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Workshop Manual Audi A8 1994 ➤

8-cylinder engine (3.7 ltr., 4.2 ltr. 5-valve), mechanics									
Engine ID	AQF	AQG	ARU	AQH	AUW	AVN	AVP	AKC	AYS
	BCS	AKB	AUX						

Edition 06.2009

List of Workshop Manual Repair Groups

Repair Group

- 00 - Technical data
- 10 - Removing and installing engine
- 13 - Crankshaft group
- 15 - Cylinder head, valve gear
- 17 - Lubrication
- 19 - Cooling
- 26 - Exhaust system



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

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00 – Technical data

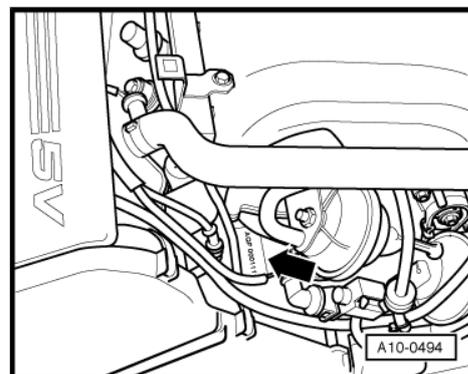
1 Technical data

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	AQF	AQG	ARU	AQH	AUW	AKB
Capacity ltr.	4.172	3.697	4.172	4.172	4.172	4.172
Power output kW at rpm	228/6200	191/6000	175/5000	265/7000	228/6200	228/6200
Torque Nm at rpm	410/3000	350/3250	400/3000	430/3500	410/3000	410/3000
Bore Ø in mm	84.5	84.5	84.5	84.5	84.5	84.5
Stroke mm	93.0	82.4	93.0	93.0	93.0	93.0
Compression ratio	11.0	10.8	11.0	11.0	11.0	11.0
RON/MON 98/88 recommended at least RON	95	95	95	95	95	95
Fuel injection system	Motronic	Motronic	Motronic	Motronic	Motronic	Motronic
Ignition system	Motronic	Motronic	Motronic	Motronic	Motronic	Motronic
Knock control	yes	yes	yes	yes	yes	yes
Self-diagnosis	yes	yes	yes	yes	yes	yes
Lambda control	yes	yes	yes	yes	yes	yes
Catalytic converter	yes	yes	yes	yes	yes	yes
Turbocharging/supercharging	no	no	no	no	no	no
Secondary air system	yes	yes	yes	yes	yes	yes

Code letters	AKC	AVN	AVP	AYS	AUX	BCS
Capacity ltr.	3.697	4.172	4.172	4.172	4.172	4.172
Power output kW at rpm	191/6000	175/4200	265/7000	265/7000	228/6200	265/7000
Torque Nm at rpm	350/3250	410/3000	420/3400	420/3400	410/3000	430/3400
Bore Ø in mm	84.5	84.5	84.5	84.5	84.5	84.5
Stroke mm	82.4	93.0	93.0	93.0	93.0	93.0
Compression ratio	10.8	11.0	11.0	11.0	11.0	11.0
RON/MON 98/88 recommended at least RON	95	95	95	95	95	98
Fuel injection system	Motronic	Motronic	Motronic	Motronic	Motronic	Motronic



Code letters	AKC	AVN	AVP	AYS	AUX	BCS
Ignition system	Motronic	Motronic	Motronic	Motronic	Motronic	Motronic
Knock control	yes	yes	yes	yes	yes	yes
Self-diagnosis	yes	yes	yes	yes	yes	yes
Lambda control	yes	yes	yes	yes	yes	yes
Catalytic converter	yes	yes	yes	yes	yes	yes
Turbocharging/supercharging	no	no	no	no	no	no
Secondary air system	yes	yes	yes	yes	yes	yes



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2 Safety precautions

2.1 Working on the cooling system

When working on the cooling system note the following warnings:

	WARNING
<i>Hot steam/hot coolant can escape - risk of scalding.</i>	
<ul style="list-style-type: none">◆ <i>The cooling system is under pressure when the engine is hot.</i>◆ <i>To allow pressure to dissipate, cover filler cap on coolant expansion tank with cloth and open carefully.</i>	

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
<i>Accidents can be caused if the driver is distracted by test equipment while road-testing, or if test equipment is not properly secured.</i>	
<i>Persons sitting in the front passenger's seat could be injured if the airbag is triggered in an accident.</i>	
<ul style="list-style-type: none">• <i>The use of test equipment while driving causes distraction.</i>• <i>There is an increased risk of injury if test equipment is not secured.</i>◆ <i>Test equipment must always be secured on the rear seat with a strap and operated from the rear seat by a second person.</i>	

2.3 Working on the exhaust system

When working on the exhaust system please note the following:

	Caution
<i>Avoid damage to flexible joint.</i>	
<ul style="list-style-type: none">◆ <i>Do not bend flexible joint more than 10°.</i>◆ <i>Install flexible joint so that it is not under tension.</i>◆ <i>Take care not to damage wire mesh on flexible joint.</i>	



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.

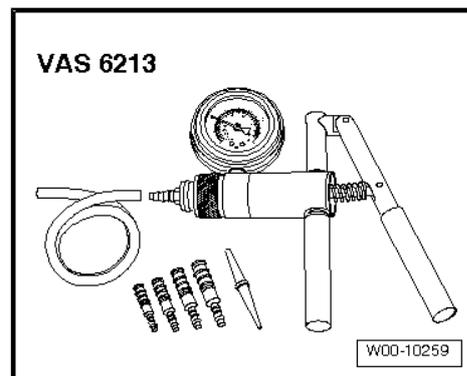
3.5 Routing and attachment of pipes, hoses and wiring

- ◆ 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-



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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.

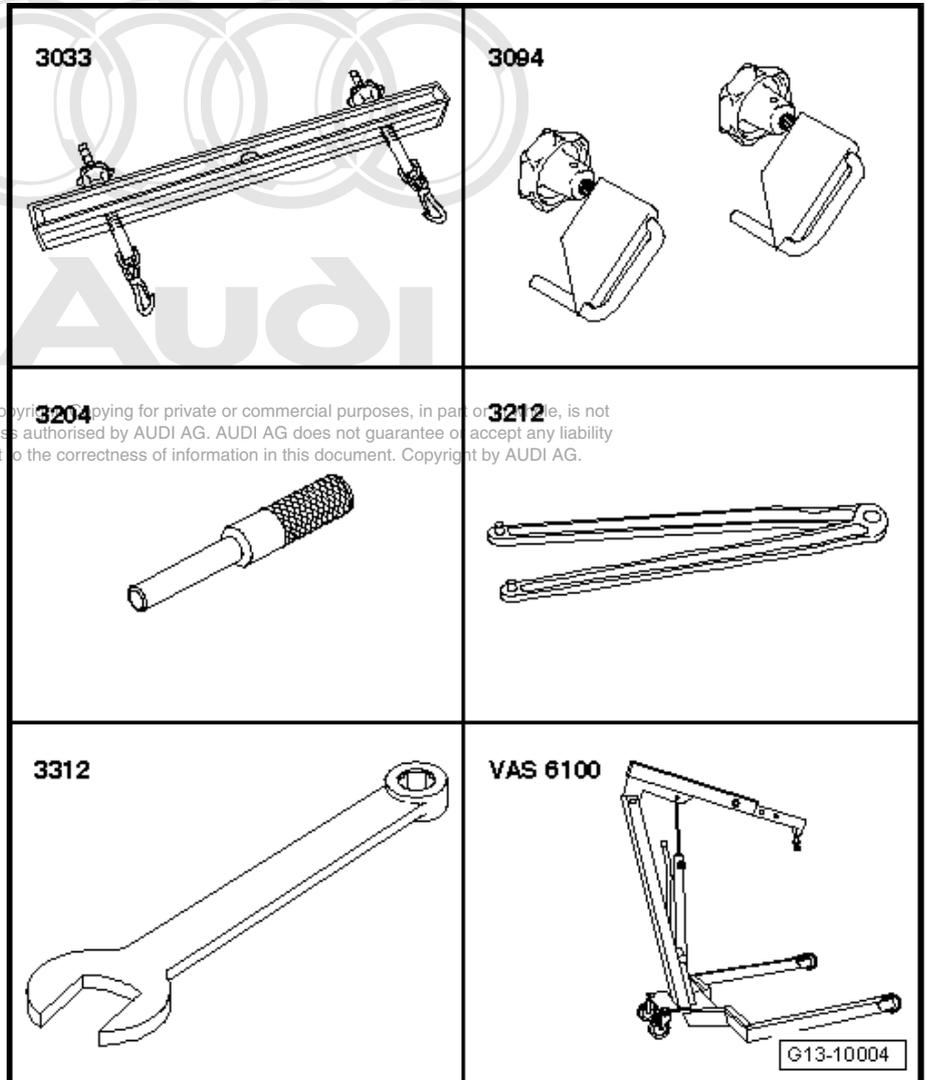
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10 – Removing and installing engine

1 Removing and installing engine

Special tools and workshop equipment required

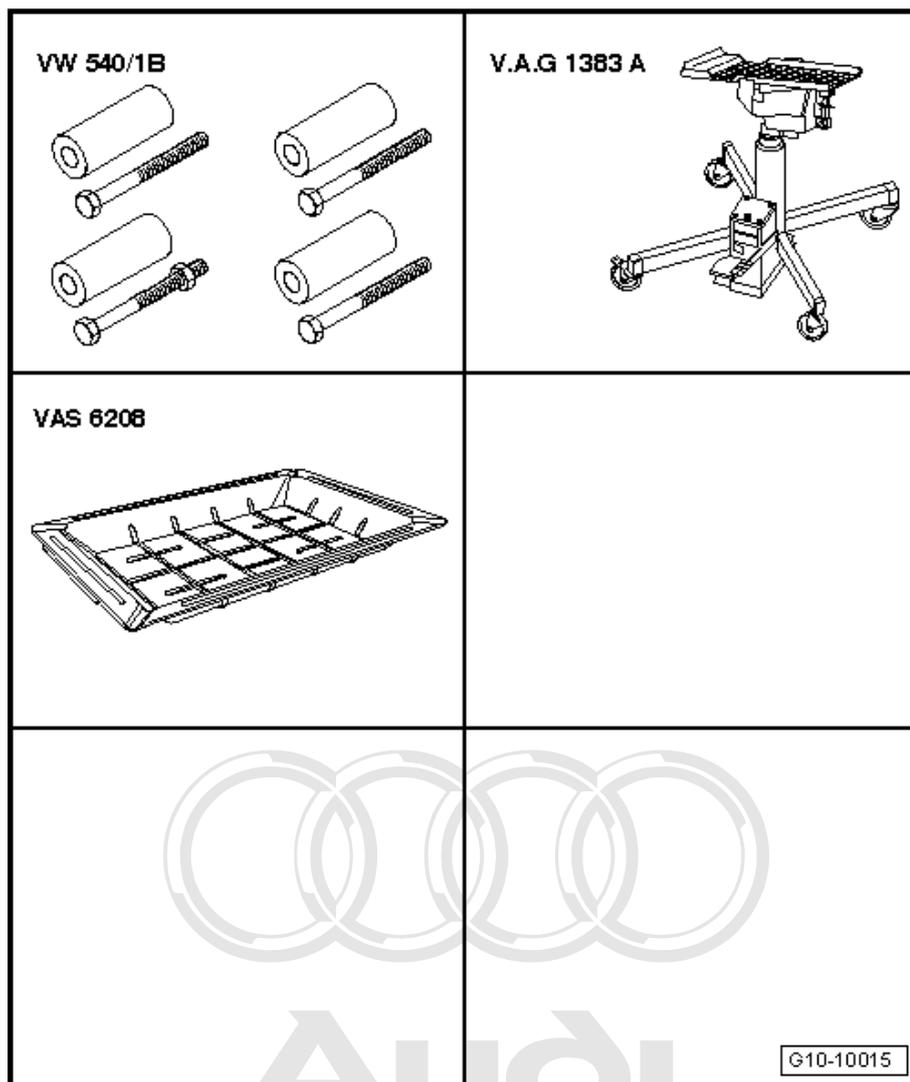
- ◆ Lifting tackle -3033-
- ◆ Hose clamps -3094-
- ◆ Locking pin -3204-
- ◆ Pin wrench -3212-
- ◆ Open-end spanner -3312-
- ◆ Workshop hoist -VAS 6100-



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- ◆ Engine and gearbox support supplement -VW 540/1 B-
- ◆ Engine and gearbox jack - V.A.G 1383 A-
- ◆ Drip tray for workshop hoist -VAS 6208-



1.1 Removing

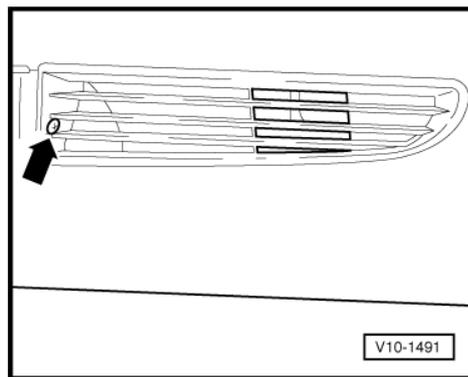


Note

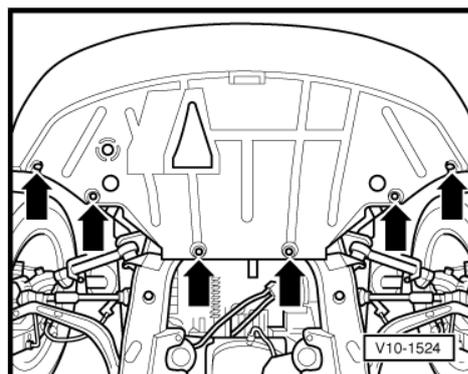
- ◆ *The engine is removed together with the gearbox from the front.*
 - ◆ *Obtain anti-theft code for radio.*
 - ◆ *Renew all cable ties which are released or cut open when removing the engine. Refit in the same position when installing the engine.*
 - ◆ *The battery is located behind a cover on the right side of the luggage compartment.*
- With ignition switched off, disconnect battery earth strap.

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- Unscrew grille on left side, unclip on right side.



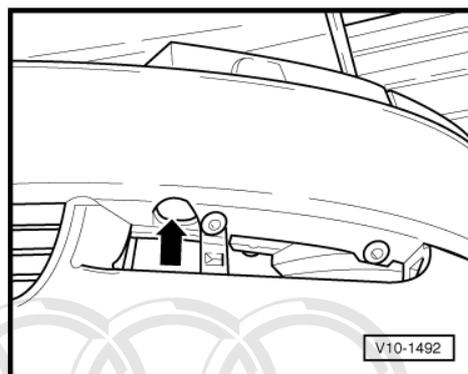
- Remove noise insulation.



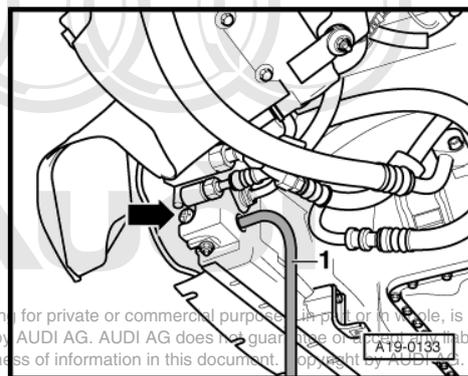
- Unbolt bumper on left and right sides.

Vehicles with headlight washers:

- Disconnect washer jet supply hose at bumper (in right intake grille).
- Fit drain hose -1- onto hose connection.
- Place drip tray -VAS 6208- under engine.



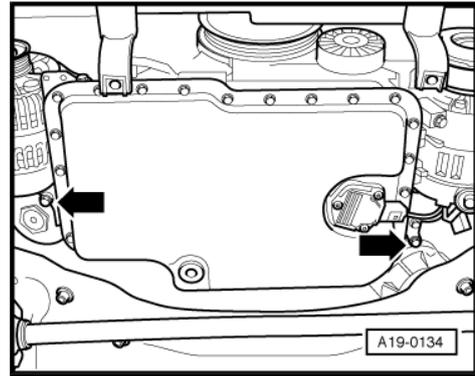
- Drain coolant from radiator (bottom left) -arrow-.



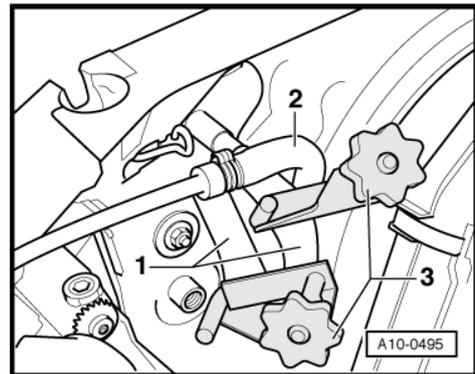
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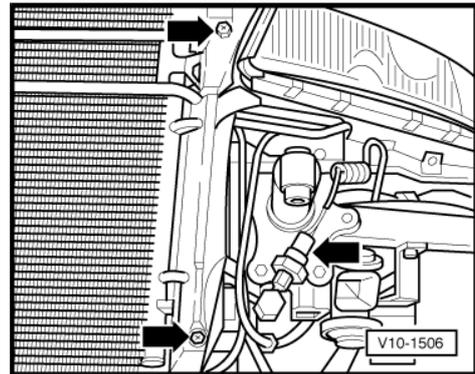
- Open drain plugs -arrows- and drain off coolant.



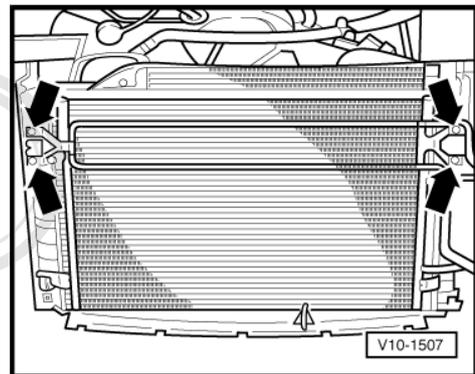
- Clamp off hoses for power steering hydraulic fluid using hose clamps -3094- .
- Disconnect hydraulic fluid lines -1- for power steering.
- Disconnect coolant hose -2-.



- Unbolt air duct for radiator (left and right).
- Unplug connector for high-pressure switch.
- Remove intake hose for air cleaner.

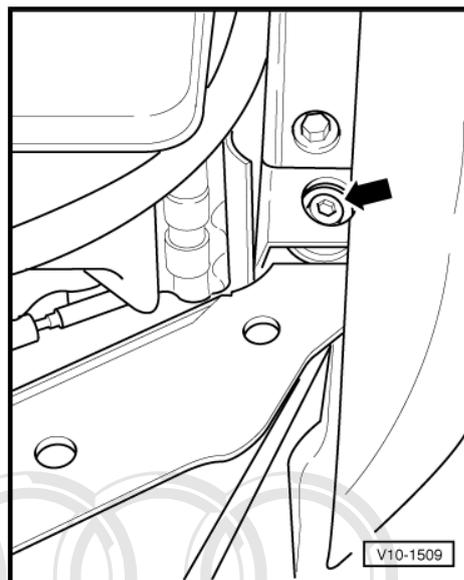


- Unbolt cooling pipes for hydraulic fluid -arrows- and move to the side.
- Detach air conditioner condenser and hook it up on one side.
- Unplug connectors for headlights (left and right).
- Unplug connectors for turn signals (left and right).
- Unbolt ATF pipes (automatic gearbox).
- Disconnect coolant hoses at bottom left and top right of radiator.
- Unplug connector for radiator fan.
- Detach bonnet lock cable.
- Detach bonnet buffers from left and right wing panels at the front.

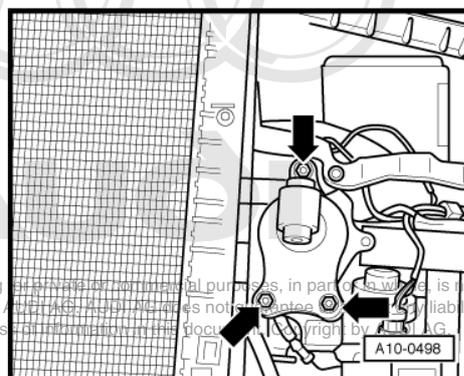


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- Unscrew bolts for lock carrier (below bonnet buffers).



- Unbolt impact absorbers for bumper on left and right -arrows-.
- Remove lock carrier together with radiator.

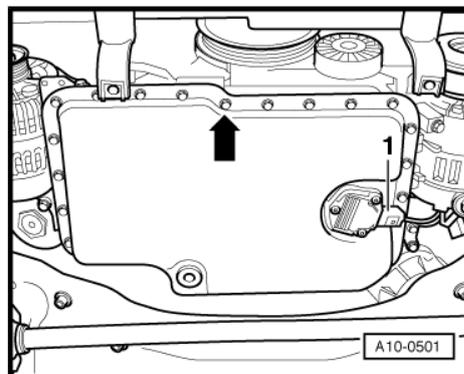


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- Unplug connector -1- from oil level sender and move wiring clear to the side.

i Note

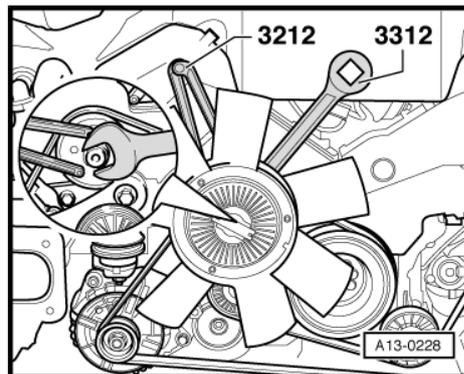
The fan has a left-hand thread.



- Hold viscous fan pulley with pin wrench -3212- and unscrew viscous fan using open-end spanner -3312- (left-hand thread).

i 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.*



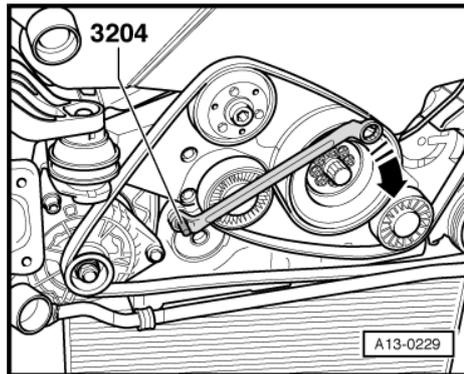


- To slacken poly V-belt, turn tensioner clockwise in direction of -arrow- with 17 mm ring spanner until the two holes are in alignment, and hold in position with locking pin -3204- .
- Take off poly V-belt.
- Unbolt poly V-belt pulley on hydraulic pump, using pin wrench -3212- as a brace.

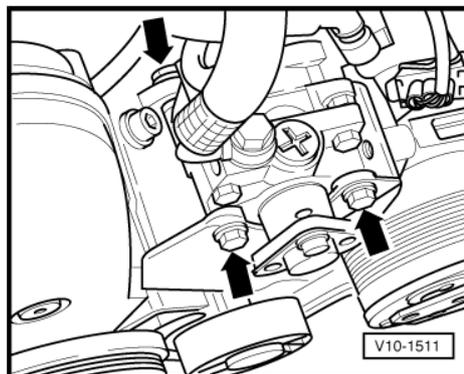


Note

Note packing plates behind the poly V-belt pulley. Put back when installing.



- Unbolt hydraulic pump from bracket and put down on longitudinal member.

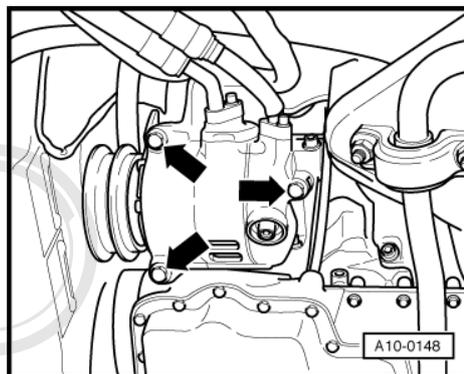


- Unbolt air conditioner compressor and hook it up on one side.

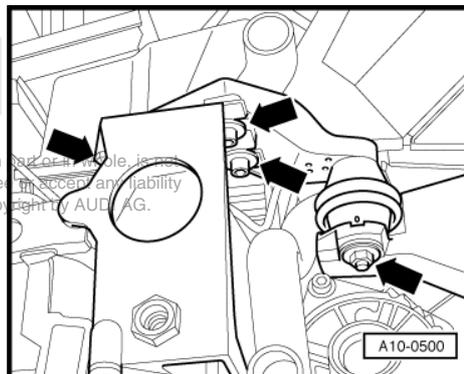


Note

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

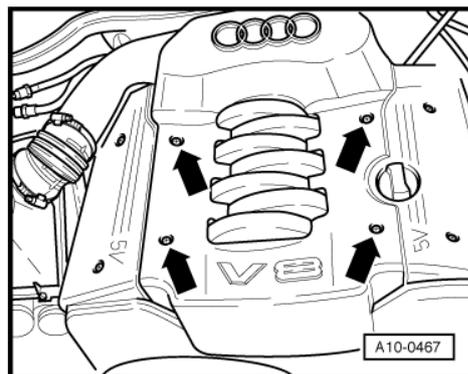


- Remove torque reaction support -arrows-.

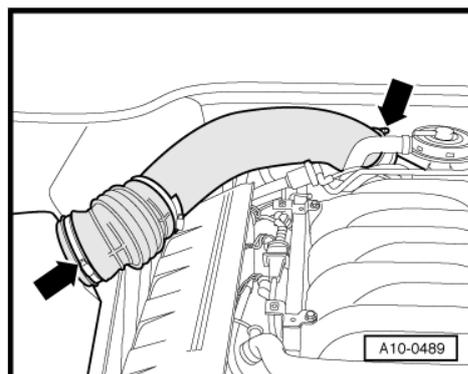


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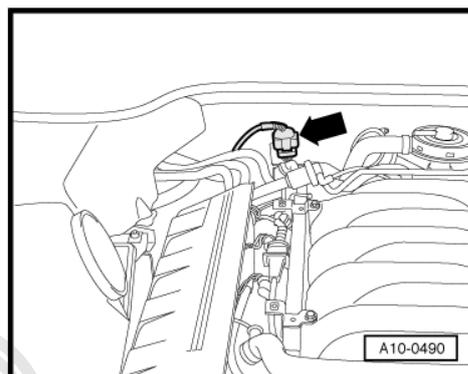
- Detach engine cover panel -arrows-.



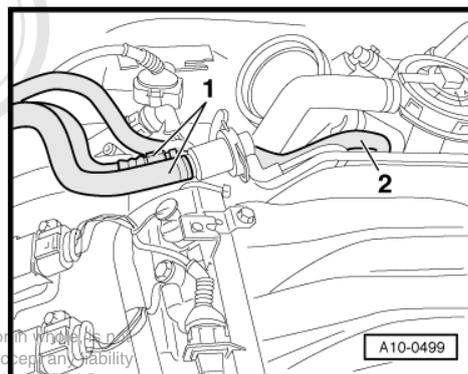
- Remove air intake pipe -arrows- between air cleaner and throttle valve unit.



- Unplug connector for Lambda probe (left-side) -arrow- and move wiring clear.



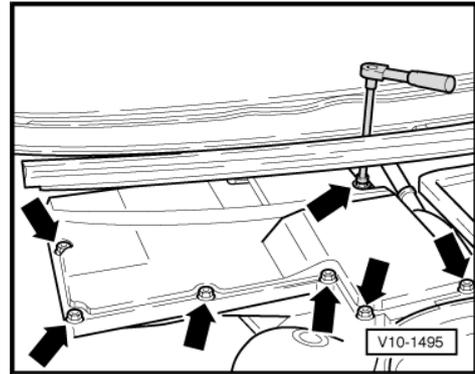
- Disconnect fuel supply pipe and return pipe -1-.
- Disconnect hose -2-.



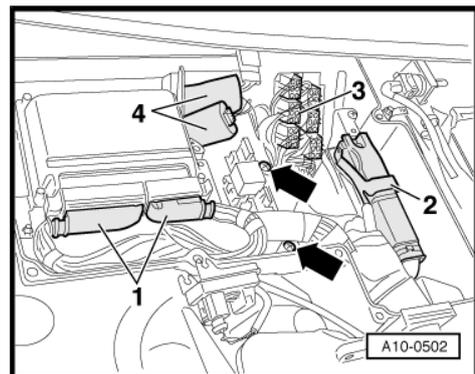
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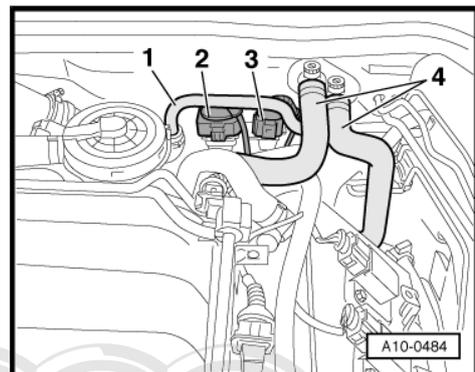
- Unscrew 7 bolts -arrow- and open cover for electronics box. For access to top left bolt, unclip cap.



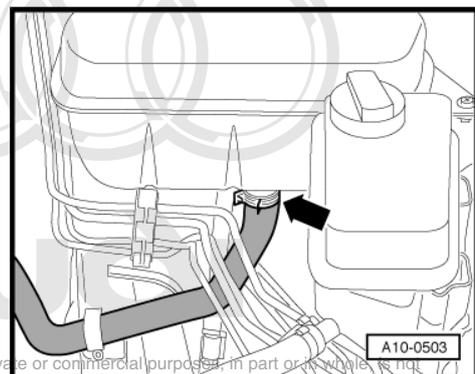
- Unplug connectors from engine control unit -1- and gearbox control unit -2-. Unplug connectors at bulkhead -3-.
- Unplug connectors -4-.
- Unscrew holder for relay and fuses -arrows-.
- Detach sealing strip between engine compartment and plenum chamber.
- Detach wiring harness from bulkhead, remove spacer sleeves and move wiring clear. Place harness on engine.



- Disconnect hose for brake servo -1-.
- Unplug connector -2- and move wiring clear.
- Unclip connector -3- and take out of retainer.
- Disconnect coolant hoses -4- going to and from heat exchanger at bleeder valves.

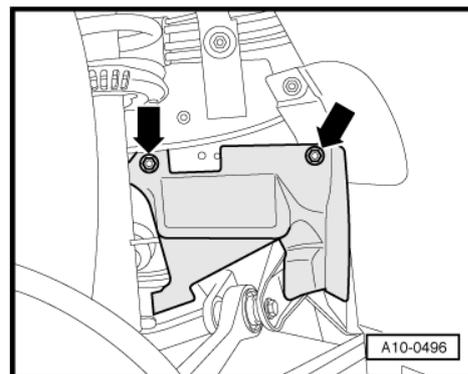


- Disconnect water hose -arrow-.
- Unbolt air cleaner (top section).
- Unplug connector on air mass meter.
- Unplug connector on ACF valve.
- Move engine wiring clear.
- Disconnect vacuum hose (for intake manifold change-over) next to left headlight.

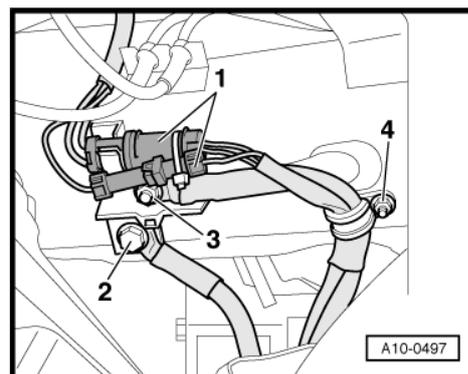


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- Remove cover -arrows- on longitudinal member.
- Unclip junction box cover.



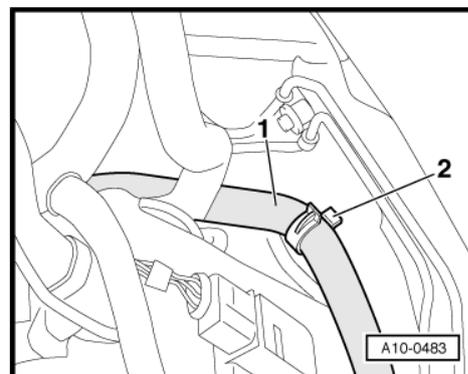
- Unclip and disconnect starter cable connector plug -1- at junction box on longitudinal member (right-side).
- Disconnect starter cable -3- in junction box.
- Disconnect earth cable -2-.
- Detach wiring harness from longitudinal member -4-.
- Detach air duct for alternator.



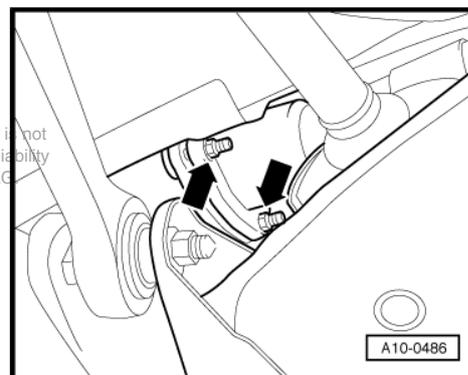
i Note

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

- Unclip hose -1- from retainer and move to the side.
- Take off retainer -2- by turning.
- Slacken upper bolt securing exhaust manifold to exhaust pipe.



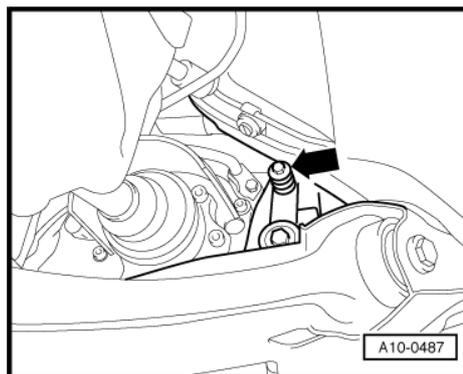
- Slacken lower bolts -arrows- securing exhaust manifold to front exhaust pipe.



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- Unbolt exhaust pipe from mounting bracket -arrow-.



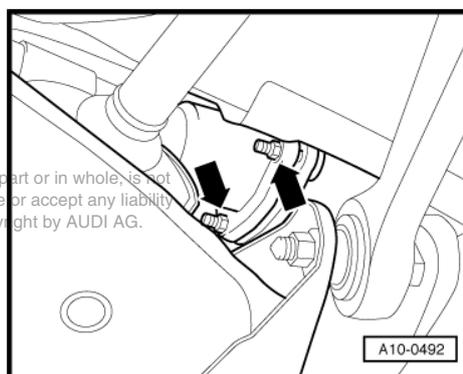
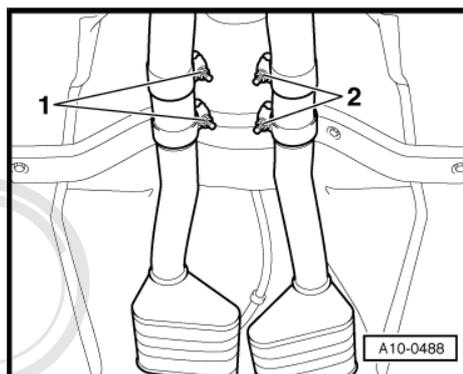
- Slacken double clamp -1- and push it forwards.
- Carefully take out exhaust pipe.



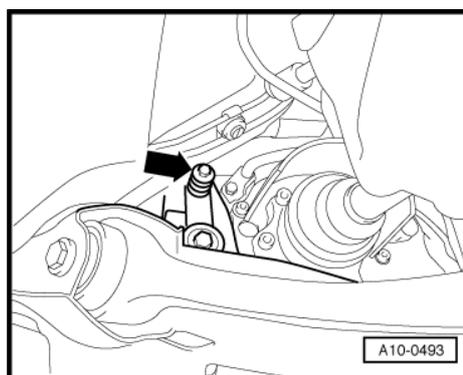
Note

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

- Take off right wheel.
- Slacken upper bolt securing exhaust manifold to exhaust pipe (accessible through track rod aperture).
- Slacken lower bolts -arrows- securing exhaust manifold to front exhaust pipe.



- Unbolt exhaust pipe from mounting bracket -arrow-.

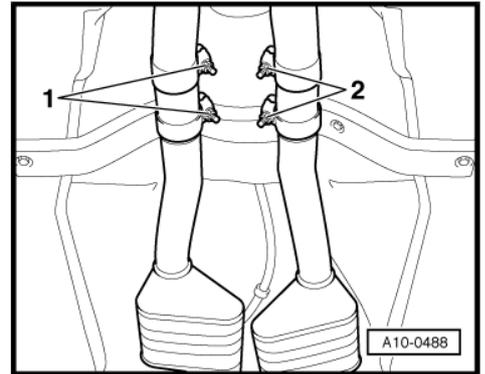


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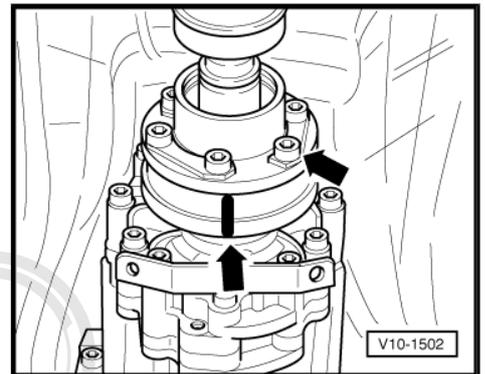
- Slacken double clamp -2- and push towards the front.
- Carefully remove exhaust pipe together with catalytic converter.

 **Note**

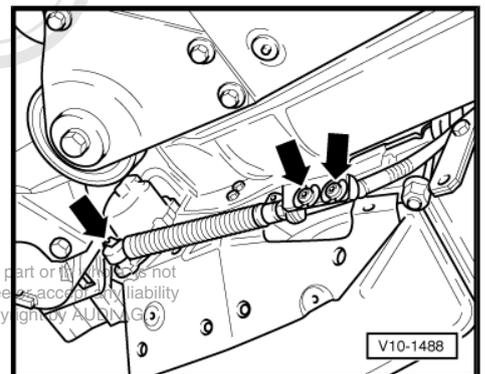
The flexible joint (de-coupling element) in the front exhaust pipe must not be bent more than 10° – otherwise it can be damaged.



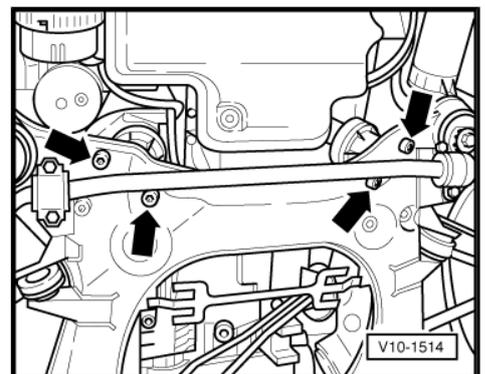
- Mark position of propshaft in relation to gearbox output flange.
- Unbolt propshaft.
- Attach propshaft support.



- Unbolt selector lever cable at bracket.
- Unclip retainer on bracket and move to the side.
- Unbolt left and right drive shafts.
- Unbolt guard plate for left drive shaft.
- Raise gearbox using engine and gearbox jack -V.A.G 1383 A- .
- Unbolt left and right gearbox mountings.
- Lower gearbox jack and take out jack.

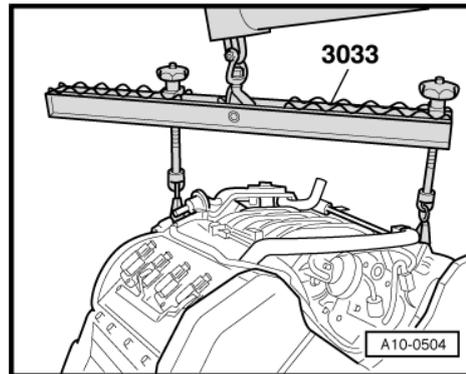


- Unbolt left and right engine mountings.



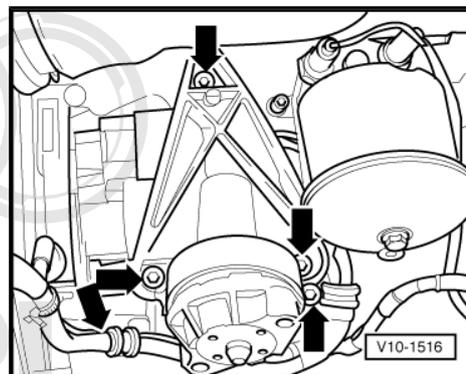


- Attach lifting tackle -3033- at the two engine lifting points shown.
- Bring workshop hoist -VAS 6100- (500 kg) into position and hook up lifting tackle -3033- .
- Carefully lift engine and remove from front.



1.2 Separating engine and gearbox

- Unbolt right engine support.
- Lower engine and gearbox onto workbench or other suitable surface, and leave suspended on hoist. If necessary place engine/gearbox assembly on 2 old tyres in order to take gearbox off engine.
- Unscrew wiring from starter.



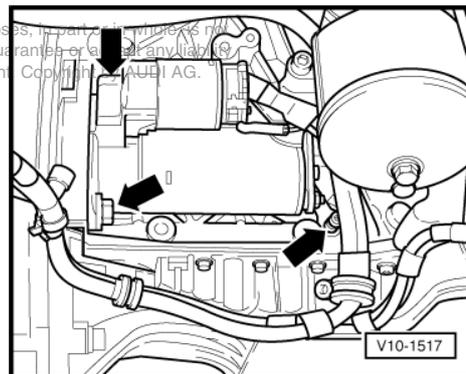
- Remove starter -arrow-
- Disconnect wiring from gearbox and move wiring clear.

If engine or gearbox is being renewed:

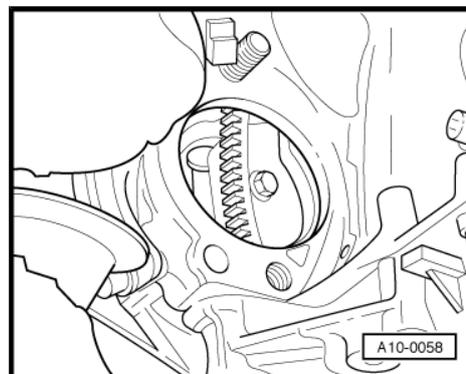
- When engine is detached from gearbox, turn engine over to TDC and align marking on gearbox bell housing with marking on torque converter.

Note

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



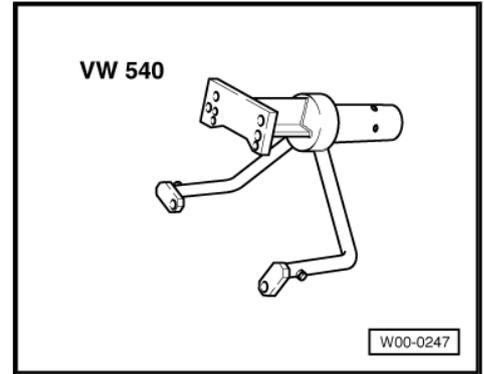
- Unbolt torque converter from drive plate (3 bolts).



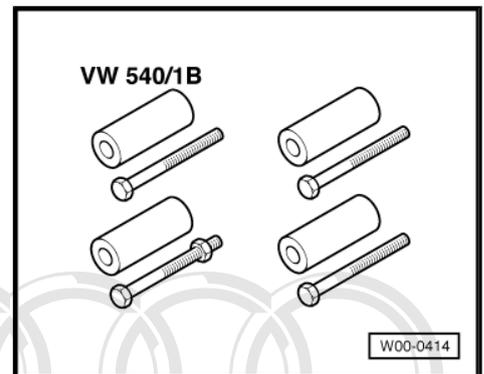
1.3 Attaching engine to engine stand

Special tools and workshop equipment required

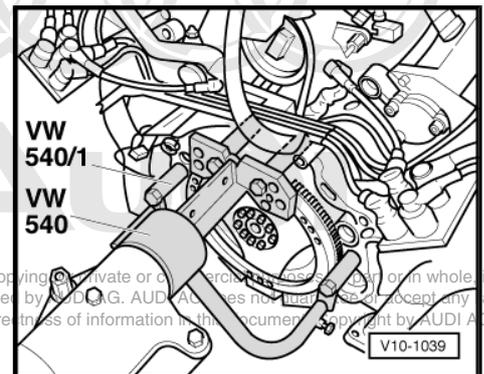
◆ Engine and gearbox support -VW 540-



◆ Engine and gearbox support supplement -VW 540/1 B-



- When dismantling/assembling engine, secure engine to repair stand using engine and gearbox support -VW 540- and engine and gearbox support supplement -VW 540/1 B- .



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1.4 Installing

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.

- Check clutch release bearing for wear; renew if necessary.
- There is no needle bearing in the crankshaft on vehicles with automatic gearbox.
- When installing an exchange engine with manual gearbox, check whether there is a needle bearing in the crankshaft. If there is no needle bearing, this must be fitted.
- Check whether dowel sleeves for centring the engine/gearbox assembly are fitted in the cylinder block; install dowel sleeves if necessary.

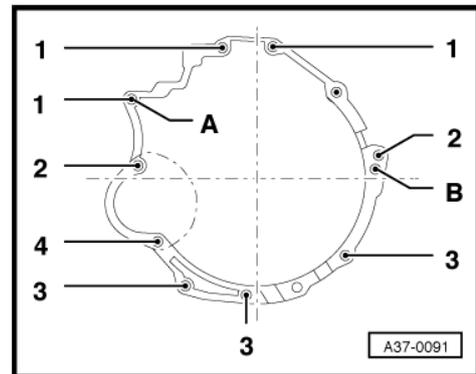


- Always renew self-locking nuts.
- Engine/gearbox attachment (gearbox flange pattern).

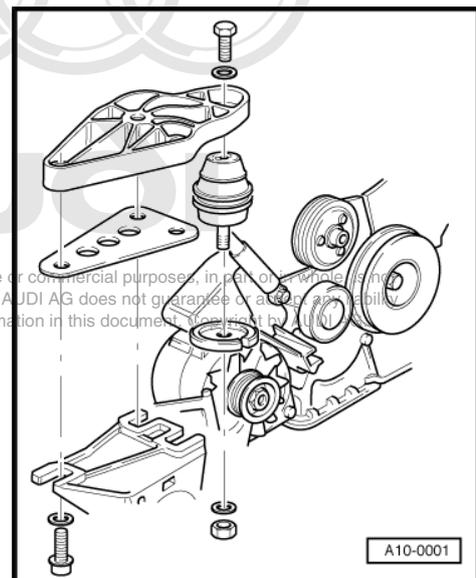
Item	Bolt	Quantity	Nm
1	M 12 x 75	3	65
2	M 12 x 90	2	65
3	M 10 x 45	3	45
4	M 10 x 80	1	65

Centring sleeves (-A- and -B-)

Bolted connection		Tightening torques
Torque converter to drive plate		85 Nm
Front right engine support to engine		45 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
Engine cross member to body		50 Nm
Wheel bolt to wheel hub		120 Nm



- Align exhaust system so it is free of stress ⇒ [page 161](#)
- Check level of hydraulic fluid and fill up if necessary.
- Fill up with coolant ⇒ [page 137](#) .
- Install torque reaction support carefully so it is not under tension - use additional plates if necessary.
- Shake engine mountings to achieve stress-free alignment.
- Install viscous fan ⇒ [page 148](#) .
- Check oil level before starting engine.
- Check ATF level (automatic gearbox).
- After connecting battery, enter anti-theft code for radio ⇒ [Radio operating instructions](#) .
- 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.



13 – Crankshaft group

1 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 23](#)

2 - 22 Nm

3 - 45 Nm

4 - Alternator

- Removing and installing
 ⇒ Rep. Gr. 27

5 - 43 Nm

6 - 10 Nm

7 - Idler roller (top)

- For poly V-belt

8 - Bearing

- For idler roller
- Note installation position: Snug fit on bracket for torque reaction support

9 - 22 Nm

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

10 - Tensioner for poly V-belt

- Pivot with ring spanner to slacken poly V-belt
 ⇒ [page 23](#)

11 - 22 Nm

12 - Vibration damper

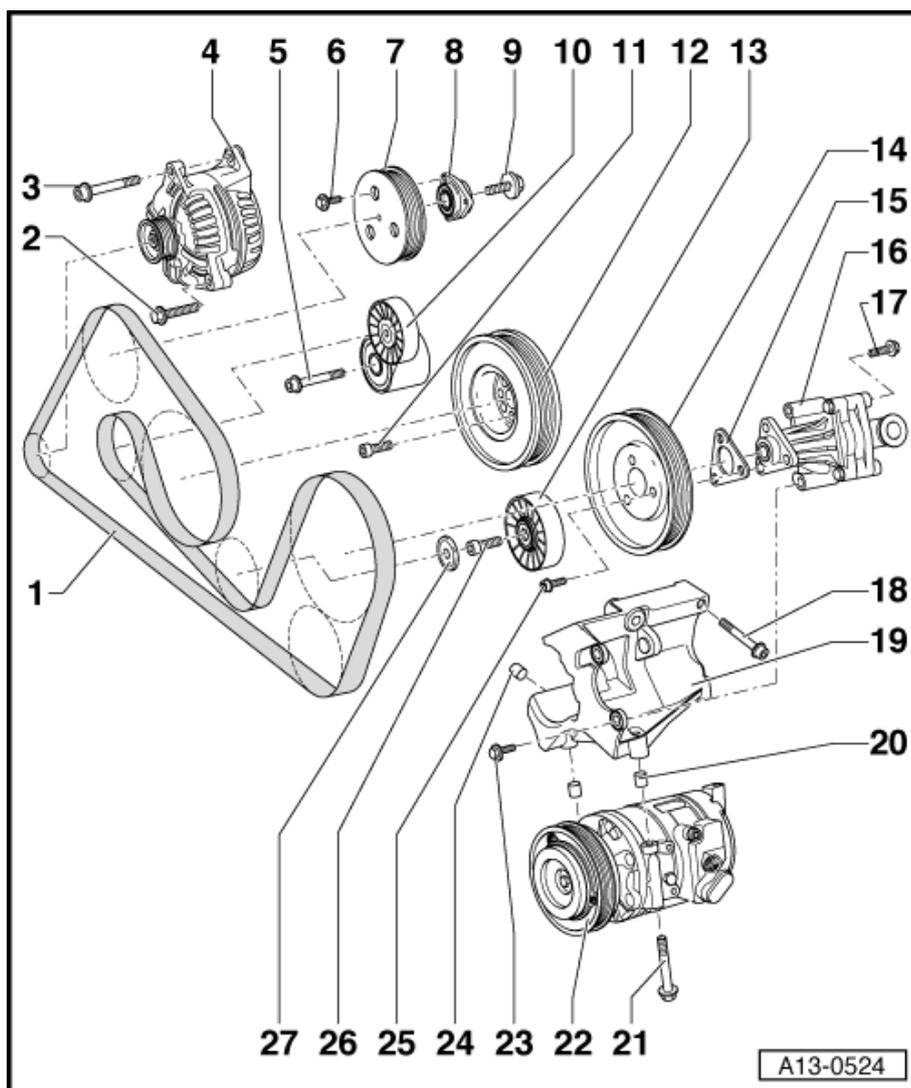
- With pulley for poly V-belt
- Removing and installing ⇒ [page 27](#)

13 - Idler roller (bottom)

- For poly V-belt

14 - Pulley

- For power steering pump
- Removing and installing ⇒ [page 22](#)





15 - 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 25](#)

16 - Power steering pump

- For power steering
- Removing and installing ⇒ Rep. Gr. 48

17 - 22 Nm

18 - 40 Nm

19 - Bracket

- For AC compressor and power steering pump
- Pay attention to dowel sleeves ⇒ [Item 24 \(page 22\)](#) when installing

20 - Dowel sleeve

- 2x
- Check for correct seating in bracket

21 - 22 Nm

22 - Air conditioner compressor

- Pay attention to dowel sleeves ⇒ [Item 20 \(page 22\)](#) when installing

23 - 22 Nm

24 - Dowel sleeve

- 2x
- Check for correct seating

25 - 22 Nm

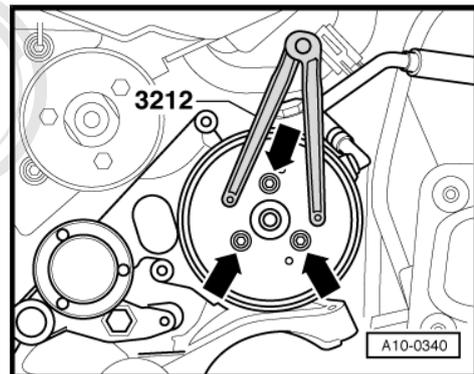
26 - 23 Nm

27 - Cover

- For idler roller

Removing and installing power steering pump pulley.

- Lock carrier in service position ⇒ Rep. Gr. 50 .
- Poly V-belt must be removed ⇒ [page 23](#) .
- Use 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 25](#) .

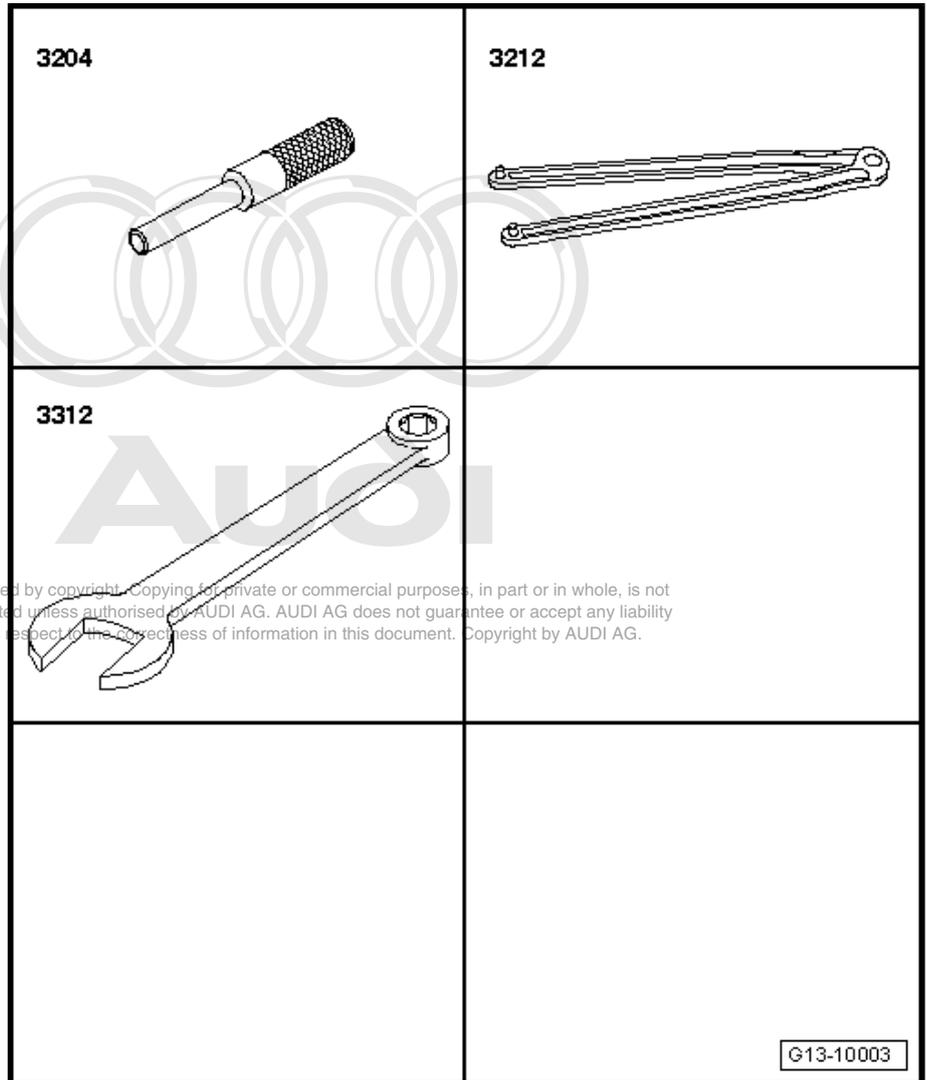


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1.1 Removing and installing poly V-belt

Special tools and workshop equipment required

- ◆ Locking pin -3204-
- ◆ Pin wrench -3212-
- ◆ Open-end spanner -3312-

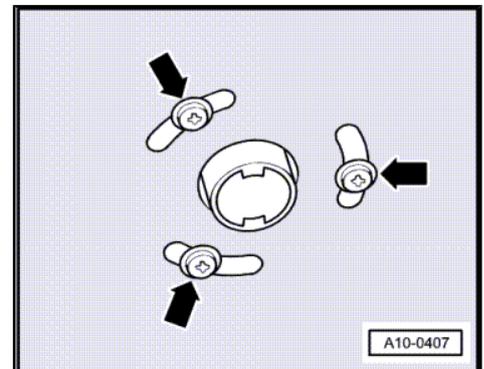


Removing

Vehicles with auxiliary heater / supplementary heater:

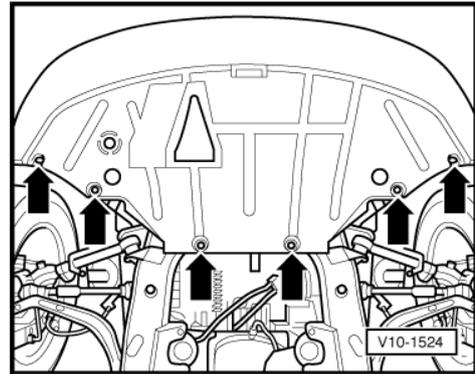
- Remove bolts -arrows- securing exhaust pipe for auxiliary/ supplementary heater to noise insulation.

All models:

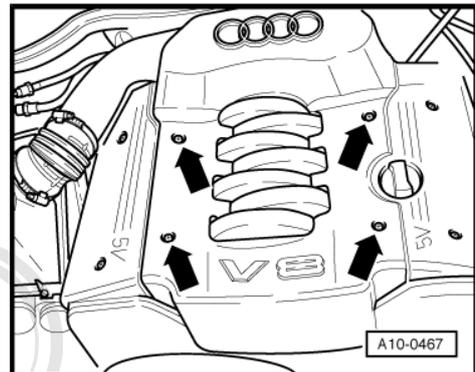




- Remove noise insulation.
- Remove bumper ⇒ Rep. Gr. 63 .
- Move lock carrier to service position ⇒ Rep. Gr. 50 .
- Remove intake hose for air cleaner.



- Detach engine cover panel.



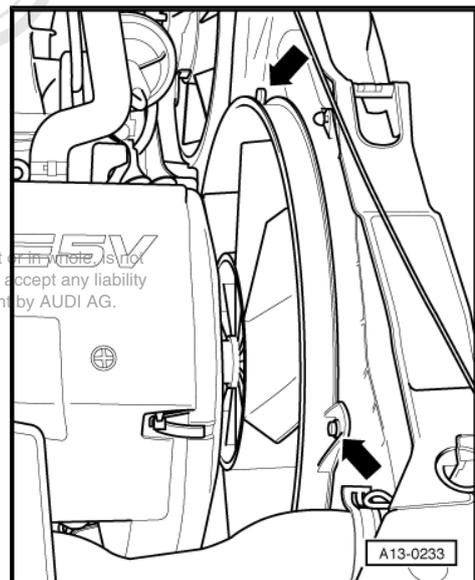
- Unbolt outer ring for viscous fan -arrows-.



Note

The fan has a left-hand thread.

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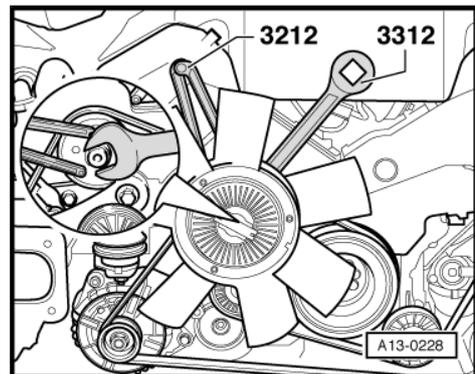


- Hold viscous fan pulley with pin wrench -3212- and unscrew viscous fan using open-end spanner -3312- (left-hand thread).
- Remove viscous fan with its outer ring.



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 17 mm ring spanner until the two holes are in alignment, and hold in position with locking pin -3204- .
- Take off poly V-belt.

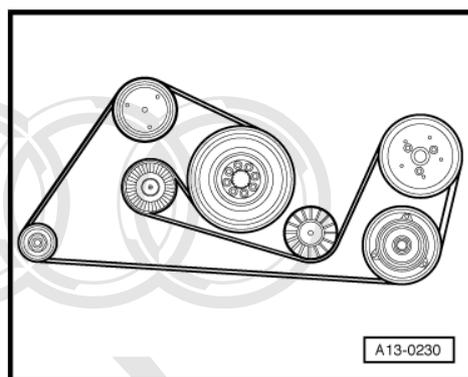
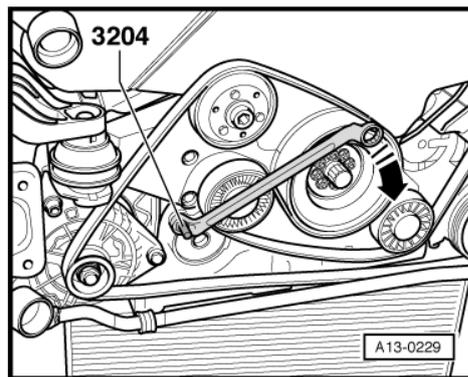
Installing

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

 **Note**

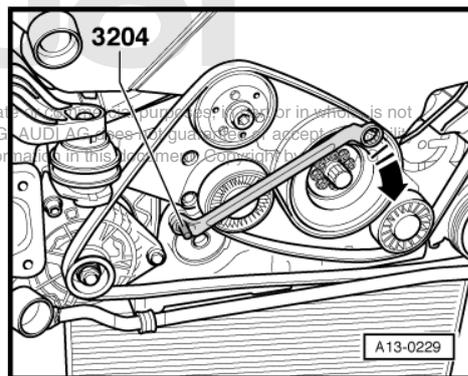
When installing the poly V-belt ensure the belt seats correctly in the belt pulleys.

- Fit poly V-belt on crankshaft pulley and idler rollers first; fit onto tensioning roller last.



- To tension poly V-belt, turn tensioner clockwise in direction of -arrow- with 17 mm ring spanner, and remove locking pin -3204- .

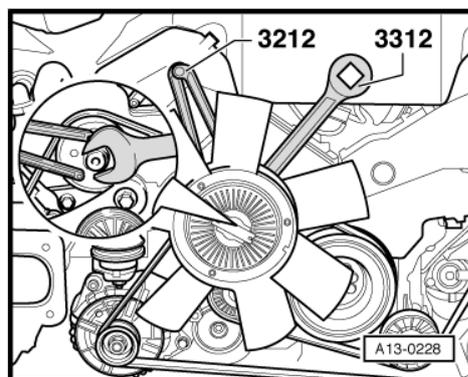
- Start engine and check that belt runs properly.
- Install viscous fan together with its outer ring (fan has left-hand thread).



- Hold viscous fan pulley with pin wrench -3212- and secure viscous fan using open-end spanner -3312- and torque wrench -V.A.G 1331- (left-hand thread).
- Fit noise insulation.
- Fit engine cover panel.

Tightening torques

Component	Nm
Viscous fan with torque wrench -V.A.G 1331- and open-end spanner -3312- .	37
Viscous fan with torque wrench -V.A.G 1332- without open-end spanner -3312- .	70
Outer ring of fan to radiator	10



1.2 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



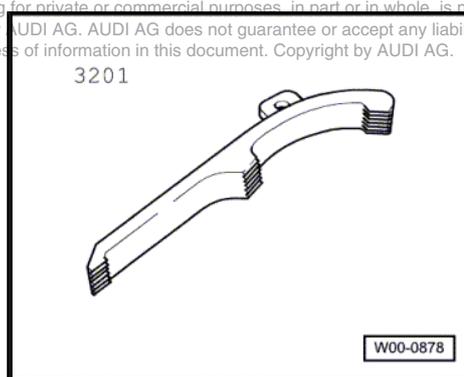
Note

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.

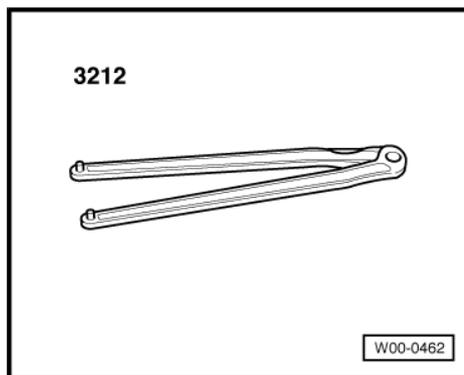
Special tools and workshop equipment required

- ◆ Alignment gauge -3201-

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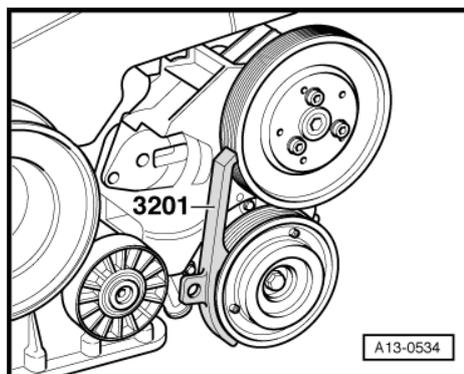
- ◆ Pin wrench -3212-



Test sequence

- Lock carrier in service position ⇒ Rep. Gr. 50 .
- Poly V-belt must be removed ⇒ [page 23](#) .
- 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.

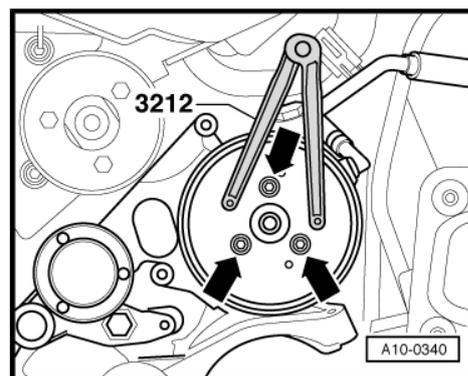
If the two poly V-belt pulleys are not aligned:



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

 **Note**

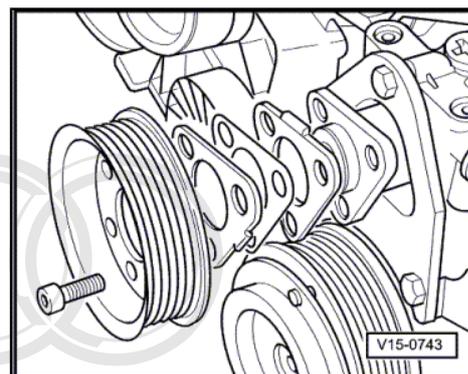
- ◆ *When slackening off and tightening bolts, counterhold with pin wrench -3212- .*
- ◆ *Installation position: the word "vorne" (front) on the poly V-belt pulley faces the direction of travel.*



- 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

1.3 Removing and installing vibration damper

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Removing

- Removing and installing poly V-belt => [page 23](#) .

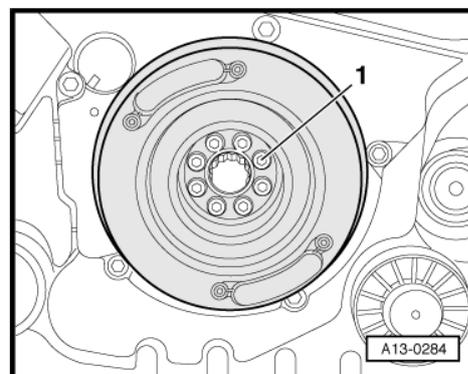
 **Note**

Central bolt does not have to be loosened when removing vibration damper.

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

Installing

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

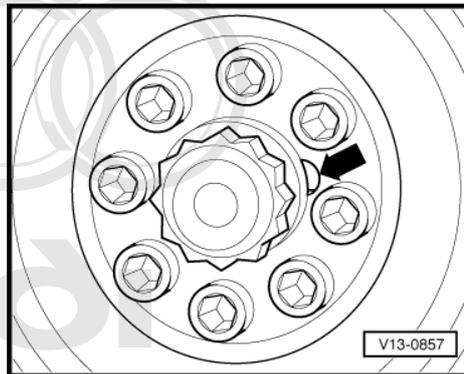




- On installation, make sure notch -arrow- in vibration damper is aligned with locating lug on toothed belt sprocket.
- Install poly V-belt => [page 23](#) .

Tightening torque

Component	Nm
Vibration damper to crankshaft sprocket	22



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2 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 - Bearing mounting

3 - 20 Nm + 90° (1/4 turn) further

- No replacement part available
- Supplied together with tensioning lever

4 - Washer

- For tensioning roller

5 - 40 Nm

6 - Tensioning roller

7 - Tensioning lever

- Fit washer
 => [Item 32 \(page 30\)](#)
 underneath

8 - 22 Nm

9 - 55 Nm

- Renew
- Lubricate threads and contact surface of bolt head

10 - Locating plate

- Renew
- Side labelled "rear/hint-en" faces rear

11 - Camshaft sprocket (right-side)

- Remove toothed belt prior to removing and installing => [page 31](#)
- Detach using two-arm puller -T40001- and claws -T40001/2-

12 - 10 Nm

- Apply locking fluid when fitting
- Locking fluid => [Parts catalogue](#)

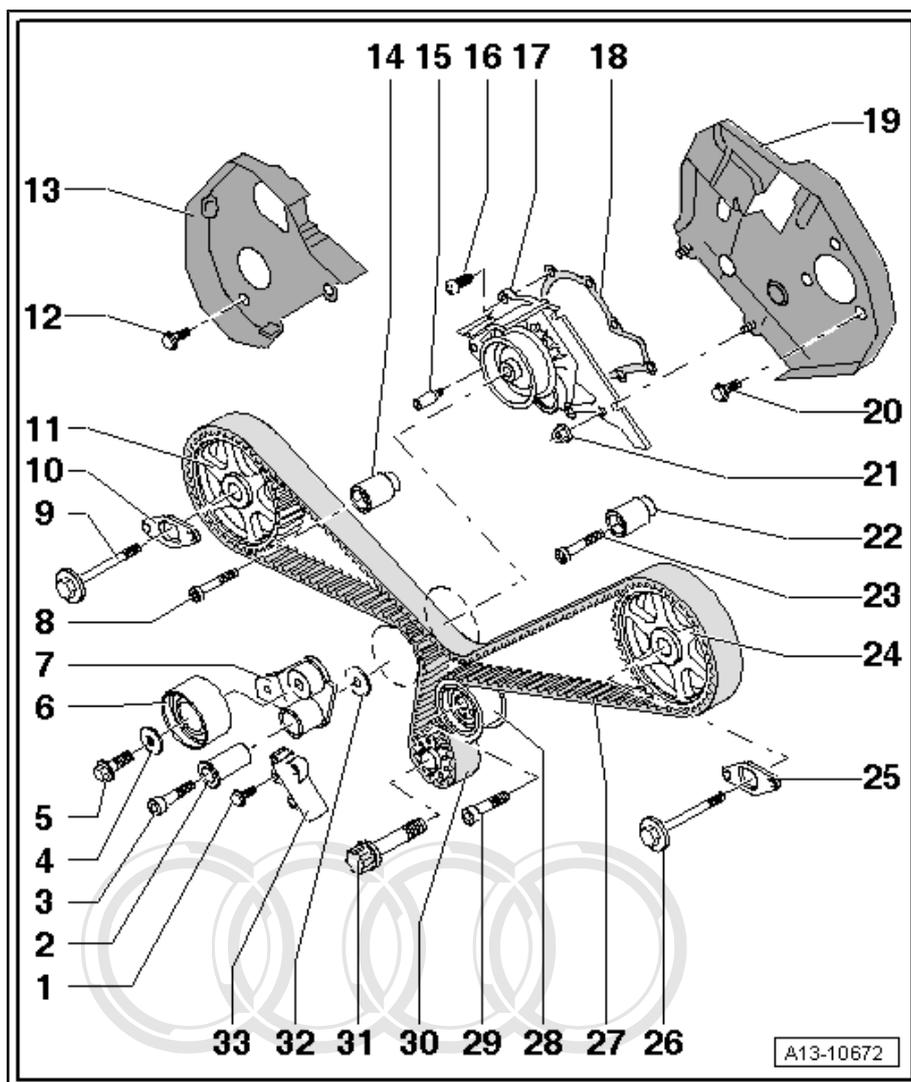
13 - Toothed belt cover (rear right)

14 - Idler roller

15 - Trunnion bolt, 9 Nm

16 - 14 Nm

- Property class 10.9



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17 - Coolant pump

- Removing and installing ⇒ [page 143](#)

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 - Idler roller

- Only for engine codes AQH, AVP, AYS, BCS

23 - 22 Nm

- Only for engine codes AQH, AVP, AYS, BCS

24 - Camshaft sprocket (left-side)

- Remove toothed belt prior to removing and installing ⇒ [page 31](#)
- Detach using two-arm puller -T40001- and claws -T40001/2-

25 - Locating plate

- Renew
- Side labelled "rear/hinten" faces rear

26 - 55 Nm

- Renew
- Lubricate threads and contact surface of bolt head

27 - Toothed belt

- Before removing, mark direction of rotation with chalk or felt-tipped pen
 - Check for wear
 - Removing ⇒ [page 31](#)
 - Installing (adjusting valve timing) ⇒ [page 31](#)
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28 - Eccentric adjuster

29 - 45 Nm

30 - Crankshaft sprocket

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

31 - 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 33](#)

32 - Washer

- For tensioning lever

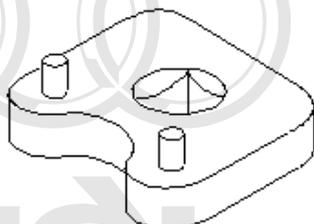
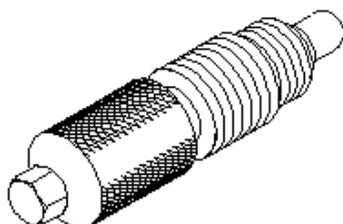
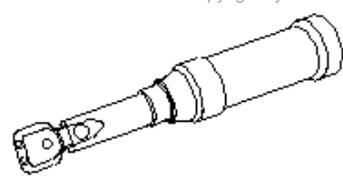
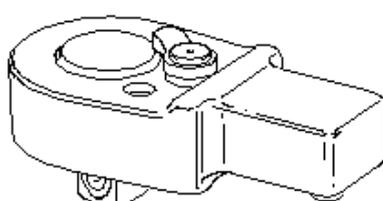
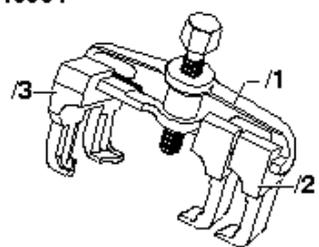
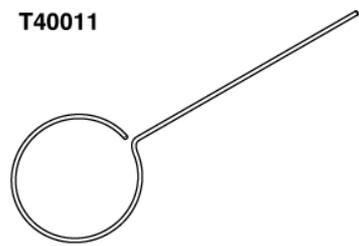
33 - Tensioner

2.1 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-

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<p>T40009</p> 	<p>3242</p> 
<p>V.A.G 1783</p> 	<p>VAS 6234</p> 
<p>T40001</p> 	<p>T40005</p>  <p style="text-align: right;">G13-10028</p>
<p>T40011</p>  <p style="text-align: right;">W00-1089</p>	<p>3212</p>  <p style="text-align: right;">W00-0462</p>

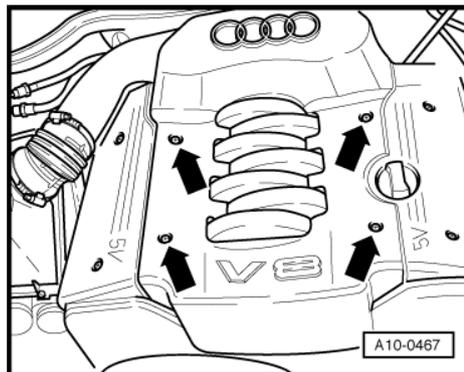


Removing

- First remove engine cover panel -arrows-.
- Remove toothed belt cover.

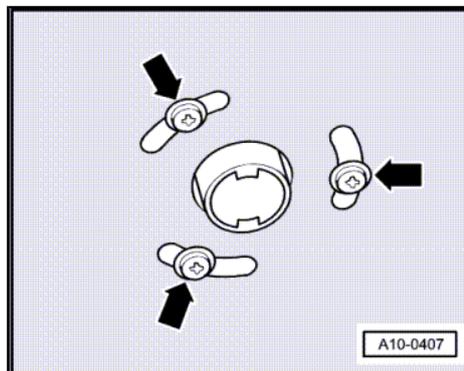
Vehicles with auxiliary heater / supplementary heater:

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



All models:

- Detach noise insulation -arrows-.



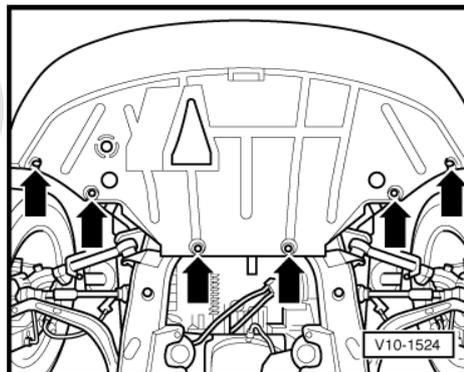
- Remove poly V-belt → [page 23](#) .



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.



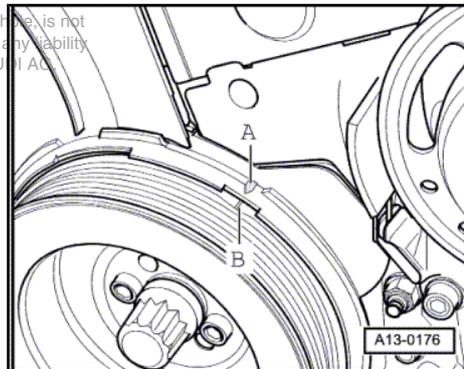
- ◆ Notch -B- is opposite mark -A-



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.



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- Remove sealing plug -arrow- from cylinder block (left-side).
- The TDC drilling in the crankshaft should be behind the sealing plug hole (feel to check).

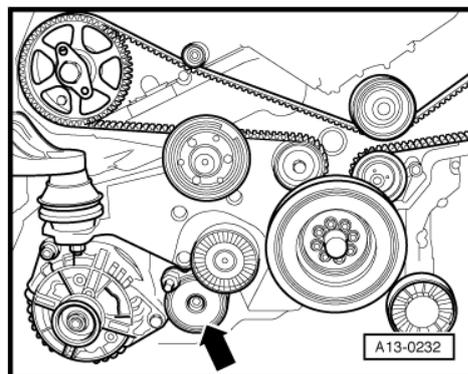
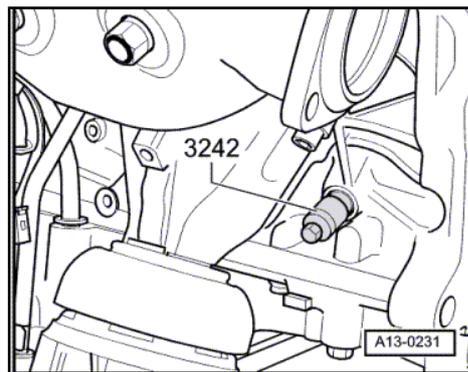
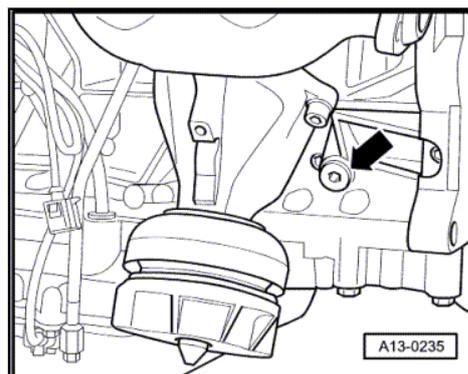
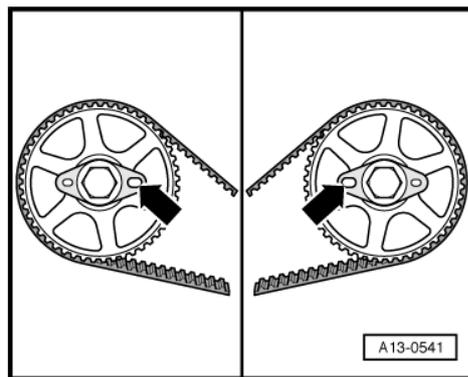


WARNING

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

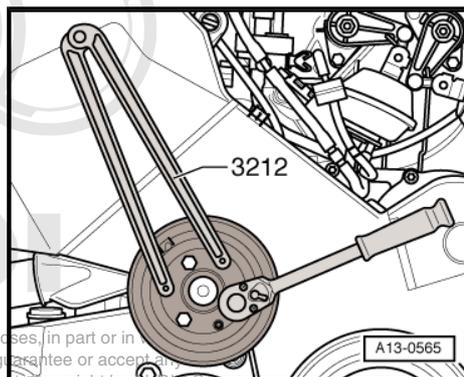
- Screw locking pin -3242- into threaded hole where plug has been removed.

- Remove tensioner for poly V-belt -arrow-.



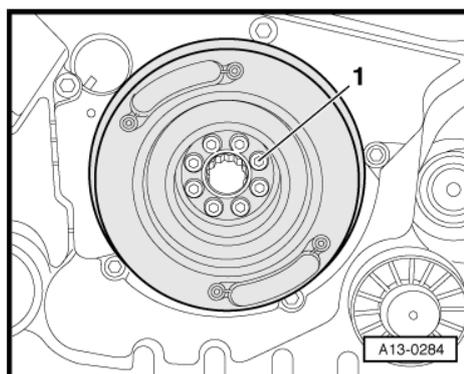


- Remove poly V-belt pulley for viscous fan using pin wrench -3212- .

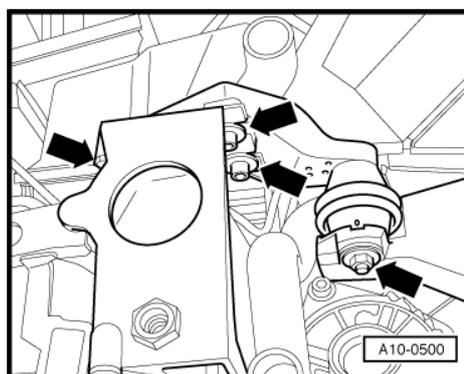


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- Slacken 8 securing bolts -1- and remove vibration damper from crankshaft.



- Remove torque reaction support -arrows-.

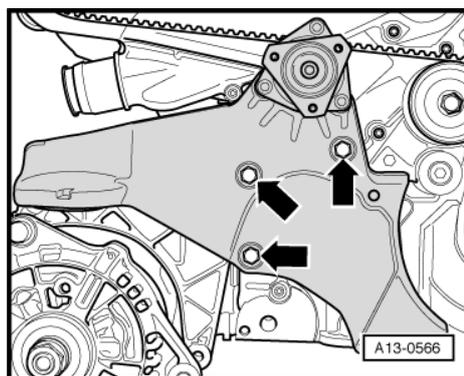


- Remove bracket for torque reaction support -arrows-.
- Remove centre section of toothed belt cover.

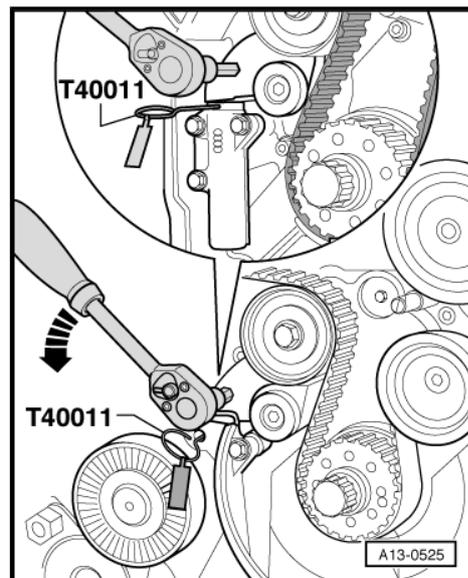


Note

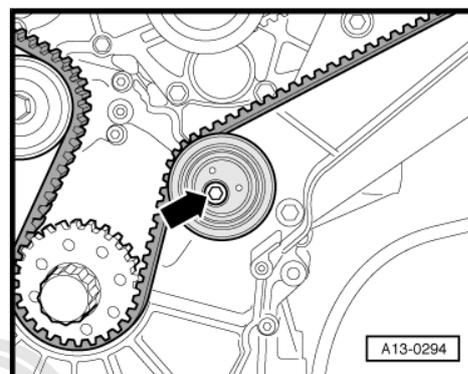
- ◆ *Mark the rotation direction of the toothed belt with chalk or felt-tip pen before removing. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*
- ◆ *The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.*



- 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.



- Loosen bolt -arrow- for eccentric adjuster.
- Fit camshaft clamp -T40005- onto the locating plates of the two camshafts.

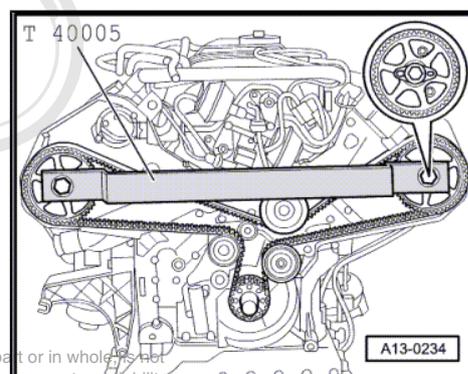


i Note

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

- Loosen the two camshaft bolts and unscrew approximately 5 turns.
- Take off camshaft clamp -T40005- .
- Pull off both camshaft sprockets using two-arm puller -T40001- .

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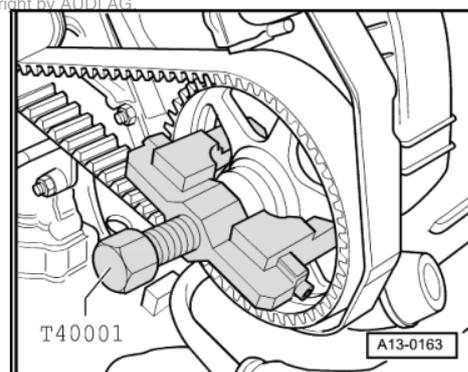


- Remove toothed belt together with camshaft sprocket for cylinder bank 1-4.



Caution

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



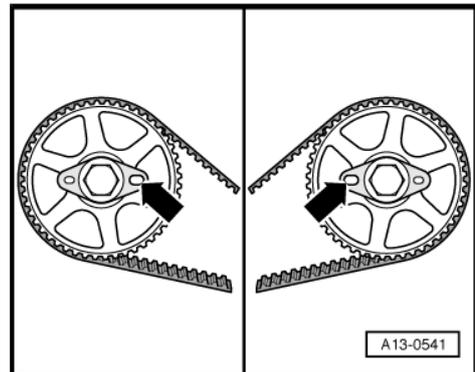
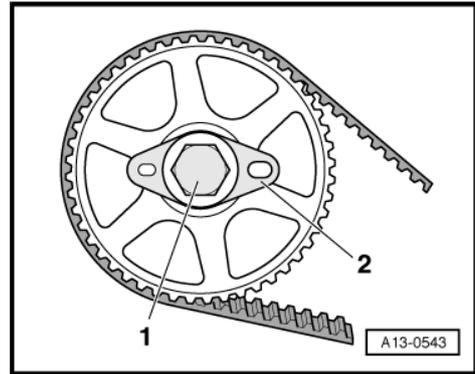
Installing

- Tightening torques => [page 29](#)

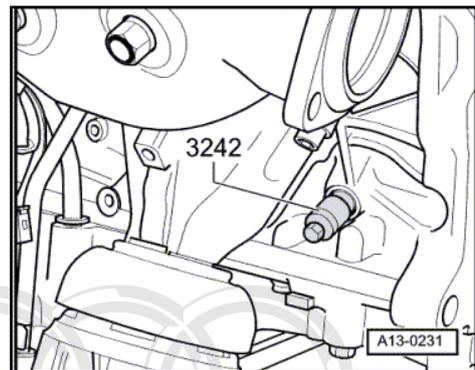


- Renew bolts -1- for camshaft sprockets and locating plates -2-.
- Oil threads and contact surface of camshaft sprocket bolt heads.
- Screw down the bolts such that the camshaft sprockets can still just be turned and do not tilt.
- Make sure the locating plates are seated correctly on the camshafts.

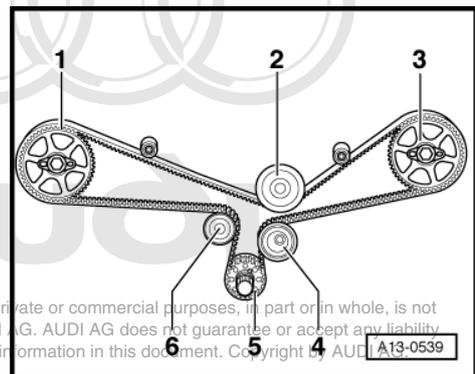
Before fitting the toothed belt, make sure the crankshaft and camshafts are set to cylinder 5 TDC:



- ◆ 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.

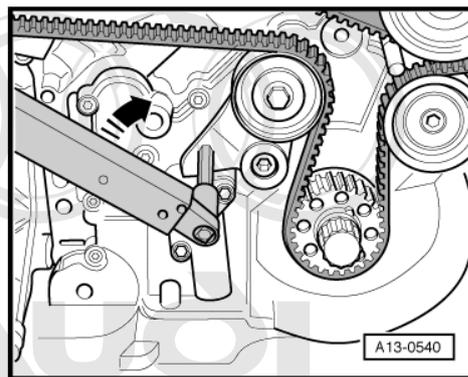


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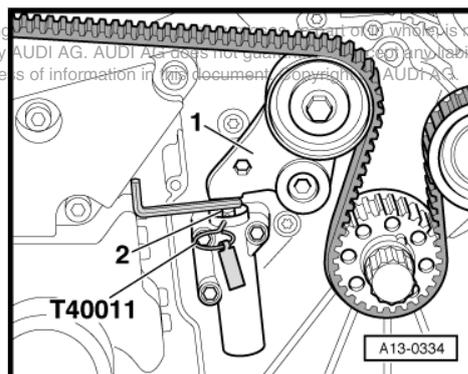
- Turn tensioning lever twice with a torque of 40 Nm in direction of -arrow- to pre-tension toothed belt.

i 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.

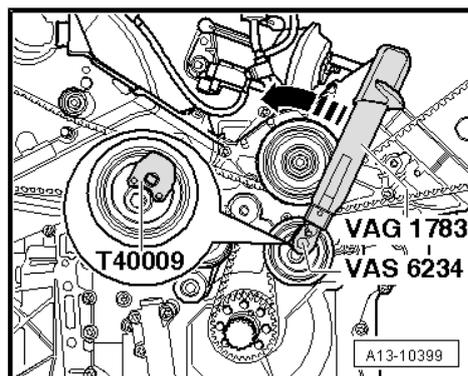


- Tension toothed belt. To do so, turn eccentric adjuster with tensioner wrench -T40009- and torque wrench -V.A.G 1783- with ratchet insert 1/4" -VAS 6234- in direction of -arrow- and maintain tension.

- ◆ Pre-tensioning torque 6 Nm
- Tighten eccentric adjuster.

i Note

Make sure the setting does not change while tightening.

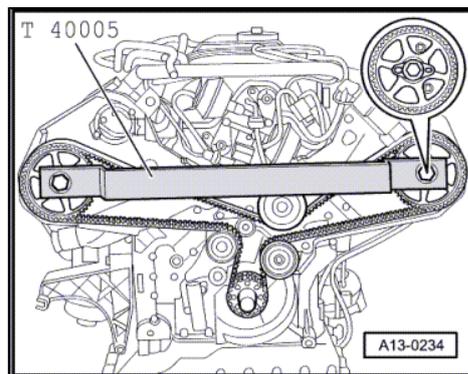


- Insert camshaft clamp -T40005- in locating plates of both camshafts.
- ◆ Push in the camshaft clamp as far as it will go.
- Tighten bolts on camshaft sprockets.

i Note

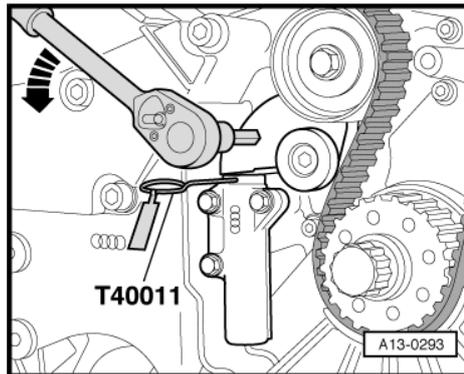
Use camshaft clamp -T40005- to prevent camshafts from turning.

- Remove camshaft clamp -T40005- .
- Remove the 5 mm Allen key

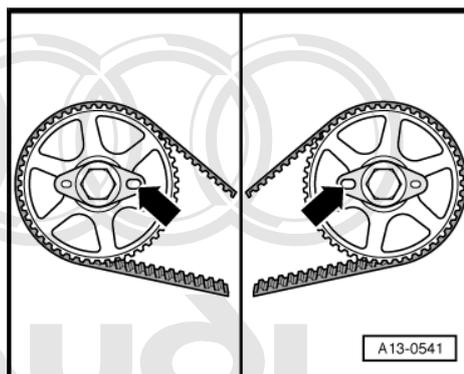




- Use 8 mm hexagon key to turn tensioning lever in direction of -arrow- until locking pin -T40011- can be pulled out.
- Remove locking pin -3242- .
- Turn crankshaft two rotations in normal direction of rotation until it is set to TDC of No. 5 cylinder again.



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

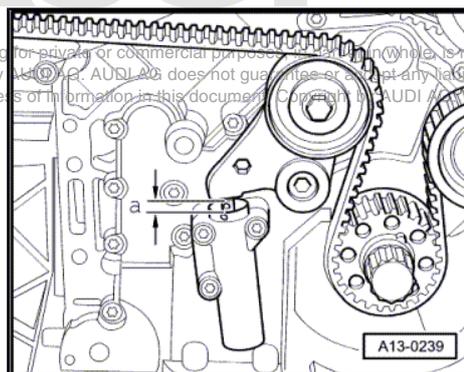


- Check dimension -a- between tensioning lever and housing of tensioner.
- ◆ Dimension -a- = 5.0 ± 1.0 mm.

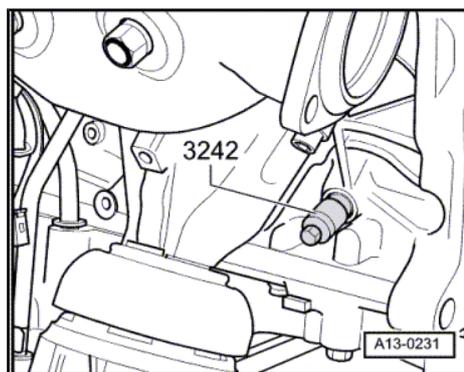
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i Note

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



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

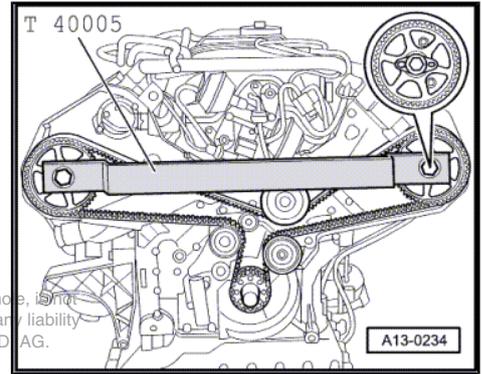


- Check positions of camshafts with camshaft clamp -T40005- .

i Note

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

- Remove camshaft clamps -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:

i 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 23](#) .

i Note

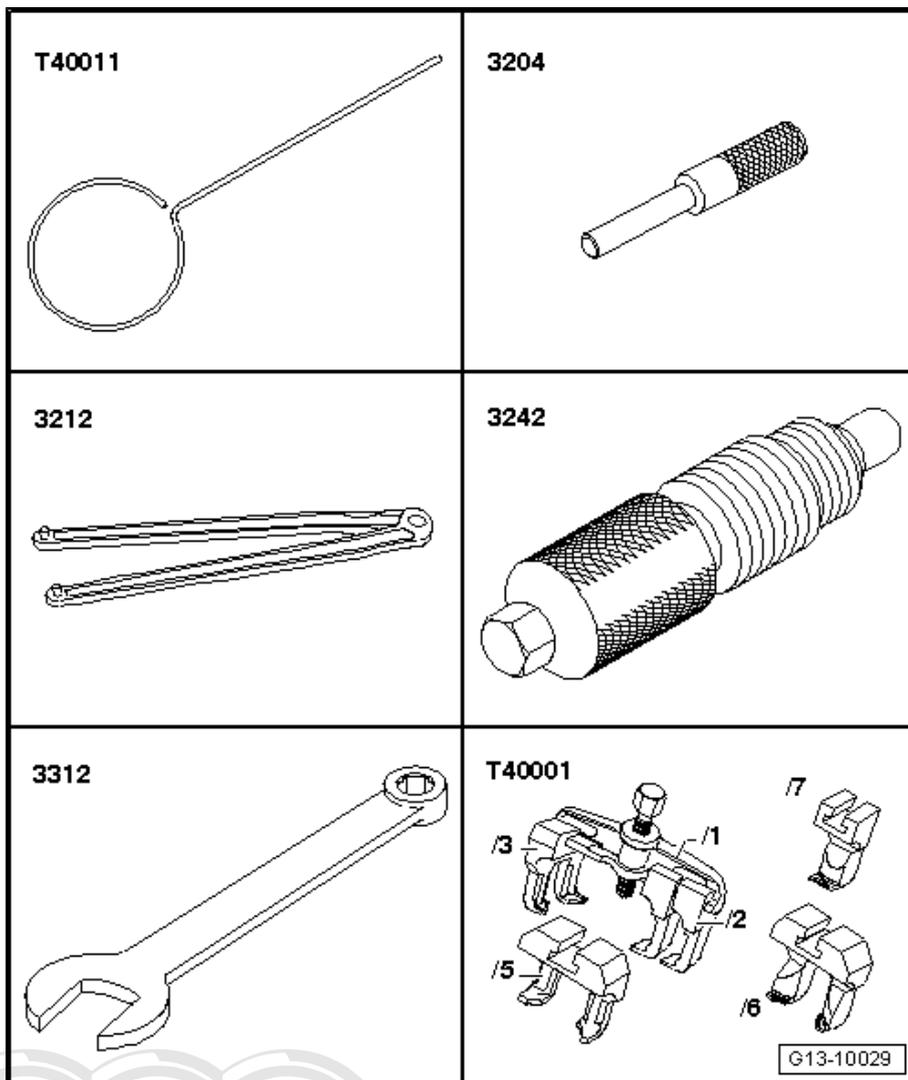
- ◆ *Drained-off coolant may only be used again if the original cylinder head and cylinder block are re-installed.*
- ◆ *Contaminated or dirty coolant must not be used again.*



2.2 Removing toothed belt from camshaft sprockets

Special tools and workshop equipment required

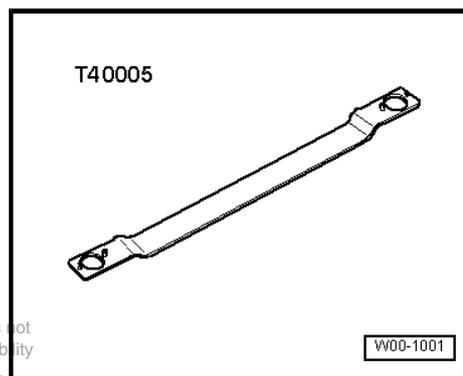
- ◆ Locking pin -T40011-
- ◆ Locking pin -3204-
- ◆ Pin wrench -3212-
- ◆ Locking pin -3242-
- ◆ Open-end spanner -3312-
- ◆ Two-arm puller -T40001-



Camshaft clamps -T40005-

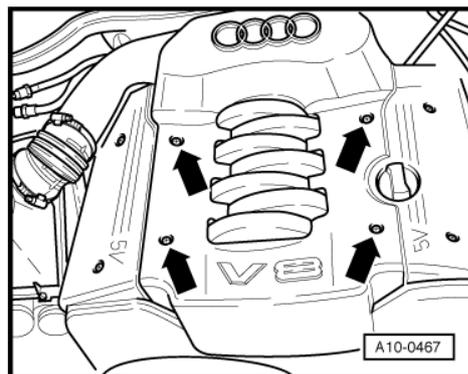
Removing

- Remove intake hose for air cleaner.
- Remove bumper ⇒ Rep. Gr. 63 .
- Move lock carrier to service position ⇒ Rep. Gr. 50 .



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- Detach engine cover panel.



- Unbolt outer ring for viscous fan -arrows-.

i Note

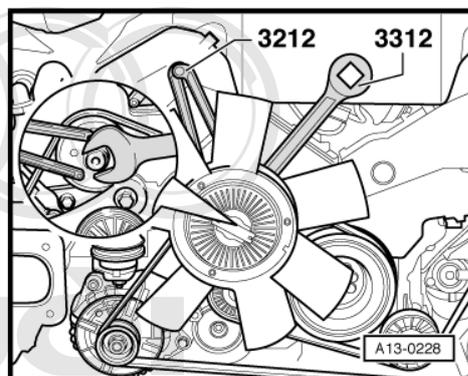
The fan has a left-hand thread.



- Hold viscous fan pulley with pin wrench -3212- and unscrew viscous fan using open-end spanner -3312- (left-hand thread).
- Remove viscous fan with its outer ring.
- Remove poly V-belt pulley for viscous fan.

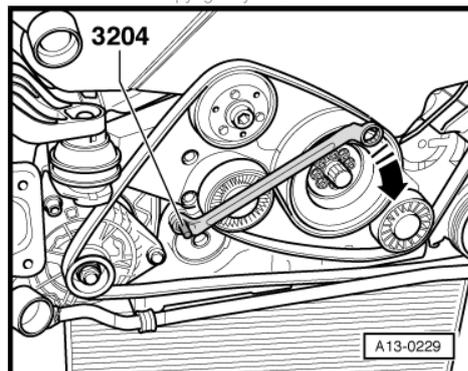
i Note

- ◆ *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.*



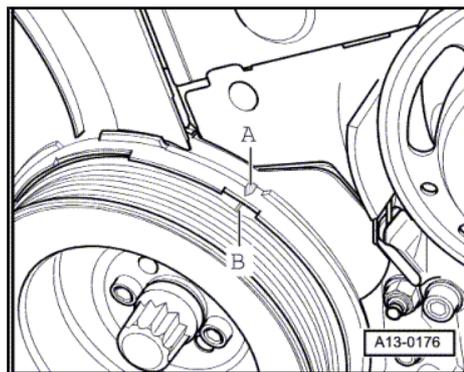
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- To slacken poly V-belt, turn tensioner clockwise in direction of -arrow- with 17 mm ring spanner until the two holes are in alignment, and hold in position with locking pin -3204- .
- Take off poly V-belt.

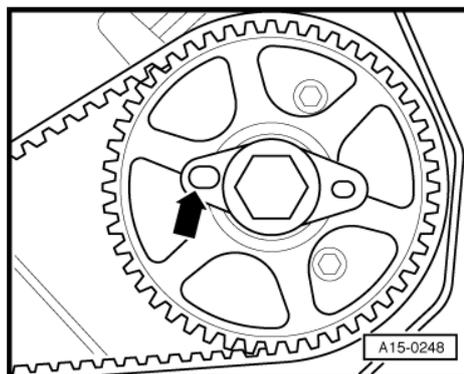




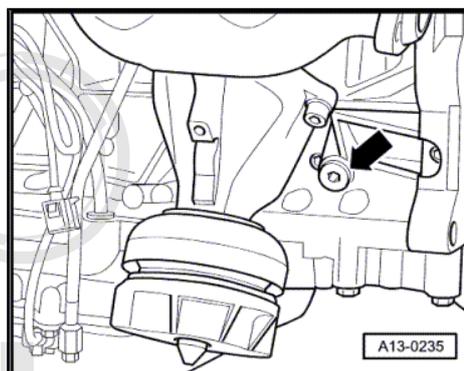
- Turn crankshaft to TDC by hand. Marks -A- and -B- must be aligned.



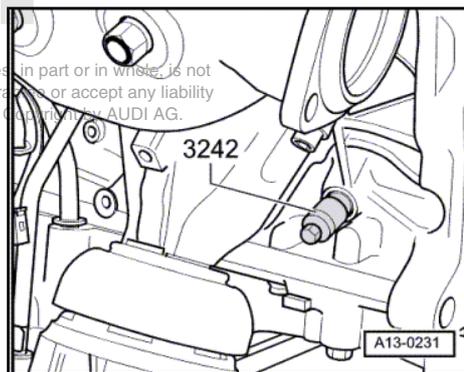
- Check position of camshafts: the larger holes in the locating plates on the camshaft sprockets must align opposite one another on the inside. If this is not the case, turn crankshaft one revolution further.



- Remove sealing plug -arrow- from cylinder block (left-side).
- The TDC drilling in the crankshaft should be behind the sealing plug hole (feel to check).



- Screw locking pin -3242- into hole where plug has been removed and tighten.



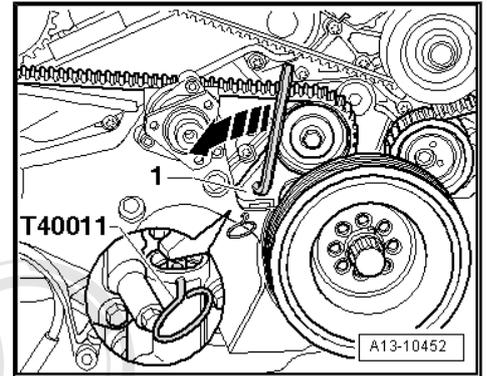
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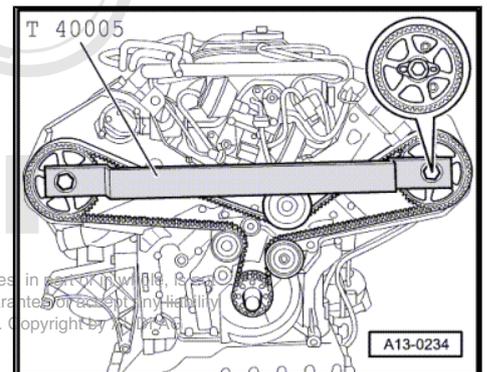
Note

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

- Using an 8 mm Allen key, turn toothed belt tensioning lever -1- anti-clockwise in direction of -arrow- until tensioner -2- is compressed far enough for the locking pin -T40011- to be fitted in the drilling and in the plunger.
- Insert locking pin -T40011- and release toothed belt tensioning lever.

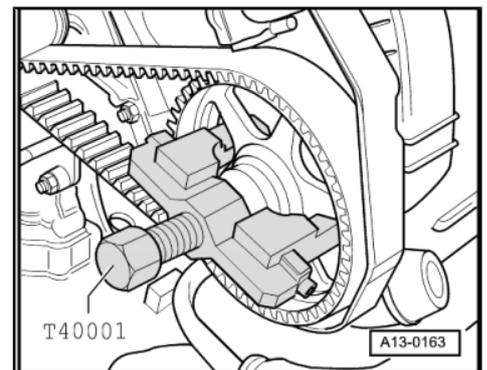


- Fit camshaft clamp -T40005- onto the locating plates of the two camshafts.
- Loosen the two camshaft bolts and unscrew approximately 5 turns.
- Take off camshaft clamp -T40005- .



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- Pull off both camshaft sprockets using two-arm puller -T40001- .
- Remove toothed belt together with camshaft sprocket for cylinder bank 1-4.



 **Caution**

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

Fitting

- Tightening torques ⇒ [page 29](#)
- Take camshaft sprocket for cylinder bank 1-4, fit toothed belt, and bolt sprocket onto camshaft.
- Lightly secure both camshaft sprockets with locating plates by tightening hand-tight.

Note

The camshaft sprockets should be just tight enough on the camshaft tapers so that they can still be turned but do not move axially.

- Fit camshaft clamp -T40005- .



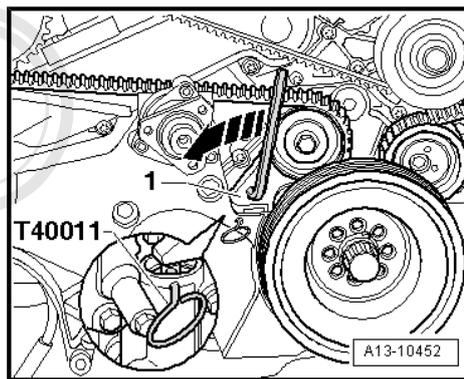
- Using an 8 mm Allen key, turn toothed belt tensioning lever -1- anti-clockwise in direction of -arrow- until the locking pin - T40011- can be removed.
- Tighten bolts on camshaft sprockets.



Note

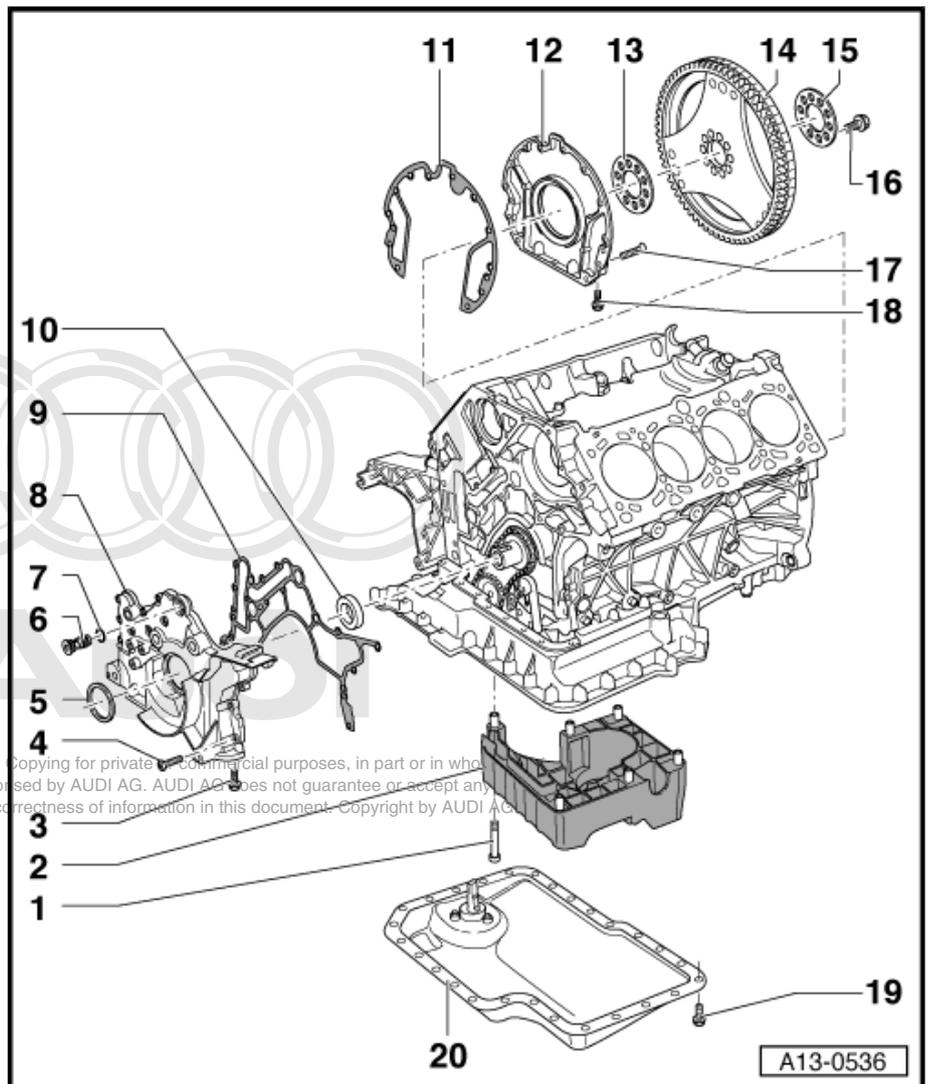
Use camshaft clamp -T40005- to prevent camshafts from turning.

- Remove camshaft clamp -T40005- .
- Unscrew locking pin -3242- and fit sealing plug in hole.
- Turn crankshaft through **2 revolutions**.
- Install viscous fan => [page 148](#).



3 Sealing flanges and drive plate - exploded view

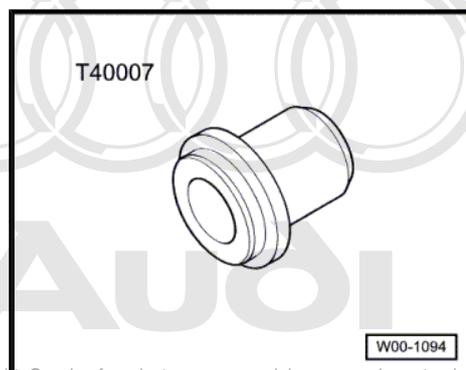
- 1 - 10 Nm
- 2 - Baffle plate
- 3 - 14 Nm
- 4 - 14 Nm
 - Property class 10.9
- 5 - Oil seal
 - For crankshaft
 - Removing and installing
⇒ [page 46](#)
- 6 - Spray nozzle valve, 35 Nm
- 7 - O-ring
 - Renew
- 8 - Sealing flange (front)
 - Removing and installing
⇒ [page 48](#)
- 9 - Gasket
 - Renew
- 10 - Thrust washer
 - If scored, detach and turn 180° or renew
⇒ [page 46](#)
- 11 - Gasket
 - Renew
- 12 - Sealing flange (rear) with oil seal
 - Removing and installing
⇒ [page 52](#)
- 13 - Shim
 - 3.4 mm thick
- 14 - Drive plate
 - Removing and installing ⇒ [page 54](#)
- 15 - Washer
 - 1.5 mm thick
- 16 - Bolt
 - Renew
 - 30 Nm + turn 90° 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 116](#)



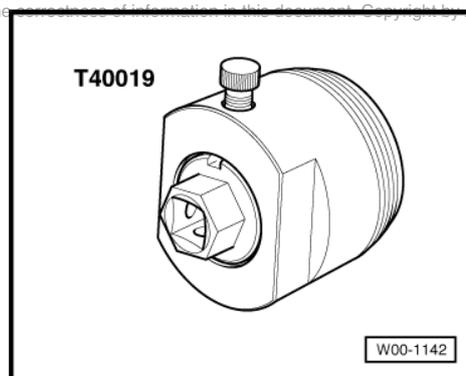
3.1 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

◆ Thrust piece -T40007-



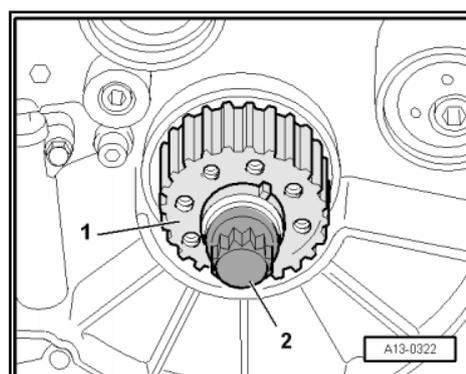
◆ Oil seal extractor -T40019-



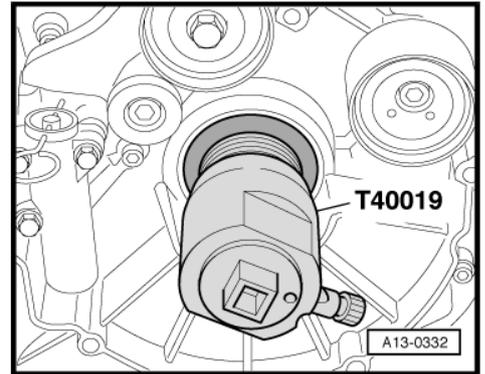
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Removing

- Remove front bumper ⇒ Rep. Gr. 63 .
- Move lock carrier to service position ⇒ Rep. Gr. 50 .
- Remove toothed belt ⇒ [page 31](#) .
- 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.



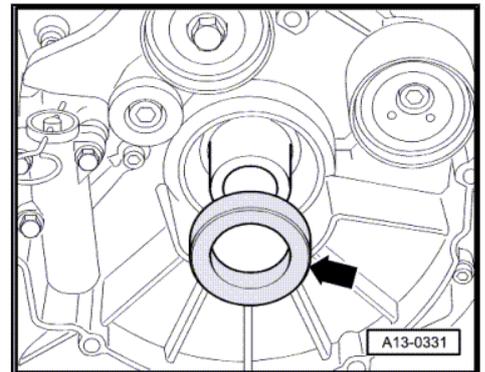
- Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.



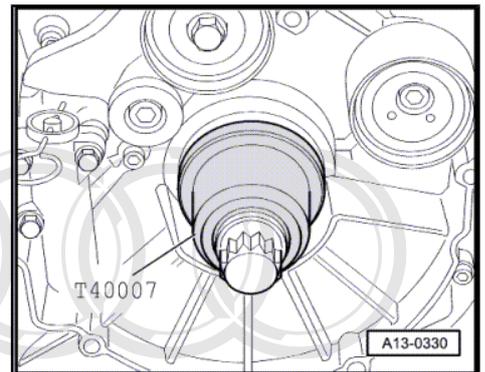
- Use waterproof felt-tip pen to mark outside surface of thrust washer -arrow-.
- Pull thrust washer off crankshaft.

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.

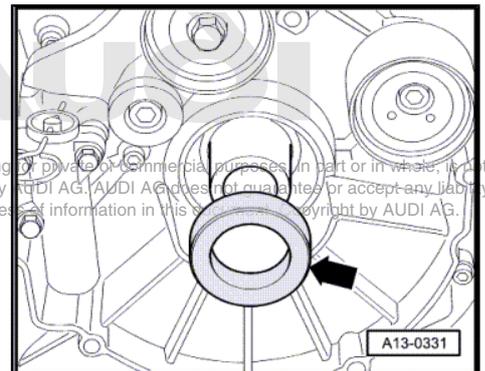


- Rotate thrust washer 180° and fit it onto crankshaft.



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 31](#) .
- Install lock carrier with attachments ⇒ Rep. Gr. 50 .

Tightening torque

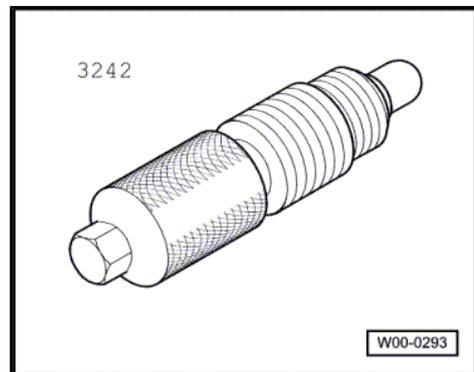
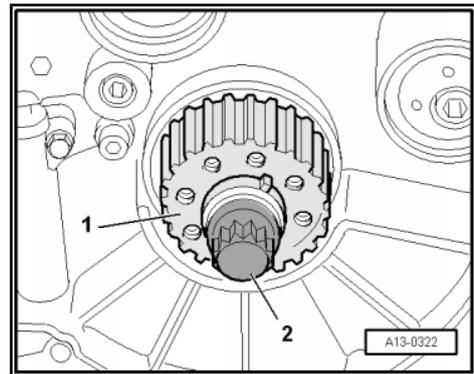
Component	Nm
Toothed belt sprocket to crankshaft	200 + 180° 1)2)

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

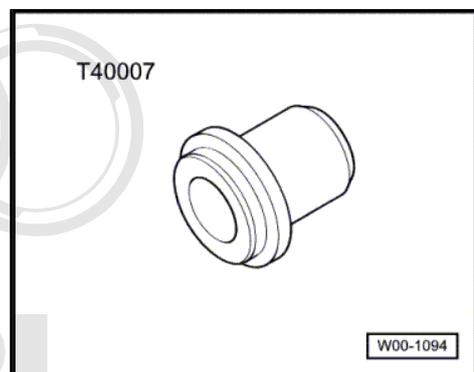
3.2 Removing and installing sealing flange (front)

Special tools and workshop equipment required

- ◆ Locking pin -3242-



- ◆ Thrust piece -T40007-



- ◆ Electric drill with plastic brush attachment

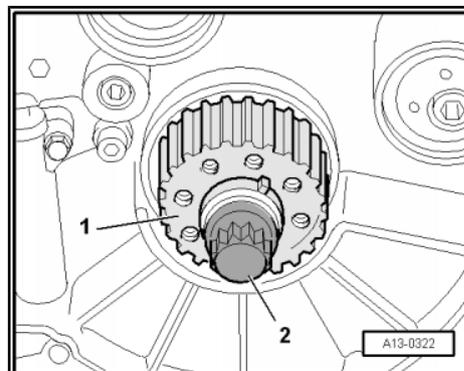
- ◆ Safety goggles

- ◆ Silicone sealant ⇒ Parts catalogue

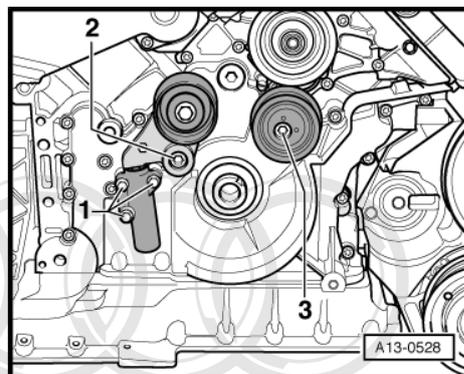
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Removing

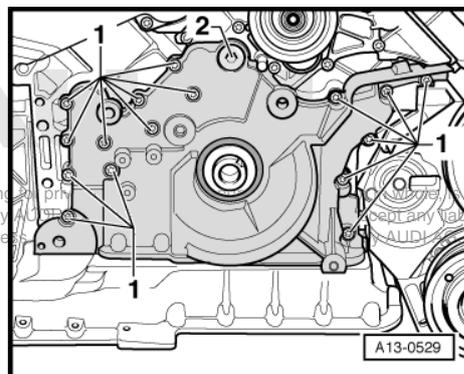
- Remove front bumper => Rep. Gr. 63 .
- Move lock carrier to service position => Rep. Gr. 50 .
- Remove poly V-belt => [page 23](#) .
- Remove toothed belt => [page 31](#) .
- Unscrew central bolt -2- for crankshaft sprocket -1-.
- Detach toothed belt sprocket.



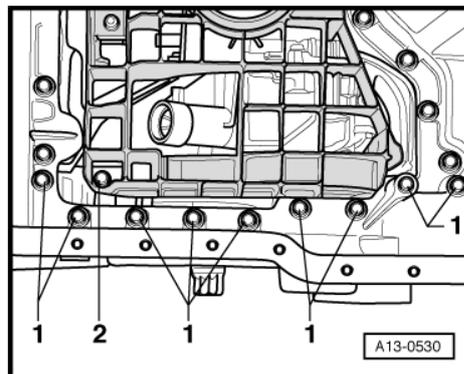
- Unbolt eccentric adjuster -3-, tensioning lever -2- with tensioning roller and tensioner -1-.



- Unscrew spray nozzle valve -2-.
- Remove bolts -1-.
- Remove sump (bottom section) => [page 115](#) .



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



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- 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.

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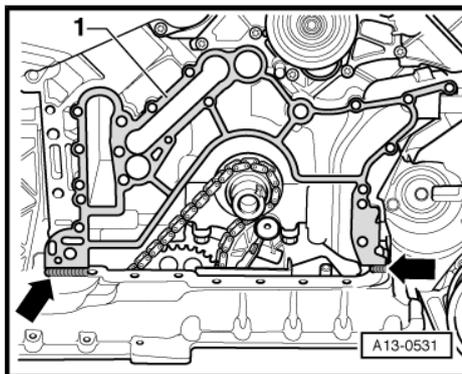
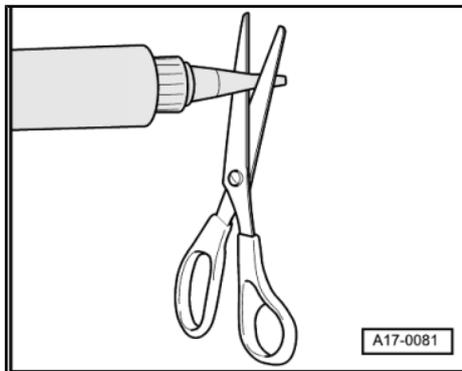
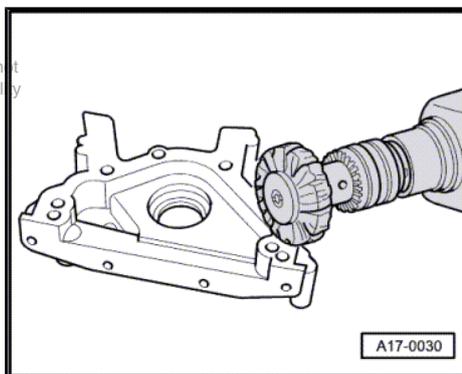
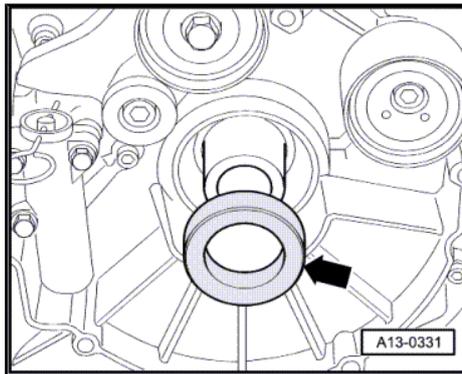


WARNING

Wear safety goggles.

- Clean sealing surfaces; they must be free of oil and grease.
- Cut off nozzle of tube at front marking (Ø 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-.



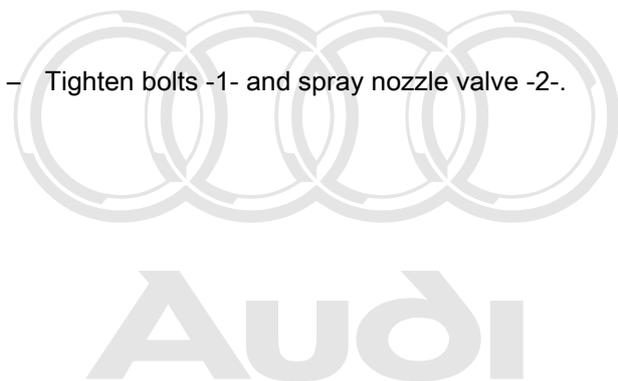
- Coat lower sealing surface on sealing flange lightly with silicone sealant (hatched area).

i Note

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

- Push the sealing flange carefully onto the dowel pins on the cylinder block.

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



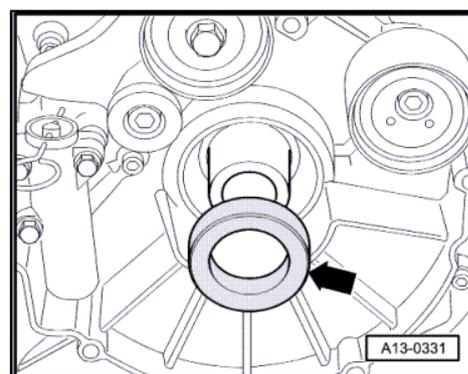
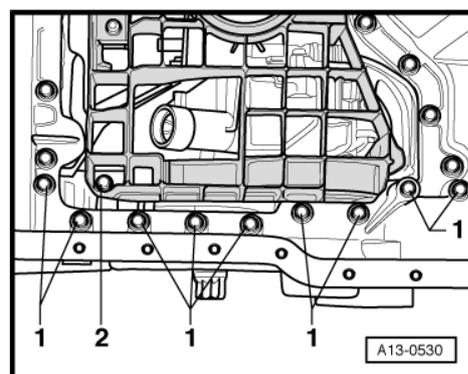
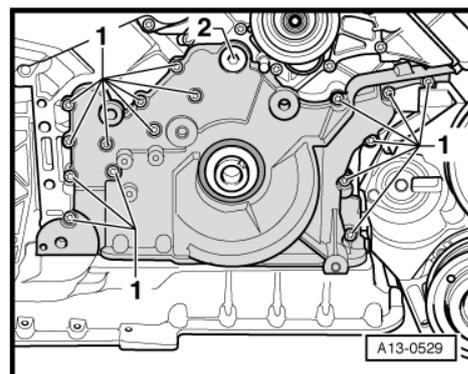
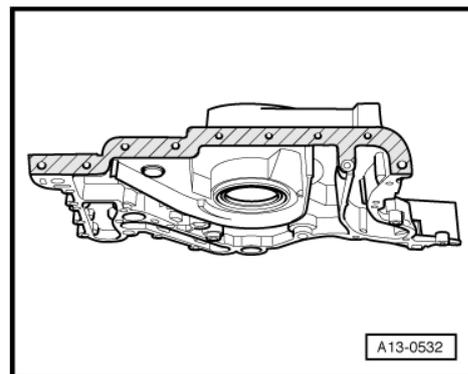
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- Tighten bolts -1- and -2-.
- Install sump (bottom section) => [page 115](#) .
- Do not lubricate sealing lip and outer circumference of oil seal before pressing in.

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

i 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.*

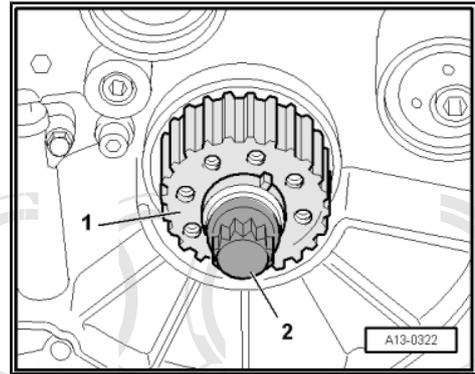
Perform further installation in reverse order, paying attention to the following:

**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 31](#) .
- Install lock carrier with attachments ⇒ Rep. Gr. 50 .

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**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.

3.3 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](#) .
- Remove drive plate ⇒ [page 54](#) .
- 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)

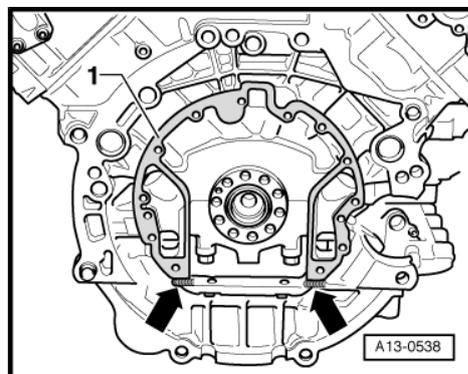
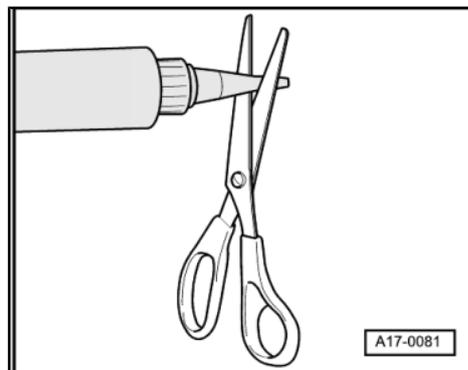
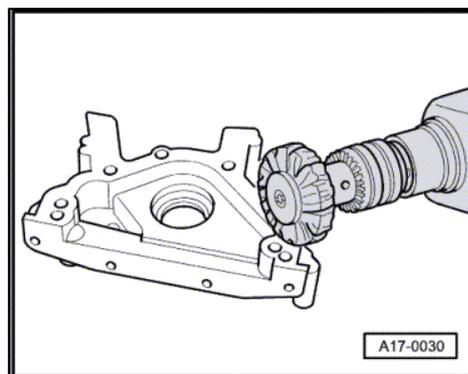
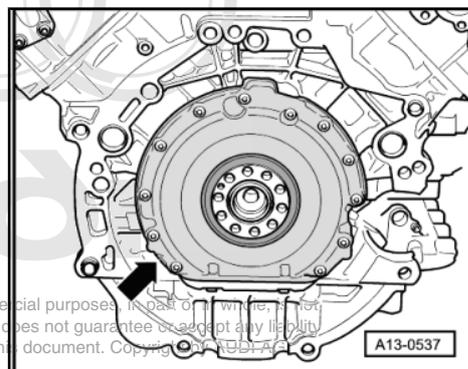
- Remove sealant residue on sealing flange using rotating plastic brush or similar.

 **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**

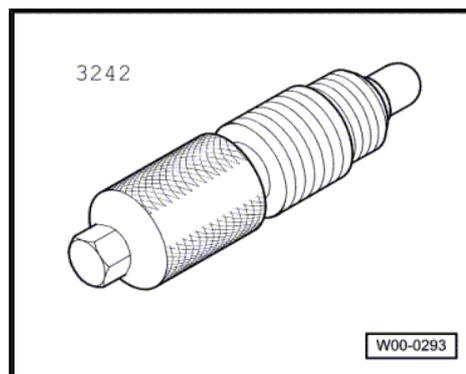
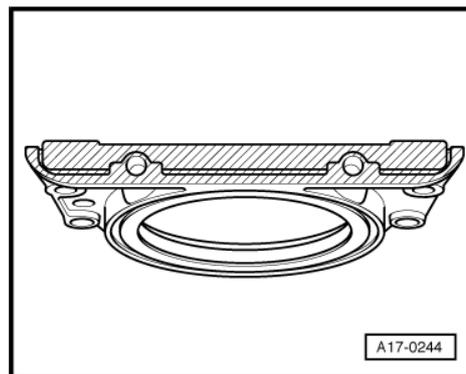
- ◆
- ◆ *The sealing flange must be installed within 5 minutes after applying the silicone sealant.*
- To install, push guide sleeve from assembly kit onto crankshaft.
- Push the sealing flange carefully onto the dowel pins on the cylinder block.
- **Secure rear sealing flange**
- Install drive plate ⇒ [page 54](#) .
- Install engine ⇒ [page 19](#) .

Tightening torques

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

3.4 Removing and installing drive plate**Special tools and workshop equipment required**

- ◆ Locking pin -3242-
- ◆

**Removing**

- Engine removed ⇒ [page 7](#) or gearbox removed ⇒ Rep. Gr. 32 .

**WARNING**

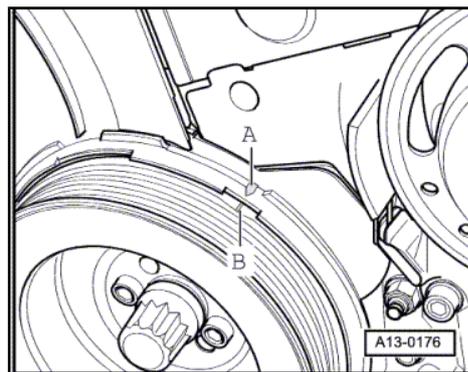
The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).

- 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-.

i Note

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



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

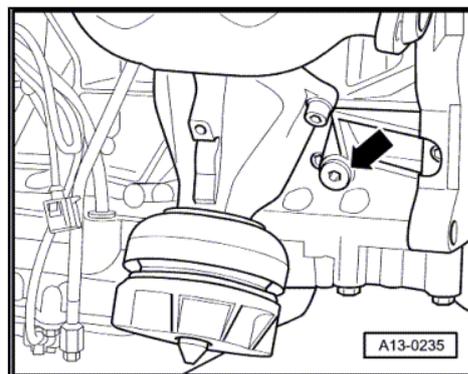
i Note

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

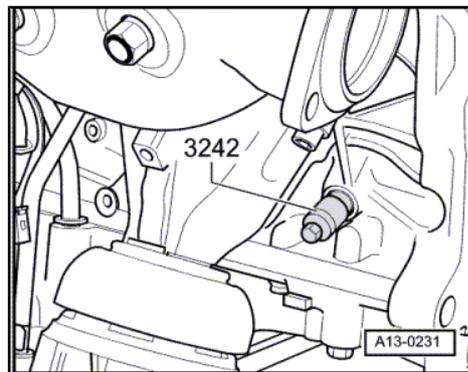


WARNING

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.



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- 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

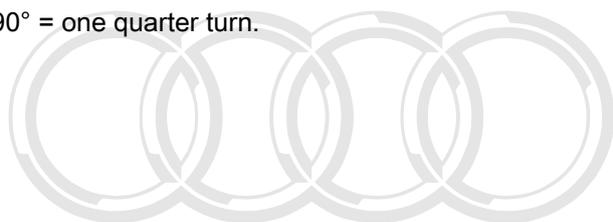
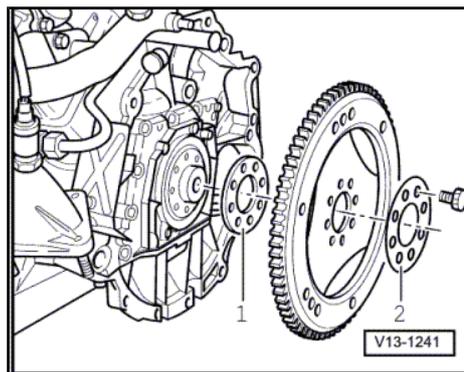
2 - Washer: thickness 1.50 mm

- 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.



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4 Crankshaft - exploded view



Note

Secure engine to engine and gearbox support -VAS 6095- when dismantling/assembling engine ⇒ [page 18](#).

1 - Bolt, 22 Nm

- For bearing cap
- Renew
- Tightening sequence ⇒ [page 59](#)

2 - Dowel sleeve

- Insert in cylinder block

3 - Drive chain sprocket for oil pump

- Removing and installing ⇒ [page 61](#)

4 - Bearing cap

- Note marking ⇒ [page 58](#)
- Removing ⇒ [page 58](#)
- Installing ⇒ [page 59](#)

5 - Nut, 35 Nm + turn 90° further

- For bearing cap
- Renew
- Tightening sequence ⇒ [page 59](#)

6 - Thrust washer

- Only fitted on 3rd crankshaft bearing
- Oil grooves face outwards
- Note location
- Measuring axial clearance of crankshaft ⇒ [page 60](#)

7 - Bearing shell

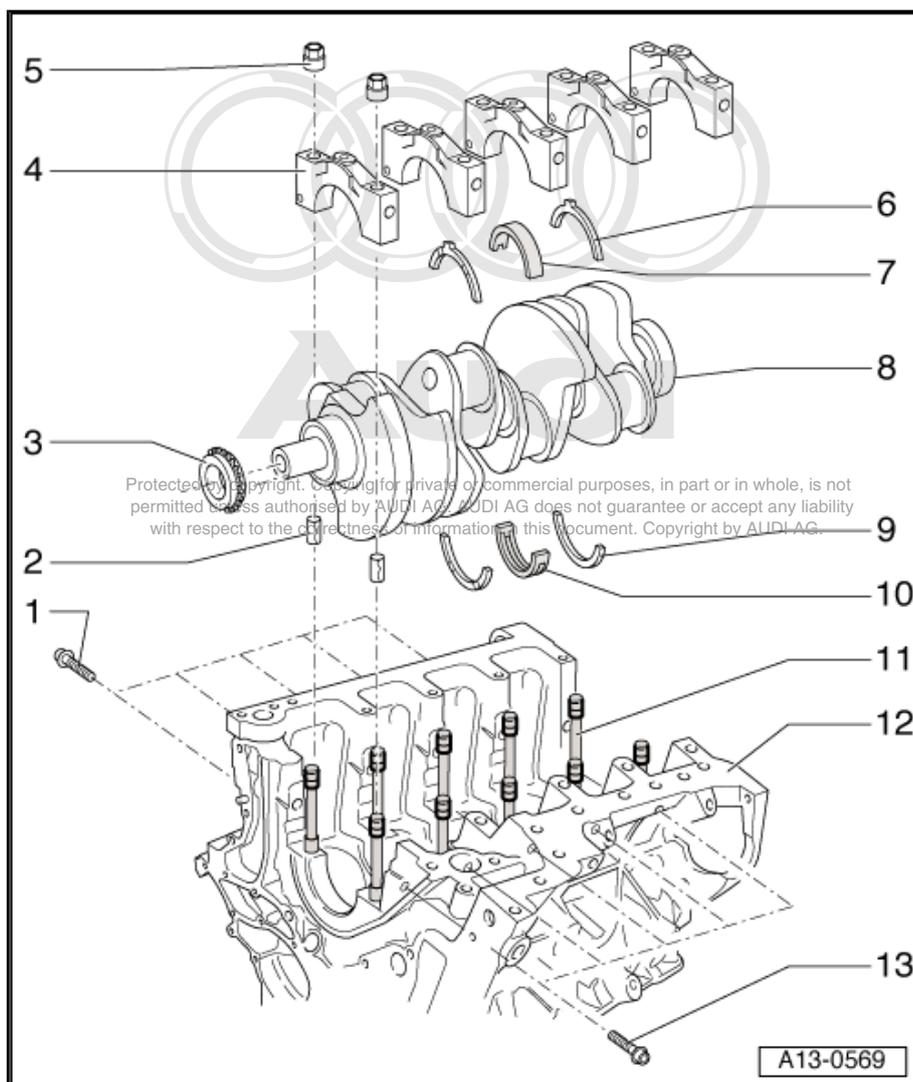
- For bearing cap (without oil groove)
- Do not interchange used bearing shells (mark positions)
- Install new bearing shells for the cylinder block with the correct coloured markings ⇒ [page 59](#)

8 - Crankshaft

- Measuring axial clearance ⇒ [page 60](#)
- Measuring radial clearance ⇒ [page 60](#)
- Do not rotate the crankshaft when checking the radial clearance
- Crankshaft dimensions ⇒ [page 60](#)

9 - Thrust washer

- Only fitted on 3rd crankshaft bearing
- Oil grooves face outwards





- ❑ Measuring axial clearance of crankshaft ⇒ [page 60](#)

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 59](#)

11 - Stud

12 - Cylinder block

13 - Bolt, 22 Nm

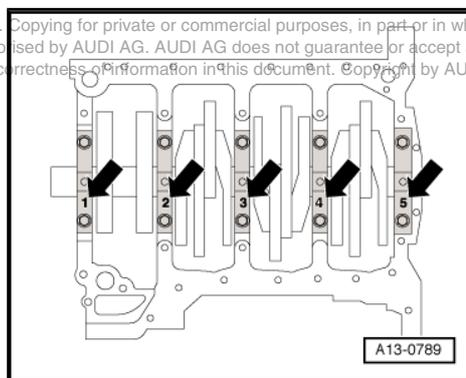
- ❑ For bearing cap
- ❑ Renew
- ❑ Tightening sequence ⇒ [page 59](#)



Markings on crankshaft bearing caps

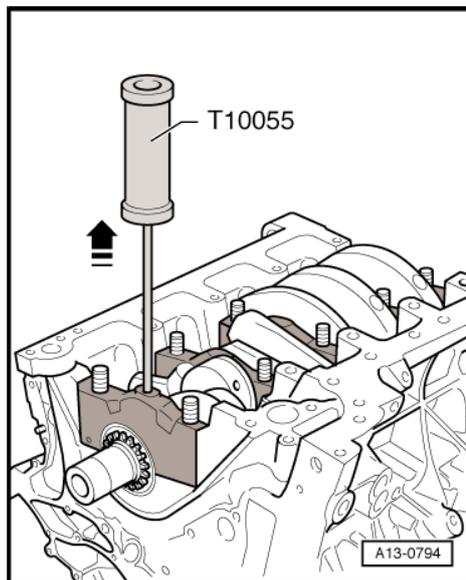
- ◆ Bearing 1 is on pulley end.

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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

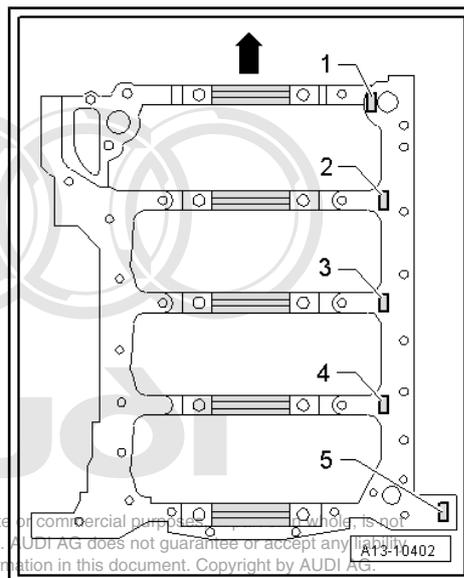
Bearing shells of the correct thickness are matched to the bearings in the cylinder block at the factory. Coloured dots on the bearing shells are used to identify the bearing shell thickness.

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.

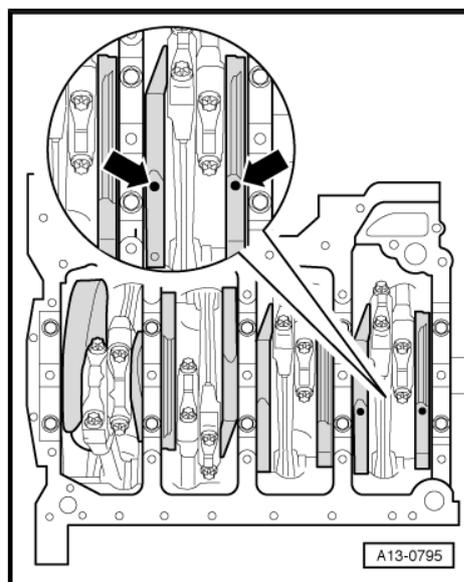
Letter on cylinder block	Colour coding of bearing
G	Yellow
B	Blue
R	Red



Matching crankshaft bearing shells to bearing caps

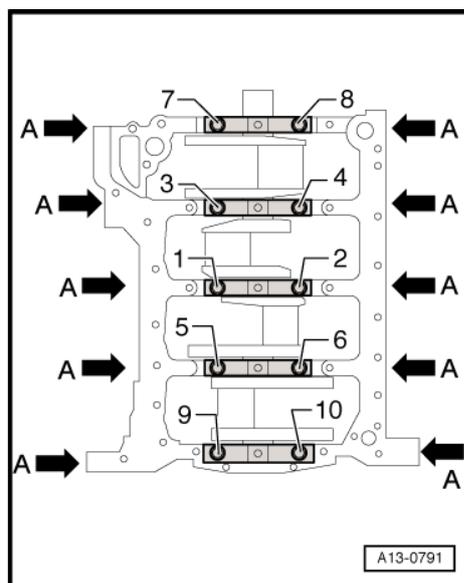
Bearing shells of the correct thickness are assigned to the bearing caps at the factory. Coloured dots on bearing shell are used to identify bearing shell thickness -arrows-.

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- hand-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.



4.1 Crankshaft dimensions

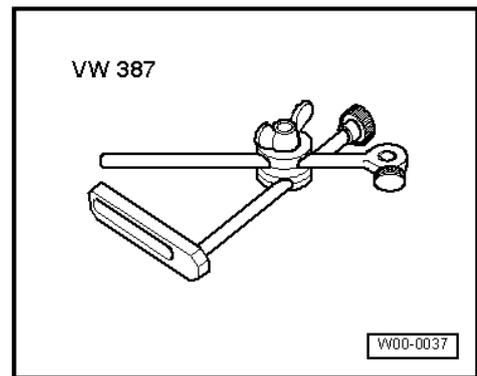
(in mm)

Honing dimension (in mm)	Crankshaft main bearing journal Ø	Conrod journal Ø
Basic dimension	-0.022	-0.022
	65.00	54.00
1st undersize	-0.042	-0.042
	64.75	53.75
2nd undersize	-0.022	-0.022
	64.50	53.50
3rd undersize	-0.042	-0.042
	64.25	53.25
	-0.022	-0.022
	-0.042	-0.042

4.2 Measuring axial clearance

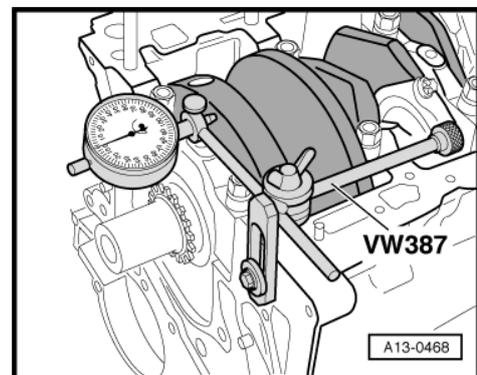
Special tools and workshop equipment required

- ◆ 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



4.3 Measuring radial clearance

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Special tools and workshop equipment required

- ◆ Plastigage

 **Note**

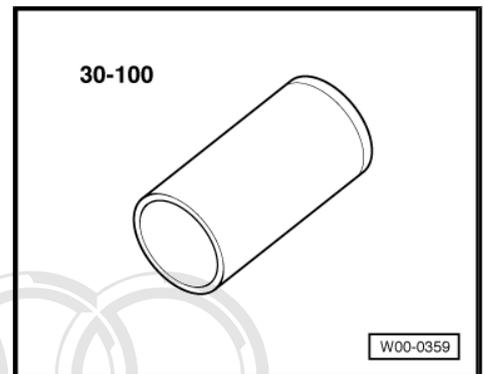
- ◆ *Do not interchange used bearings.*
- ◆ *Bearing shells worn down to nickel layer must be renewed*
- Remove main bearing cap. Clean bearing cap and bearing journal.
- Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or bearing shell.
- ◆ The Plastigage 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 calibrated scale.
- Take reading:

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

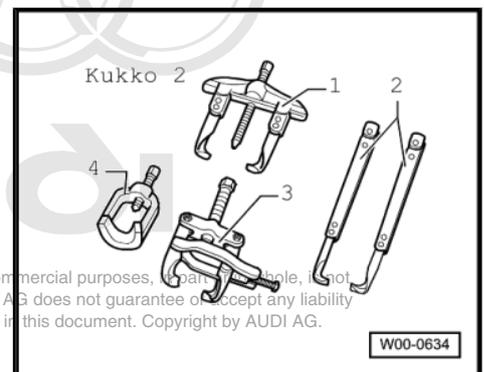
4.4 Removing and installing drive chain sprocket for oil pump

Special tools and workshop equipment required

- ◆ Drift sleeve -30 - 100-



- ◆ 1 Two-arm puller -Kukko 20/10-



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Removing

- Remove sealing flange (front) ⇒ [page 48](#) .



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

Installing

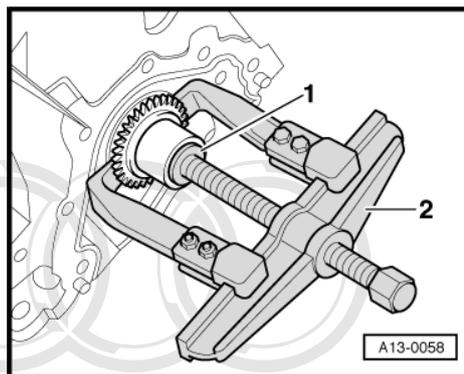
Installation is carried out in the reverse order; note the following:

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

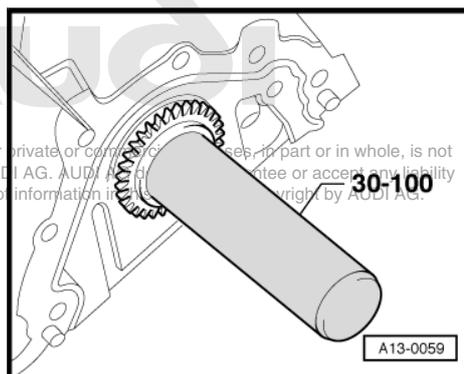


WARNING

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- .



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5 Pistons and conrods - exploded view



Note

Oil spray jet for piston cooling ⇒ [page 66](#).

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 65](#)
- 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 66](#)

3 - Bearing shell

- Note installation position
- Do not interchange used bearing shells (mark positions)
- Measuring radial clearance ⇒ [page 66](#)
- To measure radial clearance, tighten bolts ⇒ [Item 1 \(page 63\)](#) 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 65](#)
- 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 66](#)

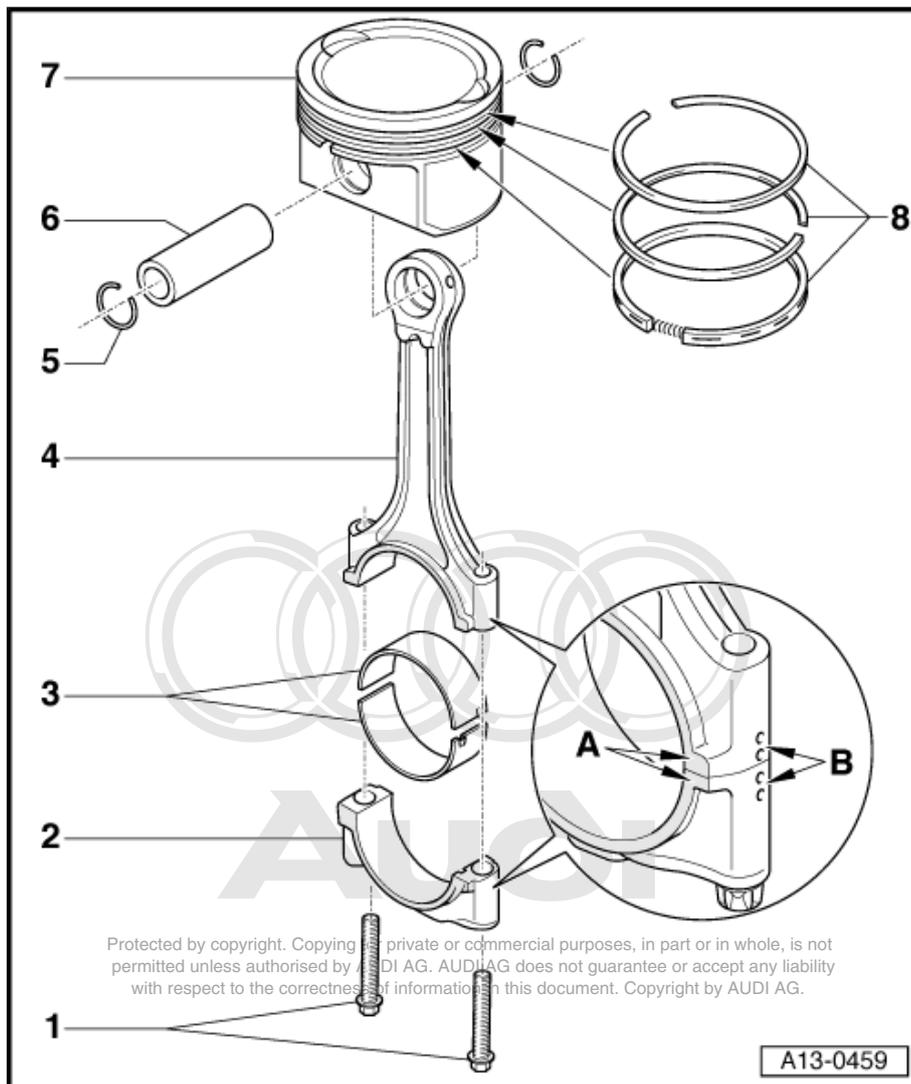
5 - Circlip

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 65](#)
- Arrow on piston crown points to pulley end





- Checking ⇒ [page 64](#)
- Install using piston ring clamp
- Piston and cylinder dimensions ⇒ [page 66](#)
- Checking cylinder bore ⇒ [page 65](#)

8 - Piston rings

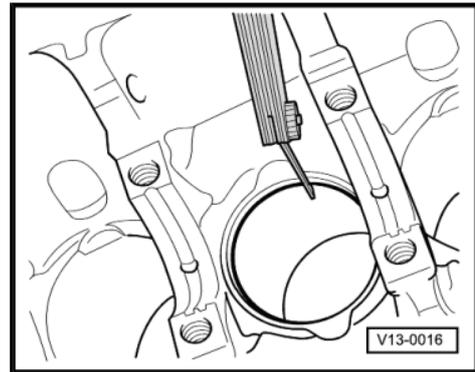
- Offset gaps by 120°
- Use piston ring pliers to remove and install
- "TOP" marking or lettering must face towards piston crown
- Checking ring gap ⇒ [page 64](#)
- Checking ring-to-groove clearance ⇒ [page 64](#)

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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.

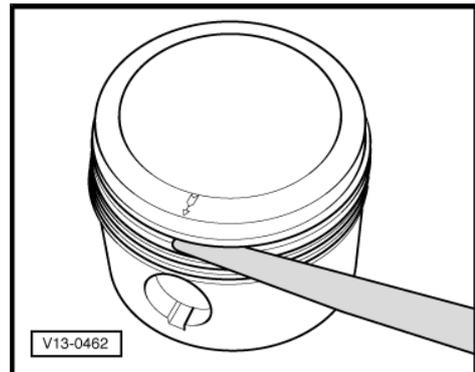
Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.35...0.50	0.8
2nd compression ring	0.60...0.80	1.0
Oil scraper ring	0.25...0.50	0.8



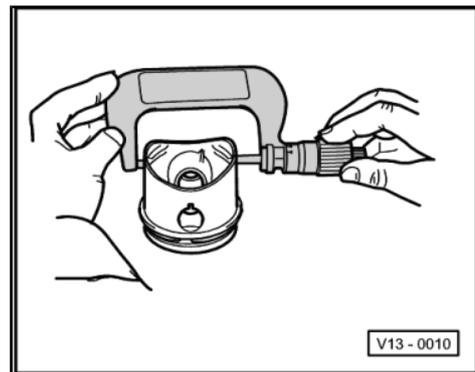
Checking ring-to-groove clearance

- Clean groove in piston before checking clearance.

Piston ring Dimensions in mm	New	Wear limit
Compression rings	0.02...0.08	0.20
Oil scraper ring	0.02...0.08	0.15



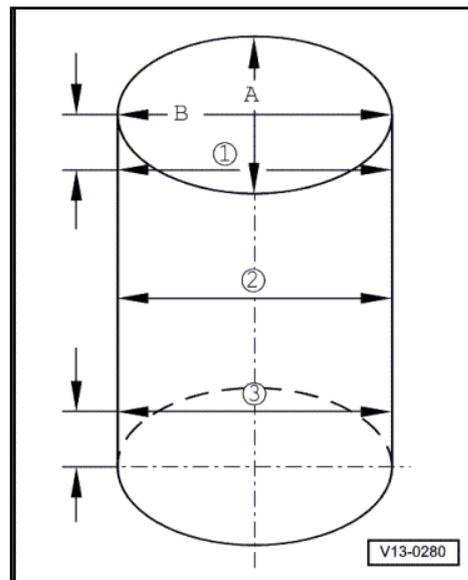
Checking piston



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 66](#) ; 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 66](#) ; Piston and cylinder dimensions

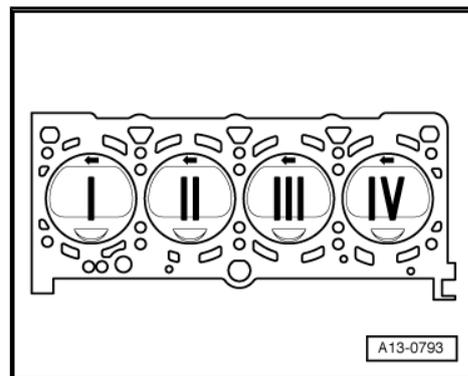
Piston installation position and piston/cylinder allocation

- 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 scribe, as this would damage the coating of the piston crown.

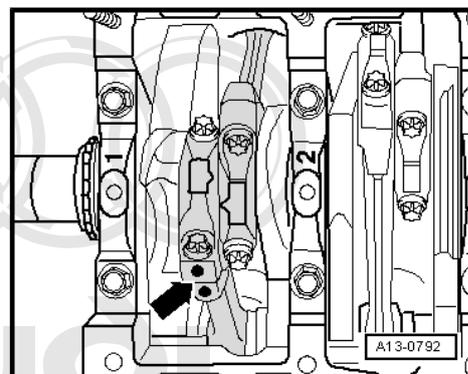
- ◆ Installation position: Arrow on piston crown points to pulley end



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-.

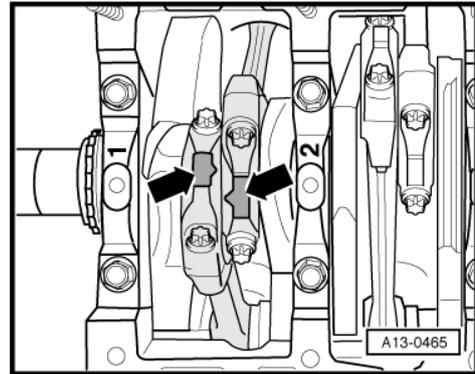


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Conrod installation position

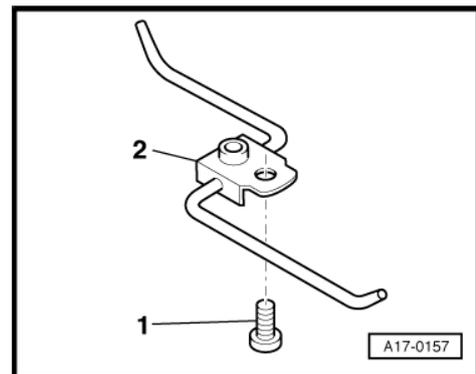
- ◆ The cast lugs -arrows- on the ground surfaces of the conrod pairs 1 and 2, 3 and 4, and 5 and 6 must face one another.



Oil spray jet for piston cooling

1 - Bolt, 10 Nm

2 - Oil spray jet for piston cooling



5.1 Piston and cylinder dimensions

Honing dimension		Piston Ø	Cylinder bore Ø
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.

5.2 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.

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

- Renew conrod bearing bolts.

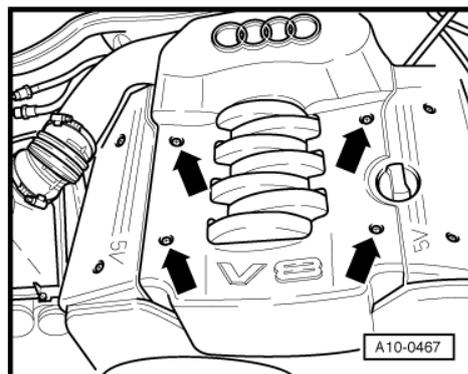
15 – Cylinder head, valve gear

1 Removing and installing cylinder head

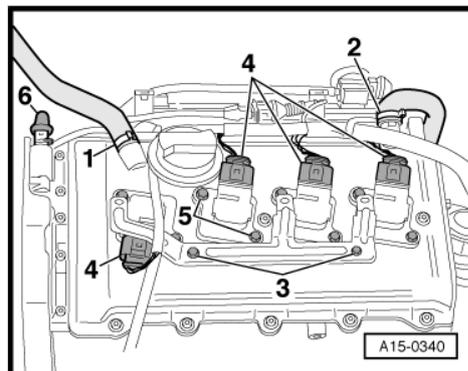
1.1 Removing and installing cylinder head cover (left-side)

Removing

- Detach engine cover panel -arrows-.



- Disconnect hose -1-.
- Disconnect hose -2-.
- Unscrew bracket -3-.
- Unplug connectors -4- on ignition coils.
- Remove ignition coils -5-.



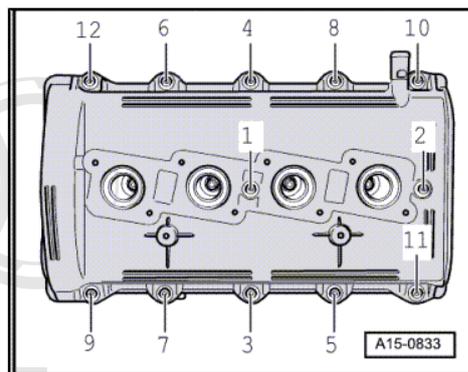
- Unscrew cylinder head cover bolts (left-side) in the sequence -12 ... 1-.
- Remove cylinder head cover.

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.*

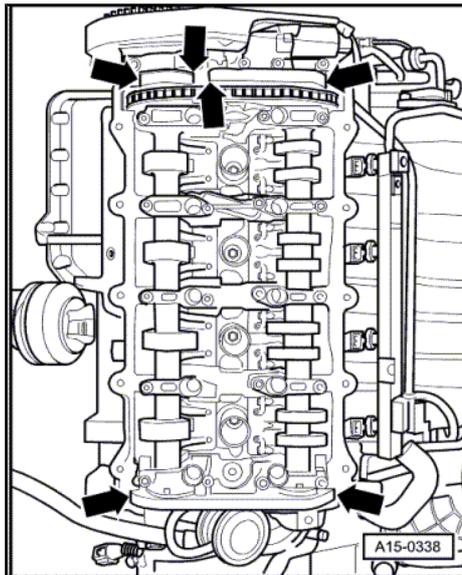


- Clean sealing surfaces; they must be free of oil and grease.

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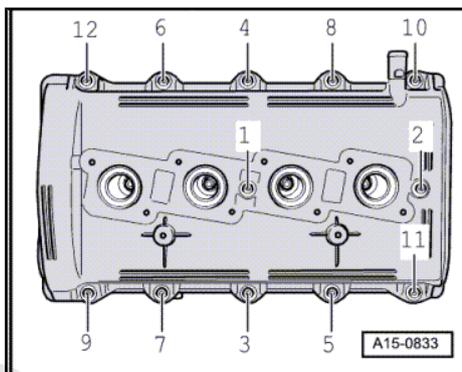
- Apply small quantity of sealant to sealing points -arrows- on upper sealing surface of cylinder head.
- ◆ Sealant ⇒ Parts catalogue



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

Tightening torques

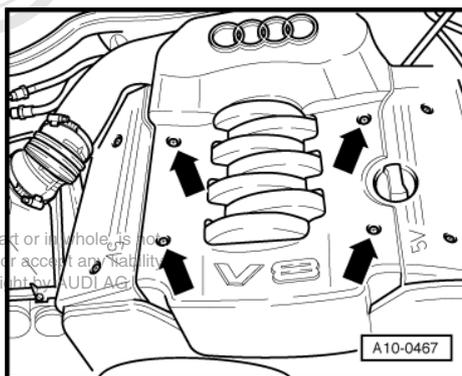
Component	Nm
Cylinder head cover to cylinder head	10



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

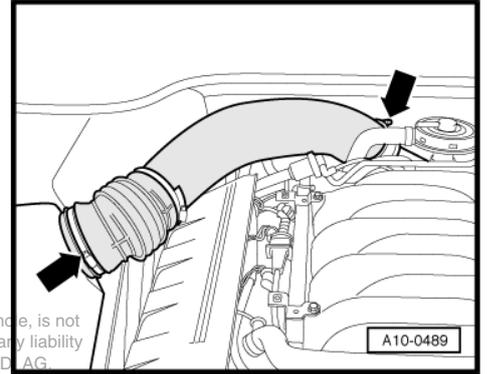
Removing

- Detach engine cover panel -arrows-.



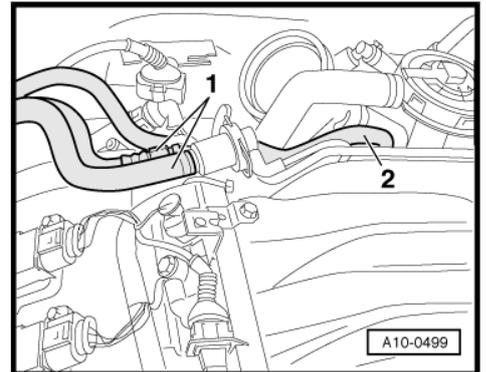
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- Remove air intake pipe -arrows- between air cleaner and throttle valve unit.

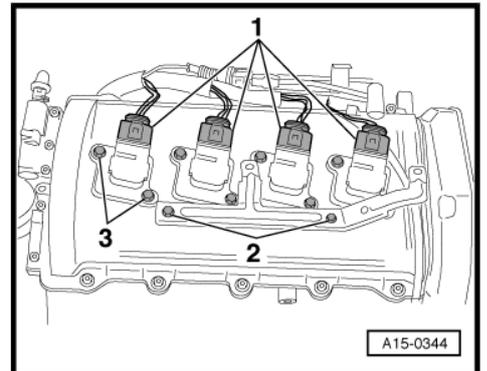


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- Disconnect fuel supply pipe and return pipe -1-.
- Disconnect hose -2-.



- Unplug connectors -1- on ignition coils.
- Unscrew bracket -2-.
- Remove ignition coils -3-.
- Disconnect crankcase breather hose.



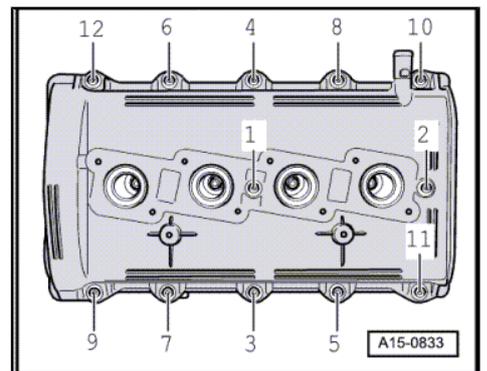
- Remove cylinder head cover bolts in the sequence -12 ... 1-.
- Remove cylinder head cover.

Installing

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

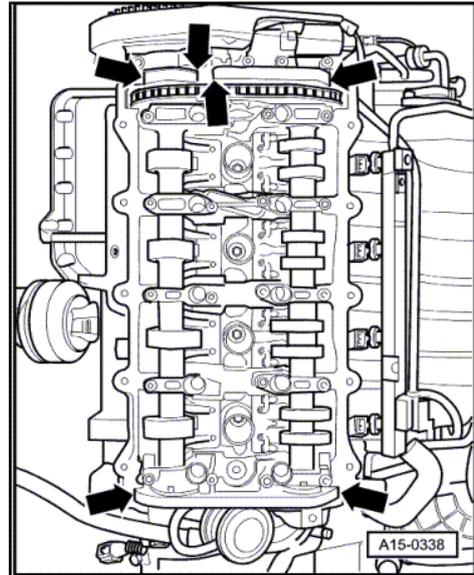
Note

- ◆ *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.*





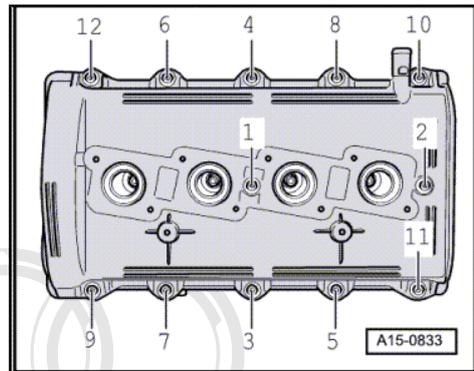
- Apply small quantity of sealant to sealing points -arrows- on upper sealing surface of cylinder head.
- ◆ Sealant → Parts catalogue



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

Tightening torques

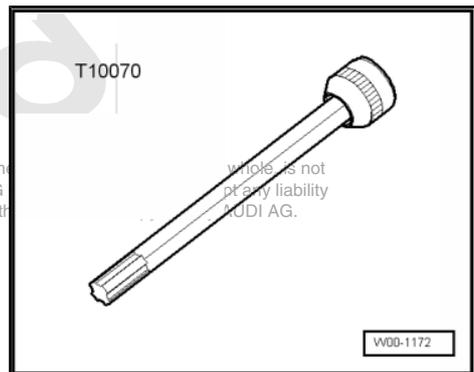
Component	Nm
Cylinder head cover to cylinder head	10



1.3 Removing cylinder head (left-side)

Special tools and workshop equipment required

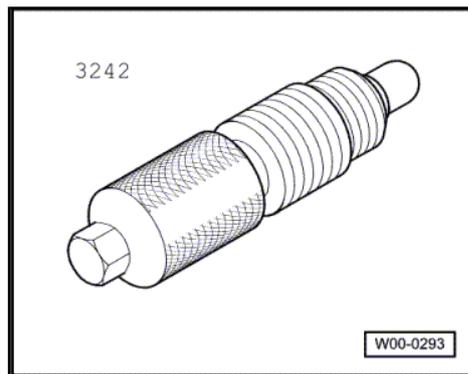
- ◆ Special wrench (Polydrive) -T10070-



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- ◆ Locking pin -3242-



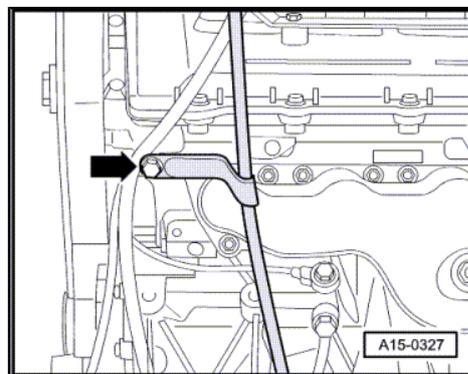
Removing



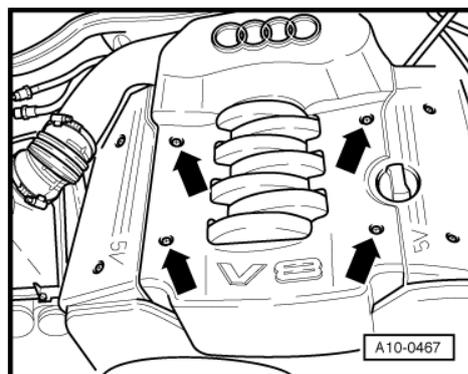
Note

- ◆ *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.*
- Drain off coolant ⇒ [page 137](#) .
- **Unbolt guide tube for oil dipstick from cylinder head.**

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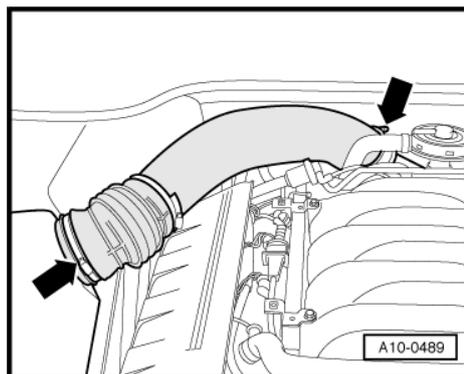


- Take off engine cover panel -arrows-.

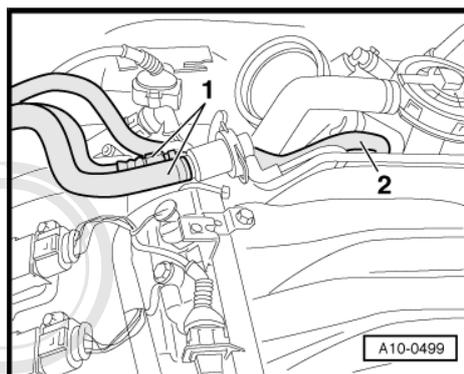




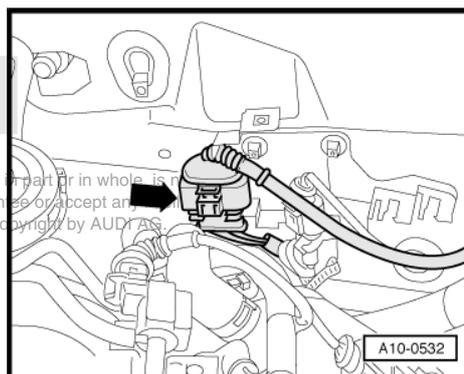
- Remove air intake pipe -arrows- between air cleaner and throttle valve unit.



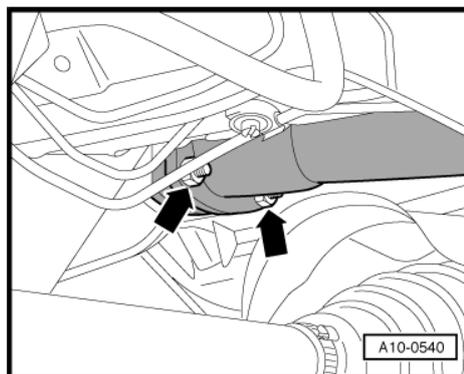
- Disconnect fuel supply pipe and return pipe -1-.
- Disconnect hose -2-.
- Slacken upper bolt securing exhaust manifold to exhaust pipe.



- Unplug connector for Lambda probe (left-side) -arrow- and move wiring clear.

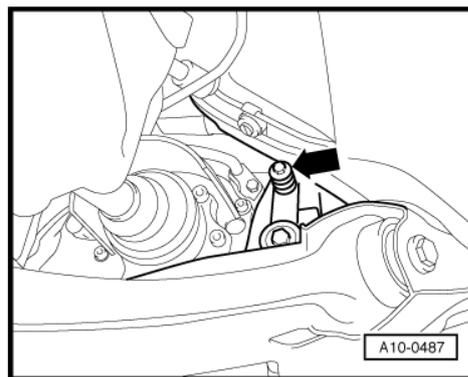


- Slacken lower bolts -arrows- securing exhaust manifold to front exhaust pipe.



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- Unbolt exhaust pipe from mounting bracket -arrow-.

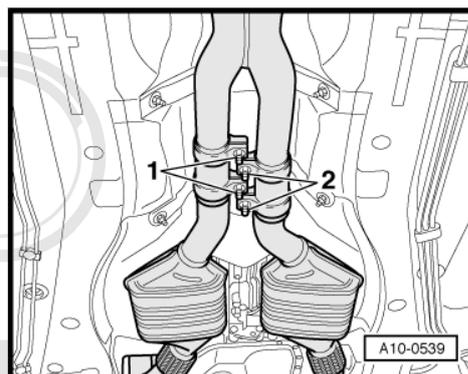


- Slacken double clamp -1- and push towards the front.
- Carefully take out exhaust pipe.

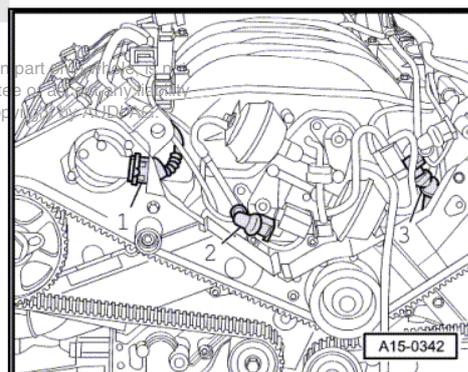
i Note

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

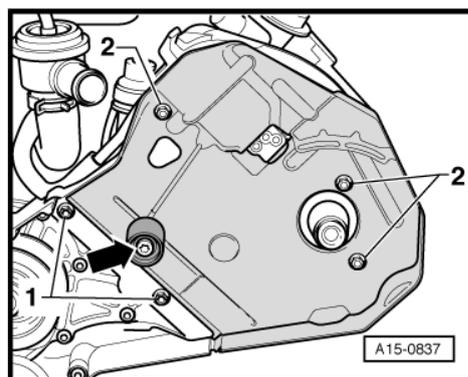
- Remove toothed belt cover.



- Unplug electrical connector -2-.
- Unplug electrical connector -3-.
- Take toothed belt off camshafts [page 40](#).
- Remove camshaft sprocket for cylinder bank 5-8.

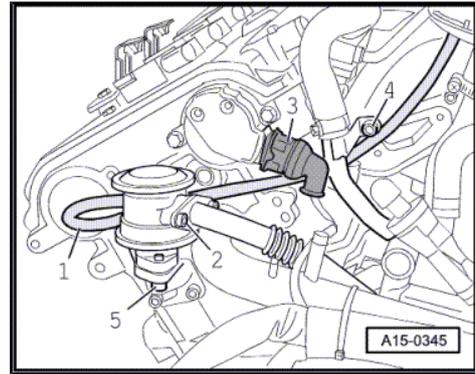


- Slacken nuts -1-.
- If fitted, remove idler roller -arrow-.
- Unscrew bolts -2- and remove toothed belt cover.

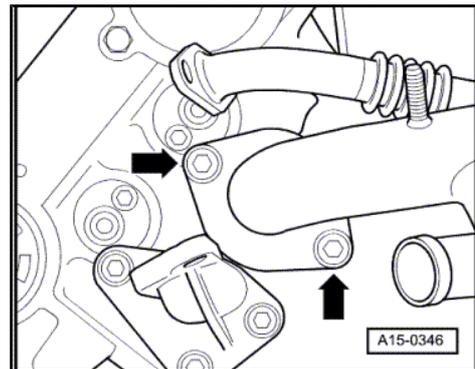




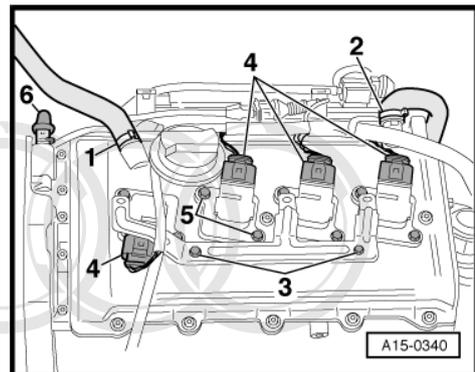
- Disconnect hose -1-.
- Remove bolts -2-.
- Unplug electrical connector -3-.
- Unscrew bolt -4- and pull out oil pipe.
- Unscrew bolts -5- and take out combination valve.



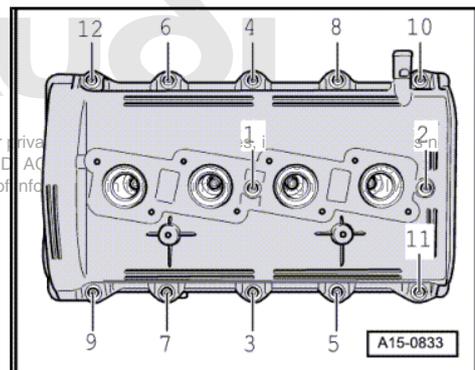
- Detach coolant pipe -arrows-.



- Disconnect hose -1-.
- Disconnect hose -2-.
- Unscrew bracket -3-.
- Unplug connectors -4- on ignition coils.
- Remove ignition coils -5-.
- Unplug electrical connector -6-.

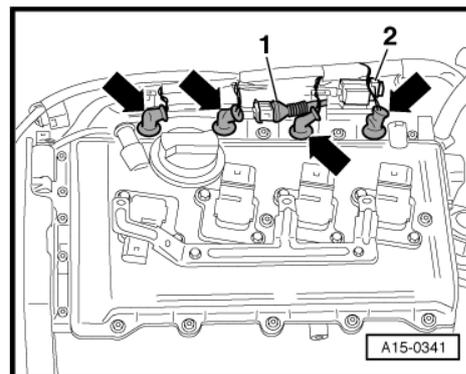


- Unscrew cylinder head cover bolts (left-side) in the sequence -12 ... 1-.
- Remove cylinder head cover.

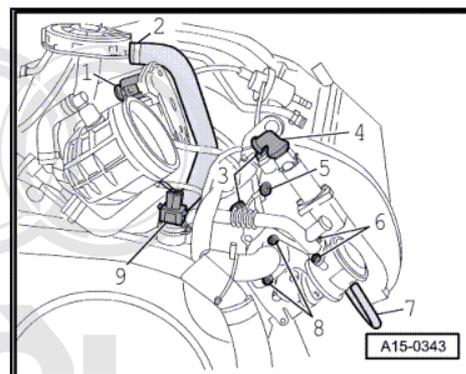


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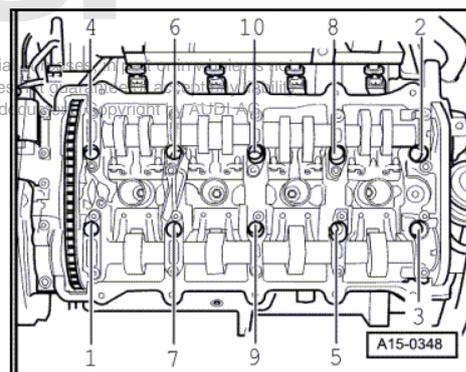
- Unplug connector -1- for knock sensor, cylinder bank 5-8.
- Unplug connectors -arrows- for injectors, cylinder bank 5-8 and move wiring harness clear.
- Unplug connector for knock sensor, cylinder bank 1-4.
- Unplug connectors from injectors, cylinder bank 1-4.



- Unplug electrical connector -1-.
- Disconnect hose -2-.
- Remove bolts -8-.
- Unplug electrical connector -9-.
- Remove coolant pipe.
- Remove intake manifold.



- Adhere to correct sequence when loosening cylinder head bolts.
- Remove cylinder head and place on a suitable soft surface.



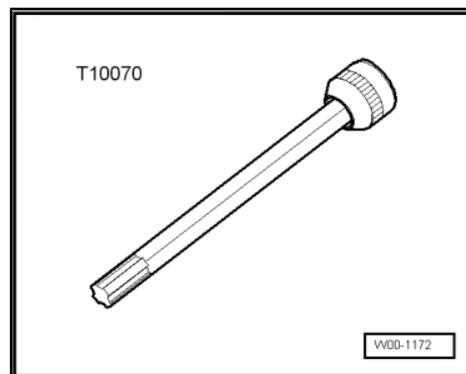
Installing

- Install cylinder head => [page 80](#) .

1.4 Removing cylinder head (right-side)

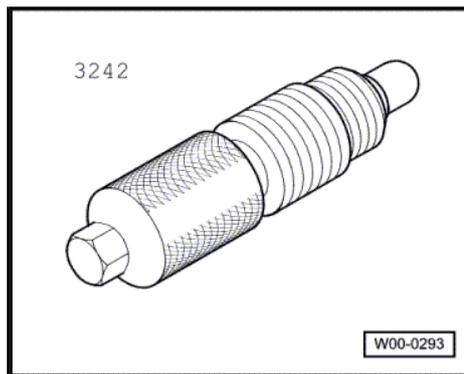
Special tools and workshop equipment required

- ◆ Special wrench (Polydrive) -T10070-





◆ Locking pin -3242-



Removing

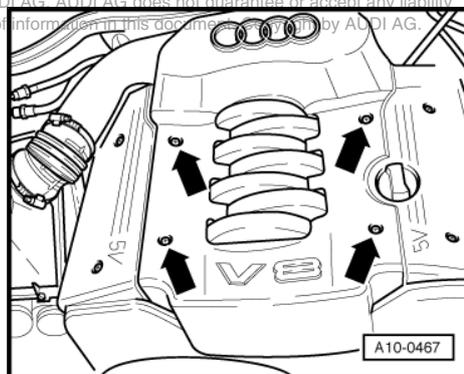


Note

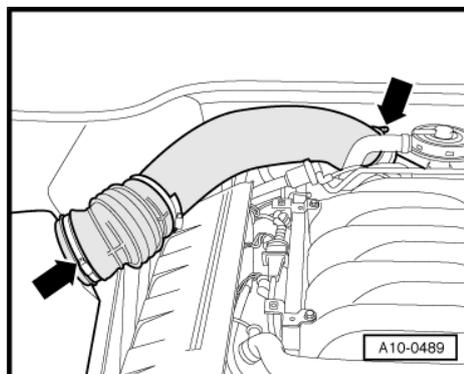
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue*
- ◆ *All cable ties which are released or cut open when removing must be refitted in the same position when installing.*
- ◆ *Renew the cylinder head bolts.*
- ◆ *On assembly, renew oil 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.*

- Drain off coolant ⇒ [page 137](#) .
- Take off engine cover panel -arrows-.

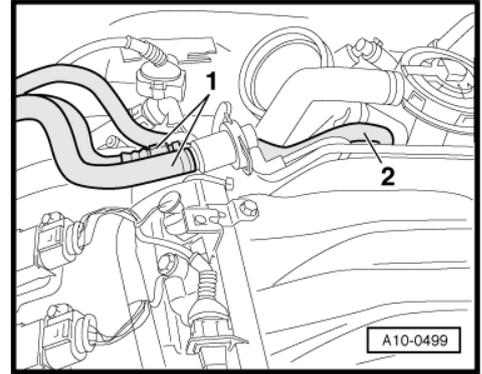
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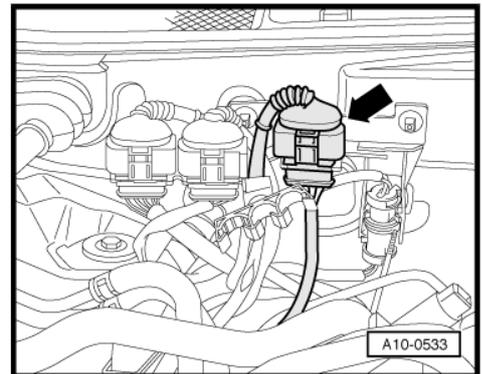
- Remove air intake pipe -arrows- between air cleaner and throttle valve unit.



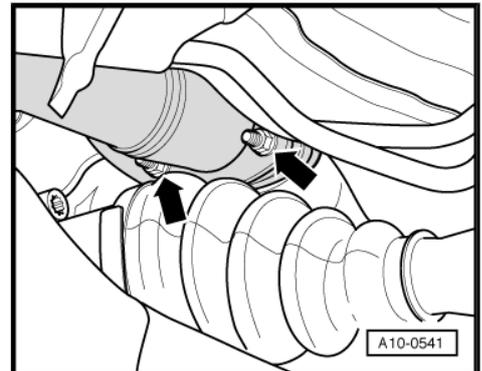
- Disconnect fuel supply pipe and return pipe -1-.
- Disconnect hose -2-.



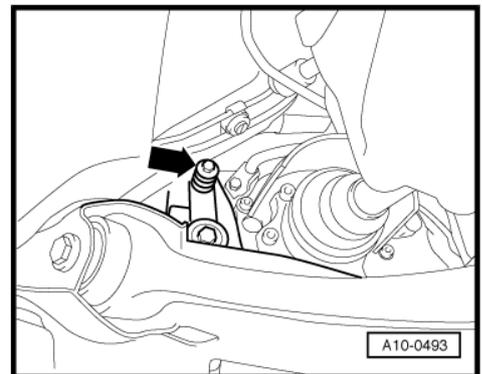
- Unplug connector for Lambda probe (right-side) -arrow- and move wiring clear.
- Take off right wheel.
- Slacken upper bolt securing exhaust manifold to exhaust pipe (accessible through track rod aperture).



- Slacken lower bolts -arrows- securing exhaust manifold to front exhaust pipe.



- Unbolt exhaust pipe from mounting bracket -arrow-.



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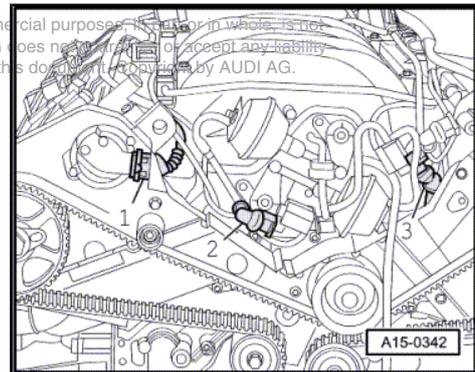
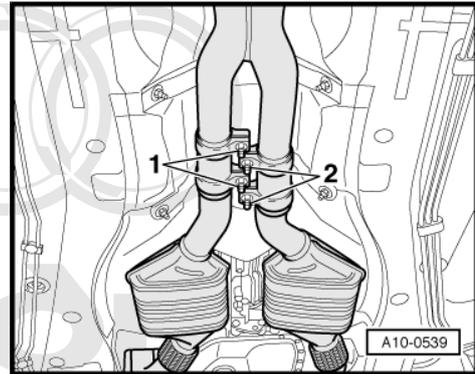
- Slacken double clamp -2- and push towards the front.
- Carefully remove exhaust pipe together with catalytic converter.



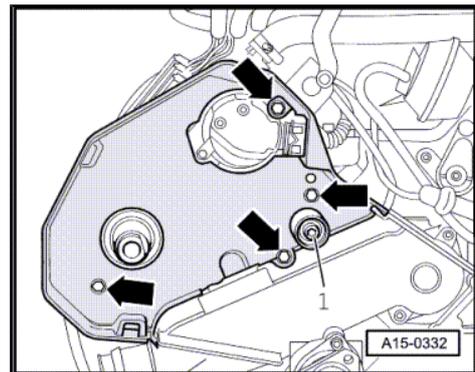
Note

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

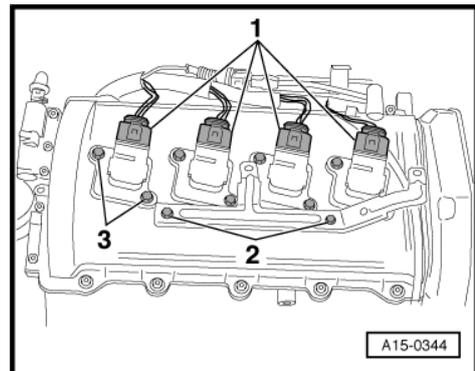
- Remove toothed belt cover.
- Unplug connector -1- from Hall sender.
- Unplug electrical connector -2-.
- Unplug electrical connector -3-.
- Take toothed belt off camshafts ⇒ [page 40](#) .



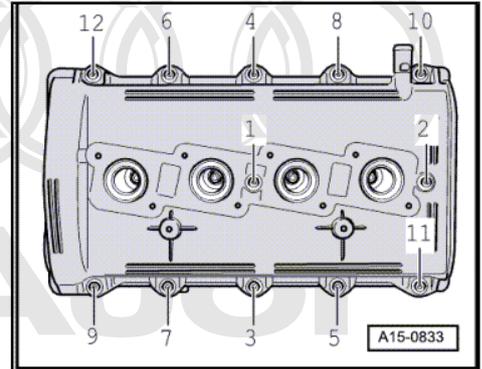
- Remove idler roller -1-.
- Remove toothed belt cover -arrows-.



- Unplug connectors -1- on ignition coils.
- Unscrew bracket -2-.
- Remove ignition coils -3-.
- Disconnect crankcase breather hose.

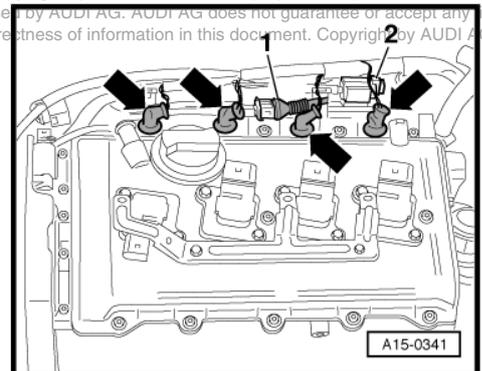


- Remove cylinder head cover bolts in the sequence -12 ... 1-.
- Remove cylinder head cover.

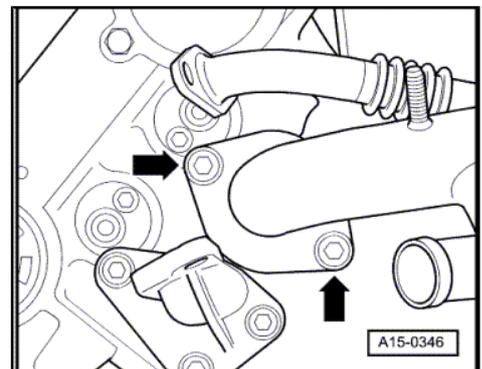


- Unplug connector -1- for knock sensor, cylinder bank 5-8.
- Unplug connectors -arrows- for injectors, cylinder bank 5-8 and move wiring harness clear.
- Unplug connector for knock sensor, cylinder bank 1-4.
- Unplug connectors from injectors, cylinder bank 1-4.

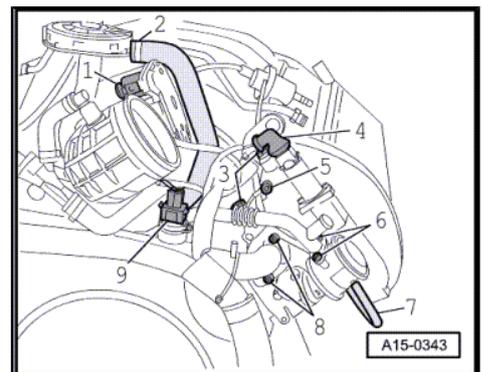
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- Detach coolant pipe -arrows-.



- 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 intake manifold.

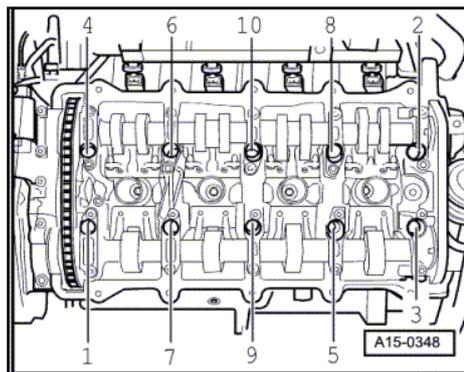




- Slacken cylinder head bolts in the correct sequence.
- Remove cylinder head and place on a suitable soft surface.

Installing

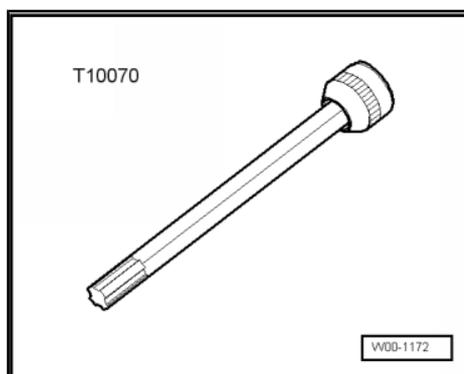
- Install cylinder head ⇒ [page 80](#) .



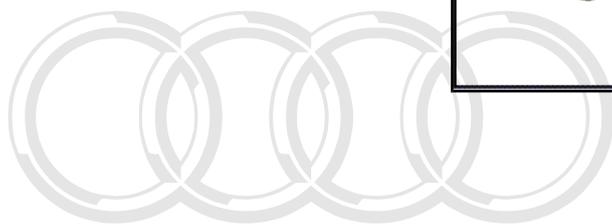
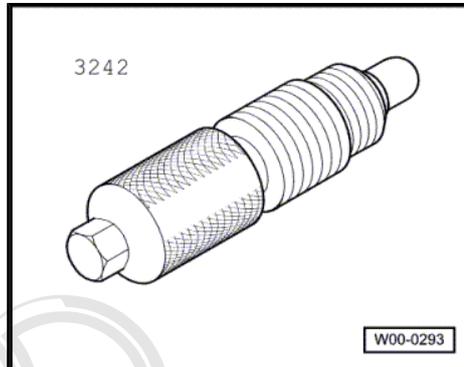
1.5 Installing cylinder head

Special tools and workshop equipment required

- ◆ Special wrench (Polydrive) -T10070-



- ◆ Locking pin -3242-



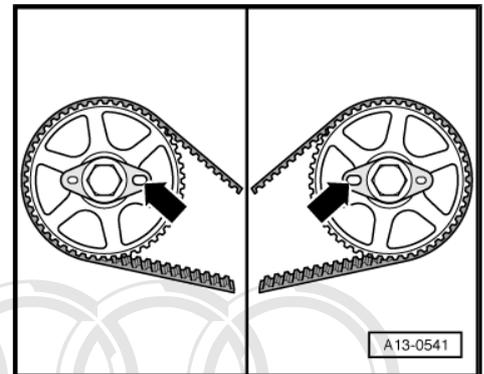
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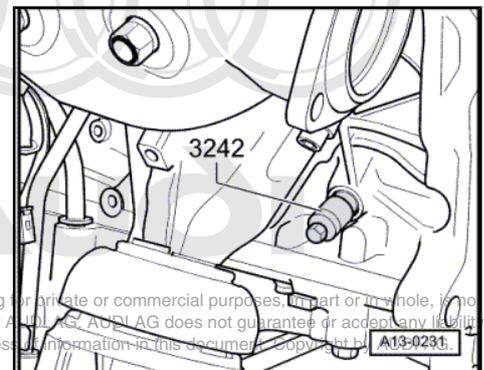
Installing

Note

- ◆ *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.*
 - ◆ *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.*
 - ◆ *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.*
 - ◆ *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.*
- Before fitting cylinder head, set crankshaft and camshafts to TDC for cylinder 5:



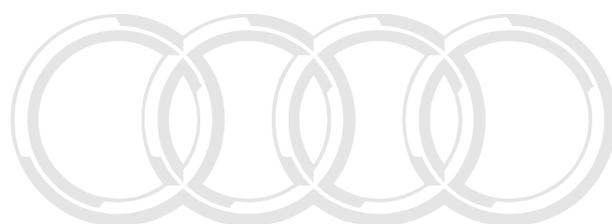
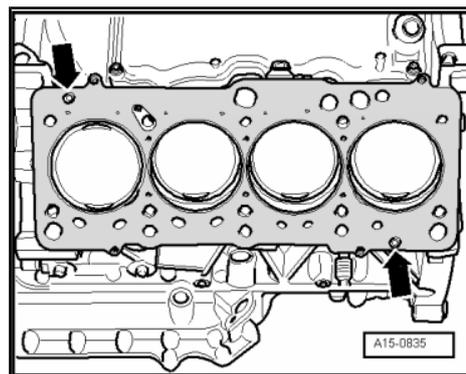
- ◆ The large holes -arrows- in the locating plates on the camshaft sprockets must be opposite one another on the inside.
- ◆ The locking pin -3242- must be screwed in.



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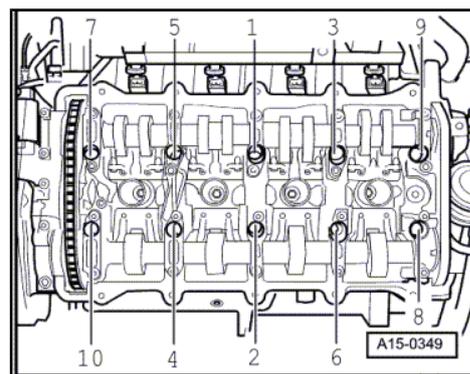
- Place cylinder head gasket in position.
- ◆ Pay attention to dowel sleeves -arrows- in cylinder block.
- ◆ Check installation position of cylinder head gasket: the word "oben" (top) or the Part No. should face towards the cylinder head.
- Fit cylinder head.
- Insert new cylinder head bolts and tighten finger-tight.



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- Tighten cylinder head bolts in four stages in sequence shown as follows:
- Tighten using torque wrench:
 - ◆ 1st stage: 35 Nm
 - ◆ 2nd stage: 60 Nm
- Tighten using rigid spanner:
 - ◆ 3rd stage: 90° (1/4 turn) further
 - ◆ 4th stage: 90° (1/4 turn) further



i 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 67](#) and (right-side) ⇒ [page 68](#) .
- Install intake manifold ⇒ Rep. Gr. 24 .
- Fit toothed belt onto camshafts ⇒ [page 43](#) .
- Install front exhaust pipe together with catalytic converter.
- Align the exhaust system so it is free of stress ⇒ [page 161](#) .

i Note

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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.

- Fill cooling system with fresh coolant ⇒ [page 139](#) .

Tightening torques

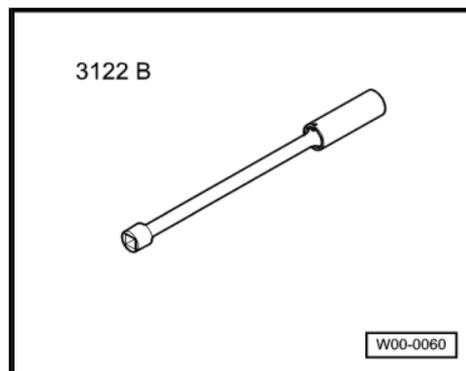
Component	Nm
Guide tube for dipstick to cylinder head	10
Toothed belt cover to cylinder head	10
Front coolant pipe to cylinder head	10
Cylinder head cover to cylinder head	10
Intake manifold to cylinder head	10
Combination valve to cylinder head	8
Locating pin for intake manifold	7
Locating screw for intake manifold gasket	0.6
Front exhaust pipe and catalytic converter to retainer bracket	25
Front exhaust pipe with catalytic converter to exhaust manifold	25
Clamp for exhaust pipe	40



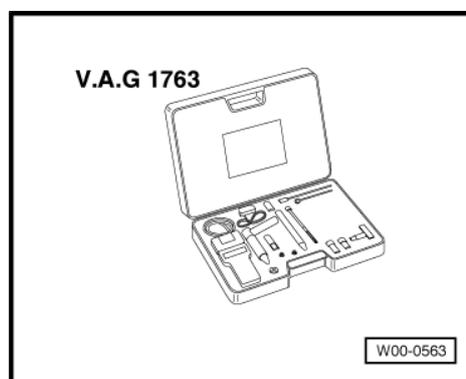
2 Checking compression

Special tools and workshop equipment required

- ◆ Spark plug socket and extension -3122 B-



- ◆ Compression tester -V.A.G 1763-

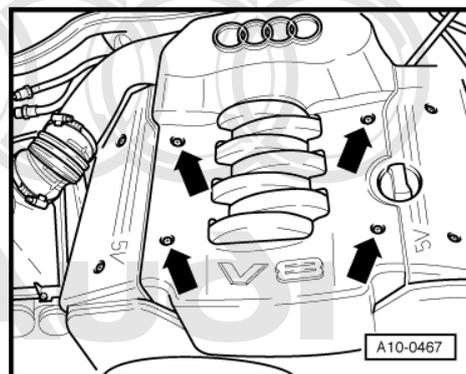


Test conditions

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

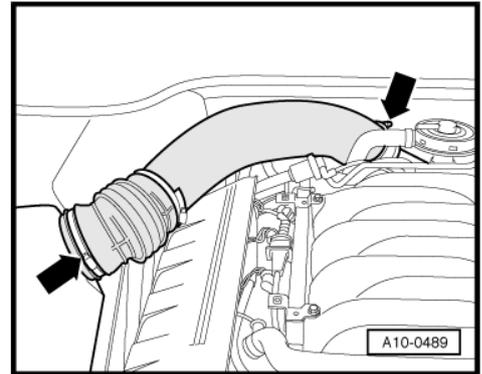
Test sequence

- Detach engine cover panel -arrows-.

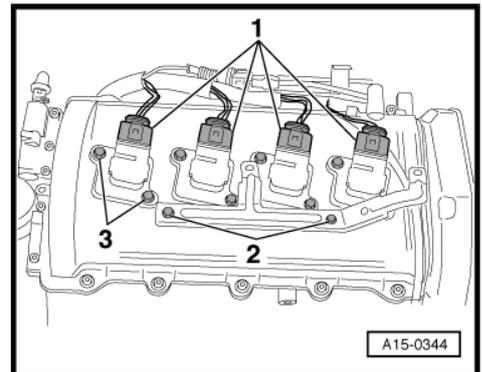


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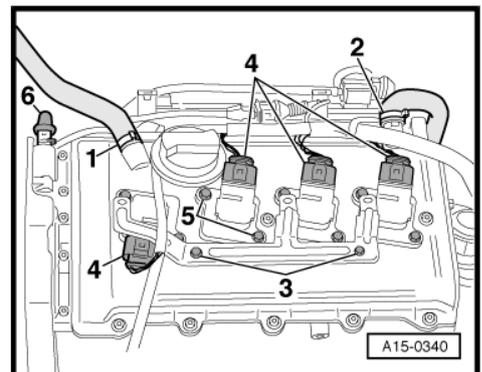
- Remove air intake pipe -arrows- between air cleaner and throttle valve unit.



- Unplug connectors -1- on ignition coils.
- Unscrew bracket -2-.
- Remove ignition coils -3-.



- Unscrew bracket -3-.
- Unplug connectors -4- on ignition coils.
- Remove ignition coils -5-.



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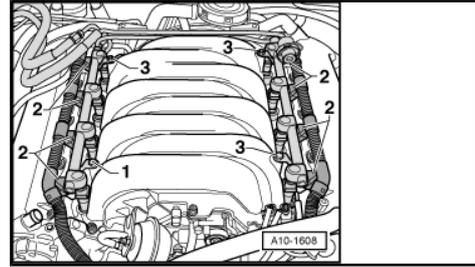
- Unplug electrical connectors from injectors -2-.
- Remove spark plugs with spark plug socket -3122 B- .
- Open throttle valve fully.
- Check compression pressure with compression tester - V.A.G 1763- .

**Note**

Using the compression tester ⇒ operating instructions .

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- 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.*
- ◆ *Always fit new seals and gaskets.*

1 - Double bearing cap

- Before fitting, apply small amount of sealant to sealing surface of bearing cap
 ⇒ [page 90](#)
- Sealant ⇒ Parts catalogue

2 - 5 Nm + 90° (1/4 turn) further

- Renew

3 - Hydraulic tappet

- Removing and installing
 ⇒ [page 108](#)
- Do not interchange
- Lubricate contact surface

4 - Exhaust camshaft

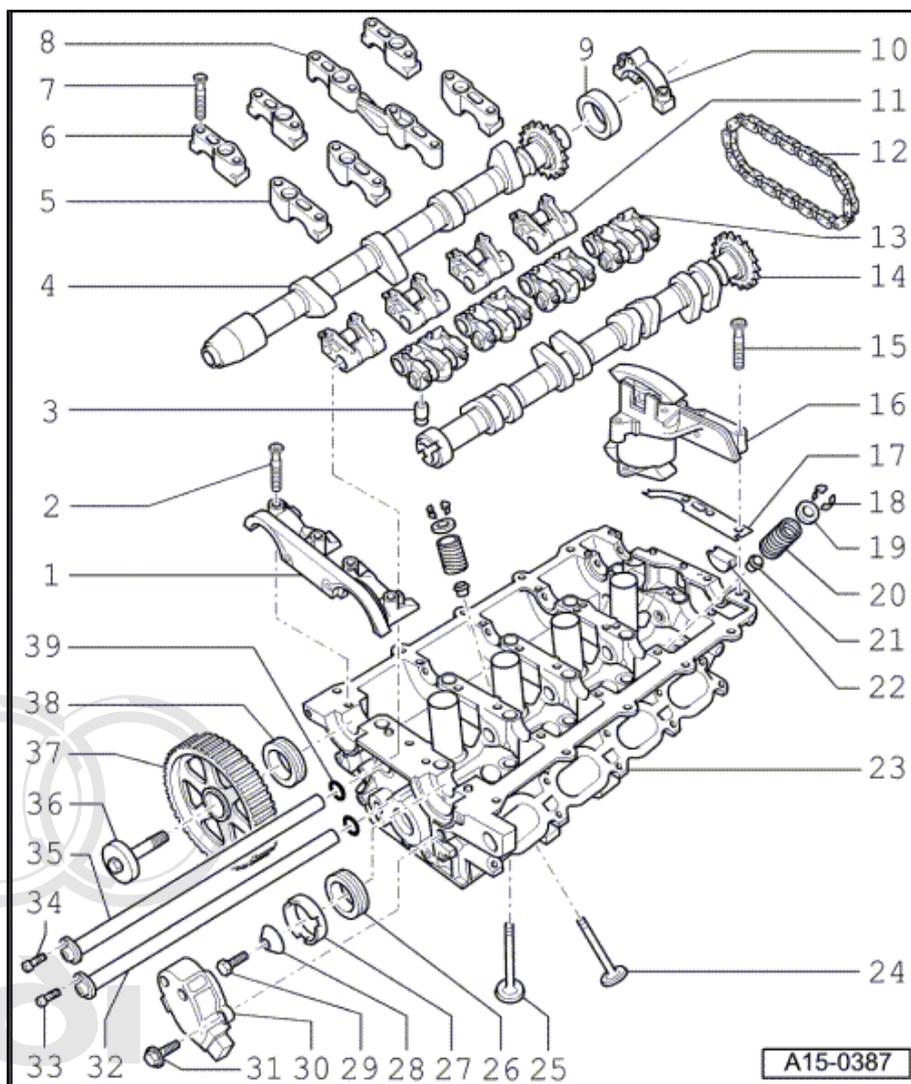
- Checking axial clearance ⇒ [page 90](#)
- Removing and installing
 ⇒ [page 101](#)
- Check radial clearance with Plastigage (roller rocker fingers removed): wear limit: 0.1 mm; run-out: 0.01 mm (maximum)

5 - Bearing cap on inlet camshaft

- Note installation position and allocation
 ⇒ [page 99](#)
- Watch position of dowel sleeve

6 - Bearing cap on exhaust camshaft

- Note installation position and allocation ⇒ [page 99](#)
- Watch position of dowel sleeve



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7 - 5 Nm + 90° (1/4 turn) further

- Renew

8 - Double bearing cap

9 - Sealing cap

- Renew
- Detach bearing cap to remove
- With bearing cap in position, drive in carefully with fitting sleeves -3202-

10 - Bearing cap

- Prior to installation, apply thin coat of sealant to bearing cap next to chain ⇒ [page 90](#)
- Sealant ⇒ Parts catalogue

11 - Roller rocker finger for exhaust camshaft

12 - Drive chain

- Installing ⇒ [page 99](#)

13 - Roller rocker finger for inlet camshaft

14 - Inlet camshaft

- Checking axial clearance ⇒ [page 90](#)
- Removing and installing ⇒ [page 101](#)
- 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 101](#)

17 - Rubber/metal gasket

18 - Valve cotters

19 - Valve spring plate

20 - Valve spring

21 - Valve stem oil seal

- Renewing ⇒ [page 108](#)

22 - Seal

- Renew

23 - Cylinder head

- See note ⇒ [page 87](#)
- Checking valve guides, grinding-in valve seats ⇒ [page 110](#)
- Machining valve seats ⇒ [page 111](#)

24 - Exhaust valve

- Do not machine, only grinding-in is permitted
- Valve dimensions ⇒ [page 89](#)
- Checking valve guides, grinding-in valve seats ⇒ [page 110](#)

25 - Inlet valve

- Do not machine, only grinding-in is permitted
- Valve dimensions ⇒ [page 89](#)
- Checking valve guides, grinding-in valve seats ⇒ [page 110](#)

26 - Oil seal

- For Hall sender
- Renewing => [page 93](#)

27 - Rotor for Hall sender

- Note fitting position (notch on camshaft)

28 - Washer

- Conical

29 - Bolt, 23 Nm

30 - Hall sender

31 - 10 Nm

32 - Shaft for rocker fingers, inlet side

33 - Bolt, 9 Nm

34 - Bolt, 9 Nm

35 - Shaft for roller rocker fingers, outlet side

36 - Bolt, 55 Nm

37 - Camshaft sprocket

38 - Oil seal

- For camshaft
- Renewing => [page 91](#)

39 - O-ring

- For shaft of roller rocker finger

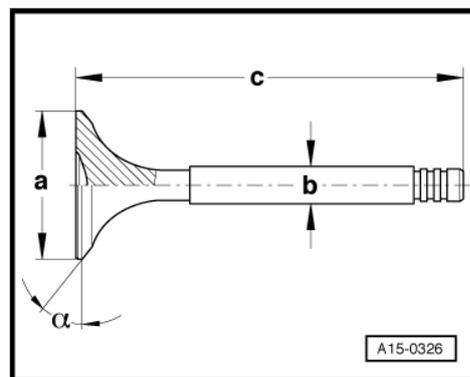
Valve dimensions



Note

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

Dimension	Inlet valve	Exhaust valve
-a- = \varnothing mm	26.8...27.0	29.8...30.0
-b- = \varnothing mm	5.96...5.97	5.94...5.95
-c- = mm	104.84...105.34	103.64...104.14
$-\alpha = \angle^\circ$	45	45



WARNING

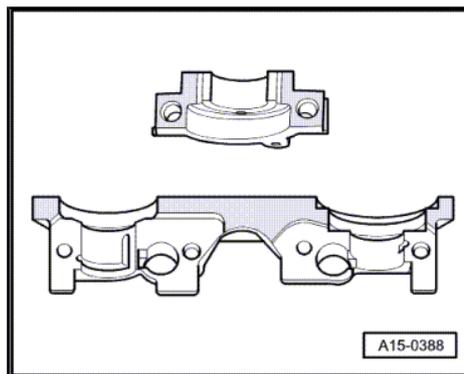
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- ◆ **Care must be taken when disposing of old sodium-cooled exhaust valves.**
- ◆ **The valves must be sawn in two with a metal saw between the centre of the stem and valve head. When doing so, the valves must not come into contact with water. After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

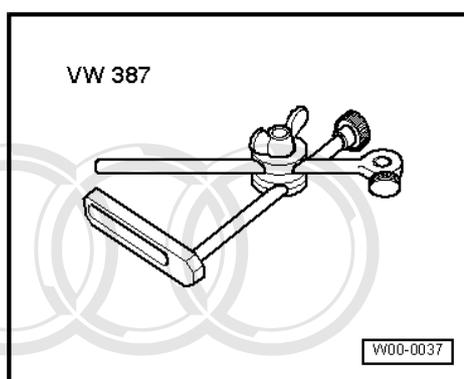
- Coat hatched areas on front and rear bearing caps for inlet camshaft with a small quantity of sealant and fit bearing caps (pay attention to dowel sleeves).
- ◆ Sealant ⇒ Parts catalogue



3.1 Checking axial clearance of camshafts

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-

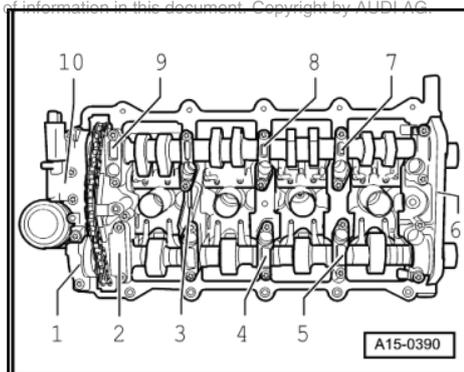


- ◆ Dial gauge

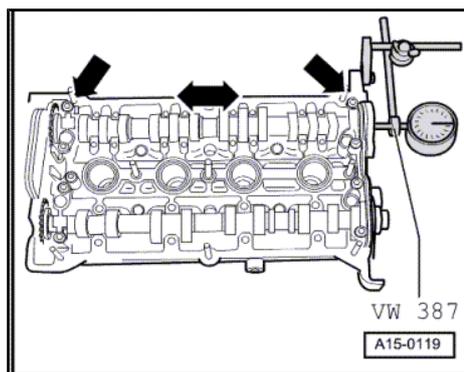
Test sequence

- Remove camshaft ⇒ [page 101](#) .
- Remove rocker fingers.
- Fit camshafts in cylinder head without drive chain and secure with bearing caps 3, 5 and 7.
- Attach dial gauge with universal dial gauge bracket -VW 387- to cylinder head:

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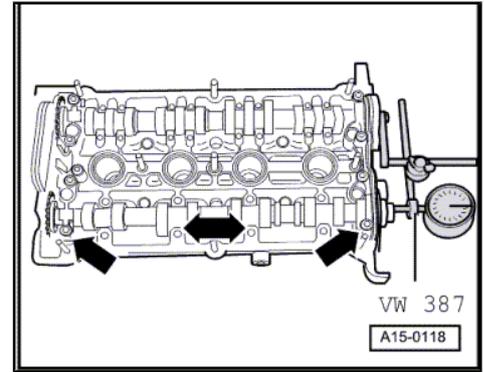
Inlet camshaft



Exhaust camshaft

Wear limit for inlet and exhaust camshaft.

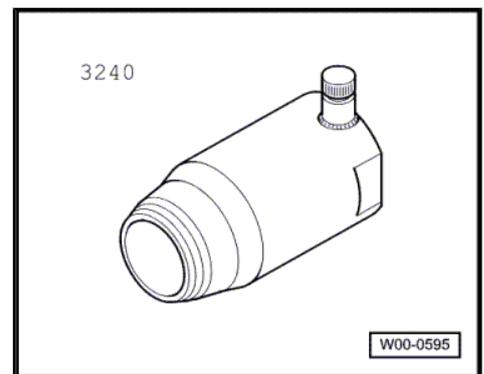
- ◆ Axial clearance: max. 0.20 mm



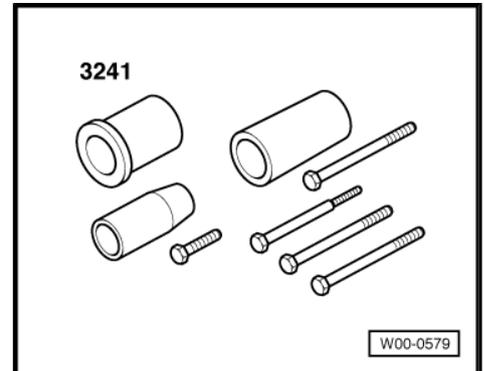
3.2 Renewing camshaft oil seals

Special tools and workshop equipment required

- ◆ Oil seal extractor -3240-



- ◆ Fitting sleeves -3241-



Removing



It is advisable to renew both oil seals if the oil seal on one side is leaking.

- Take toothed belt off camshaft sprockets ⇒ [page 40](#) .
 - Position inner section of oil seal extractor -3240- 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):

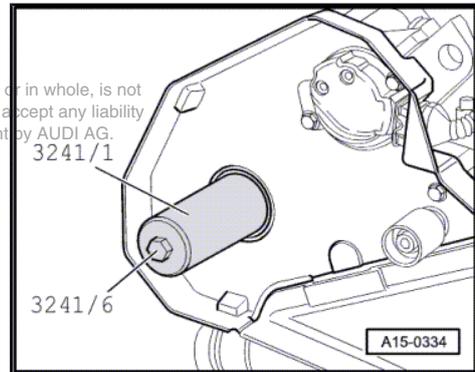
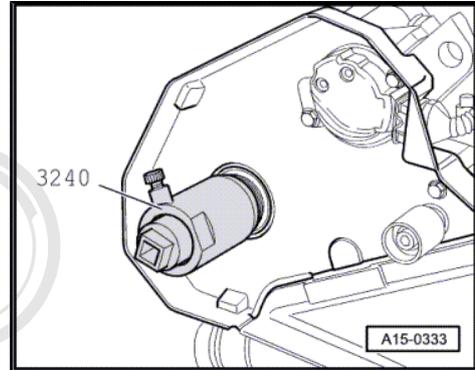
- Unscrew inner section of oil seal extractor 7 turns and lock with knurled screw.

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

- Do not apply oil to sealing lip or outer circumference of seal.
- Fit guide sleeve -3241/2- from fitting sleeve -3241/1- onto camshaft.
- Press seal flush into cylinder head with guide sleeve -3241/1- and bolt -3241/6- .
- Fit toothed belt [⇒ page 40](#)

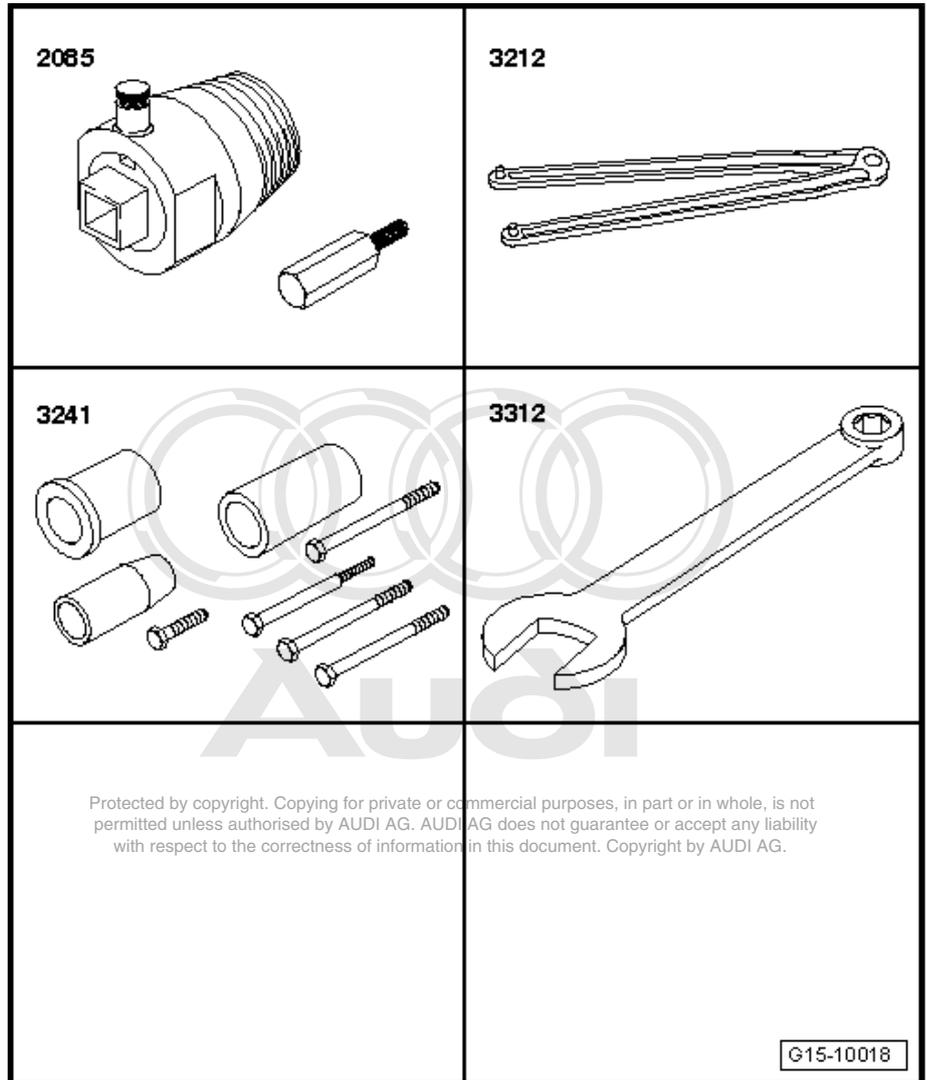


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3.3 Renewing oil seal at Hall sender

Special tools and workshop equipment required

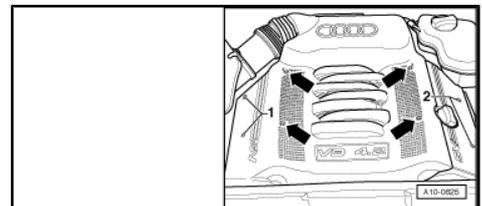
- ◆ Oil seal extractor -2085-
- ◆ Pin wrench -3212-
- ◆ Fitting sleeves -3241-
- ◆ Open-end spanner -3312-



Removing

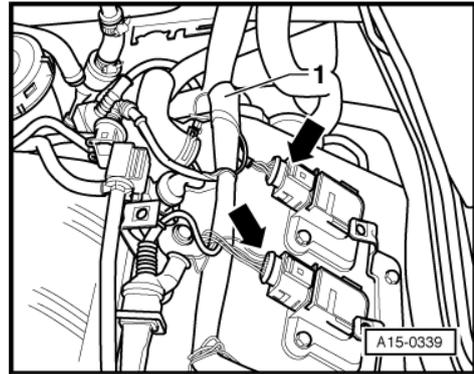
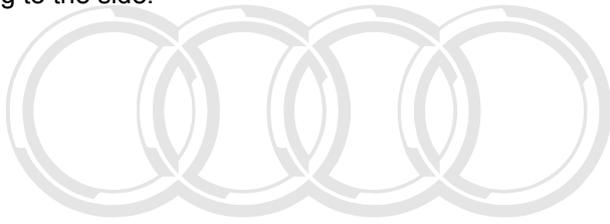
- Detach engine cover panel -arrows-.

Cylinder head (left-side):

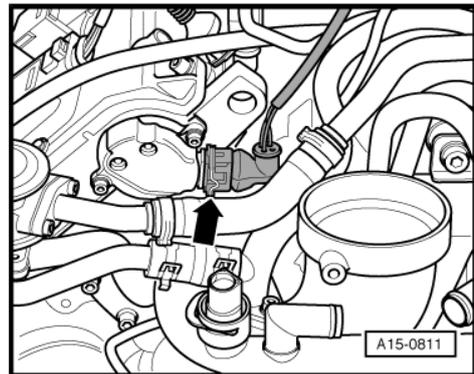




- Unplug connectors from ignition coils -arrows- and move wiring to the side.

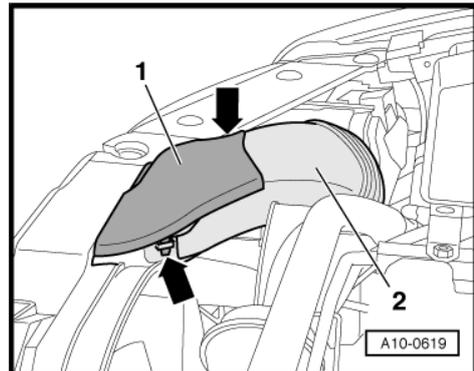


- Unplug electrical connector -arrow- at Hall sender 2 -G163- .
- **Unbolt Hall sender housing.**
- **Unscrew bolt securing Hall sender rotor and carefully lever off rotor with a screwdriver.**



Cylinder head (right-side):

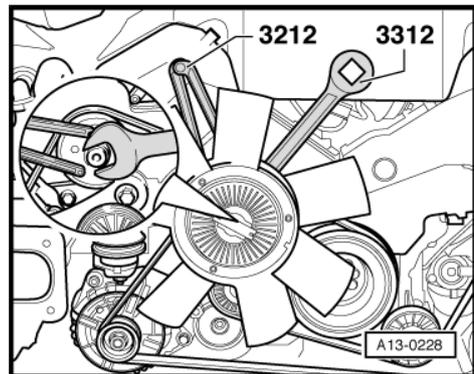
- Unclip cover -1-.
- Remove intake hose -2- for air cleaner.
- Remove bumper => Rep. Gr. 63 .
- Move lock carrier to service position => Rep. Gr. 50 .



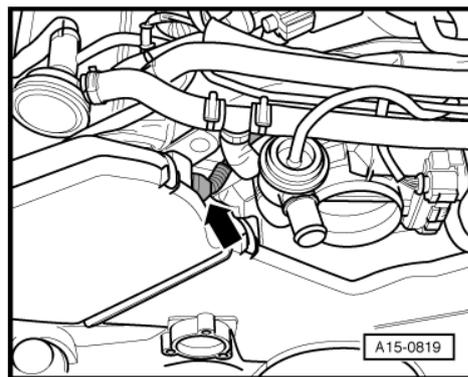
Note

The viscous fan has a left-hand thread.

- Hold viscous fan pulley with pin wrench -3212- and unscrew viscous fan using open-end spanner -3312- (left-hand thread).
- Remove toothed belt cover (right-side).



- Unplug electrical connector -arrow- at Hall sender -G40- .

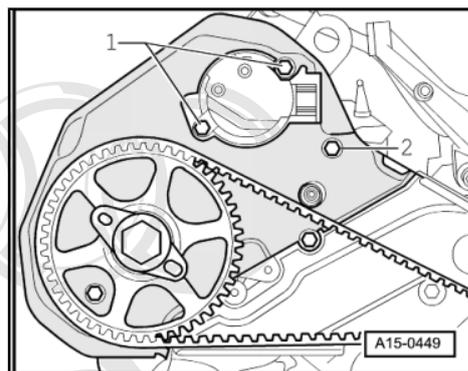


- Remove bolts -1-.
- Loosen bolt -2-.
- Pull toothed belt cover towards the front and remove Hall sender housing.

Continuation for both sides:

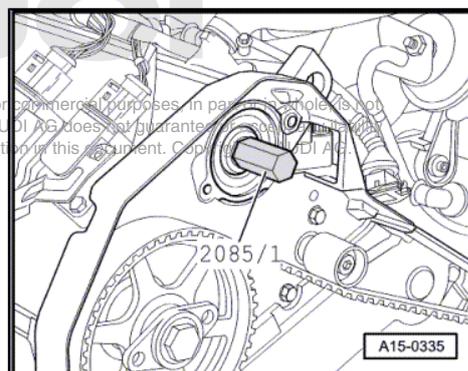
 **Note**

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



- Screw in bolt -2085/1- from oil seal extractor -2085- .

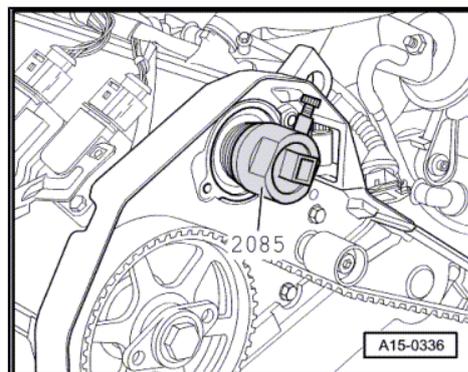
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- Pull out seal with oil seal extractor -2085- and bolt -2085/1- .

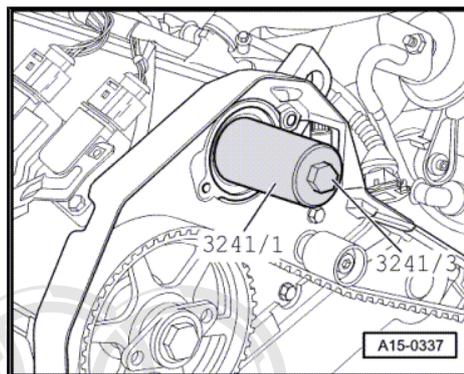
Installing

- Clean contact surface and sealing surface.
- Do not lubricate sealing lip and outer circumference of oil seal before pressing in.
- Fit guide sleeve from fitting sleeves -3241- onto camshaft.





- Press in oil seal until flush using fitting sleeve -3241/1- and bolt -3241/3- .
- Install Hall sender rotor.
- Install Hall sender housing.
- Attach connector for Hall sender.



Cylinder head (right-side):

- Install lock carrier ⇒ Rep. Gr. 50 .
- Fit bumper ⇒ Rep. Gr. 63 .

Tightening torques

Component	Nm
Hall sender housing	10
Rotor for Hall sender	23

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

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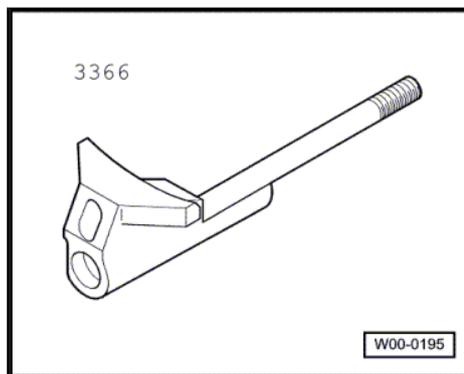


Note

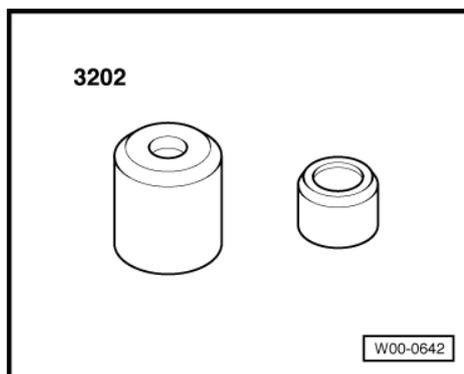
There is a basic difference in the procedures for installing the camshaft drive chains on the left and right side cylinder heads. It is important to keep to the correct procedure.

Special tools and workshop equipment required

- ◆ Chain tensioner retainer -3366-



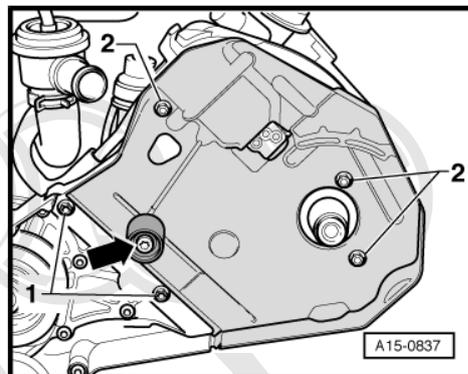
- ◆ Fitting sleeves -3202-



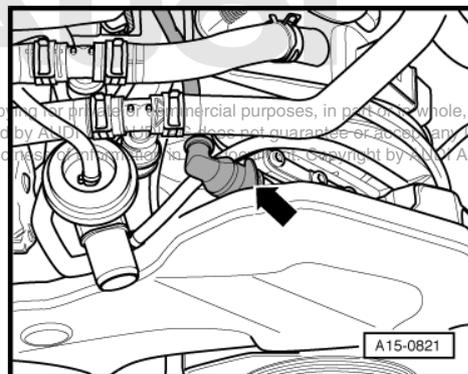
- ◆ Sealant ⇒ Parts catalogue

Removing

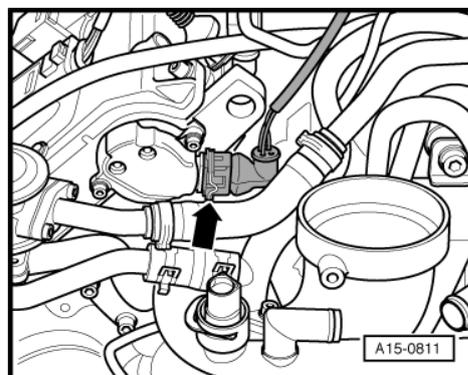
- Engine in vehicle.
- Take toothed belt off camshaft sprockets ⇒ [page 40](#) .
- Detach camshaft sprocket.
- Slacken nuts -1-.
- If fitted, remove idler roller -arrow-.
- Unscrew bolts -2- and remove toothed belt cover.



- Unplug electrical connector -arrow- at inlet camshaft control valve 2 -N208- .
- Remove cylinder head cover (left-side) ⇒ [page 67](#) .



- 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.



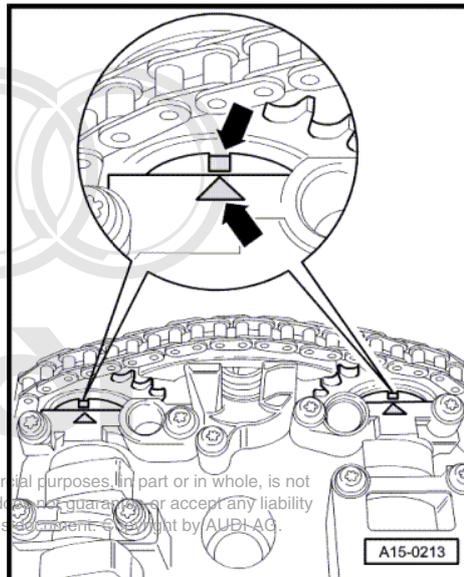
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- Check TDC position of camshafts again:
- ◆ The two marks on the camshafts must be opposite the two arrows on the bearing caps.

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.



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

 **Note**

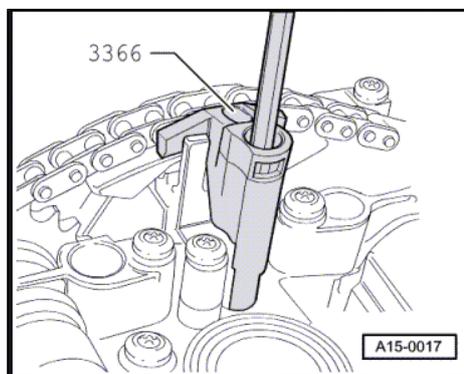
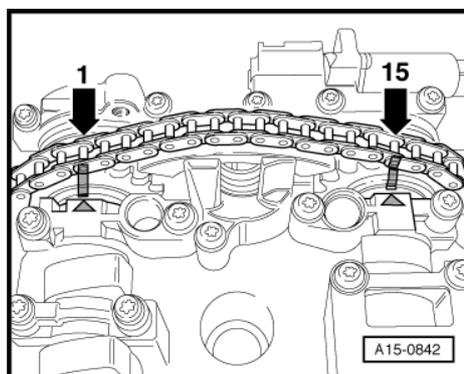
Do not mark chain with a centre punch or by making a notch or similar.

Continued:

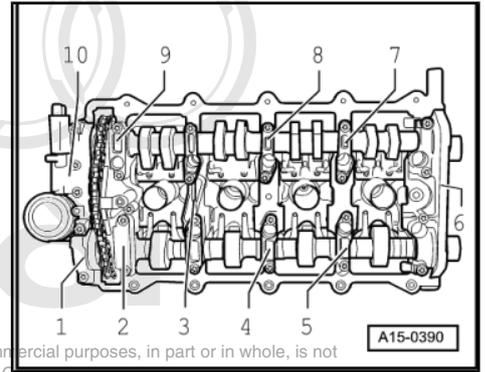
- Hold camshaft adjuster in position with chain tensioner retainer -3366- .

 **Note**

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



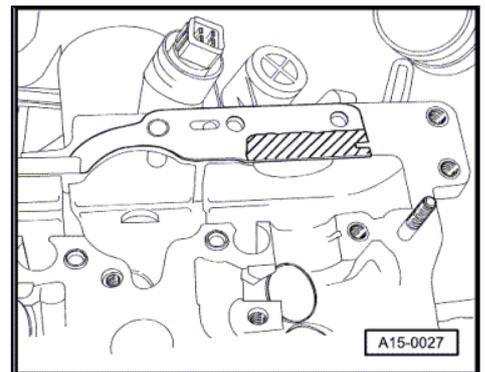
- Mark the sequence and installation positions of all bearing caps, as shown, regardless of any existing markings on the bearing caps.
- Clean the bearing caps and then use a waterproof felt-tip pen to apply markings.
- Unscrew bolts securing camshaft adjuster -10-.
- Unbolt bearing cap 1.
- Unbolt bearing 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

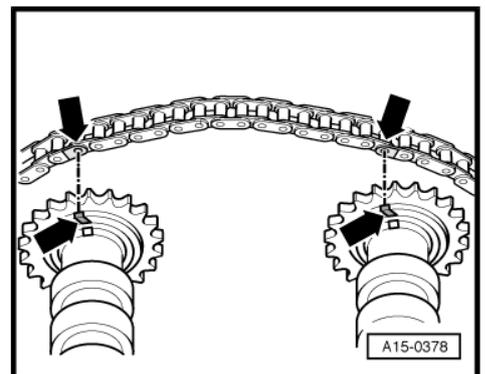
- Renew bolts for camshaft bearings and camshaft adjuster.
- Renew the semi-circular sealing plug.
- Remove all sealant residue from cylinder head and from bearing caps.
- Renew rubber/metal gasket for camshaft adjuster and apply a thin coat of sealant to the shaded area.
- ◆ Sealant ⇒ Parts catalogue
- 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:

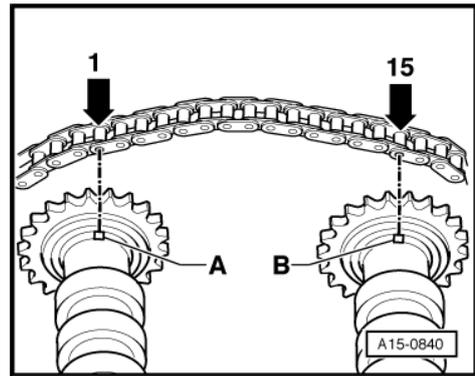
- Insert camshaft adjuster into the chain (2nd mechanic required).
- Insert camshafts with drive chain and camshaft adjuster into cylinder head.
- Oil running surfaces of both camshafts.



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:

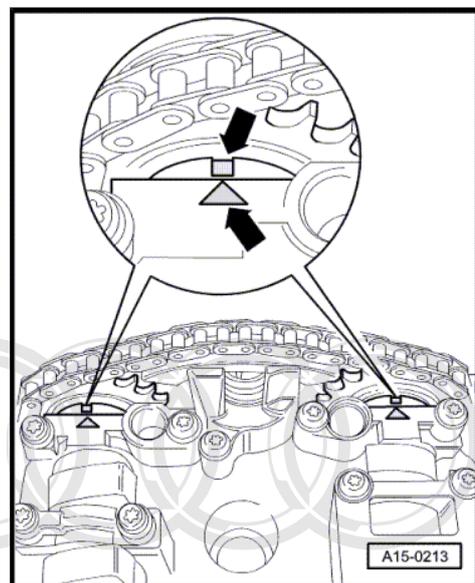
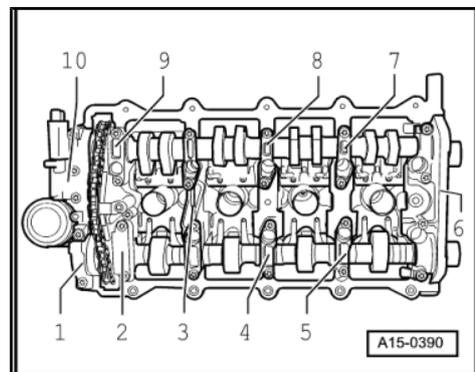


- ◆ The two markings on the camshafts must be in line with the two arrows on the bearing caps -arrows-.

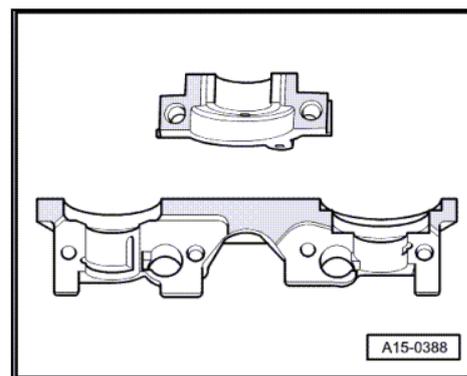


Note

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 camshafts; installing ⇒ [page 91](#) , renewing Hall sender oil seal ⇒ [page 93](#) .
- 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:

- Fit toothed belt ⇒ [page 43](#) .
- Install cylinder head cover ⇒ [page 68](#) .

 **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
(rear) to:	Coolant pump
Idler roller to cylinder head	10 3)
	10
	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)

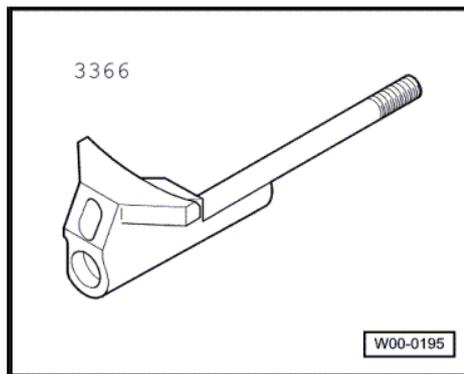
 **Note**

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.

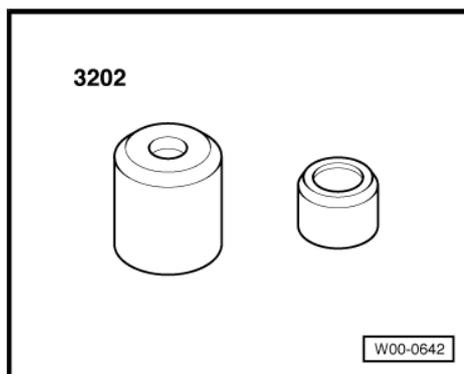
Special tools and workshop equipment required



◆ Chain tensioner retainer -3366-



◆ Fitting sleeves -3202-

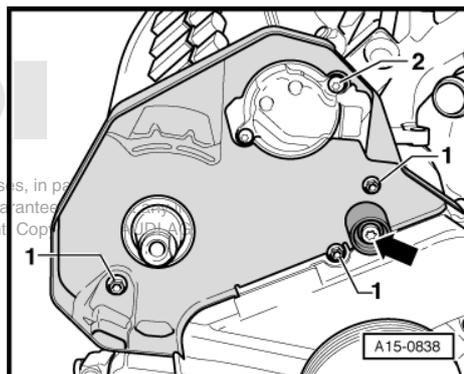


Sealant => Parts catalogue

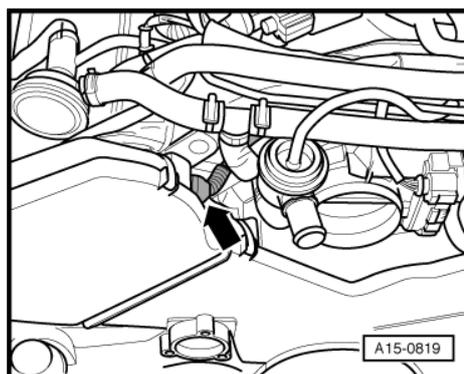
Removing

- Remove engine => [page 7](#) .
- Remove toothed belt => [page 31](#) .
- Detach camshaft sprocket.
- Unscrew idler roller -arrow-.
- Remove bolts -1- and -2- and take off toothed belt cover (rear).

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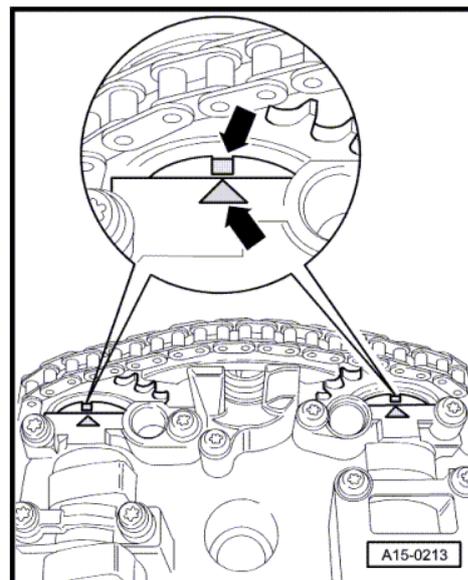
- Unplug electrical connector -arrow- at Hall sender -G40- .
- Remove housing for Hall sender.
- Remove washer and rotor for Hall sender.
- Unplug electrical connector from camshaft control valve.
- Remove cylinder head cover (right-side) => [page 68](#) .
- Turn the crankshaft approx. 45° anti-clockwise 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**

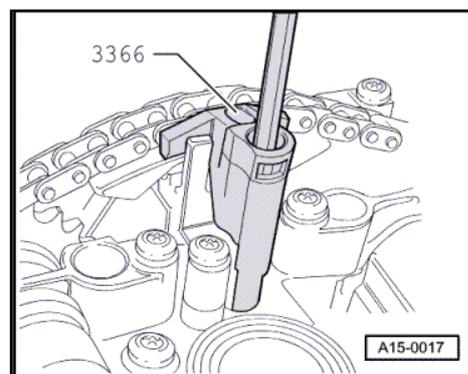
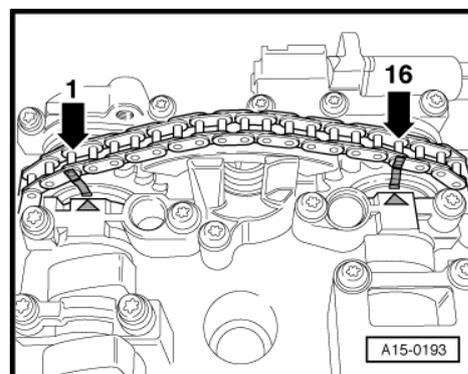
Do not mark chain with a centre punch or by making a notch or similar.

Continued:

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

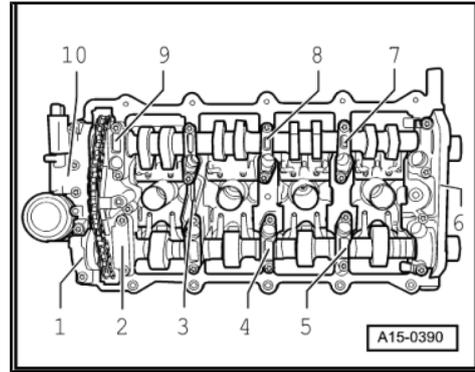
 **Note**

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.

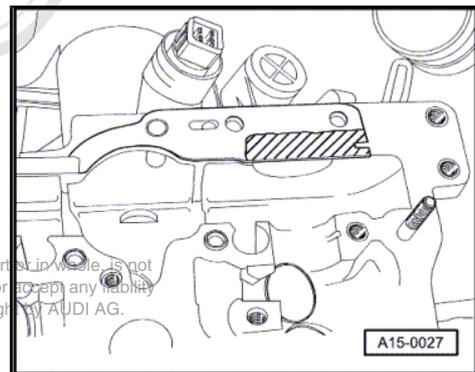


Installing

- 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:

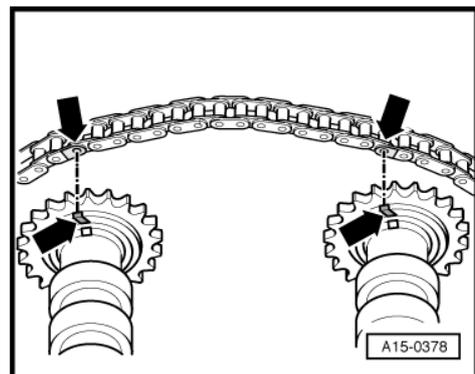
If old drive chain is being used:

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

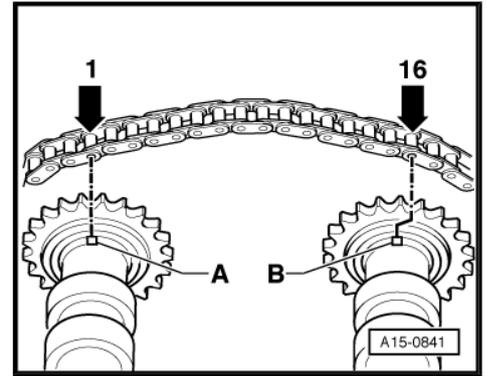
If new drive chain is being used:



- ◆ 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.

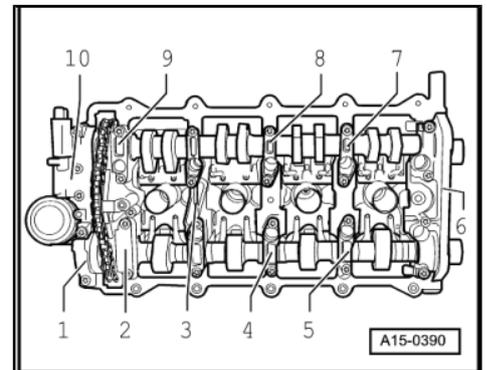


 **Note**

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

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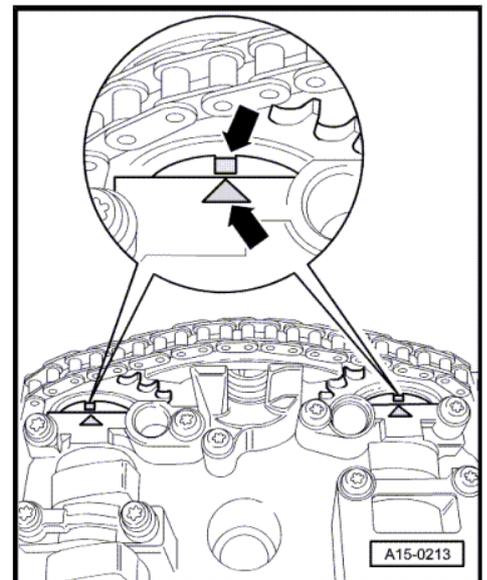
- Fit bearing caps 3, 5 and 7 as per marking.
- Tighten bearing caps 3, 5 and 7 on inlet and exhaust camshafts diagonally in alternating sequence.
- Secure camshaft adjuster -10-.
- Remove chain tensioner retainer -3366- .
- Check correct setting of camshafts:



- ◆ 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.



- 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:

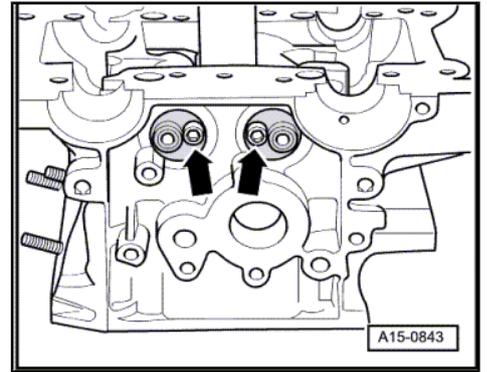
 **Note**

Renew O-rings.

- Oil bearing points of roller rocker fingers prior to installing.
- Install camshafts and camshaft adjuster on cylinder head (left-side) => [page 96](#) and/or on cylinder head (right-side) => [page 101](#).

Tightening torque

Component	Nm
Roller rocker finger shaft to cylinder head	10



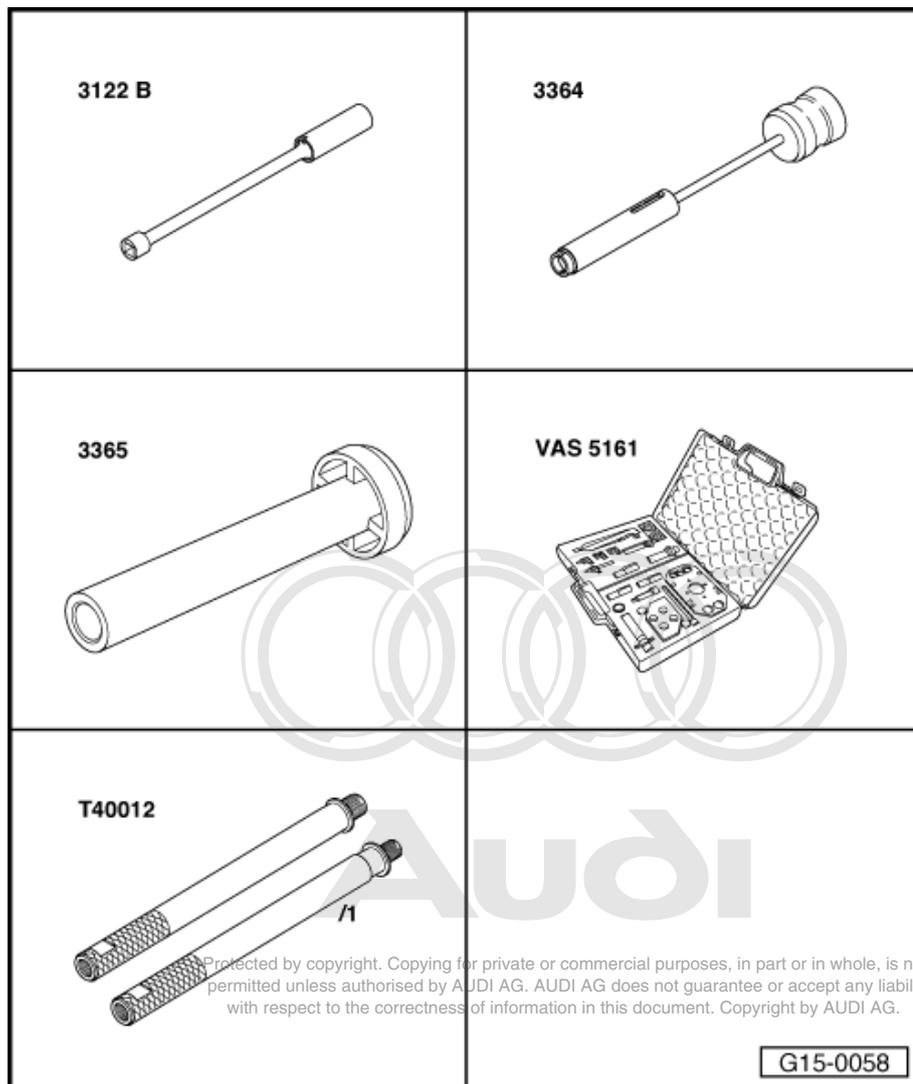
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3.7 Renewing valve stem oil seals

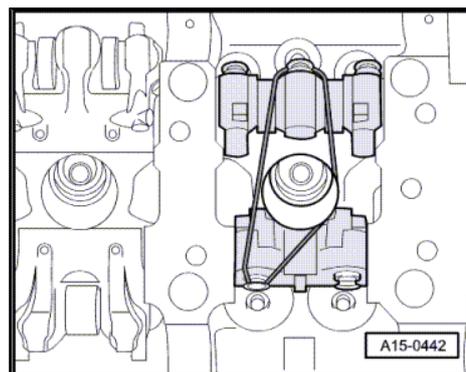
Special tools and workshop equipment required

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

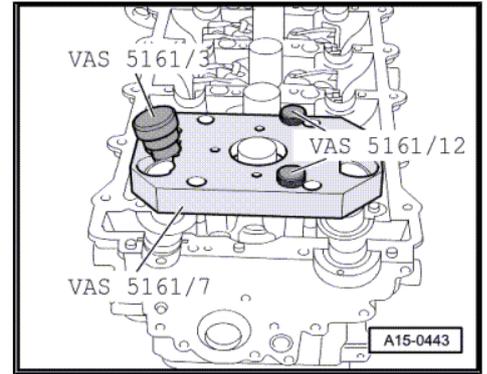


Removing

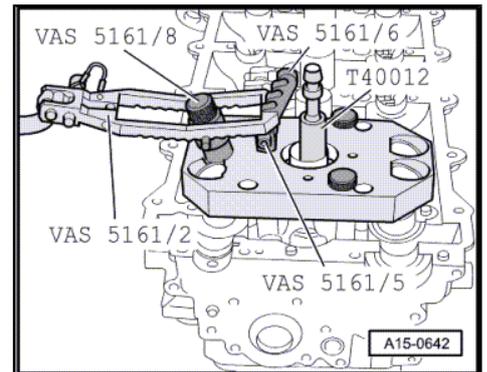
- Engine removed ⇒ [page 7](#) .
- Remove camshafts and camshaft adjuster for cylinder head (right-side) ⇒ [page 101](#) and/or cylinder head (left-side) ⇒ [page 96](#) , as required.
- Remove spark plugs with spark plug socket -3122 B- .
- Rotate roller rocker fingers upwards and secure them with a rubber band.



- Fit guide plate -VAS 5161/7- from removal / installing device for valve cotter -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 cotter loose using a plastic hammer.

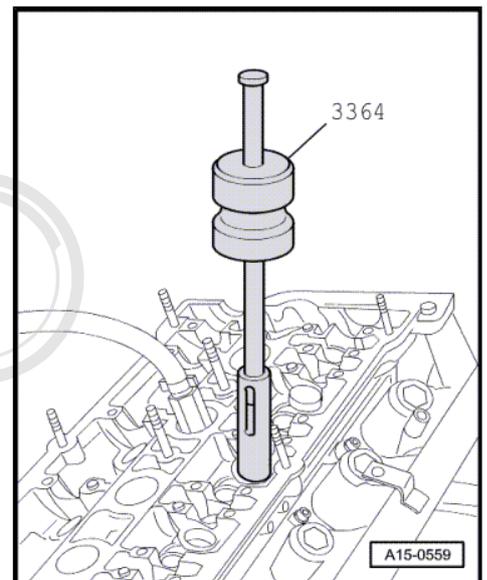


- Screw snap-in device -VAS 5161/6- with -VAS 5161/5- into guide plate -VAS 5161/7- .
- Insert assembly cartridge -VAS 5161/8- into guide plate -VAS 5161/7- .
- Screw adapter -T40012- with seal hand-tight into the corresponding spark plug thread and apply a steady pressure.



- ◆ 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 cotter.
- Move knurled screw back and forth slightly; the valve cotter 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- .

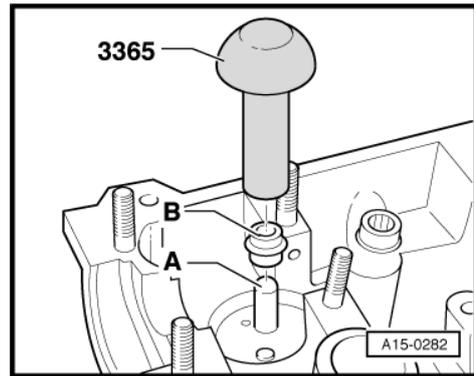
Installing



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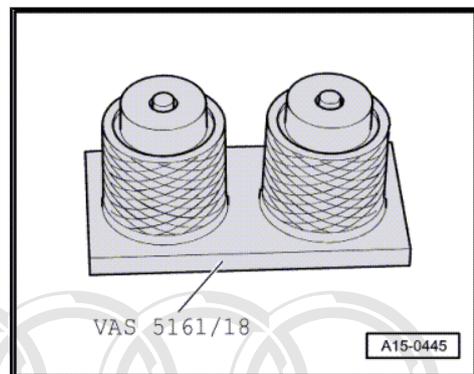
**Note**

- ◆ *To press on the valve stem seals from the current product range, the valve stem seal fitting tool -3365- must be drilled out to \varnothing 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.

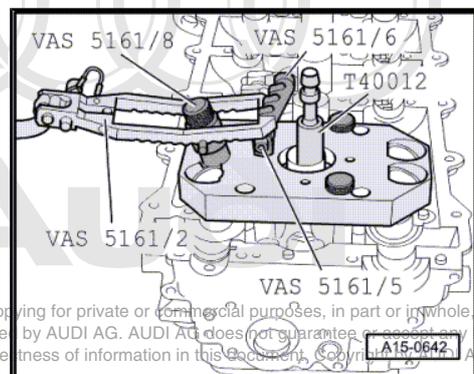
**Note**

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 96](#) and/or on cylinder head (right-side) ⇒ [page 101](#) .

**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.*

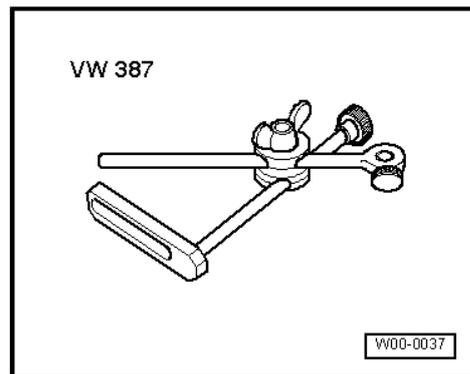


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3.8 Checking valve guides

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-



- ◆ Dial gauge

Test sequence

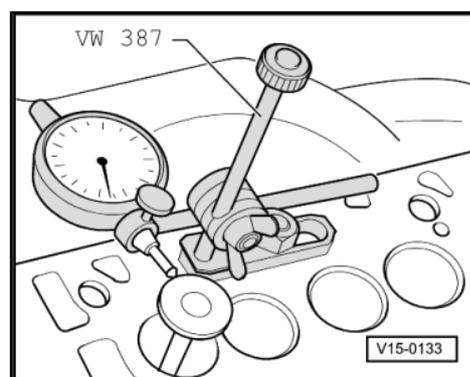
- Insert valve into guide. End of valve stem must be flush with guide. Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.
- Measure the amount of sideways play.

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

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**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 110](#).*
- ◆ *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.

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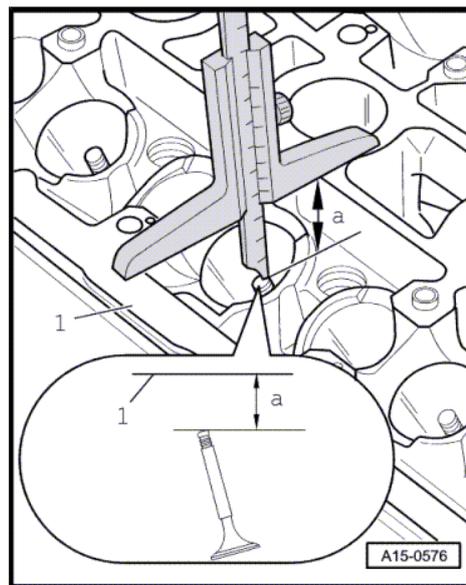
- **Measure distance *a* between end of valve stem and centre axis of camshaft (centre axis of camshaft is level with top edge of cylinder head).**
- Calculate maximum permissible machining dimension from measured distance and minimum dimension.

Minimum dimensions		
Inlet valves (outer)	Inlet valve (centre)	Exhaust valves
34.0 mm	33.7 mm	34.4 mm

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

Example for inlet valve (outer):

Measured distance	34.4 mm
- Minimum dimension	- 34.0 mm
= Maximum permissible machining dimension	= 0.4 mm

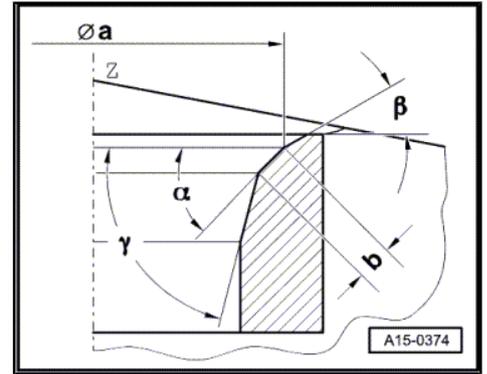
**Note**

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-	=	∅ 26.2 mm
-b-	=	1.5 ... 1.8 mm
-Z-	=	Bottom surface of cylinder head
-α-	=	45° valve seat angle
-β-	=	30° upper correction angle
-γ-	=	60° lower correction angle

Exhaust valve seat		
-a-	=	∅ 29.0 mm
-b-	=	approx. 1.8 mm
-Z-	=	Bottom surface of cylinder head
-α-	=	45° valve seat angle
-β-	=	30° upper correction angle
-γ-	=	60° lower correction angle



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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 402

Oil capacities: ⇒ Exhaust emissions test

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

1 - Sump (bottom section)

- Removing and installing ⇒ [page 116](#)
- 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 118](#)

4 - 34 Nm

5 - Chain sprocket

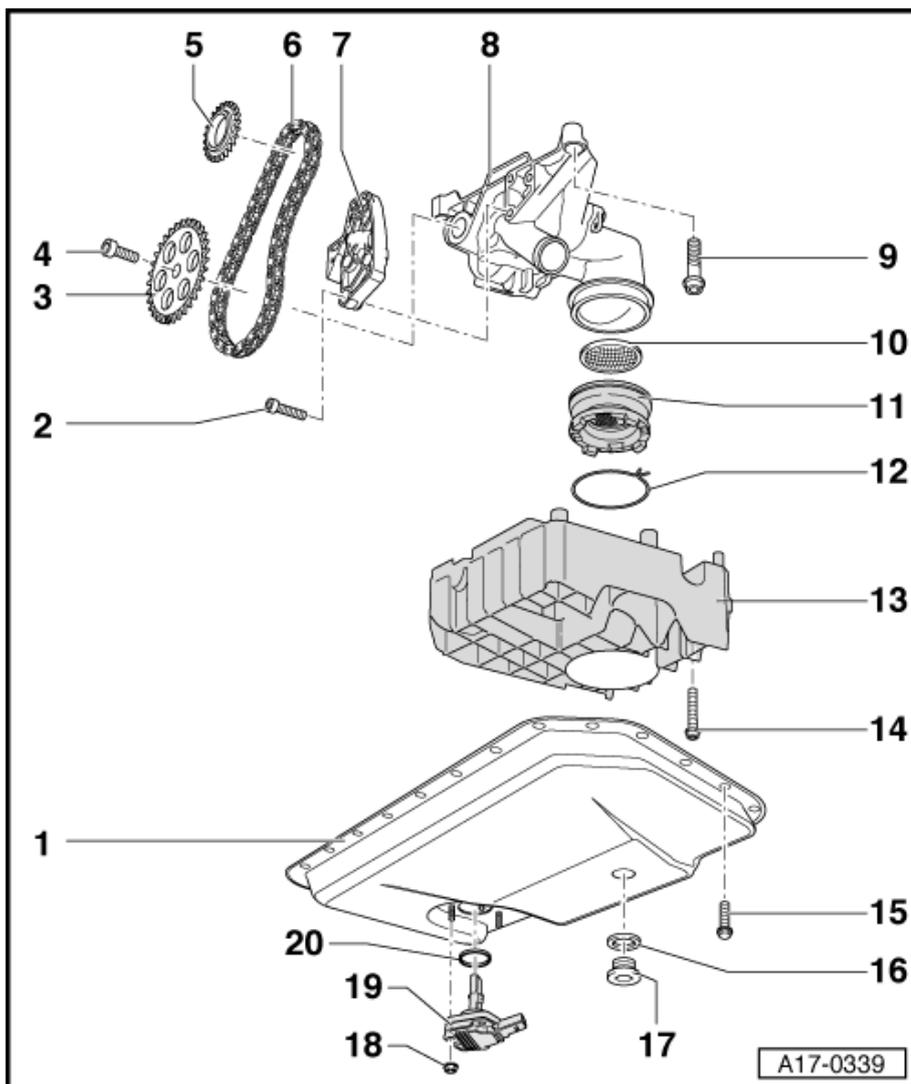
- For crankshaft
- Removing and installing ⇒ Removing and installing chain drive for oil pump ⇒ [page 118](#)

6 - Drive chain for oil pump

- Removing and installing ⇒ Removing and installing chain drive for oil pump ⇒ [page 118](#)

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 118](#)

8 - Oil pump

- Do not dismantle
- With pressure control valve: approx. 7 bar
- Removing and installing ⇒ [page 119](#)

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 - Bolt

- Initially tighten to 5 Nm.
- Tighten in diagonal sequence to 10 Nm.

16 - Seal

- Renew

17 - Oil drain plug, 50 Nm

18 - 10 Nm

19 - Oil level and oil temperature sender -G266-

- Removing and installing ⇒ [page 115](#)

20 - Seal

- Renew

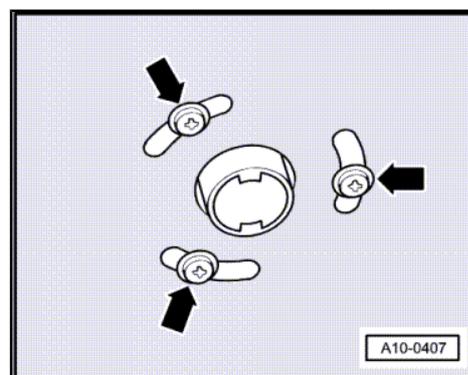
1.2 Removing and installing oil level and oil temperature sender -G266-

Removing

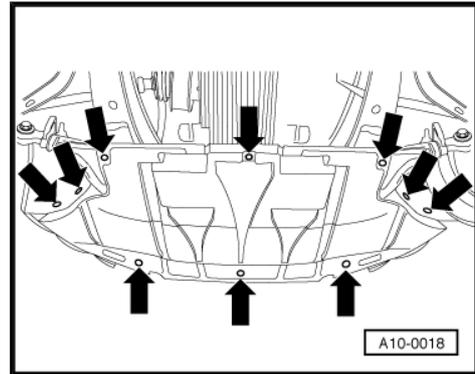
Vehicles with auxiliary heater / supplementary heater:

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

All models:



- Remove noise insulation -arrows-.
- 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-.

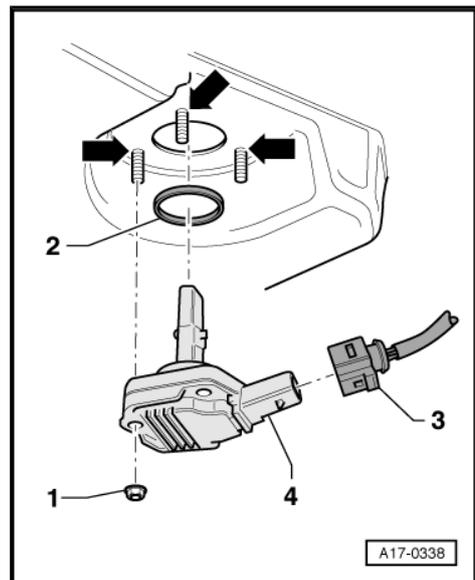
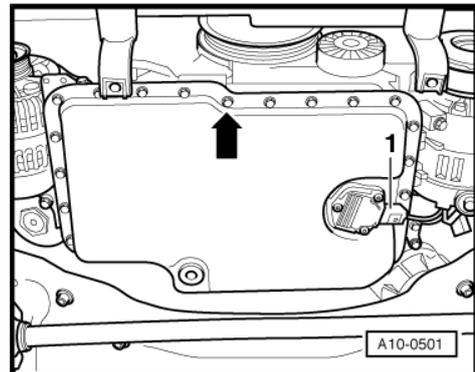
Installing



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

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1.3 Removing and installing sump (bottom section)

Special tools and workshop equipment required

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

Removing

Vehicles with auxiliary heater / supplementary heater:

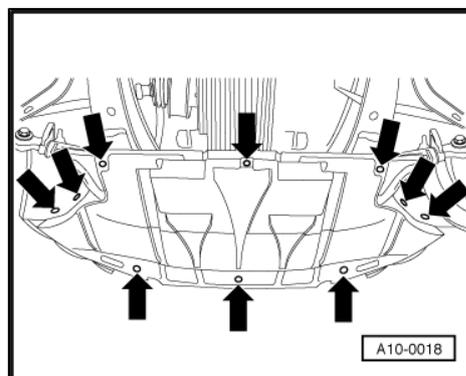
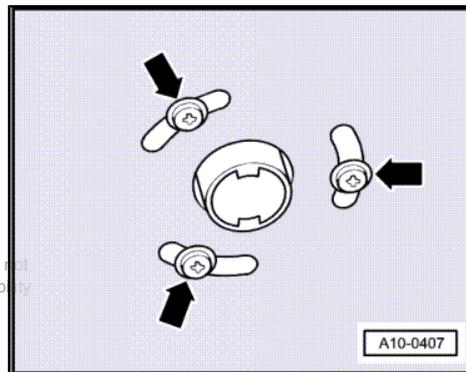
- Remove bolts -arrows- securing exhaust pipe for auxiliary/ supplementary heater to noise insulation.

All models:



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- Remove noise insulation -arrows-.
- Drain off engine oil.



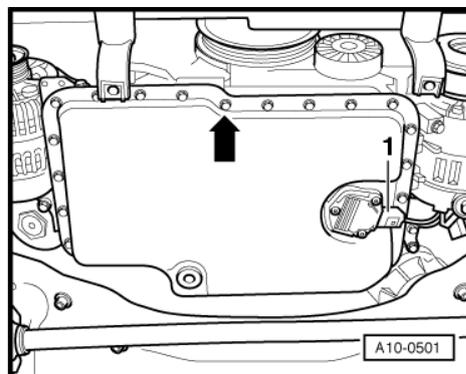
- Unplug electrical connector at oil level and oil temperature sender -G266- -1-.
- Remove sump (bottom section) -arrow-.

Installing

- Tightening torques => [page 114](#)

Perform installation in reverse order. Note the following points:

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



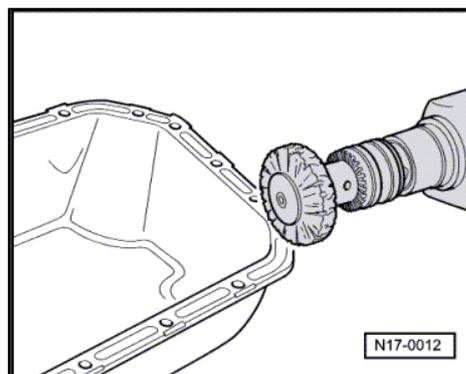


WARNING
Wear safety goggles.

- Remove remaining sealant from sump and engine block (with electric drill and plastic brush attachment or similar).

Note

The sump must be installed within 5 minutes after applying the silicone sealant.





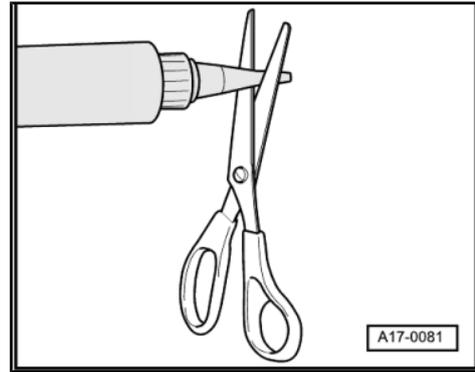
- Cut off nozzle of tube at front marking (\varnothing of nozzle approx. 3 mm).
- ◆ Thickness of sealant bead: 2...3 mm



Note

Sealant bead must not be wider than 3 mm, otherwise excess sealant could ingress into sump and clog strainer in oil intake pipe.

- Fit sump immediately and tighten (refer to ⇒ [page 114](#) for tightening torques).
- Fit new seal on oil drain plug and tighten.



Note

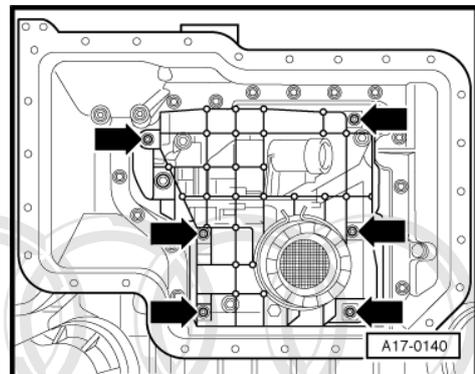
After fitting sump assembly, the sealant must dry for approx. 30 minutes. Then (and only then) fill the engine with engine oil.

- Fill up with engine oil.

1.4 Removing and installing chain drive for oil pump

Removing

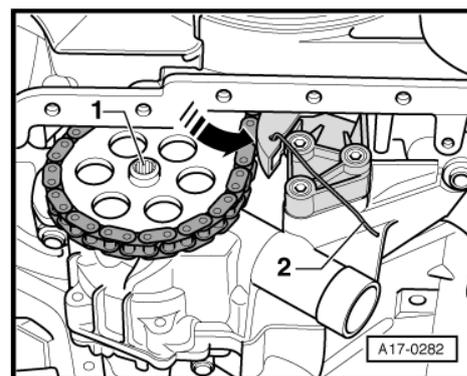
- Remove toothed belt ⇒ [page 31](#) .
- Remove sealing flange (front) ⇒ [page 48](#) .
- Unscrew baffle plate -arrows-.



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- 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 48](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 31](#) .

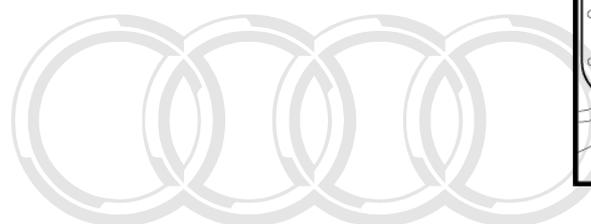
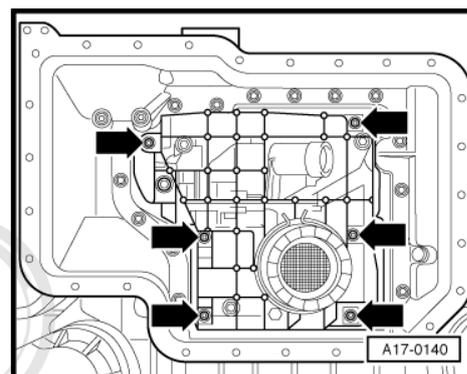
Tightening torques

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 116](#) .
- Unscrew baffle plate -arrows-.

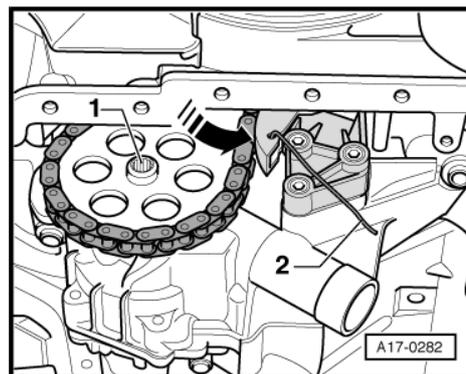


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- Secure oil pump chain tensioner with a suitably shaped piece of wire -2-.
- Unscrew bolt -1- and pull chain sprocket off oil pump.

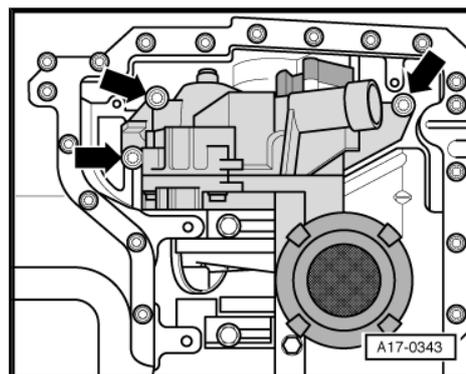


- Unscrew oil pump -arrows-.

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 116](#) .



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



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1.6 Sump (top section) - exploded view

1 - Sump (bottom section)

- Removing and installing
⇒ [page 116](#)
- With oil level and oil temperature sender - G266-
- Removing and installing oil level and oil temperature sender -G266-
⇒ [page 115](#)

2 - Baffle plate

3 - 14 Nm

- Note correct sequence when tightening
⇒ [page 122](#)

4 - Sump (top section)

- Removing and installing
⇒ [page 122](#)

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

15 - 65 Nm

16 - Intake connecting pipe

17 - Retaining ring

18 - 10 Nm

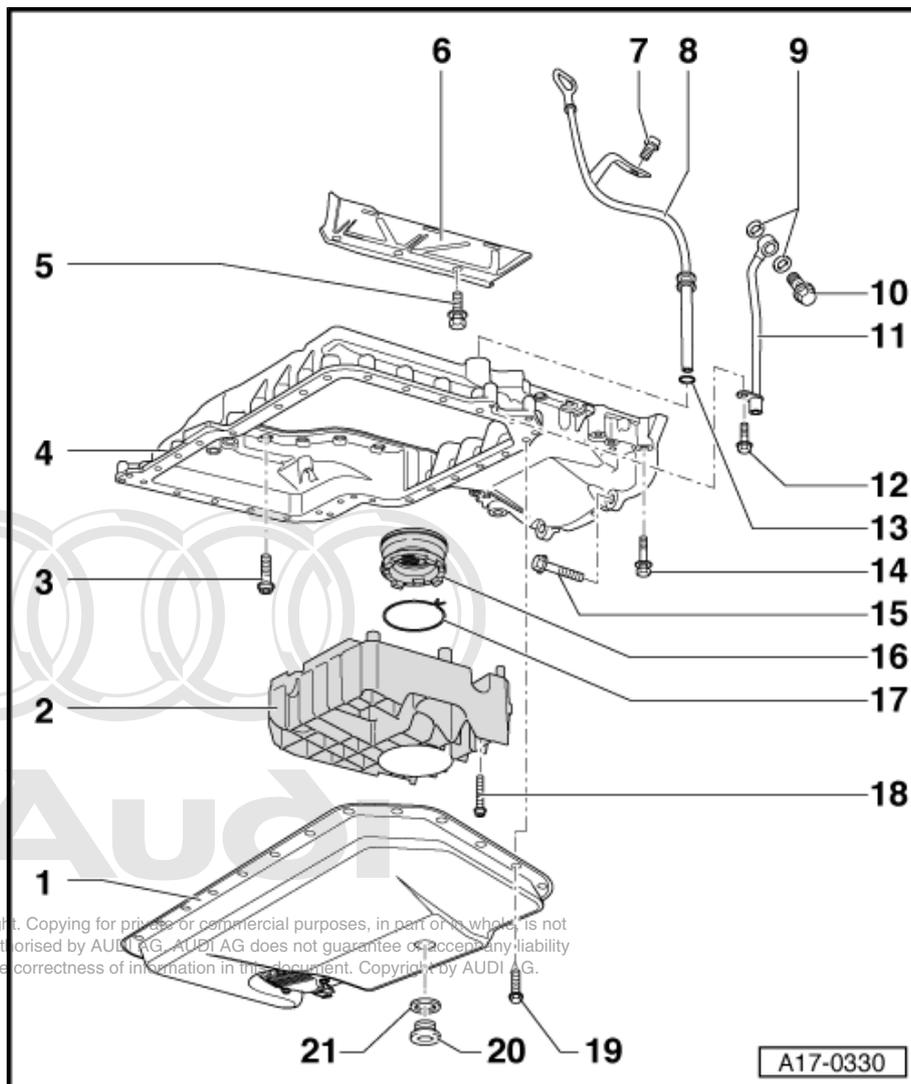
19 - 10 Nm

- Initially tighten to 5 Nm.
- Tighten in diagonal sequence to 10 Nm.

20 - Oil drain plug, 50 Nm

21 - Seal

- Renew



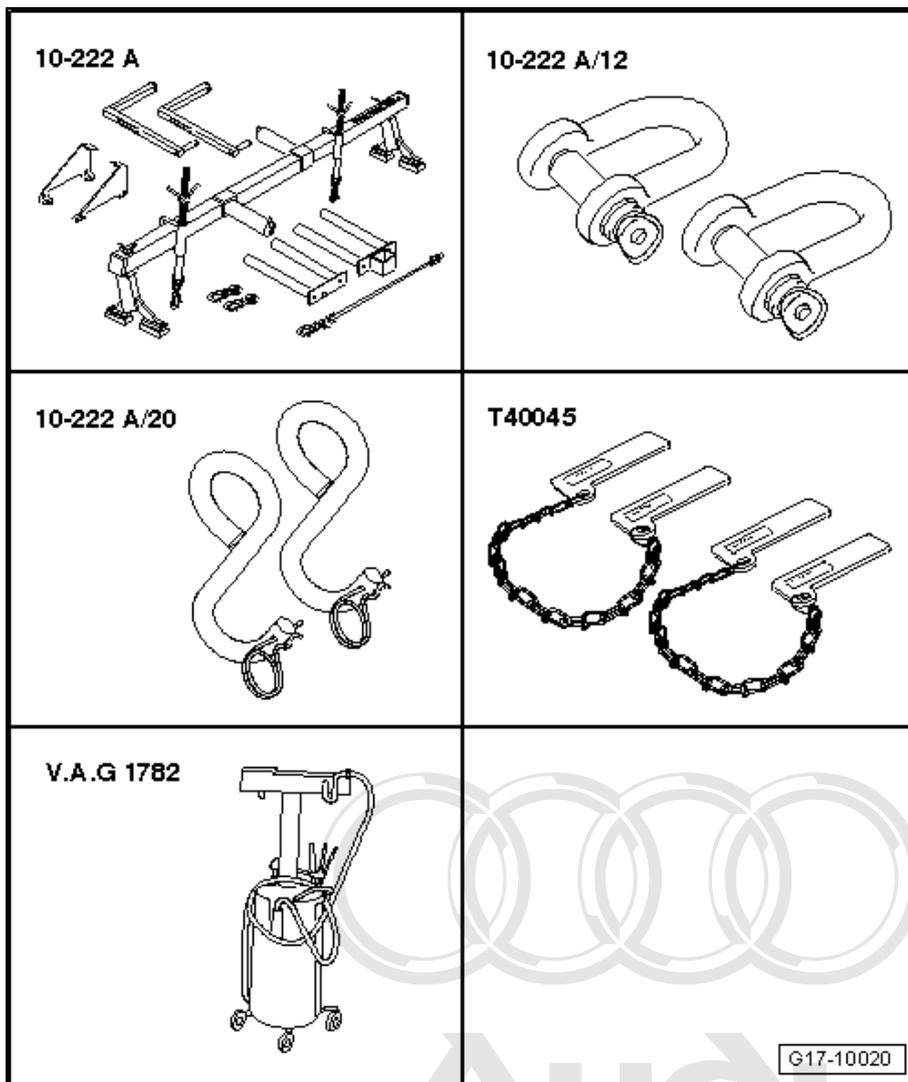
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1.7 Removing and installing sump (top section)

Special tools and workshop equipment required

- ◆ Support bracket -10 - 222 A-
- ◆ Shackle -10 - 222 A /12-
- ◆ Adapter -10 - 222 A /20-
- ◆ Mud wing compensation plate -T40045-
- ◆ 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

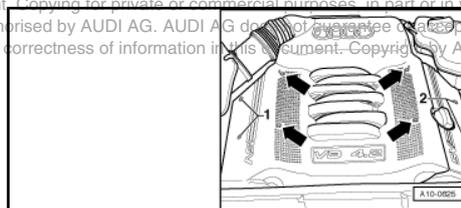


Removing

- Detach engine cover panel -arrows-.
- Remove both front wheels.

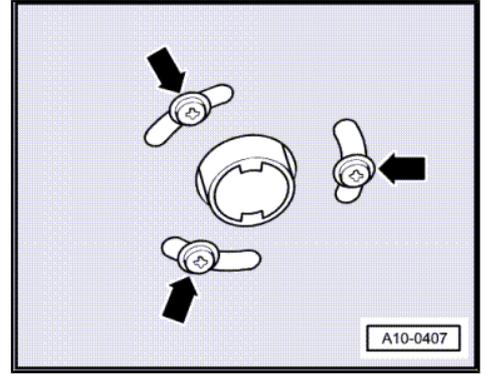
Vehicles with auxiliary heater / supplementary heater:

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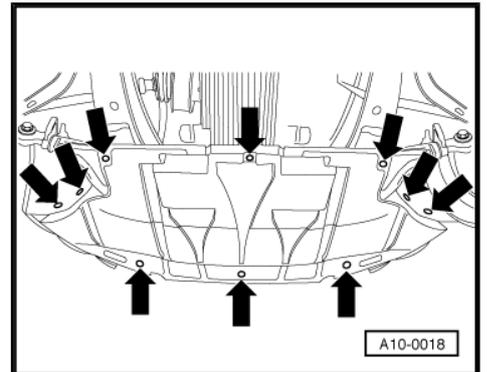


- Remove bolts -arrows- securing exhaust pipe for auxiliary/ supplementary heater to noise insulation.

All models:

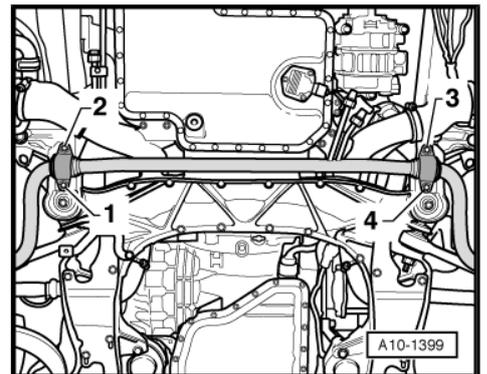


- Remove noise insulation -arrows-.

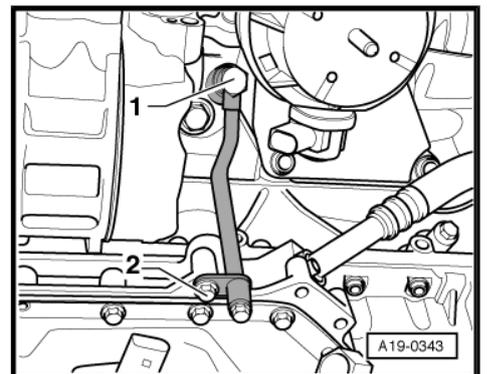


- Unscrew nuts -1 ... 4- for anti-roll bar mountings (left and right).
- Drain coolant => [page 137](#) .

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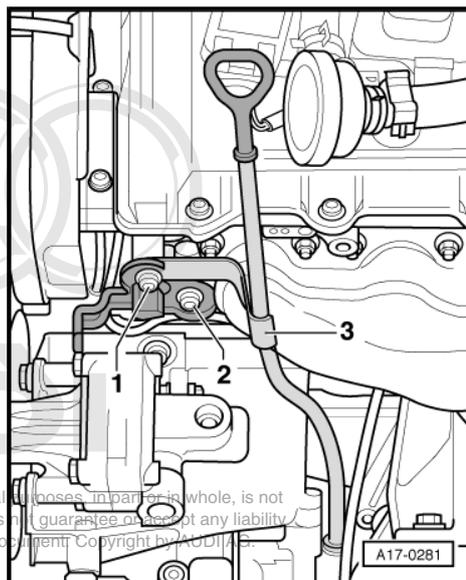


- Remove bolts -1- and -2- and detach coolant drain pipe.



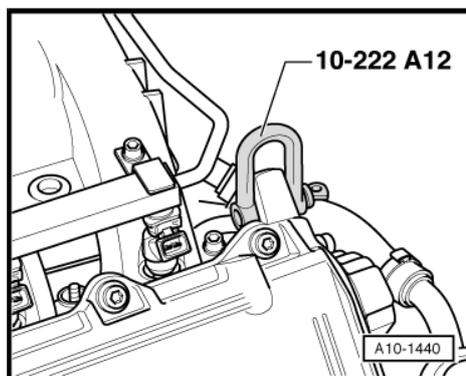


- Remove bolt -1- and slacken bolt -2- a few turns.
- Detach guide tube -3- with oil dipstick.



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- Attach shackle -10 - 222 A /12- to engine lifting eye (rear left).

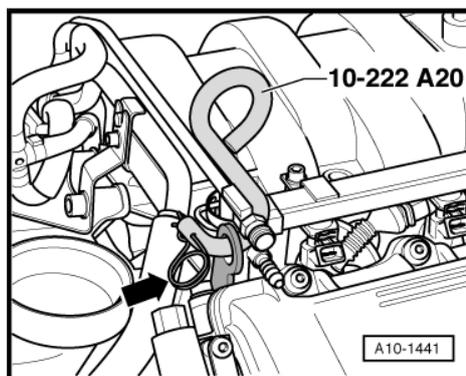


- Attach adapter -10 - 222 A /20- to engine lifting eye (rear right).



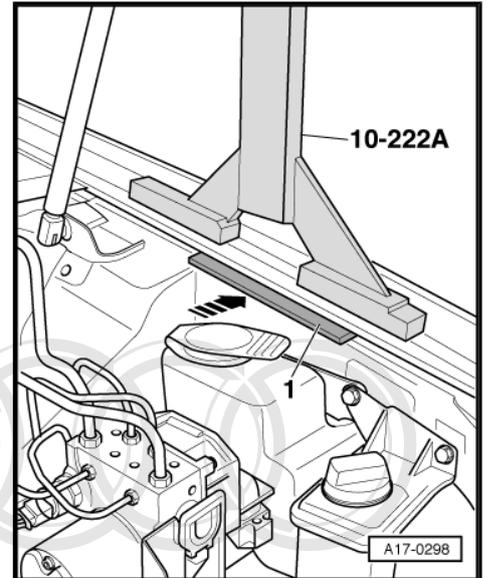
WARNING

The adapter -10 - 222 A /20- must be secured with a locking pin -arrow-.

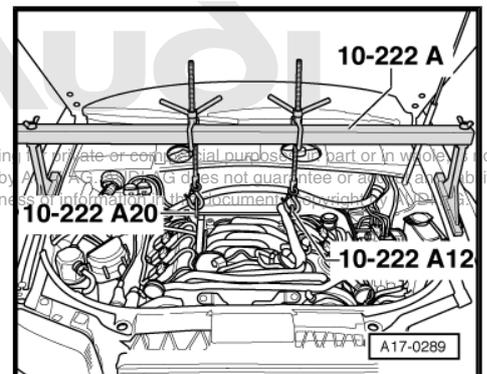


- Remove seal from wing mounting flanges.

- Place mud wing compensation plates -T40045- between the wing mounting flange and the panel underneath -arrow-, so that the support bracket -10 - 222 A- does not damage the edges of the wings .

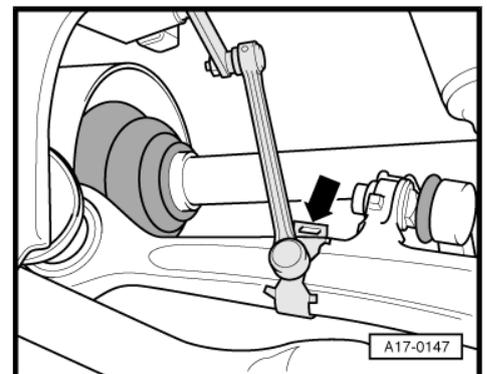


- Set up support bracket -10 - 222 A- on bolted flanges of wing panels.
- Hang shackle -10 - 222 A /12- and adapter -10 - 222 A /20- onto spindles of support bracket -10 - 222 A- .
- Partly take up weight of engine with spindles.



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- If fitted, unclip actuator rod for vehicle level sender -arrow- at bottom transverse link.

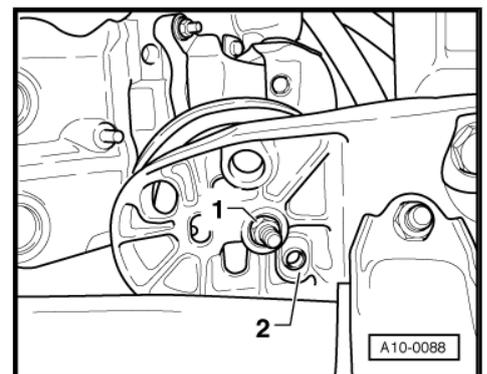


- Mark position of nuts -1- and locating sleeves -2- on bottom of engine mountings (right and left).

 **Note**

Different mounting holes are provided for the different engine versions.

- Remove bottom nut -1- at engine mountings (left and right).





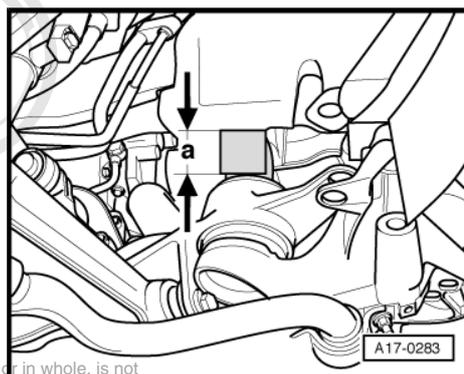
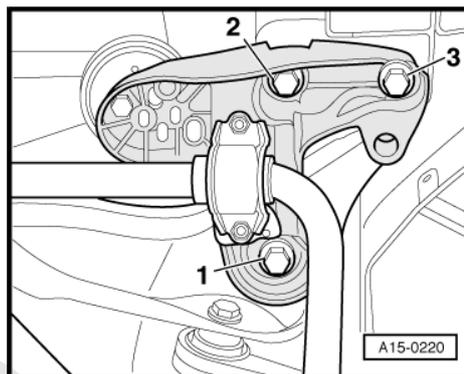
- First remove front subframe bolts -2 and 3- (left and right). Then remove bolts -1-.



Note

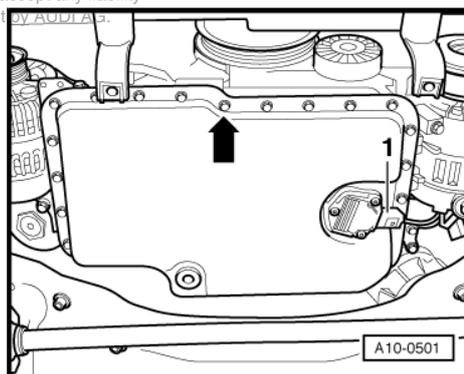
To avoid having to check and adjust wheel alignment, only loosen the front subframe mountings and lower the subframe at the front.

- Pull subframe downwards.
- Place a block of wood, height -a- = 50 mm, between front subframe mounting and vehicle body.
- Place used oil collection and extraction unit -V.A.G 1782- underneath.
- Drain off engine oil.

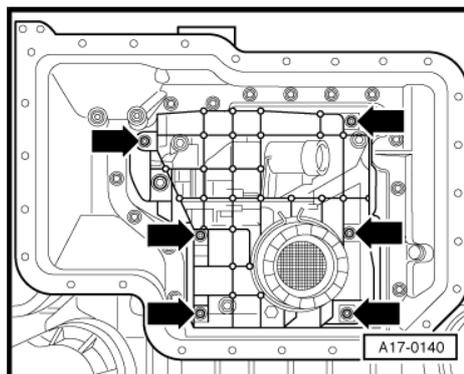


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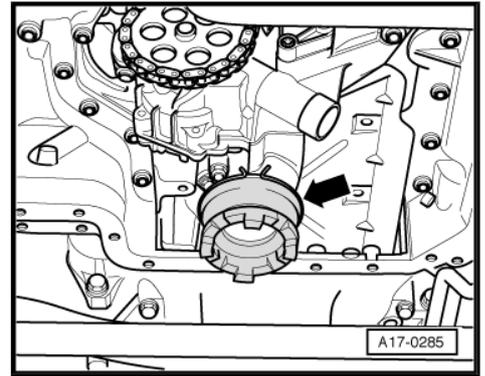
- Unplug electrical connector at oil level and oil temperature sender -G266- -1-.
- Remove sump (bottom section) -arrow-.



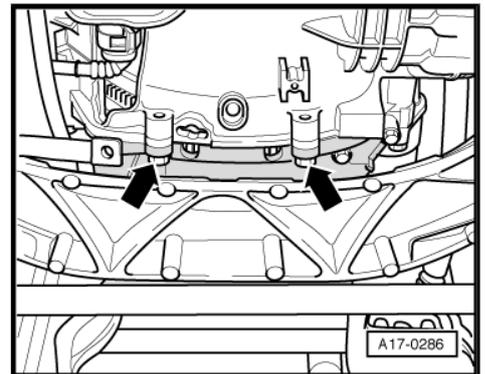
- Unscrew baffle plate -arrows-.



- Remove retaining ring.
- Detach intake connection -arrow- from oil pump.



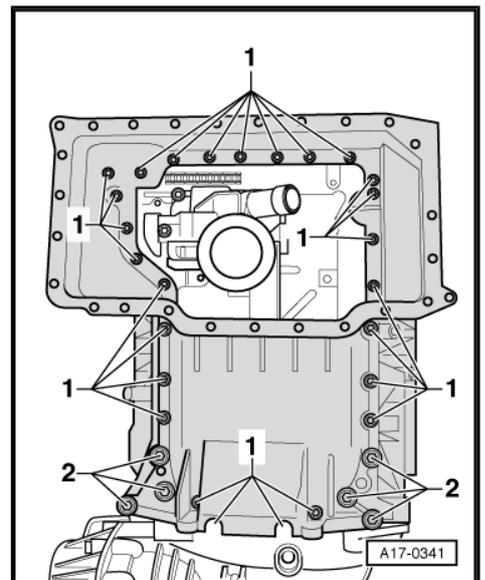
- Unscrew securing bolts -arrows- securing engine to gearbox near sump (top section).



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

Installing

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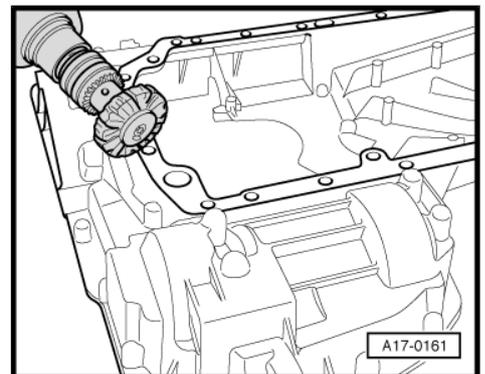
- Remove remaining sealant on sump (top section) and on cylinder block with a rotating plastic brush or similar.



WARNING

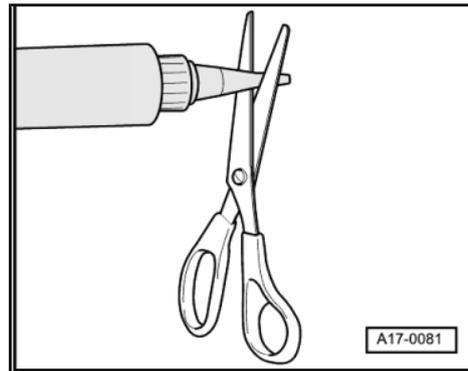
Wear safety goggles.

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





- Cut off nozzle of tube at front marking (Ø of nozzle approx. 1 mm).

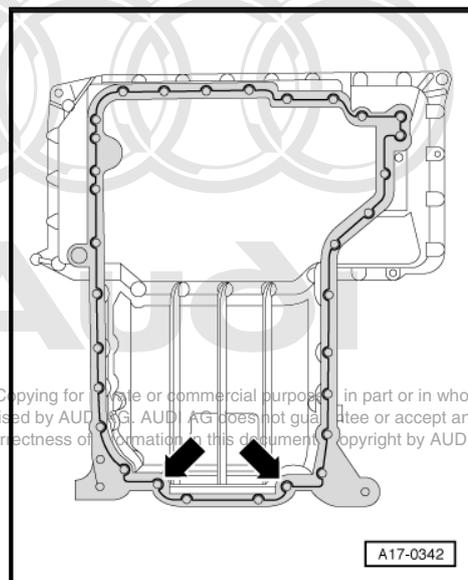


- Apply the bead of silicone sealant onto the clean sealing surface of the sump (top section), as illustrated.
- ◆ The bead of sealant should be approx. 1.5 mm wide.

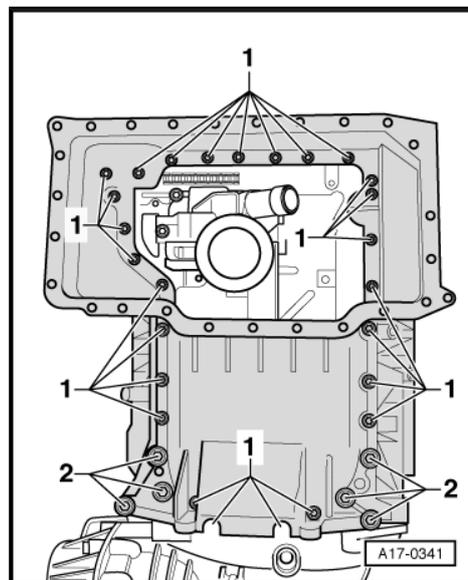


Note

- ◆ *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 hand-tight in diagonal sequence.
- Tighten bolts -1- and bolts -2- in diagonal sequence.



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- 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:

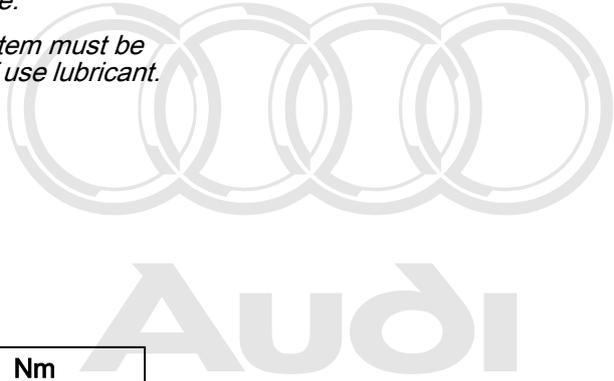
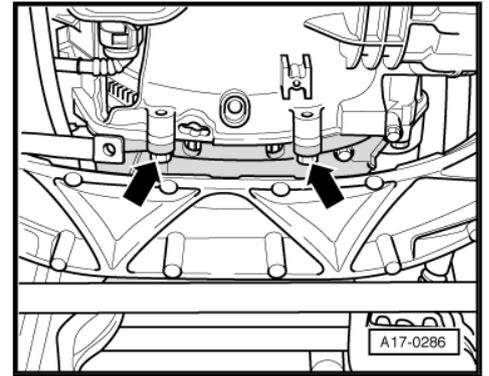
 **Note**

- ◆ *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 116](#) .
- Install subframe ⇒ Rep. Gr. 40 .
- Fill up with engine oil and check oil level.
- Fill up with coolant ⇒ [page 139](#) .

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



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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)
- Renewing ⇒ [page 130](#)

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)

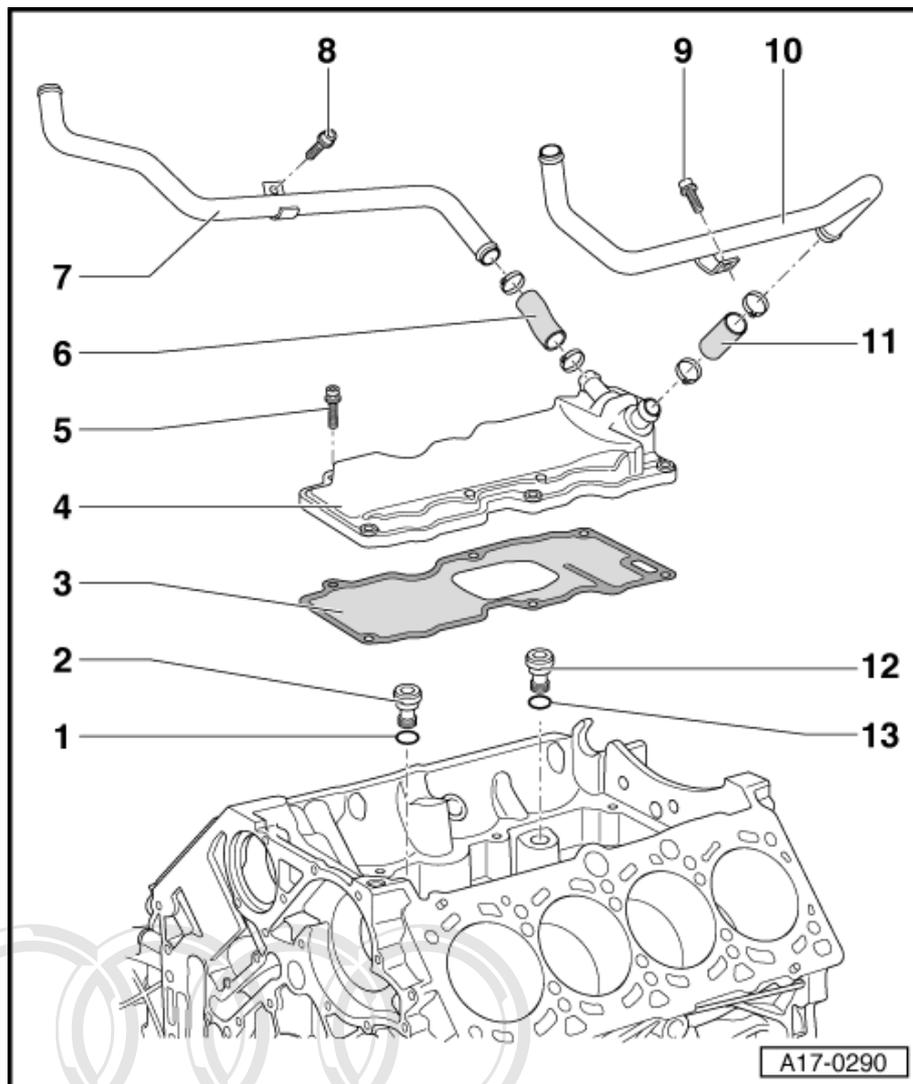
11 - Connecting hose

12 - Oil retention valve, 20 Nm

- For oil supply to cylinder head (right-side)
- Renewing ⇒ [page 130](#)

13 - O-ring

- Renew



1.9 Renewing oil retention valves



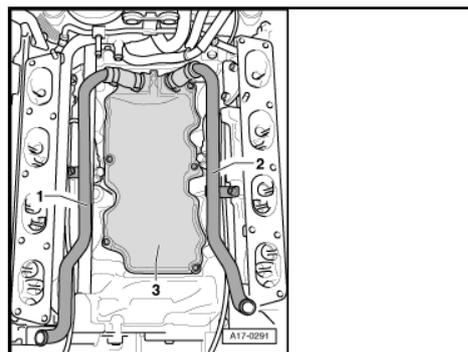
Note

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:

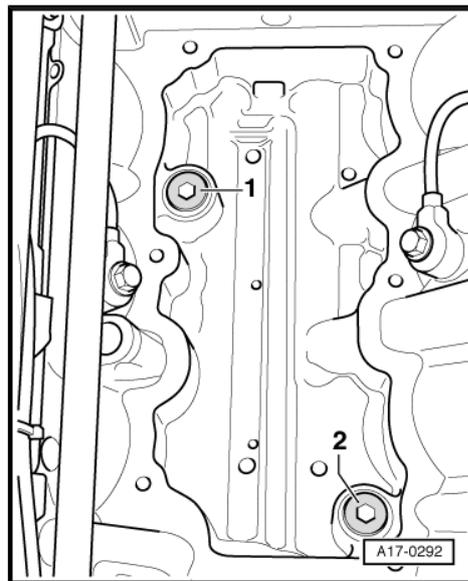
Note

- ◆ *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



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1.10 Oil filter housing - exploded view



Note

Always renew seals and gaskets.

1 - Oil filter housing

- With oil cooler
- Removing oil cooler
⇒ [page 147](#)

2 - Seal

- Renew

3 - Bolt

- 45 Nm

4 - Bolt

- 9 Nm

5 - Washer

6 - Coolant pipe

7 - 1.4 bar oil pressure switch - F1-

- 20 Nm
- Checking ⇒ [page 133](#)

8 - Oil filter

9 - Dowel sleeve

10 - Seal

- For oil passage
- Renew

11 - Seal

- Renew

12 - Coolant pipe

13 - Dowel sleeve

14 - Bolt

- 10 Nm
- Not fitted on all versions

15 - Seal

- Renew
- Not fitted on all versions

16 - Coolant drain plug

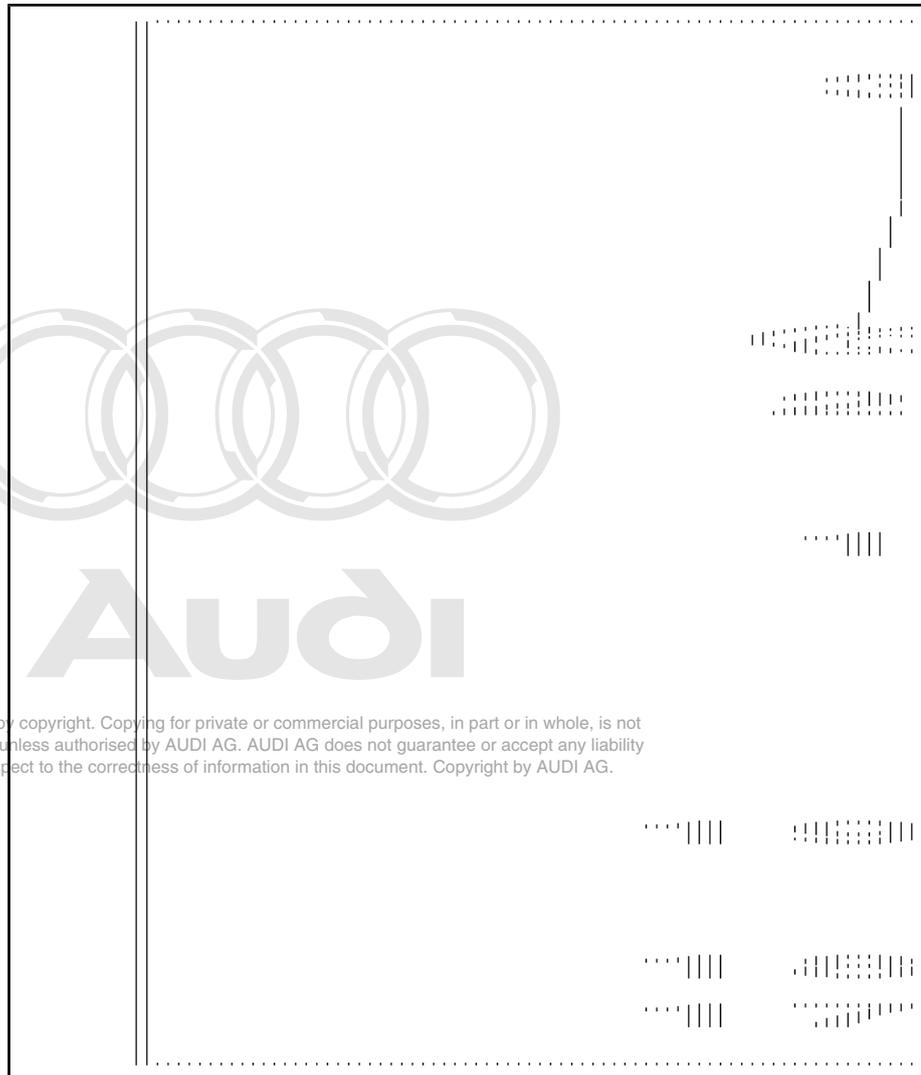
- Not fitted on all versions

17 - Coolant drain plug

- 10 Nm
- Not fitted on all versions

18 - Seal

- Renew
- Not fitted on all versions



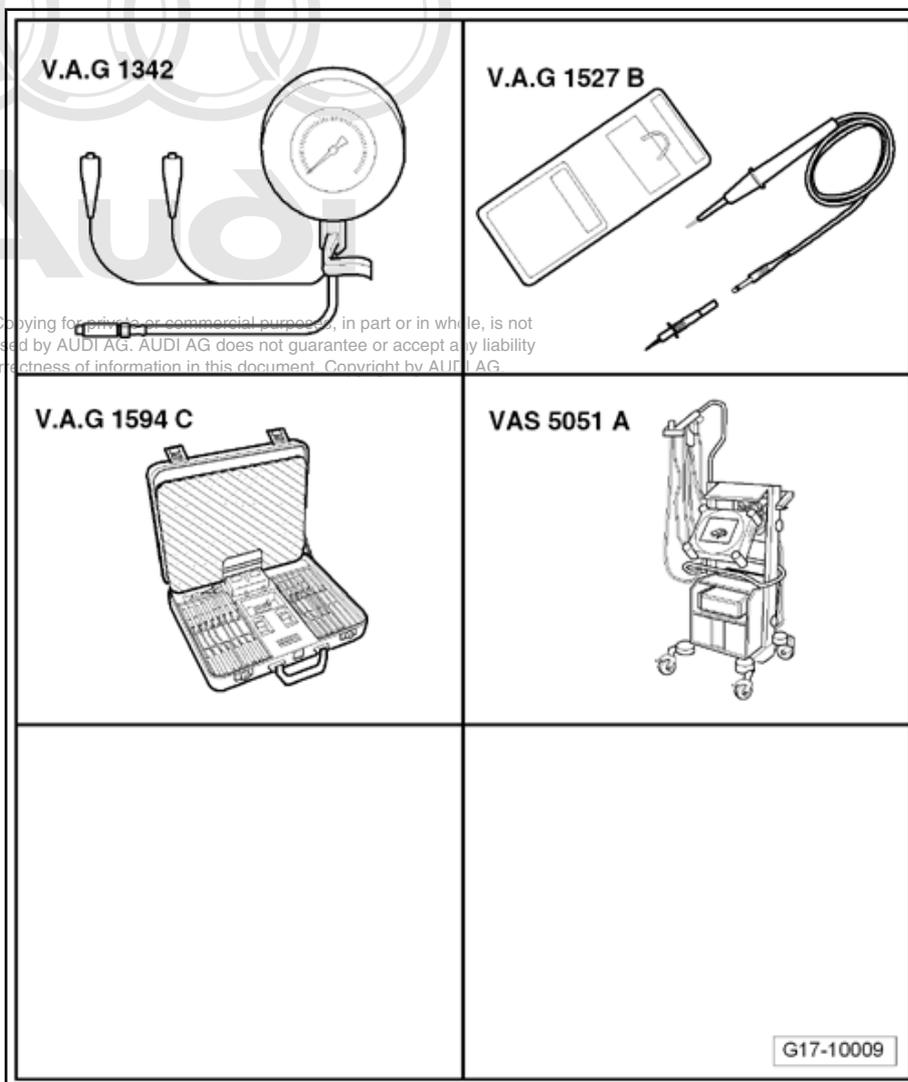
19 - Coolant drain pipe

- Not fitted on all versions

1.11 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-



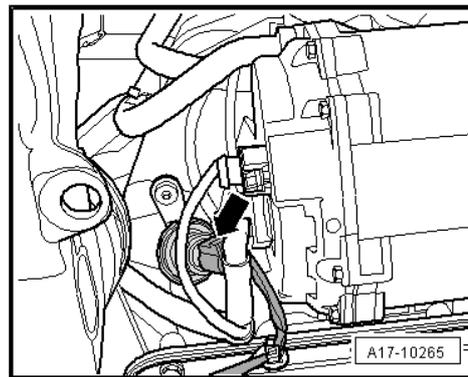
Test requirements

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

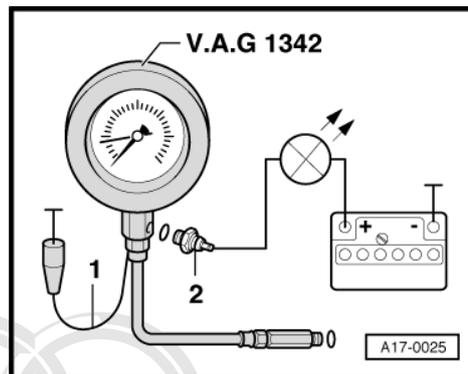


Checking oil pressure switch -F1-

- 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.

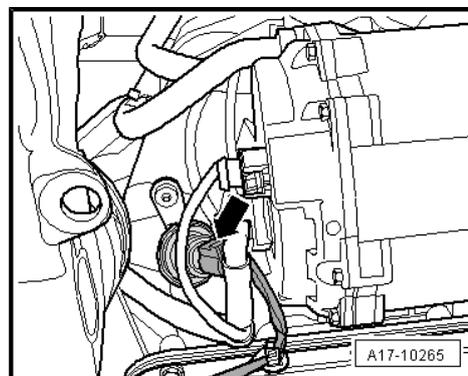
Black oil pressure switch:

- ◆ LED should light up at 1.2...1.6 bar
- If LED does NOT light up, **renew oil pressure switch**.

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Checking oil pressure

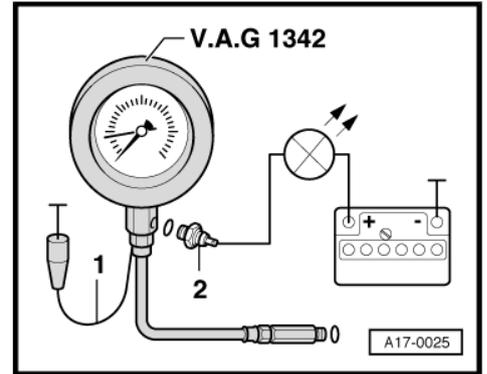
- Unplug electrical connector -arrow- at oil pressure switch.
- Unscrew oil pressure switch.



- 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

If the specifications are not obtained:

- Pressure relief valve / oil pump defective; renew oil pump.



1.12 Engine oil

A high-quality multigrade oil is put in at the factory: this can be used all year round, except in extremely cold climates.

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 402

1.13 Checking oil level



Note

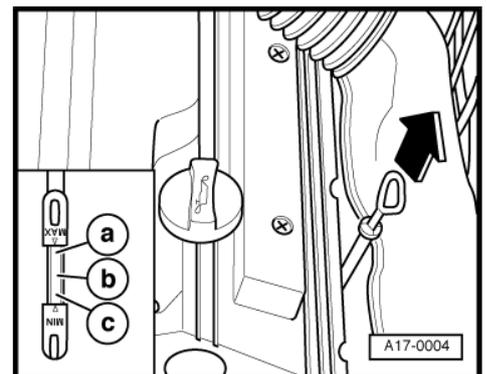
- ◆ *Always check the oil level when the engine is warm (oil temperature must be above 60° C).*
- ◆ *The car must be standing on level ground when checking the oil level.*
- ◆ *Wait for a few minutes after switching off the engine to allow the oil to flow back into the sump.*
- Pull out the dipstick, 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 in area -b- (grooved area on dipstick) after topping up.





19 – Cooling

1 Diagram of coolant hose connections



Note

- ◆ Always fit new seals and gaskets.
- ◆ Draining and filling cooling system ⇒ [page 137](#).
- ◆ Checking cooling system for leaks ⇒ [page 145](#).

1 - Coolant pipe (rear)

2 - From heat exchanger for heater

- Fitted with bleeder valve

3 - To heat exchanger for heater

- Fitted with bleeder valve

4 - Return hose

5 - Filler cap for coolant expansion tank

- Checking ⇒ [page 146](#)

6 - Expansion tank

7 - Filler hose

8 - Thermostat

- Renewing ⇒ [page 144](#)
- Checking ⇒ [page 145](#)

9 - Radiator

10 - Bracket for coolant hoses

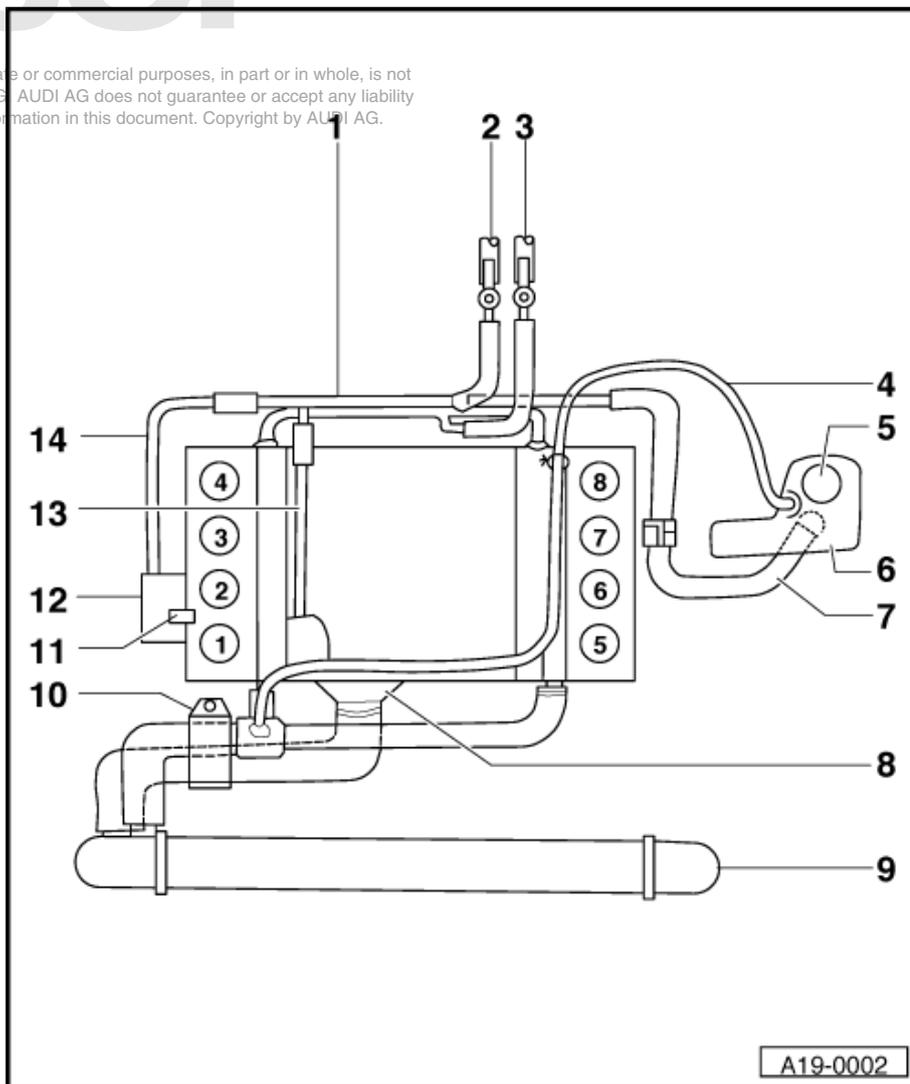
11 - Coolant pipe

- Connects oil cooler to cylinder block

12 - Oil cooler

13 - Coolant pipe

14 - Coolant pipe to oil cooler

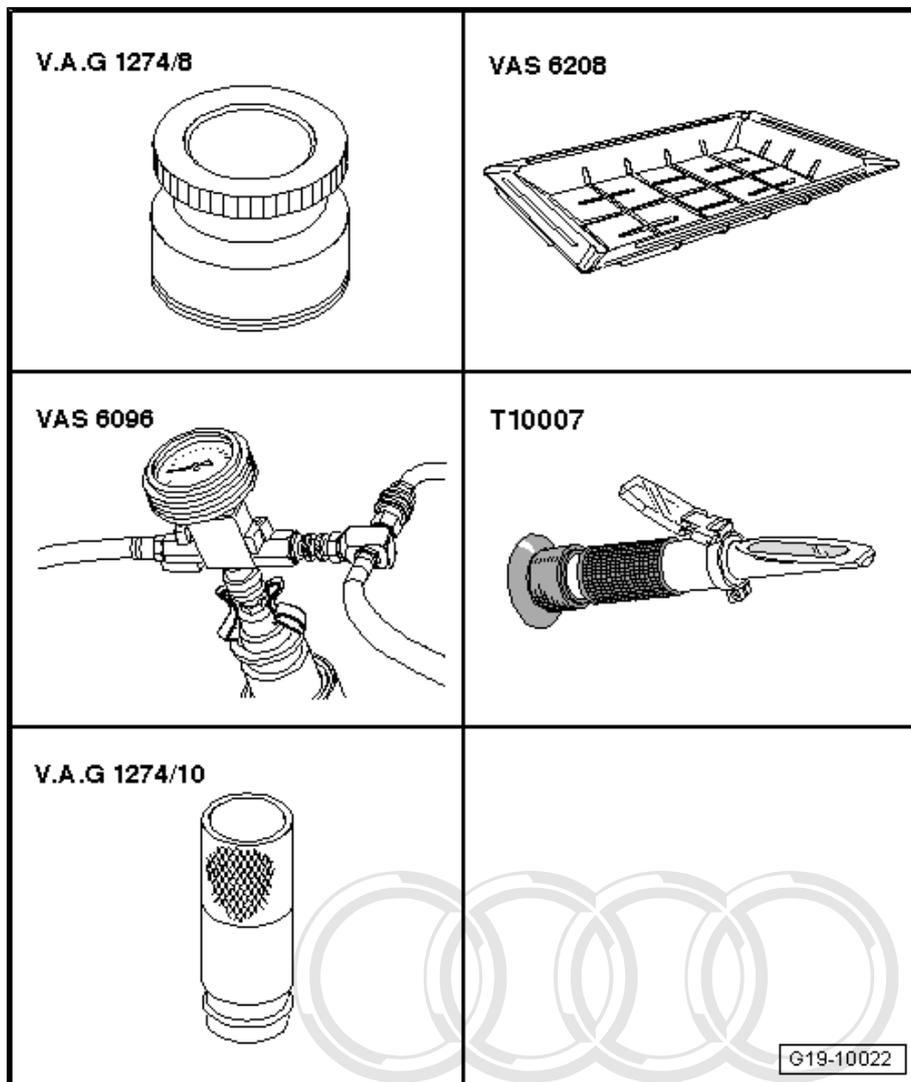


A19-0002

1.1 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 coolant



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.

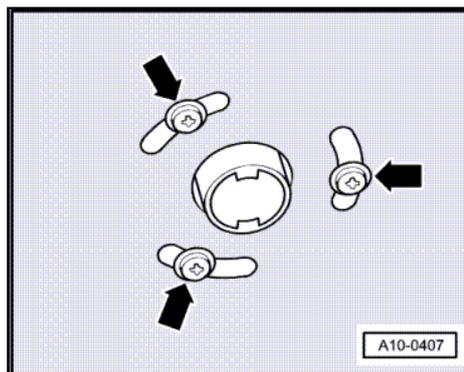


Vehicles with auxiliary heater / supplementary heater:

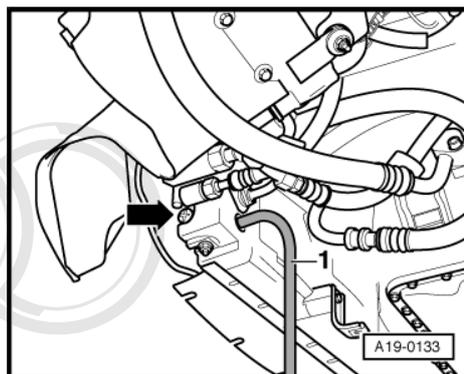
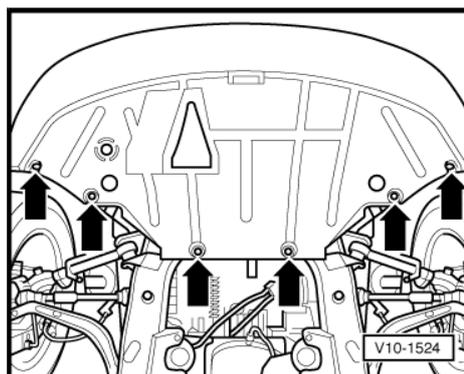
- Remove bolts -arrows- securing exhaust pipe for auxiliary/supplementary heater to noise insulation.

All models:

- Remove noise insulation.
- Remove grille on left side of bumper.



- Fit drain hose -1- onto hose connection.
- Place drip tray for workshop hoist -VAS 6208- beneath engine.
- Drain coolant from radiator (bottom left) -arrow-.



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- Open drain plugs -arrows- and drain off coolant.

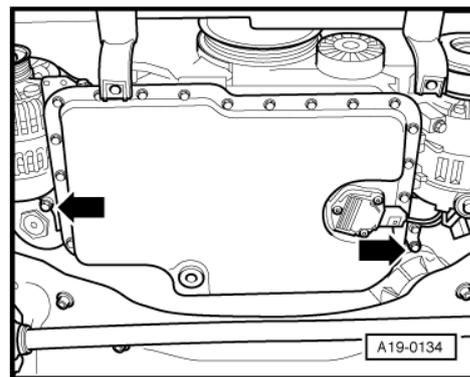
 **Note**

Instead of the coolant drain pipe on the right side, some engines have only a drain plug in the oil filter housing.

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 anti-corrosion 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.*





- Screw in coolant drain plugs on engine block (left and right sides) -arrows-, renew seals.

**Note**

Instead of the coolant drain pipe on the right side, some engines have only a drain plug in the oil filter housing.

- Close radiator drain tap and disconnect hose from hose connection.

- 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- .

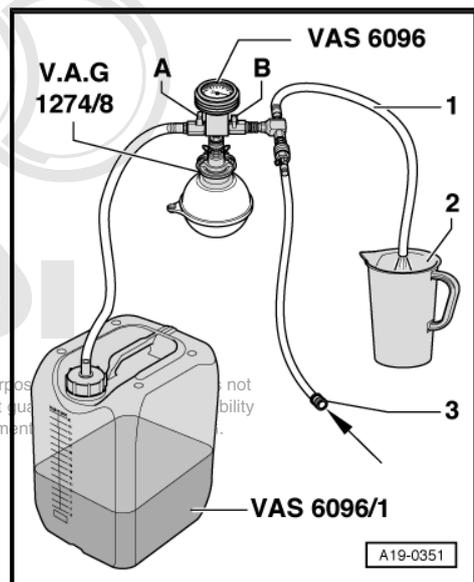
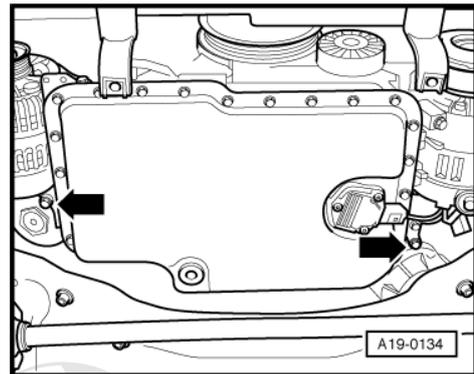
- Run vent hose -1- into a small container 2-

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

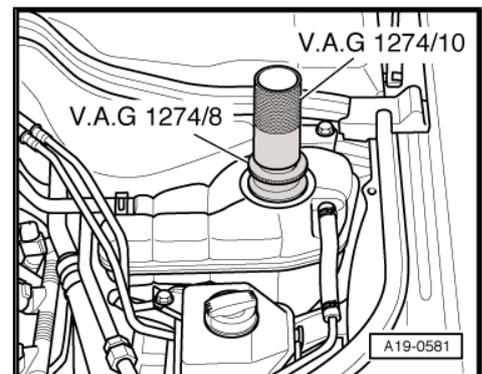
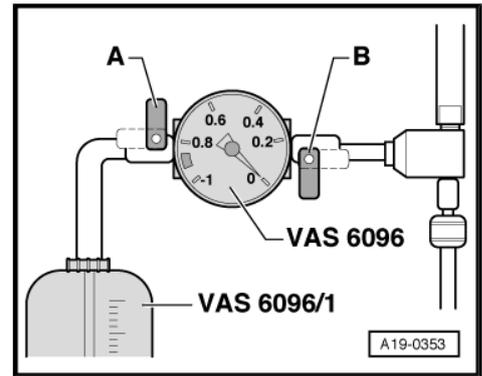
- Close the two valves -A- and -B- (levers at right angles to direction of flow).

- 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- .
- Switch on ignition.
- Set air conditioner to "HI".
- Switch off ignition.
- Open bleeder screw on heat exchanger for heater by about 2 full turns.
- Fill cooling system. Squeezing the top hose several times will help to force out the air.
- Warm up engine, leaving air conditioner set to "HI" until coolant temperature gauge reading is slightly below 100 °C. Engine speed should be between 2000 rpm and 3000 rpm for warm-up purposes and should be briefly increased several times to 4000 rpm and 5000 rpm.
- Switch off engine. Wait approx. 5 - 10 minutes and then carefully open cap on expansion tank (cooling system is under pressure).
- Top up coolant to max. mark.
- Close filler cap on expansion tank.
- Run engine and repeat topping-up procedure as necessary.



1.2 Coolant pump and thermostat - exploded view

1 - 14 Nm

- Property class 10.9

2 - 10 Nm

3 - Thermostat housing

4 - O-ring

- Renew

5 - Thermostat

- Removing and installing
⇒ [page 144](#)
- Checking ⇒ [page 145](#)
- Installation position
⇒ [page 142](#)

6 - Gasket

- Renew

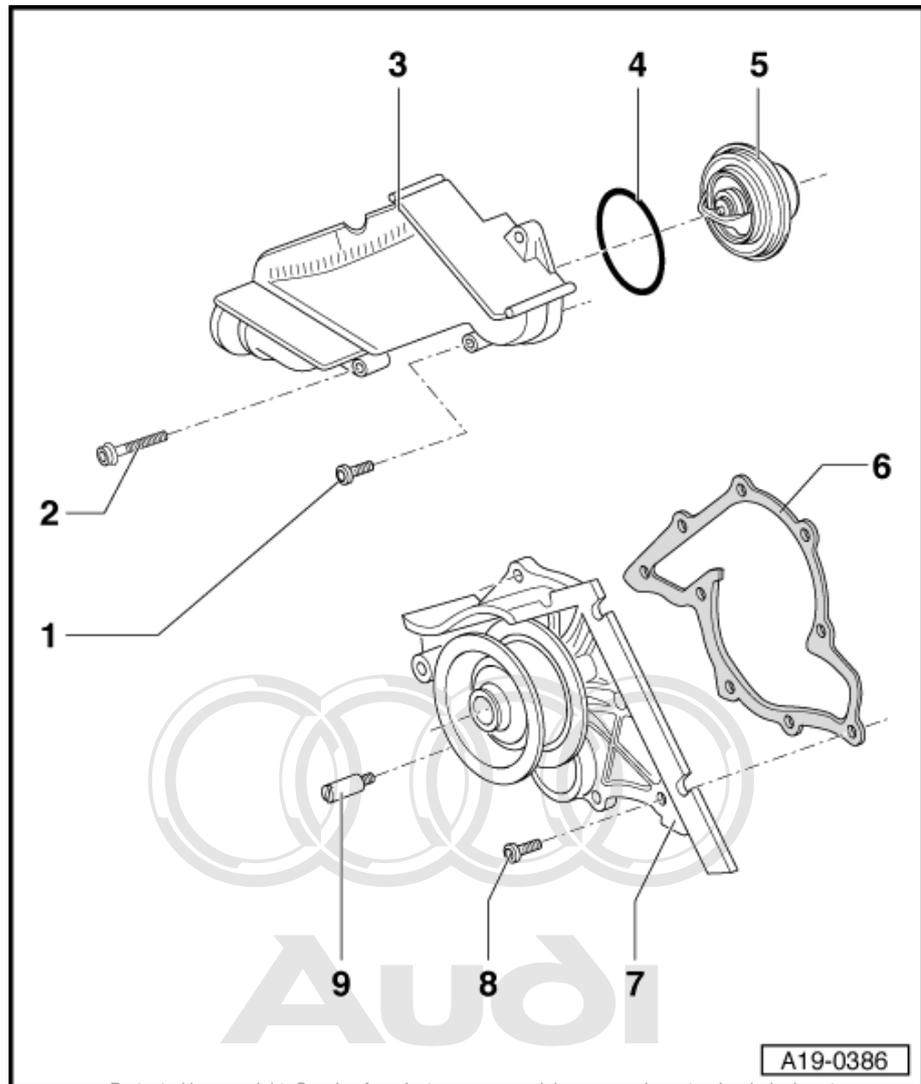
7 - Mechanical coolant pump

- Removing and installing
⇒ [page 143](#)

8 - 14 Nm

- Property class 10.9

9 - Trunnion bolt, 9 Nm



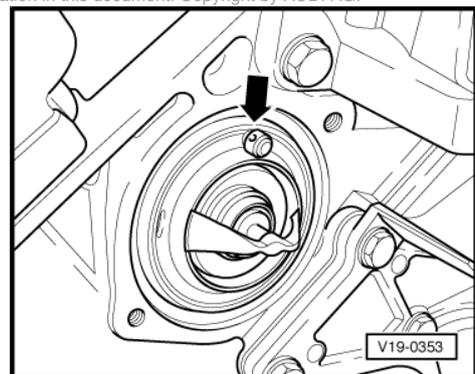
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Installation position of thermostat



Note

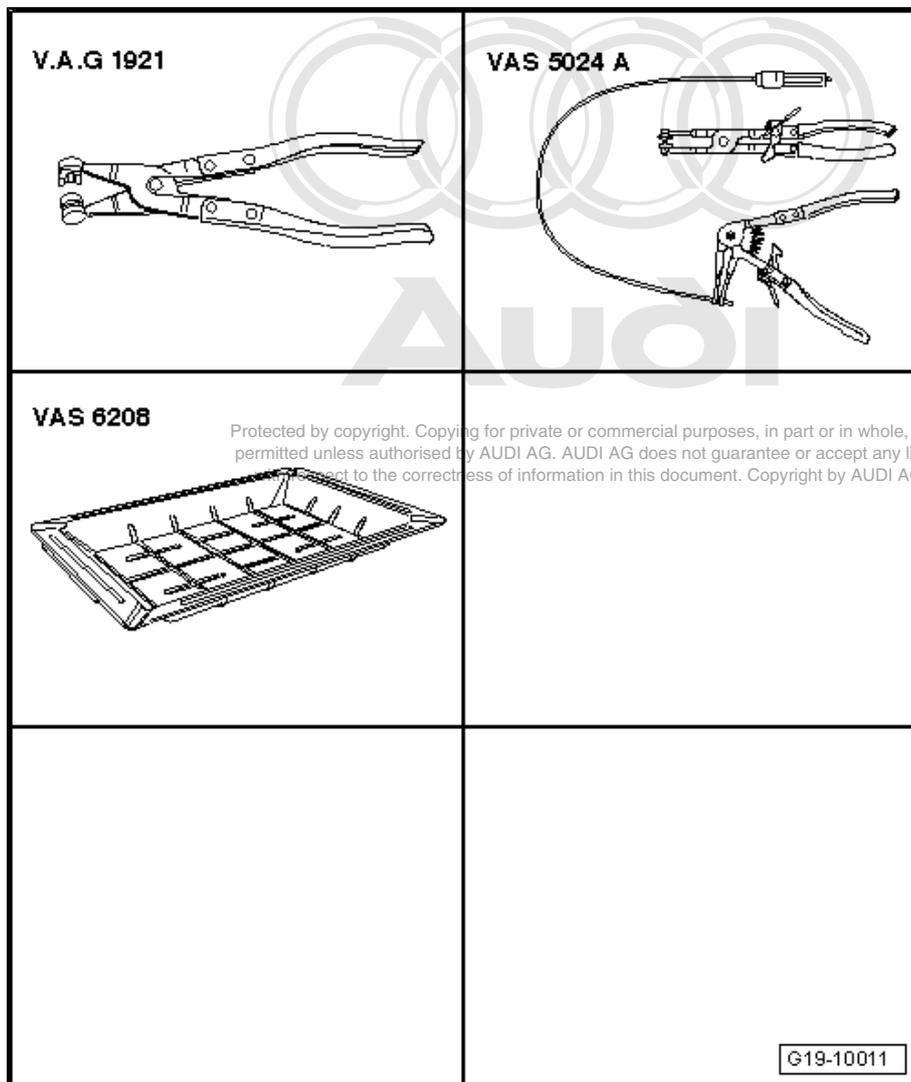
The bleeder valve -arrow- must face upwards.



1.3 Removing and installing coolant pump

Special tools and workshop equipment required

- ◆ Drip tray -V.A.G 1306-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Spring type clip pliers - V.A.S 5024 A-



Removing

 **Note**

Always renew seals and gaskets.

- Drain coolant ⇒ [page 137](#) .
- Remove toothed belt ⇒ [page 31](#) .



- 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:



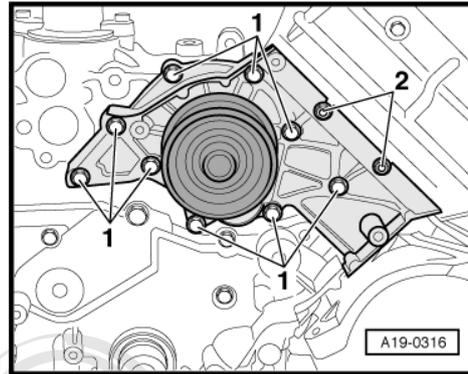
Note

Renew seals and gaskets.

- Clean sealing surfaces on cylinder block.
- Install toothed belt (adjust valve timing) ⇒ [page 31](#) .
- Fill up with coolant ⇒ [page 137](#) .

Tightening torques

Tightening torques ⇒ [page 142](#) ; Coolant pump and thermostat - exploded view

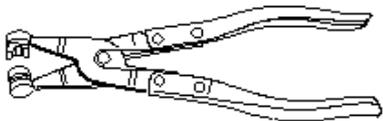
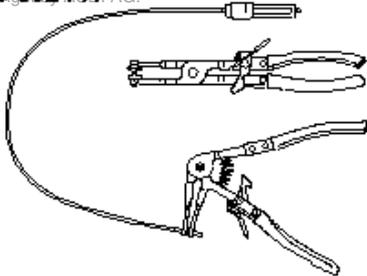
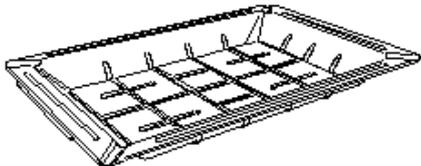


1.4 Removing, installing and checking thermostat

Special tools and workshop equipment required

- ◆ Drip tray -V.A.G 1306-
- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Spring type clip pliers - V.A.S 5024 A-

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<p>V.A.G 1921</p> 	<p>VAS 5024 A</p> 
<p>VAS 6208</p> 	
	<p>©19-10011</p>

Removing

- Drain coolant ⇒ [page 137](#) .
- Remove toothed belt ⇒ [page 31](#) .
- Detach coolant hose from thermostat housing.
- Detach thermostat housing -arrows-.
- Remove O-ring and thermostat.

Installing



Note

Renew gaskets, seals and O-rings.

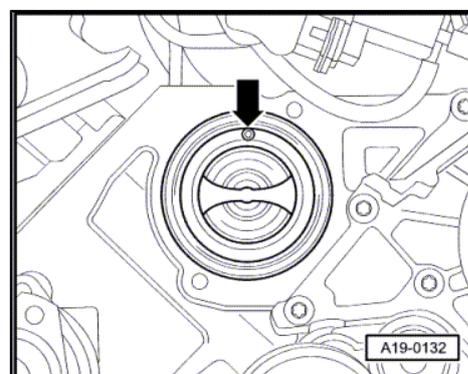
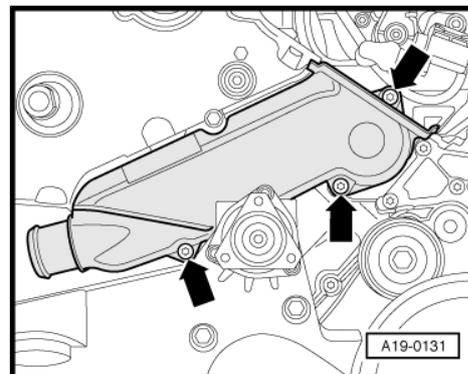
- Clean and smoothen sealing surface for O-ring.
- Install thermostat.
- ◆ Installation position: Vent valve -arrow- faces upwards.
- Install thermostat housing.

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

- Install toothed belt (adjust valve timing) ⇒ [page 31](#) .
- Fill up with coolant ⇒ [page 137](#) .

Tightening torques

Tightening torques ⇒ [page 142](#)



1.5 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

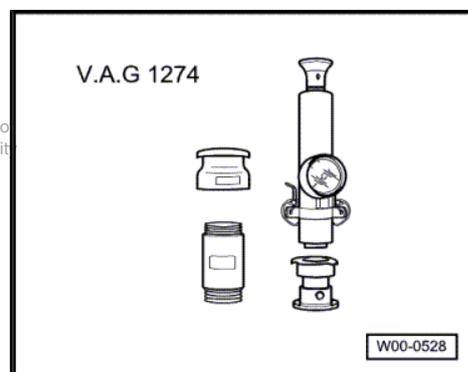
- ¹⁾ Cannot be tested

1.6 Checking cooling system for leaks

Special tools and workshop equipment required

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

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- ◆ Adapter -VW 1274/1-



Test requirements

- Engine must be warm.

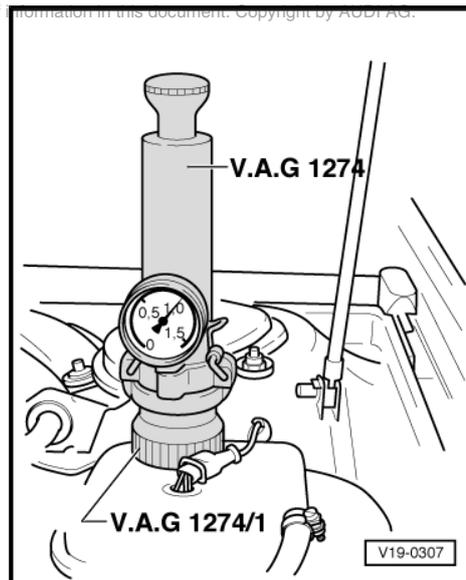
Test sequence



WARNING

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

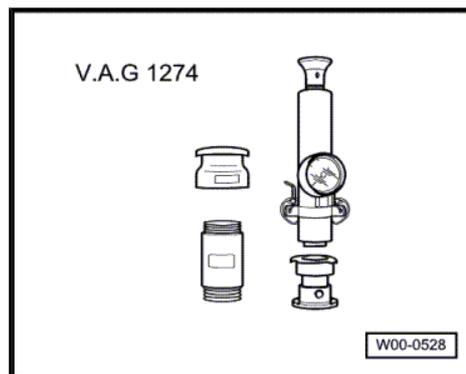
- Open filler cap on coolant expansion tank.
- Fit cooling system tester -V.A.G 1274- with adapter -VW 1274/1- onto expansion tank.
- Using hand pump on tester, build up a pressure of approx. 1.0 bar. If this pressure is not maintained, locate and rectify leaks.



1.7 Checking pressure relief valve in filler cap

Special tools and workshop equipment required

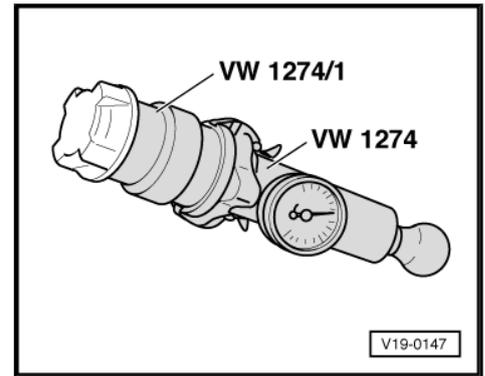
- ◆ Cooling system tester -V.A.G 1274-



- ◆ Adapter -V.A.G 1274/1-

- Fit filler cap with adapter -V.A.G 1274/1- onto cooling system tester -V.A.G 1274- .
- Build up pressure with hand pump.

The pressure relief valve should open at a pressure of 1.2 ... 1.5 bar.



1.8 Oil cooler - exploded view

1 - Oil filter housing

- Removing and installing
⇒ [page 132](#)

2 - Seal

- For oil passage
- Renew

3 - Seal

- Renew

4 - Bolt

- 5 Nm

5 - Oil cooler

6 - Seal

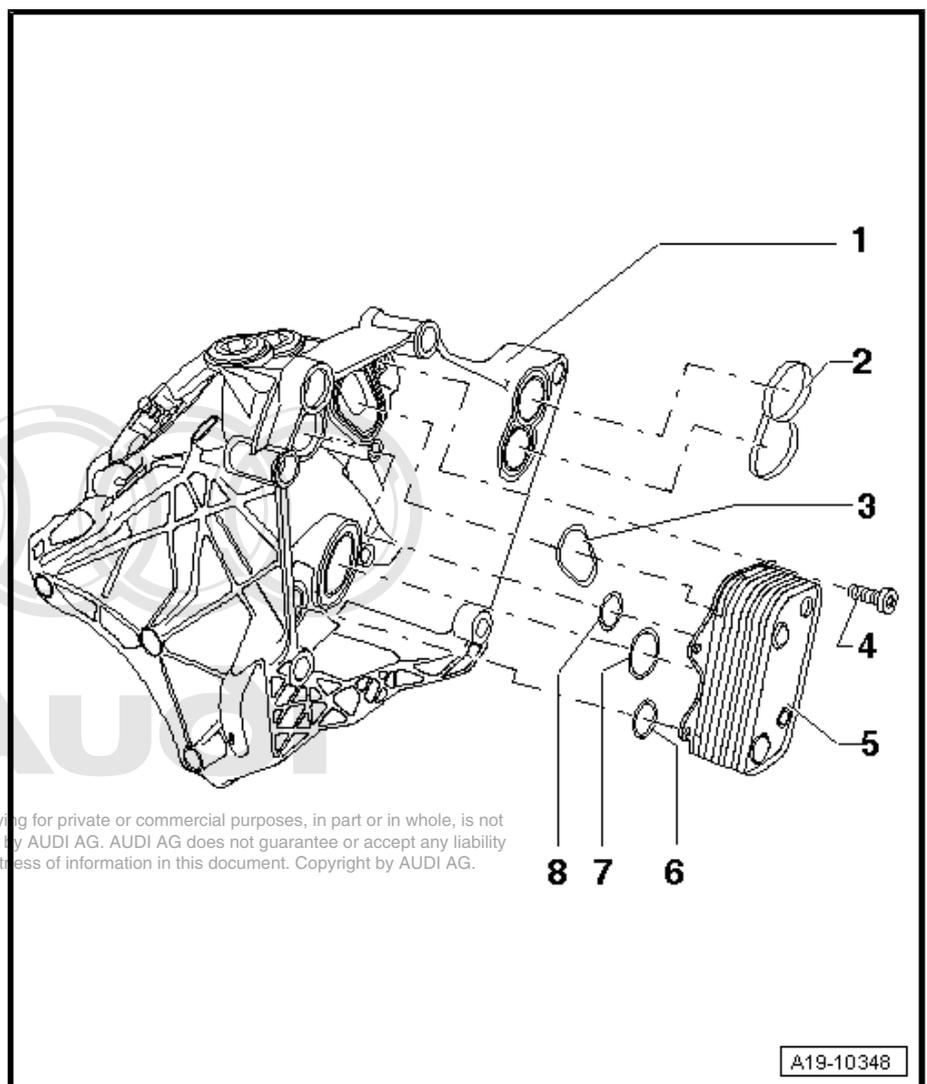
- Renew

7 - Seal

- Renew

8 - Seal

- Renew



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1.9 Removing and installing oil cooler

- Engine removed
- Remove oil filter housing ⇒ [page 132](#) .



- Remove oil cooler -arrow-

Installing

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



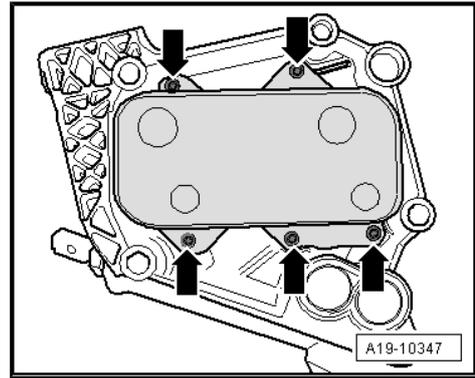
Note

Renew gaskets, seals and O-rings.

- Install alternator ⇒ Rep. Gr. 27 .

Tightening torques

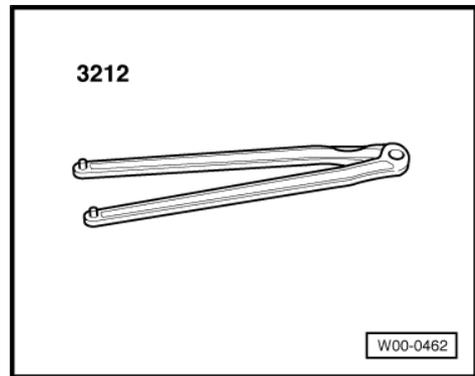
Tightening torques ⇒ [page 147](#)



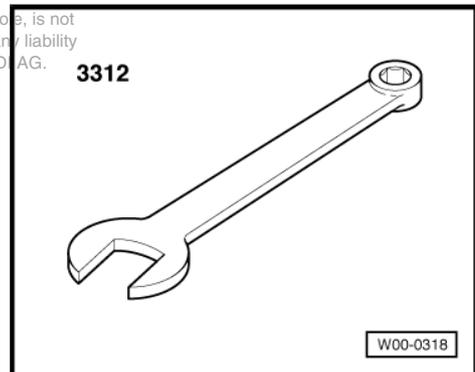
1.10 Removing and installing viscous fan

Special tools and workshop equipment required

- ◆ Pin wrench -3212-



- ◆ Open-end spanner -3312-



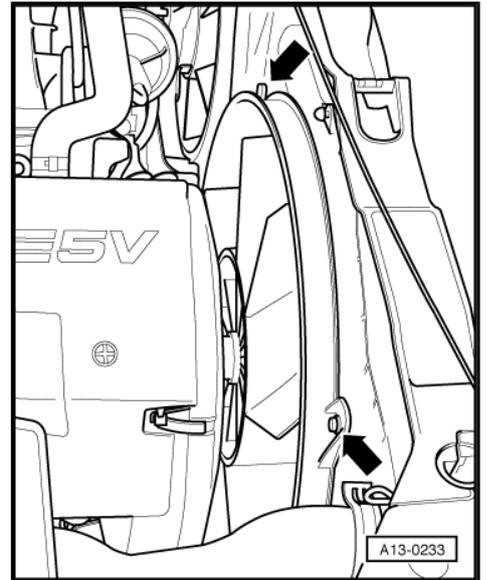
Removing

- Remove intake hose for air cleaner.
- Remove bumper ⇒ Rep. Gr. 63 .
- Move lock carrier to service position ⇒ Rep. Gr. 50 .

- Unbolt outer ring for viscous fan -arrows-.

 **Note**

The fan has a left-hand thread.

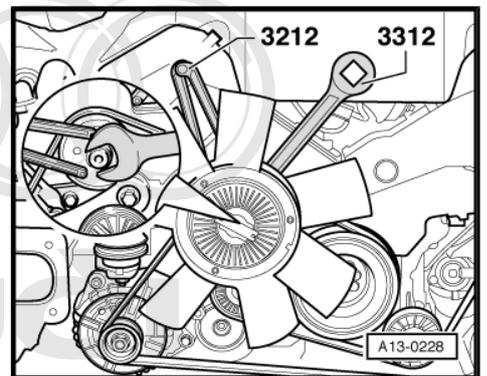


- Hold viscous fan pulley with pin wrench -3212- and unscrew viscous fan using open-end spanner -3312- (left-hand thread).
- Remove viscous fan with its outer ring.

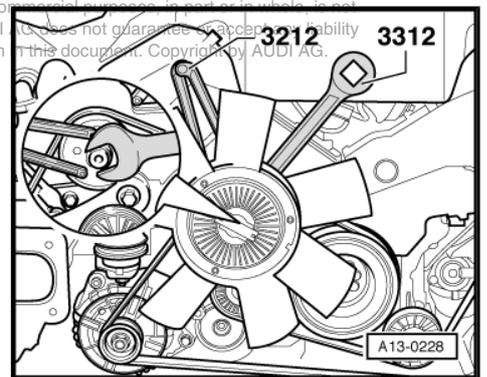
Installing

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

- Install viscous fan together with its outer ring (fan has left-hand thread).



- Hold viscous fan pulley with pin wrench -3212- and secure viscous fan using open-end spanner -3312- and torque wrench -V.A.G 1331- (left-hand thread).



Tightening torques

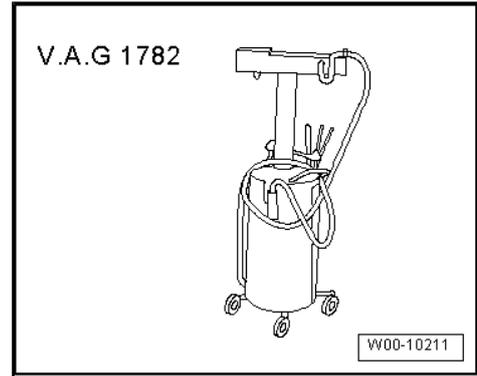
Component	Nm
Viscous fan with torque wrench -V.A.G 1331- and open-end spanner -3312- .	37
Viscous fan with torque wrench -V.A.G 1332- without open-end spanner -3312- .	70
Outer ring of fan to radiator	10

1.11 Removing and installing radiator

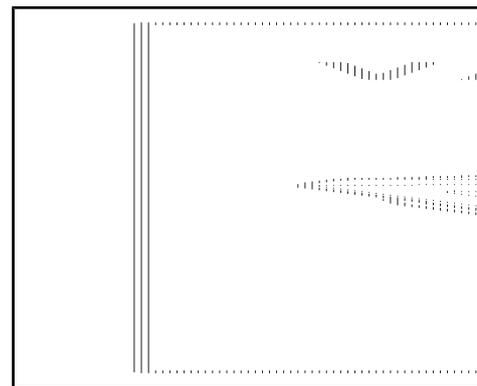
Special tools and workshop equipment required



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



- ◆ Drip tray for workshop hoist -VAS 6208-



Removing



Note



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

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WARNING

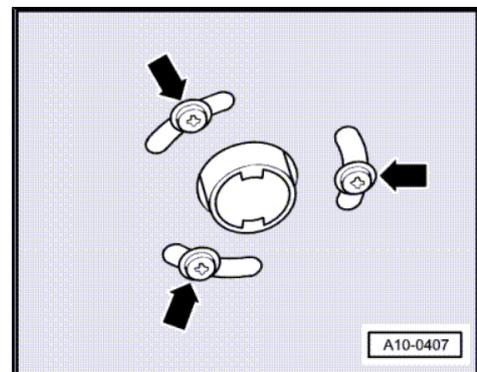
Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

- Open filler cap on coolant expansion tank.

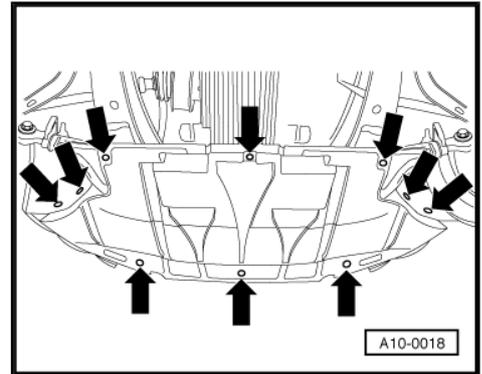
Vehicles with auxiliary heater / supplementary heater:

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

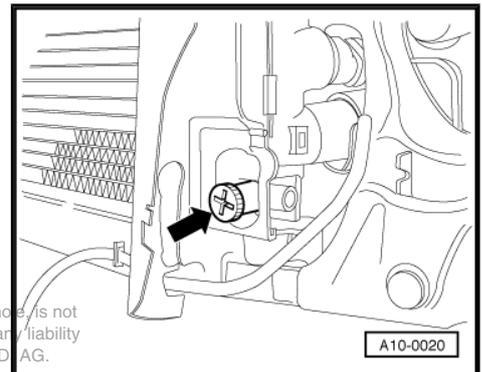
All models:



- Remove noise insulation.
- Remove bumper => Rep. Gr. 63 .
- Place drip tray -VAS 6208- under engine.

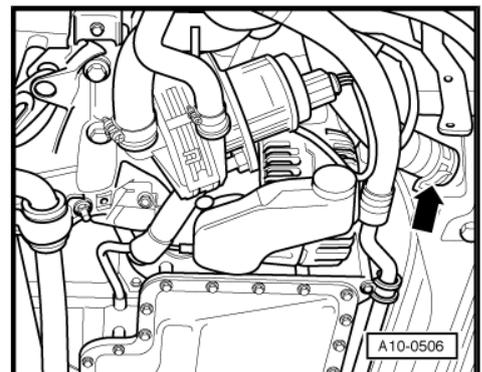


- Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.

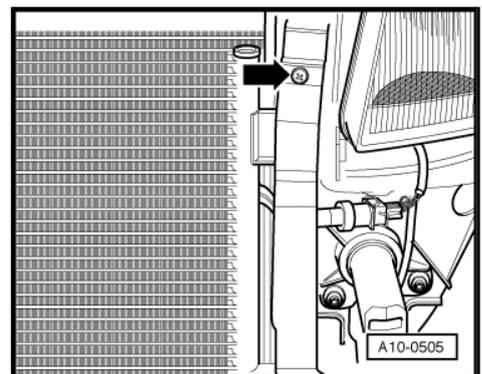


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- Disconnect coolant hose -arrow-.

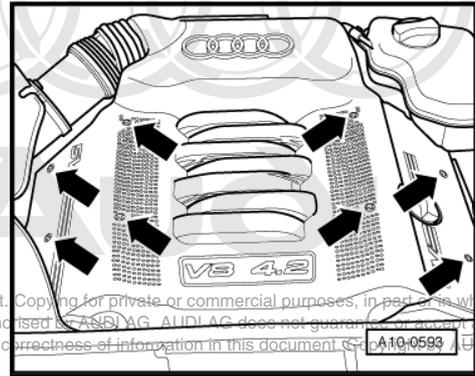


- Unbolt air duct for radiator (left and right) -arrow-.

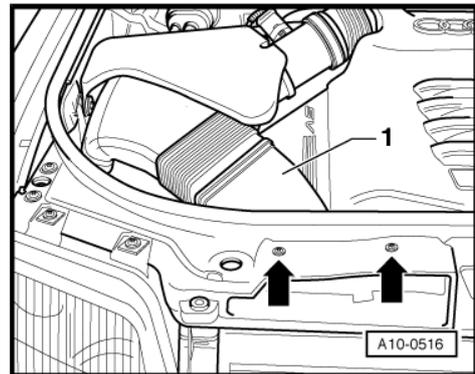




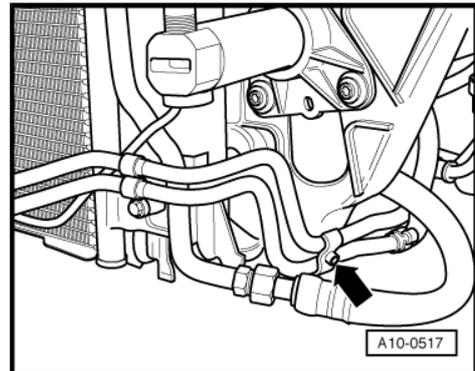
- Detach engine cover panel -arrows-.



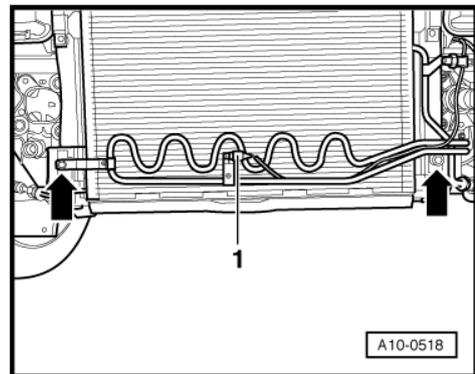
- Unscrew bolts -arrows- and remove intake hose -1- for air cleaner.



- Unbolt bracket for hydraulic lines -arrow-.

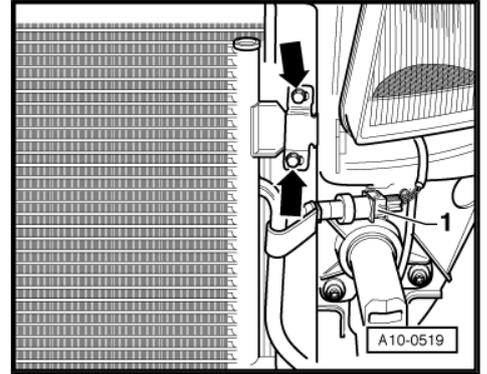


- Unplug temperature sensor -1-.
- Unbolt cooling pipes for hydraulic fluid -arrows- and move to the side.



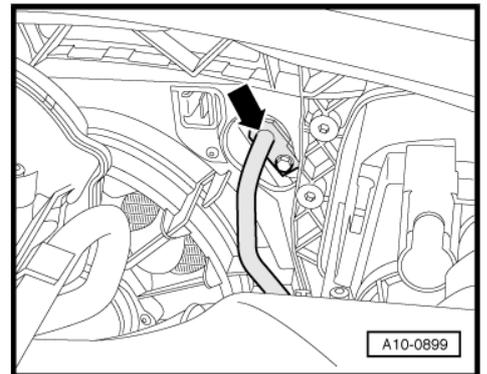
- Unplug connector -1- for high-pressure switch.
- Detach air conditioner condenser and tie it up -arrows-.

Only on automatic gearbox

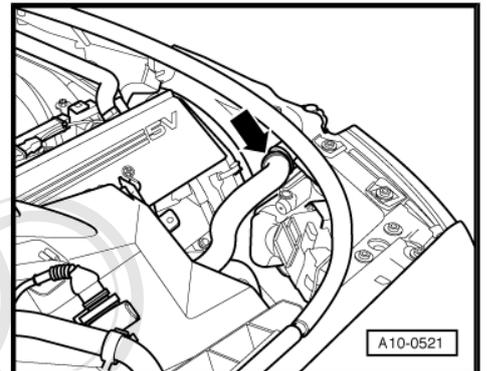


- Place used oil collection and extraction unit -V.A.G 1782- underneath.
- Detach gear oil/ATF pipes (top -arrow- and bottom) from radiator => Rep. Gr. 34 and => Rep. Gr. 37 .
- Tie gear oil/ATF pipes up onto longitudinal member to prevent fluid escaping.

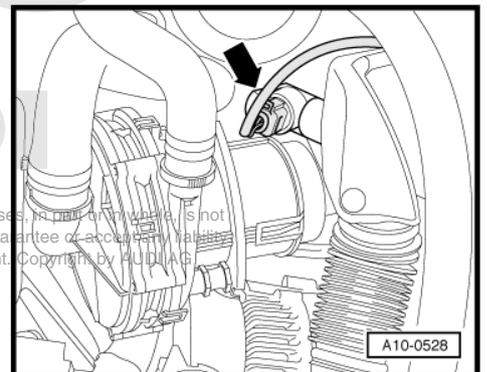
All models:



- Detach coolant hose at top right of radiator -arrow-.



- Unplug thermo-switch -arrow-.



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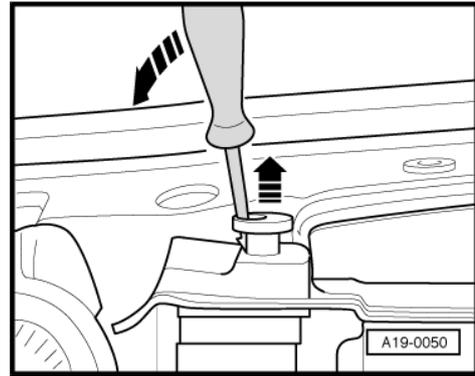


- Release two retaining pins for radiator and pull out upwards -arrows-.
- Swivel radiator forwards and lift off.

Installing

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

- Install front bumper ⇒ Rep. Gr. 63 .
- Fill cooling system ⇒ [page 139](#) .



Note

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

- Secure gear oil/ATF lines ⇒ Rep. Gr. 34 or ⇒ Rep. Gr. 37 .
- Check gear oil level ⇒ Rep. Gr. 34 or ATF level ⇒ Rep. Gr. 37 .

1.12 Removing and installing radiator fan - V7-

Removing



Note

All cable ties which are released or cut open when removing must be fitted in the same position when installing.

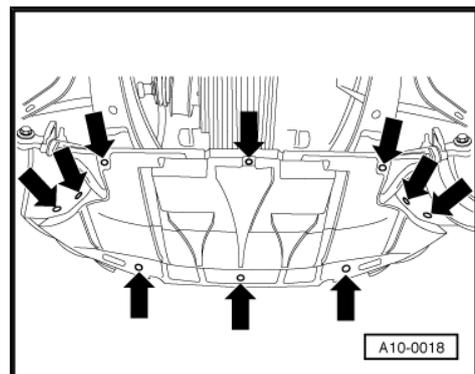
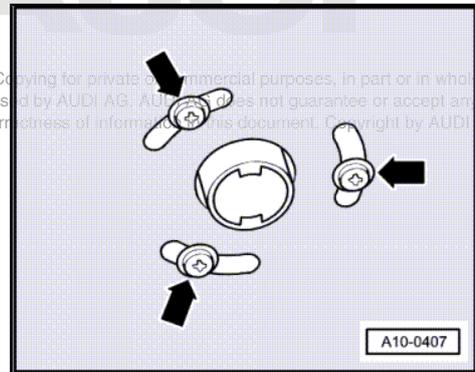
Vehicles with auxiliary heater / supplementary heater:

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

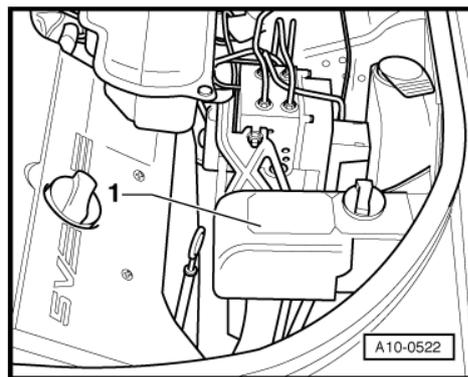
All models:

- Remove noise insulation.
- Remove front bumper ⇒ Rep. Gr. 63 .
- Move lock carrier to service position ⇒ Rep. Gr. 50 .

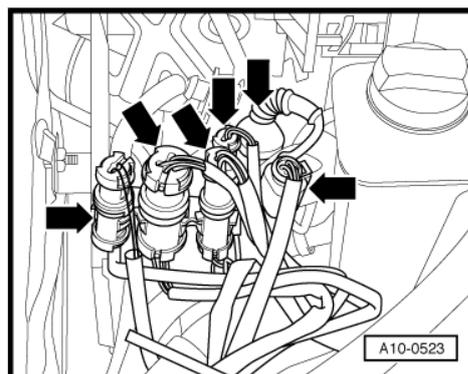
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- Remove cover -1- at front of ABS unit.



- Unplug electrical connectors -arrows- at front of ABS unit.
- Lay wiring harness to radiator fan -V7- clear.



- Remove bolt -1-.
- Turn radiator fan -V7- in direction of -arrow- and remove.

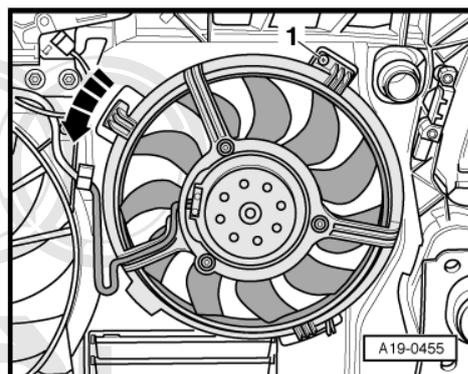
Installing

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

Note

Fit all cable ties in the original positions when installing.

- Install lock carrier ⇒ Rep. Gr. 50 .
- Install front bumper ⇒ Rep. Gr. 63 .



Tightening torque

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Component	Nm
Radiator fan -V7- to lock carrier	5



26 – Exhaust system

1 Removing and installing parts of exhaust system



Note

- ◆ Removing and installing exhaust manifold ⇒ [page 157](#).
- ◆ 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 161](#).
- ◆ Renew self-locking nuts.

1.1 Silencers with mountings - exploded view

1 - 40 Nm

2 - From catalytic converter

3 - Round-head bolt

4 - Double clamp

5 - 25 Nm

6 - Mounting

- With retaining ring

7 - Centre silencer

8 - Double clamp (for repair)

9 - Connection point

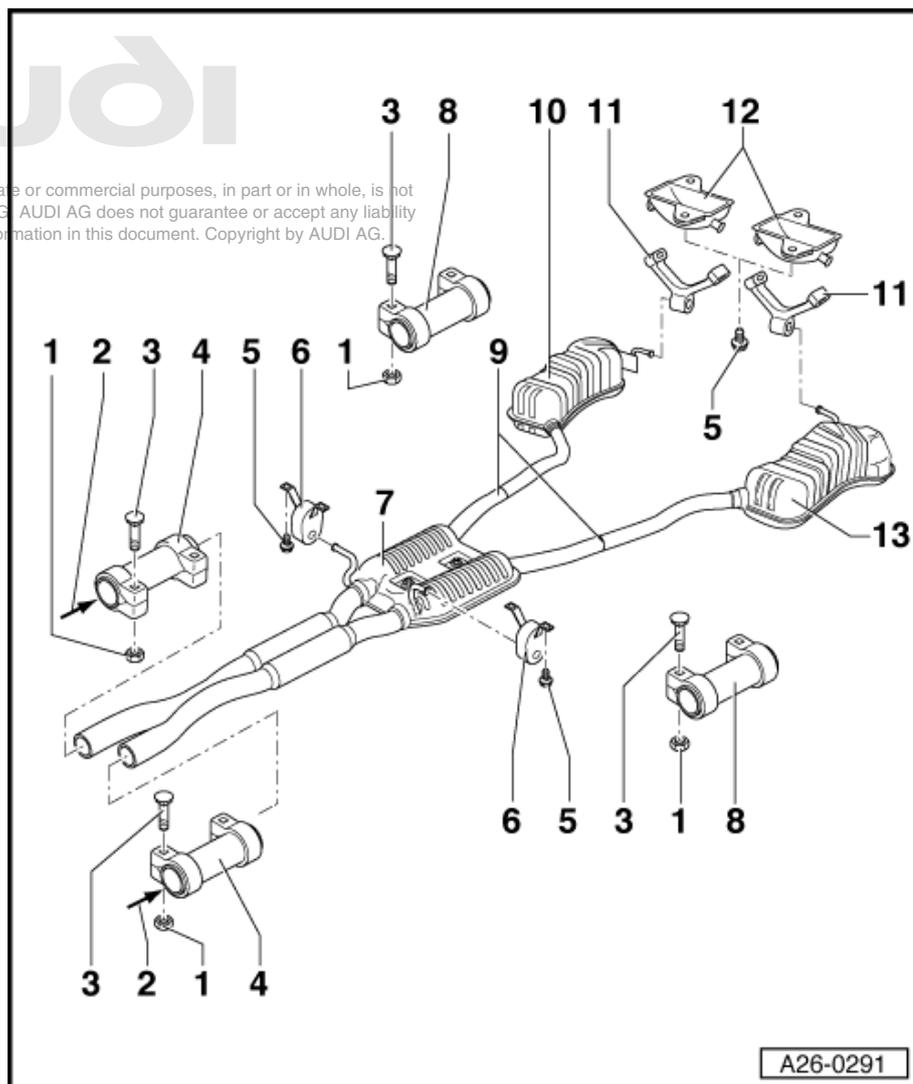
- Centre silencer and rear silencer are one unit as original equipment. For repair purposes the centre and rear silencers are supplied separately, with a double clamp for connecting the silencers
- Cutting through connecting pipe ⇒ [page 157](#)

10 - Right rear silencer

11 - Mounting

12 - Bracket

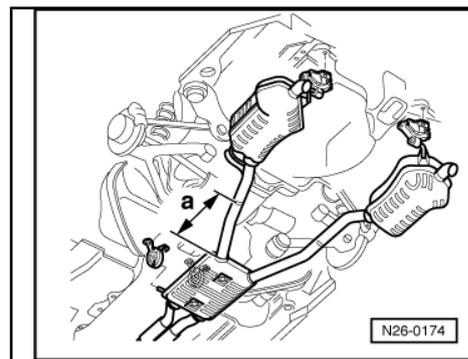
13 - Left rear silencer



A26-0291

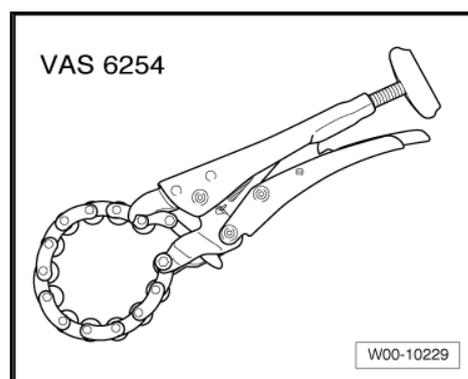
The connecting pipe can be cut through at the cutting point provided in order to renew the centre and rear silencers separately.

- ◆ The cutting point is marked by an indentation on the outside of the exhaust pipe.



Special tools and workshop equipment required

- ◆ Chain pipe cutter -VAS 6254-



- Cut through exhaust pipe at right angles with body saw (e.g. pneumatic sabre saw -V.A.G 1523 A-) at position marked.

Dimension -a- = approx. 244 mm

1.2 Removing and installing exhaust manifold

Removing

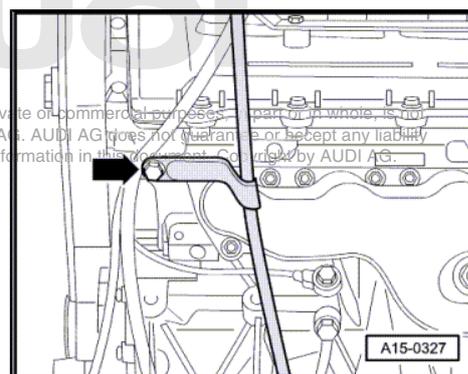
- Remove engine => [page 7](#) .

For left exhaust manifold only

- Remove guide tube for oil dipstick -arrow-.

Both exhaust manifolds

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- Unbolt exhaust manifold -arrows-.

Installing



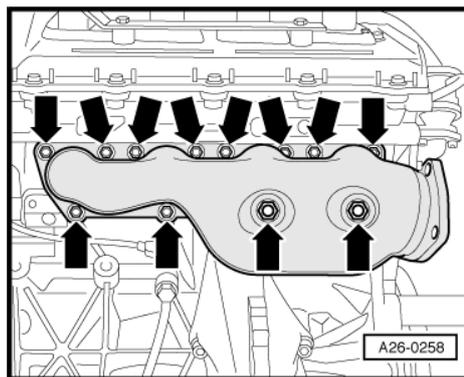
Note

- ◆ *Renew self-locking nuts.*
- ◆ *Renew gaskets.*
- ◆ *Fit new seal on guide tube for dipstick.*

- Install in reverse order.

Tightening torques

Component	Nm
Exhaust manifold to cylinder head	25
Guide tube for dipstick to cylinder head	22



1.3 Removing and installing front exhaust pipe with catalytic converter (left-side)

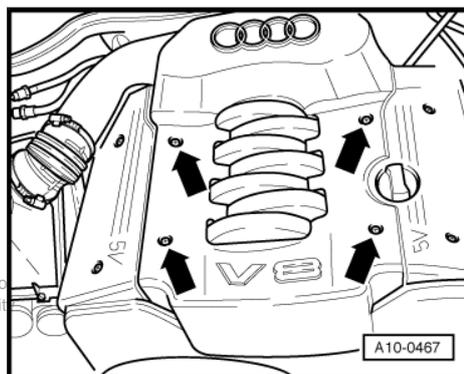


Note

- ◆ *Renew gaskets and self-locking nuts.*
- ◆ *The flexible joint (de-coupling element) in the front exhaust pipe must not be bent more than 10° - otherwise it can be damaged.*

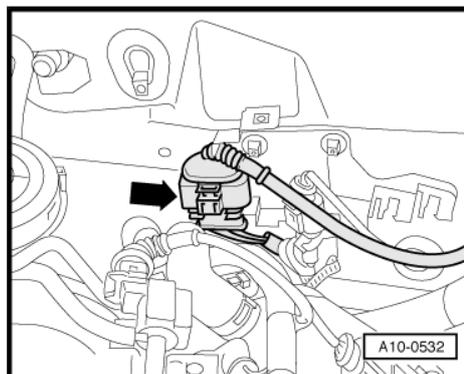
Removing

- Take off engine cover panel -arrows-.
- Take off cover above left cylinder head.
- Slacken upper bolt securing exhaust manifold to exhaust pipe.

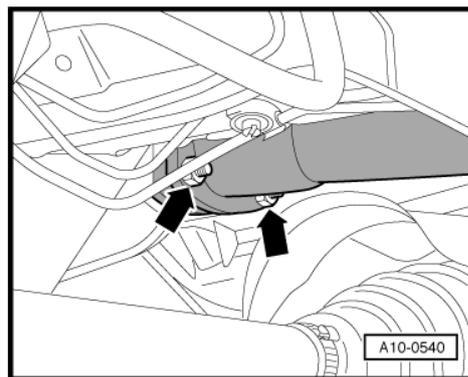


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- Unplug connector for Lambda probe (left-side) -arrow- and move wiring clear.

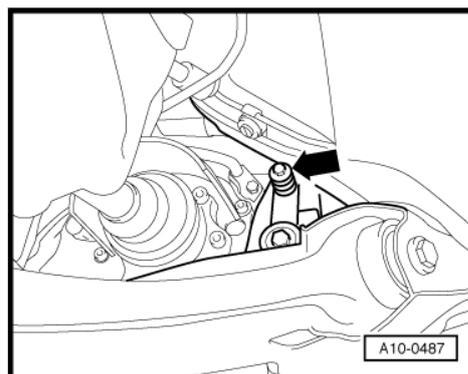


- Slacken lower bolts -arrows- securing exhaust manifold to front exhaust pipe.



- Unbolt exhaust pipe from mounting bracket -arrow-.

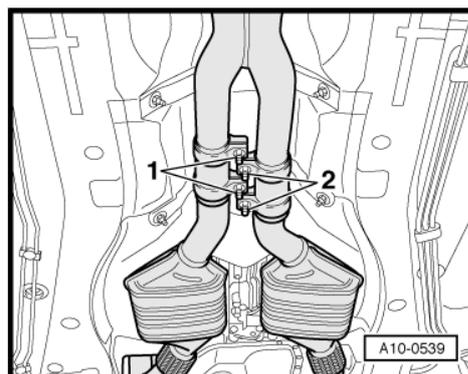
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- Slacken double clamp -1- and push towards the front.
- Carefully take out exhaust pipe.

i Note

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



Installing

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

- Align the exhaust system so it is free of stress ⇒ [page 161](#) .

Tightening torques

Component	Nm
Front exhaust pipe and catalytic converter to re- tainer bracket	25
Front exhaust pipe with catalytic converter to ex- haust manifold	25
Clamp for exhaust pipe	40

1.4 Removing and installing front exhaust pipe with catalytic converter (right-side)

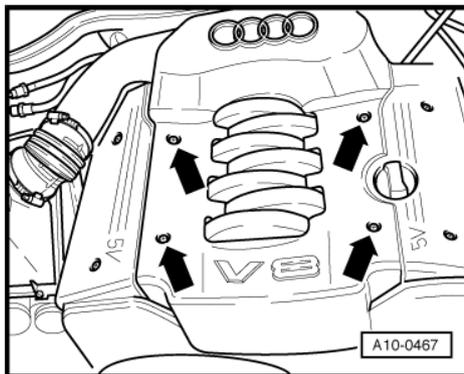
i Note

- ◆ *Renew gaskets and self-locking nuts.*
- ◆ *The flexible joint (de-coupling element) in the front exhaust pipe must not be bent more than 10° – otherwise it can be damaged.*

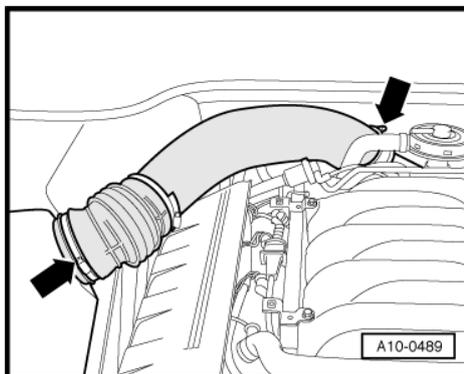


Removing

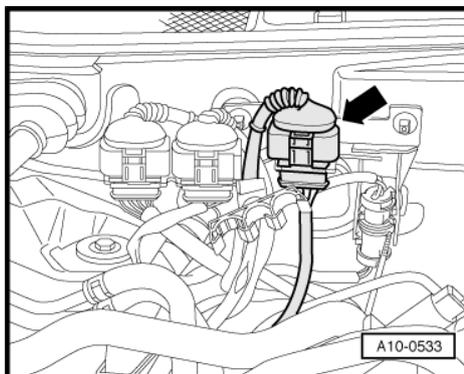
- Take off engine cover panel -arrows-.



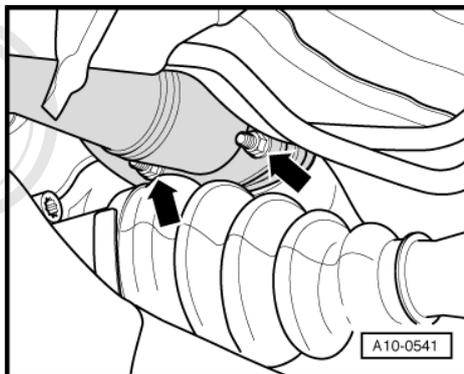
- Remove air intake pipe -arrows- between air cleaner and throttle valve unit.



- Unplug connector for Lambda probe (right-side) -arrow- and move wiring clear.
- Take off right wheel.
- Slacken upper bolt securing exhaust manifold to exhaust pipe (accessible through track rod aperture).

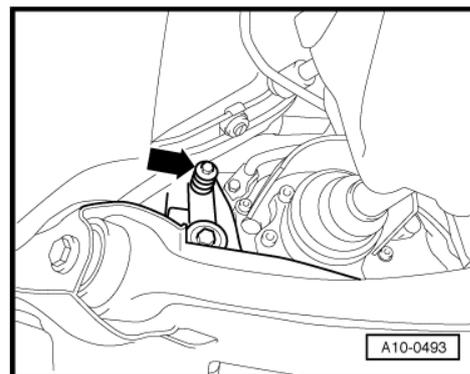


- Slacken lower bolts -arrows- securing exhaust manifold to front exhaust pipe.



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- Unbolt exhaust pipe from mounting bracket -arrow-.



- Slacken double clamp -2- and push towards the front.
- Carefully remove exhaust pipe together with catalytic converter.

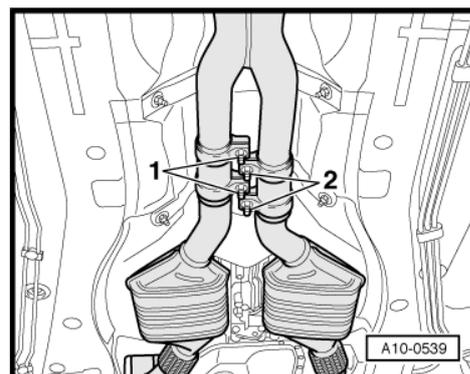
i Note

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

Installing

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

- Align the exhaust system so it is free of stress => [page 161](#) .



Tightening torques

Component	Nm
Front exhaust pipe and catalytic converter to re-tainer bracket	25
Front exhaust pipe with catalytic converter to ex-haust manifold	25
Front left wheel	120

1.5 Stress-free alignment of exhaust system

Align the exhaust system as follows to avoid stresses in the system and prevent noise being transmitted:

- ◆ It is important to accurately align and secure the front exhaust pipes and catalytic converters before installing the exhaust system components.
- ◆ Slacken all bolt connections on exhaust system (except for exhaust manifold and flange connection for catalytic converter / intermediate pipe).
- ◆ The exhaust system must be aligned when cold.
- ◆ The work should be performed in the sequence described below.
- ◆ Dimensions given in the illustrations are only approximate.

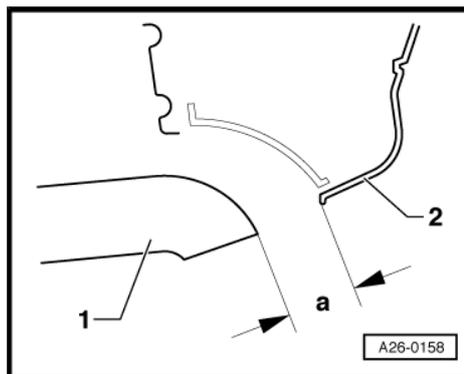
Vehicles without clamp between centre silencer and rear silencer

i Note

The exhaust system must be aligned when it is cool.



- Unfasten bolt connections of front clamps between catalytic converters and main silencer.
- Push exhaust system forwards until tailpipes -1- are at a distance -a- from bumper -2-.
- ◆ Dimension -a- = min. 40 mm
- Tighten bolt connections for front clamps between catalytic converters and main silencer evenly to 40 Nm; installation position ⇒ [page 163](#) .



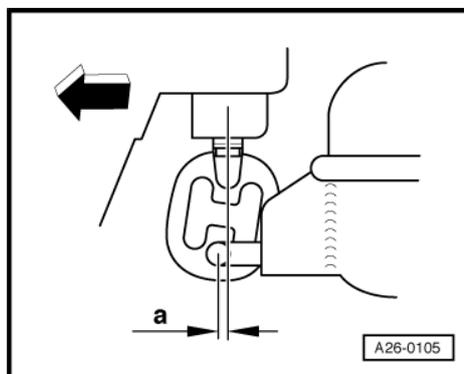
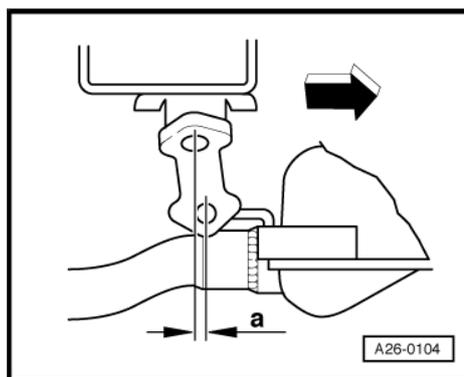
- ◆ If the distance between the tailpipes and bumper is correct, the preloading at the rear mounting of the rear silencer will be -a- = 7...11 mm.

Vehicles with clamp between centre silencer and rear silencer

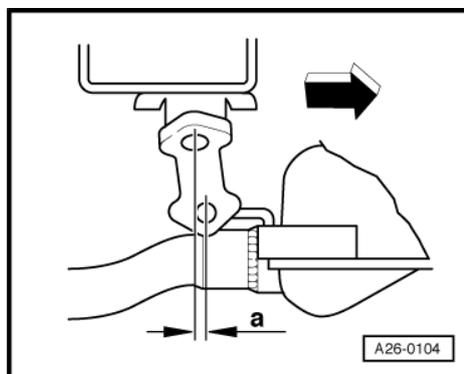
i Note

On vehicles with clamp fitted between centre silencer and rear silencer, it is also necessary to align the centre silencer.

- Unfasten bolt connections of front clamps between catalytic converters and main silencer.
- Push exhaust system towards front of vehicle -arrow- so that mounting (rear left) for centre silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolt connections for front clamps between catalytic converters and main silencer evenly to 40 Nm; installation position ⇒ [page 163](#) .

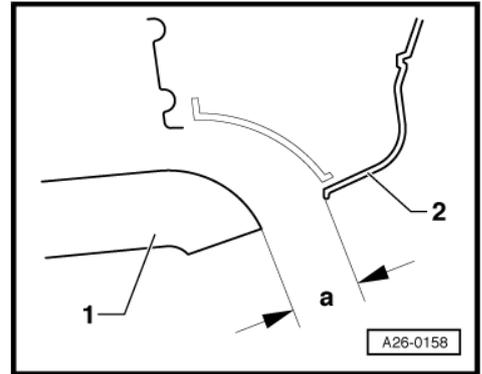


- Push rear silencer towards front of vehicle -arrow- until rubber mounting (rear right) on rear silencer is preloaded by -a- = 7 ... 11 mm.
- Tighten bolt connections for rear clamp between main silencer and rear silencer evenly to 40 Nm; installation position ⇒ [page 163](#) .



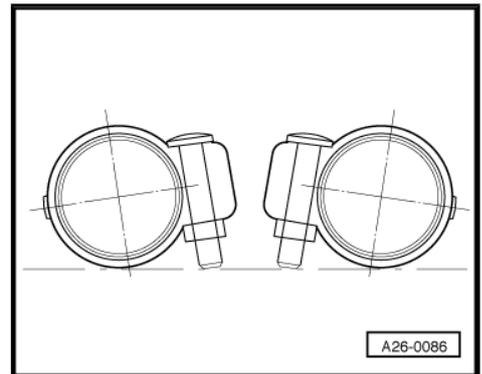
- ◆ If preload of mountings is correct, there will be a distance -a- between tailpipes -1- and bumper -2-.
- ◆ Dimension -a- = min. 40 mm

Installation position of front double clamp

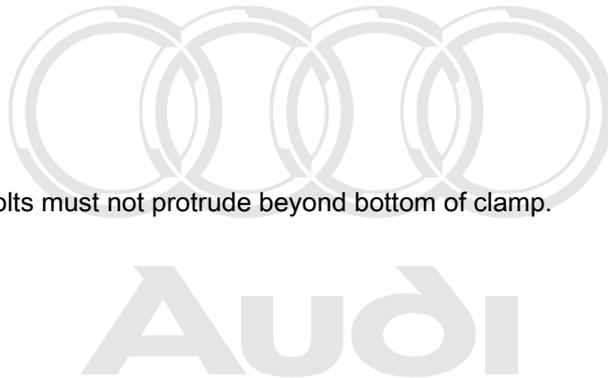


- Ends of bolts must not protrude beyond bottom of clamp.

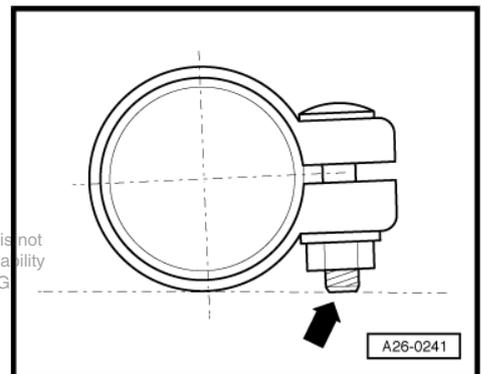
Installation position of rear double clamp



- Ends of bolts must not protrude beyond bottom of clamp.



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1.6 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.