Workshop Manual
Audi TT 2007 ➢

4-cylinder TDI engine (2.0 ltr. 4-valve common rail - generation II), mechanics									
Engine ID	CFG B								

Edition 05.2010

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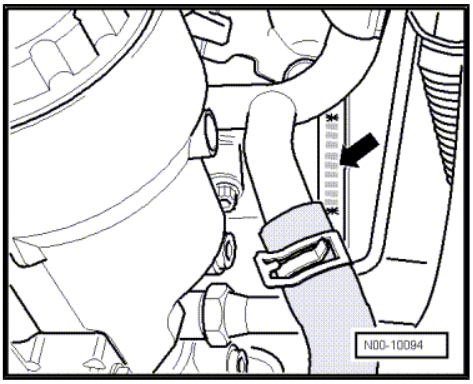
Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of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

Contents

00 – Technical data

1 Engine number



- The engine number (“Engine code” and “Serial number”) -arrow- can be found at the front of the joint between engine and gearbox.
- There is also a sticker on the toothed belt cover showing the “Engine code” and “Serial number”.
- 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 810 .*

2 Engine data

Code letters		CFGB
Capacity	ltr.	1.968
Power output	kW at rpm	125/4200
Torque	Nm at rpm	350/1750 … 2500
Bore	∅ in mm	81.0
Stroke	mm	95.5
Compression ratio		16.5
CN	not less than	51
Firing order		1-3-4-2
Exhaust gas recirculation		yes
Exhaust gas temperature control		yes
Turbocharging/supercharging		Turbocharger
Glow plugs		Steel glow plugs
Charge air cooling		yes
Lambda control		1 Lambda probe
Particulate filter		yes
Valves per cylinder		4

Note

Audi TT models with a TDI engine (2.0 ltr. 4-valve common rail) are always equipped with steel glow plugs.

3 Safety precautions

3.1 Working on the fuel system

When working on the fuel system note the following warnings:

WARNING

Risk of injury - fuel system operates under pressure.

- *Wrap a clean cloth around the connection before opening the fuel system. Then release pressure by carefully loosening the connection.*
- *Wear protective gloves.*
- *Wear safety goggles.*

The fuel can become extremely hot. This can cause injuries.

- *In extreme cases the temperature of the fuel lines and the fuel can be up to 100 °C after the engine is switched off. Allow the fuel to cool down before disconnecting the lines - danger of scalding.*
- *Wear protective gloves.*
- *Wear safety goggles.*

Observe the following points to prevent personal injuries and damage to the injection and glow plug system:

- Always switch off the ignition before connecting or disconnecting tester cables or electrical wiring for the injection or glow plug system.
- Always switch off ignition before washing engine.
- Entries are stored in event memory of engine control unit if electrical connectors were unplugged and engine was started: `Interrogate event memory` in `Vehicle self-diagnosis` ⇒ vehicle diagnostic tester .

Caution

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

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

– Disconnect battery ⇒ Electrical system; Rep. Gr. 27 .

3.2 Working on the cooling system

When working on the cooling system note the following:

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.

- *Close filler cap on coolant expansion tank (make sure it engages).*

3.3 Working on vehicles with start/stop system

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

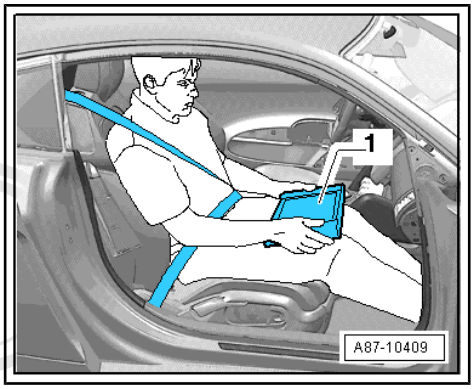
WARNING

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).*

3.4 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.*

- *Move the passenger's seat back as far as it will go.*
- *Use only vehicle diagnosis and service information system -VAS 5052 A- or diagnosis system -VAS 5053- .*
- *The test equipment -1- must rest flat on the passenger's thighs (as shown in illustration) and must be operated by the passenger.*

3.5 Working on the exhaust system

When working on the exhaust system note the following:

Caution

Avoid damage to flexible joint.

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

4 General repair instructions

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

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

- Carefully clean connection points and the surrounding area with engine cleaner or brake cleaner and dry thoroughly before opening.
- Seal off open pipes/lines and connections using engine bung set -VAS 6122- .
- Place parts that have been removed on a clean surface and cover them over. Do not use fluffy cloths.
- Carefully cover or seal open components if repairs cannot be carried out immediately.
- Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have not been stored in the proper packaging (e.g. in tool boxes etc.).
- When the system is open: Do not work with compressed air. Do not move the vehicle unless absolutely necessary.
- Protect unplugged electrical connectors against dirt and moisture and make sure connections are dry when attaching.

4.2 Checking for leaks in the fuel system

Procedure

– 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 of fuel system again for leaks.

4.3 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.

4.4 Routing and attachment of pipes, hoses and wiring

- Mark fuel lines, hydraulic lines, vacuum lines, lines 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).

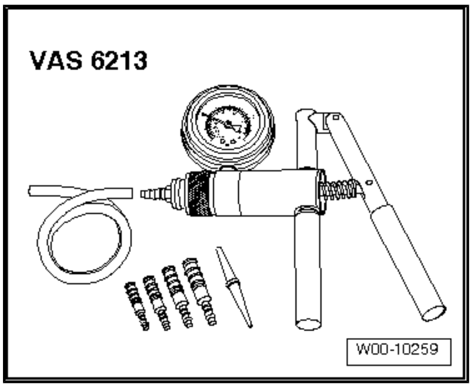
4.5 Installing radiators, condensers and charge air coolers

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

4.6 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 the vacuum lines leading to the relevant component and also check the remaining vacuum lines in the system.

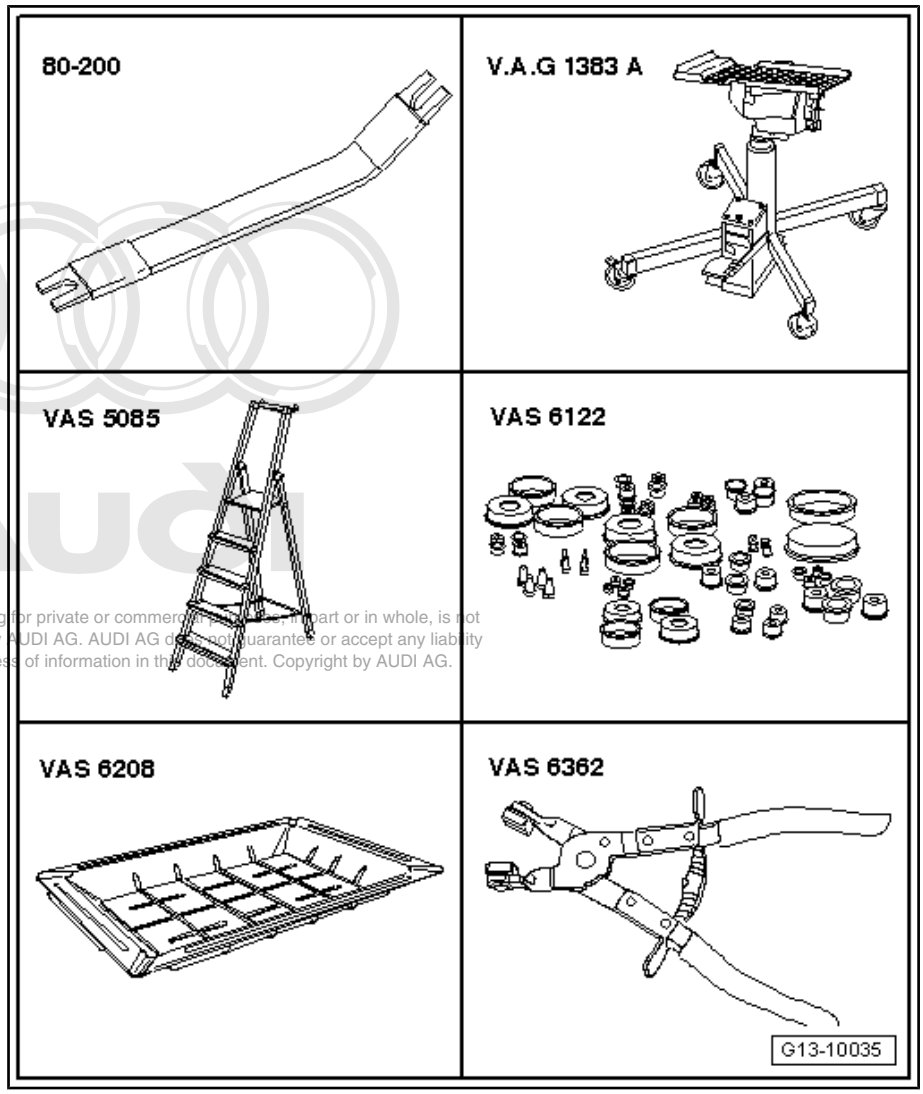
– If it is not possible to build up a vacuum with the hand vacuum pump -VAS 6213- or if the vacuum pressure drops again immediately, check the hand vacuum pump and connecting hoses for leaks.

10 – Removing and installing engine

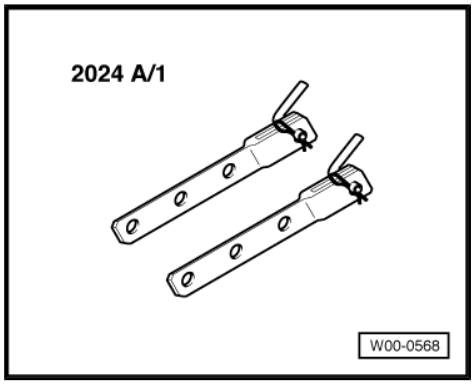
1 Removing engine

Special tools and workshop equipment required

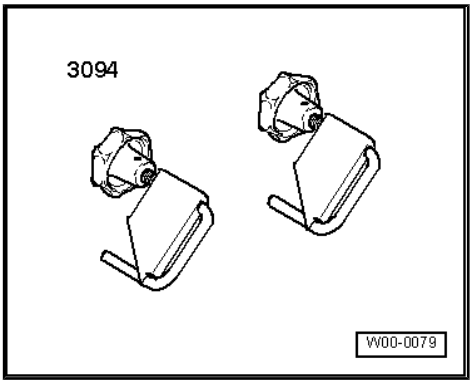
- Removal lever -80 - 200-
- Engine and gearbox jack -V.A.G 1383 A-
- Stepladder -VAS 5085-
- Engine bung set -VAS 6122-
- Drip tray for workshop hoist -VAS 6208-
- Hose clip pliers -VAS 6362-



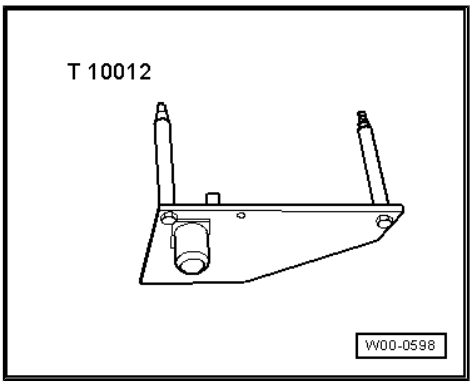
- Hook -2024 A /1- of lifting tackle -2024 A-



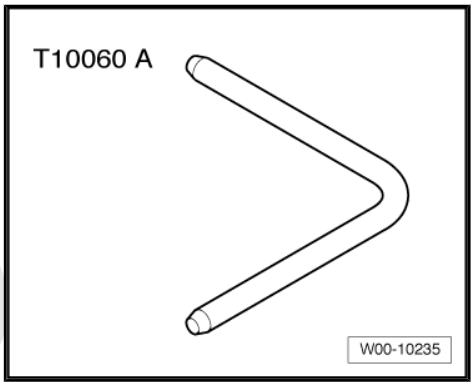
- Hose clamps for hoses up to 25 mm -3094-



- Engine bracket -T10012-



- Locking pin -T10060 A- for vehicles with air conditioner compressor and tensioner



- Safety goggles
- Protective gloves

Procedure

Note

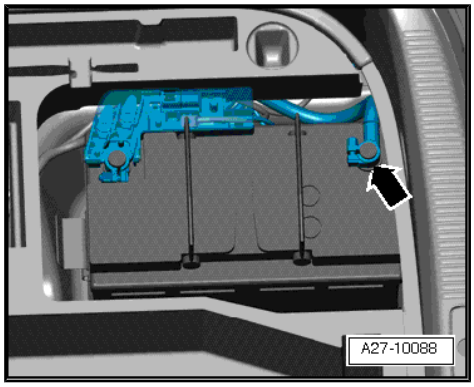
- *The engine is removed from underneath together with the gearbox.*
- *Fit all cable ties in the original positions when installing.*
- *Fit heat insulation sleeves in the original positions when installing.*

Caution

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

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

– Disconnect earth cable -arrow- from battery terminal ⇒ Electrical system; Rep. Gr. 27 .

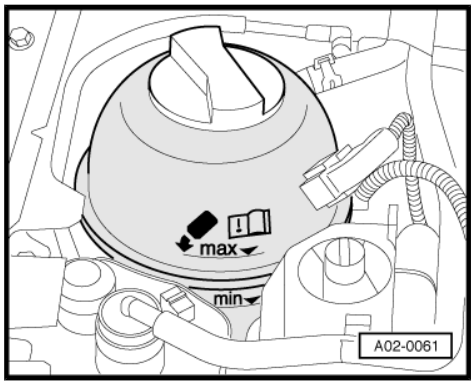


WARNING

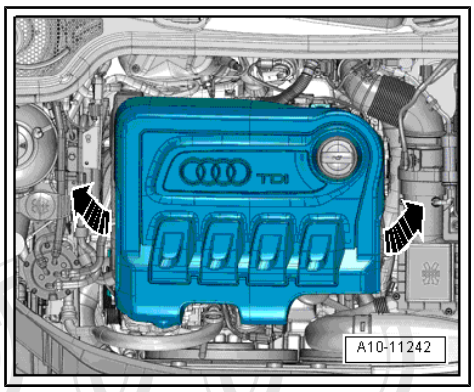
Hot steam/hot coolant can escape - risk of scalding.

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

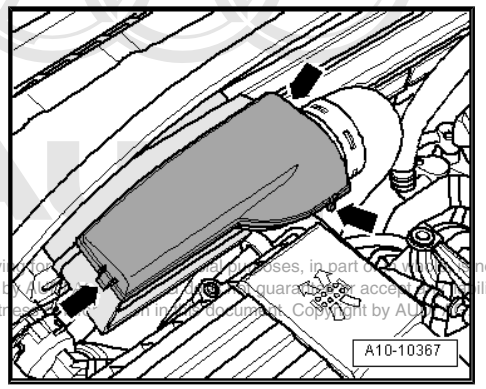
– Open filler cap on coolant expansion tank.



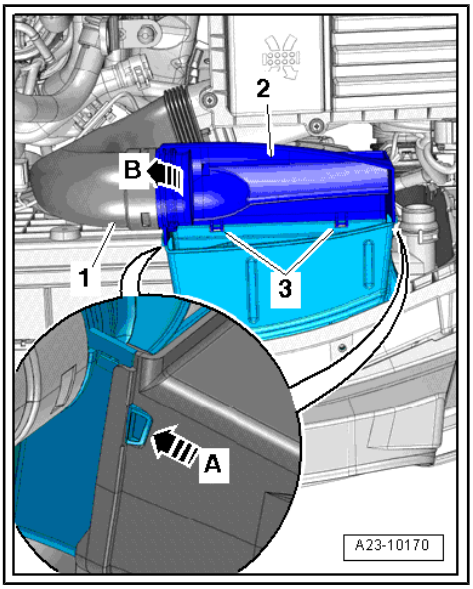
– Remove engine cover panel -arrows-.



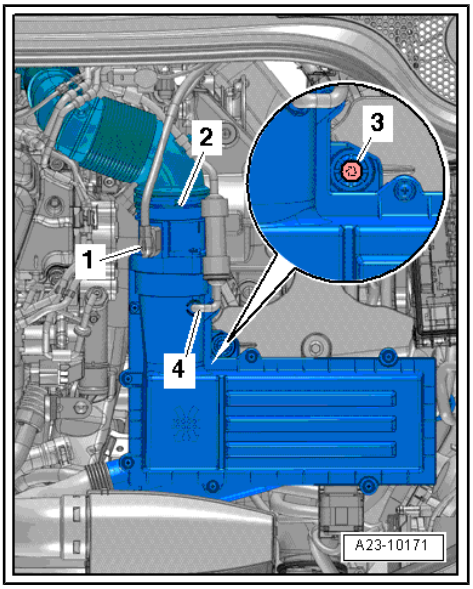
– Pull cover off air duct (release clips on sides) -arrows-.



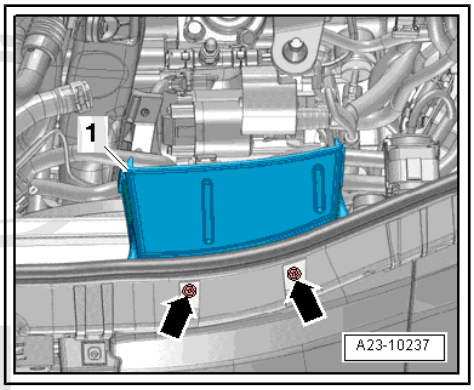
– Release clips on left and right -arrow A- and unclip air duct at bottom -2-.
– Swivel air duct (bottom) slightly to the rear and detach air duct (bottom) from retainers -3-.
– Detach air pipe -1- from air duct (bottom) -arrow B-.



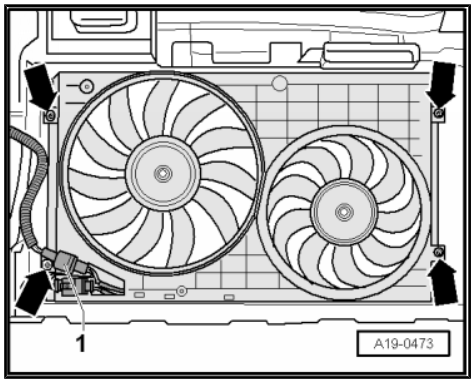
– Unplug electrical connector -1- from air mass meter -G70- .
– Detach hose -4-.
– Release hose clip -2- and detach air hose.
– Unscrew bolt -3- and remove air cleaner housing.



– Remove bolts -arrows- and detach air duct -1- from lock carrier.



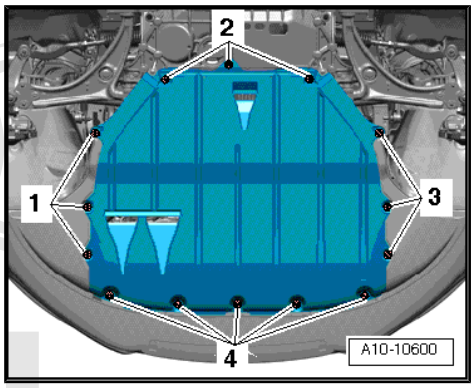
– Remove bolts -top arrows- for radiator cowl.



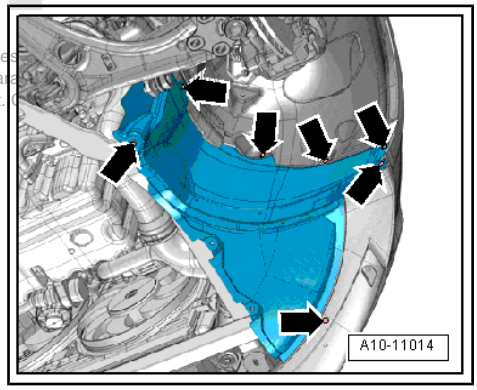
Note

The bolts -bottom arrows- are removed at a later stage.

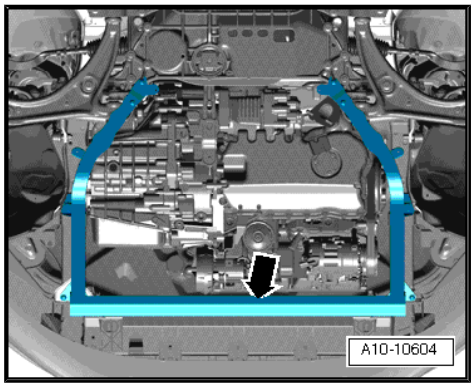
– Remove both front wheels.
– Remove noise insulation ⇒ Rep. Gr. 66 .



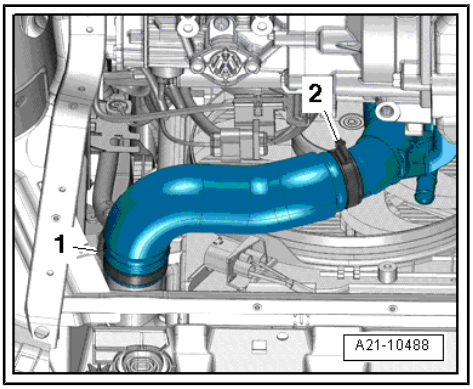
– Remove bottom sections of wheel housing liners (left and right) ⇒ Rep. Gr. 66 .



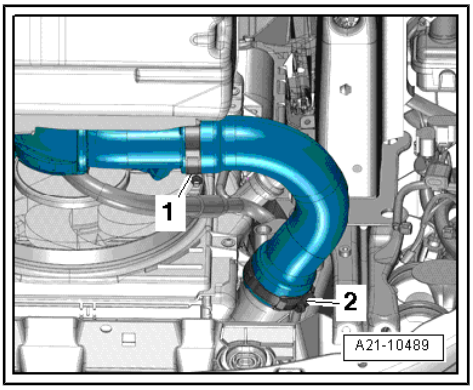
– TT Roadster: Remove noise insulation frame -arrow- ⇒ Rep. Gr. 50 .



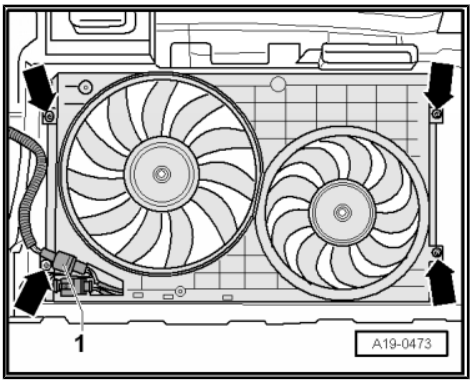
– Release hose clips -1- and -2- and remove air hose.



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



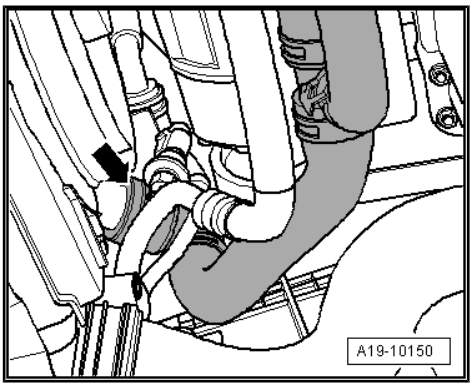
– Unplug electrical connector -1-.
– Remove bolts -bottom arrows- and take out air cowl downwards.



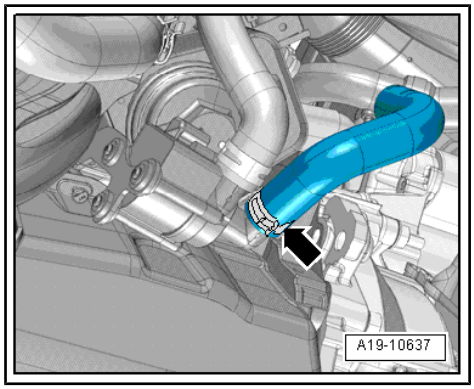
Note

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

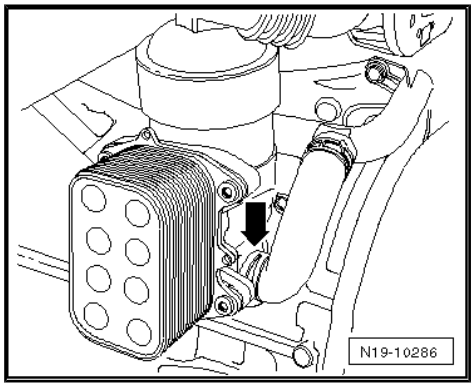
– Place drip tray for workshop hoist -VAS 6208- beneath engine.
– Lift retaining clip -arrow-, disconnect coolant hose (bottom right) from radiator and drain off coolant.



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



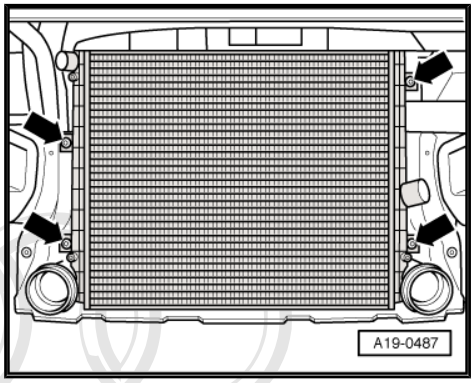
– Release hose clip -arrow-, disconnect coolant hose at oil filter housing and drain off remaining coolant.



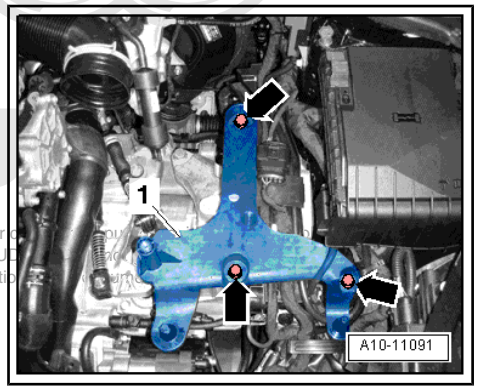
– Remove bolts -bottom arrows- on rear side of radiator.

Note

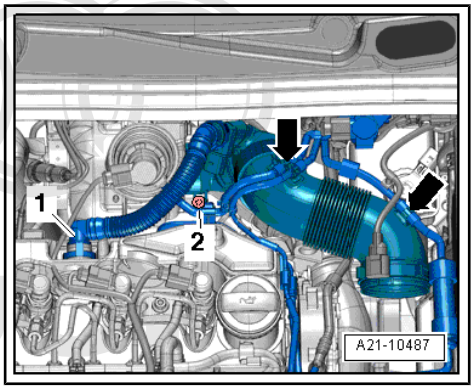
The bolts -top arrows- are removed at a later stage.



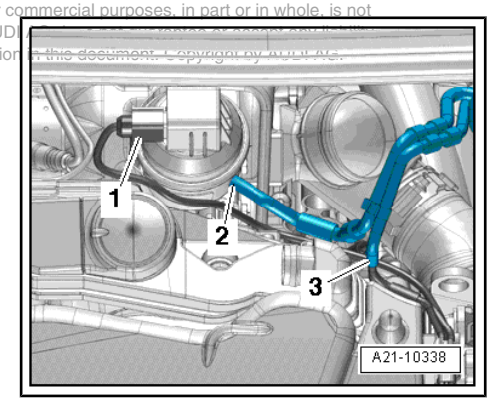
– Remove bolts -arrows- and detach bracket -1- for air cleaner housing.



– Press release tabs and disconnect crankcase breather hose -1- from cylinder head cover.
– Move clear vacuum hoses -arrows- at air pipe.
– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.



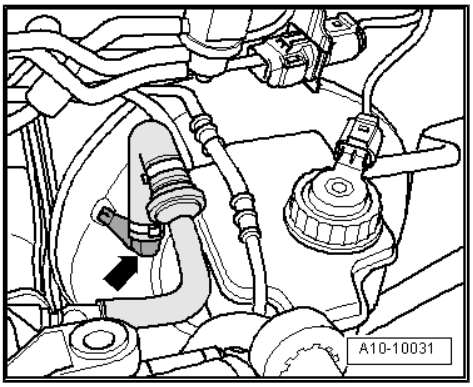
– Detach vacuum hose -2- from vacuum unit of turbocharger.
– Disconnect vacuum hose -3-.



Note

Disregard -item 1-.

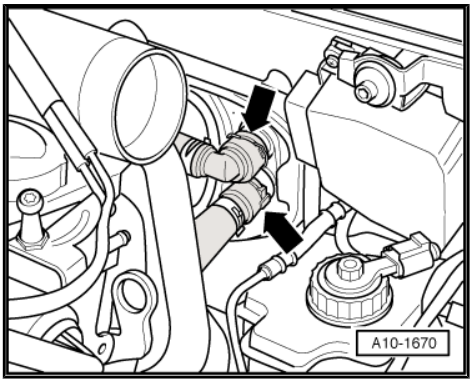
– Detach vacuum hose -arrow- from brake servo.



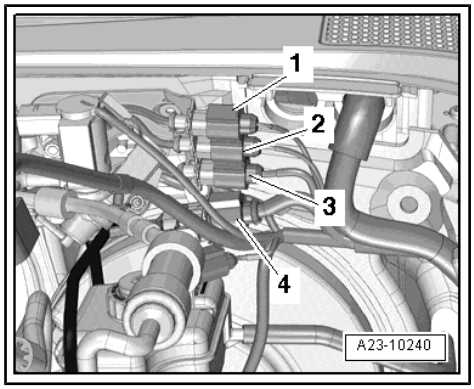
Note

Place a cloth underneath heat exchanger to catch escaping coolant.

– Lift retaining clips -arrows- and detach coolant hoses from heat exchanger.



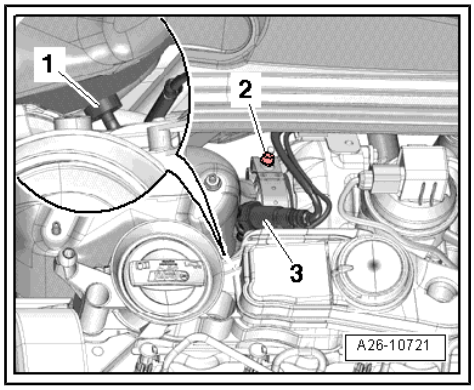
– Detach electrical connector -1- from bracket and unplug.
– Move clear electrical wiring.



Note

Disregard -items 2, 3, 4-.

– Slacken bolt -2- and remove clamp.

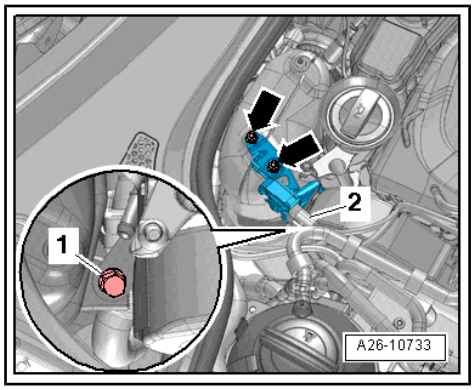


Note

Disregard -items 1, 3-.

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

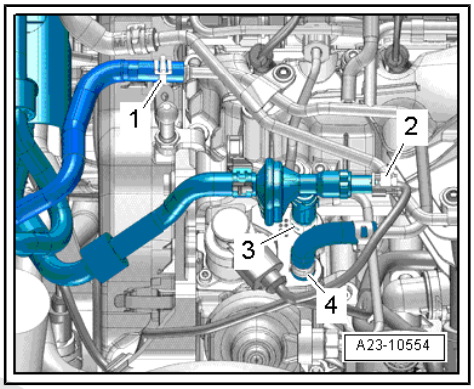
– Unplug electrical connector -2- at pressure differential sender -G505- .
– Remove bolt -1-.



Note

Disregard -arrows-.

– Unplug electrical connector -2- on fuel temperature sender - G81- .



WARNING

The fuel can become extremely hot. This can cause injuries.

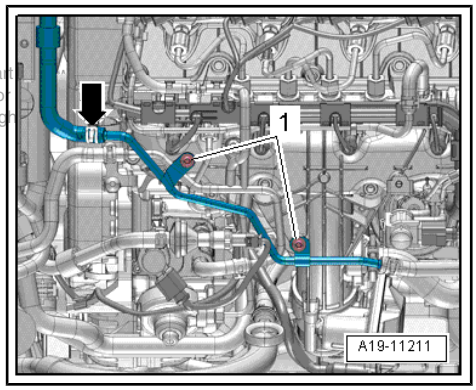
- ***In extreme cases the temperature of the fuel lines and the fuel can be up to 100 °C after the engine is switched off. Allow the fuel to cool down before disconnecting the lines - danger of scalding.***
- ***Wear protective gloves.***
- ***Wear safety goggles.***

– Release hose clips -1- and -3- and disconnect fuel supply hose and fuel return hose.

Note

Disregard -item 4-.

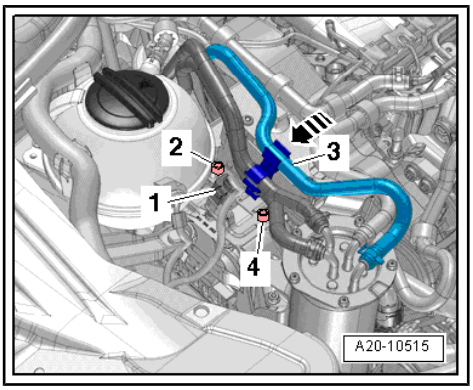
– Release hose clip -arrow- and detach coolant hose.



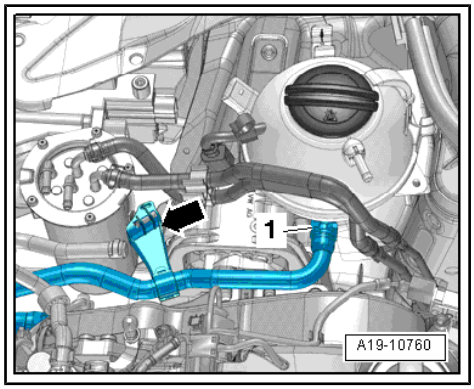
Note

Disregard -item 1-.

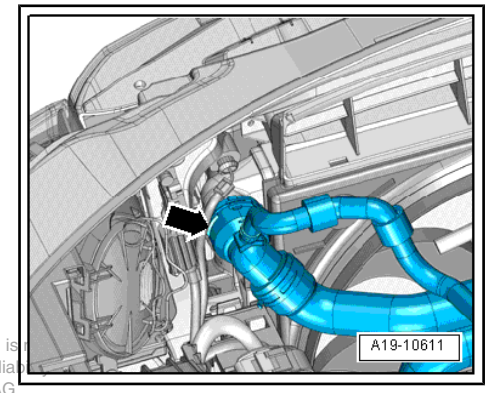
– Disengage fuel hose -3- at bracket.
– Pull off bracket for fuel lines towards right -arrow- and move clear to one side.
– Unplug electrical connector -1- at supplementary fuel pump - V393- .
– Remove bolts -2- and -4-, detach bracket with supplementary fuel pump -V393- and move clear to one side.



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



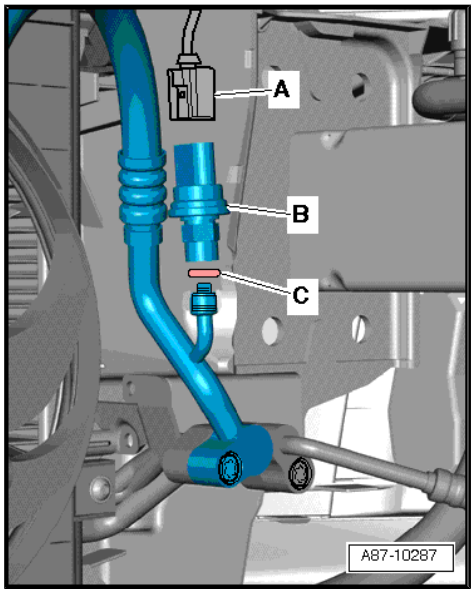
– Lift retaining clip -arrow- and disconnect coolant hose (top left) from radiator.



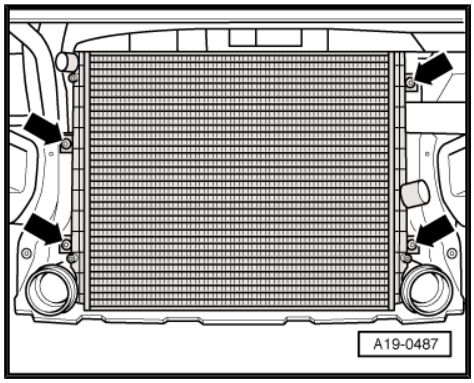
– Unplug electrical connector -A- at high-pressure sender -G65- -item B-.

Note

Disregard -item C-.

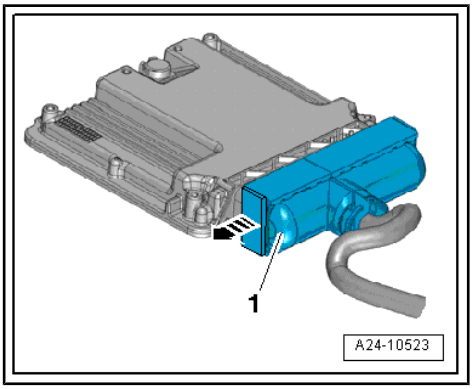


– Detach sealing lip at lock carrier (top).

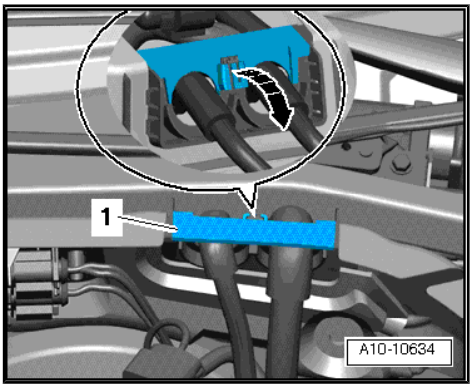


– Remove bolts -top arrows- at rear and lift out radiator.

– Release electrical connector -1- for engine wiring harness -arrow- and detach ⇒ Rep. Gr. 23 ; Removing and installing engine control unit -J623- .



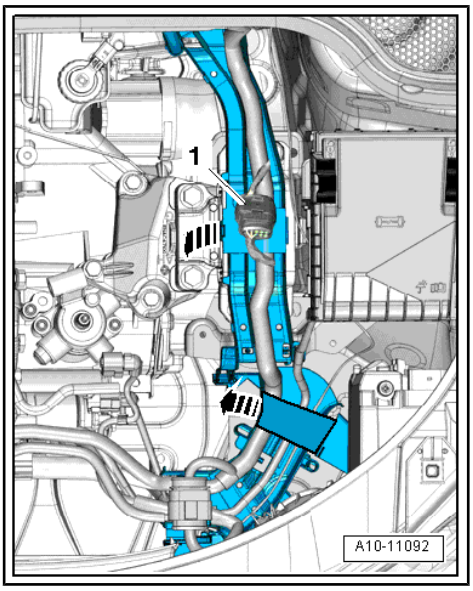
– Release wiring protector -1- for engine wiring harness -arrow- and lift off.



– Move clear and unplug electrical connector -1-.

– Open wiring duct bracket -arrows-, use removal lever -80 - 200- to unclip wiring and press wiring to side.

– Unclip wiring duct.



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

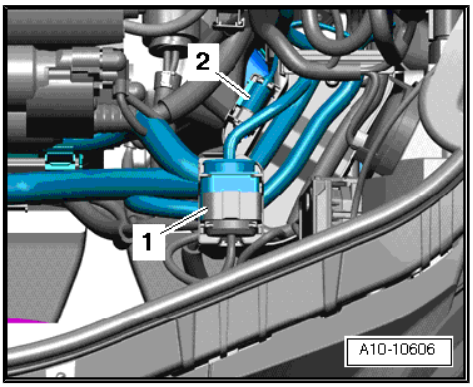
– Open wiring duct bracket located underneath.

– Unclip wiring harness for engine control unit from wiring duct.

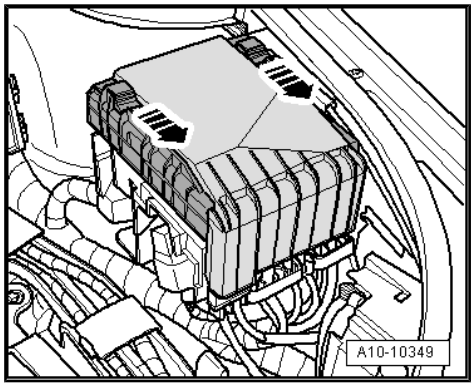
– Place engine wiring harness with engine control unit on top of engine.

– Secure engine control unit to prevent it falling.

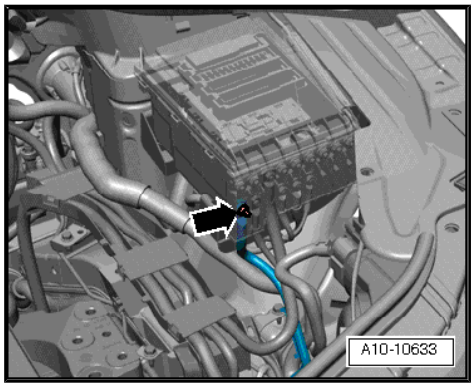
– Unclip electrical connector -2- from bracket and unplug.



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



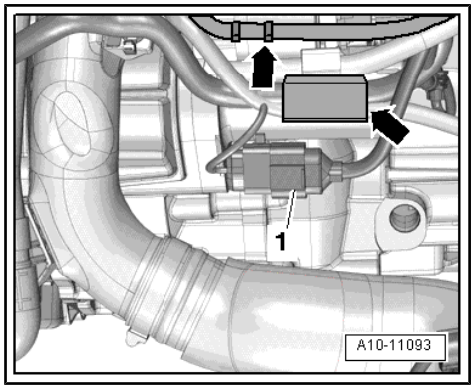
– Remove nut -arrow-, detach terminal 30 wire from electronics box in engine compartment and move it clear.



– Unplug electrical connector -1-.

Note

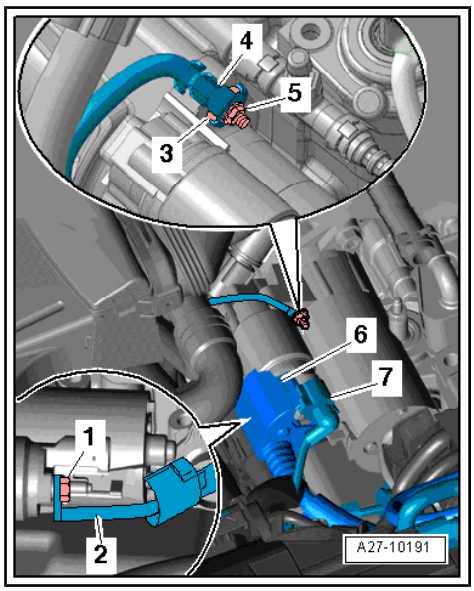
Disregard -arrows-.



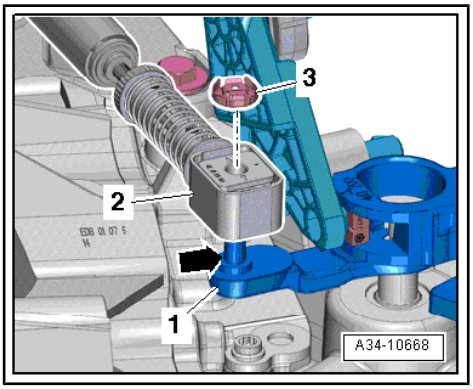
– Unplug electrical connector -7- (push retainer to the rear and press down release catch).
– Push back protective sleeve -6-.
– Remove nut -1- and detach B+ wire -item 2- from starter solenoid switch.
– Remove nut -5- and detach earth wire -4-.

Note

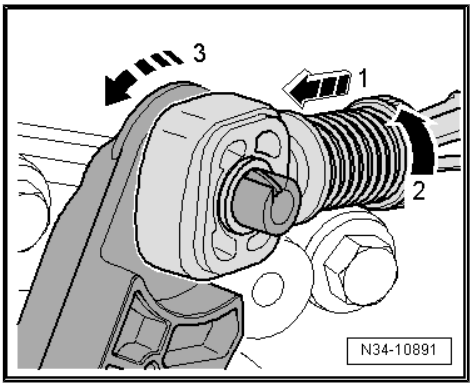
Disregard -item 3-.



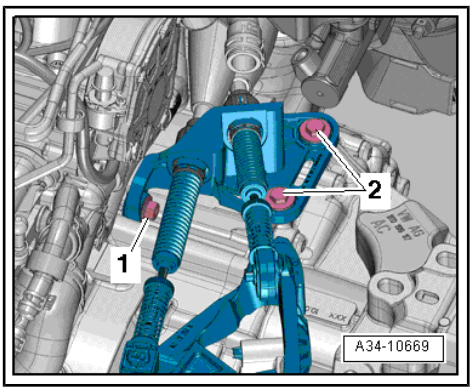
– Lift clip and detach retaining clip -3- for gear selector cable from gearbox selector lever -1-.
– Detach gear selector cable -2- from pin -arrow-.



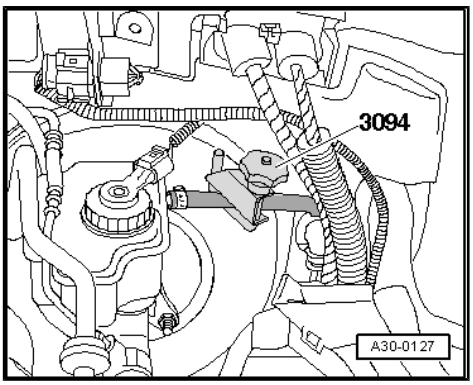
• To prevent damage to gate selector cable, cable end-piece must be detached from gate selector cable before removing.
– Pull locking device forwards onto stop -arrow 1- and lock by turning anti-clockwise -arrow 2-.
– Press selector relay lever towards front -arrow 3-.



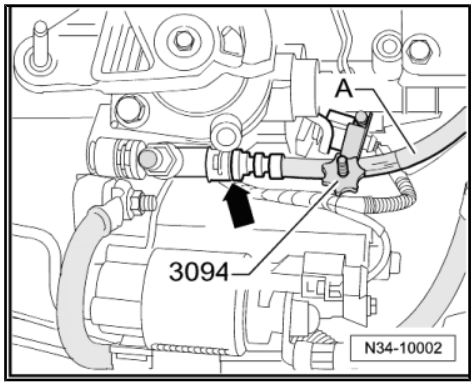
– Remove nut -1- and bolts -2-, detach cable support bracket and place to one side (selector cables remain fitted).



– Vehicles with plastic pipe between clutch master cylinder and slave cylinder: clamp off supply hose at brake fluid reservoir using hose clamp -3094- .



– Vehicles with pipe/hose assembly between clutch master cylinder and slave cylinder: clamp off hose -A- at pipe/hose assembly using hose clamp -3094- .

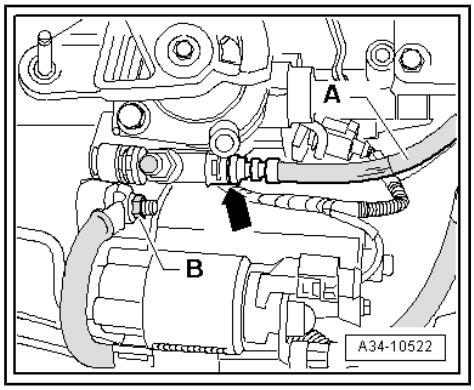


Note

Disregard -arrow-.

Note

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



– Pull out clip -arrow- as far as stop.
– Pull plastic pipe or pipe/hose assembly -A- out of bleeder connection for clutch slave cylinder.

Note

Disregard -item B-.

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

Caution

Risk of contamination by escaping brake fluid.

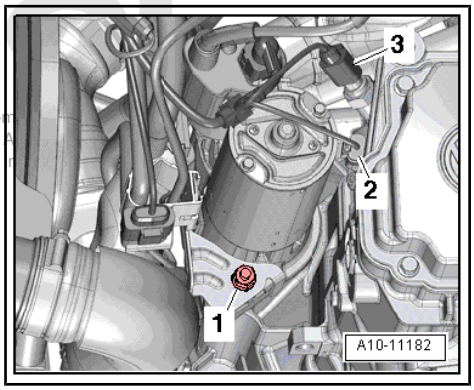
- ***Do not operate clutch pedal after detaching pipe from bleeder screw on clutch slave cylinder.***

Vehicles with start/stop system:

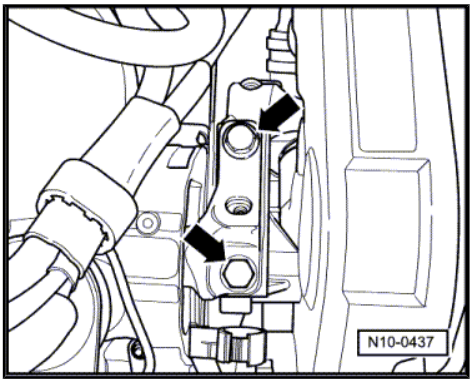
– Unplug electrical connector -3- for gearbox neutral position sender -G701- .

All vehicles (continued):

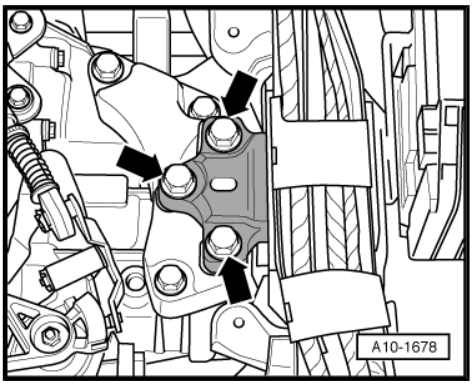
– Unplug electrical connector -2- at reversing light switch -F4- .
– Unscrew nut -1- and detach bracket for electrical connectors.



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



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

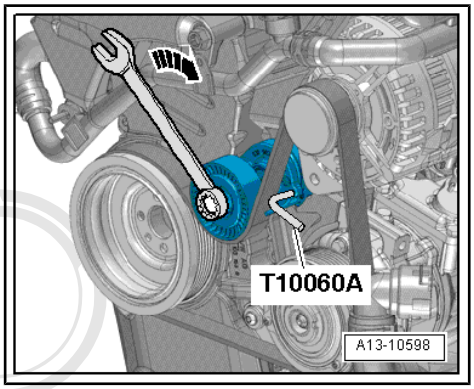


Vehicles with air conditioner compressor and tensioner:

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-tipped pen for re-installation.***



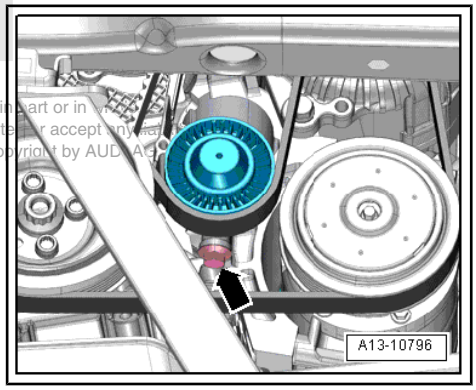
– To slacken poly V-belt turn tensioner in clockwise direction -arrow-.
– Lock tensioner with locking pin -T10060 A-
– Take off poly V-belt.

Vehicles with air conditioner compressor and tensioning roller:

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-tipped pen for re-installation.***



– Remove bolt -arrow- and detach tensioner to slacken poly V-belt.
– Take off poly V-belt.

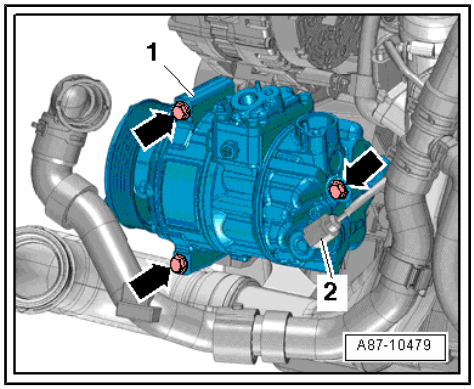
All vehicles with air conditioner compressor (continued):

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

Caution

Make sure that air conditioner compressor and refrigerant pipes and hoses are not damaged.

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

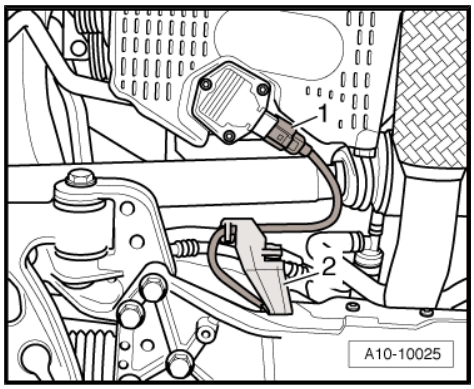


– Remove bolts -arrow-, detach air conditioner compressor -1- with refrigerant lines connected and tie up to front.

All vehicles (continued):

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

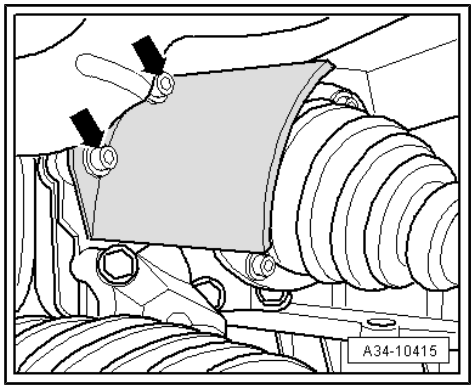
– Unclip bracket -2- for wire to oil level and oil temperature sender -G266- from subframe.



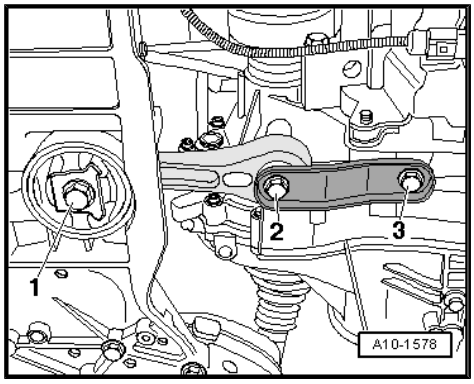
– Remove bolts -arrows- and detach heat shield for drive shaft (right-side).

– Detach drive shaft (left-side) from flange shaft of gearbox and tie up.

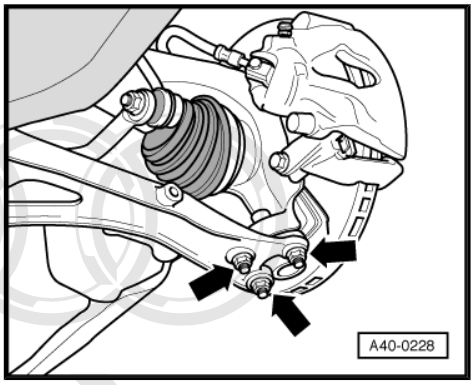
– Detach drive shaft (right-side) from flange shaft of bevel box.



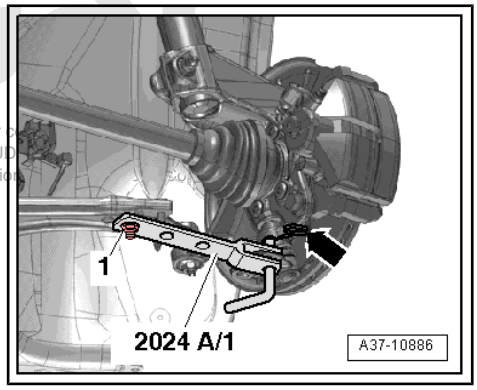
– Remove bolts -1, 2, 3- and remove pendulum support.



– Mark position of nuts -arrows- securing swivel joint.
– Remove nuts for swivel joint (right-side).
– If fitted, remove nut on bracket for front right vehicle level sender -G289- .
– Detach swivel joint from wishbone.



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



WARNING

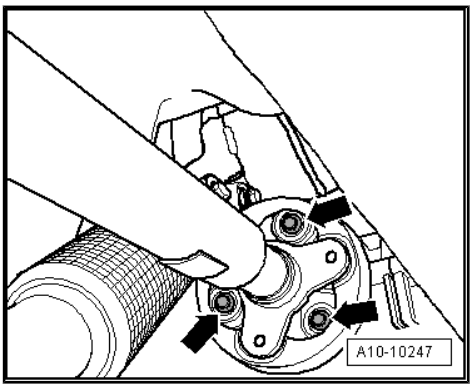
Accident risk from loose components of support bracket.

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

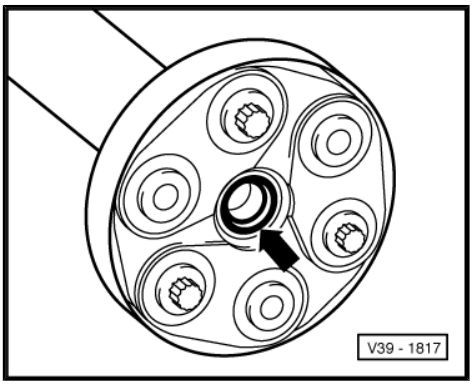
Note

The illustration shows the installation position on front suspension (left-side).

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



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



Caution

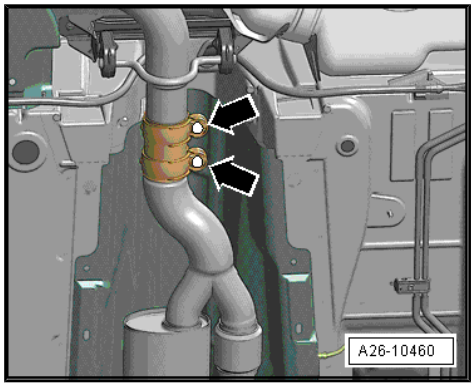
Make sure not to damage the seal -arrow- in the propshaft flange.

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

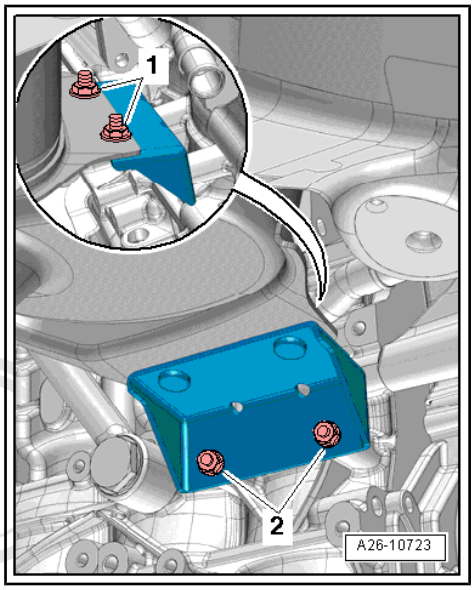
Note

The propshaft must be renewed if oil seal is damaged.

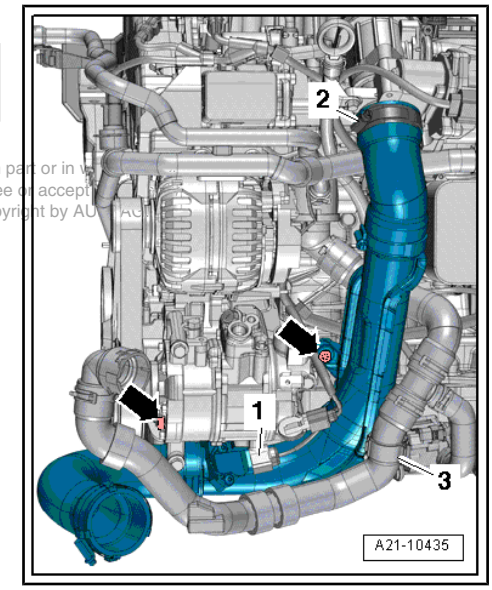
– Unfasten nuts -arrows- for clamp.



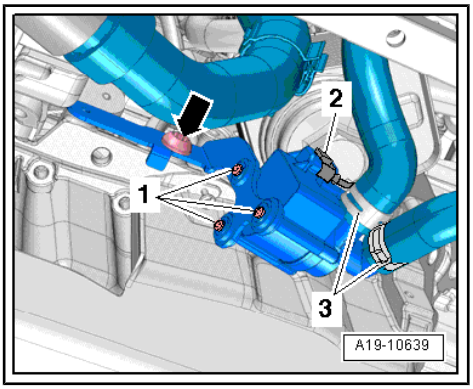
– Remove nuts -1- and -2- and detach bottom bracket for particulate filter.
– Tie up particulate filter to rear.



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



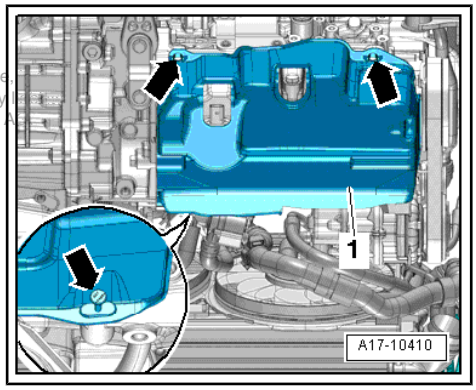
– Remove bolt -arrow- and push pump for exhaust gas recirculation cooler -V400- to the side.



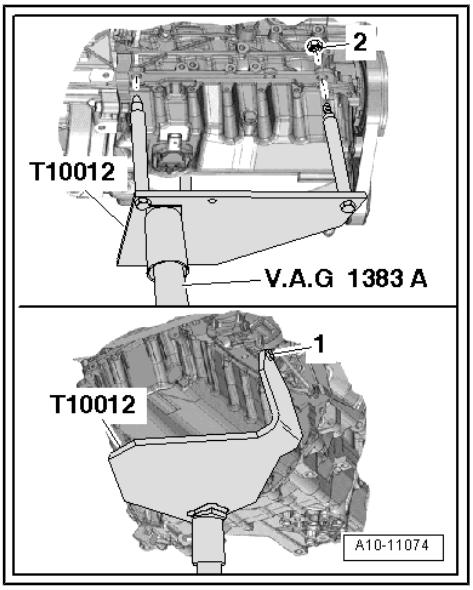
Note

Disregard -items 1, 2, 3-.

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



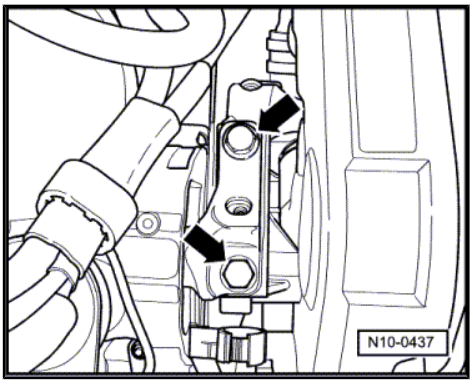
– Secure engine bracket -T10012- to cylinder block with bolt -1- and nut -2- (tightening torque: approx. 20 Nm).
– Insert engine and gearbox jack -V.A.G 1383 A- in engine support -T10012- and raise engine/gearbox assembly slightly.



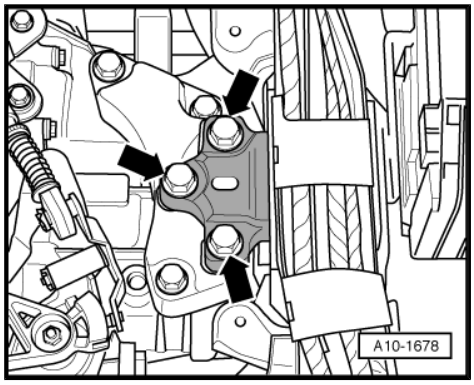
Note

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

– Remove bolts -arrows- securing engine mounting.



– Remove bolts -arrows- securing gearbox mounting.



Caution

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

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

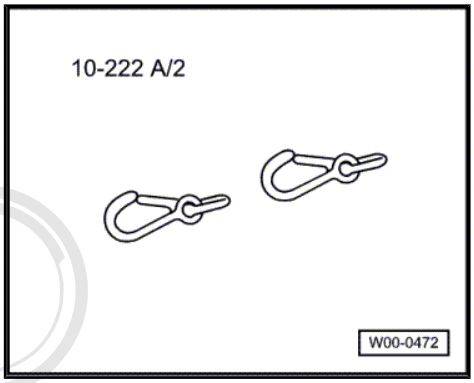
– First lower engine/gearbox assembly only slightly.

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

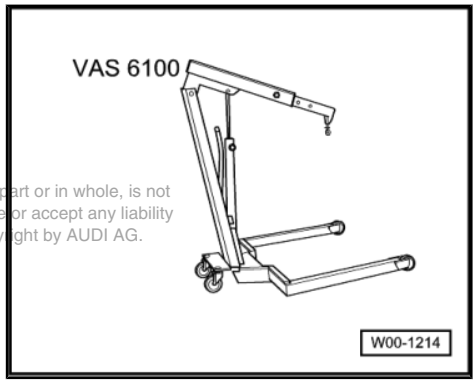
2 Separating engine from manual gearbox

Special tools and workshop equipment required

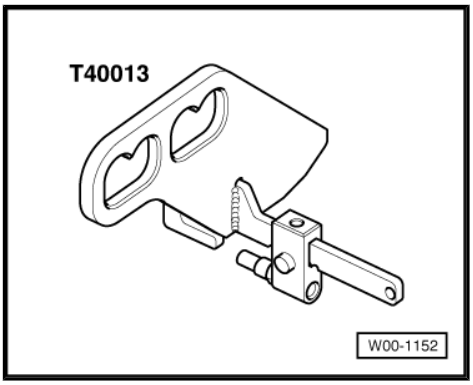
- Hooks -10 - 222 A /2-



- Workshop hoist -VAS 6100-



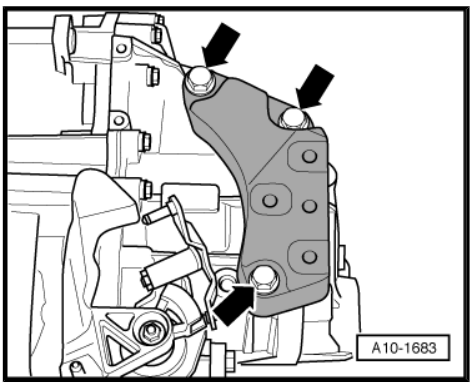
- Lifting tackle -T40013-



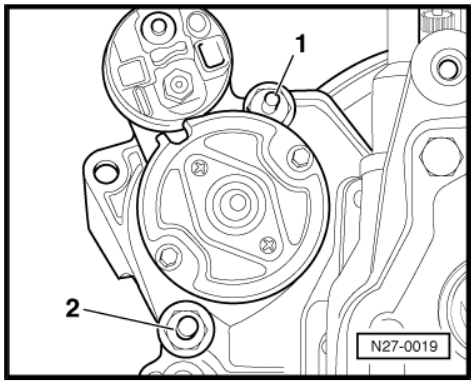
Procedure

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

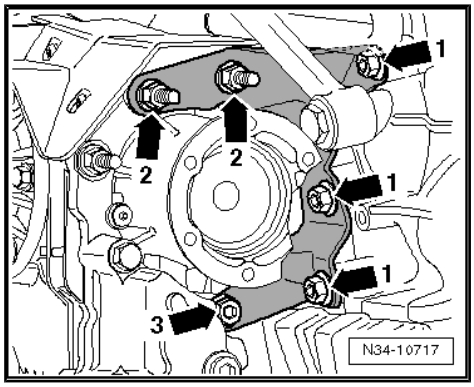
– Unscrew bolts -arrows- and detach gearbox support.



– Unscrew bolts -1- and -2- and remove starter from gearbox.



– Remove bolts -arrows 2, 3- securing bracket for bevel box.

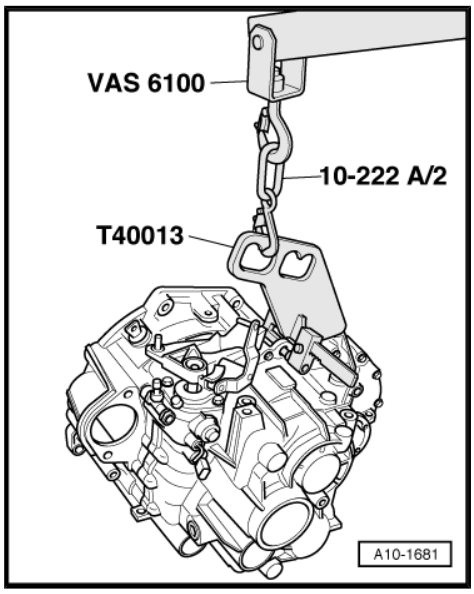


Note

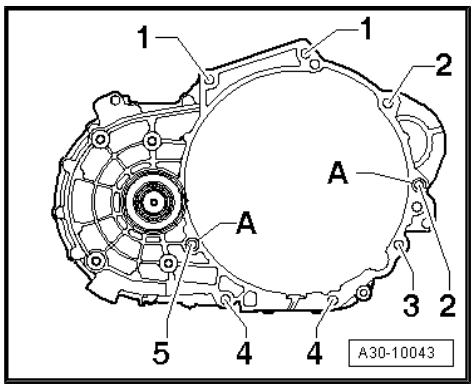
Disregard -arrows 1-.

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

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



– Remove bolts -1, 3, 4, 5- securing gearbox to engine.



Note

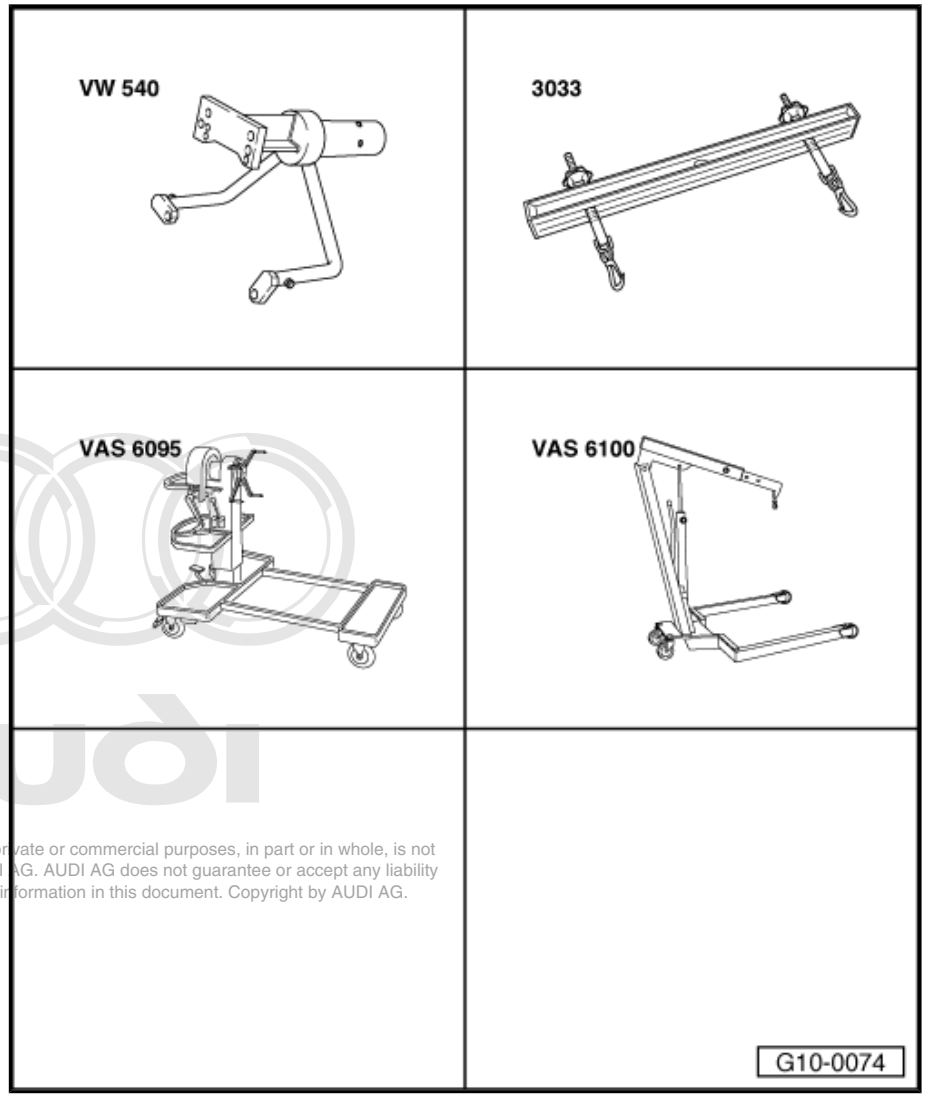
Disregard -items 2, A-.

– Detach gearbox from engine.

3 Securing engine to engine and gearbox support

Special tools and workshop equipment required

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

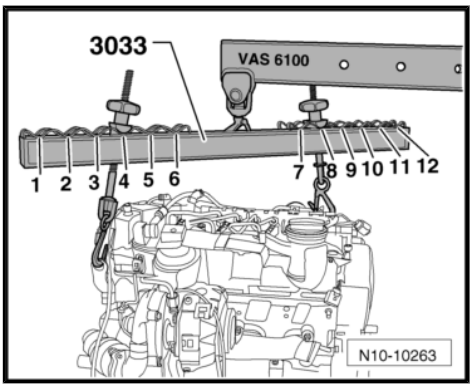


Procedure

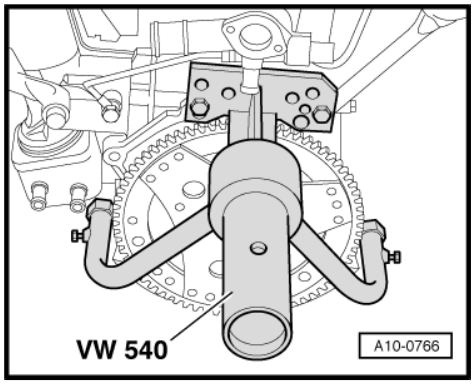
- Gearbox detached from engine ⇒ page 29 .

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

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



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



4 Installing engine

Tightening torques

Note

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

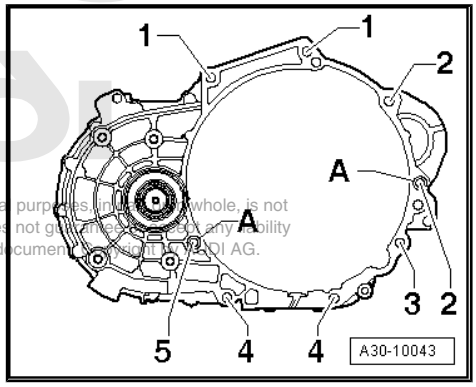
Tightening torques ⇒ page 37

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

Securing manual gearbox to engine

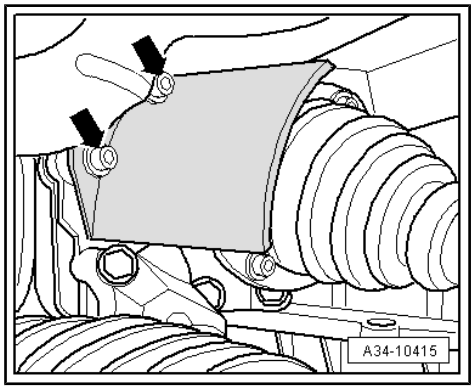
Item	Bolt [1]	Nm
1 [2]	M12x55	80
2 [2]	M12x165	80
3	M10x105	40
4	M10x50	40
5 [3]	M12x65	80
A	Dowel sleeves for centralising	

- [1] Renew bolts.
- [2] Bolt with M8 threaded pin
- [3] Screwed into gearbox from engine side



Heat shield for drive shaft (right-side) - tightening torque

– Tighten bolts -arrows- to 35 Nm.



Procedure

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

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

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 .*
- *To secure the air hoses at their connections, spray rust remover onto the worm thread of the used hose clips before installing.*
- *Fit all cable ties in the original positions when installing.*

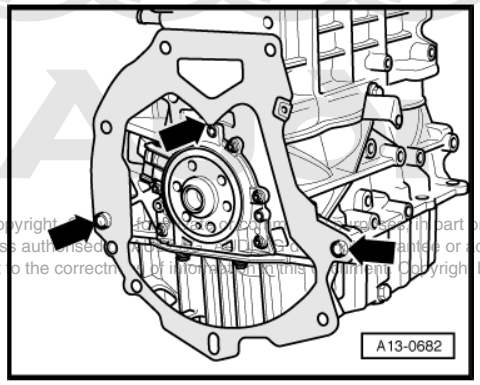
– If not already fitted, install dowel sleeves for centring engine and gearbox in cylinder block.

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

– Remove needle bearing in crankshaft if fitted ⇒ page 78 .

– Renew clutch release bearing if worn ⇒ Rep. Gr. 30 .

– Lubricate splines of gearbox input shaft lightly with grease for clutch plate splines ⇒ Electronic parts catalogue .



– Make sure that clutch plate is properly centred.

– Secure gearbox to engine.

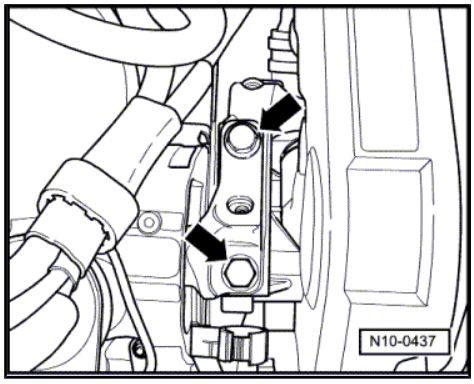
– Install gearbox support ⇒ Rep. Gr. 34 .

– Attach engine/gearbox assembly to engine bracket -T10012- .

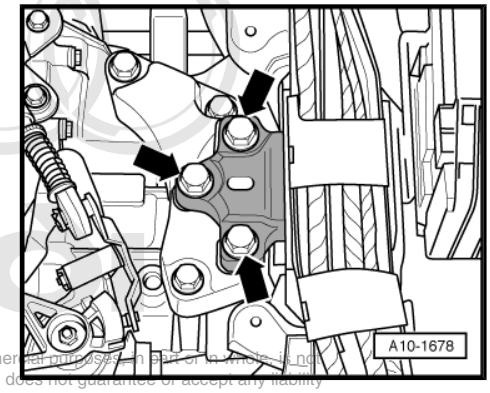
– Install bracket for bevel box ⇒ Rep. Gr. 34 .

– Guide engine/gearbox assembly into body.

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



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



Note

The bolts are tightened to final torque only after adjusting the assembly mountings ⇒ page 42 .

– Remove engine support -T10012- from engine.
– Install starter ⇒ Electrical system; Rep. Gr. 27 .
– Install pump for exhaust gas recirculation cooler -V400- ⇒ page 184 .
– Install air pipe ⇒ page 212 .
– Install air hoses with screw-type clips ⇒ page 213 .
– Install particulate filter ⇒ page 219 .
– Bolt flexible coupling on propshaft to bevel box flange ⇒ Rear final drive 02D, 0AV, 0BR and 0BY; Rep. Gr. 39 .
– Install drive shafts, wishbones and coupling rod ⇒ Rep. Gr. 40 .
– Install pendulum support ⇒ Rep. Gr. 34 .
– Install heat shield for drive shaft (right-side) ⇒ page 34 .
– Install air conditioner compressor ⇒ Rep. Gr. 87 .
– Install poly V-belt
⇒ “1.4 Removing and installing poly V-belt - vehicles with air conditioner compressor and tensioner”, page 49 ,
⇒ “1.7 Removing and installing poly V-belt - vehicles with air conditioner compressor and tensioning roller”, page 55 .
– Connect clutch slave cylinder ⇒ Rep. Gr. 30 .
– Install gear selector cable and gate selector cable ⇒ Rep. Gr. 34 .
– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Install engine control unit ⇒ Rep. Gr. 23 .
– Install radiator ⇒ page 204 .
– Adjust assembly mountings ⇒ page 42 .
– Install supplementary fuel pump -V393- ⇒ Rep. Gr. 20 .
– Connect coolant hoses with plug-in connector to heat exchanger ⇒ page 202 .
– Connect vacuum hoses ⇒ page 206 .
– Install air pipe with connection ⇒ page 207 .
– Install bottom sections of wheel housing liners ⇒ Rep. Gr. 66 .
– Fit front wheels ⇒ Rep. Gr. 44 .
– Install radiator cowl ⇒ page 202 .
– Install air cleaner housing ⇒ Rep. Gr. 23 .
– Observe notes on procedure for connecting the battery ⇒ Rep. Gr. 27 .
– Check oil level ⇒ Maintenance ; Booklet 810 .

Caution

Risk of damage to control units because of excessive voltage.

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

– Fill up with coolant ⇒ page 173 .

Note

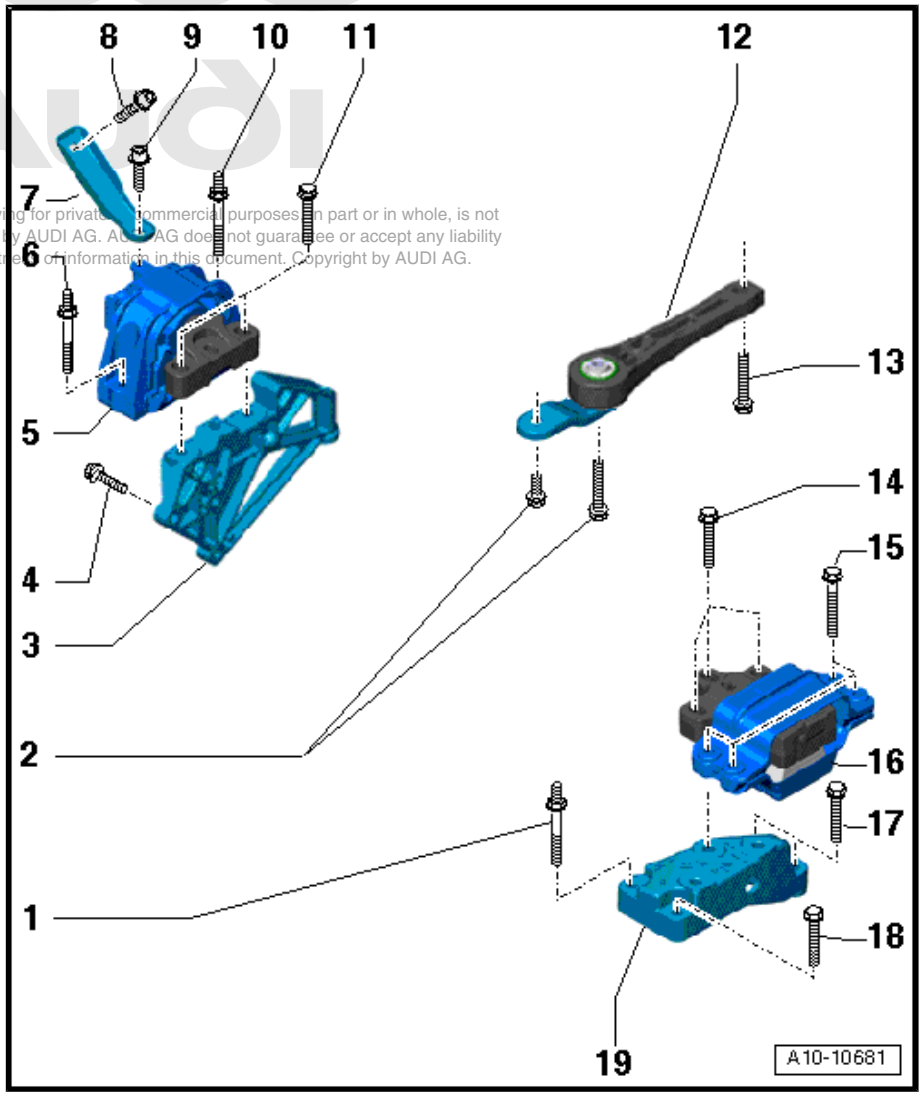
- *Drained-off coolant may only be used again if the original cylinder head and cylinder block are re-installed.*
- *Contaminated or dirty coolant must not be used again.*

– Install noise insulation frame ⇒ Rep. Gr. 50 .

– Install noise insulation ⇒ Rep. Gr. 66 .

5 Assembly mountings

5.1 Assembly mountings - exploded view



1 - Bolt

- ❑ Gearbox support to gearbox
- ❑ Tightening torque ⇒ Rep. Gr. 34

2 - Bolts

- ❑ Pendulum support to gearbox
- ❑ Tightening torque ⇒ Rep. Gr. 34

3 - Engine support

- ❑ Version fitted in vehicle may differ from illustration

4 - Bolt

- ❑ Engine support to engine
- ❑ Renew
- ❑ Tightening torque and sequence ⇒ page 38

5 - Engine mounting

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

6 - Bolt

- ❑ Engine mounting to body
- ❑ Renew
- ❑ 40 Nm +90° further

7 - Connecting bracket

8 - Bolt

- ❑ Connecting bracket to engine mounting
- ❑ Renew
- ❑ 20 Nm +90° further

9 - Bolt

- ❑ Connecting bracket to body
- ❑ Renew
- ❑ 20 Nm +90° further

10 - Bolt

- ❑ Engine mounting to body
- ❑ Renew
- ❑ 40 Nm +90° further

11 - Bolt

- ❑ Engine mounting to engine support
- ❑ Renew

- ❑ 60 Nm +90° further

12 - Pendulum support

13 - Bolt

- ❑ Pendulum support to subframe
- ❑ Tightening torque ⇒ Rep. Gr. 34

14 - Bolt

- ❑ Gearbox mounting to gearbox support
- ❑ Tightening torque ⇒ Rep. Gr. 34

15 - Bolt

- ❑ Gearbox mounting to body
- ❑ Tightening torque ⇒ Rep. Gr. 34

16 - Gearbox mounting

- ❑ With support arm

17 - Bolt

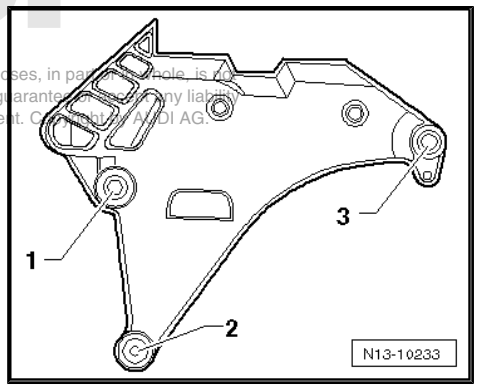
- ❑ Gearbox support to gearbox
- ❑ Tightening torque ⇒ Rep. Gr. 34

18 - Bolt

- ❑ Gearbox support to gearbox
- ❑ Tightening torque ⇒ Rep. Gr. 34

19 - Gearbox support

Engine support - tightening torque and sequence



Note

Renew the bolts tightened with specified tightening angle.

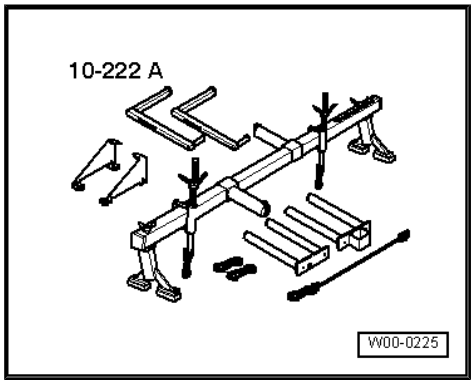
– Tighten bolts in 3 stages in the sequence shown:

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

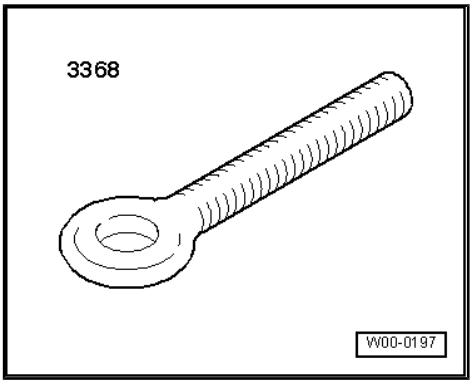
5.2 Removing and installing engine mountings

Special tools and workshop equipment required

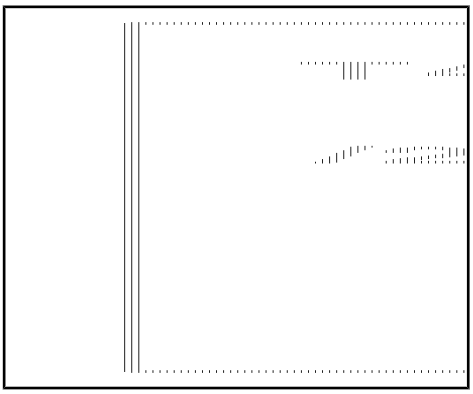
♦ Support bracket -10 - 222 A-



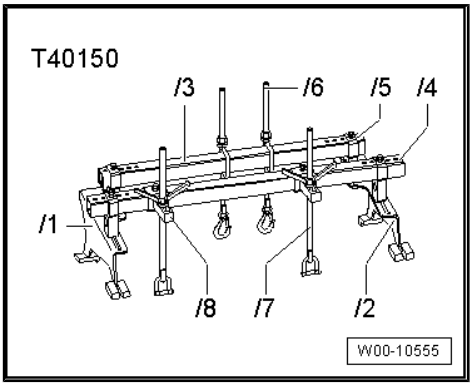
- Eye-head bolt -3368-



- Engine support bracket (supplementary set) -T40093-



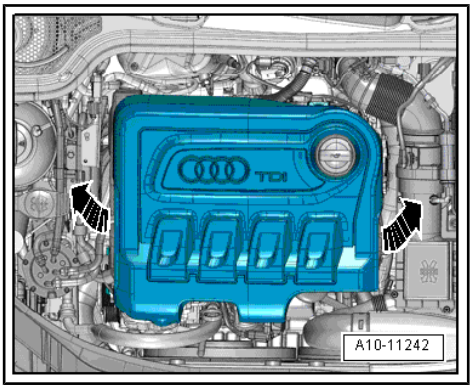
- Nut from spindle -T40150/6-



- Flange nut M10 or nut M10 with washer

Removing

– Remove engine cover panel -arrows-.



– Position support bracket -10 - 222 A- on bolted flanges of wing panels using the following tools:

♦ Rack -10 - 222 A /1- (2x)

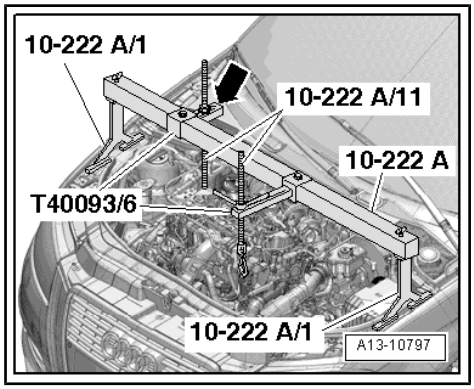
♦ Spindle -10 - 222 A /11- (2x)

♦ Adapter -T40093/6- (2x)

♦ Nut from spindle -T40150/6-

– Replace wing nut from spindle -10 - 222 A /11- (rear right) with nut -arrow- from spindle -T40150/6- .

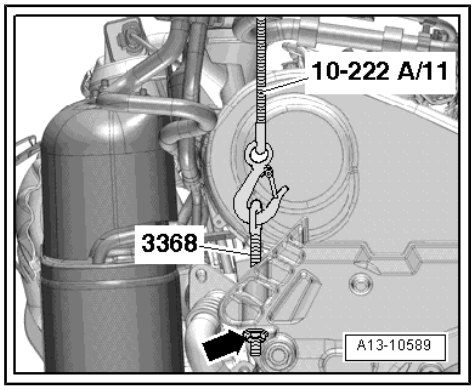
– Attach hook of spindle to engine lifting eye (left-side).



WARNING

Risk of accident because of loose bolt connections.

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



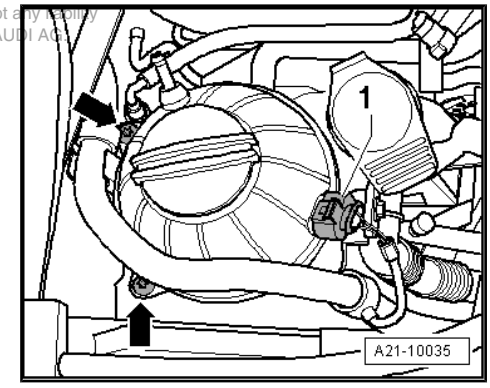
– Secure eye-head bolt -3368- with flange nut M10 or nut with washer to engine support as shown in illustration.

– Attach spindle -10 - 222 A /11- (right-side) to eye-head bolt -3368- .

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

– Remove bolts -arrows-.

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

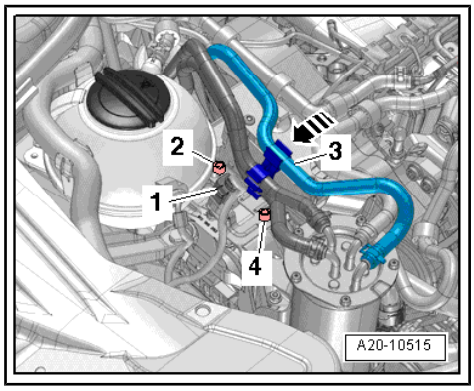


– Disengage fuel hose -3- at bracket.

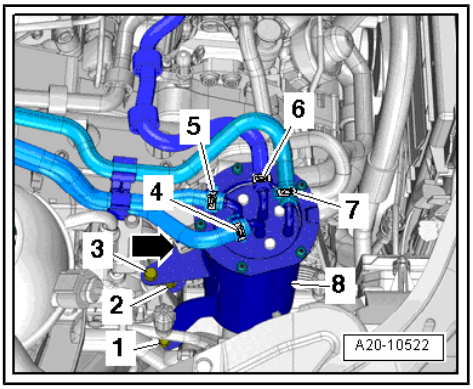
– Pull off bracket for fuel lines towards right -arrow- and move clear to one side.

– Unplug electrical connector -1- at supplementary fuel pump -V393- .

– Remove bolts -2- and -4-, detach bracket with supplementary fuel pump -V393- and move clear to one side.



– Loosen bolt -1-.
– Remove nut -2- and bolt -3-.
– Detach hose retainer -arrow- from fuel filter and move fuel filter -8- clear to one side with fuel hoses -4 ... 7- connected.



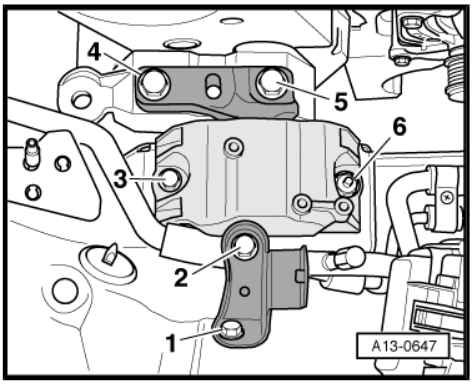
– Remove bolts -1- and -2- and remove connecting bracket.
– Remove bolts -3 ... 6- and detach engine mounting.

Installing

- Tightening torques
⇒ “5.1 Assembly mountings - exploded view”, page 37

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

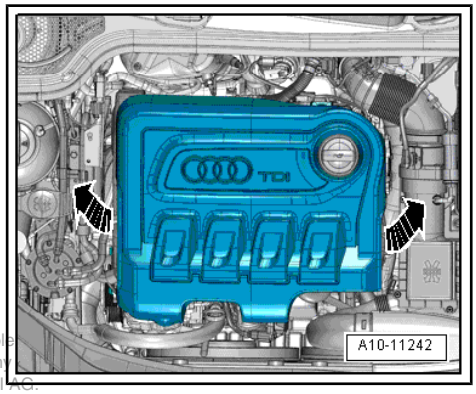
– Check adjustment of assembly mountings (engine/gearbox mountings) ⇒ page 41 .



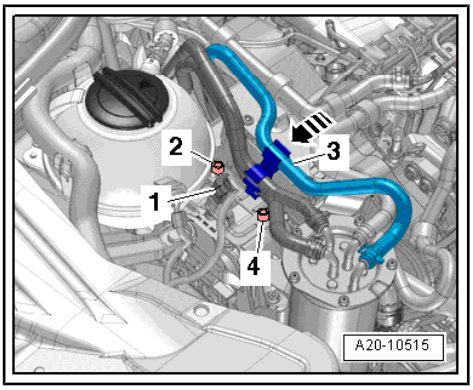
5.3 Checking adjustment of assembly mountings (engine/gearbox mountings)

Procedure

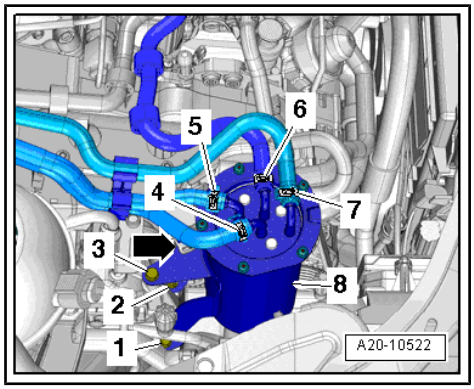
– Remove engine cover panel -arrows-.



– Disengage fuel hose -3- at bracket.
– Pull off bracket for fuel lines towards right -arrow- and move clear to one side.
– Unplug electrical connector -1- at supplementary fuel pump -V393- .
– Remove bolts -2- and -4-, detach bracket with supplementary fuel pump -V393- and move clear to one side.

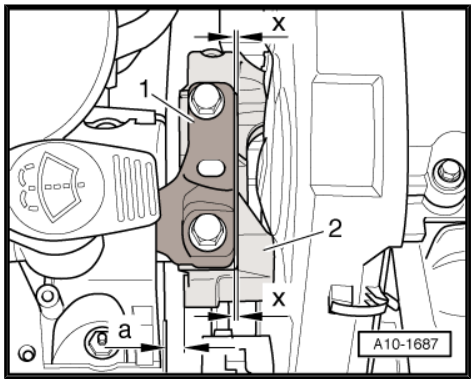


– Loosen bolt -1-.
– Remove nut -2- and bolt -3-.
– Detach hose retainer -arrow- from fuel filter and move fuel filter -8- clear to one side with fuel hoses -4 ... 7- connected.



The following specifications must be obtained:

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



Note

Distance -a- = 13.5 mm can also be checked with a metal rod of suitable size, or similar.

– If the distance measured is too large or small, the assembly mountings must be adjusted ⇒ page 42 .

Assembling

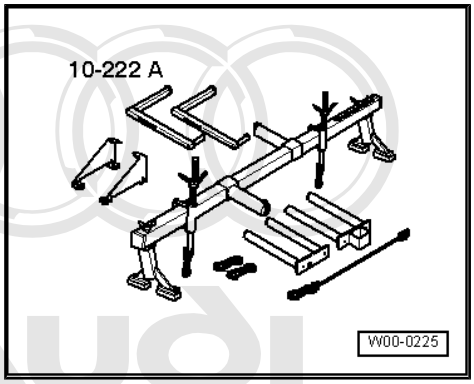
Installation is carried out in the reverse order; note the following:

– Install fuel filter and supplementary fuel pump -V393- ⇒ Rep. Gr. 20 .

5.4 Adjusting assembly mountings

Special tools and workshop equipment required

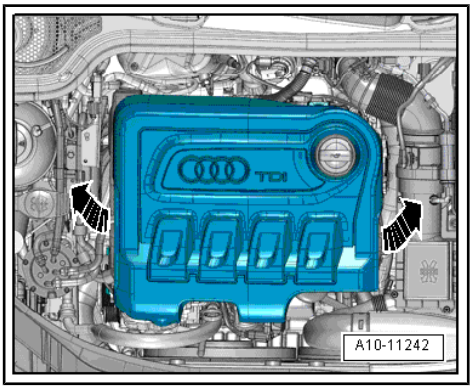
♦ Support bracket -10 - 222 A-



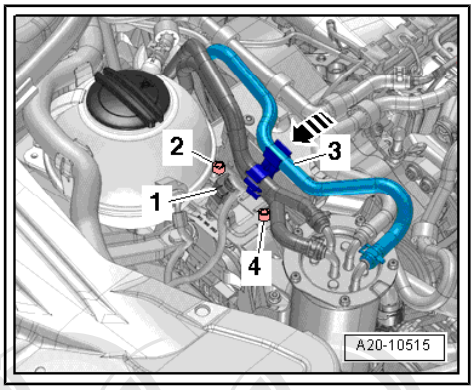
Procedure

- Tightening torques ⇒ page 37

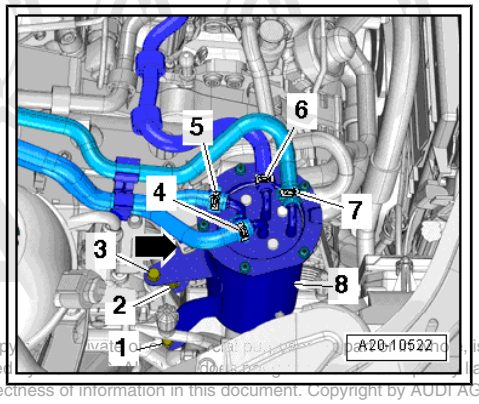
– Remove engine cover panel -arrows-.



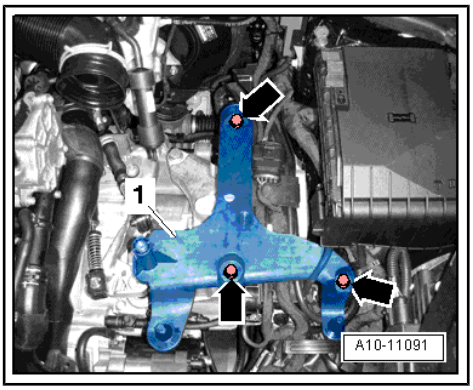
– Disengage fuel hose -3- at bracket.
– Pull off bracket for fuel lines towards right -arrow- and move clear to one side.
– Unplug electrical connector -1- at supplementary fuel pump -V393- .
– Remove bolts -2- and -4-, detach bracket with supplementary fuel pump -V393- and move clear to one side.



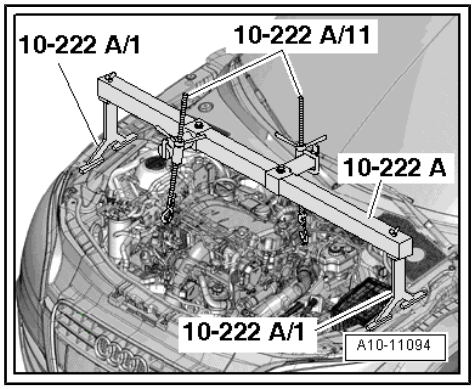
– Loosen bolt -1-.
– Remove nut -2- and bolt -3-.
– Detach hose retainer -arrow- from fuel filter and move fuel filter -8- clear to one side with fuel hoses -4 ... 7- connected.



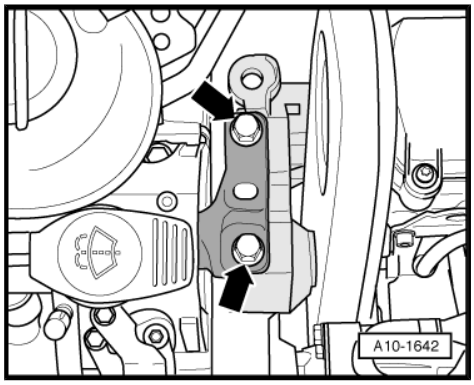
– Remove air cleaner housing ⇒ Rep. Gr. 23 .
– Remove bolts -arrows- and detach bracket -1- for air cleaner housing.



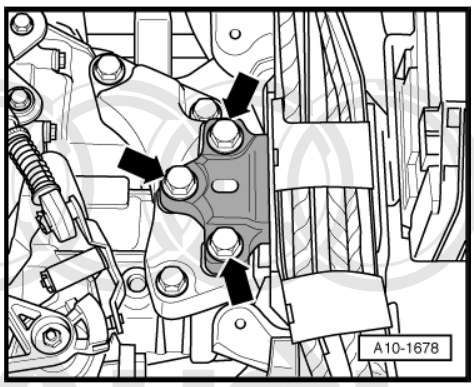
– Position support bracket -10 - 222 A- with spindles -10 - 222 A /11- on bolted flanges of wing panels as shown in illustration.
– Attach hooks of spindles to engine lifting eyes.
– Take up weight of engine/gearbox assembly evenly with both spindles (do not raise assembly).



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

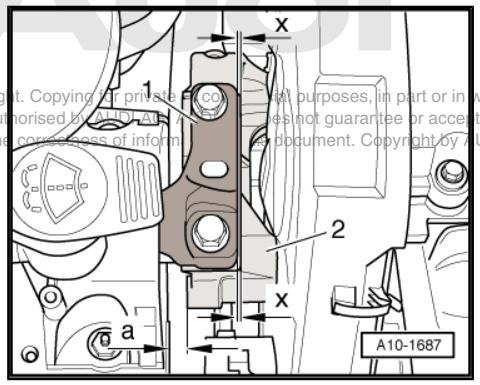


– Remove bolts -arrows- for gearbox mounting one by one and renew (if they were not renewed when installing engine).
– Initially fit bolts hand-tight.



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

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



Note

Distance -a- = 13.5 mm can also be checked with a metal rod of suitable size, or similar.

– Tighten bolts for engine mounting

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

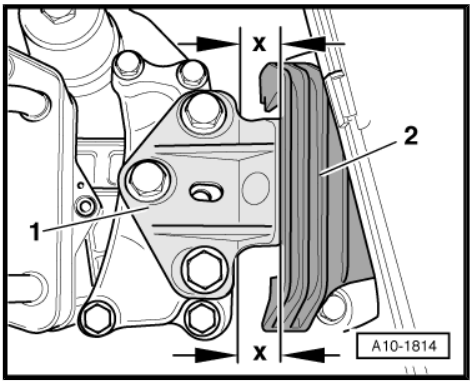
• Dimension -x- = dimension -x-.

– Tighten bolts for gearbox mounting.

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

– Install air cleaner housing ⇒ Rep. Gr. 23 .

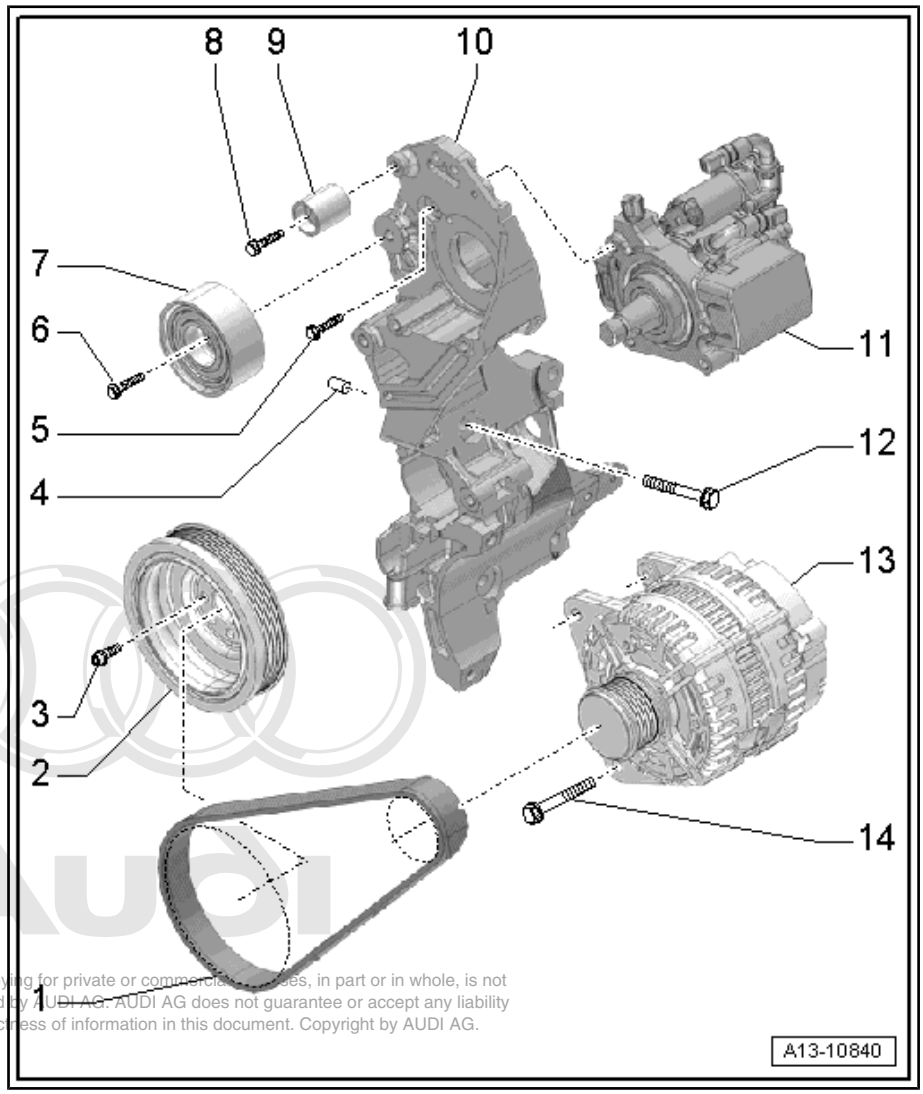
– Install fuel filter and supplementary fuel pump -V393- ⇒ Rep. Gr. 20 .



13 – Crankshaft group

1 Cylinder block (pulley end)

1.1 Poly V-belt drive without air conditioner compressor - exploded view



1 - Poly V-belt
- ❑ Renew.
- ❑ Removing and installing ⇒ page 47

2 - Vibration damper
- ❑ With poly V-belt pulley
- ❑ Installation position: hole in vibration damper must be positioned over raised section of crankshaft sprocket
- ❑ Removing and installing ⇒ page 56

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

4 - Dowel sleeve
- ❑ 2x
- ❑ Ensure correct seating in bracket for ancillaries

5 - Bolt
- ❑ Tightening torque ⇒ Rep. Gr. 23

6 - Bolt
- ❑ Tightening torque ⇒ Item 20 (page 90)

7 - Idler roller
- ❑ For toothed belt

8 - Bolt
- ❑ Tightening torque ⇒ Item 6 (page 89)

9 - Idler roller
- ❑ For toothed belt

10 - Bracket for ancillaries
- ❑ Removing and installing ⇒ page 57

11 - High-pressure pump
- ❑ Removing and installing ⇒ Rep. Gr. 23

12 - Bolt
- ❑ Different lengths ⇒ page 49
- ❑ Tightening torque and sequence ⇒ page 49

13 - Alternator

- ❑ Removing and installing ⇒ Electrical system; Rep. Gr. 27

14 - Bolt

- ❑ Tightening torque ⇒ Electrical system; Rep. Gr. 27

1.2 Removing and installing poly V-belt - vehicles without air conditioner compressor

Special tools and workshop equipment required

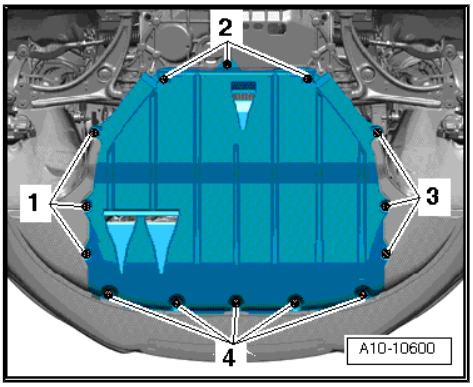
- ♦ Poly V-belt repair set with assembly tool ⇒ Electronic parts catalogue

Procedure

Note

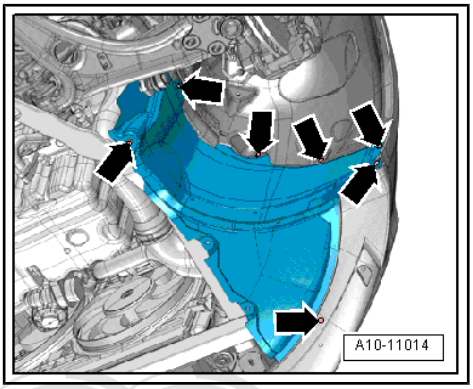
The poly V-belt repair set with assembly tool contains the assembly tool -T10367- and illustrated instructions.

– Remove noise insulation ⇒ Rep. Gr. 66 .



– Remove bottom section of wheel housing liner (right-side) ⇒ Rep. Gr. 66 .

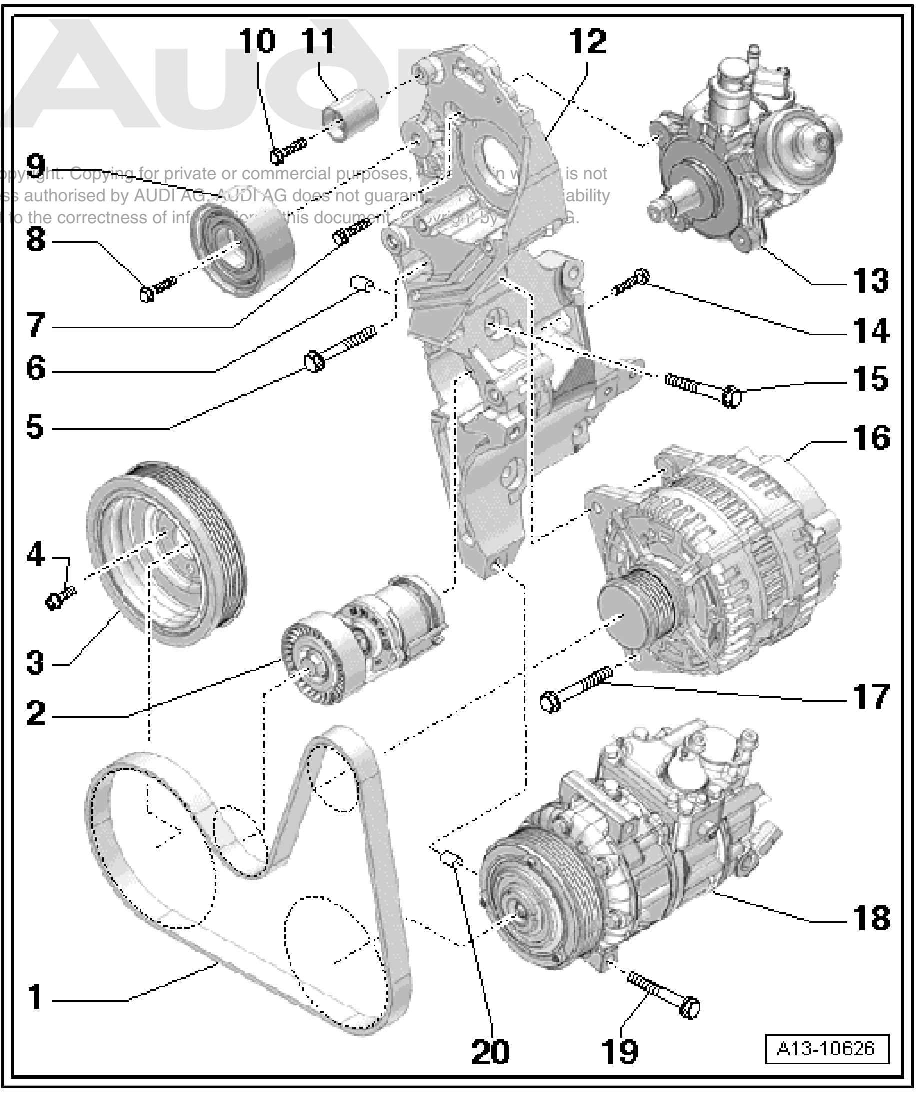
– Follow procedure specified in illustrated instructions (included in poly V-belt repair set with assembly tool).



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

– Install right wheel housing liner (bottom section) and noise insulation ⇒ Rep. Gr. 66 .

1.3 Poly V-belt drive for vehicles with air conditioner compressor and tensioner - exploded view



1 - Poly V-belt

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

2 - Poly V-belt tensioner

- ❑ Removing and installing ⇒ page 52

3 - Vibration damper

- ❑ With poly V-belt pulley
- ❑ Installation position: hole in vibration damper must be positioned over raised section of crankshaft sprocket
- ❑ Removing and installing ⇒ page 56

4 - Bolt

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

5 - Bolt

- ❑ Tightening torque ⇒ Rep. Gr. 27

6 - Dowel sleeve

- ❑ Ensure correct seating in bracket for ancillaries

7 - Bolt

- ❑ Tightening torque ⇒ Rep. Gr. 23

8 - Bolt

- ❑ Tightening torque ⇒ Item 20 (page 90)

9 - Idler roller

- ❑ For toothed belt

10 - Bolt

- ❑ Tightening torque ⇒ Item 6 (page 89)

11 - Idler roller

- ❑ For toothed belt

12 - Bracket for ancillaries

- ❑ Removing and installing ⇒ page 57

13 - High-pressure pump

- ❑ Removing and installing ⇒ Rep. Gr. 23

14 - Bolt

- ❑ 23 Nm

15 - Bolt

- ❑ Tightening torque and sequence ⇒ page 49

16 - Alternator

- ❑ Removing and installing ⇒ Rep. Gr. 27

17 - Bolt

- ❑ Tightening torque ⇒ Rep. Gr. 27

18 - Air conditioner compressor

- ❑ Removing and installing ⇒ Rep. Gr. 87

19 - Bolt

- ❑ Tightening torque ⇒ Rep. Gr. 87

20 - Dowel sleeve

- ❑ Ensure correct seating in bracket for ancillaries

Bracket for ancillaries - tightening torque and tightening sequence

Note

Renew the bolts tightened with specified tightening angle.

– Fit bolts in the following sequence:

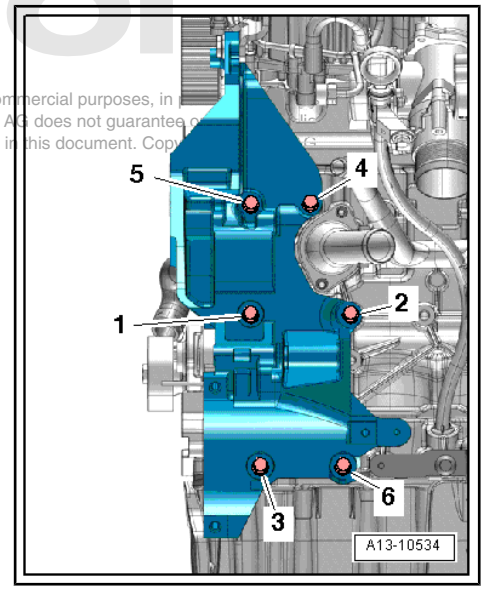
♦ Bolts -1- and -2- M10x52.

♦ Bolts -3- and -6- M10x30.

♦ Bolts -4- and -5- M10x60.

– Tighten bolts in 4 stages in the sequence shown:

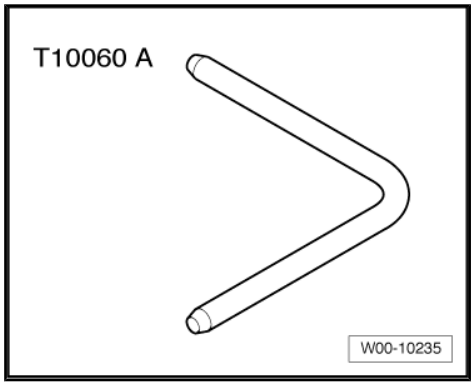
Stage	Bolts	Tightening torque/angle specification
1.	-1 … 6-	Screw in bolts by hand until they make contact.
2.	-1 … 6-	40 Nm
3.	-3- and -6-	turn 45° further
4.	-1, 2, 4, 5-	turn 90° further



1.4 Removing and installing poly V-belt - vehicles with air conditioner compressor and tensioner

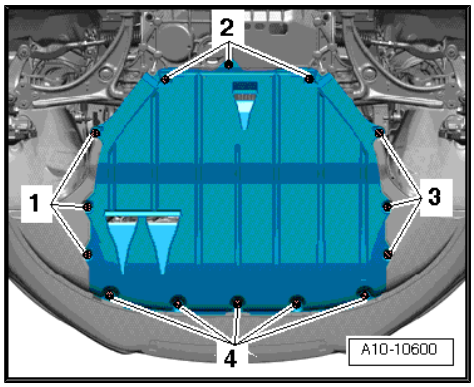
Special tools and workshop equipment required

♦ Locking pin -T10060 A-

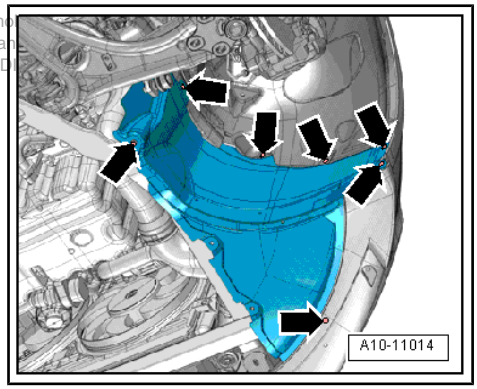


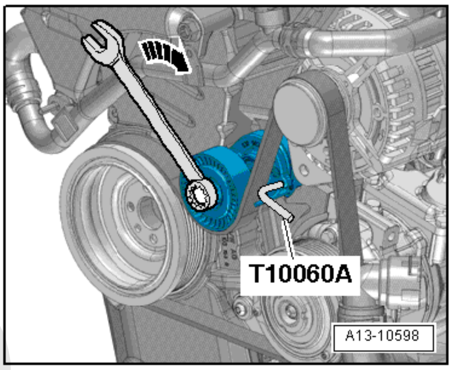
Removing

– Remove noise insulation ⇒ Rep. Gr. 66 .



– Remove bottom section of wheel housing liner (right-side) ⇒ Rep. Gr. 66 .





⚠ 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-tipped pen for re-installation.*

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

– Lock tensioner with locking pin -T10060 A-

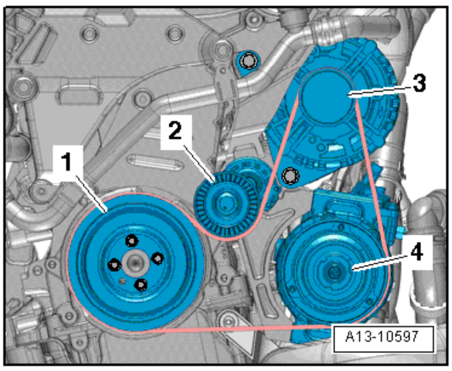
– Take off poly V-belt.

Installing

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

Note

Before fitting poly V-belt, make sure all mechanical units (alternator and air conditioner compressor) are firmly in position.



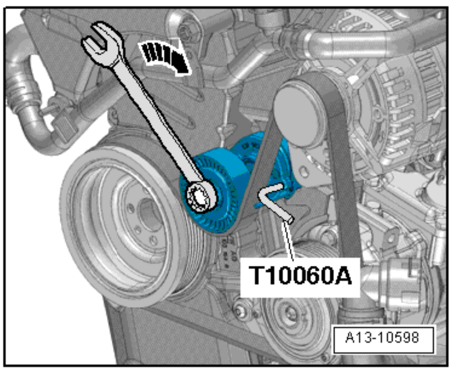
– Fit poly V-belt on all poly V-belt pulleys:

1 - Crankshaft

2 - Tensioner

3 - Alternator

4 - Air conditioner compressor



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

– Slacken tensioner.

– Check that poly V-belt is properly seated.

– Start engine and check that belt runs properly.

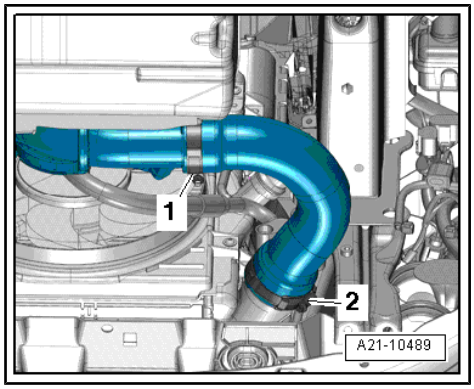
– Install right wheel housing liner (bottom section) and noise insulation ⇒ Rep. Gr. 66 .

1.5 Removing and installing tensioner for poly V-belt

Removing

– Detach poly V-belt from tensioner
⇒ “1.4 Removing and installing poly V-belt - vehicles with air conditioner compressor and tensioner”, page 49 .

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

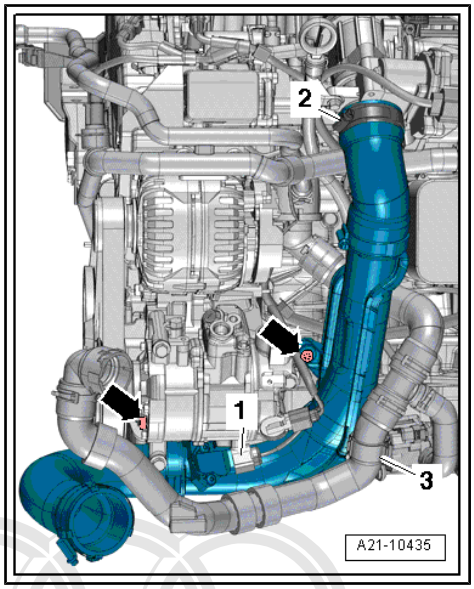


– Remove bolts -arrows-.

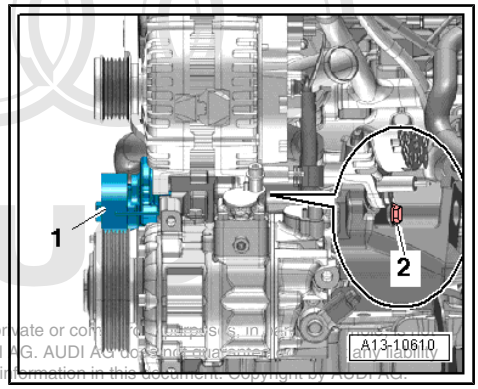
– Move coolant hose -3- clear.

– Loosen hose clip -2-.

– Unplug electrical connector -1- at charge pressure sender - G31- / intake air temperature sender -G42- and detach air pipe (right-side).



– Remove bolt -2- and take off tensioner -1- for poly-V-belt.



Installing

• Tightening torque ⇒ page 48 .

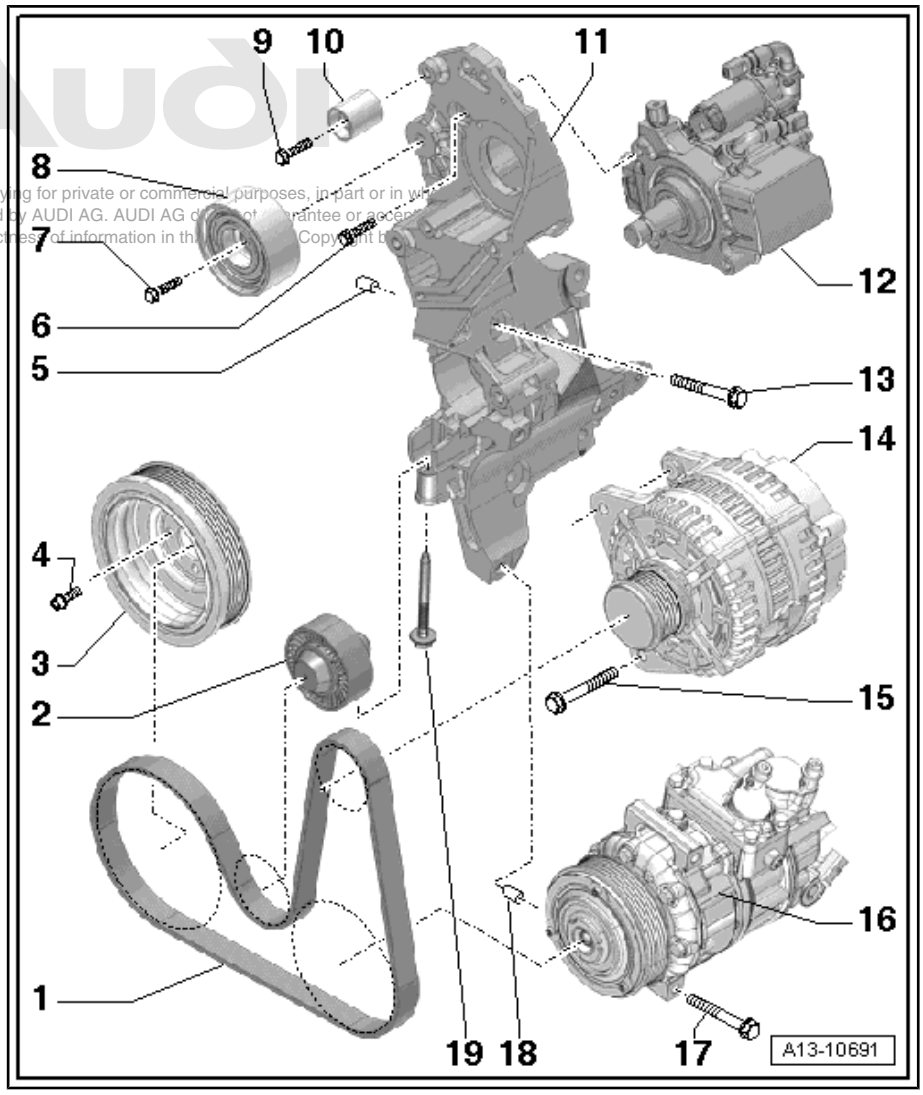
Installation is carried out in the reverse order; note the following:

– Install air pipe ⇒ page 212 .

– Install air hoses with screw-type clips ⇒ page 213 .

– Install poly V-belt ⇒ page 49 .

1.6 Poly V-belt drive for vehicles with air conditioner compressor and tensioning roller - exploded view



1 - Poly V-belt

- ❑ Check for wear
- ❑ Before removing, mark direction of rotation with chalk or felt-tip pen
- ❑ Removing and installing ⇒ page 55
- ❑ Do not kink
- ❑ When installing, make sure it is properly seated on pulleys.

2 - Tensioning roller

- ❑ For poly V-belt
- ❑ Removing and installing ⇒ “1.7 Removing and installing poly V-belt - vehicles with air conditioner compressor and tensioning roller”, page 55
- ❑ Coat contact surfaces with lubricating paste; for lubricating paste refer to ⇒ Electronic parts catalogue

3 - Vibration damper

- ❑ With poly V-belt pulley
- ❑ Installation position: hole in vibration damper must be positioned over raised section of crankshaft sprocket
- ❑ Removing and installing ⇒ page 56

4 - Bolt

- ❑ Tightening torque ⇒ Item 4 (page 48)

5 - Dowel sleeve

- ❑ Ensure correct seating in bracket for ancillaries

6 - Bolt

- ❑ Tightening torque ⇒ Rep. Gr. 23

7 - Bolt

- ❑ Tightening torque ⇒ Item 20 (page 90)

8 - Idler roller

- ❑ For toothed belt

9 - Bolt

- ❑ Tightening torque ⇒ Item 6 (page 89)

10 - Idler roller

- ❑ For toothed belt

11 - Bracket for ancillaries

- ❑ Removing and installing ⇒ page 57

12 - High-pressure pump

- ❑ Version shown in illustration corresponds to version fitted in vehicle
- ❑ Removing and installing ⇒ Rep. Gr. 23

13 - Bolt

- ❑ Tightening torque and sequence ⇒ page 49

14 - Alternator

- ❑ Removing and installing ⇒ Electrical system; Rep. Gr. 27

15 - Bolt

- ❑ Tightening torque ⇒ Electrical system; Rep. Gr. 27

16 - Air conditioner compressor

- ❑ Removing and installing ⇒ Rep. Gr. 87

17 - Bolt

- ❑ Tightening torque ⇒ Rep. Gr. 87

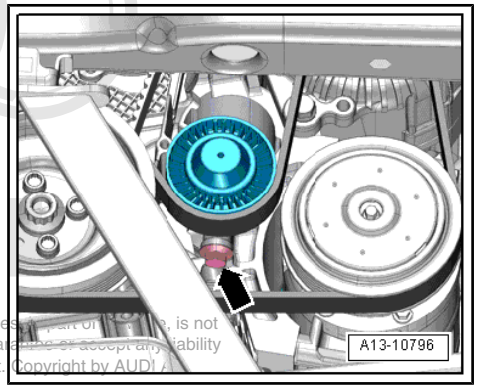
18 - Dowel sleeve

- ❑ Ensure correct seating in bracket for ancillaries

19 - Bolt

- ❑ Tightening torque and sequence ⇒ page 49

Tensioning roller for poly V-belt - tightening torque and tightening sequence



Note

- ♦ *Renew the bolts tightened with specified tightening angle.*
- ♦ *Use a brush to coat guide surfaces of tensioning roller with lubricating paste; lubricating paste ⇒ Electronic parts catalogue .*

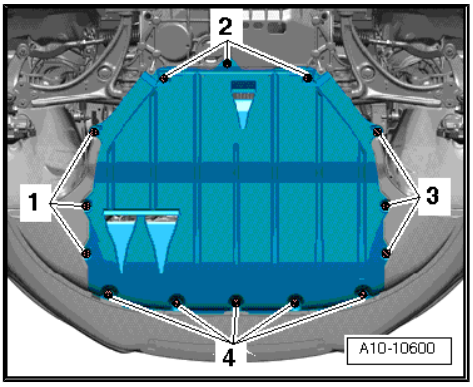
– Tighten bolt in 5 stages:

Stage	Bolt	Tightening torque/tightening angle
1.	-arrow-	Screw in bolt by hand until it makes contact. • The poly V-belt is tensioned
2.	-arrow-	Turn until the pin on the tensioning roller has contacted the stop • The poly V-belt is tensioned further
3.	-arrow-	Loosen by 90°
4.	-arrow-	30 Nm
5.	-arrow-	turn 90° further

1.7 Removing and installing poly V-belt - vehicles with air conditioner compressor and tensioning roller

Removing

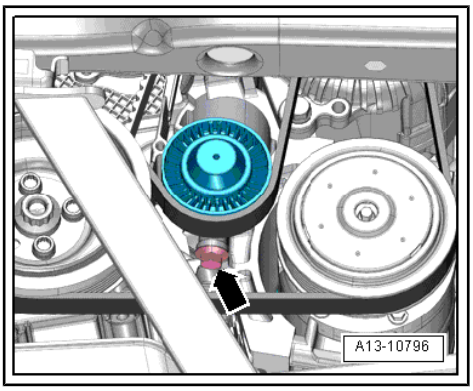
– Remove noise insulation ⇒ Rep. Gr. 66 .



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-tipped pen for re-installation.***



– Remove tensioning bolt -arrow- and detach tensioning roller to slacken poly V-belt.

– Take off poly V-belt.

Installing

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

Note

- *Renew bolt for tensioning roller.*
- *Before fitting poly V-belt, make sure all mechanical units (alternator and air conditioner compressor) are firmly in position.*

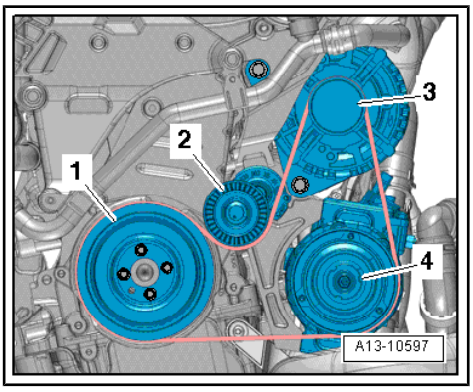
– Fit poly V-belt on all poly V-belt pulleys:

1 - Vibration damper

2 - Tensioning roller

3 - Alternator

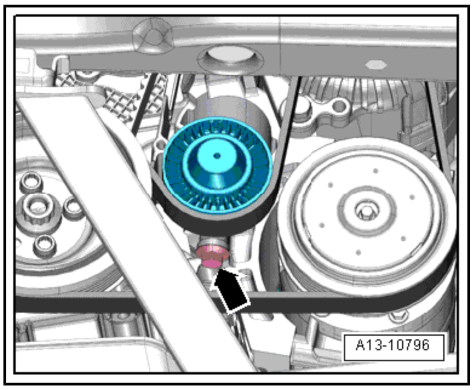
4 - Air conditioner compressor



– Use a brush to coat guide surfaces of tensioning roller with lubricating paste; lubricating paste ⇒ Electronic parts catalogue .

– Insert tensioning roller with pin into guide on bracket for ancillaries.

– Tightening bolt for tensioning roller ⇒ page 54 .



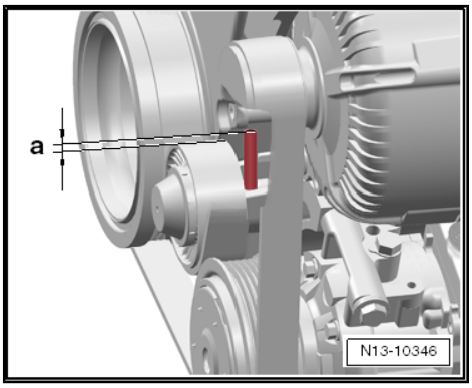
– Check that end of bolt for tensioning roller protrudes beyond contact surface of tensioning roller as far as dimension -a-.

• Distance -a- = approx. 2.5 mm.

• This ensures that the pin is at its limit stop.

– Start engine and check that belt runs properly.

– Install noise insulation ⇒ Rep. Gr. 66 .



1.8 Removing and installing vibration damper

Removing

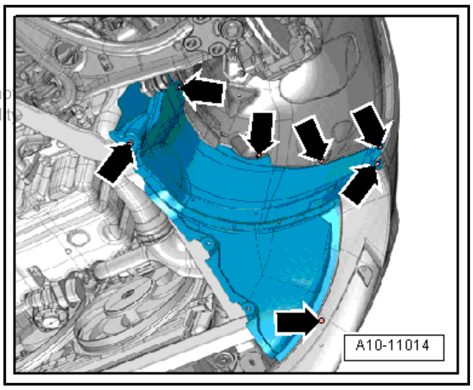
Vehicles without air conditioner compressor:

– Remove poly V-belt ⇒ page 47 .

Vehicles with air conditioner compressor:

– Vehicles with air conditioner compressor and tensioning roller: Remove bottom section of wheel housing liner (right-side) ⇒ Rep. Gr. 66 .

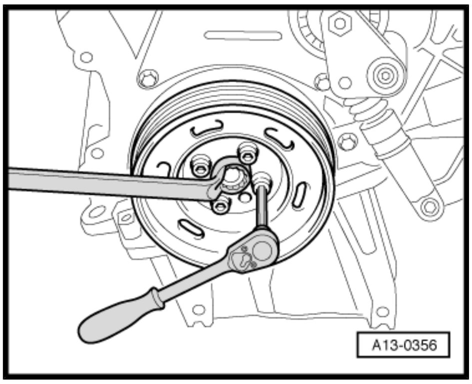
– Remove poly V-belt ⇒ “1.4 Removing and installing poly V-belt - vehicles with air conditioner compressor and tensioner”, page 49 , ⇒ “1.7 Removing and installing poly V-belt - vehicles with air conditioner compressor and tensioning roller”, page 55 .



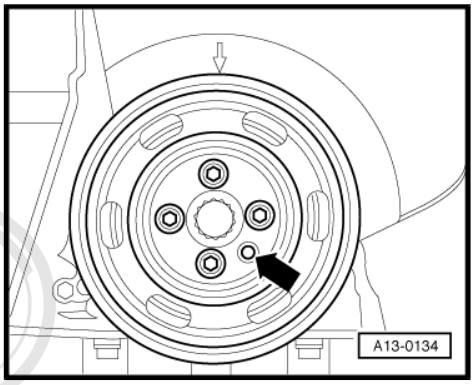
All vehicles (continued):

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

– Remove bolts and take off vibration damper.



Installing



- Tightening torque
  ⇒ “1.3 Poly V-belt drive for vehicles with air conditioner compressor and tensioner - exploded view”, page 48 .

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

Note

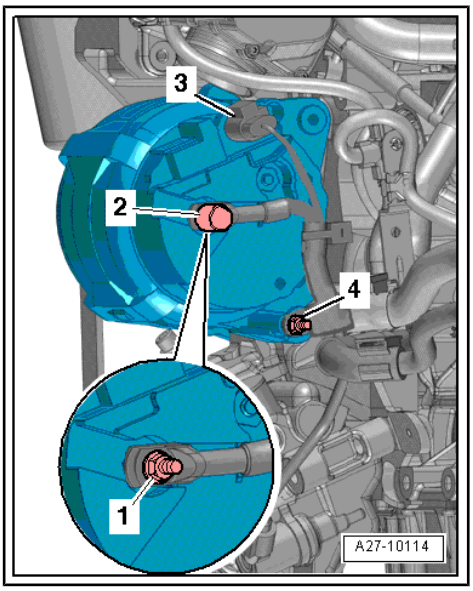
Renew bolts for vibration damper.

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

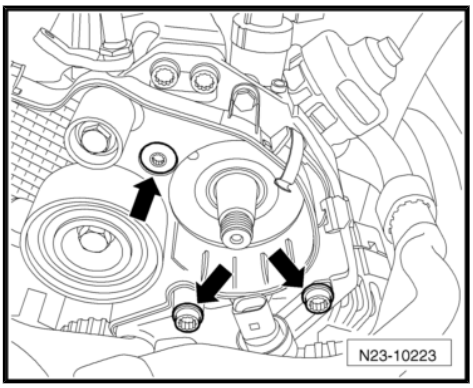
– Install poly V-belt
  ⇒ “1.2 Removing and installing poly V-belt - vehicles without air conditioner compressor”, page 47 ,
  ⇒ “1.4 Removing and installing poly V-belt - vehicles with air conditioner compressor and tensioner”, page 49 ,
  ⇒ “1.7 Removing and installing poly V-belt - vehicles with air conditioner compressor and tensioning roller”, page 55 .
– Install right wheel housing liner (bottom section) ⇒ Rep. Gr. 66 .

1.9 Removing and installing bracket for ancillaries

Removing

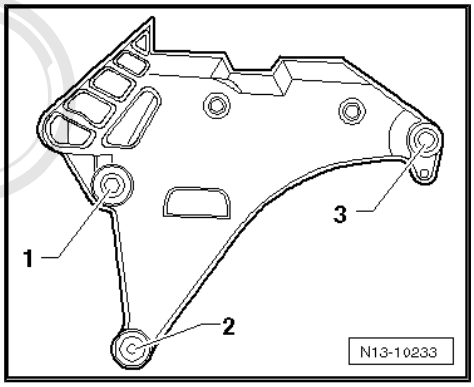


– Remove engine mounting ⇒ page 38 .
– Remove alternator ⇒ Electrical system; Rep. Gr. 27 .



– Remove high-pressure pump ⇒ Rep. Gr. 23 .

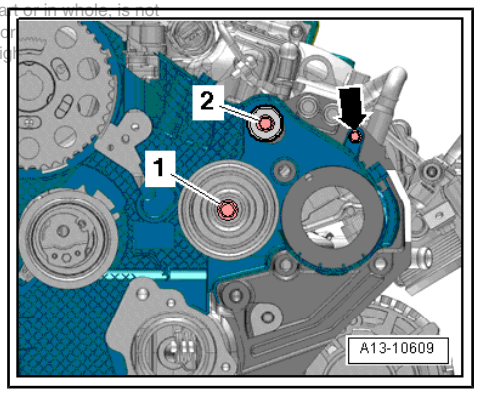
– Remove bolt -3- on engine support.
– Pull engine upwards with spindle and replace bolt.



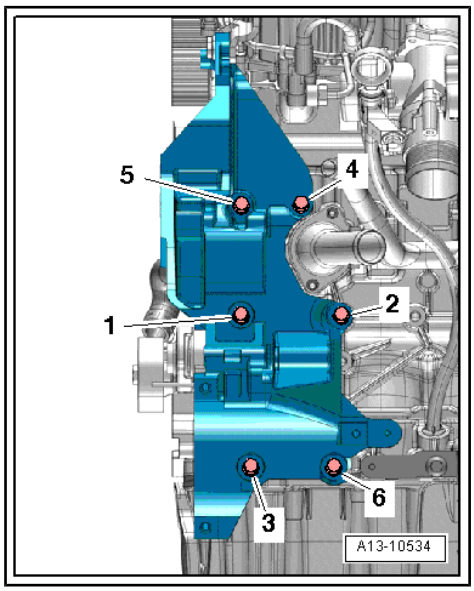
Note

Disregard -items 1, 2-.

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



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



Installing

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

Note

Renew the bolts tightened with specified tightening angle.

– Check that dowel sleeve at top right between bracket for ancillaries and cylinder block is fitted; insert dowel sleeve if necessary.
– Tighten bolts for bracket for ancillaries ⇒ page 49 .
– Install engine support ⇒ page 37 .
– Install high-pressure pump ⇒ Rep. Gr. 23 .
– Install toothed belt (adjust valve timing) ⇒ page 95 .
– Install alternator ⇒ Electrical system; Rep. Gr. 27 .
– Install engine mountings ⇒ page 37 .

1.10 Sealing flange (pulley end) - exploded view

1 - Bolt
- ❑ Tightening torque ⇒ Item 25 (page 90)

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

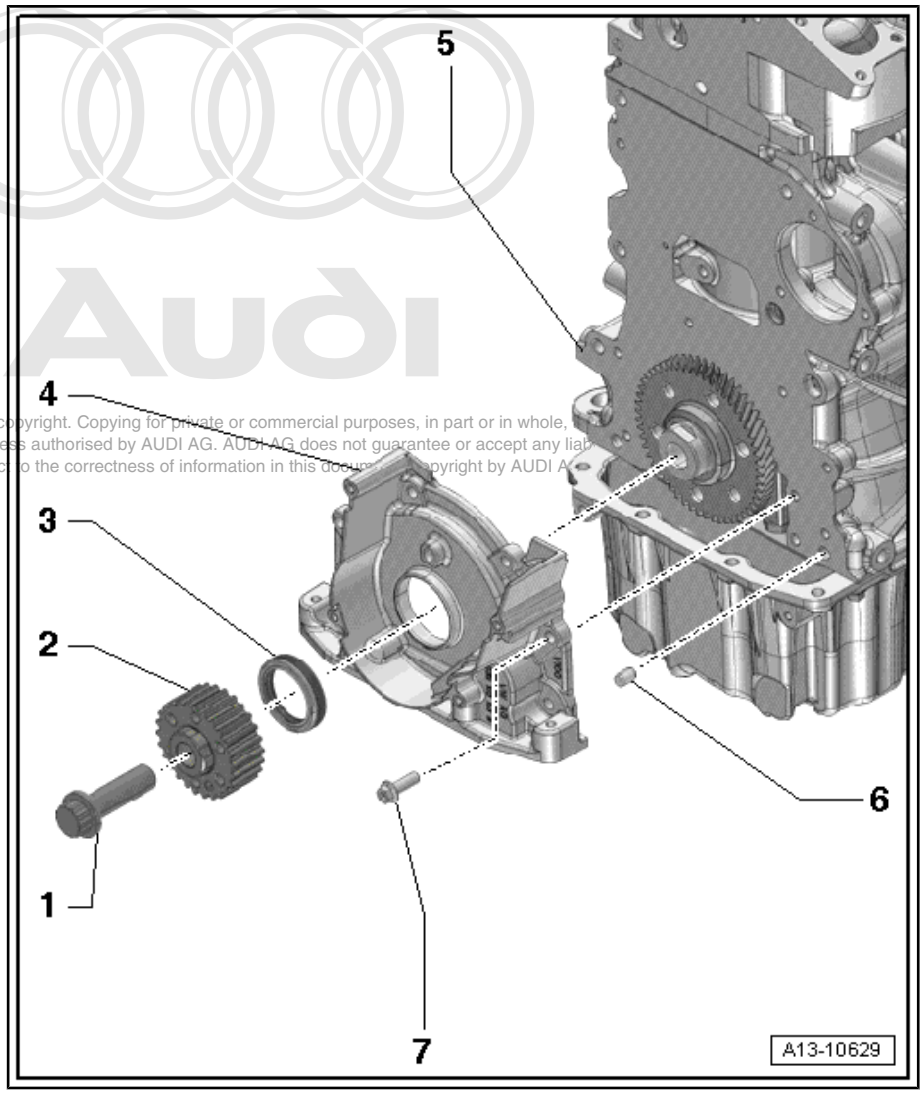
3 - Oil seal for crankshaft (pulley end)
- ❑ Renewing ⇒ page 59
- ❑ Do not lubricate with oil

4 - Sealing flange (pulley end)
- ❑ Should be positioned on dowel pins
- ❑ Removing and installing ⇒ page 61

5 - Cylinder block

6 - Dowel pin
- ❑ 2x

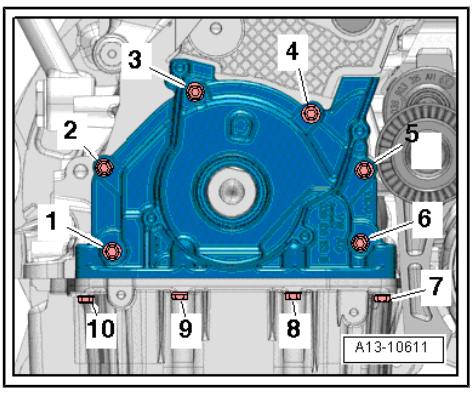
7 - Bolt
- ❑ Tightening torque and sequence ⇒ page 59



Sealing flange (pulley end) - tightening torque and sequence

– Tighten bolts in 3 stages in the sequence shown:

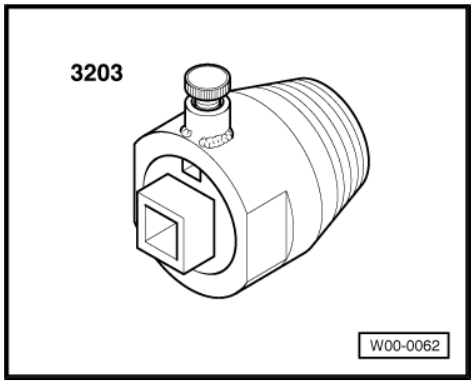
Stage	Bolts	Tightening torque
1.	-1 … 10-	Screw in bolts by hand until they make contact.
2.	-1 … 6-	Tighten in stages and in diagonal sequence; final torque 15 Nm.
3.	-7 … 10-	15 Nm



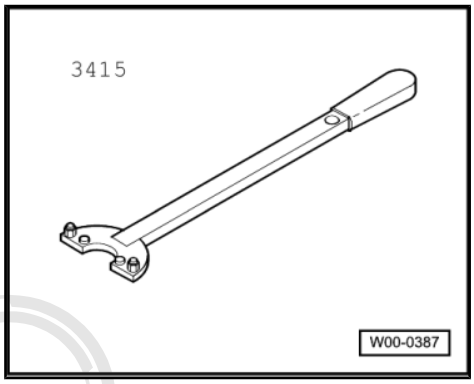
1.11 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

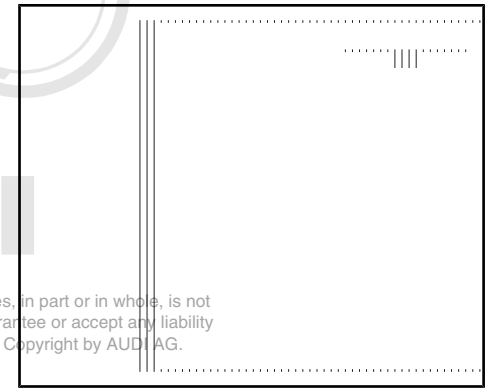
- Oil seal extractor -3203-



- Counterhold tool -3415-



- Assembly tool -T10053-

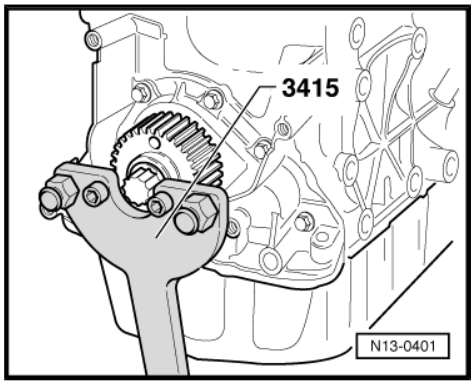


Procedure

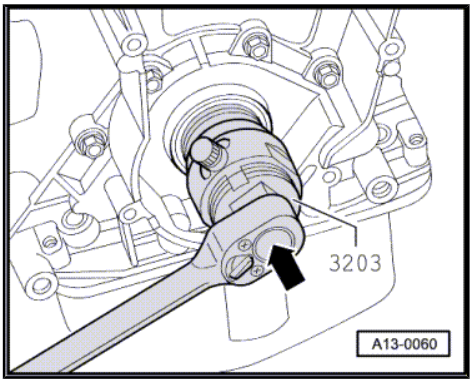
– Remove toothed belt ⇒ page 91 .

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

– Remove bolt and detach crankshaft sprocket.



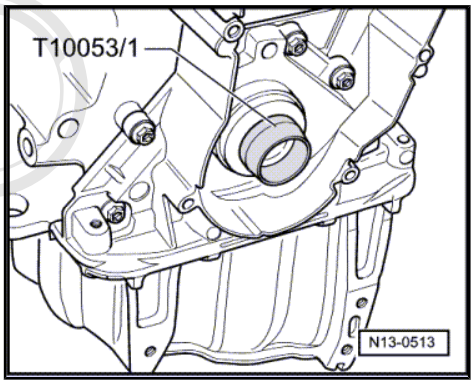
– Adjust inner section of oil seal extractor -3203- so it is flush with the outer section and lock in position with knurled screw.
– Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).
– Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.
– Clamp flats of oil seal extractor in vice and use pliers to remove oil seal.
– Clean contact surface and sealing surface for oil seal.
– Remove oil residue from crankshaft journal with a clean cloth.



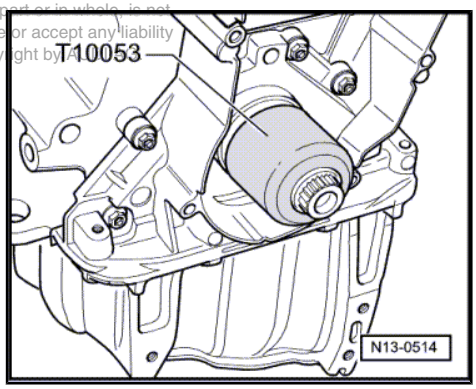
Note

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

– Fit guide sleeve -T10053/1- onto crankshaft journal.
– Push oil seal over guide sleeve onto crankshaft journal.



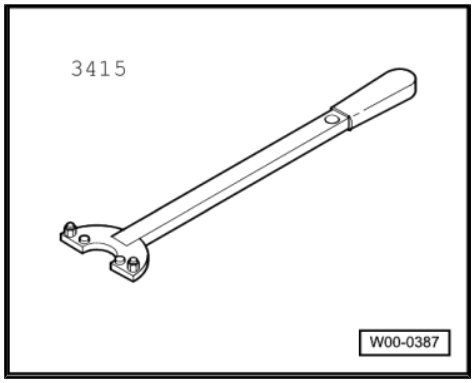
– Press in oil seal using bolt for crankshaft sprocket and thrust sleeve of assembly tool -T10053- until flush.
– Install crankshaft sprocket ⇒ page 89 .
– Install toothed belt (adjust valve timing) ⇒ page 95 .



1.12 Removing and installing sealing flange (pulley end)

Special tools and workshop equipment required

- Counterhold tool -3415-



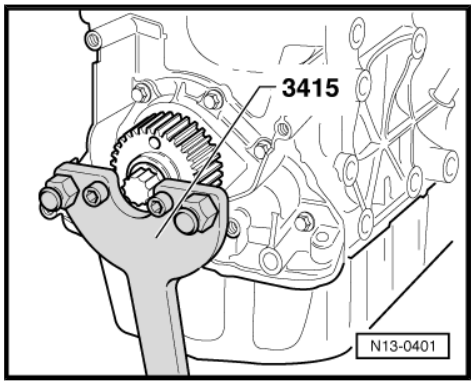
- Electric drill with plastic brush attachment
- Safety goggles
- Sealant ⇒ Electronic parts catalogue

Removing

– Remove toothed belt ⇒ page 91 .

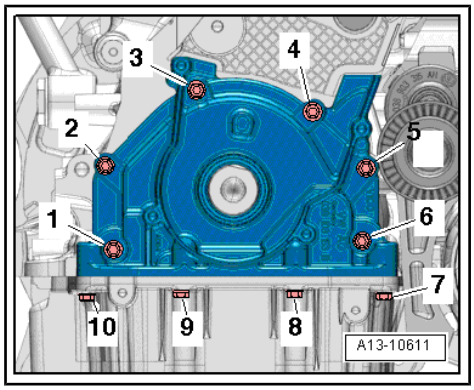
– Loosen bolt for crankshaft sprocket using counterhold tool -3415- .

– Remove bolt and detach crankshaft sprocket.



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

– Drive out oil seal with sealing flange removed.



Installing

• Tightening torque ⇒ page 59 .

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

Caution

Make sure sealant residue does not enter lubrication system.

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

– Carefully remove sealant residue on cylinder block and sump.

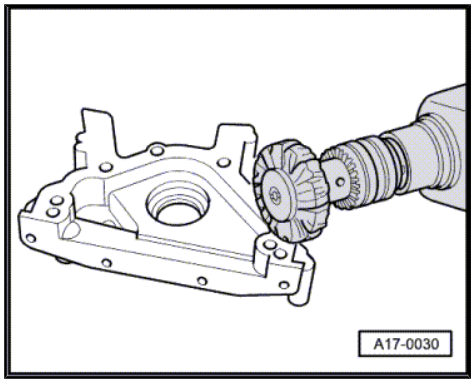
WARNING

Protect eyes against injuries.

- ***Wear safety goggles.***

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

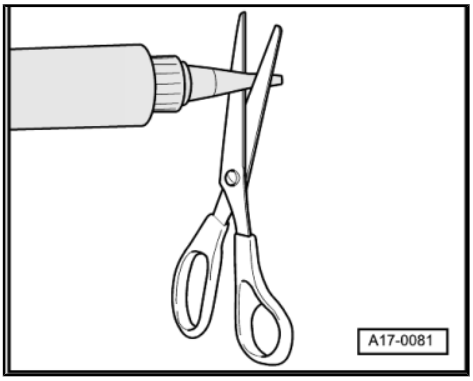
– Clean sealing surfaces; they must be free of oil and grease.



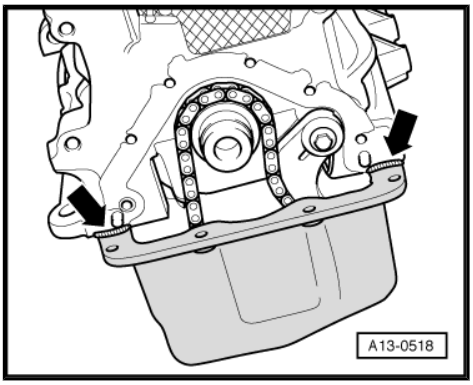
Note

Note the use-by date of the sealant.

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



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



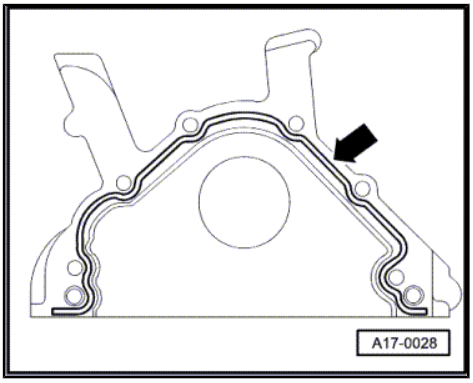
Caution

Make sure lubrication system is not clogged by excess sealant.

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

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

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

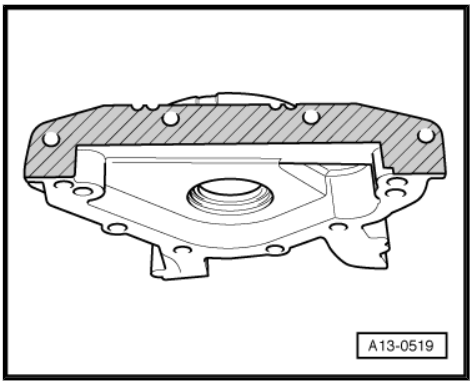


– Apply a thin coat of sealant to bottom sealing surface -shaded- on sealing flange.

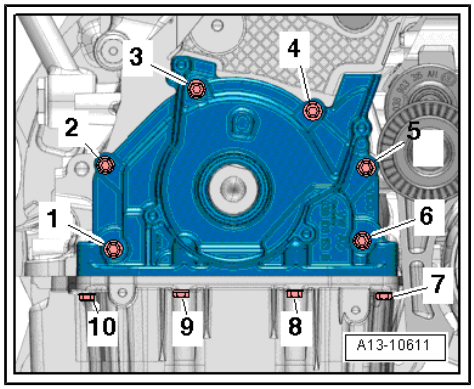
Note

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

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



– Tighten sealing flange bolts ⇒ page 59 .
– Install crankshaft oil seal (pulley end) ⇒ page 59 .

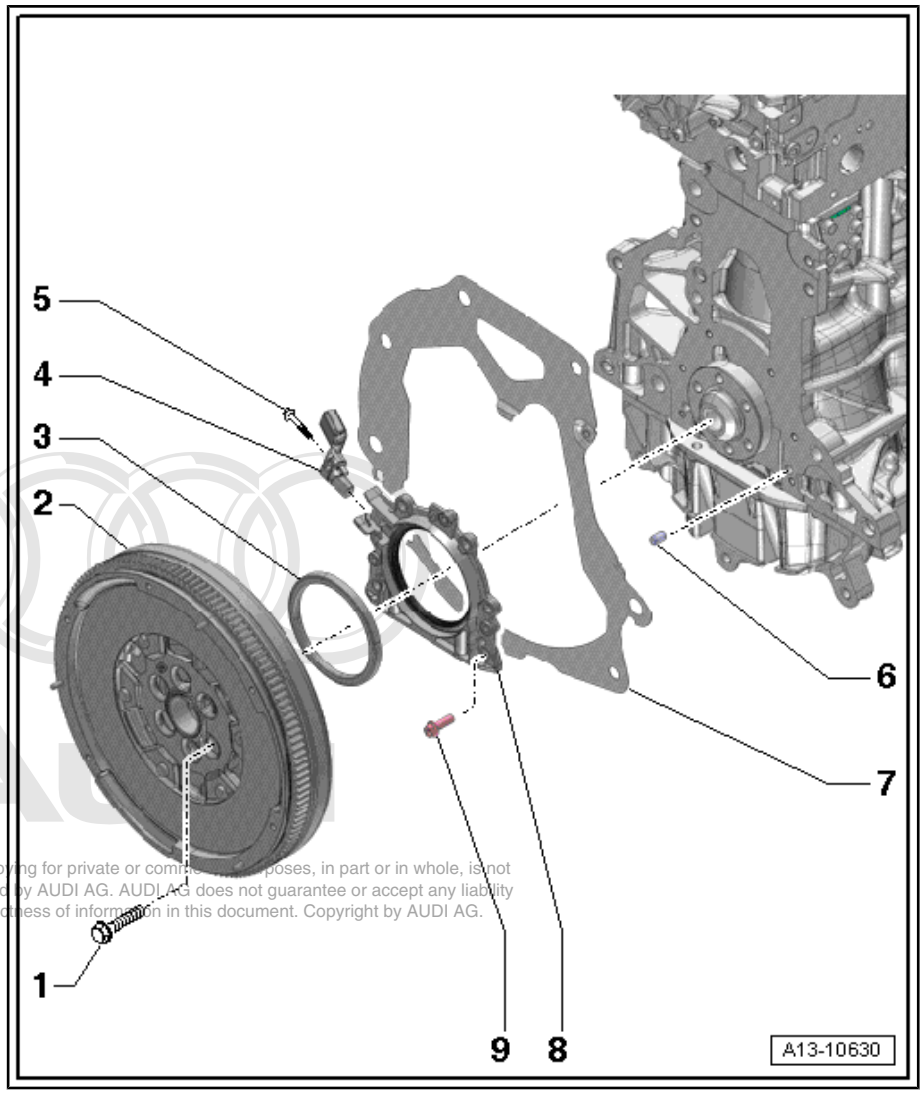


2 Cylinder block (gearbox end)

Note

Servicing clutch ⇒ Rep. Gr. 30

2.1 Dual-mass flywheel and sealing flange (gearbox end) - exploded view



1 - Bolt
- ❑ Renew
- ❑ 60 Nm + 90°

2 - Dual-mass flywheel
- ❑ Removing and installing ⇒ page 66
- ❑ Can only be installed in one position

3 - Sender wheel
- ❑ For engine speed sender -G28-
- ❑ Removing and installing ⇒ “2.3 Renewing sealing flange (gearbox end)”, page 67

4 - Engine speed sender -G28-
- ❑ Removing and installing ⇒ “2.3 Renewing sealing flange (gearbox end)”, page 67

5 - Bolt
- ❑ 4.5 Nm

6 - Dowel pin
- ❑ 2x

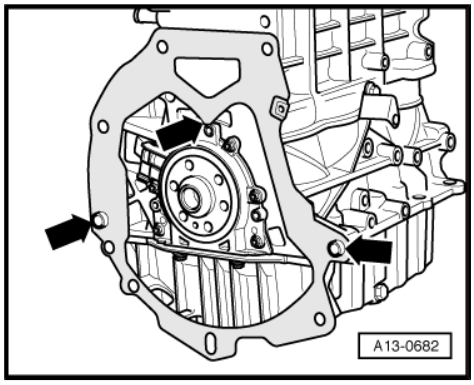
7 - Intermediate plate
- ❑ Should be positioned on dowel pins
- ❑ Do not damage or bend when assembling
- ❑ Engaging on sealing flange ⇒ page 66

8 - Sealing flange (gearbox end)
- ❑ With oil seal
- ❑ Renewing ⇒ page 67

9 - Bolt
- ❑ Tightening torque and sequence ⇒ page 66

Installing intermediate plate

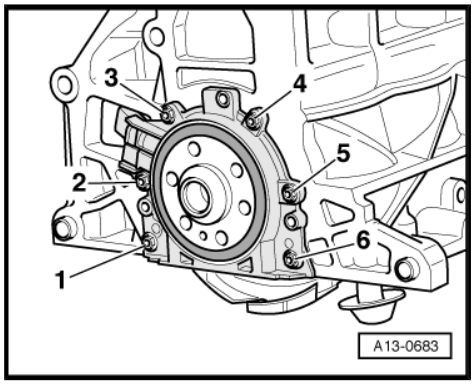
– Engage intermediate plate on sealing flange -top arrow- and push onto dowel sleeves -bottom arrows-.



Sealing flange (gearbox end) - tightening torque and sequence

– Tighten bolts in 2 stages in the sequence shown:

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



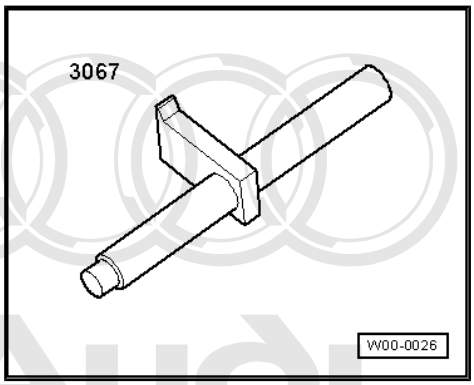
Note

Disregard -items 7, 8-.

2.2 Removing and installing dual-mass flywheel

Special tools and workshop equipment required

♦ Counterhold tool -3067-



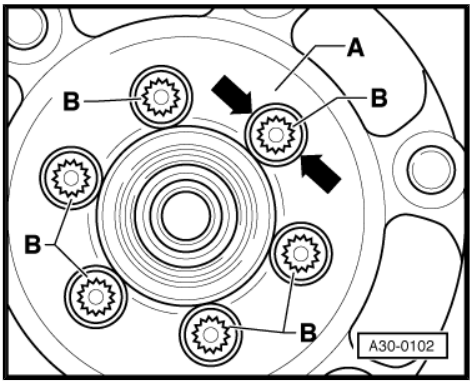
Removing

- Gearbox removed.

Caution

Make sure dual-mass flywheel is not damaged.

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



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

– Remove bolts and take off dual-mass flywheel.

Installing

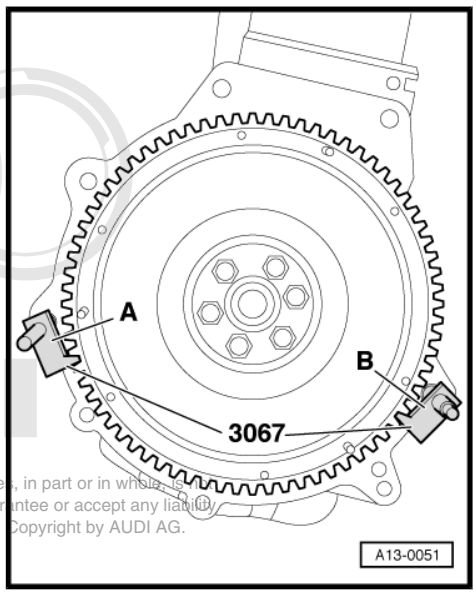
- Tightening torque
⇒ “2.1 Dual-mass flywheel and sealing flange (gearbox end) - exploded view”, page 65 .

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

Note

Renew the bolts tightened with specified tightening angle.

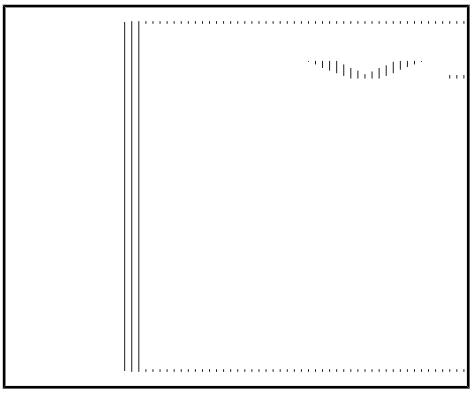
– Insert counterhold -3067- in hole on cylinder block -item A-.



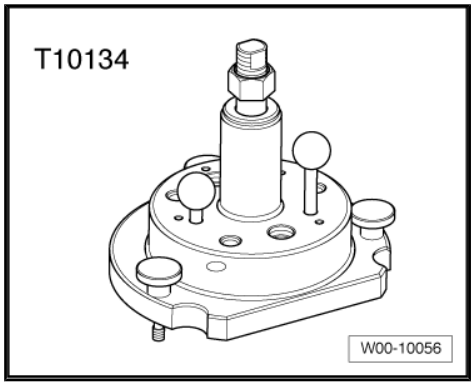
2.3 Renewing sealing flange (gearbox end)

Special tools and workshop equipment required

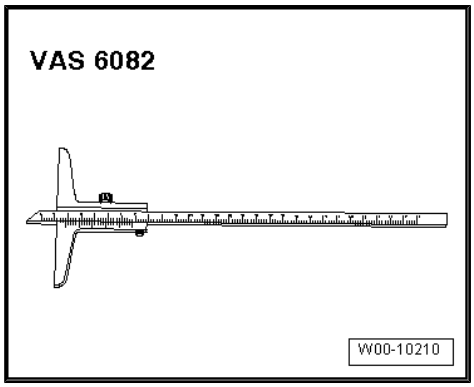
- Tool insert, AF 24 -V.A.G 1332/11-



- Assembly tool -T10134-



- Depth gauge -VAS 6082-



- Bolt M6x35 (3x)
- Bolt M7x35 (2x)

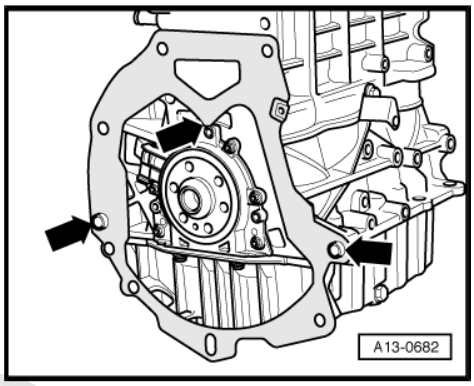
Pressing out sealing flange with sender wheel

- Gearbox removed.

– Remove dual-mass flywheel ⇒ page 66 .

Note

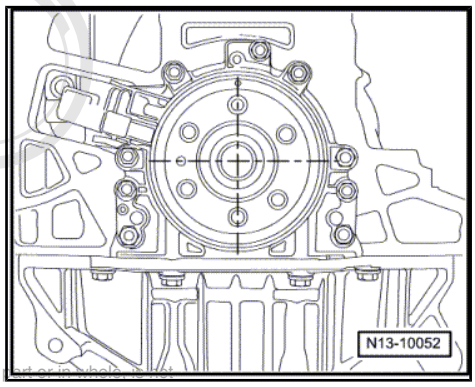
For illustration purposes, the following procedure is shown with the engine removed.



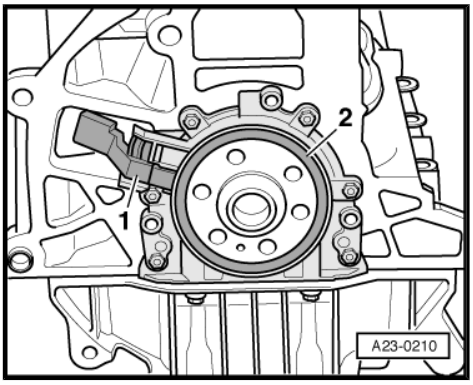
– Detach intermediate plate at sealing flange and dowel sleeves -arrows-.

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

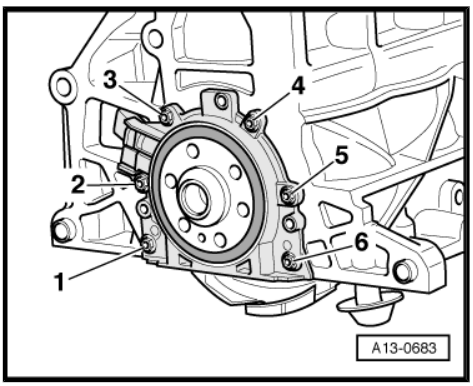
– Remove sump ⇒ page 147 .



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



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



Note

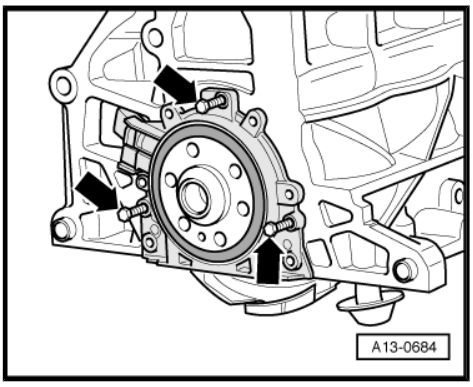
Disregard -items 7, 8-.

Note

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

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

– Take off sealing flange with sender wheel.



Pressing in sealing flange with sender wheel

Note

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

Construction of assembly tool -T10134-

A - Tightening flats

B - Hexagon nut

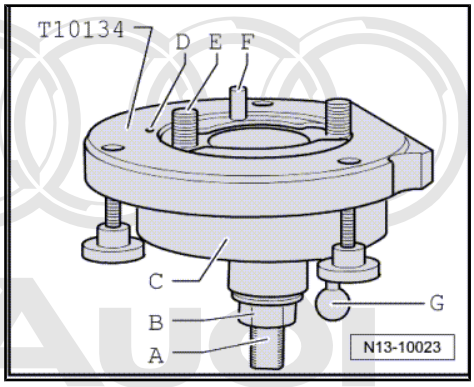
C - Assembly housing

D - Locating pin

E - Hexagon socket-head bolt

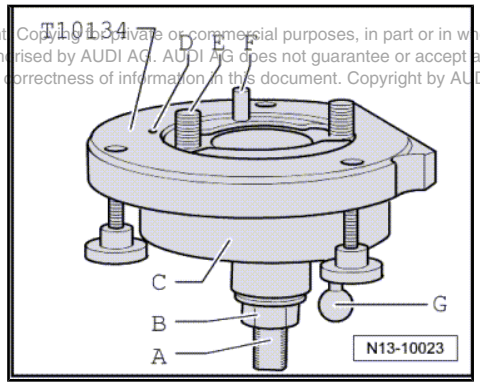
F - Guide pin for diesel engines (black handle)

G - Guide pin for petrol engines (red handle)



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

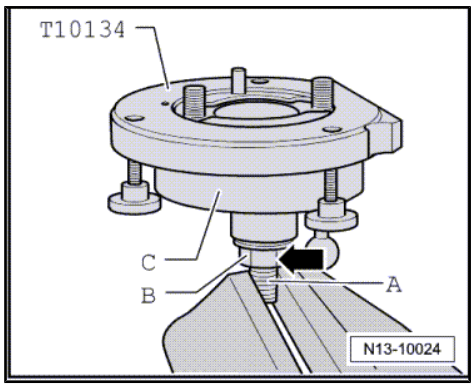
– Turn hexagon nut -B- on threadded spindle until it is just in front of flats -A-.



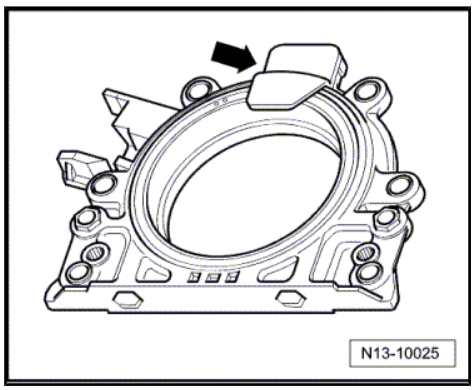
– Clamp assembly tool -T10134- in a vice on tightening flats -A- of threaded spindle.

– Press assembly housing -C- downwards so that it lies on hexagon nut -B- -arrow-.

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



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

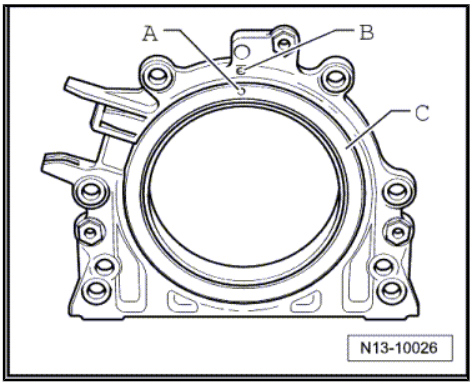


Note

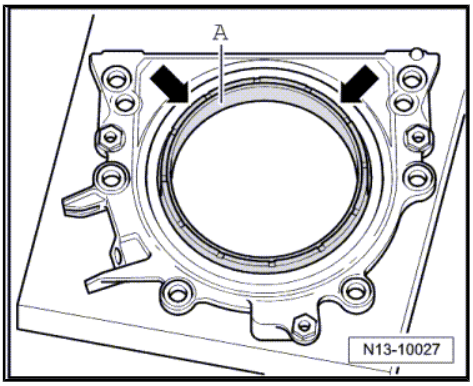
The sender wheel must not be taken out of the sealing flange or rotated out of position.

- The locating hole -A- on the sender wheel -C- must align with the marking -B- on the sealing flange.

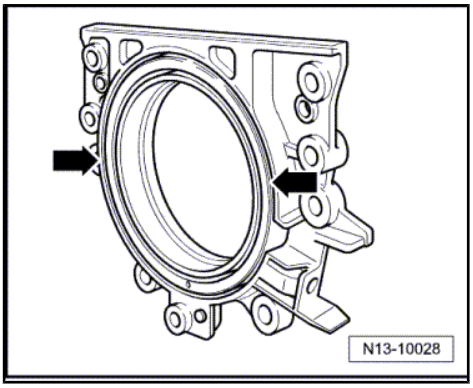
– Place the sealing flange (with the front side downwards) on a clean flat surface.



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

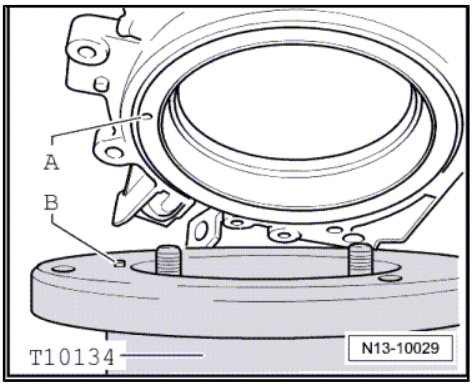


- The upper edge of the sender wheel and the front edge of the sealing flange must align -arrows-.



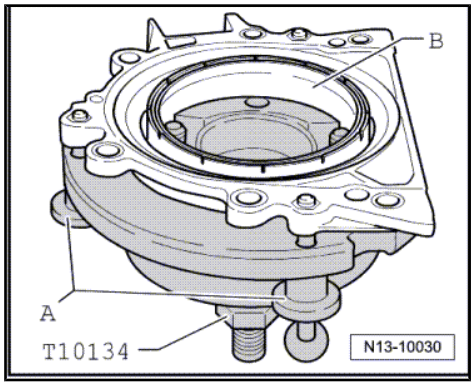
– Place front side of sealing flange on assembly tool -T10134- , so that locating pin -B- can be inserted in hole -A- in sender wheel.

- Ensure the sealing flange lies flat on the assembly tool.



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

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



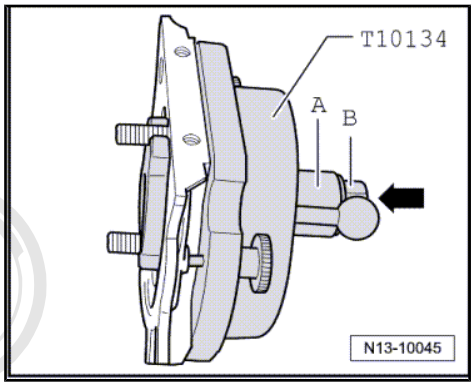
B - Installing assembly tool -T10134- with sealing flange on crankshaft flange:

• Crankshaft flange must be free of oil or grease.

• Engine is at “TDC” position.

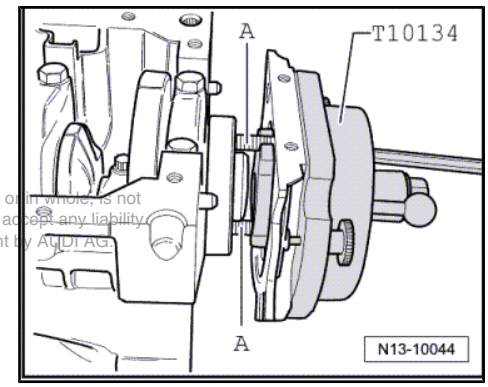
– Screw hexagon nut -B- to end of threaded spindle.

– Press the threaded spindle of assembly tool -T10134- in direction of -arrow- until the hexagon nut -B- lies on the assembly housing -A-.

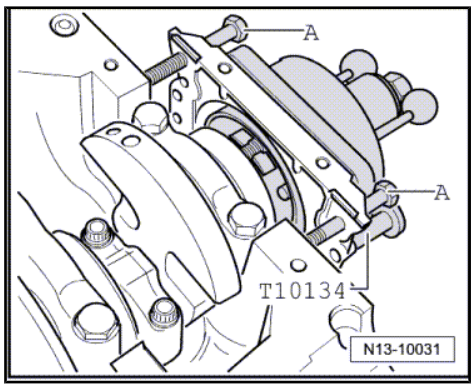


– Position flat edge of assembly housing towards sealing surface for sump on cylinder block.

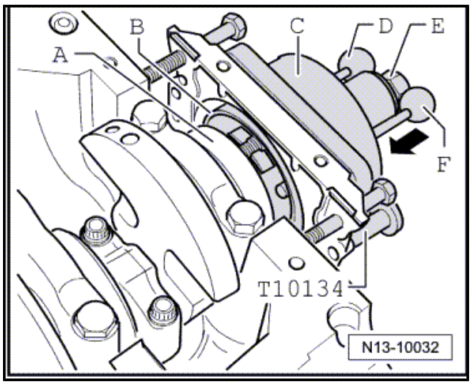
– Secure assembly tool -T10134- to crankshaft flange by screwing hexagon socket head bolts -A- approx. 5 threads into crankshaft flange.



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



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



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

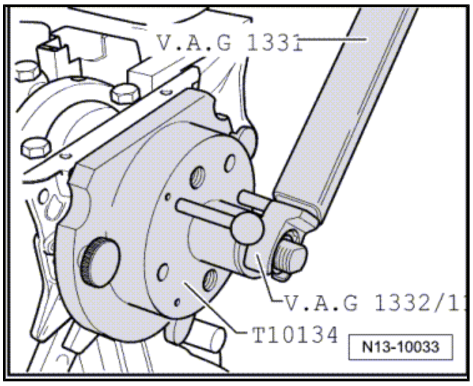
> ⚠ Caution
>
> *Do not interchange components.*
>
> ♦ *The guide pin for PETROL engines (red handle) -F- MUST NOT be inserted into the threaded hole in the crankshaft.*

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

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

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

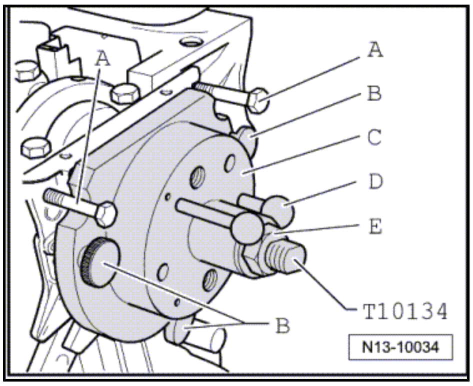
D - Pressing sender wheel onto crankshaft flange with assembly tool -T10134- :



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

• A small air gap must be present between cylinder block and sealing flange after tightening hexagon nut to 35 Nm.

E - Checking installation position of sender wheel on crankshaft:



– Screw hexagon nut -E- to end of threaded spindle.

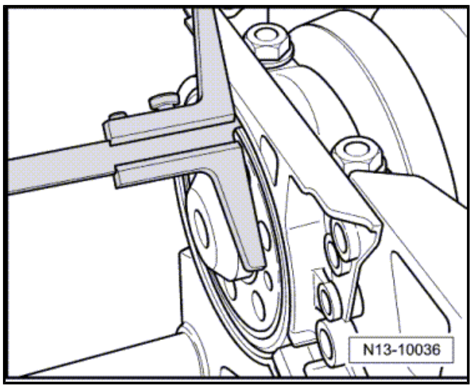
– Remove bolts -A- from cylinder block.

– Unscrew knurled screws -B- from sealing flange.

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

– Detach assembly tool -T10134- .

– Detach sealing lip support ring.



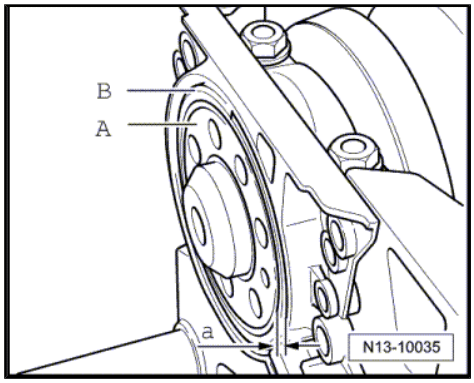
– Apply depth gauge -VAS 6082- to crankshaft flange.

– Measure distance between crankshaft flange -A- and sender wheel -B-.

• Specification: Distance -a- = 0.5 mm.

– Press sender wheel in further if distance -a- is too small ⇒ page 74 .

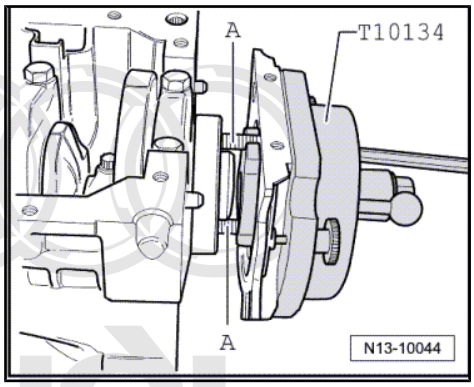
– If reading matches specification, continue with assembly ⇒ page 75 .



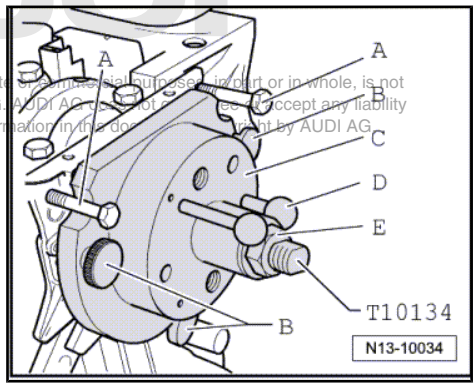
F - Pressing sender wheel in further:

– Secure assembly tool -T10134- to crankshaft flange by tightening hexagon socket head bolts -A- hand-tight.

– Press assembly tool onto sealing flange by hand.



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

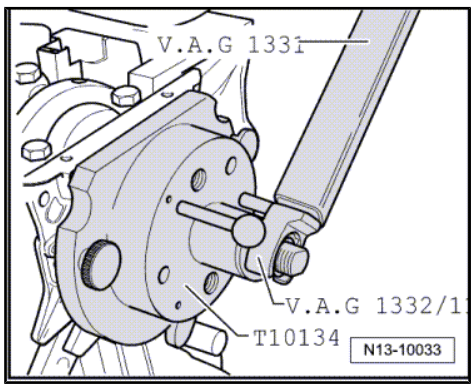


– Tighten hexagon nut on assembly tool -T10134- to 40 Nm.

– Check installation position of sender wheel on crankshaft again ⇒ page 73 .

– If distance “a” is still to small, tighten hexagon nut on assembly tool -T10134- to 45 Nm.

– Check installation position of sender wheel on crankshaft again ⇒ page 73 .

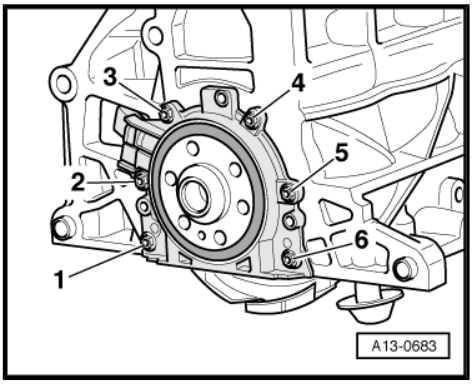


Assembling:

– Tighten sealing flange bolts ⇒ page 66 .

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

– Install engine speed sender -G28- ⇒ Rep. Gr. 28 .
– Install sump ⇒ page 147 .
– Install intermediate plate ⇒ page 66 .
– Install dual-mass flywheel ⇒ page 66 .

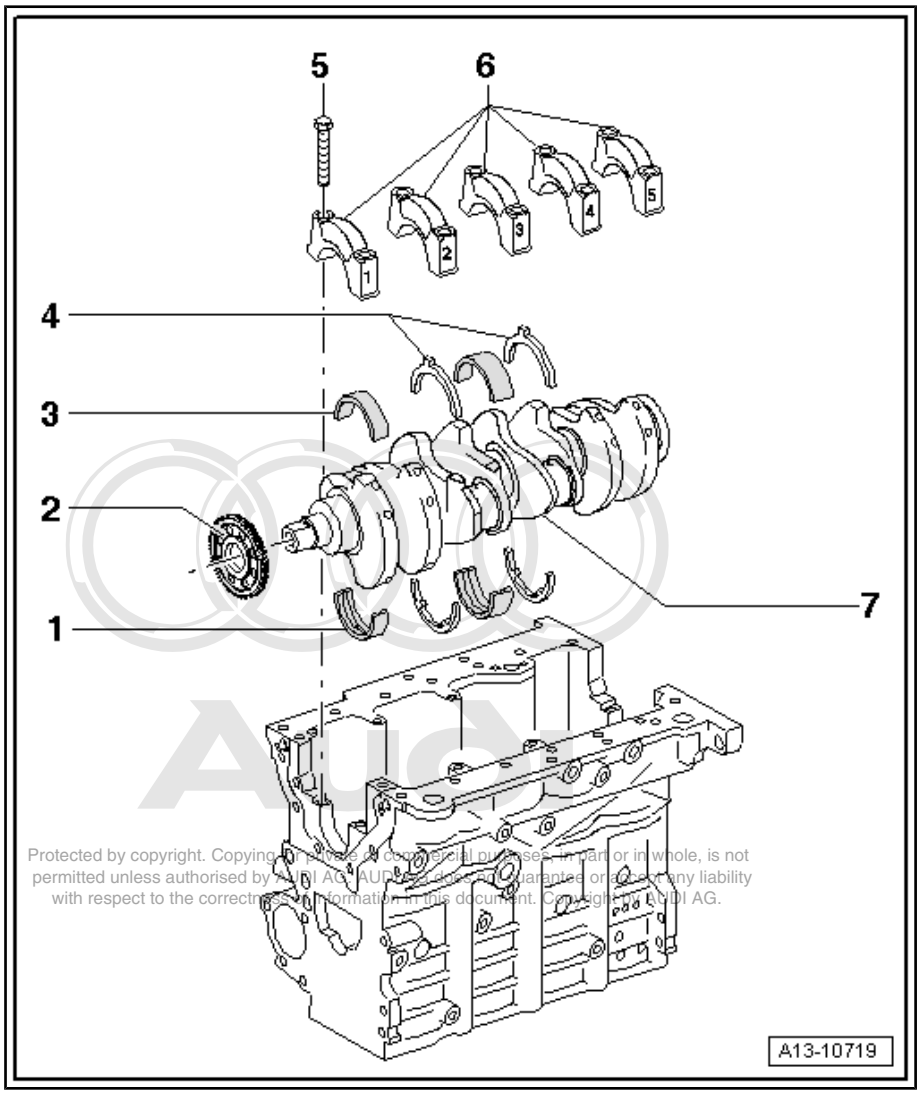


3 Crankshaft

Note

When carrying out repairs, secure engine with engine and gearbox support -VW 540- to engine and gearbox support ⇒ page 31 .

3.1 Crankshaft - exploded view



1 - Bearing shell

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

2 - Spur gear

- Renewing ⇒ page 78

3 - Bearing shell

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

4 - Thrust washers

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

5 - Bolts

- Renew
- 65 Nm +90° further

6 - Bearing cap

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

7 - Crankshaft

- No needle bearing must be fitted in the crankshaft; remove needle bearing if necessary ⇒ page 78
- Measuring axial clearance ⇒ page 77
- Measuring radial clearance ⇒ page 77
- Crankshaft dimensions ⇒ page 77
- With spur gear for balance shaft assembly

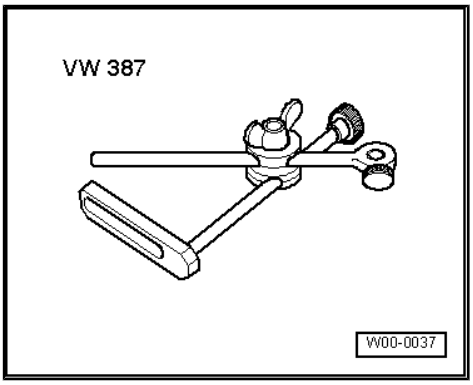
3.2 Crankshaft dimensions

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

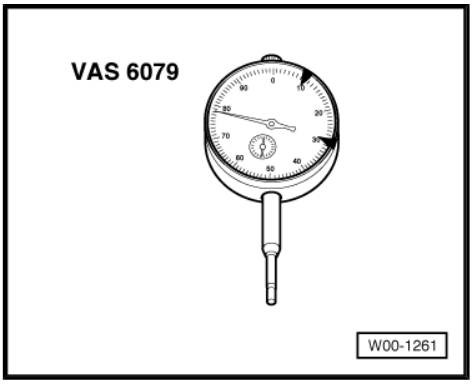
3.3 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

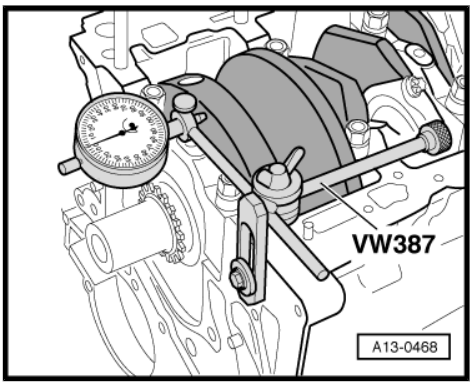
- Universal dial gauge bracket -VW 387-



- Dial gauge -VAS 6079-



Procedure



– Bolt dial gauge -VAS 6079- with universal dial gauge bracket -VW 387- onto cylinder block (as shown in illustration) and set it against crank web.

– Press crankshaft against dial gauge by hand.

– Set dial gauge to “0”.

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

Axial clearance:

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

3.4 Measuring radial clearance of crankshaft

Special tools and workshop equipment required

- Plastigage

Procedure

– Remove bearing cap and clean bearing journal.

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

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

– Fit bearing cap and tighten to 30 Nm. Do not rotate crankshaft.

– Remove bearing cap again.

– Compare width of Plastigage with measurement scale.

Radial clearance:

• New: 0.03 ... 0.08 mm

• Wear limit: 0.17 mm

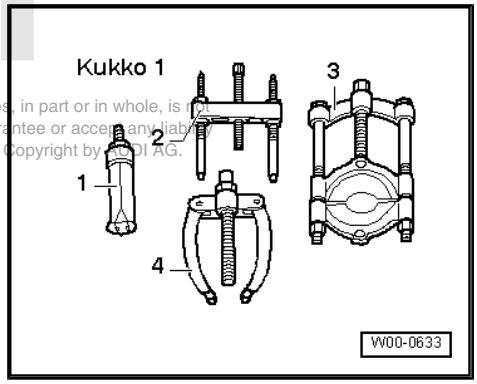
3.5 Extracting needle bearing for crankshaft

Note

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

Special tools and workshop equipment required

♦ -1- Internal puller Kukko 21/1

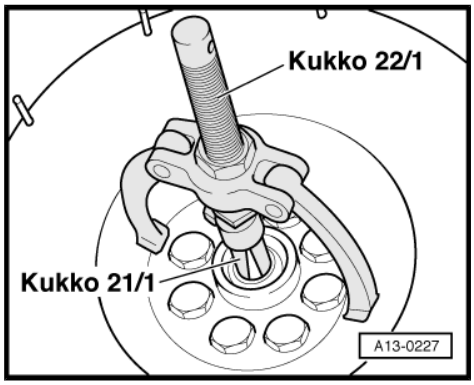


♦ -4- Counter-support Kukko 22/1

Pulling out

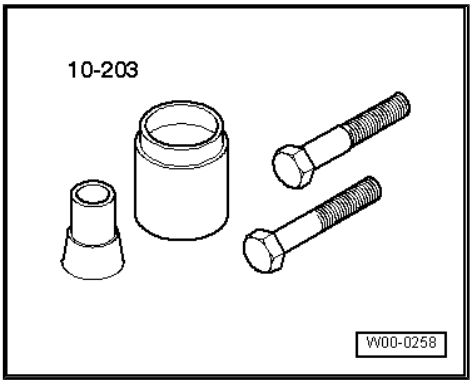
• Gearbox removed.

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

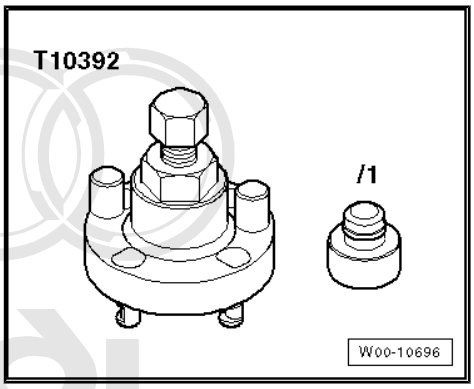


3.6 Pulling spur gear off crankshaft and shrink-fitting new spur gear

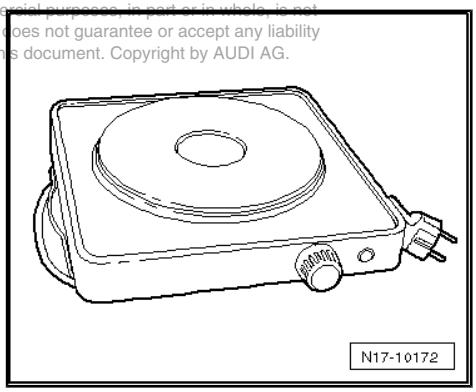
- Fitting tool -10 - 203-



- Puller -T10392-



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



– Remove sealing flange (pulley end) ⇒ page 61 .
– Remove sump ⇒ page 147 .

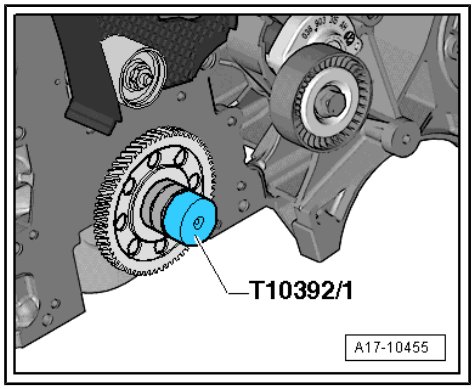
Note

If the balance shaft assembly does not have to be renewed, it is sufficient just to remove the idler gear.

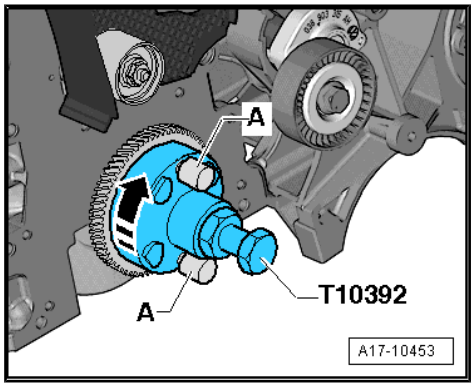
– Remove balance shaft assembly ⇒ page 153 .

Pulling off spur gear

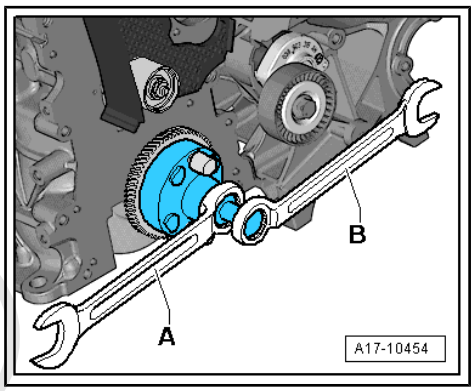
– Insert thrust piece -T10392/1- in end of crankshaft.



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



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



Shrink-fitting spur gear

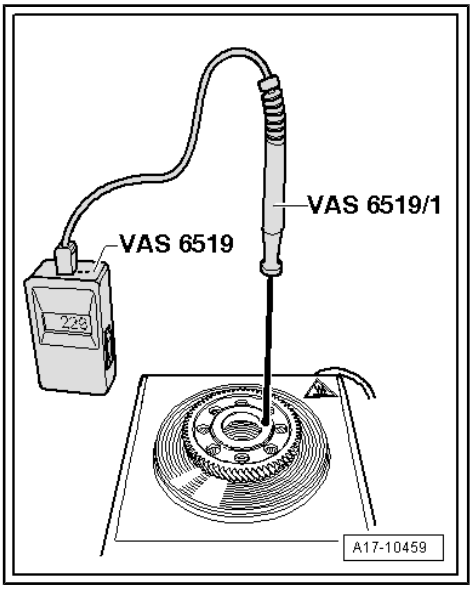
Note

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

Caution

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

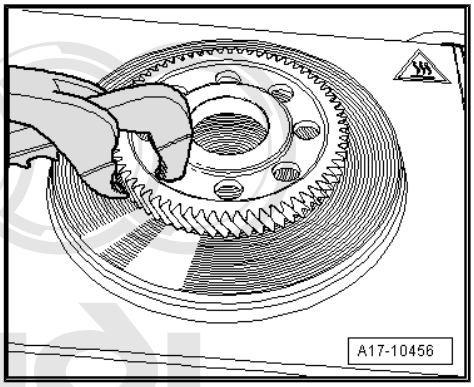
– Place the new spur gear flat on a hotplate (commercially available) and heat it to at least 200 °C, but not more than 240 °C. The lettering must face upwards.
– Set temperature gauge -VAS 6519- to measuring range 2.
– Position temperature sensor -VAS 6519/1- on collar of spur gear (as shown) and read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



WARNING

Risk of burns. Use suitable protective gloves for the following steps.

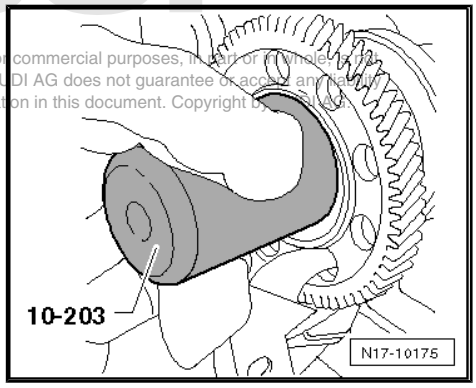
– When the required temperature has been reached, pick up the spur gear with pliers as illustrated.



Note

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

– With the aid of fitting tool -10 - 203- , slide spur gear by hand onto end of crankshaft as far as stop. This must be done without delay, taking care to keep the gear straight.
– Wait a few minutes to allow the spur gear to cool down, and then install the balance shaft assembly.



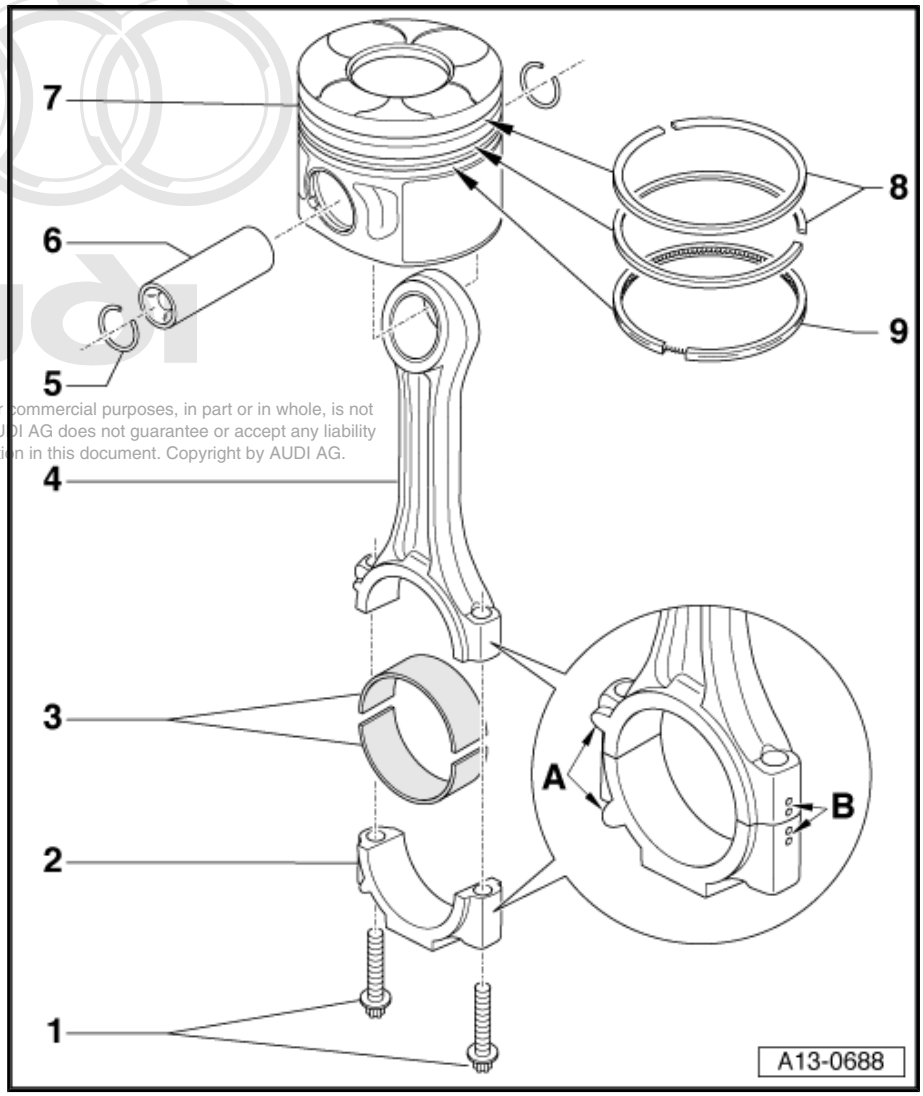
⇒ “1.6 Installing a new balance shaft assembly”, page 154
⇒ “1.7 Re-installing a used balance shaft assembly”, page 157

4 Pistons and conrods

Note

Oil spray jet and pressure relief valve ⇒ page 85

4.1 Pistons and conrods - exploded view



1 - Bolt

- ❑ Renew
- ❑ Lubricate threads and contact surface
- ❑ 30 Nm +90° further

2 - Conrod bearing cap

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

3 - Bearing shell

- ❑ Installation position ⇒ page 84
- ❑ Renew used bearing shells
- ❑ Note version: Upper bearing shell (closest to piston) is constructed from a more wear-resistant material. Distinguishing feature on new bearing shells: black marking on bearing surface near joint
- ❑ Check that it is securely seated

4 - Conrod

- ❑ Only renew as a complete set
- ❑ With industrially cracked conrod bearing cap
- ❑ Separating parts of new conrod ⇒ page 85
- ❑ Mark cylinder allocation in colour -B-
- ❑ Installation position: Markings -A- face towards pulley end
- ❑ Axial clearance: wear limit: 0.37 mm
- ❑ Measuring radial clearance ⇒ page 87

5 - Circlip

- ❑ Renew

6 - Piston pin

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

7 - Piston

- ❑ With combustion chamber
- ❑ Mark installation position and cylinder number ⇒ page 84
- ❑ Checking ⇒ page 84
- ❑ Install using piston ring clamp
- ❑ Piston and cylinder dimensions ⇒ page 87
- ❑ Measuring cylinder bore ⇒ page 84
- ❑ Measuring piston projection at “TDC” ⇒ page 85

8 - Piston rings

- ❑ Compression rings
- ❑ Offset gaps by 120°
- ❑ Use piston ring pliers to remove and install
- ❑ Installation position: marking “TOP” or side with lettering faces towards piston crown
- ❑ Measuring ring gap ⇒ page 83
- ❑ Measuring ring-to-groove clearance ⇒ page 83

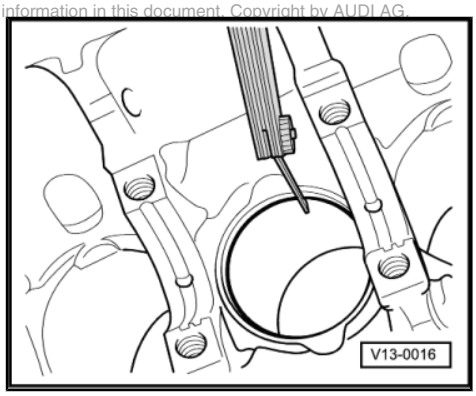
9 - Piston ring

- ❑ Oil scraper ring
- ❑ Offset gap 120° from bottom compression ring
- ❑ Use piston ring pliers to remove and install
- ❑ Installation position: marking “TOP” or side with lettering faces towards piston crown
- ❑ Measuring ring gap ⇒ page 83
- ❑ Measuring ring-to-groove clearance ⇒ page 83

Measuring piston ring gap

– Insert ring at right angle to cylinder wall from above and push down into lower cylinder opening approx. 15 mm from bottom of cylinder.

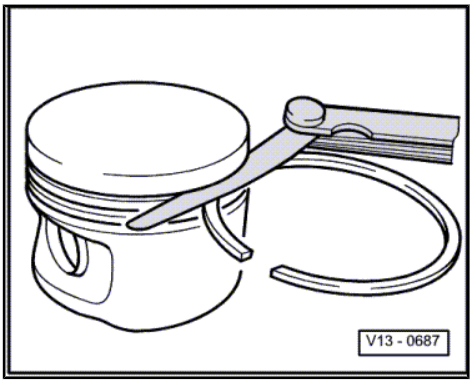
– To do so, use a piston without rings.



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

Measuring ring-to-groove clearance

– Clean groove in piston before checking clearance.



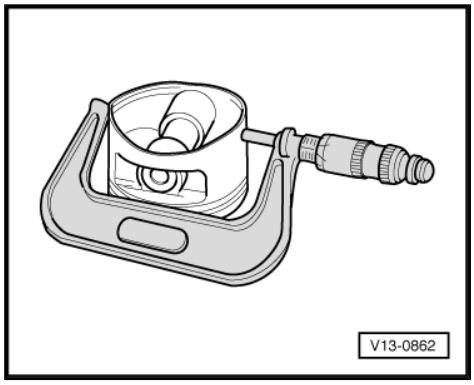
Piston ring	new mm	Wear limit mm
1st compression ring	0.06 … 0.09	0.25
2nd compression ring	0.05 … 0.08	0.25
Oil scraper ring	0.03 … 0.06	0.15

Checking piston

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

• Maximum deviation from nominal dimension: 0.04 mm.

Nominal dimension
⇒ “4.3 Piston and cylinder dimensions”, page 87 .

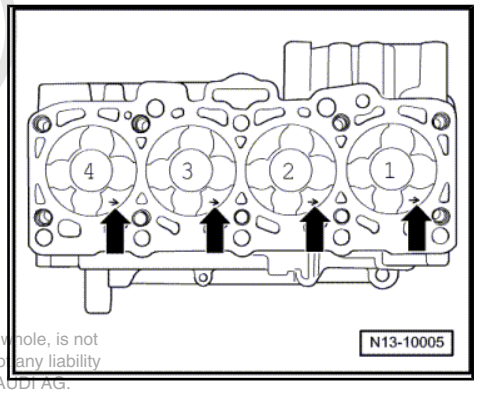


Note

Renew piston if cracking is visible on piston skirt.

Installation position of pistons and allocation of piston/cylinder

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

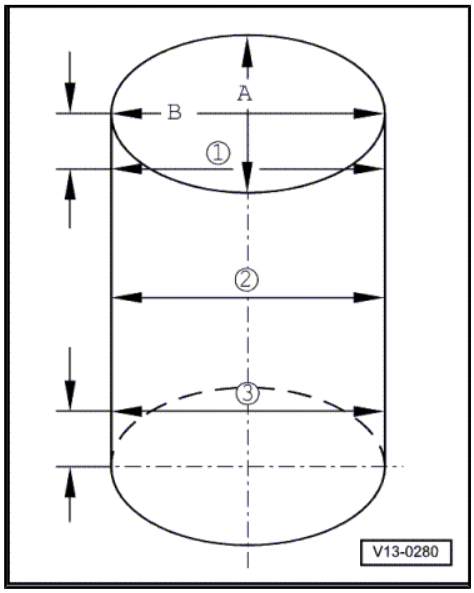


Measuring cylinder bore

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

• Maximum deviation from nominal dimension: 0.10 mm.

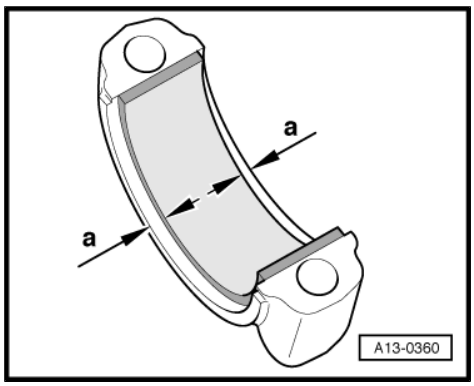
Nominal dimension
⇒ “4.3 Piston and cylinder dimensions”, page 87 .



Installation position of bearing shells in conrods

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

• Distance -a- = 2.5 mm.



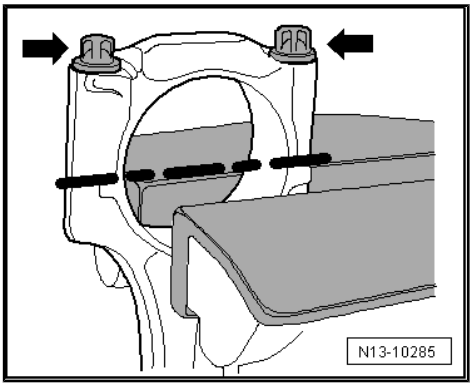
Separating parts of new conrod

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

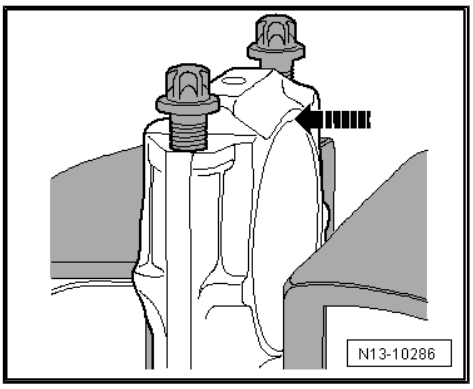
– To avoid any risk of damage, the conrod should only be clamped lightly in a vice using jaw covers as shown in illustration.

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

– Unscrew bolts -arrows- approx. 5 turns.



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

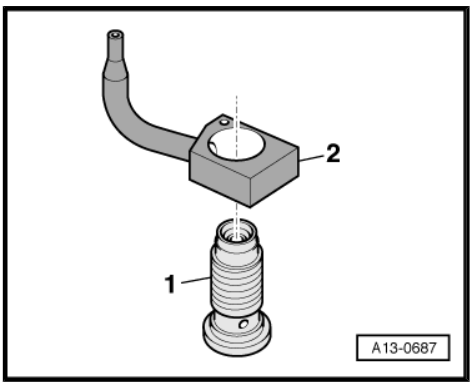


Oil spray jet and pressure relief valve

1 - Bolt with pressure relief valve, 27 Nm

2 - Oil spray jet (for cooling of pistons)

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



Note

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

♦ *Always renew bent oil spray jets.*

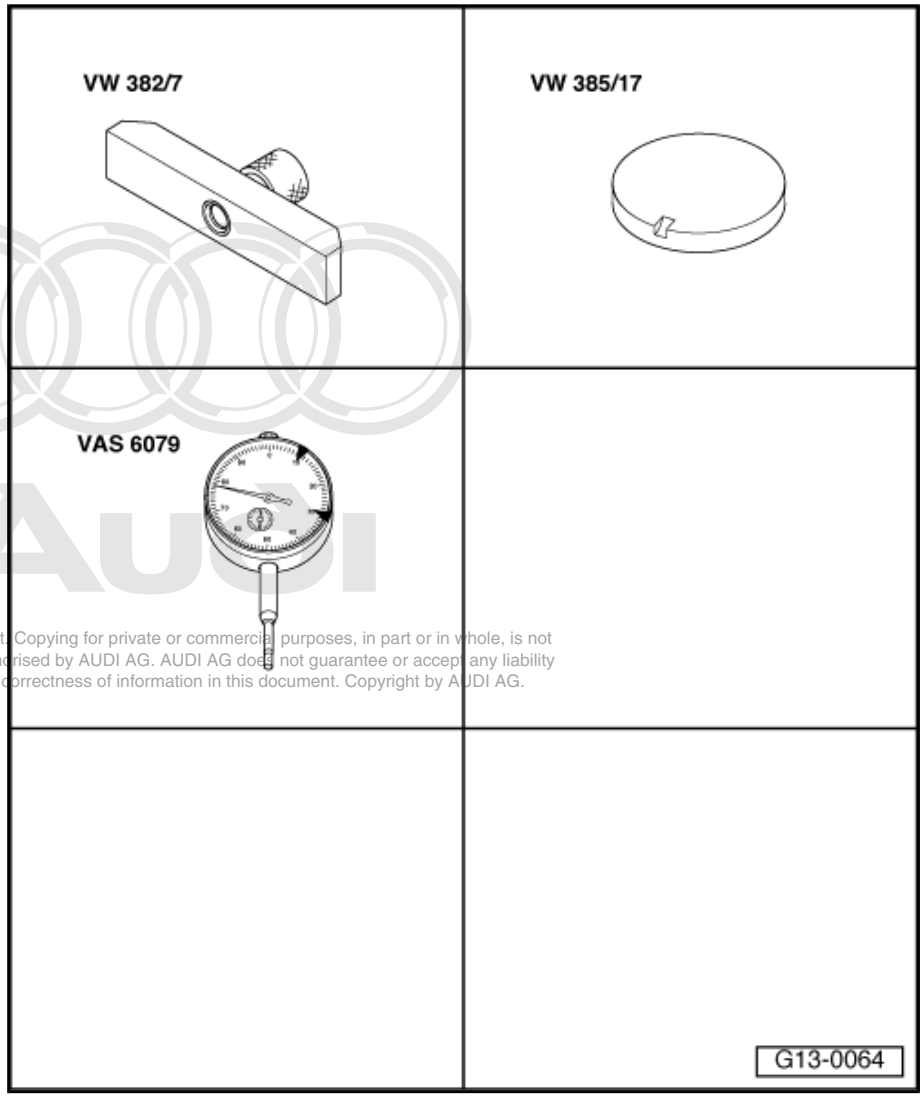
4.2 Measuring piston projection at “TDC”

Note

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

Special tools and workshop equipment required

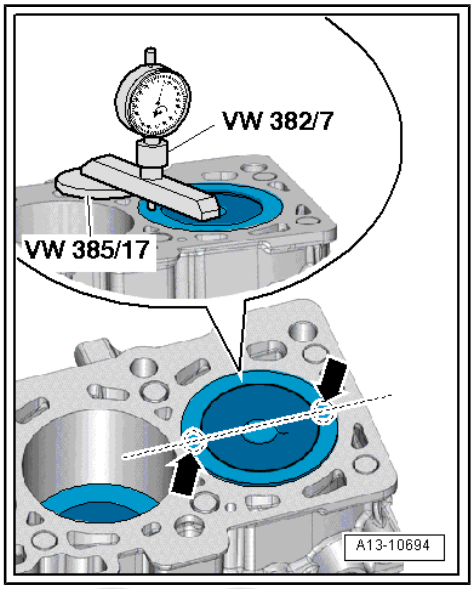
- Measuring bridge - VW 382/7- from measuring tool -VW 382-
- Measuring plate - VW 385/17- from universal measuring tool -VW 385-
- Dial gauge -VAS 6079-



Procedure

– Secure dial gauge -VAS 6079- with measuring bridge -VW 382/7- and measuring plate -VW 385/17- to cylinder block as shown in illustration.

– Measure projection at each piston at both locations marked with -arrows- (seen in longitudinal direction of engine: at front and rear of piston).



Note

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

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

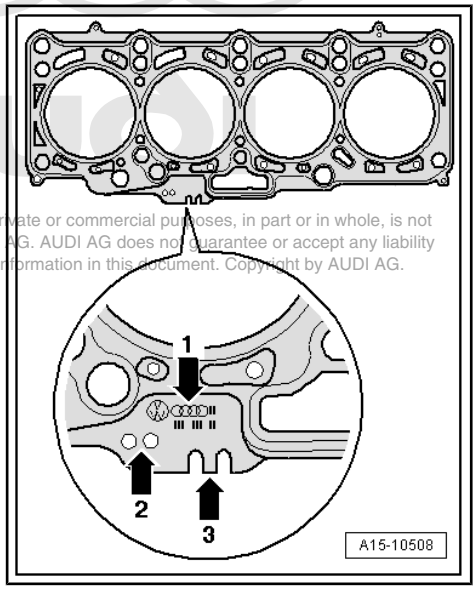
Piston projection above top surface of cylinder block mm	Identification (No. of holes)
0.91 … 1.00	1
1.01 … 1.10	2
1.11 … 1.20	3

Identification of cylinder head gasket

1 - Part number

2 - Holes

3 - Ignore



Note

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

4.3 Piston and cylinder dimensions

	Piston Ø mm	Cylinder bore Ø mm
Basic dimension	80.96 1)	81.01

• 1) Dimensions including coating (thickness 0.02 mm). The coating will wear down in service.

4.4 Measuring radial clearance of conrods

Special tools and workshop equipment required

♦ Plastigage

Procedure

– Remove conrod bearing cap. Clean bearing cap and bearing journal.

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

– Fit conrod bearing caps and tighten to 30 Nm without rotating crankshaft.

– Remove conrod bearing cap again.

– Compare width of Plastigage with measurement scale.

Radial clearance:

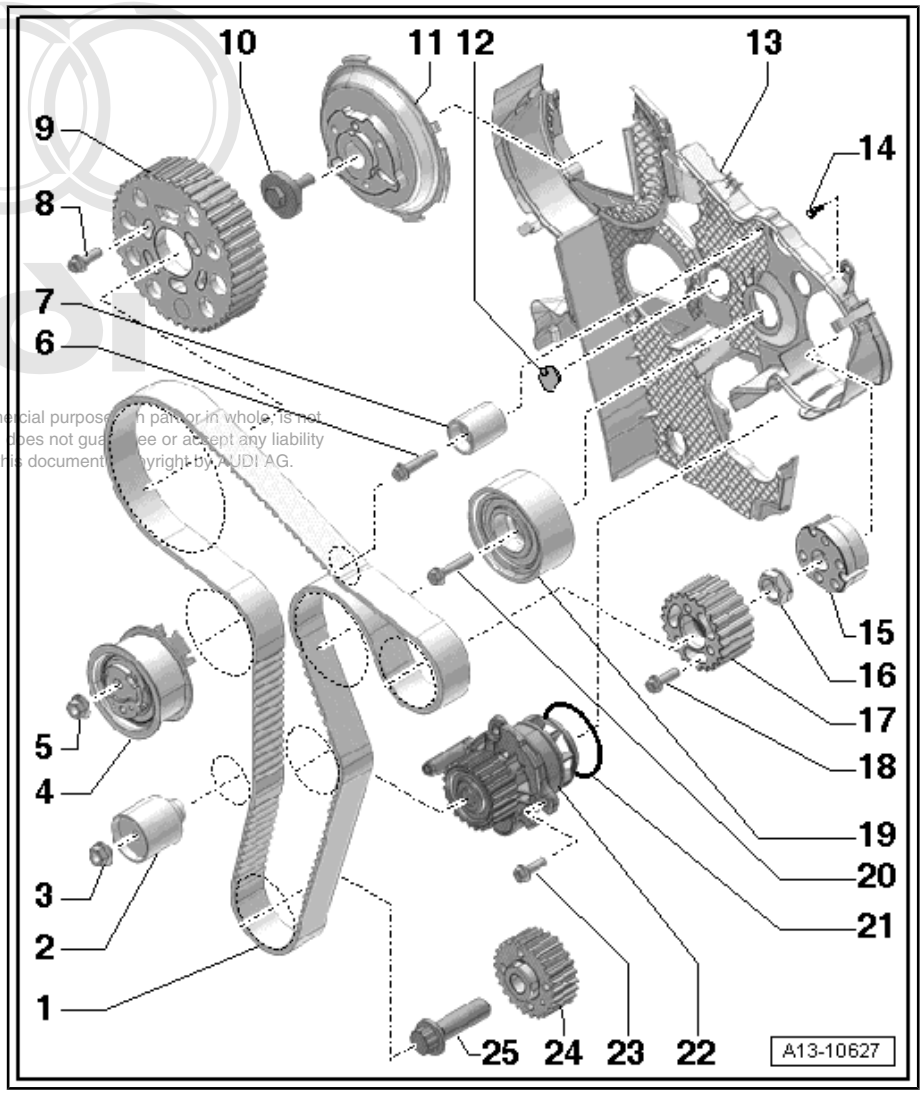
• Wear limit: 0.08 mm.

– Renew conrod bolts.

15 – Cylinder head, valve gear

1 Toothed belt drive

1.1 Toothed belt - exploded view



1 - Toothed belt

- ❑ Before removing, mark direction of rotation with chalk or felt-tip pen
- ❑ Check for wear
- ❑ Removing ⇒ page 91
- ❑ Installing (adjusting valve timing) ⇒ page 95

2 - Idler roller

3 - Nut

- ❑ 20 Nm

4 - Tensioning roller

5 - Nut

- ❑ 20 Nm +45° further

6 - Bolt

- ❑ 20 Nm

7 - Idler roller

8 - Bolt

- ❑ 25 Nm

9 - Camshaft sprocket

10 - Bolt

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

11 - Camshaft hub

- ❑ Removing and installing ⇒ “3.5 Removing and installing camshafts”, page 129

12 - Plug

13 - Toothed belt cover (rear)

14 - Bolt

- ❑ 9 Nm

15 - High-pressure pump hub

- ❑ Removing and installing ⇒ Rep. Gr. 23

16 - Nut

- ❑ Tightening torque ⇒ Rep. Gr. 23

17 - High-pressure pump sprocket

18 - Bolt

- ❑ Tightening torque ⇒ Rep. Gr. 23

19 - Idler roller

20 - Bolt

- ❑ Renew
- ❑ 50 Nm +90° further

21 - O-ring

- ❑ Renew

22 - Coolant pump

- ❑ Removing and installing ⇒ page 179

23 - Bolt

- ❑ Tightening torque ⇒ Item 2 (page 178)

24 - Crankshaft sprocket

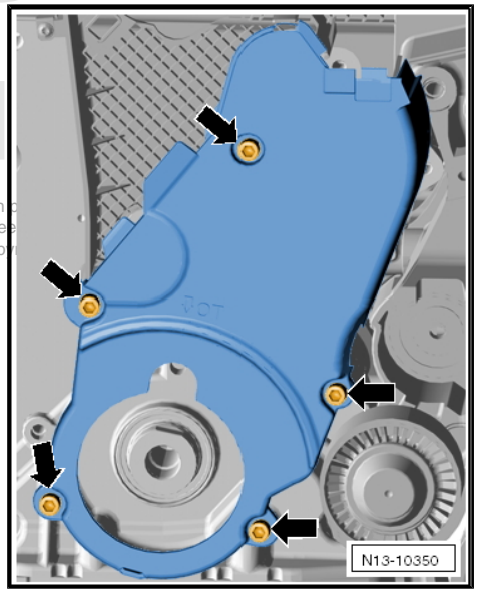
- ❑ Contact surface between sprocket and crankshaft must be free of oil
- ❑ Can only be installed in one position

25 - Bolt

- ❑ Renew
- ❑ Slacken and tighten with counterhold tool -3415-
- ❑ Do not additionally oil threads and shoulder
- ❑ 120 Nm +90° further

Toothed belt cover (bottom) - tightening torque

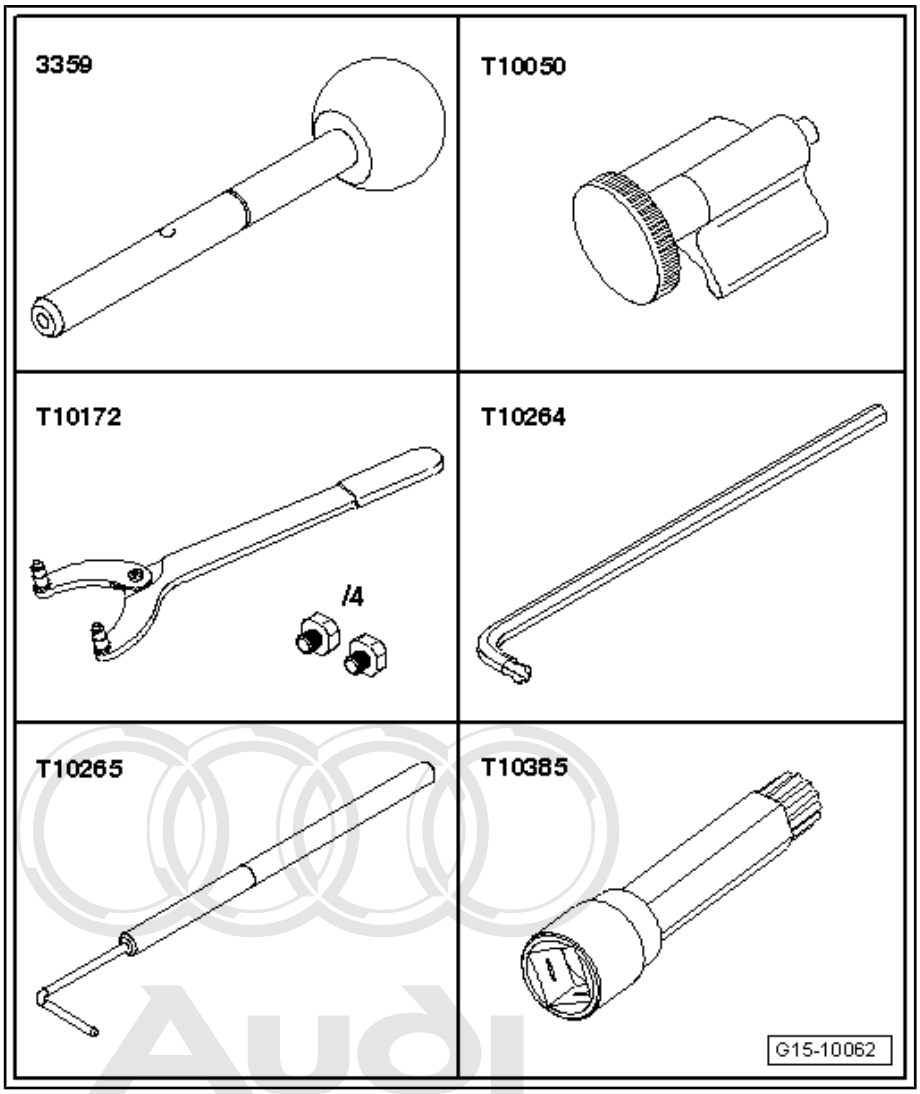
– Tighten bolts -arrows- to 9 Nm.



1.2 Removing and installing toothed belt

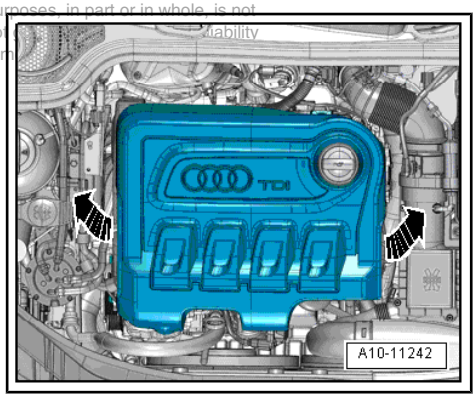
Special tools and workshop equipment required

- 2x Diesel injection pump locking pin -3359-
- Crankshaft stop -T10050-
- Counterhold tool -T10172-
- Special wrench, long reach -T10264-
- Locking tool -T10265-
- Bit XZN 10 -T10385-

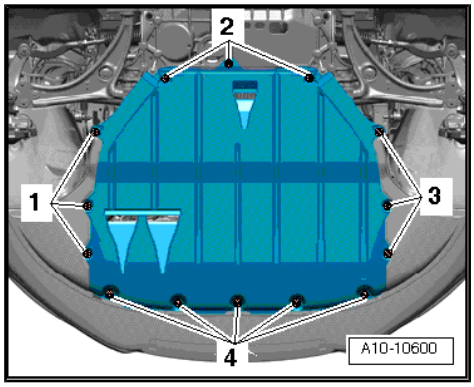


Removing

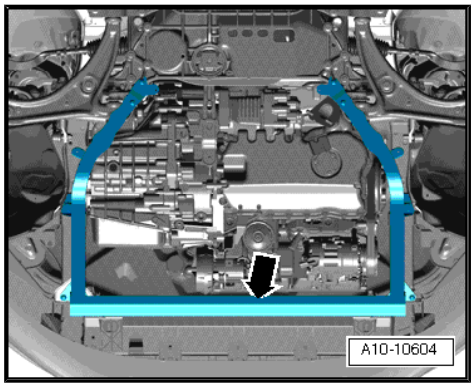
– Remove engine cover panel -arrows-.



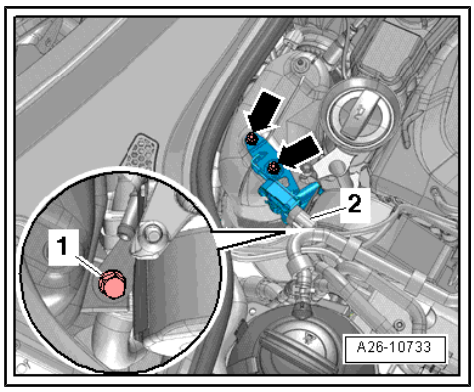
– Remove front right wheel.
– Remove noise insulation ⇒ Rep. Gr. 66 .



– TT Roadster: Remove noise insulation frame -arrow- ⇒ Rep. Gr. 50 .



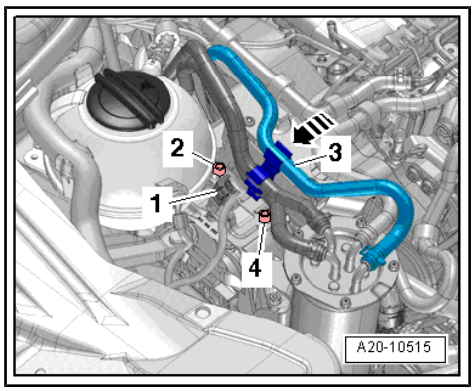
– Unplug electrical connector -2- at pressure differential sender -G505- .



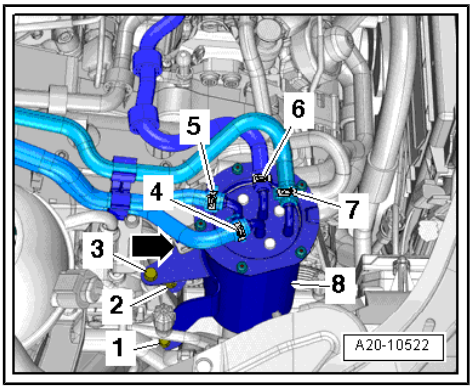
Note

Ignore items marked -1- and -arrows-.

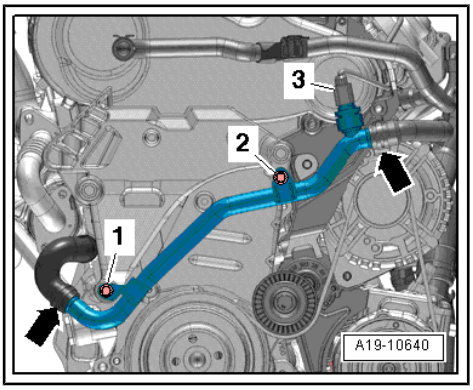
– Disengage fuel hose -3- at bracket.
– Pull off bracket for fuel lines towards right -arrow- and move clear to one side.
– Unplug electrical connector -1- at supplementary fuel pump -V393- .
– Remove bolts -2- and -4-, detach bracket with supplementary fuel pump -V393- and move clear to one side.



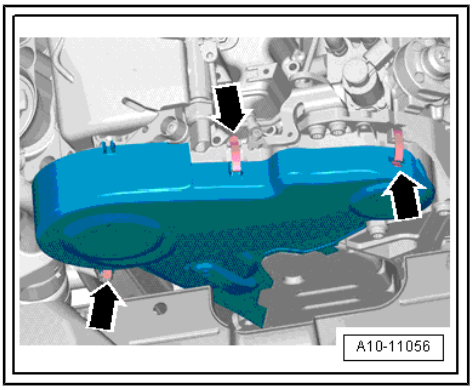
– Loosen bolt -1-.
– Remove nut -2- and bolt -3-.
– Detach hose retainer -arrow- from fuel filter and move fuel filter -8- clear to one side with fuel hoses -4 ... 7- connected.



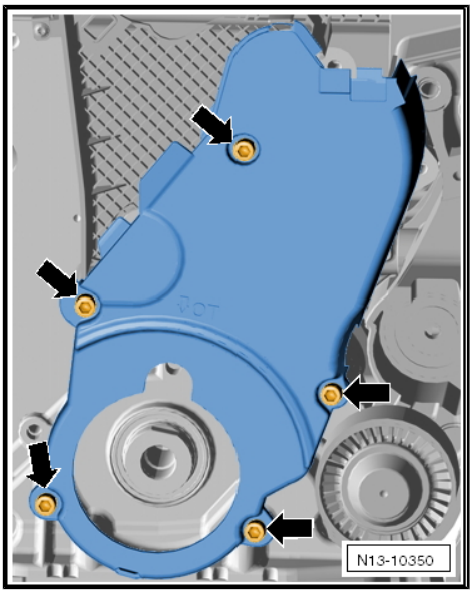
– Unplug electrical connector -3- at radiator outlet coolant temperature sender -G83- .
– Remove nut -1- and bolt -2-.
– Move coolant pipe (right-side) -arrows- to side (coolant hoses remain connected).



– Release retaining clips -arrows- and detach toothed belt cover (top).
– Remove vibration damper ⇒ page 56 .



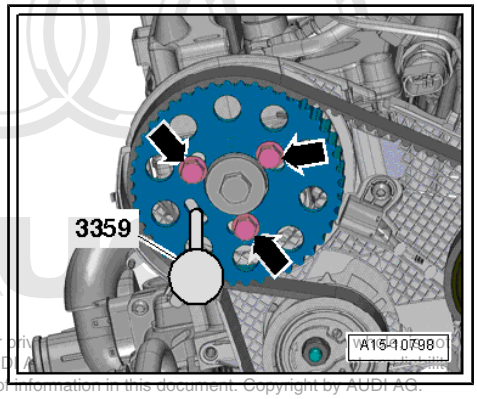
– Remove bolts -arrows-.
– Detach toothed belt cover (bottom).



Caution

Irreparable damage can be caused if the toothed belt slips.

- *Turn crankshaft only in direction of engine rotation.*



– Rotate crankshaft by turning bolt on crankshaft sprocket until camshaft sprocket is positioned at “TDC”.

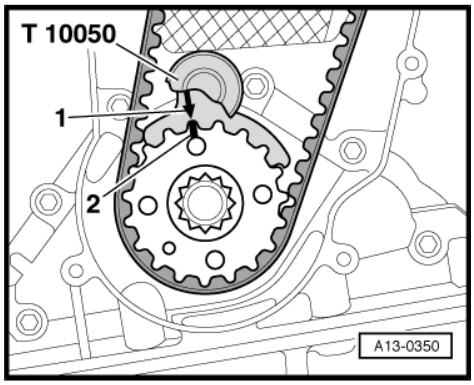
– Lock camshaft hub with diesel injection pump locking pin -3359- .

Note

Disregard -arrows-.

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

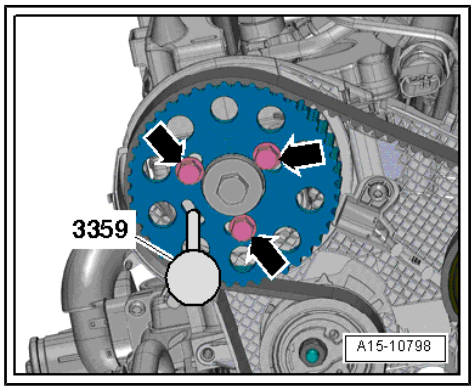
- The markings on the sprocket -2- and the crankshaft stop -1- must align -arrow-. The pin of the crankshaft stop must engage in the aperture in the sealing flange.



Note

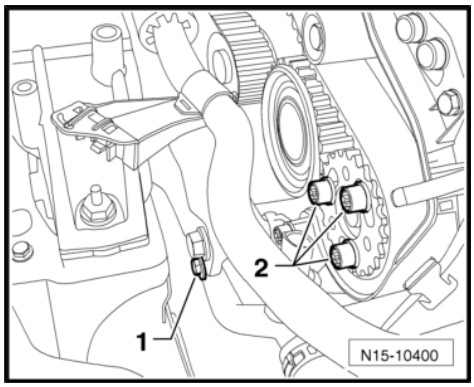
The crankshaft stop can only be pushed onto the sprocket from the front face of the teeth.

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



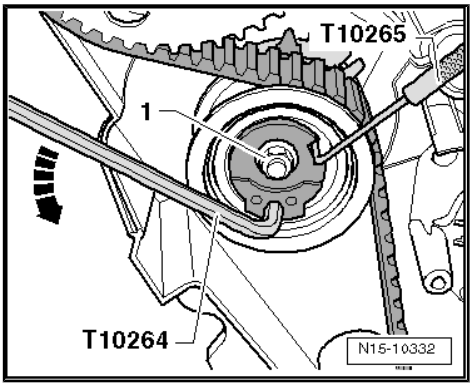
– Remove bolt -1- for coolant pipe.

– Using bit XZN 10 -T10385- , loosen bolts -2- for high-pressure pump sprocket approx. 90°.

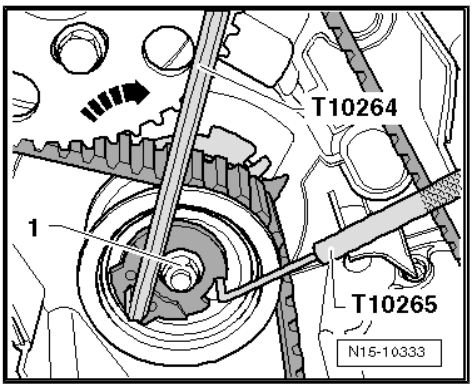


– Loosen nut -1- for tensioning roller.

– Turn eccentric adjuster of tensioning roller with special wrench, long reach -T10264- anti-clockwise -arrow- until tensioning roller can be secured with locking tool -T10265- .



– Then use special wrench, long reach -T10264- to turn eccentric adjuster of tensioning roller clockwise -arrow- as far as stop and tighten nut -1- by hand.



Caution

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

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

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

Installing (adjusting valve timing)

- Tightening torques
⇒ “1.1 Toothed belt - exploded view”, page 89

Note

Perform adjustments on toothed belt only when engine is cold.

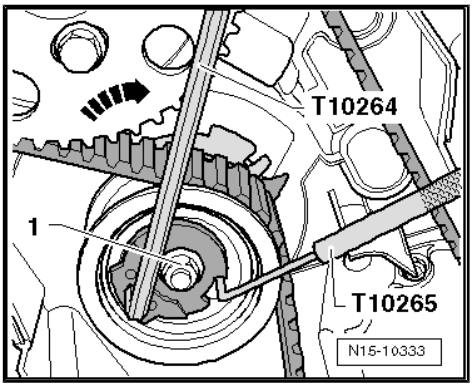
Caution

Avoid damage to valves and piston crowns.

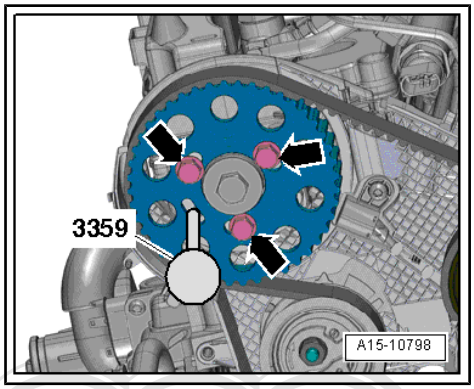
- ***The crankshaft must not be at “TDC” at any cylinder when the camshaft is turned.***

Requirements:

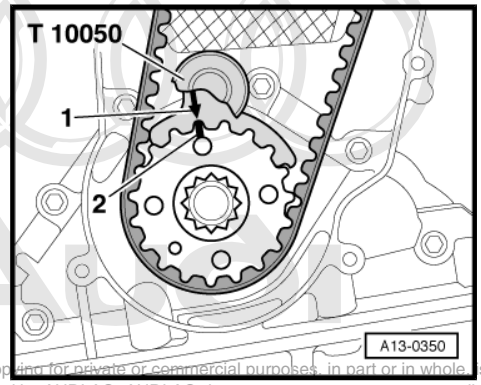
- Tensioning roller is locked with locking tool -T10265- and secured at right stop with nut.



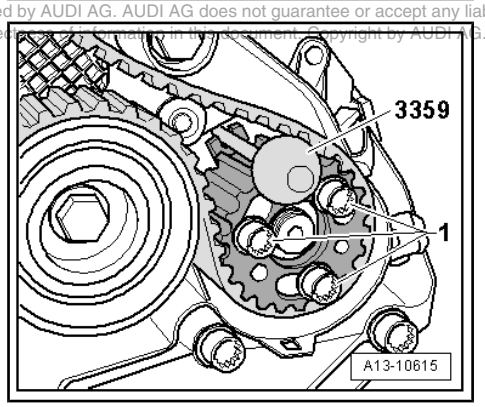
- Camshaft hub locked with diesel injection pump locking pin -3359- .
- Bolts -arrows- are fitted but not tightened.
- It should just be possible to turn the sprocket on the camshaft without axial movement.



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

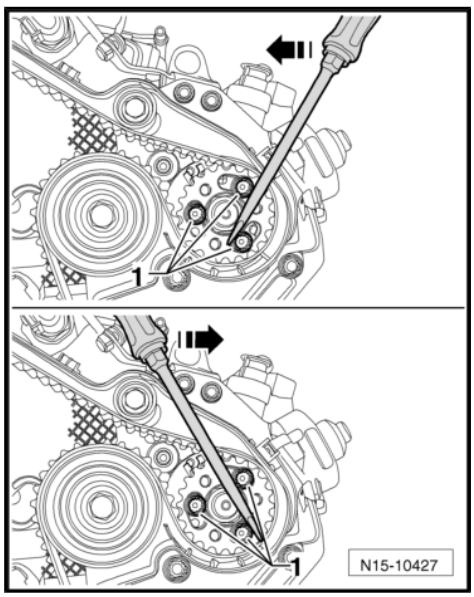


- Hub of high-pressure pump locked with diesel injection pump locking pin -3359- .
- Bolts -1- are fitted but not tightened.
- The high-pressure pump sprocket should still just turn, but there must be no axial movement.



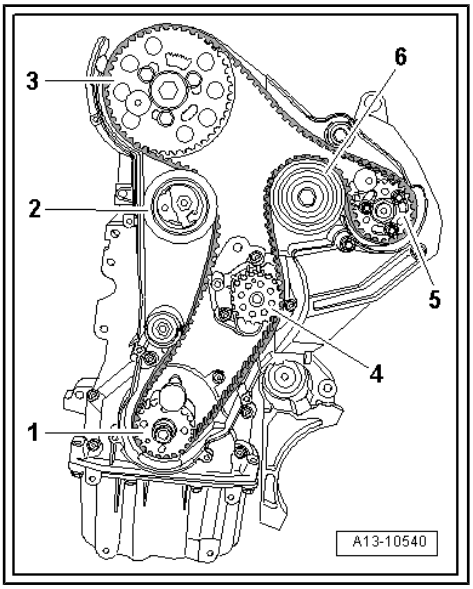
Note

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



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

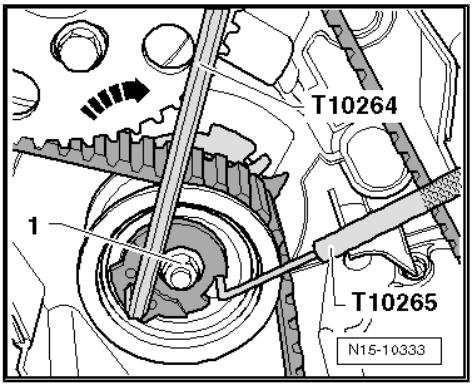
1 - Crankshaft sprocket
2 - Tensioning roller
3 - Camshaft sprocket
4 - Coolant pump sprocket
5 - High-pressure pump sprocket
6 - Idler roller



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

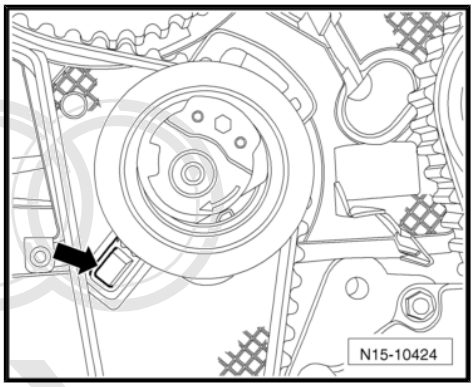
Note

Disregard -arrow-.



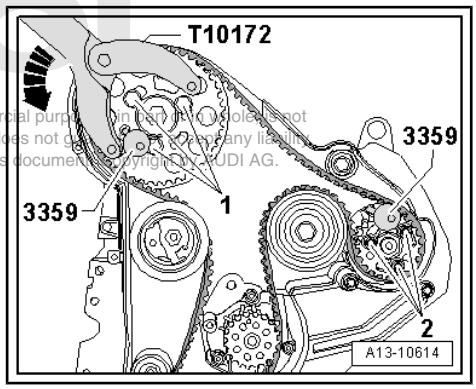
Note

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



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

• Tightening torque: 20 Nm.

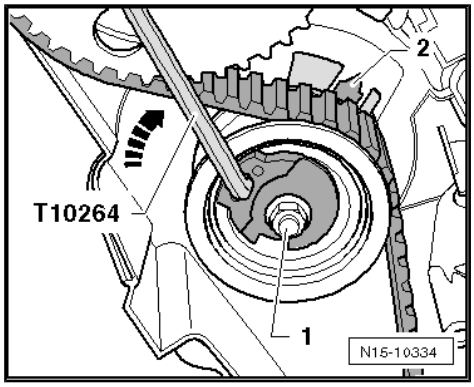


– Carefully turn eccentric adjuster of tensioning roller clockwise -arrow- using special wrench, long reach -T10264- until pointer -2- aligns with the centre of the slot on the base plate.

• Nut -1- must not turn.

– Hold tensioning roller in this position and tighten nut.

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



Checking valve timing:

Caution

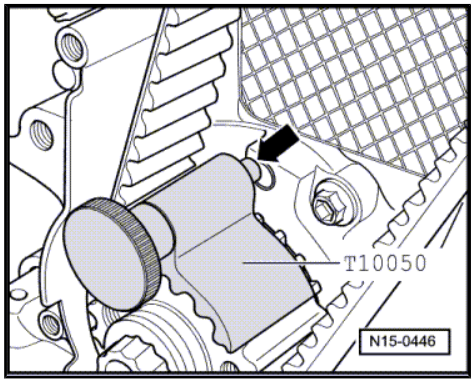
Irreparable damage can be caused if the toothed belt slips.

- ***Turn crankshaft only in direction of engine rotation.***

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

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

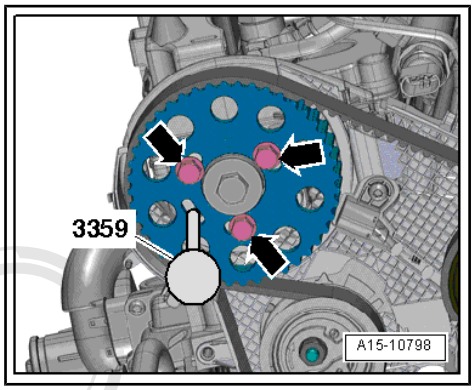
– Then turn the crankshaft in direction of engine rotation until the pin -arrow- on the crankshaft stop engages in the sealing flange as the crankshaft rotates.



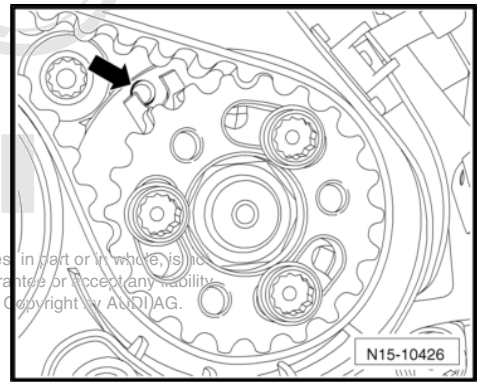
• It should now be possible to lock camshaft hub with diesel injection pump locking pin -3359- .

Note

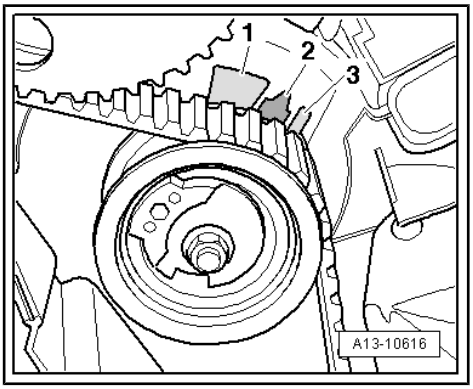
Disregard -arrows-.



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



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



Note

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

- ♦ Re-adjust valve timing if requirements are not met ⇒ page 99 .
- ♦ If requirements are met, continue with procedure after adjusting valve timing correctly as described below ⇒ page 99 .

Re-adjusting valve timing:

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

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

– Now turn crankshaft slowly in direction of engine rotation until it is possible to lock camshaft hub.

– Loosen bolts for camshaft sprocket after locking hub.

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

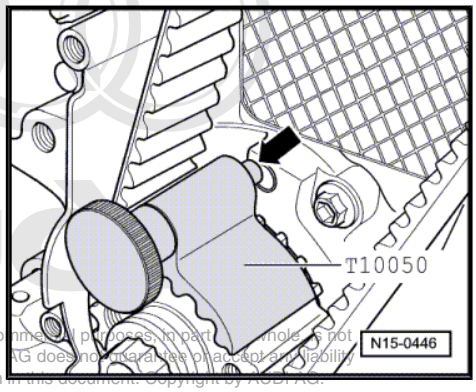
– Then turn the crankshaft in direction of engine rotation until the pin -arrow- on the crankshaft stop engages in the sealing flange as the crankshaft rotates.

– Tighten camshaft sprocket bolts to 20 Nm.

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

– Turn crankshaft slightly in opposite direction to engine rotation.

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



– Tighten camshaft sprocket bolts to 20 Nm.

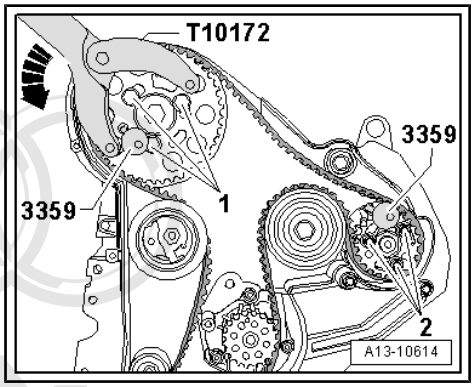
Procedure after adjusting valve timing correctly:

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

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

– Check valve timing once again ⇒ page 98 .

– If camshaft hub can now be locked, tighten camshaft sprocket bolts -1- to final torque ⇒ Item 8 (page 89) .
– Tighten bolts -2- for high-pressure pump sprocket to final torque ⇒ Rep. Gr. 23 .
– Check valve timing once again ⇒ page 98 .



Assembling

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

Note

- *Renew seals and/or gaskets.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

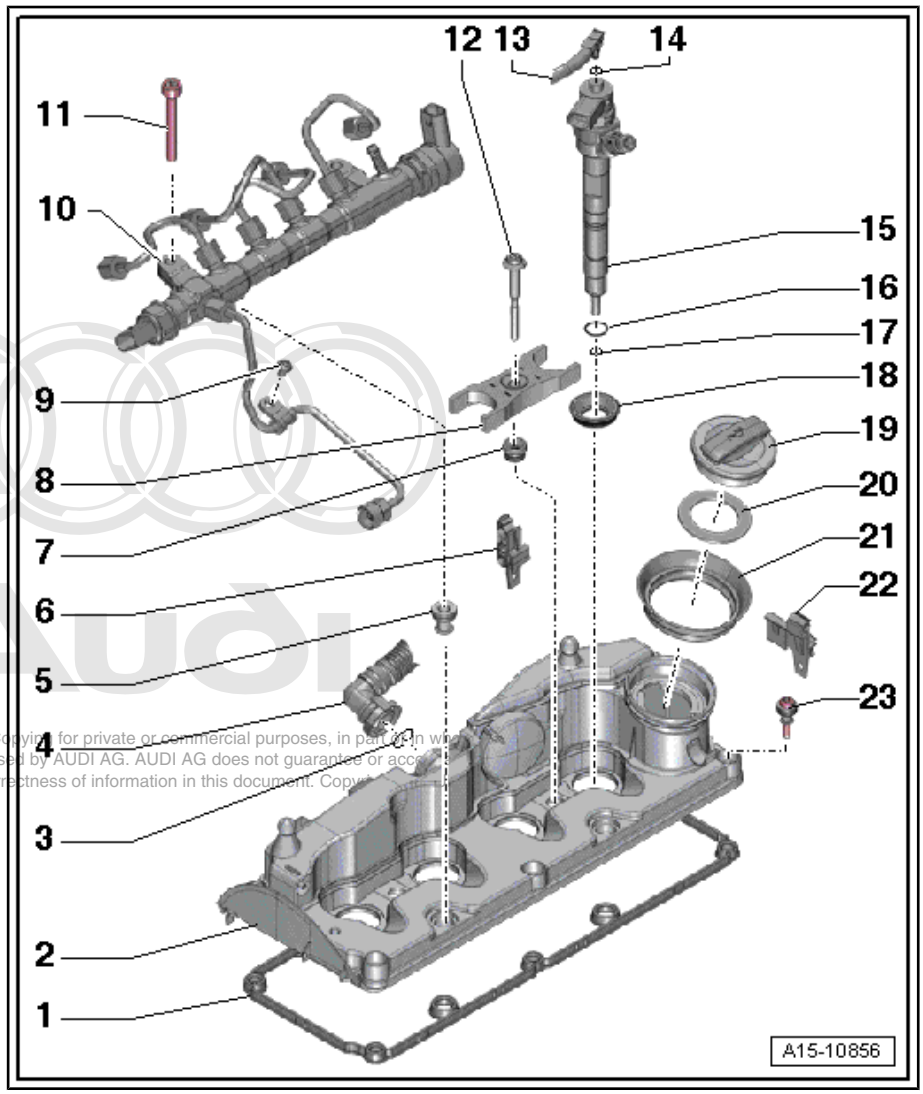
– Install vibration damper ⇒ page 56 .
– Install coolant pipe (right-side) ⇒ page 198 .
– Install fuel filter and supplementary fuel pump -V393- ⇒ Rep. Gr. 20 .
– Install noise insulation frame ⇒ Rep. Gr. 50 .
– Install noise insulation ⇒ Rep. Gr. 66 .
– Fit front wheel (right-side) ⇒ Rep. Gr. 44 .

2 Cylinder head

Note

Audi TT models with a TDI engine (2.0 ltr. 4-valve common rail) are always equipped with steel glow plugs.

2.1 Cylinder head cover - exploded view



1 - Gasket
- ❑ Renew if damaged or leaking

2 - Cylinder head cover
- ❑ Removing and installing ⇒ page 102

3 - O-ring
- ❑ Renew

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

5 - Sealing bush
- ❑ For fuel rail
- ❑ Renew if damaged or leaking

6 - Bracket
- ❑ For electrical wiring

7 - Grommet

8 - Clamping piece

9 - Bolt
- ❑ Tightening torque ⇒ Rep. Gr. 23

10 - Fuel rail
- ❑ Observe rules for cleanliness ⇒ page 6
- ❑ Do not attempt to bend high-pressure pipes to a different shape
- ❑ Installing high-pressure pipes ⇒ Rep. Gr. 23

11 - Bolt
- ❑ Tightening torque ⇒ Rep. Gr. 23

12 - Bolt
- ❑ Tightening torque ⇒ Rep. Gr. 23

13 - Fuel return line

14 - O-ring
- ❑ Renew

15 - Injector
- ❑ Observe rules for cleanliness ⇒ page 6

- ❑ Removing and installing ⇒ Rep. Gr. 23

16 - O-ring

- ❑ Renew

17 - Insulating seal

- ❑ Renew

18 - Seal

- ❑ For injector
- ❑ Renewing ⇒ page 104

19 - Filler cap

20 - Seal

- ❑ For filler cap

21 - Grommet

22 - Bracket

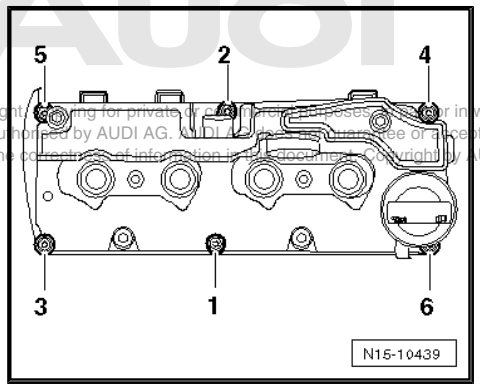
- ❑ For electrical wiring

23 - Bolt

- ❑ Renew if seal is damaged
- ❑ Tightening torque and sequence ⇒ page 102

Cylinder head cover - tightening torque and sequence

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



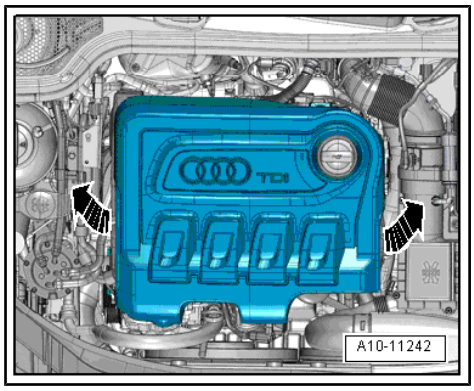
2.2 Removing and installing cylinder head cover

Removing

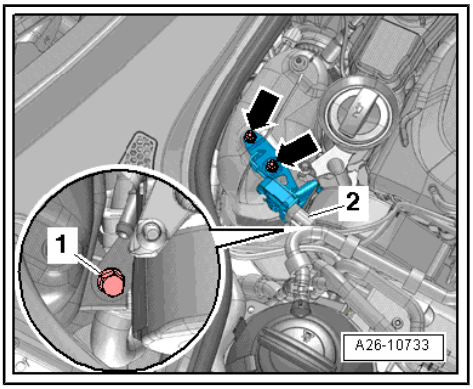
Note

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

– Remove engine cover panel -arrows-.



– Unplug electrical connector -2- at pressure differential sender -G505- .

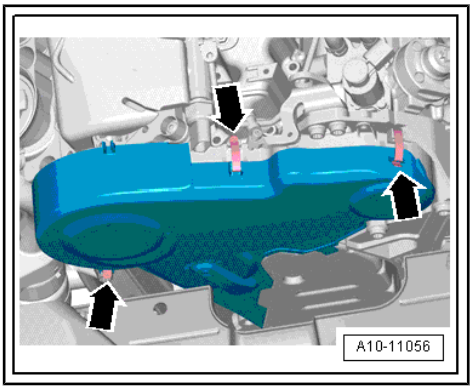


Note

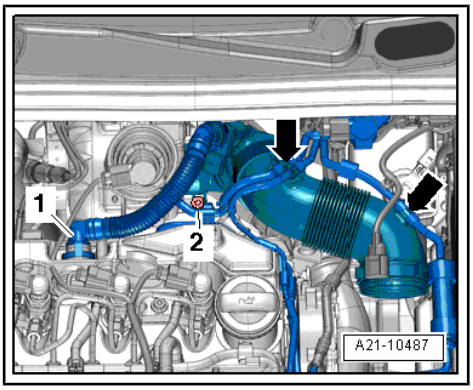
Ignore items marked -1- and -arrows-.

– Unfasten clips -arrows- and press toothed belt cover (top) to right side.

– Remove injectors and fuel rail ⇒ Rep. Gr. 23 .



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



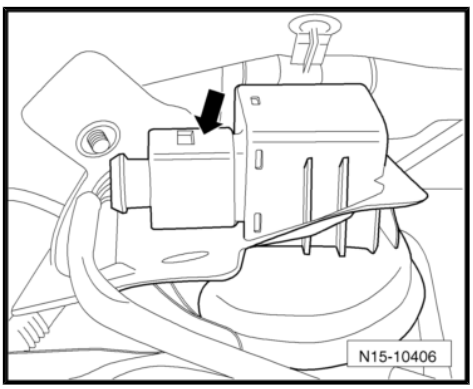
Note

Ignore items marked -2- and -arrows-.

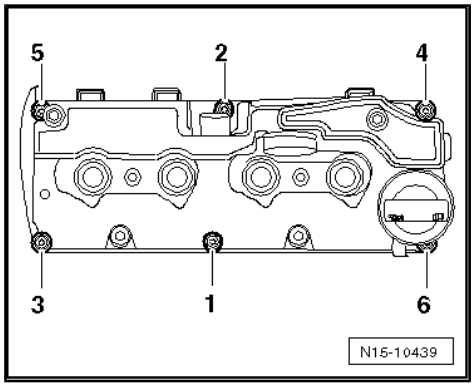
– Detach heat shield sleeve.

– Unplug electrical connector -arrow- at position sender for charge pressure positioner -G581- .

– Detach vacuum lines from bracket at cylinder head cover.

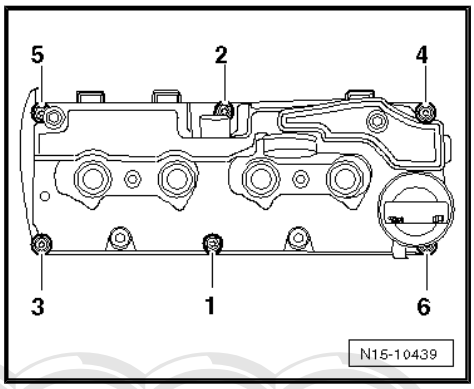


– Slacken cylinder head cover bolts in the sequence -6 ... 1- and remove.
– Detach cylinder head cover.



Installing

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

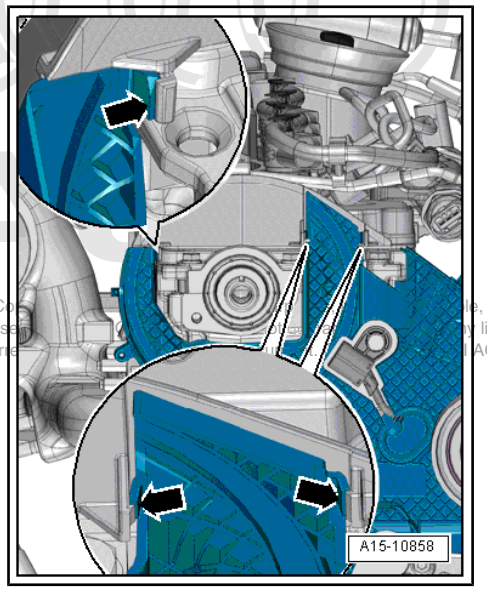


Note

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

– Tighten cylinder head cover bolts ⇒ page 102 .

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



Note

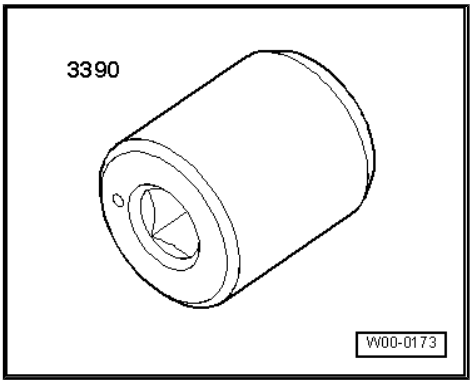
For illustration purposes, the installation position is shown with the camshaft sprocket removed.

– Make sure there is a clearance between hub and toothed belt cover.
– Install fuel rail and injectors ⇒ Rep. Gr. 23 .

2.3 Renewing injector seals

Special tools and workshop equipment required

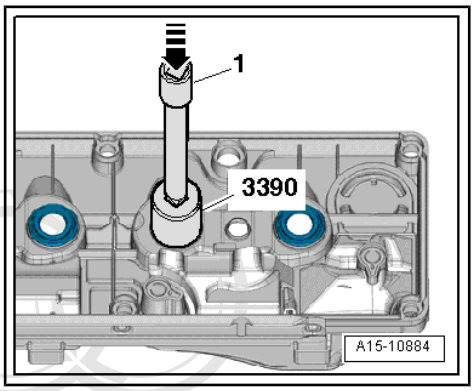
♦ Carrier -3390-



Procedure

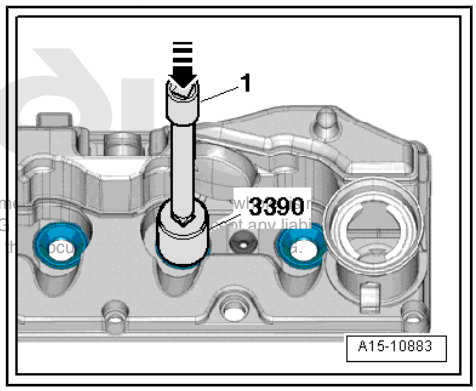
– Remove cylinder head cover ⇒ page 102 .

– Apply carrier -3390- and short extension -1- at bottom and press out injector seal upwards.

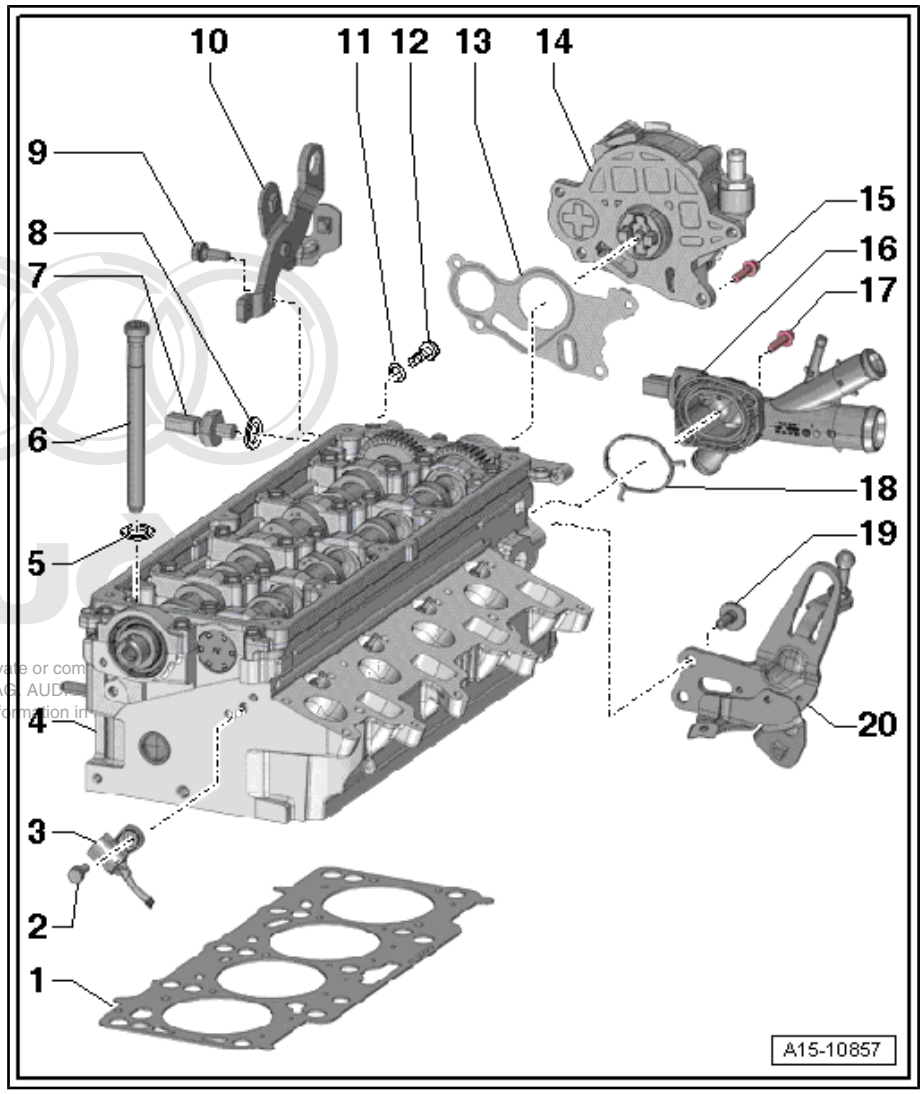


– Apply carrier -3390- and short extension -1- at top and press new injector seal in as far as stop.

– Install cylinder head cover ⇒ page 102 .



2.4 Cylinder head - exploded view



1 - Cylinder head gasket

- ❑ Renewing ⇒ “2.5 Removing and installing cylinder head”, page 109
- ❑ Identification of cylinder head gasket ⇒ page 108
- ❑ If renewed, change coolant and engine oil

2 - Bolt

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

3 - Hall sender -G40-

- ❑ For camshaft position

4 - Cylinder head

- ❑ Removing and installing ⇒ page 109
- ❑ To prevent damage to glow plugs, always place cylinder head on a soft foam surface after removal.
- ❑ Checking for distortion ⇒ page 107
- ❑ Must not be machined
- ❑ Before installing, check that the two dowel sleeves for centring cylinder head are fitted on cylinder block
- ❑ If renewed, change coolant and engine oil

5 - Washer

6 - Bolt

- ❑ Renew
- ❑ Correct sequence when slackening ⇒ page 117
- ❑ Tightening torque and sequence ⇒ page 108

7 - Oil pressure switch -F1-

- ❑ Opening/closing pressure 0.3 ... 0.6 bar
- ❑ Removing and installing ⇒ page 163
- ❑ Checking ⇒ page 164
- ❑ 20 Nm

8 - Seal

- ❑ Renew

9 - Bolt

- ❑ 20 Nm

10 - Engine lifting eye

11 - Seal

- ❑ Renew

12 - Screw plug

- ❑ 20 Nm

13 - Gasket

- ❑ Renew

14 - Exhauster pump

- ❑ Removing and installing ⇒ Rep. Gr. 47

15 - Bolt

- ❑ Tightening torque ⇒ Rep. Gr. 47

16 - Connection

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

17 - Bolt

- ❑ Tightening torque ⇒ Item 22 (page 185)

18 - Gasket

- ❑ Renew

19 - Bolt

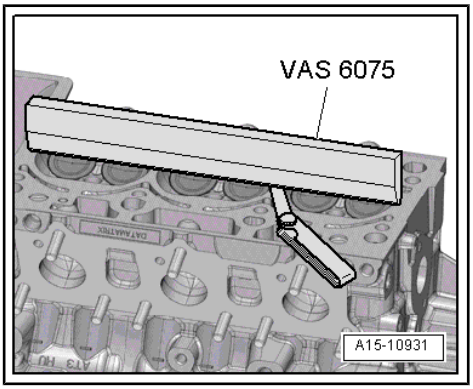
- ❑ 20 Nm

20 - Engine lifting eye

Checking cylinder head for distortion

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

• Max. permissible distortion: 0.1 mm.



Note

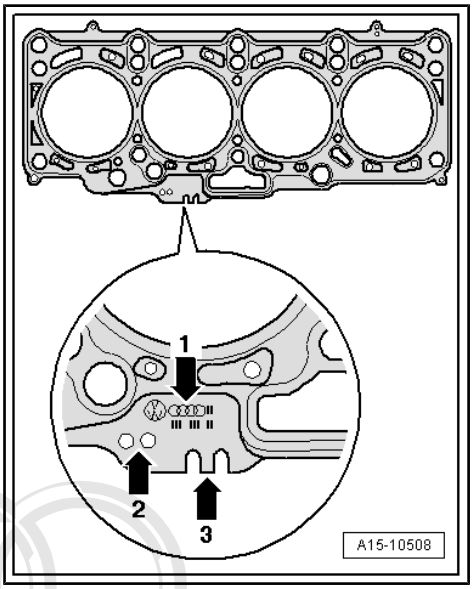
Cylinder heads must not be reworked on TDI engines.

Identification of cylinder head gasket

1 - Part number

2 - Holes

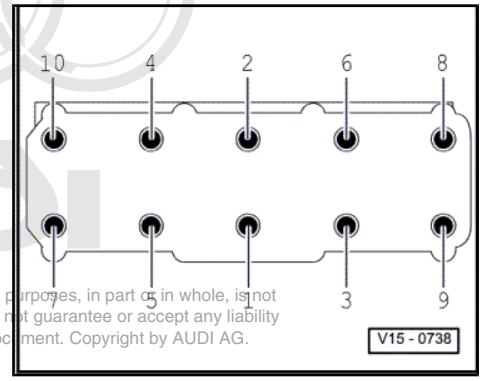
3 - Ignore



Note

Cylinder head gaskets of different thicknesses are fitted depending on the amount of piston projection ⇒ page 85 . When renewing only the cylinder head gasket, the new gasket should have the same identification as the old one.

Cylinder head - tightening torque and sequence



Note

Renew the bolts tightened with specified tightening angle.

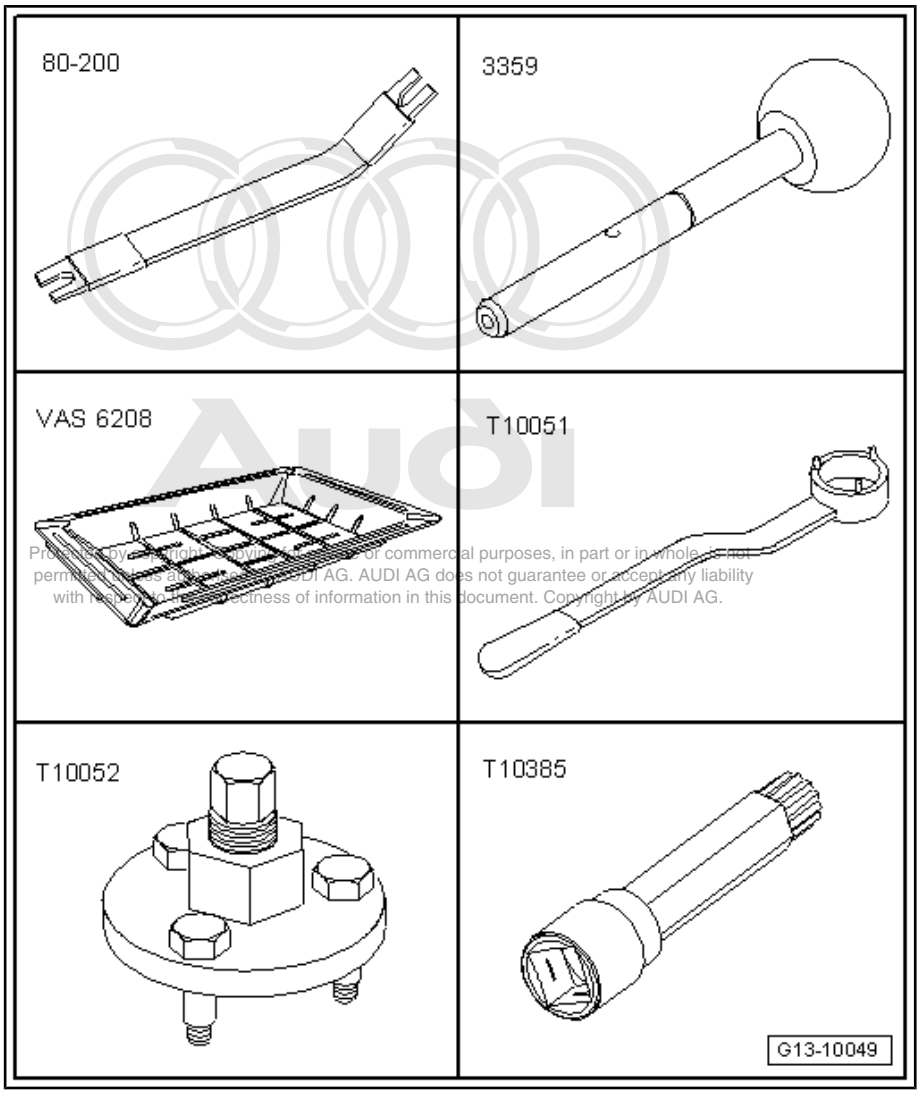
– Tighten bolts in 4 stages in the sequence shown:

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

2.5 Removing and installing cylinder head

Special tools and workshop equipment required

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

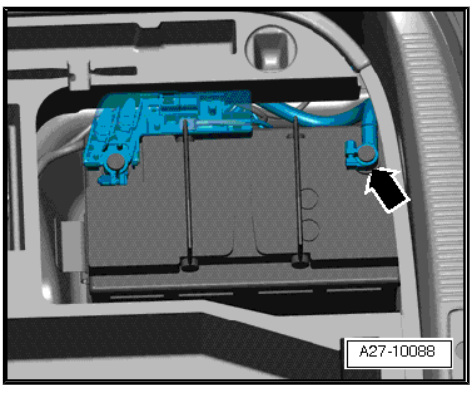


Removing

Caution

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

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

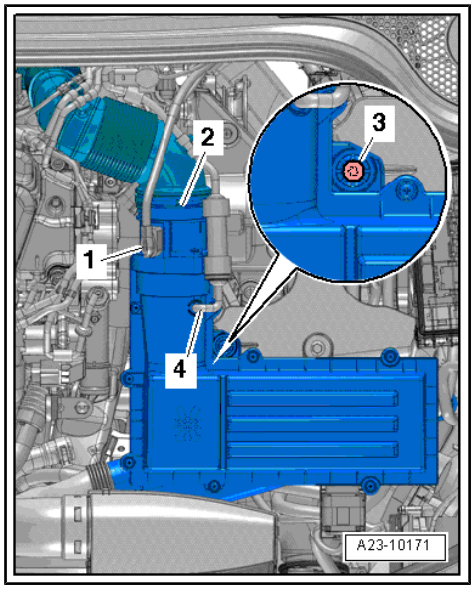


– Disconnect earth cable -arrow- from battery terminal ⇒ Electrical system; Rep. Gr. 27 .

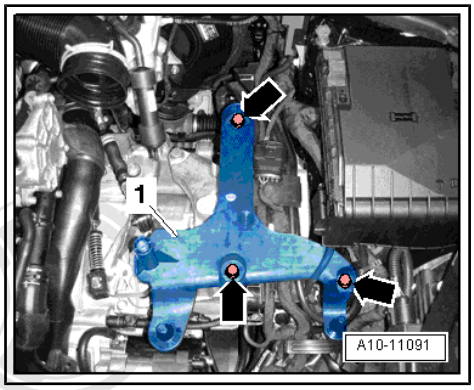
– Drain coolant ⇒ page 170 .

– Remove radiator cowl ⇒ page 202 .

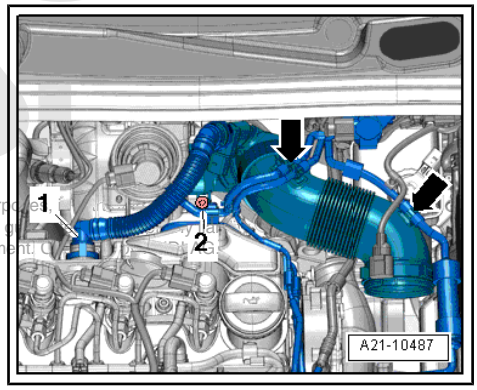
– Remove air cleaner housing ⇒ Rep. Gr. 23 .



– Remove bolts -arrows- and detach bracket -1- for air cleaner housing.



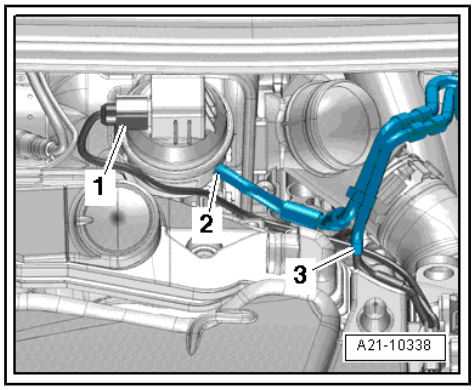
– Press release tabs and disconnect crankcase breather hose -1-.
– Move clear vacuum hoses -arrows-.
– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.



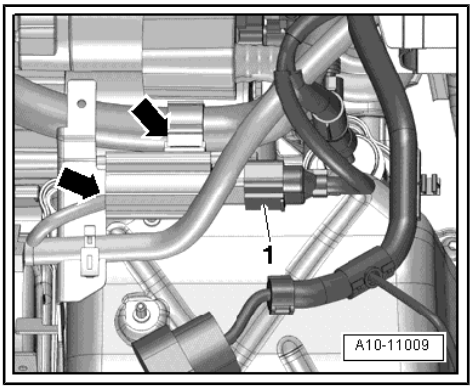
– Detach vacuum hose -2- from vacuum unit of turbocharger.
– Disconnect vacuum hose -3-.

Note

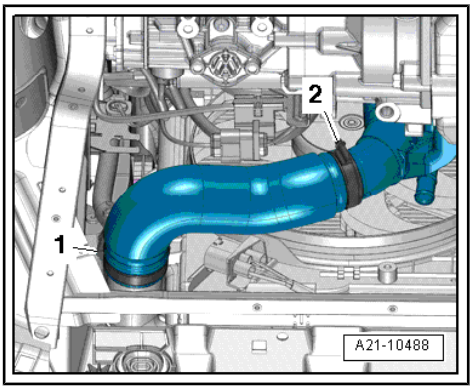
Disregard -item 1-.



– Move clear wiring harnesses -arrows- and electrical connector -1- at bracket.



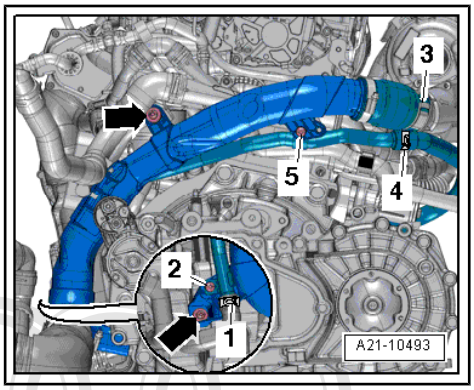
– Release hose clips -1- and -2- and remove air hose.



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

Note

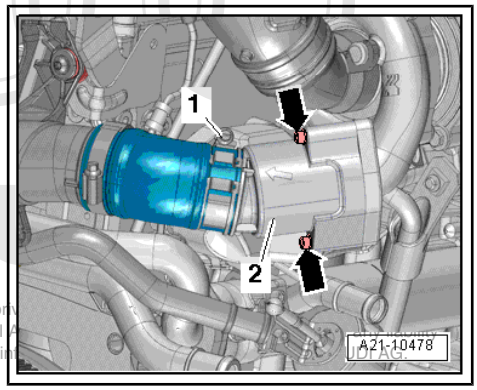
Disregard -items 1, 4-.



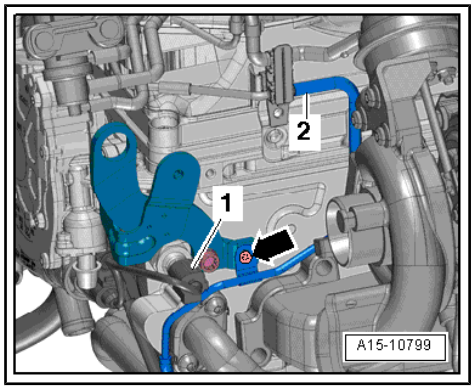
– Remove bolts -arrows- and detach pulsation damper -2-.

Note

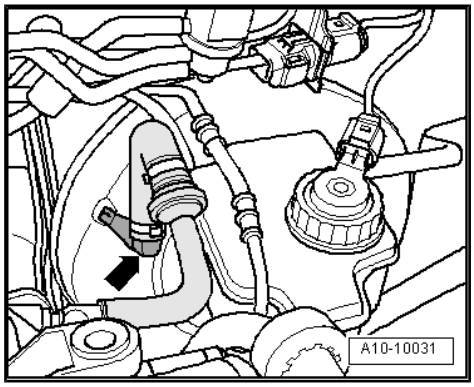
Disregard -item 1-.



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



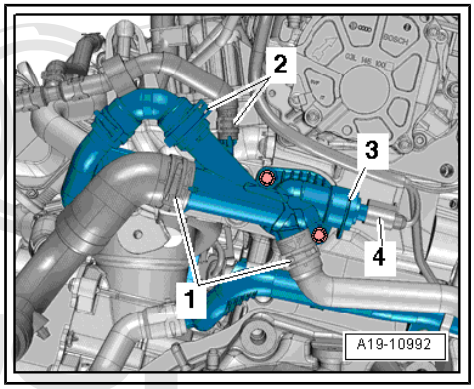
– Detach vacuum hose from brake servo -arrow-.



– Unplug electrical connector -4- at coolant temperature sender -G62- .
– Release hose clips -1- and -2- and disconnect coolant hoses from connection.

Note

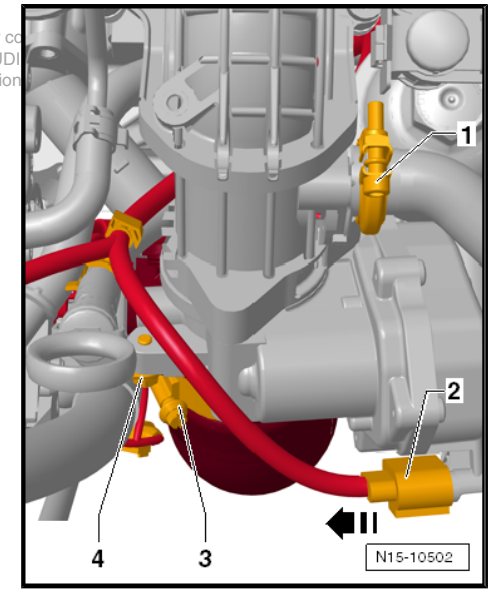
Disregard -item 3-.



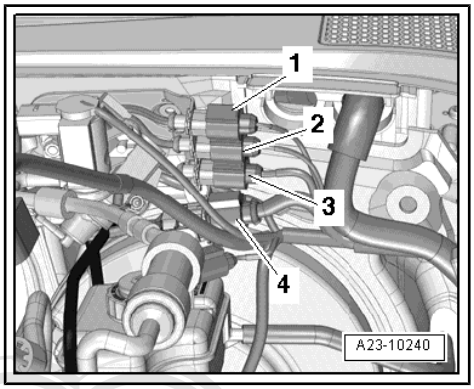
– Unplug electrical connector -2- at throttle valve module -J338- -arrow-.
– Remove bolt -4- for dipstick guide tube.

Note

Disregard -items 1, 3-.



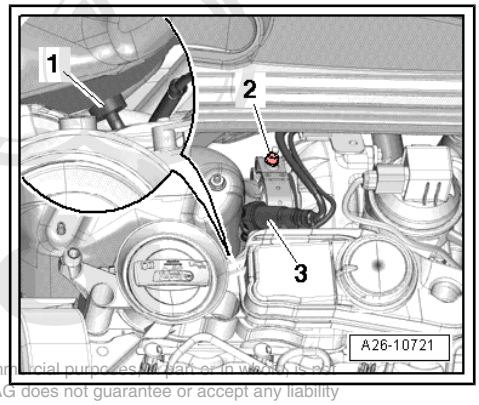
– Move clear electrical connector -1- for exhaust gas temperature sender 1 -G235- and electrical wiring.



Note

Disregard -items 2, 3, 4-.

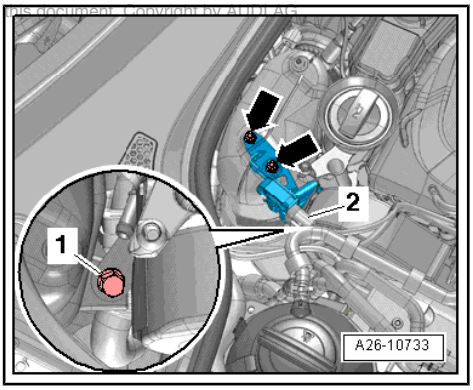
– Slacken bolt -2- and remove clamp.



Note

Disregard -items 1, 3-.

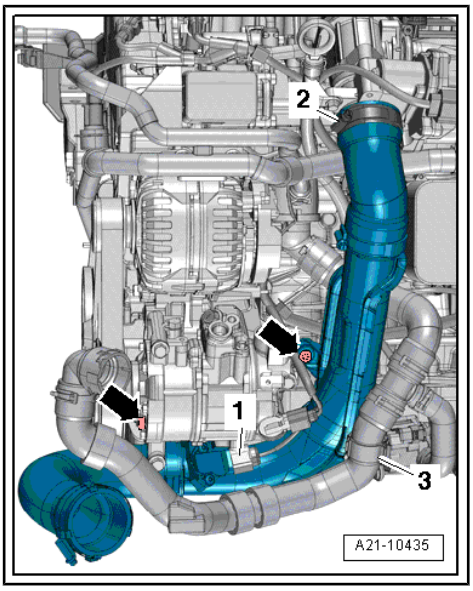
– Unplug electrical connector -2- at pressure differential sender -G505- .



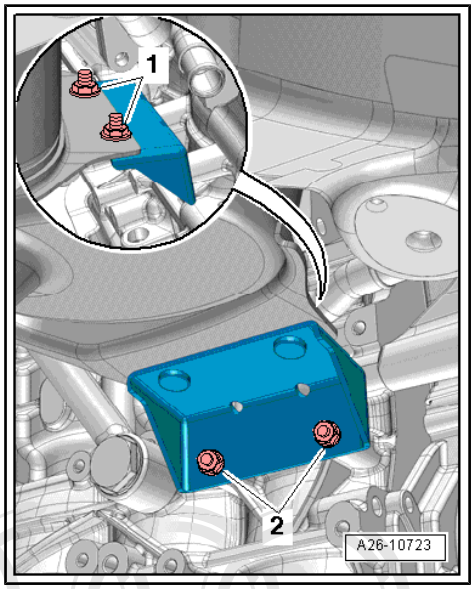
Note

Ignore items marked -1- and -arrows-.

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



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



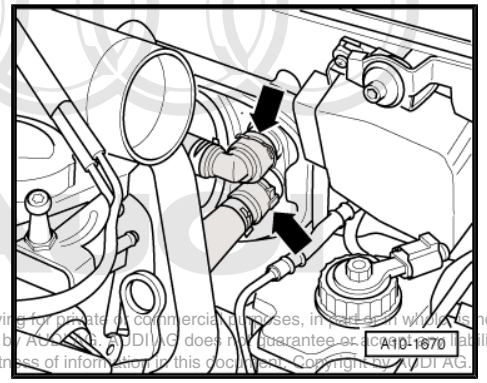
Note

Disregard -item 1-.

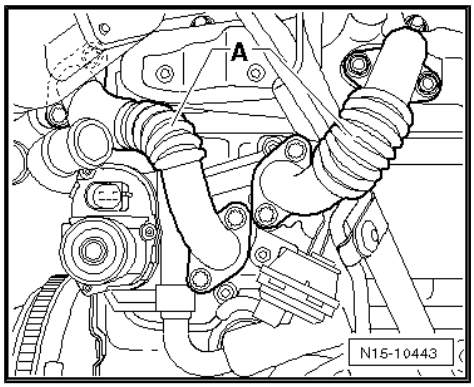
Note

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

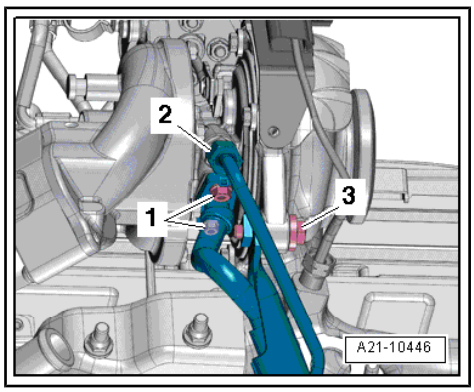
– Place drip tray for workshop hoist -VAS 6208- under connection.
– Lift retaining clips -arrows- and detach coolant hoses from heat exchanger.
– Guide coolant hoses downwards and drain off coolant.



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



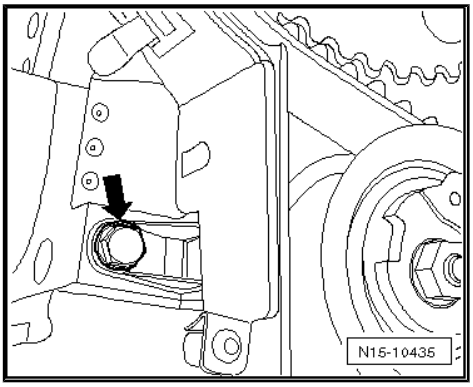
– Unscrew union nut -2- and bolt -3-.



Note

Disregard -item 1-.

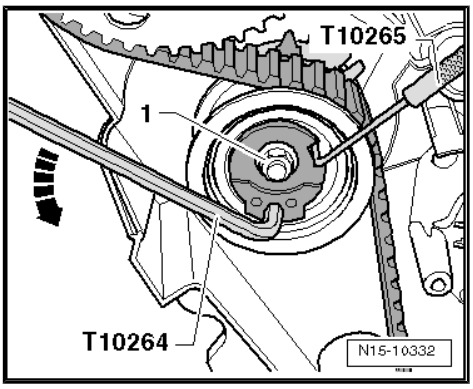
– Remove bolt -arrow- for toothed belt cover (rear).
– Take toothed belt off camshaft sprocket ⇒ page 91 .



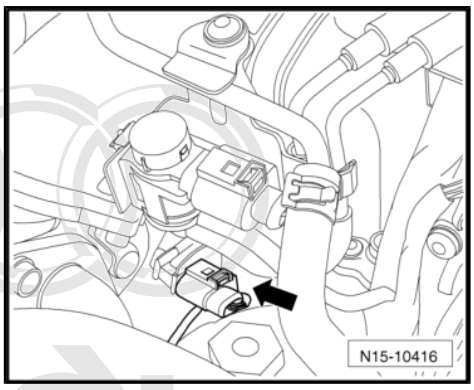
– Remove nut -1-.

Note

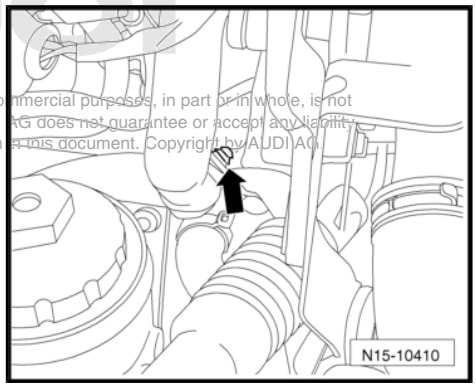
Disregard -arrow- and -T10264- .



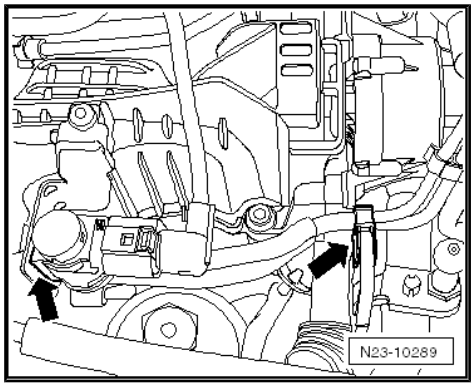
– Unplug electrical connector -arrow- at Hall sender -G40- .
– Remove cylinder head cover ⇒ page 102 .



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



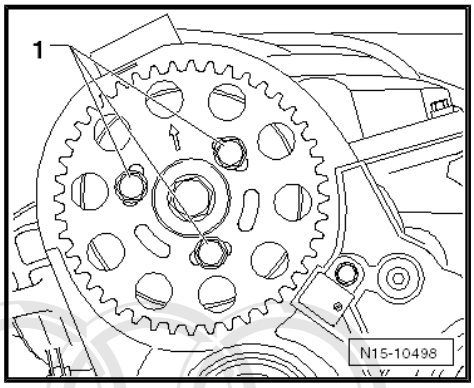
– Take exhaust gas recirculation cooler change-over valve - N345- -left arrow- out of bracket and move clear to one side.



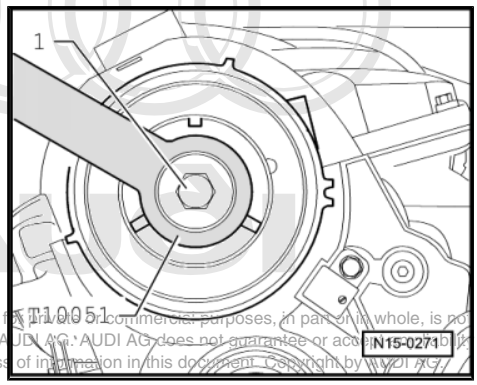
Note

Disregard -arrow- on right-side of illustration.

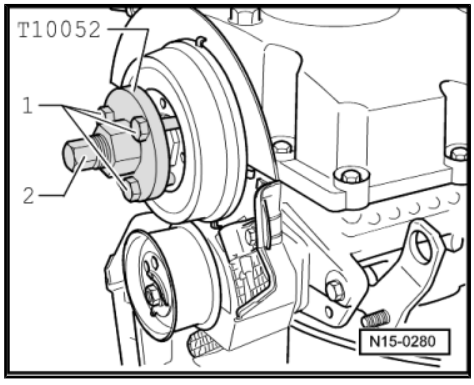
– Remove bolts -1- and detach camshaft sprocket.



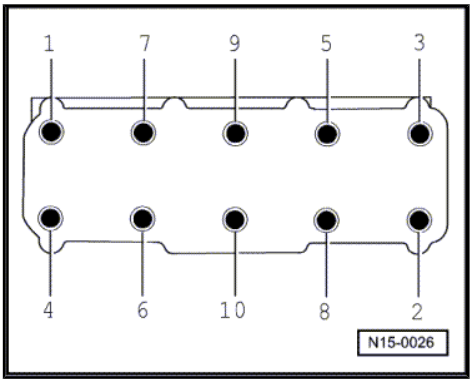
– Counterhold using counterhold tool -T10051- and loosen bolt -1- for camshaft hub.
– Unscrew bolt approx. 2 turns.



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



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



Note

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

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

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

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

Caution

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

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

Note

Audi TT models with a TDI engine (2.0 ltr. 4-valve common rail) are always equipped with steel glow plugs.

Installing

- Tightening torques
⇒ “2.4 Cylinder head - exploded view”, page 106

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

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

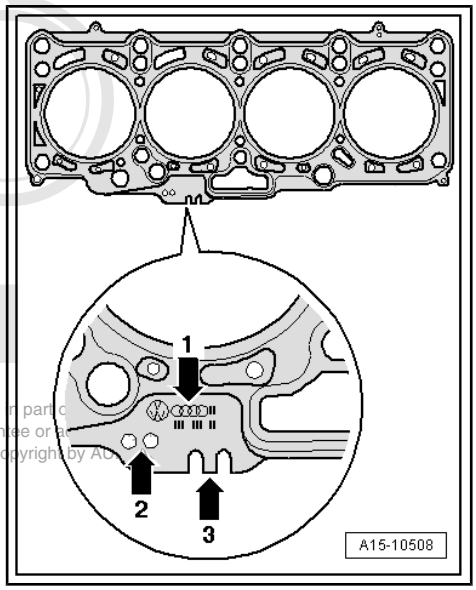
– If not already fitted, install dowel sleeves in cylinder block for centring cylinder block and cylinder head.

– Note cylinder head gasket identification:

1 - Part number

2 - Holes

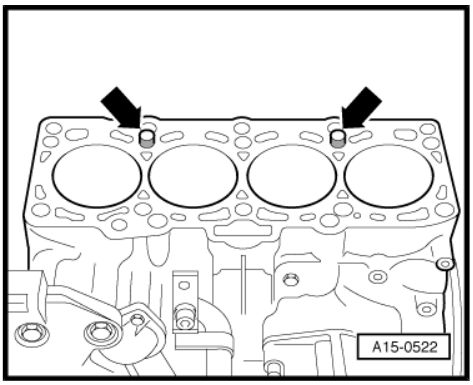
3 - Ignore



Note

- *If the cylinder head gasket or cylinder head have been replaced, select the new cylinder head gasket according to the number of holes on the old gasket.*
- *If parts of the crankshaft drive have been renewed, the new cylinder head gasket must be selected by measuring the piston projection at "TDC"* ⇒ page 85 .

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



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

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

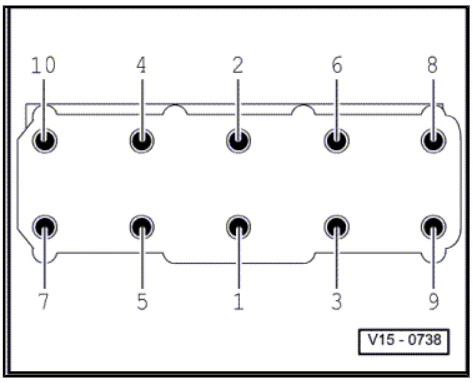
Note

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

– Fit cylinder head.

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

– Tighten cylinder head bolts ⇒ page 108 .

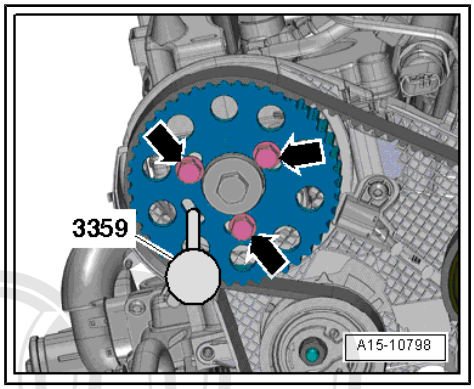


Note

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

– Install rear toothed belt cover, camshaft hub and sprocket ⇒ page 89 .

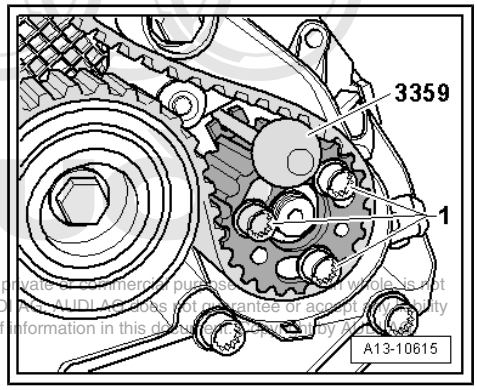
– Lock camshaft hub with diesel injection pump locking pin -3359- .



Note

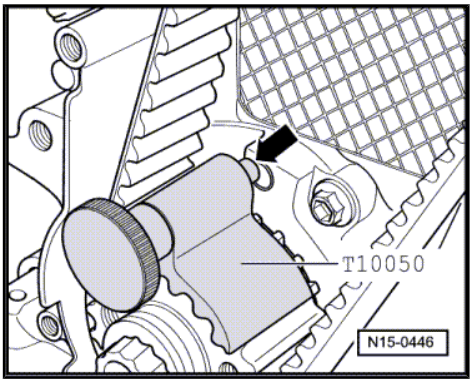
Disregard -arrows-.

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



Note

Disregard -item 1-.



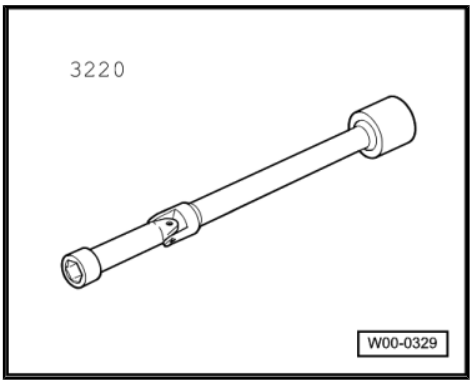
- Then turn crankshaft in direction of engine rotation until pin -arrow- on crankshaft stop -T10050- engages in sealing flange as crankshaft rotates.
- Install toothed belt (adjust valve timing) ⇒ page 95 .

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

- Install cylinder head cover ⇒ page 102 .
- Install support for turbocharger with oil supply line ⇒ page 207 .
- Install exhaust gas recirculation pipes ⇒ page 229 .
- Connect coolant hoses with plug-in connector to heat exchanger ⇒ page 202 .
- Install air pipes ⇒ page 212 .
- Install particulate filter ⇒ page 219 .
- Install dipstick guide tube ⇒ page 144 .
- Install vacuum line to exhaust gas recirculation cooler ⇒ page 229 .
- Install air pipe with connection and pulsation damper ⇒ page 207 .
- Connect vacuum hoses ⇒ page 206 .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Install air hoses with screw-type clips ⇒ page 213 .
- Observe notes on procedure for connecting the battery ⇒ Electrical system; Rep. Gr. 27 .
- Install air cleaner housing ⇒ Rep. Gr. 23 .
- Install radiator cowl ⇒ page 202 .
- Change engine oil ⇒ Maintenance ; Booklet 810 .
- Fill cooling system with fresh coolant ⇒ page 173 .

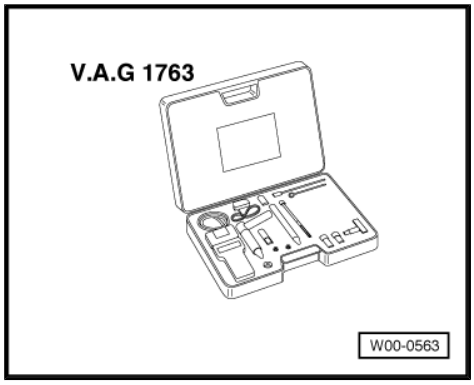
2.6 Checking compression

Special tools and workshop equipment required



♦ Jointed spanner -3220-

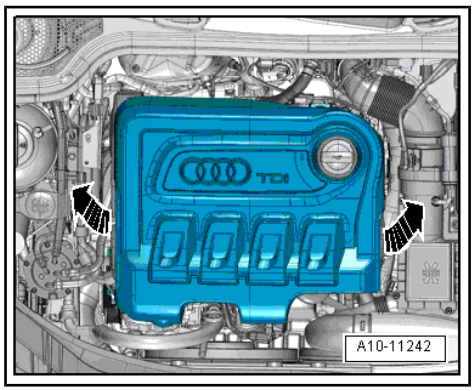
♦ Compression tester -V.A.G 1763- with adapter -V.A.G 1763/8-



Procedure

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

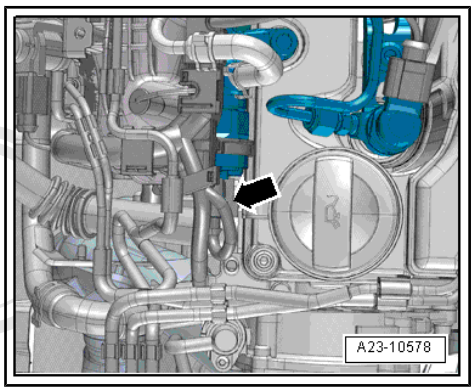
– Remove engine cover panel -arrows-.



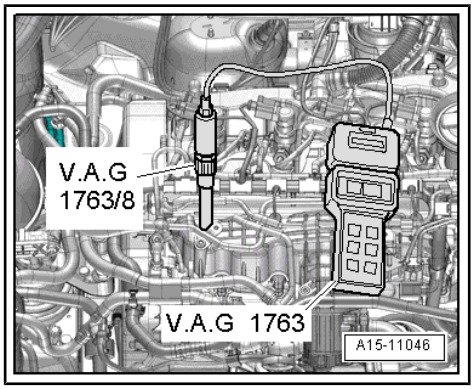
– Unplug electrical connector -arrow- for fuel pressure regulating valve -N276- at fuel rail.

– Briefly start engine to relieve fuel pressure in fuel rail.

– Remove all glow plugs ⇒ Rep. Gr. 28 .



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



Note

Using the compression tester ⇒ Operating instructions .

– Have a 2nd mechanic operate starter until tester shows no further pressure increase.
– Repeat procedure on each cylinder.

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

Assembling

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

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

3 Valve gear

Caution

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

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

Note

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

3.1 Valve gear - exploded view

1 - Valve

- ❑ Must not be machined; only grinding-in is permissible
- ❑ Mark installation position for re-installation
- ❑ Checking ⇒ page 143
- ❑ Valve dimensions ⇒ page 142
- ❑ Checking valve guides ⇒ page 142

2 - Cylinder head

3 - Valve stem oil seal

- ❑ Renewing with cylinder head installed ⇒ page 135
- ❑ Renewing with cylinder head removed ⇒ page 139

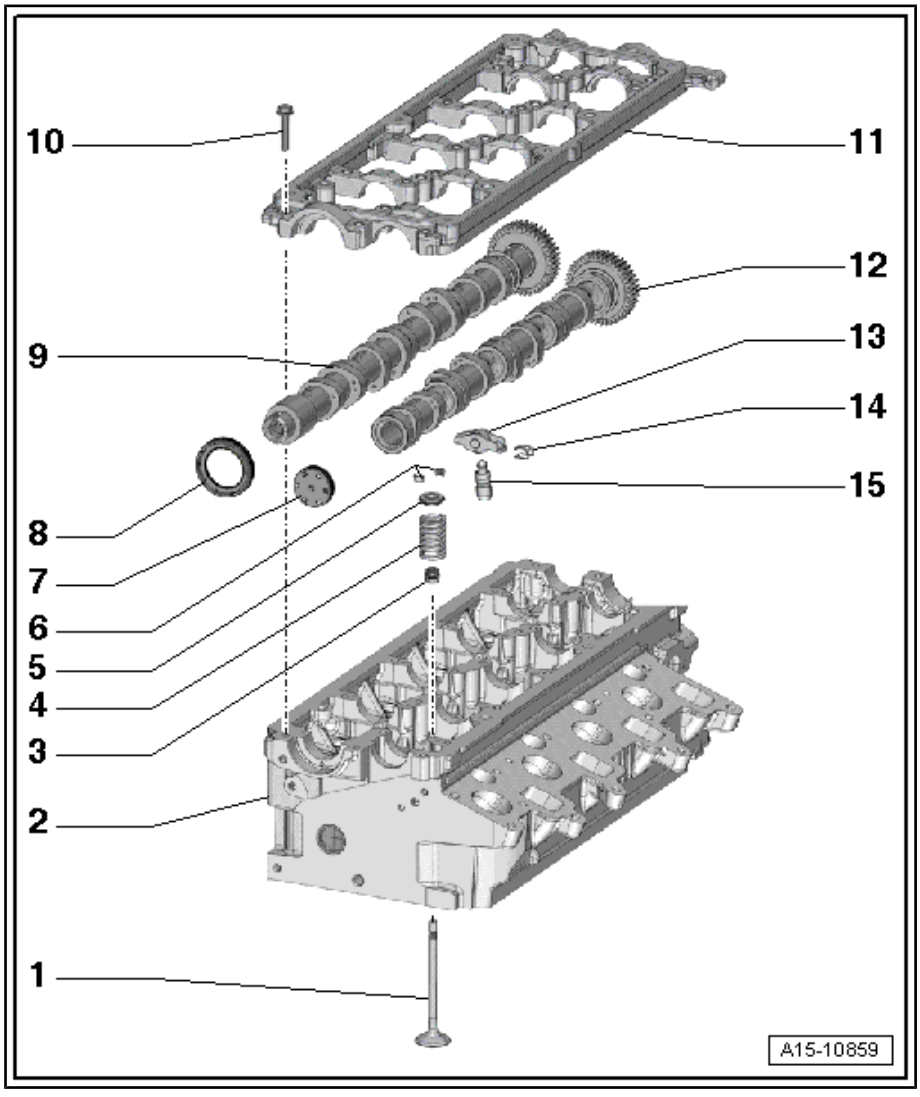
4 - Valve spring

5 - Valve spring plate

6 - Valve cotters

7 - Sealing cap

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



- ❑ Installation depth 1 ... 2 mm

8 - Oil seal

- ❑ Renewing ⇒ page 127

9 - Exhaust camshaft

- ❑ Removing and installing ⇒ page 129
- ❑ Measuring axial clearance ⇒ page 125
- ❑ Measuring radial clearance ⇒ page 126

10 - Bolt

- ❑ Correct sequence when slackening ⇒ page 130
- ❑ Tightening torque and sequence ⇒ page 125

11 - Retaining frame

- ❑ With integrated camshaft bearings
- ❑ Removing and installing ⇒ “3.5 Removing and installing camshafts”, page 129

12 - Inlet camshaft

- ❑ Removing and installing ⇒ page 129
- ❑ Measuring axial clearance ⇒ page 125
- ❑ Measuring radial clearance ⇒ page 126

13 - Roller rocker finger

- ❑ Removing and installing ⇒ “3.5 Removing and installing camshafts”, page 129
- ❑ Mark installation position for re-installation
- ❑ Check roller bearings for ease of movement
- ❑ Lubricate contact surfaces before installing

14 - Securing clip

- ❑ For hydraulic compensation element

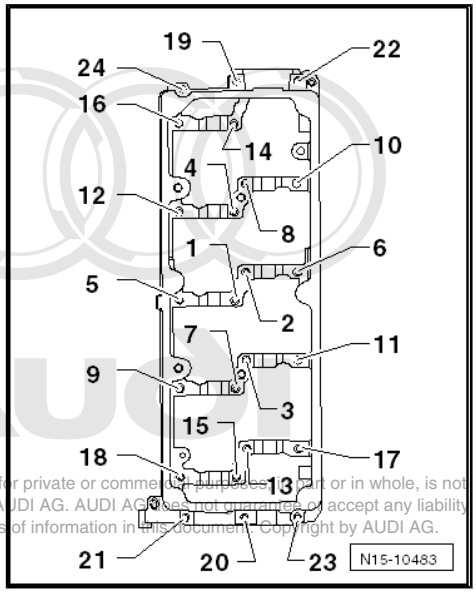
15 - Hydraulic valve compensation element

- ❑ Mark installation position for re-installation
- ❑ Lubricate contact surfaces before installing

Retaining frame - tightening torque and sequence

– Tighten bolts in 2 stages in the sequence shown:

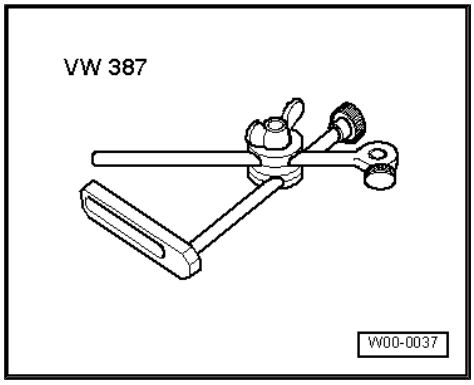
Stage	Bolts	Tightening torque
1.	-1 … 24-	Screw in bolts by hand until they make contact. • The retaining frame should make contact with the cylinder head over the full surface
2.	-1 … 24-	10 Nm



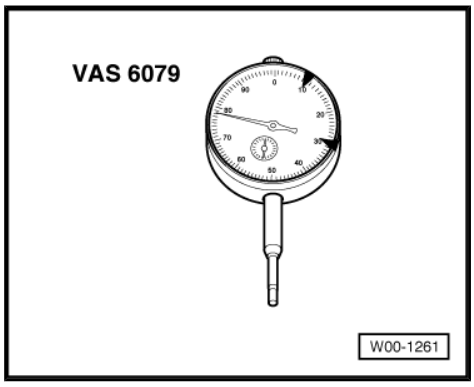
3.2 Measuring axial clearance of camshafts

Special tools and workshop equipment required

♦ Universal dial gauge bracket -VW 387-



♦ Dial gauge -VAS 6079-



Procedure

– Remove retaining frame
⇒ “3.5 Removing and installing camshafts”, page 129 .

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

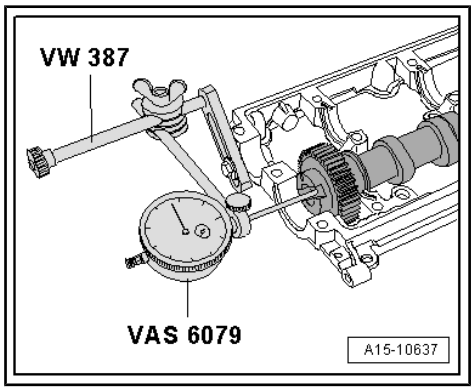
– Press camshaft against dial gauge by hand.

– Set dial gauge to “0”.

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

Axial clearance on inlet camshaft and exhaust camshaft:

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



3.3 Measuring radial clearance of camshafts

Special tools and workshop equipment required

♦ Plastigage

Procedure

– Remove roller rocker fingers
⇒ “3.5 Removing and installing camshafts”, page 129 .

– Clean bearing and bearing journal.

– 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.

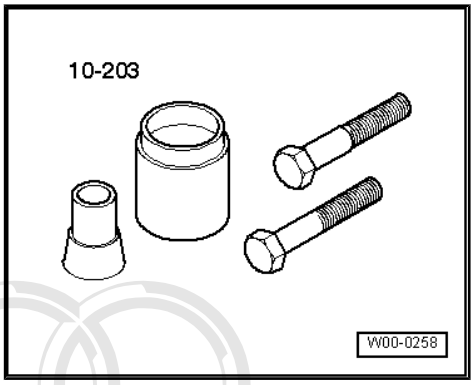
– Fit retaining frame and tighten to 10 Nm without rotating camshafts ⇒ page 125 .

– Remove retaining frame again.
– Compare width of Plastigage with measurement scale.
• Radial clearance: 0.035 ... 0.085 mm

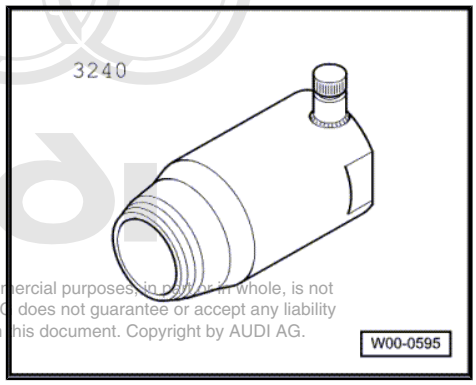
3.4 Renewing camshaft oil seal

Special tools and workshop equipment required

♦ Fitting tool -10 - 203-



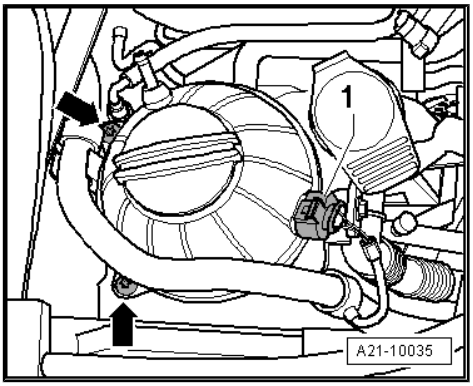
♦ Oil seal extractor -3240-



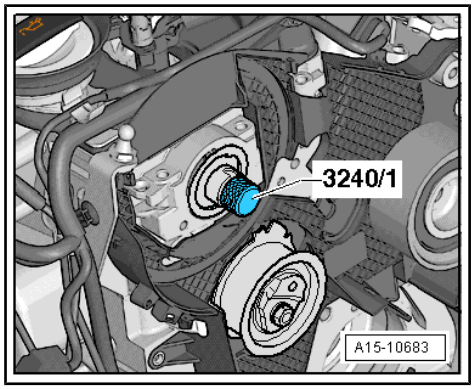
♦ Bolt M12x1.5x75

Procedure

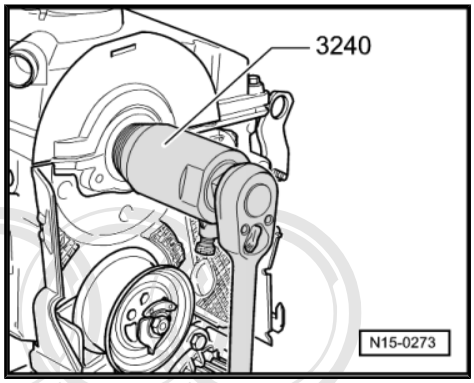
– Remove camshaft sprocket and hub
⇒ “3.5 Removing and installing camshafts”, page 129 .
– Remove bolts -arrows-.
– Detach electrical connector -1- for coolant shortage indicator switch -F66- and move coolant expansion tank to side.



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



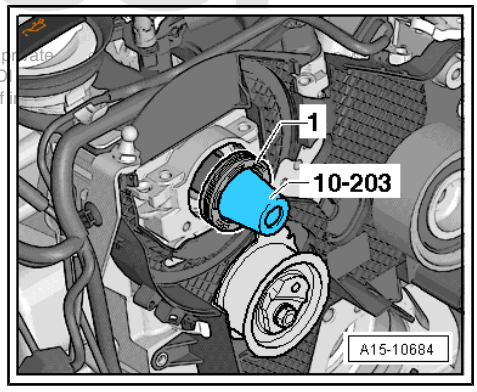
– Screw inner section of oil seal extractor -3240- two turns out of outer section (approx. 3 mm) and lock with knurled screw.
– Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).
– Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.
– Clamp flats of oil seal extractor in vice and use pliers to remove oil seal.
– Clean contact surface and sealing surface.



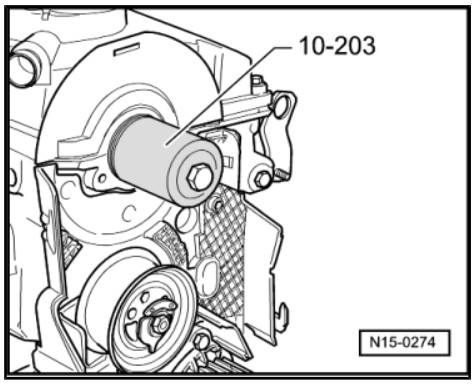
Note

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

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



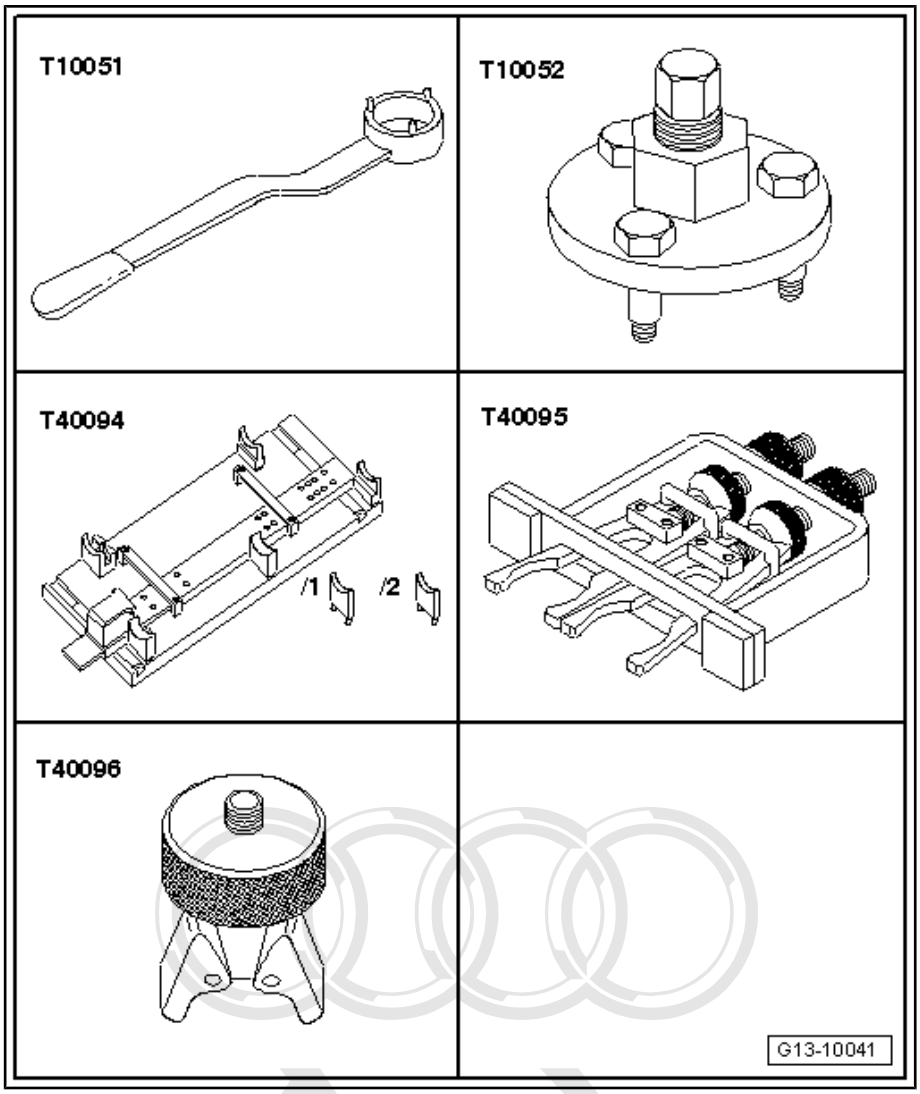
– Press in oil seal onto stop using thrust piece of fitting tool -10 - 203- and bolt M12×1.5×75.
– Install camshaft sprocket and hub
⇒ “3.5 Removing and installing camshafts”, page 129 .



3.5 Removing and installing camshafts

Special tools and workshop equipment required

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



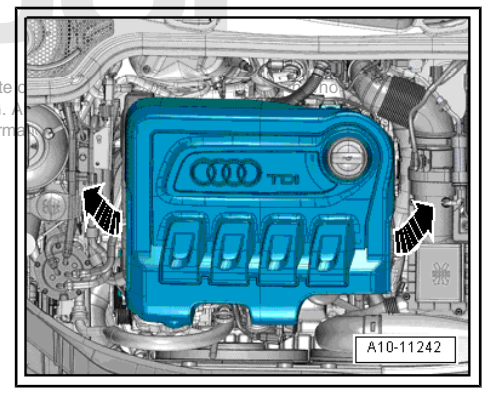
Removing

- Cylinder head installed.

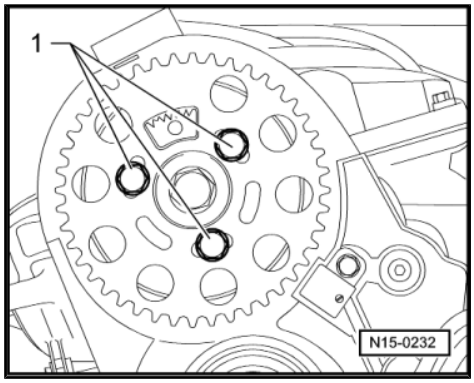
– Remove engine cover panel -arrows-.

– Take toothed belt off camshaft sprocket and high-pressure pump sprocket ⇒ page 91 .

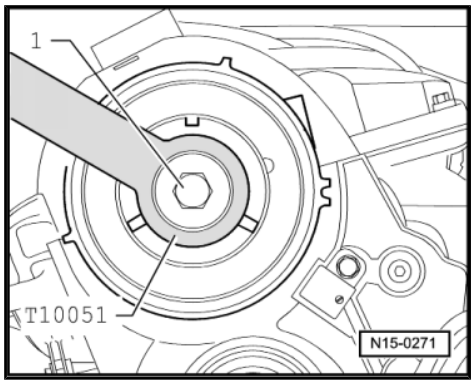
– Remove cylinder head cover ⇒ page 102 .



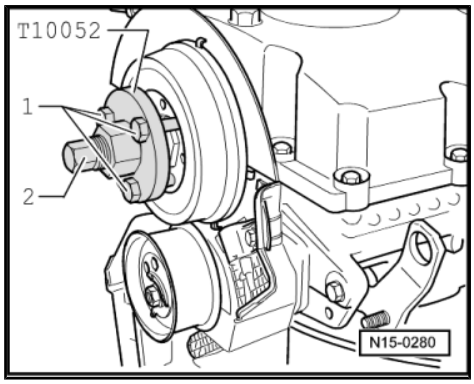
– Remove bolts -1- and detach camshaft sprocket.



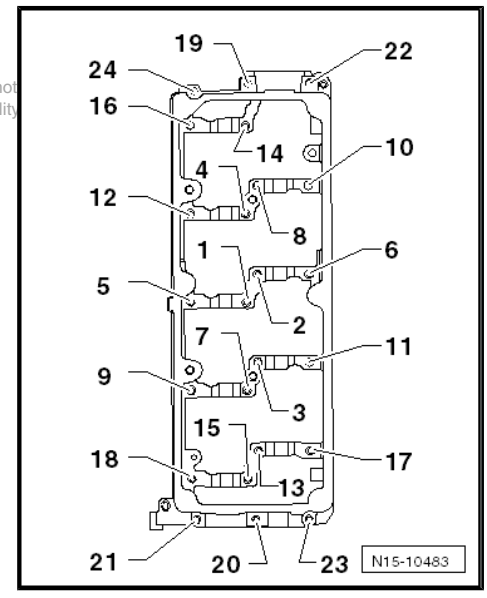
– Counterhold using counterhold tool -T10051- and loosen bolt -1- for camshaft hub.
– Unscrew bolt approx. 2 turns.



– Apply puller -T10052- to camshaft hub and and screw bolts -1- into hub.
– Counterhold on hexagon flats (30 mm) of puller and screw in bolt -2- to pull off camshaft hub.
– Detach hub from taper of camshaft.
– Remove exhauster pump ⇒ Rep. Gr. 47 .



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



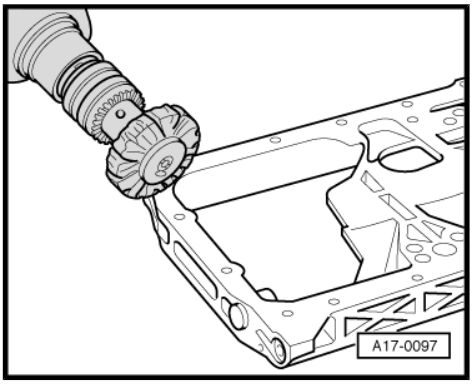
Installing

- Tightening torques
⇒ “3.1 Valve gear - exploded view”, page 124

Caution

Make sure axial bearings in retaining frame are not damaged.

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



Caution

Protect lubrication system and bearings against contamination.

- *Cover exposed parts of the engine.*

WARNING

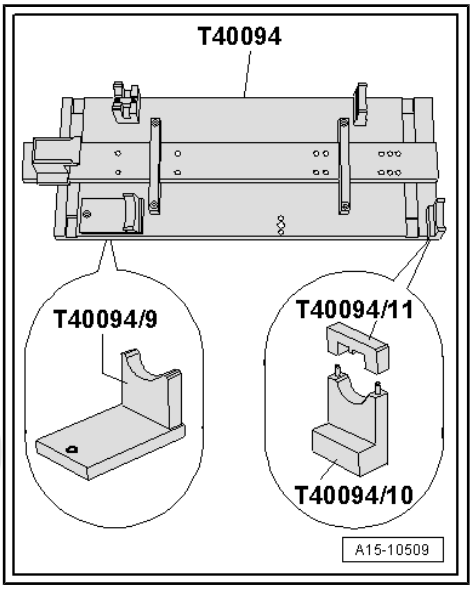
Protect eyes against injuries.

- *Wear safety goggles.*

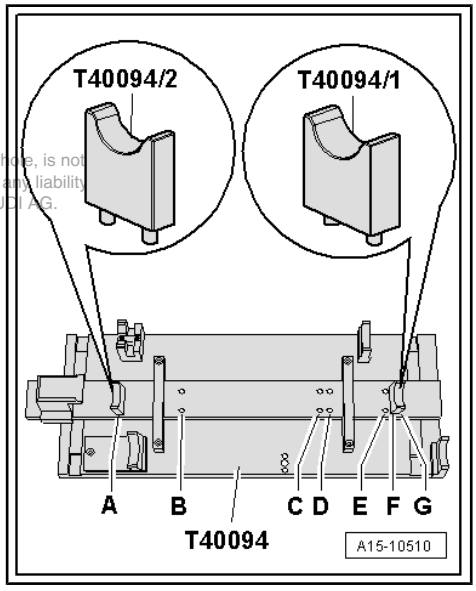
– Remove remaining sealant from cylinder head and retaining frame using rotating plastic brush or similar.
– Clean sealing surfaces; they must be free of oil and grease.
– Oil running surfaces of both camshafts.

Set up camshaft fitting tool -T40094- as follows:

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



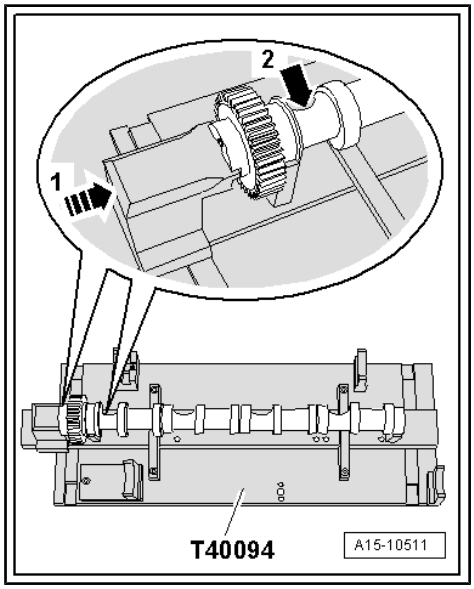
– Fit support -T40094/1- onto position -F- and support -T40094/2- onto position -A-.



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

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

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



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

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

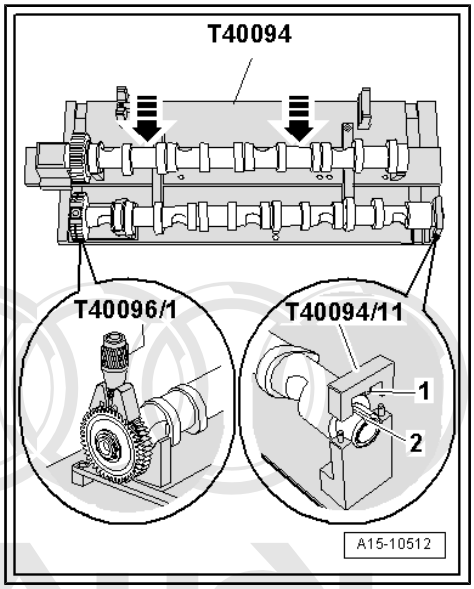
• The lug -1- on the top section must engage in the slot -2- in the camshaft,

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

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

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

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

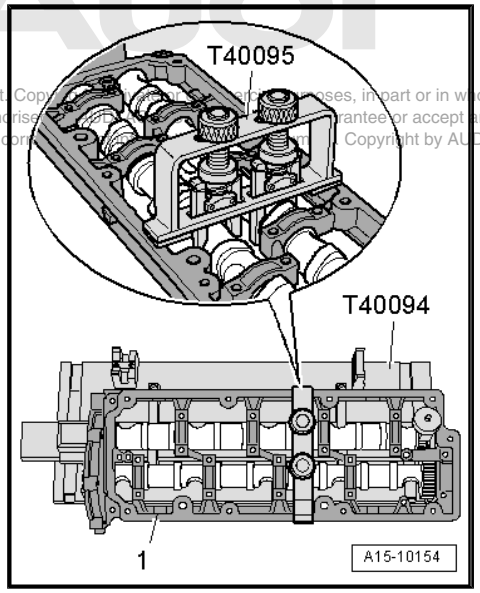


– Fit retaining frame on camshafts.

• All camshaft bearings must be seated on the camshafts.

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

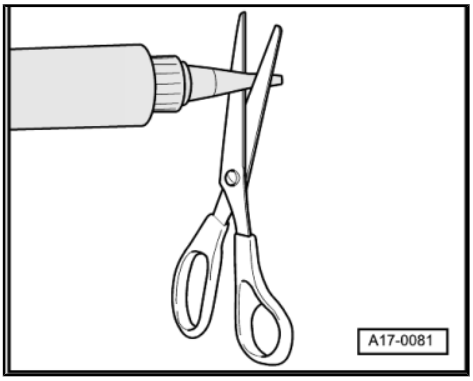
– Detach top section -T40094/11- .



Note

Note the use-by date of the sealant.

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



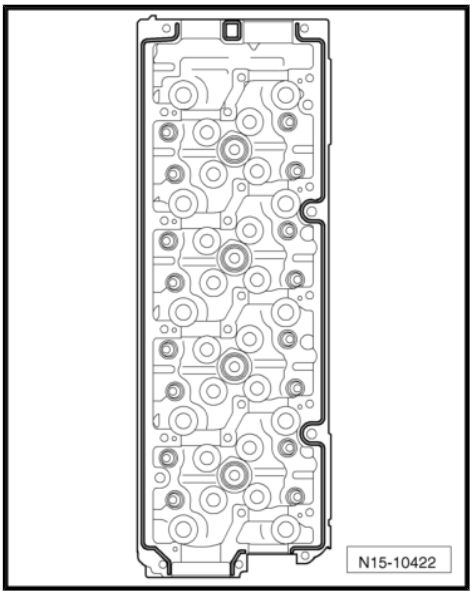
Caution

Make sure excess sealant does not contaminate camshaft bearings.

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

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

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



Note

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

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

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

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

– Tighten bolts ⇒ page 125 .

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

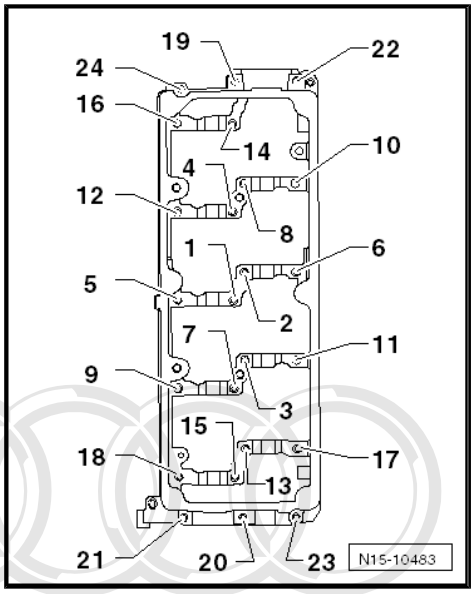
Remaining installation steps are carried out in reverse sequence; note the following:

– Install camshaft oil seal ⇒ page 127 .

– Drive new sealing cap ⇒ Item 7 (page 124) into cylinder head to a depth of approx. 1 ... 2 mm using suitable thrust piece.

– Install exhauster pump ⇒ Rep. Gr. 47 .

– Install cylinder head cover ⇒ page 102 .



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

3.6 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

- Feeler gauge

Procedure

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

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

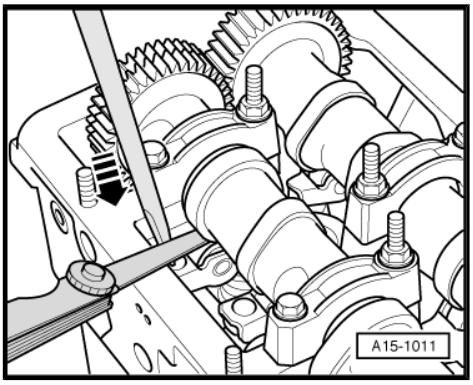
Note

If irregular valve noise disappears but repeatedly re-occurs when travelling short distances, renew oil retention valve. The oil retention valve is located in the oil filter bracket ⇒ Item 10 (page 159) .

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

– Remove cylinder head cover ⇒ page 102 .

– Rotate crankshaft by turning bolt for toothed belt sprocket until cam of supporting element to be tested is facing upwards.
– Press roller rocker finger down -arrow- to determine clearance between cam and roller rocker finger.
– If it is possible to insert a feeler gauge of 0.20 mm between cam and roller rocker finger, renew hydraulic compensation element
⇒ “3.5 Removing and installing camshafts”, page 129 .



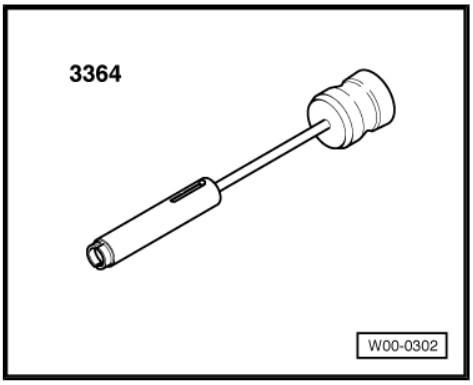
Additional steps required

– Install cylinder head cover ⇒ page 102 .

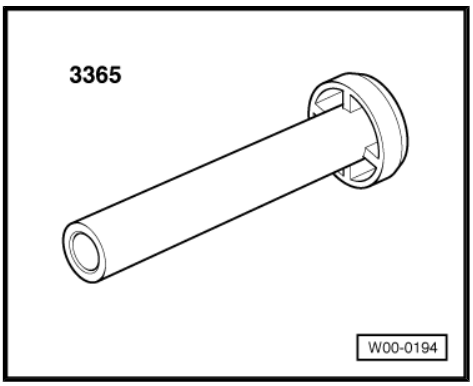
3.7 Renewing valve stem oil seals with cylinder head installed

Special tools and workshop equipment required

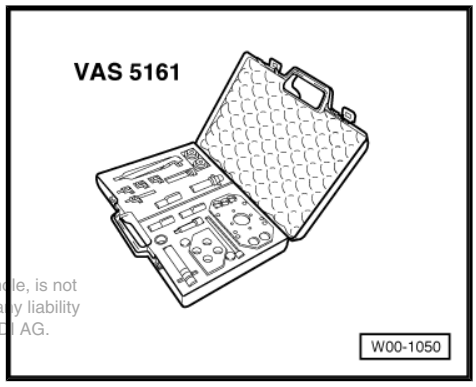
♦ Valve stem seal puller -3364-



♦ Valve stem seal fitting tool -3365-



♦ Removal and installation device for valve cotters -VAS 5161- with guide plate -VAS 5161/23- and sleeve -VAS 5161/23-1- .



♦ Bolt M6x30 (2x)

Procedure

– Remove all glow plugs ⇒ Rep. Gr. 28 .

– Remove camshafts ⇒ page 129 .

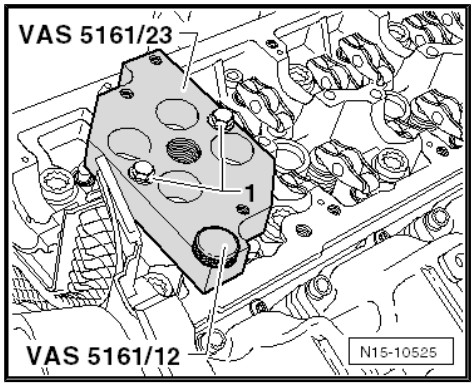
– Mark original positions of roller rocker fingers and hydraulic compensation elements for reinstallation.

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

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

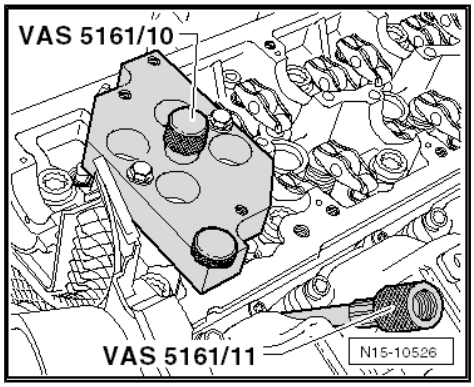
– Fit guide plate -VAS 5161/23- onto cylinder head.

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

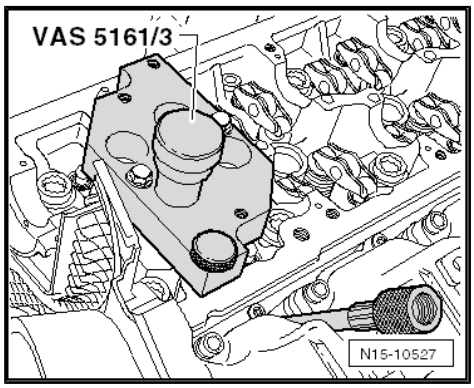


– Screw sealing pin -VAS 5161/10- into guide plate.

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



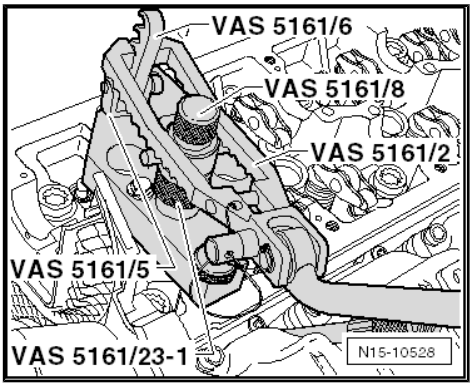
– Insert drift -VAS 5161/3- into guide plate and use plastic-headed hammer to release sticking valve cotters.



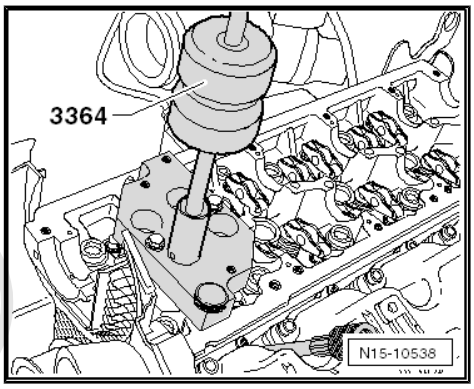
– Screw snap-in device -VAS 5161/6- with engaging fork -VAS 5161/5- into guide plate.
– Slide sleeve -VAS 5161/23-1- onto assembly cartridge -VAS 5161/8- .
– Connect adapter to compressed air line using a commercially available connection piece, and apply constant air pressure.

• Minimum pressure: 6 bar

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



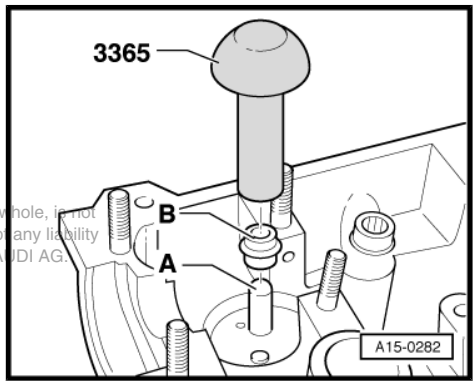
– Pull off valve stem oil seal with valve stem seal puller -3364- .



Caution

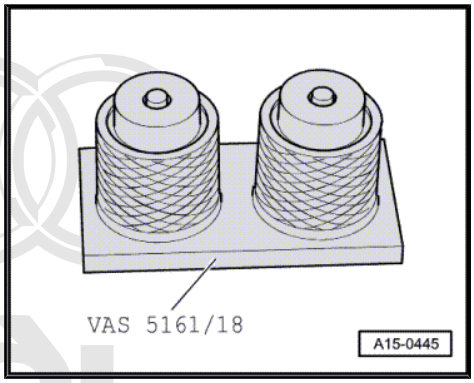
Make sure valve stem oil seals are not damaged when installing.

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



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

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



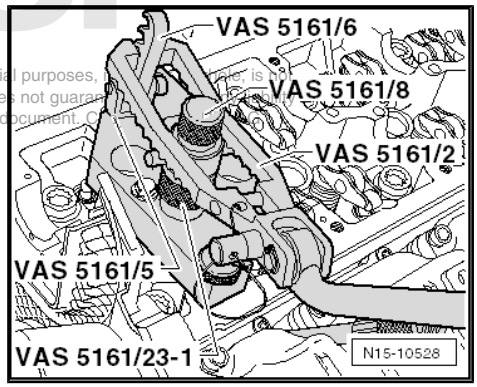
- Larger diameter of valve cotters faces upwards.

– Insert valve spring and valve spring plate.

– Press assembly cartridge onto insertion device from above and take up valve cotters.

– Insert assembly cartridge in guide plate -VAS 5161/23- again.

– Press down pressure fork and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotters.



– Release the 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.

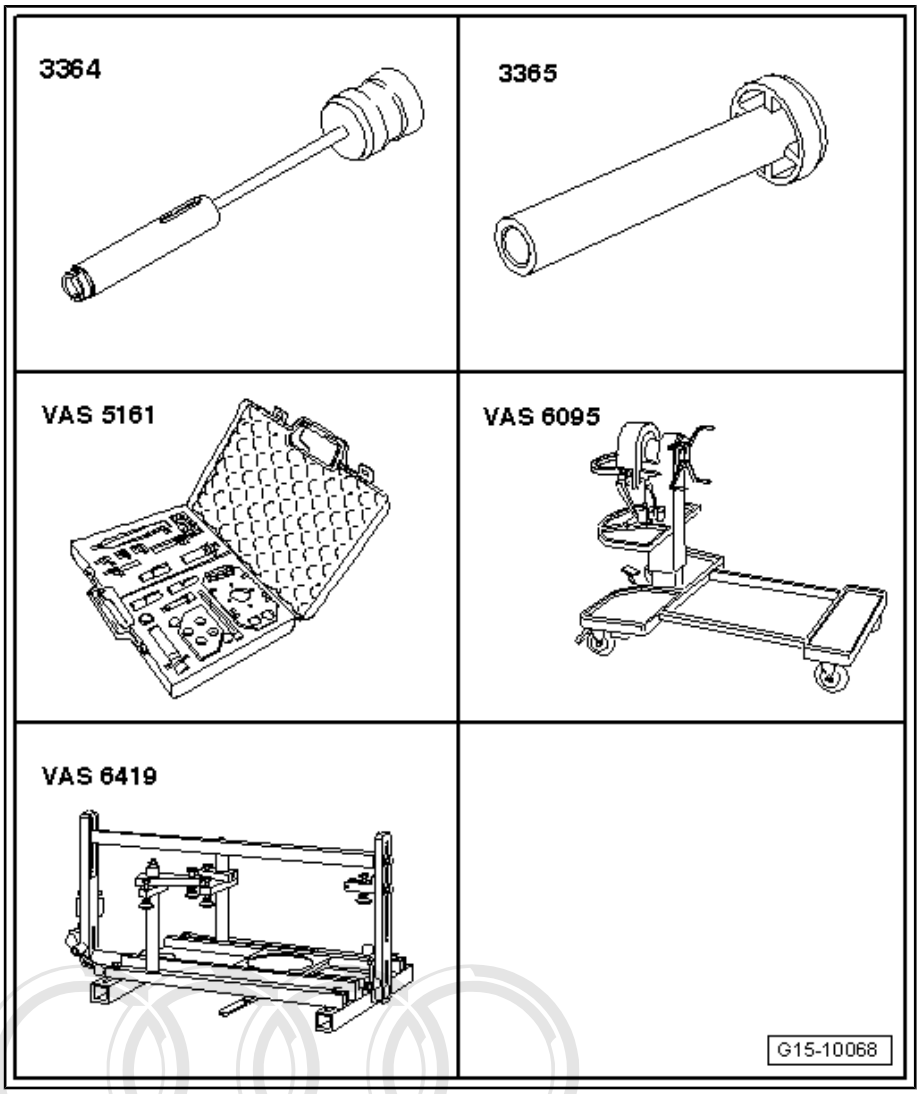
– Install camshafts ⇒ page 129 .

– Install glow plugs ⇒ Rep. Gr. 28 .

3.8 Renewing valve stem oil seals with cylinder head removed

Special tools and workshop equipment required

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



Procedure

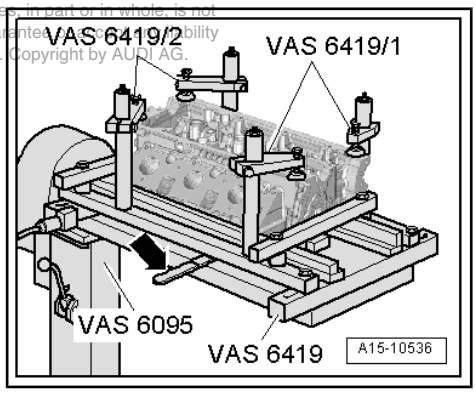
– Remove camshafts ⇒ page 129 .

– 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.

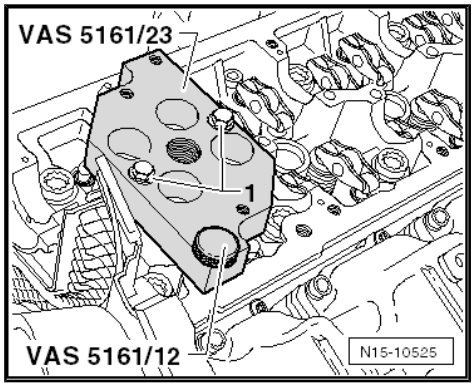


– Connect cylinder head tensioning device to compressed air.

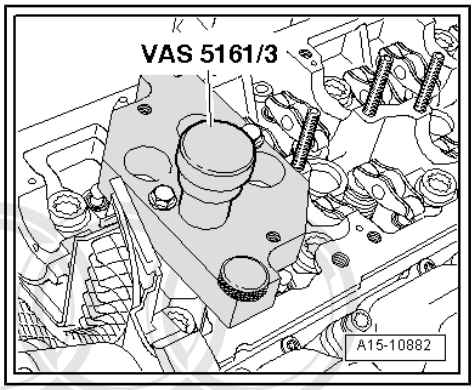
– Using lever -arrow-, slide air pad under combustion chamber where valve stem oil seal is to be removed.

– Apply just enough compressed air to bring air pad into contact with valve heads.

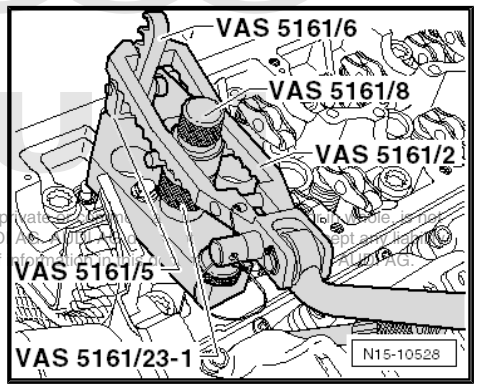
– Fit guide plate -VAS 5161/23- onto cylinder head.
– Secure guide plate on intake manifold side with knurled screw -VAS 5161/12- and 2 M6x30 bolts -item 1- by hand until they make contact.



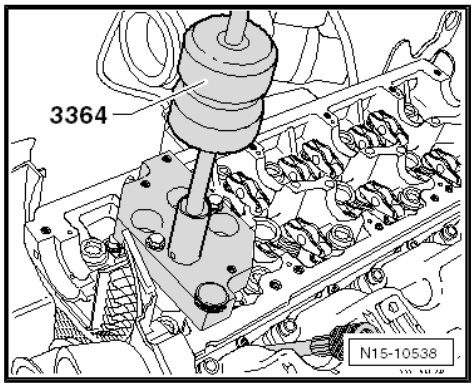
– Insert drift -VAS 5161/3- into guide plate and use plastic-headed hammer to release sticking valve cotters.



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



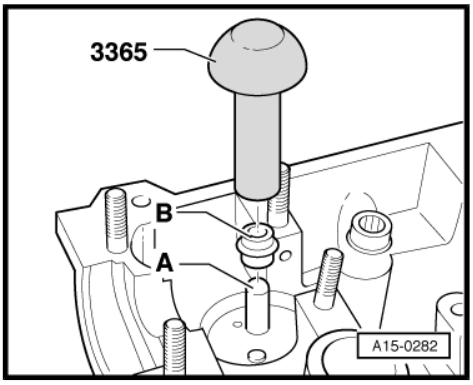
– Pull off valve stem oil seal with valve stem seal puller -3364- .



Caution

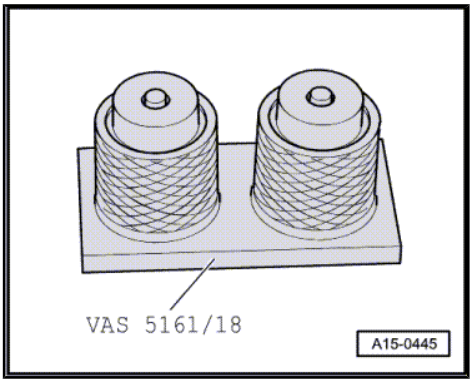
Make sure valve stem oil seals are not damaged when installing.

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



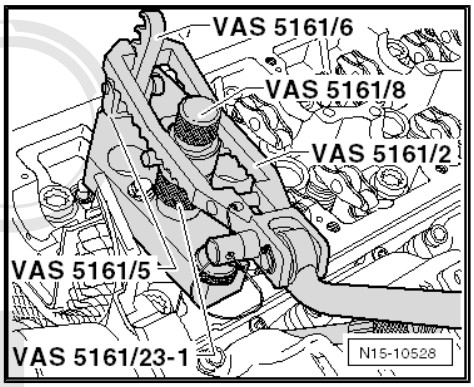
– Lightly oil sealing lip of valve stem oil seal.
– Slide valve stem oil seal onto plastic sleeve.
– Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool -3365- .
– Take off plastic sleeve.

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



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

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

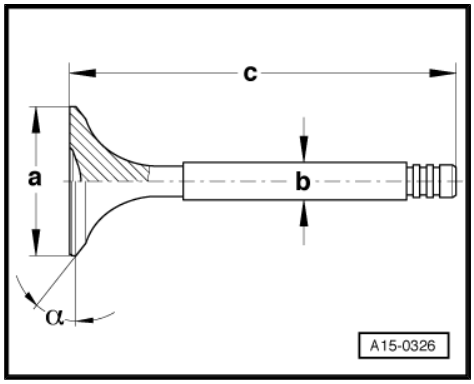


Assembling

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 129.

3.9 Valve dimensions



Note

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

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

3.10 Machining valve seats

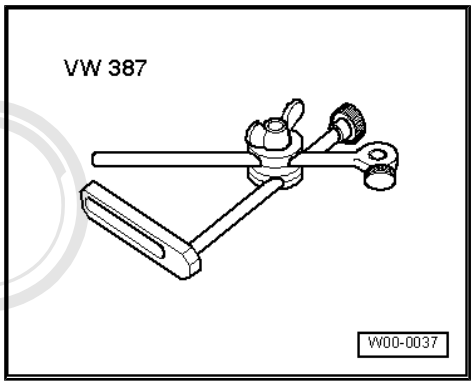
Note

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

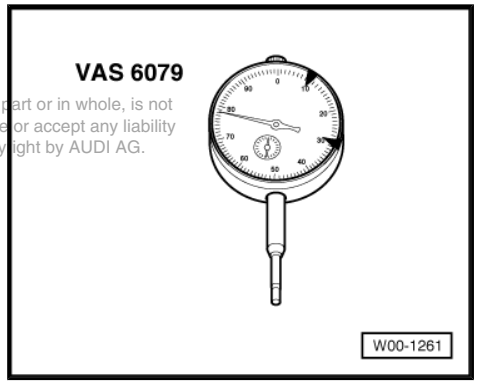
3.11 Checking valve guides

Special tools and workshop equipment required

- Universal dial gauge bracket -VW 387-



- Dial gauge -VAS 6079-



Procedure

Note

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

– Attach dial gauge -VAS 6079- with dial gauge bracket - VW 387- to cylinder head.

– Insert valve into guide.

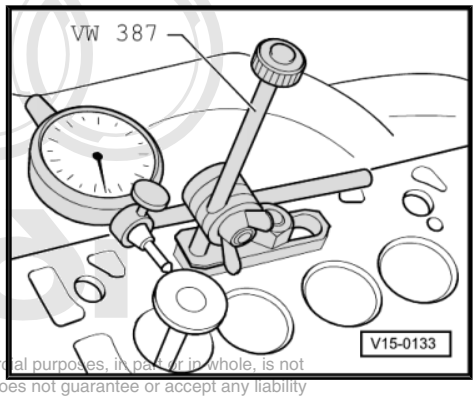
• End of valve stem must be flush with guide.

– Measure the amount of sideways play.

• Wear limit: 1.0 mm.

– If the wear limit is exceeded, repeat the measurement with new valves.

– Renew cylinder head if wear limit is still exceeded.



Note

Valve guides cannot be renewed.

3.12 Checking valves

– Visually inspect for scoring on valve stems and valve seat surfaces.

– Renew valve if scoring is clearly visible.

17 – Lubrication

1 Oil pump, sump, balance shaft assembly

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.*
- *Refer to ⇒ Maintenance tables for engine oil capacity, oil specifications and viscosity grades.*
- *Oil spray jet and pressure relief valve* *⇒ page 85*

1.1 Oil pump, sump, balance shaft assembly - exploded view

1 - Seal
- ❑ Renew

2 - Oil drain plug
- ❑ 30 Nm

3 - Sump
- ❑ Removing and installing ⇒ page 147

4 - Bolt
- ❑ 9 Nm

5 - Suction pipe
- ❑ Clean strainer if dirty

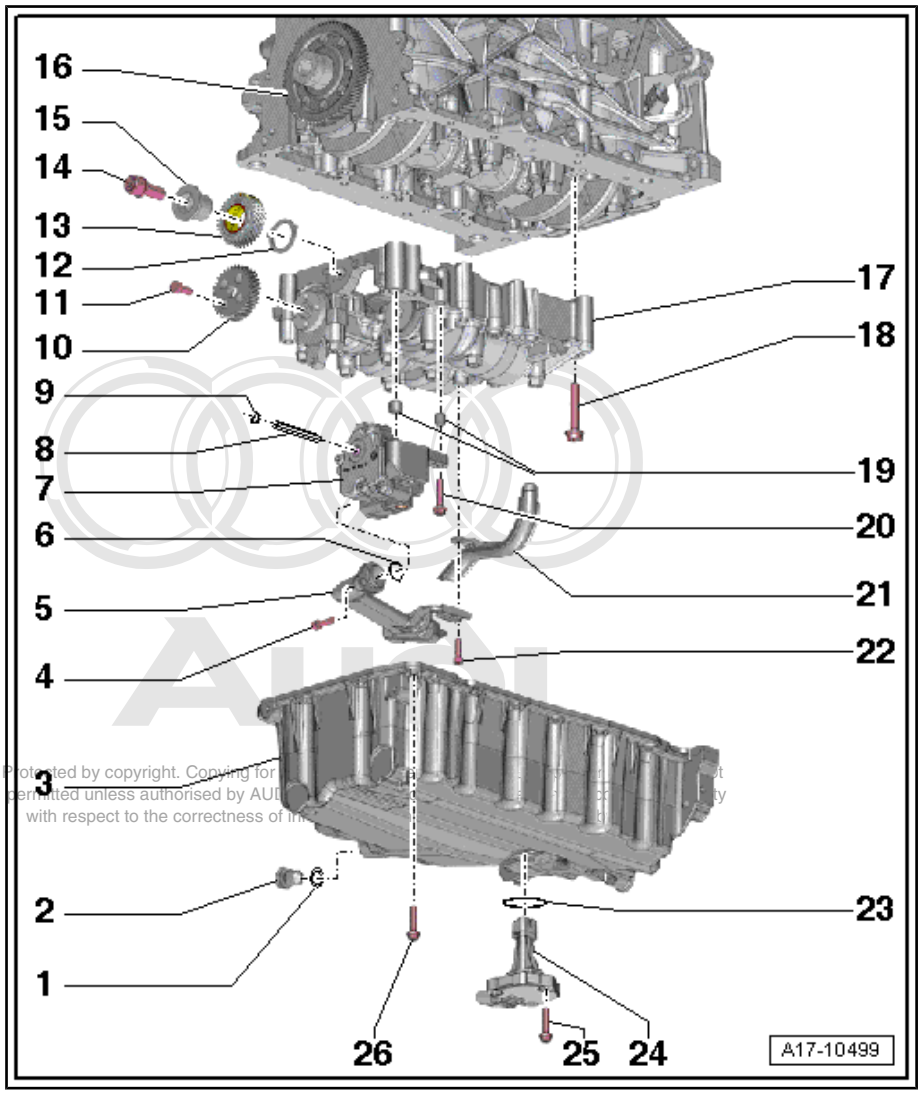
6 - O-ring
- ❑ Renew

7 - Oil pump
- ❑ Removing and installing ⇒ page 152
- ❑ Before installing, check that the two dowel sleeves for centring oil pump are fitted onto balance shaft assembly

8 - Drive shaft
- ❑ For oil pump

9 - Circlip
- ❑ Must fit securely in groove
- ❑ Renew circlip if damaged or stretched

10 - Spur gear
- ❑ For balance shaft



11 - Bolt

- ❑ Renew
- ❑ 20 Nm +90° further

12 - Thrust washer

- ❑ For idler gear
- ❑ Renew
- ❑ Installation position ⇒ page 146
- ❑ When installing idler gear, apply grease to hold washer on balance shaft assembly

13 - Idler gear

- ❑ Renew
- ❑ To achieve the correct backlash a suitably thick coating is already applied to the new idler gear; the required clearance is achieved as the coating is worn down
- ❑ Installation position: Part No. must be visible.
- ❑ Make sure thrust washer is properly seated ⇒ page 146

14 - Bolt

- ❑ With washer
- ❑ Renew
- ❑ 90 Nm +90° further

15 - Hub

- ❑ For idler gear
- ❑ Renew

16 - Crankshaft gear

17 - Balance shaft assembly

- ❑ Removing ⇒ page 153
- ❑ Re-installing "old" balance shaft assembly ⇒ page 157
- ❑ Installing new balance shaft assembly ⇒ page 154
- ❑ Before installing, check that the two dowel sleeves for centring balance shaft assembly are fitted on cylinder block

18 - Bolt

- ❑ Renew
- ❑ Tightening torque and sequence ⇒ page 146

19 - Dowel sleeves

20 - Bolt

- ❑ 9 Nm

21 - Oil intake pipe

22 - Bolt

- ❑ 9 Nm

23 - Seal

- ❑ Renew

24 - Oil level and oil temperature sender -G266-

- ❑ Removing and installing ⇒ page 147

25 - Bolt

- ❑ Self-locking
- ❑ Renew
- ❑ 9 Nm

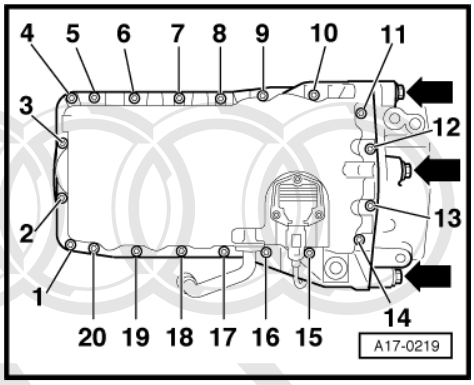
26 - Bolt

- ❑ Tightening torque and sequence ⇒ page 146

Sump - tightening torque and sequence

– Tighten bolts in 3 stages:

Stage	Bolts	Tightening torque
1.	-1 … 20-	5 Nm in diagonal sequence
2.	-arrows-	40 Nm using Allen key, long reach - T10058-
3.	-1 … 20-	Tighten in stages and in diagonal sequence; final torque 13 Nm.

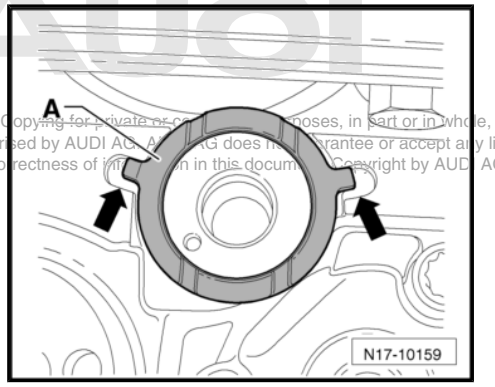


Installation position of thrust washer

Caution

Thrust washer can slip out of position behind idler gear.

- ***Make sure that thrust washer -A- does not slip out of the recesses in the balance shaft assembly -arrows- when fitting the idler gear. If this is neglected, the thrust washer can become trapped. If necessary, apply grease to hold washer on balance shaft assembly.***



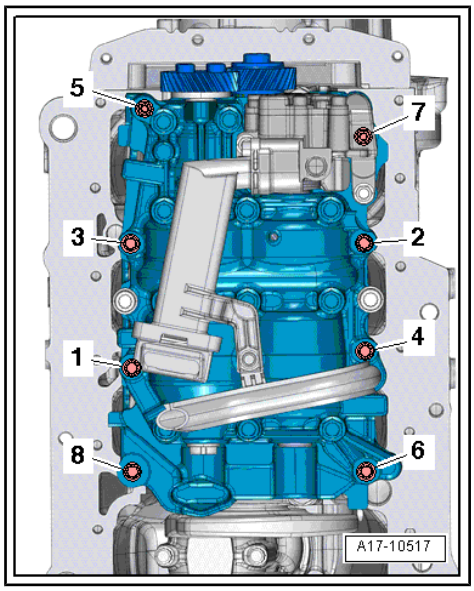
Balance shaft assembly - tightening torque and sequence

Note

Renew the bolts tightened with specified tightening angle.

– Tighten bolts in 5 stages:

Stage	Bolts	Tightening torque/angle specification
1.	-1 … 8-	Screw in bolts by hand until they make contact.
2.	-1 … 8-	6 Nm
3.	-5- and -7-	13 Nm
4.	-1, 2, 3, 4, 6, 8-	20 Nm
5.	-1 … 8-	turn 90° further

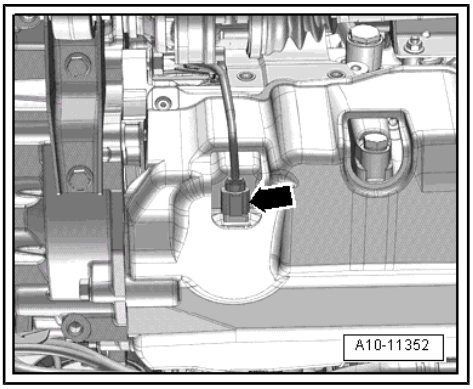


1.2 Removing and installing oil level and oil temperature sender -G266-

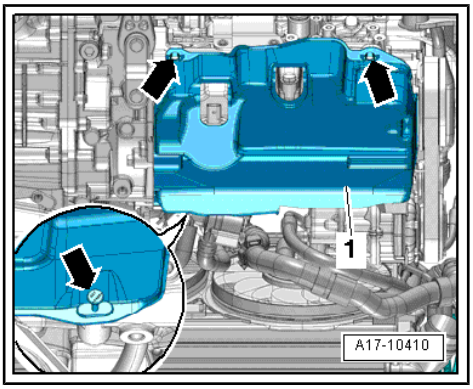
Removing

- Engine oil drained ⇒ Maintenance ; Booklet 810 .

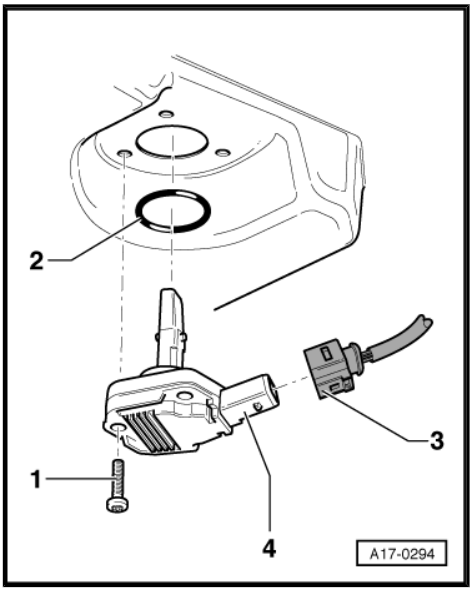
– Unplug electrical connector -arrow- at oil level and oil temperature sender -G266- .



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



– Remove bolts -1- and detach oil level and oil temperature sender -G266- -item 4-.



Note

Disregard -item 3-.

Installing

- Tightening torque
⇒ “1.1 Oil pump, sump, balance shaft assembly - exploded view”, page 144

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

Note

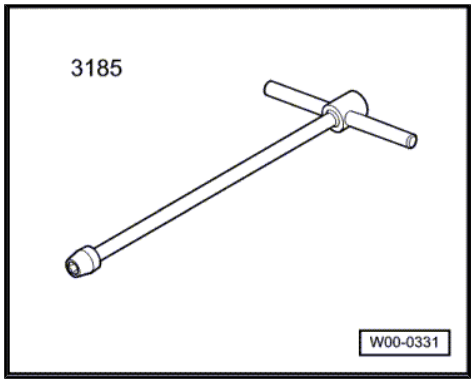
Renew seal -2- and self-locking bolts -1-.

– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 810 .

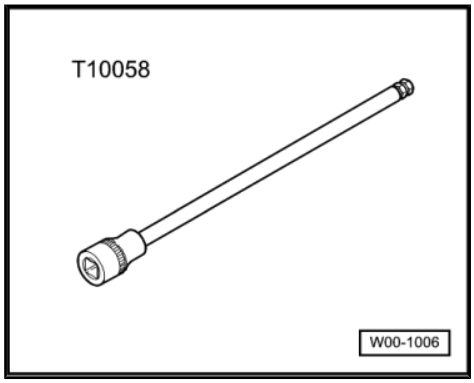
1.3 Removing and installing sump

Special tools and workshop equipment required

♦ T-bar and socket, 10 mm -3185-



♦ Allen key, long reach -T10058-

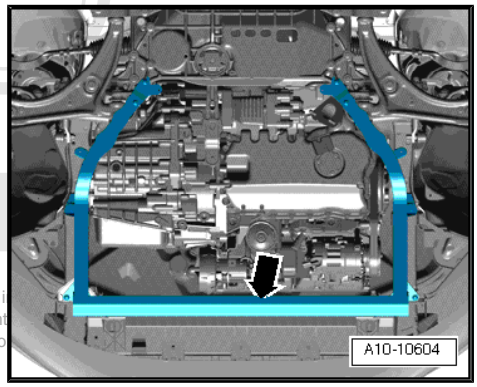


♦ Electric drill with plastic brush
♦ Sealant ⇒ Electronic parts catalogue
♦ Safety goggles

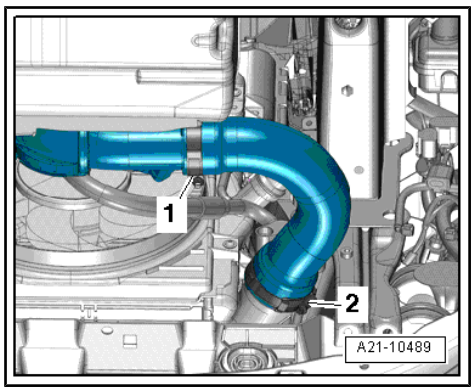
Removing

• Engine oil drained ⇒ Maintenance ; Booklet 810 .

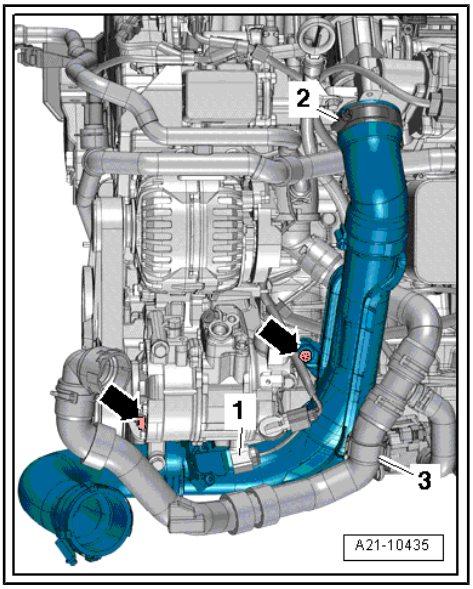
– TT Roadster: Remove noise insulation frame -arrow- ⇒ Rep. Gr. 50 .



– Release hose clip -2-, lift retaining clip -1- and remove air hose.



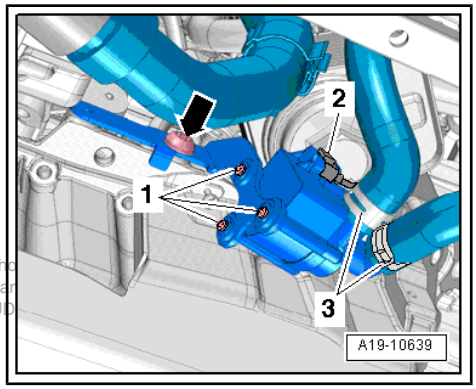
– Remove bolts -arrows-.
– Move coolant hose -3- clear.
– Loosen hose clip -2-.
– Unplug electrical connector -1- at charge pressure sender - G31- and detach air pipe (right-side).



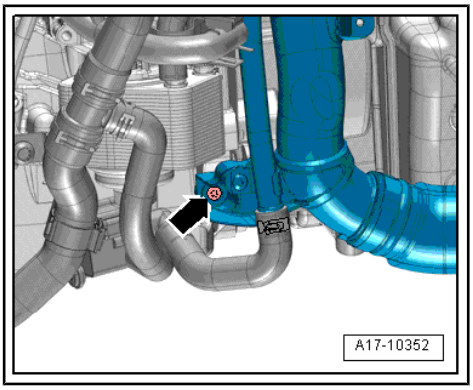
– Remove bolt -arrow- and push pump for exhaust gas recirculation cooler -V400- to the side.

Note

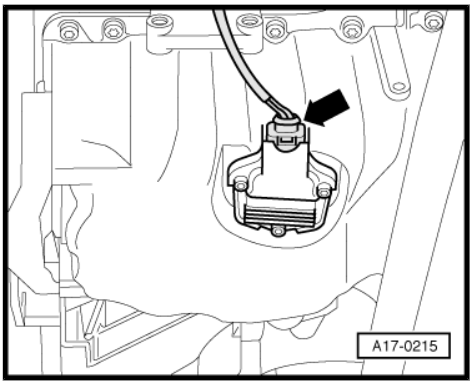
Disregard -items 1, 2, 3-.



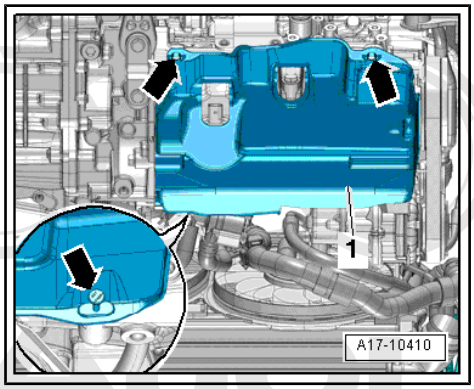
– Remove bolt -arrow- at air pipe (left-side).



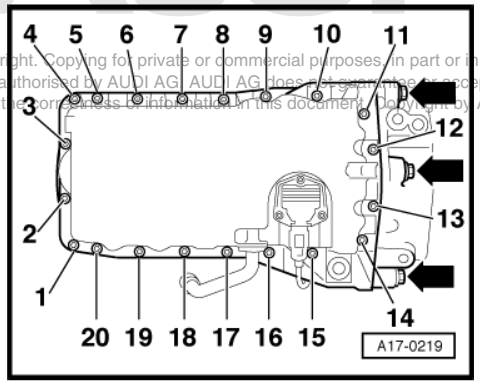
– Unplug electrical connector -arrow- at oil level and oil temperature sender -G266- .



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



– Remove bolts -arrows- securing sump to gearbox using Allen key, long reach -T10058- .
– Slacken bolts -1 ... 20- in diagonal sequence and remove.
– Carefully release sump from bonded joint.

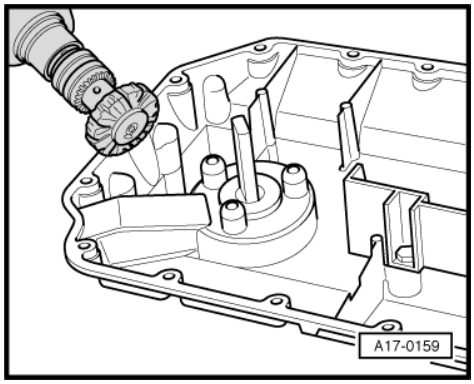


Installing

> **Caution**
>
> *Protect lubrication system and bearings against contamination.*
>
> ◆ *Cover exposed parts of the engine.*

> **WARNING**
>
> *Protect eyes against injuries.*
>
> ◆ *Wear safety goggles.*

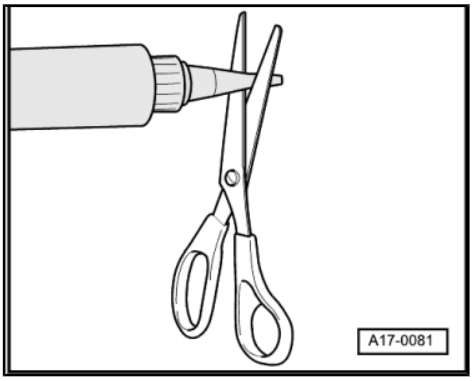
– Remove sealant residue from sump and cylinder block using rotating plastic brush or similar.
– Clean sealing surfaces; they must be free of oil and grease.



Note

Note the use-by date of the sealant.

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



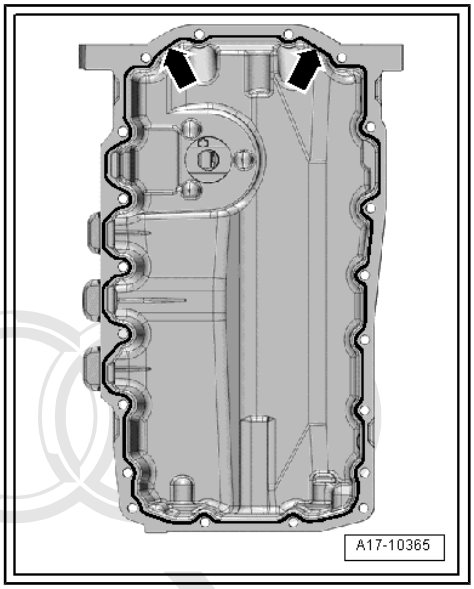
Caution

Make sure lubrication system is not clogged by excess sealant.

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

– Apply bead of sealant onto clean sealing surface of sump as illustrated.

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

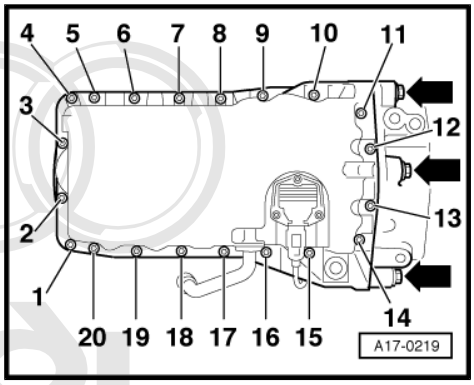


Note

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

– Fit sump and tighten bolts ⇒ page 146 .

• The sump must make flush contact with intermediate plate/ gearbox flange.



Note

♦ *When installing sump with engine removed from vehicle, ensure that sump is positioned flush with cylinder block at flywheel end.*

♦ *After fitting sump assembly, the sealant must dry for approx. 30 minutes. Then (and only then) fill the engine with engine oil.*

– Install pump for exhaust gas recirculation cooler -V400- ⇒ page 184 .

– Install air pipes ⇒ page 212 .

– Install air hoses with screw-type clips ⇒ page 213 .

– Install noise insulation frame ⇒ Rep. Gr. 50 .

– Install noise insulation ⇒ Rep. Gr. 66 .

– Fill with engine oil and check oil level ⇒ Maintenance ; Booklet 810 .

1.4 Removing and installing oil pump

Special tools and workshop equipment required

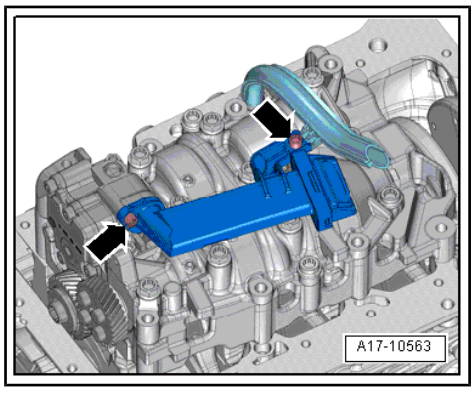
♦ Circlip pliers, commercially available

♦ Bolt M3

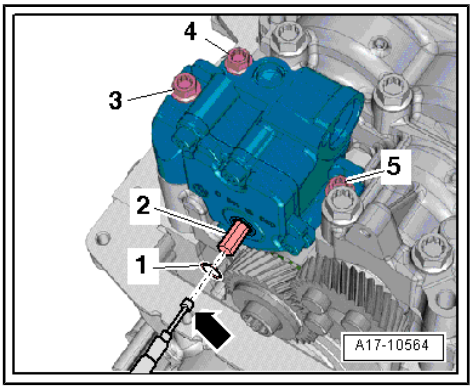
Removing

– Remove sump ⇒ page 147 .

– Remove bolts -arrows- and detach suction pipe from oil pump.



– Remove circlip -1- using circlip pliers.
– Pull drive shaft -2- out of oil pump using a magnet -arrow-.
– Remove bolts -3, 4, 5- and detach oil pump.



Caution

The bolt on the idler gear must NOT be loosened.

Installing

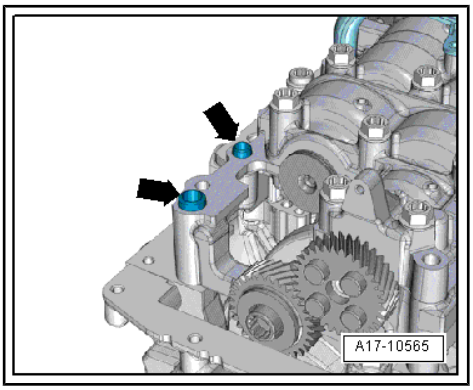
- Tightening torque
  ⇒ "1.1 Oil pump, sump, balance shaft assembly - exploded view", page 144

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

Note

- *Fit new O-ring.*
- *Renew circlip if damaged or stretched.*
- *Circlip must fit securely in groove.*

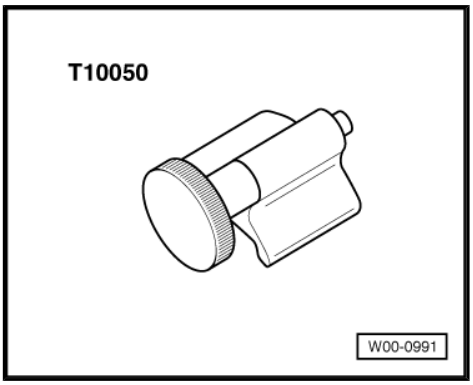
– Insert dowel sleeves -arrows- in oil pump, if not fitted.
– If no dowel sleeves for centring the oil pump are fitted in the balance shaft assembly, install missing dowel sleeves.
– Install sump ⇒ page 147 .



1.5 Removing balance shaft assembly

Special tools and workshop equipment required

- Crankshaft stop -T10050-



Procedure

– Pull out oil dipstick.
– Remove vibration damper ⇒ page 56 .

Caution

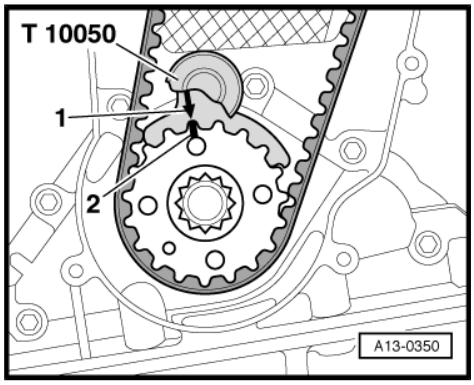
Irreparable damage can be caused if the toothed belt slips.

- *Turn crankshaft only in direction of engine rotation.*

– Rotate crankshaft by turning bolt for toothed belt sprocket until crankshaft is positioned at “TDC”.

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

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



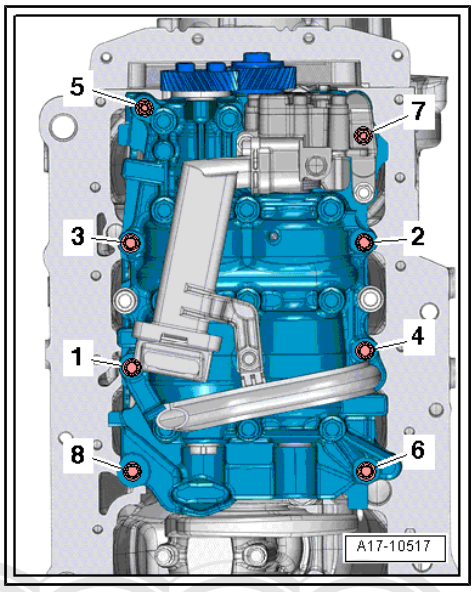
Note

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

– Remove sump ⇒ page 147 .

– Loosen bolts in the sequence -8 ... 1-.

– Remove bolts and detach balance shaft assembly with oil pump.



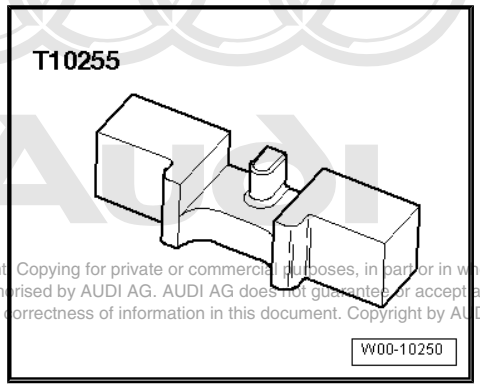
Note

- *Installing a new balance shaft assembly ⇒ page 154 .*
- *Re-installing the "old" balance shaft assembly ⇒ page 157 .*

1.6 Installing a new balance shaft assembly

Special tools and workshop equipment required

- Locking tool -T10255-



Procedure

- Tightening torques ⇒ “1.1 Oil pump, sump, balance shaft assembly - exploded view”, page 144
- Crankshaft locked in position with crankshaft stop -T10050- .

Note

- *The spur gear drive of the balance shaft assembly must be installed with a backlash of 0.038 ... 0.072 mm.*
- *To achieve the correct backlash, a suitably thick coating is already applied to the new idler gear. The coating is applied to the teeth on parts of the circumference.*
- *The coating is worn down rapidly and the backlash is then correct.*
- *A new balance shaft assembly must always be installed in conjunction with a new idler gear which has the correct coating.*
- *Renew the bolts tightened with specified tightening angle.*

Caution

Thrust washer can slip out of position behind idler gear.

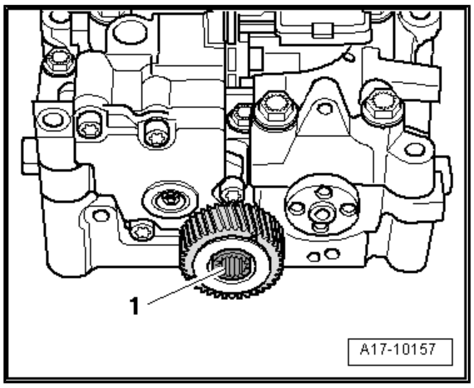
- *Before positioning balance shaft assembly, slacken off bolt for idler gear as specified below, but not further. Installation position of thrust washer* *⇒ page 146*

– Slacken bolt -1- for idler gear by approx. 45°.

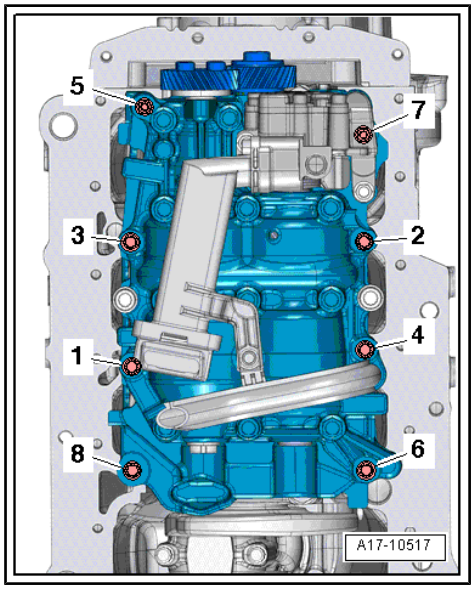
– If not already fitted, fit dowel sleeves into cylinder block for centring balance shaft assembly.

– Attach balance shaft assembly to cylinder block.

- Take care not to damage the coating of the idler gear.

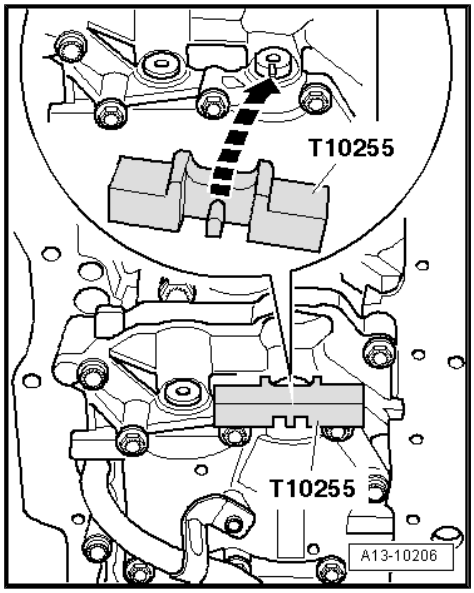


– Tighten bolts securing balance shaft assembly ⇒ page 146 .



– Lock balance shaft with locking tool -T10255- , turning balance shaft as required.

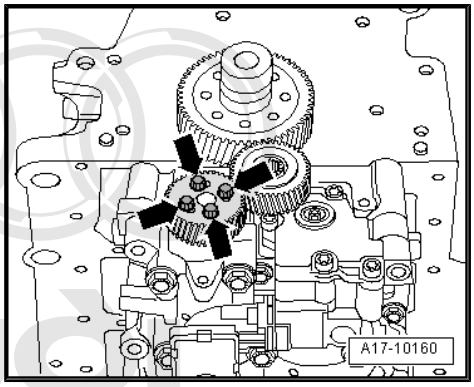
• The lug of the locking tool must engage in the groove of the balance shaft.



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

• Take care not to damage the coating of the idler gear.

• The threaded holes in the balance shaft should be aligned as centrally as possible with the elongated holes in the balance shaft gear.



Note

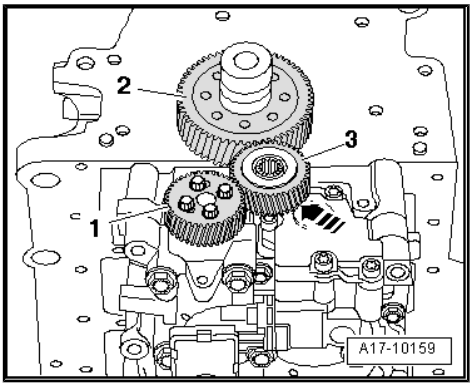
If it is not possible to align the elongated holes in the balance shaft gear with the threaded holes, you must turn the gear some teeth further as required and then fit it again.

– Tighten bolts -arrows- for balance shaft gear.

– Remove locking tool -T10255- .

Note

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



- Push idler gear -3- firmly in direction of -arrow- into teeth on spur gear -2- and balance shaft gear -1-. If necessary use a wooden rod to do so.
- At the same time, turn balance shaft gear slightly anti-clockwise.
- Tighten bolt securing idler gear.
- Remove crankshaft stop -T10050- .

Note

After installation the idler gear must have no backlash. This can be checked by exerting light pressure by hand.

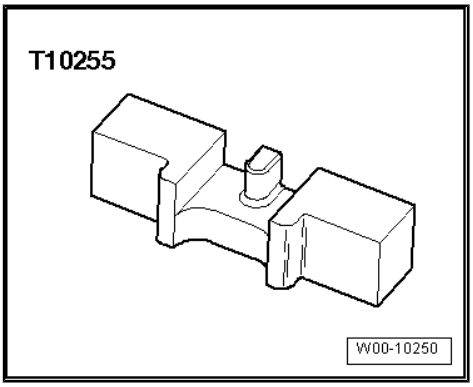
Remaining installation steps are carried out in reverse sequence; note the following:

- Install sump ⇒ page 147 .
- Install vibration damper ⇒ page 56 .

1.7 Re-installing a used balance shaft assembly

Special tools and workshop equipment required

- Locking tool -T10255-



Procedure

Note

- *If re-installing the "old" balance shaft assembly and neither the spur gear on the crankshaft nor the crankshaft itself have been renewed, proceed as described in the following. It is also essential that the idler gear has NOT been slackened.*
- *If the bolt for the idler gear has been slackened or the spur gear on the crankshaft or the crankshaft itself have been renewed, you must install a new idler gear with the appropriate coating. Procedure for installation ⇒ "1.6 Installing a new balance shaft assembly", page 154 .*
- *Renew bolts securing balance shaft assembly.*

– Lock balance shaft with locking tool -T10255- , turning balance shaft as required.

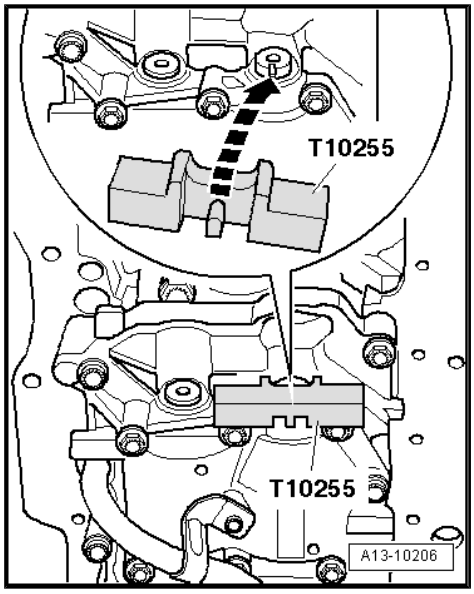
• The lug of the locking tool must engage in the groove of the balance shaft.

– If not already fitted, fit dowel sleeves into cylinder block for centring balance shaft assembly.

– Attach balance shaft assembly to cylinder block.

• With the balance shaft locked in position, the idler gear must engage in the spur gear on the crankshaft.

• Idler gear must have noticeable backlash.



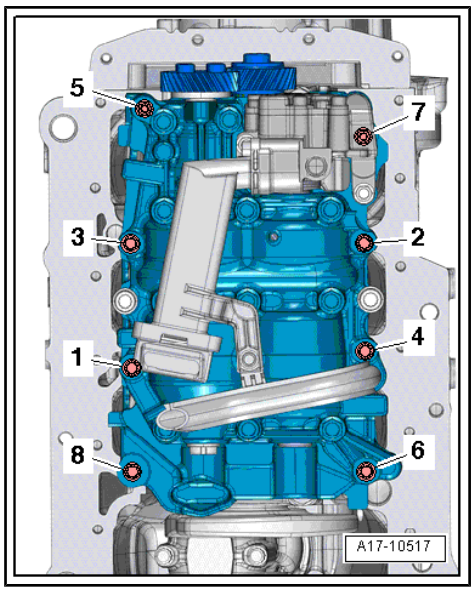
– Tighten bolts securing balance shaft assembly ⇒ page 146 .

– Remove crankshaft stop -T10050- .

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

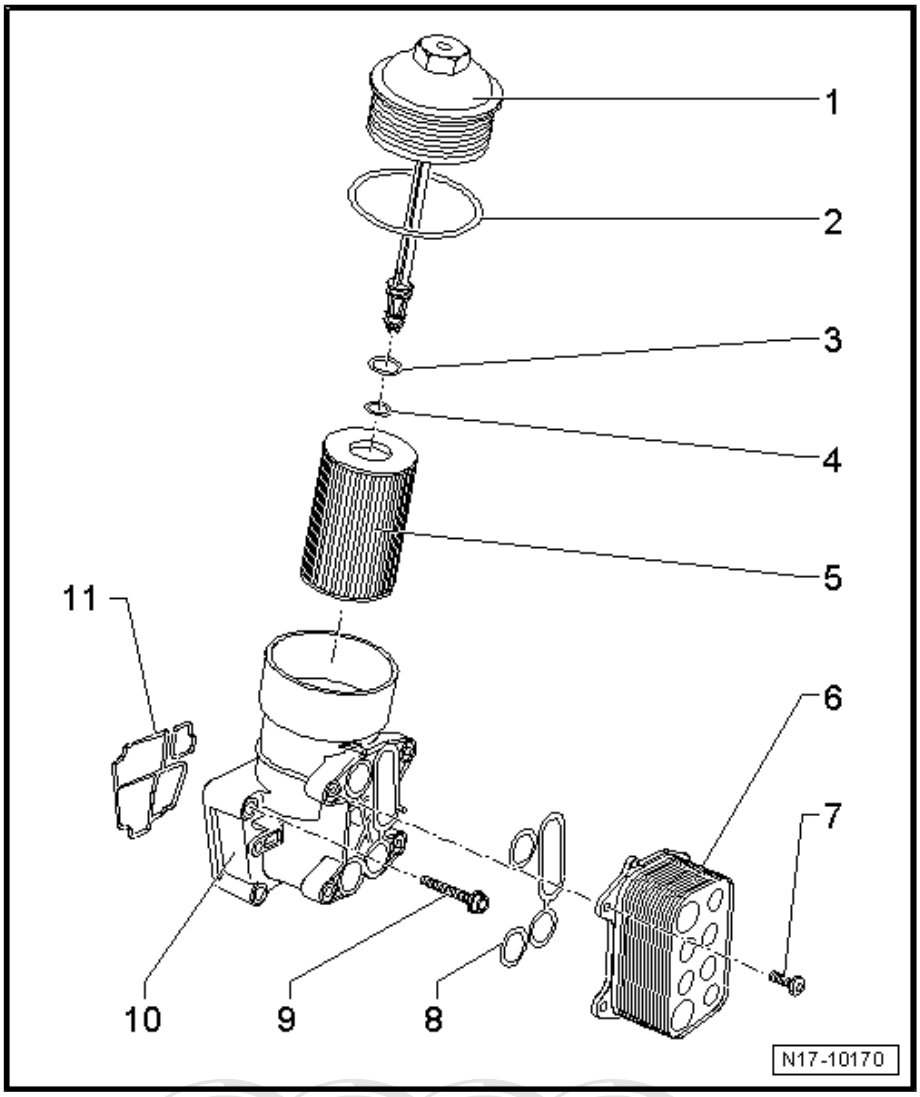
– Install sump ⇒ page 147 .

– Install vibration damper ⇒ page 56 .



2 Oil filter bracket and engine oil cooler

2.1 Oil filter bracket and engine oil cooler - exploded view



1 - Sealing cap
- ❑ 25 Nm

2 - O-ring
- ❑ Renew

3 - O-ring
- ❑ Renew

4 - O-ring
- ❑ Renew

5 - Oil filter element
- ❑ See note ⇒ page 144
- ❑ Removing and installing ⇒ Maintenance ; Booklet 810

6 - Engine oil cooler
- ❑ See note ⇒ page 144
- ❑ Diagram of coolant hose connections ⇒ page 169
- ❑ Removing and installing ⇒ “2.2 Removing and installing oil filter bracket with engine oil cooler”, page 160
- ❑ If renewed, refill system with fresh coolant

7 - Bolt
- ❑ 11 Nm

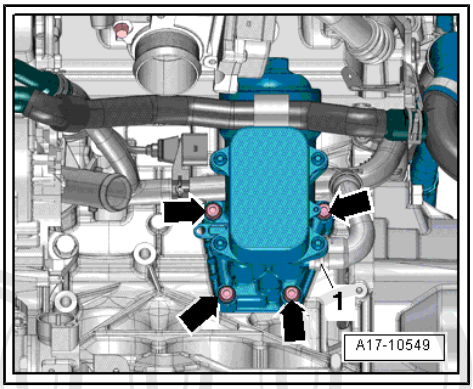
8 - Gaskets
- ❑ Renew

9 - Bolt
- ❑ Renew
- ❑ Tightening torque and sequence ⇒ page 160

10 - Oil filter bracket
- ❑ With integrated oil retention valve
- ❑ Removing and installing ⇒ “2.2 Removing and installing oil filter bracket with engine oil cooler”, page 160

11 - Gaskets
- ❑ Renew

Oil filter bracket - tightening torque and sequence



Note

Renew the bolts tightened with specified tightening angle.

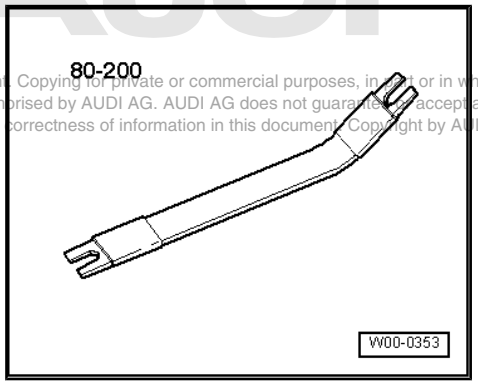
– Fit bolts at top left and bottom right first.
– Tighten bolts in 2 stages:

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

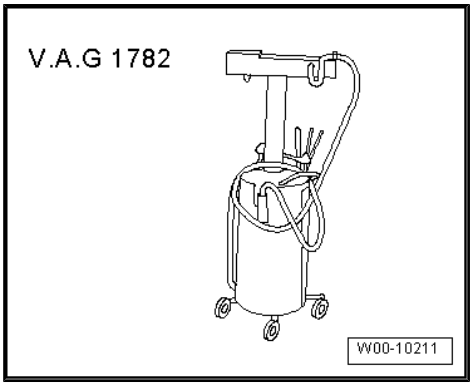
2.2 Removing and installing oil filter bracket with engine oil cooler

Special tools and workshop equipment required

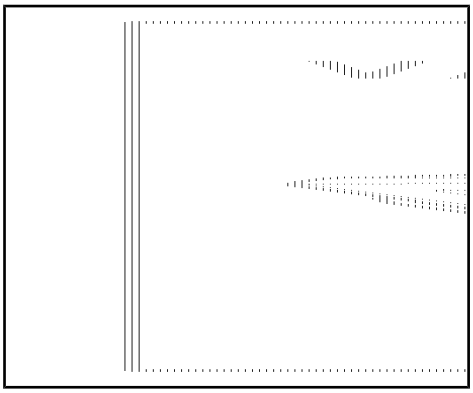
♦ Removal lever -80 - 200-



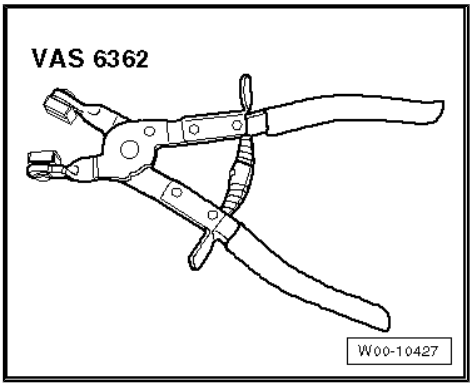
♦ Used oil collection and extraction unit -V.A.G 1782-



♦ Drip tray for workshop hoist -VAS 6208-



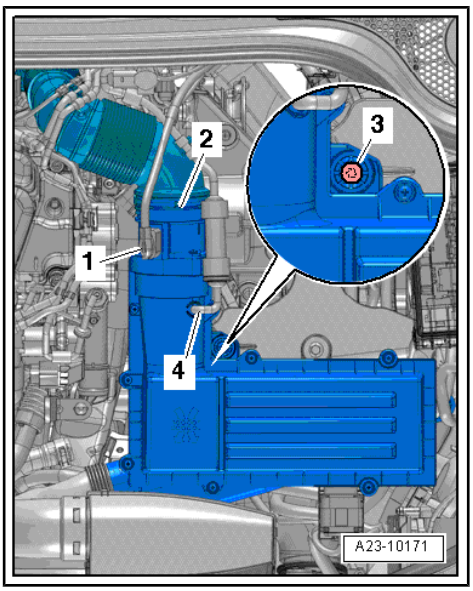
♦ Hose clip pliers -VAS 6362-



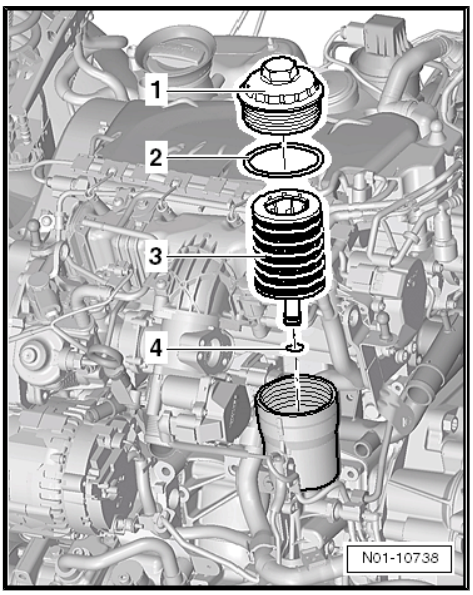
Removing

– Drain coolant ⇒ page 170 .

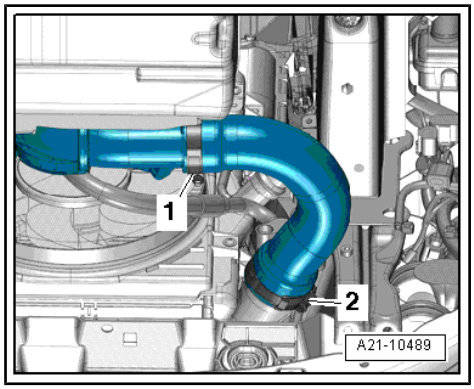
– Remove air cleaner housing ⇒ Rep. Gr. 23 .



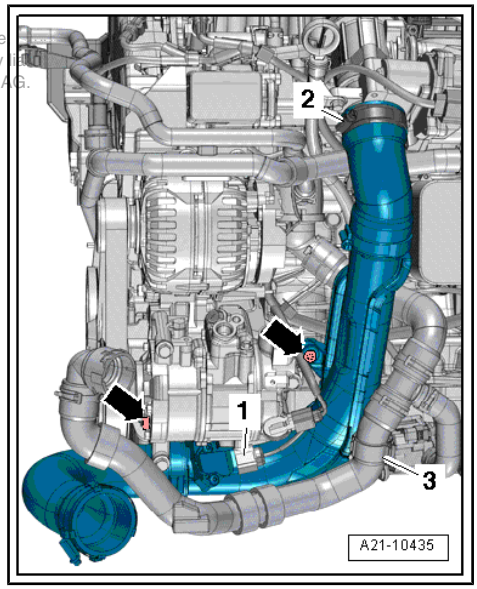
– Remove oil filter element ⇒ Maintenance ; Booklet 810 .



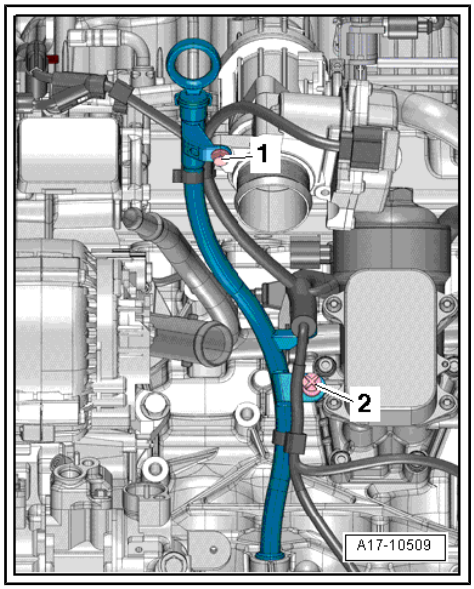
– Release hose clip -2-, lift retaining clip -1- and remove air hose.



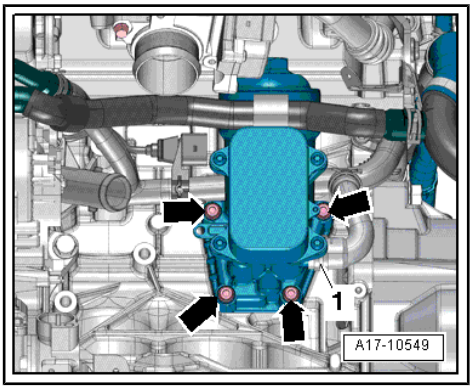
– Remove bolts -arrows-.
– Move coolant hose -3- clear.
– Loosen hose clip -2-.
– Unplug electrical connector -1- at charge pressure sender - G31- / intake air temperature sender -G42- and detach air pipe (right-side).



– Pull oil dipstick out slightly and remove bolt -1-.
– Release clip -2- with removal lever -80 - 200- .
– Pull guide tube for oil dipstick upwards out of cylinder block and push to one side.



– Place drip tray for workshop hoist -VAS 6208- under connection.
– Release hose clip -1- and detach coolant hose.
– Position used oil collection and extraction unit -V.A.G 1782- below engine.
– Unscrew bolts -arrows- and remove oil filter bracket with engine oil cooler.



Installing

- Tightening torques
⇒ “2.1 Oil filter bracket and engine oil cooler - exploded view”, page 159

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

Note

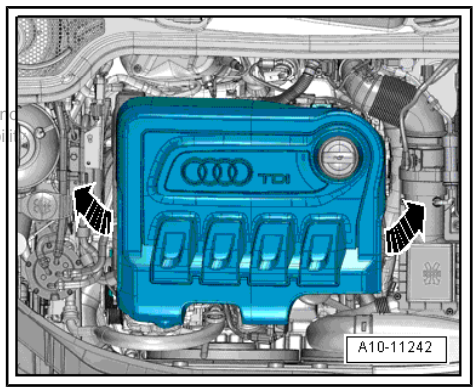
- *Renew gaskets, seals and O-rings.*
- *Hose connections and air pipes and hoses must be free of oil and grease before assembly.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Install dipstick guide tube ⇒ page 144 .
– Install air pipe ⇒ page 212 .
– Install air hoses with screw-type clips ⇒ page 213 .
– Install air cleaner housing ⇒ Rep. Gr. 23 .
– Install oil filter element, fill up with engine oil and check oil level ⇒ Maintenance ; Booklet 810 .
– Fill up cooling system (or change coolant if the engine oil cooler has been renewed) ⇒ page 173 .

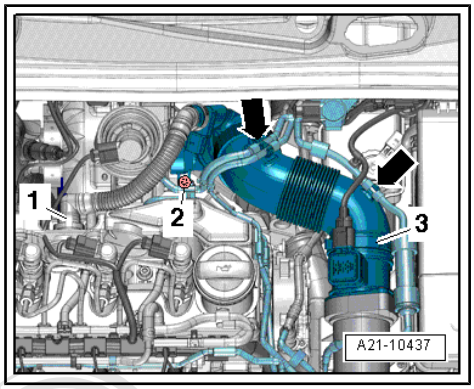
2.3 Removing and installing oil pressure switch -F1-

Removing

– Remove engine cover panel -arrows-.



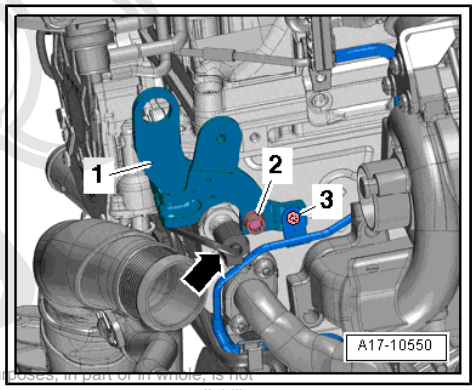
– Press release tabs and disconnect crankcase breather hose -1-.
– Move clear vacuum hoses -arrows-.
– Release hose clip -3- and detach air pipe from air cleaner housing.
– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.



– Remove bolts -2- and -3- and detach engine lifting eye -1-.
– Unplug electrical connector -arrow-.
– Unscrew oil pressure switch -F1- .

Installing

- Tightening torques
  ⇒ “2.4 Cylinder head - exploded view”, page 106



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

Note

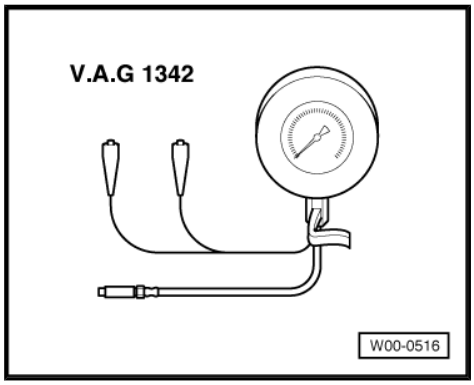
Renew seal.

– Install vacuum line to exhaust gas recirculation cooler ⇒ page 229 .
– Install air pipe with connection ⇒ page 207 .
– Install air hoses with screw-type clips ⇒ page 213 .

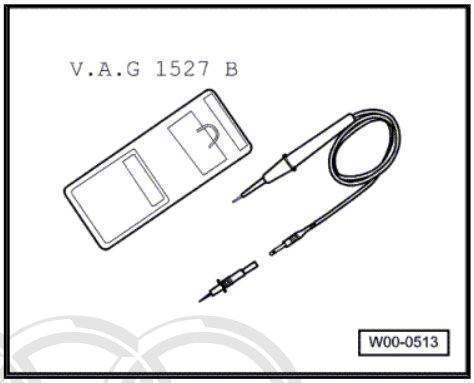
2.4 Checking oil pressure switch -F1-

Special tools and workshop equipment required

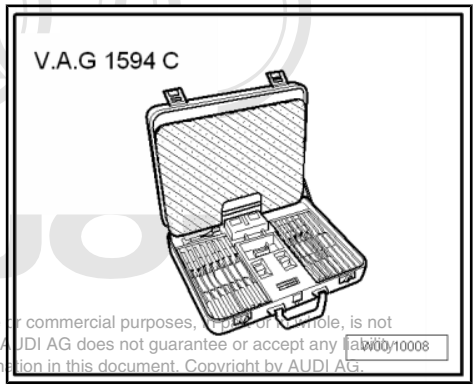
♦ Oil pressure tester -V.A.G 1342-



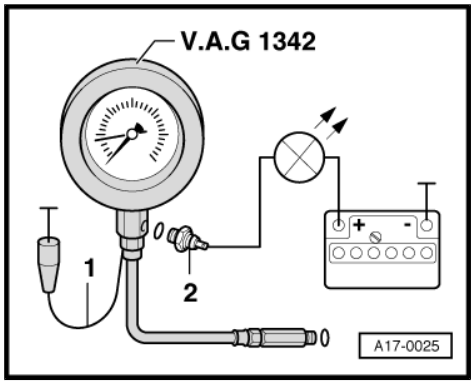
- Voltage tester -V.A.G 1527B-



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



Procedure



- Oil level OK
- Engine oil temperature approx. 80 °C.

– Remove oil pressure switch -F1- ⇒ page 163 .

– Connect oil pressure tester -V.A.G 1342- to bore for oil pressure switch.

– Screw oil pressure switch -F1- -item 2- into threaded hole in oil pressure tester.

– Connect brown wire -1- of oil pressure tester to earth (–).

– Connect voltage tester -V.A.G 1527B- with adapter lead from auxiliary measuring set -V.A.G 1594C- to oil pressure switch -F1- and battery positive (+).

- LED should not light up.

Note

Renew oil pressure switch -F1- if LED lights up at this stage.

– Start engine.

Note

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

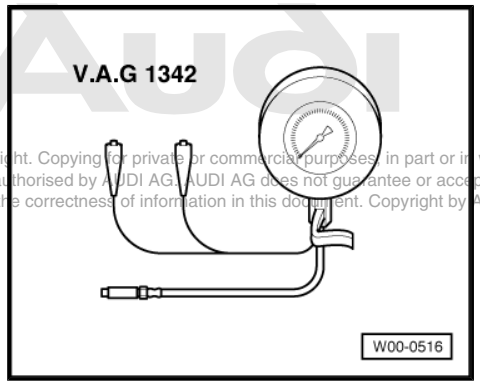
- LED should light up at 0.3 ... 0.6 bar.

– Renew oil pressure switch -F1- if LED does not light up ⇒ page 163 .

2.5 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 -F1- ⇒ page 163 .

– Connect oil pressure tester -V.A.G 1342- to threaded hole for oil pressure switch -F1- .

– Screw a used oil pressure switch into threaded hole on oil pressure tester -V.A.G 1342- to seal hole.
– Start engine.

- Oil pressure at idling speed: at least 0.8 bar.
- Oil pressure at 2000 rpm: at least 2.0 bar.

2.6 Engine oil

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

2.7 Checking oil level

Check oil level ⇒ Maintenance ; Booklet 810 .

19 – Cooling

1 Cooling system

WARNING

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

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

Note

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

1.1 Diagram of coolant hose connections

Note

- *Blue = Large coolant circuit.*
- *Red = Small coolant circuit.*
- *Brown = Heating circuit.*

1 - Radiator

- ❑ If renewed, refill system with fresh coolant

2 - Pump for exhaust gas recirculation cooler -V400-

3 - Engine oil cooler

4 - Thermostat

5 - Radiator outlet coolant temperature sender -G83-

6 - Coolant pump

7 - Cylinder head and cylinder block

- ❑ If renewed, refill system with fresh coolant

8 - Coolant expansion tank

- ❑ With filler cap
- ❑ Checking pressure relief valve in filler cap ⇒ page 177

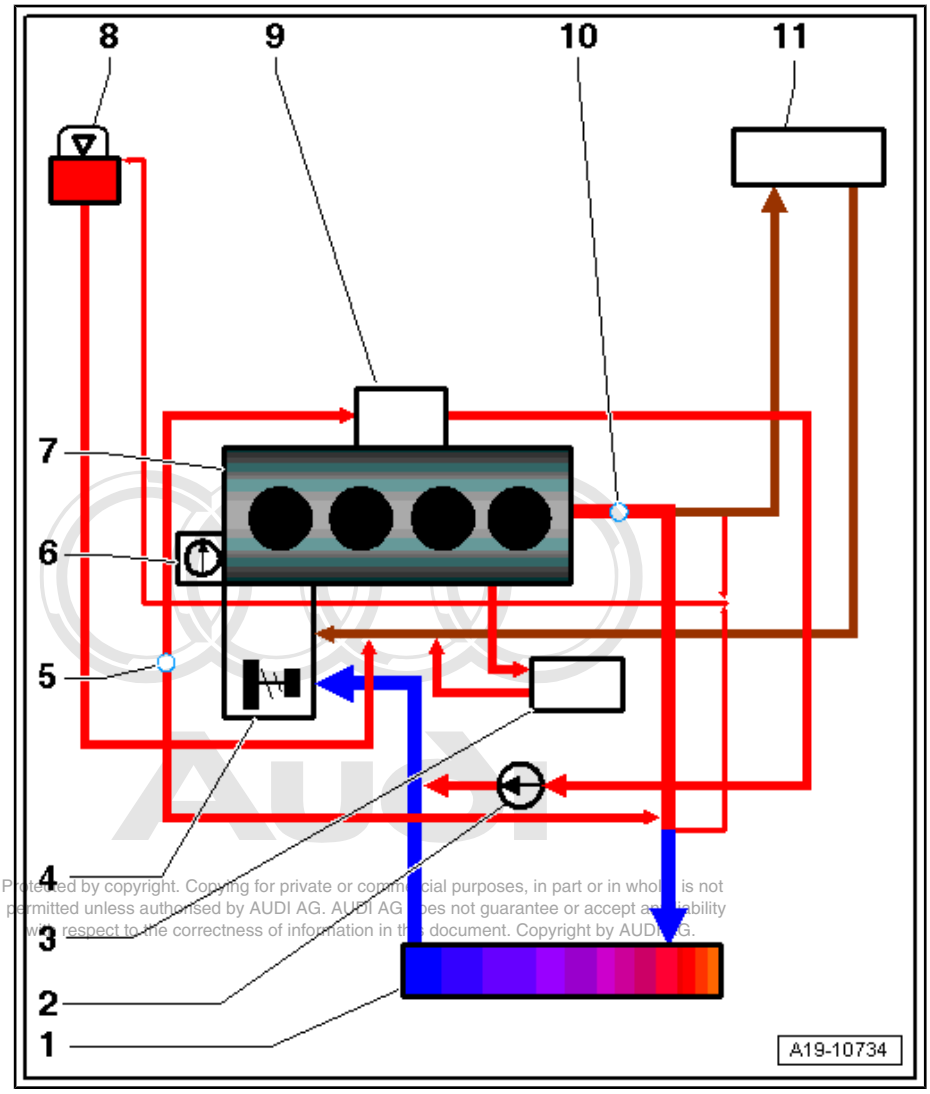
9 - Exhaust gas recirculation cooler

- ❑ If renewed, refill system with fresh coolant

10 - Heat exchanger for heater

- ❑ If renewed, refill system with fresh coolant

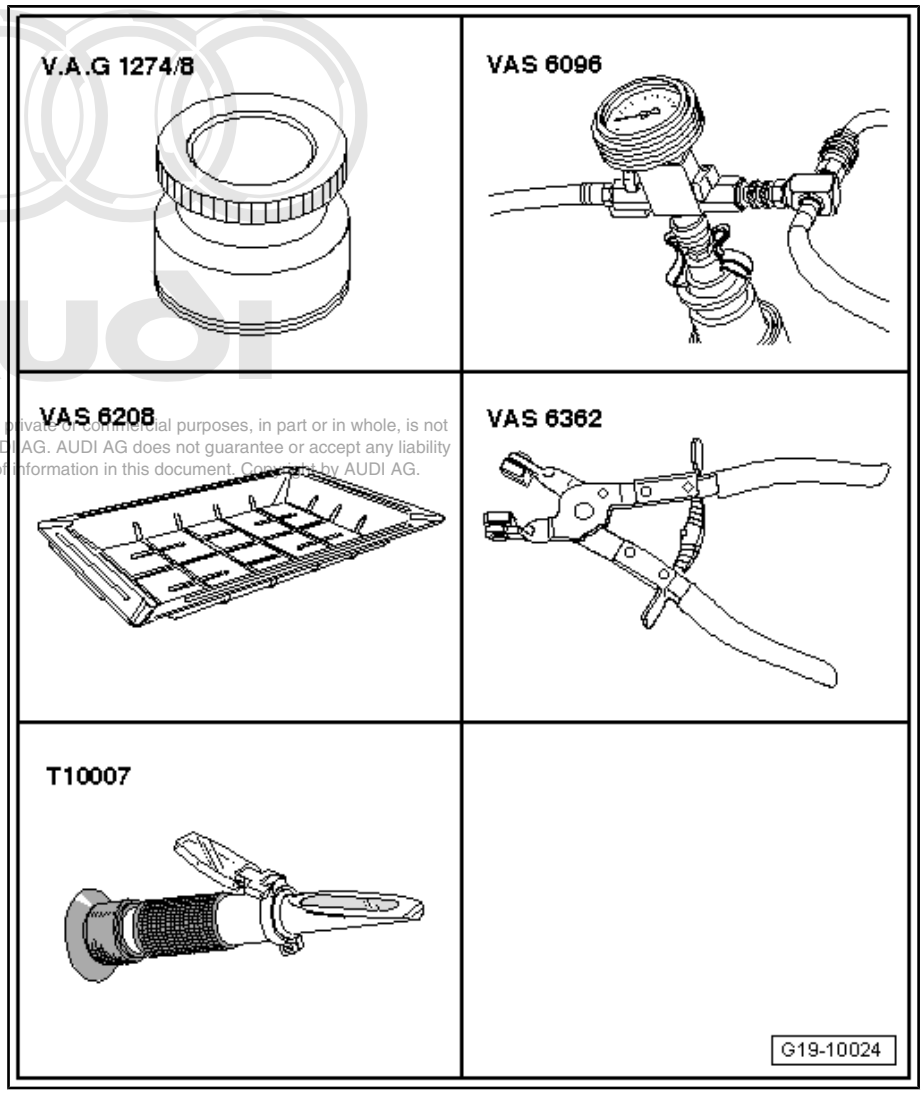
11 - Coolant temperature sender -G62-



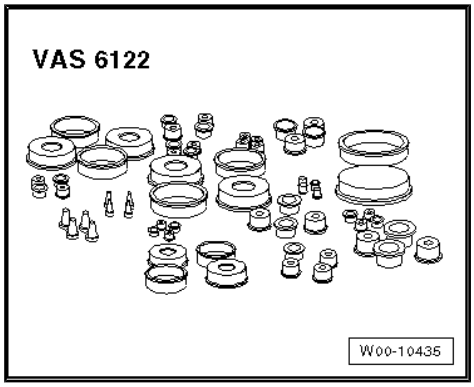
1.2 Draining and filling cooling system

Special tools and workshop equipment required

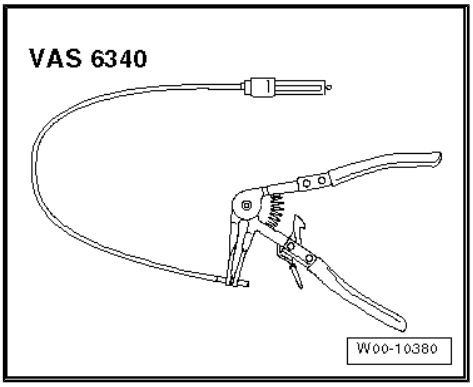
- Adapter for cooling system tester -V.A.G 1274/8-
- Cooling system charge unit -VAS 6096- with -VAS 6096/1-
- Drip tray for workshop hoist -VAS 6208-
- Hose clip pliers -VAS 6362-
- Refractometer -T10007-



- Engine bung set -VAS 6122-



- Hose clip pliers -VAS 6340-



- Safety goggles
- Protective gloves

Draining

WARNING

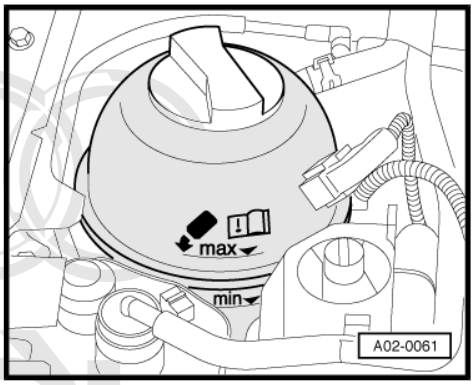
Risk of injury as the radiator fans may start up automatically.

- *Even when the ignition is switched off, the radiator fans can start up without warning due to accumulated heat in the engine compartment, etc.*

WARNING

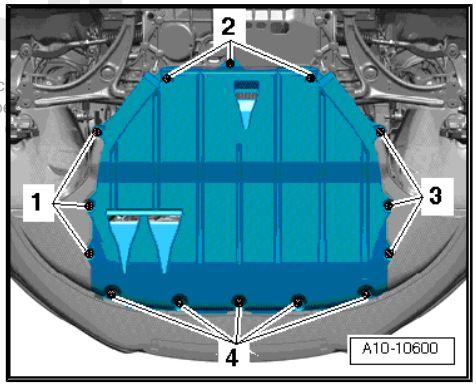
Hot steam/hot coolant can escape - risk of scalding.

- *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.*

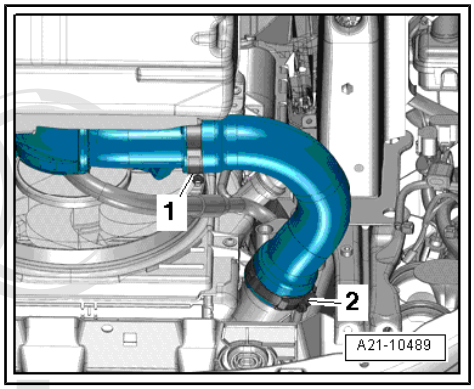


– Open filler cap on coolant expansion tank.

– Remove noise insulation ⇒ Rep. Gr. 66 .



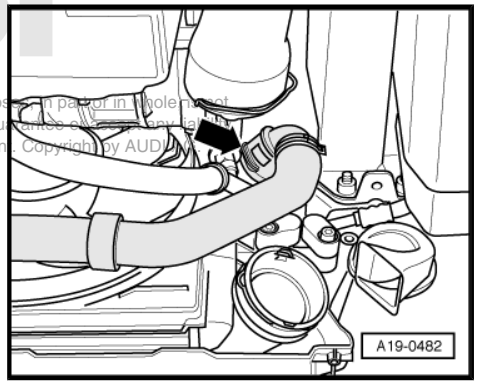
– Release hose clips -1- and -2- and remove air hose.
– Seal off open pipes/lines and connections with clean plugs from engine bung set -VAS 6122- .



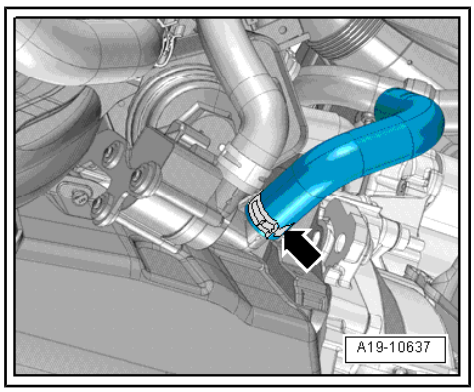
Note

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

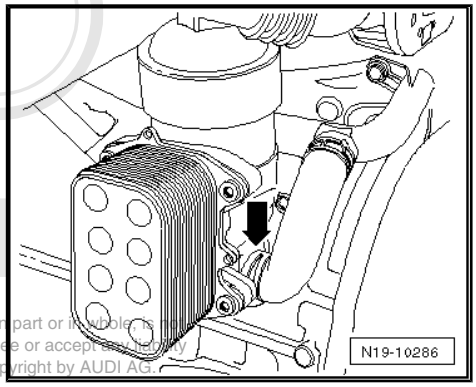
– Place drip tray for workshop hoist -VAS 6208- beneath engine.
– Lift retaining clip -arrow-, disconnect coolant hose (bottom) from radiator and drain off coolant.



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



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



Filling

Note

- *The cooling system is filled all year round with a mixture of water and coolant additive. Mixture ratio ⇒ page 173 .*
- *Use only the coolant additive listed in the ⇒ Electronic parts catalogue . Other coolant additives could seriously impair in particular the anti-corrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.*
- *The specified coolant (based on recommended mixture ratio) ⇒ page 173 prevents frost and corrosion damage and stops scaling. Such additives also raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct coolant/anticorrosion additive.*
- *Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- *Frost protection is required down to about –25 °C (in countries with arctic climate: down to about –35 °C).*
- *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The coolant concentration must be at least 40 %.*
- *If greater frost protection is required in very cold climates, the coolant concentration can be increased, but only up to 60% (this gives frost protection down to about –40 °C). If the concentration exceeds 60%, frost protection decreases again and cooling efficiency is also impaired.*
- *Use only clean tap water for mixing coolant.*
- *Drained-off coolant must not be used again if the radiator, heat exchanger, cylinder head, cylinder head gasket or cylinder block are renewed.*
- *Contaminated or dirty coolant must not be used again.*
- *To check anti-freeze protection in cooling system, use refractometer -T10007- .*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

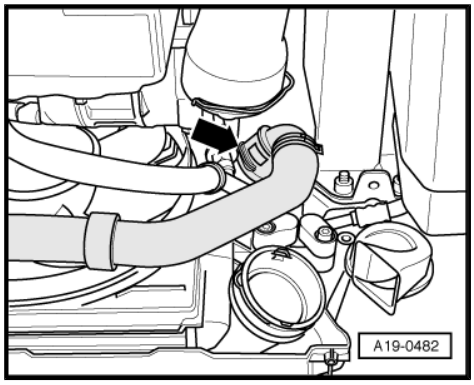
Recommended mixture ratio for coolant

- Coolant (40 %) and water (60 %) for frost protection to –25 °C
- Coolant (50 %) and water (50 %) for frost protection to –35 °C
- Coolant (60 %) and water (40 %) for frost protection to –40 °C

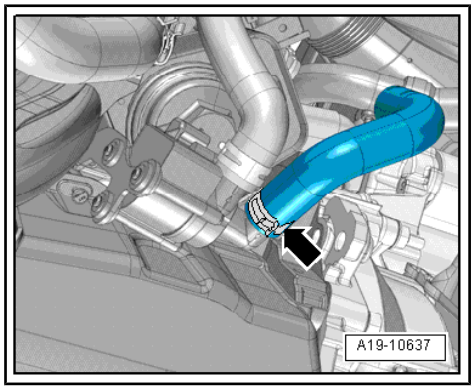
- Coolant ⇒ Electronic parts catalogue

Procedure

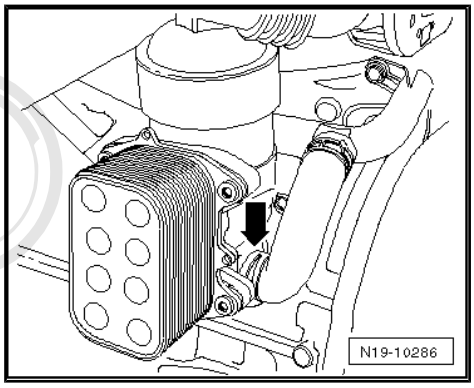
– Connect coolant hose with plug-in connector to radiator (bottom) ⇒ page 202 .



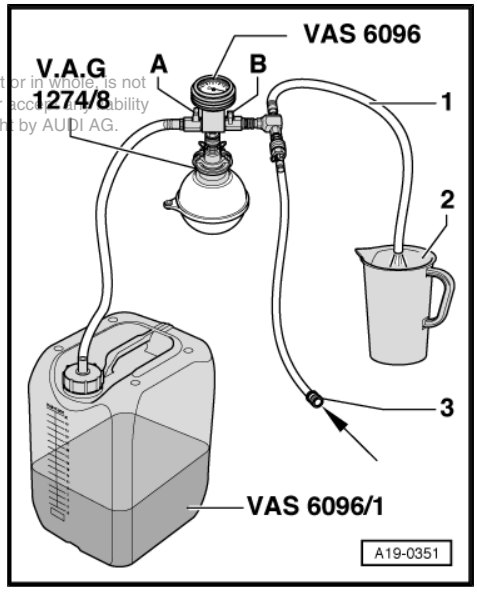
– Connect coolant hose (bottom) at pump for exhaust gas recirculation cooler -V400- -arrow-.



– Connect coolant hose (top) to engine oil cooler -arrow-.



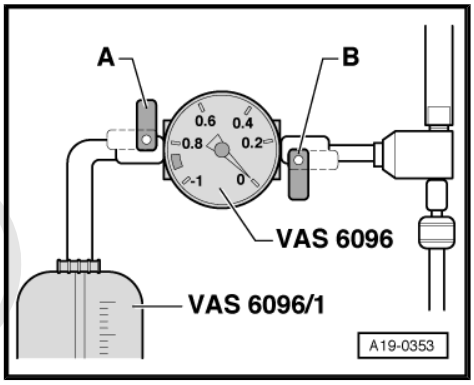
– Fill reservoir of -VAS 6096- with at least 8 litres of premixed coolant (according to recommended ratio):
– Fit adapter for cooling system tester -V.A.G 1274/8- onto coolant expansion tank.
– Attach cooling system charge unit -VAS 6096- to adapter -V.A.G 1274/8- .
– Run vent hose -1- into a small container -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 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.*

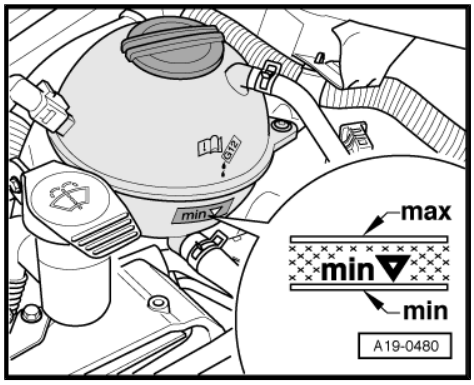
– Detach compressed air hose.

– 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 coolant expansion tank.

– Top up coolant to “max” mark.



Note

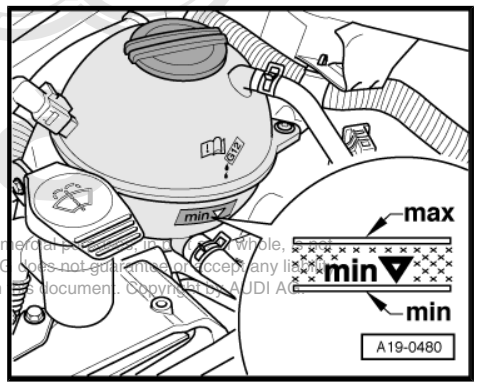
Hose connections and air pipes and hoses must be free of oil and grease before assembly.

– Install air hoses with screw-type clips ⇒ page 213 .
– Install noise insulation ⇒ Rep. Gr. 50 .
– On vehicles with auxiliary heater, switch heater on (for about 30 seconds) and then off again.
– Set temperature to “HI”.
– Switch off air conditioner compressor (press ECON button).
– Start engine and run for 2 minutes (maximum) at approx. 1500 rpm.
– Top up coolant to overflow hole on expansion tank with engine running.
– Close filler cap on coolant expansion tank (make sure it engages).
– Allow engine to run at idling speed until two large coolant hoses at radiator become warm.
– Switch off ignition and allow engine to cool down.

– Check coolant level.

- The coolant level must be between the “min” and “max” markings when the engine is cold.
- The coolant level can be at the “max” marking when the engine is warm.

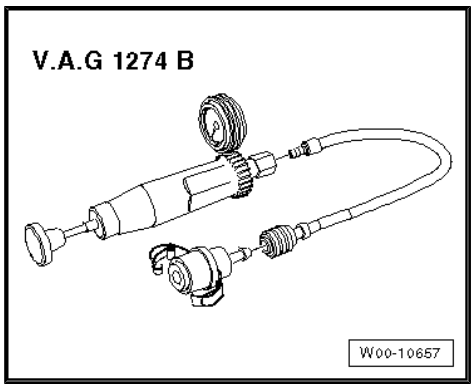
– Top up with coolant again if necessary.



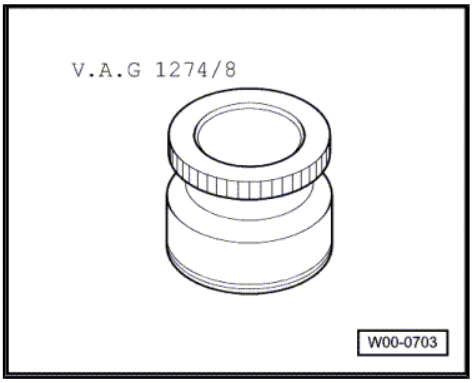
1.3 Checking cooling system for leaks

Special tools and workshop equipment required

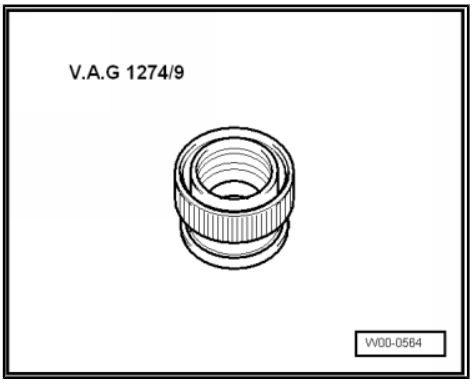
♦ Cooling system tester -V.A.G 1274 B-



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



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



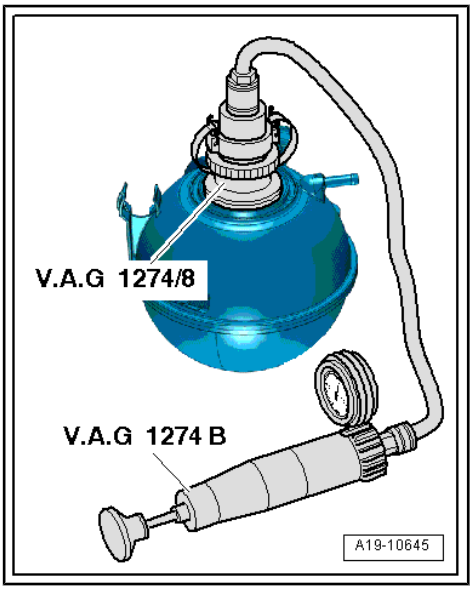
Procedure

- Engine must be warm.

WARNING

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

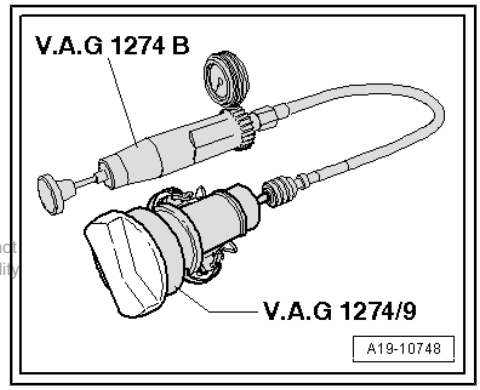
- ***The cooling system is under pressure when the engine is hot.***
- ***Cover filler cap on coolant expansion tank with a cloth and open carefully to dissipate pressure.***



– 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.



2 Coolant pump and thermostat

2.1 Coolant pump and thermostat - exploded view

1 - Coolant pump

- ❑ Removing and installing ⇒ page 179

2 - Bolt

- ❑ 15 Nm

3 - O-ring

- ❑ Renew

4 - O-ring

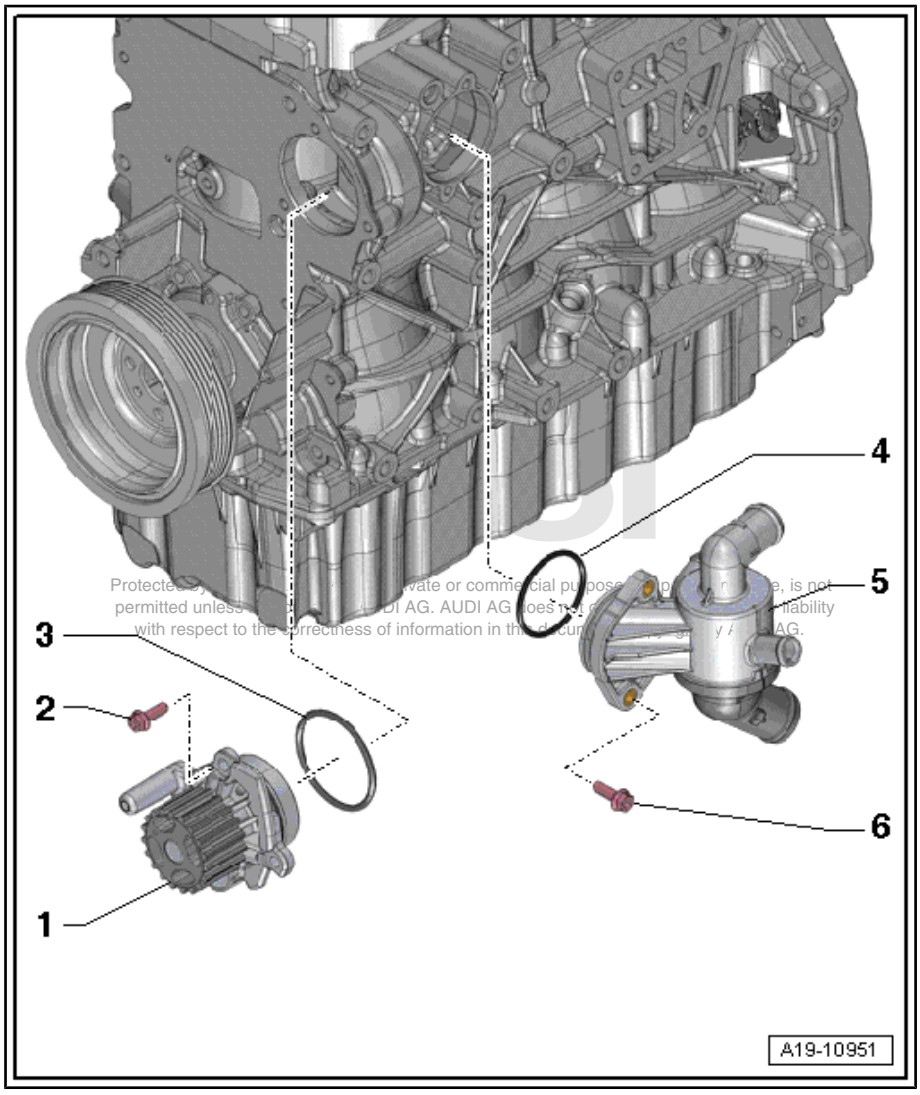
- ❑ Renew

5 - 4/2-way valve with thermostat

- ❑ The thermostat is located in the interior of the 4/2-way valve and cannot be renewed separately
- ❑ Removing and installing ⇒ page 179

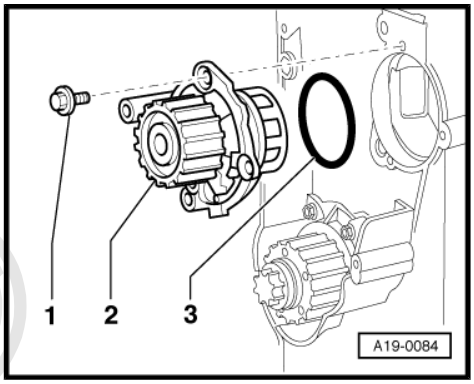
6 - Bolt

- ❑ 15 Nm



2.2 Removing and installing coolant pump

Removing



– Drain coolant ⇒ page 170 .
– Remove toothed belt ⇒ page 91 .
– Unscrew bolts -1- and remove coolant pump -2-.
– Detach O-ring -3-.

Installing

• Tightening torque
⇒ “2.1 Coolant pump and thermostat - exploded view”, page 178

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

Note

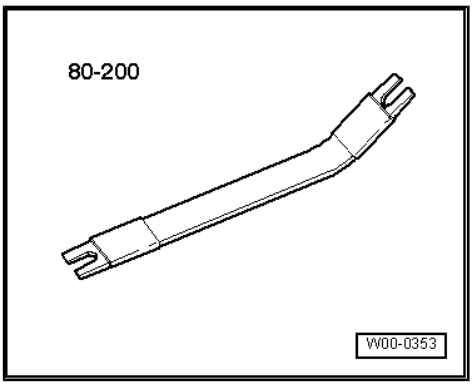
Fit new O-ring.

– Clean and smoothen sealing surface for O-ring.
– Lightly lubricate O-ring -3- with coolant.
– Fit coolant pump -2-.
• Installation position: Sealing plug in housing faces downwards.
– Install toothed belt (adjust valve timing) ⇒ page 95 .
– Fill up with coolant ⇒ page 173 .

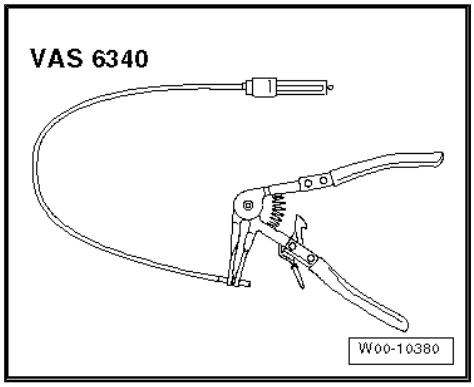
2.3 Removing and installing 4/2-way valve with thermostat

Special tools and workshop equipment required

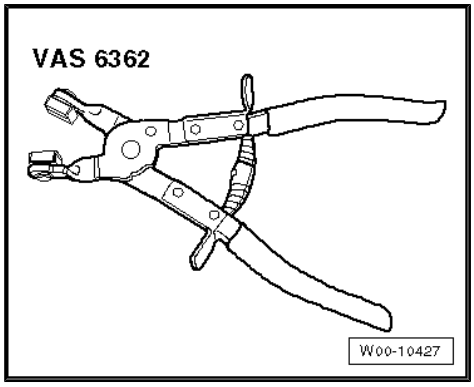
♦ Removal lever -80 - 200-



♦ Hose clip pliers -VAS 6340-



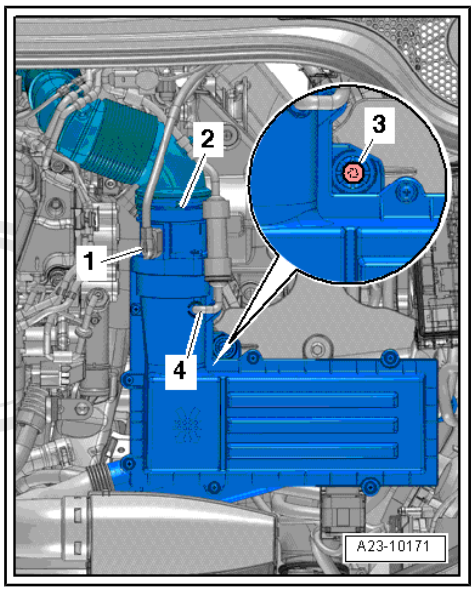
♦ Hose clip pliers -VAS 6362-



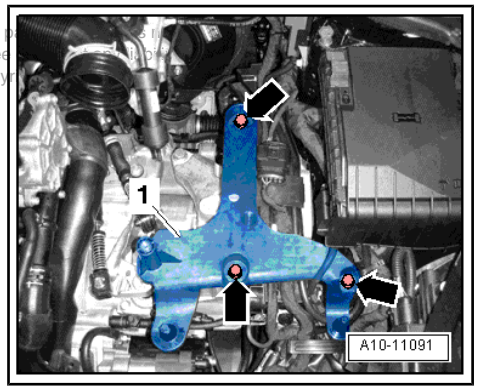
Removing

– Drain coolant ⇒ page 170 .

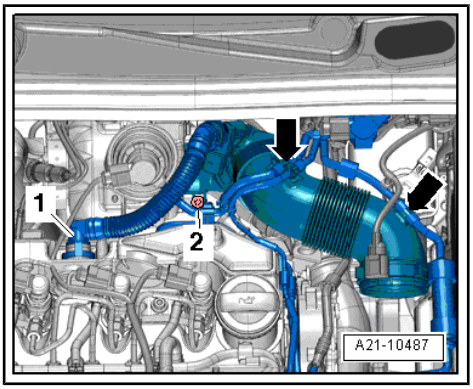
– Remove air cleaner housing ⇒ Rep. Gr. 23 .



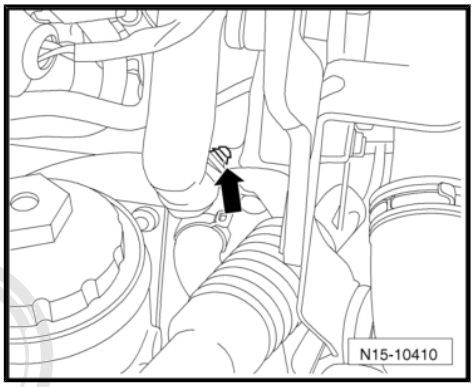
– Remove bolts -arrows- and detach bracket -1- for air cleaner housing.



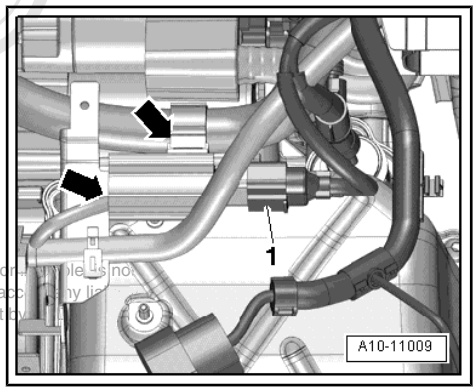
– Press release tabs and disconnect crankcase breather hose -1- from cylinder head cover.
– Move clear vacuum hoses -arrows- at air pipe.
– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.



– Unclip wiring harness from retainer -arrow-.



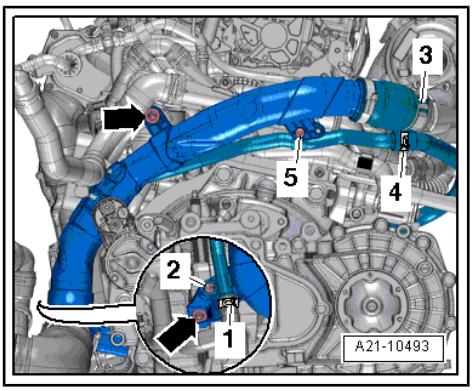
– Move clear wiring harnesses -arrows- and electrical connector -1- at bracket.



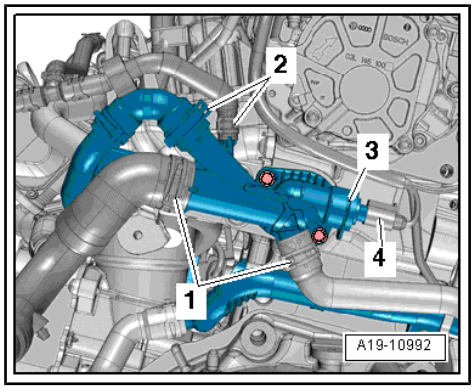
– Remove bolts -2, 5- and -arrows-.
– Using removal lever -80 - 200- , move clear electrical wiring and hoses at air pipe (left-side).
– Loosen hose clip -3- and detach air pipe (left-side).

Note

Disregard -items 1, 4-.



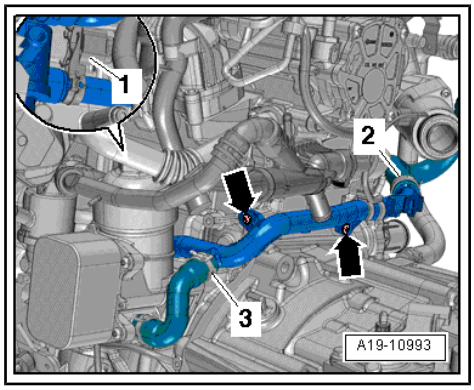
– Release hose clips -1- and detach coolant hoses.



Note

Disregard -items 2, 3, 4-.

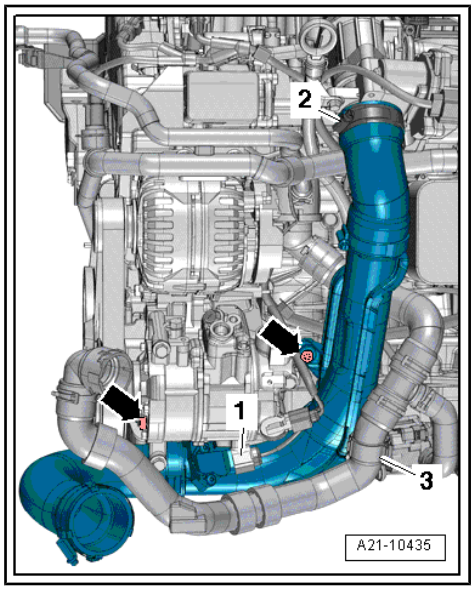
– Take electrical connector -1- for Hall sender -G40- out of retainer.
– Remove bolts -arrows-, pull off coolant pipe (front) from 4/2-way valve to left side and leave in installation position.



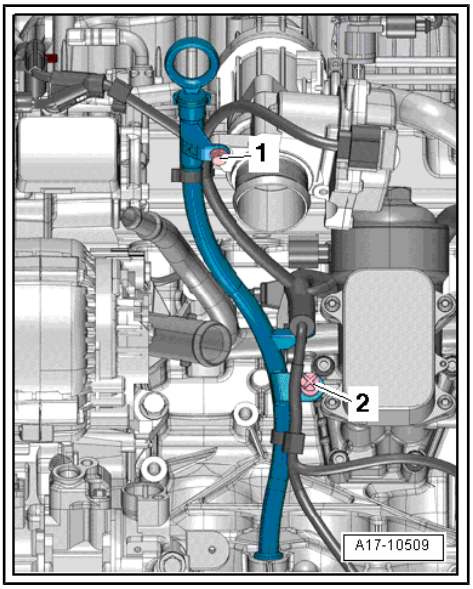
Note

Disregard -items 2, 3-.

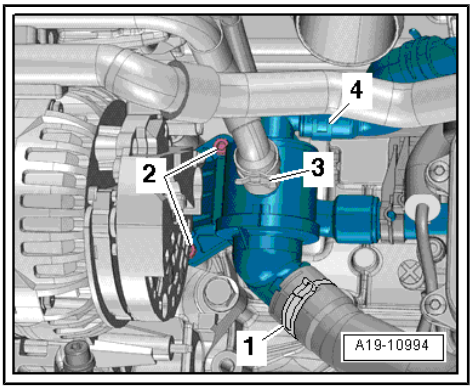
– Remove bolts -arrows-.
– Move coolant hose -3- clear.
– Loosen hose clip -2-.
– Unplug electrical connector -1- at charge pressure sender - G31- / intake air temperature sender -G42- and detach air pipe (right-side).



– Pull oil dipstick out slightly and remove bolt -1-.
– Release clip -2- with removal lever -80 - 200- .
– Pull guide tube for oil dipstick upwards out of cylinder block and push to one side.



– Remove bolts -2-.
– Loosen hose clips -1, 3, 4-, detach coolant hoses and remove 4/2-way valve with thermostat.



Installing

- Tightening torque
  ⇒ “2.1 Coolant pump and thermostat - exploded view”, page 178

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

– Install dipstick guide tube ⇒ page 144 .
– Install coolant pipe (front) ⇒ page 190 .
– Install air pipes ⇒ page 212 .
– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Install air pipe with connection ⇒ page 207 .
– Install air cleaner housing ⇒ Rep. Gr. 23 .
– Install air hoses with screw-type clips ⇒ page 213 .
– Fill up with coolant ⇒ page 173 .

2.4 Checking thermostat

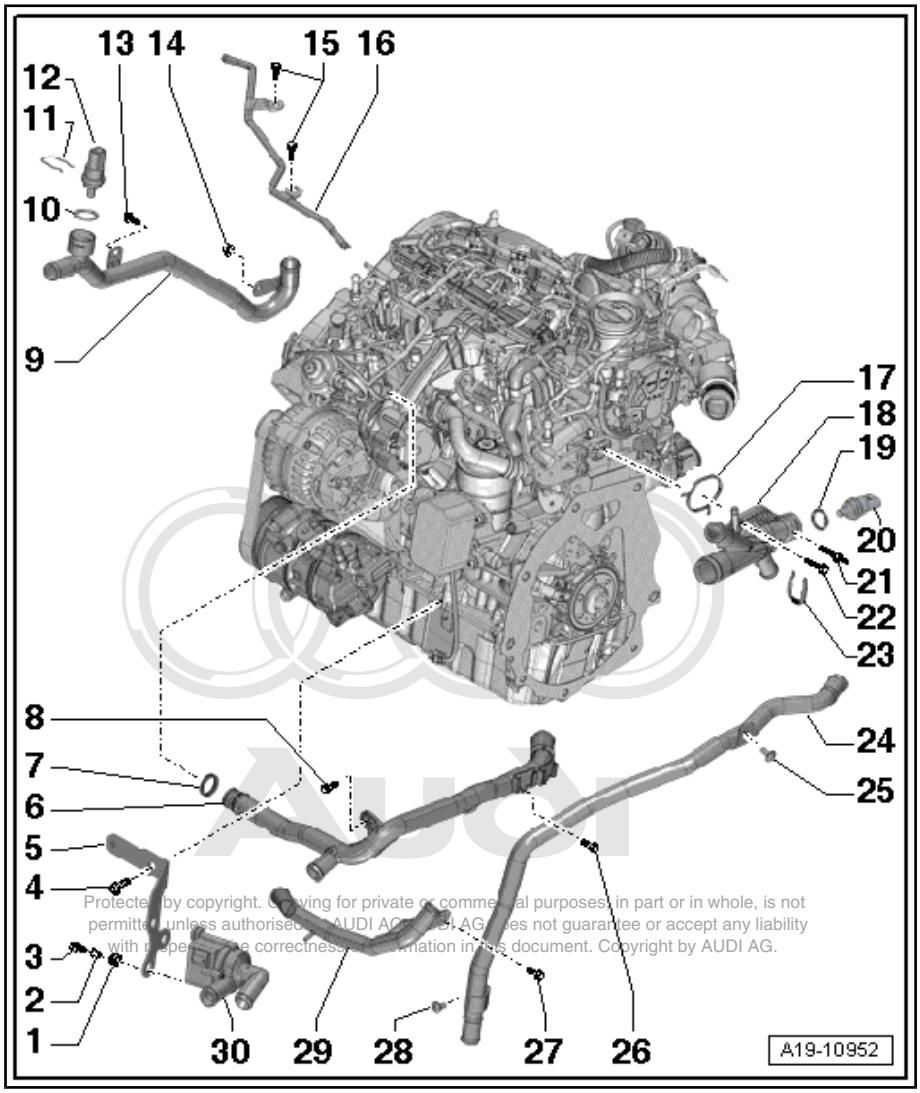
– Heat removed thermostat in water bath.

Starts to open	Fully open	Opening travel
approx. 92 °C	approx. 107 °C [1]	at least 7 mm

- [1] Cannot be tested.

3 Coolant pipes, coolant temperature senders, coolant circulation pump

3.1 Coolant pipes, coolant temperature senders, coolant circulation pump - exploded view



1 - Grommet
- ❑ Not supplied separately

2 - Sleeve
- ❑ Not supplied separately

3 - Bolt
- ❑ 2.7 Nm

4 - Bolt
- ❑ 40 Nm

5 - Bracket
- ❑ For pump for exhaust gas recirculation cooler -V400-

6 - Coolant pipe (front)
- ❑ Removing and installing ⇒ page 190

7 - O-ring
- ❑ Renew

8 - Bolt
- ❑ 9 Nm

9 - Coolant pipe (right-side)
- ❑ Removing and installing ⇒ page 198

10 - O-ring
- ❑ Renew

11 - Retaining clip

12 - Radiator outlet coolant temperature sender -G83-
- ❑ Removing and installing ⇒ page 187

13 - Bolt
- ❑ 9 Nm

14 - Nut
- ❑ 9 Nm

15 - Bolts
- ❑ 9 Nm

16 - Coolant pipe

17 - Seal
- ❑ Renew

18 - Connection
- ❑ For coolant hoses

19 - O-ring

- ❑ Renew

20 - Coolant temperature sender -G62-

- ❑ Removing and installing ⇒ page 185

21 - Centre hex stud

- ❑ 9 Nm

22 - Bolt

- ❑ 9 Nm

23 - Retaining clip

24 - Coolant pipe (left-side)

- ❑ Removing and installing ⇒ page 195

25 - Nut

- ❑ 9 Nm

26 - Bolt

- ❑ 9 Nm

27 - Bolt

- ❑ 9 Nm

28 - Nut

- ❑ 9 Nm

29 - Coolant pipe (top front)

- ❑ Removing and installing ⇒ page 193

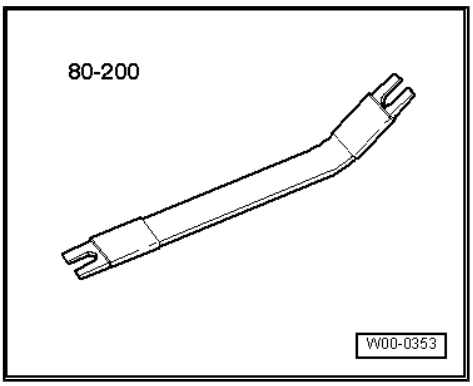
30 - Pump for exhaust gas recirculation cooler -V400-

- ❑ Removing and installing ⇒ page 188

3.2 Removing and installing coolant temperature sender -G62-

Special tools and workshop equipment required

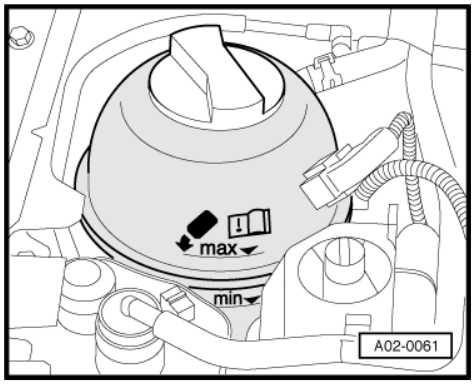
- ♦ Removal lever -80 - 200-



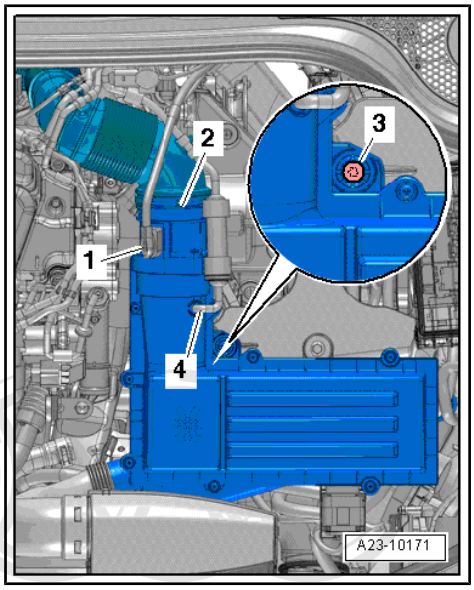
Removing

- Engine cold.

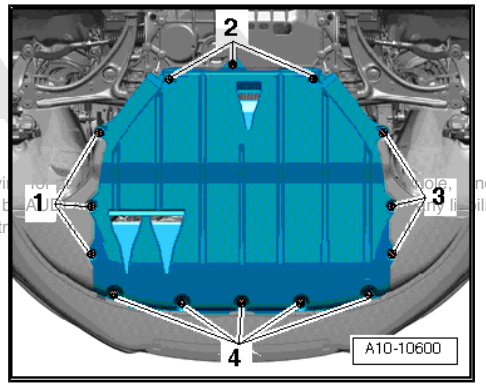
– Open filler cap on coolant expansion tank briefly and allow residual pressure in cooling system to dissipate.



– Remove air cleaner housing ⇒ Rep. Gr. 23 .



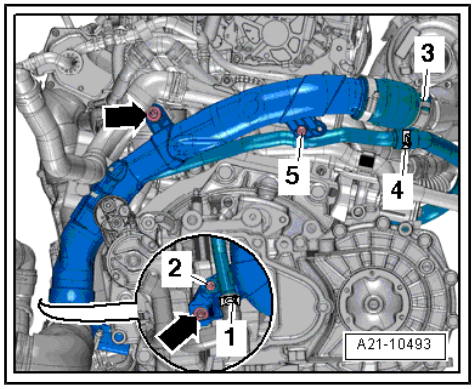
– Remove noise insulation ⇒ Rep. Gr. 66 .



– Remove bolts -arrows-.

– Using removal lever -80 - 200- , move clear electrical wiring and hoses at air pipe (left-side).

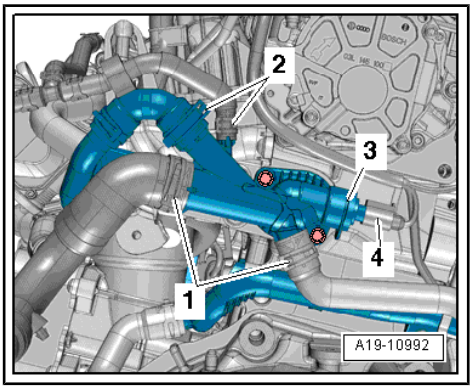
– Release hose clip -3- and push air pipe (left-side) with coolant pipe towards the left.



Note

Disregard -items 1, 2, 4 and 5-.

– Unplug electrical connector -4- at coolant temperature sender -G62- .



Note

Place a cloth underneath the connection to catch escaping coolant.

– Pull off retaining clip -3- and pull coolant temperature sender -G62- out of connection.

Note

Disregard -items 1, 2-.

Installing

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

Note

- *Fit new O-ring.*
- *To avoid loss of coolant, insert new coolant temperature sender -G62- immediately into connection.*

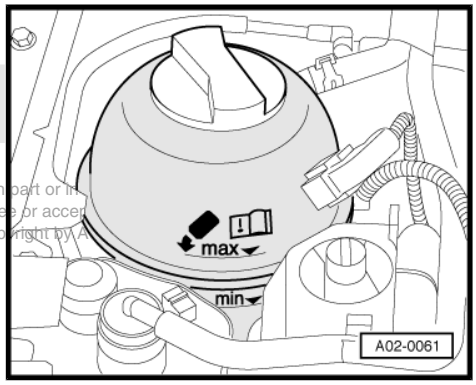
– Install air pipe ⇒ page 212 .
– Install noise insulation ⇒ Rep. Gr. 66 .
– Install air cleaner housing ⇒ Rep. Gr. 23 .
– Check coolant level ⇒ page 176 .

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

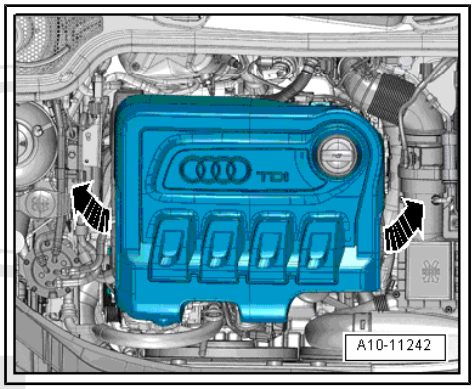
Removing

- Engine cold.

– Open filler cap on coolant expansion tank briefly and allow residual pressure in cooling system to dissipate.



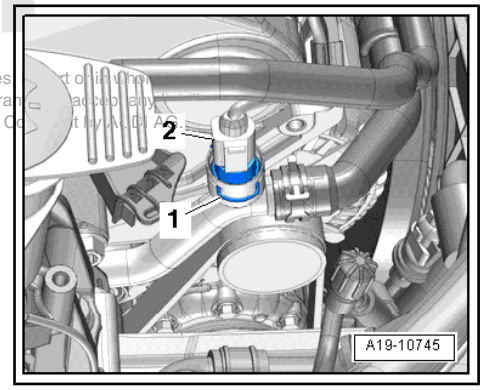
– Remove engine cover panel -arrows-.



– Unplug electrical connector -2- at radiator outlet coolant temperature sender -G83- .

Note

Place a cloth underneath to catch escaping coolant.



– Pull off retaining clip -1- and pull radiator outlet coolant temperature sender -G83- out of connection on coolant pipe.

Installing

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

Note

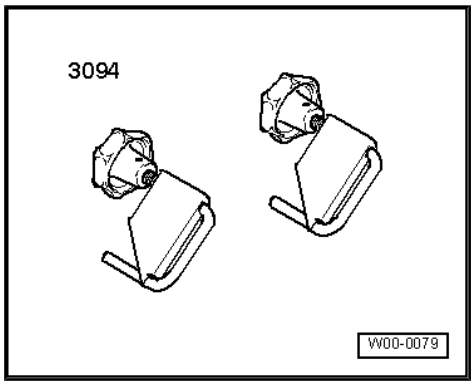
- *Fit new O-ring.*
- *To avoid loss of coolant, fit new radiator outlet coolant temperature sender -G83- into coolant pipe immediately.*

– Check coolant level ⇒ page 176 .

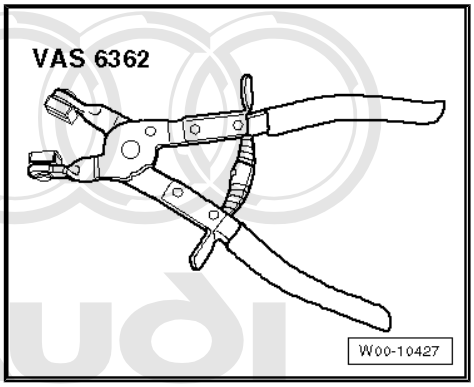
3.4 Removing and installing pump for exhaust gas recirculation cooler -V400-

Special tools and workshop equipment required

- Hose clamps for hoses up to 25 mm -3094-

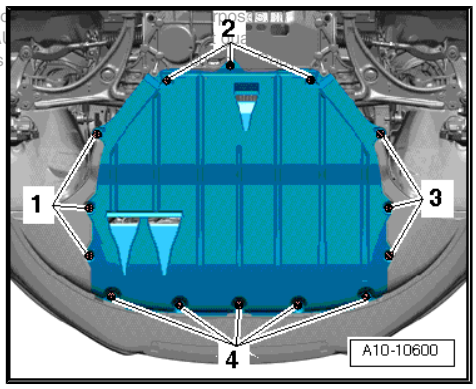


♦ Hose clip pliers -VAS 6362-

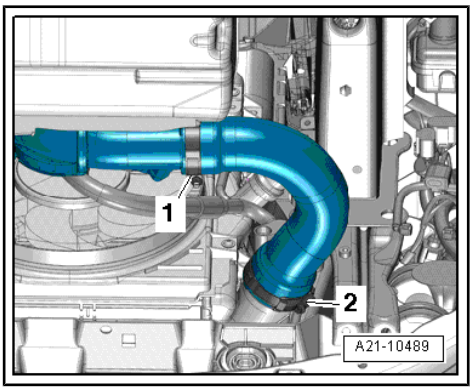


Removing

– Remove noise insulation ⇒ Rep. Gr. 66 .



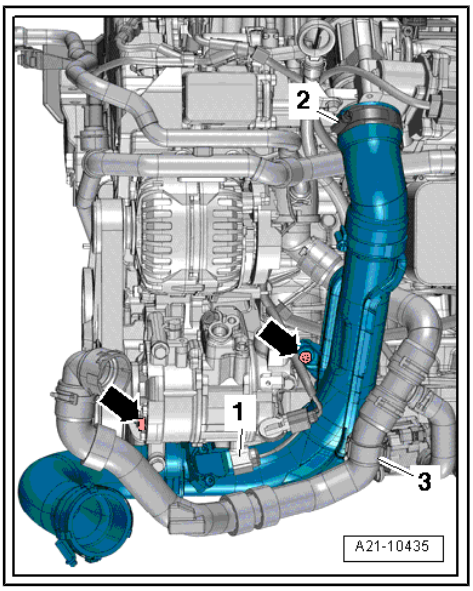
– Release hose clips -1- and -2- and remove air hose.



– Remove bolts -arrows-.
– Release hose clip -2- and push right air pipe towards the right.

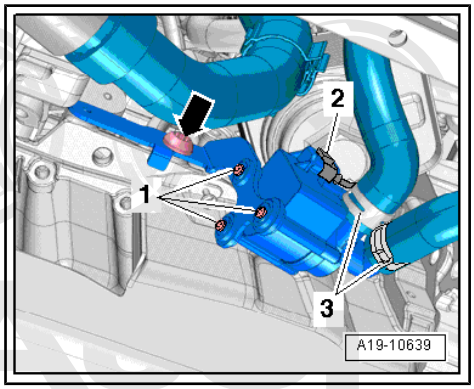
Note

Disregard -items 1, 3-.



Note

Place a cloth underneath pump for exhaust gas recirculation cooler -V400- to catch escaping coolant.



- Clamp off coolant hoses using hose clamps -3094- , release hose clips -3- and disconnect coolant hoses.
- Unplug electrical connector -2-.
- Unscrew bolts -1- and remove pump for exhaust gas recirculation cooler -V400- .

Note

Disregard -arrow-.

Installing

- Tightening torque
  ⇒ "3.1 Coolant pipes, coolant temperature senders, coolant circulation pump - exploded view", page 184

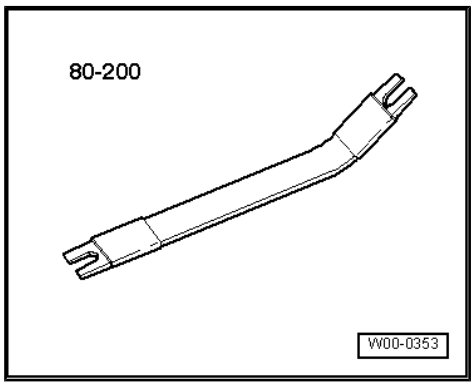
Installation is carried out in the reverse order; note the following:

- Install air pipe ⇒ page 212 .
- Install air hoses with screw-type clips ⇒ page 213 .
- Install noise insulation ⇒ Rep. Gr. 66 .
- Check coolant level ⇒ page 176 .

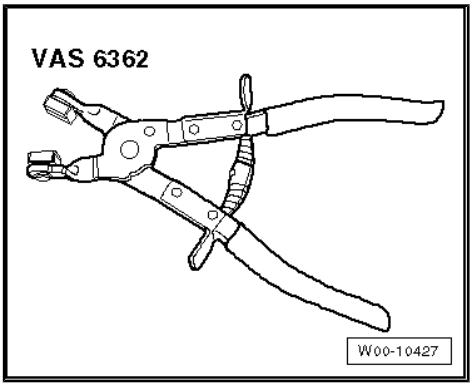
3.5 Removing and installing coolant pipe (front)

Special tools and workshop equipment required

- Removal lever -80 - 200-



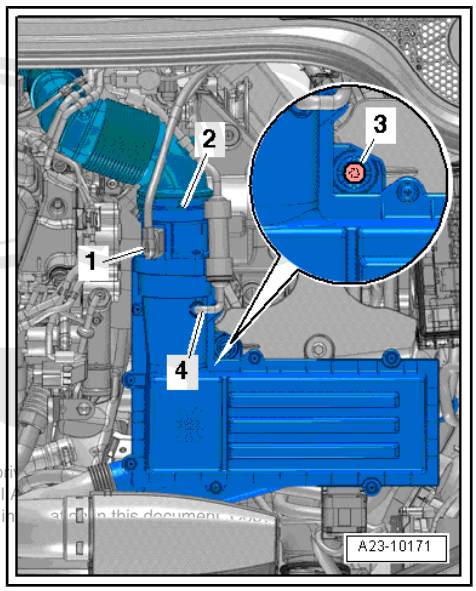
♦ Hose clip pliers -VAS 6362-



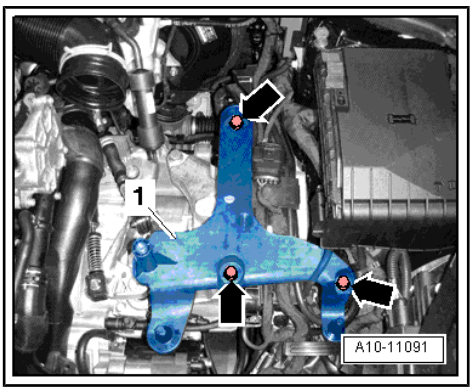
Removing

– Drain coolant ⇒ page 170 .

– Remove air cleaner housing ⇒ Rep. Gr. 23 .



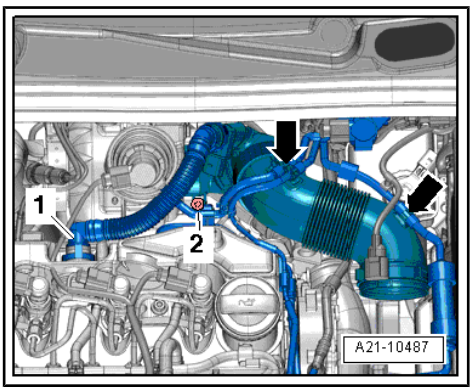
– Remove bolts -arrows- and detach bracket -1- for air cleaner housing.



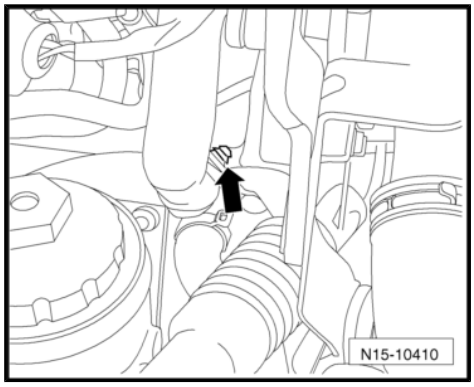
– Press release tabs and disconnect crankcase breather hose -1- from cylinder head cover.

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

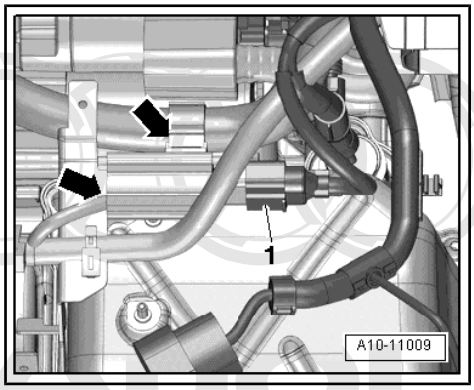
– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.



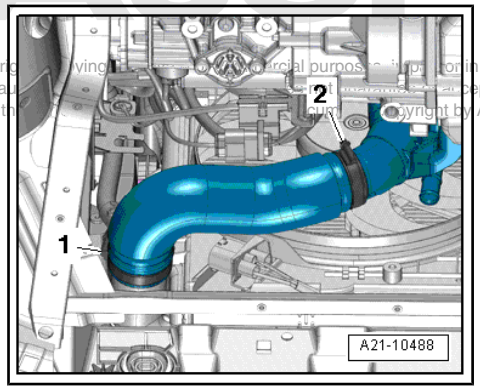
– Unclip wiring harness from retainer -arrow-.



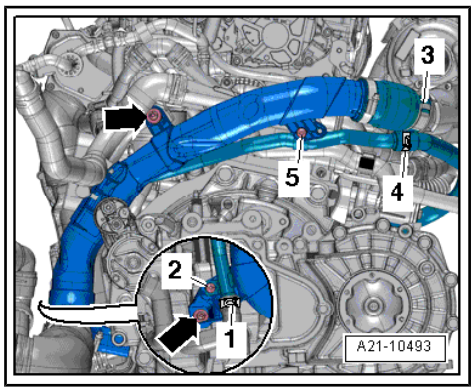
– Move clear wiring harnesses -arrows- and electrical connector -1- at bracket.



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



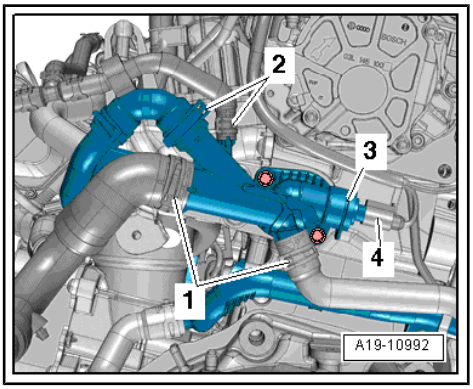
– Remove bolts -2, 5- and -arrows-.
– Using removal lever -80 - 200- , move clear electrical wiring and hoses at air pipe (left-side).
– Loosen hose clip -3- and detach air pipe (left-side).



Note

Disregard -items 1, 4-.

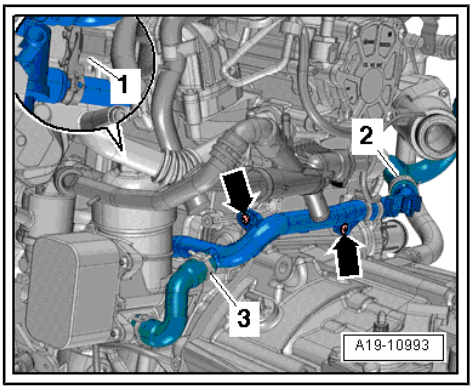
– Release hose clips -1- and detach coolant hoses.



Note

Disregard -items 2, 3, 4-.

– Take electrical connector -1- for Hall sender -G40- out of retainer.



– Detach bracket from coolant pipe (front).

– Release hose clips -2- and -3- and disconnect coolant hoses.

– Remove bolts -arrows- and detach coolant pipe (front) from 4/2-way valve to left side.

Installing

- Tightening torques
  ⇒ “3.1 Coolant pipes, coolant temperature senders, coolant circulation pump - exploded view”, page 184

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

Note

- *Renew gaskets, seals and O-rings.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Clean and smoothen sealing surface for O-ring.

– Lightly lubricate O-ring with coolant and slide O-ring onto coolant pipe (front).

– Push coolant pipe (front) into 4/2-way valve.

– Install air pipe ⇒ page 212 .

– Install air pipe with connection ⇒ page 207 .

– Install air hoses with screw-type clips ⇒ page 213 .

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

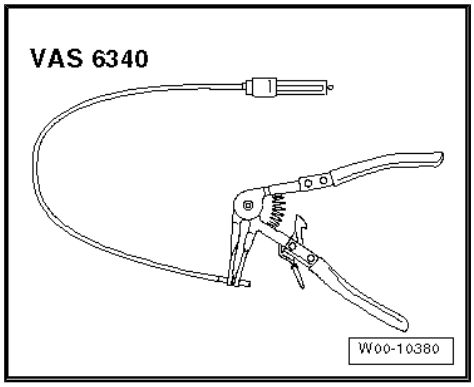
– Install air cleaner housing ⇒ Rep. Gr. 23 .

– Fill up with coolant ⇒ page 173 .

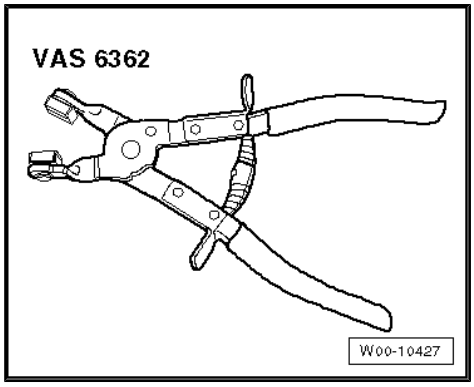
3.6 Removing and installing coolant pipe (top front)

Special tools and workshop equipment required

♦ Hose clip pliers -VAS 6340-



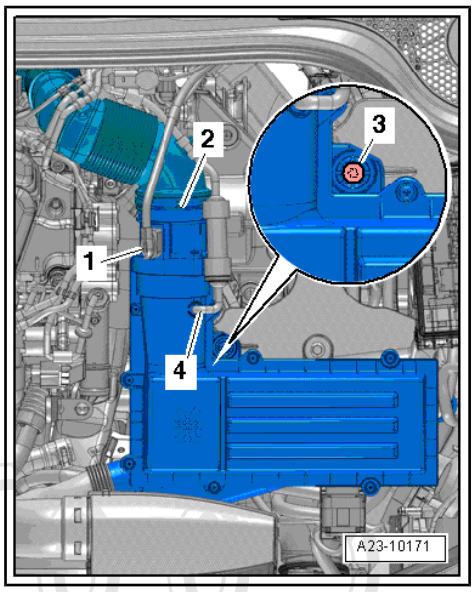
♦ Hose clip pliers -VAS 6362-



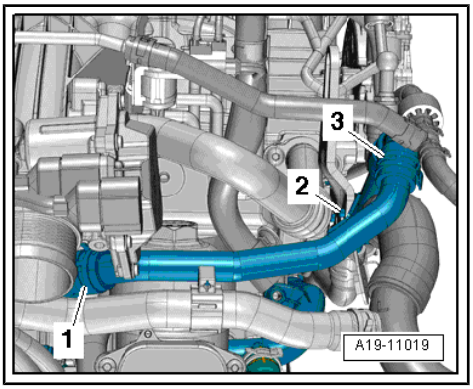
Removing

– Drain coolant ⇒ page 170 .

– Remove air cleaner housing ⇒ Rep. Gr. 23 .



– Remove bolt -2-.
– Release hose clips -1- and -3- and disconnect coolant hoses.
– Detach coolant pipe (top front).



Installing

- Tightening torques
  ⇒ "3.1 Coolant pipes, coolant temperature senders, coolant circulation pump - exploded view", page 184

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

Note

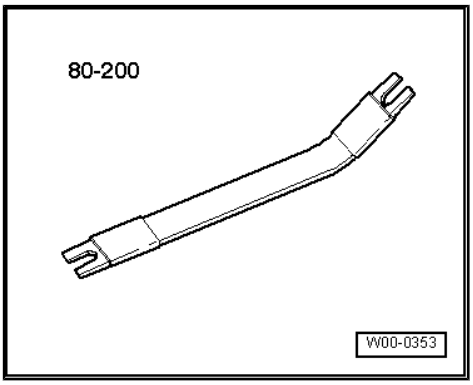
Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .

– Install air cleaner housing ⇒ Rep. Gr. 23 .
– Fill up with coolant ⇒ page 173 .

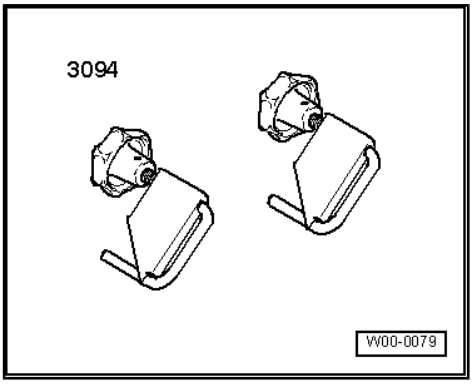
3.7 Removing and installing coolant pipe (left-side)

Special tools and workshop equipment required

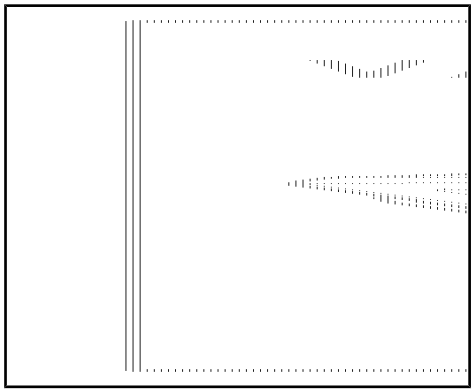
♦ Removal lever -80 - 200-



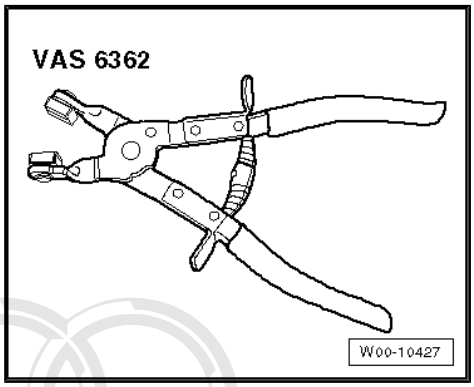
♦ Hose clamps for hoses up to 25 mm -3094-



♦ Drip tray for workshop hoist -VAS 6208-

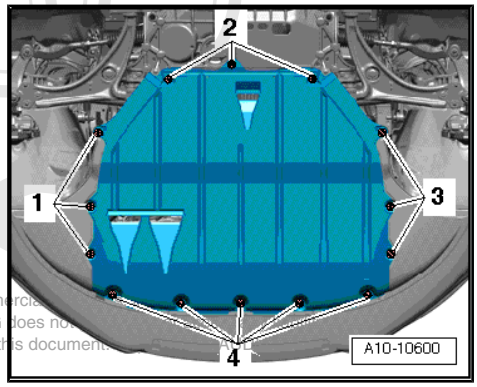


♦ Hose clip pliers -VAS 6362-

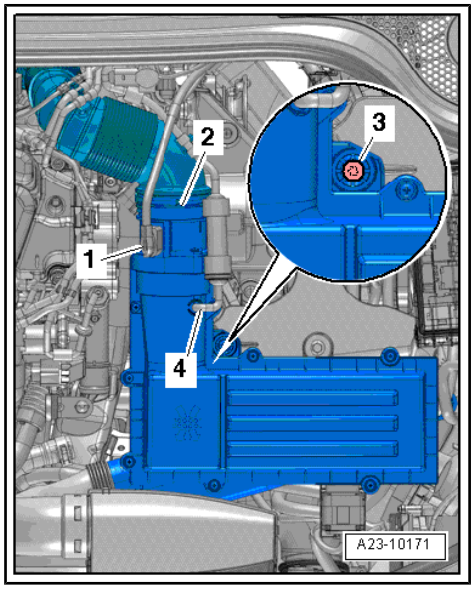


Removing

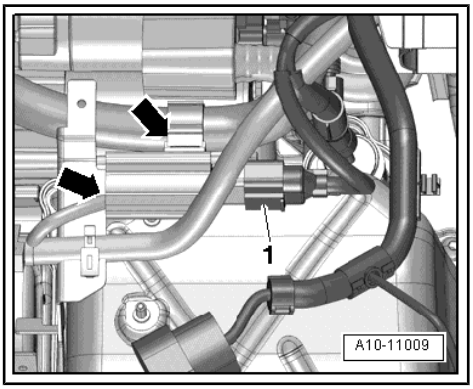
– Remove noise insulation ⇒ Rep. Gr. 66 .



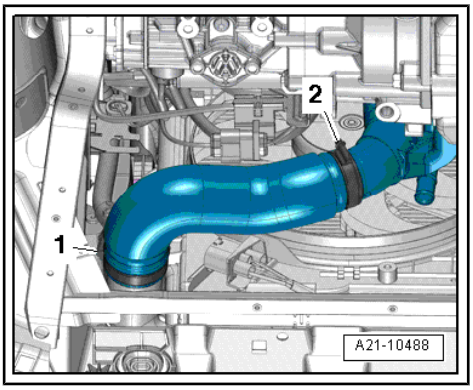
– Remove air cleaner housing ⇒ Rep. Gr. 23 .



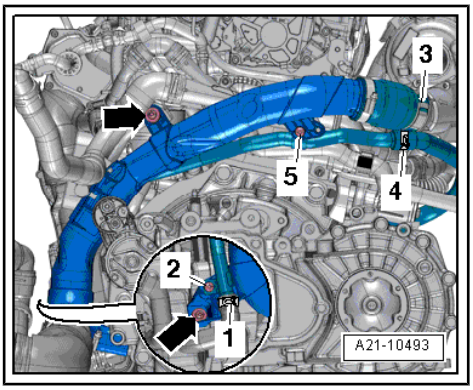
– Move clear wiring harnesses -arrows- and electrical connector -1- at bracket.



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



– Remove bolts -2, 5- and -arrows-.
– Using removal lever -80 - 200- , move clear electrical wiring and hoses at air pipe (left-side).
– Loosen hose clip -3- and detach air pipe (left-side).
– Place drip tray for workshop hoist -VAS 6208- beneath engine.
– Clamp off coolant hoses using hose clamps -3094- , release hose clips -1- and -4- and disconnect coolant hoses from coolant pipe (left-side).
– Detach coolant pipe (left-side).



Installing

- Tightening torque
  ⇒ “3.1 Coolant pipes, coolant temperature senders, coolant circulation pump - exploded view”, page 184

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

Note

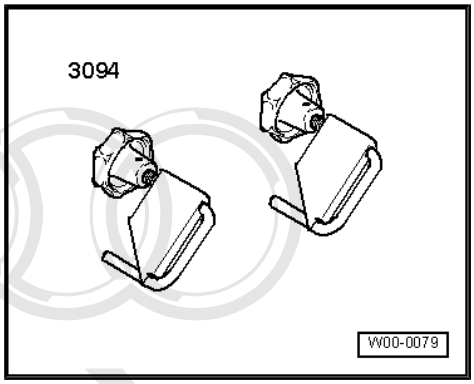
Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .

– Install air pipe ⇒ page 212 .
– Install air hoses with screw-type clips ⇒ page 213 .
– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Install air cleaner housing ⇒ Rep. Gr. 23 .
– Install noise insulation ⇒ Rep. Gr. 66 .
– Fill up with coolant ⇒ page 173 .

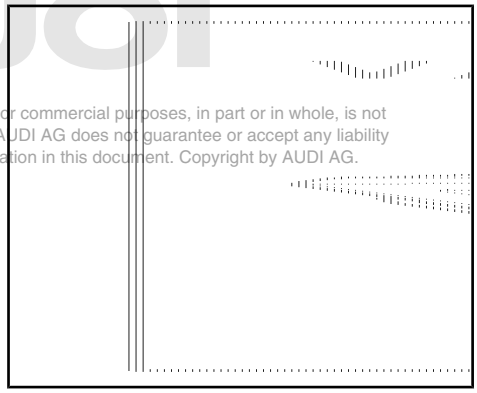
3.8 Removing and installing coolant pipe (right-side)

Special tools and workshop equipment required

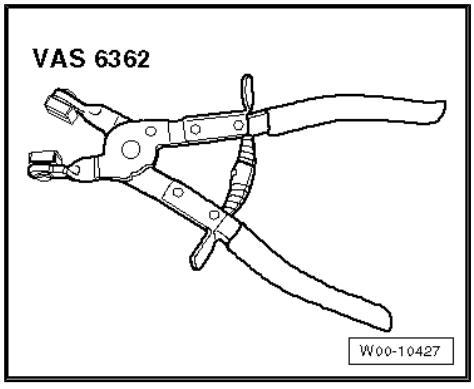
- Hose clamps for hoses up to 25 mm -3094-



- Drip tray for workshop hoist -VAS 6208-

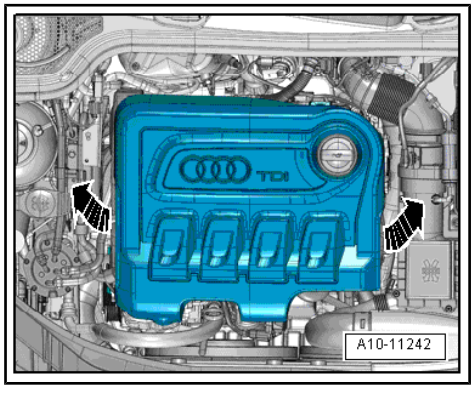


- Hose clip pliers -VAS 6362-

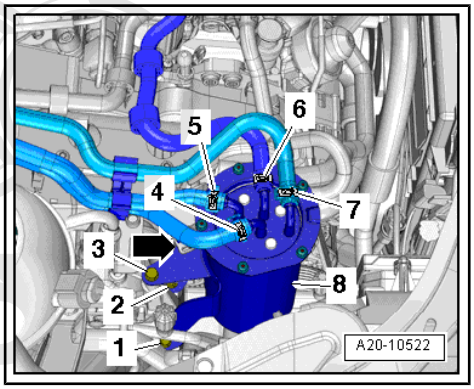


Removing

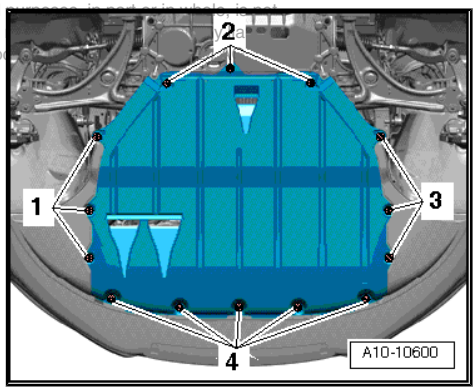
– Remove engine cover panel -arrows-.



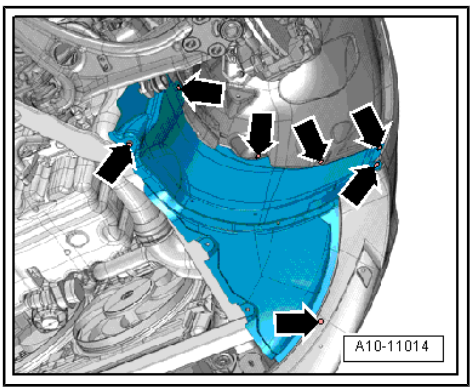
– Loosen bolt -1-.
– Remove nut -2- and bolt -3-.
– Detach hose retainer -arrow- from fuel filter and move fuel filter -8- clear to one side with fuel hoses -4 ... 7- connected.



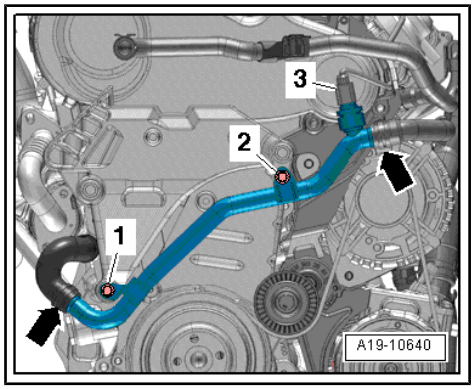
– Remove noise insulation ⇒ Rep. Gr. 66 .



– Remove bottom section of wheel housing liner (right-side) ⇒ Rep. Gr. 66 .



– Place drip tray for workshop hoist -VAS 6208- beneath engine.
– Unplug electrical connector -3- at radiator outlet coolant temperature sender -G83- .
– Clamp off coolant hoses using hose clamps -3094- , release hose clips -arrows- and disconnect coolant hoses from coolant pipe (right-side).
– Remove nut -1- and bolt -2- and take off coolant pipe (right-side).



Installing

- Tightening torque
⇒ “3.1 Coolant pipes, coolant temperature senders, coolant circulation pump - exploded view”, page 184

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 right wheel housing liner (bottom section) ⇒ Rep. Gr. 66 .
– Install noise insulation ⇒ Rep. Gr. 50 .
– Install fuel filter ⇒ Rep. Gr. 20 .
– Check coolant level ⇒ page 176 .

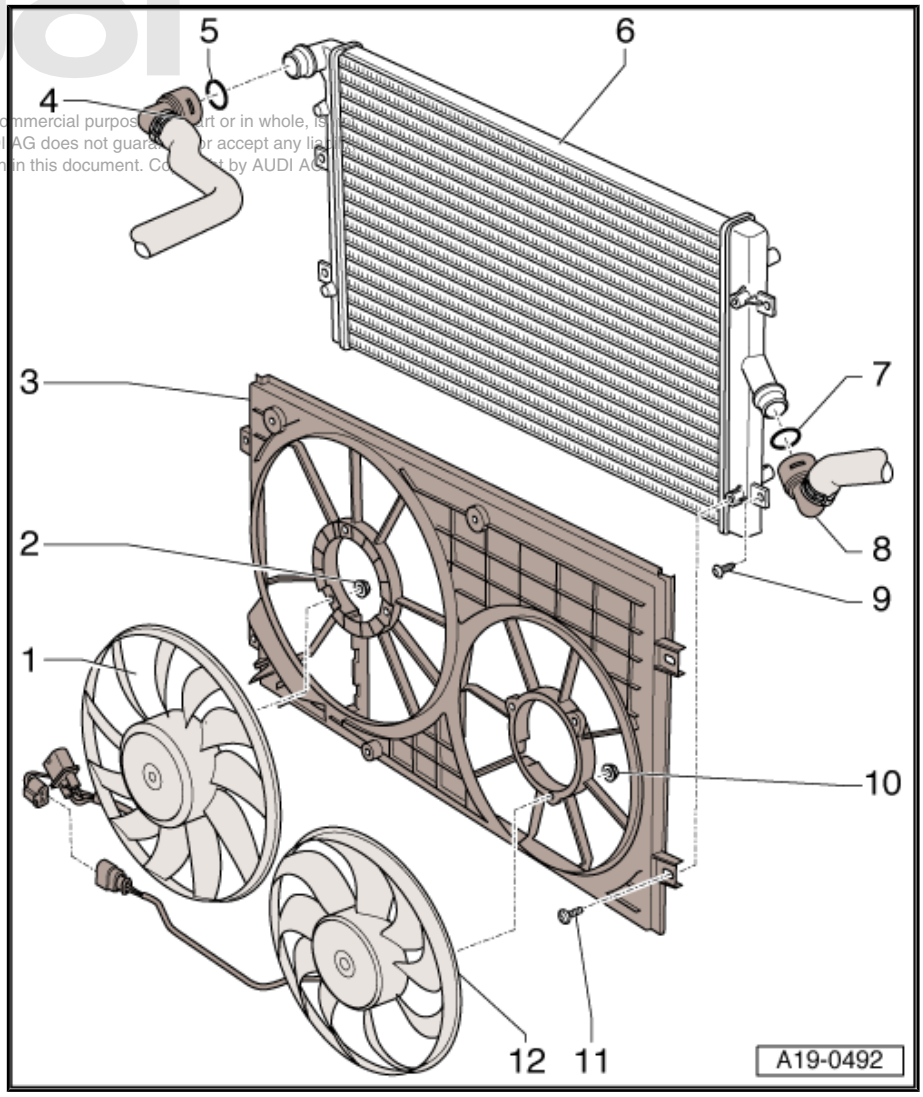
4 Radiator and radiator fans

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.*

4.1 Radiator and radiator fans - exploded view



1 - Radiator fan -V7-

- With radiator fan control unit -J293-
- Removing and installing ⇒ page 204

2 - Nut

- 5 Nm

3 - Radiator cowl

- Removing and installing ⇒ page 202

4 - Coolant hose (top)

- Lift retaining clip to detach
- Connecting to radiator ⇒ page 202

5 - O-ring

- Renew

6 - Radiator

- Removing and installing ⇒ page 204
- If renewed, refill system with fresh coolant

7 - O-ring

- Renew

8 - Coolant hose (bottom)

- Lift retaining clip to detach
- Connecting to radiator ⇒ page 202

9 - Bolt

- 5 Nm

10 - Nut

- 5 Nm

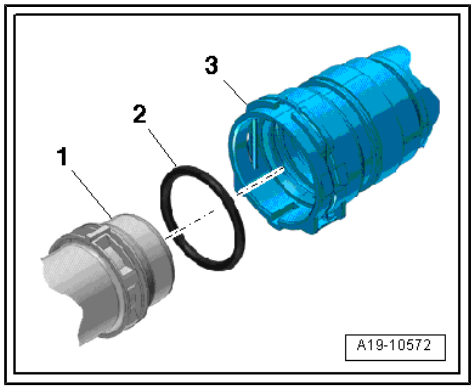
11 - Bolt

- 5 Nm

12 - Radiator fan 2 -V177-

- Removing and installing ⇒ page 204

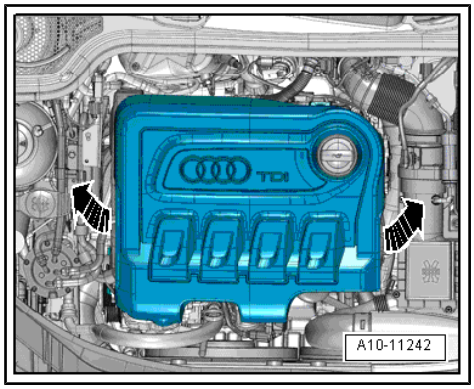
Connecting coolant hose with plug-in connector



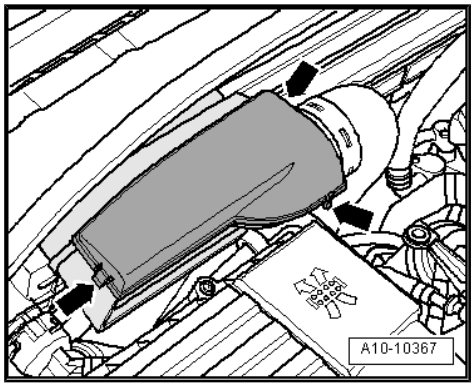
- Remove old O-ring -2- from coolant hose -3-.
- Lightly lubricate new O-ring with coolant and fit O-ring in coolant hose.
- Press coolant hose onto connection -1- until it engages audibly.
- Press coolant hose in again and then pull to check that plug-in connector is correctly engaged.

4.2 Removing and installing radiator cowl

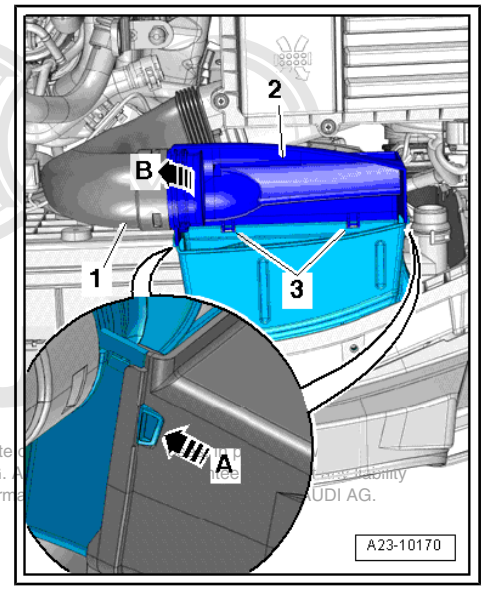
Removing



- Remove engine cover panel -arrows-.

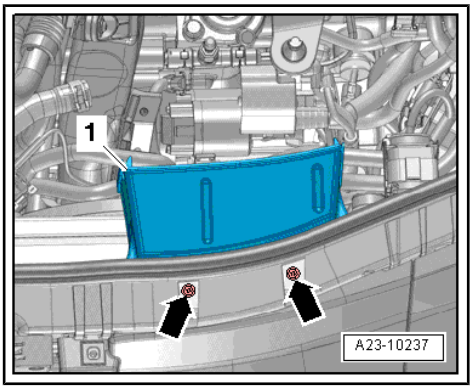


- Pull cover off air duct (release clips on sides) -arrows-.



- Release clips on left and right -arrow A- and unclip air duct at bottom -2-.
- Swivel air duct (bottom) slightly to the rear and detach air duct (bottom) from retainers -3-.
- Detach air pipe -1- from air duct (bottom) -arrow B-.

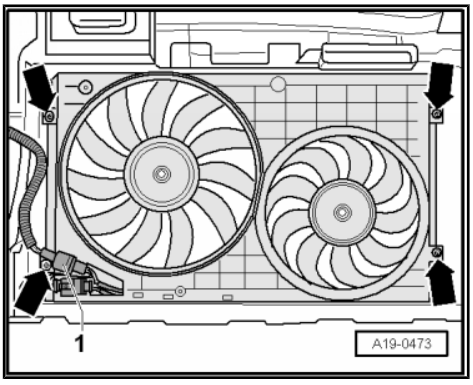
– Remove bolts -arrows- and detach air duct from lock carrier.



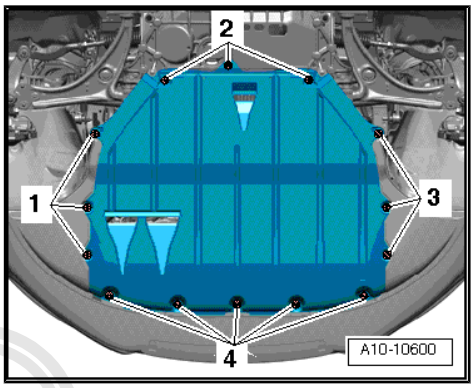
– Remove bolts -top arrows- for radiator cowl.

Note

- *The bolts -bottom arrows- are removed at a later stage.*
- *Disregard -item 1-.*



– Remove noise insulation ⇒ Rep. Gr. 66 .



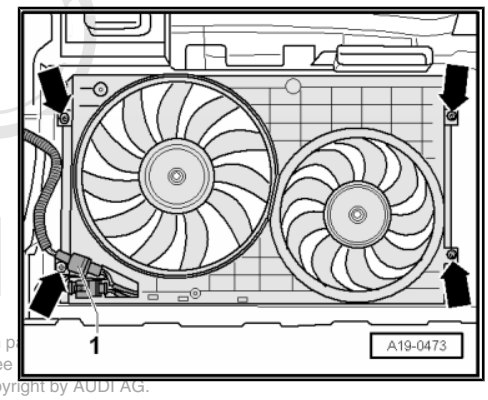
– Unplug electrical connector -1-.
– Remove bolts -bottom arrows- and lift out air cowl.

Installing

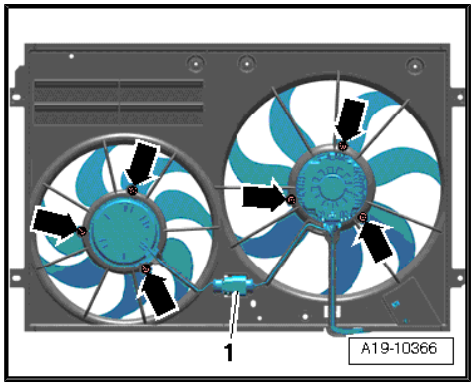
- Tightening torque
⇒ “4.1 Radiator and radiator fans - exploded view”, page 201

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

– Install noise insulation ⇒ Rep. Gr. 66 .
– Install air duct ⇒ Rep. Gr. 23 .



4.3 Removing and installing radiator fans - V7- and -V177-



Removing

– Remove radiator cowl ⇒ page 202 .

– Unplug electrical connector -1- and move clear.

– Unscrew nuts -arrows- and remove radiator fans.

Installing

• Tightening torque
⇒ "4.1 Radiator and radiator fans - exploded view", page 201

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

Note

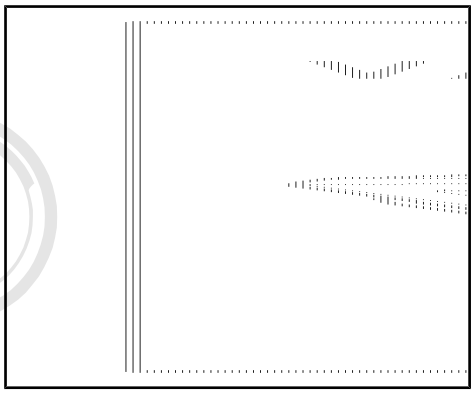
Fit all cable ties in the original positions when installing.

– Install radiator cowl ⇒ page 202 .

4.4 Removing and installing radiator

Special tools and workshop equipment required

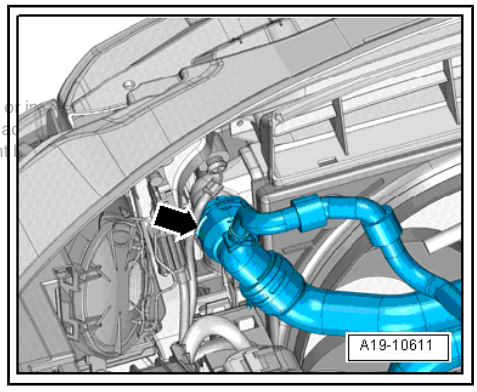
♦ Drip tray for workshop hoist -VAS 6208-



Removing

Note

If there are slight impressions on the fins, refer to ⇒ page 7 .

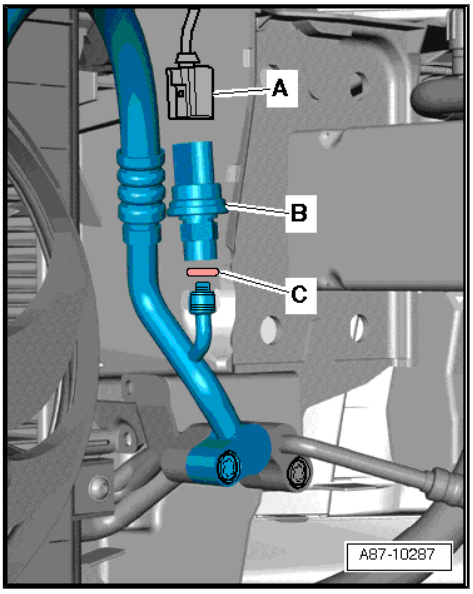


– Drain coolant ⇒ page 170 .

– Remove radiator cowl ⇒ page 202 .

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

– Unplug electrical connector -A- at high-pressure sender -G65- -item B-.

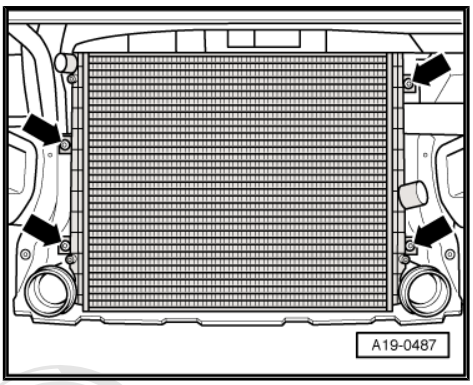


Note

Disregard -item C-.

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

– Remove bolts -arrows- at rear and lift out radiator.



Installing

- Tightening torque
  ⇒ “4.1 Radiator and radiator fans - exploded view”, page 201

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

Note

Renew seals and O-rings.

– Connect coolant hose with plug-in connector to radiator ⇒ page 202 .

– Install radiator cowl ⇒ page 202 .

– Fill up with coolant ⇒ page 173 .

21 – Turbocharging/supercharging

1 Turbocharger

– Observe rules for cleanliness ⇒ page 6 .

1.1 Diagram of vacuum connections

Caution

Risk of engine failure.

- *When routing vacuum lines, make sure they are not kinked, twisted or crushed.*

1 - Vacuum unit
- ❑ On turbocharger
- ❑ With position sender for charge pressure positioner -G581-

2 - Charge pressure control solenoid valve -N75-

3 - Noise insulation

4 - Air cleaner housing

5 - To brake servo

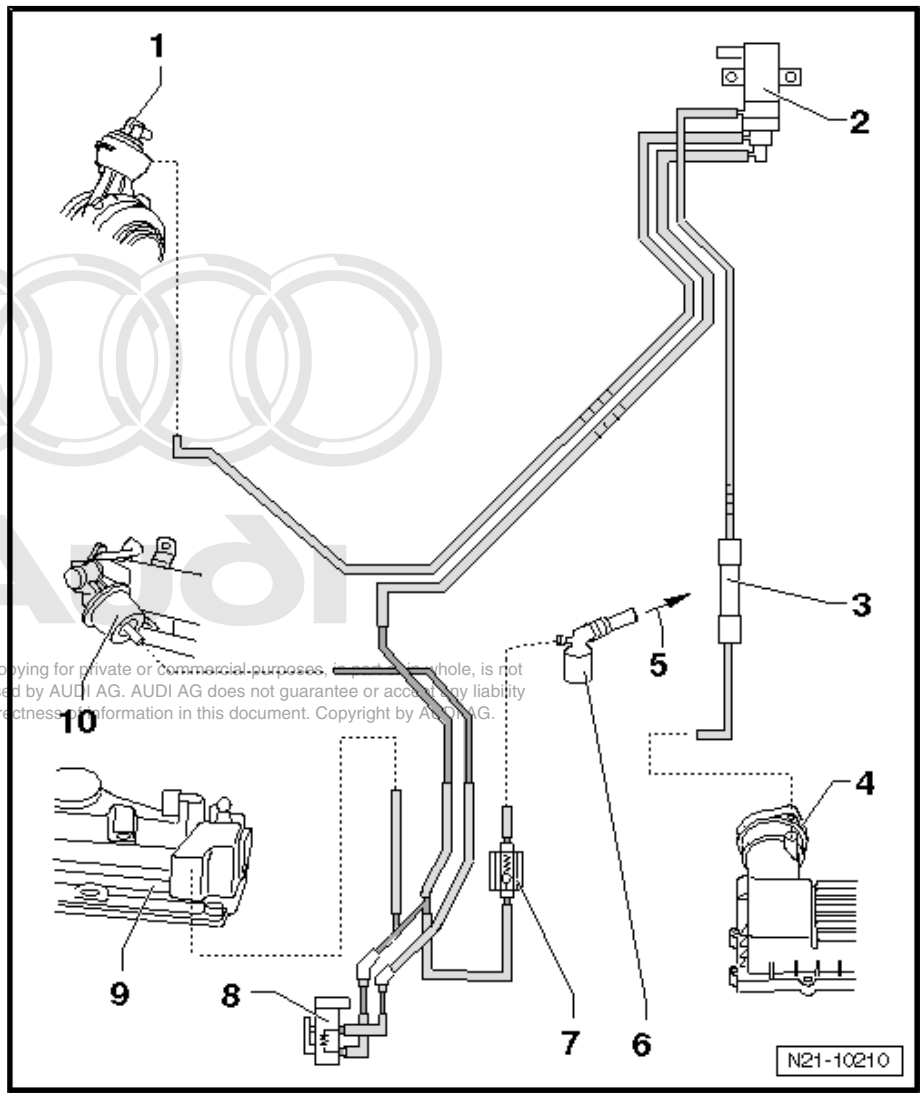
6 - Connection piece
- ❑ On exhauster pump

7 - Non-return valve
- ❑ Note installation position

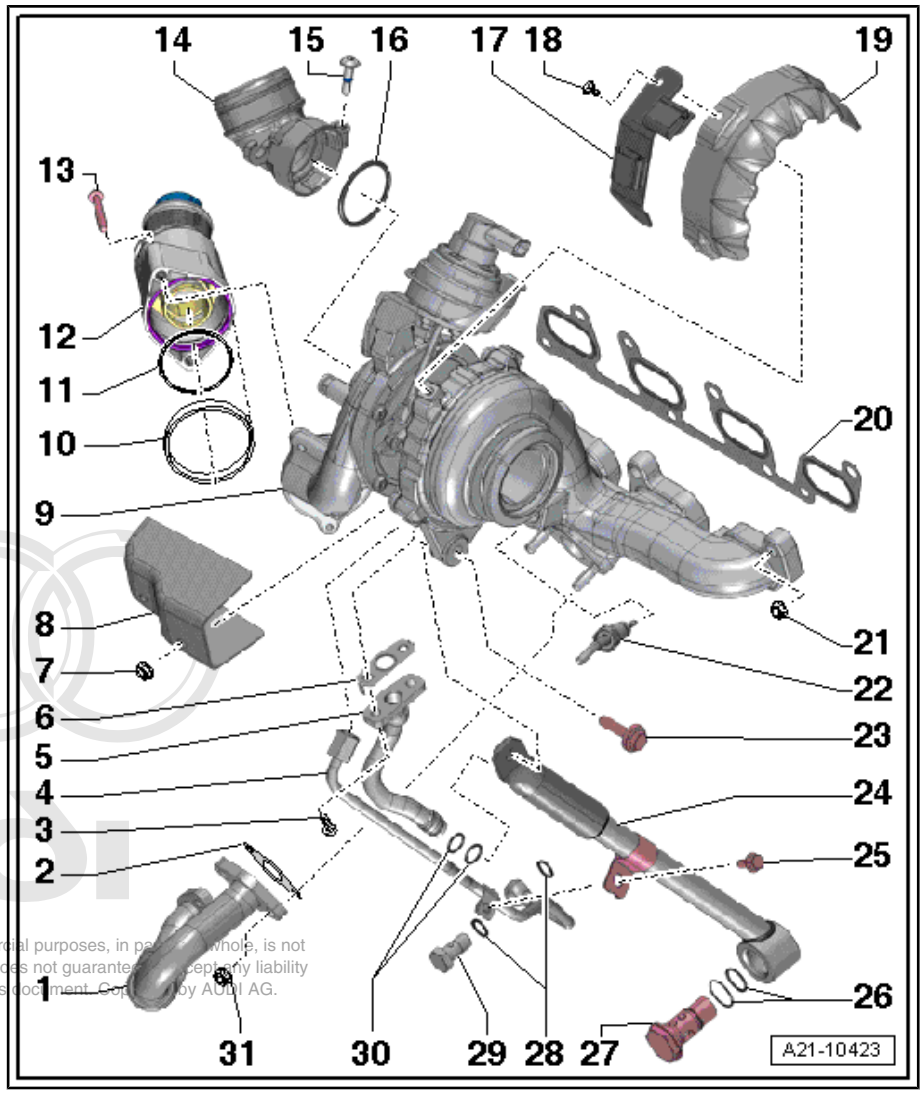
8 - Exhaust gas recirculation cooler change-over valve -N345-
- ❑ Checking change-over function ⇒ page 230

9 - Cylinder head cover

10 - Vacuum unit
- ❑ For change-over function for exhaust gas recirculation cooler



1.2 Turbocharger - exploded view



1 - Pipe for exhaust gas recirculation

- ❑ With flexible joint; do not bend joint - risk of cracking

2 - Gasket

- ❑ Renew

3 - Ribbed bolt

- ❑ Renew
- ❑ 17 Nm

4 - Oil supply pipe

- ❑ Check for obstructions
- ❑ Before installing, fill turbocharger with engine oil at connection for oil supply pipe
- ❑ Tighten union nuts to 22 Nm.

5 - Oil return pipe

6 - Gasket

- ❑ Renew

7 - Nut

- ❑ 24 Nm

8 - Heat shield

9 - Turbocharger

- ❑ Can only be renewed together with exhaust manifold and vacuum unit as one unit
- ❑ Removing and installing ⇒ page 208

10 - Retaining ring

- ❑ Can only be installed in one position

11 - O-ring

- ❑ Renew

12 - Pulsation damper

13 - Bolt

- ❑ 9 Nm

14 - Intake connecting pipe

15 - Bolt

- ❑ 9 Nm
- ❑ Captive in intake connecting pipe

16 - O-ring

- ❑ Renew

17 - Bracket

- ❑ For electrical wiring

18 - Bolt
- ❑ 15 Nm

19 - Heat shield

20 - Gasket
- ❑ Renew

21 - Nut
- ❑ Renew
- ❑ 24 Nm

22 - Exhaust gas temperature sender 1 -G235-
- ❑ Exploded view ⇒ page 224

23 - Bolt
- ❑ 20 Nm

24 - Support
- ❑ For turbocharger

25 - Bolt
- ❑ 9 Nm

26 - O-rings
- ❑ Different diameters
- ❑ Renew

27 - Banjo bolt
- ❑ 40 Nm

28 - O-rings
- ❑ Renew

29 - Banjo bolt
- ❑ 30 Nm

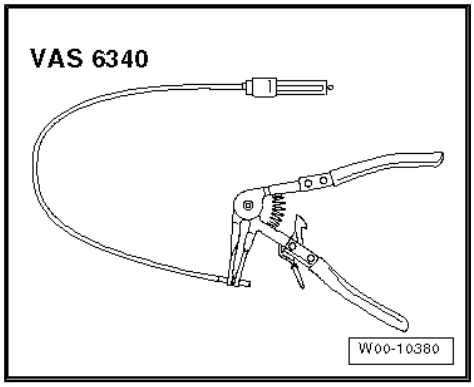
30 - O-rings
- ❑ Renew

31 - Nut
- ❑ 24 Nm

1.3 Removing and installing turbocharger

Special tools and workshop equipment required

- ♦ Hose clip pliers -VAS 6340-



Removing

Note

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

– Observe rules for cleanliness ⇒ page 6 .

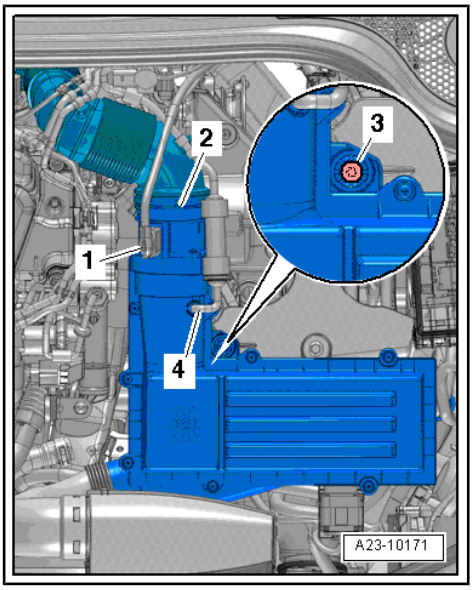
Caution

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

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

– Remove particulate filter ⇒ page 219 .

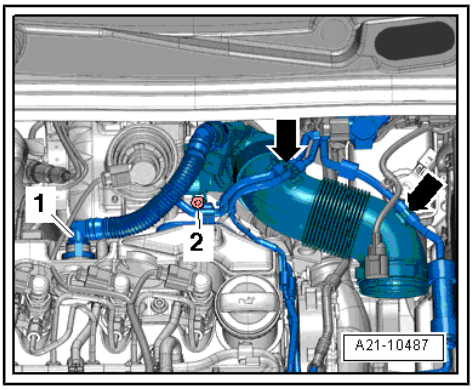
– Remove air cleaner housing ⇒ Rep. Gr. 23 .



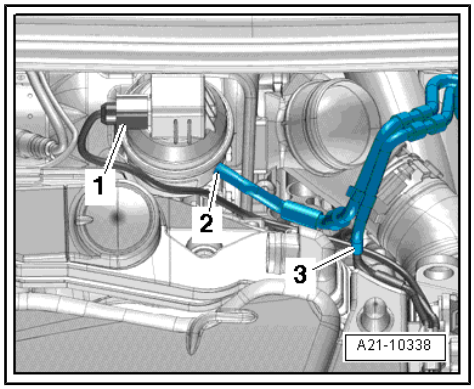
– Press release tabs and disconnect crankcase breather hose -1- from cylinder head cover.

– Move clear vacuum hoses -arrows-.

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



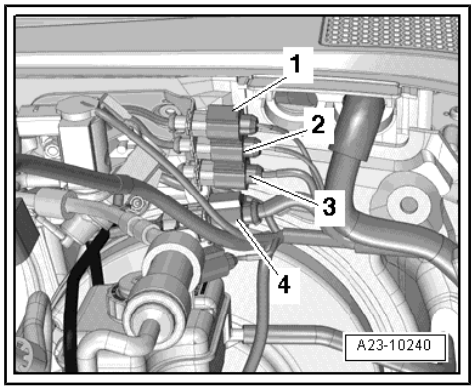
– Detach heat shield sleeve.
– Detach vacuum hose -2- from vacuum unit of turbocharger.
– Disconnect vacuum hose -3-.
– Unplug electrical connector -1- at position sender for charge pressure positioner -G581- .



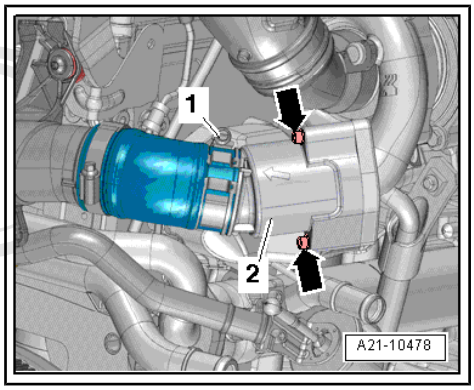
– Move clear electrical connector -1- for exhaust gas temperature sender 1 -G235- and electrical wiring.

Note

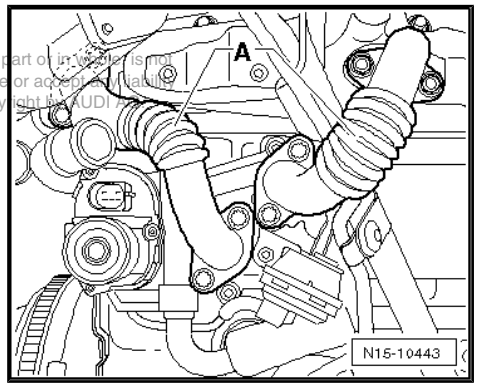
Disregard -items 2, 3, 4-.



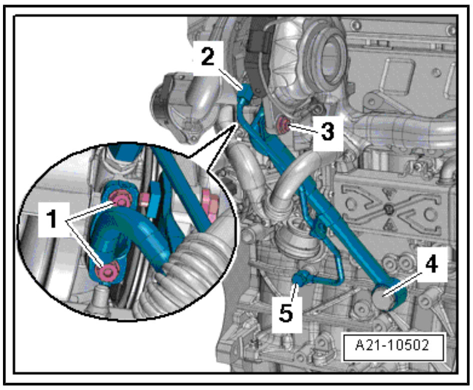
– Remove bolts -arrows-.
– Loosen hose clip -1- and detach pulsation damper -2-.



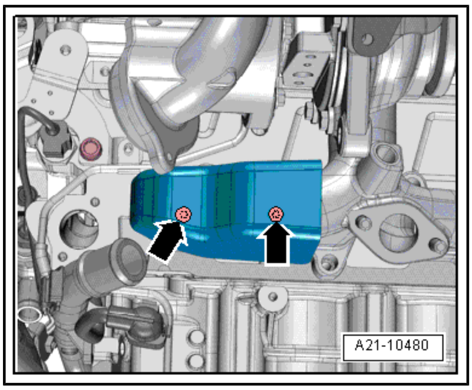
– Remove bolts and detach exhaust gas recirculation pipes -A-.



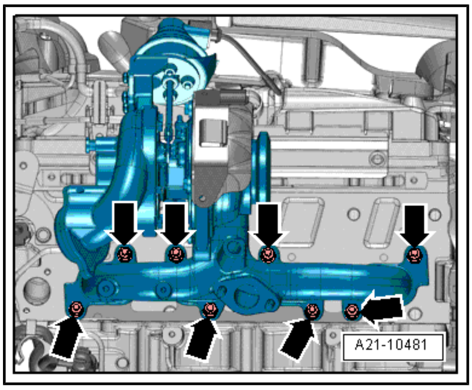
– Remove bolts -1, 3-, union nut -2- and banjo bolts -4, 5- and detach support for turbocharger with oil supply line.



– Remove bolts -arrows- and detach heat shield.



– Remove nuts -arrows- and detach turbocharger with exhaust manifold from cylinder head.



Installing

- Tightening torques ⇒ “1.2 Turbocharger - exploded view”, page 207

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

Note

- *Renew seals, gaskets, O-rings and self-locking nuts.*
- *Fill turbocharger with engine oil at connection for oil supply pipe.*

- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*
- *After installing the turbocharger, allow the engine to idle for approx. 1 minute without pressing the accelerator to ensure that the turbocharger is supplied with oil.*

– Install air hoses with screw-type clips ⇒ page 213 .

– Install exhaust gas recirculation pipes ⇒ page 229 .

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

– Connect vacuum hoses ⇒ page 206 .

– Install air cleaner housing ⇒ Rep. Gr. 23 .

– Install particulate filter ⇒ page 219 .

2 Charge air cooling

Note

- *Check that all air pipes and hoses and vacuum lines are correctly fitted and that there are no leaks before carrying out tests or repairs.*
- *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 .*
- *To ensure that the air hoses can be properly secured at their connections, spray rust remover onto the worm thread of used hose clips before installing.*

2.1 Charge air cooler - exploded view

1 - Air hose

2 - Air pipe (left-side)

3 - Sleeve

4 - Bolt

- ❑ 9 Nm

5 - Grommet

- ❑ Renew if damaged

6 - Air hose

7 - Seal

8 - Charge air cooler

- ❑ Removing and installing ⇒ page 214

9 - Seal

10 - Bolt

- ❑ 5 Nm

11 - Mounting

12 - Mounting

13 - Air hose

14 - Air hose

15 - Air pipe (right-side)

16 - Bolt

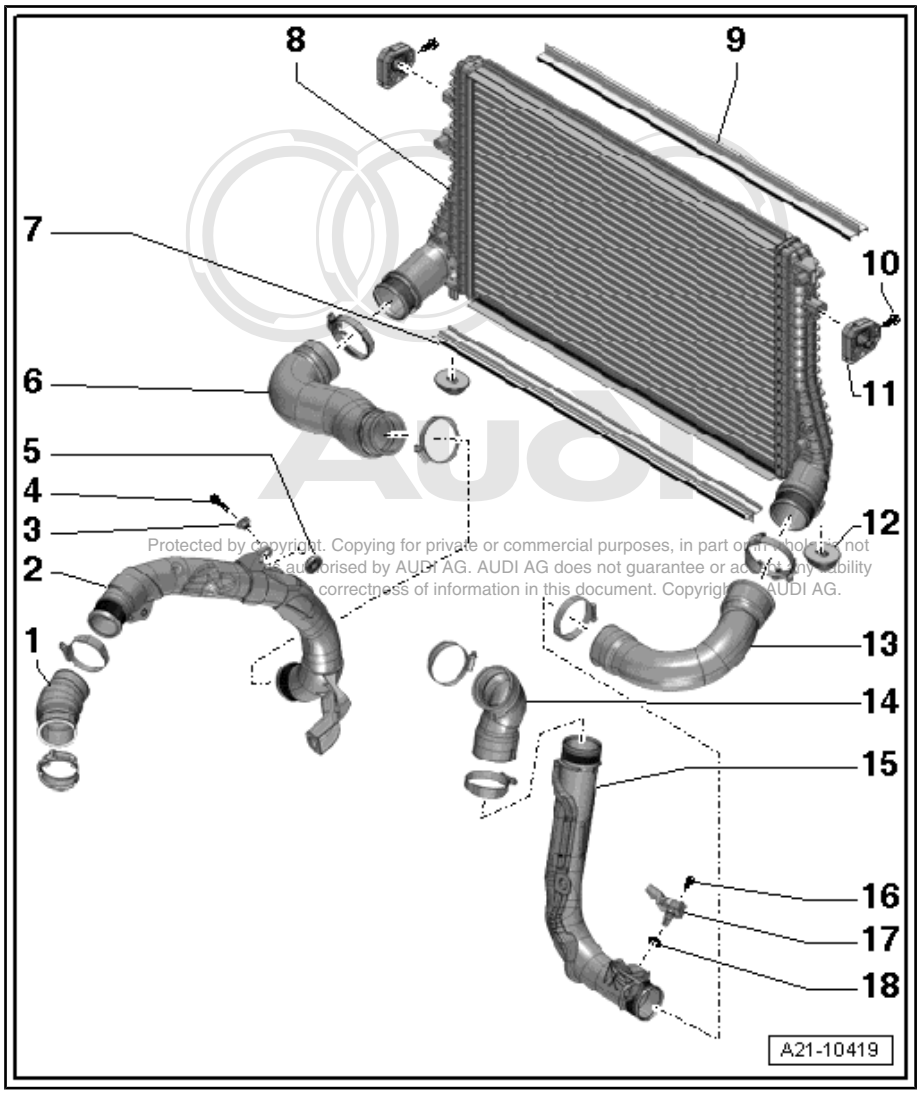
- ❑ 5 Nm

17 - Charge pressure sender - G31- / intake air temperature sender -G42-

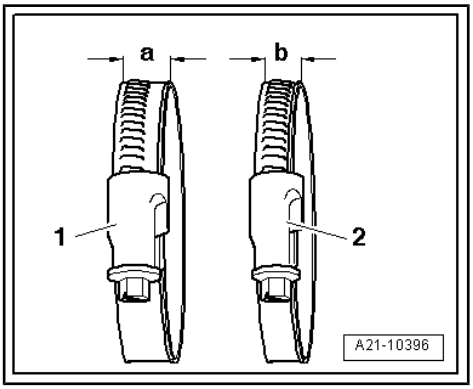
- ❑ Removing and installing ⇒ page 213

18 - O-ring

- ❑ Renew



Installing air hoses with screw-type clips



Note

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

Tightening torque for

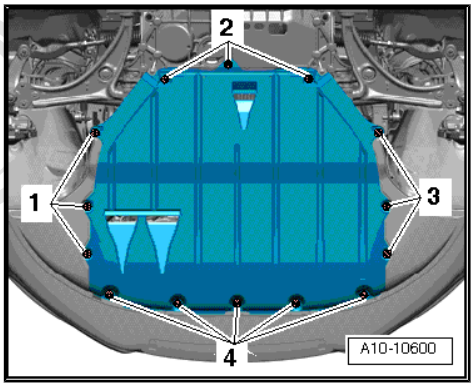
1 - Hose clip -a- = 13 mm wide: 5.5 Nm

2 - Hose clip -b- = 9 mm wide: 3 Nm

2.2 Removing and installing charge pressure sender -G31- / intake air temperature sender -G42-

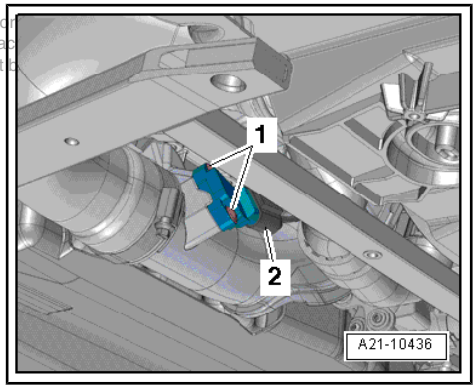
Removing

– Remove noise insulation ⇒ Rep. Gr. 66 .



– Unplug electrical connector -2-.

– Remove bolts -1- and pull charge pressure sender -G31- / intake air temperature sender -G42- out of air pipe.



Installing

- Tightening torque
  ⇒ “2.1 Charge air cooler - exploded view”, page 212

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

Note

Fit new O-ring.

– Install noise insulation ⇒ Rep. Gr. 66 .

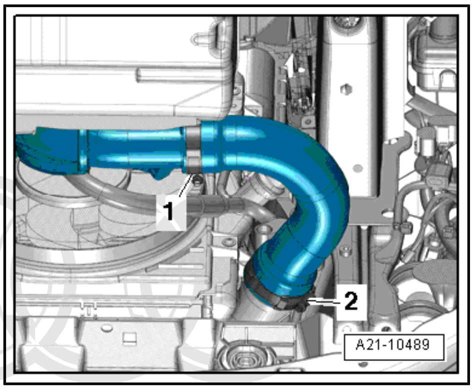
2.3 Removing and installing charge air cooler

Removing

– Remove radiator ⇒ page 204 .

– Remove bumper cover (front) ⇒ Rep. Gr. 63 .

– Release hose clips -1- and -2- and remove air hose on both sides.



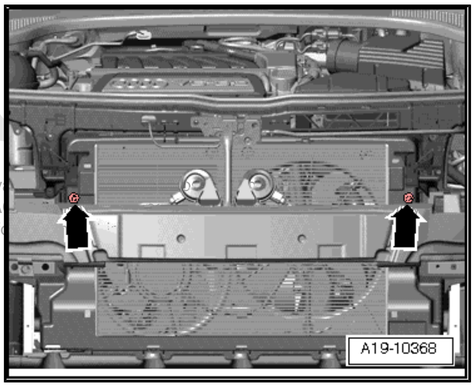
– Release air ducts (left and right) and push to one side in order to remove bolts -arrows-.

– Push top edge of charge air cooler slightly towards rear.

– Lift charge air cooler out of bottom mounting points.

– Push charge air cooler towards engine.

– Support charge air cooler from below to prevent charge air cooler from dropping.

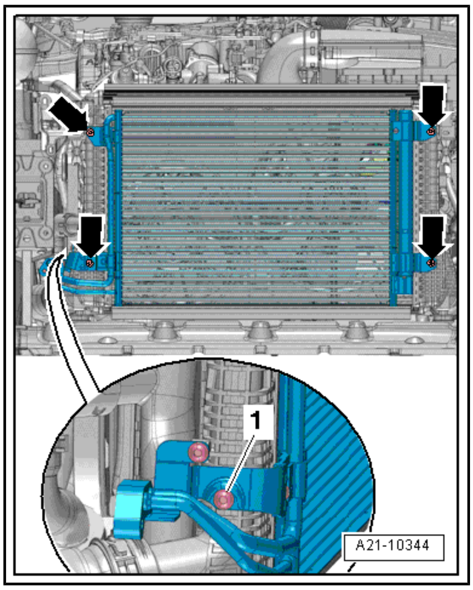


> **WARNING**
>
> *Risk of injury caused by refrigerant.*
>
> ♦ *The air conditioner refrigerant circuit must not be opened.*

> **Caution**
>
> *Make sure that condenser and refrigerant pipes and hoses are not damaged.*
>
> ♦ *Do NOT stretch, kink or bend refrigerant lines and hoses.*

– Remove bolts -arrows- and -1-.

– Detach condenser from charge air cooler and take charge air cooler out from below.



Installing

• Tightening torques ⇒ page 212

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

– Install air hoses with screw-type clips ⇒ page 213 .

– Install condenser ⇒ Rep. Gr. 87 .

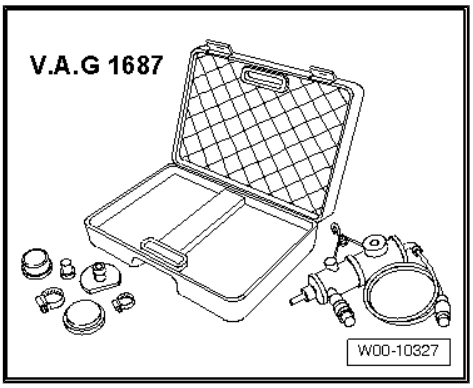
– Install bumper cover (front) ⇒ Rep. Gr. 63 .

– Install radiator ⇒ page 204 .

2.4 Checking charge air system for leaks

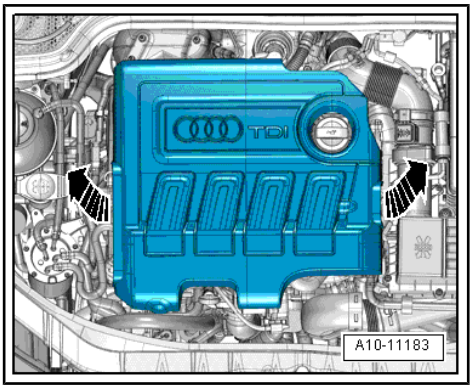
Special tools and workshop equipment required

- Charge air system tester -V.A.G 1687- with adapters -V.A.G 1687/11- and -V.A.G 1687/16-

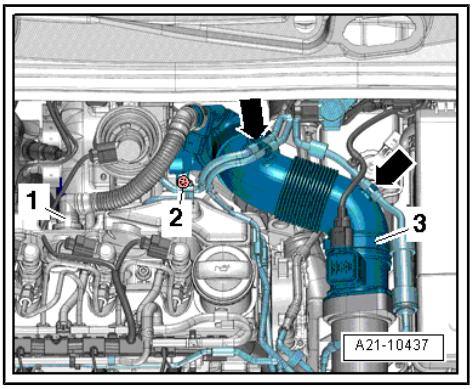


Procedure

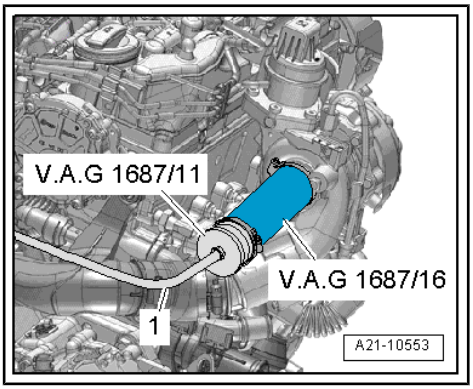
– Remove engine cover panel -arrows-.



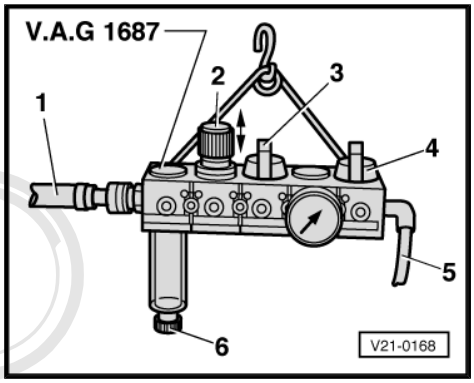
– Press release tabs and disconnect crankcase breather hose -1-.
– Move clear vacuum hoses -arrows-.
– Release hose clip -3- and detach air pipe from air cleaner housing.
– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.



– Connect adapter -V.A.G 1687/11- with -V.A.G 1687/16- to turbocharger.
– Connect hose -1- of charge air system tester -V.A.G 1687- to adapter.



Prepare charge air system tester -V.A.G 1687- as follows:



– Unscrew pressure control valve -2- completely and close valves -3- and -4-.

• Make sure knob is pulled out before turning pressure control valve -2-.

– Using a commercially available connection piece, connect charge air system tester -V.A.G 1687- to compressed air -1-.

Note

If there is water in sight glass, remove drain plug -6- and drain water.

– Open valve -3-.

Caution

Risk of damage if pressure is set too high.

- ***The pressure must not exceed 0.5 bar.***

– Adjust pressure to 0.5 bar via pressure control valve -2-.

– Open valve -4- and wait until test system is pressurised. If necessary, adjust pressure to 0.5 bar again.

– Check charge air system for audible leaks or leaks that can be felt with the hand; apply commercially available leak detecting spray or use ultrasonic tester -V.A.G 1842- .

Note

- *A small amount of air escapes through the valves and enters the engine. Therefore it is not possible to perform a pressure retention test.*
- *For operation of ultrasonic tester -V.A.G 1842- , refer to ⇒ Operating instructions .*
- *Release pressure in test circuit by detaching hose coupling from adapter before removing adapter.*

Assembling

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

Note

- *Renew gasket and O-rings.*
- *Hose connections and air pipes and hoses must be free of oil and grease before assembly.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Install air pipe with connection ⇒ page 207 .

26 – Exhaust system

1 Silencers

Note

- *After working on the exhaust system, ensure that the system is not under stress and that it has sufficient clearance from the body. If necessary, loosen clamp and align silencers and exhaust pipe so that sufficient clearance is maintained to the body at all points and the mountings are evenly loaded.*
- *Use screwdriver to unfasten and tighten lock washers for heat shields. Tightening torque: 2 Nm.*

1.1 Silencers - exploded view

1 - Centre silencer
- ❑ Combined with rear silencer
- ❑ Align exhaust system so it is free of stress
⇒ page 223

2 - Rubber mounting
- ❑ Renew if damaged

3 - Rubber mounting
- ❑ Renew if damaged

4 - Bracket

5 - Bolt
- ❑ 23 Nm

6 - Mounting
- ❑ Renew if damaged

7 - Nut
- ❑ 23 Nm

8 - Bracket (bottom)
- ❑ For particulate filter

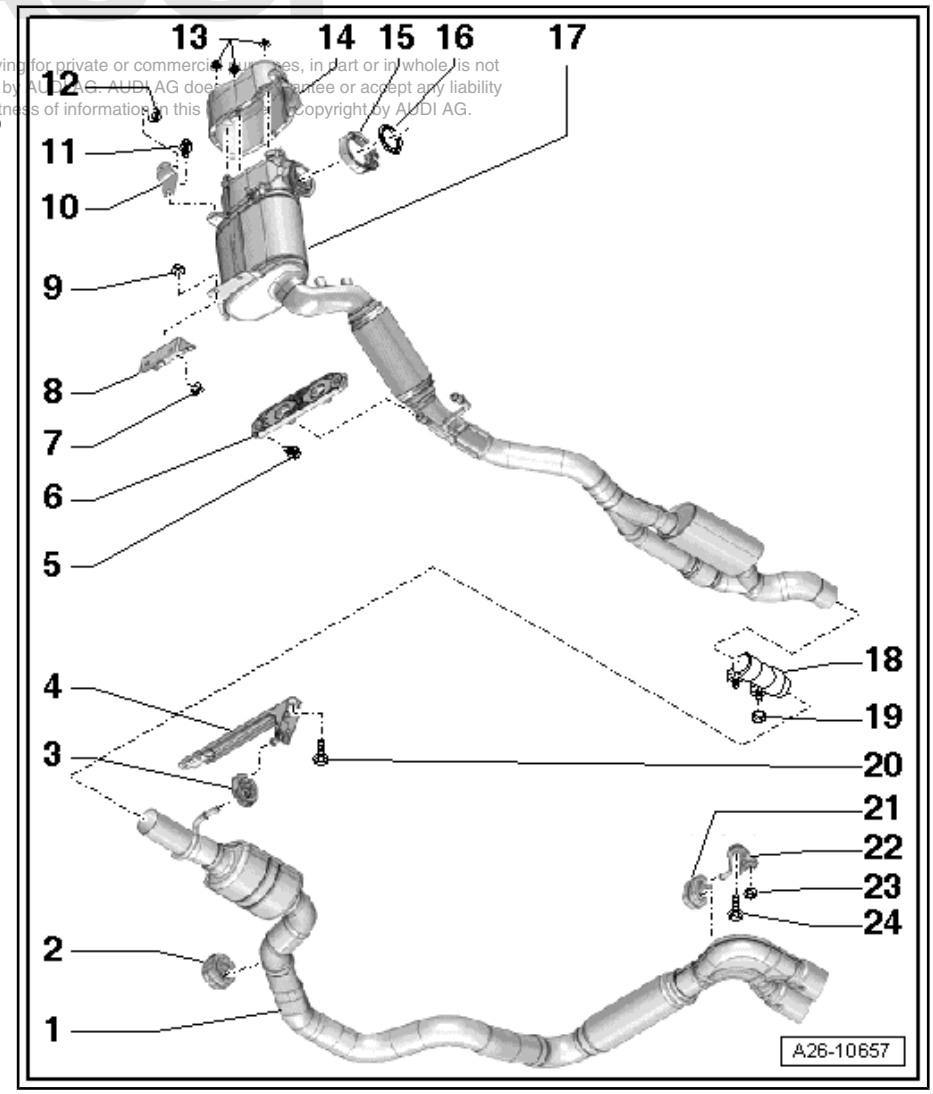
9 - Nut
- ❑ 23 Nm

10 - Bracket (top)
- ❑ For particulate filter

11 - Bolt
- ❑ 23 Nm

12 - Nut
- ❑ 23 Nm

13 - Nuts
- ❑ 9 Nm



14 - Heat shield

15 - Clamp

- ❑ For particulate filter
- ❑ Renew
- ❑ Installation position ⇒ page 219
- ❑ 7 Nm

16 - Seal

- ❑ Renew

17 - Particulate filter

- ❑ Removing and installing ⇒ page 219
- ❑ After renewing, perform `Adaption` in `Guided Functions` ⇒ vehicle diagnostic tester

18 - Clamp (front)

- ❑ Before tightening, align exhaust system so it is free of stress ⇒ page 223
- ❑ Installation position ⇒ page 218
- ❑ Tighten bolt connections evenly

19 - Nut

- ❑ 23 Nm

20 - Bolt

- ❑ 23 Nm

21 - Rubber mounting

- ❑ Renew if damaged

22 - Bracket

23 - Nut

- ❑ 23 Nm

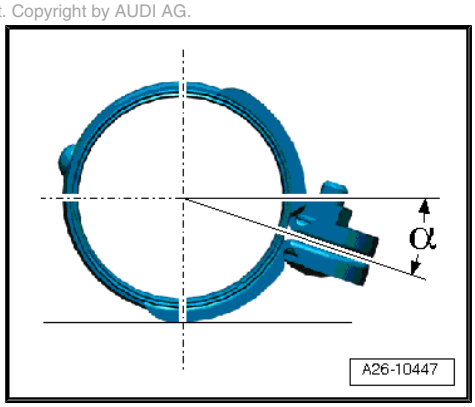
24 - Bolt

- ❑ 23 Nm

Installation position of front clamp

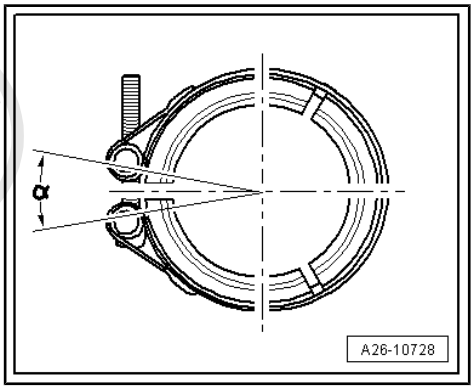
– Fit the clamp at the angle shown.

- Angle -α- = approx. 20°
- Bolt connections facing towards right
- Nuts facing upwards



Installation position of clamp for particulate filter

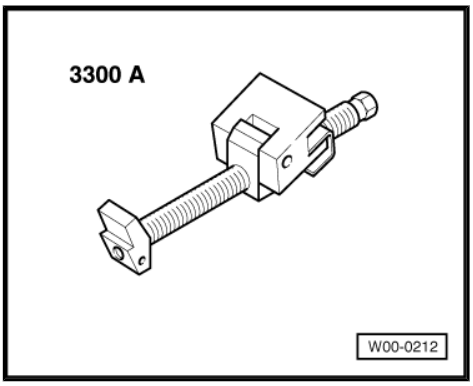
- Angle -α- = 0 ± 10°
- Bolt connection faces to rear



1.2 Removing and installing particulate filter

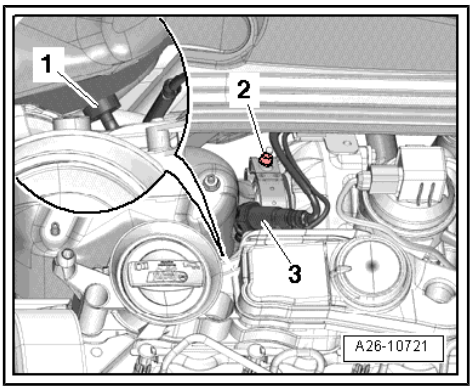
Special tools and workshop equipment required

- Engine support -3300 A-

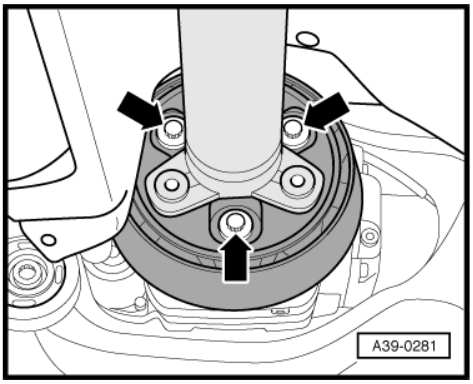


Removing

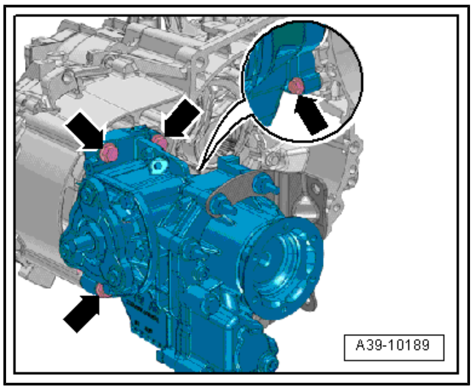
– Remove Lambda probe ⇒ Rep. Gr. 23 .



– Remove propshaft ⇒ Rear final drive 02D, 0AV, 0BR and 0BY; Rep. Gr. 39 .



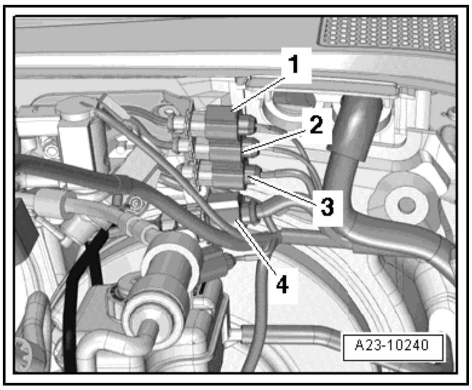
– Remove bevel box ⇒ Rep. Gr. 34 .



– Unplug electrical connector -3- for exhaust gas temperature sender 3 -G495- and move electrical wiring clear.

Note

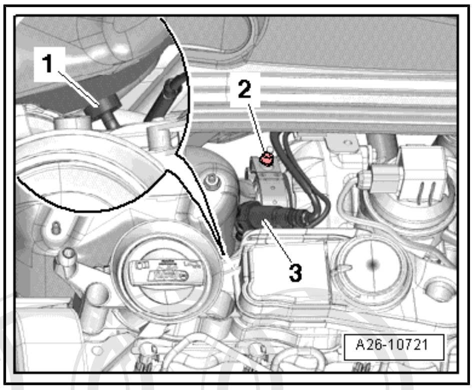
Disregard -items 1, 2, 4-.



– Slacken bolt -2- and remove clamp.

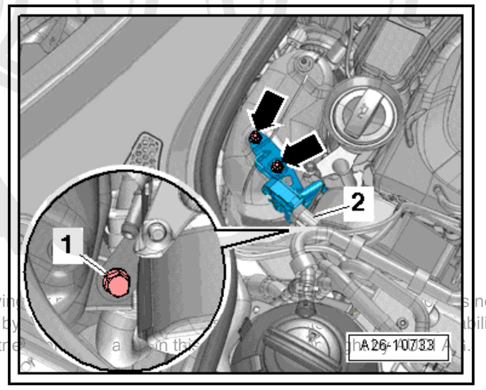
Note

Disregard -items 1, 3-.

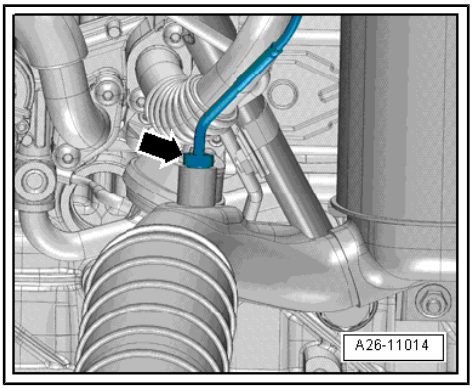


– Unplug electrical connector -2-.

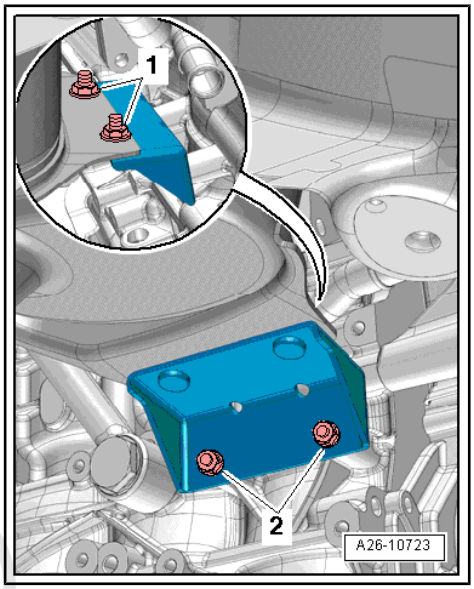
– Remove bolt -1- and nuts -arrows- and push pressure differential sender -G505- clear to one side.



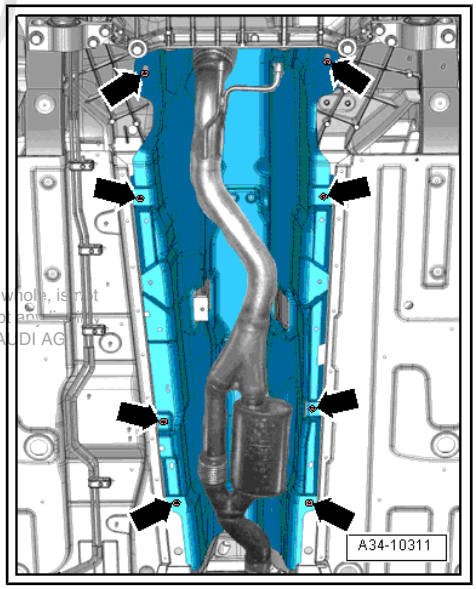
– Unscrew exhaust gas temperature sender 4 -G648- -arrow- from exhaust pipe behind particulate filter.



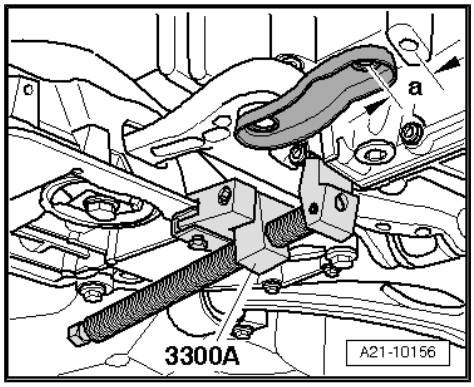
– Remove nuts -1- and -2- and detach bottom bracket for particulate filter.



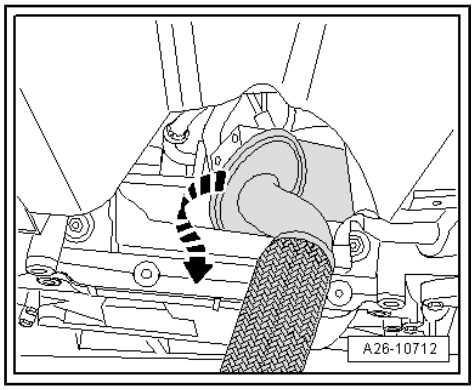
– Remove bolts and nuts -arrows-.
– Detach heat shield to rear.



– Using engine support -3300 A- , push engine/gearbox assembly forwards by distance -a-.



– Remove particulate filter by rotating through 180° around its own axis -arrow-.



Installing

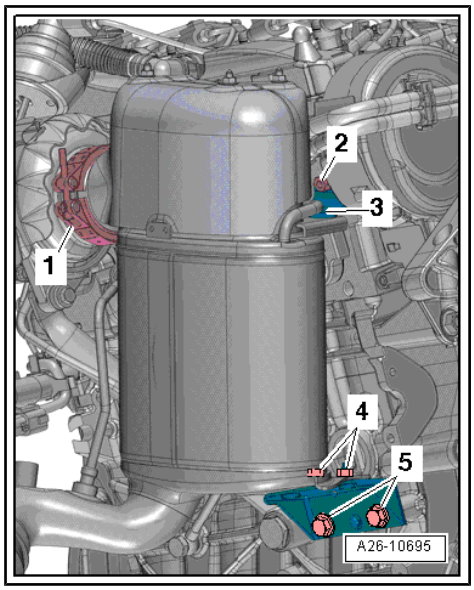
- Tightening torques
  ⇒ “1.1 Silencers - exploded view”, page 217

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

Note

- *Renew gaskets, self-locking nuts and clamp for particulate filter.*
- *Fit all cable ties in the original positions when installing.*

– Note sequence when installing particulate filter:



1.	Fit particulate filter to turbocharger, attach clip -1- without tightening
2.	Fit bolts -2 ... 5- by hand without tightening • It must still be possible to move particulate filter and bracket
3.	Tighten clip -1-
4.	Tighten bolts -2- and -5-.
5.	Tighten bolts -3- and -4-.

– Install head shield ⇒ Rep. Gr. 66 .
– Install exhaust gas temperature sender 4 -G648- ⇒ page 227 .
– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Install bevel box ⇒ Rep. Gr. 34 .
– Install propshaft ⇒ Rear final drive 02D, 0AV, 0BR and 0BY; Rep. Gr. 39 .
– Install Lambda probe -G39- and pressure differential sender -G505- ⇒ Rep. Gr. 23 .
– Align the exhaust system so it is free of stress ⇒ page 223 .
– After renewing particulate filter, perform `Adaption` in `Guided Functions` ⇒ vehicle diagnostic tester .

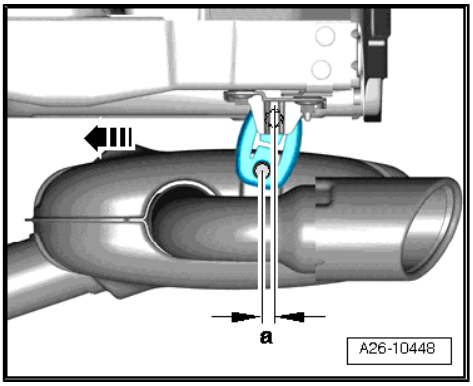
1.3 Stress-free alignment of exhaust system

Procedure

- The exhaust system must be aligned when it is cool.
- Tightening torque ⇒ page 217

– Loosen bolt connections on front clamp.

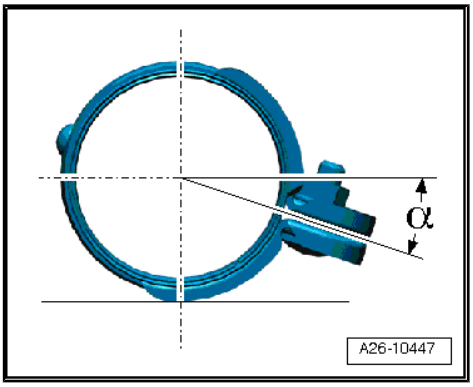
– Push exhaust system towards front of vehicle until preloading at mounting for rear silencer -a- = 11 ... 13 mm.



– Fit the clamp at the angle shown.

- Angle -α- = approx. 20°
- Bolt connections facing towards right
- Nuts facing upwards

– Tighten bolt connections on clamp evenly.

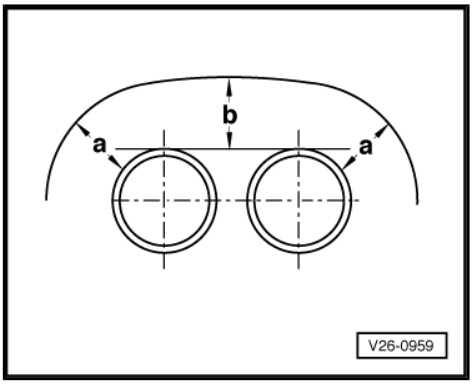


1.4 Aligning tailpipes

Procedure

– Align rear silencer so that there is an equal distance -a- and -b- between bumper cut-out and tailpipes.

– Unfasten rear silencer mounting to align tailpipes.



1.5 Checking exhaust system for leaks

Procedure

– Start the engine and run at idling speed.

– Plug tailpipes during leak test (e.g. with cloth or plug).

– Listen for noise at the connection points of cylinder head/exhaust manifold, turbocharger/front exhaust pipe etc. to locate any leaks.

– Rectify any leaks that are found.

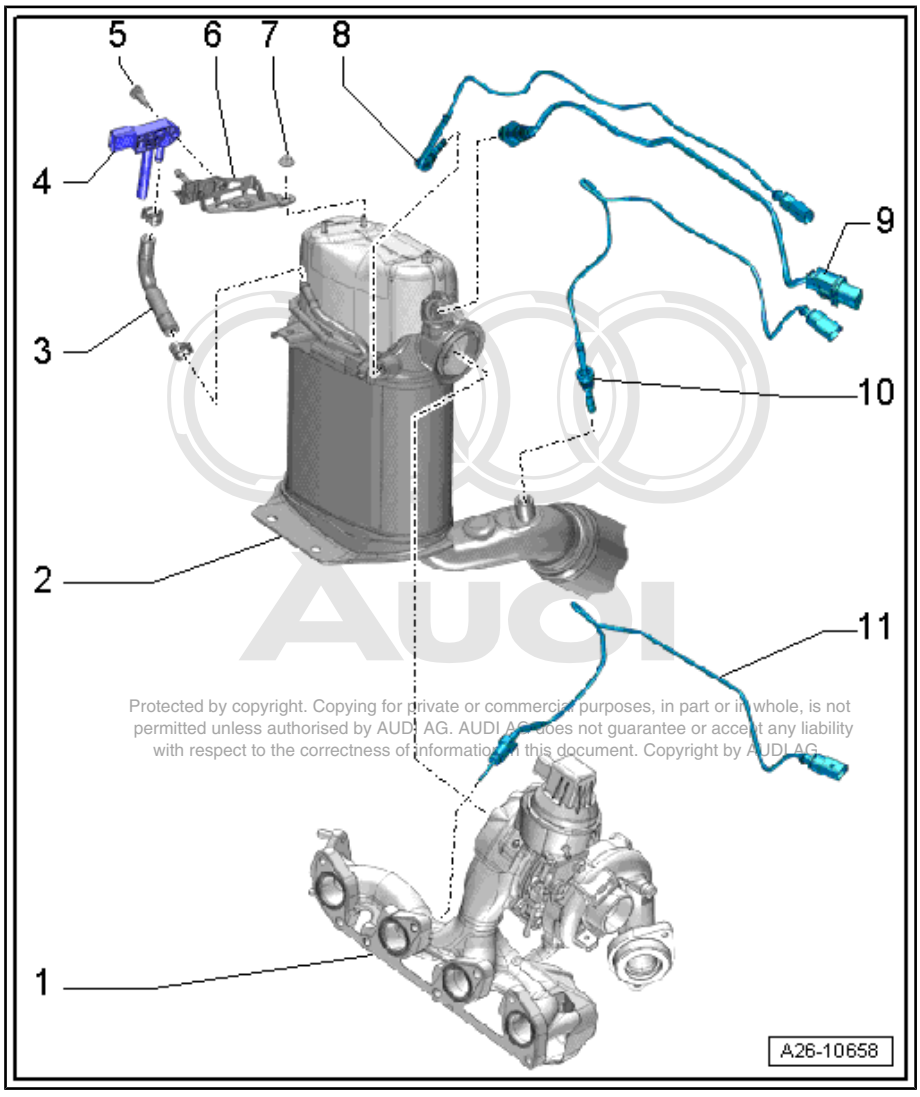
2 Exhaust gas temperature control

2.1 Exhaust gas temperature control - exploded view

Caution

Risk of malfunctions caused by improperly secured exhaust gas temperature senders.

- *The threads of the exhaust gas temperature senders -G495- and -G648- are coated. It is important that you do NOT grease them additionally with high-temperature paste and that you tighten them to the specified torque.*



1 - Turbocharger

2 - Particulate filter

3 - Hose

4 - Pressure differential sender -G505-

- ❑ Removing and installing ⇒ Rep. Gr. 23

5 - Bolt

- ❑ 8 Nm

6 - Bracket

- ❑ For pressure differential sender -G505-

7 - Nut

- ❑ 9 Nm

8 - Exhaust gas temperature sender 3 -G495-

- ❑ Removing and installing ⇒ page 226
- ❑ The thread of the exhaust gas temperature sender is coated; it must not be be additionally greased with high-temperature paste
- ❑ 60 Nm

9 - Lambda probe -G39- with Lambda probe heater -Z19-

- ❑ Removing and installing ⇒ Rep. Gr. 23

10 - Exhaust gas temperature sender 4 -G648-

- ❑ Removing and installing ⇒ page 227
- ❑ The thread of the exhaust gas temperature sender is coated; it must not be be additionally greased with high-temperature paste
- ❑ 60 Nm

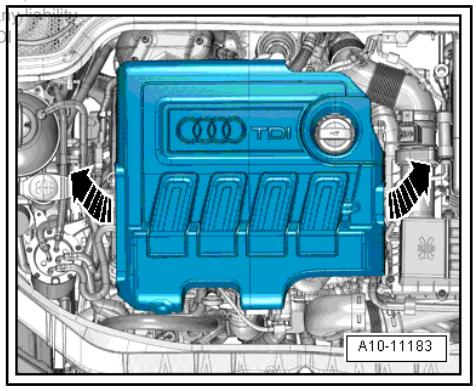
11 - Exhaust gas temperature sender 1 -G235-

- ❑ Removing and installing ⇒ page 225
- ❑ Coat thread with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue
- ❑ 45 Nm

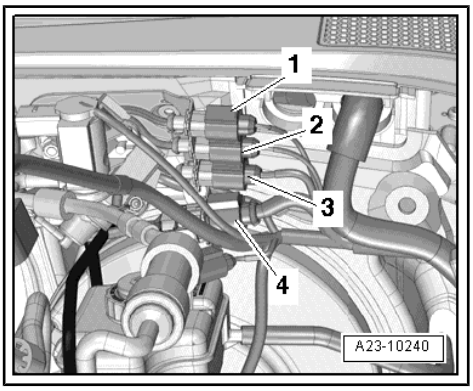
2.2 Removing and installing exhaust gas temperature sender 1 -G235-

Removing

– Remove engine cover panel -arrows-.



– Unplug electrical connector -1- for exhaust gas temperature sender 1 -G235- and move electrical wiring clear.



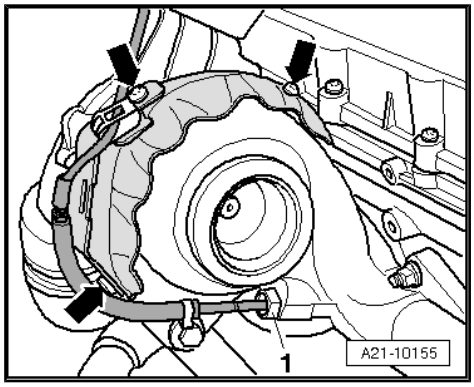
Note

Disregard -items 2, 3, 4-.

Note

The connection can be accessed from below.

– Unscrew exhaust gas temperature sender 1 -G235- -item 1- from exhaust manifold.



Note

Disregard -arrows-.

Installing

- Tightening torque
⇒ "2.1 Exhaust gas temperature control - exploded view", page 224

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

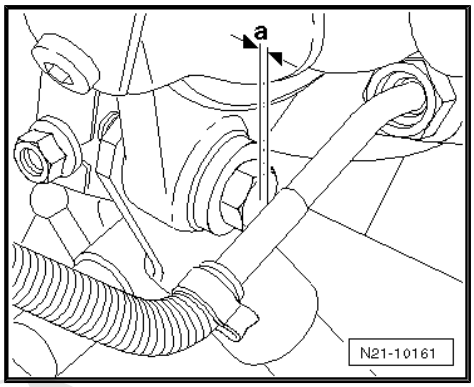
Note

Coat threads of exhaust gas temperature sender with high-temperature paste; for high-temperature paste refer to ⇒ Electronic parts catalogue .

Installation position of exhaust gas temperature sender -G235- :

- The angled part of the pipe must have a clearance of -a- = 3 … 5 mm from the bolt on the turbocharger support.

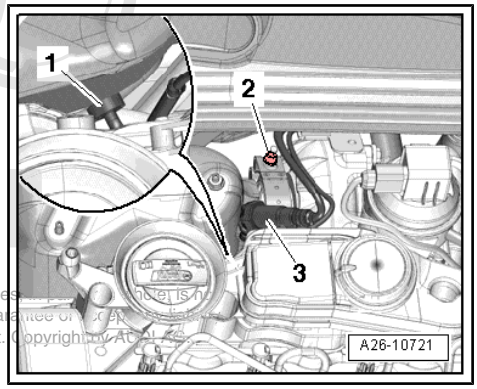
– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.



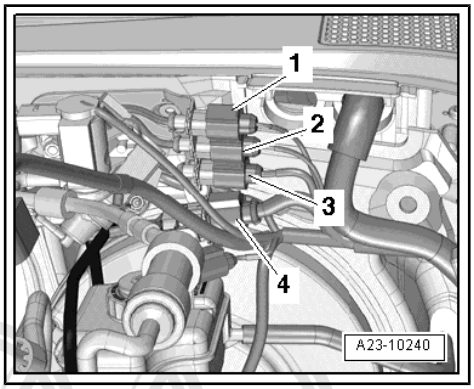
2.3 Removing and installing exhaust gas temperature sender 3 -G495-

Removing

– Remove Lambda probe -G39- ⇒ Rep. Gr. 23 .



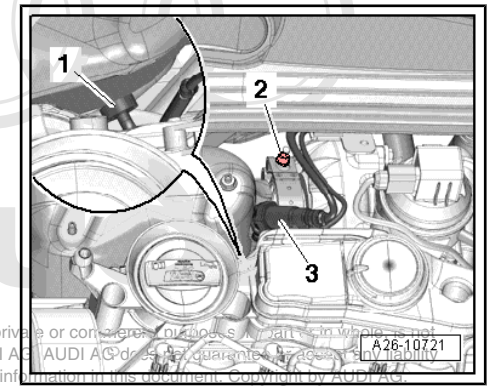
– Unplug electrical connector -3- for exhaust gas temperature sender 3 -G495- and move electrical wiring clear.



Note

Disregard -items 1, 2, 4-.

– Remove exhaust gas temperature sender 3 -G495- -item 1-.



Note

Disregard -items 2, 3-.

Installing

- Tightening torque
  ⇒ "2.1 Exhaust gas temperature control - exploded view", page 224

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

Caution

Risk of malfunctions caused by improperly secured exhaust gas temperature senders.

- ***The threads of the exhaust gas temperature senders -G495- and -G648- are coated. It is important that you do NOT grease them additionally with high-temperature paste and that you tighten them to the specified torque.***

– Align exhaust gas temperature sender 3 -G495- with as much clearance from surrounding components as possible.

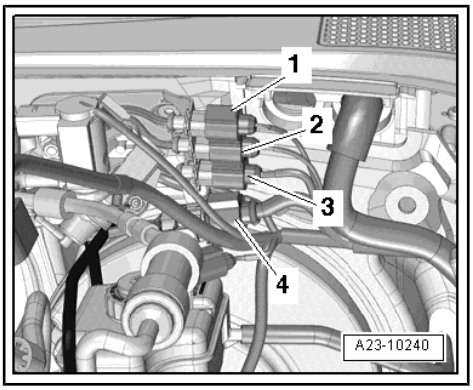
– Install Lambda probe -G39- ⇒ Rep. Gr. 23

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

2.4 Removing and installing exhaust gas temperature sender 4 -G648-

Removing

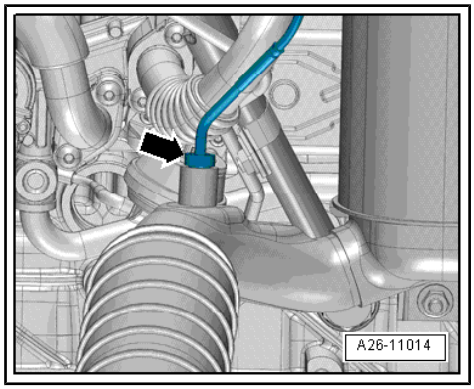
– Unplug electrical connector -2- for exhaust gas temperature sender 4 -G648- and move electrical wiring clear.



Note

Disregard -items 1, 3, 4-.

– Unscrew exhaust gas temperature sender 4 -G648- -arrow- from exhaust pipe behind particulate filter.



Installing

- Tightening torque
⇒ "2.1 Exhaust gas temperature control - exploded view", page 224

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

Caution

Risk of malfunctions caused by improperly secured exhaust gas temperature senders.

- ***The threads of the exhaust gas temperature senders - G495- and -G648- are coated. It is important that you do NOT grease them additionally with high-temperature paste and that you tighten them to the specified torque.***

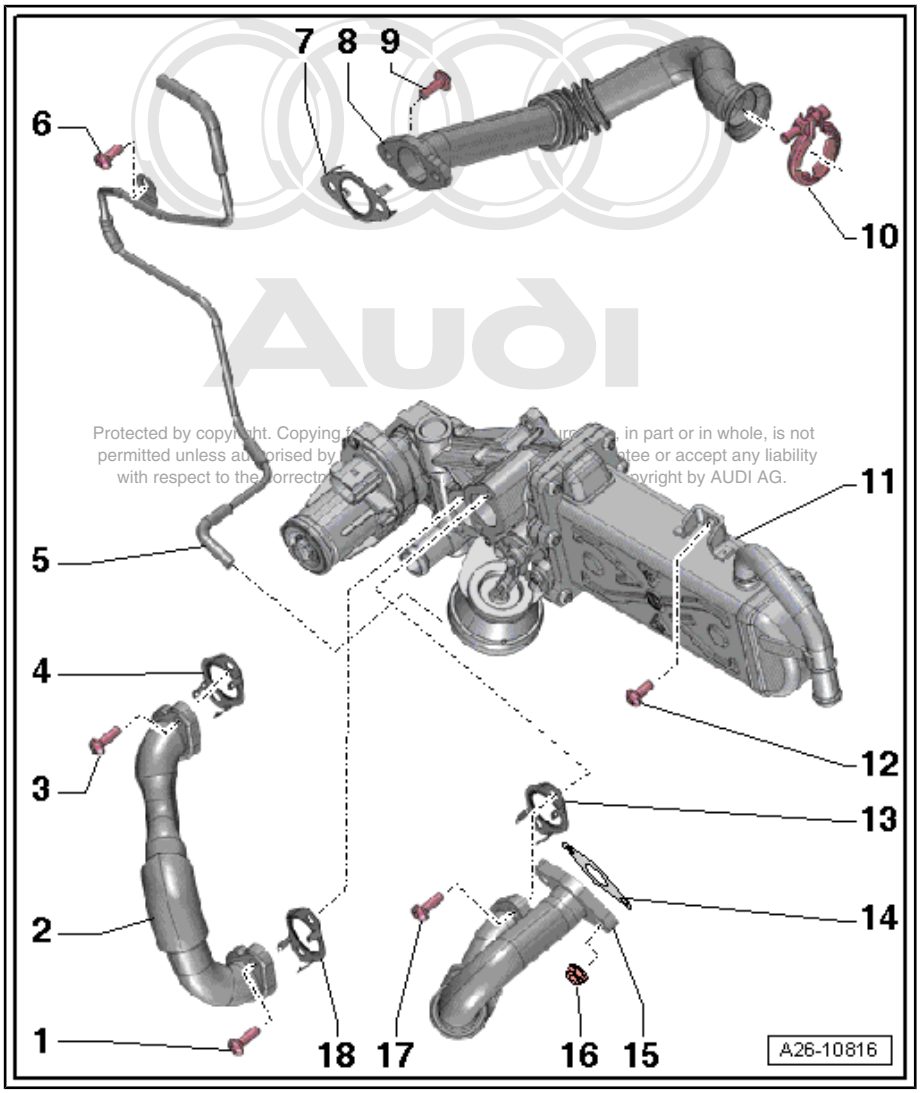
– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

3 Exhaust gas recirculation system

3.1 Diagram of vacuum connections

⇒ “1.1 Diagram of vacuum connections”, page 206 .

3.2 Exhaust gas recirculation with exhaust gas recirculation cooler - exploded view



1 - Bolt
- ❑ 9 Nm

2 - Pipe for exhaust gas recirculation
- ❑ With flexible joint; do not bend joint - risk of cracking

3 - Bolt
- ❑ 9 Nm

4 - Gasket
- ❑ Renew

5 - Vacuum line
- ❑ Do not alter shape

6 - Bolt
- ❑ 9 Nm

7 - Gasket
- ❑ Renew

8 - Pipe for exhaust gas recirculation
- ❑ With flexible joint; do not bend joint - risk of cracking

9 - Bolt
- ❑ 9 Nm

10 - Clamp
- ❑ 5 Nm

11 - Exhaust gas recirculation cooler
- ❑ With integrated exhaust gas recirculation valve - N18- with exhaust gas recirculation potentiometer -G212-
- ❑ Checking change-over function ⇒ page 230
- ❑ Removing and installing ⇒ page 230

12 - Bolt
- ❑ 9 Nm

13 - Gasket
- ❑ Renew

14 - Gasket
- ❑ Renew

15 - Pipe for exhaust gas recirculation

- ❑ With flexible joint; do not bend joint - risk of cracking

16 - Bolt

- ❑ 9 Nm

17 - Bolt

- ❑ 9 Nm

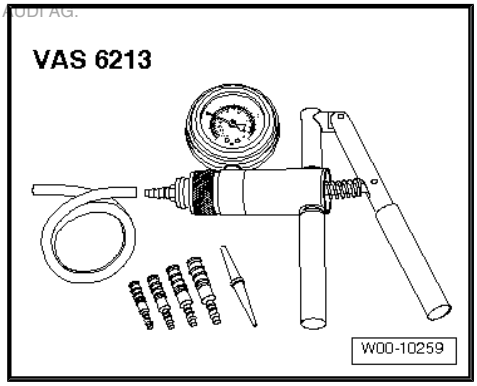
18 - Gasket

- ❑ Renew

3.3 Checking exhaust gas recirculation cooler change-over

Special tools and workshop equipment required

- ♦ Hand vacuum pump -VAS 6213-



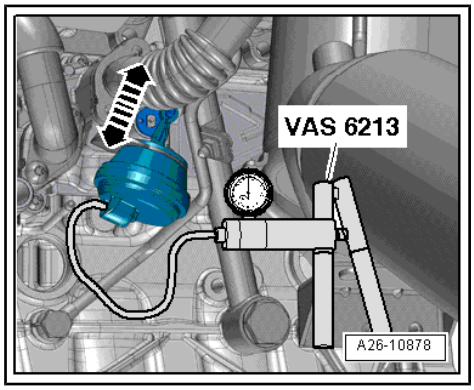
Procedure

– Detach heat shield sleeve.

– Disconnect vacuum hose from vacuum unit and connect hand vacuum pump -VAS 6213- in its place.

– Operate hand vacuum pump to produce a vacuum.

• The linkage of the exhaust gas recirculation cooler change-over should move -arrows-.



If the linkage does not move or only moves jerkily:

- ♦ The vacuum unit is defective.
- ♦ The change-over flap for exhaust gas recirculation is sticking.

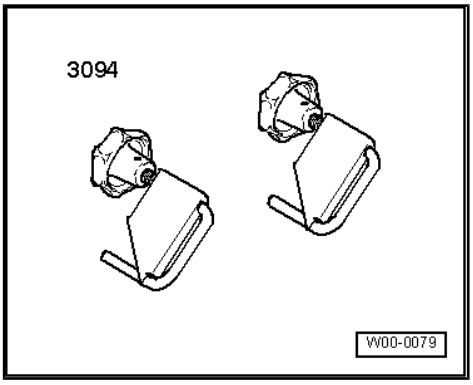
Note

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

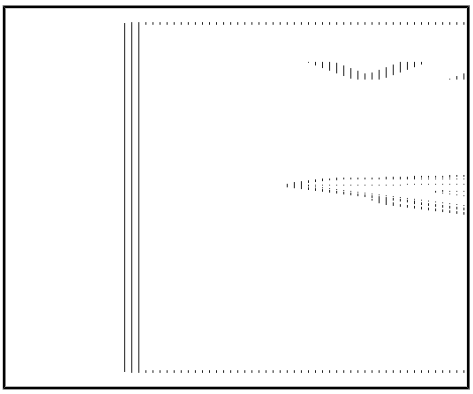
3.4 Removing and installing exhaust gas re-circulation cooler

Special tools and workshop equipment required

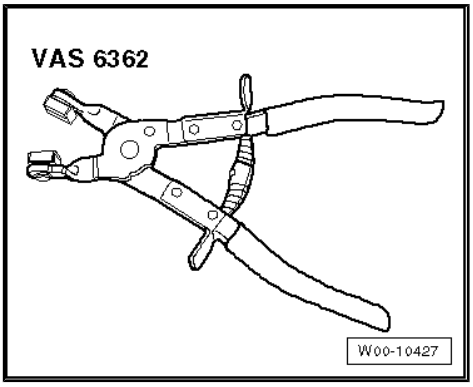
- Hose clamps for hoses up to 25 mm -3094-



- Drip tray for workshop hoist -VAS 6208-



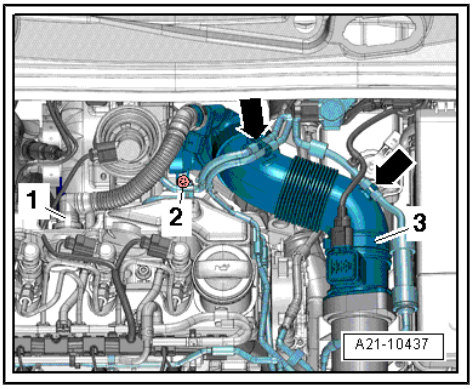
- Hose clip pliers -VAS 6362-



Removing

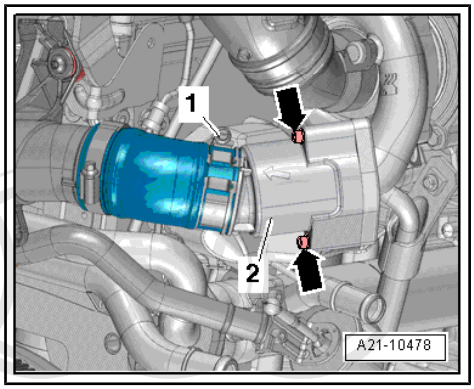
Note

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

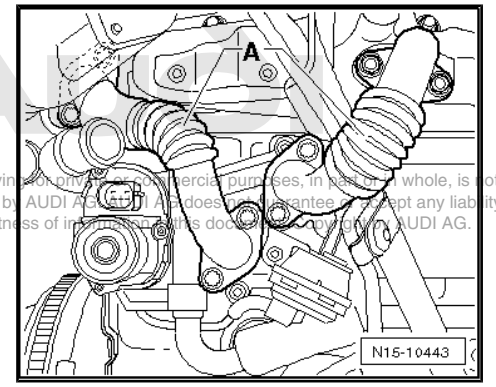


– Remove particulate filter ⇒ page 219 .
– Press release tabs and disconnect crankcase breather hose -1-.
– Move clear vacuum hoses -arrows-.
– Release hose clip -3- and detach air pipe from air cleaner housing.
– Remove bolt -2-, swivel air pipe with connection to rear and detach from turbocharger.

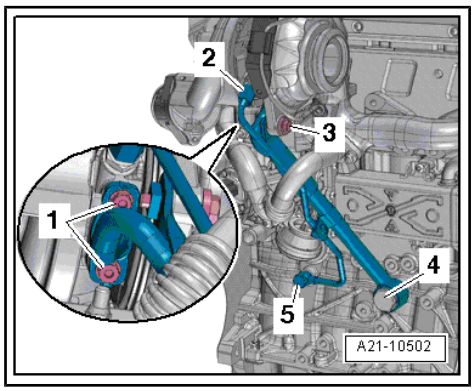
– Remove bolts -arrows-.
– Loosen hose clip -1- and detach pulsation damper -2-.



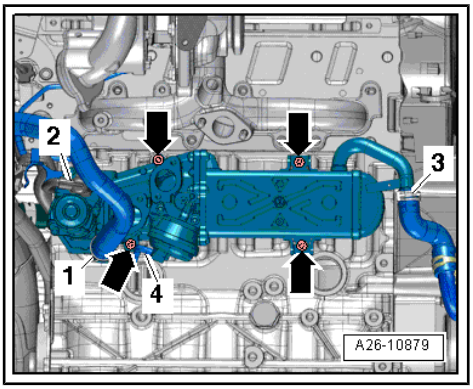
– Remove bolts and detach exhaust gas recirculation pipes -A-.



– Remove bolts -1, 3-, union nut -2- and banjo bolts -4, 5- and detach support for turbocharger with oil supply line.



– Place drip tray for workshop hoist -VAS 6208- beneath engine.
– Clamp off coolant hoses -1- and -3- using hose clamps -3094- , release hose clips and disconnect coolant hoses from exhaust gas recirculation cooler.
– Unplug electrical connector -2-.
– Detach heat insulation sleeve, disconnect vacuum hose -4- from vacuum unit and move clear.
– Remove bolts -arrows- and detach exhaust gas recirculation cooler.



Installing

- Tightening torque
⇒ “3.2 Exhaust gas recirculation with exhaust gas recirculation cooler - exploded view”, page 229

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

Note

♦ *Renew gaskets, seals and self-locking nuts.*
♦ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue .*

– Install support for turbocharger with oil supply line, pulsation damper and air pipe with connection ⇒ page 207 .
– Install air hoses with screw-type clips ⇒ page 213 .
– Install particulate filter ⇒ page 219 .
– Check coolant level ⇒ page 176 .