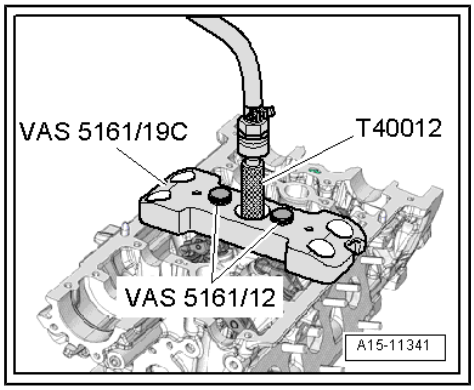
– Fit guide plate -VAS 5161/19C- from removal and installation device for valve cotters - VAS 5161 A- on cylinder head.

– Secure guide plate with knurled screws -VAS 5161/12- .

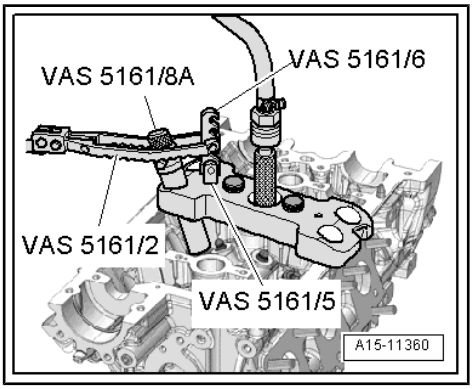
– Screw adapter - T40012- with seal hand-tight into the corresponding spark plug thread.

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

• Minimum pressure: 6 bar

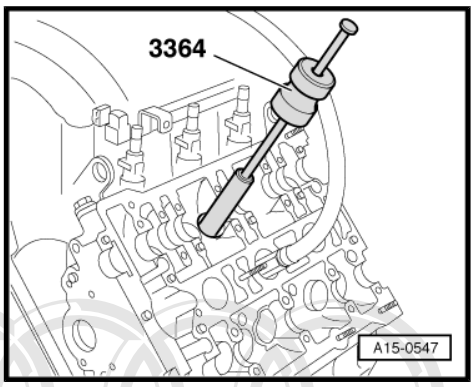


– Screw snap-in device -VAS 5161/6- with engaging fork - VAS 5161/5- into guide plate.
– Insert assembly cartridge -VAS 5161/8A- in guide plate.
– Attach pressure fork -VAS 5161/2- to snap-in device and push assembly cartridge down.
– At the same time, turn knurled screw of assembly cartridge clockwise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



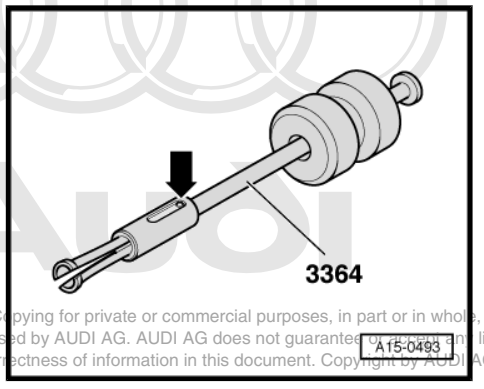
• The compressed air hose remains connected.

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

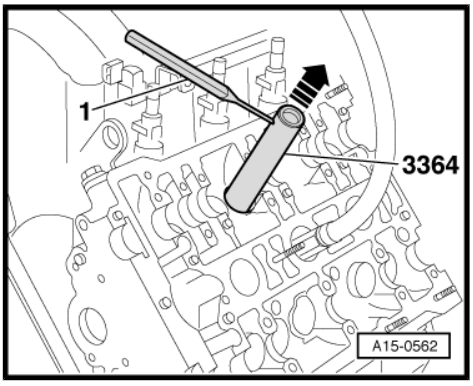


If the valve stem seal puller - 3364- cannot be used on some of the valve stem oil seals due to the confined space, proceed as follows:

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



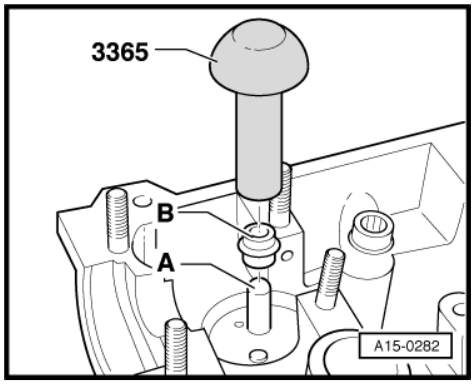
– Apply bottom section of puller -3364- to valve stem oil seal.
– Secure puller with a punch or roll-pin drift -1-, as shown in illustration.
– Apply assembly lever to puller and pull out valve stem oil seal -arrow-.



Caution

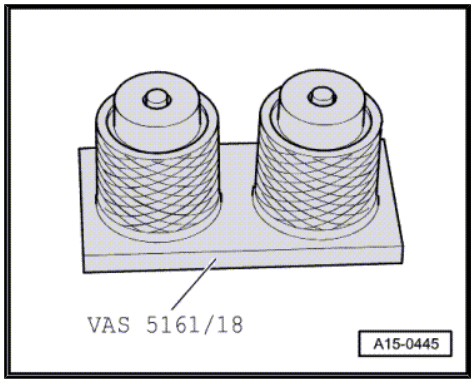
Make sure valve stem oil seals are not damaged when installing.

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



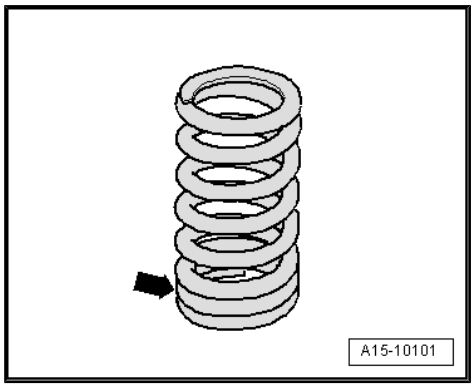
– Lightly oil sealing lip of valve stem oil seal.
– Slide valve stem oil seal onto plastic sleeve.
– Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool - 3365- .
– Remove plastic sleeve.

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

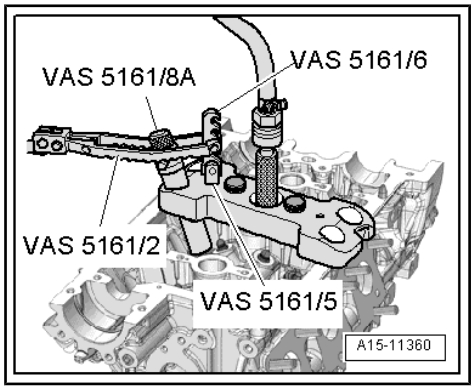


• Larger diameter of valve cotters faces upwards.
– Press assembly cartridge onto insertion device from above and take up valve cotters.

– Insert valve spring and valve spring plate.
• The closely spaced spring coils -arrow- face the cylinder head.



– Secure guide plate -VAS 5161/19C- back onto cylinder head.
– Insert assembly cartridge in guide plate.
– 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.



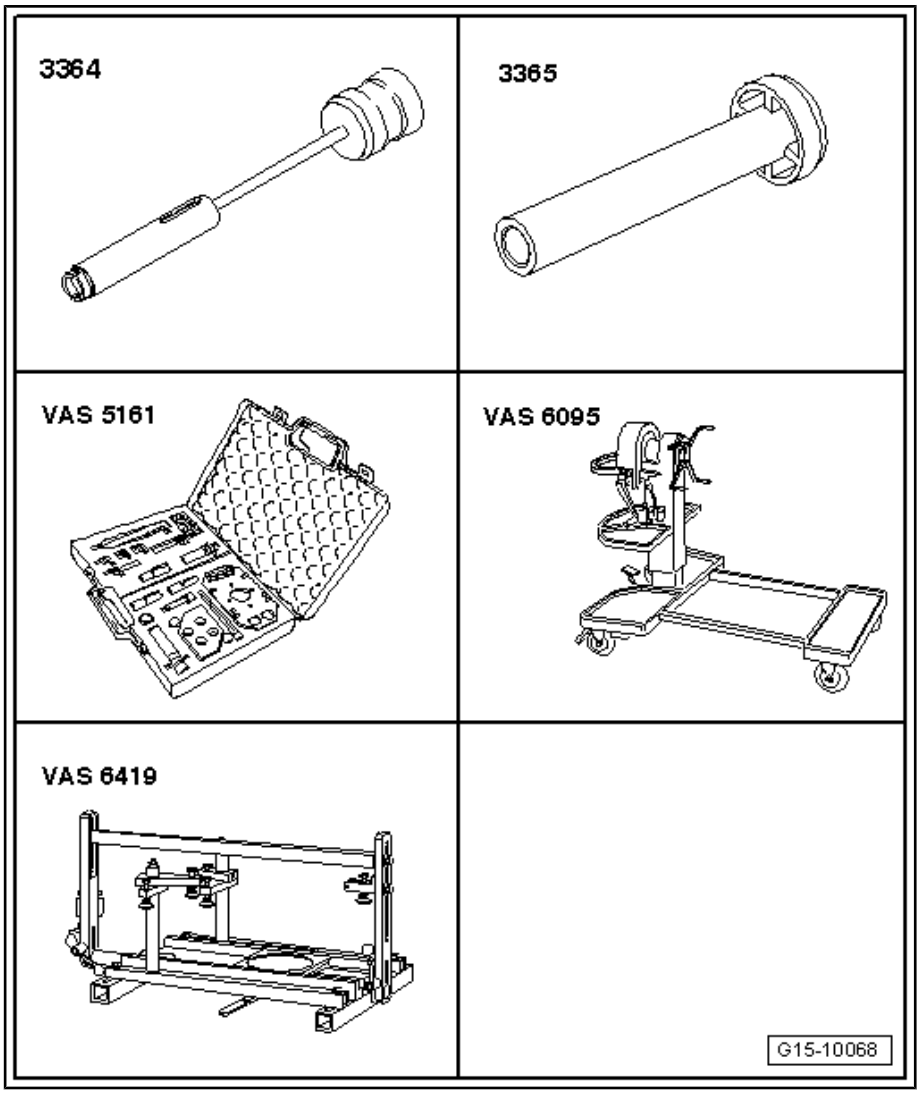
Assembling

– 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 spark plugs ⇒ Maintenance ; Booklet 410 .
– Install camshafts ⇒ page 148 .

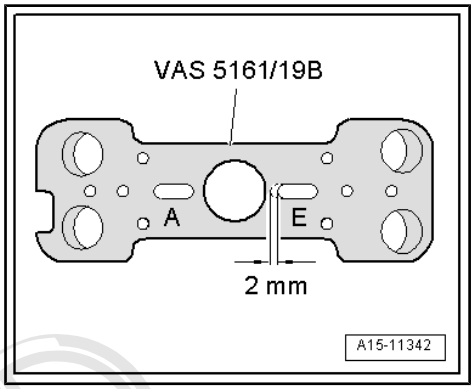
4.6.2 Removing and installing valve stem oil seals (cylinder head removed)

Special tools and workshop equipment required

- Valve stem seal puller - 3364-
- Valve stem seal fitting tool - 3365-
- Removal and installation device for valve cotters - VAS 5161 A- with guide plate -VAS 5161/19C- , or substitute -VAS 5161/19B-
- Engine and gearbox support - VAS 6095-
- Cylinder head tensioning device - VAS 6419-



Modifying guide plate for 2.0 ltr. and 3.0 ltr. FSI engine - VAS 5161/19B- :



Note

Guide plate for 2.0 ltr. and 3.0 ltr. FSI engine - VAS 5161/19B- may also be used instead of guide plate -VAS 5161/19C- . To do so, it must be modified as follows:

– Lengthen elongated hole by 2 mm, as shown in the illustration.

Note

In this case, the guide plate is only secured on cylinder head with one knurled screw.

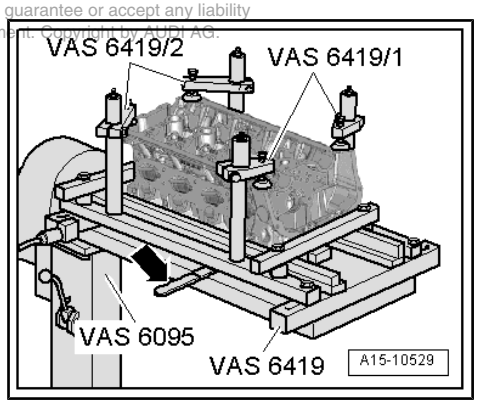
Procedure

– Remove camshafts ⇒ page 148 .

– Mark original positions of roller rocker fingers and hydraulic compensation elements for reinstallation.

– 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- .



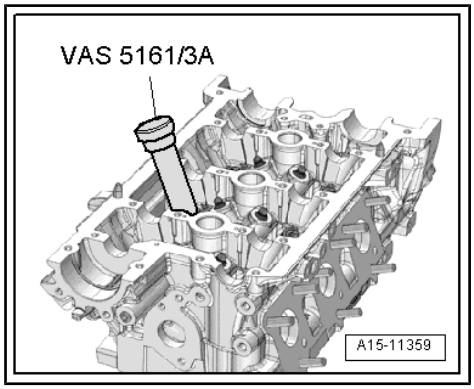
– Secure cylinder head in cylinder head tensioning device, as shown in illustration.

– Connect cylinder head tensioning device to compressed air.

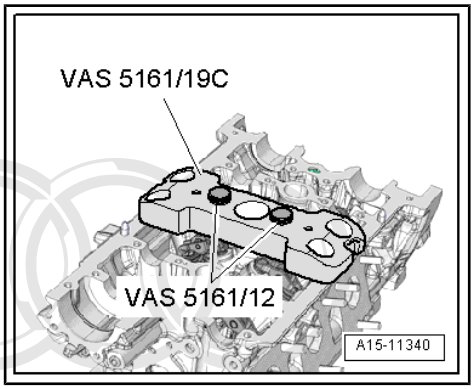
– Using lever -arrow-, slide air pad under combustion chamber where valve stem oil seal is to be removed.

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

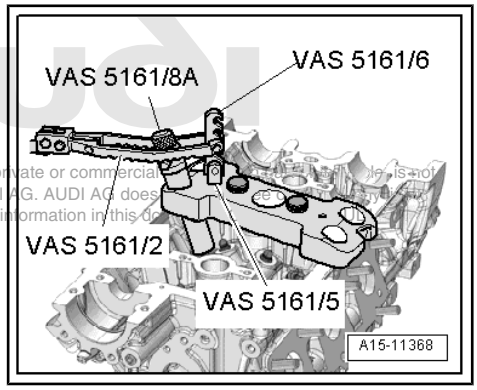
– Apply drift -VAS 5161/3A- to valve spring plate and use plastic-headed hammer to release sticking valve cotters.



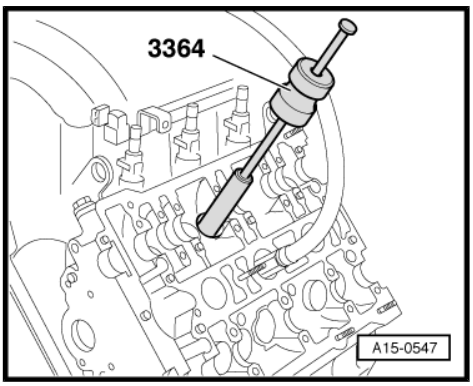
– Fit guide plate -VAS 5161/19C- from removal and installation device for valve cotters - VAS 5161 A- on cylinder head.
– Secure guide plate with knurled screws -VAS 5161/12- .



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



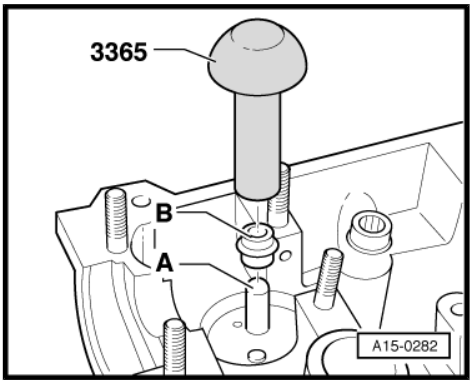
– Pull off valve stem oil seal with valve stem seal puller - 3364- .



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.***

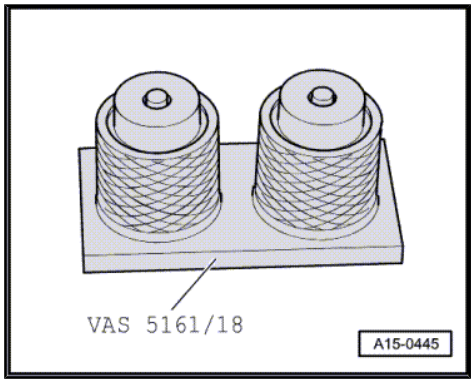


– Lightly oil sealing lip of valve stem oil seal.
– Slide valve stem oil seal onto plastic sleeve.
– Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool - 3365- .
– Remove plastic sleeve.

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

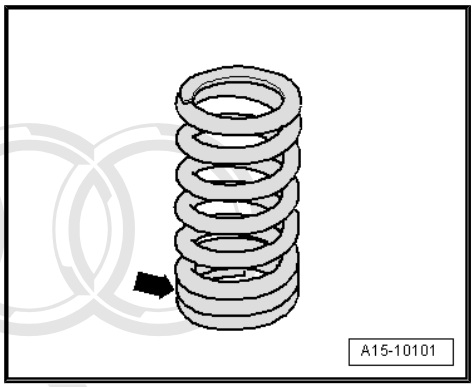
- Larger diameter of valve cotters faces upwards.

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



– Insert valve spring and valve spring plate.

- The closely spaced spring coils -arrow- face the cylinder head.



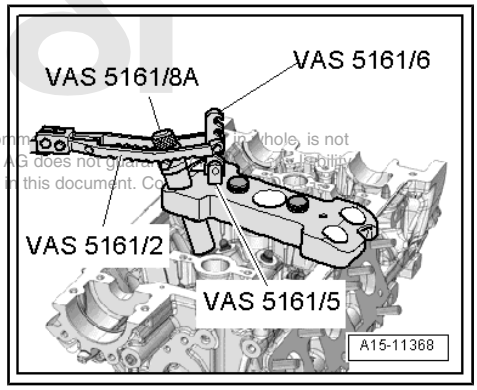
– Secure guide plate -VAS 5161/19C- back onto cylinder head.

– Insert assembly cartridge in guide plate.

– 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.

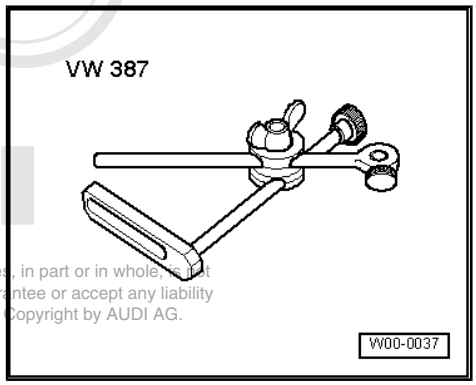
– Install camshafts ⇒ page 148 .

5 Inlet and exhaust valves

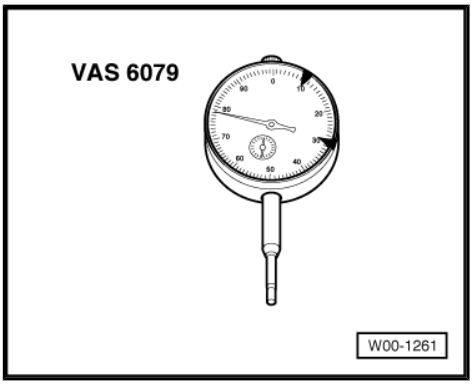
5.1 Checking valve guides

Special tools and workshop equipment required

- Universal dial gauge bracket - VW 387-



- Dial gauge - VAS 6079-

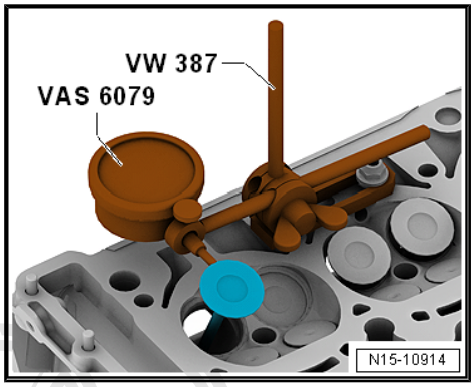


Procedure

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.*

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



– Insert valve into guide.

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

– Measure the amount of sideways play.

• Wear limit: 0.8 mm.

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

– Renew cylinder head if wear limit is still exceeded.

Note

Valve guides cannot be renewed.

5.2 Checking valves

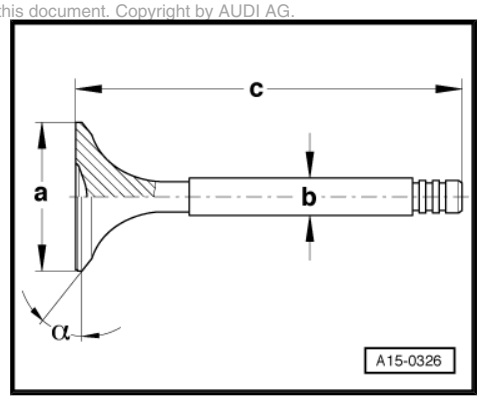
– Visually inspect for scoring on valve stems and valve seat surfaces.

– Renew valve if scoring is clearly visible.

5.3 Valve dimensions

Note

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



Dimension		Inlet valve	Exhaust valve
∅ a	mm	33.85 ± 0.10	28.0 ± 0.1
∅ b	mm	5.98 ± 0.01	5.96 ± 0.01
c	mm	103.97 ± 0.20	101.9 ± 0.2
α	∠°	45	45

WARNING

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

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

17 – Lubrication

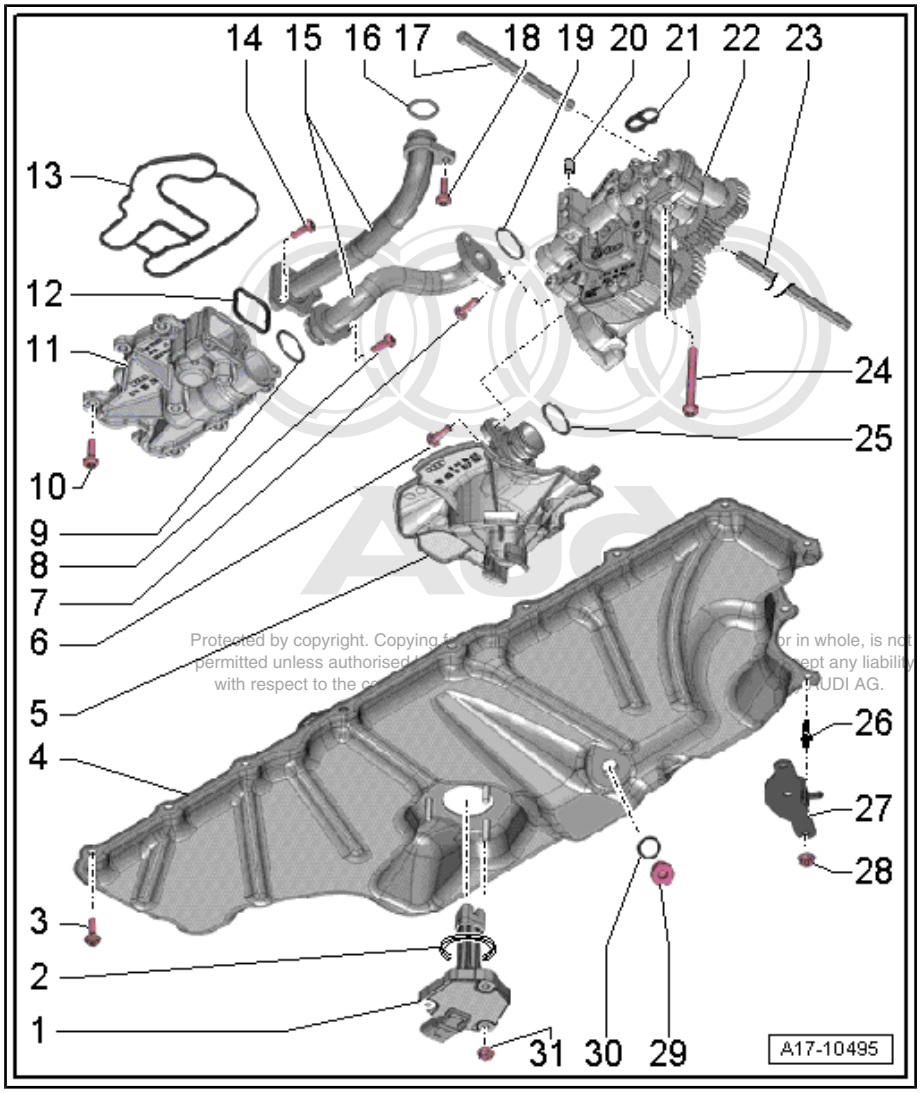
1 Sump/oil pump

1.1 Exploded view - sump/oil pump

Note

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

Sump (bottom section)



1 - Oil level and oil temperature sender - G266-

- ❑ Removing and installing ⇒ page 178

2 - Seal

- ❑ Renew

3 - Bolt

- ❑ Tightening torque and sequence ⇒ page 169

4 - Sump (bottom section)

- ❑ Removing and installing ⇒ page 171

5 - Intake connecting pipe

- ❑ For oil pump

6 - Bolt

- ❑ Renew
- ❑ 5 Nm + turn 45° further

7 - Bolt

- ❑ 9 Nm

8 - Bolt

- ❑ 9 Nm

9 - O-ring

- ❑ Renew

10 - Bolt

- ❑ Renew
- ❑ 5 Nm + turn 90° further

11 - Housing

- ❑ For oil retention valve
- ❑ Removing and installing ⇒ “1.5 Removing and installing oil pump”, page 176

12 - Gasket

- ❑ Renew

13 - Gasket

- ❑ Renew

14 - Bolt

- ❑ 9 Nm

15 - Oil pipes

- ❑ Removing and installing ⇒ “1.5 Removing and installing oil pump”, page 176

16 - O-ring

- ❑ Renew

17 - Drive shaft

- ❑ For coolant pump

18 - Bolt

- ❑ 9 Nm

19 - O-ring

- ❑ Renew

20 - Dowel sleeve

- ❑ 2x

21 - Gasket

- ❑ Renew

22 - Oil pump

- ❑ Do not dismantle
- ❑ With pressure control valve
- ❑ Removing and installing ⇒ page 176

23 - Drive shaft

- ❑ For oil pump

24 - Bolt

- ❑ Renew
- ❑ 8 Nm + turn 90° further

25 - O-ring

- ❑ Renew

26 - Bolt

- ❑ Version fitted in vehicle may differ from illustration
- ❑ Tightening torque and sequence ⇒ page 169

27 - Not fitted

28 - Not fitted

29 - Oil drain plug

- ❑ 25 Nm

30 - Seal

- ❑ Renew

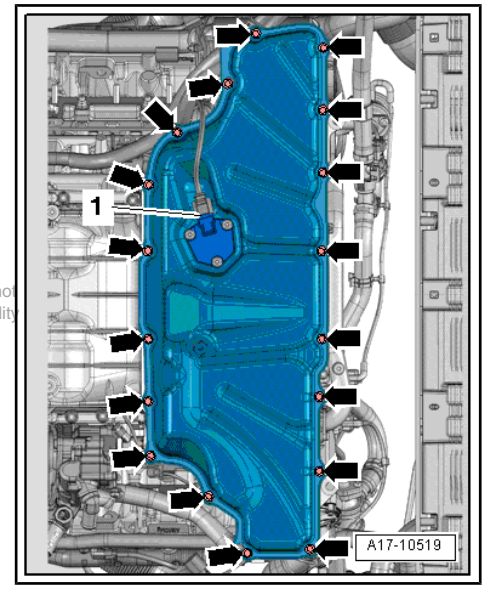
31 - Nut

- ❑ 9 Nm

Sump (bottom section) - tightening torque and sequence

– Tighten bolts in 3 stages as follows:

Stage	Bolts	Tightening torque
1.	-arrows-	Screw in by hand until contact is made
2.	-arrows-	5 Nm in diagonal sequence
3.	-arrows-	9 Nm in diagonal sequence



Sump (top section)

1 - Gasket
- ❑ Renew

2 - Sump (top section)
- ❑ Removing and installing ⇒ page 173

3 - Gasket
- ❑ Renew

4 - Gaskets
- ❑ Renew

5 - O-ring
- ❑ Renew

6 - Dowel sleeve

7 - Gasket
- ❑ Renew

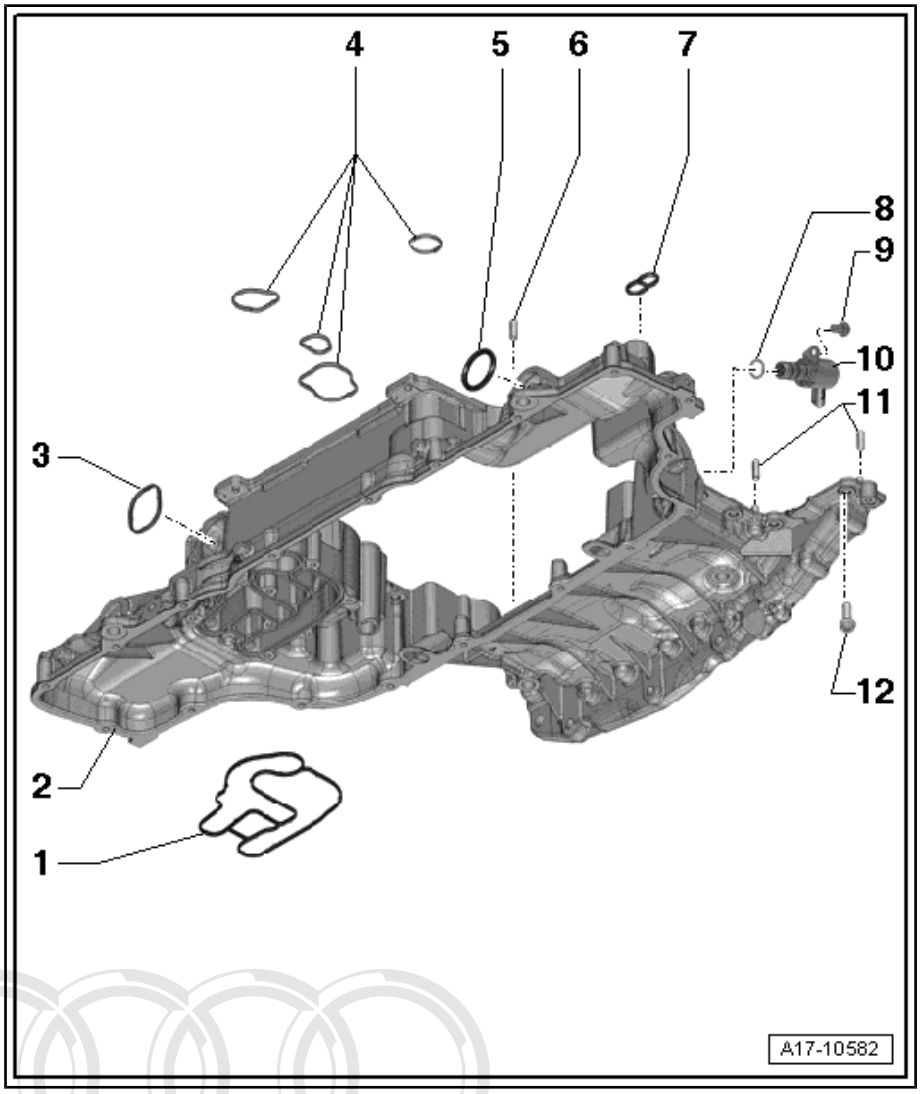
8 - O-ring
- ❑ Renew

9 - Bolt
- ❑ 9 Nm

10 - Valve for oil pressure control - N428-
- ❑ Removing and installing ⇒ page 187

11 - Dowel sleeves

12 - Bolt
- ❑ Tightening torque and sequence ⇒ page 170



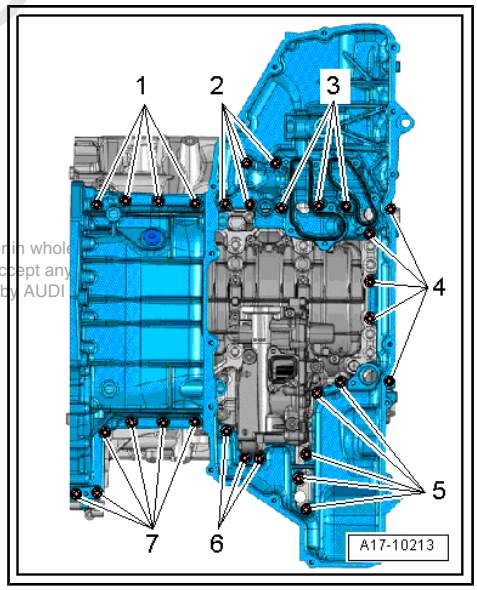
Sump (top section) - tightening torque and sequence

Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts in 3 stages as follows:

Stage	Bolts	Tightening torque/angle specification
1.	-1 … 7-	Screw in by hand until contact is made
2.	-1 … 7-	5 Nm in diagonal sequence
3.	-1 … 7-	Turn 90° further in diagonal sequence



1.2 Engine oil

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

Caution

Risk of damage to catalytic converter.

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

1.3 Removing and installing sump (bottom section)

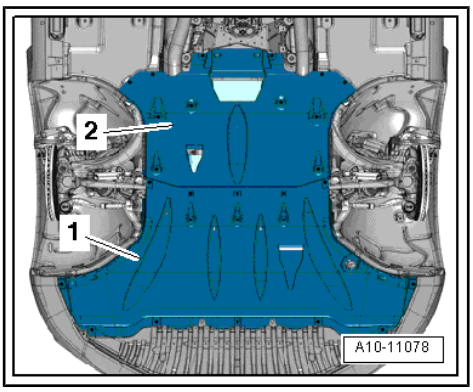
Special tools and workshop equipment required

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

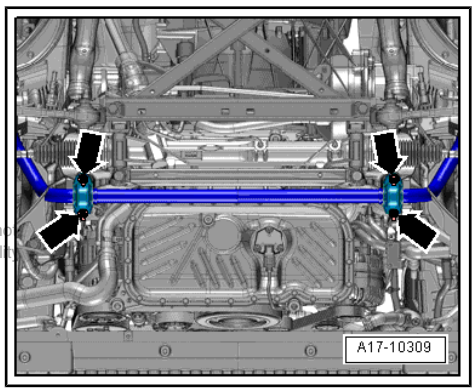
Removing

- Engine oil drained ⇒ Maintenance ; Booklet 410 .

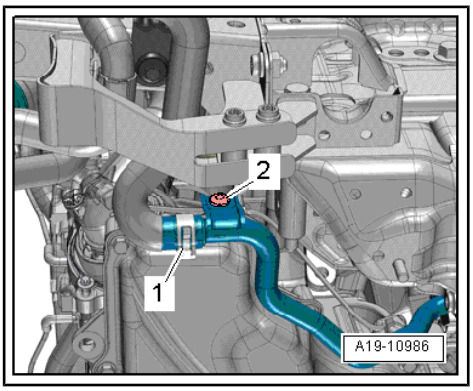
– Remove additional rear noise insulation -2- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



– Remove nuts -arrows- and lower anti-roll bar.



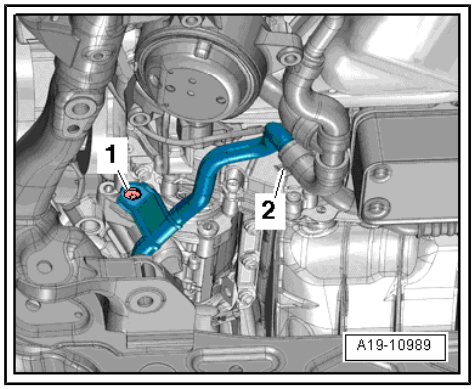
– Remove bolt -2- at coolant pipe (bottom left).



Note

Disregard -item 1-.

– Loosen bolt -1- at coolant pipe (bottom left) but do not remove.



Note

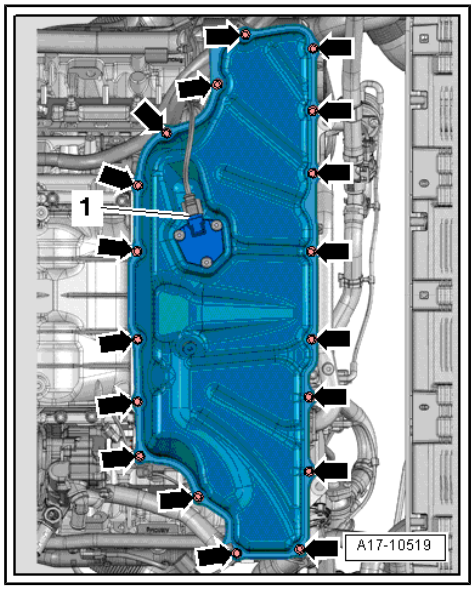
Disregard -item 2-.

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

Caution

Take care to keep components clean.

- *There will still be some oil in the sump (bottom section).*



– Loosen bolts -arrows- in diagonal sequence and remove.

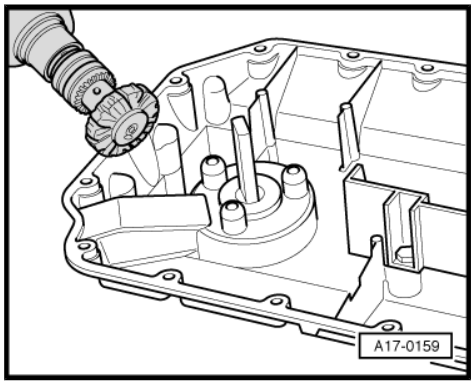
– Carefully release sump (bottom section) from bonded joint and detach.

Installing

Caution

Protect lubrication system and bearings against contamination.

- *Cover exposed parts of the engine.*



WARNING

Risk of eye injury.

- *Wear safety goggles.*

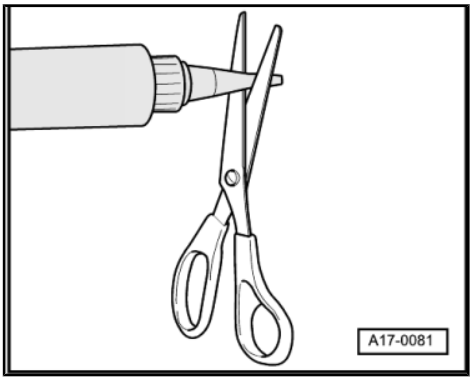
– Remove sealant residue from sump (bottom section) and sump (top section) using rotating plastic brush or similar.

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

Note

Note the use-by date of the sealant.

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



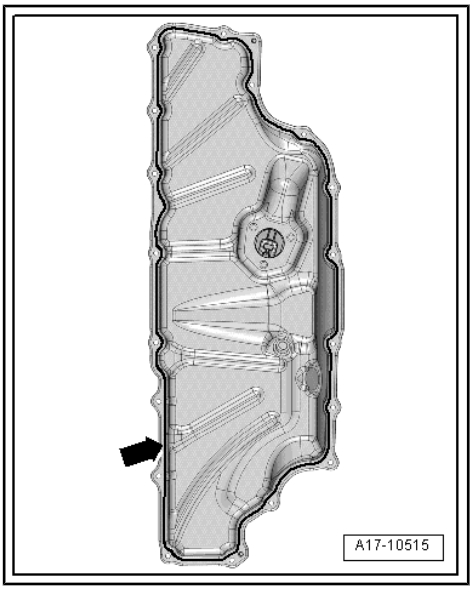
Caution

Make sure lubrication system is not clogged by excess sealant.

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

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

- Width of sealant bead: 2.5 mm.



Note

The sump (bottom section) must be installed within 5 minutes after applying the sealant.

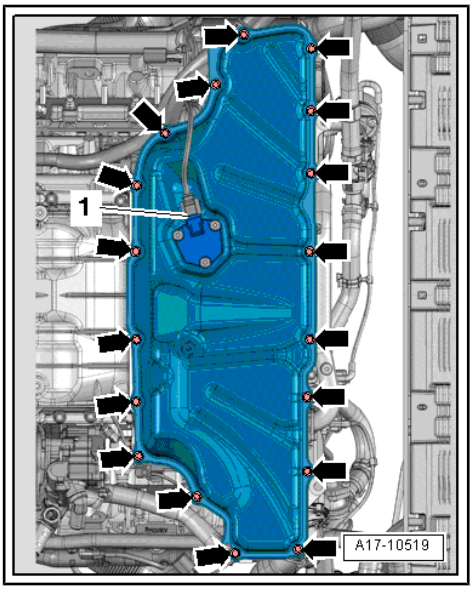
– Fit sump (bottom section), tighten bolts ⇒ page 169 and attach electrical connector -1-.

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

– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 410 .

Tightening torques

- ⇒ Fig. ""Sump (bottom section) - tightening torque and sequence"" , page 169
- Anti-roll bar ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Exploded view - subframe
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation



1.4 Removing and installing sump (top section)

Special tools and workshop equipment required

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

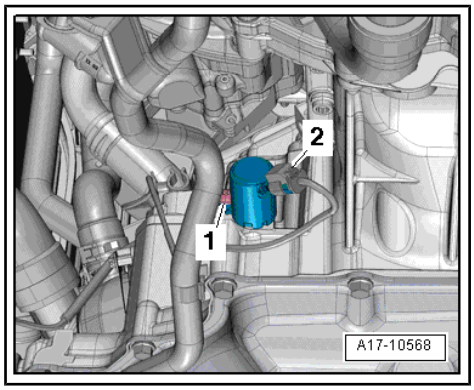
Removing

- Engine removed and secured to engine and gearbox support ⇒ page 34
- Engine oil drained ⇒ Maintenance ; Booklet 410 .

– Remove bracket for alternator ⇒ page 68 .

– Remove oil pump ⇒ page 176 .

– Unplug electrical connector -2- at valve for oil pressure control - N428- .

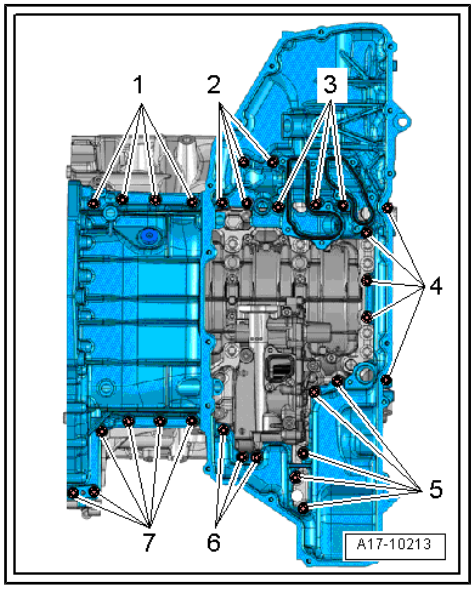


Note

Disregard -item 1-.

– Slacken bolts -1 ... 7- in diagonal sequence and remove.

– Carefully release sump (top section) from bonded joint, pry sump off dowel sleeves and detach.



Installing

Note

- *Renew gaskets and O-rings.*
- *Renew the bolts tightened with specified tightening angle.*

Caution

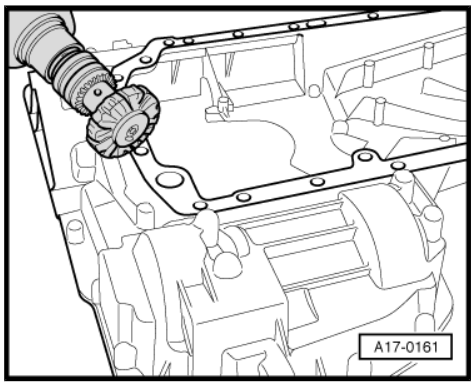
Protect lubrication system and bearings against contamination.

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

WARNING

Risk of eye injury.

- ***Wear safety goggles.***



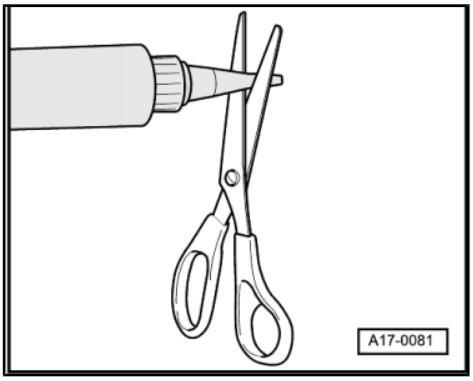
– Remove sealant residue from sump (top section) and retaining frame using rotating plastic brush or similar.

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

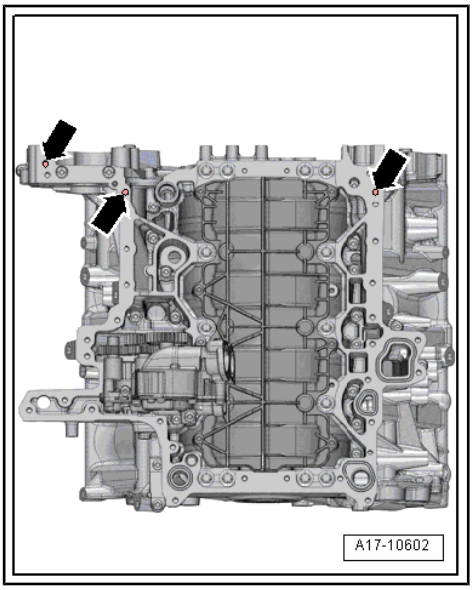
Note

Note the use-by date of the sealant.

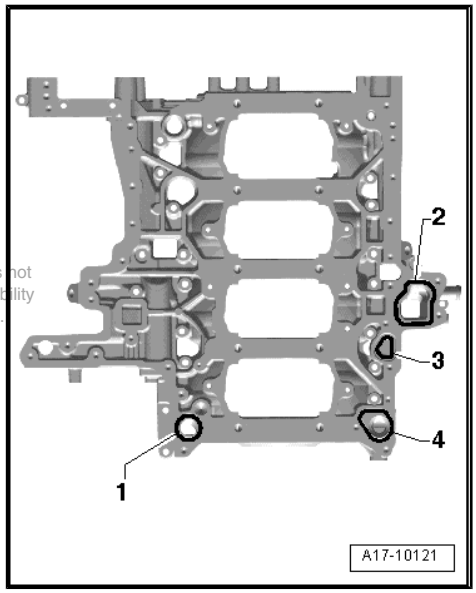
– Cut off nozzle of tube at front marking (nozzle ∅ approx. 2 mm).



– Fit dowel sleeves -arrows-, if not fitted on the cylinder block at the points marked.



– Fit new gaskets -1 … 4- in grooves on retaining frame.

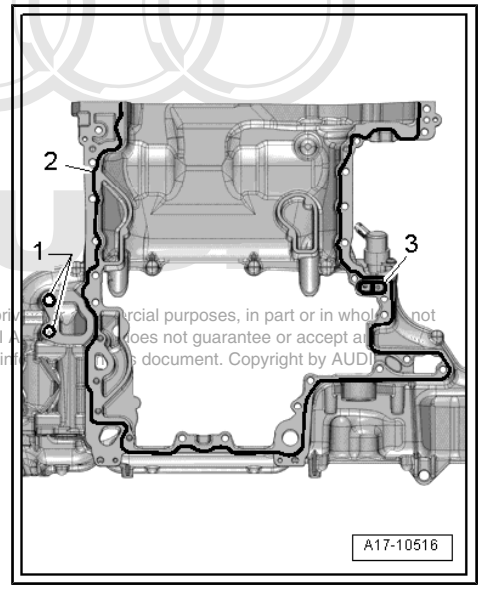


– Insert gasket -3- in sump (top section).

Caution

Make sure lubrication system is not clogged by excess sealant.

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



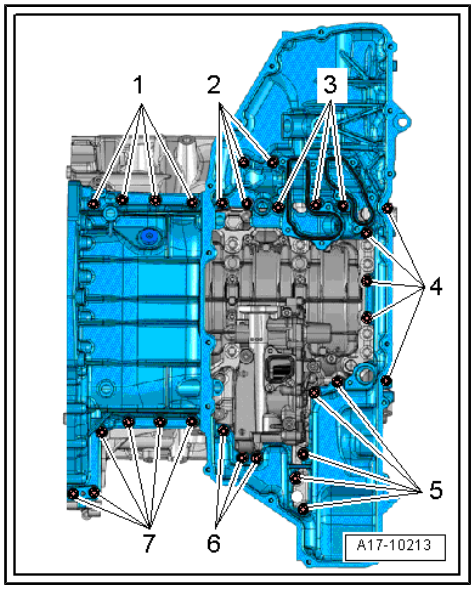
– Apply beads of sealant -1- and -2- onto clean sealing surface of sump (top section) as shown in illustration.

- Width of beads of sealant: 2.5 mm.

Note

The sump (top section) must be installed within 5 minutes after applying the sealant.

– Fit sump (top section) and tighten bolts ⇒ page 170 .



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

– Install oil pump ⇒ page 176 .

– Install bracket for alternator ⇒ page 68 .

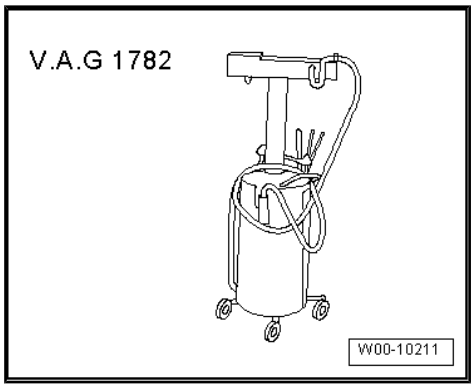
Tightening torques

- ⇒ Fig. ""Sump (top section) - tightening torque and sequence"" , page 170

1.5 Removing and installing oil pump

Special tools and workshop equipment required

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



Removing

- Gearbox removed ⇒ Rep. gr. 37 ; Removing and installing gearbox; Removing gearbox .

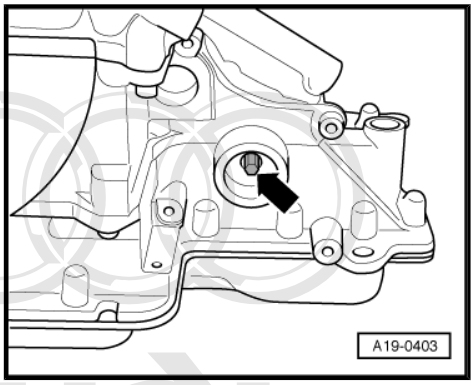
– Remove spur gear drive ⇒ page 85 .

– Remove coolant pump ⇒ page 205 .

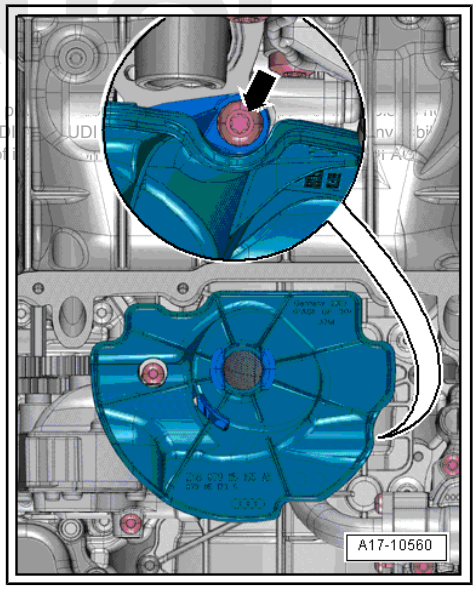
– Remove sump (bottom section) ⇒ page 171 .

– Detach coolant pump drive shaft -arrow- from oil pump.

– Place used oil collection and extraction unit - V.A.G 1782- under engine and leave in position for the following procedure.



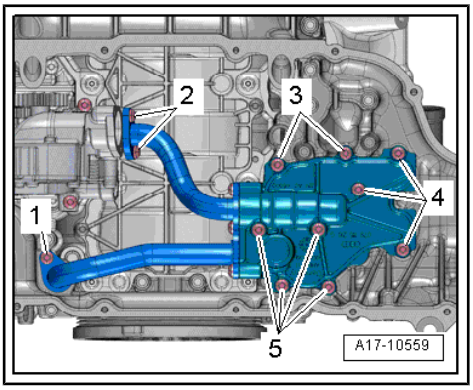
– Remove bolt -arrow- and take out intake connection.



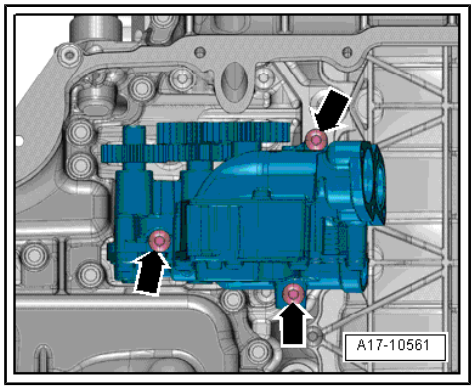
Note

Some oil will come out when oil pipes are removed.

– Remove bolts -1 ... 5- and detach oil pipes with cover plate.



– Remove bolts -arrows- and remove oil pump.



Installing

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

Note

- *Renew gaskets, seals and O-rings.*
- *Renew the bolts tightened with specified tightening angle.*

– Install sump (bottom section) ⇒ page 171 .
– Install coolant pump ⇒ page 205 .
– Install spur gear drive ⇒ page 85 .
– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 410 .

Note

Do not reuse coolant.

– Fill up with coolant ⇒ page 196 .

Tightening torques

- ⇒ “1.1 Exploded view - sump/oil pump”, page 167

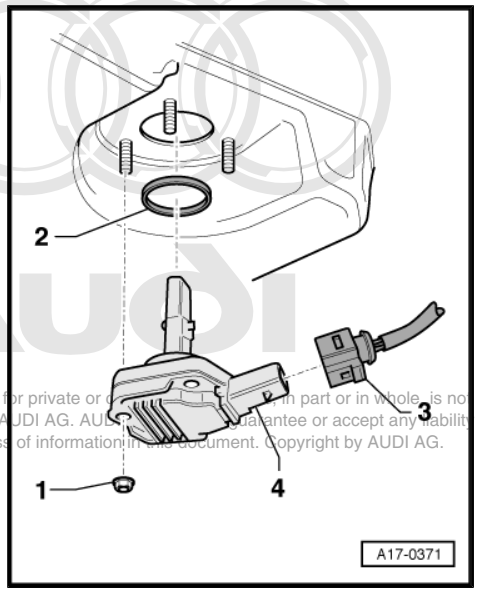
1.6 Removing and installing oil level and oil temperature sender - G266-

Removing

- Engine oil drained ⇒ Maintenance ; Booklet 410 .
– Unplug electrical connector -3-.
– Remove nuts -1- and detach oil level and oil temperature sender - G266- -item 4-.

Installing

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



Note

Renew seal -2-.

– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 410 .

Tightening torques

- ⇒ “1.1 Exploded view - sump/oil pump”, page 167

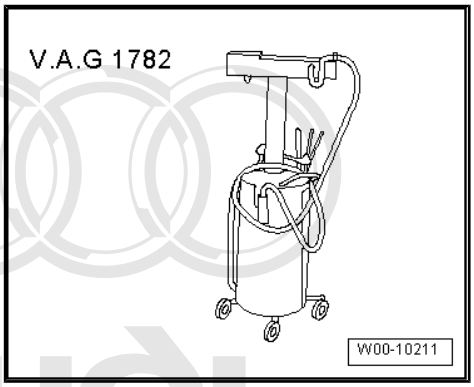
2 Engine oil cooler

⇒ “2.1 Removing and installing engine oil cooler”, page 179

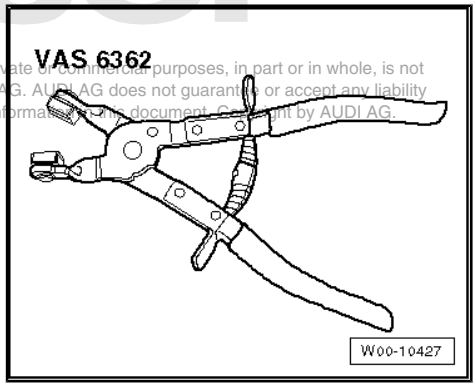
2.1 Removing and installing engine oil cooler

Special tools and workshop equipment required

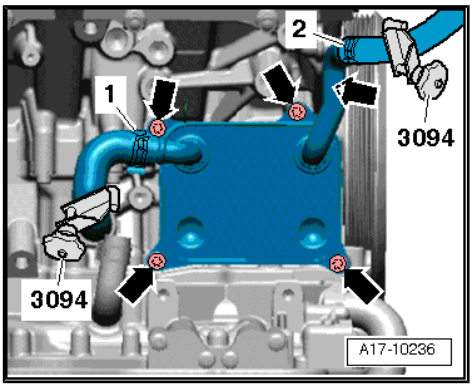
- Used oil collection and extraction unit - V.A.G 1782-



- Hose clip pliers - VAS 6362-



Removing



– Remove bracket for alternator ⇒ page 68 .
– Position used oil collection and extraction unit - V.A.G 1782- below engine.
– Release hose clips -1, 2- and disconnect coolant hoses from engine oil cooler.
– Unscrew bolts -arrows- and detach engine oil cooler.

Note

Ignore -3094- .

Installing

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

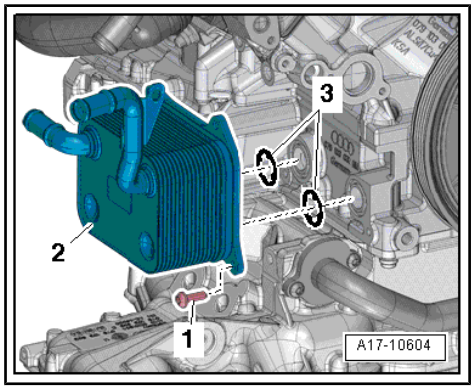
Note

- *Renew gaskets -3-.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Tighten bolts for engine oil cooler ⇒ page 180 .

– Install bracket for alternator ⇒ page 68 .

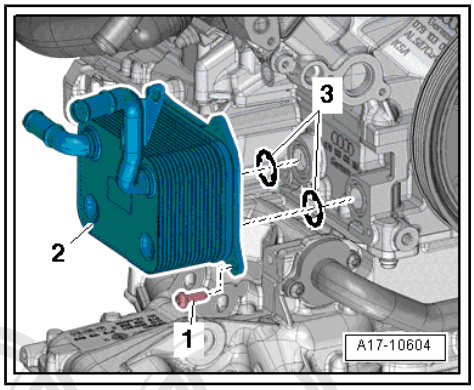
– Check coolant level ⇒ page 196 .



Tightening torques

– Tighten bolts in 2 stages as follows:

Stage	Bolts	Tightening torque
1.	-1-	3 Nm
2.	-1-	9 Nm



3 Crankcase breather

⇒ “3.1 Removing and installing hose for crankcase breather system”, page 181

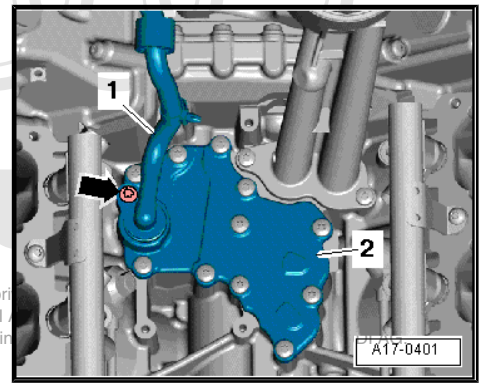
3.1 Removing and installing hose for crankcase breather system

Removing

– Remove intake manifold ⇒ page 266 .

– Remove bolt -arrow-.

– Pull out crankcase breather hose -1- from cover -2-.



Installing

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

Note

Fit new O-ring.

– Install intake manifold ⇒ page 266 .

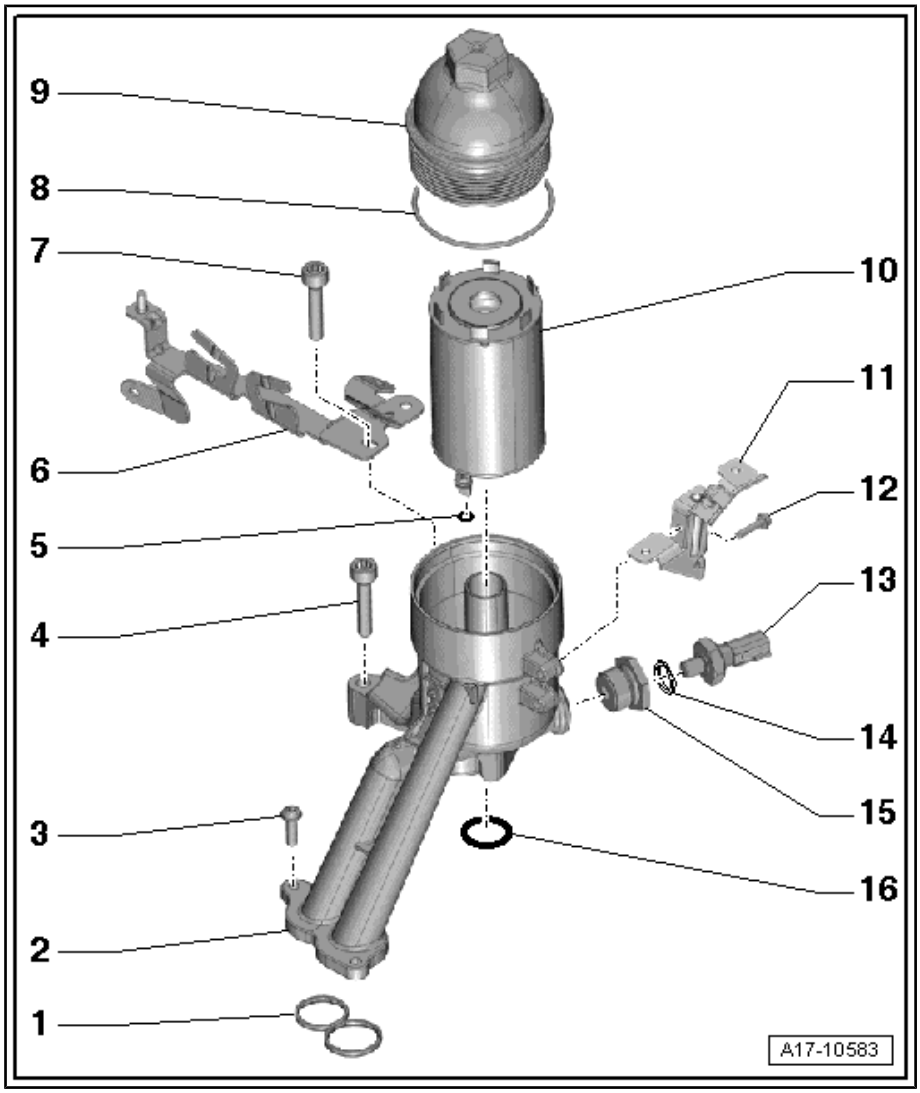
Tightening torques

◆ ⇒ “1.1 Exploded view - sump/oil pump”, page 167

4 Oil filter/oil pressure switches

4.1 Exploded view - oil filter housing/oil pressure switches

Oil filter housing, oil pressure switch



1 - Gasket
- ❑ Renew

2 - Oil filter housing
- ❑ Removing and installing ⇒ page 186

3 - Bolt
- ❑ 9 Nm

4 - Bolt
- ❑ 22 Nm

5 - O-ring
- ❑ Part of oil filter element

6 - Bracket

7 - Bolt
- ❑ 22 Nm

8 - O-ring
- ❑ Renew

9 - Sealing cap
- ❑ 25 Nm

10 - Oil filter element
- ❑ Removing and installing ⇒ Maintenance ; Booklet 410

11 - Bracket

12 - Bolt
- ❑ 9 Nm

13 - Oil pressure switch for reduced oil pressure - F378-
- ❑ Opening/closing pressure 0.3 ... 0.6 bar
- ❑ Green insulation
- ❑ Checking in `Guided Fault Finding` ⇒ vehicle diagnostic tester

- ❑ Removing and installing ⇒ page 184
- ❑ 20 Nm

14 - Seal

- ❑ Permanently attached to oil pressure switch; not available as a replacement part

15 - Screw plug

- ❑ 50 Nm

16 - O-ring

- ❑ Renew

Oil pressure switch, crankcase breather system

1 - Seal

- ❑ Permanently attached to oil pressure switch; not available as a replacement part

2 - Oil pressure switch - F22-

- ❑ Opening/closing pressure 2.7 ... 3.4 bar
- ❑ Brown insulation
- ❑ Checking in Guided Fault Finding ⇒ vehicle diagnostic tester
- ❑ Removing and installing ⇒ page 184
- ❑ 20 Nm

3 - O-ring

- ❑ Renew

4 - Spray nozzle valve

- ❑ Removing and installing ⇒ page 187

5 - Gasket

- ❑ Renew

6 - O-ring

- ❑ Renew

7 - Hose

- ❑ For crankcase breather

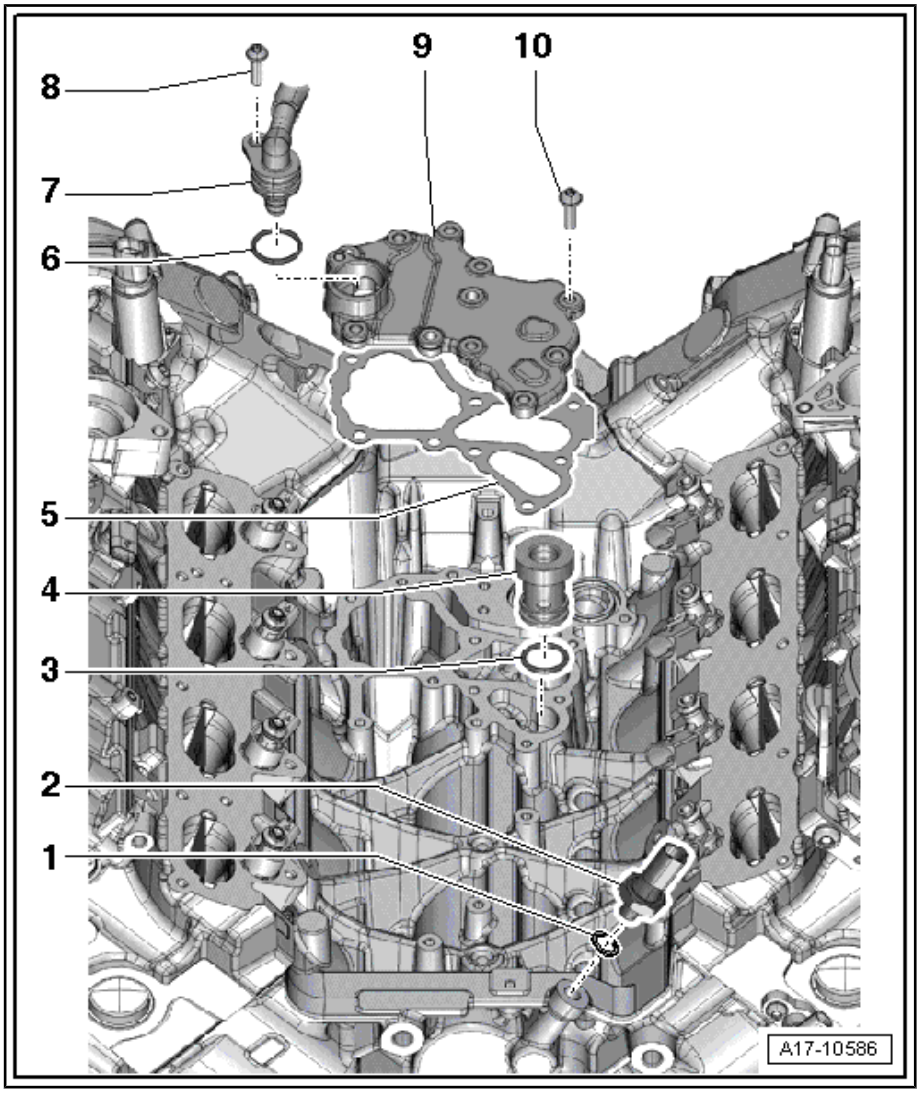
8 - Bolt

- ❑ 9 Nm

9 - Cover

10 - Bolt

- ❑ Renew
- ❑ 5 Nm + turn 90° further

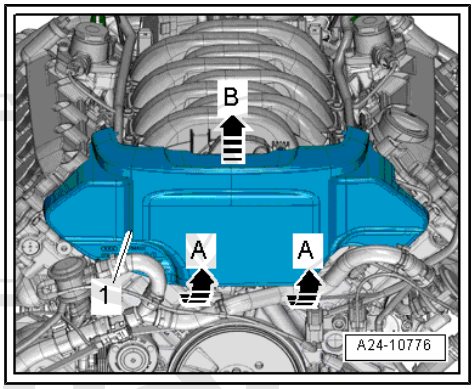


4.2 Removing and installing oil pressure switch - F22-

Removing

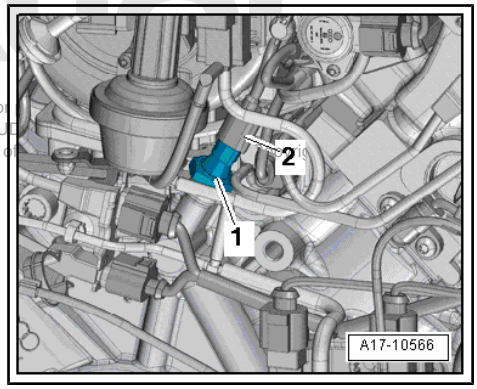
– Remove engine cover panel ⇒ page 63 .

– Pull off cover -1- towards front -arrows A- and lift off -arrow B-.



– Unplug electrical connector -2-.

– Remove oil pressure switch - F22- -item 1-.



Installing

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

Note

Renew seal.

– Install engine cover panel ⇒ page 63 .

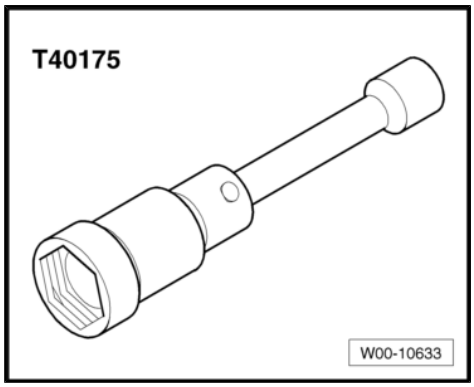
Tightening torques

◆ ⇒ “4.1 Exploded view - oil filter housing/oil pressure switches”, page 182

4.3 Removing and installing oil pressure switch for reduced oil pressure - F378-

Special tools and workshop equipment required

◆ Articulated wrench, 24 mm - T40175-

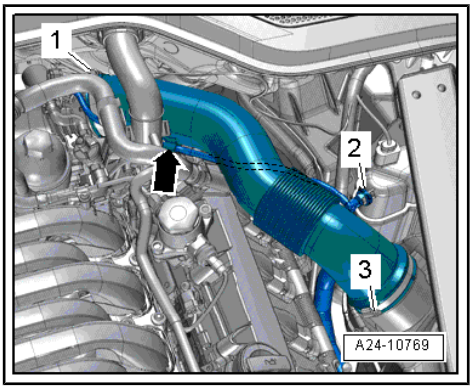


Removing

– Remove engine cover panel ⇒ page 63 .

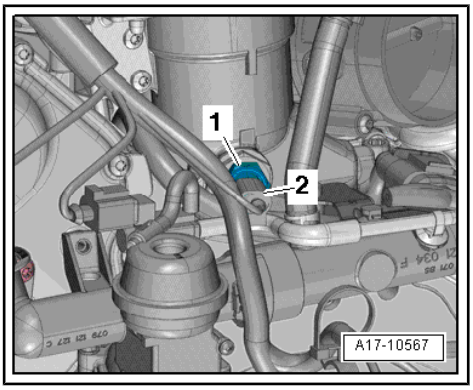
– Move coolant hose -2- clear -arrow-.

– Loosen hose clips -1- and -3- and remove air pipe.



– Unplug electrical connector -2-.

– Use articulated wrench (24 mm) - T40175- to unscrew oil pressure switch for reduced oil pressure - F378- -item 1-.



Installing

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

Note

Renew seal.

– Install air pipe ⇒ page 260 .

– Install engine cover panel ⇒ page 63 .

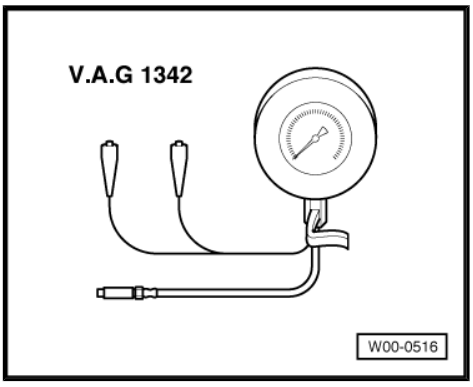
Tightening torques

♦ ⇒ “4.1 Exploded view - oil filter housing/oil pressure switches”, page 182

4.4 Checking oil pressure

Special tools and workshop equipment required

♦ Oil pressure tester - V.A.G 1342-



Procedure

• Oil level OK

• Engine oil temperature approx. 80 °C.

– Remove oil pressure switch for reduced oil pressure - F378- ⇒ page 184 .

– Connect oil pressure tester - V.A.G 1342- to bore for oil pressure switch.

– Screw oil pressure switch for reduced oil pressure - F378- into oil pressure tester.

– Start engine.

- Minimum oil pressure at idling speed: 1.3 bar.
- Minimum oil pressure at 2000 rpm: 1.9 bar.

Assembling

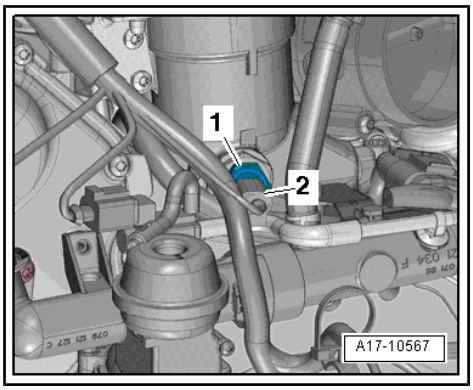
– Install oil pressure switch for reduced oil pressure - F378- ⇒ page 184 .

4.5 Removing and installing oil filter housing

Removing

– Remove intake manifold ⇒ page 266 .

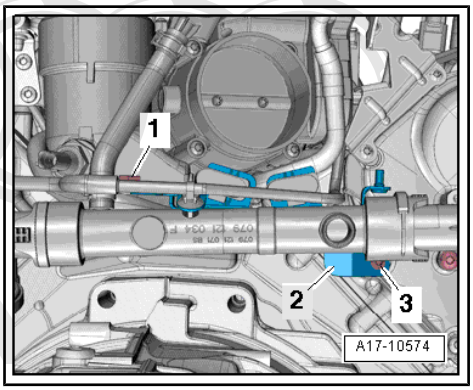
– Unplug electrical connector -2-.



Note

Disregard -item 1-.

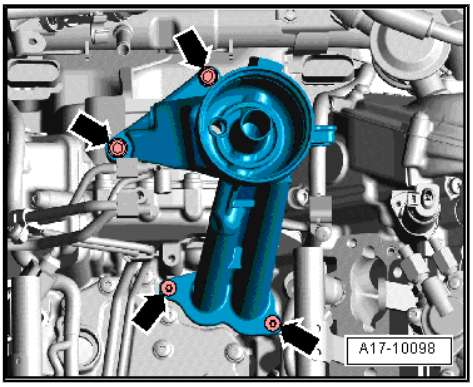
– Remove bolt -3- for bracket -2- for electrical connectors.



Note

Disregard -item 1-.

– Remove oil filter element ⇒ Maintenance ; Booklet 410 .
– Unscrew bolts -arrows- and remove oil filter housing.



Installing

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

Note

Renew seals and O-rings.

– Install oil filter element ⇒ Maintenance ; Booklet 410 .
– Install intake manifold ⇒ page 266 .
– Check oil level ⇒ Maintenance ; Booklet 410 .

Tightening torques

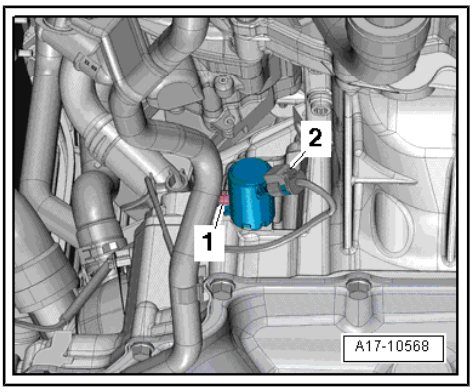
- ⇒ “4.1 Exploded view - oil filter housing/oil pressure switches”, page 182
- ⇒ Fig. ““Timing chain cover (right-side) - tightening torque and sequence”“ , page 99

4.6 Removing and installing valve for oil pressure control - N428-

Removing

– Remove power steering pump or steering hydraulics pump - V119- ⇒ Running gear, axles, steering; Rep. gr. 48 ; Hydraulic power steering; Removing and installing power steering pump .

– Remove bolt -1-.
– Unplug electrical connector -2-.
– Detach valve for oil pressure control - N428- from sump (top section).



Installing

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

Note

Fit new O-ring.

– Install power steering pump or steering hydraulics pump - V119- ⇒ Running gear, axles, steering; Rep. gr. 48 ; Hydraulic power steering; Removing and installing power steering pump .

Tightening torques

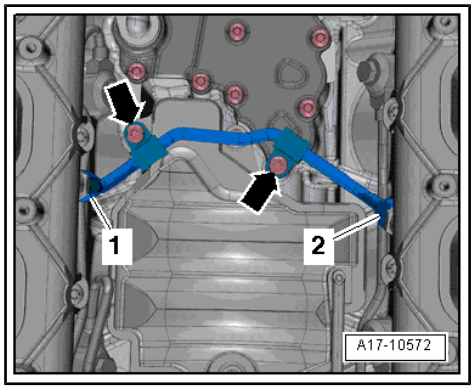
- ⇒ “4.1 Exploded view - oil filter housing/oil pressure switches”, page 182

4.7 Removing and installing spray nozzle valve

Removing

– Remove intake manifold ⇒ page 266 .

– Remove bolts -arrows-.



Caution

Risk of damage caused by particles of dirt.

- *Observe rules for cleanliness when working on the fuel supply system ⇒ page 8 .*

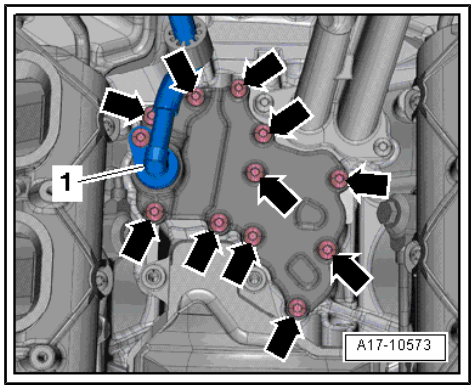
– Unscrew high-pressure pipe at connections -1- and -2- on fuel rail. To do so, counterhold at hexagon flats with an open-end spanner and slacken union nut.

– Detach high-pressure pipe.

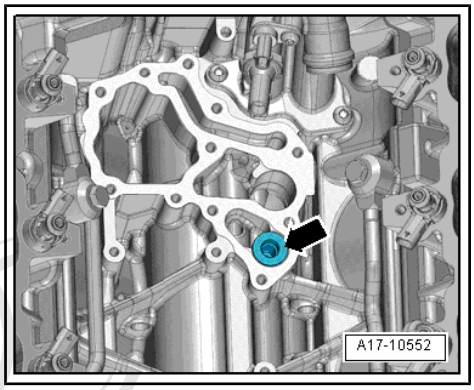
– Remove bolts -arrows-.

– Detach cover with crankcase breather hose -1-.

– Detach gasket.



– Pull out spray nozzle valve -arrow-.



Installing

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

Note

- *Renew gaskets, seals and O-rings.*
- *Renew the bolts tightened with specified tightening angle.*

– Install high-pressure pipe ⇒ page 283 .

– Install intake manifold ⇒ page 266 .

Tightening torques

- ⇒ “4.1 Exploded view - oil filter housing/oil pressure switches”, page 182

19 – Cooling

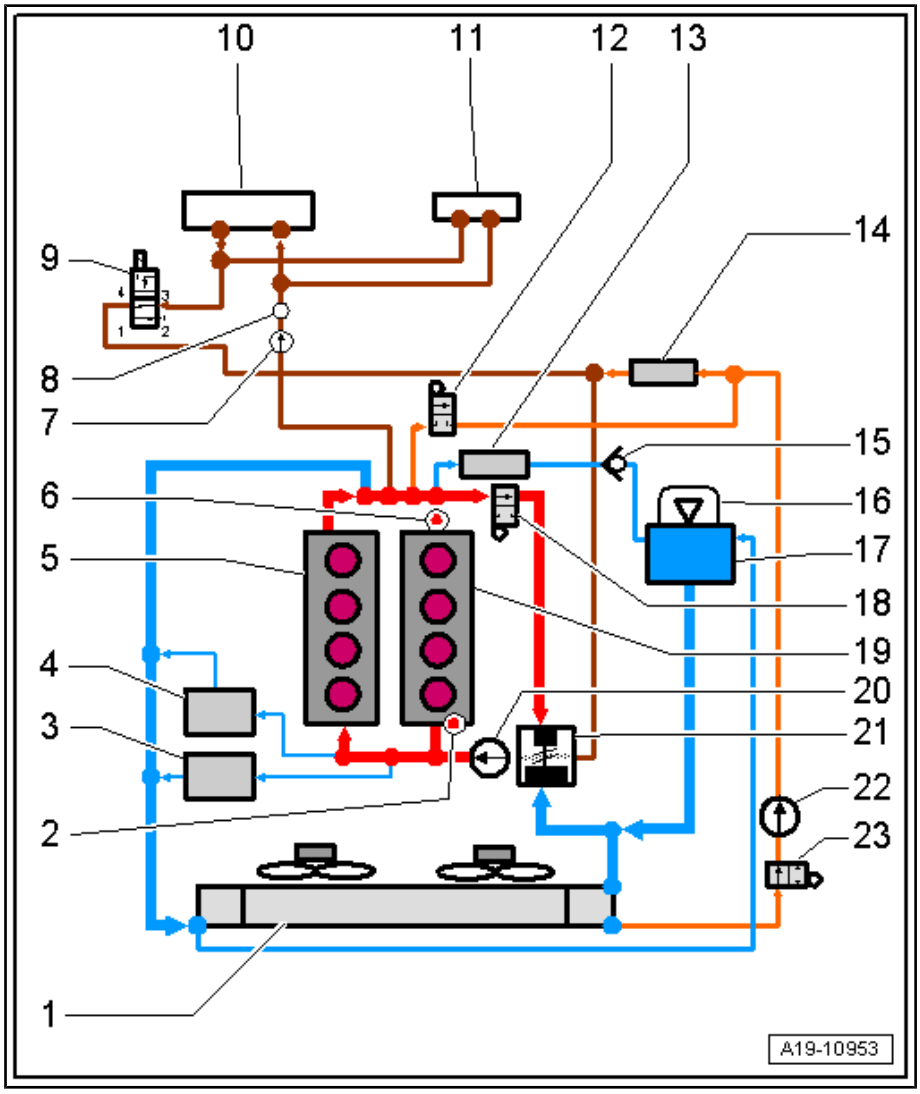
1 Cooling system/coolant

1.1 Connection diagram - coolant hoses

1.1.1 Connection diagram - coolant hoses, vehicles without auxiliary heater

Note

- *Blue = Large coolant circuit.*
- *Red = Small coolant circuit.*
- *Orange = Coolant circuit for ATF.*
- *Brown = Heating circuit.*



1 - Radiator

- ❑ If renewed, refill system with fresh coolant

2 - Temperature sender for engine temperature regulation - G694-

3 - Alternator

4 - Engine oil cooler

- ❑ If renewed, refill system with fresh coolant

5 - Cylinder head

- ❑ Cylinder bank 1 (right-side)
- ❑ If renewed, refill system with fresh coolant

6 - Coolant temperature sender - G62-

7 - Coolant circulation pump - V50-

- ❑ Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Coolant circuit

8 - Bleeder screw

9 - Coolant shut-off valve - N82-

- ❑ Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Coolant circuit

10 - Heat exchanger for heater (front)

- ❑ Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Front air conditioning unit; Removing and installing heat exchanger
- ❑ If renewed, refill system with fresh coolant

11 - Heat exchanger for heater (rear)

- ❑ Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Rear air conditioning unit; Removing and installing heat exchanger
- ❑ If renewed, refill system with fresh coolant

12 - Coolant valve for gearbox - N488-

13 - Crankcase breather

14 - ATF cooler

15 - Non-return valve

16 - Filler cap

- ❑ Checking pressure relief valve ⇒ page 194

17 - Coolant expansion tank

18 - Coolant valve for cylinder head - N489-

19 - Cylinder head

- ❑ Cylinder bank 2 (left-side)
- ❑ If renewed, refill system with fresh coolant

20 - Coolant pump

21 - Map-controlled engine cooling system thermostat - F265-

22 - Continued coolant circulation pump - V51-

23 - Gearbox oil cooling valve - N509-

1.1.2 Connection diagram - coolant hoses, vehicles with auxiliary heater

Note

- *Blue = Large coolant circuit.*
- *Red = Small coolant circuit.*
- *Orange = Coolant circuit for ATF.*
- *Brown = Heating circuit.*

1 - Radiator

- ❑ If renewed, refill system with fresh coolant

2 - Temperature sender for engine temperature regulation - G694-

3 - Alternator

4 - Engine oil cooler

- ❑ If renewed, refill system with fresh coolant

5 - Circulation pump - V55-

6 - Auxiliary heater

- ❑ Removing and installing ⇒ Auxiliary heater, supplementary heater; Rep. gr. 82 ; Auxiliary/supplementary heater; Removing and installing auxiliary/supplementary heater

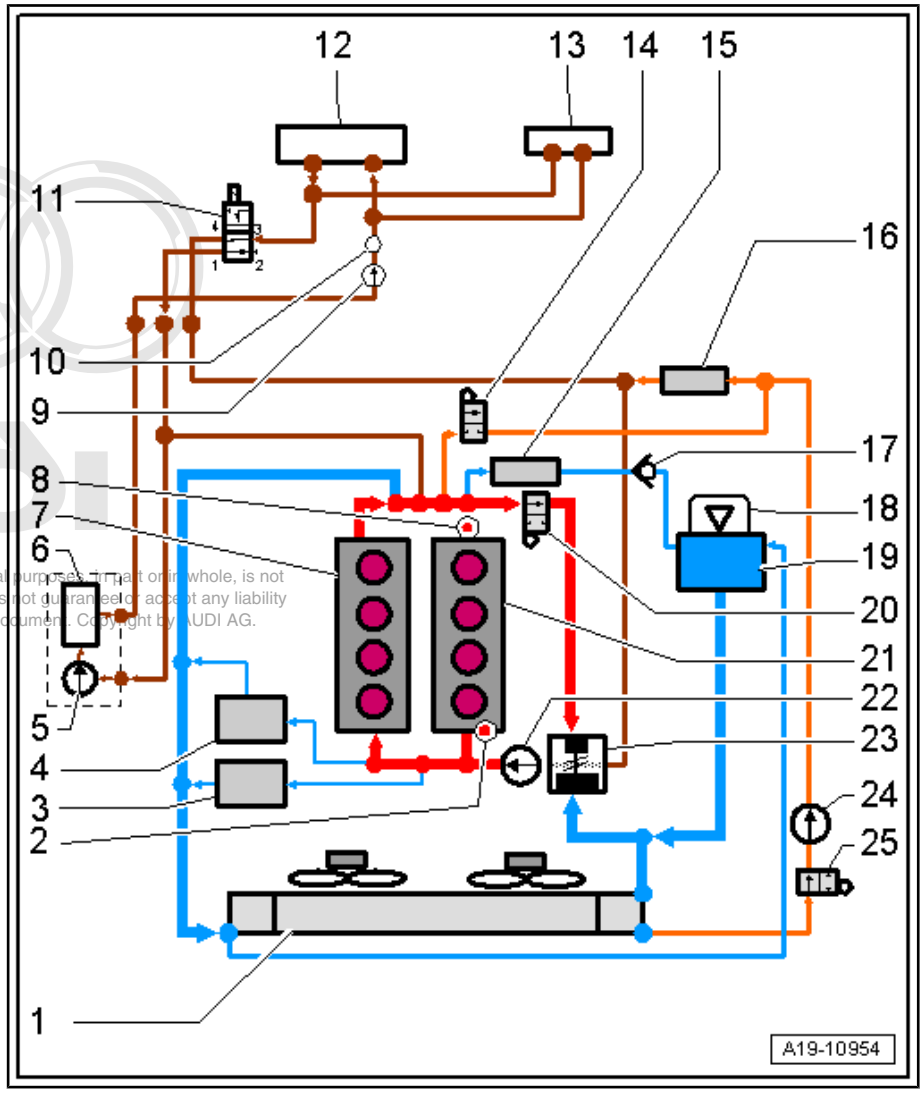
7 - Cylinder head, bank 1

- ❑ If renewed, refill system with fresh coolant

8 - Coolant temperature sender - G62-

9 - Coolant circulation pump - V50-

- ❑ Depending on version
- ❑ Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Coolant circuit



10 - Bleeder screw

11 - Heater coolant shut-off valve - N279-

- ❑ Removing and installing ⇒ Auxiliary heater, supplementary heater; Rep. gr. 82 ; Coolant circuit with auxiliary/supplementary heater; Removing and installing heater coolant shut-off valve

12 - Heat exchanger for heater (front)

- ❑ Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Front air conditioning unit; Removing and installing heat exchanger
- ❑ If renewed, refill system with fresh coolant

13 - Heat exchanger for heater (rear)

- ❑ Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Rear air conditioning unit; Removing and installing heat exchanger
- ❑ If renewed, refill system with fresh coolant

14 - Coolant valve for gearbox - N488-

15 - Crankcase breather

16 - ATF cooler

17 - Non-return valve

18 - Filler cap

- ❑ Checking pressure relief valve ⇒ page 194

19 - Coolant expansion tank

20 - Coolant valve for cylinder head - N489-

21 - Cylinder head, bank 2

- ❑ If renewed, refill system with fresh coolant

22 - Coolant pump

23 - Map-controlled engine cooling system thermostat - F265-

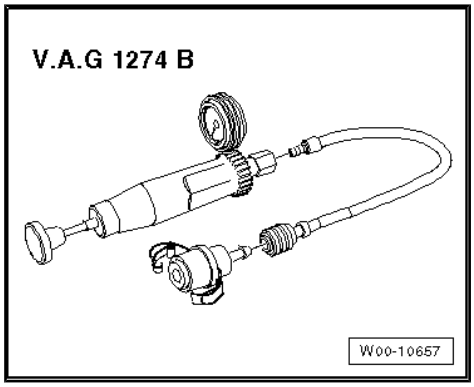
24 - Continued coolant circulation pump - V51-

25 - Gearbox oil cooling valve - N509-

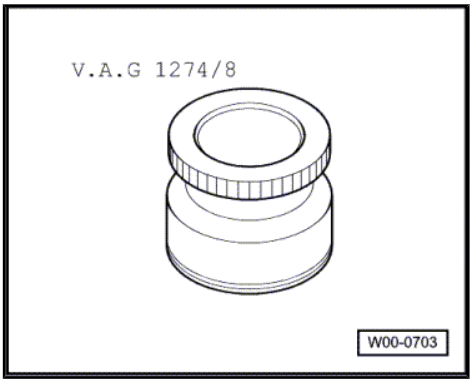
1.2 Checking cooling system for leaks

Special tools and workshop equipment required

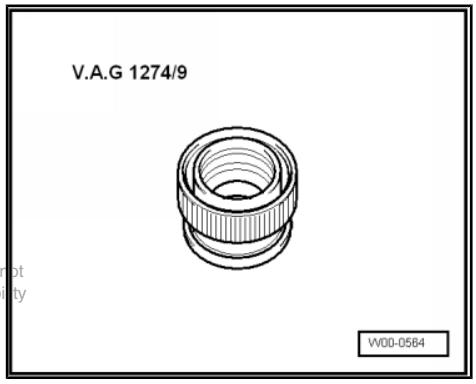
- ♦ Cooling system tester - V.A.G 1274 B-



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



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



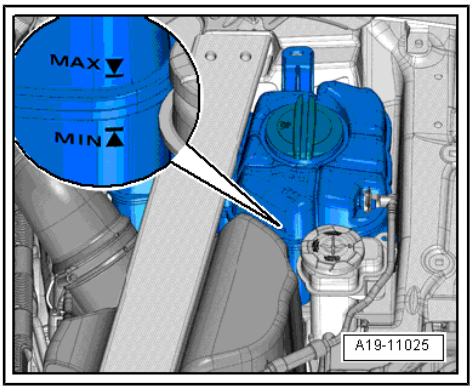
Procedure

- Engine must be warm.

WARNING

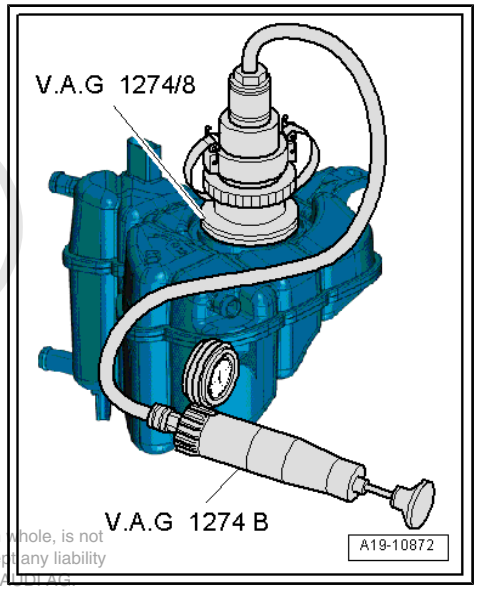
Hot steam/hot coolant can escape - risk of scalding.

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



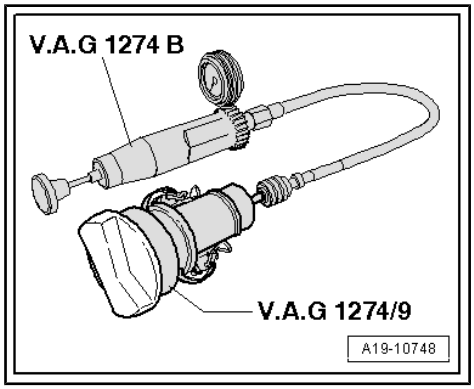
– Open filler cap on coolant expansion tank.

– Fit cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/8- onto coolant expansion tank.
– Using hand pump on cooling system tester, build up a pressure of approx. 1.0 bar.
– If this pressure is not maintained, locate and rectify leaks.



Checking pressure relief valve in filler cap

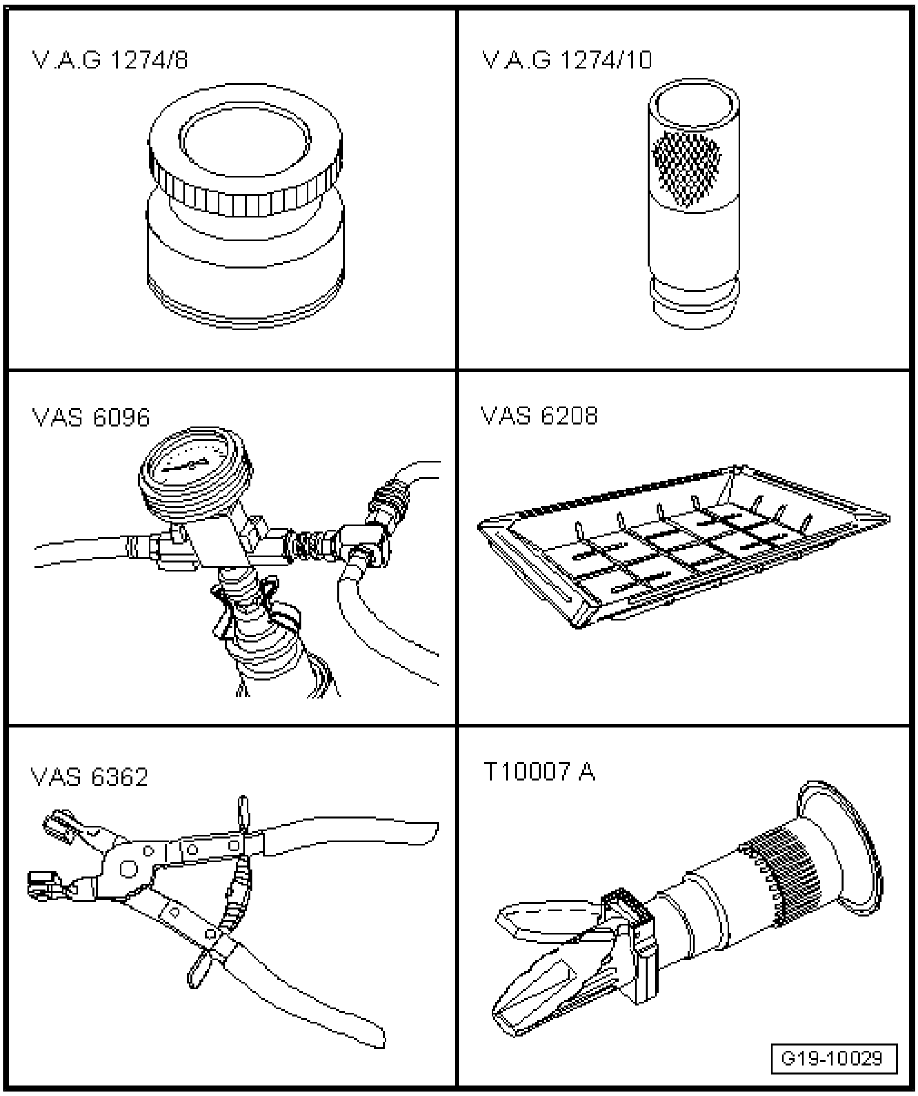
– Fit cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/9- onto filler cap.
– Build up pressure with hand pump on cooling system tester.
• The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.
– Renew filler cap if pressure relief valve does not open as described.



1.3 Draining and filling cooling system

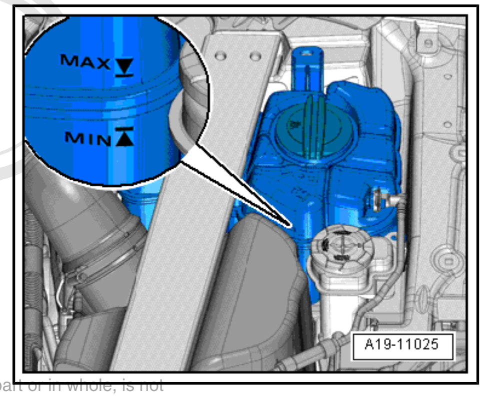
Special tools and workshop equipment required

- ♦ Adapter for cooling system tester - V.A.G 1274/8-
- ♦ Pipe for cooling system tester - V.A.G 1274/10-
- ♦ Cooling system charge unit - VAS 6096-
- ♦ Drip tray for workshop hoist - VAS 6208-
- ♦ Hose clip pliers - VAS 6362-
- ♦ Refractometer - T10007 A-



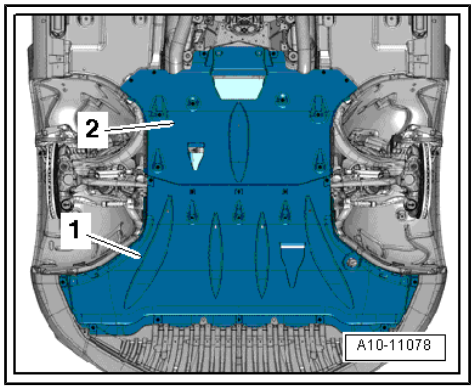
Draining

> **⚠ WARNING**
>
> *Hot steam/hot coolant can escape - risk of scalding.*
>
> - ♦ *The cooling system is under pressure when the engine is hot.*
> - ♦ *To allow pressure to dissipate, cover filler cap on coolant expansion tank with cloth and open carefully.*



– Open filler cap on coolant expansion tank.

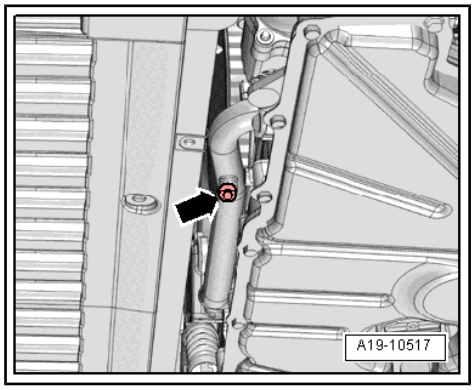
– Remove noise insulation panels -1- and -2- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



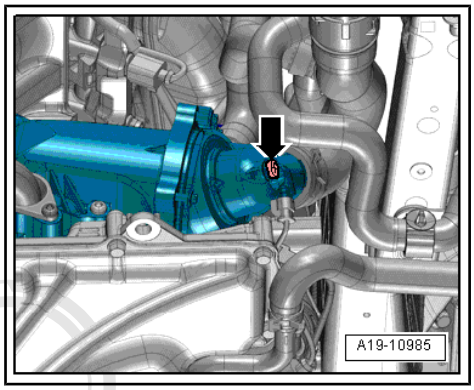
Note

Collect drained coolant in a clean container for disposal.

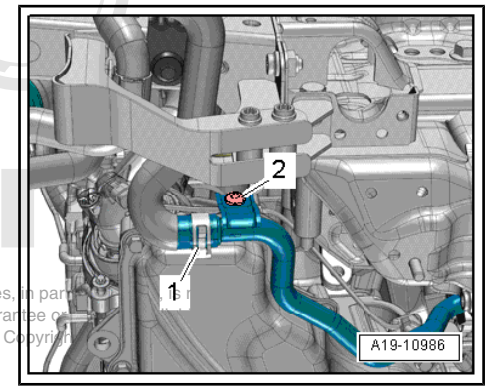
– Place drip tray for workshop hoist - VAS 6208- beneath engine.
– Unscrew drain plug -arrow- on coolant pipe (front) and drain off coolant.



– Unscrew drain plug -arrow- on map-controlled engine cooling system thermostat - F265- and drain off coolant.



– Release hose clip -1- and detach coolant hose from coolant pipe (bottom left).



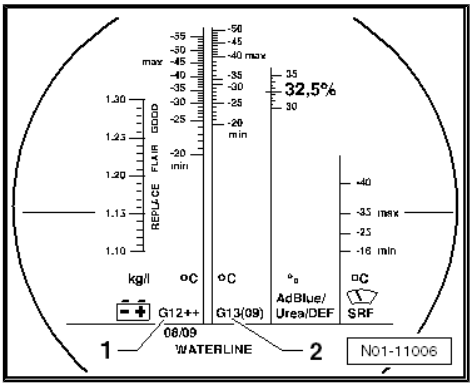
Note

Disregard -item 2-.

Filling

Caution

Always use distilled water for mixing coolant additives as this ensures optimum corrosion protection.



Note

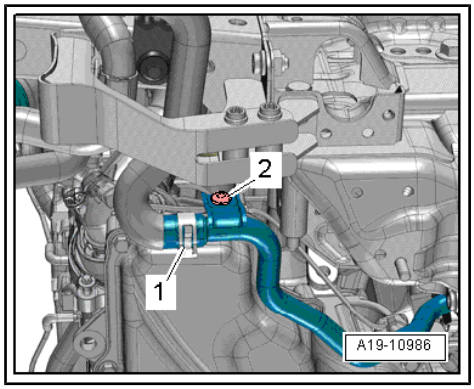
- *The effectiveness of the coolant is greatly influenced by the quality of the water with which it is mixed. Because water may contain different substances depending on the country or even the region, the water quality to be used for cooling systems has been specified. Distilled water meets all the 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) . Other coolant additives could seriously impair in particular the anti-corrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.*
- *Coolant with the recommended mixture ratio prevents frost and corrosion damage and stops scaling. At the same time it raises the boiling point of the fluid in the system. For this reason the cooling system must be filled all year round with the correct coolant additive.*
- *Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- *The refractometer - T10007A- MUST be used to determine the current level of frost protection.*
- *The mixture must guarantee frost protection down to -25 °C (in countries with arctic climate: down to -36 °C). The amount of antifreeze can only be increased if greater frost protection is required in very cold climates. This must only be up to -48 °C, however, as otherwise the cooling efficiency of the coolant is impaired.*
- *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. Frost protection must be provided to at least -25 °C.*
- *Read off the level of frost protection on the scale for the relevant coolant additive.*
- *The temperature indicated on the refractometer - T10007A- corresponds to the temperature at which the first ice crystals can form in the coolant.*
- *Do not reuse coolant.*
- *Only use water/coolant additive as a lubricant for coolant hoses.*

Recommended mixture ratio for coolant

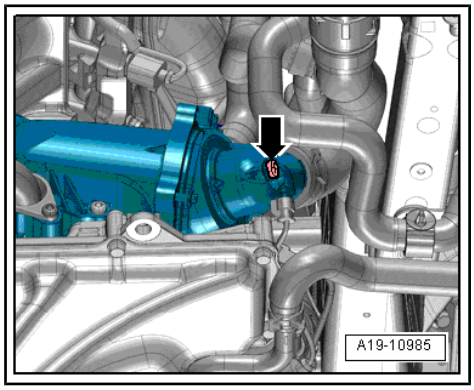
- Coolant (40 %) and water (60 %) for frost protection to -25 °C
- Coolant (50 %) and water (50 %) for frost protection to -36 °C
- Coolant: ⇒ Electronic parts catalogue (ETKA)

Procedure

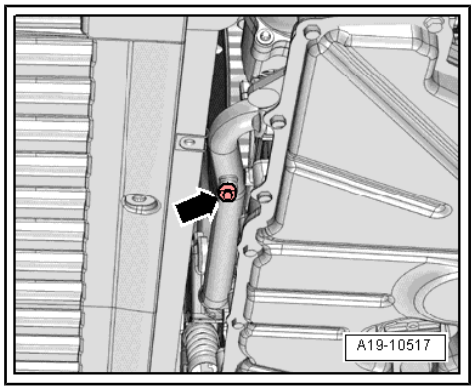
– Connect coolant hose to coolant pipe (bottom left) with hose clip -1-.



– Install drain plug -arrow- with new O-ring on map-controlled engine cooling system thermostat - F265- .



– Install drain plug -arrow- with new seal on coolant pipe (front).

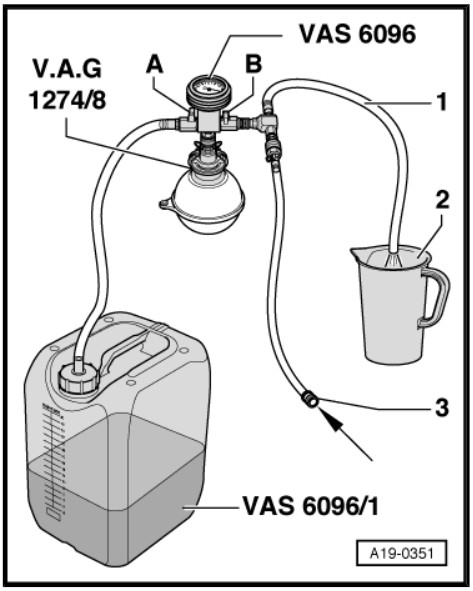


– Fill reservoir of -VAS 6096- with at least 15 litres of premixed coolant (according to recommended ratio ⇒ page 197).

– Fit adapter for cooling system tester - V.A.G 1274/8- onto coolant expansion tank.

– Attach cooling system charge unit - VAS 6096- to adapter -V.A.G 1274/8- .

– Run vent hose -1- into a small container -2-.



Note

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

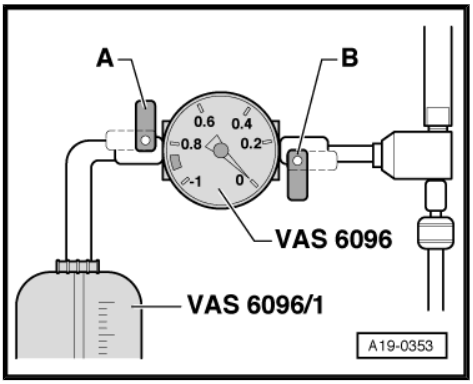
– Close both valves -A- and -B- (turn lever at right angles to direction of flow).

– Connect hose -3- to compressed air.

• Pressure: 6 ... 10 bar.

– Open valves in coolant circuit; select `01 - Coolant circuit bleeding routine` in `Guided Functions` ⇒ vehicle diagnostic tester .

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



• The suction jet pump generates a partial vacuum in the cooling system; the needle on the gauge should move into the green zone.

– Also briefly open valve -A- (turn lever in direction of flow) so that hose on reservoir of -VAS 6096- can fill with coolant.

– Close valve -A- again.

– Leave valve -B- open for another 2 minutes.

• The suction jet pump continues to generate a partial vacuum in the cooling system; the needle on the gauge should remain in the green zone.

– Close valve -B-.

• The needle on the gauge should stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.

Note

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

♦ *Check cooling system for leaks if the vacuum is not maintained.*

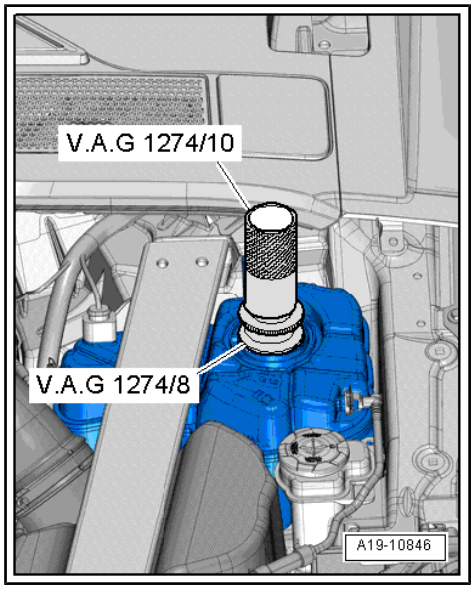
– Detach compressed air hose.

– Open valve -A-.

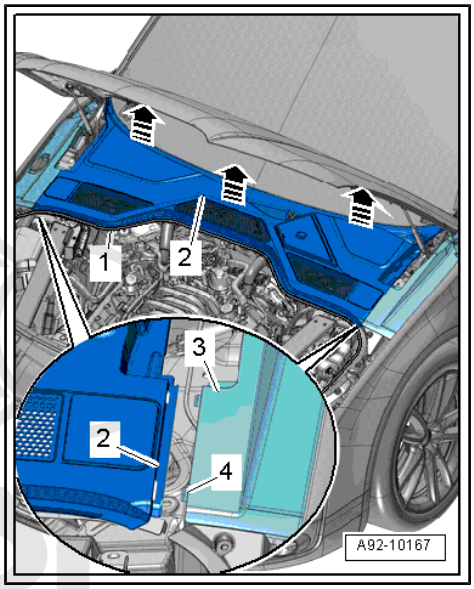
• The vacuum in the cooling system causes the coolant to be drawn out of the reservoir of -VAS 6096- ; the cooling system is then filled.

– Detach cooling system charge unit - VAS 6096- from adapter -V.A.G 1274/8- on coolant expansion tank.

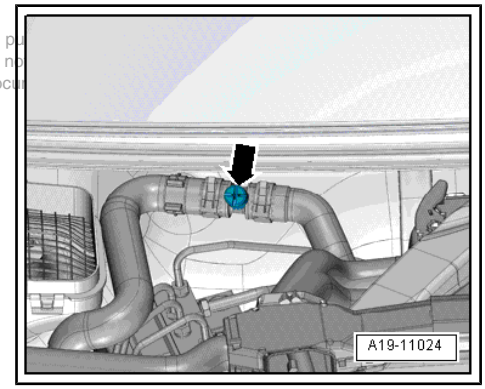
– Attach pipe -V.A.G 1274/10- onto adapter -V.A.G 1274/8- .



– Remove plenum chamber cover -2- ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Removing and installing plenum chamber cover .



– Open bleeder screw -arrow-.
– Fill up with coolant until it flows out at bleeder hole in coolant hose.
– Close bleeder screw.
– On vehicles with auxiliary heater, switch heater on (for about 30 seconds) and then off again.
– Close filler cap on coolant expansion tank (make sure it engages).
– Start engine.



Time period	Engine speed	Air conditioner / heater setting
1 minute	2000 rpm	• Air conditioning system “OFF”, LED in AC button not lit • Heating at “HI”, select lowest possible blower speed (= 0)

Time period	Engine speed	Air conditioner / heater setting
Until radiator fan starts running	Idling	• Air conditioning system “OFF” • Heating at “HI”
3 minutes	2000 rpm	• Air conditioning system “OFF” • Heating at “HI”

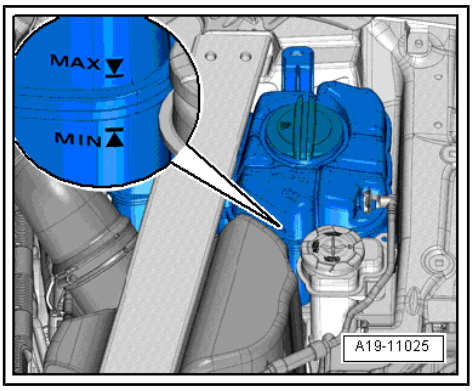
– Switch off ignition and allow engine to cool down.

– Install plenum chamber cover ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Removing and installing plenum chamber cover .

– Check coolant level.

• The coolant level must be at the MAX marking when the engine is cold.

• The coolant level can be above the MAX marking when the engine is warm.



Tightening torques

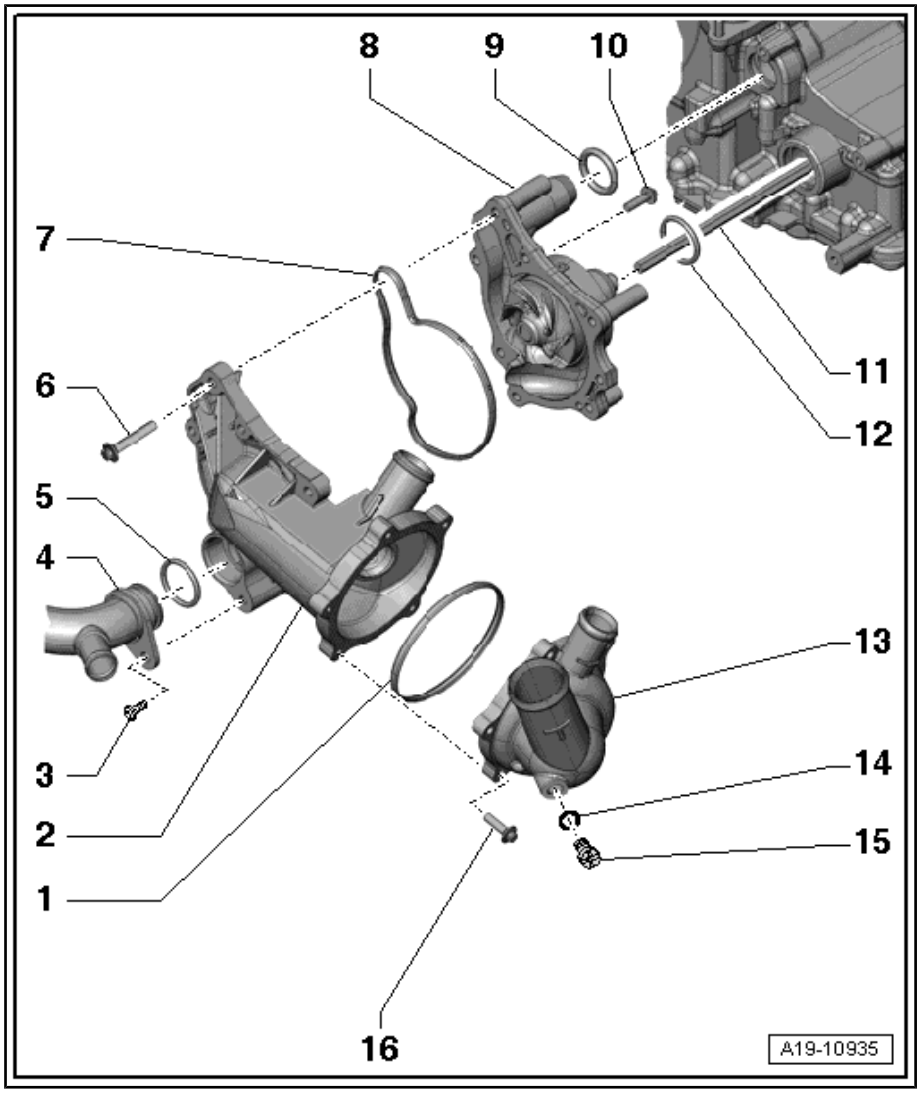
◆ ⇒ “2.1 Exploded view - coolant pump and thermostat”, page 202

◆ ⇒ “3.1 Exploded view - coolant pipes”, page 214

◆ ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation

2 Coolant pump/thermostat assembly

2.1 Exploded view - coolant pump and thermostat



1 - Seal
- ❑ Renew

2 - Housing
- ❑ For coolant pump
- ❑ Removing and installing ⇒ “2.3 Removing and installing coolant pump”, page 205

3 - Bolt
- ❑ Tightening torque ⇒ Item 28 (page 215)

4 - Coolant pipe (front)
- ❑ Version fitted in vehicle may differ from illustration
- ❑ Removing and installing ⇒ page 217

5 - O-ring
- ❑ Renew

6 - Bolt
- ❑ 9 Nm

7 - Gasket
- ❑ Renew

8 - Coolant pump
- ❑ Removing and installing ⇒ page 205

9 - O-ring
- ❑ Renew

10 - Bolt
- ❑ 9 Nm

11 - Drive shaft
- ❑ For coolant pump

12 - O-ring

- ❑ Renew

13 - Map-controlled engine cooling system thermostat - F265-

- ❑ Removing and installing ⇒ page 207
- ❑ Thermostat opening data ⇒ page 207

14 - O-ring

- ❑ Renew

15 - Drain plug

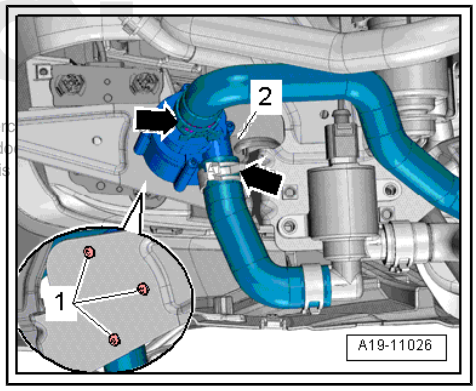
- ❑ 4 Nm

16 - Bolt

- ❑ 9 Nm

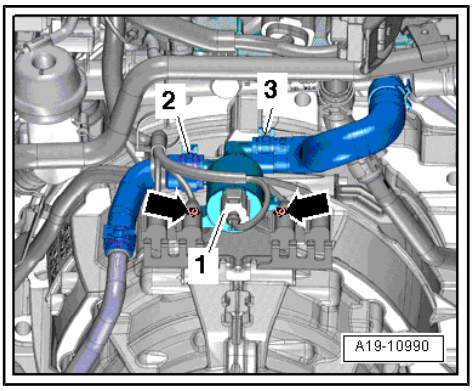
Continued coolant circulation pump - V51- - tightening torque

– Tighten bolts -1- to 5 Nm.



Coolant valve for gearbox - N488- - tightening torque

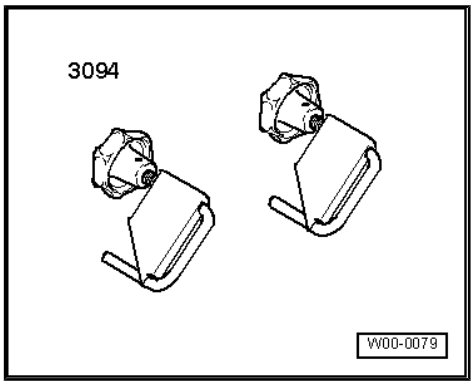
– Tighten bolts -arrows- to 9 Nm.



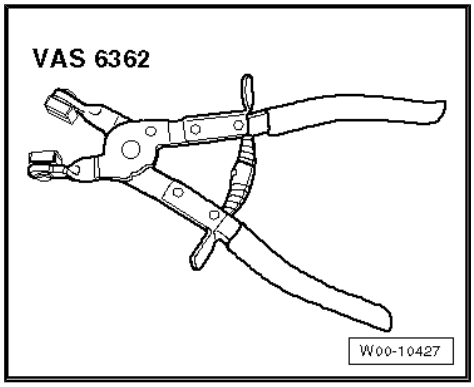
2.2 Removing and installing electrical coolant pump

Special tools and workshop equipment required

♦ Hose clamps, up to 25 mm - 3094-



- Hose clip pliers - VAS 6362-

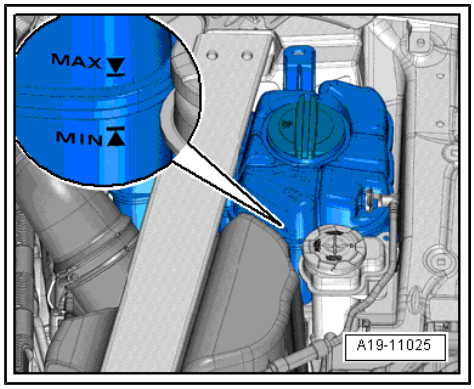


Removing

WARNING

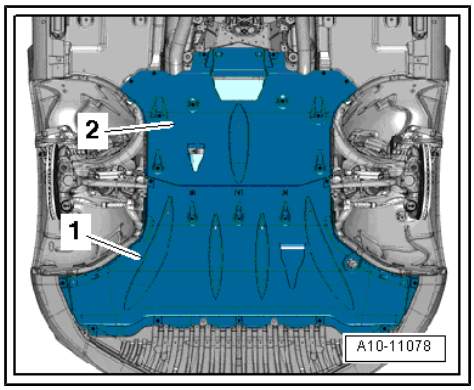
Hot steam/hot coolant can escape - risk of scalding.

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

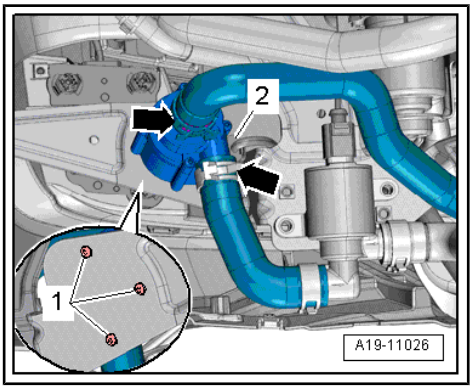


– Open filler cap on coolant expansion tank.

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



– Remove bolts -1- and detach continued coolant circulation pump - V51- .



Note

Place a cloth underneath to catch escaping coolant.

– Clamp off coolant hoses using hose clamps -3094- , release hose clips -arrows- and disconnect hoses.

– Unplug electrical connector -2-.

Installing

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

Note

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

– Check coolant level ⇒ page 201 .

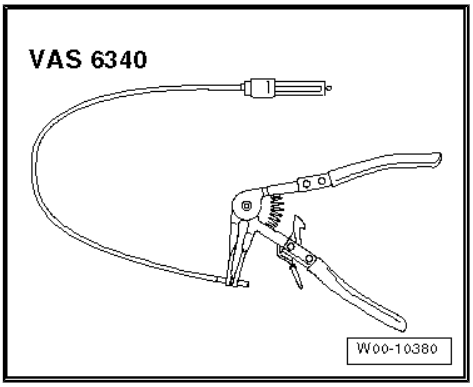
Tightening torques

- ⇒ Fig. "" Continued coolant circulation pump -V51- - tightening torque"" , page 203
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation

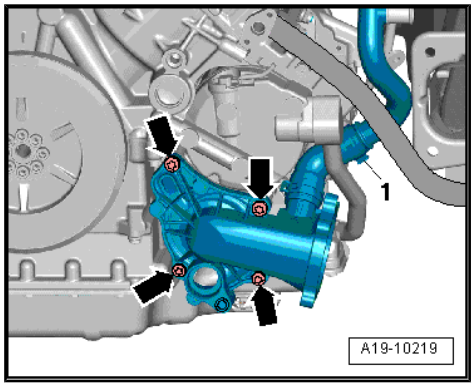
2.3 Removing and installing coolant pump

Special tools and workshop equipment required

- Hose clip pliers - VAS 6340-



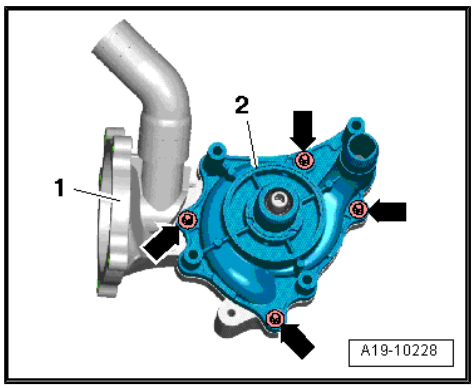
Removing



– Remove coolant pipe (front) ⇒ page 217 .
– Remove map-controlled engine cooling thermostat - F265- ⇒ page 207 .
– Release hose clip -1- and detach coolant hose.
– Remove bolts -arrows-.
– Pull off coolant pump housing forwards (note the drive shaft for coolant pump).

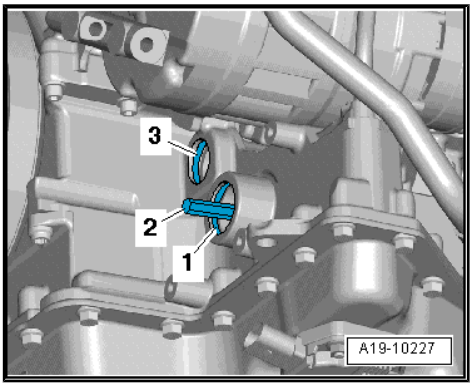
Note

The coolant hose can only be disconnected when the coolant pump is removed.



– Remove bolts -arrows- and remove coolant pump -2- from housing -1-.

Installing



Note

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

– Fit new O-rings -1- and -3-.

– Insert drive shaft -2- for coolant pump in mounting for oil pump as far as stop.

– Slide coolant pipe into mountings on sump (top section).

Note

To fit the drive flange onto the hexagon flats of the drive shaft, use your finger to turn the impeller (access through the bottom pipe connection of coolant pump) until the coolant pump can be pressed on all the way.

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

– Install map-controlled engine cooling thermostat - F265- ⇒ page 207 .

– Install coolant pipe (front) ⇒ page 217 .

Tightening torques

- ⇒ “2.1 Exploded view - coolant pump and thermostat”, page 202

2.4 Checking thermostat

Starts to open	Fully open	Opening travel	Voltage measured at thermostat
approx. 105 °C	approx. 117 °C	at least 8 mm	0 V
–	approx. 105 °C	at least 8 mm	14 V

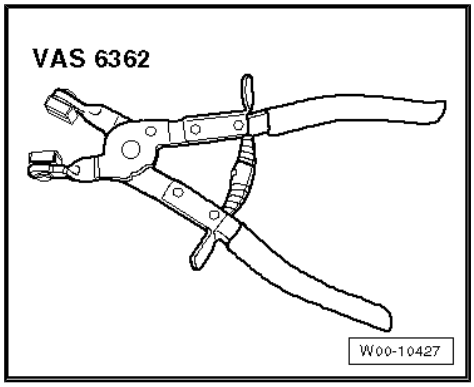
Note

The thermostat cannot be tested with workshop equipment.

2.5 Removing and installing map-controlled engine cooling system thermostat - F265-

Special tools and workshop equipment required

♦ Hose clip pliers - VAS 6362-

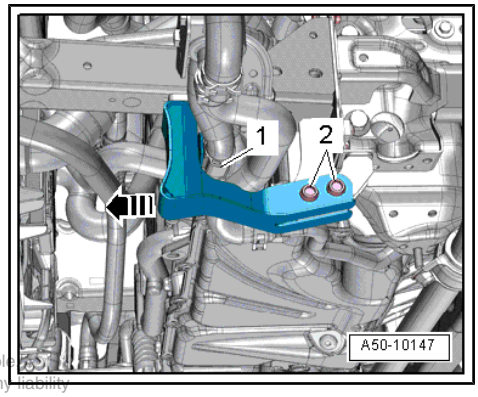


Removing

– Drain coolant ⇒ page 194 .

– Move coolant hose -1- clear.

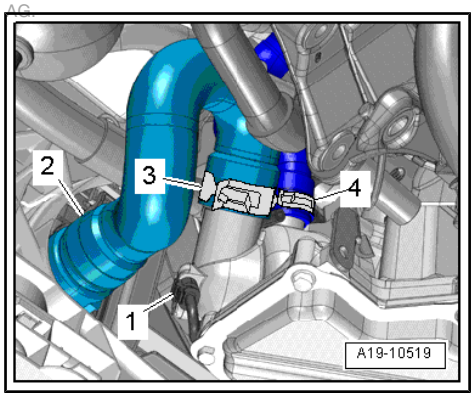
– Remove bolts -2- and detach underbody guard towards front -arrow-.



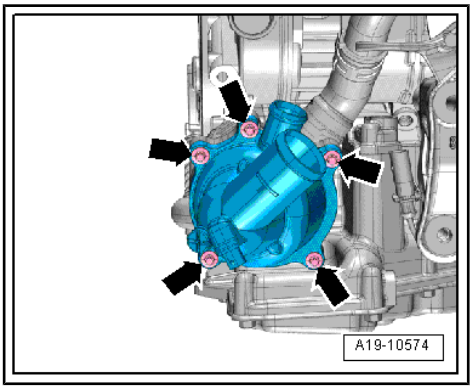
– Unplug electrical connector -1- at map-controlled engine cooling thermostat - F265- .

– Lift retaining clip -2-, release hose clip -3- and remove coolant hose.

– Release hose clip -4- and detach coolant hose.



– Remove bolts -arrows- and detach map-controlled engine cooling system thermostat - F265- .



Installing

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

Note

- *Renew seal.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *Do not reuse coolant.*

– Connect coolant hose with plug-in connector ⇒ page 237 .

– Fill up with coolant ⇒ page 196 .

Tightening torques

- ⇒ “2.1 Exploded view - coolant pump and thermostat”, page 202

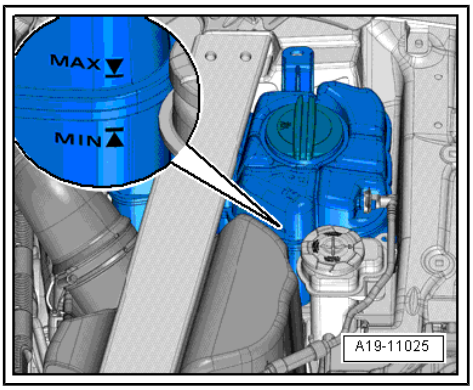
2.6 Removing and installing coolant temperature sender - G62-

Removing

• Engine cold.

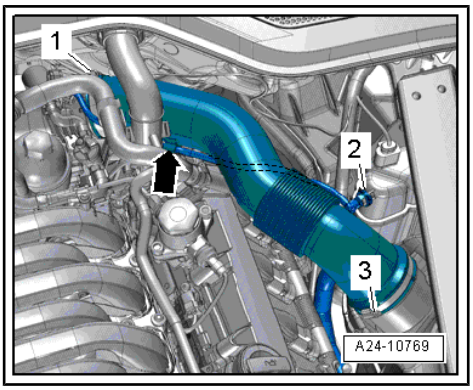
– Open filler cap on coolant expansion tank briefly and allow residual pressure in cooling system to dissipate.

– Remove engine cover panel ⇒ page 63 .

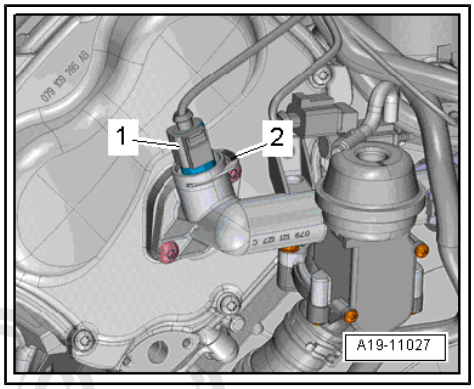


– Move coolant hose -2- clear -arrow-.

– Release hose clips -1- and -3- and remove air pipe.



– Unplug electrical connector -1-.



Note

Place a cloth underneath to catch escaping coolant.

– Pull out retaining clip -2- and detach coolant temperature sender - G62- .

Installing

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

Note

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

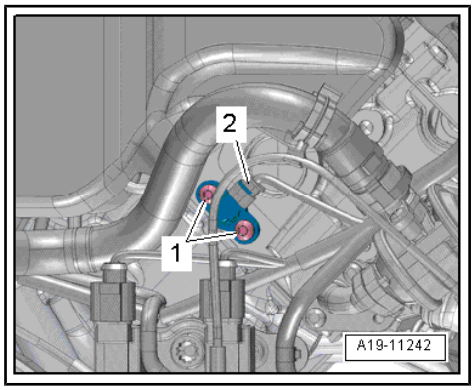
– Install air pipe ⇒ page 260 .

– Install engine cover panel ⇒ page 63 .

– Check coolant level ⇒ page 201 .

2.7 Removing and installing temperature sender for engine temperature regulation - G694-

Removing



– Unplug electrical connector -2-.

– Unscrew bolts -1- and detach temperature sender for engine temperature regulation - G694- .

Installing

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

Note

Fit new O-ring.

Tightening torques

- ⇒ “3.1 Exploded view - cylinder head”, page 129

2.8 Removing and installing coolant valves

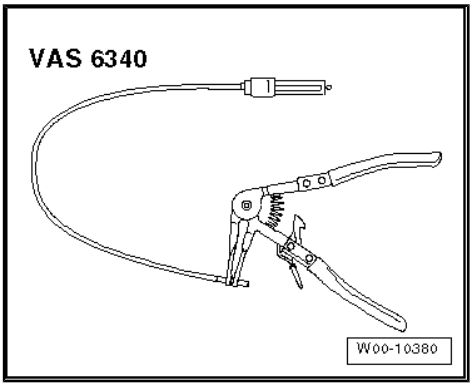
⇒ “2.8.1 Removing and installing coolant shut-off valve”, page 210

⇒ “2.8.2 Removing and installing coolant valve for gearbox N488 ”, page 211

2.8.1 Removing and installing coolant shut-off valve

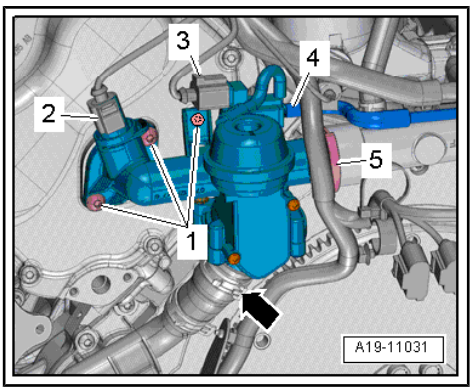
Special tools and workshop equipment required

♦ Hose clip pliers - VAS 6340-



Removing

– Remove coolant pipe (top left) ⇒ page 218 .
– Unplug electrical connector -2-.
– Unscrew bolts -1- and remove clip -5-.
– Unclip change-over valve -3- from coolant shut-off valve
– Disconnect vacuum hose -4-.
– Loosen hose clip -arrow- and detach coolant shut-off valve.



Installing

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

Note

♦ *Fit new O-rings.*
♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Install coolant pipe (top left) ⇒ page 218 .

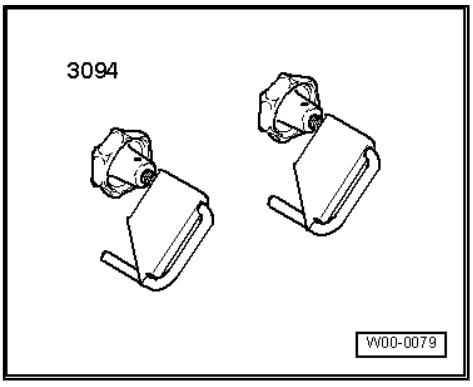
Tightening torques

♦ ⇒ “3.1 Exploded view - coolant pipes”, page 214

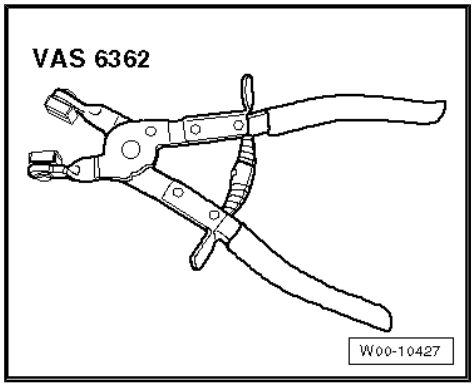
2.8.2 Removing and installing coolant valve for gearbox - N488-

Special tools and workshop equipment required

♦ Hose clamps, up to 25 mm - 3094-

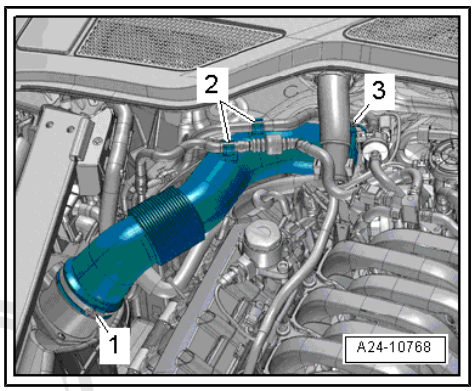


♦ Hose clip pliers - VAS 6362-

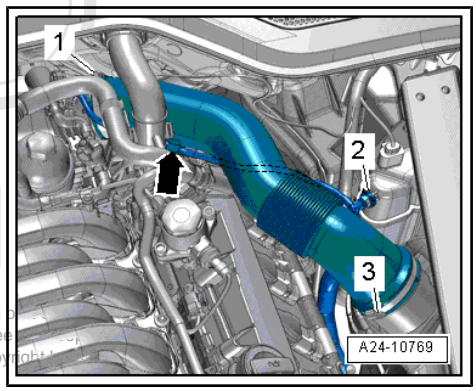


Removing

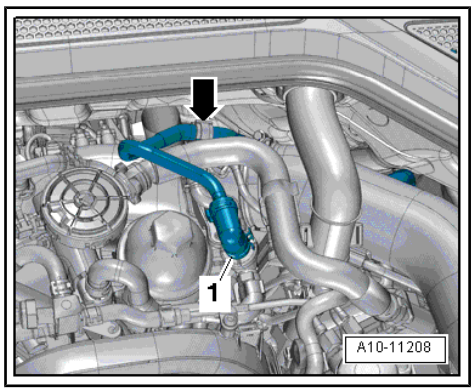
– Remove engine cover panel ⇒ page 63 .
– Move clear hoses -2- at air pipe.
– Loosen hose clips -1- and -3- and remove air pipe.



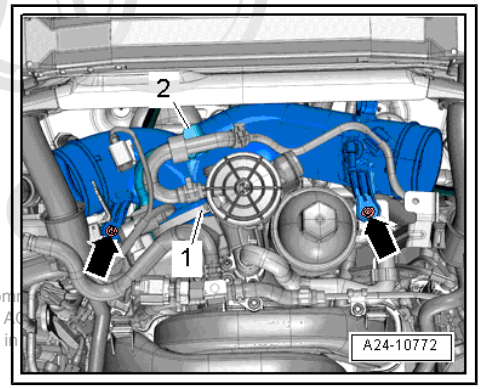
– Move coolant hose -2- clear -arrow-.
– Loosen hose clips -1- and -3- and remove air pipe.



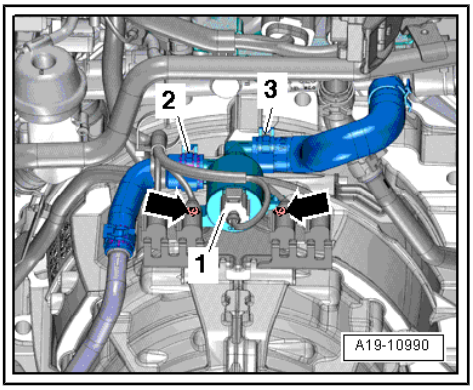
– Detach vacuum hose -1- and move clear -arrow-.



– Remove bolts -arrows-.
– Loosen clamp -1-.
– Detach air pipe and move clear to one side with crankcase breather hose -2- attached.



– Unplug electrical connector -1-.
– Remove bolts -arrows-.
– Clamp off coolant hoses using hose clamps, up to 25 mm - 3094- , release hose clips -2 and 3- and disconnect hoses.
– Take off coolant valve for gearbox - N488- .



Installing

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

Note

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

– Install air pipe ⇒ page 260 .
– Install engine cover panel ⇒ page 63 .
– Check coolant level ⇒ page 201 .

Tightening torques

- ⇒ Fig. “” Coolant valve for gearbox -N488- - tightening torque”“ , page 203

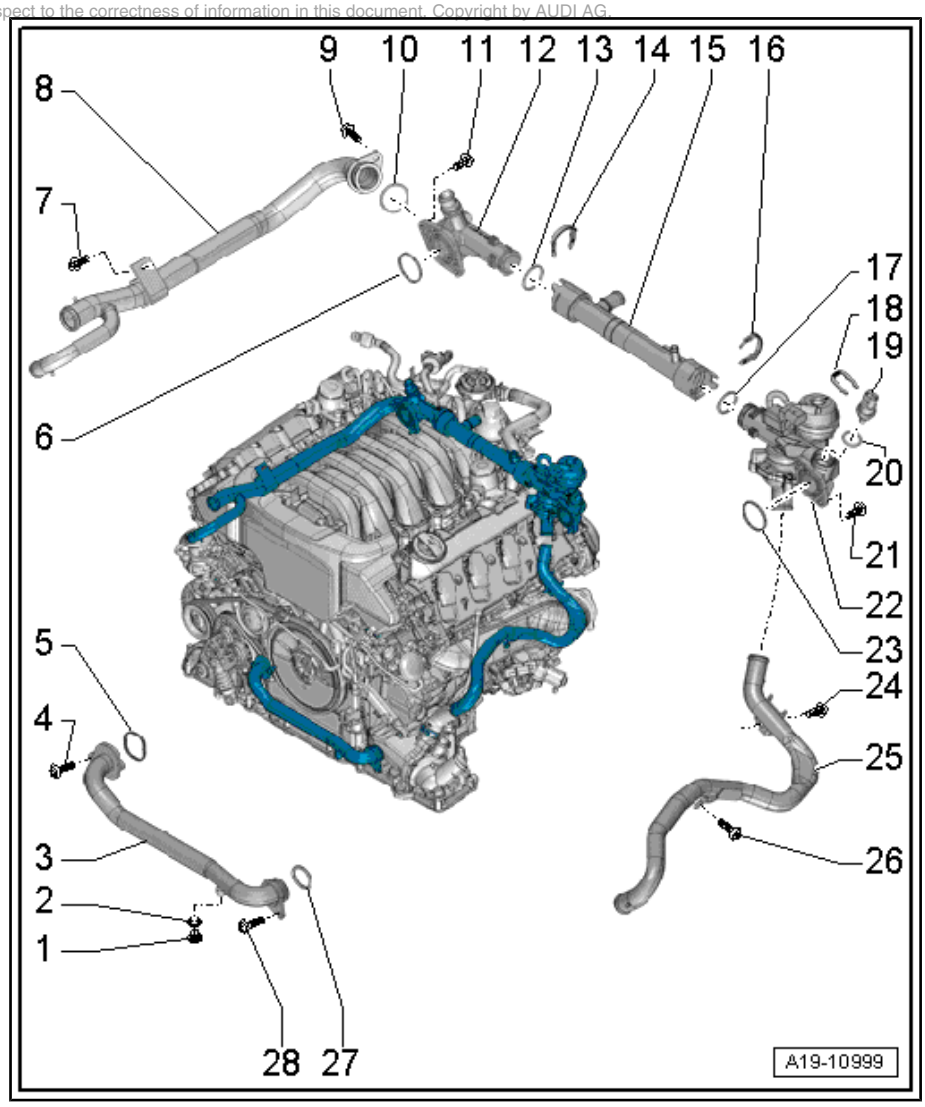
3 Coolant pipes

3.1 Exploded view - coolant pipes

Part 1

Note

The arrow markings on coolant pipes and on ends of hoses must align.



1 - Drain plug
- ❑ 10 Nm

2 - Seal
- ❑ Renew

3 - Coolant pipe (front)
- ❑ Removing and installing ⇒ page 217

4 - Bolt
- ❑ Renew
- ❑ 8 Nm + turn 90° further

5 - Seal
- ❑ Renew

6 - O-ring
- ❑ Renew

7 - Bolt
- ❑ 9 Nm

8 - Coolant pipe (right-side)
- ❑ Removing and installing ⇒ page 228

9 - Bolt
- ❑ 9 Nm

10 - O-ring
- ❑ Renew

11 - Bolt
- ❑ 9 Nm

12 - Coolant hose connection
- ❑ Removing and installing ⇒ page 230

13 - O-ring
- ❑ Renew

14 - Retaining clip

15 - Coolant pipe (rear)
- ❑ Removing and installing ⇒ page 232

16 - Retaining clip

17 - O-ring

- ❑ Renew

18 - Retaining clip

19 - Coolant temperature sender - G62-

- ❑ Removing and installing ⇒ page 209

20 - O-ring

- ❑ Renew

21 - Bolt

- ❑ 9 Nm

22 - Coolant shut-off valve

- ❑ Removing and installing ⇒ page 210

23 - O-ring

- ❑ Renew

24 - Bolt

- ❑ 9 Nm

25 - Coolant pipe (centre left)

- ❑ Removing and installing ⇒ page 218

26 - Bolt

- ❑ 9 Nm

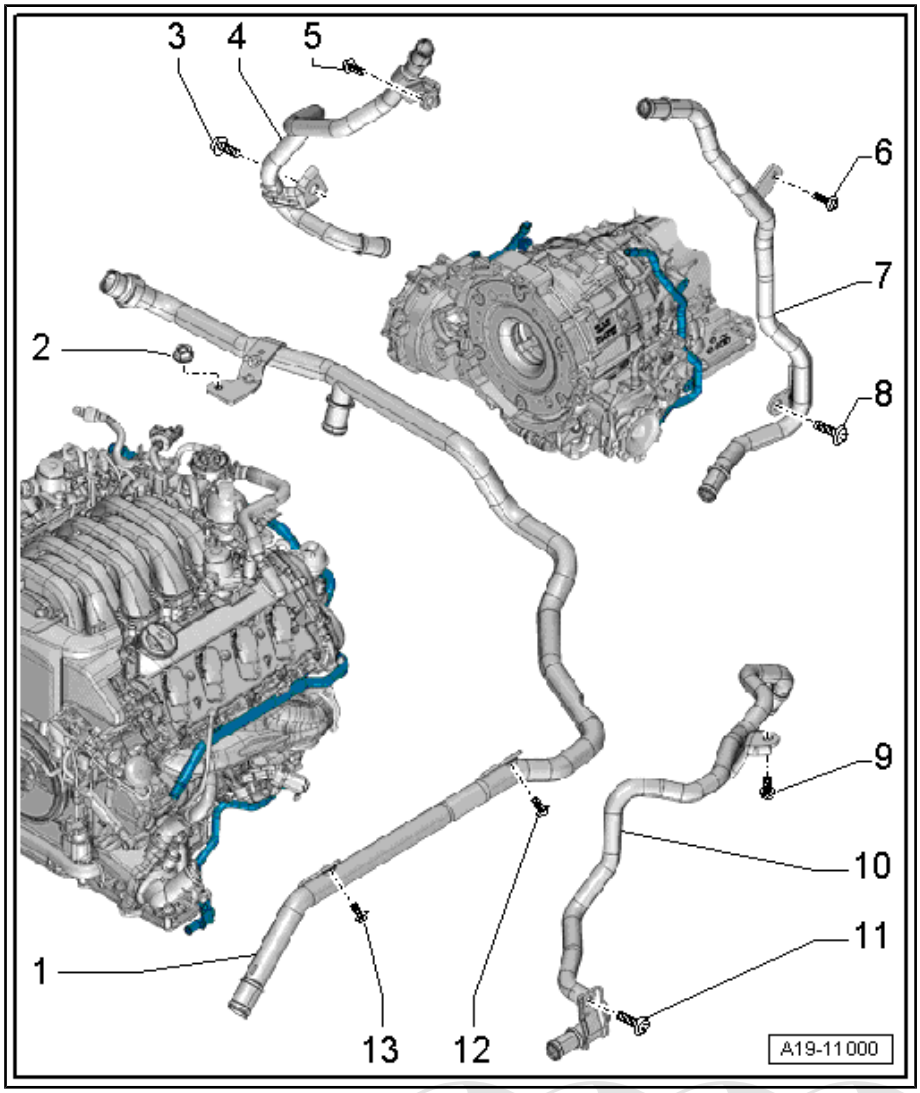
27 - O-ring

- ❑ Renew

28 - Bolt

- ❑ Renew
- ❑ 8 Nm + turn 90° further

Part 2



1 - Coolant pipe (top left)

- ❑ Removing and installing ⇒ page 218

2 - Nut

- ❑ 9 Nm

3 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

4 - Coolant pipe (right-side) on gearbox

- ❑ Removing and installing ⇒ page 234

5 - Bolt

- ❑ 9 Nm

6 - Bolt

- ❑ 9 Nm

7 - Coolant pipe (left-side) on gearbox

- ❑ Removing and installing ⇒ page 233

8 - Bolt

- ❑ Tightening torque ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

9 - Bolt

- ❑ 9 Nm

10 - Coolant pipe (bottom left)

- ❑ Removing and installing ⇒ page 222

11 - Bolt

- ❑ 9 Nm

12 - Bolt

- ❑ 9 Nm

13 - Bolt

- ❑ 9 Nm

3.2 Removing and installing coolant pipes

⇒ “3.2.1 Removing and installing coolant pipe (front)”, page 217

⇒ “3.2.2 Removing and installing coolant pipe (top left)”, page 218

⇒ “3.2.3 Removing and installing coolant pipe (centre left)”, page 221

⇒ “3.2.4 Removing and installing coolant pipe (bottom left)”, page 222

⇒ “3.2.5 Removing and installing coolant pipe (right-side)”, page 228

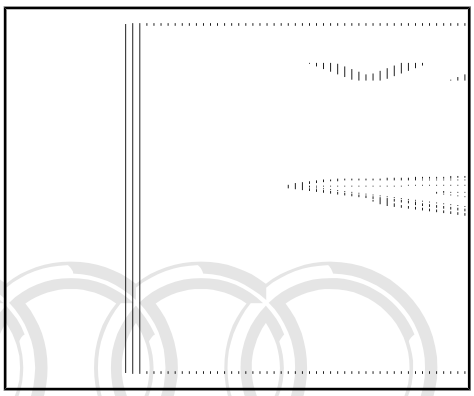
⇒ “3.2.6 Removing and installing coolant hose connection”, page 230

⇒ “3.2.7 Removing and installing coolant pipe (rear)”, page 232

3.2.1 Removing and installing coolant pipe (front)

Special tools and workshop equipment required

- Drip tray for workshop hoist - VAS 6208-

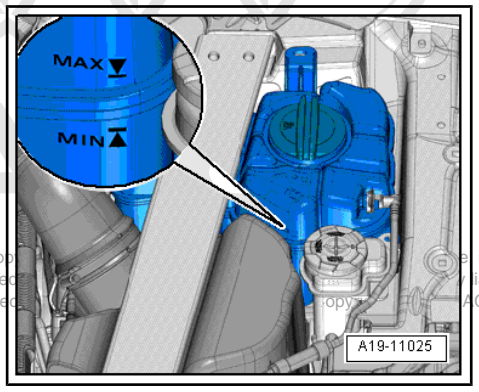


Removing

WARNING

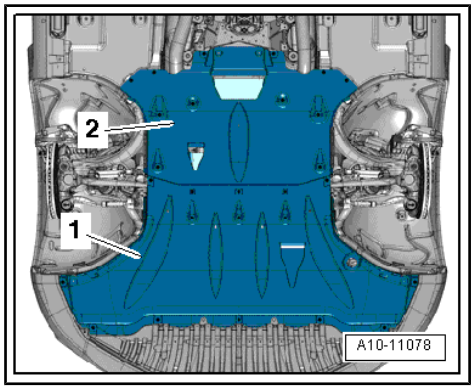
Hot steam/hot coolant can escape - risk of scalding.

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



– Open filler cap on coolant expansion tank.

– Remove noise insulation panels -1- and -2- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

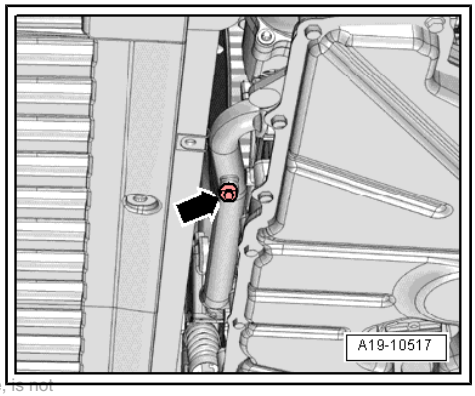


Note

Collect drained coolant in a clean container for disposal.

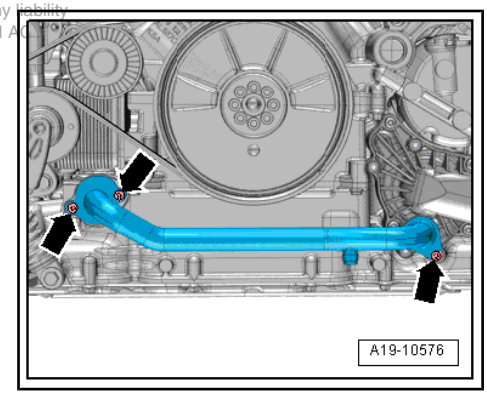
– Place drip tray for workshop hoist - VAS 6208- beneath engine.

– Unscrew drain plug -arrow- on coolant pipe (front) and drain off coolant.



– Remove bolts -arrows-.

– Detach front coolant pipe from engine and coolant pump.



Installing

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

Note

- *Renew seals and O-ring.*
- *Renew the bolts tightened with specified tightening angle.*

– Clean or smoothen sealing surfaces for seal and O-ring.

– Lubricate seal and O-ring with coolant and fit.

Note

Do not reuse coolant.

– Fill up with coolant ⇒ page 196 .

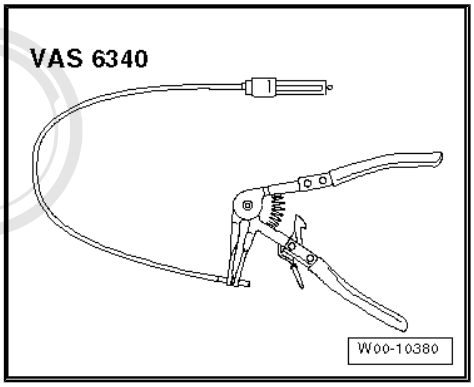
Tightening torques

- ⇒ “3.1 Exploded view - coolant pipes”, page 214

3.2.2 Removing and installing coolant pipe (top left)

Special tools and workshop equipment required

♦ Hose clip pliers - VAS 6340-



Removing

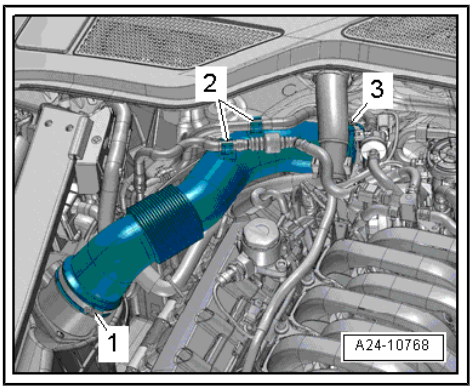
– Remove engine cover panel ⇒ page 63 .

– Drain coolant ⇒ page 194 .

– Remove plenum chamber partition panel ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Exploded view - bulkhead .

– Move clear hoses -2- at air pipe.

– Loosen hose clips -1- and -3- and remove air pipe.

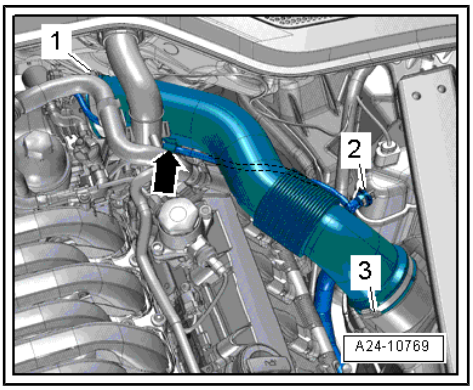


– Move coolant hose clear -arrow- and detach from coolant expansion tank (lift retaining clip -2-).

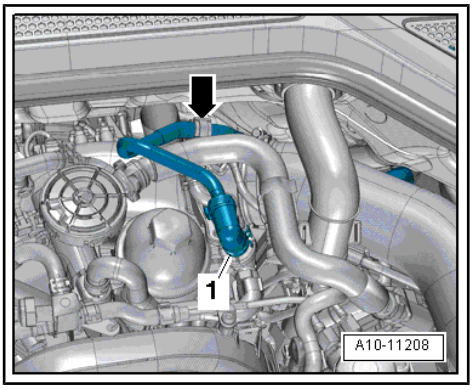
– Release hose clips -1- and -3- and remove air pipe.

– Remove air cleaner housing (left-side) ⇒ page 261 .

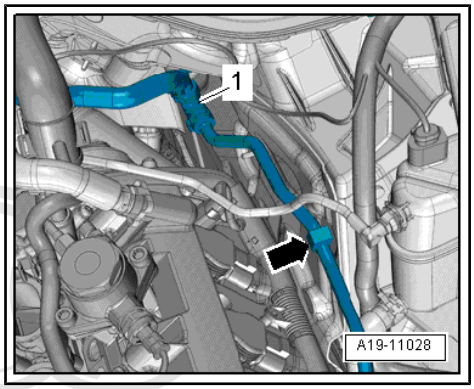
– Remove Lambda probe 2 - G108- and Lambda probe 2 after catalytic converter - G131- ⇒ page 286 .



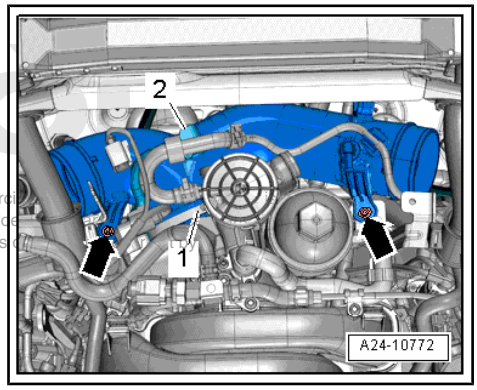
– Detach vacuum hose -1- and move clear -arrow-.



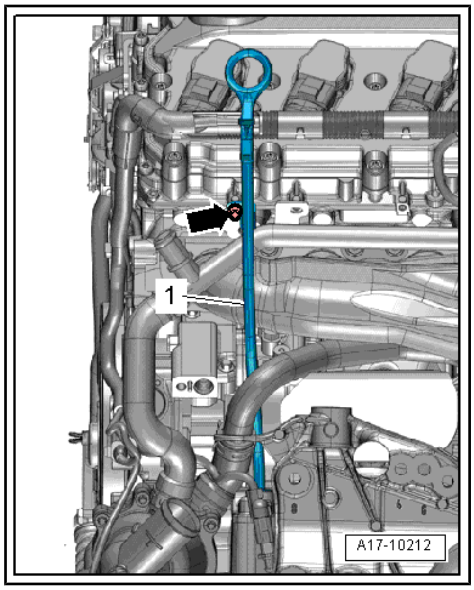
– Detach vacuum hose -1- at plenum chamber partition panel, move clear -arrow- and move to left.



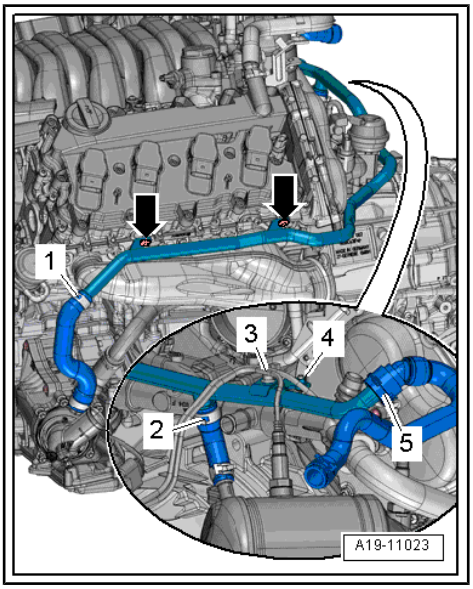
– Remove bolts -arrows-.
– Loosen clamp -1-.
– Detach air pipe and move clear to one side with crankcase breather hose -2- attached.
– Remove Hall sender 4 - G301- ⇒ page 326 .



– Remove bolt -arrow- and pull guide tube -1- for oil dipstick out of sump (top section).



– Remove bolts -arrows- and nut -4-.
– Move clear electrical wiring -3-.
– Release hose clips -1, 2-, lift retaining clip -5- and detach coolant pipe (top left) from coolant hoses.
– Take out coolant pipe (top left)



Installing

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

Note

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

– Connect coolant hose with plug-in connector ⇒ page 237 .
– Install Lambda probes ⇒ page 286 .
– Install plenum chamber partition panel ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Exploded view - bulkhead .
– Install engine cover panel ⇒ page 63 .

Note

Do not reuse coolant.

– Fill up with coolant ⇒ page 196 .

Tightening torques

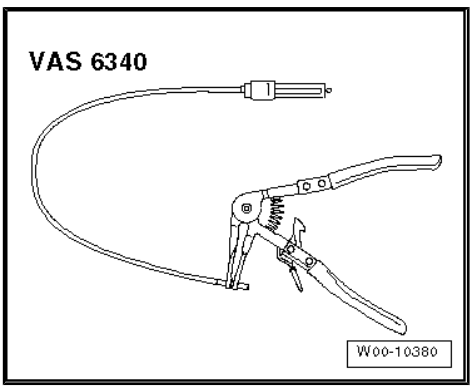
- Guide tube for oil dipstick ⇒ "3.1 Exploded view - crankshaft", page 76

- ⇒ "3.1 Exploded view - coolant pipes", page 214
- ⇒ "3.1 Exploded view - air cleaner housing", page 260
- Hall sender 4 - G301- ⇒ "1.1 Exploded view - ignition system", page 322

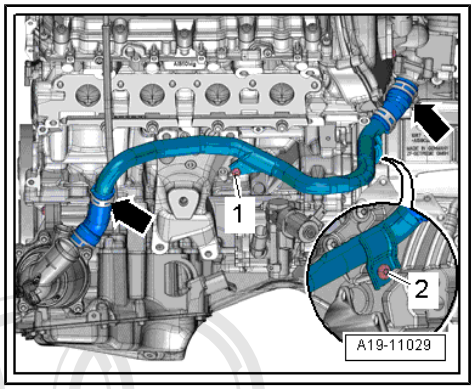
3.2.3 Removing and installing coolant pipe (centre left)

Special tools and workshop equipment required

- Hose clip pliers - VAS 6340-



Removing



– Remove exhaust manifold (left-side) ⇒ page 316 .
– Remove bolts -1 and 2-.
– Open hose clips -arrows- and detach coolant pipe (centre left) from coolant hoses.
– Detach coolant pipe.

Installing

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

Note

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

– Install exhaust manifold (left-side) ⇒ page 316 .

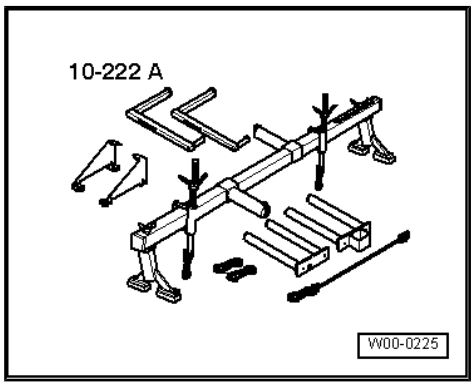
Tightening torques

♦ ⇒ “3.1 Exploded view - coolant pipes”, page 214

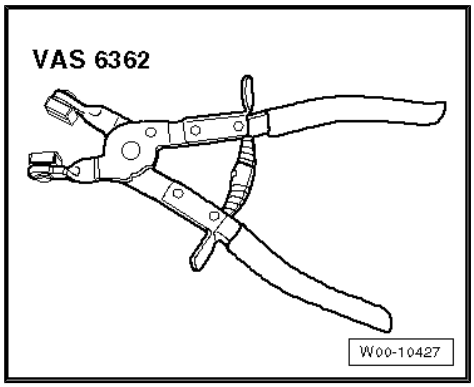
3.2.4 Removing and installing coolant pipe (bottom left)

Special tools and workshop equipment required

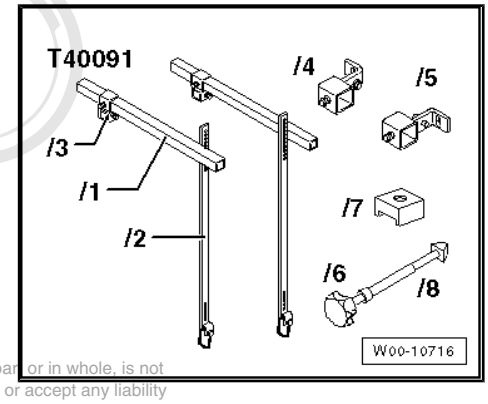
♦ Support bracket - 10 - 222 A-



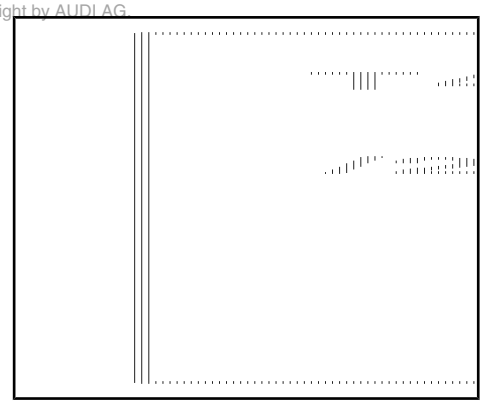
♦ Hose clip pliers - VAS 6362-



- Engine support bracket (basic set) - T40091-



- Engine support bracket (supplementary set) - T40093- with - T40093/7- and -T40093/8-



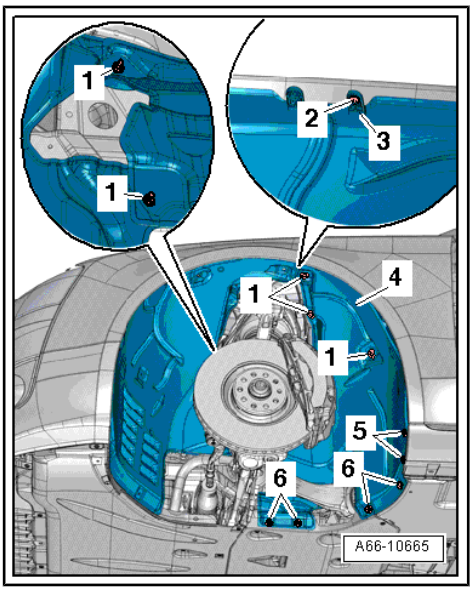
Removing

– Remove engine cover panel ⇒ page 63 .

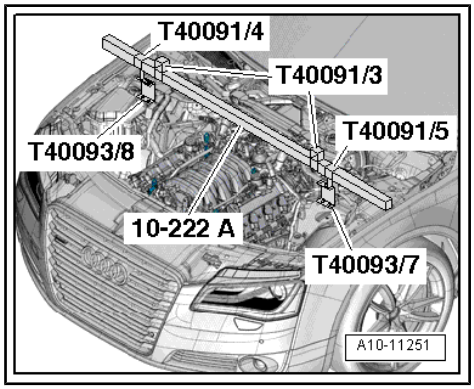
– Drain coolant ⇒ page 194 .

– Remove front wheel housing liner (left-side) completely ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Removing and installing front wheel housing liner .

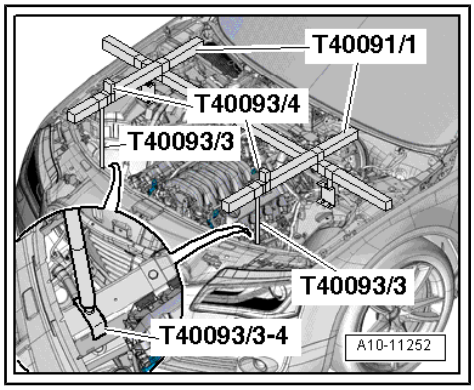
– Remove air cleaner housing (left and right) ⇒ page 261 .



– Set up support bracket - 10 - 222 A- with -T40091/3- , -T40091/4- , -T40091/5- , -T40093/7- and -T40093/8- on suspension turrets (left and right) as illustrated.

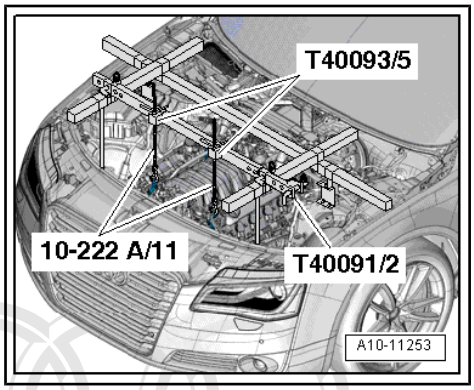


– Set up further tools -T40091/1- , -T40093/3- , -T40093/3-4- and -T40093/4- , as shown in illustration.

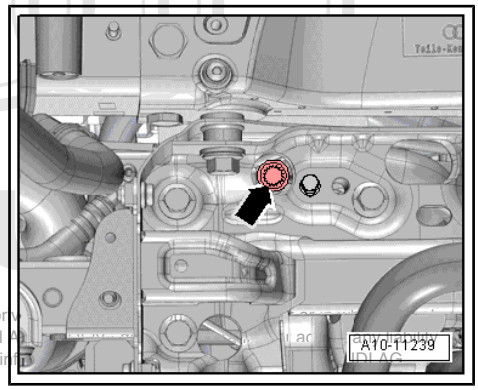


– Set up further tools -T40091/2- and -T40093/5- with spindles -10 - 222 A /11- , as shown in illustration.

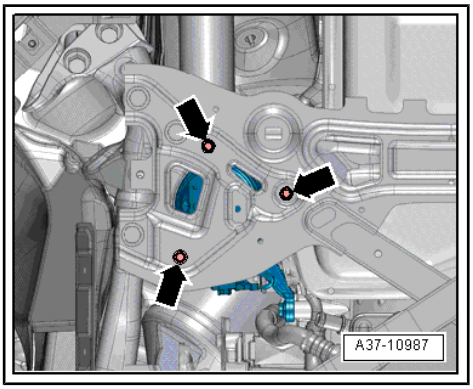
– Engage spindles on engine lifting eyes and partly take up weight of engine.



– Remove bolt -arrow- for engine mounting (left-side).



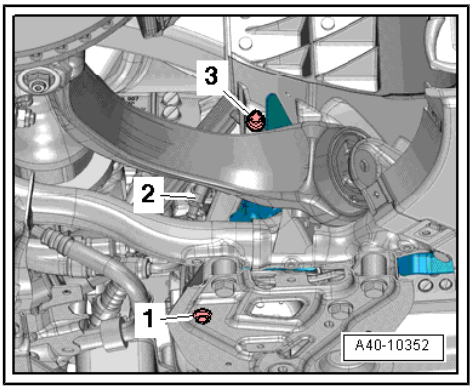
– Remove bolts -arrows- securing gearbox mounting (left-side).



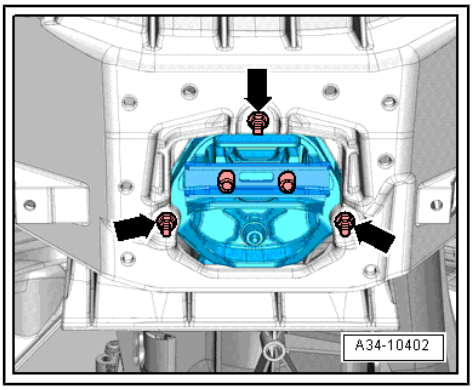
– Unscrew bolt -3- and remove strut.

Note

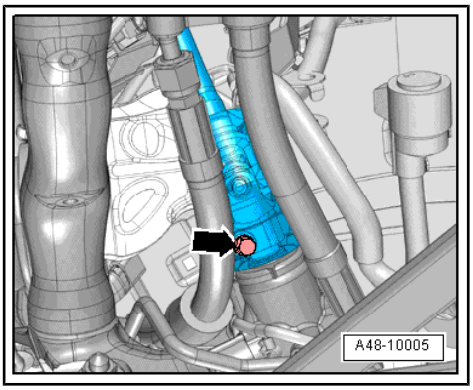
Disregard -items 1, 2-.



– Remove nuts -arrows- for tunnel cross member.

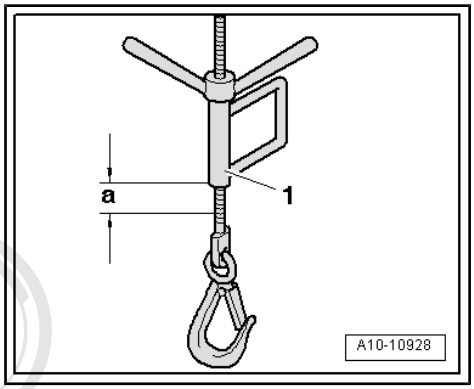


– Detach intermediate steering shaft from steering rack and move clear by telescoping upwards ⇒ Running gear, axles, steering; Rep. gr. 48 ; Steering column; Removing and installing intermediate steering shaft .



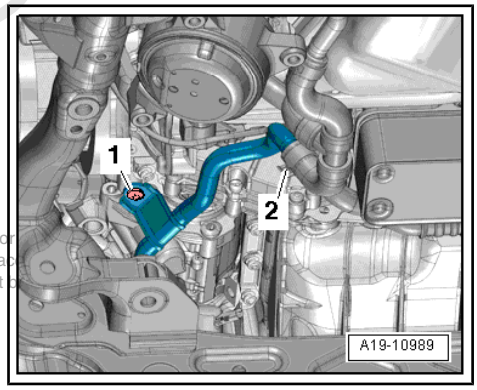
– Using spindle - 10 - 222 A /11- -item 1-, raise engine through distance -a- on left side.

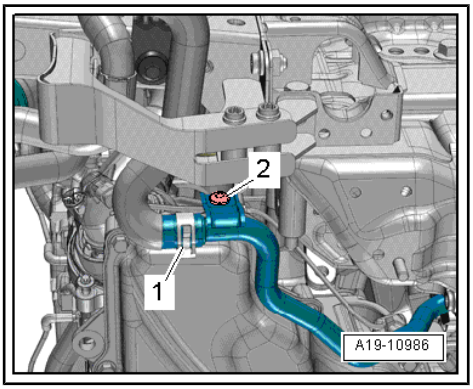
• Distance -a- = 30 mm.



– Remove bolt -1-.

– Release hose clip -2- and detach coolant hose.





– Release hose clip -1- and detach coolant hose from coolant pipe (bottom left).
– Remove bolt -2- and detach coolant pipe (bottom left).

Installing

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

Note

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

– Secure intermediate steering shaft to steering rack ⇒ Running gear, axles, steering; Rep. gr. 48 ; Steering column; Removing and installing intermediate steering shaft .
– Install gearbox mounting and strut on gearbox mounting ⇒ page 45 .
– Install engine mounting (left-side) ⇒ page 45 .
– Install tunnel cross-piece ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings .
– Install air cleaner housing ⇒ page 261 .
– Install front wheel housing liner ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Exploded view - wheel housing liner (front) .

– Install engine cover panel ⇒ page 63 .

Note

Do not reuse coolant.

– Fill up with coolant ⇒ page 196 .

Tightening torques

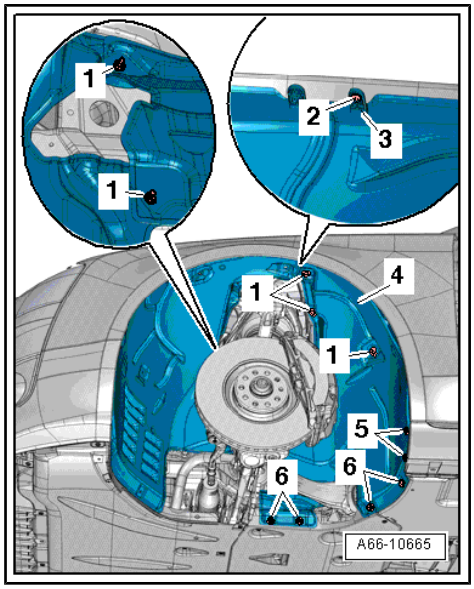
♦ ⇒ “3.1 Exploded view - coolant pipes”, page 214

3.2.5 Removing and installing coolant pipe (right-side)

Removing

– Drain coolant ⇒ page 194 .

– Remove front wheel housing liner (right-side) completely ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Removing and installing front wheel housing liner .



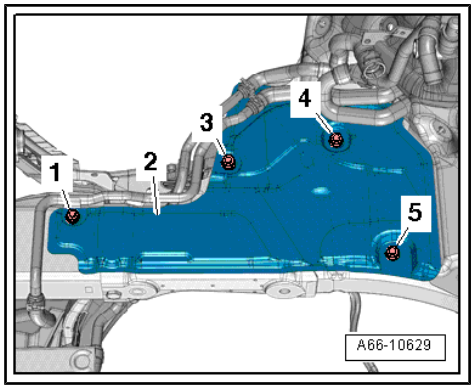
Vehicles with auxiliary heater:

– Remove bolts -1 and 3- for heat shield.

All vehicles (continued):

– Remove plenum chamber partition panel ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Exploded view - bulkhead .

– Remove Lambda probe - G39- ⇒ page 286 .



Vehicles with auxiliary heater:

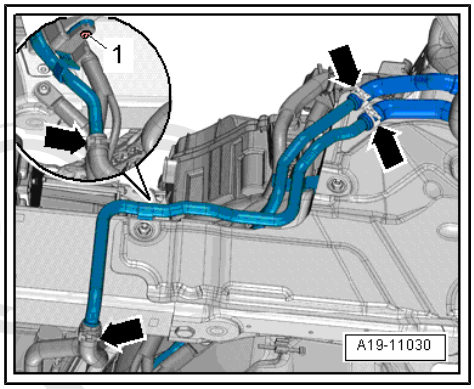
– Remove bolt -1-.

– Release hose clips -arrows- and detach coolant hoses.

– Detach coolant pipes.

Note

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

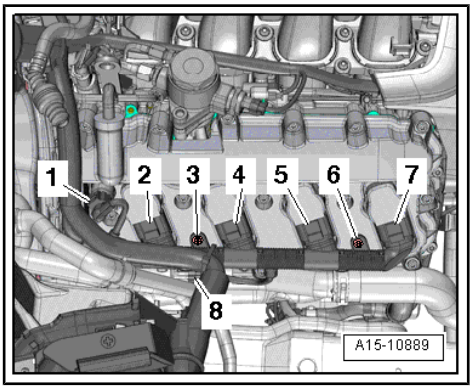


All vehicles (continued):

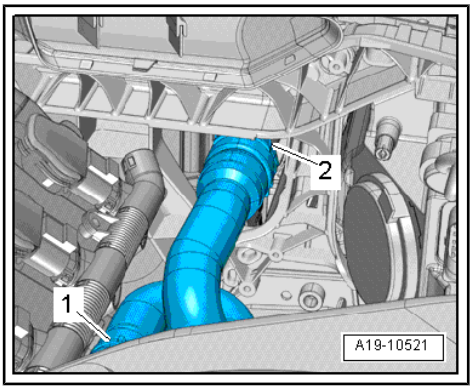
– Remove bolts -3- and -6- at cylinder head cover (right-side) and move electrical wiring harness clear.

– Unplug electrical connectors -1, 2, 4, 5, 7, 8-.

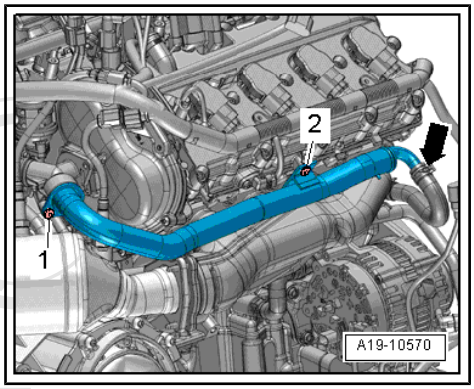
– Move wiring harness clear to the side.



– Lift retaining clip -2-, release hose clip -1- on coolant pipe (right-side) and remove coolant hose.



– Remove bolts -1- and -2-.
– Release hose clip -arrow- and detach coolant hose.
– Detach coolant pipe (right-side) from coolant hose connection and remove.



Installing

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

Note

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

– Lubricate O-ring with coolant.
– Connect coolant hose with plug-in connector ⇒ page 237.
– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Install Lambda probe - G39- ⇒ page 286
– Install plenum chamber partition panel ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Exploded view - bulkhead .
– Install front wheel housing liner ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Exploded view - wheel housing liner (front) .

Note

Do not reuse coolant.

– Fill up with coolant ⇒ page 196 .

Tightening torques

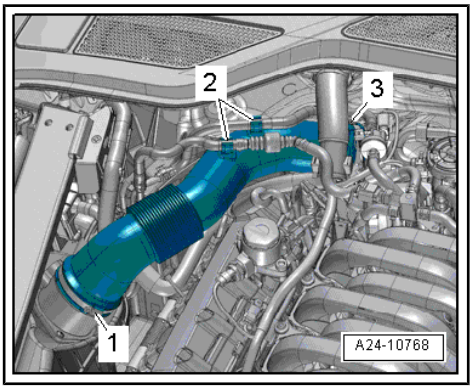
- ⇒ “3.1 Exploded view - coolant pipes”, page 214
- Heat shield for longitudinal member ⇒ General body repairs, exterior; Rep. gr. 66 ; Strips / trim panels / extensions; Exploded view - heat shield .

3.2.6 Removing and installing coolant hose connection

Removing

– Drain coolant ⇒ page 194 .
– Remove plenum chamber partition panel ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Exploded view - bulkhead .

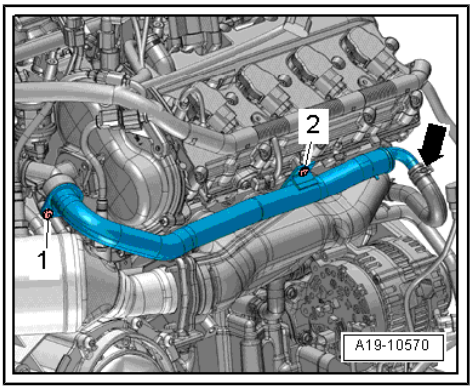
– Move clear hoses -2- at air pipe.
– Loosen hose clips -1- and -3- and remove air pipe.
– Remove air cleaner housing (right-side) ⇒ page 261 .



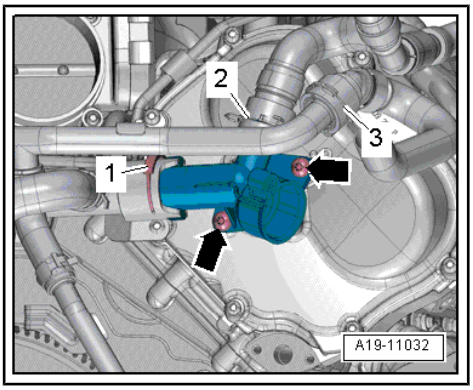
– Remove bolts -1- and -2-.
– Detach coolant pipe (right-side) from coolant hose connection.

Note

Disregard -arrow-.



– Lift retaining clips -2, 3- and disconnect coolant hoses.
– Remove bolts -arrows-.
– Detach clip -1- and detach coolant hose connection.



Installing

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

Note

Renew gasket and O-rings.

– Lubricate O-ring with coolant.
– Connect coolant hose with plug-in connector ⇒ page 237 .
– Install coolant pipe (right-side) ⇒ page 228 .
– Install plenum chamber partition panel ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Exploded view - bulkhead .

Note

Do not reuse coolant.

– Fill up with coolant ⇒ page 196 .

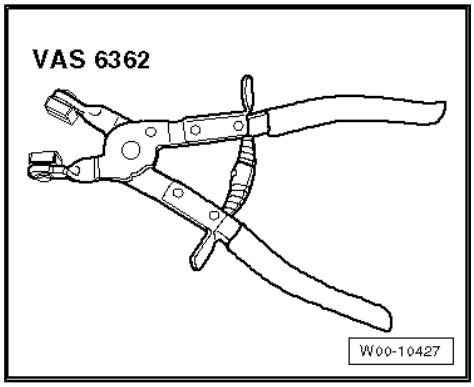
Tightening torques

- ⇒ “3.1 Exploded view - coolant pipes”, page 214
- ⇒ “3.1 Exploded view - air cleaner housing”, page 260

3.2.7 Removing and installing coolant pipe (rear)

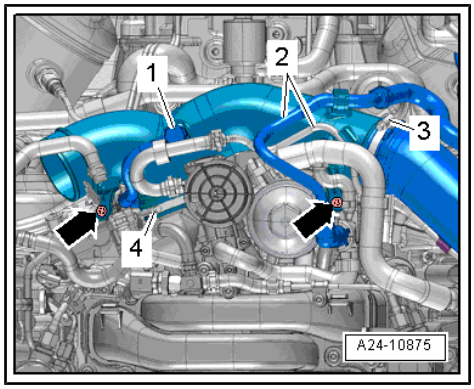
Special tools and workshop equipment required

- Hose clip pliers - VAS 6362-

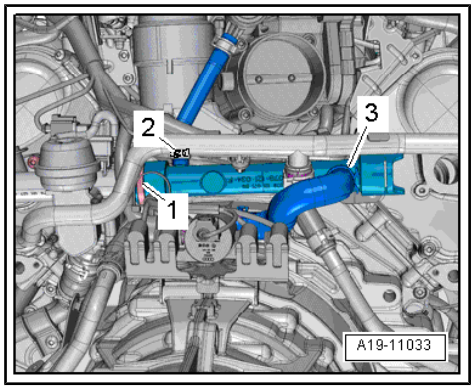


Removing

– Remove coolant hose connection ⇒ page 230 .
– Remove bolts -arrows-.
– Move hoses -2- clear.
– Release hose clips -3, 4- and detach air pipe.
– Move air pipe with hose -1- attached clear to one side.



– Release hose clips -2, 3- and disconnect coolant hoses.
– Detach clip -1- and remove coolant pipe (rear).



Installing

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

Note

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

– Lubricate O-ring with coolant.
– Install coolant hose connection ⇒ page 230 .

Tightening torques

- ⇒ “3.1 Exploded view - coolant pipes”, page 214
- Air pipe
  ⇒ “3.1 Exploded view - air cleaner housing”, page 260

3.3 Removing and installing coolant pipes for gearbox

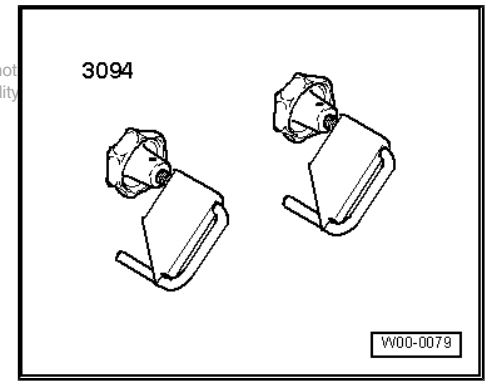
⇒ “3.3.1 Removing and installing coolant pipe (left-side) for gearbox”, page 233

⇒ “3.3.2 Removing and installing coolant pipe (right-side) for gearbox”, page 234

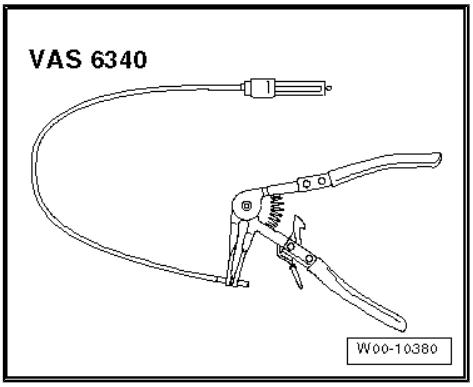
3.3.1 Removing and installing coolant pipe (left-side) for gearbox

Special tools and workshop equipment required

- Hose clamps, up to 25 mm - 3094-

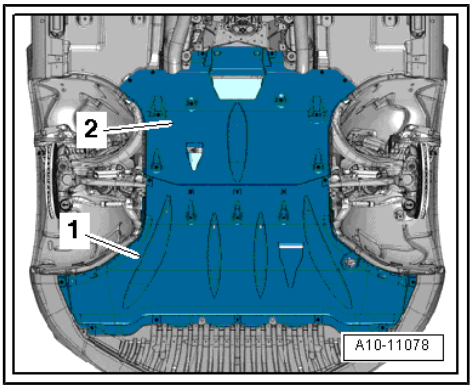


- Hose clip pliers - VAS 6340-



Removing

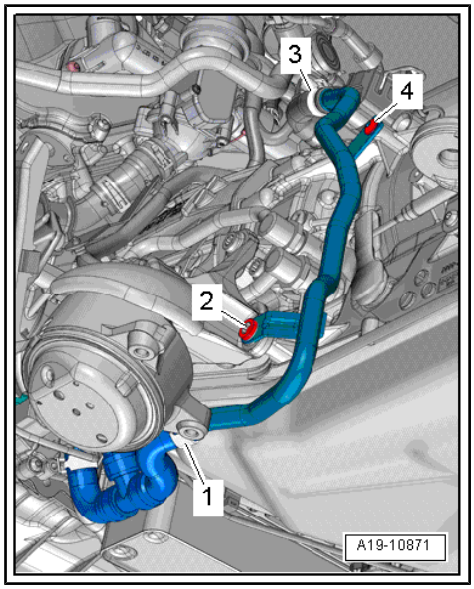
– Remove rear noise insulation -2- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



– Remove bolts -2 and 4-.

– Clamp off coolant hoses using hose clamps -3094- , release hose clips -1, 3- and disconnect coolant hoses.

– Detach coolant pipe (left-side) at gearbox.



Installing

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

Note

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

– Check coolant level ⇒ page 201 .

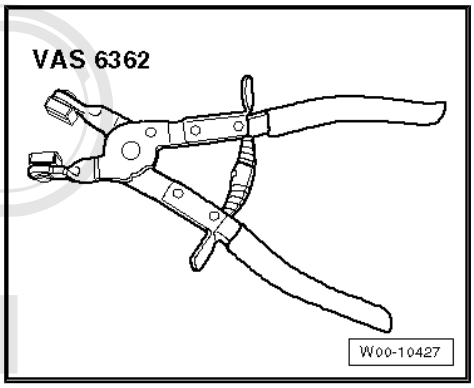
Tightening torques

- ⇒ “3.1 Exploded view - coolant pipes”, page 214
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation

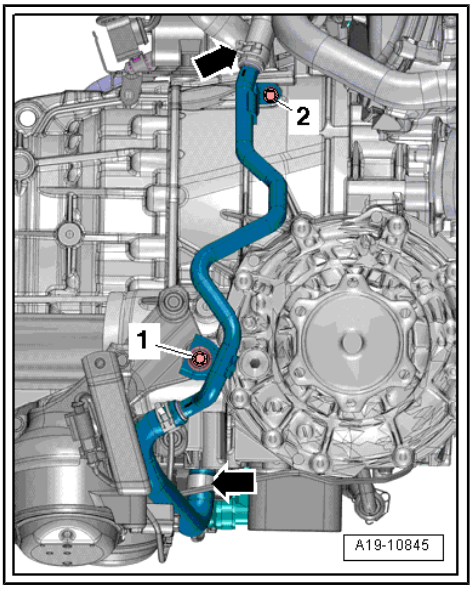
3.3.2 Removing and installing coolant pipe (right-side) for gearbox

Special tools and workshop equipment required

- Hose clip pliers - VAS 6362-



Removing



– Drain coolant ⇒ page 194 .
– Remove plenum chamber partition panel ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Exploded view - bulkhead .
– Remove bolts -1 and 2-.
– Open hose clips -arrows- and detach coolant pipe (right-side) at gearbox from coolant hoses.

Installing

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

Note

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

– Install plenum chamber partition panel ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Exploded view - bulkhead .

Note

Do not reuse coolant.

– Fill up with coolant ⇒ page 196 .

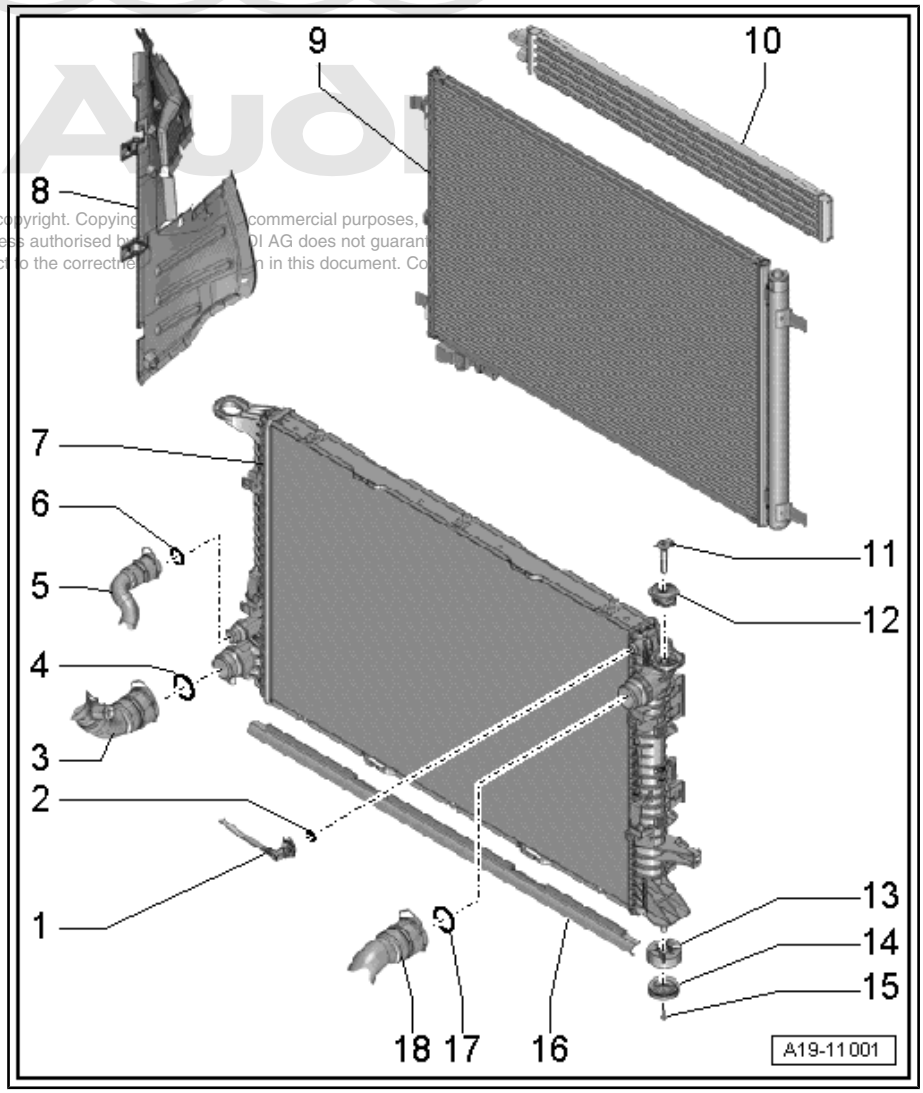
Tightening torques

◆ ⇒ “3.1 Exploded view - coolant pipes”, page 214

4 Radiator/radiator fans

4.1 Exploded view - radiator/radiator fans

Radiator



1 - Coolant hose

- ❑ To coolant expansion tank
- ❑ Lift retaining clip to detach
- ❑ Connecting ⇒ page 237

2 - O-ring

- ❑ Renew

3 - Coolant hose

- ❑ Lift retaining clip to detach
- ❑ Connecting ⇒ page 237

4 - O-ring

- ❑ Renew

5 - Coolant hose

- ❑ Lift retaining clip to detach
- ❑ Connecting ⇒ page 237

6 - O-ring

- ❑ Renew

7 - Radiator

- ❑ Removing and installing ⇒ page 238
- ❑ If renewed, change coolant in entire system

8 - Air duct

9 - Condenser

- ❑ Removing and installing ⇒ Heating, air conditioning; Rep. gr. 87 ; Refrigerant circuit; Removing and installing condenser

10 - Hydraulic fluid cooler

- ❑ For power steering
- ❑ Removing and installing ⇒ Running gear, axles, steering; Rep. gr. 48 ; Hydraulic power steering; Removing and installing hydraulic fluid cooler

11 - Retaining pin

- ❑ Use screwdriver to release and pull off

12 - Rubber buffer

13 - Rubber bush

- ❑ For radiator

14 - Washer

15 - Bolt

- ❑ 3.5 Nm

16 - Air duct

17 - O-ring

- ❑ Renew

18 - Coolant hose

- ❑ Lift retaining clip to detach
- ❑ Connecting ⇒ page 237

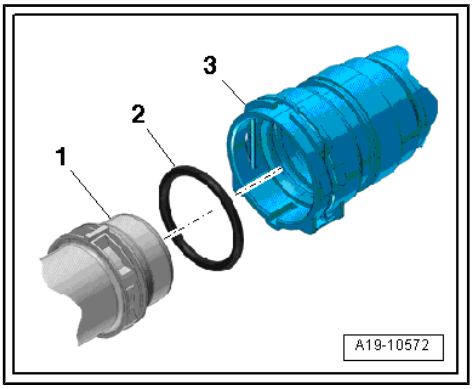
Connecting coolant hose with plug-in connector

– 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.



Radiator cowl and radiator fans

1 - Radiator fan 2 - V177-

- ❑ With radiator fan control unit 2 - J671-
- ❑ Removing and installing ⇒ page 245

2 - Radiator fan - V7-

- ❑ With radiator fan control unit - J293-
- ❑ Removing and installing ⇒ page 245

3 - Radiator cowl

- ❑ Removing and installing ⇒ page 242

4 - Bolt

- ❑ 3.5 Nm

5 - Air duct (left-side)

6 - Fan wheel

- ❑ Pin must engage in hole

7 - Bolt

- ❑ 5 Nm

8 - Fan wheel

- ❑ Pin must engage in hole

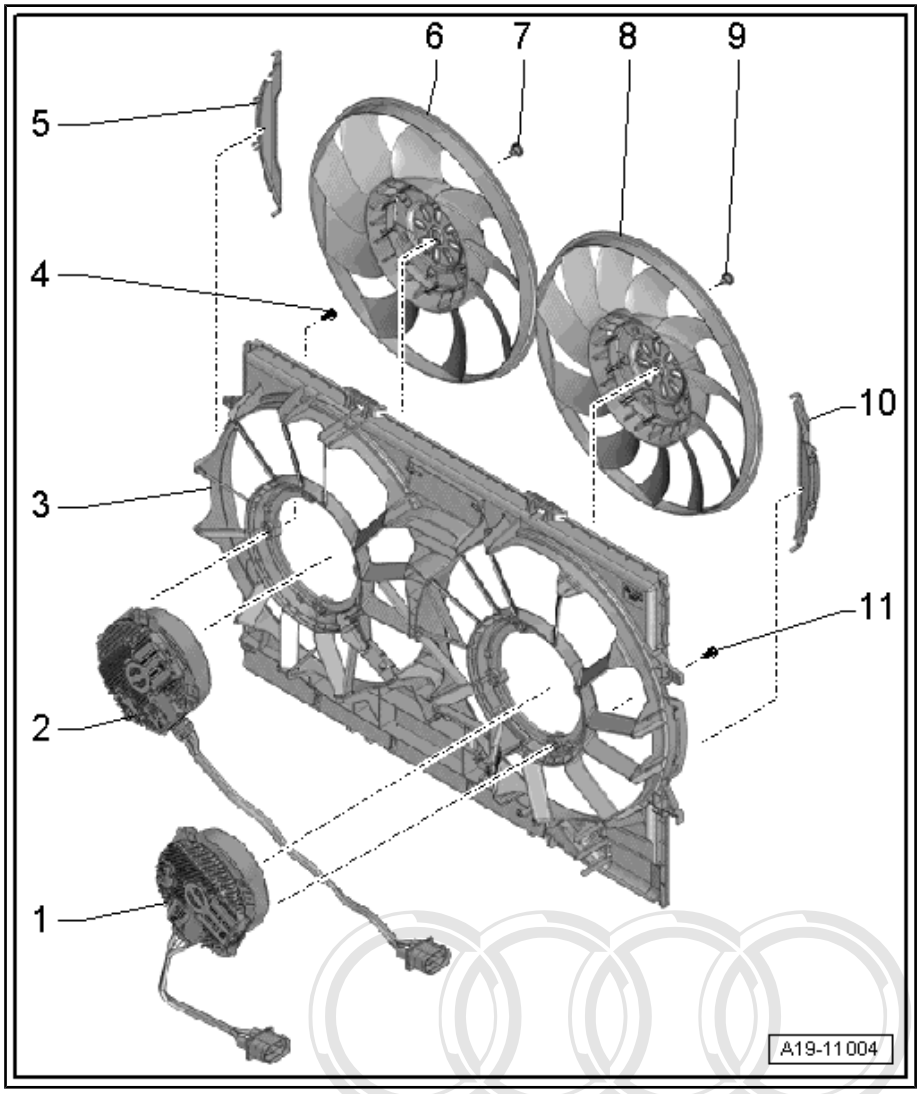
9 - Bolt

- ❑ 5 Nm

10 - Air duct (right-side)

11 - Bolt

- ❑ 3.5 Nm



4.2 Removing and installing radiator

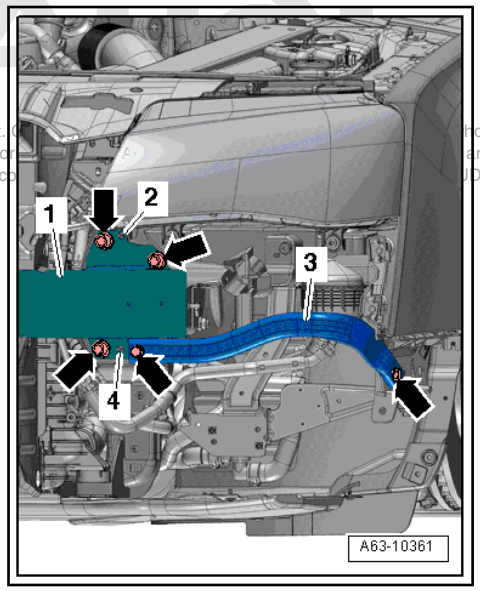
Removing

Note

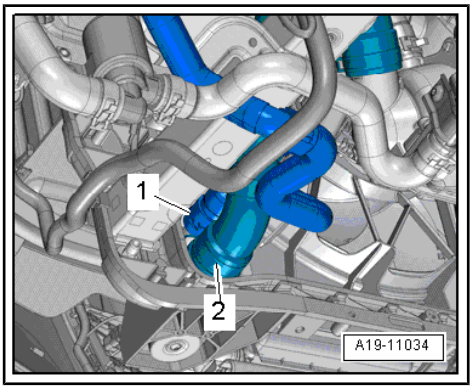
If there are slight impressions on the fins, refer to ⇒ page 9 .

– Drain coolant ⇒ page 194 .

– Remove impact bar -1- ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Removing and installing impact bar .



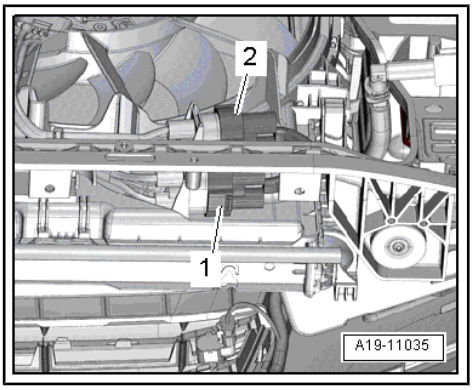
– Lift retaining clips -1 and 2- and disconnect coolant hoses from radiator.



WARNING

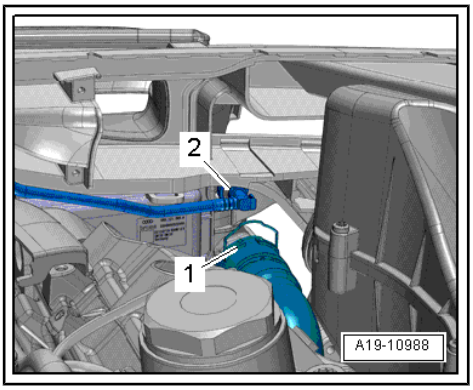
Risk of injury as the radiator fans may start up automatically.

- *Unplug electrical connectors before starting to work in the area of radiator cowl.*



– Unplug electrical connectors -1, 2- for radiator fan.

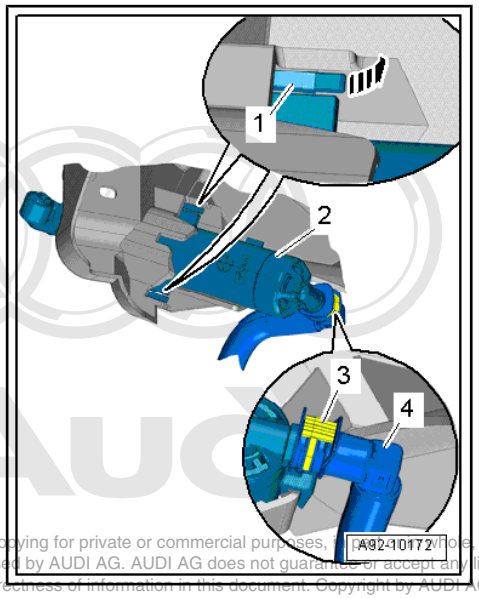
– Lift retaining clips -1 and 2- and disconnect coolant hoses (top right) from radiator.



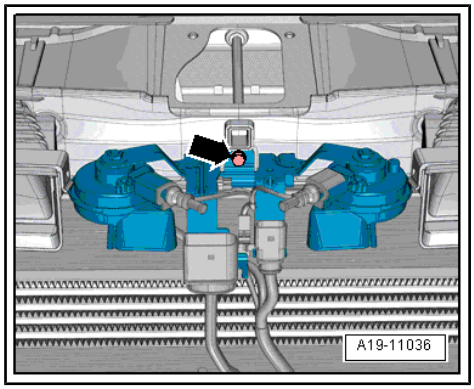
– Detach hose -4- for headlight washer system (remove clip -3-).

Note

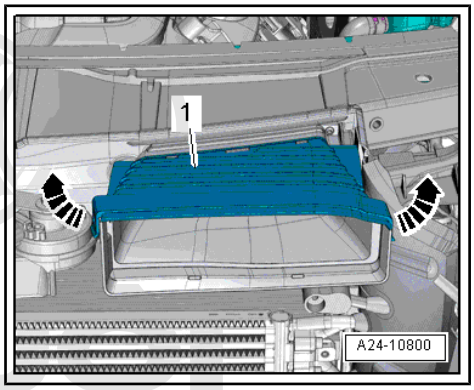
Disregard -items 1, 2- and -arrow-.



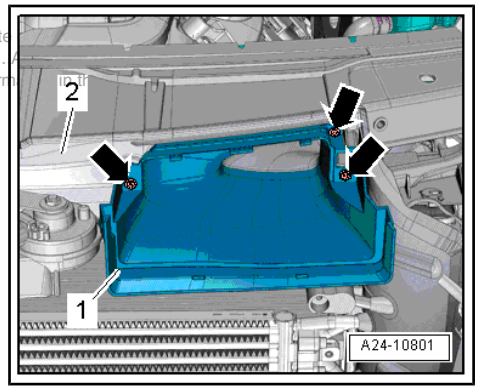
– Remove bolt -arrow-, leave bracket with horns suspended.



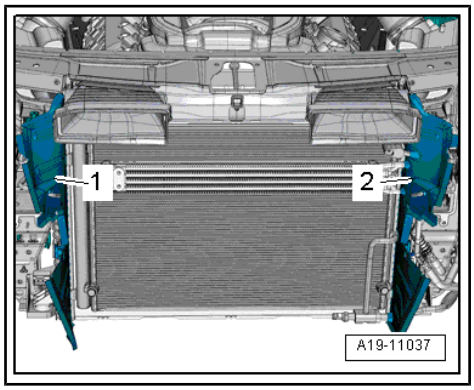
– Unclip cover -1- on both sides -arrows- and remove.



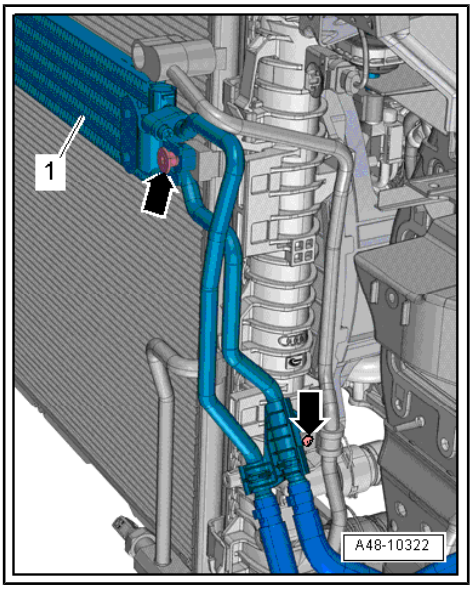
– Remove bolts -arrows- on both sides, detach air duct -1- and -2- and remove.



– Unclip air ducts -1 and 2-.

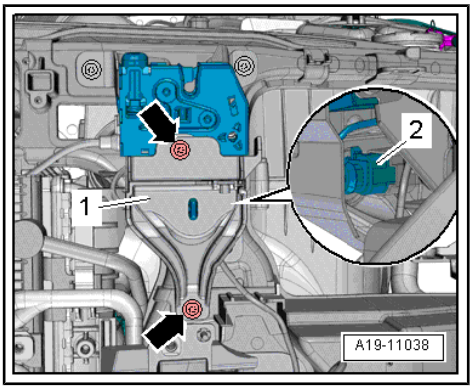


– Remove bolts -arrows-, detach hydraulic fluid cooler -1- for power steering to the left and hook it up on one side.

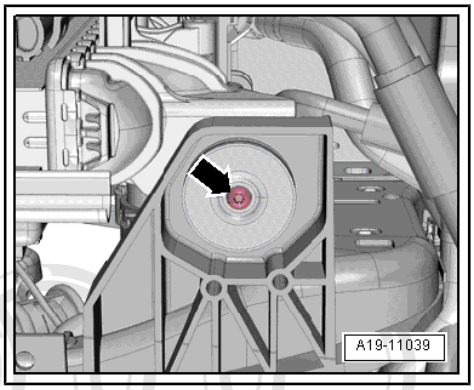


– Move clear electrical connector -2-.

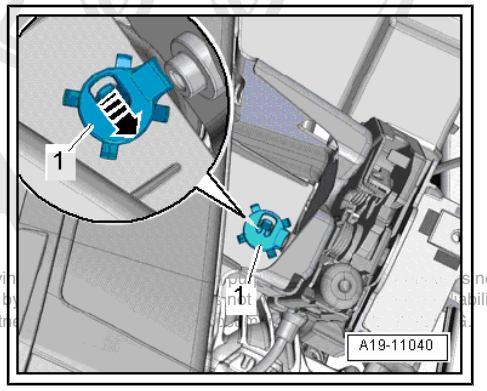
– Remove bolts -arrows- on both sides and detach support -1- from lock carrier.



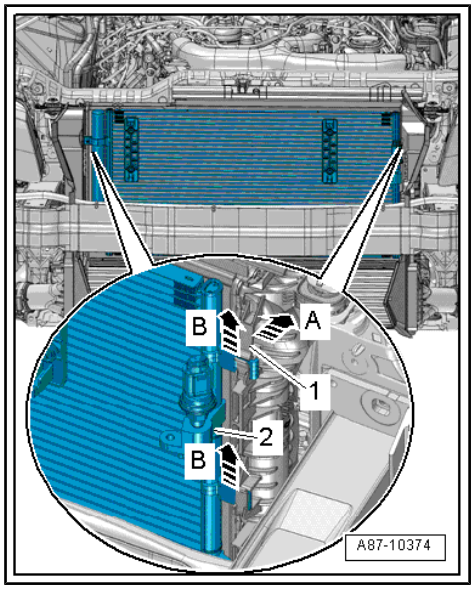
– Remove bolt -arrow- at bottom left and bottom right of radiator.



– Release retaining pins -1- for radiator on both sides -arrow- and pull out upwards.



– Have a second mechanic release retaining clips -1- in direction of -arrow A- and lift condenser -2- out of mounts on radiator -arrows B-.



Caution

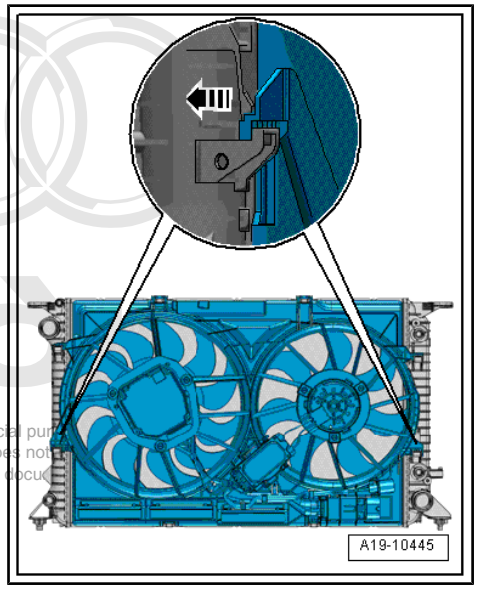
Risk of damage to condenser, refrigerant lines and refrigerant hoses.

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

– Pivot condenser forwards with pipes/hoses attached.

– Detach radiator.

– Press locking tabs on left and right sides of radiator cowl -arrow- and at the same time lift radiator cowl off radiator.



Installing

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

– Install support on lock carrier ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier; Exploded view - lock carrier .

– Install hydraulic fluid cooler ⇒ Running gear, axles, steering; Rep. gr. 48 ; Hydraulic power steering; Removing and installing hydraulic fluid cooler .

– Connect coolant hose with plug-in connector ⇒ page 237 .

Note

Do not reuse coolant.

– Fill up with coolant ⇒ page 196 .

Tightening torques

- ⇒ “4.1 Exploded view - radiator/radiator fans”, page 236
- Air ducts
  ⇒ “3.1 Exploded view - air cleaner housing”, page 260
- Bracket for horns ⇒ Electrical system; Rep. gr. 90 ; Horn; Exploded view - horn
- Impact bar ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Exploded view - impact bar

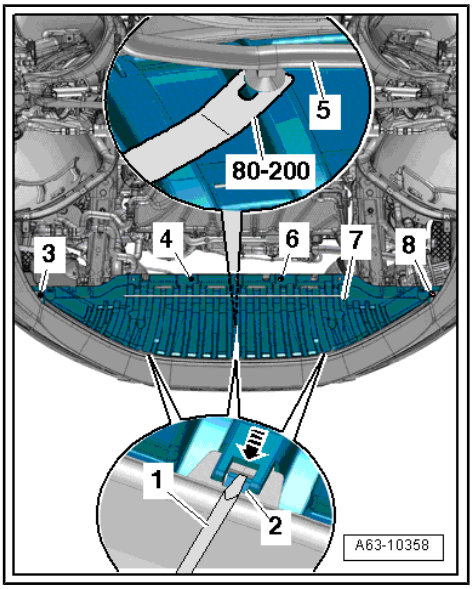
4.3 Removing and installing radiator cowl

Removing

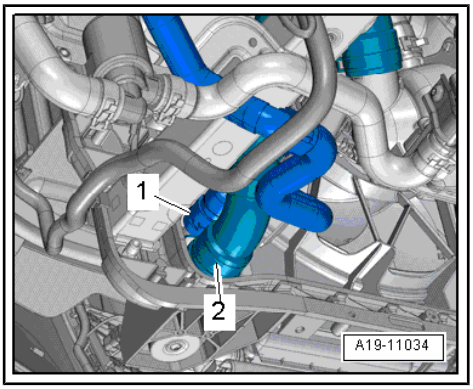
– Remove engine cover panel ⇒ page 63 .

– Remove air cleaner housing (left and right) ⇒ page 261 .

– Remove closure plate for bumper cover (front) ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Removing and installing attachments .
– Drain coolant ⇒ page 194 .



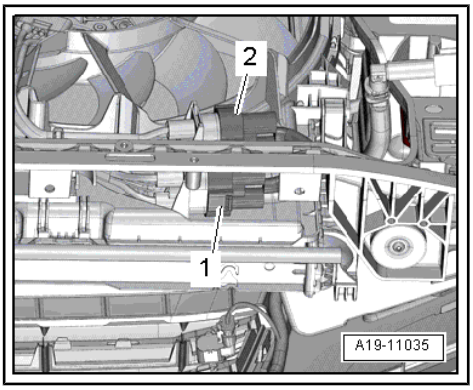
– Lift retaining clips -1, 2- and disconnect coolant hoses (bottom) from radiator.



WARNING

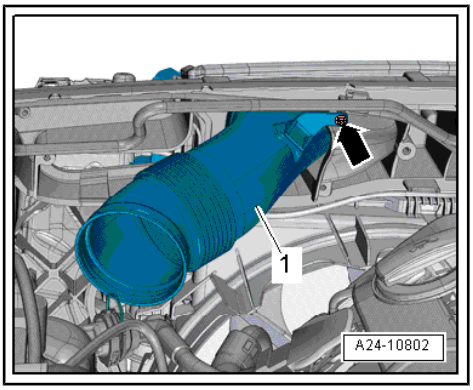
Risk of injury as the radiator fans may start up automatically.

- ***Unplug electrical connectors before starting to work in the area of radiator cowl.***

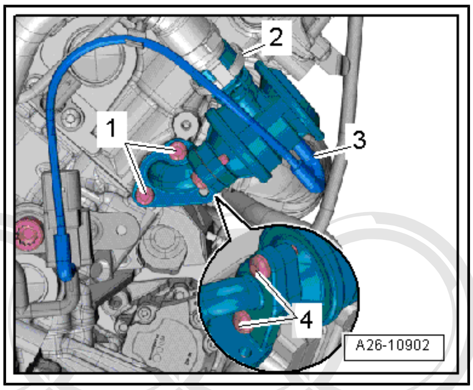


– Unplug electrical connectors -1, 2- for radiator fan.

– Remove bolt -arrow- on both sides, detach air duct -1- and remove.



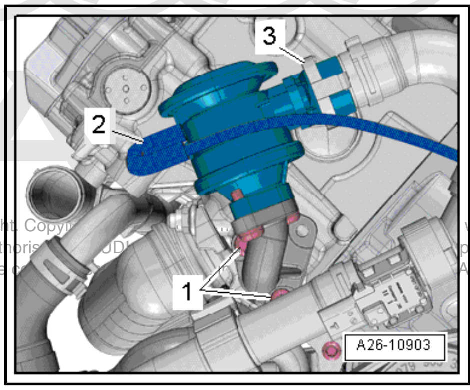
– Disconnect vacuum hose -3-.
– Unscrew bolts -1- and move combination valve (left-side) for secondary air system to top.



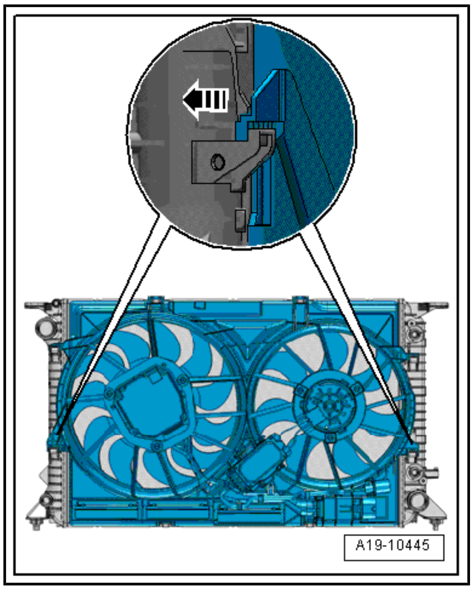
Note

Disregard -items 2, 4-.

– Disconnect vacuum hose -2-.
– Press release tabs and disconnect secondary air hose -3-.
– Unscrew bolts -1- and detach combination valve (right-side) for secondary air system.



– Press locking tabs on left and right sides of radiator cowl -arrow- and at the same time lift radiator cowl off radiator.



Installing

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

– Install combination valves for secondary air ⇒ page 313 .
– Connect coolant hose with plug-in connector ⇒ page 237 .
– Install engine cover panel ⇒ page 63 .

Note

Do not reuse coolant.

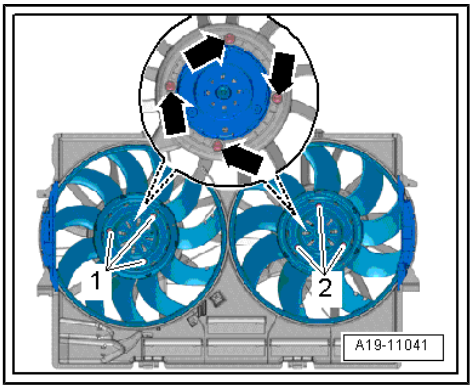
– Fill up with coolant ⇒ page 196 .

Tightening torques

♦ ⇒ “4.1 Exploded view - radiator/radiator fans”, page 236
♦ Air duct and air cleaner housing ⇒ “3.1 Exploded view - air cleaner housing”, page 260

4.4 Removing and installing radiator fans

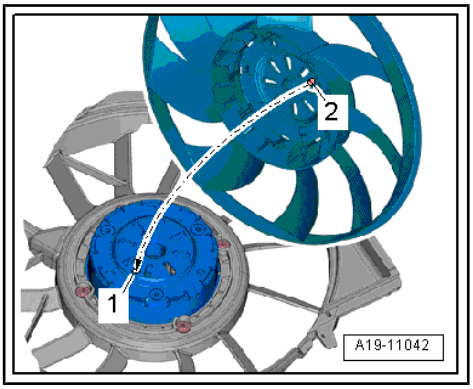
Removing



– Remove radiator cowl ⇒ page 242 .
– Remove bolts -1- or -2- and detach corresponding fan wheel.
– Remove bolts -arrows- on radiator fan.
– Move electrical wiring harness clear and detach radiator fan.

Installing

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



Note

Fit all cable ties in the original positions when installing.

– Note installation position of fan wheel:
• Pin -2- must engage in hole -1-.
– Install radiator cowl ⇒ page 242 .

Tightening torques

◆ ⇒ “4.1 Exploded view - radiator/radiator fans”, page 236

24 – Mixture preparation - injection

1 Injection system

⇒ “1.1 Overview of fitting locations - injection system”, page 246

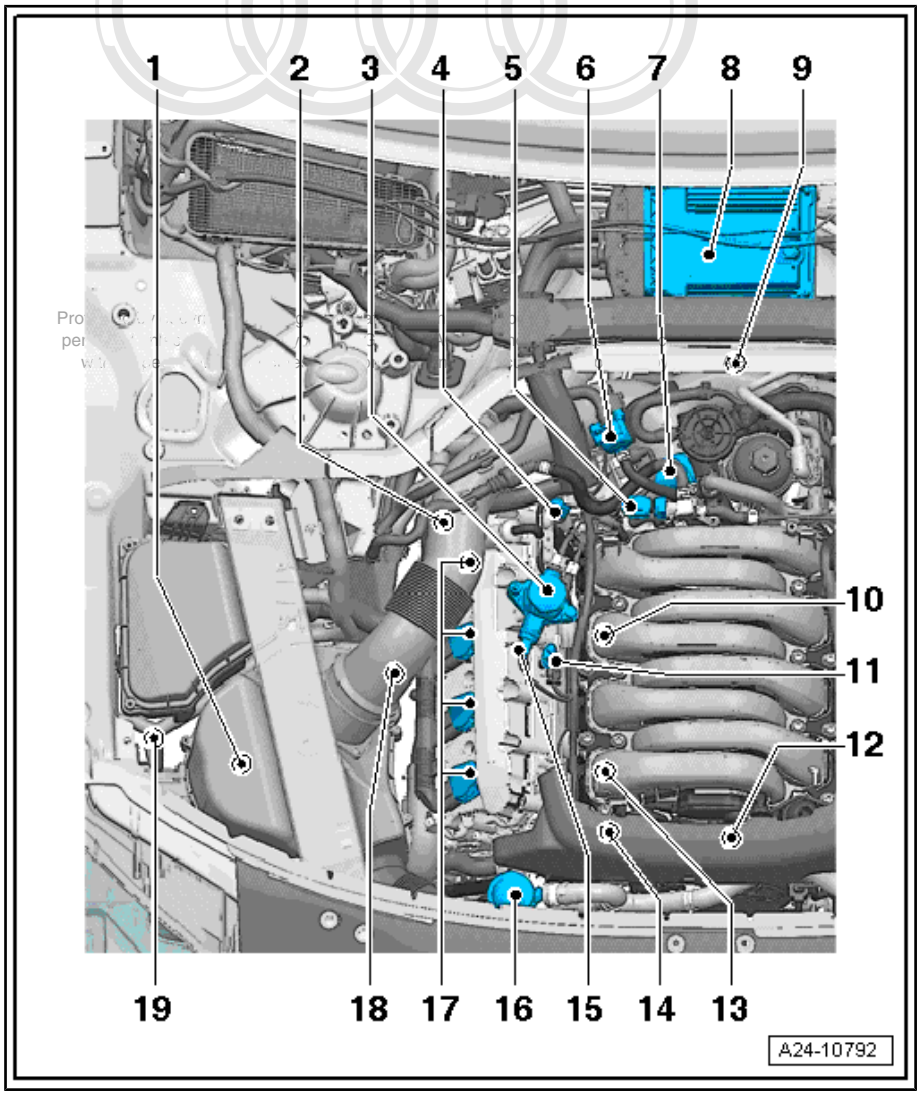
⇒ “1.2 Reducing pressure in high-pressure section of injection system”, page 255

⇒ “1.3 Filling and bleeding fuel system”, page 256

⇒ “1.4 Checking fuel system for leaks”, page 257

1.1 Overview of fitting locations - injection system

Engine compartment (right-side)



1 - Variable intake manifold change-over valve - N335-

- ❑ Fitting location: refer to exploded view of air cleaner ⇒ page 260

2 - Exhaust camshaft control valve 1 - N318-

3 - High-pressure pump

- ❑ With fuel metering valve - N290-
- ❑ Removing and installing ⇒ page 281

4 - Camshaft control valve 1 - N205-

- ❑ Fitting location ⇒ page 252

5 - Fuel pressure sender for low pressure - G410-

- ❑ Fitting location ⇒ page 252

6 - Activated charcoal filter solenoid valve 1 - N80-

7 - Throttle valve module - J338-

- ❑ After renewing, perform “Adaption” in “Guided Functions” using vehicle diagnostic tester

8 - Engine control unit - J623-

- ❑ Fitting location ⇒ page 250
- ❑ Removing and installing

⇒ page 295

9 - Electrical connectors for Lambda probes, bank 1 and 2

- ❑ For Lambda probe before catalytic converter - G39- with Lambda probe heater - Z19-
- ❑ For Lambda probe after catalytic converter - G130- with Lambda probe 1 heater after catalytic converter - Z29-
- ❑ Fitting location ⇒ page 254
- ❑ For Lambda probe 2 before catalytic converter - G108- with Lambda probe 2 heater - Z28-
- ❑ For Lambda probe 2 after catalytic converter - G131- with Lambda probe 2 heater after catalytic converter - Z30-
- ❑ Fitting location ⇒ page 254

10 - Knock sensor 2 - G66-

- ❑ Fitting location ⇒ page 252
- ❑ Electrical connector ⇒ page 253
- ❑ Removing and installing ⇒ page 325
- ❑ 20 Nm

11 - Hall sender - G40-

- ❑ Fitting location ⇒ page 252
- ❑ Removing and installing ⇒ page 326

12 - Components at front of engine

- ❑ Fitting location ⇒ page 253

13 - Knock sensor 1 - G61-

- ❑ Fitting location ⇒ page 252
- ❑ Electrical connector ⇒ page 253
- ❑ Removing and installing ⇒ page 325
- ❑ 20 Nm

14 - Fuel pressure sender - G247-

- ❑ Fitting location ⇒ page 253
- ❑ 25 Nm
- ❑ Lubricate threads lightly with clean oil

15 - Fuel metering valve - N290-

16 - Combination valve for secondary air system

- ❑ Cylinder bank 1 (right-side)
- ❑ Exploded view ⇒ page 309

17 - Ignition coils for cylinder bank 1

- ❑ Ignition coil 1 with output stage - N70-
- ❑ Ignition coil 2 with output stage - N127-
- ❑ Ignition coil 3 with output stage - N291-
- ❑ Ignition coil 4 with output stage - N292-
- ❑ Removing and installing ⇒ page 323

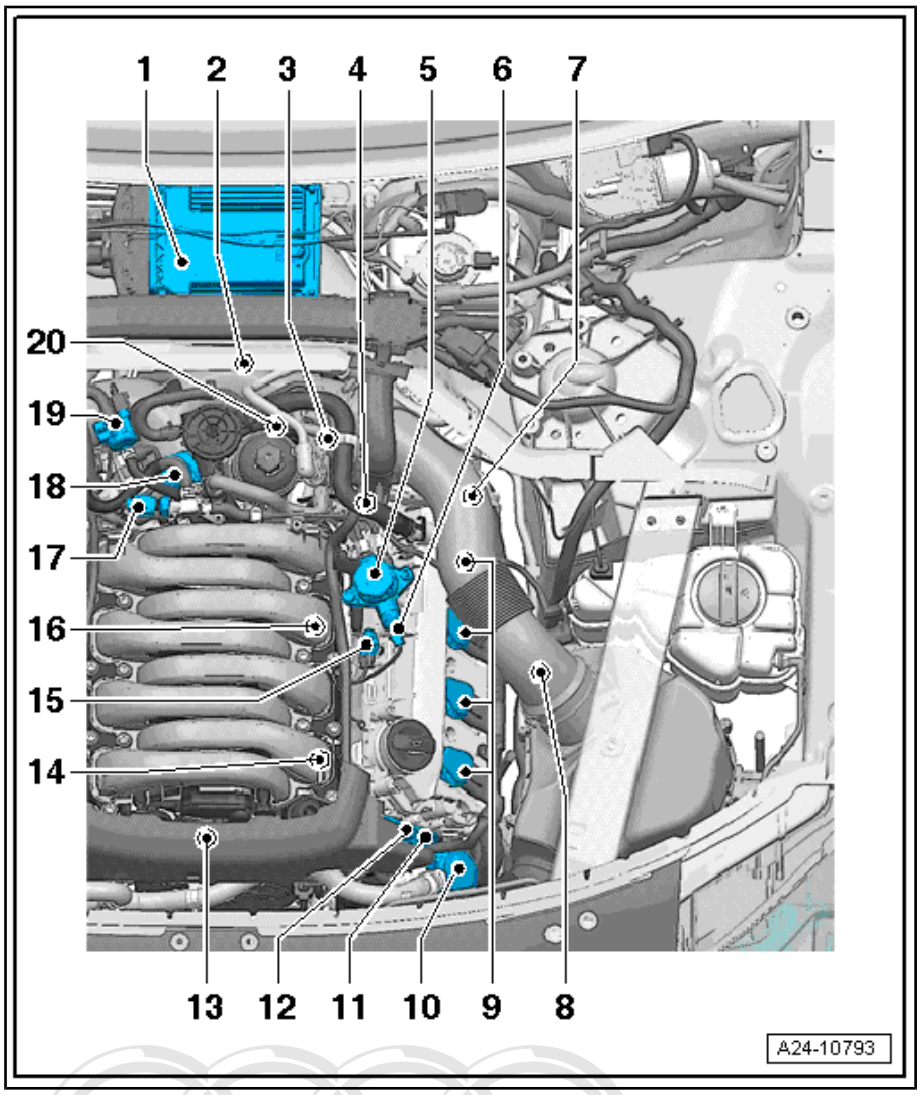
18 - Hall sender 3 - G300-

- ❑ Secured to outside of cylinder head
- ❑ Fitting location ⇒ page 252
- ❑ Removing and installing ⇒ page 326

19 - Secondary air pump motor - V101-

- ❑ Fitting location ⇒ page 255
- ❑ Exploded view ⇒ page 309

Engine compartment (left-side)



1 - Engine control unit - J623-

- ❑ Fitting location ⇒ page 250
- ❑ Removing and installing ⇒ page 295

2 - Electrical connectors

- ❑ For Lambda probe before catalytic converter - G39- with Lambda probe heater - Z19-
- ❑ For Lambda probe after catalytic converter - G130- with Lambda probe 1 heater after catalytic converter - Z29-
- ❑ Fitting location ⇒ page 254
- ❑ For Lambda probe 2 before catalytic converter - G108- with Lambda probe 2 heater - Z28-
- ❑ For Lambda probe 2 after catalytic converter - G131- with Lambda probe 2 heater after catalytic converter - Z30-
- ❑ Fitting location ⇒ page 254

3 - Coolant temperature sender - G62-

- ❑ Fitting location ⇒ page 251
- ❑ Exploded view

⇒ page 214

4 - Camshaft control valve 2 - N208-

- ❑ Fitting location ⇒ page 253

5 - High-pressure pump

- ❑ With fuel metering valve 2 - N402-
- ❑ Exploded view ⇒ page 280

6 - Fuel metering valve 2 - N402-

- ❑ Combined with high-pressure pump in one unit

7 - Exhaust camshaft control valve 2 - N319-

- ❑ Fitting location ⇒ page 252

8 - Hall sender 4 - G301-

- ❑ Fitting location ⇒ page 252
- ❑ Exploded view ⇒ page 322

9 - Ignition coils for cylinder bank 2

- ❑ Ignition coil 5 with output stage - N323-
- ❑ Ignition coil 6 with output stage - N324-
- ❑ Ignition coil 7 with output stage - N325-
- ❑ Ignition coil 8 with output stage - N326-
- ❑ Fitting location ⇒ page 252
- ❑ Exploded view ⇒ page 322

10 - Combination valve for secondary air system

- ❑ Cylinder bank 2 (left-side)
- ❑ Exploded view ⇒ page 309

11 - Electrical connector for knock sensor 4 - G199-

- ❑ Fitting location ⇒ page 253

12 - Electrical connector for knock sensor 3 - G198-

- ❑ Fitting location ⇒ page 253

13 - Components at front of engine

- ❑ Fitting location ⇒ page 253

14 - Knock sensor 3 - G198-

- ❑ Fitting location ⇒ page 253
- ❑ Exploded view ⇒ page 322

15 - Hall sender 2 - G163-

- ❑ Fitting location ⇒ page 253
- ❑ Exploded view ⇒ page 322

16 - Knock sensor 4 - G199-

- ❑ Fitting location ⇒ page 253
- ❑ Exploded view ⇒ page 322

17 - Fuel pressure sender for low pressure - G410-

- ❑ Fitting location ⇒ page 253

18 - Throttle valve module - J338-

- ❑ Exploded view ⇒ page 263

19 - Activated charcoal filter solenoid valve 1 - N80-

20 - Oil pressure switch for reduced oil pressure - F378-

- ❑ Fitting location ⇒ page 253

A - Engine speed sender - G28-

- ❑ Fitting location ⇒ page 254
- ❑ Exploded view ⇒ page 322

B - Valve for oil pressure control - N428-

- ❑ Fitting location ⇒ page 254
- ❑ Exploded view ⇒ page 167

B - Accelerator position sender - G79- and accelerator position sender 2 - G185-

- ❑ Fitting location ⇒ page 251

C - Brake light switch - F-

- ❑ Fitting location ⇒ page 251

D - Map-controlled engine cooling system thermostat - F265-

- ❑ Fitting location ⇒ page 255
- ❑ Exploded view ⇒ page 202

E - Coolant valve for gearbox - N488-

- ❑ Fitting location ⇒ page 252

F - Coolant valve for cylinder head - N489-

- ❑ Fitting location ⇒ page 251

G - Sender 1 for secondary air pressure - G609-

- ❑ Fitting location ⇒ page 255

H - Lambda probe - G39- (before catalytic converter) with Lambda probe heater - Z19-

- ❑ Fitting location ⇒ page 254
- ❑ Removing and installing ⇒ page 286

I - Lambda probe 2 before catalytic converter - G108- with Lambda probe 2 heater - Z28-

- ❑ Fitting location ⇒ page 254
- ❑ Removing and installing ⇒ page 288

J - Lambda probe after catalytic converter - G130- with Lambda probe 1 heater after catalytic converter - Z29-

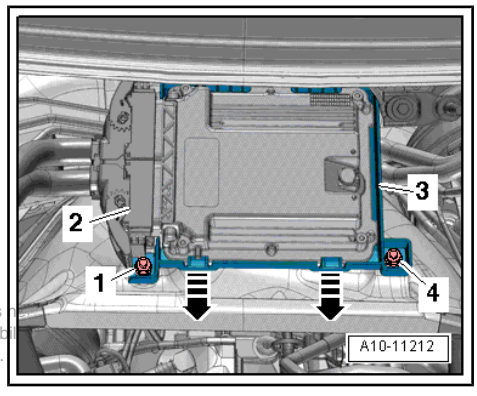
- ❑ Fitting location ⇒ page 254
- ❑ Removing and installing ⇒ page 289

K - Lambda probe 2 after catalytic converter - G131- with Lambda probe 2 heater after catalytic converter - Z30-

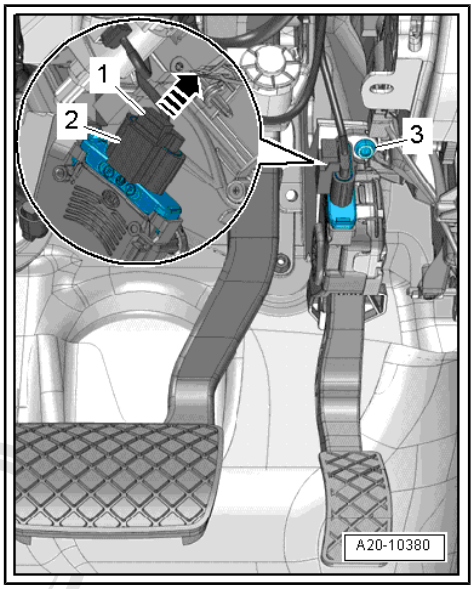
- ❑ Fitting location ⇒ page 254
- ❑ Removing and installing ⇒ page 292

Fitting location of engine control unit - J623-

Removing and installing ⇒ page 295



Fitting location of accelerator position sender - G79- / accelerator position sender 2 - G185-



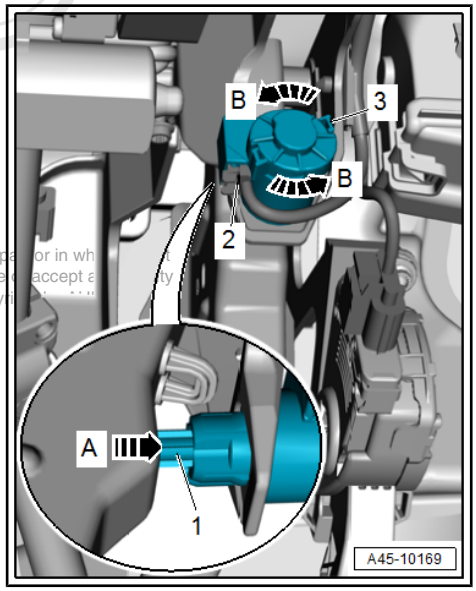
- In accelerator pedal module

Note

The accelerator position sender - G79- and accelerator position sender 2 - G185- are integrated in the accelerator pedal module and cannot be renewed individually.

Removing and installing ⇒ Fuel supply system, petrol engines; Rep. gr. 20 ; Accelerator mechanism; Removing and installing accelerator pedal module with accelerator position sender -G79- / -G185- .

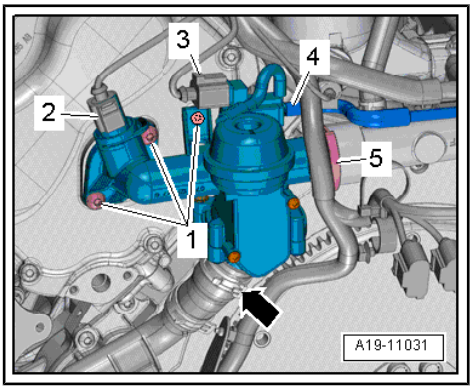
Fitting location of brake light switch - F-



- In footwell on brake pedal

Removing and installing ⇒ Brake system; Rep. gr. 45 ; Sensors; Removing and installing brake light switch

Fitting location of coolant temperature sender - G62- , coolant valve for cylinder head - N489-



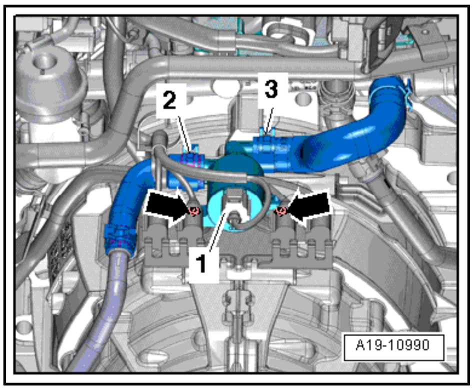
On rear coolant pipe (right-side)

2 - Coolant temperature sender - G62-

3 - Coolant valve for cylinder head - N489-

Removing and installing coolant temperature sender - G62-
⇒ page 209

Coolant valve for gearbox - N488- -1-



Fitting locations on cylinder bank 1 (right-side)

1 - Hall sender 3 - G300-

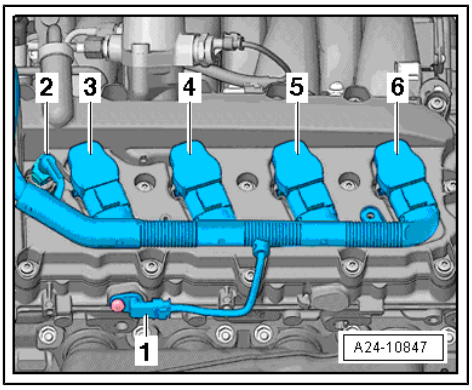
2 - Exhaust camshaft control valve 1 - N318-

3 - Ignition coil 4 with output stage - N292-

4 - Ignition coil 3 with output stage - N291-

5 - Ignition coil 2 with output stage - N127-

6 - Ignition coil 1 with output stage - N70-



Fitting locations on cylinder bank 2 (left-side)

1 - Ignition coil 5 with output stage - N323-

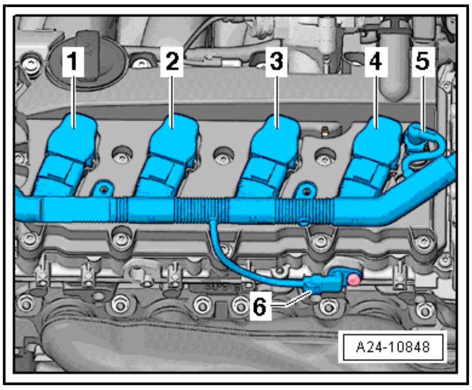
2 - Ignition coil 6 with output stage - N324-

3 - Ignition coil 7 with output stage - N325-

4 - Ignition coil 8 with output stage - N326-

5 - Exhaust camshaft control valve 2 - N319-

6 - Hall sender 4 - G301-



Fitting locations: components on inside of right cylinder head

1 - Intake manifold flap potentiometer - G336-

2 - Hall sender - G40-

3 - Fuel metering valve - N290-

4 - Camshaft control valve 1 - N205-

5 - Fuel pressure sender for low pressure - G410-

6 - Injector, cylinder 4 - N33-

7 - Injector, cylinder 3 - N32-

8 - Injector, cylinder 2 - N31-

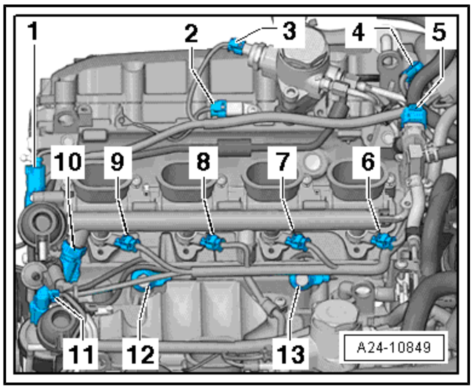
9 - Injector, cylinder 1 - N30-

10 - Fuel pressure sender - G247-

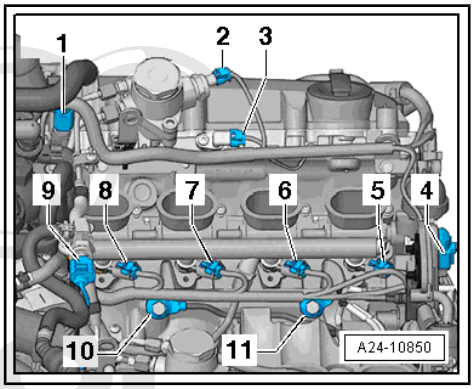
11 - Intake manifold flap valve - N316-

12 - Knock sensor 1 - G61-

13 - Knock sensor 2 - G66-



Fitting locations: components on inside of left cylinder head



1 - Camshaft control valve 2 - N208-

2 - Fuel metering valve 2 - N402-

3 - Hall sender 2 - G163-

4 - Intake manifold flap potentiometer 2 - G512-

5 - Injector, cylinder 5 - N83-

6 - Injector, cylinder 6 - N84-

7 - Injector, cylinder 7 - N85-

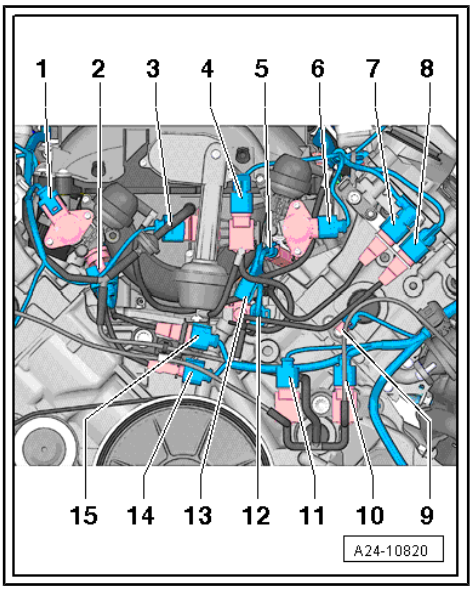
8 - Injector, cylinder 8 - N86-

9 - Fuel pressure sender for low pressure - G410-

10 - Knock sensor 4 - G199-

11 - Knock sensor 3 - G198-

Fitting location: at front of engine



1 - Intake manifold flap potentiometer - G336-

2 - Fuel pressure sender - G247-

3 - Intake manifold pressure sender - G71- with intake air temperature sender - G42-

4 - Variable intake manifold change-over valve - N156-

5 - Electrical connector for injector for cylinder 5 - N83-

6 - Intake manifold flap potentiometer 2 - G512-

7 - Electrical connector for knock sensor 3 - G198-

8 - Electrical connector for knock sensor 4 - G199-

9 - Temperature sender for engine temperature regulation - G694-

10 - Secondary air inlet valve 2 - N320-

11 - Secondary air inlet valve - N112-

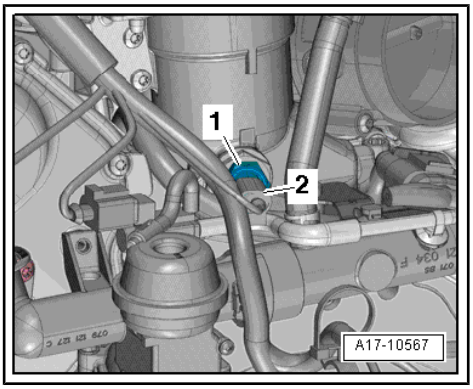
12 - Intake manifold flap valve - N316-

13 - Oil pressure switch - F22-

14 - Electrical connector for knock sensor 2 - G66-

15 - Electrical connector for knock sensor 1 - G61-

Oil pressure switch for reduced oil pressure - F378-



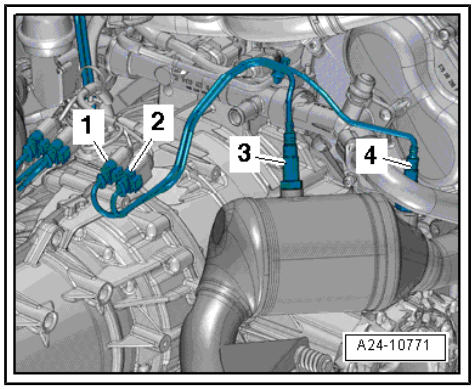
Fitting location of Lambda probes on cylinder bank 1 (right-side)

1 - Electrical connector for Lambda probe after catalytic converter - G130-

2 - Electrical connector for Lambda probe - G39-

3 - Lambda probe after catalytic converter - G130-

4 - Lambda probe - G39-



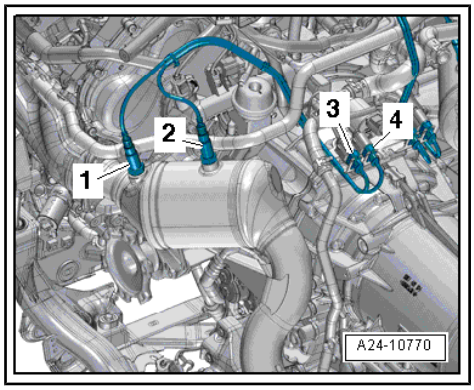
Fitting location of Lambda probes on cylinder bank 2 (left-side)

1 - Lambda probe 2 - G108-

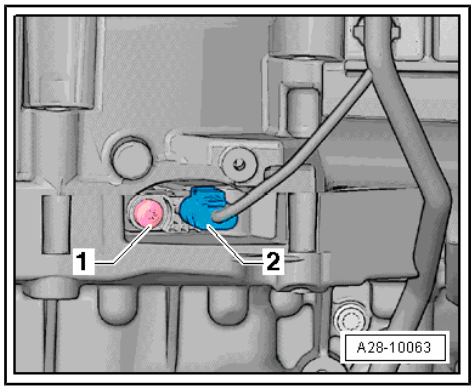
2 - Lambda probe 2 after catalytic converter - G131-

3 - Electrical connector for Lambda probe 2 - G108-

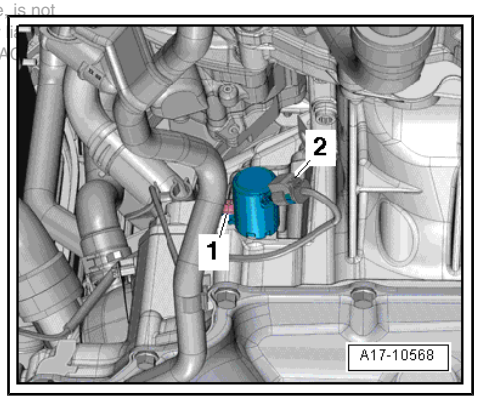
4 - Electrical connector for Lambda probe 2 after catalytic converter - G131-



Engine speed sender - G28- -2-



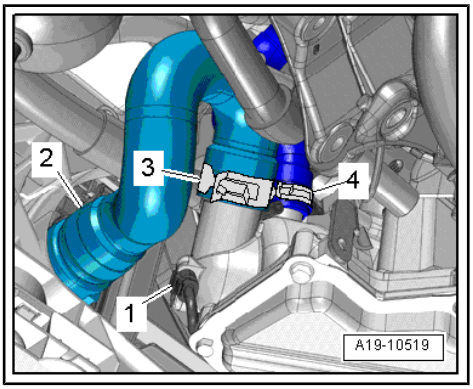
Valve for oil pressure control - N428-



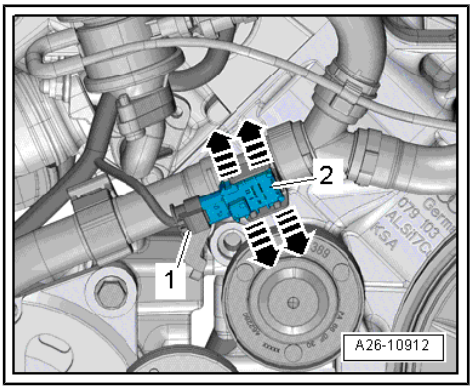
Map-controlled engine cooling system thermostat - F265-

- On engine (front left)

1 - Map-controlled engine cooling system thermostat - F265-

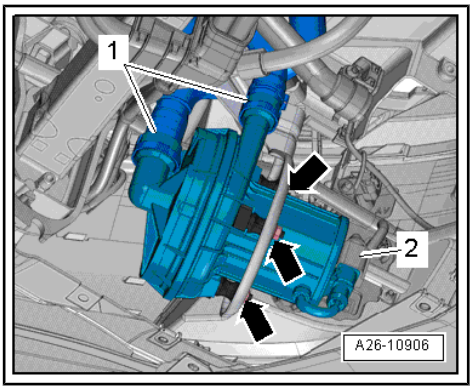


Sender 1 for secondary air pressure - G609- -2-



Secondary air pump motor - V101-

At front right, beneath headlight



1.2 Reducing pressure in high-pressure section of injection system

WARNING

The fuel system operates at extremely high pressure. This can cause injury.

- *The injection system consists of a high-pressure section and a low-pressure section.*
- *Prior to opening the high-pressure section (e.g. when removing the high-pressure pump, fuel rail, injectors, fuel pipes or fuel pressure sender - G247-), the fuel pressure in the high-pressure section must be reduced to a specified level. The procedure is described below.*

Reducing fuel pressure in high-pressure section:

– Connect a vehicle diagnostic tester.

– Start engine and run at idling speed.

– Select “Engine electronics” in vehicle self-diagnosis.
– Then select “Basic setting”.
– Select “Reducing fuel pressure in fuel rail” from the list.
– Then select “Measured values”.
– Select “Operating instructions” and “Fuel pressure” from the list.
– To activate basic setting, perform “Operating instructions” function.
– Observe fuel pressure displayed on vehicle diagnostic tester.
• Fuel pressure will drop to a specified value.
– Switch off ignition.

The fuel rail is still filled with fuel, however it is no longer under high pressure.

WARNING

There is a risk of injury: avoid skin contact with fuel.

- ***Wear safety goggles and protective clothing when opening the fuel system.***
- ***Before opening the high-pressure section of the fuel system, place a clean cloth around the connection to catch escaping fuel.***

– The high-pressure system must be opened »immediately« after reducing the fuel pressure; wrap a clean cloth around the connection. Catch the escaping fuel.

Note

- *The pressure will increase again due to the effect of residual heat if the high-pressure system is not opened immediately.*
- *The ignition must not be switched on again from this point on as this would increase the pressure again.*

Additional steps required

– Erase any entries in event memory resulting from work performed ⇒ Vehicle diagnostic tester, `Interrogate event memory`, then `Generate readiness code`.

1.3 Filling and bleeding fuel system

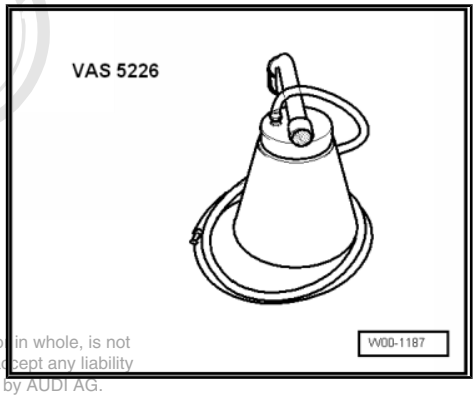
- Due to the design of the engine, with a fuel system pressurisation pump located in the fuel tank, it is not necessary to bleed the fuel system.
- The fuel system bleeds itself when the starter is operated.

Note

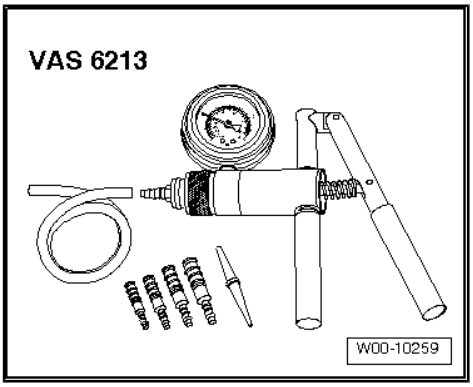
On vehicles with auxiliary heater, it is important to bleed the fuel supply line leading to the metering pump after working on the fuel delivery unit.

Special tools and workshop equipment required

♦ Diesel extractor - VAS 5226-



♦ Hand vacuum pump - VAS 6213-



Procedure

- Auxiliary heater switched off.

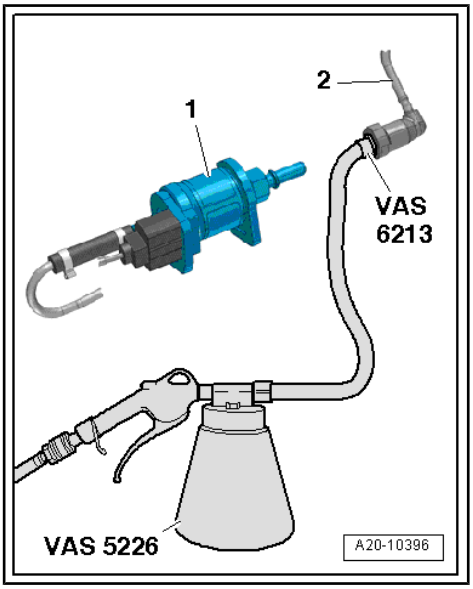
– Connect diesel extractor - VAS 5226- to compressed air.

– Remove fuel supply line -2- from fuel tank at metering pump -1-.

– Connect diesel extractor - VAS 5226- to fuel supply line with adapter from hand vacuum pump - VAS 6213- and bleed fuel supply line by operating extractor briefly.

– Re-attach fuel supply line to metering pump.

– Switch auxiliary heating on and run at full load for approx. 10 minutes.



1.4 Checking fuel system for leaks

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

– Switch off ignition.

– Check complete fuel system for leaks.

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

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

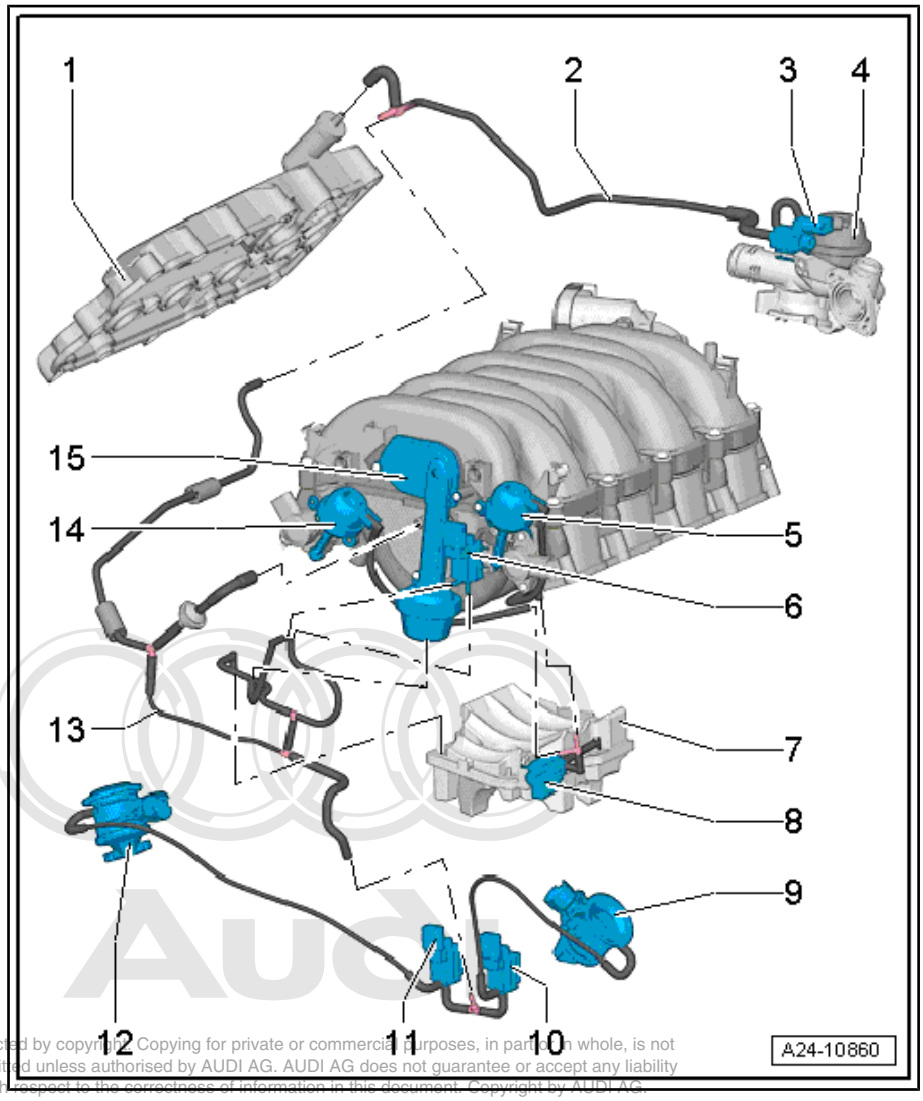
– Then inspect high-pressure section again for leaks.

2 Vacuum system

⇒ “2.1 Connection diagram - vacuum system”, page 258

⇒ “2.2 Checking vacuum system”, page 259

2.1 Connection diagram - vacuum system



1 - Cylinder head cover, cylinder bank 1

2 - Vacuum hose

3 - Coolant valve for cylinder head - N489-

4 - Vacuum unit for coolant valve for cylinder head - N489-

5 - Vacuum unit for intake manifold flap, cylinder bank 2

- ❑ For cylinder bank 2
- ❑ Check with hand vacuum pump - VAS 6213-

6 - Variable intake manifold change-over valve - N156-

7 - Vacuum reservoir

- ❑ Fitting location: beneath intake manifold

8 - Intake manifold flap valve - N316-

- ❑ Take out intake manifold for removal and installation

9 - Combination valve for secondary air system (left-side)

- ❑ Check operation and check for leaks ⇒ page 311

10 - Secondary air inlet valve 2 - N320-

11 - Secondary air inlet valve - N112-

12 - Combination valve for secondary air system (right-side)

- ❑ Check operation and check for leaks ⇒ page 311

13 - Vacuum hose

14 - Vacuum unit for intake manifold flap, cylinder bank 1

- ❑ For cylinder bank 1
- ❑ Check with hand vacuum pump - VAS 6213-

15 - Vacuum unit for intake manifold change-over

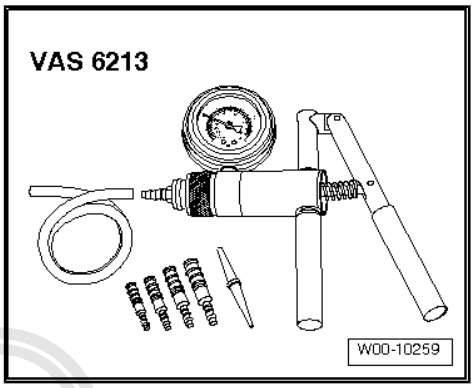
- ❑ Check with hand vacuum pump - VAS 6213-

16 - Vacuum reservoir

2.2 Checking vacuum system

Special tools and workshop equipment required

- Hand vacuum pump - VAS 6213-



Procedure

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

- Cracks
- Traces of animal bites
- Kinked or crushed lines
- Lines porous or leaking

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

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

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

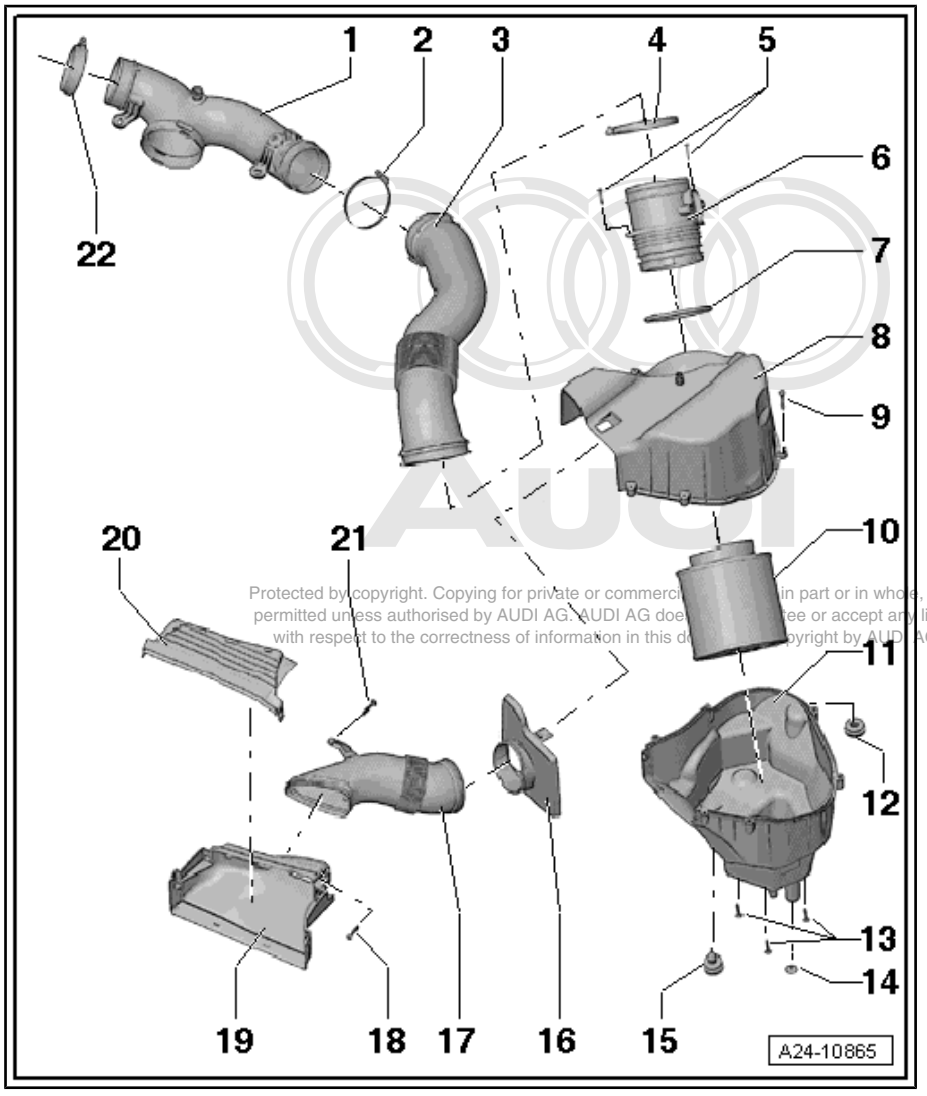
– If it is not possible to build up pressure with the hand vacuum pump - VAS 6213- or if the pressure drops again immediately, check the hand vacuum pump and connecting hoses for leaks.

3 Air cleaner

⇒ “3.1 Exploded view - air cleaner housing”, page 260

⇒ “3.2 Removing and installing air cleaner housing”, page 261

3.1 Exploded view - air cleaner housing



1 - Intake connecting pipe

2 - Hose clip

3 - Air hose

4 - Hose clip

5 - Bolt

- ❑ 1.5 Nm

6 - Adapter

7 - O-ring

- ❑ Renew if damaged

8 - Air cleaner (top section)

- ❑ Clean any salt residue, leaves and dirt out of air cleaner (top section)

9 - Bolts

- ❑ 1.5 Nm

10 - Air filter element

- ❑ Always use genuine part for air filter element
- ❑ Change intervals ⇒ Maintenance tables
- ❑ Removing and installing ⇒ Maintenance ; Booklet 410
- ❑ Also clean snow screen (if fitted)

11 - Air cleaner (bottom section)

- ❑ Clean any salt residue, leaves and dirt out of air

cleaner (bottom section)

- ❑ Important: Check for dirt in water drain and clean if necessary
- ❑ Removing and installing ⇒ page 261

12 - Rubber grommet

13 - Bolt

- ❑ 1.5 Nm

14 - Flutter valve for water drain

- ❑ Clean any leaves and dirt out of water drain

15 - Rubber grommet

16 - Cover

17 - Air duct

- ❑ Clean dirt and leaves out of air duct

18 - Bolt

- ❑ 1.5 Nm

19 - Air duct

- ❑ To lock carrier
- ❑ Clean dirt and leaves out of air duct

20 - Cover for air duct

- ❑ To lock carrier

21 - Bolt

- ❑ 1.5 Nm

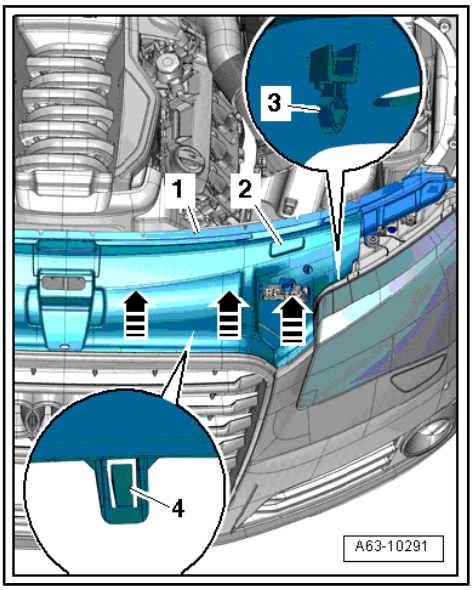
3.2 Removing and installing air cleaner housing

Removing

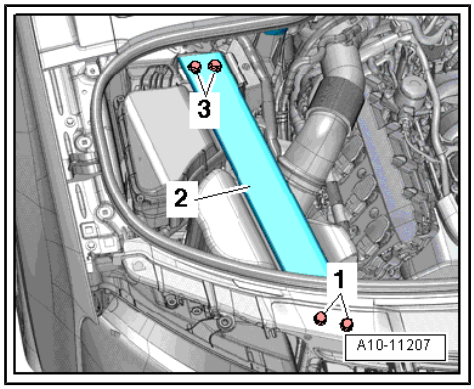
Note

The procedure for removal is described on air cleaner housing (right-side).

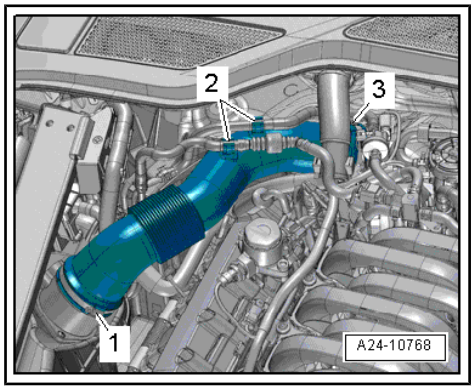
– Remove lock carrier cover -2- ⇒ General body repairs, exterior; Rep. gr. 63 ; Bumper (front); Removing and installing attachments .



– Remove longitudinal member (top right) -2- ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier; Exploded view - lock carrier .



– Open hose clip -1- and disconnect air intake hose from air cleaner housing.
– Release retainer and disconnect air duct from front of air cleaner housing.
– Pull air cleaner housing slightly upwards and disconnect air hose for secondary air pump from bottom of air cleaner housing.



Note

The air hose for the secondary air pump must only be disconnected from the air cleaner housing on the right side.

– Lift out entire air cleaner housing.

Installing

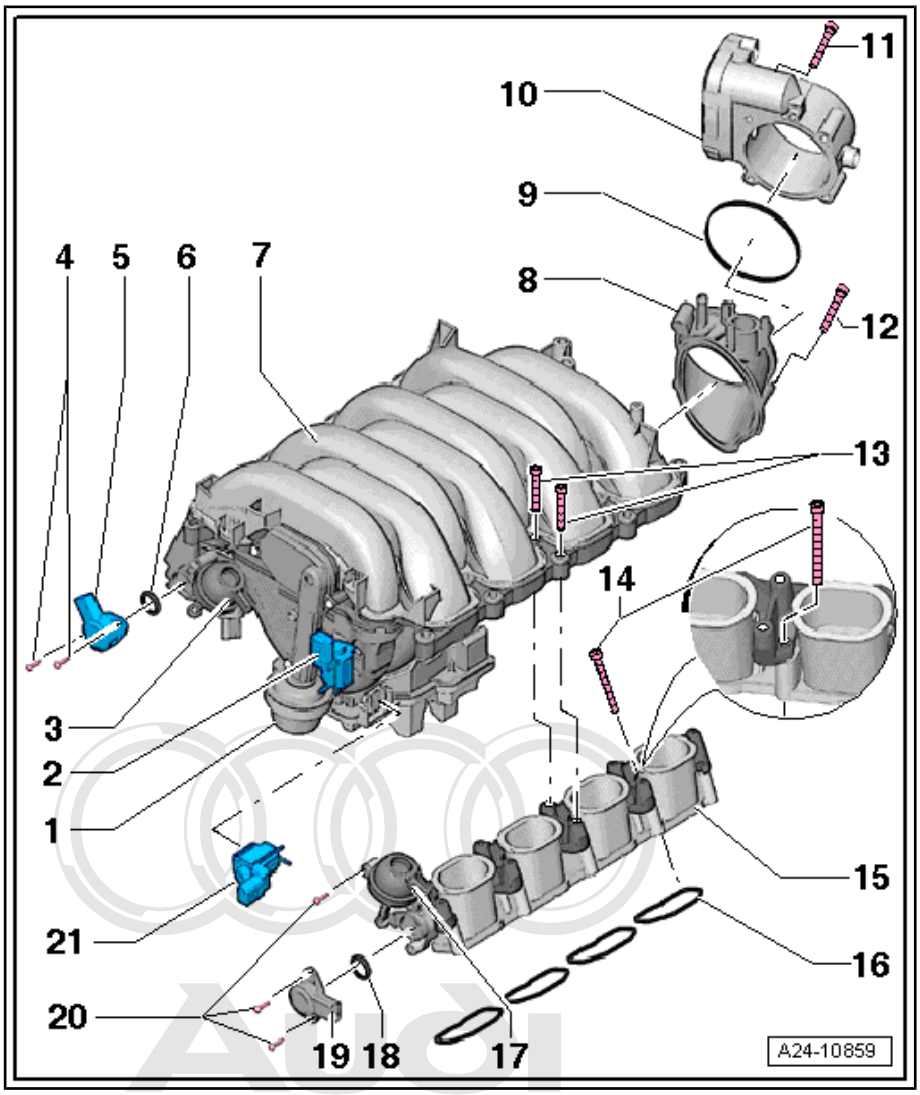
Install in reverse order.

Note

Make sure air hose for secondary air pump is secured properly.

4 Intake manifold

4.1 Exploded view - intake manifold



1 - Vacuum unit for intake manifold change-over

2 - Variable intake manifold change-over valve - N156-

3 - Vacuum unit for intake manifold flaps (cylinder bank 1)

- ❑ For CVTS tumble flaps (cylinder bank 1)

4 - Bolt

- ❑ 2.5 Nm

5 - Intake manifold flap potentiometer - G336-

- ❑ Cylinder bank 1
- ❑ After renewing, perform “Adaption” in “Guided Functions” using vehicle diagnostic tester

6 - Seal

- ❑ Renew if damaged
- ❑ Open side faces towards potentiometer

7 - Intake manifold

- ❑ Removing and installing ⇒ page 266

8 - Intermediate flange

9 - O-ring

- ❑ Renew

10 - Throttle valve module - J338-

- ❑ Removing and installing ⇒ page 271
- ❑ After renewing, perform “Adaption” in “Guided Functions” using vehicle diagnostic tester

11 - Bolt

- ❑ 9 Nm

12 - Bolt

- ❑ 9 Nm

13 - Bolt

- ❑ Tightening torque and tightening sequence ⇒ page 264

14 - Bolt

- ❑ Tightening torque and tightening sequence ⇒ page 266

15 - Intake manifold (bottom section)

16 - Gasket

- ❑ Renew

17 - Vacuum unit for intake manifold flaps (cylinder bank 2)

- ❑ For CVTS tumble flaps (cylinder bank 2)

18 - Seal

- ❑ Renew if damaged
- ❑ Open side faces towards potentiometer

19 - Intake manifold flap potentiometer 2 - G512-

- ❑ Cylinder bank 2
- ❑ After renewing, perform “Adaption” in “Guided Functions” using vehicle diagnostic tester

20 - Bolt

- ❑ 2.5 Nm

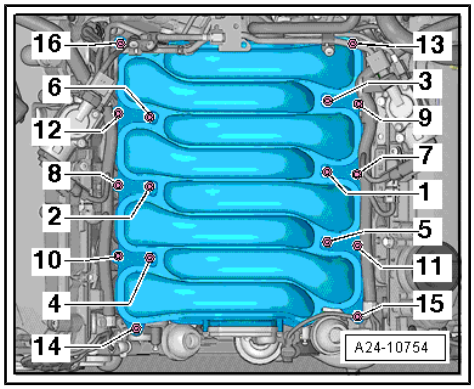
21 - Intake manifold flap valve - N316-

Tightening torque and tightening sequence for intake manifold

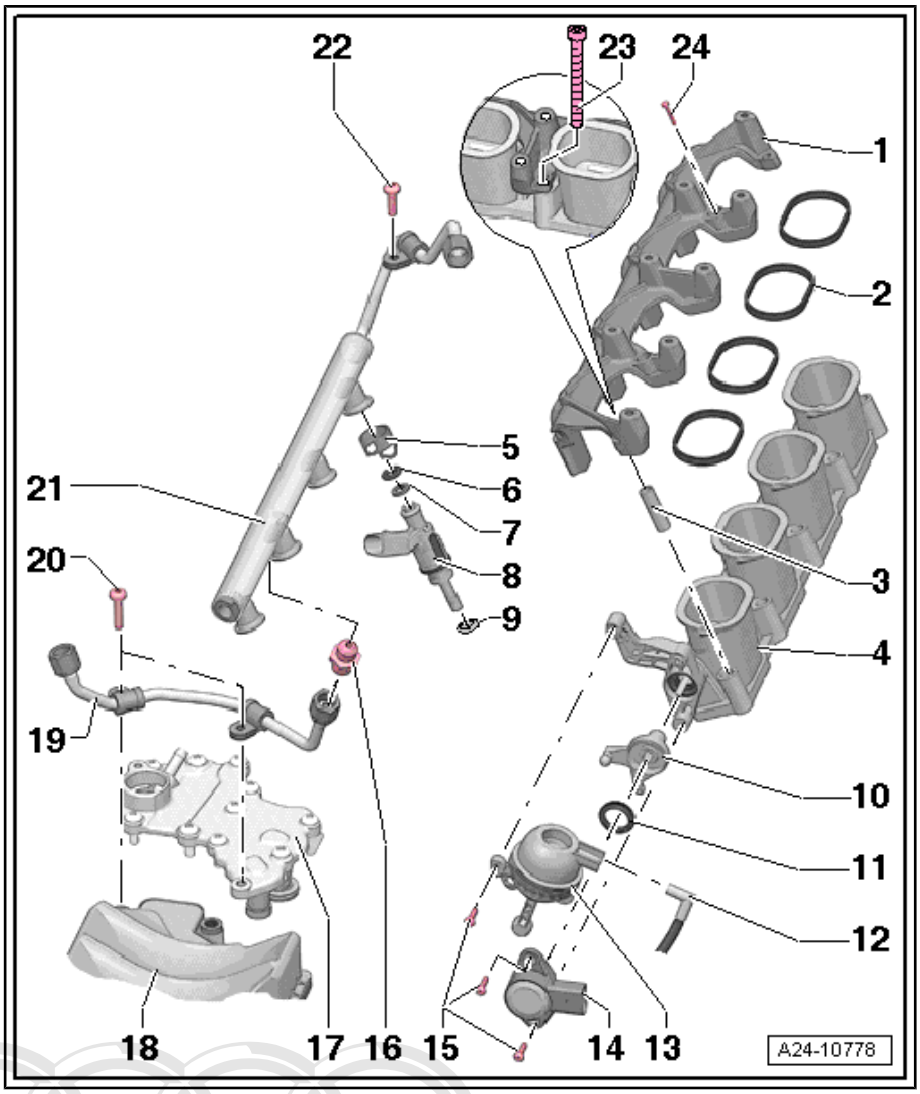
– Tighten bolts for intake manifold in the sequence -1 to 16-.

♦ Tighten initially to 8 Nm

♦ Subsequently tighten to 11 Nm



4.2 Exploded view - intake manifold (bottom section) with fuel rail



1 - Bracket

2 - Gasket

- ❑ Renew

3 - Sleeve

4 - Intake manifold (bottom section)

- ❑ When installing intake manifold (bottom section), intake manifold flaps must be in output position (intake channel fully open)
- ❑ Removing and installing ⇒ page 269
- ❑ 9 Nm

5 - Support ring

- ❑ Renew if damaged
- ❑ When installing, make sure it is seated correctly

6 - O-ring

- ❑ Renew
- ❑ Lubricate lightly with clean engine oil

7 - Spacer ring

- ❑ Renew if damaged

8 - Injector

- ❑ With support ring
- ❑ Removing and installing ⇒ page 275

9 - Combustion chamber ring seal

- ❑ Do not apply grease to ring seal or use any other lubricants
- ❑ Renew

10 - Operating lever

- ❑ For vacuum unit

11 - Seal

- ❑ Renew if damaged
- ❑ When renewing lever out with screwdriver
- ❑ Press in by hand

12 - Vacuum hose

- ❑ From intake manifold flap valve - N316-

13 - Vacuum unit for actuating intake manifold flaps

14 - Intake manifold flap potentiometer 2 - G512-

15 - Bolts

- ❑ 2.5 Nm

16 - Threaded connection

- ❑ 40 Nm

17 - Housing

- ❑ For spray nozzle valve and oil retention valve

18 - Vacuum reservoir

19 - High-pressure fuel pipe

20 - Bolts

- ❑ 9 Nm

21 - Fuel rail

22 - Bolts

- ❑ 9 Nm

23 - Bolts

- ❑ Tightening torque and sequence ⇒ page 266

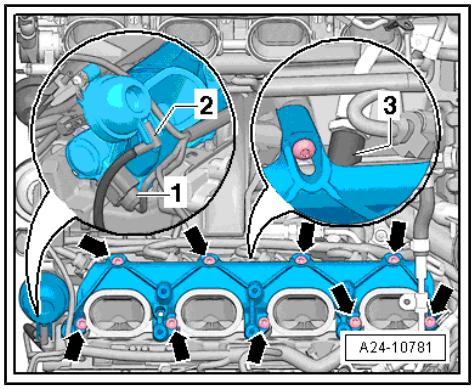
24 - Bolts

- ❑ 0.3 Nm

Intake manifold (bottom section) - tightening torque and sequence

– Tighten bolts -arrows- for intake manifold (bottom section) in diagonal sequence and in stages.

• 9 Nm



4.3 Removing and installing intake manifold (top section)

Removing

WARNING

The fuel system operates at extremely high pressure. This can cause injury.

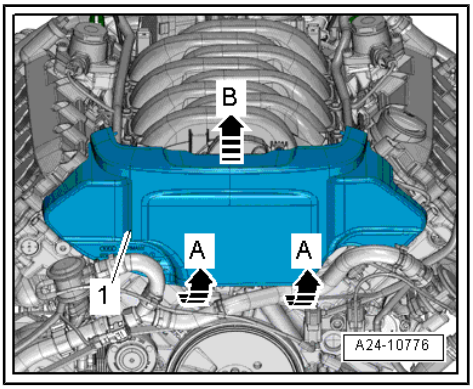
- *The fuel pressure in the high-pressure section of the injection system must be reduced to a residual pressure prior to opening the system. Procedure ⇒ page 255*
- *Wrap a clean cloth around the connection and carefully loosen the connection to allow the residual pressure to dissipate.*

Note

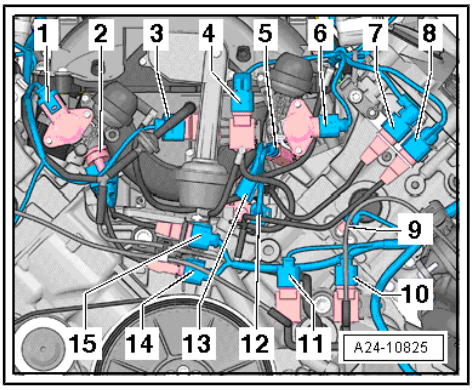
All cable ties which are released or cut open when removing must be fitted in the same position when installing.

– Remove engine cover panel ⇒ page 63 .

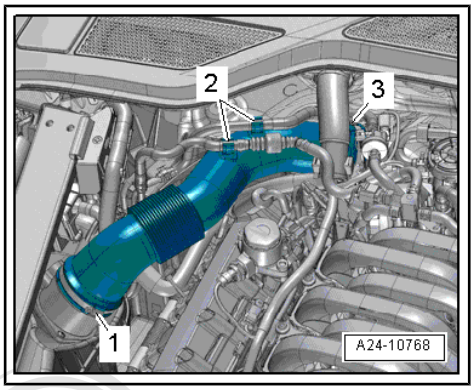
– Pull cover -1- towards front and lift off.



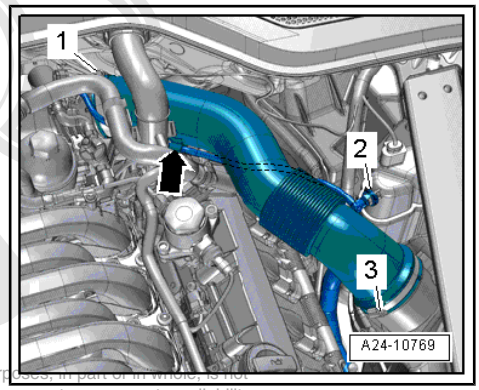
– Unplug electrical connectors -3 and 4-.
– Detach vacuum line from intake manifold (front).



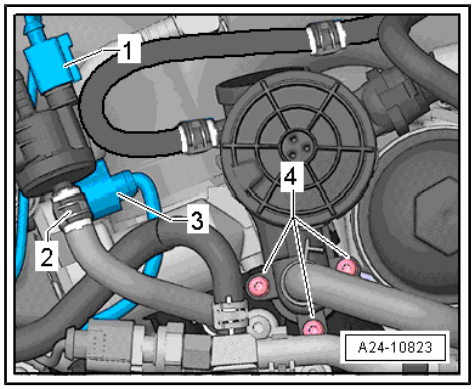
– Loosen hose clips -1 and 2- and remove air pipe (right-side).



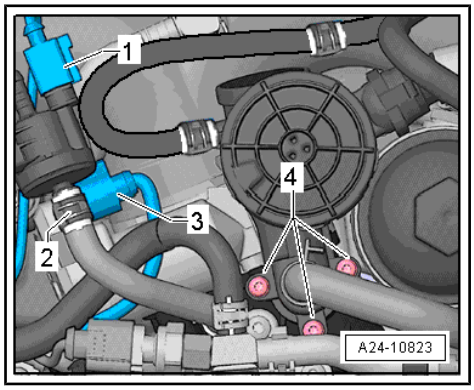
– Loosen hose clips -1 and 2- and remove air pipe (left-side).
– Disconnect vacuum lines -arrows- from air pipe.



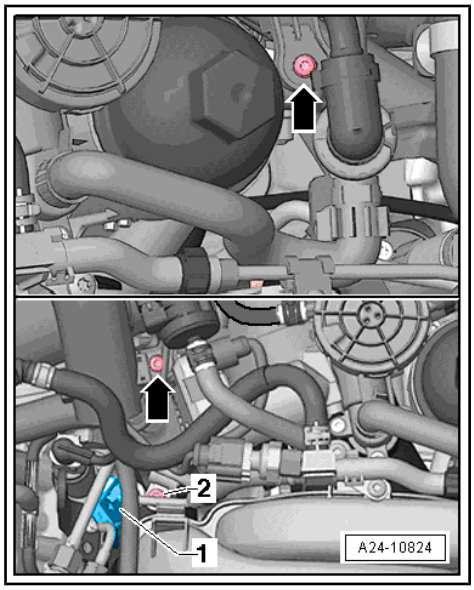
– Remove bolts -4- and move crankcase breather to one side.
– Detach hose -2- from activated charcoal filter solenoid valve 1 - N80- .
– Unplug electrical connectors -1 and 3-.



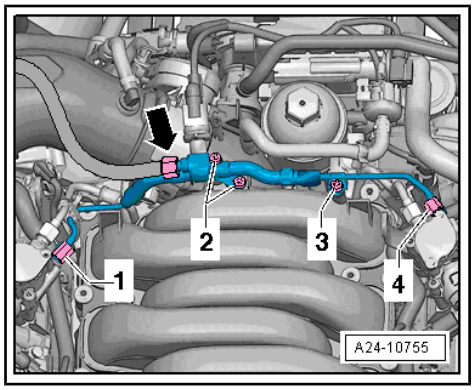
– Detach activated charcoal filter solenoid valve 1 - N80- from bracket and move it clear to the side.
– Release hose clip on intake connecting pipe.



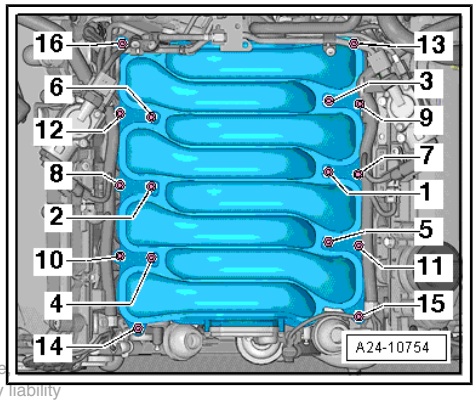
– Remove both bolts -arrows- from intake connecting pipe.
– Remove both retaining clips on fuel lines -1 and 2-.
– Press intake connecting pipe off throttle valve module - J338- to the rear.



– Disconnect fuel lines -1 and 4- at high-pressure pumps.
– Remove bolts -2 and 3-.



– Remove bolts for intake manifold in the sequence -16 to 1-.
– Remove intake manifold from engine compartment.



Note

Seal intake ports on cylinder heads with clean cloths.

Installing

Note

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

– Check seals in intake manifold for damage and make sure they are positioned correctly.
– Make sure that hoses and wires are not trapped.

The remaining installation steps are carried out in the reverse sequence.

– Install high-pressure pipes ⇒ page 283 .
– Install engine cover panel ⇒ page 63 .

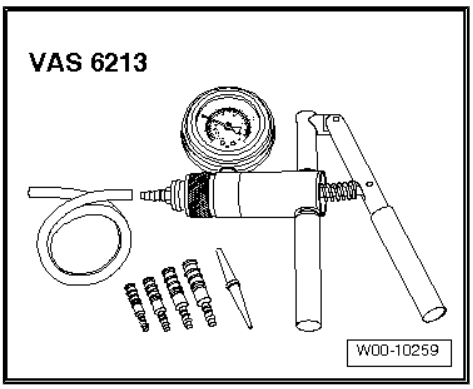
Tightening torques

- ⇒ “4.1 Exploded view - intake manifold”, page 263
- ⇒ Fig. ““Tightening torque and tightening sequence for intake manifold”“ , page 264
- ⇒ “5.1 Exploded view - fuel rail with injectors”, page 274
- ⇒ “7.1 Exploded view - high-pressure pump”, page 280

4.4 Removing and installing intake manifold (bottom section) with fuel rail

Special tools and workshop equipment required

- Tool insert (open-end ring spanner, 17 mm) -V.A.G 1331/2-
- Hand vacuum pump - VAS 6213-



Removing

Note

The following description shows the removal and installation of the bottom section of the intake manifold (left-side). The procedure for the other side is more or less identical.

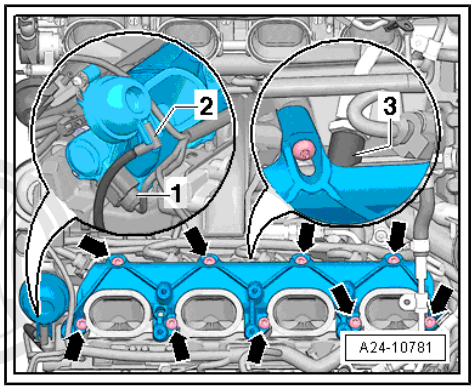
– Remove intake manifold ⇒ page 266 .

– Detach vacuum hose from vacuum unit for intake manifold flaps.

– Unscrew union nut for high-pressure fuel pipe at high-pressure pump (counterhold threaded connection).

– Unplug electrical connector -1- at intake manifold flap potentiometer and pull off vacuum hose -2-.

– Unscrew union nut -3- (counterhold threaded connection).



Note

To remove bottom section of intake manifold (right-side), unplug electrical connector for fuel pressure sender - G247- .

– Remove bolts -arrows- and detach intake manifold (bottom section) with fuel rail.

Caution

Risk of irreparable damage to engine.

- ***Block off the intake ports with clean cloths to prevent small objects from dropping into the engine through the intake ports in the cylinder heads.***

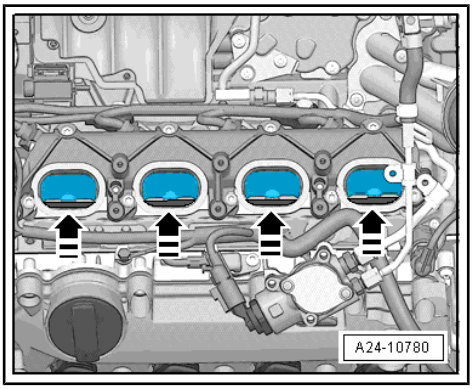
Installing

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

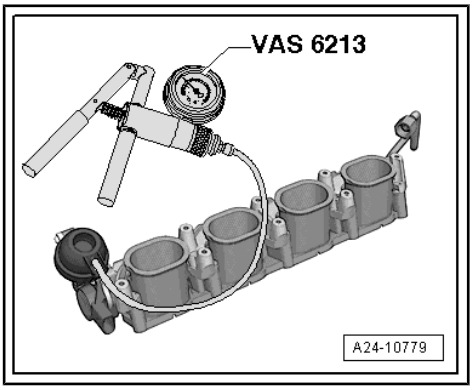
Note

- *If an injector has been pulled out of the cylinder head, the teflon ring seal must be renewed.*
- *Renew gaskets and O-rings.*
- *Lubricate O-rings of injectors lightly with clean engine oil.*

When installing intake manifold (bottom section) move intake manifold flaps in direction of -arrow-.



– Connect hand vacuum pump - VAS 6213- to connection for vacuum unit for intake manifold flaps, as shown in illustration.
– Use hand vacuum pump to generate vacuum.
• This will cause the intake manifold flaps to open.



Note

If the intake manifold flaps are not opened, they can catch on the guide plates in the cylinder head when the intake manifold (bottom section) is installed.

– Then press intake manifold (bottom section) evenly onto injectors.
– Tighten bolts for intake manifold (bottom section) in diagonal sequence to specified torque.
– Detach hand vacuum pump from connection for vacuum unit for intake manifold flaps.
– Install high-pressure pipes ⇒ page 283 .

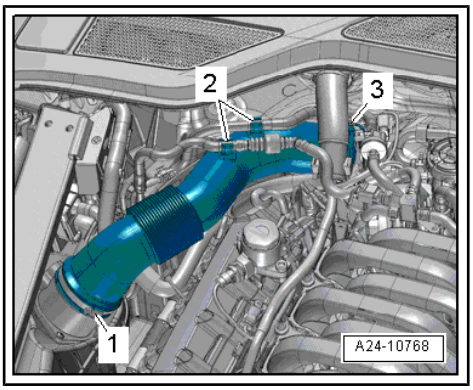
Tightening torques

◆ ⇒ “4.1 Exploded view - intake manifold”, page 263
◆ ⇒ Fig. ““Intake manifold (bottom section) - tightening torque and sequence”“ , page 266

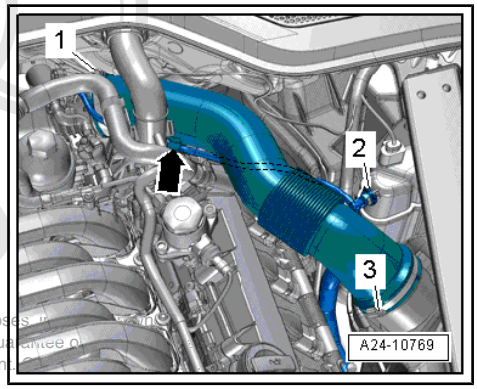
4.5 Removing and installing throttle valve module - J338-

Removing

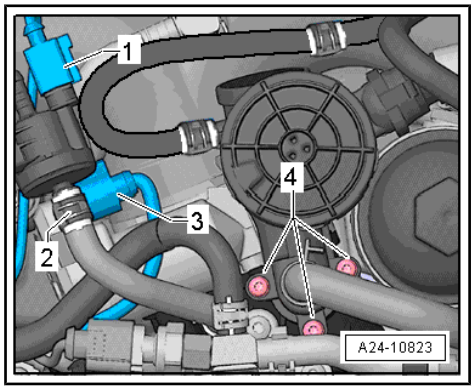
– Remove engine cover panel ⇒ page 63 .
– Unclip fuel supply line -2-.
– Loosen hose clips -1 and 3- and remove air pipe (right-side).



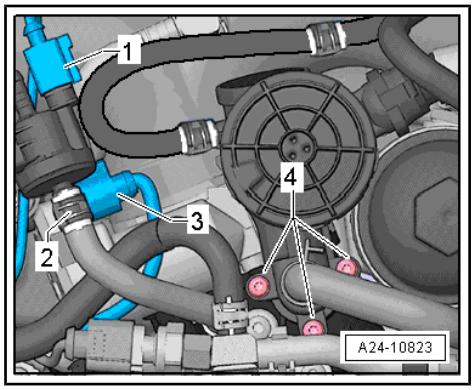
– Loosen hose clips -1 and 3- and remove air pipe (left-side).
– Disconnect vacuum lines -arrows- from intake connecting pipe.



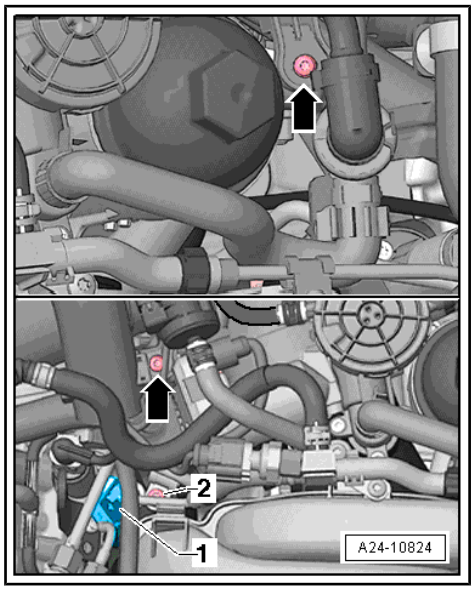
– Remove bolts -4- and detach crankcase breather.
– Detach hose -2- from activated charcoal filter solenoid valve 1 - N80- .
– Unplug electrical connectors -1 and 3-.



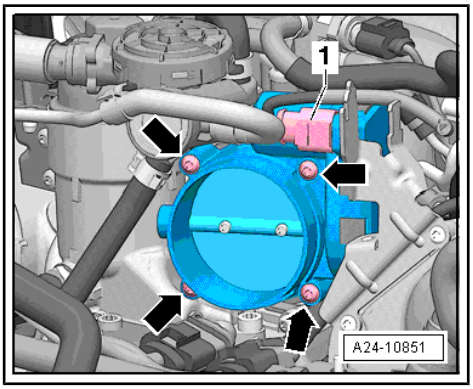
– Detach activated charcoal filter solenoid valve 1 - N80- from bracket and move it clear to the side.
– Release hose clip on intake connecting pipe.



– Remove both bolts -arrows- from intake connecting pipe.
– Guide intake connecting pipe out from above.



– Unscrew bolts -arrows- and remove throttle valve module - J338- .



Installing

Install in reverse order.

– Install engine cover panel ⇒ page 63 .

After renewing, perform “Adaption” in “Guided Functions” using vehicle diagnostic tester.

Tightening torques

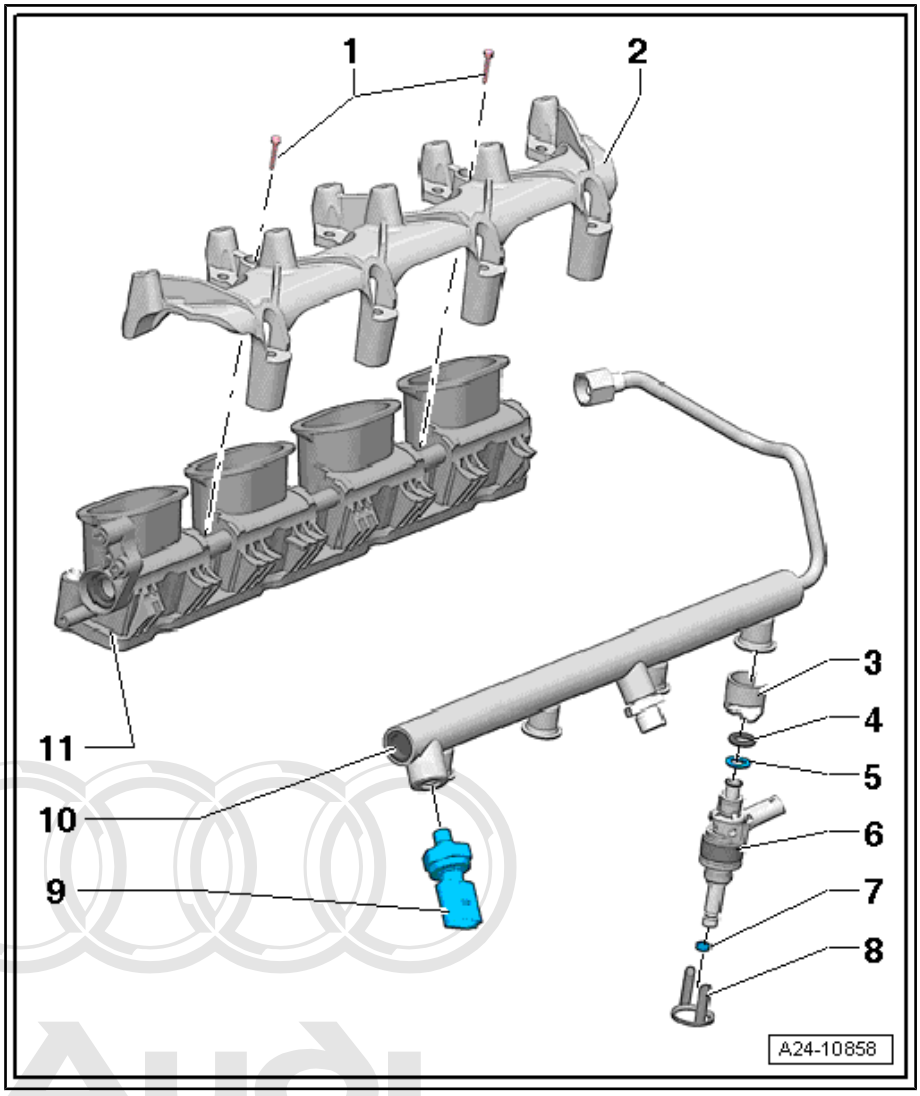
◆ ⇒ “4.1 Exploded view - intake manifold”, page 263

5 Injectors

5.1 Exploded view - fuel rail with injectors

Note

The illustration shows the fuel rail (right-side) for cylinder bank 1.



1 - Bolts
- ❑ 0.3 Nm

2 - Bracket

3 - Radial compensation element
- ❑ Renew if damaged
- ❑ Clip onto support ring ⇒ Item 8 (page 274)

4 - O-ring
- ❑ Renew
- ❑ Lubricate lightly with clean engine oil

5 - Spacer ring
- ❑ Renew if damaged

6 - Injector
- ❑ Renewing ⇒ page 275

7 - Combustion chamber ring seal
- ❑ Do not apply grease to ring seal or use any other lubricants

8 - Support ring
- ❑ Renew
- ❑ Via this support ring, the fuel rail exerts the clamping force that holds the injector in the cylinder head

9 - Fuel pressure sender - G247-
- ❑ 25 Nm
- ❑ Lubricate threads lightly with clean oil
- ❑ Removing and installing ⇒ page 279

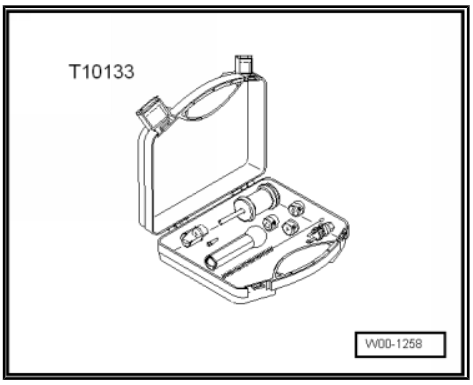
10 - Fuel rail
- ❑ Removing and installing ⇒ page 269

11 - Intake manifold (bottom section)
- ❑ Removing and installing ⇒ page 269
- ❑ 9 Nm

5.2 Removing and installing injectors

Special tools and workshop equipment required

- Tool set for FSI engines - T10133-



Removing

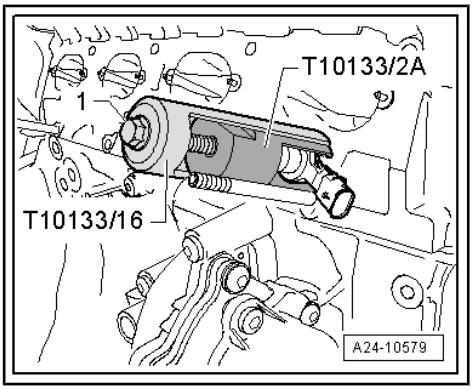
Note

The following description is for removing and installing the injectors on the left side (cylinder bank 2).

– Remove intake manifold (bottom section) on relevant side ⇒ page 269 .

– Guide puller -T10133/2A- into groove on injector.

– Then attach removal tool -T10133/16- and pull out injector by turning bolt -1-.

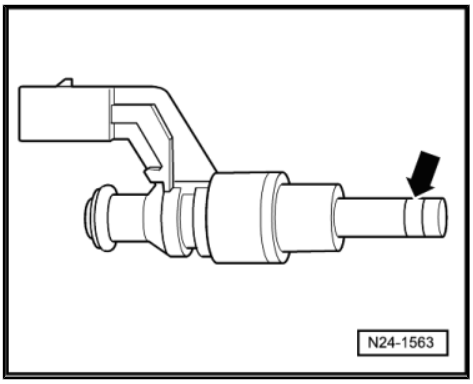


Note

When inserting the puller, there is a risk of destroying the radial compensation element due to the retainer tabs breaking.

– Carefully remove old combustion chamber ring seal -arrow-. To do so, cut open ring using knife or prise open ring with small screwdriver and then pull off forwards.

– Take care not to damage groove on injector. The injector must be renewed if the groove is damaged.

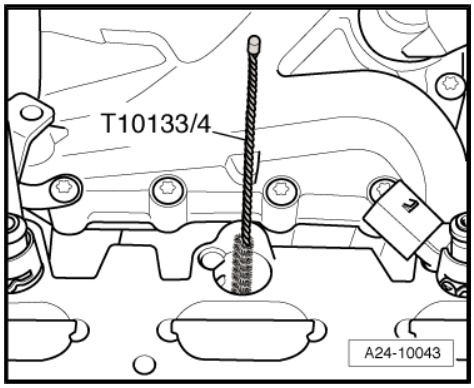


Installing

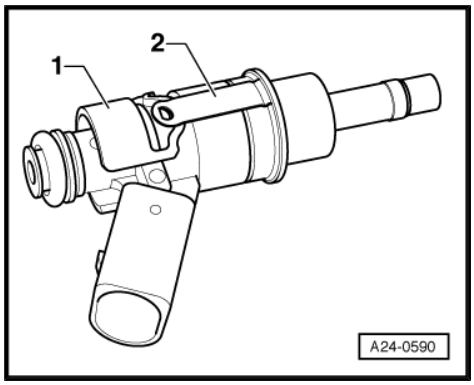
Note

- *Renew combustion chamber ring seal and O-ring.*
- *Renew spacer ring if damaged.*
- *Lightly lubricate O-rings for injectors with clean engine oil.*
- *The injectors must be re-installed on the same cylinders.*

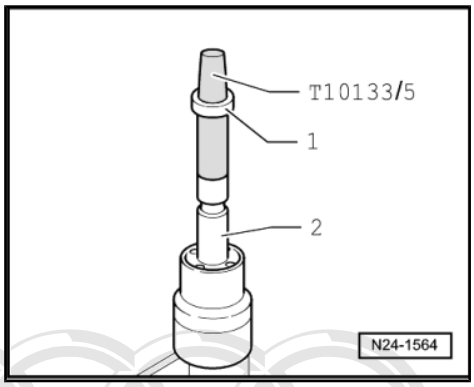
– Clean bore in cylinder head with nylon cylinder brush - T10133/4- .



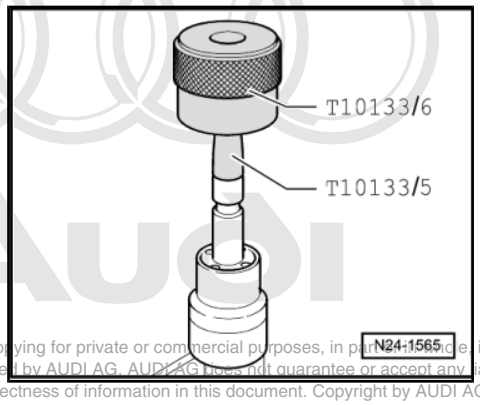
– Clip radial compensation element -1- into support ring -2-.
– When re-installing an injector, clean any combustion residue off groove for combustion chamber ring seal and injector stem with a clean cloth.



– Fit assembly cone -T10133/5- with new combustion chamber ring seal -1- onto injector -2-.

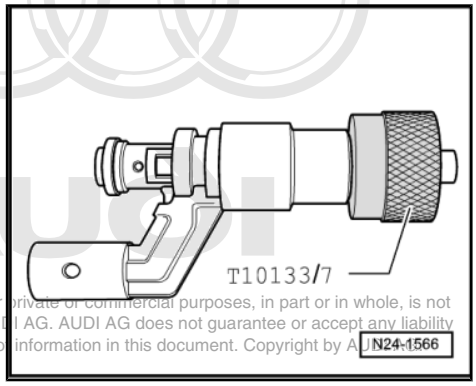


– Push combustion chamber ring seal onto assembly cone - T10133/6- as far as it will go using assembly sleeve - T10133/5- .
– Turn assembly sleeve -T10133/6- upside down and push combustion chamber ring seal into sealing ring groove.

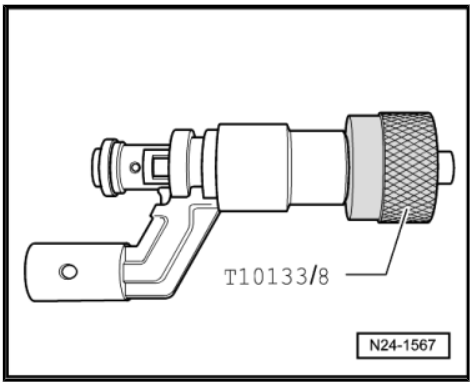


Note

The combustion chamber ring seal is widened when it is pushed onto the injector. After pushing it on, it therefore has to be compressed again. This is done in two stages, as described below.



– Push calibration sleeve -T10133/7- onto injector as far as it will go and simultaneously turn it slightly (approx. 180°).
– Pull calibration sleeve -T10133/7- off again by turning it in the opposite direction.



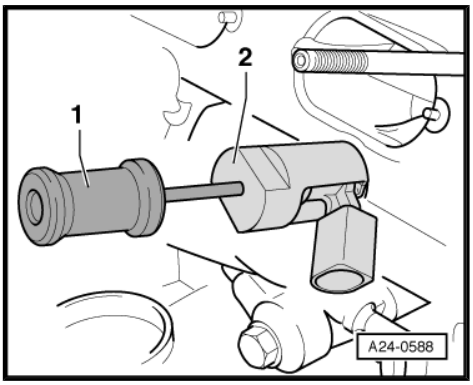
– Push calibration sleeve -T10133/8- onto injector as far as it will go and simultaneously turn it slightly (approx. 180°).
– Pull calibration sleeve -T10133/8- off again by turning it in the opposite direction.

Note

The combustion chamber ring seal must not be lubricated.

– Push injector by hand as far as it will go into aperture in cylinder head (do not use oil or grease). Ensure that the injector is properly seated in the cylinder head.

Note



- *It should be possible to insert injector easily. If necessary wait until the combustion chamber ring seal has contracted sufficiently.*
- *Note correct installation position and ensure that injectors are properly seated in cylinder head.*
- *If the injector cannot be pushed in by hand, use puller - T10133/2A- -2- with striker - T10133/3- to insert the injector.*

- Electrical connector of injector must engage in recess in cylinder head.
- Coat O-rings of injectors with clean engine oil to facilitate insertion into fuel rail.
- Renew all seals.

Perform further installation in reverse order, paying attention to the following:

– Install relevant bottom section of intake manifold ⇒ page 269 .

5.3 Cleaning injectors

Special tools and workshop equipment required

- Ultrasonic cleaning unit - VAS 6418-
- Mounting plate for injection modules - VAS 6418/1-
- Cleaning fluid ⇒ Electronic parts catalogue

Cleaning

– Remove injectors ⇒ page 275 .

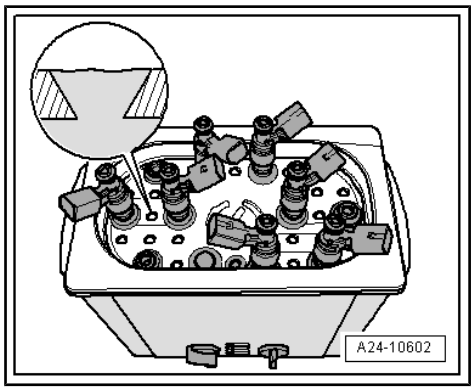
Note

Observe safety precautions and operating instructions for ultrasonic unit.

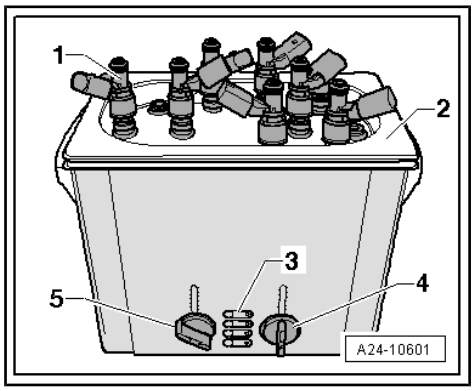
– Ultrasonic unit must be filled with cleaning fluid.

Note

Ultrasonic unit must be filled with cleaning fluid up to top edge of apertures (see detail in illustration).



– Insert injectors -1- all the way into mounting plate for injection modules - VAS 6418/1- -2-.
– Set rotary knob -4- to a temperature of 50°C.
– Select a cleaning time of 30 minutes with rotary knob -5-.
– Switch on ultrasonic unit with button -3-.



Note

The time set starts to elapse as soon as a cleaning temperature of 50°C has been reached.

– Install injectors with new combustion chamber seal ⇒ page 275 .

6 Senders and sensors

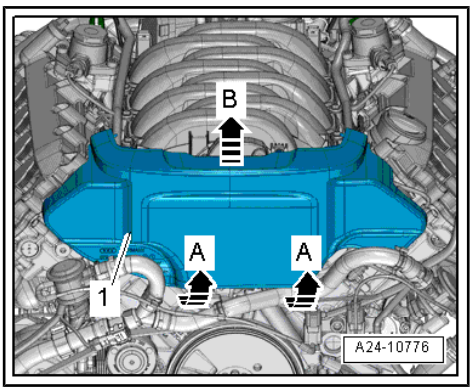
⇒ “6.1 Removing and installing fuel pressure sender G247 ”, page 279

6.1 Removing and installing fuel pressure sender - G247-

Removing

– Remove engine cover panel ⇒ page 63 .

– Pull cover -1- towards front and lift off.



– Unscrew fuel pressure sender - G247- -2-.

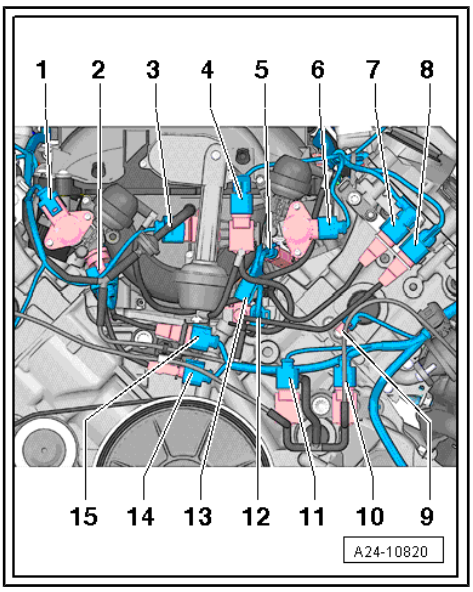
Installing

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

– Install engine cover panel ⇒ page 63 .

Tightening torques

◆ ⇒ “5.1 Exploded view - fuel rail with injectors”, page 274



7 High-pressure pump

7.1 Exploded view - high-pressure pump

1 - High-pressure pump

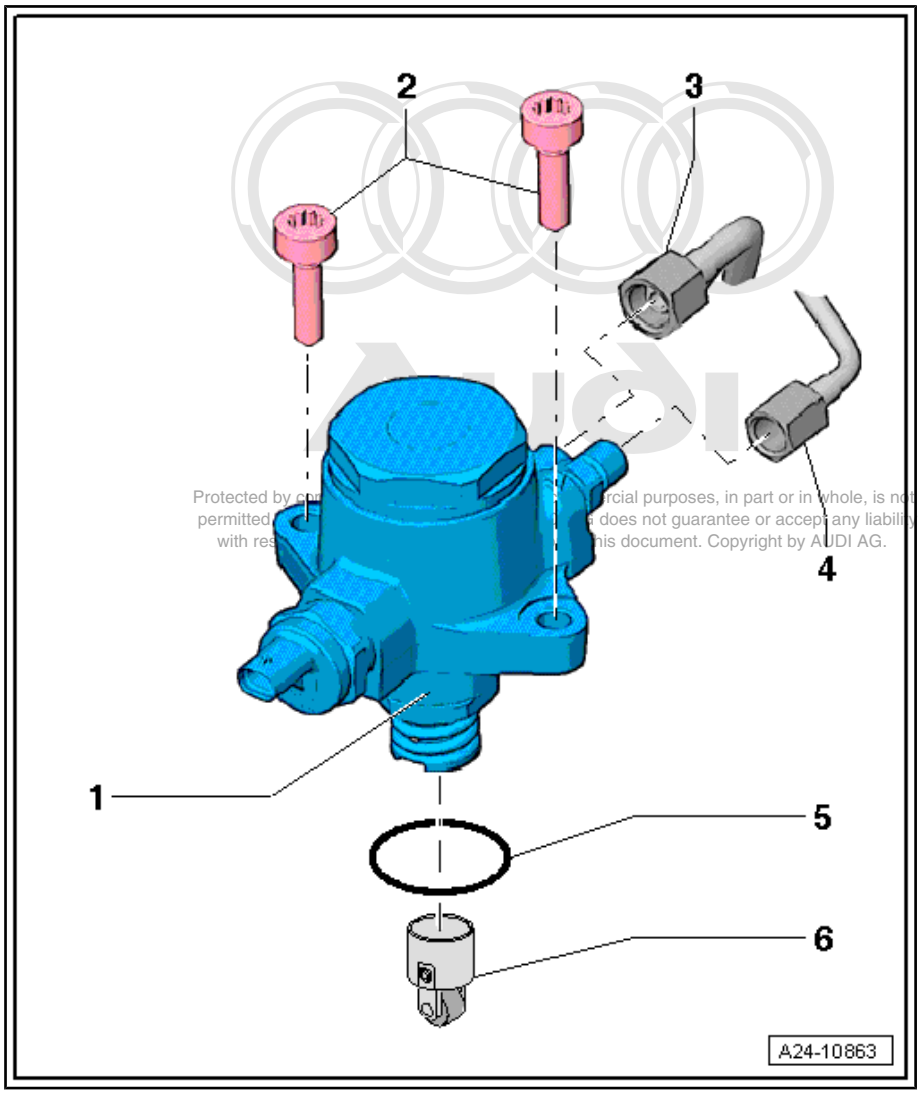
- ❑ Fuel metering valve - N290- is installed in high-pressure pump on right-side (cylinder bank 1).
- ❑ Fuel metering valve 2 - N402- is installed in high-pressure pump on left-side (cylinder bank 2).
- ❑ Removing and installing ⇒ page 281

2 - Bolt

- ❑ 9 Nm

3 - High-pressure pipe

> **WARNING**
>
> *The fuel system operates at extremely high pressure. This can cause injury.*
>
> *The fuel pressure in the high-pressure section of the injection system must be reduced to a residual pressure prior to opening the system. Procedure ⇒ page 255*
>
> *Wrap a clean cloth around the connection and carefully loosen the connection to allow the residual pressure to dissipate.*



- ❑ Connections must not be damaged
- ❑ Do not alter shape
- ❑ 25 Nm

4 - Fuel supply line

> **WARNING**
> *The fuel system operates at extremely high pressure. This can cause injury.*
> *The fuel pressure in the high-pressure section of the injection system must be reduced to a residual pressure prior to opening the system. Procedure* *⇒ page 255*
>
> *Wrap a clean cloth around the connection and carefully loosen the connection to allow the residual pressure to dissipate.*

- ❑ Connections must not be damaged
- ❑ Do not alter shape
- ❑ 25 Nm

5 - O-ring

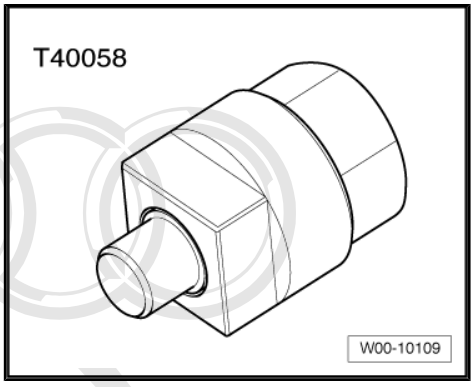
- ❑ Renew

6 - Roller tappet

7.2 Removing and installing high-pressure pump

Special tools and workshop equipment required

- ♦ Adapter - T40058-



- ♦ Feeler gauge

Removing

Note

The following description is for removing and installing the high-pressure pump on the left side.

WARNING

The fuel system operates at extremely high pressure. This can cause injury.

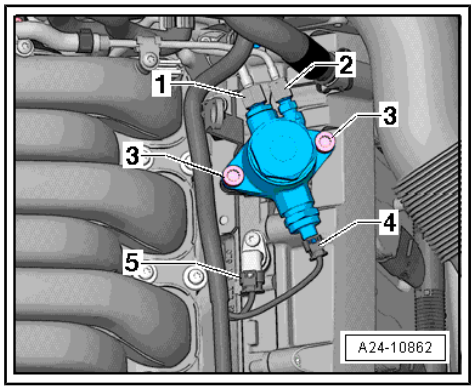
- *The fuel pressure in the high-pressure section of the injection system must be reduced to a residual pressure prior to opening the system. Procedure ⇒ page 255*
- *Wrap a clean cloth around the connection and carefully loosen the connection to allow the residual pressure to dissipate.*

– Remove engine cover panel ⇒ page 63 .

– Unplug electrical connectors -4 and 5- for fuel pressure sender for low pressure - G410- and for fuel metering valve 2 - N402- .

– Detach both union nuts for fuel lines.

– Remove bolts -3-.



Note

Do not attempt to bend high-pressure pipes to a different shape.

– Carefully pull out high-pressure pump.

– Pull roller tappet out of cylinder head.

Installing

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

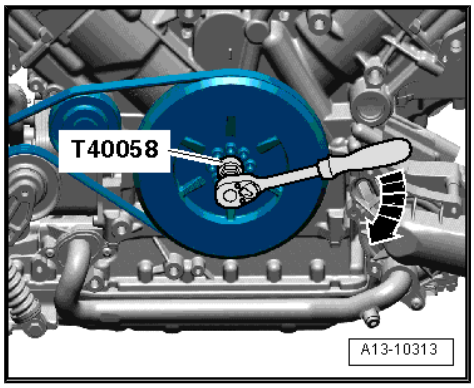
Note

Renew O-ring.

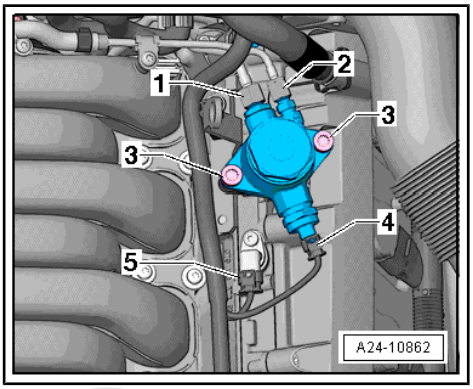
– Rotate crankshaft in direction of normal engine rotation -arrow- using adapter - T40058- , and at the same time press roller tappet into cylinder head until it reaches its lowest point.

– Only lift high-pressure pipes slightly to fit the high-pressure pump.

– Press high-pressure pump down by hand as far as possible onto stop.



– Hand-tighten bolts -3- as far as flange.



Note

The high-pressure pump can be damaged if it is tightened too much on one side (keep it straight).

– Tighten bolts alternately in stages.
– Install high-pressure pipes ⇒ page 283 .
– Install engine cover panel ⇒ page 63 .

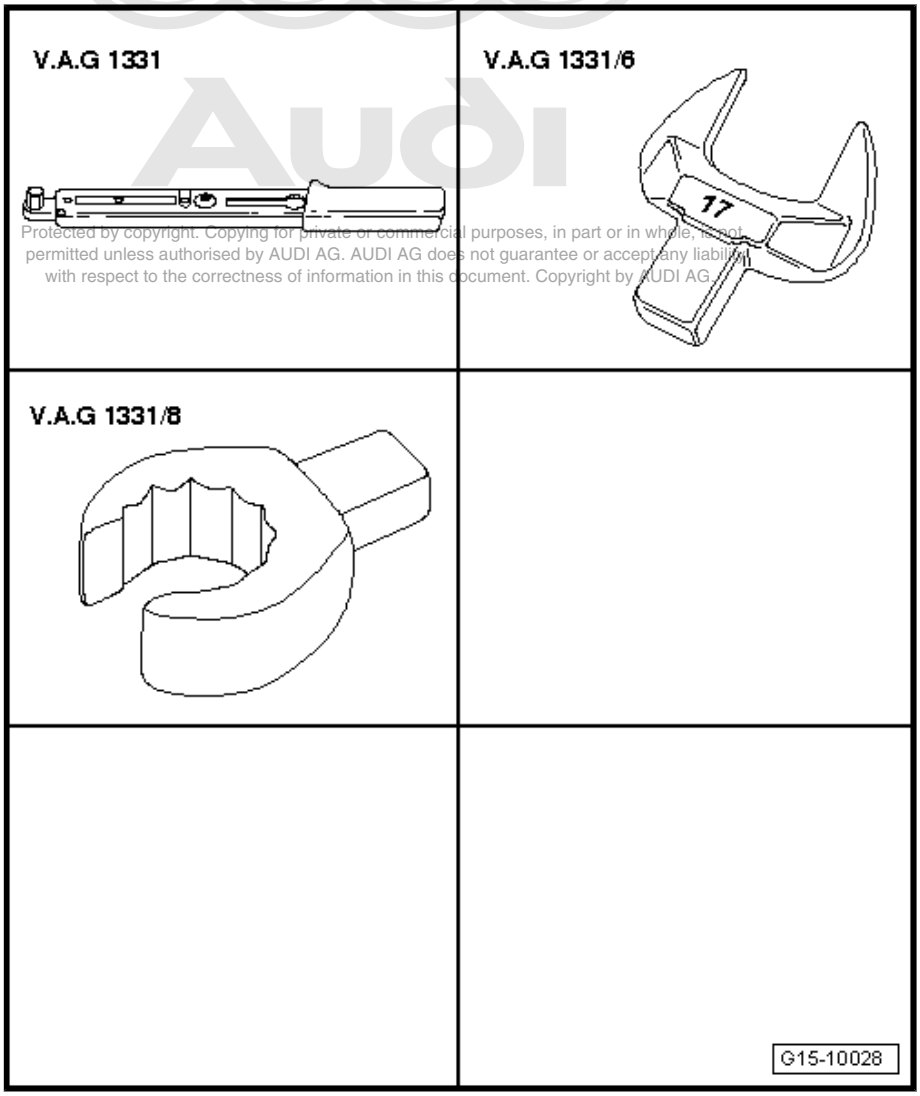
Tightening torques

♦ ⇒ “7.1 Exploded view - high-pressure pump”, page 280

7.3 Removing and installing high-pressure pipe

Special tools and workshop equipment required

♦ Torque wrench - V.A.G 1331-
♦ Open end spanner insert, AF 17 - V.A.G 1331/6-
♦ Socket insert AF 14, flared ring spanner - V.A.G 1331/8-



Removing

– To remove union nut at high-pressure pump, counterhold threaded connection.

Installing

Note

- *The connections of the high-pressure pipes must not be damaged.*
- *Do not attempt to bend high-pressure pipes to a different shape.*

– Lubricate threads of union nuts with clean engine oil.

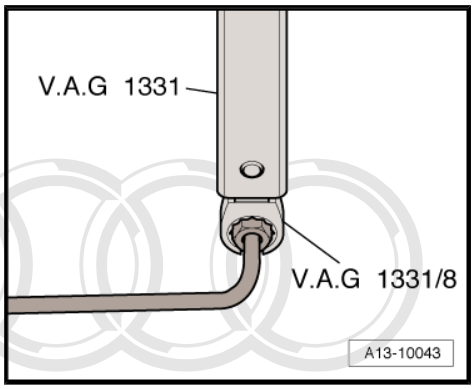
– First tighten union nut by hand until it makes contact, making sure that high-pressure pipe is not under tension.

– Tighten union nut initially to 5 Nm using torque wrench.

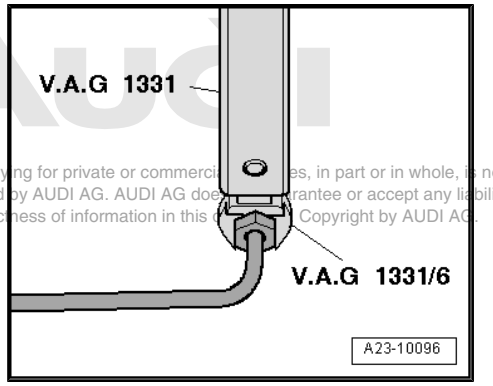
– Tighten bolts for retaining clips.

– Tighten union nut to final tightening torque using torque wrench; to do so, counterhold hexagon flats of each connection with an open-end spanner.

– To tighten union nuts (14 mm) for high-pressure pipes, use torque wrench - V.A.G 1331- with socket insert AF 14, flared ring spanner - V.A.G 1331/8- .



– To tighten union nuts (17 mm) for high-pressure pipes, use torque wrench - V.A.G 1331- with tool insert (17 mm) - V.A.G 1331/6- .



Note

Check fuel system for leaks.

Tightening torques

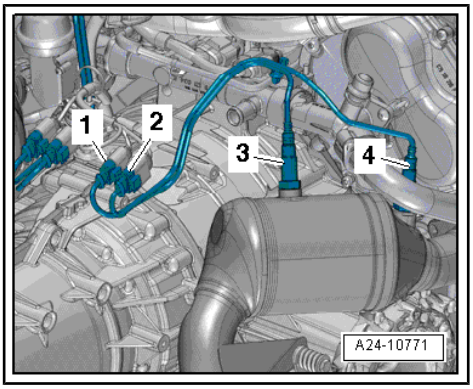
- ⇒ “4.2 Exploded view - intake manifold (bottom section) with fuel rail”, page 265
- ⇒ “7.1 Exploded view - high-pressure pump”, page 280

8 Lambda probe

⇒ “8.1 Exploded view - Lambda probe”, page 285

⇒ “8.2 Removing and installing Lambda probe”, page 286

8.1 Exploded view - Lambda probe



Fitting location of Lambda probes on cylinder bank 1 (right-side)

1 - Electrical connector for Lambda probe after catalytic converter - G130-

2 - Electrical connector for Lambda probe - G39-

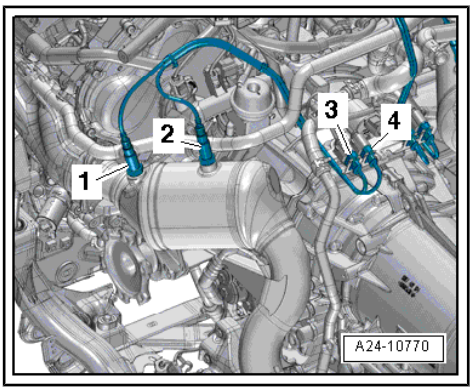
3 - Lambda probe after catalytic converter - G130-

4 - Lambda probe - G39-

Removing and installing Lambda probe - G39- ⇒ page 286

Removing and installing Lambda probe after catalytic converter - G130- ⇒ page 289

- Tightening torque: 55 Nm



Fitting location of Lambda probes on cylinder bank 2 (left-side)

1 - Lambda probe 2 - G108-

2 - Lambda probe 2 after catalytic converter - G131-

3 - Electrical connector for Lambda probe 2 - G108-

4 - Electrical connector for Lambda probe 2 after catalytic converter - G131-

Removing and installing Lambda probe 2 - G108- ⇒ page 288

Removing and installing Lambda probe 2 after catalytic converter - G131- ⇒ page 292

- Tightening torque: 55 Nm

Note

- *Threads of new Lambda probes are already coated with assembly paste; the paste must not get into the slots on the probe body.*
- *In the case of a used Lambda probe grease only the thread with high-temperature paste. The paste must not get into the slots on the Lambda probe body. High-temperature paste ⇒ Parts catalogue*
- *When installing, it is important to re-attach the Lambda probe wiring at the same locations to prevent it from coming into contact with the exhaust pipe.*

8.2 Removing and installing Lambda probe

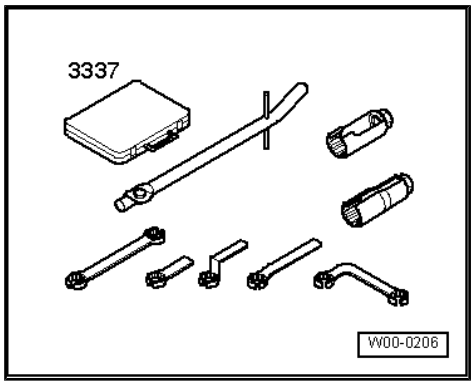
⇒ “8.2.1 Removing and installing Lambda probe G39 ”, page 286

⇒ “8.2.2 Removing and installing Lambda probe 2 G108 ”, page 288

8.2.1 Removing and installing Lambda probe - G39-

Special tools and workshop equipment required

- Lambda probe open ring spanner set - 3337-

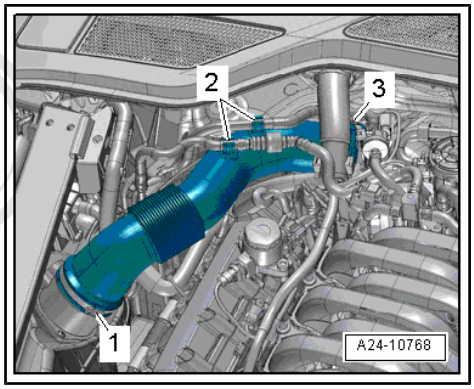


Removing

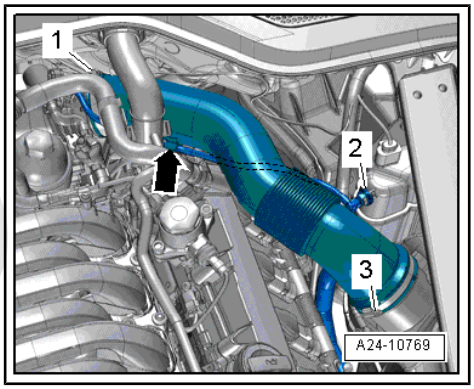
Note

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

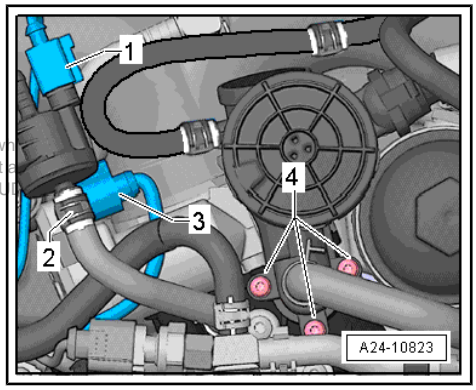
– Remove engine cover panel ⇒ page 63 .
– Unclip fuel supply line -2-.
– Loosen hose clips -1 and 3- and remove air pipe (right-side).



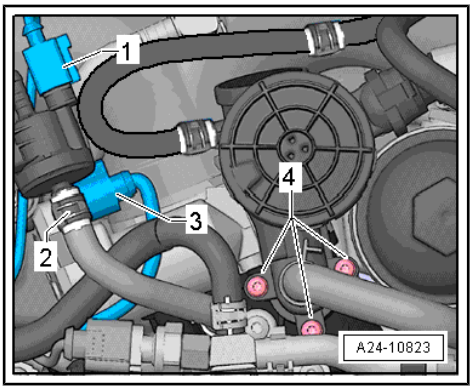
– Loosen hose clips -1 and 3- and remove air pipe (left-side).
– Disconnect vacuum lines -arrows- from intake connecting pipe.



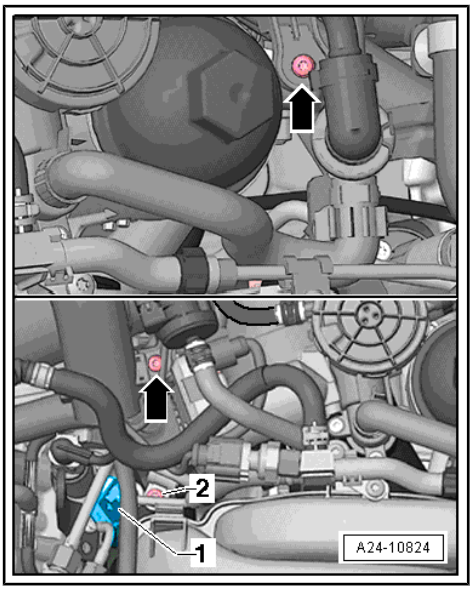
– Remove bolts -4- and detach crankcase breather.
– Detach hose -2- from activated charcoal filter solenoid valve 1 - N80- .
– Unplug electrical connectors -1 and 3-.



– Detach activated charcoal filter solenoid valve 1 - N80- from bracket and move it clear to the side.
– Release hose clip on intake connecting pipe.

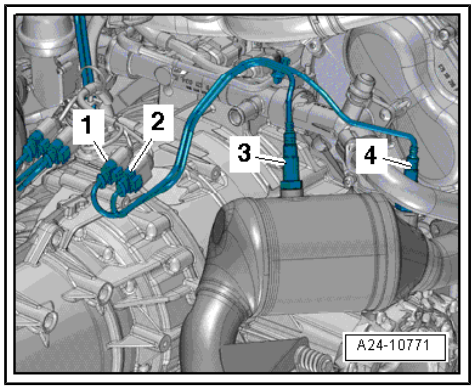


– Remove both bolts -arrows- from intake connecting pipe.
– Guide intake connecting pipe out from above.



– Unplug electrical connector -2-.

– Unscrew Lambda probe - G39- -4- using tool from Lambda probe open ring spanner set - 3337- .



Installing

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

Note

- *Threads of new Lambda probes are already coated with assembly paste; the paste must not get into the slots on the probe body.*
- *In the case of a used Lambda probe grease only the thread with high-temperature paste. The paste must not get into the slots on the Lambda probe body. High-temperature paste ⇒ Parts catalogue*
- *When installing, the Lambda probe wire must always be reattached at the same locations to prevent it from coming into contact with the exhaust pipe.*
- *Fit all cable ties in the original positions when installing.*

– Install engine cover panel ⇒ page 63 .

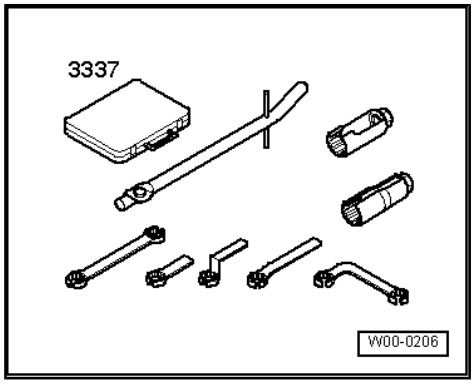
Tightening torques

- ⇒ “8.1 Exploded view - Lambda probe”, page 285

8.2.2 Removing and installing Lambda probe 2 - G108-

Special tools and workshop equipment required

- Lambda probe open ring spanner set - 3337-



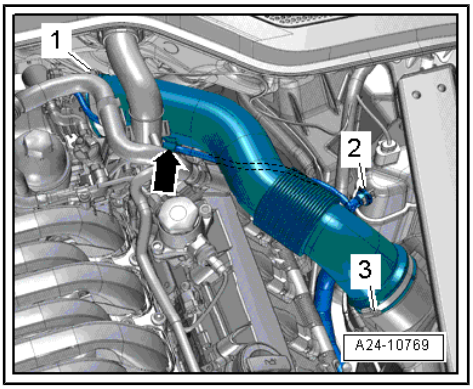
Removing

Note

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

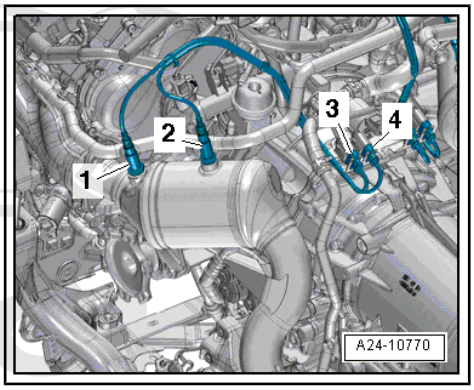
– Remove engine cover panel ⇒ page 63 .

– Loosen hose clips -1 and 2- and remove air pipe (left-side).



– Unplug electrical connector -3-.

– Unscrew Lambda probe 2 - G108- -1- using tool from Lambda probe open ring spanner set - 3337- .



Installing

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

Note

- *Threads of new Lambda probes are already coated with assembly paste; the paste must not get into the slots on the probe body.*
- *In the case of a used Lambda probe grease only the thread with high-temperature paste. The paste must not get into the slots on the Lambda probe body. High-temperature paste ⇒ Parts catalogue*
- *When installing, the Lambda probe wire must always be reattached at the same locations to prevent it from coming into contact with the exhaust pipe.*
- *Fit all cable ties in the original positions when installing.*

– Install engine cover panel ⇒ page 63 .

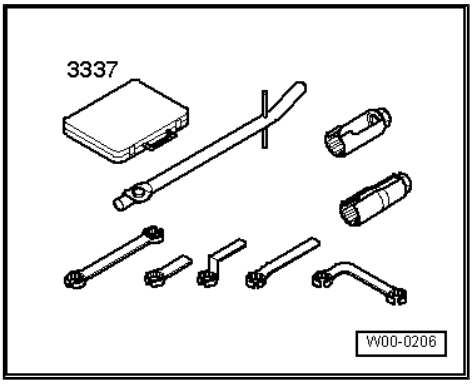
Tightening torques

- ⇒ “8.1 Exploded view - Lambda probe”, page 285

8.2.3 Removing and installing Lambda probe after catalytic converter - G130-

Special tools and workshop equipment required

- Lambda probe open ring spanner set - 3337-

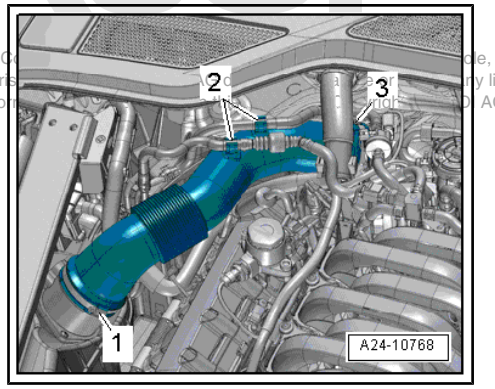


Removing

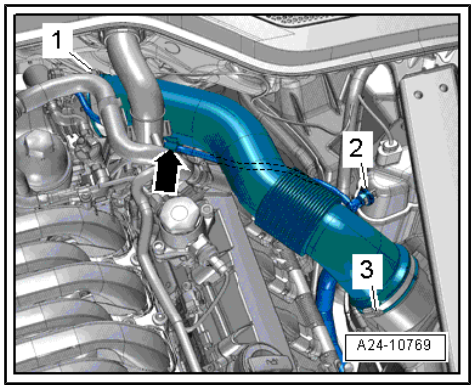
Note

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

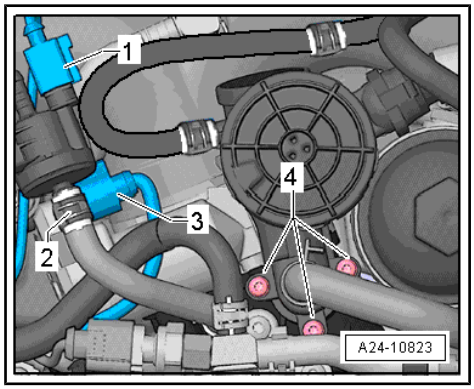
– Remove engine cover panel ⇒ page 63 .
– Unclip fuel supply line -2-.
– Loosen hose clips -1 and 3- and remove air pipe (right-side).



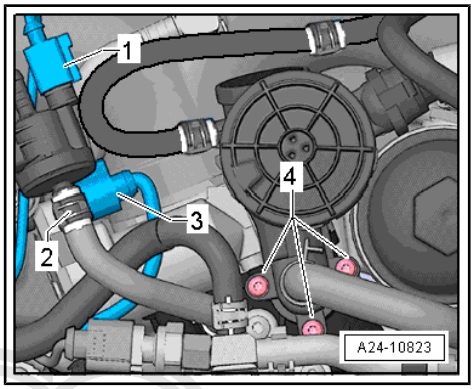
– Loosen hose clips -1 and 3- and remove air pipe (left-side).
– Disconnect vacuum lines -arrows- from intake connecting pipe.



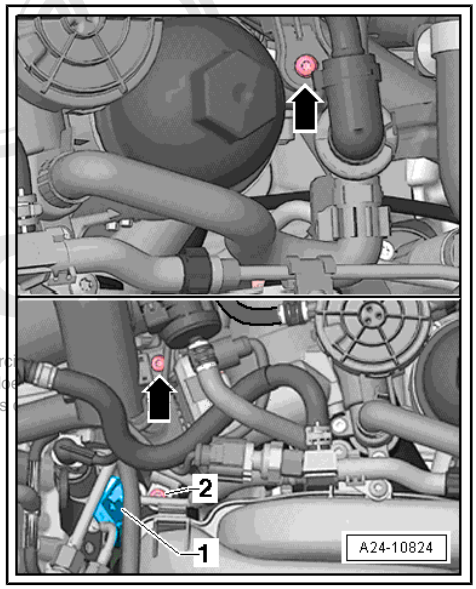
– Remove bolts -4- and detach crankcase breather.
– Detach hose -2- from activated charcoal filter solenoid valve 1 - N80- .
– Unplug electrical connectors -1 and 3-.



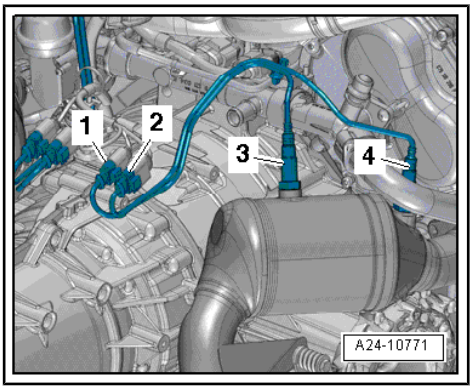
– Detach activated charcoal filter solenoid valve 1 - N80- from bracket and move it clear to the side.
– Release hose clip on intake connecting pipe.



– Remove both bolts -arrows- from intake connecting pipe.
– Guide intake connecting pipe out from above.



– Unplug electrical connector -1-.
– Unscrew Lambda probe after catalytic converter - G130- -3- using tool from Lambda probe open ring spanner set - 3337- .



Installing

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

Note

- *Threads of new Lambda probes are already coated with assembly paste; the paste must not get into the slots on the probe body.*
- *In the case of a used Lambda probe grease only the thread with high-temperature paste. The paste must not get into the slots on the Lambda probe body. High-temperature paste ⇒ Parts catalogue*
- *When installing, the Lambda probe wire must always be reattached at the same locations to prevent it from coming into contact with the exhaust pipe.*
- *Fit all cable ties in the original positions when installing.*

– Install engine cover panel ⇒ page 63 .

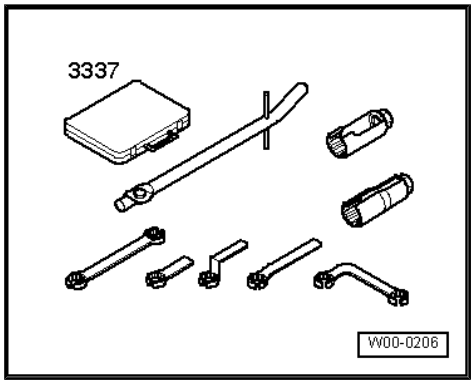
Tightening torques

- ⇒ “8.1 Exploded view - Lambda probe”, page 285

8.2.4 Removing and installing Lambda probe after catalytic converter - G131-

Special tools and workshop equipment required

- Lambda probe open ring spanner set - 3337-



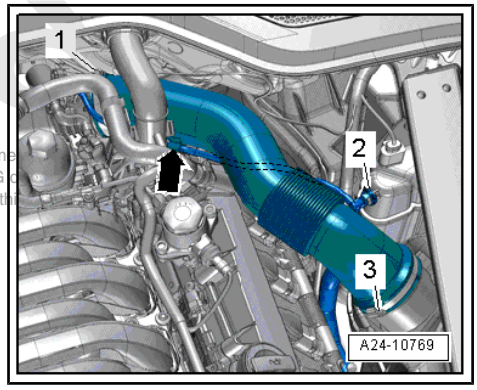
Removing

Note

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

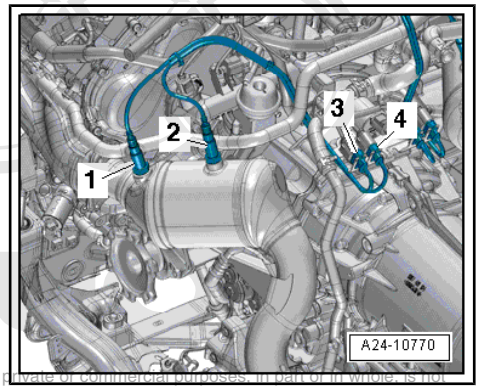
– Remove engine cover panel ⇒ page 63 .

– Loosen hose clips -1 and 2- and remove air pipe (left-side).



– Unplug electrical connector -4-.

– Unscrew Lambda probe after catalytic converter - G131- -2- using tool from Lambda probe open ring spanner set - 3337- .



Installing

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

Note

- *Threads of new Lambda probes are already coated with assembly paste; the paste must not get into the slots on the probe body.*
- *In the case of a used Lambda probe grease only the thread with high-temperature paste. The paste must not get into the slots on the Lambda probe body. High-temperature paste ⇒ Parts catalogue*
- *When installing, the Lambda probe wire must always be reattached at the same locations to prevent it from coming into contact with the exhaust pipe.*
- *Fit all cable ties in the original positions when installing.*

– Install engine cover panel ⇒ page 63 .

Tightening torques

- ⇒ “8.1 Exploded view - Lambda probe”, page 285

9 Engine control unit

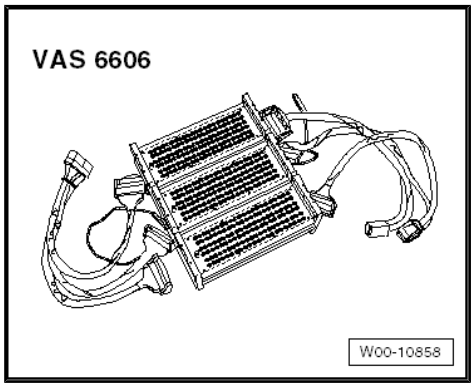
⇒ “9.1 Wiring and component check”, page 294

⇒ “9.2 Removing and installing engine control unit J623 ”, page 295

9.1 Wiring and component check

Special tools and workshop equipment required

- Isolator box, 198-pin - VAS 6606/1-1-
- Isolator box, 198-pin - VAS 6606/1-2-
- Isolator box, 198-pin - VAS 6606/1-3-
- Sheets -VAS 6606/1-1-
- Sheets -VAS 6606/2-1-
- Sheets -VAS 6606/3-1-
- Set of cables -VAS 6606/7-1- and -VAS 6606/7-2-



Note

- *Always make sure that the cables are properly connected.*
- *Do not use damaged or worn tools and accessories.*
- *Observe operating instructions.*

– Connect both cable sets -VAS 6606/7-1- and -VAS 6606/7-2- to the three isolator boxes -VAS 6606- .

– Use the following sheets:

- -VAS 6606/1-1- for isolator box, 198-pin - VAS 6606/1-1-
- -VAS 6606/2-1- for isolator box, 198-pin - VAS 6606/1-2-
- -VAS 6606/3-1- for isolator box, 198-pin - VAS 6606/1-3-

Note

Make sure that all plug-in bridges are inserted completely in all isolator boxes.

– Connect earth strap to an isolator box and to an earth point on the vehicle.

– Remove engine control unit ⇒ page 295 .

– Connect engine control unit to cable set -VAS 6606/7-1- .

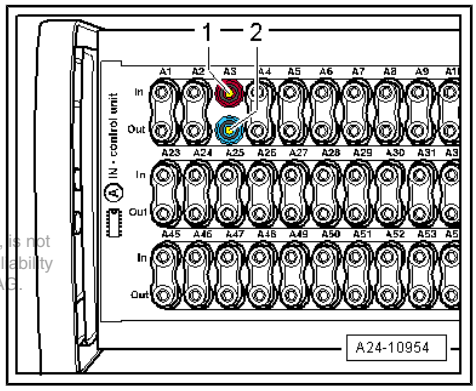
– Connect vehicle wiring harness to cable set -VAS 6606/7-2- .

The connection on the engine control unit consists of a large and a small connector.

The large connector has 105 pins and is assigned to the sheets for the isolator box marked “A 1 to A 105”.

The small connector has 91 pins and is assigned to the sheets for the isolator box marked “B 1 to B 91”.

When a push-in bridge is pulled out, the corresponding wiring connection is disconnected.



Note

- *The “In” contact -1- (red socket) leads to the engine control unit.*
- *The “Out” contact -2- (blue socket) leads to the wiring harness.*

– Carry out test as described in appropriate repair procedures.

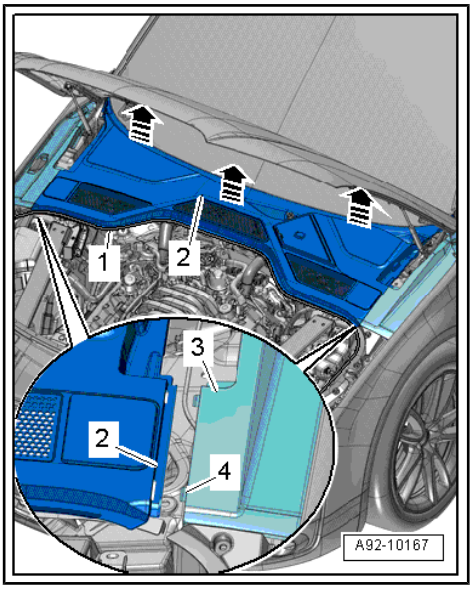
9.2 Removing and installing engine control unit - J623-

Removing

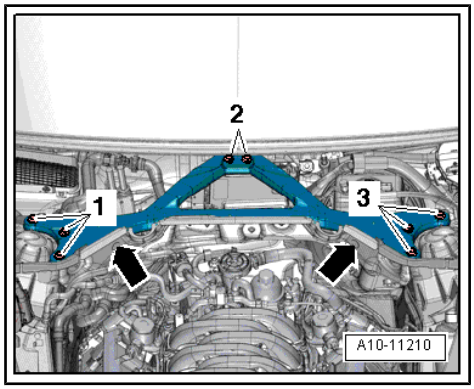
– When renewing engine control unit, select diagnosis object “Replace engine control unit” in “Guided Functions” mode of vehicle diagnostic tester.

– Switch off ignition and take out ignition key (if applicable).

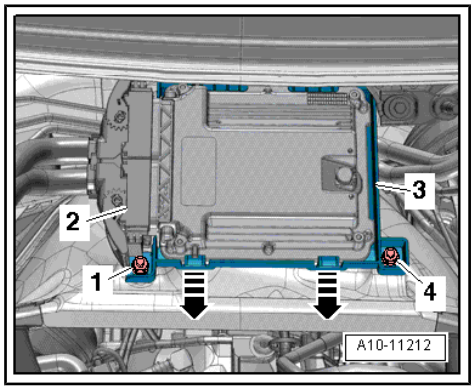
– Remove plenum chamber cover -2- ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Removing and installing plenum chamber cover .



– Remove body brace ⇒ Running gear, axles, steering; Rep. gr. 40 ; Suspension strut, upper links; Removing and installing body brace .



– Release clips -arrows- and take out engine control unit - J623- -2-.



Note

Disregard -items 1, 3, 4-.

– Release connectors on engine control unit - J623- and unplug connectors.

– Take out old engine control unit - J623- and connect new engine control unit - J623- .

Installing

Installation is performed in the reverse sequence.

– Install plenum chamber cover ⇒ General body repairs, exterior; Rep. gr. 50 ; Bulkhead; Removing and installing plenum chamber cover .

– Activate engine control unit via a vehicle diagnostic tester in “Guided Functions” mode, “Replace engine control unit”.

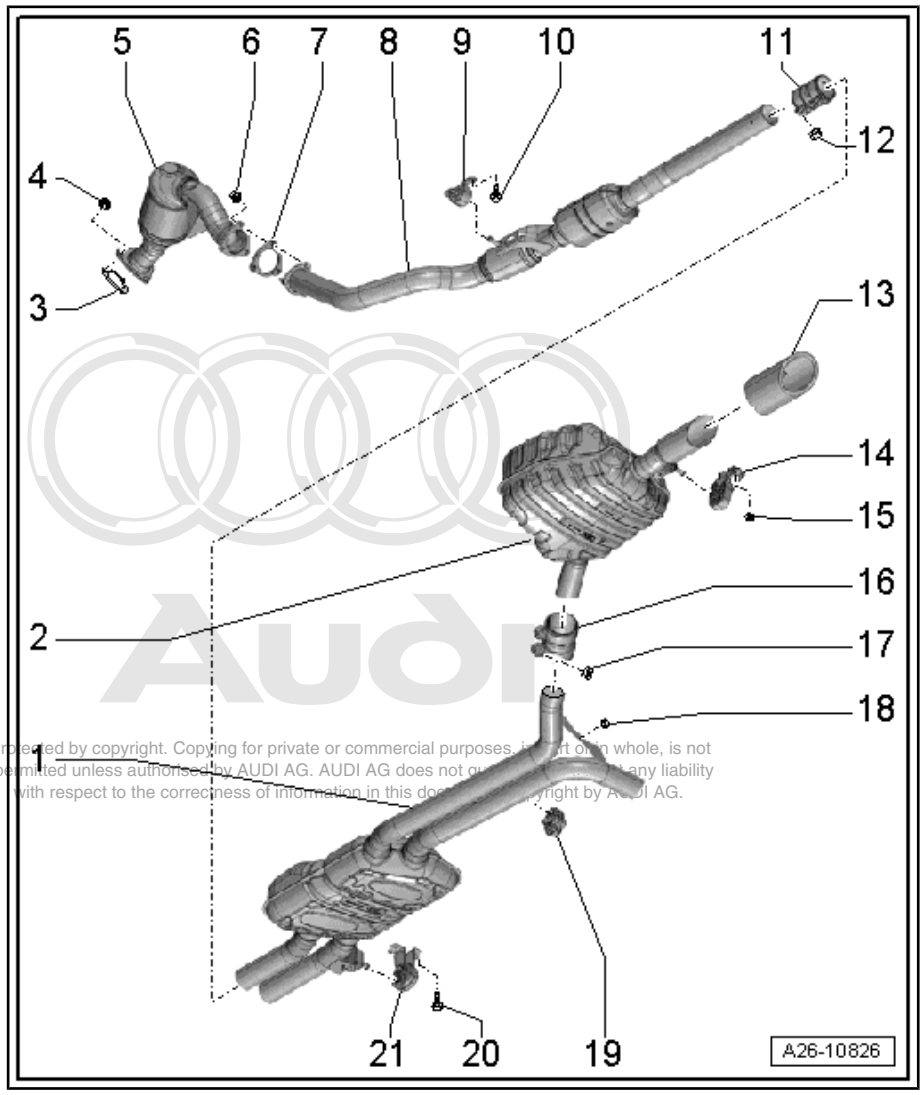
Tightening torques

♦ Body brace ⇒ Running gear, axles, steering; Rep. gr. 40 ; Suspension strut, upper links; Exploded view - suspension strut, upper links

26 – Exhaust system

1 Exhaust pipes/silencers

1.1 Exploded view - silencers



1 - Centre silencer

- Combined in one unit with rear silencers as original equipment. Can be renewed individually for repair purposes
- Cutting point ⇒ page 299
- Align exhaust system so it is free of stress ⇒ page 302

2 - Rear silencer

- Combined as one unit with centre silencer and tailpipe as original equipment
- Centre silencer and rear silencer can be renewed separately
- Cutting point: centre silencer / rear silencer ⇒ page 299
- Align exhaust system so it is free of stress ⇒ page 302

3 - Gasket

- Renew

4 - Nut

- Renew
- Coat threads with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- 20 Nm

5 - Catalytic converter

- Protect against knocks and impact
- Removing and installing: left-side ⇒ page 304 , right-side ⇒ page 306

6 - Nut

- Renew
- 20 Nm

7 - Gasket

- ❑ Renew

8 - Front silencer

- ❑ With flexible joint; do not bend flexible joint more than 10° – otherwise it can be damaged
- ❑ Removing and installing ⇒ page 300
- ❑ Align exhaust system so it is free of stress ⇒ page 302

9 - Mounting

- ❑ Renew if damaged
- ❑ Check preload ⇒ “1.4 Stress-free alignment of exhaust system”, page 302

10 - Bolt

- ❑ 23 Nm

11 - Clamp (front)

- ❑ Installation position ⇒ page 299
- ❑ Before tightening, align exhaust system so it is free of stress ⇒ page 302
- ❑ Tighten bolt connections evenly

12 - Nut

- ❑ 23 Nm

13 - Trim

- ❑ For tailpipe
- ❑ Slide onto tailpipe as far as stop

14 - Mounting

- ❑ Renew if damaged
- ❑ Check preload ⇒ “1.4 Stress-free alignment of exhaust system”, page 302

15 - Nut

- ❑ 23 Nm

16 - Clamp (rear)

- ❑ For separate replacement of centre and rear silencers
- ❑ Installation position ⇒ page 299
- ❑ Before tightening, align exhaust system so it is free of stress ⇒ page 302
- ❑ Tighten bolt connections evenly

17 - Nut

- ❑ 23 Nm

18 - Nut

- ❑ 25 Nm

19 - Mounting

- ❑ Renew if damaged
- ❑ Check preload ⇒ “1.4 Stress-free alignment of exhaust system”, page 302

20 - Bolt

- ❑ 23 Nm

21 - Mounting

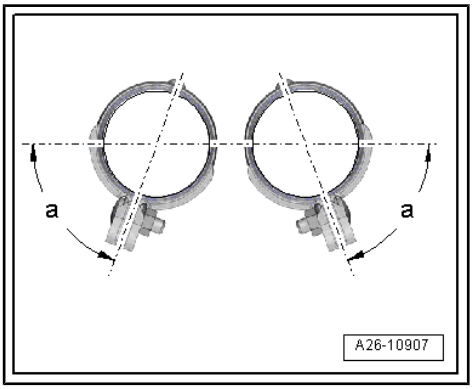
- ❑ Renew if damaged
- ❑ Check preload ⇒ “1.4 Stress-free alignment of exhaust system”, page 302

Installation position of front clamps

– Install clamps so that the bolt ends do not protrude beyond bottom of clamp.

• Installation position: bolt connections face outwards.

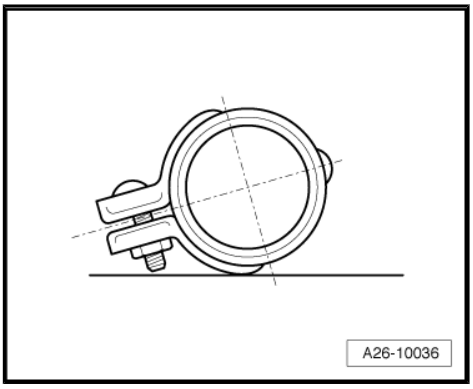
• Angle -α- = 45°



Installation position of rear clamps

– Install clamps so that the bolt ends do not protrude beyond bottom of clamp.

• Installation position: bolt connections face forwards.



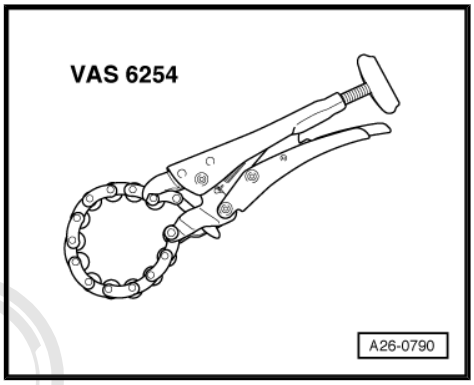
1.2 Disconnecting exhaust pipes/silencers

♦ The connecting pipe can be cut through at the cutting location in order to renew the centre or rear silencer separately.

♦ The cutting point is marked by an indentation on the circumference of the exhaust pipe.

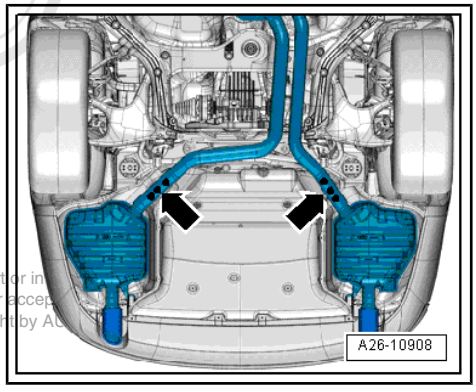
Special tools and workshop equipment required

♦ Chain pipe cutter - VAS 6254-

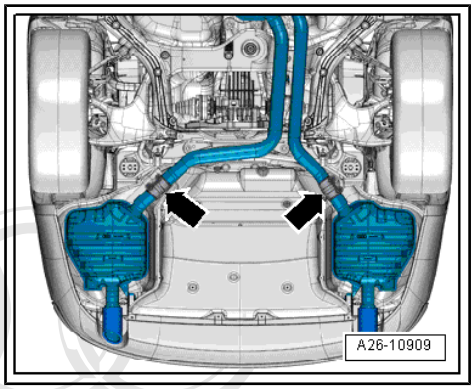


Procedure

– Cut through exhaust pipes at right angle at the position marked -arrows- using chain pipe cutter - VAS 6254- .



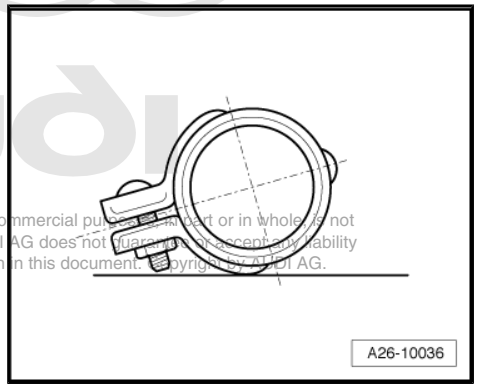
– Position centre of clamps -arrows- over cutting location.



– Install clamps so that the bolt ends do not protrude beyond bottom of clamp.

• Installation position: bolt connections face forwards.

– Align the exhaust system so it is free of stress ⇒ page 302 .



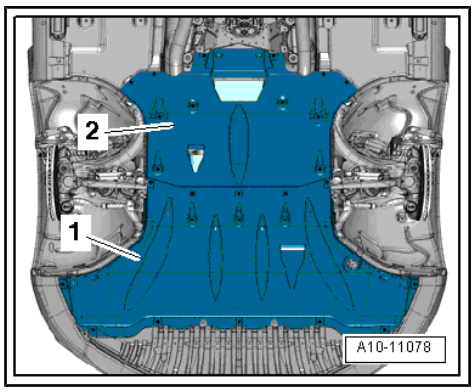
Tightening torques

◆ ⇒ “1.1 Exploded view - silencers”, page 297

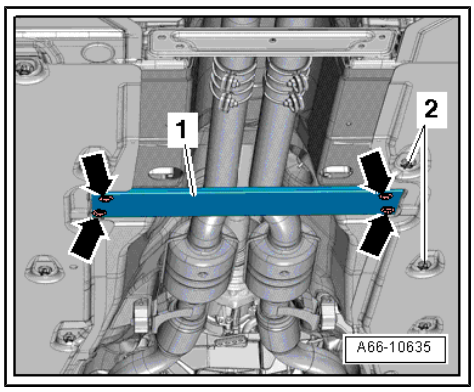
1.3 Removing and installing front silencer

Removing

– Remove rear noise insulation -2- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .

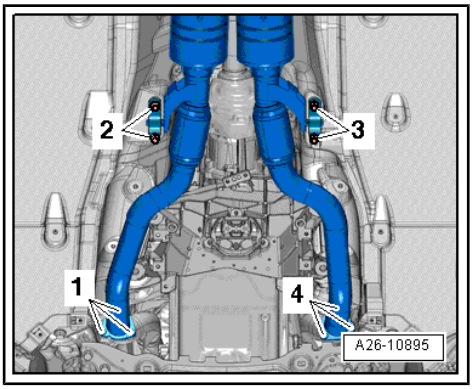


– Remove tunnel cross-piece -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Underbody trim; Removing and installing tunnel cross-piece .



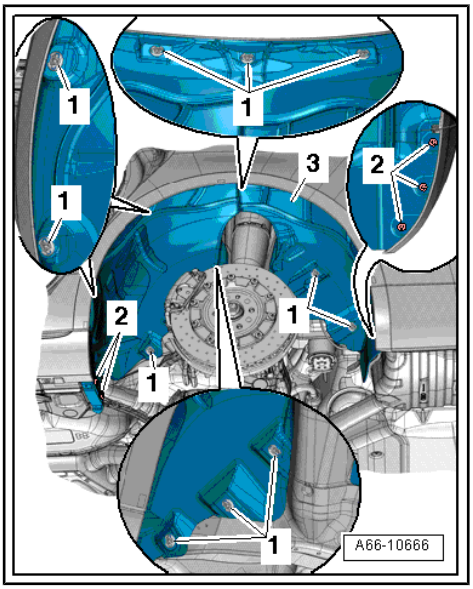
Front silencer (left-side):

– Remove nuts -1- and bolts -2-.

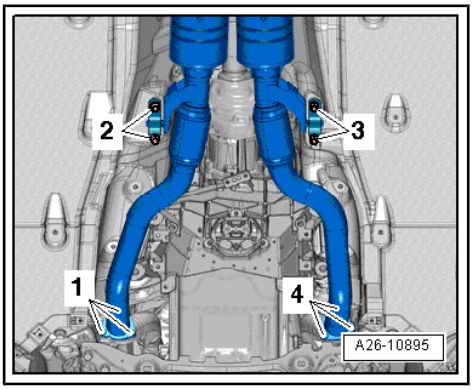


Front silencer (right-side):

– Remove rear wheel housing liner (right-side) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Removing and installing wheel housing liner (rear) .



– Remove nuts -4- and bolts -3-.

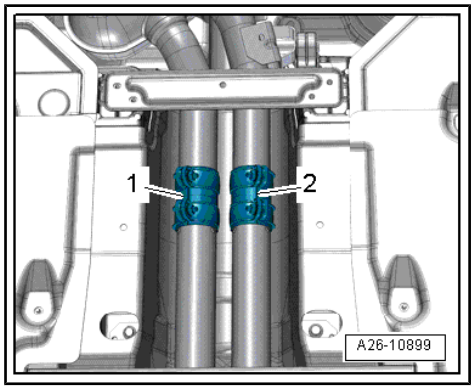


Continuation for both sides:

Caution

Avoid damage to flexible joint.

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



– Release and push back clamp -1- or -2- and detach relevant front silencer.

Installing

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

Note

Renew gaskets and self-locking nuts.

– Align the exhaust system so it is free of stress ⇒ page 302 .

– Install rear wheel housing liner ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Removing and installing wheel housing liner (rear) .

Tightening torques

- ⇒ “1.1 Exploded view - silencers”, page 297
- Tunnel cross-piece ⇒ General body repairs, exterior; Rep. gr. 66 ; Underbody trim; Exploded view - underbody trim
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation

1.4 Stress-free alignment of exhaust system

Procedure

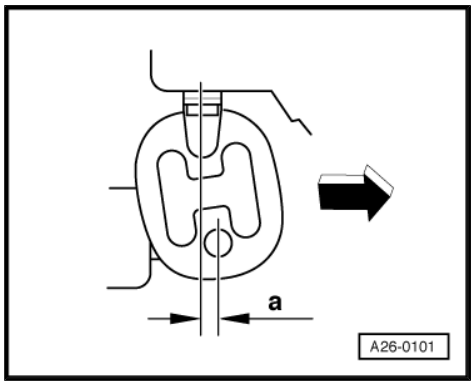
- The exhaust system must be aligned when it is cool.

Vehicles without clamps between centre silencer and rear silencers

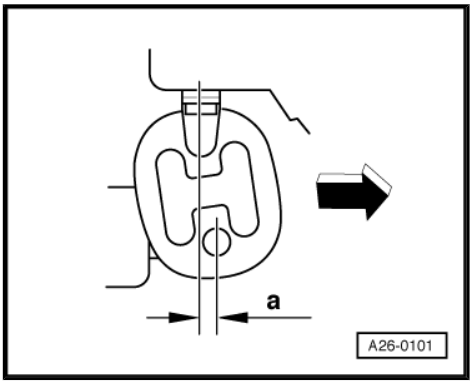
– Loosen bolt connections on front clamps.

– Push exhaust system towards front of vehicle -arrow- until mountings in front of centre silencer are preloaded by -a- = 6 ... 10 mm.

– Tighten bolt connections on clamps evenly.



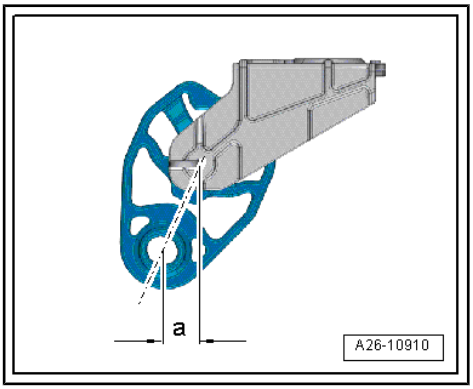
Vehicles with clamps between centre silencer and rear silencers



Note

On a vehicle with clamps fitted between the centre silencer and rear silencers, it is also necessary to align the centre silencer.

- Loosen bolt connections on front and rear clamps.
- Push exhaust system towards front of vehicle -arrow- until mountings in front of centre silencer are preloaded by -a- = 6 ... 10 mm.
- Tighten bolt connections on front clamps evenly.



- Push rear section of exhaust system towards front of vehicle -arrow-, so that mountings (rear) for rear silencers are preloaded by -a- = 11 ... 15 mm.
- Align rear silencers so they are horizontal.
- Tighten bolt connections on rear clamps evenly.

Tightening torques

♦ ⇒ “1.1 Exploded view - silencers”, page 297

1.5 Checking exhaust system for leaks

- Start the engine and run at idling speed.
- Plug tailpipe during leak test (e.g. with cloth or plugs).
- Listen for noise at connections between cylinder head/exhaust manifold, exhaust manifold/front exhaust pipe, etc. to locate any leaks.
- Rectify any leaks that are found.

2 Emission control system

⇒ “2.1 Removing and installing catalytic converter”, page 304

2.1 Removing and installing catalytic converter

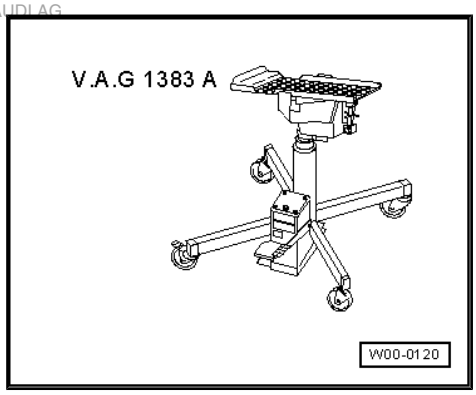
⇒ “2.1.1 Removing and installing catalytic converter (left-side)”, page 304

⇒ “2.1.2 Removing and installing catalytic converter (right-side)”, page 306

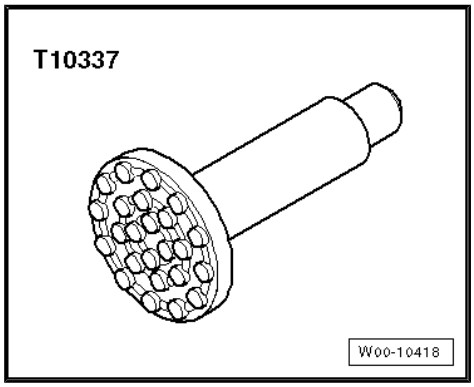
2.1.1 Removing and installing catalytic converter (left-side)

Special tools and workshop equipment required

- Engine and gearbox jack - V.A.G 1383 A-



- Gearbox support - T10337-

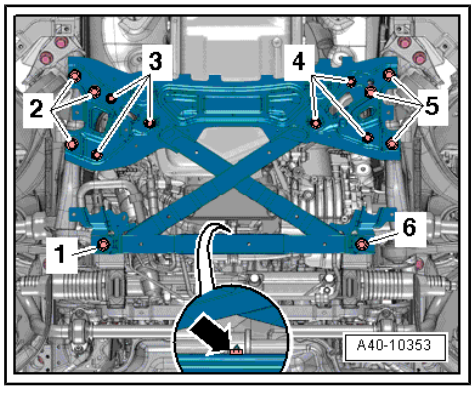


Removing

– Remove front silencer (left-side) ⇒ page 300 .

– Remove Lambda probes -G108- and -G131- ⇒ page 286 .

– Remove subframe cross brace ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Removing and installing subframe cross brace .



Caution

Risk of damage to running gear components.

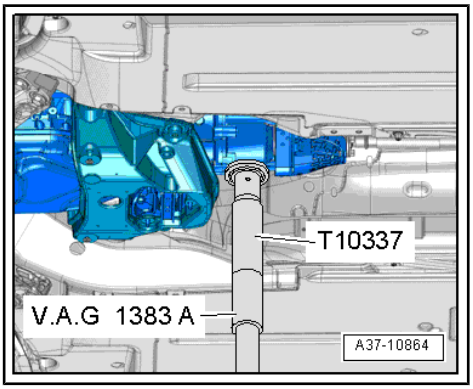
- *The vehicle must NOT be lowered onto its wheels if the engine/gearbox mountings, steering rack or subframe cross brace are not properly installed.*

– Position gearbox support - T10337- on engine and gearbox jack - V.A.G 1383 A- .
– Position gearbox support - T10337- underneath gearbox.
– Raise gearbox slightly using engine and gearbox jack.

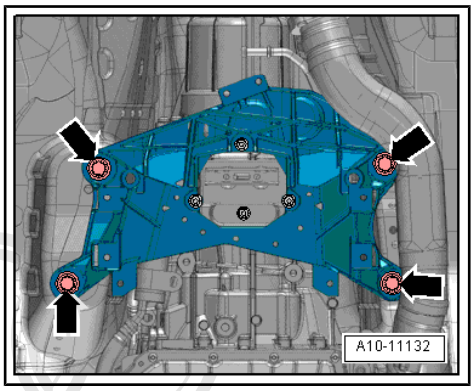
WARNING

Risk of accident.

- *Engine and gearbox jack - V.A.G 1383 A- must remain in position when work is being carried out and must not be left unattended.*

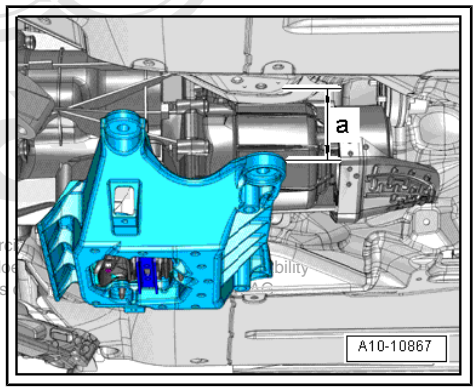


– Remove bolts -arrows- for tunnel cross member.

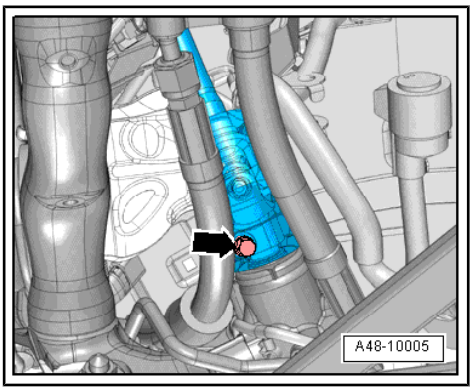


– Lower tunnel cross member as far as distance -a- using engine and gearbox jack - V.A.G 1383 A- .

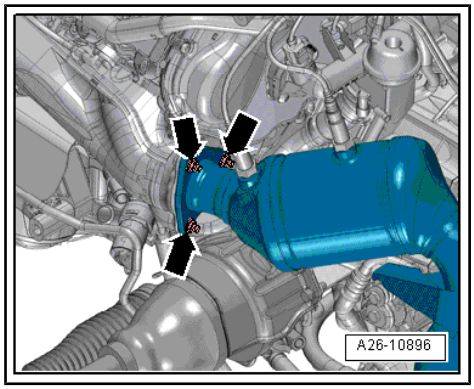
• Dimension -a- = 80 mm (maximum).



– Detach intermediate steering shaft from steering rack and move clear by telescoping upwards ⇒ Running gear, axles, steering; Rep. gr. 48 ; Steering column; Removing and installing intermediate steering shaft .



– Unscrew nuts -arrows- and detach catalytic converter (left-side).



Installing

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

Note

Renew gaskets and self-locking nuts.

– Secure universal joint to steering rack ⇒ Running gear, axles, steering; Rep. gr. 48 ; Steering column; Removing and installing intermediate steering shaft .

– Install Lambda probes -G108- and -G131- ⇒ page 286 .

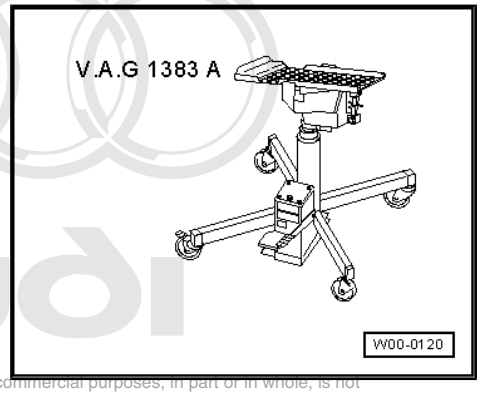
Tightening torques

- ⇒ “1.1 Exploded view - silencers”, page 297
- Tunnel cross-piece ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings
- Subframe cross brace ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Exploded view - subframe

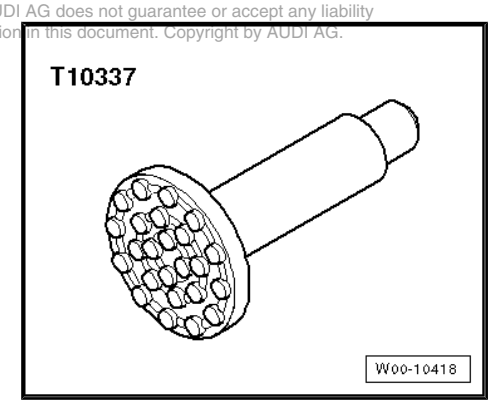
2.1.2 Removing and installing catalytic converter (right-side)

Special tools and workshop equipment required

- Engine and gearbox jack - V.A.G 1383 A-



- Gearbox support - T10337-

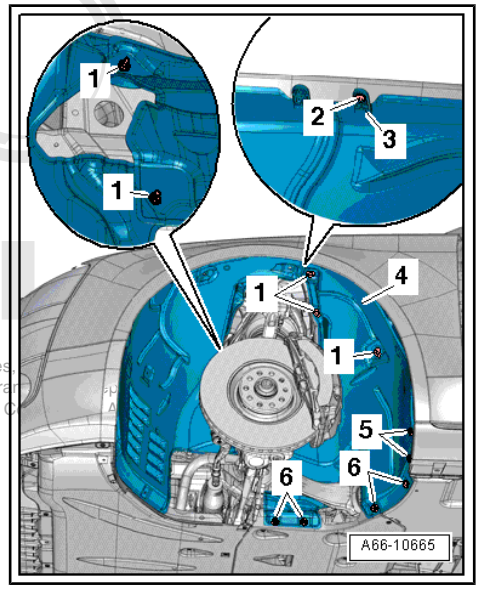


Removing

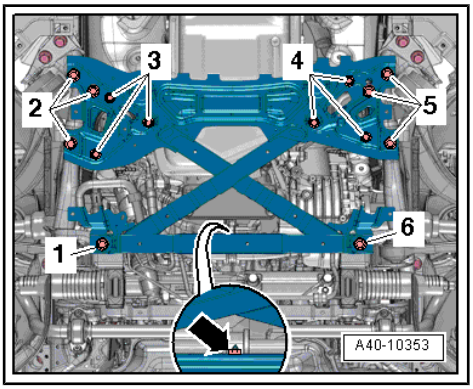
– Remove front silencer (right-side) ⇒ page 300 .

– Remove Lambda probes -G39- and -G130- ⇒ page 286 .

– Remove rear section of front wheel housing liner (right-side) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Removing and installing wheel housing liner (front) .



– Remove subframe cross brace ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Removing and installing subframe cross brace .



Caution

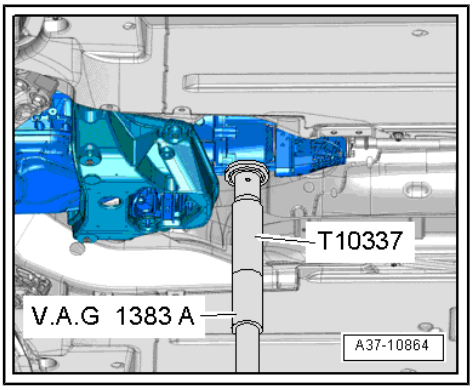
Risk of damage to running gear components.

- *The vehicle must NOT be lowered onto its wheels if the engine/gearbox mountings, steering rack or subframe cross brace are not properly installed.*

– Position gearbox support - T10337- on engine and gearbox jack - V.A.G 1383 A- .

– Position gearbox support - T10337- underneath gearbox.

– Raise gearbox slightly using engine and gearbox jack.

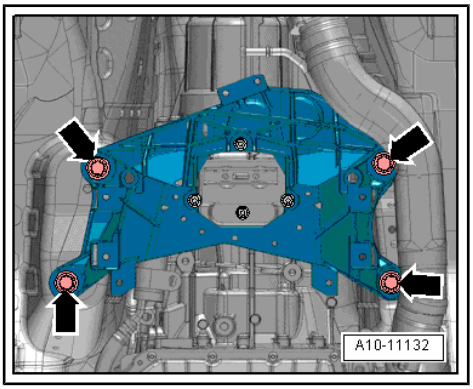


WARNING

Risk of accident.

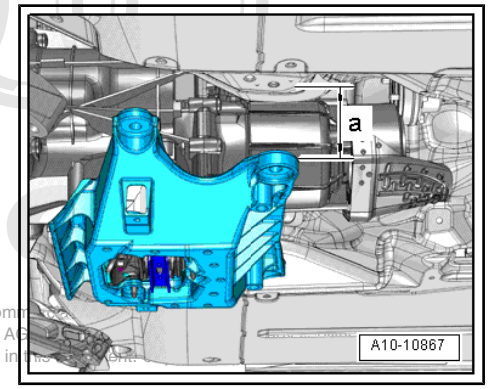
- *Engine and gearbox jack - V.A.G 1383 A- must remain in position when work is being carried out and must not be left unattended.*

– Remove bolts -arrows- for tunnel cross member.

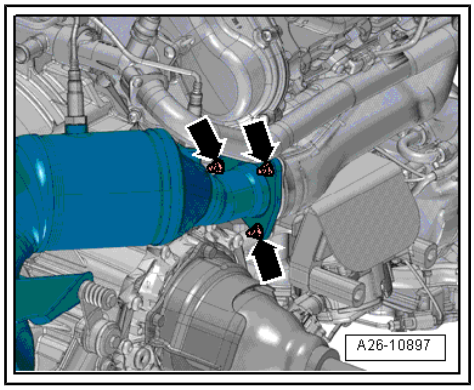


– Lower tunnel cross member as far as distance -a- using engine and gearbox jack - V.A.G 1383 A- .

• Dimension -a- = 80 mm (maximum).



– Unscrew nuts -arrows- and detach catalytic converter (right-side).



Installing

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

Note

Renew gaskets and self-locking nuts.

– Install Lambda probes -G39- and -G130- ⇒ page 286 .

Tightening torques

♦ ⇒ “1.1 Exploded view - silencers”, page 297

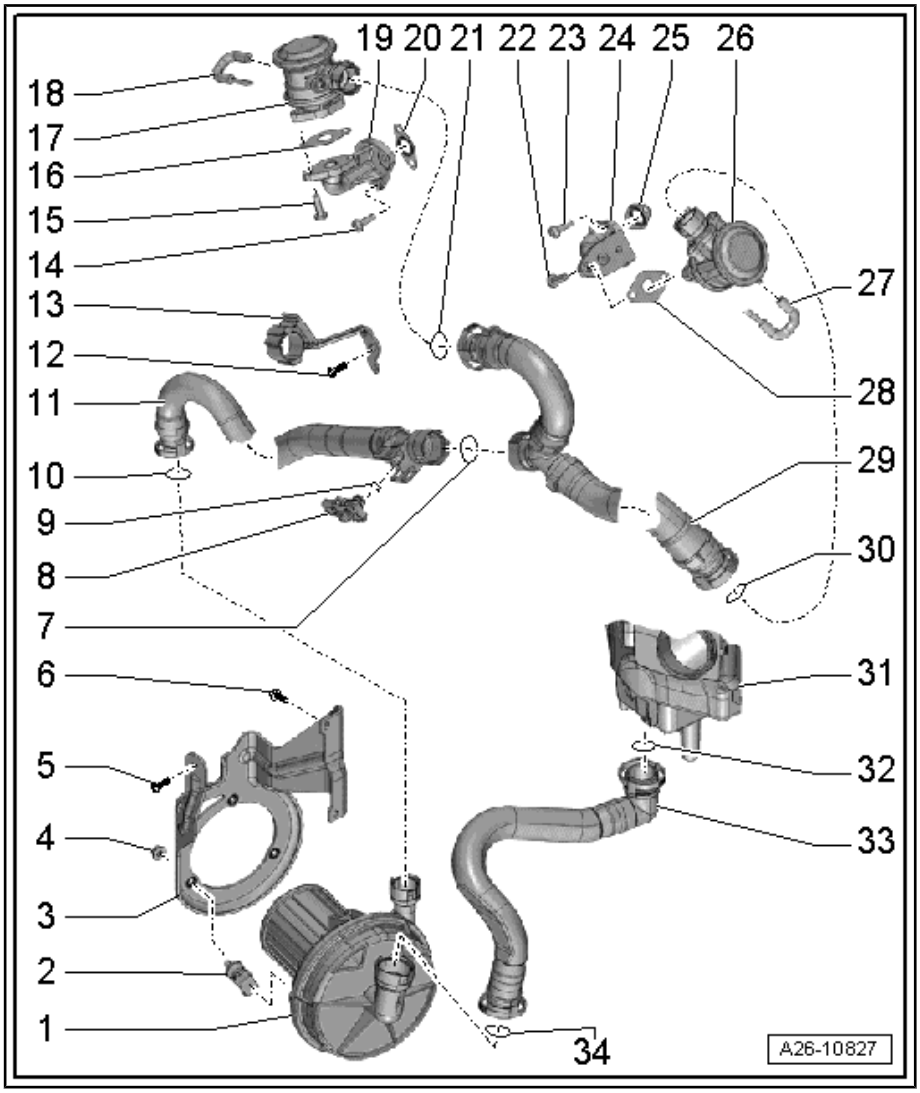
♦ Tunnel cross-piece ⇒ Rep. gr. 37 ; Assembly mountings; Exploded view - assembly mountings

♦ Subframe cross brace ⇒ Running gear, axles, steering; Rep. gr. 40 ; Subframe; Exploded view - subframe

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

3 Secondary air system

3.1 Exploded view - secondary air system



1 - Secondary air pump motor - V101-

- ❑ Fitting location: At front right in engine compartment below longitudinal member
- ❑ Removing and installing ⇒ page 311
- ❑ Checking in Guided Fault Finding ⇒ vehicle diagnostic tester

2 - Bonded rubber bush

3 - Bracket

- ❑ For secondary air pump motor - V101-

4 - Nut

- ❑ 9 Nm

5 - Bolt

- ❑ 9 Nm

6 - Bolt

- ❑ 9 Nm

7 - O-ring

- ❑ Renew

8 - Sender 1 for secondary air pressure - G609-

- ❑ Removing and installing ⇒ page 313

9 - O-ring

- ❑ Renew

10 - O-ring

- ❑ Renew

11 - Hose

- ❑ For secondary air
- ❑ Between secondary air pump motor - V101- and combination valves for secondary air system

12 - Bolt

- ❑ 9 Nm

13 - Bracket

- ❑ For secondary air hose

14 - Bolt
- ❑ 9 Nm

15 - Bolt
- ❑ 9 Nm

16 - Gasket
- ❑ Renew

17 - Combination valve for secondary air system (right-side)
- ❑ Fitting location: at front of cylinder head
- ❑ Checking ⇒ page 311
- ❑ Removing and installing ⇒ page 313

18 - Vacuum hose

19 - Connecting flange

20 - Gasket
- ❑ Renew

21 - O-ring
- ❑ Renew

22 - Bolt
- ❑ 9 Nm

23 - Bolt
- ❑ 9 Nm

24 - Connecting flange

25 - Gasket
- ❑ Renew

26 - Combination valve for secondary air system (left-side)
- ❑ Fitting location: at front of cylinder head
- ❑ Checking ⇒ page 311
- ❑ Removing and installing ⇒ page 313

27 - Vacuum hose

28 - Gasket
- ❑ Renew

29 - Secondary air hose
- ❑ To combination valves for secondary air inlet

30 - O-ring
- ❑ Renew

31 - Air cleaner housing

32 - O-ring
- ❑ Renew

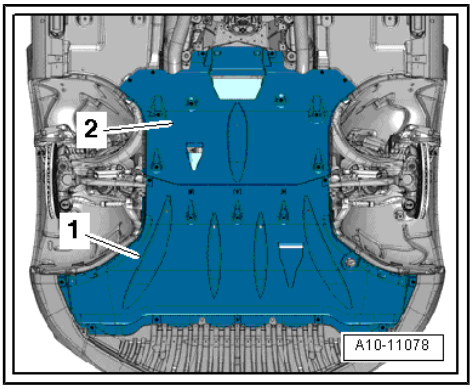
33 - Secondary air hose
- ❑ From air cleaner housing

34 - O-ring
- ❑ Renew

3.2 Removing and installing secondary air pump motor - V101-

Removing

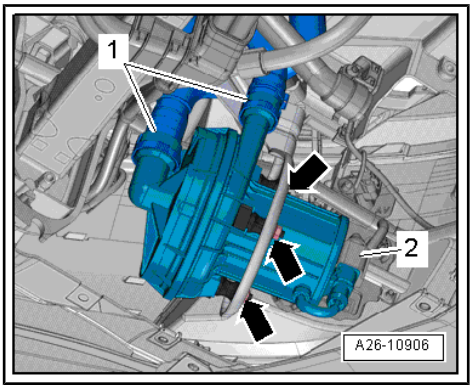
– Remove noise insulation (front) -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Removing and installing noise insulation .



– Disconnect hose -1- for secondary air system.

– Unplug electrical connector -2- at secondary air pump motor - V101- .

– Remove bolts -arrows- and detach secondary air pump.



Installing

Install in reverse order.

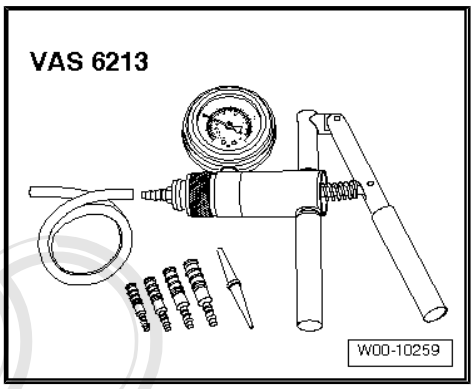
Tightening torques

- ⇒ “3.1 Exploded view - secondary air system”, page 309
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Exploded view - noise insulation

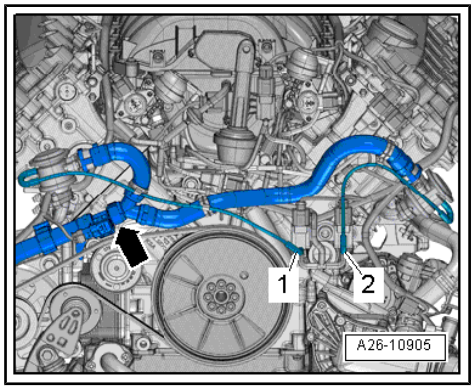
3.3 Checking combination valve

Special tools and workshop equipment required

- Hand vacuum pump - VAS 6213-



Procedure



- Vacuum hoses and hose connections do not leak.
- Vacuum hoses are not clogged.

– Detach vacuum hose -1- or -2- leading to relevant combination valve.

– Connect hand vacuum pump - VAS 6213- to vacuum hose of combination valve to be checked.

– Press release tabs and detach secondary air hose -arrow- to front from bracket.

– Blow lightly into secondary air hose with your mouth (do not use compressed air). Fit auxiliary hose if secondary air hose is not long enough.

- The combination valves for secondary air should be closed; it should not be possible to blow through the hose.

– Operate hand vacuum pump.

- The combination valve should open; it should now be possible to blow through the hose.

– Renew combination valve for secondary air system if it does not open ⇒ page 313 .

Assembling

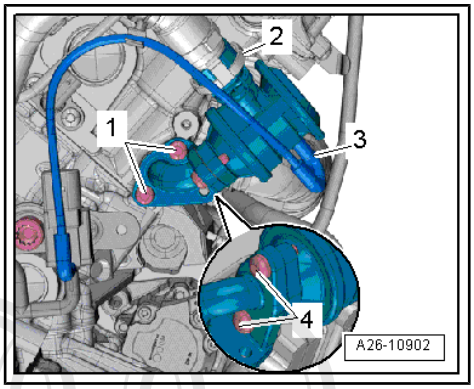
Installation is carried out in the reverse order; note the following:

Note

Fit new O-ring.

3.4 Removing and installing combination valve

Removing



Note

The following description is for removing and installing at the cylinder bank 2 (left-side).

– Disconnect vacuum hose -3-.
– Press release tabs and disconnect secondary air hose -2-.
– Unscrew bolts -4- and detach combination valve for secondary air system.

Note

Disregard -item 1-.

Installing

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

Note

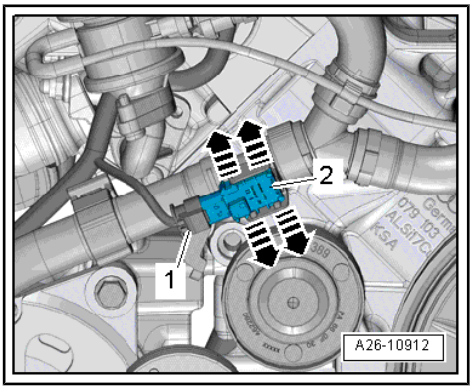
Renew gasket and O-ring.

Tightening torques

♦ ⇒ “3.1 Exploded view - secondary air system”, page 309

3.5 Removing and installing sender 1 for secondary air pressure - G609-

Removing



– Unplug electrical connector -1-.
– Release catches -arrows- and detach sender 1 for secondary air pressure - G609- -item 2-.

Installing

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

Note

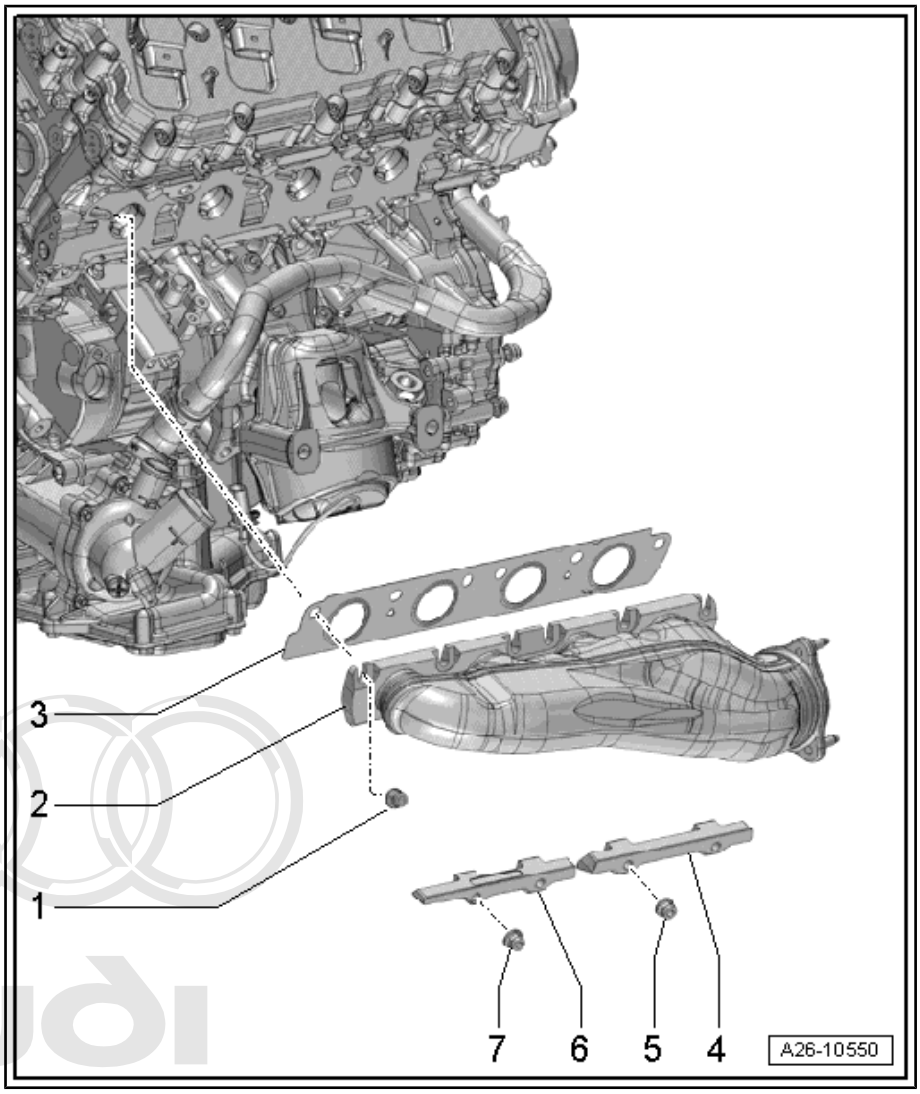
Fit new O-ring.

4 Exhaust manifolds

⇒ “4.1 Exploded view - exhaust manifold”, page 314

⇒ “4.2 Removing and installing exhaust manifold”, page 316

4.1 Exploded view - exhaust manifold



1 - Nut

- ❑ Renew
- ❑ Coat thread with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ❑ Tightening torque and tightening sequence: exhaust manifold (left-side) ⇒ page 315 ; exhaust manifold (right-side) ⇒ page 315

2 - Exhaust manifold

- ❑ Removing and installing: left-side ⇒ page 316 , right-side ⇒ page 318

3 - Gasket

- ❑ Renew

4 - Mounting strip

- ❑ Remains installed when exhaust manifold is removed

5 - Nut

- ❑ Renew
- ❑ Coat thread with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ❑ 25 Nm

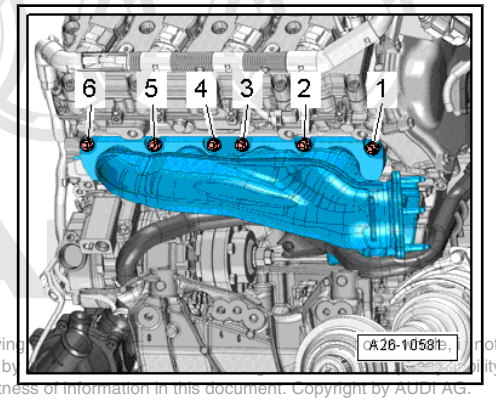
6 - Mounting strip

- ❑ Remains installed when exhaust manifold is removed

7 - Nut

- ❑ Renew
- ❑ Coat thread with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ❑ 25 Nm

Exhaust manifold (left-side) - tightening torque and sequence



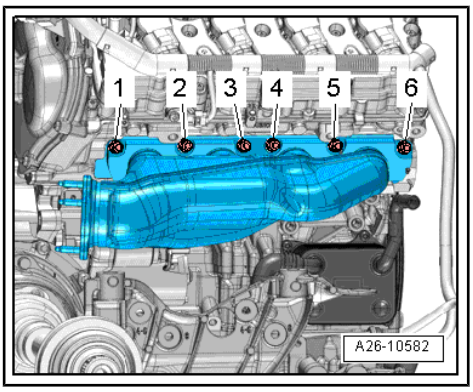
Note

- *Renew nuts for exhaust manifold.*
- *Coat threads of nuts with high-temperature paste; for high temperature paste refer to ⇒ Electronic parts catalogue .*

– Tighten nuts in 3 stages in the sequence shown:

Stage	Nuts	Tightening torque
1.	-1 … 6-	Screw in by hand until contact is made
2.	-1 … 6-	20 Nm
3.	-1 … 6-	30 Nm

Exhaust manifold (right-side) - tightening torque and sequence



Note

- *Renew nuts for exhaust manifold.*
- *Coat threads of nuts with high-temperature paste; for high temperature paste refer to ⇒ Electronic parts catalogue .*

– Tighten nuts in 3 stages in the sequence shown:

Stage	Nuts	Tightening torque
1.	-1 … 6-	Screw in by hand until contact is made
2.	-1 … 6-	20 Nm
3.	-1 … 6-	30 Nm

4.2 Removing and installing exhaust manifold

⇒ “4.2.1 Removing and installing exhaust manifold (left-side)”, page 316

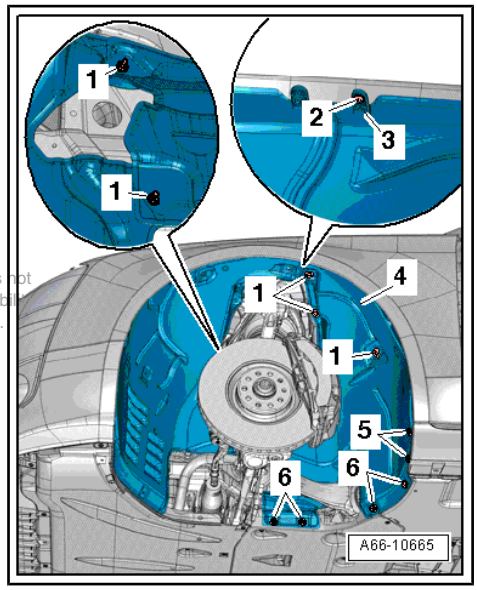
⇒ “4.2.2 Removing and installing exhaust manifold (right-side)”, page 318

4.2.1 Removing and installing exhaust manifold (left-side)

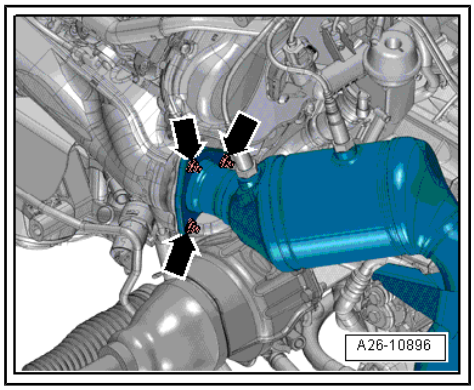
Removing

– Remove coolant pipe (top left) ⇒ page 218 .

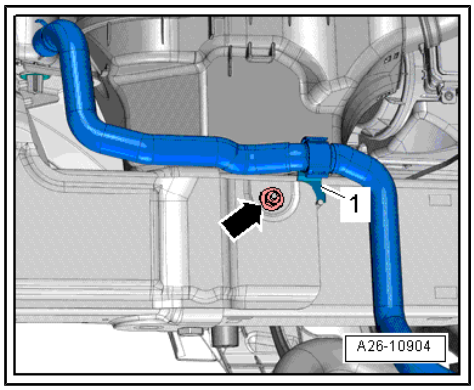
– Remove rear section of front wheel housing liner (left-side) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Removing and installing wheel housing liner (front) .



– Unscrew nuts -arrows- and detach catalytic converter (left-side) from exhaust manifold.



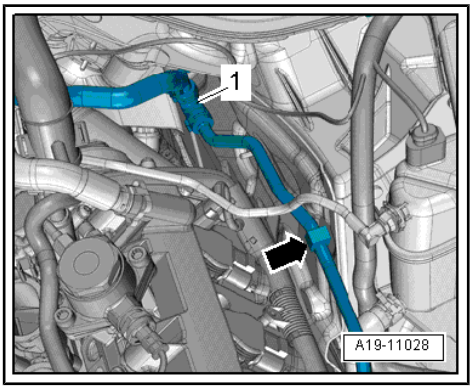
– Remove nut -arrow- at longitudinal member (left-side), press bracket -1- with coolant hose to one side.



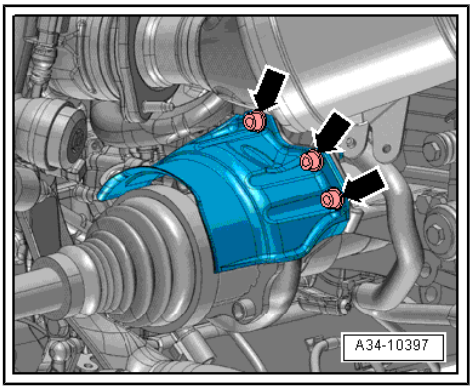
Note

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

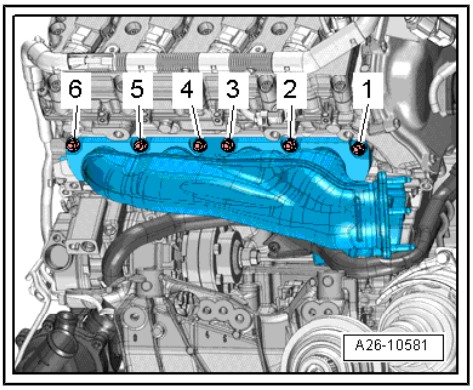
– Detach vacuum hose -1- at plenum chamber partition panel, move clear -arrow- and move to left.



– Remove bolts -arrows- and detach heat shield for drive shaft (left-side).



– Loosen nuts in the sequence -6 ... 1-.



Note

- *For illustration purposes, the installation position is shown with the engine removed.*
- *Mounting strips remain installed.*

– Unscrew nuts, detach exhaust manifold (left-side) from mounting strips and remove.

Installing

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

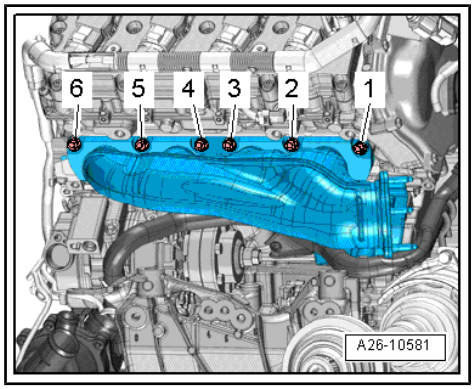
Note

- *Renew gasket and nuts.*
- *Coat threads of nuts with high-temperature paste; for high temperature paste refer to ⇒ Electronic parts catalogue .*
- *Fit all cable ties in the original positions when installing.*

– Fit gasket onto studs.

– Fit exhaust manifold in mounting strips and tighten nuts ⇒ page 315 .

– Install coolant pipe (top left) ⇒ page 218 .



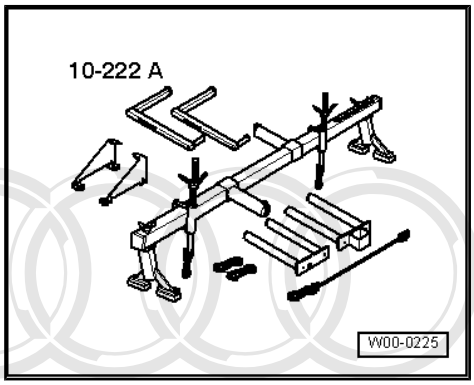
Tightening torques

- ⇒ Fig. ""Exhaust manifold (left-side) - tightening torque and sequence"" , page 315
- Heat shield for drive shaft ⇒ Running gear, axles, steering; Rep. gr. 40 ; Drive shaft; Exploded view - drive shaft
- Heat shield for longitudinal member ⇒ General body repairs, exterior; Rep. gr. 66 ; Strips / trim panels / extensions; Exploded view - heat shield .
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Exploded view - wheel housing liner (front)

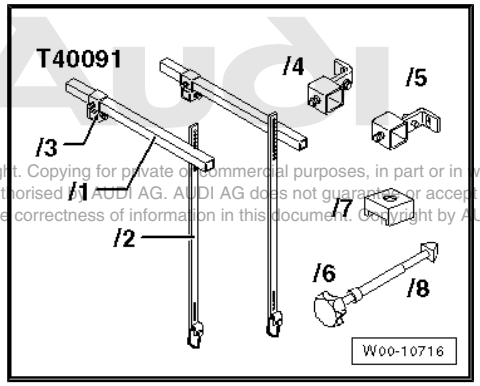
4.2.2 Removing and installing exhaust manifold (right-side)

Special tools and workshop equipment required

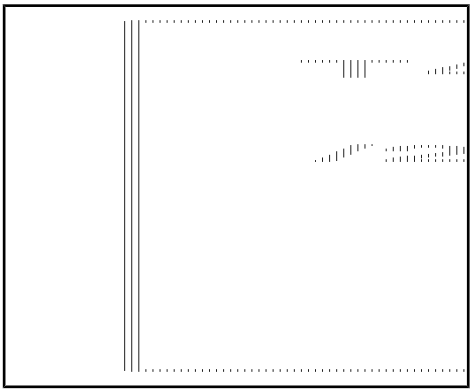
- Support bracket - 10 - 222 A-



- Engine support bracket (basic set) - T40091-



♦ Engine support bracket (supplementary set) - T40093- with - T40093/7- and -T40093/8-



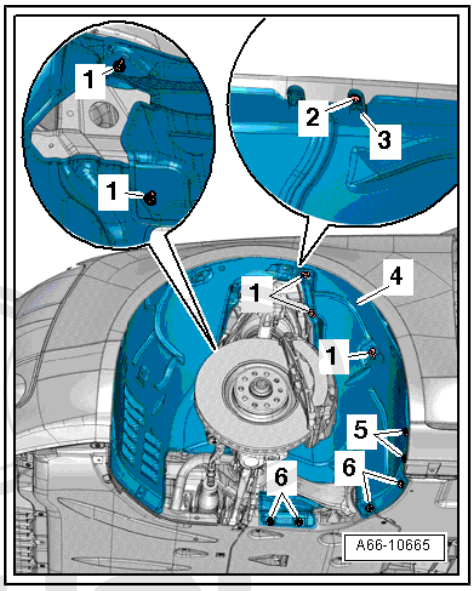
Removing

– Remove engine cover panel ⇒ page 63 .

– Remove rear section of front wheel housing liner (right-side) ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Removing and installing wheel housing liner (front) .

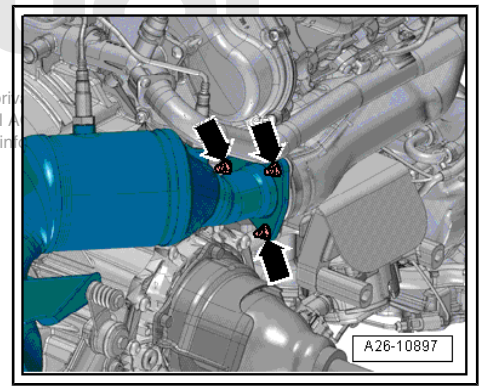
– Remove coolant pipe (right-side) ⇒ page 228 .

– Remove front silencer (right-side) ⇒ page 300 .

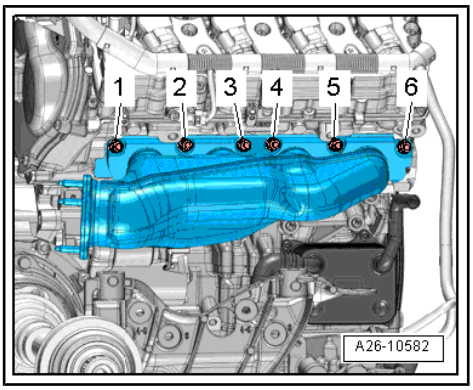


– Remove nuts -arrows-.

– Detach catalytic converter (right-side) from exhaust manifold and move clear to the side.



– Loosen nuts in the sequence -6 ... 1-.

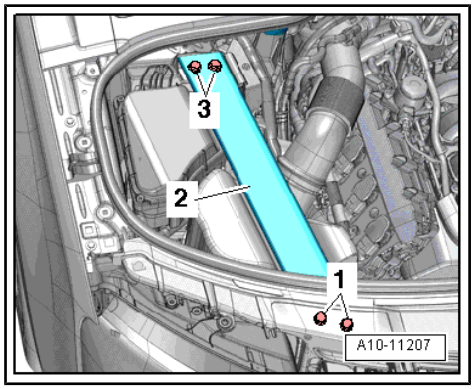


Note

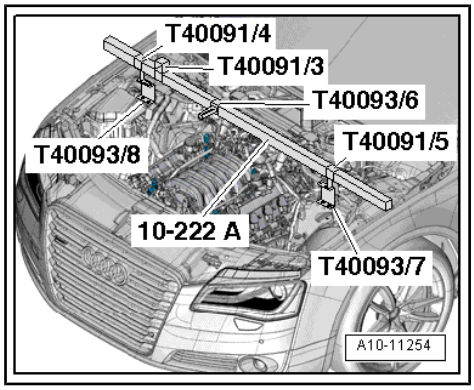
♦ *For illustration purposes, the installation position is shown with the engine removed.*

♦ *Both mounting strips (bottom) remain installed.*

– Remove longitudinal member (top right) -2- ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier; Exploded view - lock carrier .

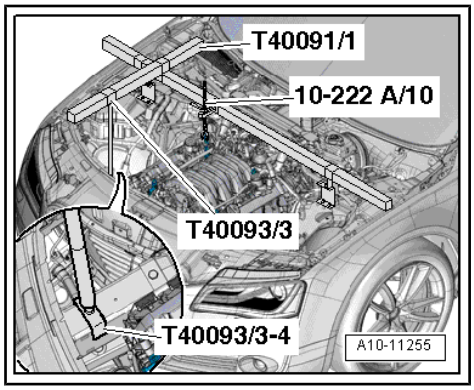


– Set up support bracket - 10 - 222 A- with -T40093/7- , -T40093/8- , -T40091/3- , -T40091/4- , -T40091/5- and -T40091/6- on suspension turrets (left and right), as shown in illustration.



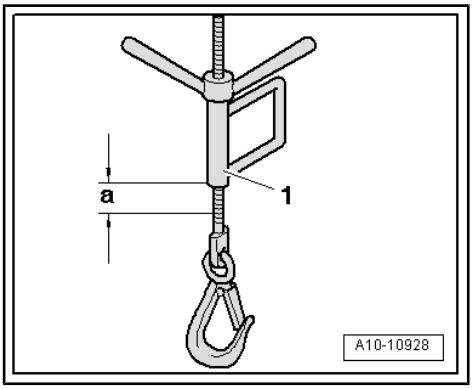
– Set up further tools: hooks - 10 - 222 A /10- , -T40091/1- , -T40091/3- and -T40093/4- , as shown in illustration.

– Attach hook - 10 - 222 A /10- to engine lifting eye (right-side).



– Using hook - 10 - 222 A /10- -item 1-, raise engine through distance -a-.

• Distance -a- = 15 mm.



– Unscrew nuts, detach exhaust manifold (right-side) from mounting strips and remove.

Note

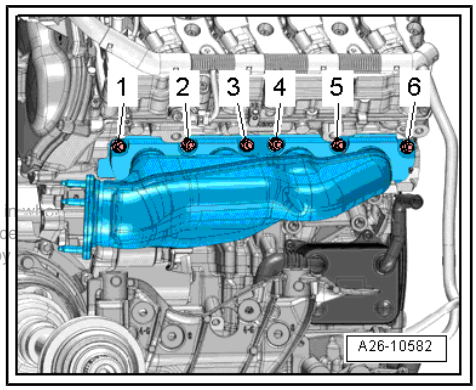
Mounting strips remain installed.

Installing

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

Note

- *Renew gasket and nuts.*
- *Coat threads of nuts with high-temperature paste; for high temperature paste refer to ⇒ Electronic parts catalogue .*



– Fit gasket onto studs.

– Fit exhaust manifold in mounting strips and tighten nuts ⇒ page 315 .

– Install catalytic converter (right-side) ⇒ page 306 .

– Install front silencer ⇒ page 300 .

– Install coolant pipe (right-side) ⇒ page 228 .

– Install engine cover panel ⇒ page 63 .

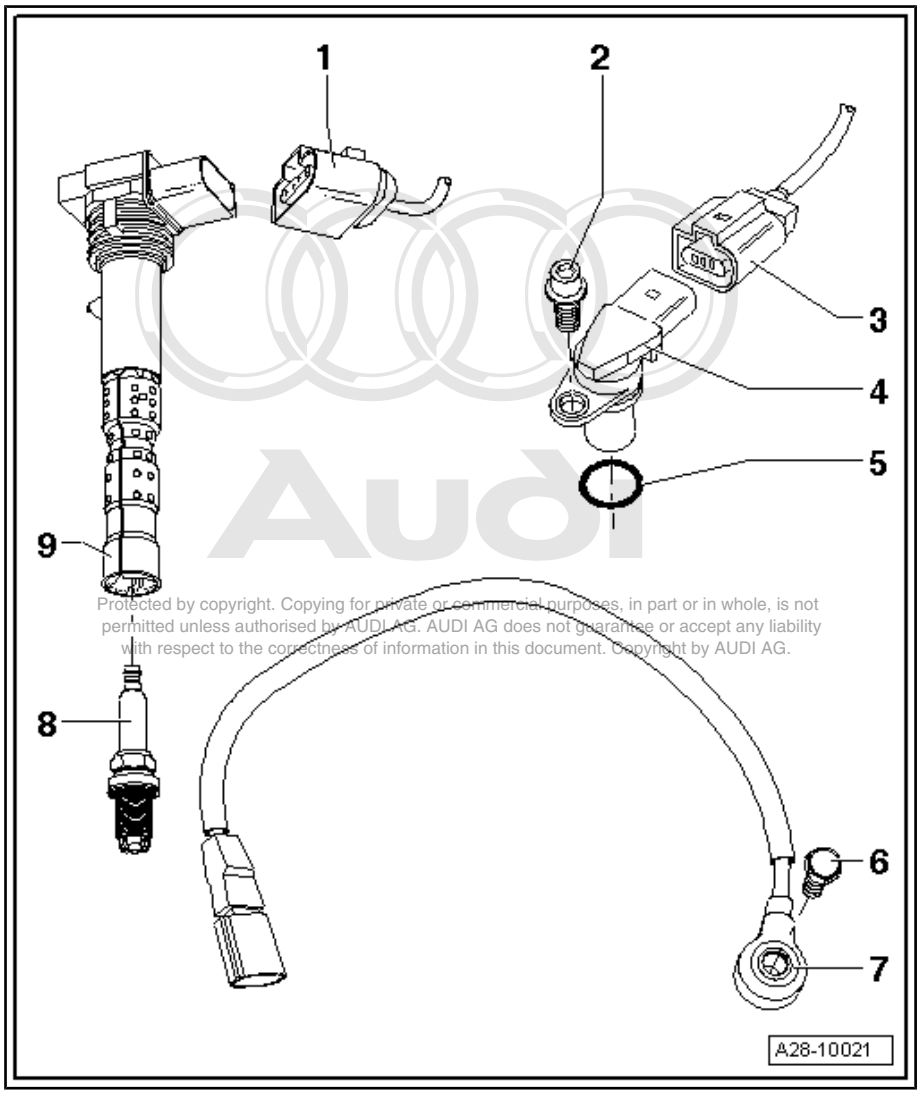
Tightening torques

- ⇒ Fig. ""Exhaust manifold (left-side) - tightening torque and sequence"" , page 315
- Upper longitudinal member ⇒ General body repairs, exterior; Rep. gr. 50 ; Lock carrier; Exploded view - lock carrier
- ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Exploded view - wheel housing liner (front)

28 – Ignition system

1 Ignition system

1.1 Exploded view - ignition system



1 - Connector for ignition coil

- 4-pin

2 - Bolt

- 10 Nm

3 - 3-pin connector

4 - Hall sender

- Hall sender - G40- (cylinder bank 1)
- Hall sender 3 - G300- (cylinder bank 1)
- Hall sender 2 - G163- (cylinder bank 2)
- Hall sender 4 - G301- (cylinder bank 2)
- Removing and installing ⇒ page 326

5 - O-ring

- Renew if damaged
- Lubricate lightly with clean engine oil

6 - Bolt

- Tightening torque influences the function of the knock sensor
- 20 Nm

7 - Knock sensors

- Contact surfaces between knock sensor and cylinder block must be free of corrosion, oil and

grease.

- ❑ Knock sensor 1 - G61- (cylinder bank 1)
- ❑ Knock sensor 2 - G66- (cylinder bank 1)
- ❑ Knock sensor 3 - G198- (cylinder bank 2)
- ❑ Knock sensor 4 - G199- (cylinder bank 2)
- ❑ Removing and installing ⇒ page 323

8 - Spark plug

- ❑ Remove and install with spark plug socket and extension - 3122 B- ⇒ Maintenance ; Booklet 410

9 - Ignition coil

- ❑ Ignition coil 1 with output stage - N70-
- ❑ Ignition coil 2 with output stage - N127-
- ❑ Ignition coil 3 with output stage - N291-
- ❑ Ignition coil 4 with output stage - N292-
- ❑ Ignition coil 5 with output stage - N323-
- ❑ Ignition coil 6 with output stage - N324-
- ❑ Ignition coil 7 with output stage - N325-
- ❑ Ignition coil 8 with output stage - N326-
- ❑ Removing and installing ⇒ page 323

1.2 Test data, spark plugs

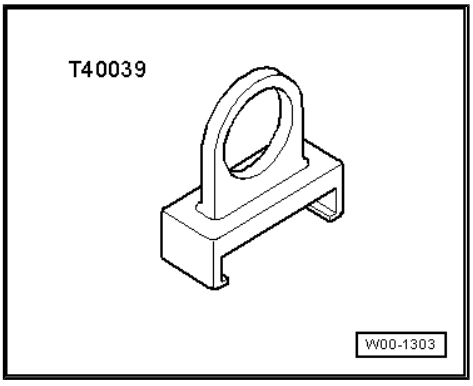
Test data		4.2 ltr. / 4-valve engine
Idling speed (not adjustable)		approx. 650 rpm [1]
Ignition timing		Not adjustable (determined by control unit)
Ignition system		Multi-coil system with 8 ignition coils (output stages integrated) connected directly to spark plugs via spark plug connectors
Spark plugs	Designations	⇒ Electronic parts catalogue
	Tightening torque	⇒ Maintenance ; Booklet 410
Firing order		1-5-4-8-6-3-7-2

• [1] Depending on demands placed on engine control unit.

1.3 Removing and installing ignition coils with output stages

Special tools and workshop equipment required

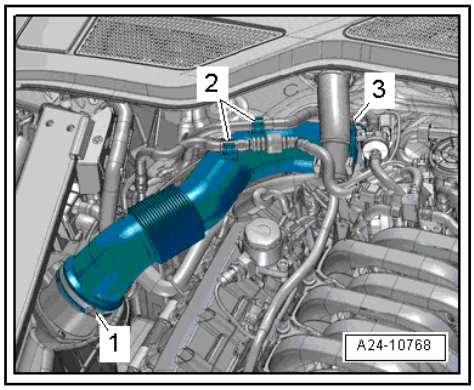
♦ Puller - T40039-



Removing

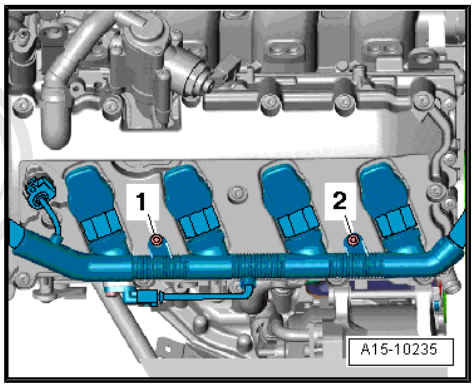
Cylinder bank 1 (right-side):

– Loosen hose clips -1 and 2- and remove air pipe (right-side).



– Remove bolts -1- and -2-.

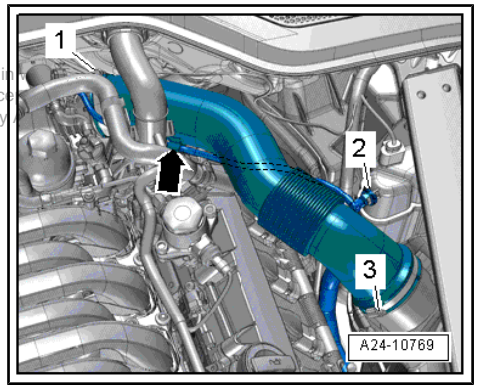
– Pull ignition coils approx. 30 mm out of spark plug holes using puller - T40039- .



Cylinder bank 2 (left-side):

– Loosen hose clips -1 and 2- and remove air pipe (left-side).

– Pull dipstick -1- out of guide tube.

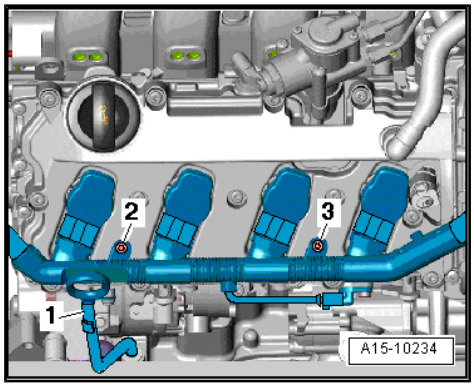


– Remove bolts -2- and -3-.

– Pull ignition coils approx. 30 mm out of spark plug holes using puller - T40039- .

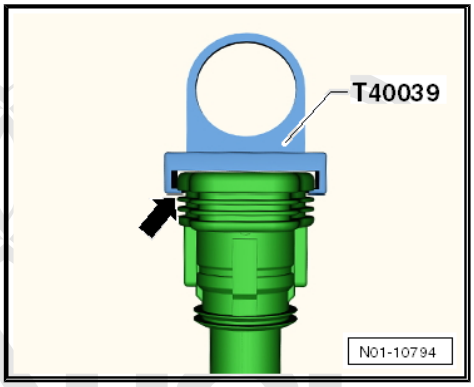
Continuation for both sides:

– Release electrical connectors and pull all connectors off ignition coils at the same time.



Note

- *To remove ignition coils, fit puller - T40039- onto upper (thick) rib -arrow- of ignition coil with output stage.*
- *The lower ribs can be damaged if they are used.*



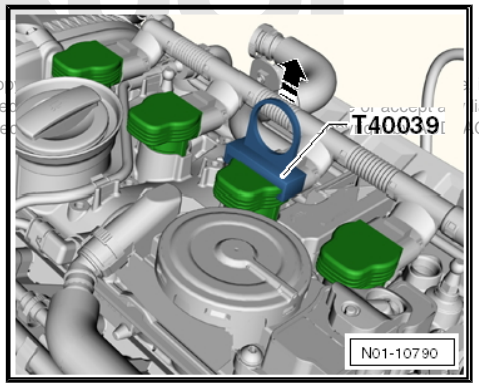
– Pull out ignition coil -arrow-.

Installing

– Fit all ignition coils loosely into spark plug holes.

– Align the ignition coils with the connectors and attach all connectors onto ignition coils simultaneously.

– Press ignition coils onto spark plugs by hand evenly (do NOT use tool).



The remaining installation steps are carried out in the reverse sequence.

Tightening torques

Component	Nm
Wiring guide for ignition coils to cylinder head cover	5

1.4 Removing and installing knock sensor

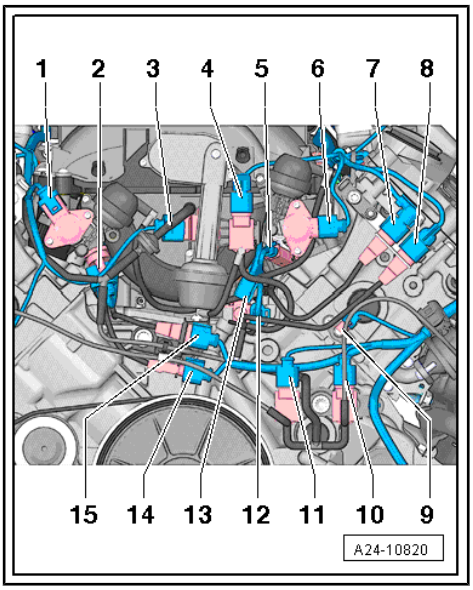
Electrical connectors

7 - Knock sensor 3 - G198-

8 - Knock sensor 4 - G199-

14 - Knock sensor 2 - G66-

15 - Knock sensor 1 - G61-



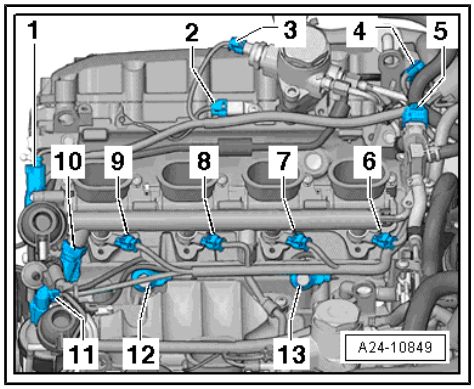
Removing

– Remove intake manifold ⇒ page 266 .

– Remove appropriate knock sensor on cylinder bank (right-side).

12 - Knock sensor 1 - G61-

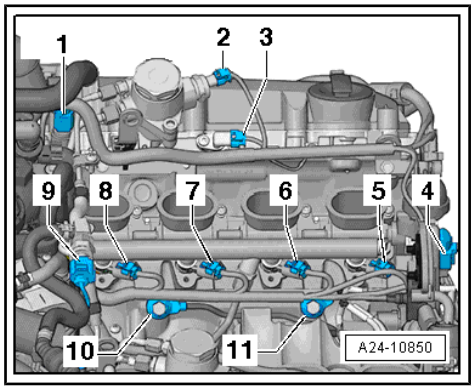
13 - Knock sensor 2 - G66-



– Remove appropriate knock sensor on cylinder bank (left-side).

11 - Knock sensor 3 - G198-

10 - Knock sensor 4 - G199-



Installing

Note

The tightening torque influences the function of the knock sensor.

– Install intake manifold ⇒ page 266 .

Tightening torques

♦ ⇒ “1.1 Exploded view - ignition system”, page 322

1.5 Removing and installing Hall senders

Note

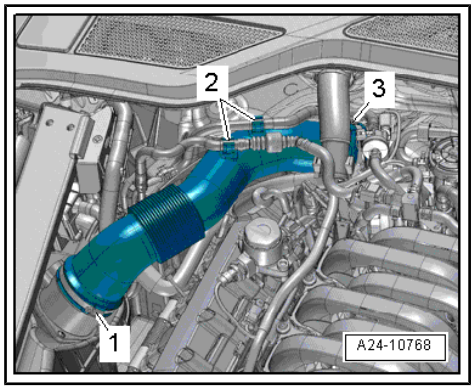
♦ *The following Hall senders are installed on cylinder bank 1 (right-side): Hall sender - G40- and Hall sender 3 - G300-*

♦ *The following Hall senders are installed on cylinder bank 2 (left-side): Hall sender 2 - G163- and Hall sender 4 - G301-*

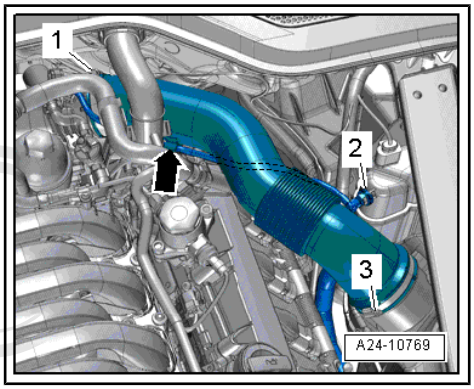
♦ *Fitting locations of the four Hall senders ⇒ page 246*

Removing

– Remove air pipe (right-side) to remove Hall sender 3 - G300- on cylinder bank 1 (release hose clips -1 and 2-).



– Remove air pipe (left-side) to remove Hall sender 4 - G301- on cylinder bank 2 (release hose clips -1 and 2-).



Installing

Note

Renew O-ring if damaged.

– Lubricate O-ring with engine oil and carefully press in Hall sender by hand.

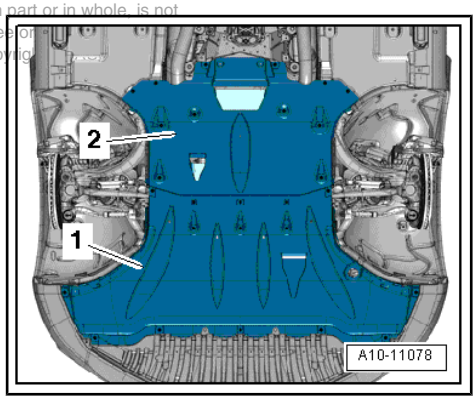
Tightening torques

♦ ⇒ “1.1 Exploded view - ignition system”, page 322

1.6 Removing and installing engine speed sender - G28-

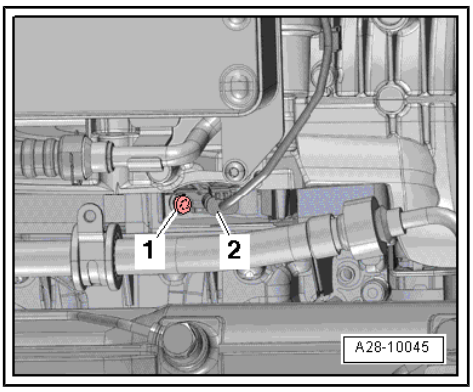
Removing

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



– Unplug electrical connector -2-.

– Unscrew bolt -1- and remove engine speed sender - G28- .



Installing

Install in reverse order.

Tightening torques

Component	Nm
Engine speed sender - G28-	9