Workshop Manual
Audi A8 2003 ➤

8-cylinder engine (3.7 ltr., 4.2 ltr. 5-valve), mechanics									
Engine ID	BFM	BFL	BGK						

Edition 05.2009

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Repair Group

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

Contents

00 – Technical data

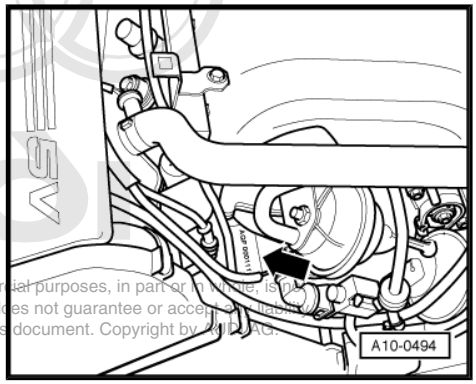
1 Technical data

1.1 Engine number

The engine number (“engine code” and “serial number”) is stamped on the left side of the cylinder block.

Additionally there is a sticker on the toothed belt cover showing the “engine code” and “serial number”.

The engine code is also to be found on the vehicle data sticker.



1.2 Engine data

Code letters		BFM	BGK	BFL
Capacity	ltr.	4.172	4.172	3.697
Power output	kW at rpm	246/6000	246/6000	206/6000
Torque	Nm at rpm	430/3500	430/3500	360/3700
Bore	∅ in mm	84.5	84.5	84.5
Stroke	mm	93.0	93.0	82.4
Compression ratio		11.0	11.0	11.0
RON		98 unleaded [1)]	98 unleaded [1)]98	98 unleaded [1)]
Injection/ignition system		Motronic	Motronic	Motronic
Firing order		1-5-4-8-6-3-7-2	1-5-4-8-6-3-7-2	1-5-4-8-6-3-7-2
Catalytic converter		yes	yes	yes
Exhaust gas recirculation		no	no	no
Turbocharging/supercharging		no	no	no
Variable valve timing		yes	yes	yes
Intake manifold change-over		yes	yes	yes
Secondary air system		yes	yes	yes
Valve timing at 1 mm valve lift and 0 mm valve clearance:				
Inlet opens after TDC		25°	25°	20°
Inlet closes after BDC		45°	45°	30°
Exhaust opens before BDC		38°	38°	38°
Exhaust closes before TDC		8°	8°	8°

1) In exceptional circumstances, fuel with 95 RON can also be used, but this will cause a loss of power

2 Safety precautions

2.1 Working on the cooling system

When working on the cooling system note the following warnings:

WARNING

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

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

2.2 Using testers and measuring instruments during a road test

Note the following if testers and measuring instruments have to be used during a road test:

WARNING

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

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

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

2.3 Working on the exhaust system

When working on the exhaust system please note the following:

Caution

Avoid damage to flexible joint.

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

3 General repair instructions

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

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

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

3.2 Checking fuel system for leaks

– Allow engine to run for several minutes at moderate rpm.
– Switch off ignition.
– Check complete fuel system for leaks.
– If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
– Road-test vehicle and accelerate with full throttle at least once.
– Then inspect high-pressure section of fuel system again for leaks.

3.3 Foreign particles in engine

- When performing assembly work on engine, all open passages in the intake and exhaust systems must be sealed with suitable plugs (e.g. from engine bung set -VAS 6122-) to prevent foreign particles from entering the engine.
- In the event of mechanical damage to one of the cylinder banks, the intake and exhaust systems and combustion chambers of the opposite cylinder bank must always be examined for foreign particles to prevent further damage occurring later.

3.4 Contact corrosion!

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

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

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

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

Note the following:

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

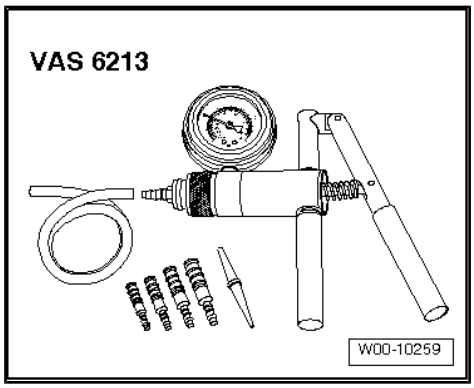
3.5 Routing and attachment of pipes, hoses and wiring

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

3.6 Checking vacuum system

Special tools and workshop equipment required

- Hand vacuum pump -VAS 6213-



Procedure

– Check all vacuum lines in the complete vacuum system for:

- Cracks
- Traces of animal bites
- Kinked or crushed lines
- Lines porous or leaking

– Check vacuum line to solenoid valve and from solenoid valve to corresponding component.

– If a fault is stored in the fault memory, check the vacuum lines leading to the corresponding component and also check the remaining vacuum lines in the system.

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

3.7 Installing radiators, condensers and charge air coolers

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

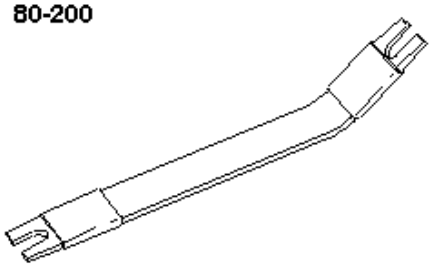
10 – Removing and installing engine

1 Removing and installing engine

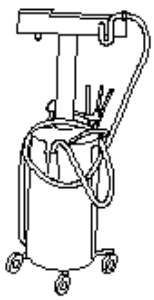
Special tools and workshop equipment required

- Removal lever -80 - 200-
- Used oil collection and extraction unit -V.A.G 1782-
- Hose clip pliers -V.A.G 1921-
- Spring type clip pliers - V.A.S 5024 A-
- Stepladder -VAS 5085-
- Scissor-type assembly platform -VAS 6131-
- Locking pin -T10060 A-
- Tensioning strap -T10038- (2x)
- 2x eye-head bolt -3368-

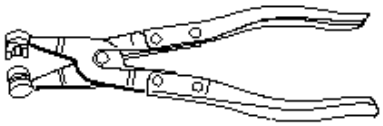
80-200



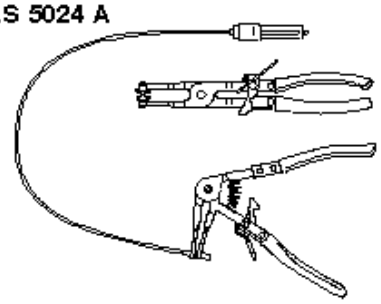
V.A.G 1782



V.A.G 1921

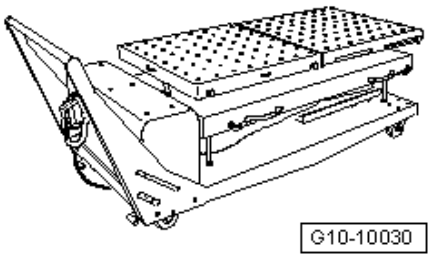


VAS 5024 A



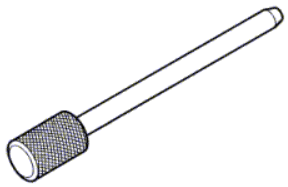
VAS 5085

VAS 6131



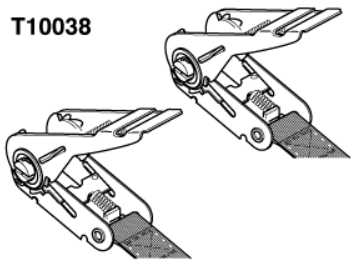
G10-10030

T10060



W00-1040

T10038



W00-1005

3368

1.1 Removing

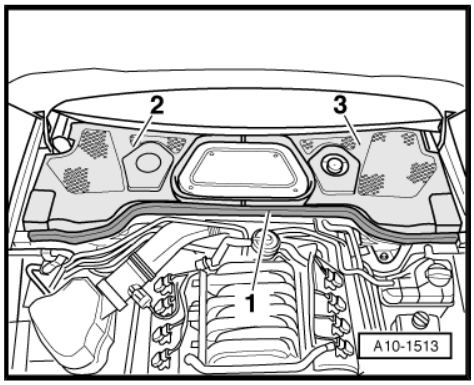
Note

- *The engine is removed from underneath together with the gearbox and subframe.*
- *Obtain anti-theft code for radio.*
- *Renew all cable ties which are released or cut open when removing the engine. Refit in the same position when installing the engine.*
- *The battery is located in the luggage compartment (right-side).*
- *Collect drained coolant in a clean container for re-use or disposal.*

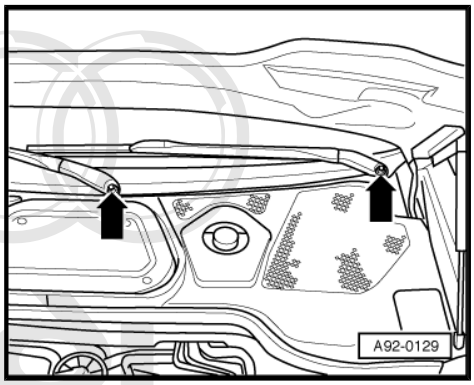
Note

Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

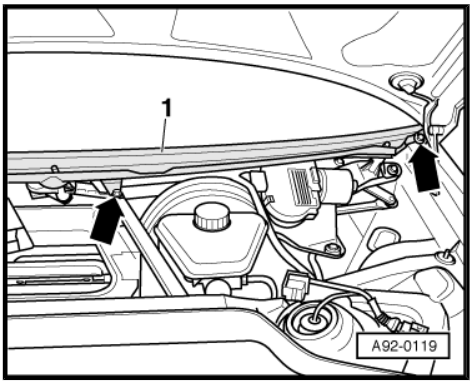
– Pull off rubber seal -1- on plenum chamber cover.
– Detach plenum chamber covers -2- and -3-.
– Switch on ignition.
– Actuate touch wipe function and allow wiper motor to move to end position.
– Switch off ignition and remove ignition key.



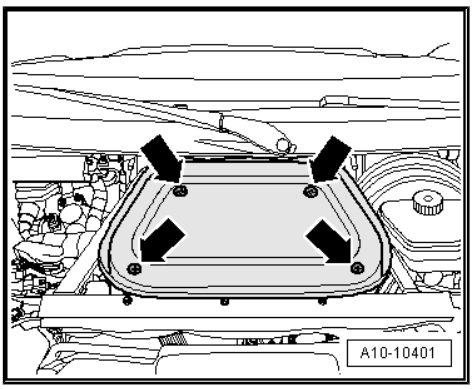
– Use screwdriver to pry off covers on wiper arms -arrows- and unscrew hexagon nuts.
– Pull wiper arms off wiper shafts.



– Remove bolts on left and right sides -arrows- (if fitted) and remove wind deflector -1-.



– Open quick release fasteners -arrows- and remove dust/pollen filter.

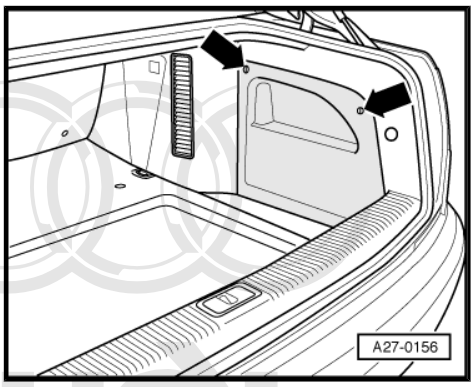


Caution

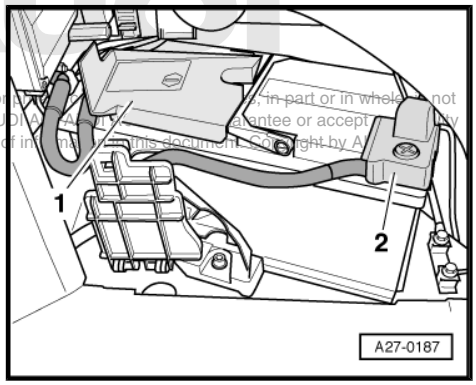
On vehicles with telematics, activate service mode of telematics control unit before disconnecting battery.

Observe notes on procedure for disconnecting the battery ⇒ Electrical system; Rep. Gr. 27 .

– Remove cover in luggage compartment side trim (right-side).



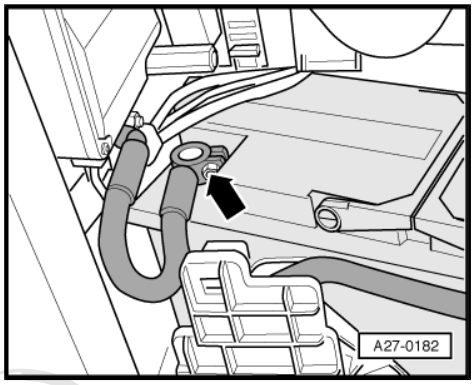
– Remove cover -1- over battery.



Note

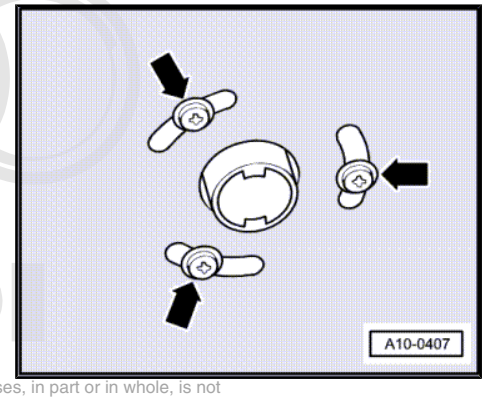
Item -2- can be disregarded.

– Disconnect earth cable -arrow- at battery.



Vehicles with auxiliary heater / supplementary heater

– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



All models:

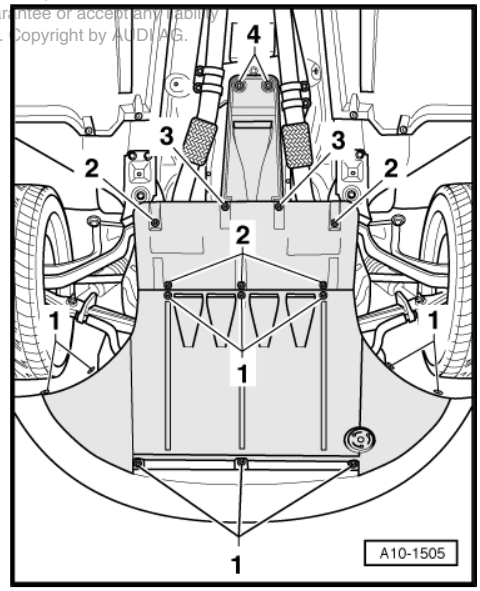
– Remove front wheels (right and left).

– Remove noise insulation -items 1...4-.

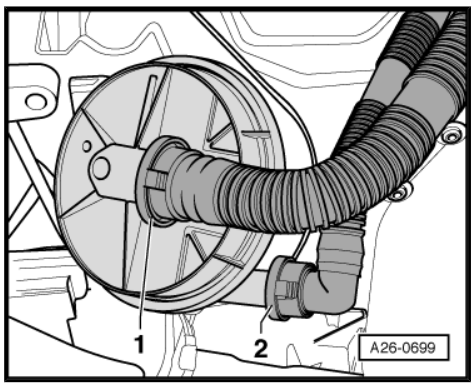
– Remove front and rear section of wheel housing liner (front right) ⇒ General body repairs, exterior; Rep. Gr. 66 .

– Remove front section of wheel housing liner (front left) ⇒ General body repairs, exterior; Rep. Gr. 66 .

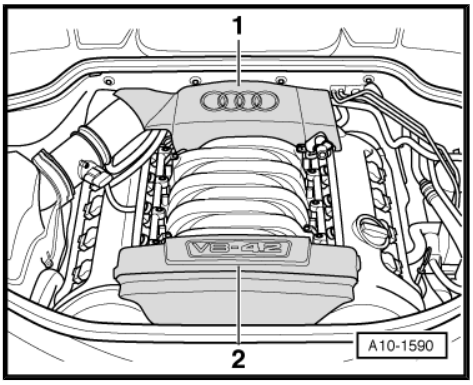
– Remove front bumper ⇒ Rep. Gr. 63 .



– Detach intake hose -1- at secondary air pump motor -V101- .



– Lift off engine cover panel -1- and -2-.

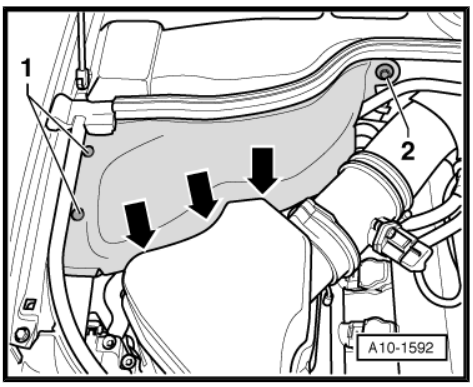


WARNING

Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

– Open filler cap on coolant expansion tank.

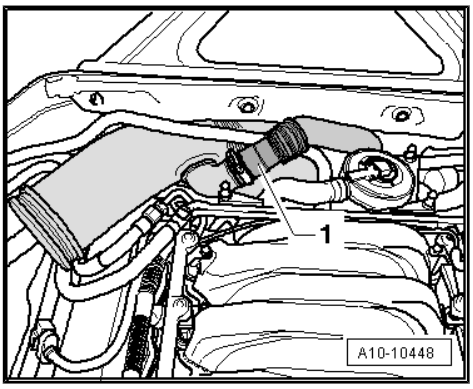
– Pull out clips -1- using removal lever -80 - 200- .
– Unscrew bolt -2- and remove cover.



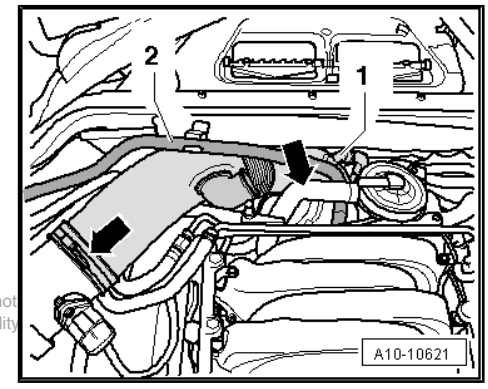
Note

Pay attention to clips -arrows- on installation.

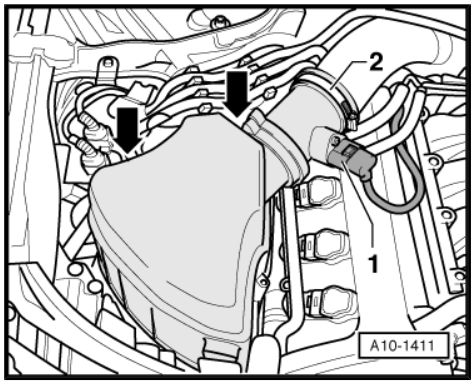
– Remove hose -1-.



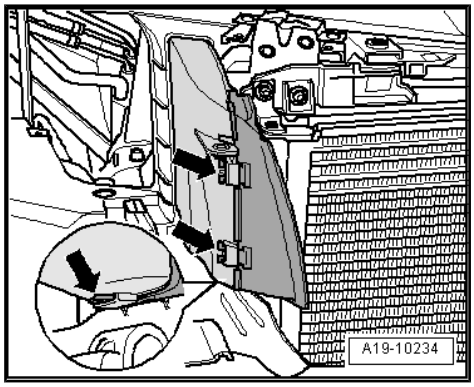
– Disconnect hose -1-.
– Unclip hose -2-.
– Remove air intake pipe -arrows-.



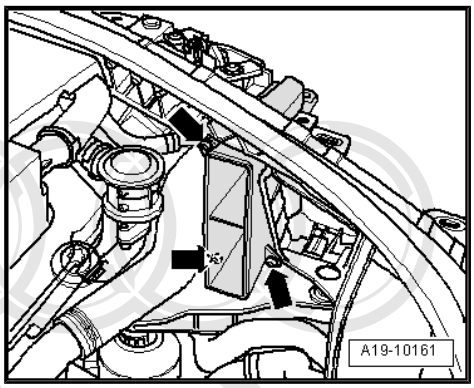
– Unplug electrical connector -1- from air mass meter.
– Remove air cleaner housing -arrows-.
– Remove headlight (right-side) ⇒ Electrical system; Rep. Gr. 94 .



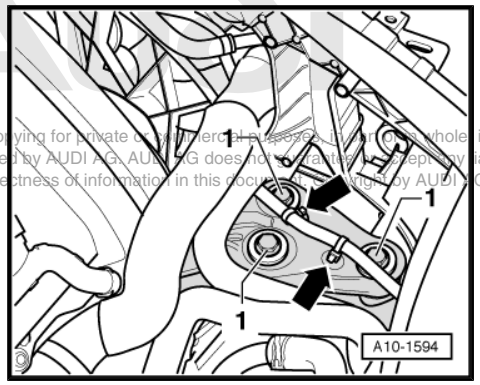
– Compress retainer catches -arrows- and detach air duct from lock carrier (front right).



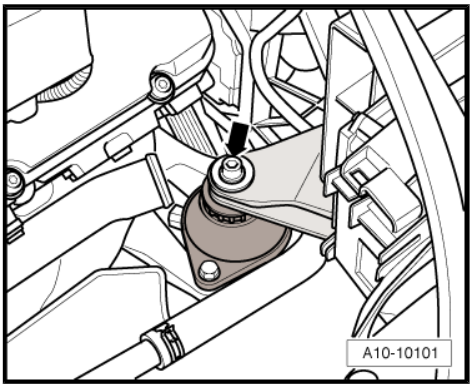
– Unscrew bolts -arrows- and remove air duct.
– Pull lock carrier forwards ⇒ Rep. Gr. 50 .



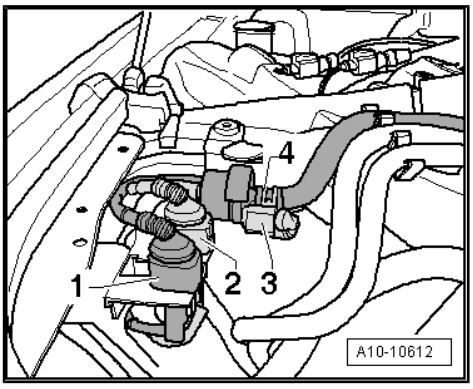
– Unclip wire -arrows-.
– Remove bolts -1- for torque reaction support.



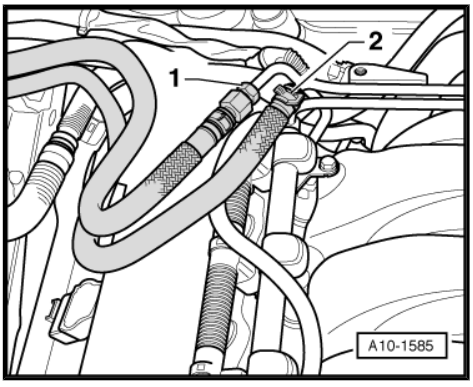
– Detach torque reaction support -arrow- from valve for torque reaction support -N382- and remove.



– Unplug connector (black) -1- for Lambda probe (before catalytic converter).
– Unplug connector (brown) -2- for Lambda probe (after catalytic converter).
– Unplug connector -3- from solenoid valve and move engine wiring harness clear.
– Detach hose -4- from solenoid valve and move hose clear.
– Move electrical wiring to Lambda probes clear.



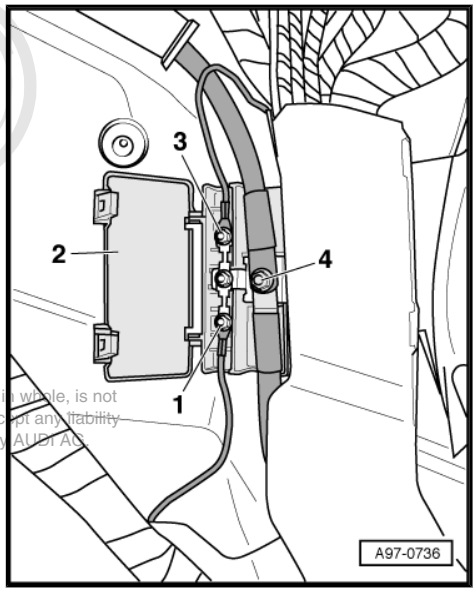
– Disconnect fuel supply line -1-.
– Disconnect fuel return line -2-.
– Remove A-pillar trim (right-side) ⇒ General body repairs, interior; Rep. Gr. 70 .
– Fold back floor carpet.
– Unbolt protective cover above main fuse holder.



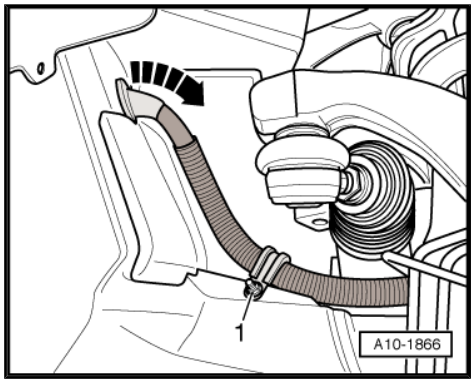
– Fold cover -2- to side.
– Remove nut -4-.
– Detach terminal 30 wire to starter.

Note

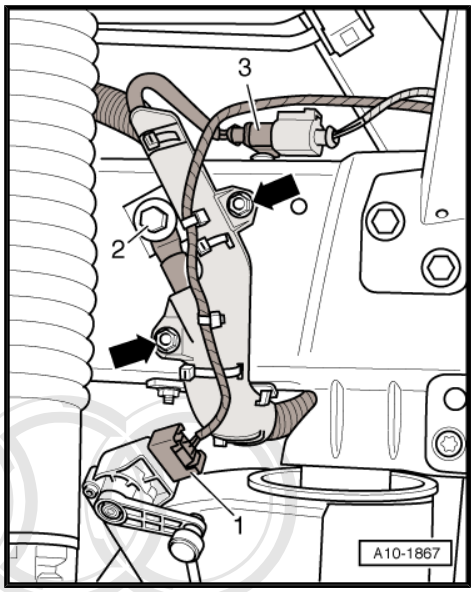
Disregard items marked -1- and -3-.



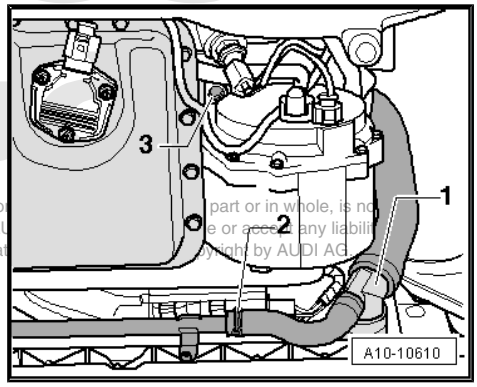
– Unscrew wiring clamp -1- in wheel housing (front right).
– Pull wiring harness out from interior -arrow-.



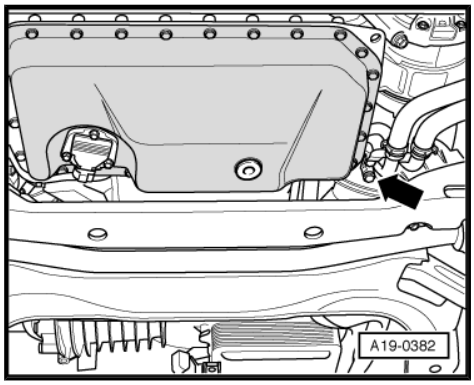
– Unplug electrical connectors -1- and -3-.
– Unbolt earth cable -2- at longitudinal member.
– Unscrew bracket for wiring harness at longitudinal member -arrows- and move wiring harness clear.
– Place drip tray for workshop hoist -VAS 6208- under engine.



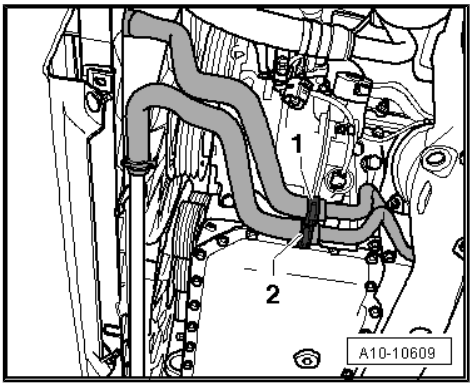
– To drain off coolant, disconnect coolant hose -1-.
– Disconnect coolant hose -2-.
– Open drain plug -3- and let coolant drain at oil filter bracket.



– Open drain plug -arrow- and let coolant drain from engine.



– Detach coolant hoses -1 and 2-.

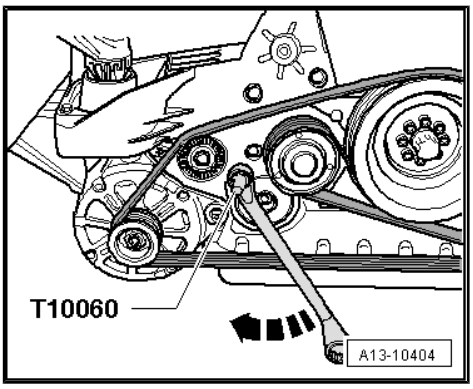


Note

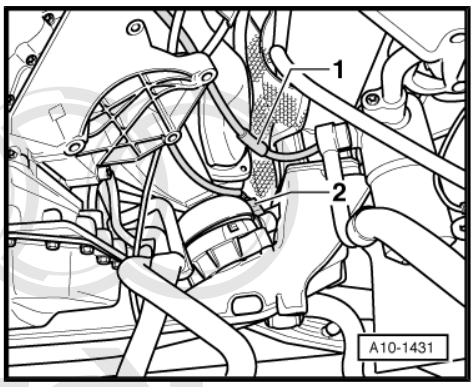
- *Before removing the poly V-belt, mark the direction of rotation with chalk or a felt pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*
- *When installing the poly V-belt ensure the belt seats correctly in the belt pulleys.*

– To slacken poly V-belt, turn tensioner clockwise in direction of -arrow- with ring spanner until the two holes are in alignment, and hold in position with locking pin -T10060 A- .

– Take off poly V-belt.



– Disconnect vacuum hose -1- for intake manifold change-over function.

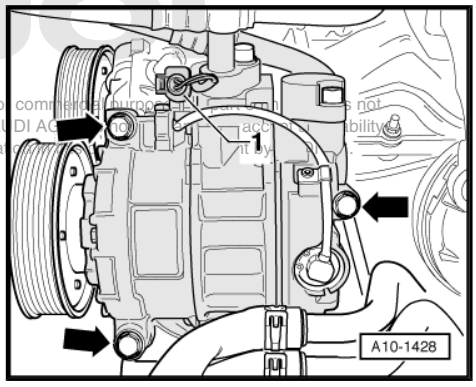


Note

Illustration shows procedure with compressor removed.

– Detach electrical connector -1- from air conditioner compressor and move wire clear.

– Unbolt A/C compressor -arrows- and tie to one side.

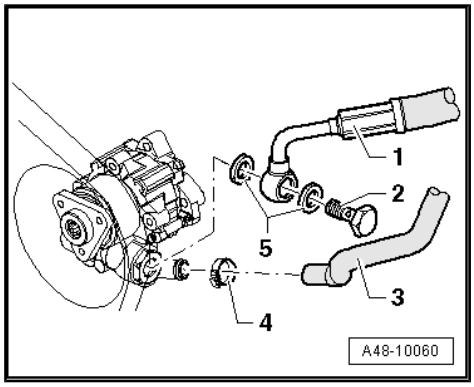


Note

- *Leave pipes/hoses connected.*
- *Take care not to bend the pipes.*
- *Watch guide sleeves for air conditioner compressor on compressor bracket.*

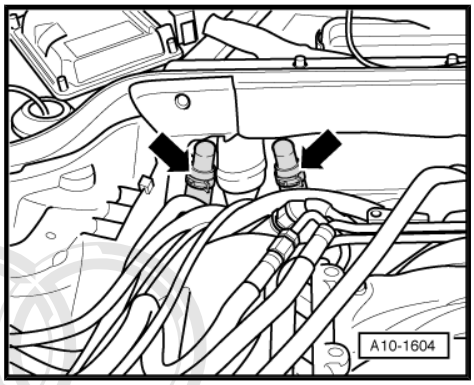
– Place drip tray for workshop hoist -VAS 6208- under component to catch escaping hydraulic fluid.

– Loosen hose clip -4-, disconnect suction hose -3- and move clear to one side.
– Unscrew banjo bolt -2- for expansion hose -1- and move expansion hose clear to one side.
– Seal off connections on power steering pump with suitable plugs.



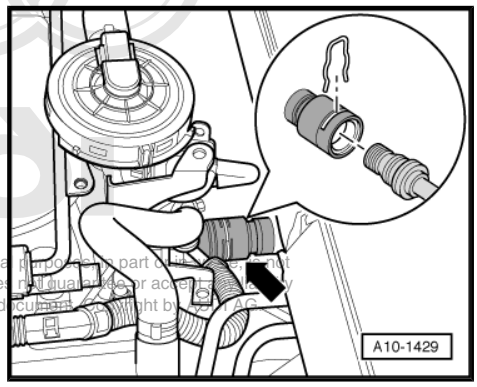
Vehicles without auxiliary heater / supplementary heater

– Detach supply hose and return hose going to heat exchanger -arrows-.



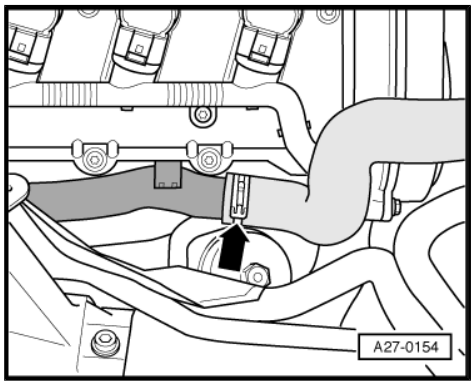
Vehicles with auxiliary heater / supplementary heater

– Disconnect water hose -arrow- from water pipe.

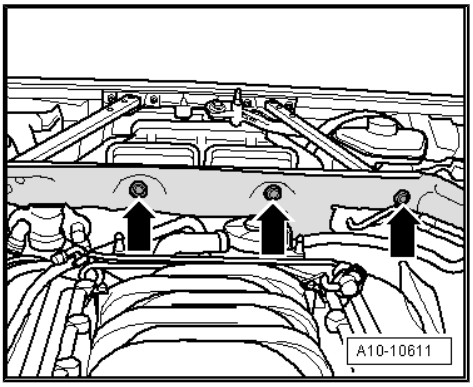


All models:

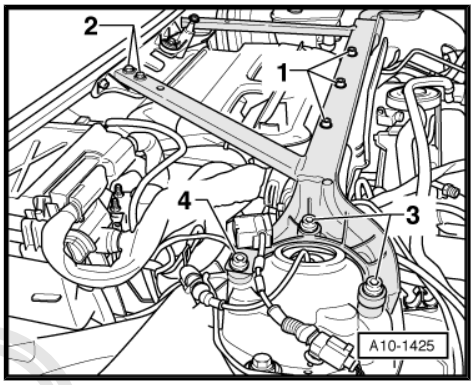
– Disconnect hose -arrow- from water pipe.



– Detach insulating mat from body brace -arrows-.



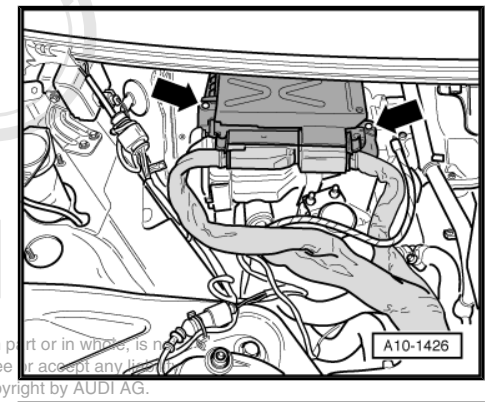
– Remove body brace -1 … 4-.



Note

Pay attention to spacer sleeves on item -2-.

– Unscrew engine control unit -arrows- and move clear to one side.

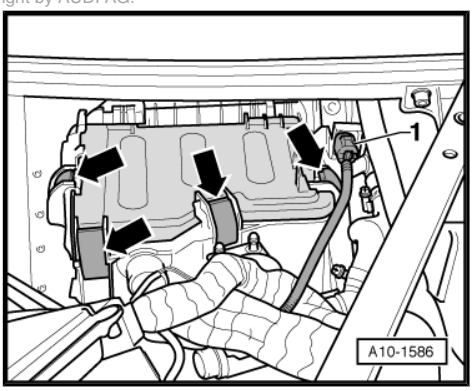


Note

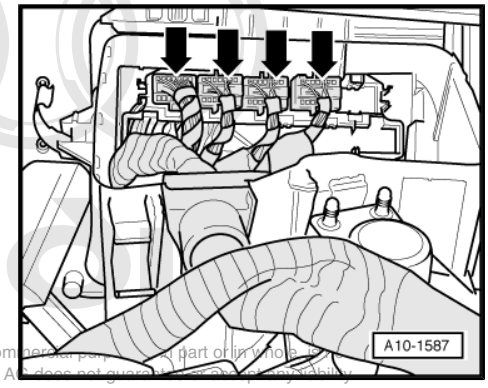
The anti-theft coding remains active (do not disconnect control unit).

– Unplug electrical connector -1-.

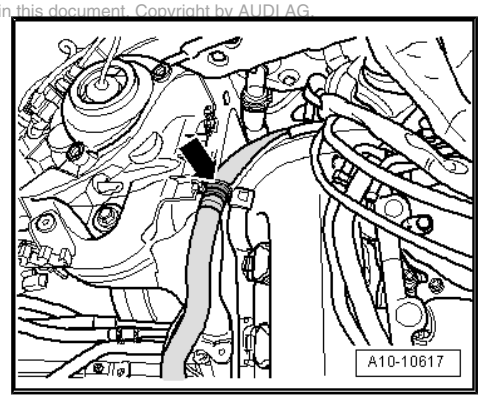
– Remove cover of electronics box -arrows-.



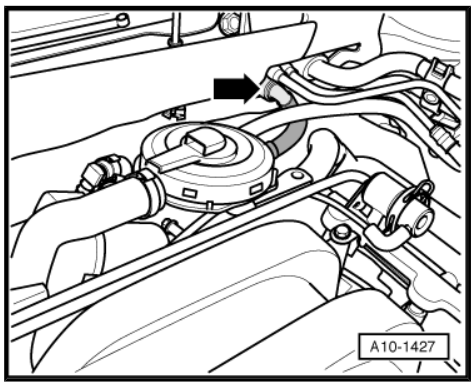
– Unplug connectors -arrows- and release control unit wiring harness as far as engine.



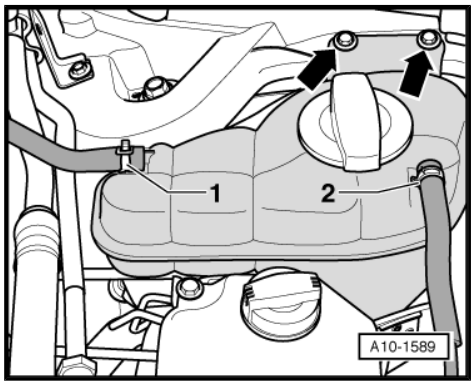
– Detach hose -arrow- for secondary air.



– Disconnect hose -arrow- leading to brake servo.



– Detach hose -1- for permanent breather at coolant expansion tank.
– Detach hose -2- for permanent breather at coolant expansion tank.
– Remove coolant expansion tank -arrows-.
– Unplug electrical connector from coolant level indicator.
– Disconnect coolant hose at bottom of coolant expansion tank.



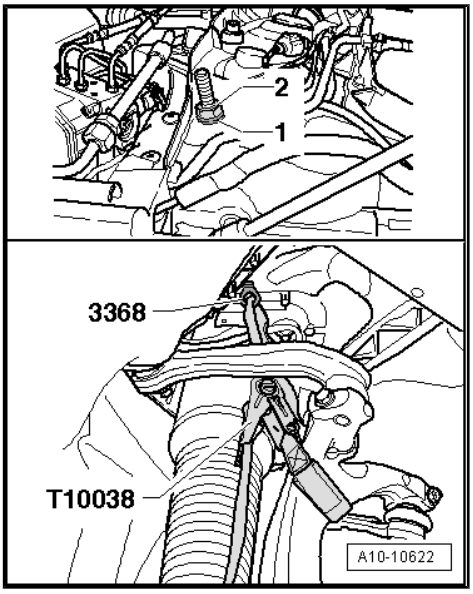
Note

Support wheel bearing housing to make sure the joints of the upper links are not damaged.

Note

Make sure that thread of eye-head bolt -3368- does not protrude too far above suspension turret.

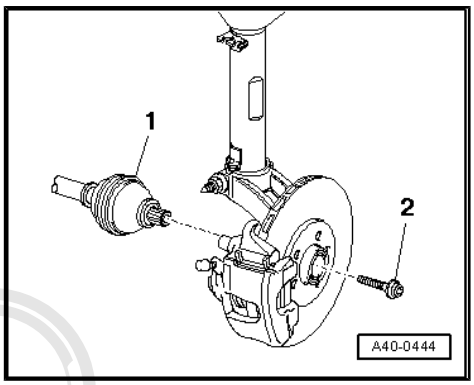
– Insert eye-head bolt -3368- in bore on suspension turret and secure bolt with washer -1- and nut -2-.
– Tie up wheel bearing housing with tensioning strap -T10038- as shown on illustration.



– Have a 2nd mechanic press the brake pedal.

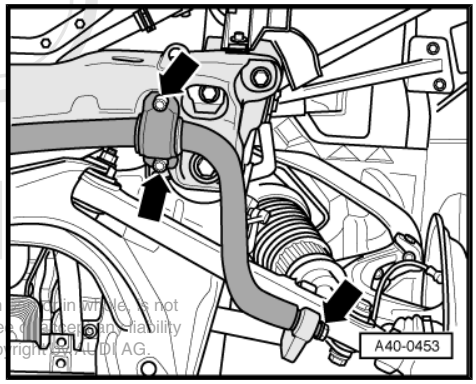
Caution

When slackening the flange bolt securing the drive shaft, the wheel bearing must not be under load (vehicle must not be standing on its wheels).

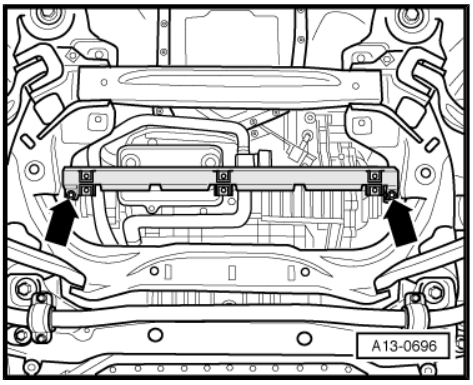


– Unscrew flange bolt -2- from drive shaft -1- (left and right).

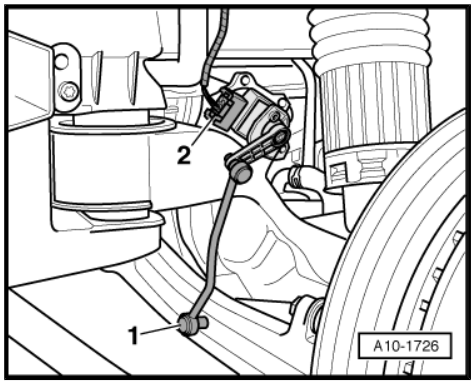
– Unscrew bolts (left and right) -arrows- evenly.
– Take out anti-roll bar.



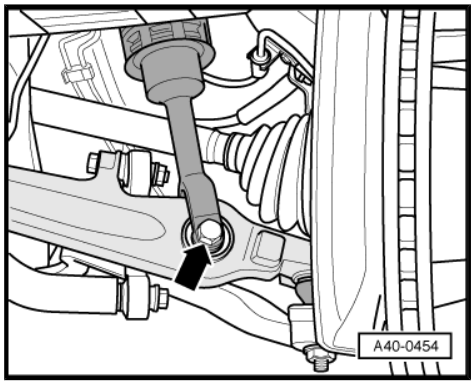
– Remove cross piece for noise insulation from subframe -arrows-.



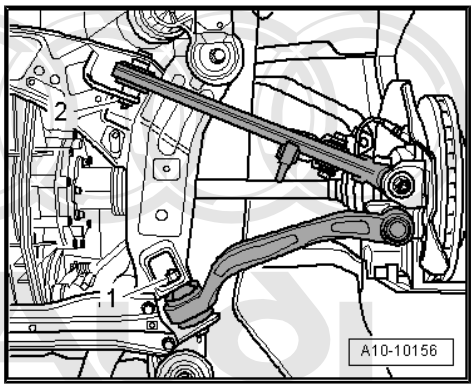
– Unplug electrical connector -2- at vehicle level sender (left-side).
– Detach coupling rod -1- at track control link (left and right).



– Unbolt air spring strut from track control link -arrow-.



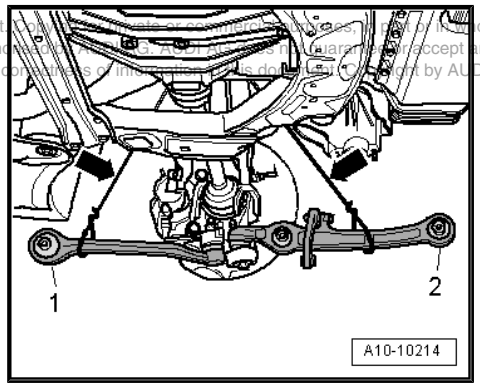
– Unbolt guide link -1- and track control link -2- at subframe.



– Pivot guide link -1- and track control link -2- outwards.

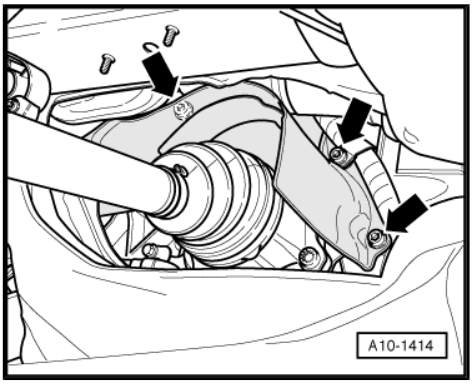
Caution

The guide link and track control link must not be allowed to hang down without support. Tie up both links to wheel bearing housing as illustrated -arrows-.



– Repeat procedure on other side of vehicle.

– Remove heat shields -arrows- for drive shafts.



Note

The heat shield (left-side) consists of two sections.

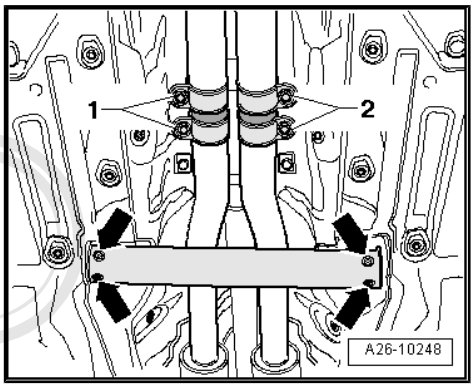
– Unbolt drive shaft from gearbox flange.

Caution

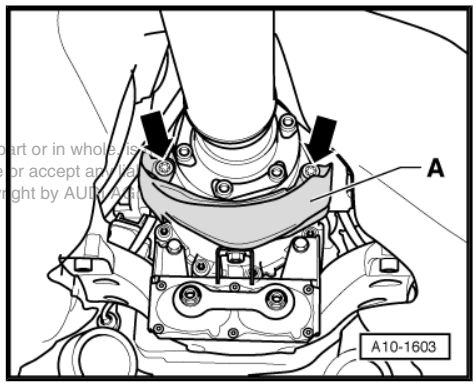
Take care not to damage brake hose.

– Pivot wheel bearing housing outwards and remove drive shaft.
– Repeat procedure on other side of vehicle.

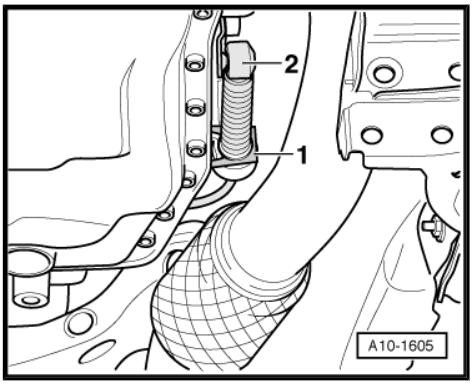
– Loosen double clamps -1- and -2- and move clamps towards front of vehicle.
– Remove front cross piece -arrows-.



– Unbolt heat shield for propshaft -A - -arrows-.
– Unscrew bolts at gearbox/propshaft flange.
– Push propshaft back towards rear final drive. The constant velocity joints can be moved axially.
– Tie up propshaft to one side on vehicle body.



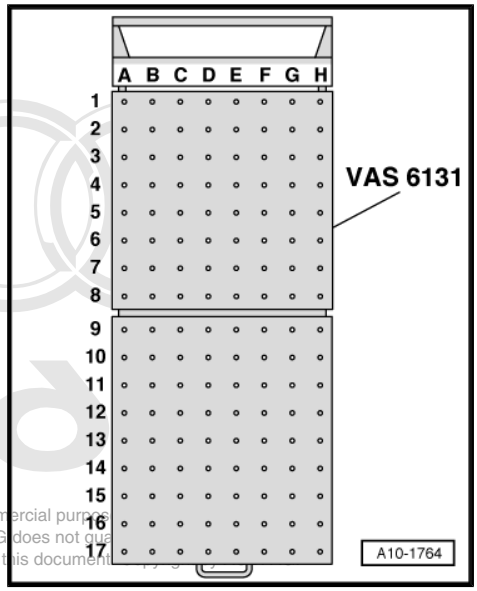
– Remove selector lever cable -2- from ball head using removal lever -80 - 200- .
– Remove retainer on bracket -1- and move selector lever cable clear.



Set up the scissor-type assembly platform as follows:

– Set up scissor-type assembly platform -VAS 6131- with support set for Audi -VAS 6131/10- and support set, Audi A8 >2002 -VAS 6131/11- as follows:

Platform co-ordinates	Parts of support set from -VAS 6131/10- and support set, Audi A8 >2002 -VAS 6131/11-			
B3	/10-1	/10-4	/10-5	/10-11
G3	/10-1	/10-4	/10-5	/11-4
B5	/10-1	/10-3	/10-5	/10-7
G5	/10-1	/10-3	/10-5	/10-7
B9	/10-1	/10-2	/10-5	/10-8
G9	/10-1	/10-2	/10-5	/10-8
C16	/10-1	/10-2	/10-5	/11-5
F16	/10-1	/10-2	/10-5	/11-5



– Initially tighten the support elements on the assembly platform only hand-tight.

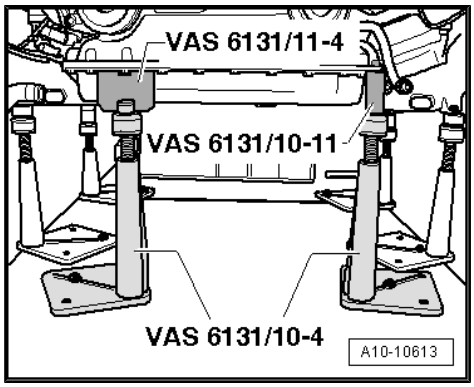
– Adjust the scissor-type assembly platform -VAS 6131- so that it is horizontal.

• Take note of spirit level (bubble gauge).

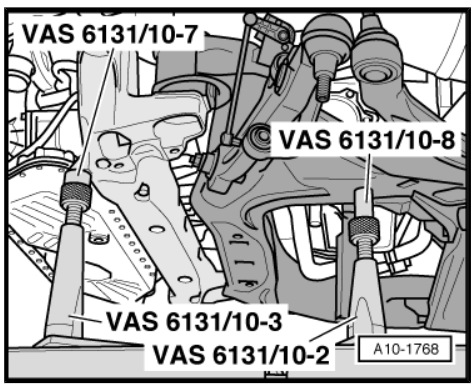
– Place scissor-type assembly platform -VAS 6131- under engine/gearbox assembly.

– Position the support elements from support set -VAS 6131/10- and support set, Audi A8 >2002 -VAS 6131/11- at front of engine, as shown in the illustration.

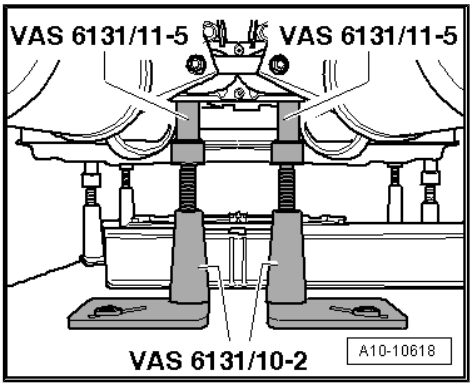
– Make sure that threaded spindles are screwed in completely.



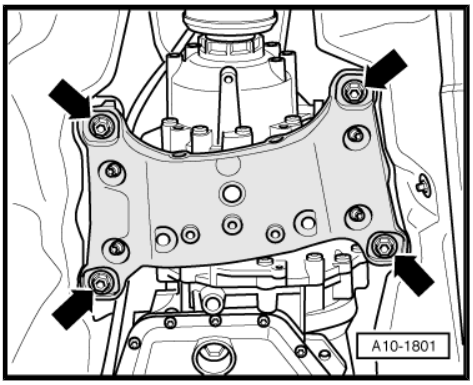
– Position support elements from support set -VAS 6131/10- on engine cross member and subframe (left and right), as shown in the illustration.



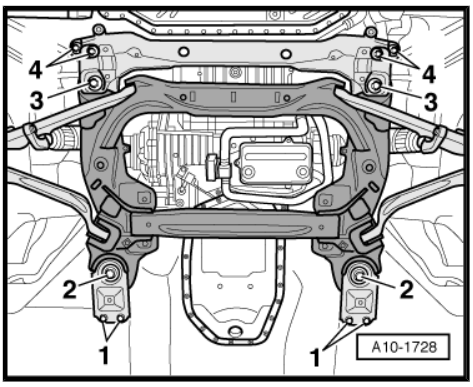
– Position the support elements from support set -VAS 6131/10- and support set, Audi A8 >2002 -VAS 6131/11- at rear of gearbox, as shown in the illustration.
– Turn all spindles for the support elements upwards until all locating lugs make contact with the mounting points.
– When all support elements make contact, raise assembly platform until load is taken off engine and gearbox mountings.
– Tighten base plates for support elements on scissor-type assembly platform -VAS 6131- to 20 Nm.



– Remove bolts -arrows- at tunnel cross member.



– Mark the installation position of subframe with a felt-tipped pen on longitudinal member.
– Remove bolts -1- and -4-.
– Remove bolts -2- and -3- in a diagonal sequence and in stages.



Note

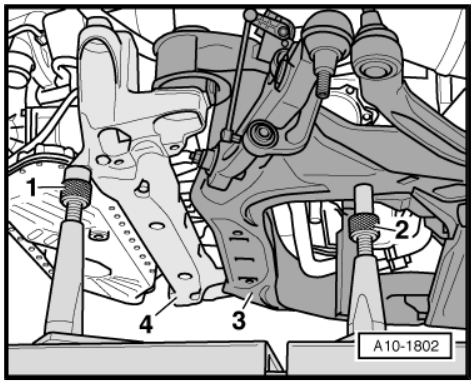
♦ *Check that all hoses and wiring connections between engine, gearbox, subframe and body have been detached.*
♦ *Carefully guide out engine/gearbox assembly with subframe from engine compartment when lowering to avoid damage.*

– Lower engine/gearbox assembly gradually.
– Pull out scissor-type assembly platform -VAS 6131- from under the vehicle.

1.2 Separating engine and gearbox

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

– Screw down spindles of support elements -2- (left and right) at subframe as far as possible.
– Remove locating lugs from spindles.
– Take out subframe -3- from the side.

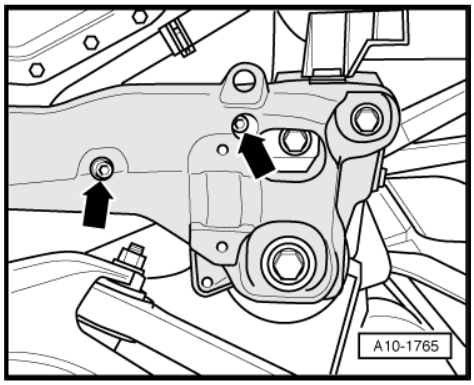


Note

A second mechanic is required for removing the subframe.

– Screw down spindles of support elements -1- (left and right) at engine cross member -4- as far as possible.

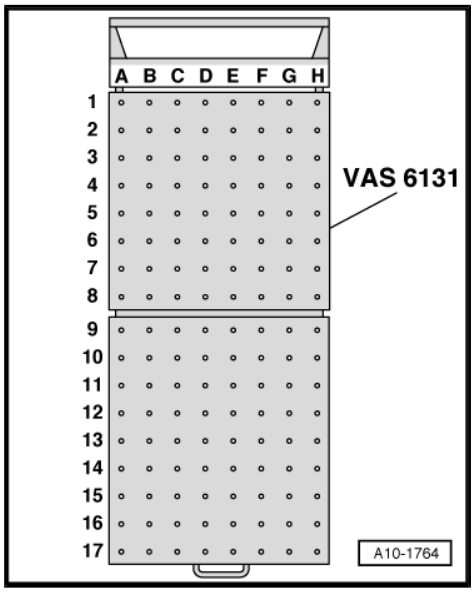
– Remove bolts -arrows- for engine mounting (left and right-side)
– Take out engine cross member.
– Unscrew the 4 base plates for support elements (for engine cross member and subframe) at assembly platform -VAS 6131- .
– Set up scissor-type assembly platform -VAS 6131- with support set for Audi -VAS 6131/10- and support set, Audi A8 >2002 -VAS 6131/11- as follows:



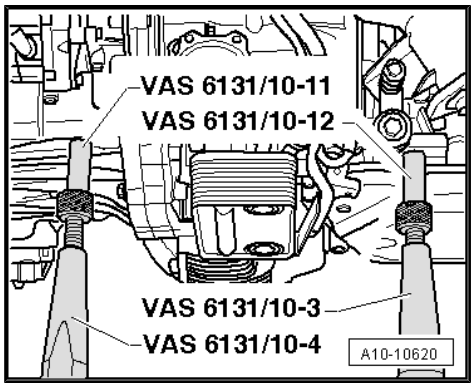
Note

The other support elements remain unchanged.

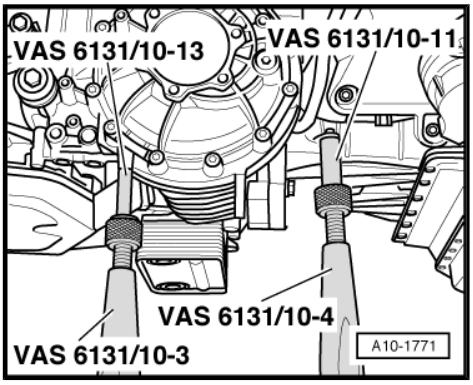
Platform co-ordinates	Parts of support set from support set for Audi -VAS 6131/10- and support set, Audi A8 >2002 -VAS 6131/11-			
C6	/10-1	/10-4	/10-5	/11-2
F7	/10-1	/10-4	/10-5	/10-11
B10	/10-1	/10-3	/10-5	/10-12
G10	/10-1	/10-3	/10-5	/10-13



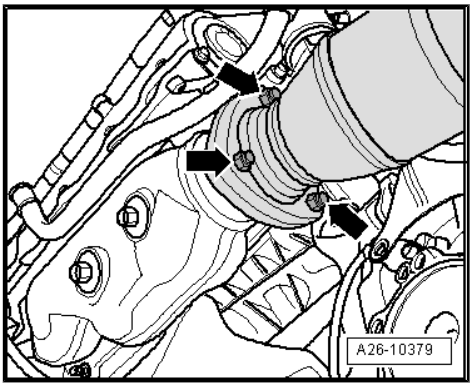
– Position the support elements from support set -VAS 6131/10- and support set, Audi A8 >2002 -VAS 6131/11- at left of engine/gearbox assembly, as shown in the illustration.



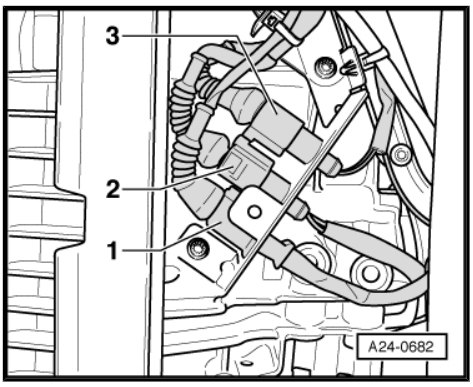
– Position support elements from support set -VAS 6131/10- at right of engine/gearbox assembly, as shown in illustration.
– Turn spindles for the support elements upwards until all locating lugs make contact with the mounting points.
– Tighten base plates for support elements on scissor-type assembly platform -VAS 6131- to 20 Nm.
– Move electrical wire for Lambda probe 2 -G108- (before catalytic converter) clear.



– Unbolt catalytic converter with front silencer from exhaust manifold -arrows-.



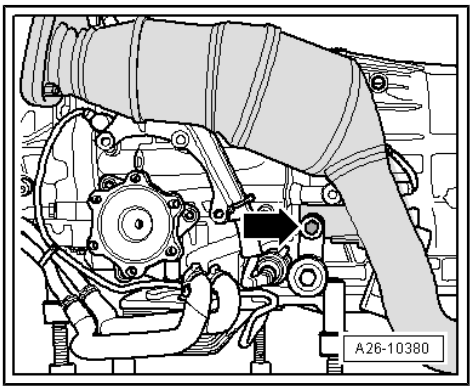
– Unplug electrical connector (brown) -3- for Lambda probe 2 after catalytic converter -G131- and move wiring clear.



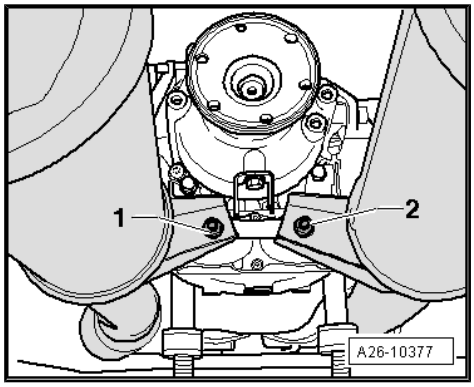
– Remove bolt -arrow- on bracket for exhaust pipe.

Note

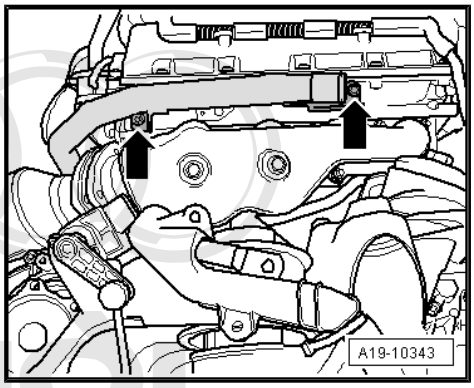
The flexible pipe connection (de-coupling element) on the front exhaust pipe must not be bent more than 10° - otherwise it can be damaged.



– Remove bolt -1- on bracket for exhaust system and remove catalytic converter with front silencer.

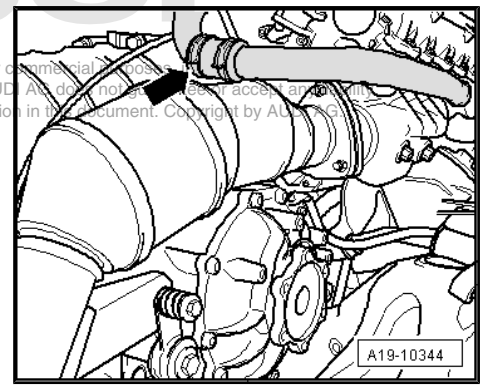


– Unbolt coolant pipe (right-side) -arrows-.

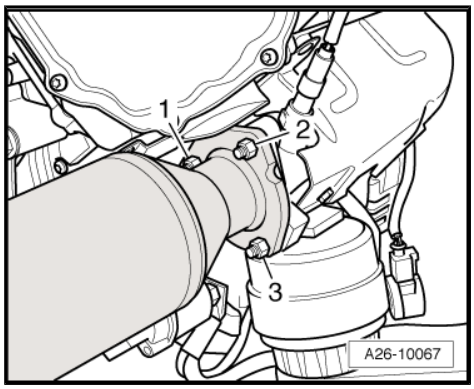


– Detach coolant pipe -arrow- and remove.

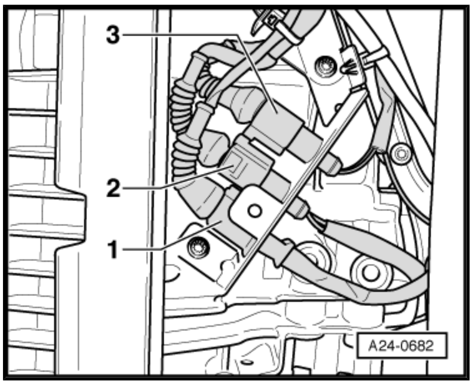
– Move electrical wire for Lambda probe -G39- (before catalytic converter) clear.



– Unbolt catalytic converter with front silencer from exhaust manifold -arrows-.



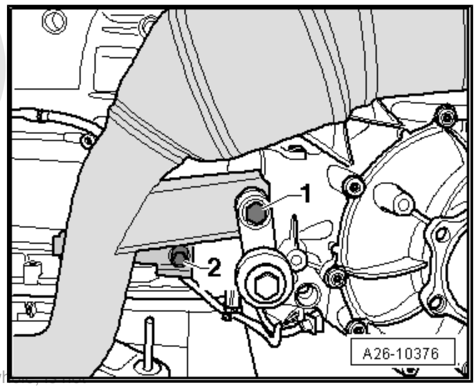
– Unplug connector -2- (black) for Lambda probe after catalytic converter -G130- .



– Remove bolt -1- on bracket for exhaust pipe.

– Detach heat shield -2-.

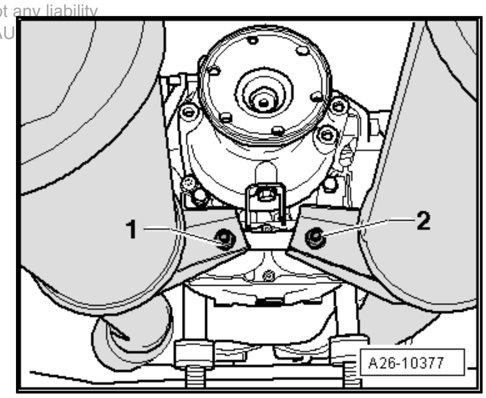
– Move electrical wire for Lambda probe after catalytic converter -G130- clear.



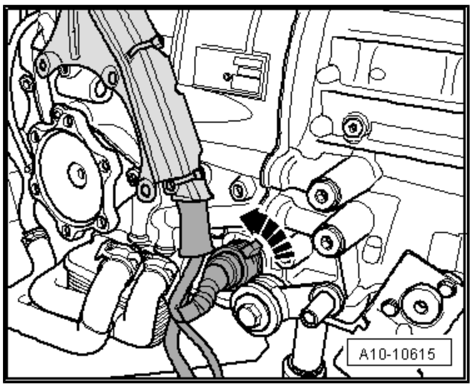
Note

The flexible pipe connection (de-coupling element) on the front exhaust pipe must not be bent more than 10° - otherwise it can be damaged.

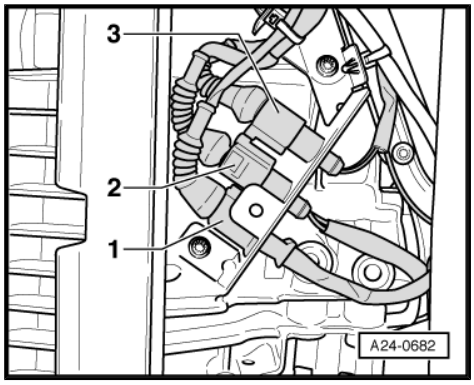
– Remove bolt -2- on bracket for exhaust system and remove catalytic converter with front silencer.



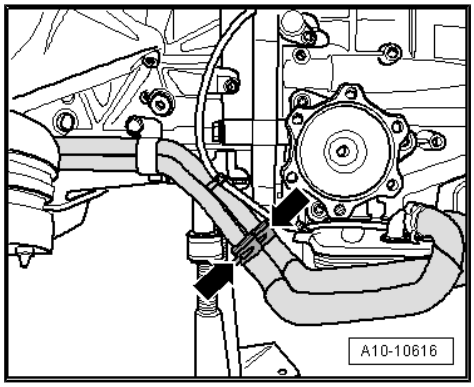
– Turn retainer catch anti-clockwise -arrow- and unplug electrical connector at gearbox.



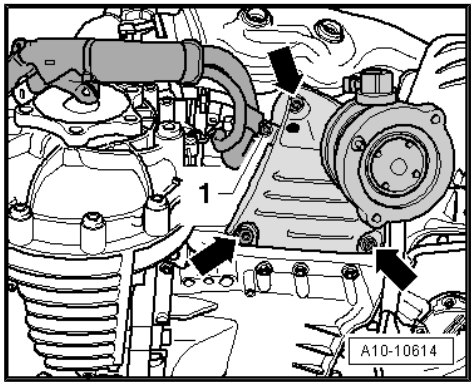
– Unplug electrical connector -1- (grey) for engine speed sender -G28- and move wire with heat shield clear.



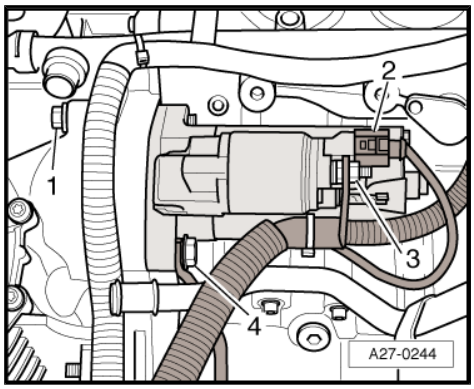
– Disconnect coolant hoses -arrows-.
– Unplug electrical connector from engine mounting.



– Unscrew wiring harness from engine support -1-.
– Remove engine support -arrows-.



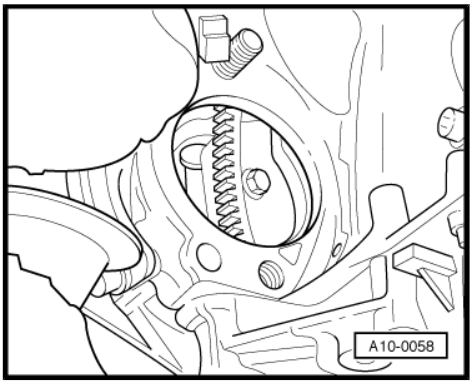
– Remove starter -1 and 4- (wiring harness remains connected).
– When engine is detached from gearbox, turn engine over to TDC and align marking on gearbox bell housing with marking on torque converter.



Note

Mark position of torque converter in relation to drive plate before unbolting.

– Unbolt torque converter from drive plate (3 bolts).



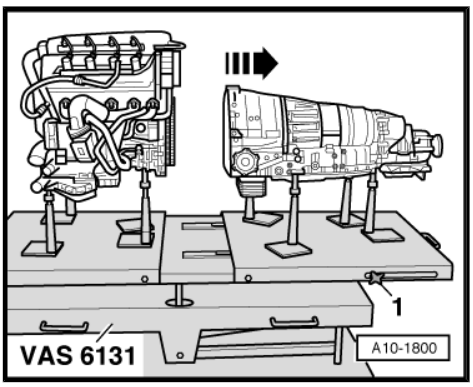
Note

When loosening torque converter bolts, counterhold at the crankshaft central bolt.

– Unscrew securing bolts for engine/gearbox.

– Loosen clamping bolts -1- on sides of scissor-type assembly platform -VAS 6131- and pull rear section of platform together with gearbox towards the rear -arrow-; simultaneously separate the torque converter from the drive plate through the opening.

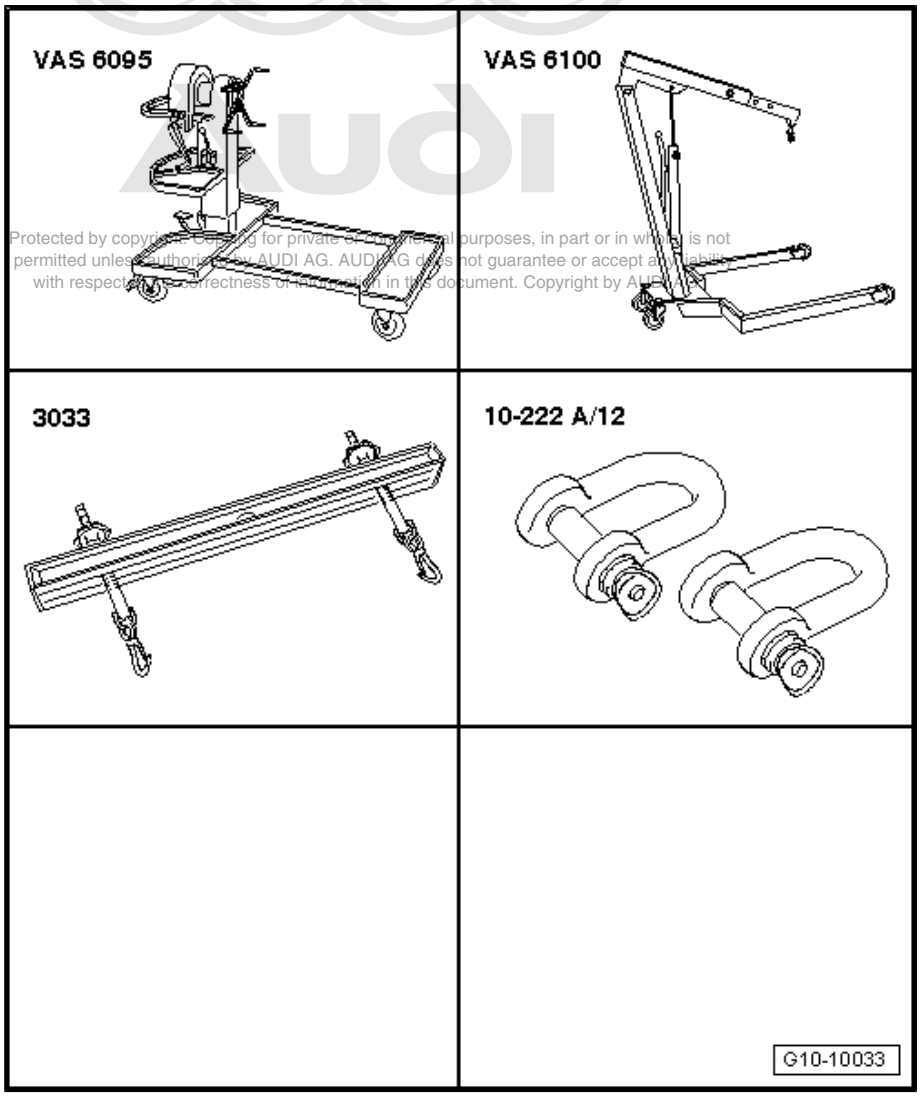
– Secure torque converter in gearbox to prevent it falling out.



1.3 Attaching engine to engine stand

Special tools and workshop equipment required

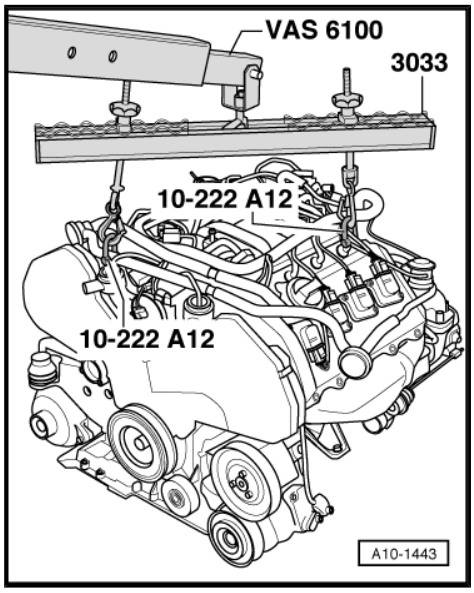
- Engine and gearbox support supplement -VW 540/1 B-
- Engine and gearbox support -VAS 6095-
- Workshop hoist -VAS 6100-
- Lifting tackle -3033-
- Shackle -10 - 222 A /12-



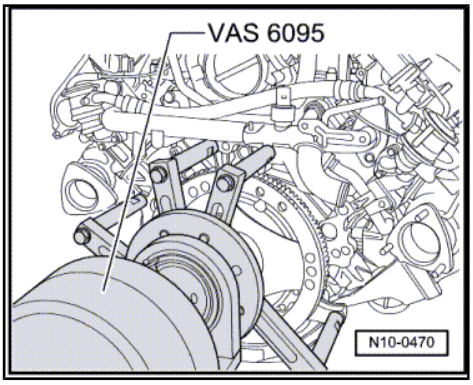
Procedure

– Engage shackles -10 - 222 A /12- at front right and rear left engine lifting eyes.

– Attach lifting tackle -3033- to shackles -10 - 222 A /12- and workshop hoist -VAS 6100- as shown in illustration.



– Raise engine with workshop hoist -VAS 6100- until centre of flywheel is in line with mounting plate of engine and gearbox support -VAS 6095- . Then secure to cylinder block using the four universal fasteners as shown in illustration.



1.4 Installing

Note

- *Renew self-locking nuts and bolts when performing assembly work.*
- *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- *Fit all cable ties in the original positions when installing.*
- *Fit all heat shields and heat insulation sleeves in the original positions when installing.*

– Install torque converter ⇒ Rep. Gr. 32 .

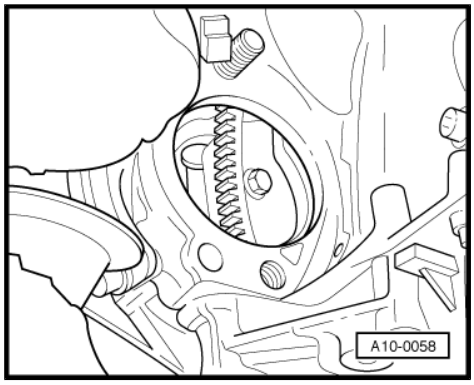
– Check whether dowel sleeves for centring the engine/gearbox assembly are fitted in the cylinder block; install dowel sleeves if necessary.

– There is no needle bearing in the crankshaft on vehicles with automatic gearbox.

– Before bringing engine and gearbox together, turn torque converter and drive plate on engine so that the holes for the securing bolts are in line with the opening for the starter motor.

– 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 .

– Secure torque converter to drive plate (3 bolts).



Note

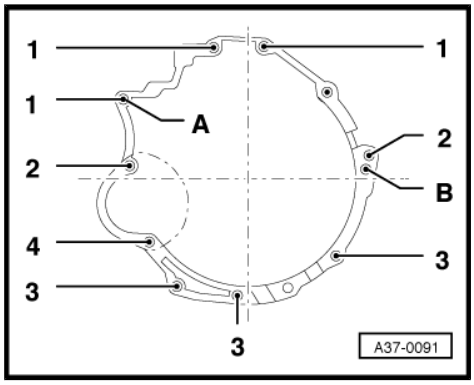
When securing torque converter bolts, counterhold at central bolt on crankshaft.

Note

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

– Engine/gearbox attachment (gearbox flange pattern)

Item	Bolt	Quantity	Nm
1	M 12 x 75	3	65
2	M 12 x 90	2	65
3	M 10 x 45	3	45
4	M 10 x 80	1	65



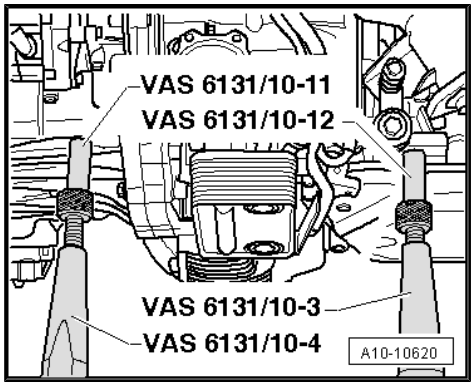
Installation is carried out in the reverse order; note the following:

Caution

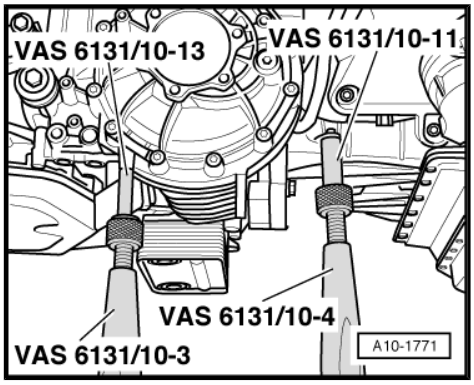
To prevent contact corrosion, use only approved bolts, screws, nuts, washers, etc.. These have a special surface coating and can be recognised from their greenish colour.

– The threaded holes in the flange shaft for the propshaft on the gearbox must be cleaned of remaining locking fluid with a thread tap before assembling.

– Screw down spindles of support elements from support set, Audi -VAS 6131/10- and support set, Audi A8 >2002 -VAS 6131/11- on left side of engine/gearbox assembly.



– Screw down spindles of support elements from support set, Audi -VAS 6131/10- on right side of engine/gearbox assembly.
– Unscrew the 4 base plates for support elements (for engine cross member and subframe) at assembly platform -VAS 6131- .



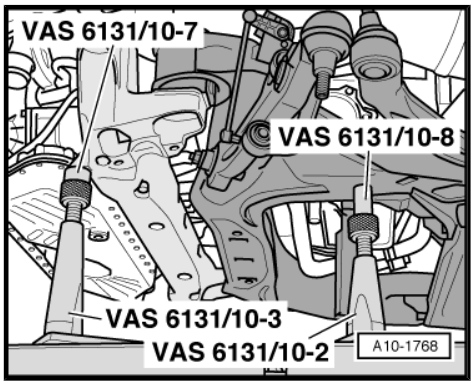
Note

The other support elements remain unchanged.

– Set up scissor-type assembly platform -VAS 6131- with support set for Audi -VAS 6131/10- and support set, Audi A8 >2002 -VAS 6131/11- as follows:

Platform co-ordinates	Parts of support set from -VAS 6131/10- and support set, Audi A8 >2002 -VAS 6131/11-			
B3	/10-1	/10-4	/10-5	/10-11
G3	/10-1	/10-4	/10-5	/11-4
B5	/10-1	/10-3	/10-5	/10-7
G5	/10-1	/10-3	/10-5	/10-7
B9	/10-1	/10-2	/10-5	/10-8
G9	/10-1	/10-2	/10-5	/10-8
C16	/10-1	/10-2	/10-5	/11-5
F16	/10-1	/10-2	/10-5	/11-5

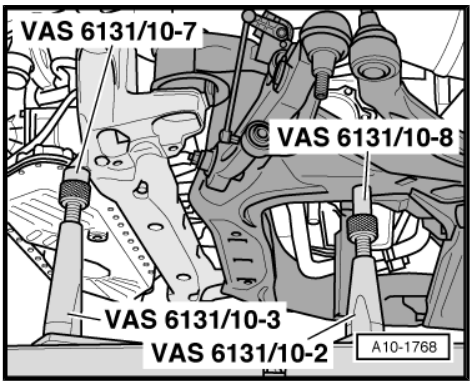
– Position engine cross member on the two support elements -VAS 6131/10-7- .
– Screw up spindles for support elements -VAS 6131/10-7- on left and right sides.
– Tighten base plates for support elements on scissor-type assembly platform -VAS 6131- to 20 Nm.



Note

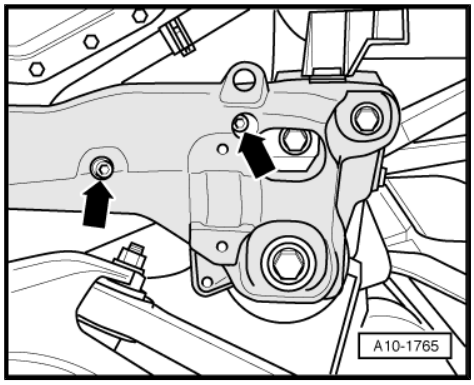
A second mechanic is required for positioning the subframe on the support elements.

– Fit subframe onto the two support elements -VAS 6131/10-8- .
– Screw up spindles for support elements -VAS 6131/10-8- on left and right sides.
– Tighten base plates for support elements on scissor-type assembly platform -VAS 6131- to 20 Nm.



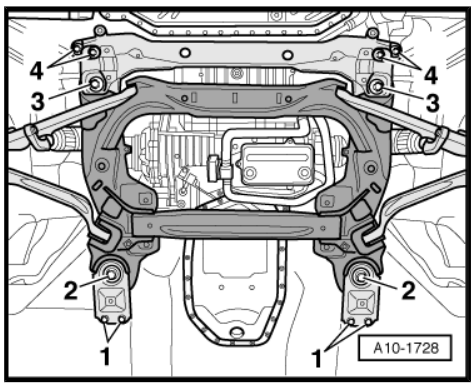
– Tighten bolts for engine mountings -arrows- on both sides.

– Guide engine/gearbox assembly together with subframe and engine cross member into the body from below using scissor-type assembly platform -VAS 6131- .



– Install subframe ⇒ Rep. Gr. 40 .

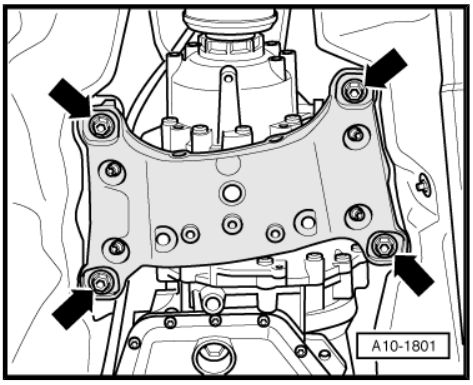
– Tighten subframe bolts only to specified torque (do not turn further). Do not tighten bolts to final setting until after wheel alignment check has been performed ⇒ Rep. Gr. 40 .



WARNING

The vehicle must not be driven at this stage.

– Tighten bolts -4- for engine cross member.



- Tighten bolts -arrows- at tunnel cross member.
- Install propshaft ⇒ Rear final drive 0AR; Rep. Gr. 39 .
- Install selector lever cable and check adjustment if necessary ⇒ Rep. Gr. 37 .
- Align exhaust system so it is free of stress ⇒ page 210
- Install guide link, track control link and anti-roll bar ⇒ Rep. Gr. 40 .
- Install drive shafts ⇒ Rep. Gr. 40 .
- Fill up with coolant ⇒ page 172 .
- Install torque reaction support ⇒ page 42 .
- Install body brace ⇒ Rep. Gr. 47 .
- Install and adjust wiper arms ⇒ Rep. Gr. 92 .
- Before starting the engine for the first time, fill up the power steering reservoir with hydraulic fluid; the power steering pump must not run dry.
- Connect battery ⇒ Rep. Gr. 27 .
- Install lock carrier with attachments ⇒ Rep. Gr. 50 .
- Install front bumper ⇒ Rep. Gr. 63 .
- Fill up hydraulic fluid for power steering and bleed steering system ⇒ Rep. Gr. 48 .
- Adjust headlights ⇒ Rep. Gr. 94 .
- Check oil level before starting engine ⇒ page 163 .
- Check ATF level (automatic gearbox).
- Perform wheel alignment check ⇒ Rep. Gr. 44 .

WARNING

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

- Close windows fully using electric window switches.
- Then operate all electric window switches again for at least one second in the “close” direction to activate the automatic one-touch function.
- Set clock to correct time.

1.5 Tightening torques

Note

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

Centring sleeves (-A- and -B-)

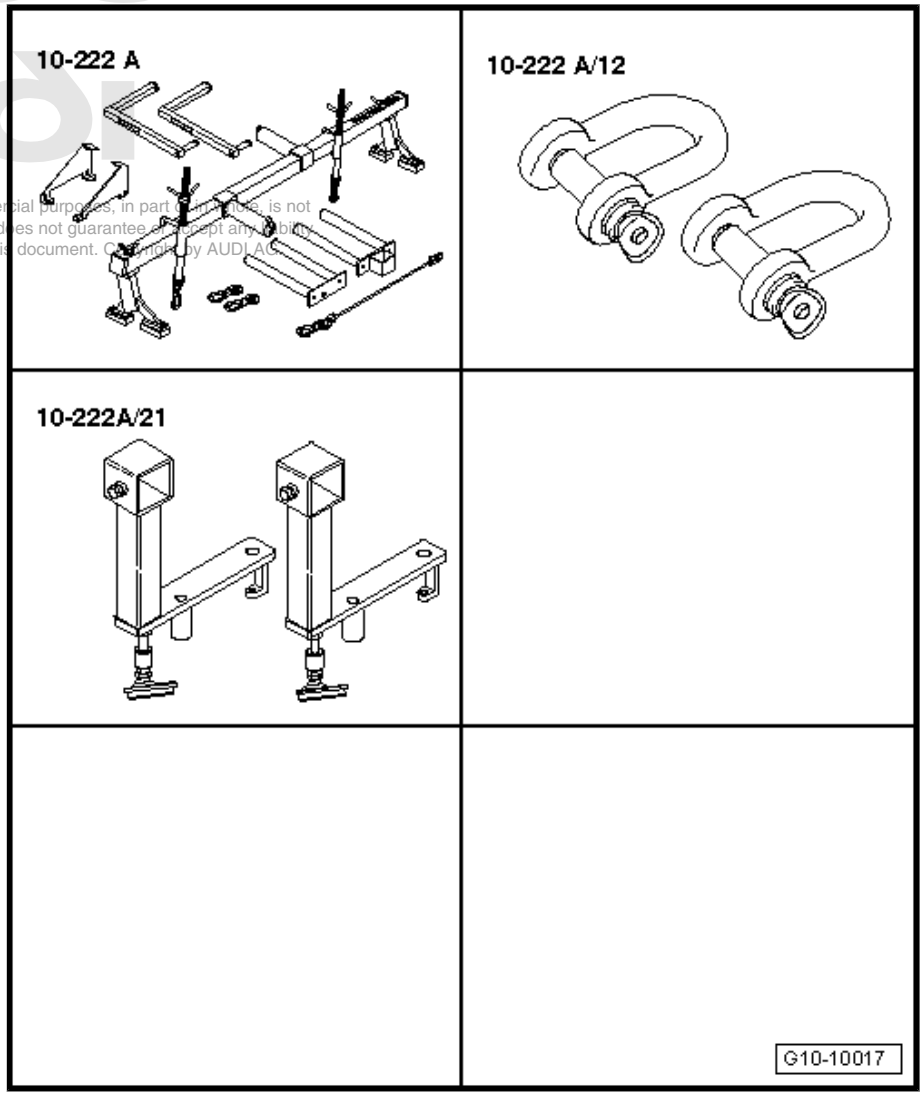
Bolted connection		Tightening torques
Engine support to valve for torque reaction support -N382-		40 Nm
Alternator to engine	M10	40 Nm
	M 8	25 Nm
Exhaust manifold to cylinder head		25 Nm
A/C compressor to bracket		25 Nm
Bracket for central hydraulic pump and A/C compressor to engine		25 Nm
Drive shafts to flange shafts	M 10	77 Nm
Exhaust pipe to manifold		40 Nm
Gearbox mounting to subframe		40 Nm
Wheel bolt to wheel hub		120 Nm
Engine cross member to engine mounting		23
Engine cross member to body		68

2 Removing and installing engine mountings

2.1 Removing and installing engine mounting (left and right)

Special tools and workshop equipment required

- Support bracket -10 - 222 A-
- Shackle -10 - 222 A /12-
- Adapter -10-222 A /21-

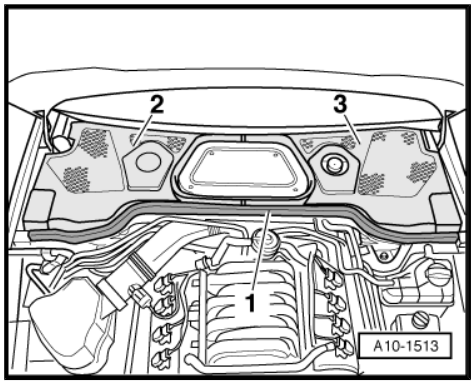


Removing

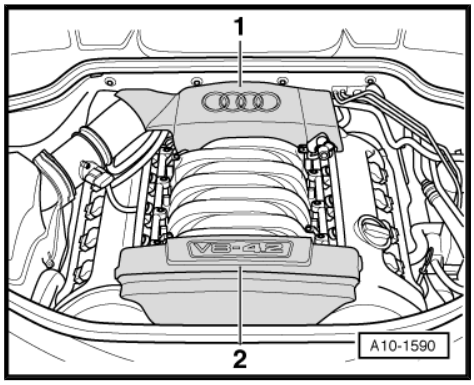
Note

Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

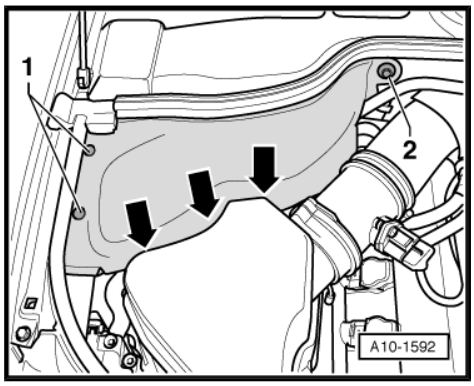
– Pull off rubber seal -1- on plenum chamber cover.
– Detach plenum chamber covers -2- and -3-.



– Lift off engine cover panel -1-.



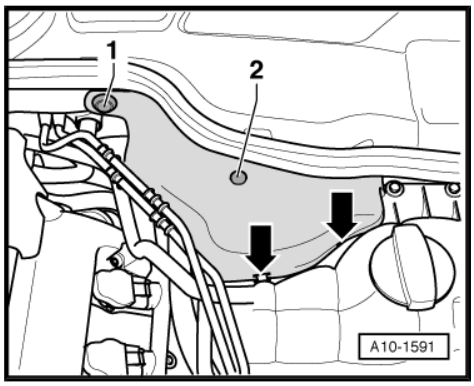
– Pull out clips -1-.
– Unscrew bolt -2- and remove cover.



Note

Pay attention to clips -arrows- on installation.

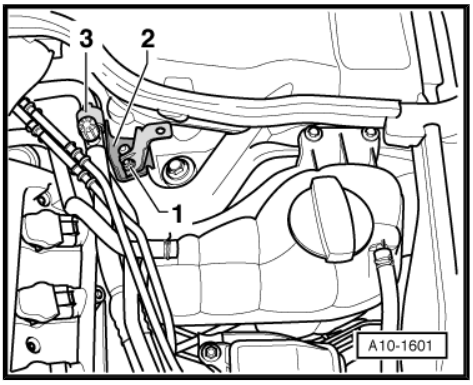
– Unscrew bolt -1- and take out spreader rivet -2- to remove cover (left-side).



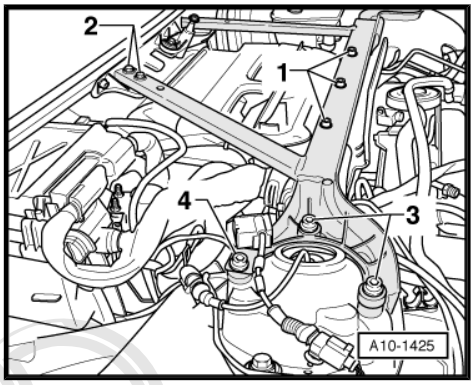
Note

Pay attention to clips -arrows- on installation.

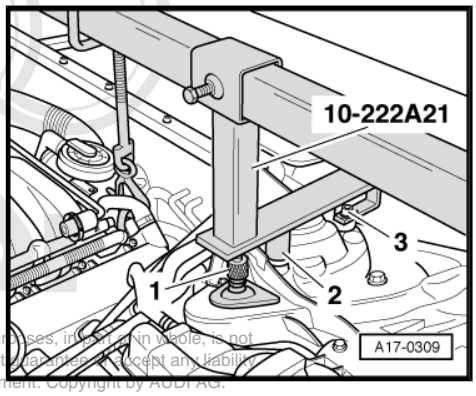
– Remove bracket for cover -1-.
– Unscrew bracket for air conditioner pipe -2-.
– Unclip bracket from air conditioner pipe -3-.



– Remove bolt -4- (left and right).

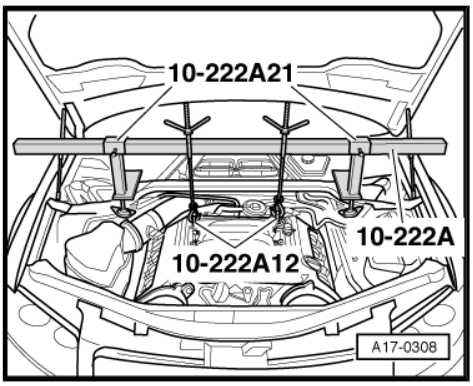


– Attach support bracket -10 - 222 A- with adapters -10 - 222 A / 21- onto suspension turrets.
– Screw adapters -10 - 222 A /21- onto body brace -3- (left and right).
♦ Supports are marked for left and right-side of vehicle.
♦ The centre support point is positioned on the front bolts for the body brace.
♦ The knurled screw -1- must be screwed down until support plate rests on suspension turret.

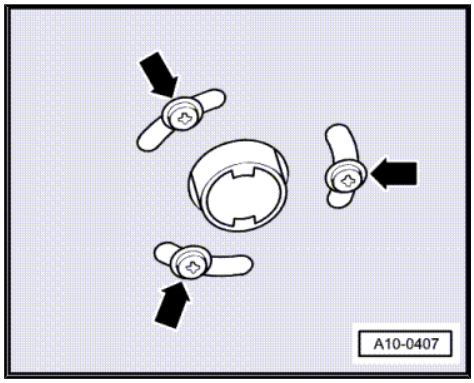


– Attach shackles -10 - 222 A /12- to rear engine lifting eyes.
– Hook shackles -10 - 222 A /12- onto spindles of support bracket -10 - 222 A- .
– Take up weight of engine with spindles of support bracket.

Vehicles with auxiliary heater / supplementary heater:

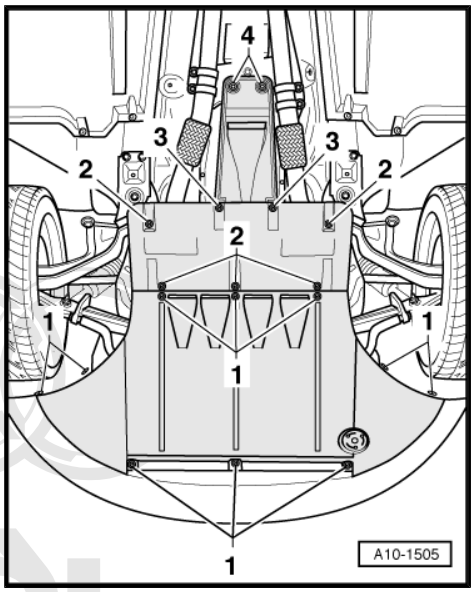


– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



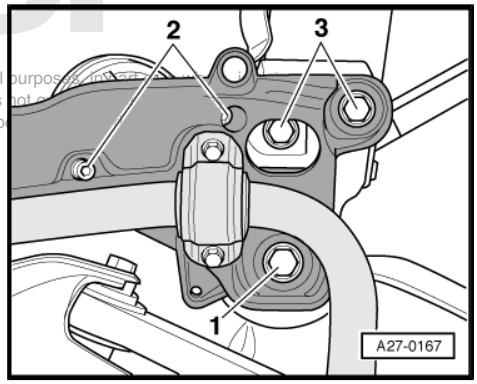
All models:

– Remove front noise insulation -1-.



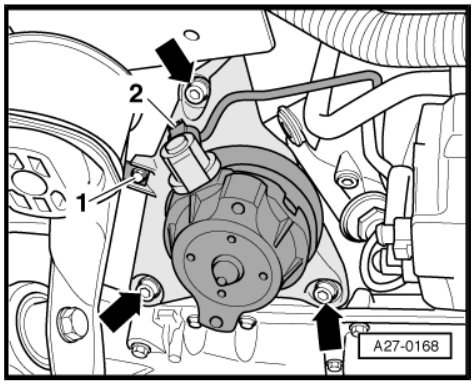
– Remove bolts -1...3- (left and right).
– Lower engine cross member.

Engine mounting (right-side)

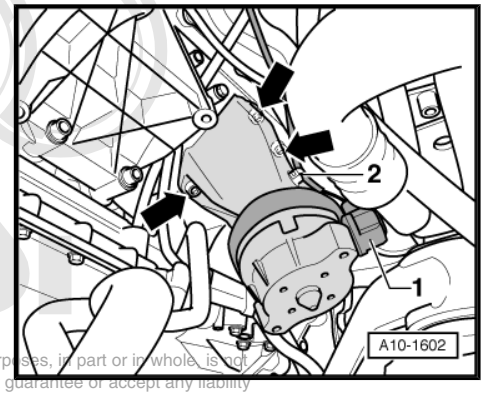


– Unplug electrical connector -2- at engine mounting.
– Unscrew cable clamp -1- from engine support.
– Remove engine support -arrows-.
– Unscrew engine mounting from engine support.

Engine mounting (left-side)



– Unplug electrical connector -1- at engine mounting.
– Unclip wire -2-.
– Remove engine support -arrows-.
– Unscrew engine mounting from engine support.



Installing

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

Note

Renew all cable ties which are released or cut open when removing the engine. Refit in the same position when installing the engine.

Tightening torques

Component	Nm
Engine support to engine	40
Engine cross member to engine mounting	23
Engine cross member to body	68
Engine mounting to engine support	40

2.2 Torque reaction support with valve for torque reaction support -N382- - exploded view

1 - 40 Nm

2 - Washer

3 - 40 Nm

4 - Torque reaction support

5 - Knurled nut

- ❑ For height adjustment

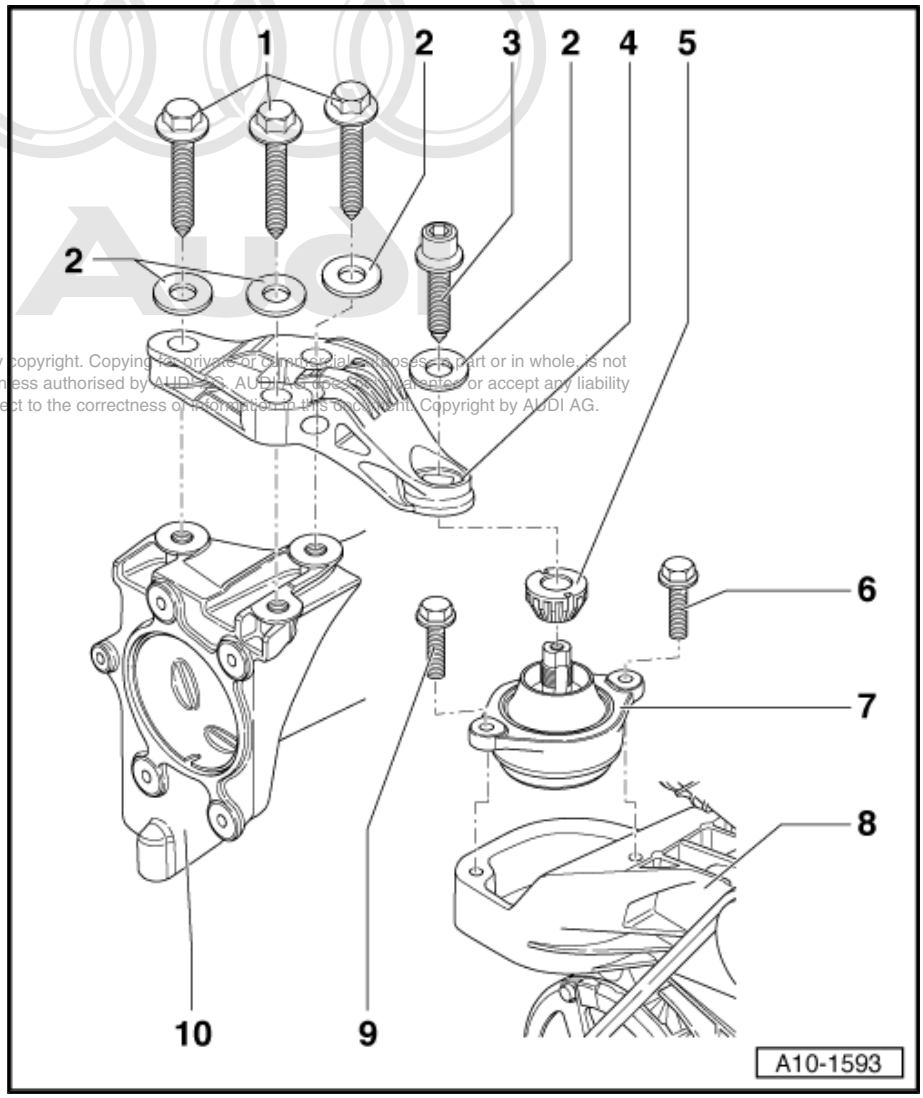
6 - 23 Nm

7 - Valve for torque reaction support -N382-

8 - Retainer for valve for torque reaction support -N382-

9 - 23 Nm

10 - Longitudinal member



Removing

Special tools and workshop equipment required

- ♦ Electric drill
- ♦ Stepped centre bit (∅ 24 mm)

Note

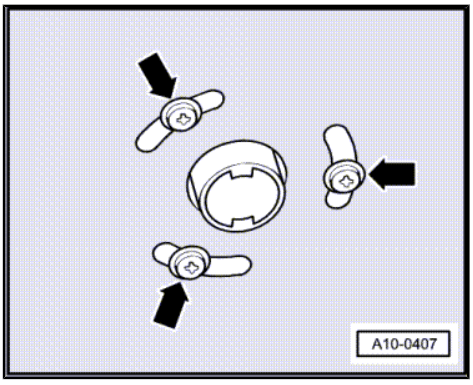
Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

– Switch off ignition and remove ignition key.

– Turn light switch to position “0”.

Vehicles with auxiliary heater / supplementary heater:

– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.

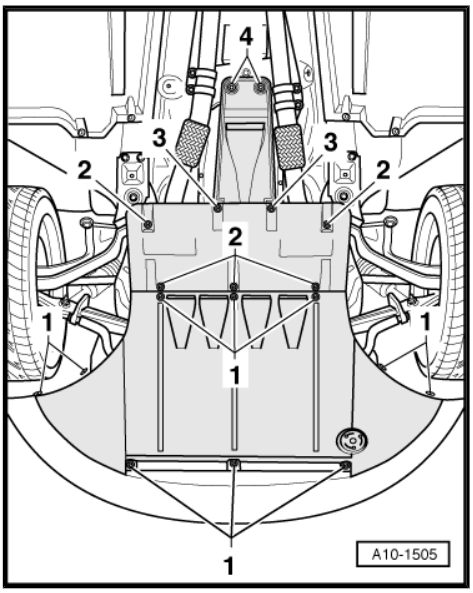


All models:

– Remove front noise insulation -1-.

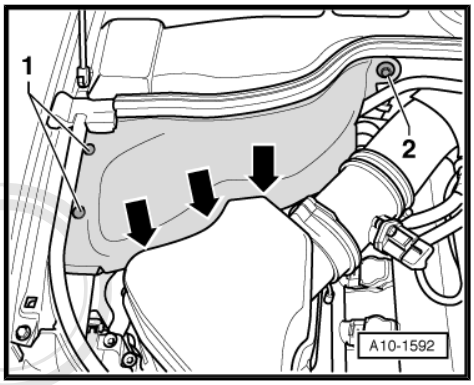
– Remove front section of wheel housing liner (front left and front right) ⇒ General body repairs, exterior; Rep. Gr. 66 .

– Remove front bumper cover ⇒ General body repairs, exterior; Rep. Gr. 63 .



– Pull out clips -1-.

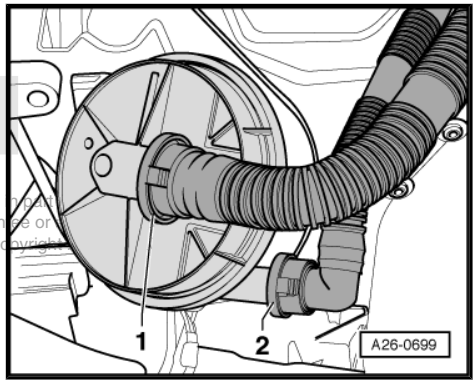
– Unscrew bolt -2- and remove cover.



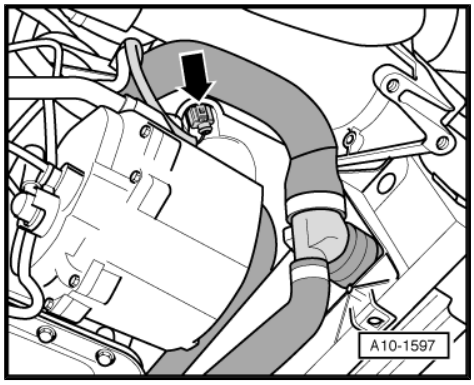
Note

Pay attention to clips -arrows- on installation.

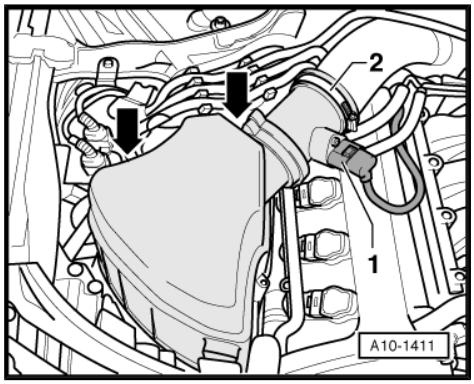
– Detach intake hose -1- from secondary air pump.



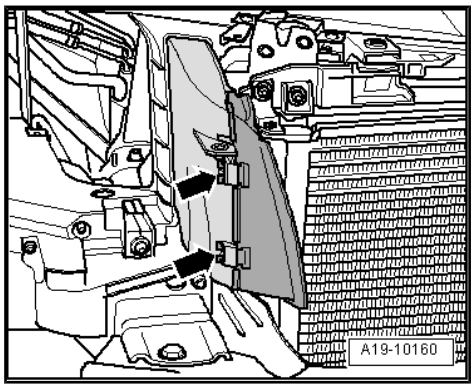
– Unplug electrical connector -arrow-.



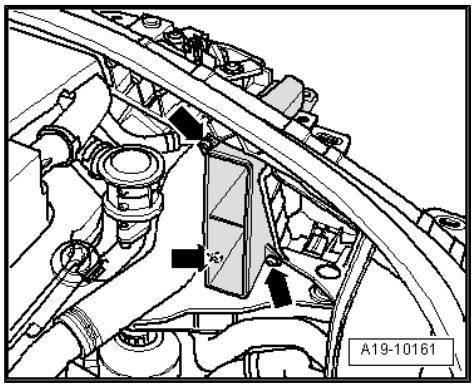
– Unplug electrical connector -1- from air mass meter.
– Detach air mass meter from air intake hose -2-.
– Remove air cleaner housing -arrows-.
– Remove headlight (right-side) ⇒ Electrical system; Rep. Gr. 94 .



– Compress retainer catches -arrows- and detach air duct from lock carrier (front right).



– Remove bolts -arrows-.
– Detach air duct from lock carrier (rear right).

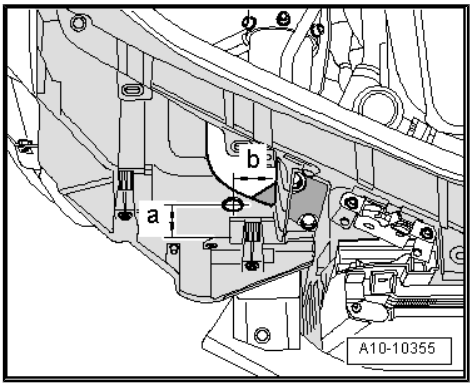


– Mark out drilling on lock carrier as illustrated according to dimensions -a- and -b-.

• Dimension -a- = 40 mm.

• Dimension -b- = 55 mm.

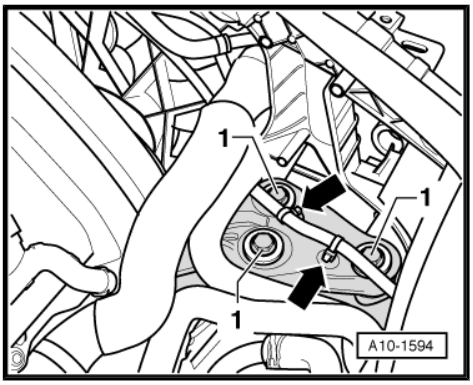
– Drill a hole of 24 mm dia.



Note

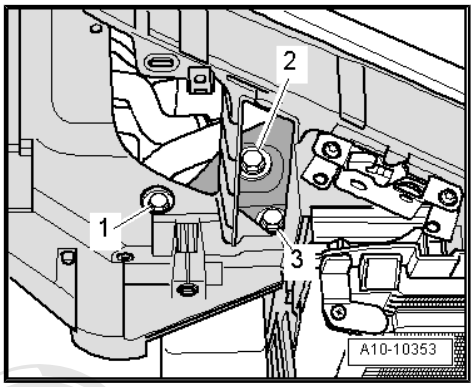
Drill a pilot hole and then drill out to 24 mm dia using the stepped centre bit.

– Unclip wire -arrows-.

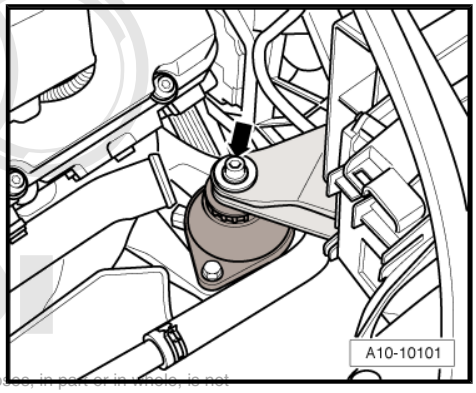


– Remove bolts -1- and -2- for torque reaction support.

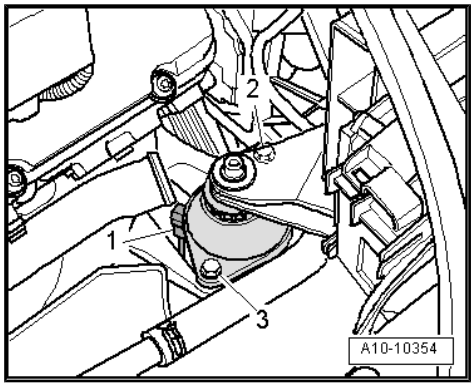
– Slacken bolt -3- a few turns.



– Detach torque reaction support -arrow- from valve for torque reaction support -N382- .



– Remove bolts -2- and -3-.
– Pivot torque reaction support to one side and unplug electrical connector -1-.
– Remove valve for torque reaction support -N382- .



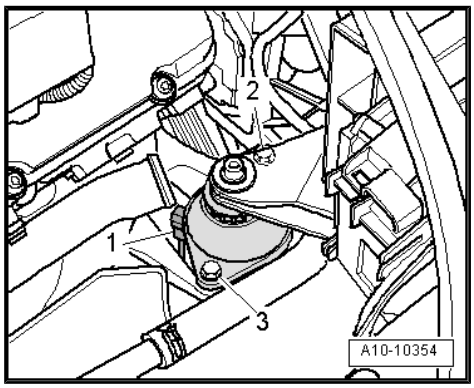
Installing

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

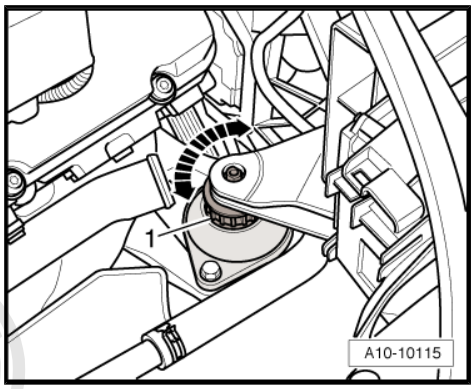
Note

- *Renew all cable ties which are released or cut open when removing the engine. Refit in the same position when installing the engine.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

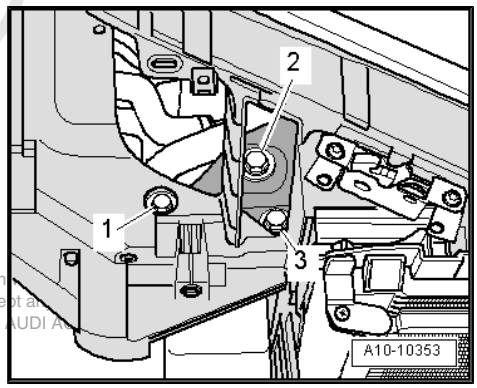
– Plug in electrical connector -1- at valve for torque reaction support -N382- .
– Fit valve for torque reaction support -N382- and tighten bolts -2- and -3-.



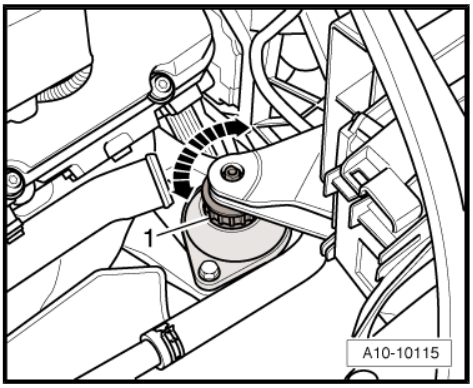
– Turn adjuster ring -1- on valve for torque reaction support -N382- clockwise to stop.



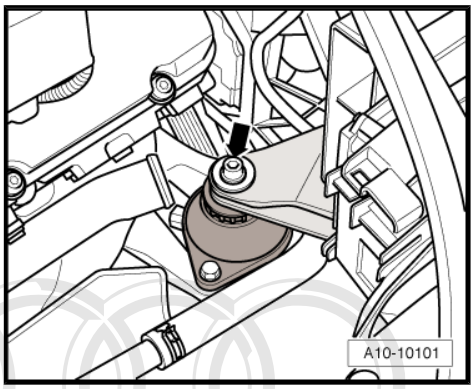
– Secure bolts -1- and -3- for torque reaction support.



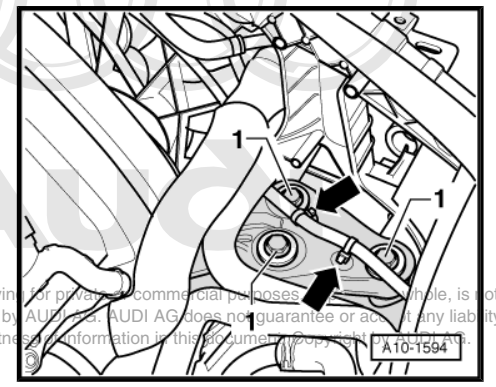
– Turn adjuster ring -1- by hand anti-clockwise until it comes into contact with valve for torque reaction support -N382- .
– Then turn adjuster ring one turn clockwise.



– Tighten bolt -arrow- at valve for torque reaction support -N382- .



– Clip in wire -arrows-.
– Install headlights ⇒ Rep. Gr. 94 .
– Install front bumper cover ⇒ General body repairs, exterior; Rep. Gr. 63 .
– Check headlight adjustment ⇒ Maintenance ; Booklet 404 .



Tightening torques

Tightening toques ⇒ page 42 Torque reaction support and valve for torque reaction support -N382- - exploded view

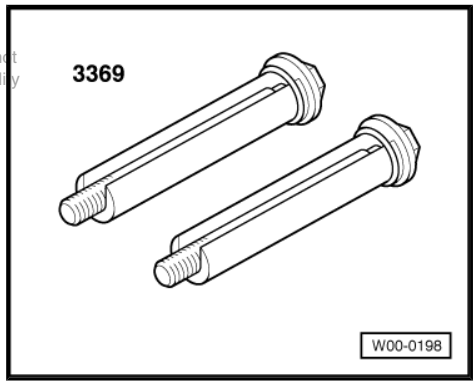
13 – Crankshaft group

1 Dismantling and assembling engine

1.1 Pulling lock carrier forwards

Special tools and workshop equipment required

- Front-end service sleeves -3369-



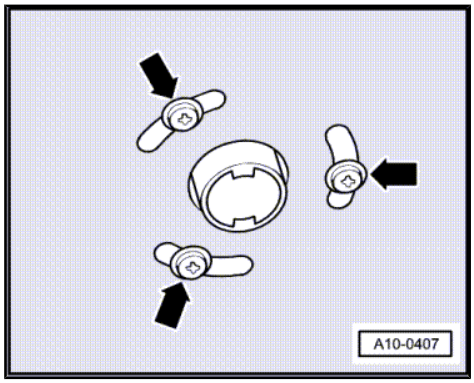
Note

Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

Procedure

Vehicles with auxiliary heater / supplementary heater

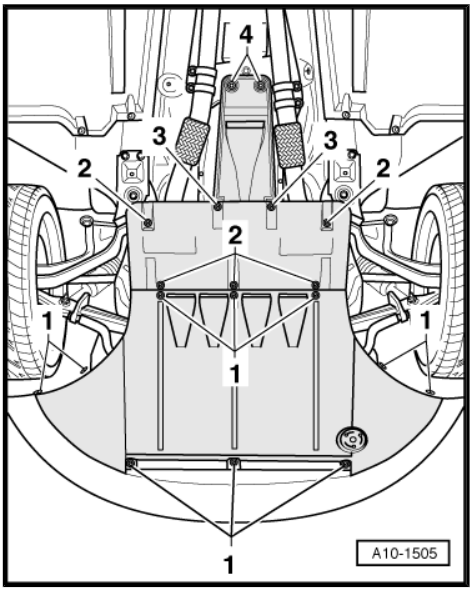
– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



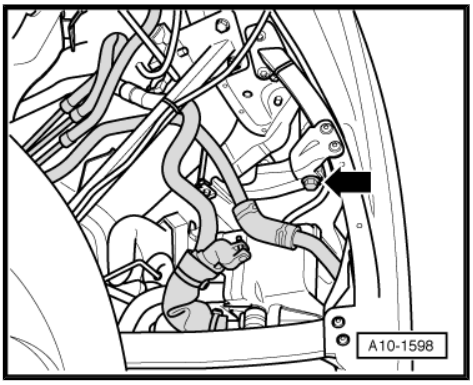
All models:

– Remove front noise insulation -1-.

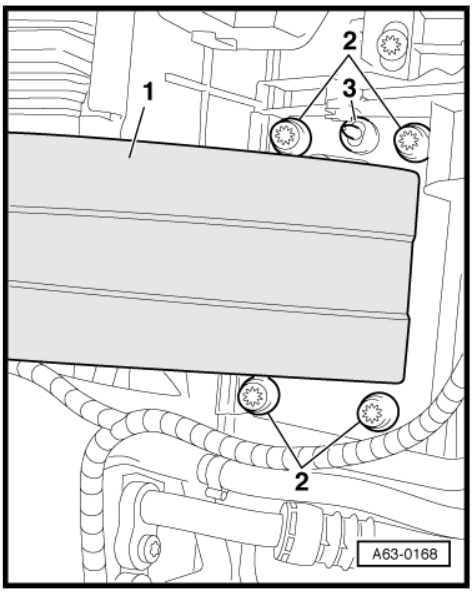
– Remove front bumper ⇒ Rep. Gr. 63 .



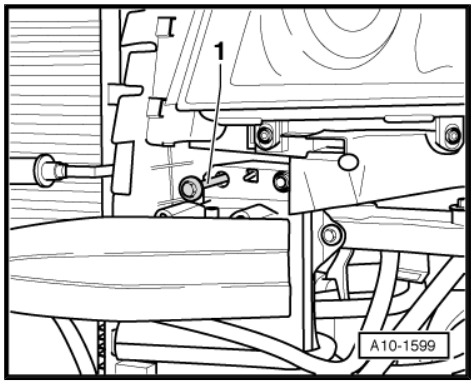
– Remove bolt (left and right) -arrow-.



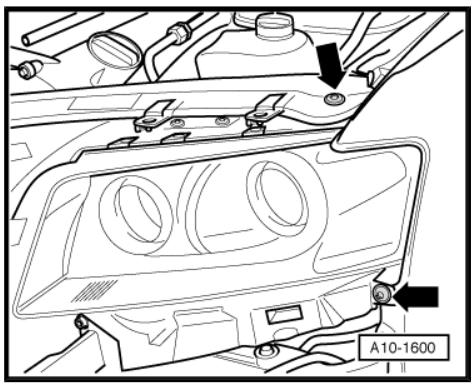
– Remove bolts -2- (left and right).



– Fit bolt -1- M8x90; e.g. from front-end service sleeves -3369- (left and right).



– Remove bolts -arrows- and pull lock carrier forwards.



Installing

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

Note

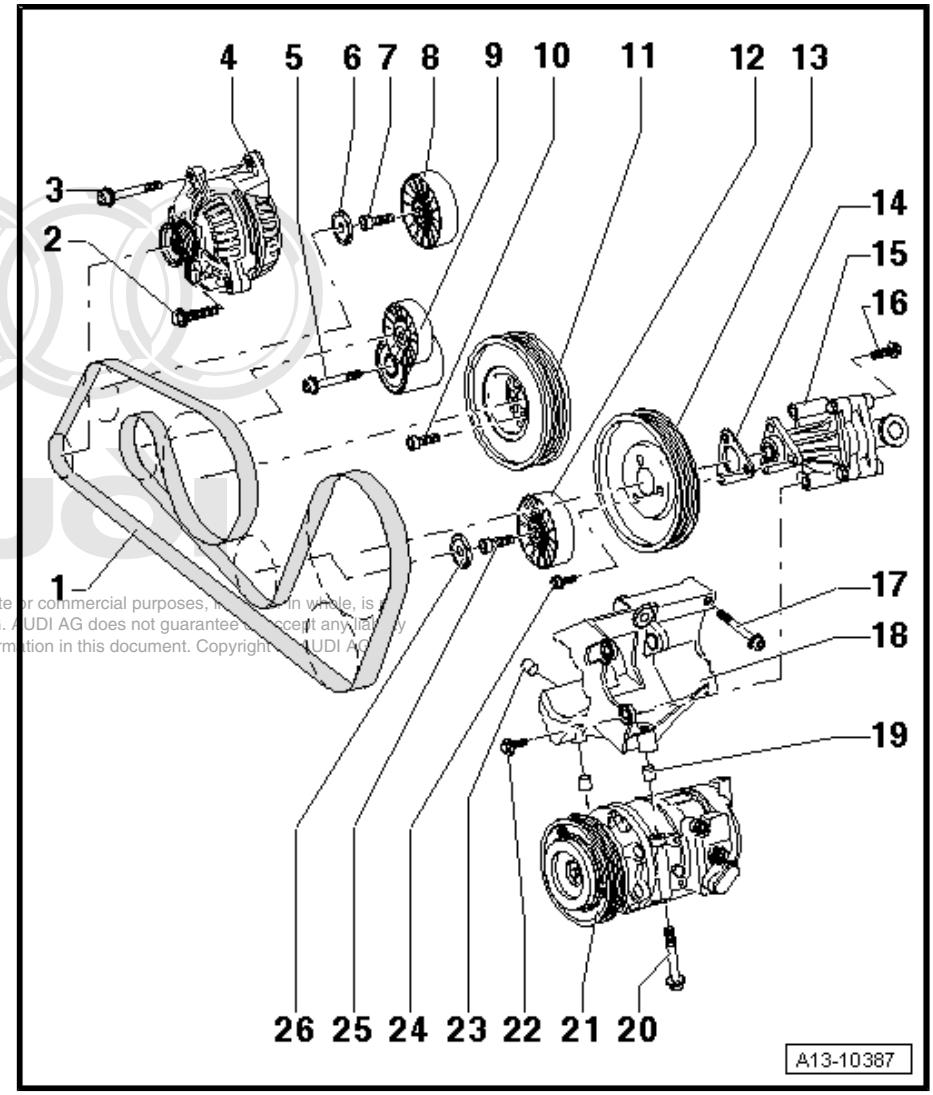
Renew all cable ties which are released or cut open when removing the engine. Refit in the same position when installing the engine.

– Install lock carrier with attachments ⇒ Rep. Gr. 50 .
– Install front bumper ⇒ Rep. Gr. 63 .
– Adjust headlights ⇒ Rep. Gr. 94 .

1.2 Poly V-belt drive - exploded view

Note

- *Before removing the poly V-belt, mark the direction of rotation with chalk or a felt pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*
- *Check that the belt runs properly on the pulleys when installing.*



1 - Poly V-belt
- ❑ Removing and installing ⇒ page 52

2 - Bolt
- ❑ Tightening torque ⇒ Rep. Gr. 27

3 - Bolt
- ❑ Tightening torque ⇒ Rep. Gr. 27

4 - Alternator
- ❑ Removing and installing ⇒ Rep. Gr. 27

5 - 43 Nm

6 - Cover
- ❑ For idler roller

7 - 45 Nm

8 - Idler roller (top)
- ❑ For poly V-belt

9 - Tensioner for poly V-belt
- ❑ Pivot with ring spanner to slacken poly V-belt ⇒ page 52

10 - 22 Nm

11 - Vibration damper
- ❑ With pulley for poly V-belt
- ❑ Removing and installing ⇒ page 56

12 - Idler roller (bottom)
- ❑ For poly V-belt

13 - Pulley
- ❑ For power steering pump
- ❑ Removing and installing ⇒ page 52

14 - Shim
- ❑ Different thicknesses
- ❑ After renewing the power steering pump, the AC compressor or the bracket for power steering pump and AC compressor, determine thickness ⇒ and check alignment of poly V-belt ⇒ page 54

15 - Power steering pump
- ❑ For power steering
- ❑ Removing and installing ⇒ Rep. Gr. 48

16 - 22 Nm

17 - 40 Nm

18 - Bracket

- ❑ For AC compressor and power steering pump
- ❑ Pay attention to dowel sleeves ⇒ Item 23 (page 52) when installing

19 - Dowel sleeve

- ❑ 2 x
- ❑ Check for correct seating in bracket

20 - 22 Nm

21 - Air conditioner compressor

- ❑ Pay attention to dowel sleeves ⇒ Item 19 (page 52) when installing

22 - 22 Nm

23 - Dowel sleeve

- ❑ 2 x
- ❑ Check for correct seating

24 - 22 Nm

25 - 23 Nm

26 - Cover

- ❑ For idler roller

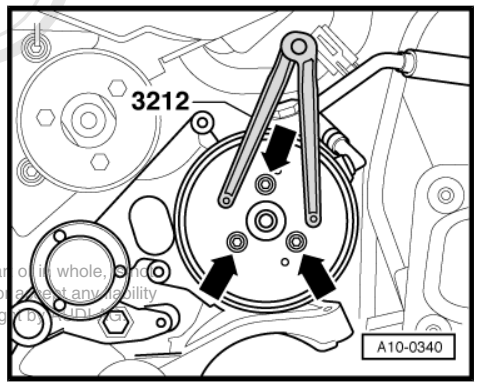
Removing and installing power steering pump pulley.

- Lock carrier must be pulled forwards ⇒ page 48 .
- Poly V-belt must be removed ⇒ page 52 .

– Use 2-hole pin wrench -3212- to counterhold when slackening and tightening bolts -arrows-.

♦ Installation position: marking “vorne” (front) faces in direction of travel.

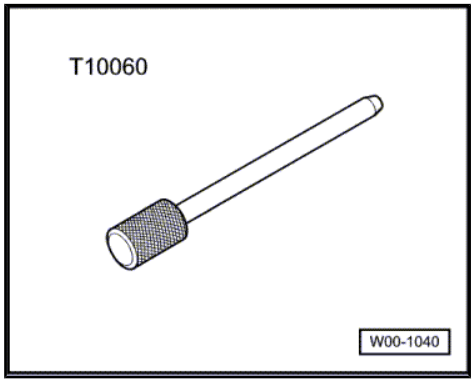
♦ Check alignment of poly V-belt ⇒ page 54 .



1.3 Removing and installing poly V-belt

Special tools and workshop equipment required

♦ Locking pin -T10060 A-



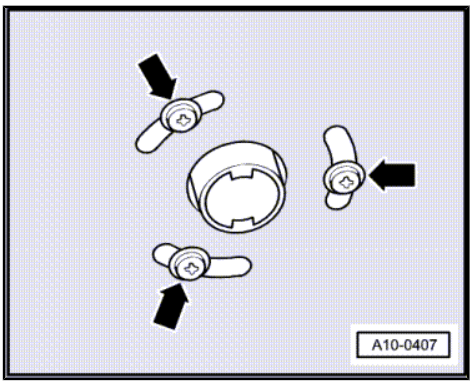
Removing

Note

Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

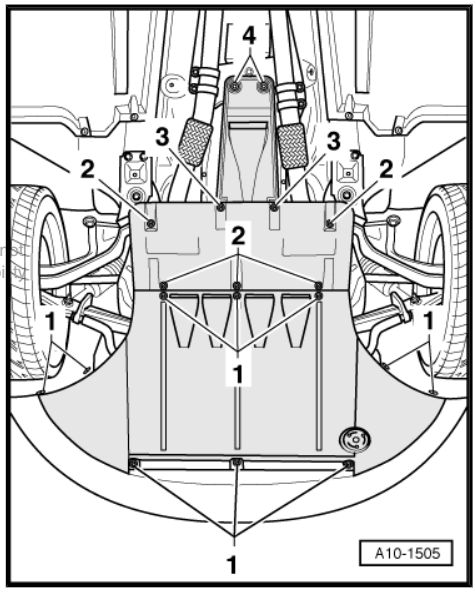
Vehicles with auxiliary heater / supplementary heater:

– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



All models:

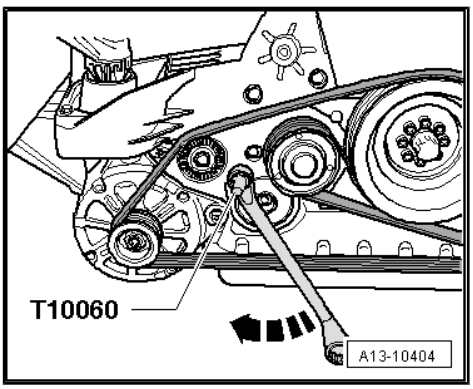
– Release fasteners -1- and remove noise insulation.



Note

- *Before removing the poly V-belt, mark the direction of rotation with chalk or a felt pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*
- *When installing the poly V-belt ensure the belt seats correctly in the belt pulleys.*

– To slacken poly V-belt, turn tensioner clockwise in direction of -arrow- with 19 mm ring spanner until the two holes are in alignment, and hold in position with locking pin -T10060- .



– Take off poly V-belt.

Installing

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

Note

- *After renewing any of the following components, it is necessary to check the alignment of the poly V-belt ⇒ page 54 .*
- *Power steering pump*
- *Air conditioner compressor*
- *Bracket for power steering pump and AC compressor*

– Position poly V-belt over pulleys in the following sequence:

1 - Idler roller (top)

2 - Crankshaft

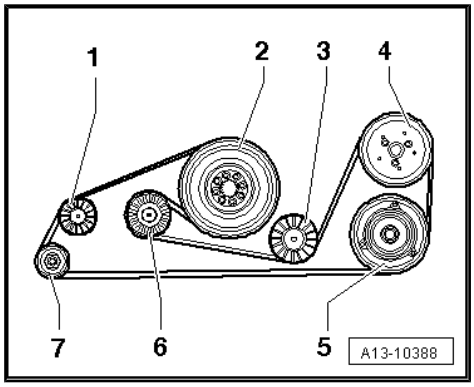
3 - Idler roller (bottom)

4 - Power steering pump

5 - Air conditioner compressor

6 - Tensioner for poly V-belt

7 - Alternator

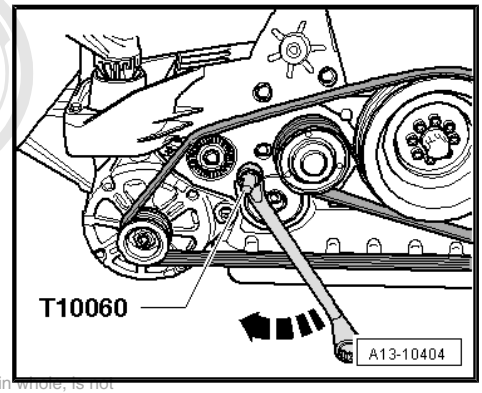


– Turn tensioner in direction of -arrow-.

– Remove locking pin -T10060- .

– Make sure poly V-belt is properly positioned and correctly routed.

– Start engine and check that belt runs properly.



1.4 Checking alignment of poly V-belt

After renewing any of the following components, it is necessary to check the alignment of the poly V-belt:

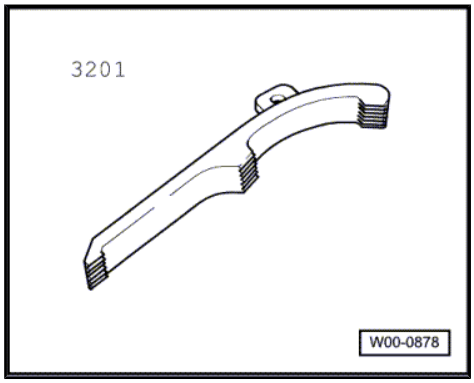
- Power steering pump
- Air conditioner compressor
- Bracket for power steering pump and AC compressor

Note

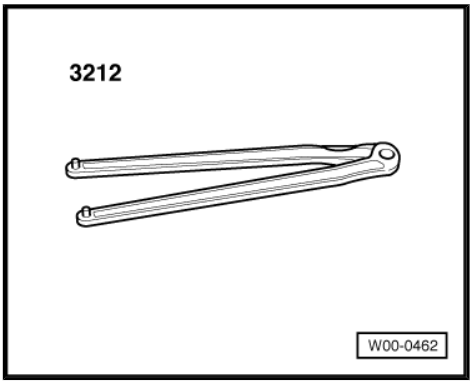
To prevent damage to the poly V-belt, check the alignment of the poly V-belt between the air conditioner compressor and the power steering pump.

Special tools and workshop equipment required

- Alignment gauge -3201-



♦ Pin wrench -3212-



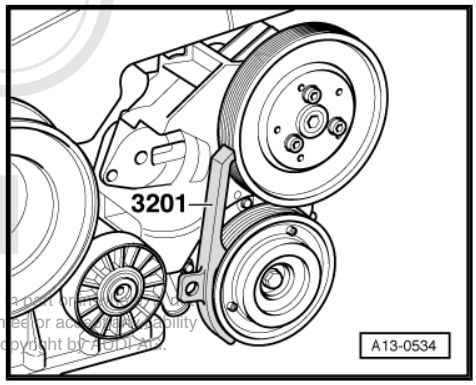
Test sequence

- Lock carrier must be pulled forwards ⇒ page 48 .
- Poly V-belt must be removed ⇒ page 52 .

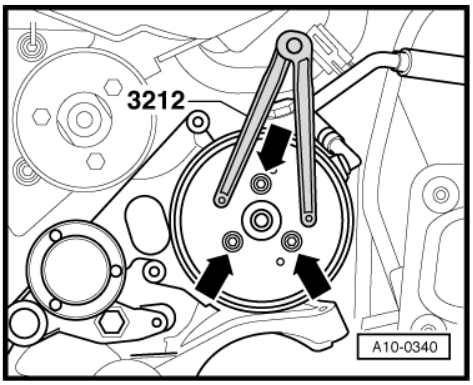
– Apply alignment gauge -3201- onto poly V-belt pulley for air conditioner compressor.

♦ The poly V-belt pulley of the power steering pump must align with the poly V-belt pulley of the air conditioner compressor.

If the two poly V-belt pulleys are not aligned:



– Unscrew bolts -arrows- at pulley for power steering pump.



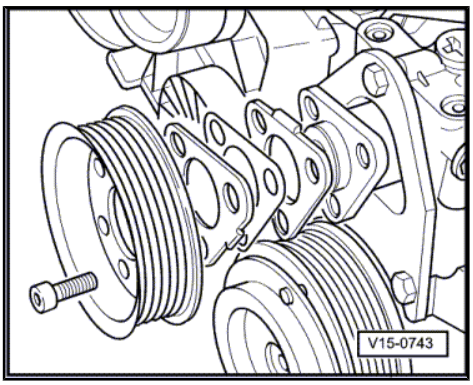
Note

♦ *When slackening off and tightening bolts, counterhold with 2-hole pin wrench -3212- .*

♦ *Installation position: the word "vorne" (front) on the poly V-belt pulley faces the direction of travel.*

– Use shims of thicknesses 0.5, 1.0 and 1.5 mm to align pulley for power steering pump with pulley for air conditioner compressor: part No. ⇒ Parts catalogue .

– Then check alignment of pulleys using alignment gauge -3201- . Repeat adjustment if necessary.



Note

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

Tightening torques

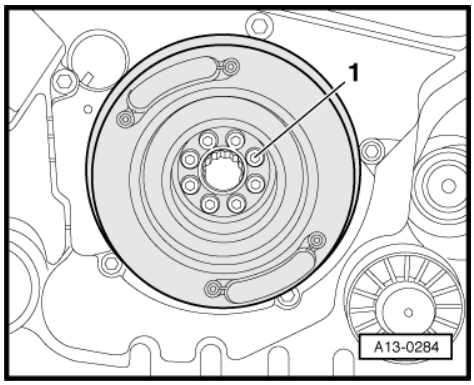
Component	Nm
Pulley to power steering pump	22

1.5 Removing and installing vibration damper

Removing

- Lock carrier must be pulled forwards ⇒ page 48 .
- Poly V-belt must be removed ⇒ page 52 .

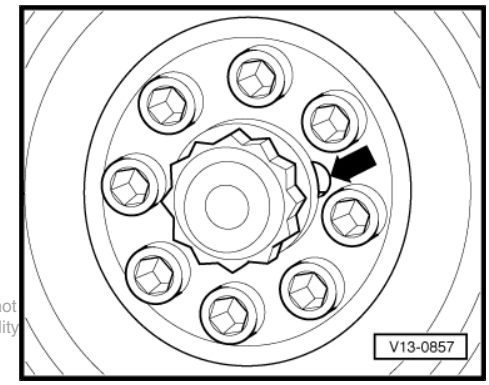
– Slacken 8 securing bolts -1- and remove vibration damper from crankshaft.



Installing

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

– On installation, make sure notch -arrow- in vibration damper is aligned with locating lug on toothed belt sprocket.



Tightening torque

Component	Nm
Vibration damper to crankshaft sprocket	22

1.6 Toothed belt covers - exploded view

1 - Plug

2 - 43 Nm

3 - Bracket

- ❑ For valve for torque reaction support -N382-

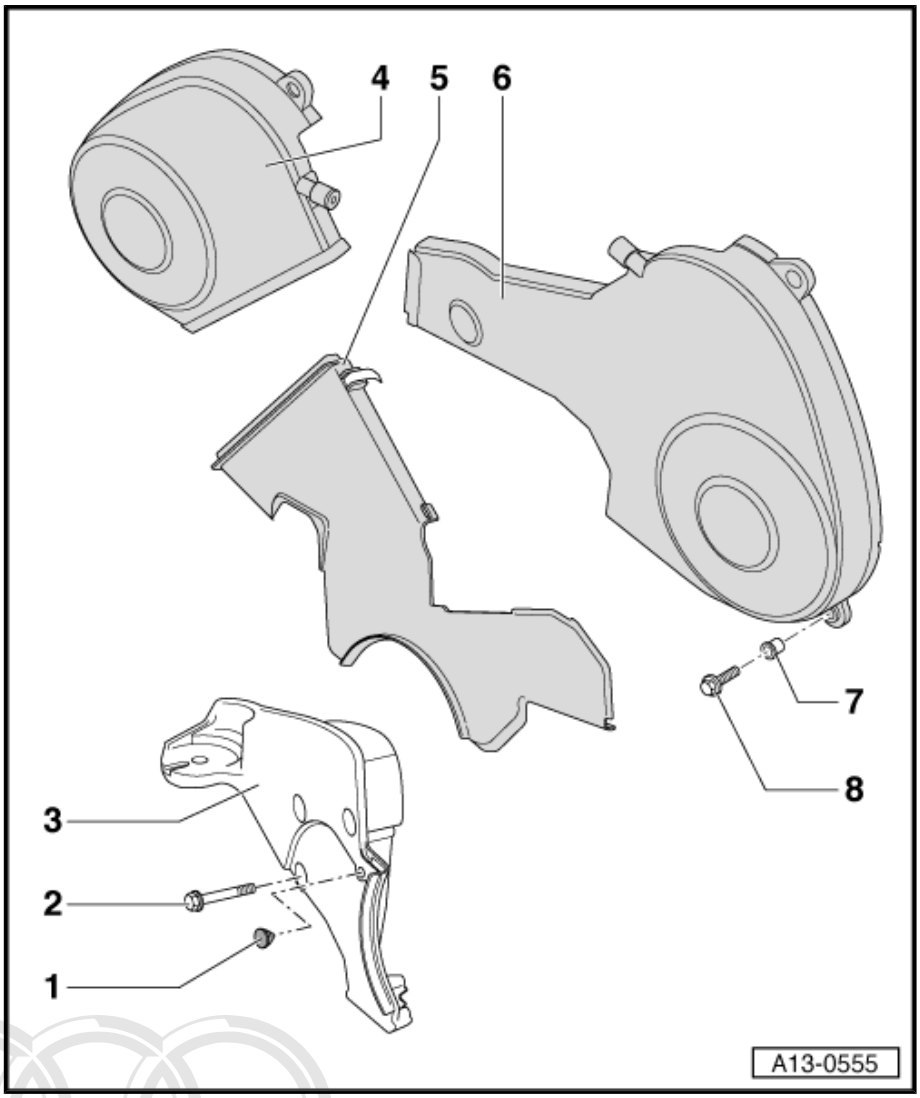
4 - Toothed belt cover (right-side)

5 - Toothed belt cover (centre)

6 - Toothed belt cover (left-side)

7 - Sleeve

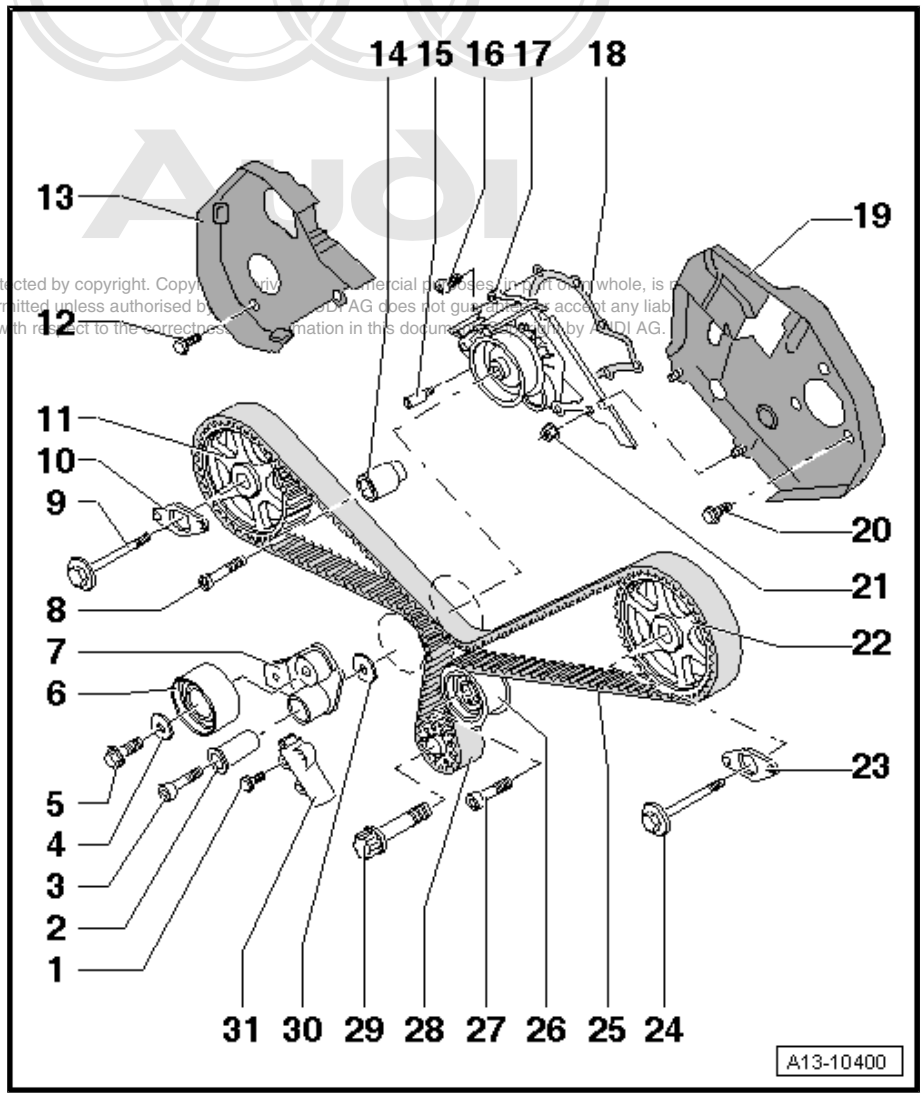
8 - 10 Nm



1.7 Toothed belt drive - exploded view

Note

Mark the rotation direction of the toothed belt with chalk or felt-tip pen before removing. If the belt runs in the opposite direction when it is refitted, this can cause breakage.



1 - 10 Nm

2 - Pivot pin

3 - 20 Nm +90° (1/4 turn) further

- ❑ Renew

4 - Washer

- ❑ For tensioning roller

5 - 40 Nm

6 - Tensioning roller

7 - Tensioning lever

- ❑ Fit washer ⇒ Item 30 (page 59) underneath

8 - 22 Nm

9 - 55 Nm

- ❑ Renew
- ❑ Lubricate threads and contact surface of bolt head

10 - Locating plate

- ❑ Renew
- ❑ Side labelled “rear/hinten” faces rear

11 - Camshaft sprocket (right-side)

- ❑ Remove toothed belt prior to removing and installing ⇒ page 60
- ❑ Detach using two-arm puller -T40001- and claws -T40001/2-

12 - 10 Nm

- ❑ Apply locking fluid when fitting
- ❑ Locking fluid ⇒ Parts catalogue

13 - Toothed belt cover (rear right)

14 - Idler roller

15 - Trunnion bolt, 9 Nm

16 - 14 Nm

- ❑ Bolt strength rating 10.9

17 - Coolant pump

- ❑ Removing and installing ⇒ page 179

18 - Gasket

- ❑ Renew

19 - Toothed belt cover (rear left)

20 - 10 Nm

- ❑ Apply locking fluid when fitting
- ❑ Locking fluid ⇒ Parts catalogue

21 - 10 Nm

22 - Camshaft sprocket (left-side)

- ❑ Remove toothed belt prior to removing and installing ⇒ page 60
- ❑ Detach using two-arm puller -T40001- and claws -T40001/2-

23 - Locating plate

- ❑ Renew
- ❑ Side labelled “rear/hinten” faces rear

24 - 55 Nm

- ❑ Renew
- ❑ Lubricate threads and contact surface of bolt head

25 - Toothed belt

- ❑ Before removing, mark direction of rotation with chalk or felt-tipped pen
- ❑ Check for wear
- ❑ Removing ⇒ page 60
- ❑ Installing (adjusting valve timing) ⇒ page 60

26 - Eccentric adjuster

27 - 45 Nm

28 - Crankshaft sprocket

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

29 - 200 Nm + 1/2 turn (180°) further

- ❑ Renew
- ❑ Do not additionally lubricate
- ❑ Use locking pin -3242- when loosening and tightening
- ❑ Screwing in locking pin -3242- ⇒ page 62

30 - Washer

- ❑ For tensioning lever

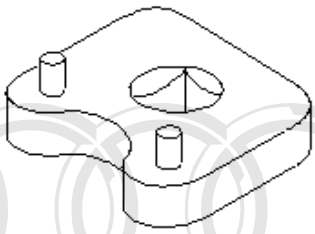
31 - Tensioner

1.8 Removing and installing toothed belt

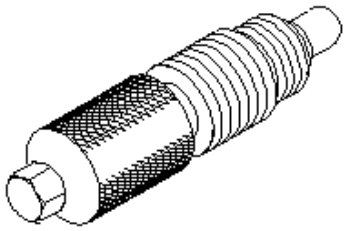
Special tools and workshop equipment required

- Tensioner wrench -T40009-
- Locking pin -3242-
- Torque wrench -V.A.G 1783-
- Ratchet insert 1/4" -VAS 6234-
- Two-arm puller -T40001- with claws -T40001/2-
- Camshaft clamp -T40005-
- Locking pin -T40011-
- Pin wrench -3212-

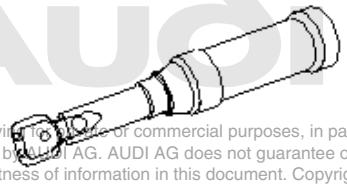
T40009



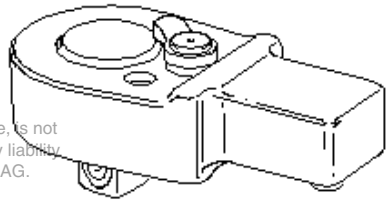
3242



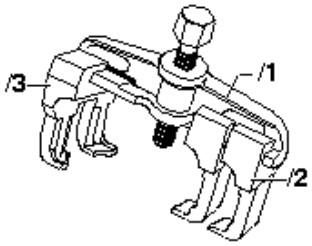
V.A.G 1783



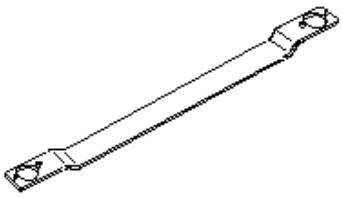
VAS 6234



T40001

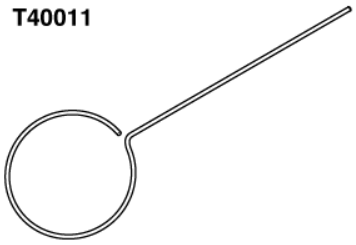


T40005



G13-10028

T40011



W00-1089

3212

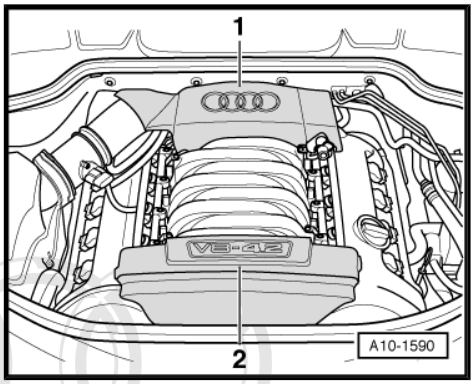
W00-0462

Removing toothed belt

Note

Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

– Remove front bumper ⇒ Rep. Gr. 63 .
– Detach lock carrier ⇒ Rep. Gr. 50 .
– Remove poly V-belt ⇒ page 52 .
– Lift off engine cover panel -2-.
– Remove toothed belt covers (top left and top right).

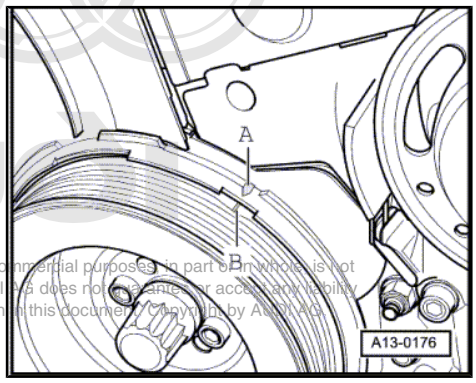


Caution

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).

– Set crankshaft to markings for TDC of No. 5 cylinder by turning central bolt on crankshaft sprocket in normal direction of rotation.

♦ Notch -B- is opposite mark -A-.



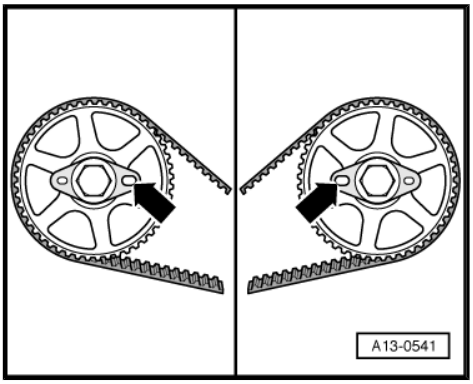
Note

Turn over the engine at the central bolt on the crankshaft.

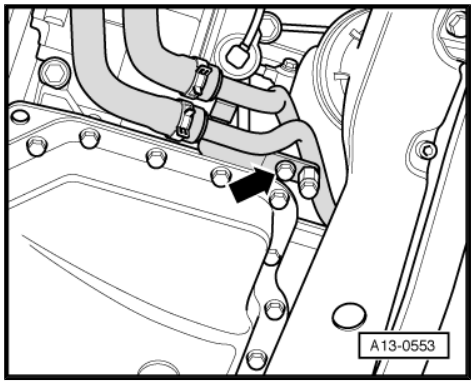
– Check position of camshafts:

♦ The large holes -arrows- in the locating plates on the camshaft sprockets must be opposite one another on the inside.

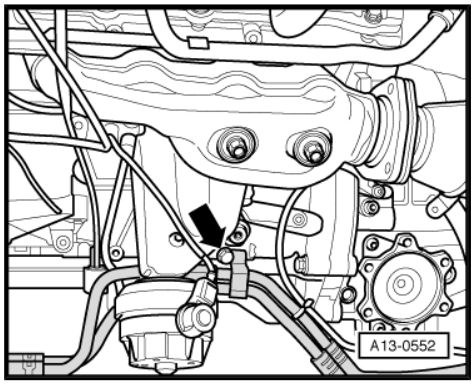
– If this is not the case, turn crankshaft one revolution further.



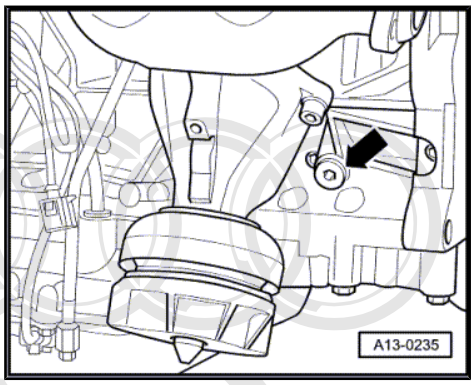
– Detach coolant pipe -arrow- from sump.



– Detach coolant pipe from cylinder block -arrow-.



– Unscrew plug -arrow- for TDC marking in sump (top section).



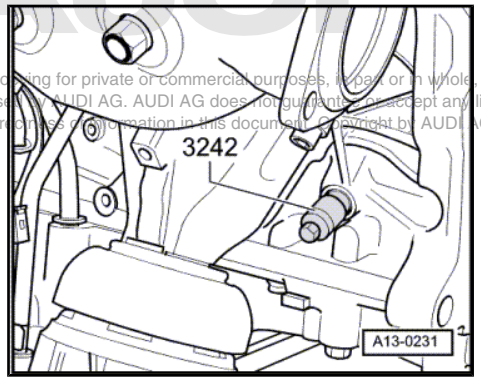
Note

There is a TDC drilling in the crankshaft directly behind the plug (it is possible to feel the hole).

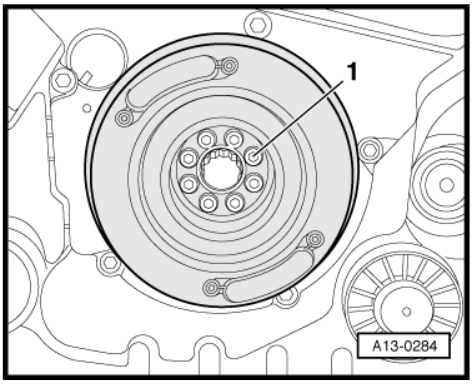
WARNING

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

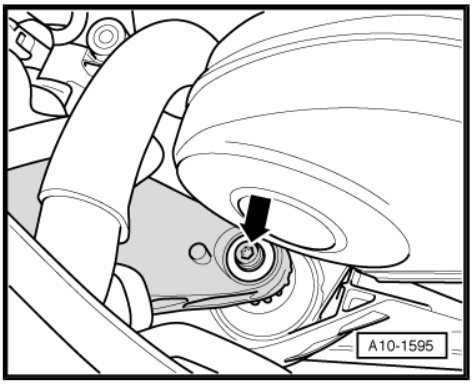
– Screw locking pin -3242- into threaded hole where plug has been removed.



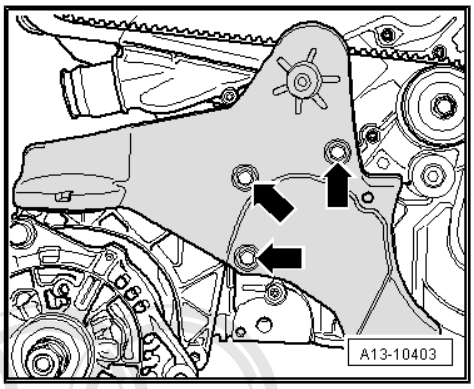
– Slacken 8 securing bolts -1- and remove vibration damper from crankshaft.
– Remove centre section of toothed belt cover.



– Detach torque reaction support -arrow- from valve for torque reaction support -N382- .



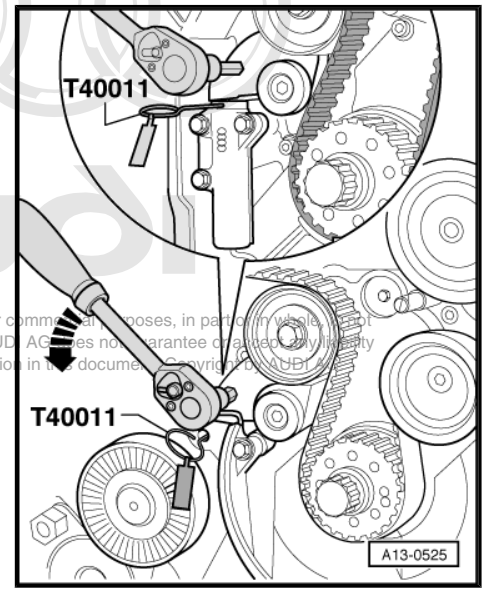
– Remove bracket for valve for torque reaction support -N382- -arrows-.



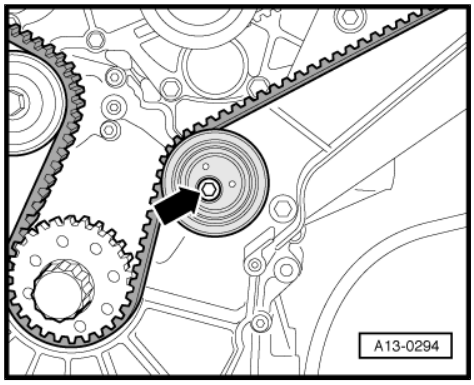
– Turn toothed belt tensioning roller in direction of the -arrow- using an 8 mm hexagon key until tensioning lever compresses tensioner far enough to allow locking pin -T40011- to be inserted into the holes in the piston and the housing.

Note

- *The bracket for valve for torque reaction support -N382- can remain fitted while performing the setting. The bracket has a hole through which the locking pin can be inserted into the bores in the tensioner.*
- *The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.*
- *Mark rotation direction of toothed belt. Running in opposite direction can cause breakage.*



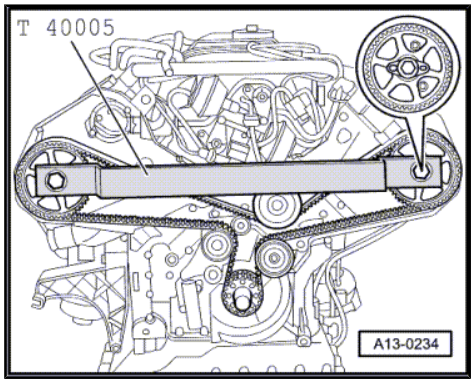
– Loosen bolt -arrow- for eccentric adjuster.



– Fit camshaft clamp -T40005- onto the locating plates of the two camshafts.
– Loosen the two camshaft sprocket bolts and unscrew approximately 5 turns.

Note

Use camshaft clamp -T40005- to prevent camshafts from turning.

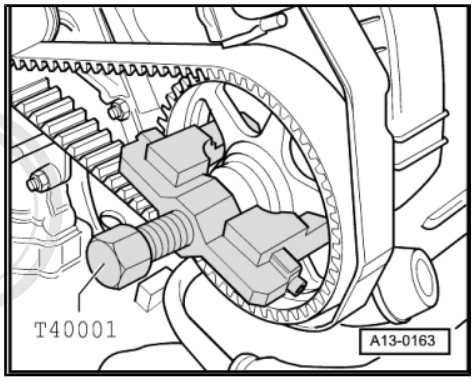


– Take off camshaft clamp -T40005- .

– Pull camshaft sprockets (left and right) off their tapers using two-arm puller -T40001- with claws -T40001/2- .
– Remove toothed belt.

Caution

Check sprockets for damage after pulling off. Renew camshaft sprockets if there are visible indentations.



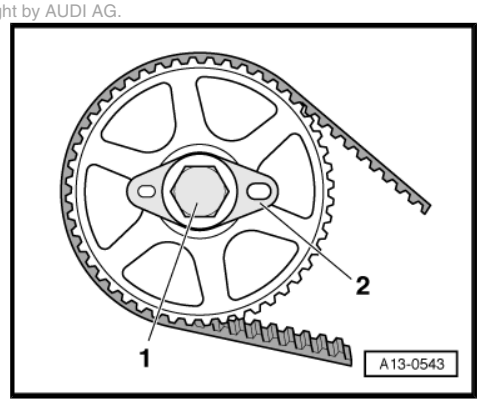
Installing (adjusting valve timing)

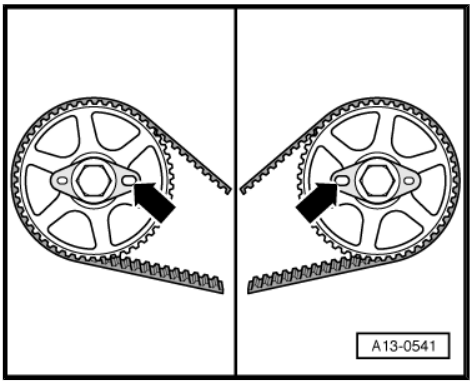
Note

When turning the camshaft, the crankshaft must not be at TDC. Otherwise, there is a risk of damage to valves and piston crowns.

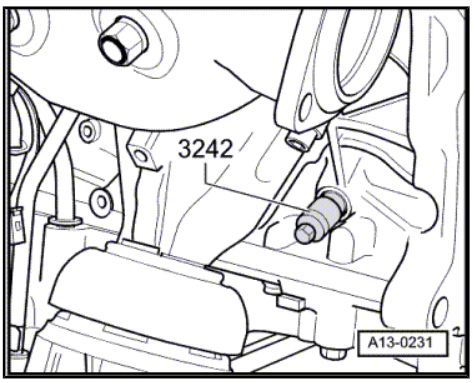
– Renew bolts -1- for camshaft sprockets and locating plates -2-.
– Oil threads and contact surface of camshaft sprocket bolt heads.
– Screw down the bolts such that the camshaft sprockets can still just be turned and do not tilt.
– Make sure the locating plates are seated correctly on the camshafts.

Before fitting the toothed belt, make sure the crankshaft and camshafts are set to cylinder 5 TDC:

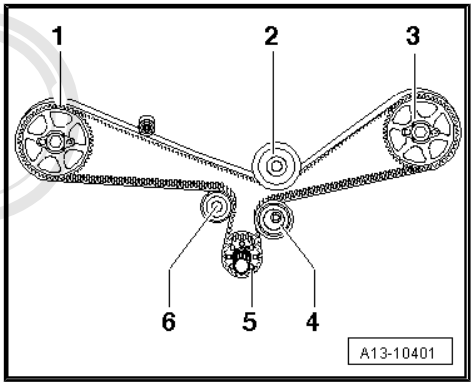




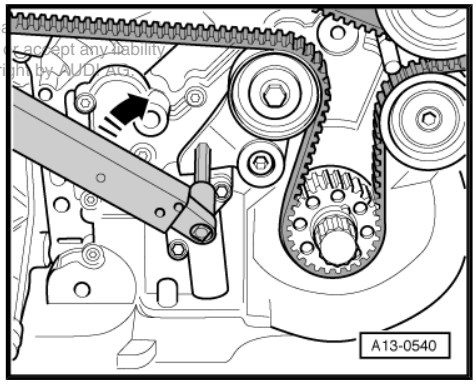
- The large holes -arrows- in the locating plates on the camshaft sprockets must be opposite one another on the inside.
- The locking pin -3242- must be screwed in.



– Initially fit toothed belt as follows: crankshaft sprocket -5-, eccentric adjuster -4-, tensioning roller -6-, camshaft sprocket (left-side) -3- and coolant pump -2-.
– Fit toothed belt on camshaft sprocket (right-side) -1- last.



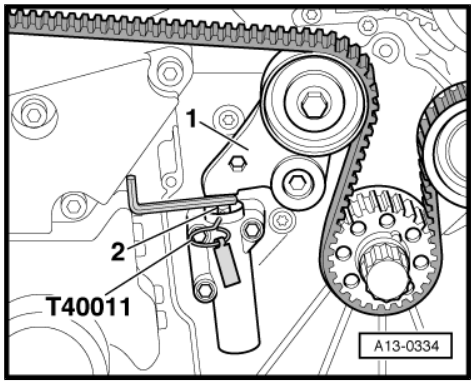
– Turn tensioning lever twice with a torque of 40 Nm in direction of -arrow- to pre-tension toothed belt.



Note

The components are Illustrated in this and the following diagram with the bracket for the torque reaction support removed.

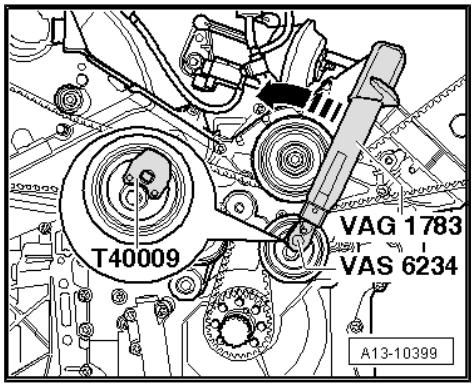
– Insert a 5 mm Allen key flat between tensioning lever -1- and piston -2- of tensioner.



– Tension toothed belt. To do so, turn eccentric adjuster with tensioner wrench -T40009- and torque wrench -V.A.G 1783- with ratchet insert 1/4" -VAS 6234- in direction of -arrow- and maintain tension.

♦ Pre-tensioning torque 6 Nm

– Tighten eccentric adjuster.



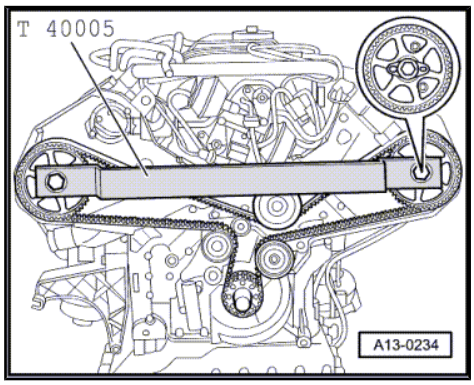
Note

Make sure the setting does not change while tightening.

– Insert camshaft clamp -T40005- in locating plates of both camshafts.

♦ Push in the camshaft clamp as far as it will go.

– Tighten bolts on camshaft sprockets.



Note

Use camshaft clamp -T40005- to prevent camshafts from turning.

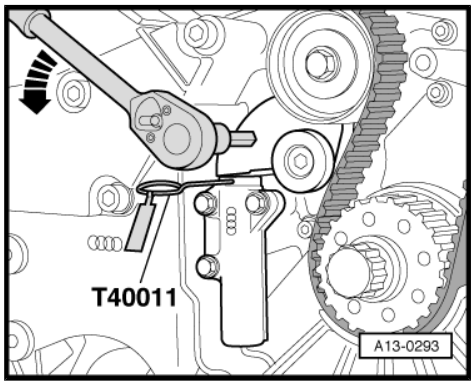
– Remove camshaft clamp -T40005- .

– Remove the 5 mm Allen key

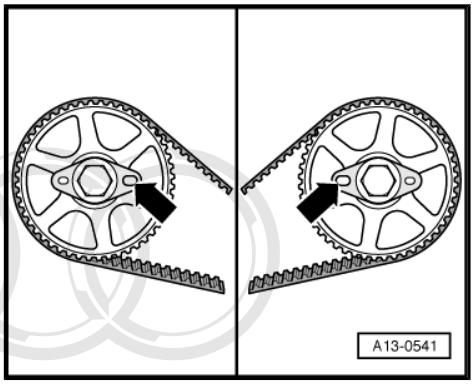
– Use 8 mm hexagon key to turn tensioning lever in direction of -arrow- until locking pin -T40011- can be pulled out.

– Remove locking pin -3242- .

– Turn crankshaft two rotations in normal direction of rotation until it is set to TDC of No. 5 cylinder again.

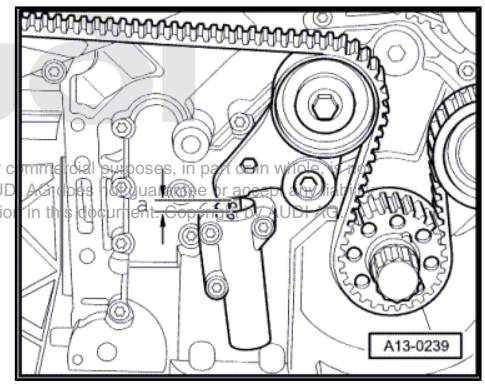


♦ The large holes -arrows- in the locating plates on the camshaft sprockets must be opposite one another on the inside.



– Check dimension -a- between tensioning lever and housing of tensioner.

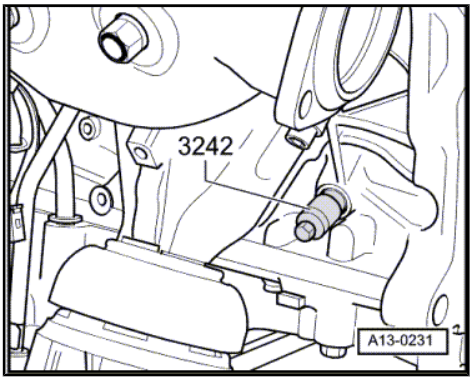
♦ Dimension -a- = 5.0 ± 1.0 mm.



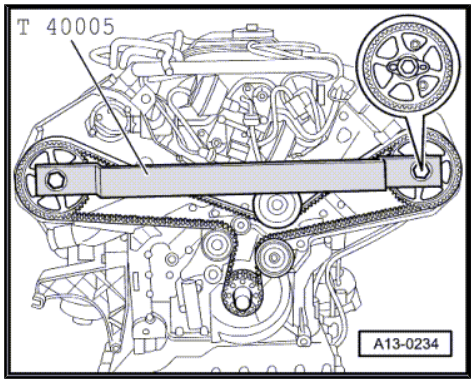
Note

If dimension -a- is not attained, repeat setting.

– To check the timing, screw locking pin -3242- back into hole in sump (top section).



– Check positions of camshafts with camshaft clamp -T40005- .



Note

If it is not possible to insert the camshaft clamp, repeat adjustment.

– Remove camshaft clamp -T40005- from both cylinder heads.
– Remove locking pin -3242- .
– Screw plug for TDC mark into sump (top section), using a new seal.

Perform further installation in reverse order, paying attention to the following:

Note

- *Renew gaskets, seals and O-rings.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

– Install poly V-belt ⇒ page 52 .
– Install lock carrier with attachments ⇒ Rep. Gr. 50 .
– Fill up with coolant ⇒ page 172 .
– Install torque reaction support ⇒ page 42 .

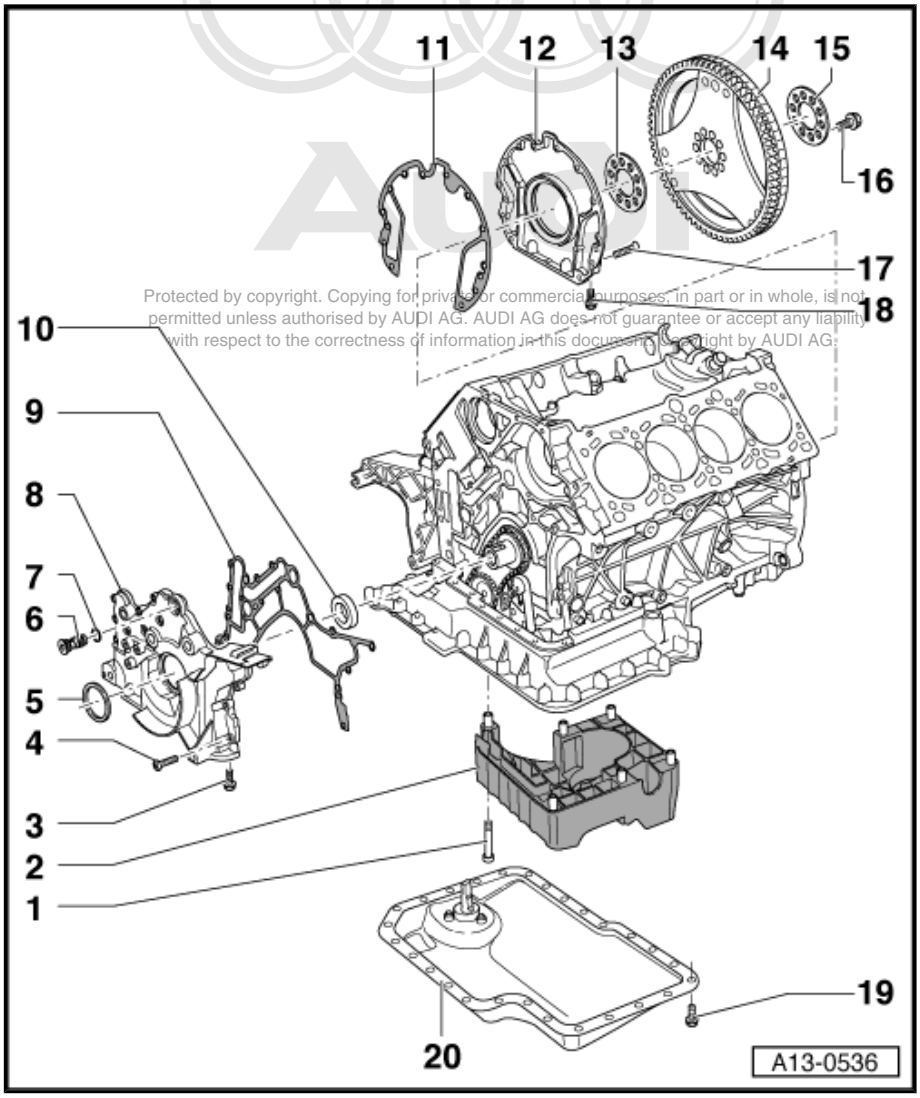
Note

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

Tightening torques

Component	Nm
Eccentric adjuster to cylinder block	45
Camshaft sprocket to camshaft	55
Screw plug in top section of sump	35
Vibration damper to crankshaft sprocket	22
Tensioning roller for poly V-belt	43

2 Sealing flanges and drive plate - exploded view



1 - 10 Nm

2 - Baffle plate

3 - 14 Nm

4 - 14 Nm

- ❑ Bolt strength rating 10.9

5 - Oil seal

- ❑ For crankshaft
- ❑ Removing and installing ⇒ page 70

6 - Spray nozzle valve, 35 Nm

7 - O-ring

- ❑ Renew

8 - Sealing flange (front)

- ❑ Removing and installing ⇒ page 72

9 - Gasket

- ❑ Renew

10 - Thrust washer

- ❑ If scored, detach and turn 180° or renew ⇒ page 70

11 - Gasket

- ❑ Renew

12 - Sealing flange (rear) with oil seal

- ❑ Removing and installing ⇒ page 79

13 - Shim

- ❑ 3.4 mm thick

14 - Drive plate

- ❑ Removing and installing ⇒ page 81

15 - Washer

- ❑ 1.5 mm thick

16 - 30 Nm + 90° (1/4 turn) further

17 - 10 Nm

18 - 14 Nm

19 - 10 Nm

- ❑ Tighten in stages and in diagonal sequence

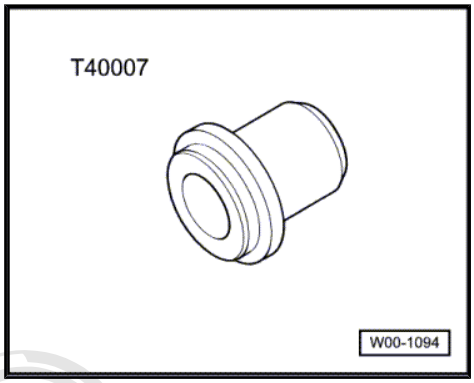
20 - Sump (bottom section)

- ❑ Removing and installing ⇒ page 144

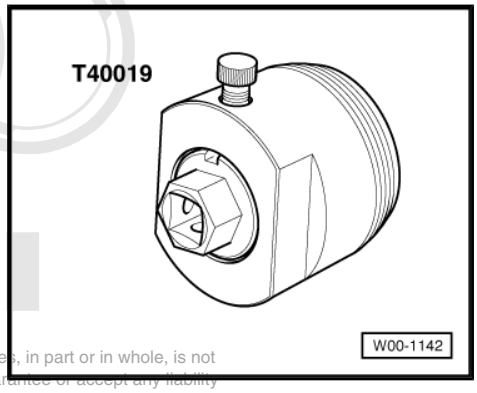
2.1 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

- Thrust piece -T40007-

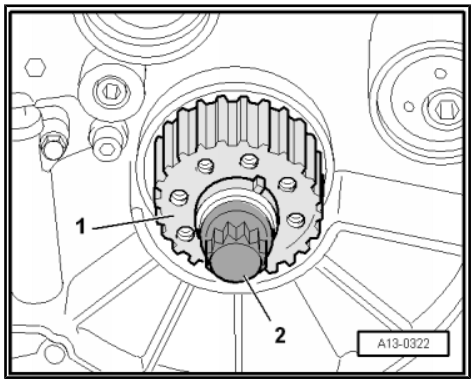


- Oil seal extractor -T40019-

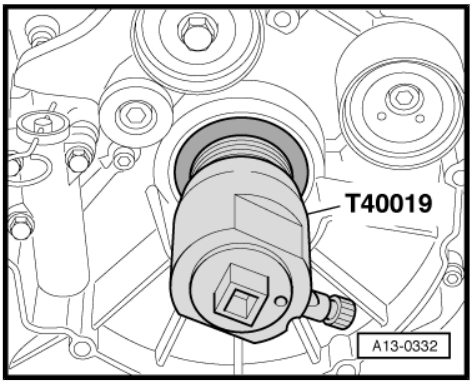


Removing

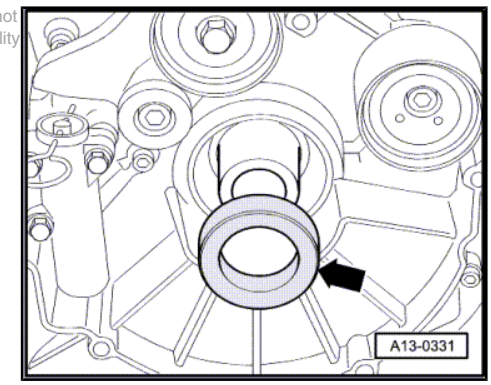
– Remove front bumper ⇒ Rep. Gr. 63 .
– Detach lock carrier ⇒ Rep. Gr. 50 .
– Remove toothed belt ⇒ page 60 .
– Unscrew central bolt -2- for crankshaft sprocket -1-.
– Detach toothed belt sprocket.
– Adjust inner part of oil seal extractor -T40019- so it is level with the outer part and lock in position 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 oil seal is pulled out.
– Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.

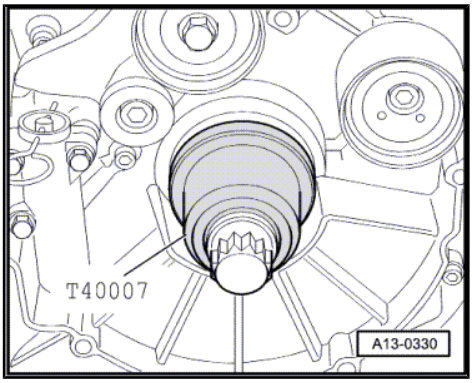


– Use waterproof felt-tip pen to mark outside surface of thrust washer -arrow-.
– Pull thrust washer off crankshaft.

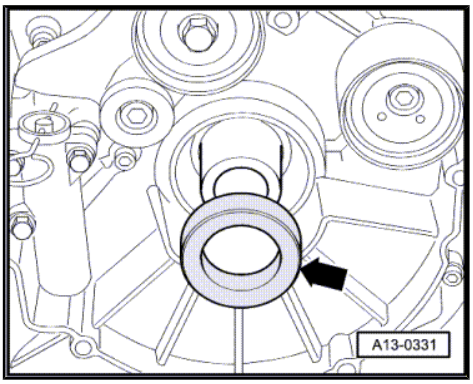


Installing

– Clean contact surface and sealing surface.
– Do not lubricate sealing lip and outer circumference of oil seal before pressing in.
– Press in oil seal using thrust piece -T40007- and central bolt.



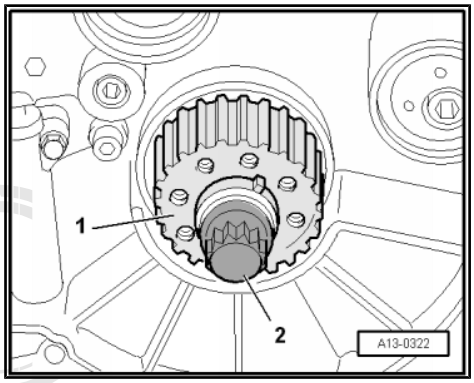
– Rotate thrust washer 180° and fit it onto crankshaft.



Note

- *The thrust washer is rotated so that the new oil seal runs on a new sealing track.*
- *The marked surface of the thrust washer must now be facing the engine.*

– Fit crankshaft sprocket -1- with new central bolt -2-.



Note

- *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- *Do not lubricate bolt for crankshaft sprocket.*

Perform further installation in reverse order, paying attention to the following:

– Install toothed belt (adjust valve timing) ⇒ page 60 .

– Install lock carrier with attachments ⇒ Rep. Gr. 50 .

– Install torque reaction support ⇒ page 42 .

Tightening torque

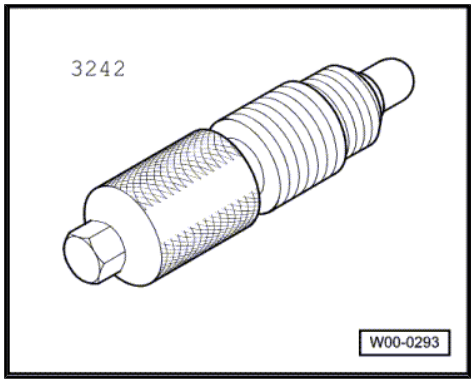
Component	Nm
Toothed belt sprocket to crankshaft	200 + 180° 1)2)

- 1) Renew bolt
- 2) 180° = one half turn.

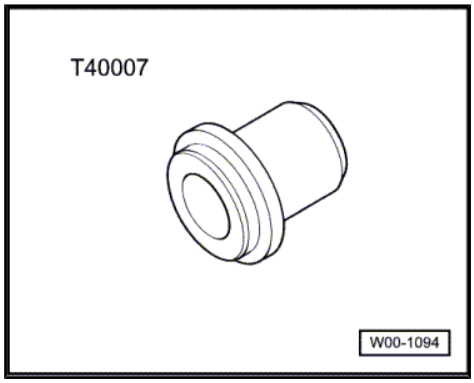
2.2 Removing and installing sealing flange (front)

Special tools and workshop equipment required

- Locking pin -3242-



- Thrust piece -T40007-



- Electric drill with plastic brush attachment
- Safety goggles
- Silicone sealant ⇒ Parts catalogue

Removing

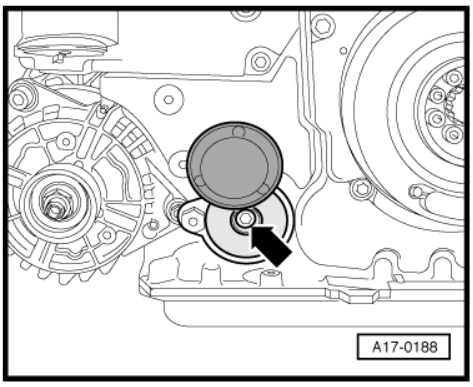
– Remove front bumper ⇒ Rep. Gr. 63 .

– Detach lock carrier ⇒ Rep. Gr. 50 .

– Remove poly V-belt ⇒ page 52 .

– Unscrew tensioning roller for poly V-belt -arrow-.

– Remove cover for bottom idler roller.

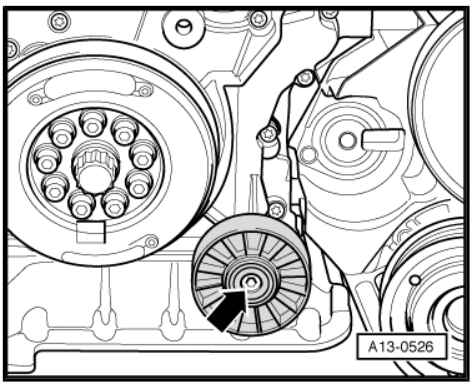


– Remove bottom idler roller for poly V-belt -arrow-.

– Remove toothed belt covers (top left and top right).

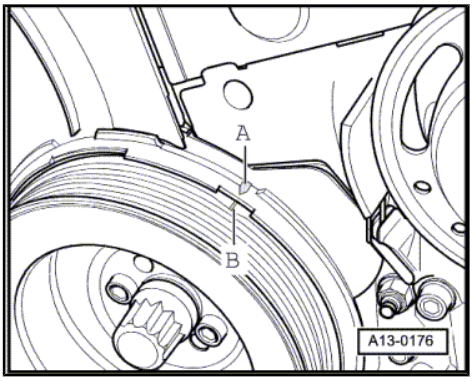
Caution

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).



– Set crankshaft to markings for TDC of No. 5 cylinder by turning central bolt on crankshaft sprocket in normal direction of rotation.

♦ Notch -B- is opposite mark -A-.



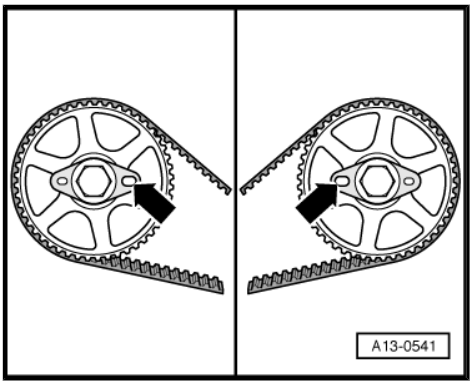
Note

Turn over the engine at the central bolt on the crankshaft.

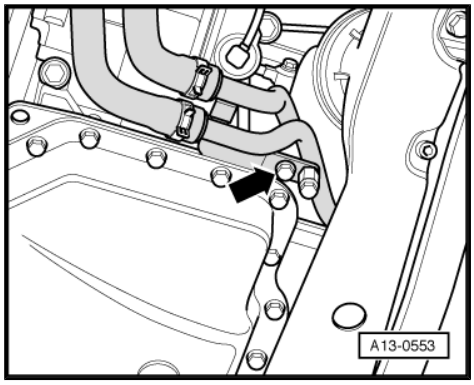
– Check position of camshafts:

♦ The large holes -arrows- in the locating plates on the camshaft sprockets must be opposite one another on the inside.

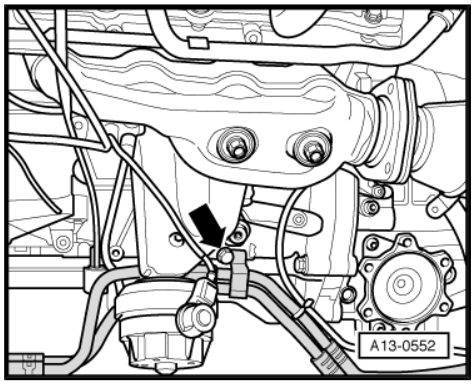
– If this is not the case, turn crankshaft one revolution further.



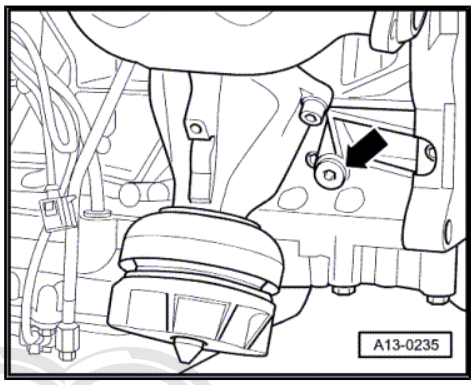
– Detach coolant pipe -arrow- from sump.



– Detach coolant pipe from cylinder block -arrow-.



– Unscrew plug -arrow- for TDC marking in sump (top section).



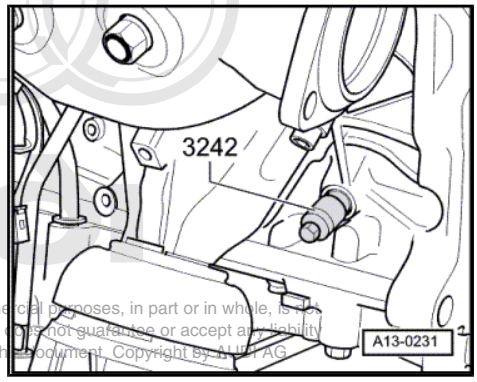
Note

There is a TDC drilling in the crankshaft directly behind the plug (it is possible to feel the hole).

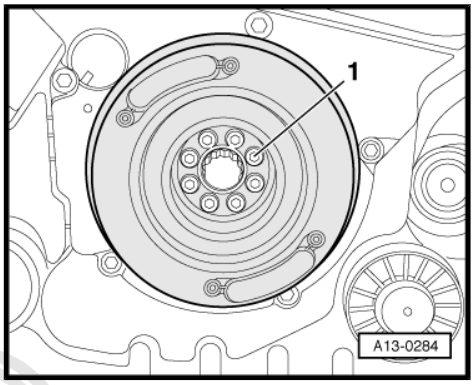
WARNING

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

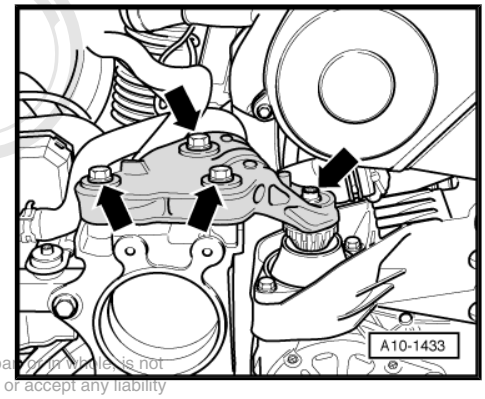
– Screw locking pin -3242- into threaded hole where plug has been removed.



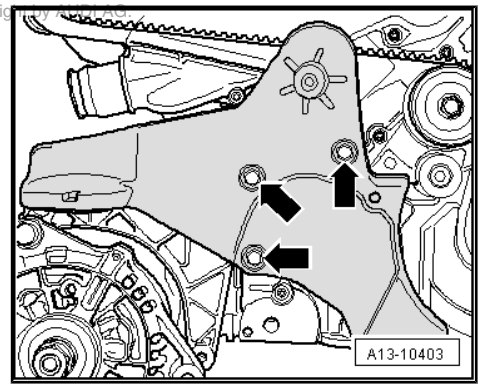
– Slacken 8 securing bolts -1- and remove vibration damper from crankshaft.
– Remove centre section of toothed belt cover.



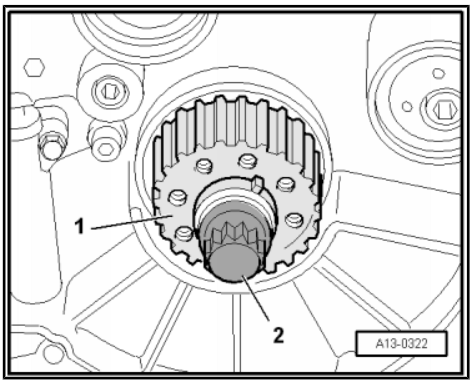
– Unscrew securing bolts -arrows- and remove torque reaction support.



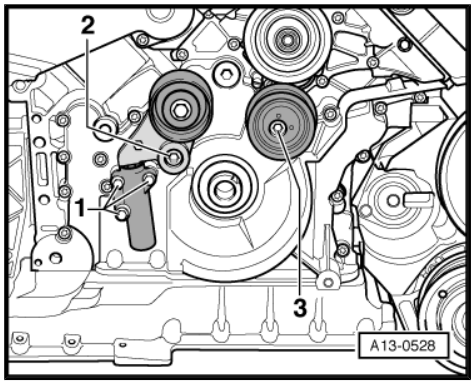
– Remove bracket for valve for torque reaction support -N382- -arrows-.
– Remove toothed belt ⇒ page 60 .



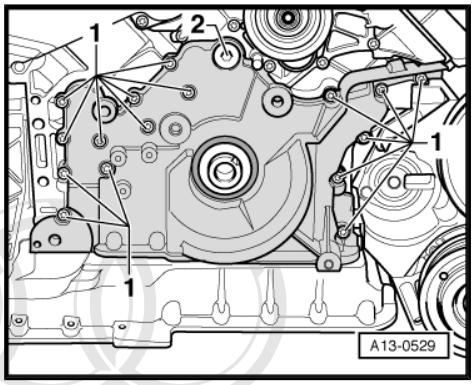
– Unscrew central bolt -2- for crankshaft sprocket -1-.
– Detach toothed belt sprocket.



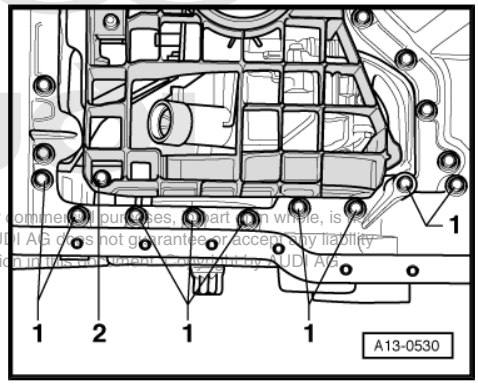
– Unbolt eccentric adjuster -3-, tensioning lever -2- with tensioning roller and tensioner -1-.



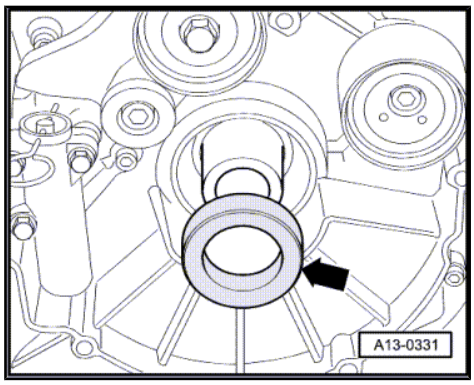
– Unscrew spray nozzle valve -2-.
– Remove bolts -1-.
– Remove sump (bottom section) ⇒ page 143 .



– Remove bolts -1- and -2-.
– Pull off sealing flange (front).
– Drive out oil seal with flange removed.



– Use waterproof felt-tip pen to mark outside surface of thrust washer -arrow-.
– Pull thrust washer off crankshaft.



Note

Diagram shows sealing flange fitted.

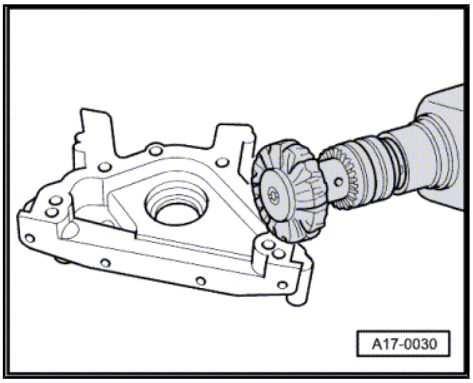
Installing

Note

Renew gaskets, seals and O-rings.

– Place a cloth over the exposed section of the sump.
– Carefully remove sealant residue from sump (top section).

– Remove sealant residue on sealing flange using rotating plastic brush or similar.

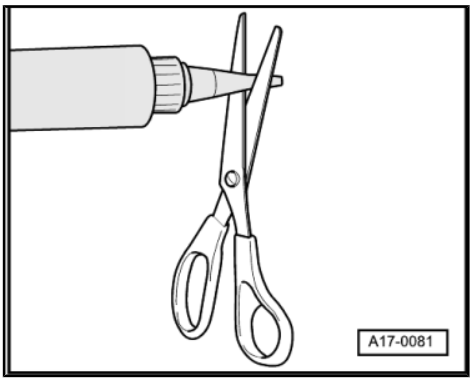


WARNING

Wear safety goggles.

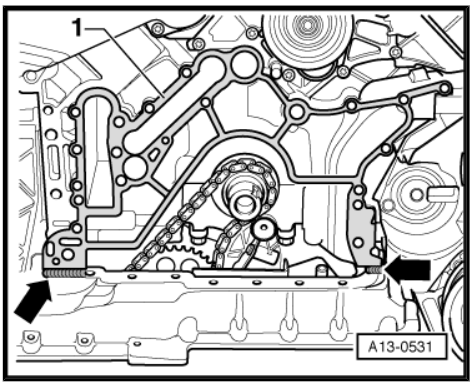
– Clean sealing surfaces; they must be free of oil and grease.

– Cut off nozzle of tube at front marking (∅ of nozzle approx. 1 mm).



– Fit new gasket -1- on cylinder block.

– Apply a thin bead of silicone sealant at the edge of the joint between the cylinder block and the sump (top section) -arrows-.

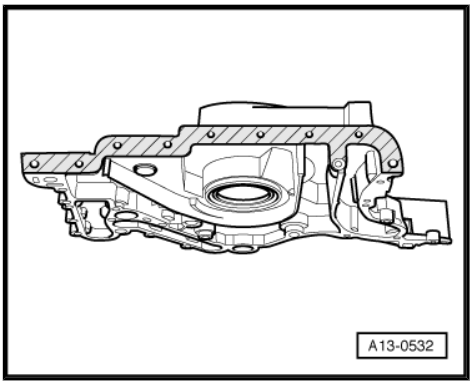


– Coat lower sealing surface on sealing flange lightly with silicone sealant (hatched area).

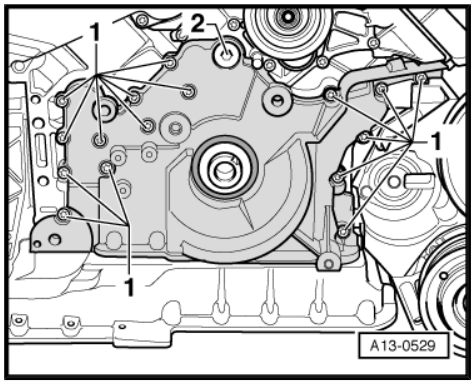
Note

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

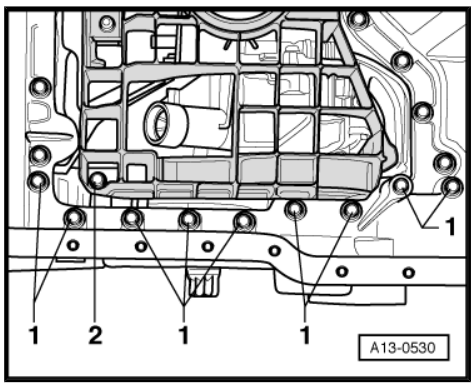
– Push the sealing flange carefully onto the dowel sleeves on the cylinder block.



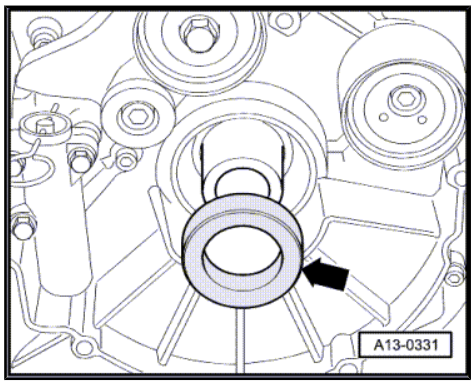
– Tighten bolts -1- and spray nozzle valve -2-.



– Tighten bolts -1- and -2-.
– Install sump (bottom section) ⇒ page 143 .
– Do not lubricate sealing lip and outer circumference of oil seal before pressing in.



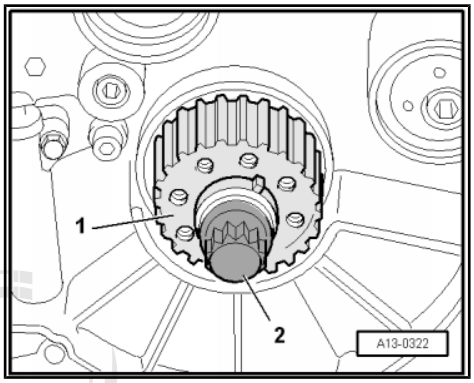
– Press in oil seal using thrust piece -T40007- and central bolt. Rotate thrust washer 180° and fit it onto crankshaft.



Note

- *The thrust washer is rotated so that the new oil seal runs on a new sealing track.*
- *The marked surface of the thrust washer must now be facing the engine.*

– Fit crankshaft sprocket -1- with new central bolt -2-.



Note

- *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- *Do not lubricate bolt for crankshaft sprocket.*
- *Pay attention to washer fitted behind tensioning lever.*

Perform further installation in reverse order, paying attention to the following:

Note

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

– Install toothed belt (adjust valve timing) ⇒ page 60 .
– Install lock carrier with attachments ⇒ Rep. Gr. 50 .
– Install torque reaction support ⇒ page 42 .

Tightening torques

Component	Nm
Front sealing flange to cylinder block	14 1)
Spray nozzle valve to cylinder block	35
Sealing flange (front) to sump (top section)	14
Baffle plate to front sealing flange	10
Tensioner to sealing flange (front)	10
Tensioning lever to sealing flange (front)	20 + 90° 1) 2)
Eccentric adjuster to front sealing flange	45
Toothed belt sprocket to crankshaft	200 + 180° 1)3)
Bracket for torque reaction support to cylinder block	43
Top idler roller for poly V-belt to bracket for torque reaction support	10
Bottom idler roller for poly V-belt to front sealing flange	23
Poly V-belt tensioning roller to sump (top section)	43

- 1) Renew bolt
- 2) 90° = one quarter turn.
- 3) 180° = one half turn.

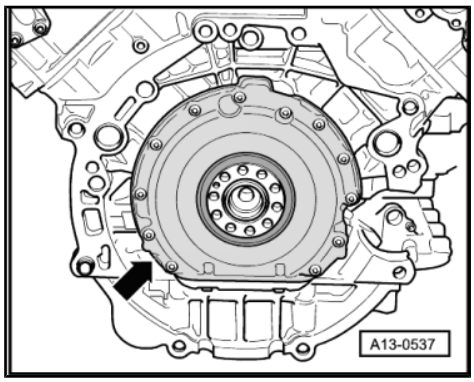
2.3 Removing and installing sealing flange (rear)

Special tools and workshop equipment required

- Electric drill with plastic brush attachment
- Safety goggles
- Silicone sealant ⇒ Parts catalogue

Removing

– Remove engine ⇒ page 7 .
– Separate engine from gearbox ⇒ page 23 .
– Remove drive plate ⇒ page 81 .
– Unbolt rear sealing flange -arrow-.



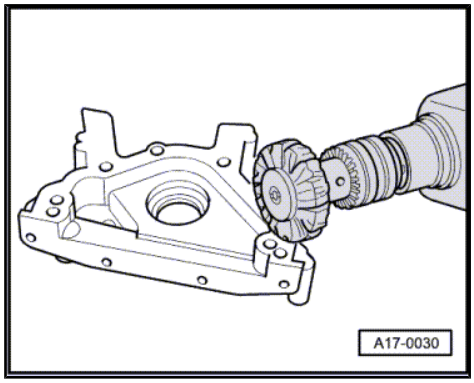
Installing

Note

Renew seals and gaskets.

– Place a cloth over the exposed section of the sump.
– Carefully remove sealant residue from sump (top section).

– Remove sealant residue on sealing flange using rotating plastic brush or similar.

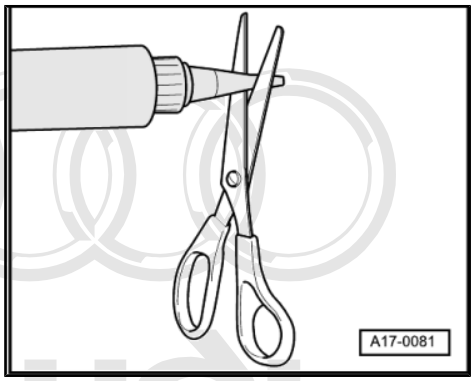


WARNING

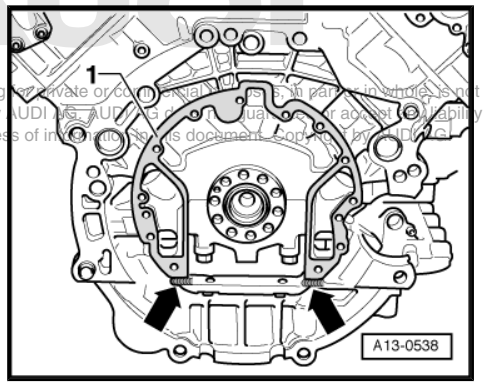
Wear safety goggles.

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

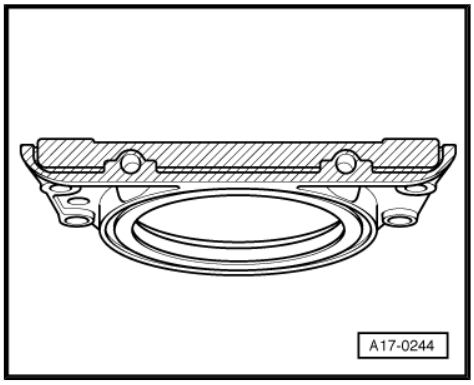
– Cut off nozzle of tube at front marking (∅ of nozzle approx. 1 mm).



– Fit new gasket -1- on cylinder block.
– Apply a thin bead of silicone sealant at the edge of the joint between the cylinder block and the sump (top section) -arrows-.



– Coat lower sealing surface on sealing flange lightly with silicone sealant (hatched area).



Note

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

– To install, push guide sleeve from assembly kit onto crankshaft.
– Push the sealing flange carefully onto the dowel sleeves on the cylinder block.
– Secure rear sealing flange.
– Install drive plate ⇒ page 81 .
– Install engine ⇒ page 31 .

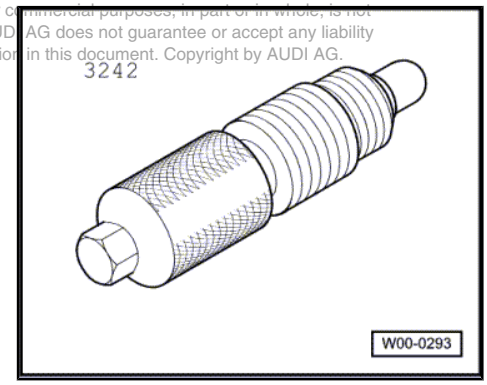
Tightening torques

Component		Nm
Rear sealing flange to:	Cylinder block	10
	Sump (top section)	14

2.4 Removing and installing drive plate

Special tools and workshop equipment required

♦ Locking pin -3242-



Removing

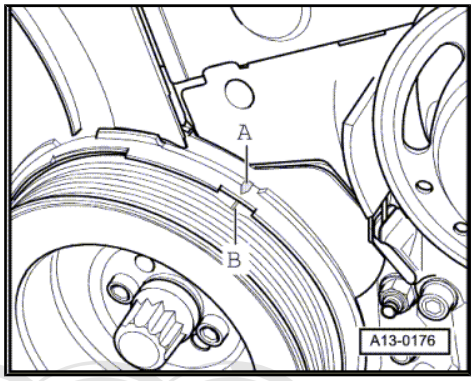
• Engine removed ⇒ page 7 .
• Engine separated from gearbox ⇒ page 23 .

WARNING

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).

– Set crankshaft to markings for TDC of No. 5 cylinder by turning central bolt on crankshaft sprocket in direction of rotation.

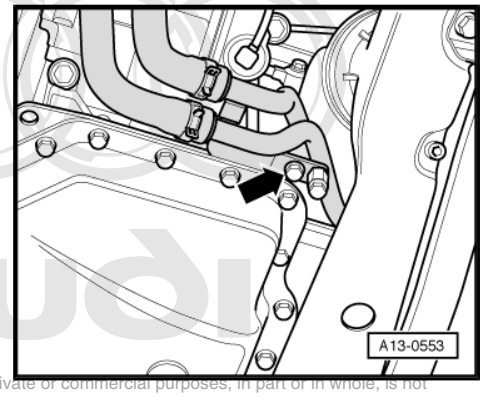
♦ Notch -B- is opposite mark -A-.



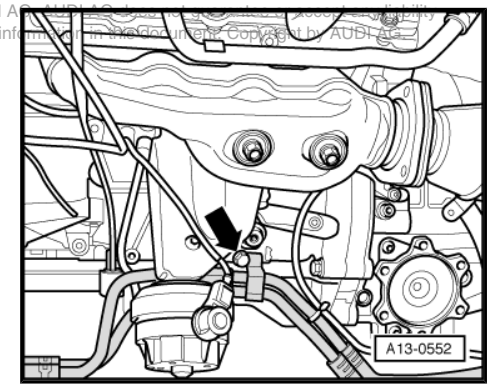
Note

Turn over the engine at the central bolt on the crankshaft.

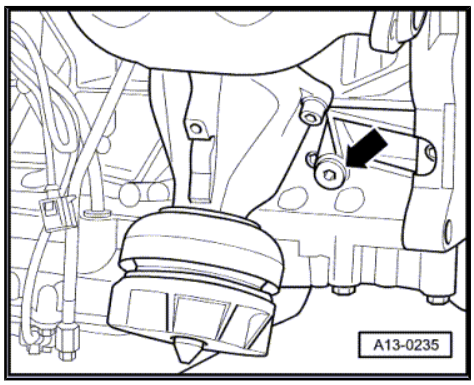
– Detach coolant pipe -arrow- from sump.



– Detach coolant pipe from cylinder block -arrow-.



– Unscrew plug -arrow- for TDC marking in sump (top section).



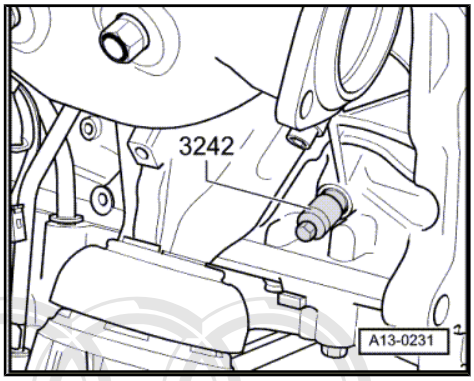
Note

There is a TDC drilling in the crankshaft directly behind the plug (it is possible to feel the hole).

WARNING

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

– Screw locking pin -3242- into threaded hole where plug has been removed.



– Mark position of drive plate, shim -1- and packing plate -2- relative to engine.

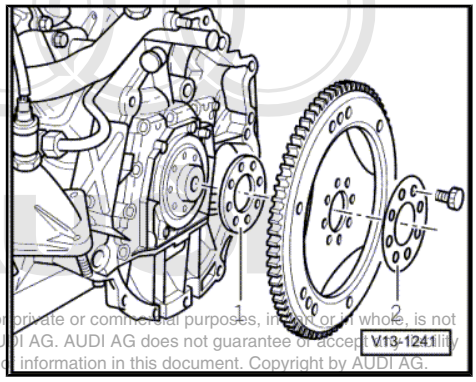
– Unbolt drive plate.

Installing

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

Note

Renew seals.



– Fit drive plate together with the following:

1 - Shim: thickness 3.4 mm

2 - Washer: thickness 1.50 mm

– Renew and tighten bolts.

Tightening torques

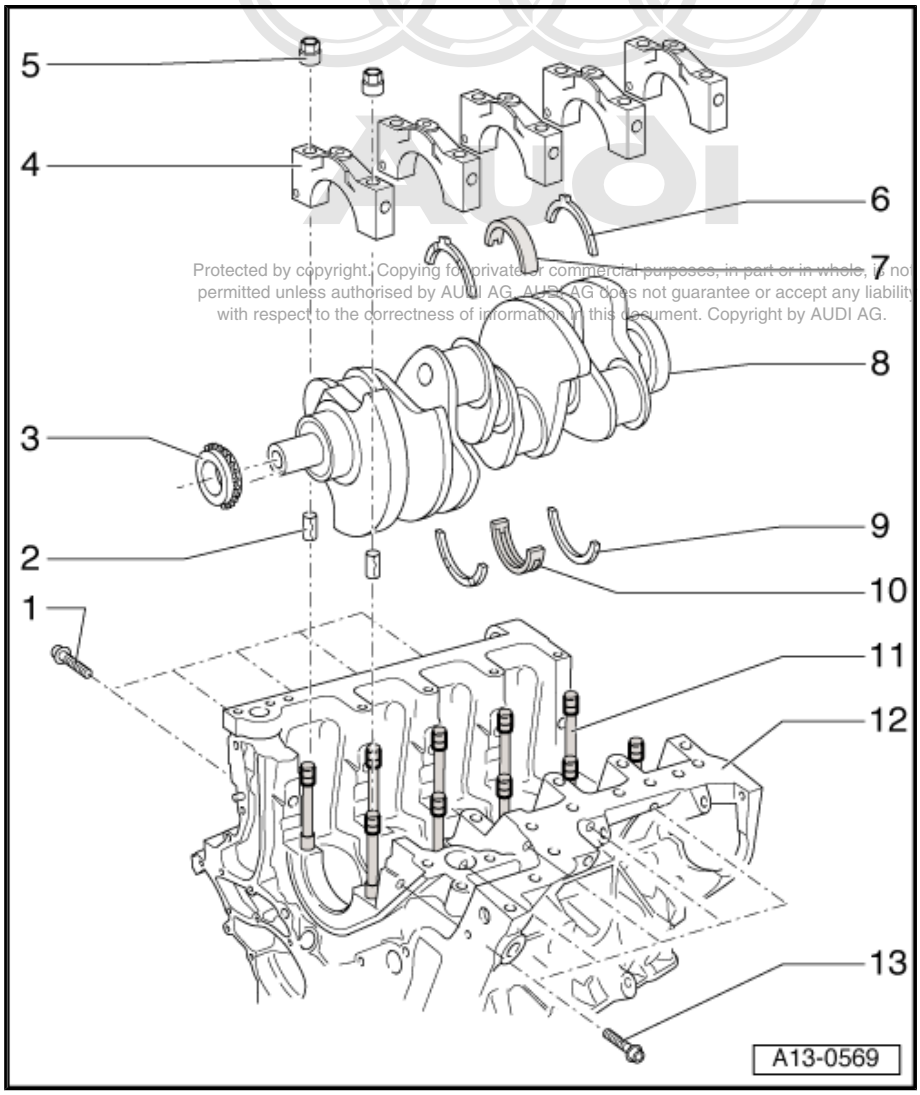
Component	Nm
Drive plate to crankshaft	30 + 90° 1)2)
Screw plug in top section of sump	35

- 1) Renew bolt
- 2) 90° = one quarter turn.

3 Crankshaft - exploded view

Note

Secure engine to repair stand using engine and gearbox support -VAS 6095- when dismantling/assembling engine ⇒ page 30 .



1 - Bolt, 22 Nm
- ❑ For bearing cap
- ❑ Renew
- ❑ Tightening sequence ⇒ page 86

2 - Dowel sleeve
- ❑ Insert in cylinder block

3 - Drive chain sprocket for oil pump
- ❑ Removing and installing ⇒ page 88

4 - Bearing cap
- ❑ Note marking ⇒ page 85
- ❑ Removing ⇒ page 85
- ❑ Installing ⇒ page 86

5 - Nut, 35 Nm + turn 90° further
- ❑ For bearing cap
- ❑ Renew
- ❑ Tightening sequence ⇒ page 86

6 - Thrust washer
- ❑ Only fitted on 3rd crankshaft bearing
- ❑ Oil grooves face outwards
- ❑ Note location
- ❑ Measuring axial clearance of crankshaft ⇒ page 87

7 - Bearing shell
- ❑ For bearing cap (without oil groove)
- ❑ Do not interchange used bearing shells (mark positions)
- ❑ Install new bearing shells for the cylinder block with the correct coloured markings ⇒ page 86

8 - Crankshaft
- ❑ Measuring axial clearance ⇒ page 87
- ❑ Measuring radial clearance ⇒ page 87
- ❑ Do not rotate the crankshaft when checking the radial clearance
- ❑ Crankshaft dimensions ⇒ page 87

9 - Thrust washer
- ❑ Only fitted on 3rd crankshaft bearing
- ❑ Oil grooves face outwards

- ❑ Measuring axial clearance of crankshaft ⇒ page 87

10 - Bearing shell

- ❑ For cylinder block (with oil groove)
- ❑ Do not interchange used bearing shells (mark positions)
- ❑ Install new bearing shells for the cylinder block with the correct coloured markings ⇒ page 86

11 - Stud

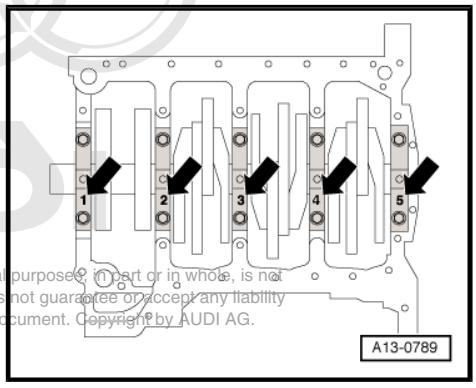
12 - Cylinder block

13 - Bolt, 22 Nm

- ❑ For bearing cap
- ❑ Renew
- ❑ Tightening sequence ⇒ page 86

Markings on crankshaft bearing caps

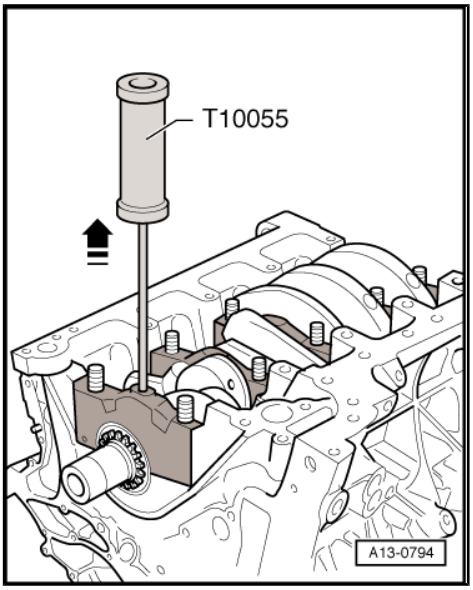
♦ Bearing 1 is on pulley end.



Removing crankshaft bearing caps

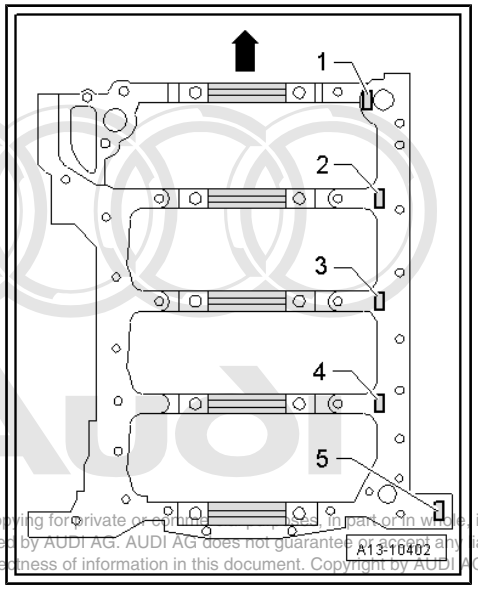
– Remove bolts and nuts for crankshaft bearing caps.

– Pull crankshaft bearing caps off cylinder block using puller - T10055- .



Matching crankshaft bearing shells to bearings in cylinder block

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



Note

The -arrow- points to pulley end.

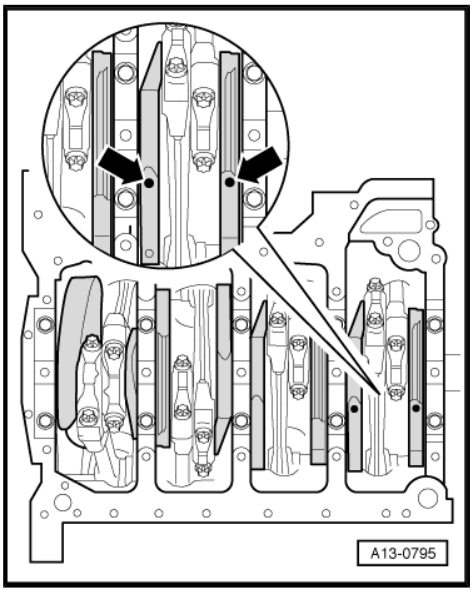
The allocation of the bearing shells to the cylinder block is identified by a code letter next to the relevant bearing.

Letter on cylinder block	Colour coding of bearing
G	Yellow
B	Blue
R	Red

Matching crankshaft bearing shells to bearing caps

Bearing shells of the correct thickness are assigned to the bearing caps at the factory. Coloured dots on bearing shell are used to identify bearing shell thickness -arrows-.

The correct allocation of bearing shells to crankshaft is indicated by coloured dots on the crank webs.



Installing crankshaft bearing caps

– Renew bolts -A- and nuts -1 ... 10-
– Insert dowel sleeves in cylinder block.
– Tighten bearing cap nuts and bolts in following sequence:

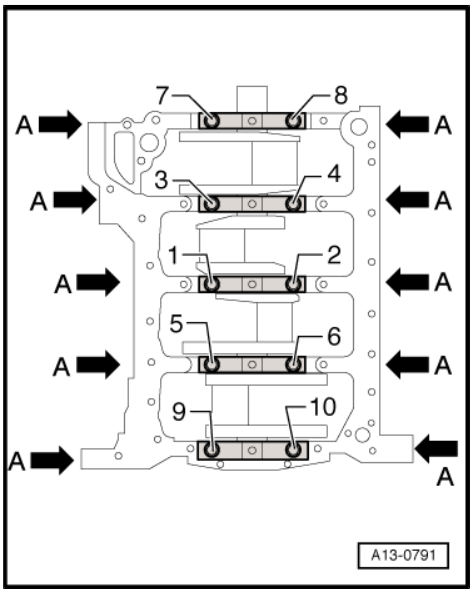
1 - Screw in bolts -A- finger-tight.

2 - Tighten nuts -1 ... 10- to 35 Nm.

3 - Turn nuts -1 ... 10- 90° ($^1/_4$ turn) further using a fixed wrench.

4 - Tighten bolts -A- to 22 Nm.

5 - Turn bolts -A- 90° ($^1/_4$ turn) further using a fixed wrench.



3.1 Crankshaft dimensions

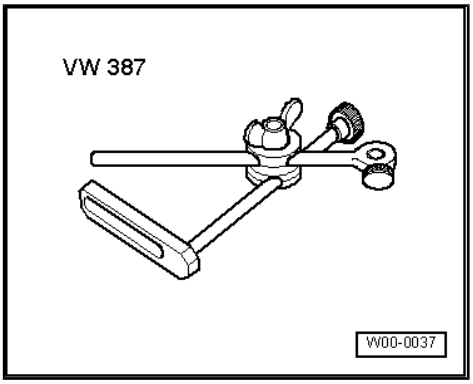
(in mm)

Honing dimension (in mm)	Crankshaft main bearing journal ∅	Conrod journal ∅
Basic dimension	-0.022 65.000 -0.042	-0.022 54.000 -0.042
1st undersize	-0.022 64.750 -0.042	-0.022 53.750 -0.042
2nd undersize	-0.022 64.500 -0.042	-0.022 53.500 -0.042
3rd undersize	-0.022 64.250 -0.042	-0.022 53.250 -0.042

3.2 Measuring axial clearance

Special tools and workshop equipment required

- Universal dial gauge bracket -VW 387-



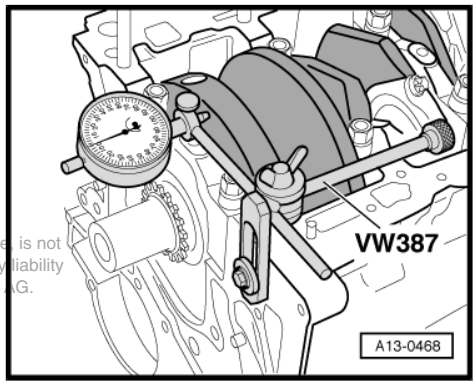
- Dial gauge

– Bolt dial gauge with universal dial gauge bracket -VW 387- onto cylinder block and apply gauge against crank web.

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

– Press crankshaft away from dial gauge.

– Take reading:



Clearance when new	Wear limit
0.07 ... 0.23 mm	0.25 mm

3.3 Measuring radial clearance

Special tools and workshop equipment required

- Plastigage

Note

- *Do not interchange used bearings.*
- *Bearing shells worn down to nickel layer must be renewed*

– Remove main 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 bearing shell.

- The Plastigage must be positioned in the centre of the bearing shell

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

– Remove main bearing cap again.

– Compare width of Plastigage with measurement scale.

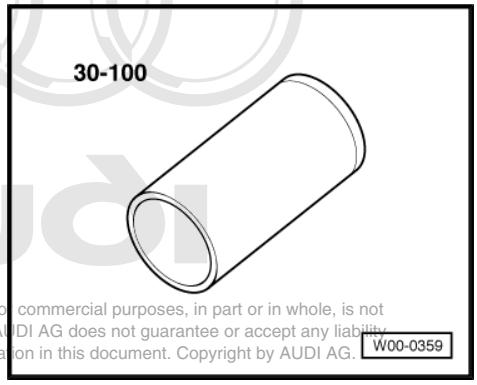
– Take reading:

Clearance when new	Wear limit
0.018 ... 0.045 mm	0.08 mm

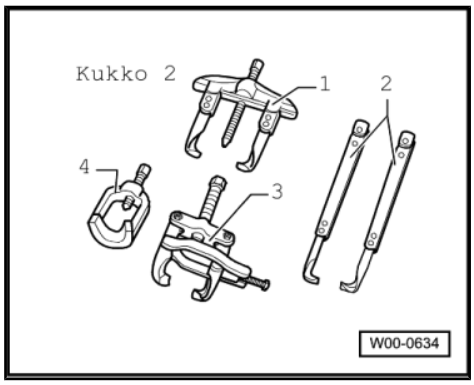
3.4 Removing and installing drive chain sprocket for oil pump

Special tools and workshop equipment required

- Drift sleeve -30 - 100-



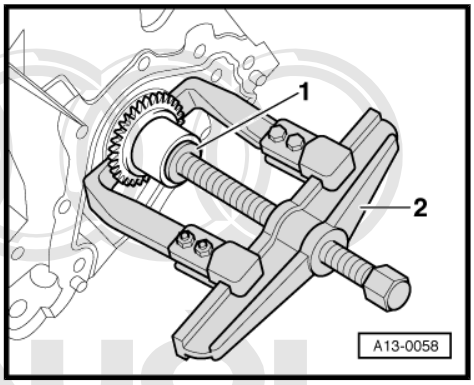
- 1 Two-arm puller -Kukko 20/10-



Removing

– Remove sealing flange (front) ⇒ page 72 .

– Pull chain sprocket off crankshaft with a puller -2- (normal commercial type); use a suitable washer -1- to protect end of crankshaft.



Installing

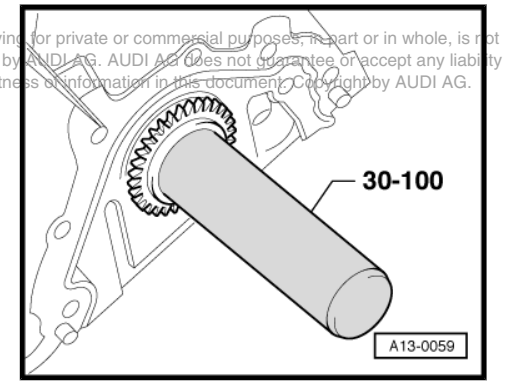
Installation is carried out in the reverse order; note the following:

– Heat chain sprocket in oven for approx. 15 minutes to 220°C.

WARNING

Wear protective gloves.

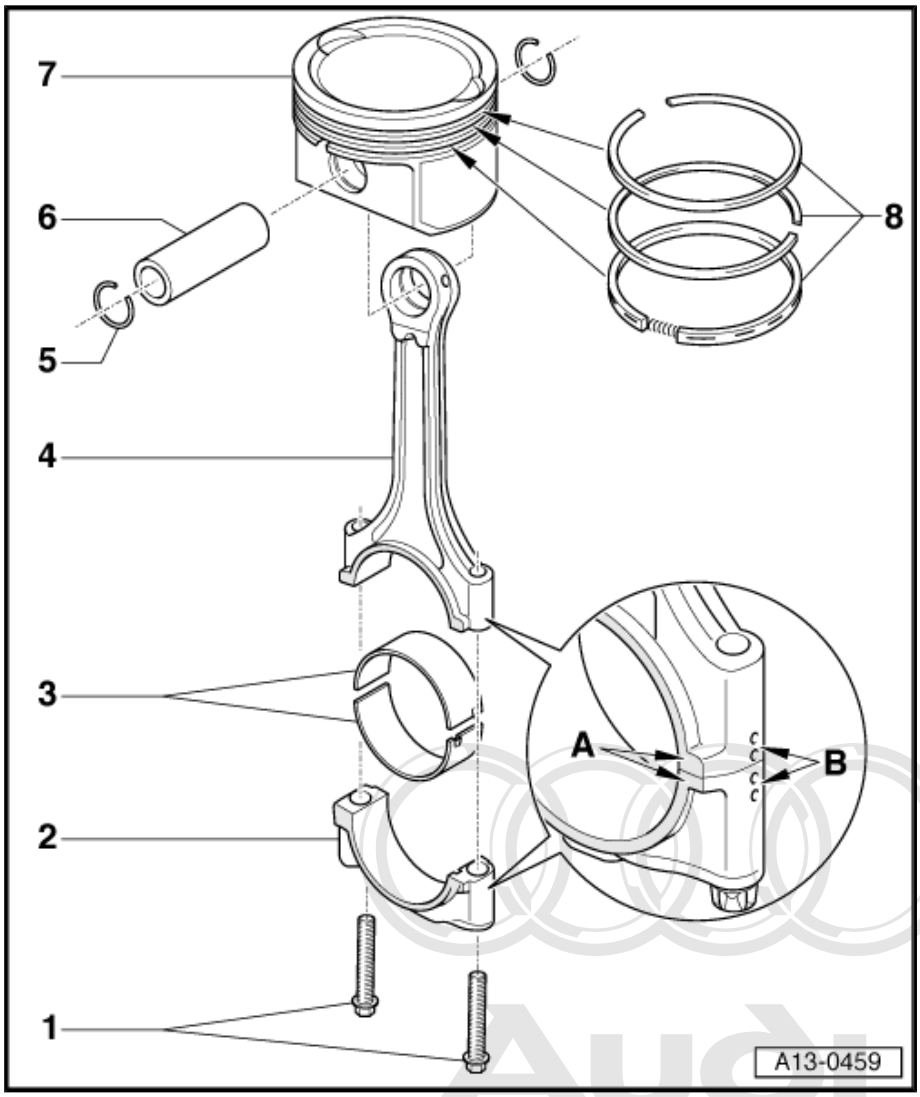
– Fit chain sprocket on end of crankshaft using pliers, and press onto crankshaft as far as the stop using drift sleeve -30 - 100- .



4 Pistons and conrods - exploded view

Note

Oil spray jet for piston cooling ⇒ page 93 .



1 - Conrod bolt, 30 Nm + 90° (1/4 turn) further

- ❑ Renew
- ❑ Lubricate threads and contact surface
- ❑ To measure radial clearance, tighten to 30 Nm but do not turn further

2 - Conrod bearing cap

- ❑ Do not interchange
- ❑ Mark cylinder allocation with a coloured pen -B- ⇒ page 92
- ❑ When installing the bearing cap, the projections on the side of the conrod must be on the same side -A-
- ❑ Installation position of conrod pairs ⇒ page 93

3 - Bearing shell

- ❑ Note installation position
- ❑ Do not interchange used bearing shells (mark positions)
- ❑ Measuring radial clearance ⇒ page 93
- ❑ To measure radial clearance, tighten bolts ⇒ Item 1 (page 90) to 30 Nm but do not turn further

4 - Conrod

- ❑ Only renew as a complete set
- ❑ Mark cylinder allocation with a coloured pen -B- ⇒ page 92
- ❑ When installing the bearing cap, the projections on the side of the conrod must be on the same side -A-
- ❑ Installation position of conrod pairs ⇒ page 93

5 - Circlip

6 - Piston pin

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

7 - Piston

- ❑ Installation position and allocation of piston/cylinder ⇒ page 92
- ❑ Arrow on piston crown points to pulley end

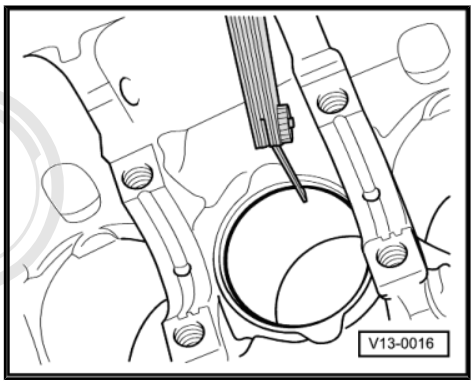
- ❑ Checking ⇒ page 91
- ❑ Install using piston ring clamp
- ❑ Piston and cylinder dimensions ⇒ page 93
- ❑ Checking cylinder bore ⇒ page 92

8 - Piston rings

- ❑ Offset gaps by 120°
- ❑ Use piston ring pliers to remove and install
- ❑ “TOP” marking or lettering must face towards piston crown
- ❑ Checking ring gap ⇒ page 91
- ❑ Checking ring-to-groove clearance ⇒ page 91

Checking piston ring gap

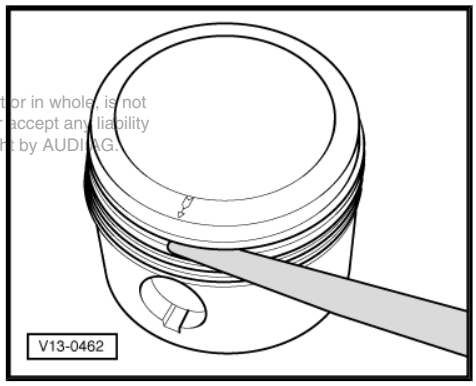
– Insert ring at right angle to cylinder wall from above and push down into lower cylinder opening approx. 15 mm from bottom of cylinder. Use a piston without rings to push ring into bore.



Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.15…0.35	0.8
2nd compression ring	0.20…0.40	0.8
Oil scraper ring	0.20…0.40	0.8

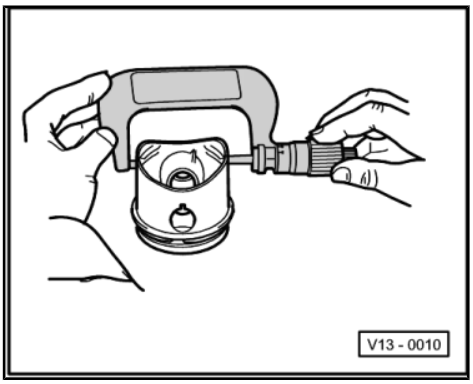
Checking ring-to-groove clearance

– Clean groove in piston before checking clearance.



Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.040…0.070	0.20
2nd compression ring	0.010…0.045	0.15
Oil scraper ring	0.012…0.032	0.15

Checking piston



Special tools and workshop equipment required

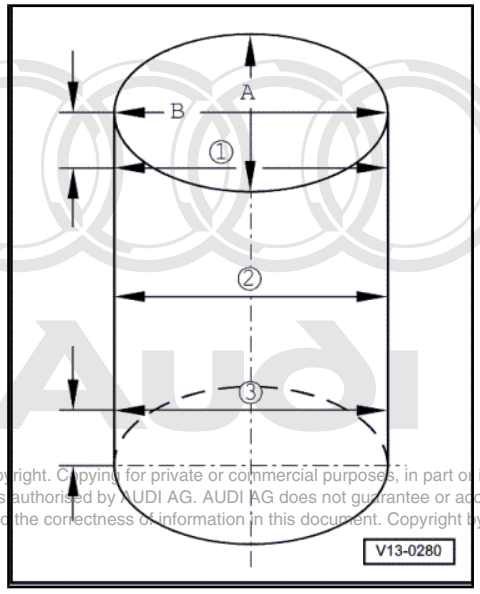
♦ Micrometer 75..100 mm

– Measure approx. 10 mm from the bottom edge, perpendicular to the piston pin axis.

♦ Difference between actual and nominal diameter: not more than 0.04 mm.

Nominal dimension ⇒ page 93 ; Piston and cylinder dimensions

Checking cylinder bore



Special tools and workshop equipment required

- ♦ Cylinder gauge 50..100 mm

– Take measurements at 3 positions in both lateral direction -A- and longitudinal direction -B-.

- ♦ Difference between actual and nominal diameter: not more than 0.08 mm.

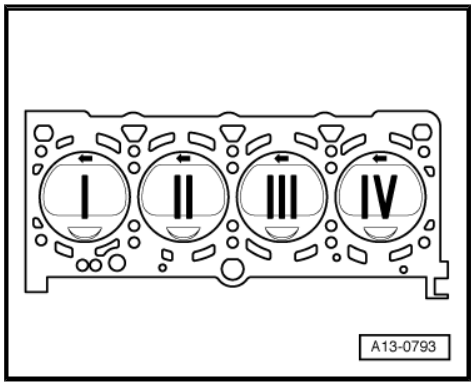
Nominal dimension ⇒ page 93 ; Piston and cylinder dimensions

Piston installation position and piston/cylinder allocation

– Use chalk or waterproof felt-tip pen to mark installation position and cylinder allocation on piston crown.

Note

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



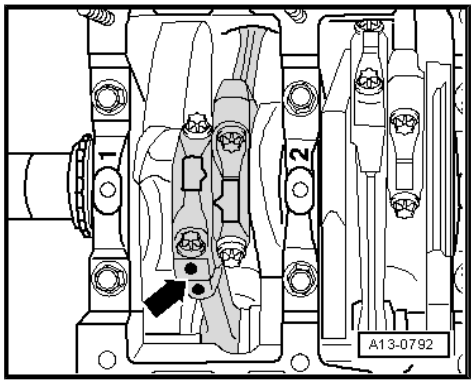
- ♦ Installation position: Arrow on piston crown points to pulley end

Marking conrods

Note

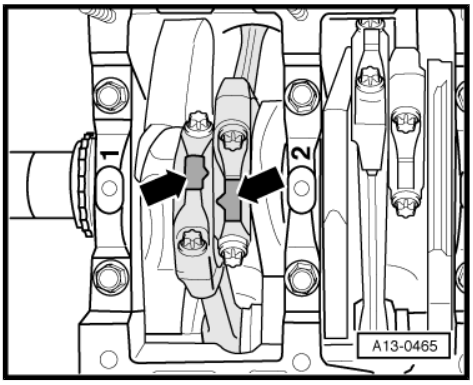
- ♦ *Only renew conrods as a complete set.*
- ♦ *Do not interchange conrod bearings.*

– Prior to removal, use a coloured pen to mark conrod and conrod bearing cap relative to one another, as well as to cylinder -arrow-.



Conrod installation position

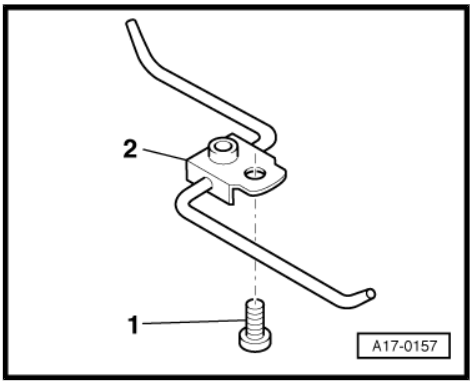
- The cast lugs -arrows- on the ground surfaces of the conrod pairs 1 and 2, 3 and 4, and 5 and 6 must face one another.



Oil spray jet for piston cooling

1 - Bolt, 10 Nm

2 - Oil spray jet for piston cooling



4.1 Piston and cylinder dimensions

Honing dimension		Piston ∅	Cylinder bore ∅
Basic dimension	mm	84.490 1)	84.510
Repair oversize	mm	84.590 1)	84.610

- 1) Dimensions not including graphite coating (thickness 0.02 mm). The graphite coating will wear down in service.

4.2 Checking radial clearance of conrod bearings

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 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 calibrated scale.

Clearance when new	Wear limit
0.015 ... 0.062 mm	0.12 mm

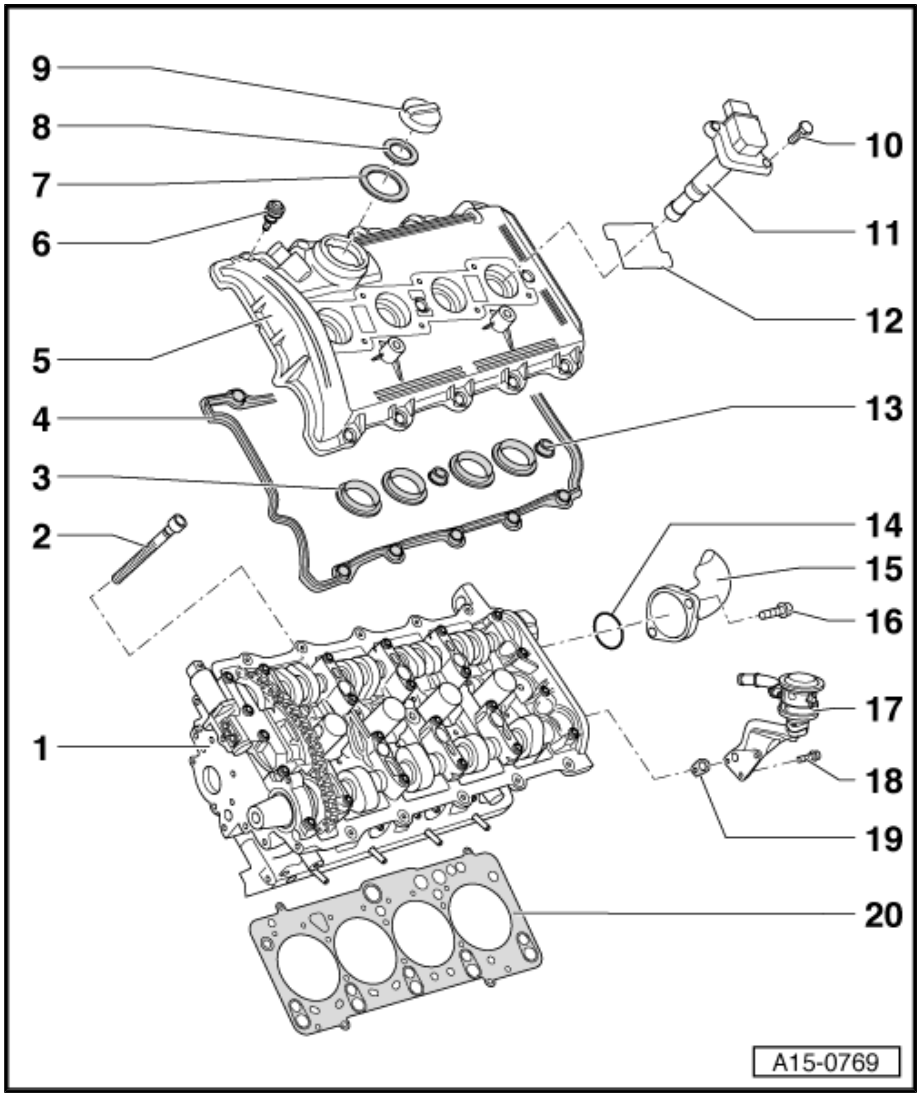
– Renew conrod bearing bolts.

15 – Cylinder head, valve gear

1 Cylinder head - exploded view

Note

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



1 - Cylinder head

- ❑ Removing cylinder head (left-side) ⇒ page 99
- ❑ Removing cylinder head (right-side) ⇒ page 102
- ❑ Checking for distortion ⇒ page 95
- ❑ Machining is not permitted
- ❑ Installing ⇒ page 105
- ❑ If renewed, refill system with fresh coolant

2 - Cylinder head bolt

- ❑ Renew
- ❑ Note correct sequence when slackening:

◆ Cylinder head (left-side) ⇒ page 102

◆ Cylinder head (right-side) ⇒ page 105

- ❑ Note correct sequence when tightening ⇒ page 108

3 - Seals for cylinder head cover and ignition coils

- ❑ Renew if damaged or leaking

4 - Gasket for cylinder head cover

- ❑ Renew if damaged or leaking
- ❑ Before fitting, apply sealant at sealing points ⇒ page 96
- ❑ Sealant ⇒ Parts catalogue

5 - Cylinder head cover

- ❑ Removing and installing cylinder head cover (left-side) ⇒ page 96
- ❑ Removing and installing cylinder head cover (right-side) ⇒ page 97

6 - Special bolt, 10 Nm

- ❑ Renew if damaged or leaking

7 - Seal

- ❑ Renew if damaged or leaking

8 - Seal

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

9 - Filler cap

10 - 10 Nm

11 - Ignition coil

- ❑ Removing ⇒ Maintenance ; Booklet 404

12 - Gasket

- ❑ Renew if damaged

13 - Gasket for cylinder head cover

- ❑ Renew if damaged or leaking

14 - O-ring

- ❑ Renew

15 - Coolant pipe (rear)

16 - 10 Nm

17 - Combination valve for secondary air system

18 - 10 Nm

19 - Seal

- ❑ Renew

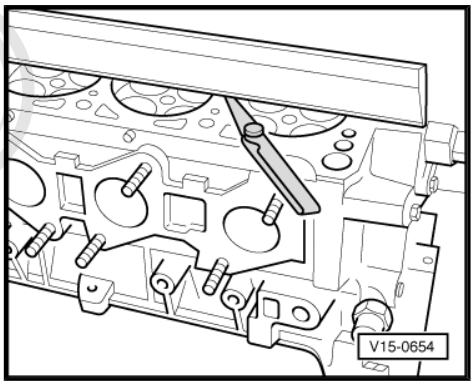
20 - Cylinder head gasket

- ❑ Renewing ⇒ Removing cylinder head ⇒ page 99
- ❑ Installation position: Part No. towards cylinder head
- ❑ If renewed, refill system with fresh coolant

Checking cylinder head for distortion

– Use straight edge and feeler gauge to measure for distortion at several points.

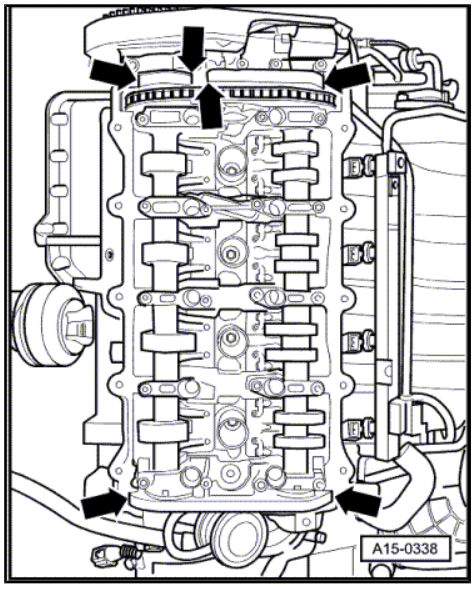
♦ Max. permissible distortion: 0.1 mm



Sealing points between bearing cap and cylinder head

– Apply a drop of sealant to the edges of the sealing surfaces between the bearing cap and cylinder head at the front and rear (∅ approx. 5 mm) -arrows-.

♦ Sealant ⇒ Parts catalogue



1.1 Removing and installing cylinder head cover (left-side)

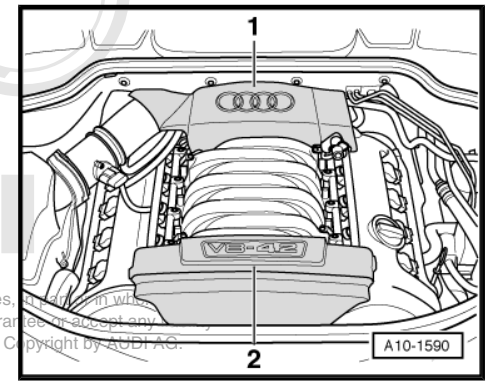
Removing

– Lift off engine cover panel -1- and -2-.

– Remove ignition coils ⇒ Rep. Gr. 28 .

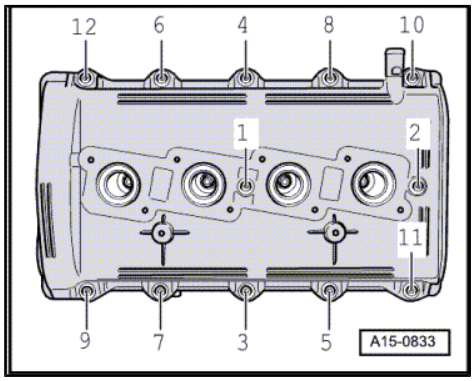
– Disconnect crankcase breather hose from cylinder head cover.

– Remove toothed belt cover.



– Remove cylinder head cover bolts (left-side) in the sequence -12 ... 1-.

– Remove cylinder head cover.



Installing

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

Note

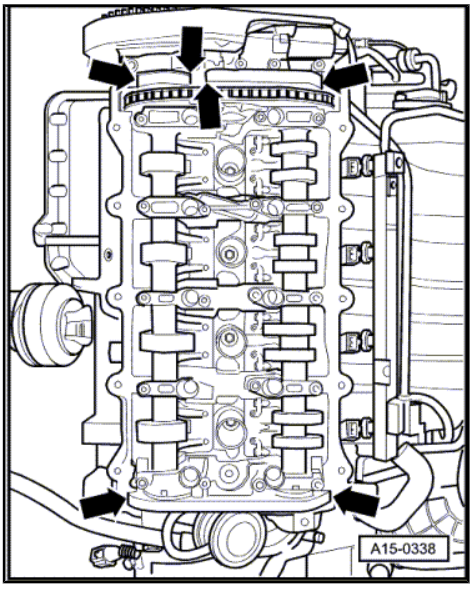
♦ *Renew seals for cylinder head cover and ignition coils if damaged.*

♦ *Renew cylinder head cover bolts if gasket is damaged.*

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

– Apply a drop of sealant to the edges of the sealing surfaces between the bearing cap and cylinder head at the front and rear (∅ approx. 5 mm) -arrows-.

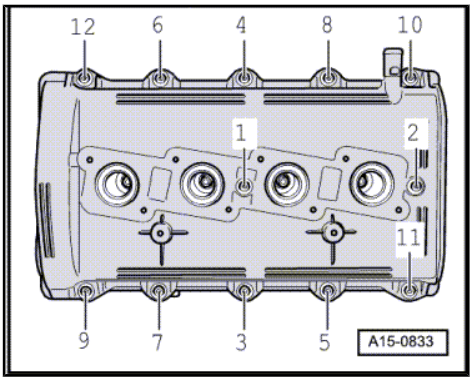
♦ Sealant ⇒ Parts catalogue



– Tighten bolts for cylinder head cover in the sequence -1 ... 12-.

Tightening torques

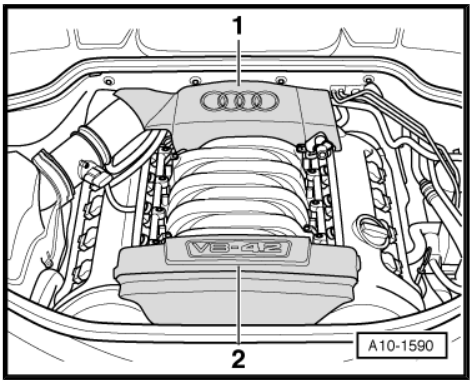
Component	Nm
Cylinder head cover to cylinder head	10
Toothed belt cover to cylinder head cover	10



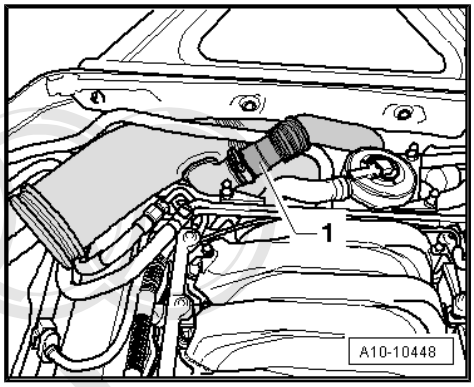
1.2 Removing and installing cylinder head cover (right-side)

Removing

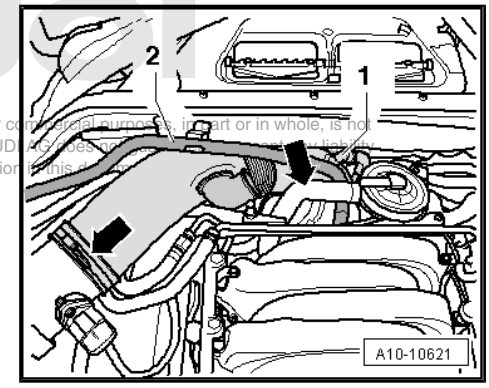
– Lift off engine cover panel -1 and 2-.



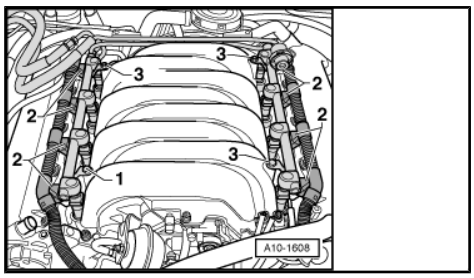
– Remove hose -1-.



– Disconnect hose -1-.
– Unclip hose -2-.
– Remove air intake pipe -arrows-.



– Disconnect hose -1-.
– Unplug electrical connectors from injectors -2-.
– Unscrew fuel rail -3- and move clear to one side.

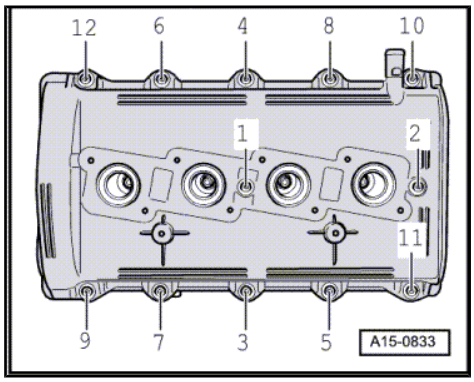


Note

Do not open fuel supply and fuel return pipes!

– Remove ignition coils ⇒ Rep. Gr. 28 .
– Disconnect crankcase breather hose from cylinder head cover.
– Remove toothed belt cover.

– Unscrew cylinder head cover bolts (right-side) in the sequence -12 ... 1-.



– Remove cylinder head cover.

Installing

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

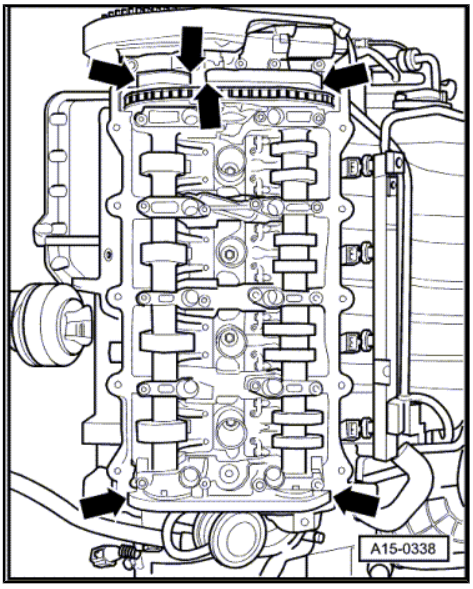
Note

- *Renew seals for cylinder head cover and ignition coils if damaged.*
- *Renew cylinder head cover bolts if gasket is damaged.*

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

– Apply a drop of sealant to the edges of the sealing surfaces between the bearing cap and cylinder head at the front and rear (∅ approx. 5 mm) -arrows-.

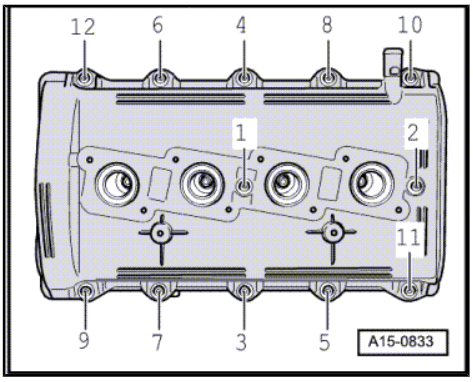
♦ Sealant ⇒ Parts catalogue



– Tighten bolts for cylinder head cover to final torque in the sequence -12 ... 1-.

Tightening torques

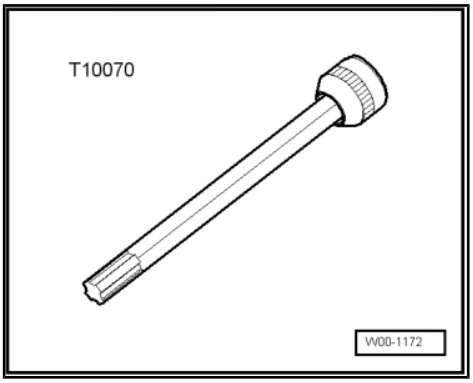
Component	Nm
Cylinder head cover to cylinder head	10
Fuel rail to intake manifold	10
Toothed belt cover to cylinder head cover	10



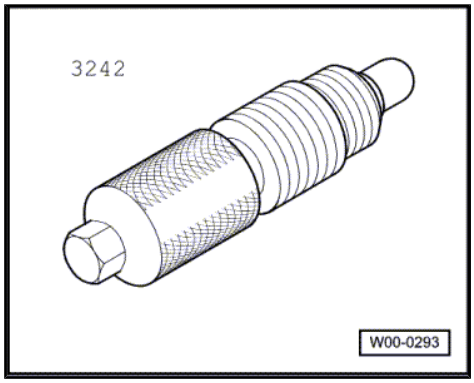
1.3 Removing cylinder head (left-side)

Special tools and workshop equipment required

♦ Locking pin -3242-



- Locking pin -3242-



Removing

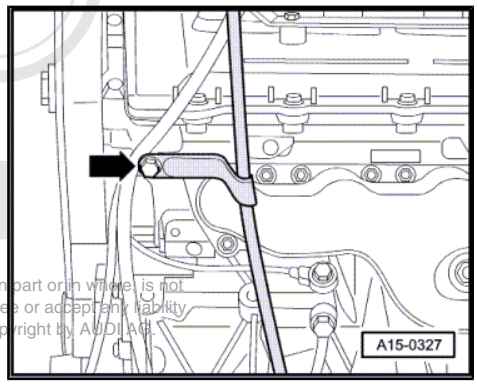
Note

Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

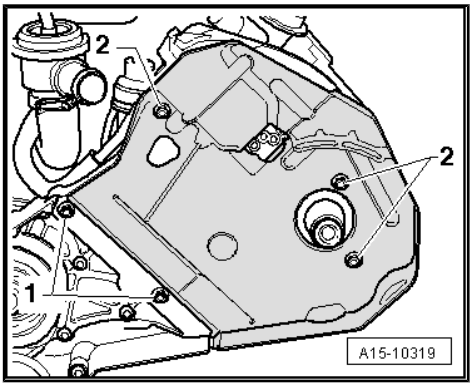
Note

- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- *All cable ties which are released or cut open when removing must be refitted in the same position when installing.*
- *Renew the cylinder head bolts.*
- *On assembly, renew oil seals and gaskets as well as self-locking nuts and bolts that are tightened by turning through to a specified angle.*
- *When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.*

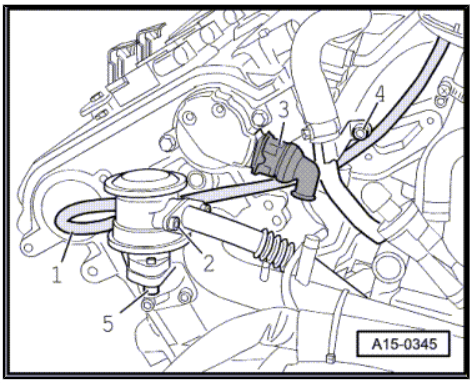
– Remove engine ⇒ page 7 .
– Unbolt guide tube for oil dipstick from cylinder head.
– Remove toothed belt ⇒ page 60 .
– Remove camshaft sprocket for cylinder bank 5-8.



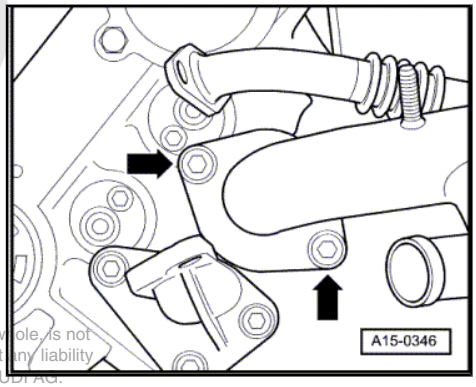
– Remove bolts -2- and detach toothed belt cover (rear).
– Slacken nuts -1-.



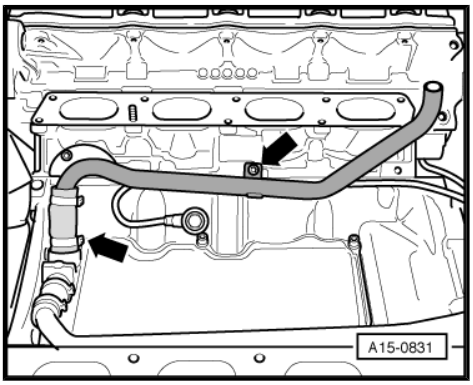
– Disconnect hose -1-.
– Remove bolts -2-.
– Unplug electrical connector -3-.
– Unscrew bolt -4- and pull out oil pipe.
– Unscrew bolts -5- and take out combination valve.



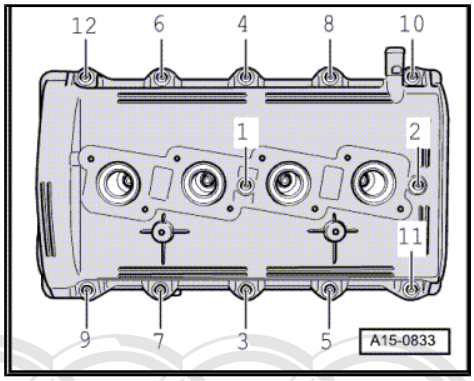
– Unbolt coolant pipe (left and right) -arrows-.
– Remove intake manifold ⇒ Rep. Gr. 24 .



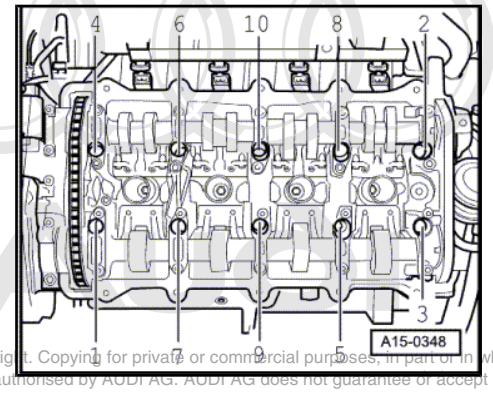
– Remove crankcase breather pipe -arrows-.
– Remove front exhaust pipe together with catalytic converter (left-side).
– Remove ignition coils ⇒ Rep. Gr. 28 .



– Remove cylinder head cover bolts (left-side) in the sequence -12 ... 1-.
– Remove cylinder head cover.



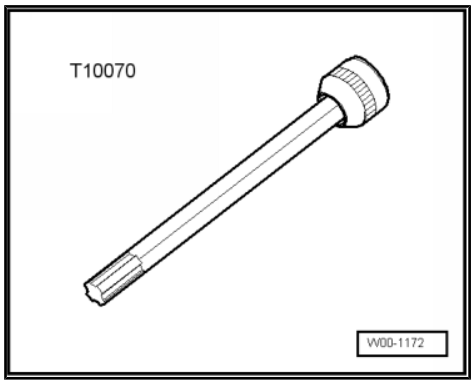
– Loosen cylinder head bolts in the sequence -1 ... 10-.
– Take off cylinder head and place it on a soft surface (such as foam plastic).



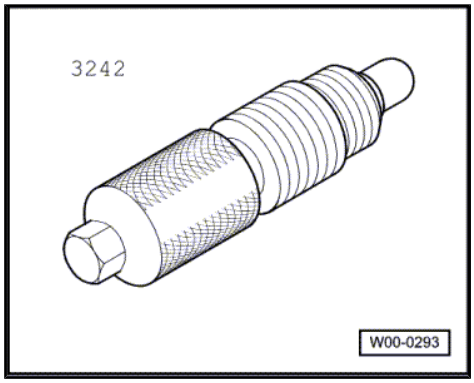
1.4 Removing cylinder head (right-side)

Special tools and workshop equipment required

♦ Locking pin -3242-



♦ Locking pin -3242-



Removing

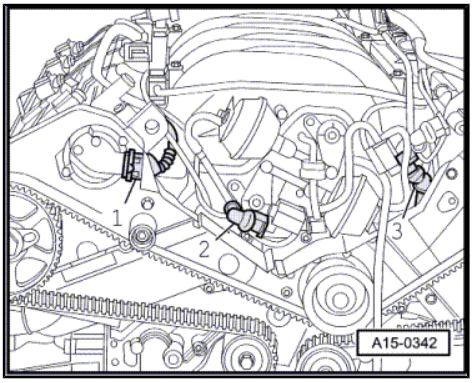
Note

Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

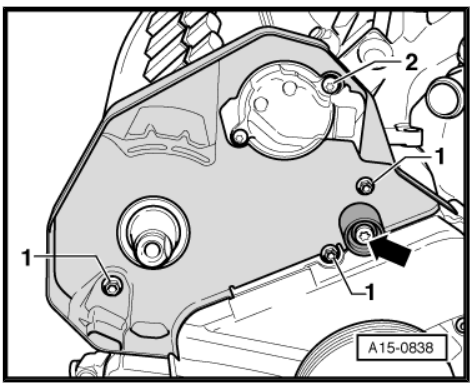
Note

- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- *All cable ties which are released or cut open when removing must be refitted in the same position when installing.*
- *Renew the cylinder head bolts.*
- *On assembly, renew oil seals and gaskets as well as self-locking nuts and bolts that are tightened by turning through to a specified angle.*
- *When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.*

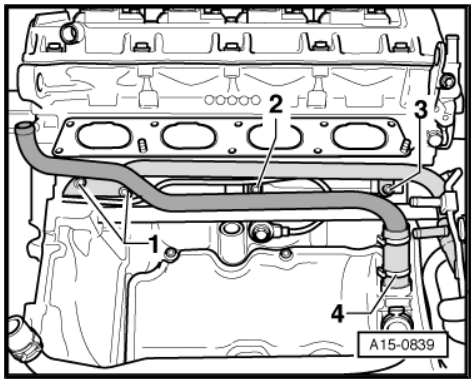
– Remove engine ⇒ page 7 .
– Remove toothed belt cover.
– Unplug connector -1- from Hall sender.
– Remove toothed belt ⇒ page 60 .
– Detach camshaft sprocket.



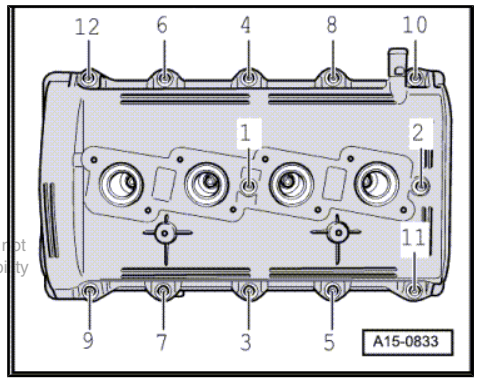
– Unscrew idler roller -arrow-.
– Remove bolts -1- and -2- and take off toothed belt cover (rear).
– Remove intake manifold ⇒ Rep. Gr. 24 .



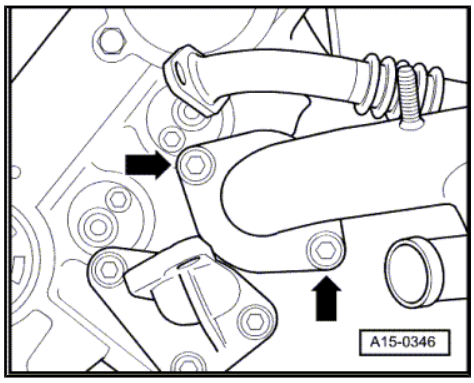
– Remove crankcase breather pipe by unscrewing bolt -2- and releasing hose clip -4-.
– Remove coolant pipe leading to cylinder head (bolts -1- and -3-).
– Remove ignition coils ⇒ Rep. Gr. 28 .



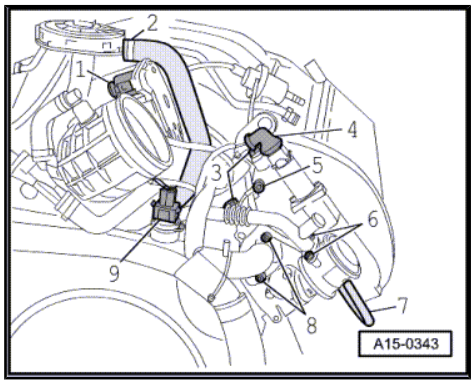
– Unscrew cylinder head cover bolts (right-side) in the sequence -12 ... 1-.
– Remove cylinder head cover.



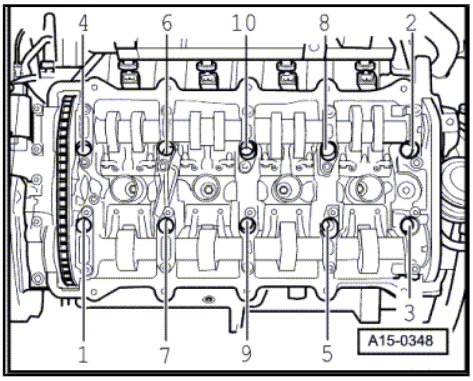
– Detach coolant pipe -arrows-.



– Unplug electrical connector -1-.
– Disconnect hose -2-.
– Unbolt bracket -3-.
– Unplug electrical connector -4-.
– Unbolt earth wire -5- from cylinder head.
– Remove bolts -6-.
– Disconnect hose -7- from combination valve.
– Remove bolts -8-.
– Unplug electrical connector -9-.
– Remove coolant pipe.
– Remove front exhaust pipe together with catalytic converter (right-side).



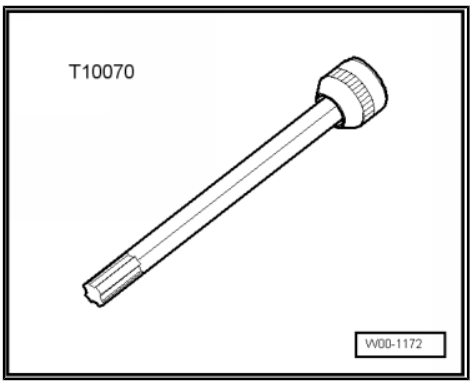
– Loosen cylinder head bolts in the sequence -1 ... 10- .
– Take off cylinder head and place it on a soft surface (such as foam plastic).



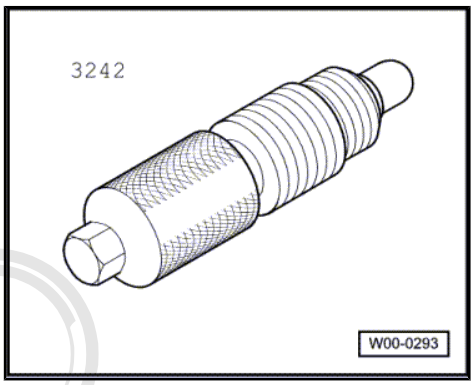
1.5 Installing cylinder head

Special tools and workshop equipment required

♦ Locking pin -3242-



♦ Locking pin -3242-

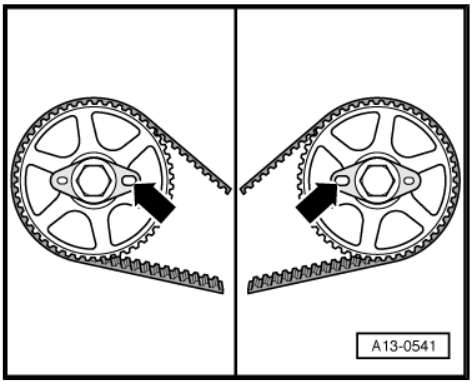


Installing

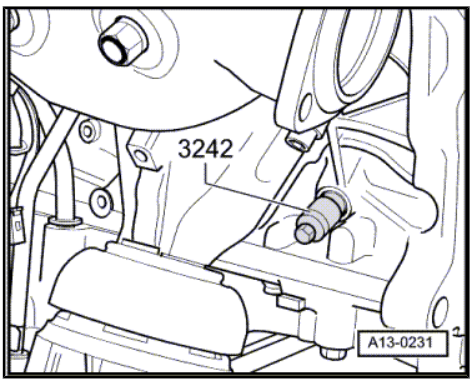
Note

- *Renew the cylinder head bolts.*
- *Renew self-locking nuts and bolts when performing assembly work.*
- *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
- *If repairing, carefully remove any remaining gasket material from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.*
- *Carefully remove any remaining emery and abrasive material.*
- *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*
- *When installing an exchange cylinder head with fitted camshafts, the contact surfaces between the bucket tappets, roller rocker fingers and cams must be oiled after installing the head.*
- *The plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*
- *When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.*
- *Reworking of the cylinder heads is not permitted.*
- *Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.*
- *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.*
- *Position cylinder head gasket on dowel sleeves. The word -oben- (top) or the Part No. must face towards cylinder head.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- *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.*
- *All cable ties which are released or cut open when removing must be refitted in the same position when installing.*

– Before fitting cylinder head, set crankshaft and camshafts to TDC for cylinder 5:



- ♦ The large holes -arrows- in the locating plates on the camshaft sprockets must be opposite one another on the inside.
- ♦ The locking pin -3242- must be screwed in.

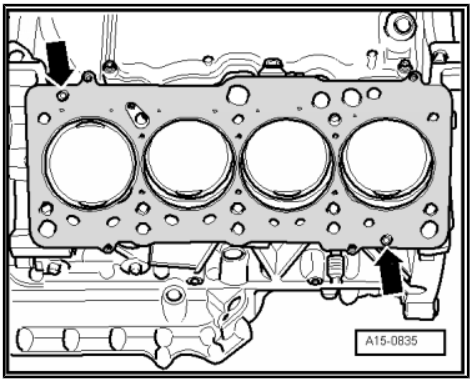


– Place cylinder head gasket in position.

- ♦ 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 finger-tight.



– Tighten cylinder head bolts in four stages in sequence shown as follows:

– Tighten using torque wrench:

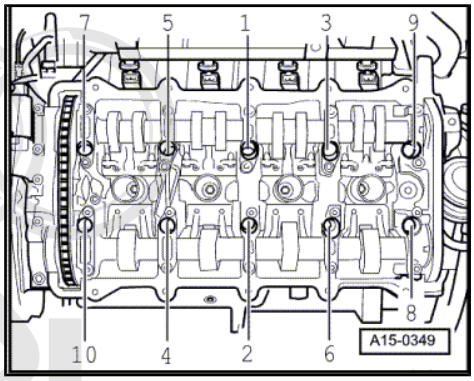
♦ 1st stage: 30 Nm

♦ 2nd stage: 60 Nm

– Tighten using rigid spanner:

♦ 3rd stage: 90° (1/4 turn) further

♦ 4th stage: 90° (1/4 turn) further



Note

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

Perform further installation in reverse order, paying attention to the following:

– Install cylinder head cover (left-side) ⇒ page 96 and (right-side) ⇒ page 97 .

– Install combination valve for secondary air (right-side) ⇒ page 220 .

– Install front exhaust pipe.

– Install intake manifold ⇒ Rep. Gr. 24 .

– Install toothed belt (adjust valve timing) ⇒ page 60 .

Note

After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.

– Install engine ⇒ page 31 .

– Fill cooling system with fresh coolant ⇒ page 172 .

– Install torque reaction support ⇒ page 42 .

Tightening torques

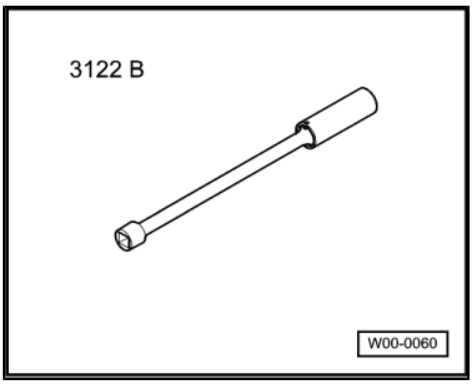
Component		Nm
Toothed belt cover (rear) to:	Cylinder head	10 1)
	Coolant pump	10
Idler roller to cylinder head		22
Guide tube for dipstick to cylinder head		10
Coolant pipe to cylinder head		10

• 1) Install bolts using locking fluid; locking fluid ⇒ Parts catalogue

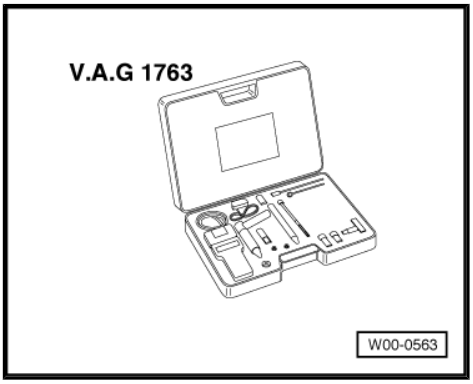
2 Checking compression

Special tools and workshop equipment required

- Spark plug socket and extension -3122 B-



- Compression tester -V.A.G 1763-

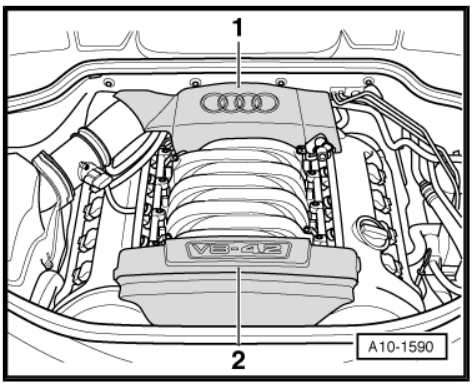


Test conditions

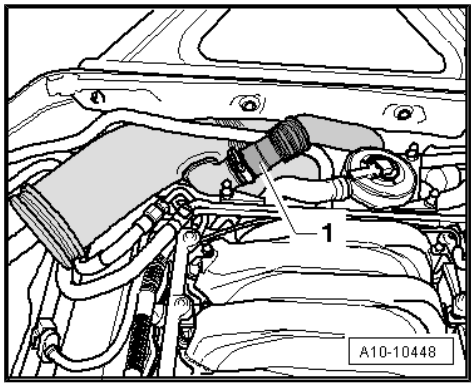
- Engine oil temperature min. 30 °C
- Battery voltage at least 12.7 V

Test sequence

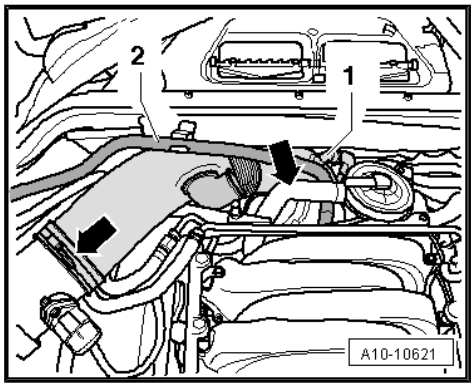
– Lift off engine cover panel -1- and -2-.



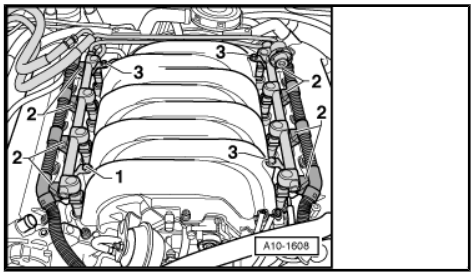
– Remove hose -1-.



– Disconnect hose -1-.
– Unclip hose -2-.
– Remove air intake pipe -arrows-.



– Unplug electrical connectors from injectors -2-.
– Remove ignition coils ⇒ Rep. Gr. 28 .
– Remove spark plugs with spark plug socket -3122 B- .
– Open throttle valve fully.
– Check compression pressure with compression tester - V.A.G 1763- .



Note

Using the compression tester ⇒ operating instructions .

– Operate starter until pressure reading on tester no longer rises.

Compression pressure:

New pressure in bar	Wear limit bar	Permissible difference between cylinders bar
10.0…13.0	7.0	Max. 3.0

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

After the compression test the following step must be carried out.

- Interrogate fault memory and erase as necessary.

For this purpose, use vehicle diagnostic, testing and information system -VAS 5051- .

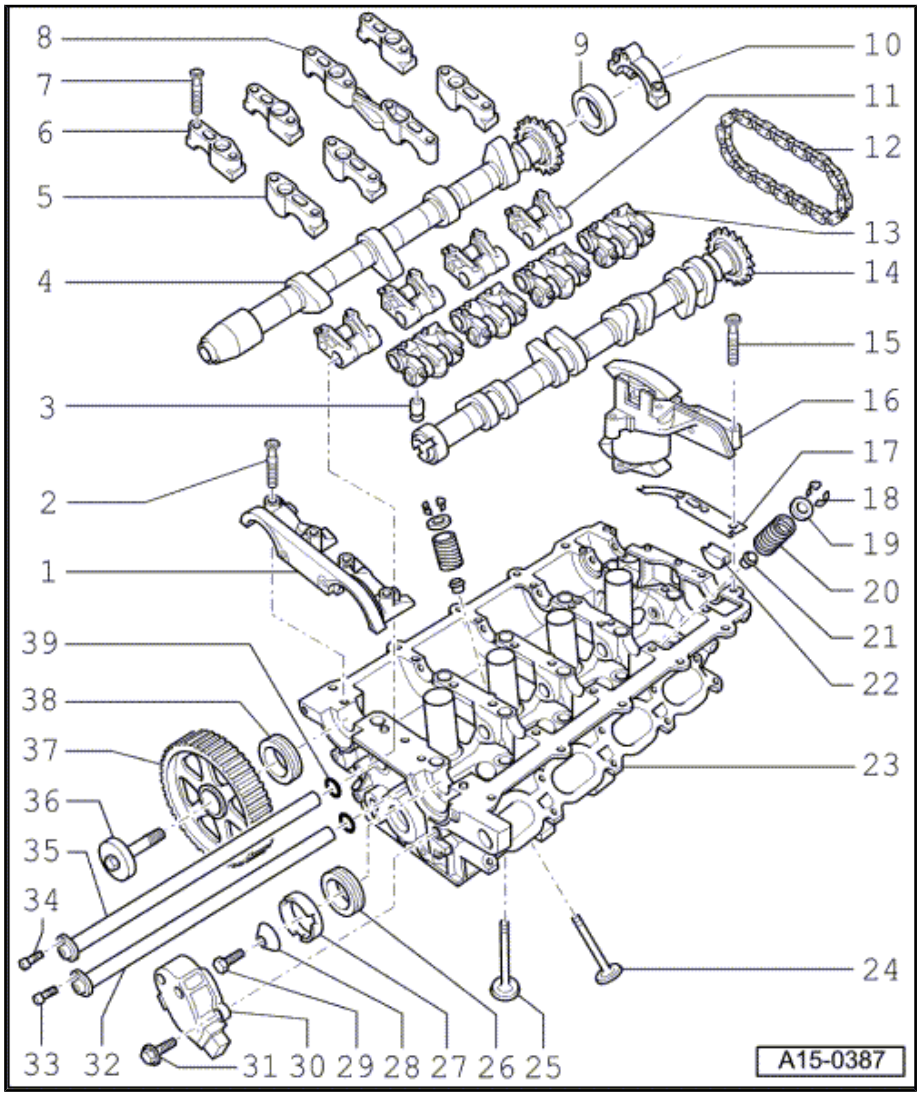
Tightening torques

Component	Nm
Spark plugs in cylinder head	30

3 Valve gear - exploded view

Note

- *Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.*
- *After installing camshafts, wait for approx. 30 minutes before starting engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*
- *After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.*
- *Renew gaskets, seals and O-rings.*



1 - Double bearing cap

- ❑ Before installing, coat contact surfaces of front and rear bearing caps with a small quantity of sealant ⇒ page 115
- ❑ Sealant ⇒ Parts catalogue

2 - 5 Nm + 90° (1/4 turn) further

- ❑ Renew

3 - Hydraulic tappet

- ❑ Pressed into roller rocker finger

4 - Exhaust camshaft

- ❑ Checking axial clearance ⇒ page 115
- ❑ Removing and installing ⇒ page 125
- ❑ Check radial clearance with Plastigage (roller rocker fingers removed): wear limit: 0.1 mm; run-out: 0.01 mm (maximum)

5 - Bearing cap on inlet camshaft

- ❑ Note installation position and allocation ⇒ page 123
- ❑ Where fitted, pay attention to dowel sleeve

6 - Bearing cap on exhaust camshaft

- ❑ Note installation position and allocation ⇒ page 123
- ❑ Where fitted, pay attention to dowel sleeve

7 - 5 Nm + 90° (1/4 turn) further

- ❑ Renew

8 - Double bearing cap

9 - Sealing cap

- ❑ Renew
- ❑ To remove, pierce with a screwdriver and lever out
- ❑ To install, drive in with fitting sleeves -3202- or a suitable lever

10 - Bearing cap

- ❑ Before installing, coat contact surfaces of front and rear bearing caps with a small quantity of sealant ⇒ page 115
- ❑ Sealant ⇒ Parts catalogue

11 - Roller rocker finger

- ❑ For exhaust camshaft
- ❑ With hydraulic tappet ⇒ Item 3 (page 112)
- ❑ Removing and installing ⇒ page 130

12 - Drive chain

- ❑ Installing:

♦ Cylinder head (left-side) ⇒ page 123

♦ Cylinder head (right-side) ⇒ page 128

13 - Roller rocker finger

- ❑ For inlet camshaft
- ❑ With hydraulic tappet ⇒ Item 3 (page 112)
- ❑ Removing and installing ⇒ page 130

14 - Inlet camshaft

- ❑ Checking axial clearance ⇒ page 115
- ❑ Removing and installing ⇒ page 125
- ❑ Check radial clearance with Plastigage (roller rocker fingers removed): wear limit: 0.1 mm; run-out: 0.01 mm (maximum)

15 - 5 Nm + 90° ($^1/_4$ turn) further

- ❑ Renew

16 - Mechanical camshaft adjuster

- ❑ With inlet camshaft control valve 1 -N205-
- ❑ Before removing, lock in position with chain tensioner retainer -3366- ⇒ page 125

17 - Rubber/metal gasket

- ❑ Renew

18 - Valve cotters

19 - Valve spring plate

20 - Valve spring

21 - Valve stem oil seal

- ❑ Renewing ⇒ page 132

22 - Seal

- ❑ Renew

23 - Cylinder head

- ❑ See note ⇒ page 112
- ❑ Checking valve guides, grinding-in valve seats ⇒ page 134
- ❑ Machining valve seats ⇒ page 135

24 - Exhaust valve

- ❑ Do not machine, only grinding-in is permitted
- ❑ Valve dimensions ⇒ page 115

- ❑ Checking valve guides, grinding-in valve seats ⇒ page 134

25 - Inlet valve

- ❑ Do not machine, only grinding-in is permitted
- ❑ Valve dimensions ⇒ page 115
- ❑ Checking valve guides, grinding-in valve seats ⇒ page 134

26 - Oil seal

- ❑ For Hall sender
- ❑ Renewing ⇒ page 118

27 - Rotor for Hall sender

- ❑ Note fitting position (notch on camshaft)

28 - Washer

- ❑ Conical

29 - 23 Nm

30 - Hall sender

31 - 10 Nm

32 - Shaft for rocker fingers, inlet side

- ❑ Removing and installing ⇒ page 130

33 - 10 Nm

34 - 10 Nm

35 - Shaft for rocker fingers, exhaust side

- ❑ Removing and installing ⇒ page 130

36 - 55 Nm

37 - Camshaft sprocket

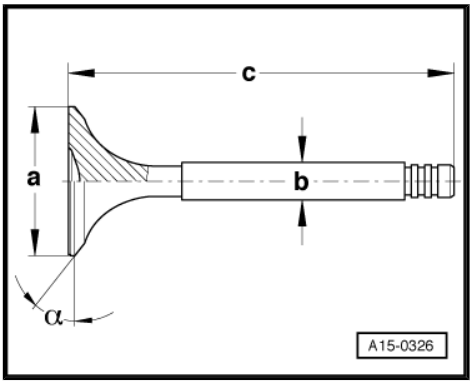
38 - Oil seal

- ❑ For camshaft
- ❑ Renewing ⇒ page 116

39 - O-ring

- ❑ For shaft of roller rocker finger
- ❑ Renew

Valve dimensions



Note

Valves are not to be machined. Only grinding-in is permitted.

Dimension	Inlet valve	Exhaust valve
-a- = ∅ mm	26.8…27.0	26.8…27.0
-b- = ∅ mm	5.94…5.95	5.94…5.95
-c- = mm	96.4…96.6	95.3…95.5
-α- = ∠°	45	45

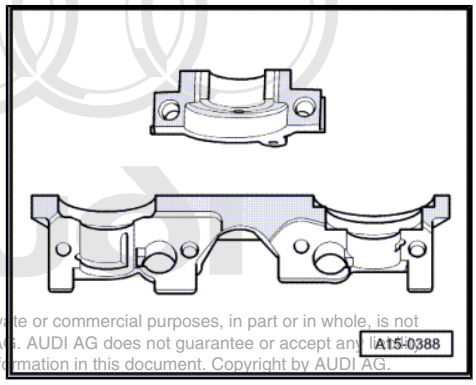
WARNING

- *Care must be taken when disposing of old sodium-cooled exhaust valves.*
- *The valves must be sawn in two with a metal saw between the centre of the stem and valve head. When doing so, the valves must not come into contact with water. 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 performing these steps the valves can be disposed of in the normal way.*

Applying sealant to bearing cap

– Apply a small quantity of sealant to the hatched area on the double bearing cap and to the outer bearing cap adjacent to the camshaft adjuster and fit the bearing caps (looking out for the dowel sleeves).

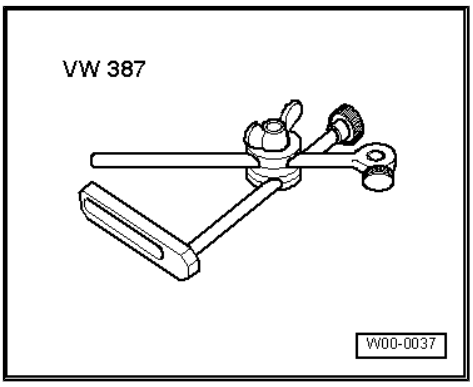
- Sealant ⇒ Parts catalogue



3.1 Checking axial clearance of camshafts

Special tools and workshop equipment required

- Universal dial gauge bracket -VW 387-



- Dial gauge

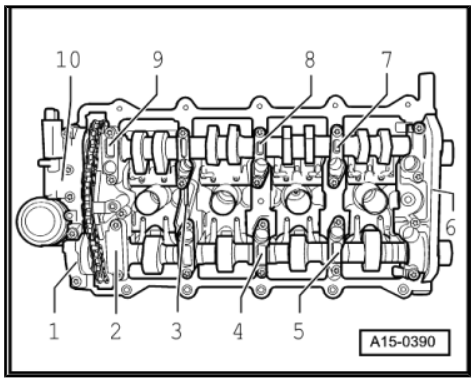
Test sequence

– Remove camshafts ⇒ page 125 .

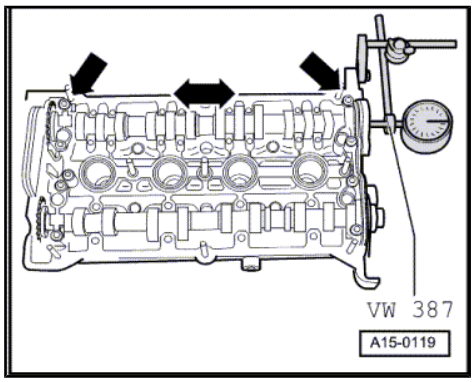
– Remove roller rocker fingers ⇒ page 130 .

– Fit camshafts in cylinder head without drive chain and secure with bearing caps 3, 5 and 7.

– Attach dial gauge bracket -VW 387- with dial gauge to cylinder head:



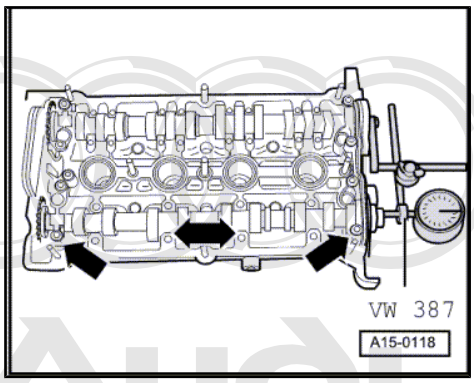
Inlet camshaft



Exhaust camshaft

Wear limit for inlet and exhaust camshaft.

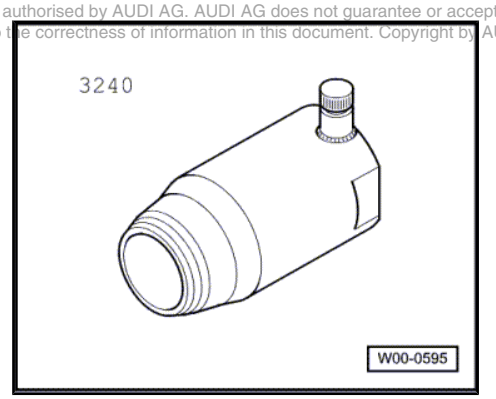
♦ Axial clearance: max. 0.20 mm



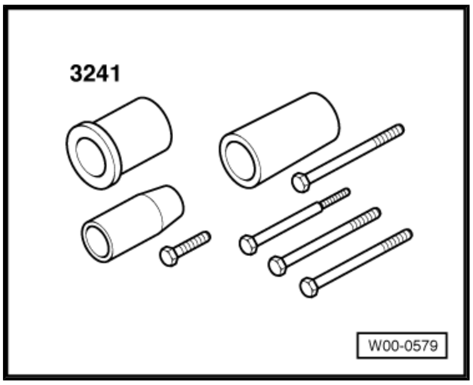
3.2 Renewing camshaft oil seals

Special tools and workshop equipment required

♦ Oil seal extractor -3240-



◆ Fitting sleeves -3241-



Removing

– Remove toothed belt ⇒ page 60 .

– Remove camshaft sprockets.

Note

Oil seals should be renewed on both cylinder heads if one oil seal is leaking.

– Adjust inner section of oil seal extractor -3240- so it is flush with outer section.

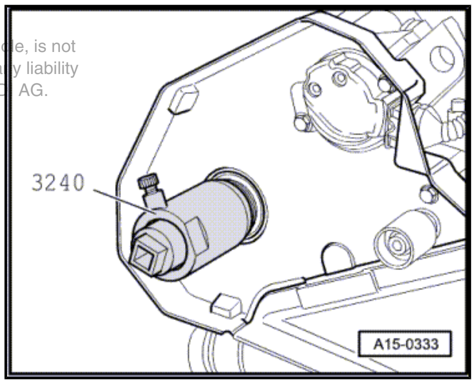
Cylinder head (left-side):

– Unscrew inner section of oil seal extractor 2 turns and lock with knurled screw.

Cylinder head (right-side):

– Unscrew inner section of oil seal extractor 7 turns and lock with knurled screw.

Continuation for both sides:



– Lubricate threaded head of oil seal extractor -3240- , place it in position and, exerting firm pressure, screw it into oil seal as far as possible.

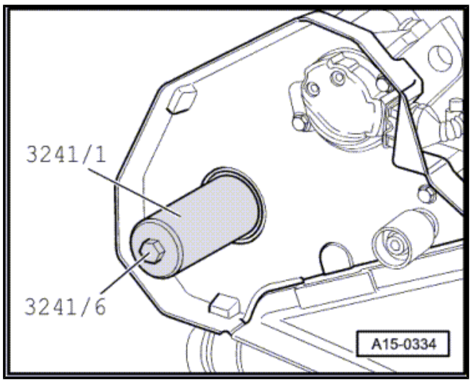
– Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.

– Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.

– Clean contact surface and sealing surface.

Installing

– Slide oil seal over taper on camshaft.



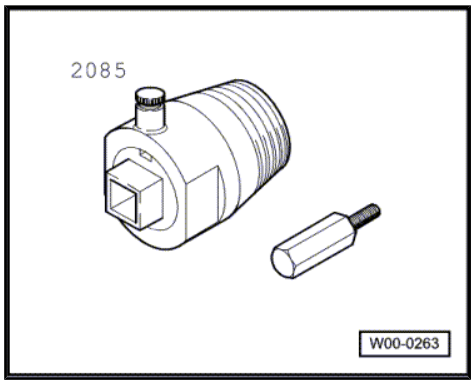
– Press oil seal on as far as the stop using fitting sleeve -3241/1- and bolt -3241/6- .

– Install toothed belt (adjust valve timing) ⇒ page 60 .

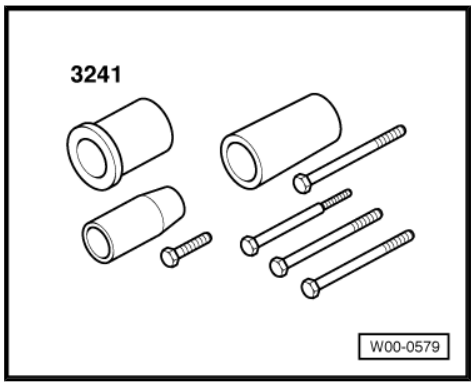
3.3 Renewing oil seal at Hall sender

Special tools and workshop equipment required

- Oil seal extractor -2085-



- Fitting sleeves -3241-

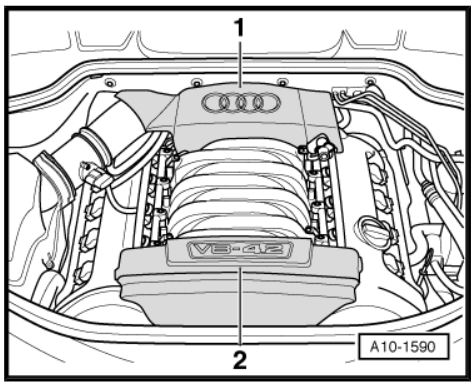


Procedure

Cylinder head (left-side):

– Lift off engine cover panel -1-.

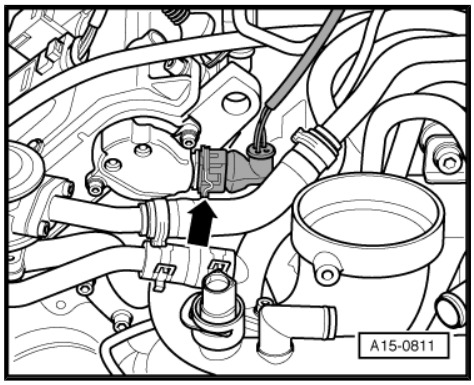
– Remove combination valve for secondary air system (left-side) ⇒ page 219 .



– Unplug electrical connector -arrow- at Hall sender 2 -G163- .

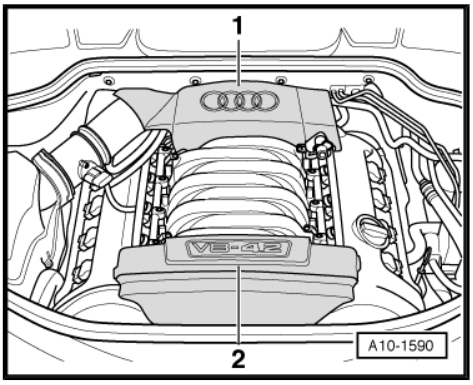
– Remove housing for Hall sender.

– Remove washer and rotor for Hall sender.

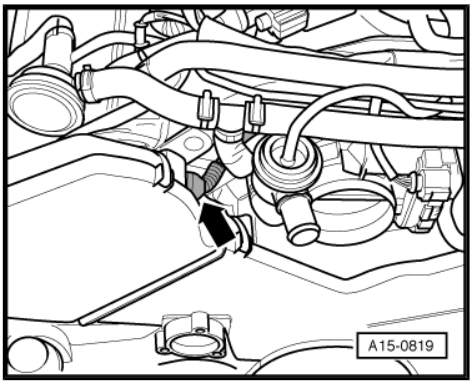


Cylinder head (right-side):

– Lift off engine cover panel -2-.
– Pull lock carrier forwards ⇒ page 48 .



– Unplug electrical connector -arrow- at Hall sender -G40- .
– Remove toothed belt cover (right-side).

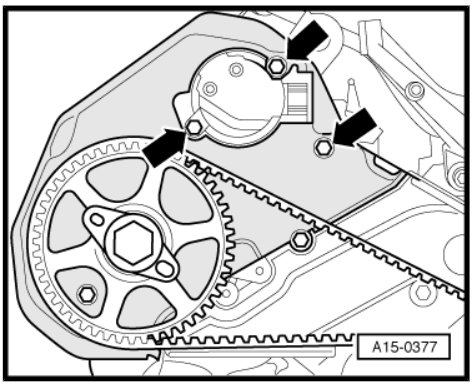


– Unscrew bolts -arrows-.
– Pull toothed belt cover forwards slightly and detach Hall sender.
– Remove washer and rotor for Hall sender.

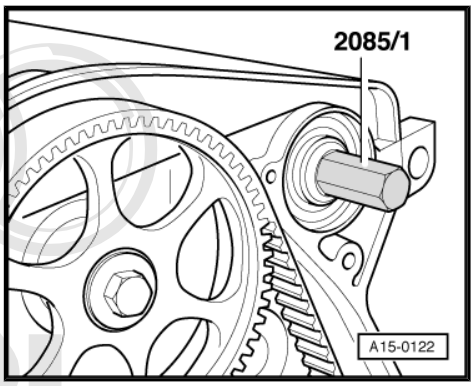
Continuation for both sides:

Note

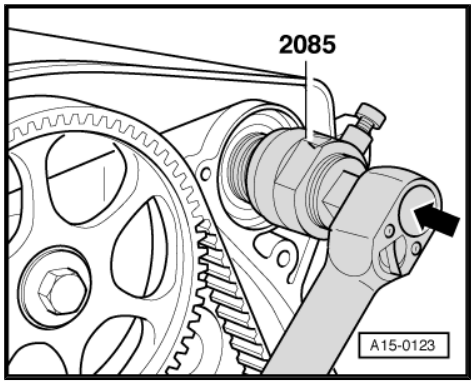
The following diagram shows the cylinder head (right-side).



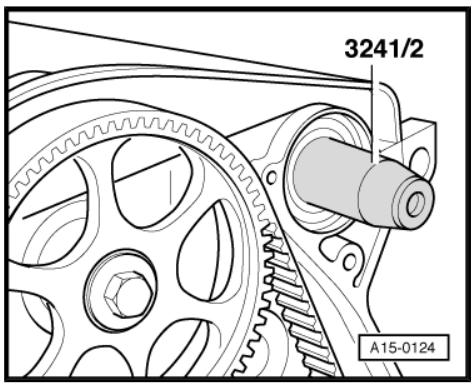
– To guide oil seal extractor, screw bolt -2085/1- by hand into camshaft as far as it will go.
– Unscrew inner section of oil seal extractor -2085- two turns out of outer section and lock with knurled screw.



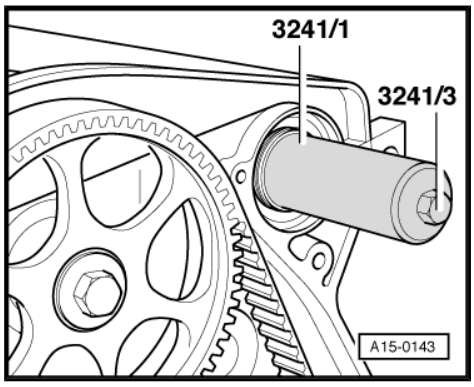
– Lubricate threaded head of oil seal extractor -2085- , place it in position and screw it into oil seal as far as possible (apply firm pressure).
– Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.



– Fit guide sleeve -3241/2- onto camshaft journal.
– Slide oil seal over guide sleeve.



– Press oil seal in onto stop with fitting sleeve -3241/1- . To do this use bolt -3241/3- .



Perform further installation in reverse order, paying attention to the following:

Note

- *Renew O-ring.*
- *Secure all hose connections with the correct type of 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. Do NOT use lubricant.*

Cylinder head (left-side):

– Install combination valve for secondary air system (left-side) ⇒ page 219 .

Cylinder head (right-side):

– Install lock carrier with attachments ⇒ Rep. Gr. 50 .

Tightening torques

Component	Nm
Hall sender rotor to camshaft	25
Hall sender housing to cylinder head	10
Rear toothed belt cover to cylinder head	10 1)

- 1) Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .

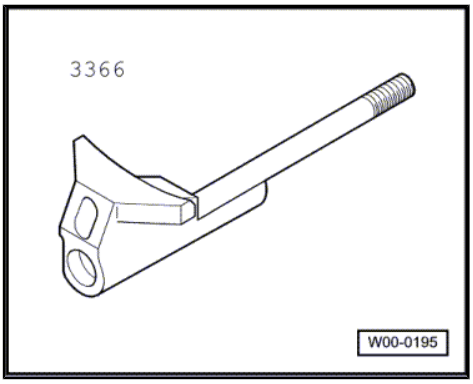
3.4 Removing and installing camshafts and camshaft adjuster - cylinder head (left-side)

Note

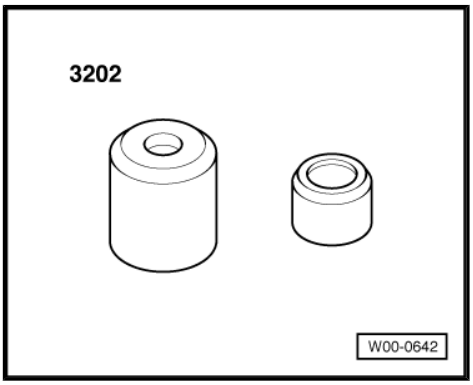
There is a basic difference in the procedures for installing the camshaft drive chains on the left and right side cylinder heads. It is important to keep to the correct procedure.

Special tools and workshop equipment required

- Chain tensioner retainer -3366-



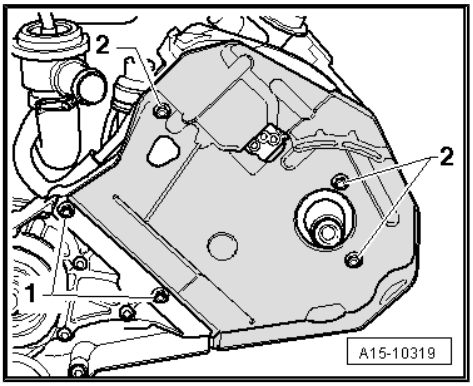
- Fitting sleeves -3202-



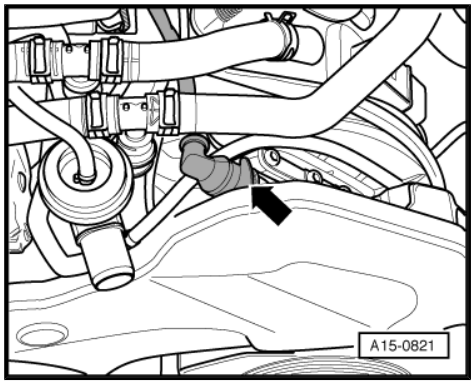
- Sealant ⇒ Parts catalogue

Removing

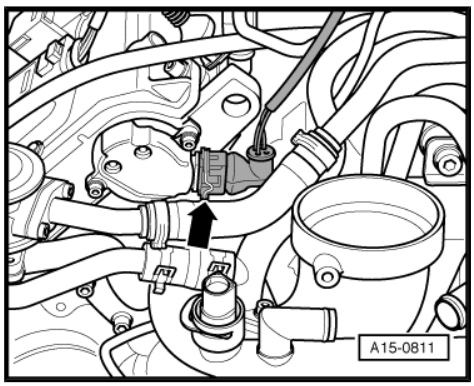
- Engine in vehicle.
- – Remove toothed belt ⇒ page 60 .
- – Detach camshaft sprocket.
- – Slacken nuts -1-.
- – Remove bolts -2- and detach toothed belt cover (rear).



– Unplug electrical connector -arrow- at inlet camshaft control valve 2 -N208- .
– Remove cylinder head cover (left-side) ⇒ page 96 .



– Unplug electrical connector -arrow- at Hall sender 2 -G163- .
– Remove housing for Hall sender.
– Remove washer and rotor for Hall sender.
– Turn the crankshaft approx. 45° anti-clockwise at the toothed belt sprocket bolt so that all pistons are clear of TDC position.

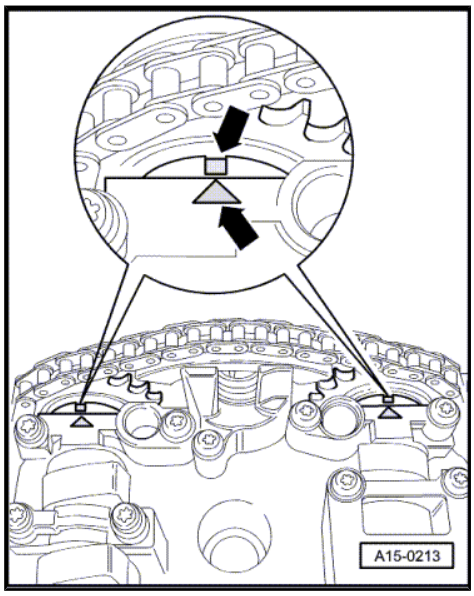


– Check TDC position of camshafts again:

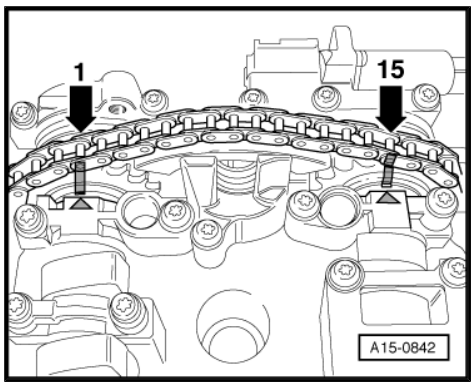
♦ The two marks on the camshafts must be opposite the two arrows on the bearing caps.

If old drive chain is to be reused:

– Clean drive chain and sprockets of camshafts opposite the two arrows on the bearing caps and mark installation position with a coloured dot.



♦ The distance between the two arrows (and thus between the coloured markings) is 15 rollers on the chain.

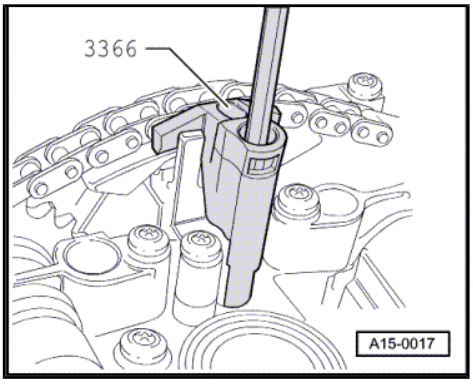


Note

Do not mark chain with a centre punch or by making a notch or similar.

Continued:

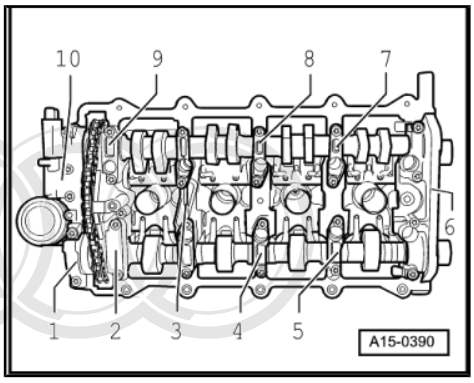
– Hold camshaft adjuster in position with chain tensioner retainer -3366- .



Note

Over-tightening retainer for chain tensioner can damage the camshaft adjuster.

– Mark the sequence and installation positions of all bearing caps, as shown, regardless of any existing markings on the bearing caps.
– Clean the bearing caps and then use a waterproof felt-tip pen to apply markings.
– Unscrew bolts securing camshaft adjuster -10-.
– Unbolt bearing cap 1.
– Unbolt bearing caps 2, 4, 6, 8, and 9 and place in sequence on a clean surface.
– Slacken off bearing caps 3, 5 and 7 of inlet and exhaust camshafts alternately in diagonal sequence, and remove.
– Lift out both camshafts together with camshaft adjuster.



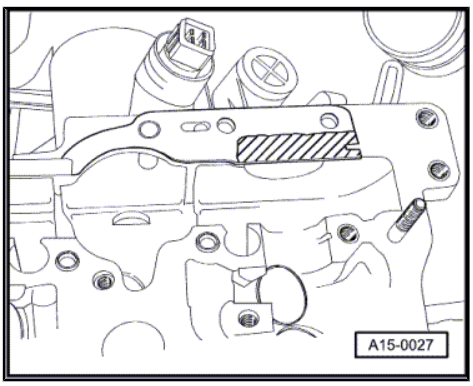
Installing

– Renew bolts for camshaft bearings and camshaft adjuster.
– Renew the semi-circular sealing plug.
– Remove all sealant residue from cylinder head and from bearing caps.

– Renew rubber/metal gasket for camshaft adjuster and apply a thin coat of sealant to the shaded area.

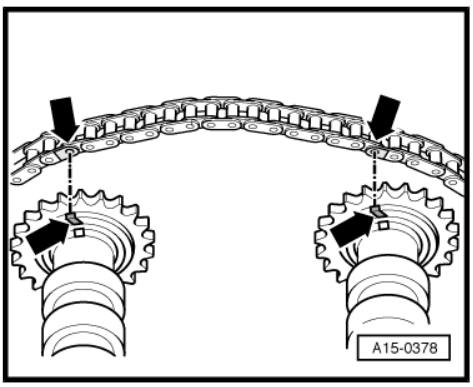
♦ Sealant ⇒ Parts catalogue

– Position drive chain on camshaft chain sprockets as follows:



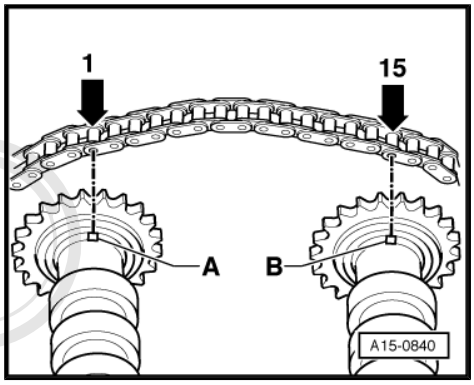
If old drive chain is being used:

♦ Adjust the colour markings -arrows- so they are aligned.



If new drive chain is being used:

♦ The distance between notches -A- and -B- on the camshafts must be 15 drive chain rollers. The illustration shows the exact positions of the 1st and 15th rollers on the sprockets.



Continued:

– Insert camshaft adjuster into the chain (2nd mechanic required).

– Insert camshafts with drive chain and camshaft adjuster into cylinder head.

– Oil running surfaces of both camshafts.

Note

Dowel sleeves for bearing caps and camshaft adjuster must be positioned in cylinder head

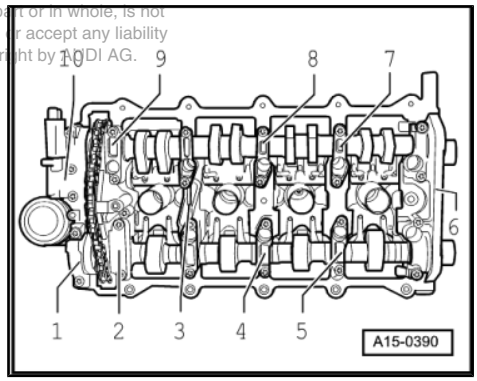
– Fit bearing caps 3, 5 and 7 as per marking.

– Tighten bearing caps 3, 5 and 7 on inlet and exhaust camshafts diagonally in alternating sequence.

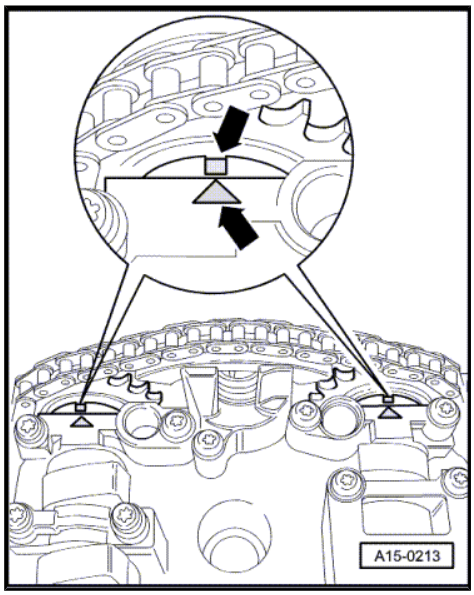
– Secure camshaft adjuster -10-.

– Remove chain tensioner retainer -3366- .

– Check correct setting of camshafts:



♦ The two markings on the camshafts must be in line with the two arrows on the bearing caps -arrows-.



Note

If necessary, turn camshaft slightly backwards or forwards so that the two marks coincide.

– Apply a small quantity of sealant to the hatched areas on the double bearing cap and the outer bearing cap adjacent to the camshaft adjuster and fit the bearing caps.

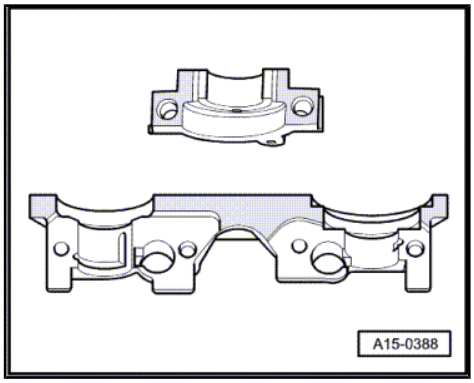
♦ Sealant ⇒ Parts catalogue

– Fit the remaining bearing caps.

– Renew oil seals for inlet and exhaust camshaft and install on camshaft ⇒ page 116 and at Hall sender ⇒ page 118 .

– Drive sealing cap in carefully using fitting sleeves -3202- .

– Turn the crankshaft approx. 45° clockwise back to TDC at the toothed belt sprocket bolt and secure crankshaft with locking pin.



Perform further installation in reverse order, paying attention to the following:

– Install toothed belt (adjust valve timing) ⇒ page 60 .

– Install cylinder head cover ⇒ page 97 .

– Install torque reaction support ⇒ page 42 .

Note

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

♦ *After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.*

Tightening torques

Component		Nm
Bearing cap to cylinder head		5 + 90° 1)2)
Camshaft adjuster to cylinder head		5 + 90° 1)2)
Toothed belt cover	Cylinder head	10 3)
(rear) to:	Coolant pump	10
Idler roller to cylinder head		22

- 1) Renew bolt
- 2) 90° = one quarter turn.
- 3) Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .

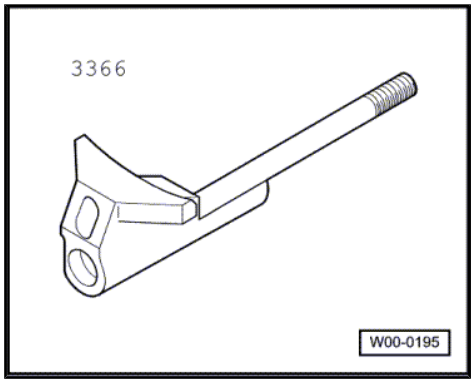
3.5 Removing and installing camshafts and camshaft adjuster - cylinder head (right-side)

Note

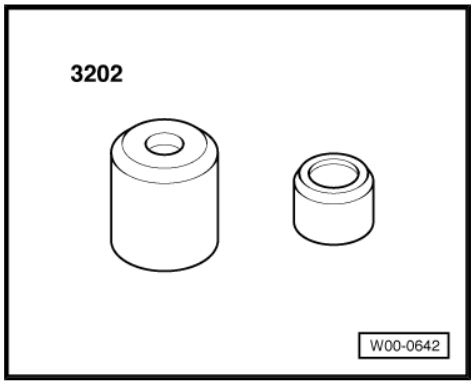
There is a basic difference in the procedures for installing the camshaft drive chains on the left and right side cylinder heads. It is important to keep to the correct procedure.

Special tools and workshop equipment required

♦ Chain tensioner retainer -3366-



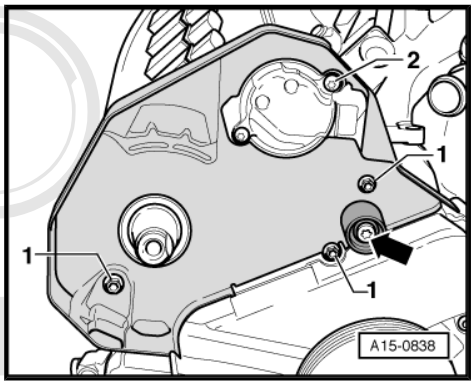
♦ Fitting sleeves -3202-



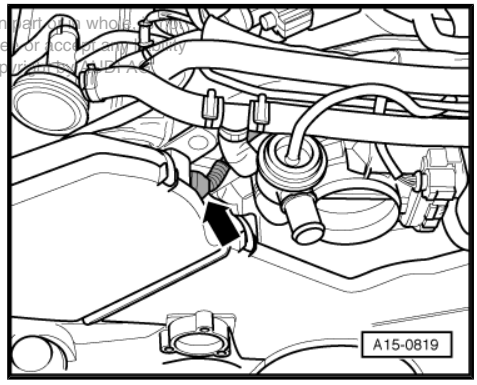
Sealant ⇒ Parts catalogue

Removing

– Remove engine ⇒ page 7 .
– Remove toothed belt ⇒ page 60 .
– Detach camshaft sprocket.
– Unscrew idler roller -arrow-.
– Remove bolts -1- and -2- and take off toothed belt cover (rear).

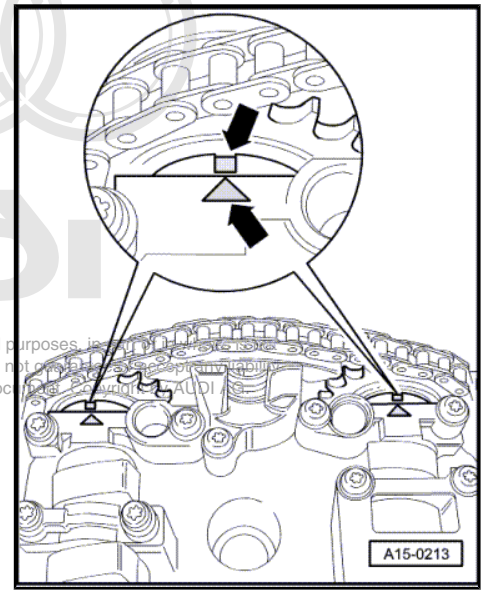


– Unplug electrical connector -arrow- at Hall sender -G40-.
– Remove housing for Hall sender.
– Remove washer and rotor for Hall sender.
– Unplug electrical connector from camshaft control valve.
– Remove cylinder head cover (right-side) ⇒ page 97 .
– Turn the crankshaft approx. 45° anti-clockwise at the toothed belt sprocket bolt so that all pistons are clear of TDC position.



– Check TDC position of camshafts again:

♦ The two marks on the camshafts must be opposite the two arrows on the bearing caps.

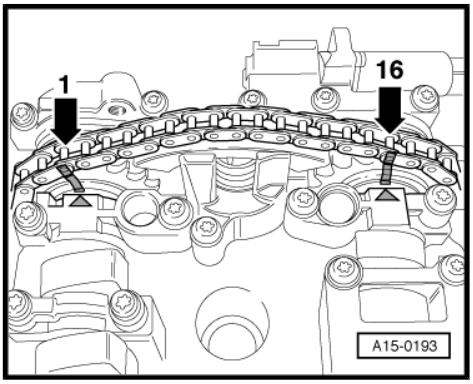


If old drive chain is to be reused:

– Clean drive chain and sprockets of camshafts opposite the two arrows on the bearing caps and mark installation position with a coloured dot.

♦ The distance between the two arrows (and thus between the coloured markings) is 16 rollers on the chain.

♦ Notch on inlet camshaft has a slight inward offset with respect to chain roller -16-.

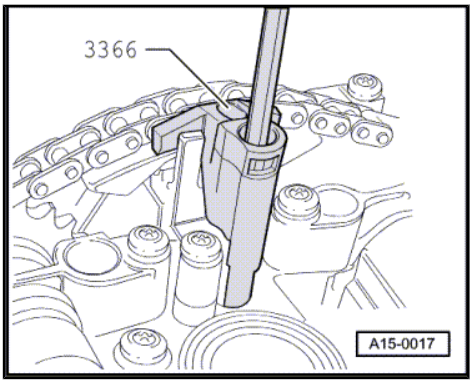


Note

Do not mark chain with a centre punch or by making a notch or similar.

Continued:

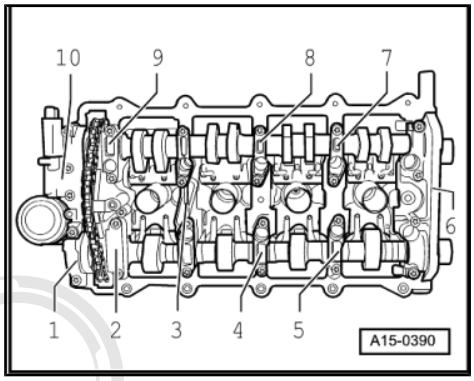
– Hold camshaft adjuster in position with chain tensioner retainer -3366- .



Note

Over-tightening retainer for chain tensioner can damage the camshaft adjuster.

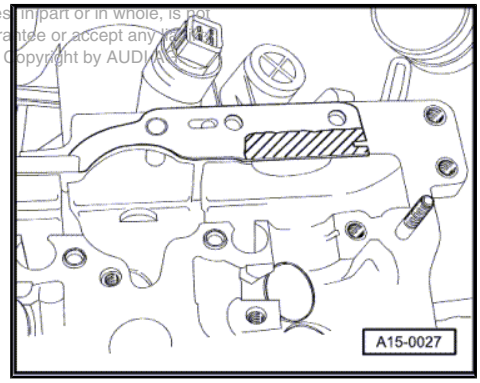
– Mark the sequence and installation positions of all bearing caps, as shown, regardless of any existing markings on the bearing caps.
– Clean the bearing caps and then use a waterproof felt-tip pen to apply markings.
– Unscrew bolts securing camshaft adjuster -10-.
– Unbolt bearing cap 1.
– Unbolt bearing caps 2, 4, 6, 8, and 9 and place in sequence on a clean surface.
– Slacken off bearing caps 3, 5 and 7 of inlet and exhaust camshafts alternately in diagonal sequence, and remove.
– Lift out both camshafts together with camshaft adjuster.



Installing

– Renew bolts for camshaft bearings and camshaft adjuster.
– Renew the semi-circular sealing plug.
– Remove all sealant residue from cylinder head and from bearing caps.

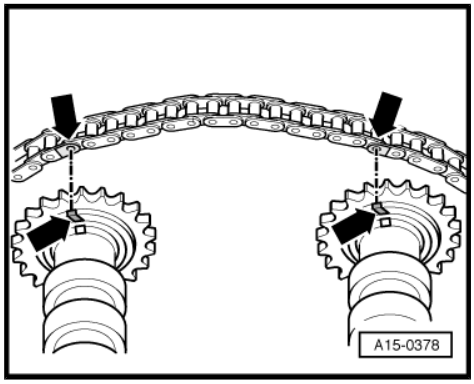
– Renew rubber/metal gasket for camshaft adjuster and apply a thin coat of sealant to the shaded area.



♦ Sealant ⇒ Parts catalogue
– Position drive chain on camshaft chain sprockets as follows:

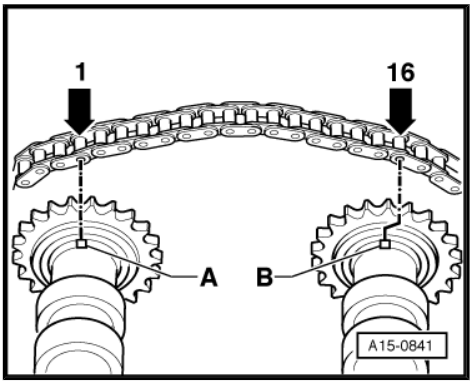
If old drive chain is being used:

♦ Adjust the colour markings -arrows- so they are aligned.



If new drive chain is being used:

- The distance between notches -A- and -B- on the camshafts must be 16 drive chain rollers. The illustration shows the exact positions of the 1st and 16th rollers on the sprockets.
- Notch -B- is offset slightly towards the inside in relation to chain roller -16-.



Continued:

– Insert camshaft adjuster into the chain (2nd mechanic required).

– Insert camshafts with drive chain and camshaft adjuster into cylinder head.

– Oil running surfaces of both camshafts.

Note

Dowel sleeves for bearing caps and camshaft adjuster must be positioned in cylinder head

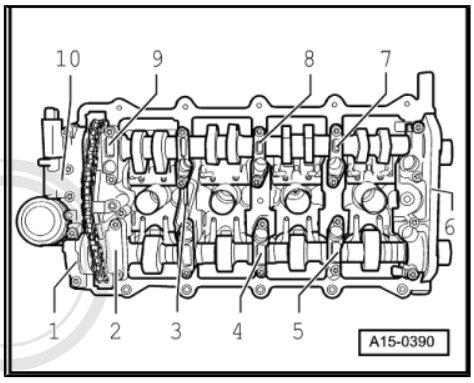
– Fit bearing caps 3, 5 and 7 as per marking.

– Tighten bearing caps 3, 5 and 7 on inlet and exhaust camshafts diagonally in alternating sequence.

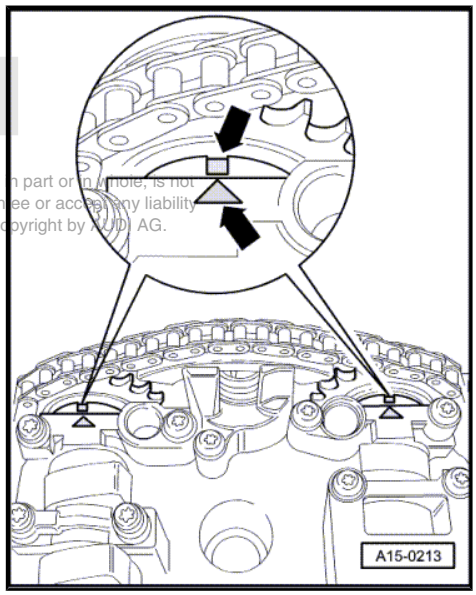
– Secure camshaft adjuster -10-.

– Remove chain tensioner retainer -3366- .

– Check correct setting of camshafts:



- The two markings on the camshafts must be in line with the two arrows on the bearing caps -arrows-.



Note

If necessary, turn camshaft slightly backwards or forwards so that the two marks coincide.

– Apply a small quantity of sealant to the hatched areas on the double bearing cap and the outer bearing cap adjacent to the camshaft adjuster and fit the bearing caps.

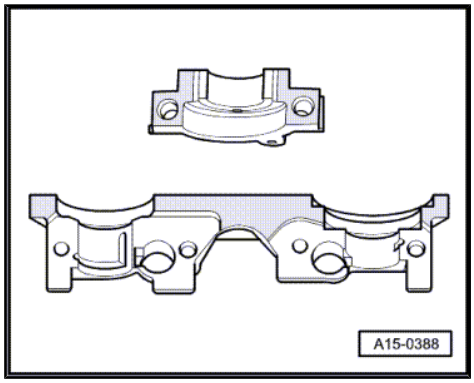
♦ Sealant ⇒ Parts catalogue

– Fit the remaining bearing caps.

– Renew oil seals for inlet and exhaust camshaft and install on camshaft ⇒ page 116 and at Hall sender ⇒ page 118 .

– Drive sealing cap in carefully using fitting sleeves -3202- .

– Turn the crankshaft approx. 45° clockwise back to TDC at the toothed belt sprocket bolt and secure crankshaft with locking pin.



Perform further installation in reverse order, paying attention to the following:

– Install toothed belt (adjust valve timing) ⇒ page 60 .

– Install cylinder head cover ⇒ page 97 .

– Install engine ⇒ page 31 .

– Install torque reaction support ⇒ page 42 .

Note

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

♦ *After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.*

Tightening torques

Component		Nm
Bearing cap to cylinder head		5 + 90° 1)2)
Camshaft adjuster to cylinder head		5 + 90° 1)2)
Toothed belt cover (rear) to:	Cylinder head	10 3)
	Coolant pump	10
Idler roller to cylinder head		22

- 1) Renew bolt
- 2) 90° = one quarter turn.
- 3) Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .

3.6 Removing and installing roller rocker fingers

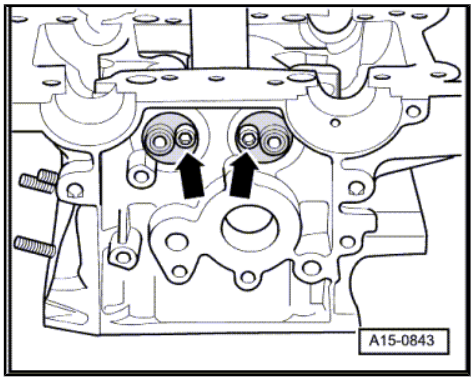
Removing

- Engine removed ⇒ page 7 .

– Remove camshafts and camshaft adjuster for cylinder head (right-side) ⇒ page 125 and/or cylinder head (left-side) ⇒ page 121 , as required.

– Mark the assignment of the roller rocker fingers and their shafts ready for refitting.

– Remove bolts -arrows-.
– Screw an M6 bolt into the hole in the roller rocker finger shaft.
– Pull the shaft out of the cylinder head and detach the roller rocker fingers.



Installing

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

Note

Renew O-rings.

– Oil bearing points of roller rocker fingers prior to installing.
– Install camshafts and camshaft adjuster on cylinder head (left-side) ⇒ page 121 and/or on cylinder head (right-side) ⇒ page 125 .

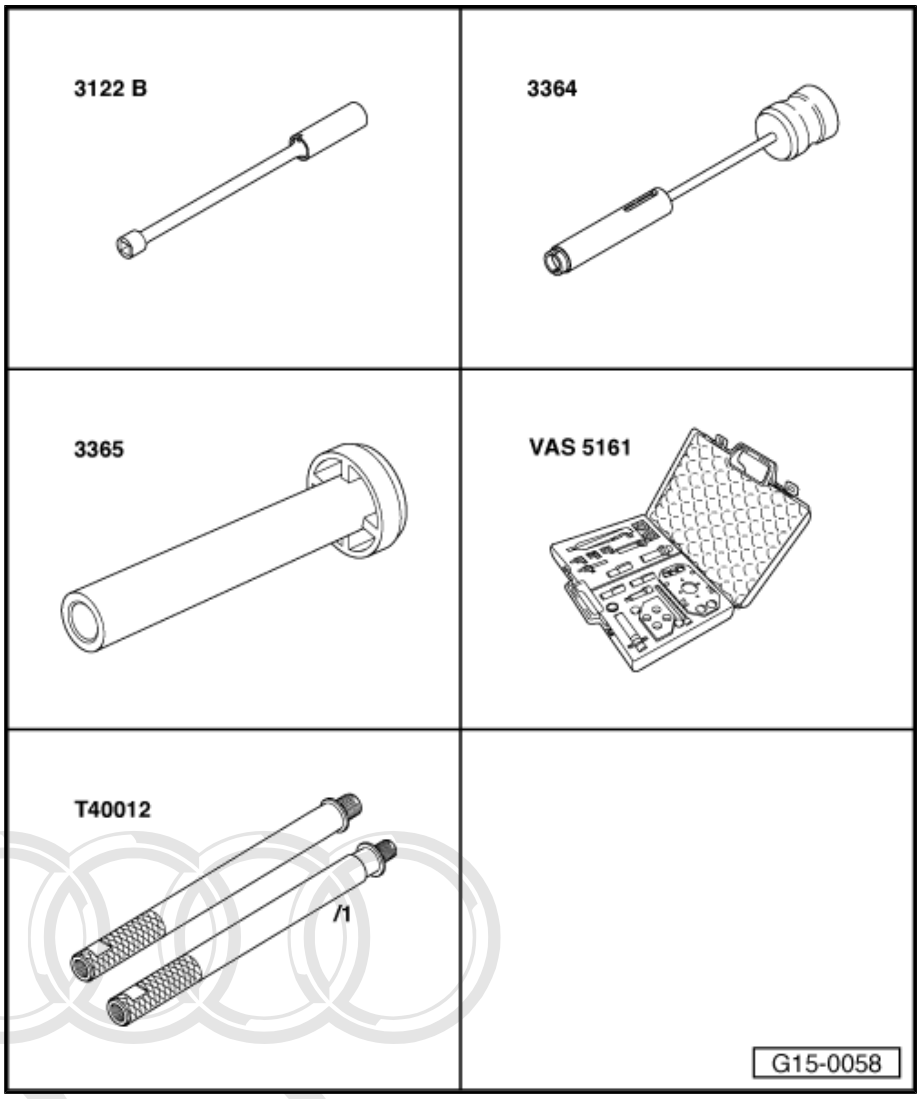
Tightening torque

Component	Nm
Roller rocker finger shaft to cylinder head	10

3.7 Renewing valve stem oil seals

Special tools and workshop equipment required

- Spark plug socket and extension -3122 B-
- Valve stem seal puller -3364-
- Valve stem seal fitting tool -3365-
- Removal / installing device for valve cotters -VAS 5161-
- Adapter -T40012-



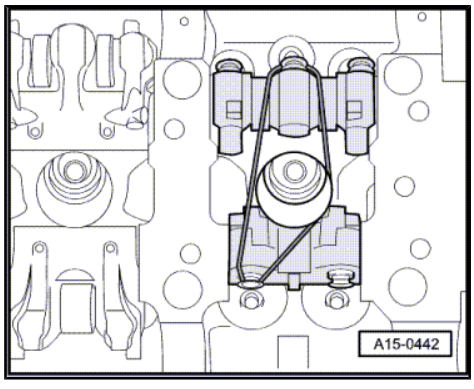
Removing

- Engine removed ⇒ page 7 .

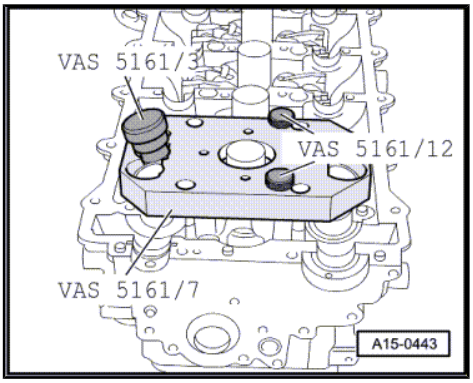
– Remove camshafts and camshaft adjuster for cylinder head (right-side) ⇒ page 125 and/or cylinder head (left-side) ⇒ page 121 , as required.

– Remove spark plugs with spark plug socket -3122 B- .

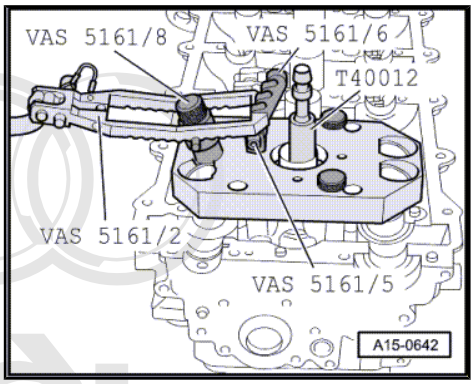
– Rotate roller rocker fingers upwards and secure them with a rubber band.



– Fit guide plate -VAS 5161/7- from removal / installing device for valve cotters -VAS 5161- on cylinder head.
– Secure guide plate -VAS 5161/7- using the knurled screws -VAS 5161/12- .
– Insert drift -VAS 5161/3- into guide plate and knock valve cotters loose using a plastic hammer.



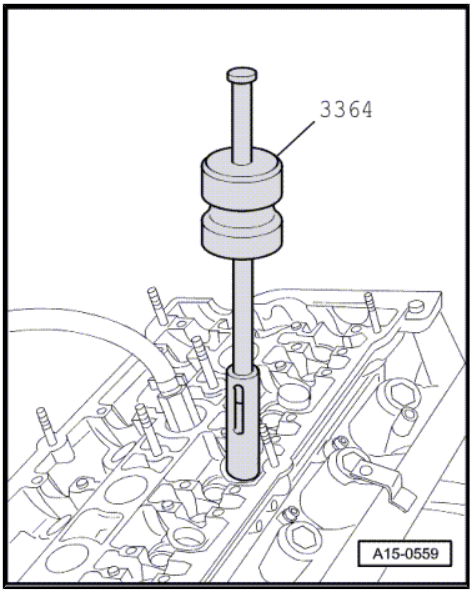
– Screw snap-in device -VAS 5161/6- with -VAS 5161/5- into guide plate -VAS 5161/7- .
– Insert assembly cartridge -VAS 5161/8- into guide plate -VAS 5161/7- .
– Screw adapter -T40012- with seal hand-tight into the corresponding spark plug thread and apply a steady pressure.
♦ Minimum pressure: 6 bar
– Attach pressure fork -VAS 5161/2- to snap-in device -VAS 5161/6- 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 cartridge.

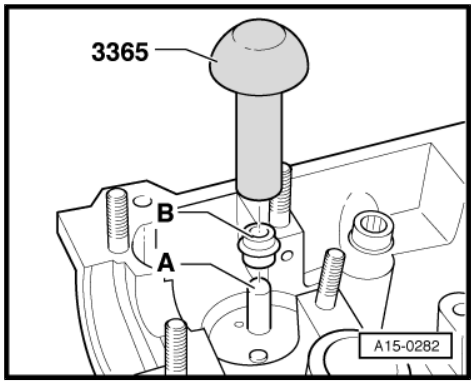


– Release the pressure fork.
– Remove assembly cartridge.
– Unscrew guide plate.
♦ The compressed air hose remains connected.

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

Installing

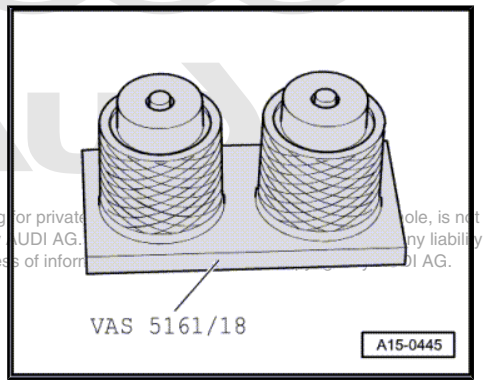




Note

- *To press on the valve stem seals from the current product range, the valve stem seal fitting tool -3365- must be drilled out to ∅ 6.5 mm.*
- *A plastic sleeve -A- is included with the new valve stem oil seals.*

– To prevent damage to the new valve stem seals -B-, attach plastic sleeve -A- to valve stem.
– Lightly oil 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.

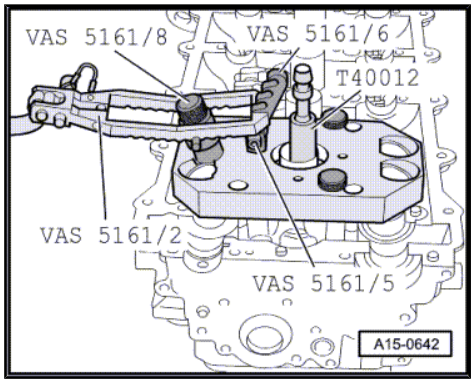


– If valve cotters have been removed from assembly cartridge, they need to be put into insertion device -VAS 5161/18- first.

Note

Larger diameter of valve cotters faces upwards.

– Insert valve spring and valve spring plate.
– Screw guide plate -VAS 5161/7- back onto cylinder head.



– Insert assembly cartridge -VAS 5161/8- into guide plate.
– Press down pressure fork and pull up knurled screw, thus inserting the valve cotters.
– Release the pressure fork with knurled screw still in pulled position.
– Install camshafts and camshaft adjuster on cylinder head (left-side) ⇒ page 121 and/or on cylinder head (right-side) ⇒ page 125 .

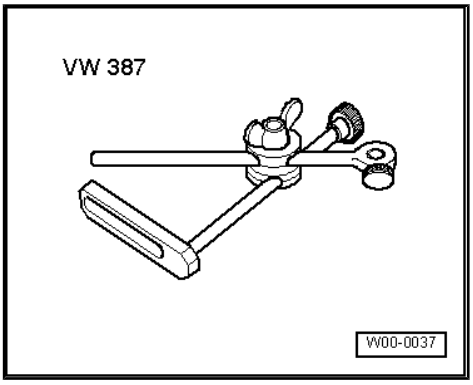
Note

- *After installing the camshaft, the engine must NOT be started for about 30 minutes. Hydraulic valve compensation elements have to 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.*

3.8 Checking valve guides

Special tools and workshop equipment required

♦ Universal dial gauge bracket -VW 387-

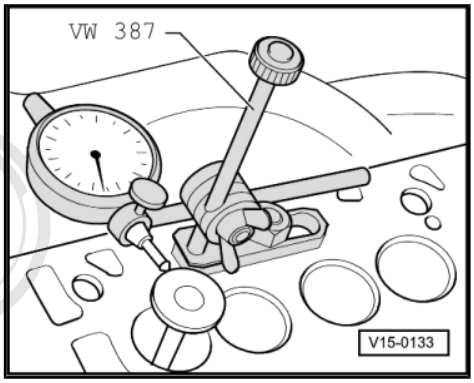


♦ Dial gauge

Test sequence

– Insert valve into guide. End of valve stem must be flush with guide. Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.

– Measure the amount of sideways play.



Wear limit

Inlet valve guide	Exhaust valve guide
0.80 mm	0.80 mm

Note

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

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

3.9 Checking valves

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

3.10 Machining valve seats

Note

If a good seating pattern cannot be obtained by grinding the valve seats (lapping), they must be refaced (machined):

Special tools and workshop equipment required

♦ Depth gauge

♦ Valve seat machining tool

Note

- *When servicing engines with leaking valves, it is not sufficient to machine (reface) the valve seats and renew the valves. The valve guides must also be checked for wear. This is particularly important on high-mileage engines* *⇒ page 134* *.*
- *Valve seats should only be machined to the extent required to give a proper seating pattern.*
- *The maximum permissible machining dimension must be calculated before starting work.*
- *If the maximum machining dimension is exceeded, the hydraulic valve clearance compensation will not work properly and the cylinder head will have to be renewed.*

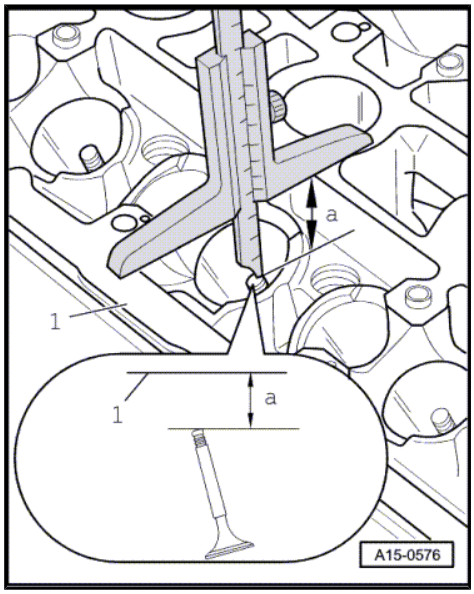
Calculating maximum permissible machining dimension

– Insert valve and press firmly against valve seat.

Note

If the valve has to be renewed as part of a repair, use a new valve for the measurement.

– Measure distance -a- between end of valve stem and centre axis of camshaft (centre axis of camshaft is level with top edge of cylinder head).



– Calculate maximum permissible machining dimension from measured distance and minimum dimension.

Minimum dimensions		
Inlet valves (outer)	Inlet valve (centre)	Exhaust valves
39.3 mm	41.0 mm	40.6 mm

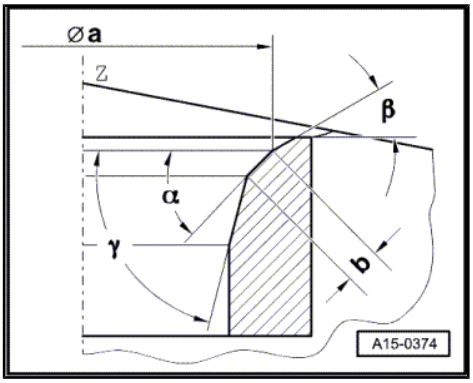
Measured distance minus minimum dimension = max. permissible machining dimension.

Example for inlet valve (outer):		
	Measured distance	39.7 mm
-	Minimum dimension	39.3 mm
=	Maximum permissible machining dimension	0.4 mm

Note

If the maximum permissible machining dimension is 0 mm or less than 0 mm, repeat the measurement with a new valve. If the result is again 0 mm or less than 0 mm, renew the cylinder head.

Machining valve seats



Inlet valve seat
a = ∅ 26.6 mm
b = approx. 1.0 mm
Z = Bottom surface of cylinder head
α = 45° valve seat angle
β = 30° upper correction angle
g = 60° lower correction angle

Exhaust valve seat
a = ∅ 26.0 mm
b = approx. 1.0 mm
Z = Bottom surface of cylinder head
α = 45° valve seat angle
β = 30° upper correction angle
g = 60° lower correction angle

4 Checking variable valve timing

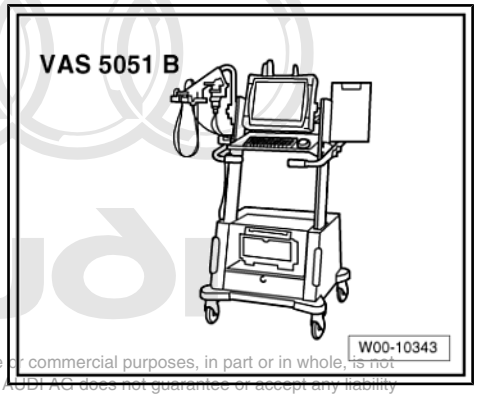
The timing of the inlet camshaft is controlled according to engine load and engine speed. Oil pressure is fed to the mechanical camshaft adjuster via the electrical camshaft control valve (solenoid valve).

Note

The variable valve timing is not activated until about 25 seconds after the engine has started.

4.1 Testing the system

- Vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/1-



Test conditions

- Coolant temperature at least 80 °C.
- Vehicles with automatic gearbox: selector lever in position P or N

Test sequence

– Connect vehicle diagnostic, testing and information system -VAS 5051- and select vehicle system “01 - Engine electronics” from list. Engine must be idling ⇒ Rep. Gr. 01 .

WARNING

- ***Test equipment must always be secured on the rear seat and operated from that position by a second person.***
- ***If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, the person sitting in this seat could be seriously injured when the airbag is triggered.***

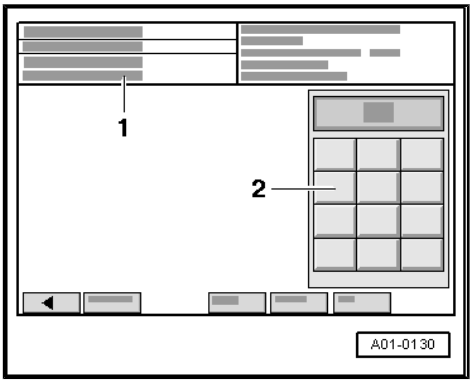
Display on -VAS 5051- :

– From list -1- select diagnostic function “04 - Basic setting”.

Display on -VAS 5051- :

1 - Enter display group

– Using the keypad -2-, enter “094” to select “Display group 094” and confirm entry with the Q key.

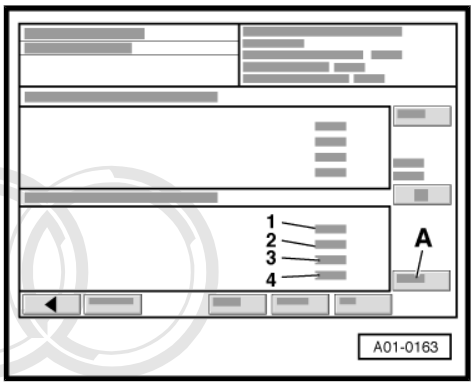


Display on -VAS 5051- :

– Activate basic setting by touching key A.

– Increase the engine speed to above 2000 rpm for approx. 10 seconds.

– Check specifications in display zones -3- and -4-.



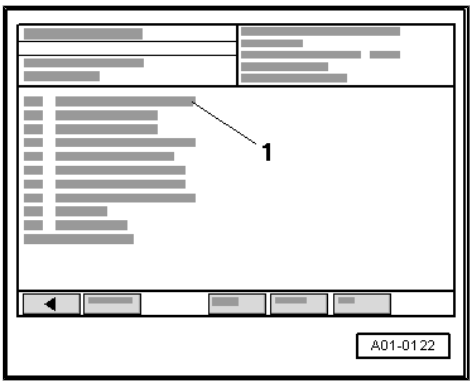
	Display zones			
	1	2	3	4
Display group 94: variable valve timing, bank 1 (right-side) and bank 2 (left-side)				
Readout	xxxx rpm	---	---	---
Display shows	Engine speed	Variable valve timing (camshaft adjustment)	Variable valve timing bank 1	Variable valve timing bank 2
Range		CS-ctrl ON CS-ctrl OFF	Test OFF Test ON Syst. OK Syst. n. OK	Test OFF Test ON Syst. OK Syst. n. OK
Specifi-cation	More than 2000 rpm		Syst. OK	Syst. OK

If specified value “Syst. OK” is NOT attained:

– Touch the < key twice.

Display on -VAS 5051- :

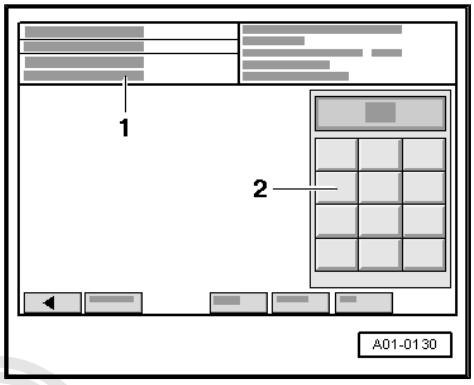
– From list -1- select diagnostic function “08 - Read measured value block”.



Display on -VAS 5051- :

1 - Enter display group

– Use keypad -2- to enter “090” for “Display group number 090” and confirm by touching the Q key.

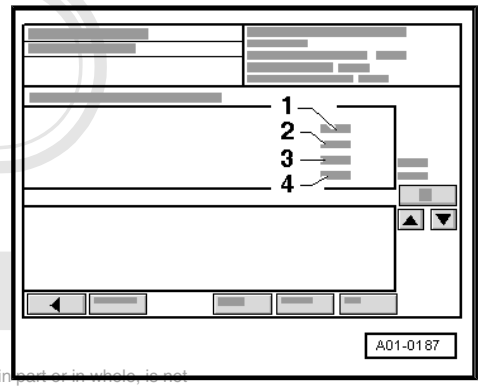


Display on -VAS 5051- :

Test condition

- Engine running at idling speed.

– Check specifications in display zones -3- and -4-.



	Display zones			
	1	2	3	4
Display group 090: variable valve timing at idling speed				
Readout	xxx rpm	---	°CA	°CA
Display shows	Engine speed	Variable valve timing	Variable valve timing bank 1 (cylinder bank right-side)	Variable valve timing bank 2 (cylinder bank left-side)
Specification	xxxx rpm	CS-ctrl OFF	-3 ..6° crankshaft	-3 ..6° crankshaft

– Perform test drive.

– Check specifications in display zones -3- and -4-.

	Display zones			
	1	2	3	4
Display group 090: variable valve timing when driving				
Readout	xxxx rpm	---	°CA	°CA
Display shows	Engine speed	Variable valve timing	Variable valve timing bank 1 (cylinder bank right-side)	Variable valve timing bank 2 (cylinder bank left-side)
Specification	xxxx rpm	CS-ctrl ON	16 ..25° CA	16 ..25° CA

– Press the < key to exit from function “08 - Read measured value block”.

If the specifications are not obtained:

– Check the camshaft control valves ⇒ Guided Fault Finding .

Note

If the readout only shows a value between 6.0° CA (crankshaft angle) and 16.0° CA during the test drive, this indicates that the electrical camshaft control valve is working correctly and feeding the oil pressure to the camshaft adjustment mechanism, but the mechanism is not able to reach its end position (possibly because it is not moving freely).

17 – Lubrication

1 Removing and installing parts of lubrication system

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 oil cooler must be renewed in order to prevent further damage occurring later.*
- *The oil level must not be above the max. mark – otherwise the catalytic converter can be damaged.*

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 404

Oil capacities: ⇒ Exhaust emissions test

1.1 Oil pump, sump (bottom section) - exploded view

1 - Sump (bottom section)
- ❑ Removing and installing ⇒ page 144
- ❑ With oil level and oil temperature sender - G266-

2 - 10 Nm

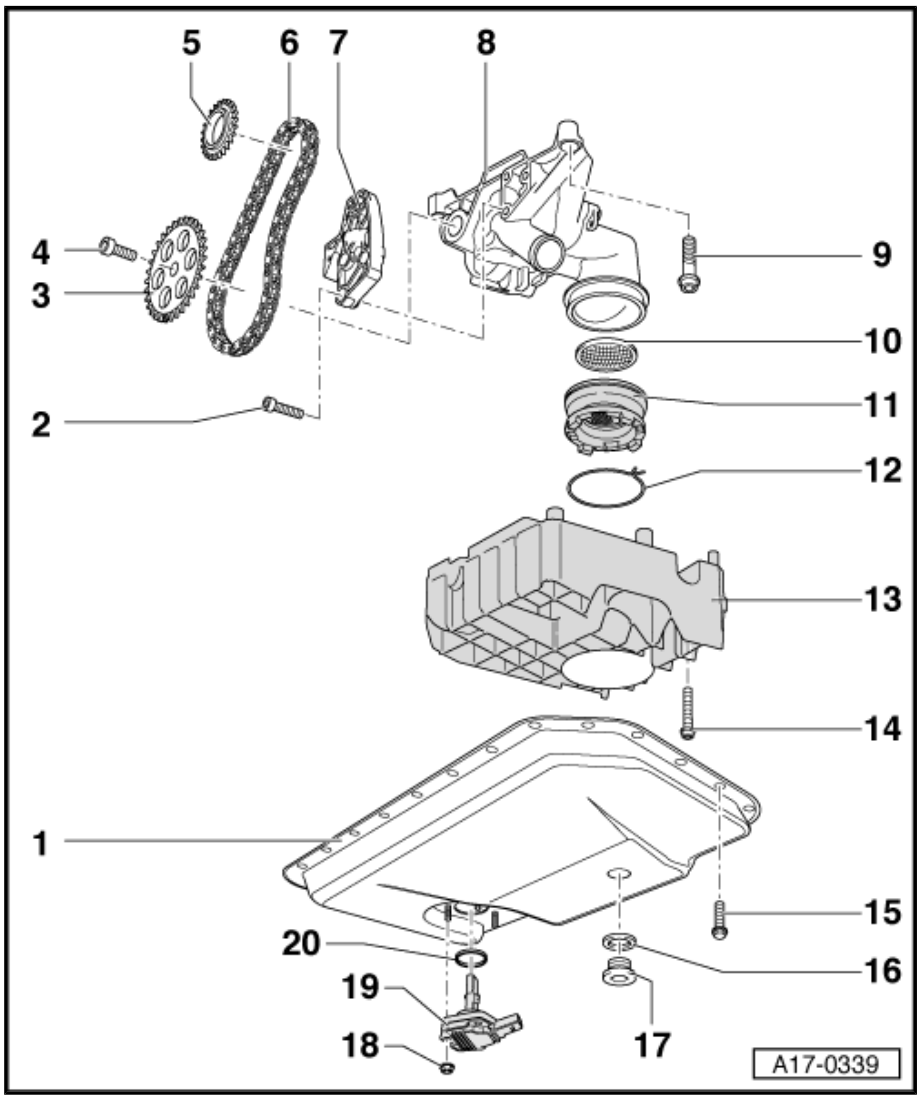
3 - Chain sprocket
- ❑ For oil pump
- ❑ Installation position: Side with lettering faces front
- ❑ Removing and installing ⇒ Removing and installing chain drive for oil pump ⇒ page 88

4 - 34 Nm

5 - Chain sprocket
- ❑ For crankshaft
- ❑ Removing and installing ⇒ Removing and installing chain drive for oil pump ⇒ page 88

6 - Drive chain for oil pump
- ❑ Removing and installing ⇒ Removing and installing chain drive for oil pump ⇒ page 88

7 - Chain tensioner
- ❑ Secure with a length of wire before removing
- ❑ Do not dismantle



- ❑ Removing and installing
  ⇒ Removing and installing chain drive for oil pump ⇒ page 88

8 - Oil pump

- ❑ Do not dismantle
- ❑ With pressure control valve: approx. 7 bar
- ❑ Removing and installing ⇒ page 147

9 - 30 Nm

10 - Oil strainer

- ❑ Clean if dirty

11 - Intake connecting pipe

12 - Retaining ring

13 - Baffle plate

14 - 10 Nm

- ❑ Different lengths

15 - 10 Nm

- ❑ Tighten in stages and in diagonal sequence

16 - Seal

- ❑ Renew

17 - Oil drain plug, 50 Nm

18 - 10 Nm

19 - Oil level and oil temperature sender -G266-

- ❑ Removing and installing ⇒ page 143

20 - Seal

- ❑ Renew

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

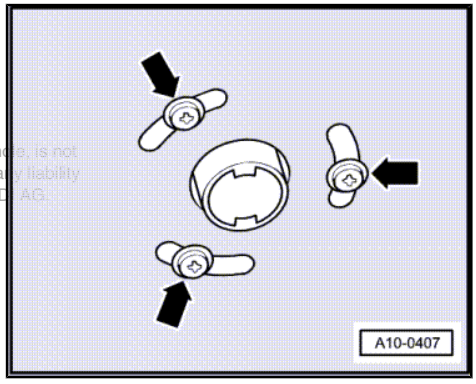
Removing

Note

Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

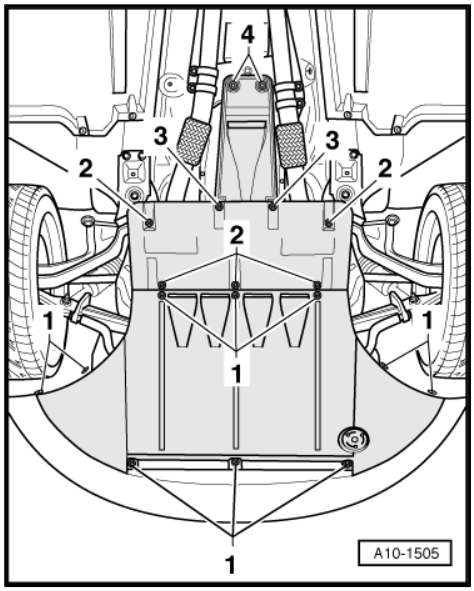
Vehicles with auxiliary heater / supplementary heater:

– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



All models:

– Release fasteners -1- and remove noise insulation.
– Place drip tray underneath.
– Drain off engine oil.



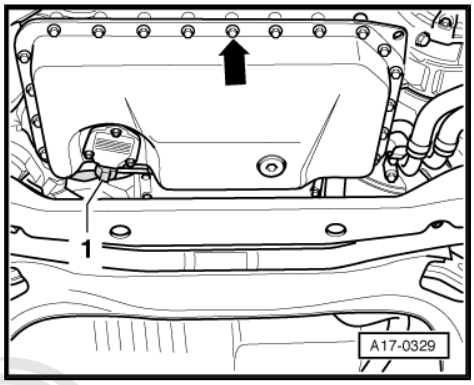
– Unplug electrical connector at oil level and oil temperature sender -G266- -1-.
– Remove oil level and oil temperature sender -G266- .

Installing

Note

Renew seals.

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



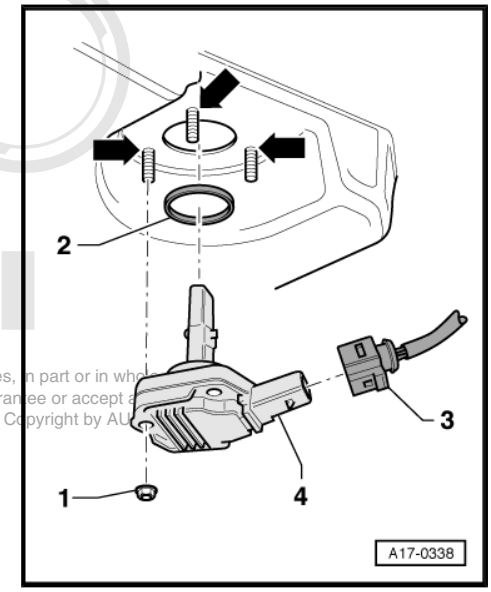
– Apply sealant to studs on sump -arrows-.

Sealant ⇒ Parts catalogue

– Install oil level and oil temperature sender -G266- -4-.
– Connect electrical wiring -3-.
– Fill up with engine oil and check oil level.
– Fit noise insulation.

Tightening torques

Component	Nm
Oil level and oil temperature sender -G266-	10
Oil drain plug	50



1.3 Removing and installing sump (bottom section)

Special tools and workshop equipment required

- Drip tray
- Electric drill with plastic brush attachment

- Safety goggles
- Silicone sealant ⇒ Parts catalogue

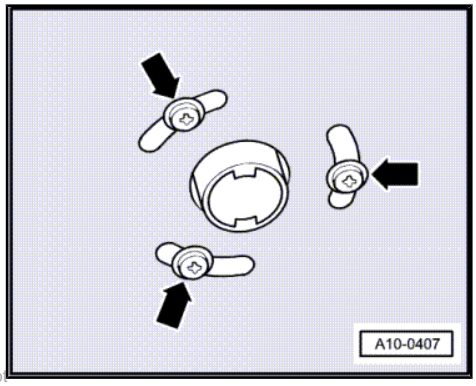
Removing

Note

Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

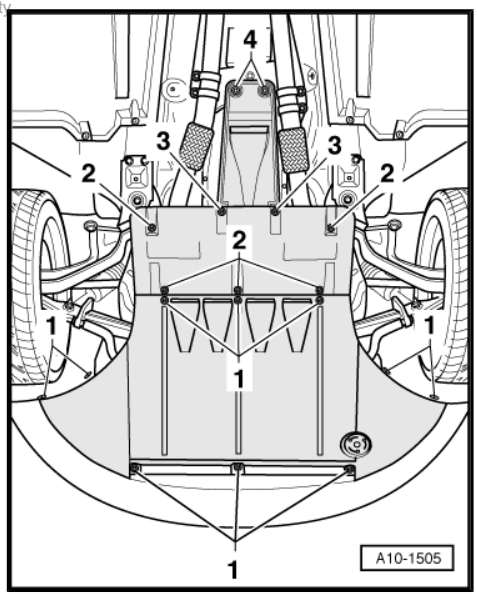
Vehicles with auxiliary heater / supplementary heater:

– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



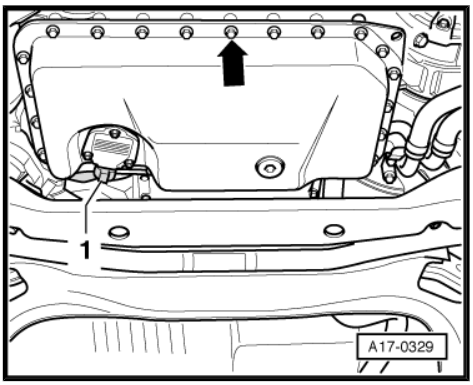
All models:

– Release fasteners -1- and remove noise insulation.



– Place drip tray underneath.
– Drain off engine oil.

– Unplug electrical connector at oil level and oil temperature sender -G266- -1-.
– Unbolt sump (bottom section) -arrow-.

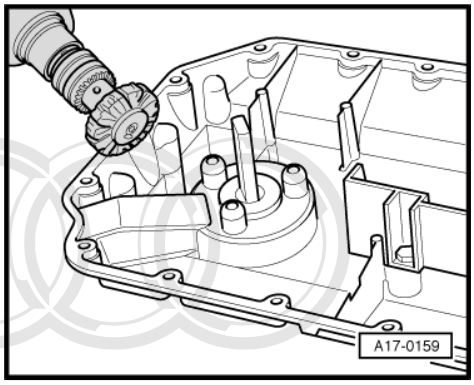


Installing

Note

Renew seals.

– Remove remaining sealant on sump (bottom and top sections) with a rotating plastic brush or similar.

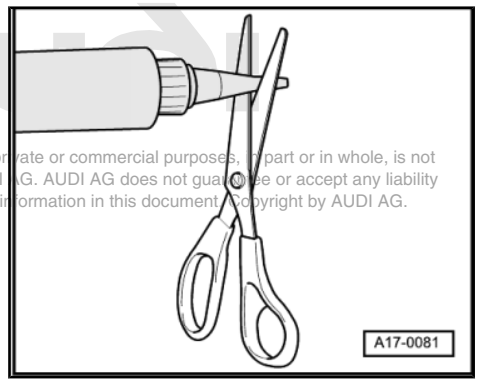


WARNING

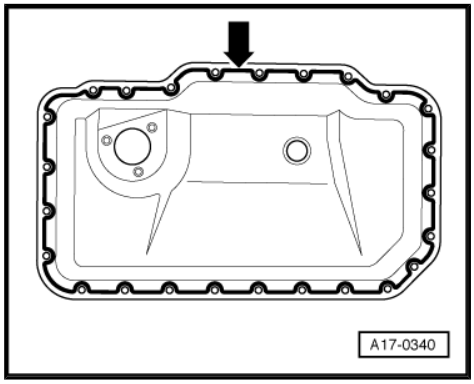
Wear safety goggles.

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

– Cut off nozzle of tube at front marking (∅ of nozzle approx. 1 mm).



– Apply the bead of silicone sealant onto the clean sealing surface of the sump (bottom section), as illustrated.



♦ The bead of sealant should be 1.5 mm wide -arrow-.

Note

♦ *The sump (bottom section) must be installed within 5 minutes after applying the silicone sealant.*

♦ *The sealant bead must not be thicker than specified, otherwise excess sealant could enter the sump (bottom section) and clog the strainer in the oil pump.*

– Fit sump (bottom section) and tighten all bolts initially to 5 Nm in diagonal sequence.

– Tighten bolts securing sump (bottom section) to 10 Nm in diagonal sequence.

– Fill up with engine oil and check oil level.

Tightening torques

Component	Nm
Sump (bottom section) to sump (top section)	10
Oil drain plug	50

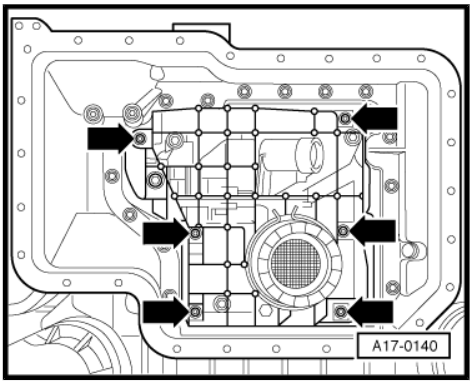
1.4 Removing and installing chain drive for oil pump

Removing

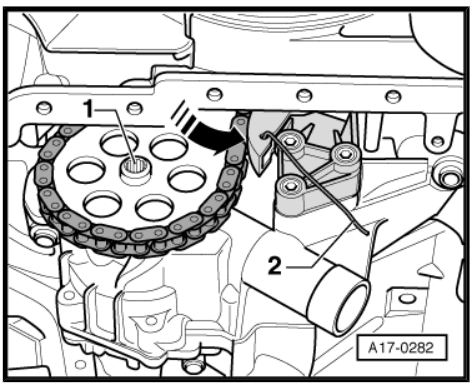
– Remove toothed belt ⇒ page 60 .

– Remove sealing flange (front) ⇒ page 72 .

– Unscrew baffle plate -arrows-.



– Secure oil pump chain tensioner with a suitably shaped piece of wire -2-.
– Unscrew bolt -1- and pull chain sprocket off oil pump.
– Pull chain sprocket off crankshaft together with chain.
– Unbolt chain tensioner from oil pump as necessary.



Installing

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

Note

Note installation position of chain sprockets. The sides with identification lettering face to the front.

– Note installation position of chain sprockets.
♦ Installation position: identification lettering faces front
– Install sealing flange (front) ⇒ page 72 .
– Install toothed belt (adjust valve timing) ⇒ page 60 .
– Install torque reaction support ⇒ page 42 .

Tightening torques

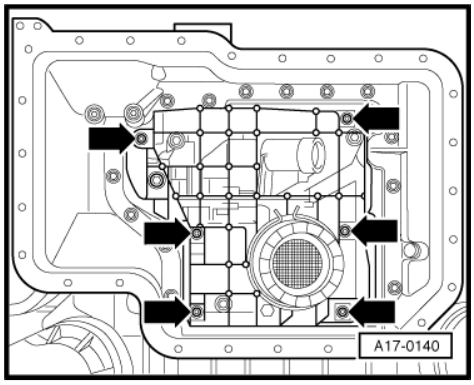
Component	Nm
Chain tensioner to oil pump	10
Chain sprocket to oil pump	34
Baffle plate to sump (top section)	10
Oil drain plug	50

1.5 Removing and installing oil pump

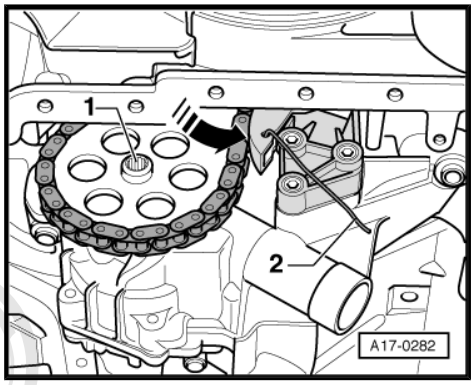
Removing

– Remove sump (bottom section) ⇒ page 144 .

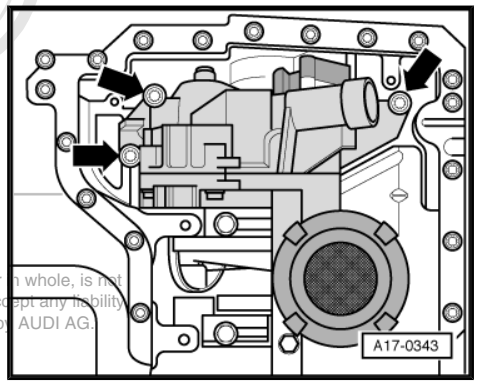
– Unscrew baffle plate -arrows-.



– Secure oil pump chain tensioner with a suitably shaped piece of wire -2-.
– Unscrew bolt -1- and pull chain sprocket off oil pump.



– Unscrew oil pump -arrows-.



Installing

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

– Pay attention to installation position of chain sprocket for oil pump.

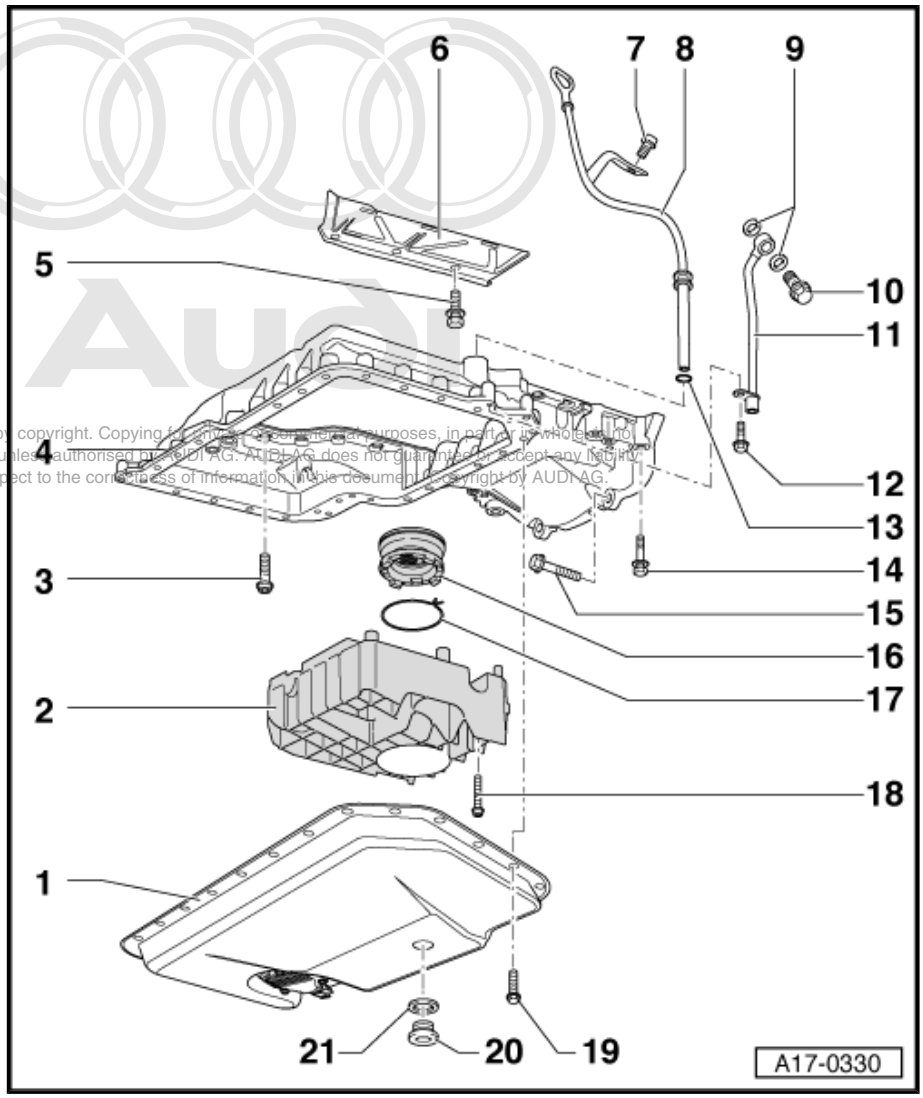
◆ Installation position: identification lettering faces front

– Install sump (bottom section) ⇒ page 144

Tightening torques

Component	Nm
Oil pump to sump (top section)	30
Chain sprocket to oil pump	34
Baffle plate to sump (top section)	10
Oil drain plug	50

1.6 Sump (top section) - exploded view



1 - Sump (bottom section)
- ❑ Removing and installing ⇒ page 144
- ❑ With oil level and oil temperature sender - G266-
- ❑ Removing and installing oil level and oil temperature sender -G266- ⇒ page 143

2 - Baffle plate

3 - 14 Nm
- ❑ Note correct sequence when tightening ⇒ page 150

4 - Sump (top section)
- ❑ Removing and installing ⇒ page 150

5 - 22 Nm

6 - Baffle plate

7 - 22 Nm

8 - Guide tube for oil dipstick

9 - Seals
- ❑ Renew

10 - 32.5 Nm

11 - Coolant drain pipe

12 - 10 Nm

13 - O-ring
- ❑ Renew

14 - 22 Nm
- ❑ Note correct sequence when tightening ⇒ page 150

15 - 65 Nm

16 - Intake connecting pipe

17 - Retaining ring

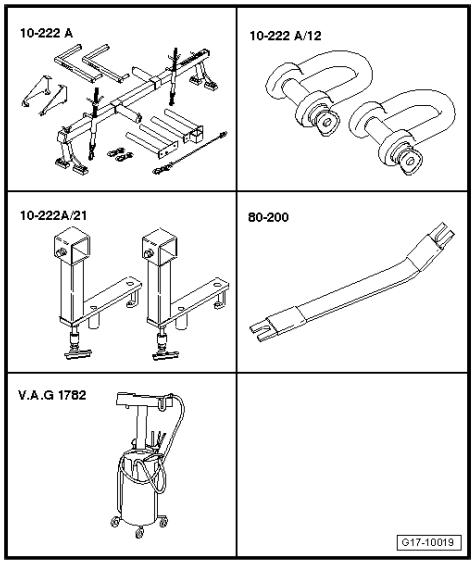
18 - 10 Nm

19 - 10 Nm
- ❑ Tighten in stages and in diagonal sequence

20 - Oil drain plug, 50 Nm

21 - Seal
- ❑ Renew

1.7 Removing and installing sump (top section)



Special tools and workshop equipment required

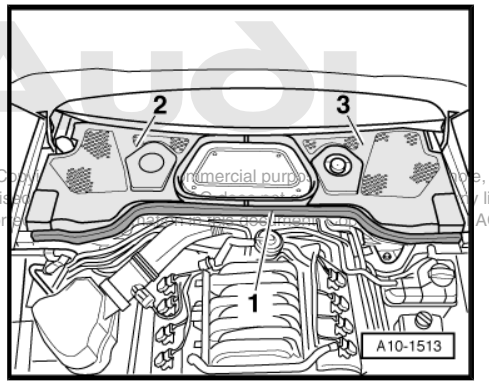
- Support bracket -10 - 222 A-
- Shackle -10 - 222 A /12-
- Adapter -10-222 A /21-
- Removal lever -80 - 200-
- Used oil collection and extraction unit -V.A.G 1782-
- Electric drill with plastic brush attachment
- Safety goggles
- Silicone sealant ⇒ Parts catalogue
- Block of wood 50 x 50 x 50 mm

Removing

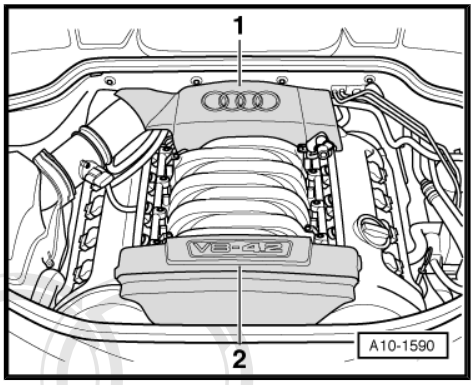
Note

Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

– Pull off rubber seal -1- on plenum chamber cover.
– Detach plenum chamber covers -2- and -3-.



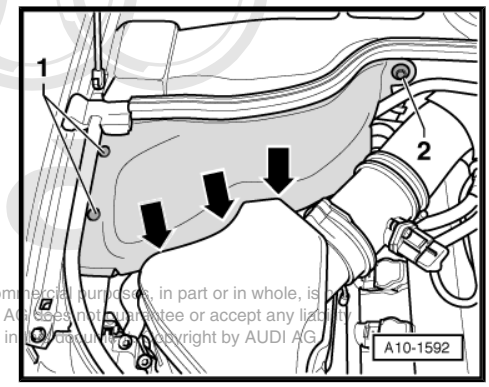
– Lift off engine cover panel -1-.



– Pull out clips -1- using removal lever -80 - 200- .
– Unscrew bolt -2- and remove cover.

Note

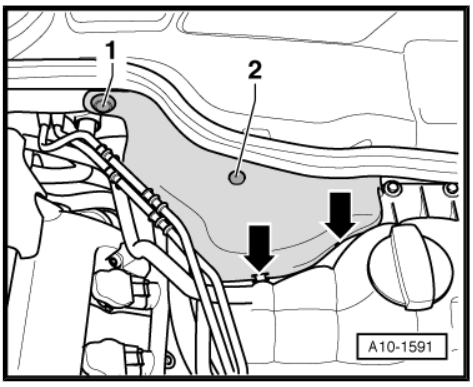
Pay attention to clips -arrows- on installation.



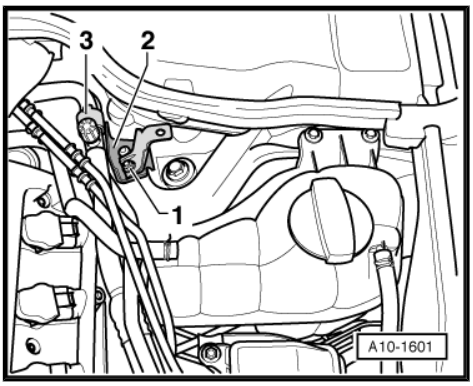
– Unscrew bolt -1- and use removal lever -80 - 200- to take out spreader rivet -2-, then remove cover (left-side).

Note

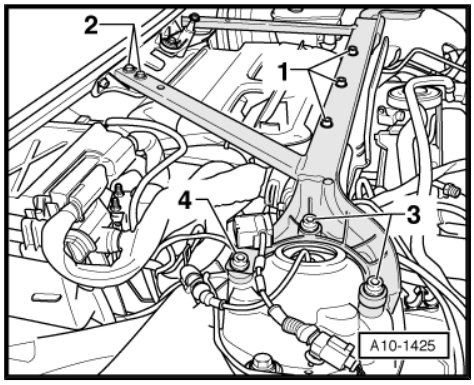
Pay attention to clips -arrows- on installation.



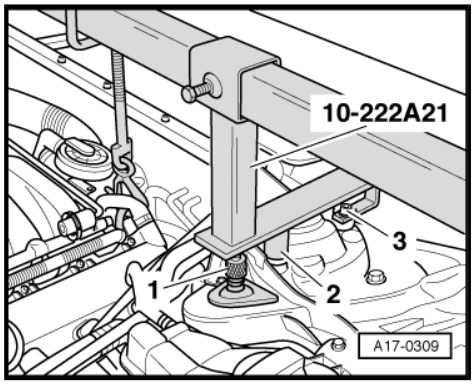
– Remove bracket for cover -1-.
– Unscrew bracket for air conditioner pipe -2-.
– Unclip bracket from air conditioner pipe -3-.



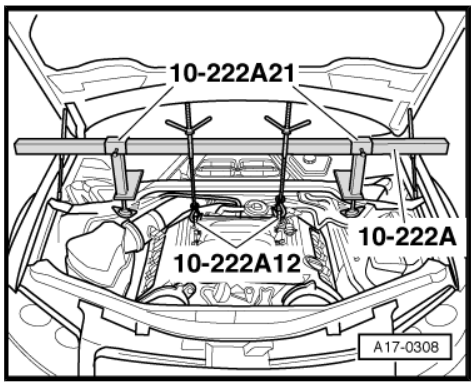
– Remove bolt -4- (left and right).



– Attach support bracket -10 - 222 A- with adapters -10 - 222 A / 21- onto suspension turrets.
– Screw adapters -10 - 222 A /21- onto body brace -3- (left and right).
♦ Supports are marked for left and right-side of vehicle.
♦ The centre support point is positioned on the front bolts for the body brace.
♦ The knurled screw -1- must be screwed down until support plate rests on suspension turret.

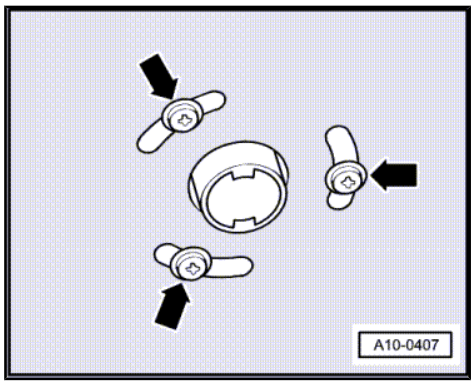


– Attach shackles -10 - 222 A /12- to rear engine lifting eyes.
– Hook shackles -10 - 222 A /12- onto spindles of support bracket -10 - 222 A-.
– Take up weight of engine with spindles of support bracket.



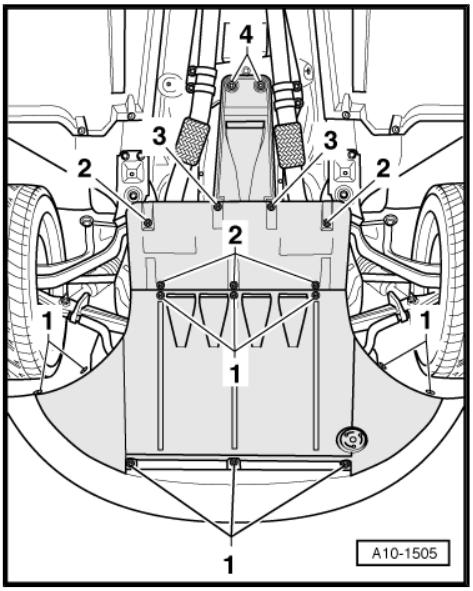
Vehicles with auxiliary heater / supplementary heater:

– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.

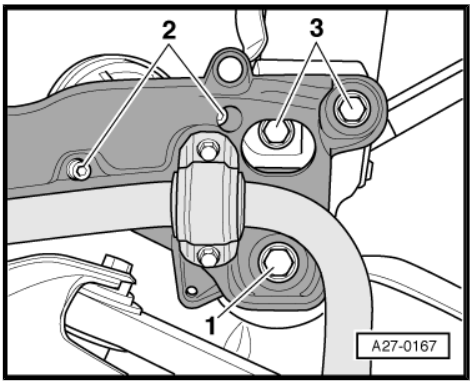


All models:

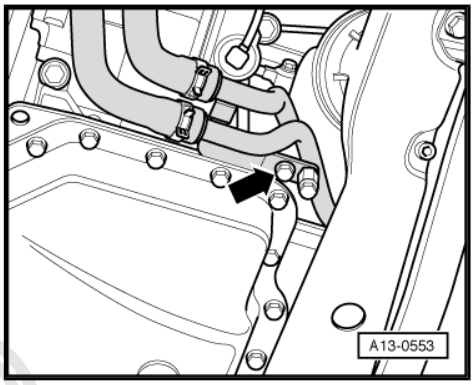
– Release fasteners -1- and remove noise insulation.



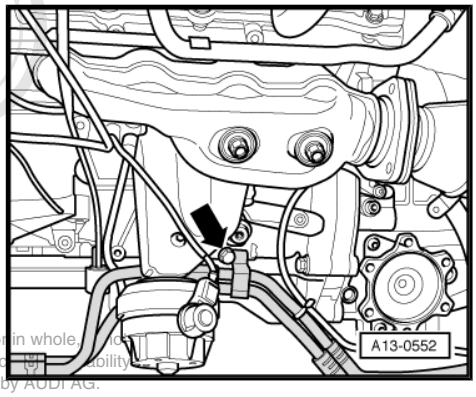
– Remove bolts -1...3- (left and right).
– Lower engine cross member.



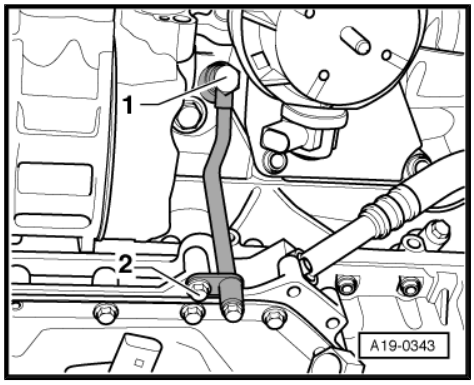
– Detach coolant pipe -arrow- from sump.



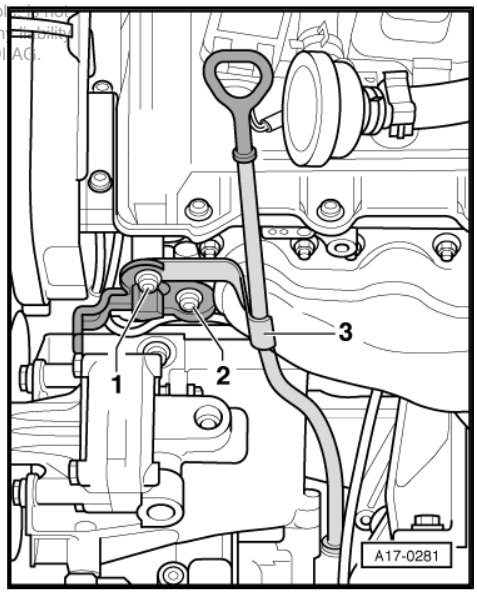
– Detach coolant pipe from cylinder block -arrow-.
– Drain coolant ⇒ page 170 .



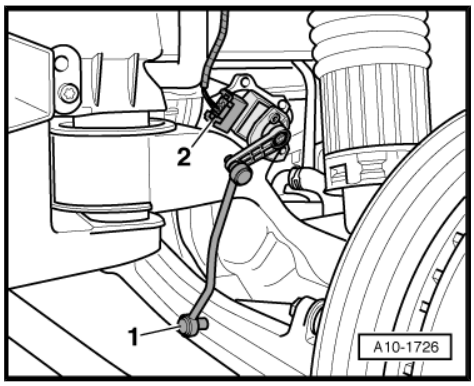
– Remove bolts -1- and -2- and detach coolant drain pipe.



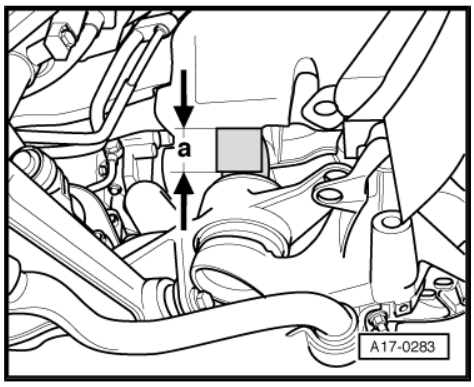
– Remove bolt -1- and slacken bolt -2- a few turns.
– Detach guide tube -3- with oil dipstick.



– Detach coupling rod -1- at track control link (left and right).
– Pull subframe downwards.



– Place a block of wood, height -a- = 50 mm, between front subframe mounting and vehicle body.

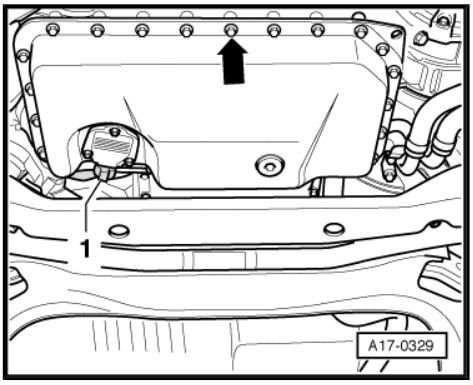


Note

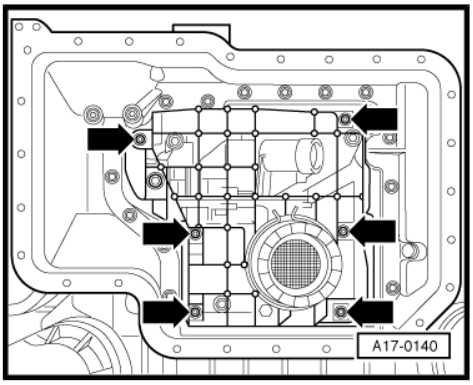
To avoid having to check and adjust wheel alignment, only loosen the front subframe mountings and lower the subframe at the front.

– Place drip tray underneath.
– Drain off engine oil.

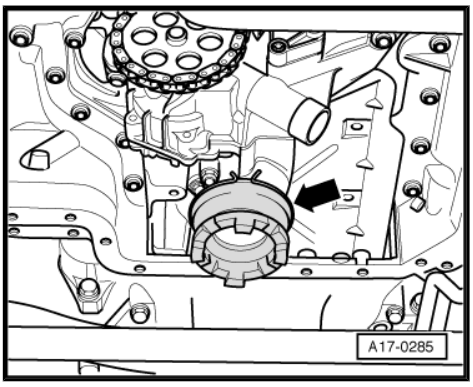
– Unplug electrical connector at oil level and oil temperature sender -G266- -1-.
– Unbolt sump (bottom section) -arrow-.



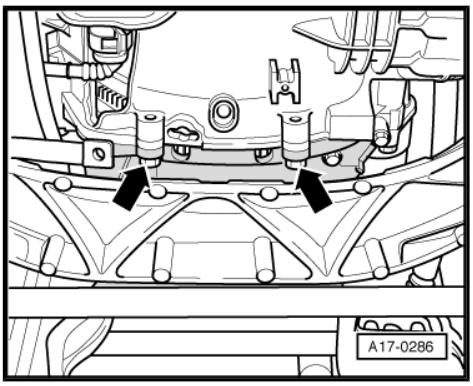
– Unscrew baffle plate -arrows-.
– Remove retaining ring.



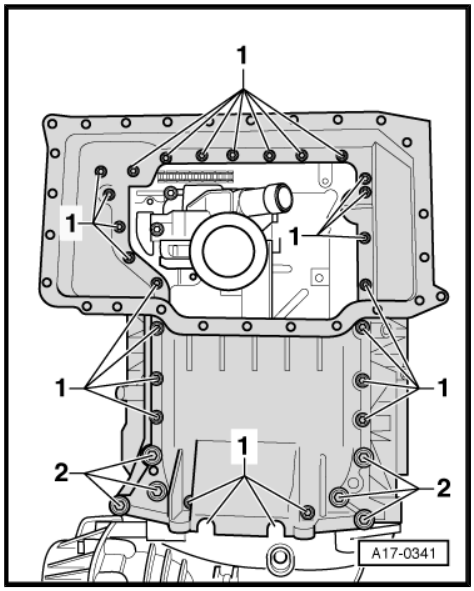
– Detach intake connection -arrow- from oil pump.



– Unscrew securing bolts -arrows- securing engine to gearbox near sump (top section).

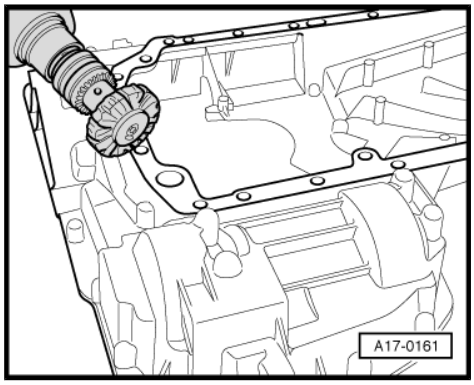


– Unscrew bolts -1- and -2- for sump (top section).
– Press sump (top section) off spring pins on cylinder block.



Installing

– Remove remaining sealant on sump (top section) and on cylinder block with a rotating plastic brush or similar.

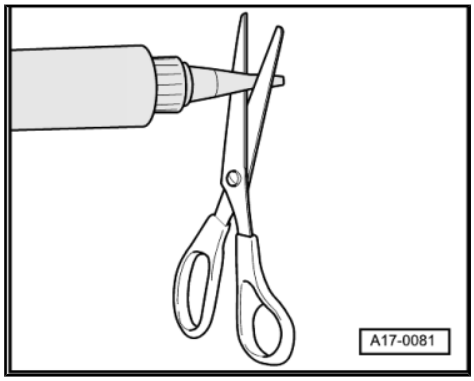


WARNING

Wear safety goggles.

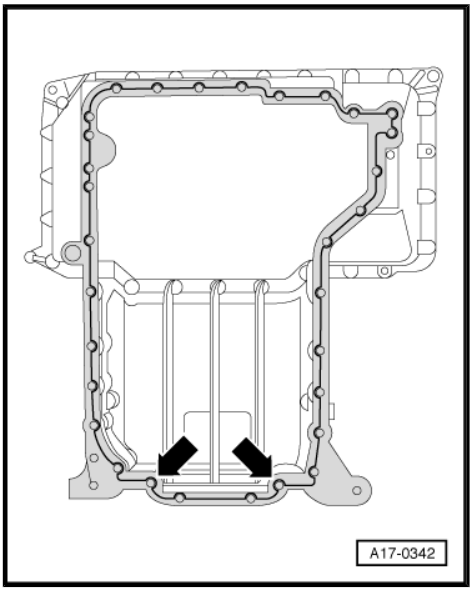
– Clean sealing surfaces; they must be free of oil and grease.

– Cut off nozzle of tube at front marking (∅ of nozzle approx. 1 mm).



– Apply the bead of silicone sealant onto the clean sealing surface of the sump (top section), as illustrated.

♦ The bead of sealant should be approx. 1.5 mm wide.



Note

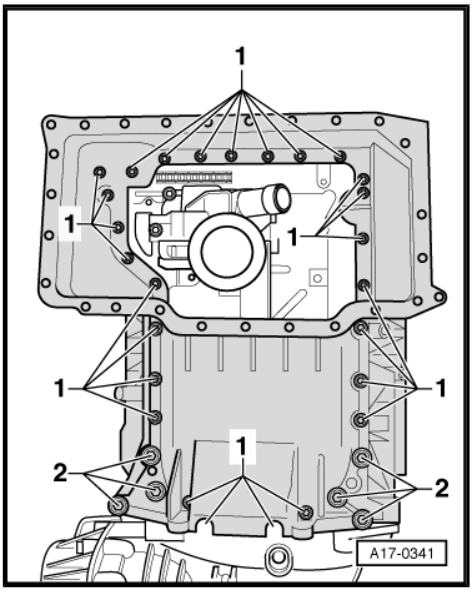
♦ *The sump (top section) must be installed within 5 minutes after applying the silicone sealant.*

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

♦ *Take particular care when applying the sealant bead in the area near the drilling in the cylinder block and the rear sealing flange -arrows-.*

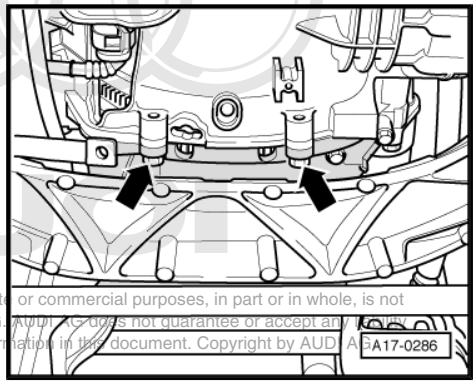
– Fit sump (top section) and tighten all bolts -1- and -2- securing sump (top section) to cylinder block initially to 5 Nm in diagonal sequence.

– Tighten bolts -1- and bolts -2- in diagonal sequence.



– Fit securing bolts -arrows- securing engine to gearbox near sump (top section).
– Tighten bolts securing sump (top section) to gearbox.
– Fit new O-ring to dipstick guide tube.

Perform further installation in reverse order, paying attention to the following:



Note

- *Renew seals and O-rings.*
- *Secure all hose connections with the correct type of 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. Do NOT use lubricant.*

– Install sump (bottom section) ⇒ page 143 .
– Install subframe ⇒ Rep. Gr. 40
– Fill up with engine oil and check oil level.
– Fill up with coolant ⇒ page 172 .

Tightening torques

Component		Nm
Sump (top section) to cylinder block and sealing flanges	M7	14
	M8	22
Sump (top section) to gearbox		65
Baffle plate to sump (top section)		10
Oil drain plug		50
Engine mounting to subframe		23
Guide tube for dipstick to cylinder head		22
Engine cross member to engine mounting		23
Engine cross member to body		68
Coolant drain pipe to:	Cylinder block	32.5
	Sump (top section)	10

1.8 Oil retention valves - exploded view

1 - O-ring
- ❑ Renew

2 - Oil retention valve, 20 Nm
- ❑ For oil supply to cylinder head (left-side)

3 - Gasket
- ❑ Renew

4 - Cover
- ❑ With connection for crankcase breather

5 - 10 Nm

6 - Connecting hose

7 - Crankcase breather pipe
- ❑ Cylinder bank 1 (right-side)

8 - 10 Nm

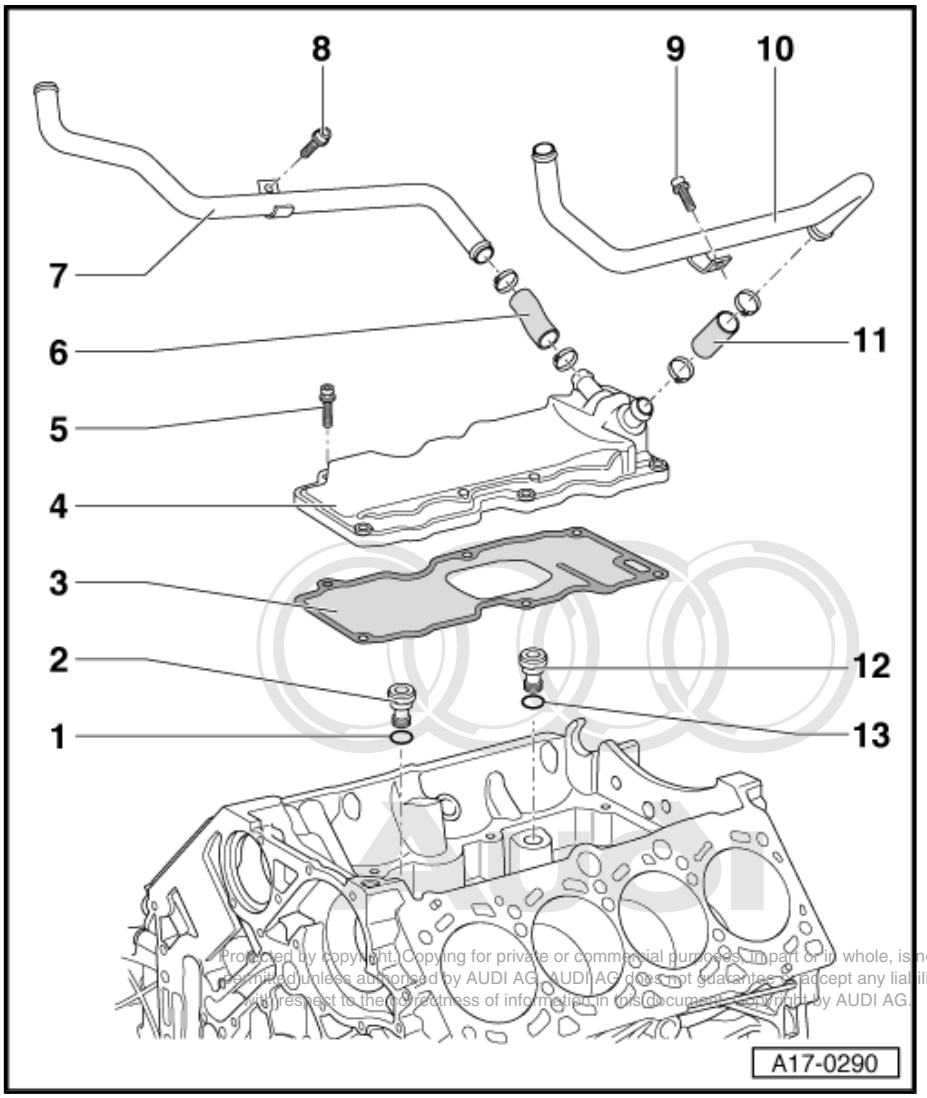
9 - 10 Nm

10 - Crankcase breather pipe
- ❑ Cylinder bank 2 (left-side)

11 - Connecting hose

12 - Oil retention valve, 20 Nm
- ❑ For oil supply to cylinder head (right-side)

13 - O-ring
- ❑ Renew



1.9 Renewing oil retention valves

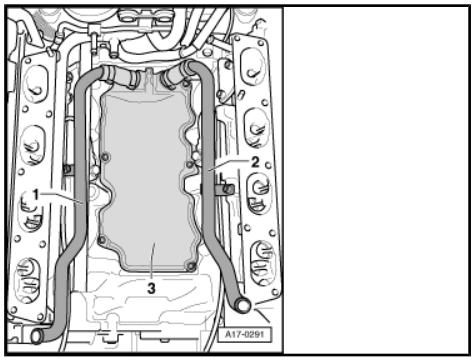
Note

In the event of irregular valve noise which disappears after a lengthy drive but repeatedly re-occurs when travelling short distances, the oil retention valves must be renewed.

Removing

– Remove intake manifold ⇒ Rep. Gr. 24 .

– Remove crankcase breather pipes -1- and -2-.
– Unbolt cover -3- below intake manifold.



– Unscrew oil retention valves -1- and -2-.

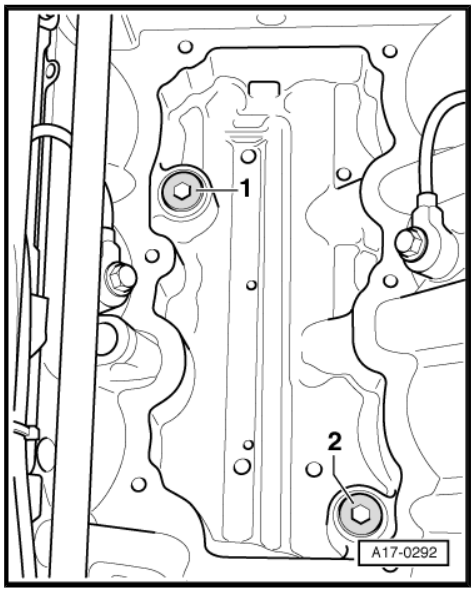
Installing

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

Note

- *Renew gaskets, seals and O-rings.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

– Install intake manifold ⇒ Rep. Gr. 24 .



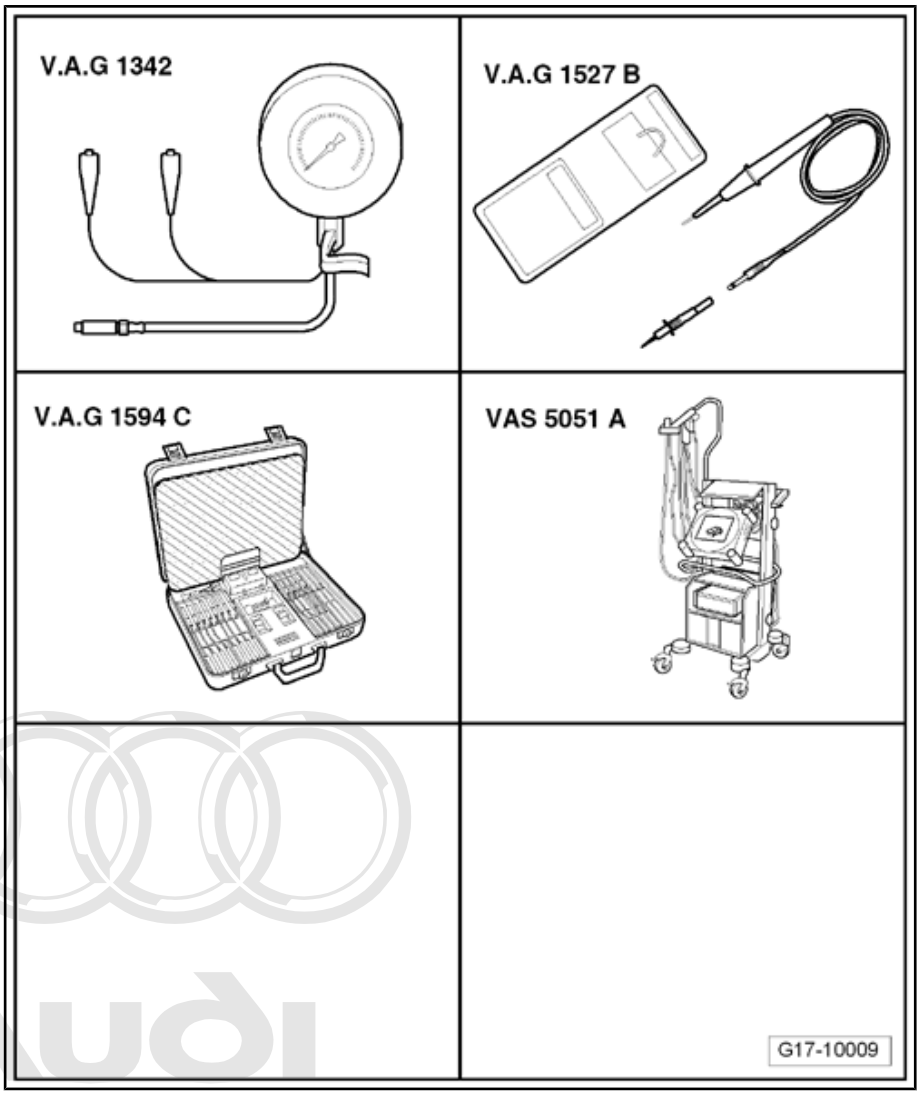
Tightening torque

Component	Nm
Oil retention valve to cylinder block	20
Cover to cylinder block	10

1.10 Checking oil pressure and oil pressure switch -F1-

Special tools and workshop equipment required

- Oil pressure tester -V.A.G 1342-
- Voltage tester -V.A.G 1527 B-
- Auxiliary measuring set -V.A.G 1594 C-
- Vehicle diagnostic, testing and information system -VAS 5051-



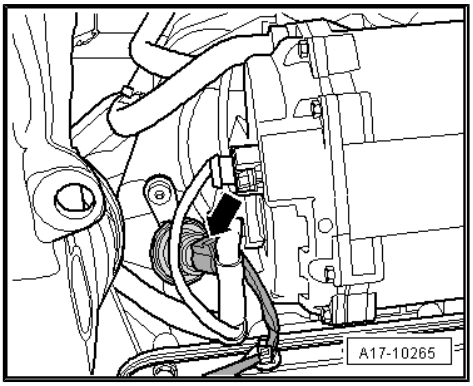
Test requirements

- Oil level OK
- Engine oil temperature approx. 80 °C

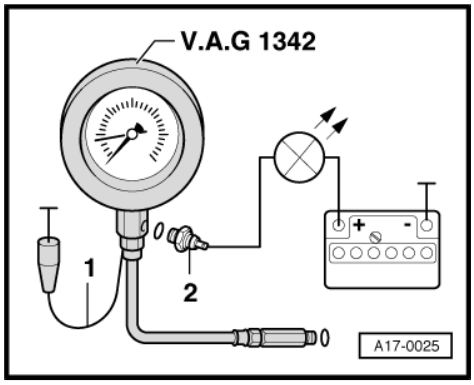
Checking oil pressure switch -F1-

– Unplug electrical connector -arrow- at oil pressure switch -F1- .

– Unscrew oil pressure switch -F1- .



– Connect oil pressure tester -V.A.G 1342- with adapter -V.A.G 1342/14- to bore for oil pressure switch -F1- .
– Screw oil pressure switch -F1- -2- into oil pressure tester -V.A.G 1342- .
– Connect brown wire -1- of tester to earth (-).
– Connect voltage tester -V.A.G 1527B- with adapter leads from auxiliary measuring set -V.A.G 1594A- to oil pressure switch -F1- and battery positive (+).



♦ LED should not light up.
– If LED lights up, renew oil pressure switch -F1- .
– Start engine.

Note

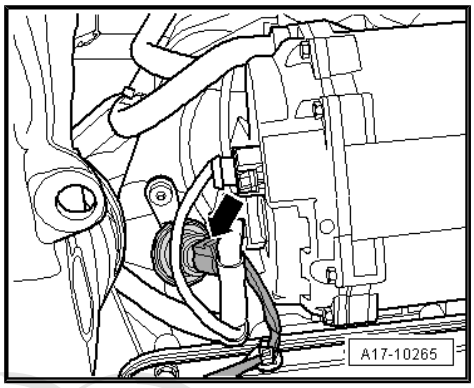
Observe tester and LED while starting, as switching point of oil pressure switch may already be exceeded when starting.

Black oil pressure switch:

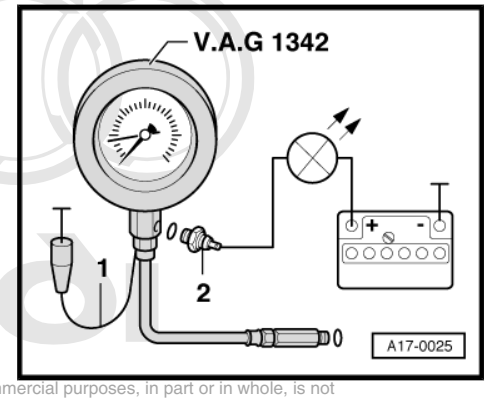
♦ LED should light up at 1.2 ... 1.6 bar
– If LED does NOT light up, renew oil pressure switch.

Checking oil pressure

– Unplug electrical connector -arrow- at oil pressure switch.
– Unscrew oil pressure switch.



– Connect oil pressure tester -V.A.G 1342- with adapter -V.A.G 1342/14- to bore for oil pressure switch.
– Screw oil pressure switch -2- into oil pressure tester -V.A.G 1342- .
– Start engine (engine oil temperature approx. 80 °C).
♦ Oil pressure at idling speed: at least 1.0 bar
♦ Oil pressure at 2000 rpm: at least 3.5 bar



1.11 Engine oil

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 404 .

1.12 Checking oil level

Test requirements

- Engine oil temperature min. 60 °C.
- Vehicle must be level (horizontal)
- Wait a few minutes after switching off the engine to allow the oil to flow back into the sump.

– Pull out the dipstick, wipe off with a clean cloth and insert it again as far as it will go.

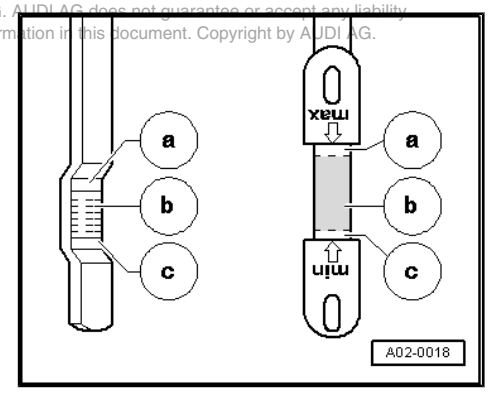
– Pull out the dipstick again and read off the oil level.

Markings on oil dipstick:

a - Do not top up oil.

b - Oil may be topped up. The oil level may rise as far as area -a- after topping up.

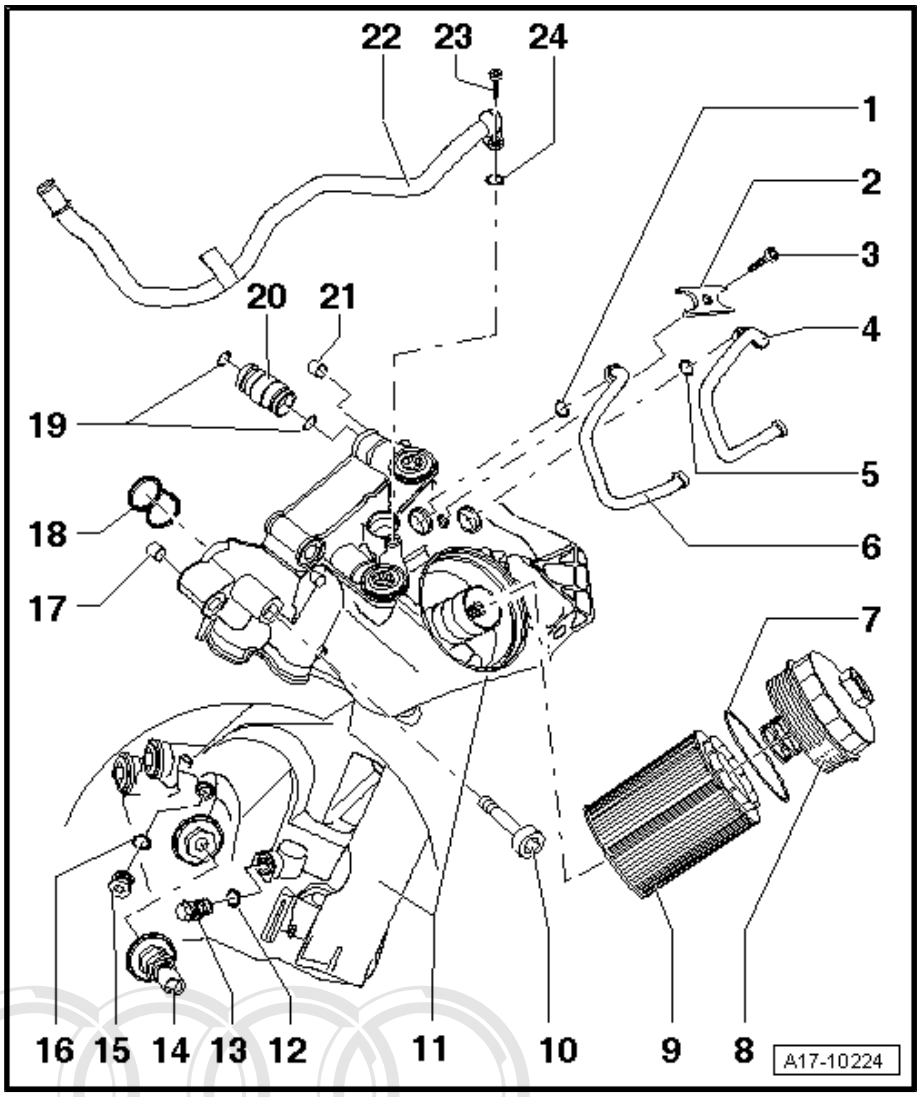
c - Oil must be topped up. It is sufficient if the oil level is somewhere in area -b- (grooved area on dipstick) after topping up.



Note

The oil level must not be above marking -a- on the dipstick.

1.13 Oil filter housing - exploded view



1 - Seal
- ❑ Renew

2 - Bracket

3 - Bolt
- ❑ 9 Nm

4 - Coolant pipe

5 - Seal
- ❑ Renew

6 - Coolant pipe

7 - Seal
- ❑ Renew

8 - Sealing cap
- ❑ 25 Nm

9 - Oil filter element
- ❑ Observe change intervals ⇒ Maintenance ; Booklet 404

10 - Bolt
- ❑ 45 Nm

11 - Oil filter housing
- ❑ With oil cooler
- ❑ Removing and installing ⇒ page 165

12 - Seal
- ❑ Renew

13 - Coolant drain plug
- ❑ 10 Nm

14 - 1.4 bar oil pressure switch -F1-
- ❑ 20 Nm
- ❑ Checking ⇒ page 161

15 - Oil drain plug
- ❑ 10 Nm

16 - Seal
- ❑ Renew

17 - Dowel sleeve

18 - Gasket
- ❑ For oil passage
- ❑ Renew

19 - Seal
- ❑ Renew

20 - Coolant pipe

21 - Dowel sleeve

22 - Coolant pipe

23 - Bolt

- ❑ 9 Nm

24 - Seal

- ❑ Renew

1.14 Removing and installing oil filter housing

– Remove engine ⇒ page 7 .

– Remove alternator ⇒ Rep. Gr. 27

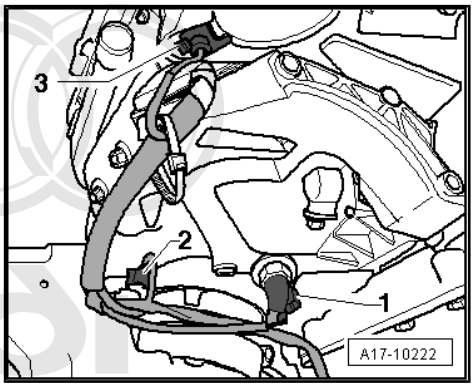
– Unplug electrical connector -1- from oil pressure switch -F1- .

– Unplug electrical connector -2- from engine mounting.

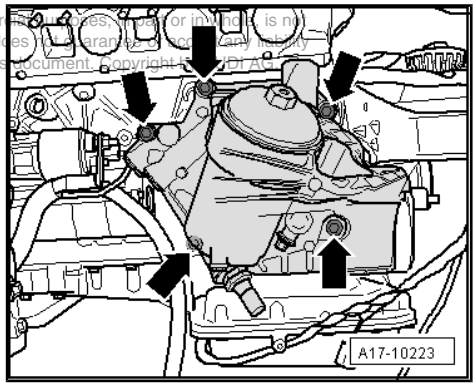
– Unplug electrical connector -3- from valve for torque reaction support -N382- .

– Remove exhaust manifold (right-side) ⇒ page 201 .

– Remove coolant pipe leading to oil filter housing ⇒ page 182 .



– Remove oil filter housing -arrows-.



Installing

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

Note

Renew gaskets, seals and O-rings.

– Install alternator ⇒ Rep. Gr. 27 .

– Install exhaust manifold (right-side) ⇒ page 201 .

– Install coolant pipe leading to oil filter housing ⇒ page 182 .

– Install torque reaction support ⇒ page 42 .

Tightening torques

Tightening torques ⇒ page 164 Oil filter housing - exploded view

19 – Cooling

1 Removing and installing parts of cooling system

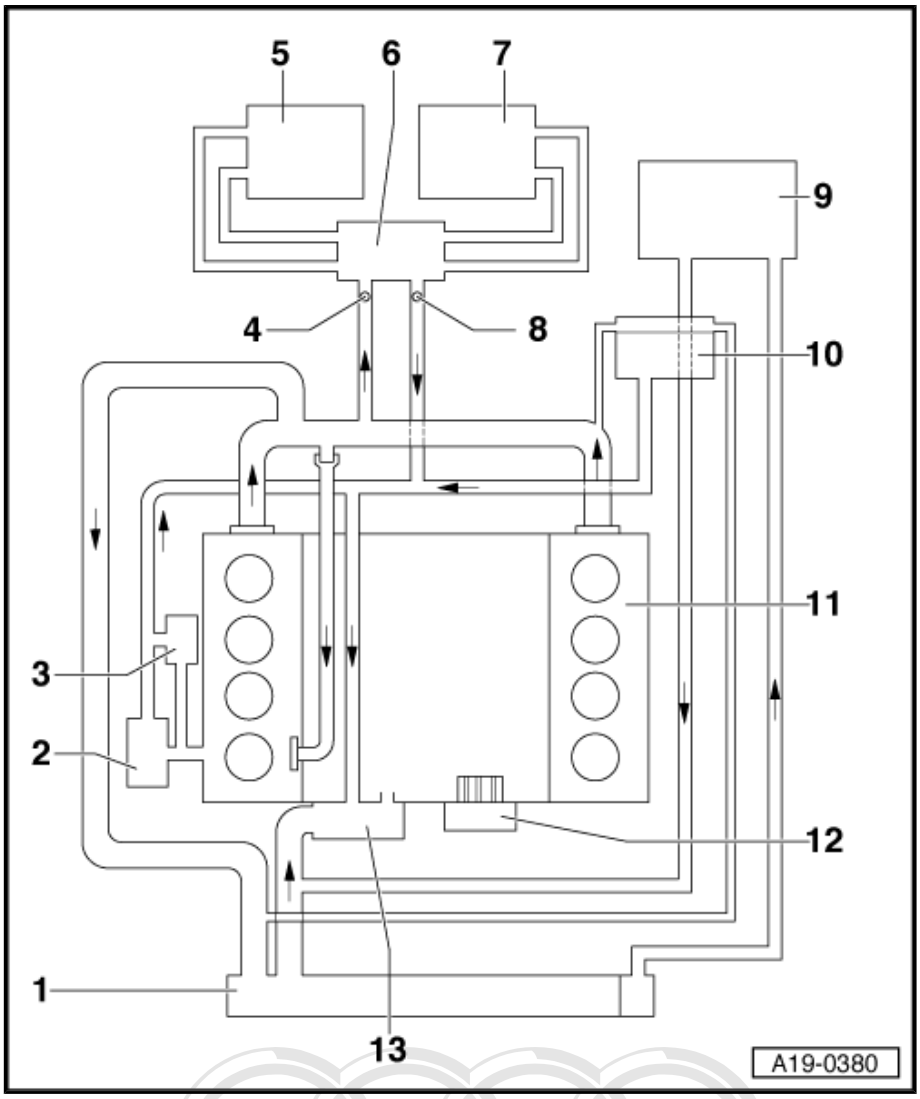
WARNING

Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

Note

- *The cooling system is under pressure when the engine is hot. If necessary, relieve pressure before commencing repair work.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- *Hose clip pliers -V.A.G 1921- are recommended for fitting spring-type hose clips.*
- *Renew gaskets and seals.*
- *The arrow markings on coolant pipes and on ends of hoses must align.*

1.1 Connection diagram for coolant hoses (vehicles without auxiliary heater)



1 - Radiator

- ❑ If renewed, refill system with fresh coolant

2 - Oil filter housing

- ❑ With oil cooler
- ❑ Removing and installing ⇒ page 165

3 - Alternator

- ❑ Water-cooled

4 - Bleeder screw

- ❑ Located in hose to pump/valve unit

5 - Heat exchanger in heater and air conditioning unit (right-side)

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

6 - Pump/valve unit

- ❑ Removing and installing ⇒ Rep. Gr. 87

7 - Heat exchanger in heater and air conditioning unit (left-side)

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

8 - Bleeder screw

- ❑ Located in hose from pump/valve unit

9 - Oil cooler for gear oil/ATF

10 - Expansion tank

- ❑ With filler cap
- ❑ Checking pressure relief valve in filler cap ⇒ page 177

11 - Cylinder head/cylinder block

- ❑ If renewed, refill system with fresh coolant

12 - Coolant pump

- ❑ Removing and installing ⇒ page 179

13 - Thermostat

- ❑ Removing and installing ⇒ page 181
- ❑ Checking ⇒ page 185

1.2 Connection diagram for coolant hoses (vehicles with auxiliary heater)

Part I

Part II ⇒ page 168

1 - Radiator

- ❑ If renewed, refill system with fresh coolant

2 - To auxiliary heater

- ❑ ⇒ Item 10 (page 169)

3 - Oil filter bracket

- ❑ With oil cooler
- ❑ Removing and installing ⇒ page 165

4 - Alternator

- ❑ Water-cooled

5 - From auxiliary heater

- ❑ ⇒ Item 9 (page 169)

6 - Expansion tank

- ❑ With filler cap
- ❑ Checking pressure relief valve in filler cap ⇒ page 177

7 - Oil cooler for gear oil/ATF

8 - Cylinder head/cylinder block

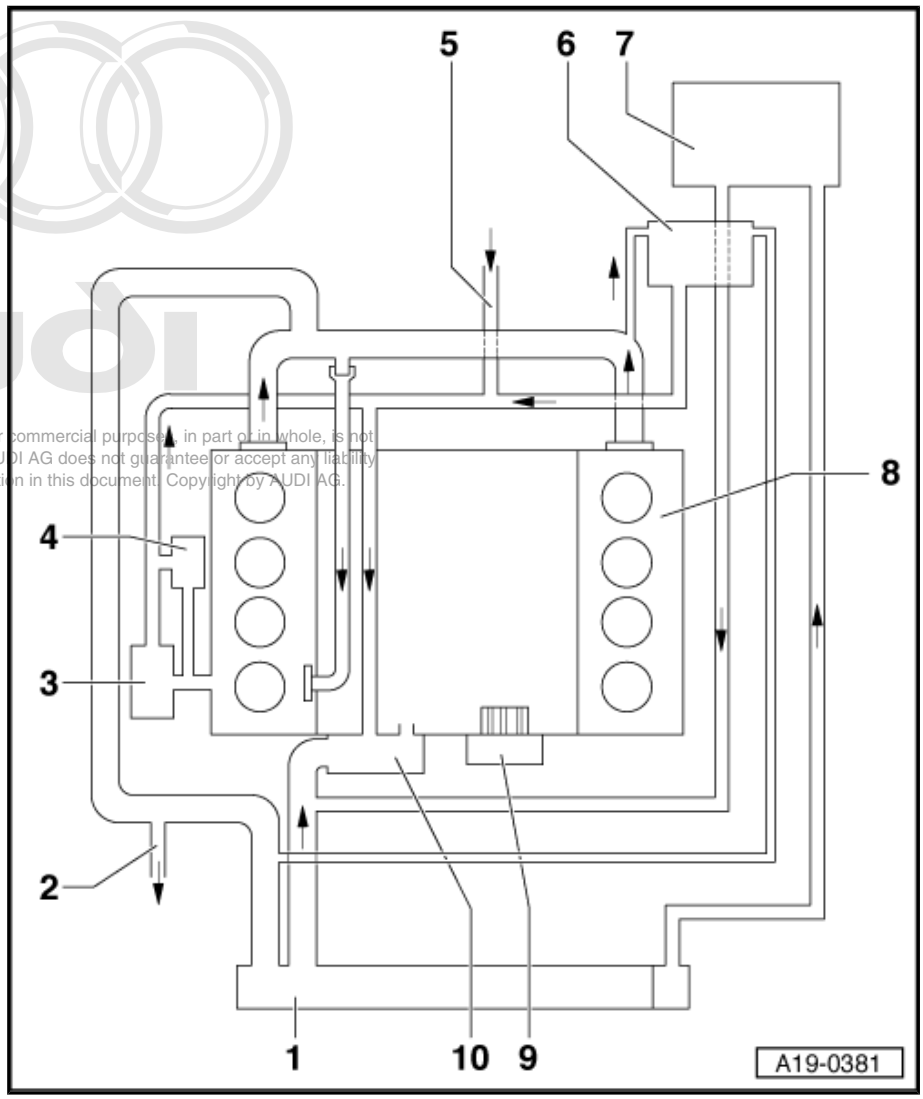
- ❑ If renewed, refill system with fresh coolant

9 - Coolant pump

- ❑ Removing and installing ⇒ page 179

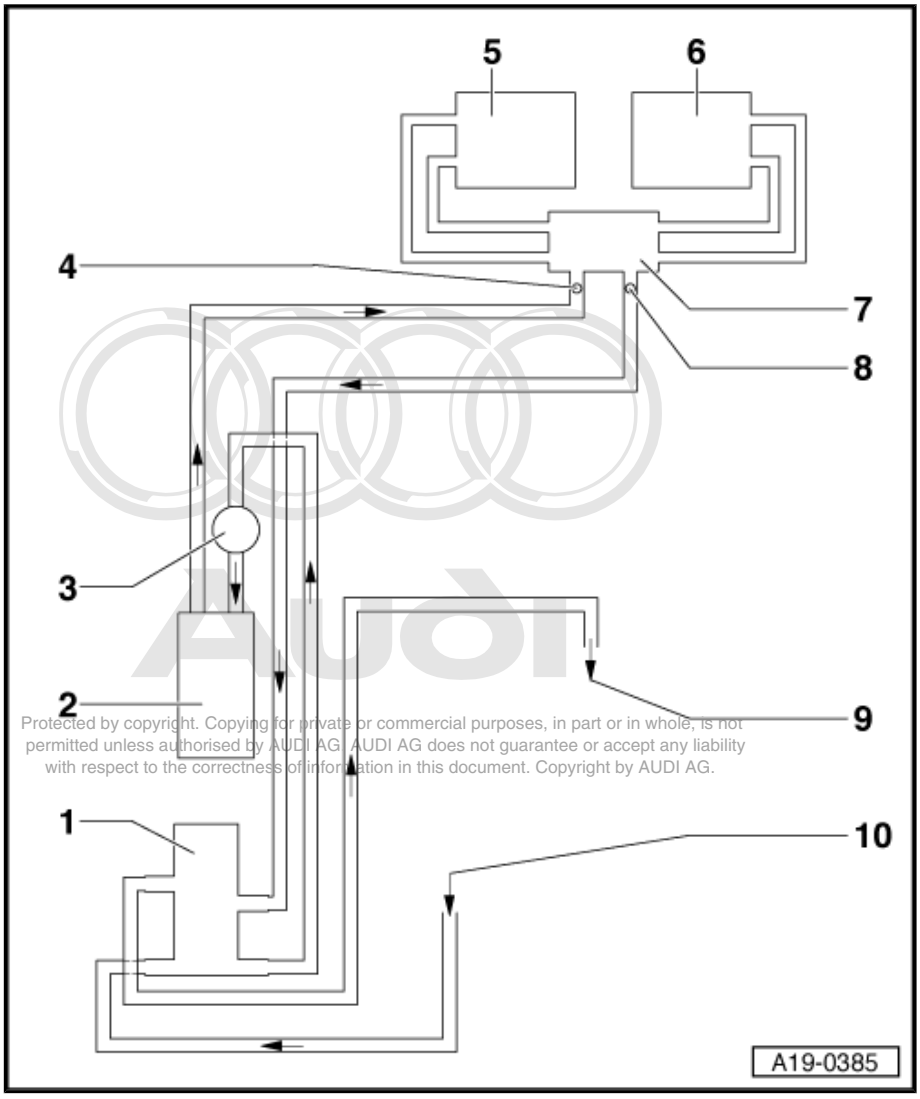
10 - Thermostat

- ❑ Removing and installing ⇒ page 181
- ❑ Checking ⇒ page 185



Part II

Part I ⇒ page 168



1 - Heater coolant shut-off valve -N279-

- ❑ Removing and installing ⇒ Rep. Gr. 82

2 - Auxiliary heater

- ❑ Removing and installing ⇒ Rep. Gr. 82

3 - Circulation pump -V55-

- ❑ Removing and installing ⇒ Rep. Gr. 82

4 - Bleeder screw

- ❑ Located in hose to pump/valve unit

5 - Heat exchanger in heater and air conditioning unit (right-side)

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

6 - Heat exchanger in heater and air conditioning unit (left-side)

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

7 - Pump/valve unit

- ❑ Removing and installing ⇒ Rep. Gr. 87

8 - Bleeder screw

- ❑ Located in hose from pump/valve unit

9 - To coolant pipe (rear)

- ❑ ⇒ Item 5 (page 168)

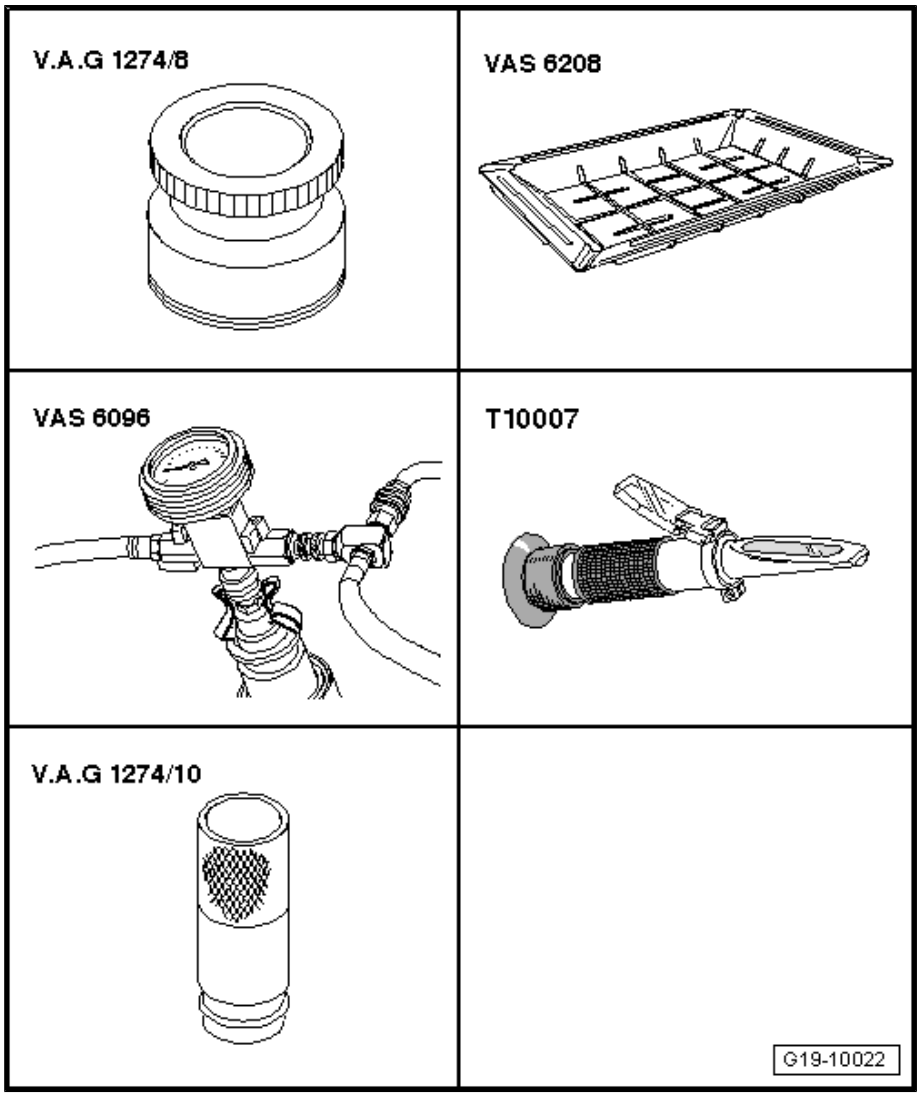
10 - From coolant hose (top)

- ❑ ⇒ Item 2 (page 168)

1.3 Draining and filling cooling system

Special tools and workshop equipment required

- Adapter for cooling system tester -V.A.G 1274/8-
- Drip tray for workshop hoist -VAS 6208-
- Cooling system charge unit -VAS 6096- with replacement reservoir for cooling system charge unit -VAS 6096/1-
- Refractometer -T10007-
- Pipe for cooling system tester -V.A.G 1274/10-



Draining

Note

- *Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .*
- *Collect drained coolant in a clean container for re-use or disposal.*

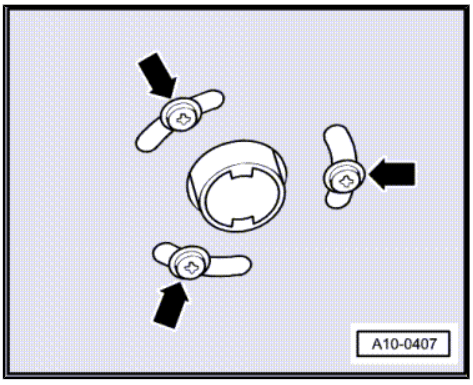
WARNING

Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

– Open filler cap on coolant expansion tank.

Vehicles with auxiliary heater / supplementary heater:

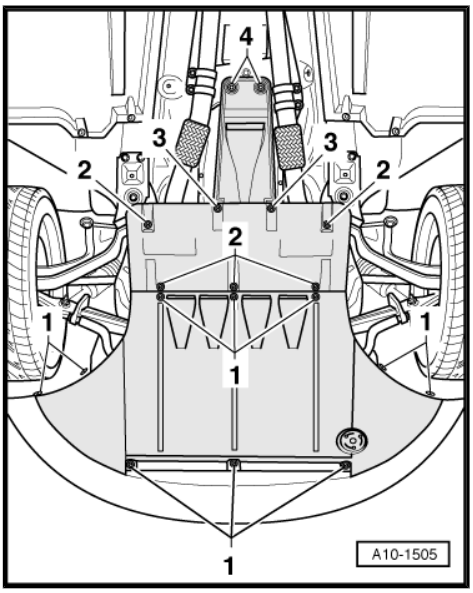
– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



All models:

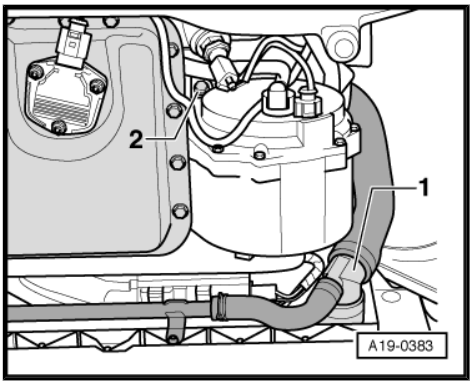
– Release fasteners -1- and remove noise insulation.

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

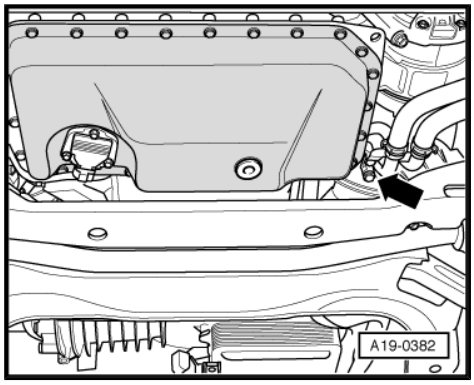


– To drain off coolant, disconnect coolant hose -1-.

– Open drain plug -2- at oil filter bracket and let coolant drain on right side of engine.



– Open drain plug -arrows- and let coolant drain on left side of engine.



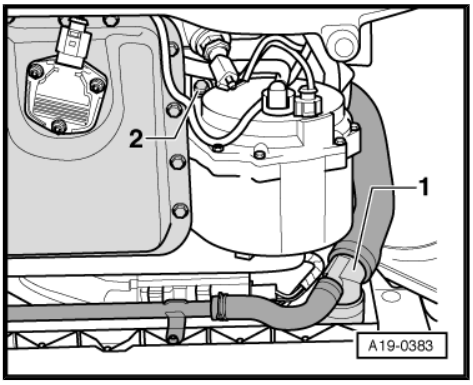
Filling

Note

- *The cooling system is filled all year round with a mixture of water and radiator antifreeze/anti-corrosion agent.*
- *It is important to use only coolant additive Plus -G 012 A8F A1- (also designated as "G12+") "meeting specification TL VW 774 F". Other coolant additives could seriously impair in particular the anticorrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.*
- *Coolant additive "G12+" may be mixed with additives "G11" and "G12".*
- *"G12+" and coolant additives marked "Conforming with specification TL VW 774 F" prevent frost and corrosion damage and stop scale from forming. Such additives also raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct antifreeze and anticorrosion additive.*
- *Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- *Frost protection is required down to about –25 °C (in countries with arctic climate: down to about –35 °C).*
- *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The antifreeze concentration must be at least 40 %.*
- *If greater frost protection is required in very cold climates, the amount of "G12+" can be increased, but only up to 60% (this gives frost protection to about –40 °C). If antifreeze concentration exceeds 60%, frost protection decreases again and cooling efficiency is also impaired.*
- *Use only clean tap water for mixing coolant.*
- *If radiator, heat exchanger, cylinder head, cylinder head gasket or cylinder block have been renewed, do not re-use old coolant.*
- *Contaminated or dirty coolant must not be used again.*
- *To check frost protection level of coolant additive "G12+" you must use a refractometer -T10007- .*
- *Renew seal.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

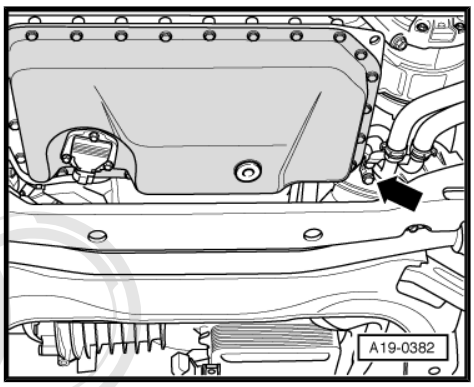
– Refit coolant hose -1-.

– Fit drain plug -2- at oil filter bracket with new seal on right side of engine.



– Fit drain plug -arrow- at oil filter bracket with new seal on left side of engine.

Component		Nm
Drain plug to:	Oil filter bracket	10
	Drain pipe	18



– Fill reservoir for cooling system charge unit -VAS 6096/1- with at least 14 litres of premixed coolant (according to recommended ratio):

- “G12+” (40 %) and water (60 %) for frost protection to –25 °C
- “G12+” (50 %) and water (50 %) for frost protection to –35 °C
- “G12+” (60 %) and water (40 %) for frost protection to –40 °C

– Screw adapter for cooling system tester -V.A.G 1274/8- onto coolant expansion tank.

– Fit cooling system charge unit -VAS 6096- onto adapter for cooling system tester -V.A.G 1274/8- .

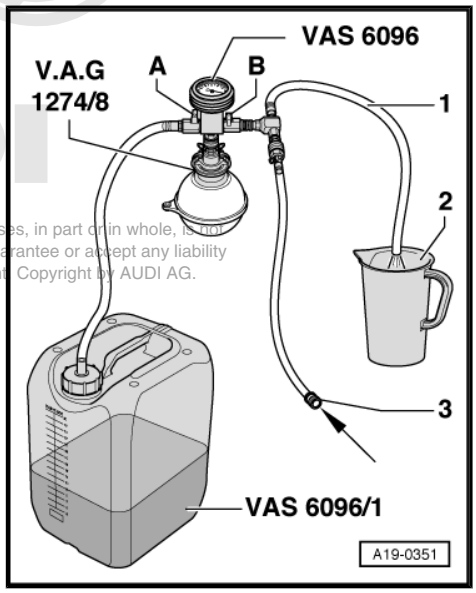
– Run vent hose -1- into a small container -2-.

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

– Close the two valves -A- and -B- (levers at right angles to direction of flow).

– Connect hose -3- to compressed air.

♦ Pressure: 6 ... 10 bar



– Open valve -B- (lever in direction of flow).

♦ The suction jet pump generates a partial vacuum in the cooling system.

♦ The needle on the gauge should move into the green zone.

– Additionally open valve -A- briefly (lever in direction of flow) so that the hose from reservoir for cooling system charge unit -VAS 6096/1- is filled with coolant.

– Close valve -A- again.

– Leave valve -B- open for another 2 minutes.

♦ The suction jet pump will continue generating a vacuum in the cooling system.

♦ The needle on the gauge should remain in the green zone.

– Close valve -B-.

♦ The needle on the gauge should stop in the green zone. The vacuum level in the cooling system is then sufficient for subsequent filling.

♦ If the needle does not reach the green zone, repeat the process.

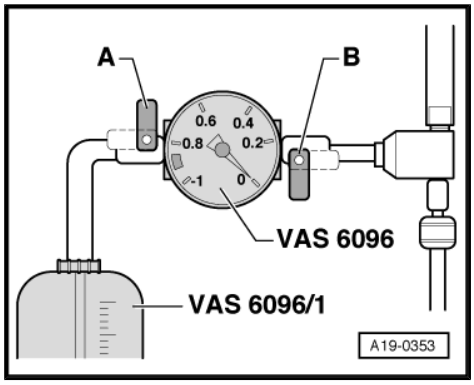
♦ If the vacuum level drops, there is a leak in the cooling system.

– Detach compressed air hose.

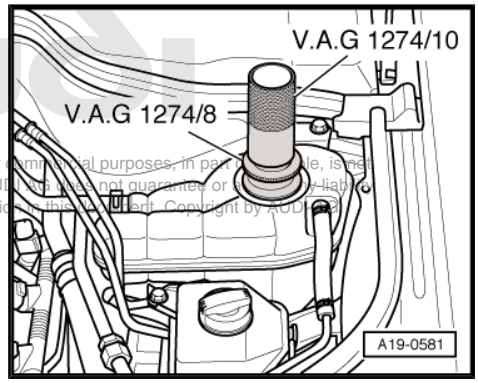
– Open valve -A-.

♦ The partial vacuum in the cooling system causes the coolant to be drawn out of the reservoir for cooling system charge unit -VAS 6096/1- ; the cooling system is then filled.

– Detach cooling system charge unit -VAS 6096- from expansion tank.

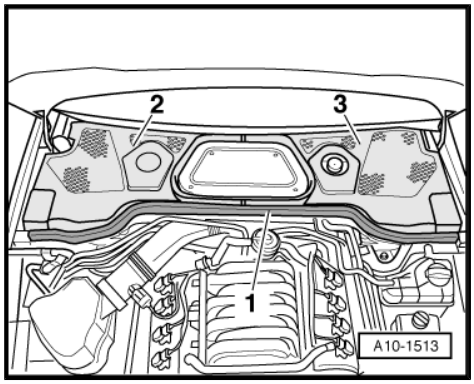


– Fit pipe -V.A.G 1274/10- onto adapter -V.A.G 1274/8- .

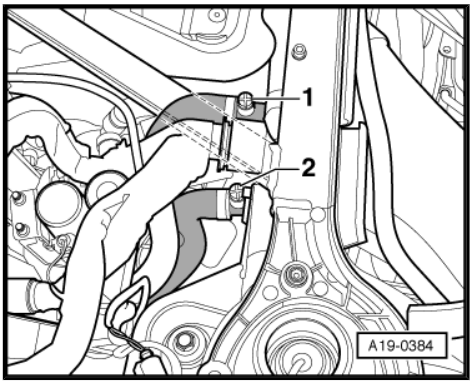


– Pull off rubber seal -1- on plenum chamber cover.

– Detach plenum chamber cover -2-.



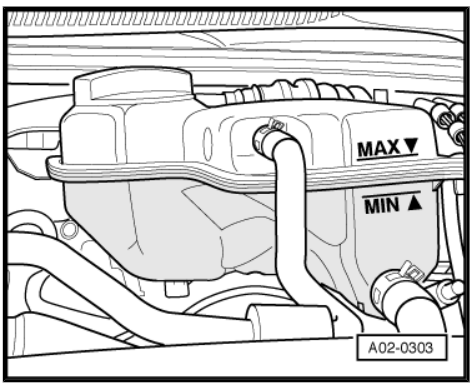
– Open bleeder screws -1- and -2-.
– Fill up with coolant until it flows out at bleeder screws -1- and -2- free of bubbles.
– Close the bleeder screws.
– Fit expansion tank cap.
– On vehicles with auxiliary heater, switch heater on (for about 30 seconds) and then off again.
– Set interior temperature to “HI”.
– Run the engine for 3 minutes at 2000 rpm.
– Allow the engine to run at idling speed until the two large coolant hoses at main radiator become warm.
– Run the engine for 1 minute at 2000 rpm.
– Switch off ignition and allow engine to cool down.



– Check coolant level.

♦ The coolant level must be at the MAX marking when the engine is cold.

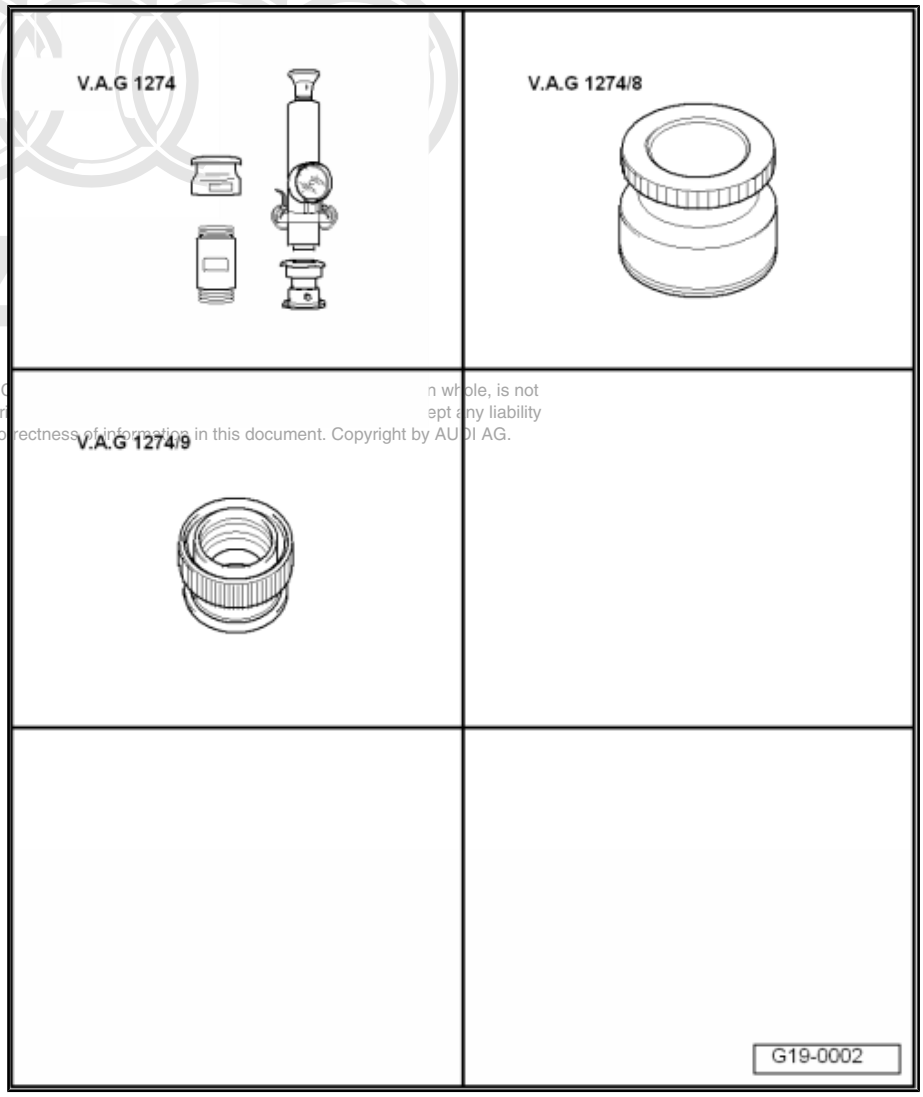
♦ The coolant level can be above the MAX marking when the engine is warm.



1.4 Checking cooling system for leaks

Special tools and workshop equipment required

- Cooling system tester - V.A.G 1274-
- Adapter for cooling system tester -V.A.G 1274/8-
- Adapter for cooling system tester -V.A.G 1274/9-



Test requirements

- Engine must be warm.

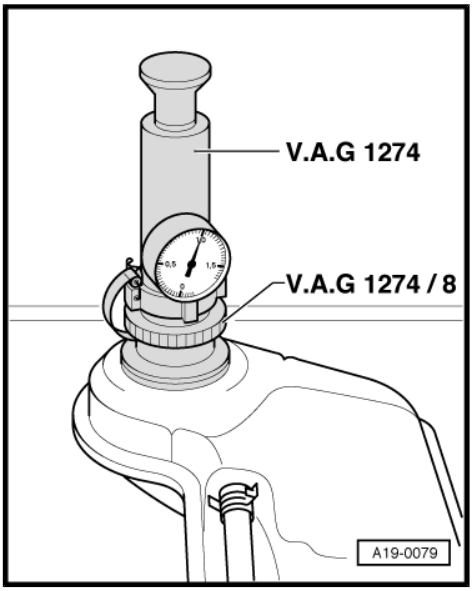
Test sequence

WARNING

Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

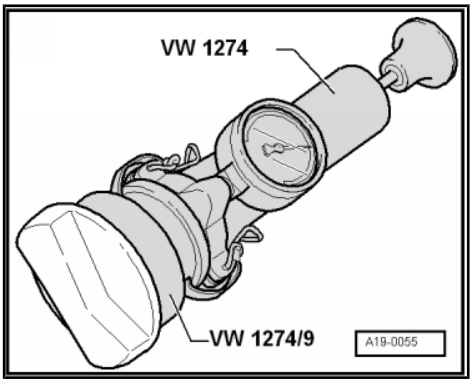
– Open filler cap on coolant expansion tank.

– Fit cooling system tester -V.A.G 1274- with adapter for cooling system tester -V.A.G 1274/8- on coolant expansion tank.
– Using hand pump on tester, build up a pressure of approx. 1.0 bar.
– If this pressure is not maintained, locate and rectify leaks.



Checking pressure relief valve in filler cap

– Fit cooling system tester -V.A.G 1274- with adapter for cooling system tester -V.A.G 1274/9- on filler cap.
– Operate hand pump.
♦ The pressure relief valve should open at pressure of 1.4 ... 1.6 bar.



1.5 Coolant pump and thermostat - exploded view

1 - 14 Nm
- ❑ Bolt strength rating 10.9

2 - 10 Nm

3 - Thermostat housing

4 - O-ring
- ❑ Renew

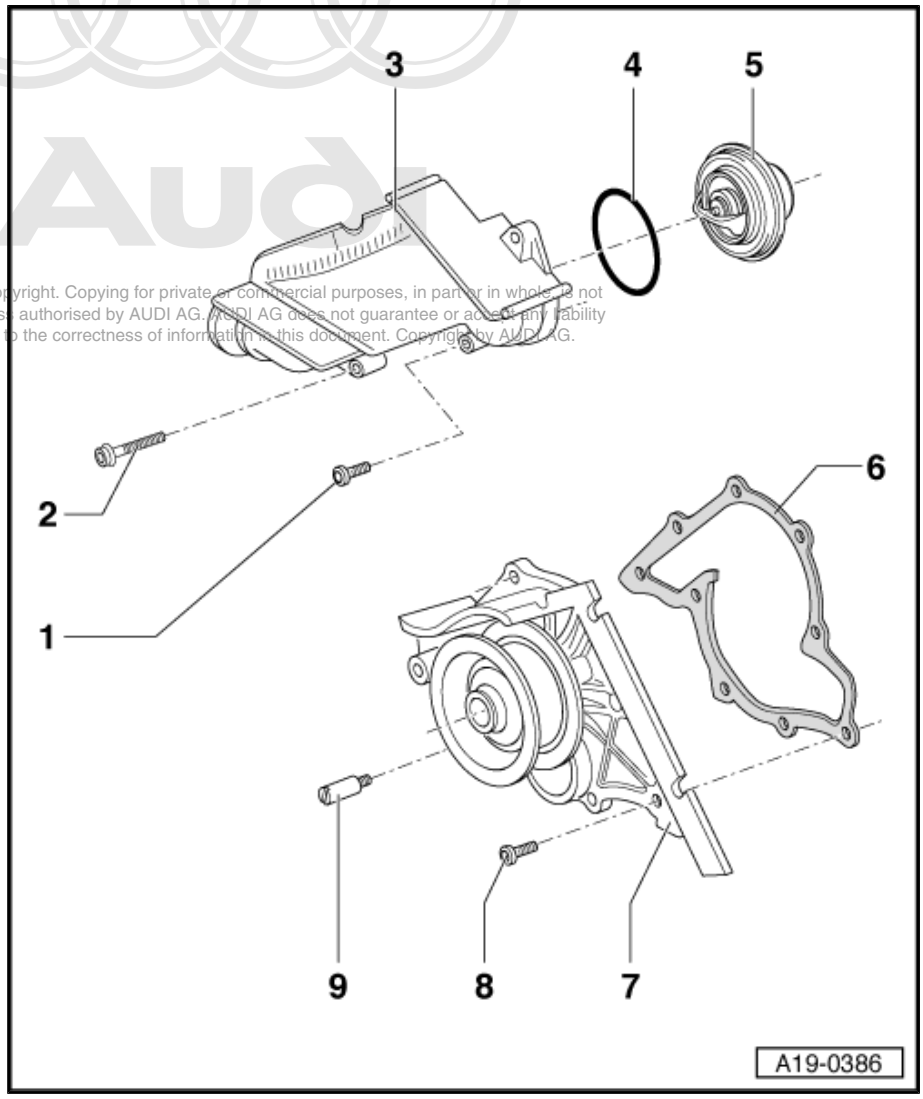
5 - Thermostat
- ❑ Removing and installing ⇒ page 181
- ❑ Checking ⇒ page 185
- ❑ Installation position ⇒ page 178

6 - Gasket
- ❑ Renew

7 - Mechanical coolant pump
- ❑ Removing and installing ⇒ page 179

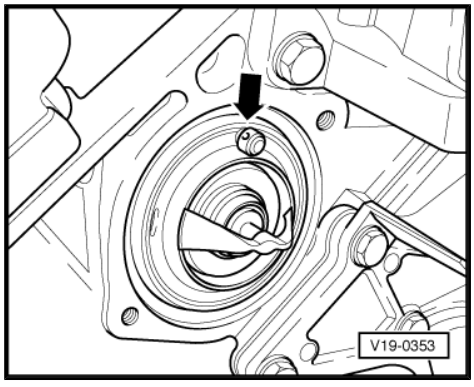
8 - 14 Nm
- ❑ Bolt strength rating 10.9

9 - Trunnion bolt, 9 Nm



Installation position of thermostat

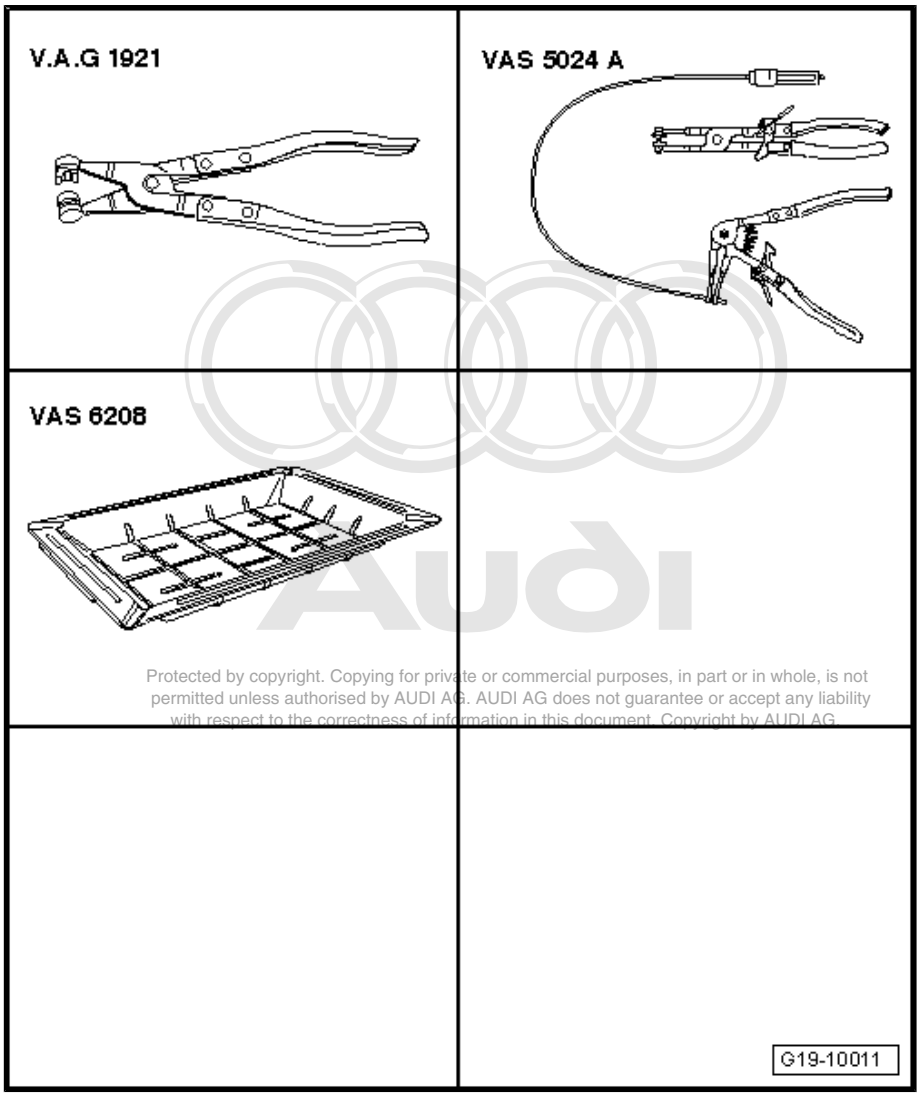
♦ Vent valve -arrow- faces upwards.



1.6 Removing and installing coolant pump

Special tools and workshop equipment required

- Drip tray for workshop hoist -VAS 6208-
- Hose clip pliers -V.A.G 1921-
- Spring type clip pliers -V.A.S 5024 A-

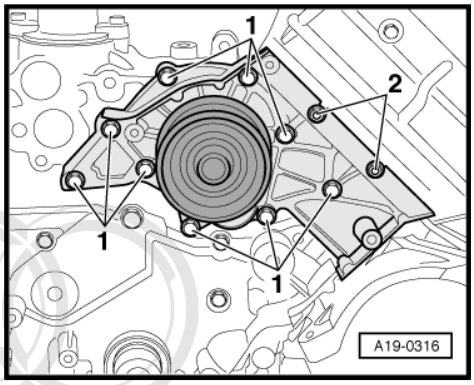


Removing

– Drain coolant ⇒ page 170 .

– Remove toothed belt ⇒ page 60 .

– Unscrew nuts -2- securing toothed belt cover (rear left).
– Unscrew bolts -1- securing coolant pump and detach coolant pump.



Installing

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

Note

Renew seals and gaskets.

– Clean sealing surfaces on cylinder block.
– Install toothed belt (adjust valve timing) ⇒ page 60 .
– Fill up with coolant ⇒ page 172 .
– Install torque reaction support ⇒ page 42 .

Tightening torque

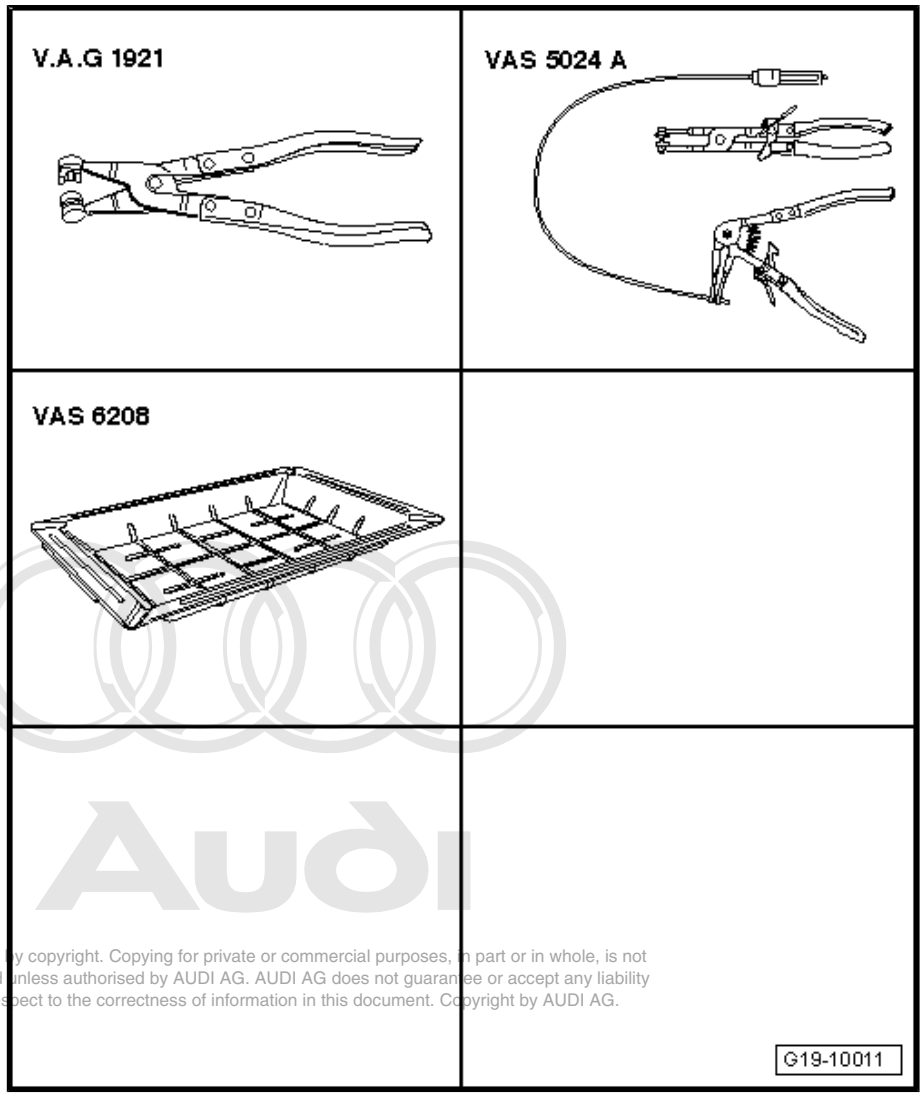
Component	Nm
Coolant pump to cylinder block	14 1)

- 1) Bolt strength rating 10.9

1.7 Removing, installing and checking thermostat

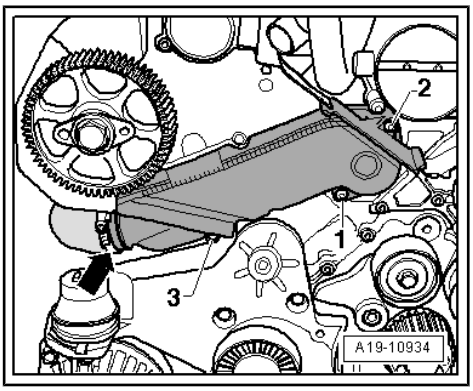
Special tools and workshop equipment required

- Drip tray for workshop hoist -VAS 6208-
- Hose clip pliers -V.A.G 1921-
- Spring type clip pliers -V.A.S 5024 A-



Removing

– Drain coolant ⇒ page 170 .
– Remove toothed belt ⇒ page 60 .
– Detach coolant hose -arrow- from thermostat housing.
– Unscrew bolts -1 ... 3- and take off thermostat housing.
– Remove O-ring and thermostat.



Installing

Note

Renew gaskets, seals and O-rings.

– Clean and smoothen sealing surface for O-ring.
– Install thermostat.

♦ Installation position: Vent valve -arrow- faces upwards.

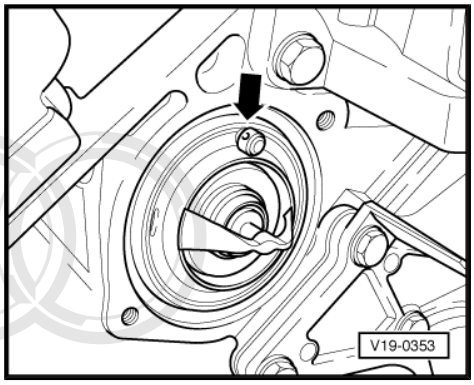
– Install thermostat housing.

Perform further installation in reverse order, paying attention to the following:

– Install toothed belt (adjust valve timing) ⇒ page 60 .

– Fill up with coolant ⇒ page 172 .

– Install torque reaction support ⇒ page 42 .



Tightening torques

Component	Nm
Thermostat housing to cylinder block	14 1)
Top idler roller for poly V-belt to bracket for torque reaction support	10

• 1) Bolt strength rating 10.9

1.8 Removing and installing coolant pipe leading to oil filter bracket

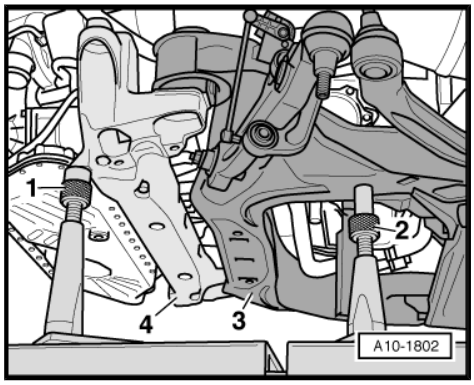
– Remove engine ⇒ page 7 .

– Remove exhaust manifold (right-side) ⇒ page 201 .

– Screw down spindles of support elements -2- (left and right) at subframe as far as possible.

– Remove locating lugs from spindles.

– Take out subframe -3- from the side.



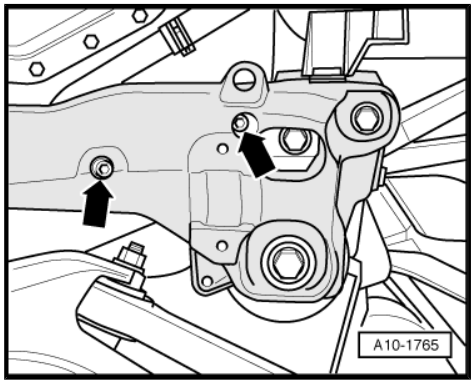
Note

A second mechanic is required for removing the subframe.

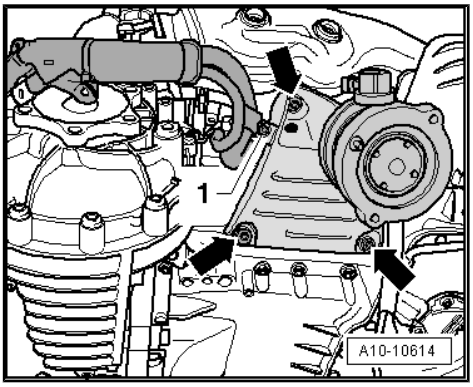
– Screw down spindles of support elements -1- (left and right) at engine cross member -4- as far as possible.

– Remove bolts -arrows- for engine mounting (left and right-side)

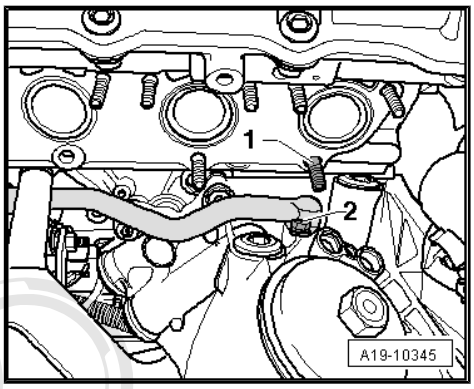
– Take out engine cross member.



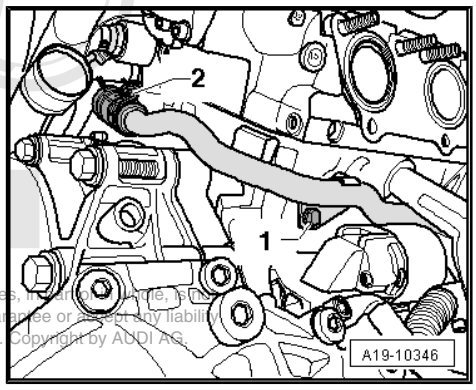
– Unscrew wiring harness from engine support -1-.
– Remove engine support -arrows-.



– Remove stud -1-.
– Unbolt coolant pipe from oil filter housing -2-.



– Unbolt coolant pipe from engine -1-.
– Detach coolant pipe -2- and remove.



1.9 Oil cooler - exploded view

1 - Oil filter housing
- ❑ Removing and installing ⇒ page 165

2 - Seal
- ❑ For oil passage
- ❑ Renew

3 - Seal
- ❑ Renew

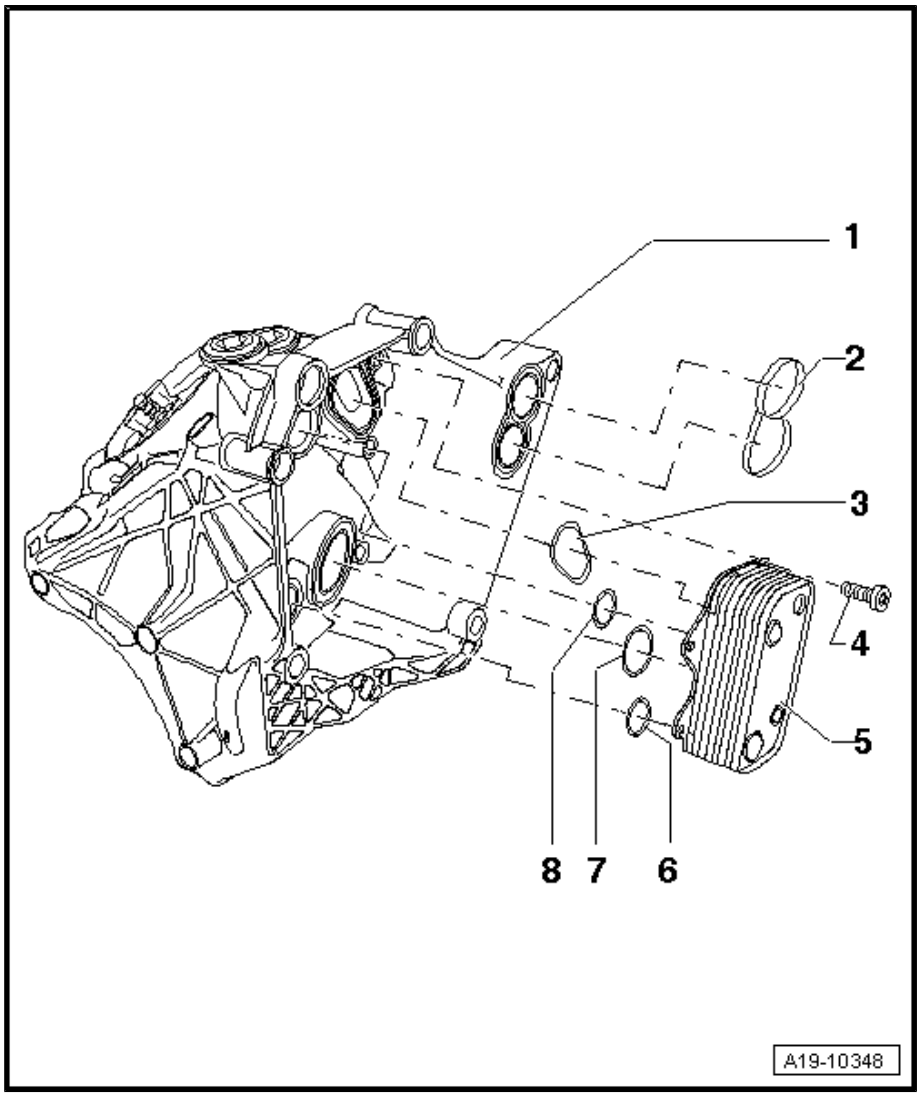
4 - Bolt
- ❑ 5 Nm

5 - Oil cooler

6 - Seal
- ❑ Renew

7 - Seal
- ❑ Renew

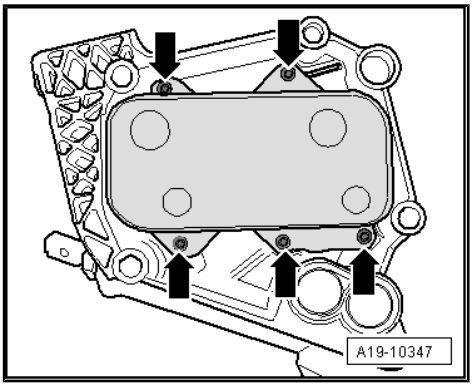
8 - Seal
- ❑ Renew



1.10 Removing and installing oil cooler

– Remove engine ⇒ page 7 .
– Remove exhaust manifold (right-side) ⇒ page 201 .
– Remove oil filter housing ⇒ page 165 .

– Remove oil cooler -arrow-.



Installing

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

Note

Renew gaskets, seals and O-rings.

– Install alternator ⇒ Rep. Gr. 27 .
– Install exhaust manifold (right-side) ⇒ page 201 .
– Install coolant pipe leading to oil filter housing ⇒ page 182 .
– Install torque reaction support ⇒ page 42 .

Tightening torques

Tightening torques ⇒ page 184 Oil cooler - exploded view

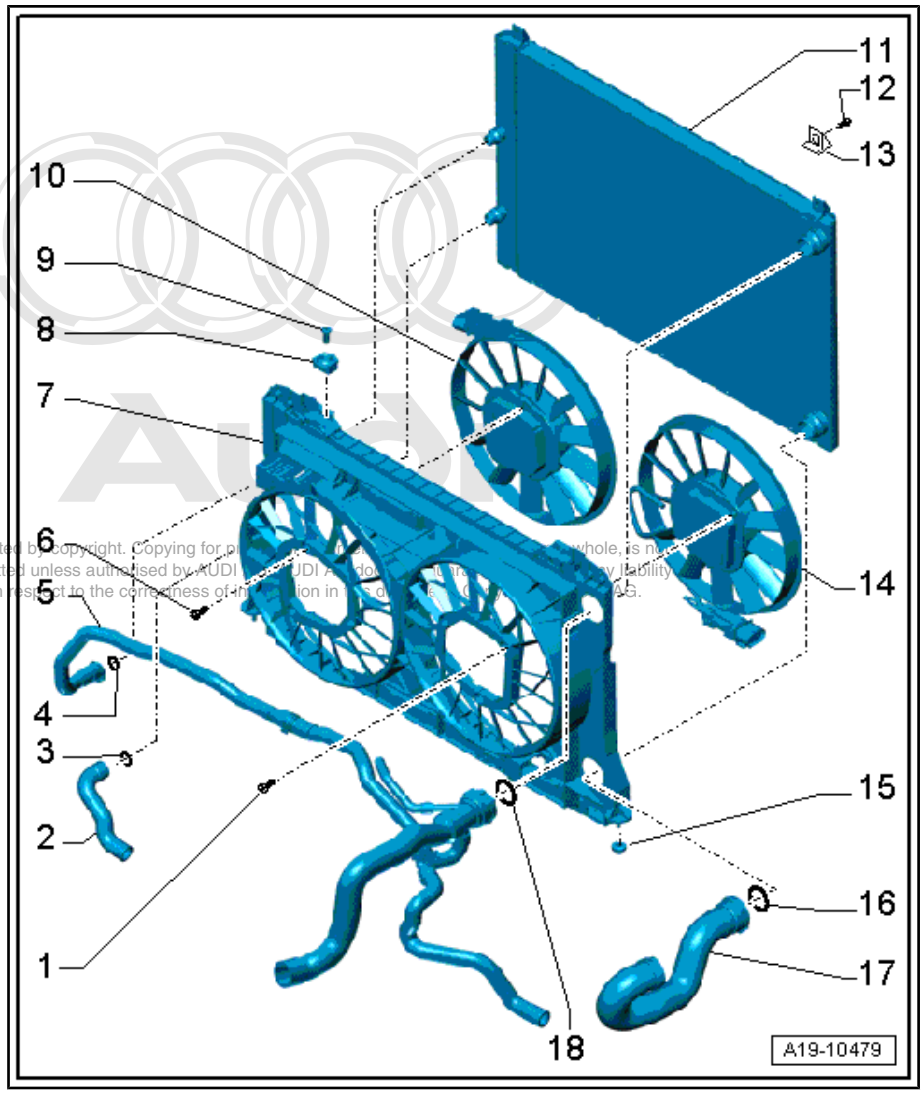
1.11 Checking thermostat

– Heat thermostat in water bath.

Starts to open	Fully open	Opening travel
approx. 87 °C	approx. 102 °C 1)	at least 8 mm

• 1) Cannot be tested

1.12 Radiator and radiator fan - exploded view



1 - 10 Nm
- ❑ Renew

2 - Coolant hose
- ❑ To detach, release retaining clip

3 - O-ring
- ❑ Renew

4 - O-ring
- ❑ Renew

5 - Coolant hose
- ❑ To detach, release retaining clip
- ❑ Illustration shows radiator with bypass; for retrofitting version with bypass refer to ⇒ page 190

6 - 10 Nm
- ❑ Renew

7 - Radiator cowl
- ❑ Removing and installing ⇒ page 192
- ❑ Illustration shows radiator with bypass; for retrofitting version with bypass refer to ⇒ page 190

8 - Rubber buffer
- ❑ Use screwdriver to release and pull off

9 - Retaining pin

10 - Radiator fan -V7-
- ❑ With radiator fan control unit -J293-
- ❑ Removing and installing ⇒ page 193

11 - Radiator
- ❑ Removing and installing ⇒ page 187
- ❑ If renewed, change coolant in entire system
- ❑ Illustration shows version with bypass; for retrofitting version with bypass refer to ⇒ page 190

12 - 6 Nm

13 - Mounting for radiator

14 - Radiator fan 2 -V177-
- ❑ With radiator fan control unit 2 -J671-
- ❑ Removing and installing ⇒ page 193

15 - Rubber bush

16 - O-ring
- ❑ Renew

17 - Coolant hose

- ❑ To detach, release retaining clip

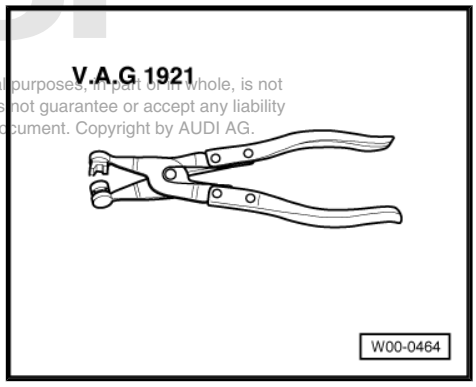
18 - O-ring

- ❑ Renew

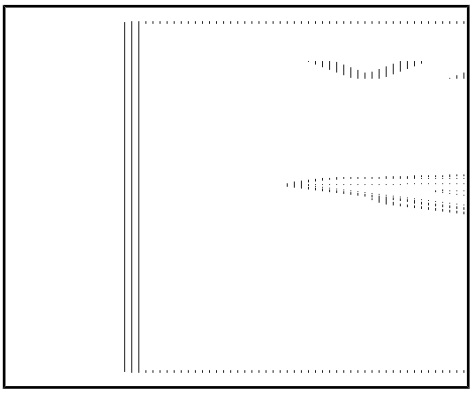
1.13 Removing and installing radiator

Special tools and workshop equipment required

- ♦ Hose clip pliers -V.A.G 1921-



- ♦ Drip tray for workshop hoist -VAS 6208-

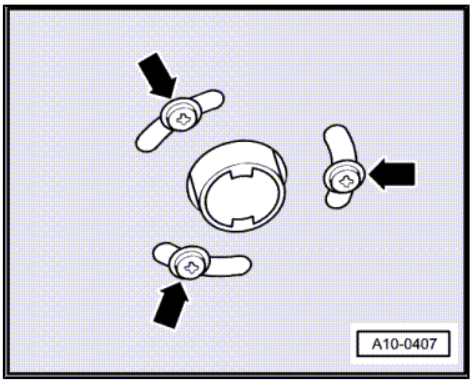


Removing

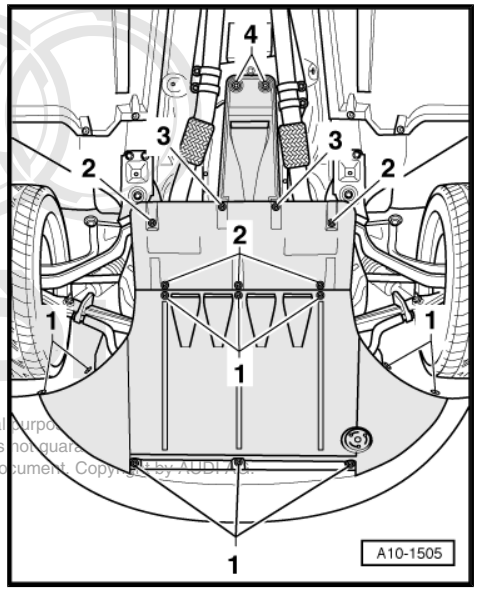
> **WARNING**
>
> *Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.*

– Open filler cap on coolant expansion tank.

– Vehicles with auxiliary heater: remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



– Release fasteners -1- to remove front noise insulation.



Note

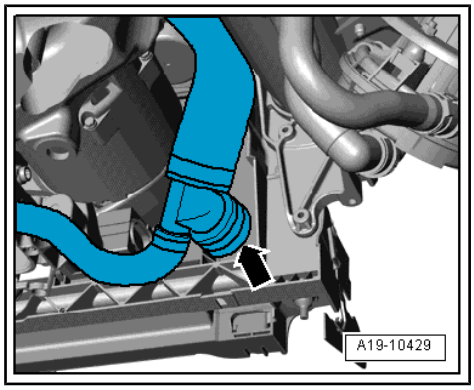
Disregard -items 2, 3 and 4-.

– Remove front section of wheel housing liner (front left and front right) ⇒ General body repairs, exterior; Rep. Gr. 66 .

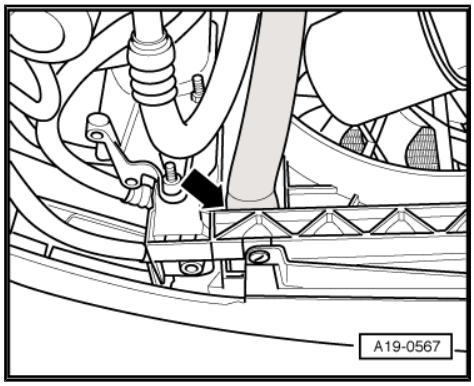
– Remove front bumper cover ⇒ General body repairs, exterior; Rep. Gr. 63 .

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

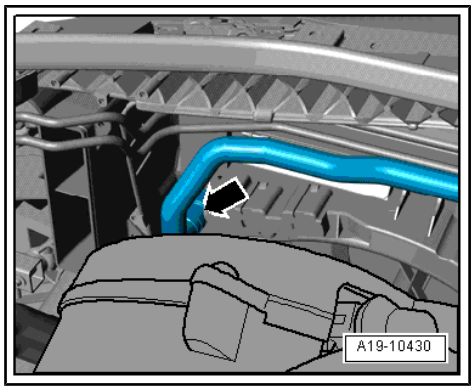
– Disconnect coolant hose -arrow- (bottom right) from radiator and drain off coolant.



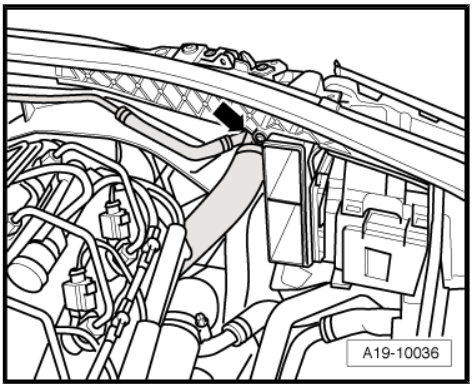
– Disconnect coolant hose (bottom left) from radiator -arrow-.



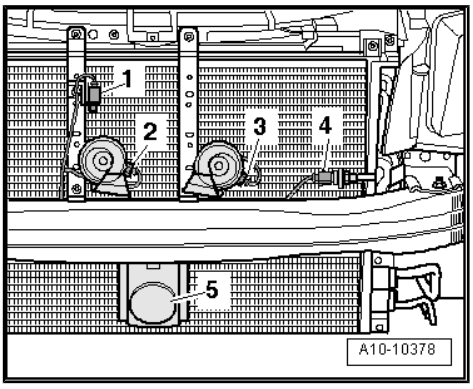
– If fitted, disconnect coolant hose (centre left) from radiator -arrow-.



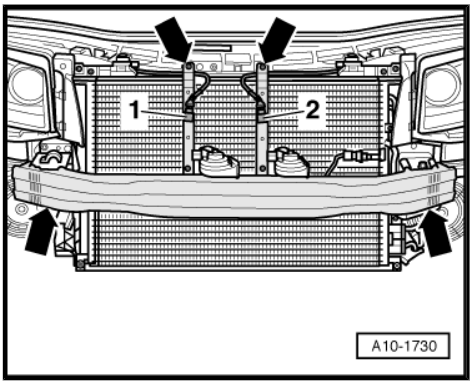
– Disconnect coolant hose (top right) from radiator -arrow-.



– Detach ambient temperature sensor -G17- -item 4-.
– Unplug electrical connectors -1, 2, 3-.
– Move electrical wiring harness clear.
– On vehicles with adaptive cruise control, unplug electrical connector at adaptive cruise control unit -J428- -item 5-.

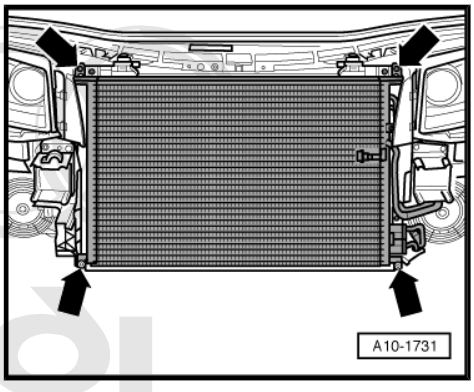


– Unplug electrical connectors -1- and -2- from struts.
– Unscrew bolts -arrows- and remove bumper together with struts.



WARNING

The air conditioner refrigerant circuit must not be opened.



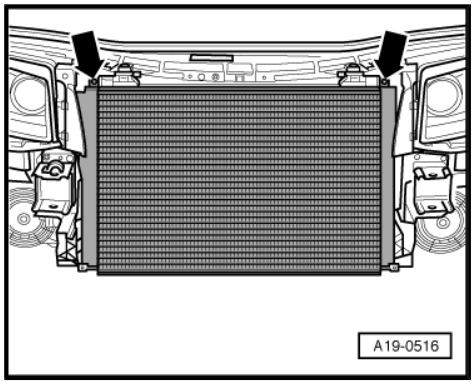
Note

To prevent damage to the air conditioner compressor and refrigerant pipes/hoses, ensure that the pipes and hoses are not stretched, kinked or bent.

– Remove bolts -arrows-.
– Swivel down condenser together with cooler for power-assisted steering and secure by tying to engine.

– Remove the two brackets for radiator -arrows-.

– Tilt top of radiator forwards slightly and lift out of lock carrier.



Installing

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

Note

- *Retrofitting radiator with bypass ⇒ page 190*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

– Install front bumper cover ⇒ General body repairs, exterior; Rep. Gr. 63 .

– Install front section of wheel housing liner (front left and front right) ⇒ General body repairs, exterior; Rep. Gr. 66 .

– Fill system with coolant ⇒ page 170 .

Note

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

Tightening torque

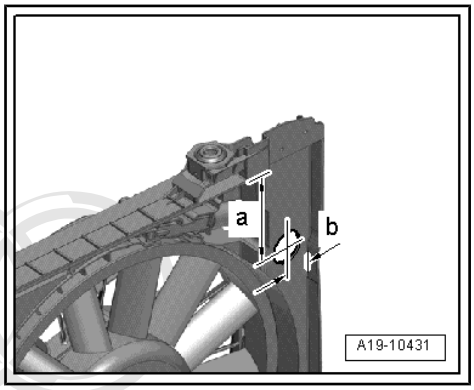
Component	Nm
Bracket for radiator to lock carrier	6
Condenser to lock carrier	6
Struts to lock carrier	9

1.14 Retrofitting radiator with bypass

Procedure

- Radiator removed

Mark out drilling on radiator cowl (with cowl installed) as illustrated according to dimensions -a and b-.



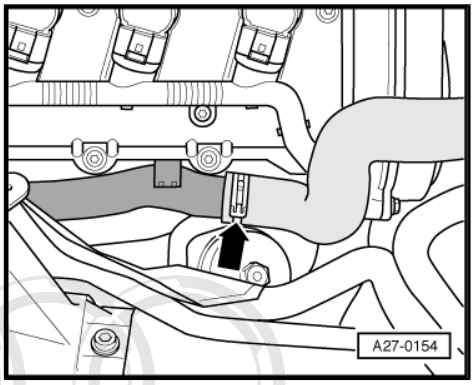
- Dimension -a- = 136 mm.
- Dimension -b- = 23 mm.

– Drill a hole of 32 mm dia.

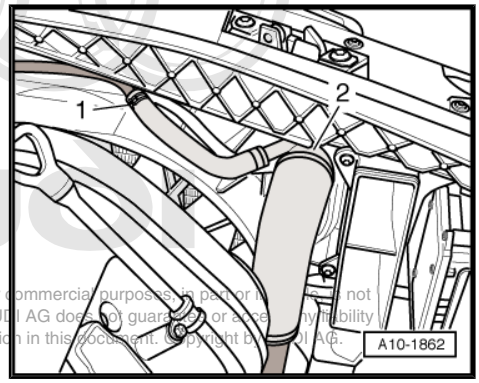
Note

Drill a pilot hole and then drill out to 32 mm dia using the stepped centre bit.

– Disconnect coolant hose (top right) from coolant pipe -arrow-.



– Disconnect coolant hose -1- from breather pipe.



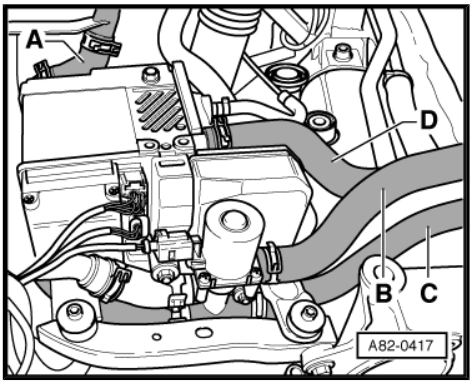
Note

Disregard -item 2-.

Vehicles with auxiliary heater:

– Remove headlight (right-side) ⇒ Electrical system; Rep. Gr. 94 .

– Disconnect coolant hose -C- from auxiliary heater.

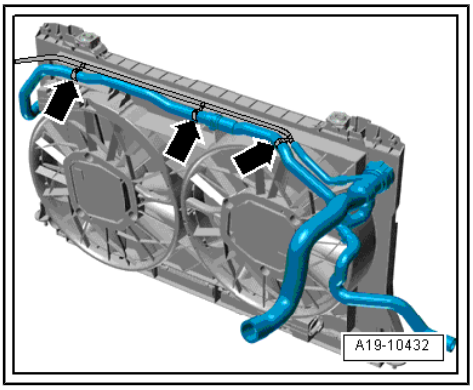


Note

Disregard -items A, B and D-.

Installing

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



Note

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

– Fit hose retainer -arrows- at breather pipe as shown in illustration.

– Clip bypass hose to hose retainer as shown in illustration.

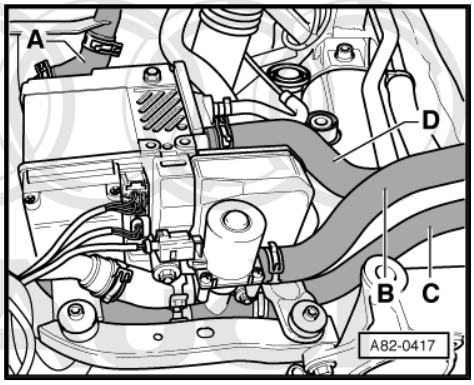
Note

Illustration shows hoses for vehicles with auxiliary heater.

Vehicles with auxiliary heater:

– Connect coolant hose -C- to auxiliary heater.

– Install right headlight ⇒ Electrical system; Rep. Gr. 94 .



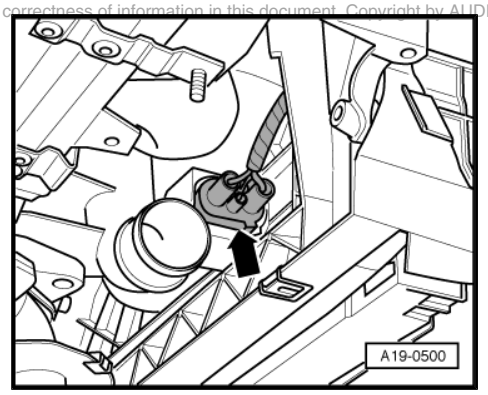
1.15 Removing and installing radiator cowl

Removing

– Drain off coolant ⇒ page 170 .

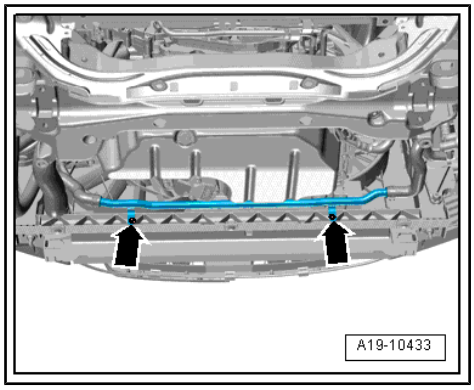
– Unplug electrical connector -arrow- leading to radiator fan (right-side).

– Move wires clear at rear of lock carrier.

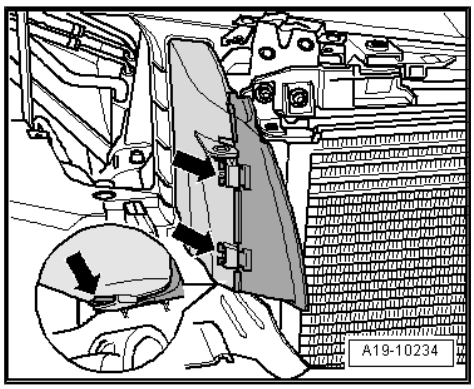


– Detach coolant pipe (bottom) from radiator cowl -arrows-.

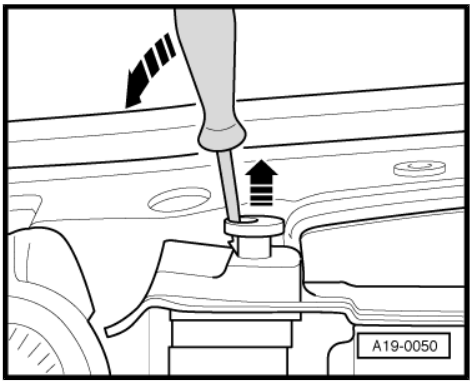
– Move breather pipe at top of radiator cowl clear.



– Compress retainer catches -arrows- and detach air duct from lock carrier (front right).



– Release both retaining pins for radiator cowl and pull out upwards -arrows-.
– Tilt top edge of radiator cowl forwards.

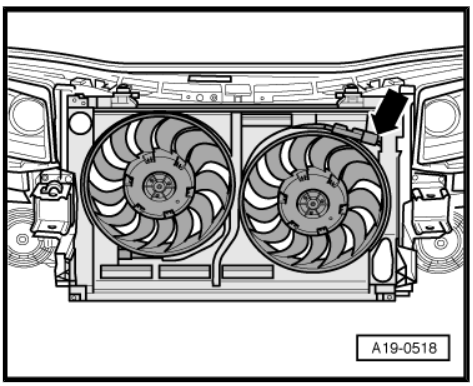


– Reach behind radiator cowl and unplug electrical connector -arrow- for radiator fans.
– Remove radiator cowl.

Installing

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

– Fill system with coolant ⇒ page 170 .



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

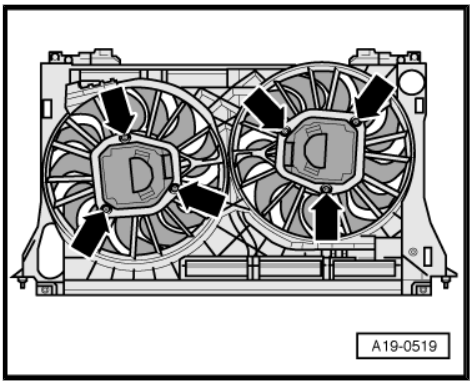
Removing

– Drain off coolant ⇒ page 170 .
– Remove radiator ⇒ page 187 .
– Remove radiator cowl ⇒ page 192 .
– Remove bolts -arrows-.
– Unclip electrical connectors and lay wiring aside.
– Remove radiator fans.

Installing

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

– Install radiator cowl ⇒ page 192 .
– Install radiator ⇒ page 187 .
– Fill system with coolant ⇒ page 172 .



Tightening torque

Component	Nm
Radiator fan to radiator cowl	10 [1]
• [1] Renew bolt.	

26 – Exhaust system

1 Removing and installing parts of exhaust system

Note

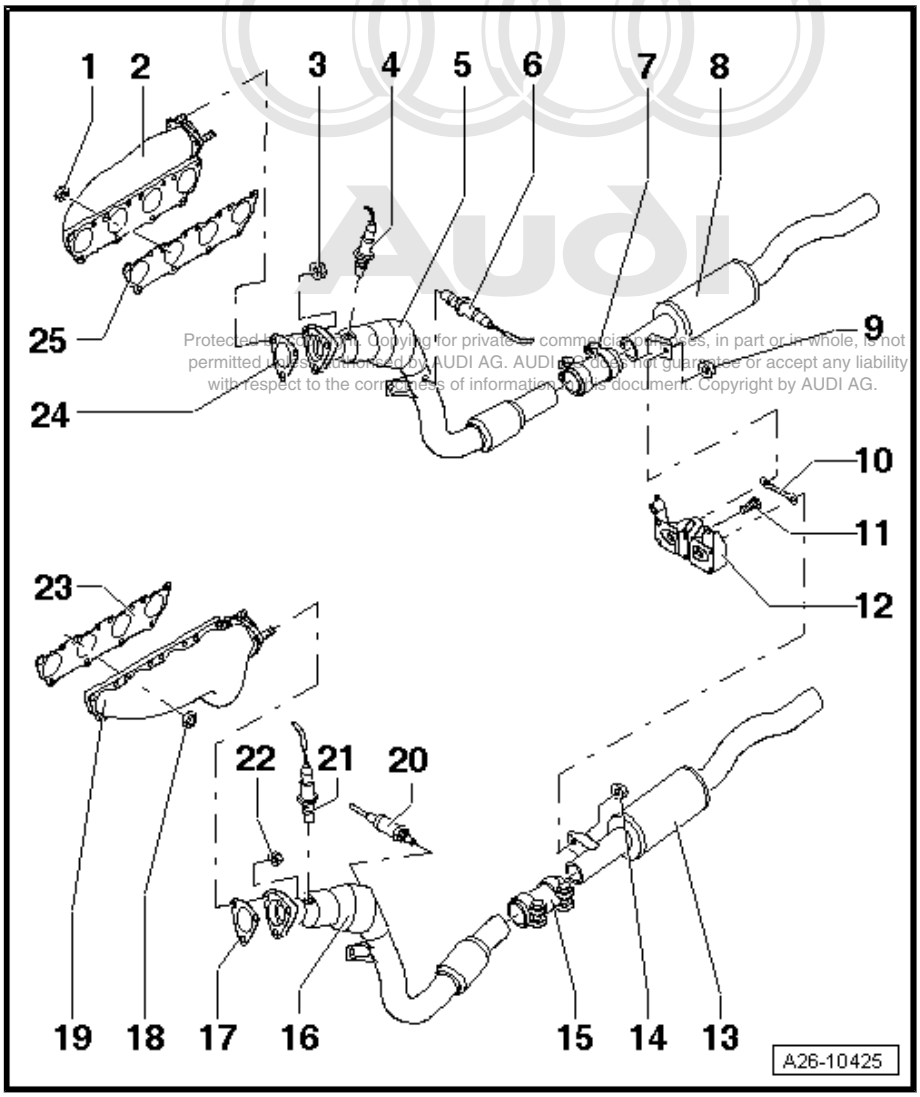
- *After working on the exhaust system, ensure that the system is not under stress and that it has sufficient clearance from the body. If necessary, loosen double and single clamps and align silencers and exhaust pipe so that sufficient clearance is maintained to the body at all points and the mountings are evenly loaded.*
- *Align the exhaust system so it is free of stress* ⇒ *page 210* .
- *Renew self-locking nuts.*

Note

Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

1.1 Exhaust system - exploded view

Exhaust system (front)



1 - Nut

- ❑ 25 Nm

2 - Exhaust manifold (right-side)

- ❑ Removing and installing ⇒ page 201

3 - Nut

- ❑ 25 Nm
- ❑

4 - Lambda probe -G39- (before catalytic converter)

- ❑ 50 Nm
- ❑ For bank 1
- ❑ The threads on the new Lambda probes are coated with a special assembly paste.
- ❑ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste.
- ❑ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ❑ Removing and installing ⇒ Rep. Gr. 24

5 - Catalytic converter (right-side)

- ❑ With flexible joint
- ❑ Do not bend flexible joint more than 10° – otherwise it can be damaged
- ❑ Mounting components ⇒ page 198
- ❑ Removing and installing ⇒ page 205

6 - Lambda probe after catalytic converter -G130-

- ❑ 50 Nm
- ❑ For bank 1
- ❑ The threads on the new Lambda probes are coated with a special assembly paste.
- ❑ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste.
- ❑ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ❑ Removing and installing ⇒ Rep. Gr. 24

7 - Double clamp

- ❑ Installation position ⇒ page 199
- ❑ Align exhaust system so it is free of stress before tightening clamp ⇒ page 210
- ❑ Tighten bolt connections evenly.

8 - Front silencer (right-side)

- ❑ Catalytic converter and front silencer are one unit as original equipment. For repair purposes the front silencer is supplied separately, with a double clamp for connecting the silencer.
- ❑ Removing and installing ⇒ page 209

9 - Nut

- ❑ 25 Nm

10 - Bracket

11 - Bolt

- ❑ 22 Nm

12 - Bracket

- ❑ Mounting components ⇒ page 199

13 - Front silencer (left-side)

- ❑ Catalytic converter and front silencer are one unit as original equipment. For repair purposes the front silencer is supplied separately, with a double clamp for connecting the silencer.
- ❑ Removing and installing ⇒ page 207

14 - Nut

- ❑ 25 Nm

15 - Double clamp

- ❑ Installation position ⇒ page 199
- ❑ Align exhaust system so it is free of stress before tightening clamp ⇒ page 210
- ❑ Tighten bolt connections evenly.

16 - Catalytic converter (left-side)

- ❑ With flexible joint
- ❑ Do not bend flexible joint more than 10° – otherwise it can be damaged
- ❑ Mounting components ⇒ page 198
- ❑ Removing and installing ⇒ page 203

17 - Gasket

- ❑ Renew

18 - Nut

- ❑ 25 Nm

19 - Exhaust manifold (left-side)

- ❑ Removing and installing ⇒ page 200

20 - Lambda probe 2 after catalytic converter -G131-

- ❑ 50 Nm
- ❑ For bank 2
- ❑ The threads on the new Lambda probes are coated with a special assembly paste.
- ❑ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste.
- ❑ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ❑ Removing and installing ⇒ Rep. Gr. 24

21 - Lambda probe 2 -G108- (before catalytic converter)

- ❑ 50 Nm
- ❑ For bank 2
- ❑ The threads on the new Lambda probes are coated with a special assembly paste.
- ❑ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste.
- ❑ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ❑ Removing and installing ⇒ Rep. Gr. 24

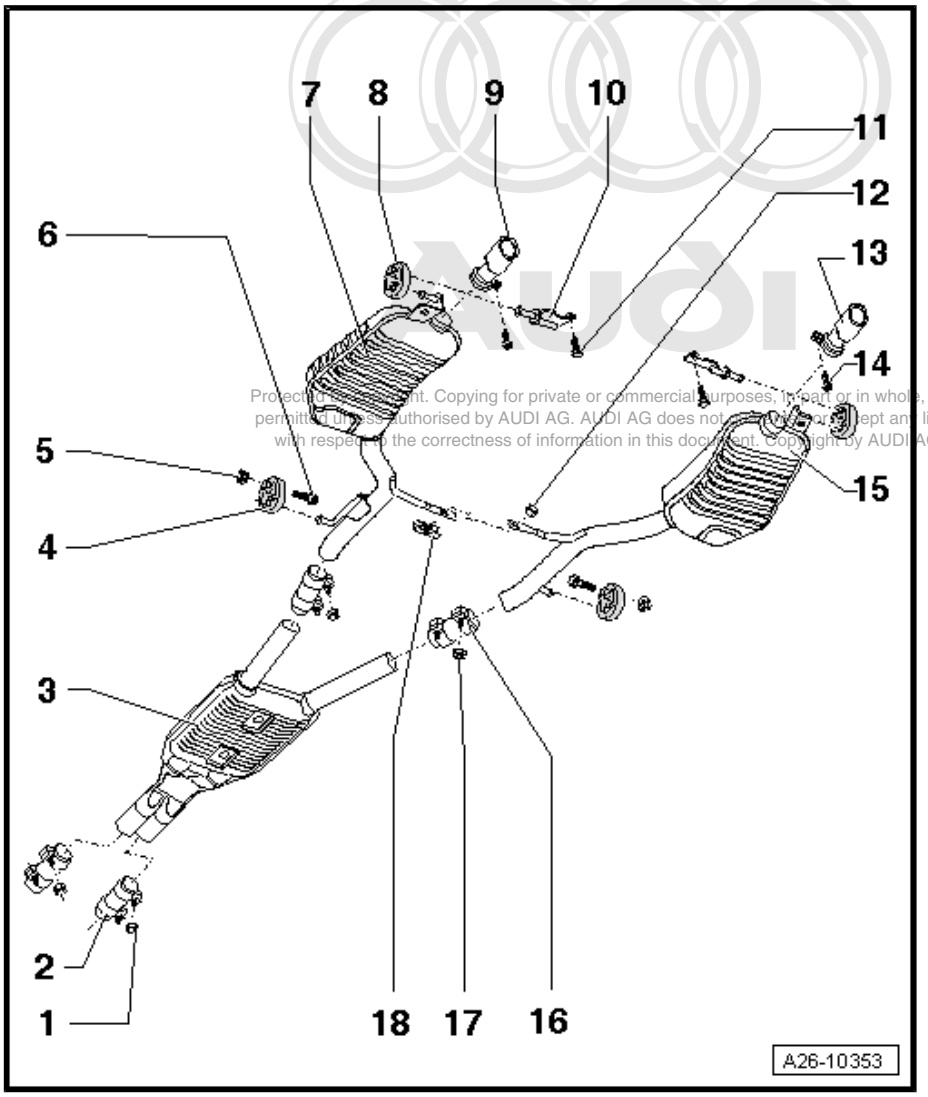
22 - Nut
- ❑ 25 Nm

23 - Gasket
- ❑ Renew

24 - Gasket
- ❑ Renew

25 - Gasket
- ❑ Renew

Exhaust system (rear)



1 - Nut
- ❑ 25 Nm

2 - Double clamp
- ❑ Installation position ⇒ page 199
- ❑ Align exhaust system so it is free of stress before tightening clamp ⇒ page 210
- ❑ Tighten bolt connections evenly.

3 - Centre silencer
- ❑ Centre silencer and rear silencer are one unit as original equipment. For repair purposes the centre and rear silencers are supplied separately, with a double clamp for connecting the silencers
- ❑ Cutting through connecting pipe ⇒ page 200

4 - Mounting

5 - Nut
- ❑ 25 Nm

6 - Bolt

7 - Left rear silencer
- ❑ Centre silencer and rear silencer are one unit as original equipment. For repair purposes the centre and rear silencers are supplied separately, with a double clamp for connecting the silencers
- ❑ Cutting through connecting pipe ⇒ page 200
- ❑ Renewing tailpipe ⇒ page 199

8 - Mounting

9 - Tailpipe
- ❑ Renewing ⇒ page 199

10 - Mounting bracket to body

11 - Bolt

- ❑ 22 Nm

12 - Nut

- ❑ 23 Nm

13 - Tailpipe

- ❑ Renewing ⇒ page 199

14 - Nut

- ❑ 23 Nm

15 - Right rear silencer

- ❑ Centre silencer and rear silencer are one unit as original equipment. For repair purposes the centre and rear silencers are supplied separately, with a double clamp for connecting the silencers
- ❑ Cutting through connecting pipe ⇒ page 200
- ❑ Renewing tailpipe ⇒ page 199

16 - Double clamp

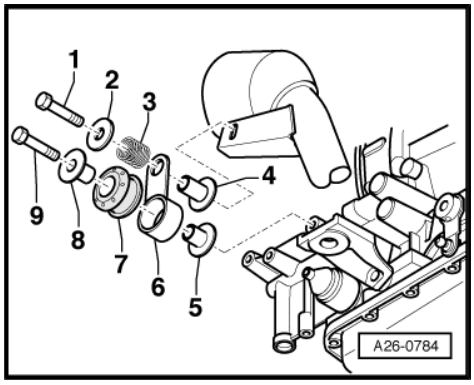
- ❑ For separate replacement of centre and rear silencers
- ❑ Installation position ⇒ page 199
- ❑ Align exhaust system so it is free of stress before tightening clamp ⇒ page 210
- ❑ Tighten bolt connections evenly.

17 - Nut

- ❑ 25 Nm

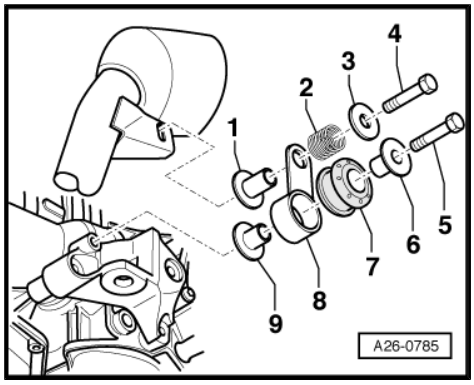
18 - Connecting bracket

Components of exhaust pipe mountings (left-side)



1 - Bolt, 25 Nm
2 - Washer
3 - Compression spring
4 - Spacer sleeve
5 - Spacer sleeve
6 - Bracket
7 - Buffer
8 - Spacer sleeve
9 - Bolt, 25 Nm

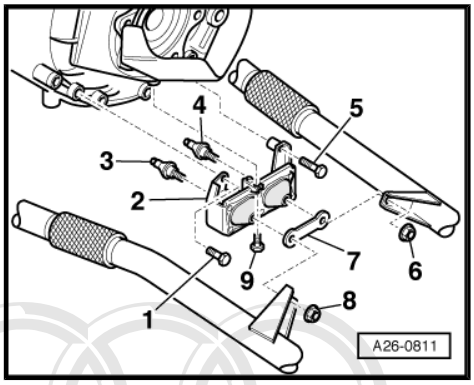
Components of exhaust pipe mountings (right-side)



1 - Spacer sleeve
2 - Compression spring
3 - Washer
4 - Bolt, 25 Nm
5 - Bolt, 25 Nm
6 - Spacer sleeve
7 - Buffer
8 - Bracket
9 - Spacer sleeve

Components of bracket (centre)

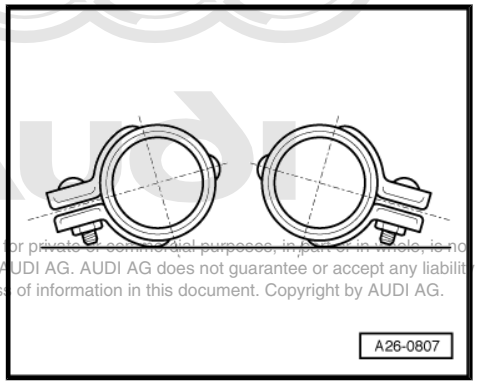
1 - Bolt, 22 Nm
2 - Bracket
3 - Stud
4 - Stud
5 - Bolt, 22 Nm
6 - Nut, self-locking, 18 Nm
7 - Bracket
8 - Nut, self-locking, 18 Nm
9 - Bolt, 22 Nm



Installation position of front double clamp

– Fit double clamp so that ends of bolts do not protrude beyond bottom of double clamp.

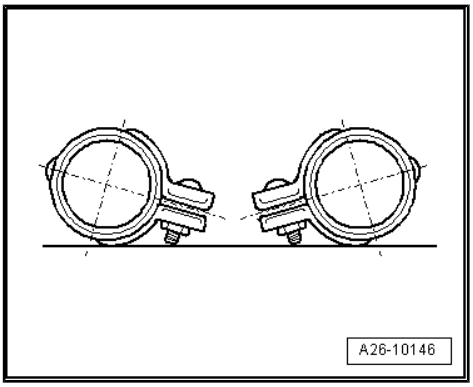
• Bolt connections face outwards.



Installation position of rear double clamp

– Fit double clamp so that ends of bolts do not protrude beyond bottom of double clamp.

♦ Bolt connections face one another.

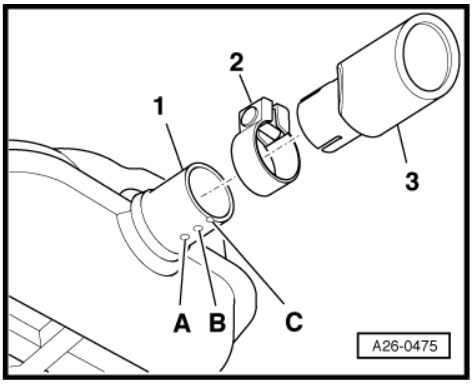


Renewing tailpipe

– Cut through tailpipe -1- with chain-type pipe cutter -VAS 6254- at the position marked -C-.

– Push new tailpipe -3- onto tailpipe as far as marking -A-. Slot on tailpipe should align with marking -B-.

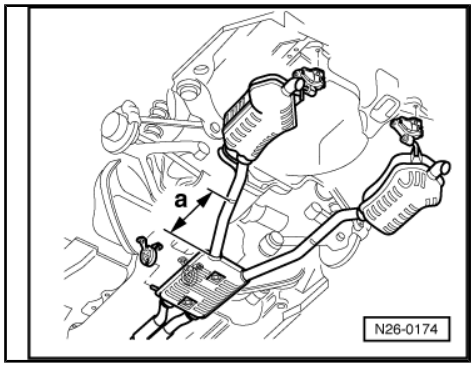
– Tighten bolts on double clamp -2-.



The connecting pipe can be cut through at the cutting point in order to renew the centre and rear silencers separately.

- ♦ The cutting point is marked by an indentation on the outside of the exhaust pipe.
- – Cut through exhaust pipe at cutting point using chain-type pipe cutter -VAS 6254- .

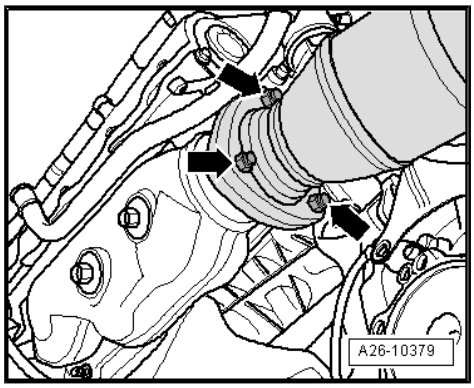
Dimension -a- = approx. 244 mm



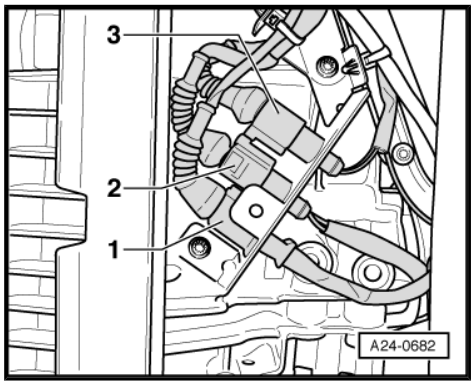
1.2 Removing and installing exhaust manifold (left-side)

Removing

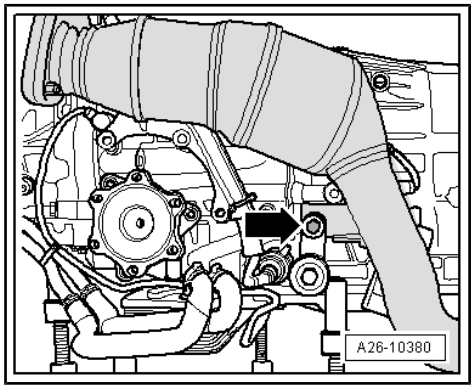
- – Remove engine ⇒ page 7 .
- – Move electrical wire for Lambda probe 2 -G108- (before catalytic converter) clear.
- – Unbolt catalytic converter with front silencer from exhaust manifold -arrows-.



- – Unplug electrical connector (brown) -3- for Lambda probe 2 after catalytic converter -G131- and move wiring clear.



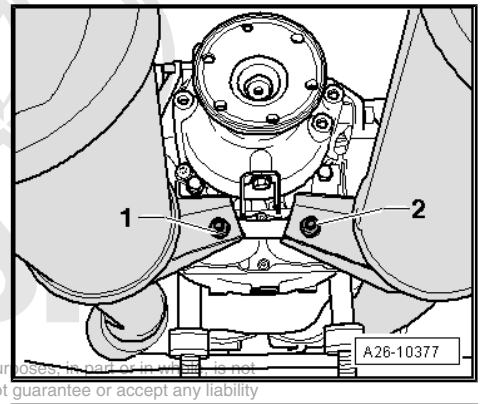
- – Remove bolt -arrow- on bracket for exhaust pipe.



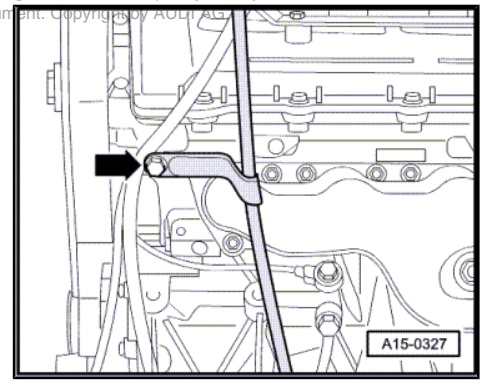
Note

The flexible pipe connection (de-coupling element) on the front exhaust pipe must not be bent more than 10° - otherwise it can be damaged.

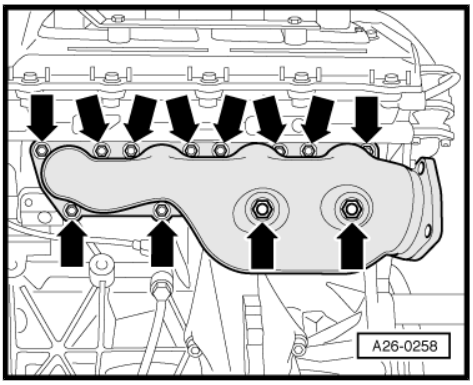
– Remove bolt -1- on bracket for exhaust system and remove catalytic converter with front silencer.



– Remove guide tube for oil dipstick -arrow-.



– Remove exhaust manifold -arrows-.



Installing

Note

- *Renew self-locking nuts.*
- *Renew gaskets.*
- *Fit new seal on guide tube for dipstick.*

– Install in reverse order.

Tightening torques

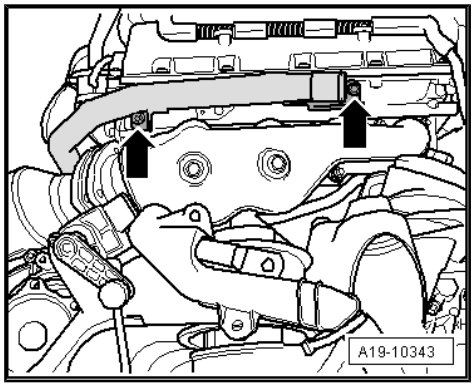
Bolted connection	Tightening torques
Exhaust manifold to cylinder head	25 Nm
Guide tube for dipstick to cylinder head	22 Nm

1.3 Removing and installing exhaust manifold (right-side)

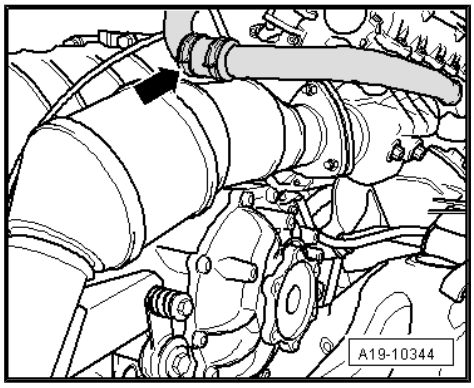
Removing

– Remove engine ⇒ page 7 .

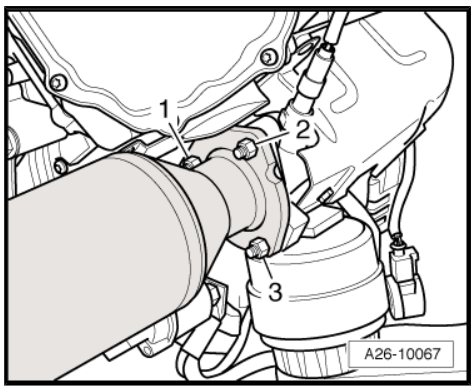
– Unbolt coolant pipe (right-side) -arrows-.



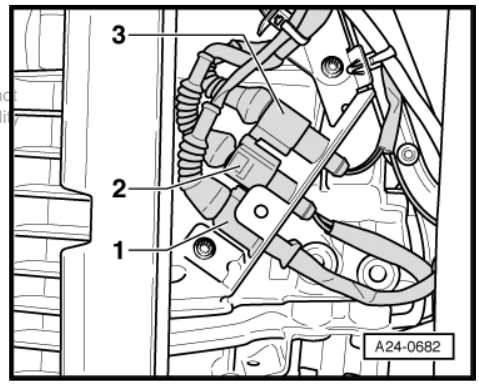
– Detach coolant pipe -arrow- and remove.
– Move electrical wire for Lambda probe -G39- (before catalytic converter) clear.



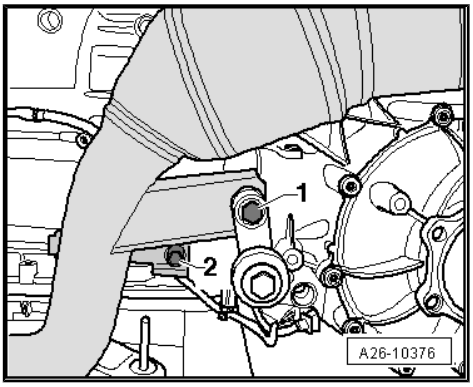
– Unbolt catalytic converter with front silencer from exhaust manifold -1 ... 3-.



– Unplug connector -2- (black) for Lambda probe after catalytic converter -G130- .



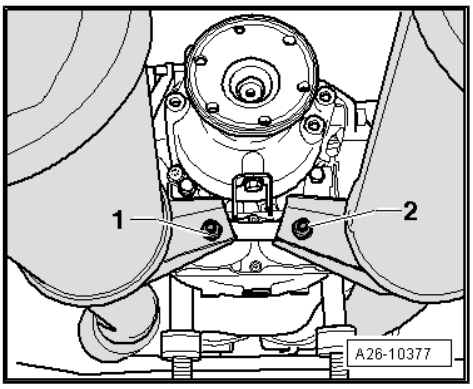
– Remove bolt -1- on bracket for exhaust pipe.
– Detach heat shield -2-.
– Move electrical wire for Lambda probe after catalytic converter -G130- clear.



Note

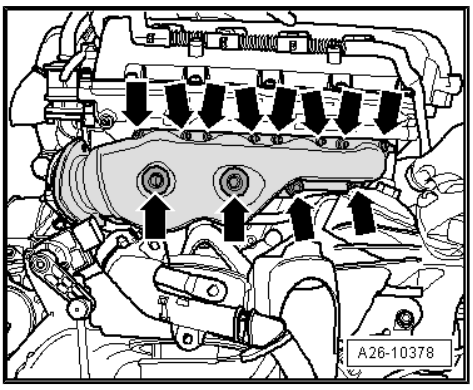
The flexible pipe connection (de-coupling element) on the front exhaust pipe must not be bent more than 10° - otherwise it can be damaged.

– Remove bolt -2- on bracket for exhaust system and remove catalytic converter with front silencer.



– Remove exhaust manifold -arrows-.

Installing



Note

- *Renew self-locking nuts.*
- *Renew gaskets.*

– Install in reverse order.

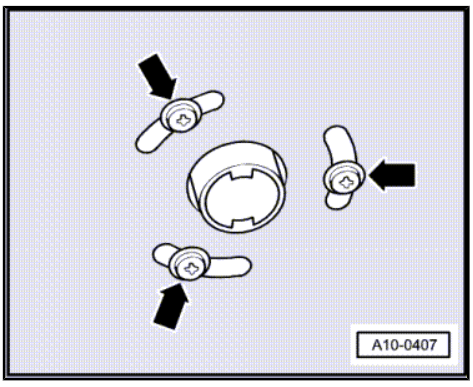
Tightening torques

Tightening torques ⇒ page 195 Exhaust system - exploded view

1.4 Removing and installing catalytic converter with front silencer (left-side)

Vehicles with auxiliary heater / supplementary heater:

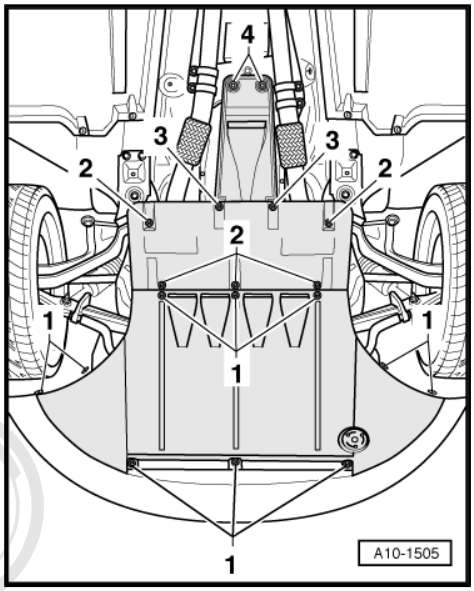
– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



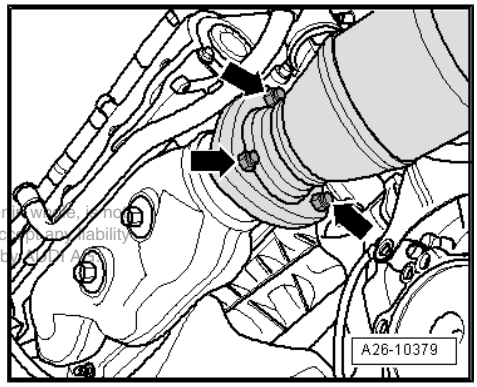
All models:

– Remove noise insulation -1...4-.

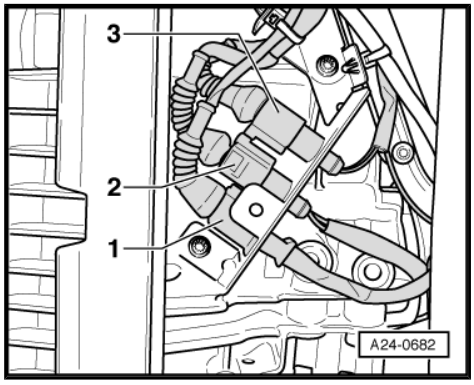
– Move electrical wire for Lambda probe 2 -G108- (before catalytic converter) clear.



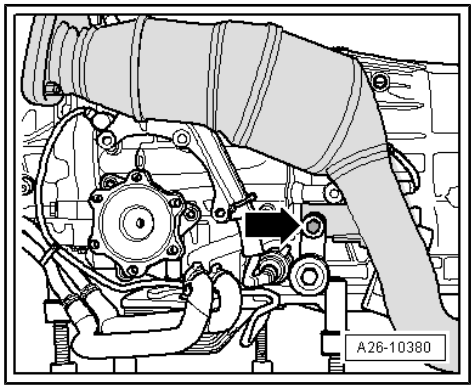
– Unbolt catalytic converter with front silencer from exhaust manifold -arrows-.



– Unplug electrical connector (brown) -3- for Lambda probe 2 after catalytic converter -G131- and move wiring clear.



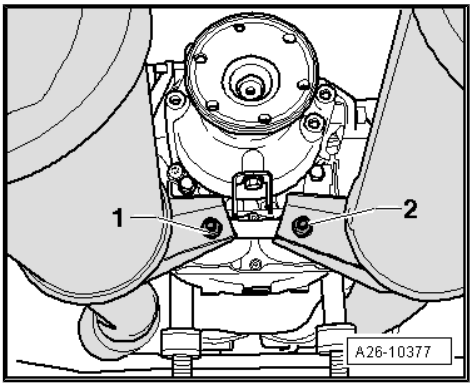
– Remove bolt -arrow- on bracket for exhaust pipe.



Note

The flexible pipe connection (de-coupling element) on the front exhaust pipe must not be bent more than 10° - otherwise it can be damaged.

– Remove bolt -1- on bracket for exhaust system and remove catalytic converter with front silencer.



Installing

– Install in reverse order.

Note

- *Renew self-locking nuts.*
- *Renew gaskets.*

– Align the exhaust system so it is free of stress ⇒ page 210 .

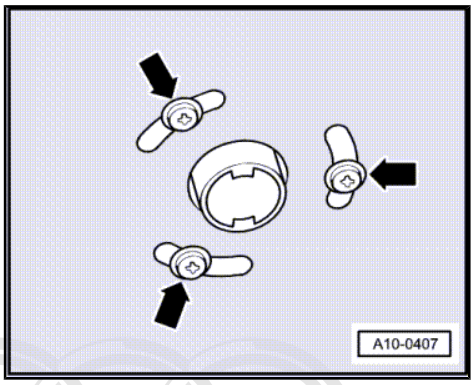
Tightening torques

Tightening torques ⇒ page 195 Exhaust system - exploded view

1.5 Removing and installing catalytic converter with front silencer (right-side)

Vehicles with auxiliary heater / supplementary heater:

– Remove bolts -arrows- securing exhaust pipe for auxiliary/ supplementary heater to noise insulation.

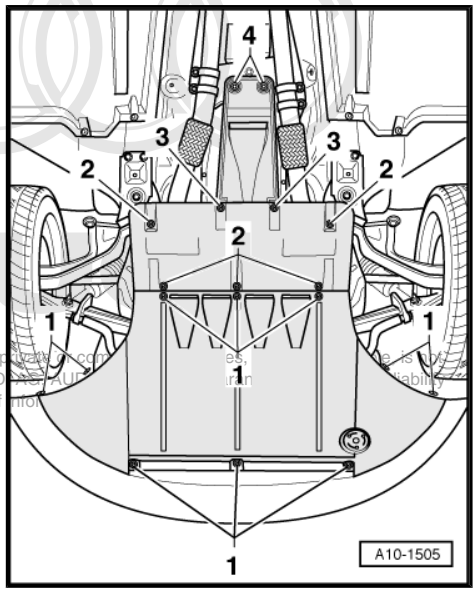


All models:

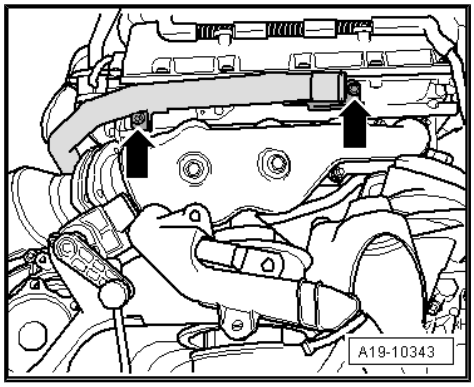
– Remove noise insulation -1...4-.

– Drain off coolant ⇒ page 170 .

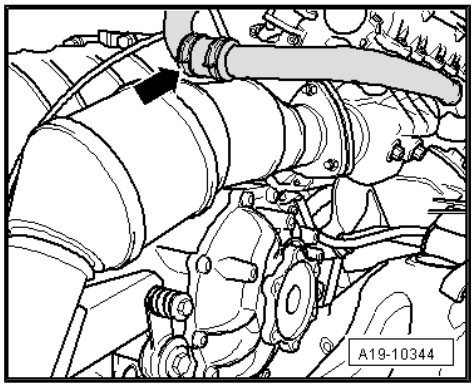
– Remove air cleaner ⇒ Rep. Gr. 24 .



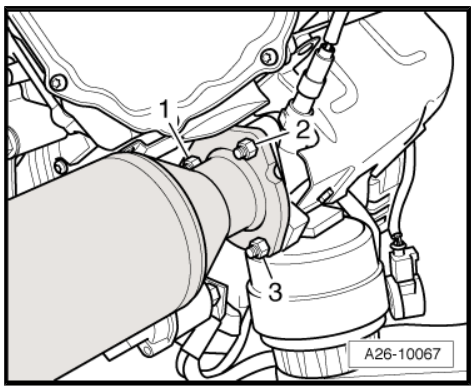
– Unbolt coolant pipe (right-side) -arrows-.



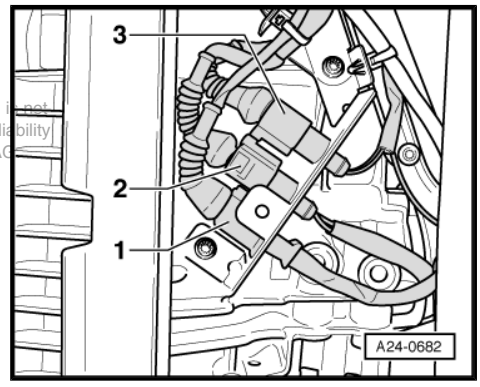
– Detach coolant pipe -arrow- and remove.
– Move electrical wire for Lambda probe -G39- (before catalytic converter) clear.



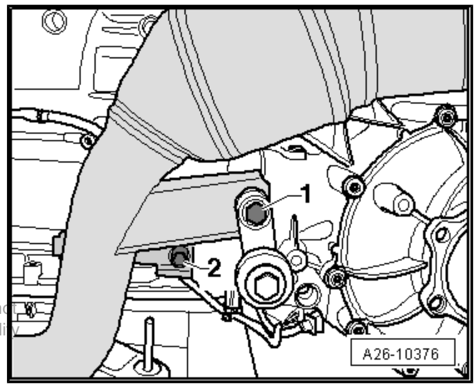
– Unbolt catalytic converter with front silencer from exhaust manifold -1 ... 3-.



– Unplug connector -2- (black) for Lambda probe after catalytic converter -G130- .



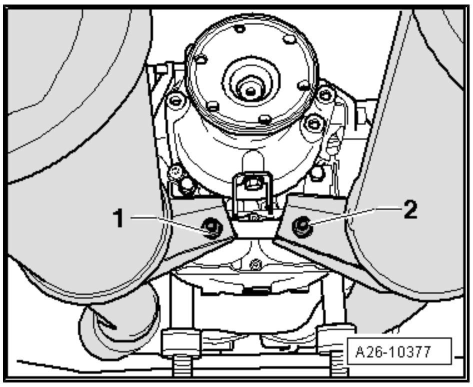
– Remove bolt -1- on bracket for exhaust pipe.
– Detach heat shield -2-.
– Move electrical wire for Lambda probe after catalytic converter -G130- clear.



Note

The flexible pipe connection (de-coupling element) on the front exhaust pipe must not be bent more than 10° otherwise it can be damaged.

– Remove bolt -2- on bracket for exhaust system and remove catalytic converter with front silencer.



Installing

– Install in reverse order.

Note

- *Renew self-locking nuts.*
- *Renew gaskets.*

– Align the exhaust system so it is free of stress ⇒ page 210 .
– Install air cleaner ⇒ Rep. Gr. 24 .
– Fill system with coolant ⇒ page 172 .

Tightening torques

Tightening torques ⇒ page 195 Exhaust system - exploded view

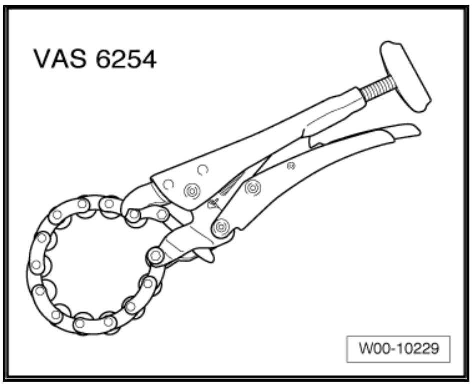
1.6 Removing and installing front silencer (left-side)

Note

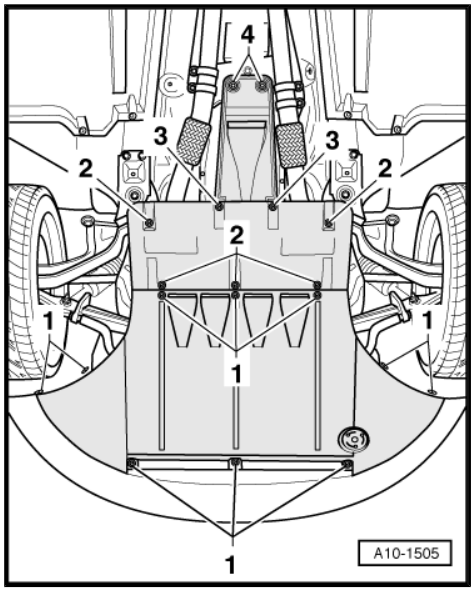
Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

Special tools and workshop equipment required

- Chain-type pipe cutter -VAS 6254-

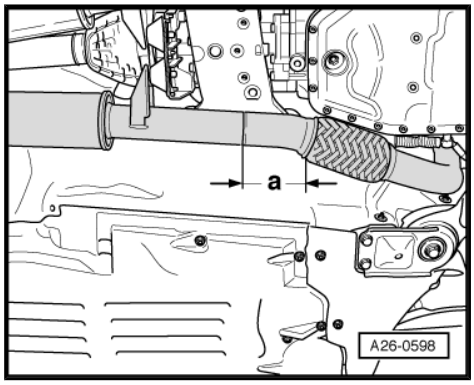


– Remove noise insulation -2...4-.



– Cut through exhaust pipe (left-side) using chain-type pipe cutter -VAS 6254- .

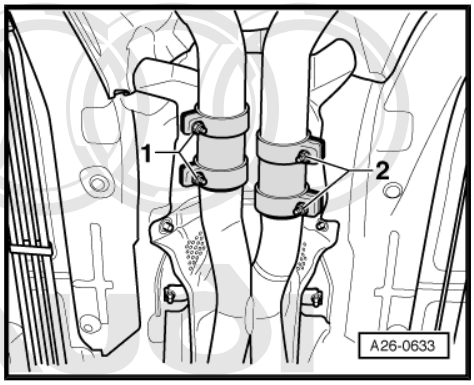
♦ Dimension -a- = 110 mm



Note

The flexible pipe connection (de-coupling element) on the front exhaust pipe must not be bent more than 10° - otherwise it can be damaged.

– Slacken double clamp -1- and push it forwards.



– Unscrew exhaust pipe (left-side) -1- from bracket.

Installing

Note

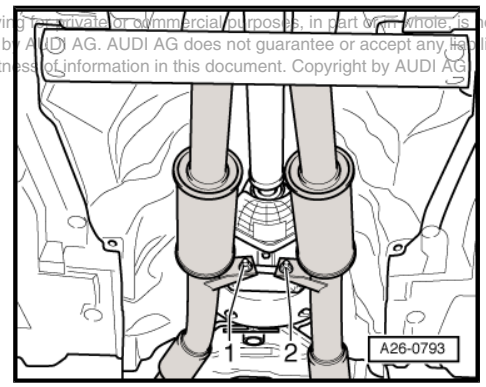
Renew self-locking nuts.

– Install in reverse order.

– Align the exhaust system so it is free of stress ⇒ page 210 .

Tightening torques

Tightening torques ⇒ page 195 Exhaust system - exploded view



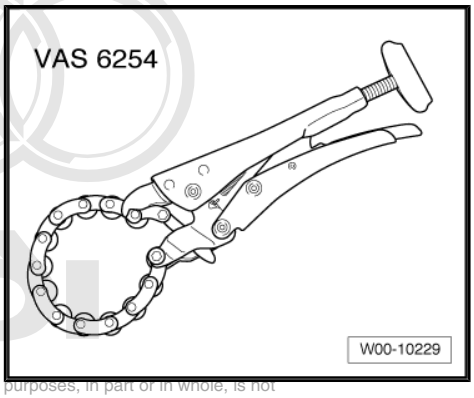
1.7 Removing and installing front silencer (right-side)

Note

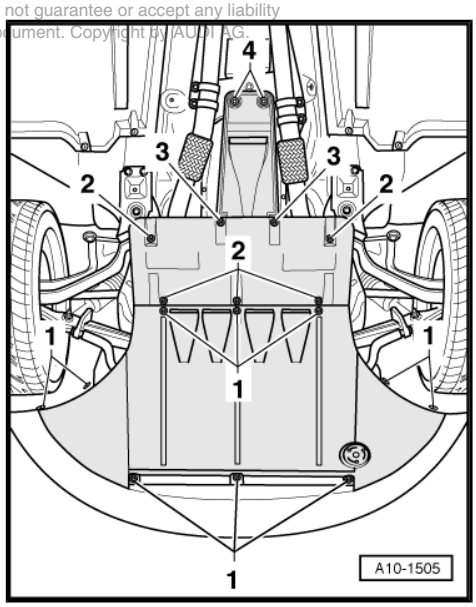
Activate jacking-up mode before driving vehicle onto lifting platform and lifting wheels off ground ⇒ Rep. Gr. 43 .

Special tools and workshop equipment required

- Chain-type pipe cutter -VAS 6254-

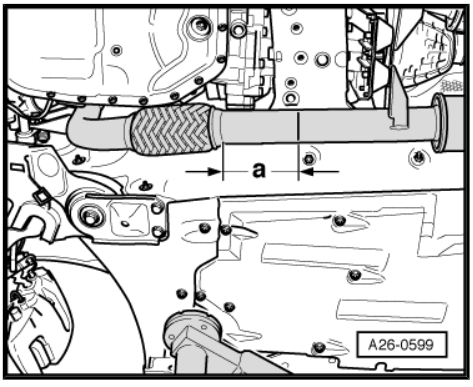


– Remove noise insulation -2...4-.



– Cut through exhaust pipe (right-side) using chain-type pipe cutter -VAS 6254-

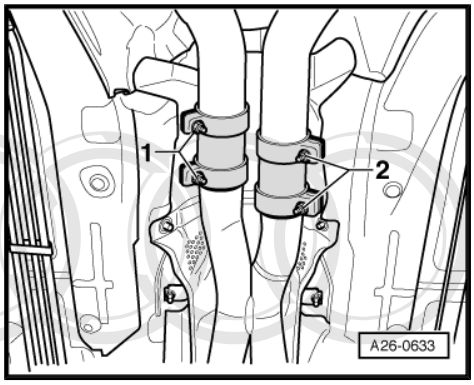
- Dimension -a- = 67 mm



Note

The flexible pipe connection (de-coupling element) on the front exhaust pipe must not be bent more than 10° - otherwise it can be damaged.

– Slacken double clamp -2- and push it forwards.

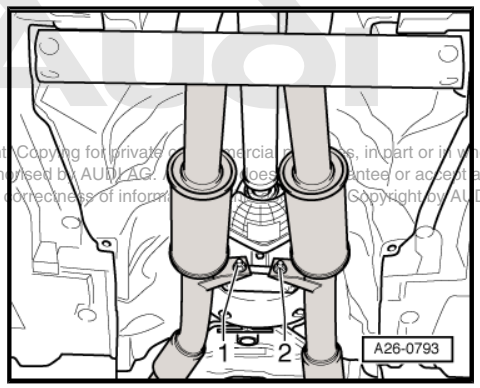


– Unscrew exhaust pipe (right-side) -2- from bracket.

Installing

Note

Renew self-locking nuts.



– Install in reverse order.
– Align the exhaust system so it is free of stress ⇒ page 210 .

Tightening torques

Tightening torques ⇒ page 195 Exhaust system - exploded view

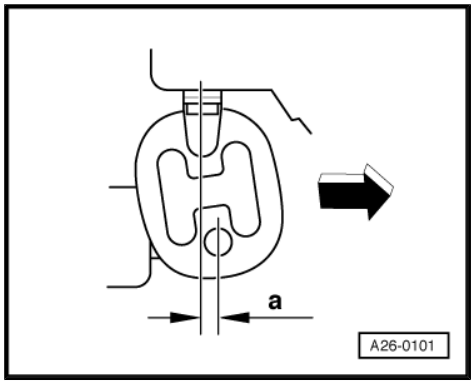
1.8 Stress-free alignment of exhaust system

- The exhaust system must be aligned when it is cool.

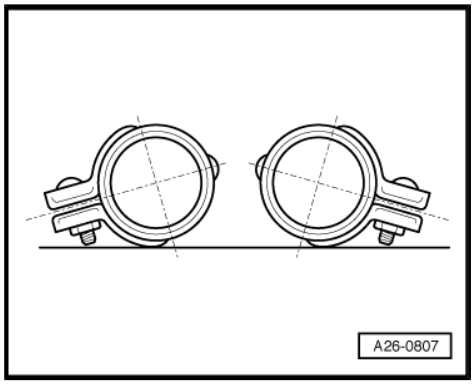
– Loosen bolt connections of all double clamps on exhaust system.
– Press rear silencer to front -arrow- until the rubber mountings are pre-loaded to the specified dimensions:

- Rubber mounting (front): -a- = 11 mm.
- Rubber mounting (rear): -a- = 14 mm.

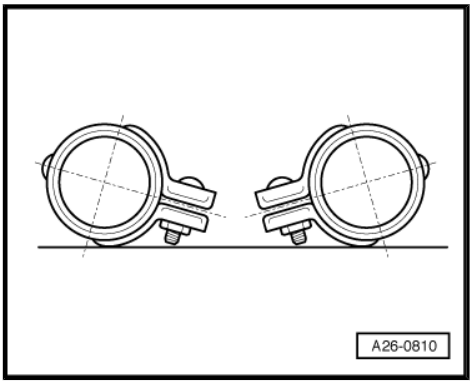
– Align rear silencer horizontally.



– Position double clamps so that they align with centre of cutting points.
– Align front double clamps so that ends of bolts do not protrude beyond bottom of double clamps.

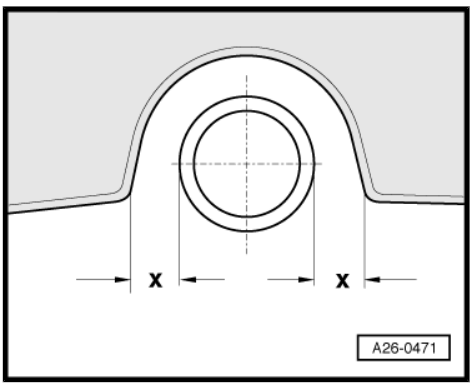


– Align rear double clamps so that ends of bolts do not protrude beyond bottom of double clamps.
– Tighten bolts on double clamps evenly.



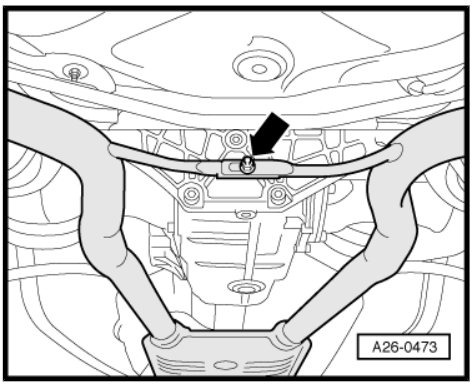
Aligning tailpipes

– Check the spacing of the left and right side tailpipes to the bumper cover:
• Dimension -x- (left-side) = dimension -x- (right-side)

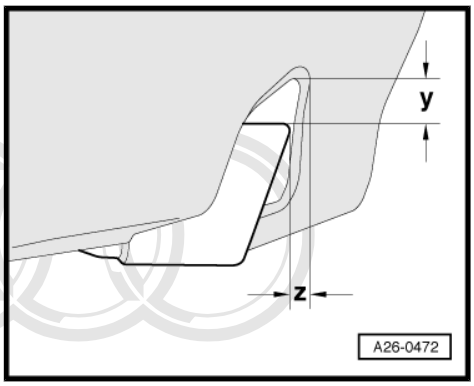


If necessary, correct dimension “x” as follows:

– Slacken bolt connection -arrow- on brace between exhaust pipes.
– Adjust the distance between the rear silencers.
– Tighten bolt connection.



– Check distances -y- and -z- between tailpipes and bumper.
• Dimension -y- = 18 ... 22 mm.
• Dimension -z- = 8 ... 12 mm.



1.9 Checking exhaust system for leaks

– Start engine and run at idling speed.
– Plug the tailpipe (e. g. with rags or stopper) and leave plugged until the check is complete.
– Listen for leaks at connection points between cylinder head/exhaust manifold, exhaust manifold/turbocharger and turbocharger/catalytic converter etc.

– Rectify any leaks that are found.

2 Secondary air system

The secondary air system is designed to enable the catalytic converter to heat up and reach its operating temperature more quickly after a cold start.

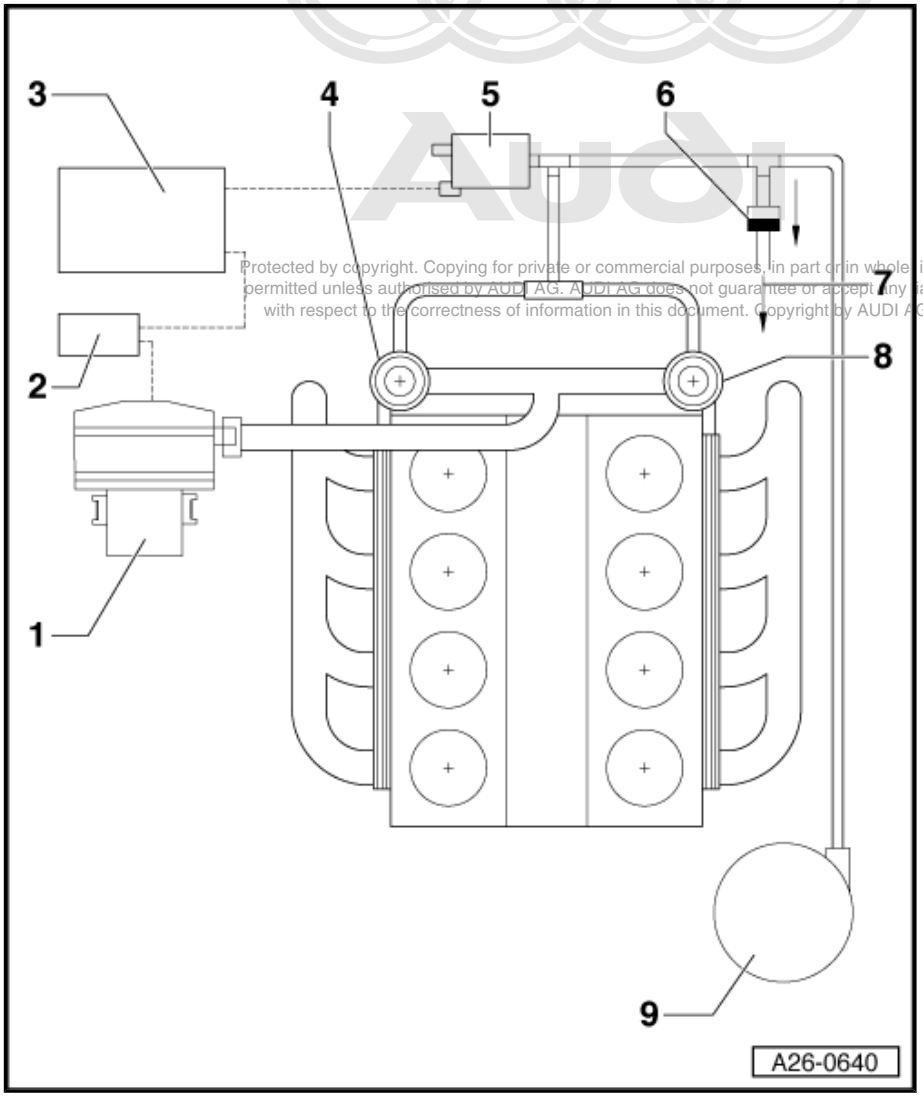
Principle

Because of the over-enrichment of the mixture in the cold start phase, the proportion of unburned hydrocarbons in the exhaust gas is higher.

The secondary air system improves the afterburning (oxidation) process in the catalytic converter, and thus reduces toxic emissions.

The heat generated by oxidisation accelerates the “light off” of the catalytic converter and significantly improves exhaust gas quality during warm-up.

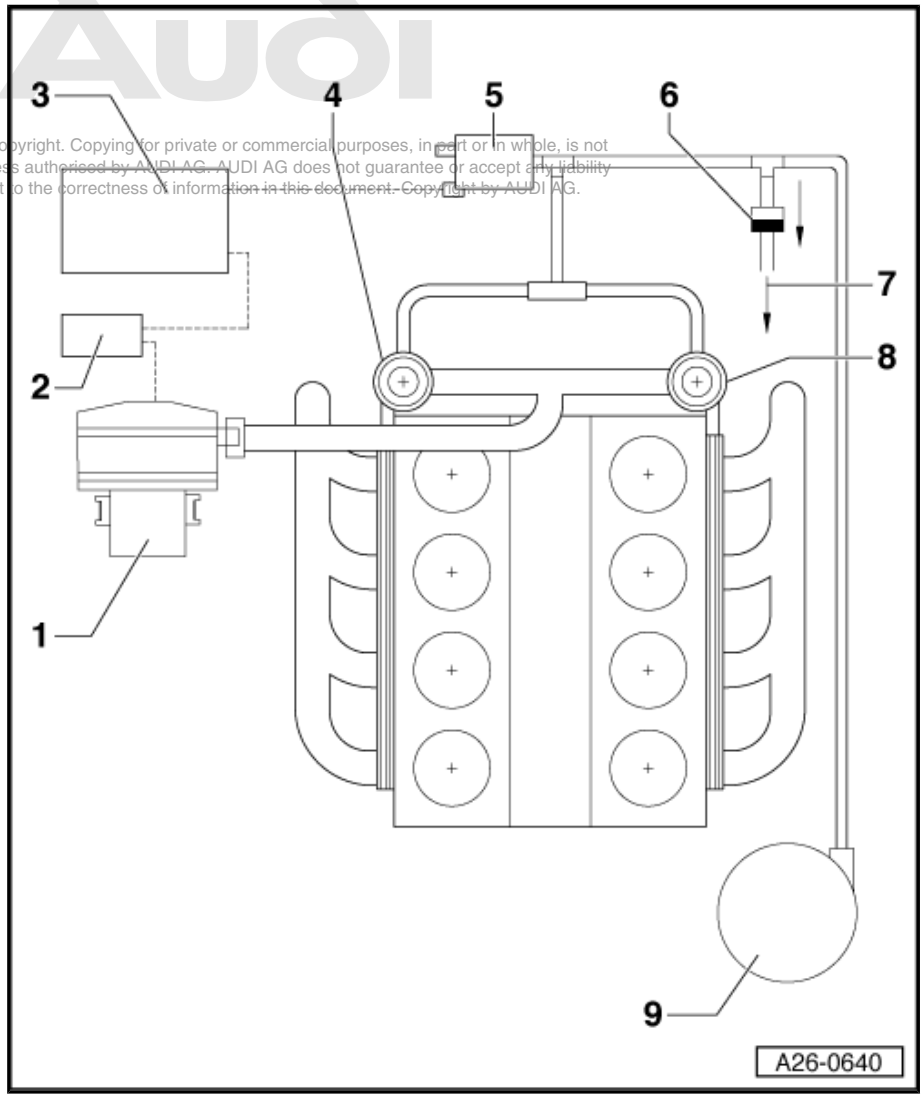
Function



- During the warm-up phase, the engine control unit -3- activates the secondary air pump -1- via the secondary air pump relay -2-. Air is directed to the combination valves for secondary air system -4- and -8-.

- At the same time, the secondary air inlet valve -5- is actuated, thus allowing vacuum to reach the combination valves for secondary air system -4- and -8-. In this way, the combination valve for secondary air opens a passage for the secondary air system to supply air to the exhaust ports in the cylinder head.

Overview



1 - Secondary air pump motor -V101-

- ❑ Fitting location ⇒ page 215
- ❑ Removing and installing ⇒ page 216

2 - Secondary air pump relay -J299-

- ❑ Fitting location ⇒ page 215

3 - Motronic control unit -J220-

4 - Combination valve for secondary air system (right-side)

- ❑ Fitting location ⇒ page 215
- ❑ Checking ⇒ page 217
- ❑ Removing and installing ⇒ page 220

5 - Secondary air inlet valve -N112-

- ❑ Fitting location ⇒ page 215

6 - Non-return valve

- ❑ Installation position: as shown in illustration, the -arrow- points in direction of flow

7 - To intake manifold

8 - Combination valve for secondary air system (left-side)

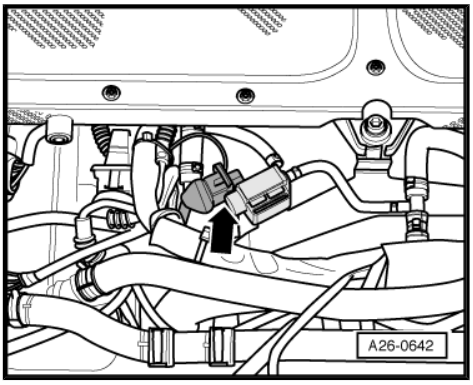
- ❑ Fitting location ⇒ page 215
- ❑ Checking ⇒ page 217
- ❑ Removing and installing ⇒ page 219

9 - Vacuum reservoir

- ❑ Fitting location: in front left wheel housing beneath liner

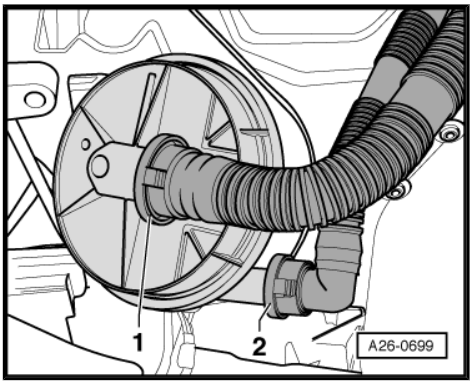
Fitting location of secondary air inlet valve -N112-

- At front right on intake manifold -arrow-



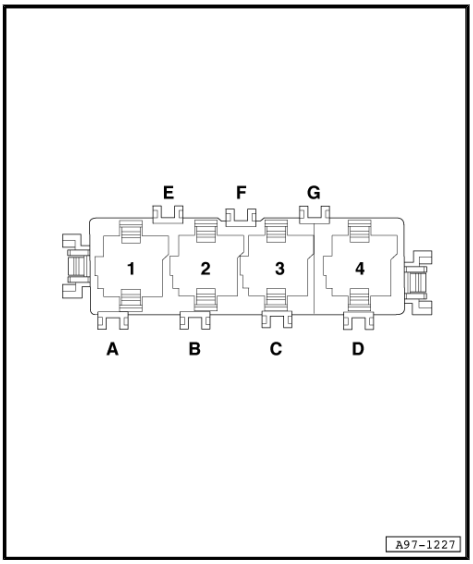
Fitting location of secondary air pump motor -V101-

- At front right of engine compartment below longitudinal member



Fitting location of secondary air pump relay -J299-

- Position 1 in electronics box (plenum chamber)

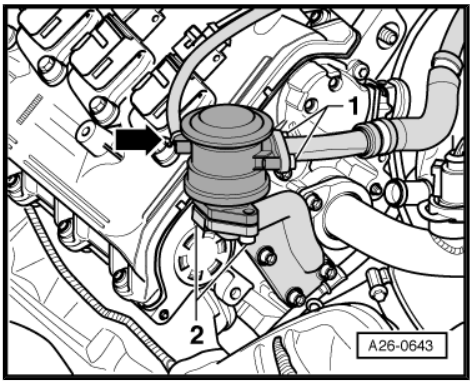


Combination valve for secondary air system

- At rear of cylinder heads

Note

In the illustration the left-side valve is shown.

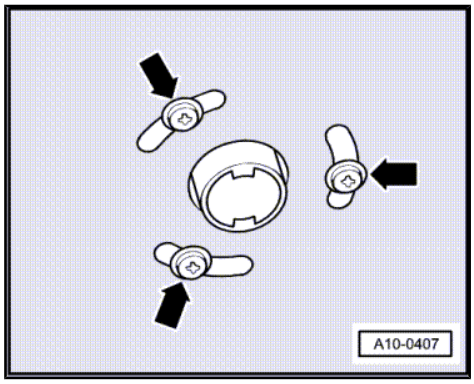


2.1 Removing and installing secondary air pump motor -V101-

Removing

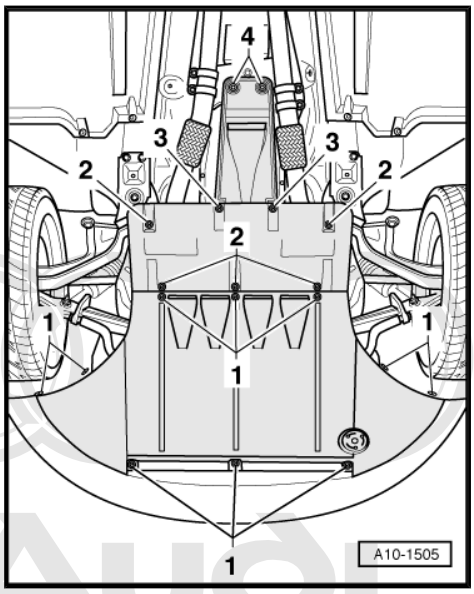
Vehicles with auxiliary heater / supplementary heater:

– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.



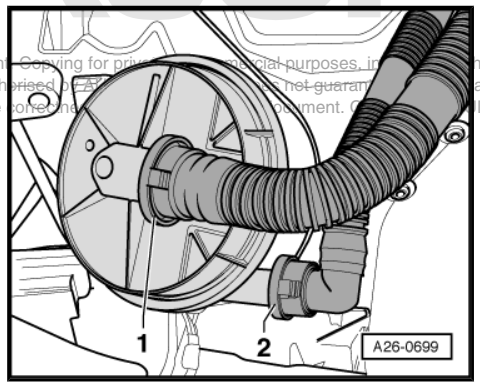
All models:

– Remove noise insulation -1-.

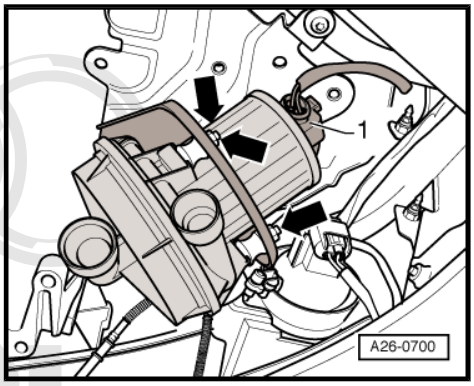


– Disconnect air hose -1-.

– Disconnect air hose -2-.



– Unplug electrical connector -1-.
– Remove secondary air pump motor -V101- -arrows-.



Installing

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

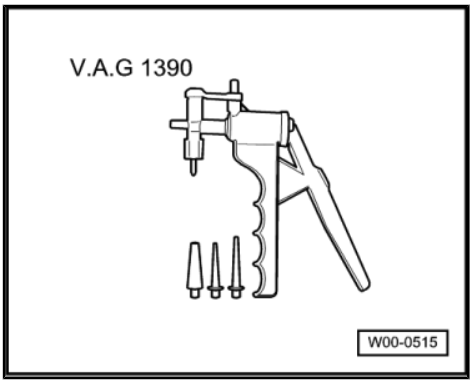
Tightening torque

Component	Nm
Secondary air pump motor to bracket	10

2.2 Checking combination valve for secondary air system for proper operation and leakage

Special tools and workshop equipment required

♦ Hand-operated vacuum pump -V.A.G 1390-

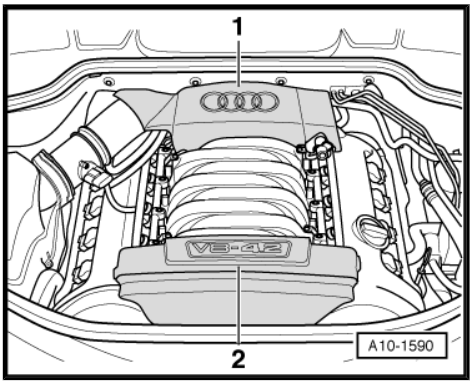


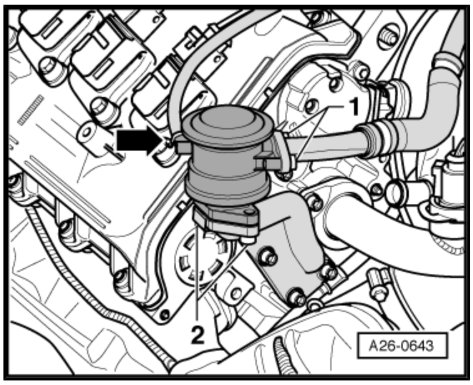
Test requirements

- Vacuum hoses and hose connections do not leak.
- Vacuum hoses are not clogged.

Test sequence

– Lift off engine cover panel -1-.





– Disconnect vacuum hose -arrow- from combination valve which is to be tested.

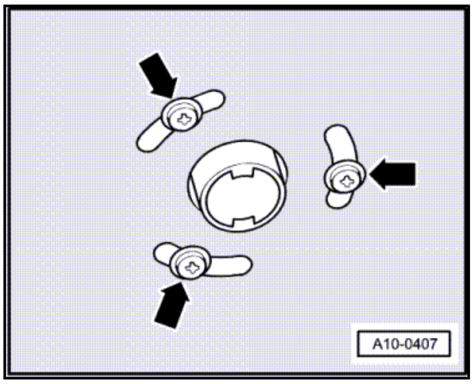
– Connect the hand-operated vacuum pump -V.A.G 1390- to vacuum hose of combination valve you want to check.

Note

♦ *Illustration shows engine from rear.*

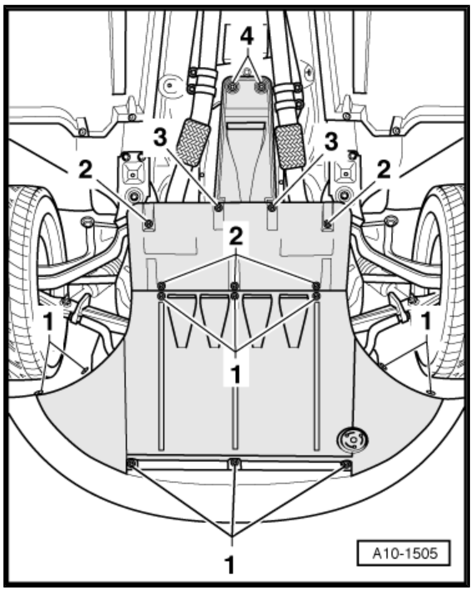
♦ *In the illustration shows the left-side combination valve.*

Vehicles with auxiliary heater / supplementary heater:

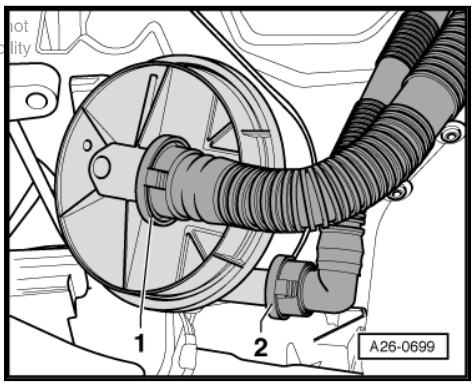


– Remove bolts -arrows- securing exhaust pipe for auxiliary/additional heater to noise insulation.

All models:



– Remove noise insulation -1-.



– Detach pressure hose -2- from secondary air pump motor -V101- and blow into it with light pressure (do not use compressed air).

♦ Both combination valves must be closed and it must not be possible to blow through the hose.

– Operate vacuum pump.

♦ The combination valve should open; it should now be possible to blow through the hose.

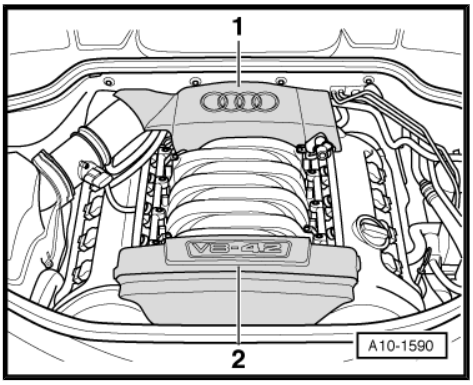
If the relevant combination valve does not open:

– Renew combination valve: left-side ⇒ page 219 , right-side ⇒ page 220 .

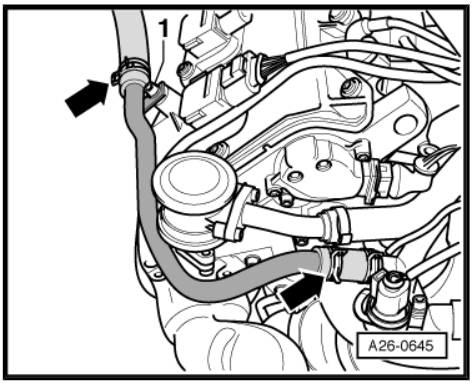
2.3 Removing and installing combination valve for secondary air system (left-side)

Removing

– Lift off engine cover panel -1-.



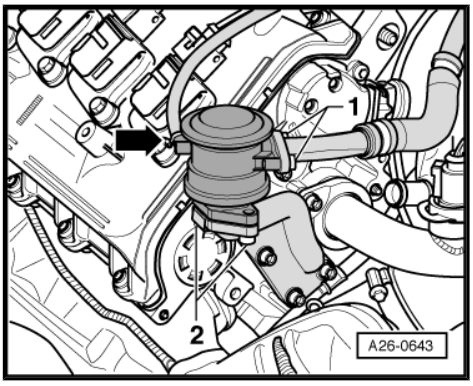
– Remove bolt -1-.
– Remove crankcase breather pipe -arrows-.



Note

Illustration shows engine from rear.

– Disconnect vacuum hose -arrow-.
– Unscrew bolts -1- and -2- and detach combination valve.



Note

Illustration shows engine from rear.

Installing

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

Note

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

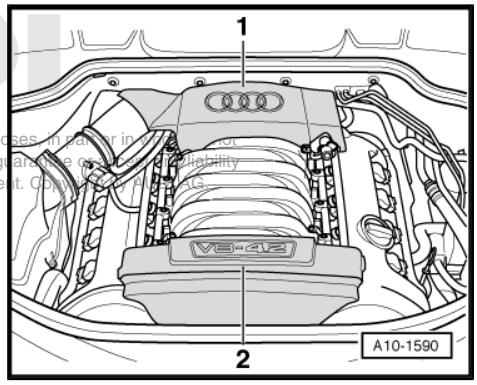
Tightening torques

Component	Nm
Combination valve to connecting flange	10
Connecting pipe to combination valve	10
Crankcase breather pipe to cylinder head cover	10

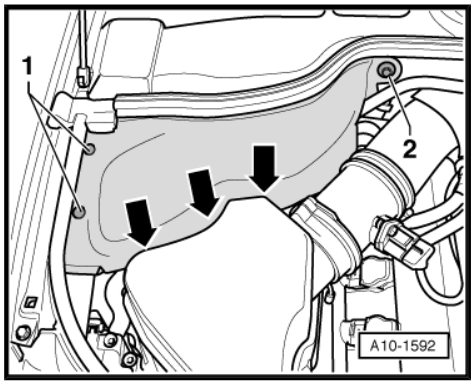
2.4 Removing and installing combination valve for secondary air system (right-side)

Removing

– Lift off engine cover panel -1-.



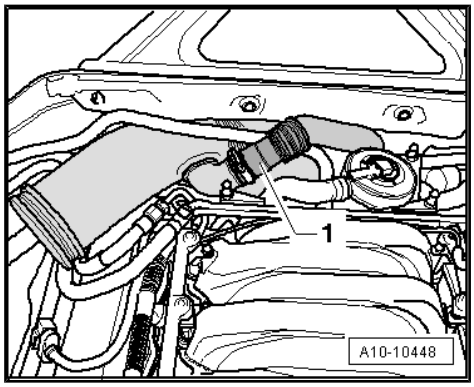
– Pull out clips -1-.
– Unscrew bolt -2- and remove cover.



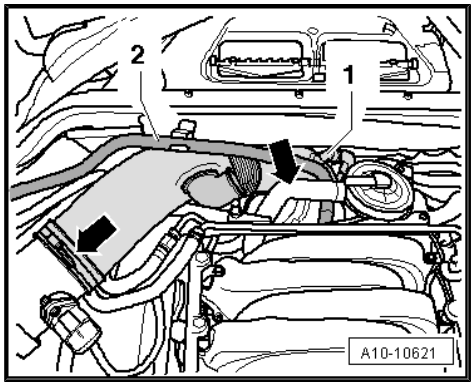
Note

Pay attention to clips -arrows- on installation.

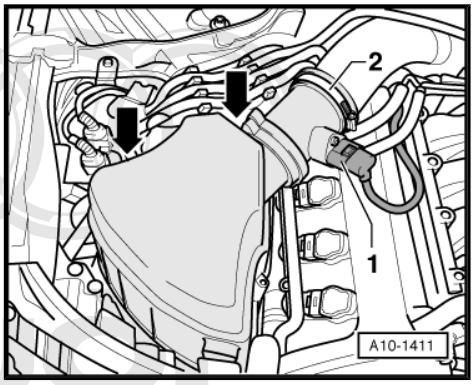
– Remove hose -1-.



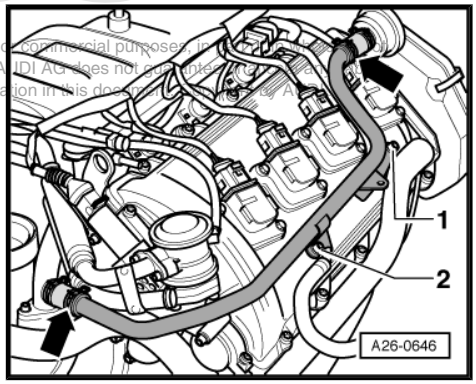
– Disconnect hose -1-.
– Unclip hose -2-.
– Remove air intake pipe -arrows-.



– Unplug electrical connector -1- from air mass meter.
– Remove air cleaner housing -arrows-.



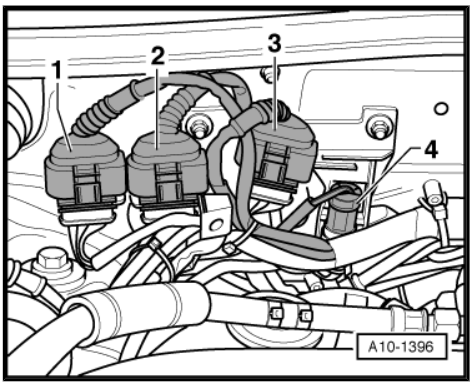
– Remove bolts -1- and -2-.
– Remove crankcase breather pipe -arrows-.



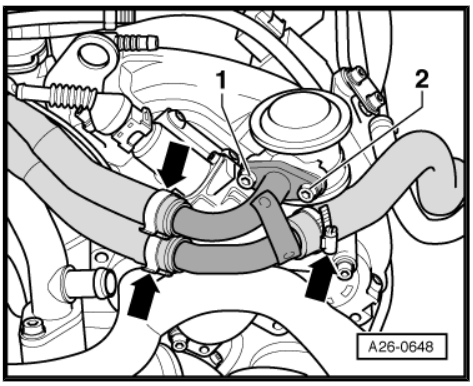
Note

Illustration shows engine from rear.

– Remove electrical connectors -1 ... 4- from bracket (on right side of bulkhead).
– Unbolt bracket from bulkhead.



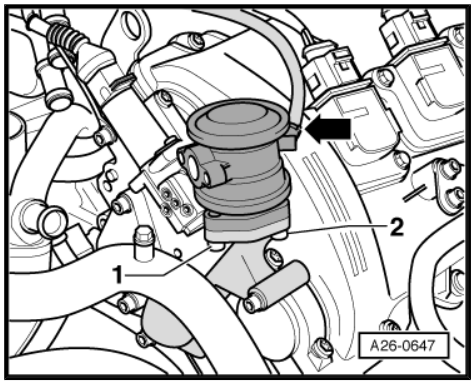
– Detach hoses for secondary air system at the connections indicated by the -arrows-.
– Unscrew bolts -1- and -2- and detach pipe for secondary air system.



Note

Illustration shows engine from rear.

– Disconnect vacuum hose -arrow-.
– Unscrew bolts -1- and -2- and detach combination valve.



Note

Illustration shows engine from rear.

Installing

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

Note

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

– Install air cleaner ⇒ Rep. Gr. 24 .

Tightening torques

Component		Nm
Combination valve to connecting flange		10
Connecting pipe to:	Combination valve	10
	Cylinder head cover	10