Workshop Manual

Touareg 2010 ➢

6-cyl. diesel engine (3.0 l engine, common rail)									
Engine ID	CAS A	CAT A	CAS D						

Edition 10.2017

List of Workshop Manual Repair Groups

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

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00 – Technical data

1 Technical data

(VRL010971; Edition 10.2017)

Note

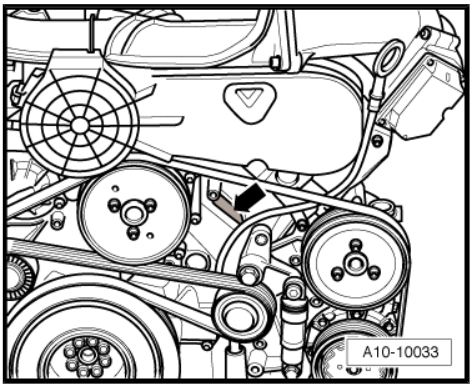
The term “common rail” means that all injectors on one cylinder bank have the “same” fuel rail. Pressure generation and fuel injection are separate in this system: a separate high-pressure pump generates the high-pressure required for injection. This is stored in a fuel rail and is supplied to the injectors via short injection lines.

⇒ “1.1 Engine number”, page 1 .

⇒ “1.2 Engine data”, page 1 .

1.1 Engine number

The engine number (“engine code” and “serial number”) can be found at the front left below the toothed belt for the high-pressure pump -arrow-.



There is also a sticker on the intake manifold showing the “engine code” and “serial number”.

The engine code is also included on the vehicle data sticker.

Vehicles with four digit engine codes

Four-place engine codes are being introduced, starting with letter “C”. The first 3 places show the mechanical design of engine and are stamped on the engine as previously. The fourth digit shows the engine output and torque and varies according to engine control unit. The four-digit engine code can be found on the type plate, the vehicle data label and on the engine control unit.

Note

Vehicles for certain export countries have no type plate. Fittings locations for vehicle data sticker and identification plate ⇒ Maintenance ; Booklet .

1.2 Engine data

Codes		CASA	CASD	CATA[1)]
Manufactured		03.10 ▸	11.10 ▸	08.10 ▸
Exhaust emissions fulfil		EU5 standard	EU5 standard	BIN5
Displacement	l	3.0	3.0	3.0
Power	kW at rpm	176/4000	150/4000	165/4500
Torque	Nm at rpm	550/2000	400/2000	550/2000
Bore	Diameter, mm	83.0	83.0	83.0
Stroke	mm	91.4	91.4	91.4
Compression ratio		16.8	17.0	16.4
Fuel:	acc. to	DIN EN 590	DIN EN 590	---
Firing order		1 - 4 - 3 - 6 - 2 - 5	1 - 4 - 3 - 6 - 2 - 5	1 - 4 - 3 - 6 - 2 - 5
Exhaust gas recirculation		yes	yes	yes

Codes	CASA	CASD	CATA[1)]
Charging	yes	yes	yes
Catalytic converter	yes	yes	yes
Particulate filter	yes	yes	yes
Charge air cooler	yes	yes	yes
Lambda regulation	yes	yes	yes
Valves per cylinder	4	4	4
Selective catalytic reduction (SCR system)	No	No	yes

1) Only vehicles for USA

10 – Removing and installing engine

1 Engine and gearbox

⇒ “1.1 Removing and installing engine cover”, page 3 .

⇒ “1.2 Removing engine”, page 3 .

⇒ “1.3 Separating engine and gearbox”, page 17 .

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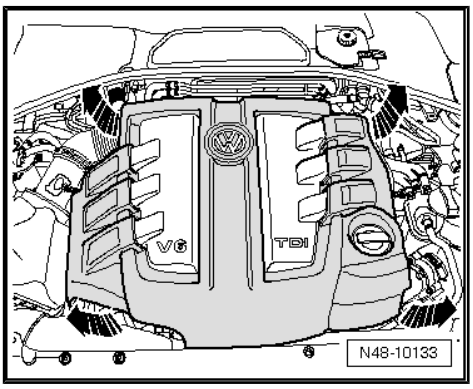
⇒ “2.1 Assembly overview - assembly mountings”, page 31 .

⇒ “2.2 Removing and installing motor mounting”, page 32 .

1.1 Removing and installing engine cover

Removing

– First of all, pull off the engine cover panel (in direction of travel) with both hands -arrows- and then lift it up with both hands by the rear (near plenum chamber bulkhead).

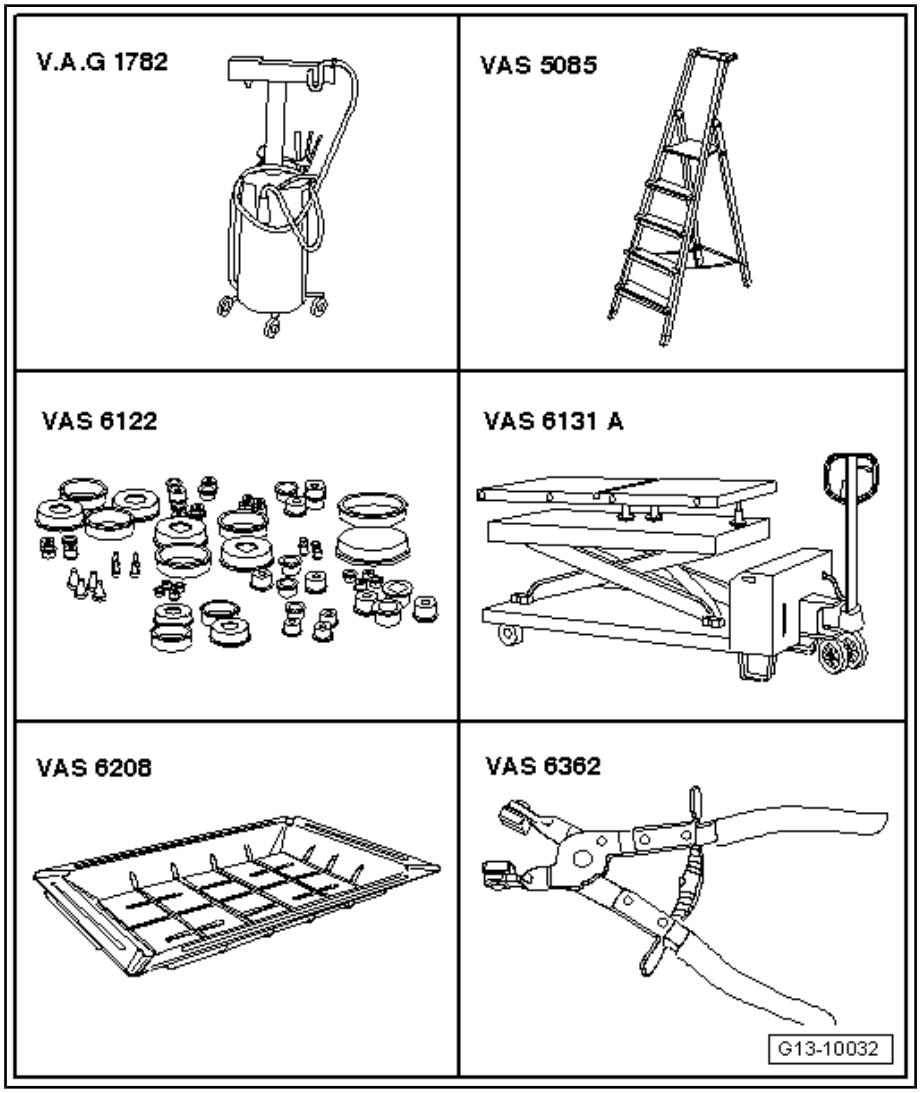


Installing

– Position engine cover panel on securing points and press into fasteners.

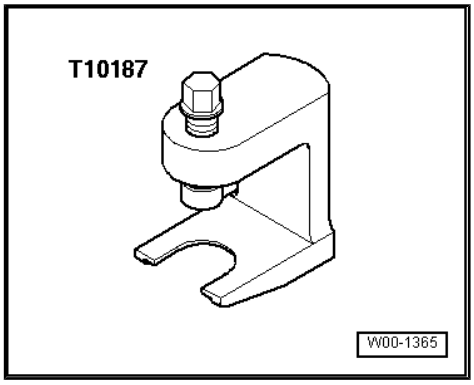
1.2 Removing engine

Special tools and workshop equipment required



- Used oil collector and extractor - V.A.G 1782-
- Stepladder - VAS 5085-
- Engine plug set - VAS 6122-
- Scissor-type assembly platform - VAS 6131 A- with support set for Audi - VAS 6131/10- as well as support set - VAS 6131/11- , -VAS 6131/13- and 3x -VAS 6131/10-2-
- Drip tray for workshop hoist - VAS 6208-
- Spring-type clip pliers - VAS 6362-

♦ Ball joint puller - T10187-



– Before removing, read event memory of all control units: ⇒ Vehicle diagnostic tester; or VAS 5052 “Guided Functions” .

Note

♦ *Use suitable materials, e.g. cable ties, to attach all disconnected cables and wires to the engine/assembly (depending on »origin«). Fit dummy plugs in all open connections.*

♦ *Move the selector lever to the “N” position so that the propshaft can turn freely.*

♦ *To make sure you can still move the front wheels when the battery has been disconnected, only disconnect the battery with the ignition key inserted.*

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

– Remove engine cover panel ⇒ page 3 .

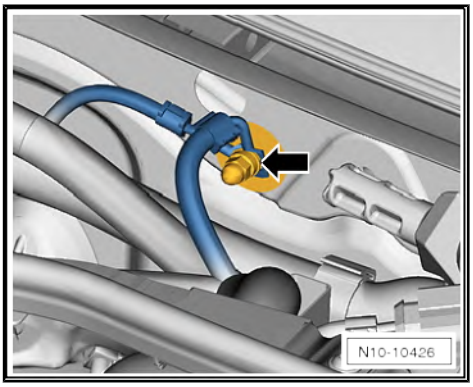
– Pull engine compartment seal from plenum chamber bulkhead.

– Remove windscreen wiper arms ⇒ Electrical system; Rep. gr. 92 ; Windscreen wiper system; Removing and installing wiper arms .

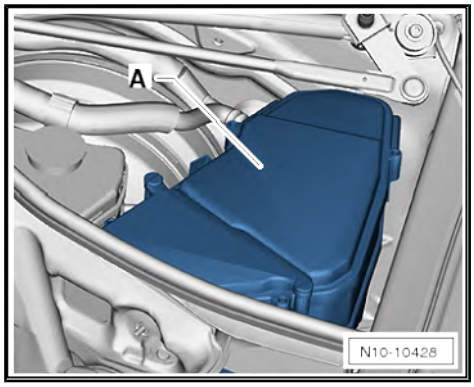
– Remove plenum chamber cover ⇒ General body repairs, exterior; Rep. gr. 50 ; Plenum chamber cover; Plenum chamber cover .

– Pull off engine pre-wiring harness connector off at engine control unit.

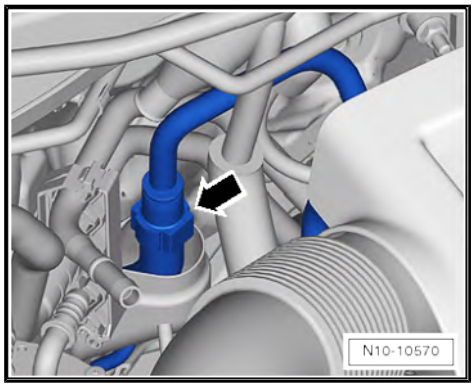
– Unscrew earth connection -arrow- in plenum chamber.



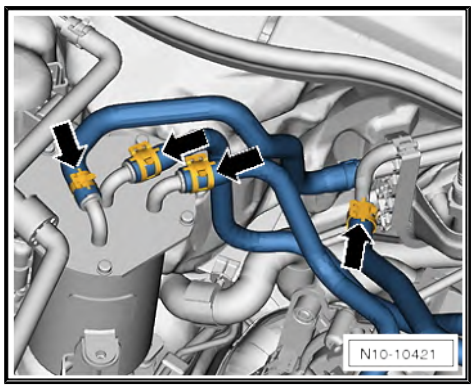
– Open cover -A- of central electrical system.
– Detach all connectors whose wires go to the engine.
– Remove wiring harness from plenum chamber bulkhead and place it on the engine.



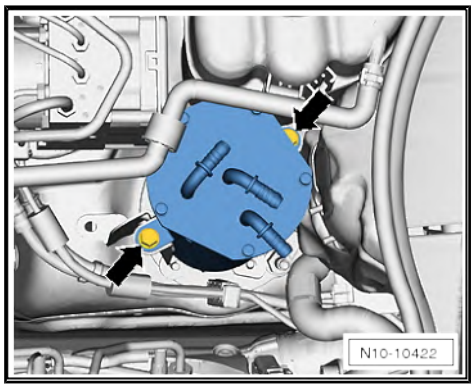
– Separate vacuum line at connection -arrow-.



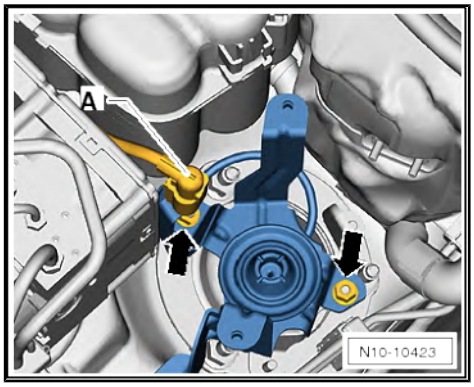
– Open clips and pull all feed and return fuel lines off the fuel filter.



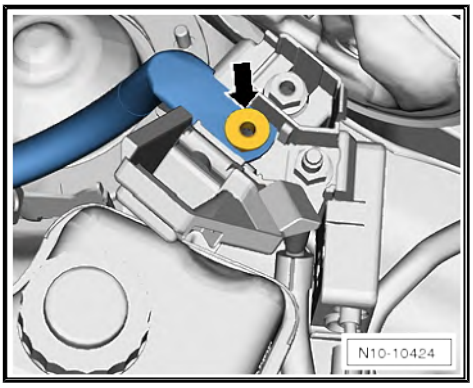
– Unscrew bolts -arrows- and remove fuel filter upwards.



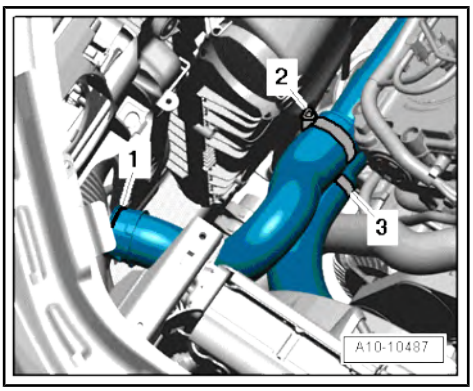
– If fitted, disconnect connector for air suspension, unscrew securing bolts -arrows- and remove fuel filter bracket.



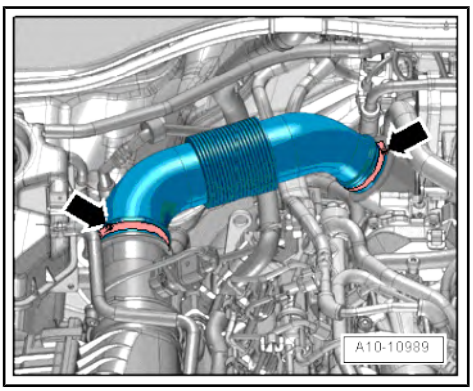
– Undo securing bolt -arrow- and place positive cable leading to starter on the engine.
– Remove throttle valve module/charge air pipe connecting hose.



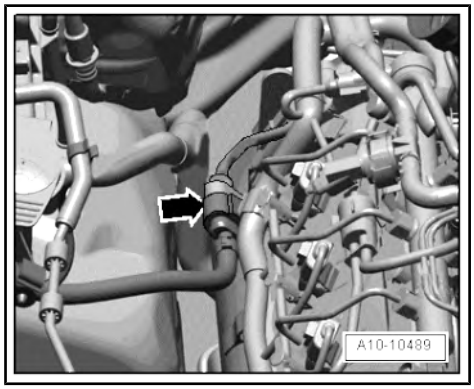
– Open clamps -2- and -3- and pull connecting hoses off right charge air pipe.
– If fitted, unclip line for gearbox breather -2-.



– Open clamps -arrows- and remove intake line.

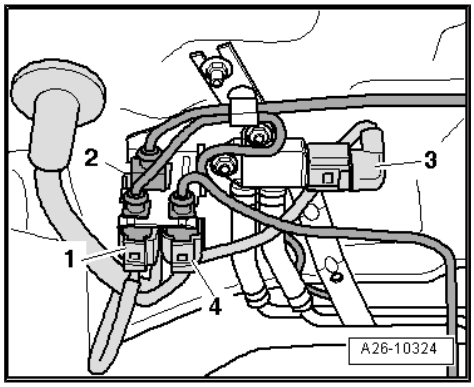


– Remove electrical connector -arrow- from bracket and disconnect.
– Unbolt bracket for connector from cylinder head cover.



– Remove connectors -1-, -2- and -4- from retainers on plenum chamber bulkhead and separate.

Vehicles with engine code CATA



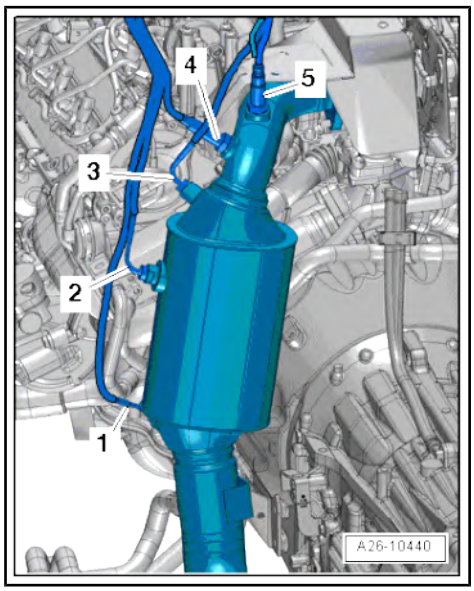
– Unscrew NOx sender - G295- -4- move it aside and tie it up.

Note

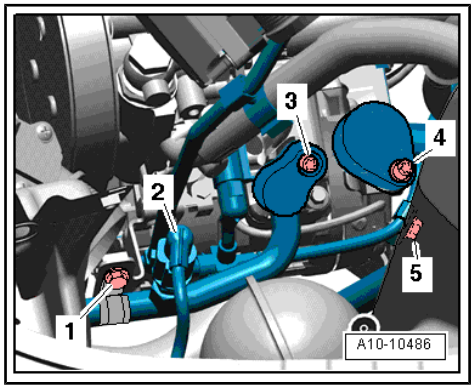
Disregard -items 1 … 3- and -5-.

Continuation for all engine codes

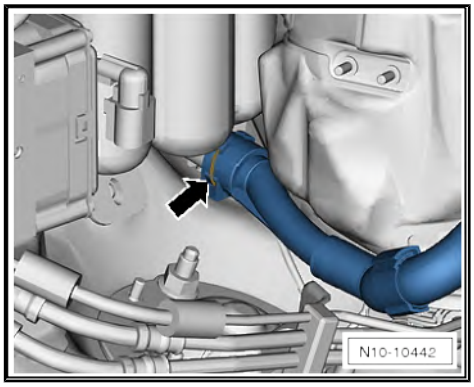
– Extract refrigerant from air conditioner: ⇒ Heating, air conditioning system; Rep. gr. 87 .



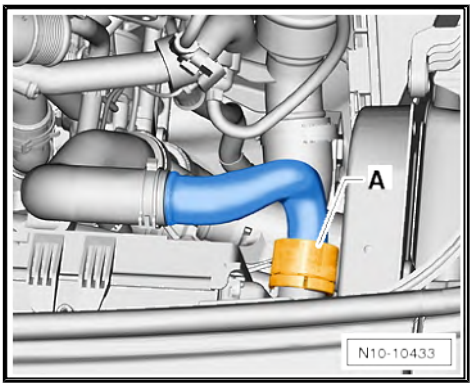
– Where fitted, disconnect electrical connector -2-.
– Remove retaining clamps -1- and -5-.
– Unscrew bolts -3- and -4- and remove refrigerant lines from A/C compressor.
– Remove noise insulation: ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation; Assembly overview - noise insulation .
– Remove front wheels.
– Remove front wheel housing liners: ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Front wheel housing liner .
– Drain coolant ⇒ page 187 .



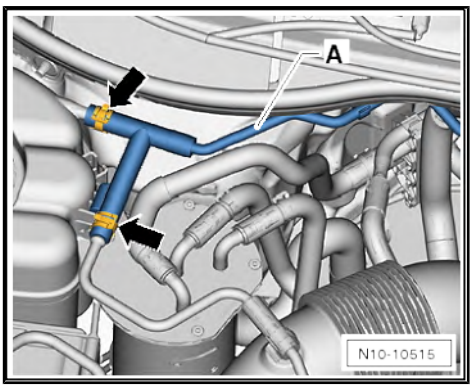
– Open plug-in connector -A- under the coolant expansion tank and pull off coolant hose.



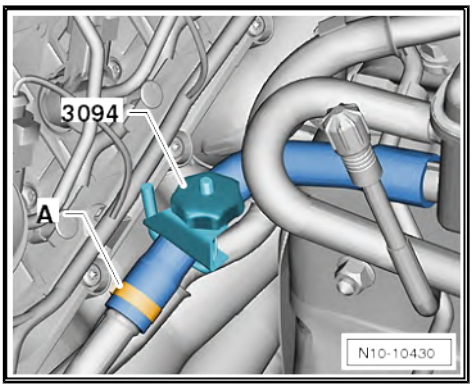
– Open plug-in connector -A- at top of radiator and pull coolant hose off.



– Disconnect coolant line -A- at coolant expansion tank -arrows-, release at plenum chamber bulkhead and place on engine.

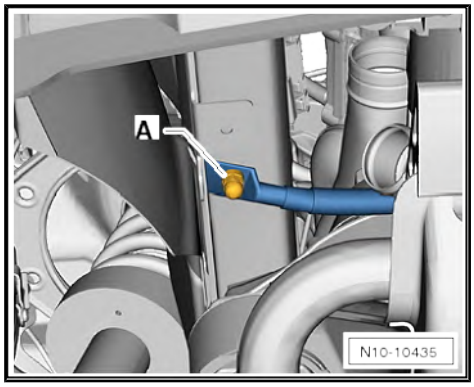


– Disconnect hose of servo steering with hose clips up to 25 mm - 3094- , open clip -A- and pull off hose.

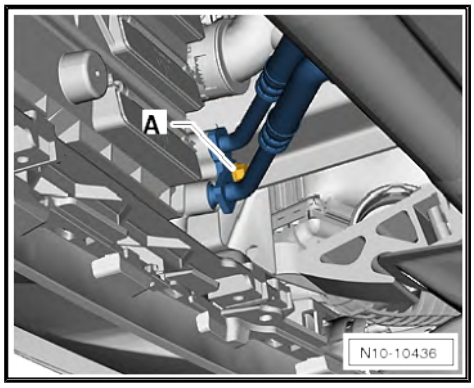


Raise vehicle

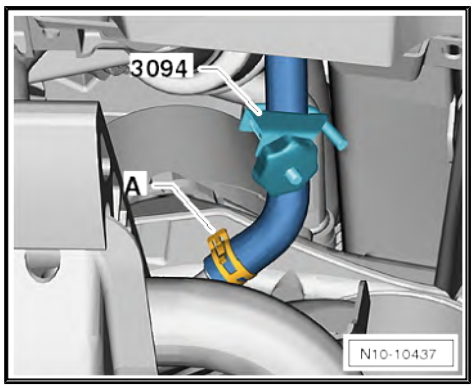
– Unscrew earth connection -A- on right longitudinal member.



– Unscrew bolt -A- and pull connections off gear oil cooler. Catch oil which runs out.



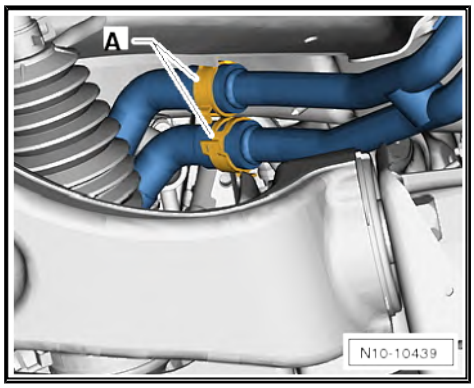
– Disconnect hose of servo steering with hose clips up to 25 mm - 3094- , open clip -A- and pull off hose.



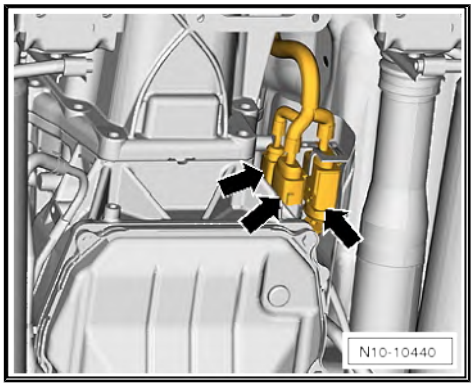
– Open clips -A- and pull off auxiliary heater coolant hoses.

– Remove rear exhaust system ⇒ page 310 .

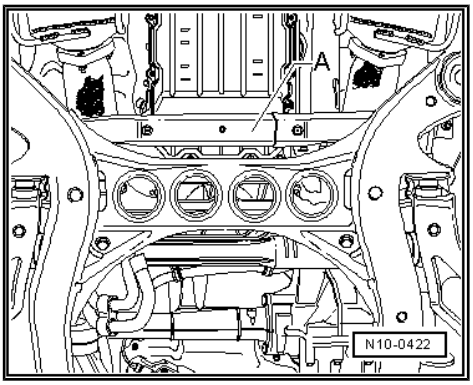
– Remove propshaft ⇒ Transfer box and final drive; Rep. gr. 39 ; Removing and installing propshafts: Removing and installing rear propshaft .



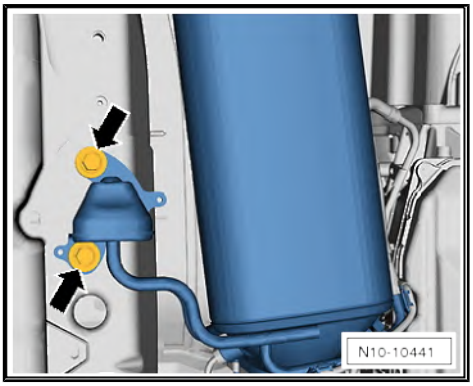
– Detach connector -A- at gearbox.



– Remove noise insulation retaining plate -A-.

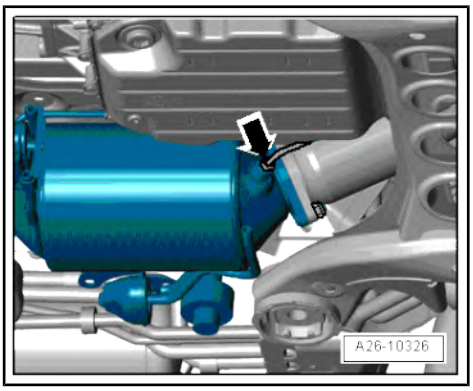


– Unscrew mountings -arrow- from particulate filter.



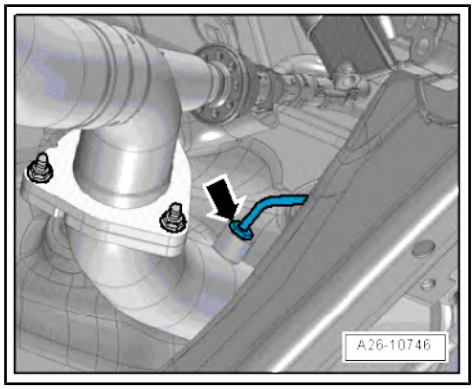
Vehicles with engine code CASA or CASD

– Unscrew exhaust gas temperature sender 3 - G495- -arrow-.



Vehicles with engine code CATA

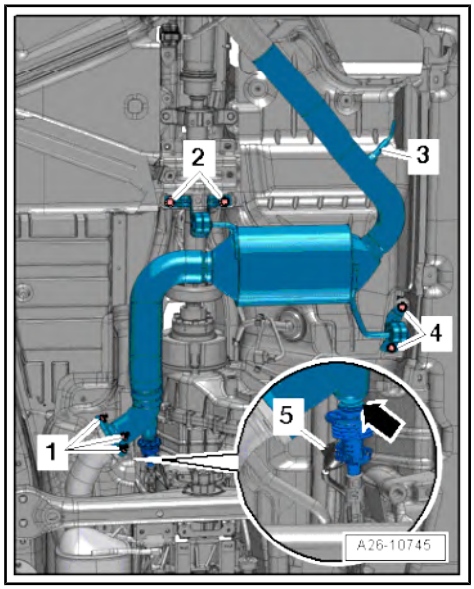
– Remove exhaust temperature sender 4 - G648- -arrow- and tie to body.



– Remove NOx sender 2 - G687- -3- and tie to body.

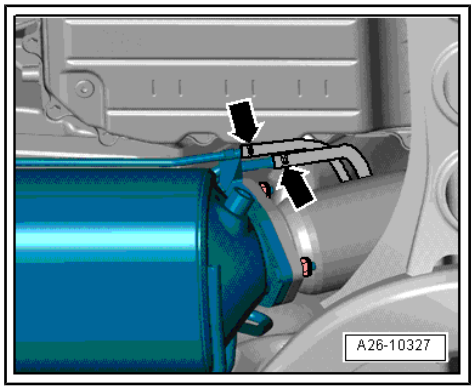
– Remove injector for reducing agent - N474- -5- ⇒ page 318 .

– Unscrew nuts -1- and bolts -2- and -4- and remove reduction catalytic converter.



Continuation for all engine codes

– Pull connecting hoses -arrows- to pressure differential sender - G505- from pressure lines on particulate filter.

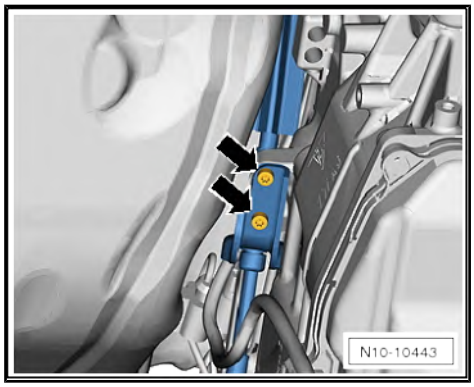


– Disconnect selector mechanism at ball head and unscrew from gearbox.

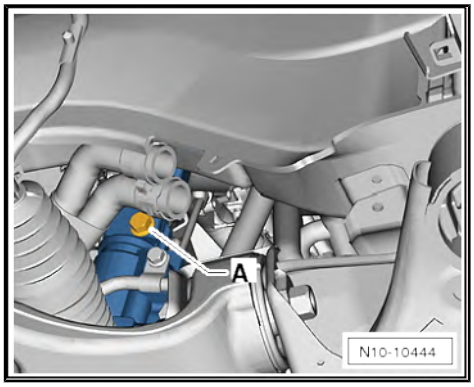
Caution

Danger of airbag coil connectors becoming twisted.

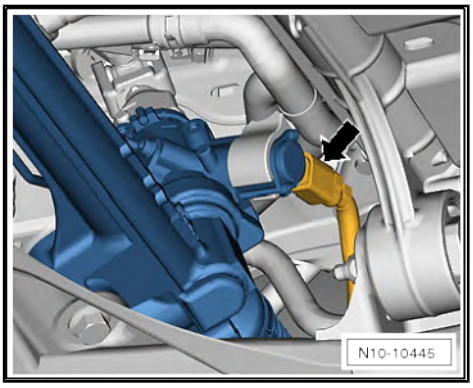
- *Only disconnect universal joint from steering rack when front wheels are in straight-ahead position.*
- *Secure steering wheel with adhesive tape so that position of steering wheel and steering rack no longer change.*



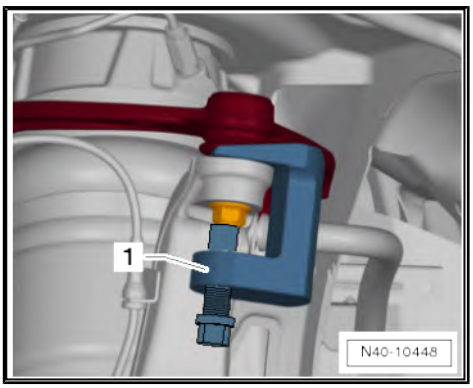
– Unscrew bolt -A- and remove universal joint from steering rack.



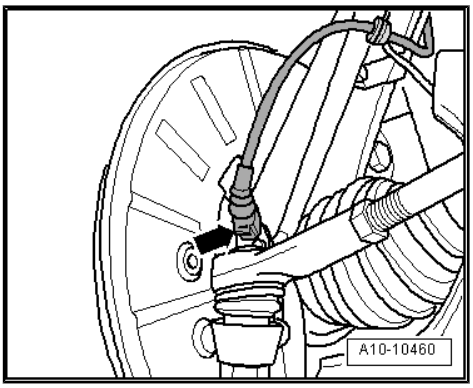
– Disconnect connector at steering rack.



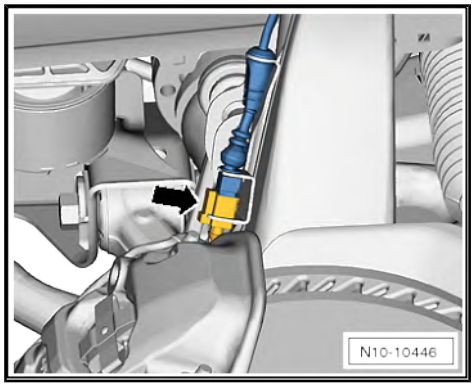
– Unscrew nut for upper suspension link by several turns and separate joint using ball joint puller - T10187- -1-.
– Completely unscrew nut and detach suspension link.



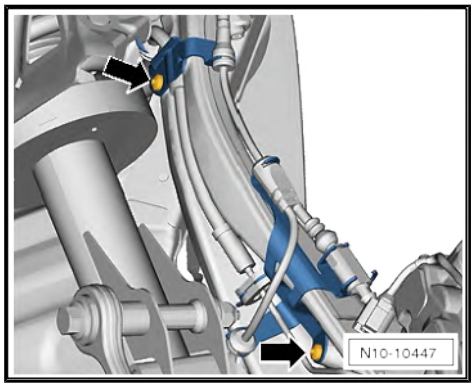
– Disconnect connectors on left and right from front speed sensors -arrow-.



– Disconnect connector -arrow- for wear indicator.



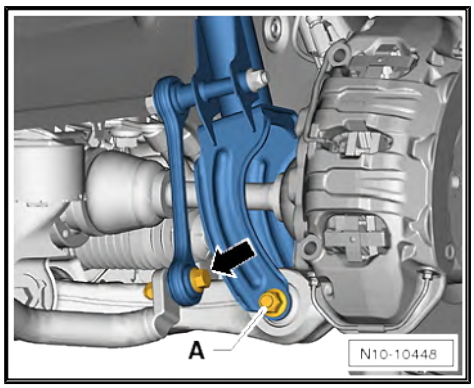
– Remove bolts -arrows- for cable retainers.



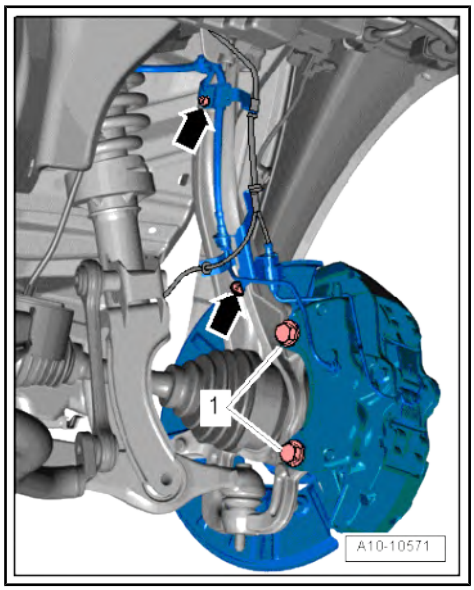
– Unscrew bolt -arrow- of coupling rod at bottom.
– Unscrew nut -A- from lower wishbone, leave bolt in hole.

Caution

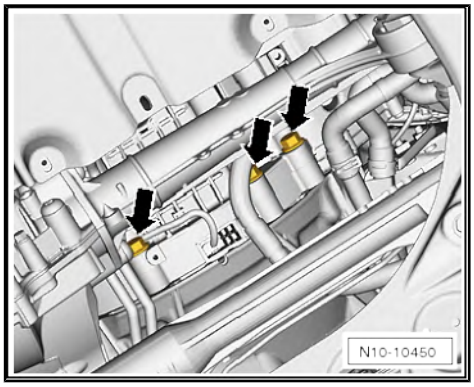
When removing or mounting brake caliper, make sure that no cables or wires are stretched. Make sure that the bent shape of the brake line is not changed.



– Unscrew bolts -arrows- of brake caliper, remove brake caliper and fasten it in wheel housing with a clamping belt - T10038- .
– Repeat work sequence of suspension on opposite side of vehicle.



– If engine and gearbox are to be separated after removal, unscrew bolts -arrows- at bottom of gearbox.



Prepare scissor-type assembly platform - VAS 6131- with basic set for Touareg - VAS 6131/6- as follows:

1 - VAS 6131/6-1
- ❑ Bolting point: A2; B1; B2

2 - VAS 6131/6-2
- ❑ Bolting point: H2; G1; G2

3 - VAS 6131/6-3
- ❑ Bolting point: A3; B3
- ❑ Use rotating plate with short spindle

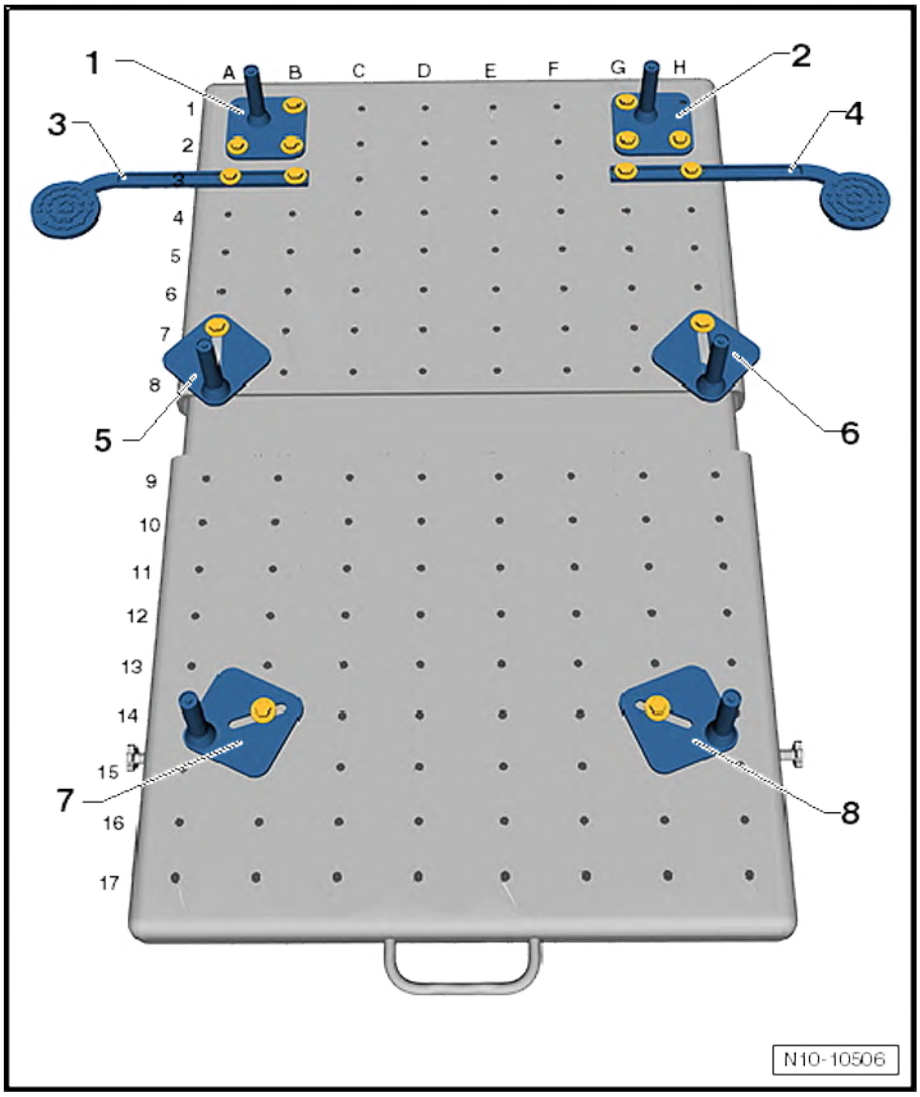
4 - VAS 6131/6-4
- ❑ Bolting point: G3; H3
- ❑ Use rotating plate with short spindle

5 - VAS 6131/6-5
- ❑ Bolting point: A7

6 - VAS 6131/6-5
- ❑ Bolting point: H7

7 - VAS 6131/6-6
- ❑ Bolting point: B14

8 - VAS 6131/6-6
- ❑ Bolting point: G14



Note

The basic set for Touareg - VAS 6131/6- consists of the supports - VAS 6131/6-1- to -VAS 6131/6-7- . To make the following procedure easier to understand, we designate them here as support 1 (for VAS 6131/6-1) to support 7 (for VAS 6131/6-7).

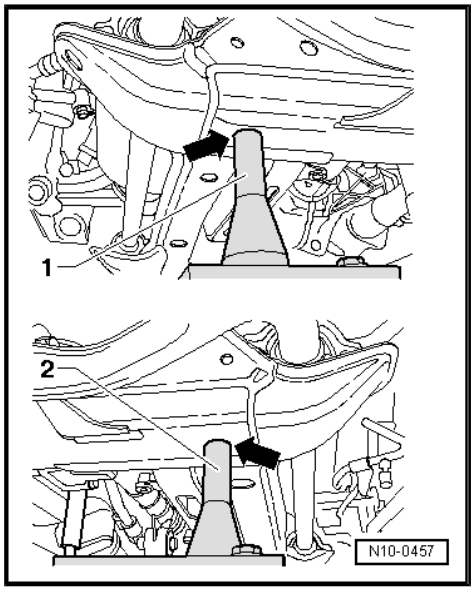
– First, bolt mounting elements to scissor-type mounting platform and tighten bolts by hand.

– Place the scissor-type mounting platform in a horizontal position.

• Check spirit level (bubble gauge) on scissor-type mounting platform.

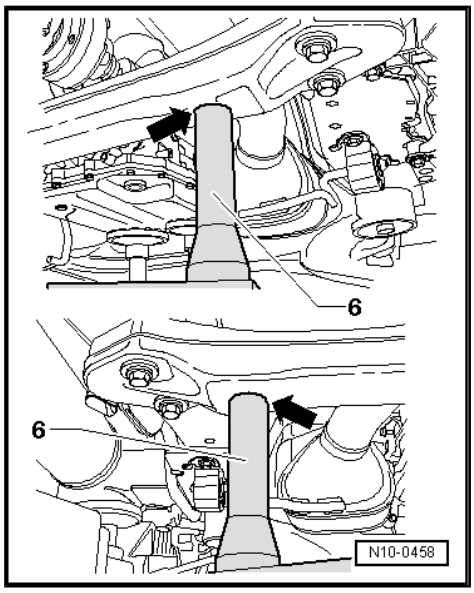
– Position scissor-type mounting platform - VAS 6131 A- under the vehicle.

– The supports -1- and -2- must be guided into corresponding mountings on left and right -arrow-.

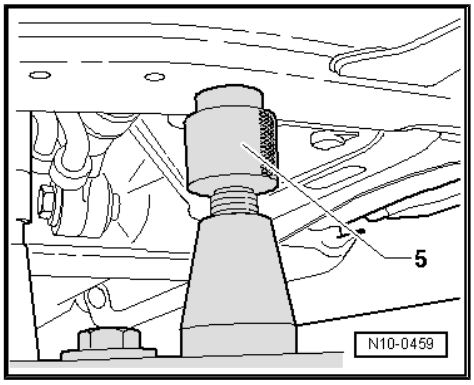


– At the same time, guide the supports -6- for the left and right sides of the gearbox transverse into corresponding holes -arrows-.

When all four supports are in the receptacle holes without pressure:



– Guide supports -5- into their respective receptacles in subframe. If necessary, adjust support height with knurled nut.
– Bolt on the rotating plates of supports 3 and 4 under the wishbones, applying a small amount of pretension.
– Locating the installation position of subframe ⇒ Running gear, axles, steering; Rep. gr. 40 ; Locating the subframe .
– Mark the installation position of the engine mounting on the longitudinal member using a felt-tipped pen.
– Unscrew bolts -1-.

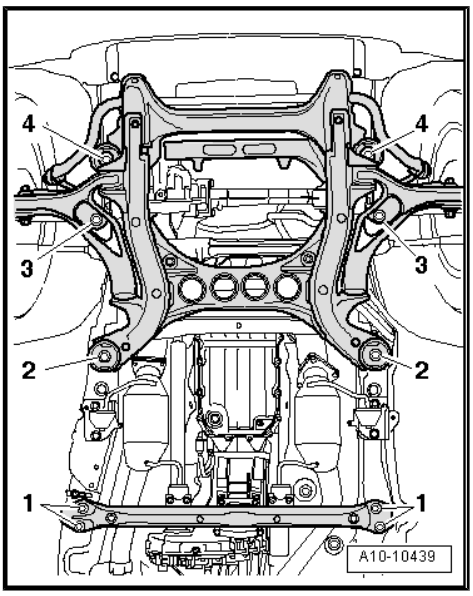


– Unscrew and remove bolts -2 … 4- in stages in diagonal sequence.

Caution

Be very careful when lowering. Make sure that all connections to the body have been detached. Do this now if necessary.

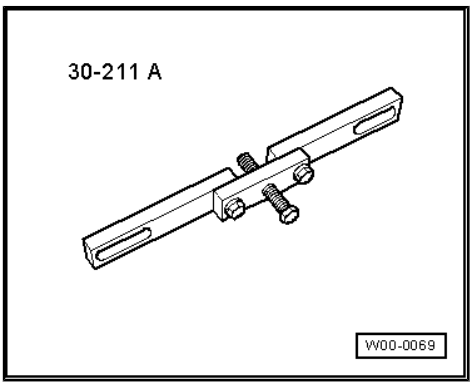
– Carefully lower engine/gearbox unit.



1.3 Separating engine and gearbox

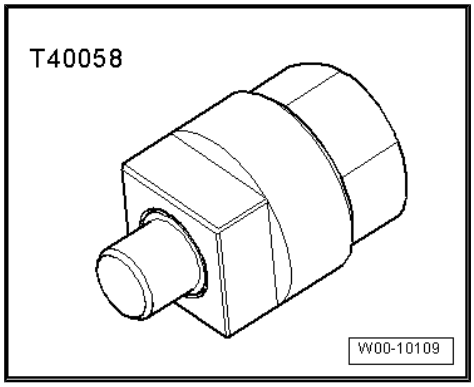
Special tools and workshop equipment required

♦ Support bridge - 30 - 211 A-

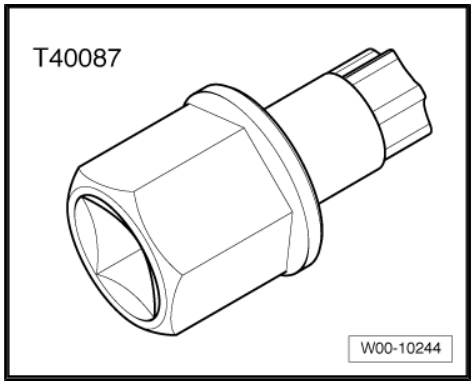


♦ Support set, Audi - VAS 6131/10- plus supplementary set - VAS 6131/12- and supplementary set, Audi Q7 -VAS 6131/13-

♦ Adapter - T40058-



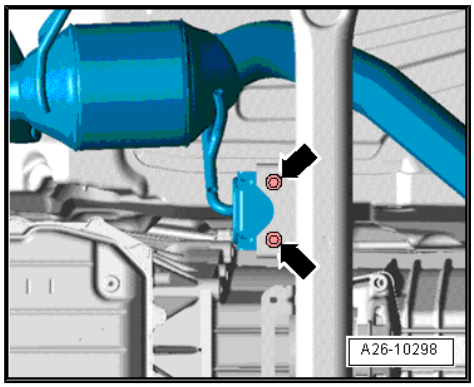
♦ Socket Torx T 60 - T40087-



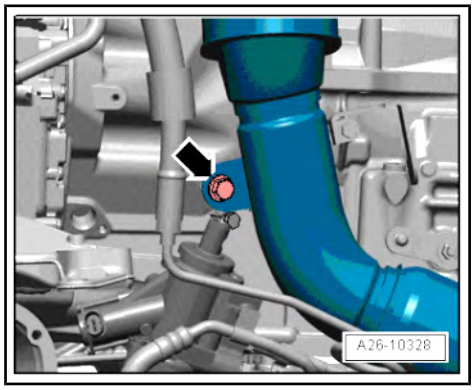
Procedure

- Engine/gearbox assembly removed and placed on scissor-type assembly platform - VAS 6131 A- .

– Remove bolts -arrows- from particulate filter bracket.



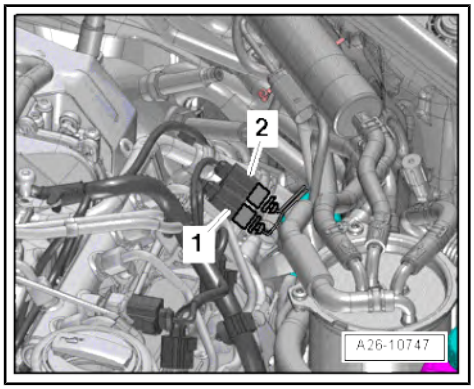
– Unscrew bolt -arrow- at bracket for starter catalytic converter/ catalytic converter.



Vehicles with engine code CATA

– Disconnect connectors for catalytic converter temperature sensor 1 - G20- (orange) and exhaust gas temperature sender 3 - G495- (brown).

– Move electrical wiring for both of these components clear.



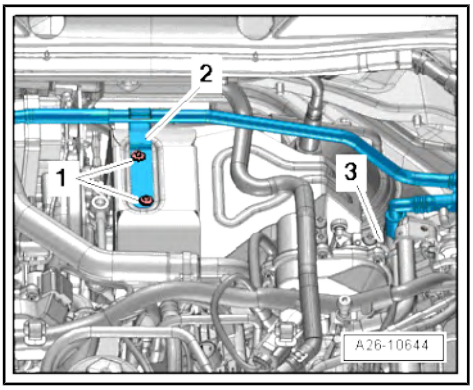
Continuation for all engine codes

– Unscrew bolts -1- and only loosen bolt -3-.

Note

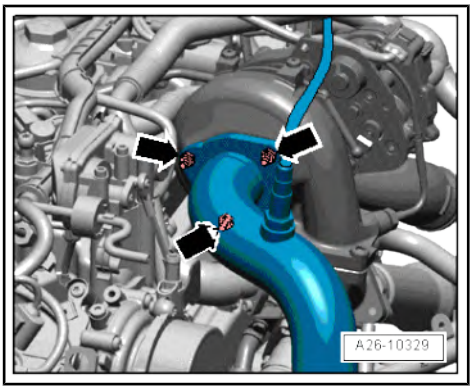
Vacuum line with bracket -2- is only installed on vehicles with engine codes CASA or CASD.

– Lay vacuum hose with bracket -2- aside and remove heat shield for turbocharger.



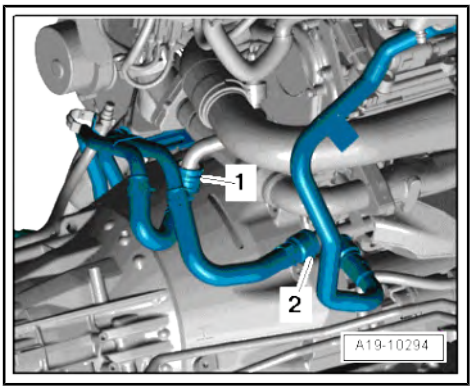
– Unscrew nuts -arrows-.

– Remove starter catalytic converter/catalytic converter with particulate filter.

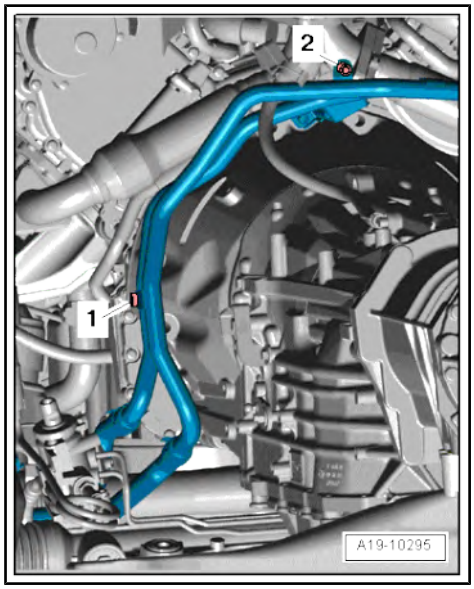


Vehicles with engine code CASA or CASD

– Detach right coolant hoses -1- and -2- from engine.

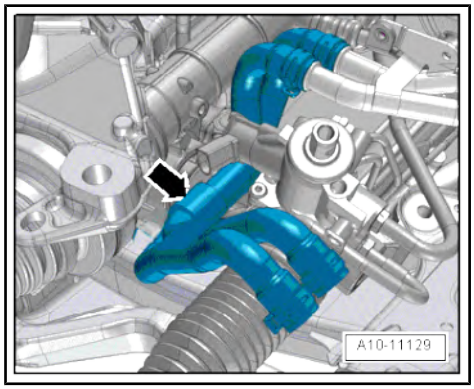


– Remove bolts -1- and -2-.
– Remove both rear left coolant pipes with coolant hoses.

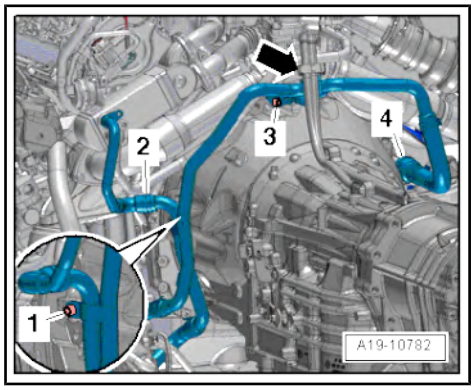


Vehicles with engine code CATA

– Release coolant hoses -arrows-.

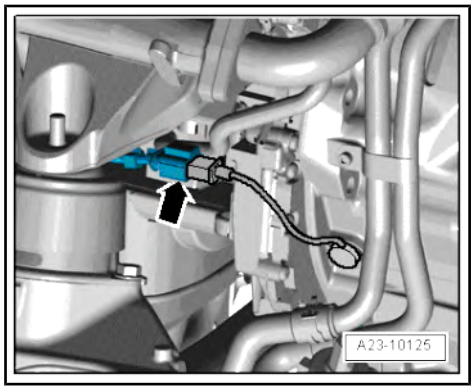


– Remove coolant hoses by loosening hose clip -2- and lifting retainer -4-.
– Release breather hose -arrow- for gearbox.
– Remove bolts -1- and -3-, take left coolant pipe on rear of gearbox off along with coolant hoses.



Continuation for all engine codes

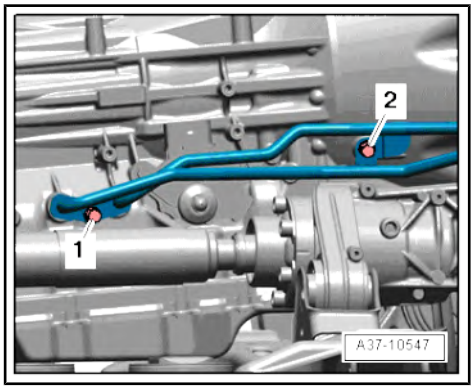
– Remove electrical connector -arrow- for engine speed sender - G28- from bracket and separate.
– Separate front propshaft at transfer box ⇒ Transfer box and final drive; Rep. gr. 39 ; Removing and installing propshafts: Removing and installing front propshaft .



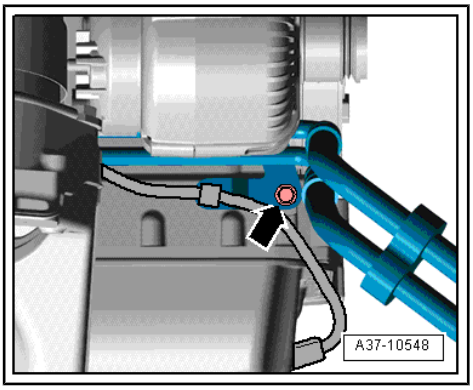
Note

- *Lay a cloth under the separating point to catch escaping ATF.*
- *Observe rules for cleanliness when working on automatic gearbox ⇒ 8-speed automatic gearbox 0C8; Rep. gr. 37 .*

– Unscrew bolts -1- and -2- and pull ATF lines from gearbox.



– Unscrew bolt -arrow- and remove ATF lines.

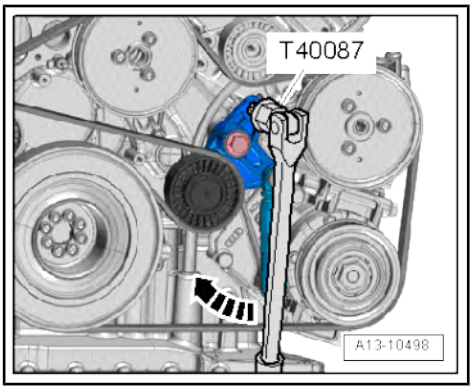


Caution

Danger of destruction due to reverse running direction in the case of a poly V-belt that has already run.

- ***Before removing the poly V-belt, use a piece of chalk or a felt pen to mark the running direction.***

– Slacken poly V-belt by swivelling tensioning element in -direction of arrow- using socket Torx T 60 - T40087- .

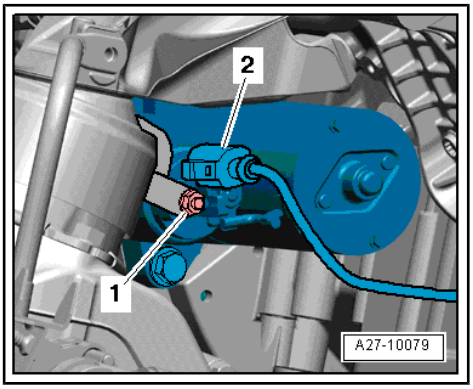


– Remove poly V-belt and relieve tensioning element.

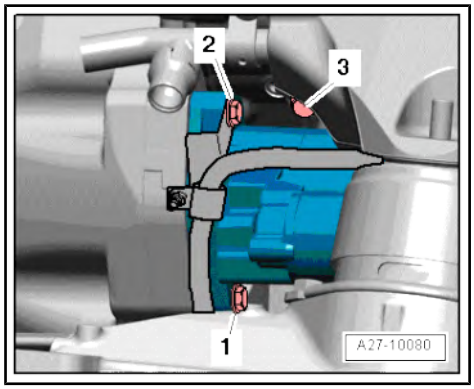
– Remove alternator ⇒ Electrical system; Rep. gr. 27 ; Alternator .

– Separate electrical connector -2-.

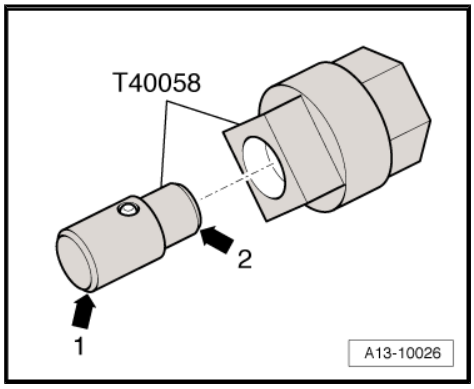
– Unscrew B+ cable -1-.



– Unscrew bolt -3- for engine support.
– Unscrew bolts -1- and -2- and remove starter.



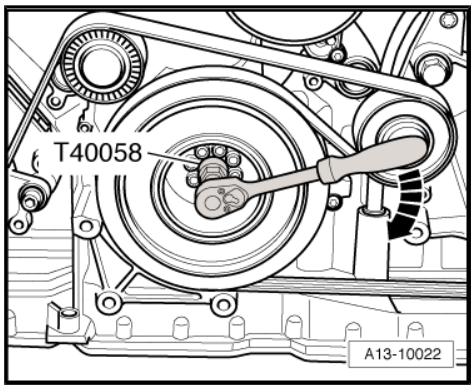
– Insert guide pin of adapter -T40058- as follows:
• The larger diameter -arrow 1- points towards the engine.
• The smaller diameter -arrow 2- faces the adapter.



– When loosening torque converter bolts, counterhold crankshaft using adapter - T40058- .

Note

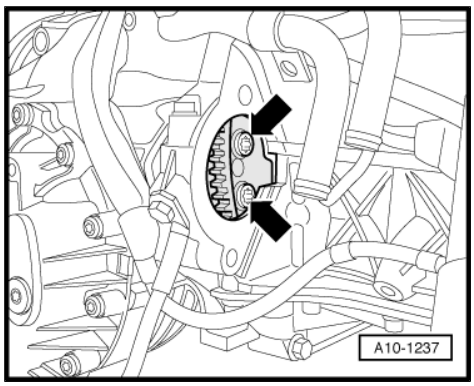
Ignore -arrow-.



Caution

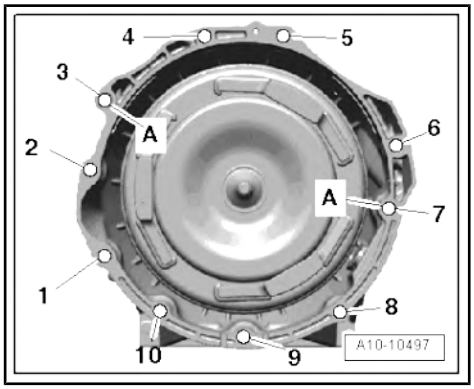
Risk of irreparable damage from camshaft timing chains jumping.

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

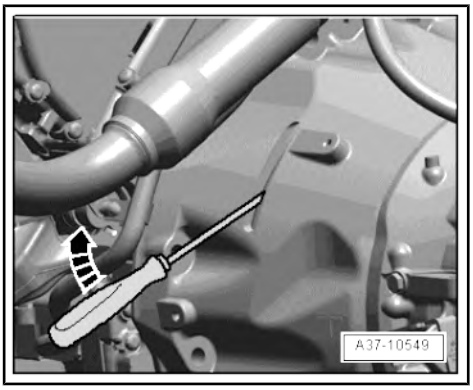


– Unscrew 6 bolts -arrows- for torque converter, working through opening of removed starter (turn crankshaft $^{1}/_{3}$ turn in direction of engine rotation each time).
– Secure engine and gearbox to respective sump to prevent them from tipping over, e.g. with wooden wedges.

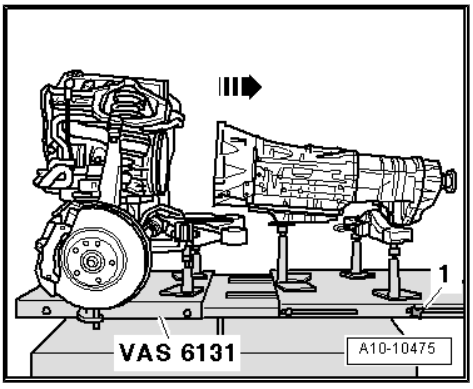
– Unscrew engine/gearbox connecting bolts -3 … 10-.



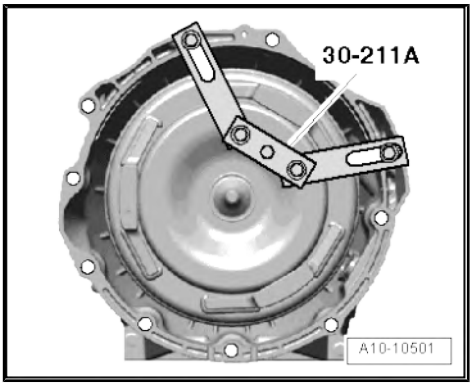
– Press gearbox off engine and simultaneously press torque converter from drive plate -arrow-.



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



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



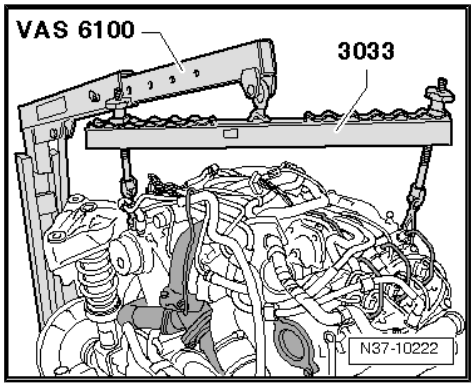
1.4 Removing engine from scissor-type assembly platform - VAS 6131-

Procedure

– Hold engine in installation position as shown

– Unbolt gearbox from engine: ⇒ 8-speed automatic gearbox 0C8; Rep. gr. 37 ; Removing and installing gearbox .

– Lift engine off scissor-type assembly platform - VAS 6131- .



1.5 Securing engine to assembly stand

Before carrying out repair work, secure engine on assembly stand with engine and gearbox support - VAS 6095/1- using universal mounting - VAS 6095/1-4- and bracket for V6 TDI engine - VAS 6095- .

Procedure

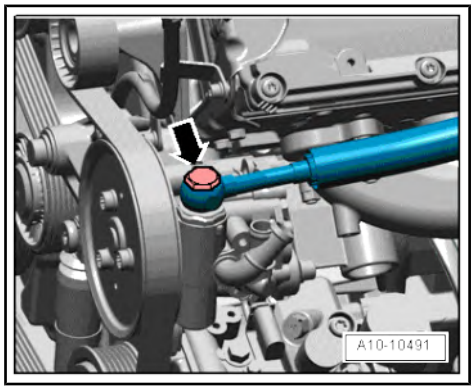
Engine/gearbox assembly removed and separated on scissor-type assembly platform - VAS 6131 A- ⇒ page 17 .

– Remove engine bracket from cylinder head.

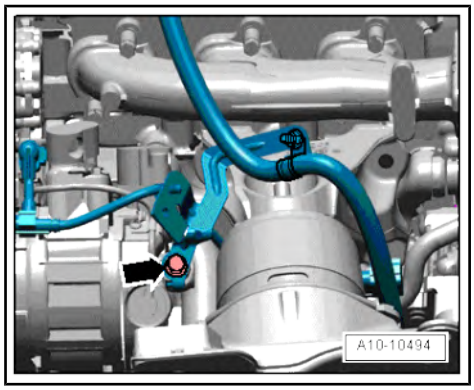
Note

Lay a cloth under the separating point to catch escaping hydraulic fluid.

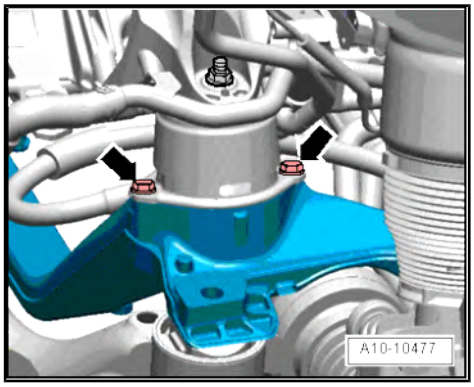
– Unscrew banjo bolt -arrow- for power-assisted steering pressure line.



– Unbolt retainer for electrical cable from air conditioner compressor -arrow-.



– Remove bolts -arrows- for engine mounting on left and right sides.

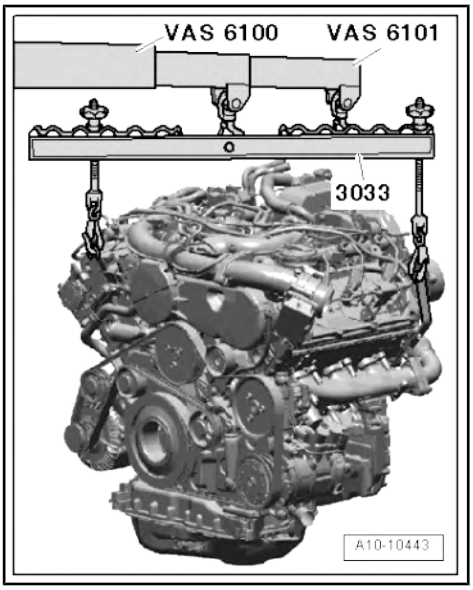


Note

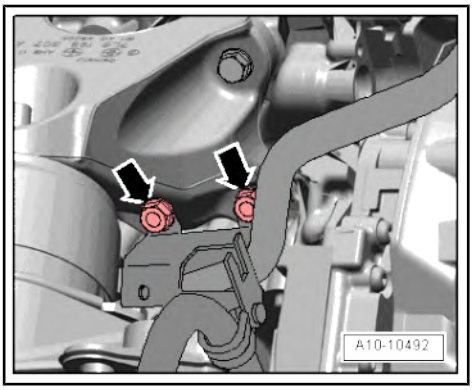
The engine carrier remains in installation position.

– Attach the lifting tackle - 3033- to engine lifting eyes and workshop hoist - VAS 6100- with lift arm extension/workshop hoist - VAS 6101- as shown in the illustration.

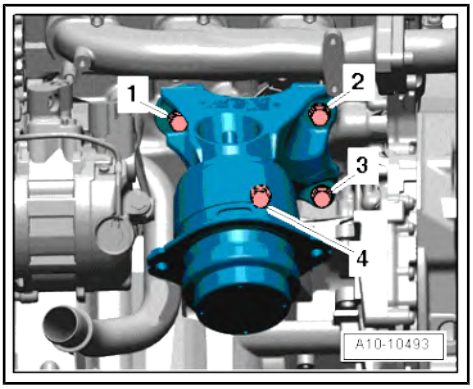
– Lift engine off engine carrier.



– Unscrew nuts -arrows- and remove bracket for connector from left engine support.



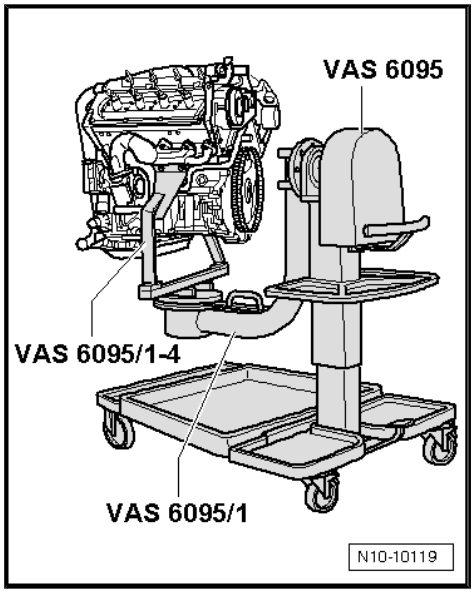
– Unscrew bolts on left and right -1 … 4- and remove engine supports.



Note

Illustration shows left engine support.

– Using bracket -VAS 6095/1-4- , secure engine to engine and gearbox support - VAS 6095- to 60 Nm as shown in illustration.



1.6 Notes on installing

Note

When moving engine/gearbox into body it is essential to position the subframe relative to the body with aid of scissor-type assembly platform. "Pulling up" the subframe with the securing bolts will damage threads.

– Reassemble all electrical connections, lines, hoses and connectors that were disconnected during removal.

Installation is carried out in the reverse order. When installing, note the following:

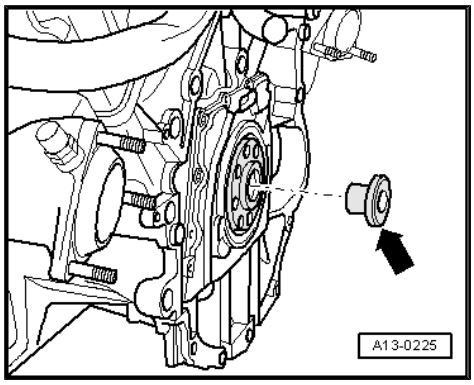
Specified torques ⇒ page 28 .

– Check whether dowel sleeves for aligning engine and gearbox are fitted in cylinder block and install if necessary.

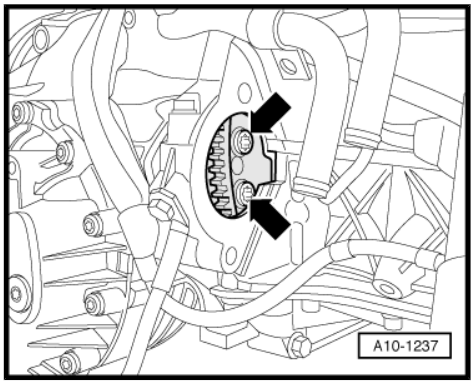
Centring sleeve for torque converter

– Check installation dimensions of torque converter ⇒ 8-speed automatic gearbox 0C8; Rep. gr. 32 ; Handling torque converter correctly and installing torque converter properly; Overview of torque converter .

– In vehicles with an automatic gearbox, check that rear centring bushing -arrow- is inserted in crankshaft. Drive centring bushing in if necessary.



– Before bringing engine and gearbox together, turn torque converter and drive plate on engine so that holes or threaded holes are in line with opening for removed starter -arrows-.



Caution

Danger of gearbox destruction due to incorrectly fitted torque converter.

- *Before and during tightening of connecting bolts on engine/gearbox, continually check that the torque converter behind the drive plate can be turned.*
- *If the torque converter cannot be turned, the drive plate of the ATF pump and, as a result, the gearbox can be destroyed when the connections are finally tightened.*

– To secure torque converter on drive plate, use only new ribbed bolts of the correct type (same as original equipment) as specified in ⇒ Parts catalogue .

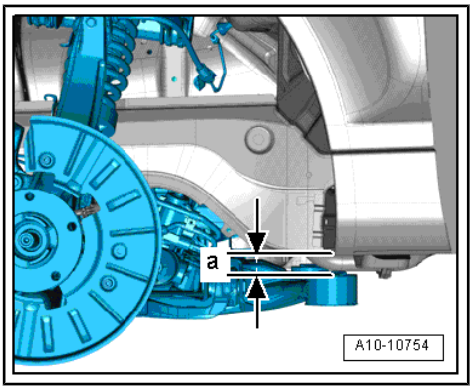
– Bolt gearbox to engine.

– Raise engine/gearbox assembly using scissor-type assembly platform but, initially, only until distance between subframe and body is -a-.

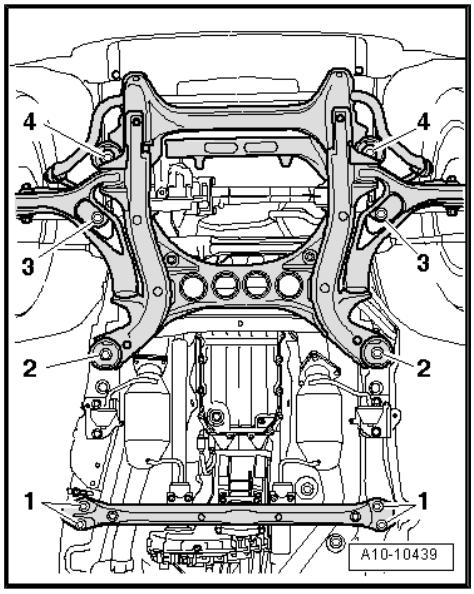
• Distance -a- = at least 250 mm.

– Install selector lever cable and check adjustment ⇒ 8-speed automatic gearbox 0C8; Rep. gr. 37 ; Selector mechanism; Removing and installing selector lever cable .

– Raise engine/gearbox assembly and subframe further, using scissor-type assembly platform.



– Align the subframe, engine mounting and gearbox support according to the locating devices or the markings made on the longitudinal members during removal.
– Replace the locating devices with new subframe bolts one after the other and tighten to specified torque ⇒ Running gear, axles, steering; Rep. gr. 40 ; Assembly overview - subframe
– Fit new engine mounting bolts in position and tighten them firmly. Specified torque ⇒ page 31 .
– Fit new gearbox support bolts in position and tighten them firmly. Specified torque ⇒ Differential and final drive; Rep. gr. 34 ; Removing and installing gearbox support and console .



WARNING

Danger of accidents due to loose bolted-connections.

- ***If the bolts for the subframe have not been finally tightened, it is not permissible to drive the vehicle.***

– Top up ATF level: ⇒ 8-speed automatic gearbox 0C8; Rep. gr. 37 ; Checking ATF level and topping-up: Topping-up ATF
– Electrical connections and routing: ⇒ Electrical system; Rep. gr. 97 .
– Reconnect lines/wiring of air conditioning system: ⇒ Heating, air conditioning system; Rep. gr. 87 ; Repair work on refrigerant circuit which may be performed only in appropriate workshops by specially trained mechanics .
– Fill power-assisted steering system with prescribed oil and bleed system: ⇒ Running gear, axles, steering; Rep. gr. 48 ; Bleeding steering system and checking system for leaks; Bleeding steering system .
– Install noise insulation: ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation: Assembly overview - noise insulation .
– Add coolant ⇒ page 189 .

Observe applicable safety precautions during road test ⇒ page 233 .

– Carry out road test and read all event memories ⇒ Vehicle diagnostic tester.

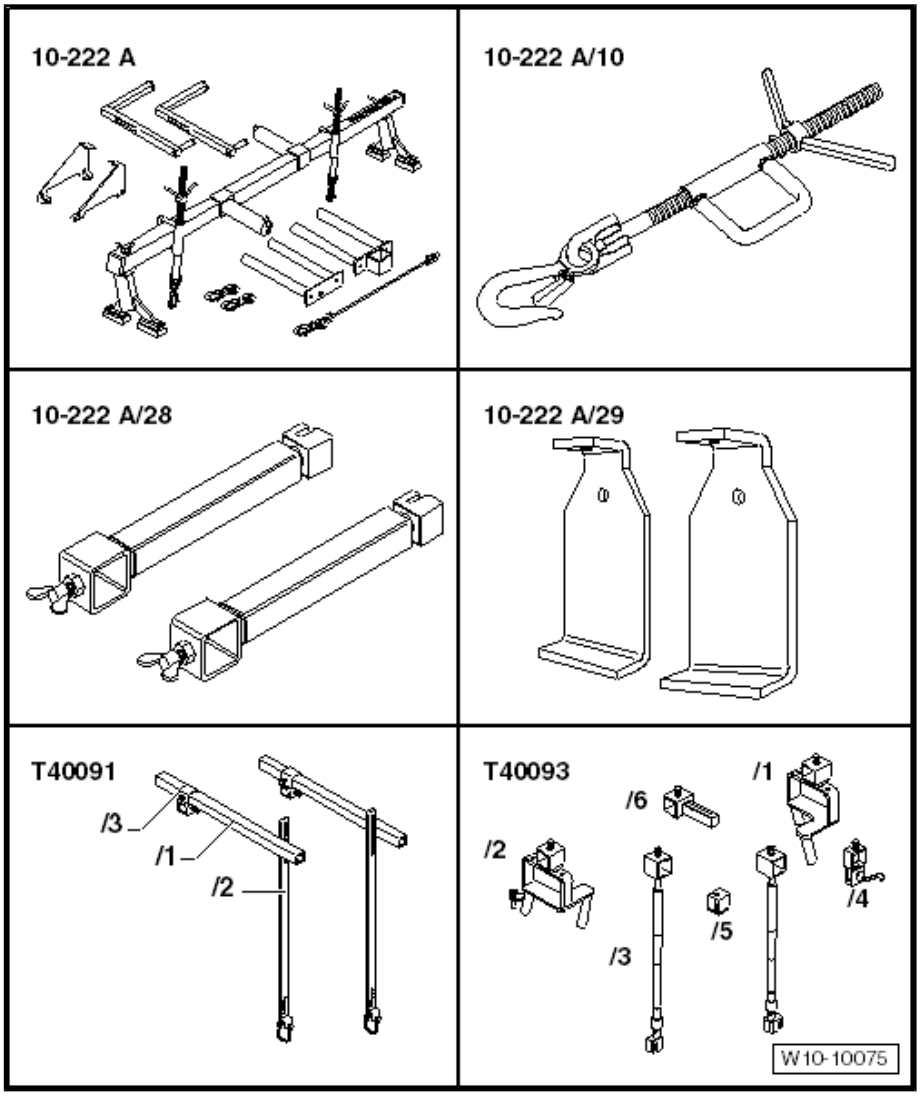
Specified torques

Bolted connection		Specified torque
Nuts and bolts	M6	10 Nm
	M7	15 Nm
	M8	25 Nm
	M10	40 Nm
	M12	60 Nm

Specified torques for front engine mounting ⇒ page 31 .

1.7 Supporting engine in installation position

Special tools and workshop equipment required

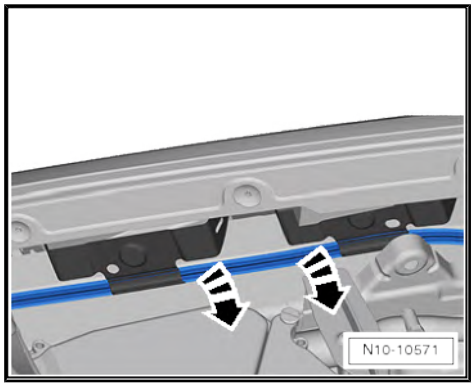


- ♦ Support - 10 - 222 A-
- ♦ Hook - 10 - 222 A /10-
- ♦ Adapter - 10 - 222 A /28-
- ♦ Adapters - 10 - 222 A /29-
- ♦ 2 × square section tubes from engine support basic set - T40091-
- ♦ Hook rail from engine support basic set - T40091-
- ♦ 2 × swivel joint from engine support basic set - T40091-
- ♦ 2 × swivel joint from engine support supplementary set - T40093-
- ♦ Mounting from engine support supplementary set - T40093-

– Remove windscreen wiper arms ⇒ Electrical system; Rep. gr. 92 ; Windscreen wiper system; Removing and installing wiper arms .

– Remove left plenum chamber cover ⇒ General body repairs, exterior; Rep. gr. 50 ; Plenum chamber cover: Plenum chamber cover .

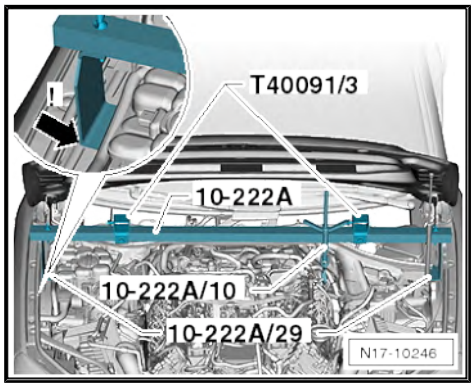
– Unclip Bowden cable for bonnet from retainers -arrows- and lay to side.
– Slide rotary joints - T40091/3- and hooks - 10 - 222 A /10- onto square section tube of bracing device - 10 - 222 A- .
– Fit adapter - 10 - 222 A /29- onto square section tube.



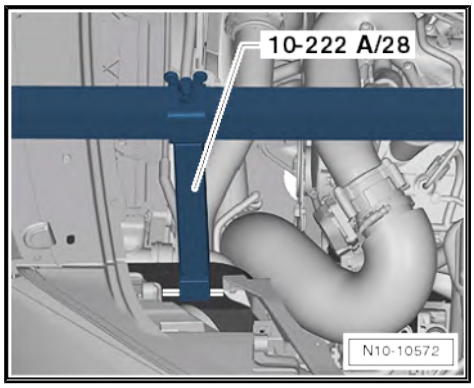
Caution

It must be ensured that the support device is not placed on the retainers for the Bowden cable for the bonnet!

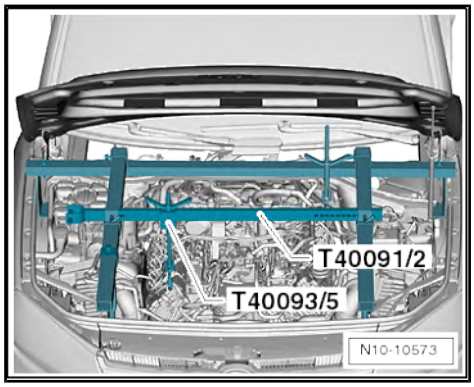
– Position support device between retainers for Bowden cable for bonnet, as shown.
– Push articulated joint - T40093/4- as well as adapter - 10 - 222 A /28- onto square tube - T40091/1- .



– Place adapter - 10 - 222 A /28- onto longitudinal member and push square tube - T40091/1- into articulated joint - T40091/3- .
– Repeat procedure on opposite side of vehicle.
– Push hook rail - T40091/2- on one side through articulated joint - T40093/4- .

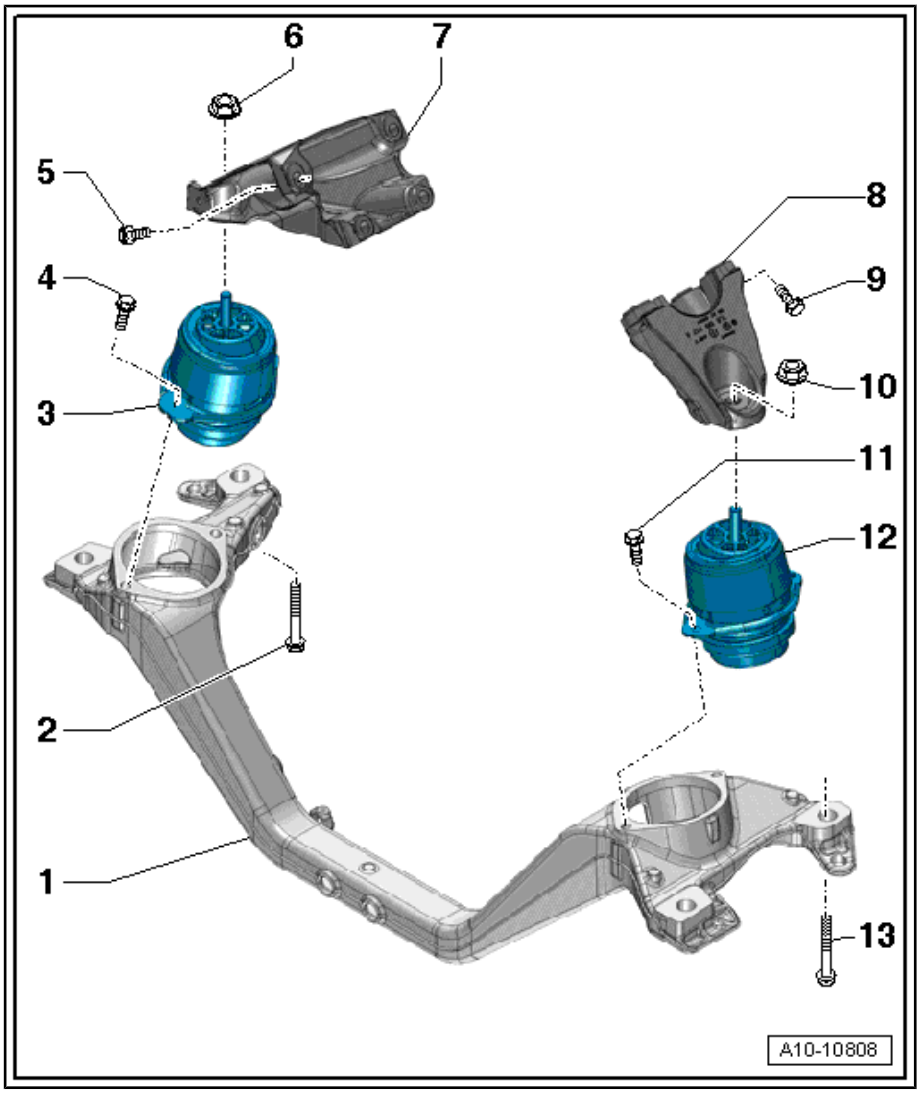


– Push mounting - T40093/5- onto the hook rail - T40091/2- then slide hook rail onto other side of rotary joint.
– Set retaining pin and secure with split pins.
– Tighten all screw connections of support bracket until finger-tight.
– Insert hooks of spindles into the engine lifting eyes and brace engine in installation position.



2 Assembly mountings

2.1 Assembly overview - assembly mountings



1 - engine mounts
- ❑ Removing and installing ⇒ page 33

2 - Bolt
- ❑ Renew
- ❑ 120 Nm + 180° (1/2 turn further)

3 - Right engine mounting
- ❑ Removing and installing ⇒ page 32

4 - Bolt
- ❑ 60 Nm

5 - Bolt
- ❑ Renew
- ❑ 50 Nm + 90° (1/4 turn further)

6 - Nut
- ❑ 75 Nm

7 - Right engine support

8 - Left engine support

9 - Bolt
- ❑ Renew
- ❑ 50 Nm + 90° (1/4 turn further)

10 - Nut
- ❑ 75 Nm

11 - Bolt
- ❑ 60 Nm

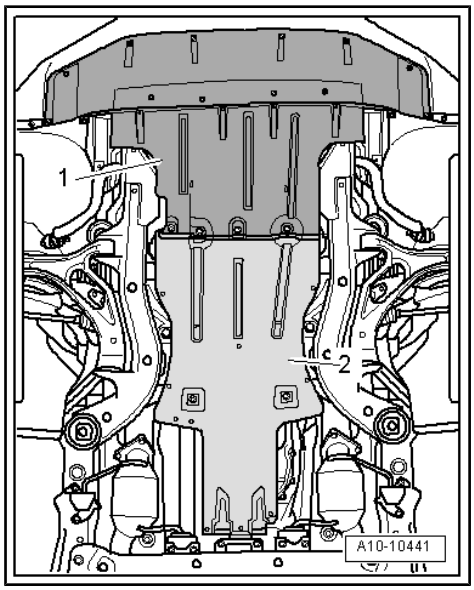
12 - Left engine mounting
- ❑ Removing and installing ⇒ page 32

13 - Bolt
- ❑ Renew
- ❑ 120 Nm + 180° (1/2 turn further)

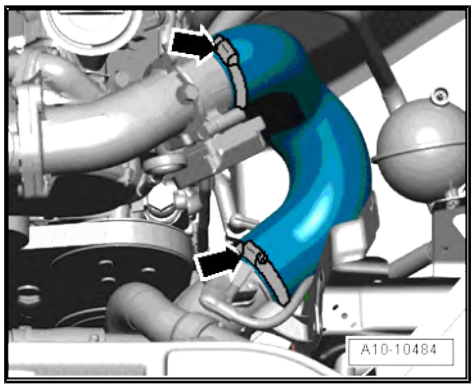
2.2 Removing and installing motor mounting

Removing

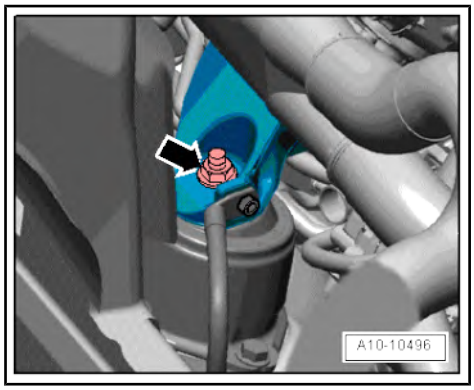
– Unscrew bolts and remove front -1- and rear -2- noise insulation.



– Remove air hose -arrows-.



– Remove nuts -arrows- for left and right engine mountings.

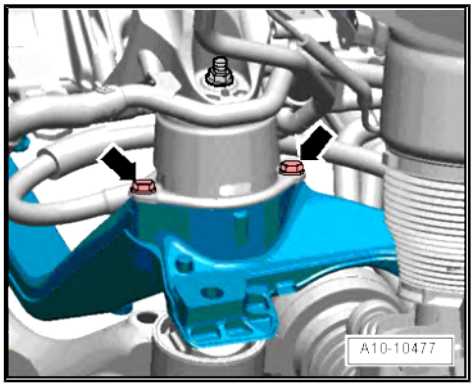


– Remove bolts -arrows- for engine mounting on left and right sides.

– Supporting engine in installation position ⇒ page 28

– Lift engine until the engine supports are above the studs of the engine mountings. Do do this, pretension both spindles evenly to ensure the weight is distributed evenly.

– Remove left and right engine mountings.



Installing

• Specified torques ⇒ page 31 .

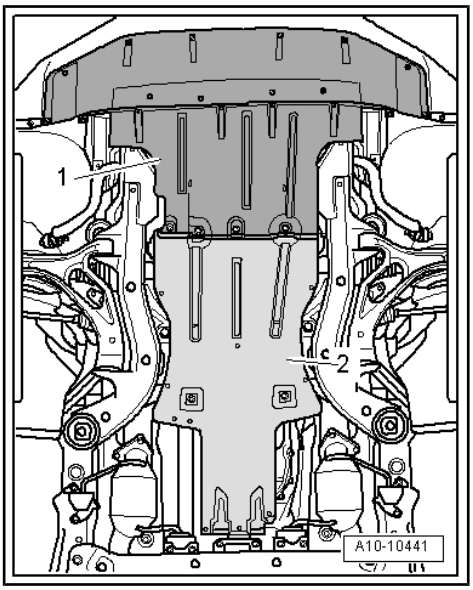
Install in reverse order of removal.

2.3 Removing and installing engine mounting

Removing

– Remove left and right engine mountings ⇒ page 32 .

– Unscrew bolts and remove front -1- and rear -2- noise insulation.

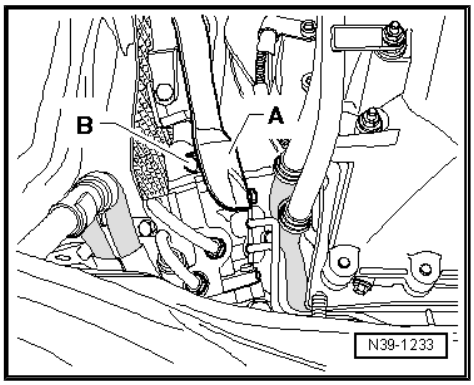


– Unbolt heat shield -A- from steering rack.

Caution

Danger of airbag coil connectors becoming twisted.

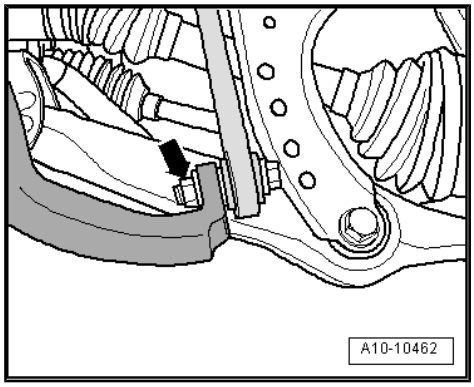
- *Only disconnect universal joint from steering rack when front wheels are in straight-ahead position.*
- *Secure steering wheel with adhesive tape so that position of steering wheel and steering rack no longer change.*



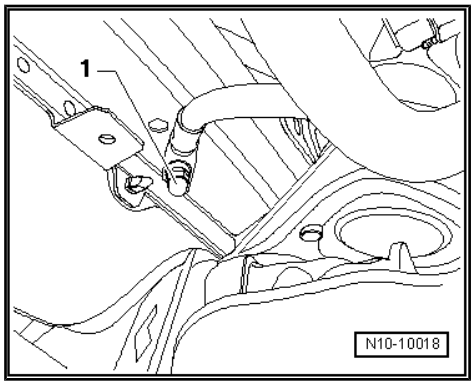
– Unscrew bolt -B- for universal joint ⇒ Running gear, axles, steering; Rep. gr. 48 .

– Press universal joint off steering rack.

– Unbolt coupling rod from anti-roll bar on left and right -arrow-.



– Unscrew earth connection -1- from right longitudinal member.

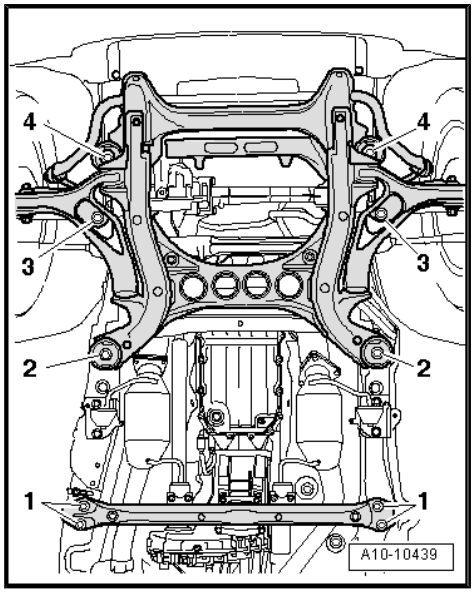


– Mark the installation position of the assembly carrier and engine mounting on the longitudinal beams using a felt-tip pen

WARNING

Risk of accident.

- *Bolts -1 and 2- must remain screwed in.*



– Unscrew bolts -3 and 4- and lower front part of subframe with engine carrier.

– Remove engine carrier forwards.

Installing

• Specified torques ⇒ page 31 .

Install in reverse order of removal, observing the following.

– Install subframe and engine carrier ⇒ Running gear, axles, steering; Rep. gr. 40 ; Assembly overview - subframe .

– Install left and right engine mountings ⇒ page 32 .

– Install anti-roll bar ⇒ Running gear, axles, steering; Rep. gr. 40 ; Assembly overview - anti-roll bar; Removing and installing anti-roll bar .

– Reconnect universal joint to steering rack ⇒ Running gear, axles, steering; Rep. gr. 48 .

13 – Crankshaft group

1 Dismantling and assembling engine

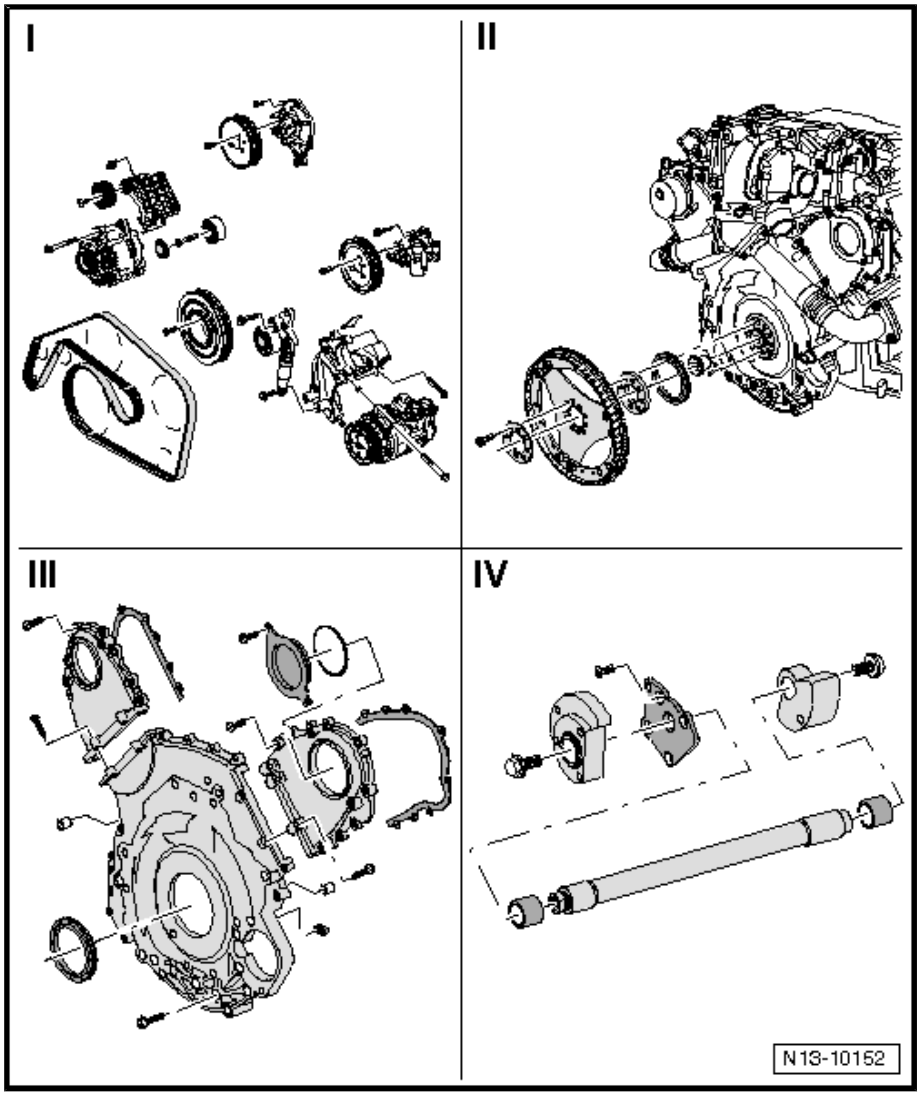
Caution

If large quantities of swarf or metal particles (caused, for example, by partial seizure of the crankshaft or conrod bearings) are found in the engine oil when performing repairs, clean the oil passages thoroughly and renew the engine oil cooler in order to prevent subsequent damage.

The engine should not be set down on the sump, otherwise the liquid gasket between the upper and lower sump will be damaged.

Note

Before carrying out repair work, secure engine on assembly stand with engine and gearbox support - VAS 6095/1- using universal mounting - VAS 6095/1-4- and bracket for V6 TDI engine - VAS 6095- .



Part I ⇒ “1.1 Assembly overview - poly V-belt drive”, page 36

Part II ⇒ “1.5 Assembly overview - drive plate”, page 46

Part III
⇒ “1.8 Assembly overview - timing chain covers”, page 50

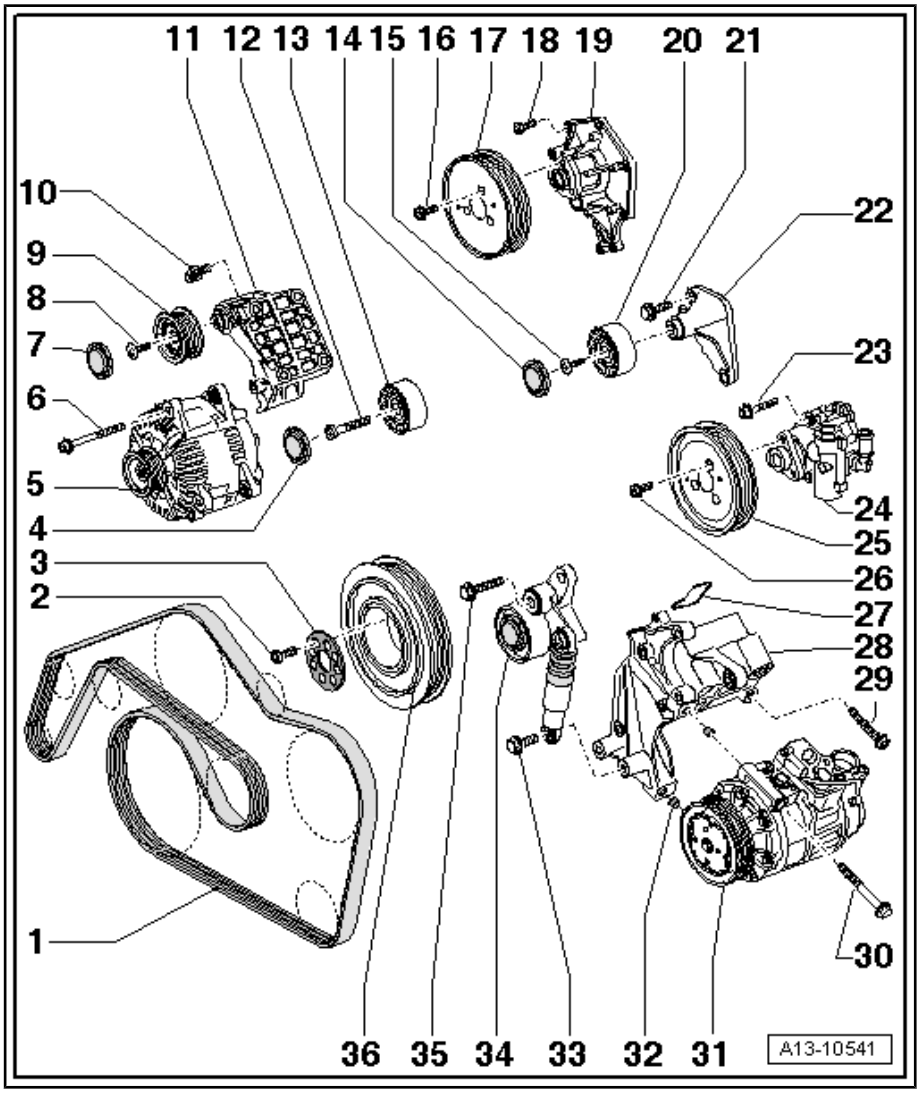
Part IV ⇒ “1.12 Assembly overview - balance shaft”, page 63

1.1 Assembly overview - poly V-belt drive

⇒ **“1.2 Removing and installing poly-V belt”, page 40** .

⇒ **“1.3 Renewing crankshaft oil seal – belt pulley end”, page 42** .

⇒ **“1.4 Removing and installing front sealing flange”, page 43** .



1 - Poly V-belt

- ❑ Mark direction of rotation before removing. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ❑ Check for wear
- ❑ When installing, make sure it is properly seated on pulleys.
- ❑ Removing and installing ⇒ page 40

2 - Bolt

- ❑ 20 Nm + 90° (1/4 turn further)
- ❑ Renew
- ❑ Use shim ⇒ page 40 .

3 - Shim

- ❑ Renew

4 - Cover for idler roller

5 - Alternator

- ❑ Removing and installing: ⇒ Electrical system; Rep. gr. 27 ; Alternator .
- ❑ To facilitate attachment of alternator, knock back threaded bushes for alternator securing bolts slightly.

6 - Bolt

- ❑ 22 Nm

7 - Cover for idler roller

8 - Bolt

- ❑ 25 Nm

9 - Idler roller for poly V-belt

- ❑ Observe installation position

10 - Bolt

- ❑ 40 Nm

11 - Bracket for alternator and idler roller

- ❑ Observe specified torque and tightening sequence ⇒ page 40

12 - Bolt

- ❑ 22 Nm

13 - Idler roller for right poly V-belt

- ❑ Observe installation position

14 - Cover for left idler roller

- ❑ Only vehicles with additional idler roller.

15 - Bolt

- ❑ 22 Nm
- ❑ Only vehicles with additional idler roller.

16 - Bolt

- ❑ 22 Nm

17 - Poly V-belt pulley for coolant pump

- ❑ Installation position: marking “vorne” (front) faces in direction of travel.
- ❑ To remove and install: counterhold with 2-hole pin wrench - 3212- .

18 - Bolt

- ❑ 9 Nm

19 - Coolant pump

- ❑ Removing and installing ⇒ page 204

20 - Left idler roller for poly V-belt

- ❑ Only vehicles with additional idler roller.
- ❑ Observe installation position

21 - Bolt

- ❑ 22 Nm
- ❑ Only vehicles with additional idler roller.

22 - Bracket for idler roller

- ❑ Only vehicles with additional idler roller.

23 - Bolt

- ❑ 22 Nm

24 - Power steering vane pump

- ❑ Removing and installing ⇒ Running gear, axles, steering; Rep. gr. 48 .
- ❑ Installation position: marking “vorne” (front) faces in direction of travel.

25 - Poly V-belt pulley for vane pump

- ❑ To remove and install: counterhold with 2-hole pin wrench - 3212- .

26 - Bolt

- ❑ Specified torque ⇒ Running gear, axles, steering; Rep. gr. 48 .

27 - Seal

- ❑ Renew

28 - Bracket for air conditioner compressor and vane pump

29 - Bolt

- ❑ 40 Nm

30 - Bolt

- ❑ 25 Nm
- ❑ Note washers.

31 - Air conditioner compressor

- ❑ Removing and installing ⇒ Heating, air conditioning system; Rep. gr. 87 .
- ❑ When installing check dowel sleeves ⇒ Item 32 (page 38) .

32 - Dowel sleeve

- ❑ Check for correct seating in bracket.

33 - Bolt

- ❑ 25 Nm

34 - Poly V-belt tensioning element

> **Caution**
> *Depending on the vehicle version, the securing thread in the cylinder crankcase for the tensioner can have an M10 or M11 thread. It is absolutely necessary to correctly assign bolt and tensioner to the appropriate cylinder crankcase.*

- ❑ Swivel with Torx 60 insert.

35 - Bolt

> **Caution**
> *Different threads in crankcase.*
>
> *Before installation, check whether the thread is an M10 or M11.*
>
> *Use corresponding bolt size. Risk of engine damage.*
>
> *It is absolutely necessary to correctly assign bolt and tensioner to the appropriate cylinder crankcase.*

- ❑ M10: 50 Nm + 90° further
- ❑ M11: 60 Nm + 90° further

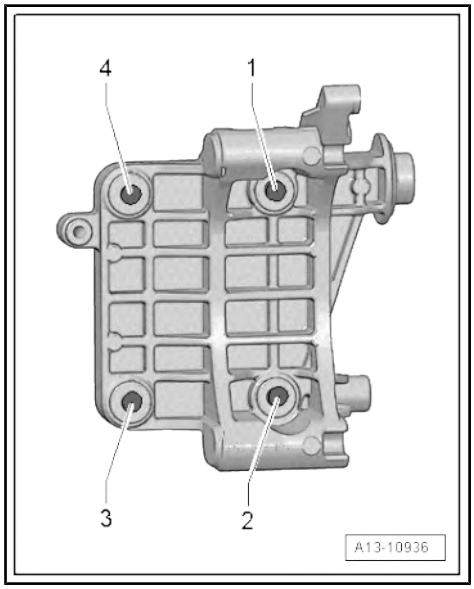
36 - Vibration damper

- ❑ Mark installation position of vibration damper.

Bracket for alternator and idler roller - specified torques and tightening sequence

– Start bolts in the sequence -1 … 4-.

– Tighten bolts in the sequence -1 … 4- to 40 Nm.

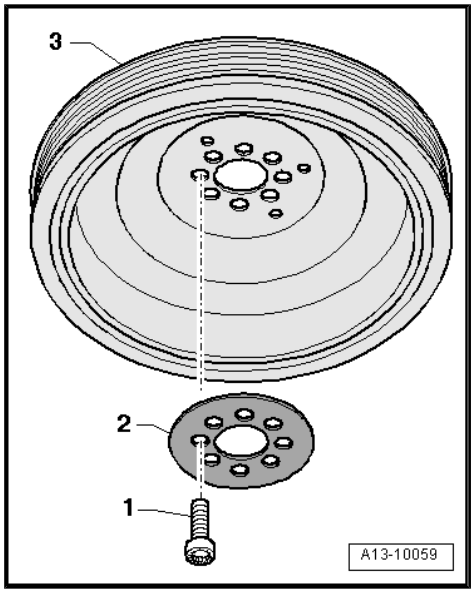


Bolted connection for vibration damper

1 - 20 Nm + 90° ($^1/_4$ turn) further, renew

2 - Shim, renew

3 - Vibration damper



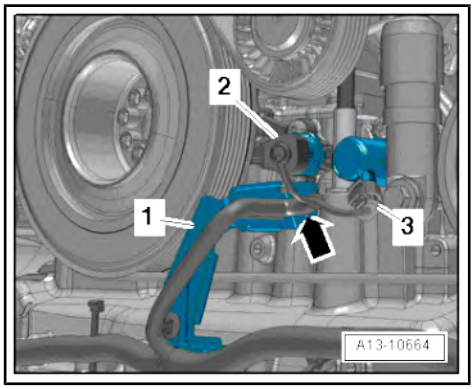
1.2 Removing and installing poly-V belt

Removing

Note

Before removing the poly V-belt, mark the direction of rotation with chalk or a felt-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

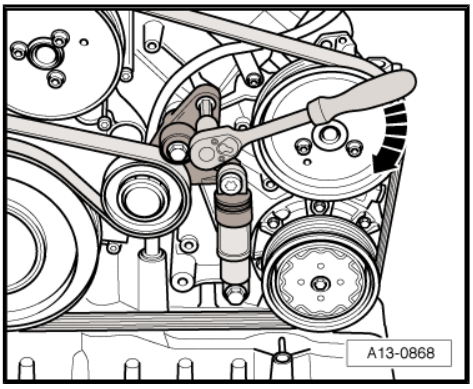
– Separate electrical connectors -2- and -3-.
– Remove retainer -1- and move electrical wiring aside.



Note

Ignore -arrow-.

– Slacken poly V-belt by swinging tensioning element in -direction of arrow-, using a lever with a TORX 60 bit.
– Remove poly V-belt from tensioning roller.

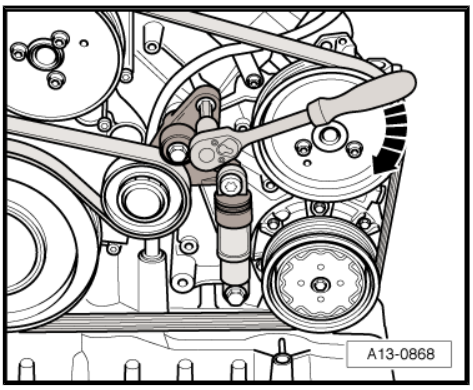


Installing

Note

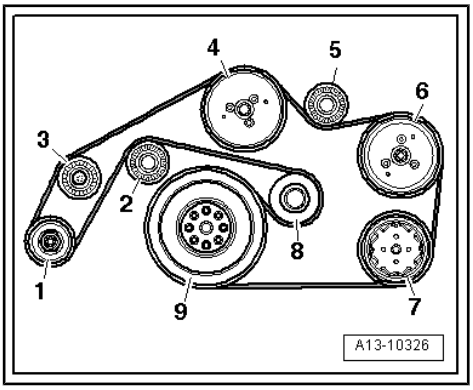
- *Ensure, before installing poly V-belt, that all ancillaries (alternator, air conditioner compressor, vane pump) are secured tightly.*
- *Check that idler rollers turn easily.*
- *When fitting the poly V-belt observe belt direction of rotation and that the belt is seated correctly in the belt pulleys.*

– Slacken poly V-belt by swivelling tensioner in -direction of arrow-, using a lever with Torx 60 bit.
– Fit poly V-belt as illustrated.

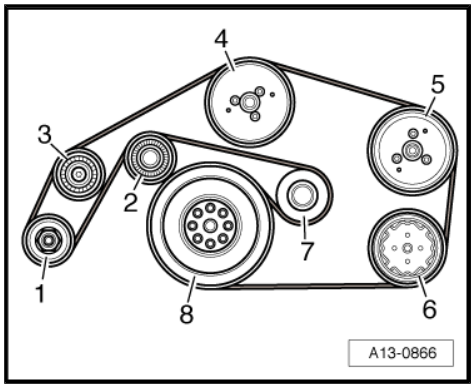


Vehicles with additional idler roller:

1 - Alternator
2 - Idler roller
3 - Idler roller
4 - Coolant pump
5 - Idler roller
6 - Power steering pump
7 - Air conditioner compressor
8 - Poly V-belt tensioning element
9 - Crankshaft



Vehicles without additional idler roller:



1 - Alternator
2 - Idler roller
3 - Idler roller
4 - Coolant pump
5 - Power steering pump
6 - Air conditioner compressor
7 - Tensioning device for poly V-belt
8 - Crankshaft

All:

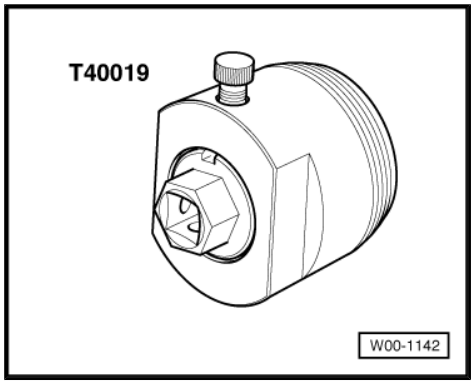
After completing repairs always:

– Start engine and check belt running

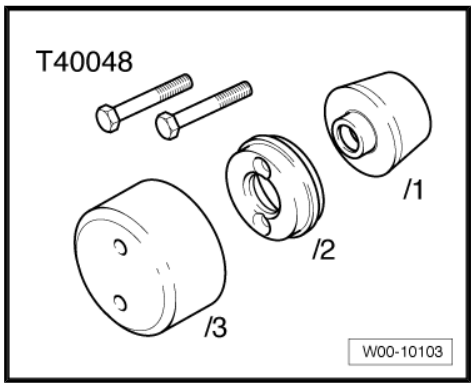
1.3 Renewing crankshaft oil seal – belt pulley end

Special tools and workshop equipment required

♦ Seal puller - T40019-



♦ Assembly appliance - T40048- with -T40048/4-

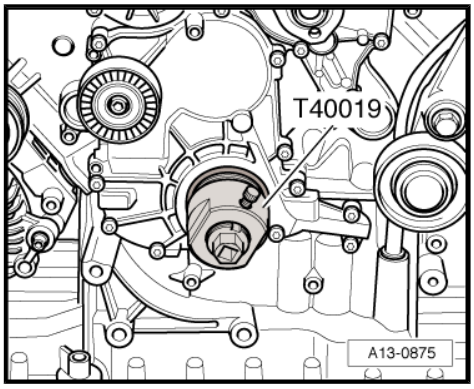


Procedure

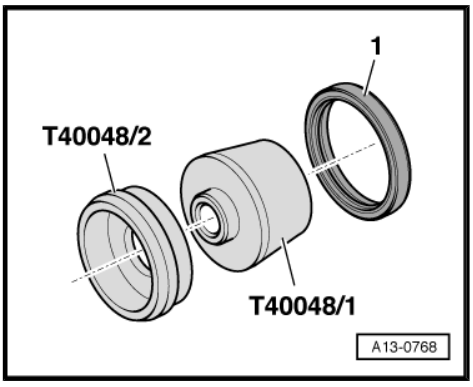
– Remove poly V-belt ⇒ page 40 .

– Remove vibration damper.

– Adjust inner part of oil seal extractor - T40019- so that it is level with the outer part and lock in position with knurled screw.
– Lubricate threaded head of oil seal extractor, place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
– Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.
– Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.
– Clean contact surface and sealing surface.



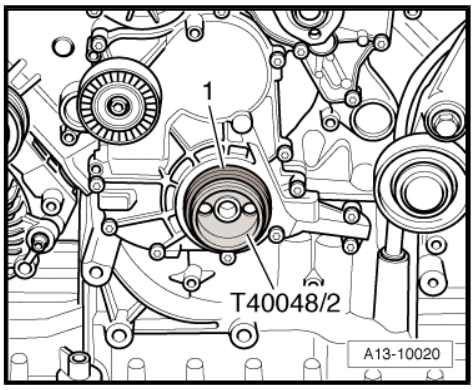
– Fit assembly aid - T40048/1- onto assembly sleeve - T40048/2- and slide oil seal -1- onto assembly sleeve.
– Remove assembly aid.



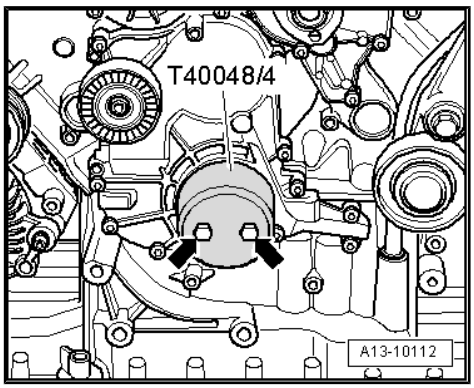
– Fit assembly sleeve - T40048/2- on crankshaft and slide oil seal -1- into sealing surface in engine.

Note

Leave assembly sleeve - T40048/2- in position on crankshaft for pressing in seal.



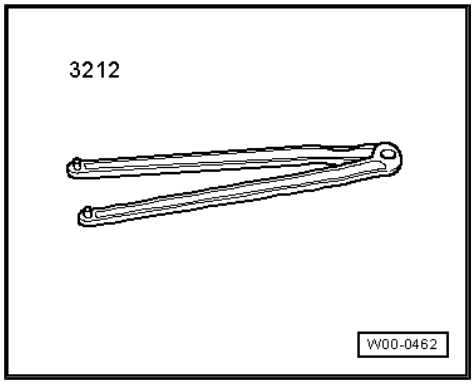
– Apply press sleeve - T40048/4- (installation depth 5 mm) to crankshaft using M8×55 mm bolts.
– Screw in bolts hand-tight to start with.
– Tighten bolts alternately, $^1/_2$ turn at a time, to press in oil seal onto stop.
– Install vibration damper.
– Install poly V-belt ⇒ page 40 .



1.4 Removing and installing front sealing flange

Special tools and workshop equipment required

- Pin wrench - 3212-



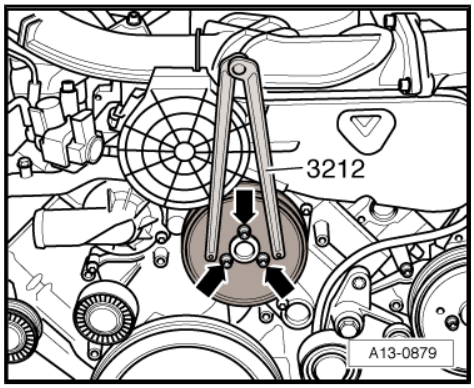
- Hand drill with plastic brush
- Safety glasses
- Silicone sealant - D176 404 A2-

Removing

– Install poly V-belt ⇒ page 40 .

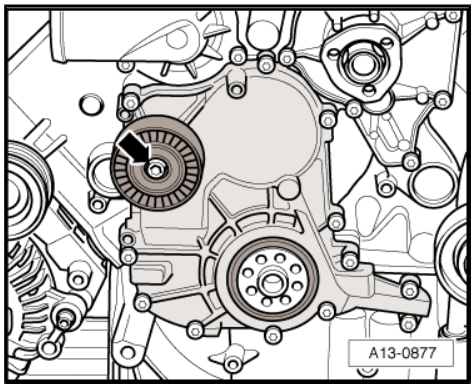
– Remove vibration damper.

– Remove poly V-belt pulley for coolant pump. Counterhold using pin wrench - 3212- when loosening bolts -arrows-.

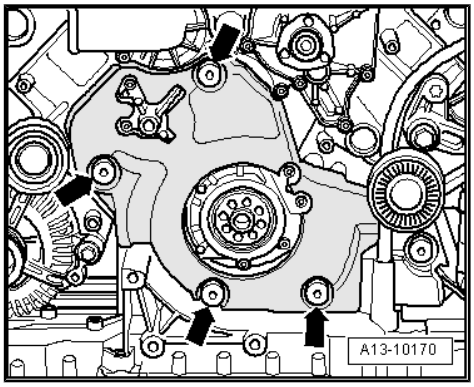


– Pry cover off idler roller for poly V-belt.

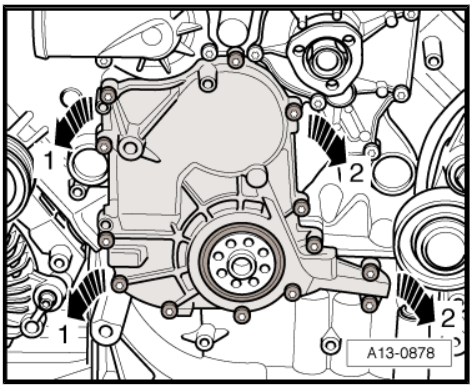
– Unscrew bolt -arrow- and remove idler roller from sealing flange.



– Remove noise insulation from front sealing flange -arrows-.
– Remove coolant pipe securing nuts.
– Lever coolant pipe tab up.



– Remove securing bolts from sealing flange.
– Pull off front sealing flange (right-side first -arrow 1-, then left-side -arrow 2-.
– Drive out oil seal with flange removed.



Installing

Note

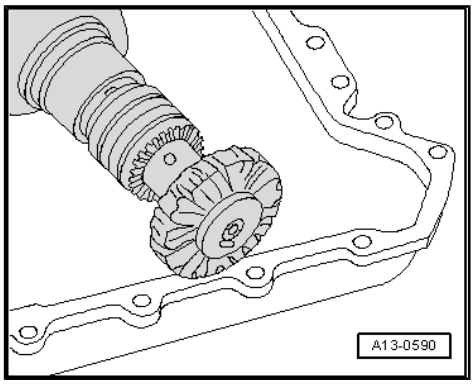
Renew seals and O-rings.

– Remove old sealant from grooves in sealing flange and from sealing surfaces.

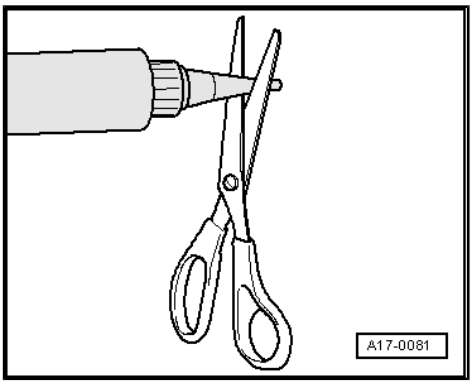
WARNING

Wear protective goggles.

– Remove remaining sealant from sealing flange and cylinder block/upper part of sump with rotating plastic brush or similar.
– Clean sealing surfaces; they must be free of oil and grease.



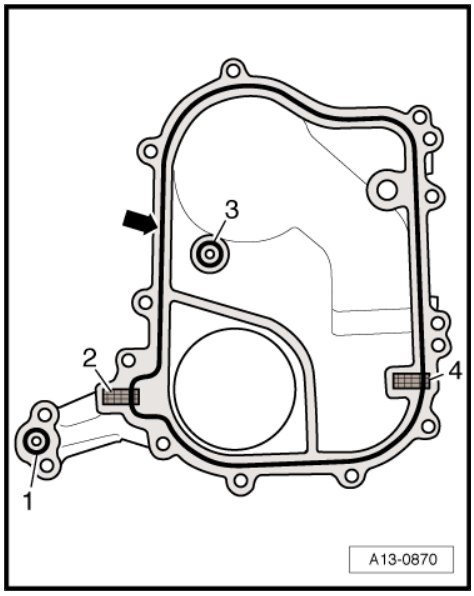
– Cut off nozzle on tube at front marking (∅ of nozzle approx. 2 mm).



– Install sealing elements -2- and -4- and O-rings -1- and -3-.

– Apply bead of sealant -arrow- onto clean sealing surface of front sealing flange, as illustrated.

• The bead of sealant must project 1.5 … 2.0 mm above the sealing surface.



Note

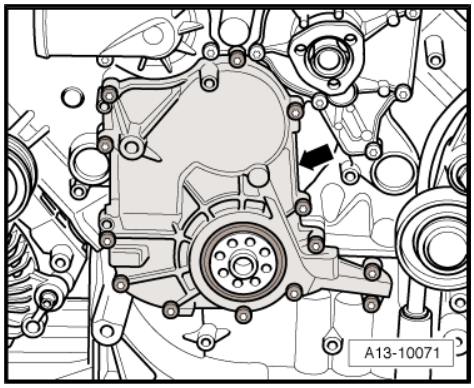
◆ *The sealant bead must not be thicker than specified, otherwise excess sealant could enter the sump and block the strainer in the oil pump.*

◆ *The front sealing flange must be installed within 5 minutes after applying sealant.*

– Tighten bolts on sealing flange in stages and in diagonal sequence. Specified torque: 9 Nm.

– Install new oil seal ⇒ page 42 .

Further installation is carried out in reverse order of removal.



1.5 Assembly overview - drive plate

⇒ “1.6 Removing and installing drive plate”, page 48 .

⇒ “1.7 Renewing crankshaft oil seal – timing chain end”, page 48 .

1 - Drive plate

- ❑ Removing and installing drive plate ⇒ page 48

2 - Washer

3 - Securing bolt

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

4 - Washer

5 - Sender wheel

- ❑ For engine speed sender - G28-
- ❑ Removing and installing engine speed sender - G28- ⇒ page 47 .

6 - Crankshaft oil seal – timing chain end

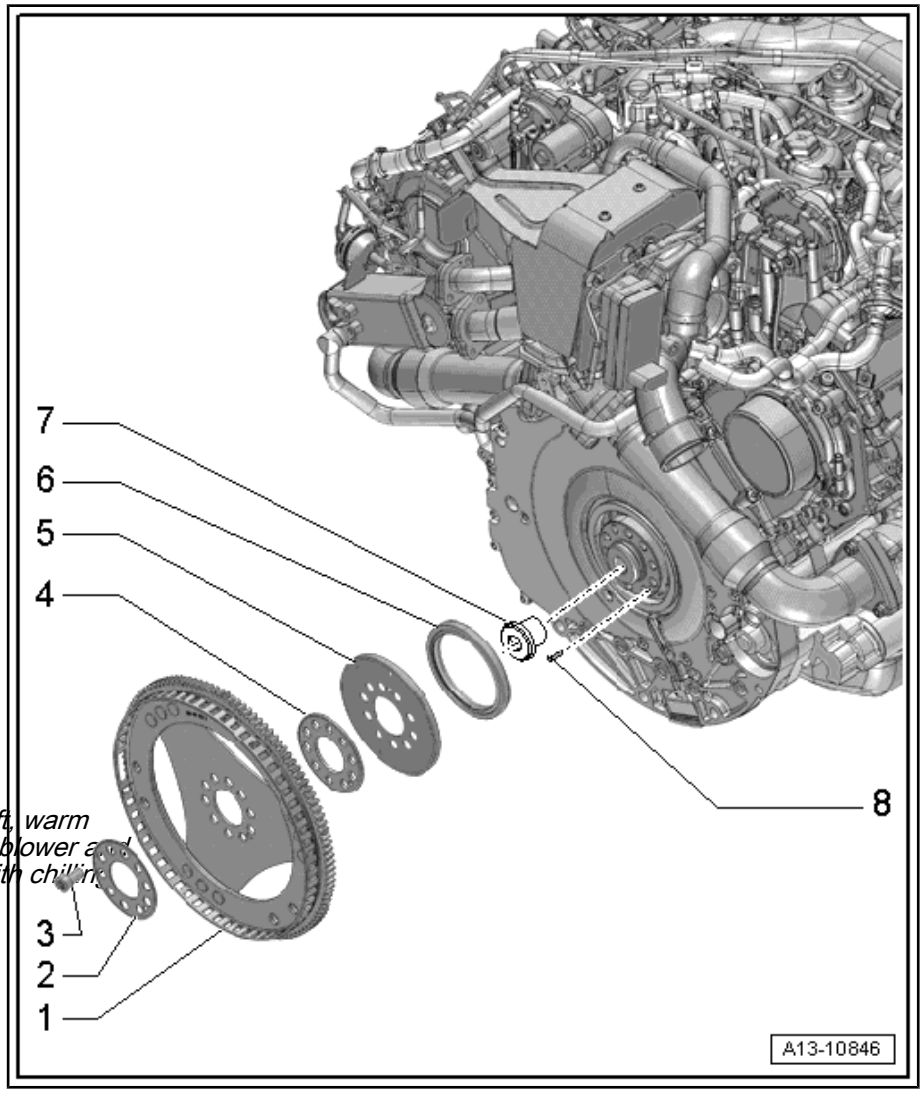
- ❑ Removing and installing ⇒ page 48

7 - Centring sleeve for torque converter

Note

To drive into crankshaft, warm crankshaft with hot air blower and cool centring sleeve with chilling agent

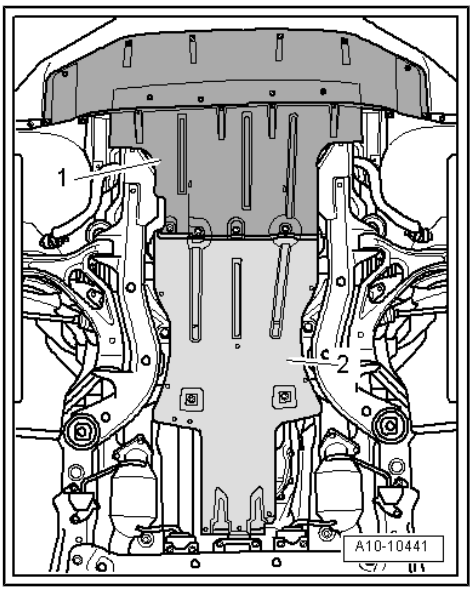
8 - Dowel sleeve



1.5.1 Removing and installing engine speed sender - G28-

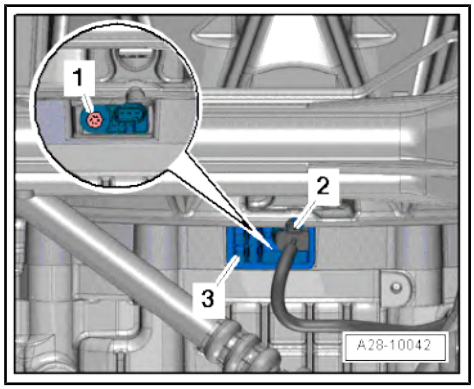
Removing

– Release fasteners and remove rear noise insulation panel -2-.



– Disconnect connector -2-.

– Unscrew and remove bolt -1- and remove engine speed sensor - G28- -



Installing

Install in reverse order of removal, observing the following.

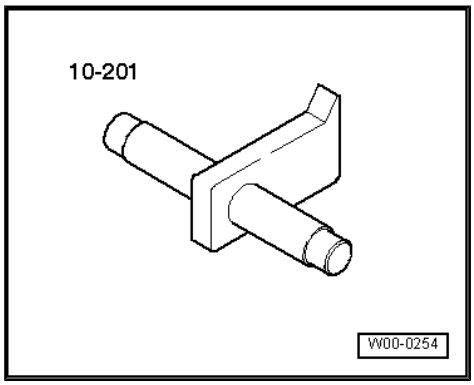
- Specified torque: 9 Nm

– Fit noise insulation ⇒ Rep. gr. 50 .

1.6 Removing and installing drive plate

Special tools and workshop equipment required

♦ Counter-hold tool - 10-201-



Removing

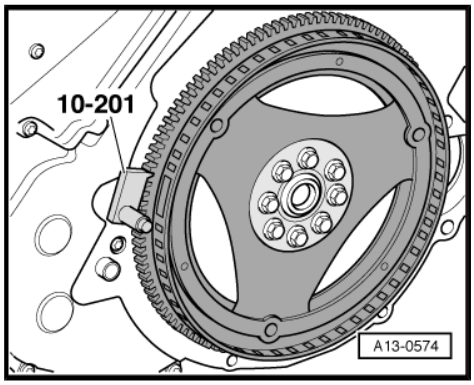
- Engine/gearbox removed.

– Mark installation position of drive plate on engine.

– Use counterhold - 10-201- to loosen bolts.

– Unbolt drive plate.

– Take out shim located behind.



Installing

Installation is carried out in the reverse order. When installing, note the following:

– Fit 1.5 mm shim onto crankshaft.

– Install drive plate with washer (3.4 mm).

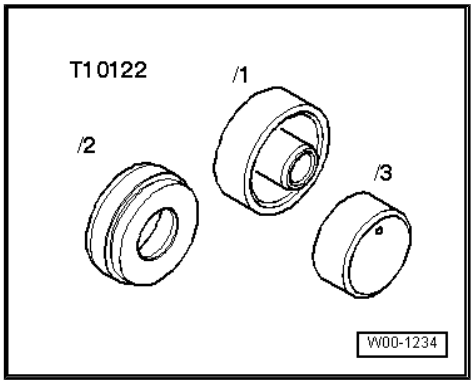
– Use new bolts for securing.

– Reverse position of counter-hold tool - 10-201- in order to tighten bolts. Specified torque: 30 Nm + 90° ($^1/_4$ turn) further.

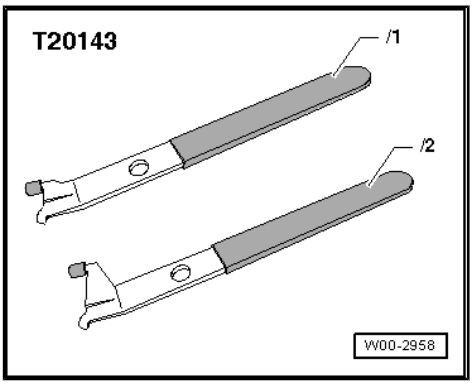
1.7 Renewing crankshaft oil seal – timing chain end

Special tools and workshop equipment required

♦ Fitting tool - T10122-



♦ Removal tool - T20143/2-

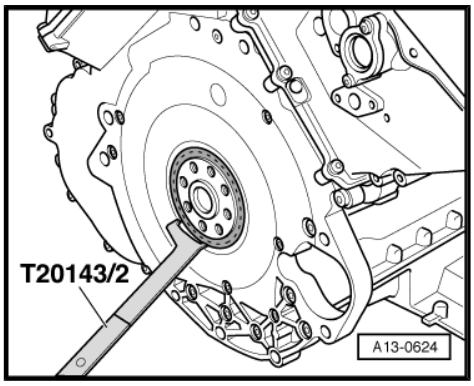


Procedure

- Engine/gearbox removed.

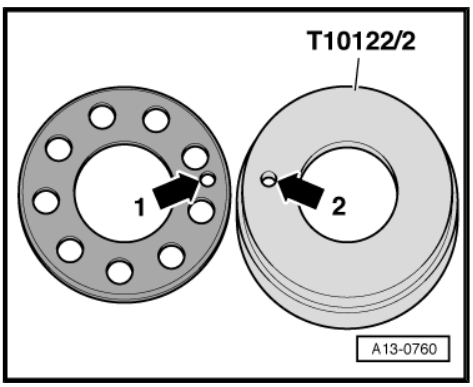
– Remove drive plate ⇒ page 48 .

– Lever out seal using removal tool - T20143/2- .

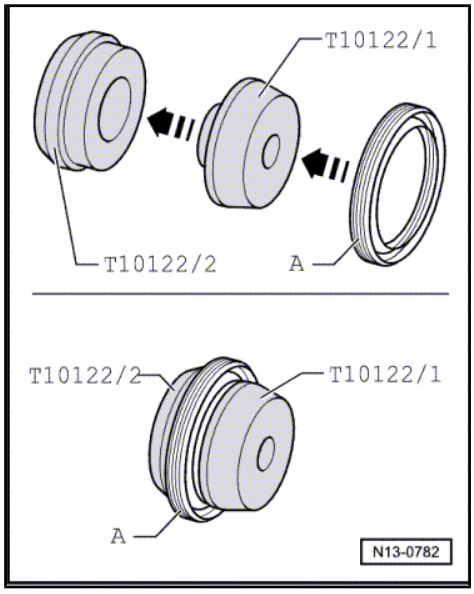


– Modify assembly sleeve - T10122/2- by drilling an 8 mm ∅ hole -arrow 2- for the dowel sleeve.

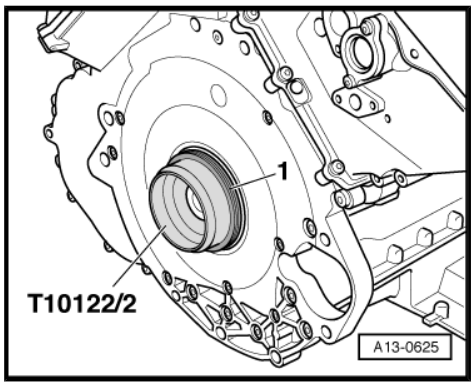
– Use hole -arrow 1- in washer as a drilling template.



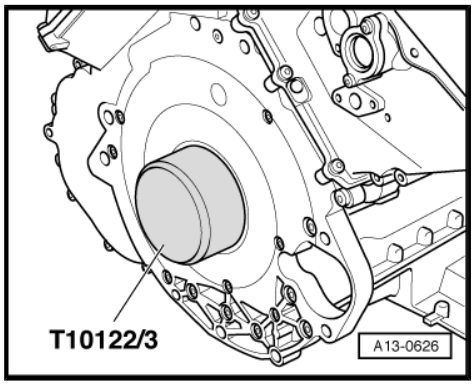
– Clean running surface and sealing surface.
– Fit guide sleeve - T10122/1- onto assembly sleeve - T10122/2- and slide oil seal -A- onto assembly sleeve.
– Remove guide sleeve.



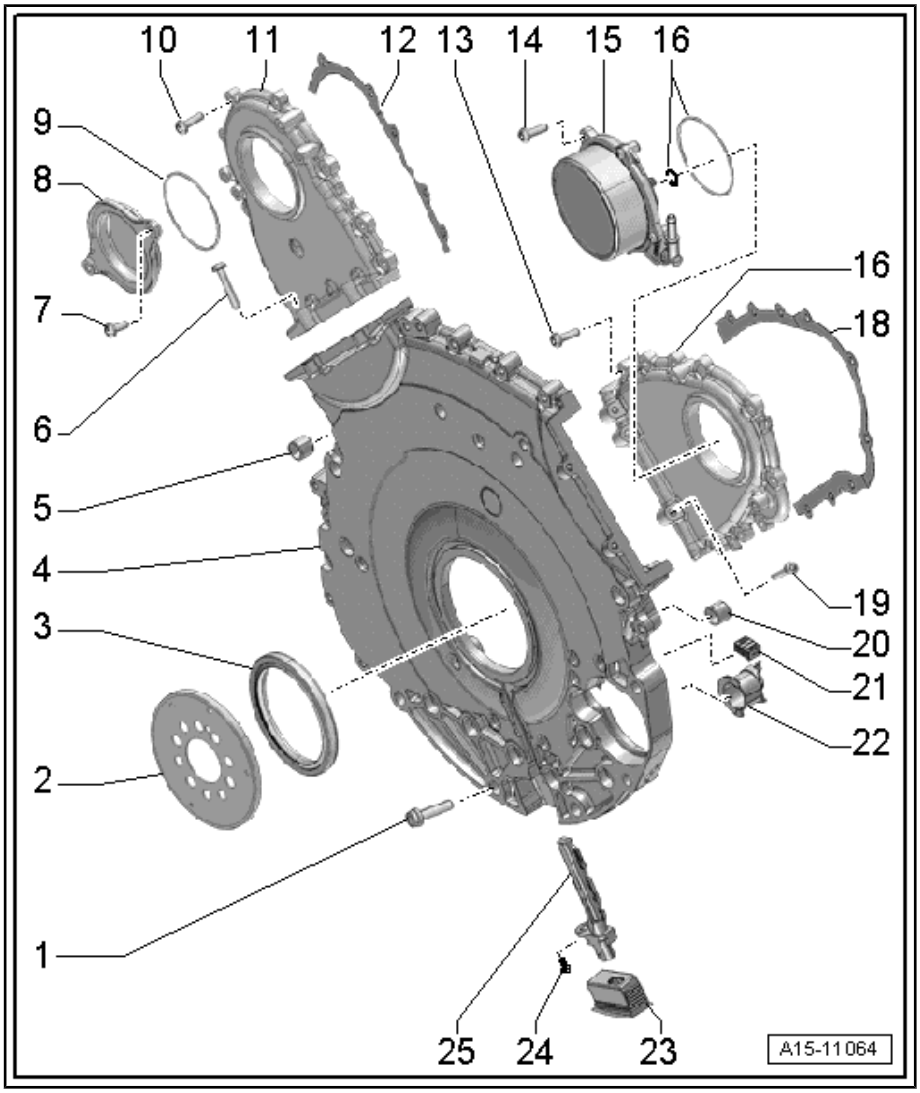
– Fit assembly sleeve with oil seal onto crankshaft.



– Press in oil seal uniformly until flush all round using press sleeve - T10122/3- .
– Install drive plate ⇒ page 48 .



1.8 Assembly overview - timing chain covers



1 - Bolt
- ❑ 9 Nm
- ❑ Note sequence when tightening ⇒ page 57 .

2 - Sender wheel
- ❑ For engine speed sender - G28-

3 - Crankshaft oil seal – timing chain end
- ❑ Removing and installing ⇒ page 48

4 - Lower timing chain cover
- ❑ Removing and installing ⇒ page 57

5 - Dowel sleeve
- ❑ Qty. 2

6 - Bolt
- ❑ Note sequence when tightening ⇒ page 62 .

7 - Bolt
- ❑ 9 Nm

8 - Cap

9 - O-ring
- ❑ Renew

10 - Bolt
- ❑ Renew
- ❑ Specified torque and tightening sequence ⇒ page 62

11 - Left timing chain cover
- ❑ Removing and installing ⇒ page 52

12 - Seal
- ❑ Renew

13 - Bolt
- ❑ 9 Nm
- ❑ Note sequence when tightening ⇒ page 61 .

14 - Bolt
- ❑ 9 Nm

15 - Vacuum pump

16 - O-ring
- ❑ Renew

17 - Right timing chain cover
- ❑ Removing and installing ⇒ page 54

18 - Seal
- ❑ Renew

19 - Bolt
- ❑ Note sequence when tightening ⇒ page 61 .

20 - Dowel sleeve

- ❑ Qty. 2

21 - Sealing element

- ❑ Qty. 2

22 - Cover

- ❑ For starter

23 - Cover

- ❑ For engine speed sender - G28-

24 - Bolt

- ❑ 9 Nm

25 - Engine speed sender - G28-

- ❑ Removing and installing ⇒ page 47

1.9 Removing and installing timing chain cover (left)

Special tools and workshop equipment required

- ♦ Hand drill with plastic brush
- ♦ Safety glasses
- ♦ Sealant ⇒ Electronic parts catalogue

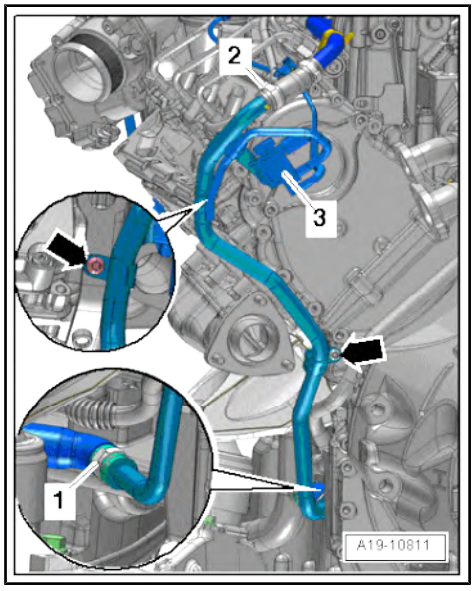
Removing

– Remove left intermediate pipe ⇒ page 335 .

– Take exhaust gas recirculation cooler changeover valve 2 - N381- -item 3- out of retainer.

– Unscrew bolts -arrows-.

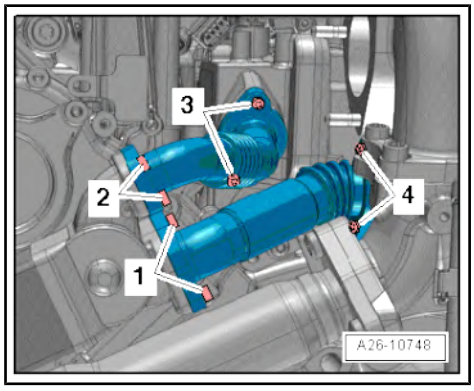
– Remove coolant hose -2- and press left rear coolant pipe to side.



Note

Disregard -item 1-.

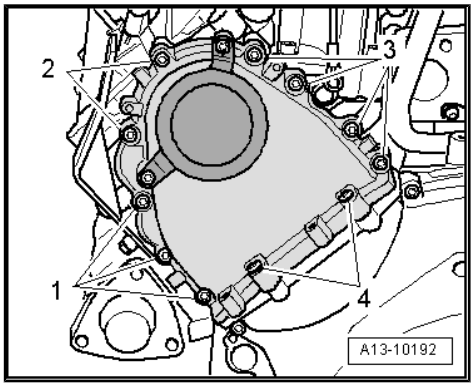
– Unscrew bolts -3- and -4- and remove pipes for exhaust gas recirculation.



Note

-Items 1, 2- can be disregarded.

– Unscrew bolts -1 … 4- and detach left cover for timing chain.



Installing

Note

Renew bolts for left cover for timing chain.

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

Caution

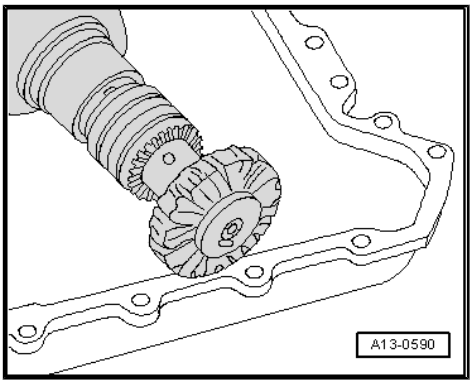
Danger of soiling lubrication system.

- ***Cover open parts of engine.***

WARNING

Risk of eye injury.

- ***Wear safety goggles.***



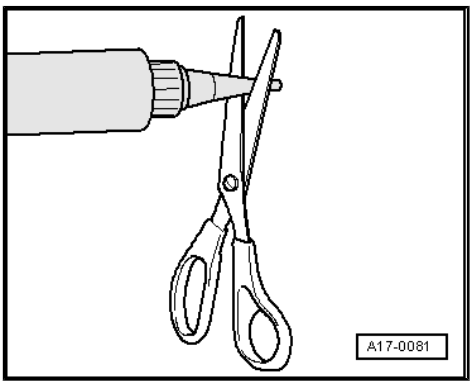
– Remove remaining sealant on timing chain cover and cylinder head using rotating plastic brush or similar.

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

Note

Check the expiry date of the sealant.

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



Caution

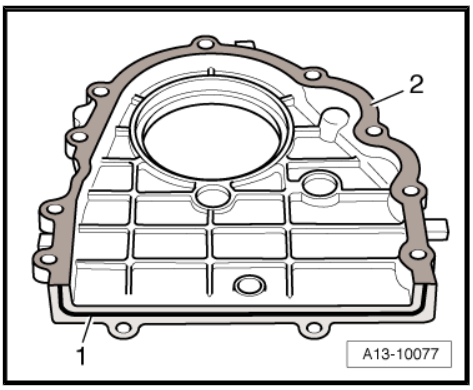
Danger of blocking lubrication system with excess sealant.

- ***Do not apply a sealant bead that is thicker than prescribed.***

– Apply sealant bead to clean sealing surface of left timing chain cover as illustrated.

- The groove -1- on the sealing surface must be completely filled with sealant.
- The bead of sealant must project 1.5 … 2.0 mm above the sealing surface.

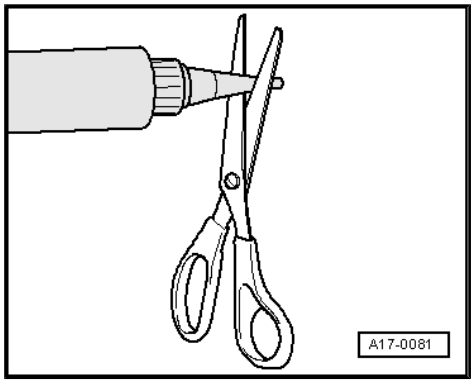
– Fit gasket -2-.



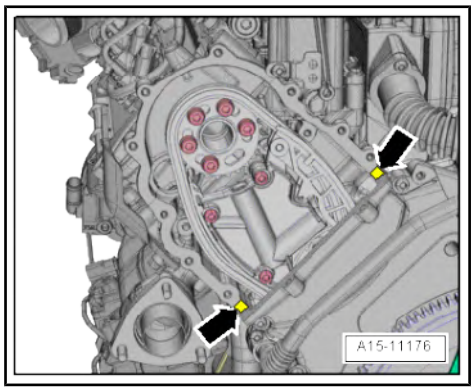
Note

Check the expiry date of the sealant.

– Cut off nozzle on tube at front marking (∅ of nozzle approx. 3 mm).



– Apply a ∅ 3 mm bead of sealant to each transition between cylinder head and bottom timing chain cover -arrows-, as shown in the illustration.



Caution

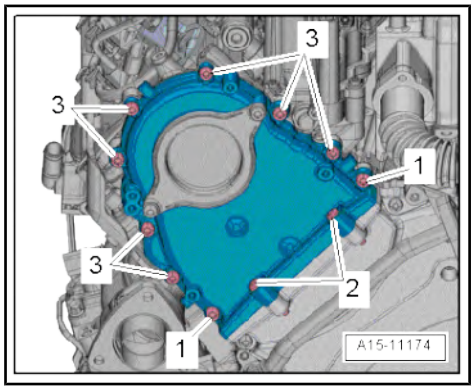
Danger of blocking lubrication system with excess sealant.

- ***Do not apply a sealant bead that is thicker than prescribed.***

Note

The timing chain cover must be installed within 5 minutes after sealant has been applied.

– Fit timing chain cover (left) and tighten bolts ⇒ page 62 .



Now continue installing in reverse order of removal, observing the following:

– Install rear left coolant pipe ⇒ page 175 .

– Install left intermediate pipe ⇒ page 335 .

- Specified torques
⇒ “1.2 Assembly overview - turbocharger”, page 209 ,
⇒ “2.1 Assembly overview - exhaust gas recirculation system”, page 339

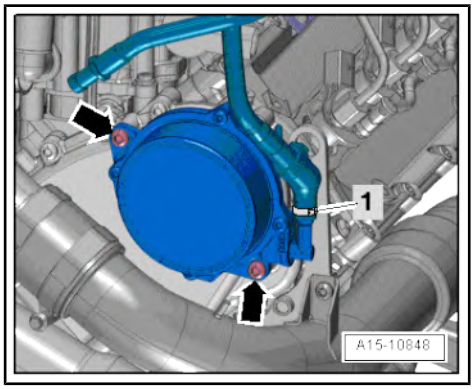
1.10 Removing and installing timing chain cover (right)

Special tools and workshop equipment required

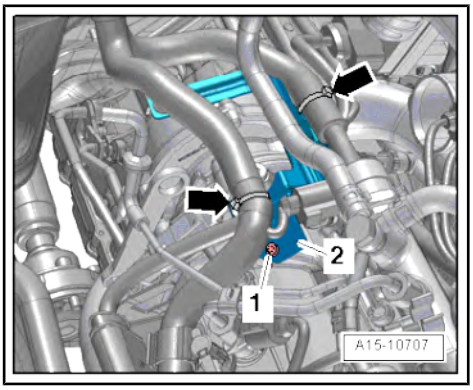
- Hand drill with plastic brush
- Safety glasses
- Sealant ⇒ Electronic parts catalogue

Removing

– Remove vacuum pump ⇒ page 103 .



– Move electrical wiring clear -arrows-.
– Unscrew bolt -1- and remove retainer -2-.



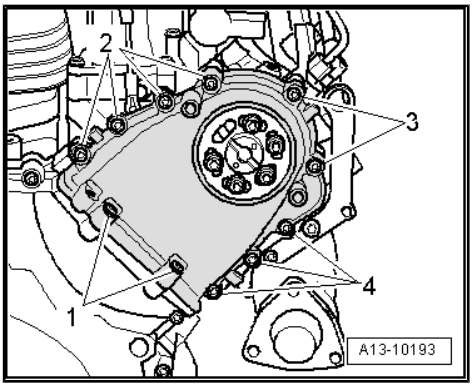
– Unscrew bolts -1 … 4- and detach right cover for timing chain.

Installing

Note

Renew bolts for right cover for timing chain.

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



Caution

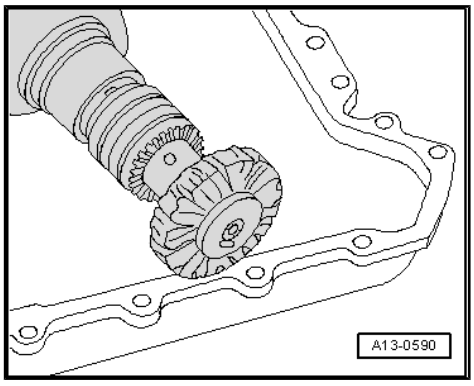
Danger of soiling lubrication system.

- ***Cover open parts of engine.***

WARNING

Risk of eye injury.

- ***Wear safety goggles.***

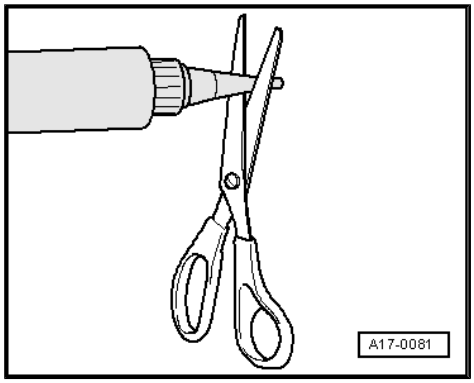


– Remove remaining sealant on timing chain cover and cylinder head using rotating plastic brush or similar.
– Clean sealing surfaces; they must be oil and grease free.

Note

Check the expiry date of the sealant.

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



Caution

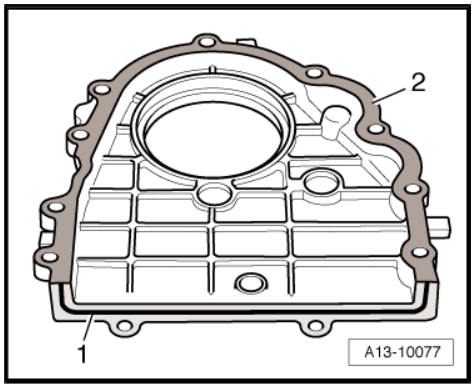
Danger of blocking lubrication system with excess sealant.

- ***Do not apply a sealant bead that is thicker than prescribed.***

– Apply sealant bead to clean sealing surface of right timing chain cover as illustrated.

- The groove -1- on the sealing surface must be completely filled with sealant.
- The bead of sealant must project 1.5 … 2.0 mm above the sealing surface.

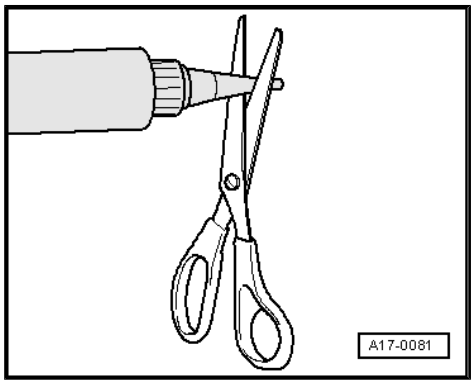
– Fit gasket -2-.



Note

Check the expiry date of the sealant.

– Cut off nozzle on tube at front marking (∅ of nozzle approx. 3 mm).

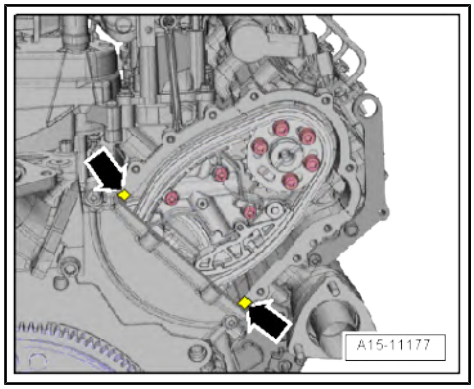


– Apply a ∅ 3 mm bead of sealant to each transition between cylinder head and bottom timing chain cover -arrows-, as shown in the illustration.

Caution

Danger of blocking lubrication system with excess sealant.

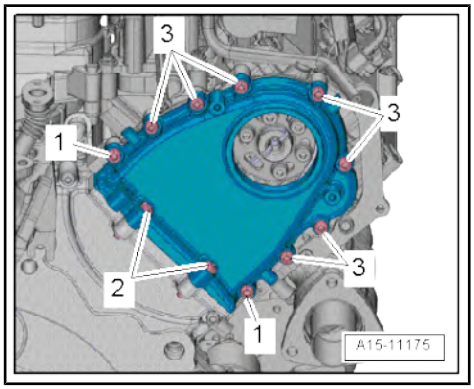
- ***Do not apply a sealant bead that is thicker than prescribed.***



Note

The timing chain cover must be installed within 5 minutes after sealant has been applied.

– Fit timing chain cover (right) and tighten bolts ⇒ page 63 .



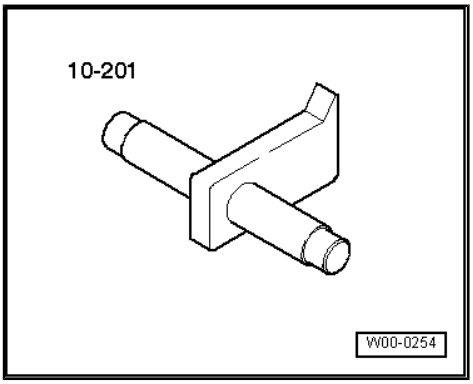
Now continue installing in reverse order of removal, observing the following:

– Install vacuum pump ⇒ page 103 .

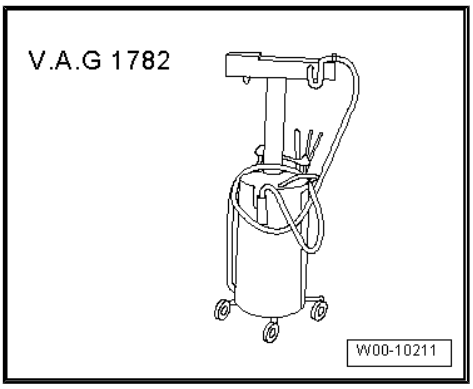
1.11 Removing and installing timing chain cover (bottom)

Special tools and workshop equipment required

♦ Counter-hold tool - 10-201-



♦ Used oil collector and extractor - V.A.G 1782-



♦ Hand drill with plastic brush

♦ Safety glasses

♦ Sealant ⇒ Parts catalogue

Removing

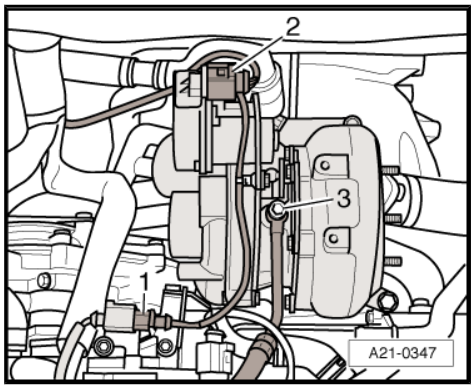
Note

The procedure refers to the removal and installation of all timing chain covers. Fit cable ties in all the same places during installation from which they were detached or cut during removal.

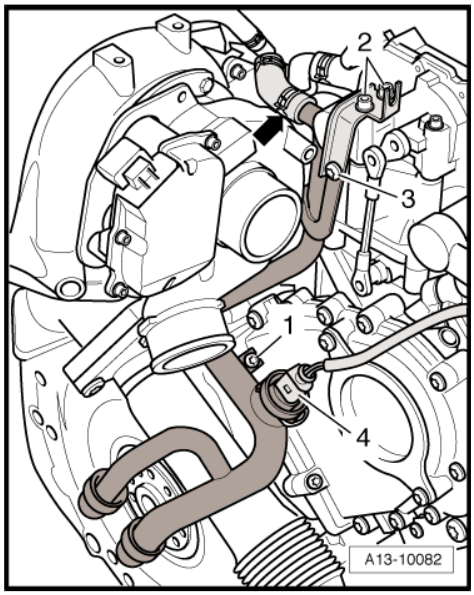
– Drain engine oil.

– Remove engine ⇒ page 3 .

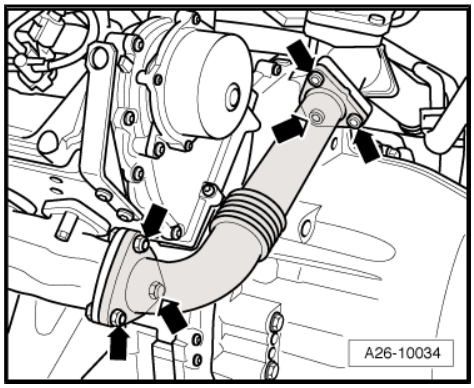
– Separate engine from gearbox ⇒ page 24 .
– Secure engine to engine stand ⇒ page 24 .
– Unbolt drive plate ⇒ page 48 .
– Take out shim located behind.
– Remove charge air pipe with connecting hose for crankcase breather.
– Separate connectors -1- and -2-.
– Unscrew banjo bolt -3- for oil supply line.



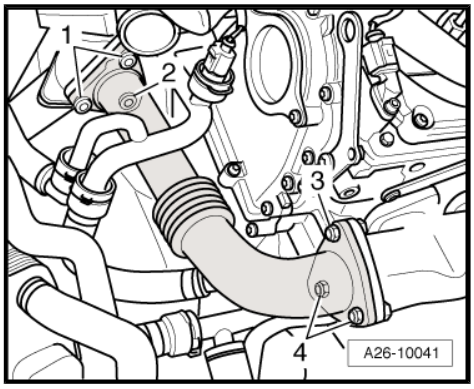
– Disconnect connector -4-.
– Remove bolts -2- and -3- and remove bracket.
– Remove bolt -1-.
– Detach coolant pipe (rear) from coolant hose -arrow-.
– Remove oil return line from turbocharger ⇒ Item 26 (page 211) .



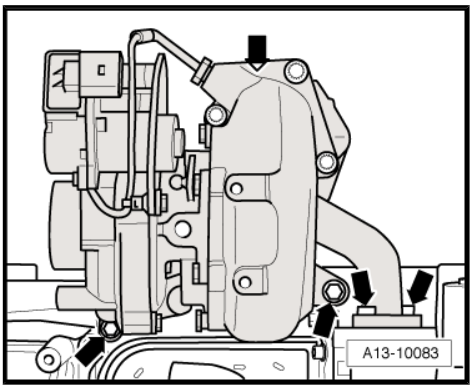
– Unscrew nuts and bolts -arrows- and detach left intermediate pipe.



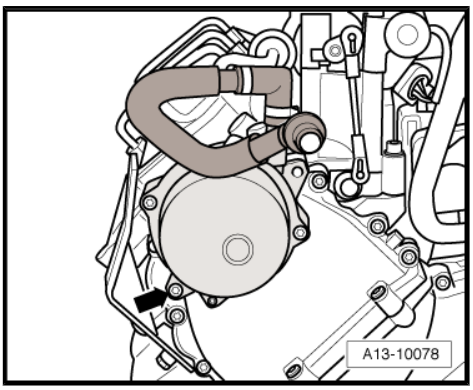
– Unscrew bolts and nuts -1 … 4- and detach right intermediate pipe.



– Unscrew bolts -arrows- and remove turbocharger.



– Unscrew bolt -arrow- and remove vacuum pump.



Note

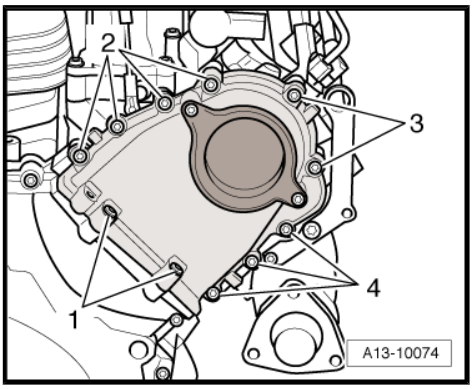
- *The figure shows the location of the vacuum pump on cylinder bank 2 (left side) on vehicles with engine code CASA or CASD.*
- *The vacuum pump is installed on cylinder bank 1 (right side) on vehicles with engine code CATA.*

Vehicles with engine code CATA

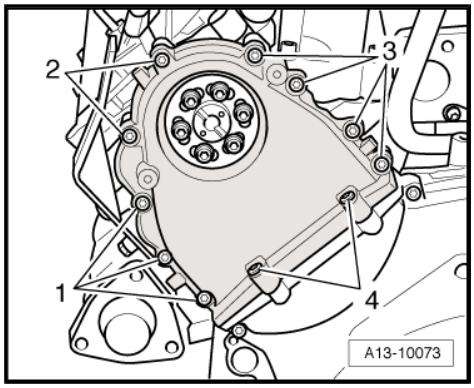
– Remove supplementary cooler for exhaust gas recirculation system ⇒ page 352 .

Continuation for all engine codes

– Unscrew bolts -1 … 4- and remove right timing chain cover.



– Unscrew bolts -1 … 4- and remove left timing chain cover.



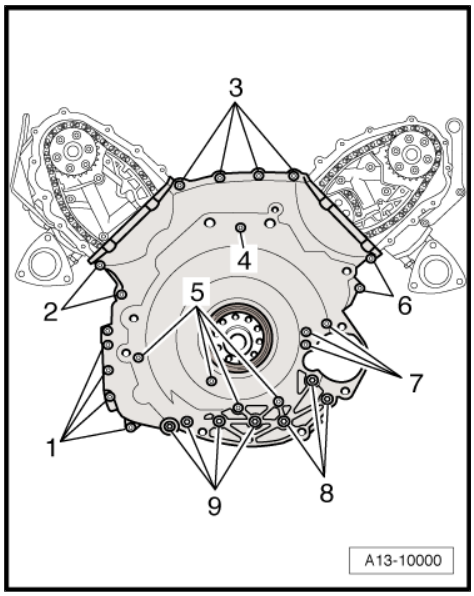
– Unscrew bolts -1 … 9- and remove lower timing chain cover.

– Press out crankshaft oil seal (rear) from timing chain cover.

Installing

Note

- *Renew gaskets, seals and O-rings.*
- *Reinstall all cable ties in the same locations when assembling.*



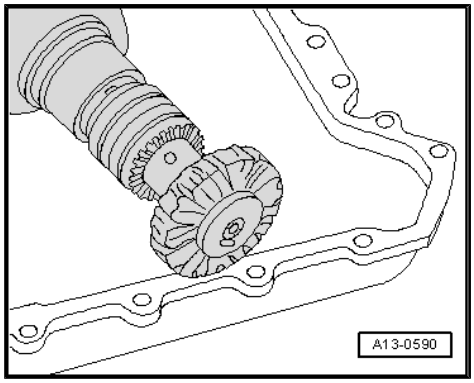
– Remove old sealant from grooves in timing chain covers and from sealing surfaces.

WARNING

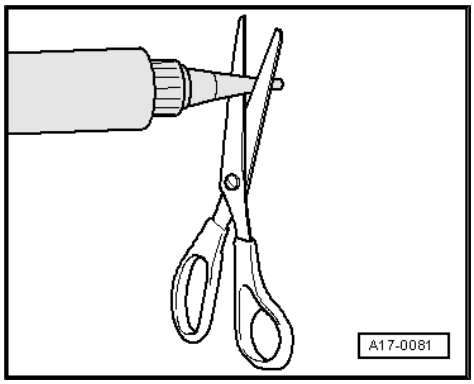
Wear protective goggles.

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

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



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



Note

- *The sealant beads must not be thicker than specified, otherwise excess sealant could enter the sump and clog the strainer in the oil pump.*
- *The timing chain covers must be installed within 5 minutes after applying sealant.*

– Insert sealing elements -2- and -5-

– Apply sealant beads -1- and -4- to clean sealing surface of lower timing chain cover as illustrated.

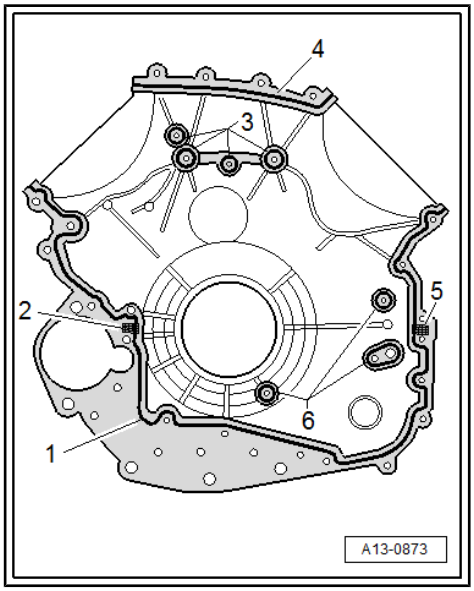
• The grooves on the sealing surfaces must be completely filled with sealant.

• The bead of sealant must project 1.5 … 2.0 mm above the sealing surface.

• The bead of sealant round drillings -3- and -6- must be 1.5 … 2.0 mm thick.

– Check whether the 2 dowel sleeves are fitted in the cylinder block; install if necessary.

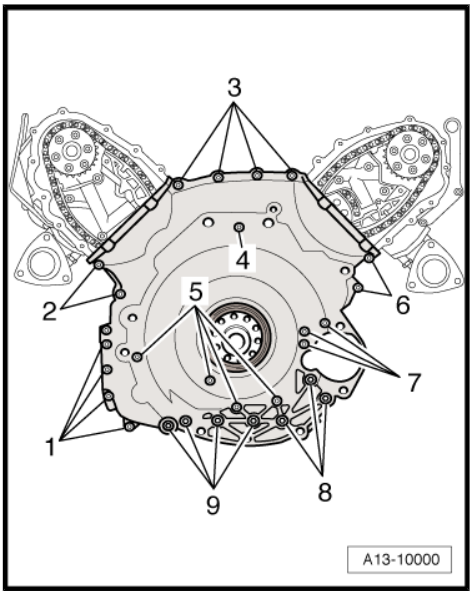
– Fit lower timing chain cover and tighten bolts as follows:



Cover at bottom for timing chain - Specified torque and sequence

– Tighten bolts in 3 stages in the sequence shown:

Stage	Bolts	Specified torque/turning further angle
1.	-1 … 9-	5 Nm tightened diagonally from inside to outside
2.	-1 … 7-	9 Nm tightened diagonally from inside to outside
3.	-8- and -9-	23 Nm

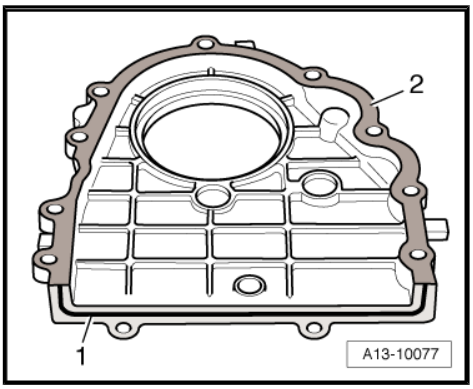


– Apply bead of sealant onto clean sealing surface of left timing chain cover as illustrated.

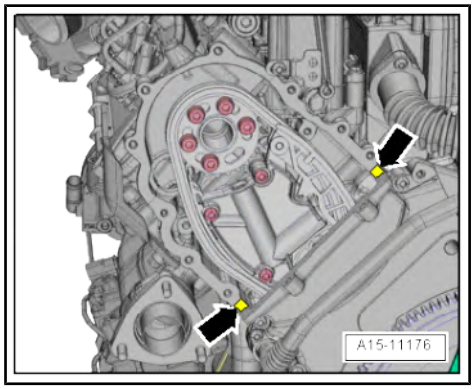
• The groove -1- on the sealing surface must be completely filled with sealant.

• The bead of sealant must project 1.5 … 2.0 mm above the sealing surface.

– Fit gasket -2-.



– Apply a ∅ 3 mm bead of sealant to each transition between cylinder head and bottom timing chain cover -arrows-, as shown in the illustration.



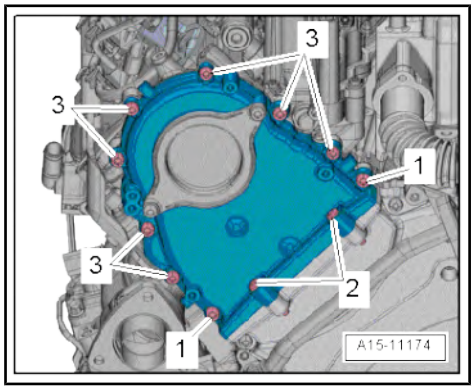
Caution

Danger of blocking lubrication system with excess sealant.

- *Do not apply a sealant bead that is thicker than prescribed.*

– Fit left timing chain cover and tighten bolts as follows:

Cover on left for timing chain - Specified torque and sequence



Note

If a further tightening angle is specified for certain bolts, these must be renewed.

– Tighten bolts in 4 stages in the sequence shown:

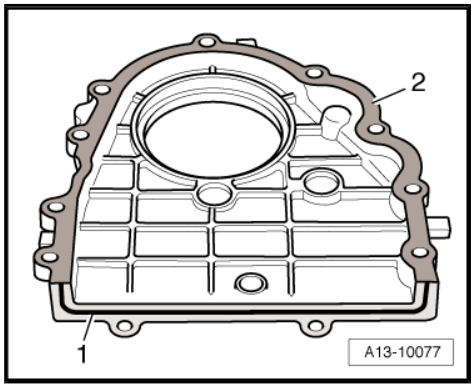
Stage	Bolts	Specified torque
1.	-1-	3 Nm
2.	-2-	9 Nm
3.	-1-	9 Nm
4.	-3-	Tighten to 9 Nm in diagonal sequence

Right timing chain cover

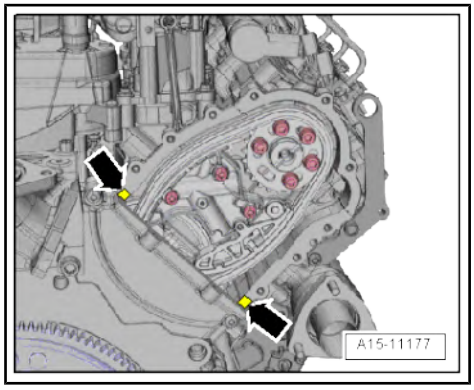
– Apply bead of sealant onto clean sealing surfaces of right timing chain cover as illustrated.

- The groove -1- on the sealing surface must be completely filled with sealant.
- The bead of sealant must project 1.5 … 2.0 mm above the sealing surface.

– Fit gasket -2-.



– Apply a ∅ 3 mm bead of sealant to each transition between cylinder head and bottom timing chain cover -arrows-, as shown in the illustration.



Caution

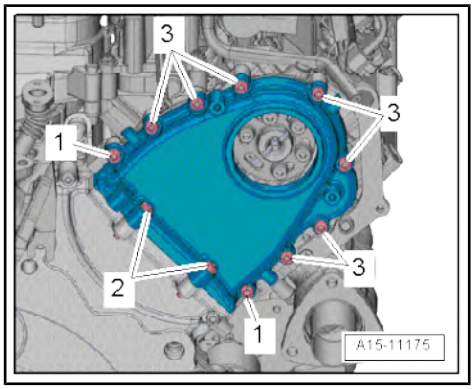
Danger of blocking lubrication system with excess sealant.

- *Do not apply a sealant bead that is thicker than prescribed.*

– Fit timing chain cover (right) and tighten bolts as follows:

Stage	Bolts	Specified torque
1.	-1-	3 Nm
2.	-2-	9 Nm
3.	-1-	9 Nm
4.	-3-	Tighten to 9 Nm in diagonal sequence

Continue installation in reverse order of removal.



1.12 Assembly overview - balance shaft

Removing and installing balance shaft ⇒ page 63 .

1 - Sleeve bearing

2 - Bolt

- ❑ 60 Nm
- ❑ Counterhold with diesel injection pump locking pin - 3359- when loosening and tightening.

3 - Balance weight - timing chain end

4 - Bolt

- ❑ 9 Nm

5 - Bearing plate

6 - Balance weight – belt pulley end –

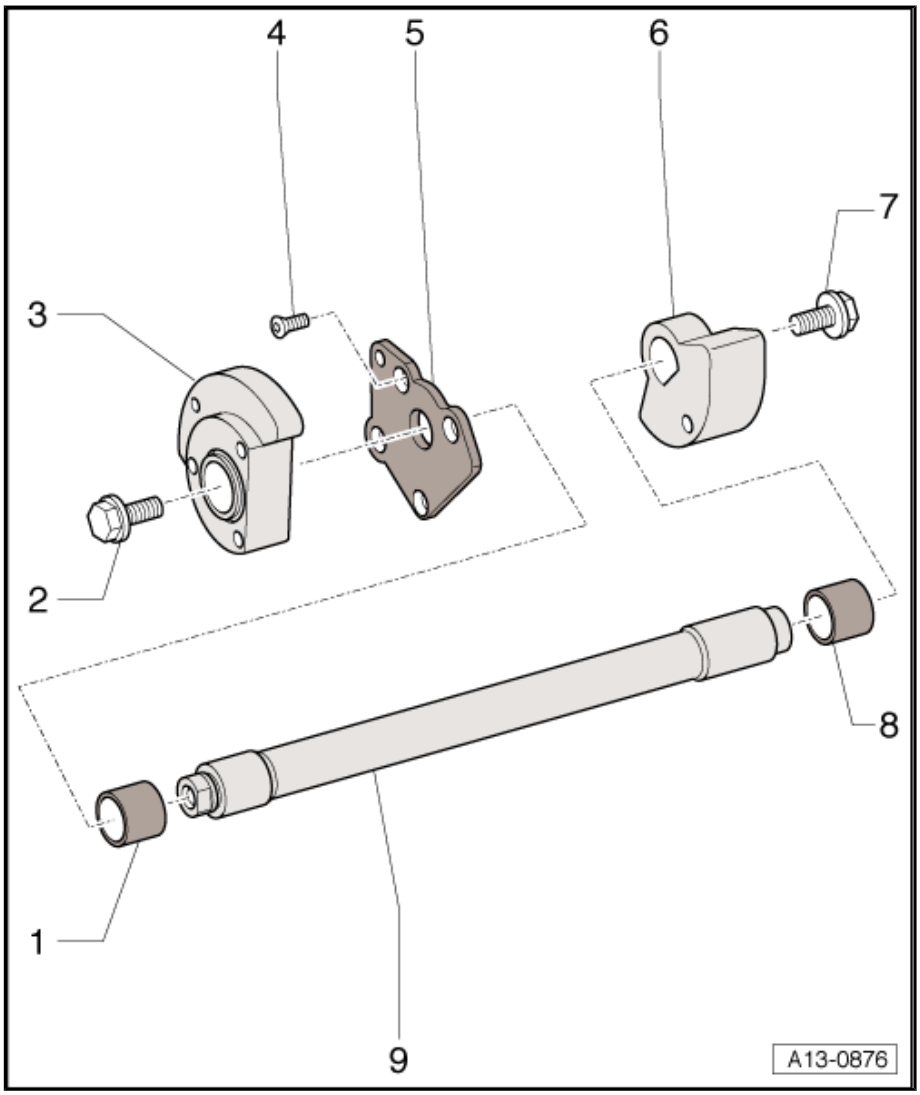
7 - Bolt

- ❑ 60 Nm
- ❑ Counterhold with diesel injection pump locking pin - 3359- when loosening and tightening.

8 - Sleeve bearing

9 - Balancer shaft

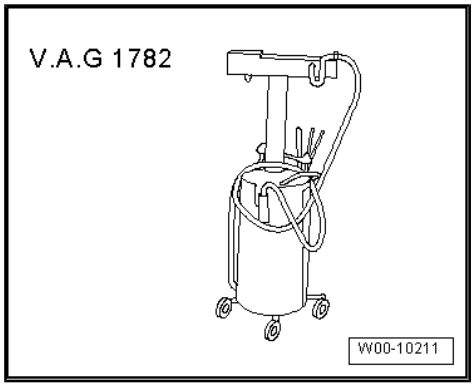
- ❑ Removing and installing ⇒ page 63



1.13 Removing and installing balance shaft

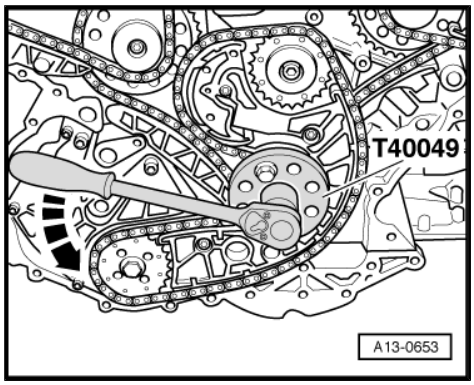
Special tools and workshop equipment required

♦ Used oil collector and extractor - V.A.G 1782-

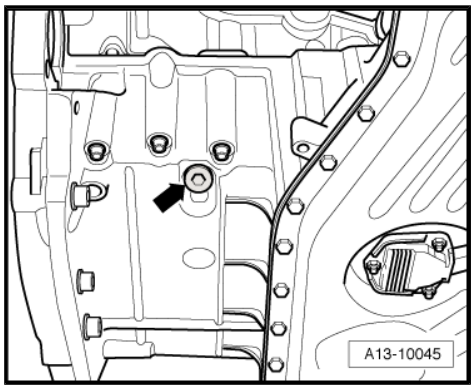


Removing

– Drain engine oil.
– Remove engine ⇒ page 3 .
– Separate engine from gearbox ⇒ page 24 .
– Secure engine to engine stand ⇒ page 24 .
– Unbolt drive plate ⇒ page 48 .
– Take out shim located behind.
– Remove timing chain covers ⇒ page 57 .
– Remove front sealing flange ⇒ page 43 .
– Attach adapter - T40049- to rear end of crankshaft using two old securing bolts for drive plate.



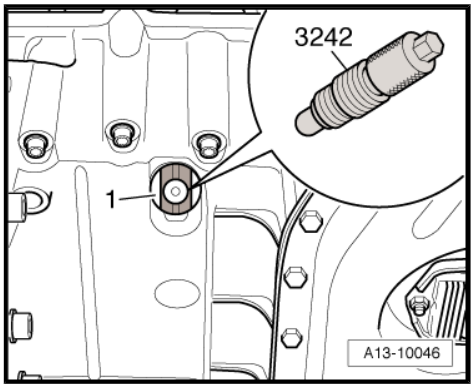
– Lay a cloth under upper part of sump to catch engine oil.
– Unscrew plug from upper part of sump.



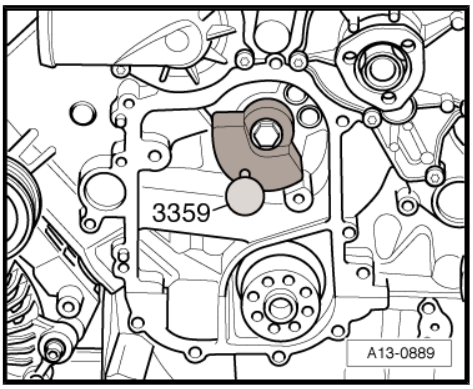
WARNING

To avoid any risk of injury, do not rotate crankshaft while feeling for TDC hole with your finger.

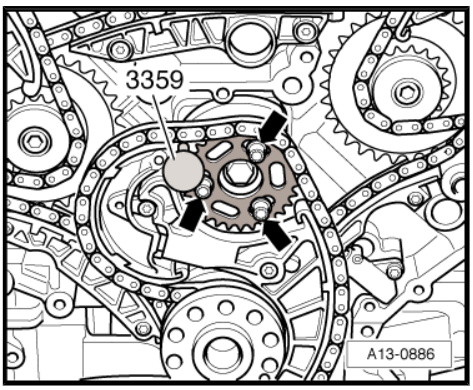
– Screw locking pin - 3242- into threaded hole (20 Nm); if necessary, turn crankshaft -1- backwards and forwards slightly to fully centre locking pin.



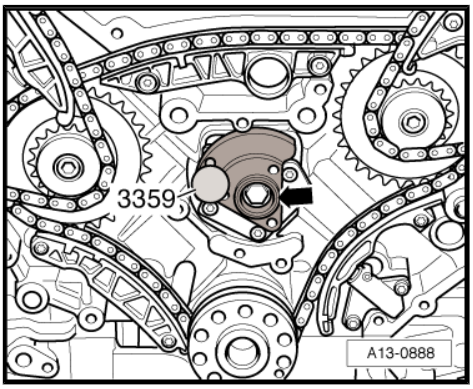
– Lock balance shaft at front of engine with diesel injection pump locking pin - 3359-
– Unscrew bolt and remove balance weight from balance shaft.



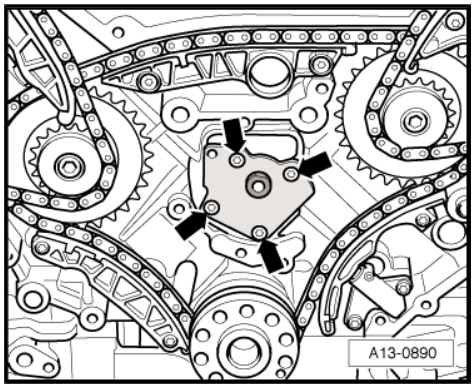
– Lock balance shaft at rear of engine with diesel injection pump locking pin - 3359-
– Unscrew bolts -arrows- and remove sprocket from balance weight.



– Unscrew bolt -arrow- and remove balance weight from balance shaft.



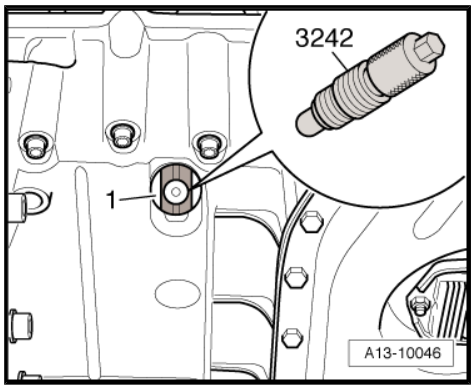
– Unscrew bolts -arrows- and remove bearing plate for balance shaft.
– Pull balance shaft out of cylinder block.



Installing

• Crankshaft locked in TDC position with locking pin - 3242- .

Install in reverse order of removal.



2 Chain drive

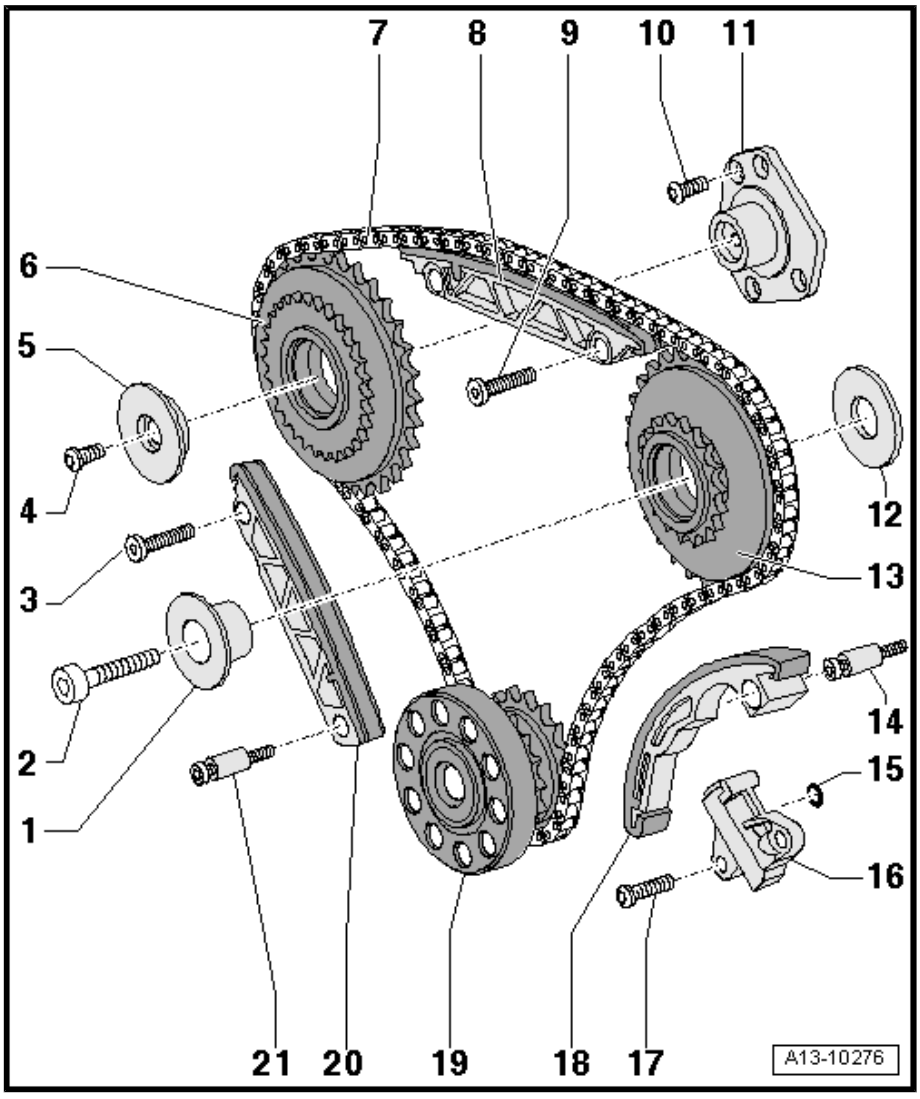
⇒ “2.1 Assembly overview - drive chain for valve gear”, page 67 .

⇒ “2.2 Removing and installing drive chain for valve gear”, page 68 .

⇒ “2.3 Assembly overview - chain for balance shaft and oil pump”, page 69 .

⇒ “2.4 Removing and installing chain for balance shaft and oil pump”, page 71 .

2.1 Assembly overview - drive chain for valve gear



1 - Bearing mounting for drive sprocket

2 - Bolt

- ❑ 45 Nm

3 - Bolt

- ❑ Renew
- ❑ 5 Nm + 90° (1/4 turn further)

4 - Bolt

- ❑ Renew
- ❑ 5 Nm + 90° (1/4 turn further)

5 - Thrust washer for drive sprocket

6 - Drive sprocket for left timing chain

7 - Drive chain for valve gear

- ❑ Before removing, mark running direction with paint
- ❑ Removing and installing ⇒ page 68

8 - Slide rail

- ❑ Observe installation position

9 - Bolt

- ❑ Renew
- ❑ 5 Nm + 90° (1/4 turn further)

10 - Bolt

- ❑ Renew
- ❑ 5 Nm + 90° (1/4 turn further)

11 - Bearing bracket for drive sprocket

12 - Thrust washer

13 - Drive sprocket for right timing chain

14 - Locating pin

- ❑ 12 Nm
- ❑ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .

15 - O-ring

- ❑ Renew

16 - Chain tensioner

17 - Bolt

- ❑ 12 Nm

18 - Tensioning rail

19 - Crankshaft

- ❑ With sprockets.

20 - Slide rail

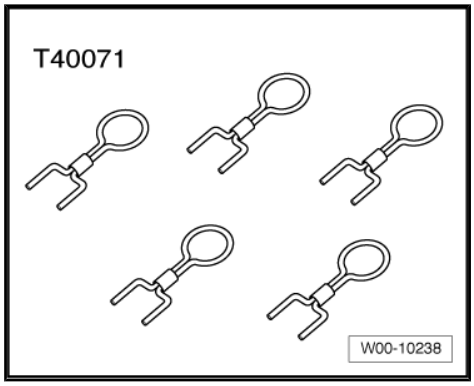
21 - Locating pin

- ❑ 12 Nm
- ❑ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .

2.2 Removing and installing drive chain for valve gear

Special tools and workshop equipment required

- ♦ Pin - T40071-

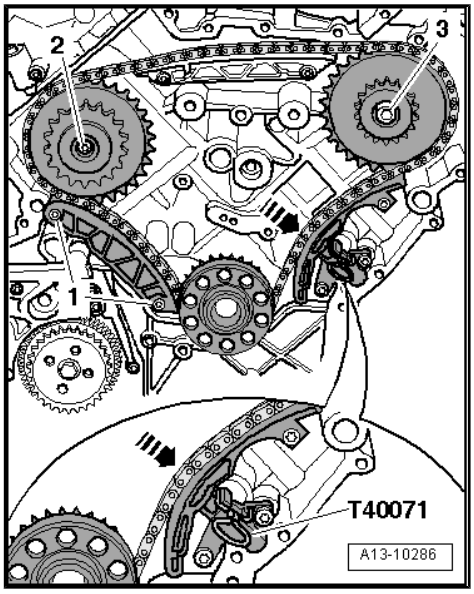


- ♦ Drill bit, ∅ 3.3 mm

Removing

- • Gearbox is removed.
- – Remove drive plate ⇒ page 48 .
- – Remove timing chain covers ⇒ page 57 .
- – Remove camshaft timing chains ⇒ page 125 .
- – Remove chain for auxiliary drives ⇒ page 71 .

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



Caution

Drive chain may be destroyed if it runs in the opposite direction to the direction it ran before.

- ***If chain is to be reinstalled: mark direction of rotation with a coloured arrow.***

– Unscrew bolts -1- and remove guide rail.

– Unscrew bolts -2- and -3- and remove sprockets with drive chain.

Installing

• Specified torques ⇒ page 67 .

Install in reverse order of removal, observing the following.

– Install chain for auxiliary drives ⇒ page 71 .

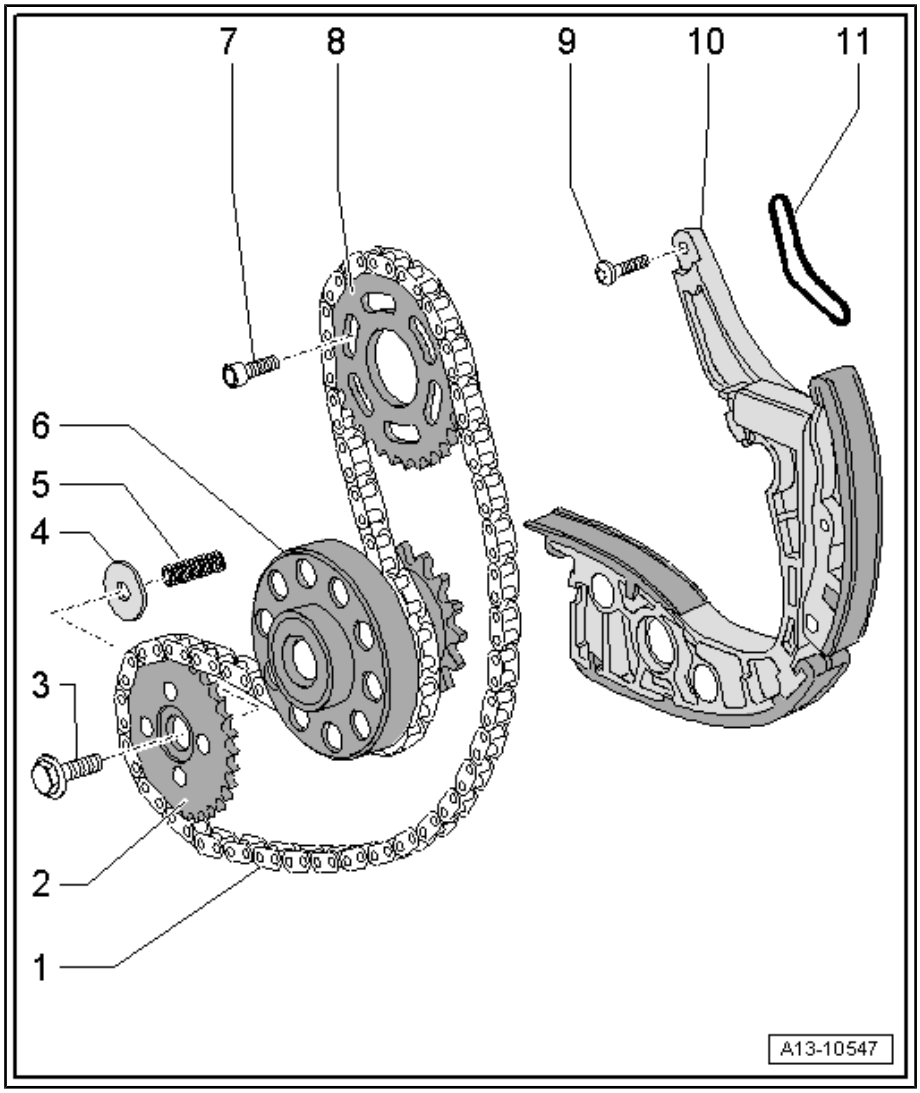
– Install camshaft timing chains ⇒ page 125 .

– Install timing chain covers ⇒ page 57 .

– Install drive plate ⇒ page 48 .

– Replenish engine oil and check oil level ⇒ Maintenance ; Booklet ; Engine oil: Drain or extract; Renewing oil filter and replenishing engine oil .

2.3 Assembly overview - chain for balance shaft and oil pump



1 - Drive chain for auxiliary drives

- ❑ Removing and installing ⇒ page 71

2 - Drive sprocket for oil pump

- ❑ Installation position: side with lettering towards engine.

3 - Bolt

- ❑ 62 Nm
- ❑ If bolt cannot be tightened to torque, remove lower part of sump with baffle plate and counterhold oil pump drive shaft using an open-end spanner.

4 - Thrust washer

5 - Compression spring

6 - Crankshaft

7 - Bolt

- ❑ 23 Nm

8 - Chain sprocket for balance shaft

- ❑ Installation position: side with lettering towards gearbox.

9 - Bolt

- ❑ 9 Nm
- ❑ Qty. 4

10 - Chain tensioner

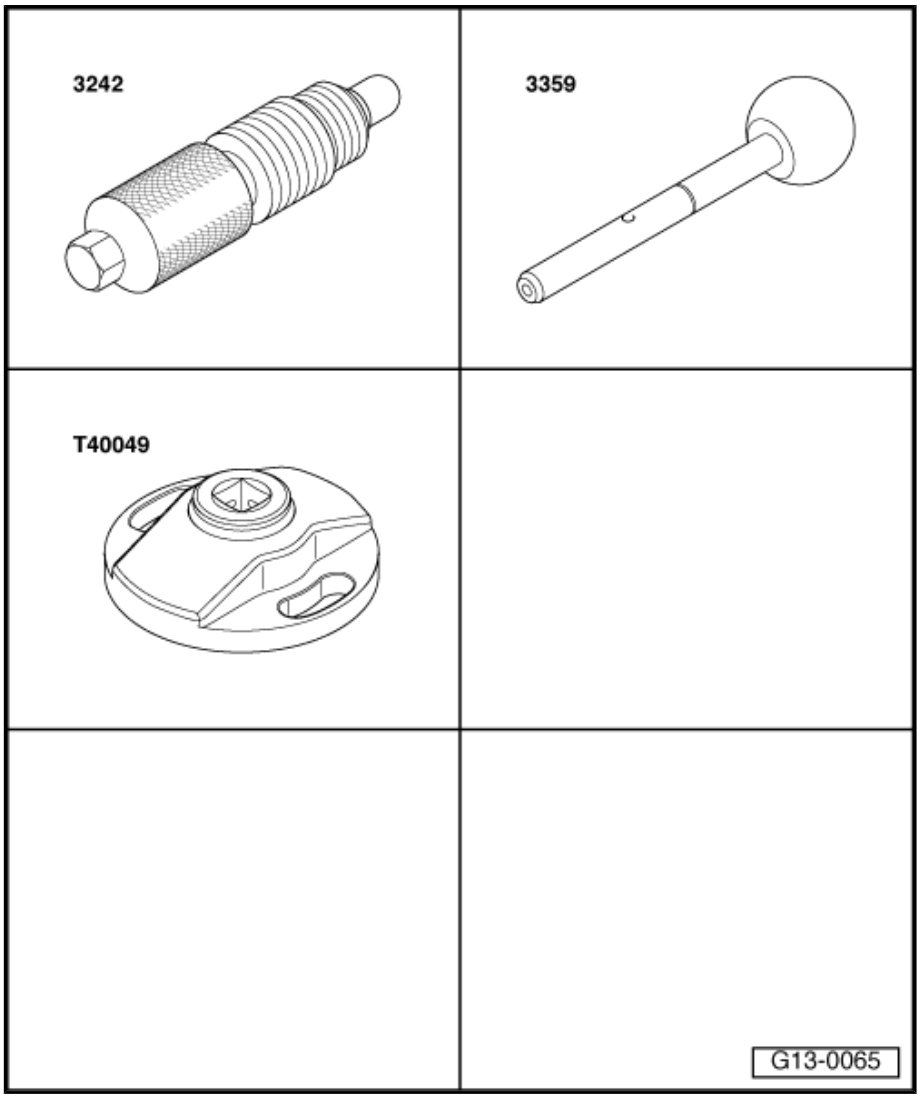
- ❑ With guide rail.

11 - Seal

- ❑ Renew

2.4 Removing and installing chain for balance shaft and oil pump

Special tools and workshop equipment required

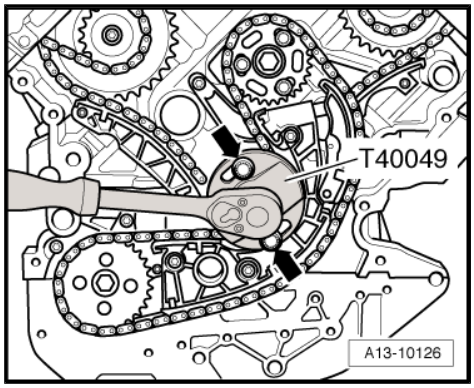


- ♦ Locating bolt - 3242-
- ♦ Diesel injection pump locking pin - 3359-
- ♦ Special wrench - T40049-
- ♦ Drill bit, ∅ 3.3 mm

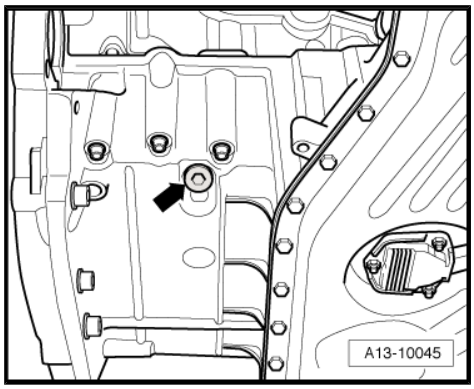
Removing

- • Gearbox is removed.
- – Remove drive plate ⇒ page 48 .
- – Remove timing chain covers ⇒ page 57 .

– Install special wrench - T40049- on rear of crankshaft, use 2 old drive plate bolts -arrows- for this.



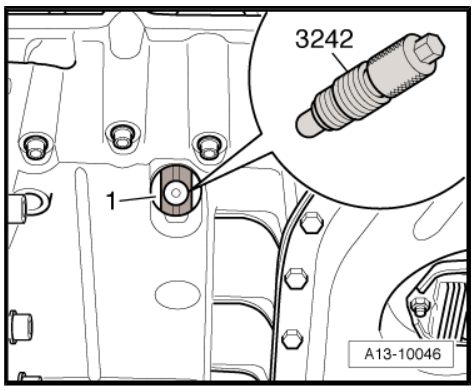
– Unscrew plug -arrow- from upper part of sump.



WARNING

Risk of injury when feeling for "TDC" hole with finger.

- *Do not turn crankshaft -1-.*

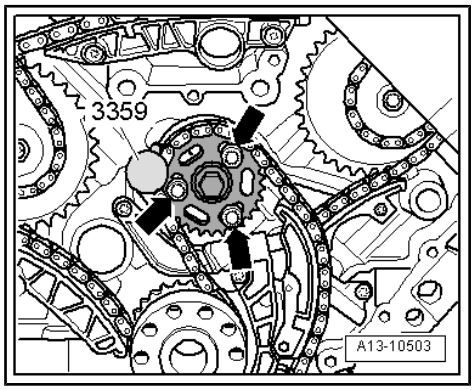


– Screw locking pin - 3242- into hole (20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centre locking pin.

Caution

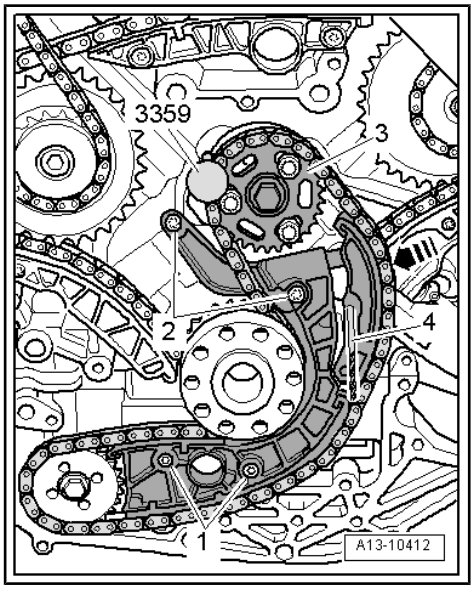
Chain for auxiliary drive may be destroyed if it runs in the opposite direction to the direction it ran before.

- *If chain for auxiliary drive is to be reinstalled: mark direction of rotation with a coloured arrow.*



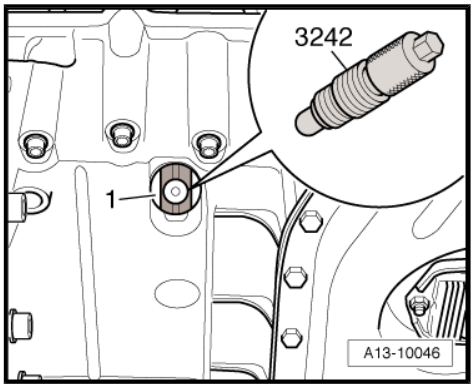
– Lock balance shaft on rear of engine with diesel injection pump locking pin - 3359- and loosen bolts -arrows- for balance shaft sprocket.

– Wrap insulating tape around cutting end and cutting edges of 3.3 mm ∅ drill to prevent flesh wounds.
– Press guide rail of chain tensioner in direction of -arrow- and lock chain tensioner by inserting 3.3 mm ∅ drill bit -item 4-.
– Remove bolts -1- and -2- and take out chain tensioner, balance shaft sprocket -3- and chain.

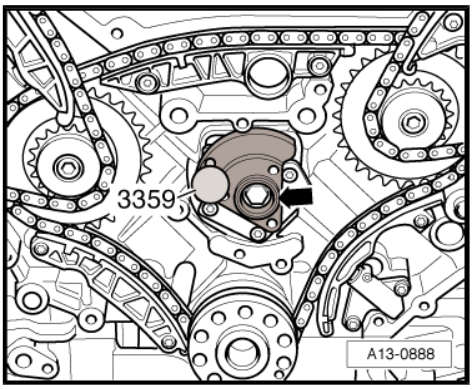


Installing

- Specified torques ⇒ page 69 .
- Crankshaft -1- locked at “TDC” with locking pin - 3242- .



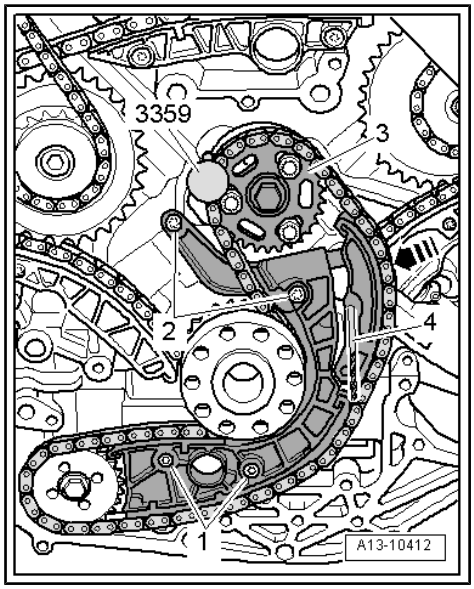
– Lock balance shaft -arrow- on rear of engine with diesel injection pump locking pin - 3359- .



– Install chain tensioner with chain and balance shaft sprocket.

• Elongated holes in sprocket -3- must be aligned centrally over threaded holes in balance shaft.

– Tighten chain tensioner bolts -1- and -2-.

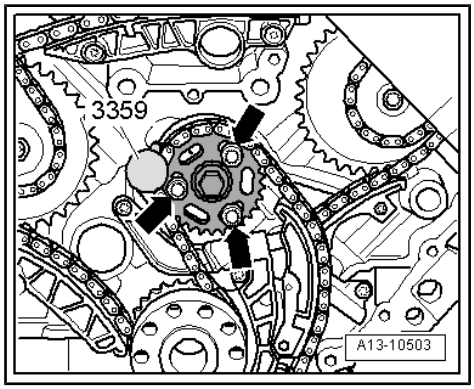


Note

Disregards -item 4- and -arrows-.

– Screw in sprocket bolts -arrows- loosely.

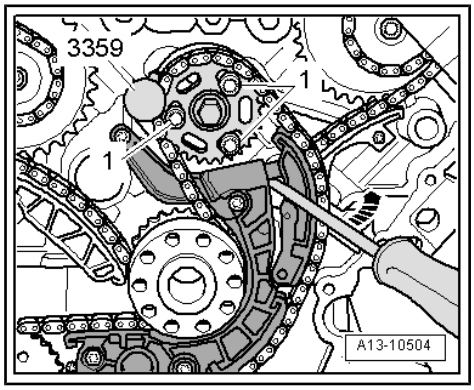
• It should just be possible to turn sprocket on balance shaft without axial movement.



– Pull drill bit out of locating hole, this releases the chain tensioner.

– Press against guide rail of chain tensioner with a screwdriver in -direction of arrow- and simultaneously tighten bolts -1- for sprocket.

– Pull diesel injection pump locking pin - 3359- out of balance shaft.



Now continue installing in reverse order of removal, observing the following:

– Install timing chain covers ⇒ page 57 .

– Install drive plate ⇒ page 48 .

– Replenish engine oil and check oil level ⇒ Maintenance ; Booklet ; Engine oil: Drain or extract; Renewing oil filter and replenishing engine oil .

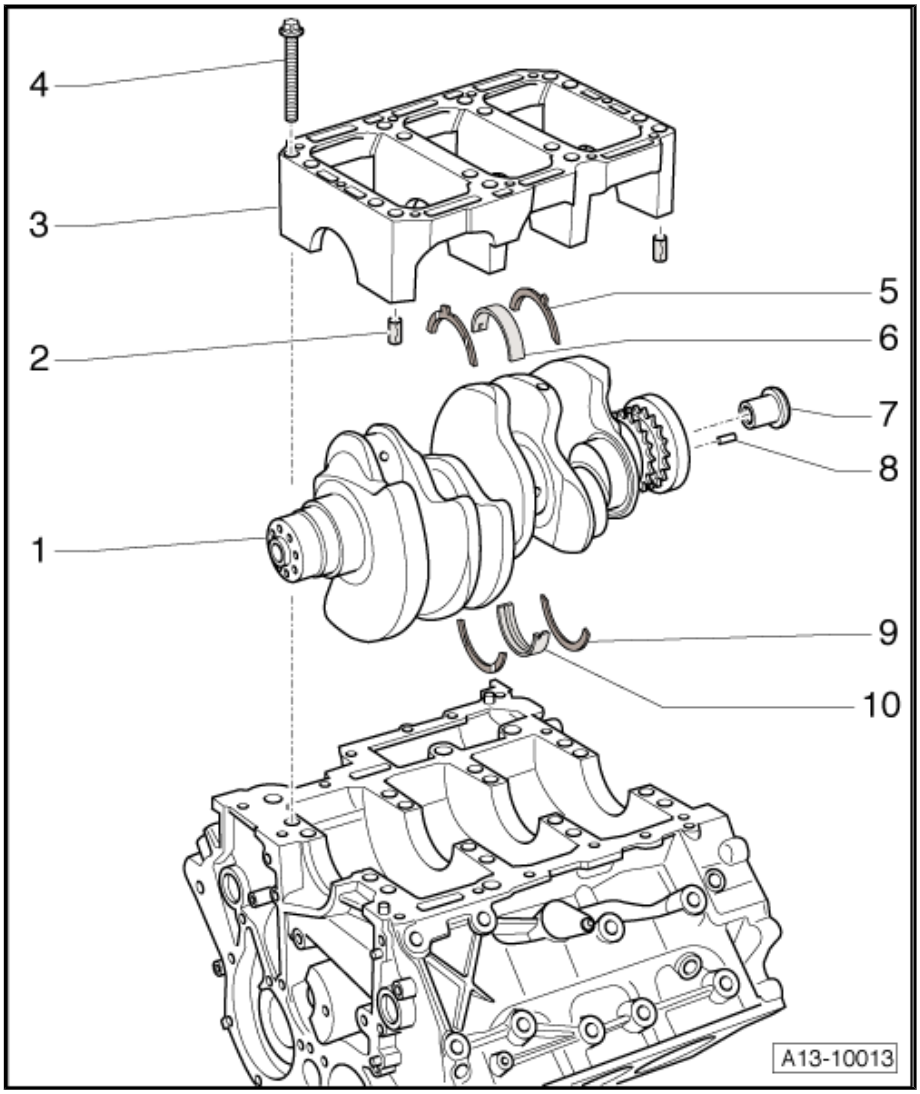
3 Removing and installing crankshaft

Note

- *Before carrying out repair work, secure engine on assembly stand with engine and gearbox support - VAS 6095/1- using universal mounting - VAS 6095/1-4- and bracket for V6 TDI engine - VAS 6095- .*
- *All bearing and running surfaces must be oiled before assembly.*

⇒ "3.1 Assembly overview - crankshaft", page 75 .
⇒ "3.2 Crankshaft dimensions", page 77 .
⇒ "3.3 Measuring axial clearance", page 77 .
⇒ "3.4 Measuring radial clearance", page 78 .

3.1 Assembly overview - crankshaft



1 - Crankshaft
- ❑ Measuring axial clearance ⇒ page 77 .
- ❑ Measuring radial clearance ⇒ page 78
- ❑ Do not rotate crankshaft when checking radial clearance
- ❑ Crankshaft dimensions ⇒ page 77 .

2 - Dowel sleeve
- ❑ Qty. 2
- ❑ Insert in cylinder block.

3 - Ladder frame
- ❑ Installing ⇒ page 76

4 - Bolt
- ❑ Renew
- ❑ Tightening sequence ⇒ page 76

5 - Thrust washer
- ❑ Only fitted on 3rd crankshaft bearing.
- ❑ Oil grooves face outwards.
- ❑ Note fixing arrangement
- ❑ Measuring axial clearance of crankshaft ⇒ page 77 .

6 - Bearing shell
- ❑ For retaining frame.
- ❑ Do not interchange used bearing shells (mark).
- ❑ Bearing shells worn down to nickel layer must be renewed.

❑ Install new bearing shells for retaining frame with correct coloured markings ⇒ page 77 .

7 - Centring sleeve for torque converter

❑ Notes on centring sleeve ⇒ page 77 .

8 - Dowel pin

❑ Check that pin is firmly seated in crankshaft.

9 - Thrust washer

❑ Only fitted on 3rd crankshaft bearing.
❑ Oil grooves face outwards.
❑ Note fixing arrangement
❑ Measuring axial clearance of crankshaft ⇒ page 77 .

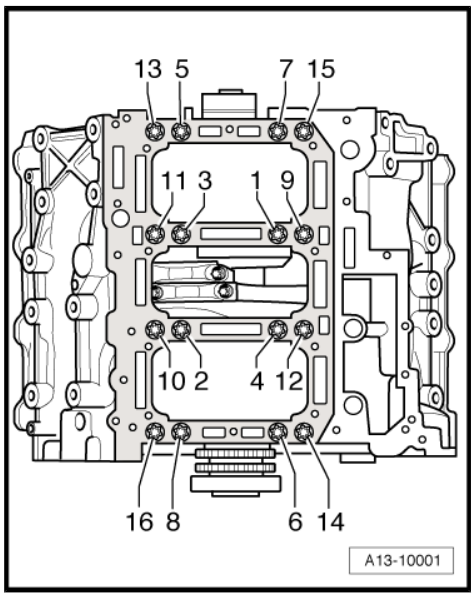
10 - Bearing shell

❑ For cylinder block with oil groove
❑ Do not interchange used bearing shells (mark).
❑ Install new bearing shells for the cylinder block with the correct coloured markings ⇒ page 76 .

Installing retaining frame

– Renew bolts -1 … 16-.
– Fit both dowel sleeves into retaining frame.
– Tighten securing bolts for retaining frame in the following sequence:

1. Tighten bolts -1 … 16- to 30 Nm with torque wrench.
2. Tighten bolts -1 … 16- to 50 Nm with torque wrench.
3. Tighten bolts -1 … 16- 90° further ($^1/_4$ turn) using a rigid wrench.



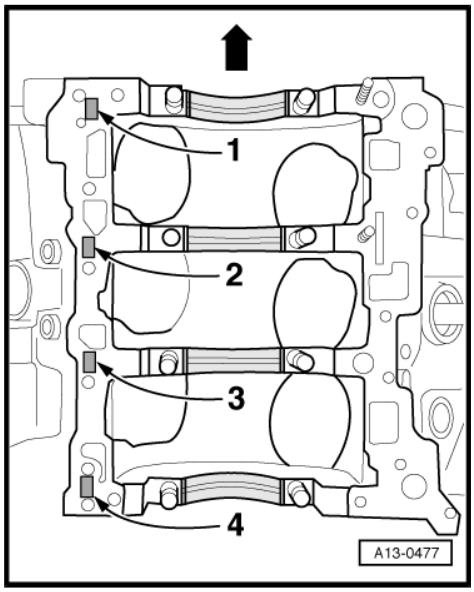
Allocation of crankshaft bearing shells for cylinder block

Bearing shells of the correct thickness are allocated to the cylinder block at the factory. Coloured dots on bearing shell are used to identify bearing shell thickness.

- The -arrow- points to belt pulley end.

The allocation of the bearing shells to the cylinder block is identified by a code letter next to the relevant bearing.

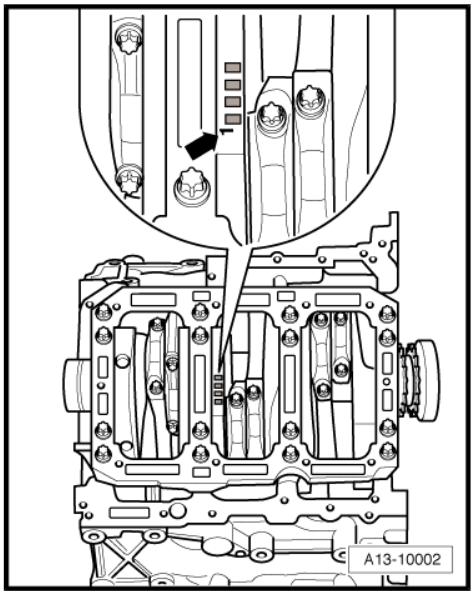
Letter on cylinder block	Bearing colour
R =	red
G =	yellow
B =	blue



Allocation of crankshaft bearing shells for retaining frame

- The bearing caps are assigned bearing shells of the correct thickness at the factory. Coloured dots on bearing shell are used to identify bearing shell thickness.
- The correct allocation of bearing shells to crankshaft is indicated by a sequence of letters on the crankshaft flank. The number “1” -arrow- preceding the sequence of letters indicates the colour code for No. 1 bearing.

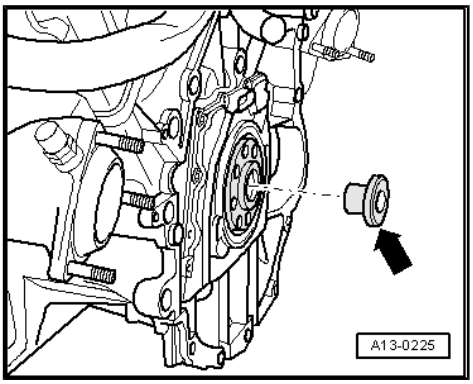
Letter on crankshaft	Bearing colour
R =	red
G =	yellow
B =	blue



Bearing bush for torque converter

Note

Short engines and reconditioned (exchange) engines, as well as new and reconditioned crankshafts, are supplied without centring sleeve -arrow-. The bush must be driven in before installing the drive plate.



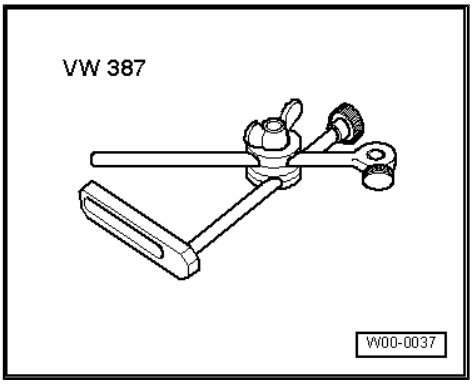
3.2 Crankshaft dimensions

Honing dimension (in mm)	Crankshaft main journal ∅	Conrod journal ∅
Basic dimension	65.00 – 0.022 – 0.042	60.00 – 0.022 – 0.042

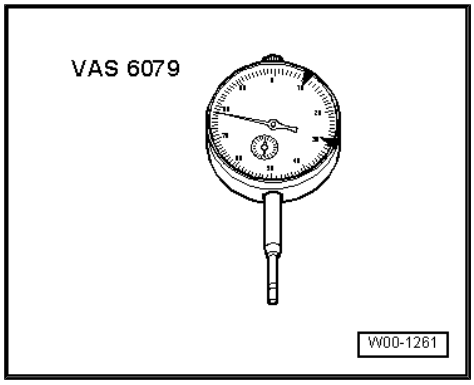
3.3 Measuring axial clearance

Special tools and workshop equipment required

- Universal dial gauge holder - VW 387-



♦ Dial gauge - VAS 6079-



Test sequence

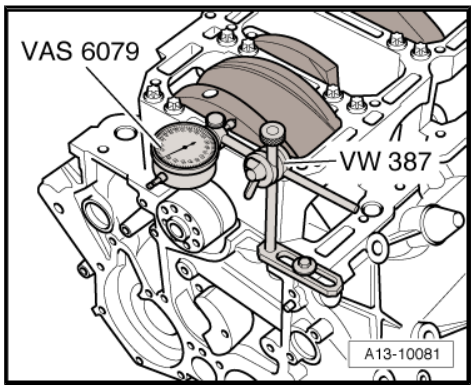
– Fit dial gauge onto universal dial gauge bracket - VW 387- , install bracket on cylinder block and set gauge against crankshaft web.

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

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

• Axial clearance (new): 0.090 … 0.215 mm.

• Axial clearance wear limit: 0.280 mm



3.4 Measuring radial clearance

Special tools and workshop equipment required

♦ Plastigage

Procedure

Note

♦ *Do not interchange used bearings.*

♦ *Bearing shells worn down to nickel layer must be renewed.*

– Remove retaining frame and clean bearing journals.

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

• The Plastigage must rest in the middle of the bearing shell.

– Fit retaining frame and tighten to 30 Nm. Do not rotate crankshaft.

– Remove retaining frame again.

– Compare width of width of Plastigage with measurement scale:

• Radial clearance (new): 0.018…0.045 mm

• Radial clearance: wear limit: 0.10 mm

4 Pistons and conrods

Note

All bearing and running surfaces must be oiled before assembly.

⇒ "4.1 Assembly overview - pistons and conrods", page 79 .
⇒ "4.2 Checking piston projection at TDC", page 82 .
⇒ "4.3 Piston and cylinder dimensions", page 84 .
⇒ "4.4 Checking radial clearance of conrods", page 84 .

4.1 Assembly overview - pistons and conrods

Note

Oil spray jet for piston cooling ⇒ page 80 .

1 - Conrod bolt

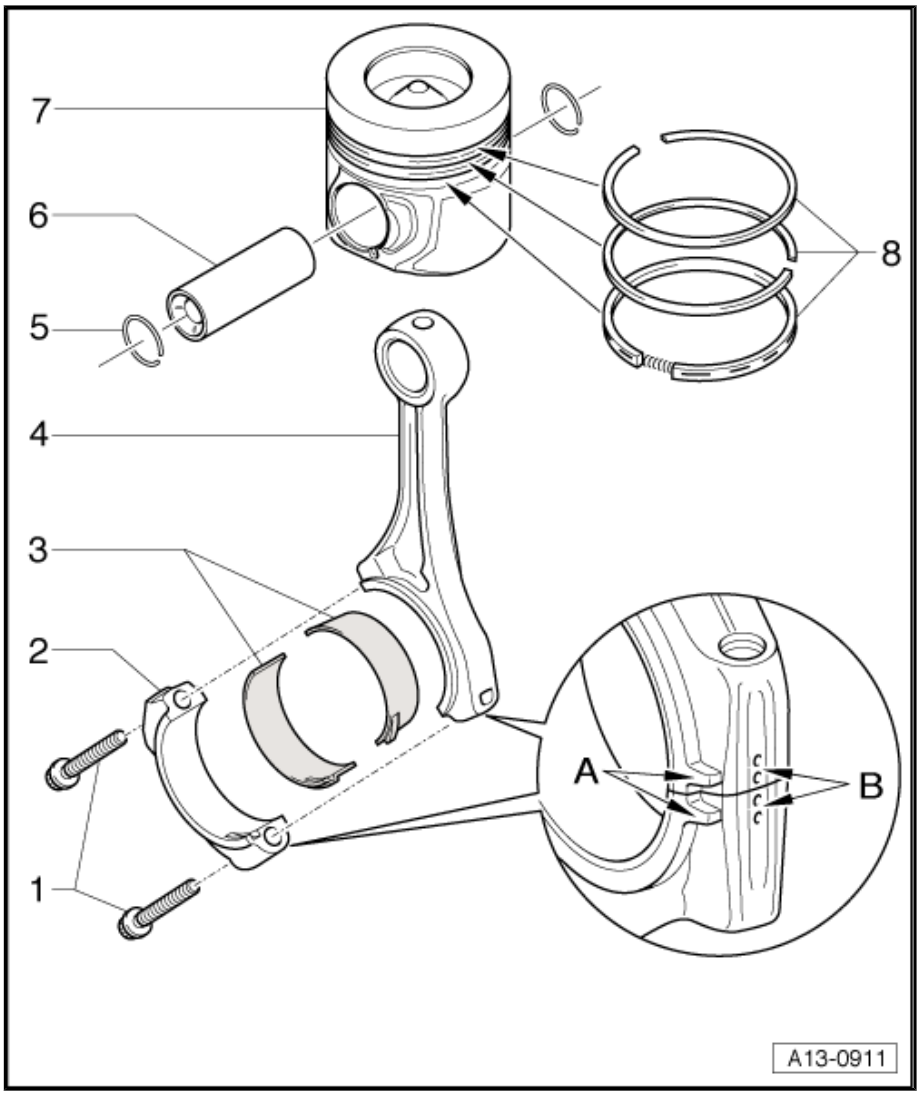
- ❑ Renew
- ❑ 30 Nm + 90° (1/4 turn further)
- ❑ Oil threads and contact surface
- ❑ To measure radial clearance, tighten to 30 Nm but not further.
- ❑ Measuring radial clearance ⇒ page 84

2 - Conrod bearing cap

- ❑ Do not interchange
- ❑ Mark cylinder number -B- ⇒ page 82
- ❑ Installation position: Note position of lugs on casting -A-.

3 - Bearing shells

- ❑ Observe installation position
- ❑ Do not interchange used bearing shells (mark).
- ❑ Bearing shells worn down to nickel layer must be renewed.
- ❑ Measuring radial clearance ⇒ page 84
- ❑ To measure radial clearance, tighten bolts ⇒ Item 1 (page 79) to 30 Nm but not further.



4 - Connecting rod

- ❑ Renew as set only.
- ❑ Mark cylinder number -B- ⇒ page 82
- ❑ Installation position: Note position of lugs on casting -A-.
- ❑ Axial clearance for each conrod pair (when new): 0.20 … 0.44 mm

5 - Retaining ring

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 81 .
- ❑ Checking ⇒ page 81
- ❑ Install using piston ring clamp.
- ❑ If cracking is visible on piston skirt, renew piston.
- ❑ Piston and cylinder dimensions ⇒ page 84 .
- ❑ Checking piston projection at TDC ⇒ page 82 .
- ❑ Checking cylinder bores ⇒ page 81 .

8 - Piston rings

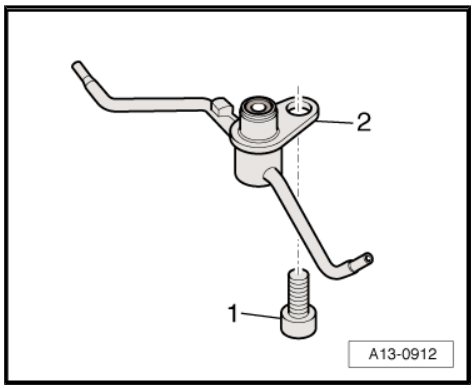
- ❑ Offset gaps by 120°
- ❑ Use piston ring pliers to remove and install.
- ❑ “TOP” must face towards piston crown.
- ❑ Checking ring gap ⇒ page 80 .
- ❑ Checking ring-to-groove clearance ⇒ page 81 .

Oil spray jet for piston cooling

1 - Bolt - 9 Nm

2 - Oil spray jet with spray nozzle valve for piston cooling

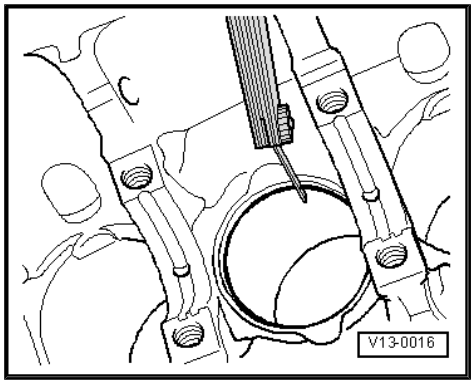
- Opening pressure: 1.3 bar



Checking piston ring gap

– Push ring at right angles to cylinder wall from above down to approx. 15 mm from bottom end of cylinder. Push in using a piston without rings.

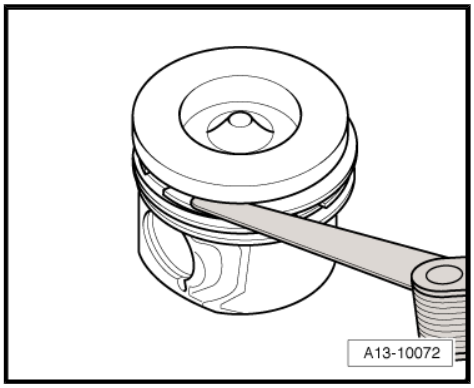
Piston ring dimensions in mm	New	Wear limit
1st compression ring	0.25 … 0.38	0.80
2nd compression ring	0.70 … 0.90	1.30
Oil scraper ring	max. 0.40	0.70



Checking ring-to-groove clearance

– Clean ring groove of piston before checking.

Piston ring dimensions in mm	New	Wear limit
1st compression ring	0.120 … 0.160	0.175
2nd compression ring	0.020 … 0.090	0.115
Oil scraper ring	0.020 … 0.090	0.115

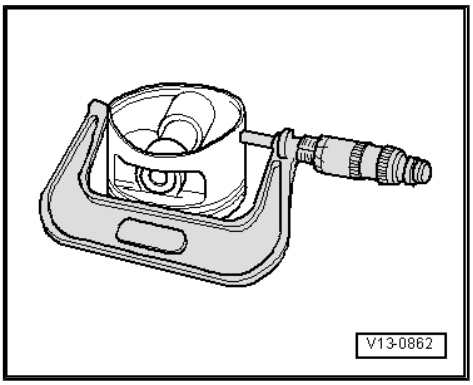


Checking piston

– Using a micrometre (75 … 100 mm), measure approx. 10 mm from the lower edge, perpendicular to the piston pin axis.

• Maximum deviation from nominal dimension: 0.05 mm.

Nominal dimension ⇒ page 84

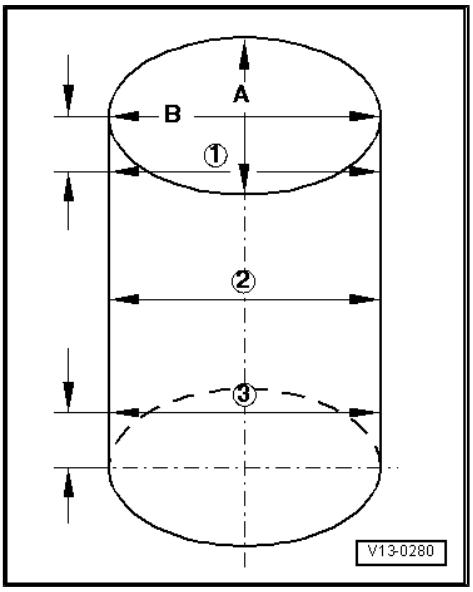


Checking cylinder bores

– Use 50 … 100 mm internal dial gauge to take measurements at 3 points in transverse direction -A- and longitudinal direction -B-.

• Maximum deviation from nominal dimension: 0.08 mm.

Nominal dimension ⇒ page 84



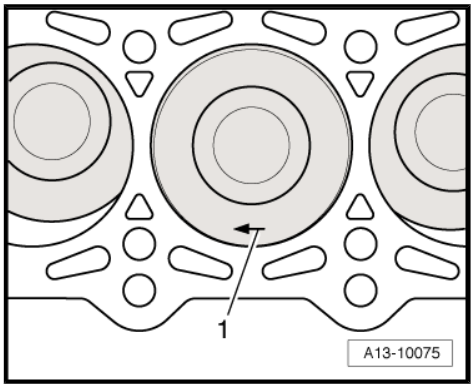
Installation position of pistons

• Installation position: arrow -item 1- on piston crown points to belt pulley end.

Note

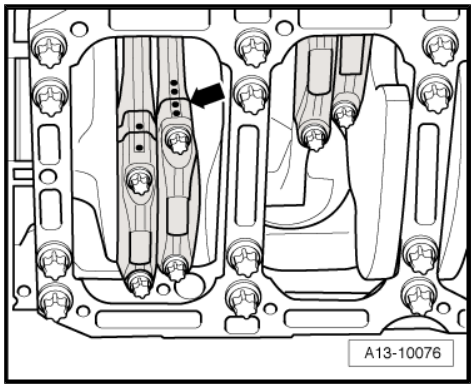
♦ *If used pistons are being re-installed, use chalk or waterproof felt-tip pen to mark installation position and cylinder number on piston crown.*

♦ *Do not use a centre punch or scriber, as this would damage the coating of the piston crown.*



Marking conrods

– Before removing, mark mating positions of conrods and conrod bearing caps -arrow-.

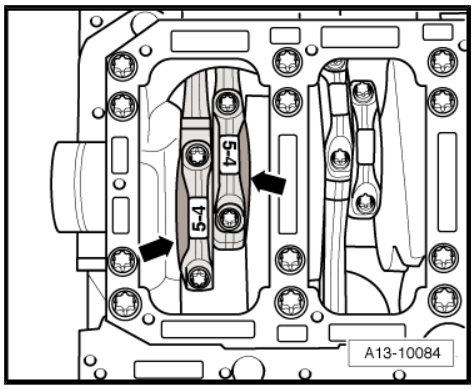


Note

- *Only renew conrods as a complete set.*
- *Do not interchange conrod bearings.*

Conrod installation position

The larger contact shoulder on the conrod -arrows- faces towards the adjacent crankshaft bearing.

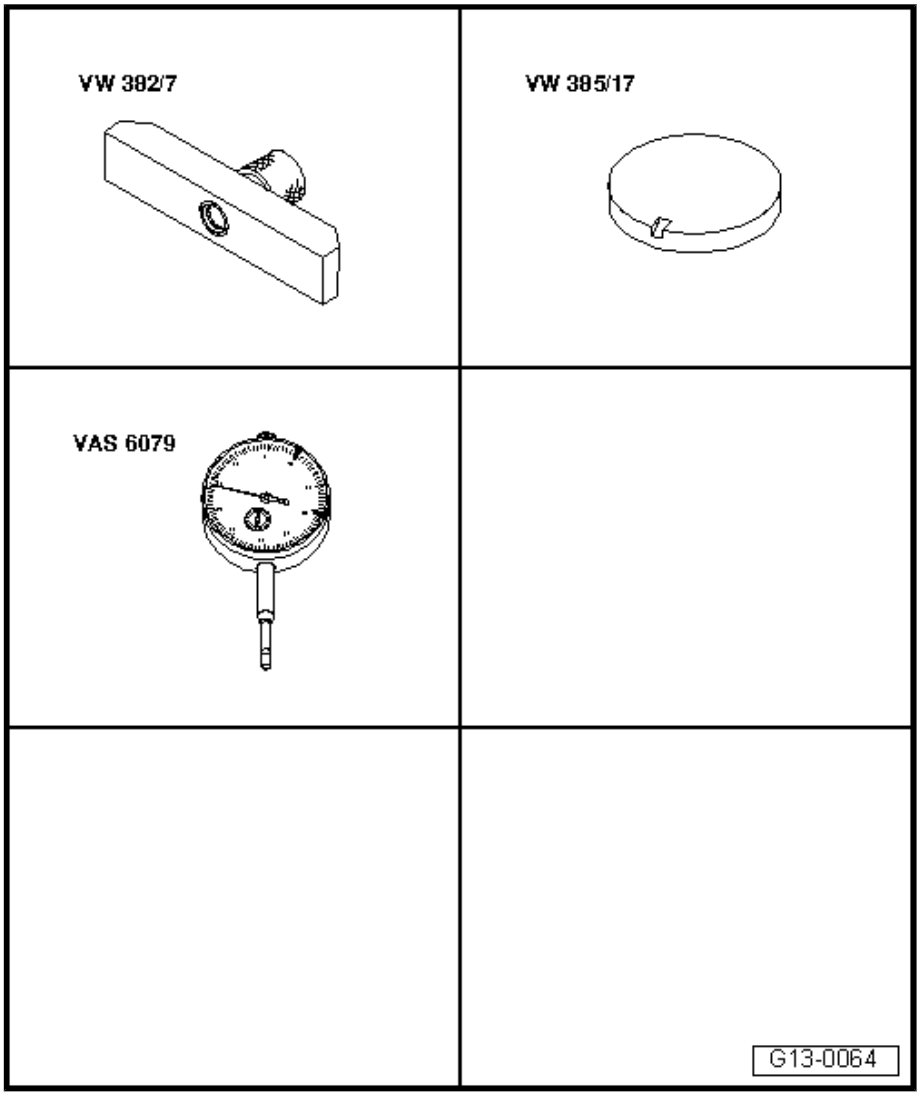


Note

Illustration shows front pair of conrods.

4.2 Checking piston projection at TDC

Special tools and workshop equipment required



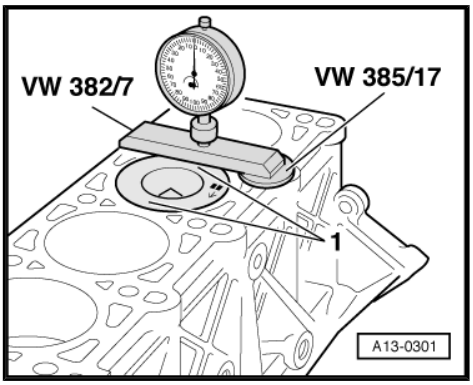
- -VW 382/7- from measuring tool - VW 382-
- -VW 385/17- from universal measuring tool - VW 385-
- Dial gauge - VAS 6079-

Test sequence

– Set up dial gauge - VAS 6079- with -VW 382/7- and -VW 385/17- .

– Measure piston projection at two points -1- for each piston.

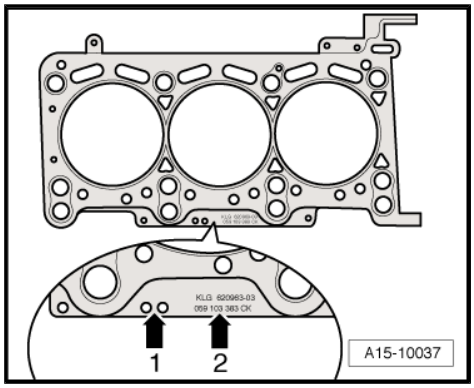
Piston projection above top surface of cylinder block	Identification (No. of holes)
0.39 to 0.49 mm	1
0.49 to 0.54 mm	2
0.54 to 0.65 mm	3



Cylinder head gasket identification

-Arrow 1-: holes

-Arrow 2-: part number



Note

The cylinder head gaskets for the left and right cylinder heads have different shapes and cannot be interchanged.

4.3 Piston and cylinder dimensions

Honing dimension in mm	Piston ∅	Cylinder bore ∅
Basic dimension	82.939 … 82.951 1)	83.006 … 83.014
Repair oversize	82.979 … 82.991 1)	83.046 … 83.054

1) Dimensions without graphite coating (thickness 0.02 mm). The graphite coating will wear down.

4.4 Checking radial clearance of conrods

Special tools and workshop equipment required

♦ Plastigage

Test sequence

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

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

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

– Remove conrod bearing cap again.

– Compare width of Plastigage with measurement scale:

• Radial clearance (new): 0.015 … 0.062 mm.

• Radial clearance: wear limit: 0.12 mm

– Renew conrod bolts.

15 – Cylinder head, valve gear

1 Cylinder head

⇒ “1.1 Assembly overview - cylinder head”, page 85 .

⇒ “1.2 Assembly overview - cylinder head cover”, page 88 .

⇒ “1.3 Removing and installing cylinder head cover”, page 90 .

⇒ “1.4 Removing and installing cylinder head”, page 95 .

⇒ “1.5 Checking compression”, page 102 .

⇒ “1.6 Assembly overview - vacuum pump”, page 103 .

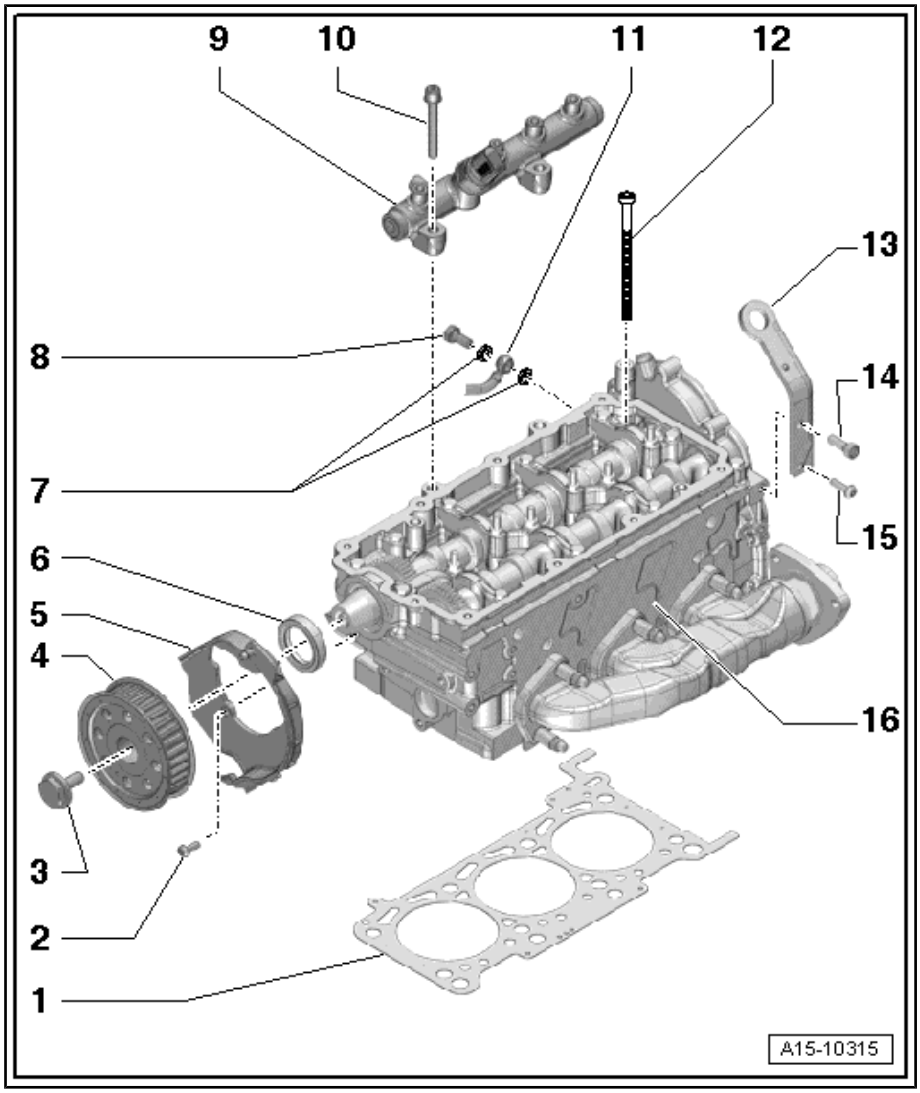
Note

- *If an exchange cylinder head is installed, all the contact surfaces between the supporting elements, roller rocker fingers and the running surfaces of the camshafts must be oiled before the cylinder head cover is installed.*
- *The plastic protectors fitted to protect the open valves must be removed only immediately before the cylinder head is fitted.*
- *If the cylinder head is renewed, all the coolant in the system must also be renewed.*
- *Reworking diesel cylinder heads is not permissible.*

1.1 Assembly overview - cylinder head

Note

Diagram shows cylinder head on cylinder bank 2 (left side).



1 - Cylinder head gasket

- ❑ Renewing ⇒ page 95
- ❑ Identification ⇒ page 87
- ❑ Installation position: part number faces towards cylinder head
- ❑ If renewed, refill system with fresh coolant.

2 - Bolt

- ❑ 9 Nm

3 - Bolt

- ❑ 75 Nm
- ❑ Use counter-hold tool -3036- to loosen and tighten ⇒ page 87

4 - Toothed belt drive pulley

- ❑ Use counter-hold tool -3036- when loosening and tightening central bolt ⇒ page 87
- ❑ Remove using puller -T10320- ⇒ page 87 .

5 - Rear toothed belt guard

6 - Oil seal for toothed belt pulley for high-pressure pump

- ❑ Renewing ⇒ page 107

7 - Oil seals

- ❑ Renew

8 - Banjo bolt

- ❑ 15.5 Nm

9 - High-pressure accumulator (rail)

- ❑ Comply with rules for cleanliness ⇒ page 234
- ❑ Do not attempt to reshape high-pressure lines.
- ❑ Tighten high-pressure lines at fuel rails ⇒ page 89 .

10 - Bolt

- ❑ 23 Nm

11 - Coolant breather line

- ❑ Illustration does not show version installed in vehicle.

12 - Cylinder head bolt

- ❑ Renew
- ❑ Note sequence when loosening ⇒ page 98 .
- ❑ Note sequence when tightening ⇒ page 102 .

13 - Lifting eye

14 - M8 bolt

- ❑ 23 Nm

15 - M6 bolt

- ❑ 9 Nm

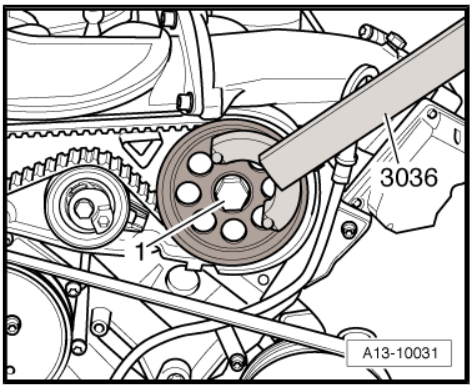
16 - Cylinder head

- ❑ To prevent damage to glow plugs, always place cylinder head on a soft foam surface after removal.

- ❑ Removing ⇒ page 95
- ❑ Check for distortion ⇒ page 87 .
- ❑ Diesel cylinder heads must not be reworked.
- ❑ Installing ⇒ page 98
- ❑ If renewed, refill system with fresh coolant.

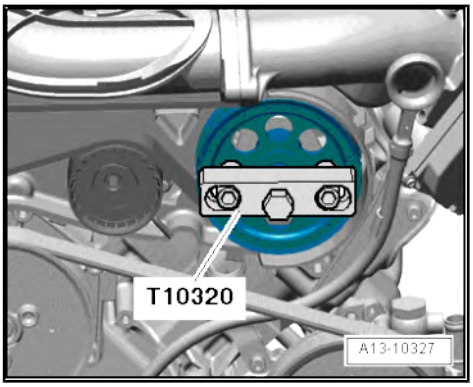
Loosening and tightening central bolt for toothed belt drive pulley

– Use counter-hold tool - 3036- when loosening and tightening central bolt -1-.



Removing toothed belt drive pulley

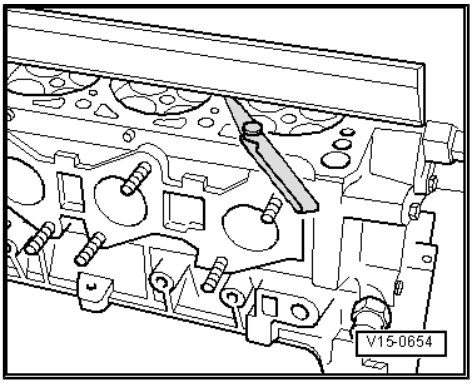
– Use puller - T10320- to pull off toothed belt drive pulley.



Checking cylinder head for distortion

– Use straightedge and feeler gauge to check for distortion at several points.

• Max. permissible distortion: 0.1 mm



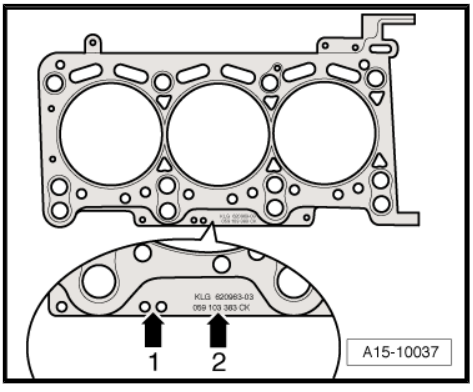
Cylinder head gasket identification

1 - Holes

2 - Part number

Note

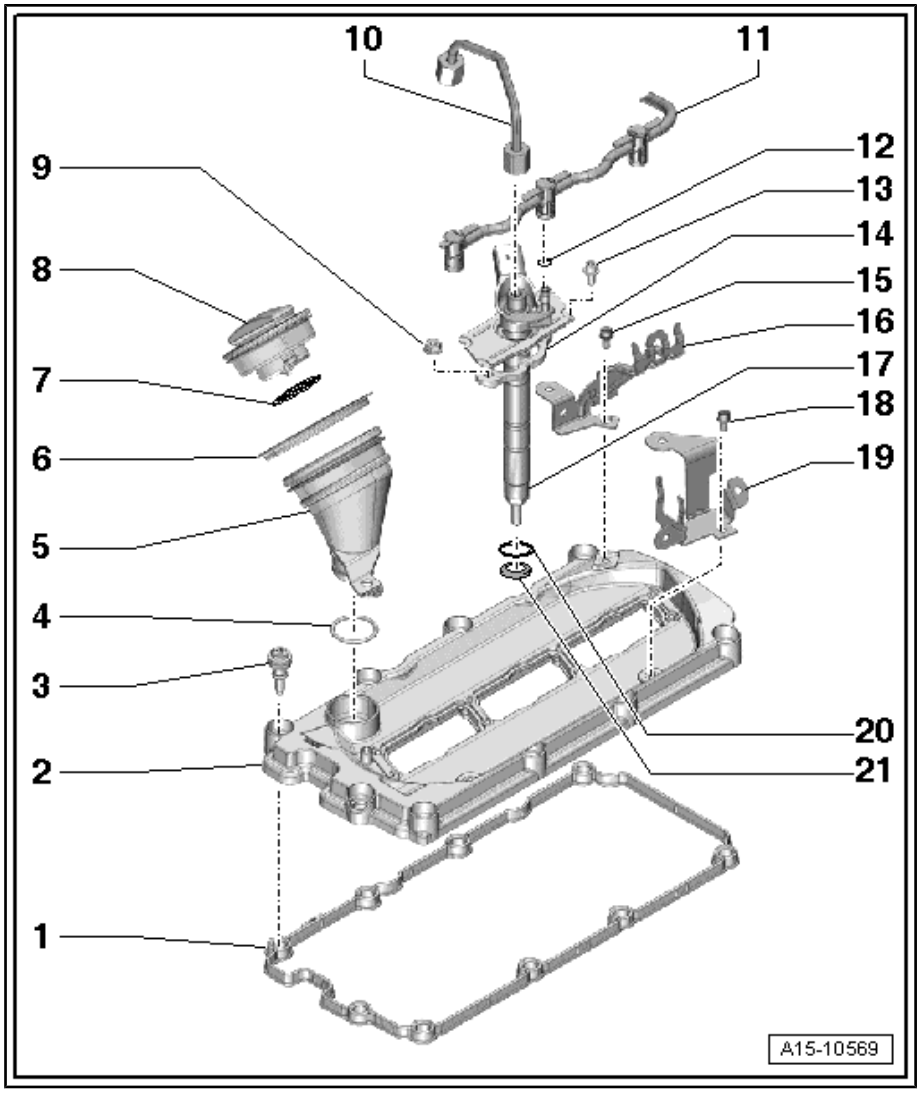
The cylinder head gaskets for the left and right cylinder heads have different shapes and cannot be interchanged.



1.2 Assembly overview - cylinder head cover

Note

Diagram shows cylinder head cover on cylinder bank 2 (left side).



1 - Gasket for cylinder head cover
- ❑ Renew if damaged or leaking

2 - Cylinder head cover
- ❑ Removing and installing ⇒ page 90

3 - Special bolt
- ❑ 9 Nm
- ❑ Renew if damaged or leaking
- ❑ Tighten diagonally in stages from inside to outside.

4 - O-ring
- ❑ Renew

5 - Oil filler neck
- ❑ To remove: lift tab, turn oil filler neck anti-clockwise and take out.

6 - Seal
- ❑ Renew if damaged or leaking

7 - Seal
- ❑ Renew if damaged or leaking

8 - Cap

9 - Hexagon collared nut
- ❑ 10 Nm
- ❑ For clamping piece.

10 - High-pressure line
- ❑ Comply with rules for cleanliness ⇒ page 234
- ❑ Mark allocation of high-pressure lines to the injectors.
- ❑ Do not attempt to reshape high-pressure lines.
- ❑ Tighten high-pressure lines at fuel rails, AF 19 mm ⇒ page 89 .
- ❑ Tighten high-pressure lines at fuel rails, AF 14 mm ⇒ page 89 .
- ❑ Tighten high-pressure lines at injectors ⇒ page 90 .

11 - Fuel return line
- ❑ Comply with rules for cleanliness ⇒ page 234

12 - O-ring
- ❑ Renew

13 - Bolt
- ❑ 5.5 Nm

❑ Cover for injector on cylinder head cover.

14 - Clamping piece

❑ If they are to be re-installed, the injector units and clamping pieces must always be re-installed on the cylinder they were removed from.

❑ When an injector is renewed, the corresponding clamping piece must be renewed at the same time.

15 - Bolt

❑ 9 Nm

16 - Bracket

❑ For electrical connectors.

❑ Different versions are available; allocation ⇒ Parts catalogue

17 - Injector

❑ Comply with rules for cleanliness ⇒ page 234

❑ Removing and installing ⇒ page 90

❑ When an injector is renewed, also renew the high-pressure line and clamping piece at the same time.

18 - Bolt

❑ 9 Nm

❑ Only for vehicles with engine code CATA.

19 - Bracket

❑ For wiring harness

❑ Only for vehicles with engine code CATA.

20 - O-ring

❑ Renew

21 - Copper seal

❑ Renew

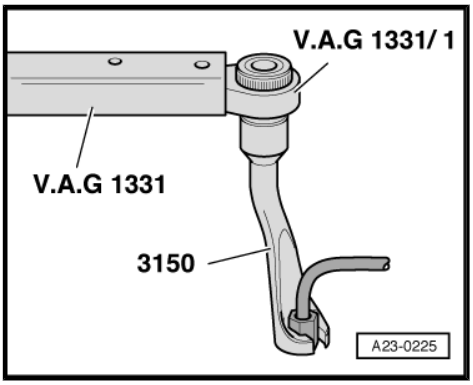
Tightening high-pressure lines at fuel rails (AF 14 mm)

– Tighten union nuts on high-pressure lines finger-tight initially.

– Ensure that high-pressure lines are not under tension.

– To tighten high-pressure lines, use torque wrench - V.A.G 1331- and 14 mm socket - 3150- .

• Specified torque: 28 Nm.



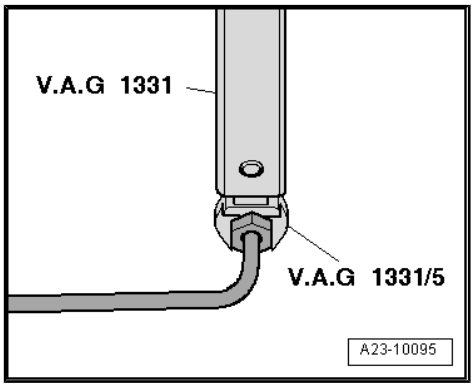
Tightening high-pressure lines at fuel rails (AF 19 mm)

– Tighten union nuts on high-pressure lines finger-tight initially.

– Ensure that high-pressure lines are not under tension.

– To tighten high-pressure lines, use torque wrench - V.A.G 1331- and 19 mm socket - V.A.G 1331/5- .

• Specified torque: 28 Nm.



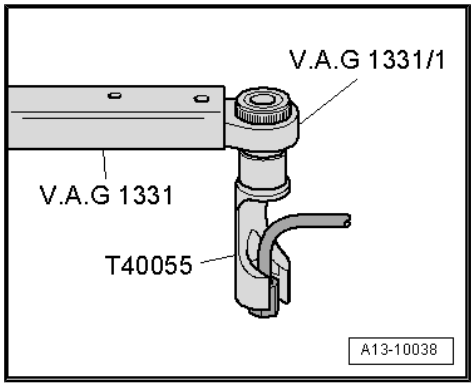
Tightening high-pressure lines at injectors (AF 17 mm)

– Tighten union nuts on high-pressure lines finger-tight initially.

– Ensure that high-pressure lines are not under tension.

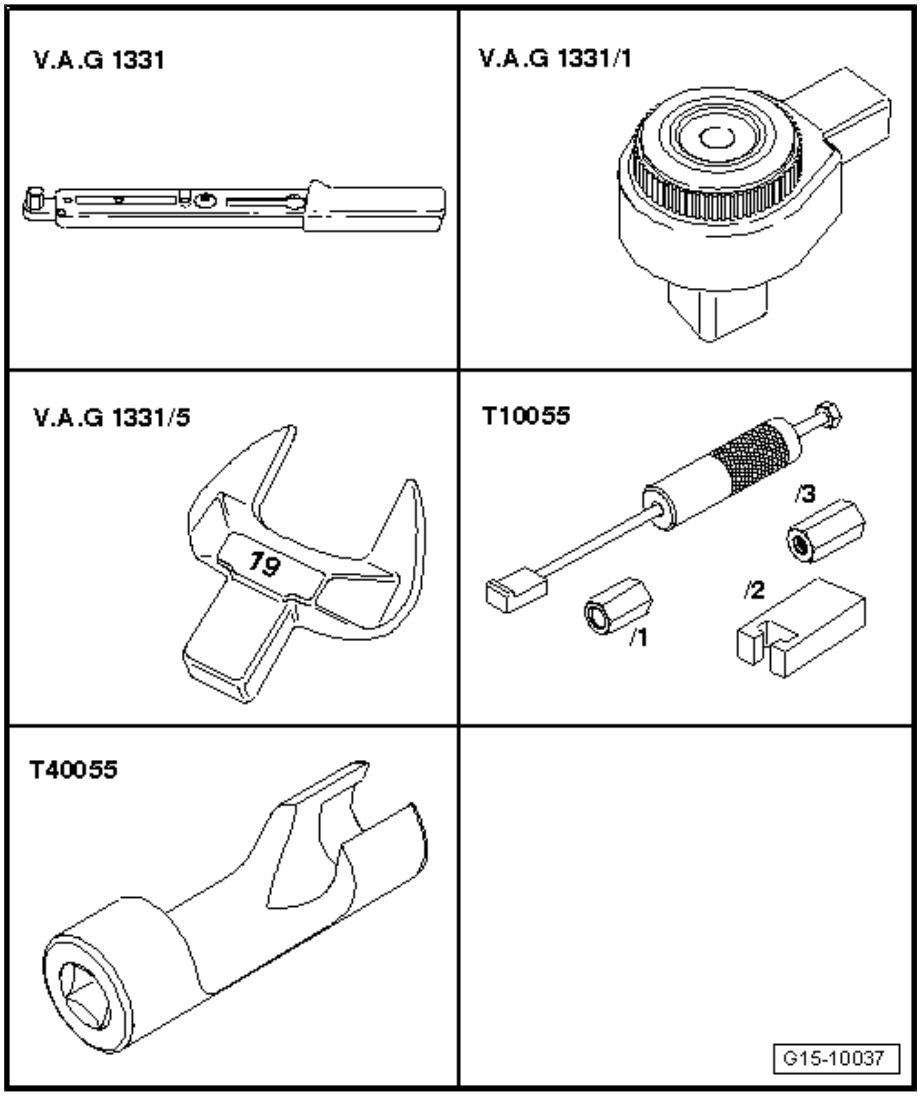
– To tighten high-pressure lines at injectors, use torque wrench - V.A.G 1331- with ratchet - V.A.G 1331/1- and 17 mm socket - T40055- .

• Specified torque: 28 Nm.



1.3 Removing and installing cylinder head cover

Special tools and workshop equipment required



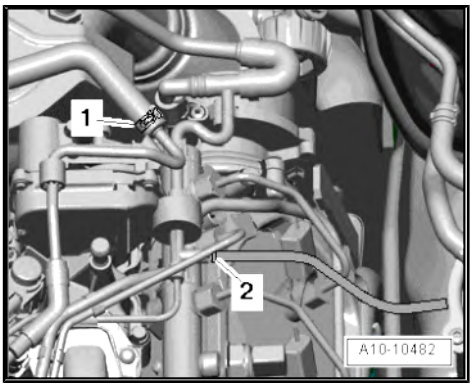
- Torque wrench - V.A.G 1331-
- Ratchet wrench - V.A.G 1331/1-
- Tool insert 19 mm - V.A.G 1331/5-
- Puller - T10055- with adapter -T10055/1-
- Socket - T40055-

Removing

Note

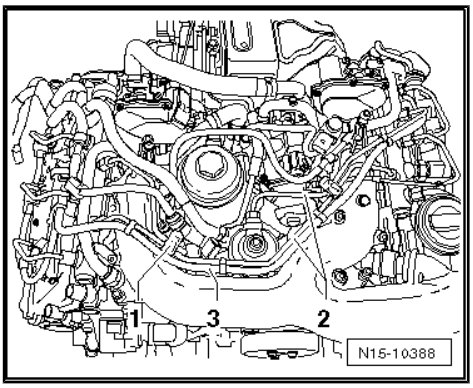
The following description shows the removal and installation of the left cylinder head cover. The procedure for the other side is the same, except that some steps are not required.

– Disconnect vacuum hose to vacuum reservoir -2-.
– Remove cable tie -1-.



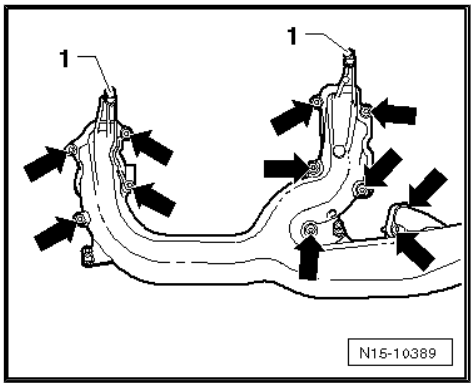
– Remove fuel high-pressure line -2- and fuel return line -3-.

Only for removal of left cylinder head cover:

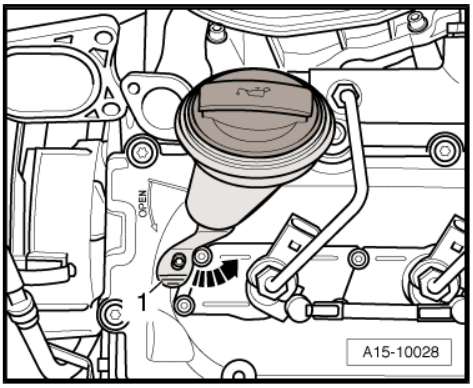


– Unscrew bracket for engine cover panel -1- and also securing bolts -arrows- and remove upper part of intake manifold.

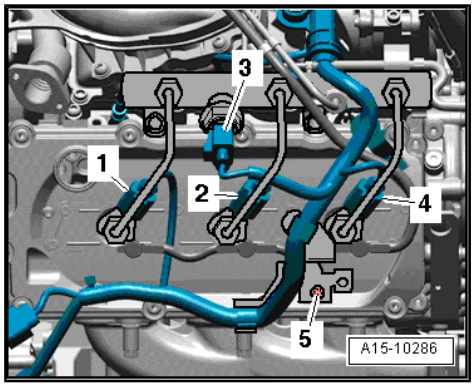
Continuation for both sides



– Remove oil filler neck. To do so, lift tab -1- and turn oil filler neck anti-clockwise -arrow-.



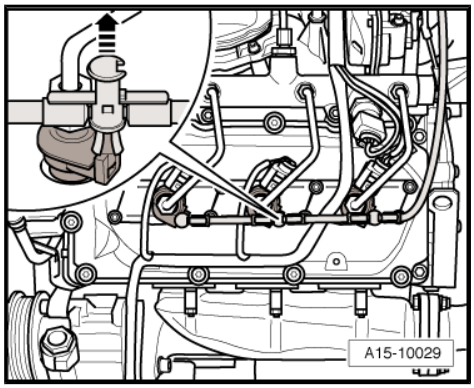
– Remove wiring harness bracket -5- from cylinder head cover.
– Detach electrical connectors -1 … 4- from fuel rail and injectors.



– Move electrical wiring harness clear.

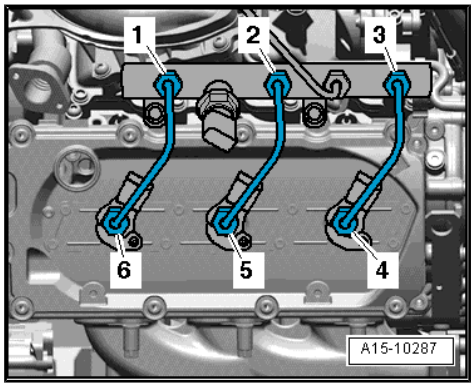
Caution

Observe rules for cleanliness when working on the injection system ⇒ page 234 .

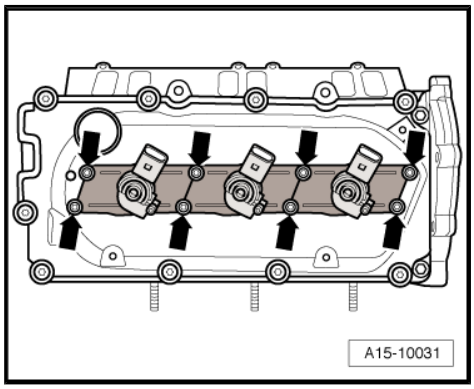


– Pull release pins upwards -arrow- and remove return line connections from injectors.
– Mark allocation of high-pressure lines to the injectors.

– Loosen union nuts of high-pressure lines -1 … 6- using 19 mm tool insert - V.A.G 1331/5- or 14 mm tool insert - 3150- and socket - T40055- .
– Remove high-pressure lines.

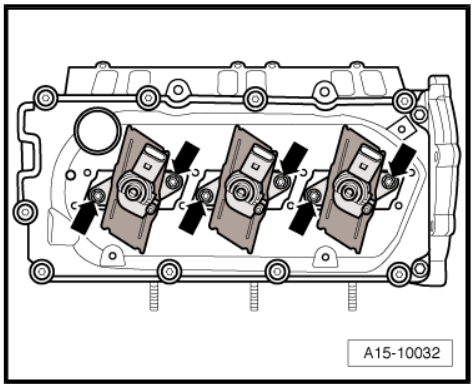


– Unbolt covers for injectors -arrows-.



– Pull covers upwards and turn $^{1}/_{4}$ turn (90°).

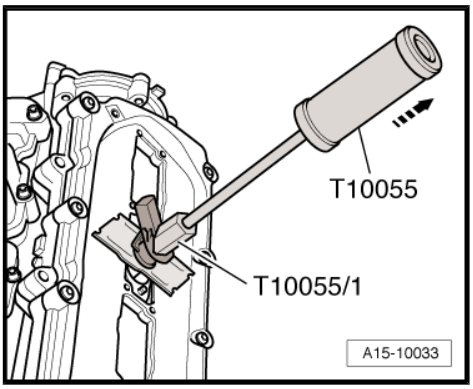
– Unbolt injectors -arrows-.



– Pull out injectors using puller - T10055- with adapter - T10055/1- .

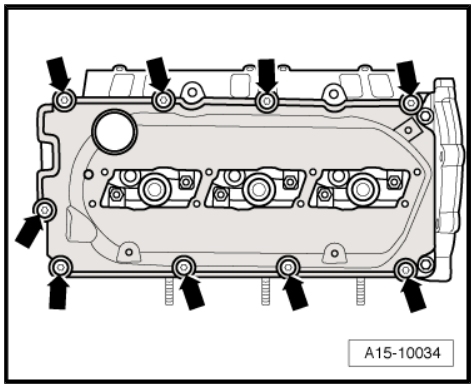
Caution

- *Mark cylinder numbers on injectors.*
- *Used injectors must always be re-installed on the same cylinder.*



– Loosen bolts -arrows- of cylinder head cover using diagonal sequence and working from outside inwards.

– Remove bolts and take off cylinder head cover.



Installing

Install in reverse order of removal, observing the following.

Note

- *Renew cylinder head cover gaskets if damaged.*
- *Renew gaskets, seals and O-rings.*
- *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- *Secure all hose connections with hose clips (same as original equipment) ⇒ Parts catalogue .*

– Tighten cylinder head cover bolts diagonally and in stages working from inside outwards.

Instructions for installing injectors:

- Make sure that the injectors and the installation area are clean before installing. If necessary, clean holes for injectors using a clean cloth, taking care not to cause damage (do not use any sharp edged tools).
- Always install new seals and gaskets. Lubricate all seals and gaskets lightly with engine oil or assembly oil before installing.
- The injectors must be completely undamaged. To remove the old copper seal from the injector, clamp the seal carefully in a vice so that it is just held between the jaws without turning. Then carefully pull and twist the injector out of the copper seal by hand.
- When an injector is renewed, also renew the injection line and clamping piece at the same time.
- Used injectors and injector pipes may be re-installed only on the same cylinder.

– Install injectors.

– Tighten union nuts on high-pressure lines hand-tight initially.

– Ensure that high-pressure lines are not under tension.

– Tighten high-pressure lines:

AF 14 mm ⇒ page 89

AF 17 mm ⇒ page 90

AF 19 mm ⇒ page 89

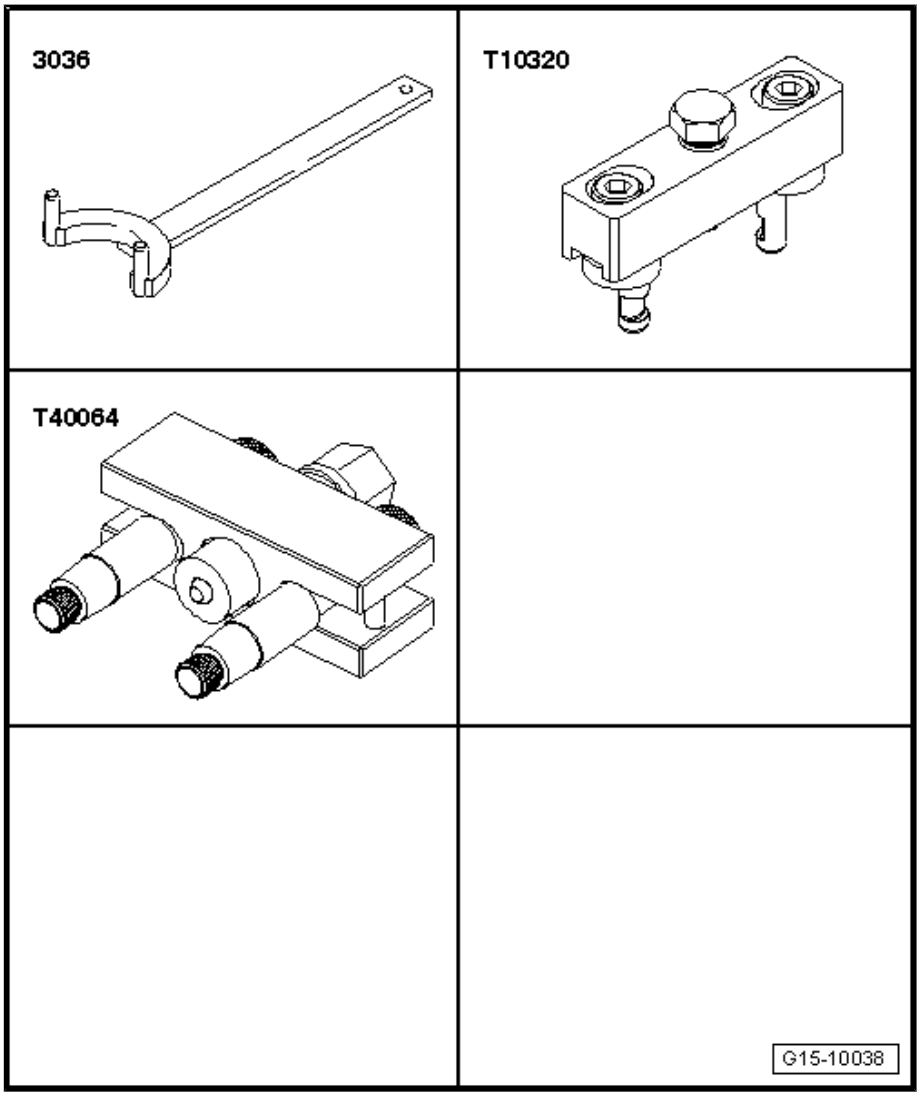
– Check fuel system for leaks ⇒ page 272 .

Specified torques

Component		Nm
Cylinder head cover to cylinder head		9
Injector to cylinder head		10
Cover for injector to cylinder head		5.5
High-pressure lines		28
Wiring harness bracket to cylinder head		9
Bracket for intake connecting pipe to cylinder head		9
Throttle valve module - J338- with intake connecting pipe to	Intake manifold	9
	Bracket	9
	Connecting pipe for mechanical exhaust gas recirculation valve	9
Hose clips (13 mm wide)		5.5

1.4 Removing and installing cylinder head

Special tools and workshop equipment required



♦ Counterhold - 3036- (for left cylinder head)

- Puller - T10320- (for left cylinder head)
- Puller - T40064- (for left cylinder head)

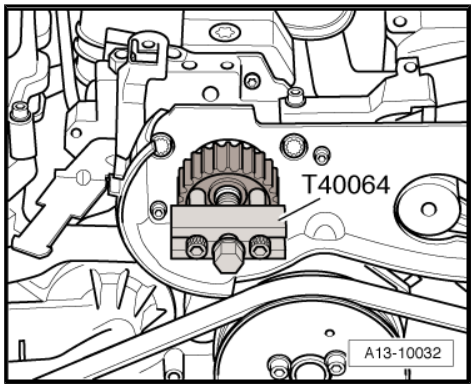
Removing

– Drain coolant ⇒ page 187 .

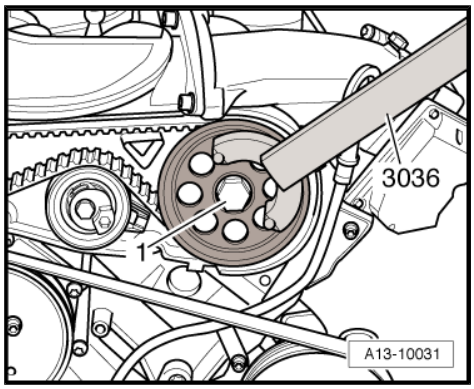
Left cylinder head:

– Remove toothed belt for high-pressure pump ⇒ page 257 .

– Use puller - T40064- to pull off belt sprocket for high-pressure pump.

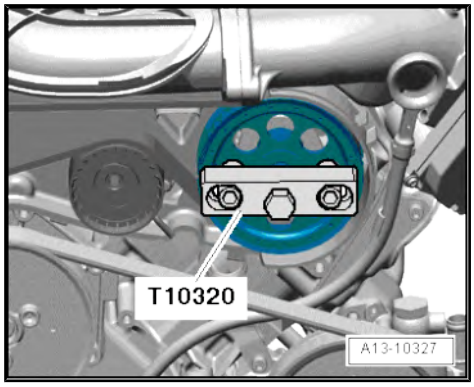


– Loosen central bolt -1- for toothed belt pulley by approx. 2 turns using counter-hold tool - 3036- .

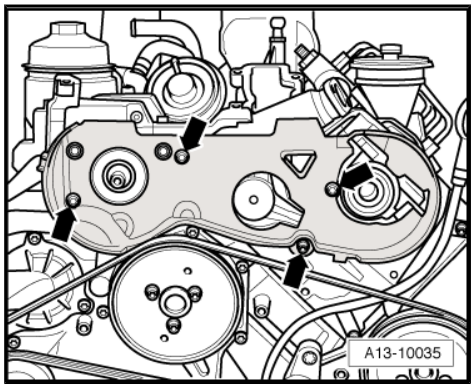


– Use puller - T10320- to pull off toothed belt drive pulley.

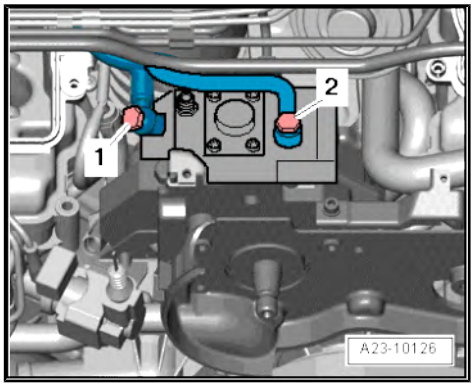
– Take off toothed belt drive pulley together with toothed belt.



– Remove bolts -arrows- and detach rear toothed belt cover.



– Disconnect fuel supply line -2- and fuel return line -1- from high-pressure pump and move lines clear to side.



Continuation for both sides

– Remove upper part of intake manifold ⇒ page 274 .

– Remove lower part of intake manifold on left or right ⇒ page 276 .

– Remove relevant timing chain from camshafts ⇒ page 110 .

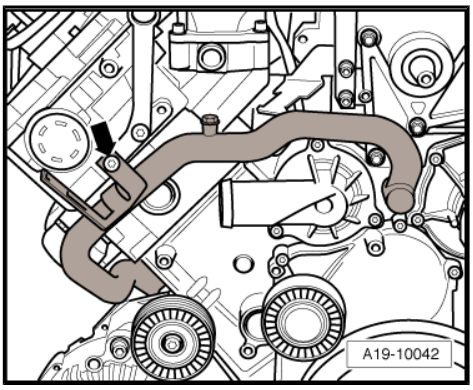
– Unscrew banjo bolt ⇒ Item 8 (page 86) and remove coolant breather line.

– Remove intermediate pipe: left side ⇒ page 335 , right side ⇒ page 337 .

– Remove cylinder head cover (left or right) ⇒ page 90 .

Right cylinder head:

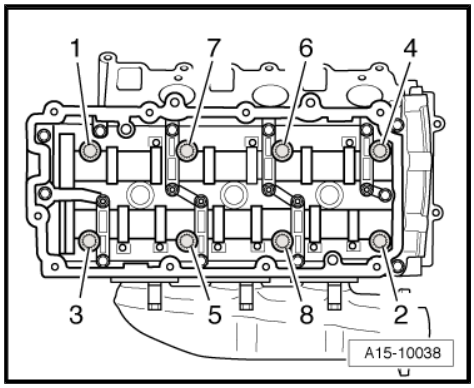
– Unbolt coolant pipe (right side) from cylinder head -arrow-.



Continuation for both sides

– Loosen cylinder head bolts in the sequence shown.

– Remove bolts and carefully remove cylinder head.



Caution

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

Installing

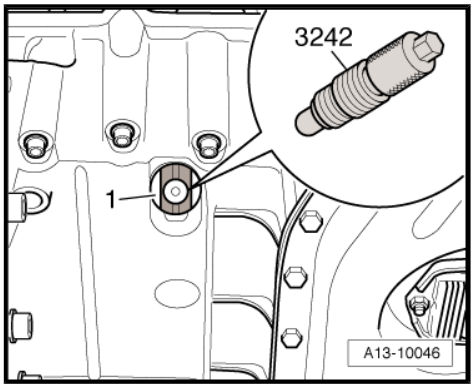
Note

- *Reworking diesel cylinder heads is not permissible.*
- *Renew cylinder head bolts.*
- *When performing repair work, renew self-locking nuts and bolts.*
- *Renew bolts which have been tightened further as well as oil seals and gaskets.*
- *In cases of repair, carefully remove gasket remains from cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.*
- *Carefully remove remains of emery and abrasives.*
- *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*
- *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
- *Handle gasket very carefully. Damage to the silicone coating or the indented area will lead to leaks.*
- *The plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*
- *When installing an exchange cylinder head with fitted camshafts, oil contact surfaces between the roller rocker fingers and cams.*
- *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*
- *Secure all hose connections with hose clips (same as original equipment) ⇒ Parts catalogue .*
- *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- *When cylinder head or cylinder head gasket is renewed the complete coolant must be renewed and engine oil changed.*
- *To ensure a leak-free finish, please use the sealing compound intended for this purpose ⇒ Parts catalogue .*

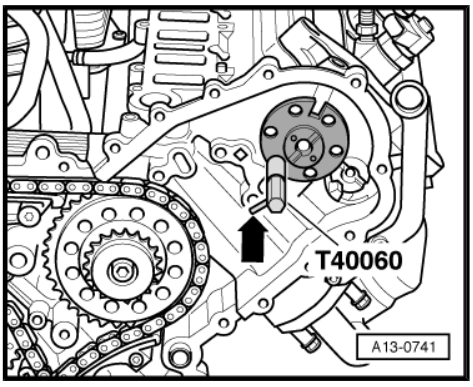
Install in reverse order of removal, observing the following.

– Set crankshaft and camshafts to “TDC” before fitting cylinder head:

• The locking pin - 3242- must be screwed in with crankshaft at “TDC” position -1-.



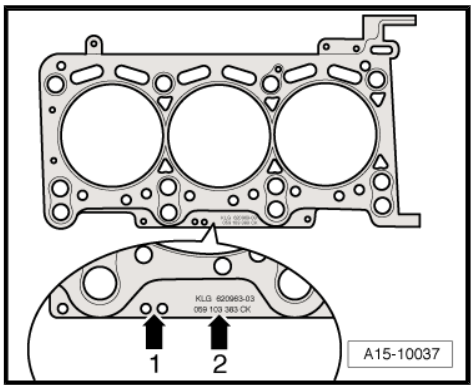
• The camshafts on both cylinder heads must have been locked in place with adjustment pin - T40060- .



– Note identification of cylinder head gasket:

1 - Holes

2 - Part number



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 assembly have been renewed, the new cylinder head gasket must be selected by measuring the piston projection at “TDC” ⇒ page 82 .*

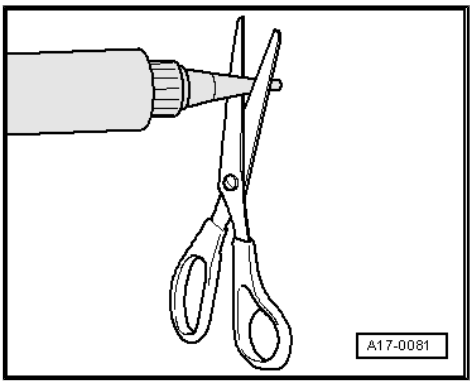
♦ *The cylinder head gaskets for the left and right cylinder heads have different shapes and cannot be interchanged.*

– Remove any oil and grease from sealing surfaces.

Note

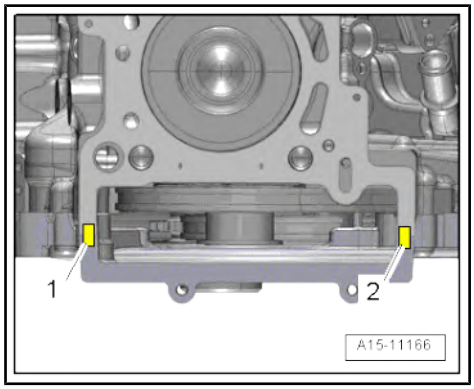
Check the expiry date of the sealant.

– Cut off nozzle on tube at front marking (∅ of nozzle approx. 5 mm).



Left cylinder head:

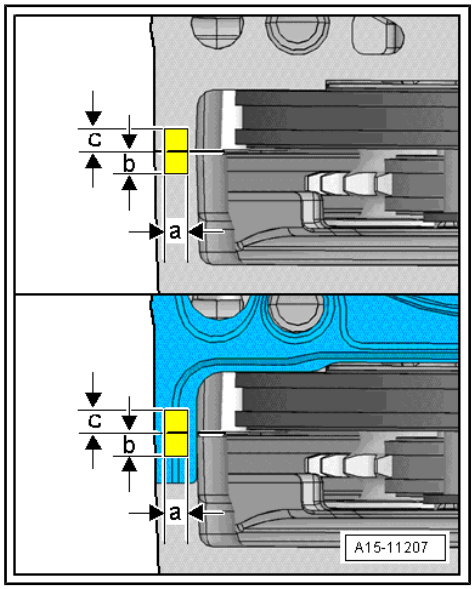
– Apply sealant beads -1- and -2- to the clean sealing surface of the cylinder block and the timing chain cover (bottom) as illustrated.



– Apply sealing compound in the sizes specified.

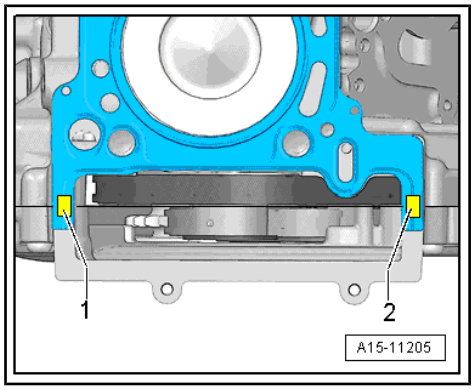
- a = 7mm
- b = 7mm
- c = 7mm

– Position cylinder head gasket.

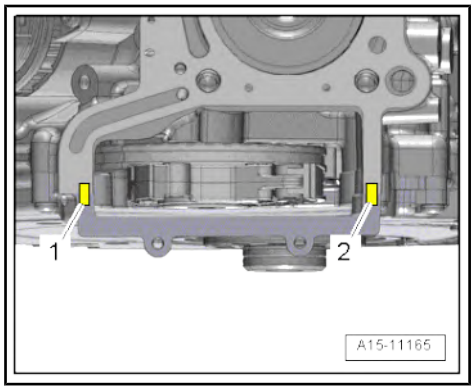


– Apply sealant beads -1- and -2- to the cylinder head gasket, as shown in the illustration.

Right cylinder head:



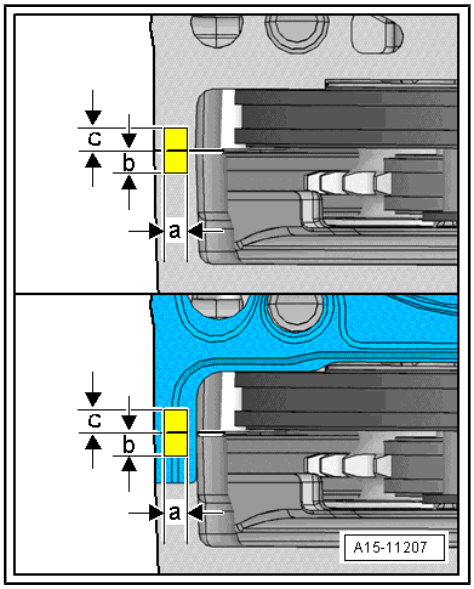
– Apply sealant beads -1- and -2- to the clean sealing surface of the cylinder block and the timing chain cover (bottom) as illustrated.



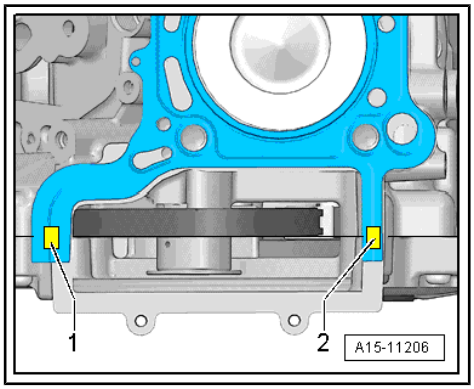
– Apply sealing compound in the sizes specified.

- a = 7mm
- b = 7mm
- c = 7mm

– Position cylinder head gasket.



– Apply sealant beads -1- and -2- to the cylinder head gasket, as shown in the illustration.

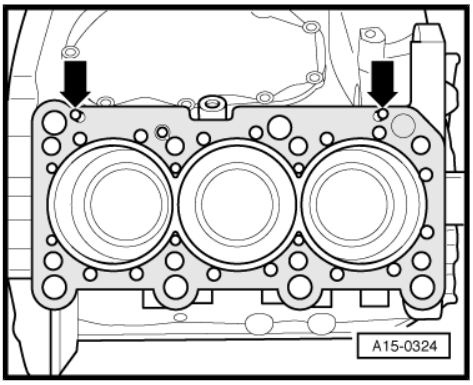


Continuation for both sides

- Pay attention to dowel sleeves -arrows- in cylinder block.
- Check installation position of cylinder head gasket: the word “oben” (top) or the Part No. should face towards the cylinder head.

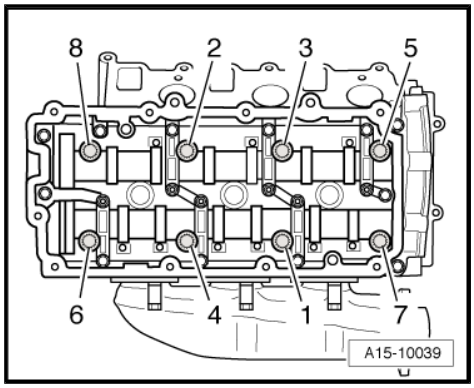
– Fit cylinder head.

– Insert new cylinder head bolts and tighten hand-tight.



– Tighten cylinder head bolts in the sequence -1 … 8- as follows:

1. Tighten to 35 Nm using torque wrench.
2. Tighten to 60 Nm using torque wrench.
3. Use fixed wrench to turn 90° further.
4. Use fixed wrench to turn 90° further.



Note

After repair work it is not necessary to retighten the cylinder head bolts.

– Install cylinder head cover (left and right) ⇒ page 90 .
– Install camshaft timing chains ⇒ page 110 .
– Install intermediate pipe: left side ⇒ page 335 , right side ⇒ page 337 .
– Install lower part of injection manifold on left or right ⇒ page 276 .
– Install upper part of intake manifold ⇒ page 274 .

Left cylinder head:

– Install toothed belt for high-pressure pump ⇒ page 257 .

Continuation for both sides

– Change engine oil ⇒ Maintenance ; Booklet ; Engine oil: Drain or extract; Renewing oil filter and replenishing engine oil .
– Fill cooling system with fresh coolant ⇒ page 189 .
– Check fuel system for leaks ⇒ page 272 .

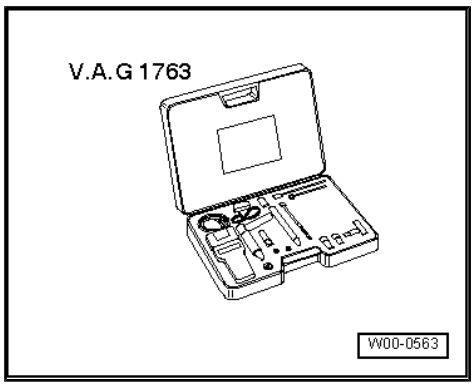
Specified torques

Component	Nm
Coolant line to cylinder head	15.5
Right coolant pipe to cylinder head	9
Toothed belt drive pulley to camshaft	75
Rear toothed belt guard to engine	9
Fuel supply and return lines to high-pressure pump	28

1.5 Checking compression

Special tools and workshop equipment required

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



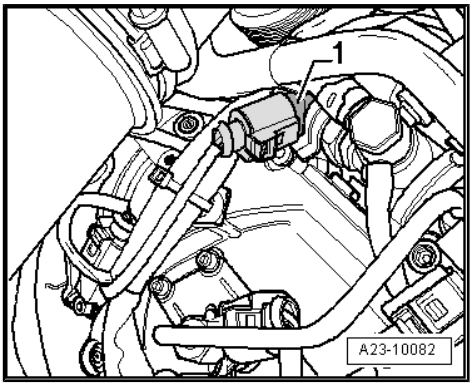
Procedure

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

– Remove engine cover panel ⇒ page 3 .

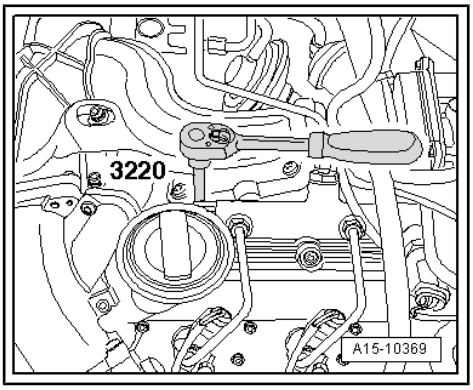
– Disconnect electrical connectors at glow plugs.

– Disconnect electrical connector at fuel pressure regulating valve - N276- -item 1- on fuel rail of cylinder bank 1 (right).

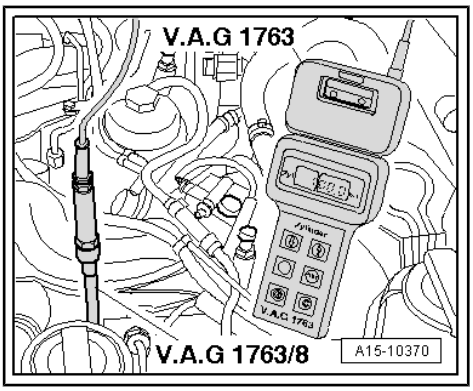


– Start engine briefly to reduce fuel pressure in fuel rail.

– Remove all glow plugs ⇒ page 355 .



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



Note

Using compression tester ⇒ operating instructions .

– Have starter operated by a 2nd mechanic until tester shows no further pressure increase.

Compression pressures	bar
New	28 … 33
Wear limit	21
Difference between cylinders	max. 5

Assembly is carried out in the reverse order, note the following:

– Install glow plugs ⇒ page 355 .

– Finally read and clear event memory of engine control unit, because events have been stored when connectors were separated ⇒ Vehicle diagnostic tester.

1.6 Assembly overview - vacuum pump

1 - Bolt
- ❑ 9 Nm

2 - Vacuum pump

3 - Vacuum hose

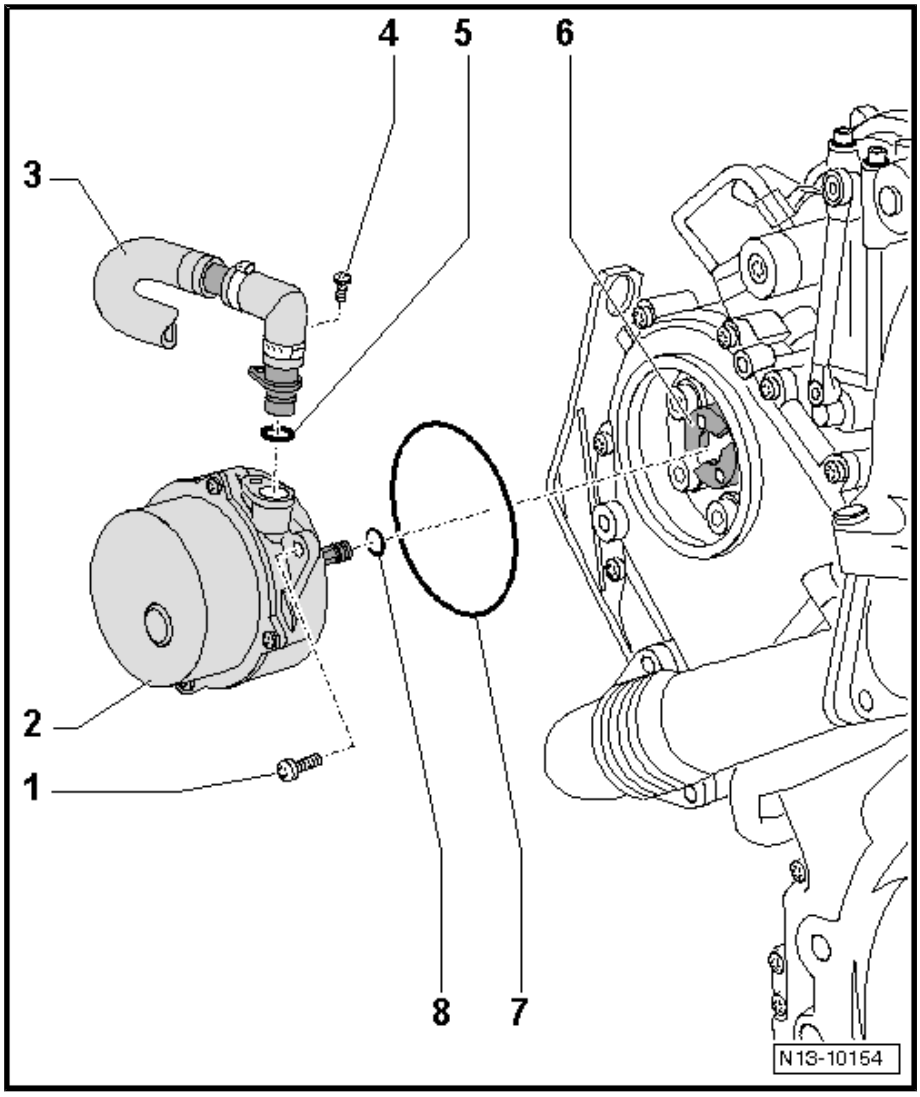
4 - Bolt
- ❑ 5 Nm

5 - O-ring
- ❑ Renew

6 - Inlet camshaft

7 - O-ring
- ❑ Renew

8 - O-ring
- ❑ Renew



2 Assembly overview - valve gear

⇒ “2.1 Checking axial clearance of camshafts”, page 106 .

⇒ “2.2 Renewing camshaft oil seal”, page 107 .

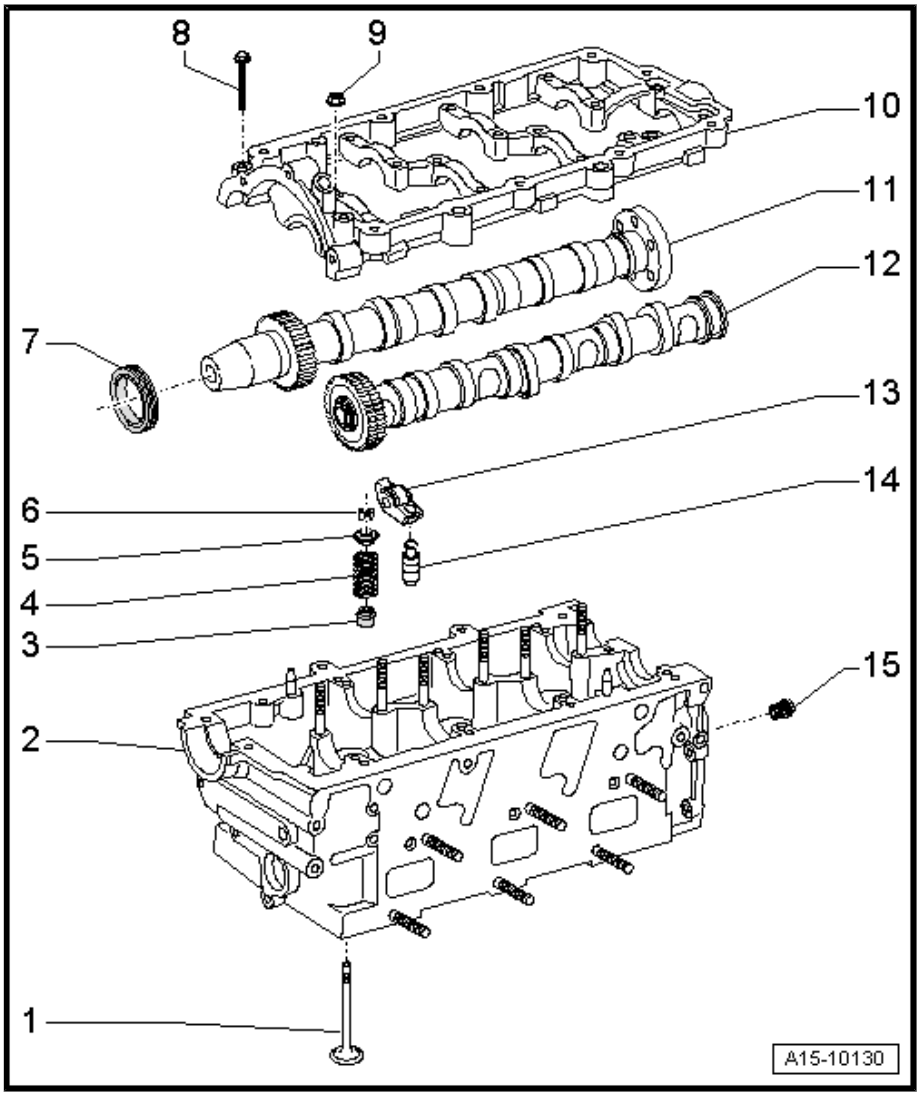
⇒ “2.3 Removing and installing camshafts”, page 110 .

⇒ “2.4 Renewing valve stem seals”, page 116 .

⇒ “2.5 Checking hydraulic valve compensation elements”, page 120 .

⇒ “2.6 Valve dimensions”, page 121 .

⇒ “2.7 Checking valve guides”, page 121 .



1 - Valve

- ❑ Renew if shaft and seat are scored.
- ❑ Do not rework. Only lapping in is permitted.
- ❑ Mark installation position for re-installation.
- ❑ Valve dimensions ⇒ page 121
- ❑ Checking valve guides ⇒ page 121

2 - Cylinder head

- ❑ Removing and installing ⇒ page 95

3 - Valve stem seal

- ❑ Renewing ⇒ page 116

4 - Valve springs

5 - Valve spring plate

6 - Valve cotters

7 - Camshaft oil seal

- ❑ Renewing ⇒ page 107

8 - Bolt

- ❑ 9 Nm
- ❑ Observe tightening sequence ⇒ page 110

9 - Nut

- ❑ 9 Nm
- ❑ Observe tightening sequence ⇒ page 110

10 - Ladder frame

- ❑ With integrated camshaft bearings.
- ❑ Removing and installing ⇒ page 110

11 - Inlet camshaft

- ❑ Removing and installing ⇒ page 110
- ❑ Checking axial clearance ⇒ page 106 .
- ❑ Check radial clearance with Plastigage (roller rocker fingers removed).
- ❑ Radial clearance (new): 0.035 … 0.085 mm
- ❑ Radial clearance: wear limit: 0.1 mm.

- ❑ Runout: max. 0.01 mm

12 - Exhaust camshaft

- ❑ Removing and installing ⇒ page 110
- ❑ Checking axial clearance ⇒ page 106 .
- ❑ Check radial clearance with Plastigage (roller rocker fingers removed).
- ❑ Radial clearance (new): 0.035 … 0.085 mm
- ❑ Radial clearance: wear limit: 0.1 mm.
- ❑ Runout: max. 0.01 mm

13 - Roller rocker fingers

- ❑ Mark installation position
- ❑ Do not interchange
- ❑ Check roller bearing for ease of movement.
- ❑ Oil contact surface

14 - Hydraulic compensation element

- ❑ Mark installation position
- ❑ Checking ⇒ page 120
- ❑ Lubricate contact surfaces before installing.

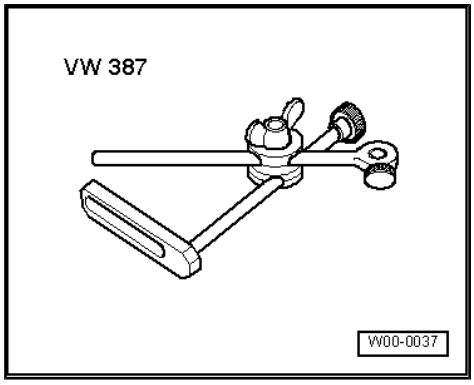
15 - Pressure limiting valve

- ❑ 25 Nm
- ❑ For lubricating points in cylinder head

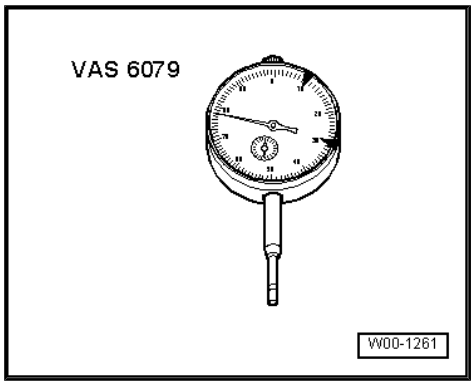
2.1 Checking axial clearance of camshafts

Special tools and workshop equipment required

- ♦ Universal dial gauge holder - VW 387-



- ♦ Dial gauge - VAS 6079-

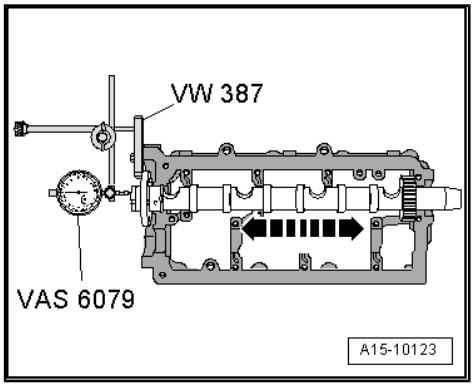


Test sequence

– Perform measurement with retaining frame removed.

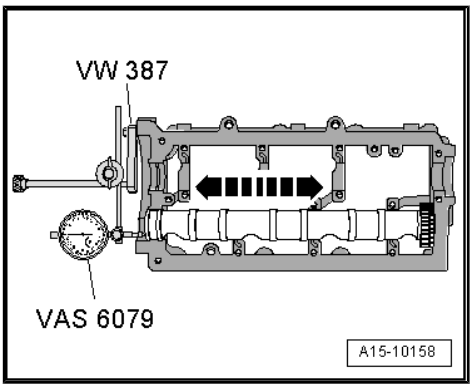
Inlet camshaft

- New: 0.03 … 0.08 mm.
- Wear limit: 0.12 mm.



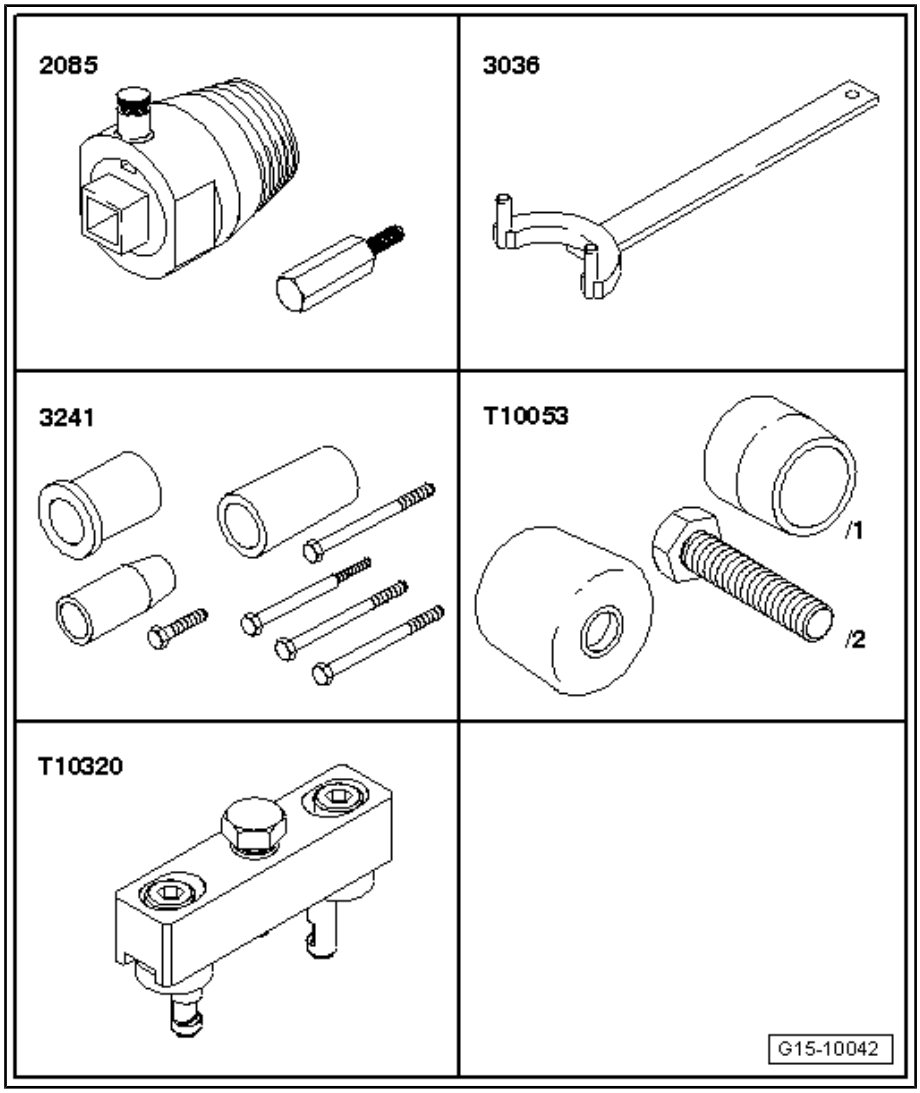
Exhaust camshaft

- New: 0.03 … 0.08 mm.
- Wear limit: 0.12 mm.



2.2 Renewing camshaft oil seal

Special tools and workshop equipment required



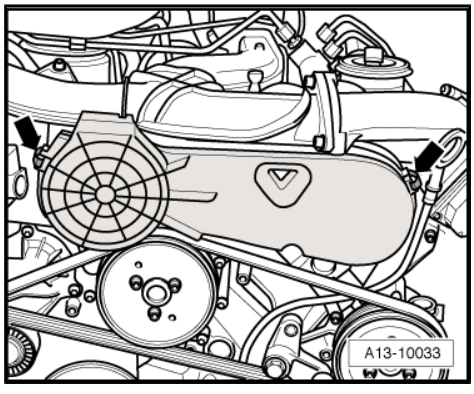
- Seal puller - 2085-
- Counter-hold tool - 3036-
- Hexagon bolt M10 x 1.25 x 40 from fitting sleeves - 3241-
- Assembly tool - T10053-
- Puller - T10320-

Procedure

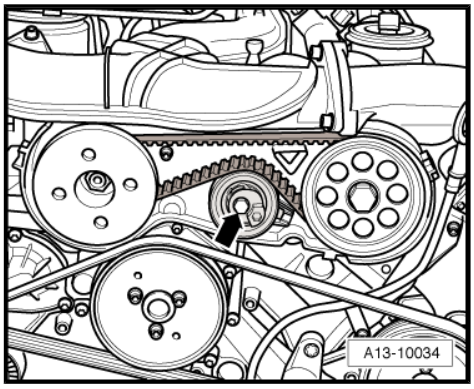
– Remove engine cover panel ⇒ page 3 .

– Loosen clamps -arrows-.

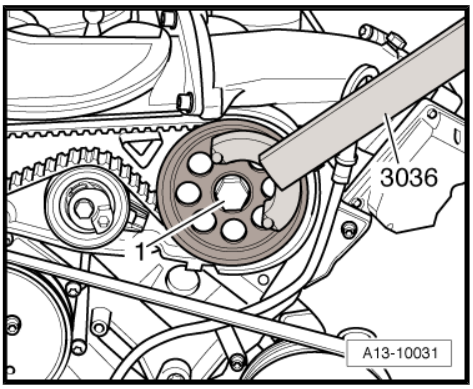
– Pivot toothed belt guard forward and disengage retaining pegs on lower side of toothed belt guard.



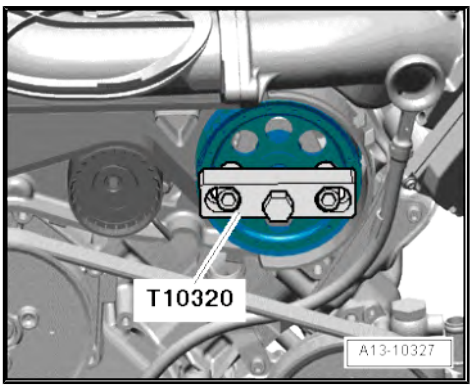
– Loosen bolt -arrow- for tensioning roller approx. 2 turns.



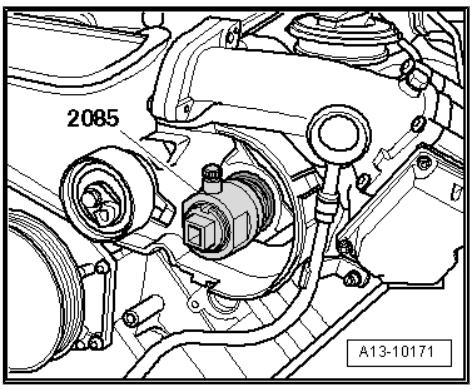
– Loosen central bolt -1- for toothed belt pulley by approx. 2 turns using counter-hold tool - 3036- .



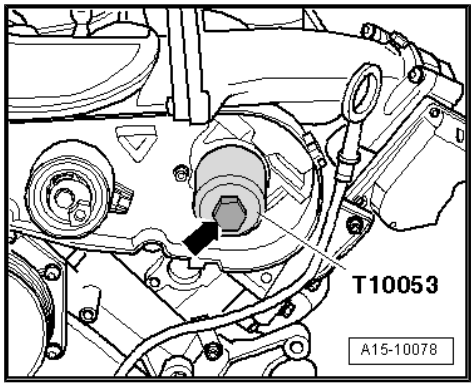
– Use puller - T10320- to pull off toothed belt drive pulley.
– Take off toothed belt drive pulley together with toothed belt.



– Unscrew inner section of oil seal extractor -2085- 3 turns out of outer section and lock with knurled screw.
– Lubricate threaded head of oil seal extractor, place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
– Loosen knurled screw and turn inner part against camshaft until oil seal is pulled out.
– Clamp flats of oil seal extractor in vice and use pliers to remove seal.
– Clean running surface and sealing surface.



– Press in new oil seal until stop using press sleeve -T10053- and hexagon bolt M10 x 1.25 x 40 -arrow- from fitting sleeves - 3241- .

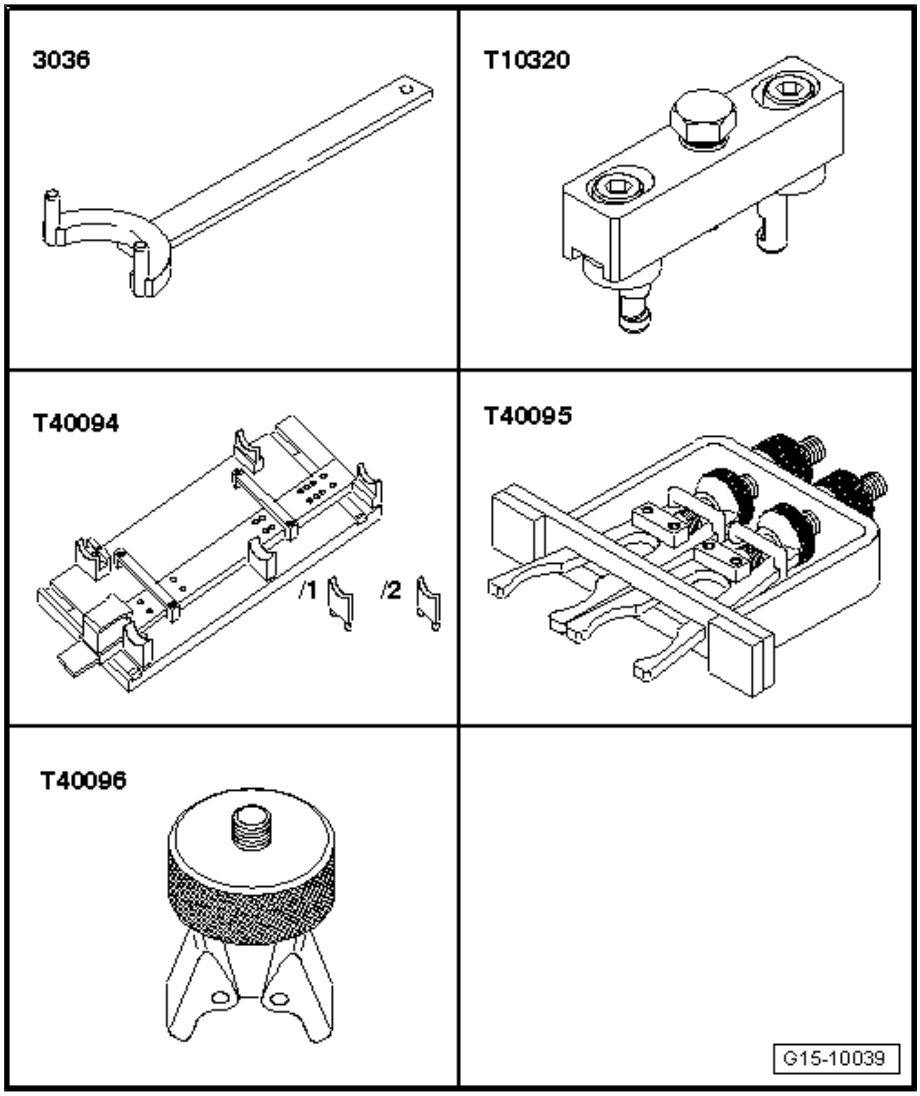


Further installation is carried out in reverse order; note the following:

– Install toothed belt for high-pressure pump ⇒ page 257 .

2.3 Removing and installing camshafts

Special tools and workshop equipment required



- Counter-hold tool - 3036-
- Puller - T10320-
- Camshaft fitting tool - T40094-
- Camshaft fitting tool - T40095-
- Camshaft fitting tool - T40096-

- Hand drill with plastic brush
- Safety glasses
- Sealant ⇒ Parts catalogue

Removing

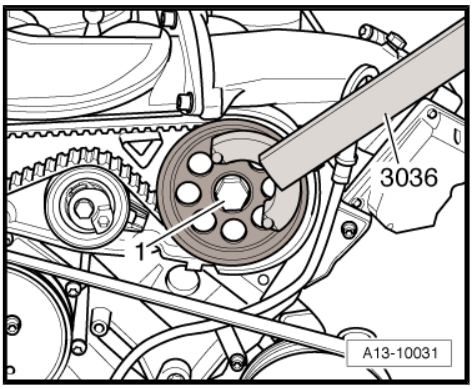
– Remove relevant timing chain from camshafts ⇒ page 132 .

Left cylinder head:

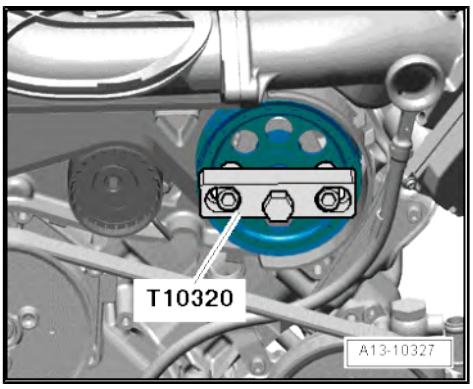
– Remove upper part of intake manifold ⇒ page 274 .

– Remove toothed belt for high-pressure pump ⇒ page 257 .

– Loosen central bolt -1- for toothed belt pulley by approx. 2 turns using counter-hold tool - 3036- .



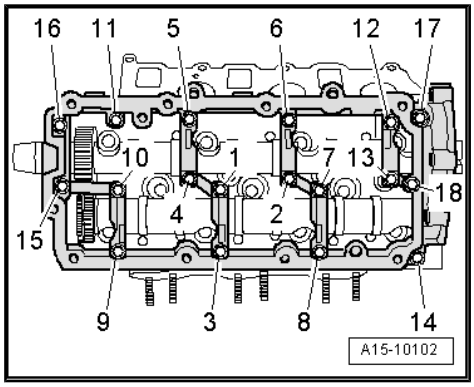
– Use puller - T10320- to pull off toothed belt drive pulley.



Continuation for both sides

– Remove cylinder head cover (left or right) ⇒ page 90 .

– Unscrew retaining frame bolts and nuts in the sequence -18 … 1-.



Note

Make sure you do not damage roller rocker fingers and compensation elements when removing camshafts.

– Carefully remove retaining frame and camshafts.

Installing

Caution

The camshafts MUST only be installed using the camshaft fitting tool - T40094- as described in the following, as the thrust bearings in the retaining frame would otherwise be destroyed. The cylinder head would then have to be renewed.

WARNING

Wear protective goggles.

– Remove sealant residue from cylinder head and retaining frame, e.g. with a rotating plastic brush.

Caution

Make sure that no sealant residue gets into the cylinder head or the bearings.

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

– Lubricate running surfaces of camshafts.

Set up camshaft fitting tool - T40094- as follows:

Left cylinder head:

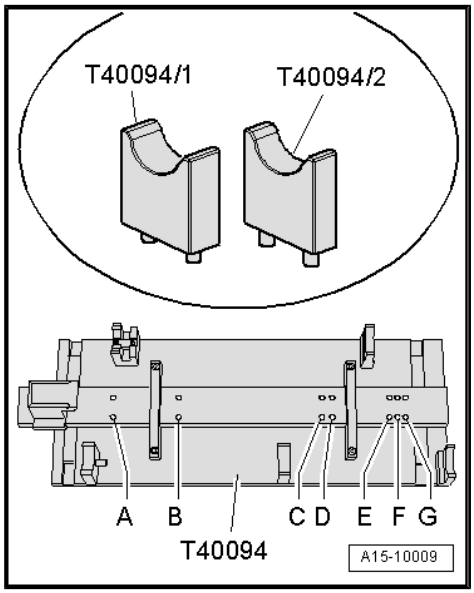
– Insert support -T40094/2- in position -A-.

– Insert support -T40094/1- in position -D-.

Right cylinder head:

– Insert support -T40094/2- in position -B-.

– Insert support -T40094/1- in position -C-.



Continuation for both sides

Note

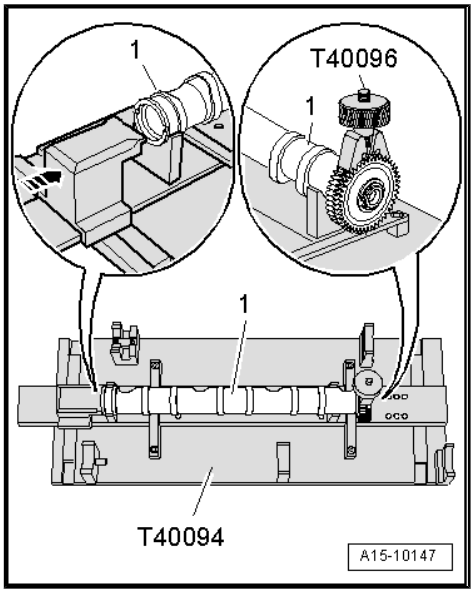
- *The procedure is described below applies to the left cylinder head.*
- *The procedure for the right cylinder head is analogous and is performed in the same sequence.*

– Place exhaust camshaft -1- in support -T40094/1- and support -T40094/2- .

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

– Place camshaft fitting tool - T40096- on teeth of camshaft gear so that the two arms of the tool engage on the two halves of the gear (one in each half).

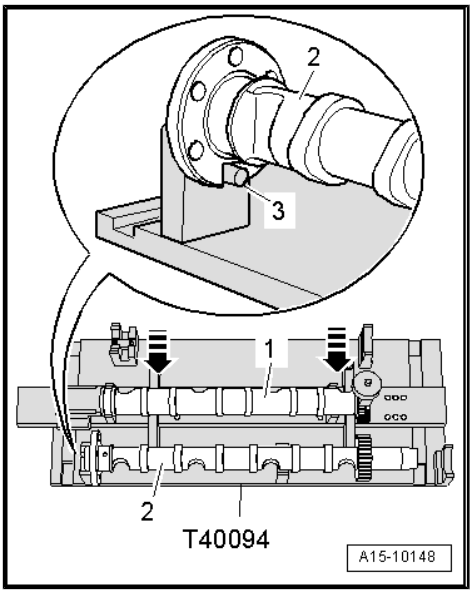
– Tension clamping tool using knurled wheel so that faces of gear teeth are in alignment.



– Place inlet camshaft -2- in camshaft fitting tool - T40094- .

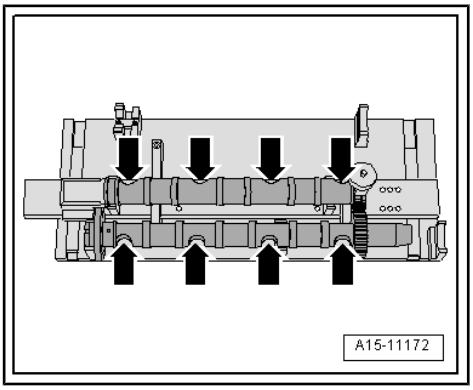
• The locating pin -3- must engage in the slot on the camshaft.

– Slide exhaust camshaft -1- towards inlet camshaft until gear teeth engage.



– Check correct position of camshafts:

• The indentations -arrows- on both camshafts must face upwards.

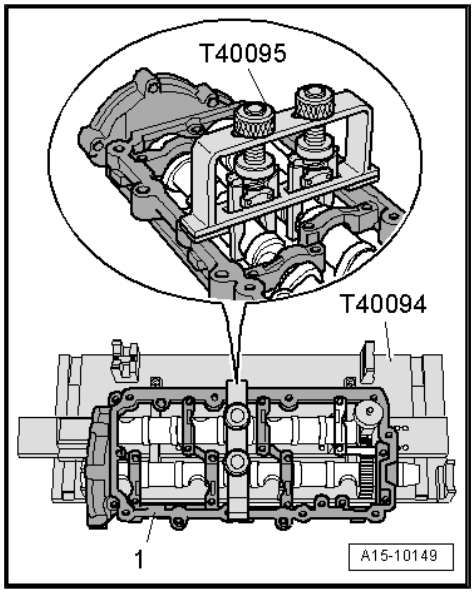


– Fit retaining frame -1- onto camshafts.

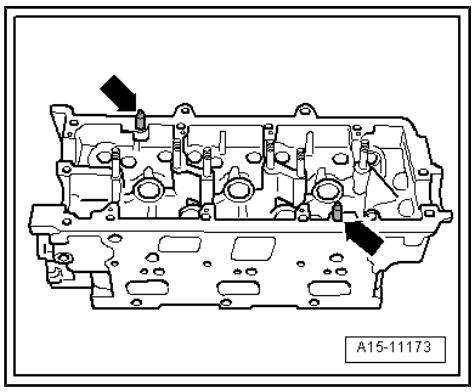
• All camshaft bearings must be seated on the camshafts.

– Fit camshaft fitting tool - T40095- onto camshafts, and align gripping arms of retainer as required and grip with knurled nuts -2-.

– Tension camshafts upwards by tightening knurled nuts -3-.



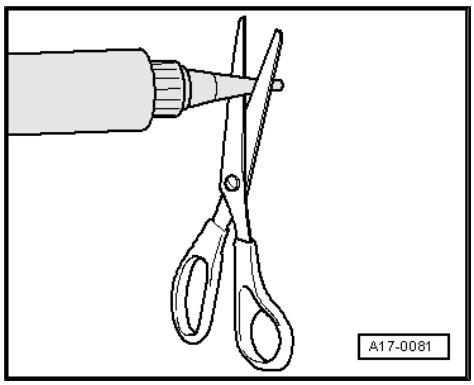
– Check whether dowels -arrows- are fitted in the cylinder head. Insert dowels if any are missing.

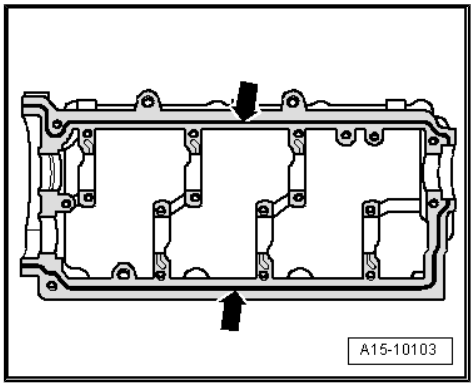


Note

Check the expiry date of the sealant.

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





Note

For greater clarity, the retaining frame is shown without camshafts.

– Turn retaining frame upside down.

Caution

Danger of blocking lubrication system with excess sealant.

- ***Do not apply sealant beads that are thicker than prescribed.***

– Apply the beads of sealant -arrows- onto the clean sealing surfaces of the retaining frame as illustrated.

- The grooves -arrows- on the sealing surface must be completely filled with sealant.
- The beads of sealant must project 1.5 … 2.0 mm above the sealing surface.

Note

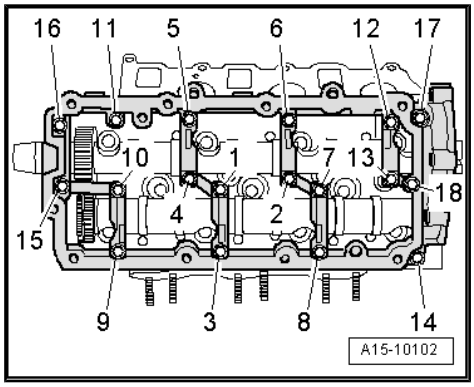
- *The sealant beads must not be thicker than specified, or excess sealant could enter the camshaft bearings.*
- *The retaining frame must be installed within 5 minutes after applying sealant.*

Caution

Risk of engine damage.

- ***Ensure that all roller rocker fingers contact the valve ends and compensation elements correctly.***

– Fit retaining frame together with both camshafts and camshaft fitting tool - T40095- onto cylinder head immediately.



Note

After installing the retaining frame, wait about 30 minutes for the sealant to dry.

– Tighten retaining frame bolts evenly in the sequence -1 … 18-, initially only hand-tight.

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

– Tighten retaining frame bolts to final torque in the sequence -1 … 18-.

– Remove camshaft fitting tool - T40095- and camshaft fitting tool - T40096- .

Now continue installing in reverse order of removal, observing the following:

Note

♦ *After installing camshafts wait for approx. 30 minutes before starting engine. Hydraulic compensation elements must settle (otherwise valves will strike pistons).*

♦ *After working on valve gear, carefully crank engine at least 2 revolutions by hand to ensure that no valves make contact on starting.*

– Install cylinder head cover (left and right) ⇒ page 90 .

Left cylinder head:

– Renew camshaft oil seal ⇒ page 107 .

– Install toothed belt for high-pressure pump ⇒ page 257 .

– Install upper part of intake manifold ⇒ page 274 .

Right cylinder head:

– Renew sealing cap on front cylinder head.

– Using a suitable drift, knock in new sealing cap (core plug) until flush.

Continuation for both sides

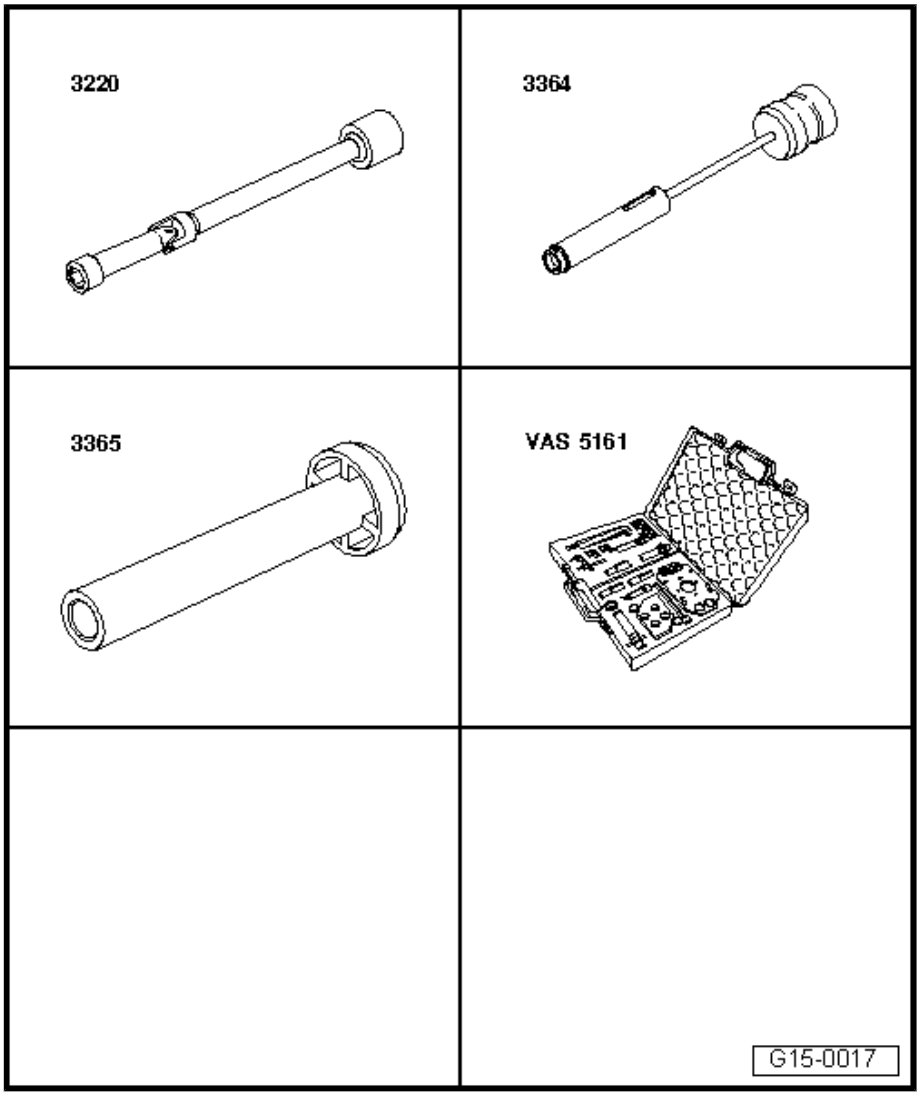
– Install camshaft timing chain ⇒ page 125 .

Specified torques

Component	Nm
Retaining frame to cylinder head	9
Toothed belt drive pulley to camshaft	75

2.4 Renewing valve stem seals

Special tools and workshop equipment required



- 10 mm jointed spanner - 3220-
- Valve stem seal puller - 3364-
- Valve stem seal fitting tool - 3365-
- Removal / installing device for valve cotters - VAS 5161- with guide plate - VAS 5161/23- and knurled spacer ring - VAS 5161/23-1-

Procedure

Vehicles with ceramic glow plugs:

Caution

- *Due to their special material properties, ceramic glow plugs are easily damaged and require extra care when handling during removal/installation. Adherence to the prescribed procedures is vital on removal and installation* *⇒ page 355* *.*

Vehicles with metal glow plugs:

– Remove all glow plugs using U/J extension and socket - 3220- .

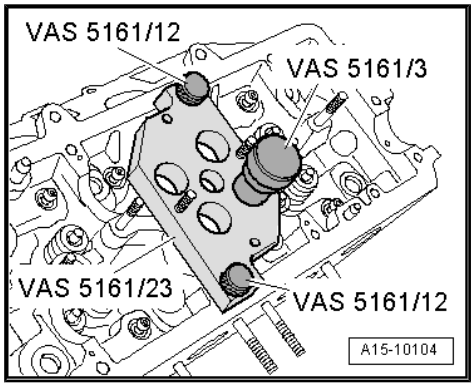
Continued for all vehicles:

– Remove camshafts ⇒ page 110 .

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

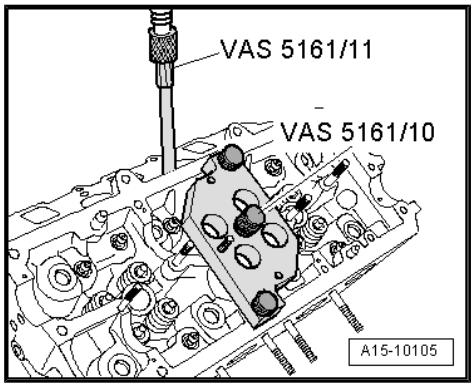
– Secure guide plate using the knurled screws - VAS 5161/12- .

– Insert drift - VAS 5161/3- into guide plate and knock valve cotters loose using a plastic hammer.



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

– Screw adapter - VAS 5161/11- hand-tight into glow plug hole of relevant cylinder.



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

– Slide knurled spacer ring - 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.

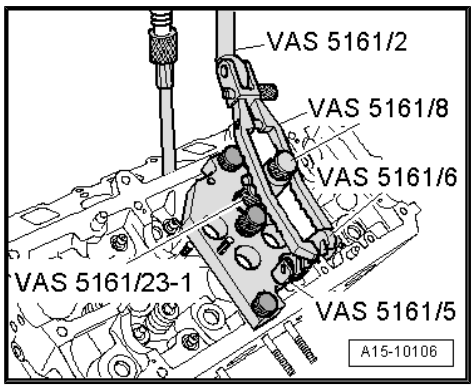
– Attach pressure fork - VAS 5161/2- to snap-in device and push assembly cartridge down.

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

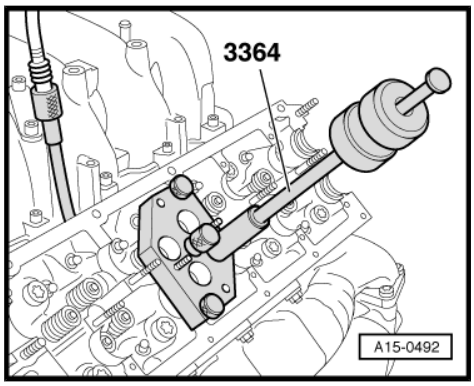
– Move knurled screw back and forth slightly; the valve cotters are thus forced apart and taken up by the assembly cartridge.

– Release pressure fork.

– Remove assembly cartridge with knurled spacer ring, valve plate and valve spring.

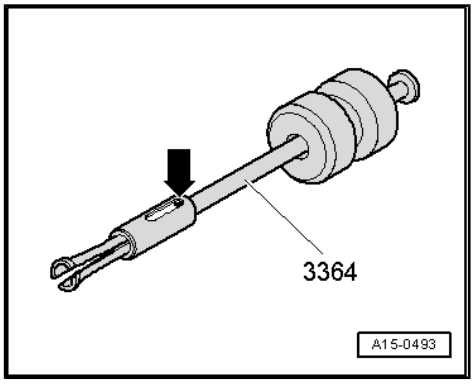


– Remove valve stem oil seals using valve stem seal puller - 3364- .

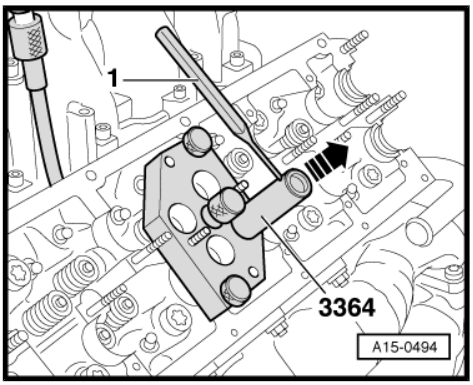


If the valve stem seal puller - 3364- cannot be used on some of the valve stem oil seals due to the confined space, proceed as follows:

– Knock out pin -arrow- of valve stem seal puller - 3364- using a punch and remove extractor attachment.



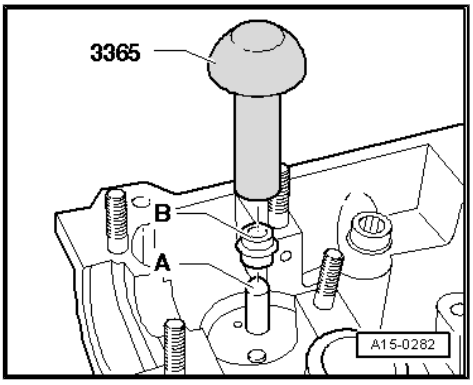
– Apply lower part of valve stem seal puller - 3364- to valve stem oil seal.
– Secure valve stem seal puller with a punch -1- or pin driver, as illustrated.
– Apply a puller to valve stem seal puller and pull out valve stem oil seal -arrow-.



Note

A plastic sleeve -A- is included with the new valve stem oil seals.

– Fit plastic sleeve -A- onto valve stem to prevent damage to new valve stem oil seal -B-.
– Lightly lubricate sealing lip of valve stem oil seal.
– Slip valve stem oil seal over plastic sleeve.
– Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool - 3365- .
– Remove plastic sleeve.

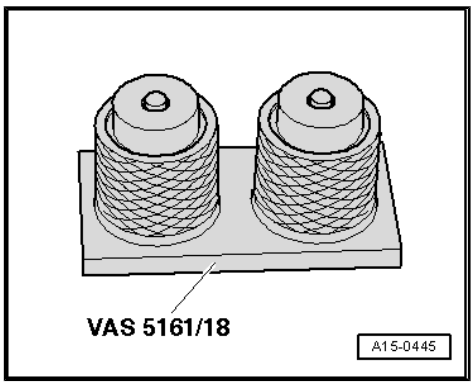


– If valve cotters have been removed from assembly cartridge , they need to be put into insertion device - VAS 5161/18- first.

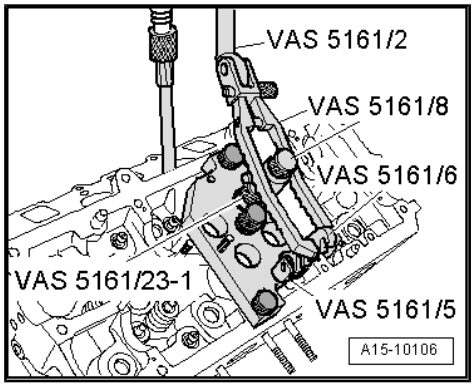
Note

Larger diameter of valve cotters faces upwards.

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



– Re-insert assembly cartridge - VAS 5161/8- into guide plate .
– To insert valve cotters, push pressure fork down and pull knurled screw upwards while turning screw in both directions.
– Release pressure fork with knurled screw still in pulled position.



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

– Install glow plugs ⇒ page 355 .
– Install camshafts ⇒ page 110 .

Note

- *Engine is not to be rotated for approx. 30 minutes after installing camshafts. Hydraulic compensation elements must settle (otherwise valves will strike pistons).*
- *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

2.5 Checking hydraulic valve compensation elements

Special tools and workshop equipment required

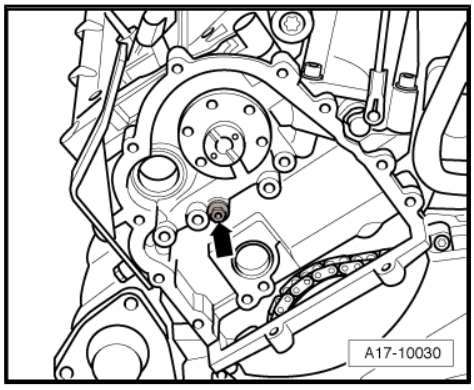
- -Feeler gauge-

Note

- *The hydraulic compensation elements cannot be repaired.*
- *Irregular valve noise during starting is normal.*

Procedure

– Start engine and run until coolant temperature reaches approx. 80°C.
– Increase engine speed to about 2500 rpm for 2 minutes (carry out a road test if necessary).



Note

If the irregular valve noises stop but recur repeatedly during short trips, the oil retention valve -arrow- at the rear end of the respective cylinder head must be renewed.

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

– Remove cylinder head cover (left or right) ⇒ page 90 .
– Rotate crankshaft until cam of hydraulic compensation element to be checked faces upwards. To do this:

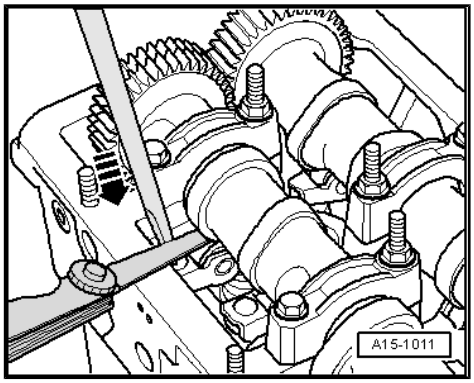
- Vehicles with manual gearbox: push vehicle forwards with 4th gear engaged and ignition switched off.
- Vehicles with automatic gearbox: remove noise insulation and rotate crankshaft clockwise via central bolt for vibration damper.

– Determine clearance between cam and roller rocker finger.

– Press roller rocker finger down -arrow- using a screwdriver.

If it is possible to insert a feeler gauge of 0.20 mm between camshaft and roller rocker finger:

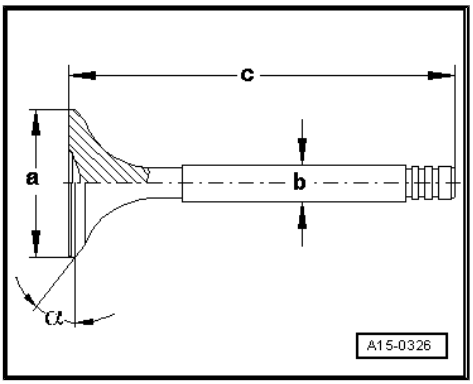
– Renew hydraulic compensation element.



2.6 Valve dimensions

Note

Never rework the inlet and exhaust valves. Only lapping-in is permitted.



Dimension		Inlet valve	Outlet valve
∅ a	mm	28.60 … 28.80	26.70 … 26.90
∅ b	mm	5.968 … 5.982	5.958 … 5.972
c	mm	97.25 … 97.45	97.35 … 97.55
α	∠°	45	45

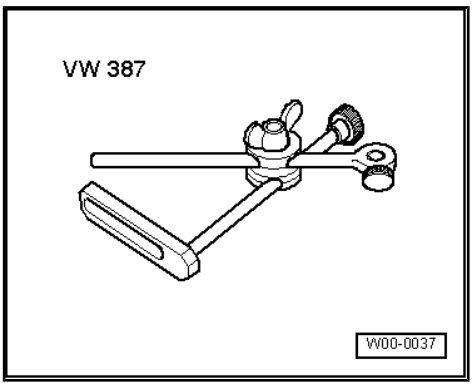
WARNING

- *Worn sodium filled exhaust valves must not be disposed of without first preparing the valves.*
- *The valves must be sawn in two with a metal saw between the centre of the stem and valve plate. When doing this, ensure that they do not come into contact with water. After preparing the valves, throw a maximum of ten into a bucket of water. Then step away immediately, since a chemical reaction will occur in which the sodium filling burns.*
- *After carrying out these procedures, the valves can be disposed of in the normal way.*

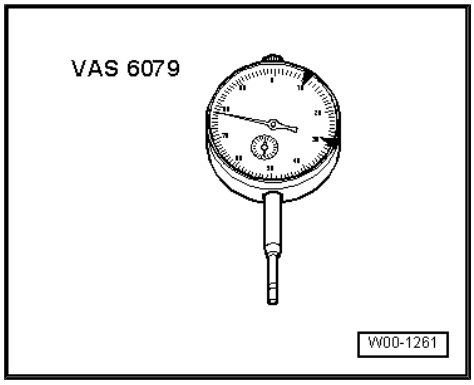
2.7 Checking valve guides

Special tools and workshop equipment required

- Universal dial gauge holder - VW 387-



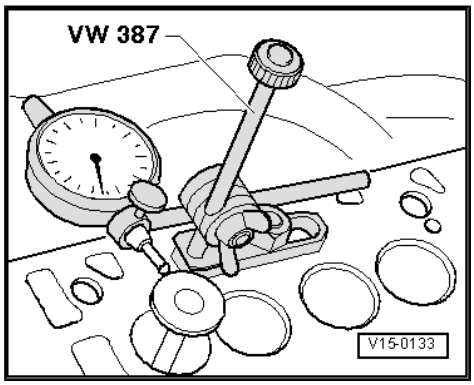
♦ Dial gauge - VAS 6079-



Test sequence

– Insert valve into valve guide.

• End of valve stem must be flush with valve guide.



Note

On account of differing stem diameters, only use inlet valve in inlet valve guide and exhaust valve in exhaust valve guide.

– Determine rock.

• Wear limit (sideways play) for inlet and exhaust valve guide: 1.0 mm.

Note

♦ *If the wear limit is exceeded, repeat the measurement with new valves. If the wear limit is exceeded again, renew the cylinder head. Valve guides cannot be renewed.*

♦ *If the valve is to be renewed as part of a repair, use a new valve for the calculation.*

3 Chain drive for camshafts

3.1 Camshaft timing chains

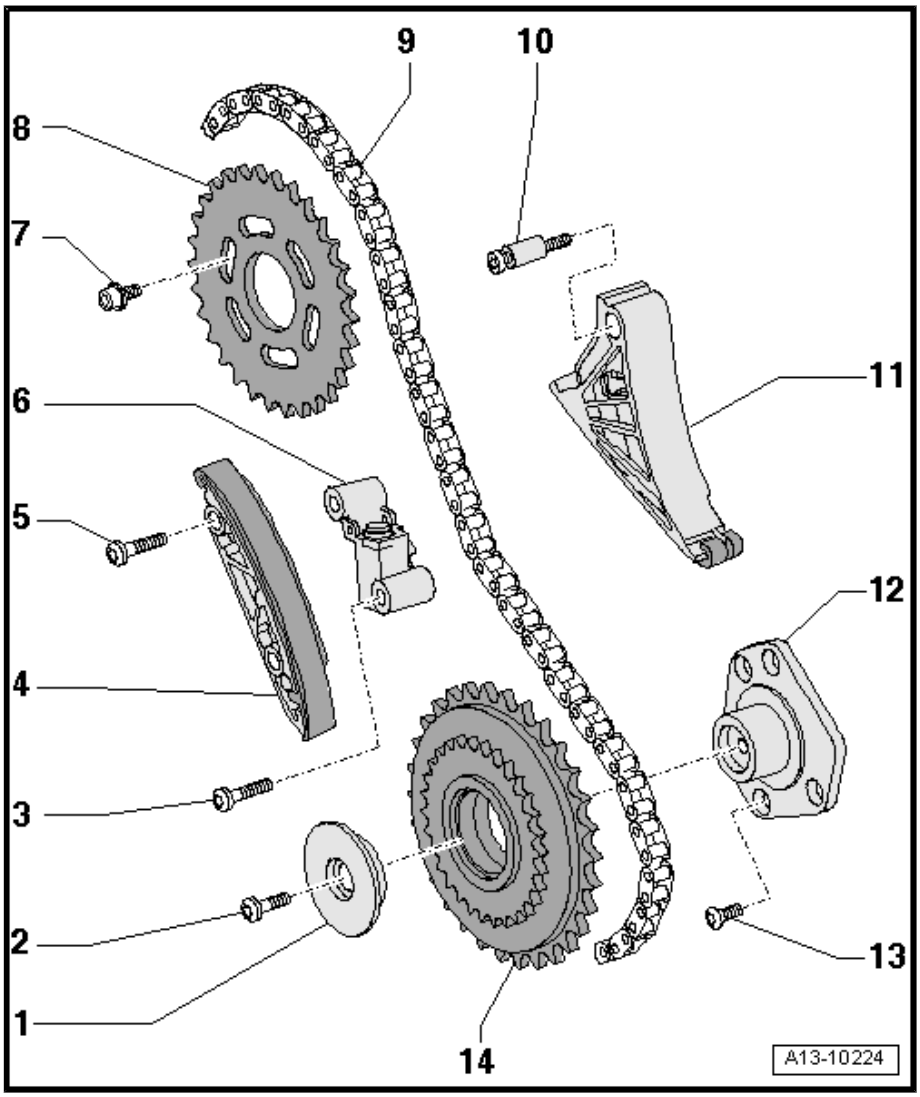
⇒ “3.1.1 Assembly overview - left camshaft timing chain”, page 123 .

⇒ “3.1.2 Assembly overview - right camshaft timing chain”, page 124 .

⇒ “3.1.3 Removing and installing camshaft timing chains”, page 125 .

⇒ “3.1.4 Removing camshaft timing chains from camshafts”, page 132 .

3.1.1 Assembly overview - left camshaft timing chain



1 - Thrust washer
- ❑ For drive sprocket.

2 - Bolt
- ❑ Specified torque ⇒ Item 4 (page 67)

3 - Bolt
- ❑ Renew
- ❑ 5 Nm + 90° (1/4 turn further)

4 - Slide rail
- ❑ Observe installation position

5 - Bolt
- ❑ Renew
- ❑ 5 Nm + 90° (1/4 turn further)

6 - Chain tensioner
- ❑ For left camshaft timing chain.

7 - Bolt
- ❑ 23 Nm

8 - Camshaft sprocket
- ❑ For inlet camshaft
- ❑ Installation position: side with lettering facing forwards

9 - Left camshaft timing chain
- ❑ Removing from camshafts ⇒ page 132 .
- ❑ Before removing, mark running direction with paint
- ❑ Removing and installing ⇒ page 125

10 - Bolt
- ❑ With sleeve
- ❑ Renew

- ❑ 5 Nm + 90° (1/4 turn further)

11 - Tensioning rail

12 - Mounting bracket

- ❑ For drive sprocket.

13 - Bolt

- ❑ Specified torque ⇒ Item 10 (page 67)

14 - Drive sprocket

- ❑ For left camshaft timing chain.

3.1.2 Assembly overview - right camshaft timing chain

1 - Bolt

- ❑ Specified torque ⇒ Item 2 (page 67)

2 - Locating pin

- ❑ For drive sprocket.

3 - Right camshaft timing chain

- ❑ Removing from camshafts ⇒ page 132 .
- ❑ Before removing, mark running direction with paint
- ❑ Removing and installing ⇒ page 125

4 - Camshaft sprocket

- ❑ For inlet camshaft
- ❑ Installation position: side with lettering facing forwards

5 - Bolt

- ❑ 23 Nm

6 - Chain tensioner

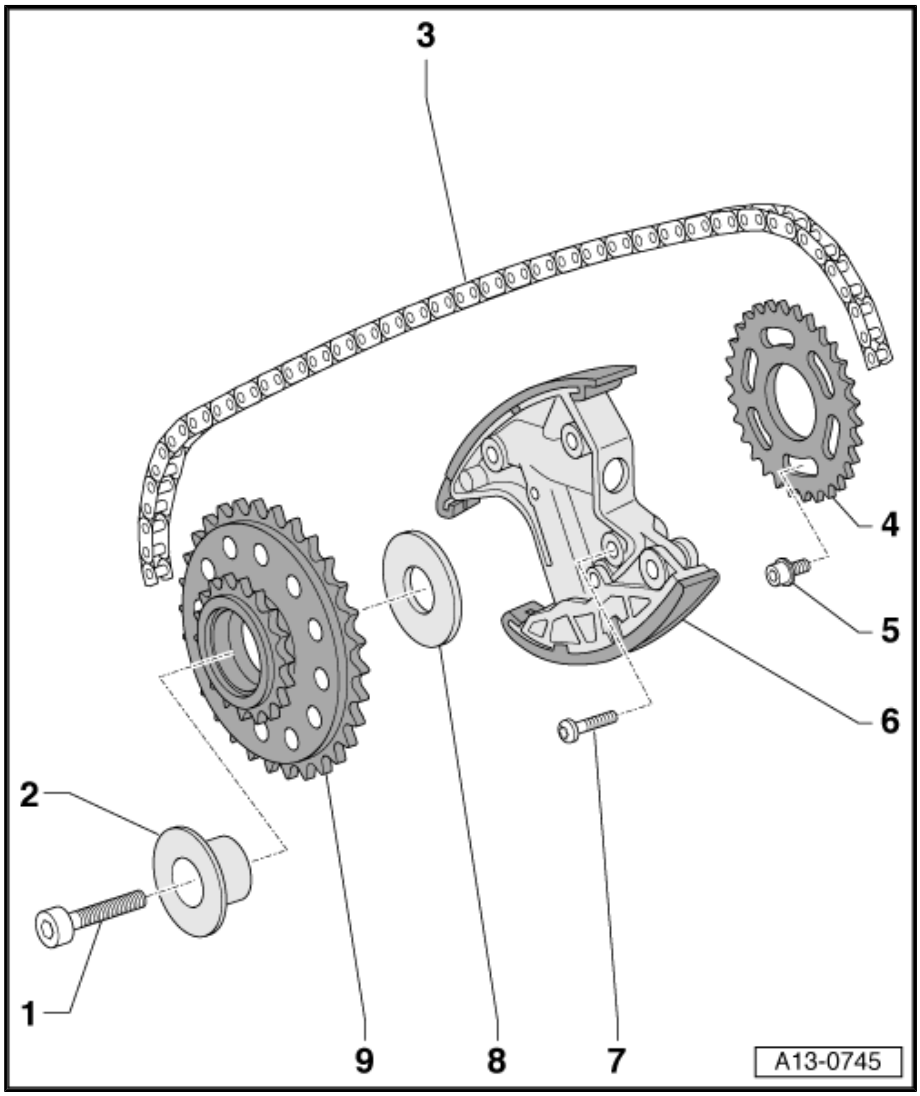
- ❑ For right camshaft timing chain.

7 - Bolt

- ❑ Renew
- ❑ 5 Nm + 90° (1/4 turn further)
- ❑ Qty. 3

8 - Thrust washer

- ❑ For drive sprocket.

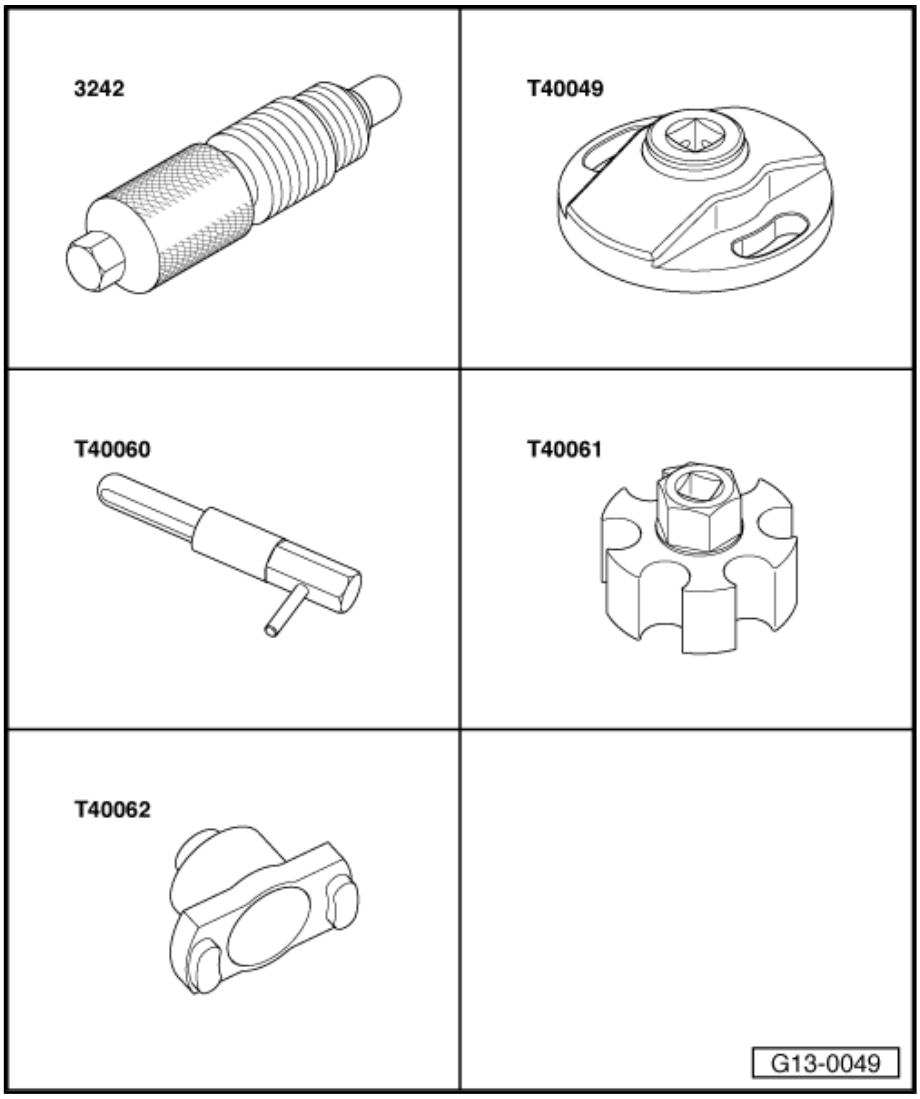


9 - Drive sprocket

- ❑ For right camshaft timing chain.

3.1.3 Removing and installing camshaft timing chains

Special tools and workshop equipment required



- Locating bolt - 3242-
- Special wrench - T40049-
- Adjustment pin - T40060- (qty. 2)
- Adapter - T40061-
- Adapter - T40062-
- Drill bit, 3.3 mm ∅ (qty. 2)

Removing

- Gearbox is removed.

Caution

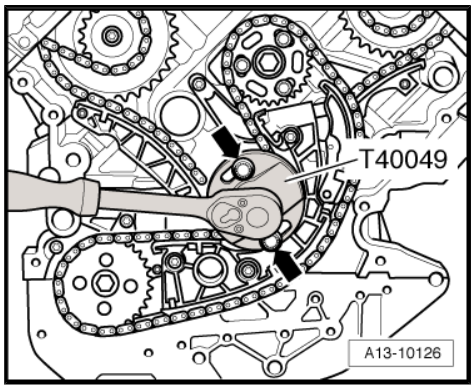
Avoid damage to valves and piston crowns.

- *Crankshaft and camshafts may only be turned with chain drive mechanism fully installed.*

– Remove drive plate ⇒ page 48 .

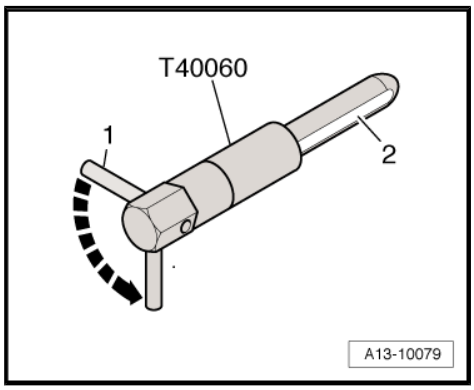
– Remove timing chain covers ⇒ page 57 .

– Install special wrench - T40049- on rear of crankshaft, use 2 old drive plate bolts -arrows- for this.



Note

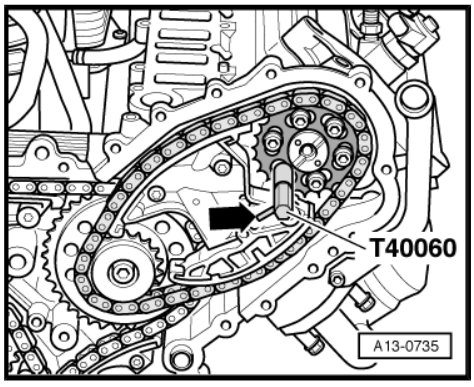
- *The adjustment pin - T40060- has a flat -2- which makes it easier to insert when the locating holes in the camshaft and cylinder head are not exactly in line.*
- *The adjustment pin is inserted initially so that the pin -1- so it is perpendicular to a radius vector.*
- *To obtain the correct "TDC" position, the pin -1- must then be turned 90° -arrow- so it is parallel to a radius vector.*



Caution

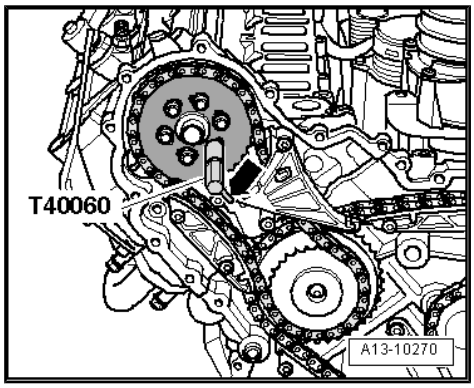
Risk of irreparable damage from camshaft timing chains jumping.

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

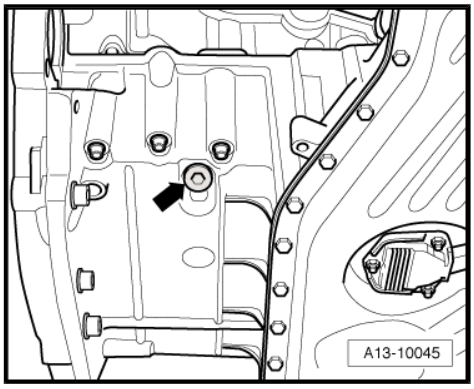


– Turn crankshaft to "TDC":

- It should be possible to lock camshafts with adjustment pin - T40060- .
- Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 1 (right side).
- Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 2 (left side).



– Unscrew plug -arrow- from upper part of sump.

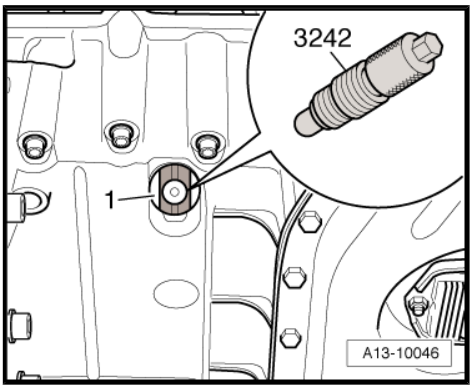


WARNING

Risk of injury when feeling for "TDC" hole with finger.

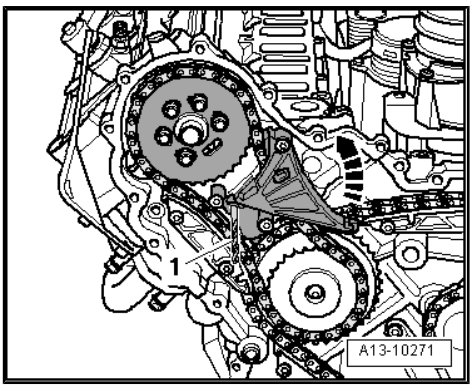
- *Do not turn crankshaft -1-.*

– Screw locking pin - 3242- into hole (20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centre locking pin.



– Wrap insulating tape around cutting end and cutting edges of 3.3 mm ∅ drill to prevent flesh wounds.

– Press tensioning rail of chain tensioner for left camshaft timing chain in direction of -arrow- and lock chain tensioner by inserting 3.3 mm ∅ drill bit -item 1-.



Caution

Camshaft timing chain may be destroyed if it runs in the opposite direction to the direction it ran before.

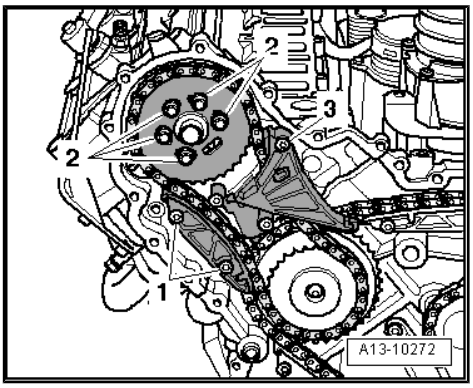
- *If camshaft timing chain is to be reinstalled: mark direction of rotation with a coloured arrow.*

– Remove adjustment pin - T40060- from both camshafts.

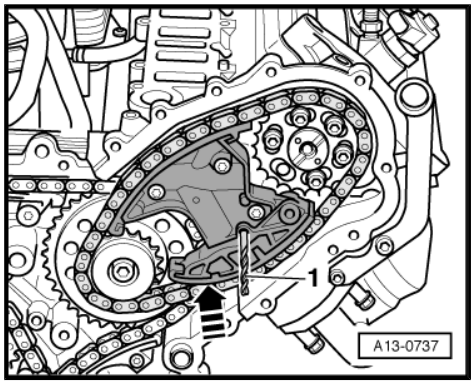
– Unscrew bolt -3- and remove tensioning rail.

– Unscrew bolts -1- for guide rail and -2- for camshaft sprocket.

– Remove camshaft sprocket, guide rail and left camshaft timing chain.



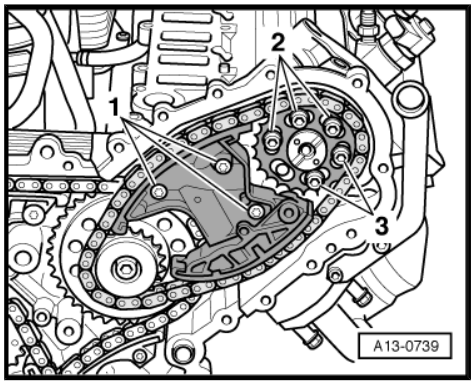
– Wrap insulating tape around cutting end and cutting edges of 3.3 mm ∅ drill to prevent flesh wounds.
– Press guide rail of chain tensioner for right camshaft timing chain in direction of -arrow- and lock chain tensioner by inserting 3.3 mm ∅ drill bit -item 1-.



Caution

Camshaft timing chain may be destroyed if it runs in the opposite direction to the direction it ran before.

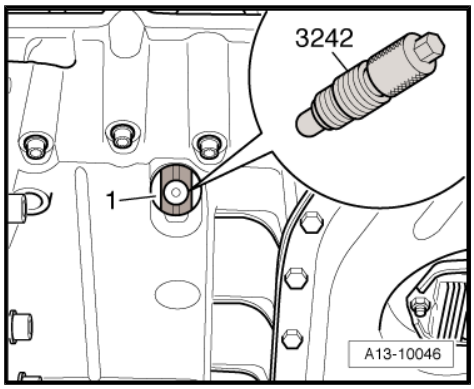
- *If camshaft timing chain is to be reinstalled: mark direction of rotation with a coloured arrow.*



– Unscrew bolts -1- for chain tensioner and -2- and -3- for camshaft sprocket.
– Remove camshaft sprocket, chain tensioner and right camshaft timing chain.

Installing

- Specified torques ⇒ page 123 .
- Crankshaft -1- locked at “TDC” with locking pin - 3242- .
- Drive chain for valve gear installed ⇒ page 71



Note

- *Renew seal for “TDC” mark sealing plug.*
- *If a further tightening angle is specified for certain bolts, these must be renewed.*

Caution

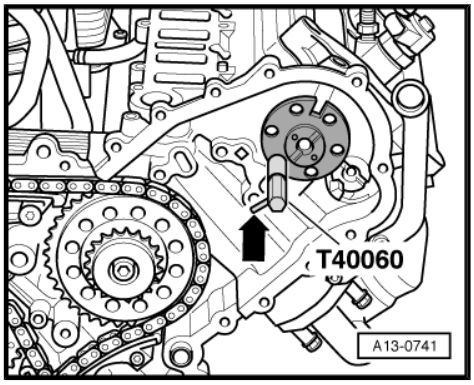
Avoid damage to valves and piston crowns.

- *When turning camshaft, crankshaft must be positioned so that no piston is positioned at “TDC”.*

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

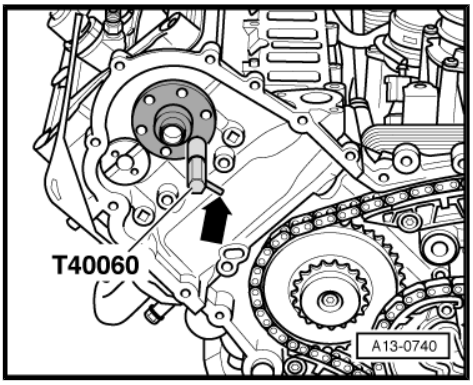
• It should be possible to lock camshafts with adjustment pin - T40060- .

• Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 1 (right side).



• Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 2 (left side).

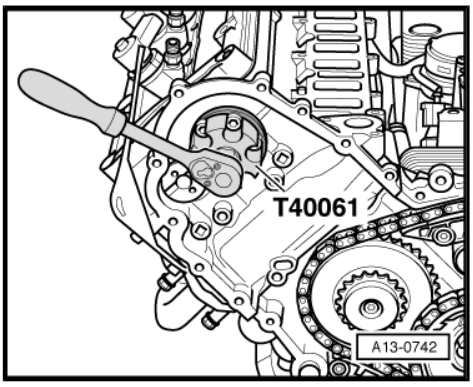
– Remove adjustment pin - T40060- from both camshafts.



Caution

Avoid damage to valves and piston crowns.

- *When turning camshaft, crankshaft must be positioned so that no piston is positioned at “TDC”.*



Note

If the camshaft cannot be locked, the camshafts can be turned slightly using adapter - T40061- . To do so, screw securing bolts for camshaft sprocket into camshaft.

– Install left camshaft timing chain with camshaft sprocket, guide rail and tensioning rail.

• Elongated holes in camshaft sprocket must be aligned centrally with threaded holes in camshaft.

– Tighten bolts -1- and -3- for guide rail and tensioning rail.

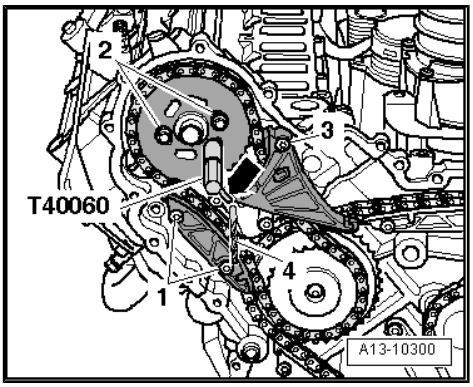
– Screw both bolts -2- for camshaft sprocket in loosely.

• It should just be possible to turn camshaft sprocket on camshaft without axial movement.

– Lock left camshaft with adjustment pin - T40060- .

• Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft.

– Pull drill -4- out of locating hole, this releases the left chain tensioner.



– Install right camshaft timing chain with camshaft sprocket and chain tensioner.

• Elongated holes in camshaft sprocket must be aligned centrally with threaded holes in camshaft.

– Tighten bolts -1- for chain tensioner.

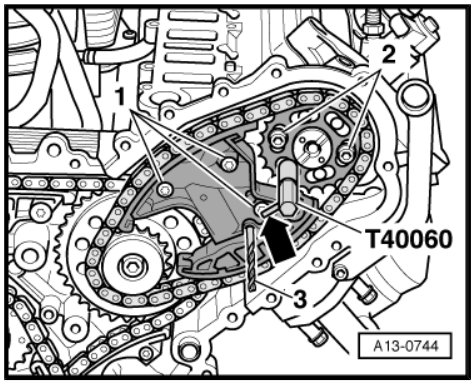
– Screw both bolts -2- for camshaft sprocket in loosely.

• It should just be possible to turn camshaft sprocket on camshaft without axial movement.

– Lock right camshaft with adjustment pin - T40060- .

• Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft.

– Pull drill -3- out of locating hole, this releases the right chain tensioner.

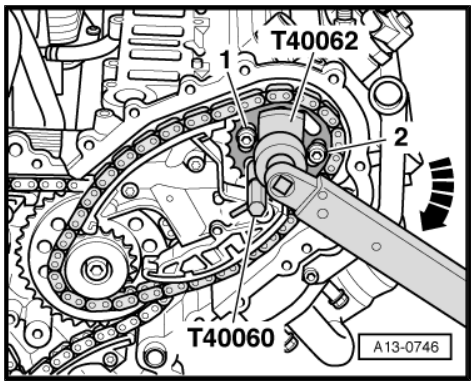


– Pretension right camshaft sprocket to 20 Nm in -direction of arrow- using adapter - T40062- and torque wrench and hold at this tension.

– Tighten bolts -1- and -2-.

– Remove adapter - T40062- and adjustment pin - T40060- .

– Tighten remaining bolts for right camshaft sprocket.

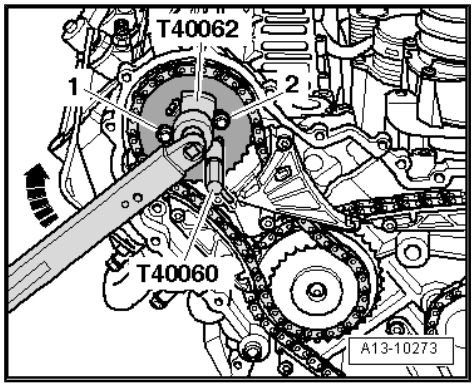


– Pretension left camshaft sprocket to 15 Nm in -direction of arrow- using adapter - T40062- and torque wrench and hold at this tension.

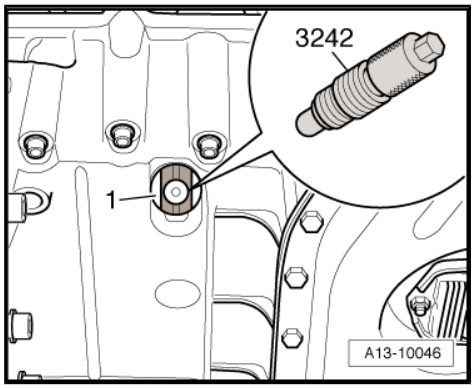
– Tighten bolts -1- and -2-.

– Remove adapter - T40062- and adjustment pin - T40060- .

– Tighten remaining bolts for left camshaft sprocket.



– Remove locking pin - 3242- .

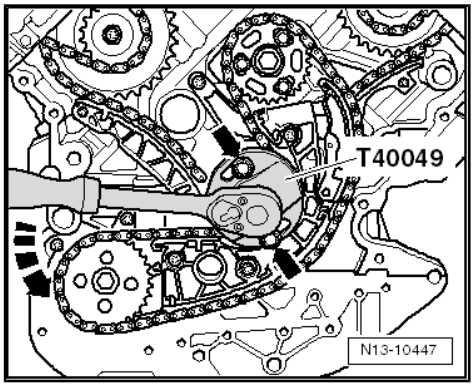


Checking valve timing

Caution

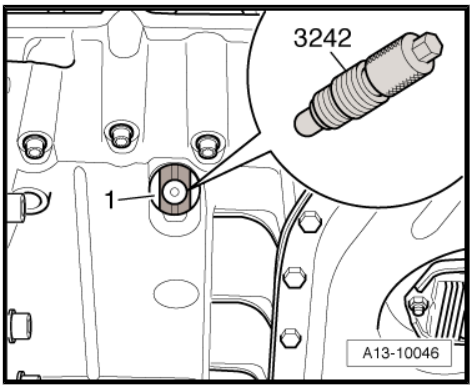
Risk of irreparable damage from camshaft timing chains jumping.

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



– Turn crankshaft 2 rotations until crankshaft is just before “TDC” again using special wrench - T40049- .

– While turning in this direction, lock crankshaft -1- with locking pin - 3242- . Tighten locking pin to 20 Nm.



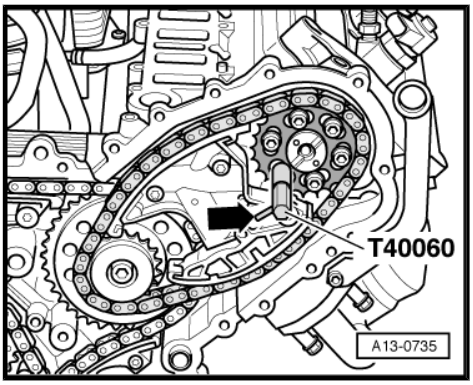
Caution

Adjustment fault through inexact “TDC” position.

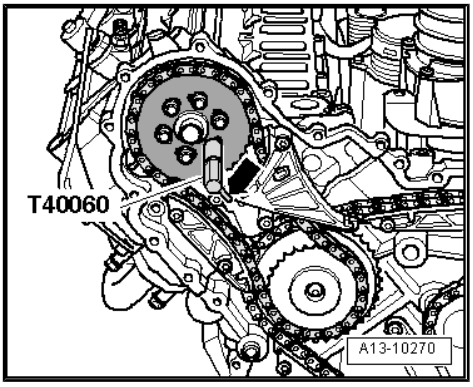
- *If the crankshaft has been rotated even only slightly beyond the “TDC” position, first turn crankshaft back approx. 10° then turn again in engine direction of rotation to “TDC”.*

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

- It should be possible to lock camshafts with adjustment pin - T40060- .
- Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 1 (right side).

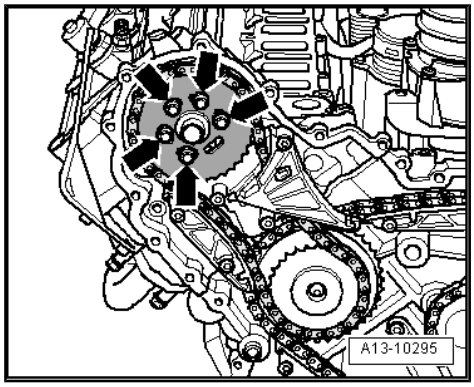


- Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 2 (left side).

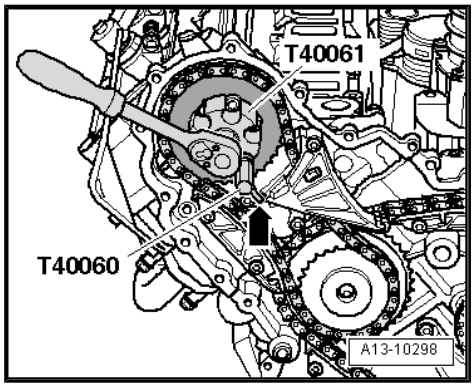


Adjusting valve timing

– If one of the camshafts cannot be locked, loosen all bolts -arrows- of relevant camshaft sprocket approx. 1 turn.

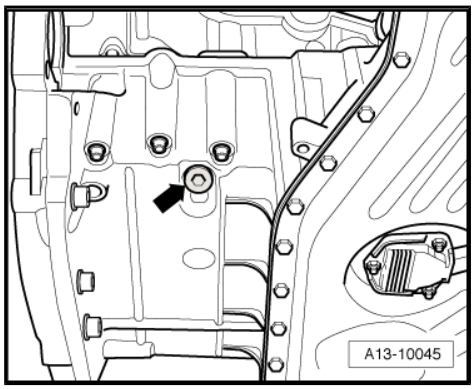


– Fit adapter - T40061- over bolt heads of loosened bolts.
– Turn camshaft slightly backwards and forwards with adapter - T40061- until adjustment pin - T40060- can be inserted.
• Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft.
– Tighten bolts for camshaft sprocket to approx. 5 Nm with adapter - T40061- and adjustment pin - T40060- still fitted.
– Remove adjustment pin - T40060- and adapter - T40061- .
– Tighten bolts for camshaft sprocket to specified torque.
– If necessary, repeat procedure for other cylinder bank.
– Remove locking pin - 3242- .
– Check valve timing again ⇒ page 131 .



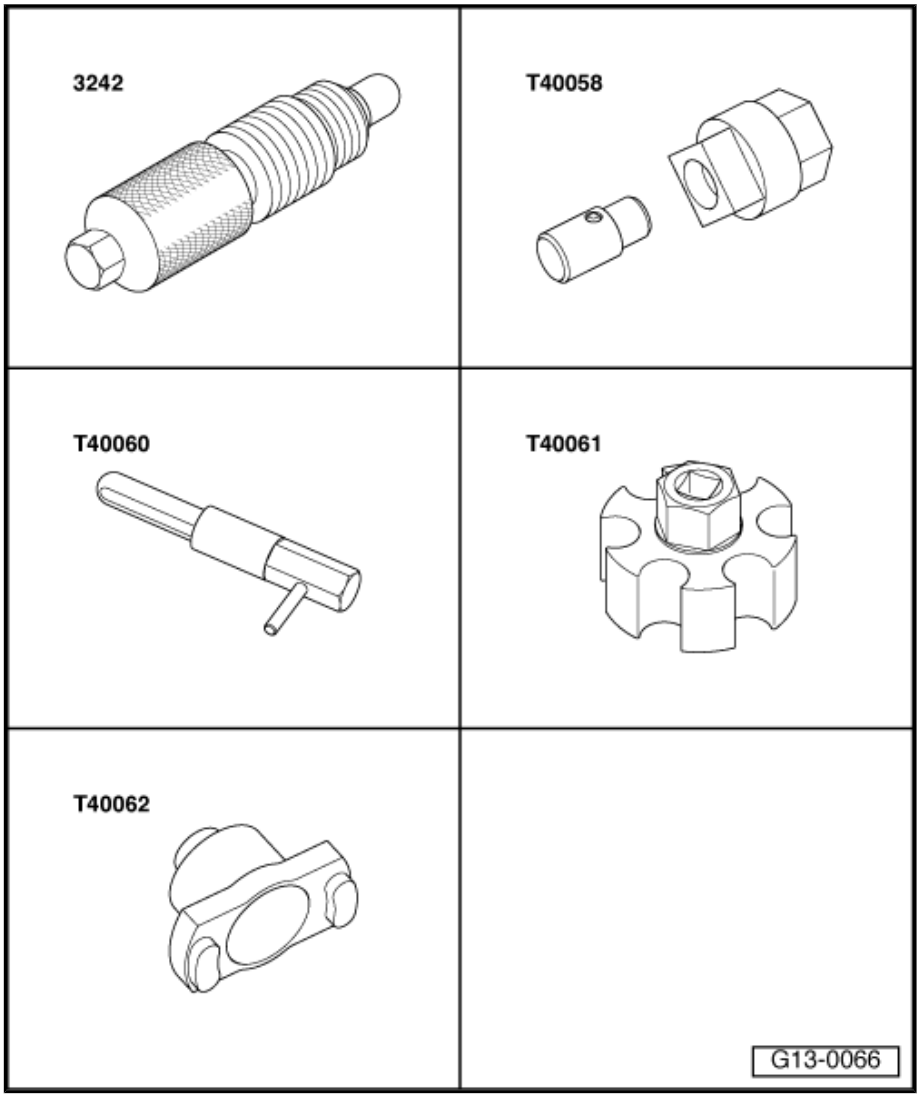
Now continue installing in reverse order of removal, observing the following:

– Screw in sealing plug -arrow- for “TDC” mark in upper part of oil sump ⇒ page 150 .
– Install timing chain covers ⇒ page 57 .
– Install drive plate ⇒ page 48 .
– Replenish engine oil and check oil level ⇒ Maintenance ; Booklet ; Engine oil: Drain or extract; Renewing oil filter and replenishing engine oil .



3.1.4 Removing camshaft timing chains from camshafts

Special tools and workshop equipment required



- Locating bolt - 3242-
- Adapter - T40058-
- Adjustment pin - T40060- (qty. 2)
- Adapter - T40061-
- Adapter - T40062-
- Drill bit, 3.3 mm ∅ (qty. 2)

Removing

- Engine and gearbox in vehicle

Note

If repairs have been undertaken on only one cylinder head, then it is sufficient to check the valve timing on the cylinder head on which the repairs were made.

– Drain coolant ⇒ page 187 .
– Remove starter catalytic converter ⇒ page 284 .
– Remove vacuum pump ⇒ page 103 .

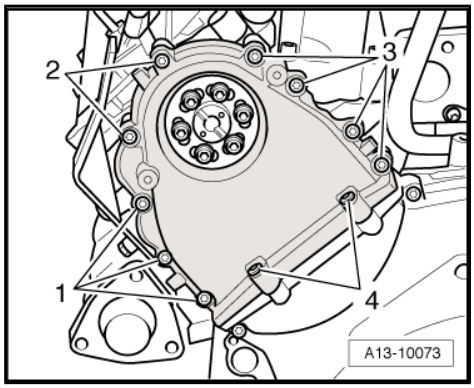
– Remove rear right coolant pipe ⇒ page 182 .

– Remove rear left coolant pipe ⇒ page 175 .

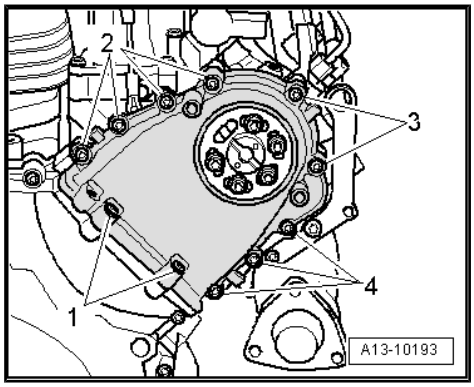
Note

For illustration purposes, the following work on the timing chains is shown from the rear with the engine removed

– Unscrew bolts -1 … 4- and remove left timing chain cover.

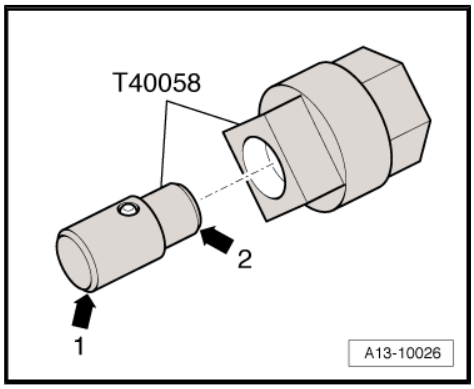


– Unscrew bolts -1 … 4- and remove right timing chain cover.



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

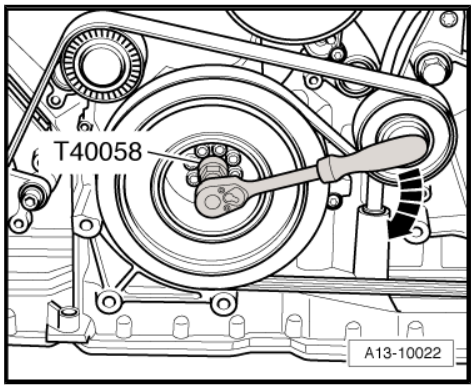
- The larger diameter -arrow 1- points towards the engine.
- The smaller diameter -arrow 2- faces the adapter.



Caution

Risk of irreparable damage from camshaft timing chains jumping.

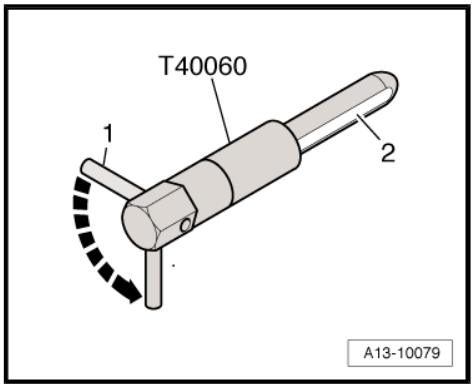
- ***Only turn crankshaft in engine direction of rotation -arrow-.***



– Turn crankshaft to “TDC” using adapter - T40058- .

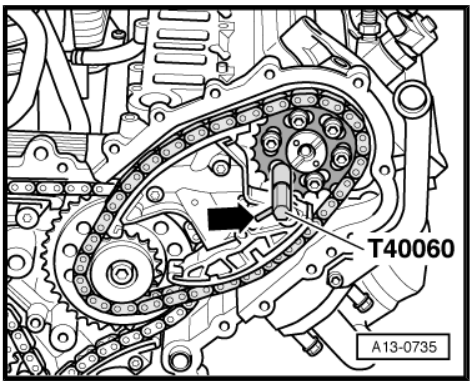
Note

- *The adjustment pin - T40060- has a flat -2- which makes it easier to insert when the locating holes in the camshaft and cylinder head are not exactly in line.*
- *The adjustment pin is inserted initially so that the pin -1- so it is perpendicular to a radius vector.*
- *To obtain the correct "TDC" position, the pin -1- must then be turned 90° -arrow- so it is parallel to a radius vector.*

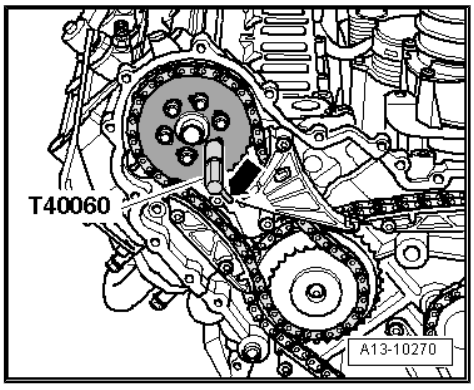


– Check that camshafts on both cylinder heads are positioned at "TDC":

- It should be possible to lock camshafts with adjustment pin - T40060- .
- Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 1 (right side).



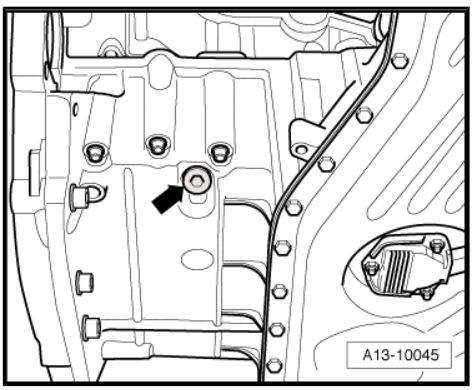
- Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 2 (left side).



Note

Place a cloth underneath upper part of sump to catch escaping engine oil.

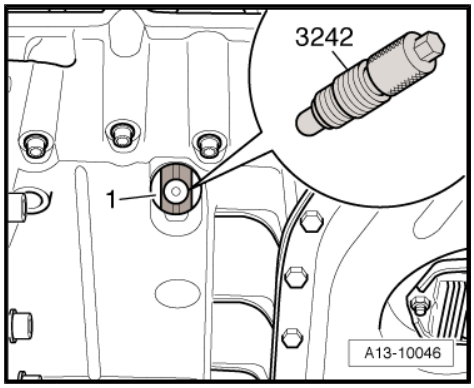
– Unscrew plug -arrow- from upper part of sump.



WARNING

Risk of injury when feeling for "TDC" hole with finger.

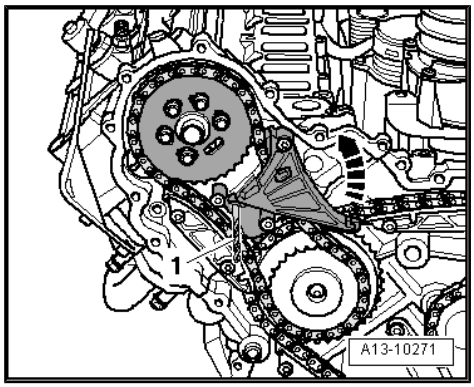
- *Do not turn crankshaft -1-.*



– Screw locking pin - 3242- into hole (20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centre locking pin.

– Wrap insulating tape around cutting end and cutting edges of 3.3 mm ∅ drill to prevent flesh wounds.

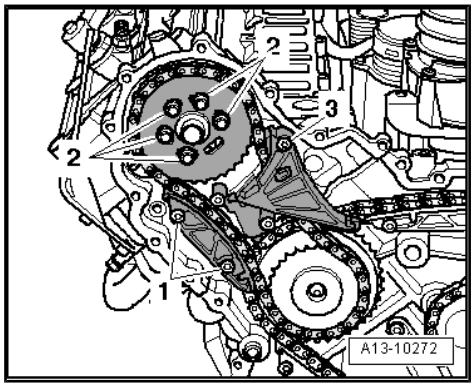
– Press tensioning rail of chain tensioner for left camshaft timing chain in direction of -arrow- and lock chain tensioner by inserting 3.3 mm ∅ drill bit -item 1-.



Caution

Risk of damage to engine.

- *Block off opening in valve timing housing with a clean cloth to prevent small items from dropping into engine.*



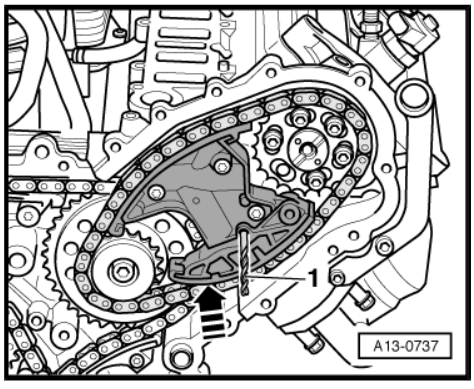
– Unscrew bolt -3- and remove tensioning rail.

– Unscrew bolts -1- for guide rail and -2- for camshaft sprocket.

– Remove camshaft sprocket and guide rail.

– Wrap insulating tape around cutting end and cutting edges of 3.3 mm ∅ drill to prevent flesh wounds.

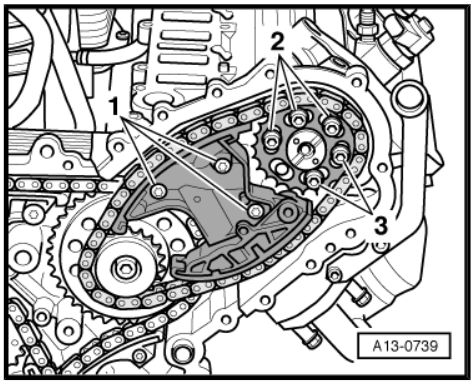
– Press guide rail of chain tensioner for right camshaft timing chain in direction of -arrow- and lock chain tensioner by inserting 3.3 mm ∅ drill bit -item 1-.



Caution

Risk of damage to engine.

- *Block off opening in valve timing housing with a clean cloth to prevent small items from dropping into engine.*

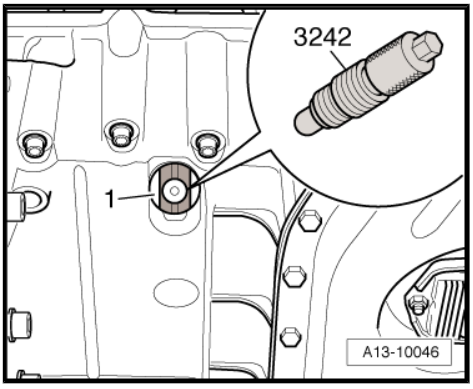


– Unscrew bolts -1- for chain tensioner and -2- and -3- for camshaft sprocket.

– Remove camshaft sprocket and right chain tensioner.

Installing

- Specified torques ⇒ page 123 .
- Crankshaft -1- locked at “TDC” with locking pin - 3242- .



Note

- *If a further tightening angle is specified for certain bolts, these must be renewed.*
- *Renew seal for “TDC” mark sealing plug.*

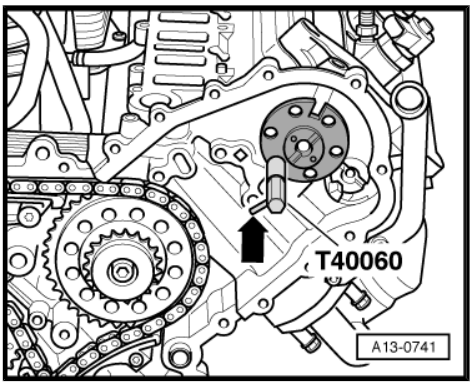
Caution

Avoid damage to valves and piston crowns.

- *When turning camshaft, crankshaft must be positioned so that no piston is positioned at “TDC”.*

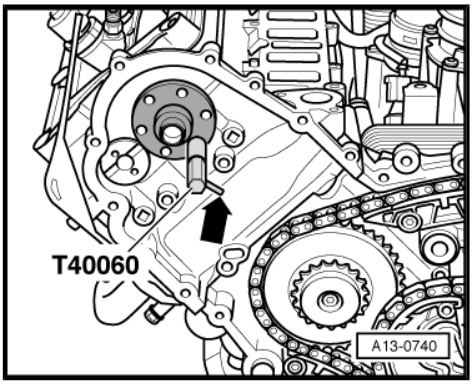
– Check that camshafts on both cylinder heads are positioned at “TDC”.

- It should be possible to lock camshafts with adjustment pin - T40060- .
- Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 1 (right side).



- Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 2 (left side).

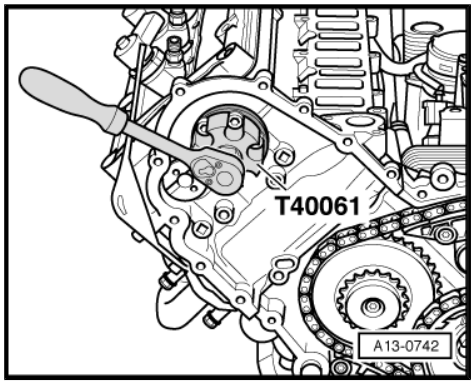
– Remove adjustment pin - T40060- from both camshafts.



Caution

Avoid damage to valves and piston crowns.

- *When turning camshaft, crankshaft must be positioned so that no piston is positioned at "TDC".*



Note

If the camshaft cannot be locked, the camshafts can be turned slightly using adapter - T40061- . To do so, screw securing bolts for camshaft sprocket into camshaft.

– Install left camshaft timing chain with camshaft sprocket, guide rail and tensioning rail.

• Elongated holes in camshaft sprocket must be aligned centrally with threaded holes in camshaft.

– Tighten bolts -1- and -3- for guide rail and tensioning rail.

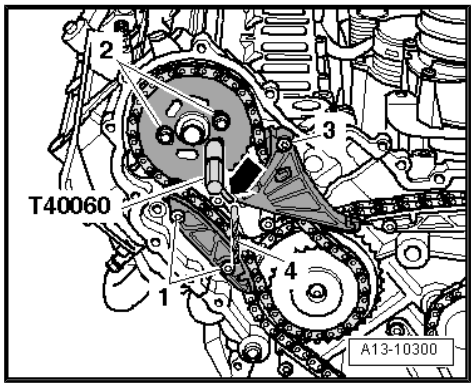
– Screw both bolts -2- for camshaft sprocket in loosely.

• It should just be possible to turn camshaft sprocket on camshaft without axial movement.

– Lock left camshaft with adjustment pin - T40060- .

• Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft.

– Pull drill -4- out of locating hole, this releases the left chain tensioner.



– Install right camshaft timing chain with camshaft sprocket and chain tensioner.

• Elongated holes in camshaft sprocket must be aligned centrally with threaded holes in camshaft.

– Tighten bolts -1- for chain tensioner.

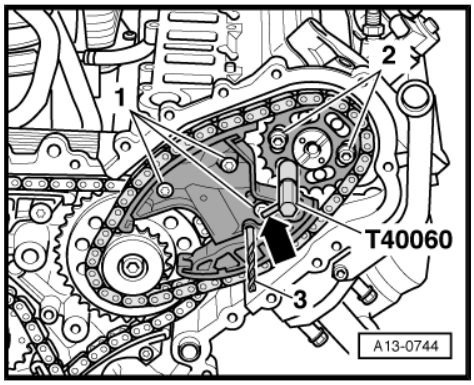
– Screw both bolts -2- for camshaft sprocket in loosely.

• It should just be possible to turn camshaft sprocket on camshaft without axial movement.

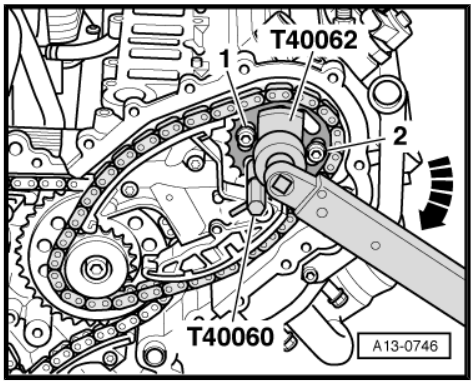
– Lock right camshaft with adjustment pin - T40060- .

• Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft.

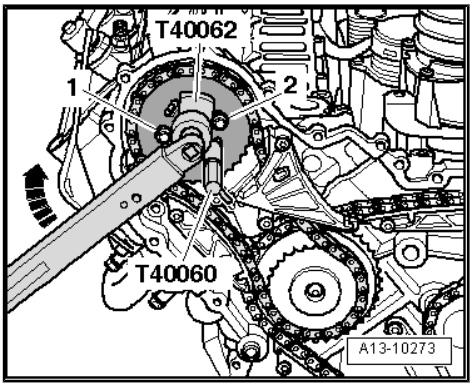
– Pull drill -3- out of locating hole, this releases the right chain tensioner.



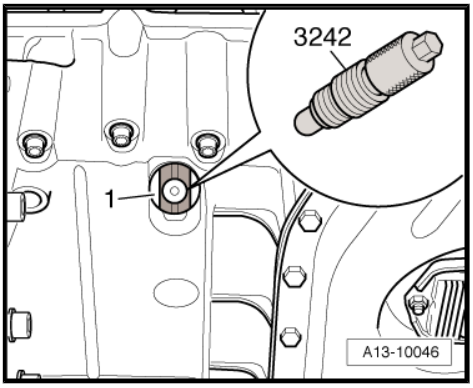
– Pretension right camshaft sprocket to 20 Nm in -direction of arrow- using adapter - T40062- and torque wrench and hold at this tension.
– Tighten bolts -1- and -2-.
– Remove adapter - T40062- and adjustment pin - T40060- .
– Tighten remaining bolts for right camshaft sprocket.



– Pretension left camshaft sprocket to 15 Nm in -direction of arrow- using adapter - T40062- and torque wrench and hold at this tension.
– Tighten bolts -1- and -2-.
– Remove adapter - T40062- and adjustment pin - T40060- .
– Tighten remaining bolts for left camshaft sprocket.



– Remove locking pin - 3242- .



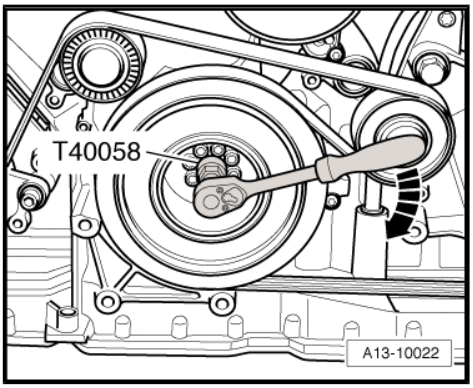
Checking valve timing

Caution

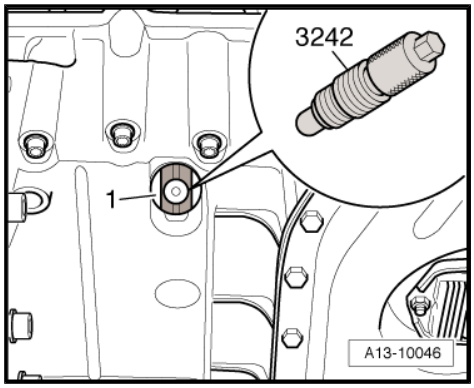
Risk of irreparable damage from camshaft timing chains jumping.

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

– Turn crankshaft 2 rotations until crankshaft is just before “TDC” again.



– While turning in this direction, lock crankshaft -1- with locking pin - 3242- . Tighten locking pin to 20 Nm.

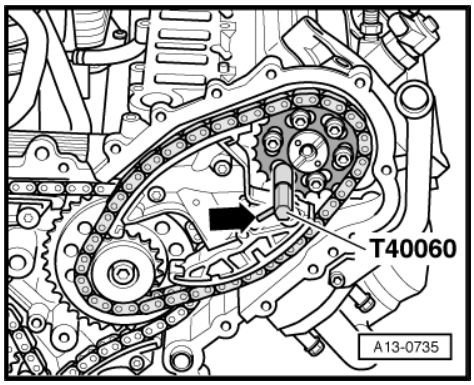


Caution

Adjustment fault through inexact "TDC" position.

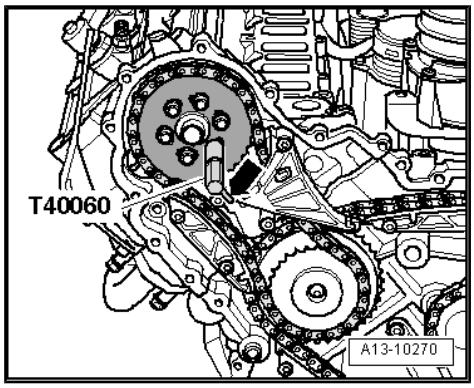
- *If the crankshaft has been rotated even only slightly beyond the "TDC" position, first turn crankshaft back approx. 10° then turn again in engine direction of rotation to "TDC".*

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



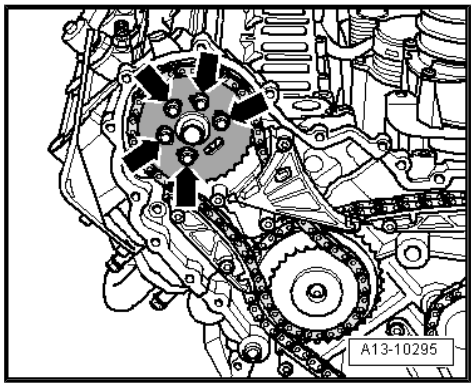
- It should be possible to lock camshafts with adjustment pin - T40060- .
- Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 1 (right side).

- Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft on cylinder bank 2 (left side).



Adjusting valve timing

– If one of the camshafts cannot be locked, loosen all bolts -arrows- of relevant camshaft sprocket approx. 1 turn.



– Fit adapter - T40061- over bolt heads of loosened bolts.

– Turn camshaft slightly backwards and forwards with adapter - T40061- until adjustment pin - T40060- can be inserted.

• Side pin -arrow- on adjustment pin - T40060- must be parallel to a radius vector of camshaft.

– Tighten bolts for camshaft sprocket to approx. 5 Nm with adapter - T40061- and adjustment pin - T40060- still fitted.

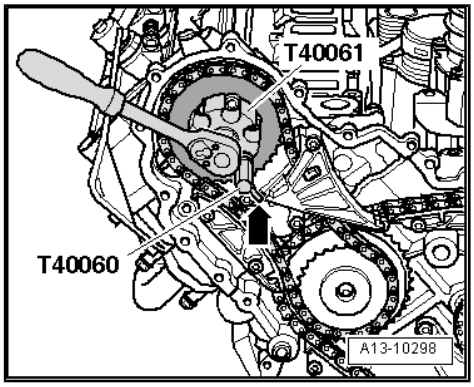
– Remove adjustment pin - T40060- and adapter - T40061- .

– Tighten bolts for camshaft sprocket to specified torque.

– If necessary, repeat procedure for other cylinder bank.

– Remove locking pin - 3242- .

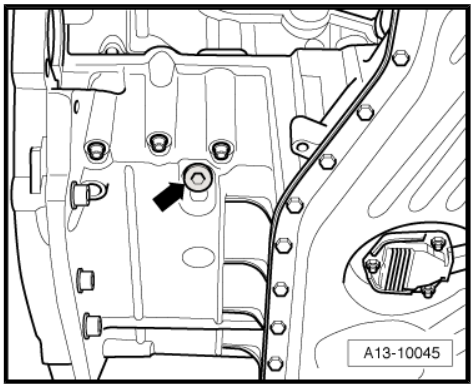
– Check valve timing again ⇒ page 139 .



Now continue installing in reverse order of removal, observing the following:

– Screw in sealing plug -arrow- for “TDC” mark in upper part of oil sump ⇒ page 150 .

– Install timing chain covers ⇒ page 57 .



17 – Lubrication

1 Engine oil:

Caution

Risk of damage to catalytic converter.

- *The oil level must not be above the "MAX" mark.*

Note

If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully, and the engine oil cooler must be renewed in order to prevent further damage occurring later.

Engine oil specifications ⇒ Maintenance ; Booklet ; Service tables .

⇒ "1.1 Oil capacities", page 142 .

⇒ "1.2 Using tester to check engine oil level", page 142 .

1.1 Oil capacities

With oil filter, 7.7 l

1.2 Using tester to check engine oil level

Using oil level tester to check engine oil level ⇒ Maintenance ; Booklet ; Checking engine oil level

Test conditions

- Engine oil temperature min. 60°C.
- Vehicle on hard level standing.
- Wait a few minutes after switching engine off to allow oil to flow back into sump.

1.2.1 Using tester to check engine oil level

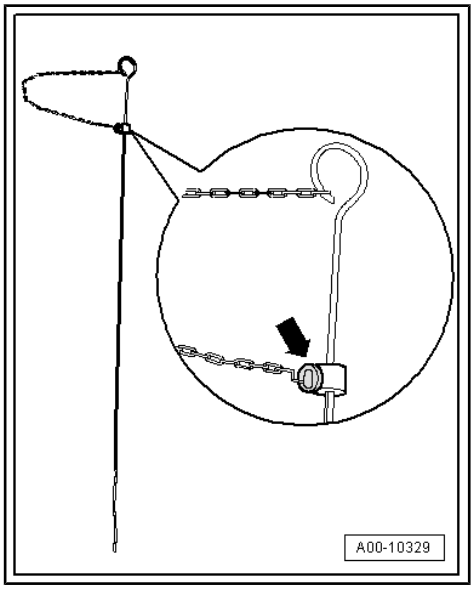
Using oil level tester to check engine oil level ⇒ Maintenance ; Booklet ; Checking engine oil level

Test conditions

- Engine oil temperature min. 60°C.
- Vehicle on hard level standing.
- Wait a few minutes after switching engine off to allow oil to flow back into sump.

Special tools and workshop equipment required

♦ Oil level test tool - T40178-

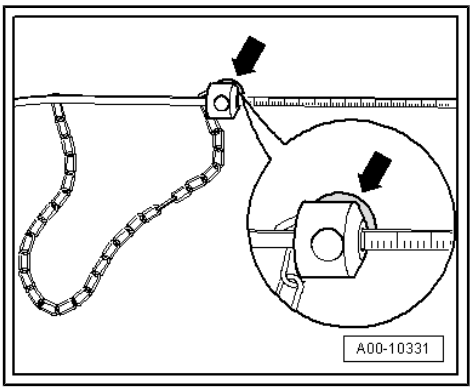


Test sequence

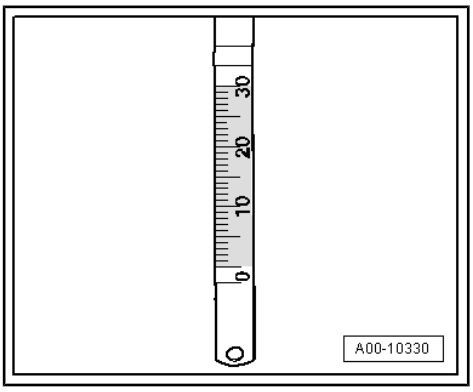
Marking area on tester:

– Set the value from the table at the bottom side of the setting ring by undoing the knurled screws and sliding the setting ring on the upper scale of the tester -arrow-.

– Push tester into dipstick tube as far as it will go (setting ring), then pull it out again and read off the oil level.



– Read off the value on the lower scale.



Engine	Setting value at top setting ring	Minimum oil level on lower scale	Maximum oil level on lower scale
3.0 l TDI	11	0	16

2 Parts of lubrication system

⇒ “2.1 Assembly overview - oil pump, lower part of sump”, page 144 .

⇒ “2.2 Removing and installing lower part of sump”, page 146 .

⇒ “2.3 Removing and installing oil pump”, page 149 .

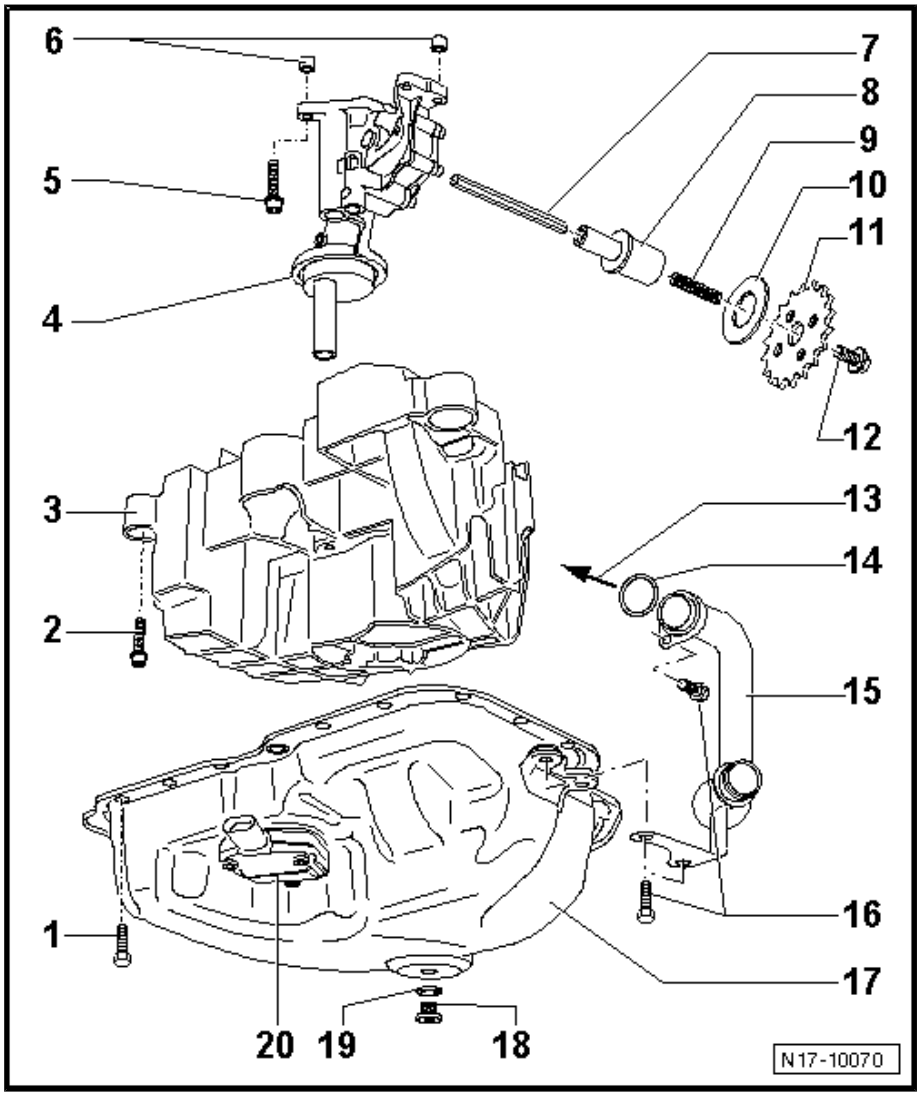
⇒ “2.4 Assembly overview - upper part of sump”, page 150 .

⇒ “2.5 Removing and installing oil pressure switch F22 ”, page 152 .

⇒ “2.6 Removing and installing oil pressure regulating valve N428 ”, page 152 .

⇒ “2.7 Removing and installing upper part of sump”, page 153 .

2.1 Assembly overview - oil pump, lower part of sump



1 - Bolt

- ❑ Renew
- ❑ 8 Nm + 90° ($^1/_4$ turn further)
- ❑ Tighten in stages and in diagonal sequence.

2 - Bolt

- ❑ Renew
- ❑ 9 Nm

3 - Baffle plate

4 - Oil pump

- ❑ Do not dismantle.
- ❑ With pressure relief valve for cold condition (11 bar) and pressure control valve (3.5 bar).
- ❑ Removing and installing ⇒ page 149

5 - Bolt

- ❑ 24 Nm

6 - Dowel sleeves

7 - Drive shaft for oil pump

8 - Yoke

9 - Compression spring

10 - Thrust washer

11 - Chain sprocket for oil pump

- ❑ Installation position: side with inscription faces engine.

12 - Bolt

- ❑ 64 Nm
- ❑ To loosen, use 2-hole pin wrench - 3212- to counterhold sprocket.
- ❑ If bolt cannot be tightened to torque, remove lower part of sump with baffle plate and counterhold oil pump drive shaft using an open-end spanner.

13 - To bracket for air conditioner compressor

14 - O-ring

- ❑ Renew

15 - Coolant pipe

- ❑ Connection diagram for coolant hoses ⇒ page 164

16 - Bolt

- ❑ 9 Nm

17 - Lower part of sump

- ❑ With oil level and oil temperature sender - G266- .
- ❑ Clean sealing surface before fitting.
- ❑ Install with silicone sealant - D 176 501- .
- ❑ Removing and installing ⇒ page 146

18 - Oil drain plug

- ❑ M14: 30 Nm
- ❑ M24: 50 Nm

19 - Seal

- ❑ Renew

20 - Oil level and oil temperature sender - G266-

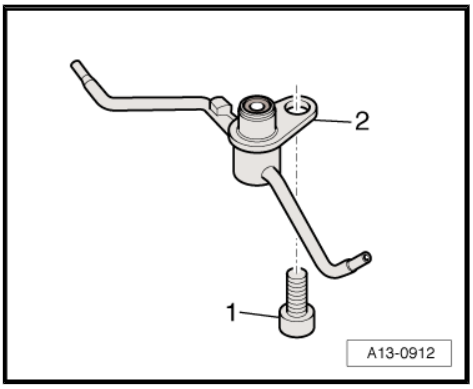
- ❑ Checking ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

Oil spray jet for piston cooling

1 - Bolt - 9 Nm

2 - Oil spray jet with spray nozzle valve for piston cooling

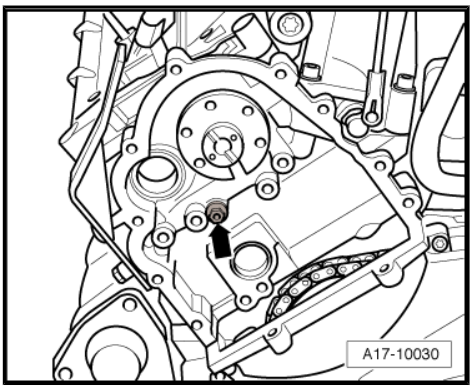
- Opening pressure: 1.3 bar



Oil retention valves

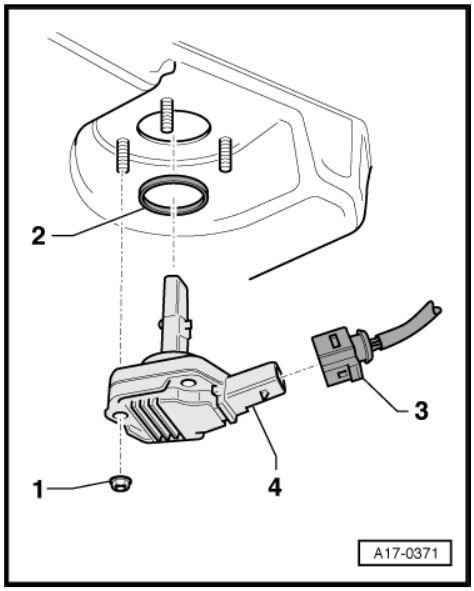
The oil retention valves are located at the rear end of the cylinder heads (left and right) -arrow-. They are accessible after removing the timing chains from the left or right camshaft, as applicable ⇒ page 132 .

- Specified torque: 25 Nm.



Removing and installing oil level/temperature sender - G266-

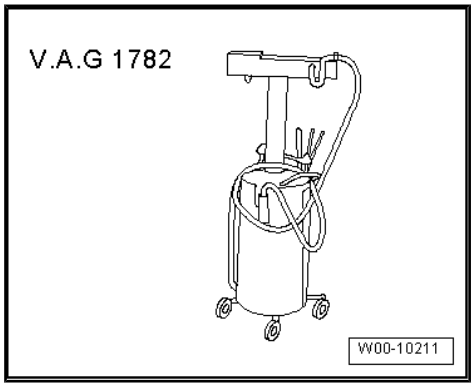
1 - Nut - 9 Nm
2 - Seal; renew
3 - Connector
4 - Oil level and oil temperature sender - G266-



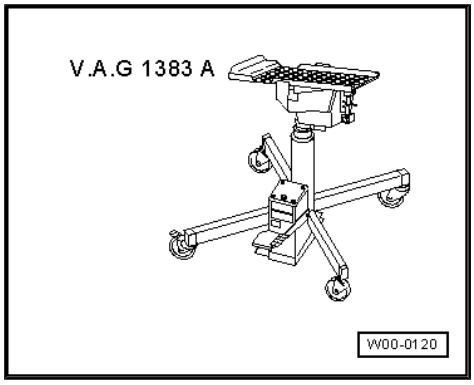
2.2 Removing and installing lower part of sump

Special tools and workshop equipment required

- Used oil collector and extractor - V.A.G 1782-



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

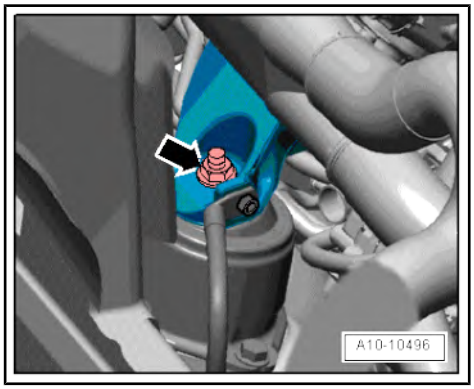


- Hand drill with plastic brush
- Safety glasses
- Sealant ⇒ Parts catalogue

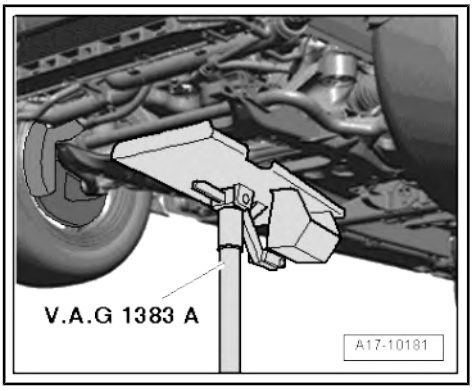
Removing

– Take up weight of engine in installation position ⇒ page 28 .

– Remove nuts -arrows- for left and right engine mountings.
– Lift engine until the engine supports are above the studs of the engine mounting, tighten all spindles evenly to ensure the weight is distributed evenly.



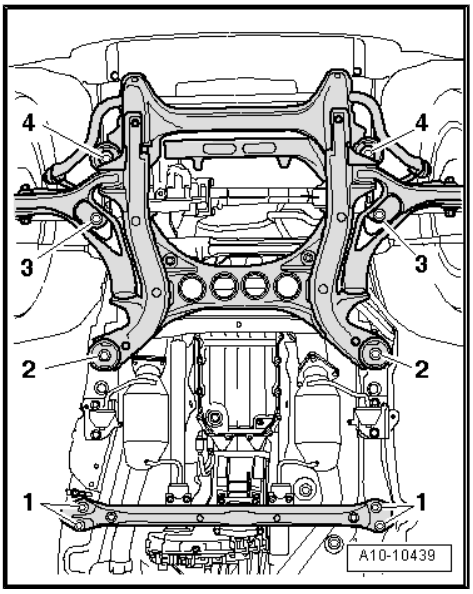
– Fit engine and gearbox jack - V.A.G 1383 A- to subframe underneath.
– Locate subframe in position using locating pins - T10300- ⇒ Running gear, axles, steering; Rep. gr. 40 ; Assembly overview - subframe; Locating subframe .



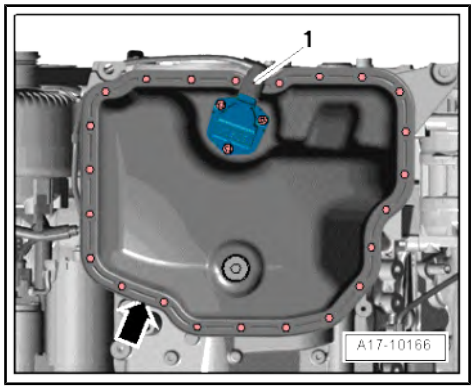
– Unscrew bolts -4- and carefully lower subframe using engine and gearbox jack - V.A.G 1383 A- .
– Remove bolts -3- for engine carrier and place engine carrier on subframe.

Note

Disregard -item 1-.



– Disconnect electrical connector at oil level and oil temperature sender - G266- -item 1-.
– Place used oil collection and extraction unit - V.A.G 1782- under engine.
– Drain engine oil.
– Remove oil level and oil temperature sender - G266- .
– Unbolt lower part of sump -arrow-.
– Turn lower part of sump through 180° and remove it forwards.



Note

When removing lower part of sump, note that it still contains a residual amount of oil.

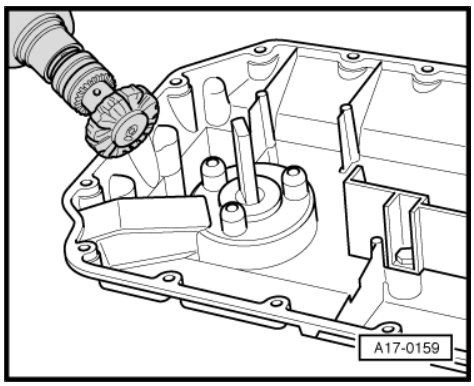
Installing

Note

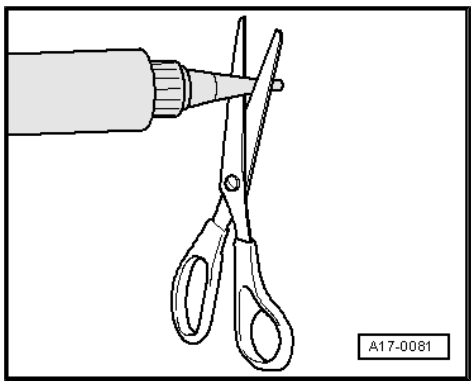
Renew sealing rings.

WARNING

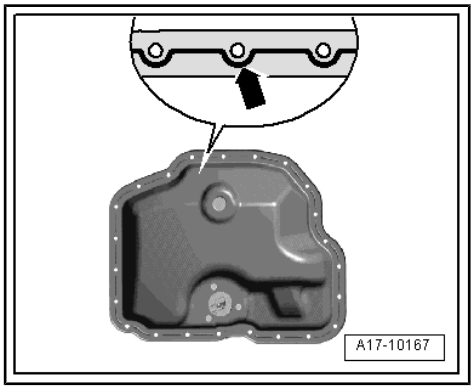
Wear protective goggles.



– Remove sealant residues from upper and lower parts of sump, e.g. with a rotating plastic brush.
– Clean sealing surfaces; they must be free of oil and grease.
– Cut off tube nozzle at forward marking (approx. 1.5 mm ∅ of nozzle).



– Apply bead of sealant -arrow- onto clean sealing surface of lower part of sump as illustrated.



Note

Ensure that the sealant bead on the lower part of the sump is applied so that the tapered web on the upper part of the sump is sealed correctly.

- Width of sealant bead: 2 mm.

Note

- *The sealant bead must not be thicker than specified, or excess sealant could enter the sump and block the strainer in the oil pump.*
- *The upper part of the sump must be installed within 5 minutes after applying sealant.*

– Fit lower part of sump and tighten all bolts initially to 5 Nm in diagonal sequence.

– Tighten bolts on lower part of sump in diagonal sequence.

– Install oil level and oil temperature sender - G266- ⇒ page 146 .

– Install subframe: ⇒ Running gear, axles, steering; Rep. gr. 40 ; Assembly overview - subframe; Removing and installing subframe

Note

If the position of the subframe on the body could not be fixed, check wheel alignment on the vehicle after reinstalling.

– Fill with engine oil and check oil level ⇒ page 142 .

Specified torques

Component		Nm
Sump (bottom section) to sump (top section)		8 + 90° 1)
Engine cross member to longitudinal member		120 + 180° 1)
Engine mounting to engine support		75
Oil drain plug	M14	30
	M24	50
1) Renew bolts.		

2.3 Removing and installing oil pump

Special tools and workshop equipment required

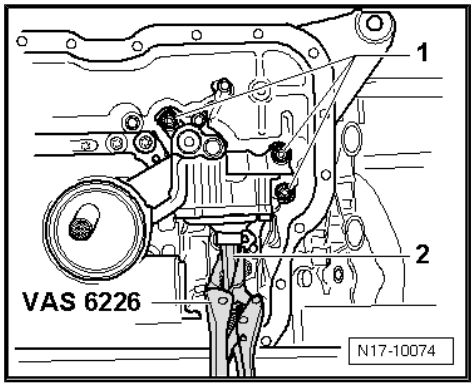
- Long-nose grip pliers - VAS 6226-

Removing

– Unbolt lower part of sump ⇒ page 146 .

– Remove baffle plate ⇒ Item 3 (page 144) .

– Unscrew bolts -1-.
– Grip oil pump drive shaft -2- using long-nose grip pliers - VAS 6226- and press it back against spring force.
– Remove oil pump.



Note

The drive shaft for oil pump remains inserted.

Installing

Installation is carried out in the reverse order. When installing, note the following:

Note

Replace oil seals and O-rings.

2.4 Assembly overview - upper part of sump

1 - Compression spring

2 - Yoke

3 - Drive shaft for oil pump

4 - Upper part of sump
- ❑ Clean sealing surface before fitting.
- ❑ Silicone adhesive sealant - D 176 501-
- ❑ Removing and installing ⇒ page 153

5 - Bracket
- ❑ For wiring harness

6 - Bolt
- ❑ 9 Nm

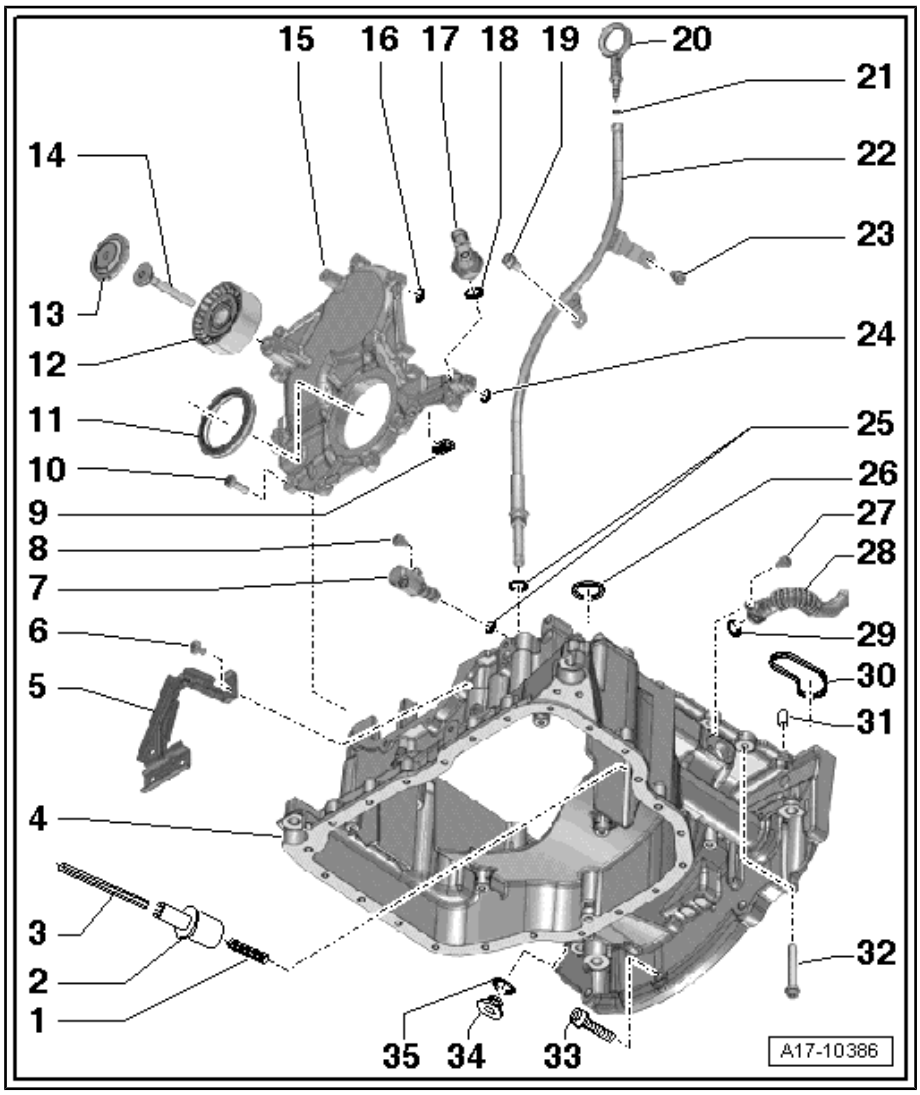
7 - Valve for oil pressure control - N428-
- ❑ Removing and installing ⇒ page 152

8 - Bolt
- ❑ 9 Nm

9 - Sealing element
- ❑ Qty. 2
- ❑ Renew

10 - Bolt
- ❑ 9 Nm
- ❑ Tighten in stages and in diagonal sequence.

11 - Crankshaft oil seal – belt pulley end
- ❑ Renewing ⇒ page 42



12 - Idler roller for right poly V-belt
- ❑ Observe installation position

13 - Cover for right idler roller

14 - Bolt
- ❑ 22 Nm

15 - Front sealing flange
- ❑ Removing and installing ⇒ page 43

16 - O-ring
- ❑ Renew

17 - Oil pressure switch - F22-
- ❑ 20 Nm
- ❑ Switch pressure 2.5 to 3.2 bar
- ❑ 2-pin, grey insulation
- ❑ Removing and installing ⇒ page 152

18 - Seal
- ❑ Renew

19 - Bolt
- ❑ 9 Nm

20 - Sealing plug
- ❑ Illustration does not show version installed in vehicle.

21 - O-ring
- ❑ Renew

22 - Guide tube for oil level tester - T40178-

23 - Bolt
- ❑ 9 Nm

24 - O-ring
- ❑ Renew

25 - O-ring
- ❑ Renew

26 - Seal
- ❑ Renew

27 - Bolt
- ❑ 9 Nm

28 - Oil return pipe

29 - O-ring
- ❑ Renew

30 - Seal
- ❑ Renew

31 - Dowel sleeve
- ❑ Qty. 2

32 - Bolt
- ❑ 14 Nm
- ❑ Tighten in stages and in diagonal sequence.

33 - Bolt
- ❑ 45 Nm

34 - Sealing plug for “TDC” hole

- ❑ 35 Nm

35 - Seal

- ❑ Renew

2.5 Removing and installing oil pressure switch - F22-

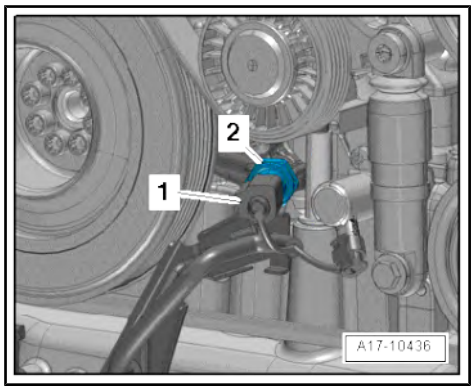
Removing

– Vehicles with air suspension: Activate jacking mode ⇒ Running gear, axles, steering; Rep. gr. 43 ; Jacking mode .

– Remove front noise insulation ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation; Assembly overview - noise insulation .

– Disconnect connector -1-.

– Unscrew oil pressure switch - F22- -item 2-.



Installing

Install in reverse order of removal, observing the following.

Specified torque: 20 Nm

Note

Renew the seal.

– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation; Assembly overview - noise insulation .

– Vehicles with air suspension: Deactivate jacking mode ⇒ Running gear, axles, steering; Rep. gr. 43 ; Jacking mode .

2.6 Removing and installing oil pressure regulating valve - N428-

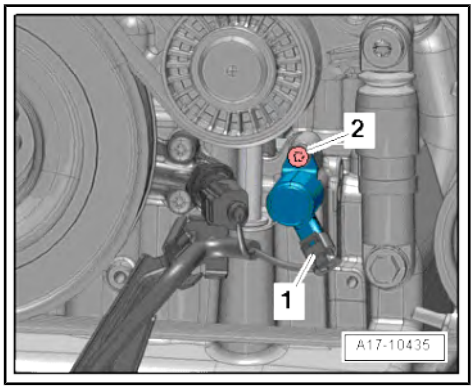
Removing

– Vehicles with air suspension: Activate jacking mode ⇒ Running gear, axles, steering; Rep. gr. 43 ; Jacking mode .

– Remove front noise insulation ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation; Assembly overview - noise insulation .

– Disconnect connector -1-.

– Remove bolt -2- and remove oil pressure control valve - N428- .



Installing

Install in reverse order of removal, observing the following.

Specified torque: 9 Nm

Note

Renew O-ring.

– Install noise insulation ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation; Assembly overview - noise insulation .

– Vehicles with air suspension: Deactivate jacking mode ⇒ Running gear, axles, steering; Rep. gr. 43 ; Jacking mode .

2.7 Removing and installing upper part of sump

Special tools and workshop equipment required

- Hand drill with plastic brush
- Silicone adhesive sealant - D 176 501-
- Safety glasses

Removing

– Remove engine ⇒ page 3 .

– Separate engine from gearbox ⇒ page 24 .

– Secure engine to engine stand ⇒ page 24 .

– Unbolt drive plate ⇒ page 48 .

– Take out shim located behind.

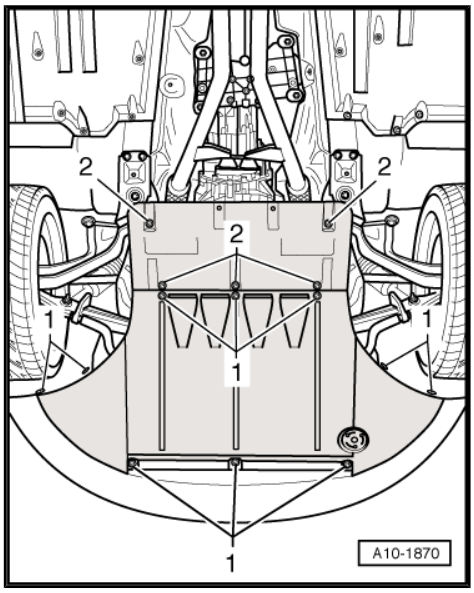
– Remove timing chain covers ⇒ page 57 .

– Remove chain for oil pump and balance shaft ⇒ page 71 .

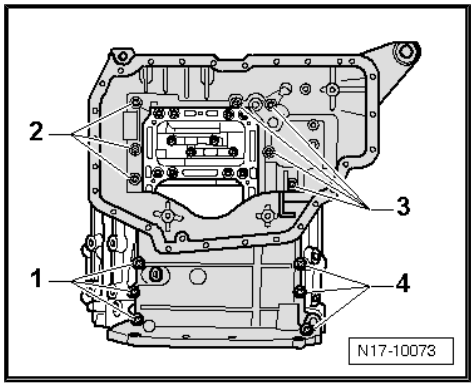
– Remove sealing flange at belt pulley end ⇒ page 43 .

– Remove lower part of sump ⇒ page 146 .

– Remove oil pump ⇒ page 149 .



– Unscrew bolts -1 … 4- for upper part of sump.
– Press sump - upper part from cylinder block spring pins.



Installing

Note

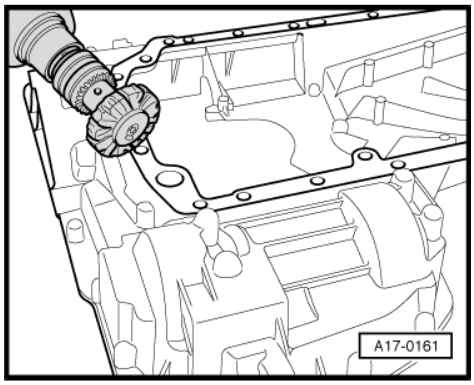
Renew gaskets, seals and O-rings.

– Remove old sealant from grooves in upper part of sump and from sealing surfaces.

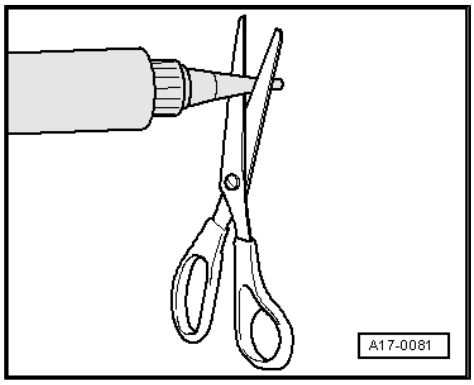
WARNING

Wear protective goggles.

– Remove sealant residue on sump with a rotating brush, e.g. an electric drill with plastic brush attachment (wear eye protection).
– Clean sealing surfaces; they must be free of oil and grease.



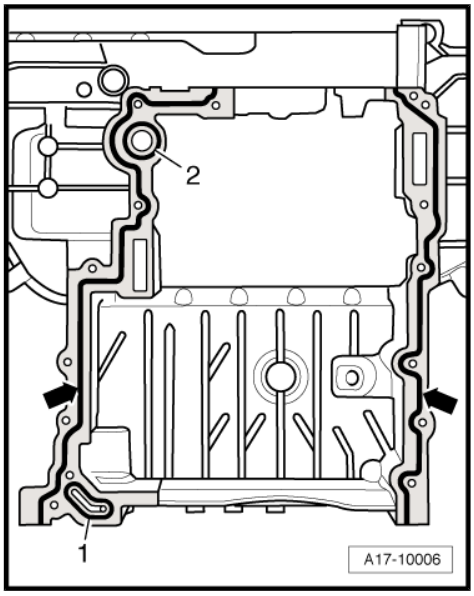
– Cut off nozzle on tube at front marking (∅ of nozzle approx. 3 mm).



– Install seals -1- and -2- in upper part of sump.

– Apply beads of sealant -arrows- onto clean sealing surface of upper part of sump as illustrated.

- The grooves -arrows- on the sealing surfaces must be completely filled with sealant.
- The bead of sealant must project 1.5 … 2.0 mm above the sealing surface.



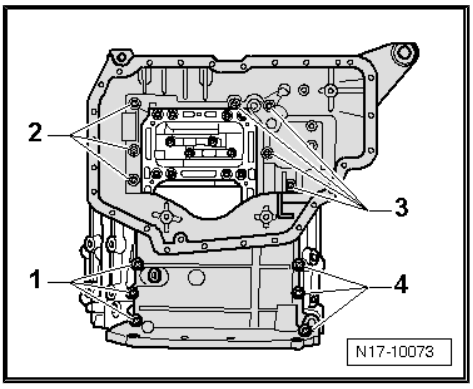
Note

- *The sealant beads must not be thicker than specified, otherwise excess sealant could enter the sump and clog the strainer in the oil pump.*
- *The upper part of the sump must be installed within 5 minutes after applying sealant.*

– Fit upper part of sump and tighten bolts -1…4- in diagonal sequence to 5 Nm.

– Tighten bolts -1…4- in diagonal sequence.

Continue installation in reverse order of removal.



3 Engine oil cooler, pressure control valve and oil filter housing

⇒ “3.1 Assembly overview - engine oil cooler, pressure control valve and oil filter housing”, page 156 .

⇒ “3.2 Removing and installing engine oil cooler”, page 157 .

⇒ “3.3 Removing and installing oil filter housing”, page 158 .

⇒ “3.4 Removing and installing pressure control valve for crankcase breather system”, page 159 .

⇒ “3.5 Removing and installing mounting plate for engine oil cooler, pressure control valve and oil filter housing”, page 160 .

⇒ “3.6 Removing and installing oil pressure switch F1 / oil pressure switch for reduced oil pressure F378 ”, page 161 .

⇒ page 161 .

3.1 Assembly overview - engine oil cooler, pressure control valve and oil filter housing

1 - Mounting plate
- ❑ For engine oil cooler, pressure control valve of crankcase breather system, oil filter housing.
- ❑ Removing and installing ⇒ page 160

2 - Bolt
- ❑ 9 Nm

3 - Seal
- ❑ Renew

4 - Oil pressure switch, 0.9 bar
- ❑ Grey insulation.
- ❑ Checking ⇒ page 161
- ❑ Removing and installing ⇒ page 161
- ❑ Oil pressure switch for reduced oil pressure - F378-

5 - O-ring
- ❑ Renew

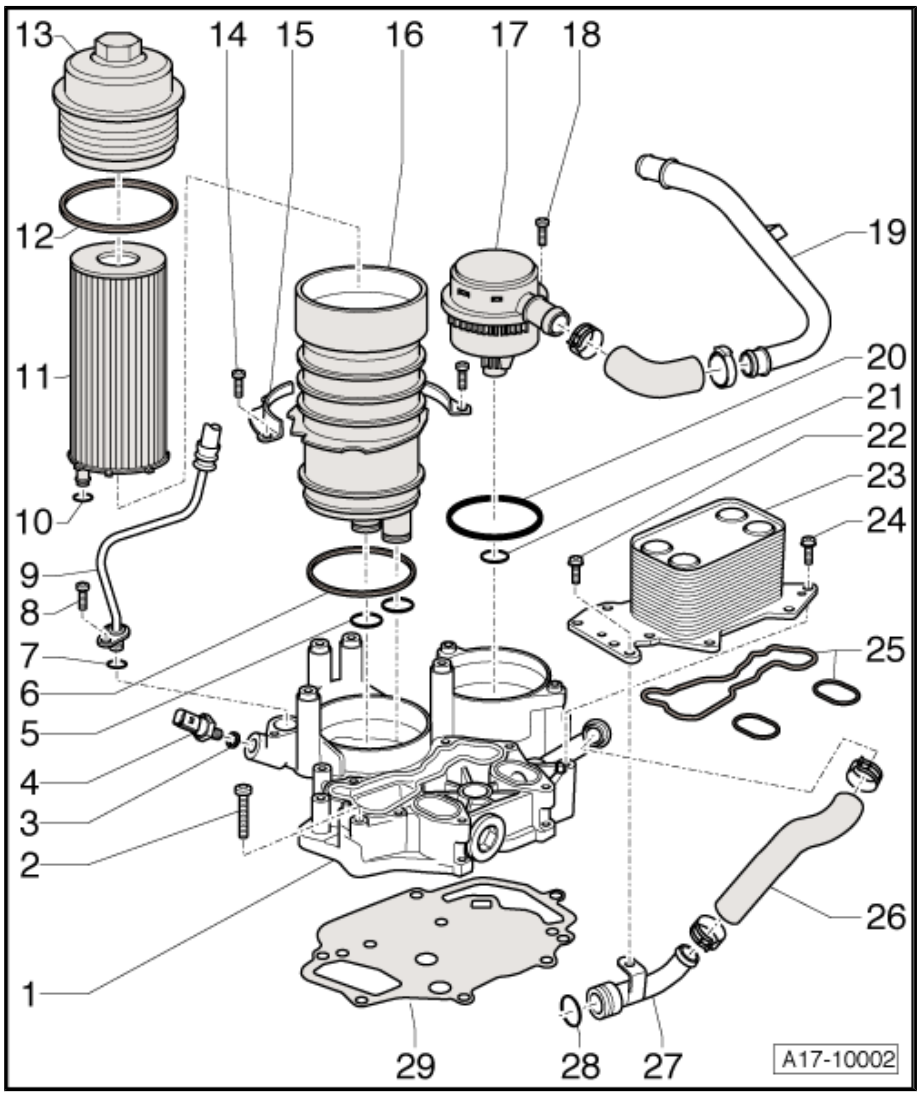
6 - Seal
- ❑ Renew

7 - O-ring
- ❑ Renew

8 - Bolt
- ❑ 9 Nm

9 - Oil supply line
- ❑ To turbocharger

10 - O-ring
- ❑ Renew



11 - Oil filter element

- ❑ When removing, pull out of sealing cap ⇒ Item 13 (page 157) .
- ❑ When installing, fit connection at bottom of oil filter element in bore in oil filter housing.

12 - Seal

- ❑ Renew

13 - Cap

- ❑ 35 Nm
- ❑ Use 32 mm socket to loosen and tighten

14 - Bolt

- ❑ 9 Nm

15 - Retaining clip

16 - Oil filter housing

- ❑ Removing and installing ⇒ page 158
- ❑ With oil filter bypass valve, 2.0 … 3.0 bar (pressure differential upstream/downstream of filter).

17 - Pressure regulating valve for crankcase breather.

- ❑ Removing and installing ⇒ page 159

18 - Bolt

- ❑ 9 Nm

19 - Crankcase breather pipe

20 - O-ring

- ❑ Renew

21 - O-ring

- ❑ Renew

22 - Bolt

- ❑ 9 Nm

23 - Engine oil cooler

- ❑ Observe notes ⇒ page 156
- ❑ Removing and installing ⇒ page 157
- ❑ With oil cooler bypass valve, 2.0 … 3.0 bar (differential pressure upstream/downstream of engine oil cooler).

24 - Bolt

- ❑ 9 Nm

25 - Seals

- ❑ Renew

26 - Coolant hose

27 - Coolant pipe

28 - O-ring

- ❑ Renew

29 - Seal

- ❑ Renew

3.2 Removing and installing engine oil cooler

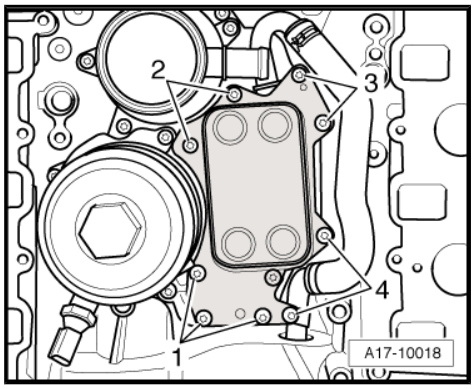
Removing

– Drain coolant ⇒ page 187 .

– Remove upper part of intake manifold ⇒ page 274 .
– Remove lower part of intake manifold on left or right ⇒ page 276 .
– Remove toothed belt for high-pressure pump ⇒ page 257 .
– Remove high-pressure pump ⇒ page 266 .
– Remove exhaust gas recirculation cooler:

  Vehicles with engine code CASA or CASD ⇒ page 341

  Vehicles with engine code CATA ⇒ page 349
– Spread out rags round engine oil cooler to catch escaping oil.
– Unscrew bolts -1 … 5- and remove engine oil cooler.



Installing

Installation is carried out in the reverse order. When installing, note the following:

Note

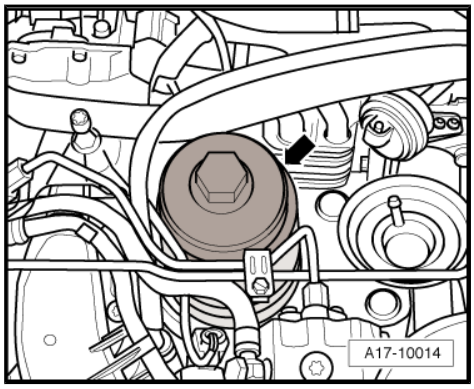
Renew seals and O-ring for upper coolant pipe.

– Fill with engine oil and check oil level ⇒ page 142 .
– Fill with coolant ⇒ page 189 .

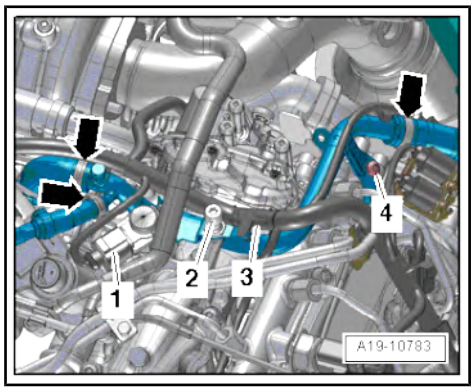
3.3 Removing and installing oil filter housing

Removing

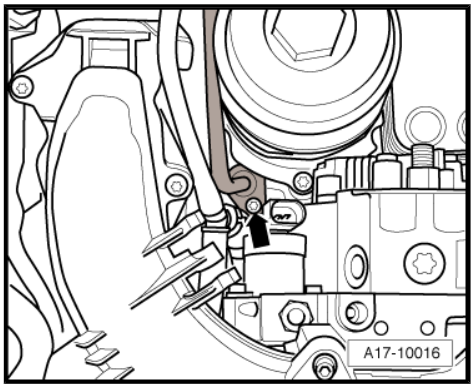
– Remove upper part of intake manifold ⇒ page 274 .
– Loosen sealing cap -arrow- with 32 mm socket. Remove sealing cap together with oil filter element.
– Pull oil filter element off sealing cap.



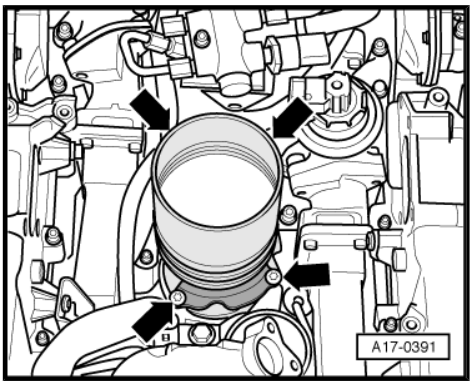
– Remove connector and intake manifold for cooler changeover valve - N345- -position 1- out of retainer.
– Disconnect the connector from fuel metering valve - N290- on the high-pressure pump, move wiring clear.
– Remove exhaust gas recirculation control motor - V338- ⇒ page 340 .



– Disconnect oil supply line -arrow- from mounting plate.



– Unbolt retainer -arrows-.
– Spread out rags around oil filter housing to catch escaping oil.
– Pull oil filter housing off.



Installing

Installation is carried out in the reverse order. When installing, note the following:

Note

Renew gaskets, seals and O-rings.

– Install control motor for exhaust gas recirculation - V338- ⇒ page 340 .
– Install upper part of intake manifold ⇒ page 274 .

3.4 Removing and installing pressure control valve for crankcase breather system

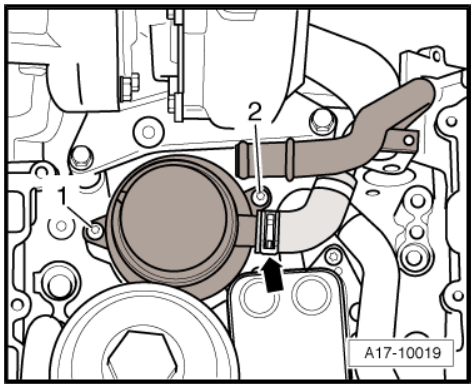
Removing

– Drain coolant ⇒ page 187 .
– Remove upper part of intake manifold ⇒ page 274 .
– Remove lower part of intake manifold on left or right ⇒ page 276 .
– Remove exhaust gas recirculation cooler:

  Vehicles with engine code CASA or CASD ⇒ page 341

  Vehicles with engine code CATA ⇒ page 349

– Detach hose -arrow- from pressure control valve for crankcase breather system.
– Remove bolts -1- and -2-.
– Remove pressure control valve for crankcase breather system.



Installing

Installation is carried out in the reverse order. When installing, note the following:

Note

- *Renew O-rings.*
- *Secure all hose connections with hose clips which conform to production standard.*

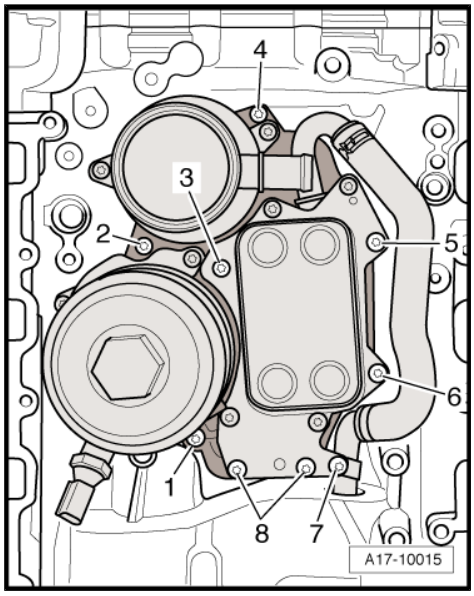
3.5 Removing and installing mounting plate for engine oil cooler, pressure control valve and oil filter housing

Removing

– Drain coolant ⇒ page 187 .
– Remove upper part of intake manifold ⇒ page 274 .
– Remove lower part of intake manifold on left or right ⇒ page 276 .
– Remove toothed belt for high-pressure pump ⇒ page 257 .
– Remove high-pressure pump ⇒ page 266 .
– Remove exhaust gas recirculation cooler:

  Vehicles with engine code CASA or CASD ⇒ page 341

  Vehicles with engine code CATA ⇒ page 349
– Unscrew bolts -1 … 8-.
– Remove mounting plate with engine oil cooler, pressure control valve and oil filter housing.



Installing

Installation is carried out in the reverse order. When installing, note the following:

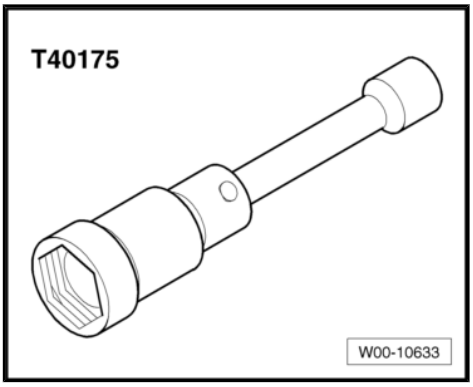
Note

- *Renew gaskets, seals and O-rings.*
- *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- *Secure all hose connections with hose clips which conform to production standard.*

3.6 Removing and installing oil pressure switch - F1- / oil pressure switch for reduced oil pressure - F378-

Special tools and workshop equipment required

- 24 mm jointed spanner - T40175-

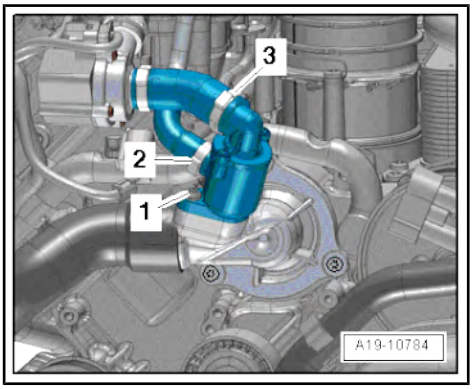


Removing

– Remove pump for exhaust gas recirculation cooler - V400- ⇒ page 186 .

Vehicles with engine code CATA

– Remove coolant hose and push to side, loosen clip -2- for this.



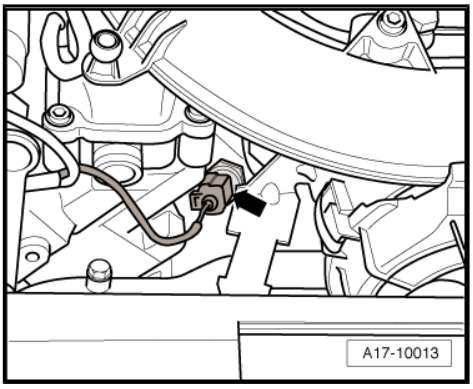
Note

Disregard -items 1, 3, 4-.

Continuation for all engine codes

– Pull connector -arrow- off oil pressure switch - F1- or oil pressure switch for reduced oil pressure - F378- .

– Remove oil pressure switch using jointed wrench 24 mm - T40175- .



Installing

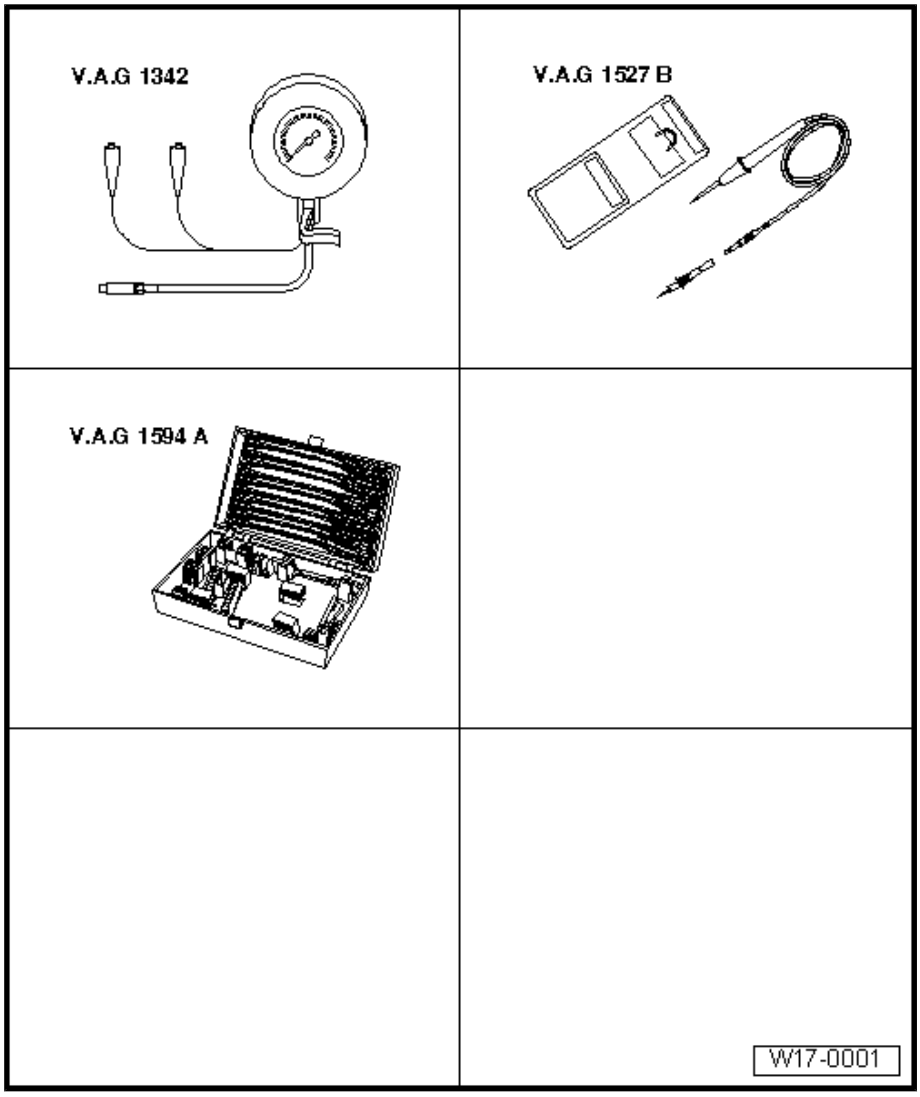
Installation is carried out in the reverse order. When installing, note the following:

Note

Renew seal.

3.7 Checking oil pressure and oil pressure switch

Special tools and workshop equipment required



- Oil pressure tester - V.A.G 1342-
- Diode test lamp - V.A.G 1527 B-
- Adapter set - V.A.G 1594 A-

Note

Functional check and repair of the optical and acoustic oil pressure warning: ⇒ Current flow diagrams, Electrical fault finding and Fitting locations

Test conditions

- Engine oil temperature min. 80°C
- Engine oil level OK

Test sequence

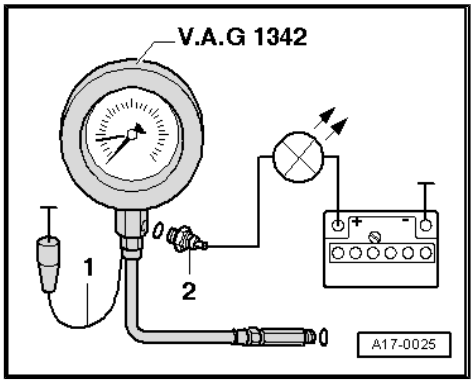
– Remove oil pressure switch ⇒ page 161 .

– Connect oil pressure tester - V.A.G 1342- to hole for oil pressure switch.
– Screw oil pressure switch -2- into oil pressure tester - V.A.G 1342- .
– Connect brown line -1- of oil pressure tester to earth (-).
– Connect diode test lamp - V.A.G 1527 B- to oil pressure switch and battery positive (+) using test lead from auxiliary measuring set - V.A.G 1594 C- .

• LED should not light up.

If the LED lights up:

– Renew oil pressure switch.
– Start engine.



Note

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

• LED should light up at 0.7 … 1.1 bar.

If the LED does not light up:

– Renew oil pressure switch.

Checking oil pressure

– Start engine.

• Oil pressure at idling speed: at least 0.8 bar
• Minimum oil pressure at 2000 rpm: at least 1.5 bar

The pressure relief valve or oil pump is defective if the specifications are not attained.

– Renew oil pump ⇒ page 149 .

19 – Cooling

1 Cooling system

⇒ “1.1 Coolant hose connection diagram”, page 164 .

⇒ “1.2 Assembly overview - coolant pipes”, page 166 .

⇒ “1.3 Removing and installing coolant pipes”, page 170 .

⇒ “1.4 Removing and installing coolant temperature sender G62 ”, page 183

⇒ “1.5 Removing and installing radiator outlet coolant temperature sender G83 ”, page 184

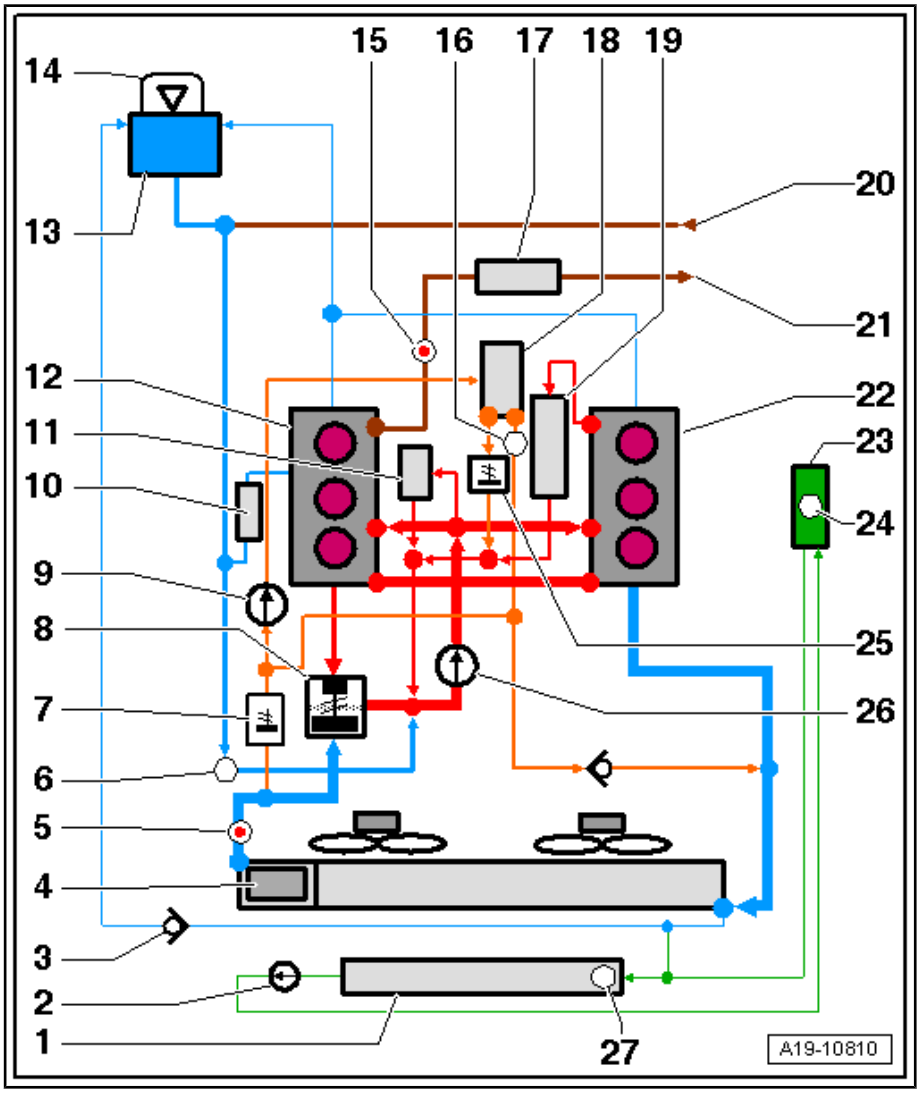
⇒ “1.6 Assembly overview - pump for exhaust gas recirculation cooler V400 ”, page 185 .

⇒ “1.7 Removing and installing pump for exhaust gas recirculation cooler V400 ”, page 186 .

1.1 Coolant hose connection diagram

Note

- *Blue = large coolant circuit.*
- *Brown = heater circuit.*
- *Green = fuel system coolant circuit.*
- *Orange = exhaust gas recirculation coolant circuit.*
- *Red = small coolant circuit.*



1 - Cooler for fuel system

- ❑ Renew coolant after replacing

2 - Fuel cooling pump - V166-

- ❑ Discontinued from model year 2010

3 - Non-return valve

- ❑ Arrow points in direction of flow.

4 - Radiator for engine coolant

- ❑ Renew coolant after replacing

5 - Radiator outlet coolant temperature sender - G83-

- ❑ Removing and installing ⇒ page 184

6 - Bleed screw

7 - Thermostat

- ❑ For exhaust gas recirculation coolant circuit

8 - Thermostat

9 - Pump for exhaust gas recirculation cooler - V400-

- ❑ In exhaust gas recirculation coolant circuit

10 - Alternator

11 - Engine oil cooler

12 - Cylinder head, bank 1 (right side)

- ❑ Renew coolant after replacing

13 - Coolant expansion tank

- ❑ Renew seal if damaged.
- ❑ Check cooling system for leaks with cooling system tester - V.A.G 1274- and adapter - V.A.G 1274/8- .
- ❑ Check cap using cooling system tester - V.A.G 1274- and adapter - V.A.G 1274/9- .
- ❑ Test pressure: 1.4 … 1.6 bar

14 - Cap for coolant expansion tank

15 - Radiator outlet coolant - G62-

- ❑ Removing and installing ⇒ page 183

16 - Bleed screw

17 - Supplementary cooler for exhaust gas recirculation

- ❑ Only for vehicles with engine code CATA.

18 - Exhaust gas recirculation cooler

- ❑ Renew coolant after replacing

19 - Changeover flap for exhaust gas recirculation cooler

20 - From heat exchanger for heater unit

21 - To heat exchanger for heater unit.

22 - Cylinder head, bank 2 (left side)

- ❑ Renew coolant after replacing

23 - Cooling element

- ❑ On fuel filter

24 - Bleed screw

25 - Thermostat

- ❑ For exhaust gas recirculation coolant circuit
- ❑ With exhaust gas recirculation control motor - V338-

26 - Coolant pump

27 - Bleed screw

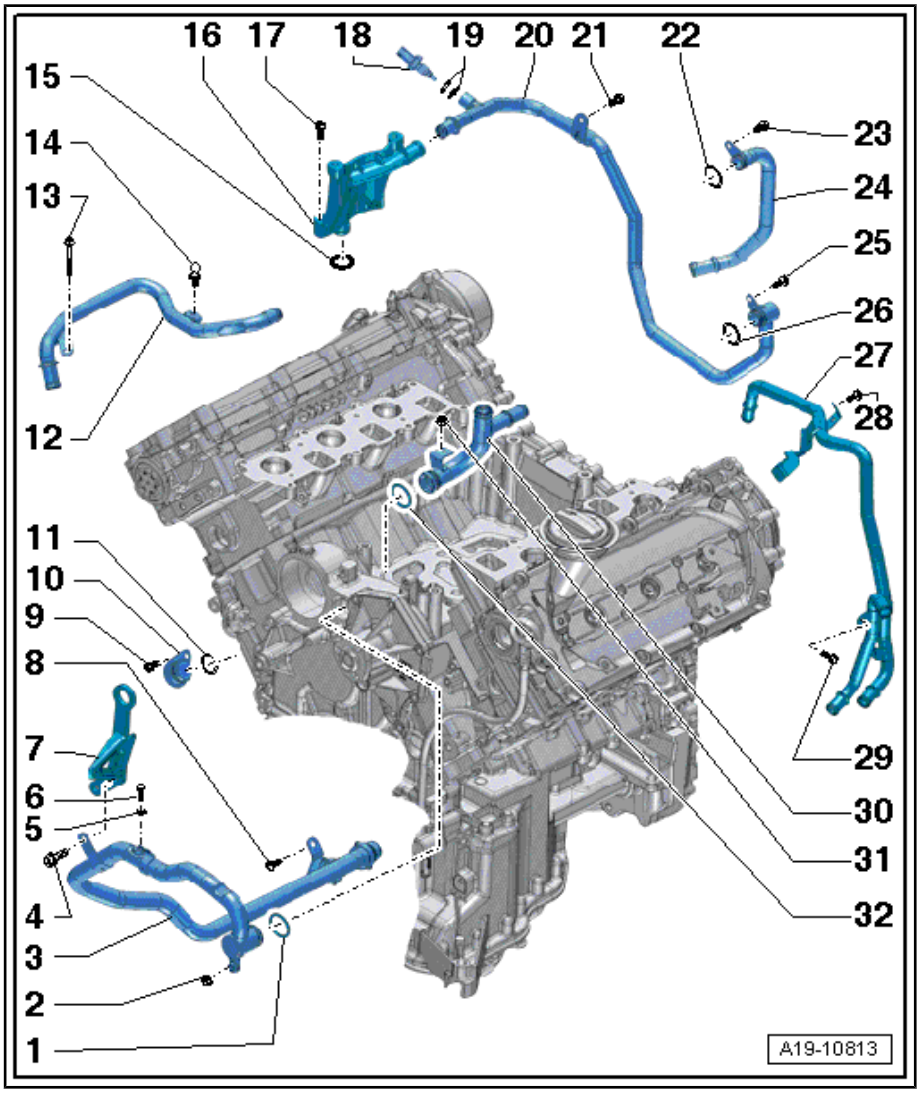
1.2 Assembly overview - coolant pipes

⇒ “1.3 Removing and installing coolant pipes”, page 170 .

Part 1

Note

- *Illustrated is the version for vehicles with engine code CATA.*
- *In the case of vehicles with engine code CASA or CASD, the actual appearance may differ from illustration.*



1 - O-ring
- ❑ Renew

2 - Bolt
- ❑ 9 Nm

3 - Right coolant pipe
- ❑ Removing and installing ⇒ page 178

4 - Bolt
- ❑ 23 Nm

5 - Seal
- ❑ Renew

6 - Bleed screw
- ❑ 9 Nm

7 - Engine lifting eye

8 - Bolt
- ❑ 9 Nm

9 - Bolt
- ❑ 9 Nm

10 - Connection

11 - O-ring
- ❑ Renew

12 - Upper right coolant pipe
- ❑ Removing and installing ⇒ page 181

13 - Bolt

14 - Mounting pin for engine cover panel
- ❑ 5 Nm

15 - O-ring
- ❑ Renew

16 - Union

17 - Bolt
- ❑ 9 Nm

18 - Radiator outlet coolant - G62-
- ❑ 2 Nm
- ❑ Removing and installing ⇒ page 183

19 - O-ring
- ❑ Renew
- ❑ Note various diameters.

20 - Rear coolant pipe
- ❑ Removing and installing, engine codes CASA and CASD ⇒ page 181
- ❑ Removing and installing, engine code CATA ⇒ page 182
- ❑ Different versions are available; allocation ⇒ Parts catalogue

21 - Bolt
- ❑ 9 Nm

22 - O-ring

- ❑ Renew
- ❑ Only for vehicles with engine code CATA.

23 - Bolt

- ❑ 9 Nm
- ❑ Only for vehicles with engine code CATA.

24 - Rear left coolant pipe on exhaust gas recirculation cooler

- ❑ Removing and installing ⇒ page 177
- ❑ Only for vehicles with engine code CATA.

25 - Bolt

- ❑ 9 Nm
- ❑ Only for vehicles with engine code CATA.

26 - O-ring

- ❑ Renew
- ❑ Only for vehicles with engine code CATA.

27 - Rear left coolant pipe on gearbox

- ❑ Removing and installing, engine codes CASA and CASD ⇒ page 173
- ❑ Removing and installing, engine code CATA ⇒ page 174
- ❑ Different versions are available; allocation ⇒ Parts catalogue

28 - Bolt

- ❑ 9 Nm

29 - Bolt

- ❑ 9 Nm

30 - Upper coolant pipe

- ❑ Removing and installing ⇒ page 170

31 - Bolt

- ❑ 9 Nm

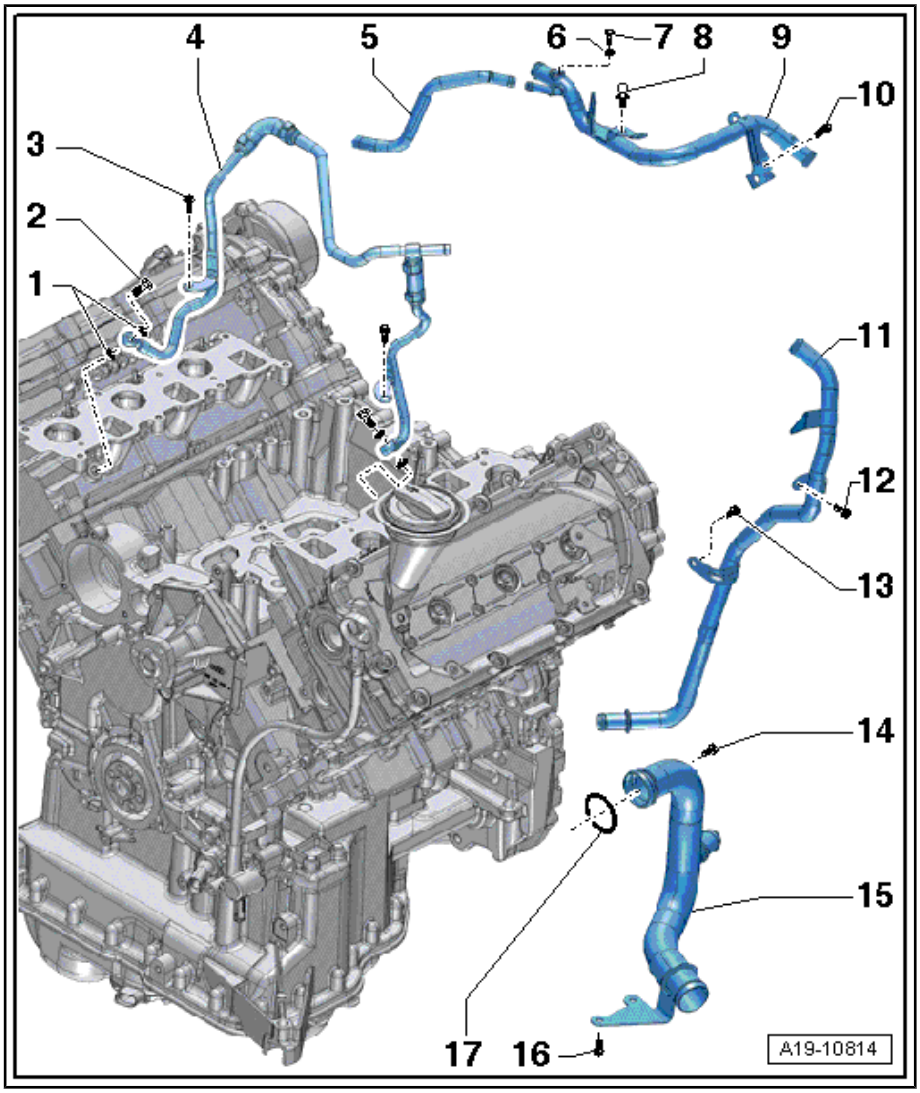
32 - O-ring

- ❑ Renew

Part 2

Note

- ♦ *Illustrated is the version for vehicles with engine code CATA.*
- ♦ *In the case of vehicles with engine code CASA or CASD, the actual appearance may differ from illustration.*



1 - Oil seals
- ❑ Renew

2 - Banjo bolt
- ❑ 15 Nm

3 - Bolt
- ❑ 9 Nm

4 - Coolant line
- ❑ To cylinder heads.

5 - Coolant hose
- ❑ From exhaust gas recirculation valve.
- ❑ Only for vehicles with engine code CATA.

6 - Seal
- ❑ Renew

7 - Bleed screw
- ❑ 9 Nm

8 - Mounting pin for engine cover panel
- ❑ 5 Nm

9 - Upper left coolant pipe
- ❑ Removing and installing, engine codes CASA and CASD ⇒ page 175 (together with rear left coolant pipe)
- ❑ Removing and installing, engine code CATA ⇒ page 176

10 - Bolt
- ❑ 9 Nm

11 - Rear left coolant pipe
- ❑ Removing and installing, engine codes CASA and CASD ⇒ page 175
- ❑ Removing and installing, engine code CATA ⇒ page 175

12 - Bolt
- ❑ 9 Nm

13 - Bolt
- ❑ 9 Nm

14 - Bolt
- ❑ 9 Nm

15 - Left coolant pipe
- ❑ Removing and installing ⇒ page 171

16 - Bolt
- ❑ 9 Nm

17 - O-ring
- ❑ Renew

1.3 Removing and installing coolant pipes

⇒ “1.3.1 Removing and installing upper coolant pipe”, page 170 .

⇒ “1.3.2 Removing and installing left coolant pipe”, page 171 .

⇒ “1.3.3 Removing and installing rear left coolant pipe on gearbox (engine codes CASA and CASD)”, page 173 .

⇒ “1.3.4 Removing and installing rear left coolant pipe on gearbox (engine code CATA)”, page 174 .

⇒ “1.3.5 Removing and installing rear left coolant pipe (engine codes CASA and CASD)”, page 175 .

⇒ “1.3.6 Removing and installing rear left coolant pipe (engine code CATA)”, page 175 .

⇒ “1.3.7 Removing and installing upper left coolant pipe (engine code CATA)”, page 176 .

⇒ “1.3.8 Removing and installing rear left coolant pipe on supplementary cooler for exhaust gas recirculation (engine code CATA)”, page 177 .

⇒ “1.3.9 Removing and installing right coolant pipe”, page 178 .

⇒ “1.3.10 Removing and installing upper right coolant pipe”, page 181 .

⇒ “1.3.11 Removing and installing rear right coolant pipe (engine codes CASA and CASD)”, page 181 .

⇒ “1.3.12 Removing and installing rear coolant pipe (engine code CATA)”, page 182 .

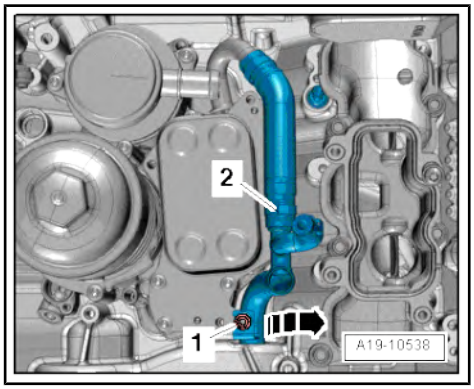
1.3.1 Removing and installing upper coolant pipe

Removing

– Drain coolant ⇒ page 187 .

– Remove engine oil cooler ⇒ page 156 .

– Loosen hose clip -2- and remove coolant hose.



Note

Ignore -item 1- and -arrow-.

– Pull front coolant pipe out of cylinder block.

Installing

Install in reverse order of removal, observing the following.

Note

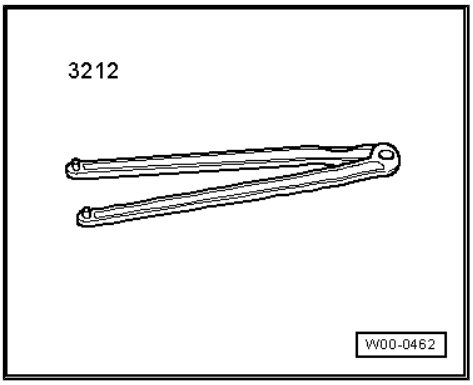
- *Renew O-ring.*
- *Secure all hose connections with hose clips (same as original equipment) ⇒ Parts catalogue .*

– Clean or smoothen sealing surface for O-ring.
– Moisten new O-ring with coolant and slide onto coolant pipe.
– Install engine oil cooler ⇒ page 156 .
– Add coolant ⇒ page 189 .

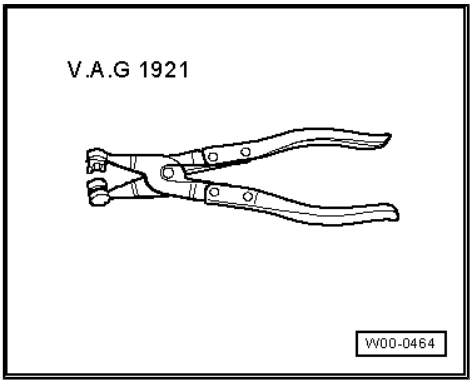
1.3.2 Removing and installing left coolant pipe

Special tools and workshop equipment required

- Pin wrench - 3212-



- Hose clamp pliers - V.A.G 1921-

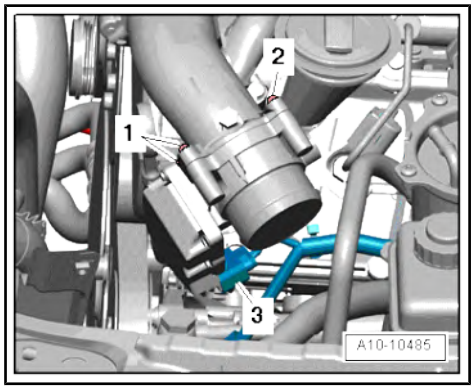


Removing

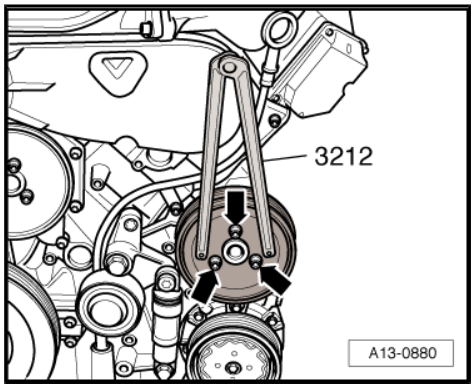
– Separate electrical connector -3-.

– Remove bolts -1- and -2-, take throttle valve module - J338- off intake union.

– Remove poly V-belt ⇒ page 40 .



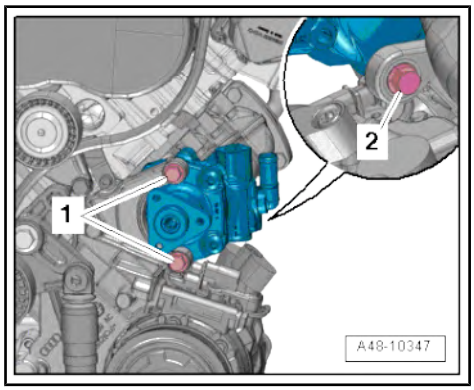
– Remove bolts -arrows-, using 2-hole pin wrench - 3212- to counterhold and remove poly V-belt pulley for servo pump.



– Unscrew bolts -1- and -2-.

– Remove power steering pump, raise and tie.

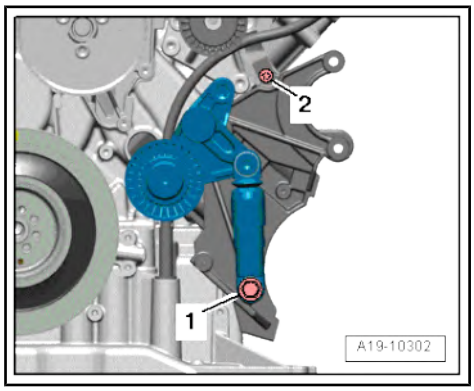
– Remove air conditioner compressor ⇒ Heating, air conditioning; Rep. gr. 87



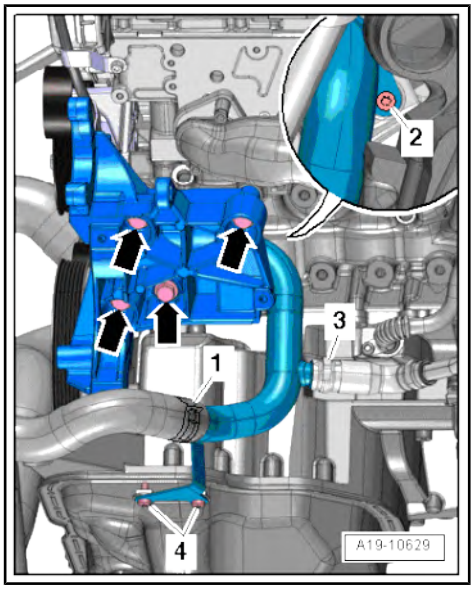
– Remove bolt -2- for guide tube.

– Remove bolt -1- for poly V-belt tensioning element.

– Drain coolant ⇒ page 187 .



– Remove coolant hose from left coolant pipe, loosen hose clip -1- for this.
– Unscrew bolts -4- and -arrows- and remove bracket for ancillaries.
– Remove coolant hose from left coolant pipe, loosen hose clip -3- for this.
– Remove bolt -2- and pull left coolant pipe off retainer.



Installing

Install in reverse order of removal, observing the following.

Specified torque ⇒ page 166 .

Note

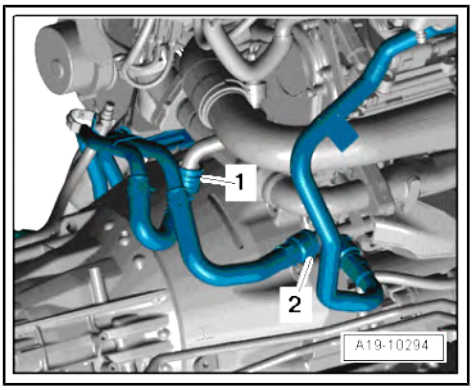
♦ *Renew seal and O-ring.*
♦ *Secure all hose connections with hose clips which conform to production standard.*

– Clean or smoothen sealing surface for seal and O-ring.
– Moisten new seal and O-ring with coolant and slide onto coolant pipe.
– Install bracket for ancillaries and tensioning element for poly V-belt ⇒ page 36 .
– Install guide pipe ⇒ page 150 .
– Install air conditioner compressor ⇒ Heating, air conditioning; Rep. gr. 87 .
– Install power-assisted steering pump ⇒ Running gear, axles, steering; Rep. gr. 48 .
– Install throttle valve module - J338- ⇒ page 273 .
– Add coolant ⇒ page 189 .

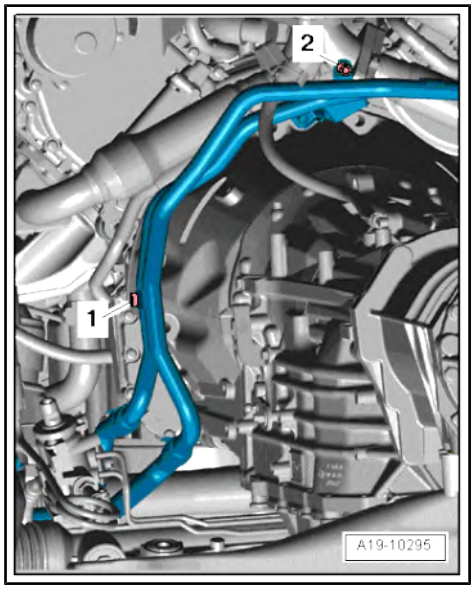
1.3.3 Removing and installing rear left coolant pipe on gearbox (engine codes CASA and CASD)

Removing

– Drain coolant ⇒ page 187 .
– Remove catalytic converter ⇒ page 284 .
– Detach right coolant hoses -1- and -2- from engine.



– Remove bolts -1- and -2-.
– Remove both rear left coolant pipes on gearbox along with coolant hoses.



Installing

Install in reverse order of removal, observing the following.

Specified torque ⇒ page 166 .

Note

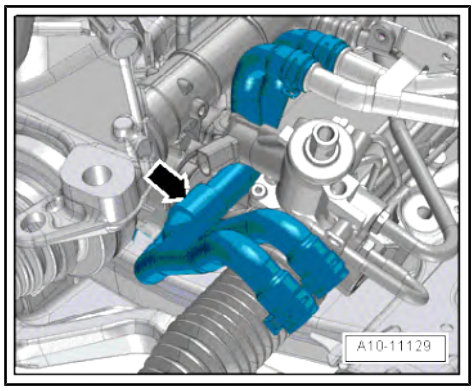
Secure all hose connections with hose clips of the same factory standard.

– Install catalytic converter ⇒ page 284 .
– Add coolant ⇒ page 189 .

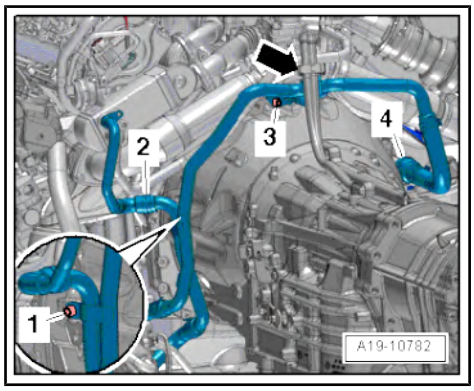
1.3.4 Removing and installing rear left coolant pipe on gearbox (engine code CATA)

Removing

– Drain coolant ⇒ page 187 .
– Remove catalytic converter ⇒ page 284 .
– Release coolant hoses -arrows-.



– Remove coolant hoses by loosening hose clip -2- and lifting retainer -4-.
– Release breather hose -arrow- for gearbox.
– Remove bolts -1- and -3-, take left coolant pipe on rear of gearbox off along with coolant hoses.



Installing

Install in reverse order of removal, observing the following.

Specified torque ⇒ page 166 .

Note

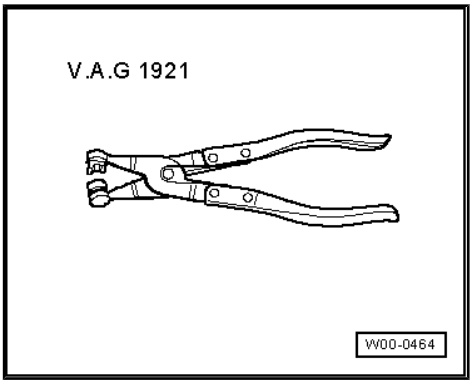
Secure all hose connections with hose clips of the same factory standard.

– Install catalytic converter ⇒ page 284 .
– Add coolant ⇒ page 189 .

1.3.5 Removing and installing rear left coolant pipe (engine codes CASA and CASD)

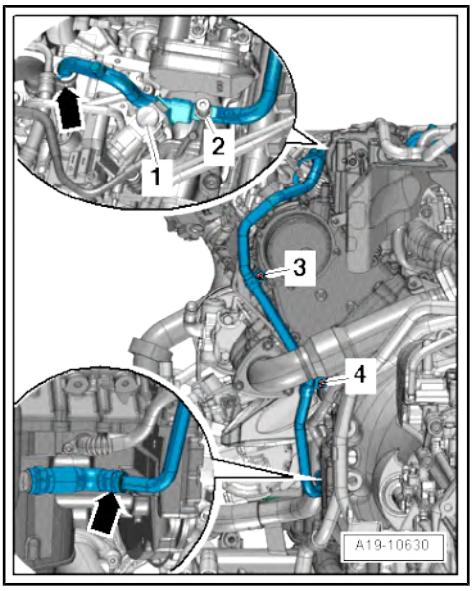
Special tools and workshop equipment required

- Hose clamp pliers - V.A.G 1921-



Removing

– Drain coolant ⇒ page 187 .
– Remove left intermediate pipe ⇒ page 335 .
– Disconnect electrical connector on glow plug for cylinder 6.
– Take exhaust gas recirculation cooler changeover valve - N345- -item 1- out of retainer.
– Remove bolts -3- and -4- and ball pin -2-.
– Release wiring harness from rear left coolant pipe.
– Disconnect rear left coolant pipe from coolant hoses -arrows-.



Installing

Install in reverse order of removal, observing the following.

Specified torque ⇒ page 166 .

Note

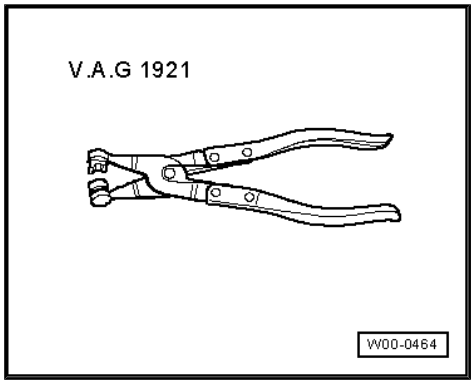
Secure all hose connections with hose clips which conform to production standard.

– Install left intermediate pipe ⇒ page 335 .
– Add coolant ⇒ page 189 .

1.3.6 Removing and installing rear left coolant pipe (engine code CATA)

Special tools and workshop equipment required

- Hose clamp pliers - V.A.G 1921-



Removing

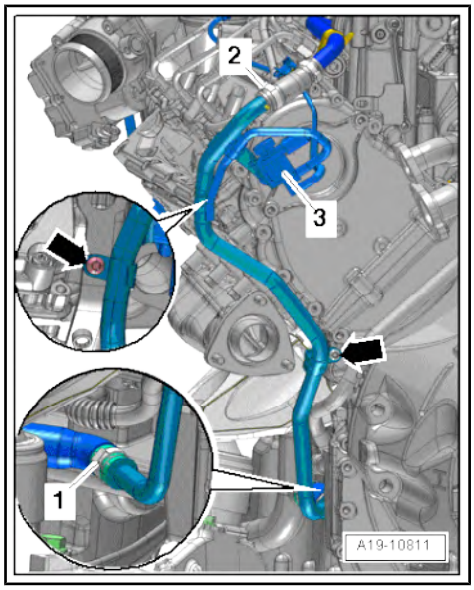
– Drain coolant ⇒ page 187 .

– Remove left intermediate pipe ⇒ page 335 .

– Take exhaust gas recirculation cooler changeover valve 2 - N381- -item 3- out of retainer.

– Unscrew bolts -arrows-.

– Remove rear left coolant pipe from coolant hoses, loosen hose clips -1- and -2- for this.



Installing

Install in reverse order of removal, observing the following.

Note

Secure all hose connections with hose clips which conform to production standard.

– Install left intermediate pipe ⇒ page 335 .

– Add coolant ⇒ page 189 .

Specified torque:

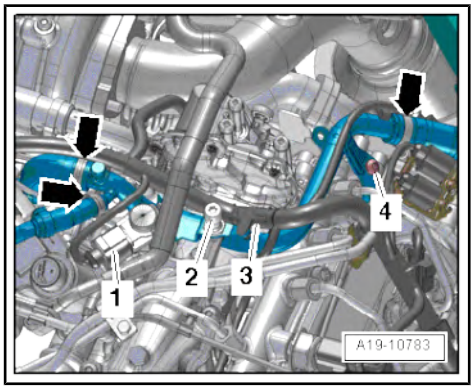
- ⇒ “1.2 Assembly overview - front exhaust pipe with catalytic converter, reduction catalytic converter and particulate filter (engine code CATA)”, page 287
- ⇒ “3.1 Assembly overview - exhaust gas recirculation system”, page 346
- ⇒ “1.2 Assembly overview - coolant pipes”, page 166
- ⇒ “3.2 Assembly overview - supplementary cooler for exhaust gas recirculation system”, page 348

1.3.7 Removing and installing upper left coolant pipe (engine code CATA)

Removing

– Drain coolant ⇒ page 187 .

– Take exhaust gas recirculation cooler changeover valve - N345- -item 1- out of retainer.
– Unscrew bolt -4- and mounting pin for engine cover panel -2-.
– Release wiring harness -3- from upper left coolant pipe.
– Remove upper left coolant pipe, loosen hose clips -arrows- for this.



Installing

Install in reverse order of removal, observing the following.

Specified torque ⇒ page 166 .

Note

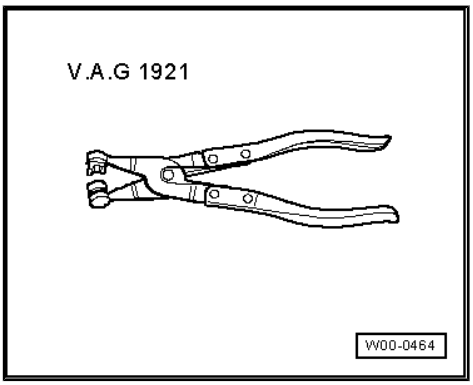
Secure all hose connections with hose clips which conform to production standard.

– Add coolant ⇒ page 189 .

1.3.8 Removing and installing rear left coolant pipe on supplementary cooler for exhaust gas recirculation (engine code CATA)

Special tools and workshop equipment required

♦ Hose clamp pliers - V.A.G 1921-



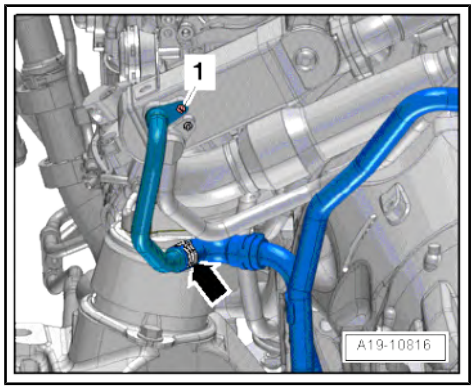
Removing

– Drain coolant ⇒ page 187 .

– Unscrew bolt -1-.

– Pull rear left coolant pipe off supplementary cooler for exhaust gas recirculation.

– Loosen hose clip -arrow- and remove coolant hose.



Installing

Install in reverse order of removal, observing the following.

Specified torque ⇒ page 166 .

Note

Secure all hose connections with hose clips which conform to production standard.

– Clean or smoothen sealing surface for O-ring.

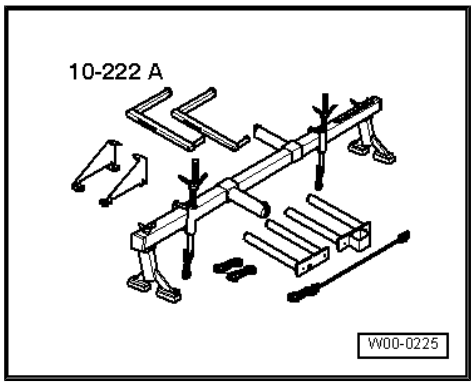
– Moisten new O-ring with coolant and slide onto coolant pipe.

– Add coolant ⇒ page 189 .

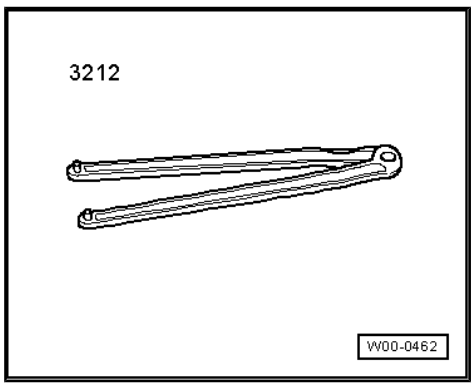
1.3.9 Removing and installing right coolant pipe

Special tools and workshop equipment required

♦ Support - 10 - 222 A-



♦ Pin wrench - 3212-



Removing

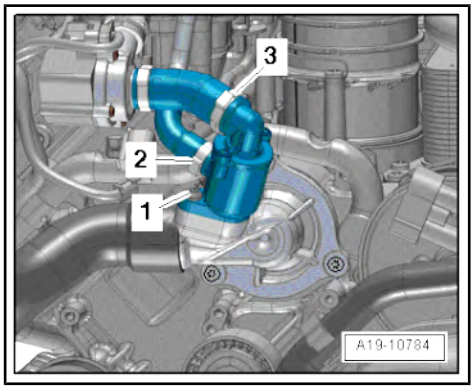
– Drain coolant ⇒ page 187 .

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

– Remove pump for exhaust gas recirculation cooler - V400- ⇒ page 186 .

Vehicles with engine code CATA

– Remove bolt -1- and pull exhaust gas recirculation thermostat with union off thermostat with union.

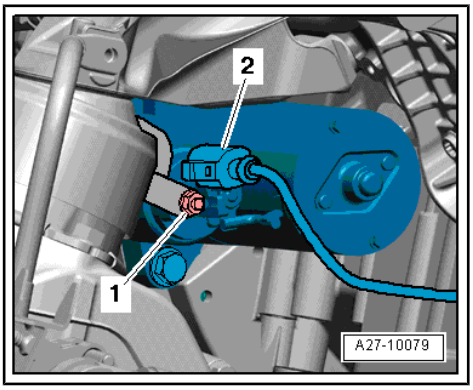


Note

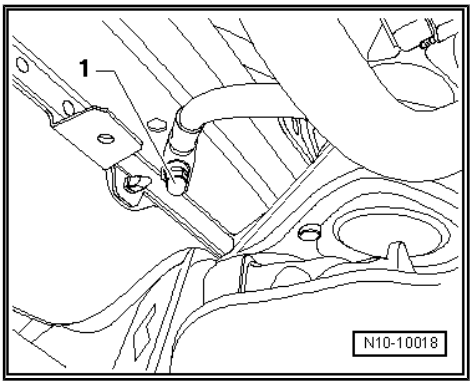
-Items 2, 3- can be disregarded.

Continuation for all engine codes

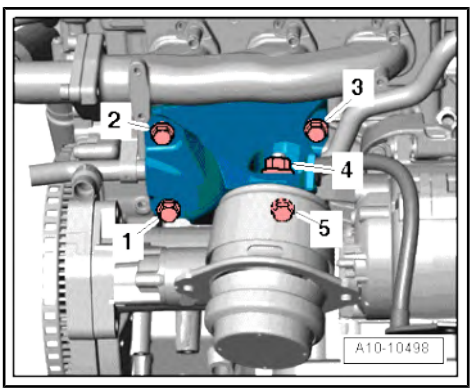
– Separate electrical wiring connector -2- on starter.
– Unscrew nut -1-, pull B+ line off stud on starter.
– Support engine in its installation position ⇒ page 28 .
– Take up weight of engine with spindle of support bracket.



– Remove nut -1- on right longitudinal member and pull off earth connector.

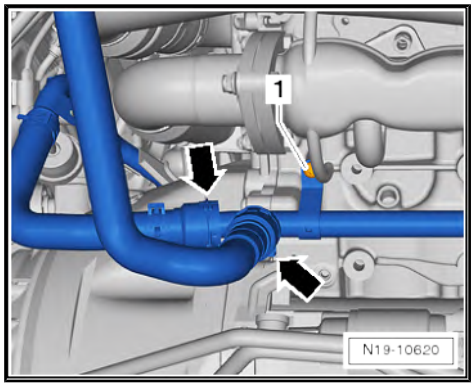


– Remove nuts and bolts -1 … 5- and remove right engine support upwards.

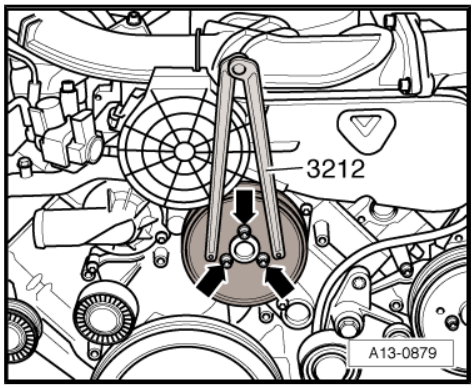


– Unscrew bolt -1-.

– Lift retaining clip -arrow- and remove coolant hose from right coolant pipe.

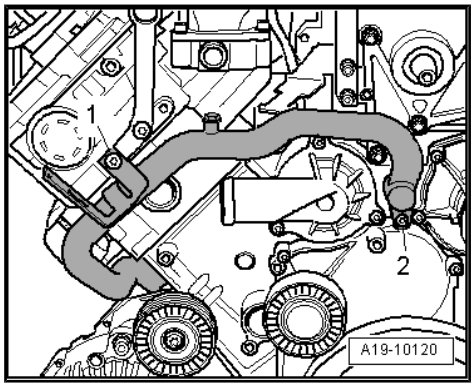


– Remove bolts -arrows-, use 2-hole pin wrench - 3212- to counterhold, remove poly V-belt pulley for coolant pump.



– Unscrew bolt -1- and nut -2-.

– Pull right coolant pipe forwards out of cylinder block and remove it.



Installing

Install in reverse order of removal, observing the following.

Specified torque ⇒ page 166 .

Note

- *Renew O-rings.*
- *Hose unions and air intake pipes and hoses must be free of oil and grease before installation.*
- *Secure all hose connections with hose clips which conform to production standard.*

– Install poly V-belt pulley for coolant pump ⇒ page 203 .

– Specified torque for engine mountings ⇒ page 31 .

– Screw B+ lead to starter ⇒ Electrical system; Rep. gr. 27 ; Starter, vehicles with automatic gearbox

Vehicles with engine code CATA

– Install exhaust gas recirculation thermostat ⇒ page 203 .

Continuation for all engine codes

– Install pump for exhaust gas recirculation cooler - V400- ⇒ page 186 .

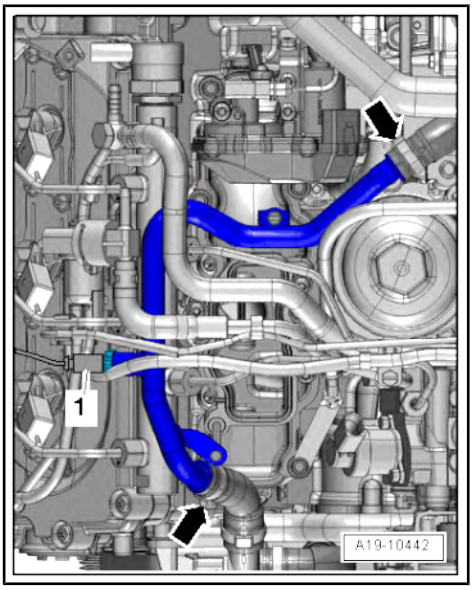
– Install alternator ⇒ Electrical system; Rep. gr. 27 ; Alternator

– Add coolant ⇒ page 189 .

1.3.10 Removing and installing upper right coolant pipe

Removing

– Drain coolant ⇒ page 187 .
– Remove upper part of intake manifold ⇒ page 274 .
– Disconnect electrical connectors for glow plugs for cylinders “1” and “2”.
– Release wiring harness from upper right coolant pipe.
– Separate connector -1-.
– Loosen hose clips -arrows- and remove coolant hoses.
– Remove upper right coolant pipe.



Installing

Install in reverse order of removal, observing the following.

Note

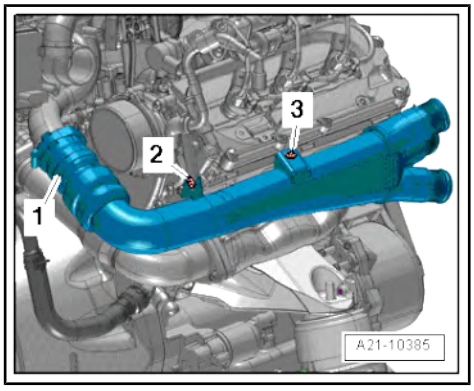
Secure all hose connections with hose clips which conform to production standard.

– Install upper part of intake manifold ⇒ page 274 .
– Add coolant ⇒ page 189 .

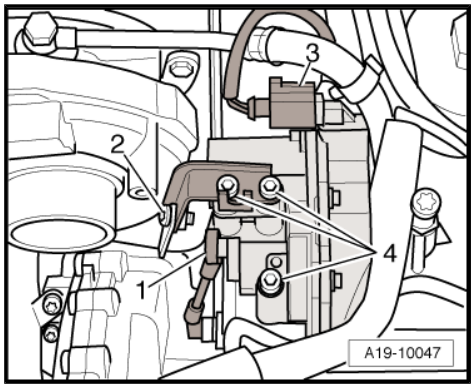
1.3.11 Removing and installing rear right coolant pipe (engine codes CASA and CASD)

Removing

– Drain coolant ⇒ page 187 .
– Remove upper part of air filter ⇒ page 281 .
– Unscrew bolts -2- and -3-.
– Pull right air intake pipe forwards off air intake hose, loosen hose clip -1- for this.



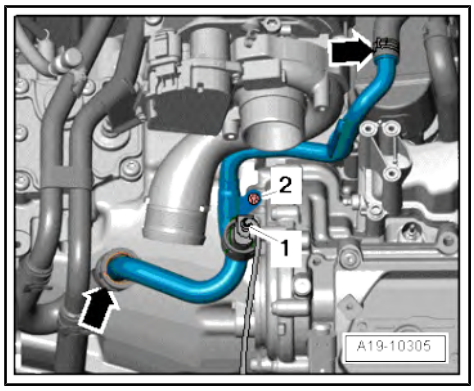
– Disconnect electrical connector -3- on intake manifold flap motor - V157- .
– Remove bolts -2- and -4- and move intake manifold flap motor - V157- clear to the side (with connecting rod installed).



Note

In order to prevent damage to the intake manifold flap motor - V157- , the connecting rod -1- is not detached.

– Disconnect electrical connector -1- at coolant temperature sender - G62- .
– Unscrew bolt -2-.
– Detach the coolant hoses -arrows- and remove the rear right coolant pipe.



Installing

Install in reverse order of removal, observing the following.

Note

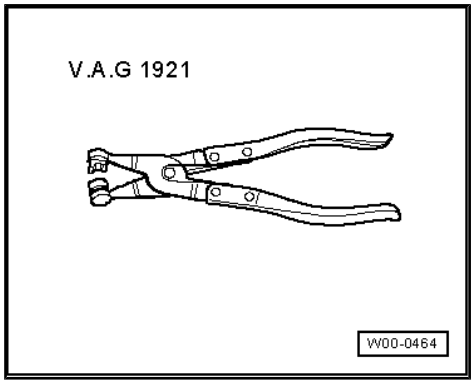
Secure all hose connections with hose clips which conform to production standard.

– Install intake manifold flap motor - V157- ⇒ page 273 .
– Install right air pipe ⇒ page 229 .
– Install upper part of air filter ⇒ page 281 .
– Add coolant ⇒ page 189 .

1.3.12 Removing and installing rear coolant pipe (engine code CATA)

Special tools and workshop equipment required

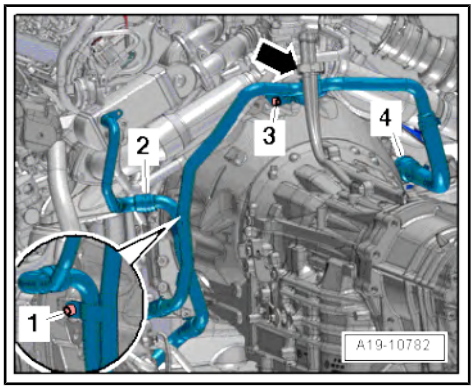
♦ Hose clamp pliers - V.A.G 1921-



Removing

– Drain coolant ⇒ page 187 .
– Remove turbocharger ⇒ page 209 .
– Remove catalytic converter ⇒ page 284 .

– Remove bolts -1- and -3-, push left coolant pipe on rear of gearbox to rear.



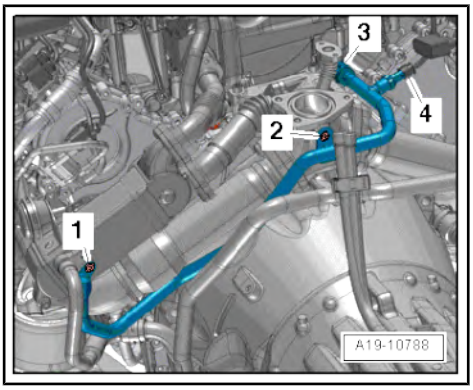
Note

- *For reasons of clarity, diagram shows installation position with removed engine.*
- *Ignore -items 2, 4- and -arrow-.*

– Disconnect electrical connector -4- at coolant temperature sender - G62- .

– Remove bolts -1- and -2-, pull rear coolant pipe off cooler for exhaust gas recirculation.

– Remove rear coolant pipe, loosen hose clip -3- for this.



Installing

Install in reverse order of removal, observing the following.

Specified torque ⇒ page 166 .

Note

- *Renew O-ring.*
- *Hose unions and air intake pipes and hoses must be free of oil and grease before installation.*
- *Secure all hose connections with hose clips which conform to production standard.*

– Add coolant ⇒ page 189 .

1.4 Removing and installing coolant temperature sender - G62-

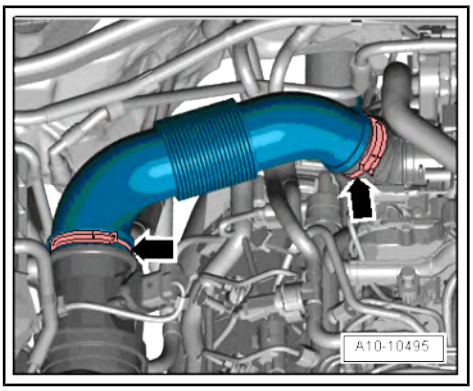
Removing

• Engine cold.

– Briefly open filler cap for coolant expansion tank in order to reduce pressure in cooling system.

– Carefully pull engine cover panel off four retaining pins, one after the other.

– Remove air intake hose. To do this, loosen hose clips -arrows-.

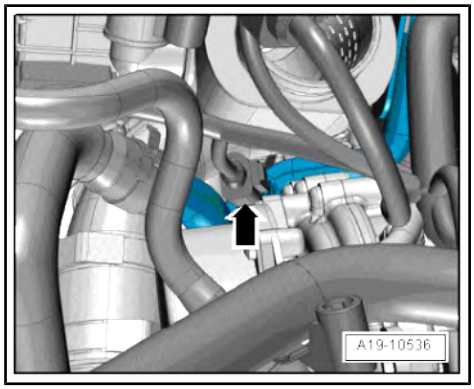


Engine code CATA

– Remove connection for air intake hose ⇒ Item 14 (page 210) .

– Pull connector -arrow- off coolant temperature sender - G62- .

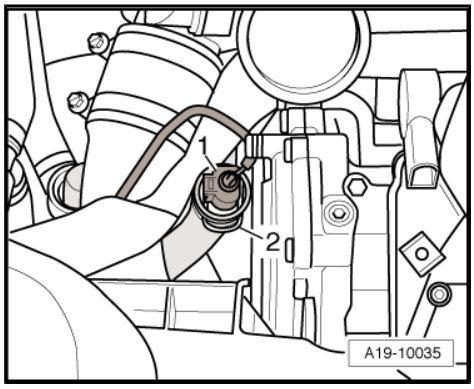
– Unscrew coolant temperature sender - G62- .



Continuation for all engine codes

– Pull connector -1- off coolant temperature sender - G62- .

– Pull off retaining clip -2- and pull out coolant temperature sender - G62- .



Installing

Install in reverse order of removal, observing the following.

- Specified torque
  ⇒ “1.2 Assembly overview - coolant pipes”, page 166 .

Note

- *Renew O-rings.*
- *Start new coolant temperature sender - G62- immediately in thread to avoid loss of coolant.*
- *Hose unions and air intake pipes and hoses must be free of oil and grease before installation.*
- *Secure all hose connections with the same type of hose clips as original equipment ⇒ Electronic parts catalogue .*

– Check coolant level.

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

Removing

- Engine cold.

– Briefly open filler cap for coolant expansion tank in order to reduce pressure in cooling system.

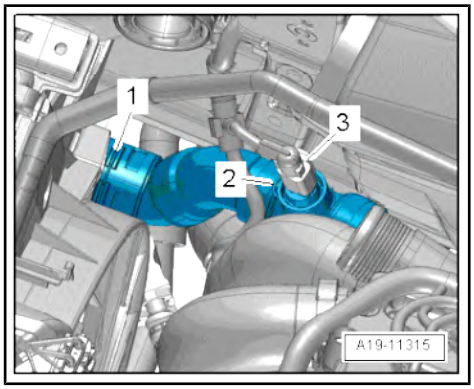
– Carefully pull engine cover panel off four retaining pins, one after the other.

Note

Place a cloth underneath to catch escaping coolant.

– Separate electrical connector -3-.

– Pull off retaining clip -2- and remove radiator outlet coolant temperature sender - G83- .



Note

Disregard -item 1-.

Installing

Install in reverse order of removal, observing the following.

Note

- *Renew O-ring.*
- *Insert new radiator outlet coolant temperature sender - G83- into connection immediately to avoid loss of coolant.*

– Check coolant level.

1.6 Assembly overview - pump for exhaust gas recirculation cooler - V400-

1 - Coolant hose
- ❑ To thermostat.

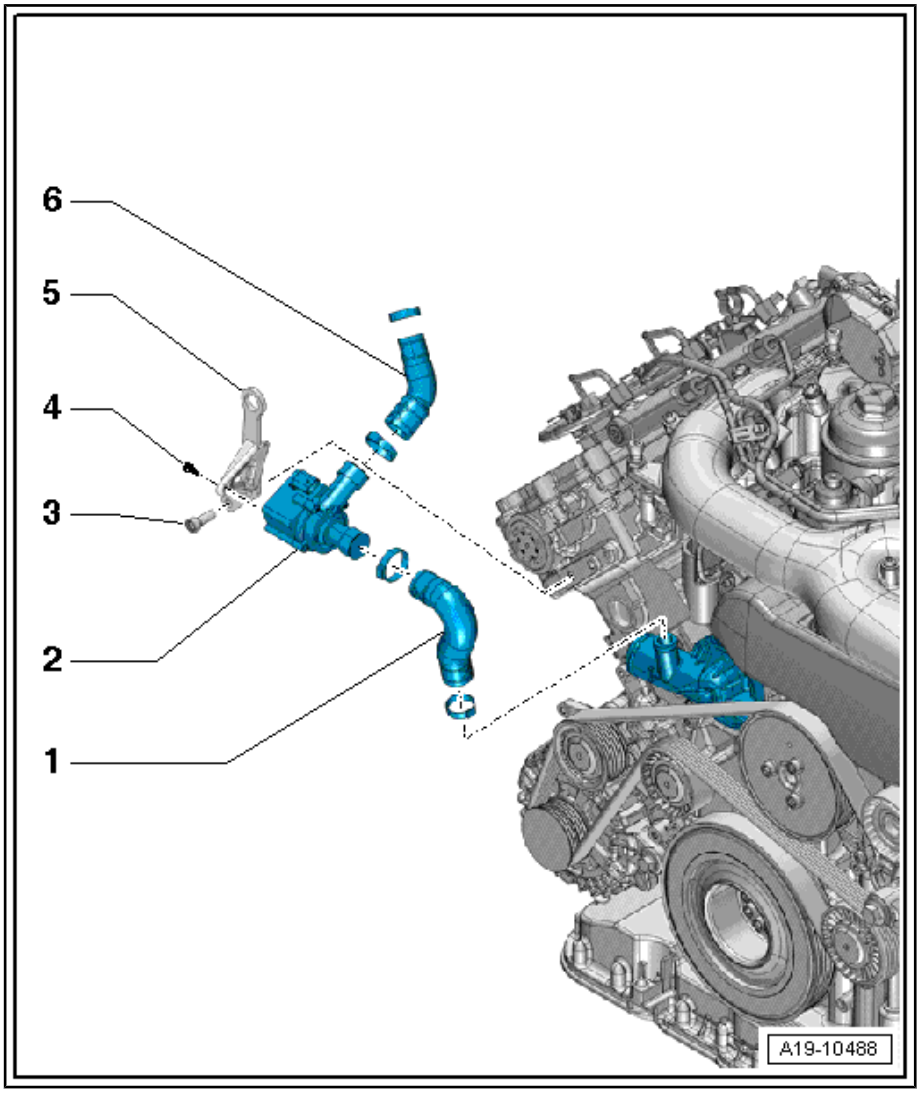
2 - Pump for exhaust gas recirculation cooler - V400-
- ❑ Removing and installing ⇒ page 186

3 - Bolt
- ❑ 23 Nm

4 - Bolt
- ❑ 3 Nm

5 - Engine lifting eye

6 - Coolant hose
- ❑ To exhaust gas recirculation cooler



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

Removing

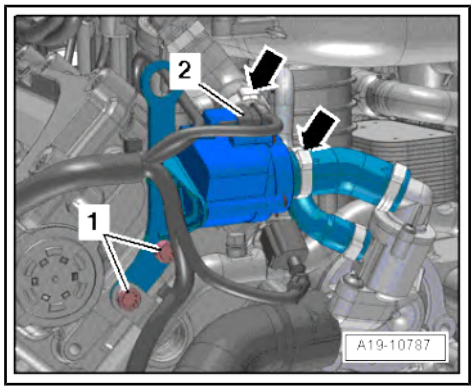
– Drain coolant ⇒ page 187 .

– Disconnect connector -2-.

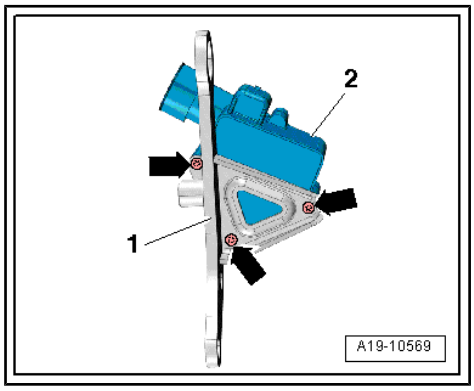
– Unscrew bolts -1-.

– Loosen hose clips -arrows- and remove coolant hoses.

– Remove pump for exhaust gas recirculation cooler - V400- with engine lifting eye.



– Remove bolts -arrows- and take pump for exhaust gas recirculation cooler - V400- off engine lifting eye.



Installing

• Specified torques ⇒ page 185 .

Install in reverse order of removal, observing the following.

Note

Secure all hose connections with hose clips which conform to production standard.

– Add coolant ⇒ page 189 .

2 Coolant

WARNING

Danger of scalding by steam and hot coolant.

- *On a warm engine, the cooling system is under high pressure.*
- *Cover filler cap on expansion tank with a cloth and open it carefully to release pressure.*

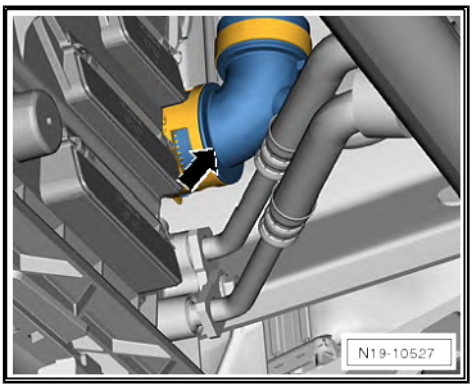
⇒ "2.1 Draining coolant", page 187 .
⇒ "2.2 Draining cooling system", page 188 .
⇒ "2.3 Filling with coolant", page 189 .
⇒ "2.4 Checking filling quality", page 192 .
⇒ "2.5 Checking cooling system for leaks", page 193 .

2.1 Draining coolant

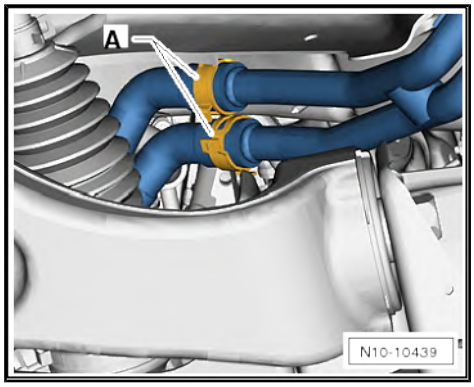
Caution

If large components (e.g. engine, radiator etc.) are to be removed/installed, it is absolutely necessary to drain the cooling system ⇒ page 188 . Otherwise, hidden air bubbles can result in incorrect filling. This results in temperature problems in the cooling system and heating circuit.

– Remove noise insulation ⇒ General body repairs, exterior; Rep. gr. 50 ; Assembly overview - noise insulation; noise insulation .
– Place drip tray - VAS 6208- beneath engine.
– Open filler cap on coolant expansion tank.
– Pull off quick-release coupling -arrow- on lower right of radiator.



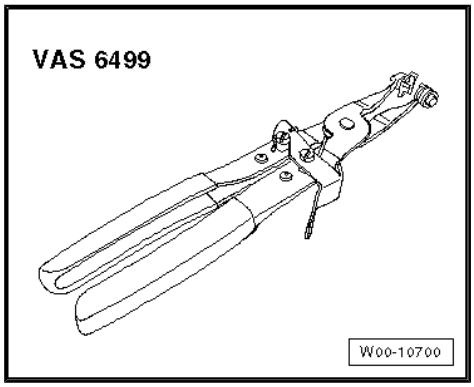
– Open clips -A- and pull off auxiliary heater coolant hoses.



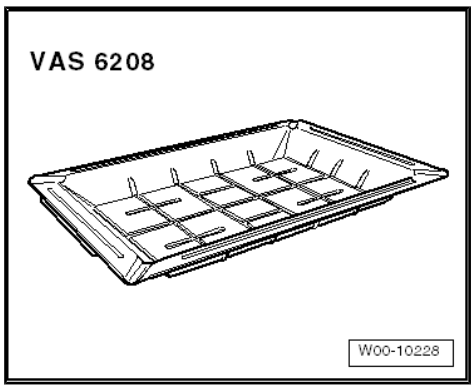
2.2 Draining cooling system

Special tools and workshop equipment required

♦ Spring-type clip pliers - VAS 6499-



♦ Drip tray for workshop hoist - VAS 6208-



♦ Hose extension ∅ 20 mm

♦ 2 x dummy plugs ∅ 20 mm

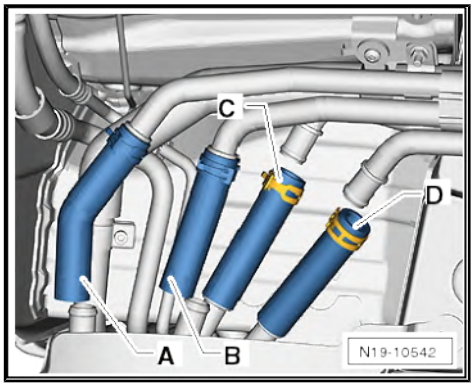
♦ Compressed air gun

– Drain coolant ⇒ page 187 .

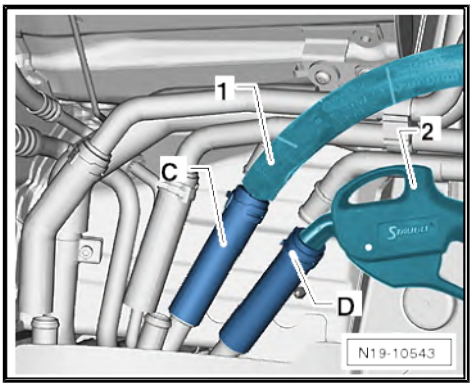
– Install left front wheel ⇒ Running gear, axles, steering; Rep. gr. 44 ; Specified torque for wheel bolts .

– Remove front left wheel housing liner ⇒ General body repairs, exterior; Rep. gr. 66 ; Wheel housing liner; Front wheel housing liner .

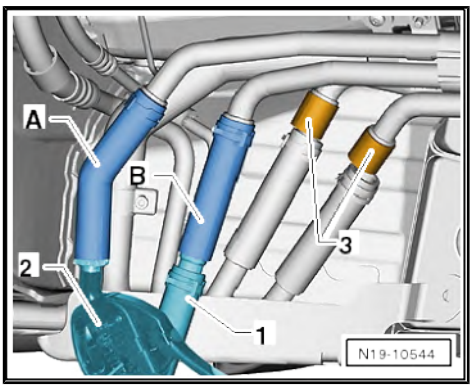
– Open clips and pull off coolant hoses -A … D-.
– Extend the line -C- with a suitable hose -1- so that it ends in drip tray for workshop hoist - VAS 6208- .



– Apply maximum air pressure of 1 bar in line -D- by means of pneumatic cartridge gun-2- until circuit is completely drained.



– Fit dummy plugs -3- as shown and extend line -B- with a suitable hose -1- so that it ends in drip tray for workshop hoist - VAS 6208- .
– Apply maximum air pressure of 1 bar in line -A- by means of pneumatic cartridge gun -2- until circuit is completely drained.
– Re-attach coolant hoses and secure with clips.



2.3 Filling with coolant

Note

The water used for mixing has a major influence on the effectiveness of the coolant. Because the water quality differs from country to country and even region to region, Volkswagen has decided to define the quality of the water to be used in the coolant system. Distilled water fulfils all requirements. Therefore, it is recommended that coolant mixed with distilled water be used to replenish systems or fill them, even on older models. The use of distilled water is obligatory for new types of vehicle (year of manufacture 2010 ➢).

Caution

Use only distilled water for mixing coolant additives. The use of distilled water ensures optimum protection against corrosion.

Note

- *Use only coolant additive G 12 plus-plus in accordance with TL VW 774 G.*
- *It is only permissible to use distilled water for mixing.*
- *Coolant additives marked "in accordance with TL VW 774 G" prevent lime accretion, frost damage and corrosion. Such additives also raise the boiling point of the coolant. Therefore, the cooling system must be filled all year round with coolant additive.*
- *Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- *The frost protection must be guaranteed to approx. -25°C. (In countries with an arctic climate, down to approx. -35°C).*
- *Do not reduce the coolant concentration by adding water even in warmer seasons and in warmer countries. The coolant additive concentration must be at least 40%.*
- *If a stronger anti-freeze mixture is necessary due to harsher weather conditions, the coolant additive content can be increased. However, this is only permitted to 60% (antifreeze protection to about -40°C). Since the frost protection will otherwise be reduced again and also the cooling effect will be worsened.*
- *The refractometer - T10007- is recommended for determining the current anti-freeze density.*
- *Never reuse old coolant.*

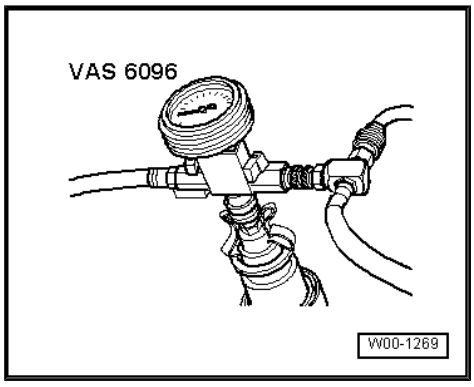
Recommended mixture ratios:

Frost protection to	Amount of anti-freeze	G 12 plus-plus *)	Water *)
-25°C -35°C	40% 50%	4.5 l 5.0 l	5.5 l 5.0 l

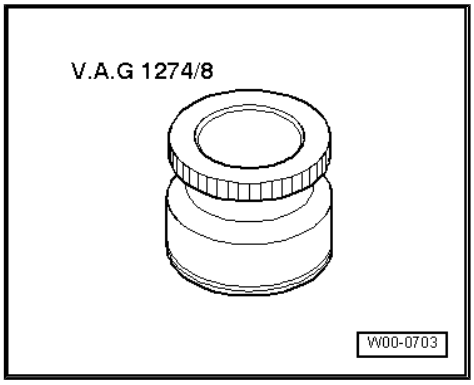
*) The amount of coolant can vary, depending on the vehicle's equipment.

Special tools and workshop equipment required

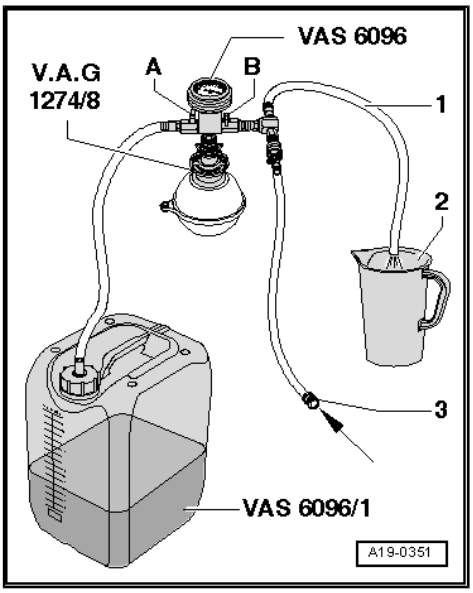
- Coolant system charge unit - VAS 6096-



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



– Check to make sure all connections are sealed off.
– Fill reservoir of -VAS 6096- with at least 17 litres of pre-mixed coolant in correct mixture ratio.
– Screw adapter for cooling system tester - V.A.G 1274/8- onto coolant expansion tank.
– Mount cooling system charge unit - VAS 6096- on adapter - V.A.G 1274/8- .
– Feed vent hose -1- into a small container -2-.



Note

Exhaust air takes a slight quantity of coolant along with it; this should be collected.

– Close valves -A- and -B- (turn lever transverse to direction of flow to do this).
– Connect hose -3- to compressed air.
• Pressure: 6 to 10 bar.

– Open valve -B-; turn lever in direction of flow to do this.

• The suction-jet pump reduces pressure in the cooling system to below atmospheric pressure. The needle on the gauge should move into the green zone.

– In addition, briefly open valve -A- (turn lever in direction of flow to do this) so that hose on -VAS 6096- reservoir fills with coolant.

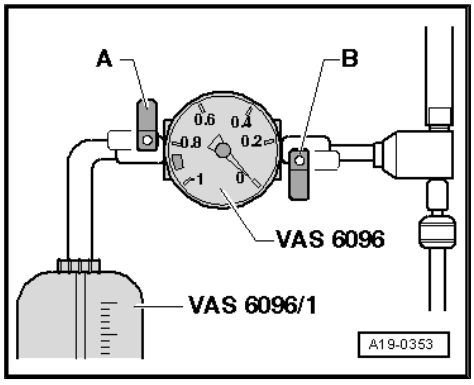
– Close valve -A- again.

– Leave valve -B- open for a further 2 minutes.

• The suction-jet pump will continue generating a vacuum in the cooling system. The needle on the gauge must remain in the green zone.

– Close valve -B-.

• The needle on the gauge must stay in the green zone. The low pressure in the cooling system is then sufficient for subsequent filling.



Note

If vacuum drops, cooling system must be checked for leaks.

– Pull off compressed air hose.

– Open valve -A- slowly.

• The partial vacuum in cooling system causes coolant to be extracted from -VAS 6096- reservoir and coolant system to be filled.

– Remove cooling system charge unit - VAS 6096- from adapter -V.A.G 1274/8- on coolant expansion tank.

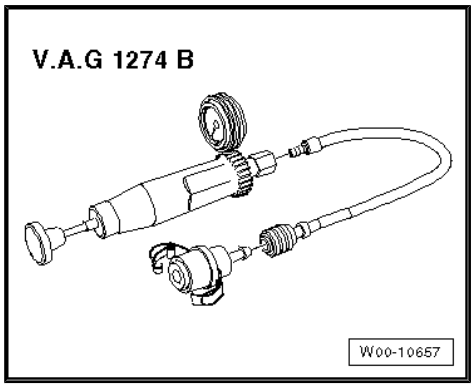
– Check coolant level in expansion tank. If necessary, fill up to “MAX” mark or drain off.

– Check coolant for air bubbles ⇒ page 192

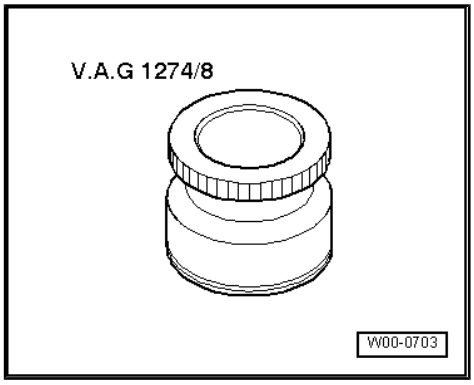
2.4 Checking filling quality

Special tools and workshop equipment required

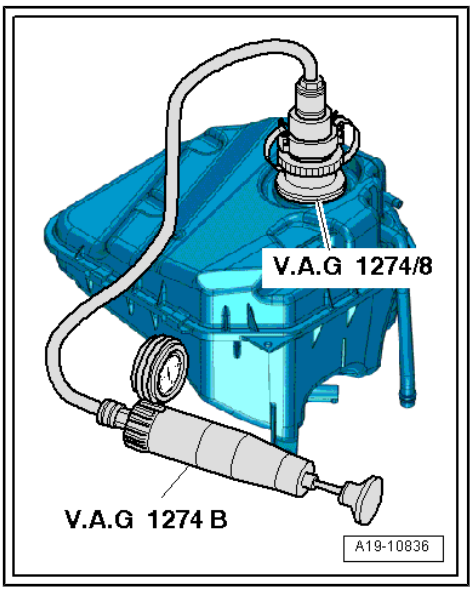
◆ Cooling system tester - V.A.G 1274 B-



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



– Open filler cap on expansion tank.
– Fit cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/8- to coolant expansion tank.
– Build up pressure of approx. 1.0 bar using hand pump of cooling system tester.
– Observe coolant level in expansion tank.



Caution

If there are no leaks in the cooling system, it is only permissible for the coolant level to fall by a maximum of 25 mm. A considerably larger drop in the coolant level or evaporation of the coolant from the expansion tank suggests that there is an air bubble in the cooling system.

Coolant level OK:

– Perform road test until operating temperature of engine is reached.
– Check coolant level again.

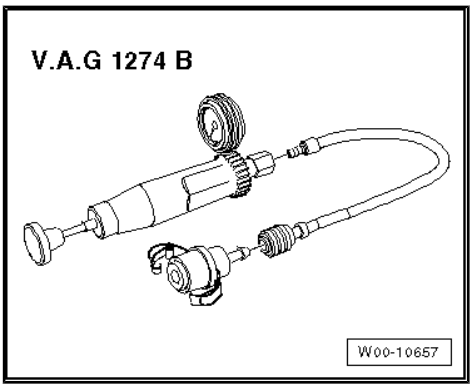
Coolant level drops considerably:

– Drain cooling system ⇒ page 188 .
– Repeat cooling system filling process ⇒ page 189
– Check coolant for air bubbles ⇒ page 192

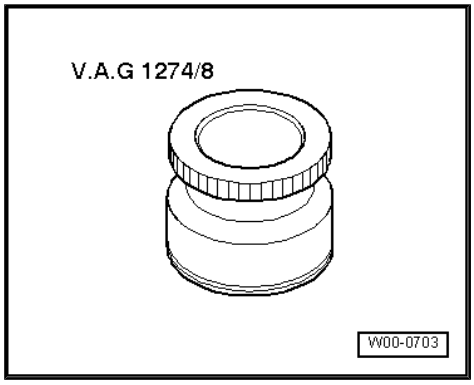
2.5 Checking cooling system for leaks

Special tools and workshop equipment required

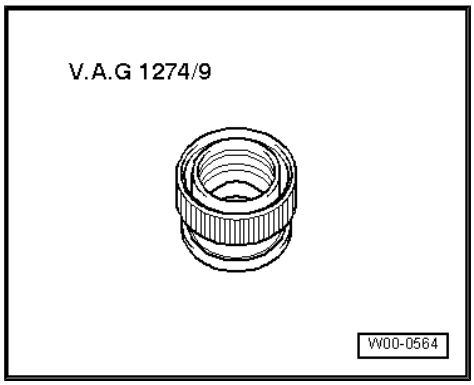
♦ Cooling system tester - V.A.G 1274 B-



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



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



Procedure

- Engine at operating temperature.

WARNING

Danger of scalding by steam and hot coolant.

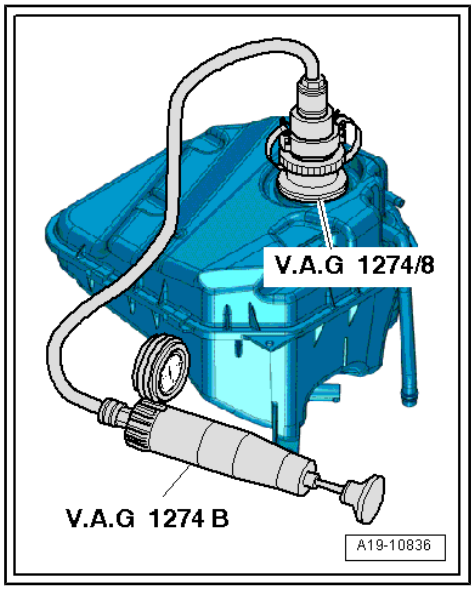
- *On a warm engine, the cooling system is under high pressure.*
- *Cover filler cap on expansion tank with a cloth and open carefully to release pressure.*

– Open filler cap on expansion tank.

– Fit cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/8- to coolant expansion tank.

– Build up pressure of approx. 1.0 bar using hand pump of cooling system tester.

– If this pressure is not maintained, locate and rectify leaks.



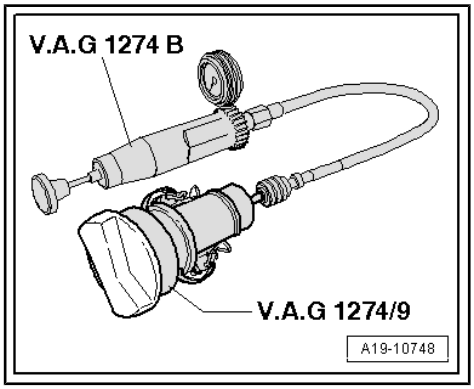
Check pressure relief valve in cap.

– Fit cooling system tester - V.A.G 1274 B- with adapter - V.A.G 1274/9- onto coolant filler cap.

– Build up pressure using hand pump of cooling system tester.

• The pressure relief valve must open at a pressure of 1.4 … 1.6 bar.

– Renew filler cap, if pressure relief valve does not open as described.



3 Radiator module and radiator fan

⇒ “3.1 Assembly overview - radiator module and radiator fan”, page 196 .

⇒ “3.2 Removing and installing radiator cowl and radiator fan ”, page 197 .

⇒ “3.3 Removing, installing and dismantling radiator module”, page 197 .

3.1 Assembly overview - radiator module and radiator fan

1 - Cooler module
- ❑ With condenser and ATF cooler

2 - Radiator cowl
- ❑ Removing and installing ⇒ page 197

3 - Radiator fan - V7-
- ❑ Remove together with radiator cowl

4 - Rubber mounting
- ❑ For radiator mounting

5 - Lower radiator mounting

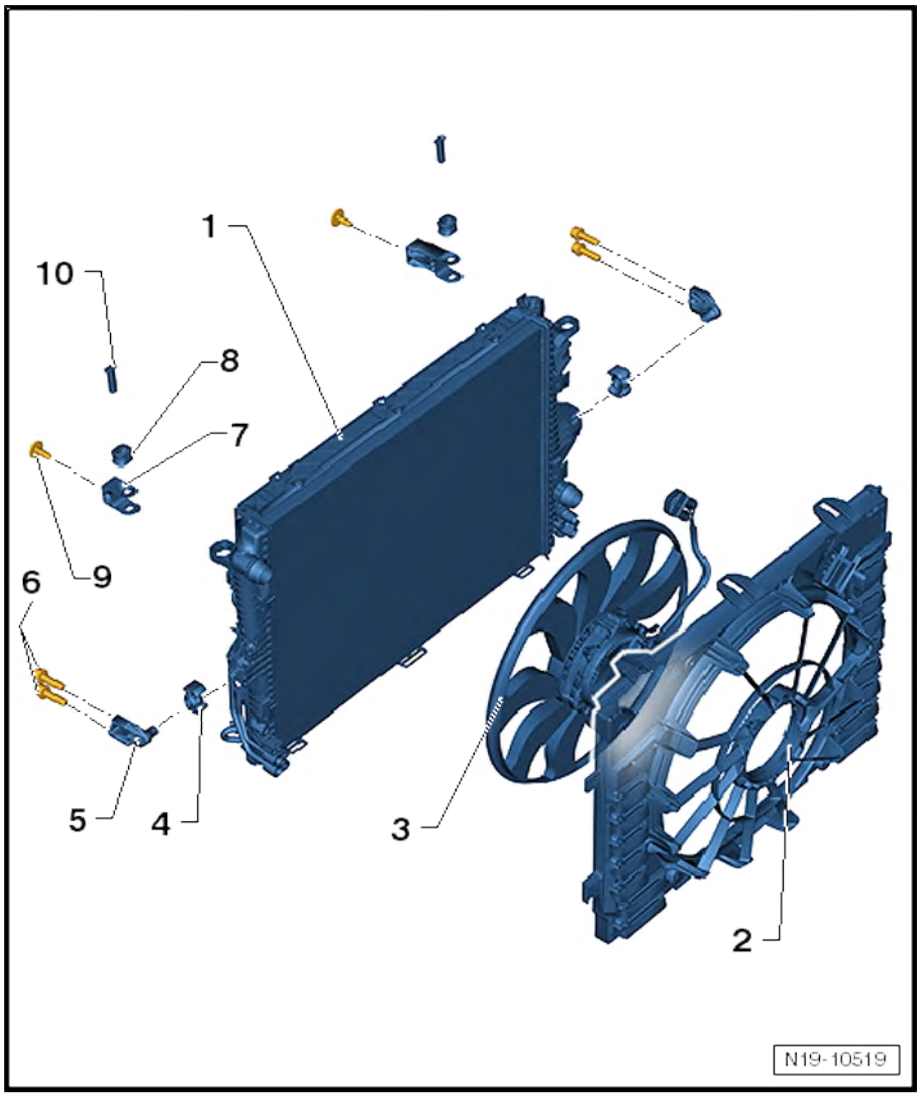
6 - Bolts
- ❑ 25 Nm

7 - Upper radiator mounting

8 - Rubber mounting
- ❑ For radiator mounting

9 - Bolt
- ❑ 5 Nm

10 - Locking pin



3.2 Removing and installing radiator cowl and radiator fan

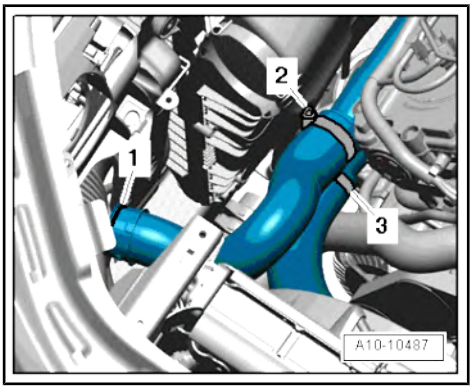
Removing

– Open clamp -2- and pull off connecting hose to left charge air pipe.

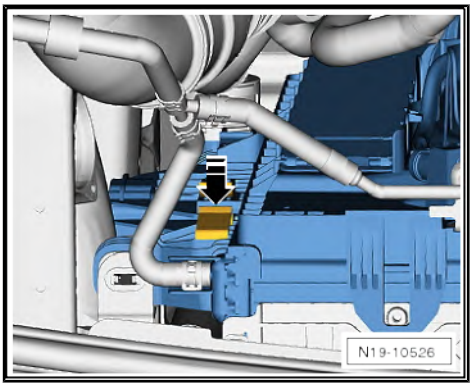
– Unbolt charge air pipes and coolant lines at radiator cowl.

– Remove upper charge air pipe from left charge air cooler.

– Detach connector from radiator cowl and free wiring.



– Press in clips -arrows- on both sides of cowl and take cowl out upwards.



Installing

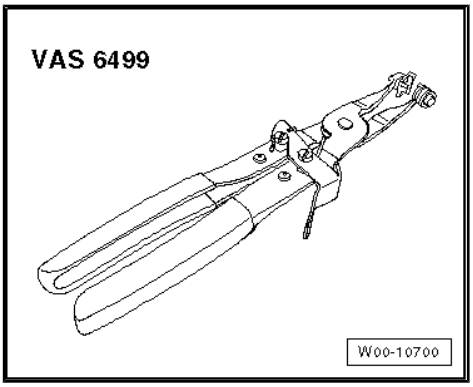
– Install in reverse order of removal.

3.3 Removing, installing and dismantling radiator module

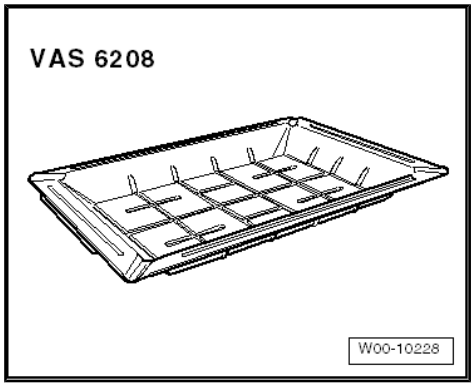
3.3.1 Removing

Special tools and workshop equipment required

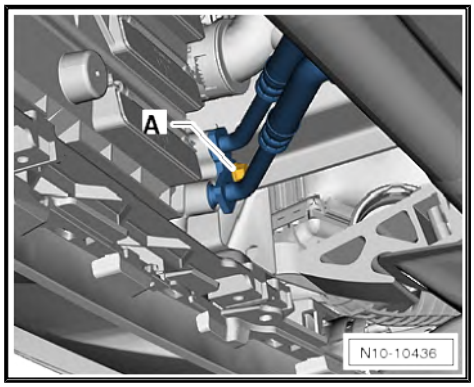
♦ Spring-type clip pliers - VAS 6499-



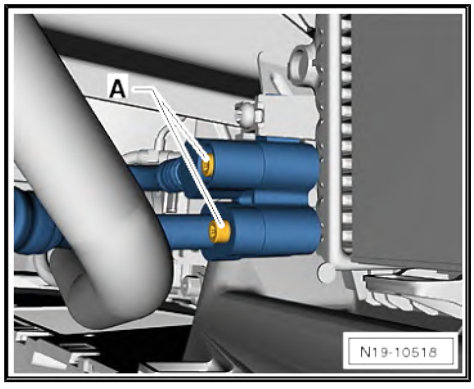
♦ Drip tray for workshop hoist - VAS 6208-



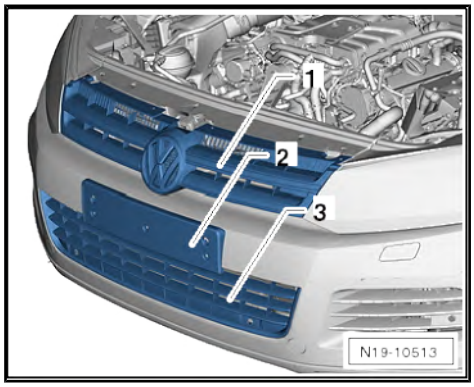
– Drain coolant ⇒ page 187 .
– Remove radiator cowl ⇒ page 197 .
– Extract refrigerant from air conditioning system ⇒ Heating, air conditioning system; Rep. gr. 87 .
– Unscrew bolt -A- and pull connections off gear oil cooler. Catch oil which runs out.



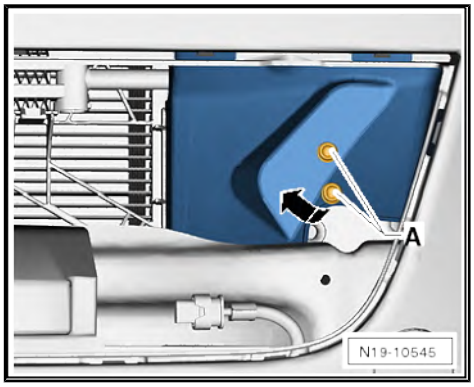
– Unscrew refrigerant lines -arrow- from radiator module.
– Detach all coolant lines from radiator.



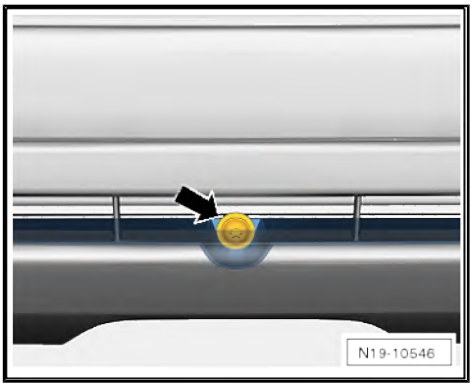
– Remove radiator grille -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Radiator grille; Removing and installing radiator grille .
– Remove number plate carrier -2- and centre air grille -3- ⇒ General body repairs, exterior; Rep. gr. 63 ; Front bumper; Front bumper attachments .



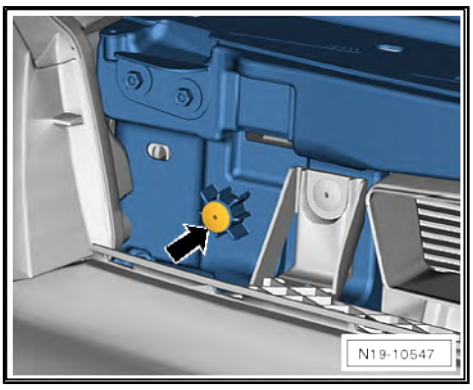
– Lift up air guide on both sides of the air grille opening -arrow- and unscrew the bolts behind it -A- in each case.
– Pull the two radiator mountings sideways out of the radiator module over the longitudinal members.



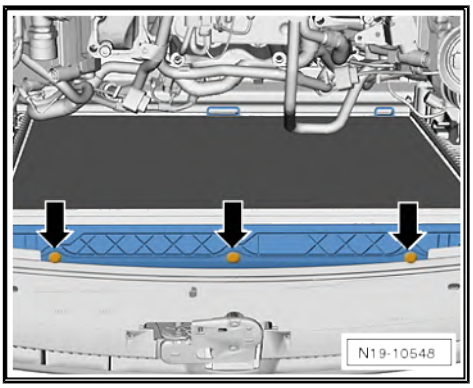
– Reach in through the lowest air grill to unscrew bolts -arrow- (3 bolts) of air guide.



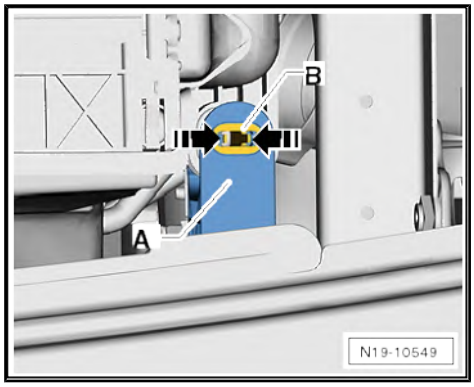
– Unscrew bolt -arrow- next to headlights on left and right.



– Push radiator module in direction of engine and release clips -arrows- of air guide on top of radiator and remove.

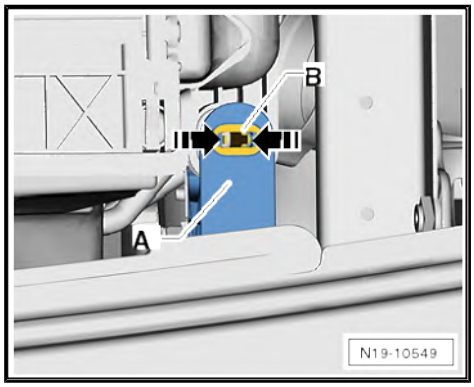


– Release locking pins -B- of both upper radiator mountings -A- by pressing in direction of -arrow- and pulling out upwards.
– Remove the two radiator mountings at top -A-.
– Take radiator module out upwards.



3.3.2 Installing

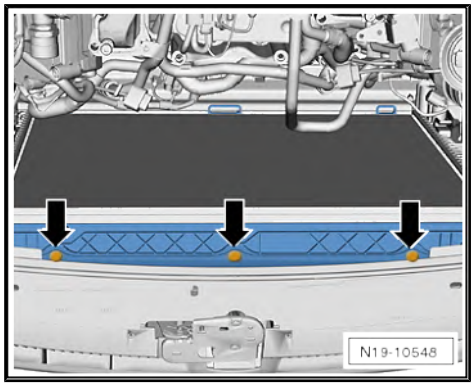
– Position upper mountings for radiator and bolt-on.
– Insert radiator module from above into the radiator mountings at top -A- and then push in locking bolt -B-.
– Insert lower side radiator mounting into radiator module and tighten.



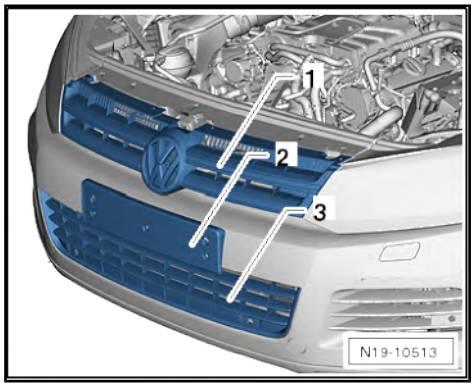
– Press in clips -arrows- for upper air duct on radiator and lock.

Further installation is carried out in reverse order of removal, observing the following:

– Drain cooling system completely before filling it ⇒ page 188 .
– Add coolant ⇒ page 189 .
– Charge air conditioner with refrigerant ⇒ Heating, air conditioning system; Rep. gr. 87 .
– Check ATF level ⇒ 8-speed automatic gearbox 08C; Rep. gr. 37 ; Checking and topping up ATF level; Checking ATF level .



– Install radiator grille -1- ⇒ General body repairs, exterior; Rep. gr. 66 ; Radiator grille; Removing and installing radiator grille .
– Install number plate carrier -2- and centre air grille -3- ⇒ General body repairs, exterior; Rep. gr. 63 ; Front bumper; Front bumper attachments .



3.3.3 Dismantling cooler module

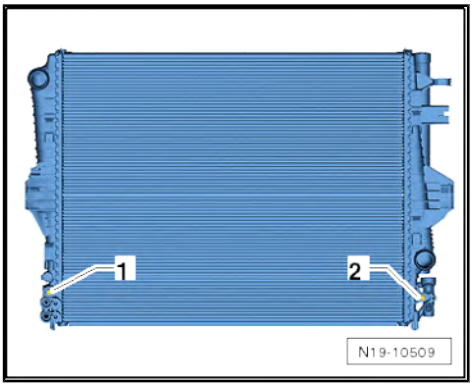
Note

The radiator module consists of a radiator for coolant, a condenser, a hydraulic oil cooler and a gearbox oil cooler.

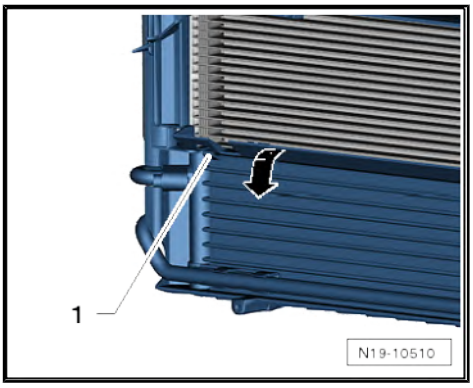
Condition

- Radiator module removed ⇒ page 197 .

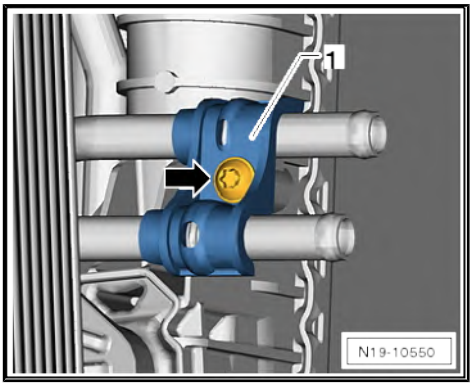
– Unscrew securing bolts -1- and -2-.



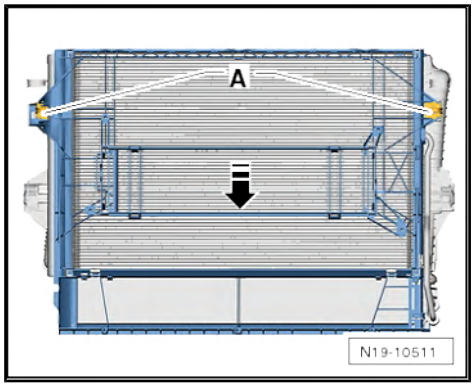
– Turn radiator module over. Press locking mechanism -1- and swing out gear oil cooler.



– Unscrew bolts -arrows- and remove bracket -1- and then swing out hydraulic oil cooler.



– Remove clamps -A-, lift condenser a little and remove from radiator in direction of arrow.



4 Coolant pump and thermostat

⇒ “4.1 Assembly overview - thermostat and coolant pump (engine codes CASA and CASD)”, page 203 .

⇒ “4.2 Assembly overview - coolant pump and thermostat (engine code CATA)”, page 204 .

⇒ “4.3 Removing and installing coolant pump”, page 204 .

⇒ “4.4 Removing and installing thermostat with union (engine codes CASA and CASD)”, page 206 .

⇒ “4.5 Removing and installing thermostat with union (engine code CATA)”, page 206 .

⇒ “4.6 Removing and installing thermostat for exhaust gas recirculation with union (engine code CATA)”, page 207 .

4.1 Assembly overview - thermostat and coolant pump (engine codes CASA and CASD)

Note

Coolant hose schematic diagram ⇒ page 164

1 - Bolt
- ❑ 23 Nm

2 - Bolt
- ❑ 9 Nm

3 - Coolant hose
- ❑ From lower right of radiator

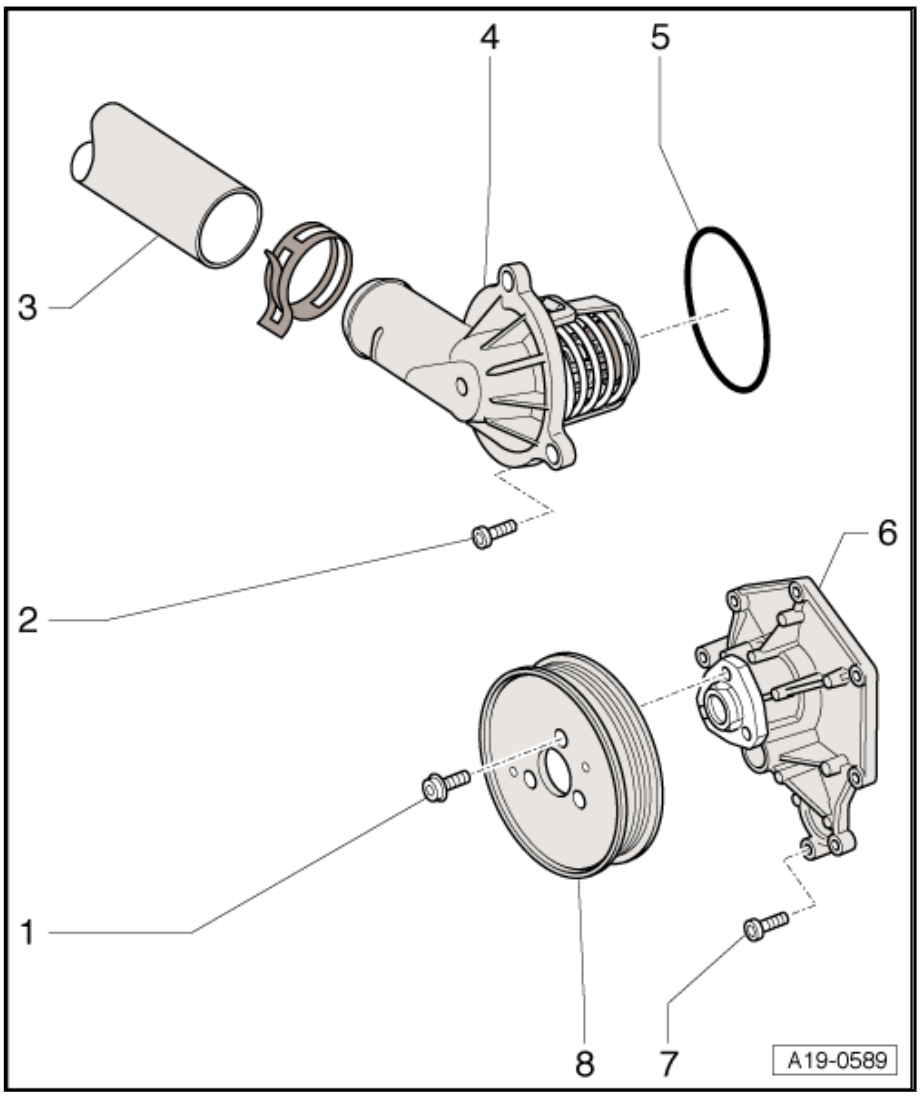
4 - Thermostat with union
- ❑ Removing and installing ⇒ page 206

5 - Seal
- ❑ Renew

6 - Coolant pump
- ❑ Removing and installing ⇒ page 204

7 - Bolt
- ❑ 9 Nm

8 - Poly V-belt pulley for coolant pump
- ❑ Installation position: marking “vorne” (front) faces in direction of travel.
- ❑ To remove and install, counterhold with 2-hole

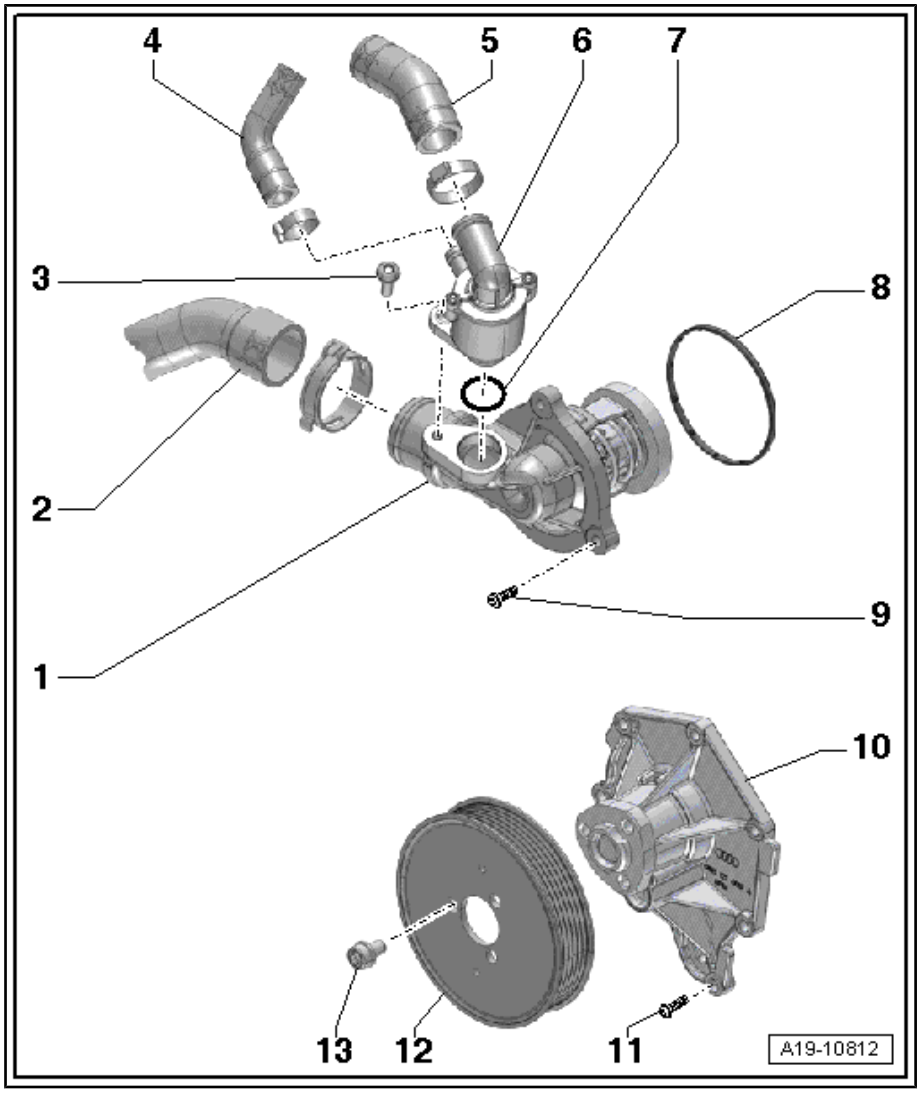


pin wrench - 3212- .

4.2 Assembly overview - coolant pump and thermostat (engine code CATA)

Note

Coolant hose schematic diagram ⇒ page 164



1 - Thermostat with union
- ❑ Removing and installing ⇒ page 206

2 - Coolant hose
- ❑ From lower right of radiator

3 - Bolt
- ❑ 9 Nm

4 - Coolant hose
- ❑ To upper left coolant pipe

5 - Coolant hose
- ❑ From pump for exhaust gas recirculation cooler - V400-

6 - Thermostat for exhaust gas recirculation with union
- ❑ Removing and installing ⇒ page 207

7 - O-ring
- ❑ Renew

8 - Seal
- ❑ Renew

9 - Bolt
- ❑ 9 Nm

10 - Coolant pump
- ❑ Removing and installing ⇒ page 204

11 - Bolt
- ❑ 9 Nm

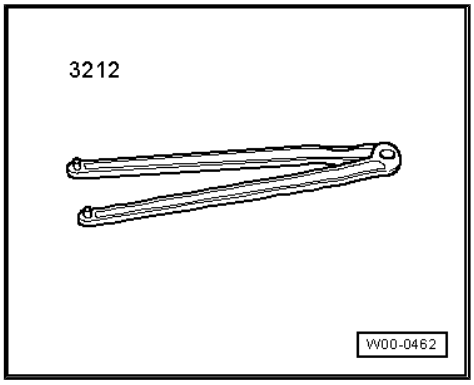
12 - Poly V-belt pulley for coolant pump
- ❑ Installation position: marking “vorne” (front) faces in direction of travel.
- ❑ To remove and install, counterhold with 2-hole pin wrench - 3212- .

13 - Bolt
- ❑ 23 Nm

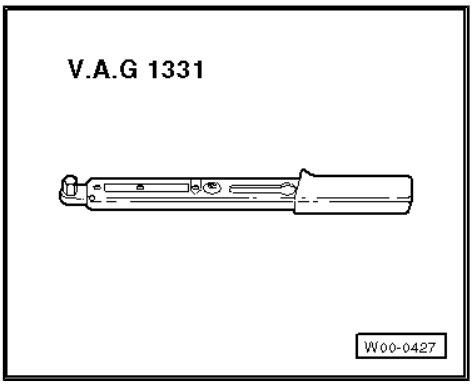
4.3 Removing and installing coolant pump

Special tools and workshop equipment required

♦ Pin wrench - 3212-

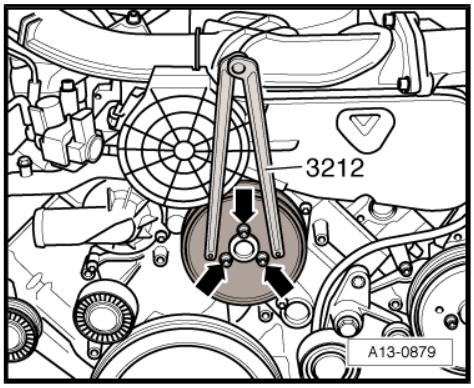


♦ Torque wrench (5 to 50 Nm) - V.A.G 1331-

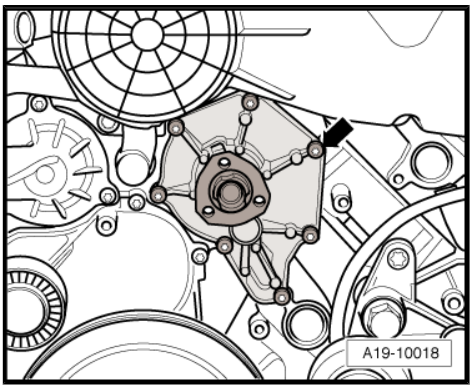


Removing

– Drain coolant ⇒ page 187 .
– Remove poly V-belt ⇒ page 40 .
– Remove belt pulley for coolant pump.
– Counterhold using pin wrench - 3212- when loosening bolts -arrows-.



– Unscrew bolts -arrow- and remove coolant pump.



Installing

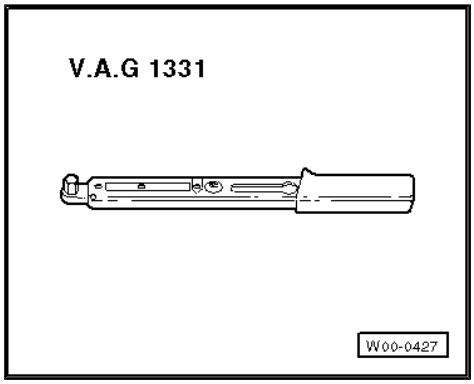
Installation is carried out in the reverse order. When installing, note the following:

– Clean sealing surface.
– Install coolant pump.
– Install belt pulley for coolant pump.
– Install poly V-belt ⇒ page 40 .
– Fill with coolant ⇒ page 189 .

4.4 Removing and installing thermostat with union (engine codes CASA and CASD)

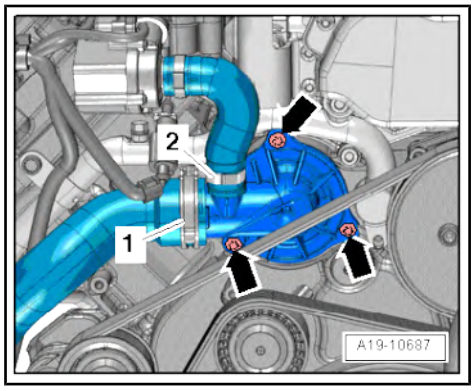
Special tools and workshop equipment required

- Torque wrench (5 to 50 Nm) - V.A.G 1331-



Removing

– Drain coolant ⇒ page 187 .
– Remove poly V-belt ⇒ page 40 .
– Remove coolant hoses -1- and -2-, loosening hose clips to do so.
– Unscrew bolts -arrows- and remove thermostat with union.



Installing

Installation is carried out in the reverse order. When installing, note the following:

Note

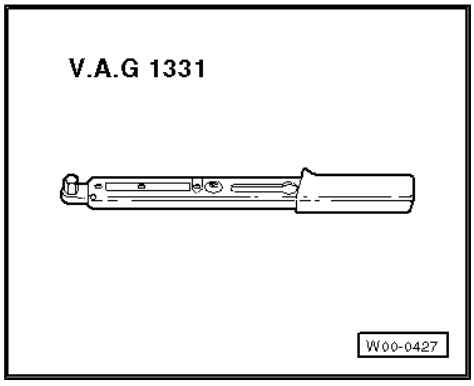
Renew O-ring.

– Clean sealing surface.
– Install thermostat with union, specified torque for bolts: 9 Nm.
– Install poly V-belt ⇒ page 40 .
– Fill with coolant ⇒ page 189 .

4.5 Removing and installing thermostat with union (engine code CATA)

Special tools and workshop equipment required

- Torque wrench (5 to 50 Nm) - V.A.G 1331-

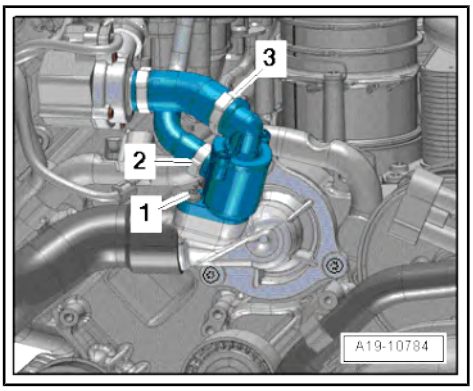


Removing

– Drain coolant ⇒ page 187 .

– Remove poly V-belt ⇒ page 40 .

– Remove bolt -1- and pull exhaust gas recirculation thermostat off union.

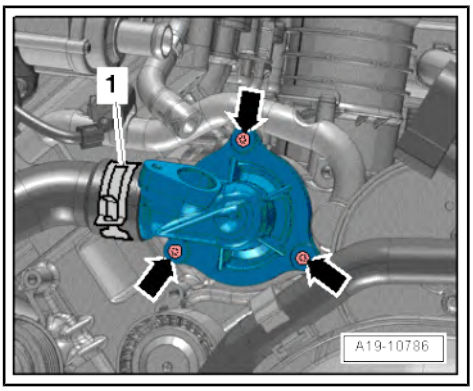


Note

-Items 2, 3- can be disregarded.

– Remove coolant hoses. To do this, loosen hose clips -1-.

– Unscrew bolts -arrows- and remove thermostat with union.



Installing

Installation is carried out in the reverse order. When installing, note the following:

Note

Renew O-ring.

– Clean sealing surface.

– Install thermostat with union, specified torque for bolts: 9 Nm.

– Install poly V-belt ⇒ page 40 .

– Fill with coolant ⇒ page 189 .

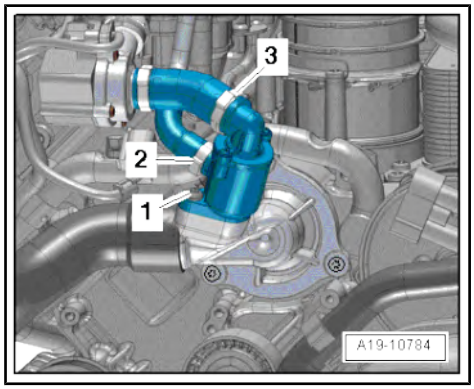
4.6 Removing and installing thermostat for exhaust gas recirculation with union (engine code CATA)

Removing

– Drain coolant ⇒ page 187 .

– Unscrew bolt -1-.

– Detach thermostat for exhaust gas recirculation with union from union and remove from coolant hoses, loosening hose clips -2- and -3- to do so.



Installing

Installation is carried out in the reverse order. When installing, note the following:

Note

Renew O-ring.

– Install thermostat for exhaust gas recirculation with union, specified torque for bolt: 9 Nm.

– Fill with coolant ⇒ page 189 .

21 – Turbocharging/supercharging

1 Exhaust turbocharger

⇒ “1.1 Rules for cleanliness”, page 209 .

⇒ “1.2 Assembly overview - turbocharger”, page 209 .

⇒ “1.3 Removing and installing turbocharger”, page 212 .

⇒ “1.4 Removing and installing turbocharger 1 control unit J724 ”, page 217 .

Note

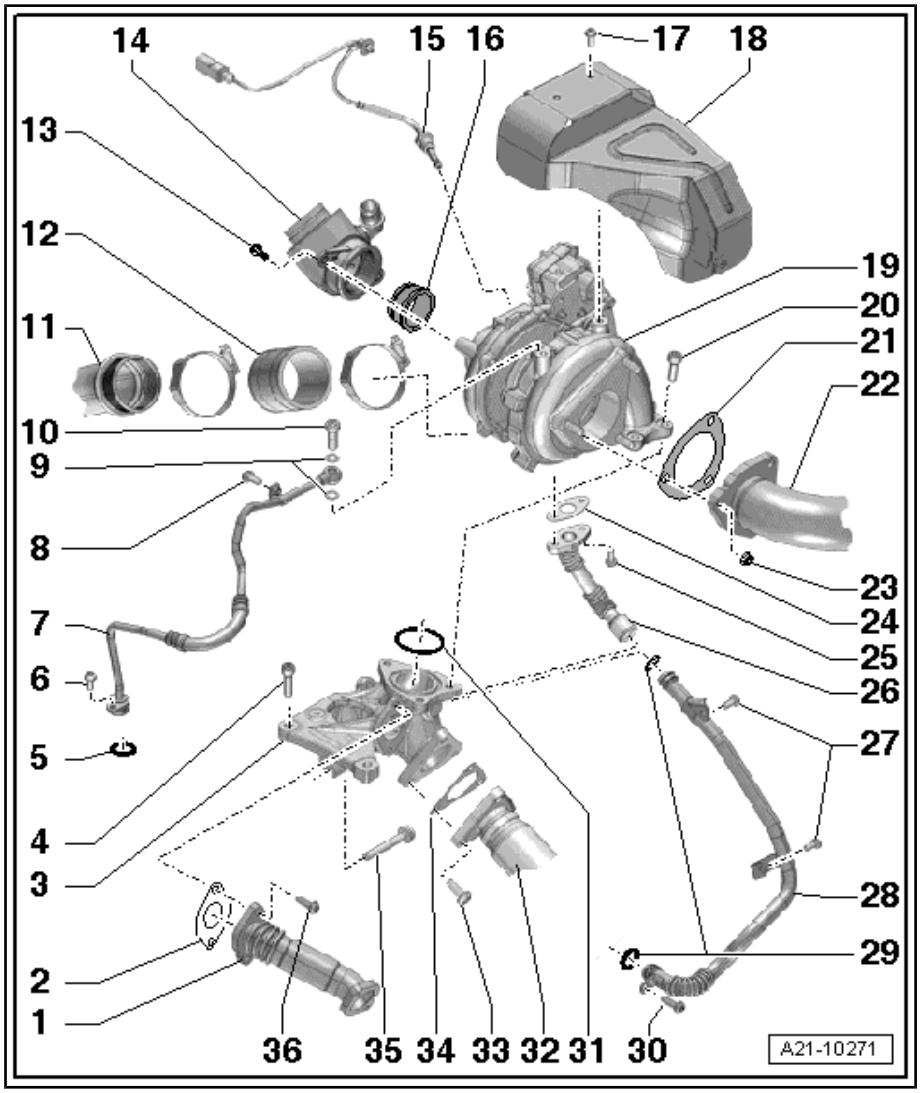
- *All hose connections are secured with hose clips or retaining clips.*
- *Charge air system must be free of leaks.*
- *Renew self-locking nuts.*
- *After installing turbocharger run engine for approx. 1 minute at idling speed, do not rev engine. This ensures that the turbocharger/compressor is adequately lubricated.*

1.1 Rules for cleanliness

When working on the turbocharger, pay careful attention to the following “5 rules” for cleanliness:

- Thoroughly clean all joints and surrounding areas before dismantling.
- Place removed parts on a clean surface and cover them over. Use lint-free cloths only.
- Carefully cover opened components or seal them if repairs cannot be carried out immediately.
- Install only clean parts; do not remove new parts from packaging until immediately before installing. Do not use parts that have been kept unpackaged (for example in toolboxes).
- If system is open: do not use compressed air if possible. Try not to move the vehicle.

1.2 Assembly overview - turbocharger



1 - Tube

- ❑ Engine codes CASA and CASD: to change-over flap for exhaust gas recirculation.
- ❑ Engine code CATA: to change-over flap for supplementary cooler for exhaust gas recirculation.
- ❑ With catalytic converter.

2 - Seal

- ❑ Renew

3 - Intermediate flange

4 - Bolt

- ❑ 25 Nm

5 - O-ring

- ❑ Renew

6 - Bolt

- ❑ 9 Nm

7 - Oil supply line

- ❑ From cylinder block.

8 - Bolt

- ❑ 9 Nm

9 - Oil seals

- ❑ Renew

10 - Banjo bolt

- ❑ 15 Nm

11 - Air pipe (right side)

12 - Air intake hose

- ❑ From turbocharger to right air pipe.

13 - Bolt

- ❑ 9 Nm

14 - Connecting piece for air intake hose

- ❑ From air mass meter - G70- to turbocharger.
- ❑ Must be free of oil and grease before installing.

15 - Exhaust gas temperature sender 1 - G235-

- ❑ 45 Nm
- ❑ Coat with high-temperature paste, for high-temperature paste refer to ⇒ Parts catalogue .
- ❑ Removing and installing, engine codes CASA and CASD ⇒ page 297 .
- ❑ Removing and installing, engine code CATA ⇒ page 304 .

16 - Seal

- ❑ Renew if damaged

17 - Bolt

- ❑ 9 Nm

18 - Heat shield for turbocharger

19 - Exhaust turbocharger

- ❑ Removing and installing ⇒ page 212

- ❑ With turbocharger 1 control unit - J724- .

20 - Bolt

- ❑ Renew
- ❑ 30 Nm + 90° (1/4 turn further)
- ❑ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .

21 - Seal

- ❑ Renew

22 - Starter catalytic converter

23 - Nut

- ❑ Renew
- ❑ 23 Nm
- ❑ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .

24 - Seal

- ❑ Renew

25 - Bolt

- ❑ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .
- ❑ Initially tighten to 7 Nm.
- ❑ 9 Nm

26 - Upper part of oil return line

- ❑ From turbocharger

27 - Bolts

- ❑ 9 Nm

28 - Lower part of oil return line

- ❑ To cylinder block.

29 - O-ring

- ❑ Renew

30 - Bolt

- ❑ 9 Nm

31 - Seal

- ❑ Renew

32 - Intermediate pipe

- ❑ Removing and installing: left side ⇒ page 335 , right side ⇒ page 337 .

33 - Bolt

- ❑ Renew
- ❑ 30 Nm + 90° (1/4 turn further)
- ❑ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .

34 - Seal

- ❑ Renew

35 - Bolt

- ❑ 25 Nm

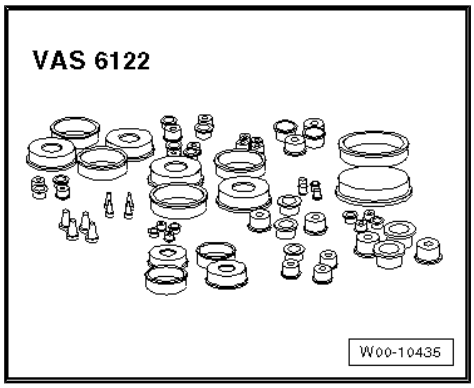
36 - Bolt

- ❑ 5 Nm + turn 90° further
- ❑ Renew

1.3 Removing and installing turbocharger

Special tools and workshop equipment required

- Engine plug set - VAS 6122-

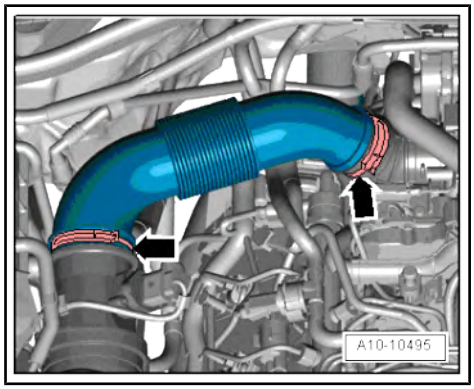


Removing

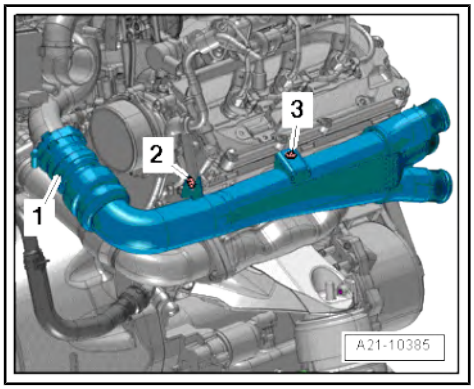
> **Caution**
>
> *If a mechanical fault is discovered on the turbocharger (e.g. a destroyed compressor impeller), it is not sufficient to just renew the turbocharger. To avoid any subsequent damage, the following work must be carried out:*
>
> - *Check air filter housing, air filter element and air inlet hoses for contamination.*
> - *Check the whole charge air path and charge air cooler for foreign objects.*
> - *If foreign objects are discovered in the charge air system, clean the charge air path and, if necessary, renew the charge air cooler.*

– Remove engine cover panel ⇒ page 3 .

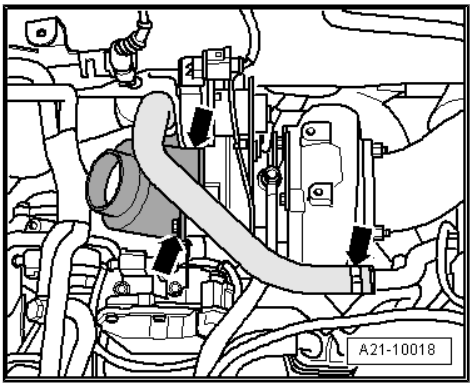
– Remove air intake hose. To do this, loosen spring-type clip -arrows-.



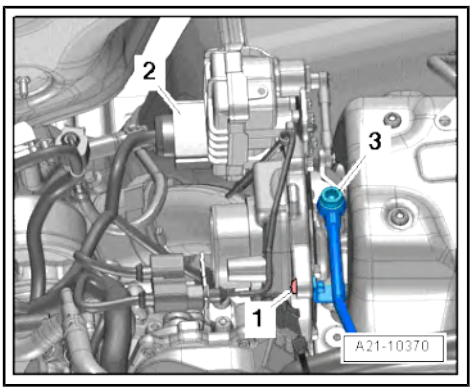
– Unscrew bolts -2- and -3-.
– Loosen hose clip -1- and pull air intake pipe forwards off air intake hose.



– Remove bolts -left arrows- and place air intake connection along with connected hoses -right arrow- aside.

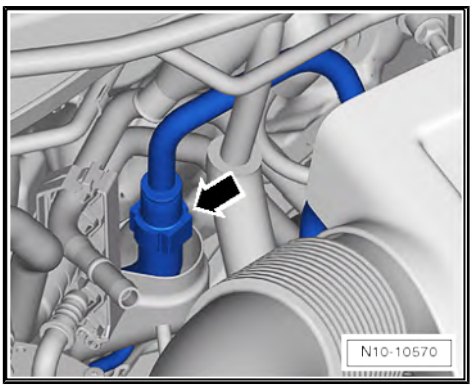


– Disconnect electrical connector -2- at turbocharger 1 control motor - V280- .
– Remove bolt -1- and banjo bolt -3- for oil supply line on turbocharger.



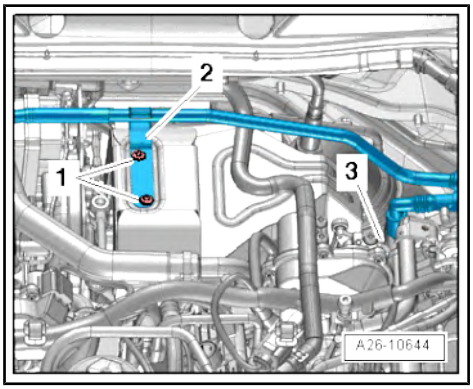
Vehicles with engine code CASA or CASD

– Separate vacuum line at connection -arrow-.



Continuation for all engine codes

– Unscrew bolts -1-, but only loosen bolt -3-.

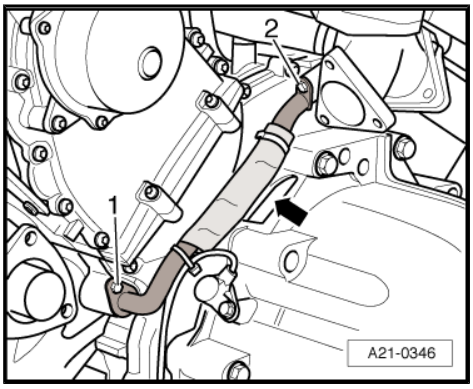


Note

Vacuum line with bracket -2- is only installed on vehicles with engine codes CASA or CASD.

– Lay vacuum hose with bracket -2- aside and remove heat shield for turbocharger.

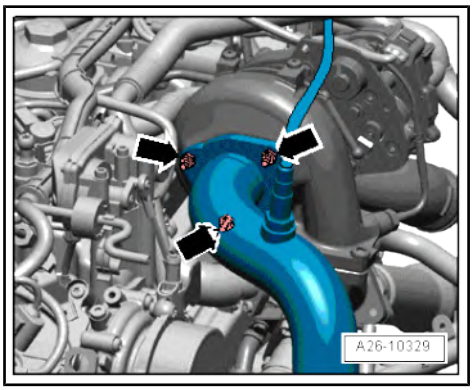
– Cover opening -arrow- in gearbox to prevent small parts from dropping in.



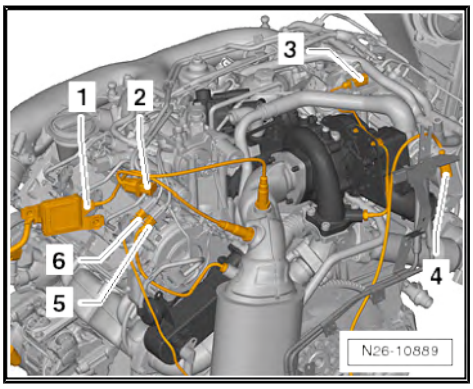
Note

- *For greater clarity, shown with intermediate pipe removed.*
- *Ignore items -1- and -2-.*

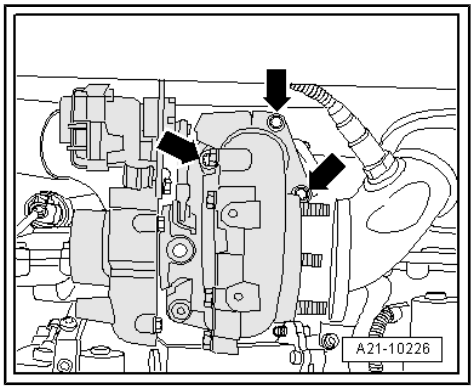
– Remove nuts -arrows- and pull starter catalytic converter off turbocharger.



– Separate connector -3- (black) for exhaust gas temperature sender 1 - G235- .



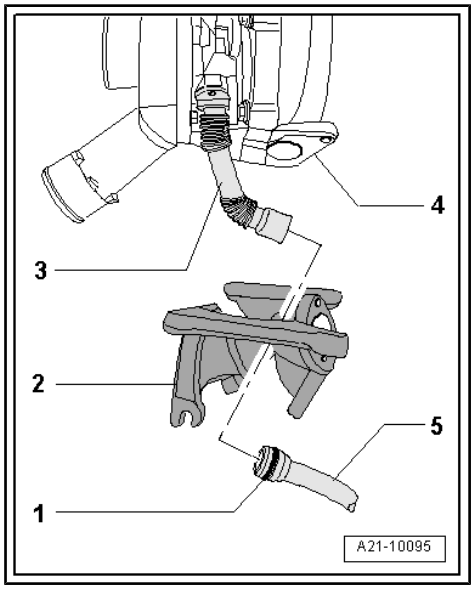
– Remove bolts -arrows- for turbocharger.



Caution

Danger of damaging both pipes for oil return line.

- *The upper part of oil return line -3- secured to the turbocharger must be carefully pulled off the lower part of oil return line -5-.*
- *To avoid bending the two pipes of the oil return line, move the turbocharger -4- slightly backwards and forwards while pulling it off upwards and towards one side.*



1 - O-ring

2 - Intermediate flange

– Remove turbocharger.

– Seal open lines and unions with clean plugs from engine sealing plug set - VAS 6122- .

Note

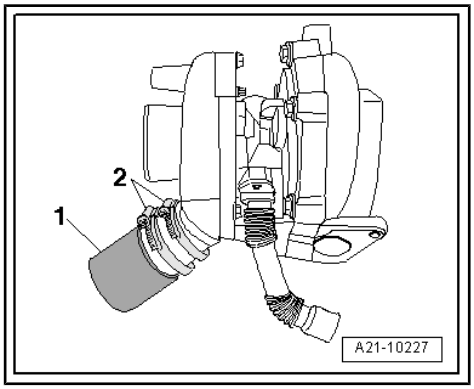
To prevent damage, do not place removed turbocharger on upper part of oil return line.

Installing

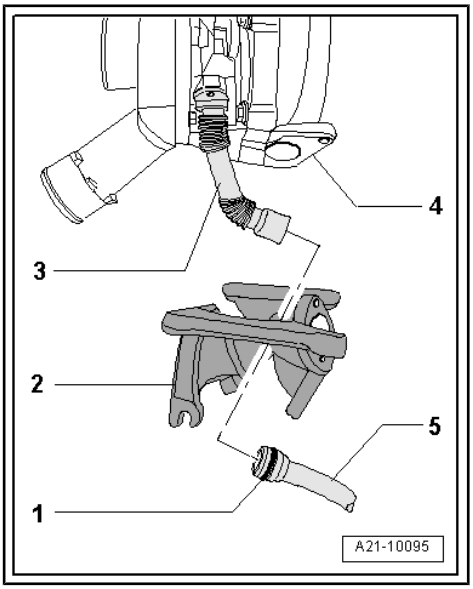
Note

- *Renew gaskets, seals and O-rings.*
- *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- *Secure all hose connections with hose clips (same as original equipment) ⇒ Parts catalogue .*
- *In order to be in a position to securely attach the charge air hoses on their connections, the worm screws of the used hose clips have to the sprayed with penetrating spray before installing.*
- *Fit all heat insulation sleeves in the original position when installing.*
- *Fill turbocharger with engine oil at oil supply line connection.*
- *After installing turbocharger, run engine for about 1 minute at idling speed and do not rev up immediately. This ensures that the turbocharger is fully primed with oil.*

– Prepare turbocharger for installation. To do this, push on connecting hose -1- and both hose clips -2- onto turbocharger flange.



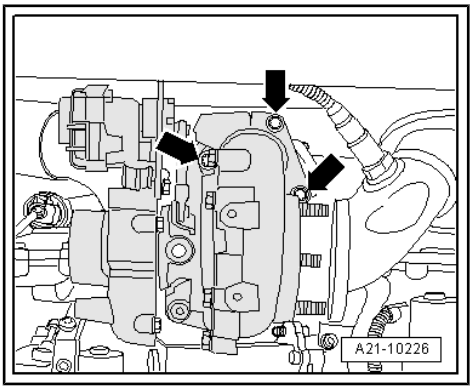
– Fit the new O-ring -1- on lower part -5- of oil return line.
– Lightly lubricate O-ring and inner sealing surface on upper part -3- of oil return line.
– When fitting turbocharger in place -4-, guide upper part -3- of oil return line through intermediate flange -2- to lower part -5- of oil return line.
– Place upper part of oil return line carefully on lower part of oil return line.



Caution

The O-ring must not be damaged.

– Tighten turbocharger bolts -arrows-.



Now continue installing in reverse order of removal, observing the following:

– Install starter catalytic converter.

Specified torques

Component		Nm
Turbocharger to intermediate flange		30 + 90° 1)2)
Oil supply line to turbocharger		15
Starter catalytic converter to turbocharger		23 1)
Hose clip	9 mm wide	3
	13 mm wide	5.5

- 1) Renew nuts/bolts.
- 2) Coat with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .

1.4 Removing and installing turbocharger 1 control unit - J724-

Special tools and workshop equipment required

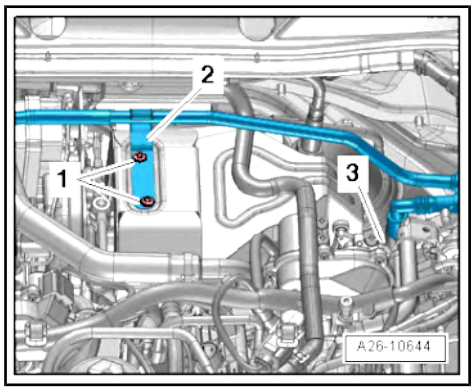
- E-box - VAS 6395/1-
- Connector cable - VAS 6395/4-2-

♦ 10 mm open-end spanner, 90 mm long - VAS 6395/4-3-

Removing

– Remove engine cover panel ⇒ page 3 .

– Unscrew bolts -1-, but only loosen bolt -3-.



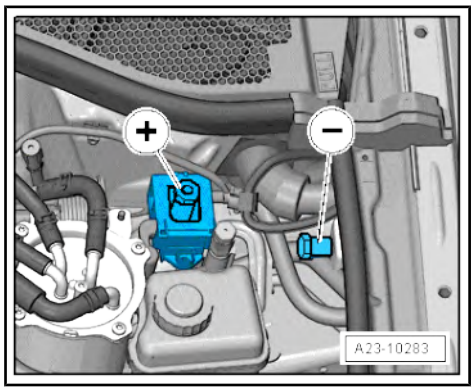
Note

Vacuum line with bracket -2- is only installed on vehicles with engine codes CASA or CASD.

– Lay vacuum hose with bracket -2- aside and remove heat shield for turbocharger.

– Open cover over positive terminal connector.

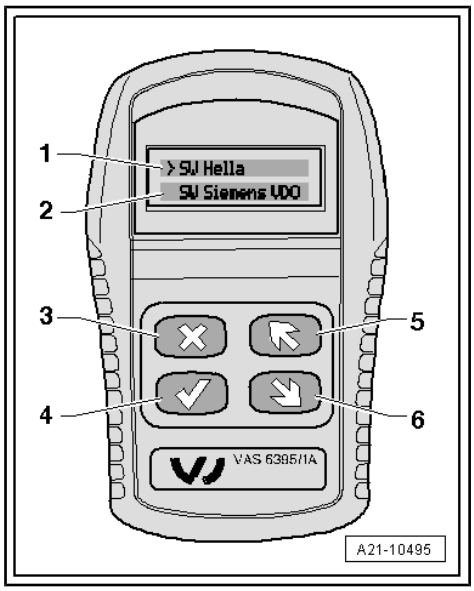
– Connect electronics box - VAS 6395/1- with connector cable - VAS 6395/4-2- to positive terminal connector “+” and to earth terminal connector “–”.



Procedure for electronics box - VAS 6395 /1A- :

– Use buttons [↑] -item 5- and [↓] -item 6- to select software version.

– Confirm software version with button [V] -item 4-.



Note

The Hella software version -item 1- is selected in this example.

Procedure for electronics box - VAS 6395 /1- :

Checking software version of electronics box - VAS 6395 /1- :

Caution

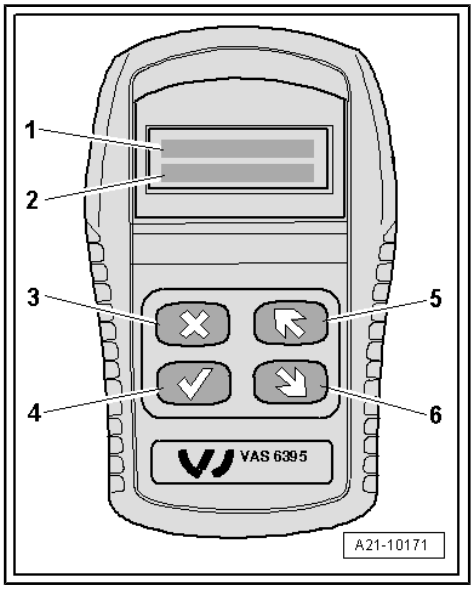
The turbocharger 1 control unit - J724- could be damaged.

- ***Before continuing with the procedure, first check that the correct software has been installed in the electronics box - VAS 6395 /1- as follows:***

Indicated on display of -VAS 6395 /1- (2 seconds after connecting voltage supply) with correct software download:

1 - > 1. START

2 - 2. NEXT [>]



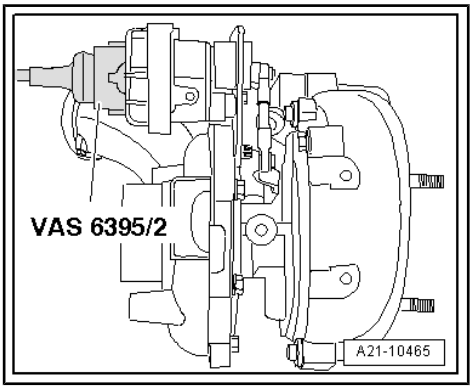
Note

- *The following appears on display with incorrect software download:*
- *1. >TEST*
- *2. LEARN*
- *In this case the correct software must be downloaded via "Audi ServiceNet" from the "Workshop Equipment" area.*

Continuation for both electronics boxes:

– Separate electrical connector for turbocharger 1 control unit - J724- .

– Connect connector cable - VAS 6395/2- to turbocharger 1 control unit - J724- and to electronics box - VAS 6395 /1A- .



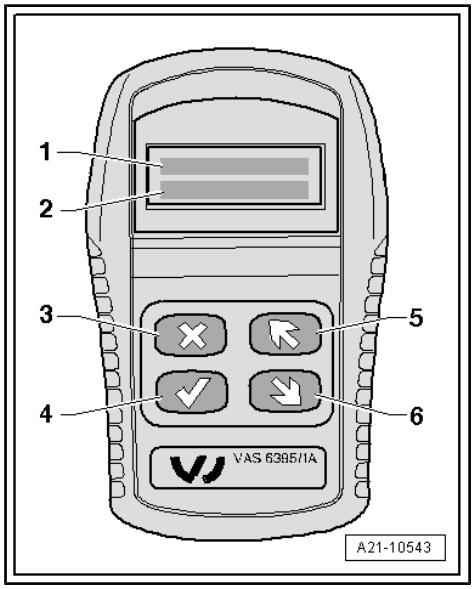
Indicated on display of -VAS 6395 /1A- :

1 - > 1. START

2 - 2. NEXT [>]

– To continue, press V button -item 4-.

• Electronics box - VAS 6395 /1A- runs through adjustment range of turbocharger 1 control unit - J724- in stages, and checks whether end points are reached. “CHECK” is shown in display.



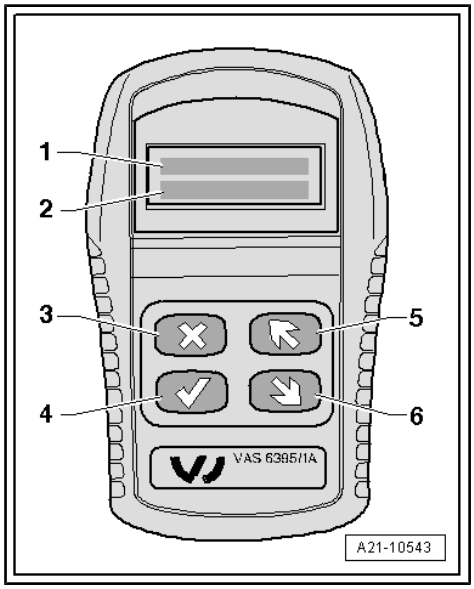
Indicated on display of -VAS 6395 /1A- :

1 -

2 - [OK]

Note

- *When “[OK]” is shown on display, adjustment range of turbocharger 1 control unit - J724- is OK.*
- *When “FAULT [OK]” is shown on display, tap several times on housing of turbocharger 1 control unit - J724- using handle of a screwdriver and repeat test by pressing V button -item 4-.*

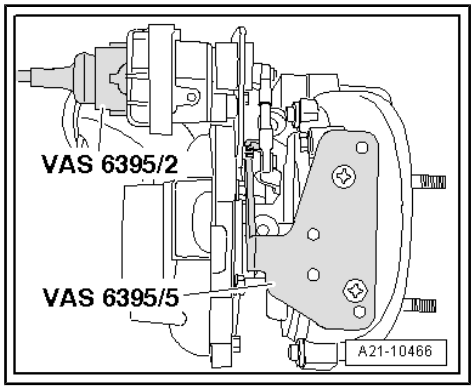


– Tighten bracket - VAS 6395/5- with enclosed countersunk head bolts screwed into bracket to 8 Nm.

Caution

Measurement error due to improperly secured bracket - VAS 6395/5- .

- ***Bracket may only be tightened with enclosed countersunk head bolts.***
- ***Bracket must no longer be released until work sequence is completed.***

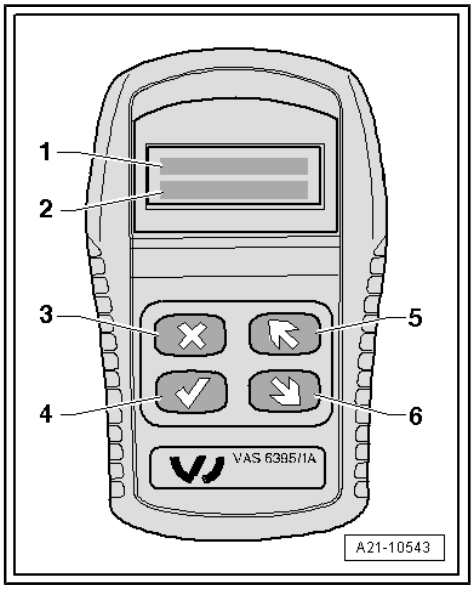


– To continue, press [V] button -item 4-.

• To determine voltage value, turbocharger 1 control unit - J724- moves back and forth between stops several times.

• Turbocharger 1 control unit - J724- then moves to installation position.

– Whilst determining voltage value, constantly tap on housing of turbocharger 1 control unit - J724- with handle of screwdriver until following is shown on display:



Indicated on display of -VAS 6395 /1A- :

1 - X.XXX V

2 - [↑][↓][OK]

– Note voltage value.

• Specification: 3.3 … 3.7 V.

Note

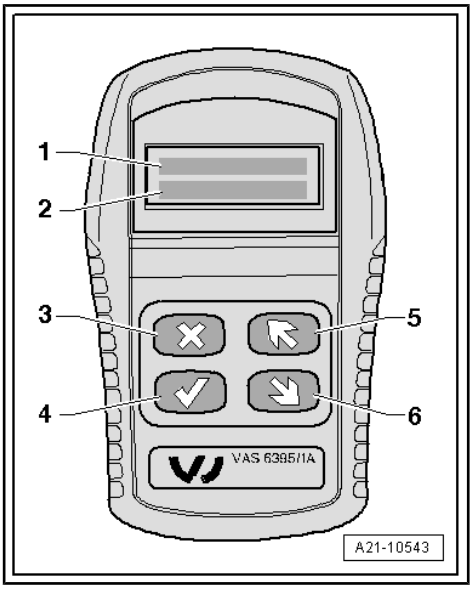
When "FAULT [OK]" or a voltage value of less than 3.3 V or greater than 3.7 V is shown on display, disconnect electronics box - VAS 6395 /1A- and repeat entire work sequence *⇒ page 219* *.*

Indicated on display of -VAS 6395 /1A- :

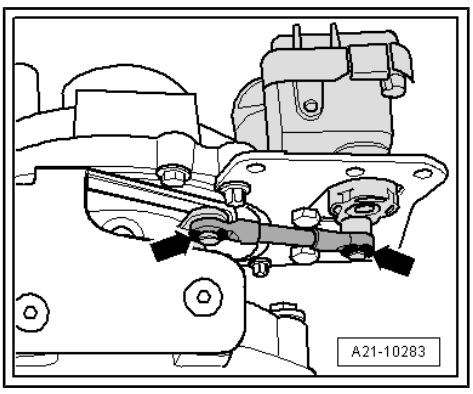
1 - X.XXX V

2 - [↑][↓][OK]

– Using buttons [↑] -item 5- and [↓] -item 6-, adjust turbocharger 1 control unit - J724- so that the coupling rod is accessible for removing.



– Unclip and dispose of retaining rings -arrows-, remove coupling rod.

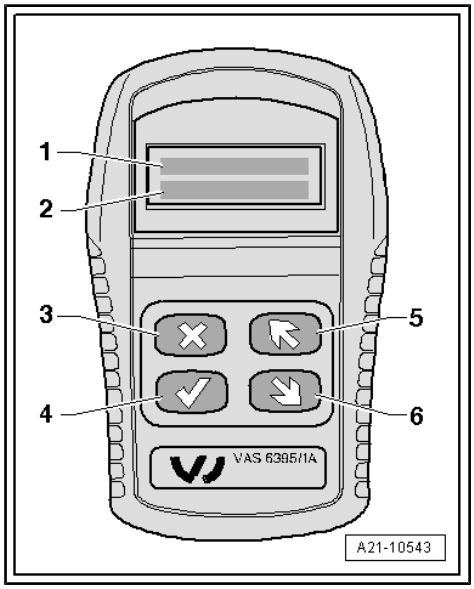


Indicated on display of -VAS 6395 /1A- :

1 - X.XXX V

2 - [↑][↓][OK]

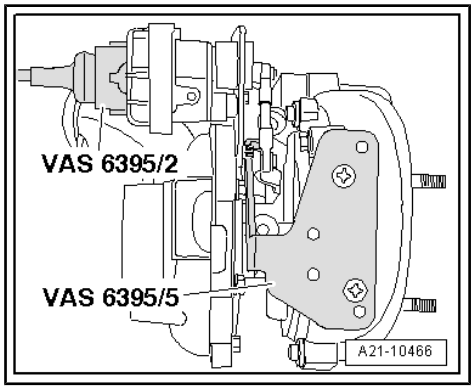
– Using buttons [↑] -item 5- and [↓] -item 6-, adjust turbocharger 1 control unit - J724- so that bolts for -J724- are easily accessible.



– Separate connector cable - VAS 6395/2- from turbocharger 1 control unit - J724- .

Caution

The voltage supply for electronics box - VAS 6395 /1A- must remain connected.

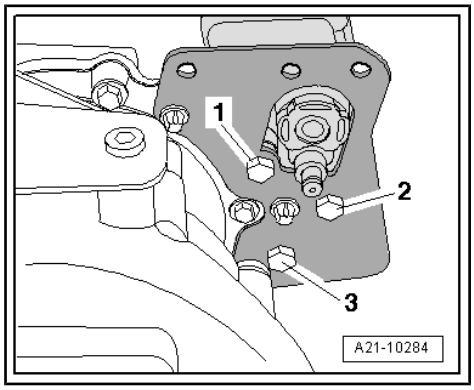


– Unscrew and dispose of bolts -1, 2, 3-.

– Remove old turbocharger 1 control unit - J724- and dispose of.

Caution

Check whether the 3 insulating washers are fitted between turbocharger 1 control unit - J724- and bracket.



– Install new turbocharger 1 control unit - J724- in reverse order.

– Screw in new bolts as follows:

1 - M6 x 15 with tapered shaft

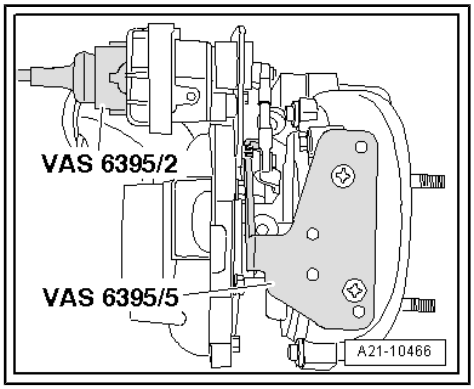
2 - M6 x 15 with tapered shaft

3 - M6 x 15

– Tighten bolts by hand only.

• The turbocharger 1 control unit - J724- must contact the retaining plate without play, but should even be moved by hand.

– Connect connector cable - VAS 6395/2- to new turbocharger 1 control unit - J724- .



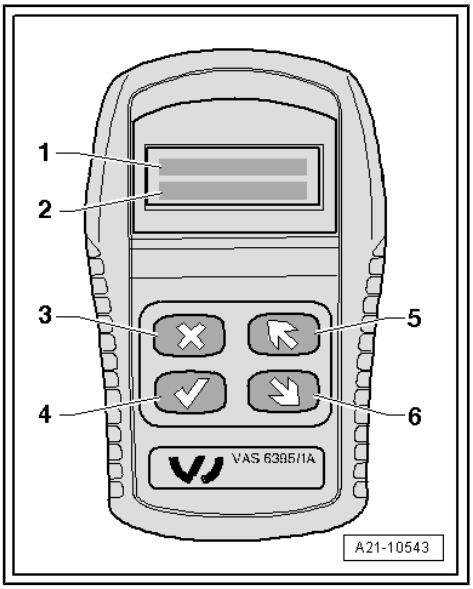
– To continue, press V button -item 4-.

Indicated on display of -VAS 6395 /1A- :

1 - > 1. START

2 - 2. NEXT [>]

– Use button ↓ -item 6- to select menu item “NEXT”.



– To continue, press V button -item 4-.

• Electronics box - VAS 6395 /1A- runs through adjustment range of turbocharger 1 control unit - J724- in stages, and checks whether end points are reached. “CHECK” is shown in display.

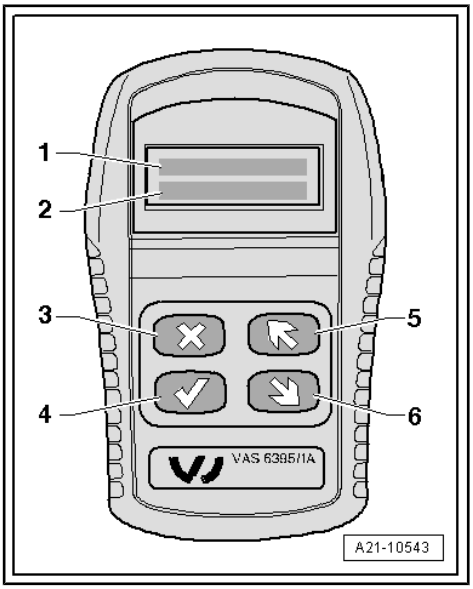
Indicated on display of -VAS 6395 /1A- :

1 - X.XXX V

2 - [OK]

Note

When “FAULT” is shown on display, new turbocharger 1 control unit - J724- must be renewed again.

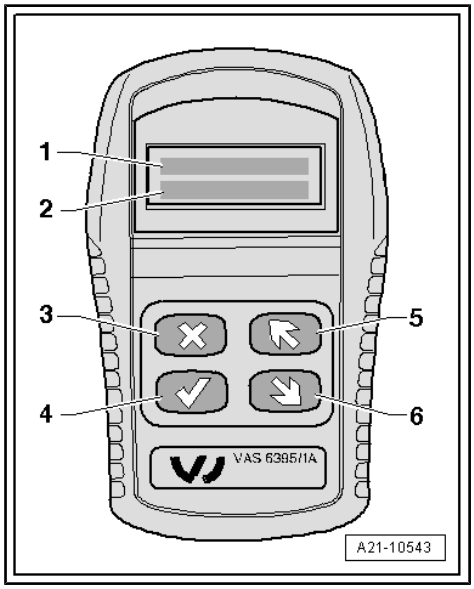


– To continue, press V button -item 4-.

Indicated on display of -VAS 6395 /1A- :

1 -

2 - [OK]



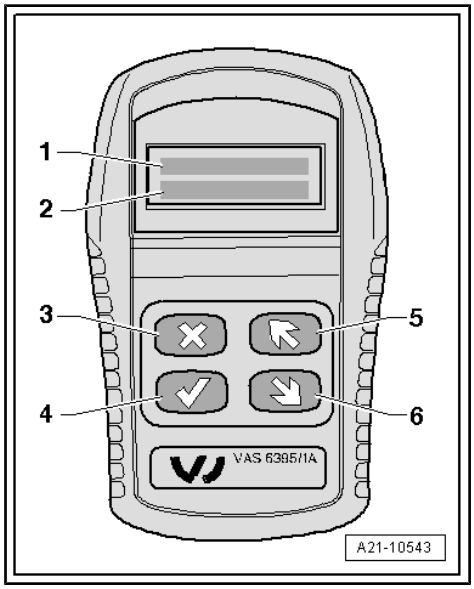
– To continue, press V button -item 4-.

Indicated on display of -VAS 6395 /1A- :

1 - X.XXX V (initially determined voltage value)

2 - [OK]

• Turbocharger 1 control unit - J724- then moves to installation position.

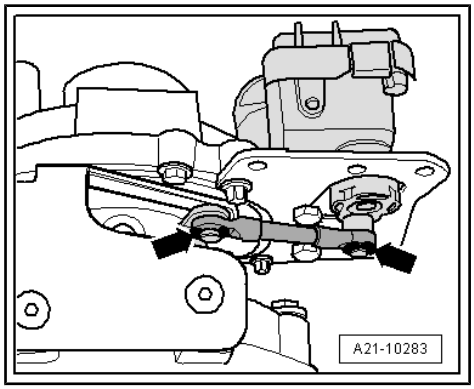


– Insert coupling rod.

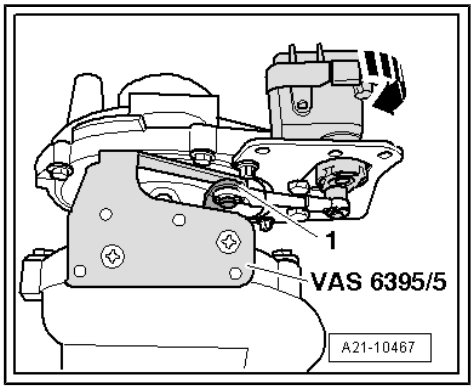
• Installation position: Eye with greater wall thickness is positioned on shaft of turbocharger 1 control unit - J724- .

– Position retaining rings -arrows-.

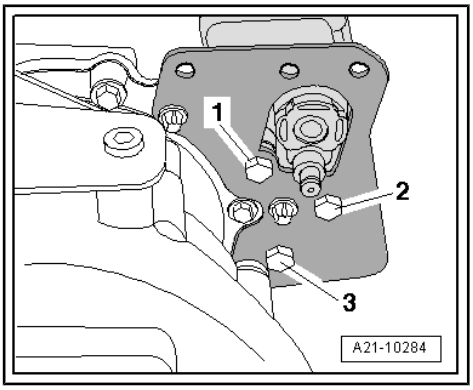
• Circlips must audibly engage.



– Press turbocharger 1 control unit - J724- backwards without force -arrow- until lever -1- lightly contacts bracket - VAS 6395/5- .
– Hold -J724- in this position.



– Tighten bolts -1, 2, 3- to 5 Nm.

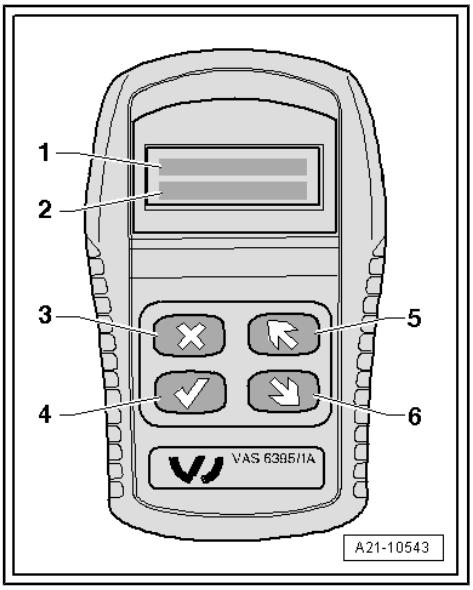


– To continue, press V button -item 4-.
• Turbocharger 1 control unit - J724- moves back and forth between stops several times and is set to initially determined voltage value.

Indicated on display of -VAS 6395 /1A- :

1 - X.XXX V (initially determined voltage value)

2 - [OK]



Note

♦ *If [OK] was shown on display, end adjustment ⇒ page 227 .*
♦ *If "CHECK" was shown on display, proceed as described in the following.*

Procedure if “CHECK” is shown on display:

Indicated on display of -VAS 6395 /1A- :

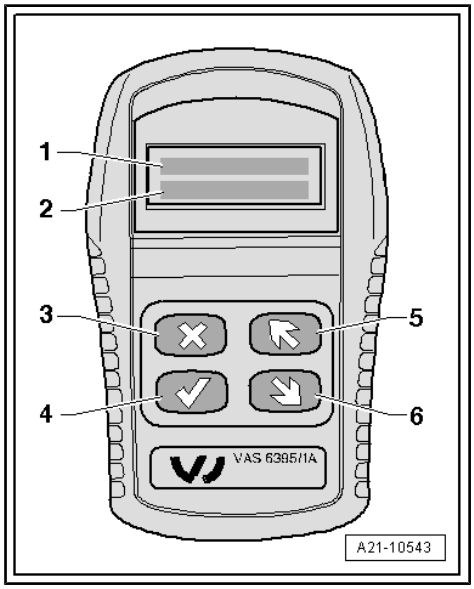
1 - [<<<]

2 - CHECK

Or

1 - [>>>]

2 - CHECK

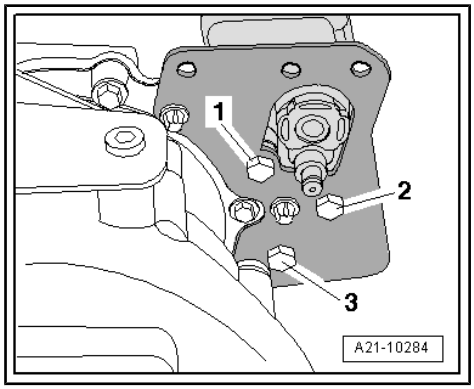


– Loosen bolts -1, 2, 3- just enough so that turbocharger 1 control unit - J724- can be moved with slight resistance in specified direction:

• If [<<<] is displayed, shift -J724- slightly in direction of travel.

• If [>>> is displayed, shift -J724- slightly counter to direction of travel.

– Tighten bolts -1, 2, 3- to 5 Nm.



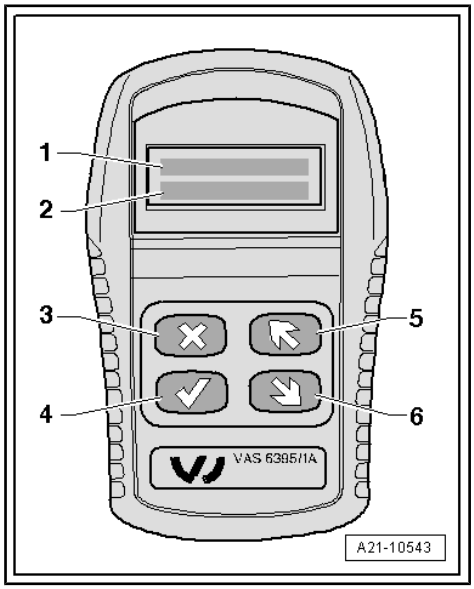
– To continue, press V button -item 4-.

• Turbocharger 1 control unit - J724- again moves back and forth between stops several times and is set to initially determined voltage value.

Indicated on display of -VAS 6395 /1A- :

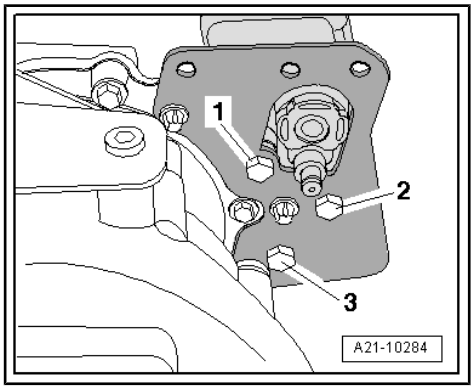
1 - X.XXX V

2 - [OK]



End adjustment:

– Tighten bolts -1, 2, 3- to 10 Nm.

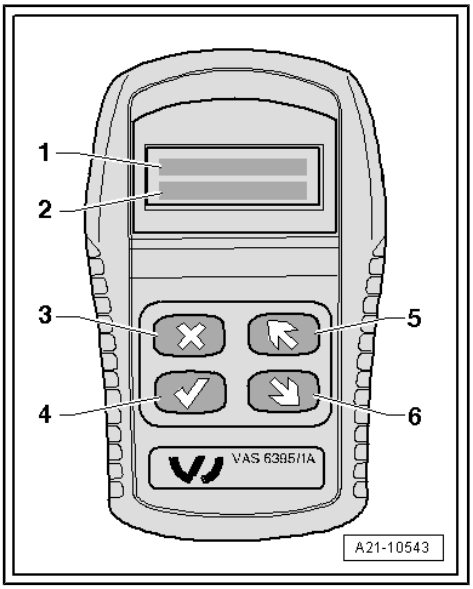


– To continue, press V button -item 4-.

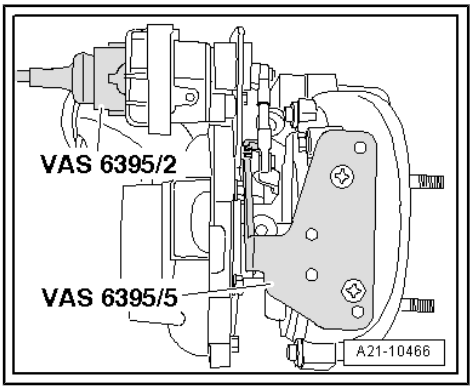
Indicated on display of -VAS 6395 /1A- :

1 - X.XXX V

2 - [OK]



– Unbolt bracket - VAS 6395/5- .



– To continue, press [V] button -item 4-.

• Turbocharger 1 control unit - J724- moves to end points.

Note

When "FAULT" is shown on display, new turbocharger 1 control unit - J724- must be renewed ⇒ page 222 .

Indicated on display of -VAS 6395 /1A- :

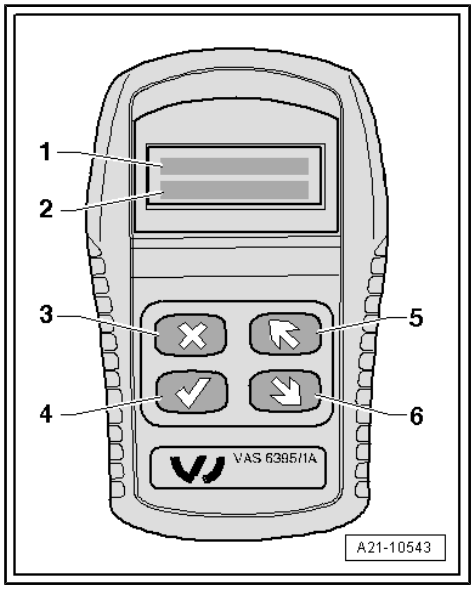
1 -

2 - [OK]

• The setting is complete.

– Separate electrical connectors for electronics box - VAS 6395 / 1A- .

Assemble in reverse order of dismantling.



2 Charge air cooler

⇒ “2.1 Removing and installing parts of charge air cooling”, page 229 .

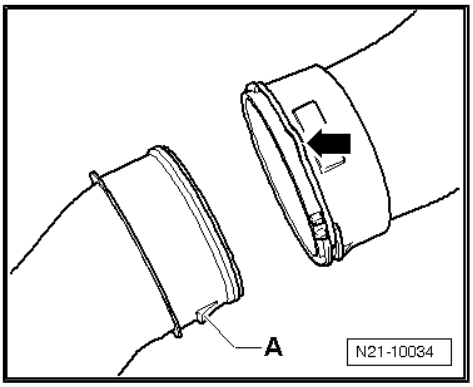
⇒ “2.2 Charge air cooler parts”, page 229 .

⇒ “2.3 Checking charge air system for leaks”, page 230

2.1 Removing and installing parts of charge air cooling

Note

- *All charge air system hose connections are secured by spring-type clips or by plug-in connectors. The following points must be observed for plug-in connectors:*
- *Release connection by pulling the locking clip -arrow-.*
- *Pull off hose or pipe without the use of tools.*
- *When installing, ensure the locking lugs -A- engage correctly.*



Parts of charge air cooler ⇒ page 229 .

2.2 Charge air cooler parts

1 - Bolt
- ❑ 9 Nm

2 - Charge air cooler (right)

3 - O-ring
- ❑ Renew

4 - Air pipe (right side)

5 - Bolt
- ❑ 9 Nm

6 - From turbocharger

7 - Throttle valve module - J338-

8 - Bolt
- ❑ 9 Nm

9 - Intake air temperature sender - G42-
- ❑ With charge pressure sender - G31- .

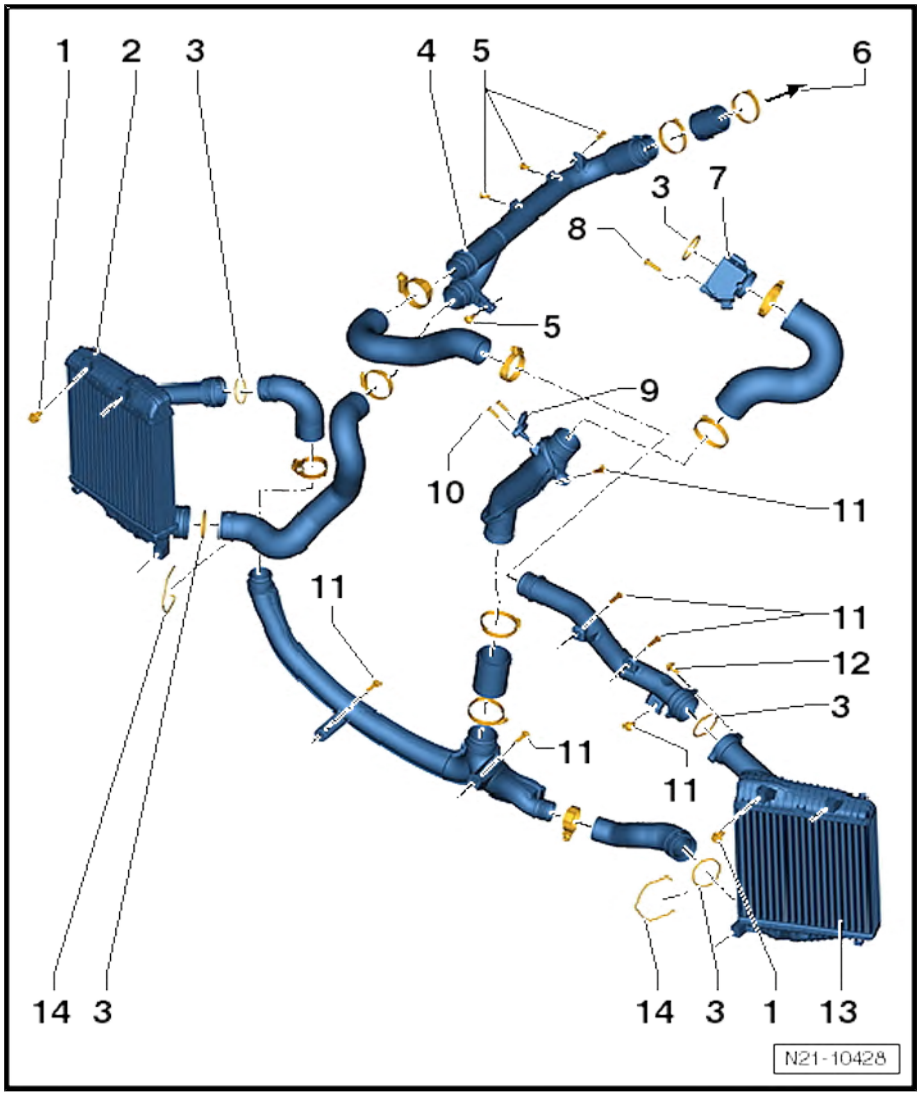
10 - Bolt
- ❑ 5 Nm

11 - Bolt
- ❑ 9 Nm

12 - Bolt
- ❑ 9 Nm

13 - Charge air cooler (left)

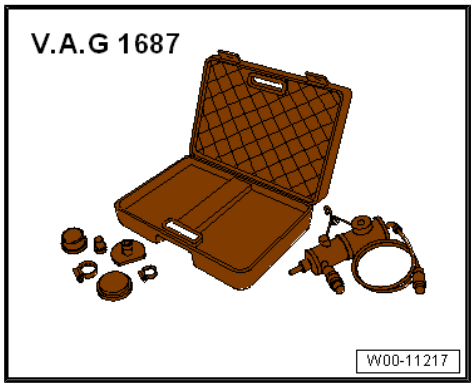
14 - Retaining clip



2.3 Checking charge air system for leaks

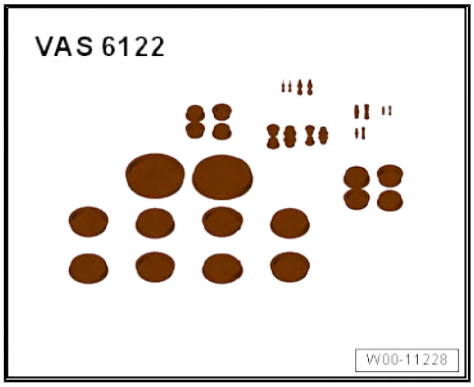
Special tools and workshop equipment required

- Charge air system tester - V.A.G 1687-

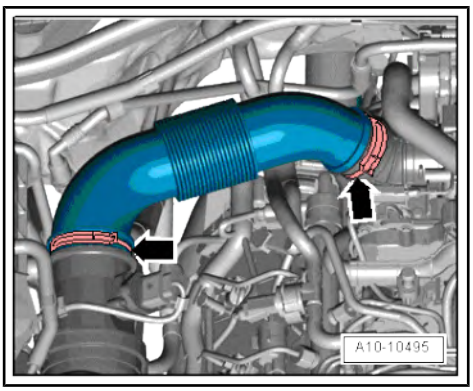


- Plug - V.A.G 1687/3-
- Adapter - 1687/11-
- Adapter - V.A.G 1687/16-
- Plug - V.A.G 1687/17-

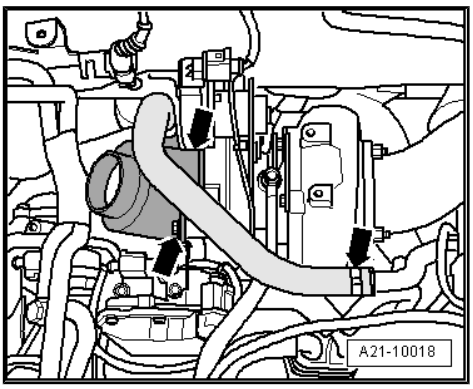
♦ Engine bung set - VAS 6122-



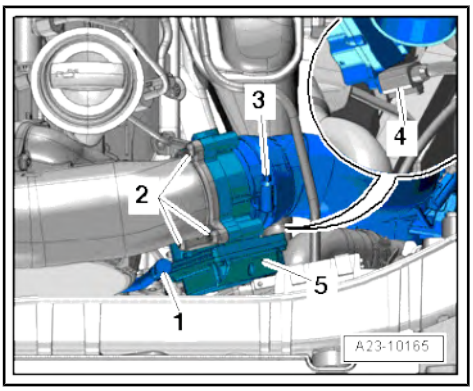
– Remove air intake hose. To do this, loosen spring-type clip -arrows-.
– Seal open connection on turbocharger using suitable means from charge air system tester - V.A.G 1687- or engine bung set - VAS 6122- .



– Open clamp and remove breather hose.
– Seal open connection using suitable means from charge air system tester - V.A.G 1687- or engine bung set - VAS 6122- .



– Remove air intake hose. To do this, loosen hose clip -3-.
– Connect a suitable adapter from charge air system tester - V.A.G 1687- to air intake hose for throttle valve module - J338- .
– Connect charge air system tester - V.A.G 1687- to adapter.

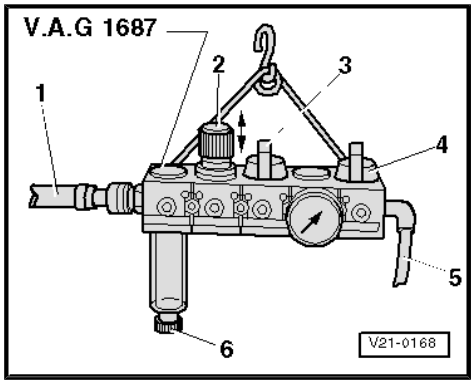


Prepare charge air system tester - V.A.G 1687- as follows:

– Completely unscrew pressure regulating valve -2-, close valves -3- and -4-.

• To turn pressure regulating valve -2-, rotary knob must be pulled upwards.

– Connect charge air system tester - V.A.G 1687- to compressed air -1- via commercial adapter.



Note

If there is water in the sight glass, drain at water drain screw -6-.

– Open valve -3-.

Caution

Risk of damage because pressure is set too high.

- ***The pressure must not exceed 0.5 bar.***

– Adjust pressure to 0.5 bar with pressure control valve -2-.

– Open valve -4- and wait until test circuit is full. If necessary, adjust pressure to 0.5 bar.

– Check charge air system for leaks by hearing, touching, with commercially available leak detector spray or using ultrasonic tester - V.A.G 1842- .

Note

- *How to use the ultrasonic tester -V.A.G 1842- ⇒ operating instructions*
- *Before removing the adapter, release pressure in the test circuit by pulling off hose coupling.*

Installing

Assembly is carried out in reverse sequence; note the following:

– Check O-rings for damage and renew if necessary.

23 – Mixture preparation - injection

1 Safety precautions and rules for cleanliness

⇒ “1.1 Safety precautions”, page 233 .

⇒ “1.2 Rules for cleanliness and instructions for working on fuel system”, page 234 .

1.1 Safety precautions

WARNING

Danger of scalding from very hot fuel.

- *In extreme cases the fuel lines and fuel can reach a temperature of 100°C in vehicles with a common rail engine after the engine has been switched off. Allow the fuel to cool down before disconnecting the lines - risk of scalding.*
- *Wear protective gloves.*
- *Wear protective goggles.*

Risk of injury due to highly-pressurised fuel.

- *For safety reasons, the fuse must be removed from the fuel pump control unit - J538- before the fuel system is opened if the battery has not been disconnected. Otherwise the fuel pump will be activated by the driver door contact switch.*
- *Wrap a clean cloth around the connection before opening the fuel system. Then release pressure by carefully loosening the connection.*
- *Wear protective gloves.*
- *Wear protective goggles.*

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

- Test and measuring instruments must always be secured to rear seat and operated by a second person from this location.

If test and measuring instruments are operated from front passenger seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.

WARNING

Secure fault reader to rear seat and operate from this position.

To prevent injuries to persons and/or destruction of the injection and glow plug system, the following must be noted:

Caution

- *Observe required procedures when disconnecting battery ⇒ Electrical system; Rep. gr. 27 ; Battery; Disconnecting and reconnecting battery.*

- Switch off the ignition before connecting or disconnecting injection or glow plug system wiring or tester cables.
- If the engine is to be turned over at starter speed without it starting, pull connector off fuel pressure regulating valve - N276- .
- Before disconnecting battery, obtain radio code for radios with anti-theft coding.
- Disconnecting and connecting the battery must only be done with the ignition switched off, as otherwise the control unit for diesel direction injection system could become damaged.

1.2 Rules for cleanliness and instructions for working on fuel system

- Place removed parts on a clean surface and cover them over. Use lint-free cloths only.
- Carefully cover opened components or seal them if repairs cannot be carried out immediately.
- Install only clean parts; do not remove new parts from packaging until immediately before installing. Do not use parts that have been kept unpackaged (for example in toolboxes).
- Clean tools and workbench etc. before working on injection system.
- Thoroughly clean all joints and surrounding areas before dismantling.
- When removing components, plug all open connections immediately with suitable clean sealing caps.
- Do not remove sealing caps from components until immediately prior to installation. After removal, components should be kept in new, sealable packaging (plastic bags or wooden boxes; not in cartons). If available, use the original new part packaging).
- Before installation, check injectors and their surroundings visually; they must be undamaged and free of lint. Ensure that the injector bore is clean. If necessary, clean injector bores using a clean cloth, taking care not to cause damage (do not use any sharp tools!).
- When renewing a component, also renew all high-pressure fuel lines leading from the relevant component.
- If components are not being renewed, always mark the high-pressure fuel lines on removal. High-pressure fuel lines must always be re-installed in their original positions (i.e. on the same cylinder).
- The following components and seals/O-rings must always be renewed when the injectors are removed and installed: “copper seal”, “O-ring for injector bore”, “O-ring for injector return connection”.
- The following components and seals/O-rings must always be renewed when an injector is renewed: “clamping piece”, “injector pipe”, “copper seal”, “O-ring for injector bore”, “O-ring for injector return connection”.

- Always fit new copper seals for the injectors. Check all new O-rings for damage before installing. Lubricate O-rings lightly with assembly oil or clean engine oil before installing.
- Take care not to damage the injectors when removing the old copper seals.
- Align the high-pressure fuel lines so they are free of tension. First tighten all unions hand-tight before tightening to final torque.
- Never attempt to reshape high-pressure fuel lines.
- When working on any parts of the high-pressure fuel system, tools may only be used for loosening and tightening pipe unions. All other components must always be removed and installed by hand without using tools or other equipment.
- Press the return lines onto the injectors by hand from above so that they engage audibly on each injector (do not press in the release pins when doing this). Then press down the release pin after connecting the return line. Pull return lines upwards by hand to check that they are firmly attached and are not leaking.

2 Diesel direct injection system

⇒ “1.1 Safety precautions”, page 233 .

⇒ “1.2 Rules for cleanliness and instructions for working on fuel system”, page 234 .

⇒ “2.1 Schematic overview of the fuel system”, page 236 .

⇒ “2.2 Assembly overview - fuel system”, page 239 .

⇒ “2.3 Removing and installing injectors (piezo injectors)”, page 242 .

⇒ “2.4 Installing high-pressure lines”, page 247 .

⇒ “2.7 Checking return flow rate of injectors (piezo injectors) with engine running”, page 250 .

⇒ “2.8 Checking return flow rate of injectors (piezo injectors) at starting speed”, page 251 .

⇒ “2.9 Checking for injectors sticking open (piezo injectors).”, page 253 .

⇒ “2.10 Checking throttle in fuel return line”, page 255 .

⇒ “2.11 Assembly overview - toothed belt for high-pressure pump”, page 255 .

⇒ “2.12 Removing and installing toothed belt for high-pressure pump”, page 257 .

⇒ “2.13 Assembly overview - high-pressure pump”, page 264 .

⇒ “2.14 Removing and installing high-pressure pump”, page 266 .

⇒ “2.15 Removing and installing fuel pressure regulating valve N276 ”, page 267 .

⇒ “2.16 Checking fuel pressure regulating valve N276 ”, page 269 .

⇒ “2.17 Removing and installing fuel pressure sender G247 ”, page 270 .

⇒ “2.18 Bleeding fuel system/filling tank with fuel for first time”, page 271 .

⇒ “2.19 Checking fuel system for leaks”, page 272 .

2.1 Schematic overview of the fuel system

WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 234 .*
- *Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.*

Caution

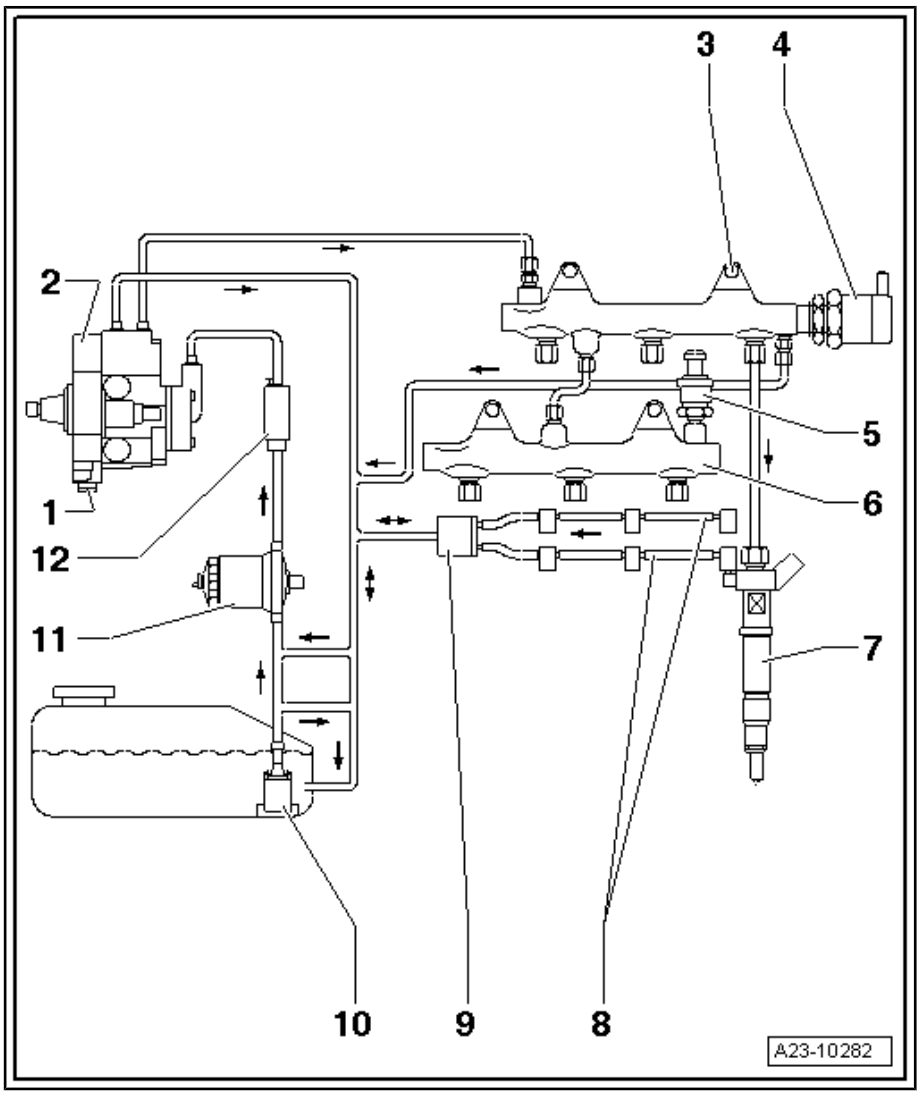
To prevent the high-pressure fuel pump from running while it is empty and to ensure that the engine starts quickly after parts have been renewed, it is important to observe the following:

If components of the fuel system between the tank and the high-pressure fuel pump are removed or renewed, the basic setting "Checking fuel supply pump" must be performed to bleed the fuel system.

If supplementary fuel pump, fuel line (between fuel tank and high-pressure fuel pump) or the fuel filter are removed or renewed, perform basic setting "first fuel filling" »once« before first starting engine.

If the high-pressure fuel pump is removed or renewed, the basic setting channel 35 "first fuel filling" must be performed »three times« before the engine is started for the first time.

Performing first fuel filling after installing high-pressure pump *⇒ page 271* .



1 - Fuel metering valve - N290-

- ❑ Do not unscrew.

2 - High-pressure pump

- ❑ After renewing, a first fuel filling "must" be performed (it is important not to allow the pump to run while it is still empty) ⇒ page 271 .
- ❑ Assembly overview - high-pressure pump ⇒ page 264 .
- ❑ Removing and installing ⇒ page 266

3 - High-pressure accumulator (rail)

- ❑ Cylinder bank 1

4 - Fuel pressure regulating valve - N276-

- ❑ On cylinder bank 1.
- ❑ Cannot be re-installed.
- ❑ Installing and removing ⇒ page 267

5 - Fuel pressure sender - G247-

- ❑ Screwed into rail element on cylinder bank 2.
- ❑ Installing and removing ⇒ page 270
- ❑ Can be re-used ⇒ page 271

6 - High-pressure accumulator (rail)

- ❑ For cylinder bank 2

7 - Injectors (piezo injectors)

- ❑ Injectors 1 … 6
- ❑ Installing and removing ⇒ page 242

8 - Fuel return lines (from injectors)

- ❑ Do not dismantle the fuel return lines; they must be renewed only complete with pressure retention valve.
- ❑ After renewal, engine must be run at idling speed for approx. 2 minutes to bleed fuel system. Then check fuel return lines for leaks.

9 - Pressure retention valve

- ❑ The pressure retention valve maintains a residual pressure of approx. 10 bar in the return lines.
- ❑ This residual pressure is required for the control function of the piezo injectors.
- ❑ The pressure retention valve may only be renewed complete with the fuel return lines.
- ❑ After renewal, engine must be run at idling speed for approx. 2 minutes to bleed fuel system.
- ❑ Checking ⇒ page 255

10 - Fuel

- ❑ With fuel system pressurisation pump - G6- .

11 - Fuel filter

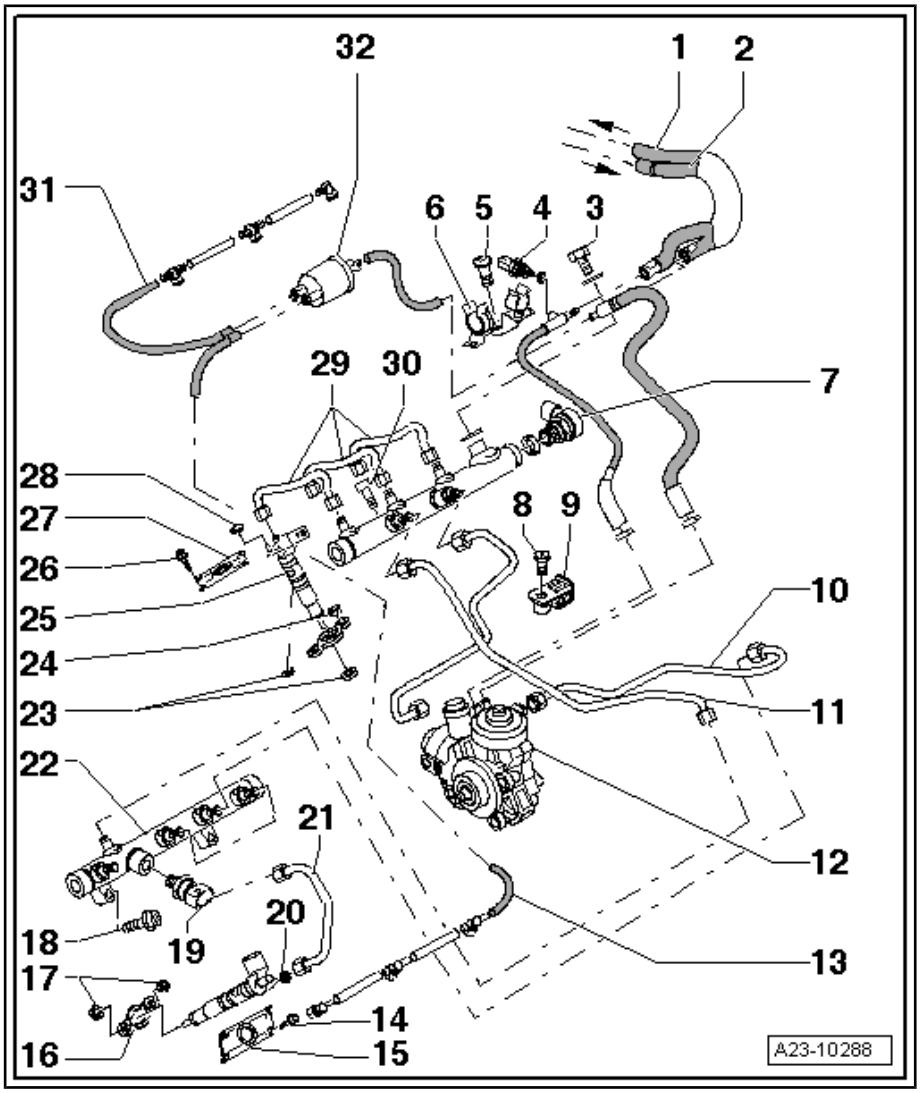
- ❑ Fuel filter - assembly overview ⇒ Fuel supply - diesel engines; Rep. gr. 20

12 - Supplementary fuel pump - V393-

2.2 Assembly overview - fuel system

WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 234 .*
- *Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.*



1 - Fuel return line

- ❑ To fuel tank
- ❑ The fuel return line must be free of kinks, damage and blockages.

2 - Fuel supply line

- ❑ From fuel filter.

3 - Banjo bolt for fuel return line

- ❑ 25 Nm

4 - Fuel temperature sender - G81-

5 - Bolt

- ❑ 9 Nm

6 - Bracket

7 - Fuel pressure regulating valve - N276-

- ❑ Located on cylinder bank 1.
- ❑ Cannot be re-installed.
- ❑ Installing and removing ⇒ page 267

8 - Bolt

- ❑ 9 Nm

9 - Bracket

10 - High-pressure pipe

- ❑ 28 Nm
- ❑ Between high-pressure pump and rail element.

11 - High-pressure pipe

- ❑ 28 Nm
- ❑ Between rail element for cylinder bank 1 and rail element for cylinder bank 2.
- ❑ Before re-using “high-pressure fuel line”, perform visual check of taper seats for damage such as transverse scores or corrosion; always renew if damaged.
- ❑ If high-pressure line is not O.K., always renew high-pressure line.

12 - High-pressure pump

- ❑ With fuel metering valve - N290- .
- ❑ After renewing high-pressure pump, a first fuel filling must be performed (never allow pump to run while it is still empty) ⇒ page 271 .
- ❑ Assembly overview - high-pressure pump ⇒ page 264 .
- ❑ Removing and installing ⇒ page 266

13 - Fuel return lines (from injectors)

- ❑ Do not dismantle the fuel return lines; they must be renewed only complete with pressure retention valve.
- ❑ After renewal, engine must be run at idling speed for approx. 2 minutes to bleed fuel system. Then check fuel return lines for leaks.

14 - Bolt

- ❑ 5.5 Nm
- ❑ Cover for injector on cylinder head cover.

15 - Injector cover

16 - Clamping piece

- ❑ If they are to be re-installed, the injector units and clamping pieces must always be re-installed on the cylinder they were removed from.
- ❑ When an injector is renewed, the corresponding clamping piece must be renewed at the same time.

17 - Hexagon flange nut

- ❑ 10 Nm
- ❑ For clamping piece.

18 - Bolt

- ❑ 22 Nm
- ❑ For rail element (fuel rail) for cylinder bank 2.

19 - Fuel pressure sender - G247-

- ❑ Screwed into rail element on cylinder bank 2.
- ❑ Removing and installing ⇒ page 270
- ❑ 30 Nm
- ❑ Can be re-used ⇒ page 271

20 - Seal

- ❑ Renew

21 - High-pressure lines

- ❑ 28 Nm
- ❑ For cylinder bank 2

22 - Rail element (common rail)

- ❑ For cylinder bank 2

23 - Oil seals

- ❑ Renew

24 - Hexagon flange nut

- ❑ 10 Nm
- ❑ For clamping piece.

25 - Injector (piezo injectors)

- ❑ When removing and installing, always renew the following components and seals/O-rings: “copper seal”, “O-ring for injector bore”, “O-ring for injector return connection”.
- ❑ The following components and seals/O-rings must always be renewed when an injector is renewed: “clamping piece”, “copper seal”, “O-ring for injector shaft” and “O-ring for injector return connection”.
- ❑ Before re-using “high-pressure line”, perform visual check of taper seats for damage such as transverse scores or corrosion; always renew if damaged.
- ❑ If they are to be re-installed, the injectors, high-pressure lines and clamping pieces must always be re-fitted in their original positions (i.e. on the same cylinder).
- ❑ Removing and installing ⇒ page 242

26 - Bolt

- ❑ 5.5 Nm
- ❑ Cover for injector on cylinder head cover.

27 - Injector cover

28 - Seal

- ❑ Renew

29 - High-pressure lines

- ❑ 28 Nm
- ❑ For cylinder bank 1

30 - Bolt

- ❑ 22 Nm
- ❑ For rail element (fuel rail) of cylinder bank 1

31 - Fuel return lines (from injectors)

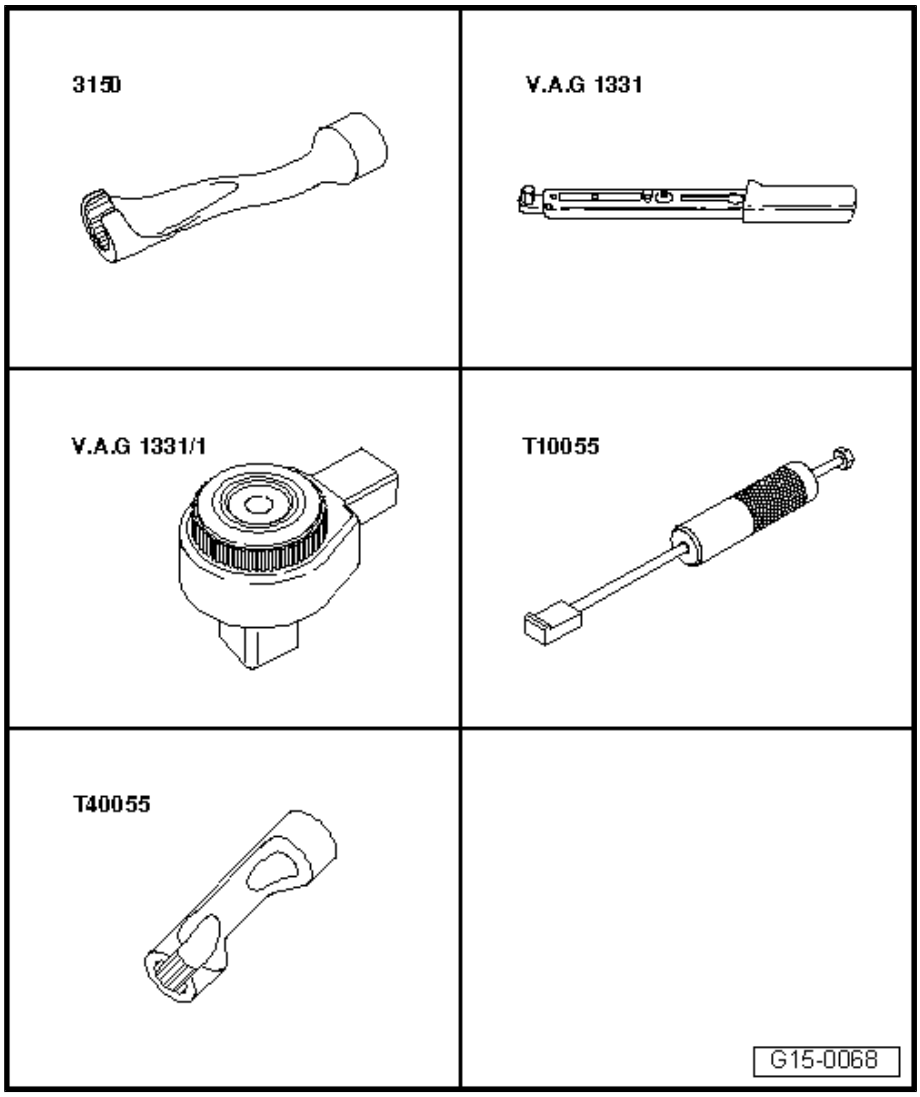
- ❑ Do not dismantle the fuel return lines; they must be renewed only complete with pressure retention valve.
- ❑ After renewal, engine must be run at idling speed for approx. 2 minutes to bleed fuel system. Then check fuel return lines for leaks.

32 - Restrictor

- ❑ In return lines from cylinder banks 1 and 2.
- ❑ The throttle has the job of always maintaining residual pressure in the fuel return lines.
- ❑ This residual pressure is required for the control function of the piezo injectors.
- ❑ The throttle must be renewed only completely together with the fuel return lines.
- ❑ After renewal, engine must be run at idling speed for approx. 2 minutes to bleed fuel system.
- ❑ Checking ⇒ page 255

2.3 Removing and installing injectors (piezo injectors)

Special tools and workshop equipment required



- 14 mm socket - 3150-
- Torque wrench (5 to 50 Nm) - V.A.G 1331-
- Ratchet wrench - V.A.G 1331/1-
- Puller - T10055- with adapter - T10055/1-
- 17 mm socket - T40055-
- Tool insert 19 mm - V.A.G 1331/5-

Removing

Caution

Always observe rules for cleanliness and instructions when working on fuel system ***⇒ page 234*** ***.***

Follow these instructions before starting work and while working on the fuel system.

When renewing an injector, the correction value for the new injector must be written in the engine control unit ***⇒ page 249*** ***.***

Note

The following description shows removal and installation of the injectors on cylinder bank 2 (left side). The procedure for cylinder bank 1 is the same, except that some steps are not required.

– Remove engine cover panel ⇒ page 3 .

WARNING

Mark cylinder numbers on injectors.

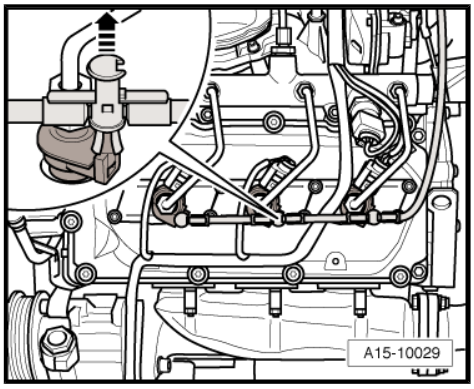
Observe rules for cleanliness when working on the injection system.

Plug open connections with suitable sealing caps immediately.

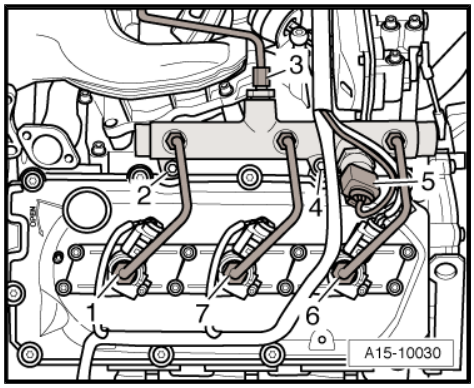
Note

Step required only for cylinder bank 1: Remove upper part of air filter with air mass meter *⇒ page 281* *.*

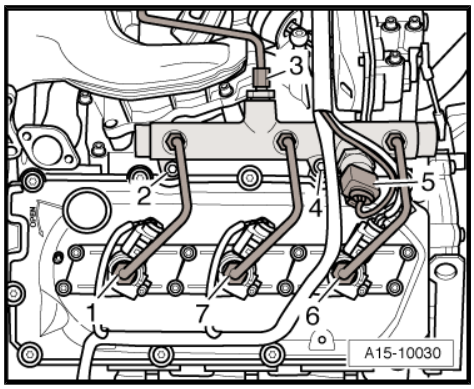
– Pull release pins upwards -arrow- and pull return line connections off injectors.
– Disconnect electrical connectors at injectors which are to be removed.



– Loosen union nuts for injector lines -1-, -6- and -7- at injectors using 17 mm socket - T40055- .

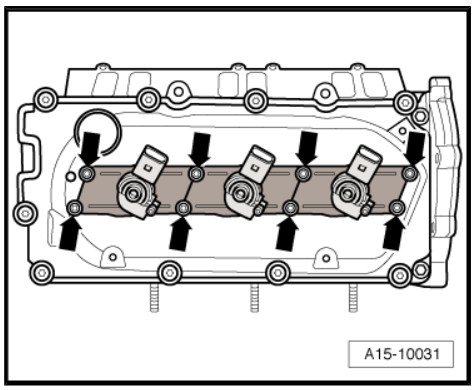


– Loosen union nuts for injector lines -1-, -6- and -7- at fuel rail using 14 mm socket - 3150- or 19 mm tool insert - V.A.G 1331/5- .

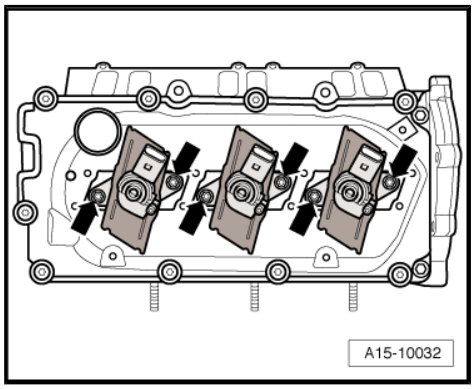


– Unbolt covers for injectors -arrows-.

– Pull covers upwards and turn $^{1}/_{4}$ turn (90°).

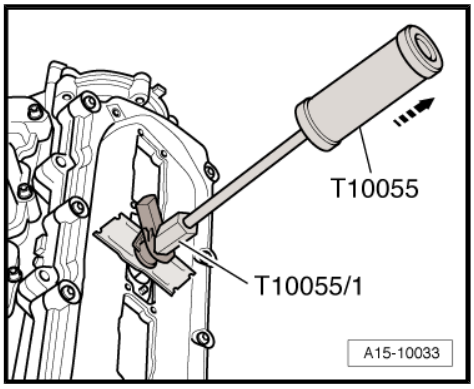


– Unbolt clamping pieces for injectors -arrows-.



– Pull out injectors using puller - T10055- with adapter - T10055/1- .

– After removal, lay injectors on a clean cloth.



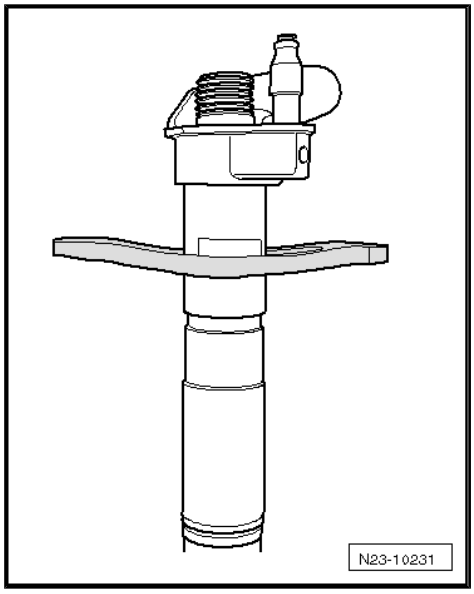
Important instructions for installing injectors

- When removing and installing, always renew the following components and seals/O-rings: “copper seal”, “O-ring for injector bore”, “O-ring for injector return connection”.
- The following components and seals/O-rings must always be renewed when an injector is renewed: “clamping piece”, “injector pipe”, “copper seal”, “O-ring for injector bore”, “O-ring for injector return connection”.
- Used injectors and injector pipes may be re-installed only on the same cylinder.
- Make sure that the injectors and the installation area are clean before installing.
- The injectors must be completely undamaged.
- Lubricate all O-rings with engine oil or assembly oil before installing.

Installation position of clamping piece

If a used injector is being re-installed:

- Spray tip of injector nozzle with rust-releasing spray. Wait approx. 5 minutes and wipe off soot particles and oil with a cloth.
- If an injector is very dirty, the tip of the nozzle should also be cleaned with a soft brass wire brush to make it easier to remove the copper seal. Do not apply the wire brush to the bores in the nozzle.
- To remove the old copper seal from the injector, clamp the seal carefully in a vice so that it is just held between the jaws without turning. Then carefully pull and twist the injector out of the copper seal by hand.
- Clean off deposits under the copper seal using a suitable scraper.
- Use a plastic bush to fit the new copper seal.
- Check O-ring for fuel return connection on injector for damage and deformation.



If there is any damage or deformation on the O-ring:

- Renew O-ring for fuel return connection. Lubricate O-ring with assembly oil before installing.
- Lubricate O-ring for fuel return connection as well as fuel return connection with assembly oil or clean engine oil.
- Roll new O-ring with great care on fuel return connection. Check that it is seated correctly.

Continuation

- To remove carbon deposits from the injector sealing surface, clean the injector seat in the cylinder head with a cloth soaked in engine oil or rust solvent. Take care not to damage the sealing surface.
- Install injectors.
- Tighten union nuts on high-pressure lines and injector lines hand-tight to start with.
- Ensure that high-pressure lines and injector lines are not under stress.
- Tighten high-pressure lines:

  AF 14 mm ⇒ page 89

  AF 17 mm ⇒ page 90

  AF 19 mm ⇒ page 89
- Press return line connections carefully over seals and onto injectors (check seal for damage before connecting return line). The catch should engage audibly. Then press release pin down carefully.
- Checking and adjusting injector correction values ⇒ page 249 .
- Bleed fuel system and check for leaks ⇒ page 271 .

Renew the affected component if leakage still occurs after tightening to the correct torque.

Note

The return lines can only be renewed together with the pressure retention valve as one unit.

Observe applicable safety precautions during road test
⇒ page 233 .

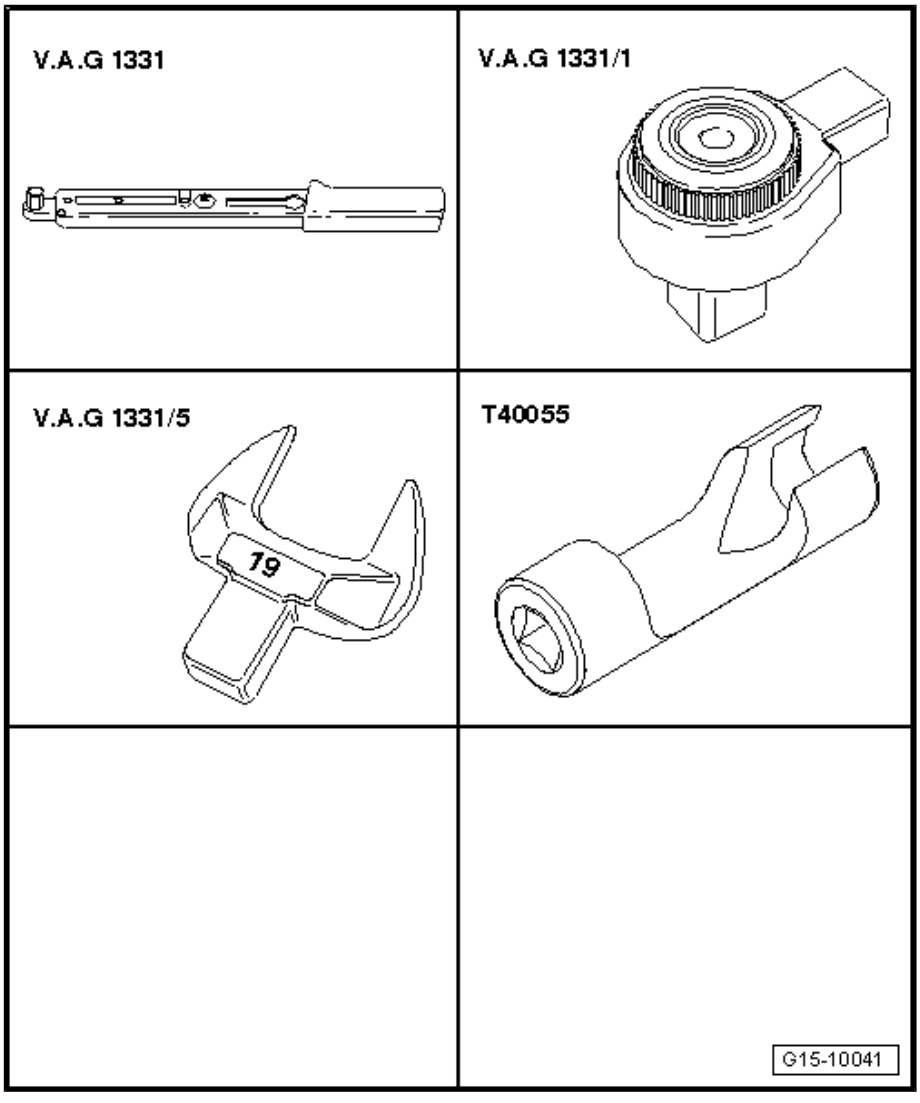
– After completing the repair, road-test the vehicle over a distance of at least 20 km. Accelerate with full throttle at least once. Then inspect the high-pressure section of the fuel system again for leaks.

Note

If there is still air in the fuel system, the engine can change to emergency running mode during road test. Switch off the engine and erase event memory ⇒ Vehicle diagnostic tester. Then continue road test.

2.4 Installing high-pressure lines

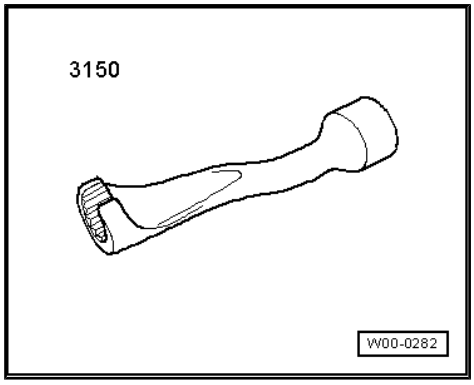
Special tools and workshop equipment required



- Torque wrench - V.A.G 1331-
- Ratchet wrench - V.A.G 1331/1-
- Tool insert 19 mm - V.A.G 1331/5-
- Socket - T40055-

Special tools and workshop equipment required

- Socket, 14 mm - 3150-



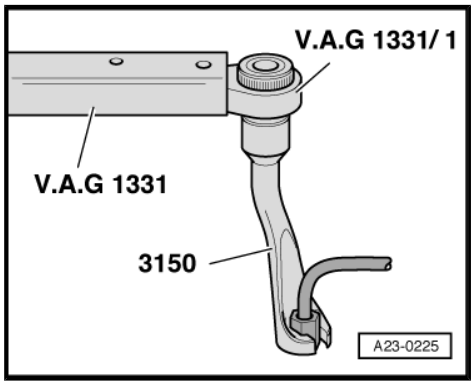
Procedure

Note

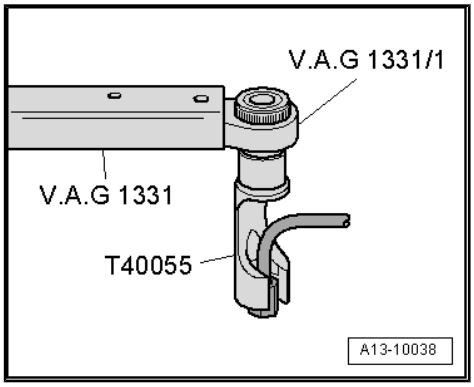
- *Observe cylinder-specific markings if reusing high-pressure lines.*
- *The high-pressure lines may be re-used after the following checks:*
- *Check taper seat of respective high-pressure line for deformation and cracks.*
- *The inside of the line must be free of deformations, constrictions and damage.*
- *Corroded lines should no longer be used.*

– Extract soiling from taper seat on rail.
– Clean fuel line and head of line using cold cleaning solvent and dry using compressed air.
– Moisten union nut thread with fuel.
– Tighten high-pressure union nuts hand-tight, check lines are free of stress when doing this.
• Specified torque: 28 Nm
– To tighten high-pressure lines, use the following tools depending on width across flats:

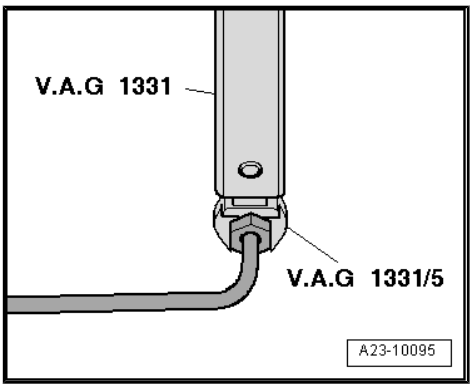
Tightening high-pressure lines at fuel rails (AF 14 mm)



Tightening high-pressure lines at fuel rails (AF 17 mm)



Tightening high-pressure lines at fuel rails (AF 19 mm)



– Checking fuel system for leaks ⇒ page 272 .

2.5 Testing injectors

There are 4 different methods for testing the injectors.

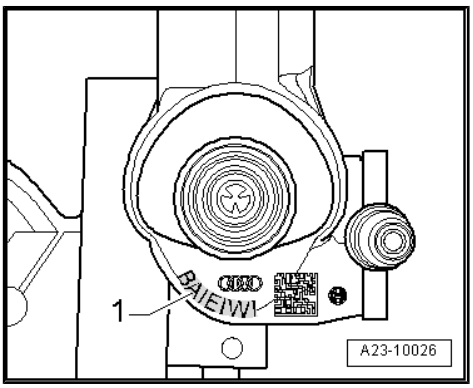
- Checking and adjusting “injector correction values” ⇒ page 249 .
- Checking return flow rate of injectors with engine running ⇒ page 250
- Checking return flow rate of injectors at starter speed ⇒ page 250
- Checking for injectors sticking open ⇒ page 253 .

2.6 Checking and setting injector correction values

Special tools and workshop equipment required

- ♦ Vehicle diagnostic tester
- ♦ The “injector correction value” serves to correct the injection rates for each cylinder of a common rail system individually across the entire ignition map range.
- ♦ The 7-character adaptation value -1- (example) is imprinted on each injector. They may consist of letters and/or numbers (ASCII code).

– When a new »injector« is installed, the adaptation value for the new injector must be stored in the engine control unit.



The adaption procedure is described in the Guided Fault-Finding. (The procedure is also described under Guided Functions).

Also check all other injectors in respect of “injector correction values” to make sure all calibration values have been entered correctly. Do NOT attempt to re-enter these calibration values if the correct values are already stored in the engine control unit.

2.7 Checking return flow rate of injectors (piezo injectors) with engine running

WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 234 .*
- *Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.*

Special tools and workshop equipment required

- Return flow meter - VAS 6684-

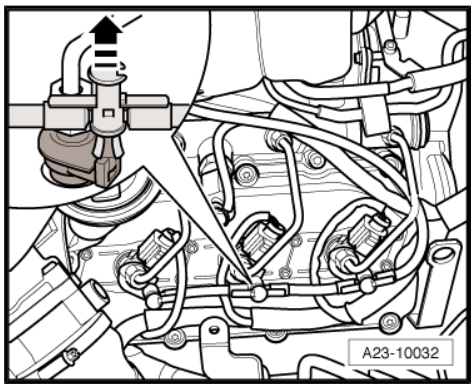
Each injector normally has a relatively low return flow rate. If the return flow rate at one injector is relatively high compared to the other injectors, that injector is probably defective.

– Remove engine cover panel ⇒ page 3 .

– Clean all return line connections (e.g. with commercial cleaning solution) before removing.

– Dry all cleaned parts.

– Pull return line connections off the 6 injectors of the two cylinder banks. To do this, push down connection on tabs and pull up centre piece to release -arrow-.

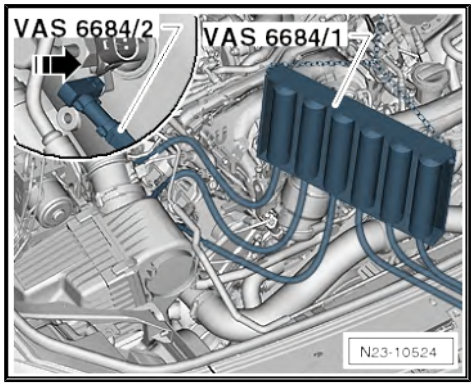


Note

- *Illustration shows cylinder bank 2.*
- *On cylinder bank 2 the coolant expansion tank must be detached; coolant hoses remain connected.*
- *Adhere strictly to rules of cleanliness. No dirt must be allowed to get into the disconnected fuel return lines or the open connections on the injectors.*

– Connect return flow meter - VAS 6684- as illustrated.

Connecting return flow meter



Note

All 6 injector units can be connected at the same time, or each cylinder bank can be measured individually.

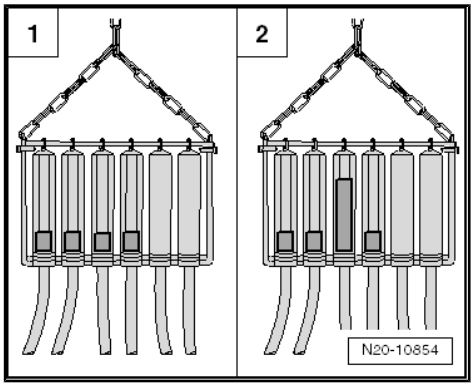
– Start engine and allow to idle for several minutes:

Caution

Do NOT press the accelerator during this test; the engine must only run at idling speed.

Running the engine at higher speeds with the return lines disconnected will cause damage to the injectors.

Evaluation of return flow rate



- 1. Injector units OK. Return flow rate of all injector units approximately equal.
- 2. Cylinder 3 injector unit not OK. The return flow rate is more than three times the lowest measured return flow rate.

Note

There is a mechanical fault in the injector unit if the return flow rate is more than three times the lowest measured return flow rate. This injector unit must be renewed.

– If necessary, renew the injector unit diagnosed as faulty ⇒ page 242 .

– Check O-ring for fuel return connection on injector for damage and deformation.

If there is any damage or deformation on the O-ring:

– Renew O-ring for fuel return connection.

– Lubricate O-ring for fuel return connection as well as fuel return connection with assembly oil or clean engine oil.

– Roll new O-ring with great care onto fuel return connection. Check that it is correctly seated.

– Carefully press connections of return lines onto injector. The catch should engage audibly. Then press release pin down carefully.

– Re-attach electrical connector of fuel pressure regulating valve - N276- .

– Delete event memory entry ⇒ Vehicle diagnostic tester.

– Checking fuel system for leaks ⇒ page 272 .

2.8 Checking return flow rate of injectors (piezo injectors) at starting speed

If the engine cannot be started, the return flow rate of the injectors can also be checked at starter motor speed.

Special tools and workshop equipment required

- Return flow meter - VAS 6684- .

WARNING

- *Read rules for cleanliness and the instructions for working on the fuel system ⇒ page 233 .*
- *Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.*

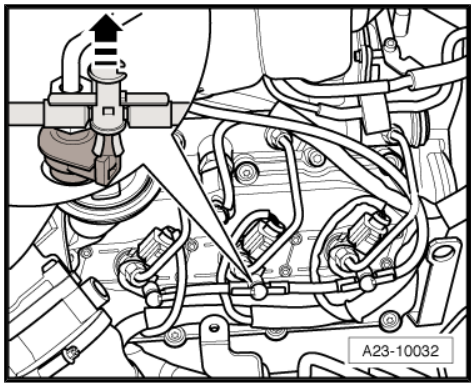
Each injector normally has a relatively low return flow rate. If the return flow rate at one injector is relatively high compared to the other injectors, that injector is probably defective.

– Remove engine cover panel ⇒ page 3 .

– Clean all return line connections (e.g. with commercial cleaning solution) before removing.

– Dry all cleaned parts.

– Pull return line connections off the 6 injectors of the two cylinder banks. To do this, push down connection on tabs and pull up centre piece to release -arrow-.

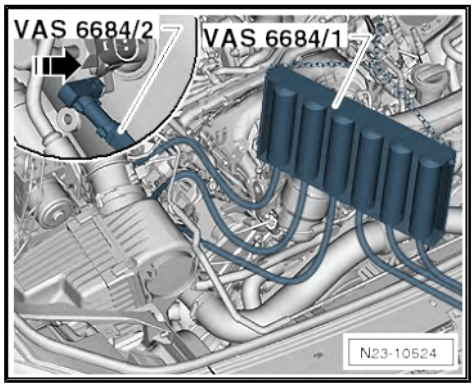


Note

- *Illustration shows cylinder bank 2.*
- *On cylinder bank 2 the coolant expansion tank must be detached; coolant hoses remain connected.*
- *Adhere strictly to rules of cleanliness. No dirt must be allowed to get into the disconnected fuel return lines or the open connections on the injectors.*

– Connect return flow meter - VAS 6684- as illustrated.

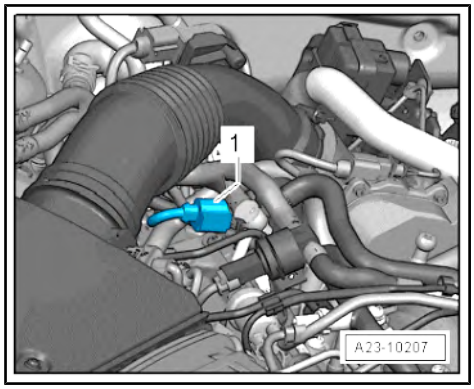
Connecting return flow meter



Note

All 6 injector units can be connected at the same time, or each cylinder bank can be measured individually.

– Pull electrical connector -1- from fuel pressure regulating valve - N276- .

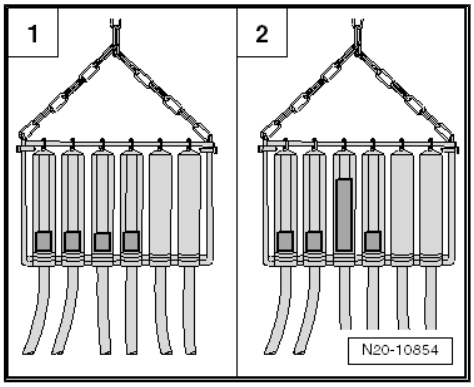


Note

This prevents the fuel from being injected during the attempt at starting.

– Operate the starter 3 times. (Wait approx. 20 seconds each time after operating starter to prevent it from overheating).

Evaluation of return flow rate



- 1) Injector units OK. Return flow rate of all injector units approximately equal. Target value: approx. 0 ml.
- 2) Injector of cylinder no. 3 is not OK. The return flow rate is more than three times the lowest measured return flow rate.

Note

There is a mechanical fault in the injector unit if the return flow rate is more than three times the lowest measured return flow rate. This injector unit must be renewed.

– If necessary, renew the injector unit diagnosed as faulty ⇒ page 242 .

– Check O-ring for fuel return connection on injector for damage and deformation.

If there is any damage or deformation on the O-ring:

– Renew O-ring for fuel return connection.

– Lubricate O-ring for fuel return connection as well as fuel return connection with assembly oil or clean engine oil.

– Roll new O-ring with great care onto fuel return connection. Check that it is correctly seated.

– Carefully press connections of return lines onto injector. The catch should engage audibly. Then press release pin down carefully.

– Re-attach electrical connector of fuel pressure regulating valve - N276- .

– Delete event memory entry ⇒ Vehicle diagnostic tester.

– Checking fuel system for leaks ⇒ page 272 .

2.9 Checking for injectors sticking open (piezo injectors).

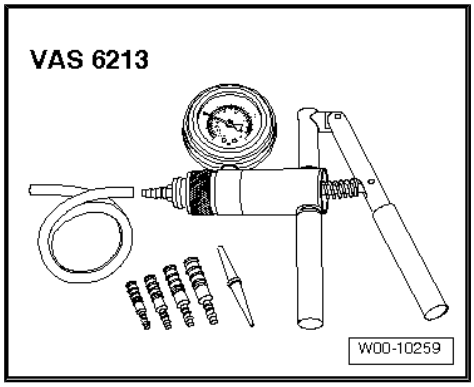
If one of the injectors is sticking open, this means that the injector needle is not closing fully and fuel escapes into the cylinder.

WARNING

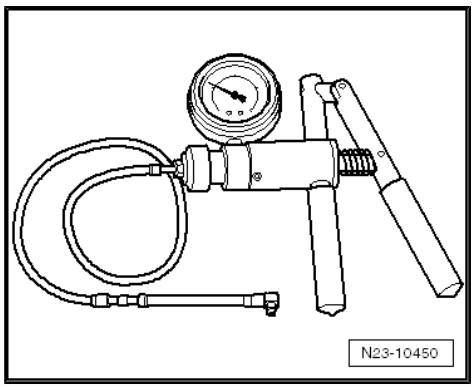
- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 234 .*
- *Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.*

Special tools and workshop equipment required

♦ Hand operated vacuum pump - VAS 6213-



♦ Make an -adapter- from a return line.



– Clear fault memory entry using vehicle diagnostic tester.
– Remove engine cover panel ⇒ page 3 .
– Clean all connections (e.g. with commercial cleaning solution) before removing.

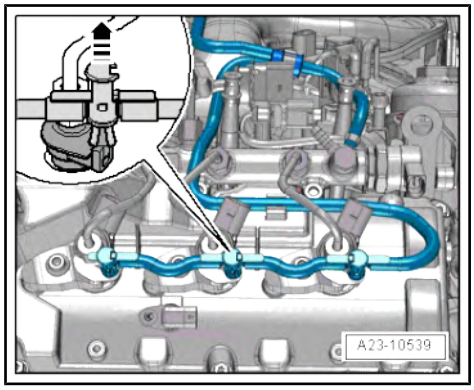
Note

♦ *Make sure all parts are clean; no dirt must be allowed to enter the fuel system.*
♦ *Check all cylinders in turn.*

– Dry all components after cleaning.

Start with cylinder 1.

– Pull fuel return hoses off the injectors by pressing the two tabs downwards and simultaneously pulling the centre piece upwards in order to release them -arrow-.
– Connect clean, blown-out adapter to return-flow connection piece of injector to be tested.
– Use hand vacuum pump - VAS 6213- to generate vacuum of approx. 500 mbar.



If injector is OK, pressure remains constant for 30 seconds.

If injectors are defective, the pressure drops to 0 bar within 2 … 3 seconds.

Repeat check is necessary, observe pressure loss at hand-operated vacuum pump - VAS 6213- .

– Renew defective injectors ⇒ page 242

2.10 Checking throttle in fuel return line

In the case of vehicles with a 6 bar fuel system, the throttle in the fuel return line has the job of always ensuring a certain amount of residual pressure (control amount). This residual pressure is required for the control function of the piezo injectors.

Special tools and workshop equipment required

- VAS pressure gauge - 6330-

WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 234 .*
- *Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.*

– Remove engine cover panel ⇒ page 3 .

– Clean return line connection of cylinder no. 1 (e.g. with commercially available cold cleaning solvent) before removing.

– Dry return line connection of cylinder no. 1.

– Cover return line connection on cylinder no. 1 with a cloth.

– Pull off return line connection at no. 1 cylinder. To do this, push down connection at tabs and pull up centre piece to release.

Note

Adhere strictly to rules of cleanliness; no dirt must be allowed to get into the disconnected return line and in the connection on the injector.

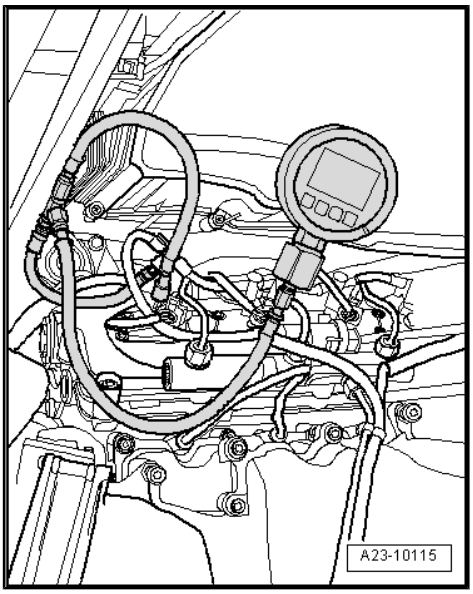
– Install VAS pressure gauge - 6330- between return line connection on injector and return line.

– Start engine.

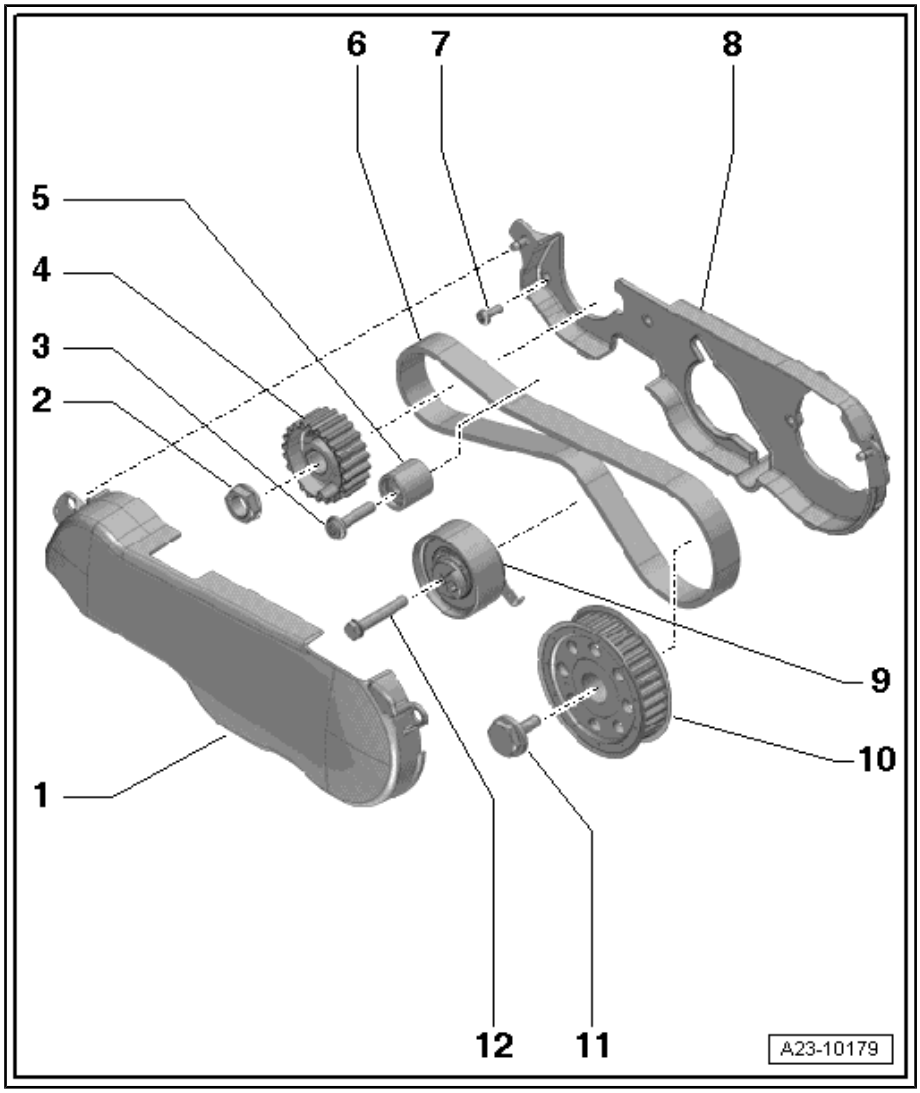
– Check pressure on pressure gauge.

- Specification: approx. 4 bar

If the specification is not achieved, renew fuel return line, inc. throttle.



2.11 Assembly overview - toothed belt for high-pressure pump



1 - Front toothed belt guard

- ❑ Engage in position at the bottom at clip on at the side.

2 - Nut

- ❑ 70 Nm

3 - Bolt

- ❑ 23 Nm

4 - Toothed belt pulley for high-pressure pump

- ❑ Remove using puller - T40064- ⇒ page 256 .

5 - Idler roller

6 - Toothed belt for high-pressure pump

- ❑ Before removing, mark direction of rotation with chalk or felt-tipped pen. If the toothed belt runs in the opposite direction when it is refitted, this can cause breakage.
- ❑ Check for wear
- ❑ Removing and installing ⇒ page 257

7 - Bolt

- ❑ 9 Nm

8 - Rear toothed belt guard

9 - Toothed belt tensioning roller

10 - Toothed belt drive pulley

11 - Bolt

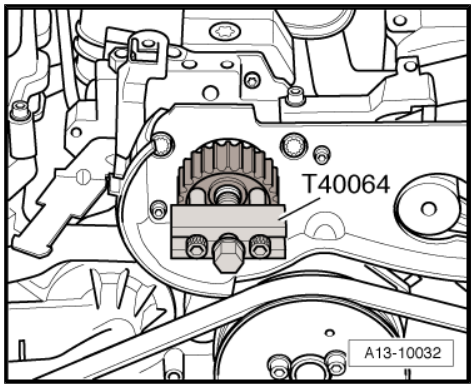
- ❑ 75 Nm
- ❑ With washer
- ❑ Use counter-hold tool - 3036- to loosen and tighten

12 - Bolt

- ❑ 23 Nm

Pulling off toothed belt pulley for high-pressure pump

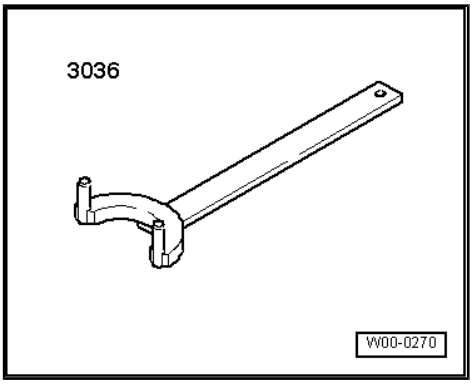
– Use puller - T40064- to pull off belt sprocket for high-pressure pump.



2.12 Removing and installing toothed belt for high-pressure pump

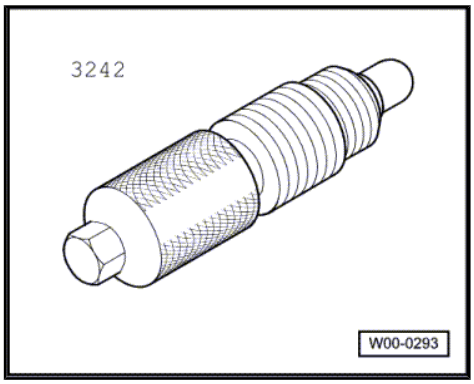
Special tools and workshop equipment required

- Counter-hold tool - 3036-

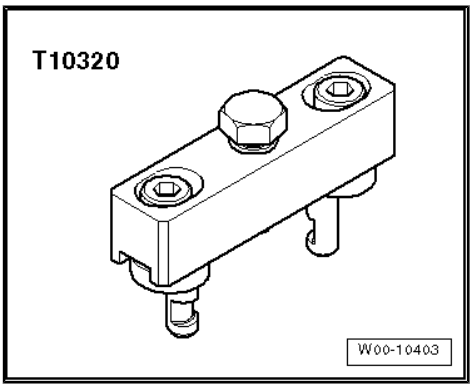


- or counterhold tool - T10172A-

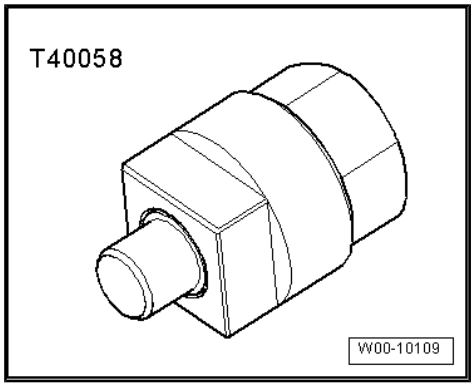
- Locating bolt - 3242-



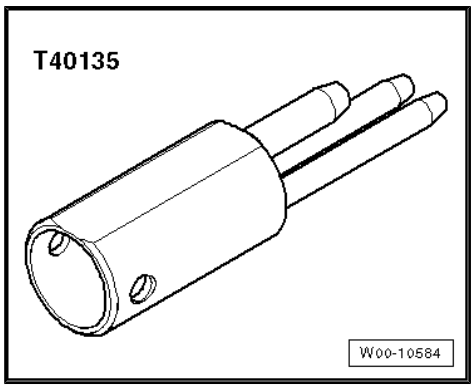
- Puller - T10320-



♦ Adapter - T40058-



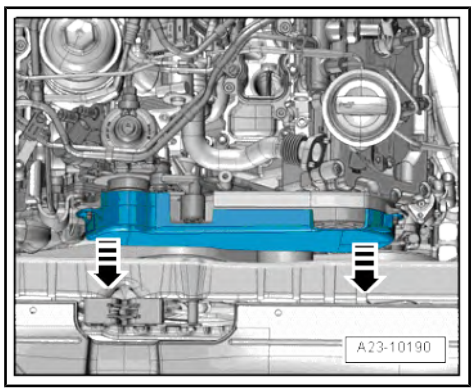
♦ Locking pin -T40135-



Removing

– Remove engine cover panel ⇒ page 3 .

– Pivot toothed belt guard forwards -arrows- and unhook retaining pin on underside of toothed belt guard.



Note

For illustration purposes, the procedure is shown with the toothed belt guard removed.

Caution

Risk of irreparable damage if direction of rotation is reversed on previously used toothed belt.

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

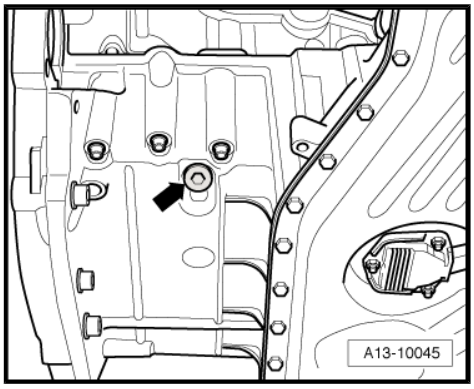
– Remove noise insulation ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation .

– Set engine to »Ignition TDC«:

Note

To prevent any engine oil from escaping, place a cloth below the upper part of sump.

– Unscrew plug -arrow- from upper part of sump.



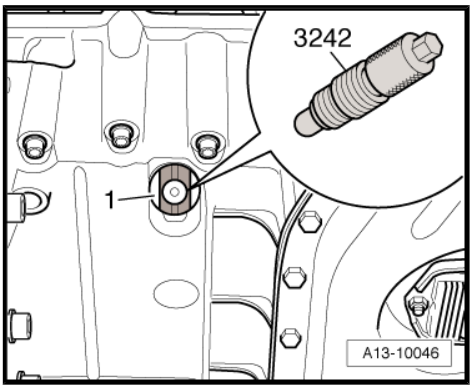
WARNING

Risk of injury when feeling for "TDC" hole with finger.

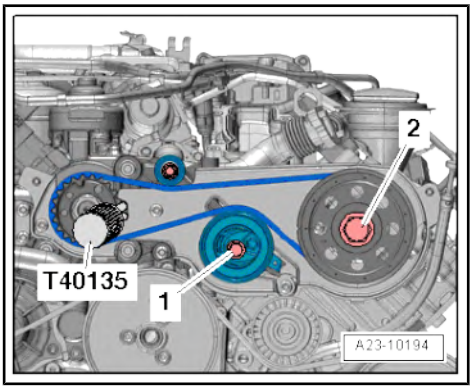
- ***Do not turn crankshaft -1-.***

– Screw locking pin - 3242- into hole (20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centre locking pin.

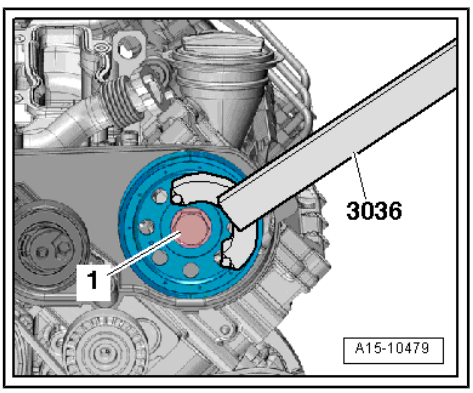
– Lock toothed belt pulley for high-pressure pump using locking pin -T40135- .



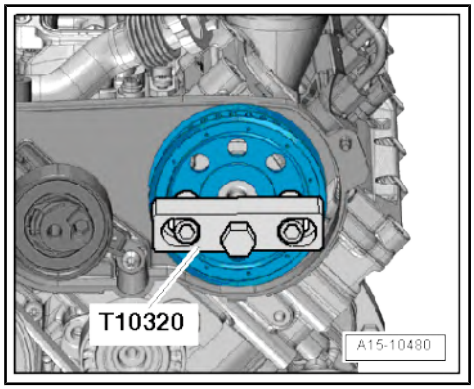
– Loosen bolt -1- for toothed belt tensioning roller about 1 full turn. Ignore position -2-.



– Loosen bolt -1- for toothed belt pulley by approx. 2 turns using counter-hold tool - 3036- or counter-hold tool - T10172A- .



– Pull off toothed belt drive pulley using puller - T10320- .



Note

The toothed belt drive pulley remains on the camshaft.

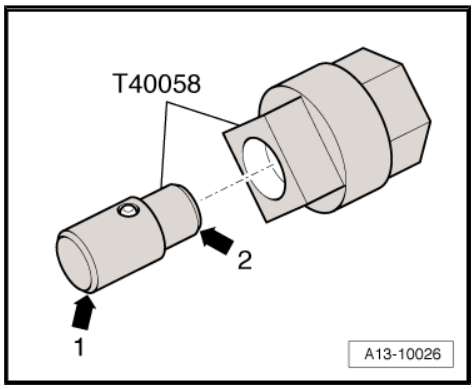
– First remove toothed belt from toothed belt pulley for high-pressure pump and then from toothed belt drive pulley.

Installing

Install in reverse order of removal, observing the following.

– Remove noise insulation.

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

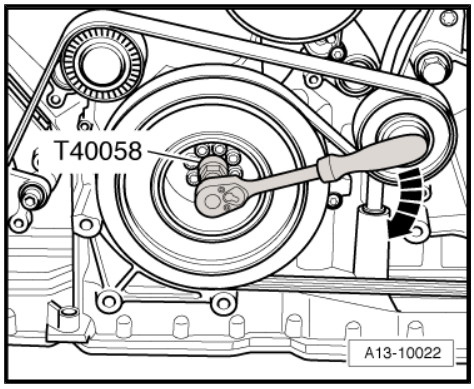


- The larger diameter -arrow 1- points towards the engine.
- The smaller diameter -arrow 2- faces the adapter.

Caution

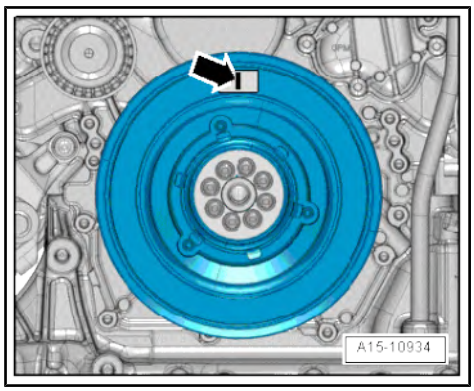
Risk of irreparable damage due to jumping of camshaft timing chain.

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

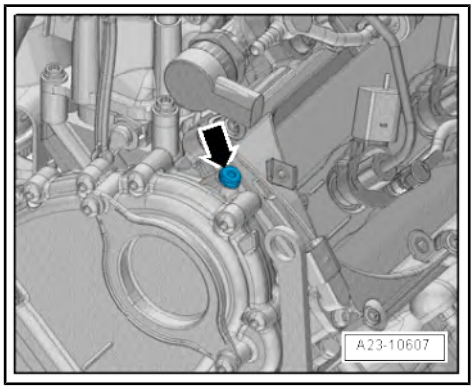


– Turn crankshaft to “TDC” using adapter - T40058- .

- The marking -arrow- must be perpendicular to the middle of the crankshaft as shown in illustration.



– Unscrew plug -arrow- at rear of cylinder head on right.

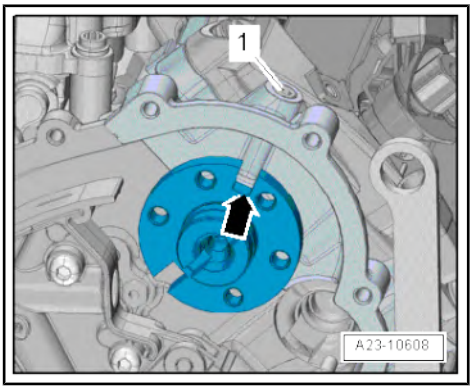


Note

For reasons of clarity, the installation position as seen from the rear with the engine removed is shown.

– Check whether the groove -arrow- in the flange of the camshaft can be seen through the hole -1- for plug.

– To do this, use a small torch to shine light into the plug hole.



Note

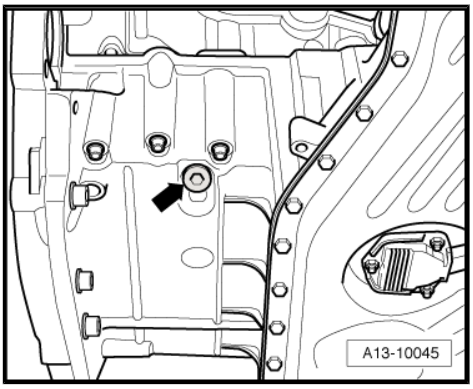
For reasons of clarity, the flange of the camshaft is shown without chain drive and without timing chain cover.

– If the groove is not beneath the hole, turn crankshaft 360 degrees in the engine's direction of rotation.

Note

Place a cloth underneath upper part of sump to catch escaping engine oil.

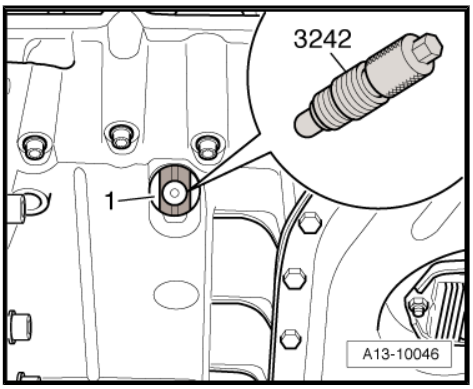
– Unscrew plug -arrow- from upper part of sump.



WARNING

Risk of injury when feeling for "TDC" hole with finger.

- ***Do not turn crankshaft -1-.***



– Screw locking pin - 3242- into hole (20 Nm); if necessary, turn crankshaft backwards and forwards slightly to fully centre locking pin.

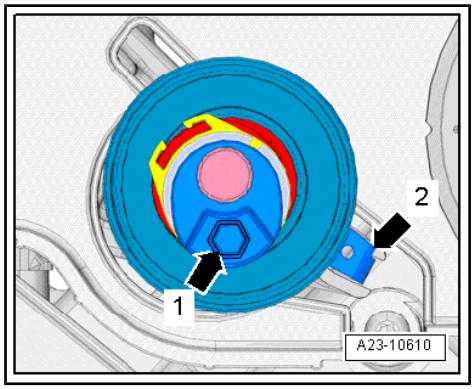
Note

Before installing the toothed belt, the high-pressure pump and toothed belt sprocket for high-pressure pump must be properly secured in place.

– Check installation of toothed belt tensioning roller:

• Retaining lug -arrow 2- must engage in slot on front bracket for high-pressure pump.

• Tensioning roller must be relieved, hexagon drive mounting -arrow 1- faces downwards.

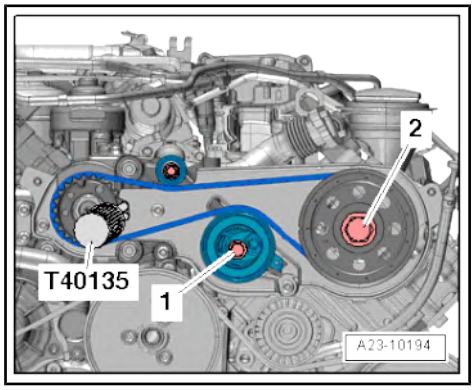


– Fit toothed belt.

– Screw in bolt -1- for toothed belt tensioning roller without applying pressure until eccentric of toothed belt tensioning roller can just be turned without tilting.

– Screw in bolt -2- for toothed belt drive pulley until toothed belt drive pulley can just be turned without tilting.

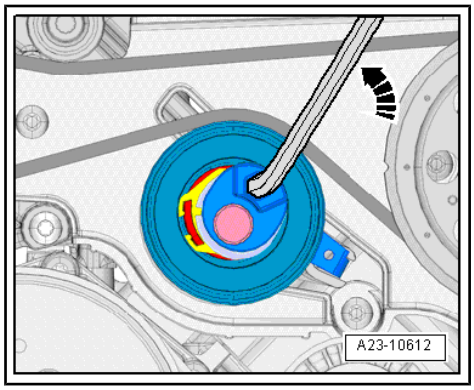
– Lock toothed belt pulley for high-pressure pump using locking tool - T40135- .



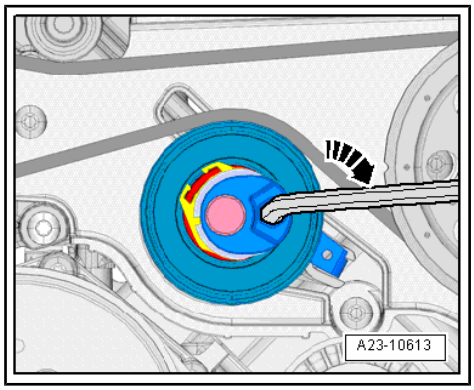
– Pre-tension toothed belt tensioning roller with hexagon key by turning in direction of -arrow- until hexagon drive mounting is positioned at -1 o'clock-

Caution

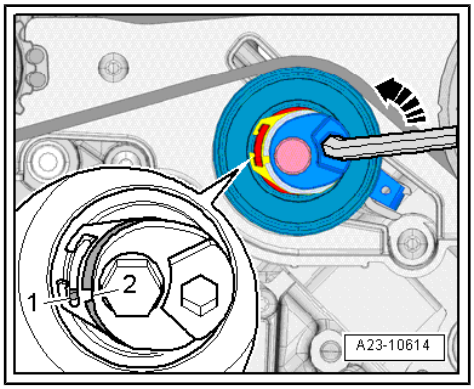
Never turn tensioning roller to "12 o'clock position" or beyond.



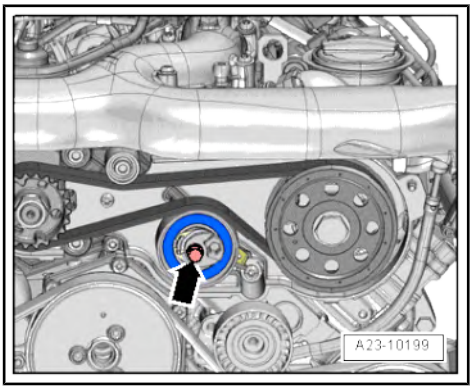
– Now relieve tension of toothed belt tensioning roller -arrow- until hexagon drive mounting is positioned at -3 o'clock-



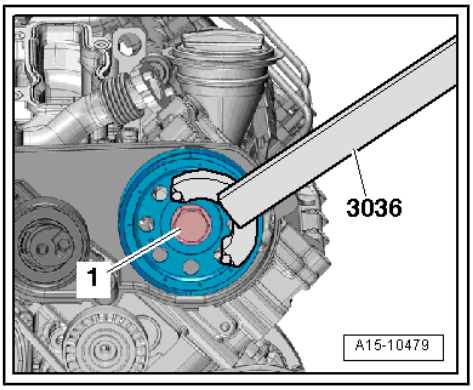
– From the -3 o'clock- position, pre-tension toothed belt tensioning roller -arrow- until lug -1- and notch -2- align exactly.



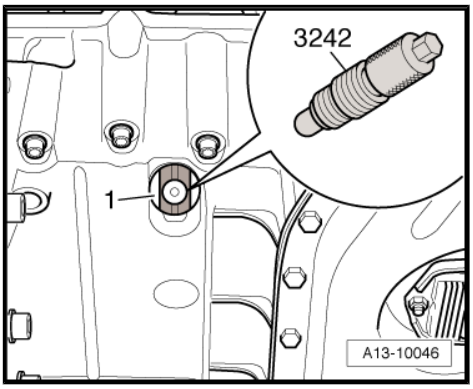
– Hold toothed belt tensioning roller in this position and tighten bolt -arrow- ⇒ Item 12 (page 256) .



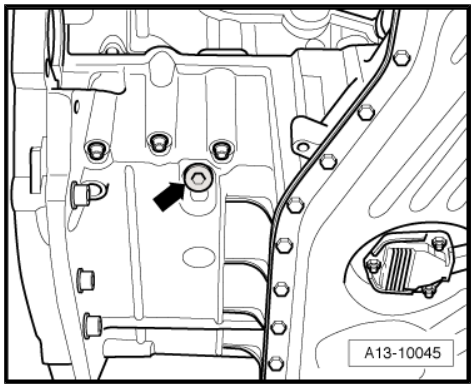
– Tighten bolt -1- for toothed belt pulley using counter-hold tool - 3036- or counter-hold tool - T10172A-
⇒ Item 11 (page 256) .



– Remove locking pin - 3242- .



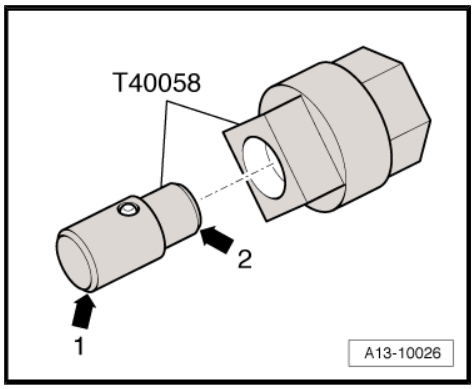
– Screw in sealing plug -arrow- for “TDC” mark in upper part of oil sump ⇒ Rep. gr. 17 .



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

• The larger diameter -arrow 1- points towards the engine.

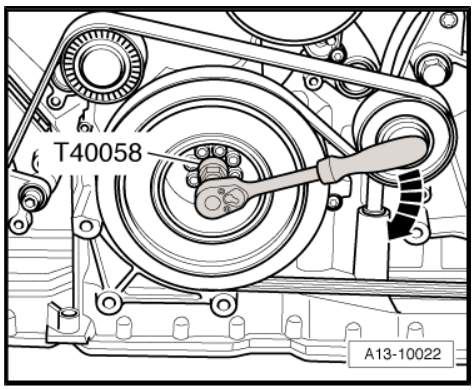
• The smaller diameter -arrow 2- faces the adapter.



Caution

Risk of irreparable damage from camshaft timing chains jumping.

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

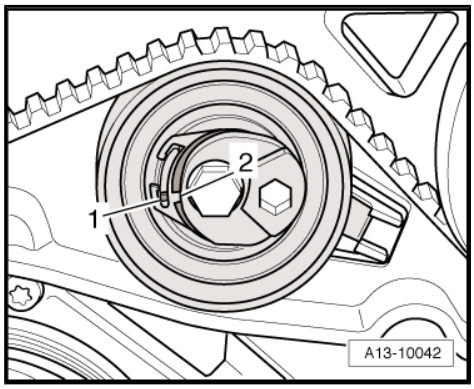


– Turn crankshaft 1 full turn using adapter - T40058- .

– Check toothed belt tension:

• Lug -1- should align with notch -2-.

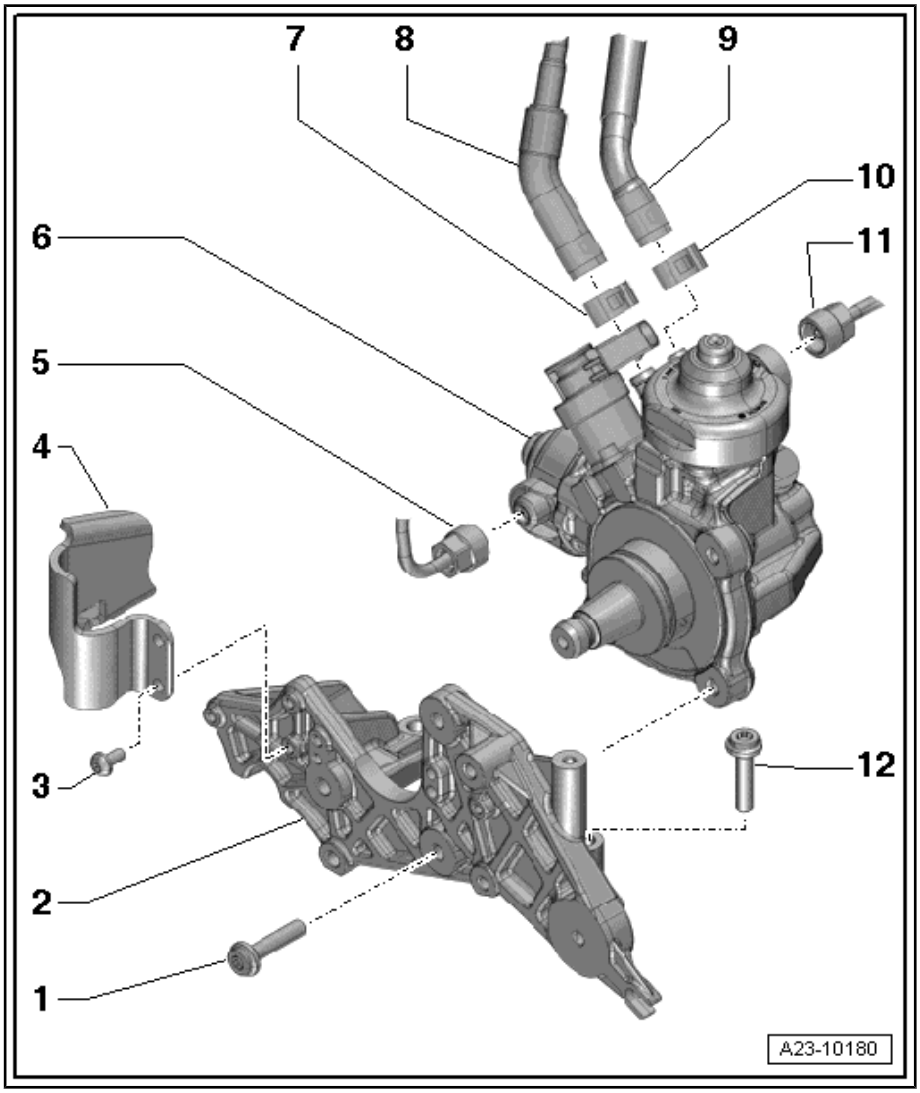
– If specification is not reached, adjust toothed belt tension again.



Further assembly is carried out in the reverse order of removal.

• Assembly overview - specified torques for toothed belt for high-pressure pump ⇒ page 255

2.13 Assembly overview - high-pressure pump



1 - Bolt

- ❑ M6: 9 Nm
- ❑ M8: 23 Nm

2 - Bracket for high-pressure pump

3 - Bolt

- ❑ 9 Nm

4 - Protective plate

5 - Union nut for high-pressure line

- ❑ 28 Nm

6 - High-pressure pump

> **Caution**
>
> *Observe rules for cleanliness when working on the injection system ⇒ page 234 .*
>
> *The high-pressure pump must first be filled with fuel before the engine is started. Do not run the high-pressure pump while empty.*

- ❑ Removing and installing ⇒ page 266
- ❑ The fuel system must be bled after installing high-pressure pump ⇒ page 271 .

7 - Hose clamp

- ❑ Use only hose clips that are of the equivalent standard used in series production ⇒ Parts catalogue .

8 - Fuel hose

- ❑ With hose connection 13.3 mm = supply line
- ❑ With hose connection 11.1 mm = return line
- ❑ The fuel line must not be kinked, damaged or blocked.

9 - Fuel hose

- ❑ With hose connection 13.3 mm = supply line
- ❑ With hose connection 11.1 mm = return line
- ❑ The fuel line must not be kinked, damaged or blocked.

10 - Hose clamp

- ❑ Use only hose clips that are of the equivalent standard used in series production ⇒ Parts catalogue .

11 - Union nut for high-pressure line

- ❑ 28 Nm

12 - Bolt

- ❑ 23 Nm

2.14 Removing and installing high-pressure pump

Removing

– Remove upper part of intake manifold ⇒ page 274 .

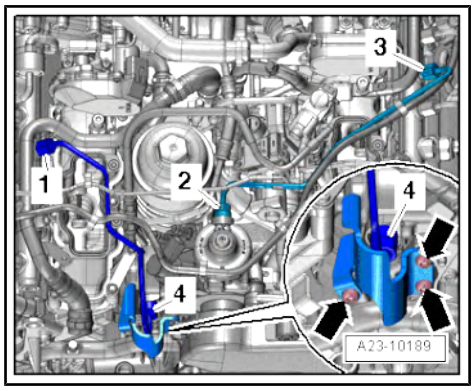
– Removing toothed belt for high-pressure pump ⇒ page 257 .

– Unscrew bolts -arrows- and detach guard for high-pressure line.

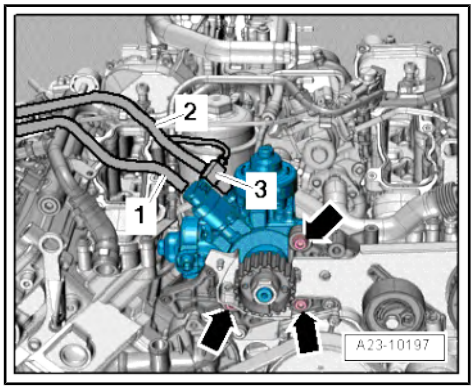
– Unscrew union nuts -1 … 4- and place high-pressure lines to one side.

– Separate electrical connector -3-.

– Remove fuel supply hose -1- and fuel return hose -2-.



– Unscrew bolts -arrows- and remove high-pressure pump.



WARNING

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 234 .*
- *Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.*

Installing

- Specified torques ⇒ page 264 .

Install in reverse order of removal, observing the following.

Note

If the fuel pressure regulating valve - N276- or the high-pressure pump have been exchanged, the learnt values for the regulating valve must be reset using the vehicle diagnostic tester : Guided Functions; Resetting learnt values for fuel pressure regulating valve.

Caution

Risk of irreparable damage to high-pressure pump if allowed to run dry.

- *The high-pressure pump must first be filled with fuel before the engine is started.*

Note

- *Renew seals and gaskets.*
- *The fuel return line must not be kinked, damaged or blocked.*

– Install toothed belt for high-pressure pump ⇒ page 257 .

– Install high-pressure lines ⇒ page 247 .

– Install upper part of intake manifold ⇒ page 274 .

– Bleed fuel system after installing high-pressure pump ⇒ page 271 .

2.15 Removing and installing fuel pressure regulating valve - N276-

The fuel pressure regulating valve is located in the right fuel rail (cylinder bank 1). It maintains a constant pressure in the fuel rail and the injection lines (high-pressure fuel circuit).

If the pressure in the high-pressure fuel circuit is too high, the regulating valve opens to allow some of the fuel to flow back from the fuel rail to the fuel tank via a return line.

If the pressure in the high-pressure fuel circuit is too low, the valve closes and seals off the high-pressure section of the system from the low-pressure section.

The fuel pressure regulating valve - N276- cannot be re-used.

Removing

Caution

Always observe rules for cleanliness and instructions when working on fuel system ⇒ page 234 .

Follow these instructions before starting work and while working on the fuel system.

– Remove engine cover panel ⇒ page 3 .

– Before removal, clean area around thread for fuel pressure regulating valve using commercial cold cleaning solution, etc. (no dirt must enter the bore in the fuel rail).

Note

Do not allow any cleaning agent to get into the connector, clean it carefully.

– Dry off fuel pressure regulating valve - N276- .

– Disconnect connector on fuel pressure regulating valve - N276- .

– Loosen union nut, counterholding on hexagonal flats on housing. Then unscrew and remove by hand.

– Extract dirt from fuel rail bore (threads and sealing surface). Do not use tools or other instruments for this purpose.

Note

Seal off fuel rail bore immediately with a suitable plug to prevent dirt from entering.

Installing

Note

- *The fuel pressure regulating valve - N276- has a deformable sealing lip and no separate seal; it can therefore be used only once.*
- *Check that sealing surfaces (deformable sealing lip) and threads on new fuel pressure regulating valve - N276- are not damaged.*
- *Also check sealing surface at fuel rail bore.*
- *Thread on fuel pressure regulating valve - N276- must be free of oil and grease.*

– Screw on union nut by hand.

– Align fuel pressure regulating valve - N276- so that connecting wire is free of tension after connector is attached.

Tighten union nut in 2 stages.

1st stage: 60 Nm while counterholding on hexagonal flats of housing

Then back off union nut 1/4 turn (90°); counterhold hexagonal flats on housing.

2nd stage: 85 Nm while counterholding on hexagonal flats of housing

– After installation, run engine at moderate speed for several minutes and then switch off.
– Check fuel system for leaks ⇒ page 272 .

Note

If the fuel pressure regulating valve - N276- or the high-pressure pump have been exchanged, the learnt values for the regulating valve must be reset using the vehicle diagnostic tester : Guided Functions; Resetting learnt values for fuel pressure regulating valve.

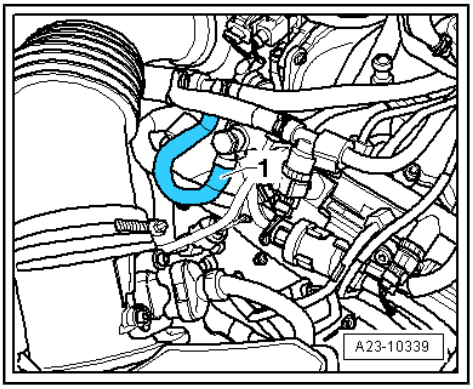
– Read event memory ⇒ Vehicle diagnostic tester.
– After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.
– Read event memory again ⇒ Vehicle diagnostic tester.

2.16 Checking fuel pressure regulating valve - N276-

WARNING

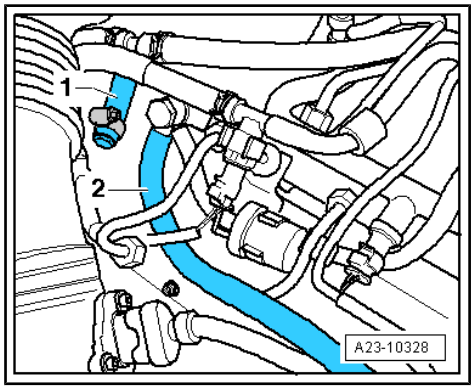
- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 234 .*
- *Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.*

– Remove engine cover panel ⇒ page 3 .
– Pull off fuel return line -1-.



– Seal open fuel return line connection with a blanking plug -1-.
– Connect open fuel return line connection to suitable hose -2-.
– Hold end of this hose -2- in suitable container to measure return flow rate.
– Carry out test at starting speed.
• Specification: the return flow is 0 ml while the starter turns over

If the specification is not attained, the fuel pressure regulating valve - N276- is defective.



2.17 Removing and installing fuel pressure sender - G247-

The fuel pressure sender - G247- (rail pressure sender) is located in the left fuel rail (cylinder bank 2) and continuously measures the current fuel pressure in the high-pressure system. It transmits a corresponding voltage signal to the engine control unit - J623- .

Should the sender fail, the engine control unit will control the fuel pressure via a mapped open-loop backup function, allowing a maximum of approx. 3000 rpm.

Removing

Caution

Always observe rules for cleanliness and instructions when working on fuel system ⇒ page 234 .

Follow these instructions before starting work and while working on the fuel system.

– Remove engine cover panel ⇒ page 3 .
– Before removal, clean area around thread for fuel pressure sender, using e.g. a commercially available cold cleaning solvent. No dirt must enter the hole in the fuel rail.

Note

Do not allow any cleaning agent to get into the connector, clean it carefully.

– Dry fuel pressure sender - G247- .
– Pull connector off fuel pressure sender - G247- .
– Unscrew fuel pressure sender - G247- .
– Extract dirt from fuel rail bore (threads and sealing surface). Do not use tools or other instruments for this purpose.

Note

Seal off fuel rail bore immediately with a suitable plug to prevent dirt from entering.

Installing

Note

- *Check that sealing surfaces (deformable sealing lip) and threads on fuel pressure sender - G247- are undamaged. Re-using fuel pressure sender - G247- if possible if it has been tested OK.*
- *Also check sealing surface in hole of fuel rail.*
- *The beginning of the thread and the deformable sealing lip of the fuel pressure sender - G247- must be coated with diesel fuel.*

– Screw fuel pressure sender - G247- on hand-tight.

– Tighten fuel pressure sender to specified torque ⇒ Item 19 (page 240) (19).

– After installation, run engine at moderate speed for several minutes and then switch off.

– Check fuel system for leaks.

– Read event memory ⇒ Vehicle diagnostic tester.

– After completing the repair, road-test the vehicle. Accelerate with full throttle at least once. Then check the high-pressure section of the fuel system again for leaks.

– Read event memory ⇒ Vehicle diagnostic tester.

2.18 Bleeding fuel system/filling tank with fuel for first time

Caution

After installation, the high-pressure pump must first be filled with fuel before the engine is started (the high-pressure pump must not be allowed to operate while empty).

Note

There must be sufficient fuel in the tank.

Bleeding fuel system

Proceed as follows to fill high-pressure pump with fuel:

– Connect battery charger if necessary ⇒ Electrical system; Rep. gr. 27 ; Charging battery .

– Connect vehicle diagnostic tester and then carry out guided function “Fuel pump activation”.

Note

The fuel pump will be activated for 240 seconds.

– After pump activation, start the engine.

– Allow engine to run for several minutes at mid revs, then switch engine off again.

– Checking fuel system for leaks ⇒ page 272
– Observe applicable safety measures when carrying out a road test ⇒ page 233 .
– Then, road-test the vehicle for more than 20 km with full throttle acceleration at least once.
– Check high-pressure area for leaks again ⇒ page 272

Note

If there is still air in the fuel system, the engine can change to emergency running mode during road test. In this case, switch engine off and erase event memory ⇒ Vehicle diagnostic tester. Then continue with a road test.

2.19 Checking fuel system for leaks

– Allow engine to run at average revs for a few minutes.
– Switch off ignition.
– Check entire fuel system for leaks.
– If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
– Then road-test the vehicle, accelerating to full throttle at least once.
– Check high-pressure area for leaks again

3 Intake manifolds

⇒ “3.1 Assembly overview - intake manifold”, page 273 .

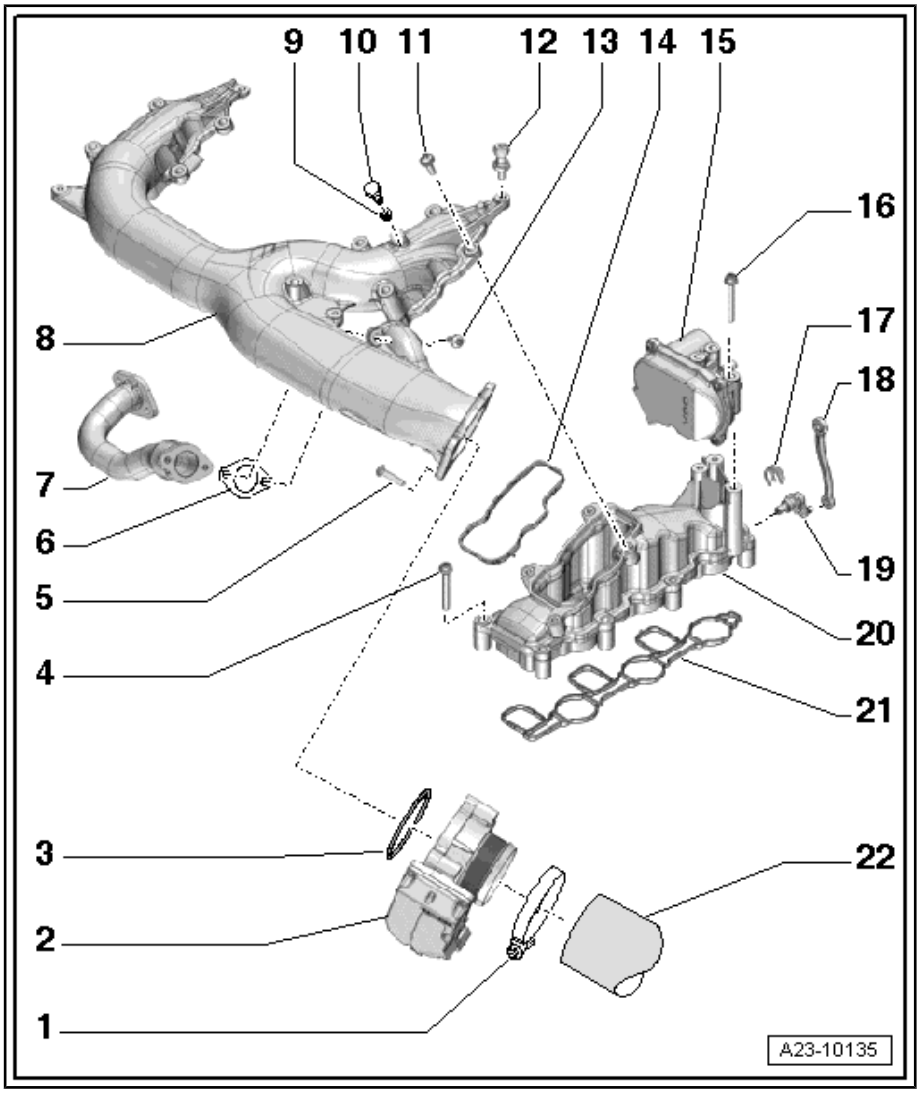
⇒ “3.2 Removing and installing intake manifold upper part”, page 274 .

⇒ “3.3 Removing and installing lower parts of intake manifold”, page 276 .

3.1 Assembly overview - intake manifold

Note

The illustration shows the left upper and lower intake manifold.



1 - Clamp
- ❑ 5.5 Nm
- ❑ Reinforced.

2 - Throttle valve module - J338-
- ❑ 9 Nm

3 - O-ring
- ❑ Renew

4 - Bolt
- ❑ 9 Nm
- ❑ Tighten in stages and in diagonal sequence.

5 - Bolt
- ❑ 9 Nm

6 - Seal
- ❑ Renew

7 - Connecting pipe for exhaust gas recirculation

8 - Upper part of intake manifold
- ❑ Removing and installing ⇒ page 274

9 - Seal
- ❑ Renew

10 - Plug
- ❑ 10 Nm

11 - Bolt
- ❑ 9 Nm

12 - Mounting pin for engine cover panel
- ❑ 5 Nm

13 - Bolt
- ❑ 9 Nm

14 - Seal
- ❑ Renew

15 - Intake manifold flap motor

- ❑ Cylinder bank 1 (right side): intake manifold flap motor - V157- .
- ❑ Cylinder bank 2 (left side): intake manifold flap motor 2 - V275- .

16 - Bolt

- ❑ 10 Nm

17 - Retaining clip

18 - Connecting rod

19 - Yoke

20 - Intake manifold lower part

21 - Seal

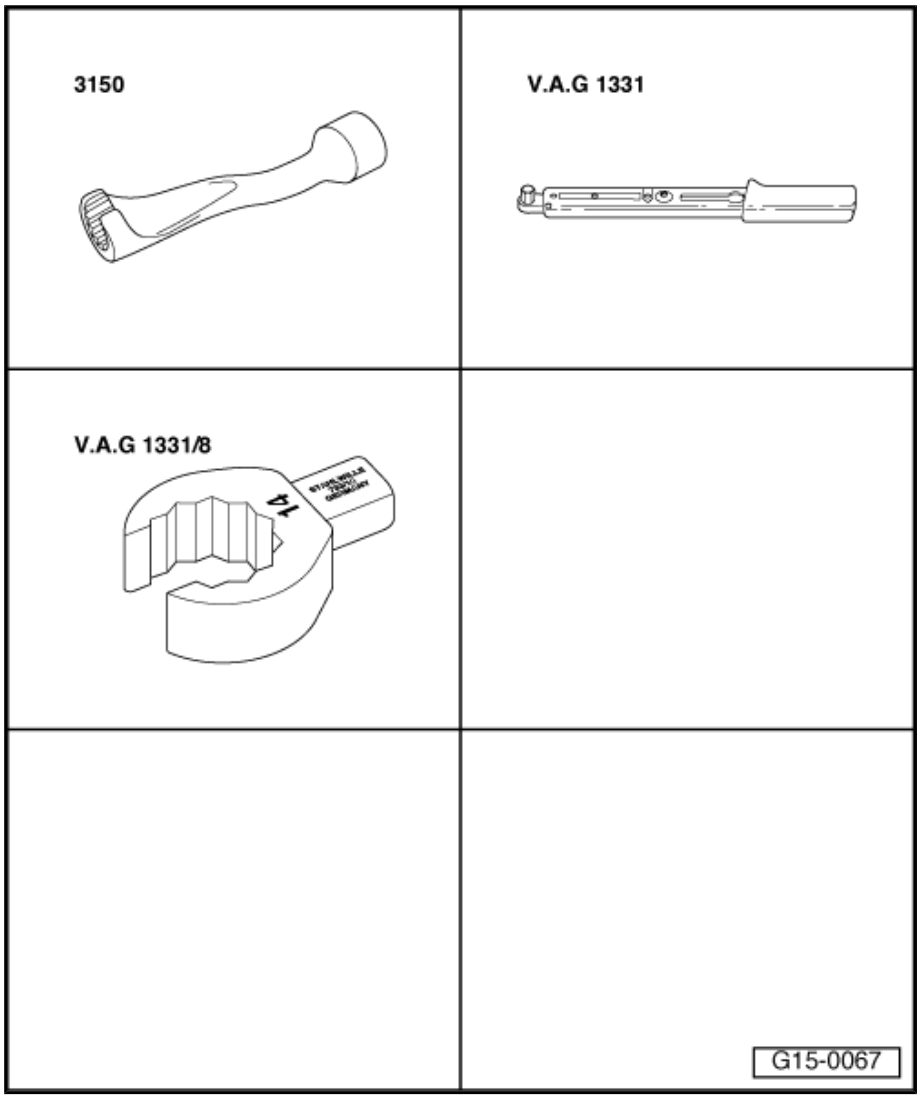
- ❑ Renew

22 - Air intake hose

- ❑ Must be free of oil and grease when installing.

3.2 Removing and installing intake manifold upper part

Special tools and workshop equipment required



♦ 14 mm socket - 3150-

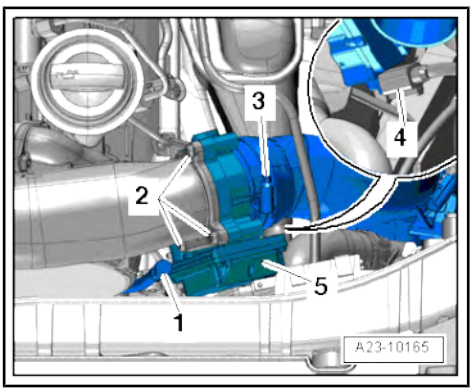
- Torque wrench - V.A.G 1331-
- Ratchet wrench - V.A.G 1331/1-
- Open ring tool insert - V.A.G 1331/8-

Removing

Caution

- *Always read rules for cleanliness and instructions for working on fuel system ⇒ page 234 .*
- *Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.*

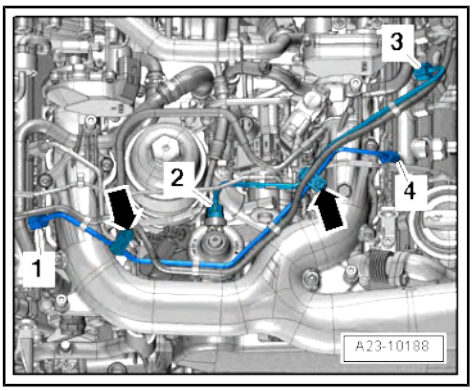
– Remove engine cover panel ⇒ page 3 .
– Remove air intake hose. To do this, loosen hose clip -3-.
– Unscrew bolt -2- and separate electrical connector -4-.
– Remove throttle valve module - J338- -item 5-.



Note

Disregard -item 1-.

– Unscrew bolts -arrows- and remove retaining clamps.
– Unscrew union nuts -1- and -4- and remove high-pressure line.

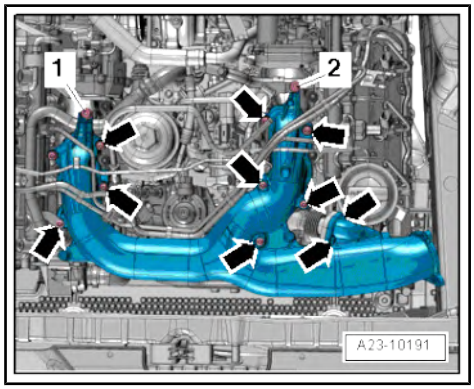


Note

-Items 2, 3- should be disregarded.

– Unscrew mounting pin for engine cover panel -1- and -2-.

– Unscrew bolts -arrows- and remove upper part of intake manifold.



Installing

Install in reverse order of removal, observing the following.

- For specified torques, see assembly overview for intake manifold ⇒ page 273

Note

- *Renew seals and gaskets.*
- *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- *Secure all hose connections with hose clips (same as original equipment) ⇒ Parts catalogue .*
- *In order to be in a position to securely attach the charge air hoses on their connections, the worm screws of the used hose clips have to the sprayed with penetrating spray before installing.*

– Install high-pressure lines ⇒ page 247 .

3.3 Removing and installing lower parts of intake manifold

⇒ "3.3.1 Removing and installing lower part of left intake manifold", page 276 .

⇒ "3.3.2 Removing and installing lower part of right intake manifold", page 278 .

3.3.1 Removing and installing lower part of left intake manifold

Removing

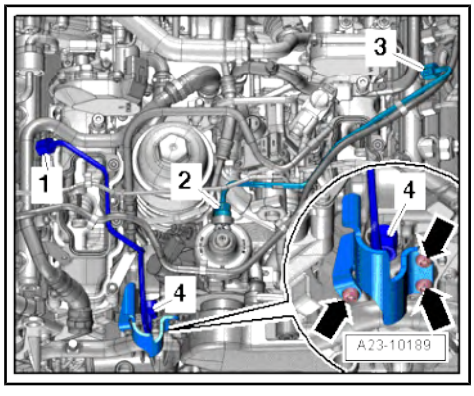
WARNING

- ***Always read rules for cleanliness and instructions for working on fuel system ⇒ page 234 .***
- ***Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.***

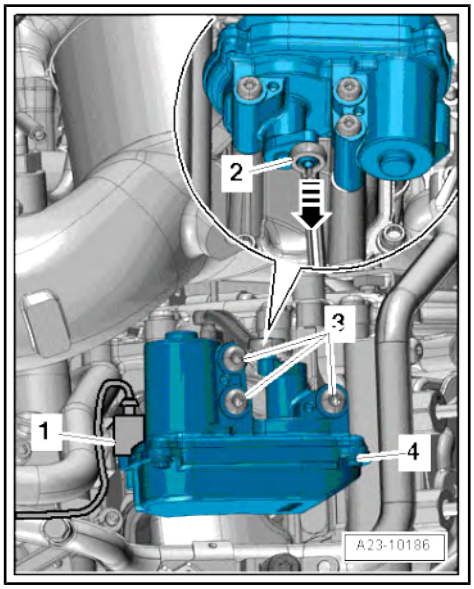
– Remove engine cover panel ⇒ page 3 .

– Remove upper part of intake manifold ⇒ page 274 .

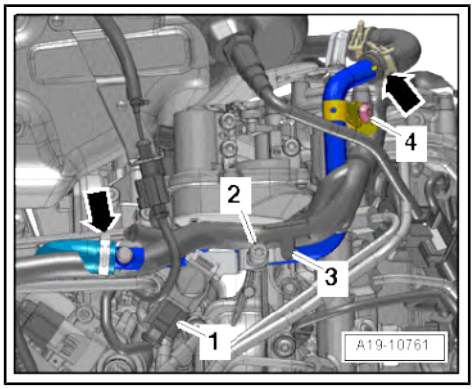
– Unscrew union nuts -2- and -3- and remove high-pressure line.



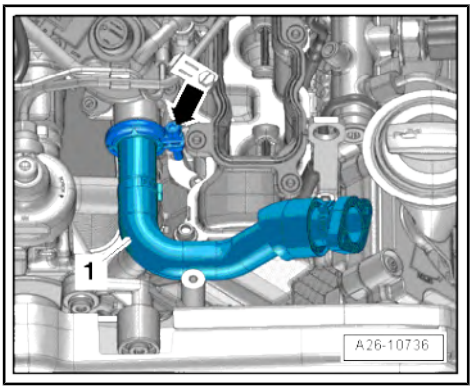
– Carefully press connecting rod -arrow- off intake manifold flap motor 2 - V275- .
– Separate connector -1-.
– Unscrew bolts -3- and remove intake manifold flap 2 motor - V275- -item 4-.
– Disconnect electrical connectors for glow plugs for cylinders 4, 5, 6.



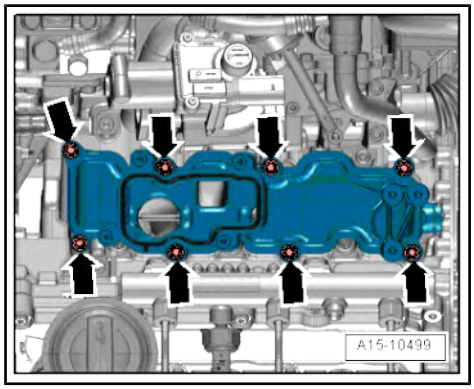
– Take exhaust gas recirculation cooler changeover valve - N345- -1- out of retainer.
– Unscrew bolt -4-.



– Release clip -arrow- and remove pipe -1- for exhaust gas re-circulation.



– Unscrew bolts -arrows-.
– Carefully remove lower part of intake manifold.



Note

Block off intake ports in cylinder head with a clean rag.

Installing

- Specified torques: assembly overview - intake manifold ⇒ page 273

Install in reverse order of removal, observing the following.

Note

Renew seals and gaskets.

– Install intake manifold flap 2 motor - V275- ⇒ page 273 .
– Install upper part of intake manifold ⇒ page 274 .
– Install high-pressure lines ⇒ page 247 .
– Check fuel system for leaks ⇒ page 272 .

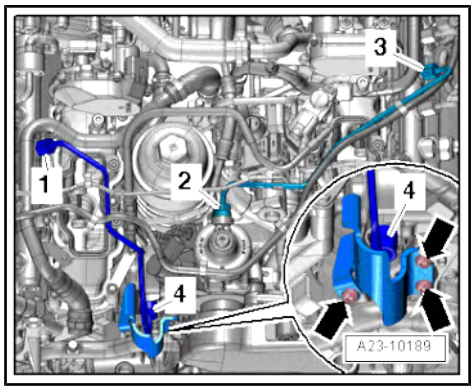
3.3.2 Removing and installing lower part of right intake manifold

Removing

WARNING

- ***Always read rules for cleanliness and instructions for working on fuel system ⇒ page 234 .***
- ***Always follow these rules for cleanliness and instructions before starting work and while working on the fuel system.***

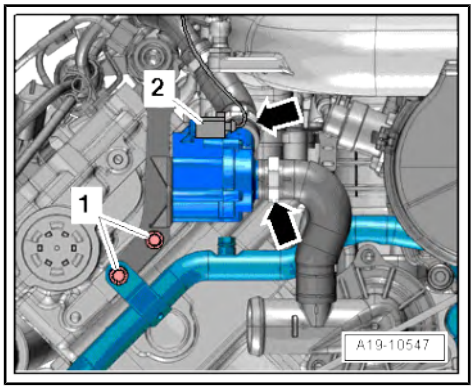
– Remove engine cover panel ⇒ page 3 .
– Remove upper part of intake manifold ⇒ page 274 .
– Unscrew bolts -arrows- and detach guard for high-pressure line.
– Unscrew union nuts -1- and -4- and remove high-pressure line.



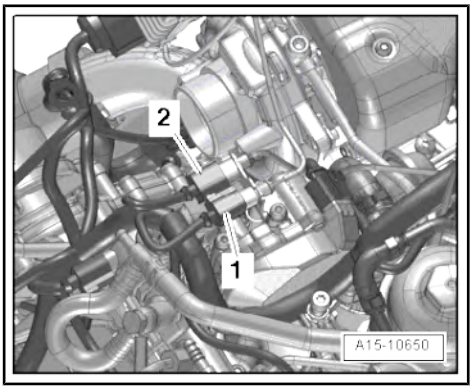
Note

-Items 2, 3- should be disregarded.

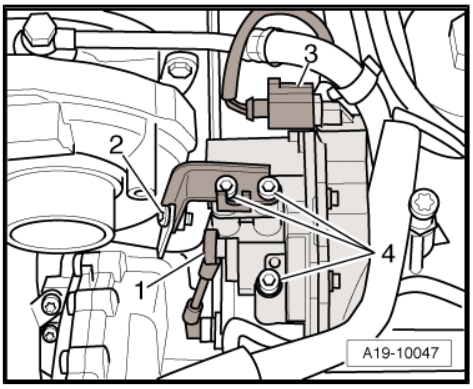
– Disconnect electrical connector -2- from pump for exhaust gas recirculation cooler - V400- .
– Unscrew bolts -1-.



– Remove electrical connectors -1- and -2- from bracket.

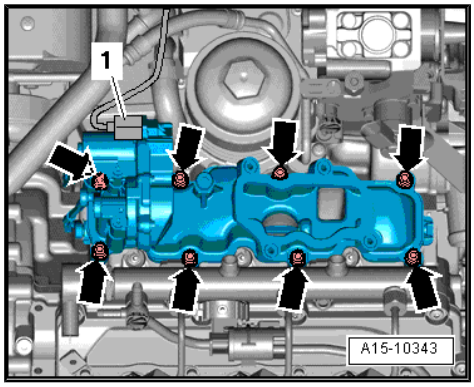


– Carefully press connecting rod -1- off intake manifold flap motor - V157- .
– Disconnect electrical connector -3- on intake manifold flap motor - V157- .
– Unscrew bolts -2- and -4- and remove intake manifold flap motor - V157- .
– Disconnect electrical connectors for glow plugs for cylinders 1, 2, 3.
– Move wiring harness aside.



– Unscrew bolts -arrows-.

– Push coolant pipe aside and remove lower part of right intake manifold.



Note

- *-Item 1- should be disregarded.*
- *Block off intake ports in cylinder head with a clean rag.*

Installing

- Specified torques: assembly overview - intake manifold ⇒ page 273

Install in reverse order of removal, observing the following.

Note

Renew gaskets.

– Install intake manifold flap motor - V157- ⇒ page 273 .

– Install upper part of intake manifold ⇒ page 274 .

– Install high-pressure lines ⇒ page 247 .

– Check fuel system for leaks ⇒ page 272 .

4 Air filter

4.1 Assembly overview - air filter

1 - Air filter lower part

2 - Bolt
- ❑ 10 Nm

3 - Filter element

4 - Bolt
- ❑ 6 Nm

5 - Clip
- ❑ Remove and install with -VAS 5024-

6 - Connecting pipe
- ❑ To turbocharger

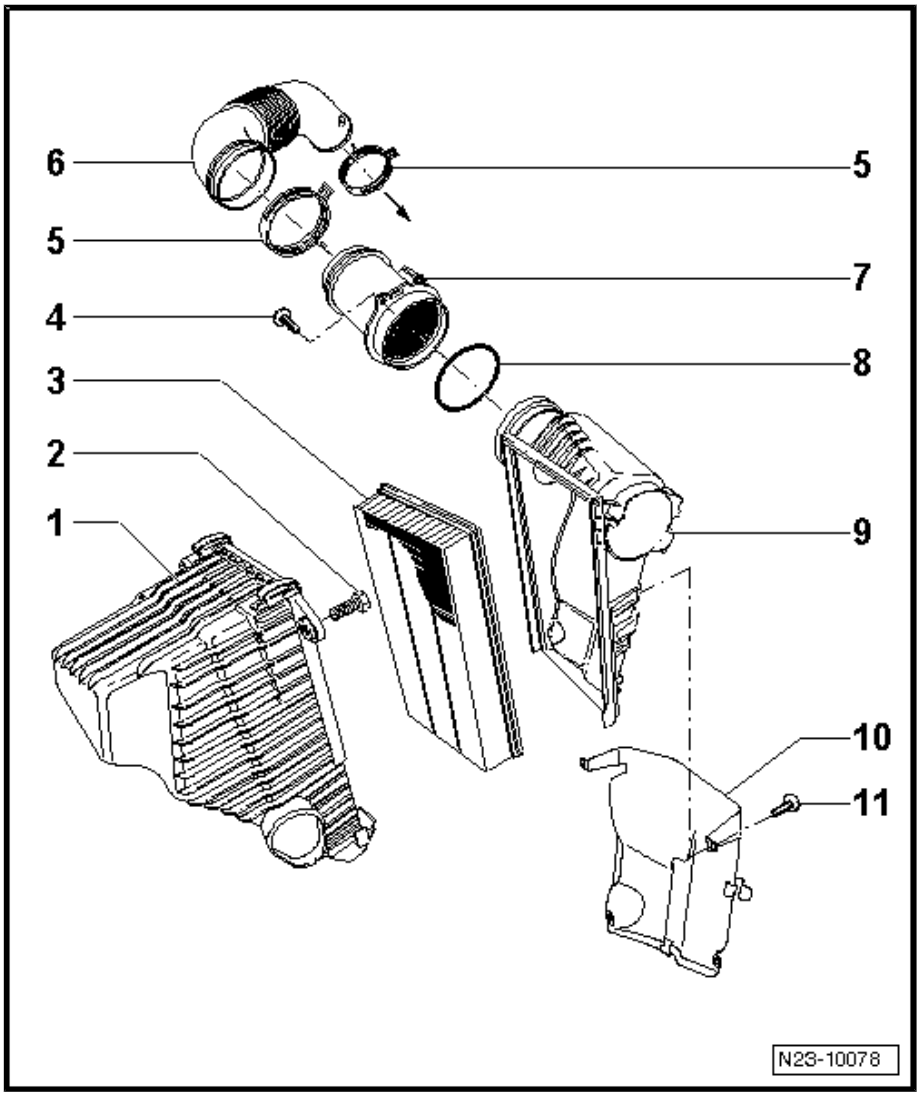
7 - Air mass meter - G70-

8 - O-ring
- ❑ Renew if damaged

9 - Air filter upper part

10 - Heat shield

11 - Bolt
- ❑ 6 Nm



5 Engine (motor) control unit

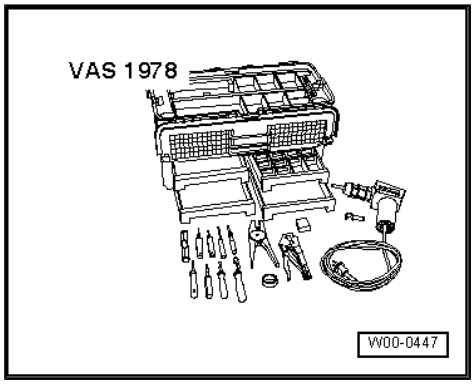
5.1 Removing and installing engine (motor) control unit - J623-

Note

If you wish to renew the engine control unit, please carry out the "Renew engine control unit" guided function ⇒ Vehicle diagnostic tester.

Special tools and workshop equipment required

- Hot air blower from wiring harness repair set - VAS 1978-



- Nozzle attachment from wiring harness repair set - VAS 1978-
- Grip pliers

Removing

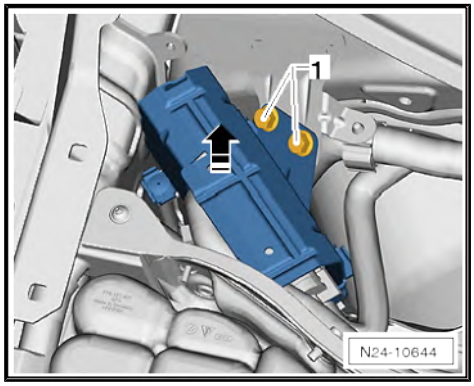
– Switch off ignition.

– Remove wiper arms ⇒ Electrical system; Rep. gr. 92 ; Windscreen wiper system; Removing and installing wiper arms .

– Remove plenum chamber cover ⇒ General body repairs, exterior; Rep. gr. 50 ; Plenum chamber cover; Plenum chamber cover .

– Cover engine compartment in the area of the engine control unit in order to prevent paintwork from being scratched.

– Unscrew bolts and remove engine control unit upwards.



Note

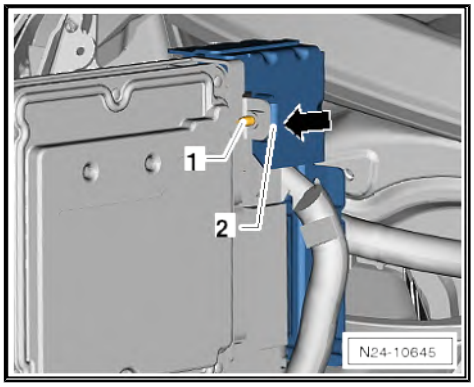
The shear-head bolt threads are coated with locking compound. Heating the shear-head bolt with a hot air blower releases the locking effect of the locking compound.

Caution

Make sure that no components are damaged due to burning.

When shear-head bolts are heated up, parts of the protective housing will be subjected to a large amount of heat. Wear protective gloves to avoid possible injury.

– Heat shear-head bolt -arrow- with the help of a hot-air blower.
– Fit clamping pliers to end of bolt -1- and loosen bolt.
– Bend down metal edges of protective housing and unscrew bolts.



Installing:

– Renew protective housing.
– Install new protective housing with new shear-head bolts.
– Tighten shear-head bolts evenly until bolt head breaks off.
– Insert engine control unit into plenum chamber.
– Install plenum chamber cover ⇒ General body repairs, exterior; Rep. gr. 50 ; Plenum chamber cover; Plenum chamber cover .
– Install wiper arms ⇒ Electrical system; Rep. gr. 92 ; Windscreen wiper system; Removing and installing wiper arms .

26 – Exhaust system

1 Parts of the exhaust system

⇒ “1.1 Assembly overview - front exhaust pipe with catalytic converter and particulate filter (engine codes CASA and CASD)”, page 285 .

⇒ “1.2 Assembly overview - front exhaust pipe with catalytic converter, reduction catalytic converter and particulate filter (engine code CATA)”, page 287 .

⇒ “1.4 Removing and installing particulate filter”, page 291 .

⇒ “1.5 Removing and installing reduction catalytic converter”, page 294 .

⇒ “1.6 Assembly overview - exhaust gas temperature regulation (engine codes CASA and CASD)”, page 294 .

⇒ “1.7 Assembly overview - exhaust gas temperature regulation (engine code CATA)”, page 300 .

⇒ “1.8 Silencer with mountings”, page 310 .

⇒ “1.9 SCR system (selective catalytic reduction)”, page 311 .

⇒ “1.10 Replacing tail pipes”, page 329 .

⇒ “1.11 Aligning exhaust system free of stress”, page 329 .

⇒ “1.12 Check exhaust system for leaks”, page 330 .

⇒ “1.13 Assembly overview - exhaust manifold with intermediate pipe”, page 330 .

⇒ “1.14 Removing and installing left exhaust manifold”, page 331 .

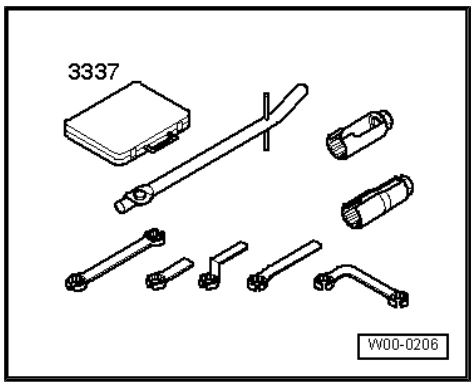
⇒ “1.15 Removing and installing right exhaust manifold”, page 333 .

⇒ “1.16 Removing and installing intermediate pipe (left side)”, page 335 .

⇒ “1.17 Removing and installing intermediate pipe (right side)”, page 337 .

Special tools and workshop equipment required

- Lambda probe open ring spanner set - 3337-



WARNING

Observe the following points during all installation work, in particular in the engine compartment, due to the space limitations:

- *Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.*
- *Ensure that there is sufficient clearance to all moving or hot components.*

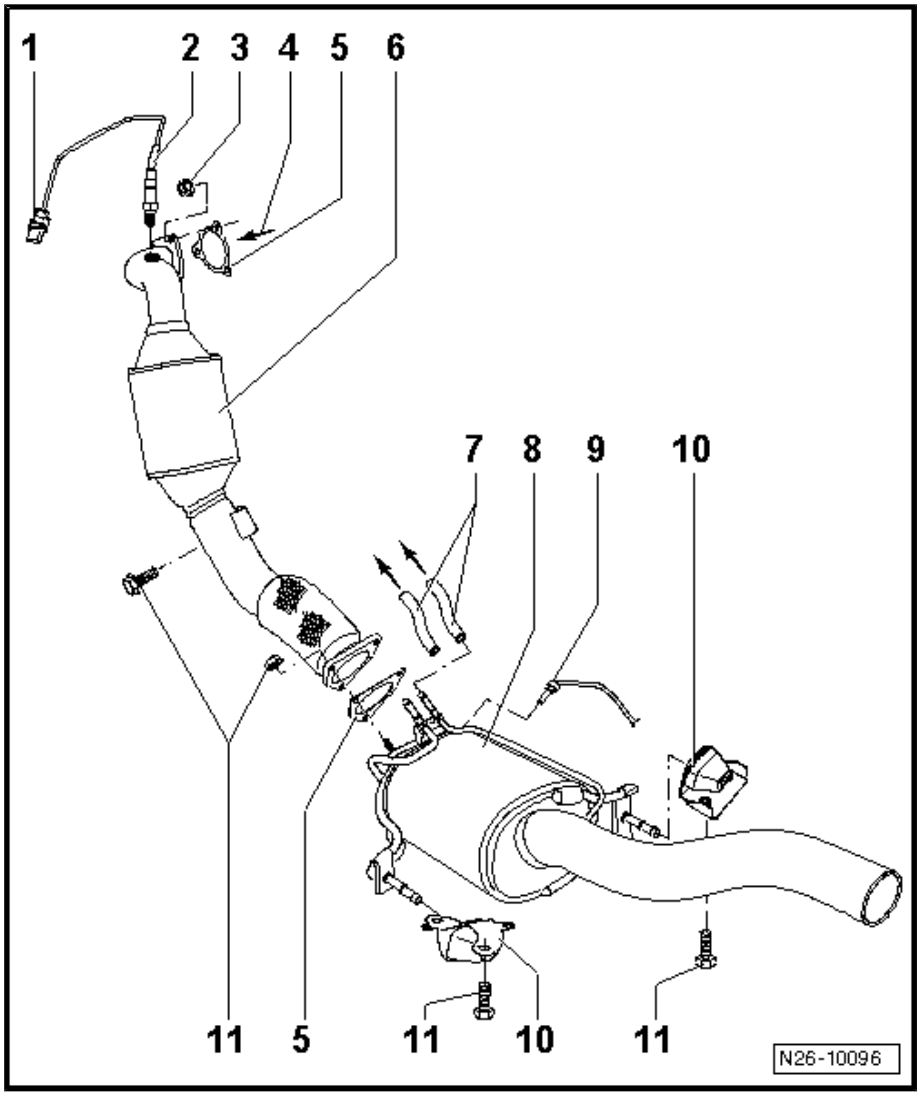
Note

- *After working on the exhaust system, ensure that the system is not under stress and that there is sufficient clearance to the bodywork. If necessary, loosen double and single clamps and align silencer and exhaust pipe so that sufficient clearance is maintained to the bodywork and the support rings are evenly loaded.*
- *Renew self-locking nuts.*

1.1 Assembly overview - front exhaust pipe with catalytic converter and particulate filter (engine codes CASA and CASD)

Note

If particulate filter or pressure differential sender - G505- is exchanged, pressure differential sender - G505- must be adapted using vehicle diagnostic tester as a matter of priority: Guided Functions; Adapting pressure differential sender - G505- .



1 - Connector

- For Lambda probe 1 before catalytic converter - GX10- .

2 - Lambda probe 1 before catalytic converter - GX10-

- 50 Nm
- With Lambda probe - G39-
- With Lambda probe heater - Z19- .
- Grease only the thread with high-temperature paste - G 052 112 A3- . Do not allow high-temperature paste - G 052 112 A3- to get into slots of probe body.
- To remove use Lambda probe open ring spanner set - 3337- .
- Removing and installing ⇒ page 296

3 - Nut

- Renew
- 23 Nm
- Coat with high-temperature paste, for high-temperature paste refer to ⇒ Parts catalogue .

4 - From turbocharger

5 - Seal

- Renew

6 - Catalytic converter

- When removing, support gearbox with engine and gearbox jack - V.A.G 1383 A- and gearbox cross member.

7 - Pressure line

- To pressure differential sender - G505-
- Engine codes CASA and CASD, only one pressure line to pressure differential sender - G505- .

8 - Particulate filter

- To remove, support gearbox using engine and gearbox jack - V.A.G 1383 A- and remove gearbox transverse support.
- After renewing, adaptation of ash mass comparison must be set to “0” ⇒ Vehicle diagnostic tester “Guided Functions”.

9 - Exhaust gas temperature sender 3 - G495-

- 45 Nm
- Coat with high-temperature paste, for high-temperature paste refer to ⇒ Parts catalogue .
- Removing and installing ⇒ page 297

10 - Mounting

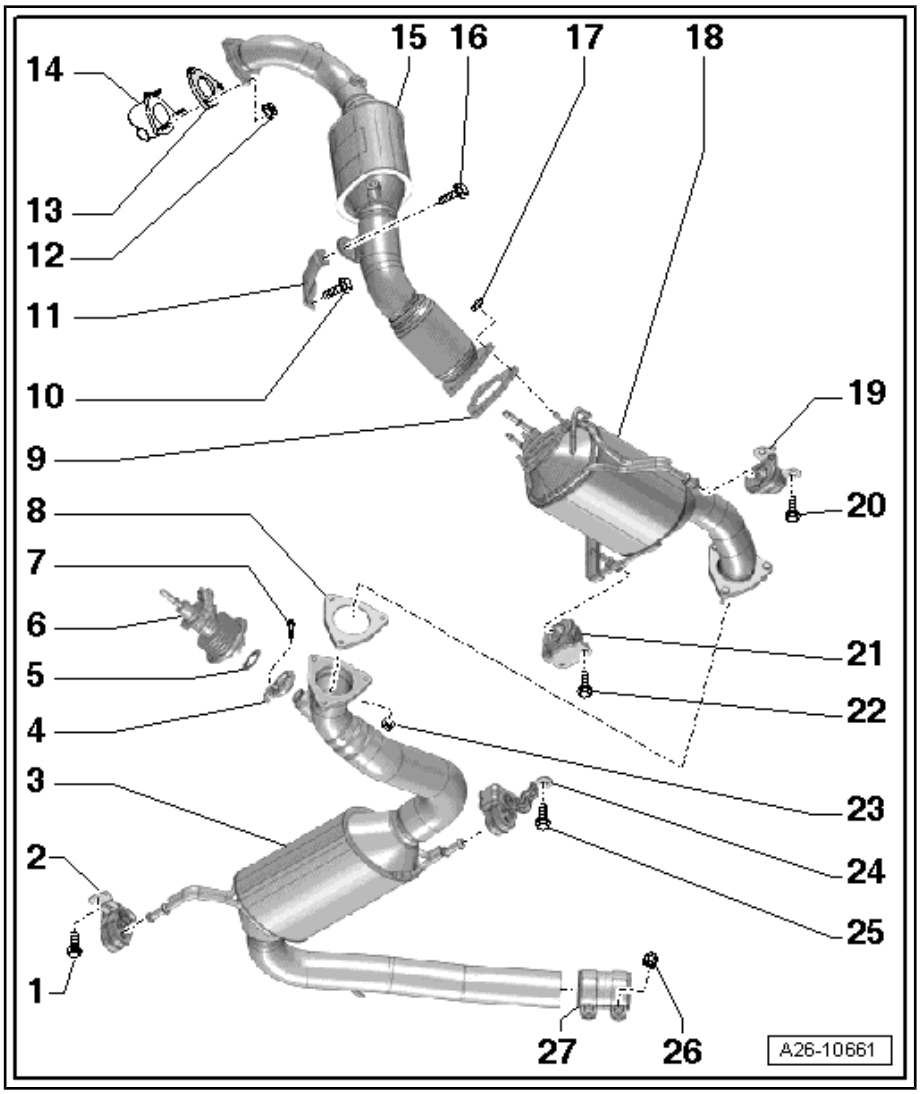
11 - Bolt/nut

- 25 Nm

1.2 Assembly overview - front exhaust pipe with catalytic converter, reduction catalytic converter and particulate filter (engine code CATA)

Note

If particulate filter or pressure differential sender - G505- is exchanged, pressure differential sender - G505- must be adapted using vehicle diagnostic tester as a matter of priority: Guided Functions; Adapting pressure differential sender - G505- .



1 - Bolt
- ❑ 23 Nm

2 - Mounting
- ❑ Renew if damaged

3 - Reduction catalytic converter

4 - Clamp

5 - Seal
- ❑ Renew

6 - Injector for reducing agent - N474-
- ❑ Removing and installing ⇒ page 318

7 - Bolt
- ❑ 5 Nm
- ❑ Renew

8 - Seal
- ❑ Renew

9 - Seal
- ❑ Renew

10 - Bolt
- ❑ 23 Nm

11 - Bracket
- ❑ For starter catalytic converter

12 - Nut
- ❑ Renew
- ❑ 23 Nm
- ❑ Coat with high-temperature paste, for high-temperature paste refer to ⇒ Parts catalogue .

13 - Seal
- ❑ Renew

14 - Exhaust turbocharger

15 - Starter catalytic converter
- ❑ With decoupling element.
- ❑ Do not bend flexible joint more than 10° - otherwise it can be damaged.
- ❑ Protect from damage by knocks and impact.

16 - Bolt
- ❑ 23 Nm

17 - Nut

- ❑ 23 Nm
- ❑ Renew
- ❑ Coat with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .

18 - Particulate filter

- ❑ With catalytic converter.
- ❑ With pressure line for pressure differential sender - G505- .

19 - Mounting

- ❑ Renew if damaged

20 - Bolt

- ❑ 25 Nm

21 - Mounting

- ❑ Renew if damaged

22 - Bolt

- ❑ 23 Nm

23 - Nut

- ❑ 23 Nm
- ❑ Renew

24 - Mounting

- ❑ Renew if damaged

25 - Bolt

- ❑ 25 Nm

26 - Nut

- ❑ 23 Nm

27 - Clamping sleeve

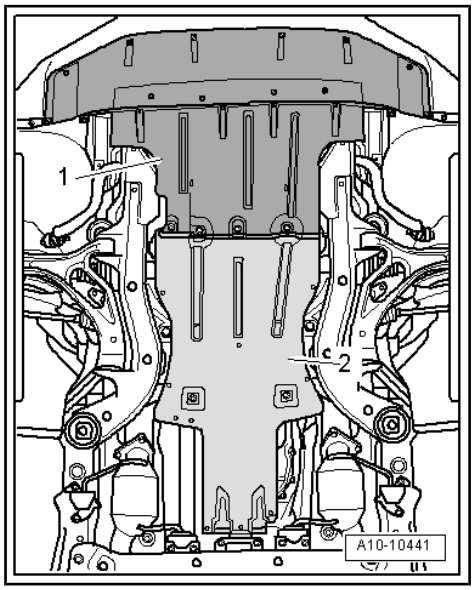
- ❑ Tighten threaded connections evenly.

1.3 Removing and installing starter catalytic converter

Removing

– Remove noise insulation elements -1- and -2- ⇒ Rep. gr. 66 .

– Drain coolant ⇒ page 187 .



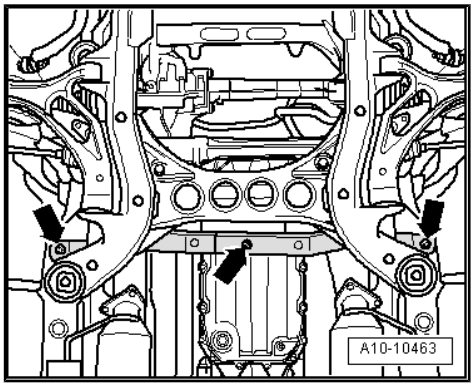
– Unscrew bolts -arrows- and remove bracket for noise insulation.

– Remove particulate filter ⇒ page 291 .

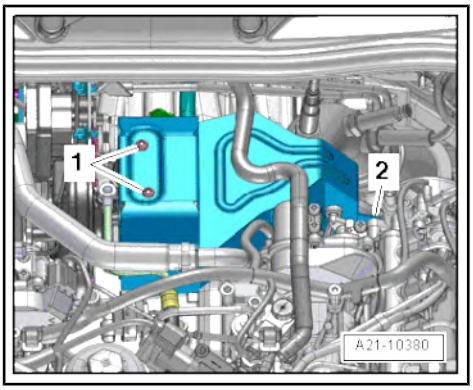
– Remove lambda probe 1 before catalytic converter - GX10- .

◆ Vehicles with engine code CATA ⇒ page 302 .

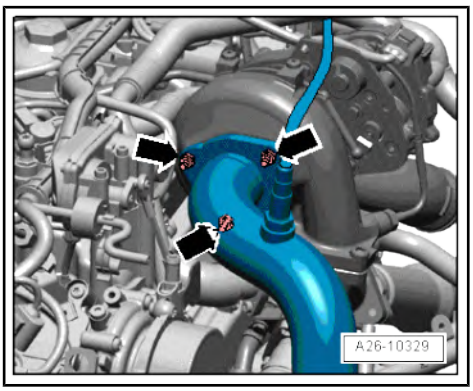
◆ Vehicles with engine code CASA or CASD ⇒ page 296 .



– Unscrew bolts -1- and -2- and remove heat shield for turbocharger.



– Unscrew nuts -arrows-.



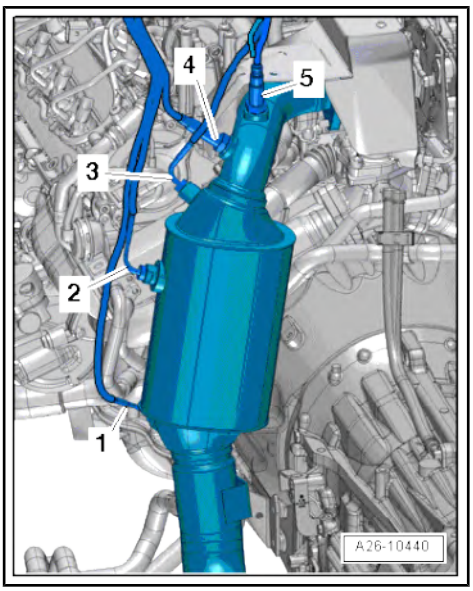
– Unscrew senders which are accessible from above:

2 - Catalytic converter temperature sensor 1 - G20- - engine code CATA only

3 - Exhaust gas temperature sender 2 - G448- - engine code CATA only

4 - NOx sender - G295-

– Unscrew exhaust gas temperature sender 3 - G495- -item 1- which is accessible from below.

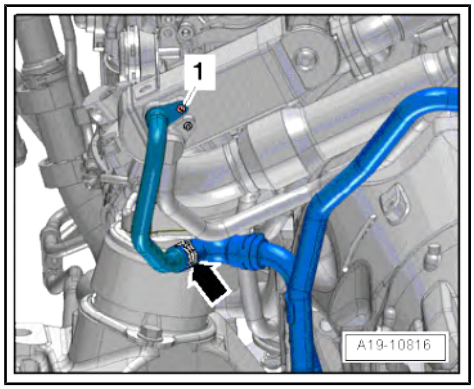


Note

-Item 5- has already been unscrewed.

– Unscrew bolt -1-.

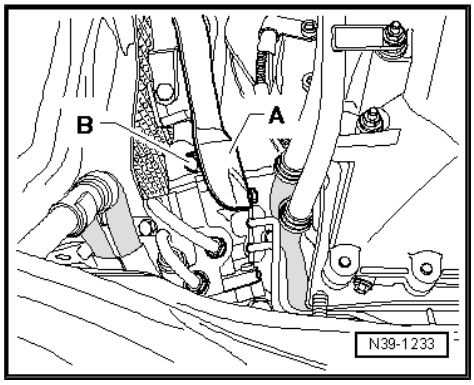
– Pull rear left coolant pipe off supplementary cooler for exhaust gas recirculation.



Note

Ignore -arrow-.

– Remove heat shield -A- from steering rack.



Caution

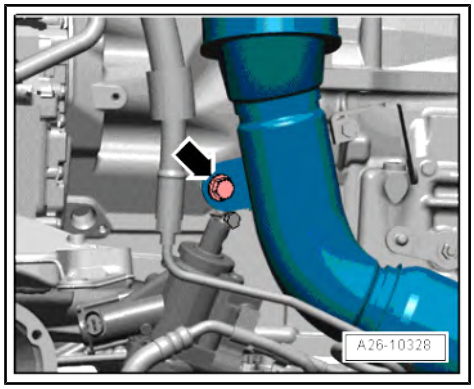
Danger of airbag coil connectors becoming twisted.

- ***Only disconnect universal joint from steering rack when front wheels are in straight-ahead position.***
- ***Secure steering wheel with adhesive tape so that position of steering wheel and steering rack no longer change.***

– Unscrew bolt -B- for universal joint.

– Press universal joint off steering rack.

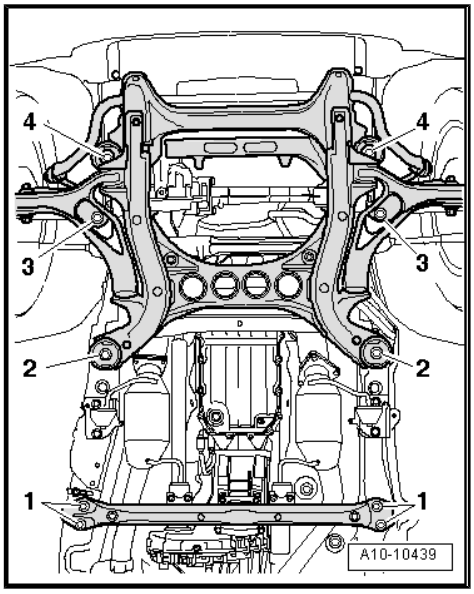
– Remove bolt -arrow- on retainer for starter catalytic converter.



WARNING

Danger of accidents due to unsecured subframe.

- *Bolts -1, 3, 4- for subframe must not be loosened.*



– Unscrew bolts -2- to lower subframe at rear.

– Remove starter catalytic converter downwards.

Installing

Install in reverse order of removal, observing the following.

- Specified torques for engine codes CASA, CASD ⇒ page 285 .
- Specified torques for engine code CATA ⇒ page 287 .

Note

- *Renew gaskets and self-locking nuts.*
- *Fit all cable ties in the original position when installing.*

– Install subframe ⇒ Rep. gr. 40 .

– Attach universal joint to steering rack ⇒ Rep. gr. 48 .

– Install exhaust temperature sender 3 - G495- ⇒ page 297 .

– Installing exhaust temperature sender 2 - G448- ⇒ page 305 .

– Install heat shield for turbocharger.

– Install NOx sender - G295- and Lambda probe 1 before catalytic converter - GX10- ⇒ page 296 .

– Install particulate filter ⇒ page 291 .

– Align exhaust system free of stress ⇒ page 329 .

– Add coolant ⇒ page 189 .

– Install noise insulation bracket and noise insulation ⇒ Rep. gr. 66 .

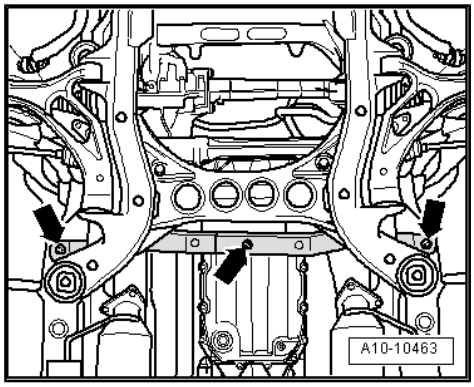
– For vehicles with air suspension, deactivate jacking mode ⇒ Rep. gr. 43 .

1.4 Removing and installing particulate filter

Removing

– Remove rear noise insulation -2-: ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Assembly overview - noise insulation .

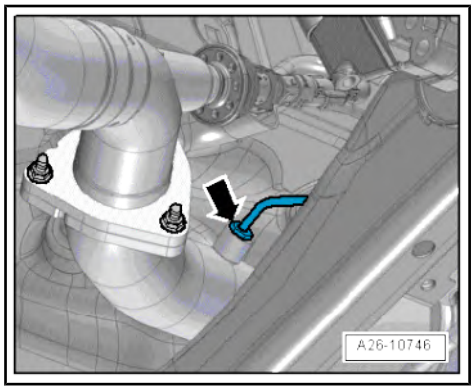
– Unscrew bolts -arrows- and remove bracket for noise insulation.



Vehicles with engine code CATA

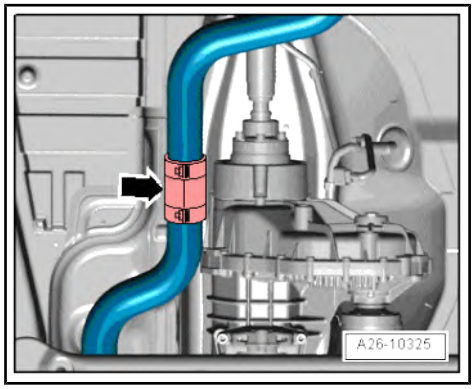
– Remove reduction catalytic converter ⇒ page 294 .

– Unscrew exhaust gas temperature sender 4 - G648- -arrow-.



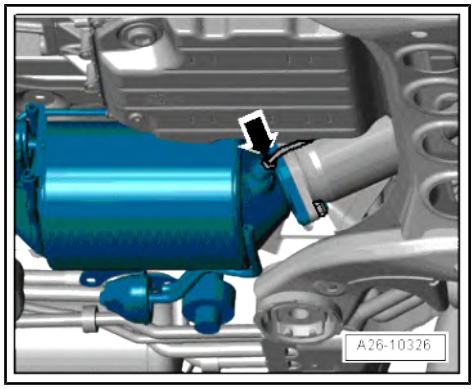
Vehicles with engine code: CASA or CASD

– Separate exhaust system at clamp -arrows-.

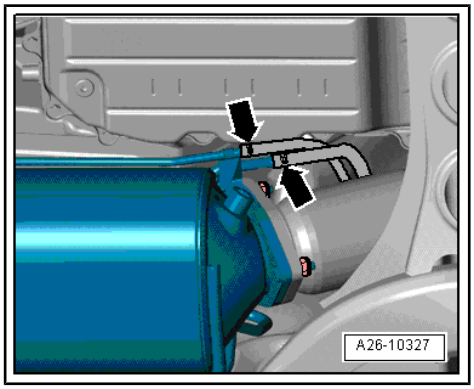


– Unscrew exhaust gas temperature sender 3 - G495- -arrow-.

Continued for all vehicles

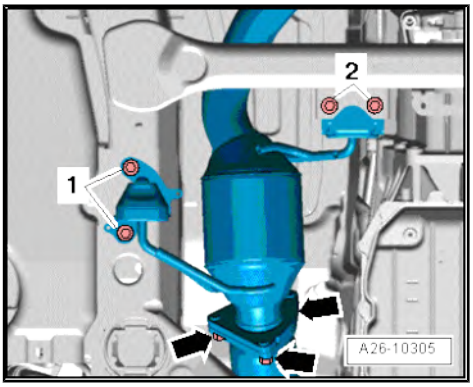


– Detach hoses -arrows- to pressure differential sender - G505- from pressure lines on particulate filter.



– Unscrew bolts -1- and -2- for particulate filter bracket.

– Unscrew nuts -arrows- and remove particulate filter.



Installing

Install in reverse order of removal, observing the following.

- Specified torques for engine codes CASA, CASD ⇒ page 285 .
- Specified torques for engine code CATA ⇒ page 287 .

Note

- *Renew gaskets and self-locking nuts.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue (ETKA) .*

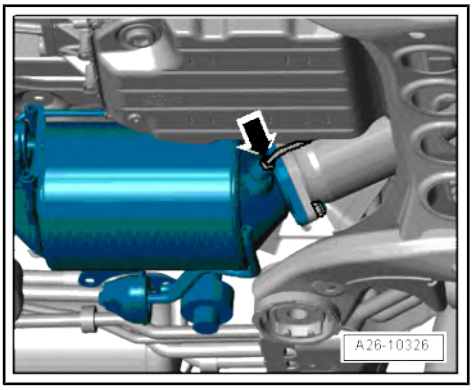
Vehicles with engine code CATA

– Installing exhaust temperature sender 4 - G648- ⇒ page 307 .

– Install reduction catalytic converter ⇒ page 294 .

Vehicles with engine code: CASA or CASD

– Install exhaust temperature sender 3 - G495- -arrow- ⇒ page 297 .



Continued for all vehicles

– Align exhaust system free of stress ⇒ page 329 .

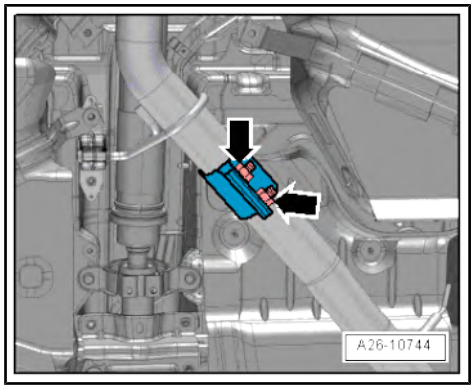
– Install noise insulation bracket and noise insulation ⇒ General body repairs, exterior; Rep. gr. 66 ; Noise insulation; Assembly overview - noise insulation .

– After renewing particulate filter carry out “adaptation” in “Guided Functions” ⇒ Vehicle diagnostic tester.

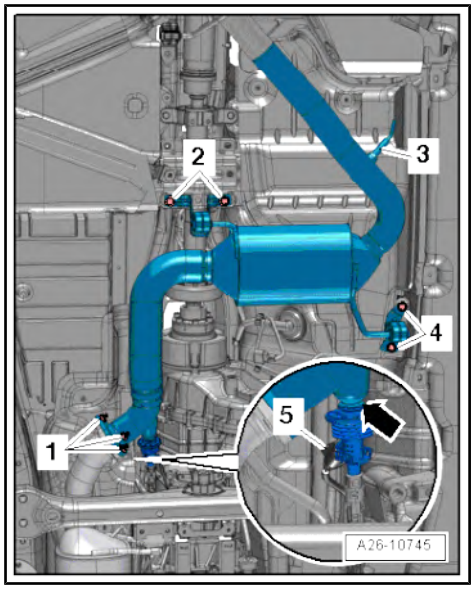
1.5 Removing and installing reduction catalytic converter

Removing

– Separate exhaust system at clamp -arrows-.



– Unscrew NOx sender 2 - G687- -item 3-
– Separate electrical connector -5-.
– Loosen retaining clip -arrow- and detach injector for reducing agent - N474- .
– Unscrew nuts -1- and bolts -2- and -4-, remove reduction catalytic converter.



Installing

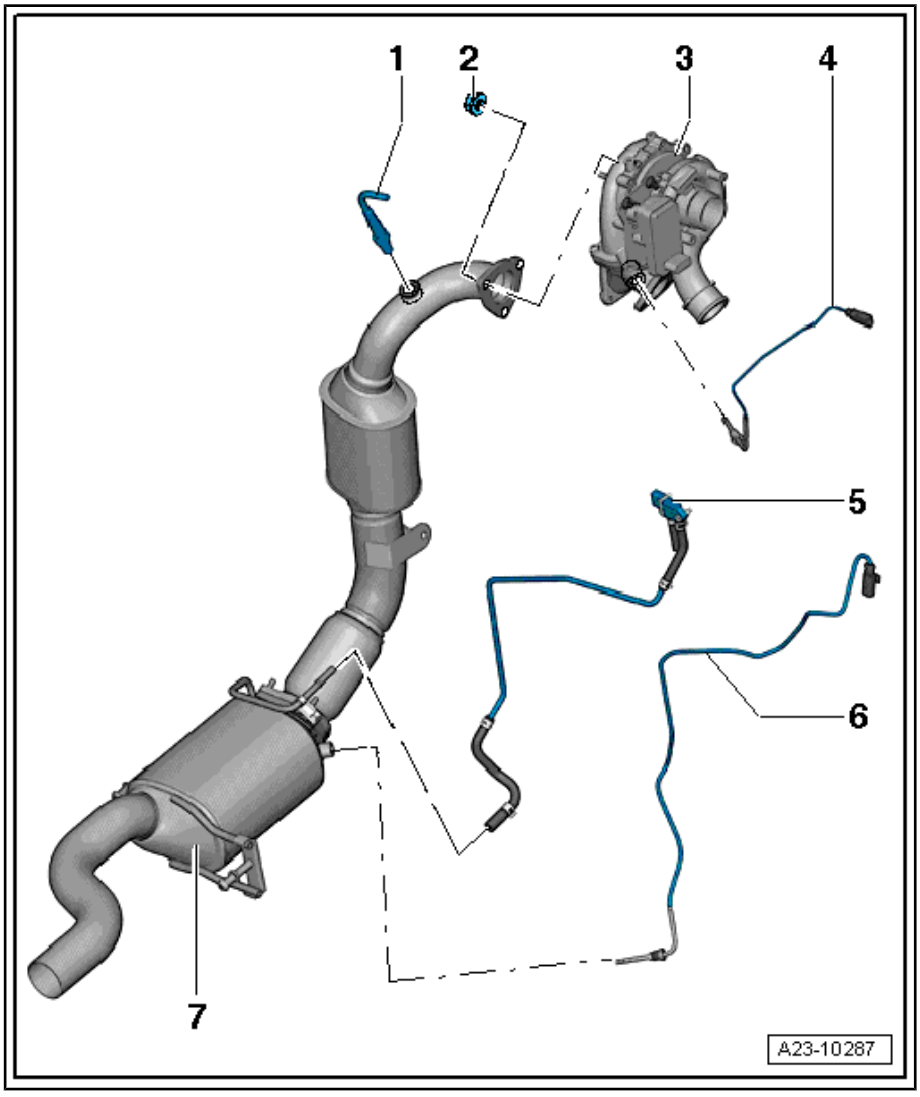
Install in reverse order of removal, observing the following.

- Specified torques ⇒ page 287 .
– Install injector for reducing agent - N474- ⇒ page 318 .
– Install NOx sender 2 - G687- ⇒ page 309 .

1.6 Assembly overview - exhaust gas temperature regulation (engine codes CASA and CASD)

Note

- *If particulate filter or pressure differential sender - G505- is exchanged, pressure differential sender - G505- must be adapted using vehicle diagnostic tester as a matter of priority: Guided Functions; Adapting pressure differential sender - G505- .*
- *Locations of connectors ⇒ page 295*



1 - Lambda probe 1 before catalytic converter - GX10-

- ❑ 50 Nm
- ❑ With Lambda probe - G39-
- ❑ With Lambda probe heater - Z19- .
- ❑ Grease thread only with high-temperature paste - G 052 112 A3- . High-temperature paste - G 052 112 A3- must not get into slots of probe body.
- ❑ To remove use Lambda probe open ring spanner set - 3337- .
- ❑ Removing and installing ⇒ page 296

2 - Nut

- ❑ Renew
- ❑ 23 Nm
- ❑ Coat with high-temperature paste, for high-temperature paste refer to ⇒ Parts catalogue .

3 - Exhaust turbocharger

4 - Exhaust gas temperature sender 1 - G235-

- ❑ 45 Nm
- ❑ Coat with high-temperature paste, for high-temperature paste refer to ⇒ Parts catalogue .
- ❑ Removing and installing ⇒ page 297

5 - Pressure differential sender - G505-

- ❑ Removing and installing ⇒ page 299

6 - Exhaust gas temperature sender 3 - G495-

- ❑ 45 Nm
- ❑ Coat with high-temperature paste, for high-temperature paste refer to ⇒ Parts catalogue .
- ❑ Removing and installing ⇒ page 297

7 - Particulate filter

Locations for exhaust gas treatment connectors

1 - NOx sender - G295- (engine code CATA only)

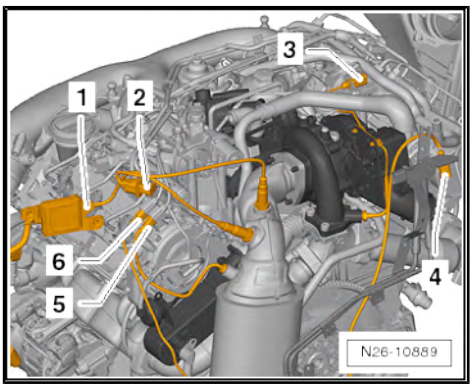
2 - Lambda probe 1 before catalytic converter - GX10-

3 - Exhaust gas temperature sender 1 - G235-

4 - Exhaust gas temperature sender 4 - G648- (engine code CATA only)

5 - Exhaust gas temperature sender 2 - G448-

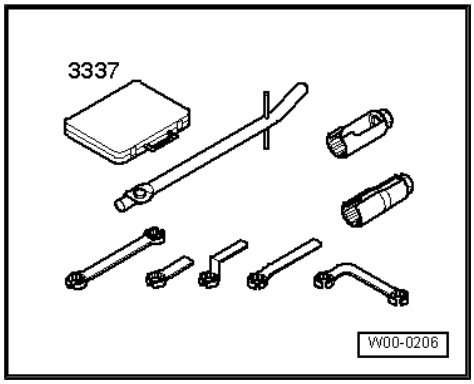
6 - Exhaust gas temperature sender 3 - G495-



1.6.1 Removing and installing Lambda probe 1 before catalytic converter - GX10-

Special tools and workshop equipment required

- Lambda probe open ring spanner set - 3337-

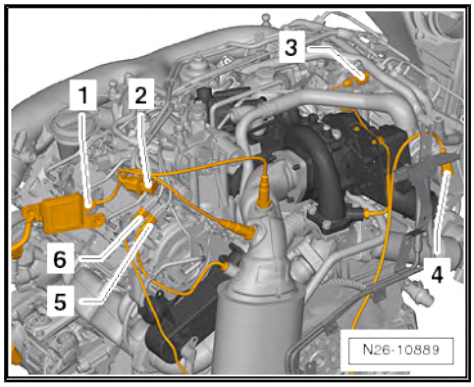


Removing

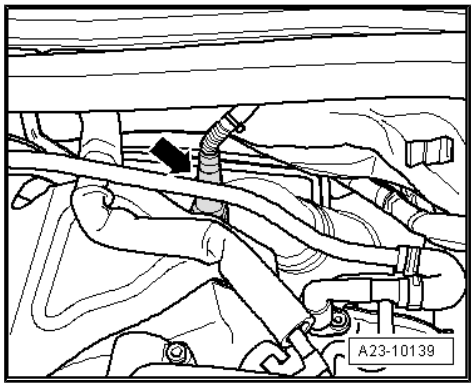
– Remove engine cover panel ⇒ page 3 .

– Remove connector -2- from retainer and disconnect.

– Expose cable routing to Lambda probe 1 before catalytic converter - GX10- .



– Unscrew and remove Lambda probe 1 before catalytic converter - GX10- -arrow- using suitable spanner from Lambda probe open ring spanner set - 3337- .



Installing

- Specified torques ⇒ page 294

Installation is carried out in the reverse order. When installing, note the following:

Note

- *New lambda probes are coated with an assembly paste. Do not allow any paste to enter the slots on the probe body.*
- *In the case of a used Lambda probe, grease only the thread with high-temperature paste (⇒ Parts catalogue). Do not allow any paste to enter the slots on the probe body.*
- *When installing, the Lambda probe electrical wiring must always be reattached at the same locations to prevent the Lambda probe wiring from coming into contact with the exhaust pipe.*

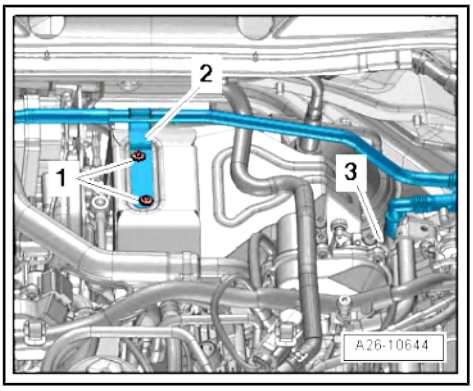
1.6.2 Removing and installing exhaust gas temperature sender 1 - G235-

Removing

– Remove engine cover panel ⇒ page 3 .

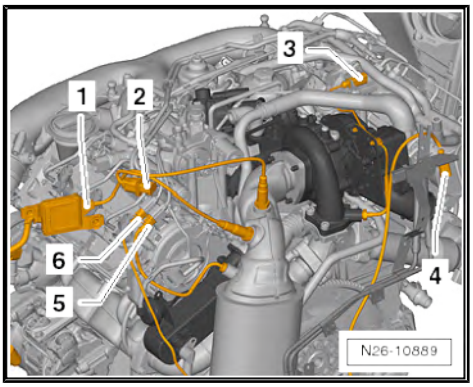
– Unscrew bolts -1- and only loosen bolt -3-.

– Push vacuum hose with retainer -2- aside and remove heat shield for turbocharger.



– Remove connector -3- from bracket and separate.

– Expose wiring to exhaust gas temperature sender 1 - G235- .



– Unscrew exhaust temperature sender 1 - G235- -arrow- and remove.

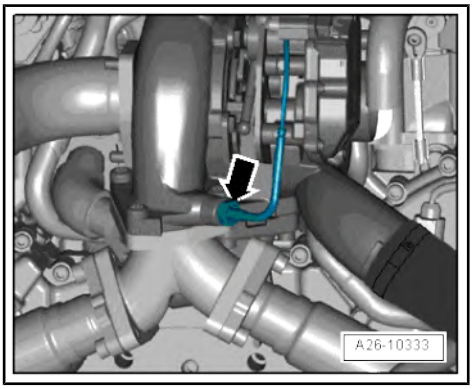
Installing

• Specified torques ⇒ page 294

Installation is carried out in the reverse order. When installing, note the following:

Note

Coat thread of exhaust gas temperature sender 1 - G235- with high-temperature paste; high-temperature paste ⇒ Parts catalogue .



• Installation position: exhaust gas temperature sender 1 - G235- faces upwards.

1.6.3 Removing and installing exhaust gas temperature sender 3 - G495-

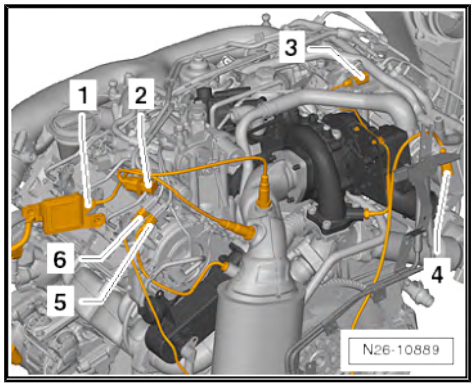
Removing

– Remove engine cover panel ⇒ page 3 .

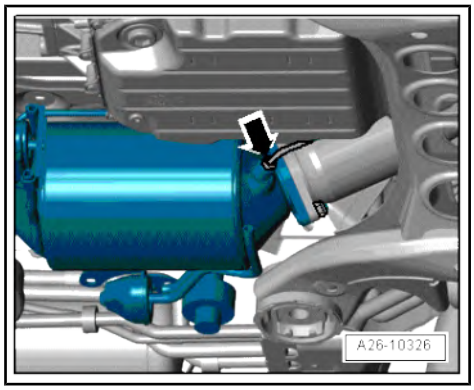
– Remove connector -6- from bracket and separate.

– Expose wiring to exhaust gas temperature sender 3 - G495- .

– Remove rear noise insulation: ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation; Assembly overview - noise insulation .



– Unscrew exhaust temperature sender 3 - G495- -arrow- and remove.



Installing

- Specified torques ⇒ page 294

Installation is carried out in the reverse order. When installing, note the following:

Note

Coat thread of exhaust gas temperature sender 3 - G495- with high-temperature paste; high-temperature paste ⇒ Parts catalogue .

– Install rear noise insulation: ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation; Assembly overview - noise insulation .

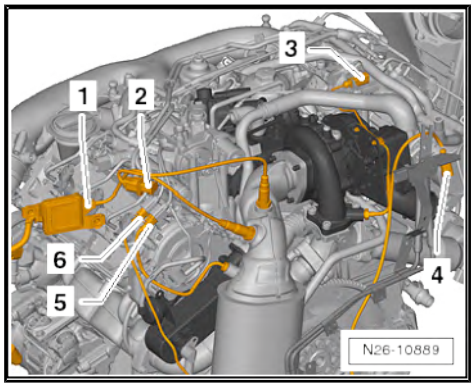
1.6.4 Removing and installing exhaust gas temperature sender 2 - G448-

Removing

– Remove engine cover panel ⇒ page 3 .

– Remove connector -5- from bracket and separate.

– Expose wiring to exhaust gas temperature sender 2 - G448- .



– Unscrew exhaust temperature sender 2 - G448- -3- and remove.

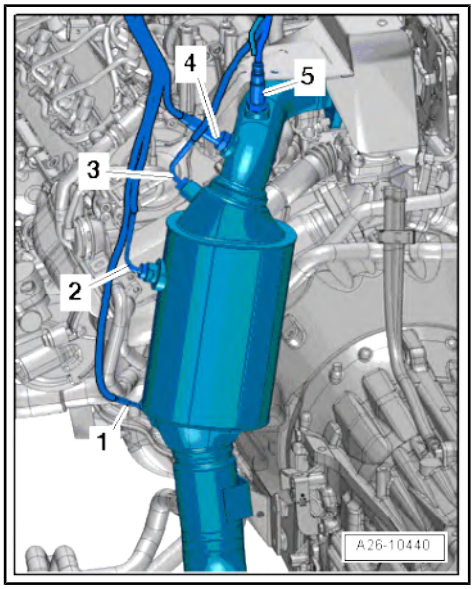
Installing

- Specified torque: 45 Nm

Installation is carried out in the reverse order. When installing, note the following:

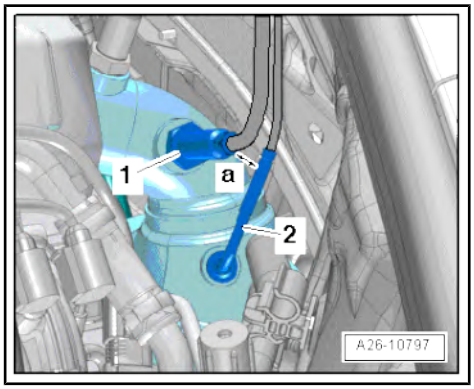
Note

Coat thread of exhaust gas temperature sender 2 - G448- with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA) .



Note installation position:

- Dimension -a- = 20 mm between exhaust temperature sender 2 - G448- -2- and NOx sender - G295- -1-.



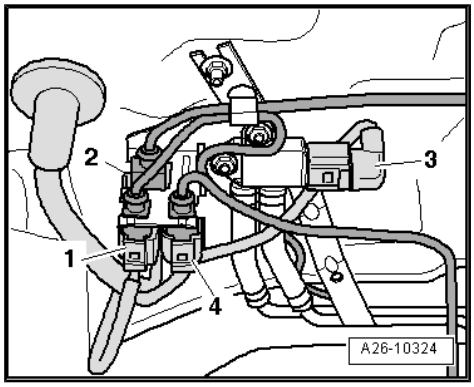
1.6.5 Removing and installing pressure differential sender - G505-

Removing

– Remove engine cover panel ⇒ page 3 .

– Disconnect connector -3- at pressure differential sender - G505- .

– Carefully pull pressure line to particulate filter off union on pressure differential sender - G505- (union on pressure differential sender - G505- breaks easily).



Note

The second pressure line is approx. 7 cm long and is exposed to atmospheric pressure (relative pressure sensor concept). This must only be pulled off when replacing pressure differential sender - G505- .

– Undo securing nut and remove pressure differential sender - G505- .

Installing

Installation is carried out in the reverse order. When installing, note the following:

Note

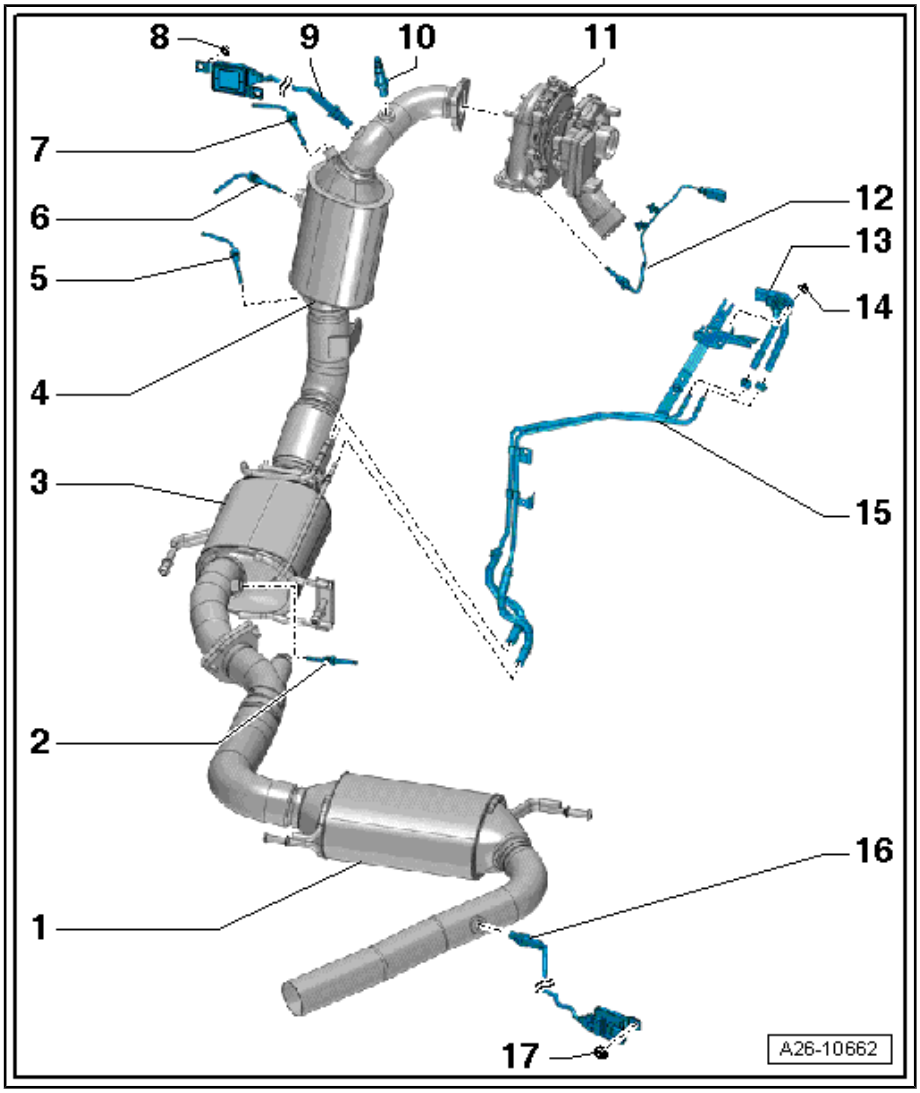
- *Make sure that the pressure line is securely fitted and does not leak.*
- *If particulate filter or pressure differential sender - G505- is exchanged, pressure differential sender - G505- must be adapted using vehicle diagnostic tester as a matter of priority: Guided Functions; Adapting pressure differential sender - G505- .*

- Specified torque for securing nut: 3.5 Nm

1.7 Assembly overview - exhaust gas temperature regulation (engine code CATA)

Note

- *If particulate filter or pressure differential sender - G505- is exchanged, pressure differential sender - G505- must be adapted using vehicle diagnostic tester as a matter of priority: Guided Functions; Adapting pressure differential sender - G505- .*
- *Locations of connectors* *⇒ page 302* .



1 - Reduction catalytic converter

2 - Exhaust gas temperature sender 4 - G648-

- ❑ 45 Nm
- ❑ Coat with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA)
- ❑ Removing and installing ⇒ page 307

3 - Particulate filter

4 - Starter catalytic converter

5 - Exhaust gas temperature sender 3 - G495-

- ❑ 45 Nm
- ❑ Observe installation position
- ❑ Coat with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA)
- ❑ Removing and installing ⇒ page 306

6 - Catalytic converter temperature sensor 1 - G20-

- ❑ 45 Nm
- ❑ Observe installation position
- ❑ Coat with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA)
- ❑ Removing and installing ⇒ page 303

7 - Exhaust gas temperature sender 2 - G448-

- ❑ 45 Nm
- ❑ Observe installation position
- ❑ Coat with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA)
- ❑ Removing and installing ⇒ page 305

8 - Nut

- ❑ 2.5 Nm

9 - NOx sender - G295-

- ❑ 45 Nm
- ❑ Removing and installing ⇒ page 308

10 - Lambda probe 1 before catalytic converter - GX10-

- ❑ 50 Nm
- ❑ With Lambda probe - G39-
- ❑ With Lambda probe heater - Z19- .
- ❑ Grease thread only with high-temperature paste - G 052 112 A3- . High-temperature paste - G 052 112 A3- must not get into slots of probe body.
- ❑ To remove use Lambda probe open ring spanner set - 3337- .

❑ Removing and installing ⇒ page 302

11 - Exhaust turbocharger

12 - Exhaust gas temperature sender 1 - G235-

❑ 45 Nm
❑ Coat with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA)
❑ Removing and installing ⇒ page 304

13 - Pressure differential sender - G505-

❑ Removing and installing ⇒ page 309

14 - Securing nut

❑ 3.5 Nm

15 - Pressure line for pressure differential sender - G505-

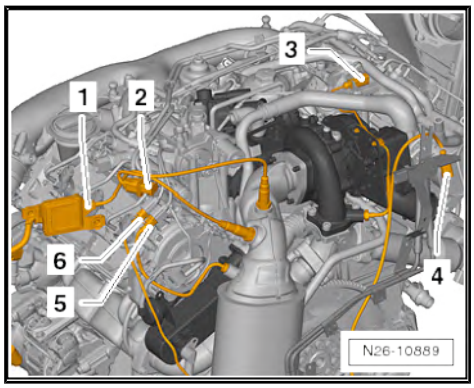
16 - NOx sender 2 - G687-

❑ 45 Nm
❑ Removing and installing ⇒ page 309

17 - Securing nut

❑ 3.5 Nm

Locations for exhaust gas treatment connectors



1 - NOx sender - G295- (engine code CATA only)

2 - Lambda probe 1 before catalytic converter - GX10-

3 - Exhaust gas temperature sender 1 - G235-

4 - Exhaust gas temperature sender 4 - G648- (engine code CATA only)

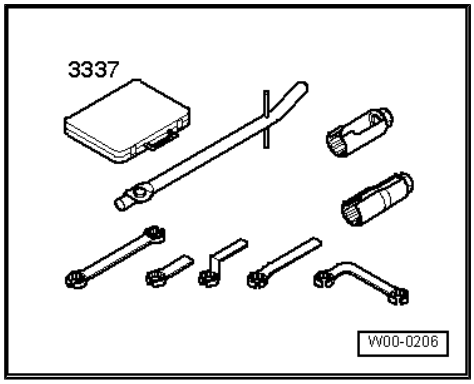
5 - Exhaust gas temperature sender 2 - G448-

6 - Exhaust gas temperature sender 3 - G495-

1.7.1 Removing and installing Lambda probe 1 before catalytic converter - GX10-

Special tools and workshop equipment required

♦ Lambda probe open ring spanner set - 3337-

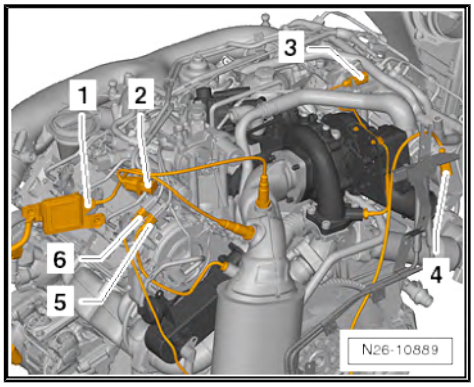


Removing

– Remove engine cover panel ⇒ page 3 .

– Remove connector -2- from retainer and disconnect.

– Expose cable routing to Lambda probe 1 before catalytic converter - GX10- .



– Unscrew and remove Lambda probe 1 before catalytic converter - GX10- -5- using suitable spanner from Lambda probe open ring spanner set - 3337- .

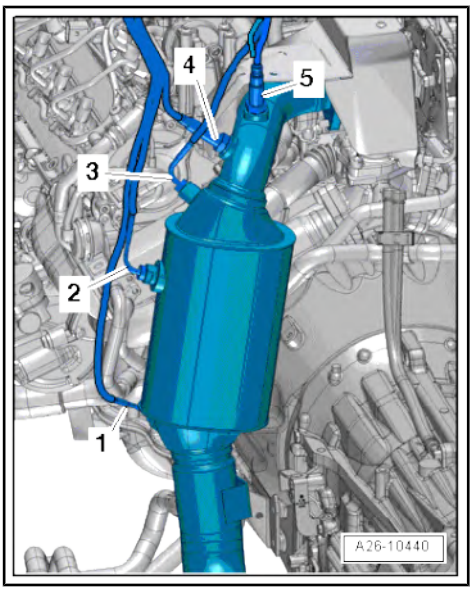
Installing

• Specified torques ⇒ page 300

Installation is carried out in the reverse order. When installing, note the following:

Note

- *New lambda probes are coated with an assembly paste. Do not allow any paste to enter the slots on the probe body.*
- *In the case of a used Lambda probe, grease only the thread with high-temperature paste (⇒ Electronic parts catalogue (ETKA)). Do not allow any paste to enter the slots on the probe body.*
- *When installing, the Lambda probe electrical wiring must always be reattached at the same locations to prevent the Lambda probe wiring from coming into contact with the exhaust pipe.*



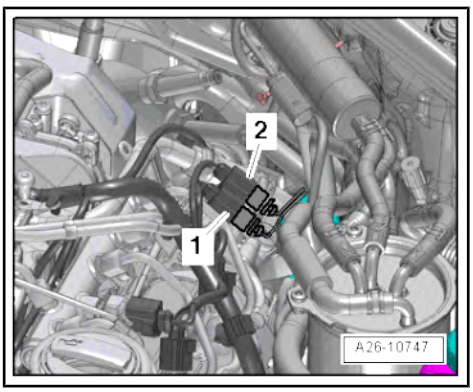
1.7.2 Removing and installing catalytic converter temperature sensor 1 - G20-

Removing

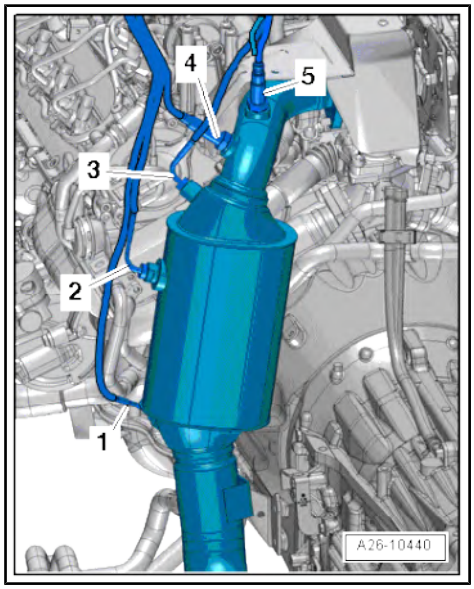
– Remove engine cover panel ⇒ page 3 .

– Remove connector -1- from bracket and separate.

– Expose wiring to catalytic converter temperature sensor 1 - G20- .



– Unscrew catalytic converter temperature sensor 1 - G20- -2- and remove.



Installing

- Specified torques ⇒ page 300

Installation is carried out in the reverse order. When installing, note the following:

Note

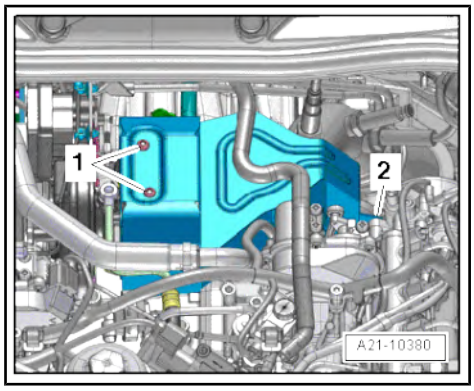
Coat thread of catalytic converter temperature sensor 1 - G20- with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA) .

1.7.3 Removing and installing exhaust gas temperature sender 1 - G235-

Removing

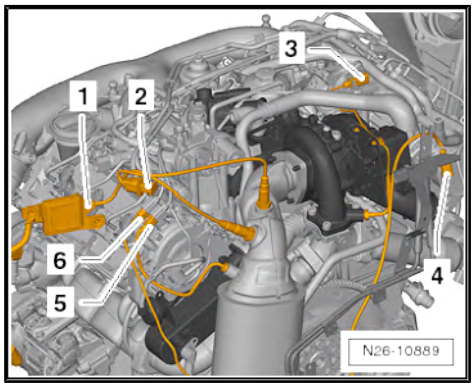
– Remove engine cover panel ⇒ page 3 .

– Remove bolts -1-, loosen bolt -2- and remove heat shield for turbocharger.

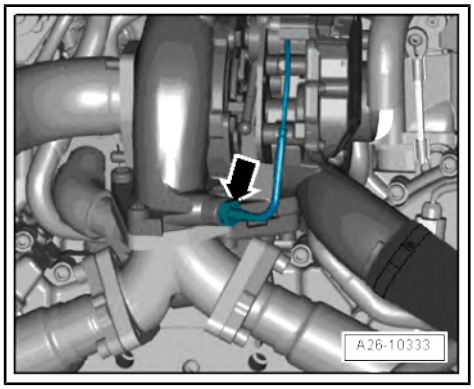


– Remove connector -3- from bracket and separate.

– Expose wiring to exhaust gas temperature sender 1 - G235- .



– Unscrew exhaust temperature sender 1 - G235- -arrow- and remove.



Installing

- Specified torques ⇒ page 300

Installation is carried out in the reverse order. When installing, note the following:

Note

Coat thread of exhaust gas temperature sender 1 - G235- with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA) .

- Installation position: exhaust gas temperature sender 1 - G235- faces upwards.

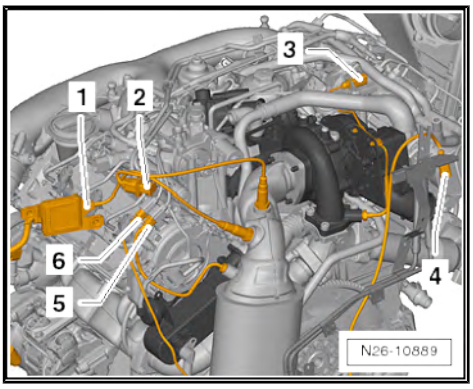
1.7.4 Removing and installing exhaust gas temperature sender 2 - G448-

Removing

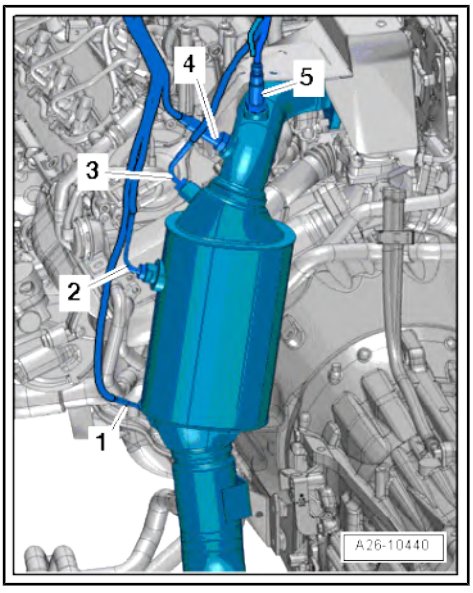
– Remove engine cover panel ⇒ page 3 .

– Remove connector -5- from bracket and separate.

– Expose wiring to exhaust gas temperature sender 2 - G448- .



– Unscrew exhaust temperature sender 2 - G448- -3- and remove.



Installing

- Specified torques ⇒ page 300

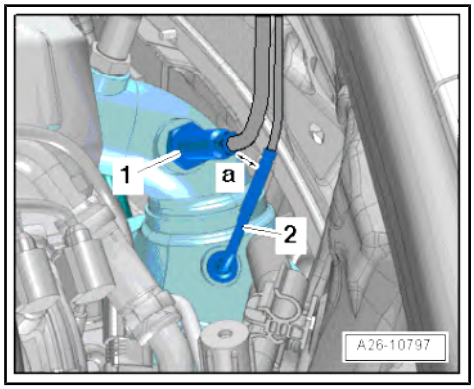
Installation is carried out in the reverse order. When installing, note the following:

Note

Coat thread of exhaust gas temperature sender 2 - G448- with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA) .

Note installation position:

- Dimension -a- = 20 mm between exhaust temperature sender 2 - G448- -2- and NOx sender - G295- -1-.



1.7.5 Removing and installing exhaust gas temperature sender 3 - G495-

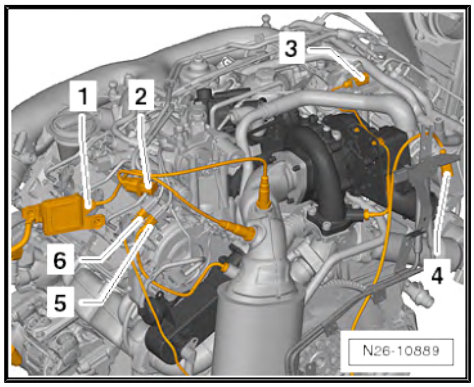
Removing

– Remove engine cover panel ⇒ page 3 .

– Remove connector -6- from bracket and separate.

– Expose wiring to exhaust gas temperature sender 3 - G495- .

– Remove rear noise insulation: ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation; Assembly overview - noise insulation .



– Unscrew exhaust temperature sender 3 - G495- -1- and remove.

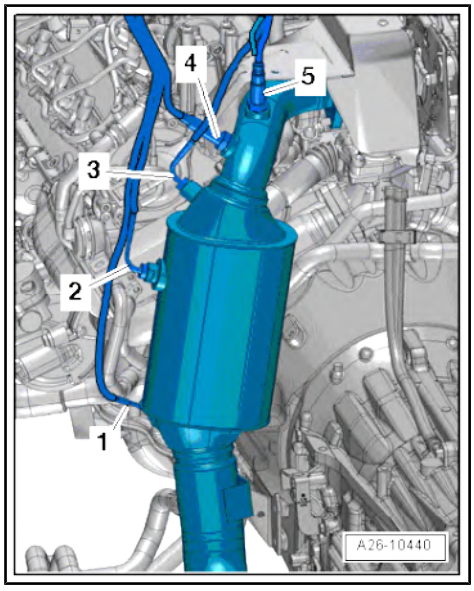
Installing

- Specified torques ⇒ page 300

Installation is carried out in the reverse order. When installing, note the following:

Note

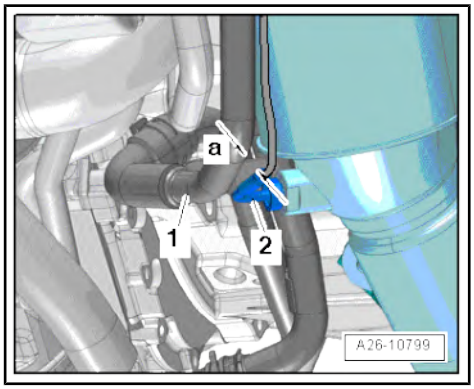
Coat thread of exhaust gas temperature sender 3 - G495- with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA) .



Note installation position:

- Dimension -a- = 10 mm between exhaust temperature sender 3 - G495- -2- and coolant line -1-.

– Install rear noise insulation: ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation; Assembly overview - noise insulation .

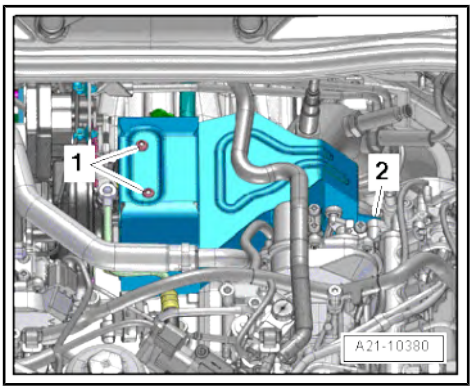


1.7.6 Removing and installing exhaust gas temperature sender 4 - G648-

Removing

– Remove engine cover panel ⇒ page 3 .

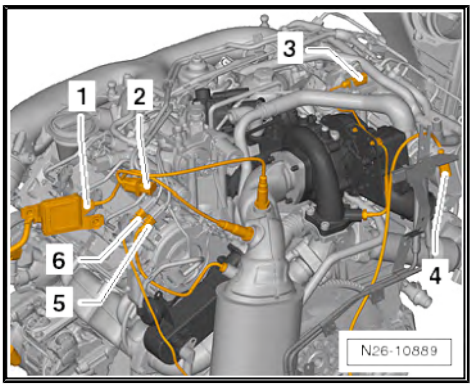
– Remove bolts -1-, loosen bolt -2- and remove heat shield for turbocharger.



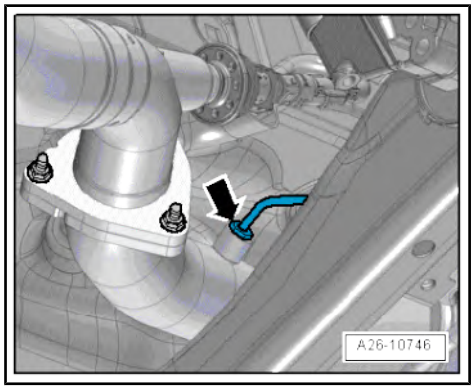
– Remove connector -4- from bracket and separate.

– Lay aside wiring for exhaust gas temperature sender 4 - G648- .

– Remove noise insulation: ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation; Assembly overview - noise insulation .



– Unscrew exhaust temperature sender 4 - G648- -arrow- and remove.



Installing

• Specified torques ⇒ page 300

Installation is carried out in the reverse order. When installing, note the following:

Note

Coat thread of exhaust gas temperature sender 3 - G495- with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA) .

– Install noise insulation: ⇒ General body repairs, exterior; Rep. gr. 50 ; Noise insulation: Assembly overview - noise insulation .

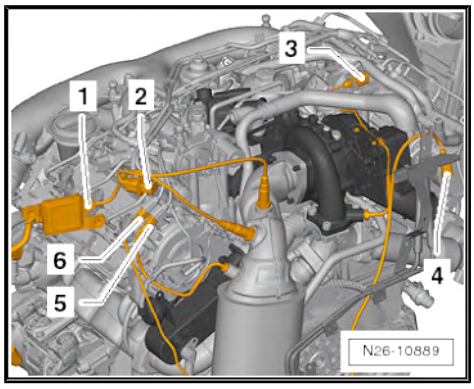
1.7.7 Removing and installing NOx sender - G295-

Removing

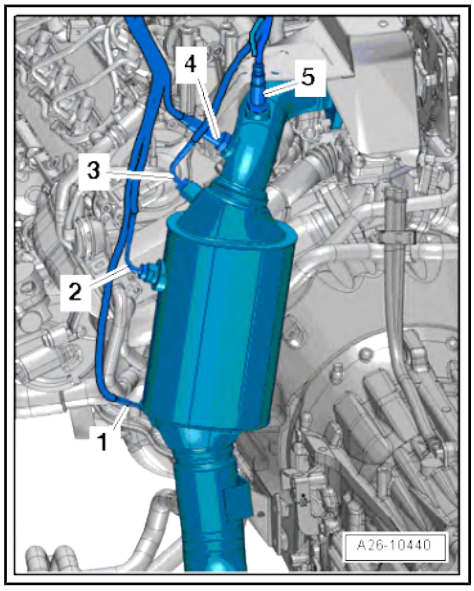
– Remove engine cover panel ⇒ page 3 .

– Disconnect connector -1- at NOx sender control unit - J583- .

– Undo nuts -arrows- and remove NOx sender control unit - J583- .



– Unscrew NOx sender - G295- -4- and remove.



Installing

• Specified torques ⇒ page 300

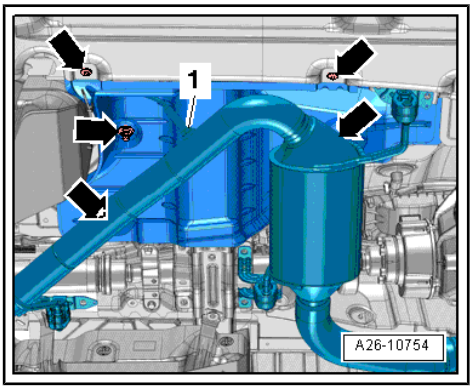
Install in reverse order of removal.

1.7.8 Removing and installing NOx sender 2 - G687-

Removing

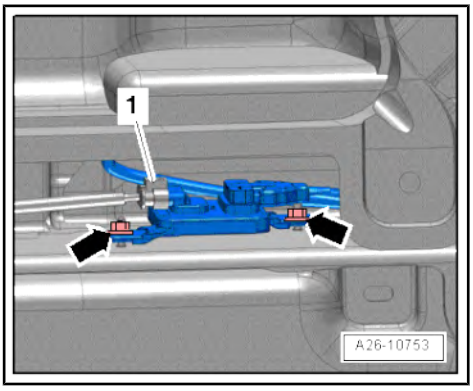
– Unscrew NOx sender 2 - G687- -1-

– Undo securing elements -arrows- and push heat shield over to left.



– Disconnect connector -1- at NOx sender control unit 2 - J881- .

– Undo nuts -arrows- and remove NOx sender control unit 2 - J881- along with NOx sender 2 - G687- .



Installing

• Specified torques ⇒ page 300

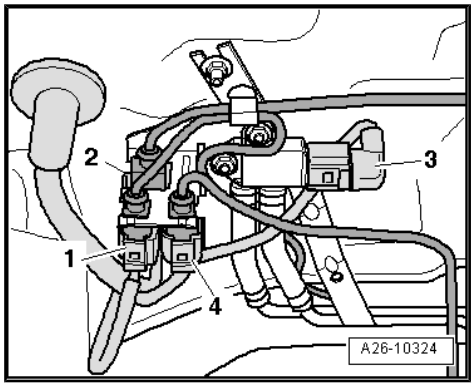
Install in reverse order of removal.

1.7.9 Removing and installing pressure differential sender - G505-

Removing

– Remove engine cover panel ⇒ page 3 .

– Disconnect connector -3- at pressure differential sender - G505- .
– Carefully pull pressure lines off unions on pressure differential sender - G505- (unions on pressure differential sender - G505- break easily).
– Undo securing nut and remove pressure differential sender - G505- .



Installing

- Specified torques ⇒ page 300

Installation is carried out in the reverse order. When installing, note the following:

Note

- *Make sure that the pressure lines are securely fitted and do not leak.*
- *If particulate filter or pressure differential sender - G505- is exchanged, pressure differential sender - G505- must be adapted using vehicle diagnostic tester as a matter of priority: Guided Functions; Adapting pressure differential sender - G505- .*

1.8 Silencer with mountings

1 - From particulate filter/reduction catalytic converter

2 - Double clamp

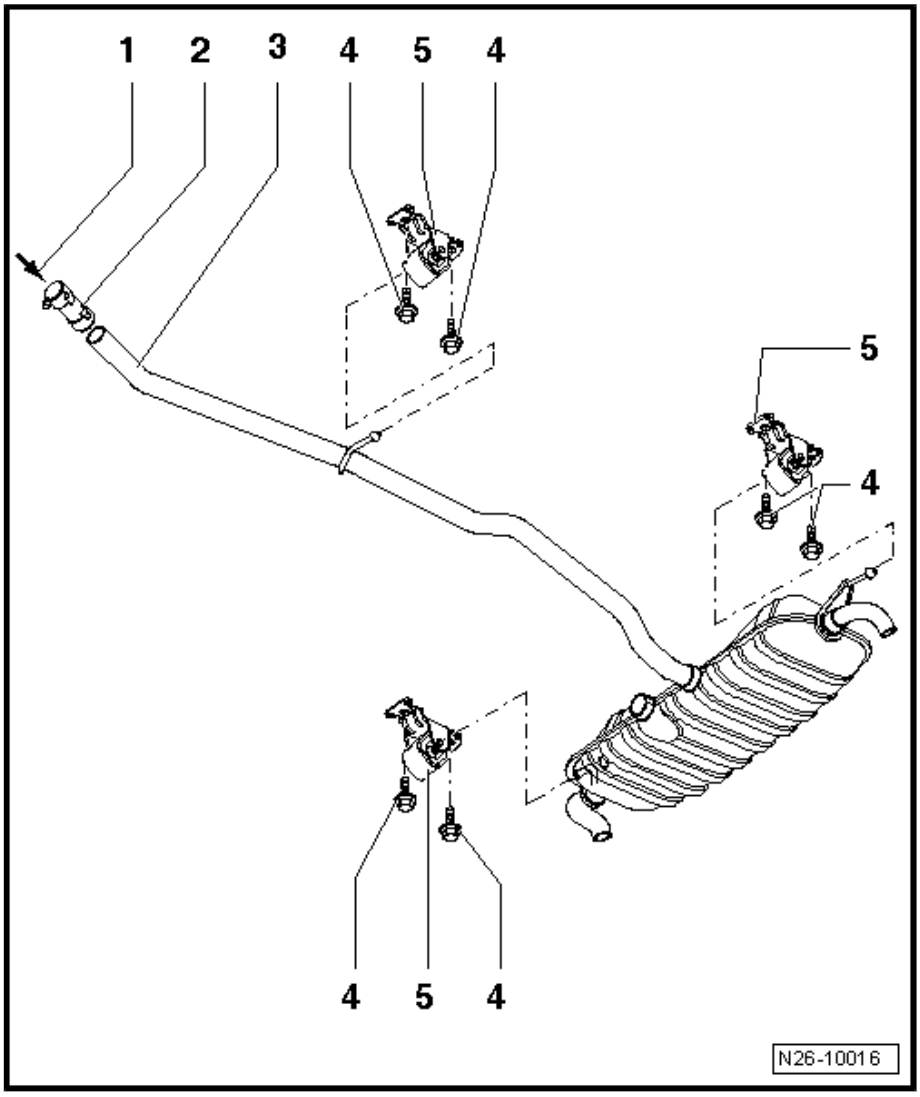
3 - Exhaust pipe with rear silencer

4 - Bolt

- ❑ 25 Nm

5 - Mounting

- ❑ Renew if damaged



1.9 SCR system (selective catalytic reduction)

Note

- *To keep the following description as short as possible, the "NO_X reducing agent AUS 32" (AdBlue®) is just called "reducing agent".*
- *The design and function of the SCR systems is described in ⇒ Self-study programme No. 424 ; Selective Catalytic Reduction .*

⇒ “1.9.1 Assembly overview - tank for reducing agent”, page 312 .

⇒ “1.9.2 Assembly overview - delivery module for reducing agent”, page 314 .

⇒ “1.9.3 Assembly overview - reducing agent supply line”, page 315 .

⇒ “1.9.4 Removing and installing reducing agent supply line”, page 315 .

⇒ “1.9.5 Removing and installing injector for reduction agent N474 ”, page 318 .

⇒ “1.9.6 Removing and installing reducing agent tank”, page 320 .

⇒ “1.9.7 Draining reducing agent tank”, page 322 .

⇒ “1.9.8 Removing and installing delivery module”, page 325 .

WARNING

- *The reducing agent can irritate skin, eyes and respiratory organs.*
- *In the event of skin contact with this fluid, immediately wash off with plenty of water.*
- *If necessary seek advice from a doctor.*

1.9.1 Assembly overview - tank for reducing agent

1 - Reducing agent tank

- ❑ Removing and installing ⇒ page 320

2 - Delivery module

- ❑ With pump for reducing agent - V437- .
- ❑ Removing and installing ⇒ page 325

3 - Sheet metal tray

4 - Nut

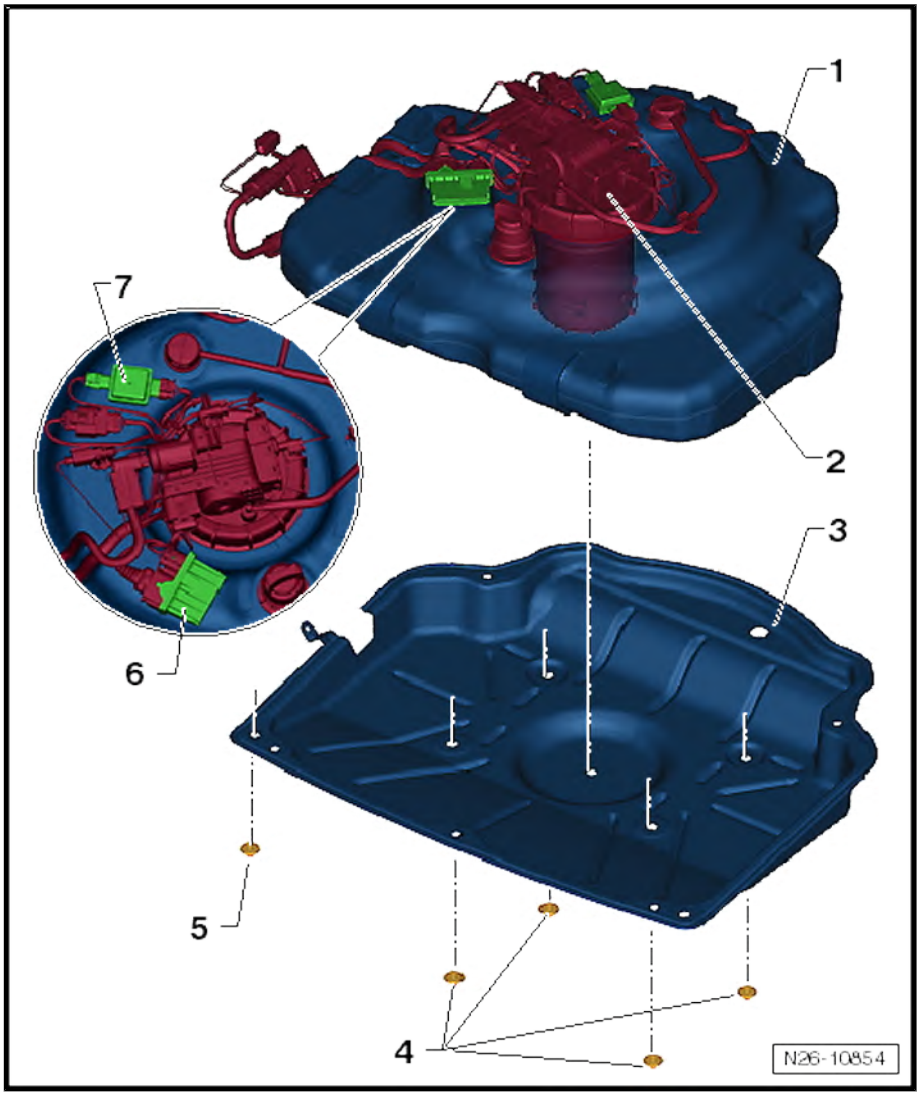
- ❑ 10 Nm

5 - Nut

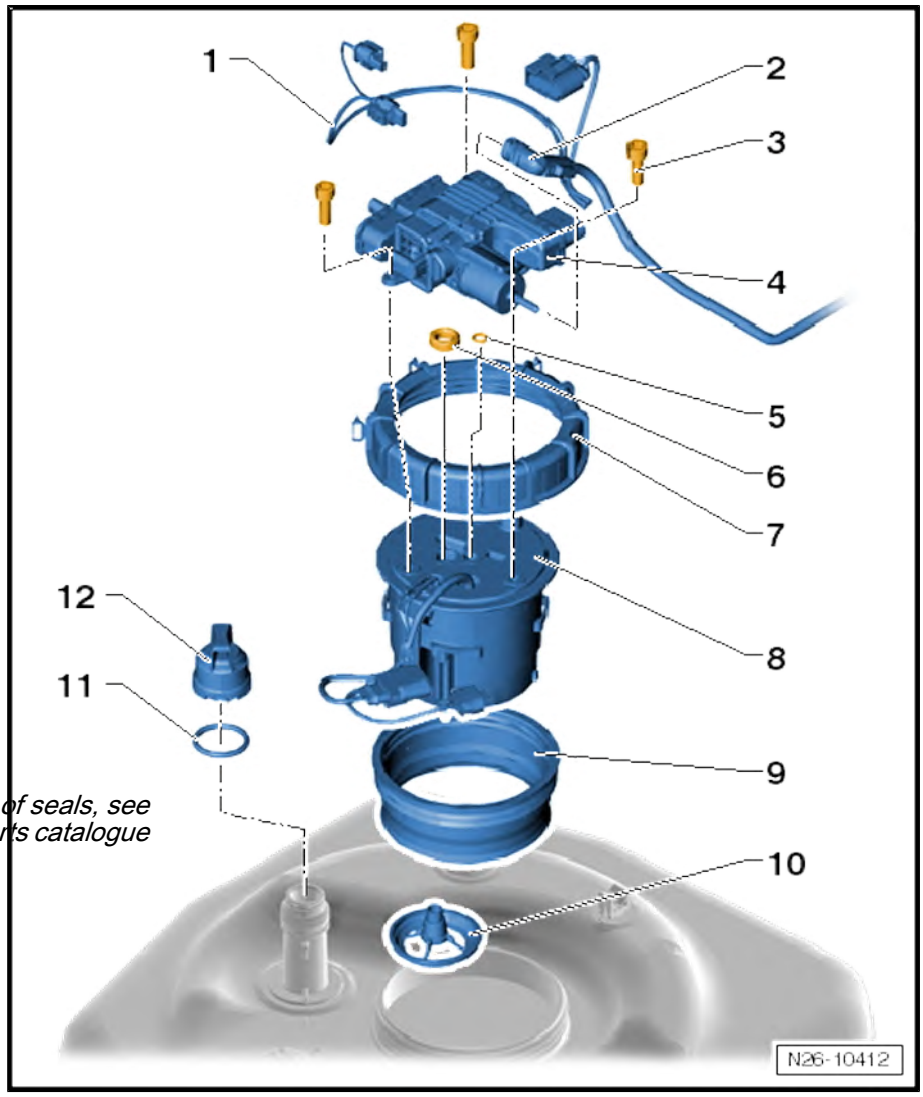
- ❑ 20 Nm

6 - Control unit for reducing agent heater - J891-

7 - Evaluation unit for reducing agent level - G698-



1.9.2 Assembly overview - delivery module for reducing agent



1 - Wiring harness

2 - Delivery line

- ❑ For reducing agent
- ❑ With heater for reducing agent line - Z104- .
- ❑ Assembly overview ⇒ page 315

3 - Bolt

- ❑ 5 Nm

4 - Pump for reducing agent - V437-

- ❑ With heater for reducing agent pump - Z103- .
- ❑ With pressure sender for reducing agent metering system - G686- .
- ❑ With reversal valve for reducing agent - N473- .

5 - Seal

- ❑ Renew

Note

When using a new set of seals, see note in ⇒ Electronic parts catalogue (ETKA) .

6 - Seal

- ❑ Renew

7 - Locking ring

- ❑ 80 Nm
- ❑ Remove and install using wrench - T50014- .

8 - Heater element (heater cup)

- ❑ With heater for reducing agent tank - Z102- .
- ❑ With reducing agent level sender - G697-
- ❑ With temperature sender for reducing agent - G685-
- ❑ Removing and installing ⇒ page 325

9 - Seal

- ❑ Renew if damaged

10 - Filter

11 - Seal

- ❑ Renew if damaged

12 - Cap

- ❑ For filling
- ❑ Accessible from luggage compartment

1.9.3 Assembly overview - reducing agent supply line

1 - NOx sender 2 - G687-

- ❑ With NOx sender 2 control unit - J881- .
- ❑ Remove right underbody panel in order to remove and install.

2 - Reducing agent supply line

- ❑ Removing and installing ⇒ page 315

3 - Clip

- ❑ Renew
- ❑ 5 Nm

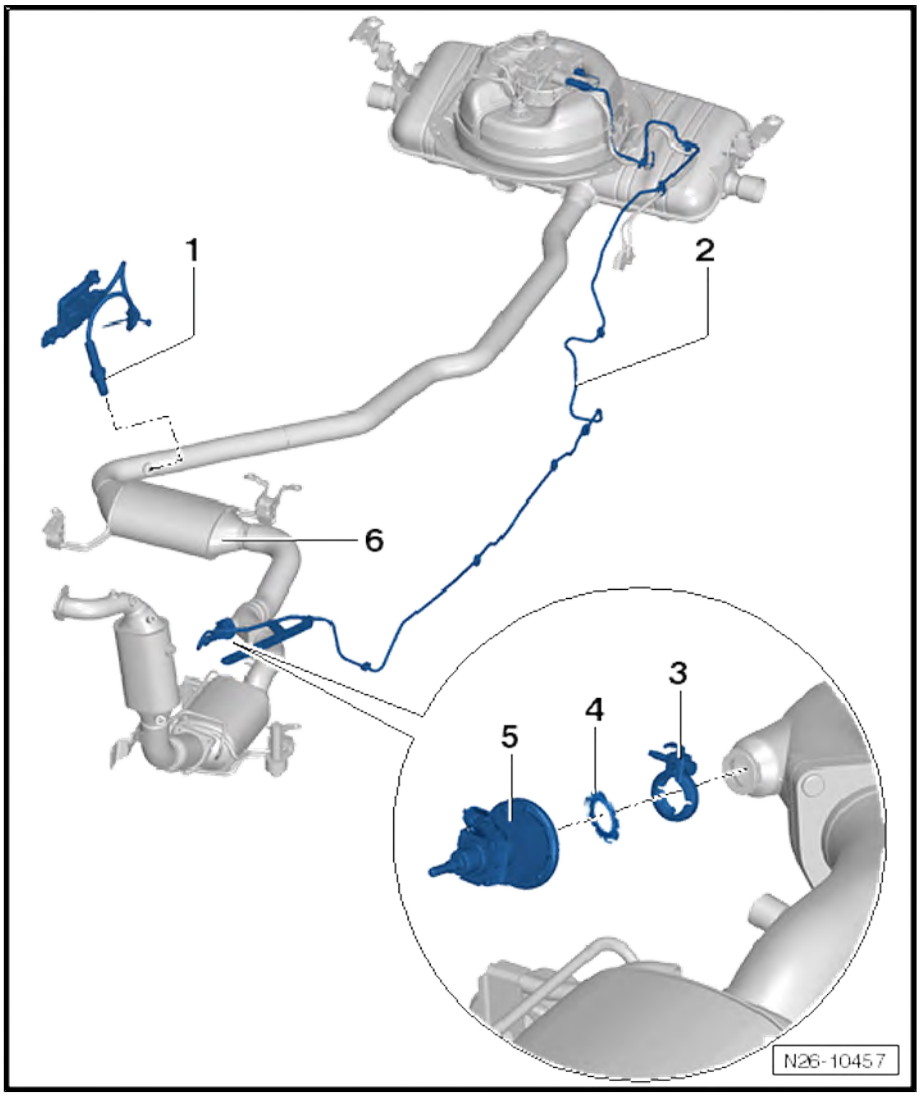
4 - Seal

- ❑ Renew

5 - Injector for reducing agent - N474-

- ❑ Removing and installing ⇒ page 318

6 - Reduction catalytic converter



1.9.4 Removing and installing reducing agent supply line

Note

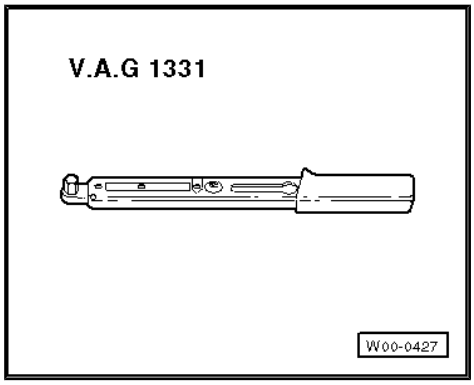
To keep the following description as short as possible, the "NO_X reducing agent AUS 32" (AdBlue®) is just called "reducing agent".

WARNING

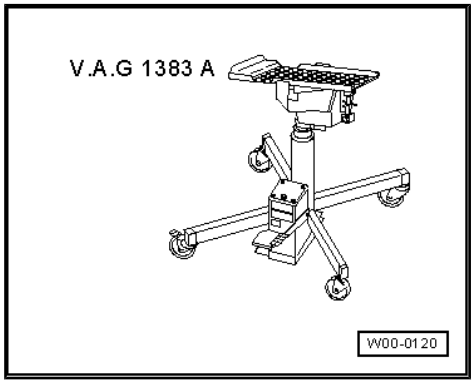
- ***The reducing agent can irritate skin, eyes and respiratory organs.***
- ***In the event of skin contact with this fluid, immediately wash off with plenty of water.***
- ***If necessary seek advice from a doctor.***

Special tools and workshop equipment required

- Torque wrench (5 to 50 Nm) - V.A.G 1331-



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



Removing

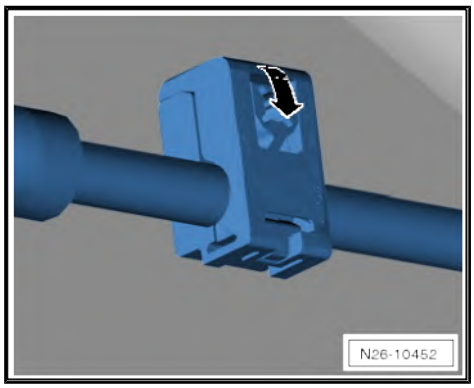
– Remove tank for reduction agent ⇒ page 320 .

– Remove left underbody panel ⇒ General body repairs, exterior; Rep. gr. 50 .

– Remove heat shield from particulate filter.

– Open clips of delivery line, open upper part in direction of -arrow- for this.

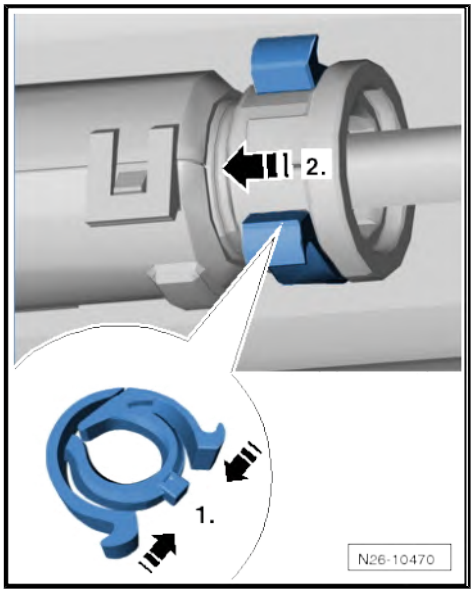
– Unclip supply line above rear axle and heat shield for particulate filter from retainers.



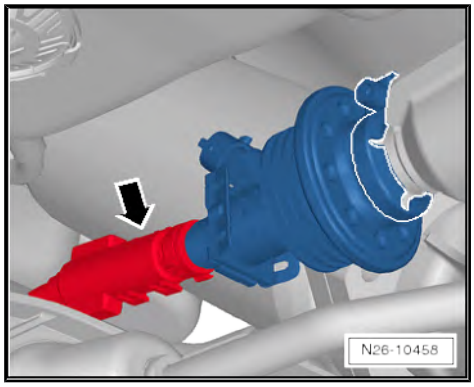
Caution

Protect separated electrical connections against wetting from reducing agent by suitable means, e.g. plastic bag and cable ties. Due to the high tendency to creep combined with subsequent crystallisation of the reducing agent, the electrical connections can be damaged.

– First press securing clip for line connection on injector for reduction agent - N474- together in direction of -arrow 1.- as shown, and pull off delivery line in direction of -arrow 2.- without tools and without »jerking«.



– Pull delivery line -arrow- off injector for reducing agent - N474- .



Caution

Immediately seal openings in lines using suitable plugs to prevent ingress of dirt. Even very small particles of dirt can cause considerable damage to the system.

Caution

The delivery line is pre-formed and is equipped with a heater element over the complete length. Ensure the line is not kinked, twisted or stretched. Otherwise the heater element will be damaged and therefore the delivery line.

– Carefully guide delivery line over heat shield of particulate filter.
– Finally guide delivery line out forwards over rear axle/subframe.

Installing

Install in reverse order of removal, observing the following.

Caution

The delivery line is pre-formed and is equipped with a heater element over the complete length. Ensure the line is not kinked, twisted or stretched. Otherwise the heater element will be damaged and therefore the delivery line.

– First guide delivery line over rear axle/subframe then over heat shield for particulate filter.
– Remove sealing plugs and connect delivery line to injector for reducing agent - N474- .
– Press delivery line into respective clips, working from front to rear.
– Close retaining clips.
– Install tank for reduction agent ⇒ page 320 .

1.9.5 Removing and installing injector for reduction agent - N474-

Note

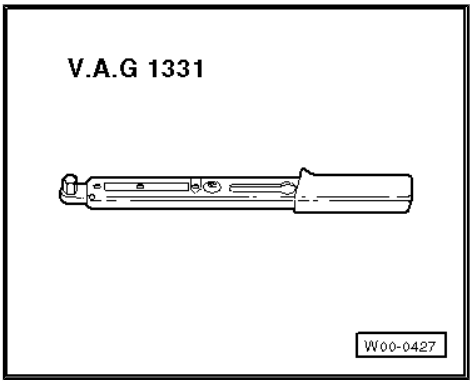
To keep the following description as short as possible, the "NO_X reducing agent AUS 32" (AdBlue®) is just called "reducing agent".

WARNING

- *The reducing agent can irritate skin, eyes and respiratory organs.*
- *In the event of skin contact with this fluid, immediately wash off with plenty of water.*
- *If necessary seek advice from a doctor.*

Special tools and workshop equipment required

- Torque wrench (5 to 50 Nm) - V.A.G 1331-

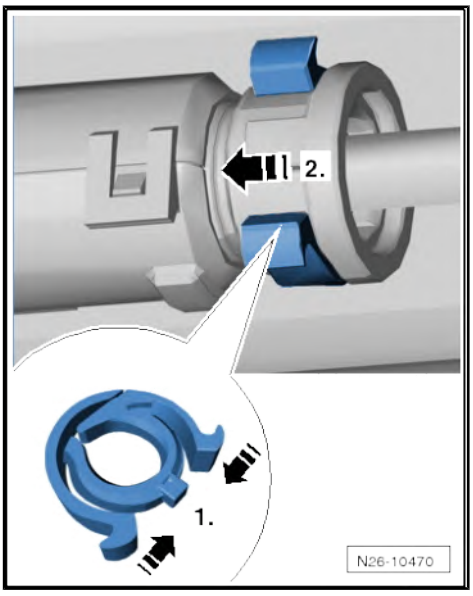


Removing

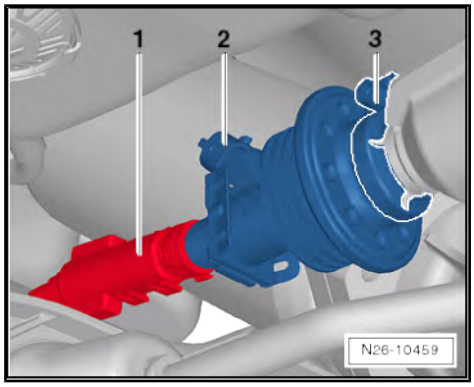
Caution

Protect separated electrical connections against wetting from reducing agent by suitable means, e.g. plastic bag and cable ties. Electrical connections may be damaged due to the high penetration ability of the reducing agent along with subsequent crystallisation of the reducing agent.

– First press securing clip for line connection on injector for reducing agent - N474- together in direction of -arrow 1- as shown, and pull off delivery line -1- in direction of -arrow 2- without tools and without »jerking«.



– Pull connector -1- off injector for reducing agent - N474- .



Caution

Immediately seal all openings and connections using suitable plugs to stop ingress of dirt. Even very small particles of dirt can cause considerable damage to the system.

– Open clip -3- and remove injector for reducing agent - N474- from exhaust system.

Installing

– Install injector for reduction agent - N474- with a new sealing washer, observing lug on reducer catalytic converter (electrical connector faces upwards).

– Place new securing clamp over connection and press it together until it engages. This action locates the injector for reducing agent - N474- .

– Start bolt and tighten to specified torque
⇒ Item 3 (page 315) .

– Reconnect connector and reconnect delivery line.

1.9.6 Removing and installing reducing agent tank

Note

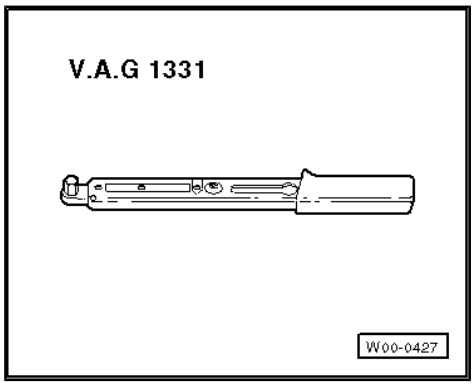
To keep the following description as short as possible, the "NO_X reducing agent AUS 32" (AdBlue®) is just called "reducing agent".

WARNING

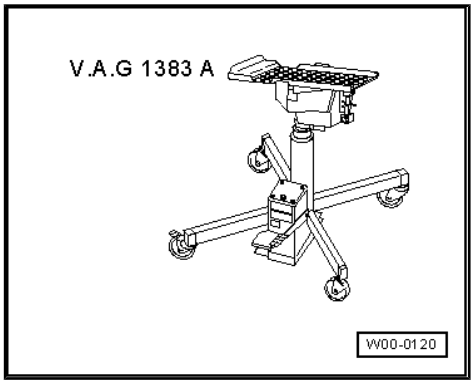
- ***The reducing agent can irritate skin, eyes and respiratory organs.***
- ***In the event of skin contact with this fluid, immediately wash off with plenty of water.***
- ***If necessary seek advice from a doctor.***

Special tools and workshop equipment required

- Torque wrench (5 to 50 Nm) - V.A.G 1331-



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



Removing

– Empty tank for reducing agent. ⇒ page 322

– Remove silencer ⇒ page 310 .

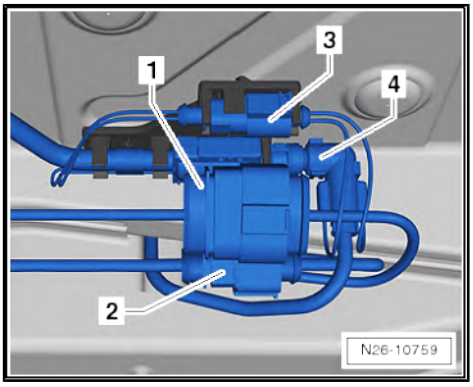
– Remove heat shield for silencer.

– Release anti-roll bar for real axle and fold it downwards ⇒ Running gear, axles, steering; Rep. gr. 42 ; Assembly overview - anti-roll bar .

Caution

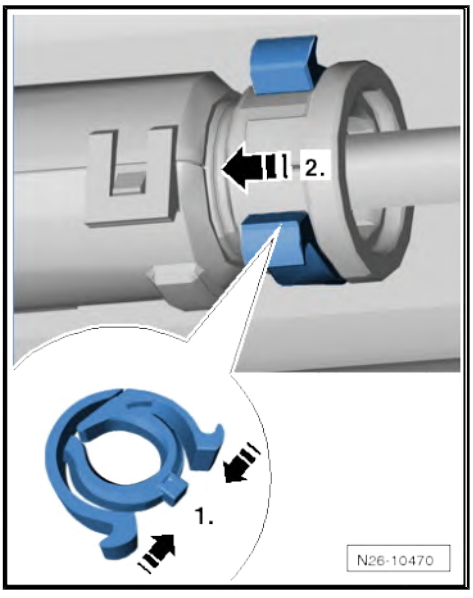
Protect separated electrical connections against wetting from reducing agent by suitable means, e.g. plastic bag and cable ties. Due to the high tendency to creep combined with subsequent crystallisation of the reducing agent, the electrical connections can be damaged.

– Remove connectors -1…3- from retainers and separate.



– Also remove reducing agent line -4- from retainer and disconnect as follows:

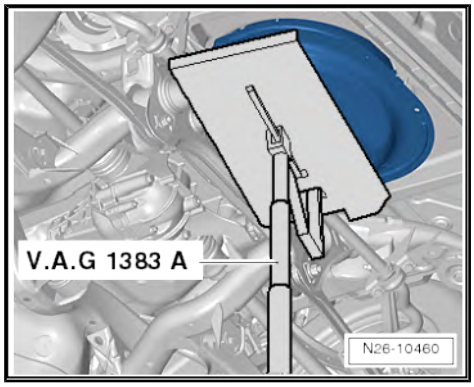
– First press securing clip for line connection on injector for reducing agent - N474- together in direction of -arrow 1- as shown, and pull off delivery line -A- in direction of -arrow 2- without tools and without »jerking«.



Caution

Immediately seal all openings and connections using suitable plugs to stop ingress of dirt. Even very small particles of dirt can cause considerable damage to the system.

– Position engine and gearbox jack - V.A.G 1383 A- under reduction agent tank.



– Undo securing nuts -arrows- and lower reducing agent tank using engine and gearbox jack - V.A.G 1383 A- .

Installing

– Carefully raise tank for reducing agent using engine and gearbox jack - V.A.G 1383 A- until electrical wiring and delivery line can be reconnected.

– Fit upper part of insulation on reducing agent tank.

Note

Ensure all components are installed on tank for reducing agent, the upper insulation is fitting exactly and that no lines are squashed.

– Carefully lift reducing agent tank using engine and gearbox jack - V.A.G 1383 A- until securing nuts can be fitted.

– Tighten securing nuts to specified torque: 20 Nm.

Further assembly is basically the reverse of the removal procedure.

– Install anti-roll bar ⇒ Running gear, axles, steering; Rep. gr. 42 ; Assembly overview - anti-roll bar .

– Fill reducing agent tank ⇒ Maintenance ; Booklet ; Reducing agent (AdBlue®): Filling .

1.9.7 Draining reducing agent tank

Note

To keep the following description as short as possible, the "NO_X reducing agent AUS 32" (AdBlue®) is just called "reducing agent".

WARNING

- ***The reducing agent can irritate skin, eyes and respiratory organs.***
- ***In the event of skin contact with this fluid, immediately wash off with plenty of water.***
- ***If necessary seek advice from a doctor.***

Special tools and workshop equipment required

♦ Vacuum box - VAS 6557-

Note

Tank for reducing agent is emptied via filler neck.

Caution

Always ensure that no reducing agent contacts clothing or bodywork.

If this occurs, wash out reducing agent using clear water and a lint-free cotton cloth.

If the reducing agent has already crystallised, use warm water and a sponge.

Reducing agent that has not been removed will crystallise and damage the surface after some time.

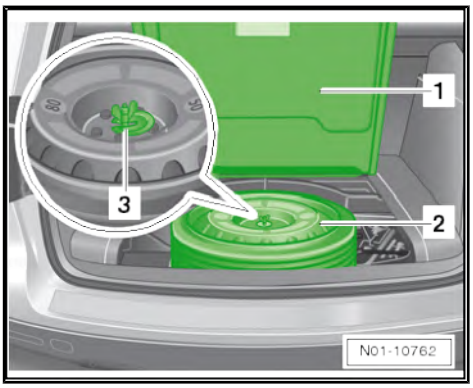
Information concerning storage and disposal ⇒ ServiceNet → Environmental protection → Workshop disposal ! Request country specific information concerning storage and disposal from importer.

The reducing agent tank's filler aperture is located under the floor covering in the luggage compartment.

– Lift floor covering -1- and slide it back.

– Remove spare wheel -2-, if available, by unscrewing wing nut -3-.

– Remove foam part, if fitted.

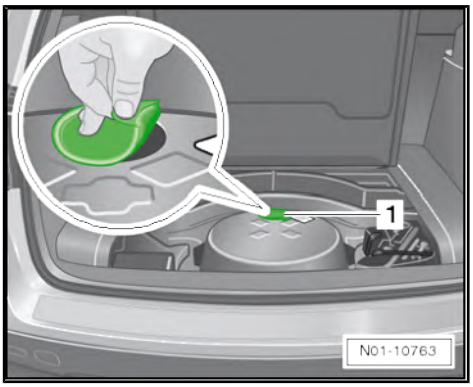


WARNING

Protect hands when removing cap from tank filler neck.

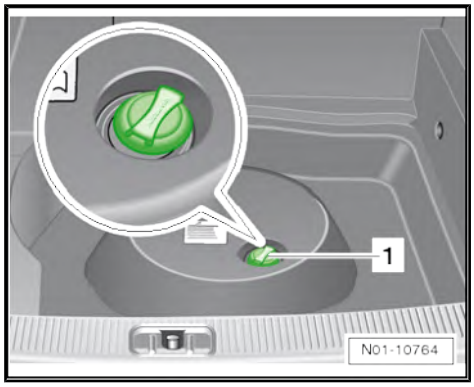
Risk of injury from sharp-edged body parts.

– Remove tank filler neck sealing plug -1-.

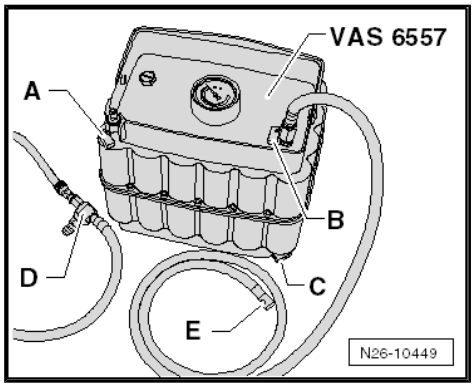


– Open cover of tank -1- in luggage compartment.

Prepare vacuum box - VAS 6557- as follows:



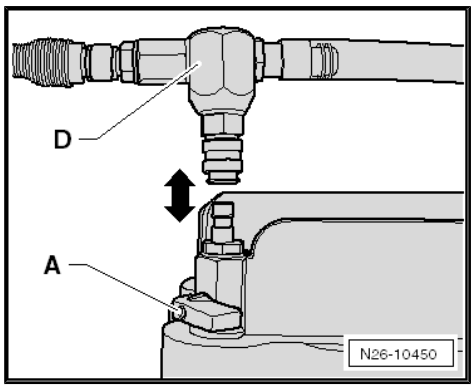
– Close shut-off taps -A-, -B- and -C-.



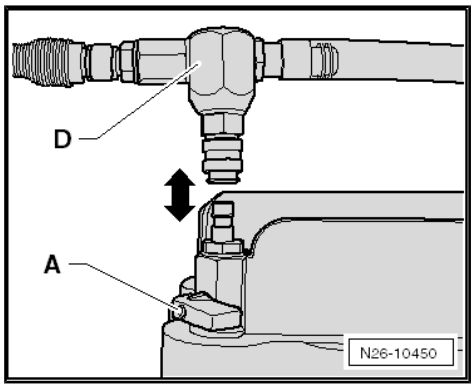
– Connect coupling -D- with connection to shut-off tap -A- and pressurize compressed air hose with compressed air.
– Open shut-off tap -A-.

A vacuum is now created in the vacuum box - VAS 6557- .

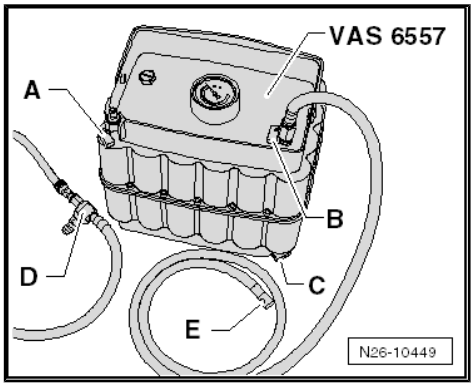
– Close shut-off valve -A- as soon as the pressure gauge registers a pressure of 0.8 bar.



– Disconnect coupling -D- from connection on shut-off tap -A- and interrupt compressed air from compressed air hose.



– Guide end of hose -E- into filler neck to bottom of tank for reducing agent then open shut-off tap -B-.



Note

The reducing agent is then drawn from the tank and into the vacuum box - VAS 6557- by the vacuum. The capacity of the vacuum box - VAS 6557- is 11 litres, which is sufficient to allow the removal of the tank for reducing agent. If the reducing agent tank holds a greater amount and the tank is to be emptied, then repeat the process.

– To empty the vacuum box - VAS 6557- , hold shut-off tap -C- over a suitable container and open shut-off valves -A- and -C-.

Caution

Extracted reducing agent must never be used again. Information concerning storage and disposal ⇒ ServiceNet → Environmental protection → Workshop disposal ! Request country specific information concerning storage and disposal from importer.

– Flush vacuum box - VAS 6557- out carefully using water upon completion of procedure.

1.9.8 Removing and installing delivery module

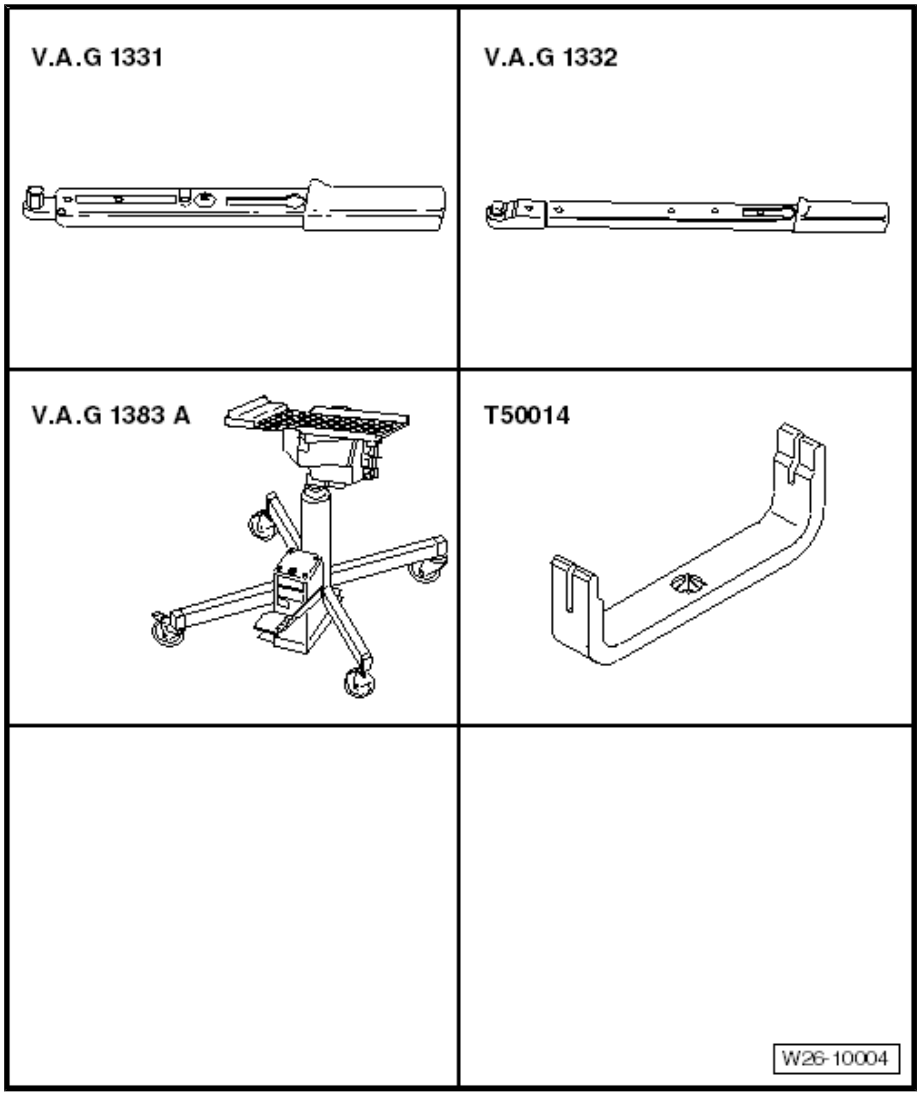
Note

To keep the following description as short as possible, the "NO_X reducing agent AUS 32" (AdBlue®) is just called "reducing agent".

WARNING

- ***The reducing agent can irritate skin, eyes and respiratory organs.***
- ***In the event of skin contact with this fluid, immediately wash off with plenty of water.***
- ***If necessary seek advice from a doctor.***

Special tools and workshop equipment required



- Torque wrench (5 to 50 Nm) - V.A.G 1331-
- Torque wrench (40 to 200 Nm) - V.A.G 1332-
- Engine and gearbox jack - V.A.G 1383 A-
- Special wrench - T50014-

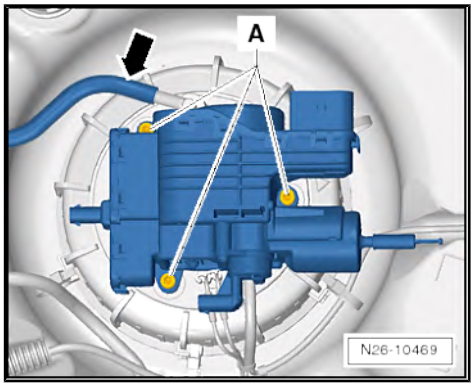
Removing

– Remove tank for reduction agent ⇒ page 320 .

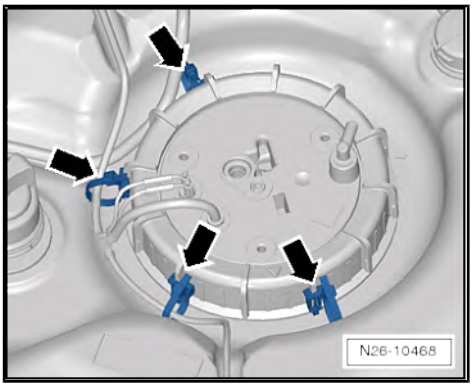
Caution

Protect separated electrical connections against wetting from reducing agent by suitable means, e.g. plastic bag and cable ties. Electrical connections may be damaged due to the high penetration ability of the reducing agent and its subsequent crystallisation.

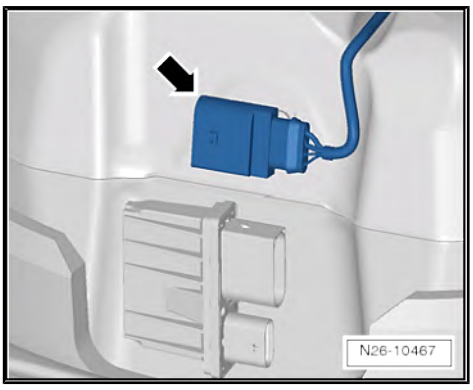
– Pull off breather line -arrow-.
– Unscrew securing bolts -A- and pull off pump for reducing agent - V437- upwards.



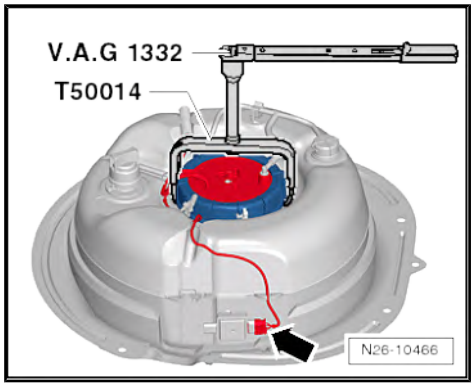
– Cut through cable ties -arrows- on sealing ring.



– Pull connector -arrow- off right side of reducing agent tank.



– Pull connector -arrow- off evaluation unit for reducing agent tank - G698- .
– Fit special wrench - T50014- onto locking ring as shown and unscrew it.



Caution

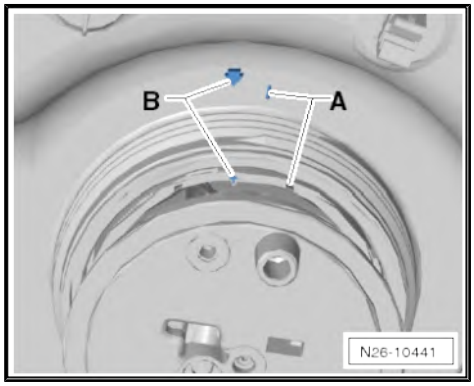
When open, only tilt cover a max. of 30° this prevents damage to electrical cables and suction probe of delivery module.

– Open cover of delivery module, if necessary use wedge - 3409- .
– Carefully grasp in cup of delivery module and release it from the locking device by turning it anti-clockwise.
– Remove delivery module upwards out of tank for reduction agent.

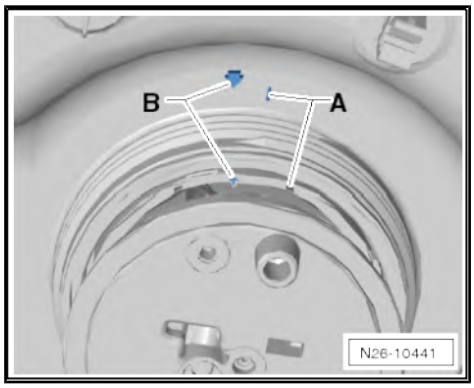
Installing

– Fit seal ⇒ Item 9 (page 314) to opening of tank for reduction agent.

– Fit delivery module into tank for reduction agent, note markings -A-. The marks -A- must align when inserting.



– Carefully grasp in cup of delivery module and engage it by turning it clockwise. The marks -B- must align when engaged correctly.



– Moisten sealing pin of cover with water and press it carefully into seal. The marks -1- must align.

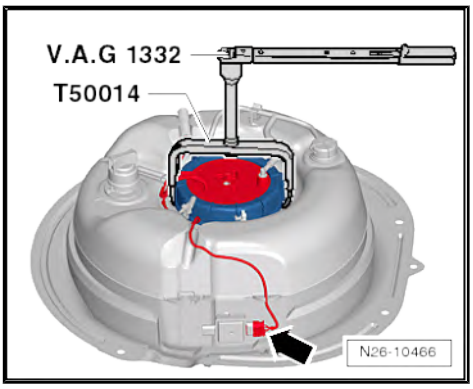
– Fit locking ring and tighten it hand-tight.

> **Caution**
>
> *Ensure locking ring is not cross threaded on threads of tank for reducing agent. This will cause leaks along with serious corrosion damage.*

– Fit wrench - T50014- onto sealing ring as shown and tighten it. Specified torque ⇒ Item 7 (page 314) .

– Wash off excessive reduction agent using water.

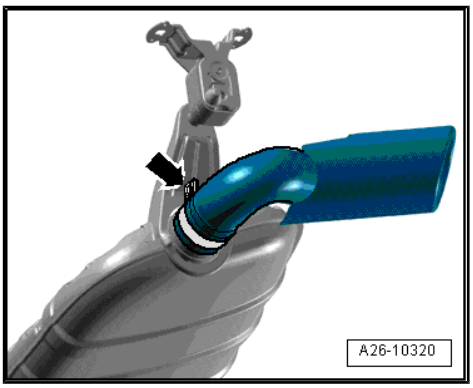
Further assembly is basically the reverse of the removal procedure.



1.10 Replacing tail pipes

Procedure

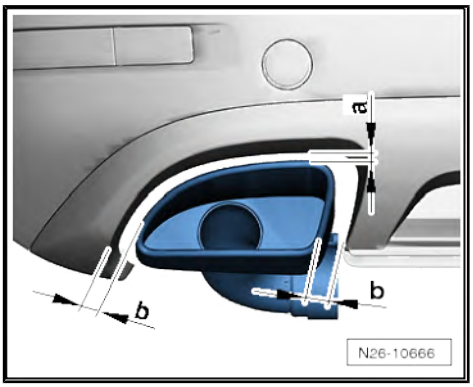
– Unbolt exhaust tailpipe -arrows-.



– Fit exhaust tailpipe onto rear silencer and align.

– Check distance between left and right exhaust tailpipes and bumper:

- Distance -a- = min. 20 mm
- Distance -b- = align uniformly
- Specified torque: 60 Nm.



1.11 Aligning exhaust system free of stress

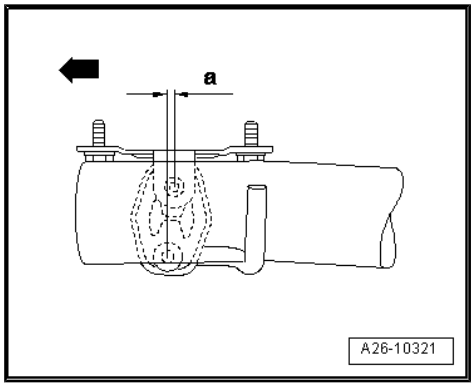
- The exhaust system must be aligned when cold.
- Specified torques ⇒ page 310 .

– Loosen threaded connections of front clamps.

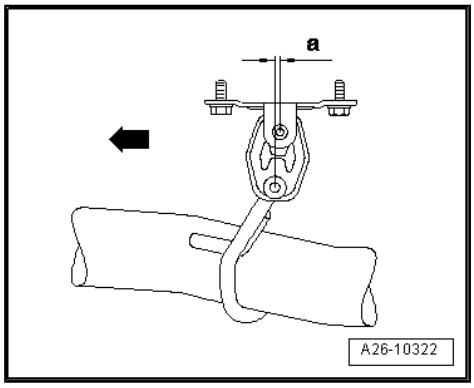
– Loosen threaded connections of rear clamping sleeves if there are any.

– Push exhaust system forwards -arrow- until preload at rubber mountings is as follows:

• Front right mounting: dimension -a- = 2 mm:

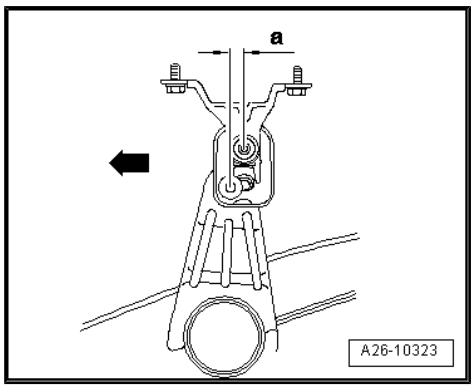


• Front left retainer: dimension -a- = 4 mm.



• Rear left and right mountings: distance -a- = 10 mm.

– Hold exhaust system in this position and tighten threaded connections of clamping sleeves uniformly.



Note

♦ *A second mechanic is required when aligning an exhaust system with clamping sleeves between middle and rear silencers.*

♦ *If all adjustment dimensions are impossible to achieve, loosen respective bracket at body and move bracket.*

– Align tailpipes ⇒ page 329 .

1.12 Check exhaust system for leaks

– Start engine and run it at idling speed.

– Seal end exhaust pipes with cloths or plugs, for example, for the duration of the leakage test.

– Check (by listening) points of connection between exhaust manifold and the cylinder head, between turbocharger and exhaust manifold to make sure there are no leaks.

– Repair any leaks found.

1.13 Assembly overview - exhaust manifold with intermediate pipe

1 - Exhaust turbocharger

2 - Bolt/nut

- ❑ 25 Nm
- ❑ Renew
- ❑ Coat with high-temperature paste - G 052 112 A3- .

3 - Seal

- ❑ Renew

4 - Intermediate flange

5 - Seal

- ❑ Renew

6 - Left intermediate pipe

- ❑ Removing and installing ⇒ page 335

7 - Nut

- ❑ 25 Nm
- ❑ Renew
- ❑ Coat with high-temperature paste - G 052 112 A3- .

8 - Left exhaust manifold

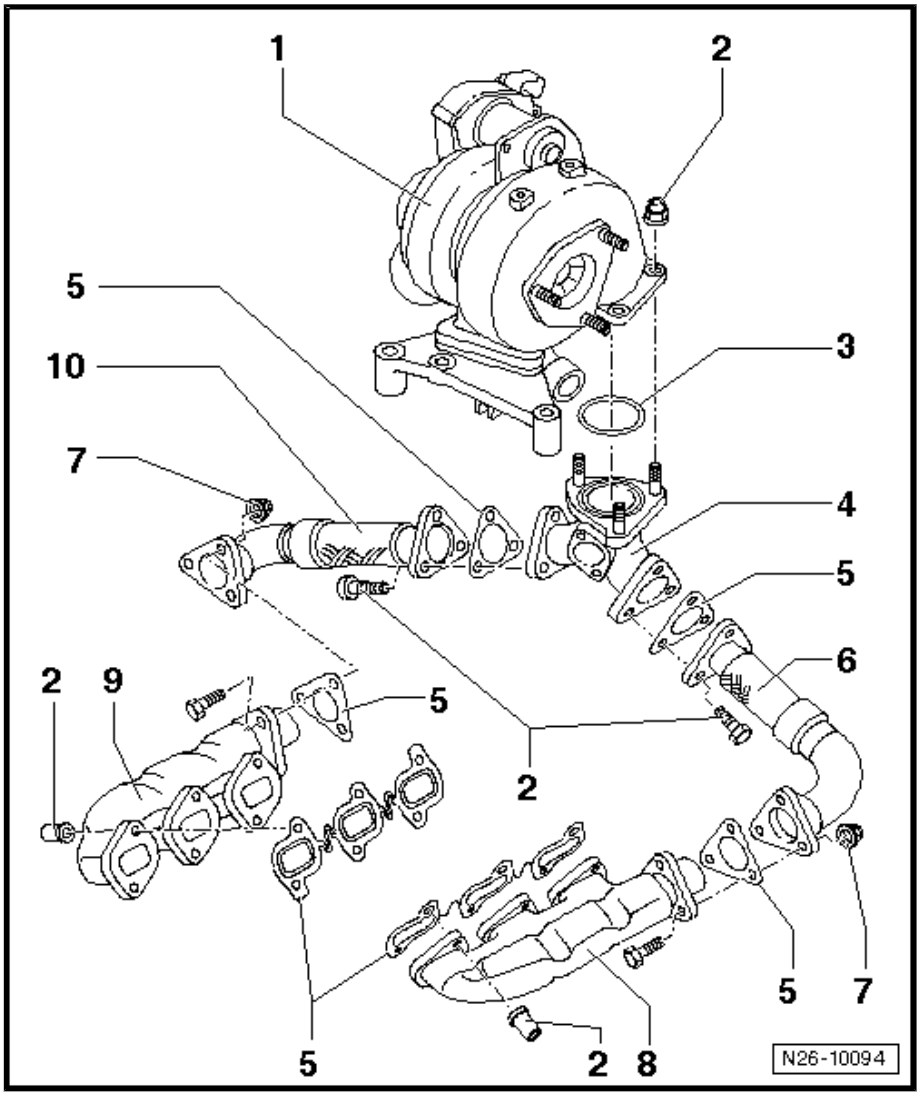
- ❑ Removing and installing ⇒ page 331

9 - Right exhaust manifold

- ❑ Removing and installing ⇒ page 333

10 - Right intermediate pipe

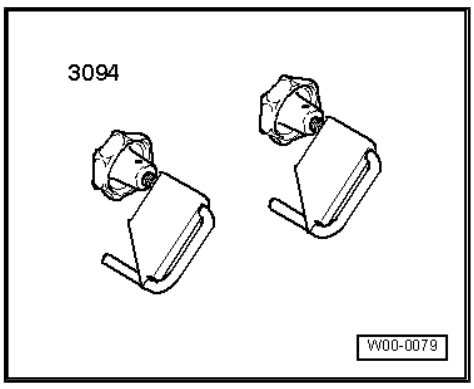
- ❑ Removing and installing ⇒ page 337



1.14 Removing and installing left exhaust manifold

Special tools and workshop equipment required

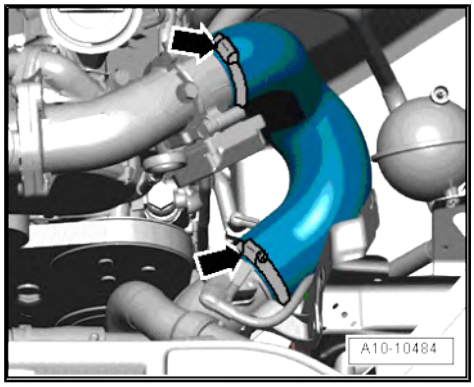
♦ Hose clamps, up to 25 mm - 3094-



Removing

– Remove engine cover panel ⇒ page 3 .

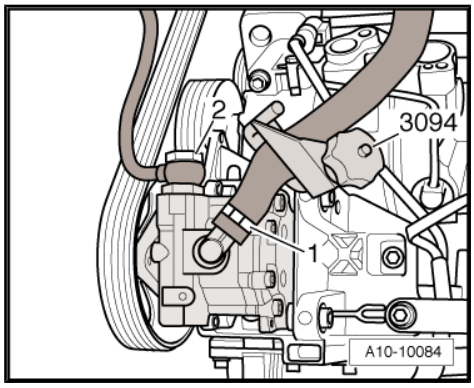
– Remove air hose -arrows-.



Note

Lay a cloth under the separating point to catch any escaping hydraulic fluid.

– Clamp off hydraulic hose for power steering pump using hose clamp - 3094- .
– Remove hydraulic hose -1- from power-assisted steering pump.
– Unscrew banjo bolt -2- and move pressure line to side.



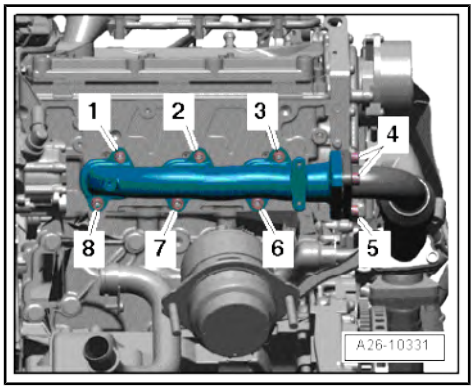
Vehicles with engine code CASA or CASD

– Remove vacuum pump ⇒ page 103 .

Continuation for all engine codes

– Remove left intermediate pipe ⇒ page 335 .

– Unscrew bolts -1 … 8- and remove exhaust manifold.



Installing

Install in reverse order of removal, observing the following.

Note

- *Renew seals, gaskets, O-rings and self-locking nuts.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Electronic parts catalogue (ETKA) .*

– Tighten threaded connections for intermediate pipe/exhaust manifold as follows:

1. Tighten initially to 10 Nm using torque wrench
2. Tighten to 30 Nm using torque wrench.
3. Turn 90° further ($^1/_4$ turn) using a rigid wrench.

– Align exhaust system free of stress.

– Check hydraulic oil level of power-assisted steering ⇒ Maintenance ; Booklet ; Power-assisted steering: Checking oil level .

Specified torques

Component	Nm
Exhaust manifold on cylinder head	25 1)2)
Intermediate pipe to exhaust manifold	30 + 90° 1)2)
Banjo bolt for pressure line to power steering pump	50
Hose clips (13 mm wide)	5.5

- 1) Renew bolts.
- 2) Coat with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA) .

1.15 Removing and installing right exhaust manifold

Removing

– Remove engine cover panel ⇒ page 3 .

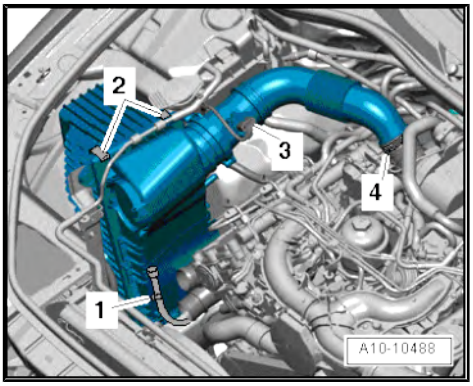
– Drain coolant ⇒ page 187 .

– Unclip breather hose -1- for differential from upper part of air filter.

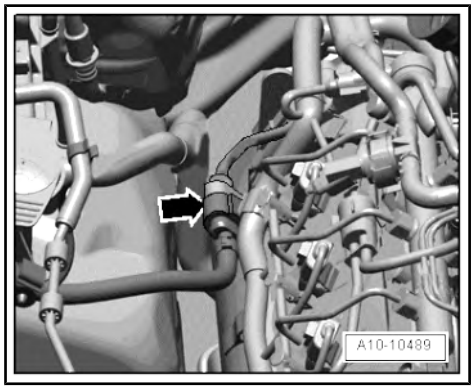
– Disconnect electrical connector -3- at air mass meter - G70- .

– Remove air hose -4- from turbocharger.

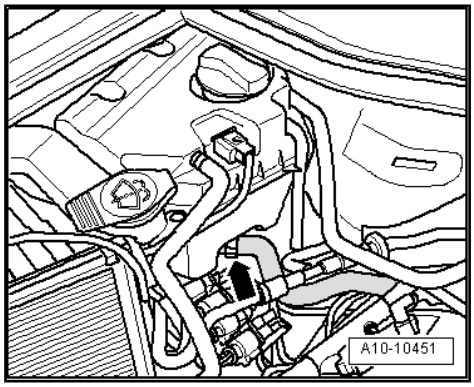
– Release retaining clips -2- and remove upper part of air filter housing.



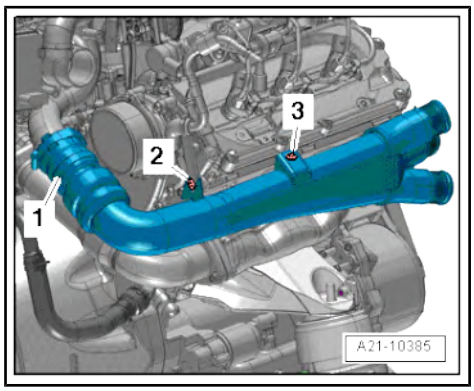
– Remove electrical connector -arrow- from bracket and separate.
– Unbolt bracket for electrical connector from cylinder head cover.



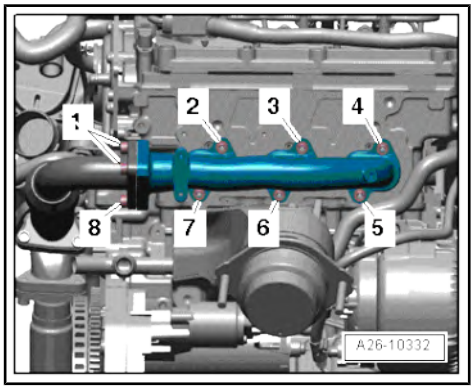
– Detach coolant hose -arrow- from coolant expansion tank.



– Unscrew bolts -2- and -3-.
– Loosen hose clip -1- and pull air intake pipe forwards off air intake hose.
– Remove right intermediate pipe ⇒ page 337 .



– Unscrew bolts -1 … 8- and remove exhaust manifold.



Installing

Install in reverse order of removal, observing the following.

Note

- *Renew seals, gaskets and self-locking nuts.*
- *Hose connections and hoses for charge air system 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 (ETKA) .*

– Fill with coolant ⇒ page 189 .

Specified torques

Component	Nm
Exhaust manifold on cylinder head	25 1)2)
Intermediate pipe to exhaust manifold	30 + 90° 1)2)
Air duct to bracket	9
Hose clips (13 mm wide)	5.5

- 1) Renew bolts.
- 2) Coat with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA) .

1.16 Removing and installing intermediate pipe (left side)

Removing

Engine codes CASA and CASD

– Remove catalytic converter ⇒ page 285 .

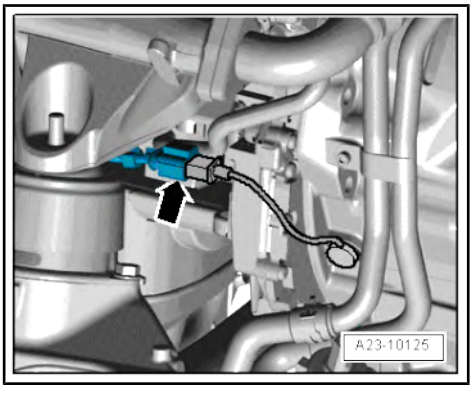
Engine code CATA

– Remove starter catalytic converter ⇒ page 287 .

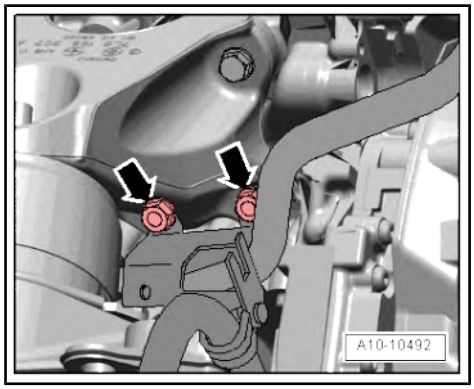
– Remove supplementary cooler for exhaust gas recirculation system ⇒ page 352 .

Continued for all vehicles

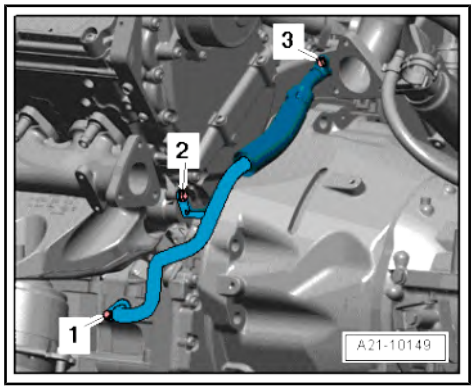
– Remove electrical connector -arrow- for engine speed sender - G28- from bracket and separate.



– Unscrew nuts -arrows- and remove bracket for connector from left engine support.



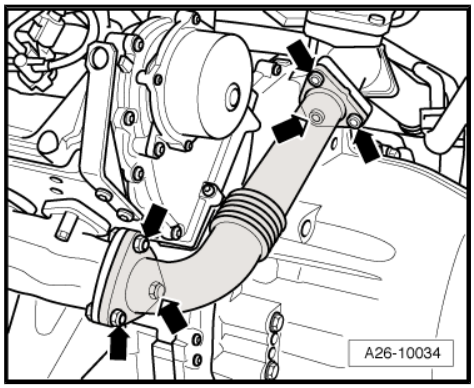
– Remove bolts -1 … 3- and remove oil return line.



Note

For better clarity, illustration shows engine removed and intermediate pipe detached.

– Unbolt and remove intermediate pipe -arrows-.



Installing

Install in reverse order of removal. The following should be observed:

Note

Renew seals and O-rings.

Engine codes CASA and CASD

– Install catalytic converter ⇒ page 285 .

Engine code CATA

– Install supplementary cooler for exhaust gas recirculation system ⇒ page 352 .

– Install primary catalytic converter ⇒ page 287 .

Specified torques

Component		Nm
Intermediate pipe to	Exhaust manifold	30 + 90° 1)2)
	Intermediate flange	30 + 90° 1)2)
Oil return line to	Cylinder block	9
	Intermediate flange	9
	Upper part of sump	9

- 1) Renew bolts.
- 2) Coat with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA) .

1.17 Removing and installing intermediate pipe (right side)

Removing

– Remove engine cover panel ⇒ page 3 .

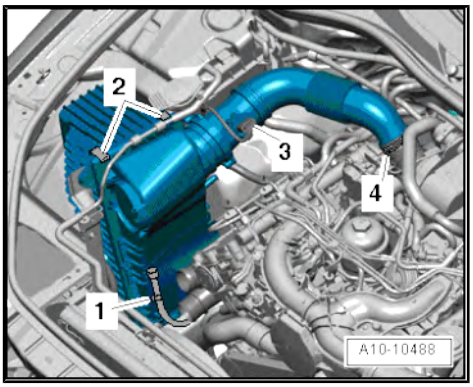
– Drain coolant ⇒ page 187 .

– Unclip breather hose -1- for differential from upper part of air filter.

– Disconnect electrical connector -3- at air mass meter - G70- .

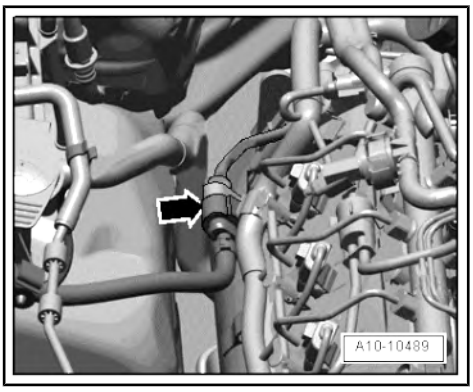
– Remove air hose -4- from turbocharger.

– Release retaining clips -2- and remove upper part of air filter housing.

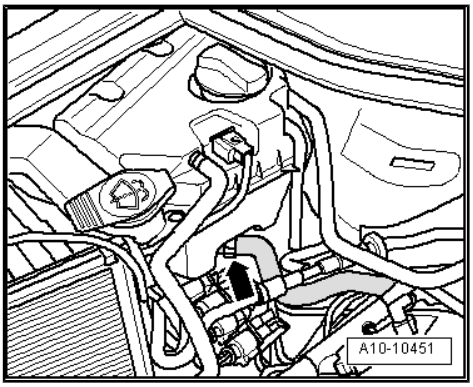


– Remove electrical connector -arrow- from bracket and separate.

– Unbolt bracket for electrical connector from cylinder head cover.

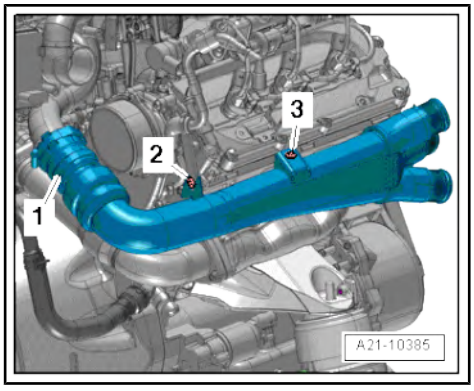


– Detach coolant hose -arrow- from coolant expansion tank.

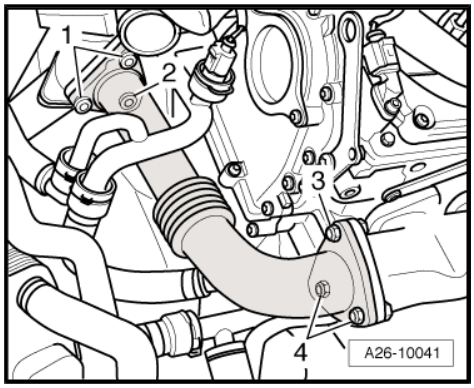


– Unscrew bolts -2- and -3-.

– Loosen hose clip -1- and pull air intake pipe forwards off air intake hose.



– Remove threaded connections -1 … 4- and remove intermediate pipe.



Note

For greater clarity, shown with engine removed.

Installing

Install in reverse order of removal, observing the following.

Note

Renew seals.

– Fill with coolant ⇒ page 189 .

Specified torques

Component		Nm
Intermediate pipe to	Exhaust manifold	30 + 90° 1)2)
	Intermediate flange	30 + 90° 1)2)
Air duct to bracket		9
Bracket for connector to cylinder head cover		9

- 1) Renew bolts.
- 2) Coat with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA) .

2 Exhaust gas temperature regulation (engine codes CASA and CASD)

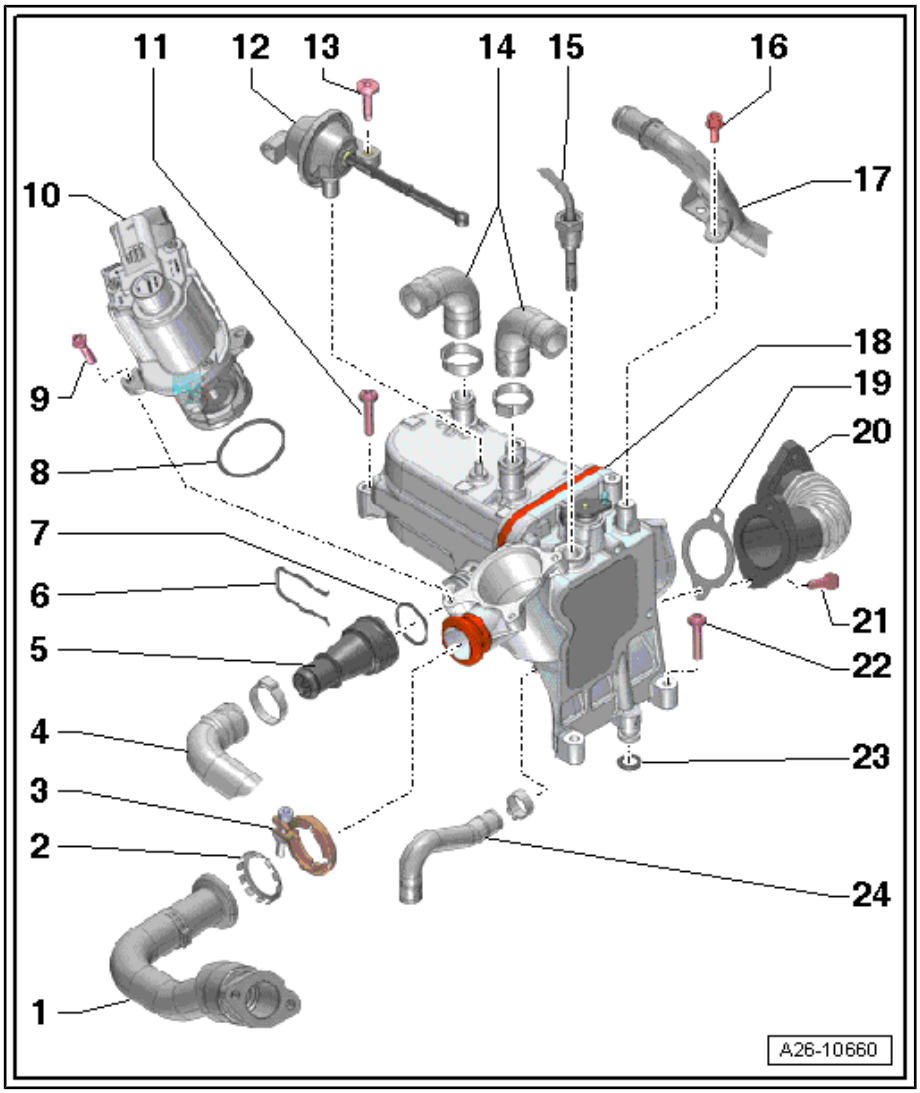
⇒ “2.1 Assembly overview - exhaust gas recirculation system”, page 339 .

⇒ “2.2 Removing and installing exhaust gas recirculation control motor V338 ”, page 340 .

⇒ “2.3 Removing and installing exhaust gas recirculation cooler”, page 341 .

⇒ “2.4 Removing and installing exhaust gas recirculation temperature sensor G98 ”, page 344 .

2.1 Assembly overview - exhaust gas recirculation system



1 - Connecting pipe for exhaust gas recirculation

2 - Sealing disc

- ❑ Renew

3 - Clip

- ❑ Installation position: as shown in illustration.
- ❑ 9 Nm

4 - Coolant hose

5 - Connection with thermostat for exhaust gas recirculation

6 - Retaining clip

7 - O-ring

- ❑ Renew

8 - O-ring

- ❑ Renew

9 - Bolt

- ❑ 9 Nm

10 - Exhaust gas recirculation control motor - V338-

- ❑ With exhaust gas recirculation potentiometer - G212-
- ❑ Removing and installing ⇒ page 340

11 - Bolt

- ❑ 9 Nm

12 - Vacuum unit for exhaust gas recirculation changeover function

13 - Bolt

- ❑ 9 Nm

14 - Coolant hoses

15 - Exhaust gas recirculation temperature sensor - G98-

- ❑ Removing and installing ⇒ page 344

16 - Bolt

- ❑ 9 Nm

17 - Crankcase breather pipe

18 - Exhaust gas recirculation cooler

- ❑ With changeover flap for exhaust gas recirculation cooler.
- ❑ Removing and installing ⇒ page 341

19 - Seal

- ❑ Renew

20 - Connecting pipe for exhaust gas recirculation

21 - Bolt

- ❑ 9 Nm

22 - Bolt

- ❑ 9 Nm

23 - O-ring

- ❑ Renew

24 - Coolant hose

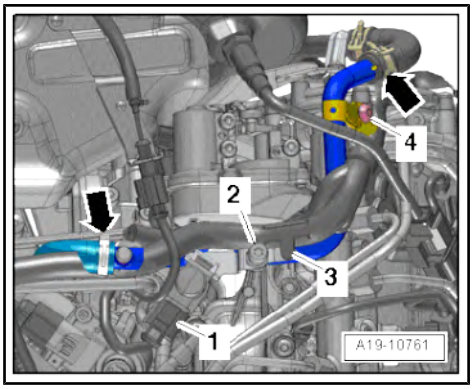
2.2 Removing and installing exhaust gas recirculation control motor - V338-

Removing

– Remove engine cover panel ⇒ page 3 .

– Take exhaust gas recirculation cooler changeover valve - N345- -item 1- out of retainer.

– Loosen bolt -4- several turns.

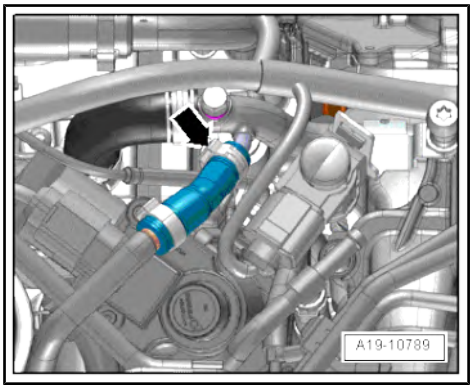


Note

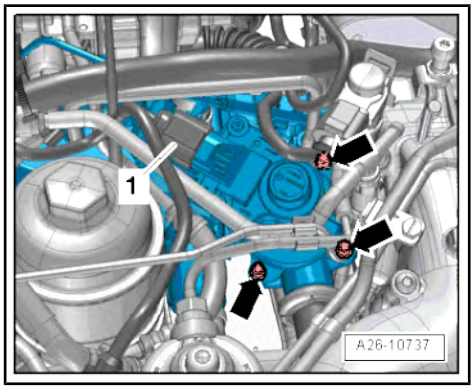
Ignore -items 2, 3- and -arrows-.

– Briefly open filler cap for coolant expansion tank in order to reduce pressure in cooling system.

– If coolant hose is fitted, loosen hose clip -arrow- and remove hose.



– Seal open lines and connections with suitable plugs from engine bung set - VAS 6122- .
– Separate connector -1-.



Note

If the control motor sits too tightly due to coking, spray commercially available rust remover onto gap of the flange and allow it to work for some time.

– Unscrew bolts -arrows- and remove exhaust gas recirculation control motor - V338- .

Installing

Install in reverse order of removal, observing the following.

- Specified torque
⇒ “2.1 Assembly overview - exhaust gas recirculation system”, page 339 .

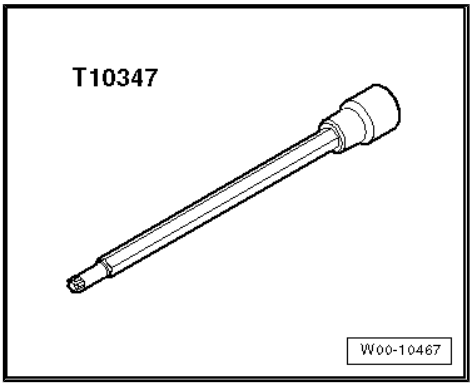
Note

Renew O-ring.

2.3 Removing and installing exhaust gas recirculation cooler

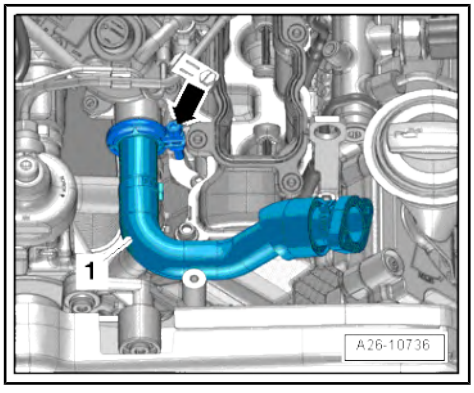
Special tools and workshop equipment required

♦ Torx bit - T10347-

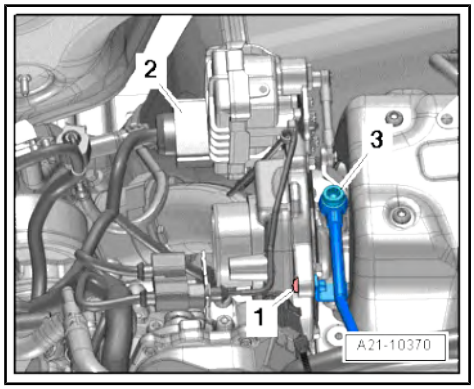


Removing

– Drain coolant ⇒ page 187 .
– Remove oil filter housing ⇒ page 158 .
– Release clip -arrow- and remove pipe -1- for exhaust gas recirculation.



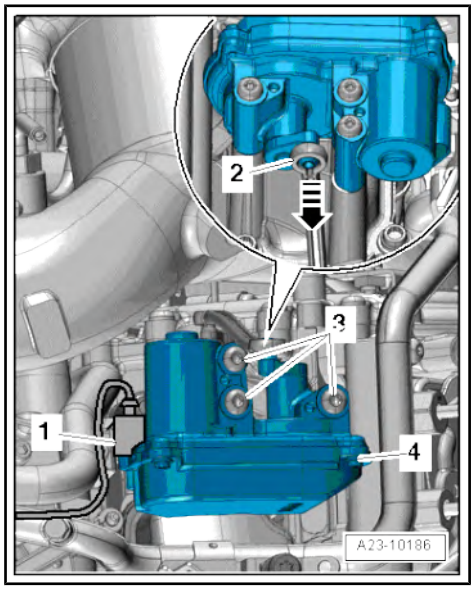
– Unscrew bolt -1- and banjo bolt -3-, remove oil supply line.



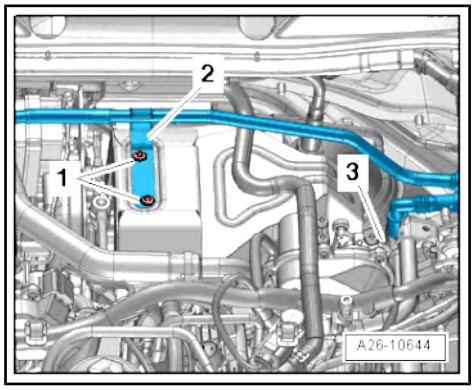
Note

Disregard -item 2-.

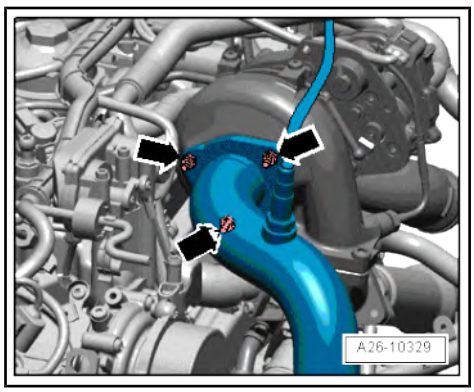
– Separate connector -1-.
– Carefully press of linkage -2- from ball head -arrow-.
– Unscrew bolts -3- and remove intake manifold flap 2 motor - V275- -item 4-.
– Repeat work sequence on opposite side of vehicle.



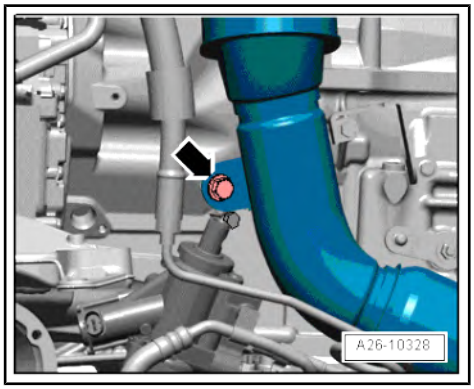
– Unscrew bolts -1-, but only loosen bolt -3-.
– Lay vacuum hose with bracket -2- aside and remove heat shield for turbocharger.



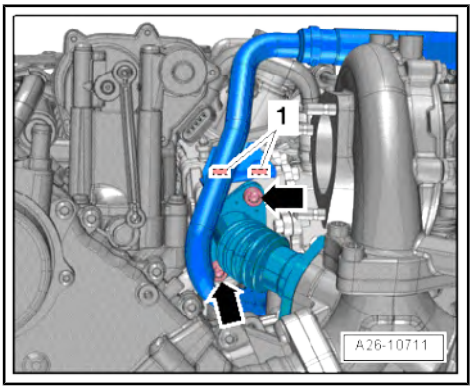
– Unscrew nuts -arrows-.



– Remove bolt -arrow- on retainer for starter catalytic converter.
– Press starter catalytic converter to left and fix into position if necessary.



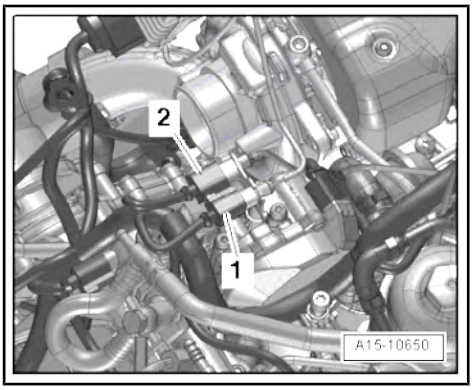
– Remove bolts -arrows- and -1-.



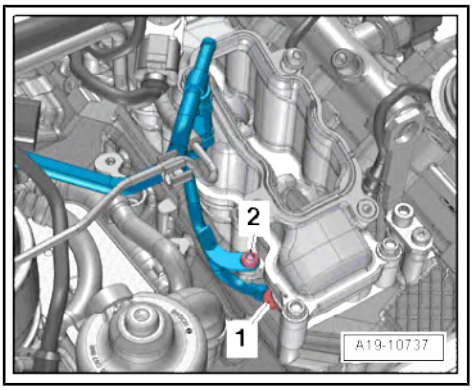
– Remove electrical connection -2- for exhaust gas recirculation temperature sensor - G98- from retainer and separate.

Note

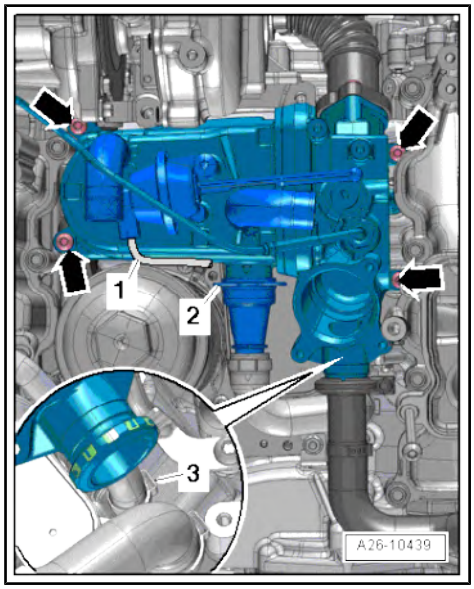
Disregard -item 1-.



– Unscrew banjo bolt -1- and bolt -2-, move coolant line clear to side.
– Detach vacuum hose -1-.



– Open hose clips and detach coolant hoses ⇒ Item 14 (page 339) (14) at top of exhaust gas recirculation cooler.
– Remove coolant hose, lift retaining clip -2- for this.
– Open hose clip -3- and remove coolant hose.
– Unscrew bolts -arrows- and pull exhaust gas recirculation cooler upwards off cylinder block.



Installing

Install in reverse order of removal, observing the following.

- Specified torque ⇒ "2.1 Assembly overview - exhaust gas recirculation system", page 339 .

Note

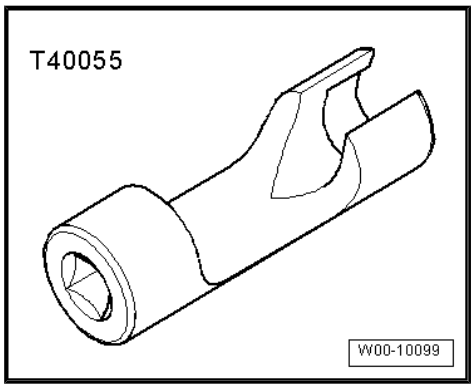
♦ *Renew gaskets/seals and O-rings.*
♦ *Secure all hose connections with the same type of hose clips as original equipment ⇒ Electronic parts catalogue .*

– Install intake manifold flap motors ⇒ page 273 .
– Install coolant line.
– Install oil filter housing ⇒ page 158 .
– Add coolant ⇒ page 189 .
– Install starter catalytic converter ⇒ page 288

2.4 Removing and installing exhaust gas recirculation temperature sensor - G98-

Special tools and workshop equipment required

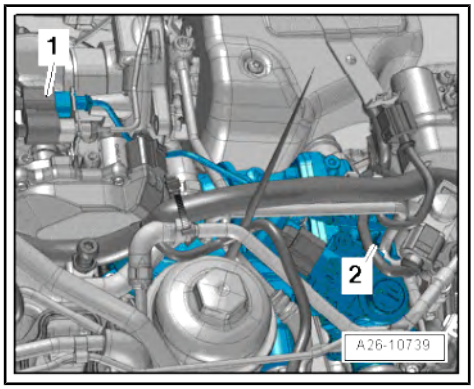
♦ Socket - T40055-



Removing

– Remove connector -1- for exhaust gas recirculation temperature sensor - G98- from retainer, separate connector and move electrical wiring clear.

– Unscrew exhaust gas recirculation temperature sensor - G98- -item 2- using socket insert - T40055- .



Installing

- Specified torque ⇒ page 339 .

Install in reverse order of removal, observing the following.

- Specified torque ⇒ page 339 .

3 Exhaust gas recirculation (engine code CATA)

⇒ “3.1 Assembly overview - exhaust gas recirculation system”, page 346 .

⇒ “3.2 Assembly overview - supplementary cooler for exhaust gas recirculation system”, page 348 .

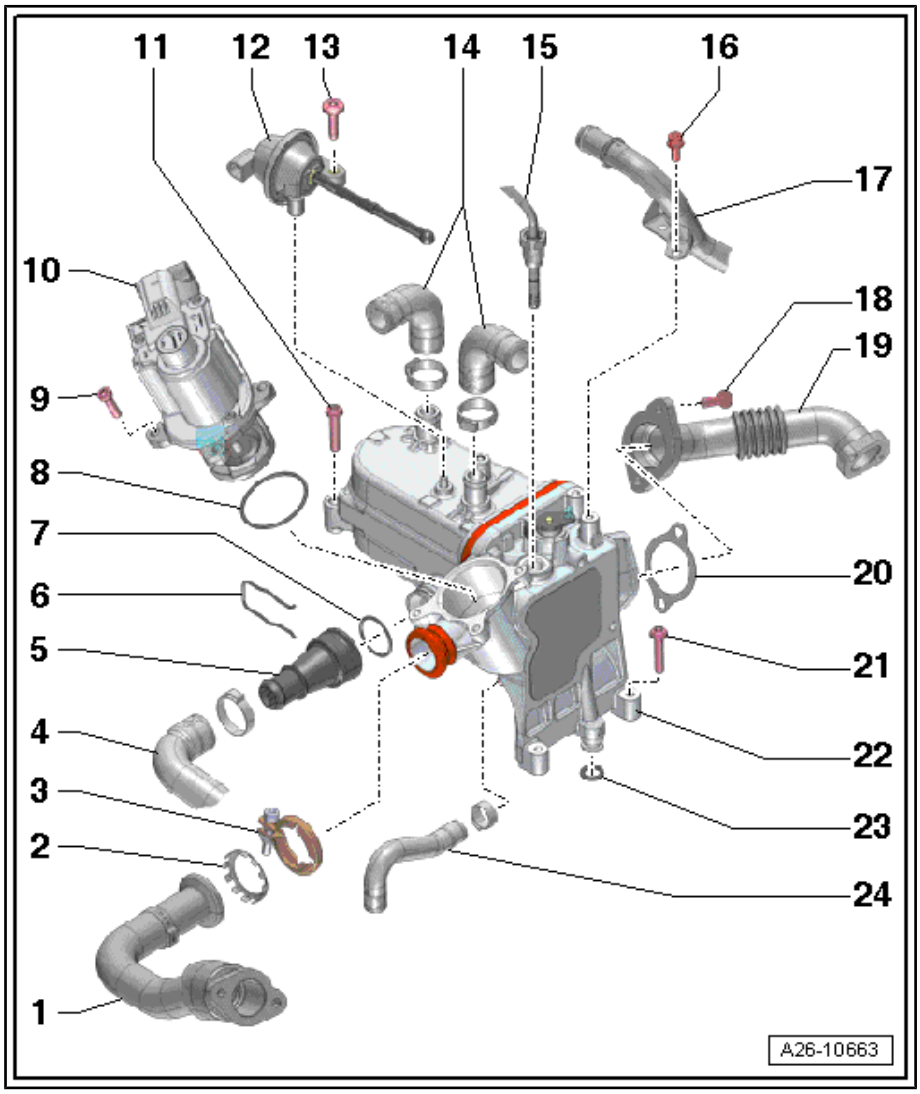
⇒ “3.3 Removing and installing exhaust gas recirculation control motor V338 ”, page 348 .

⇒ “3.4 Removing and installing exhaust gas recirculation cooler”, page 349 .

⇒ “3.5 Removing and installing supplementary cooler for exhaust gas recirculation system”, page 352 .

⇒ “3.6 Removing and installing exhaust gas recirculation temperature sensor G98 ”, page 354 .

3.1 Assembly overview - exhaust gas recirculation system



1 - Exhaust gas recirculation pipe

2 - Sealing disc
- ❑ Renew

3 - Clip
- ❑ 9 Nm
- ❑ Installation position: as shown in illustration

4 - Coolant hose

5 - Thermostat for exhaust gas recirculation with union

6 - Retaining clip

7 - O-ring
- ❑ Renew

8 - O-ring
- ❑ Renew

9 - Bolt
- ❑ 9 Nm

10 - Exhaust gas recirculation control motor - V338-
- ❑ With exhaust gas recirculation potentiometer - G212-
- ❑ Removing and installing ⇒ page 348

11 - Bolt
- ❑ 9 Nm

12 - Vacuum unit for exhaust gas recirculation changeover function

13 - Bolt
- ❑ 9 Nm

14 - Coolant hoses

15 - Exhaust gas recirculation temperature sensor - G98-

- ❑ 45 Nm
- ❑ Removing and installing ⇒ page 354
- ❑ Coat with high-temperature paste; High-temperature paste ⇒ Electronic parts catalogue (ETKA) .

16 - Bolt

- ❑ 9 Nm

17 - Crankcase breather pipe

18 - Bolt

- ❑ 9 Nm

19 - Exhaust gas recirculation pipe

20 - Seal

- ❑ Renew

21 - Bolt

- ❑ 9 Nm

22 - Exhaust gas recirculation cooler

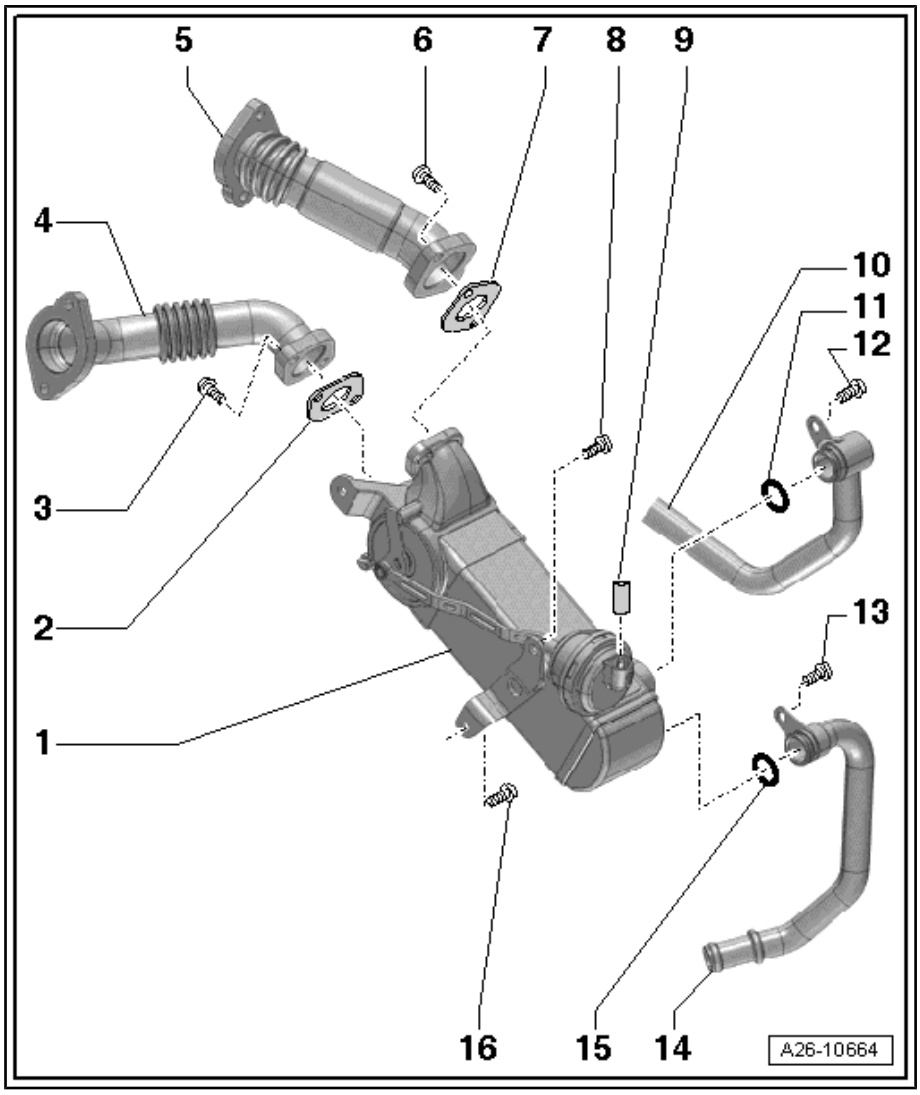
- ❑ With changeover flap for exhaust gas recirculation cooler.
- ❑ Removing and installing ⇒ page 349

23 - O-ring

- ❑ Renew

24 - Coolant hose

3.2 Assembly overview - supplementary cooler for exhaust gas recirculation system



1 - Supplementary cooler for exhaust gas recirculation
- ❑ Removing and installing ⇒ page 352

2 - Seal
- ❑ Renew

3 - Bolt
- ❑ 9 Nm

4 - Exhaust gas recirculation pipe

5 - Exhaust gas recirculation pipe
- ❑ With catalytic converter.

6 - Bolt
- ❑ 9 Nm

7 - Seal
- ❑ Renew

8 - Bolt
- ❑ 9 Nm

9 - Vacuum hose
- ❑ From exhaust gas recirculation cooler changeover valve 2 - N381-

10 - Rear coolant pipe
- ❑ Removing and installing ⇒ page 182

11 - O-ring
- ❑ Renew

12 - Bolt
- ❑ 9 Nm

13 - Bolt
- ❑ 9 Nm

14 - Rear left coolant pipe
- ❑ Removing and installing ⇒ page 177

15 - O-ring
- ❑ Renew

16 - Bolt
- ❑ 9 Nm

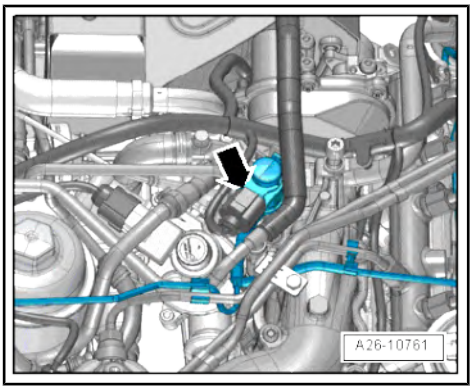
3.3 Removing and installing exhaust gas recirculation control motor - V338-

Removing

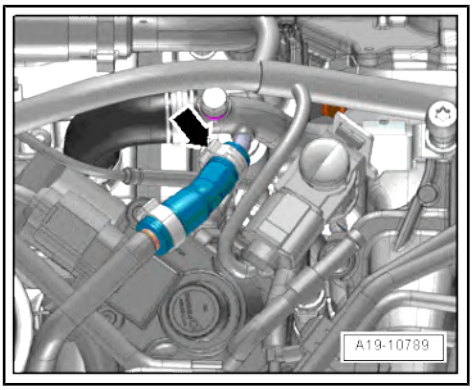
– Drain coolant ⇒ page 187 .

– Remove engine cover panel ⇒ page 3 .

– Take exhaust gas recirculation cooler changeover valve - N345- -arrow- out of retainer.

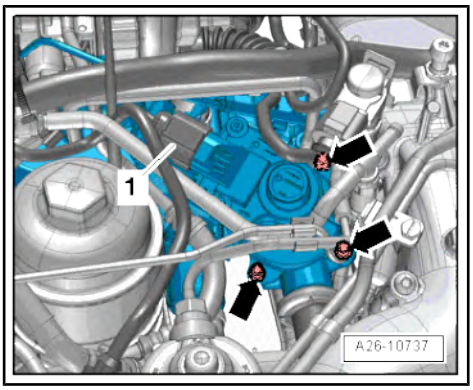


– Loosen hose clip -arrow- and remove coolant hose.



– Pull off connector -1-.

– Unscrew bolts -arrows- and remove exhaust gas recirculation control motor - V338- .



Installing

Install in reverse order of removal, observing the following.

Note

- *Renew O-ring.*
- *Secure all hose connections with hose clips which conform to production standard.*

– Add coolant ⇒ page 189 .

3.4 Removing and installing exhaust gas recirculation cooler

Removing

– Drain coolant ⇒ page 187 .

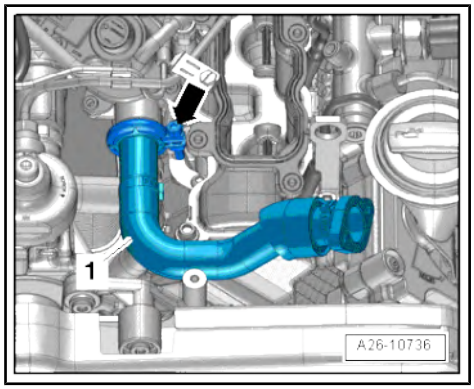
– Remove upper left coolant pipe ⇒ page 176 .

– Remove upper right coolant pipe ⇒ page 181 .

– Remove oil filter housing ⇒ page 156 .

– Remove starter catalytic converter ⇒ page 288 .

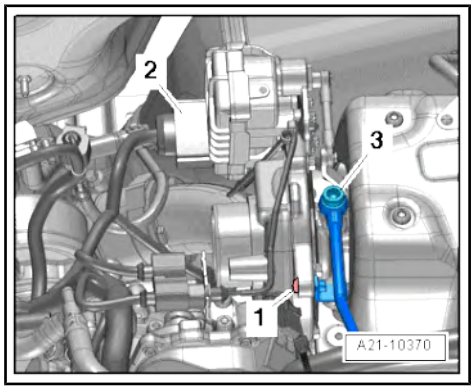
– Release clip -arrow- and remove pipe -1- for exhaust gas recirculation.



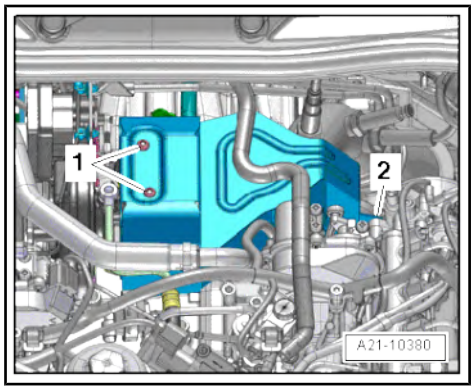
– Remove bolt -1- and banjo bolt -3- and move oil supply line for turbocharger to side.

Note

Disregard -item 2-.



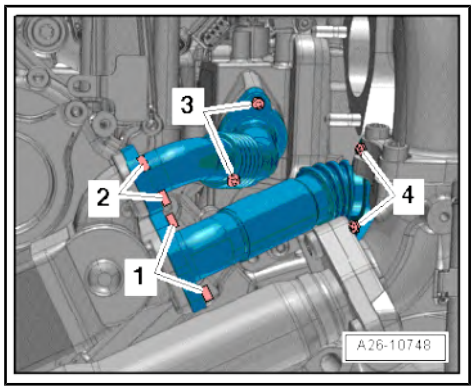
– Remove bolts -1-, loosen bolt -2- and remove heat shield for turbocharger.



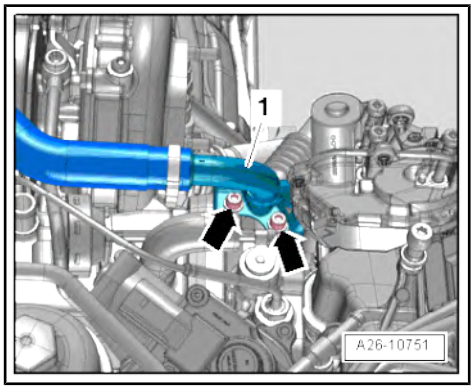
– Unscrew bolts -2- and -3-, remove pipe for exhaust gas recirculation.

Note

-Items 1, 4- can be disregarded.



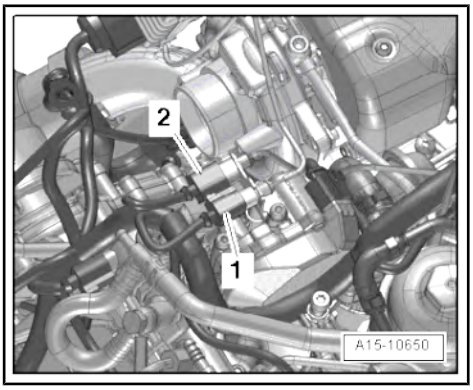
– Unscrew bolts -arrows- and push crankcase breather pipe -1- to rear.



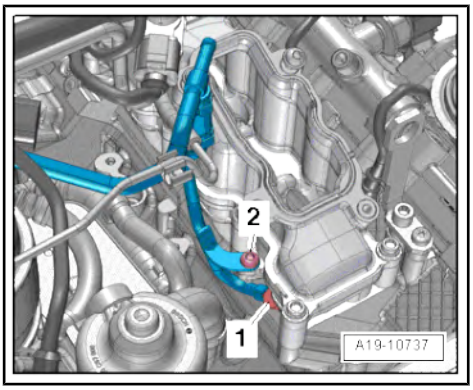
– Remove electrical connection -2- for exhaust gas recirculation temperature sensor - G98- from retainer and separate.

Note

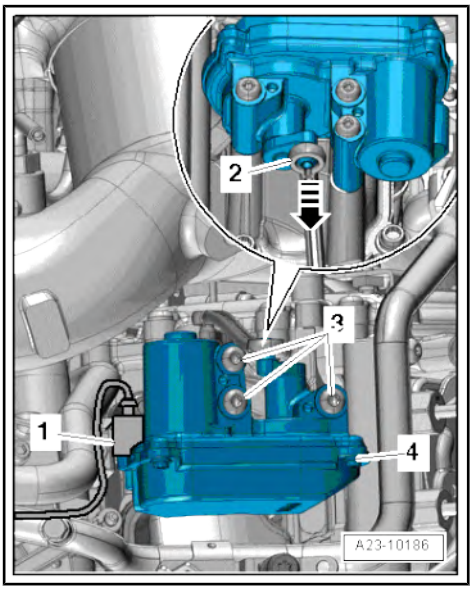
Disregard -item 1-.



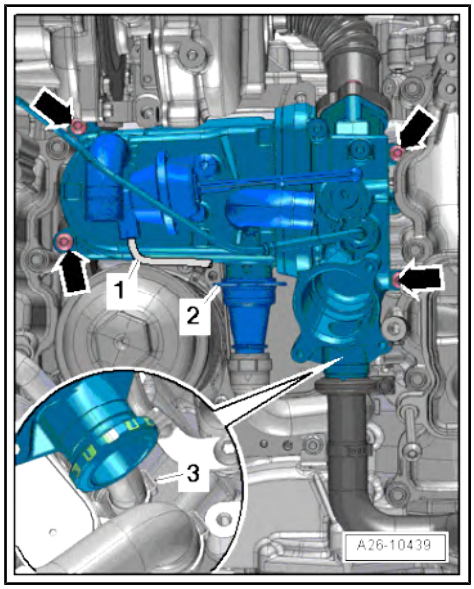
– Unscrew banjo bolt -1- and bolt -2-, move coolant line clear to side.



– Pull off connector -1-.
– Carefully press of linkage -2- from ball head -arrow-.
– Unscrew bolts -3- and remove intake manifold flap 2 motor - V275- -item 4-.
– Repeat work sequence on opposite side of vehicle.



– Detach vacuum hose -1-.
– Remove coolant hose, lift retaining clip -2- for this.
– Open hose clip -3- and remove coolant hose.
– Unscrew bolts -arrows- and pull exhaust gas recirculation cooler upwards off cylinder block.



Installing

Install in reverse order of removal, observing the following.

Note

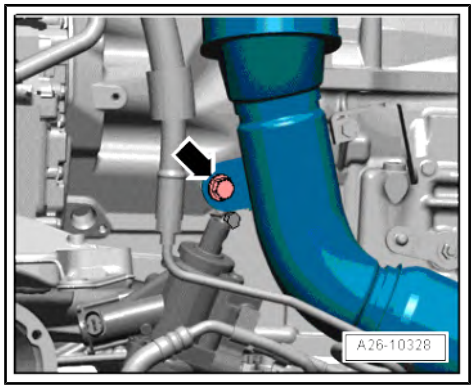
- *Renew gaskets, seals and O-rings.*
- *Secure all hose connections with hose clips which conform to production standard.*

– Install starter catalytic converter ⇒ page 288 .
– Install intake manifold flap motors ⇒ page 273 .
– Install oil filter housing ⇒ page 156 .
– Install right upper coolant pipe ⇒ page 181 .
– Install upper coolant pipe ⇒ page 176 .
– Add coolant ⇒ page 189 .

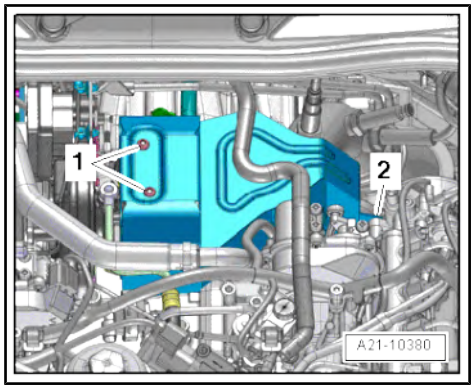
3.5 Removing and installing supplementary cooler for exhaust gas recirculation system

Removing

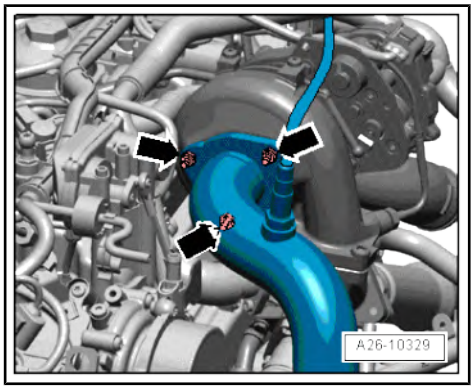
– Remove bolt -arrow- on retainer for starter catalytic converter.
– Remove engine cover panel ⇒ page 3 .
– Drain coolant ⇒ page 187 .
– Remove rear left coolant pipe on supplementary cooler for exhaust gas recirculation ⇒ page 177 .
– Remove coolant pipe (rear) ⇒ page 182 .



– Remove bolts -1-, loosen bolt -2- and remove heat shield for turbocharger.



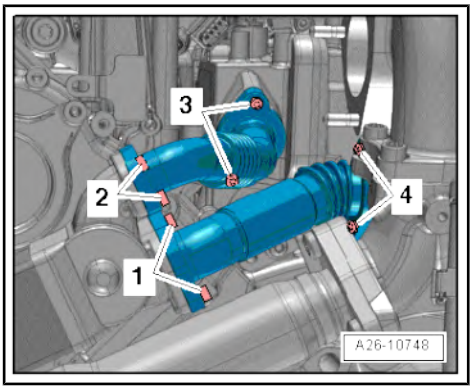
– Unscrew nuts -arrows-.
– Pull starter catalytic converter off turbocharger and push to rear.



– Unscrew bolts -1- and -2-.

Note

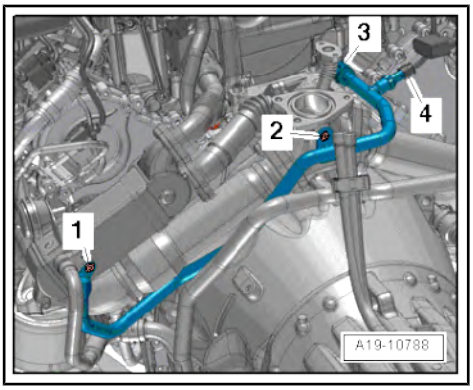
Disregard -items 3, 4-.



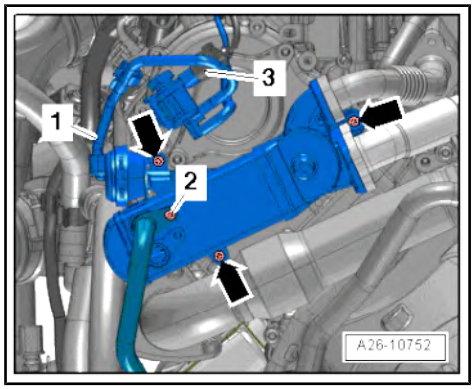
– Unscrew bolts -1- and -2-, pull rear coolant pipe off supplementary cooler for exhaust gas recirculation.

Note

Disregard -items 3, 4-.



– Pull vacuum hose -1- off vacuum unit and take exhaust gas recirculation cooler changeover valve 2 - N381- -item 3- out of retainer.
– Unscrew bolt -2- and pull rear left coolant pipe off supplementary cooler for exhaust gas recirculation.
– Unscrew bolts -arrows- and remove supplementary cooler for exhaust gas recirculation



Installing

Install in reverse order of removal, observing the following.

Note

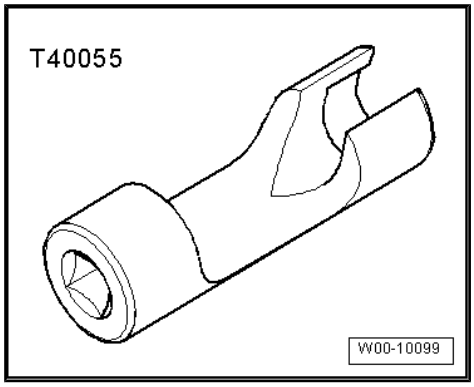
Renew gaskets/seals and O-rings.

– Install rear left coolant pipe on supplementary cooler for exhaust gas recirculation ⇒ page 177 .
– Install rear coolant pipe ⇒ page 182 .
– Add coolant ⇒ page 189 .

3.6 Removing and installing exhaust gas recirculation temperature sensor - G98-

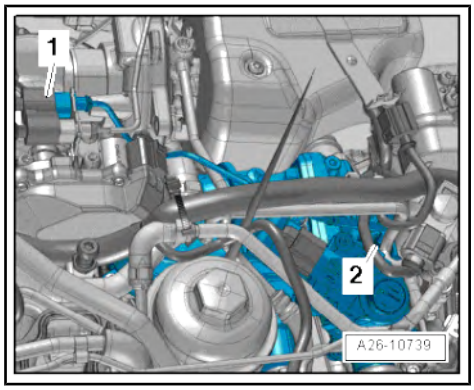
Special tools and workshop equipment required

◆ Socket - T40055-



Removing

– Remove engine cover panel ⇒ page 3 .
– Remove connector -2- for exhaust gas recirculation temperature sensor - G98- from retainer, separate connector and move electrical wiring clear.
– Unscrew exhaust gas recirculation temperature sensor - G98- -item 1- using socket insert - T40055- .



Installing

Install in reverse order of removal.

28 – Glow plug system

1 Glow plug system

⇒ “1.1 Assembly overview - Glow plugs, Hall sender, engine speed sender”, page 355

⇒ “1.2 Removing and installing glow plugs”, page 355

⇒ “1.3 Removing and installing engine speed sender G28 ”, page 357

⇒ “1.4 Removing and installing Hall sender G40 ”, page 358

1.1 Assembly overview - Glow plugs, Hall sender, engine speed sender

1 - Sender wheel

- ❑ For engine speed sender - G28-
- ❑ Removing and installing ⇒ page 46

2 - Glow plug

Cylinder bank 1 (right side):

- ❑ Glow plug 1 - Q10- , Glow plug 2 - Q11- , Glow plug 3 - Q12-

Cylinder bank 2 (left side):

- ❑ Glow plug 4 - Q13- , glow plug 5 - Q14- , glow plug 6 - Q15-
- ❑ 12 Nm

3 - Electrical connector

4 - Bolt

- ❑ 9 Nm

5 - Hall sender - G40-

- ❑ Removing and installing ⇒ page 358

6 - O-ring

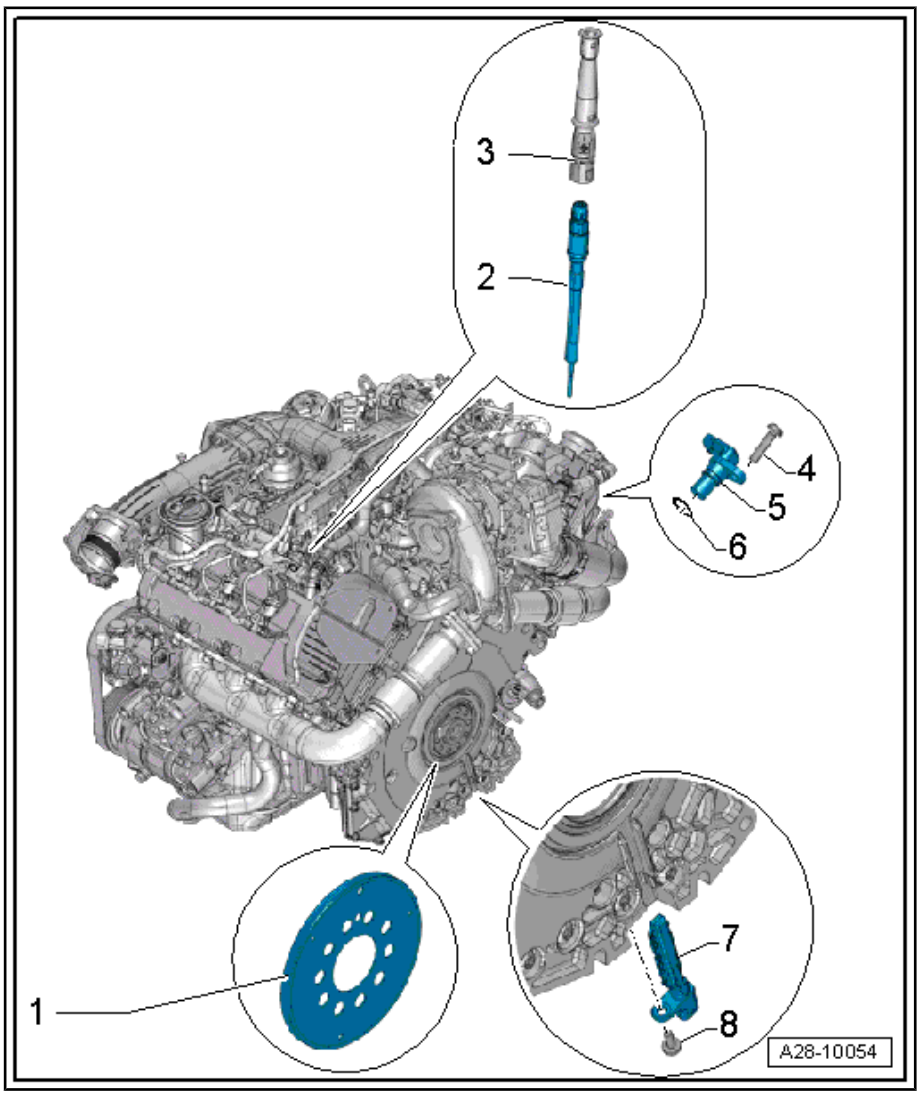
- ❑ Renew

7 - Engine speed sender - G28-

- ❑ Removing and installing ⇒ page 357

8 - Bolt

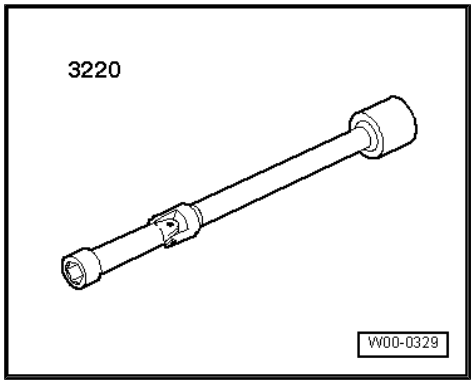
- ❑ 9 Nm



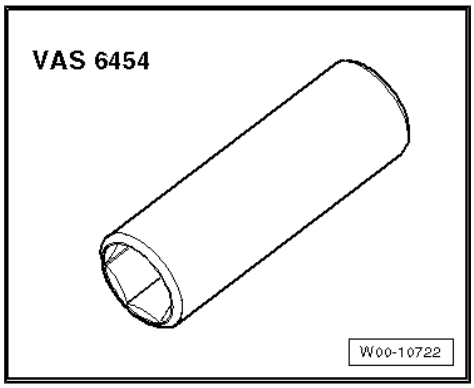
1.2 Removing and installing glow plugs

Special tools and workshop equipment required

- Swivel socket, 10 mm - 3220- (for glow plugs “1, 3, 4, 6”)



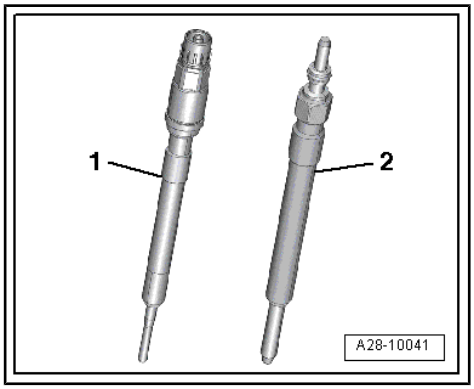
- Socket, 12 mm - VAS 6454- (for glow plugs, “cylinders 2 and 5”)



Removing

– Switch off ignition.

– Pull off engine cover panel ⇒ page 3 .



Note

- *For cylinders 3 and 6, the respective intake manifold flap motors must be unbolted.*
- *A combustion chamber pressure sender is integrated in the glow plugs for cylinders 2 and 5.*
- *Master list term: glow plug 2 - Q11- with cylinder 2 combustion chamber pressure sender - G678-*
- *Electric components list term: glow plug 5 - Q14- with cylinder 5 combustion chamber pressure sender - G681-*

Glow plug versions

1 - Glow plug with compression chamber pressure sender (fitted only in cylinders 2 and 5)

2 - Glow plug without combustion chamber pressure sender

– Pull connectors off glow plugs.

– Clean glow plug port in cylinder head; make sure no dirt falls into cylinder.

Note

- *Cleaning procedure:*
- *Use a vacuum cleaner to remove coarse dirt.*
- *Then use an oil-soaked cloth to clean the glow plug opening.*

– Loosen glow plugs “1, 3, 4, 6” using swivel socket, 10 mm - 3220- .

– Loosen glow plugs “2 and 5” using socket, 12 mm - VAS 6454- .

– Then, carefully unscrew glow plugs by hand or with a suitable hose without canting them.

Installing

– Carefully screw in the glow plugs by hand or with a suitable hose without canting them.

– Tighten glow plugs using swivel socket, 10 mm - 3220- or socket, 12 mm - VAS 6454- with a suitable torque wrench.

• Specified torque for glow plugs: 17 Nm

– Push connector back onto the respective glow plug, ensuring that the electrical connections are secure.

The remaining installation steps are carried out in the reverse sequence of removal.

• Specified torque for intake manifold flap motor: Assembly overview - intake manifold ⇒ page 273

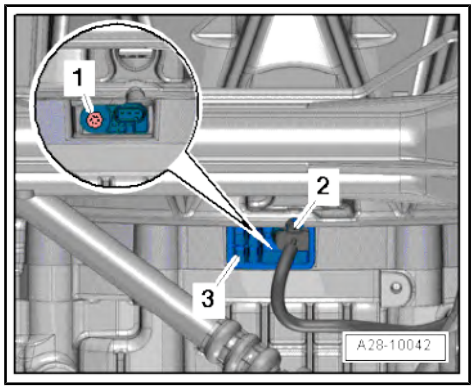
1.3 Removing and installing engine speed sender - G28-

Removing

– Remove rear noise insulation.

– Disconnect connector -2-.

– Unscrew and remove bolt -1- and remove engine speed sensor - G28- -



Installing

Install in reverse order of removal, observing the following.

- Specified torque: 9 Nm

– Fit noise insulation ⇒ Rep. gr. 66 .

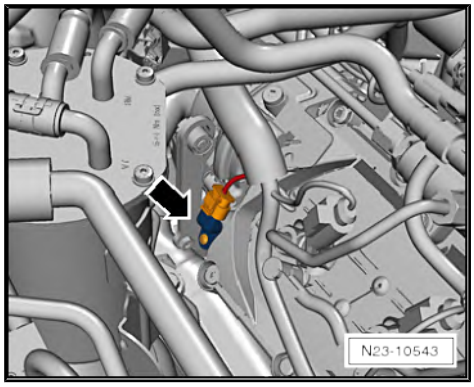
1.4 Removing and installing Hall sender - G40-

Removing

– Pull off engine cover panel ⇒ page 3 .

– Separate electrical connector:

– Unscrew bolt and remove Hall sender - G40- -arrow-.



Installing

- Specified torque: 9 Nm

Install in reverse order of removal, observing the following.

Note

Renew O-ring.