

Audi 100 1991 ➤

5-cylinder Engine (2-valve), Mechanical Components

Engine ID	AAR								
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Edition 12.2001

Audi

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List of Workshop Manual Repair GroupsList of Workshop Manual Repair Groups

Audi 100 1991 ➤

5-cylinder Engine (2-valve), Mechanical Components

Repair Group

00 - Technical data

10 - Removing and installing engine

13 - Crankshaft group

15 - Cylinder head, Valve gear

17 - Lubrication

19 - Cooling system

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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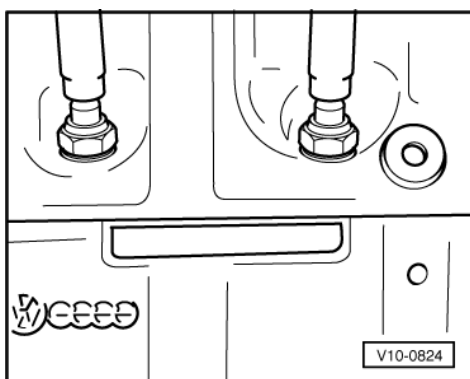
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00 - Technical data

1 - Technical data

1.1 - Technical data

1.2 - Engine number



-> The engine number ("Engine code" and "Serial number") can be found on the left of the cylinder block.

Additionally, there is a sticker on the toothed belt guard with "Engine code" and "Serial number".

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

1.3 - Engine data

Code letters	AAR
Capacity l	2.3
Output kW at rpm	98/5500
Torque Nm at rpm	186/4000
Bore ø in mm	82.5
Stroke mm	86.4
Compression	10.0
RON	95
Injection-/Ignition system	KE III Jetronic/fully-electronic ignition system (FEI)
Firing order	1-2-4-5-3
Knock control	yes
Lambda control	yes
Catalytic converter	yes
Turbocharging	no
Exhaust gas recirculation system	no
Intake manifold changeover	no

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Code letters	AAR
Camshaft timing control	no

Code letters	AAR
Valve timing with 1 mm valve lift and 0 mm valve play	
Inlet opens after TDC	4°
Inlet closes after BDC	1°
Exhaust opens before BDC	46°
Exhaust closes before TDC	5°

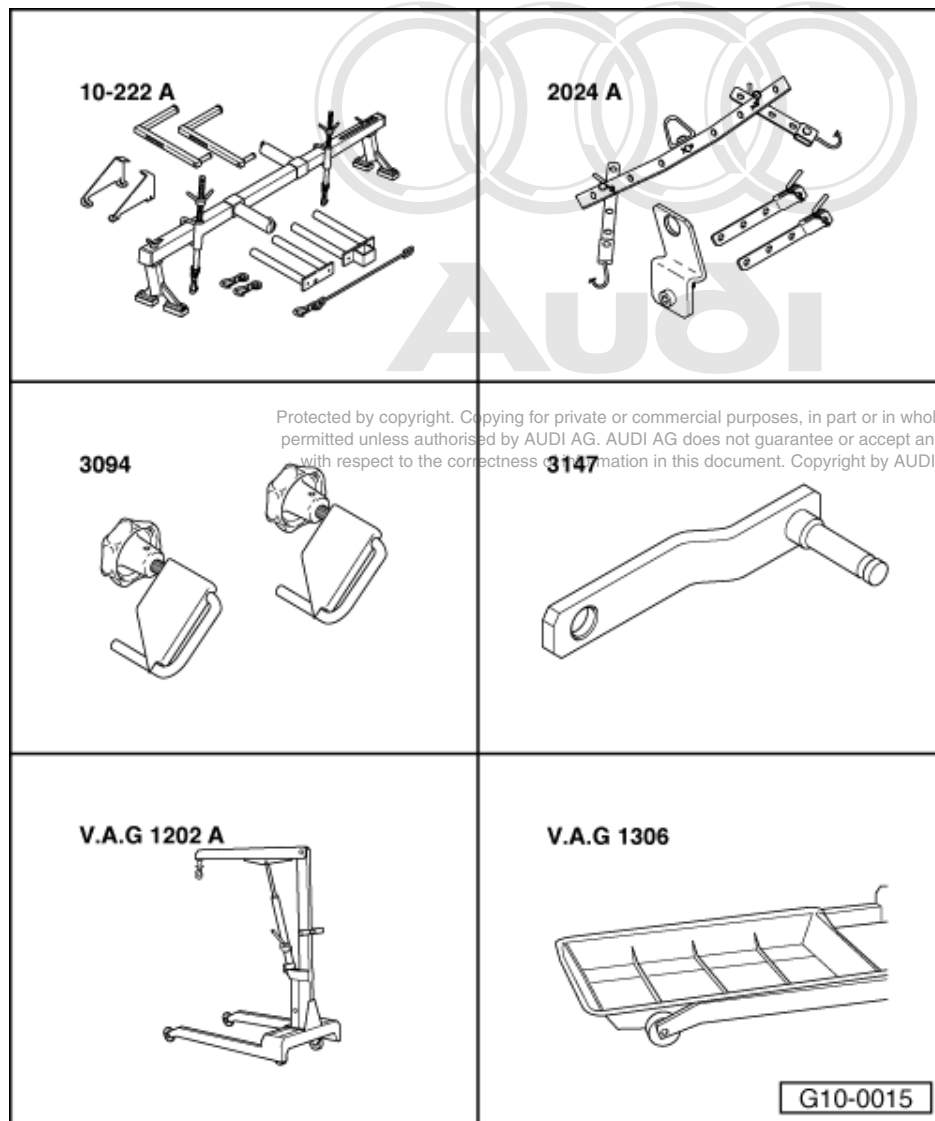


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10 - Removing and installing engine

1 - Removing and installing engine

1.1 - Removing and installing engine



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Special tools and workshop equipment required

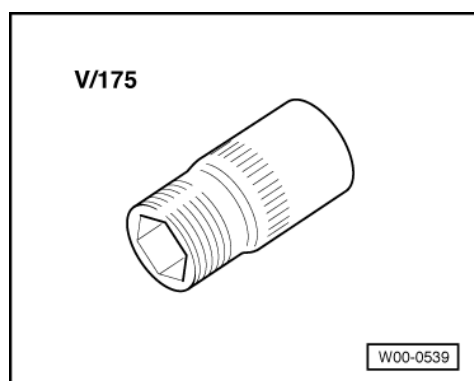
- ♦ Support bar 10-222 A with 10-222 A/2
- ♦ Lifting tackle 2024 A
- ♦ Hose clamps 3094
- ♦ Gearbox support 3147
- ♦ V.A.G 1202 A

or

- ♦ Workshop crane VAS 6100



- ♦ Drip tray V.A.G 1306



- ♦ 15 mm socket attachment Matra V/175 (Vehicles with automatic gearbox)

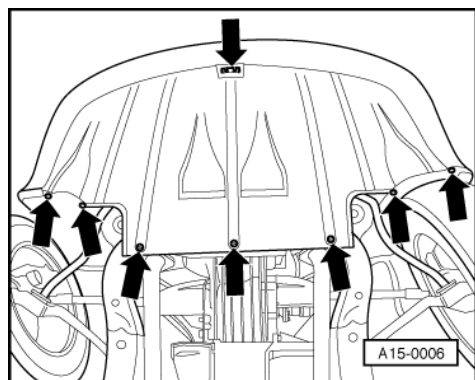


1.2 - Removing

Notes:

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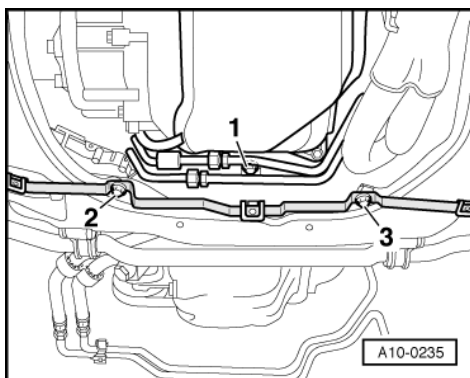
- ♦ Take out engine towards top without gearbox.
 - ♦ Collect drained coolant in a clean container for re use or disposal.
 - ♦ Renew all cut and defective cable ties. Refit cable ties in the same position when installing the engine.
- Observe or obtain radio code on vehicles with coded radio.
 - Disconnect earthing strap at battery with ignition switched off.



Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

- Open the cover of the coolant expansion tank
- -> Remove the noise insulation -arrows-.



- -> Remove bracket for noise insulation -bolts 2 and 3-.

Vehicles with automatic gearbox:

- Unscrew bolt -1- for ATF line.

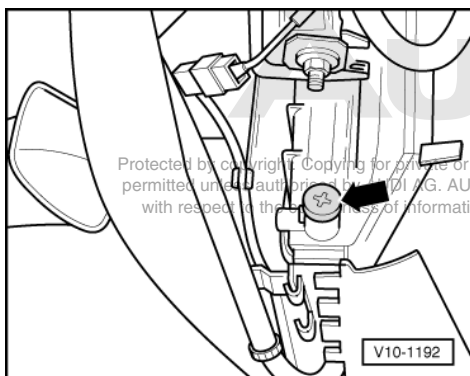
All models:

- Remove the front bumper:

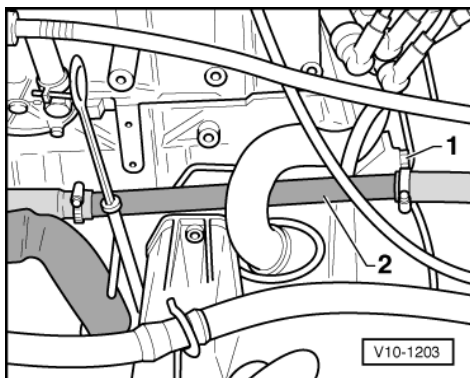
=> General Body Assembly; Repair group 63; Front bumper Front bumper

- Remove lock carrier:

=> General Body Assembly; Repair group 50; Front body Front body



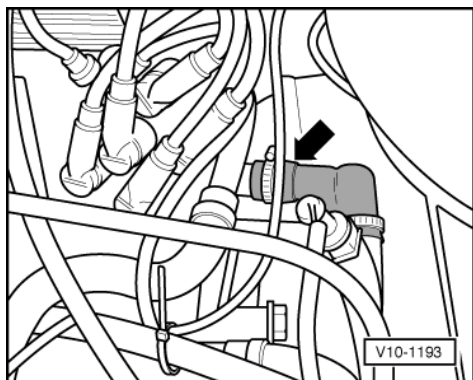
- Place drip tray V.A.G 1306 below engine.
- -> Turn drain plug -arrow- on radiator anti-clockwise. If necessary, fit drain hose on connection.



- -> Unscrew bolt -1-.
- Remove coolant hoses from coolant pipe -2-.
- Remove the coolant pipe -2-.

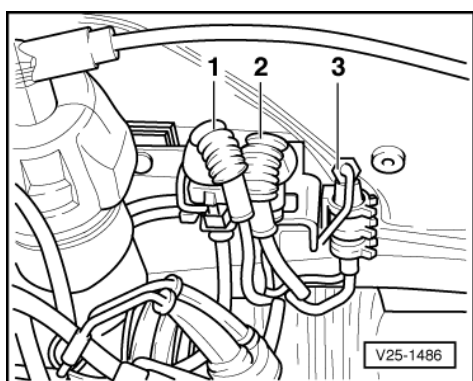


- Detach coolant hose from connection at thermostat housing.

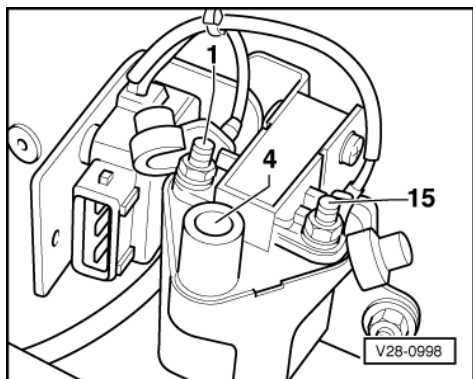


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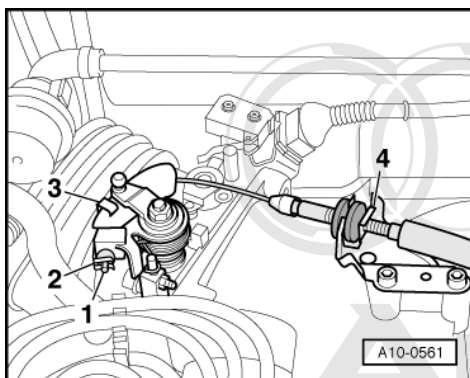
- -> Detach coolant hose -arrow- from connection at rear of cylinder block.



- -> Unplug knock sensor connector -1- and lay wiring aside.
- Detach main ignition lead from ignition coil.

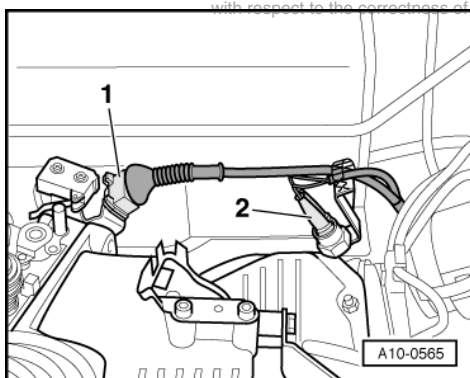


- -> Unscrew earth wire from intake manifold -arrow-.
- Unscrew earth wire at cylinder head cover.

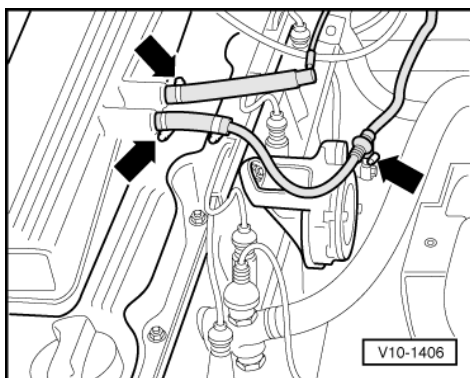


- -> Remove securing clips -2- and -3-.
- Detach throttle cable -1- at throttle valve body and support bracket (do not remove throttle cable retainer -4-). Move throttle cable to the side.

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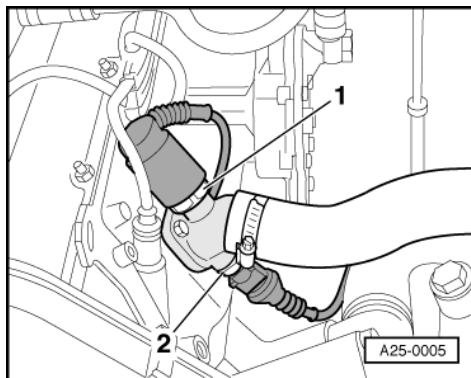
- -> Unplug connector from throttle valve switch -1-.
- Unplug connector at fan run-on thermoswitch -2-.
- Unplug connector for Hall sender at the distributor.
- Remove distributor cap leaving leads connected.
- Disconnect distributor rotor.



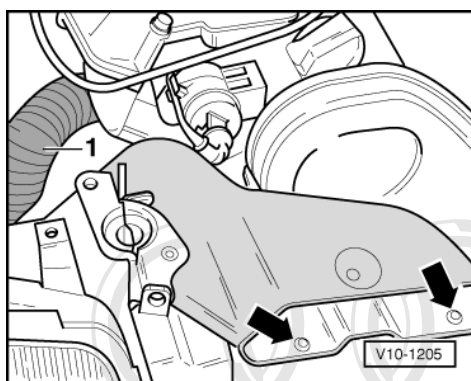
- -> Detach the vacuum hoses -arrows-.

Note:

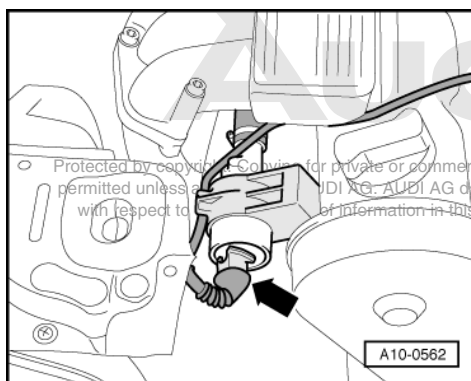
Illustration shows vehicle with air conditioner.



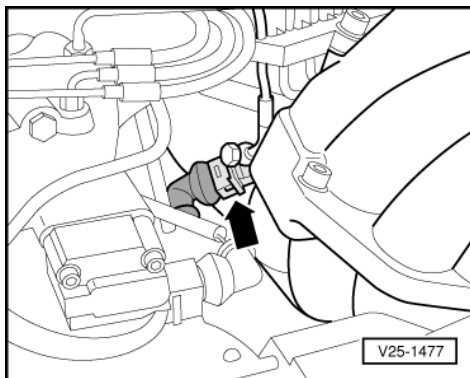
- -> Detach connectors from electronic thermoswitch -F76 -Item 1- and from coolant temperature sender - G62 -Item 2-.
- Detach oil pressure switch connectors and oil pressure switch sender.
- Disconnect electrical wiring at alternator.
- Loosen cable tie and expose electrical wiring.
- Detach coolant hose from connection on cylinder head.



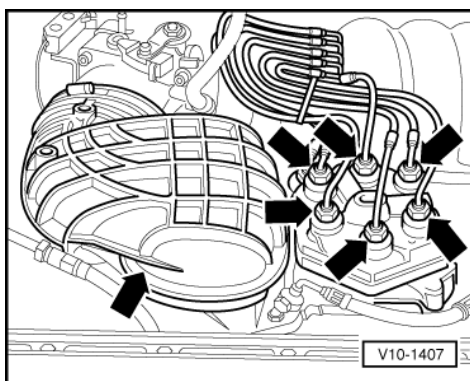
- -> Detach and remove air intake connection -arrows-.
- Detach hose -1- of intake air preheater from warm air arrester plate on exhaust manifold.



- -> Detach connector -arrow- from idling stabilisation valve.



- -> Unplug connector from cold start valve -arrow-.
- Expose engine wiring harness and place to rear.



Important

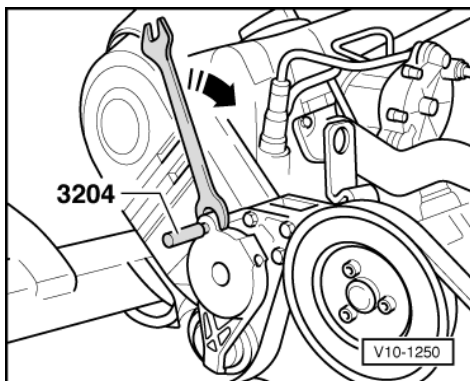
- ◆ Clean connection points on fuel distributor before detaching the fuel lines.
- ◆ The fuel system is pressurised. Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.

- -> Detach intake cowl -left arrow- from fuel distributor, unscrew injector pipes -right arrows-.

Notes:

- ◆ Carefully protect injector pipes and connections in fuel distributor from dirt.
- ◆ Leave hoses to crankcase breather and idling stabilisation valve connected to intake cowl.

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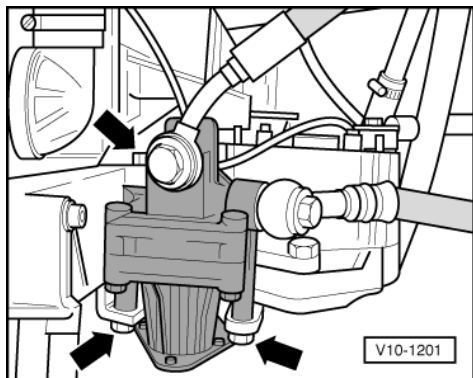




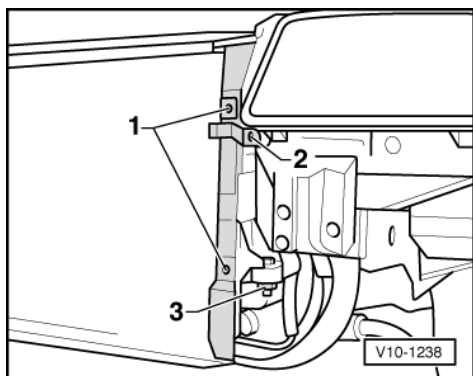
Note:

Mark the running direction with chalk or a felt-tipped pen before removing the ribbed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

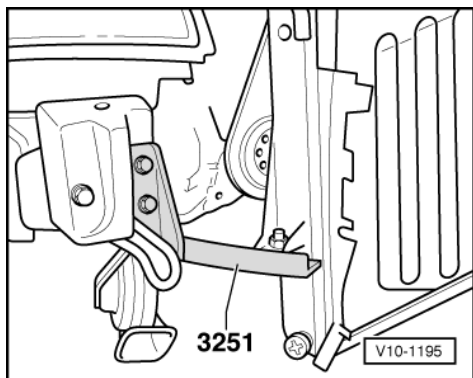
- Remove the ribbed belt guard.
- -> To slacken ribbed belt, turn tensioner in direction of arrow.
- Secure tensioner in position with pin 3204.
- Remove ribbed belt and release tensioner.



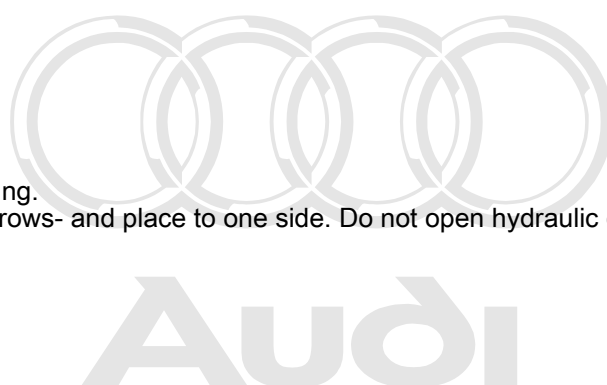
- Unbolt pulley from vane pump for power steering.
- -> Unscrew the power steering vane pump -arrows- and place to one side. Do not open hydraulic connections.



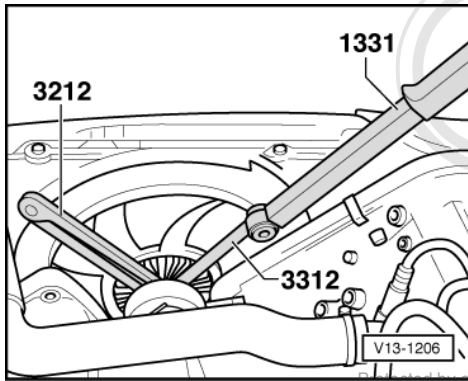
- -> Unscrew bolt -2- of retaining clip of trim on right headlight.
- Unscrew bolts -1- of air duct on left of radiator and remove air duct.
- Loosen bolts -3- on left and right of radiator.



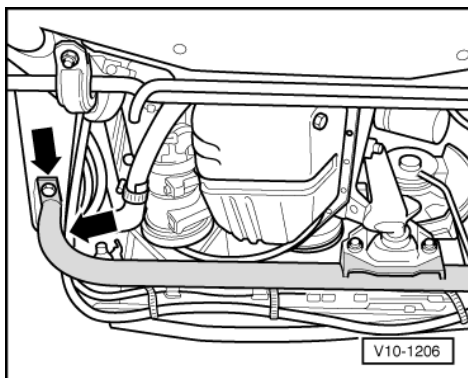
- -> Secure support 3251 on right bumper mounting and swing radiator forwards.



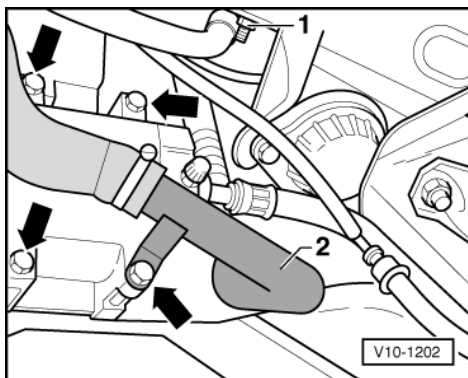
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- -> Counterhold pulley for viscous fan with 2-hole pin wrench 3212 and unscrew viscous fan with wrench 3312 (left-hand thread).
- Remove the viscous fan.



- -> Unscrew cross member -arrows- and limit stop for torque reaction support.

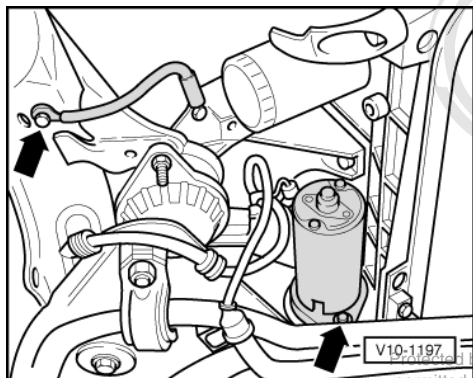


Vehicles with air conditioner:

- -> Unscrew nut -1- of refrigerant pipe retaining clamp.
- Remove coolant pipe -2-.

Important
The air conditioner refrigerant circuit must not be opened.

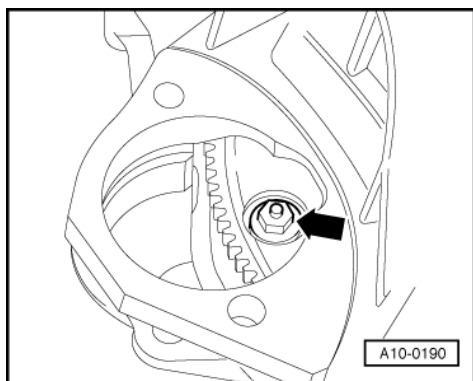
- Unscrew the A/C compressor from the bracket -arrows-.
- Attach air conditioner compressor onto longitudinal member, leaving lines connected.



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All models:

- -> Unbolt starter -bottom arrow-.
- Attach starter onto longitudinal member, leaving lines connected.
- Unscrew earth wire at body -top arrow-.

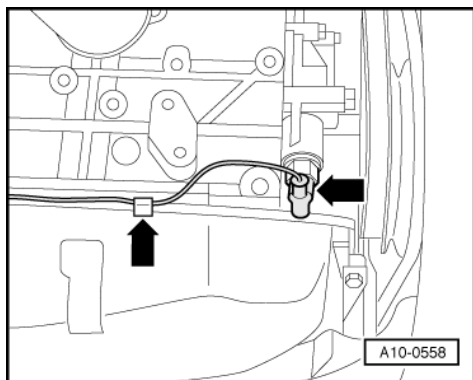


Vehicles with automatic gearbox:

- -> Use Matra V/175 socket attachment (15 mm A/F) to screw out 3 nuts of torque converter in opening in removed starter (give crankshaft 1/3 of a turn in each case).

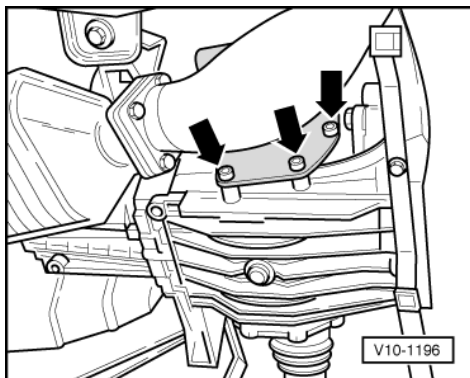
Note:

To prevent engine from turning when loosening torque converter nuts, counterhold central bolt on vibration damper.

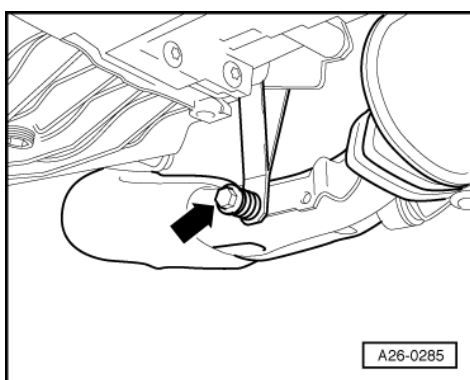


All models:

- -> Unscrew the electrical wire from oil temperature sender -arrow- and set aside.



- -> Unbolt heat shield for drive shaft on right of gearbox -arrows-.
- Unscrew exhaust manifold/front exhaust pipe nuts.



- -> Unbolt retainer for exhaust system -arrow-.
- Push exhaust system towards the rear so that studs on exhaust manifold are free.

Note:

Watch for electrical wiring of lambda probe.

- Unscrew engine/gearbox securing bolts accessible from below.

Note:

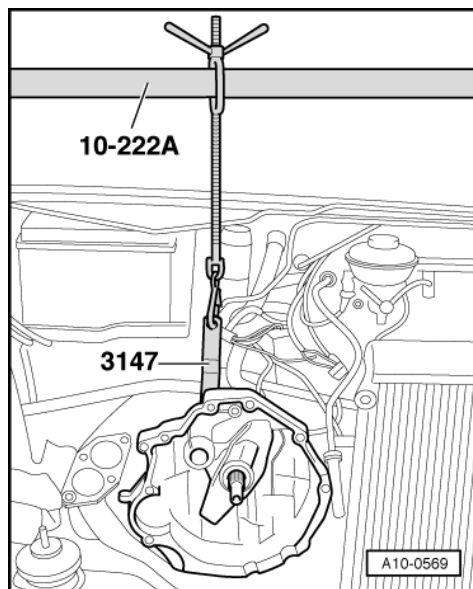
On removal, note the bolt lengths and assignment for re-installation.

- Unscrew upper engine/gearbox securing bolts. Leave one bolt in place (hand tight).

Note:

On removal, note the bolt lengths and assignment for re-installation.

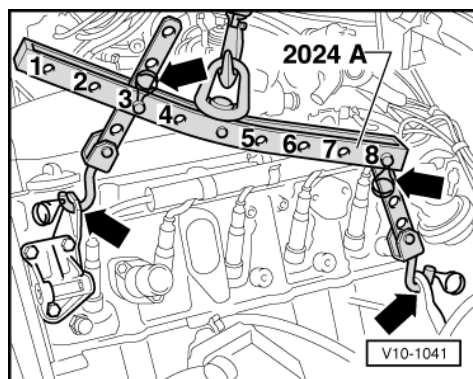
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- -> Set up support bar 10-222 A on wing panel flanges.
- Engage gearbox support 3147 in bolt hole of bell housing as shown in the illustration.
- Connect gearbox support 3147 and support bar 10-222 A.

Note:

Shown in illustration with engine removed.



- -> Attach lifting tackle 2024 A to engine and workshop lifter 1202 A.

Note:

To balance the centre of gravity of the engine, position the hook attachments as shown in the illustration.

Important

The hooks and locating pins of the lifting tackle must be secured with locking pins -arrows in illustration-.

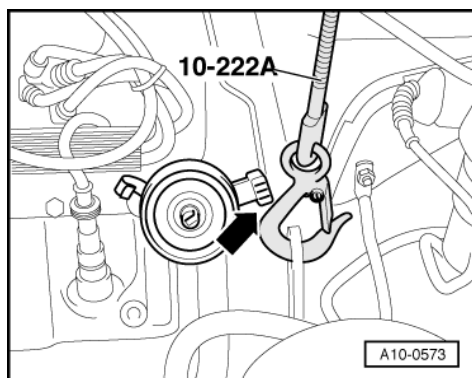
- Unscrew nuts on left and right engine mounts (top).
- Slightly raise engine.
- Remove left and right engine mounting.
- Unscrew last engine/gearbox securing bolt.

Note:

Check that all hoses and other connections between engine and gearbox have been detached.

- Raise engine.

- Tighten spindle of support bar 10-222 A.



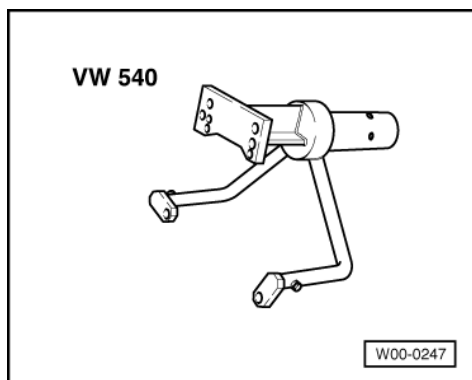
- -> Ensure that the hook of the support bar does not damage the connector -arrow- on the distributor.
- Detach engine from gearbox and lift upwards out of engine compartment.

Vehicles with automatic gearbox:

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

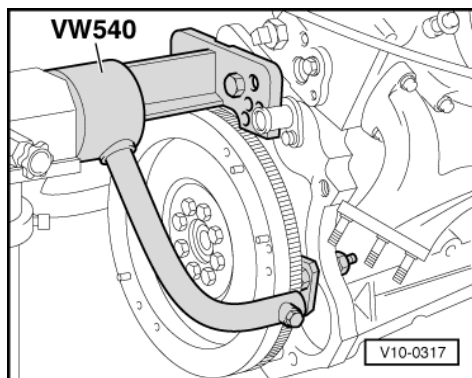
1.3 - Attaching engine to engine stand

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Special tools and workshop equipment required

- ♦ Engine and gearbox support VW 540



Procedure

-> When working on the engine, it should be secured to the repair stand using the engine bracket VW 540.

1.4 - Installing

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

Notes:

- ♦ When performing repairs, replace seals, gaskets, self-locking nuts and bolts which have a specified tightening angle.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

Vehicles with manual gearbox:

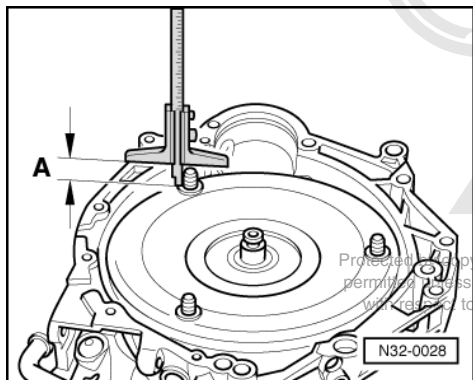
- Check clutch release bearing for wear, renew if necessary.
- Lightly lubricate splines on gearbox input shaft with G 000 100. Do not lubricate guide sleeve for release bearing.
- If necessary, check that clutch plate is properly centred.
- A ball bearing must be fitted in the crankshaft in engines on vehicles with manual gearbox. Installing ball bearing, if necessary => Page 57 .

Vehicles with automatic gearbox:

- In engines on vehicles with automatic gearbox, no ball bearing must be fitted in the crankshaft. Removing ball bearing, if necessary => Page 57 .
- To secure the torque converter on the drive plate only use the correct nuts as specified in the parts catalogue.

=> Parts List

- Secure nuts of torque converter with special tool Matra V/175.
- Before installing engine, rotate torque converter and drive plate so that one hole and one stud are level with the aperture for the starter motor.



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Checking position of torque converter

-> If the torque converter is correctly installed, the distance -A- between the contact surfaces at the bottom of the studs on the torque converter and the contact surface of the torque converter bell housing is about 23 mm.

If the torque converter has not been completely inserted, this distance will be approx. 13 mm.

Important

If the torque converter is not installed correctly, the torque converter drive plate or the ATF pump will be seriously damaged when the gearbox is attached to the engine.

All models:

- Installing engine mounts free of stress. Ensure that engine mounts are free of stress by shaking engine to align it before tightening engine mounts.
- Install A/C compressor and power steering vane pump.
- Install ribbed belt=> Page **25**.
- Adjusting limit stop for torque reaction support. Allow limit stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten bolts to 40 Nm.
- Install viscous fan => Page **144**.
- Installing lock carrier with attachments:

=> General Body Assembly; Repair group 50; Front body Front body

- Install the front bumper:

=> General Body Assembly; Repair group 63; Front bumper Front bumper

- Stress-free alignment of exhaust system => Page **171**
- Top up coolant => Page **138**.

Notes:

- ◆ Drained coolant may only be used again if the original cylinder head and cylinder block are re installed.
- ◆ Coolant must not be used again if it is dirty.

- Check throttle cable setting

=> Fuel Supply - Petrol Engines; Repair group 20; Servicing throttle mechanism Servicing throttle mechanism

- Electrical connections and routing:

=> Current Flow Diagrams, Electrical Fault-finding and Fitting Locations binder

Note:

If the battery is reattached make sure that the vehicle equipment (radio, clock, electrical window lifter) is actuated according to the operating instructions.

Important

Do not use charging unit for boost starting. There is danger of damaging the vehicle control units.

- Check oil level before starting engine.
- To interrogate fault memory:

=> KE III Jetronic/Ignition System (5-cylinder); Repair group 01; Self-diagnosis of KE III Jetronic/fully-electronic ignition (FEI); Interrogating and erasing fault memory Self-diagnosis of KE III Jetronic/fully-electronic ignition (FEI) Interrogating and erasing fault memory

Note:

Faults will have been recorded in the fault memory because the connectors have been unplugged. Therefore interrogate and erase fault memory after installing engine.



1.5 - Tightening torques

Notes:

- ♦ The tightening torques listed on this page apply only to lightly greased, oiled, phosphated, or black finished nuts and bolts.
- ♦ Additional lubricant such as engine or gearbox oil may be used, but do not use graphite lubricant.
- ♦ Do not use degreased parts.
- ♦ Tightening torque tolerance $\pm 15\%$.

Component		Nm
Bolts/nuts	M6	10
	M8	20
	M10	45
	M12	65
Except for the following:		
Engine mounting to body		40
Engine mounting to engine support		40

Component	Nm
Drive plate to	
Torque converter M10 x1	85
Front exhaust pipe to exhaust manifold	30
Front exhaust pipe to mountings on gearbox	25
Heat shield for drive shaft to gearbox	23
A/C compressor to bracket	20
Brackets for ATF lines	10
Cross member with limit stop of torque reaction support to body	40
Noise insulation bracket	10
Vane pump to bracket	20
Belt pulley to vane pump	20
Radiator to front	20
Hose clamps	2

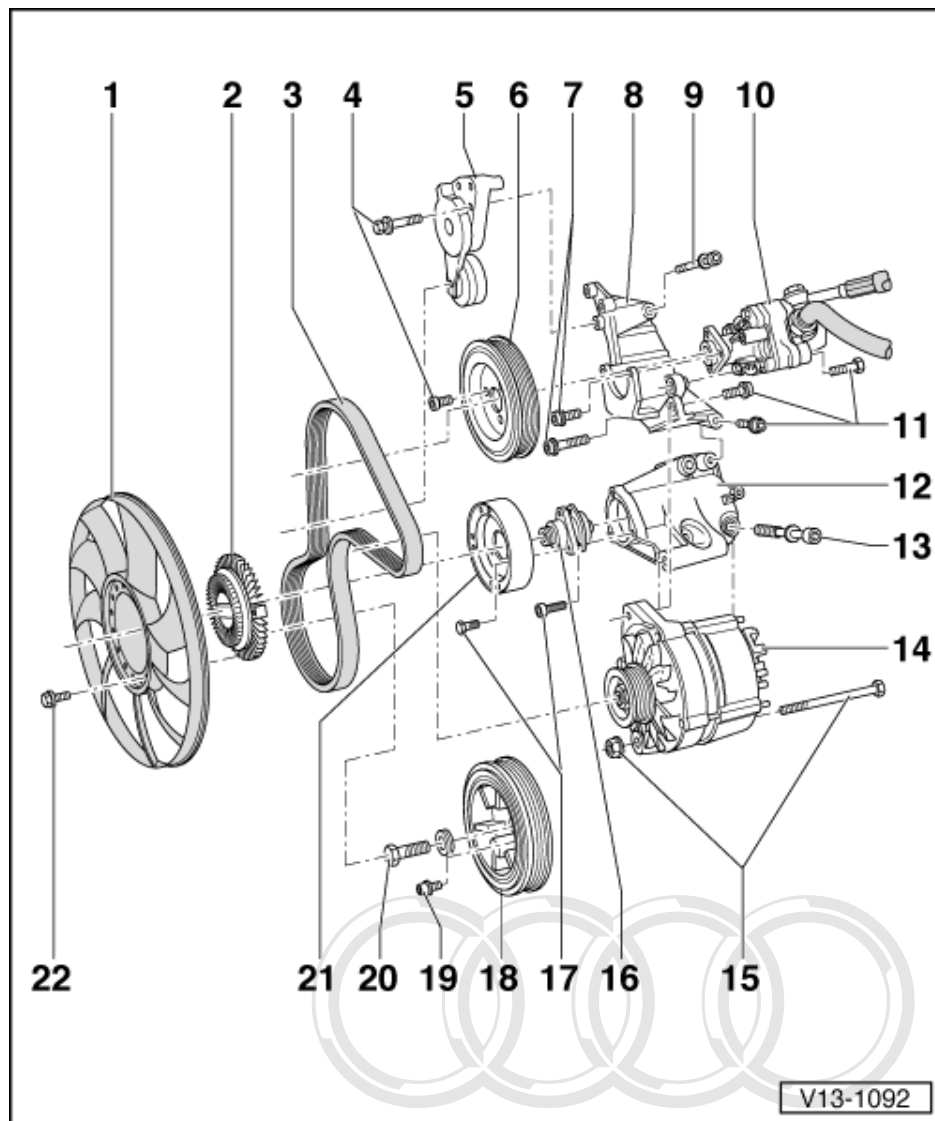


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13 - Crankshaft group

1 - Dismantling and assembling engine

1.1 - Dismantling and assembling engine



1.2 - Ribbed belt drive for vane pump, alternator and viscous fan

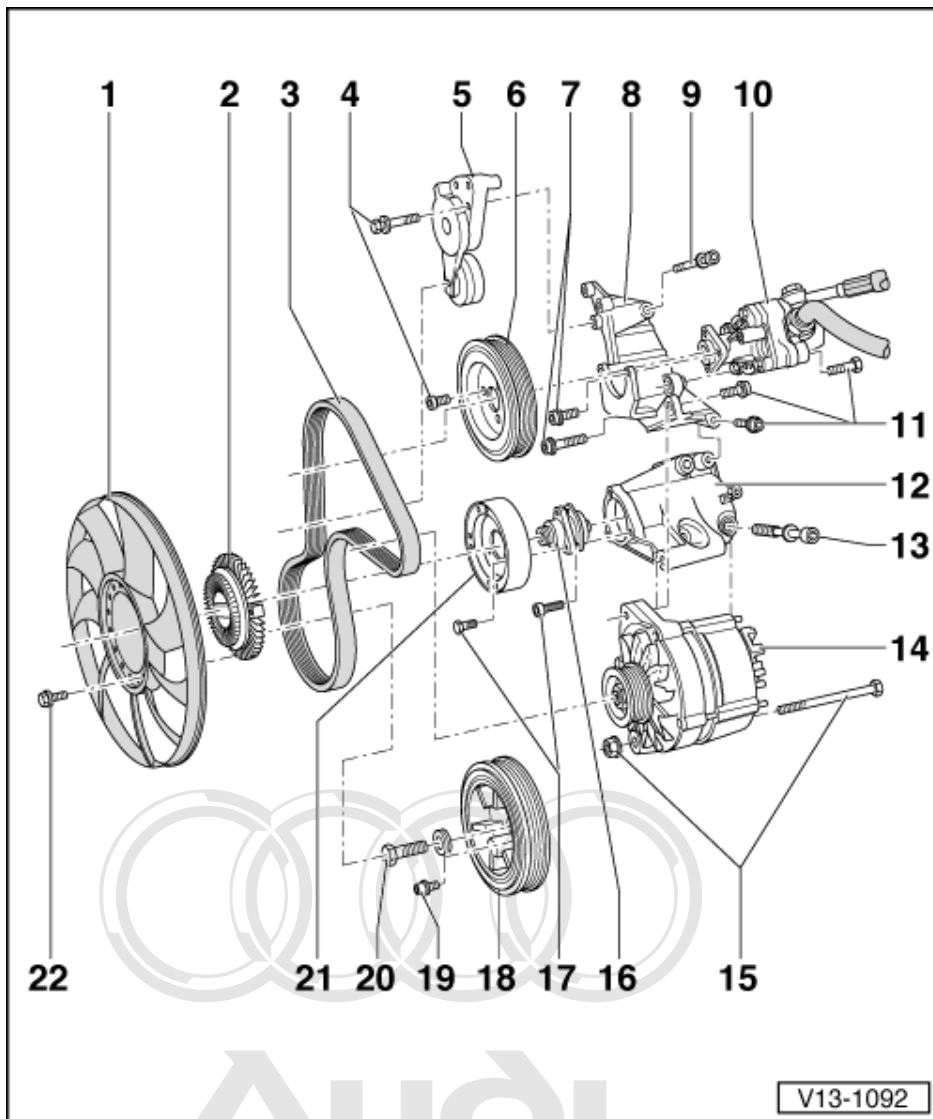
Note:

Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted without the written permission of Audi AG. *Mark the running direction with chalk or felt pen before removing the ribbed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*

1 Fan wheel

- ◆ For viscous fan
- ◆ "FRONT" marked on outer race must point in direction of travel
- ◆ Removing and installing

=>Page 144 .



2 Viscous coupling

- ◆ Switching temperature: 72...80 °C ambient temperature at the viscous coupling
- ◆ Checking => Page 145
- ◆ Removing and installing =>Page 144 .

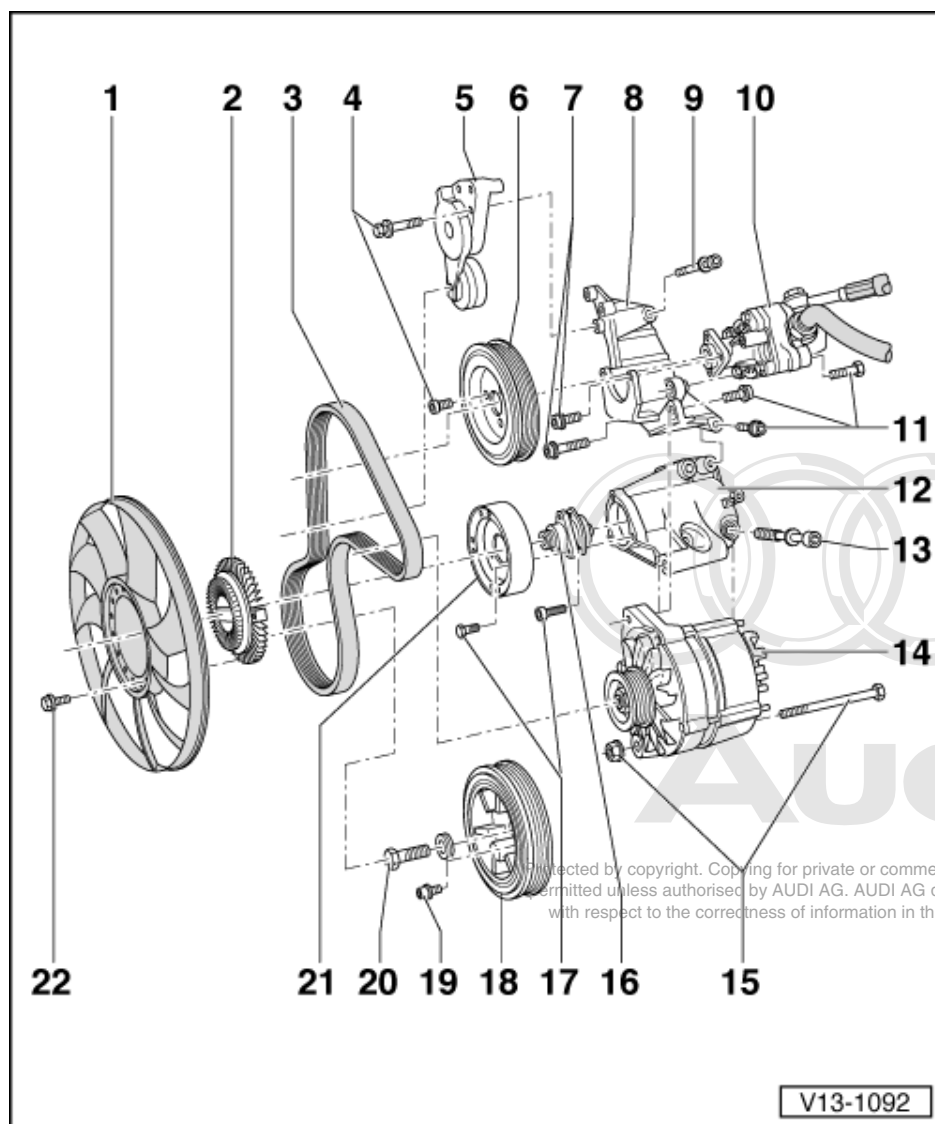
3 Ribbed belt

- ◆ Check for wear
- ◆ Do not kink
- ◆ Removing and installing
=>Page 24 .
- ◆ Routing of ribbed belt
=>Fig. 24
- ◆ Ribbed belt on vehicles with air conditioner=>Fig. 24

4 20 Nm

5 Tensioner for ribbed belt

- ◆ Swivel with open-ended spanner to slacken ribbed belt => Page 25 .
- ◆ Secure in position with mandrel 3204



6 Belt pulley

- ♦ For vane pump

7 20 Nm

8 Bracket

- ♦ For vane pump

9 20 Nm

10 Vane pump

- ♦ For power steering
- ♦ Removing and installing:

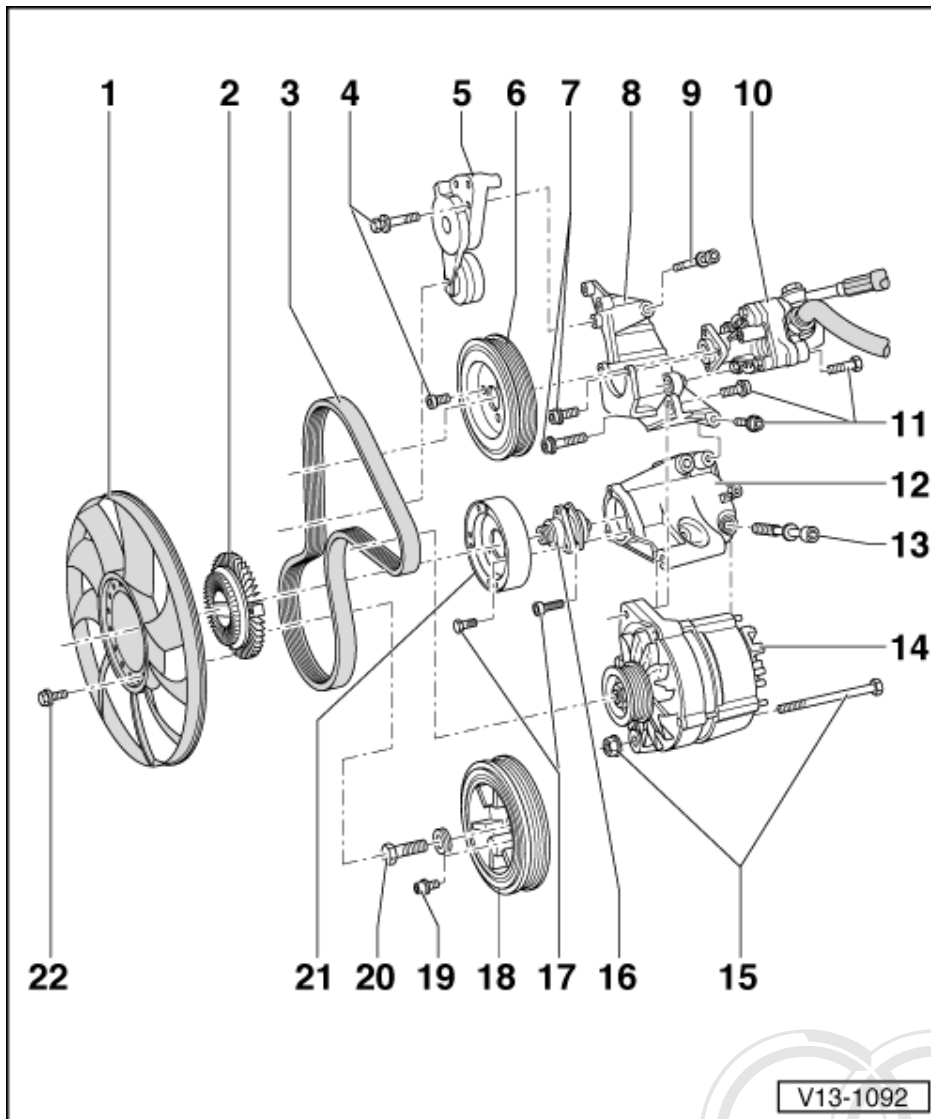
=> FWD and 4WD Running Gear; Repair group 48; Exploded view: Vane pumps Exploded view: Vane pumps

11 20 Nm

12 Bracket

- ♦ For alternator

13 45 Nm

**14 Alternator**

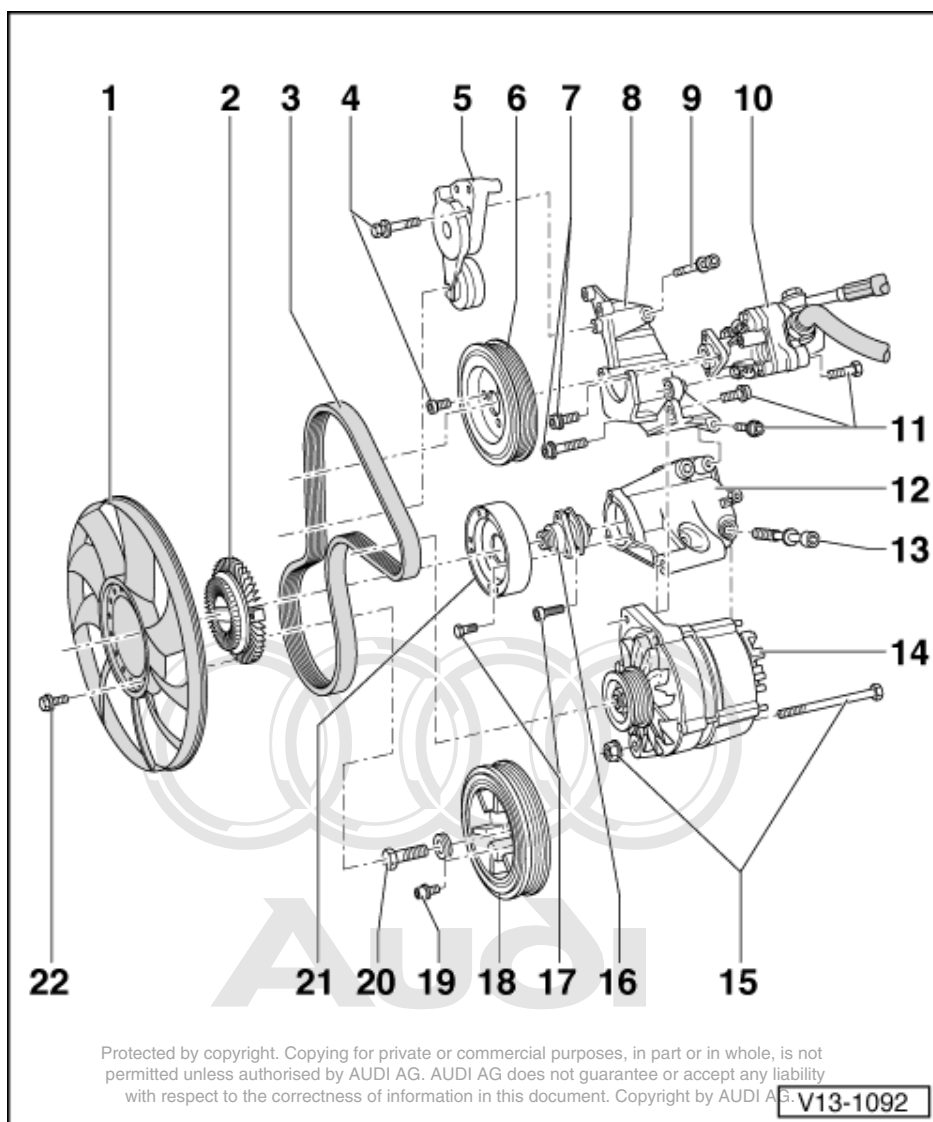
- ◆ Removing:
 - Disconnect battery earthing strap
 - Removing ribbed belt
=>Page 24 .
 - Disconnect wiring from alternator
 - Disconnect the connector and expose wiring.
 - Unscrew bolts from top and bottom from bracket.
 - Remove alternator
- ◆ To facilitate attachment of the alternator drive back bush for lower securing bolt slightly at bracket

15 45 Nm**16 Mounting**

- ◆ For viscous fan
- ◆ Check for ease of movement
- ◆ Removing and installing
=>Page 144 .

17 10 Nm

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**18 Vibration damper**

- ♦ Can only be installed in one position
- ♦ Removing and installing
=>Page 26 .

19 20 Nm**20 Central bolt**

- ♦ Replace
- ♦ Coat turns and contact surface of bolt body with sealing paste
- ♦ Sealing paste

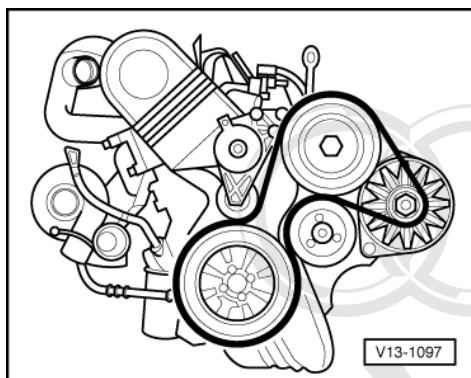
=> Parts List

- ♦ Counter hold with 3256 to loosen and tighten
- ♦ Tightening torque 350 Nm using special tool 2079
- ♦ Tightening torque 450 Nm without special tool 2079
- ♦ Removing and installing
=>Page 26 .

21 Belt pulley

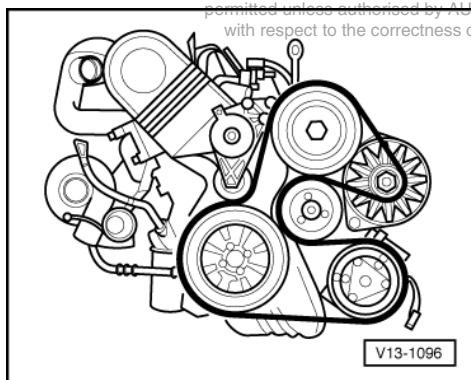
- ♦ For viscous fan
- ♦ Removing and installing
=>Page 144 .

22 10 Nm



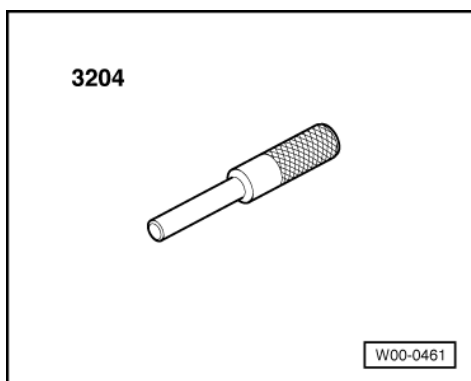
-> Fig.1 Ribbed belt routing on vehicles without air conditioner

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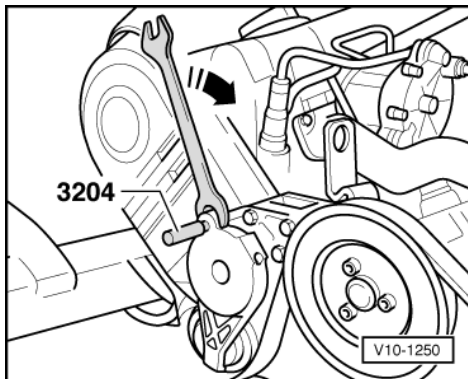
-> Fig.2 Ribbed belt routing on vehicles with air conditioner

1.3 - Removing and installing ribbed belt



Special tools and workshop equipment required

- ♦ Mandrel 3204



Removing

Note:

Mark the running direction with chalk or a felt-tipped pen before removing the ribbed belt. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Remove the ribbed belt guard.
- -> To slacken ribbed belt, turn tensioner in direction of arrow.
- Secure tensioner in position with mandrel 3204.
- Remove secured tensioner for ribbed belt.
- Take out ribbed belt.

Installing

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

Note:

Ensure that the ribbed belt is properly seated on the pulleys when installing.

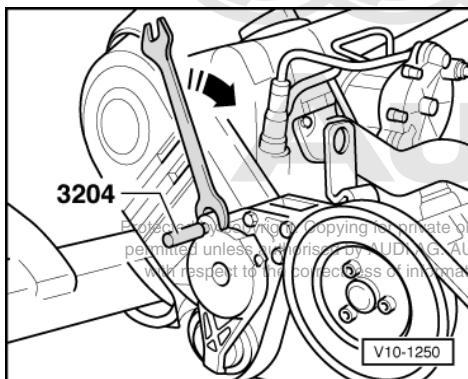
- Insert ribbed belt.
- Tighten the tensioner secured with mandrel 3204.
- Fit ribbed belt.
- Check that ribbed belt is properly seated.

Vehicles without air conditioner:

- Routing of ribbed belt => Fig. 24

Vehicles with air conditioner:

- Routing of ribbed belt => Fig. 24



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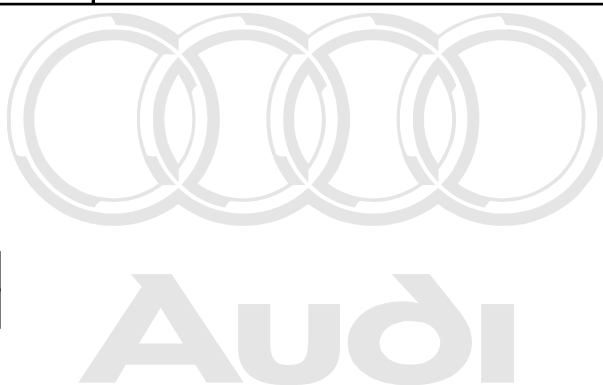


All models:

- -> Tension ribbed belt by removing mandrel 3204.
- Start engine and check belt running.

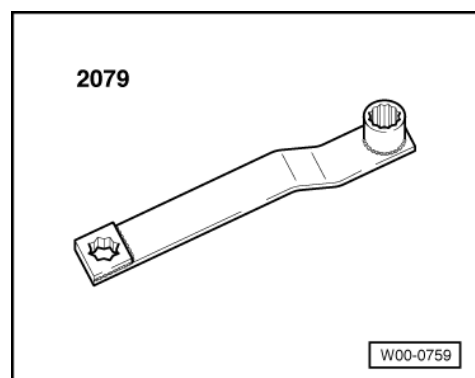
Tightening torque

Component	Nm
Ribbed belt tensioner to retainer	20



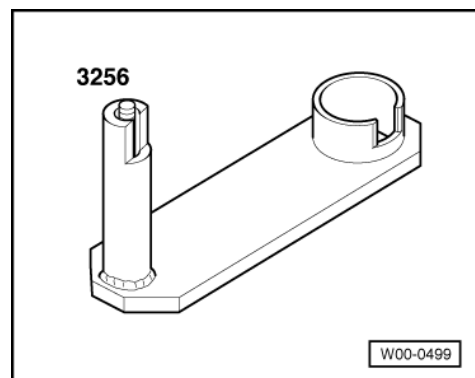
1.4 - Removing and installing vibration damper

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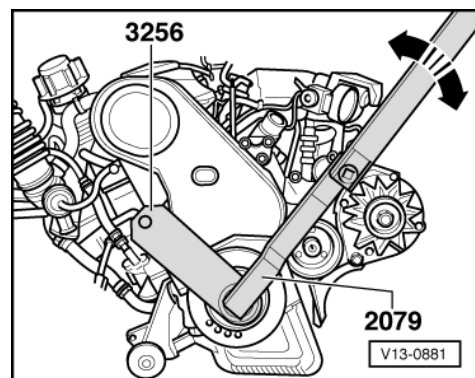


Special tools and workshop equipment required

- ♦ Spanner for vibration damper 2079



- ♦ Counterhold for vibration damper 3256



Removing

- Ribbed belt must be removed =>Page **24** .
- -> Insert vibration damper counterhold 3256 as illustrated, and unscrew central bolt.
- Unscrew the 4 securing bolts (M8) of vibration damper and remove vibration damper.

Installing

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

- Tighten central bolt of vibration damper (use counterhold 3256):
 - Tightening torque with special tool 2079: 350 Nm

Important

The tightening torque of 350 Nm only applies in conjunction with special tool 2079. The tool must be aligned with the torque wrench.

- Tightening torque without special tool 2079: 450 Nm
- Install ribbed belt=> Page **25** .

Tightening torques

Component	Nm
Vibration damper with toothed belt to crankshaft 1)	
using special tool 2079	350
without special tool 2079	450
Toothed belt tensioner to cylinder block	10
Toothed belt guard - lower	10

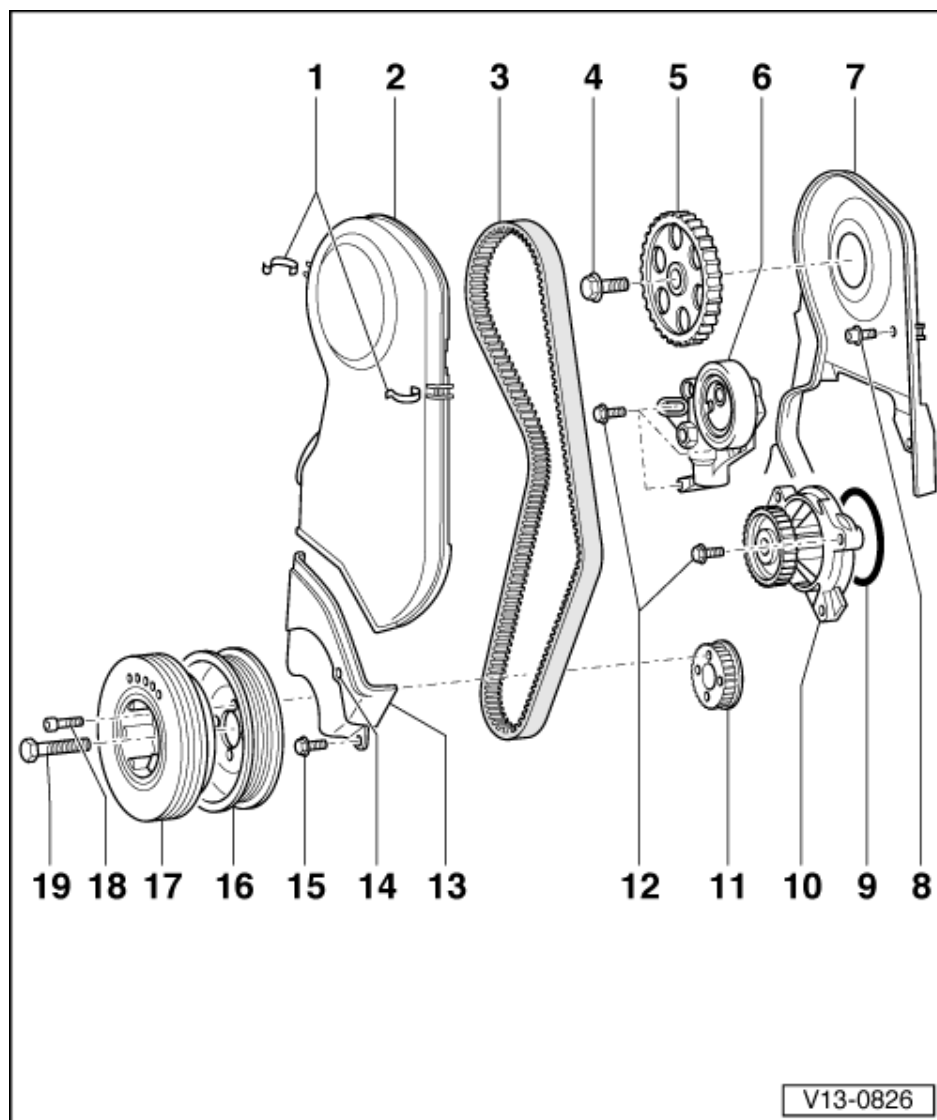
- 1) Always fit new central bolt



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1.5 - Toothed belt drive



Note:

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

1 Bracket

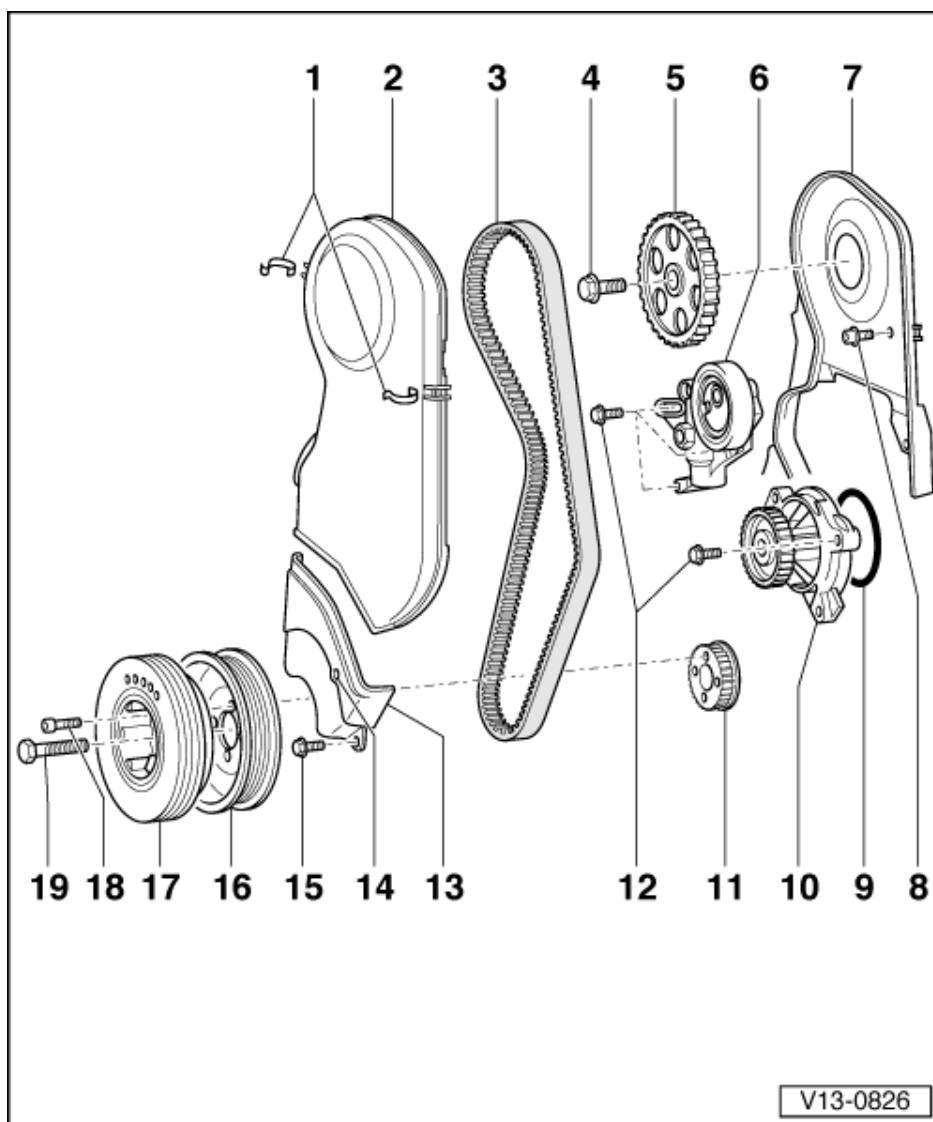
- ◆ 2 off

2 Toothed belt guard - top

3 Toothed belts

- ◆ Mark running direction with chalk or felt pen before removing
- ◆ Check for wear
- ◆ Removing => Page 33
- ◆ Install (adjust valve timing) => Page 37.
- ◆ Always adjust toothed belt tension when engine is cold.

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4 65 Nm

- ♦ Counter hold with 3036 to loosen and tighten

5 Camshaft sprocket

- ♦ To remove and install, first remove toothed belt from camshaft sprocket => Page 40
- ♦ Installation position located by Woodruff key

6 Tensioning roller

- ♦ With tensioner
- ♦ Always adjust toothed belt tension when engine is cold

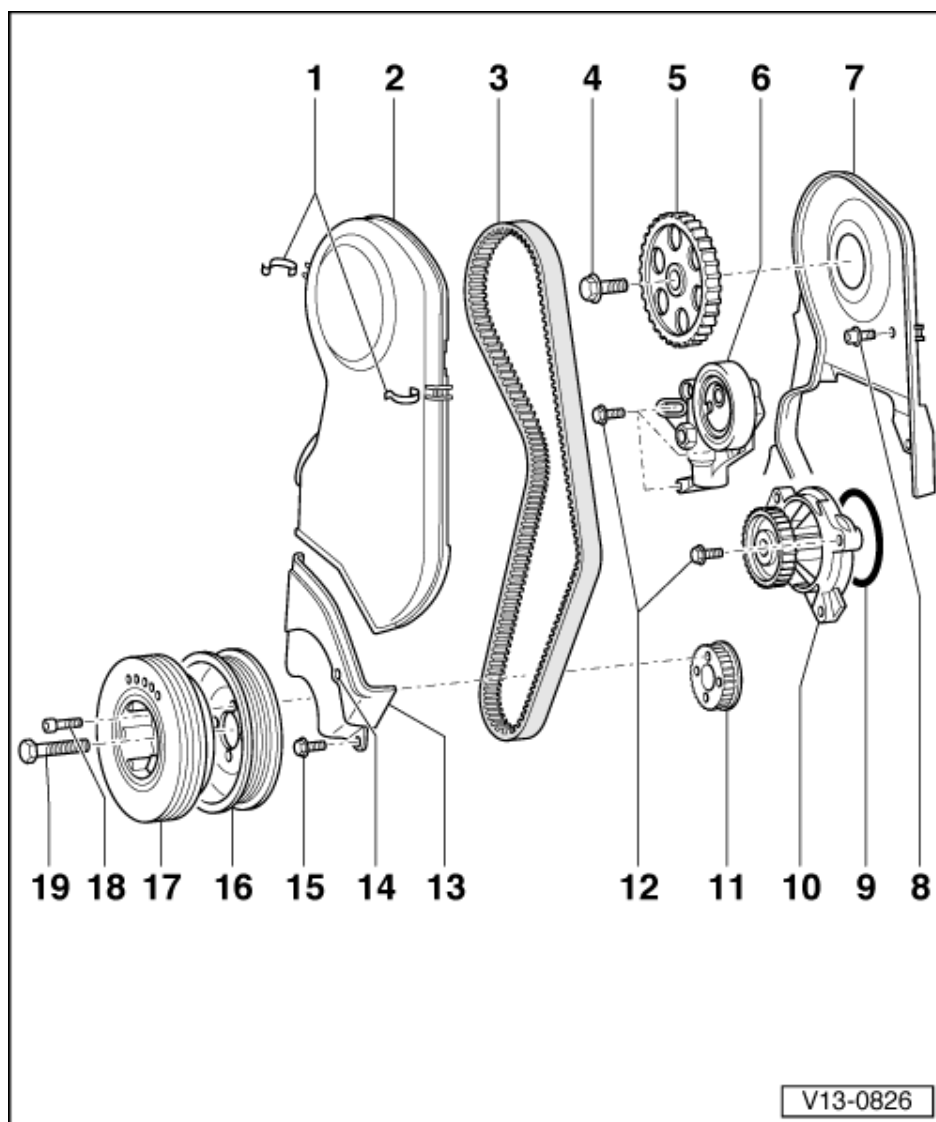
7 Toothed belt guard - rear

8 10 Nm

9 O-ring

- ♦ Replace
- ♦ Lubricate with coolant

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10 Coolant pump

- ◆ Check for ease of movement
- ◆ Removing and installing
=> Page 142

11 Crankshaft sprocket

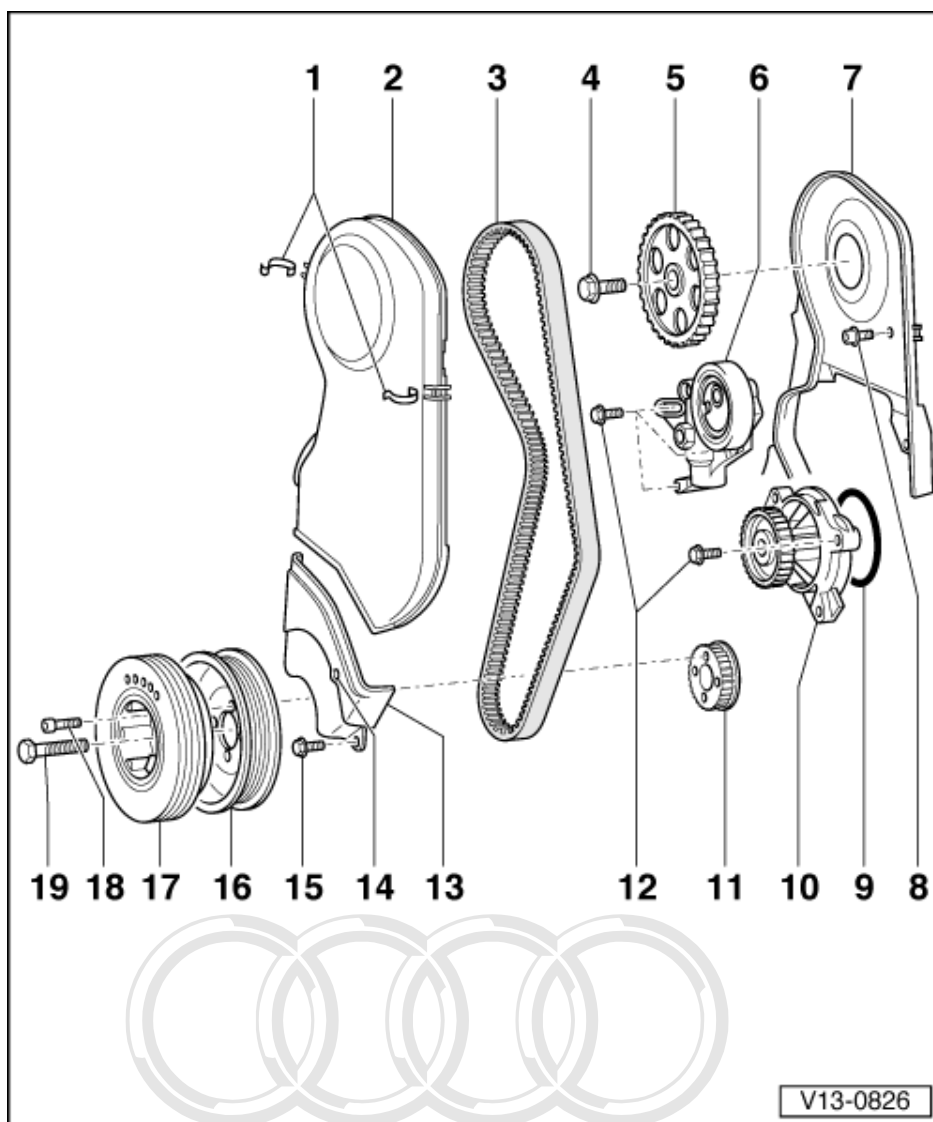
- ◆ Contact surface between sprocket and crankshaft must be free of oil
- ◆ Can only be installed in one position

12 Bolt

- ◆ Tighten M6 hexagon bolt to 10 Nm
- ◆ Tighten M8 hexagon bolt to 20 Nm
- ◆ Tighten M8 hexagon socket head bolt to 30 Nm



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13 Toothed belt guard - lower

14 TDC marking

15 10 Nm

16 V-belt pulley

- ♦ When installing note location at toothed belt sprocket
- ♦ Can only be installed in one position

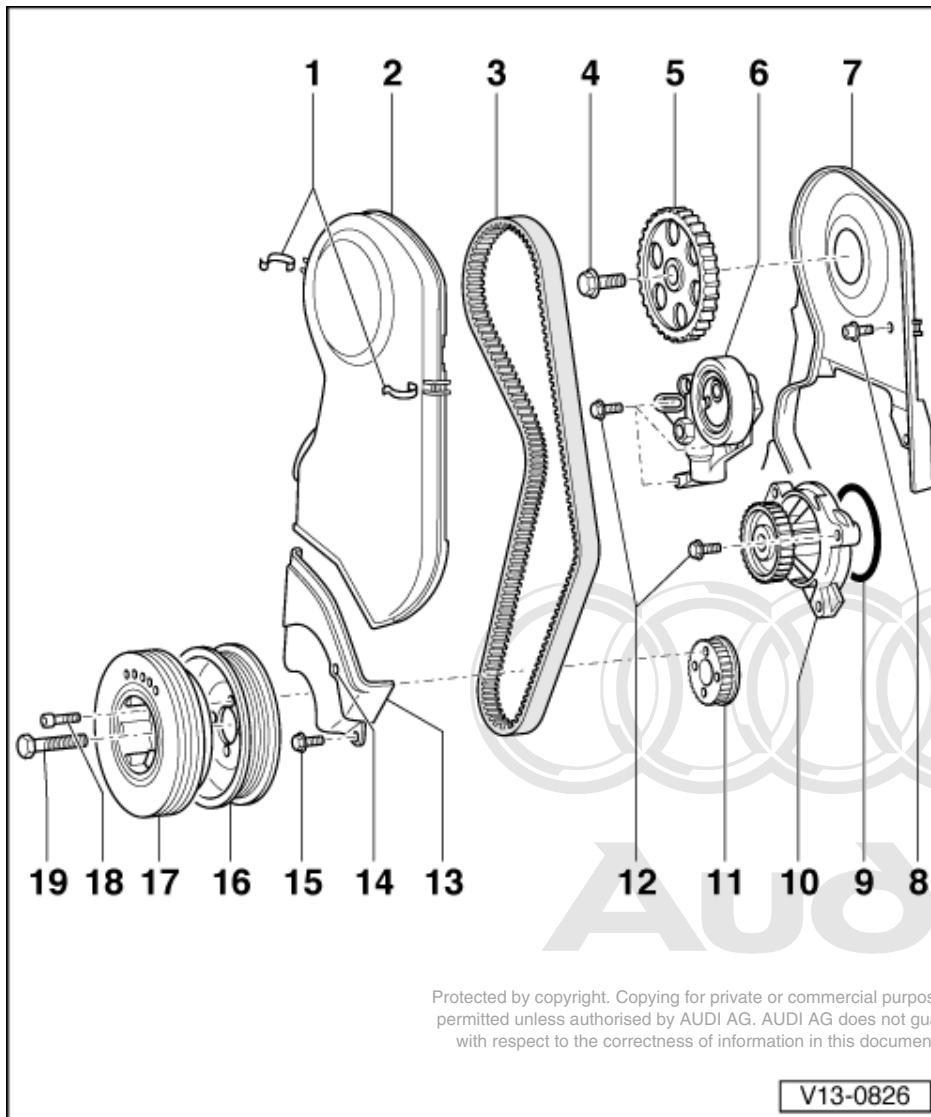
17 Vibration damper

- ♦ When installing note location at toothed belt sprocket
- ♦ Can only be installed in one position

♦ Removing and installing

=>Page 26.

18 20 Nm



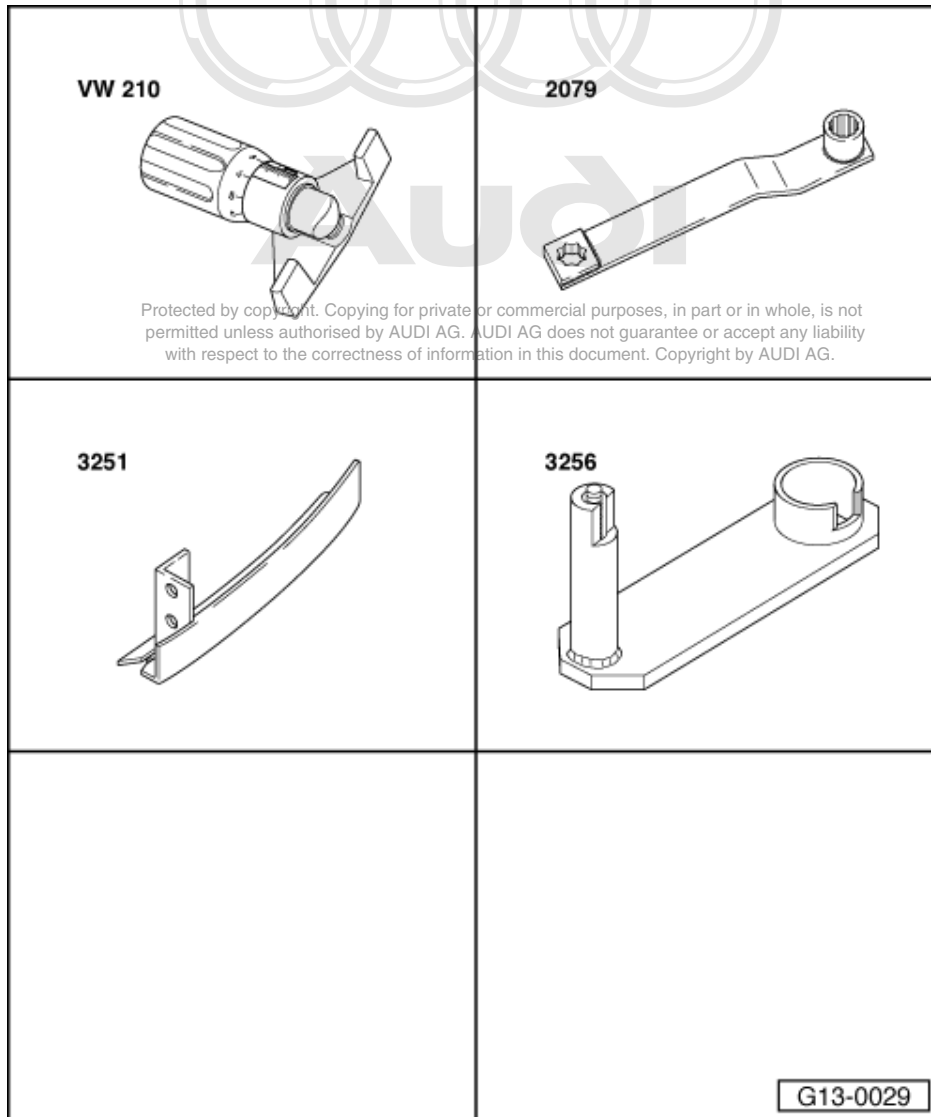
19 Securing bolt for pulley/vibration damper

- ◆ Replace
- ◆ Coat turns and contact surface of bolt body with sealing paste
- ◆ Sealing paste

=> Parts List

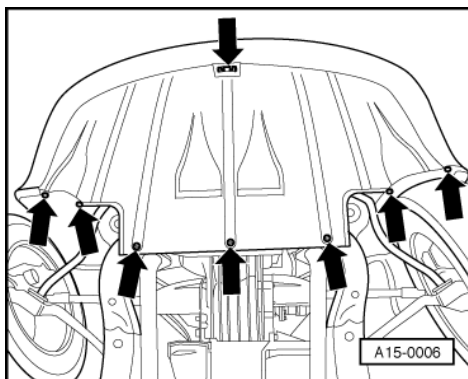
- ◆ Counter hold with 3256 to loosen and tighten
 - ◆ Tightening torque 350 Nm using special tool 2079
 - ◆ Tightening torque 450 Nm without special tool 2079
 - ◆ Removing and installing
- =>Page 26 .

1.6 - Removing and installing toothed belt (when removing belt completely)



Special tools and workshop equipment required

- ◆ V-belt and toothed belt test unit VW 210
- ◆ Spanner for vibration damper 2079
- ◆ Support 3251
- ◆ Counterhold for vibration damper 3256





Removing

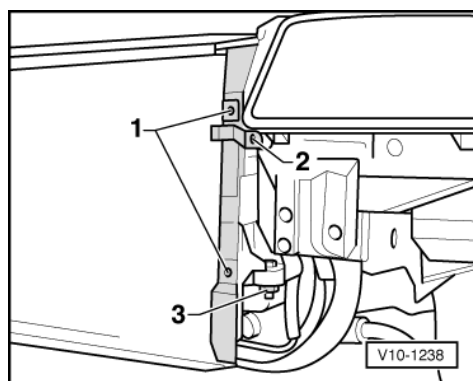
- Engine in vehicle

- -> Remove the noise insulation -arrows-.
- Remove the front bumper:

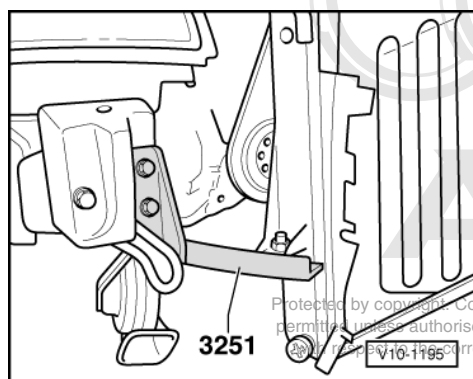
=> General Body Assembly; Repair group 63; Front bumper Front bumper

- Remove lock carrier:

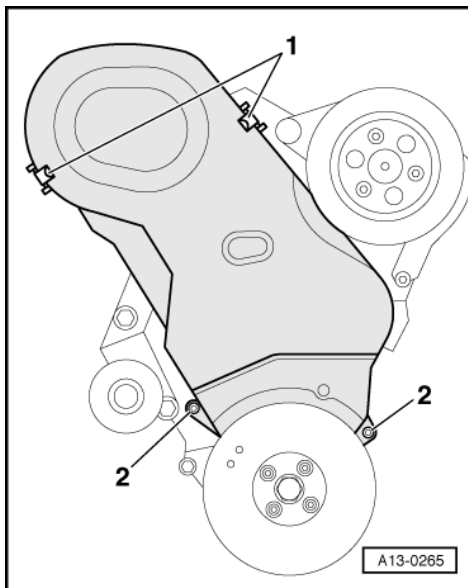
=> General Body Assembly; Repair group 50; Front body Front body



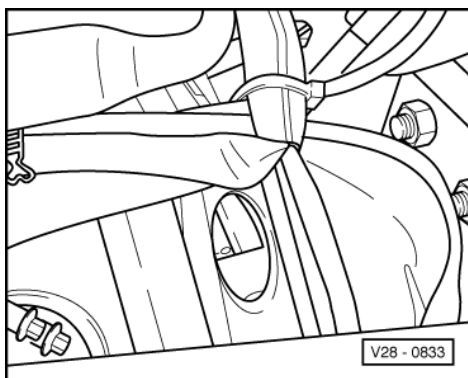
- -> Unscrew bolt -2- of retaining clip of trim on right headlight.
- Unscrew bolts -1- of air duct on left of radiator and remove air duct.
- Loosen bolts -3- on left and right of radiator.



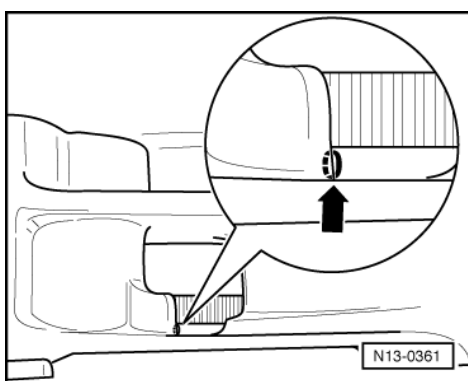
- -> Secure support 3251 on right bumper mounting and swing radiator forwards.
- Remove ribbed belt => Page 24 .
- Remove the viscous fan => Page 144 .



- -> Remove toothed belt guard at top and bottom by releasing fasteners -1- or unscrewing bolts -2-.



- Set crankshaft to TDC marking of No. 1 cylinder at central bolt of crankshaft toothed belt sprocket in direction of engine rotation ...
- -> Vehicles with manual gearbox



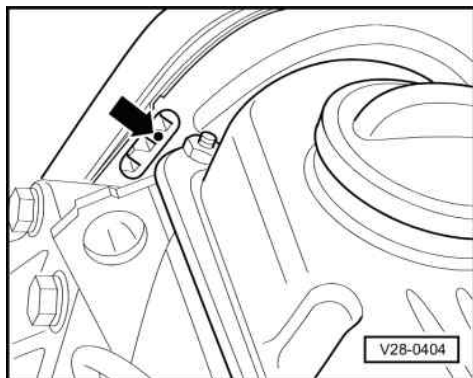
- -> Vehicles with automatic gearbox

Note:

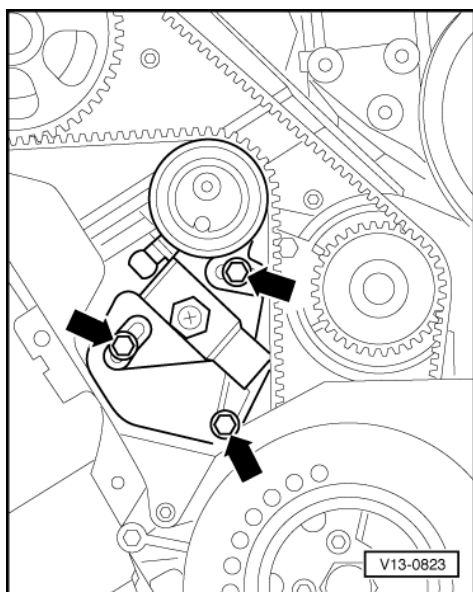
Position crankshaft to TDC for cylinder 1 with engine removed=> Page 45.



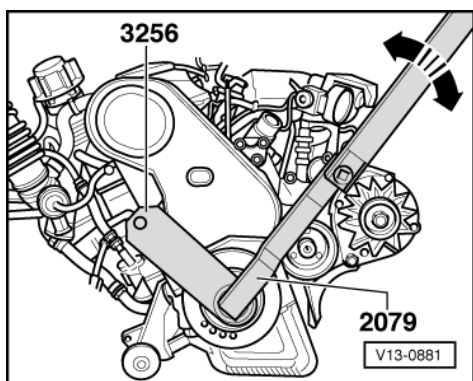
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- -> ... at same time, marking -arrow- at rear of camshaft sprocket must line up with the upper edge of the gasket. Turn crankshaft 1 turn further, if necessary.
- Mark running direction of belt with chalk or felt pen.



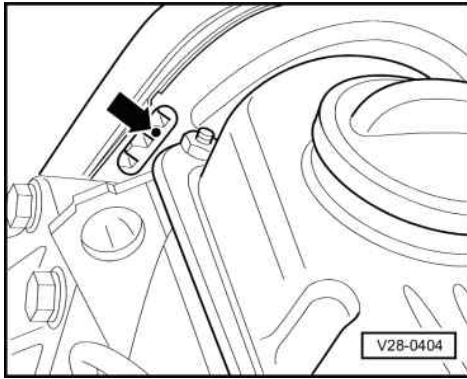
- -> Unscrew two top bolts of tensioner (slots) 1 turn.
- Unscrew lower bolt until tensioner can be moved.



- -> Remove vibration damper with toothed belt sprocket (crankshaft), holding vibration damper in position with counterhold 3256.
- Remove vibration damper and toothed belt.



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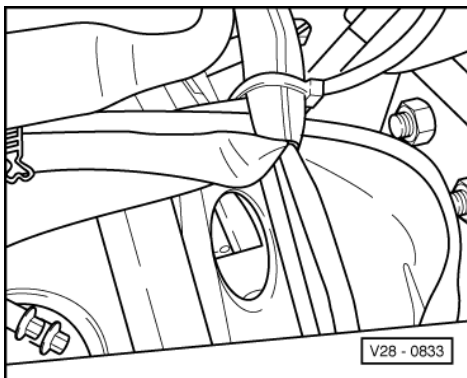
Installing (adjusting valve timing)

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

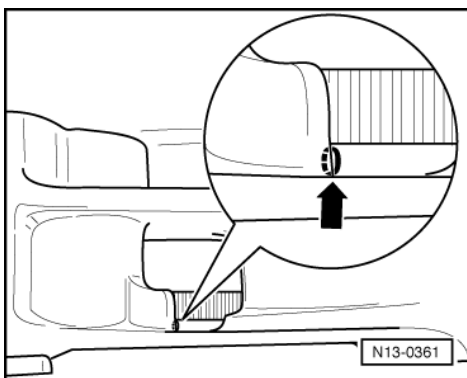
Notes:

- ◆ When turning the camshaft, the crankshaft must not be at TDC at any cylinder. Danger of damage to valves/piston crown.
- ◆ Adjustment of the toothed belt tension must be carried out when engine is cold.
- -> Align marking -arrow- at camshaft sprocket with upper edge of gasket

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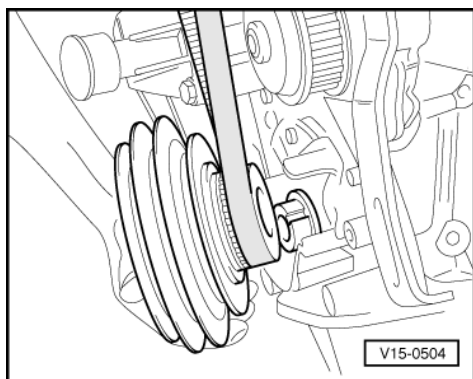
- Check again whether the crankshaft is positioned to TDC for cylinder 1:
- -> Vehicles with manual gearbox



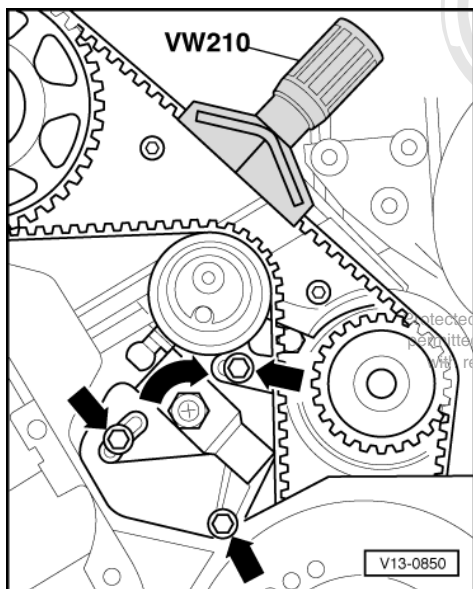
- -> Vehicles with automatic gearbox

Note:

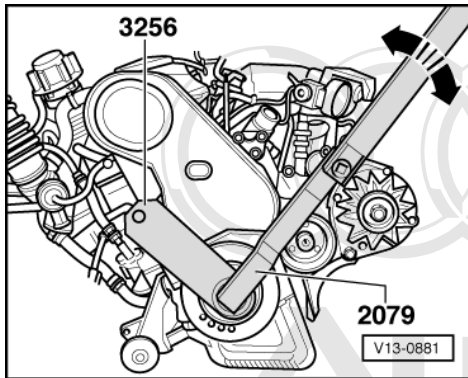
Position crankshaft to TDC for cylinder 1 with engine removed=> Page 45.



- -> Place toothed belt on toothed belt sprocket (crankshaft) and attach to crankshaft with vibration damper/pulley.
- Coat turns and contact surface of bolt head of central bolt with sealing paste AMV 188 001 02.
- Tighten central bolt slightly.



- Attach toothed belt to tensioning roller, coolant pump and camshaft sprocket.
- -> Tension toothed belt by turning tensioner at hexagon flat 25 Nm to right, holding it in place and tightening bolts -arrows- to 10 Nm.
- Turn crankshaft two turns in direction of engine rotation and check that camshaft and crankshaft markings are in line with their reference points.
- Check toothed belt tension with VW 210.
 - Scale reading: 14...14.5
- Correct setting, if necessary.



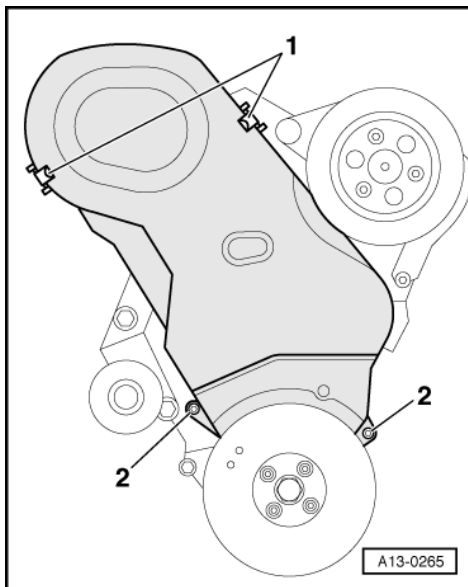
- Tighten central bolt of vibration damper (use counterhold 3256):
- -> Tightening torque with special tool 2079: 350 Nm

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Important

The tightening torque of 350 Nm only applies in conjunction with special tool 2079. The tool must be aligned with the torque wrench.

- Tightening torque without special tool 2079: 450 Nm



- -> Install toothed belt guard at top and bottom -1- and -2-.
- Install ribbed belt=> Page 25 .
- Install viscous fan => Page 144 .
- Installing lock carrier with attachments:

=> General Body Assembly; Repair group 50; Front body Front body

- Install the front bumper:

=> General Body Assembly; Repair group 63; Front bumper Front bumper

- Checking and if necessary adjusting ignition point:

=> KE III Jetronic/Ignition System (5-cylinder); Repair group 28; Checking ignition system; Adjusting ignition point
Checking ignition system Adjusting ignition point

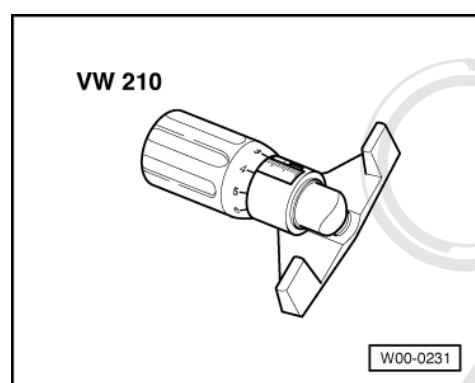


Tightening torques

Component	Nm
Vibration damper with toothed belt to crankshaft 1)	
using special tool 2079	350
without special tool 2079	450
Toothed belt tensioner to cylinder block	10
Toothed belt guard - lower	10

- 1) Always fit new central bolt

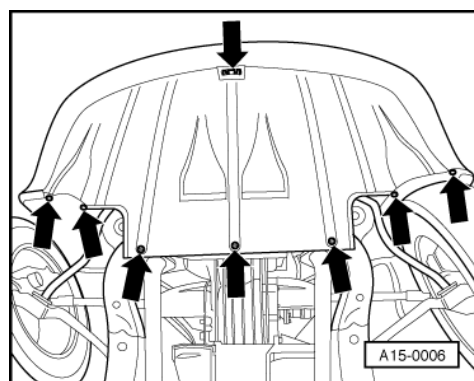
1.7 - Removing toothed belt from camshaft sprocket



Special tools and workshop equipment required

- ♦ V-belt and toothed belt test unit VW 210

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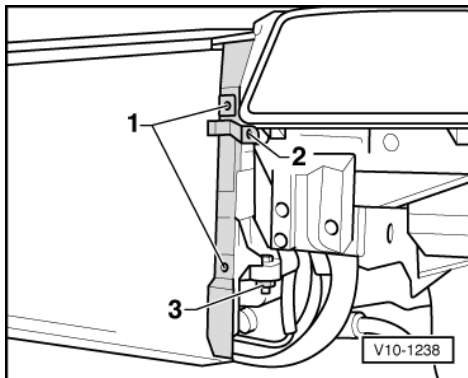
Removing

- Engine in vehicle
- -> Remove the noise insulation -arrows-.
- Remove the front bumper:

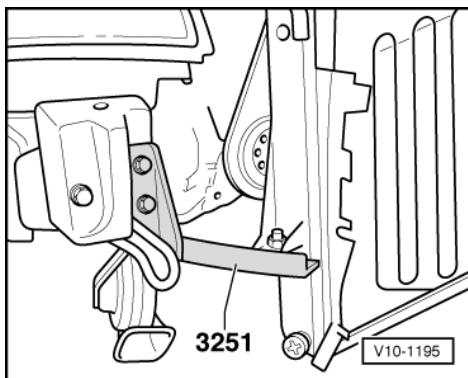
=> General Body Assembly; Repair group 63; Front bumper Front bumper

- Remove lock carrier:

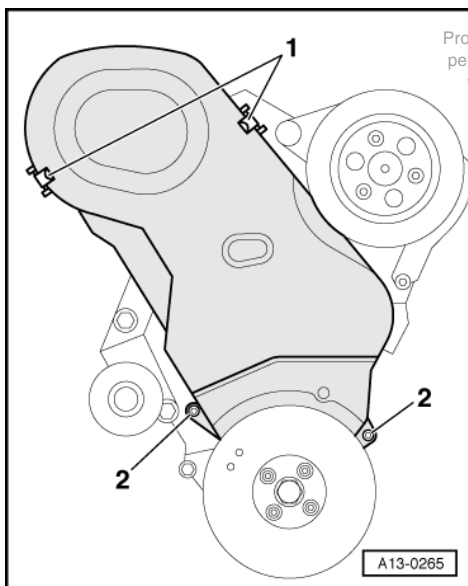
=> General Body Assembly; Repair group 50; Front body Front body



- -> Unscrew bolt -2- of retaining clip of trim on right headlight.
- Unscrew bolts -1- of air duct on left of radiator and remove air duct.
- Loosen bolts -3- on left and right of radiator.

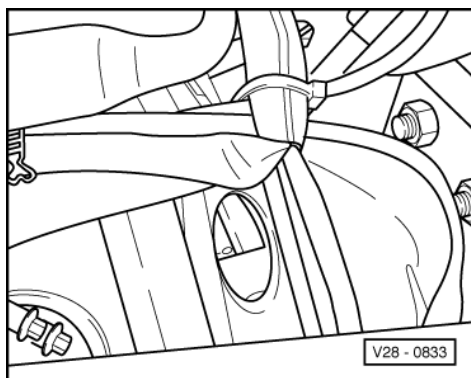


- -> Secure support 3251 on right bumper mounting and swing radiator forwards.
- Remove ribbed belt => Page 24 .
- Remove the viscous fan => Page 144 .

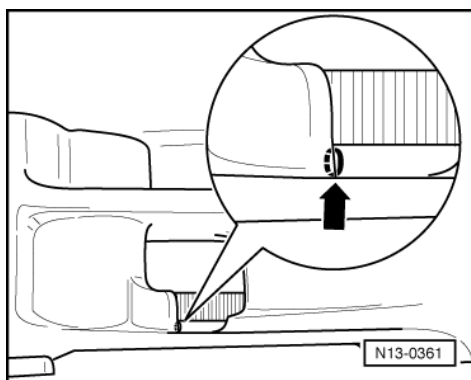


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- -> Remove top toothed belt guard by releasing fasteners -1-. Bottom toothed belt guard -2- remains installed.



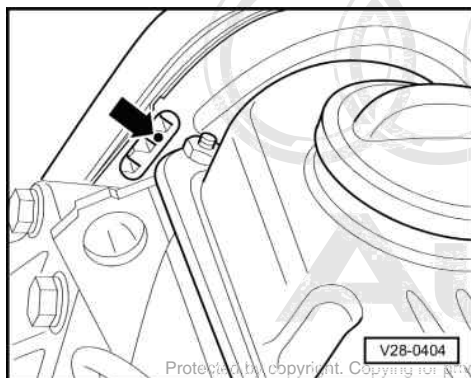
- Set crankshaft to TDC marking of No. 1 cylinder at central bolt of crankshaft toothed belt sprocket in direction of engine rotation ...
- -> Vehicles with manual gearbox



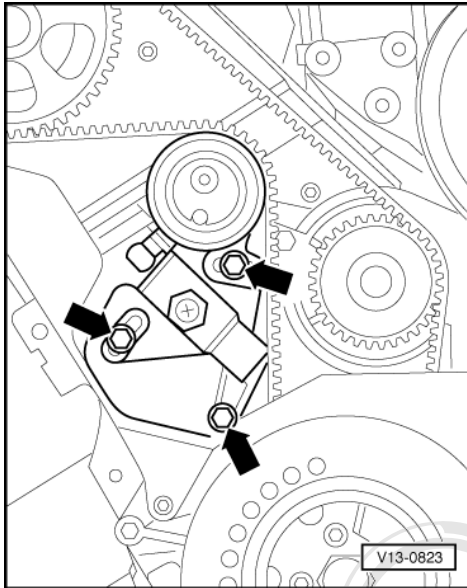
- -> Vehicles with automatic gearbox

Note:

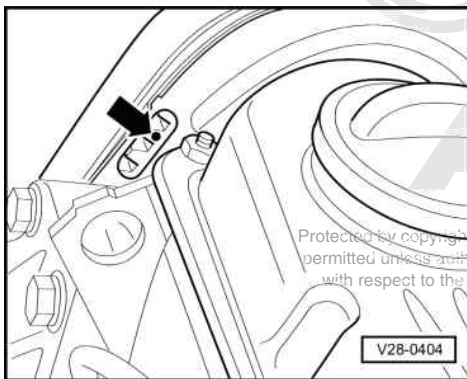
Position crankshaft to TDC for cylinder 1 with engine removed=> Page 45 .



- -> ... at same time, marking -arrow- at rear of camshaft sprocket must line up with the upper edge of the gasket. Turn crankshaft 1 turn further, if necessary.



- -> Unscrew two top bolts of tensioner (slots) 1 turn.
- Unscrew lower bolt until tensioner can be moved.
- Take toothed belt off camshaft sprocket.



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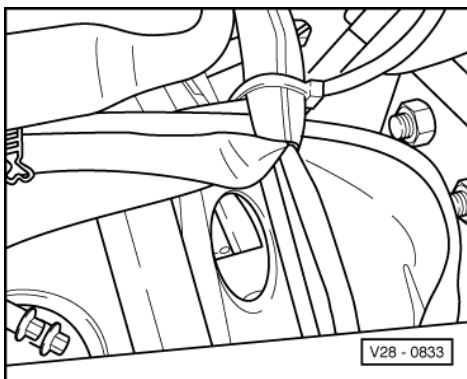
Installing (adjusting valve timing)

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

Notes:

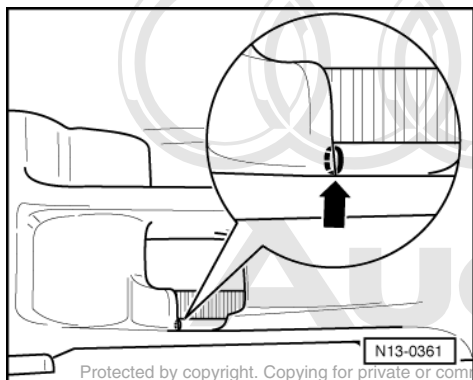
- ◆ When turning the camshaft, the crankshaft must not be at TDC at any cylinder. Danger of damage to valves/ piston crown.
- ◆ Adjustment of the toothed belt tension must be carried out when engine is cold.

- -> Align marking -arrow- at camshaft sprocket with upper edge of gasket.





- Check again whether the crankshaft is positioned to TDC for cylinder 1:
- -> Vehicles with manual gearbox

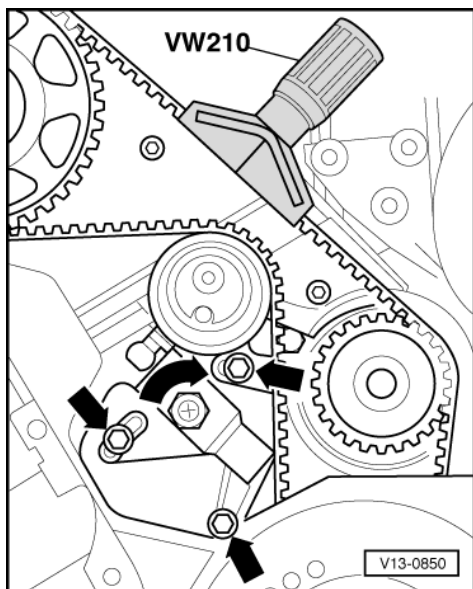


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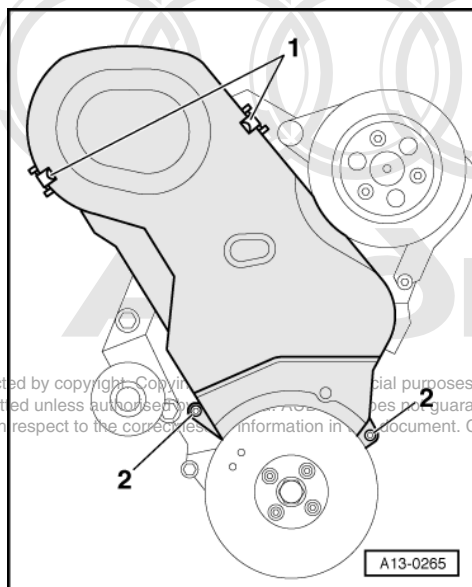
- -> Vehicles with automatic gearbox

Note:

Position crankshaft to TDC for cylinder 1 with engine removed=> Page 45 .



- Attach toothed belt to tensioning roller, coolant pump and camshaft sprocket.
- -> Tension toothed belt by turning tensioner at hexagon flat 25 Nm to right, holding it in place and tightening bolts -arrows- to 10 Nm.
- Turn crankshaft two turns in direction of engine rotation and check that camshaft and crankshaft markings are in line with their reference points.
- Check toothed belt tension with VW 210.
 - Scale reading: 14...14.5
- Correct setting, if necessary.



- -> Install the upper toothed belt guard -arrows-.
- Install ribbed belt=> Page 25 .
- Install viscous fan => Page 144 .
- Installing lock carrier with attachments:

=> General Body Assembly; Repair group 50; Front body Front body

- Install the front bumper:

=> General Body Assembly; Repair group 63; Front bumper Front bumper

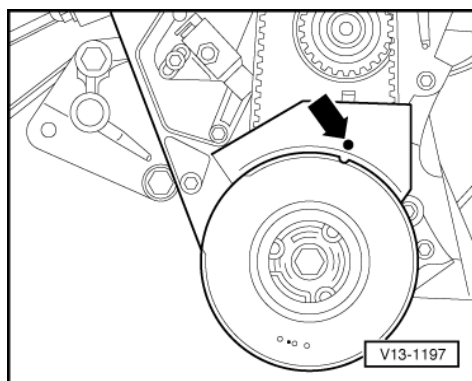
- Checking and if necessary adjusting ignition point:

=> KE III Jetronic/Ignition System (5-cylinder); Repair group 28; Checking ignition system; Adjusting ignition point Checking ignition system Adjusting ignition point

Tightening torque

Component	Nm
Toothed belt tensioner to cylinder block	10

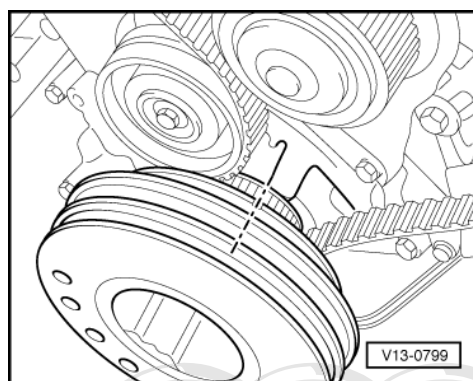
1.8 - Positioning crankshaft to TDC with engine removed





Lower toothed belt guard installed:

- -> Align notch on vibration damper with alignment mark -arrow- on lower toothed belt guard.



Lower toothed belt guard removed:

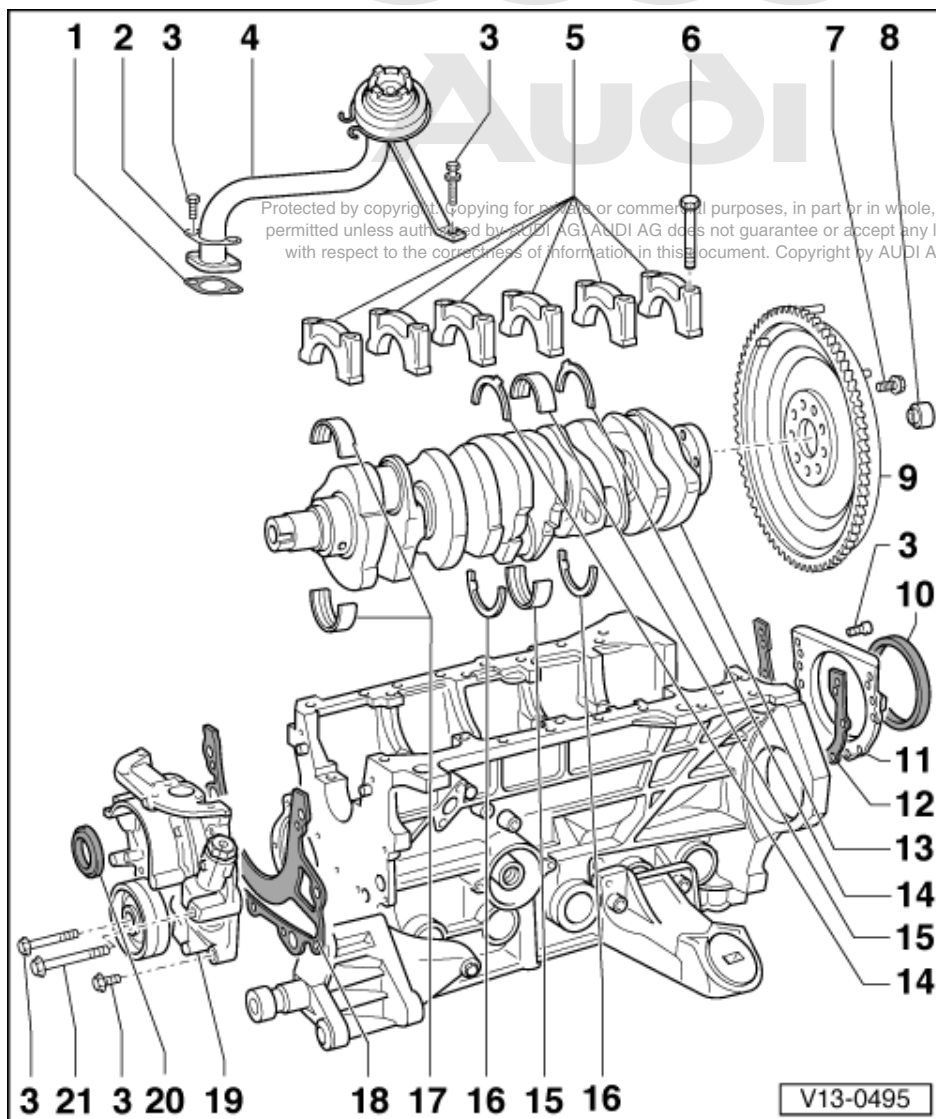
- -> Align notch on vibration damper with alignment mark on oil pump housing.



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2 - Removing and installing crankshaft, flywheel/drive plate and sealing flange

2.1 - Removing and installing crankshaft, flywheel/drive plate and sealing flange

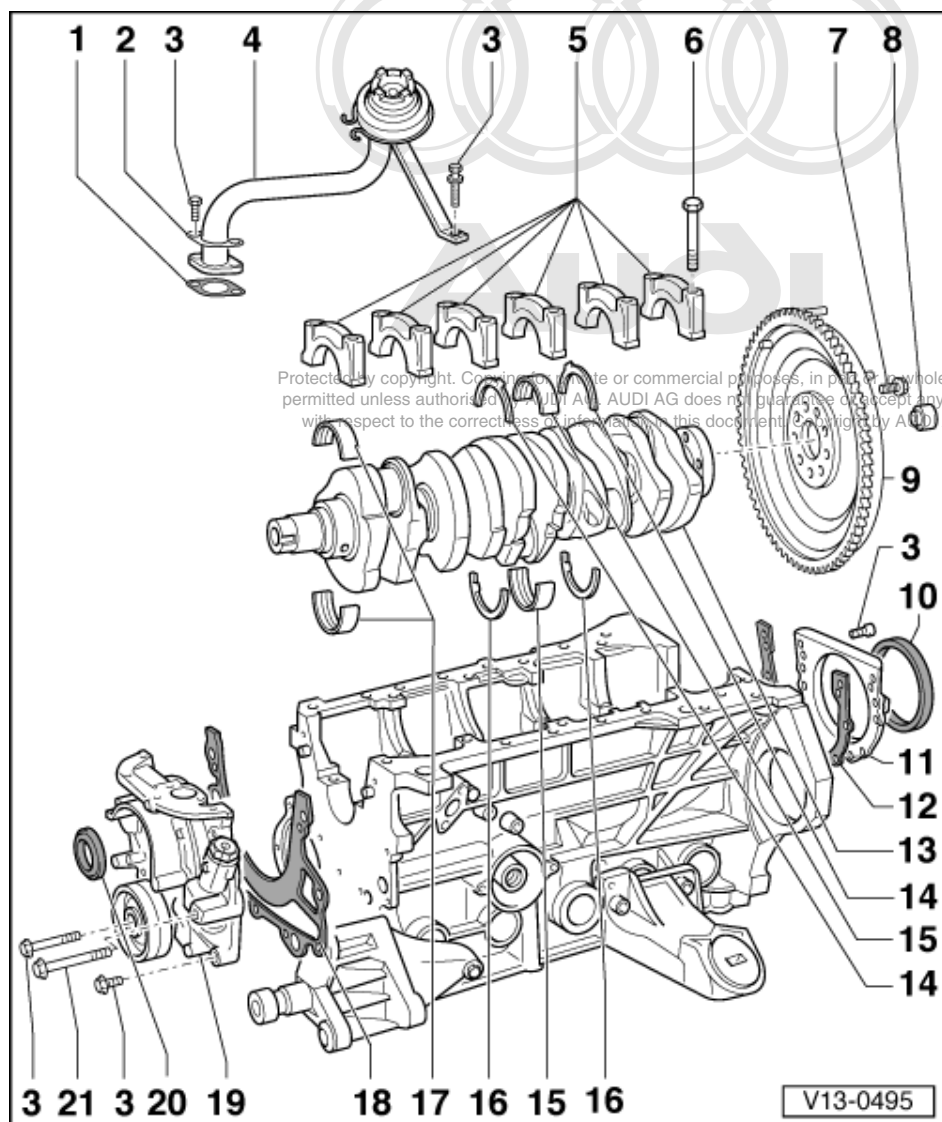


Notes:

- ◆ For repairs to the clutch:
- ◆ When working on the engine, it should be secured to the engine stand using the engine bracket VW 540.

1 Gasket

- ◆ Replace
- ◆ As of engine no. AAR 037 700: O-ring



2 Locking plate

- ♦ Replace

3 10 Nm

- ♦ install using locking fluid
- ♦ Locking fluid

=> Parts List

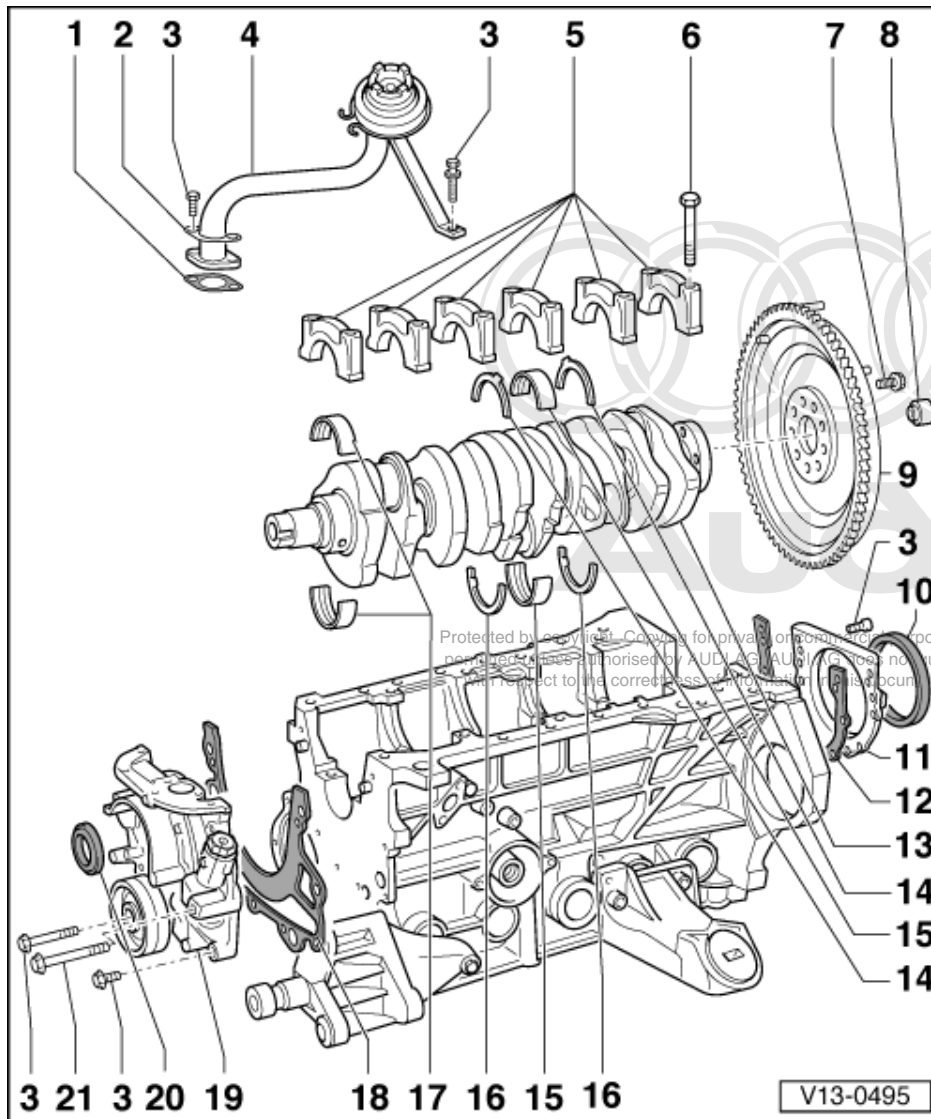
4 Suction pipe

- ♦ Fasten at oil pump first

5 Bearing cap

- ♦ Bearing cap 1: Pulley end
- ♦ Bearing shell retaining lugs (cylinder block/bearing cap) must be on the same side.

6 65 Nm

**7 30 Nm + 1/4 turn (90°) further**

- ♦ Replace

8 Ball bearing

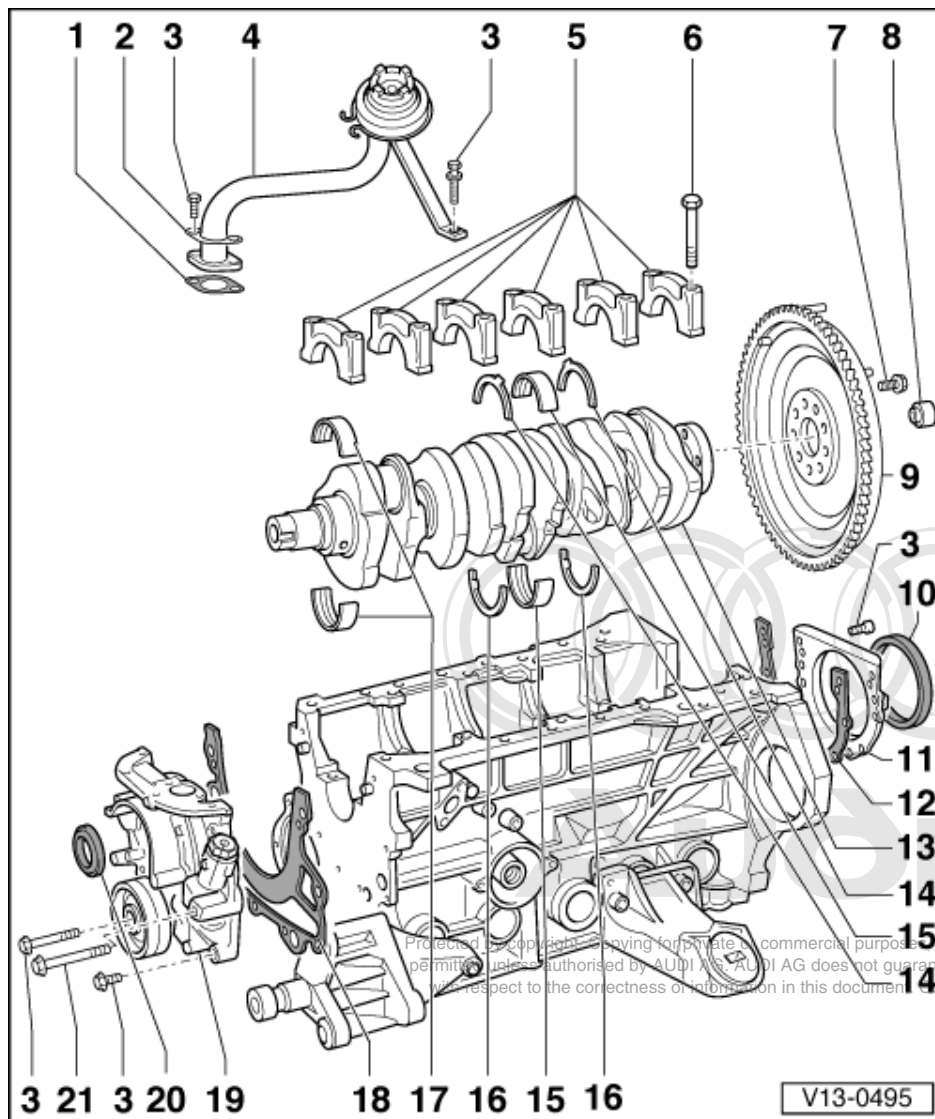
- ♦ Replace if not running smoothly or stiff
- ♦ Pulling out and driving in
=> Page 57

9 Flywheel or drive plate

- ♦ Removing and installing flywheel
=> Page 55
- ♦ Removing and installing drive plate => Page 55
- ♦ Retrofitting ignition point notch
=> Fig. 53

10 Sealing ring

- ♦ Can only be replaced together with -Item 11 -

**11 Rear sealing flange**

- ◆ With sealing ring
- ◆ Before fitting sump, apply a small amount of sealant to sealing points between sealing flange and cylinder block
- ◆ Sealants

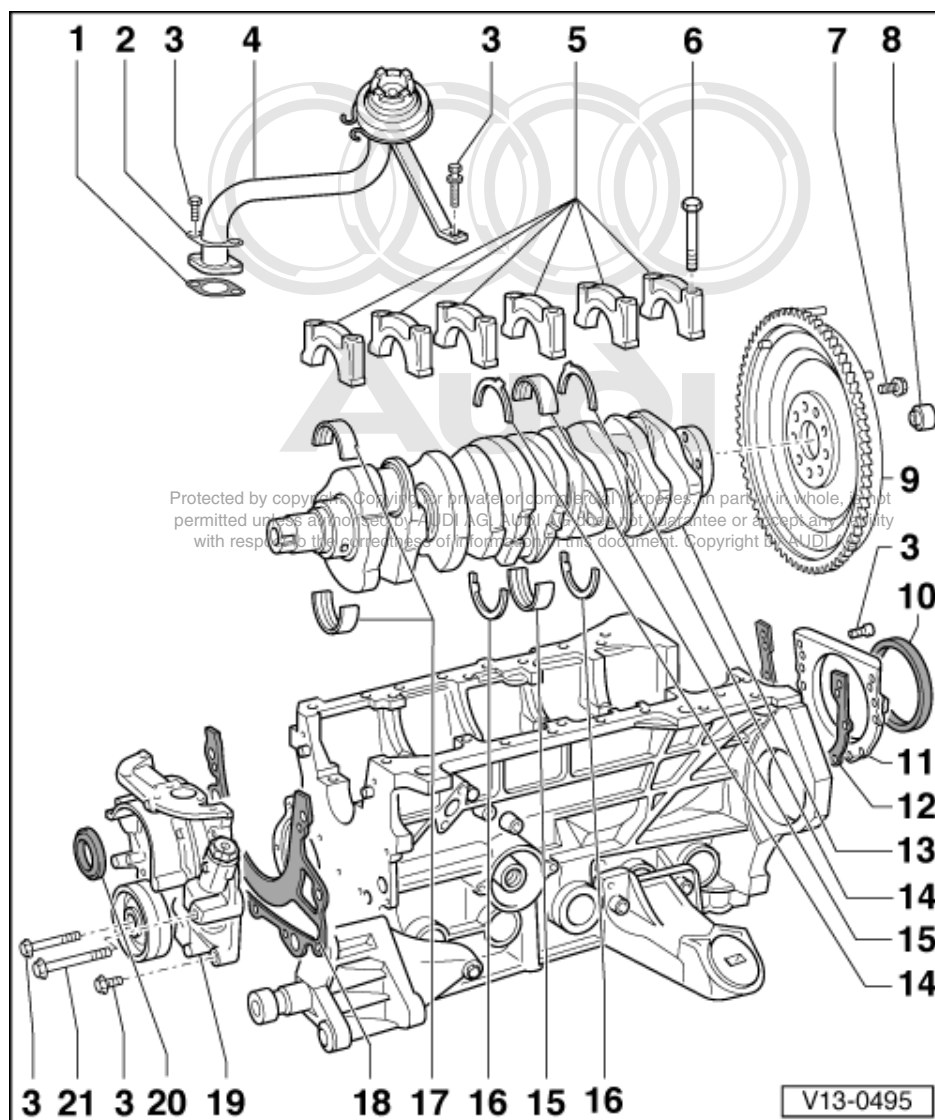
=> Parts List

12 Gasket

- ◆ Replace

13 Crankshaft

- ◆ Axial clearance new: 0.07...0.23 mm
Wear limit: 0.25 mm
- ◆ Check radial play with Plastigage
New: 0.018...0.058 mm
Wear limit: 0.10 mm
- ◆ Do not rotate the crankshaft when checking the radial play.
- ◆ Crankshaft dimensions
=>Page 58 .

**14 Thrust washers**

- ◆ For bearing 3 bearing cap
- ◆ Note fixing arrangement

15 Bearing shell

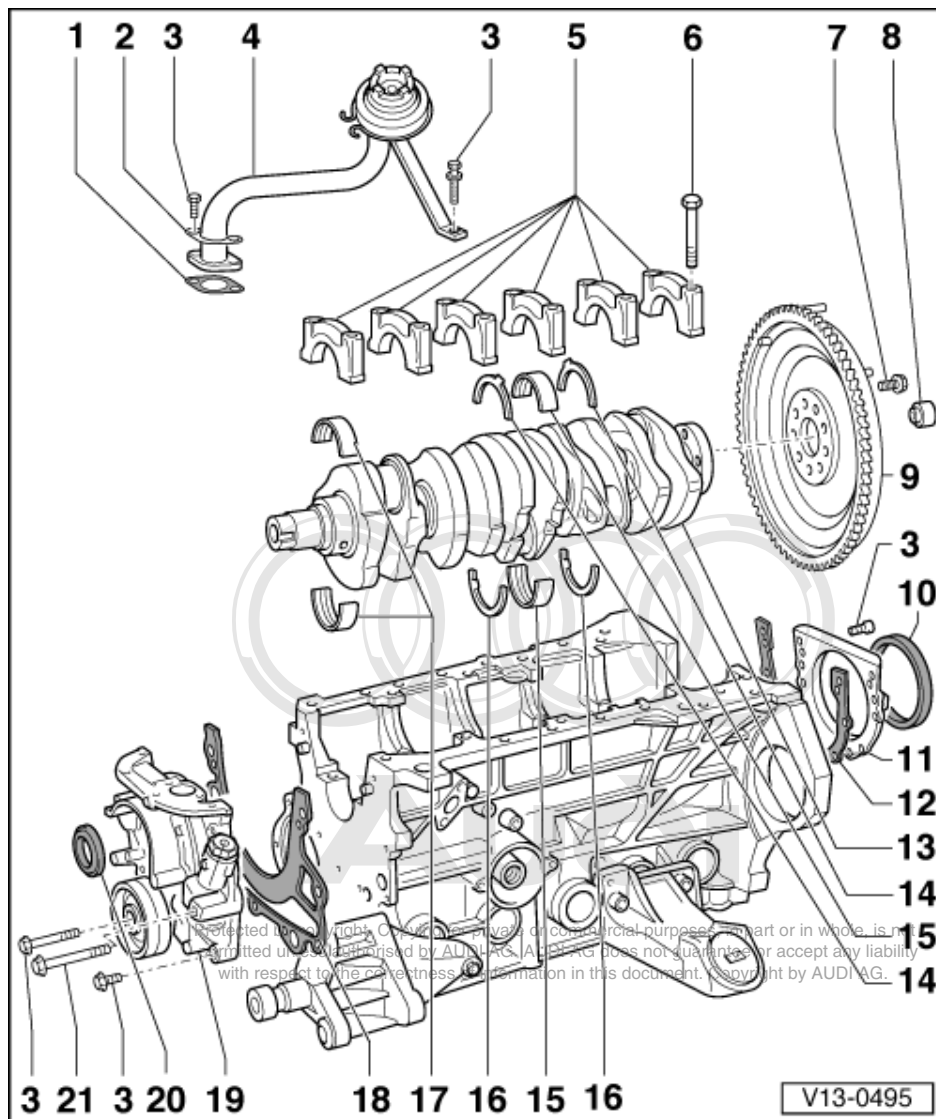
- ◆ For bearing cap without oil groove
- ◆ For cylinder block with oil groove
- ◆ Do not interchange used bearing shells (mark).

16 Thrust washers

- ◆ For cylinder block (without retaining lugs)
- ◆ Note fixing arrangement

17 Bearing shell

- ◆ For bearing cap without oil groove
- ◆ For cylinder block with oil groove
- ◆ Do not interchange used bearing shells (mark).

**18 Gasket**

- ◆ Replace

19 Oil pump

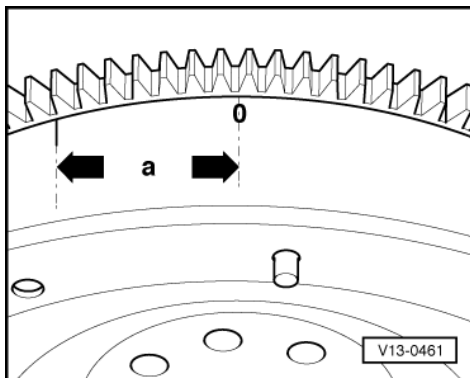
- ◆ Removing and installing
=>Page 124 .
- ◆ When installing, watch position of follower at crankshaft

20 Oil seal

- ◆ For crankshaft
- ◆ Removing and installing
=>Page 53 .

21 20 Nm

- ◆ Not installed



-> Fig.1 Retrofitting ignition point notch

Note:

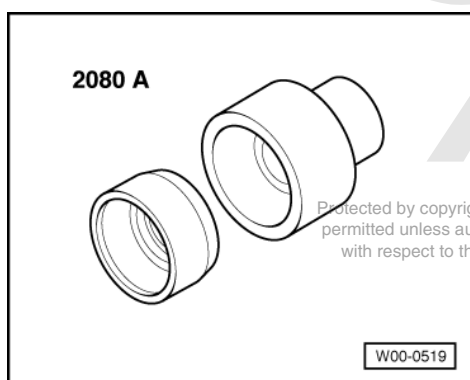
Replacement flywheels and drive plates are only supplied with TDC marking "0". The ignition point notch must be retrofitted when the flywheel or drive plate is replaced.

- Mark the ignition point notch leftwards from the centre of the TDC mark. The curve dimension must be measured.
- Dimension a = 36.5 mm

Note:

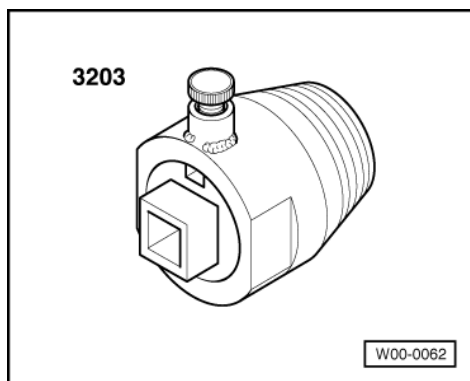
Dimension "a" corresponds to an ignition point of 15 ° before TDC.

2.2 - Renewing crankshaft oil seal on pulley end



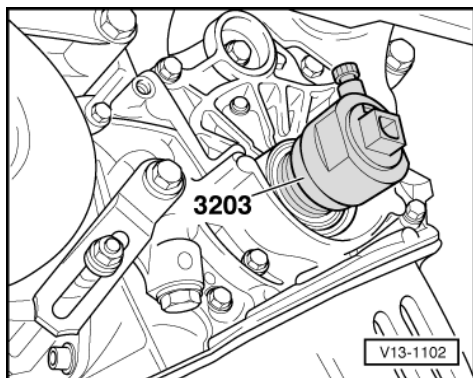
Special tools and workshop equipment required

- ♦ Inserting ring for oil seal 2080 A



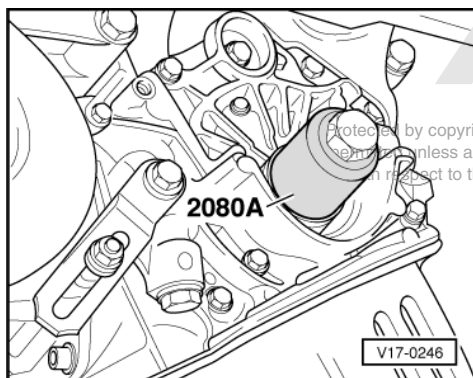


♦ Oil seal extractor 3203



Removing

- Engine in vehicle
- Remove toothed belt => Page 33 .
- Unscrew inner part of oil seal extractor 3203 one turn (approx. 2 mm) from the outer part and lock in position with knurled screw.
- -> Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.

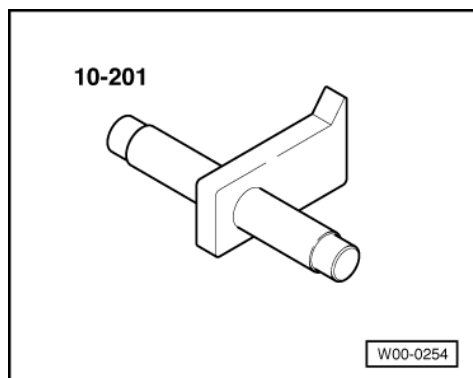


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Installing

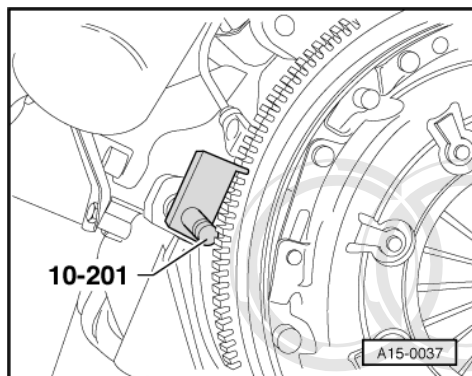
- Place guide sleeve from 2080 A onto crankshaft journal.
- Carefully push oil seal over guide sleeve.
- -> Press oil seal in as far as limit stop using insertion sleeve and cleaned vibration damper bolt.
- Install toothed belt (adjust valve timing) => Page 37 .

2.3 - Removing and installing flywheel/drive plate



Special tools and workshop equipment required

- ♦ Counter-hold tool 10-201



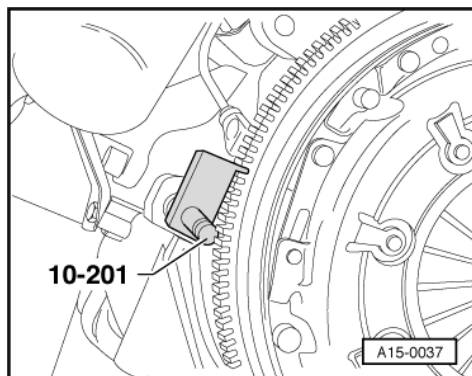
Flywheel

- -> Plug in counterhold 10-201 for loosening and tightening the bolts.
- Mark position of flywheel relative to engine.
- Only use new bolts to secure.

Tightening torque

Component	Nm
Flywheel to crankshaft	30 + 90°1)

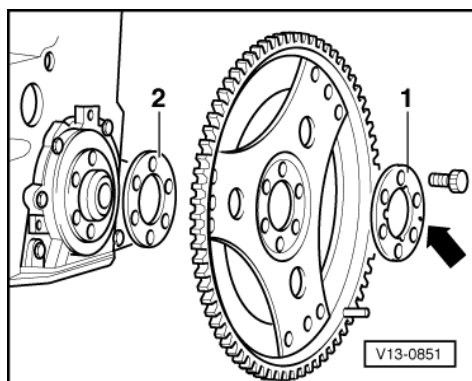
- 1) 90° corresponds to a quarter of a turn



Drive plate

Removing

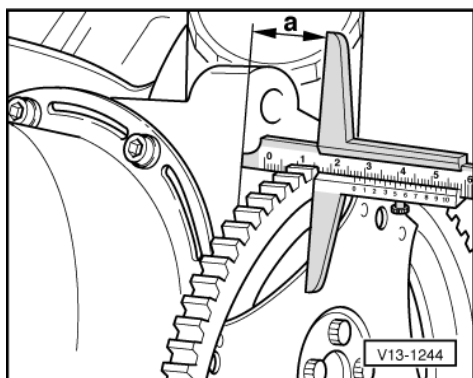
- -> Plug in counterhold 10-201 for loosening and tightening the bolts.
- Mark position of drive plate relative to engine.



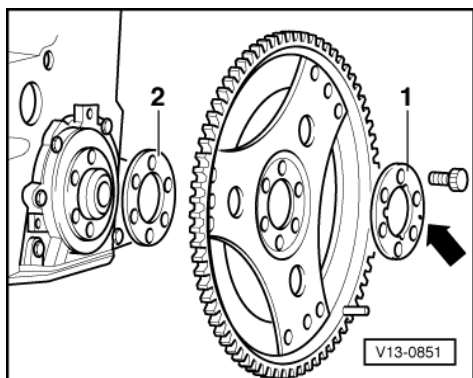


Installing

- -> Place drive plate with shim -2- and washer -1- in position. Lug -arrow- must face towards torque converter.
- Insert at least 3 of the old securing bolts and tighten to 30 Nm.



- -> Measure dimension -a- at three points and calculate average value.
- Specification for automatic gearbox 097:
21.3...22.9 mm



If nominal value is exceeded:

- -> Remove drive plate again and fit without shim -2-. Retighten bolts to 30 Nm.
- Measure distance again.

If specified value is attained:

- Only use new bolts to secure.

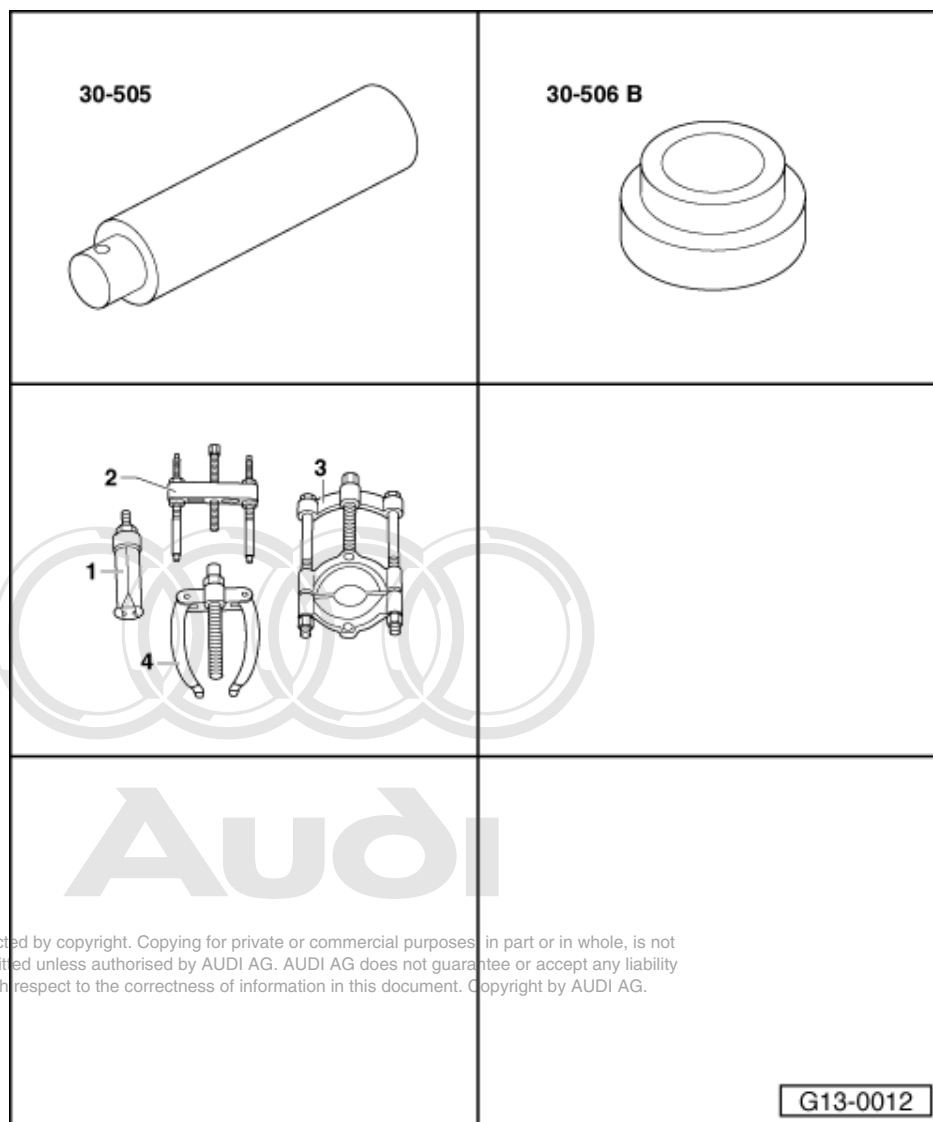
Tightening torque

Component	Nm
Drive plate to crankshaft	30 + 90° 1)

- 1) 90° corresponds to a quarter of a turn

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2.4 - Removing and installing ball bearing in crankshaft



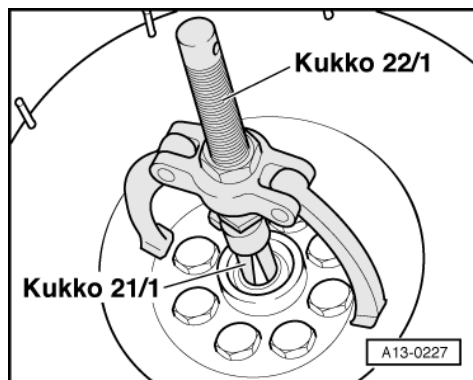
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Special tools and workshop equipment required

- ◆ Mandrel 30-505
- ◆ Press tool 30-506 B
- ◆ Kukko 21/1 (Item 1) and
Kukko 22/1 (Item 4) or 10-202

Notes:

- ◆ A ball bearing must be fitted in the crankshaft in engines on vehicles with manual gearbox. Install ball bearing if necessary.
- ◆ No ball bearing must be fitted in the crankshaft in engines on vehicles with automatic gearbox. Remove ball bearing if necessary.



Removing

- Remove circlip.
- -> Pull out ball bearing with Kukko 21/1 and Kukko 22/1 or with 10-202.

Installing

- Insert ball bearing using fitting mandrel 30-505 and insertion tool 30-506 B.
- Fit circlip.

2.5 - Crankshaft dimensions

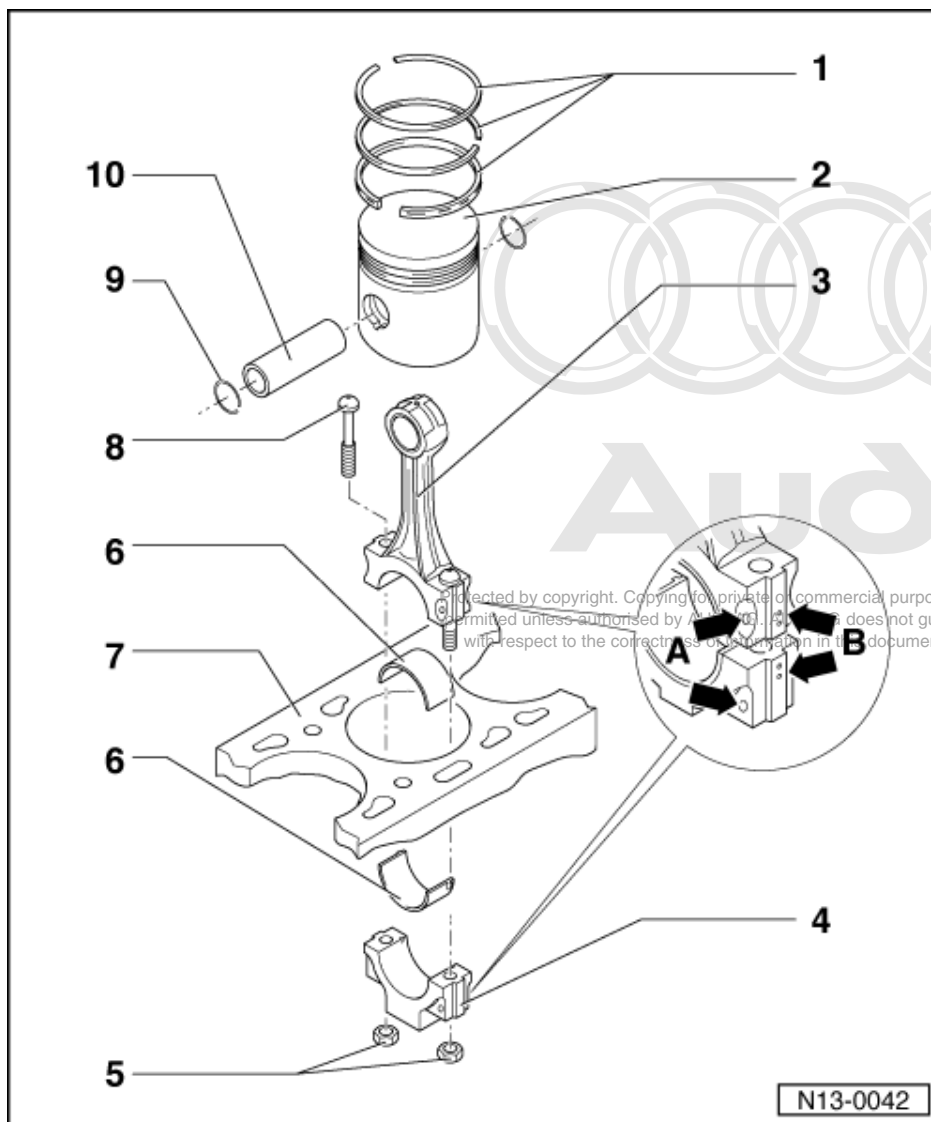
(in mm)

Honing dimension	Crankshaft bearing journal $\varnothing$	Conrod bearing journal $\varnothing$
Basic dimension	-0.022 58.00 -0.042	-0.022 47.80 -0.042
1st undersize	-0.022 57.75 -0.042	-0.022 47.55 -0.042
2nd undersize	-0.022 57.50 -0.042	-0.022 47.30 -0.042
3rd undersize	-0.022 57.25 -0.042	-0.022 47.05 -0.042

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3 - Dismantling and assembling pistons and conrods

3.1 - Dismantling and assembling pistons and conrods



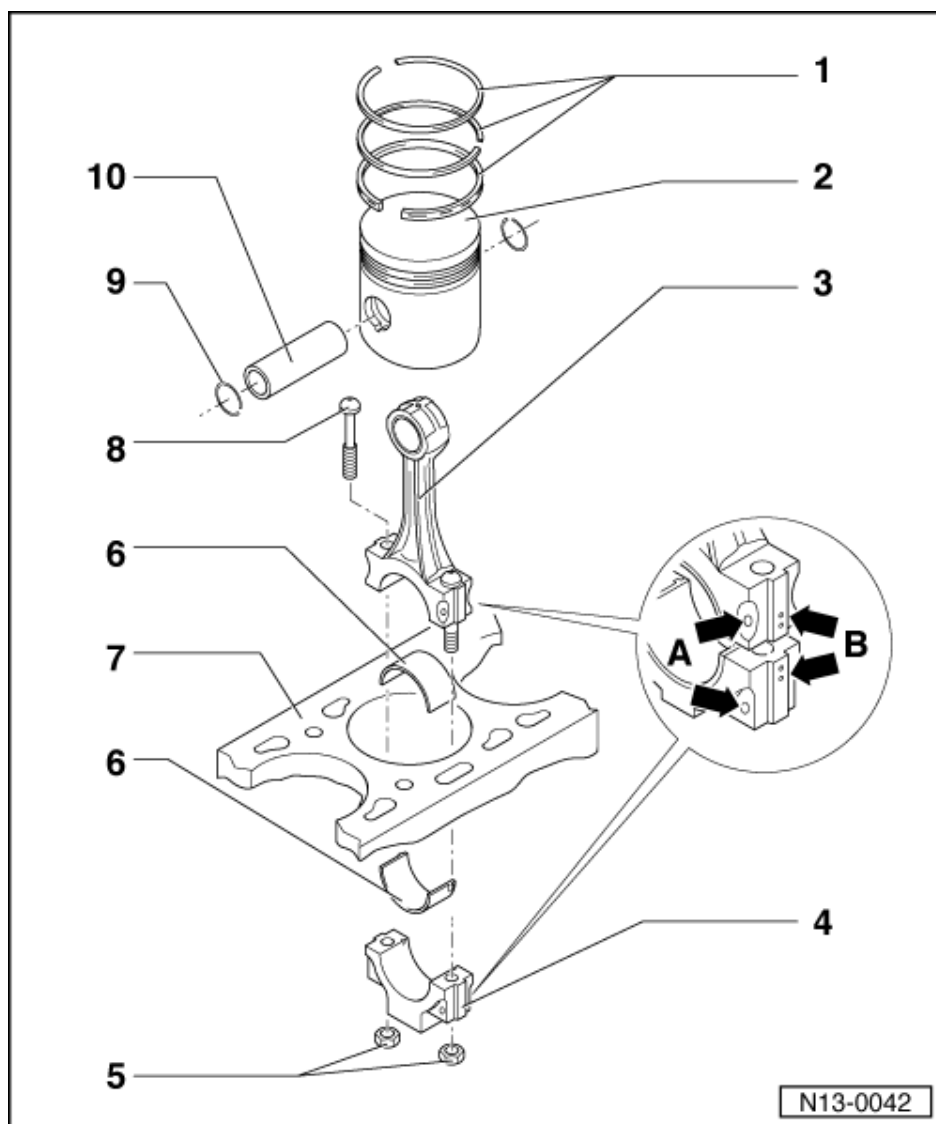
Note:

Oil spray jet and pressure relief valve

=> Fig. 66

1 Piston rings

- ◆ Offset gaps by 120°
- ◆ Remove and install with piston ring pliers.
- ◆ "TOP" must face piston crown.
- ◆ Checking ring gap
=> Fig. 63
- ◆ Checking ring to groove clearance
=> Fig. 63



2 Piston

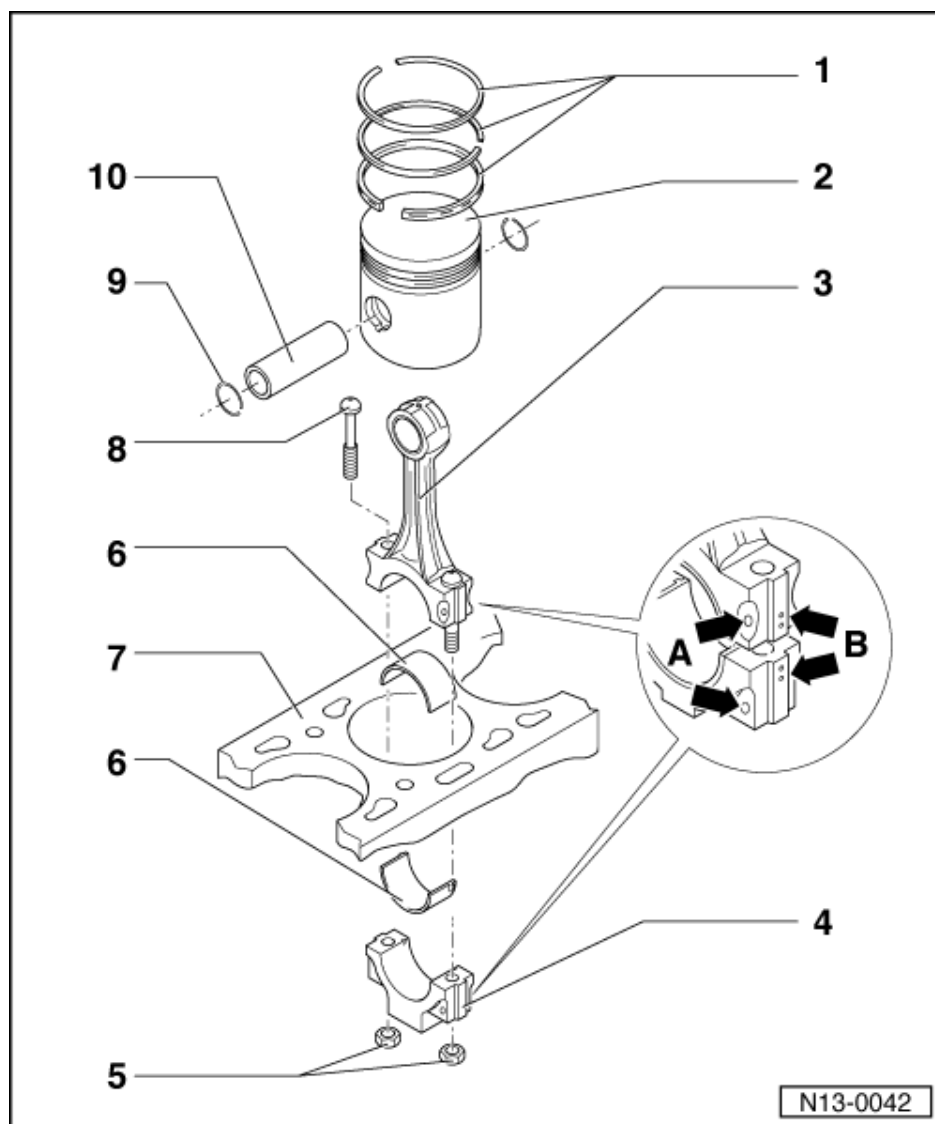
- ◆ Checking => Fig. 64
- ◆ Installation position and arrangement of piston/cylinder
=> Fig. 64
- ◆ Install using piston ring clamp.
- ◆ Piston and cylinder dimensions
=>Page 66 .

3 Conrod

- ◆ Only renew as a set
- ◆ Mark cylinder number B
- ◆ Installation position:
Markings A face towards pulley side
- ◆ With oil bore for piston pin lubrication
- ◆ Checking axial clearance
=> Fig. 65
- ◆ Measuring radial clearance
=>Page 66 .



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4 Conrod bearing cap

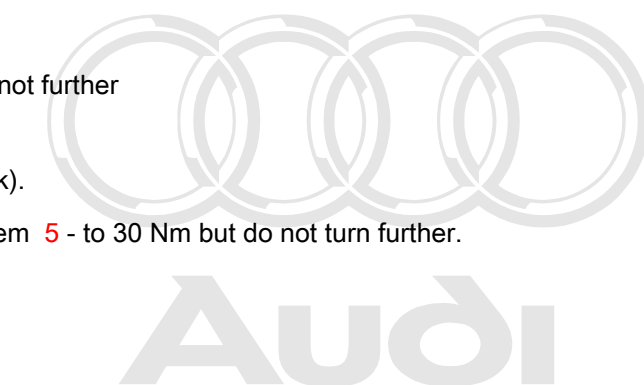
- ♦ Mark cylinder number B
- ♦ Installation position:
Markings A face towards pulley side

5 30 Nm + 1/4 turn (90°) further

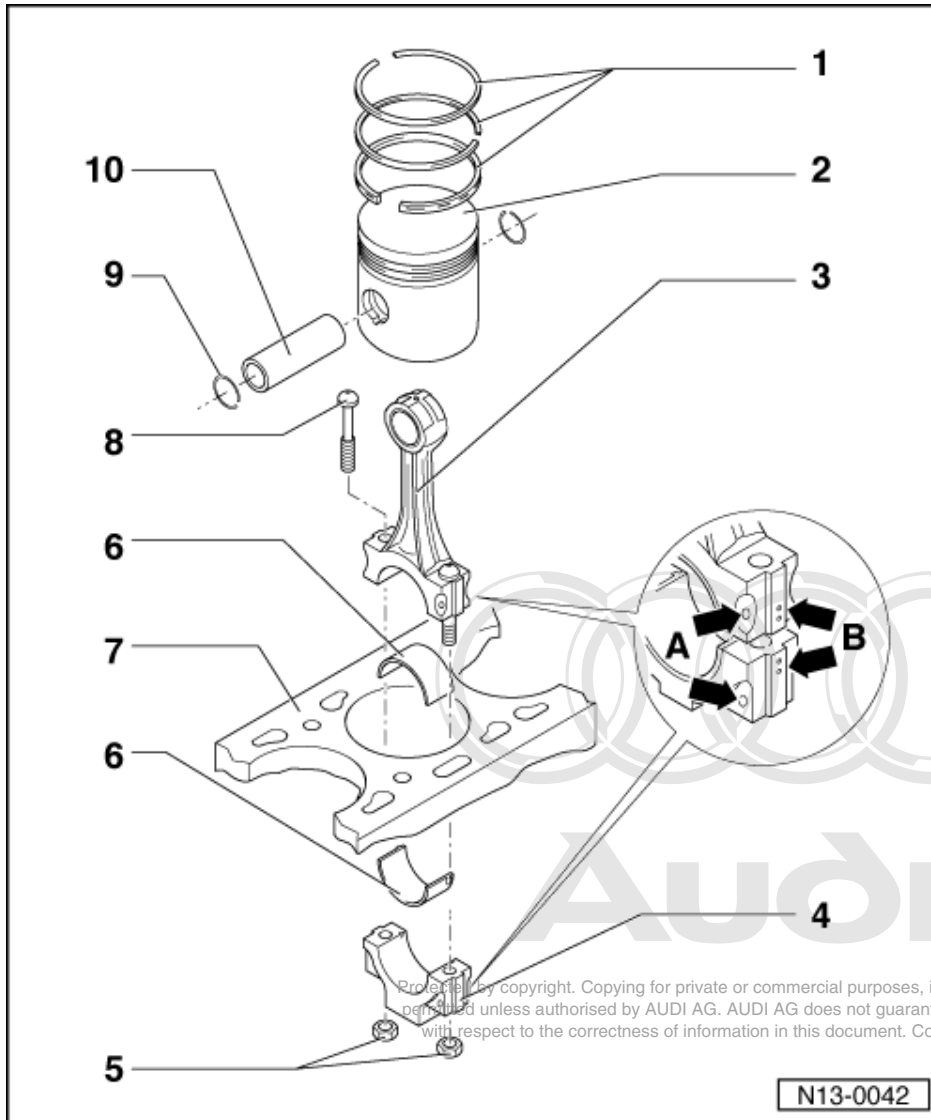
- ♦ Replace conrod bolt -Item 8 -
- ♦ Oil threads and contact surface
- ♦ To measure radial play tighten to 30 Nm but not further

6 Bearing shell

- ♦ Note installation position
- ♦ Do not interchange used bearing shells (mark).
- ♦ Ensure retaining lugs fit tightly in recesses.
- ♦ To measure radial clearance, tighten nuts -Item 5 - to 30 Nm but do not turn further.



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7 Cylinder block

- ♦ Checking cylinder bore
=> Fig. 65
- ♦ Piston and cylinder dimensions
=>Page 66 .

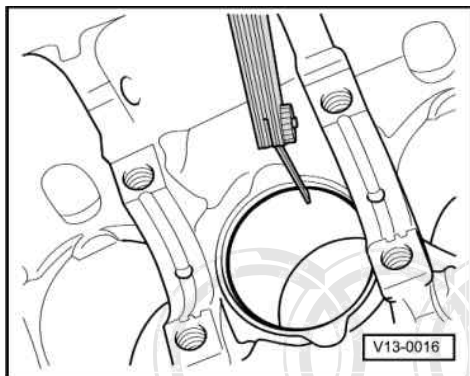
8 Conrod bolt

- ♦ Replace

9 Circlip

10 Piston pin

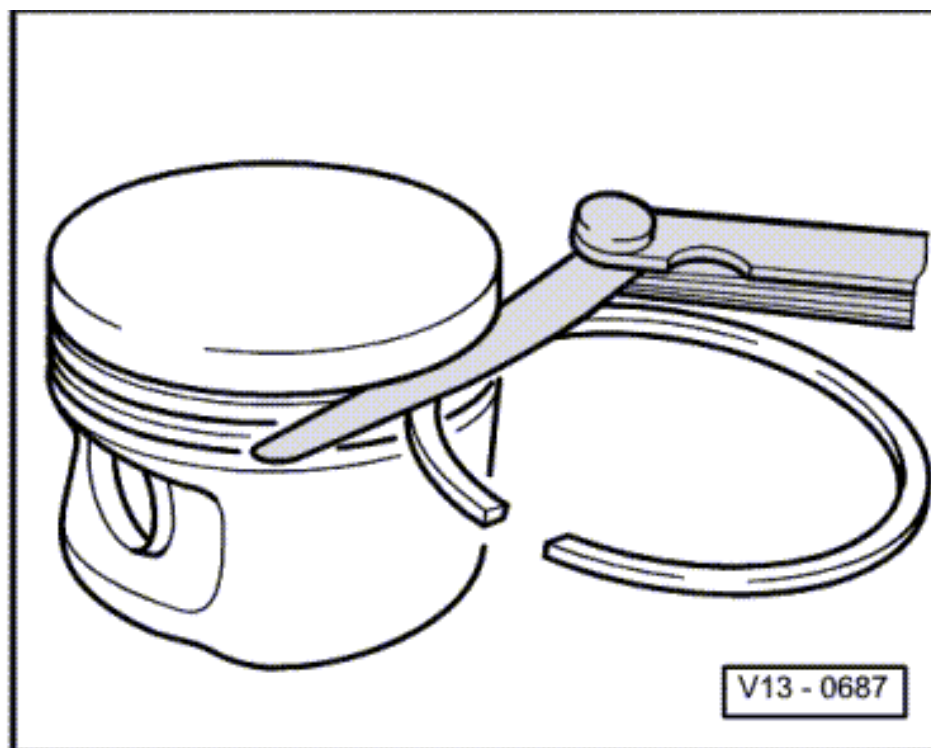
- ♦ If difficult to remove, heat piston to approx. 60 °C.
- ♦ Remove and install with VW 222a



-> Fig. 1 Checking piston ring gap

- Push ring squarely from above down into the lower cylinder aperture approx. 15 mm from the cylinder edge.

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.20...0.40	1.0
2nd compression ring	0.20...0.40	1.0
Oil scraper ring	0.25...0.50	1.0

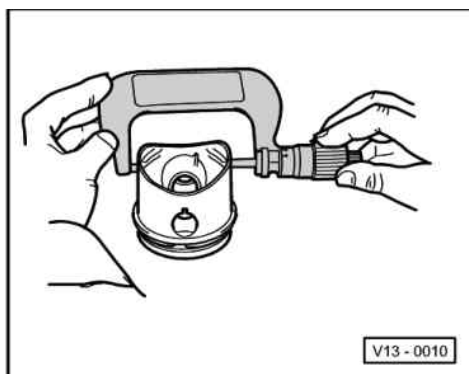


-> Fig. 2 Checking ring to groove clearance

- Clean groove before checking clearance.

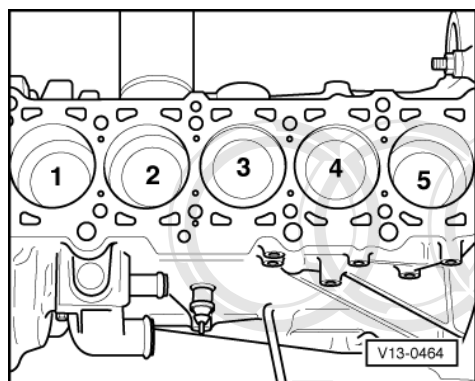
Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.02...0.07	0.15
2nd compression ring	0.02...0.07	0.15

Piston ring Dimensions in mm	New	Wear limit
Oil scraper ring	0.02...0.06	0.15



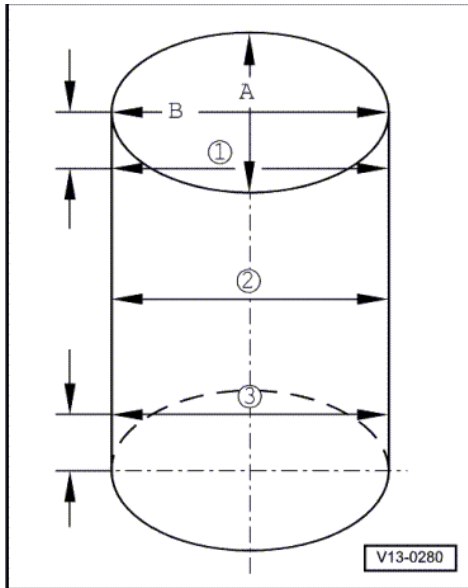
→ Fig. 3 Checking piston

- Measure approx. 10 mm from the lower edge, offset by 90° to the piston pin axis.
- Permissible deviation from nominal dimension:
no more than 0.04 mm.



→ Fig.4 Piston installation position and arrangement of piston/cylinder

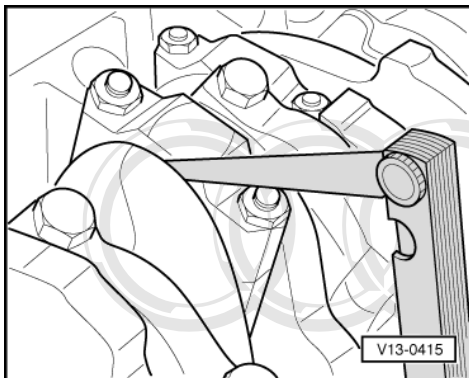
- Mark installation position and allocation on inside of piston (not on piston crown) with electric pen or felt-tip pen.
- Installation position.
Arrow on piston crown points to pulley end.
- Mark piston number in relation to cylinders -1...5-.



-> Fig. 5 Checking cylinder bores.

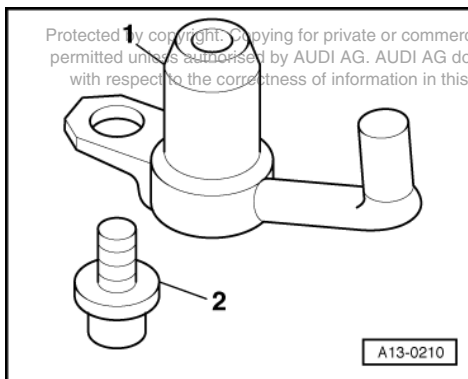
Special tools and workshop equipment required

- ◆ Use internal dial gauge 50...100 mm.
- Take measurements at 3 positions in both lateral direction -A- and longitudinal direction -B-.
 - Permissible deviation from nominal dimension: no more than 0.08 mm.



-> Fig.6 Checking axial clearance of conrods

- ◆ Wear limit: 0.40 mm



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**-> Fig.7 Oil spray jet and pressure relief valve**

- 1 - Oil spray jet and pressure relief valve
- 2 - Bolt - 10 Nm
- install using locking compound
- Locking compound

=> Parts List

3.2 - Piston and cylinder dimensions

(in mm)

Honing dimension	Piston $\varnothing$	Cylinder-hole $\varnothing$
Basic dimension	82.48	82.51
1st undersize	82.73	82.76
2nd undersize	82.98	83.01

3.3 - Checking radial play of conrods**Notes:**

- ♦ Do not interchange used bearing shells.
- ♦ Do not twist crankshaft when measuring radial clearance.

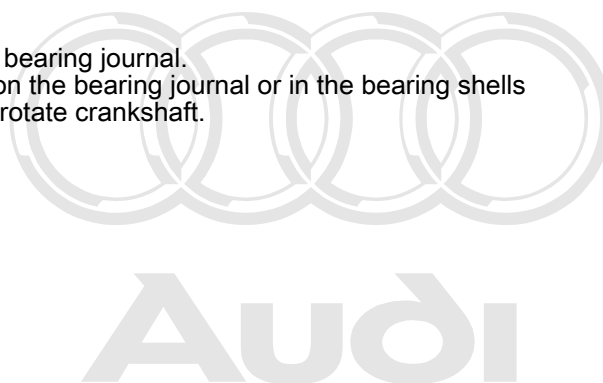
Auxiliary equipment required

- ♦ Plastigage

Test sequence

- Remove conrod bearing cap. Clean bearing cap and bearing journal.
- Place a length of Plastigage of corresponding width on the bearing journal or in the bearing shells
- 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.

Play when new	Wear limit
0.010...0.056 mm	0.1 mm



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15 - Cylinder head, Valve gear

1 - Removing and installing cylinder head

1.1 - Removing and installing cylinder head

Notes:

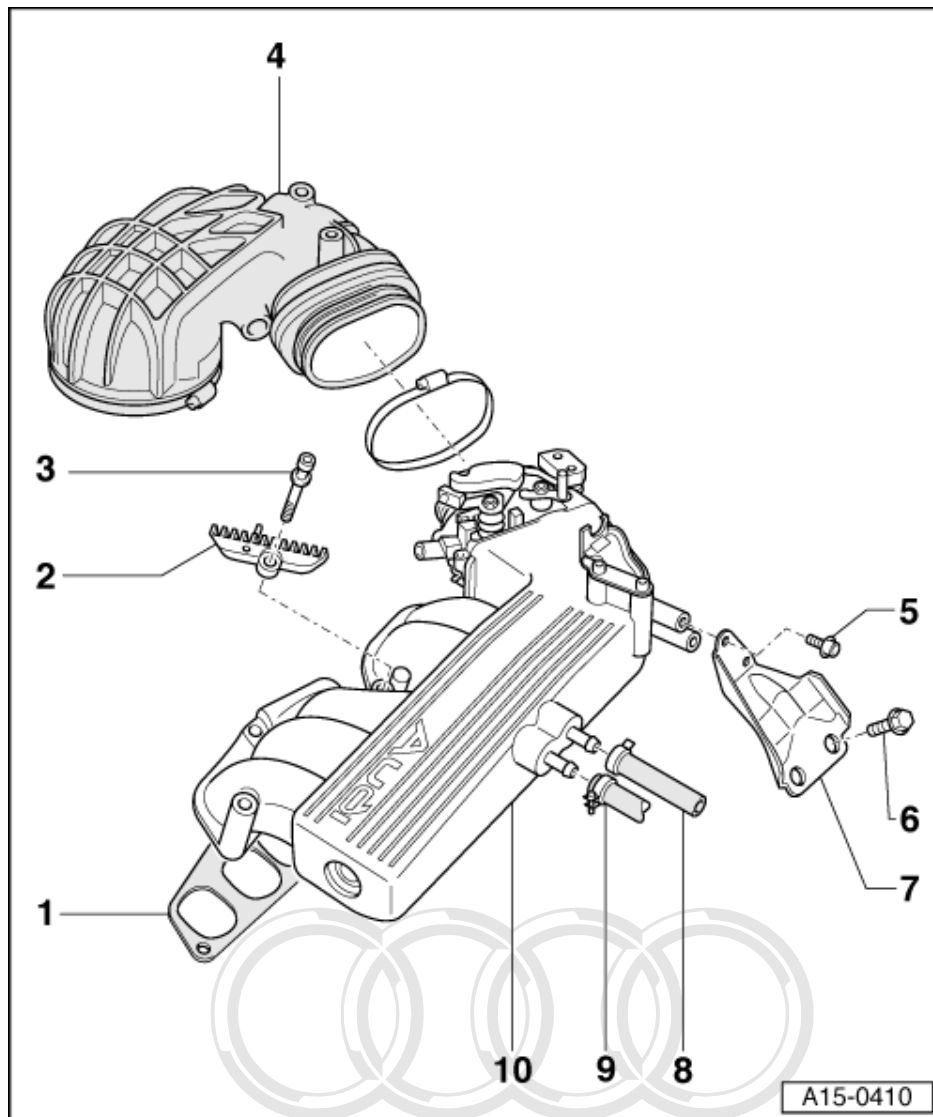
- ◆ Replace the cylinder head bolts.
- ◆ When performing repairs, replace seals, gaskets, self-locking nuts and bolts which have a specified tightening angle.
- ◆ When installing a replacement cylinder head with the camshafts fitted, the contact surfaces between bucket tappet and cam running surface must be oiled after installation of the cylinder head.
- ◆ The plastic protectors fitted to protect the open valves must only be removed immediately before fitting the cylinder head.
- ◆ When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and re-fill with new coolant.
- ◆ Cylinder heads which have cracks between the valve seats or between valve seat inserts and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first 4 turns of the spark plug threads are cracked.
- ◆ To remove cylinder head, the upper part of the intake manifold must be removed.



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1.2 - Upper part of intake manifold - Overview



1 Gasket

- ♦ Replace

2 Bracket

- ♦ For injector pipes

3 22 Nm

4 Intake cowl

5 10 Nm

6 22 Nm

7 Support

- ♦ For intake manifold

8 Vacuum hose

9 Vacuum hose

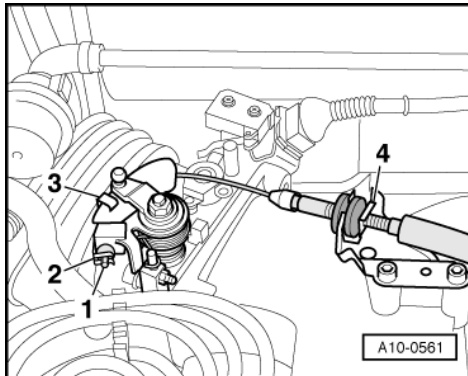
- ♦ To brake servo

10 Intake manifold - upper part

- ♦ Removing and installing=>Page 69

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1.3 - Installing and removing upper part of intake manifold

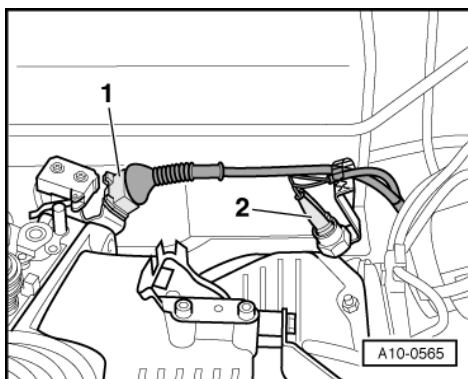


Removing

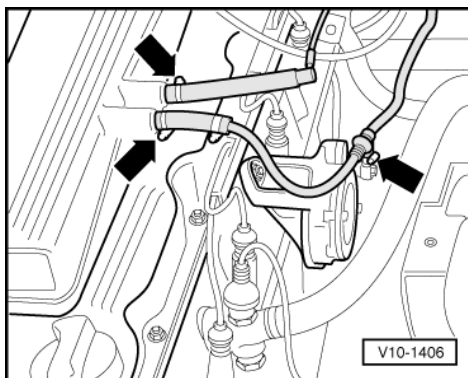
Note:

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

- -> Remove securing clips -2- and -3-.
- Detach throttle cable -1- at throttle valve body and support bracket (do not remove throttle cable retainer -4-). Move throttle cable to the side.



- -> Detach connector from throttle valve switch -1-. Connector -2- remains plugged in.

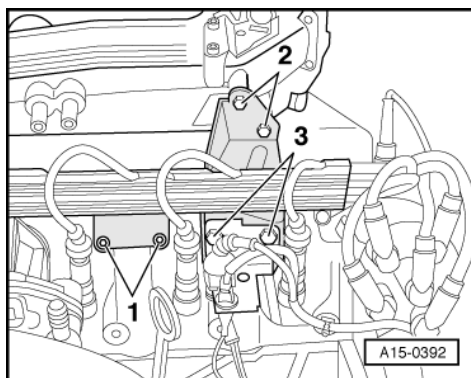


- -> Remove the vacuum hoses -arrows-.

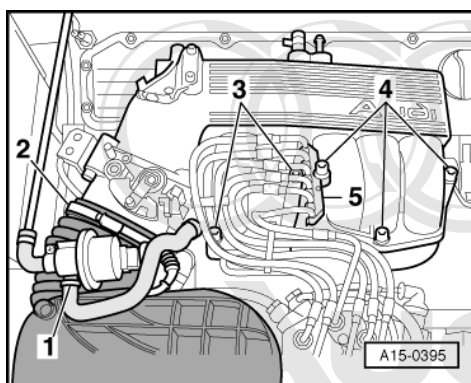
Note:

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Illustration shows vehicle with air conditioner.



- -> Loosen bolts -1- several turns.
- Unscrew bolts -2- and -3-.
- Remove intake manifold support.
- Unscrew earth wire from intake manifold.



- -> Disconnect hose -1- to ACF valve at throttle valve body.
- Loosen hose clamp -2-.
- Unscrew bolts -3- and -4-.
- Remove bracket -5-.
- Detach upper part of intake manifold.

Notes:

- ♦ Plug intake ports on intake manifold (lower part) with clean cloths.
- ♦ Ensure that spring pins are firmly seated in lower part of intake manifold.

Installing

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

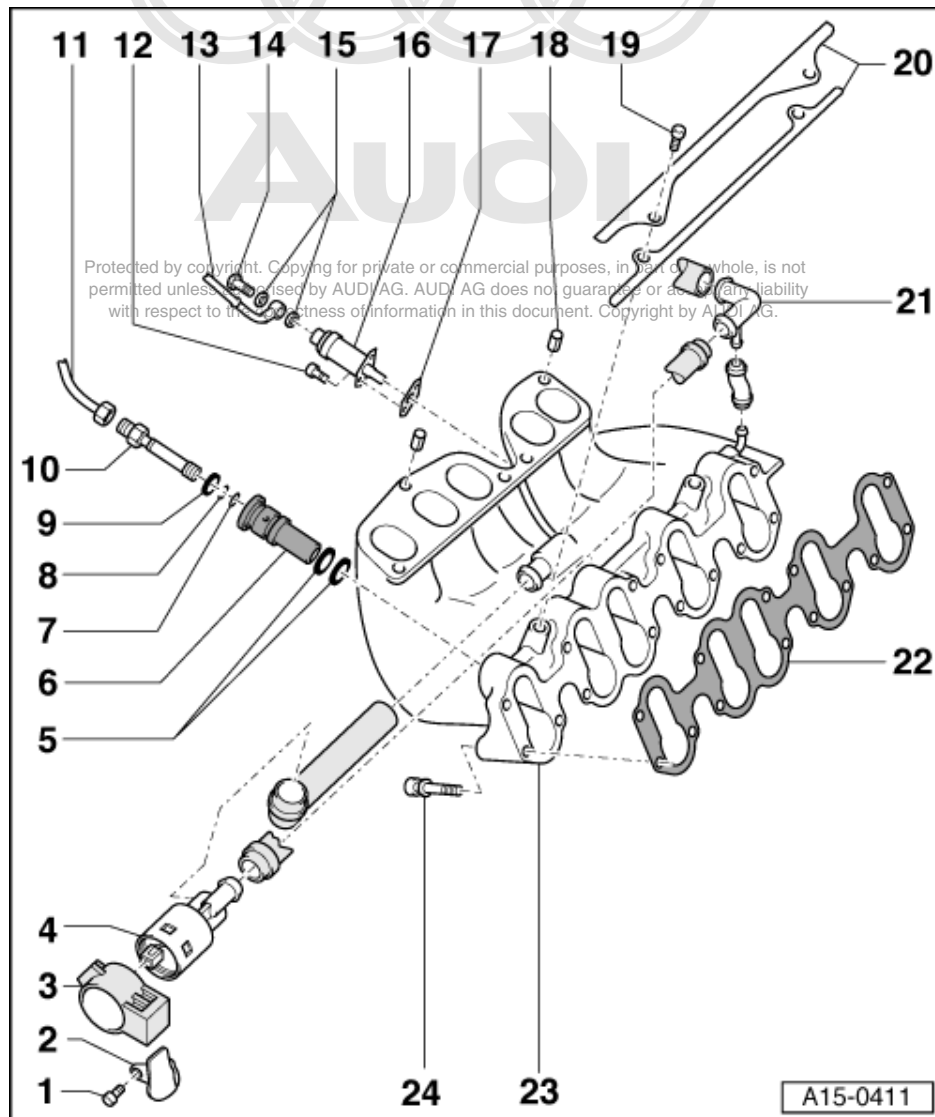
Note:

Renew gasket.

Tightening torques

Component	Nm
Intake manifold upper section to intake manifold lower section	22
Support for intake mani- to intake manifold fold	10
to cylinder head	22

1.4 - Lower part of intake manifold - Overview

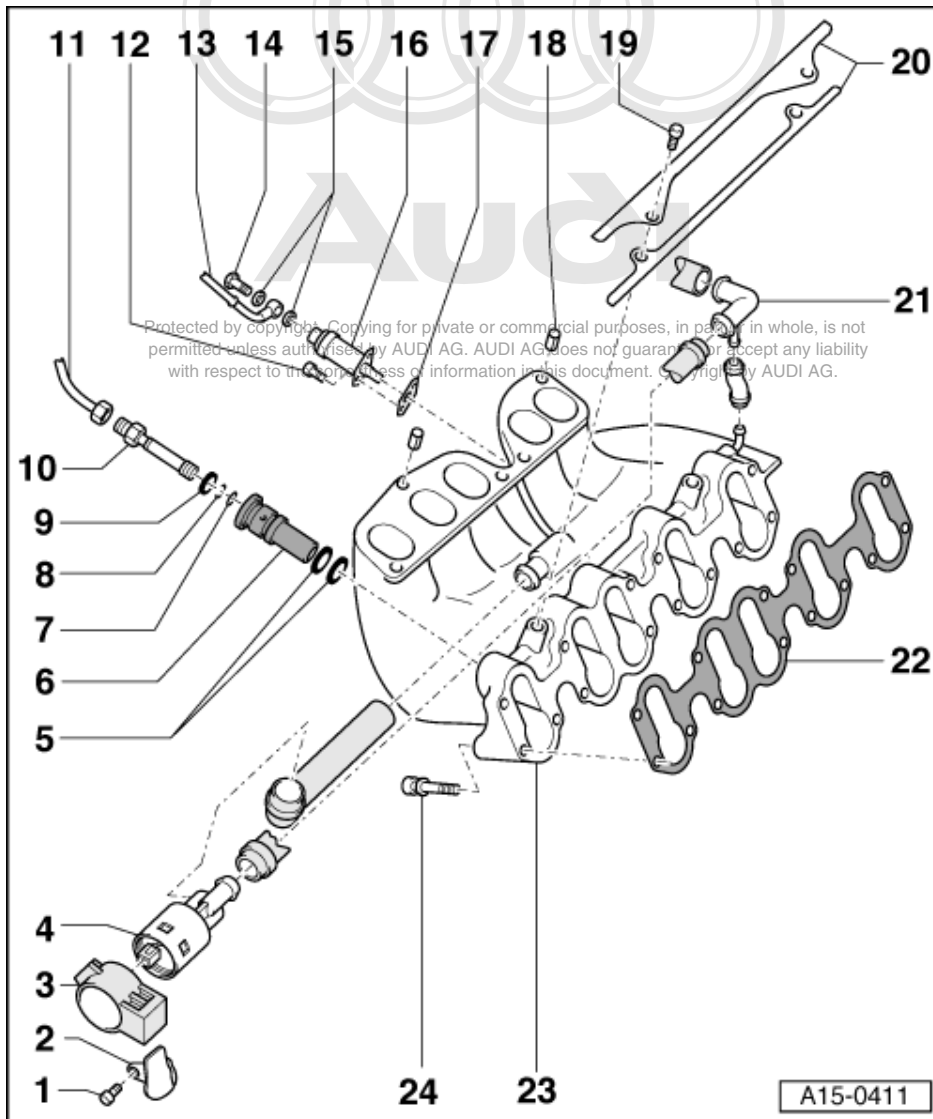


- 1 10 Nm
- 2 Bracket
 - ♦ For idling stabilisation valve -N71
- 3 Mounting
 - ♦ for idling stabilisation valve -N71
- 4 Idling stabilisation valve -N71
 - ♦ Checking:

=> Fuel Injection and Ignition System; Repair group 25

- 5 O-rings
 - ♦ Replace
- 6 Insert for injector
 - ♦ Removing and installing:

=> Fuel Injection and Ignition System; Repair group 25



7 O-ring

- ♦ Replace

8 Circlip

9 O-ring

- ♦ Replace

10 Injector

- ♦ Checking:

=> Fuel Injection and Ignition System; Repair group 25

11 Injector pipe - 20 Nm

12 10 Nm

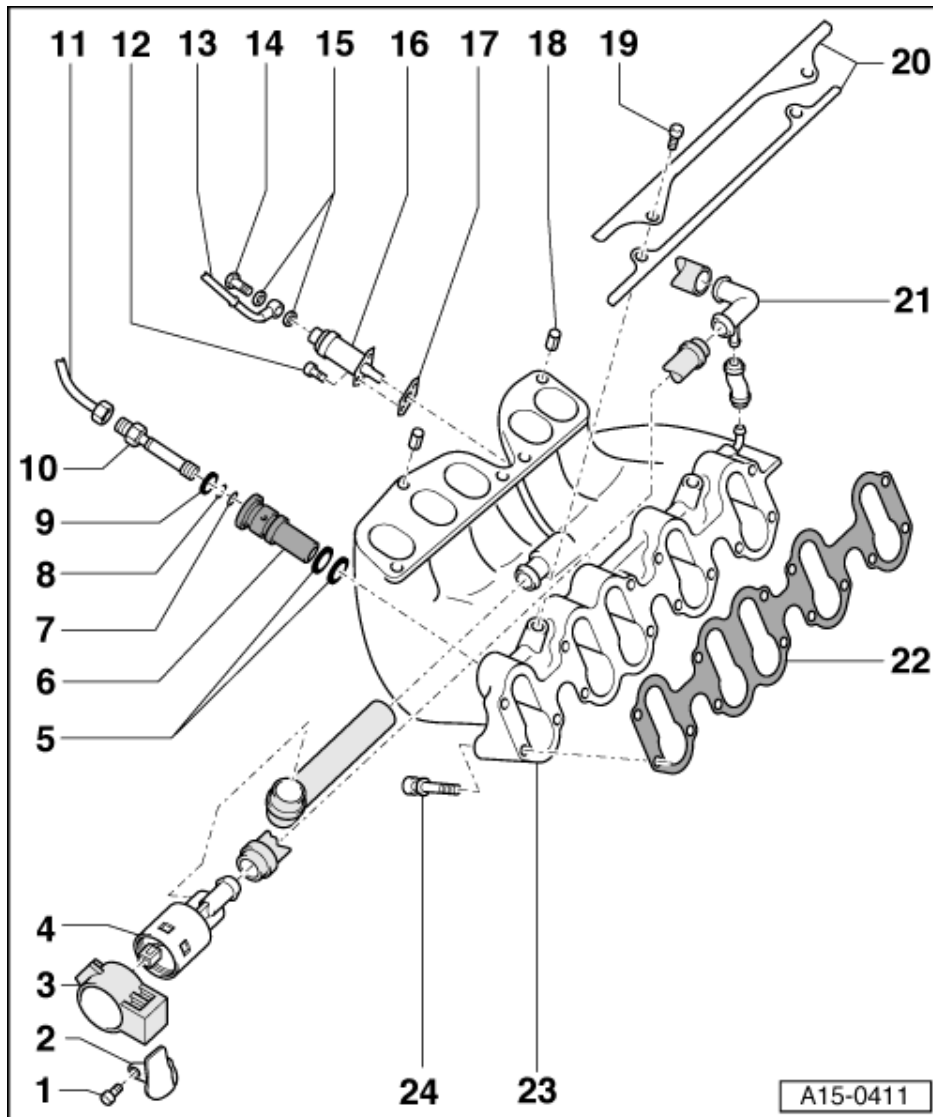
13 Fuel pipe

- ♦ For cold start valve

14 Banjo bolt - 10 Nm

15 Seals

- ♦ Replace

**16 Cold start valve -N17**

- ♦ Checking:

=> Fuel Injection and Ignition System; Repair group 25

17 Gasket

- ♦ Replace

18 Spring pin

19 10 Nm

20 Retaining plates

- ♦ For injectors

21 Angled connector**22 Gasket**

- ♦ Replace

23 Intake manifold - lower part

- ♦ Removing and installing
=>Page 24 .

24 22 Nm

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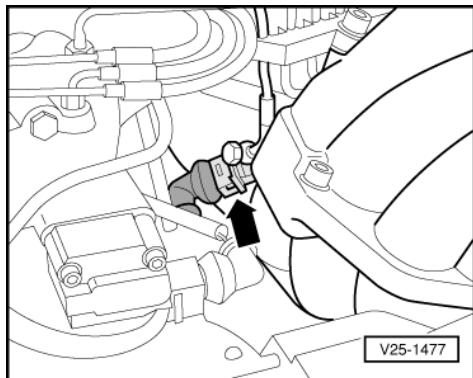
1.5 - Installing and removing lower part of intake manifold

Removing

Note:

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

- Remove the upper part of the intake manifold
=>Page 69 .

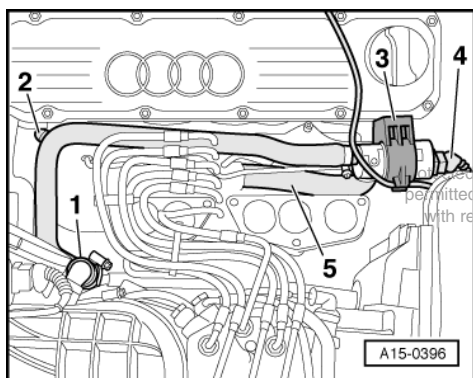


- -> Unplug connector from cold start valve -arrow-.

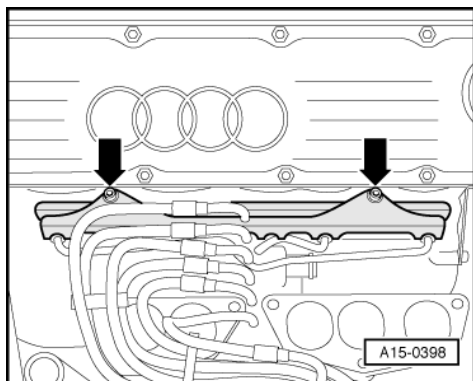
Important

The fuel system is pressurised. Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.

- Unbolt fuel line.



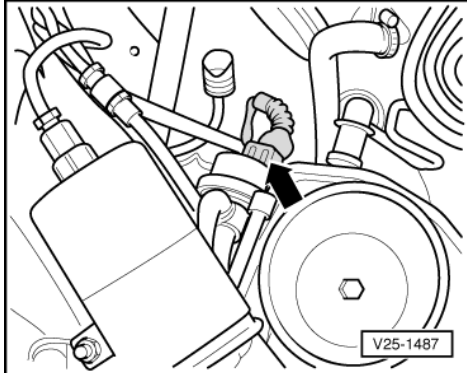
- -> Unplug connector -4-.
- Detach hoses -1-, -2- and -5-.
- Detach idling stabilisation valve bracket -3-.



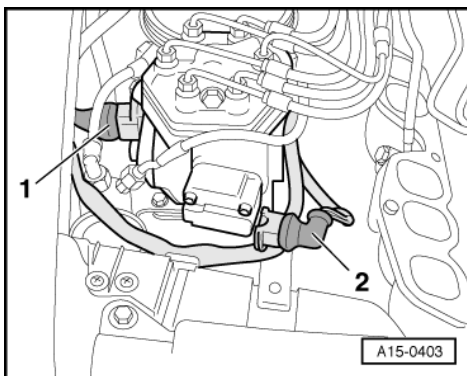
- -> Unscrew bolts -arrows-.
- Remove retaining plates.
- Remove injectors from lower part of intake manifold and set aside.

Note:

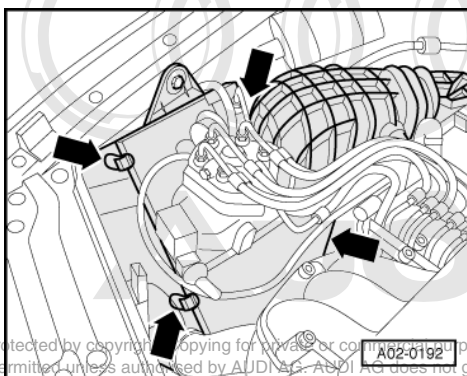
Protect the removed injectors from contamination.



- Remove crankcase breather hose from intake cowl.
- Detach air intake cowl.
- -> Detach connector -arrow- from ACF valve.
- Unclip ACF valve from bracket and tie back.



- -> Detach connectors -1- and -2-.
- Lay wiring aside.



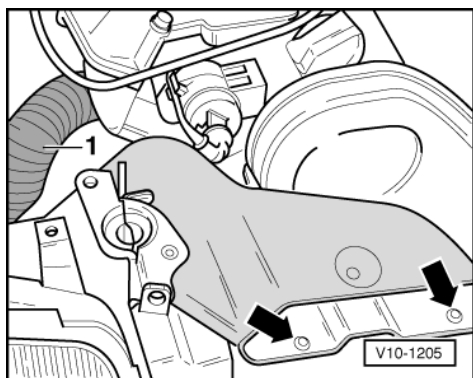
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Important

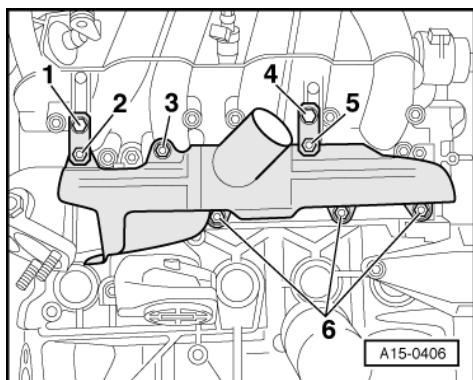
The fuel system is pressurised. Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.



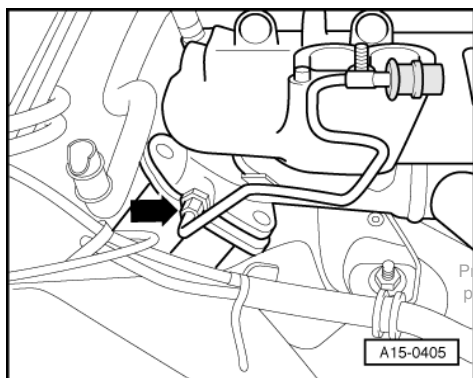
- Disconnect fuel supply and return hoses from mixture control unit.
- -> Release clips around air cleaner housing -arrows-.
- Detach mixture control unit with upper section of air cleaner housing.



- -> Detach and remove air intake connection -arrows-.
- Detach hose -1- of intake air preheater from warm air arrester plate on exhaust manifold.
- Remove the lower section of the air cleaner housing.



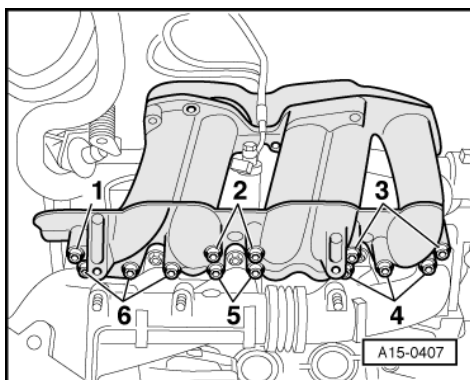
- -> Unscrew warm air arrester plate -1...6-.



- -> Unscrew CO test pipe -arrow-.



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- -> Unscrew lower part of intake manifold -1...6-.

Note:

Plug intake ports on cylinder head with clean cloths.

Installing

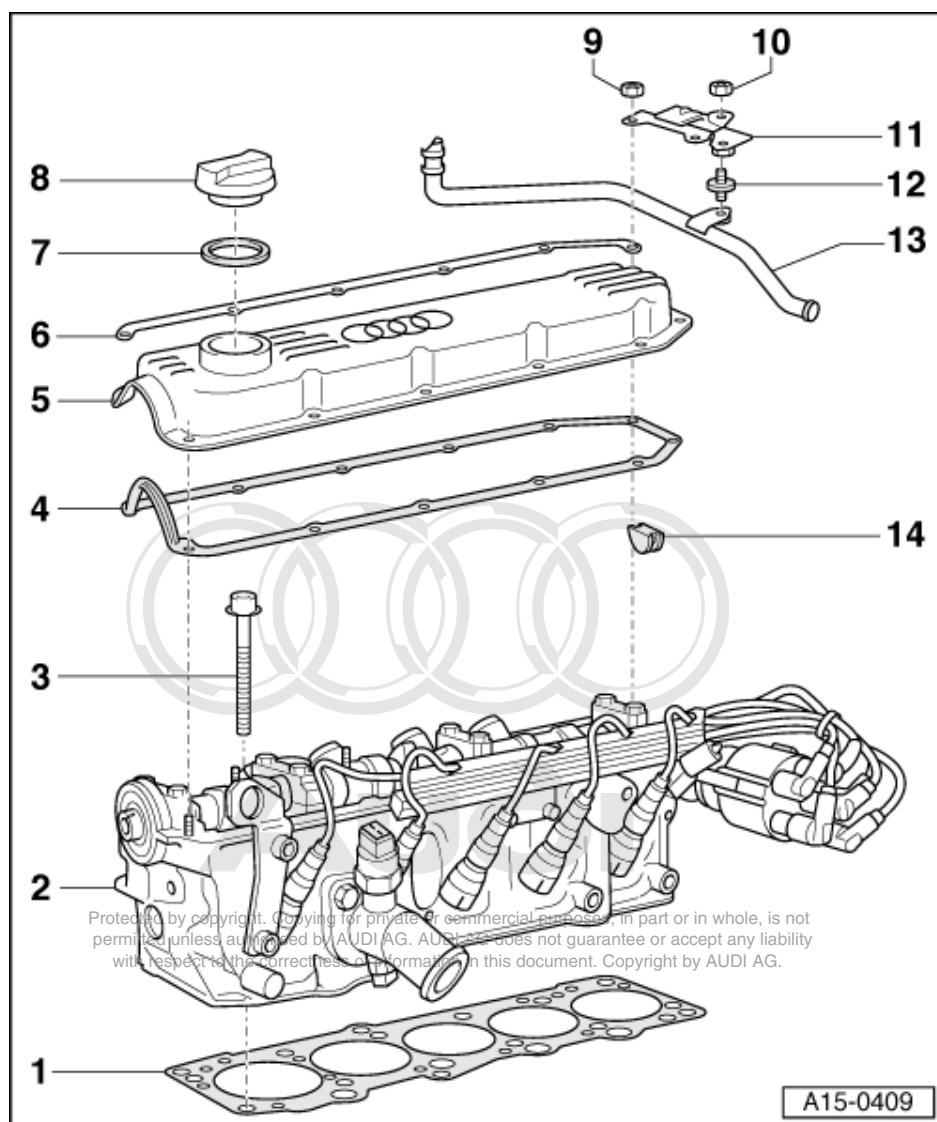
Install in reverse order.

Tightening torques

Component	Nm
Lower part of intake manifold to cylinder head	22
CO test pipe to exhaust manifold	20
CO test pipe and earth wire to lower part of intake manifold	10
Warm air arrester plate to cylinder head	25
Warm air arrester plate to exhaust manifold	22
Retaining plates to lower part of intake manifold	10
Fuel line to cold start valve	10
Fuel supply and return pipes	23

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1.6 - Cylinder head - Overview

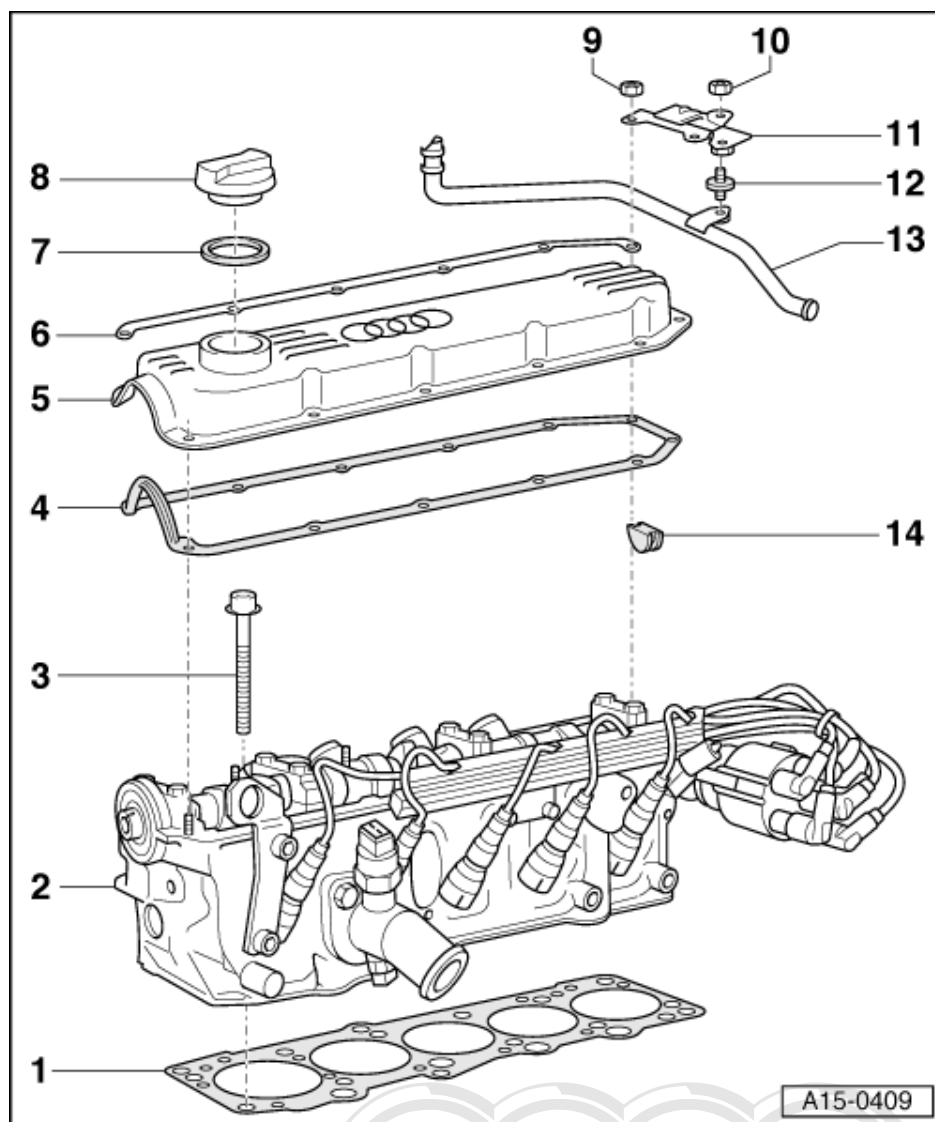


1 Cylinder head gasket

- ◆ Renew => Removing cylinder head, Page 84 .
- ◆ Installation position: Marking "oben" (top) or part no. must face cylinder head
- ◆ After replacing, fill with fresh coolant

2 Cylinder head

- ◆ Removing => Page 84
- ◆ Checking for distortion
=> Fig. 81
- ◆ Reworking dimension
=> Fig. 81
- ◆ Installing => Page 88
- ◆ After replacing, fill with fresh coolant

**3 Cylinder head bolt**

- ◆ Replace
- ◆ Note sequence when loosening => Page 88
- ◆ Note sequence when tightening => Page 89

4 Cylinder head cover gasket

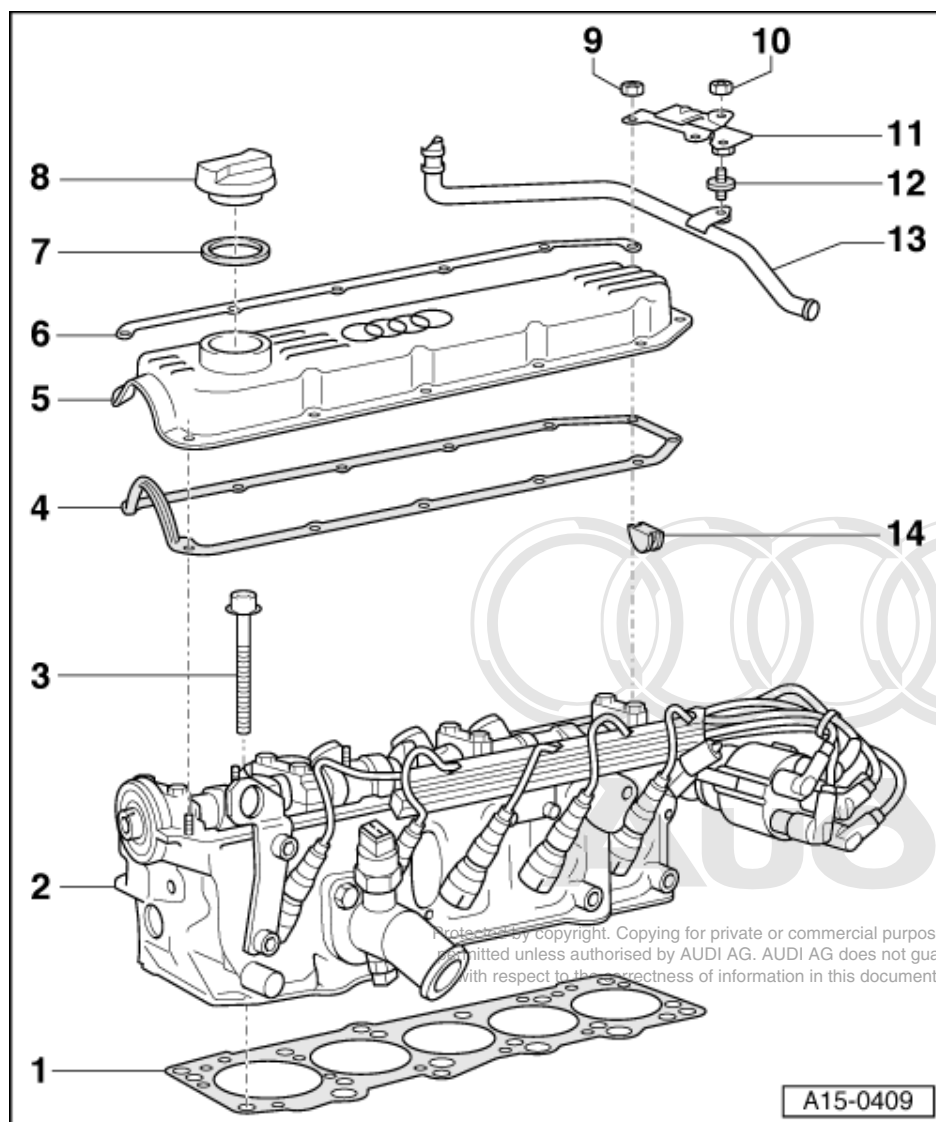
- ◆ Renew if damaged or leaking
- ◆ Removing and installing
=>Page 82 .
- ◆ Before fitting gasket apply sealant at sealing points => Fig. 81

5 Cylinder head cover

- ◆ Removing and installing
=>Page 82 .

6 Reinforcement strip

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7 Gasket

- ♦ Renew if damaged or leaking

8 Cap

9 Nut

- ♦ Note sequence when tightening => Page 84

10 10 Nm

11 Bracket

- ♦ For fan run-on thermoswitch -F87

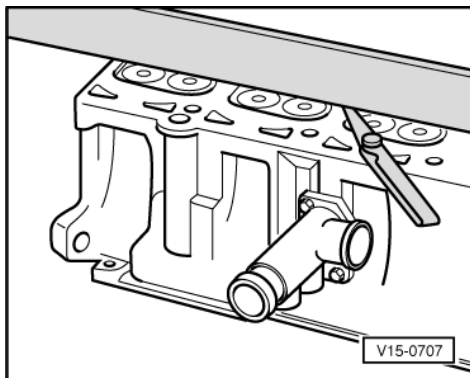
12 Bonded rubber bush

13 Pipe

- ♦ For crankcase breather

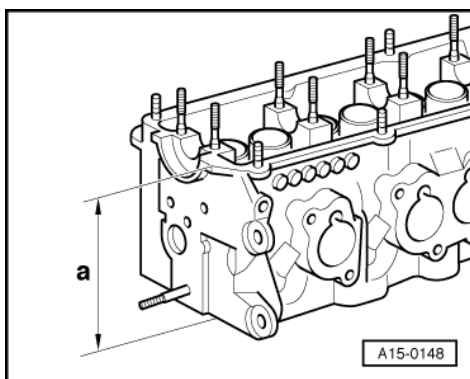
14 Half moon seal

- ♦ Renew if damaged or leaking



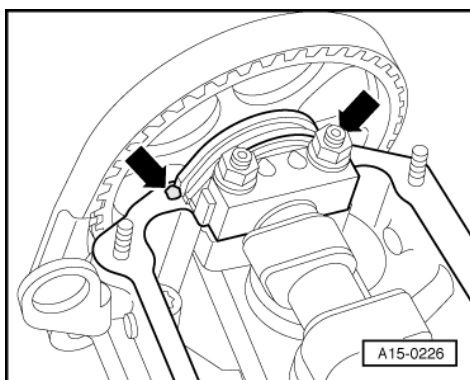
-> Fig.1 Check cylinder head for distortion

- Use knife edge, straightedge and feeler gauge to measure at several points.
 - Max. permissible distortion: 0.1 mm



-> Fig.2 Reworking dimension for cylinder head

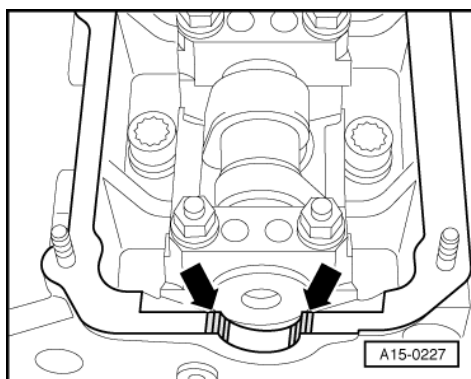
- Reworking the cylinder head (grinding) is only permitted down to minimum dimension a.
 - Minimum dimension a = 132.75 mm



-> Fig.3 Seal connections between bearing cap and cylinder head

- Apply a small quantity of sealing compound to sealing points -arrows- on upper sealing surface of cylinder head.
 - Sealing compound

=> Parts List

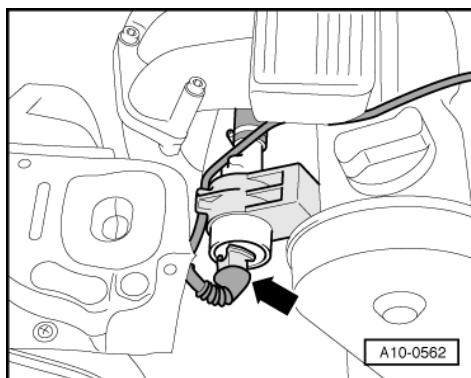


-> Fig.4 Applying sealant to sealing points

- Apply a small quantity of sealing compound to sealing points for half moon seal -arrows- on upper sealing surface of cylinder head.
- Sealing compound

=> Parts List

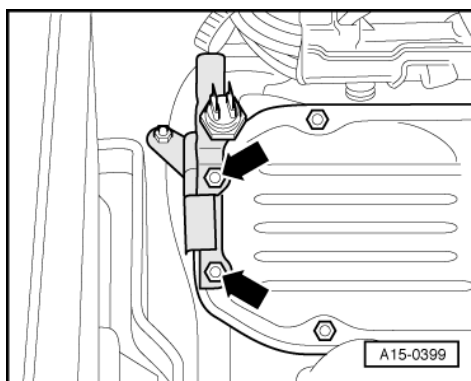
1.7 - Removing and installing cylinder head cover



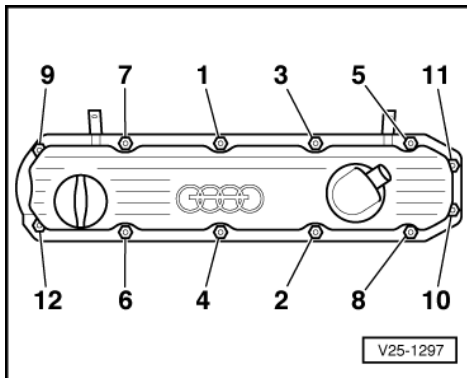
Removing

- Remove the upper part of the intake manifold
=>Page 69 .
- -> Detach connector -arrow- from idling stabilisation valve.
- Lay wiring aside.

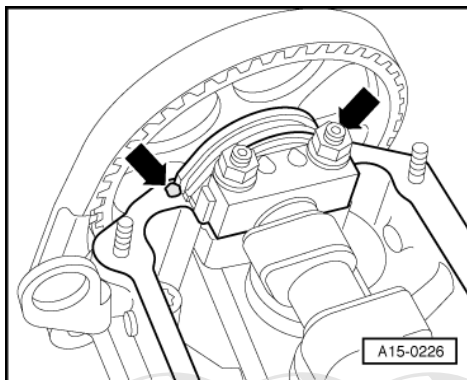
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- -> Unscrew bracket of fan run-on thermoswitch -F87 -arrows- and push back.



- -> Loosening nuts on cylinder head cover.
- Detaching reinforcement strips and cylinder head cover.



Installing

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

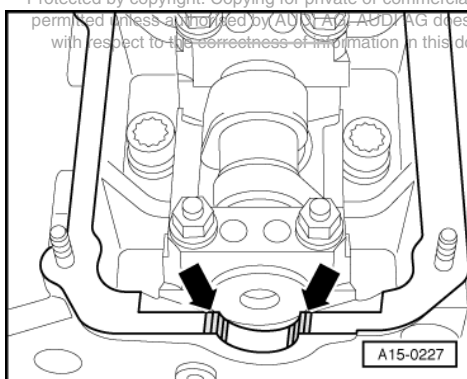
Note:

Replace gaskets and seals.

- -> Apply a small quantity of sealing compound to sealing points -arrows- on upper sealing surface of cylinder head.
- Sealing compound

=> Parts List

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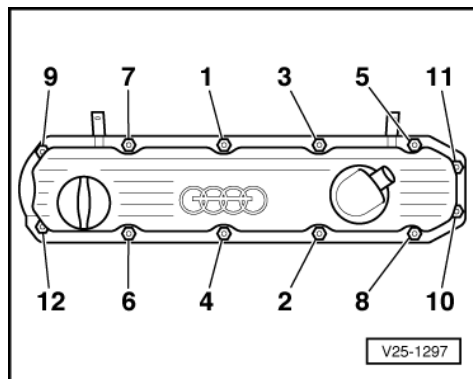
- -> Apply a small quantity of sealing compound to sealing points for half moon seal -arrows- on upper sealing surface of cylinder head.



- Sealing compound

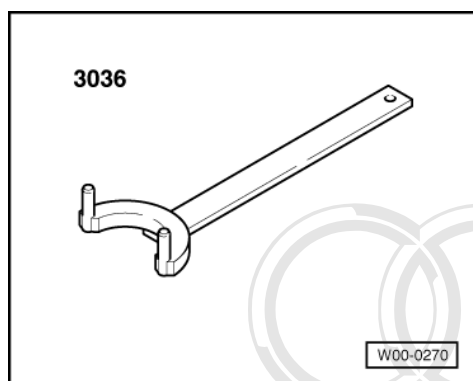
=> Parts List

- Installing cylinder head cover and reinforcement strips.



- -> Tighten cylinder head cover in three stages in sequence shown, as follows:
 - 1st Stage: 5 Nm
 - 2nd Stage: 10 Nm
 - 3rd Stage: 12 Nm
 - Install the upper section of the intake manifold
- =>Page 70 .

1.8 - Removing cylinder head



Special tools and workshop equipment required

- ♦ Holding tool 3036

Procedure

- Engine in vehicle

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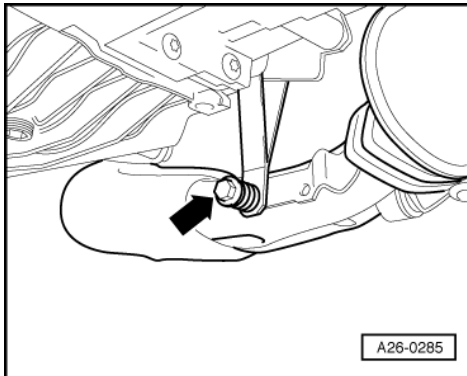
Notes:

- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

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

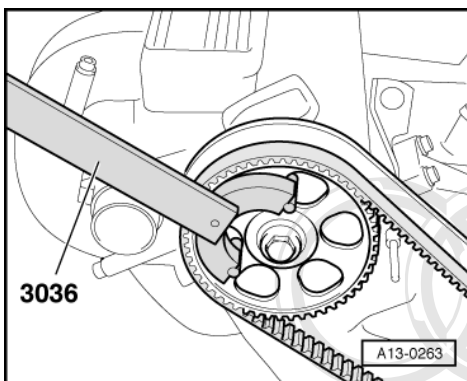
- Observe or obtain radio code on vehicles with coded radio.
- Disconnect earthing strap at battery with ignition switched off.
- Drain coolant => Page 136 .



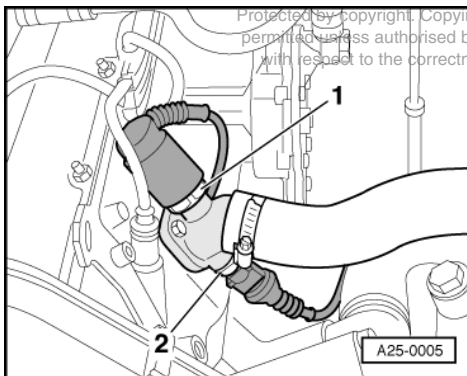
- Unscrew exhaust manifold/front exhaust pipe nuts.
- -> Unbolt retainer for exhaust system -arrow-.
- Push exhaust system towards the rear so that studs on exhaust manifold are free.

Note:

Watch for electrical wiring of lambda probe.



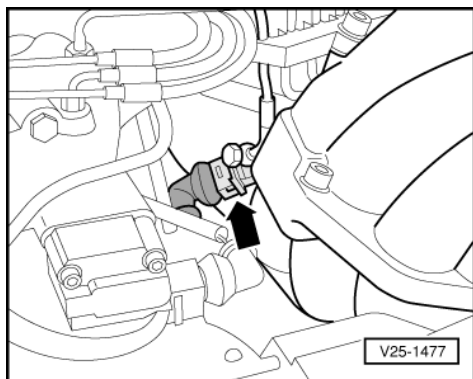
- Removing toothed belt from camshaft sprocket
=>Page 40 .
- -> Loosen bolt on camshaft sprocket using special tool 3036 to counterhold.
- Remove camshaft sprocket.
- Remove Woodruff key from camshaft.
- Remove the rear toothed belt guard.



- -> Detach connectors from electronic thermoswitch -F76 -Item 1- and from coolant temperature sender - G62 -Item 2-.
- Detach coolant hose from connection on cylinder head.
- Unplug the connector of the Hall sender at the ignition distributor.



- Detach main ignition wire from ignition coil.

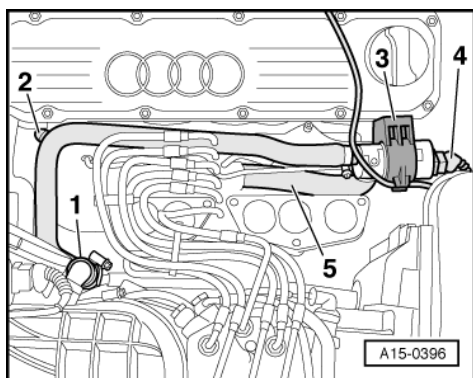


- Remove the upper section of the intake manifold
=>Page 69 .
- -> Unplug connector from cold start valve -arrow-.

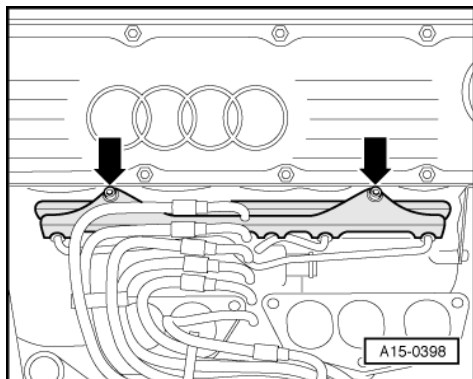
Important

The fuel system is pressurised. Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.

- Unbolt fuel line.



- -> Unplug connector -4-.
- Detach hoses -1-, -2- and -5-.
- Detach idling stabilisation valve bracket -3-.
- Detach hose of intake air preheater from warm air arrester plate on exhaust manifold.



- -> Unscrew bolts -arrows-.
- Remove retaining plates.

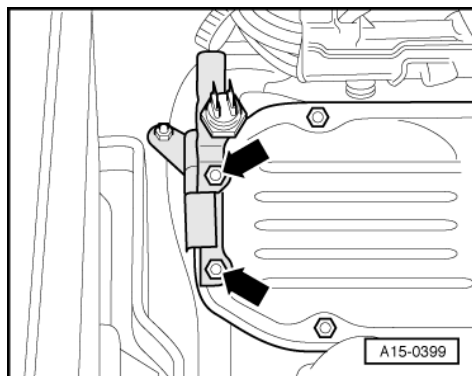


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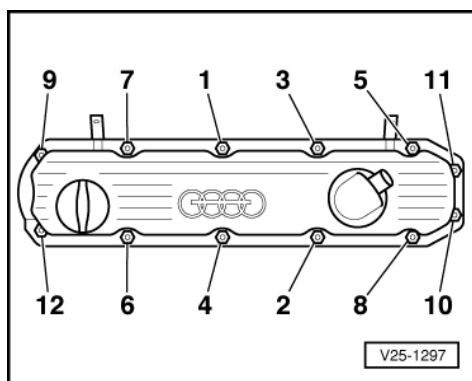
- Remove injectors from lower section of intake manifold and set aside.

Note:

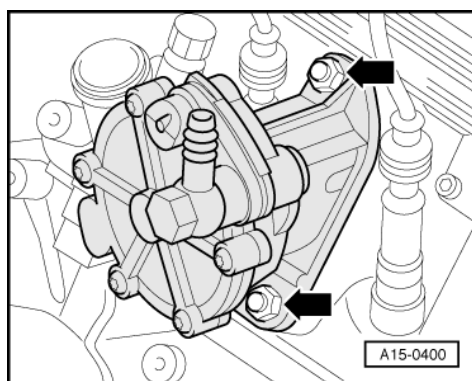
Protect the removed injectors from contamination.



- -> Unscrew bracket of fan run-on thermoswitch -F87 -arrows- and push back.

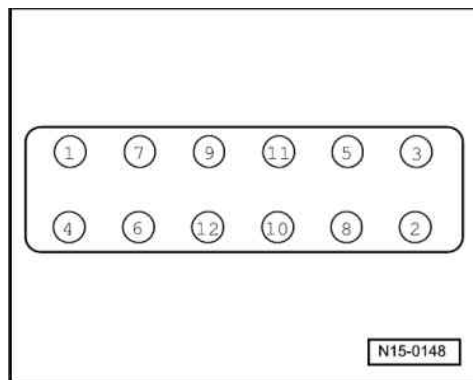


- -> Loosen nuts on cylinder head cover.
- Detach reinforcement strips and cylinder head cover.



- -> Unscrew nuts -arrows-.
- Detach vacuum pump and push rod.

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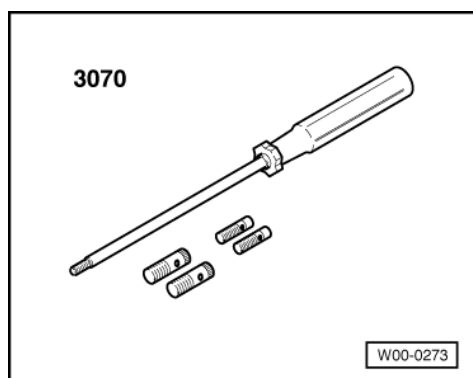


- -> Loosen cylinder head bolts in the sequence 1...12
- Remove cylinder head with cylinder head gasket.

1.9 - Installing cylinder head

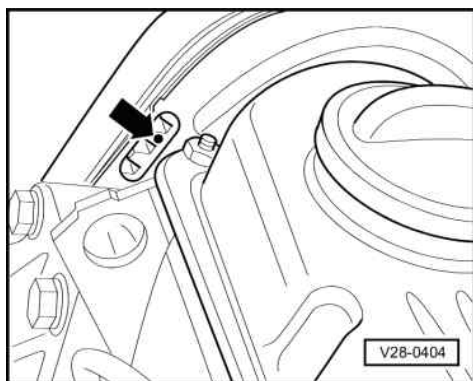
Notes:

- ♦ Replace the cylinder head bolts.
- ♦ When performing repairs, replace seals, gaskets, self-locking nuts and bolts which have a specified tightening angle.
- ♦ If repairing, carefully remove any remains of gasket material from the cylinder head and cylinder block. Make sure that no long scores or scratches are made on the surfaces.
- ♦ Carefully remove any remaining emery and abrasive material.
- ♦ Remove new cylinder head gasket from packaging, just before installation.
- ♦ Handle gasket extremely carefully. Damaging the silicone layer or the indented area will lead to leaks.
- ♦ No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder head.



Special tools and workshop equipment required

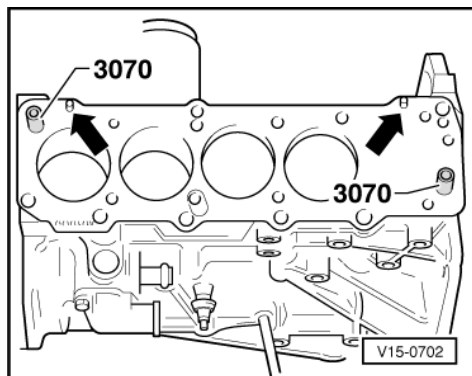
- ♦ Guide pin 3070



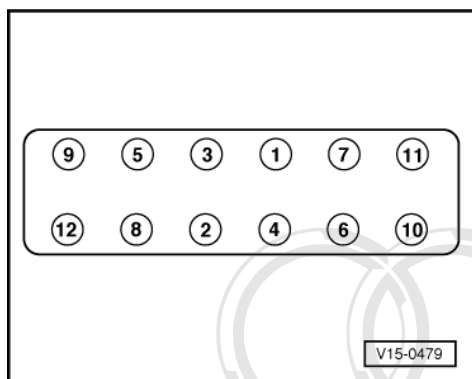
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Procedure

- -> Before positioning cylinder head, set camshaft to TDC of cylinder 1.



- -> To centre, screw guide pins from 3070 into holes for cylinder head bolts 9 and 10.
- Place cylinder head gasket in position.
 - Note position of centralising pins in cylinder block -arrows-.
 - Check installation position of cylinder head gasket: mark "top" or the part No. must face cylinder head.
- Position cylinder head.
- Fit 10 cylinder head bolts and tighten by hand.



- Unscrew guide pins with removal tool from 3070 through bolt holes in cylinder head and install remaining cylinder head bolts.
- -> Tighten cylinder head in three stages in sequence shown, as follows:
 - 1st Stage: 40 Nm
 - 2nd Stage: 60 Nm
- Tighten with rigid wrench:
 - 3rd Stage: 180° (1/2 turn) further

Notes:

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- ♦ It is permissible to torque by 2 x 90°.
- ♦ It is not necessary to re-tighten the cylinder head bolts.

- Install cylinder head cover => Page 82 .
- Remove the upper section of the intake manifold
=>Page 70 .
- Install toothed belt (adjust valve timing) => Page 37 .

Note:

Note all instructions on removing and installing the toothed belt =>Page 33 .

- Check throttle cable setting

=> Fuel Supply - Petrol Engines; Repair group 20; Servicing throttle mechanism Servicing throttle mechanism



- Replace coolant => Page **138** .

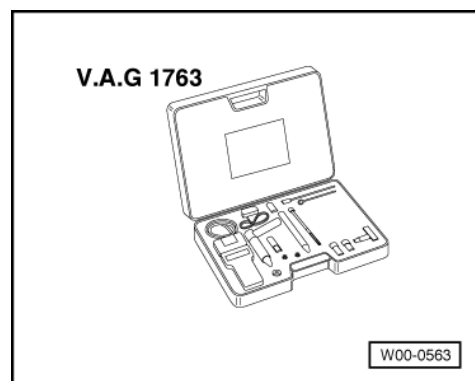
Note:

If the battery is reattached make sure that the vehicle equipment (radio, clock, electrical window lifter) is actuated according to the operating instructions.

Tightening torques

Component	Nm
Retaining plates to lower section of intake manifold	10
Fuel line to cold start valve	10
Exhaust system bracket to front exhaust pipe	25
Rear toothed belt guard to cylinder head	10
Hose clamps	2

1.10 - Checking compression

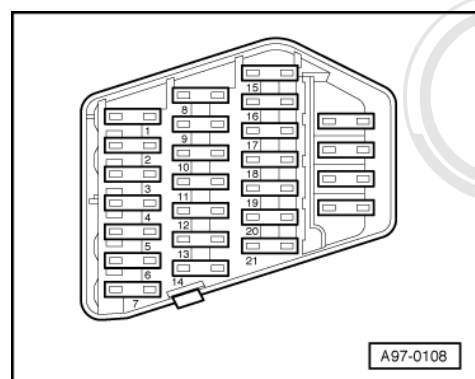


Special tools and workshop equipment required

- ♦ Compression tester V.A.G 1381/V.A.G 1763.

Test conditions

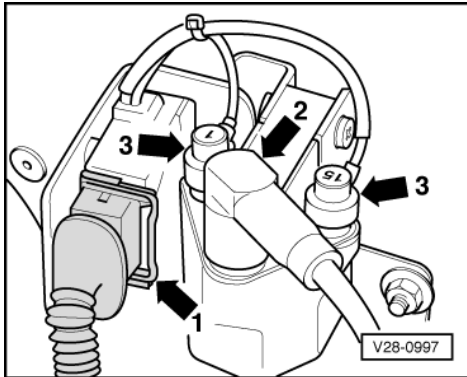
- Engine oil temperature at least 30 °C
- Battery voltage at least 12.7 V



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Test sequence

- Open fuse box cover on the left side of the dashboard panel.
- -> Pull out fuse S17.



- -> Separate the connector -arrow 1- from the power output stage and the main ignition cable -arrow 2- from the ignition transformer.
- Remove spark plugs.
- Fully open throttle valve.
- Check compression with compression tester V.A.G 1381/V.A.G 1763.

Note:

Using the compression tester

=> Operating instructions

- Operate starter until tester shows no further pressure increase.

Compression values:

New Pressure in bar	Wear limit Pressure in bar	Permissible difference between cylinders Pressure in bar
10.0...14.0	8.0	max. 3.0

- Install spark plugs.
- Refit fuse S17.
- To interrogate fault memory:

=> KE III Jetronic/Ignition System (5-cylinder); Repair group 01; Self-diagnosis of KE III Jetronic/fully-electronic ignition (FEI); Interrogating and erasing fault memory Self-diagnosis of KE III Jetronic/fully-electronic ignition (FEI) Interrogating and erasing fault memory

Note:

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Faults will have been recorded in the fault memory because the connectors have been unplugged. Therefore interrogate and erase fault memory after installing engine.

Tightening torque

Component	Nm
Spark plugs in cylinder head	30

- ♦ Before installation, apply thin coating of housing sealing compound to contact surfaces of bearing cap no. 1
- ♦ Housing sealing compound

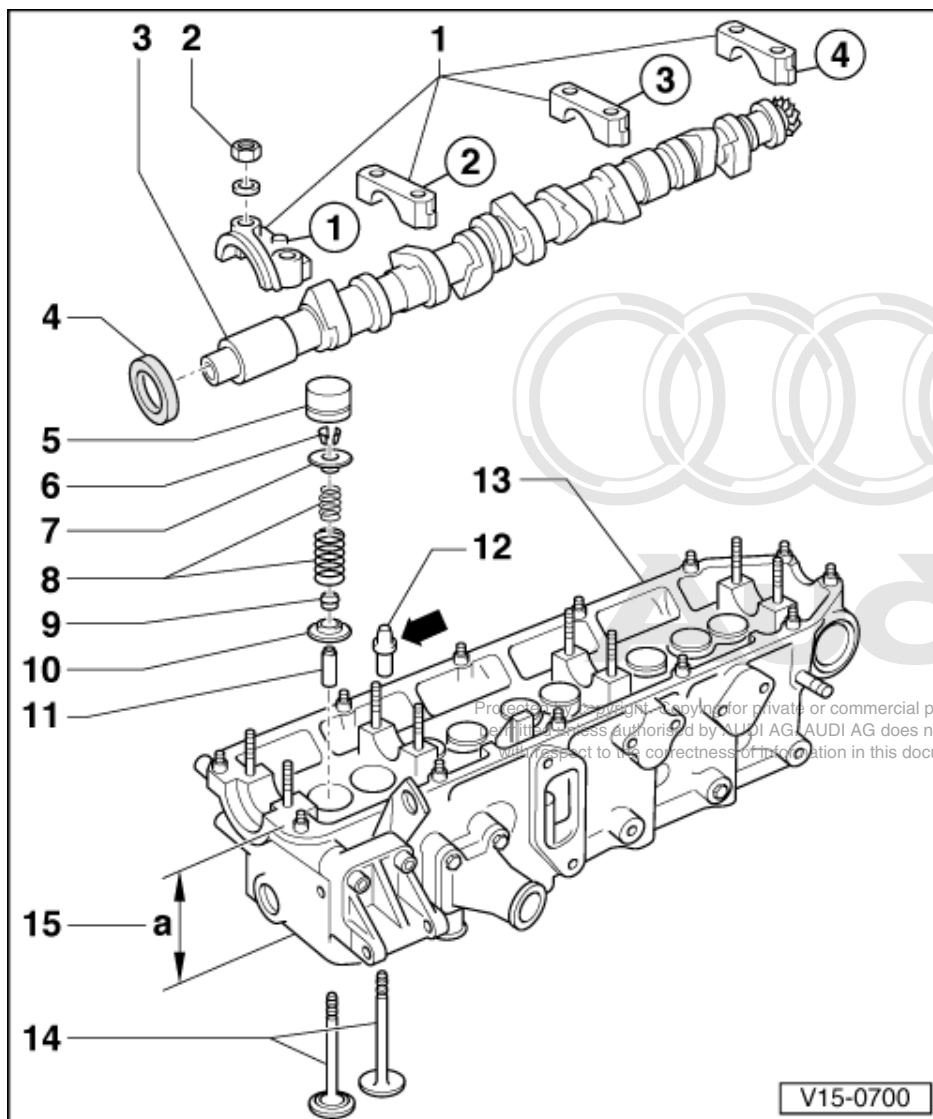
=> Parts List

- ♦ Applying sealant to sealing points => Fig. 81

2 20 Nm

3 Camshaft

- ♦ Checking axial clearance
=> Fig. 96
- ♦ Removing and installing
=>Page 100.
- ♦ Checking radial clearance with Plastigage
Wear limit: 0.1 mm
- ♦ Run-out: no more than 0.01 mm



4 Sealing ring

- ♦ Replacing => Page 98 .

5 Hydraulic bucket tappet

- ♦ Checking => Page 103
- ♦ Removing and installing
=>Page 105 .
- ♦ Do not interchange

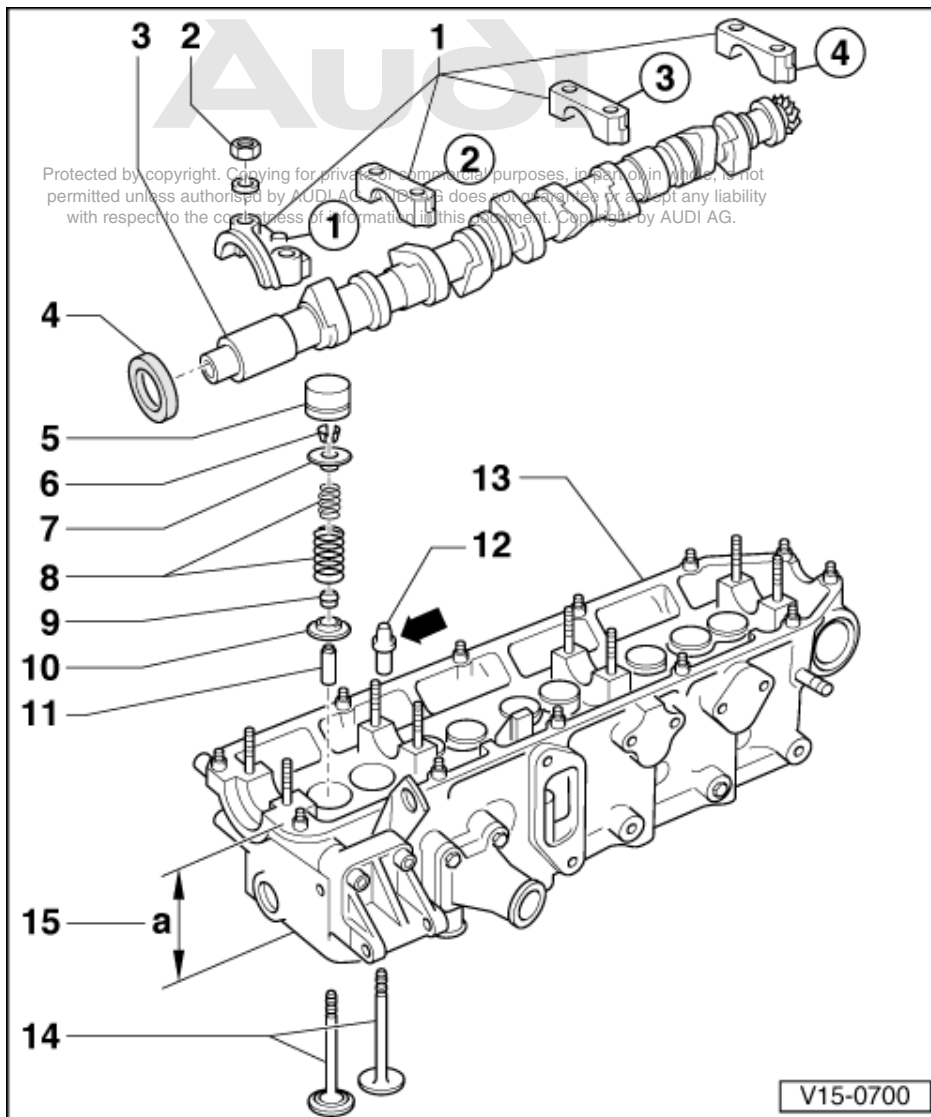
- ◆ Store with cam contact surface downwards
- ◆ Before installing check camshaft axial play => Fig. 96
- ◆ Oil contact surface

6 Valve cotters

- ◆ Removing and installing:
Cylinder head
removed: with 2037
installed: =>Page 105 .

7 Upper valve spring bracket

- ◆ Removing and installing:
Cylinder head
removed: with 2037
installed: =>Page 105 .
- ◆ Identification:
- wide outside chamfer
- inside chamfer



8 Valve springs

- ◆ Removing and installing:
Cylinder head
removed: with 2037
installed: =>Page 105 .

9 Valve stem seal

- ◆ Replacing => Page 105 .

10 Lower valve spring retainer

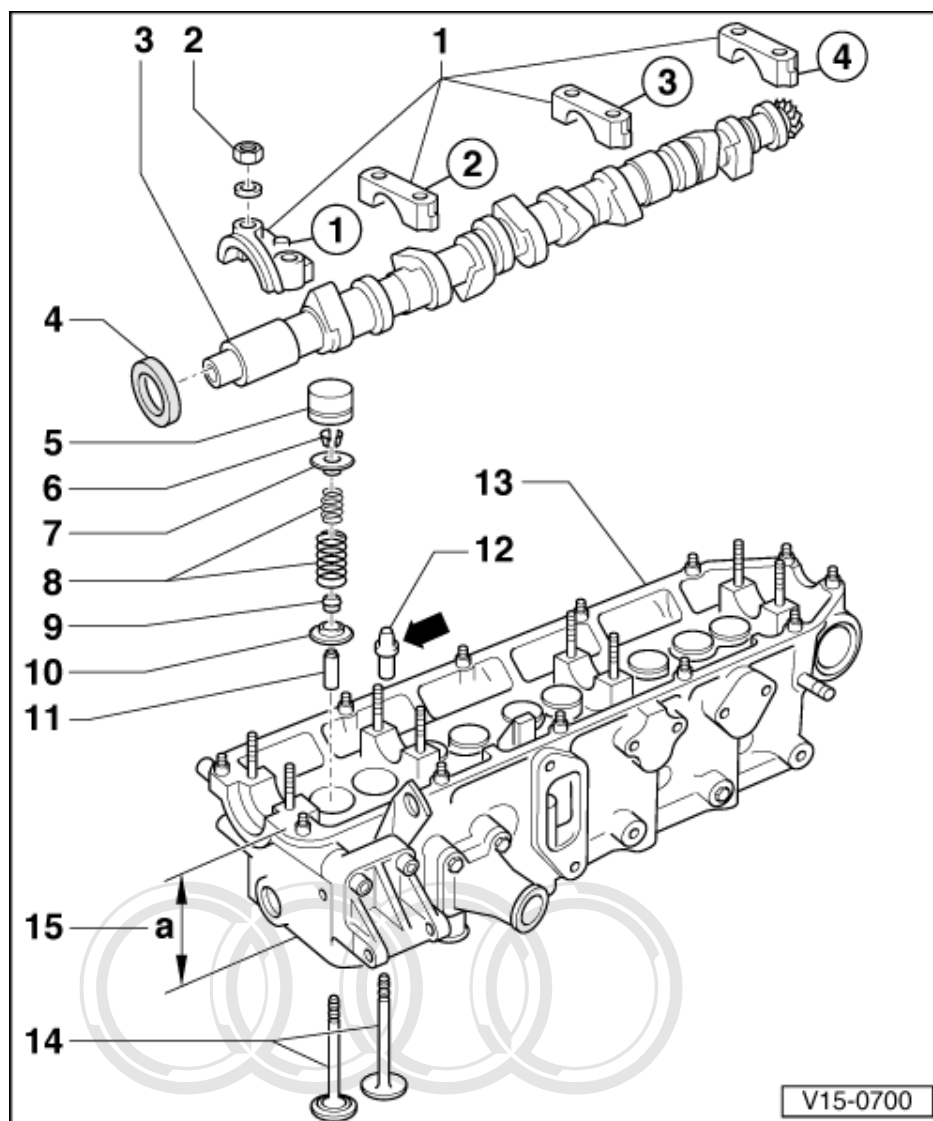
- ♦ Removing and installing:
Cylinder head removed: with 2037
installed: =>Page 105 .

11 Valve guide

- ♦ Checking => Page 108
- ♦ Replacing => Page 109 .

12 Valve guide

- ♦ Repair version with collar
-Arrow-

**13 Cylinder head**

- ♦ See notes
=>Page 92 .
- ♦ Removing => Page 84
- ♦ Installing =>Page 88
- ♦ Checking for distortion
=> Fig. 81
- ♦ Checking valve guides
=>Page 108 .
- ♦ Rework valve seats
=>Page 111 .

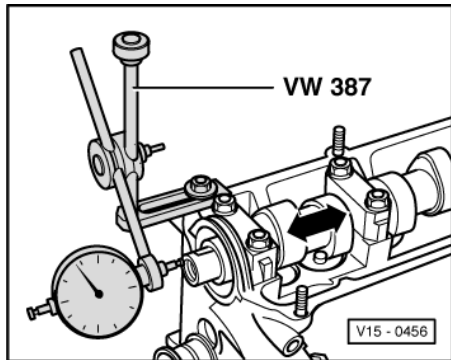
14 Valves

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- ◆ Do not rework only grinding in is permitted
- ◆ Valve dimensions
=> Fig. 97

15 Reworking dimension

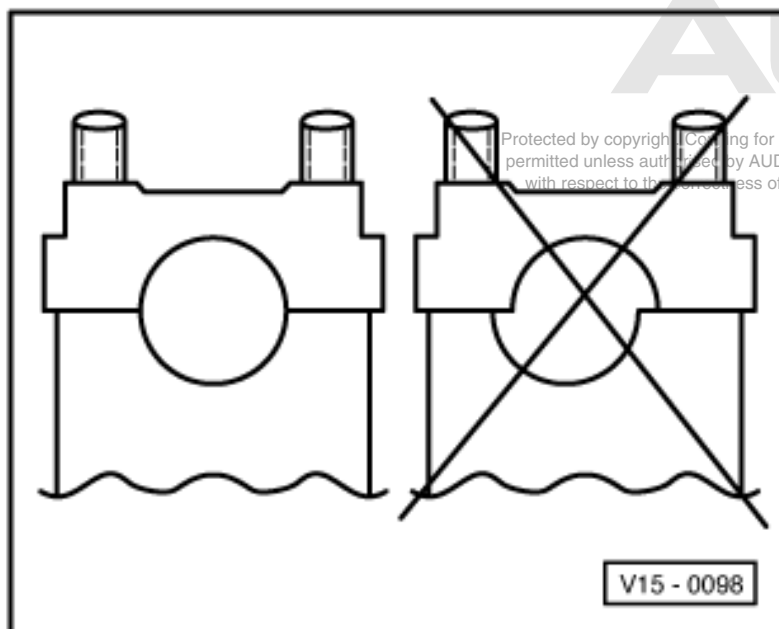
- ◆ For cylinder head
- ◆ Minimum dimension
"a" = 132.75 mm
- ◆ Reworking dimension
=> Fig. 81



-> Fig.1 Camshaft, checking axial play

Wear limit: no more than 0.15 mm

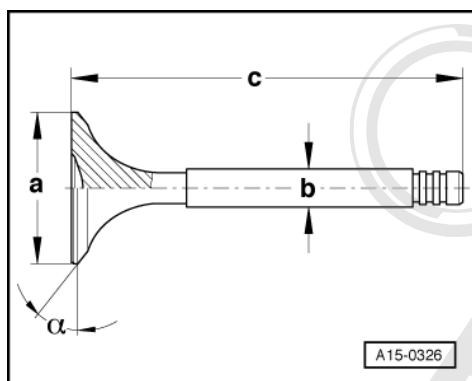
Measure with tappets removed and with first and last bearing caps fitted.



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-> Fig.2 Installation position of camshaft bearing caps

Note offset. Before installing camshaft fit bearing caps and determine installation position.



-> Fig.3 Valve dimensions

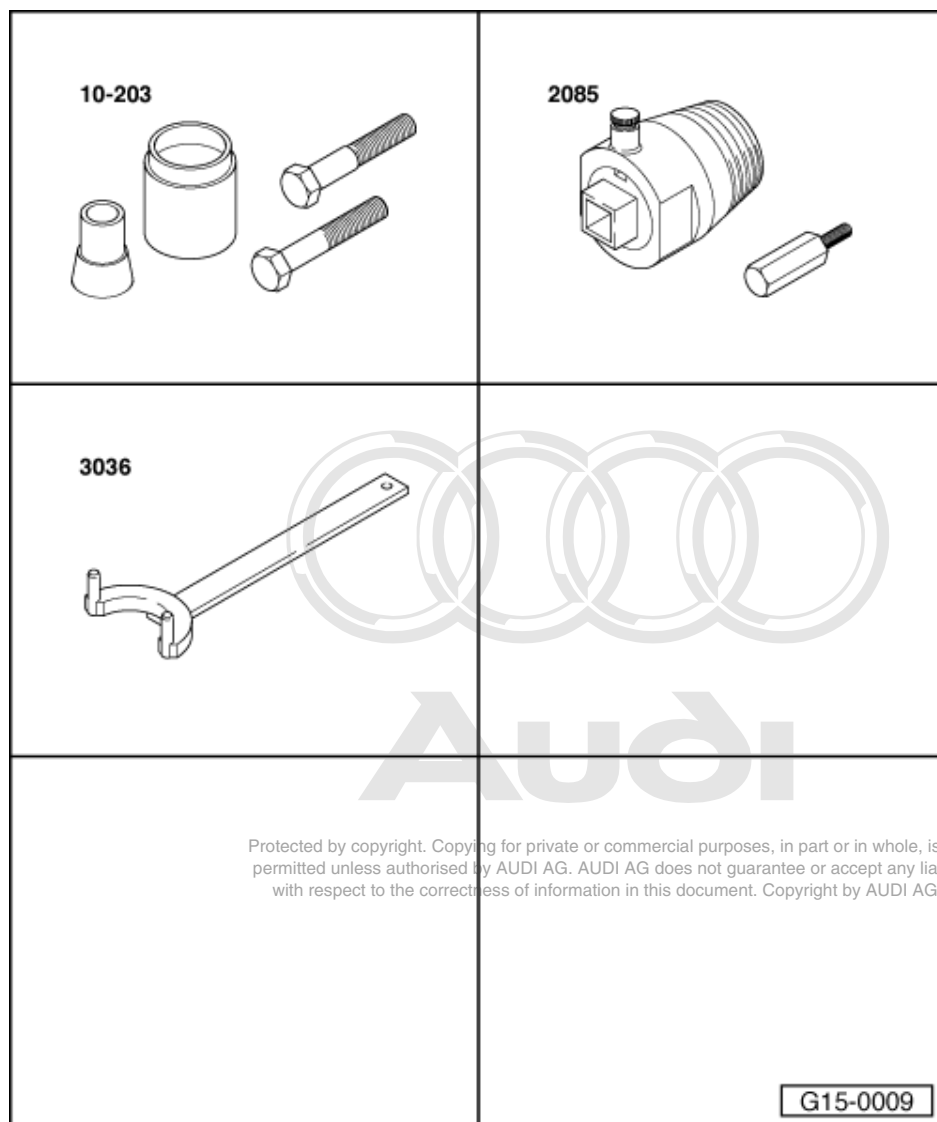
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Note:

Valves must not be reworked. Only grinding in is permitted.

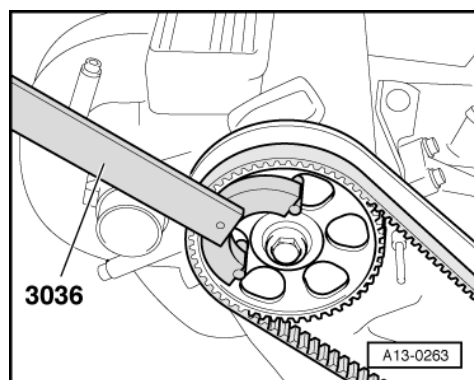
Dim.		Inlet valve	Exhaust valve
ø a	mm	40.0	33.0
ø b	mm	7.97	7.95
c	mm	91.9	91.2
α	<°	45	45

2.2 - Replacing camshaft oil seal



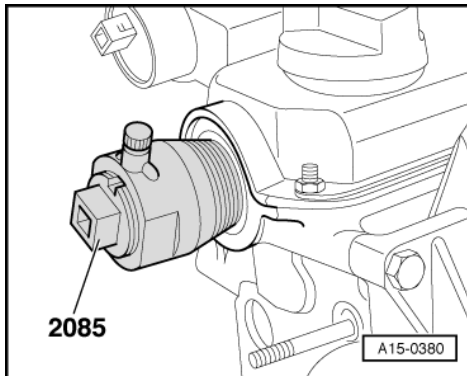
Special tools and workshop equipment required

- ♦ Installing tool 10-203
- ♦ Oil seal extractor 2085
- ♦ Holding tool 3036

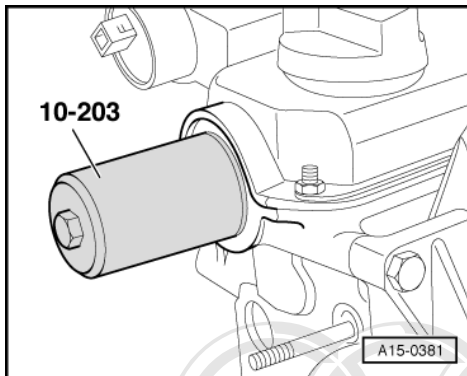


Removing

- Cylinder head installed
- Removing toothed belt from camshaft sprocket
=>Page 40 .
- -> Loosen bolt on camshaft sprocket using special tool 3036 to counterhold.
- Remove camshaft sprocket.
- Remove Woodruff key from camshaft.
- Screw camshaft sprocket securing bolt and washer into camshaft as far as limit stop.
- Adjust inner part of oil seal extractor 2085 two turns (ca. 3 mm) from the outer part and lock in position with the knurled screw.



- -> Lubricate threaded head of oil seal extractor 2085, place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.
- Clamp flats of oil seal extractor in vice. Remove oil seal with pliers.

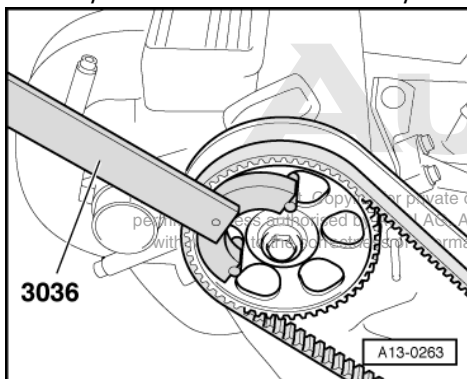


Installing

- -> Hold oil seal in position with guide sleeve from 10-203 and press in until flush using press sleeve 10-203.

Note:

Do not press oil seal onto limit stop as the oil return hole would be covered.



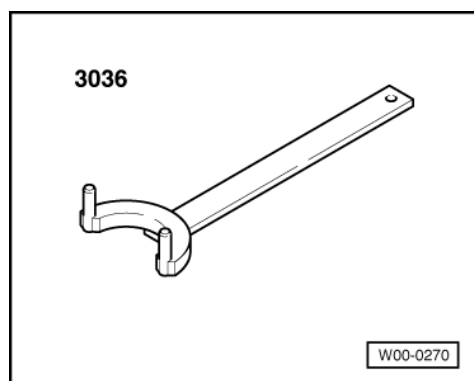


- Insert Woodruff key.
- Fit camshaft sprocket.
- -> Install securing bolt of camshaft sprocket (use counterhold 3036).
- Install toothed belt (adjust valve timing) => Page 37 .

Tightening torque

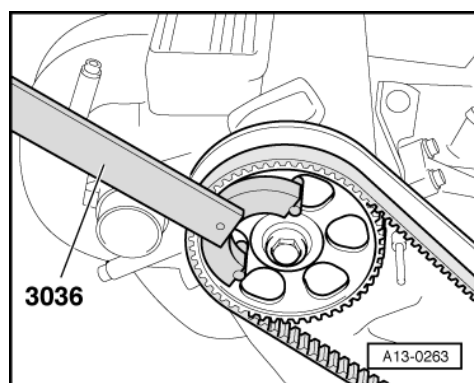
Component	Nm
Camshaft sprocket to camshaft	65

2.3 - Removing and installing camshaft



Special tools and workshop equipment required

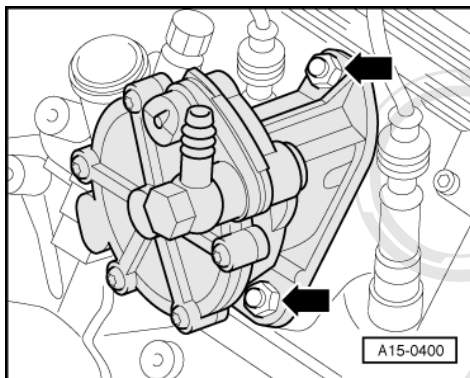
- ♦ Holding tool 3036



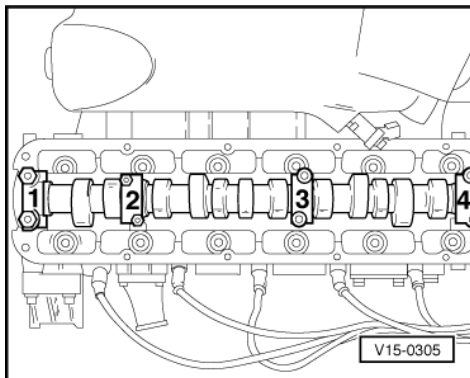
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Removing

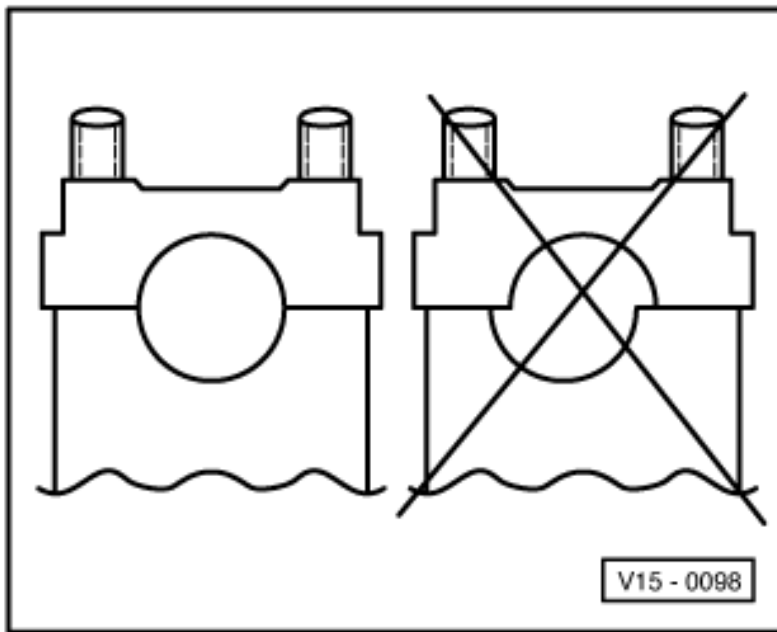
- Cylinder head installed
- Removing toothed belt from camshaft sprocket =>Page 40 .
- -> Loosen bolt on camshaft sprocket using special tool 3036 to counterhold.
- Remove camshaft sprocket.
- Remove Woodruff key from camshaft.
- Remove the rear toothed belt guard.



- Remove the upper section of the intake manifold
 =>Page 69.
- Remove cylinder head cover => Page 82 .
- -> Unscrew nuts -arrows-
- Detach vacuum pump and push rod.



- -> Loosen bearing caps 2 and 4 alternately and diagonally.
- Loosen bearing caps 1 and 3 alternately and diagonally.
- Detach camshaft.

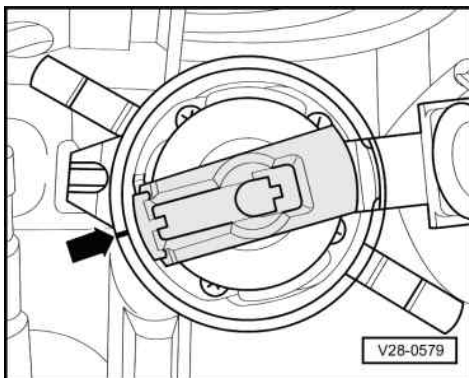


Installing

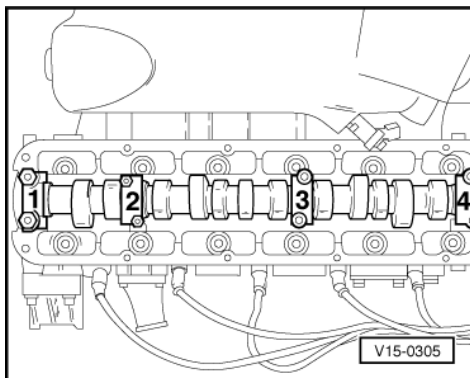
Notes:

- ♦ Renew camshaft oil seal.
- ♦ When installing the camshaft, No. 1 cylinder cams must point upwards.
- ♦ -> Before installing bearing caps, note bore offset and determine installation position.
- Oil camshaft running surfaces.

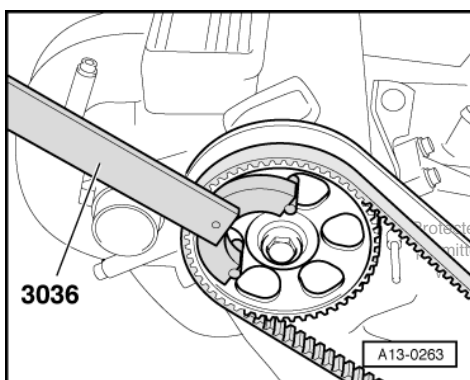
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- Remove distributor cap leaving leads connected.
- -> Position distributor rotor so that it points towards the marking -arrow- for cylinder 1 on the distributor housing.
- Insert camshaft.



- -> Tighten bearing caps 2 and 4 alternately and diagonally to 20 Nm.
- Install bearing caps 1 and 3 and also tighten to 20 Nm.
- Install oil seal for camshaft
=>Page 99 .
- Install toothed belt guard on rear.
- Insert Woodruff key in camshaft.
- Fit camshaft sprocket.



- -> Install securing bolt of camshaft sprocket (use counterhold 3036).
- Install toothed belt (adjust valve timing) => Page 37 .

Notes:

- ♦ After installing the camshaft, wait for about 30 minutes before starting the 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 to ensure that none of the valves make contact when the starter is operated.
- Installing cylinder head cover => Page 82
- Install the upper section of the intake manifold
=>Page 70 .

Tightening torques

Component	Nm
Bearing cap to cylinder head	20
Camshaft sprocket to camshaft	65
Rear toothed belt guard to cylinder head	10

2.4 - Checking hydraulic bucket tappets

Special tools and workshop equipment required

- ♦ Feeler gauge

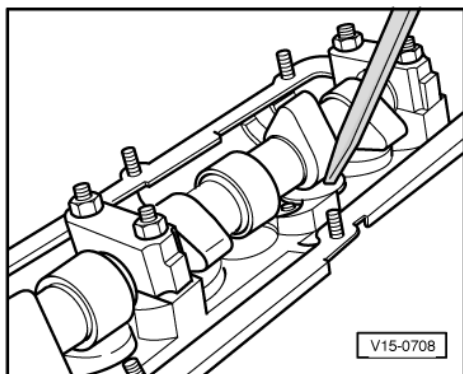
- ♦ Wood or plastic wedge

Notes:

- ♦ Hydraulic tappets cannot be adjusted or repaired.
- ♦ Irregular valve noise during starting is normal.
- Start engine and leave it running until coolant temperature has reached approx. 80 °C.
- Increase engine speed to about 2500 rpm for 2 minutes (perform road test if necessary).

If the hydraulic tappets are still noisy, locate defective tappets as follows:

- Remove cylinder head cover => Page **82**.
- Rotate crankshaft until the cams of the bucket tappets to be checked are pointing upwards:
 - Vehicles with manual gearbox: Push vehicle forwards with 4th gear engaged and ignition switched off.
 - Vehicles with automatic gearbox: remove noise insulation and turn crankshaft clockwise by applying spanner to central bolt on crankshaft sprocket.
- Determine play between cam and tappet.



- -> Use a wooden or plastic wedge to push down bucket tappet. If an 0.20 mm feeler gauge can be inserted between camshaft and tappet, renew tappet.
- Replacing bucket tappet => Removing camshaft, Page **100**.

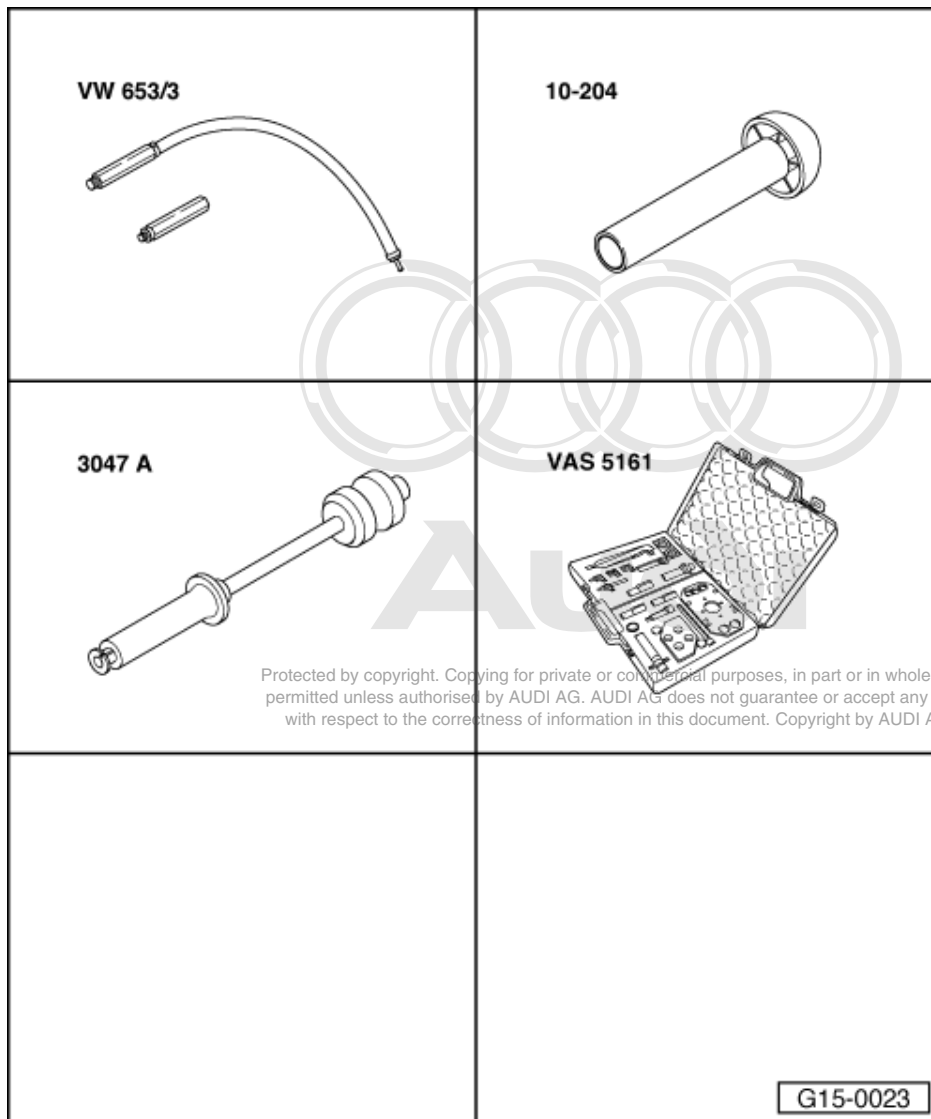
Notes:

- ♦ After installing the camshaft, wait for about 30 minutes before starting the 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 to ensure that none of the valves make contact when the starter is operated.



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2.5 - Replacing valve stem seals



Special tools and workshop equipment required

- ◆ Pressure hose VW 653/3
- ◆ Press-on tool 10-204
- ◆ Puller 3047 A
- ◆ Disassembly and assembly tool VAS 5161

Removing

- Cylinder head installed

Note:

When cylinder head has been removed, the valve springs can be removed using special tool 2037.

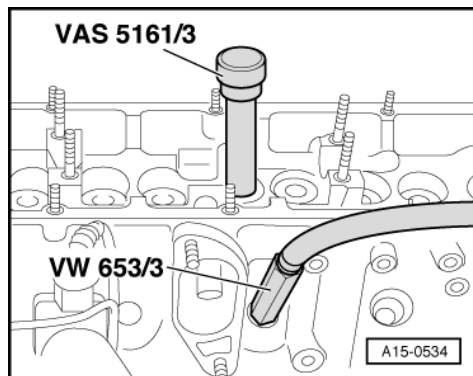
- Removing camshaft => Page 100 .

Notes:

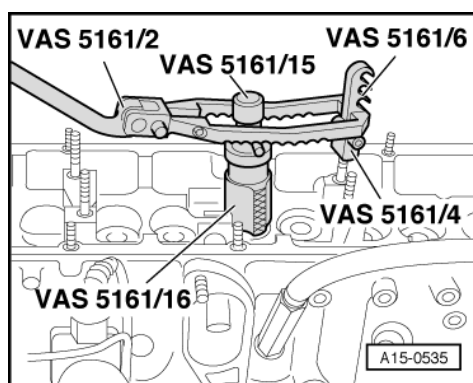
- ◆ Make sure that the bucket tappets are not interchanged.



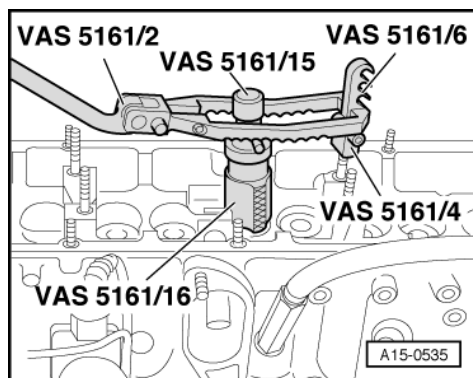
- ♦ Mark allocation of bucket tappets on rear with a waterproof felt-tip pen.
- Remove the bucket tappets from guides and put them down with the contact surface downwards.
- Remove spark plugs.
- Set piston of appropriate cylinder to "bottom dead centre".



- -> Screw in the pressure hose VW 653/3 into spark plug thread and put under constant pressure; at least 6 bar excess pressure.
- Install pin VAS 5161/3 into bucket tappet guide.
- Knock tightly fitting valve wedges of both valves loose using a plastic hammer.



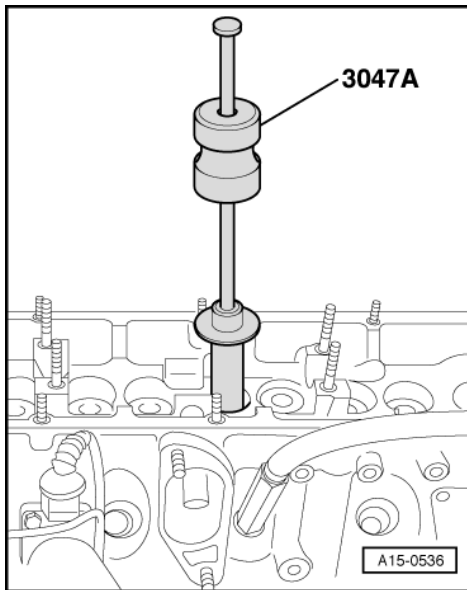
- -> Screw the catch part VAS 5161/6 with insertion fork VAS 5161/4 onto a stud on the cylinder head.
- Push guide bush VAS 5161/16 into bucket tappet guide of the valve to be removed until limit stop.
 - Installation position: Corrugated surfaces are transverse to the driving direction.
- Push assembly cartridge VAS 5161/15 into guide bush.



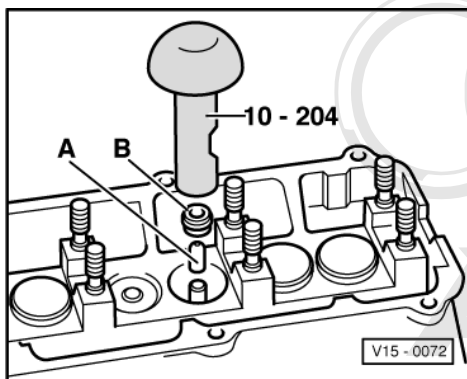
- -> Attach pressure fork VAS 5161/2 to catch part VAS 5161/6 and push assembly cartridge down.
- At the same time turn knurled screw of assembly cartridge towards the right until the tips of the valve wedges engage.
- Slightly move the knurled screw back and forth. This causes the valve wedges to be pressed apart and taken into the cartridge.
- Release the pressure fork.

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- Remove assembly cartridge, guide bush, valve plate and valve springs.



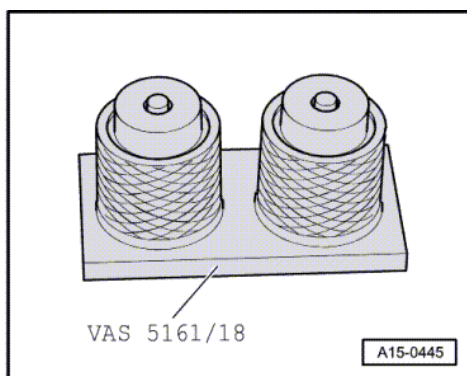
- -> Use 3047 A to remove valve stem seals.



Installing

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- -> To prevent damage to the new valve stem seals -B-, place plastic sleeve -A- on valve stem.
- Lightly lubricate sealing lip of valve stem seal.
- Push valve stem seal onto plastic sleeve.
- Carefully press the valve stem seal onto the valve guide using press-on tool 10-204.
- Remove plastic sleeve again.

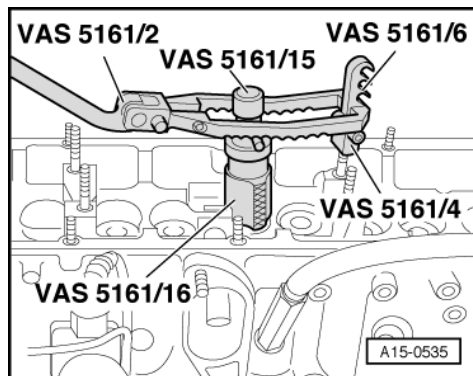


- -> If the valve wedges were taken out of the assembly cartridge they must first be inserted into the installing tool VAS 5161/18.

Note:

The large diameter of the valve wedges points upwards.

- Push assembly cartridge VAS 5161/15 from the top onto installing tool and take up the valve wedges.

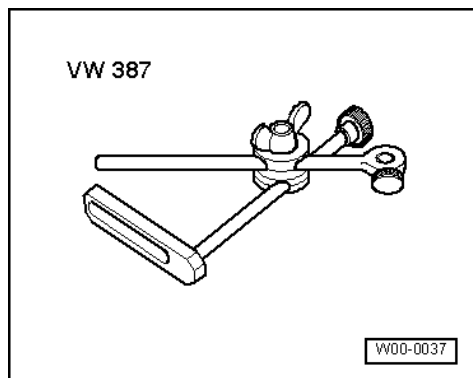


- -> Reinstall the assembly cartridge VAS 5161/15 into guide bush VAS 5161/16.
- Push pressure fork down and pull knurled screw upwards by turning to left and right - thus the valve wedges are installed.
- Take load of the pressure fork when knurled screw is still tight.
- Insert bucket tappet.
- Installing camshaft =>Page 102 .

Notes:

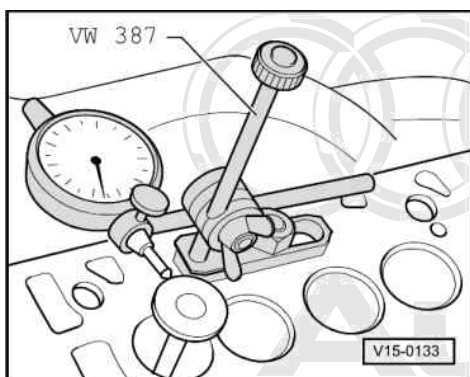
- ♦ After installing the camshaft, wait for about 30 minutes before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).
- ♦ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.

2.6 - Checking valve guides

**Special tools and workshop equipment required**

- ♦ Universal dial gauge bracket VW 387
- ♦ Dial gauge

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- -> Insert valve in guide. Valve stem end must be flush with guide. Due to the slight difference in stem diameters. Ensure that only an inlet valve is used in the inlet guide and an exhaust valve in the exhaust guide.
- Determine rock.

Wear limit

Inlet valve guide	Exhaust valve guide
1.0 mm	1.3 mm

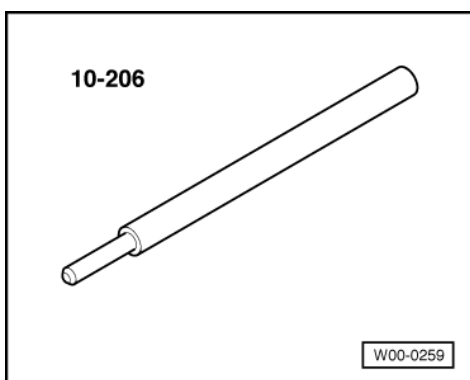
Notes:

- ♦ If the wear limit is exceeded, repeat the measurement with new valves. Replace valve guide if wear limit is still exceeded.
- ♦ If the valve must be renewed as part of a repair, use a new valve for the calculation.

2.7 - Checking valves

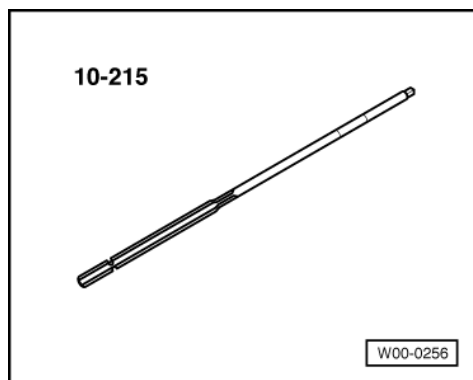
- Visually inspect stem and seat for scoring. Replace valves in the case of severe scoring.

2.8 - Renewing valve guides



Special tools and workshop equipment required

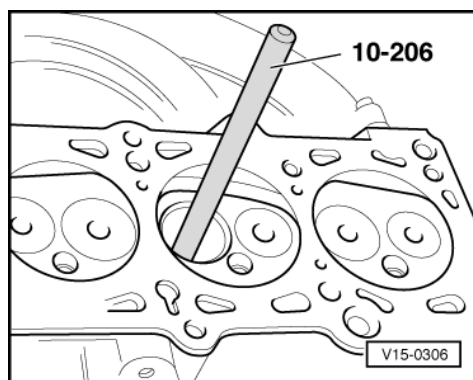
- ♦ Driver 10-206



- ♦ Hand reamer 10-215 and cutting fluid

Removing

- Clean and check cylinder head. Cylinder heads in which the valve seats can no longer be reworked, or cylinder heads which have already been machined to the minimum dimension, should not have the valve guides replaced.
- Press out worn valve guides with 10-206 as follows:
 - Valve guides without collar:
From the camshaft end
 - Valve guides with collar (repair version):
From the combustion chamber end

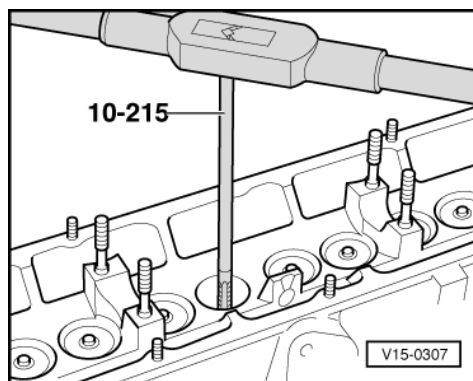


Installing

- -> Lubricate new valve guides with oil and press in with 10-206 from the camshaft end (cylinder head cold) until collar makes contact.

Note:

When the collar on the valve guide makes contact, the pressure must not exceed 10 kN (approx. 1.0 t) otherwise the collar can break off.



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- -> Ream valve guide with hand reamer 10-215. Use plenty of cutting fluid.
- Reworking valve seats => Page 111 .
- Renewing valve stem seals => Page 105 .

2.9 - Reworking valve seats

Note:

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

Special tools and workshop equipment required

- ◆ Depth gauge
- ◆ Valve seat machining tool

Notes:

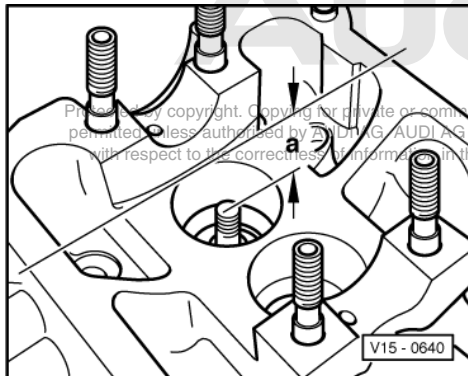
- ◆ When repairing engines with leaking valves, it is not sufficient to reface the valve seats and renew the valves. The valve guides must also be checked for wear. This is particularly important on high mileage engines => Page 108 .
- ◆ Only rework the valve seats as far as is necessary to ensure a good seating pattern.
- ◆ Before starting to rework the valve seats, calculate the maximum permissible reworking dimension.
- ◆ If the maximum reworking dimension is exceeded, the hydraulic tappets will not work properly and the cylinder head will have to be renewed.

Calculating maximum permissible reworking dimension

- Insert valve and press firmly against valve seat.

Note:

If the valve must be renewed as part of a repair, use a new valve for the calculation.



- -> Measure distance a between valve stem end and top edge of cylinder head.

Measured distance a in relation to minimum dimension.
= max. permissible reworking dimension.

Minimum dimensions:
Inlet valve 33.8 mm
Exhaust valve 34.1 mm

Example:

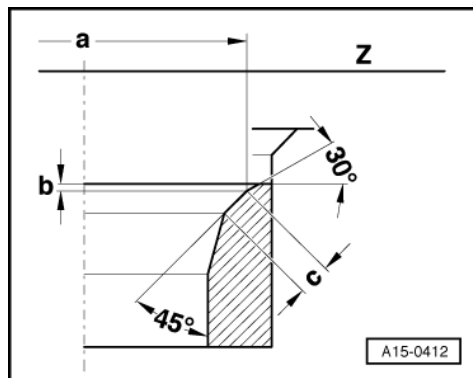
- Measured distance a	35.1 mm
Minimum dimension	34.1 mm



= max. permissible reworking dim. 1.0 mm

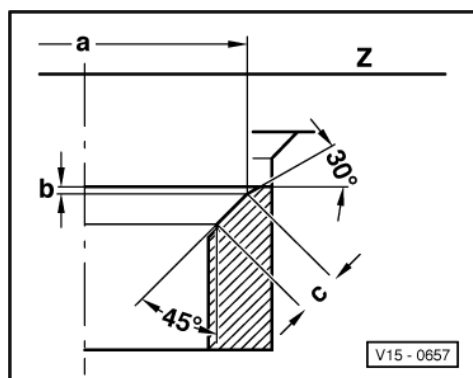
Note:

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



-> Reworking inlet valve seat

Inlet valve seat	
a	= $\varnothing 39.2$ mm
b	= max. permissible reworking dimension 1)
c	= approx. 2.0 mm
Z	= Lower surface of cylinder head
45°	= Valve seat angle
30°	= Upper correction angle



-> Reworking exhaust valve seat

Exhaust valve seat	
a	= $\varnothing 32.4$ mm
b	= max. permissible reworking dimension 1)
c	= approx. 2.4 mm
Z	= Lower surface of cylinder head
45°	= Valve seat angle
30°	= Upper correction angle

- 1) Calculating maximum permissible reworking dimension



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=> Page 111

Note:

Exhaust valve seat inserts also have an additional constriction. When reworking it is essential to ensure that the radius of the constriction is not damaged.



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17 - Lubrication

1 - Removing and installing parts of the lubrication system

1.1 - Removing and installing parts of the lubrication system

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Notes:

- ♦ If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil channels must be cleaned carefully to prevent further damage occurring later.
- ♦ The oil level must not be above max. mark on dipstick - danger of damage to catalytic converter.
- ♦ Refer to current information when using sealant.

=> Parts List

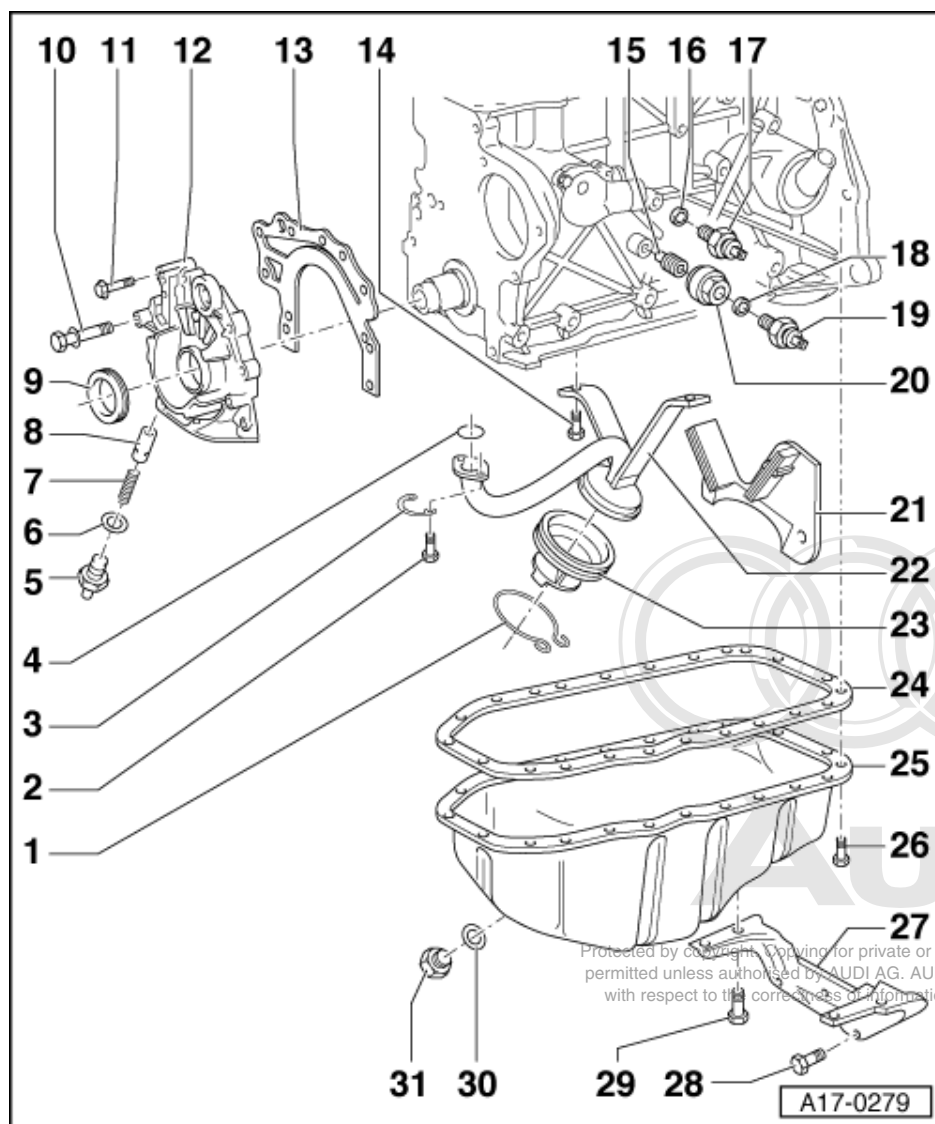
- ♦ Oil spray jet and pressure relief valve
=> Fig. 121

Viscosity grades and oil specifications:

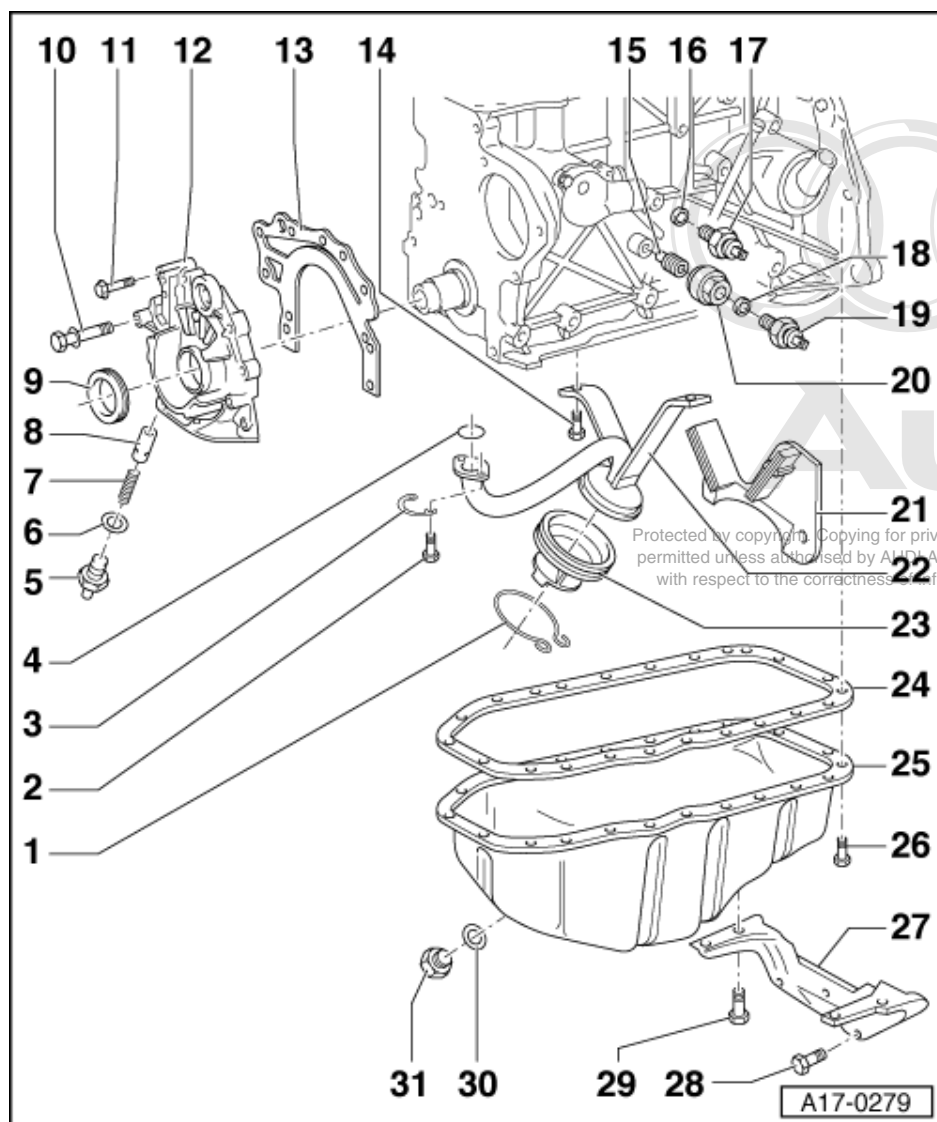
=> Maintenance Manual

Oil system capacity:

=> Exhaust Emission Test binder



- 1 Retaining ring**
- ♦ Installation depending on production date
- 2 10 Nm**
- 3 Locking plate**
- ♦ Dependent on construction condition
 - ♦ Replace
- 4 O-ring/oil seal**
- ♦ Up to engine no. AAR 037 699:
Gasket
 - ♦ Replace
- 5 Oil temperature sender -G8 - 40 Nm**
- 6 Sealing ring**
- ♦ Replace
- 7 Spring**
- ♦ For oil pressure relief valve



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8 Piston

- ♦ For oil pressure relief valve

9 Oil seal

- ♦ For crankshaft
- ♦ Removing and installing
=>Page 53.

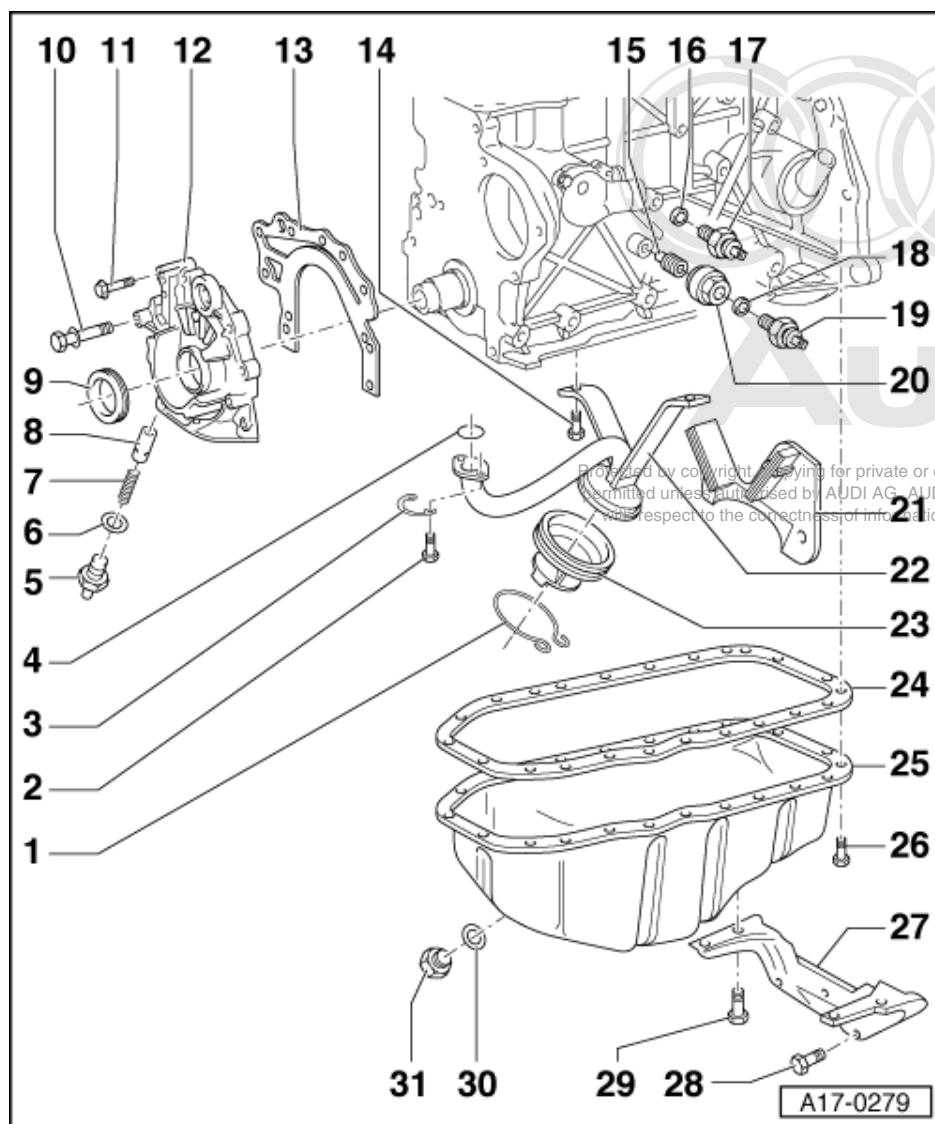
10 20 Nm**11 10 Nm**

- ♦ Install using locking compound
- ♦ Locking compound

=> Parts List

12 Oil pump

- ♦ Removing and installing
=>Page 124.
- ♦ When installing, watch position of follower at crankshaft

**13 Gasket**

- ◆ Replace

14 10 Nm**15 Oil retention valve - 6 Nm**

- ◆ Removing and installing: with multi-point 8 mm socket insert
- ◆ Install using locking compound
- ◆ Locking compound

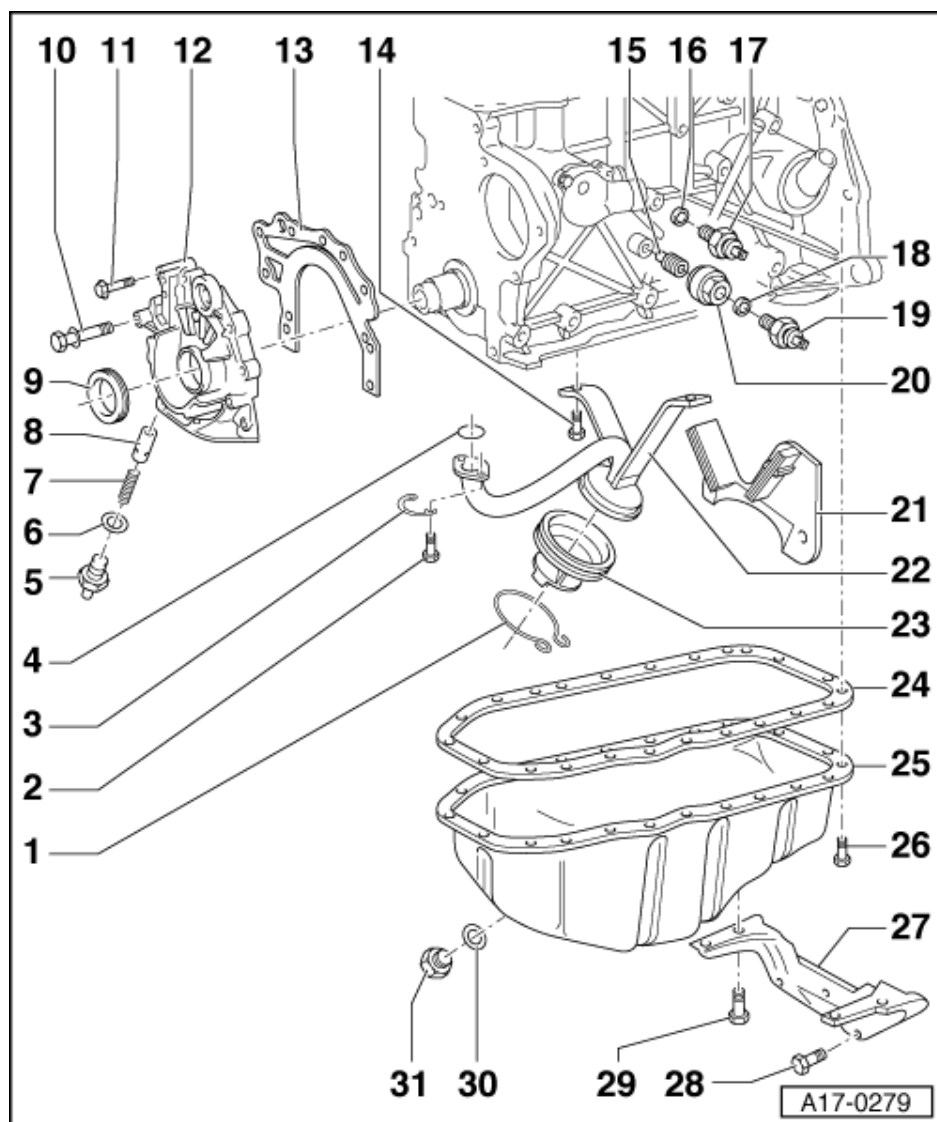
=> Parts List

16 Sealing ring

- ◆ Replace

17 Oil pressure switch -F22 - 25 Nm

- ◆ 0.25 bar - blue or 0.3 bar - brown
- ◆ As a replacement for the 0.3 bar oil pressure switch (brown) a 0.25 bar oil pressure switch (blue) is supplied.
- ◆ Checking => Page 127



18 Sealing ring

- ◆ Replace

19 Oil pressure switch -F1 - 25 Nm

- ◆ 1.8 bar - white
- ◆ Checking => Page **128**

20 Adapter

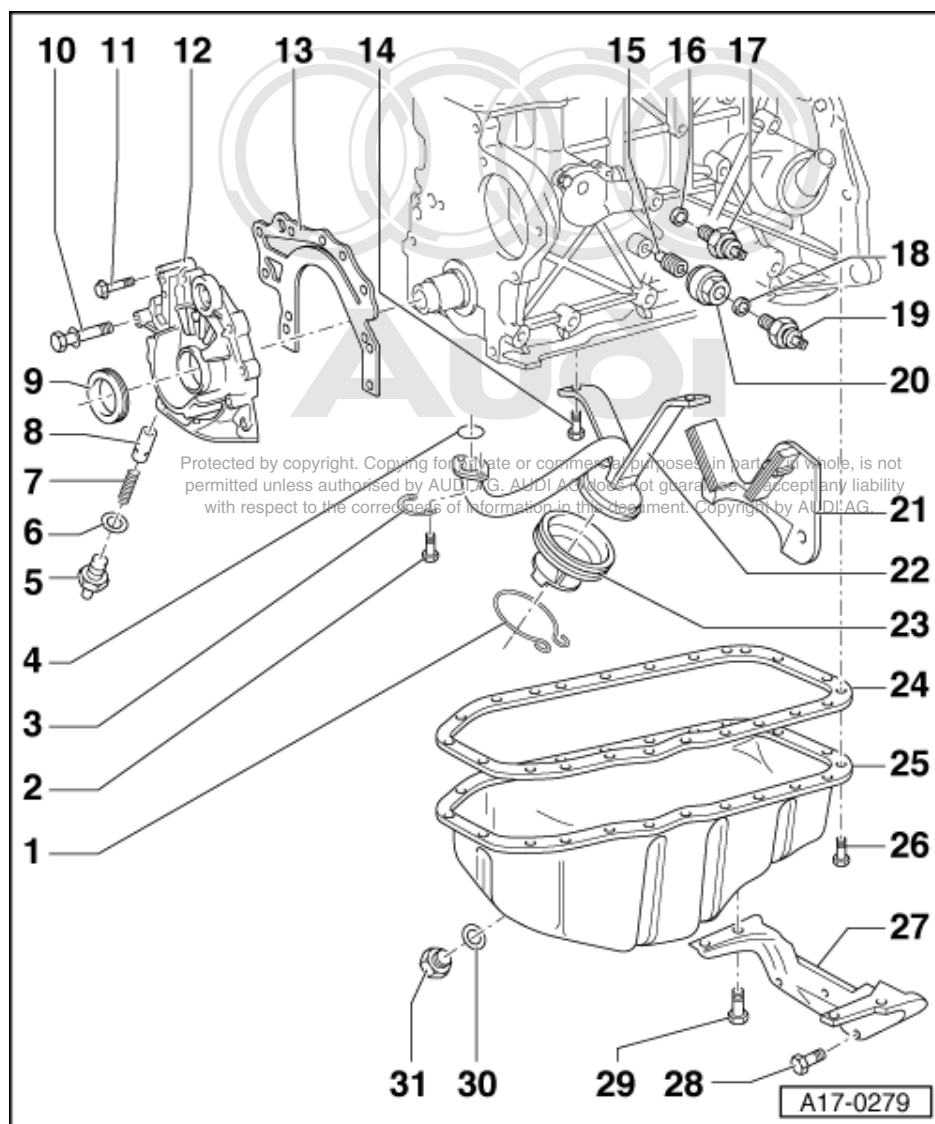
- ◆ Tighten to 50 Nm

21 Baffle plate

22 Suction pipe

- ◆ Clean strainer if soiled

23 Inlet connection

**24 Gasket**

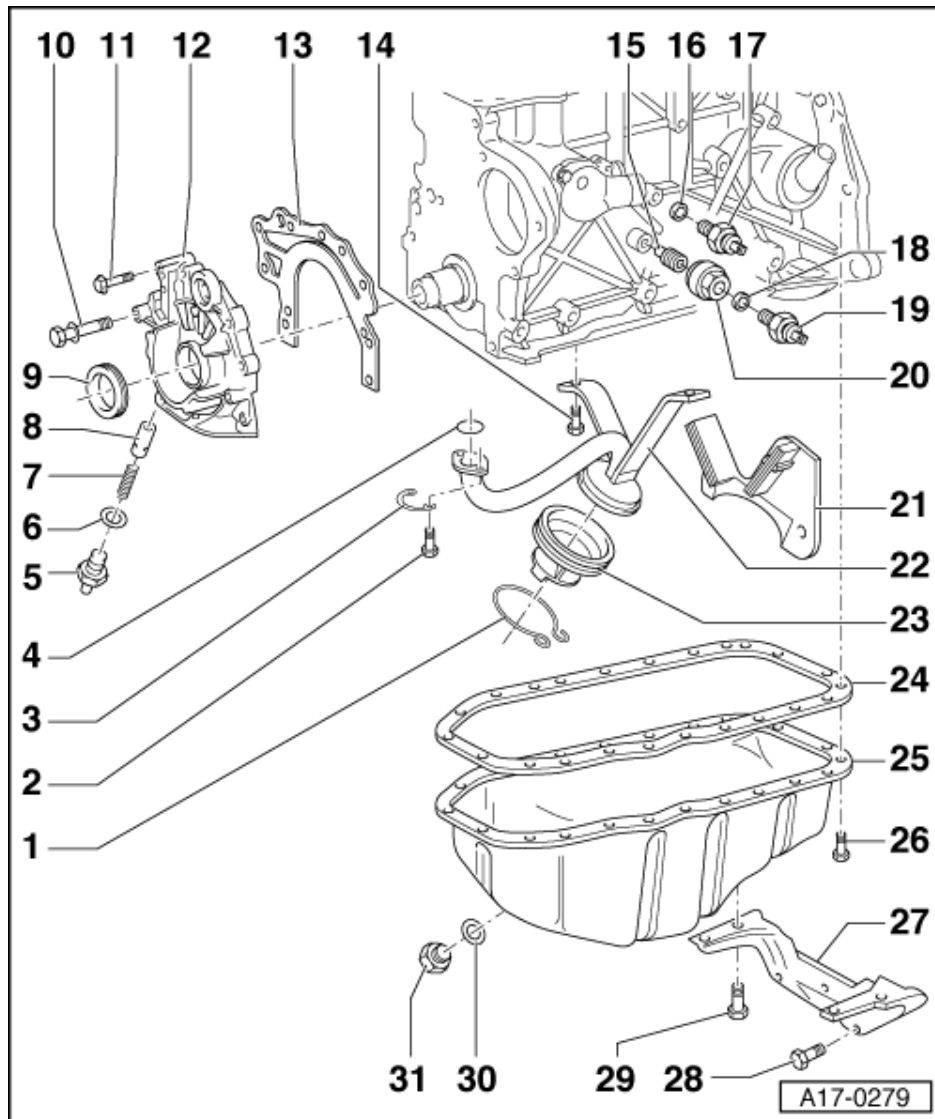
- ◆ Replace
- ◆ Install dry
- ◆ Apply thin coat of sealant to sealing points of sealing flange/cylinder block
- ◆ Sealants

=> Parts List

25 Oil pan

- ◆ Removing and installing=>Page **121**
- ◆ Clean sealing surfaces before installing
- ◆ Apply thin coat of sealant to sealing points of sealing flange/cylinder block
- ◆ Sealants

=> Parts List

**26 Bolt (special type)**

- ♦ Use only correct bolts (same as original equipment); strength rating 10.9.

=> Parts List

- ♦ Tighten in stages and in diagonal sequence
- ♦ Tighten to 20 Nm

27 Engine/gearbox support

- ♦ When installing with engine removed ensure that the engine/gearbox support is aligned flush with the cylinder block

28 M8 - 25 Nm
M10 - 45 Nm

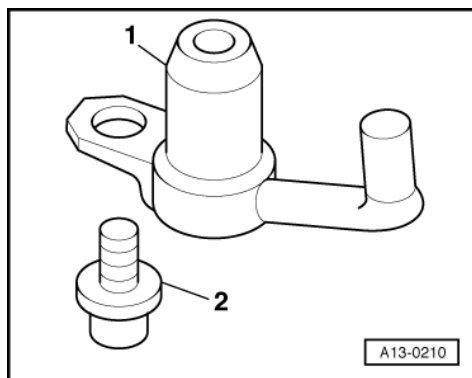
29 25 Nm

30 Sealing ring

- ♦ Replace

31 Oil drain plug, 30 Nm

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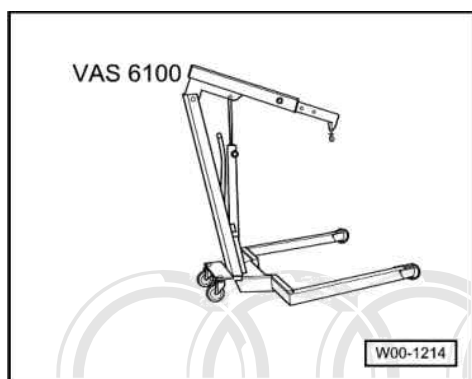


-> Fig.1 Oil spray jet and pressure relief valve

- 1 - Oil spray jet and pressure relief valve
- 2 - Bolt - 10 Nm
- Install using locking compound
- Locking compound

=> Parts List

1.2 - Removing and installing oil pan

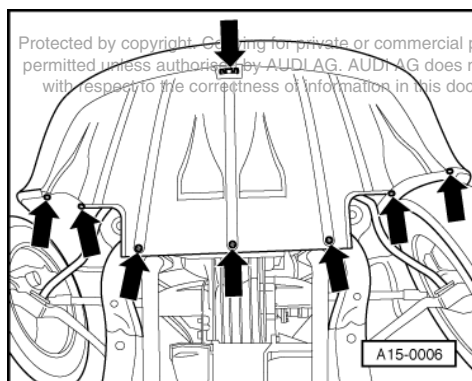


Special tools and workshop equipment required

- ♦ Workshop crane VAS 6100

or

- ♦ Workshop crane V.A.G 1202 A

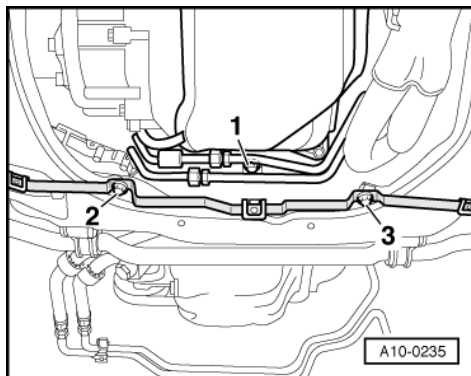


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Removing

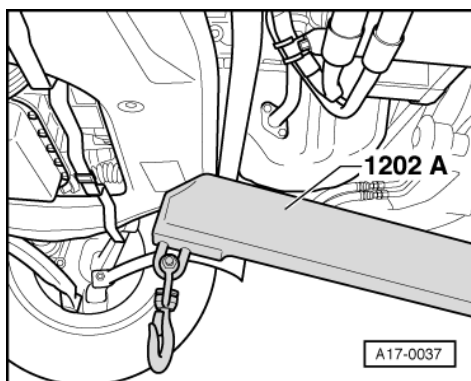
- -> Remove the noise insulation -arrows-.
- Drain engine oil.



- -> Remove bracket for noise insulation -bolts 2 and 3-.

Vehicles with automatic gearbox:

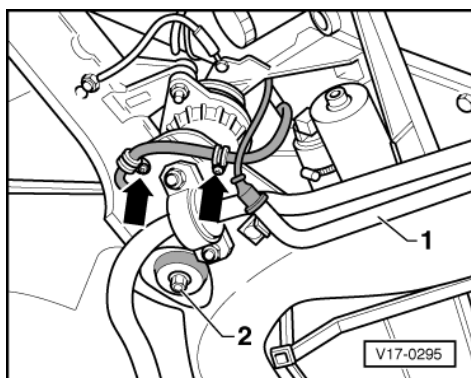
- Unscrew bolt -1- for ATF line.



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All models:

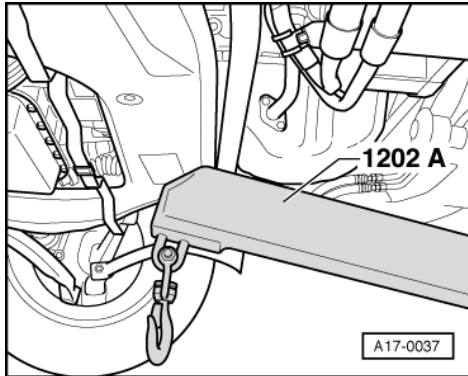
- -> Support subframe with workshop crane VAS 6100 or V.A.G 1202 A.



- -> Unscrew retaining clamps -arrows- for starter cable at subframe.
- Unscrew cable routing -1- for alternator at subframe.
- Unscrew left and right bolts -2- on front of subframe.

Note:

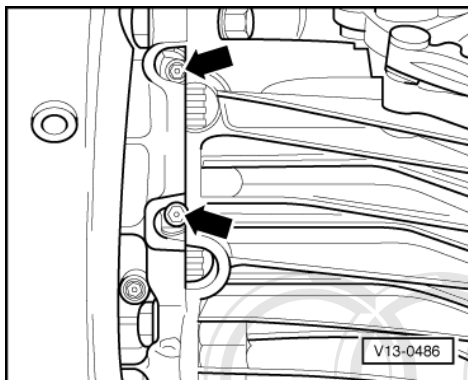
The subframe should be detached and lowered at the front only, otherwise it will be necessary to check wheel alignment.



- -> Slowly lower subframe with workshop crane VAS 6100 or V.A.G 1202 A.

Important

The subframe is lowered by releasing the bolts approx. 100



- Unclip electrical wire from oil temperature sender at sump and set aside.
- -> Turn crankshaft until the two securing bolts -arrows- of the sump are visible at the recesses.
- Unscrew and remove sump, if necessary loosen it by striking lightly with a rubber hammer.

Installing

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

Notes:

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- ♦ Replace seals and gaskets.
- ♦ When installing engine/gearbox support with engine removed, ensure that the engine/gearbox support is flush with the cylinder block on the flywheel side.
- Clean sealing surfaces before installing sump.
- Apply a thin coating of sealant to front and rear sealing flange/cylinder block sealing points at sealing surface to sump.
 - Sealants

=> Parts List



- Tighten bolts securing sump to cylinder block in two stages in diagonal sequence.
- Fitting subframe with new bolts:

=> Running Gear, FWD and 4WD; Repair group 40

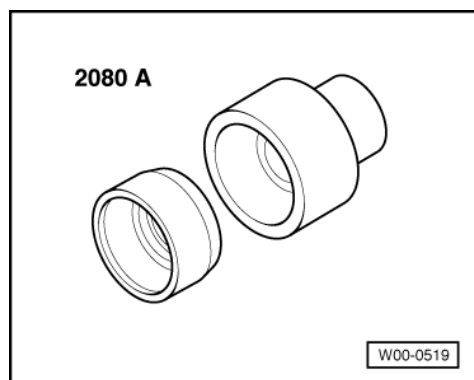
Tightening torques

Component	Nm
Sump to cylinder block 1)	20
Brackets for ATF lines	10
Oil drain plug	30

- 1) Special bolts, use genuine replacement bolts only

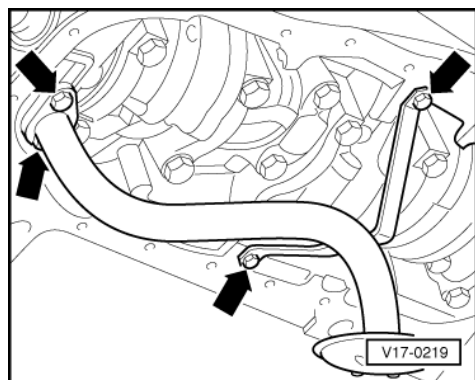
=> Parts List

1.3 - Removing and installing oil pump



Special tools and workshop equipment required

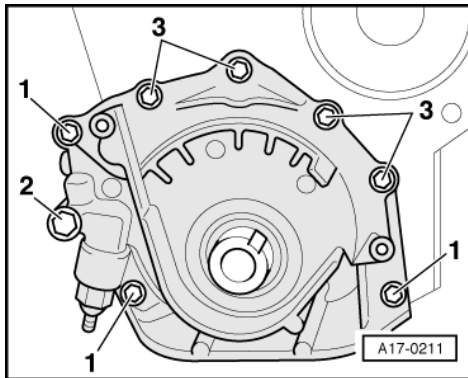
- ♦ Inserting ring for sealing ring 2080 A



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Removing

- Remove toothed belt => Page 33 .
- Remove oil pan => Page 121 .
- -> Remove oil intake pipe -arrows-.



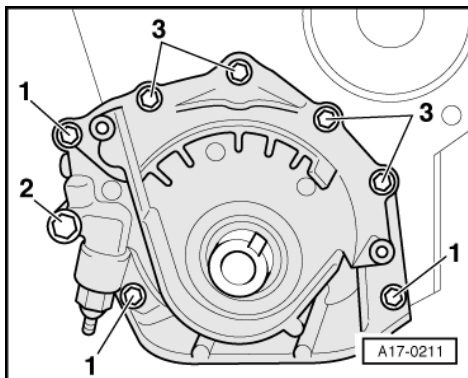
- -> Remove bolts -1-, -2- and -3-.
- Detach oil pump at front.
- Drive out sealing ring with oil pump removed.

Installing

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

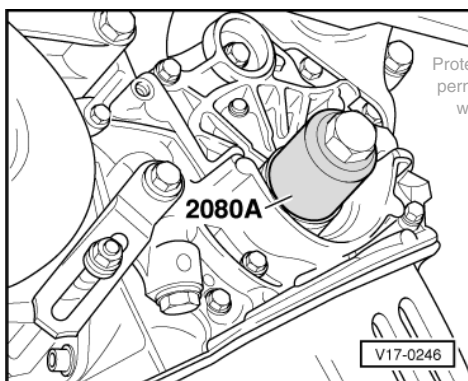
Notes:

- ♦ Replace seals and gaskets.
- ♦ If the oil pump is installed with the sealing ring already fitted, place guide sleeve from 2080 A on end of crankshaft before installing oil pump.
- Clean sealing surfaces before installing oil pump.
- Set up oil pump, so that it engages in the actuating arms on the crankshaft.



- -> Tighten bolts -1- to 10 Nm and bolt -2- to 20 Nm.
- Insert bolts -3- with locking compound and tighten to 10 Nm.
- Locking compound

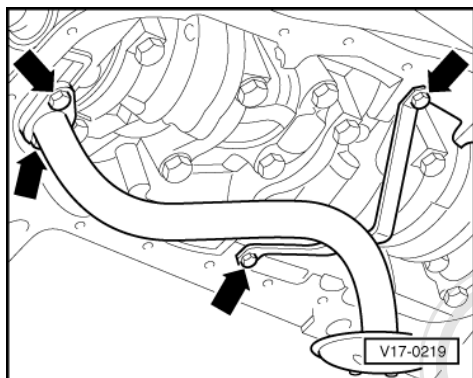
=> Parts List



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- Place guide sleeve from 2080 A onto crankshaft journal.
- Carefully push sealing ring over guide sleeve.
- -> Press sealing ring in as far as limit stop using insertion sleeve and cleaned vibration damper bolt.



- -> Install oil intake pipe -arrows-.

Notes:

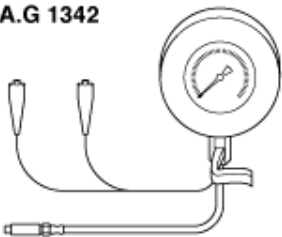
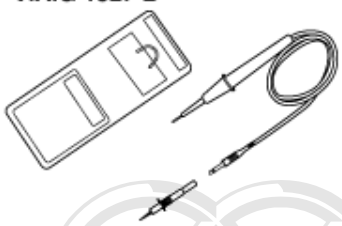
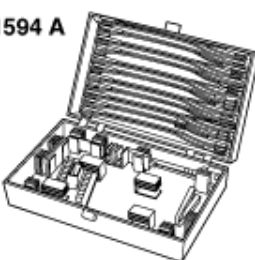
- ♦ Depending on the production date, the front bolts of the oil intake pipe must be secured with a new locking plate.
- ♦ Contact surface between sprocket and crankshaft must be free of oil.
- Installing oil pan => Page 123
- Install toothed belt (adjust valve timing) => Page 37.

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Tightening torques

Component		Nm
Oil intake pipe to oil pump or cylinder block		10
Oil pump to cylinder block	M6	10
	M8	20

1.4 - Checking oil pressure and oil pressure switch

V.A.G 1342 	V.A.G 1527 B 
V.A.G 1594 A 	Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.
	G17-0001

Special tools and workshop equipment required

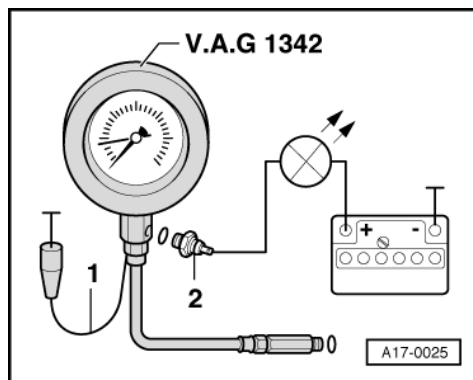
- ◆ V.A.G 1342
- ◆ V.A.G 1527 B
- ◆ V.A.G 1594 A

Test requirements:

- Oil level OK.
- Oil pressure warning lamp K3 must come on when ignition is switched on.
- In vehicles with auto check system the "OK" display must appear (call up symbol).
- Engine oil temperature approx. 80 °C.

Checking warning lamp

The oil pressure warning lamp lights up when the ignition is switched on ("Terminal 15 on") with the engine not running (this does not apply to vehicles with auto check system).



Checking oil pressure switch 0.3 bar (brown) or 0.25 bar (blue)

- Disconnect wire from oil pressure switch.
- -> Unscrew oil pressure switch and screw in oil pressure tester V.A.G 1342.
- Screw oil pressure switch -2- into V.A.G 1342.
- Connect brown wire 1 of tester to earth (-).
- Connect voltage tester V.A.G 1527 B to oil pressure switch and positive side of battery (+) using test leads from V.A.G 1594 A.
- The LED should illuminate.
- If the LED does not illuminate, fit a new oil pressure switch.
- Start the engine.

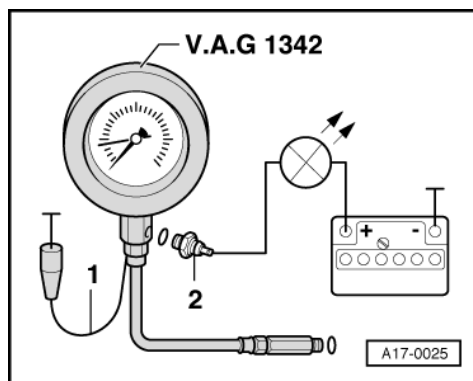
Note:

The switching point of the oil pressure switch can be reached when the engine is cranked on the starter motor, so watch the tester and the LED while starting the engine.

- At 0.15...0.45 bar the LED should go out
- If the LED does not go out, fit a new oil pressure switch.

Note:

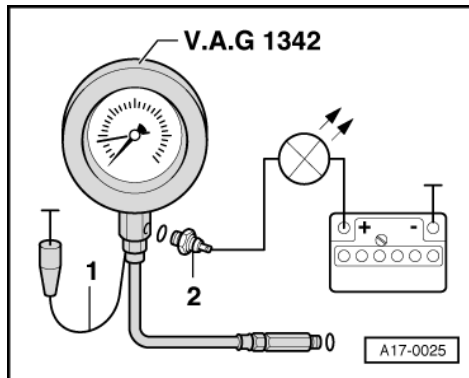
As a replacement for the 0.3 bar oil pressure switch (brown) a 0.25 bar oil pressure switch (blue) is supplied.



Checking 1.8 bar oil pressure switch (white).

- Disconnect wire from oil pressure switch.
- -> Unscrew oil pressure switch and screw in oil pressure tester V.A.G 1342.
- Screw oil pressure switch -2- into V.A.G 1342.
- Connect brown wire 1 of tester to earth (-).
- Connect voltage tester V.A.G 1527 B to oil pressure switch and positive side of battery (+) using test leads from V.A.G 1594 A.
- LED should not illuminate.
- If the LED lights up, fit a new oil pressure switch.
- Start the engine.
- At 1.6...2.0 bar.

- If the LED does not illuminate, fit a new oil pressure switch.



Checking oil pressure

- Disconnect wire from oil pressure switch.
- -> Unscrew oil pressure switch and screw in oil pressure tester V.A.G 1342.
- Screw oil pressure switch -2- into V.A.G 1342.
- Start engine (engine oil temperature approx. 80 °C).
 - Oil pressure at 2000 rpm: at least 2.0 bar
 - Oil pressure at higher engine speeds: max. 6.3 bar

If the specified values are not obtained:

- Pressure relief valve or oil pump defective, replace oil pump => Page 124 .

Note:

If the oil pressure is extremely high, too much pressure will be exerted on the hydraulic tappets. The engine cuts out shortly after being started and the next time starting is attempted, it is turned at a noticeably higher speed by the starter due to lack of compression. The engine will not start.

1.5 - Engine oil

Viscosity grades and oil specifications

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=> Maintenance Manual

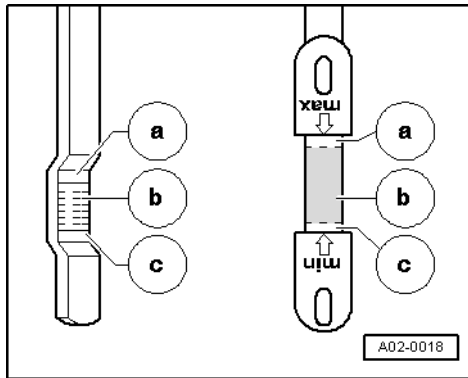
1.6 - Check oil level

Test requirements:

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

Test sequence

- Pull out the dipstick, wipe with a clean cloth and insert again to stop.
- Pull out the dipstick again and read off the oil level.



-> Markings on oil dipstick:

- a - Oil must not be topped up.
- 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. The oil level is sufficient if somewhere in area -b- (grooved area) after topping up.

Note:

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



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19 - Cooling system

1 - Removing and installing parts of the cooling system

1.1 - Removing and installing parts of the cooling system

Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

Notes:

- ♦ When the engine is warm the cooling system is under pressure. If necessary release pressure before commencing repair work.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

- ♦ Hose clamp pliers V.A.G 1921 are recommended when installing spring clamps.
- ♦ Tightening torque for screw-type clips: 2 Nm.
- ♦ Renew all gaskets and seals.
- ♦ The arrow markings on the coolant pipes and on the ends of the hoses must align.



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1.2 - Parts of cooling system

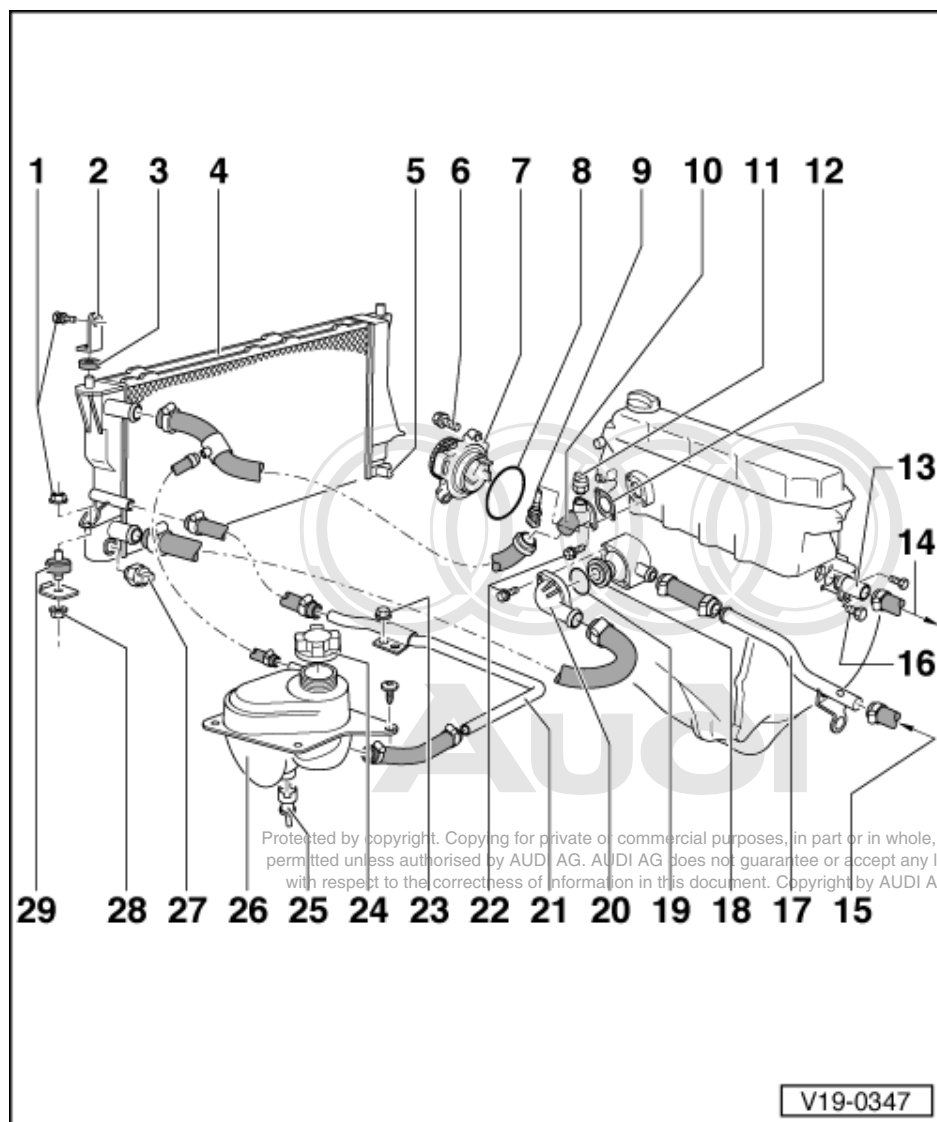
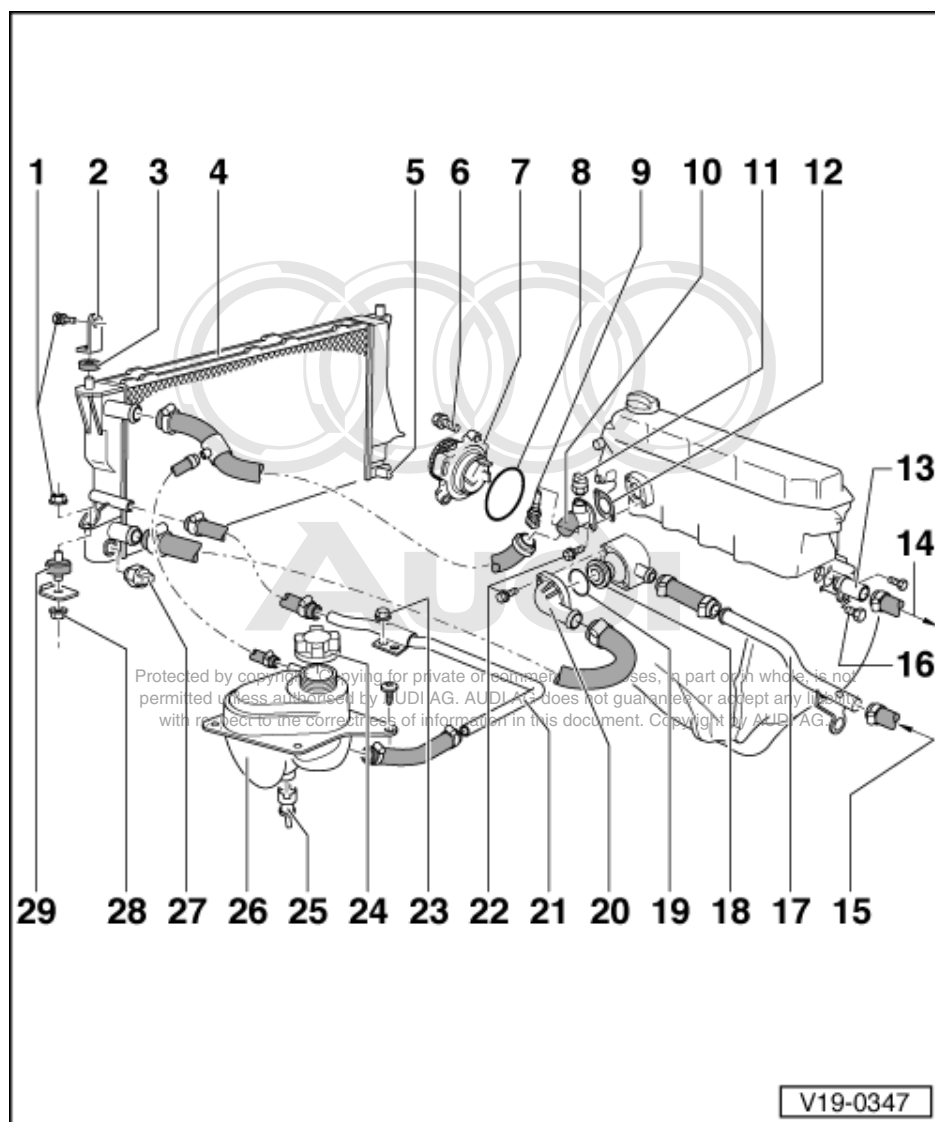


Diagram of coolant hose connections

- 1 10 Nm
- 2 Angle bracket
- 3 Rubber grommet
- 4 Radiator
 - ♦ Removing and installing
=>Page 146 .
 - ♦ After replacing, fill with fresh coolant
 - ♦ Installation position of lower coolant hose =>Fig. 136
- 5 Coolant drain plug
- 6 20 Nm
- 7 Coolant pump
 - ♦ Removing and installing coolant pump => Page 142
 - ♦ Check for ease of movement

**8 O-ring**

- ◆ Replace
- ◆ Lubricate with coolant

9 Coolant temperature sender -G62

- ◆ Install with sealing ring
- ◆ Checking:

=> Electrical System; Repair group 90; Checking components of dash panel insert Checking components of dash panel insert

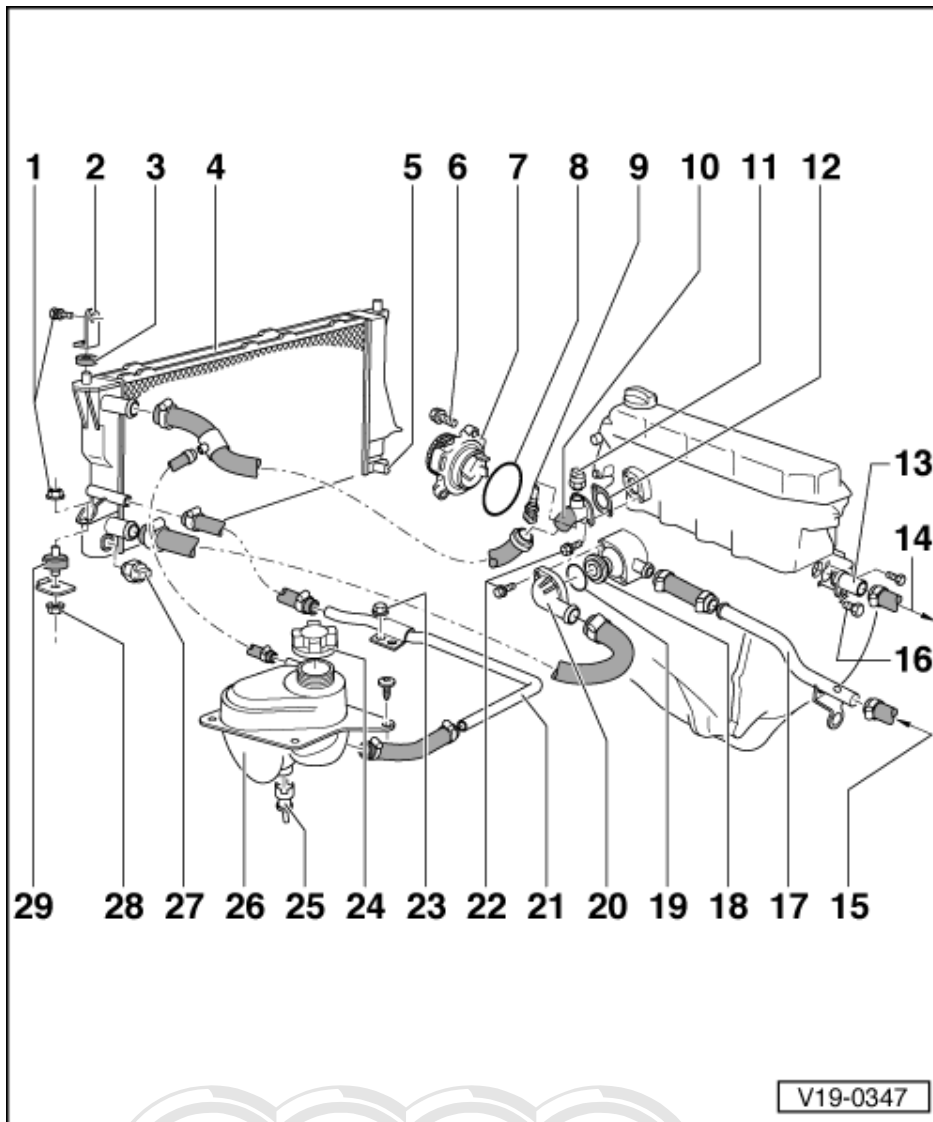
10 Pipe union**11 Electronic thermoswitch -F76**

- ◆ Install with sealing ring
- ◆ Checking:

=> Electrical System; Repair group 90; Checking components of dash panel insert Checking components of dash panel insert

12 Gasket

- ◆ Replace



13 Pipe union

14 To heat exchanger

15 From heat exchanger

16 20 Nm

17 Coolant pipe

18 Thermostat

- ♦ Removing and installing
=>Page 143
- ♦ Checking => Page 144

19 O-ring

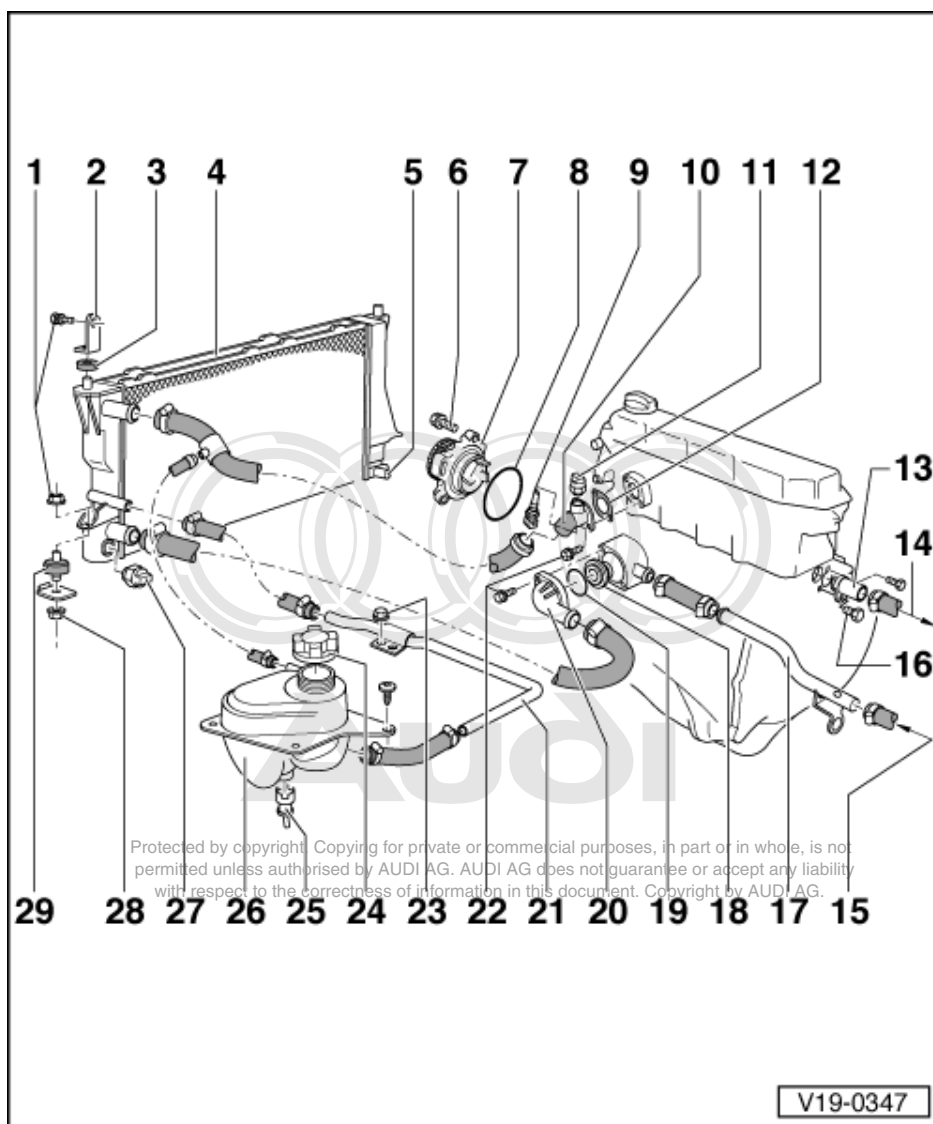
- ♦ Replace
- ♦ Lubricate with coolant

20 Pipe union

21 Coolant pipe

22 10 Nm

23 10 Nm

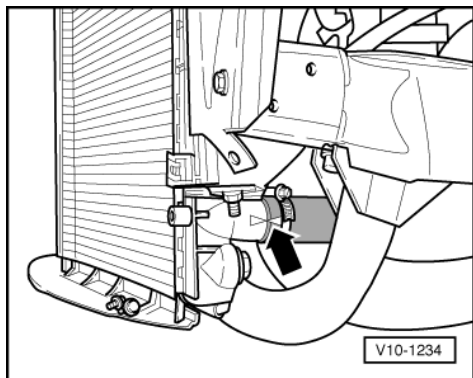
**24 Cap**

- ♦ With pressure relief valve
- ♦ Check pressure relief valve in sealing cap => Page **151**

25 Switch for low coolant level display -F66**26 Expansion tank****27 Thermoswitch for radiator fan -F18 - 25 Nm**

- ♦ Switching temperatures:
- 1st stage
- on: 92...97 °C
- off: 84...91 °C
- 2nd stage
- on: 99...105 °C
- off: 91...98 °C
- + = lead

28 10 Nm**29 Bonded rubber bush**

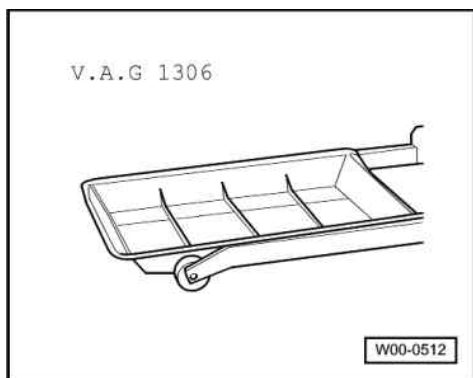


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-> Fig.1 Installation position of lower coolant hose

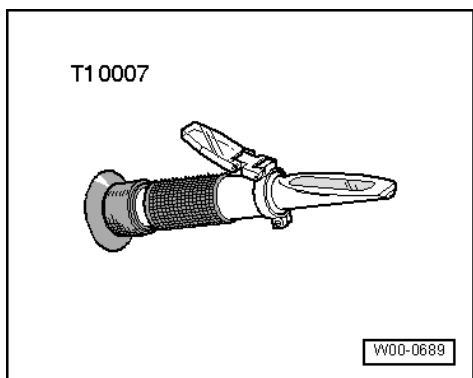
- ♦ The markings must be aligned -arrow-

1.3 - Draining and filling cooling system

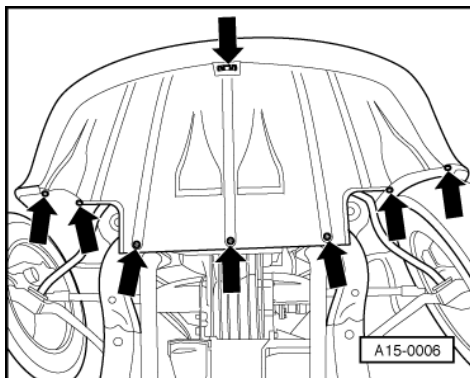


Special tools and workshop equipment required

- ♦ Drip tray V.A.G 1306



- ♦ Special tool T10007 (for coolant additive G 012 A8 D)



Draining

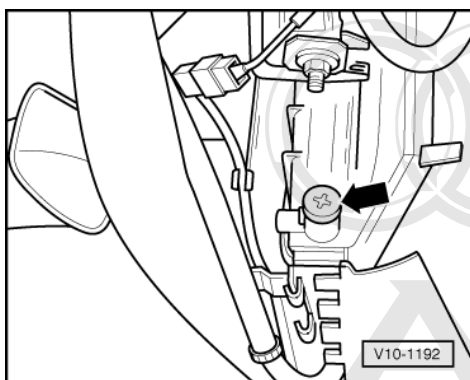
Note:

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

Important

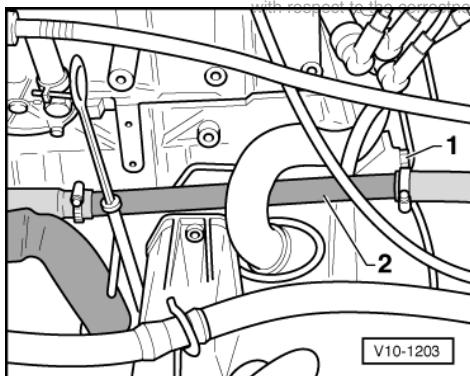
Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

- Open the cover of the coolant expansion tank
- -> Remove the noise insulation -arrows-.

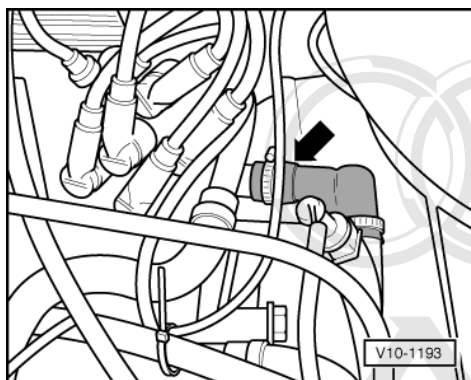


- Place drip tray V.A.G 1306 below engine.
- -> Turn drain plug -arrow- on radiator anti-clockwise. If necessary, fit drain hose on connection.

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- -> Unscrew bolt -1-.
- Remove coolant hoses from coolant pipe -2-.
- Remove the coolant pipe -2-.



- -> Detach coolant hose -arrow- from the connection at rear of cylinder block.

Filling

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Notes:

- ♦ The cooling system is filled all year round with a mixture of water and antifreeze/corrosion protection agent.
- ♦ Coolant additive G 011 A8 C (green) is used in vehicles up to 06.96.
- ♦ Only coolant additive G 012 A8 D (red) is used in vehicles from 07.96 onwards.

Important

The two different coolant additives G 011 A8 C and G 012 A8 D must not be mixed together. Otherwise, this can result in serious damage to the engine.

- ♦ If the fluid in the expansion tank is brown, this means G 012 A8 D has been mixed with another type of coolant. In this case, flush out the cooling system and fill with fresh coolant. To flush the system, fill it with clean water and run the engine for about 2 minutes. This should remove as much of the old coolant as possible.
- ♦ G 011 A8 C and G 012 A8 D and coolant additives marked TL VW 774 C" or meeting specification TL VW 774 D) prevent frost and corrosion damage, stop scaling and at the same time raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct anti freeze and anti corrosion additive.
- ♦ Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.
- ♦ Protection against frost must be assured to about -25 °C (in countries with an arctic climate to about -35 °C).
- ♦ The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The anti freeze ratio must be at least 40 %.
- ♦ If greater frost protection is required in very cold climates, the amount of G 011 A8 C or G 012 A8 D can be increased, but only up to 60 % (this gives frost protection to around -40 °C), as otherwise frost protection is reduced again and cooling effectiveness is also reduced.
- ♦ Only use clean drinking water to mix the coolant.
- ♦ If radiator, heat exchanger, cylinder head or cylinder head gasket is replaced, do not reuse old coolant.
- ♦ Use special tool T10007 to check frost protection of coolant additive G012 A8 D in cooling system.

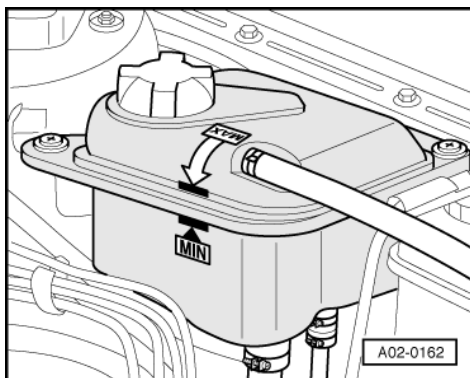
Recommended mixture ratios:

Frost protec- tion to	Antifreeze con- centration	G11/G12 1)	Water 1)
-25 °C	40 %	3.2 l	4.8 l
-35 °C	50 %	4.0 l	4.0 l

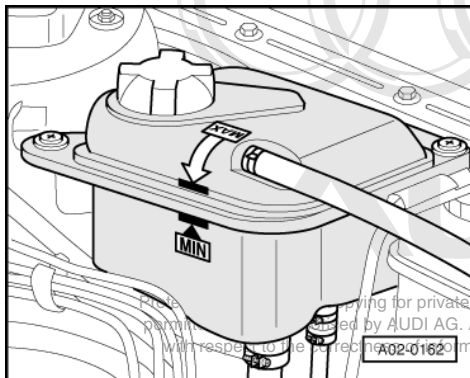
1) Coolant quantity: 8.0 litres (may vary depending upon the vehicle equipment)

- Installing and securing coolant hoses.

- Close drain plug on radiator.



- -> Top up coolant to max. mark on expansion tank.
- Fit expansion tank cap.
- Start the engine.
- Run engine until operating temperature is attained (coolant temperature gauge reading approx. 80 °C).



- -> Check coolant level and top up if necessary
- If the engine is warm, the coolant level may be above the MAX mark
- If the engine is cold, the coolant level must be between the MIN and MAX marks

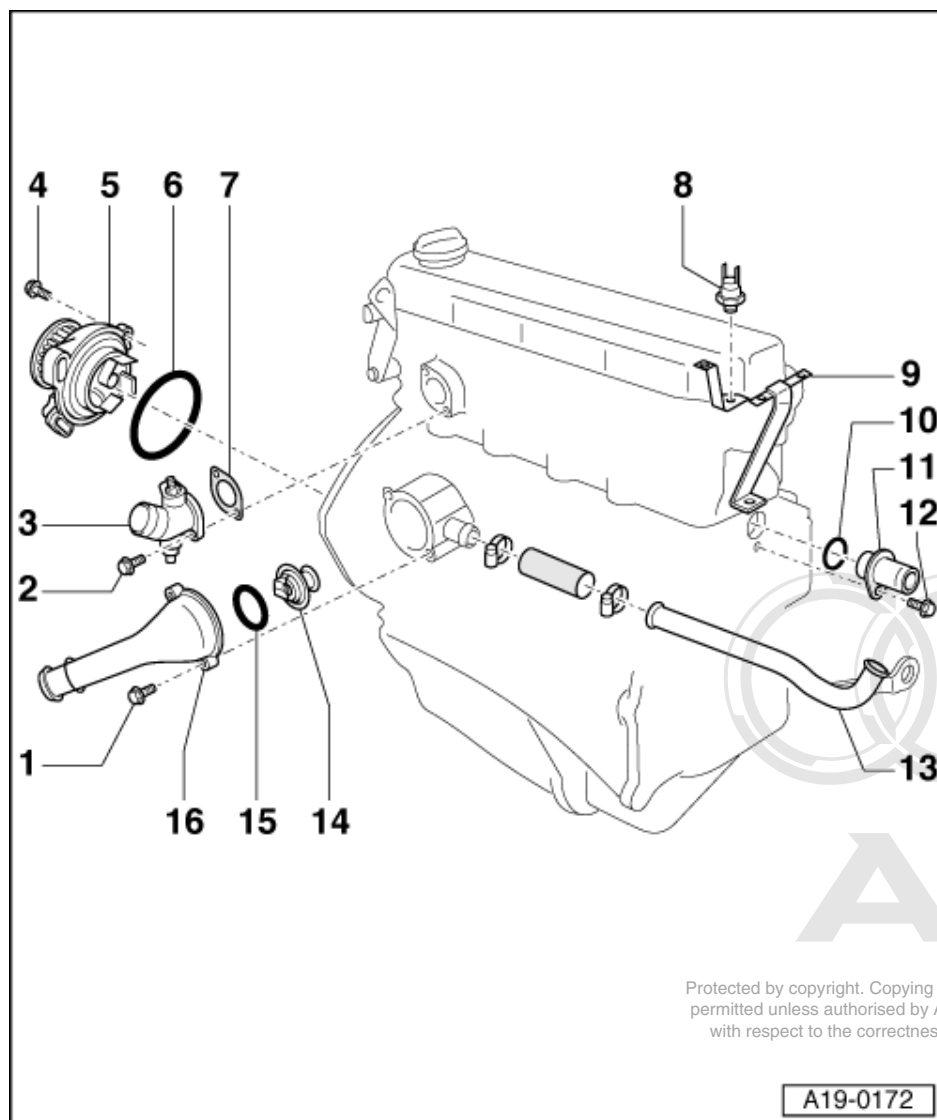
Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

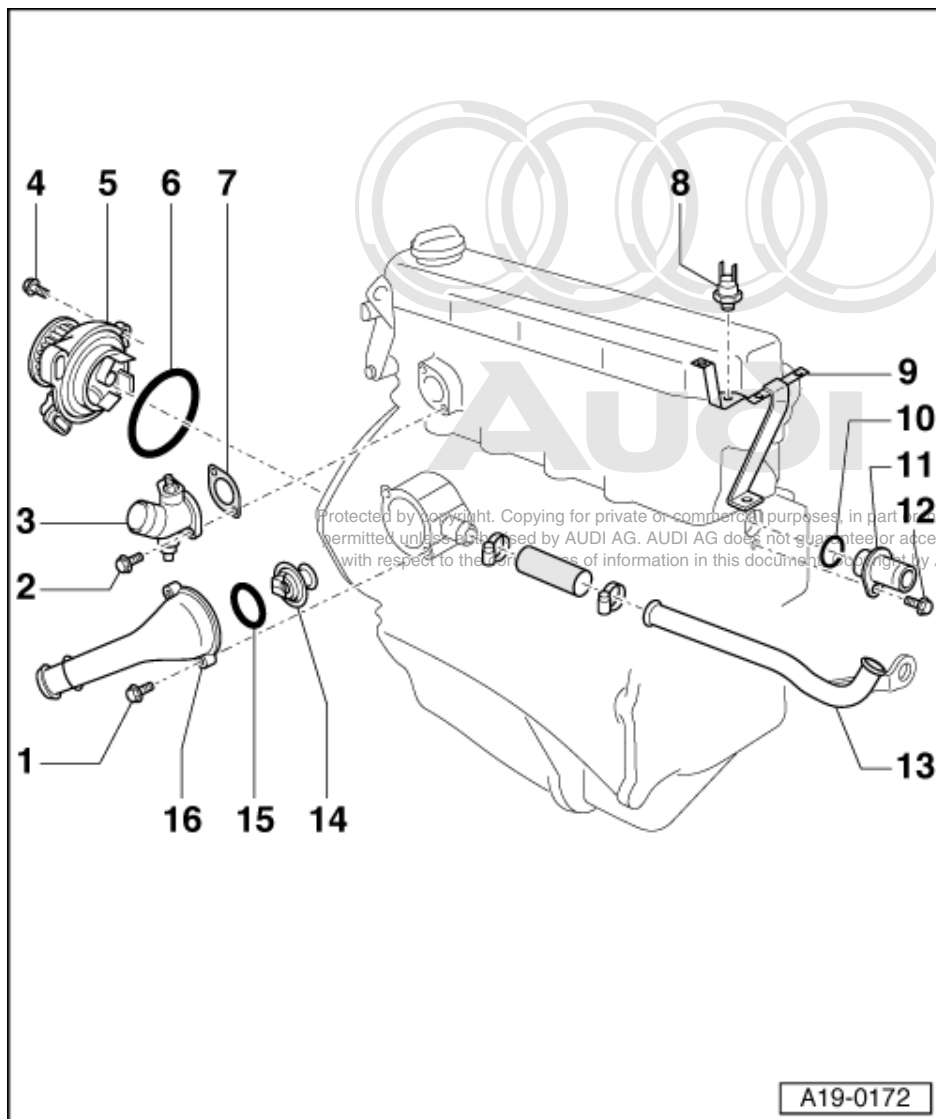
- Stop engine.



1.4 - Coolant pump and thermostat - Overview



- 1 10 Nm
- 2 10 Nm
- 3 Pipe union
 - ♦ With electronic thermoswitch -F76
 - ♦ With coolant temperature sender -G62
- 4 Bolt
 - ♦ Tighten hexagon bolt to 20 Nm
 - ♦ Tighten hexagon socket head bolt to 30 Nm

**5 Coolant pump**

- ◆ Removing and installing
=> Page 142
- ◆ Check for ease of movement

6 O-ring

- ◆ Replace
- ◆ Lubricate with coolant

7 Gasket

- ◆ Replace

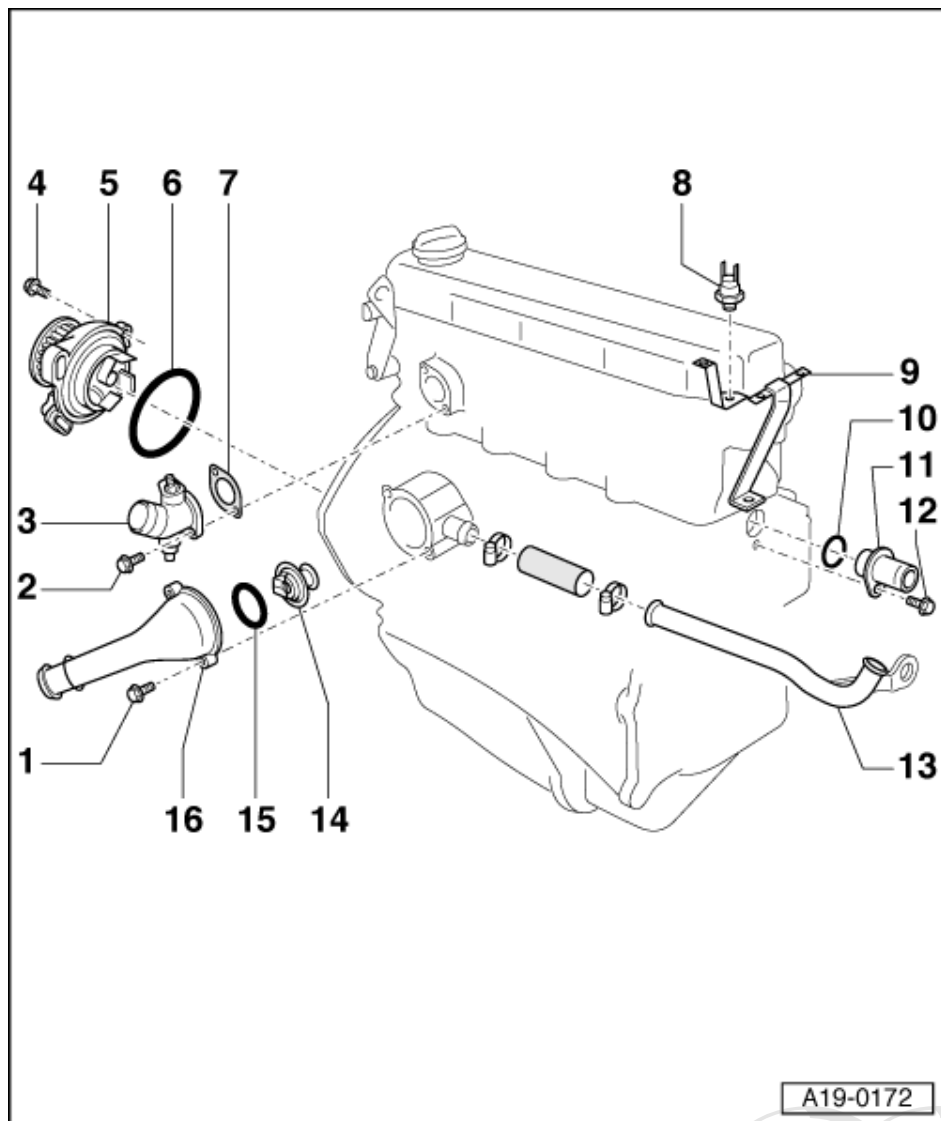
8 Fan run-on thermostatic switch -F87**9 Bracket**

- ◆ For fan run-on thermostatic switch -F87

10 O-ring

- ◆ Replace

11 Pipe union



12 20 Nm

13 Coolant pipe

14 Thermostat

- ♦ Removing and installing
=>Page 143 .
- ♦ Checking => Page 144

15 O-ring

- ♦ Replace
- ♦ Lubricate with coolant

16 Pipe union

1.5 - Removing and installing coolant pump

Removing

- Drain coolant => Page 136 .
- Removing toothed belt from camshaft sprocket
=>Page 40 .
- Unscrew coolant pump bolts and detach coolant pump.

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Installing

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

Note:

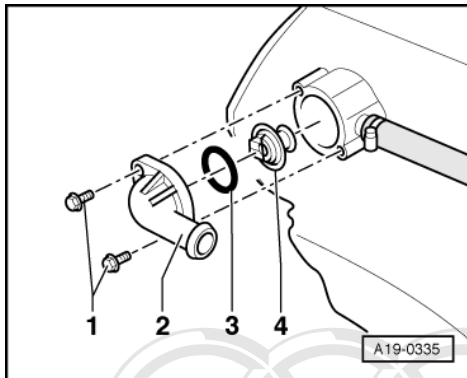
Fit new O-ring on coolant pump.

- Before installing, clean and smooth down sealing surface for O- ring.
- Lubricate new O-ring with G11/G12 and position at coolant pump.
- Screw down coolant pump.
- Install toothed belt (adjust valve timing) => Page 37 .
- Top up coolant => Page 138 .

Tightening torques

Component	Nm
Coolant pump to cylinder block	
Hexagon bolt	20
Hexagon socket-head bolt	30

1.6 - Removing, installing and checking coolant thermostat



Removing

- Drain coolant => Page 136 .
- -> Unscrew bolts -4- remove connection -3-, O-Ring -2- and coolant adjuster -1-.

Installing

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

Note:

Replace seals and gaskets: private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.

- Clean and smooth down sealing surface for O-ring as required.
- Insert coolant thermostat.
 - Installation position: Cross-piece on thermostat should be vertical.
- Lubricate new O-ring with G11/G12.
- Top up coolant => Page 138 .

Tightening torque

Component	Nm
-----------	----



Connection to cylinder block	10
------------------------------	----

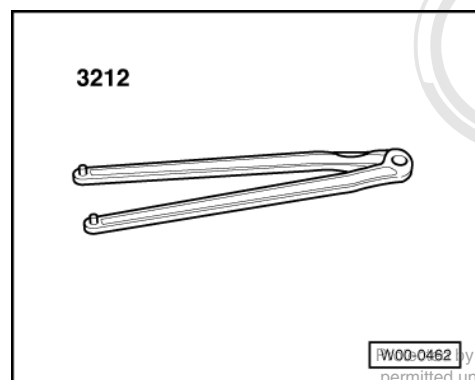
Check coolant thermostat

- Heat thermostat in water bath.

Starts to open	Fully open	Opening travel
approx. 87 °C	approx. 102 °C 1)	at least 8 mm

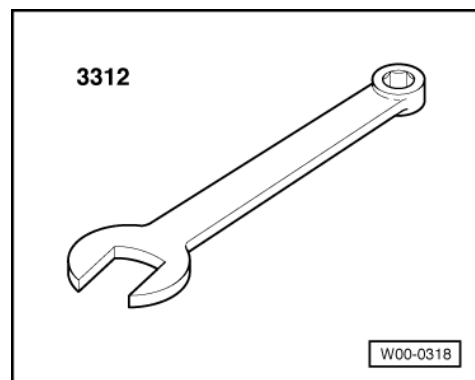
- 1) cannot be tested

1.7 - Removing and installing viscous fan

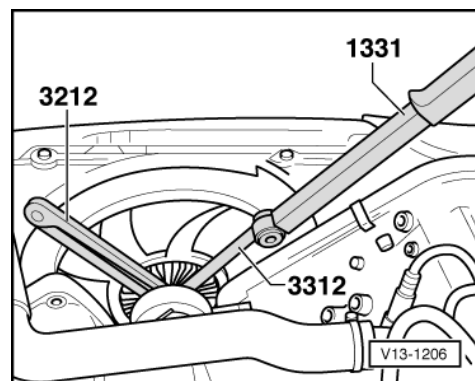


Special tools and workshop equipment required

- ♦ Pin wrench 3212



- ♦ Open-end spanner 3312

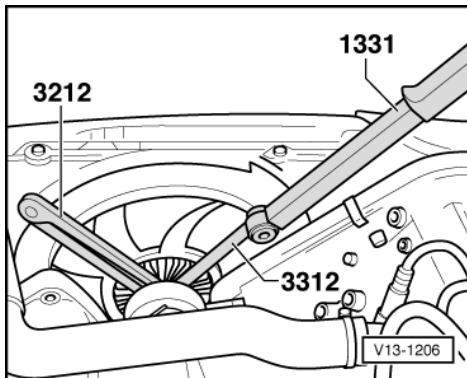


Removing

- Remove lock carrier:

=> General Body Assembly; Repair group 50; Front body Front body

- -> Counterhold pulley for viscous fan with 2-hole pin wrench 3212 and unscrew viscous fan with wrench 3312 (left-hand thread).
- Remove viscous fan from mounting and put in front of radiator cowl.
- If necessary, unclip wiring harness at bottom on radiator cowl.
- Unscrew radiator cowl from radiator and remove it and the viscous fan from above.



Installing

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

- -> Tighten the viscous fan with wrench 3312 and torque wrench V.A.G 1331 (left-hand thread).
- Tighten using 2-hole pin wrench 3212 as counterhold.
- Installing lock carrier with attachments:

=> General Body Assembly; Repair group 50; Front body Front body

Tightening torque for viscous fan	Nm
Torque wrench V.A.G 1331 and open-end spanner 3312	37
Torque wrench without open-end spanner 3312	70

Note:

If a torque wrench other than V.A.G 1331 is used, the tightening torque depends on the length of the torque wrench (measured from square to centre of handle):

220 mm = 22 Nm; 280 mm = 37 Nm;

300 mm = 39 Nm; 440 mm = 45 Nm.

1.8 - Checking viscous fan

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Note:

The operation of the viscous fan clutch cannot be tested with workshop equipment.

Visual check

- Check viscous fan for oil leaks. The coupling housing must be clean and dry on the rear.

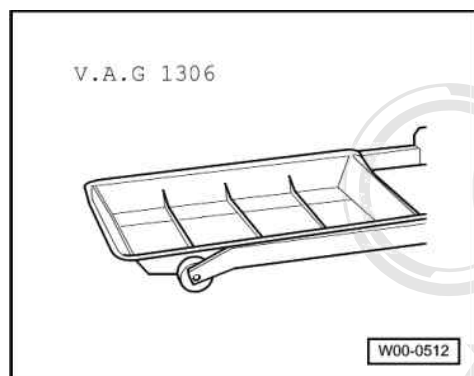


- Check the ease of movement of the fan when the engine is not running. It should be possible to turn the fan wheel without any appreciable resistance.

Checking axial play

- Measure at outside circumference of fan wheel.
 - Axial play: no more than 15 mm

1.9 - Removing and installing radiator



Special tools and workshop equipment required

- ♦ Drip tray V.A.G 1306
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Removing

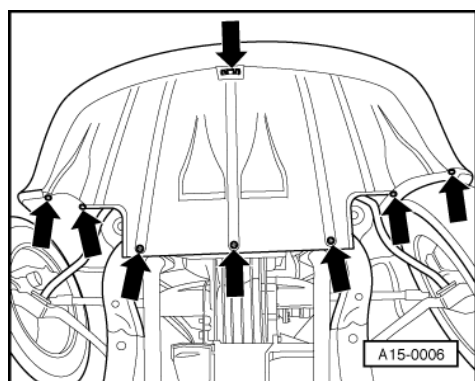
Note:

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

Important

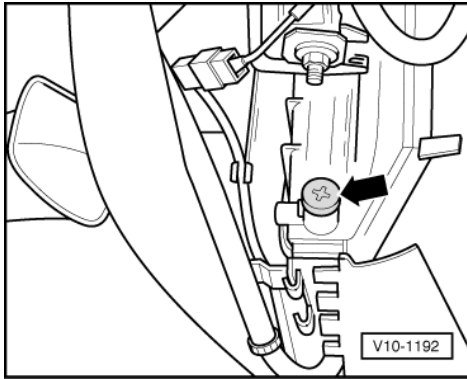
Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

- Open the cover of the coolant expansion tank

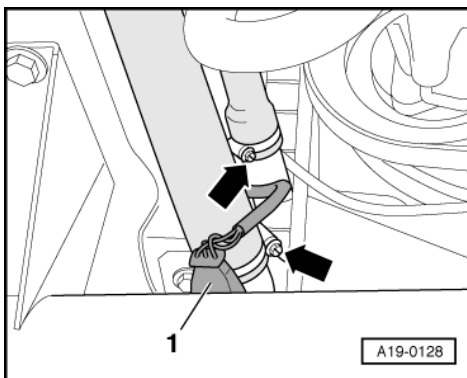


- -> Remove the noise insulation -arrows-.
- Remove the front bumper:

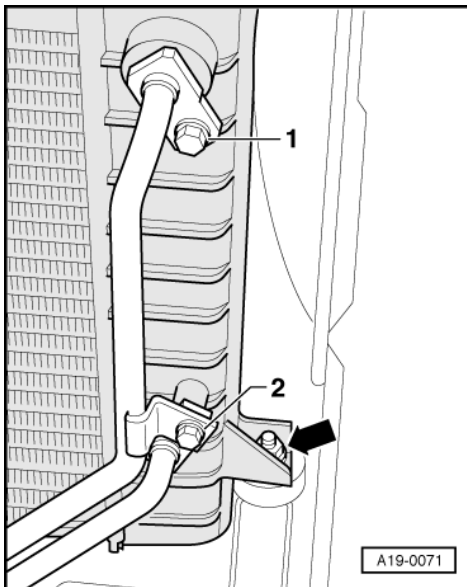
=> General Body Assembly; Repair group 63; Front bumper Front bumper



- Place drip tray V.A.G 1306 below engine.
- -> Turn drain plug -arrow- on radiator anti-clockwise. If necessary, fit drain hose on connection.



- -> Detach both coolant hoses at bottom of radiator -arrows-.
- Unplug connector -1- at radiator fan thermoswitch.
- Detach top left coolant hose from radiator.



Vehicles with automatic gearbox:

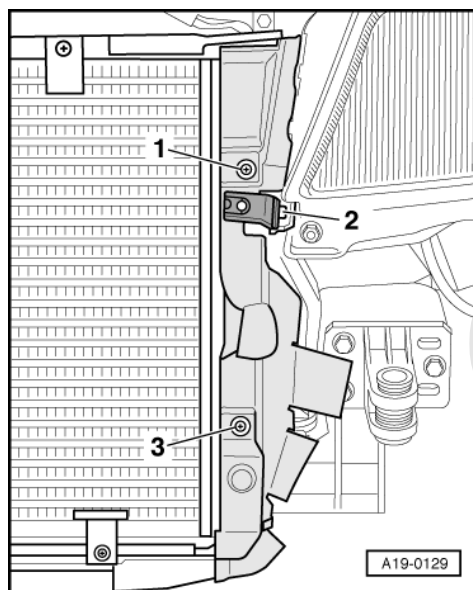
- -> Removing ATF lines from radiator (bolts -1- and -2-):

=> Automatic Gearbox; Repair group 37



Note:

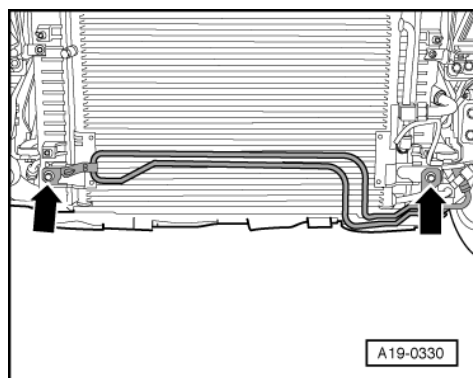
The nut -arrow- at lower right radiator fastening point must not be loosened.



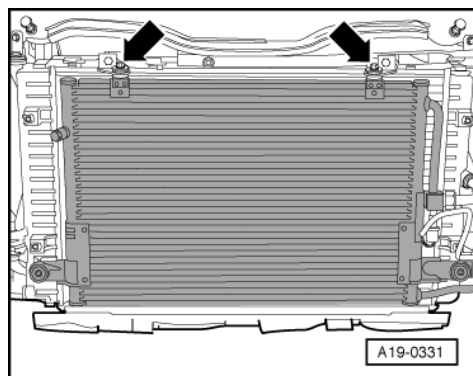
All models:

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- -> Unscrew bolt -2- of retaining clip of trim on headlight at housing.
- Unscrew bolts -1- and -3- of air ducts on left and right of radiator and remove air ducts.



- -> Detach cooling pipes for power steering hydraulic fluid -arrows-.



Vehicles with air conditioner:

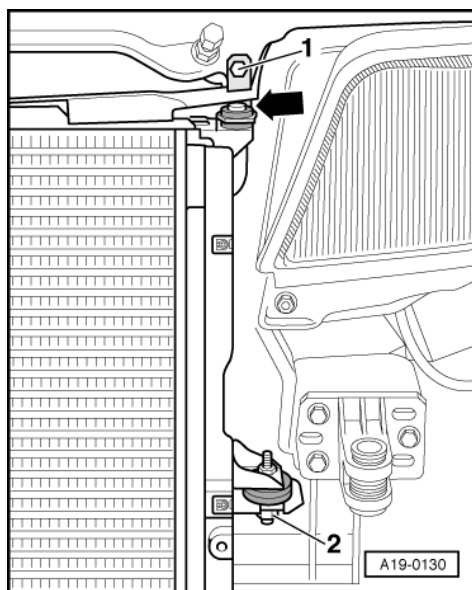
Important
 The air conditioner refrigerant circuit must not be opened.

- -> Remove the securing bolts for the condenser.

Note:

To prevent damage to the condenser and refrigerant pipes/hoses, ensure that the pipes and hoses are not stretched, kinked or bent.

- Leave condenser with connected refrigerant pipes/hoses in installation position.
- Unscrew radiator cowl at rear of radiator -arrows-.
- Remove radiator cowl from brackets and tie it to lock carrier.



All models:

- -> Unscrew nuts -2- at bonded rubber mounting.
- Remove bottom of radiator from bonded rubber mounting support from front.
- Disengage upper radiator attachment -arrow- downwards (if necessary unscrew bolt -1- at radiator support).

Installing

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

- Install the front bumper:

=> General Body Assembly; Repair group 63; Front bumper Front bumper

- Top up coolant => Page 138

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Note:

All coolant must be replaced when a new radiator is fitted.

Vehicles with automatic gearbox:

- Attach ATF lines.



=> Automatic Gearbox; Repair group 37

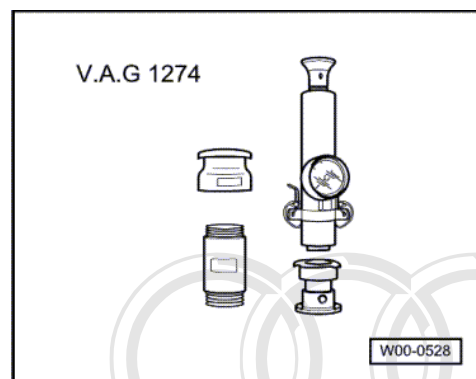
- Check ATF level:

=> Automatic Gearbox; Repair group 37

Tightening torques

Component		Nm
Radiator to lock carrier	M6	10
	M8	20
Radiator cowl to radiator		10
Condenser to radiator		10
Power steering coolant pipes to radiator		10

1.10 - Checking cooling system for leaks

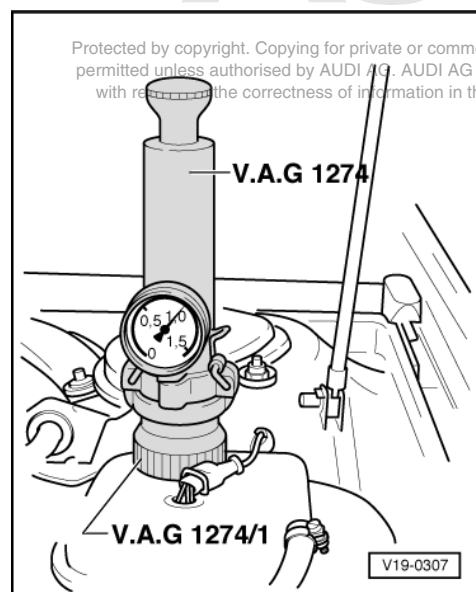


Special tools and workshop equipment required

- ♦ V.A.G 1274 with V.A.G 1274/1

Test requirements:

- Engine at operating temperature.

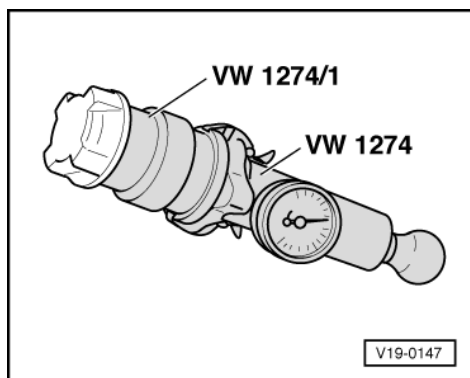


Test sequence

Important

Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

- Open the cover of the coolant expansion tank
- -> Fit tester V.A.G 1274 with adapter V.A.G 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.



Checking pressure relief valve in filler cap.

- -> Fit tester V.A.G 1274 with adapter V.A.G 1274/1 (2 parts) onto filler cap.
- Operate hand pump.
- The pressure relief valve should open at a pressure of 1.2...1.5 bar.



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26 - Exhaust system

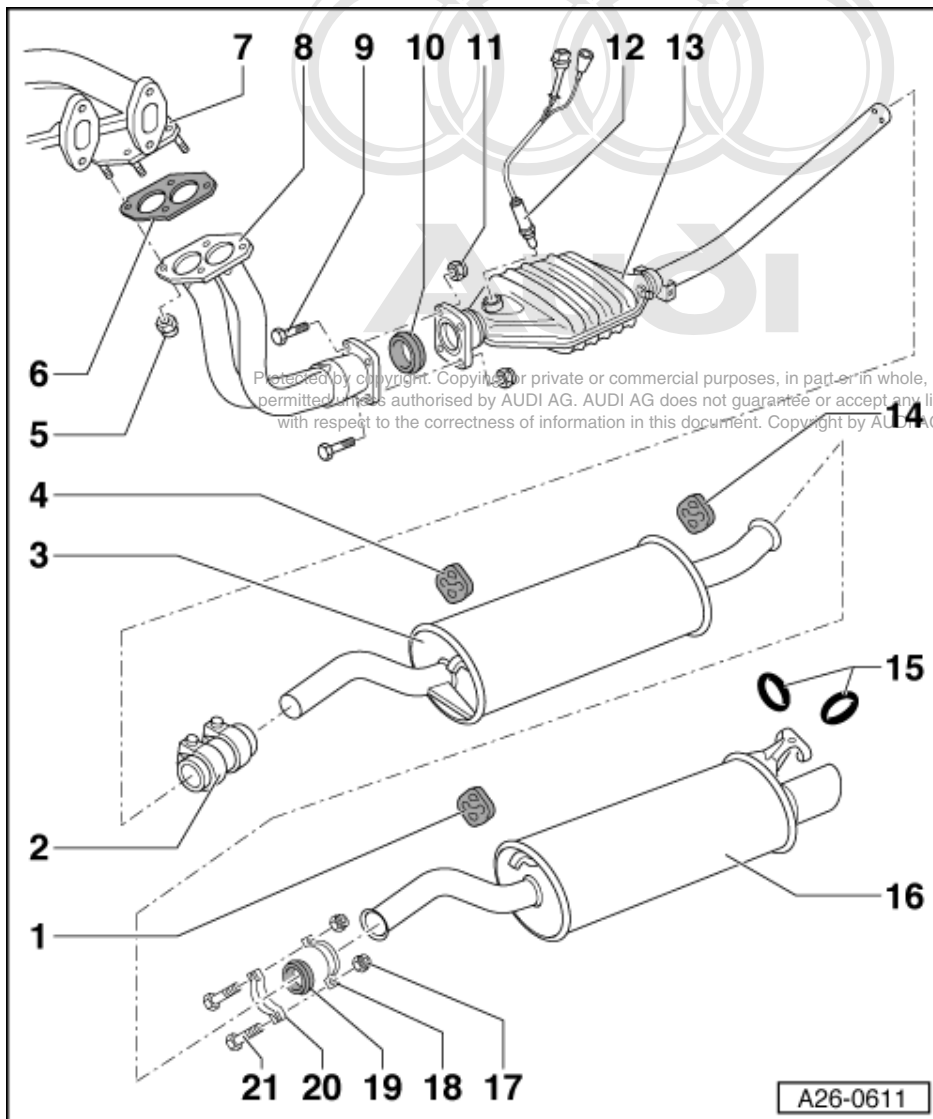
1 - Removing and installing parts of exhaust system

1.1 - Removing and installing parts of exhaust system

Notes:

- ♦ Always replace seals, gaskets and self-locking nuts.
- ♦ After working on the exhaust system ensure that the system is not under stress, and that it has sufficient clearance from the body. If necessary, loosen clamp and align silencer and exhaust pipe so that sufficient clearance is maintained to the body at all points and the support rings are evenly loaded.
- ♦ Removing and installing floor cross member
=> Fig. 164

1.2 - Vehicles with front-wheel drive



1 Retainer

- ♦ Replace if damaged
- ♦ Bending over securing tabs
=> Fig. 156

2 Clamp

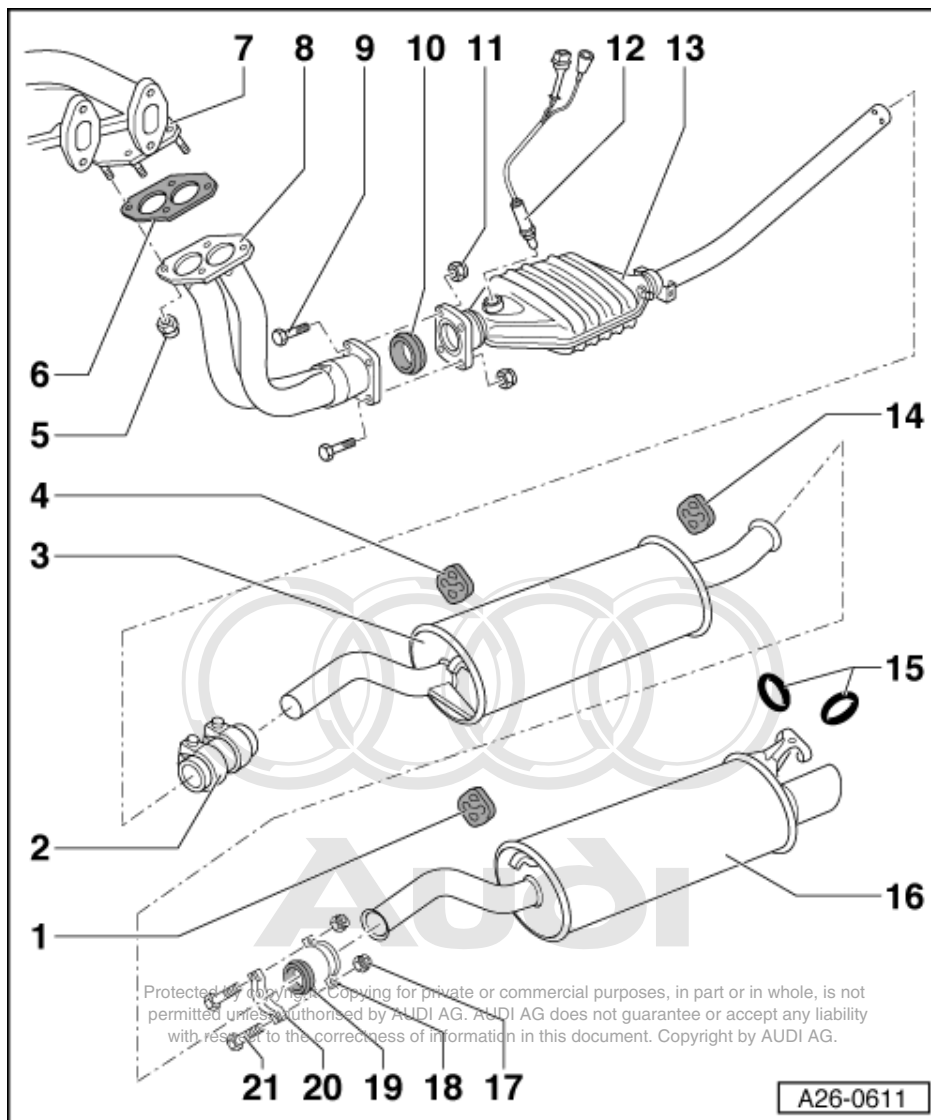
- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 171
- ♦ Installation position
=> Fig. 156
- ♦ Tighten bolted connections evenly to 40 Nm

3 Centre silencer

- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 171

4 Retainer

- ♦ Replace if damaged
- ♦ Bending over securing tabs
=> Fig. 156



5 30 Nm

- ♦ Replace

6 Gasket

- ♦ Replace

7 Exhaust manifold

- ♦ Removing and installing
=>Page 168 .



8 Front exhaust pipe

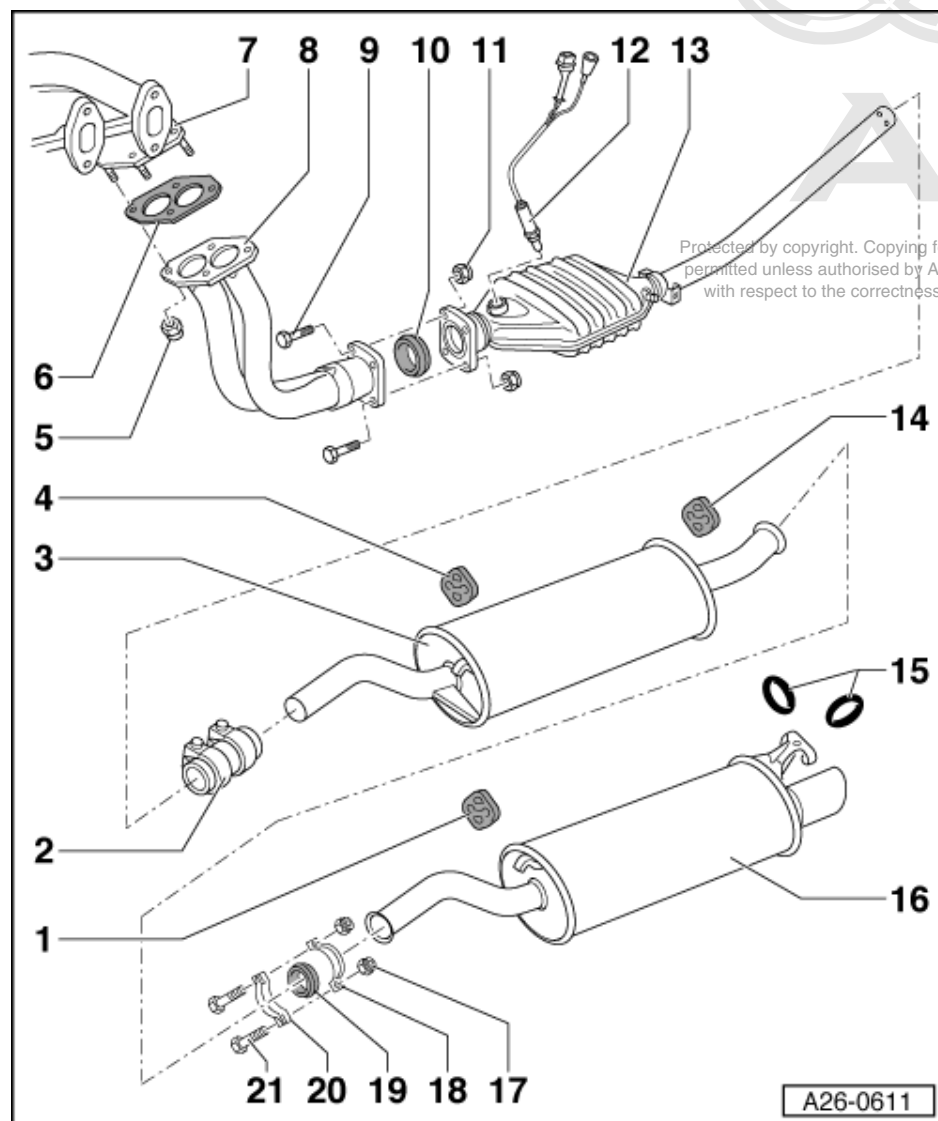
9 25 Nm

10 Sealing ring

- ♦ Sensitive to impact; take care not to drop

11 25 Nm

- ♦ Replace



12 Lambda probe - 55 Nm

- ♦ Grease only the thread with high-temperature lubricant "G 052 112 A3", ensuring that the lubricant does not get into the slots on the probe body.
- ♦ Checking:

=> KE III Jetronic/ignition system (5-cylinder); Repair group 25; Checking lambda control Checking lambda control

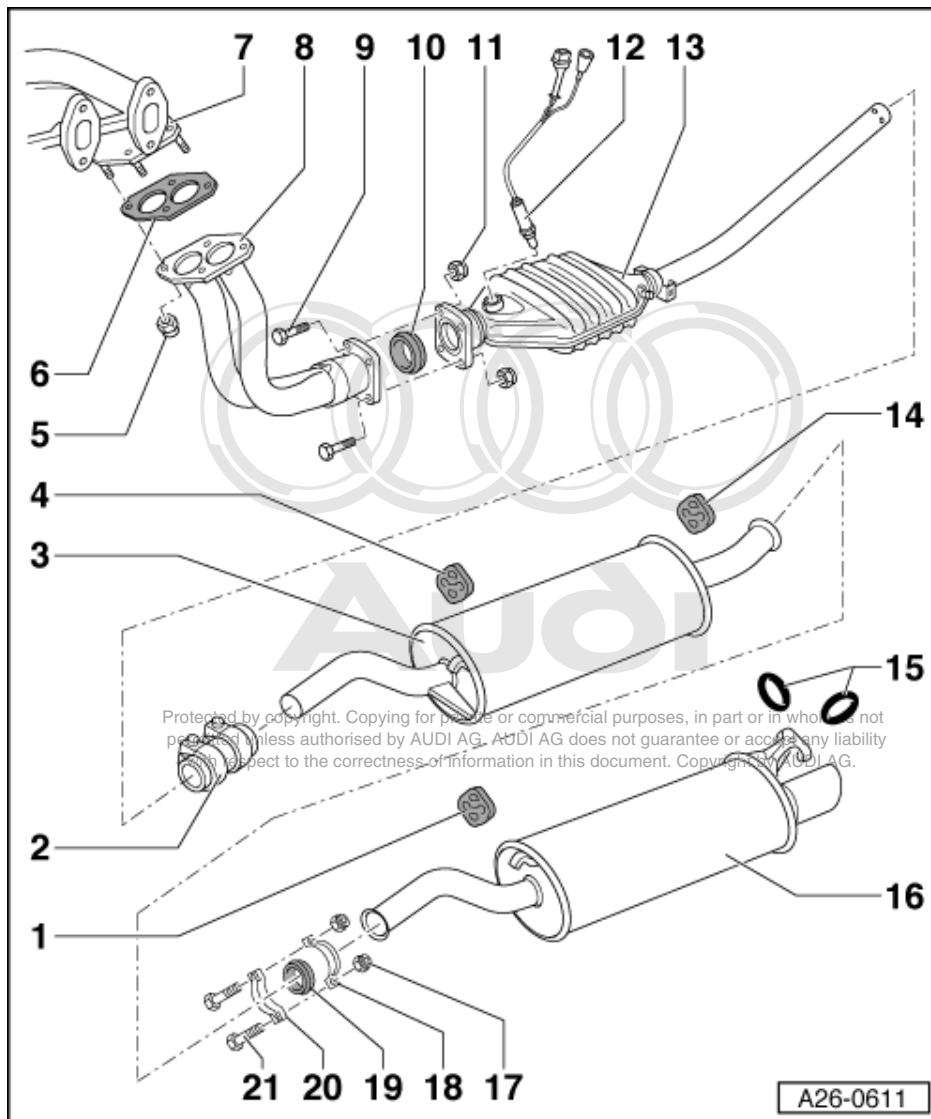
13 Catalytic converter

- ♦ Protect from damage by knocks and impact
- ♦ Components of mounting for vehicles with manual gearbox => Fig. 157
- ♦ Components of mounting for vehicles with automatic gearbox => Fig. 158

14 Retainer

- ♦ Replace if damaged

- ♦ Bending over securing tabs => Fig. 156



15 Retaining ring

- ♦ Replace if damaged
- ♦ Bending over securing tabs => Fig. 157

16 Rear silencer

- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 171

17 15 Nm

- ♦ Replace

18 Clip

- ♦ Installation position
=> Fig. 156

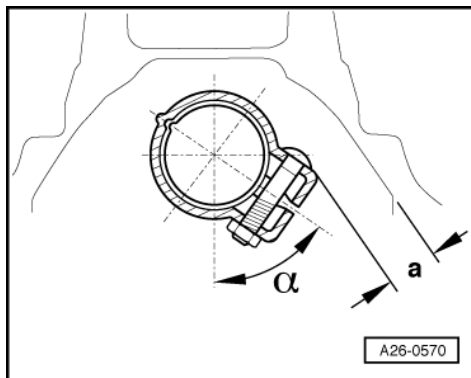
19 Sealing ring

- ♦ Sensitive to impact; take care not to drop

20 Clip

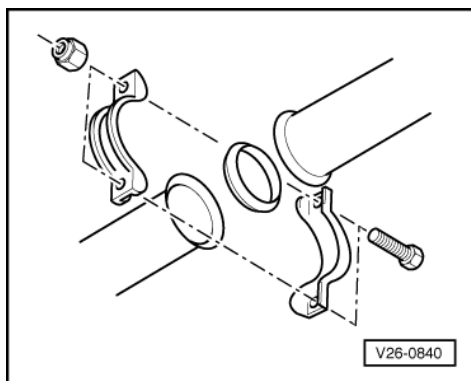
- ♦ Installation position
=> Fig. 156

21 15 Nm



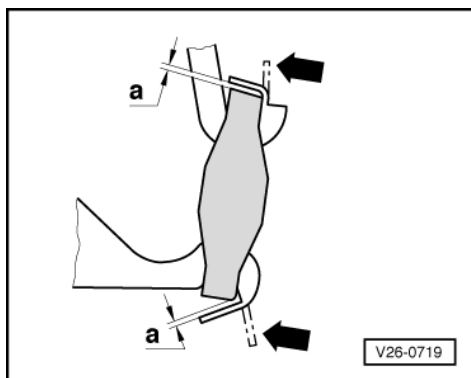
-> Fig.1 Installation position of the clamping sleeve

- Fit clamp in horizontal position.
 - Bolted connections face to right
 - $\alpha = 45^\circ$
 - $a = 27 \dots 37 \text{ mm}$



-> Fig.2 Installation position of clamp

- Fit clamping sleeve vertically.
 - Bolt head faces to right



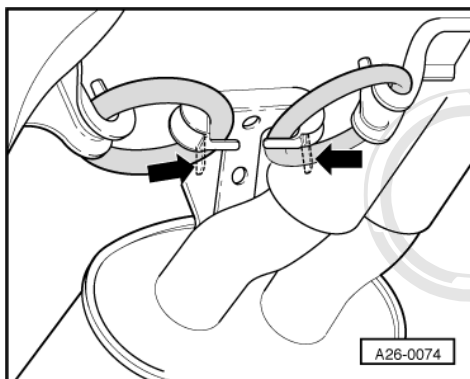
-> Fig.3 Bending over securing tabs on brackets of front mounting

- Centre and rear silencers
 - After installing the exhaust system, bend over the securing tabs -arrows- approx. 90° .
 - Ensure that a distance corresponding to dimension -a- is maintained between retainer and securing tab.



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- Dimension a = 2 mm

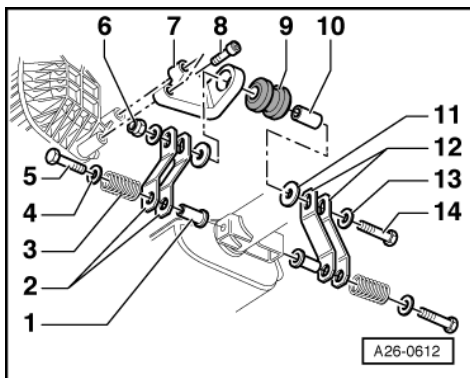


-> Fig.4 Bending over securing tabs on brackets of rear mounting

- Rear silencer

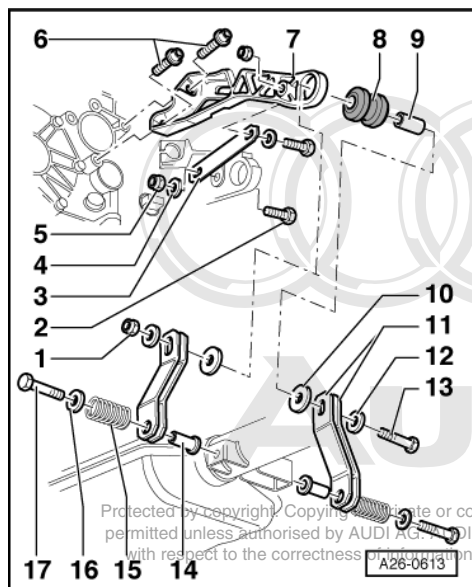
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- After installing the exhaust system, bend over the securing tabs -arrows approx. 90°.



-> Fig.5 Individual parts of mounting for vehicles with manual gearbox

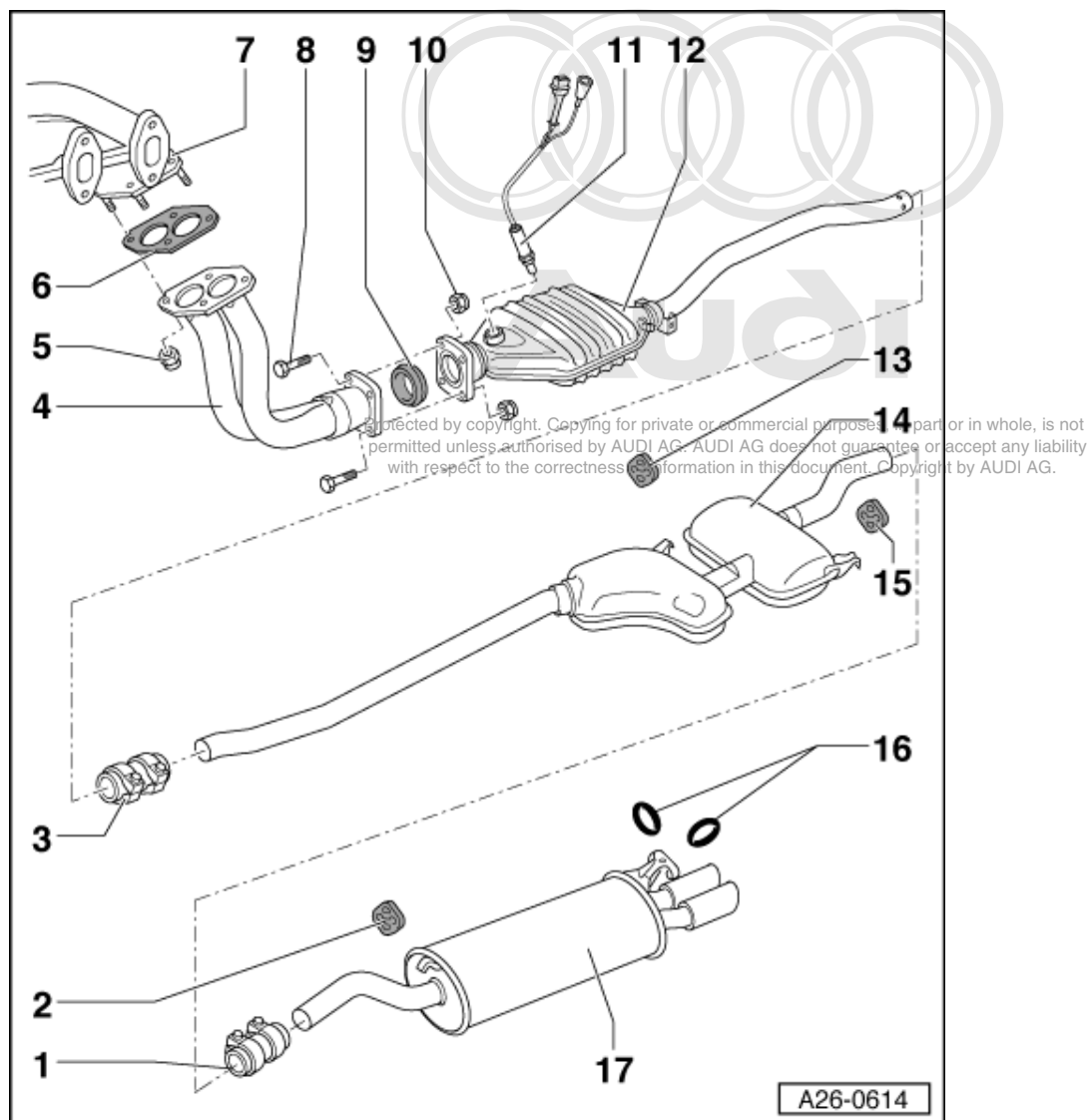
- 1 - Spacer
- 2 - Link
- 3 - Pressure spring
- 4 - Plate
- 5 - Bolt - 25 Nm
- 6 - Nut, self-locking - 25 Nm
- 7 - Console
- 8 - Torx socket head bolt - 25 Nm
- 9 - Buffer
- 10 - Spacer
- 11 - Plate
- 12 - Link
- 13 - Plate
- 14 - Bolt - 25 Nm



-> Fig.6 Individual parts of mounting for vehicles with automatic gearbox

- 1 - Nut, self-locking - 25 Nm
- 2 - Bolt
- 3 - Brace
- 4 - Plate
- 5 - Nut, self-locking - 23 Nm
- 6 - Hexagon socket head bolt - 40 Nm
- 7 - Console
- 8 - Buffer
- 9 - Spacer
- 10 - Plate
- 11 - Link
- 12 - Plate
- 13 - Bolt
- 14 - Spacer
- 15 - Pressure spring
- 16 - Plate
- 17 - Bolt - 25 Nm

1.3 - 4WD vehicles

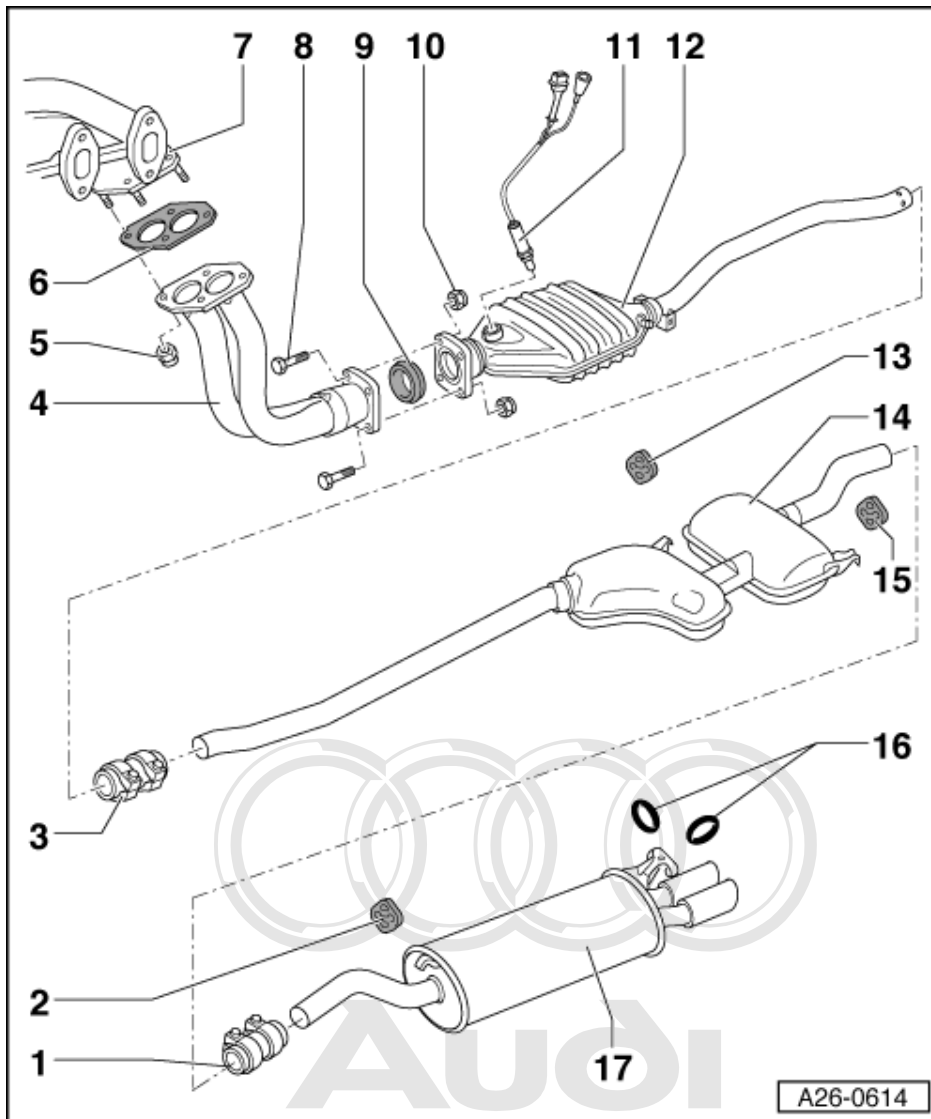


1 Rear clamping sleeve

- ◆ For separate replacement of centre and rear silencers
- ◆ Align exhaust system so it is free of stress before tightening clamp => Page 171
- ◆ Installation position
=> Fig. 163
- ◆ Tighten bolted connections evenly to 40 Nm

2 Retainer

- ◆ Replace if damaged
- ◆ Bending over securing tabs => Fig. 164

**3 Front clamping sleeve**

- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 171
- ♦ Installation position
=> Fig. 163
- ♦ Tighten bolted connections evenly to 40 Nm

4 Front exhaust pipe**5 30 Nm**

- ♦ Replace

6 Gasket

- ♦ Replace

7 Exhaust manifold

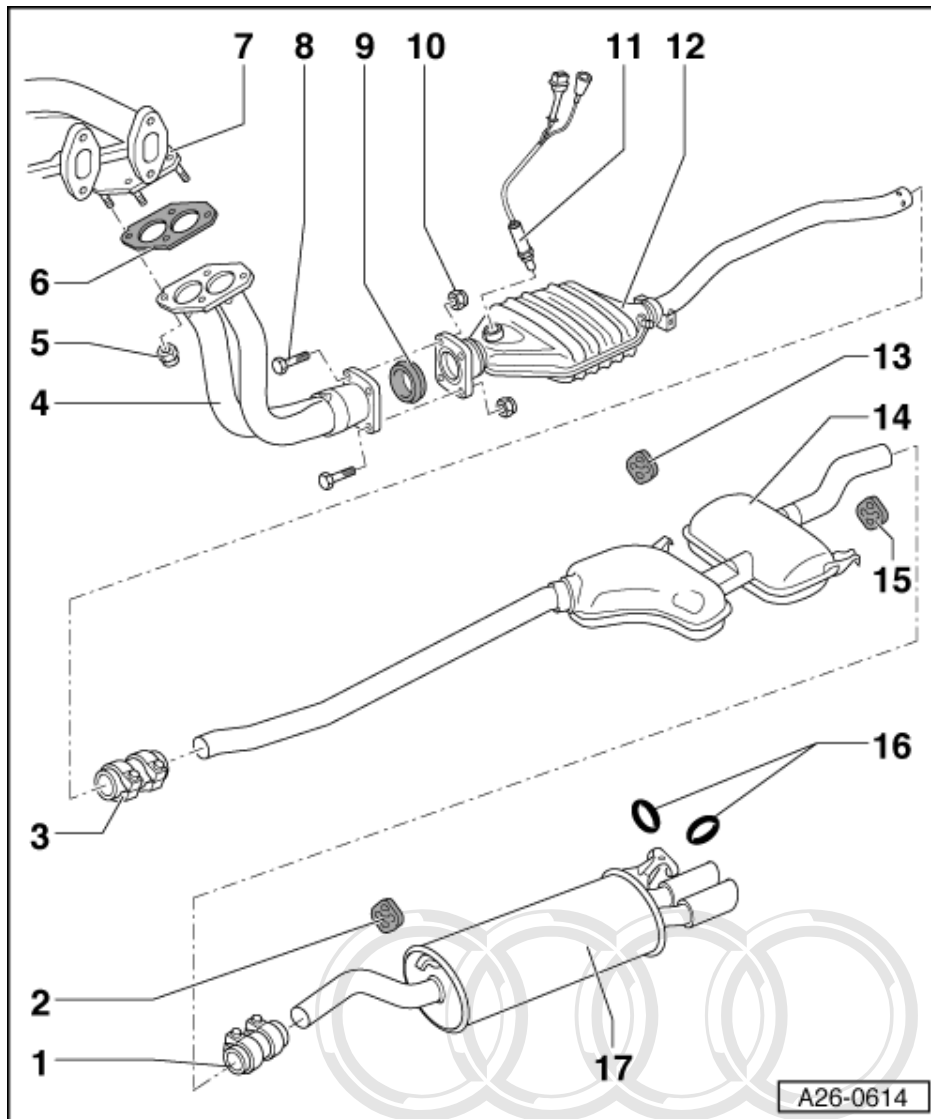
- ♦ Removing and installing
=>Page 168 .

8 25 Nm**9 Sealing ring**

- ♦ Sensitive to impact; take care not to drop

10 25 Nm

- ♦ Replace



11 Lambda probe - 55 Nm

- ♦ Grease only the thread with high-temperature lubricant "G 052 112 A3", ensuring that the lubricant does not get into the slots on the probe body.
- ♦ Checking:

=> KE III Jetronic/ignition system (5-cylinder); Repair group 25; Checking lambda control Checking lambda control

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12 Catalytic converter

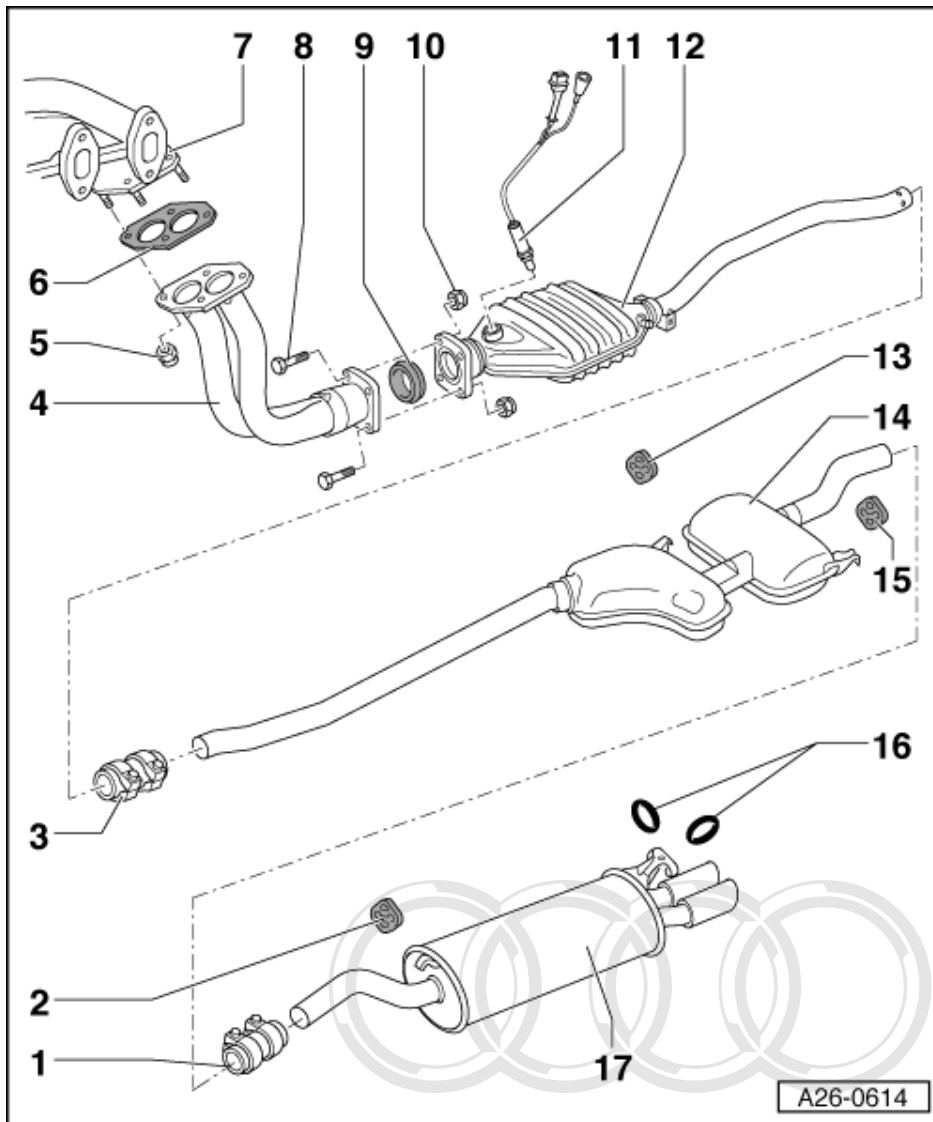
- ♦ Protect from damage by knocks and impact
 - ♦ Mounting components
- => Fig. 163

13 Retainer

- ♦ Replace if damaged
- ♦ Bending over securing tabs => Fig. 164

14 Centre silencer

- ♦ Centre and rear silencers are one unit as original equipment. In cases of repair renew individually
- ♦ Cutting point => Page 165
- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 171

**15 Retainer**

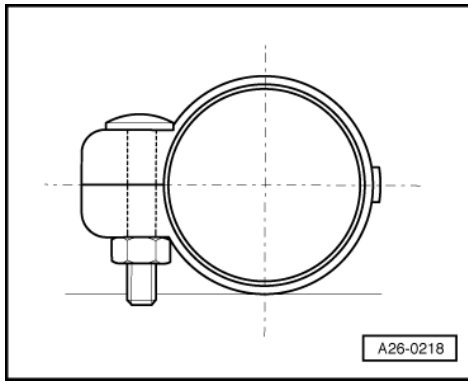
- ◆ Replace if damaged
- ◆ Bending over securing tabs => Fig. 164

16 Retaining ring

- ◆ Replace if damaged
- ◆ Bending over securing tabs => Fig. 165

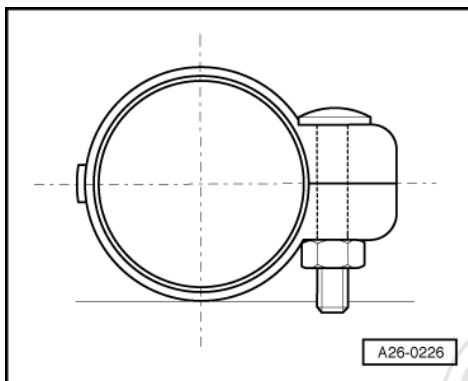
17 Rear silencer

- ◆ Rear and centre silencer are one unit as original equipment. In cases of repair renew individually
- ◆ Cutting point => Page 165
- ◆ Align exhaust system so it is free of stress before tightening clamp => Page 171



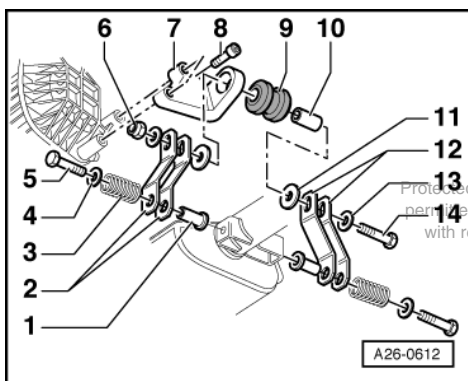
-> Fig.1 Installation position of front clamp

- Fit clamp in horizontal position.
- Bolted connection facing to the left



-> Fig.2 Installation position of rear clamp

- Fit clamp in horizontal position.
- Bolted connection faces right

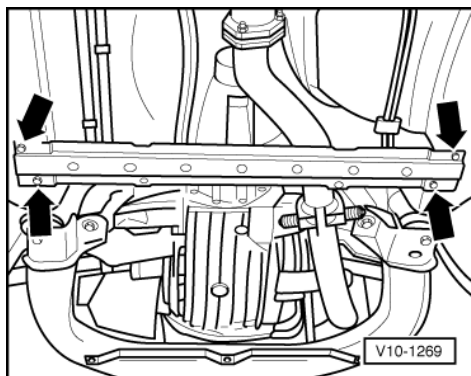


-> Fig.3 Components of mounting

- 1 - Spacer
- 2 - Link
- 3 - Pressure spring
- 4 - Plate
- 5 - Bolt - 25 Nm
- 6 - Nut, self-locking - 25 Nm
- 7 - Console
- 8 - Torx socket head bolt - 25 Nm
- 9 - Buffer

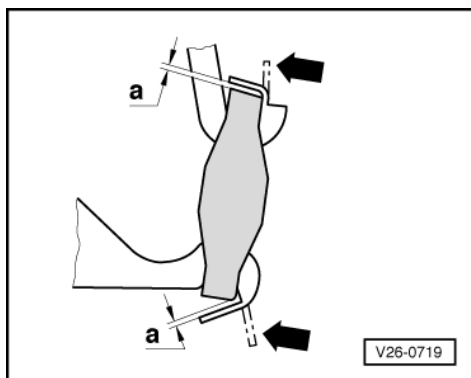


- 10 - Spacer
- 11 - Plate
- 12 - Link
- 13 - Plate
- 14 - Bolt - 25 Nm



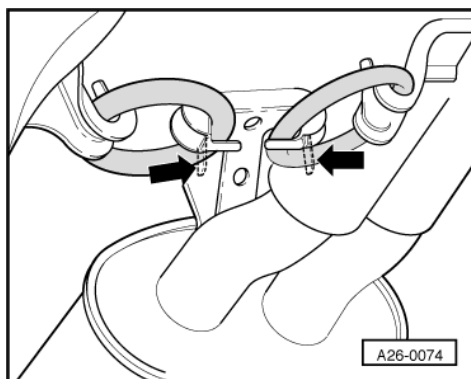
-> Fig.4 Removing and installing floor cross member

- ♦ Tightening torque: 20 Nm



-> Fig.5 Bending over securing tabs on brackets of front mounting

- Centre and rear silencers
- After installing the exhaust system, bend over the securing tabs -arrows- approx. 90°.
- Ensure that a distance corresponding to dimension -a- is maintained between retaining ring and securing tab.
 - Dimension a = 2 mm



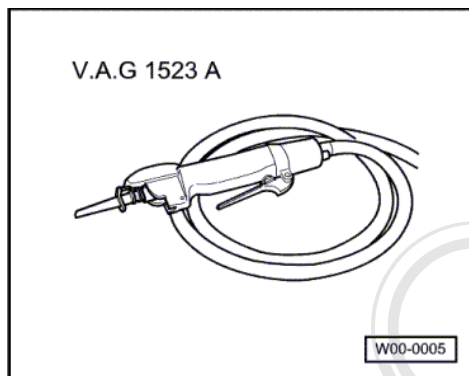
-> Fig.6 Bending over securing tabs on brackets of rear mounting

- Rear silencer
- After installing the exhaust system, bend over the securing tabs -arrows- approx. 90°.

1.4 - Separating centre and rear silencers

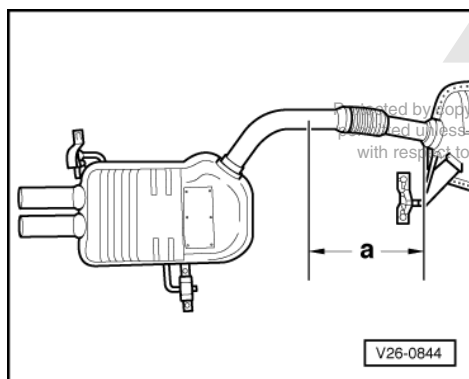
Vehicles with four-wheel drive:

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



Special tools and workshop equipment required

- ♦ V.A.G 1523 A



Procedure

Important
Wear protective goggles.

- -> Cut through exhaust pipe at right angles at specified cutting point -a- using body saw, e.g. V.A.G 1523 A.
- ♦ The cutting point is marked with an indentation on the outside of the exhaust pipe.



Note:

A short clamp is provided for connecting the main and rear silencers when performing repairs.

- When installing, position clamping sleeve centrally over saw cut.

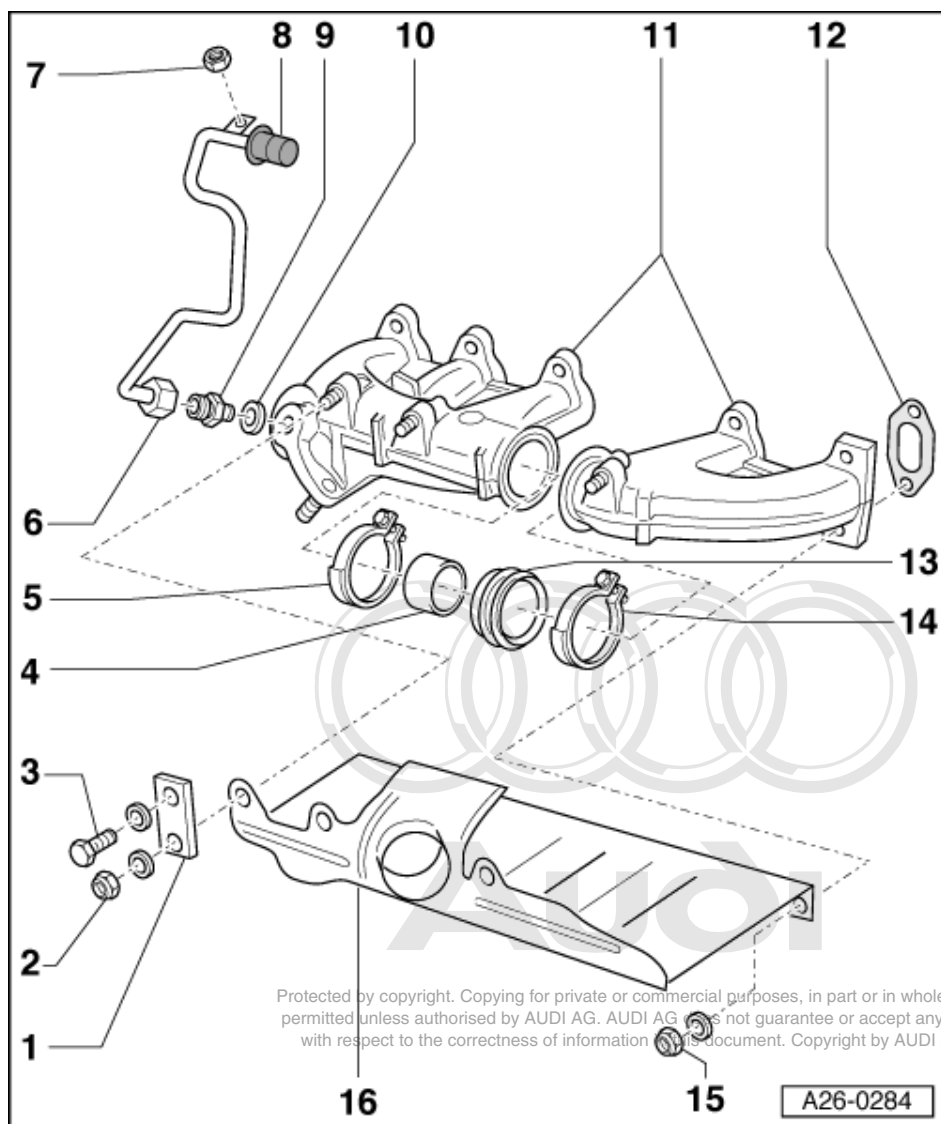
- Installation position of clamp

=> Fig. 163

- Stress-free alignment of exhaust system => Page 171

- Tighten bolted connections on clamp evenly to 40 Nm.

1.5 - Exhaust manifold - Overview



1 Bracket

- ♦ For intake manifold

2 22 Nm

3 22 Nm

4 Connecting pipe

5 Screw-type clamp

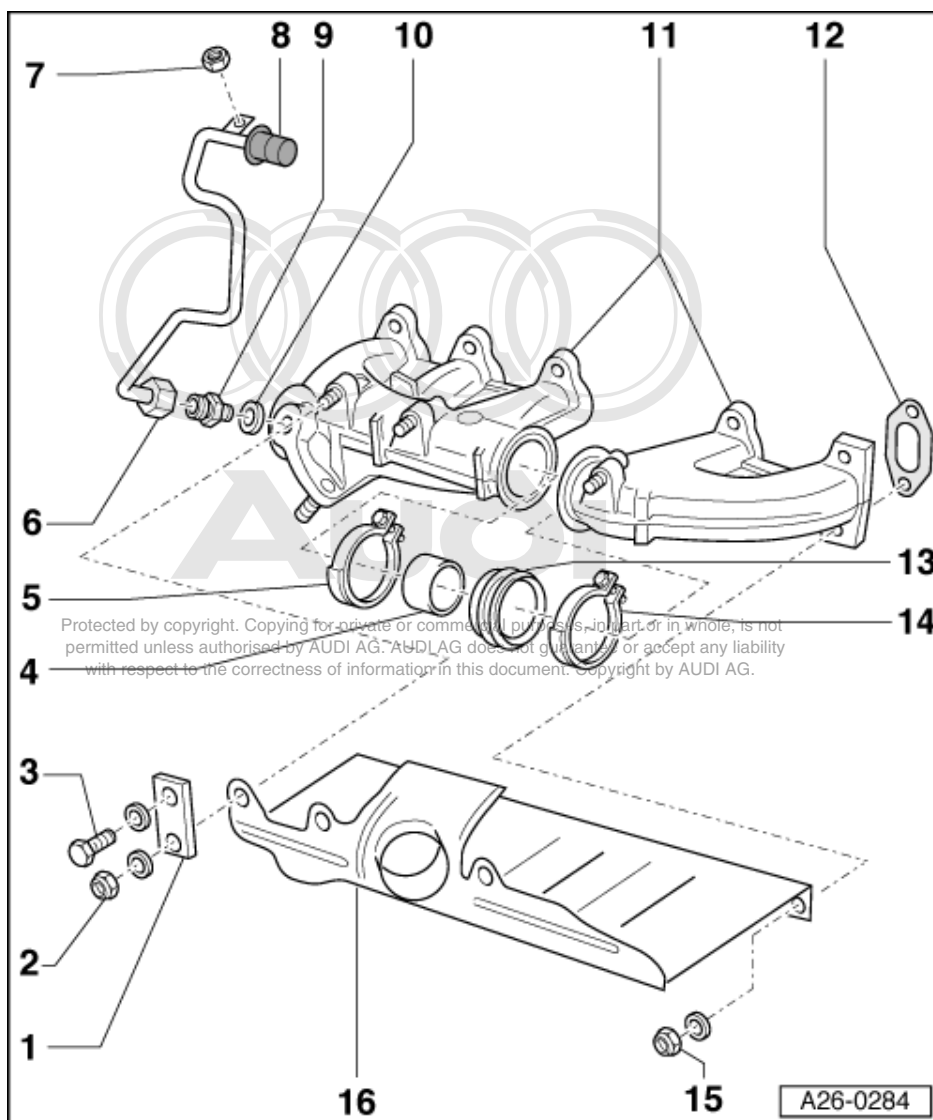
- ♦ Tighten to 10 Nm

6 CO test pipe

- ♦ Tighten to 20 Nm

7 10 Nm

8 Plug



9 27 Nm

10 Sealing ring

- ♦ Replace

11 Exhaust manifold

- ♦ Removing and installing
=>Page 168 .

12 Gasket

- ♦ Replace

13 Corrugated pipe

14 Screw-type clamp

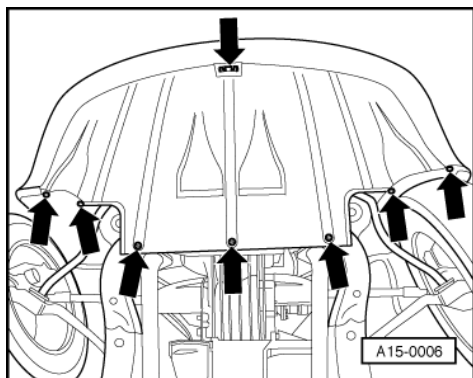
- ♦ Tighten to 10 Nm

15 25 Nm

16 Warm air arrester plate

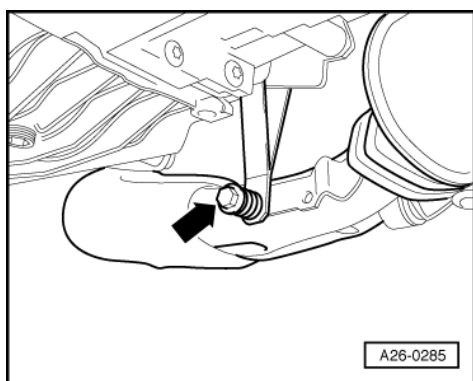
- ♦ For intake air preheater

1.6 - Removing and installing exhaust manifold



Removing

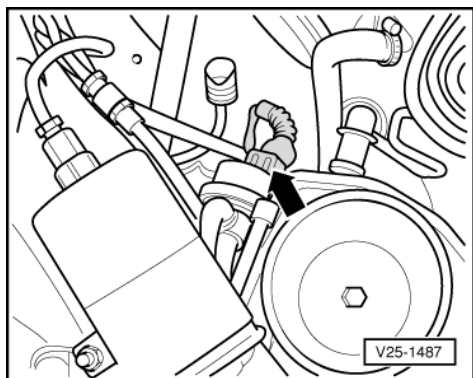
- -> Remove the noise insulation -arrows-.



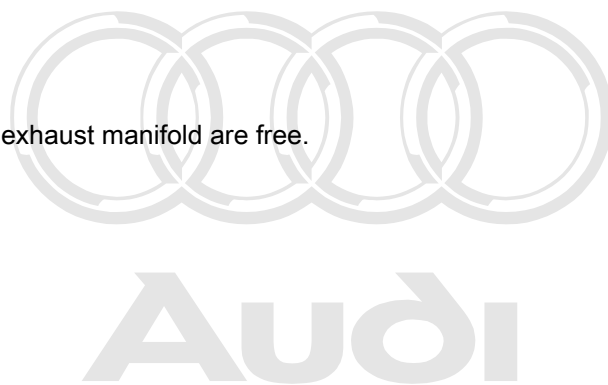
- Unscrew exhaust manifold/front exhaust pipe nuts.
- -> Unbolt retainer for exhaust system -arrow-.
- Push exhaust system towards the rear so that studs on exhaust manifold are free.

Note:

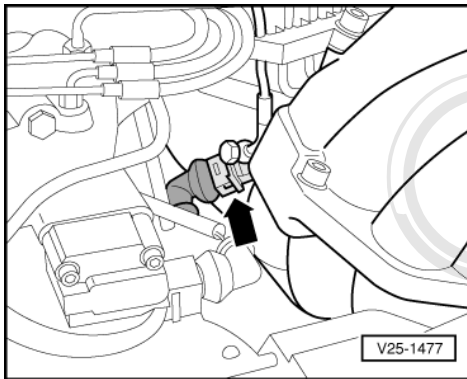
Watch for electrical wiring of lambda probe.



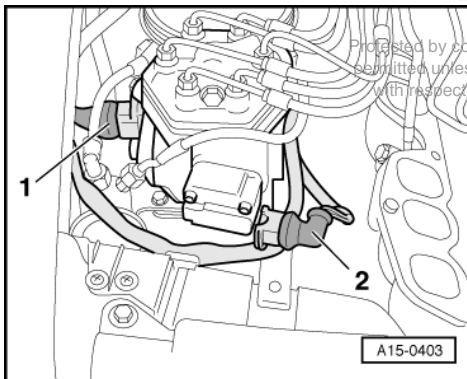
- Remove crankcase breather hose from intake cowl.
- Detach air intake cowl.
- -> Detach connector -arrow- from ACF valve.
- Unclip ACF valve from bracket and tie back.



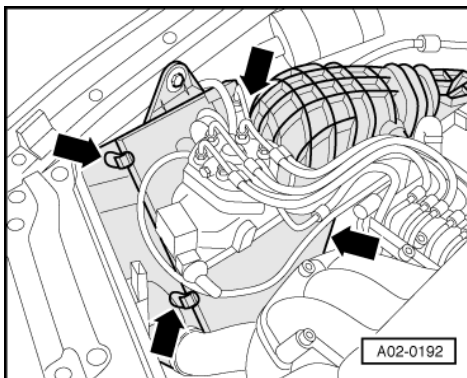
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- -> Unplug connector from cold start valve -arrow-.



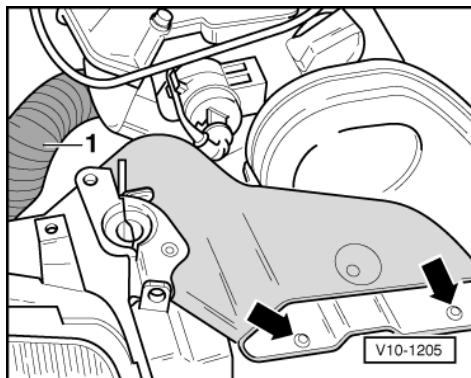
- -> Detach connectors -1- and -2-.
- Lay wiring aside.



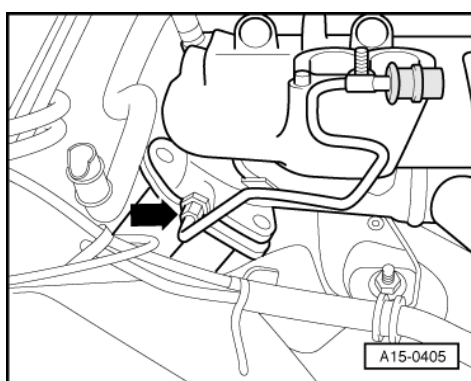
Important

The fuel system is pressurised. Before opening the system place a cloth around the connection. Then release pressure by carefully loosening the connection.

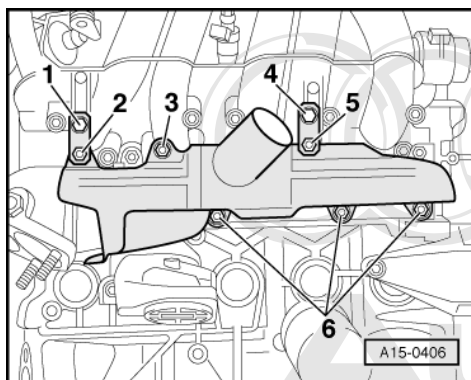
- Disconnect fuel supply and return hoses from mixture control unit.
- -> Release clips around air cleaner housing -arrows-.
- Pull mixture control unit and upper section of air cleaner housing upwards and set aside on engine with wiring connected.



- -> Detach and remove air intake connection -arrows-.
- Detach hose -1- of intake air preheater from warm air arrester plate on exhaust manifold.
- Remove the lower section of the air cleaner housing.

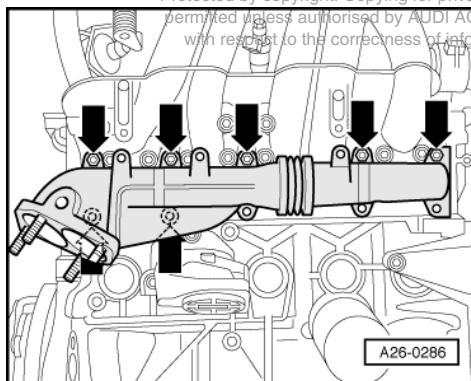


- -> Unscrew CO test pipe -arrow-.

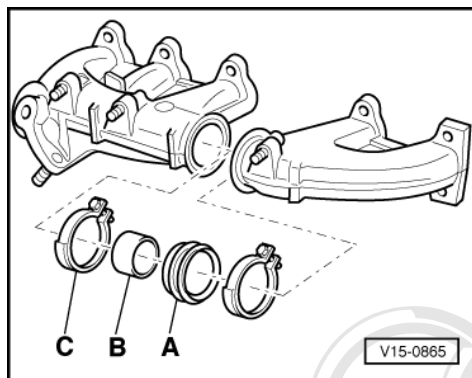


- -> Unscrew warm air arrester plate -1...6-.

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- -> Unscrew all nuts -arrows- on exhaust manifold.
- Remove washers and exhaust manifold.



Installing

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

Notes:

- ◆ Always replace seals, gaskets and self-locking nuts.
- ◆ The raised edge of the exhaust manifold/cylinder head gaskets must point towards the exhaust manifold.

The exhaust manifold is in two parts:

- -> Fit the exhaust manifold with pre-installed corrugated pipe -A-, connection pipe -B- and screw-type clips -C- to cylinder head.
- Ensure that connection pipe -B- is inserted in corrugated pipe -A-.

Note:

Tighten nuts on exhaust manifold then the screw-type clips -C-.

- Stress-free alignment of exhaust system => Page 171

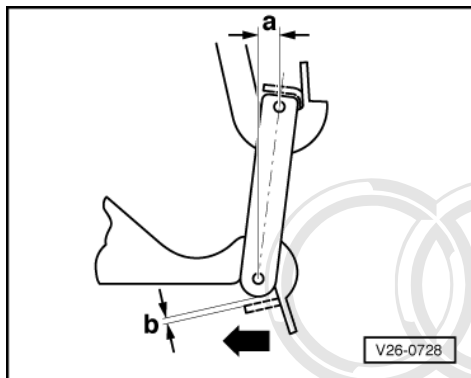
Tightening torques

Component	Nm
Exhaust manifold to cylinder head	25
Front exhaust pipe to exhaust manifold	30
CO test pipe to exhaust manifold	20
CO test pipe to lower section of intake manifold	10
Warm air arrester plate to cylinder head	25
Warm air arrester plate to exhaust manifold	22
Screw-type clips to exhaust manifold connection pipe	10

1.7 - Stress free alignment of exhaust system

Note:

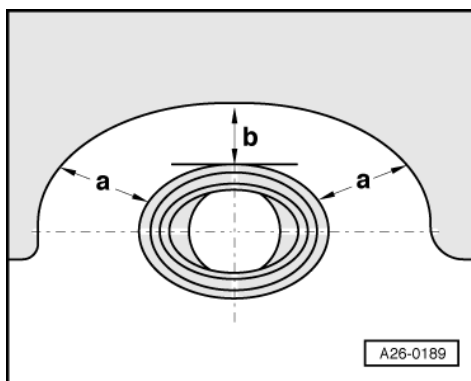
The exhaust system must be aligned when cold.



Vehicles with front-wheel drive:

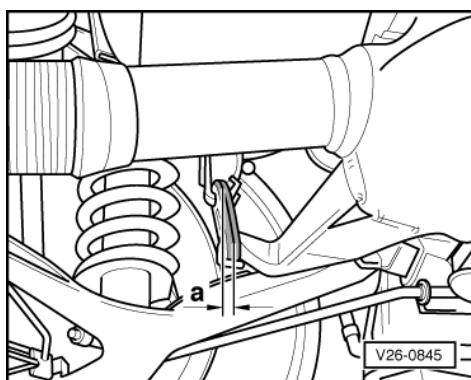
- Loosen bolted connections on clamp -Item **153**
 - -> Push exhaust system towards front of vehicle -arrow- until rear mounting on centre silencer is preloaded by $a = 7 \dots 10 \text{ mm}$.
 - Tighten bolted connections on clamp evenly to 40 Nm.
 - Note installation position of front clamp
- => Fig. **156**

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Aligning tailpipe

- -> Align tailpipe so that distance -a- is the same on both sides.
- At the same time, distance -b- must be obtained between bumper cut-out and tailpipe:
 - Dimension b = approx. 30 mm



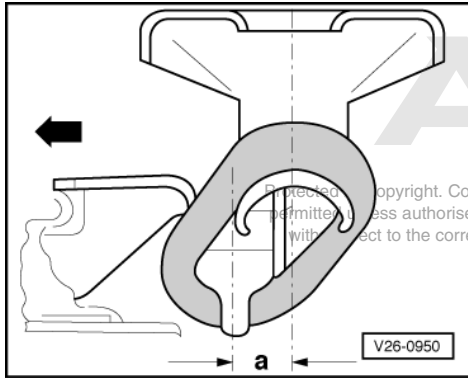
Vehicles with four-wheel drive:

- Vehicles with clamping sleeve between centre silencer and rear silencer

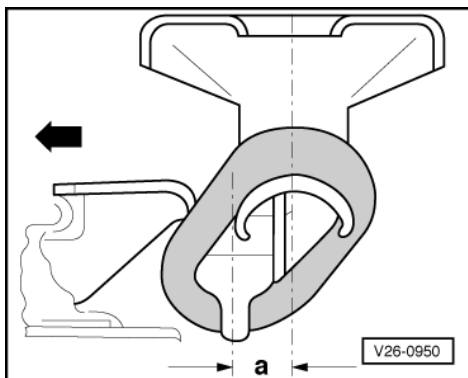
Note:

It is only necessary to additionally align the centre silencer on vehicles with clamp fitted between centre silencer and rear silencer.

- Loosen bolted connections on clamp -Item 159 .
- -> Push exhaust system towards front of vehicle until rear mounting of centre silencer is preloaded by $a = 7...10 \text{ mm}$.
- Tighten bolts on front clamping sleeve -Item 160 evenly to 40 Nm.

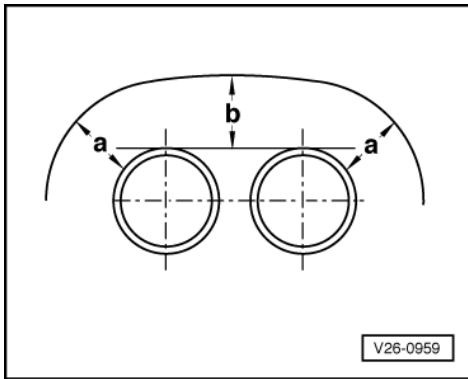


- Note installation position of front clamp
=> Fig. 163
- -> Push rear silencer towards front of vehicle -arrow- until rear mounting on rear silencer is preloaded by $a = 12...14 \text{ mm}$.
- Tighten bolts on rear clamp -Item 159 evenly to 40 Nm.
- Note installation position of front clamp
=> Fig. 163



• Vehicles without clamping sleeve between centre silencer and rear silencer

- Loosen bolted connections on front clamping sleeve -Item 160 .
- -> Push rear silencer towards front of vehicle -arrow- until rear mounting on rear silencer is preloaded by $a = 12...14 \text{ mm}$.
- Tighten bolts on front clamping sleeve -Item 160 evenly to 40 Nm.
- Note installation position of front clamp
=> Fig. 163



Aligning tailpipes

- -> Align tailpipes so that distance -a- is the same on both sides.
- At the same time, distance -b- must be obtained between bumper cut-out and tailpipe:
 - Dimension b = approx. 30 mm

1.8 - Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug the tailpipe(s) (e. g. with rags or stoppers) and leave plugged until leak check is complete.
- Listen for noise at the connection points (cylinder head/manifold; manifold/front exhaust pipe; front exhaust pipe/catalytic converter etc.) to locate any leaks.
- Rectify any leaks that are found.

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