



Audi 100 1991 ➤

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4-cyl. Engine (5-valve), Mechanical Components

Engine ID

ADR

Edition 02.2002

List of Workshop Manual Repair GroupsList of Workshop Manual Repair Groups

Audi 100 1991 ➤

4-cyl. Engine (5-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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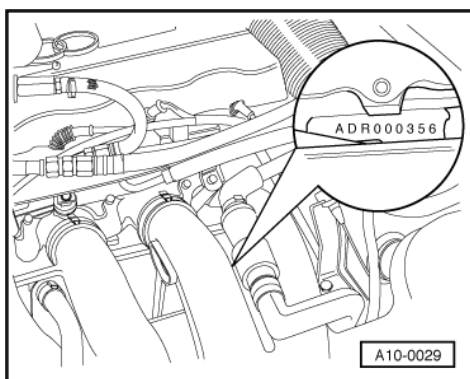
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00 - Technical data

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.

Note:

The engine code is also stamped on the front engine-lifting eye (which is visible when the engine cover panel is removed).

1.3 - Engine data

Code	ADR
Capacity	1.781
Output	92/5800
Torque	168/3500
Bore	81
Stroke	86.4
Compression	10.3
RON	95 unleaded
Injection-/Ignition system	Bosch Motronic
Knock control	yes
Self-diagnosis	yes
Lambda control	yes
Catalytic converter	yes
Turbocharging	no



Code	ADR
Exhaust gas recirculation system	no
Intake manifold changeover	yes
Camshaft timing control	yes

Code	ADR
Valve timing at 1 mm valve lift and 0 mm valve play, camshaft adjuster not active	
Inlet opens after TDC	12°
Inlet closes after BDC	34°
Exhaust opens before BDC	38°
Exhaust closes before TDC	8°

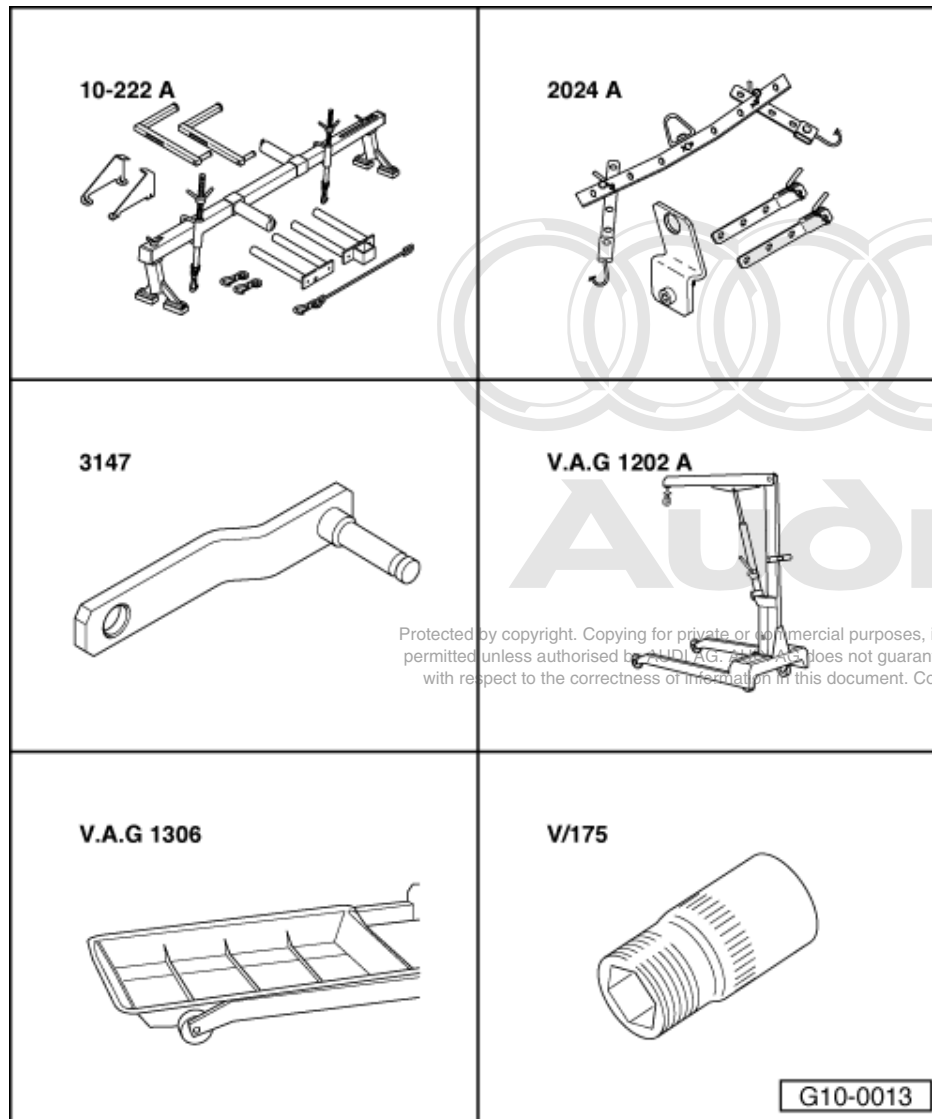


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10 - Removing and installing engine

1 - Removing and installing engine

1.1 - Removing and installing engine



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Special tools and workshop equipment required

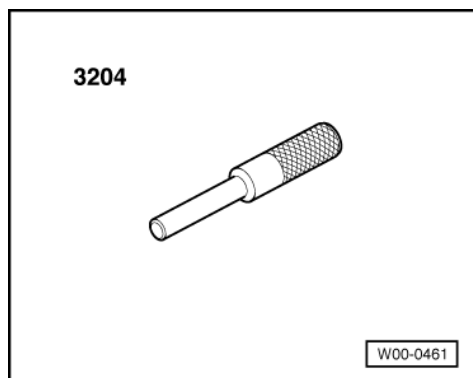
- ♦ Support bar 10-222 A with 10-222 A/2
- ♦ Lifting tackle 2024 A
- ♦ Gearbox support 3147
- ♦ V.A.G 1202 A

or

- ♦ Workshop crane VAS 6100
- ♦ Drip tray V.A.G 1306



- ♦ 15 mm socket insert Matra V/175 (on vehicles with automatic gearbox)



- ♦ Mandrel 3204

1.2 - Removing

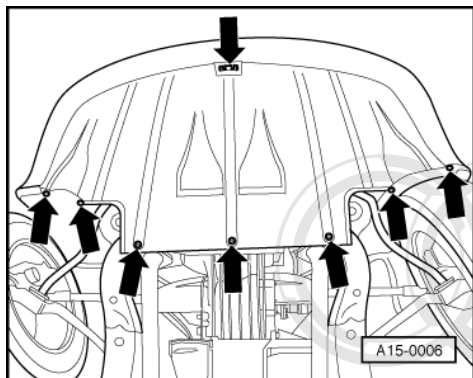
Notes:

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

Important

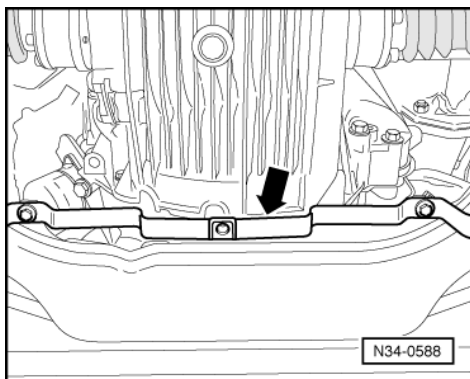
Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

- Open the cover of the coolant expansion tank

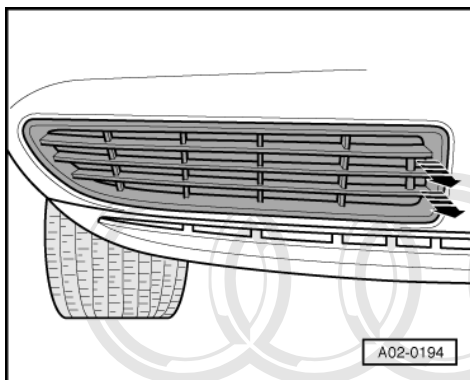


- -> Remove the noise insulation -arrows-.

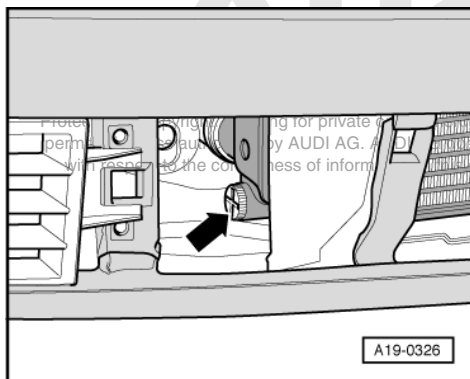
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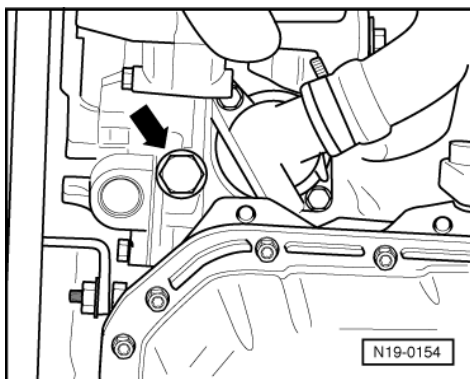
- -> Unbolt bracket for noise insulation -arrow-.



- -> Pull back retainer catch -arrows- and remove air intake grille.

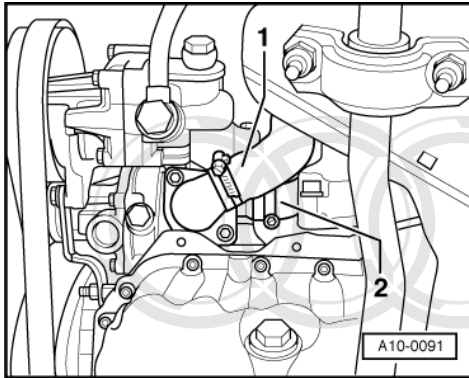


- Place drip tray V.A.G 1306 below engine.
- -> Turn drain plug -arrow- on radiator anti-clockwise. If necessary, fit drain hose on connection.

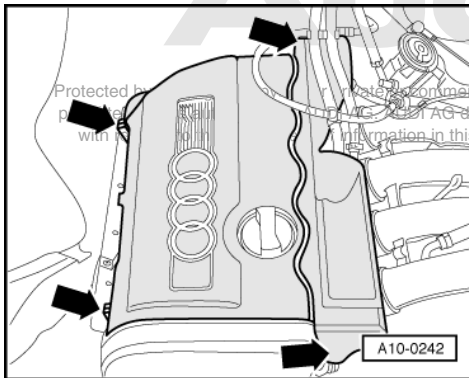




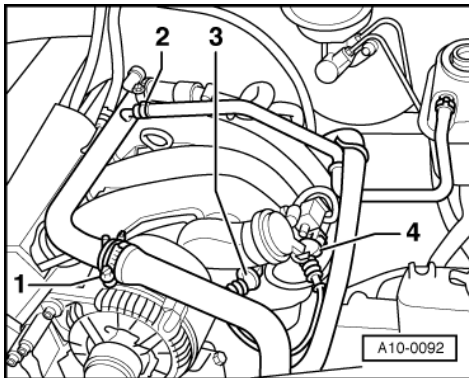
- -> Also open the drain plug -arrow- on bearing housing of coolant pump.



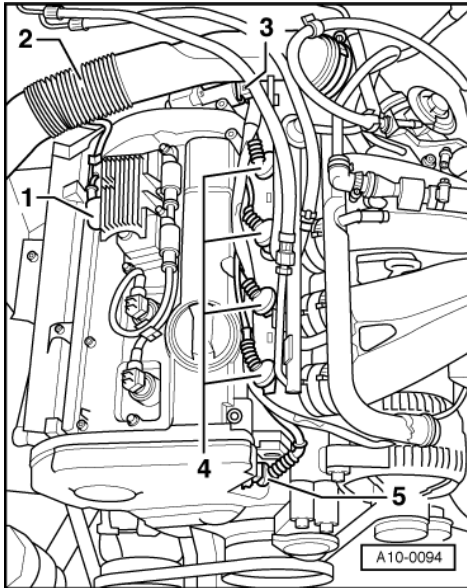
- -> Remove coolant hose -1- to radiator from thermostat housing.



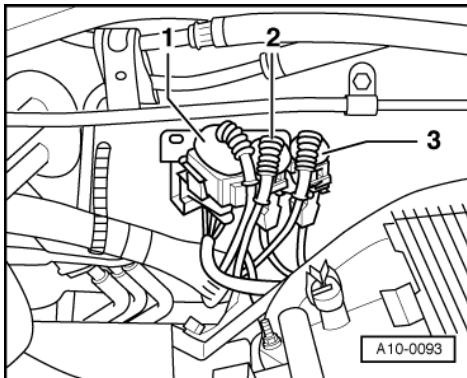
- -> Remove engine cover panels -arrows-.



- -> Disconnect top coolant hose -1- leading to radiator from coolant pipe.
- Cut through cable ties at top of coolant hose.
- Detach connector at intake air temperature sender -G42 -Item 3- and at solenoid valve for intake manifold changeover -Item 4-.
- Disconnect coolant hose -2- leading to expansion tank at coolant pipe at top.

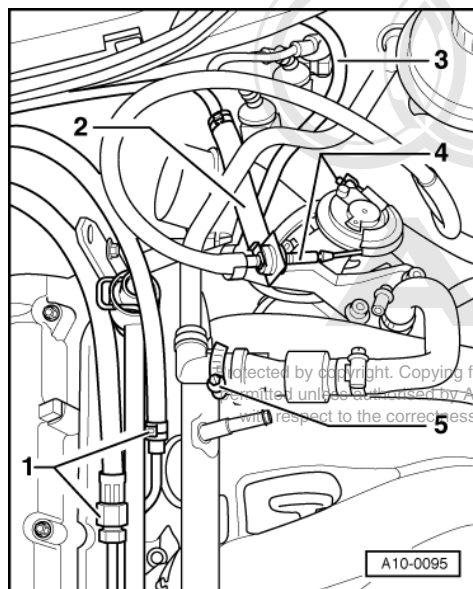


- -> Remove air duct -2-.
- Unplug the connectors at:
 - 1 - Ignition coil with power end stage -N70 and -N127 (additionally unscrew earth cable)
 - 3 - Camshaft adjuster valve -N205
 - 4 - Injectors -N30 ... -N33
 - 5 - Hall sender -G40
 - both temperature senders on back of cylinder head (2nd sender is only fitted on vehicles with AC)
 - Throttle valve control unit -J338
- Pull blue 1-pin connector leading to alternator warning lamp out of bracket of coolant pipe (rear) and detach.
- Loosen cable tie and lay wiring aside to the rear.



- -> Unplug connectors -1 ... 3- from retainer at right of bulkhead.
- Unplug connectors:
 - 1 - Black connector for Lambda probe -G39
 - 2 - Green connector for knock sensor 1 -G61
 - 3 - Blue connector for knock sensor 2 -G66

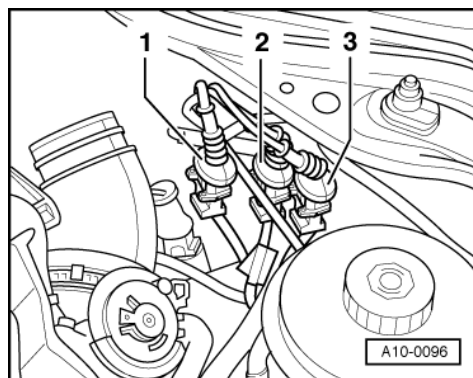
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Important

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

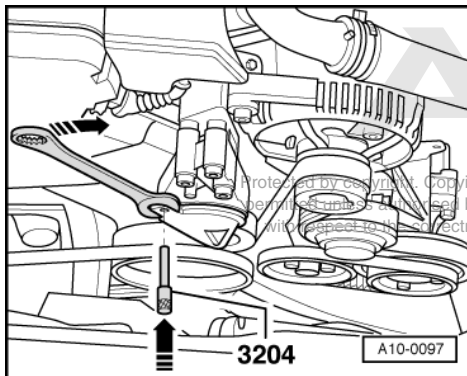
- -> Disconnect fuel supply and return lines -1-.
- Detach the throttle cable from throttle valve control unit and resistance bearing -arrows- (do not remove retainer).
- Disconnect the following vacuum pipes:
 - 2 - to solenoid valve 1 for activated charcoal filter -N80
 - 3 - to AC
 - 5 - to servo unit



- -> Unplug connectors -1 ... 3- from retainer at left of bulkhead.
- Unplug connectors:
 - 1 - Black connector for earth as well as for oil pressure switch and speedometer sender
 - 2 - Brown connector for oil temperature sender -G8
 - 3 - Grey connector for engine speed sender -G28
- Disconnect both coolant hoses from heating system heat exchanger.
 - At the supply hose, lift retainer with screwdriver and detach hose.
 - Return hose: Release clamp.
- Unplug connector at speedometer sender on left of gearbox, set wiring aside.

Vehicles with manual gearbox:

- Unplug connector for reversing light switch on gearbox.

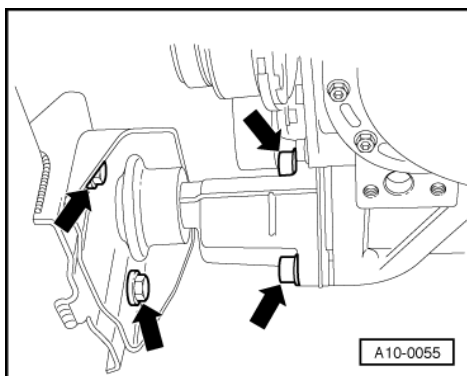


All models:

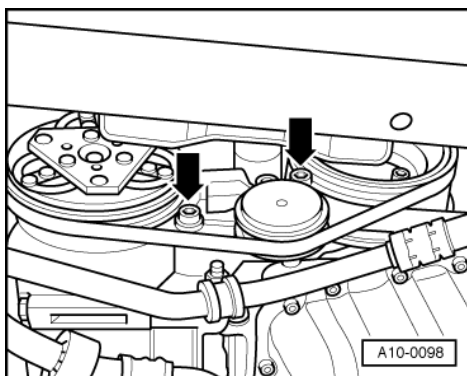
Note:

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.

- -> Swivel the ribbed belt tensioner for vane pump and alternator for releasing tension of ribbed belt in direction of arrow using open-ended wrench.
- Lock tensioner by inserting mandrel 3204 into holes -arrow at bottom-.
- Remove ribbed belt.
- Remove pin 3204.



- -> Unbolt torque reaction support from engine and cross member -arrows-.



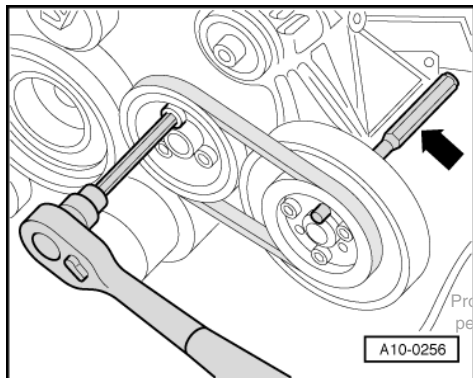


Vehicles with air conditioner:

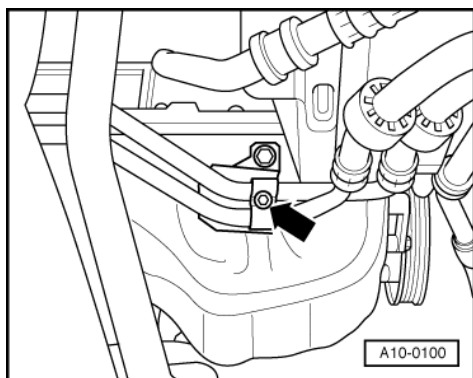
Note:

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.

- -> Loosen bolts securing ribbed belt tensioning roller for A/C compressor -arrows-. Slacken belt and remove.

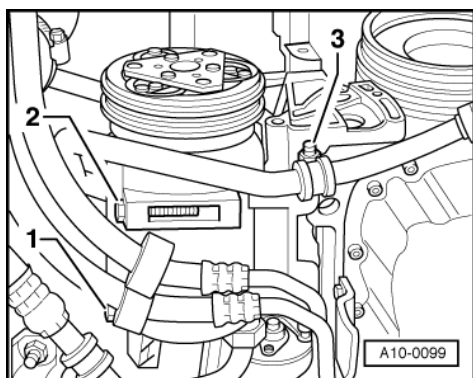


- -> Unscrew pulley for coolant pump. To prevent pulleys from turning, insert a pin -arrow- in the vane pump pulley.
- Remove V-belt.
- Unscrew pulleys from power steering vane pump.
- Unbolt power steering vane pump and set aside. Do not detach hydraulic connections.



Vehicles with automatic gearbox:

- -> Unscrew bracket -arrow- for ATF line at engine oil sump.



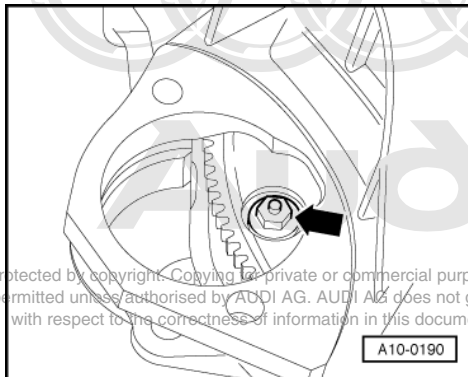
Vehicles with air conditioner:

Important
The air conditioner refrigerant circuit must not be opened.

- -> Unscrew the line bracket -3- for refrigerant line.
- Detach connector for solenoid clutch at air conditioner.
- Unscrew air conditioning compressor (4 bolts -Item 1- and -Item 2-) and suspend to the side together with the connected refrigerant hoses.

All models:

- Unscrew earth wire at longitudinal carrier on right.
- Disconnect wiring on starter motor and remove starter motor.



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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.

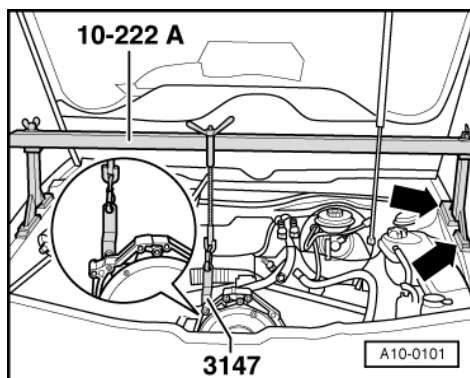
All models:

- Screw exhaust pipe off exhaust manifold and press to rear.
- Vehicles with four-wheel drive: Unscrew exhaust system bracket from gearbox.

Note:

The isolating element in front exhaust pipe must not be deflected more than 10° to avoid damage.

- Unscrew engine/gearbox securing bolts. Leave one bolt in place at top (hand tight).
- Unscrew nuts of engine bearing on left and right.

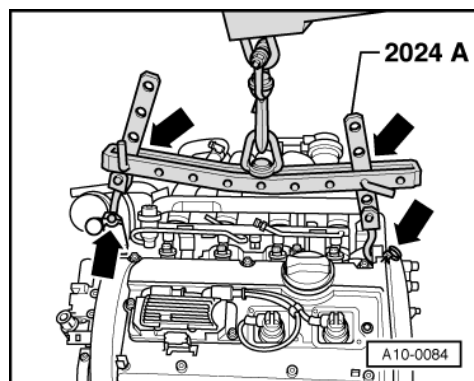




- -> Set up support bar 10-222 A behind gas pressure spring onto wing bolt edge. Spindle is at front.
- Engage gearbox support 3147 in the top right bolt hole on the bell housing as shown in the illustration.

Notes:

- ♦ Illustration shows a vehicle with automatic gearbox with engine removed.
- ♦ Height of gearbox can be adjusted using wing nut of attachment hook.
- ♦ Take care not to excessively pretension as otherwise pressure pipe to clutch operating cylinder at manual gearbox could be damaged.



- -> 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-.

- Lift engine over studs of engine mounts.
- Tighten spindle of support bar 10-222 A.
- Remove the remaining bolt connecting the engine to the gearbox.

Note:

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

Vehicles with automatic gearbox:

- Press gearbox off engine. At the same time, press torque converter off the drive plate.

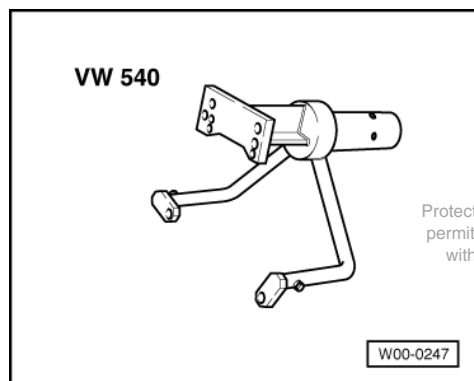
All models:

- Pull engine from gearbox and raise it until arm of workshop crane is just below the bonnet.
- Guide the engine carefully while lifting it to avoid damaging bonnet, radiator and lock carrier.

Vehicles with automatic gearbox:

- If necessary, secure torque converter in gearbox with wire to prevent it falling out.

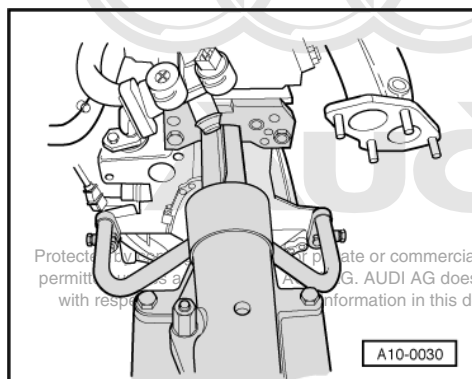
1.3 - Attaching engine to repair stand



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Special tools and workshop equipment required

- ♦ Engine and gearbox support VW 540



Procedure

- -> For work on the engine, attach engine to repair stand using engine mount VW 540 and special tool VW 540/1.

1.4 - Installing

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

Notes:

- ♦ When installing the engine all cable ties must be fitted in the same position.
- ♦ Secure all hose connections with the correct hose clamps (same as original equipment):

=> Parts List

- ♦ When performing installation procedures always replace self-locking nuts and bolts.
- ♦ Replace seals, gaskets, and bolts which have a specified tightening angle.
- Check whether the dowel sleeves for centralising engine/gearbox are in the cylinder block, install if necessary.
- Fit intermediate plate onto dowel sleeves.

Vehicles with manual gearbox:

- Clean input shaft splines and (in the case of used clutch plates) the hub splines. Remove corrosion and apply only a very thin coating of grease G 000 100 to the splines. Do not grease guide sleeve.
- Check clutch release bearing for wear, replace if necessary.
- If necessary, check that clutch plate is properly centred.
- A needle bearing must be fitted in the crankshaft on vehicles with manual gearbox. Install needle bearing, if necessary => Page 58 .

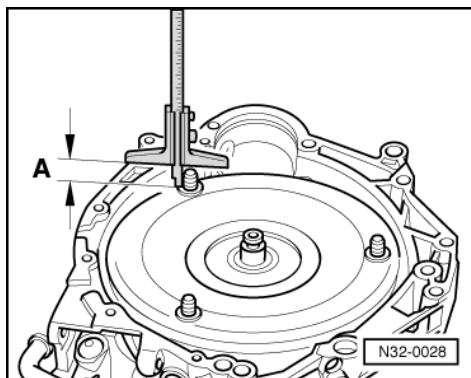
Vehicles with automatic gearbox:

- In vehicles with automatic gearbox, no needle bearing must be fitted in the crankshaft. Remove needle bearing if necessary => Page 58 .
- 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.



Checking position of torque converter

-> If the torque converter has been fitted correctly, the distance -A- between the contact surfaces at the base of the studs on the torque converter should be 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 joined to the engine.

All models:

- Before installing engine, place rubber covers for engine mounting in installation position.
- Installing engine mounts free of stress. Ensure that engine mounts are free of stress by shaking engine to align it before tightening engine mounts.
- Check throttle cable setting

=> Fuel Supply - Petrol Engines; Repair group 20

- Install ribbed belt =>Page 32 .
- Stress-free alignment of exhaust system => Page 169
- Top up coolant => Page 143 .

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.

- Electrical connections and routing:

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

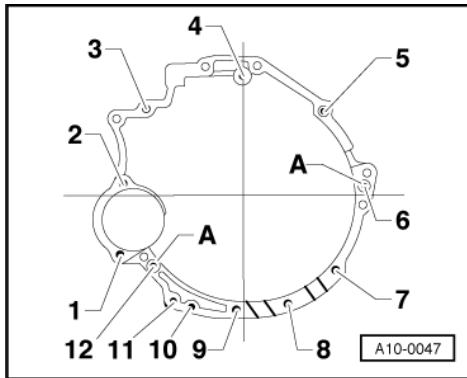
Notes:

- ♦ When the battery is reconnected make sure that the vehicle equipment (radio, clock, electrical window lifter) is activated according to the operating instructions.
- ♦ Further measures after reconnection of voltage supply:

=> Motronic Injection and Ignition System (4-cylinder, 5-valve); Repair group 24

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

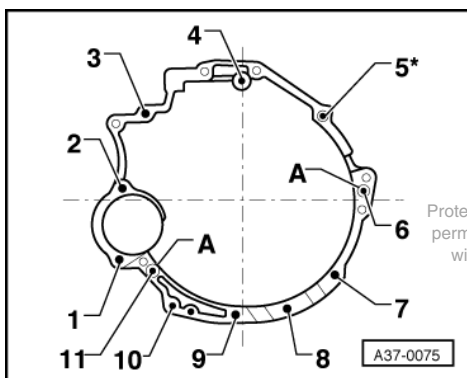
- Check oil level before starting engine.



-> Engine/gearbox mountings (manual gearbox)

Item	Bolt	Nm
1, 3, 4	M12 x 67	65
2	M12 x 80	65
5, 6	M12 x 90	65
7	M10 x 50	45
8, 11	M8 x 32	25
9	M10 x 30	45
10	M10 x 45	45
12	M12 x 100	65

A: Centring sleeves



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-> Fastening engine to gearbox in vehicles with automatic gearbox

Item	Bolt	Nm
1	M12 x 50	65
2, 3, 4, 11	M12 x 67	65
5, 6	M12 x 90	65
7...10	M10 x 45	45

A: Centring sleeves

Component		Nm
Bolts/nuts	M6	10
	M8	20
	M10	45
	M12	65



Component	Nm
Except for the following:	
Drain plug to coolant pump	30
Front exhaust pipe to exhaust manifold	25
A/C compressor to bracket	25
Drive plate to Torque converter M10 x1	85
Power steering pump to retainer	25
Alternator to mounting M8 1)	35
Hose clamps	2

- 1) Bolt strength rating 10.9

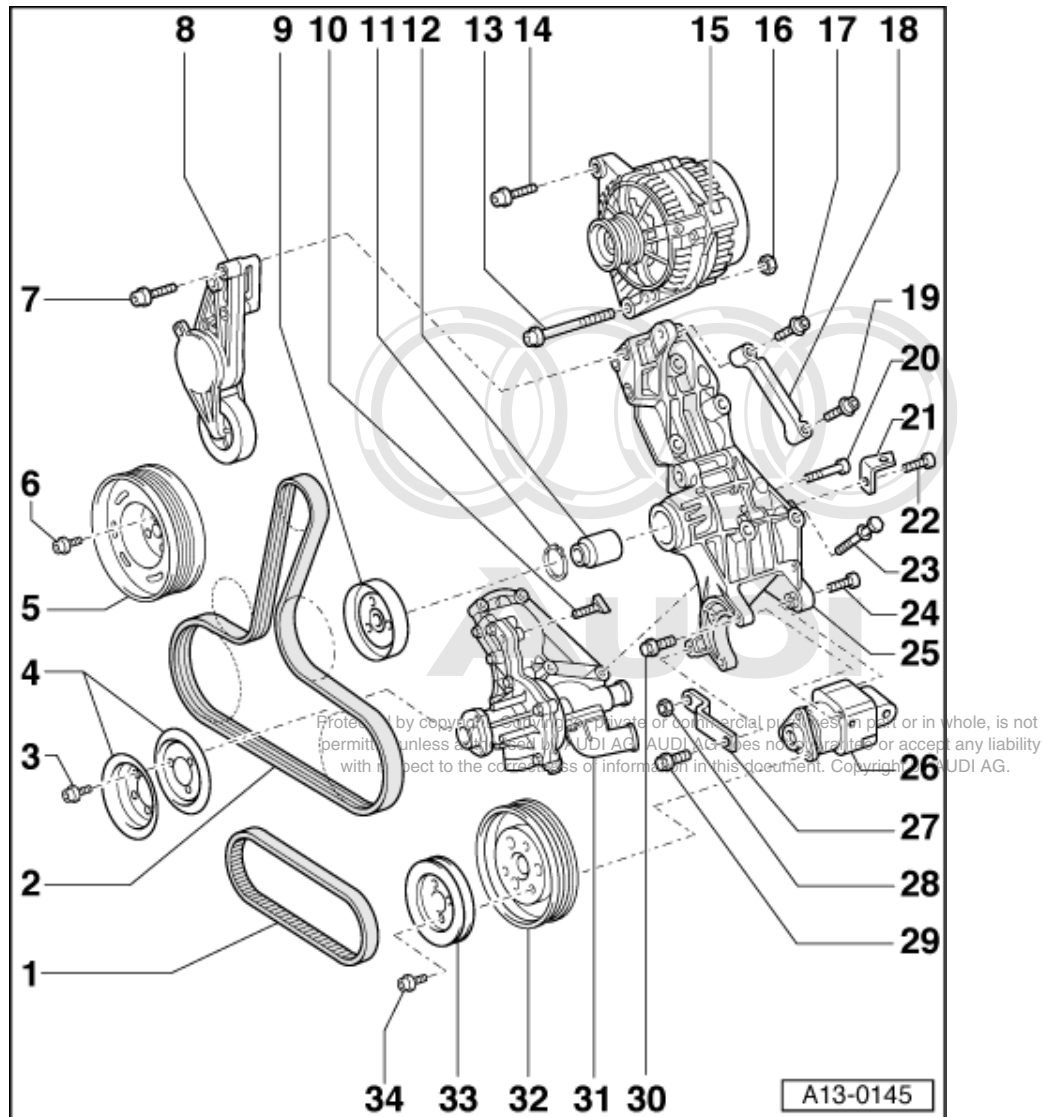


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13 - Crankshaft group

1 - Dismantling and assembling engine

1.1 - Dismantling and assembling engine



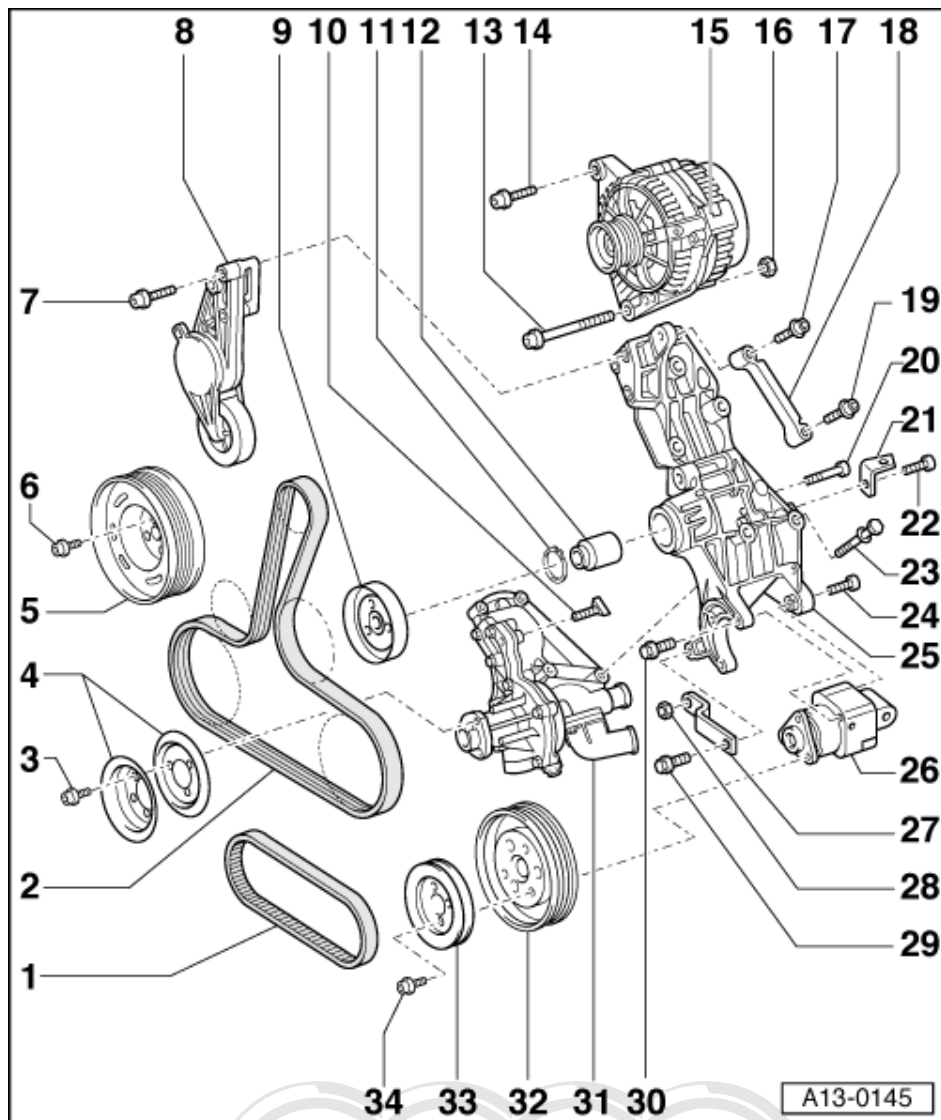
1.2 - Ribbed belt drive for vane pump, alternator and idler wheel; V-belt drive for coolant pump

Note:

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. Ensure that the belt is properly seated in the pulleys when installing.

1 V-belt

- ♦ For coolant pump
- ♦ Removing and installing
=>Page 32



2 Ribbed belt

- ♦ Removing and installing
=>Page 30
- ♦ Check for wear
- ♦ Do not kink

3 25 Nm

4 Belt pulley

- ♦ For coolant pump
- ♦ V-belt version
- ♦ Installation position: Flat section of pulley pin to -Item 31 -

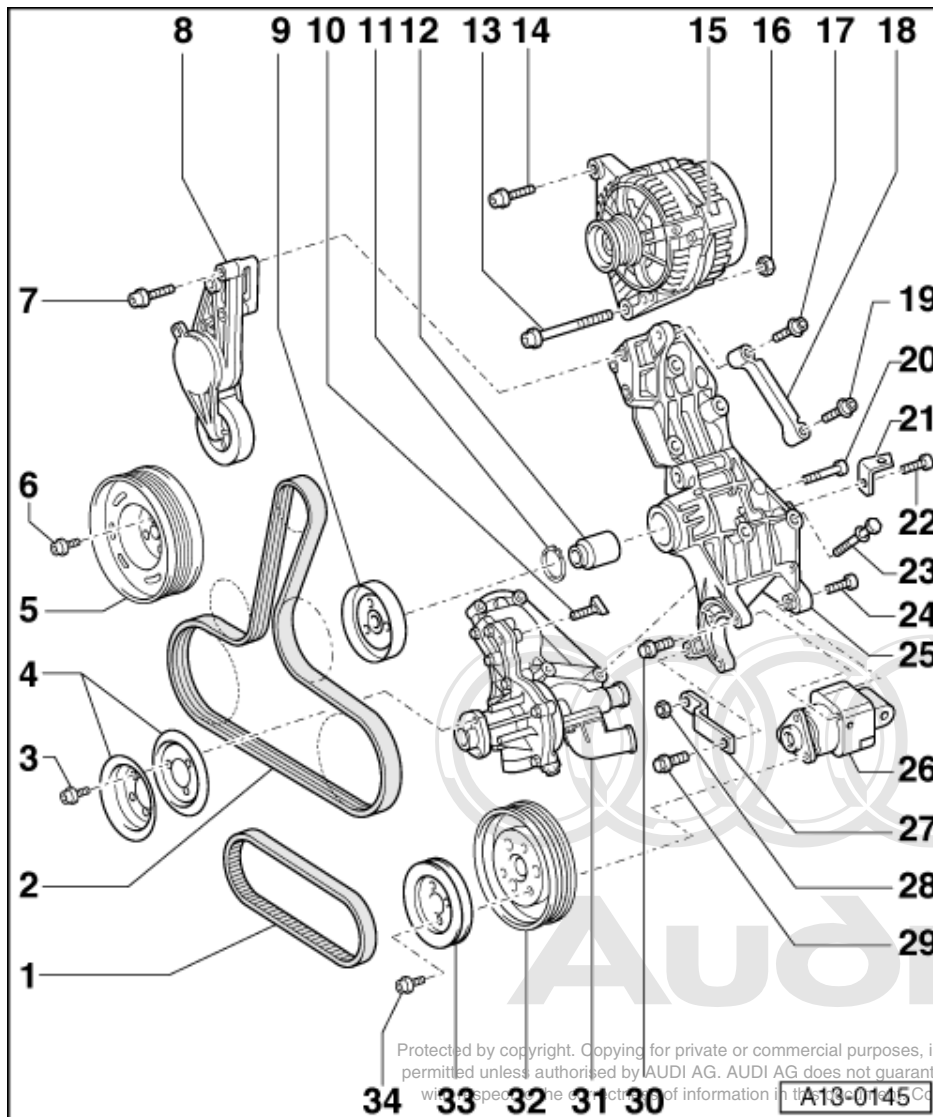
5 Vibration damper

- ♦ With pulley for ribbed belt
- ♦ Can only be installed in one position => Fig. 29

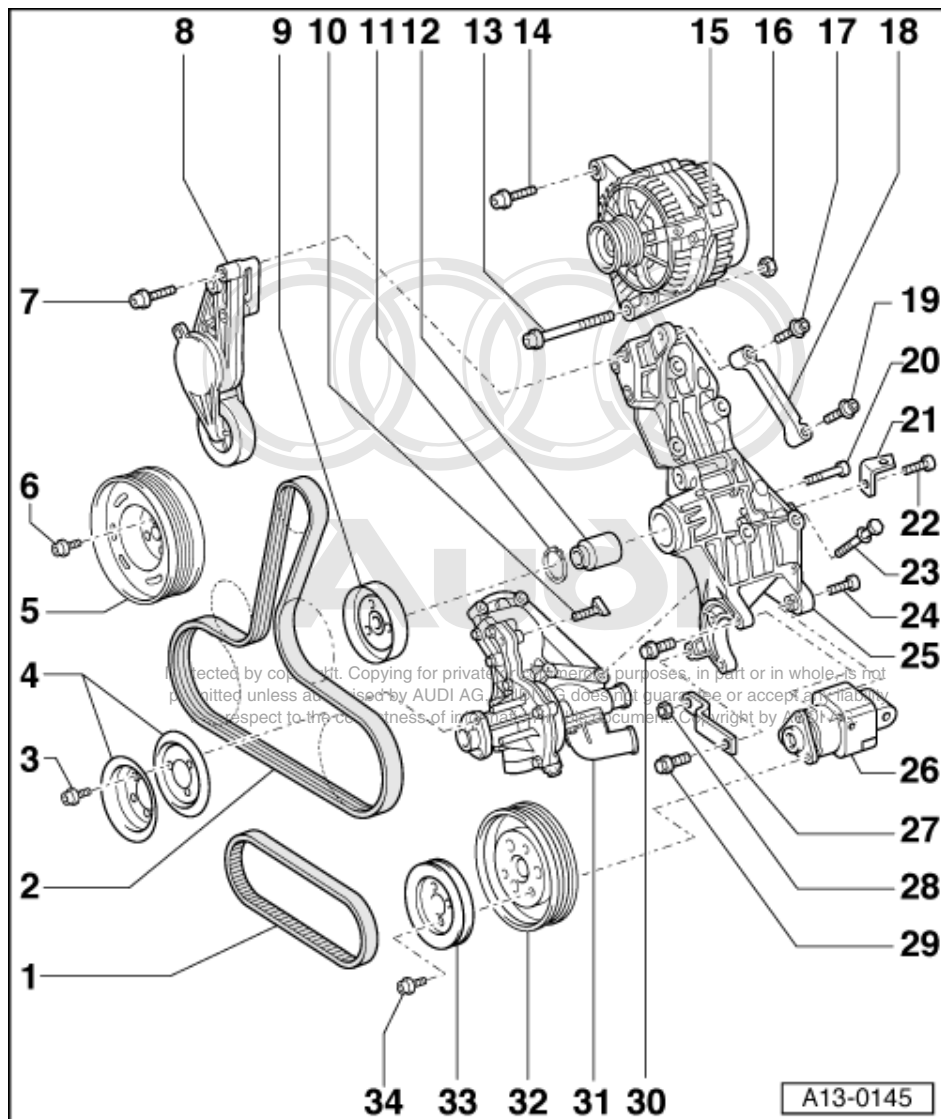
6 Bolt (special type)

- ♦ Tighten to 40 Nm
- ♦ Use only correct bolts (same as original equipment); strength rating 10.9.

=> Parts List



- 7 25 Nm
- 8 **Tensioner for ribbed belt**
 - ♦ Swivel with open-ended spanner to slacken ribbed belt => Page 30 .
- 9 **Idler roller**
 - ♦ Removing and installing => Fig. 29
- 10 **Hammer head bolt**
 - ♦ Insert vane pump and idler wheel before installing retainer for alternator
- 11 **Circlip**
 - ♦ For bearing for idler wheel
 - ♦ Removing and installing=>Page 34
- 12 **Mounting**
 - ♦ For idler wheel
 - ♦ Removing and installing=>Page 34

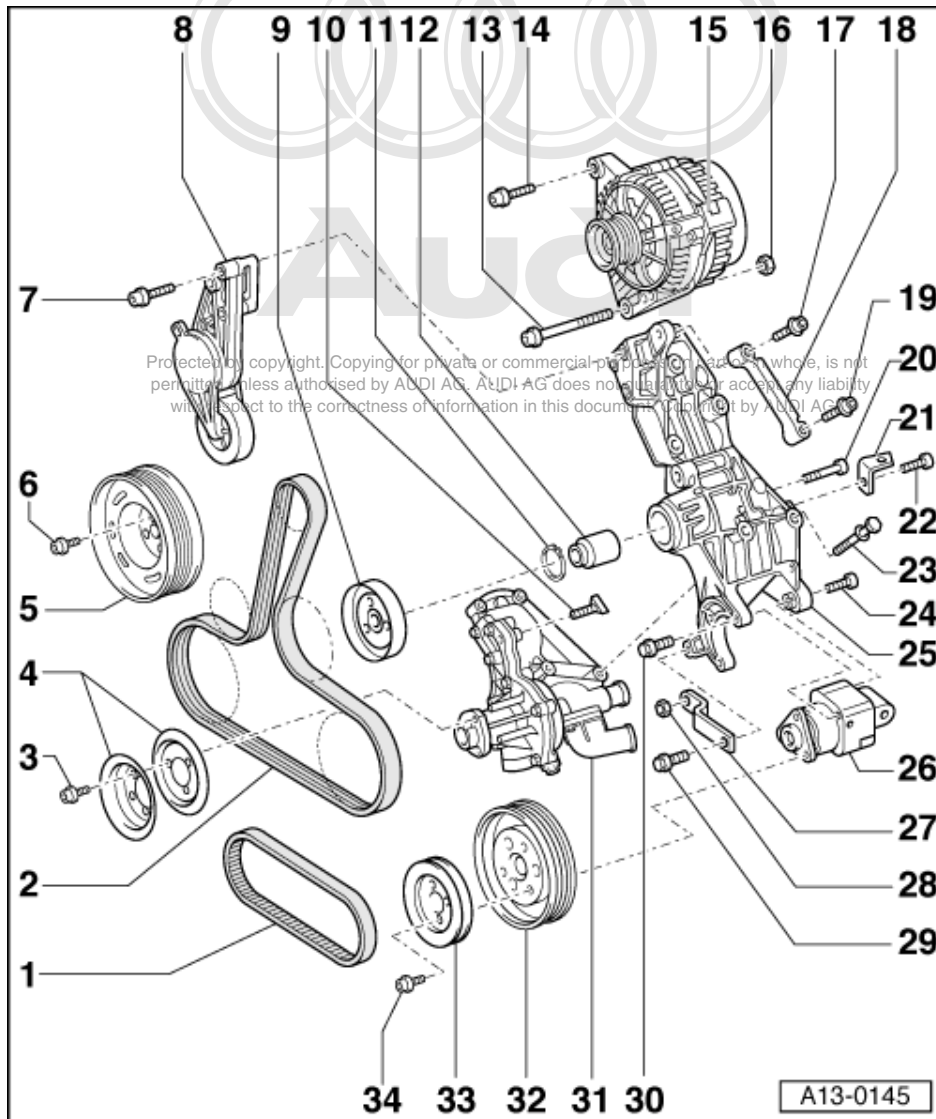


13 40 Nm

14 25 Nm

15 Alternator

- ◆ Removing:
 - Disconnect battery earth strap
 - Removing ribbed belt =>Page 30 .
 - Slacken mountings at top and bottom at the alternator.
 - Remove alternator, unscrew lines.
- ◆ To facilitate attachment of the alternator drive back bush for lower securing bolt slightly at bracket



16 40 Nm

17 Bolt M10

- ♦ Tighten to 40 Nm

18 Brace

- ♦ To cylinder block

19 25 Nm

20 45 Nm

- ♦ Removing and installing idler wheel => Fig. 29

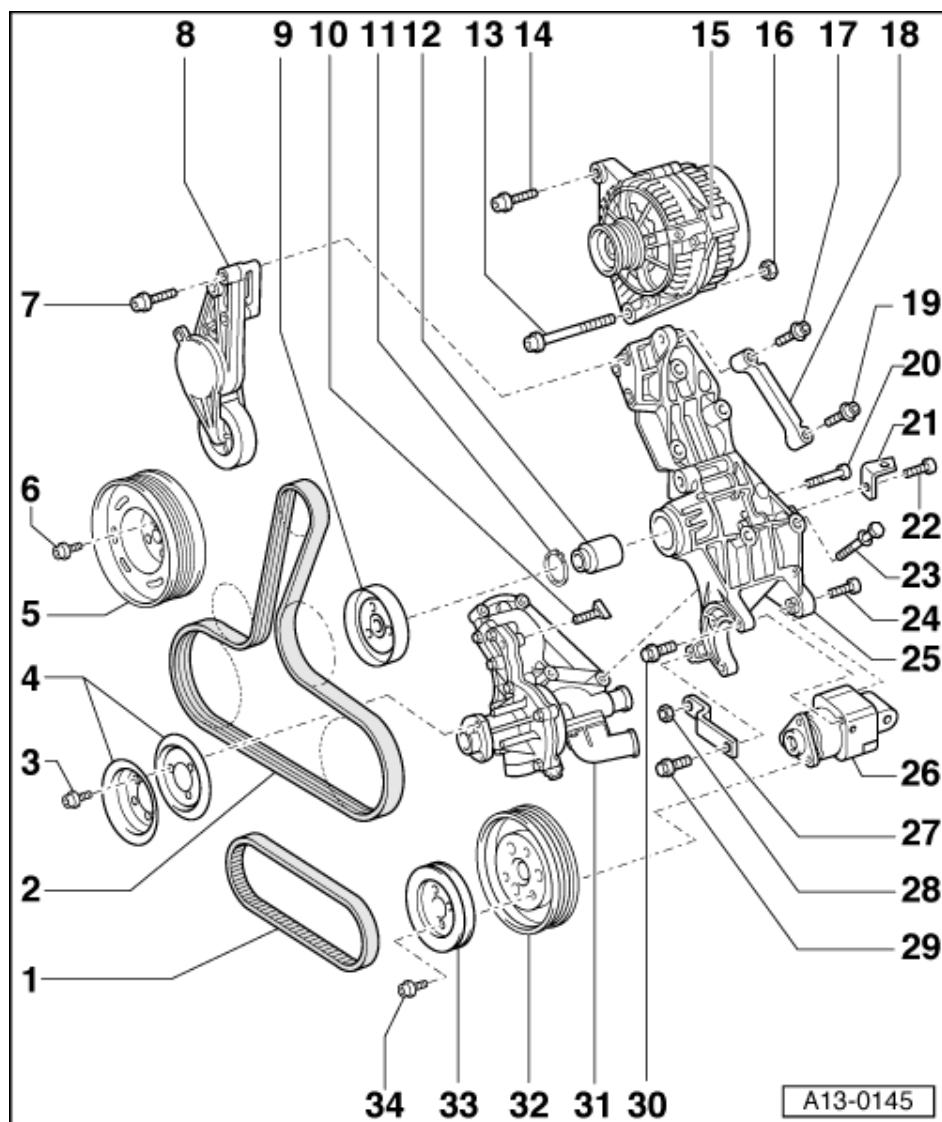
21 Support

- ♦ For intake manifold

22 20 Nm

23 25 Nm

- ♦ Bolts have different lengths. Allocation and tightening sequence => Page 148



24 25 Nm

25 Bracket

- ♦ For alternator, vane pump and idler wheel
- ♦ Removing and installing
=>Page 29.

26 Vane pump

- ♦ For power steering and brake servo

27 Bracket

28 25 Nm

29 20 Nm

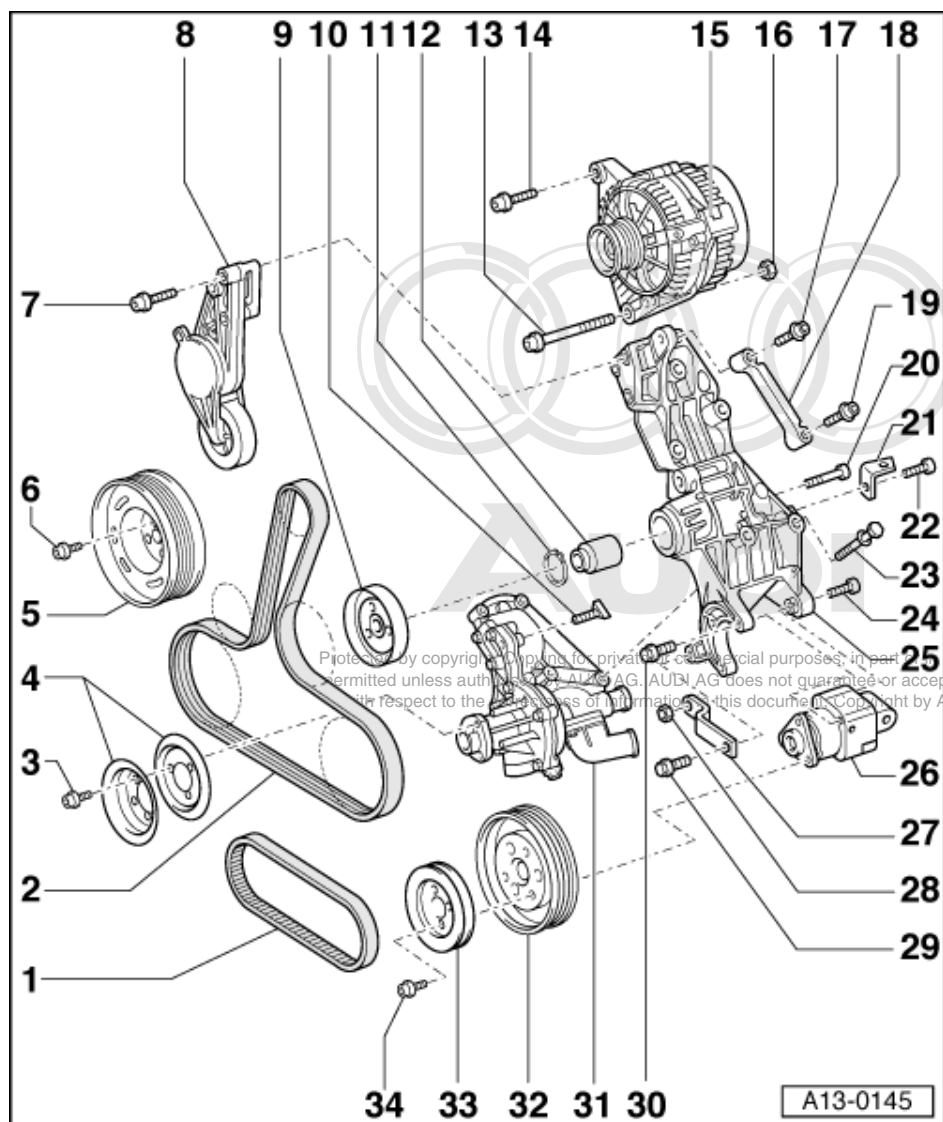
30 25 Nm

31 Coolant pump

- ♦ With thermostat
- ♦ Removing and installing=>Page 146



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32 Belt pulley

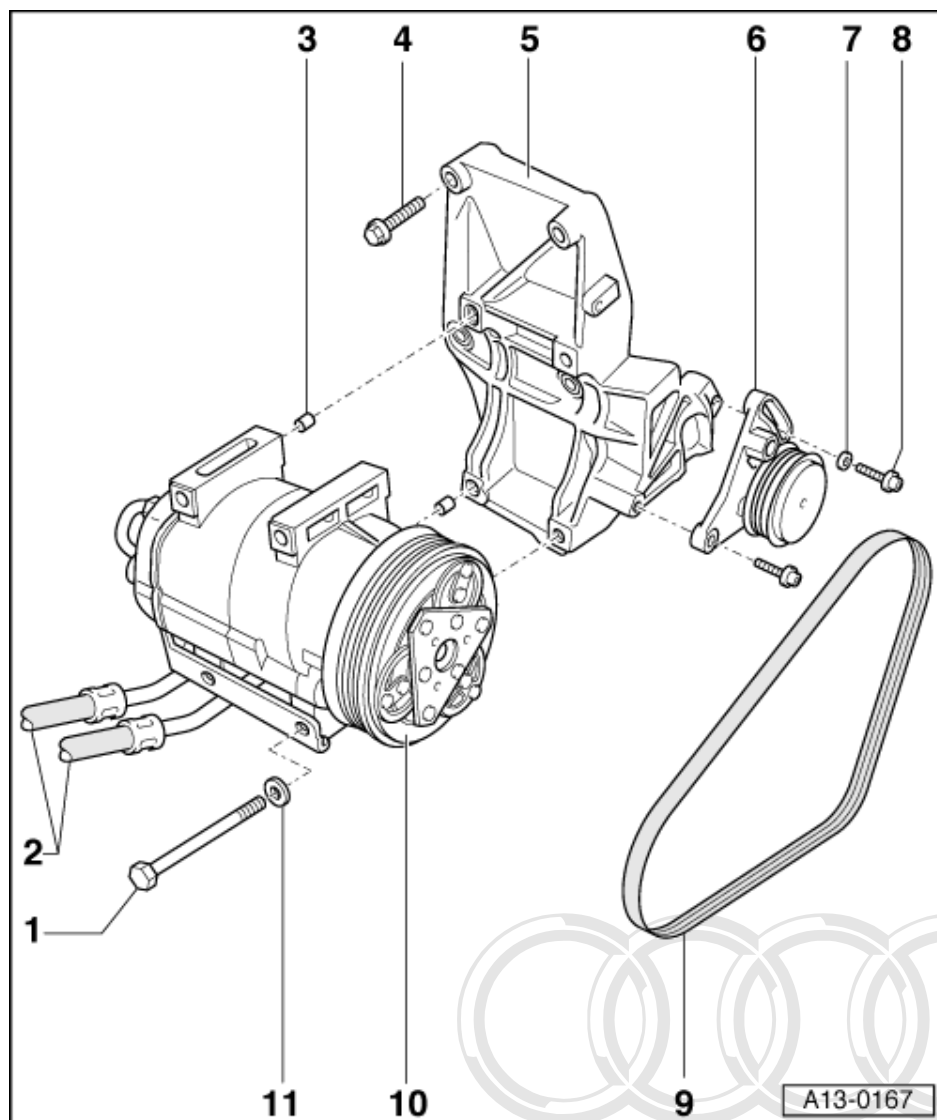
- ◆ For vane pump
- ◆ Ribbed belt version
- ◆ Installation position: Open side faces to front of vehicle

33 Belt pulley

- ◆ For vane pump
- ◆ V-belt version

34 25 Nm

1.3 - Ribbed belt drive for air conditioner



Important

The air conditioner refrigerant circuit must not be opened.

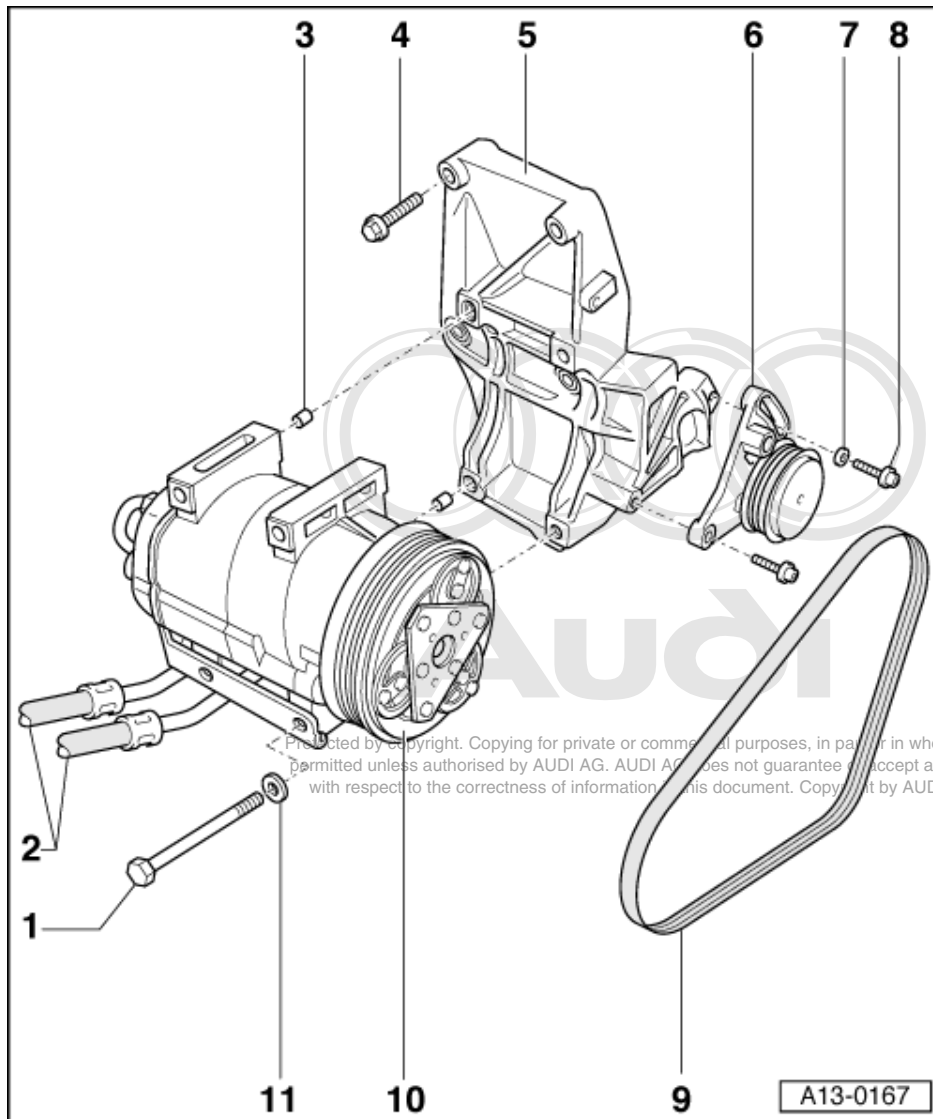
Note:

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. Ensure that the belt is properly seated in the pulleys when installing.

1 25 Nm

2 Refrigerant pipes

- ♦ Do not unscrew or disconnect pipes.



3 Dowel sleeve

- ♦ Check sleeve is correctly seated in retainer.

4 Bolt

- ♦ Bolt with strength rating 8.8: tighten to 25 Nm.
- ♦ Bolt with strength rating 10.9: tighten to 30 Nm.

=> Parts List

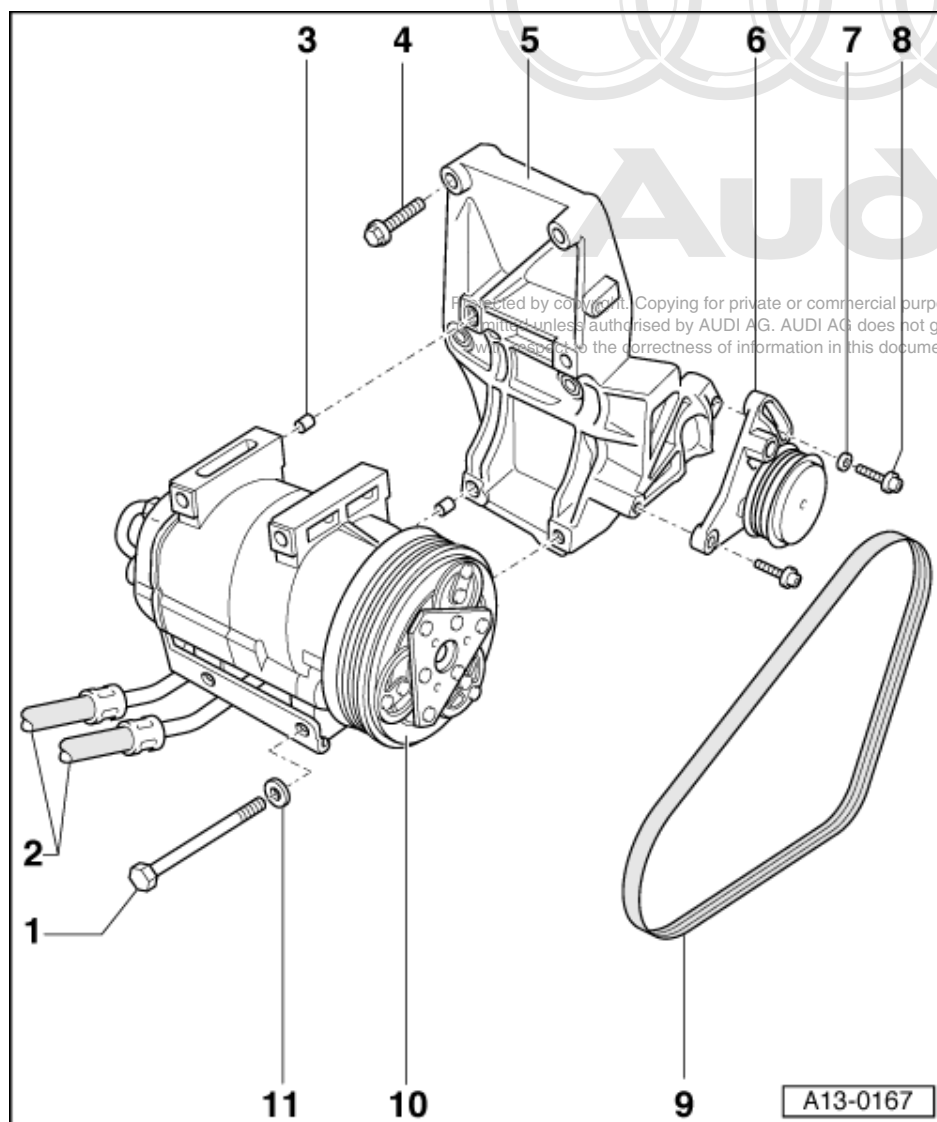
5 Bracket

- ♦ For A/C compressor

6 Tensioning roller

- ♦ For ribbed belt
- ♦ Removing and installing ribbed belt => Page 30

7 Washer



8 20 Nm

9 Ribbed belt

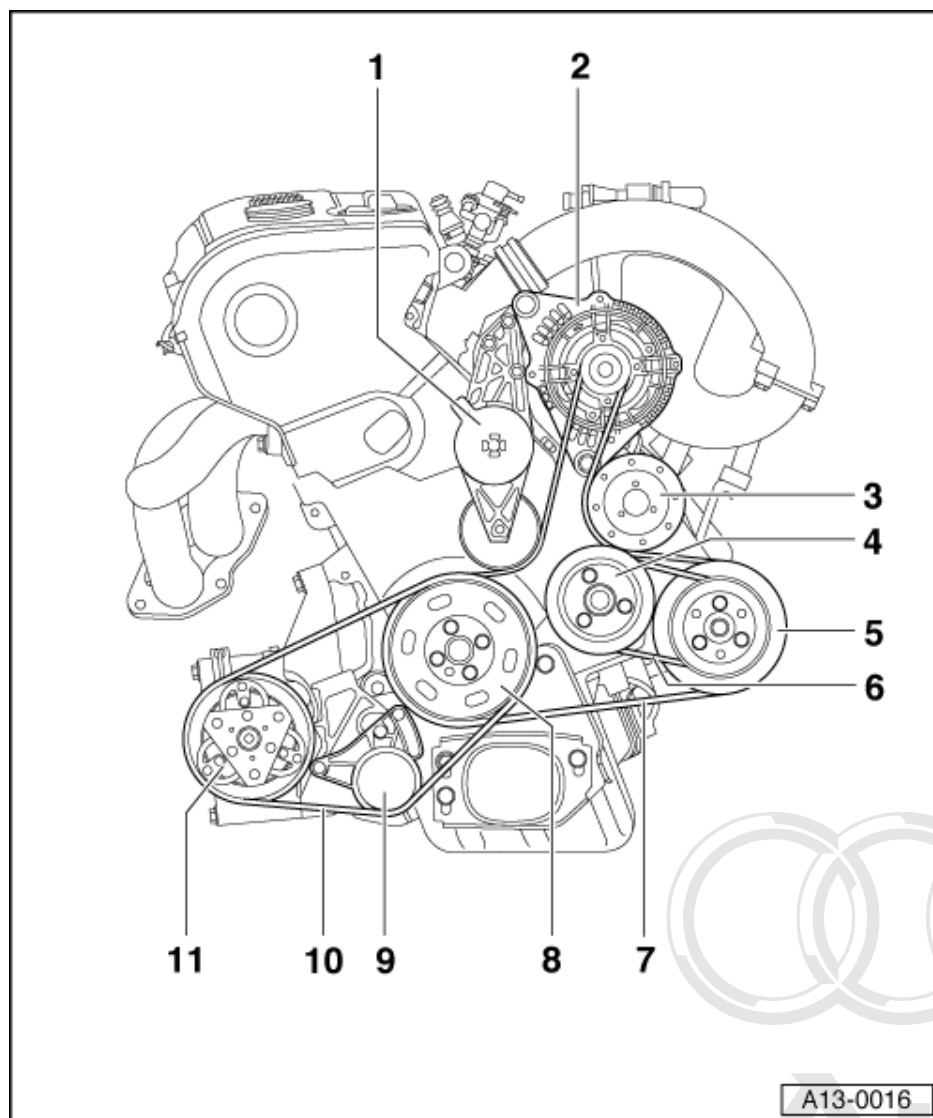
- ♦ Removing and installing
=>Page 30.
- ♦ Check for wear

10 Air conditioner compressor

- ♦ After removing compressor from mountings, secure to chassis side member with wire or similar. Do not leave compressor suspended on refrigerant hoses.
- ♦ Do not unscrew or disconnect refrigerant hoses or pipes.

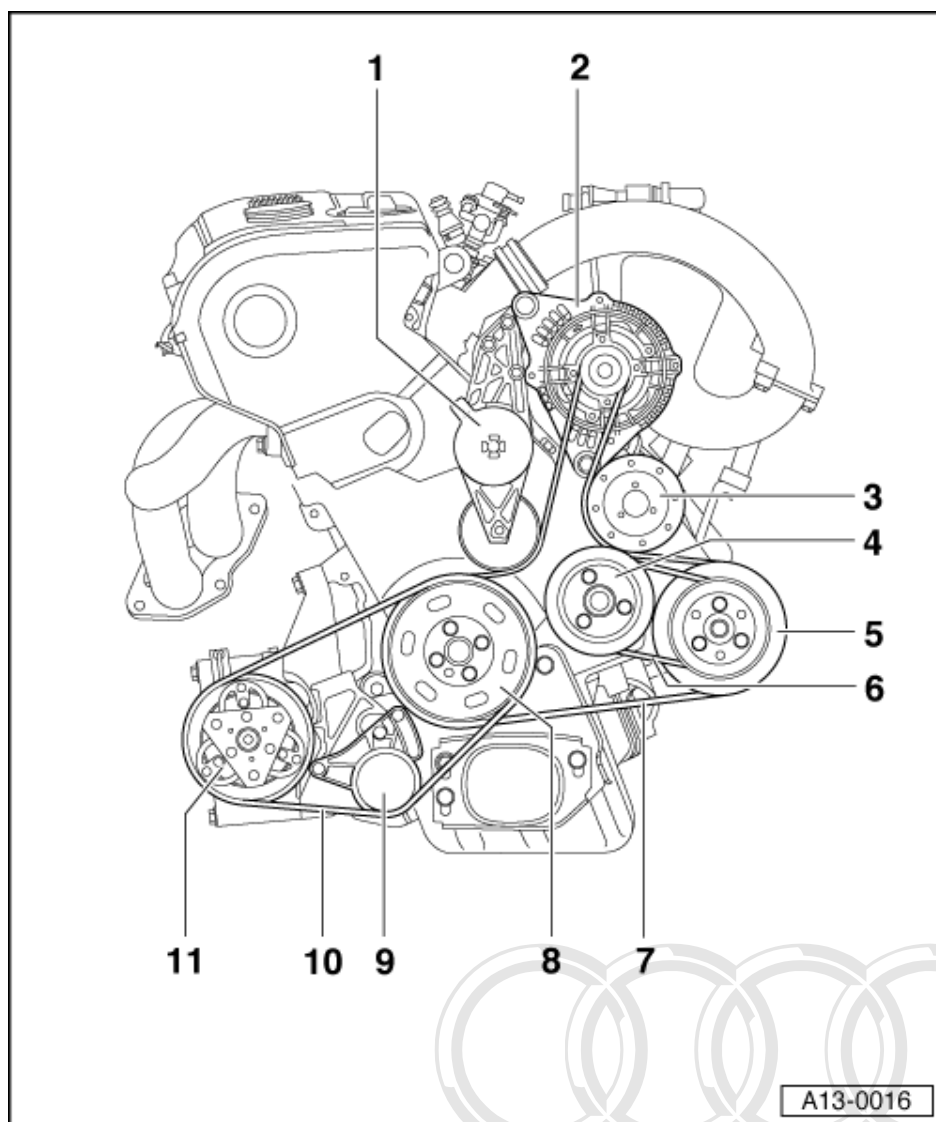
11 Washer

1.4 - Routing of V-belt and ribbed belt



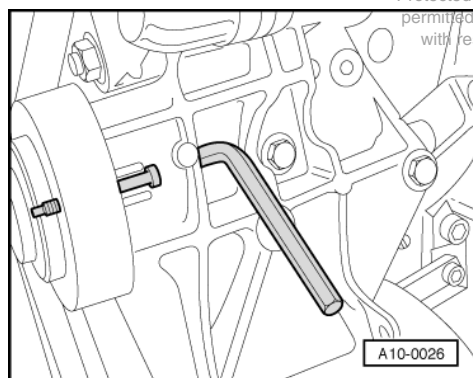
- 1 Tensioner for ribbed belt
- 2 Alternator
- 3 Idler roller
- 4 Coolant pump
- 5 Vane pump
- 6 V-belts
 - ♦ For coolant pump
- 7 Ribbed belt
 - ♦ For alternator and vane pump

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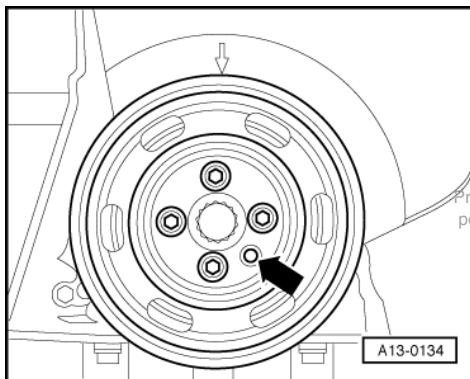
- 8 Vibration damper
- 9 Tensioner for ribbed belt
 - ♦ For A/C compressor
- 10 Ribbed belt
 - ♦ For A/C compressor
- 11 Air conditioner compressor

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-> Fig.1 Removing and installing idler wheel

- Ribbed belt must be slackened => Page 31 .
- Secure idler wheel with M5 x 60 mm bolt and unscrew with Allen key.
- Remove idler wheel.
- Tighten idler wheel to 45 Nm.



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-> Fig.2 Installing vibration damper

- Ribbed belt must be removed =>Page 30 .
- When installing vibration damper, use only correct bolts (strength rating 10.9, same as original equipment):

=> Parts List

- Can only be installed in one position. The hole -arrow- in the vibration damper must fit over the projection on the toothed belt sprocket.
- Tighten bolts for vibration damper to 40 Nm.

1.5 - Removing and installing retainer for alternator, vane pump (power steering) and idler wheel

Removing

- Observe or obtain radio code on vehicles with coded radio.
- Disconnect earth strap at battery with ignition switched off.
- Remove ribbed belt and tensioner for ribbed belt => Page 30 .

Note:

Ribbed belt for air conditioner does not have to be removed.

- Remove V-belt => Page 32
- Unbolt pulley from vane pump for power steering.
- Unscrew power steering vane pump from retainer for alternator, vane pump and idler wheel and tie up to one side. Do not detach hydraulic connections.
- Perform all steps listed under "Removing and installing coolant pump" => Page 146 .

Note:

Coolant pump is bolted to retainer for alternator, power steering vane pump and idler wheel.

Installing

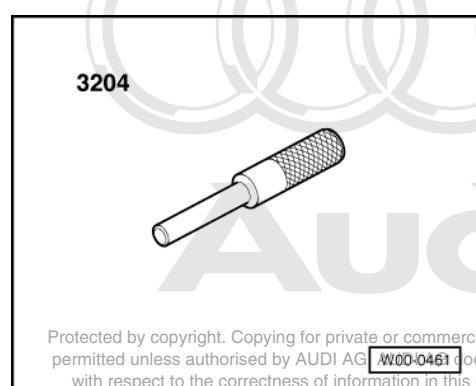
Installation is carried out in the reverse order; note the following:

- Replace coolant pump seal to prevent leaks.

Tightening torques

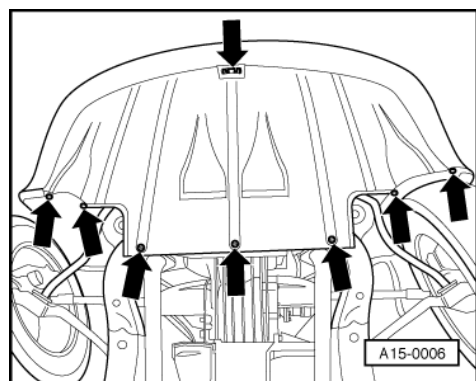
Component	Nm
Vane pump to retainer for alternator, vane pump and idler wheel	25
Belt pulley to vane pump	25

1.6 - Removing and installing ribbed belt



Special tools and workshop equipment required

- ♦ Mandrel 3204



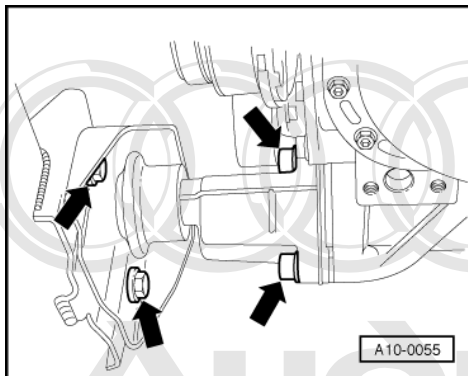
Removing

Note:

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. Ensure that the belt is properly seated in the pulleys when installing.

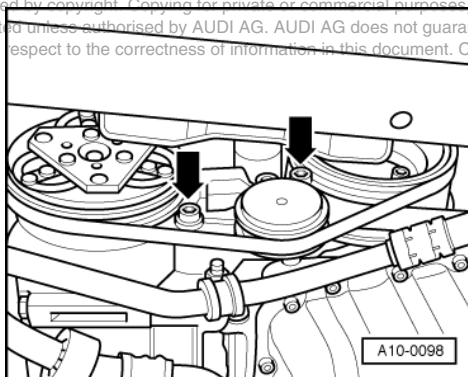
Vehicles with air conditioner:

- -> Remove the noise insulation -arrows-.

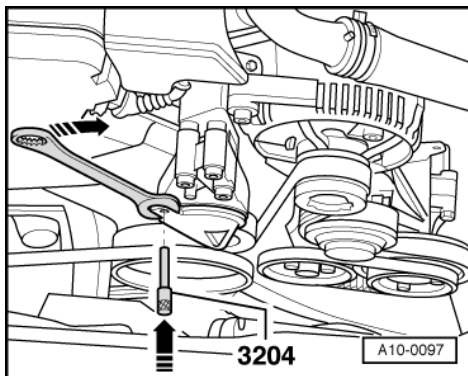


- -> Unbolt torque reaction support from engine and cross member -arrows-.

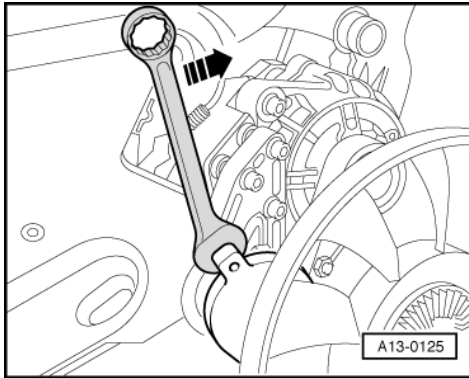
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- -> Loosen bolts securing ribbed belt tensioning roller for A/C compressor -arrows-, slacken belt and remove.

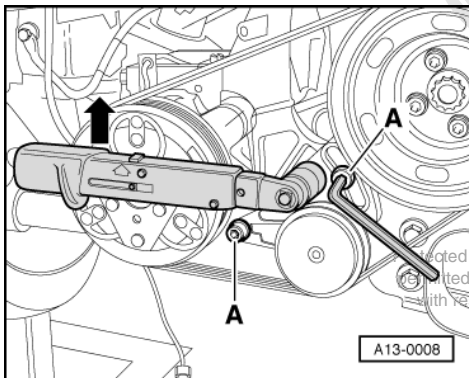


- -> Swivel the ribbed belt tensioner for vane pump and alternator for releasing tension of ribbed belt in direction of arrow using open-ended wrench.
- Lock tensioner by inserting mandrel 3204 into holes -arrow at bottom-.
- Remove ribbed belt.



Installing

- Fit ribbed belt over vibration damper pulley, idler wheel pulley and alternator pulley. If necessary, pull the belt upwards using a suitable tool.
- ➔ Turn ribbed belt tensioner in direction of arrow.
- Remove pin 3204.
- Fit ribbed belt over alternator pulley last. Release tensioner.
- Check that ribbed belt is properly seated.
 - Ribbed belt routing => Page 27



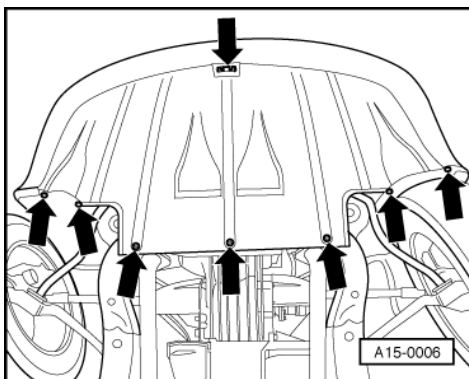
Vehicles with air conditioner:

- Fit ribbed belt for A/C compressor.
 - Ribbed belt routing => Page 27
- ➔ Apply torque wrench to hexagon on tensioning roller and tension with a torque of 25 Nm.
- At the same time, tighten bolts -A- to 20 Nm.

All models:

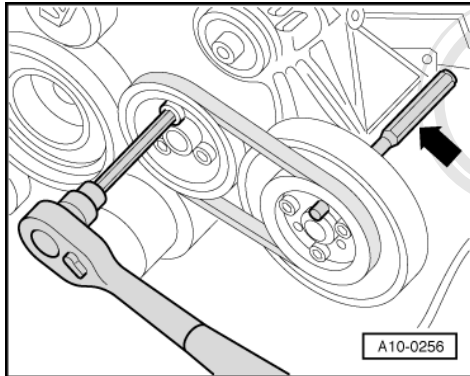
- Start engine and check belt running.

1.7 - Removing and installing V-belt



Removing

- Ribbed belt must be slackened => Page 31 .
- -> Remove the noise insulation -arrows-.



- -> Unscrew pulley for coolant pump. To prevent pulleys from turning, insert a pin -arrow- in the vane pump pulley.
- Remove V-belt.

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Installing

- Installation position of pulley sections: flat section of pulley towards coolant pump
- Fit V-belt and assemble two sections of pulley on coolant pump without tightening bolts. Tighten the bolts securing the two sections of the pulley in stages while turning the coolant pump.
- As the bolts are tightened, the V-belt should gradually move outwards until seated on the contact surface. Tighten bolts to 25 Nm.

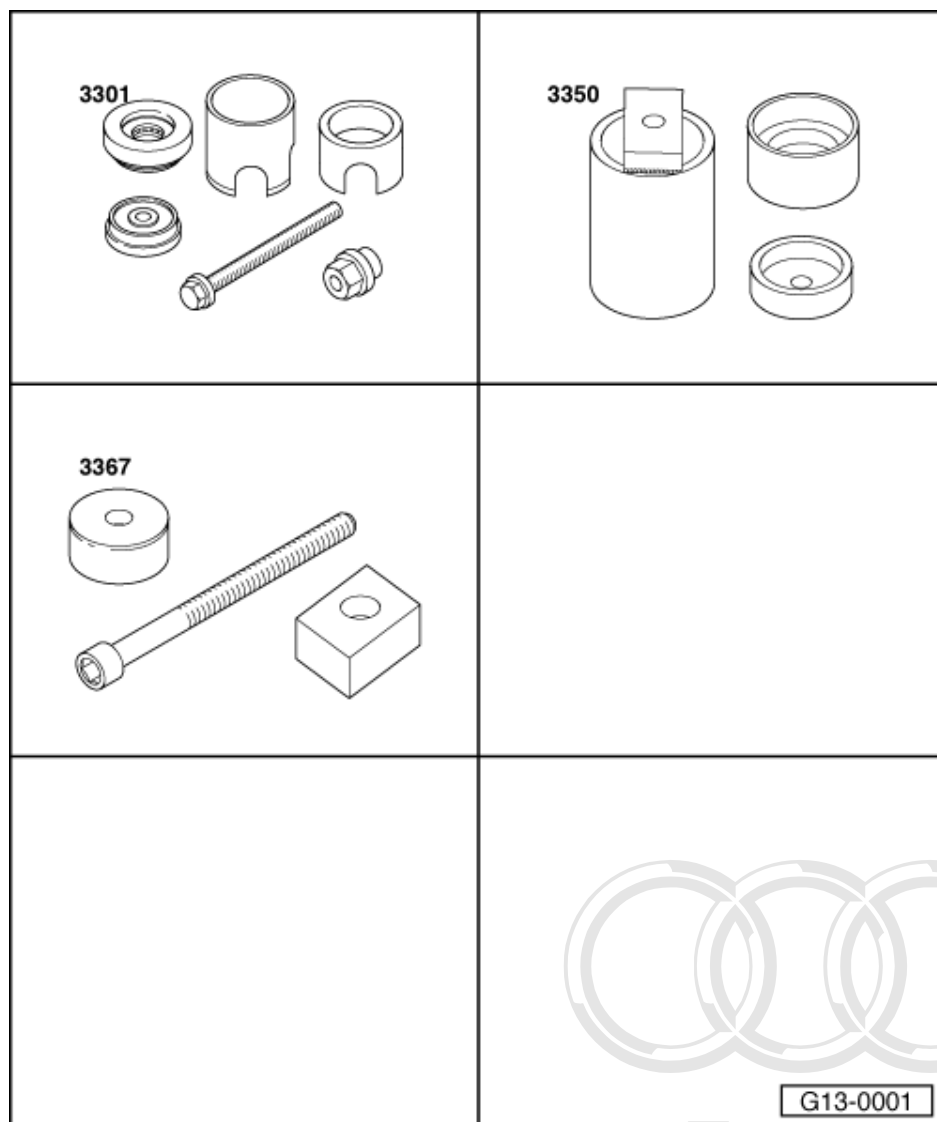
Note:

It is not necessary to adjust the tension of the V-belt for the coolant pump.

- Position ribbed belt, release tensioner.
- Start engine and check belt running.
- Check to ensure that the bolts for the coolant pump pulley are tightened to the correct torque.



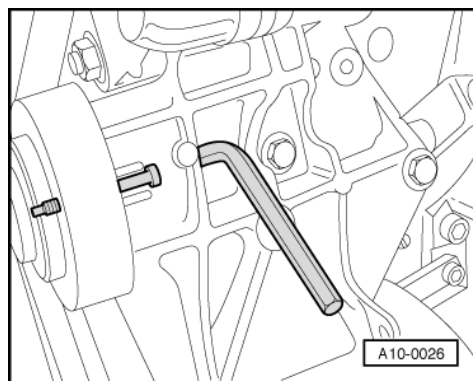
1.8 - Removing and installing bearing for idler wheel



Special tools and workshop equipment required

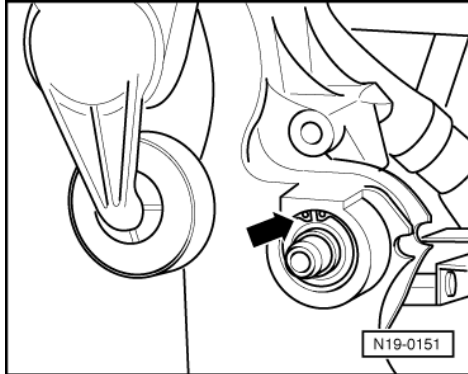
- ◆ Assembly tool 3301
- ◆ Assembly tool 3350
- ◆ Special tool 3367

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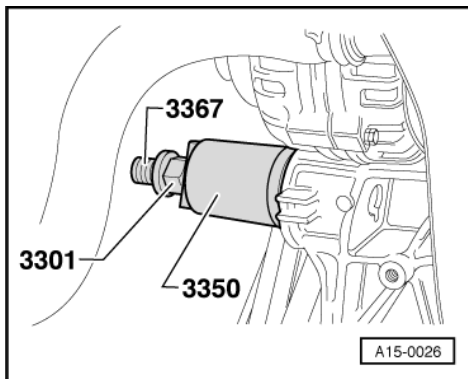


Removing

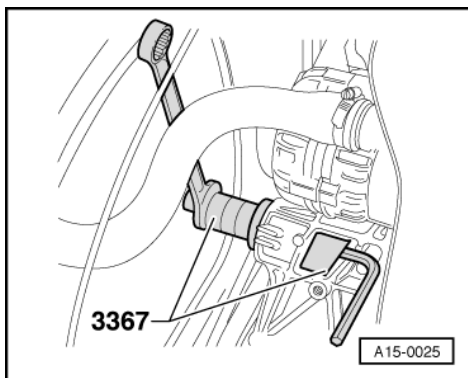
- Remove ribbed belt => Page 30
- -> Secure idler wheel with M5 x 60 mm bolt and unscrew with Allen key.
- Remove idler wheel.



- -> Remove the bush circlip -arrow-.



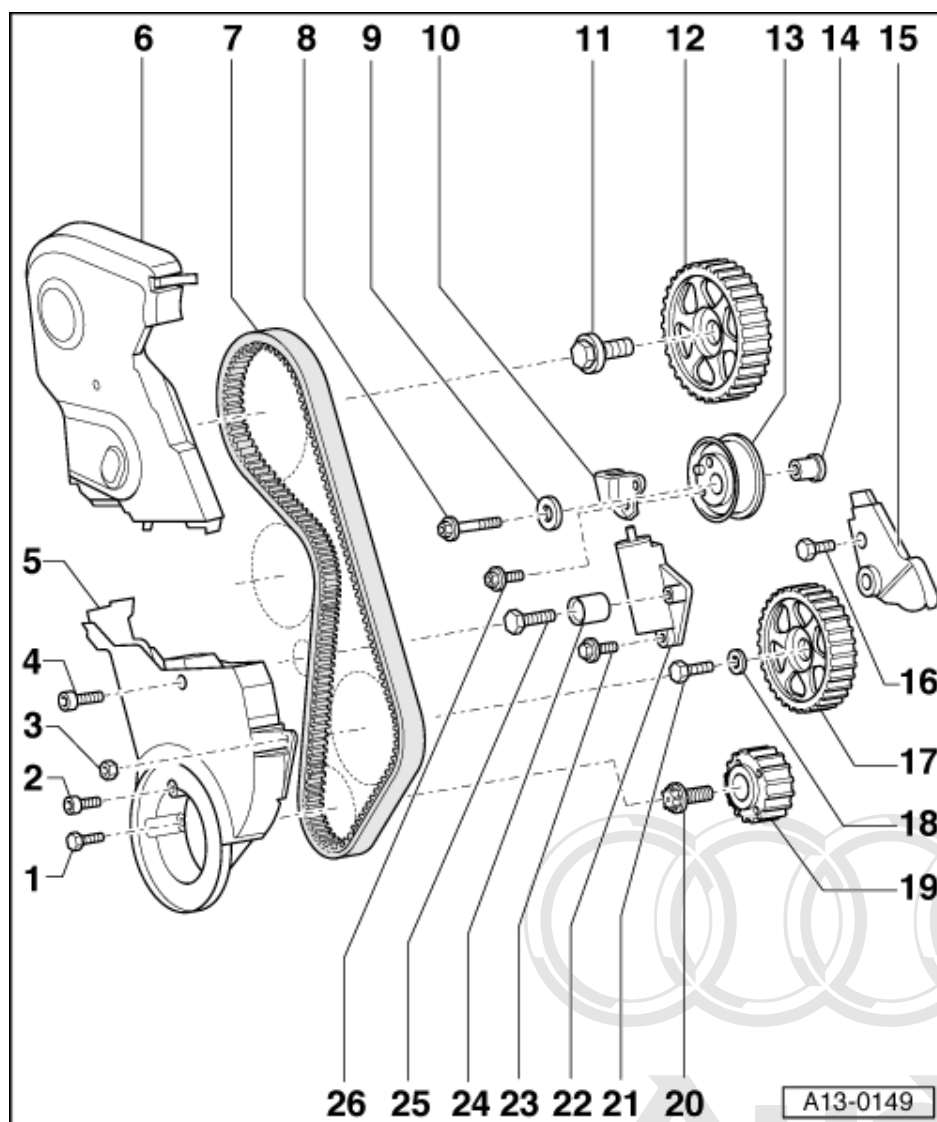
- -> Remove bearing with nut from assembly mounting 3301, bolt from special tool 3367 and pipe 3350 from retainer.



Installing

- -> Press in bearing with special tool 3367 and nut of assembly device 3301.
- Fit circlip in retainer for idler wheel using angle circlip pliers.
- Tighten idler wheel to 45 Nm.
- Position ribbed belt => Page 32 .

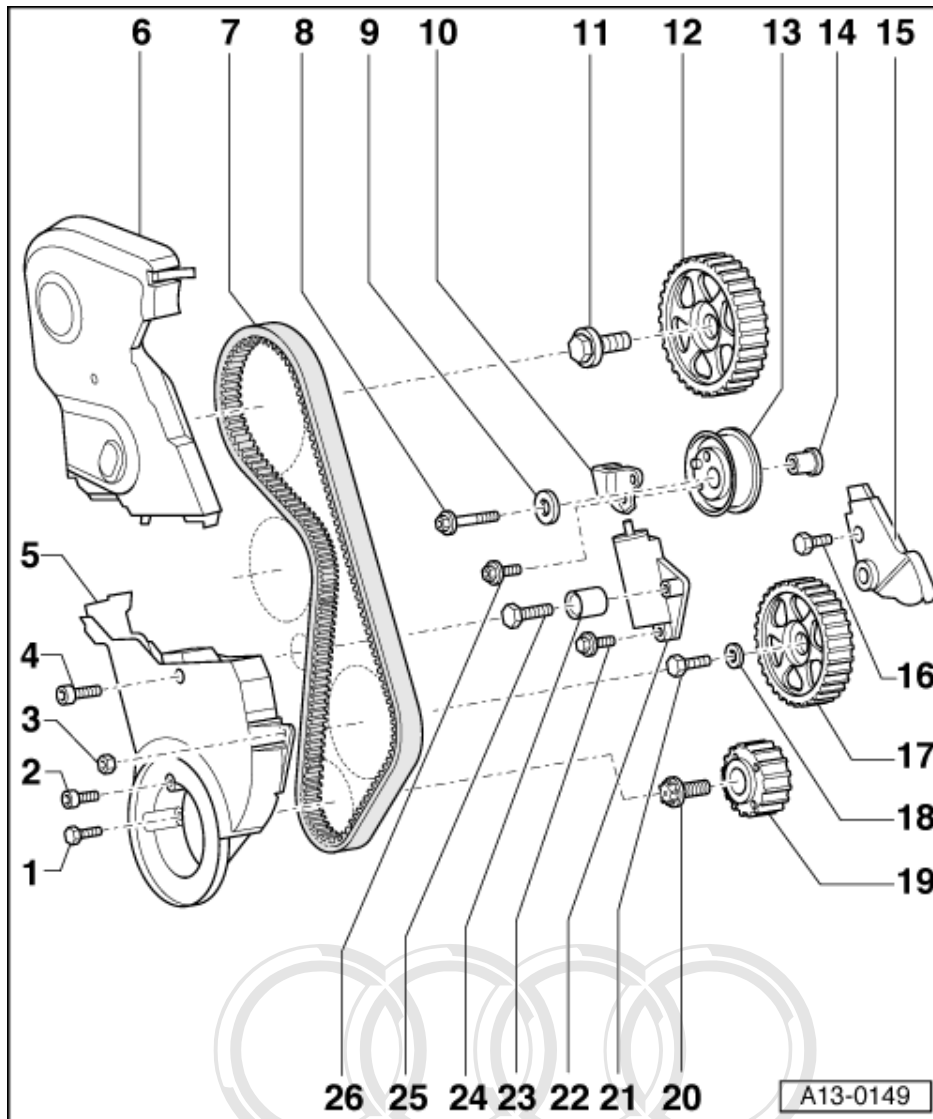
1.9 - Removing and installing toothed belt



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 10 Nm
- 2 10 Nm
- 3 10 Nm
- 4 20 Nm
- 5 Toothed belt guard - lower
 - ♦ To remove, unbolt vibration damper



6 Toothed belt guard - upper

- ◆ Unbolt tensioning roller for ribbed belt before removing.
- ◆ When installing, engage carefully in lower toothed belt guard.

7 Toothed belts

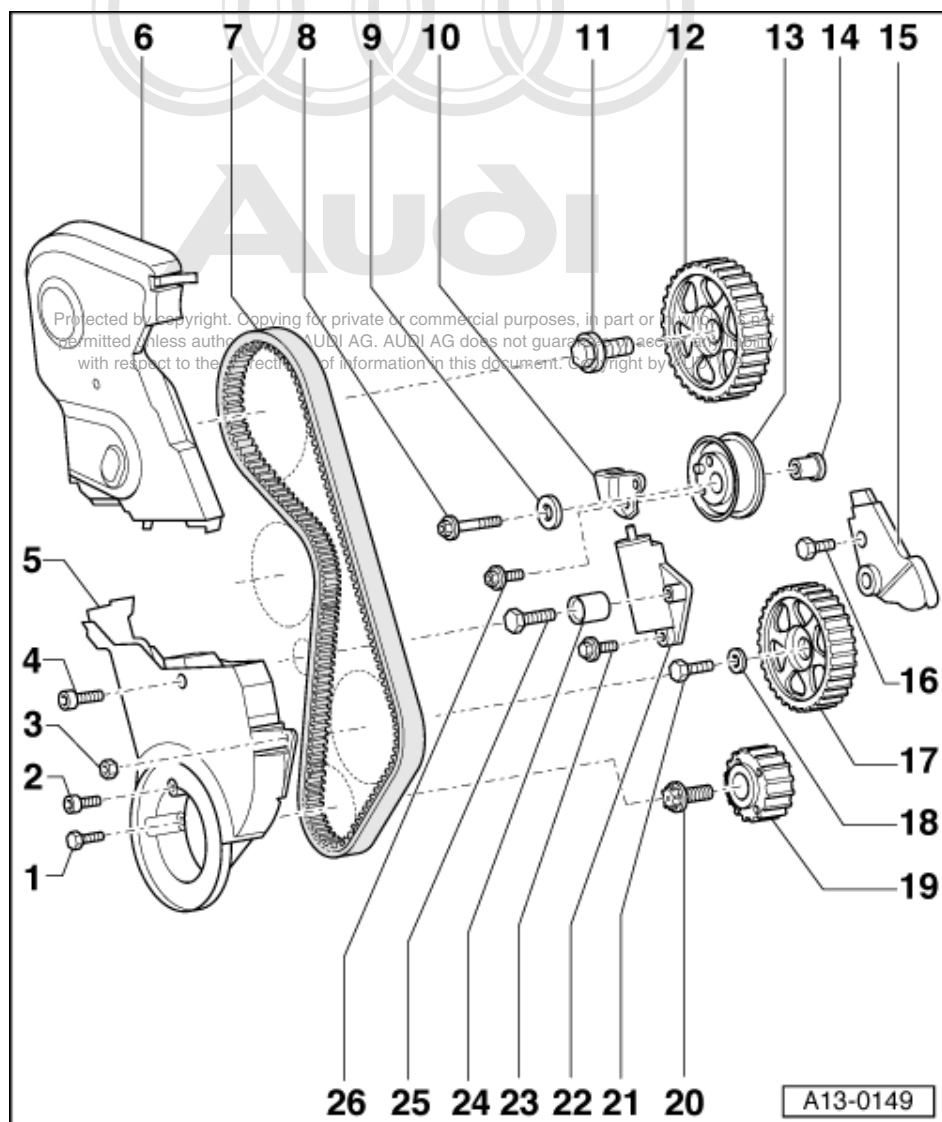
- ◆ Mark running direction with chalk or felt pen before removing
- ◆ Check for wear
- ◆ Removing => Page 41
- ◆ Install (adjust valve timing) => Page 43

8 40 Nm

9 Washer

10 Lever

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11 65 Nm

- ♦ For loosening and tightening use counterhold 3036 =>Fig. 41

12 Camshaft sprocket

- ♦ For exhaust camshaft
- ♦ For removal and installation remove toothed belt => Page 41
- ♦ Installation position
=> Fig. 41

13 Tensioning roller

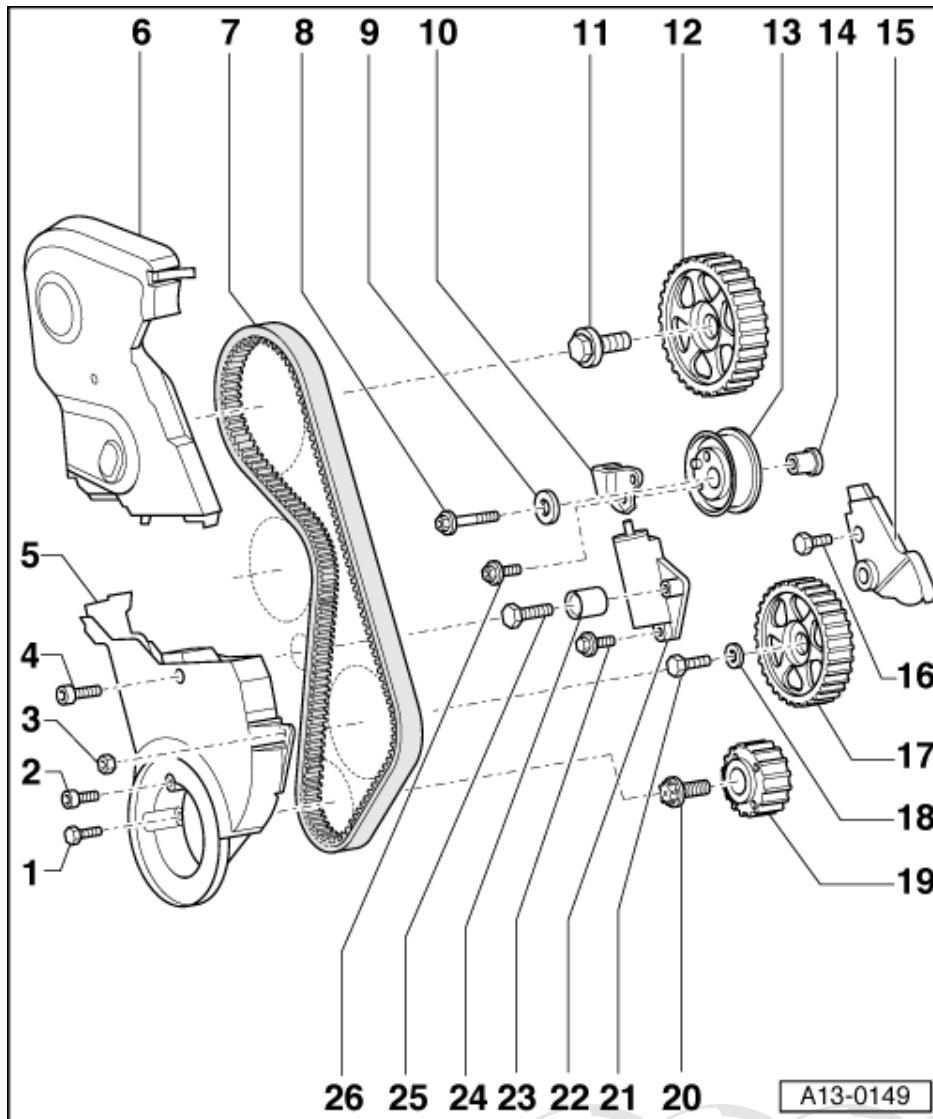
14 Bearing sleeve

- ♦ For tensioning roller

15 Toothed belt guard - rear

16 20 Nm

17 Intermediate shaft sprocket



18 Washer

19 Crankshaft sprocket

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

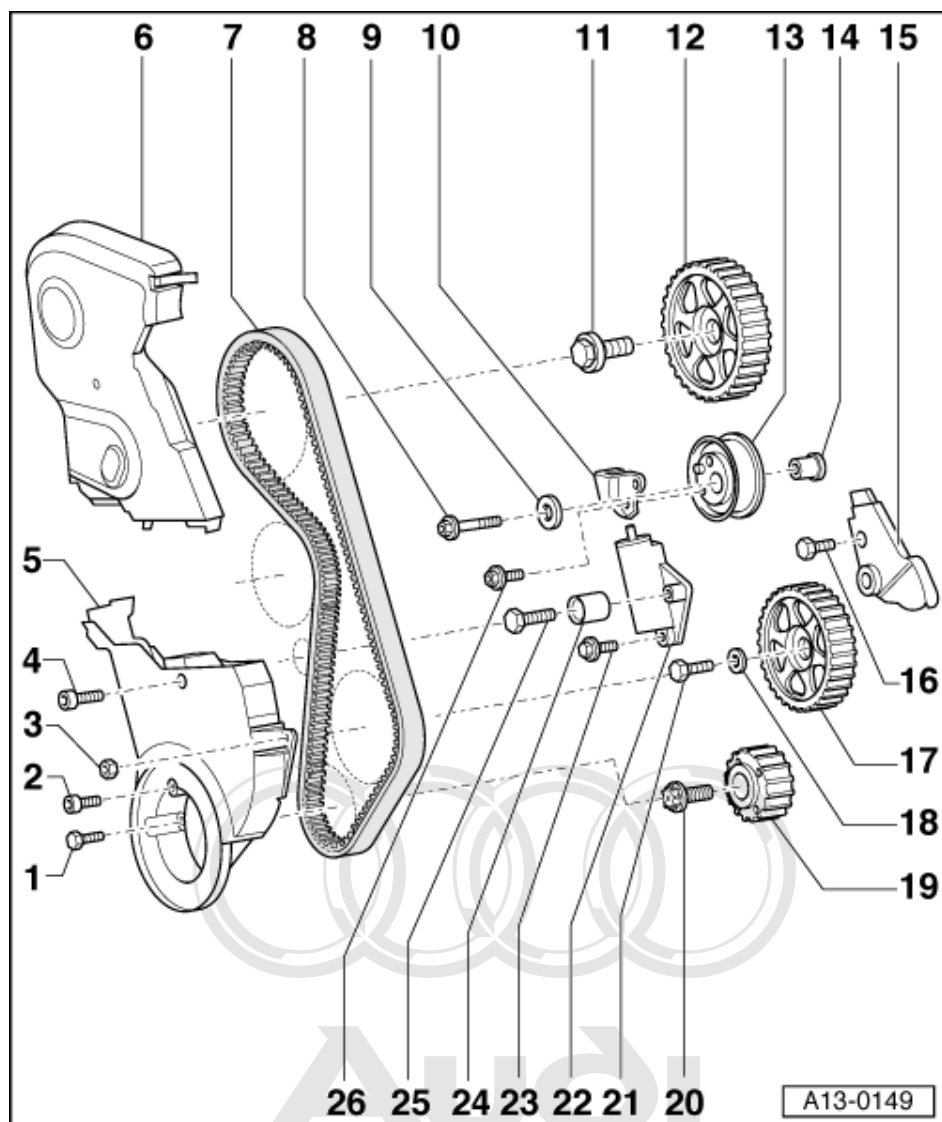
20 90 Nm + 1/4 turn (90°) further

- ◆ Replace
- ◆ Do not use oil
- ◆ Counter hold with 3099 to loosen and tighten
- ◆ Bolting on counterhold tool 3099 => Page 49

21 65 Nm

- ◆ Counter hold with 3036 to loosen and tighten

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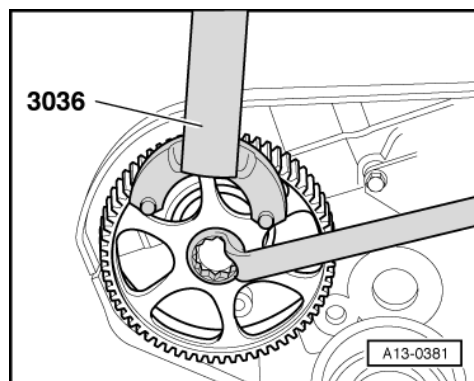
22 Tensioner for toothed belt

23 10 Nm 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.

24 Idler roller

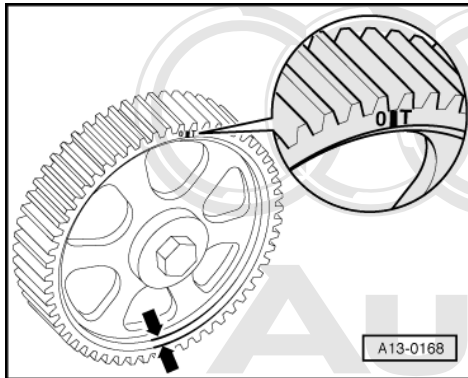
25 25 Nm

26 10 Nm



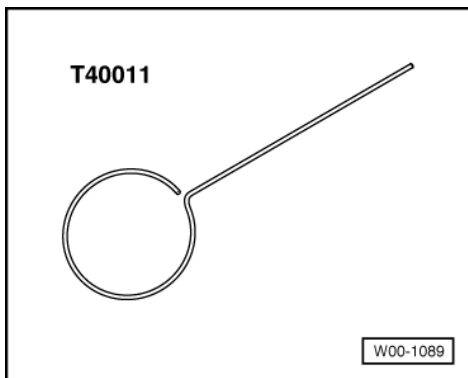
-> Fig.1 Detaching camshaft sprocket

- Use counter-hold tool 3036 to loosen and tighten the central bolt.



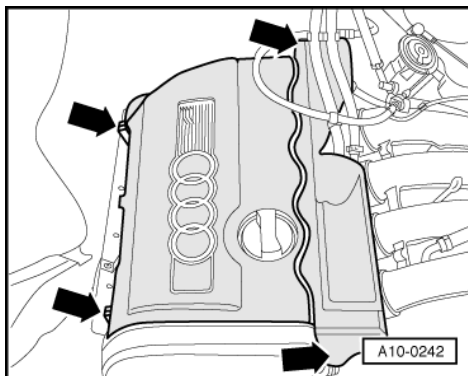
-> Fig.2 Installation position of camshaft sprocket

- ♦ Narrow web on camshaft sprocket faces outwards
arrows- and marking for No. 1 cylinder TDC is visible from the front.



Special tools and workshop equipment required

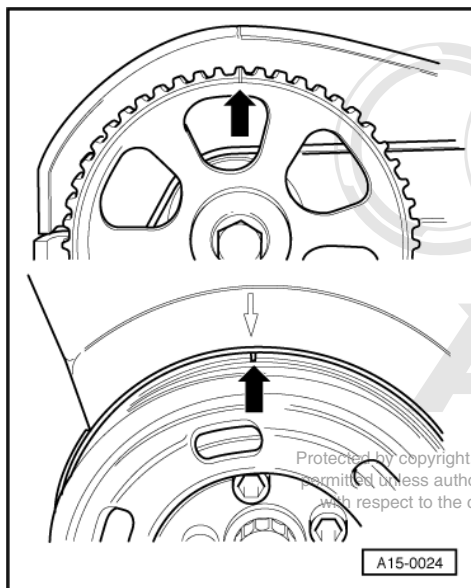
- ♦ Pin T40011



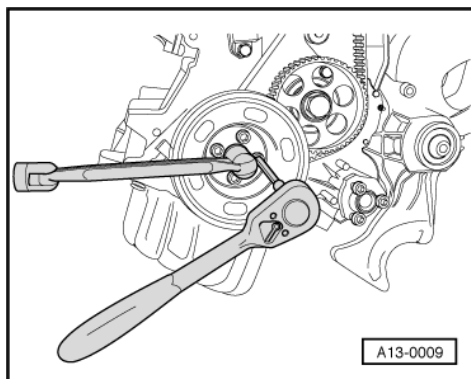
Removing toothed belt

- Engine in vehicle

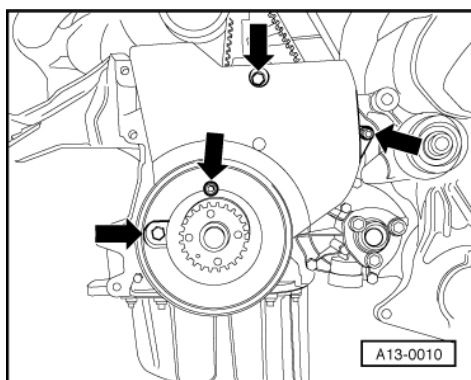
- Remove ribbed belt and tensioner for ribbed belt => Page 30 .
- -> Remove cover over injectors -arrows on right-.
- Remove upper toothed belt guard.
- Mark direction of rotation of toothed belt with chalk or felt pen.



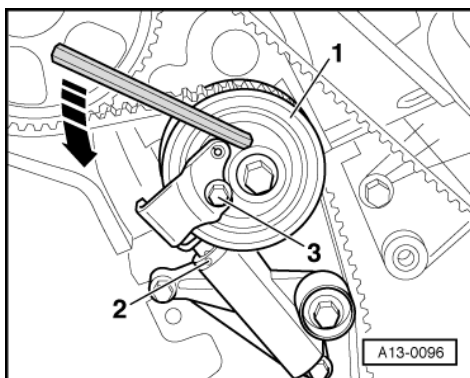
- -> Set crankshaft to markings for TDC of No. 1 cylinder -arrows- by turning central bolt on crankshaft sprocket in direction of rotation.



- -> Unbolt vibration damper.



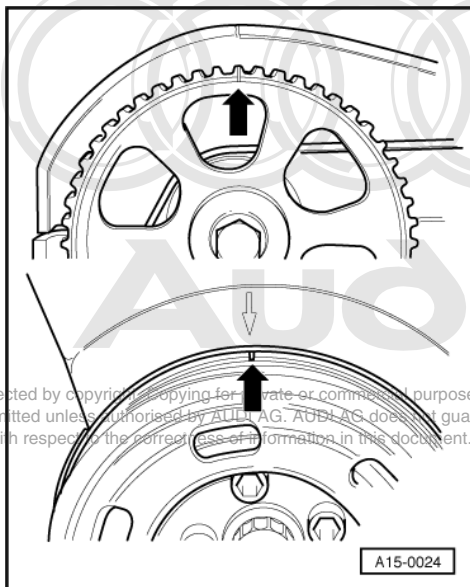
- -> Unbolt lower toothed belt guard -arrows-.



- -> Turn toothed belt tensioner -1- with 8 mm Allen key slowly with constant pressure in direction of arrow until the bores -2- of piston and housing of the tensioning element are aligned.
- In this position push pin T40011 in both bores.
- Remove toothed belt.

Note:

Do not loosen bolt -3-.

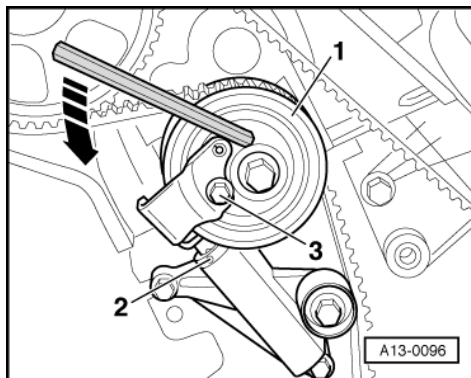


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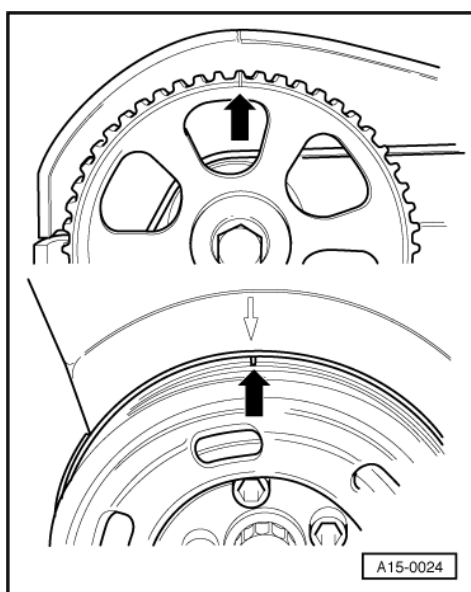
Installing (adjusting valve timing)

Notes:

- ◆ The position of the toothed belt must be set as described below, even after repairs in which the belt is only taken off the camshaft sprocket.
 - ◆ When turning the camshaft the crankshaft must not be at TDC. Danger of damage to valves/piston crown.
 - ◆ The setting can be performed with engine cold or engine warm.
-
- -> Align marking on camshaft sprocket with marking at cylinder head cover.
 - Place toothed belt on crankshaft sprocket (observe DOR).
 - Install toothed belt guard - lower part.
 - Secure vibration damper/belt pulley with one bolt (note fixing arrangement).
 - Set the crankshaft to TDC for cylinder No. 1.
 - Place toothed belt on tensioning roller and camshaft sprocket.



- -> Using 8 mm hexagon key, turn toothed belt tensioning roller -1- in direction of arrow until the retaining pin can be pulled out of the tensioner.



- -> Turn crankshaft at central bolt of the toothed belt crankshaft in direction of engine rotation twice and check whether the camshaft and crankshaft markings align with their respective reference points.
- Install vibration damper/belt pulley.

Note:

Use only original bolts.

=> Parts List

- Install toothed belt guard (top section).
- Install ribbed belt and tensioner for ribbed belt => Page 32 .

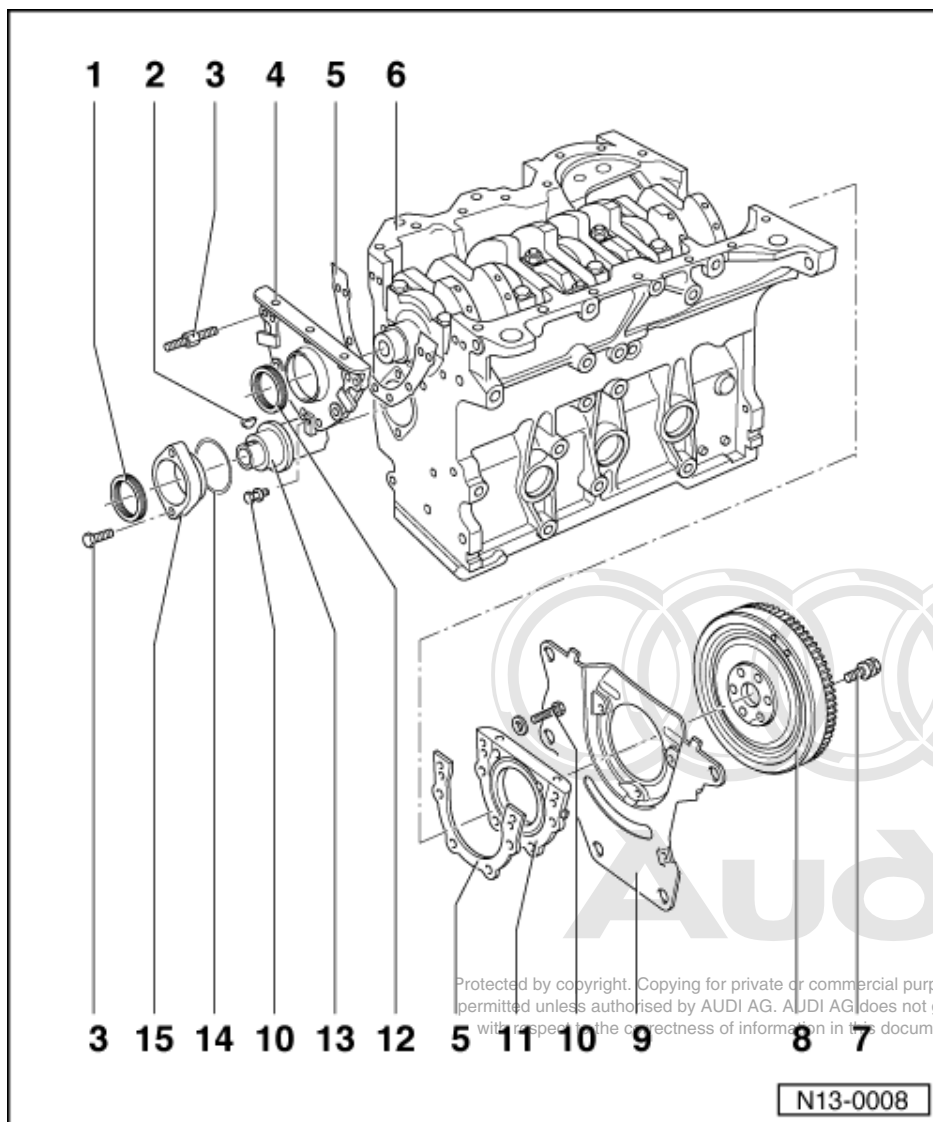
Tightening torques

Component		Nm
Toothed belt guard to lower cylinder block	M6	10
	M8	20
Vibration damper/belt pulley to crankshaft		401)
Ribbed belt tensioner to retainer		25

- 1) Bolt strength rating 10.9

2 - Removing and installing sealing flanges and flywheel/drive plate

2.1 - Removing and installing sealing flanges and flywheel/drive plate



Note:

For repairs to the clutch:

=> 5-speed Manual Gearbox 01A, 4WD; Repair group 30; Servicing clutch Servicing clutch

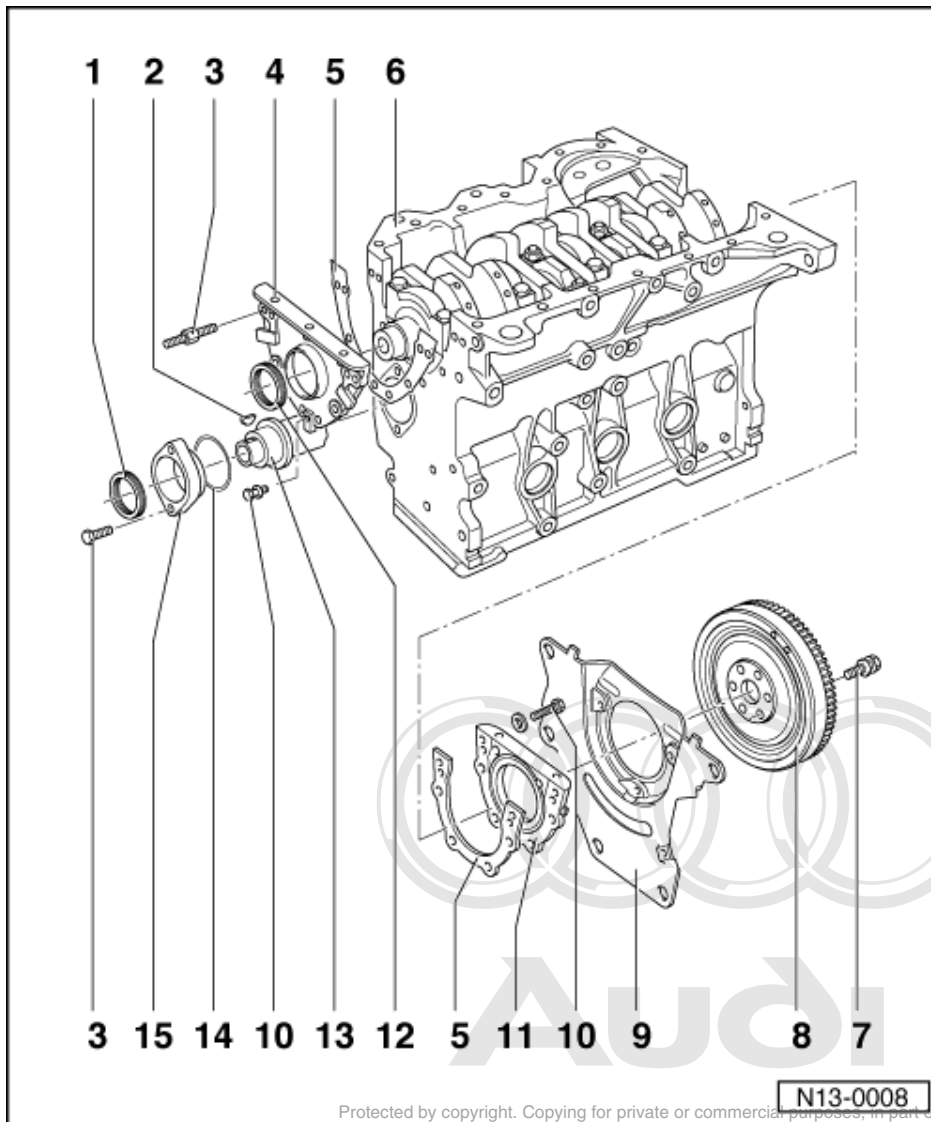
1 Sealing ring

- ◆ To remove, remove sealing flange -Item **15** -
- ◆ Install with 10-203
- ◆ Lightly oil sealing lip of sealing ring

2 Woodruff key

- ◆ Ensure tight fit

3 25 Nm



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N13-0008

4 Sealing flange - front

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

=> Parts List

5 Seal

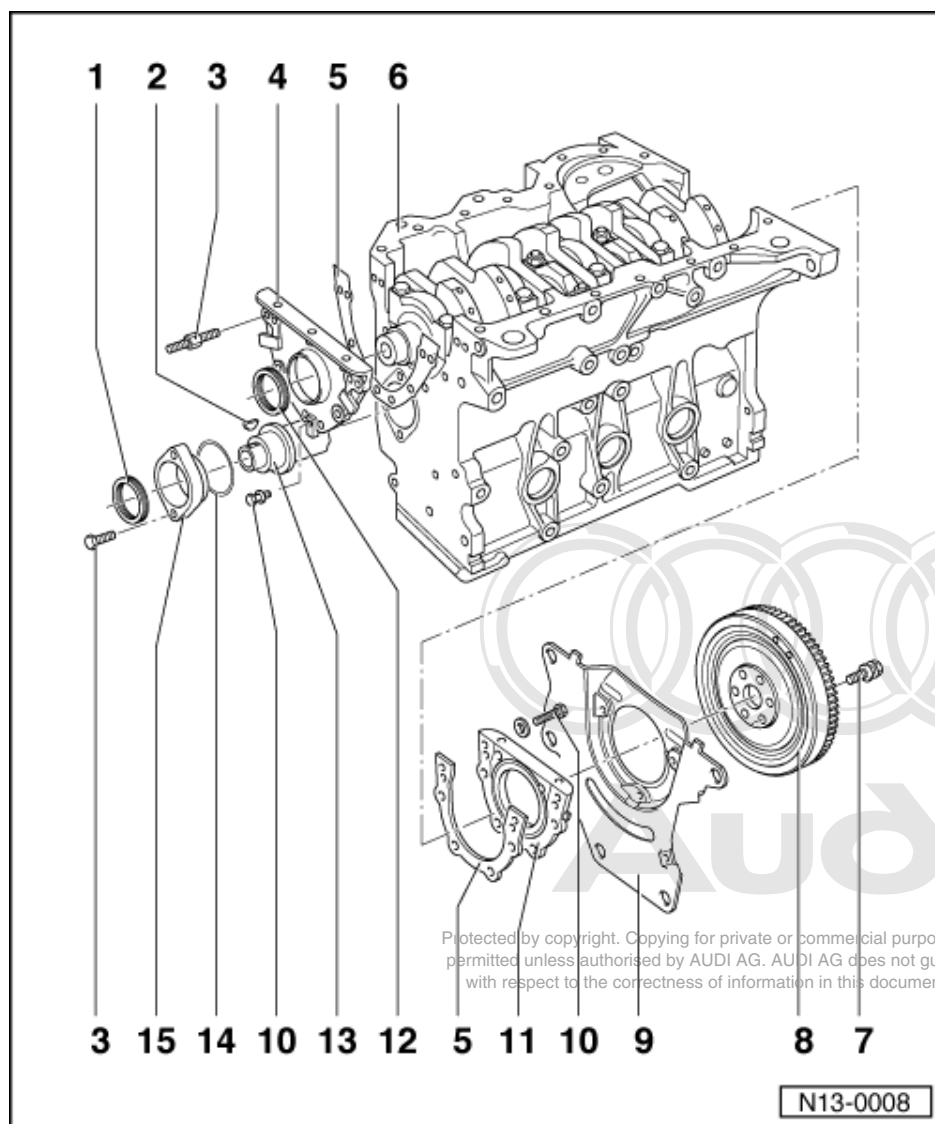
- ◆ Replace

6 Cylinder block

- ◆ Removing and installing crankshaft=> Page 55
- ◆ Dismantling and assembling pistons and conrods => Page 61

7 Securing bolt for dual-mass flywheel or drive plate

- ◆ Replace
- ◆ Tightening torque for dual mass flywheel=>Page 52
- ◆ Tightening torque for drive plate (vehicles with automatic gearbox) => Page 54

**8 Dual-mass flywheel/drive plate**

- ♦ Removing and installing dual mass flywheel=> Page 52
- ♦ Removing and installing drive plate => Page 53

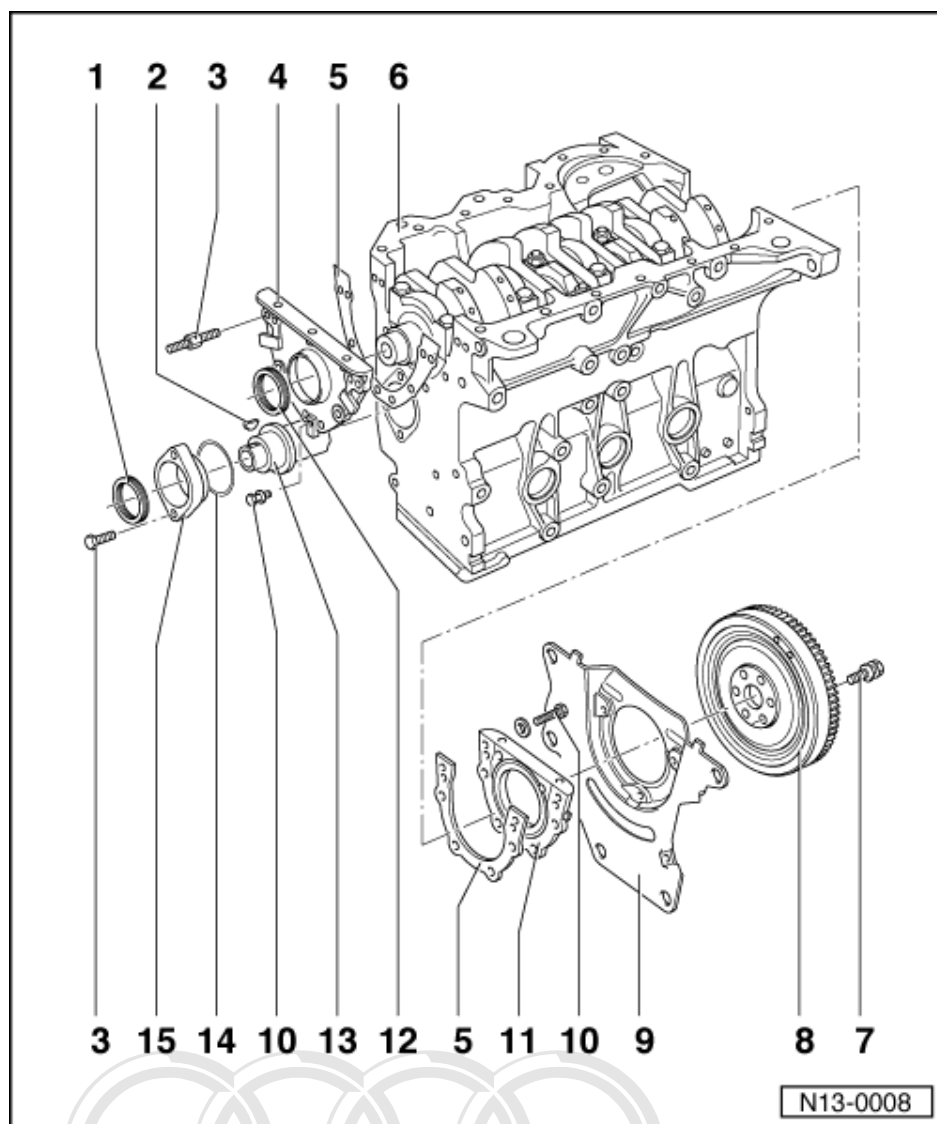
9 Intermediate plate

- ♦ Must be located on dowel sleeves
- ♦ Do not damage/bend when assembling.

10 10 Nm**11 Rear sealing flange**

- ♦ With sealing ring
- ♦ Replace only as complete unit
- ♦ Lightly oil sealing lip of oil seal
- ♦ Before fitting sump, apply a small amount of sealant to sealing points between sealing flange and cylinder block
- ♦ Sealants

=> Parts List



12 Oil seal

- ♦ Replacing => Page 49 .

13 Intermediate shaft

- ♦ Axial play max. 0.25 mm

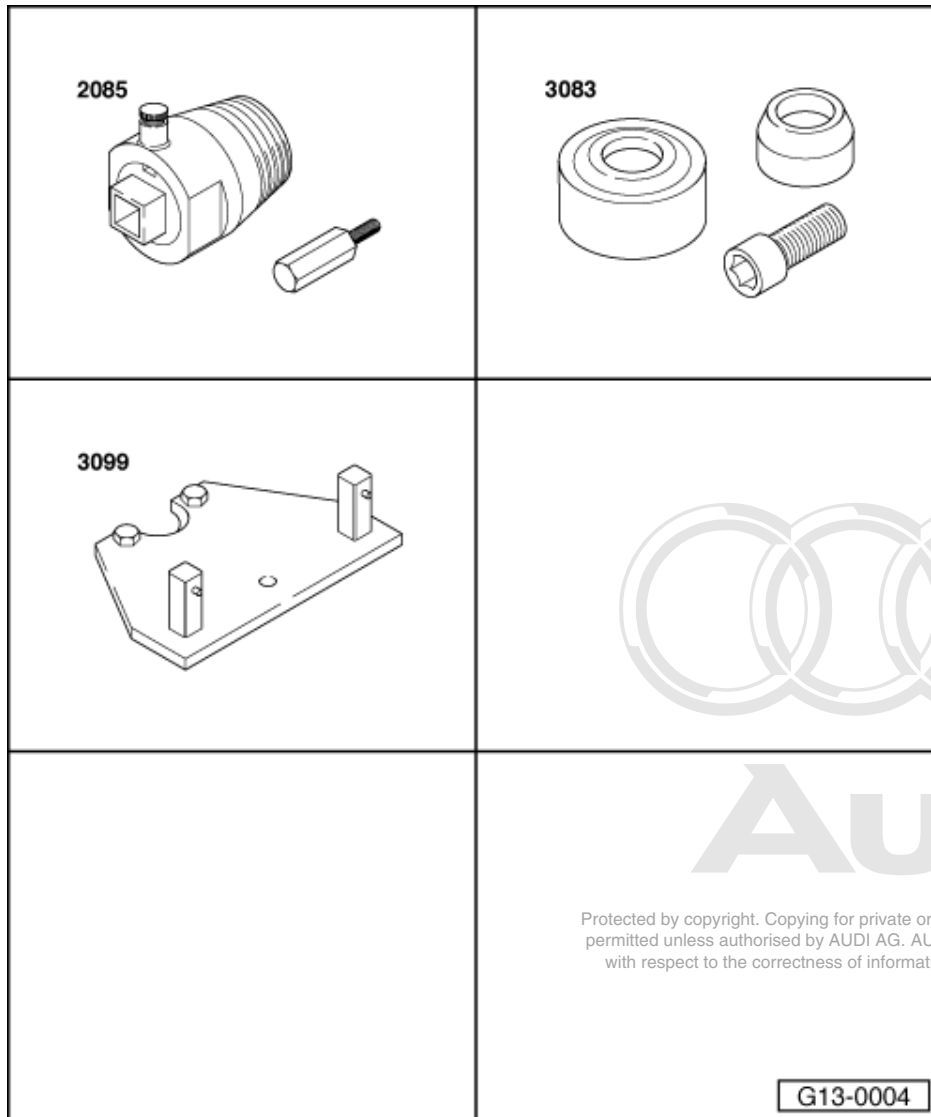
14 O-ring

- ♦ Replace

15 Sealing flange for intermediate shaft

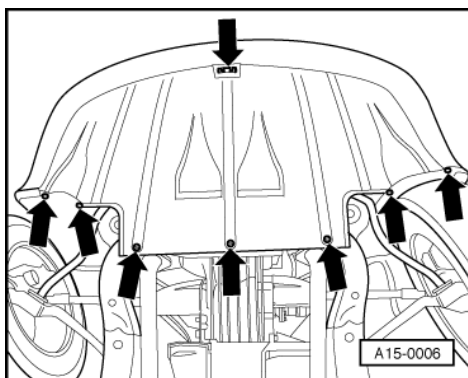
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2.2 - Replacing crankshaft oil seal on pulley end



Special tools and workshop equipment required

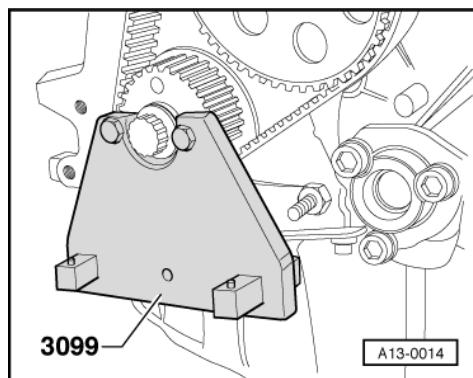
- ◆ Oil seal extractor 2085
- ◆ Fitting tool 3083
- ◆ Counterhold 3099





Removing

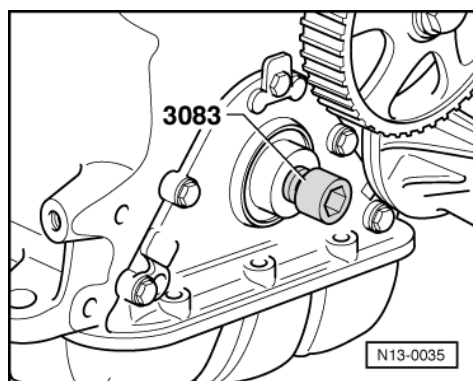
- Engine in vehicle
- -> Remove the noise insulation -arrows-.
- Remove ribbed belt and tensioner for ribbed belt => Page 30 .
- Remove toothed belt => Page 41 .



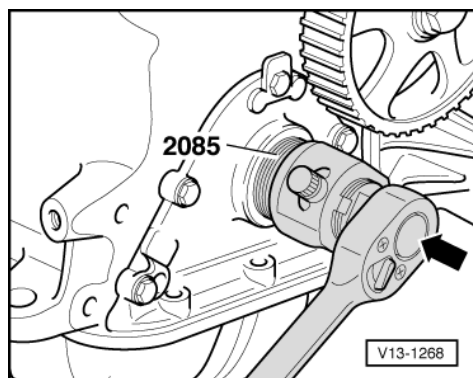
- -> Remove crankshaft toothed belt sprocket. Counter hold sprocket with 3099.

Note:

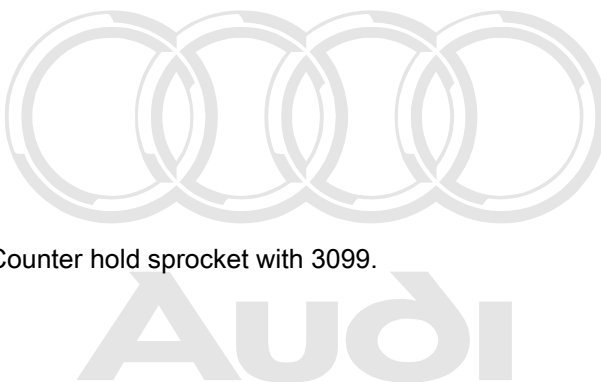
It is also possible to use special tool 3415.



- -> Before applying oil seal extractor, screw cheese-head bolt from 3083 into crankshaft as far as it will go.

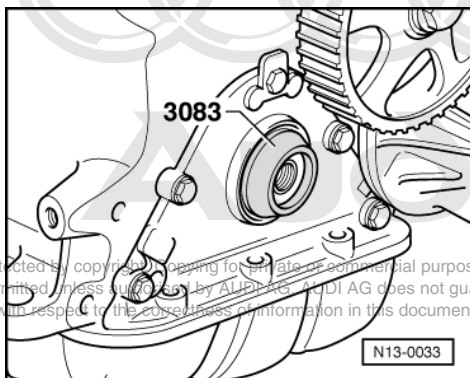


- Adjust inner part of oil seal extractor 2085 two turns (approx. 3 mm) from the outer part and lock in position with the knurled screw.
- -> Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure, screw it into oil seal as far as possible.



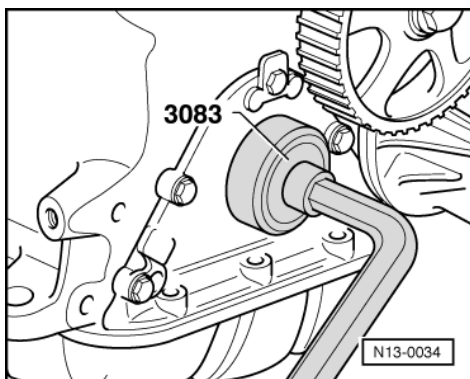
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- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.



Installing

- Lightly oil sealing lip of oil seal.
- -> Place guide sleeve from 3083 onto crankshaft journal.
- Push oil seal over guide sleeve.



- -> Press oil seal in until stop using press sleeve from 3083.
- Install crankshaft sprocket and lock in position with retainer 3099.

Notes:

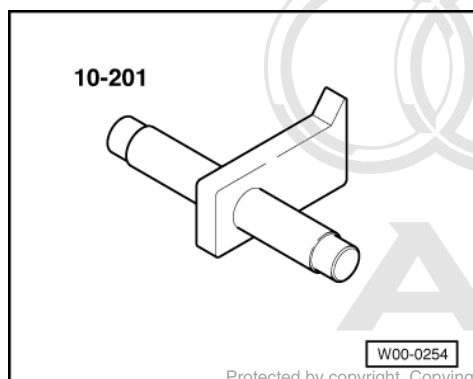
- ◆ Contact surface between sprocket and crankshaft must be free of oil.
- ◆ Do not oil bolt for crankshaft sprocket.
- Install toothed belt (adjust valve timing) => Page 43 .
- Install ribbed belt and tensioner for ribbed belt => Page 32 .

Tightening torque

Component	Nm
Toothed belt sprocket to crankshaft	90 + 90° 1)2)

- 1) Replace bolt
- 2) 90° corresponds to a quarter of a turn

2.3 - Removing and installing dual mass flywheel/drive plate

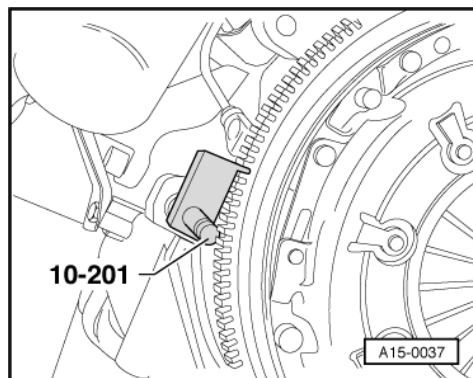


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Dual-mass flywheel

Special tools and workshop equipment required

- ♦ Special tool 10-201



Removing

- -> Plug in counterhold 10-201 for loosening and tightening the bolts.
- Mark position of dual mass flywheel relative to engine.
- Unbolt dual mass flywheel.

Installing

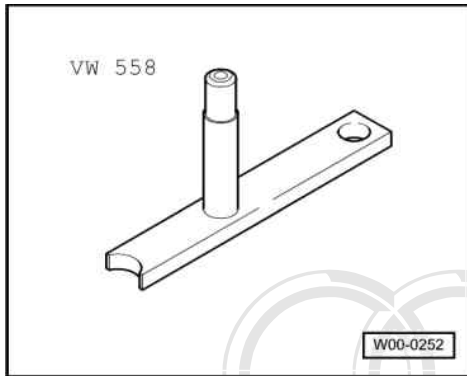
Installation is carried out in the reverse order; note the following:

- Replace bolts.

Tightening torque

Component		Nm
Dual-mass flywheel	22.5 mm1)	60 + 90°2)
to crankshaft	43 mm 1)	60 + 180°3)

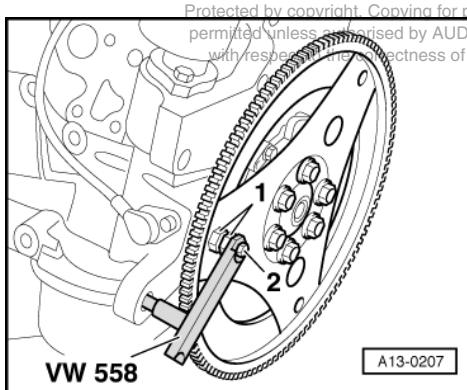
- 1) Bolt length
- 2) 90° corresponds to a quarter of a turn
- 3) 180° = 1/2 turn



Drive plate

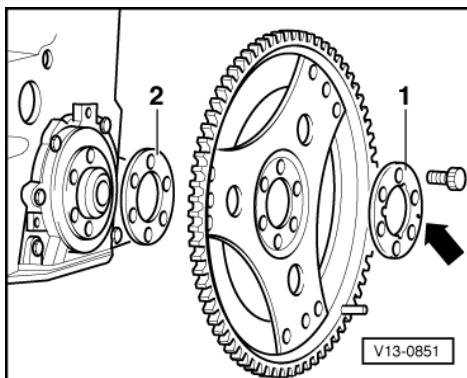
Special tools and workshop equipment required

- ◆ Counterhold VW 558
- ◆ Hexagon bolt M8 x 45 and two M10 hexagon nuts
- ◆ Caliper gauge or depth gauge



Removing

- -> Secure counter hold tool VW 558 to the drive plate with a hexagon bolt M8 x 45 -Item 2- Place two M10 hexagon nuts -1- between counterhold and drive plate.
- Mark position of drive plate relative to engine.
- Unbolt drive plate.

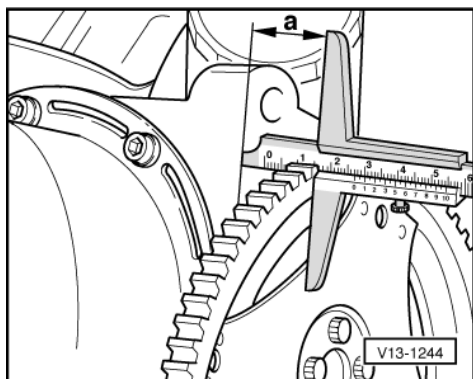


Installing

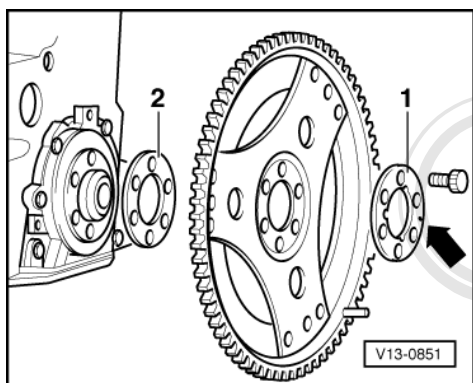
- -> Place drive plate with shim -2- and washer -1- in position. Lug -arrow- must face towards torque converter.



- Insert at least 3 of the old securing bolts and tighten to 30 Nm.



- -> Measure dimension -a- at three points and calculate average value.
- Specified value for automatic gearbox 01N: 26...28 mm



If specification is exceeded:

- -> Remove drive plate again and fit without shim -2-. Retighten bolts to 30 Nm.
 - Measure distance again.
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If specification is attained:

- Only use new bolts to secure.

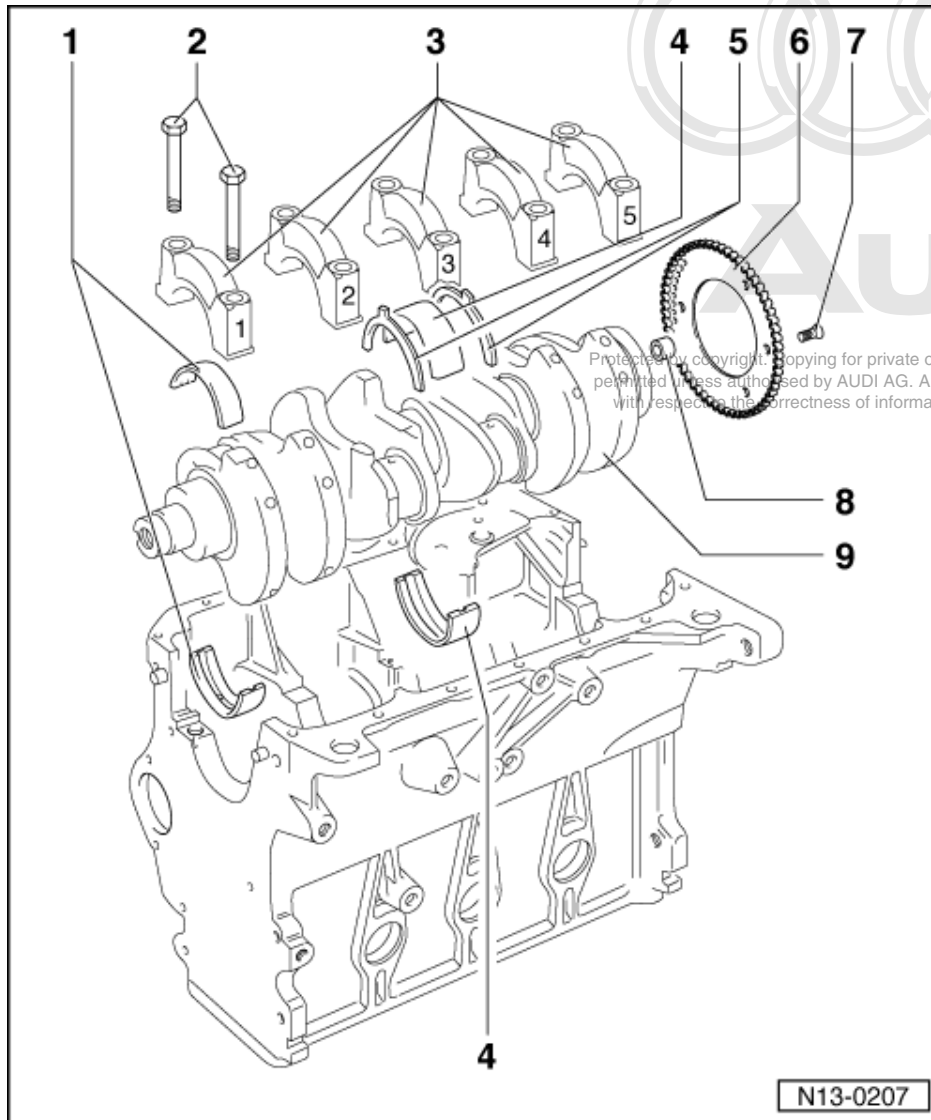
Tightening torque

Component	Nm
Drive plate to crankshaft	60 + 90°1)

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

3 - Removing and installing crankshaft

3.1 - Removing and installing crankshaft



Note:

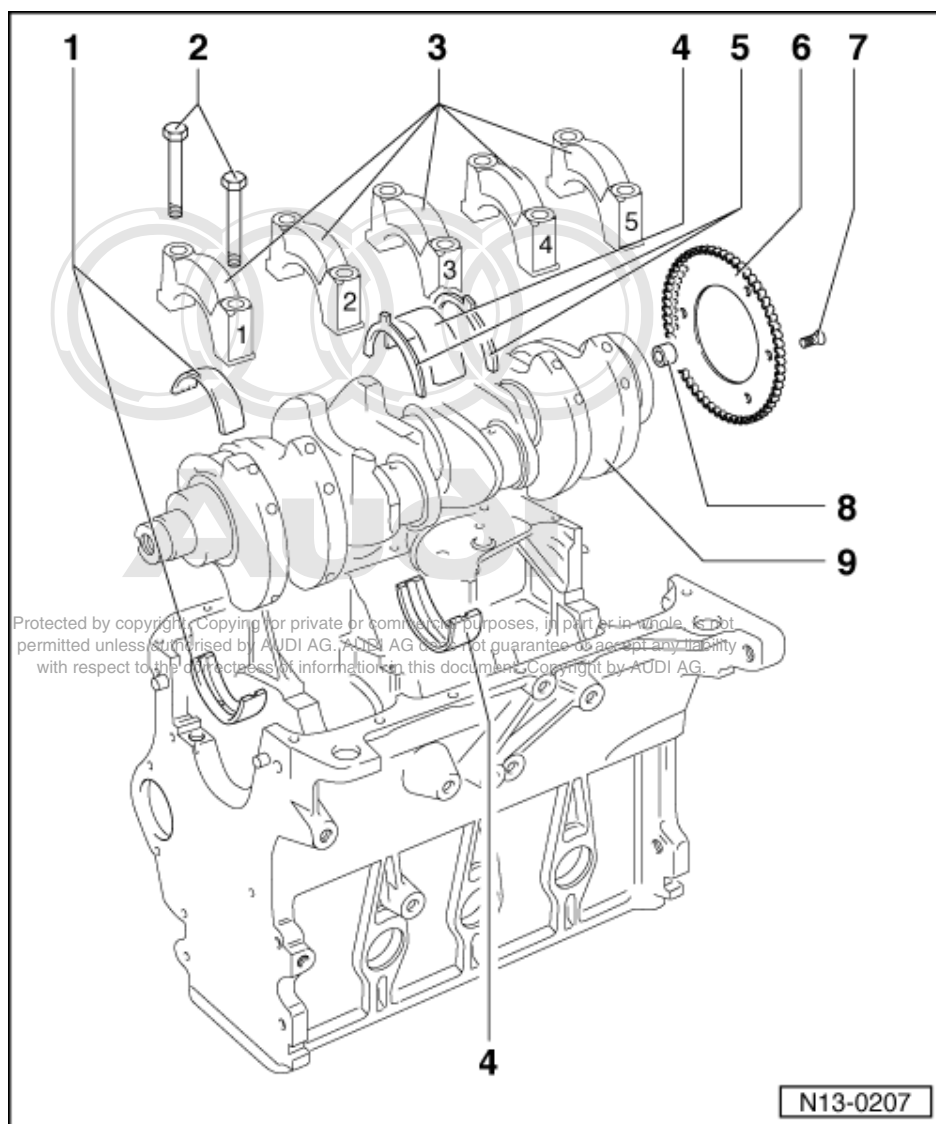
When working on the engine, it should be secured to the engine stand using the engine bracket VW 540.

1 Bearing caps 1, 2, 4 and 5

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

2 65 Nm + 1/4 turn (90°) further

- ◆ Replace
- ◆ When measuring radial play of crankshaft, tighten to 65 Nm but do not turn further.



3 Bearing cap

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

4 Bearing shell 3

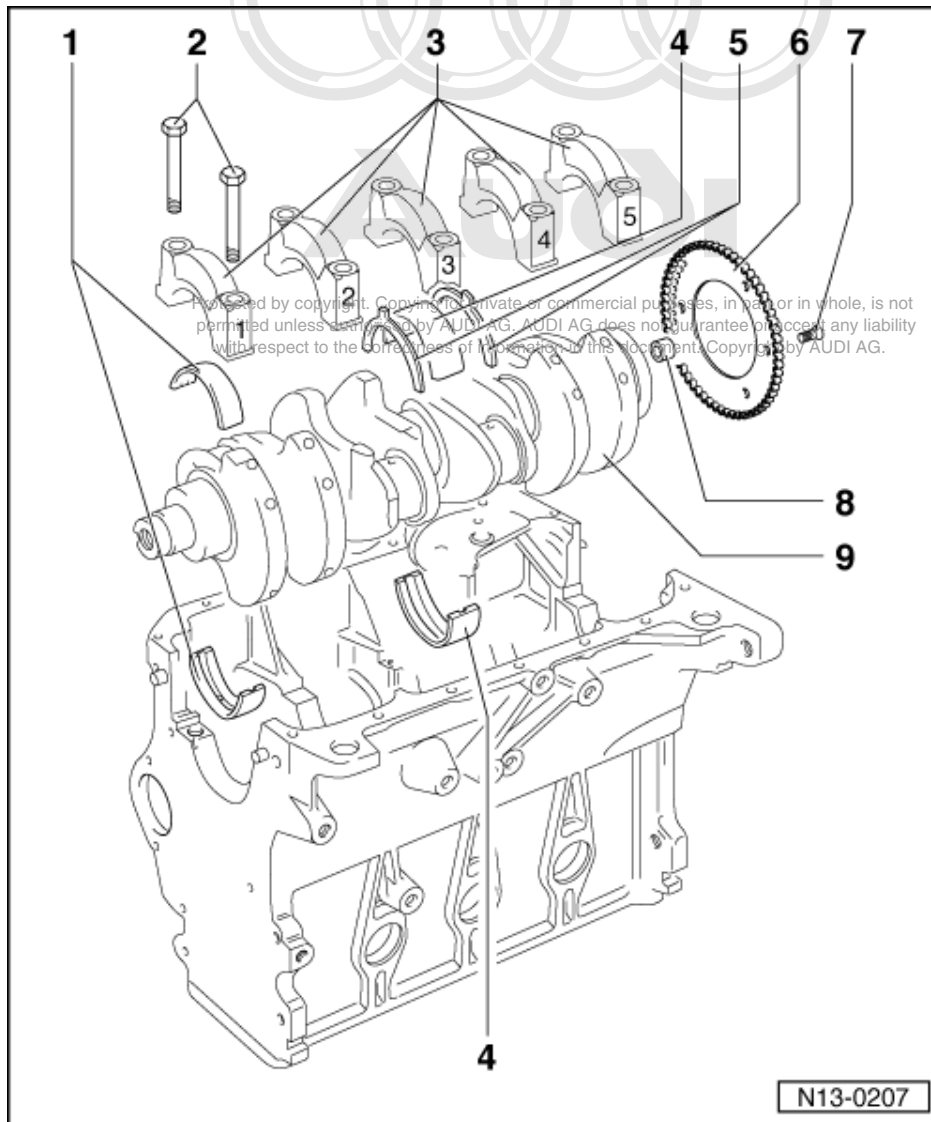
- ◆ For bearing cap without oil groove
- ◆ For cylinder block with oil groove
- ◆ Do not interchange used bearing shells (mark).

5 Thrust washer

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

6 Sender wheel

- ◆ For engine speed sender -G28
- ◆ Can only be installed in one position. Holes are off set
- ◆ Always replace sender wheel if securing bolts have been unscrewed.
- ◆ Removing and installing
=> Fig. 58

**7 10 Nm + 1/4 turn (90°) further**

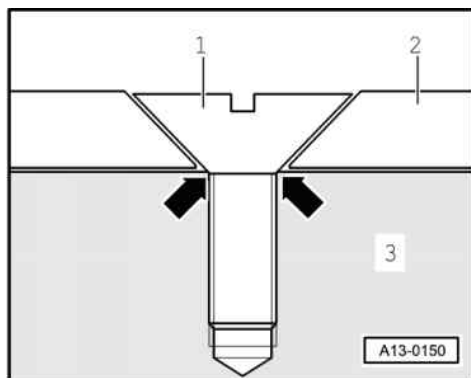
- ◆ Replace
- ◆ Always replace sender wheel if securing bolts have been unscrewed.

8 Needle bearing

- ◆ Pulling out and driving in
=>Page 58 .

9 Crankshaft

- ◆ Axial play new: 0.07...0.23 mm
Wear limit: 0.30 mm
- ◆ Check radial play with Plastigage
New: 0.02...0.04 mm
Wear limit: 0.15 mm
- ◆ Do not rotate the crankshaft when checking the radial play.
- ◆ Crankshaft dimensions
=>Page 60 .



→ Fig.1 Removing and installing sender wheel

- Always replace sender wheel -2- if securing bolts -1- have been unscrewed.

Notes:

- ♦ If the securing bolts are tightened a second time, the seats for the countersunk bolt heads in the sender wheel will be distorted to such an extent that the bolt heads will come into direct contact with the crankshaft -3- -arrows- and the sender wheel will only fit loosely under the bolts.
- ♦ The mounting holes are asymmetrically spaced, so it is only possible to install the sender wheel in one position.

Tightening torque

Component	Nm
Sender wheel to crankshaft	10 + 90° 1)2)

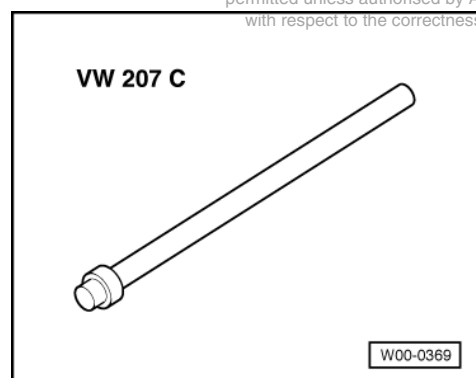
- 1) Replace bolts
- 2) 90° corresponds to a quarter of a turn

3.2 - Removing and installing needle bearing in crankshaft

Notes:

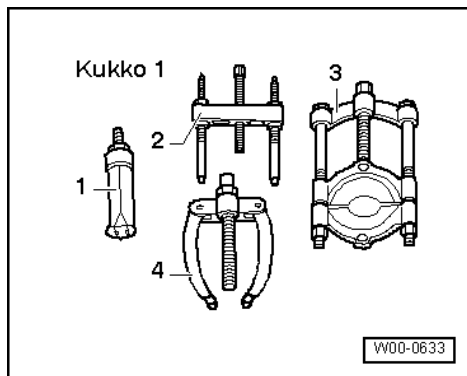
- ♦ A needle bearing must be fitted in the crankshaft on vehicles with manual gearbox. Install needle bearing if necessary.
- ♦ The needle bearing must not be fitted in the crankshaft on vehicles with automatic gearbox. Remove needle bearing if necessary.

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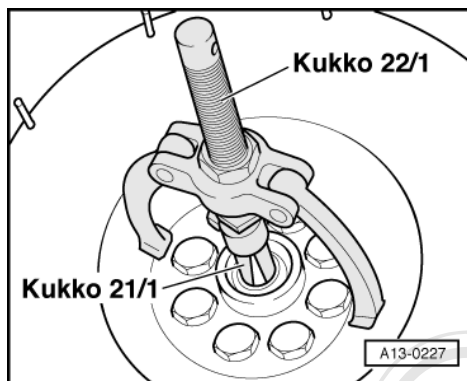


Special tools and workshop equipment required

- ♦ Drift 207 c

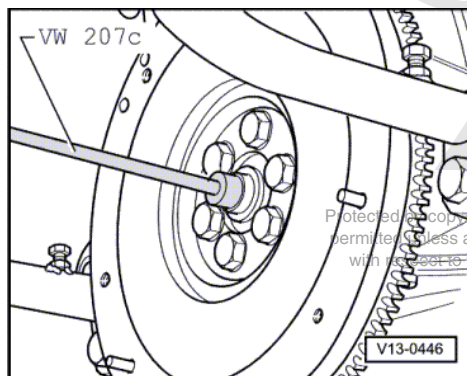


- ♦ Special tool Kukko 21/1 (Item 1) and Kukko 22/1 (Item 4)



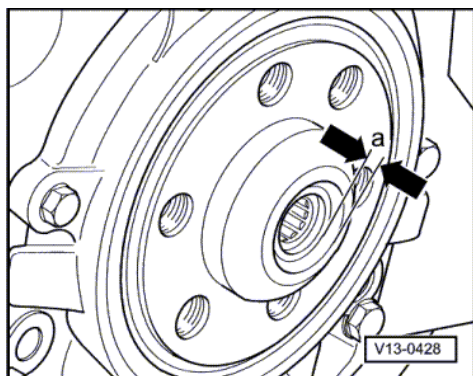
Removing

- -> Pull out needle bearing with Kukko 21/1 and Kukko 22/1.



Installing

- -> Drive in using drift VW 207C or centring drift 3176.
- Lettering on needle bearing must be visible when installed.



-> Installation depth of needle bearing

♦ Dimension a = 1.5 mm

3.3 - Crankshaft dimensions

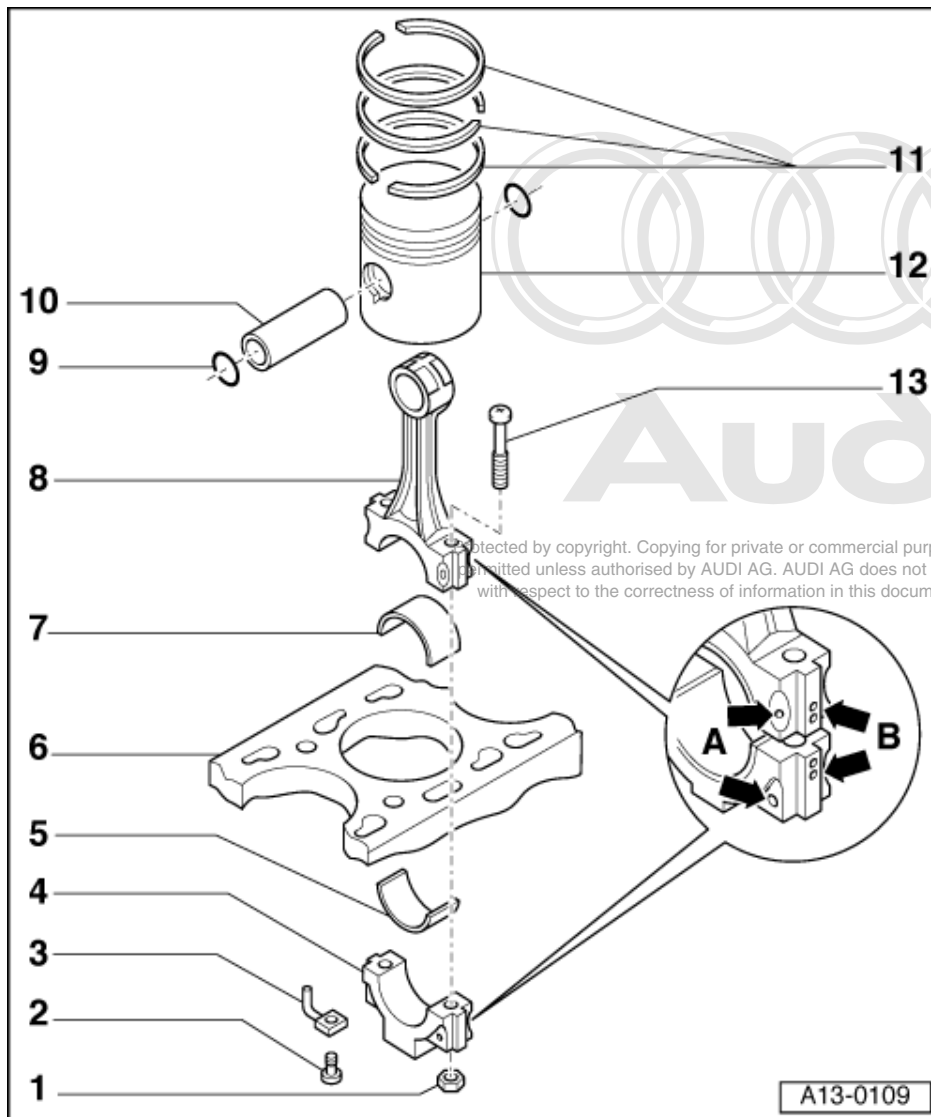
(in mm)

Honing dimension	Crankshaft bearing journal $\varnothing$	Conrod bearing journal $\varnothing$
Basic dimension	-0.017	-0.022
	54.00	47.80
	-0.037	-0.042
1st undersize	-0.017	-0.022
	53.75	47.55
	-0.037	-0.042
2nd undersize	-0.017	-0.022
	53.50	47.30
	-0.037	-0.042
3rd undersize	-0.017	-0.022
	53.25	47.05
	-0.037	-0.042

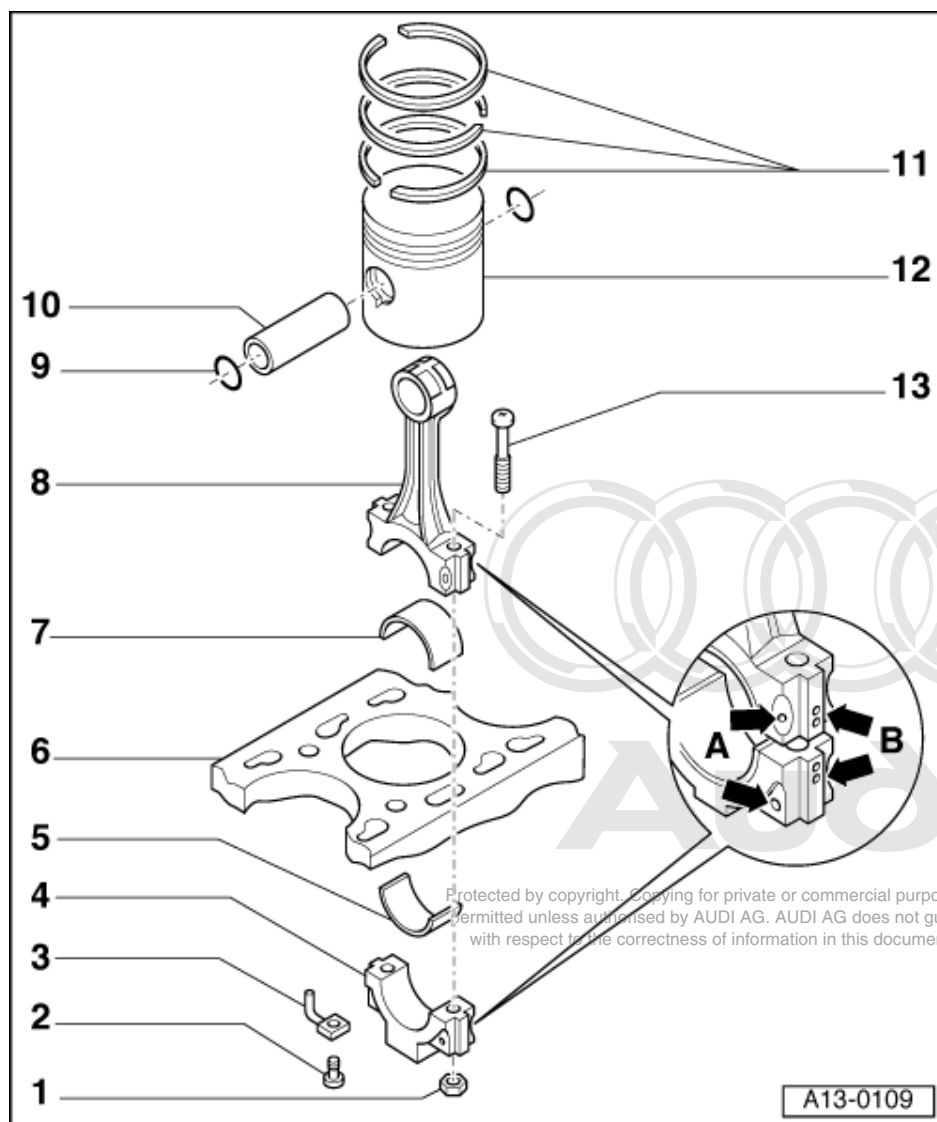
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4 - Dismantling and assembling pistons and conrods

4.1 - Dismantling and assembling pistons and conrods



- 1 30 Nm + 1/4 turn (90°) further
 - ♦ Replace conrod bolt -Item 13 -
 - ♦ Oil threads and contact surface
 - ♦ To measure radial play tighten to 30 Nm but not further
- 2 Pressure relief valve, 27 Nm
 - ♦ Opens at:
Excess pressure of 2.5...3.2 bar
- 3 Oil spray jet
 - ♦ For piston cooling

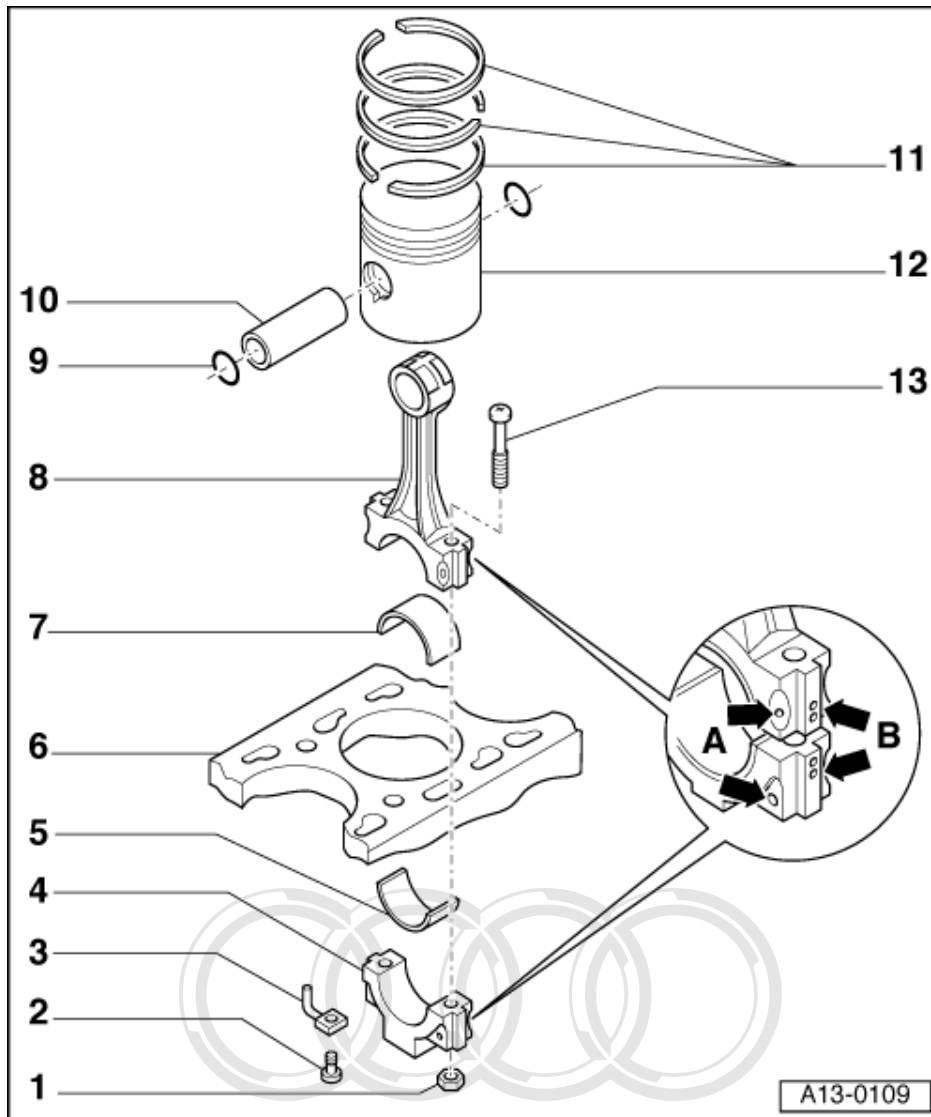


4 Conrod bearing cap

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

5 Bearing shell

- ◆ Note installation position
- ◆ Do not interchange used bearing shells (mark).
- ◆ Ensure retaining lugs fit tightly in recesses.
- ◆ Axial play
New: 0.10...0.35 mm
Wear limit: 0.40 mm
- ◆ Check radial play with Plastigage:
New: 0.01...0.05 mm
Wear limit: 0.12 mm
Do not rotate crankshaft when checking radial play
- ◆ To measure radial play, tighten nuts -Item 1 - to 30 Nm but do not turn further.

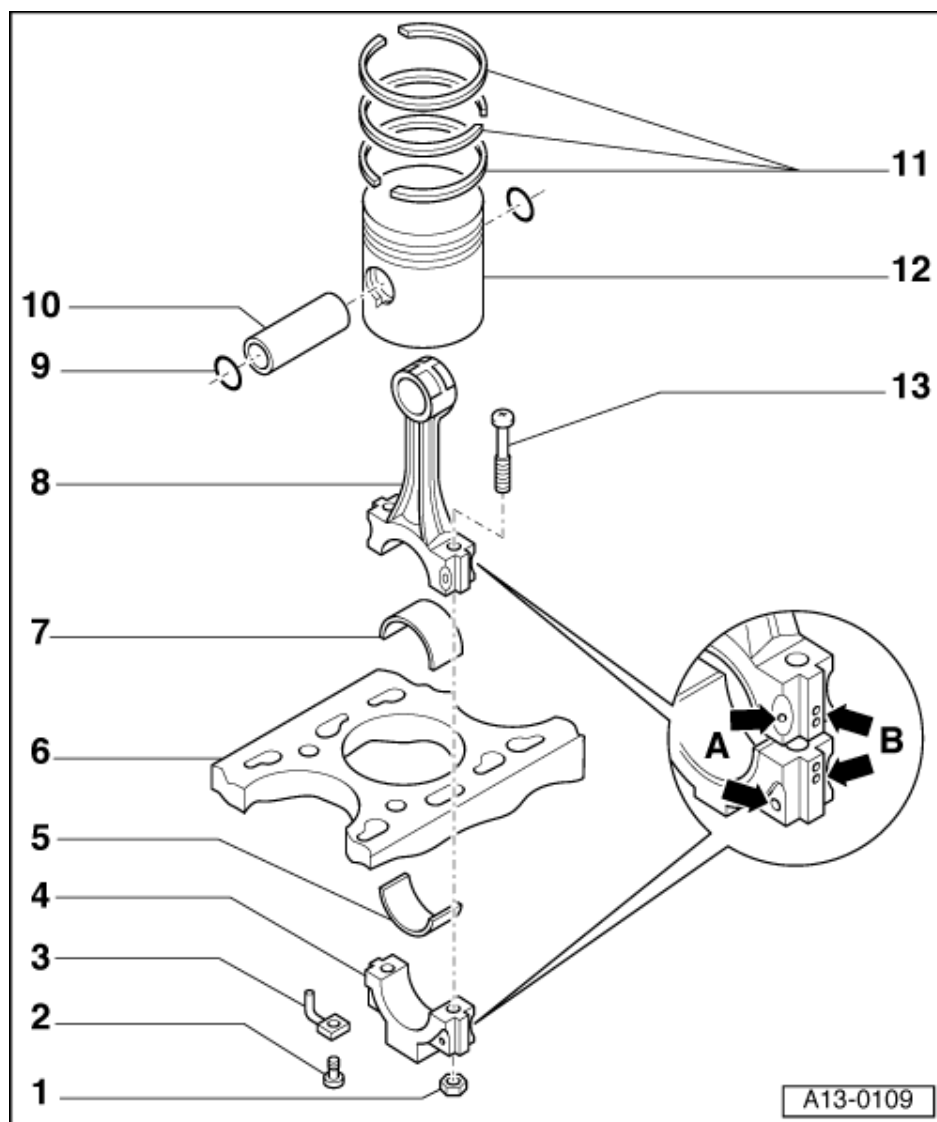


6 Cylinder block

- ◆ Checking cylinder bore
=> Fig. 67
- ◆ Piston and cylinder dimensions
=>Page 67.

7 Bearing shell

- ◆ With oil bore for piston pin lubrication
- ◆ Note installation position
- ◆ Do not interchange used bearing shells (mark).
- ◆ Axial play
New: 0.10...0.35 mm
Wear limit: 0.40 mm
- ◆ Check radial play with Plastigage:
New: 0.01...0.05 mm
Wear limit: 0.12 mm
Do not rotate crankshaft when checking radial play
- ◆ To measure radial play, tighten nuts -Item 1 - to 30 Nm but do not turn further.



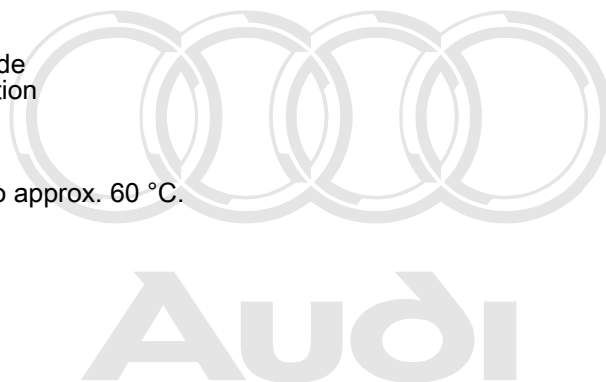
8 Conrod

- ◆ Only replace as a set
- ◆ Mark cylinder number B
- ◆ Installation position:
Markings A face towards pulley side
- ◆ With oil bore for piston pin lubrication

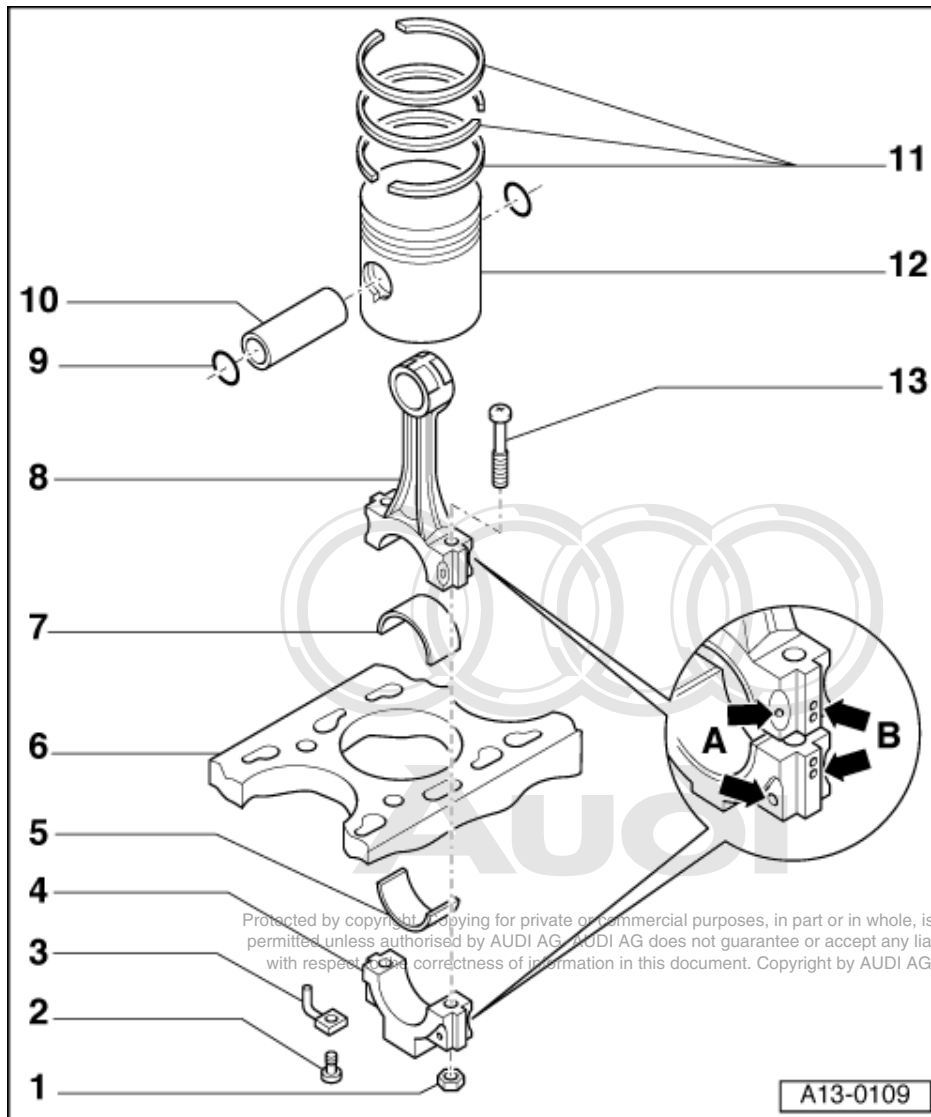
9 Circlip

10 Piston pin

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



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**11 Piston rings**

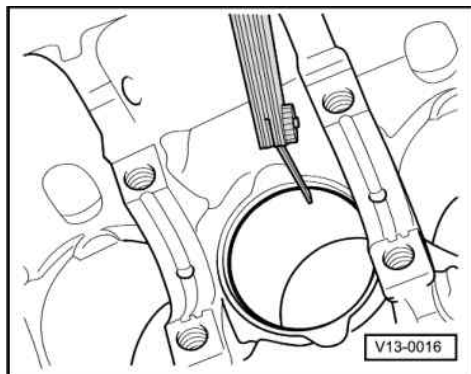
- ♦ Offset gaps by 120°
- ♦ Remove and install with piston ring pliers.
- ♦ "TOP" must face piston crown.
- ♦ Checking ring gap
=> Fig. 66
- ♦ Checking ring to groove play
=> Fig. 66

12 Piston

- ♦ Checking => Fig. 67
- ♦ Mark installation position and cylinder number.
- ♦ Arrow on piston crown points to pulley end.
- ♦ Install using piston ring clamp.

13 Conrod bolt

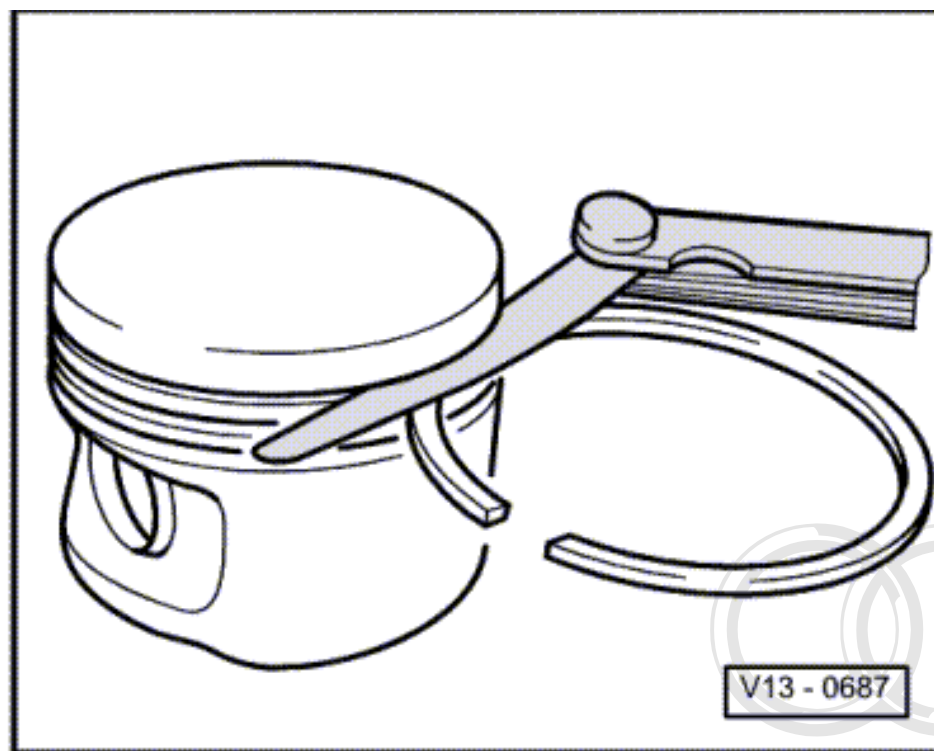
- ♦ Replace



-> 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	0.8
2nd compression ring	0.20...0.40	0.8
Oil scraper ring	0.25...0.50	0.8



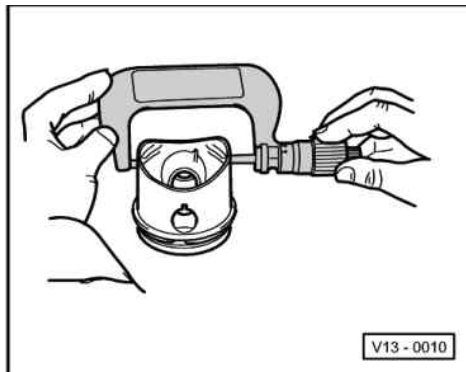
-> Fig.2 Checking ring to groove play

- Clean groove before checking play.

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.06...0.09	0.20
2nd compression ring	0.05...0.08	0.20

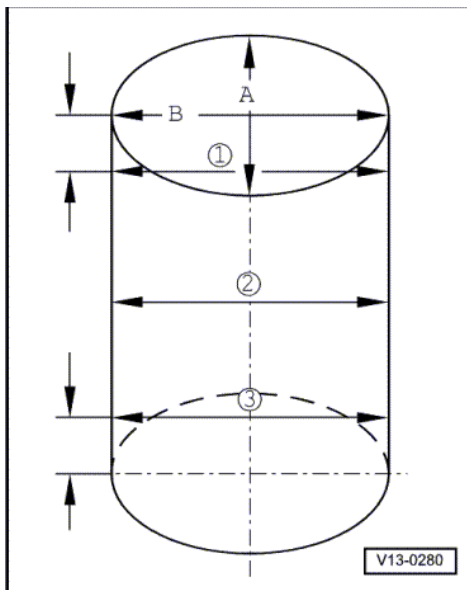
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Piston ring Dimensions in mm	New	Wear limit
Oil scraper ring	0.03...0.06	0.15



-> 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 Checking cylinder bores

- 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.

4.2 - Piston and cylinder dimensions

Honing dimension	Piston ø	Cylinder bore ø
Basic dimension mm	80.975 1)	81.01
Oversize mm	81.475 1)	81.51

1) Dimension without graphite coating (thickness 0.02 mm)



The graphite coating wears away.



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15 - Cylinder head, Valve gear

1 - Removing and installing cylinder head

1.1 - Removing and installing cylinder head

Notes:

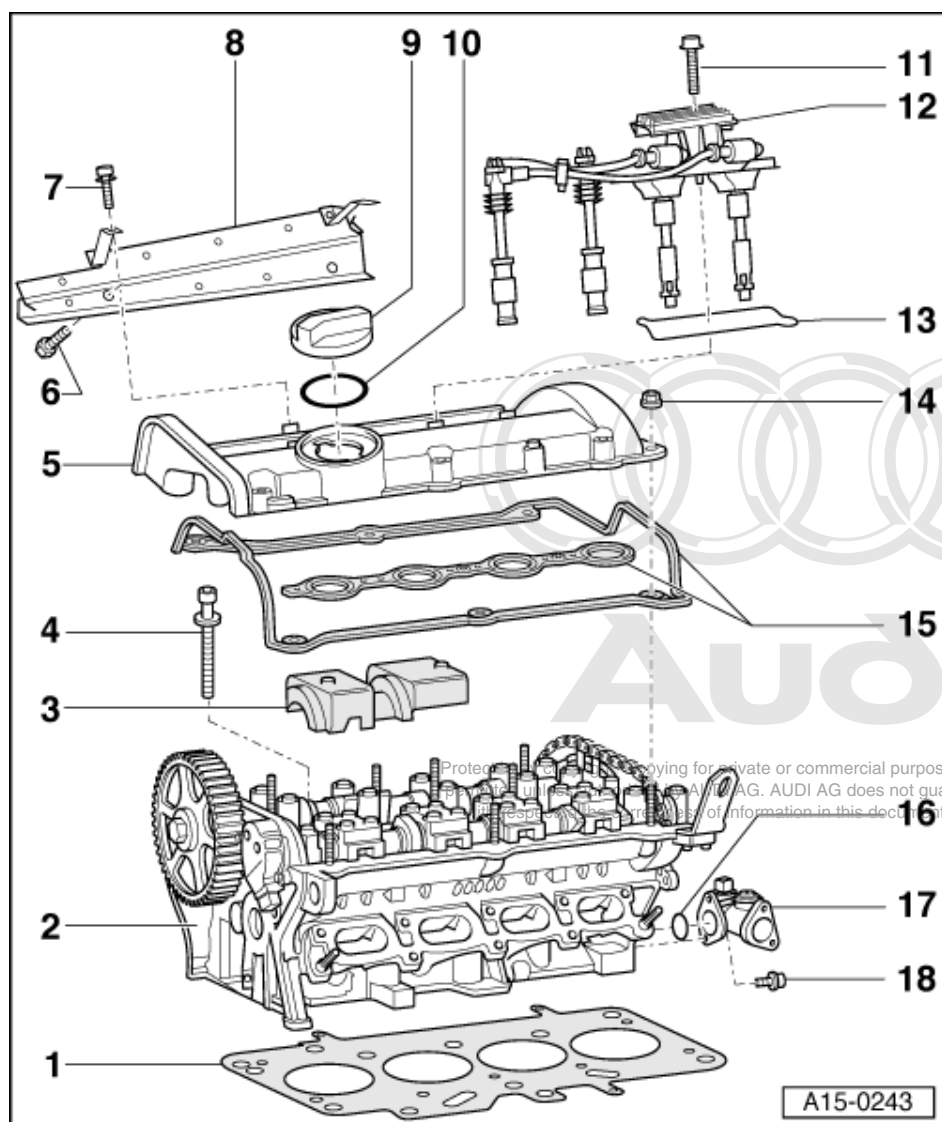
- ◆ Replace the cylinder head bolts.
- ◆ When performing repairs, replace seals, gaskets, self-locking nuts and bolts which have a specified tightening angle.
- ◆ When installing a replacement cylinder head with the camshafts fitted, the contact surfaces between bucket tappet and cam running surface 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.



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1.2 - Part I

**1 Replace cylinder head gasket**

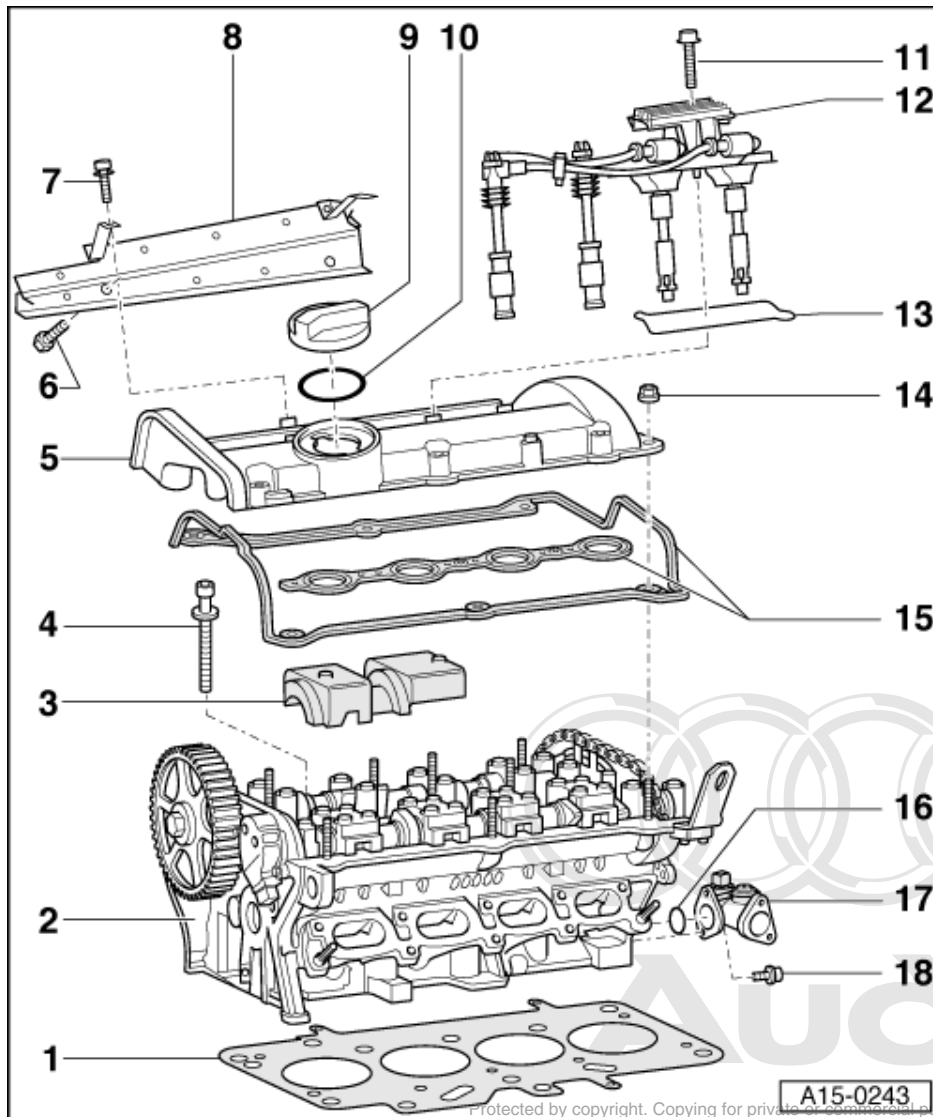
- ◆ Removing cylinder head
=> Page 83 .
- ◆ Installation position: Part No. to cylinder head
- ◆ After replacing, fill with fresh coolant

2 Cylinder head

- ◆ Removing => Page 83
- ◆ Checking for distortion
=> Fig. 75
- ◆ Reworking dimension
=> Fig. 75
- ◆ Installing => Page 85
- ◆ After replacing, fill with fresh coolant

3 Oil deflector

- ◆ Note correct installation position:
via inlet camshaft between cylinder 1 and 2



A15-0243

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4 Cylinder head bolt

- ◆ Replace
- ◆ Note sequence when loosening => Page 85
- ◆ Note sequence when tightening => Page 86

5 Cylinder head cover

- ◆ Removing and installing
=>Page 81.

6 20 Nm

7 10 Nm

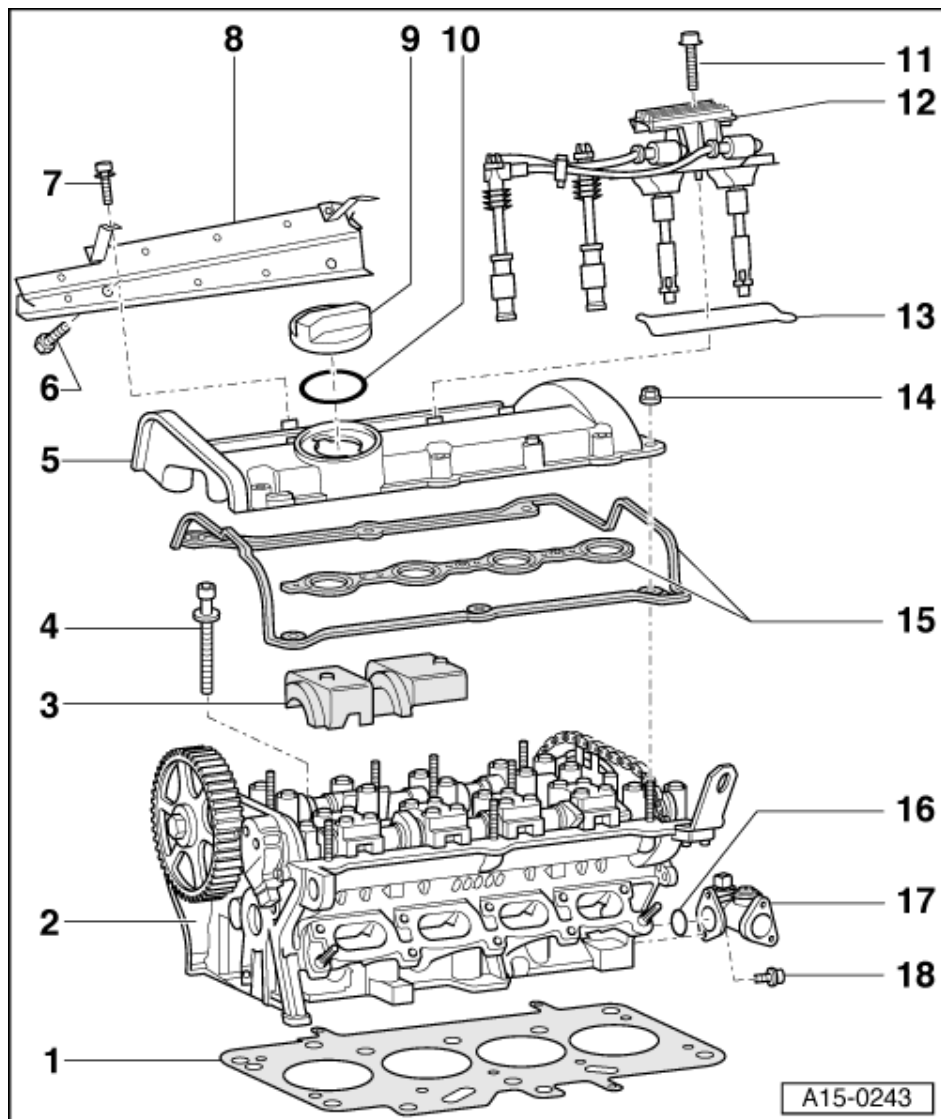
8 Heat shield

9 Cap

10 Seal

- ◆ Replace if damaged or leaking

11 10 Nm



12 Ignition coil

- ♦ With output stage and spark plug connectors

13 Seal

- ♦ For ignition coil
- ♦ Replace if damaged

14 10 Nm

15 Cylinder head cover gasket

- ♦ Replace if damaged or leaking
- ♦ Before fitting gasket apply sealant at sealing points => Fig. 75

16 O-ring

- ♦ Replace

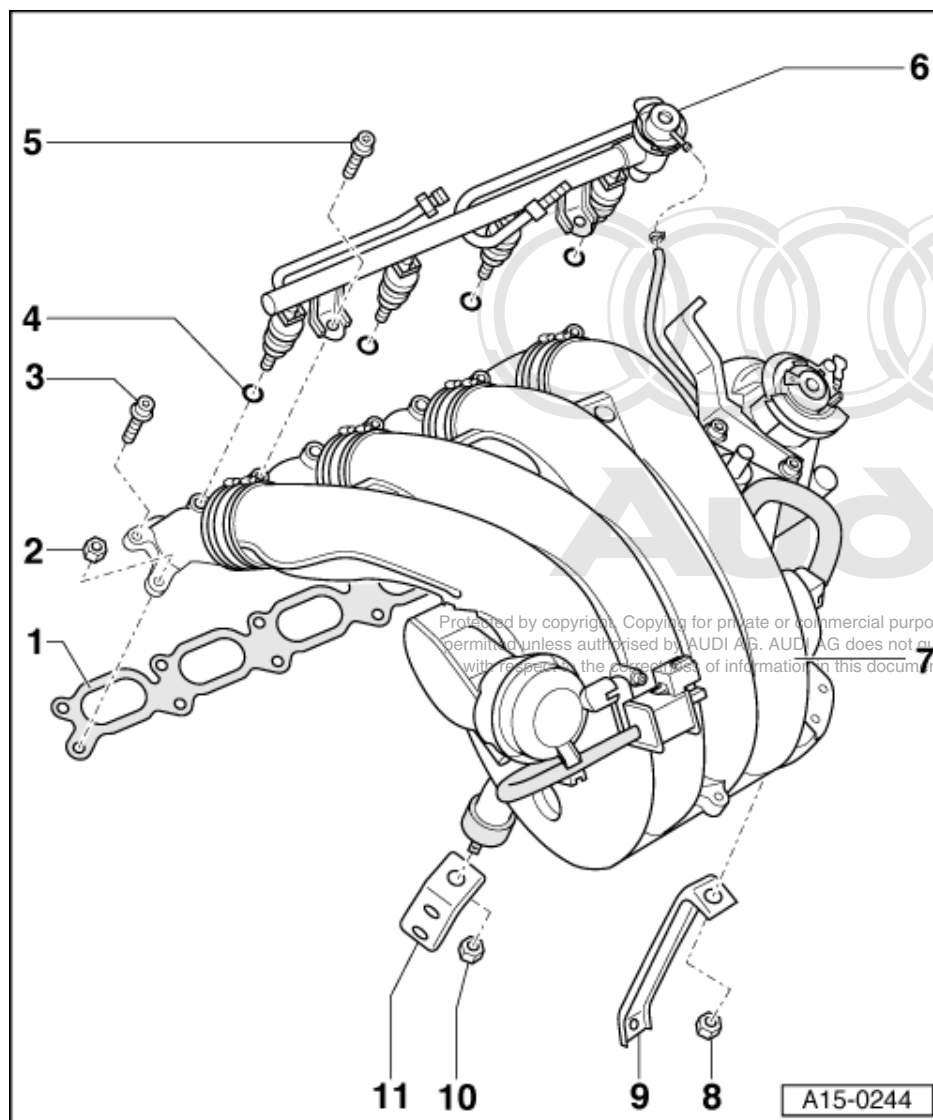
17 Coolant flange

- ♦ With coolant temperature sender

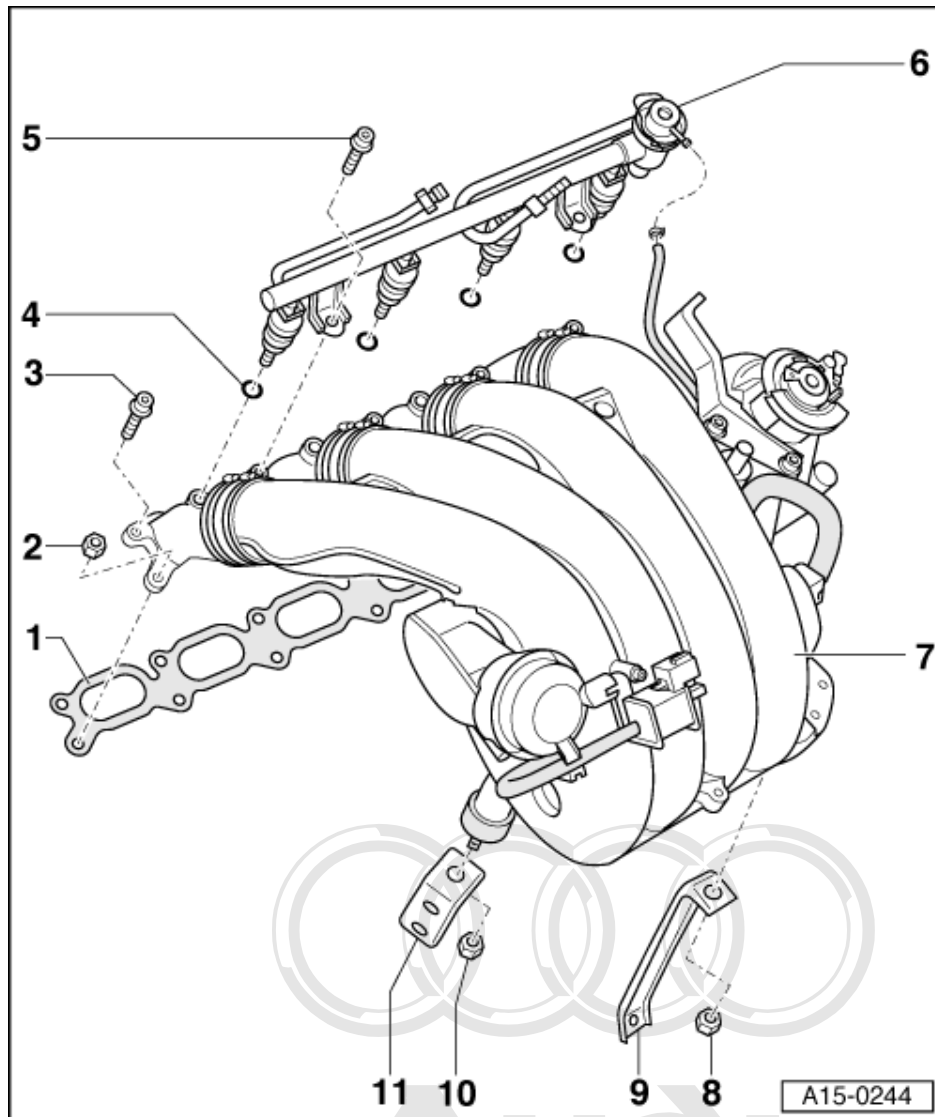
18 10 Nm

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1.3 - Part II



- 1 **Seal**
 - ♦ Replace
- 2 **10 Nm**
- 3 **10 Nm**
- 4 **O-ring**
 - ♦ For injector
 - ♦ Replace
- 5 **10 Nm**
- 6 **Fuel rail pipe**
 - ♦ With injectors

**7 Intake manifold**

- ♦ Cannot be dismantled
- ♦ Checking intake manifold change-over function:

Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted without the express written consent of Audi AG.
 => Motronic Injection and Ignition System (4-cylinder, 5-valve); Repair group 24; Checking intake manifold change-over function; Checking function Checking intake manifold change-over function Checking function

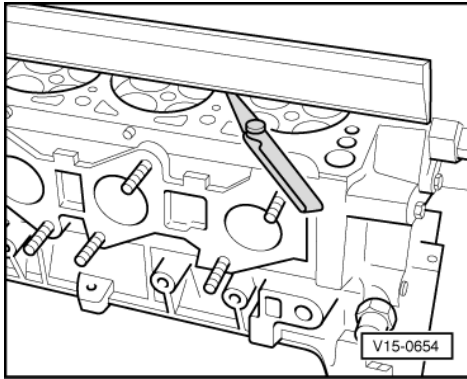
- ♦ With intake air temperature sender -G42
- ♦ With vacuum unit for intake manifold changeover function
- ♦ Removing and installing=>Page 76

8 25 Nm**9 Support**

- ♦ For intake manifold

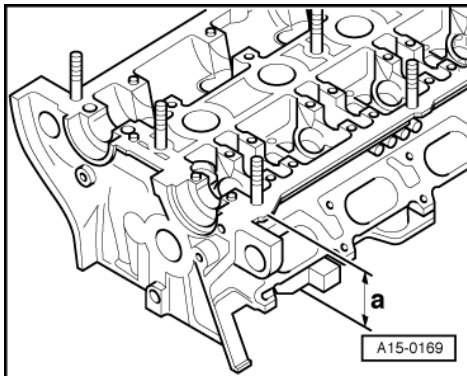
10 25 Nm**11 Support**

- ♦ For intake manifold



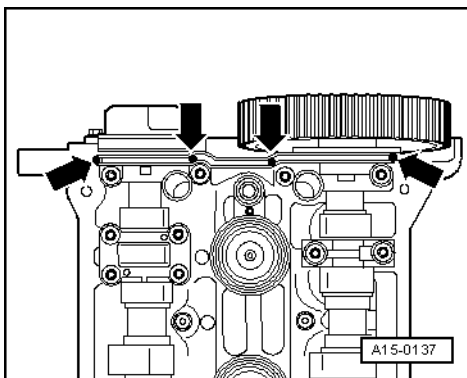
-> Fig.1 Checking cylinder head for distortion

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



-> Fig.2 Reworking dimension for cylinder head

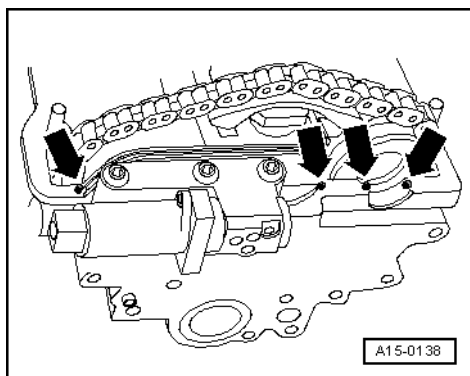
- Reworking the cylinder head (grinding to level surface) is only permitted down to minimum dimension -a-.
- Minimum dimension a = 139.25 mm



-> Fig.3 Sealing points for bearing caps/ cylinder head

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

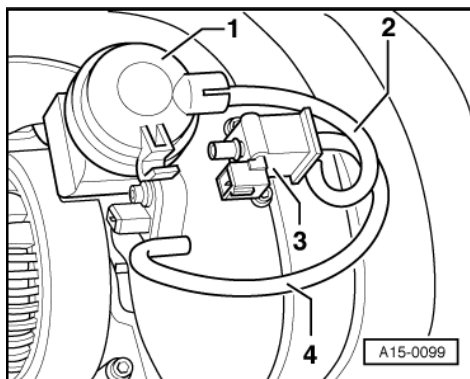
=> Parts List



-> Fig.4 Sealing connections between camshaft adjuster and cylinder head

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

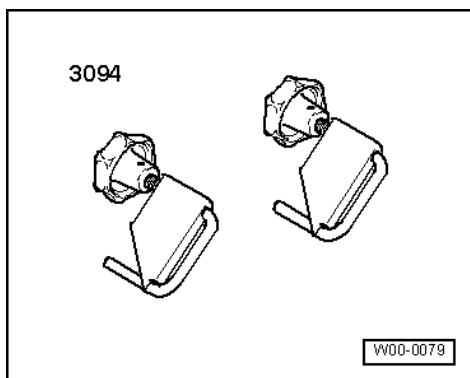
=> Parts List



-> Fig.5 Connection diagram for intake manifold changeover function

- 1 - Vacuum unit for intake manifold changeover
- 2 - Vacuum hose, solenoid valve/vacuum unit
- 3 - Intake manifold changeover solenoid valve -N156
- 4 - Vacuum hose, solenoid valve/intake manifold

1.4 - Removing and installing intake manifold



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Special tools and workshop equipment required

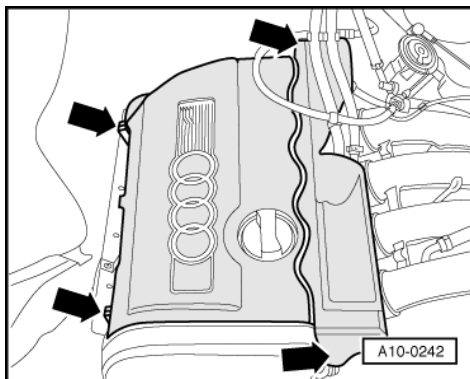
- ♦ Hose clamps 3094

Removing

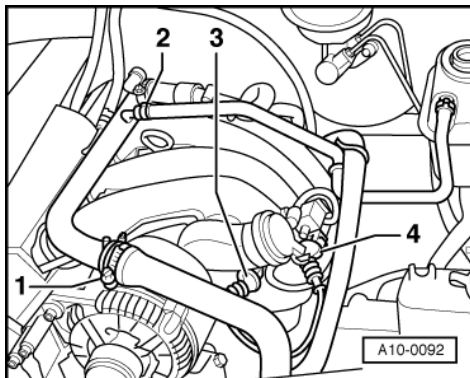
Note:

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 earth strap at battery with ignition switched off.
- Drain coolant => Page **141**.

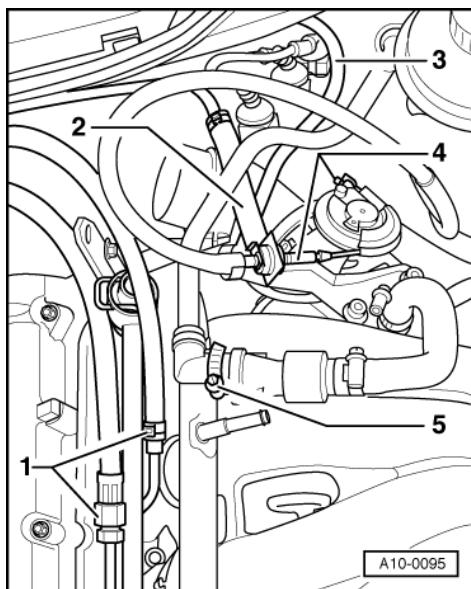


- -> Remove cover over injectors -arrows on right-.



- -> Disconnect top coolant hose -1- leading to radiator from coolant pipe.
- Cut through cable ties at top of coolant hose.
- Detach connector at intake air temperature sender -G42 -Item 3- and at solenoid valve for intake manifold changeover -Item 4-.
- Disconnect coolant hose -2- leading to expansion tank at coolant pipe at top.
- Unplug connector -1- at throttle valve control part -J338.

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- Detach the throttle cable from throttle valve control unit and resistance bearing -arrows- (do not remove retainer).
- Disconnect the following vacuum lines:
 - 2 - to solenoid valve 1 for activated charcoal filter -N80
 - 3 - to AC
 - 5 - to servo unit
- Disconnect coolant hoses from throttle valve control part.

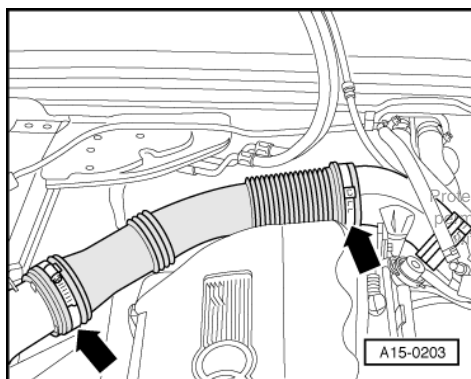
Note:

Fuel lines -1- and -2- do not have to be disconnected.

- Cut open all cable ties at cylinder head, lay wiring aside.
- Unscrew bracket between cylinder head and intake manifold in area of fuel pressure regulator.

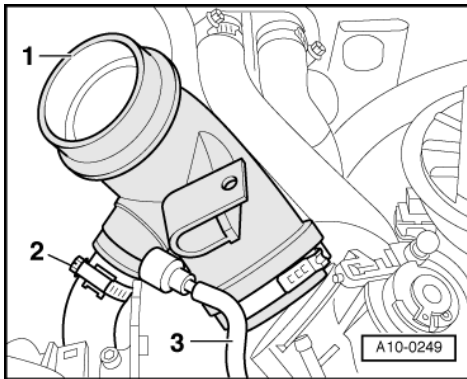
Vehicles with cruise control system

- Detach vacuum hose from vacuum unit.
- Remove operating rod.

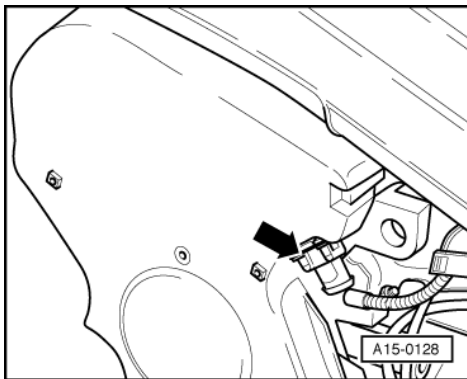


All models:

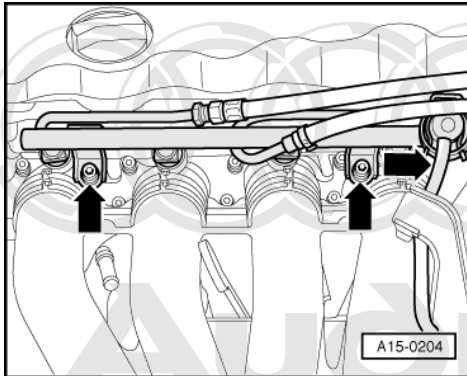
- -> Disconnect air intake hose at intake pipe connection and air mass meter -arrows-.



- -> Disconnect intake pipe connection -1- from throttle valve connection.
- Disconnect vacuum hose 3.
- Detach hose -2- to crankcase breather.

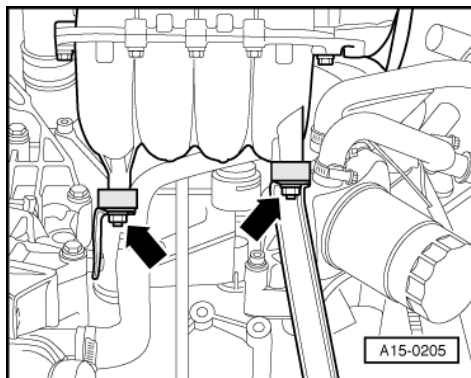


- -> Unplug connector -arrow- at Hall sender -G40.
- Unscrew coolant pipe (rear) at flange and at brackets.

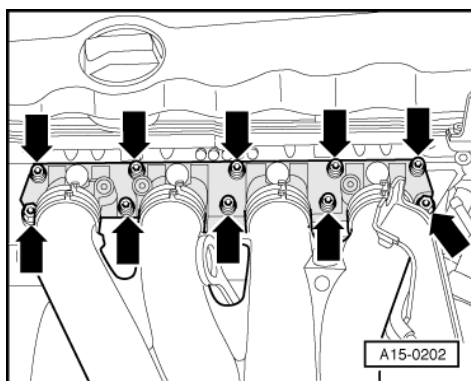


- -> Unscrew retaining bolts for fuel rail and detach vacuum line from fuel pressure regulator -arrows-.
- Detach fuel distributor rail together with injectors from intake manifold and place it on a clean cloth at the back of the engine compartment.

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- -> Unbolt intake manifold from the two bottom supports -arrows-.



- Pull out oil dipstick.
- -> Unbolt intake manifold from cylinder head -arrows- and remove.

Note:

Plug intake ports on cylinder head with clean cloths.

Installing

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

Note:

Replace gaskets and seals.

- Check throttle cable setting

=> Fuel Supply - Petrol Engines; Repair group 20

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- Top up coolant => Page 143

Note:

When the battery is reconnected make sure that the vehicle equipment (radio, clock, electrical window lifter) is activated according to the operating instructions.

- Perform throttle-valve control unit adaption:

=> Motronic Injection and Ignition System (4-cylinder, 5-valve); Repair group 24; Checking throttle valve control part; Adapting throttle valve control part to engine control unit Checking throttle valve control part Adapting throttle valve control part to engine control unit

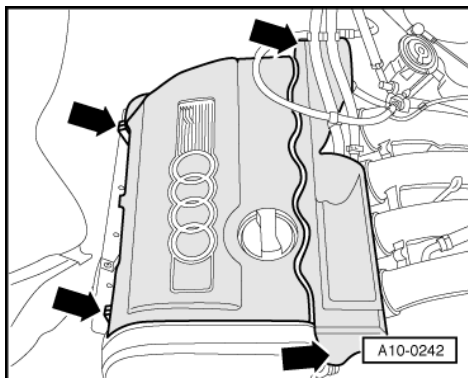
- To interrogate fault memory:

=> Motronic Injection and Ignition System (4-cylinder, 5-valve); Repair group 01; Interrogating and erasing fault memory Interrogating and erasing fault memory

Tightening torques

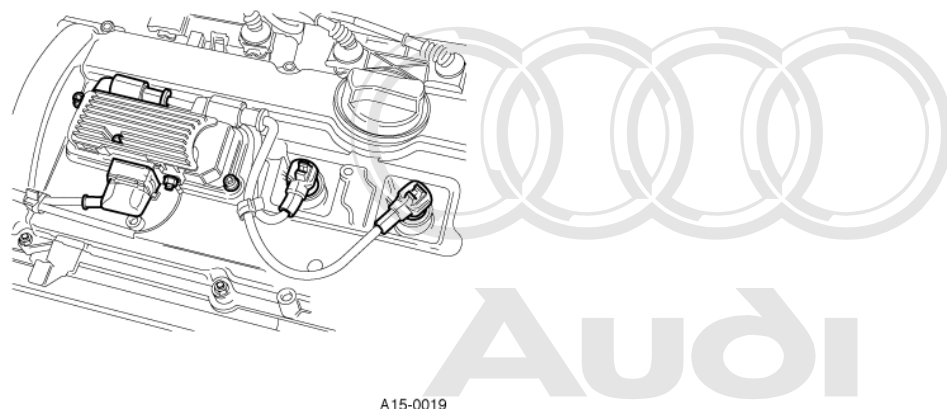
Component	Nm
Intake manifold to cylinder head	10
Support for intake pipe to intake pipe	20
Fuel distributor rail to intake manifold	10
Intake pipe connection to engine-lifting eye	10

1.5 - Removing and installing cylinder head cover

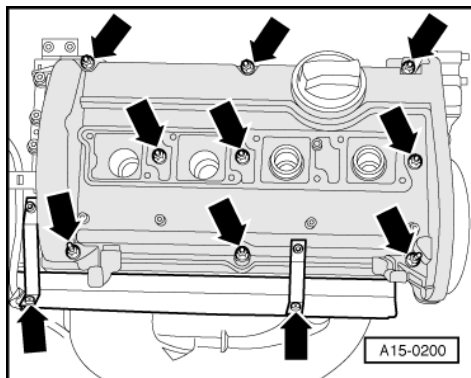


Removing

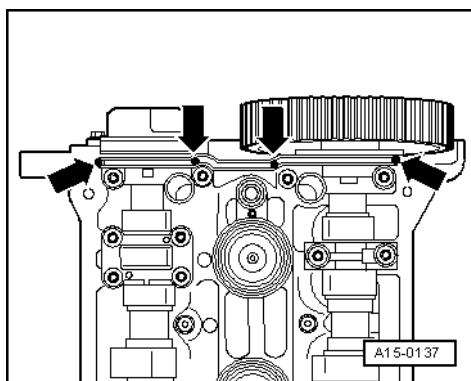
- -> Remove engine cover panels -arrows-.



- -> With ignition switched off, unscrew and unclip connector and earth wire from ignition coil with output stage -arrows-.
- Unbolt ignition coil and detach together with the two spark plug connectors.
- Remove upper toothed belt guard => Page 37



- -> Loosen nuts and bolts -arrows- on cylinder head cover and remove cylinder head cover.



Installing

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

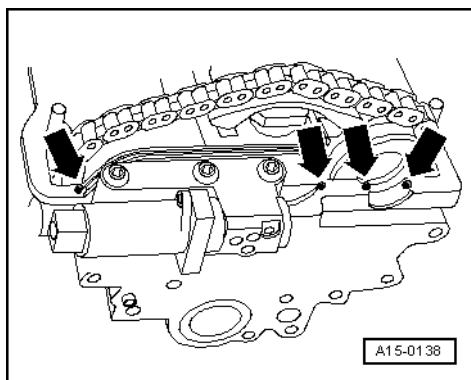
Note:

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Replace gasket if damaged.

- -> Apply a small quantity of sealant to joints -arrows- on upper sealing surface of cylinder head.
- Sealants

=> Parts List



- -> Apply a small quantity of sealant to joints -arrows- on upper sealing surface of cylinder head.
- Sealants

=> Parts List

- Tighten nuts for cylinder head cover in diagonal sequence.

Tightening torques

Component	Nm
Cylinder head cover to cylinder head	10
Ignition coil with output stage to cylinder head cover	10

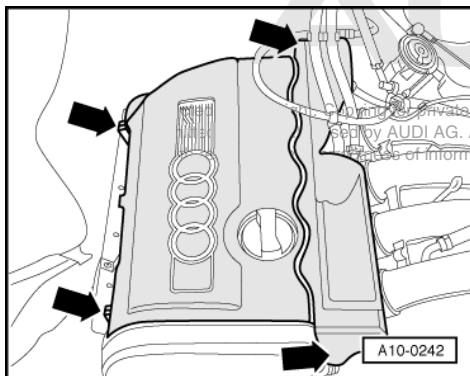
1.6 - Removing cylinder head

- Engine in vehicle

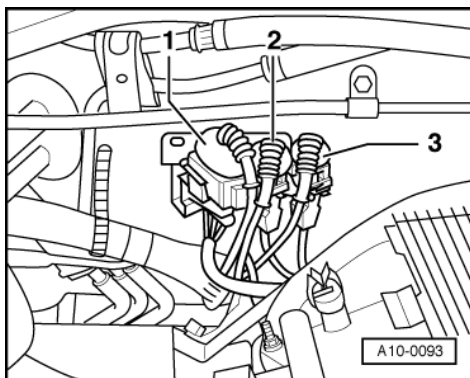
Note:

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 earth strap at battery with ignition switched off.
- Drain coolant => Page 141 .
- Unscrew exhaust manifold/front exhaust pipe connecting bolts.
- Unbolt gearbox support for exhaust system.
- Push exhaust system towards the rear so that studs on exhaust manifold are free.
- Remove intake manifold => Page 76 .

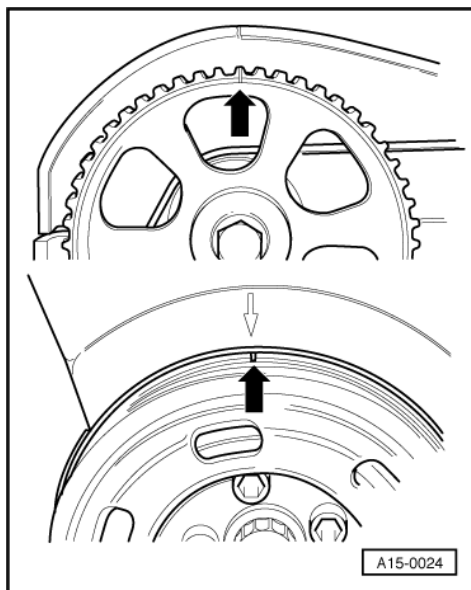


- -> Remove engine cover panels -arrows-.
- Disconnect both coolant hoses from heating system heat exchanger.
 - At the supply hose, lift retainer with screwdriver and detach hose.
 - Return hose: Slacken off clip.
- Unplug the connectors at the camshaft adjuster valve -N205 and at both temperature senders at rear at the cylinder head (the 2nd temperature sender is only fitted on vehicles with AC).

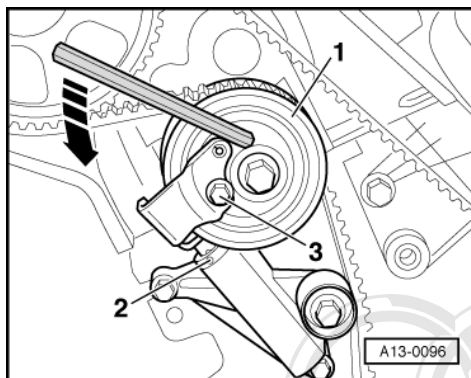


- -> Detach connector -1- of lambda probe on right at bulkhead and remove from bracket.
- Lay wiring aside.

- Remove upper toothed belt guard => Page 37



- -> Set crankshaft to markings for TDC of No. 1 cylinder -arrows- by turning central bolt on crankshaft sprocket in direction of rotation.

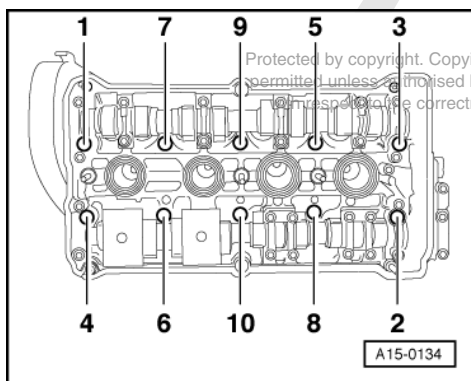


- -> Turn toothed belt tensioner -1- with 8 mm Allen key slowly with constant pressure in direction of arrow until the bores -2- of piston and housing of the tensioning element are aligned.
- In this position push pin T40011 in both bores.

Note:

Do not loosen bolt -3-.

- Take toothed belt off camshaft sprocket.
- Remove cylinder head cover => Page 81.



- -> Maintain sequence when loosening cylinder head bolts.
- Remove cylinder head.

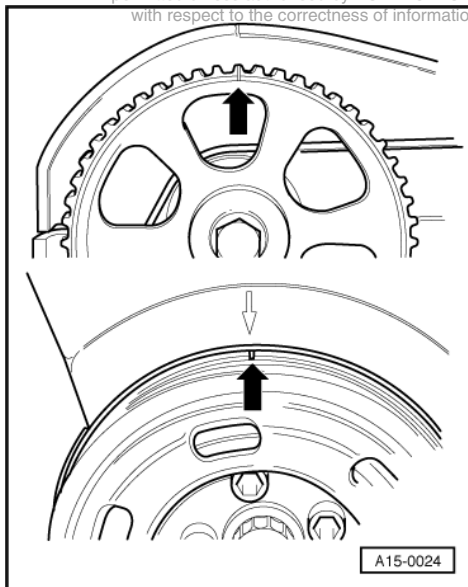
1.7 - Installing cylinder head

Notes:

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

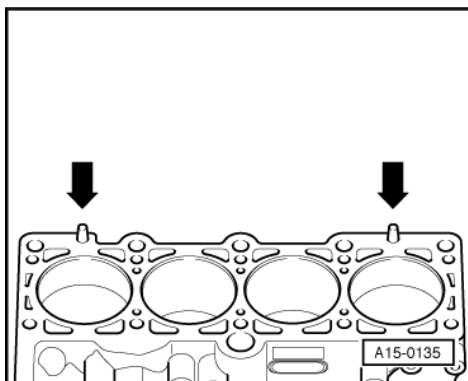
=> Parts List

- ◆ 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.



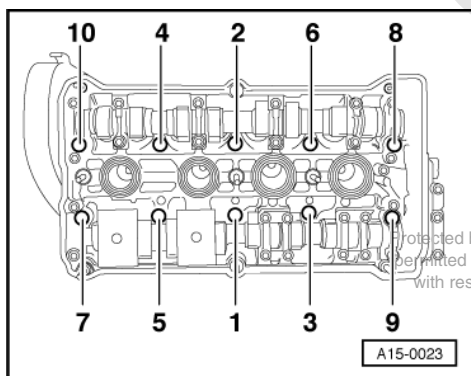
Installation is carried out in the reverse order; note the following:

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





- -> Place cylinder head gasket in position.
 - Note position of centring 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.
- Insert cylinder head bolts and tighten by hand.



- -> Tighten cylinder head bolts in two stages in sequence shown as follows:
- Tighten using torque wrench:
 - 1st Stage: 60 Nm
- Tighten with rigid wrench:
 - 2nd Stage: 180°(1/2 turn) further)

Notes:

- ♦ 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 .
- Install toothed belt (adjust valve timing) => Page 43 .

Note:

Note all instructions on removing and installing the toothed belt =>Page 41 .

- Install intake manifold => Page 80 .
- Check throttle cable setting

=> Fuel Supply - Petrol Engines; Repair group 20

- Stress-free alignment of exhaust system => Page 169
- Replace coolant => Page 143 .

Notes:

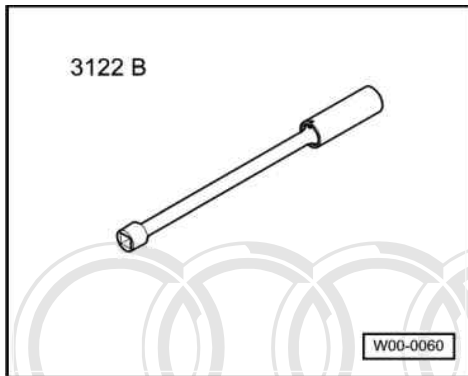
- ♦ When the battery is reconnected make sure that the vehicle equipment (radio, clock, electrical window lifter) is activated according to the operating instructions.
- ♦ Further measures after reconnection of voltage supply:

=> Motronic Injection and Ignition System (4-cylinder, 5-valve); Repair group 24

Tightening torques

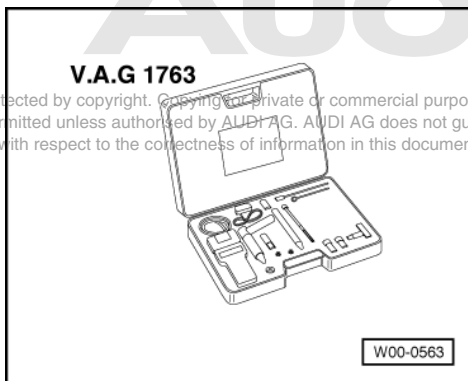
Component	Nm
Coolant connection to cylinder head	10
Upper coolant pipe to bracket for alternator, vane pump and idler wheel	20

1.8 - Checking compression



Special tools and workshop equipment required

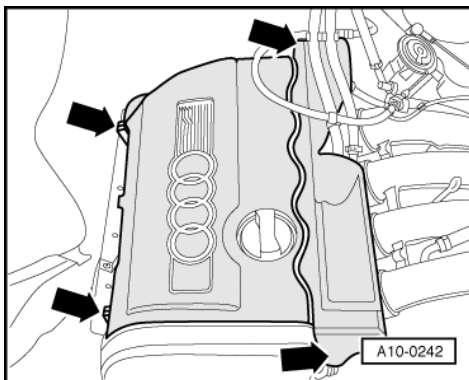
- ♦ Spark plug socket 3122 B



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

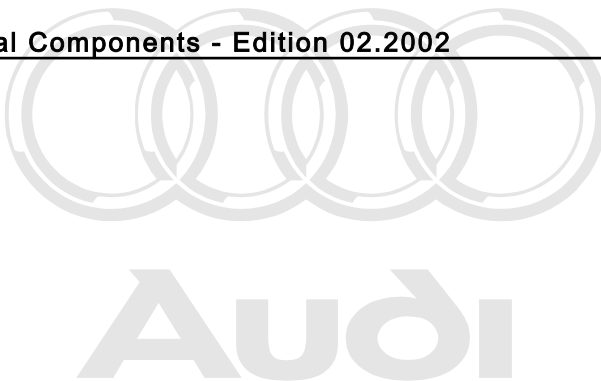
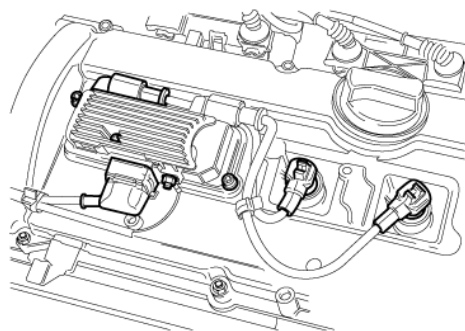
Test requirements:

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



Test sequence

- -> Remove engine cover panels -arrows-.



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A15-0019

- -> With ignition switched off, unscrew and unclip connector and earth wire from ignition coil with output stage -arrows-.
- Unbolt ignition coil and detach together with the two spark plug connectors.
- Unplug connectors from all injectors.
- Remove spark plugs with spark plug spanner 3122B.
- 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 cyl. pressure in bar
9.0...14.0	7.5	max. 3.0

- Fit spark plugs and ignition coil with output stage.
- To interrogate fault memory:

=> Motronic Injection and Ignition System (4-cylinder, 5-valve); Repair group 01; Interrogating and erasing fault memory 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.

Tightening torques

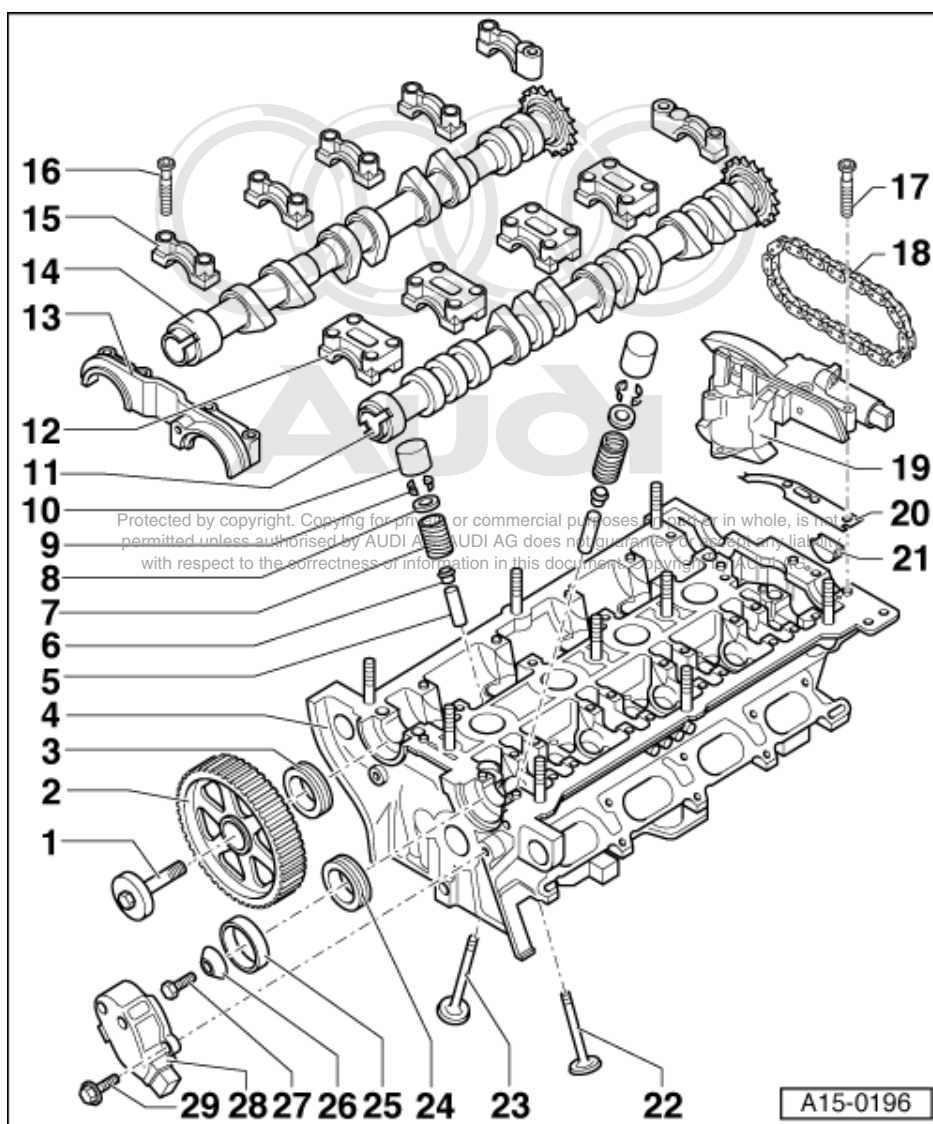
Component	Nm
Spark plugs in cylinder head	30
Ignition coil with output stage to cylinder head cover	10

2 - Servicing valve gear

2.1 - Servicing valve gear

Notes:

- ♦ 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.
- ♦ 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.
- ♦ Replace seals and gaskets.



1 65 Nm

- ♦ For loosening and tightening use counterhold 3036 =>Fig. 41

2 Camshaft sprocket

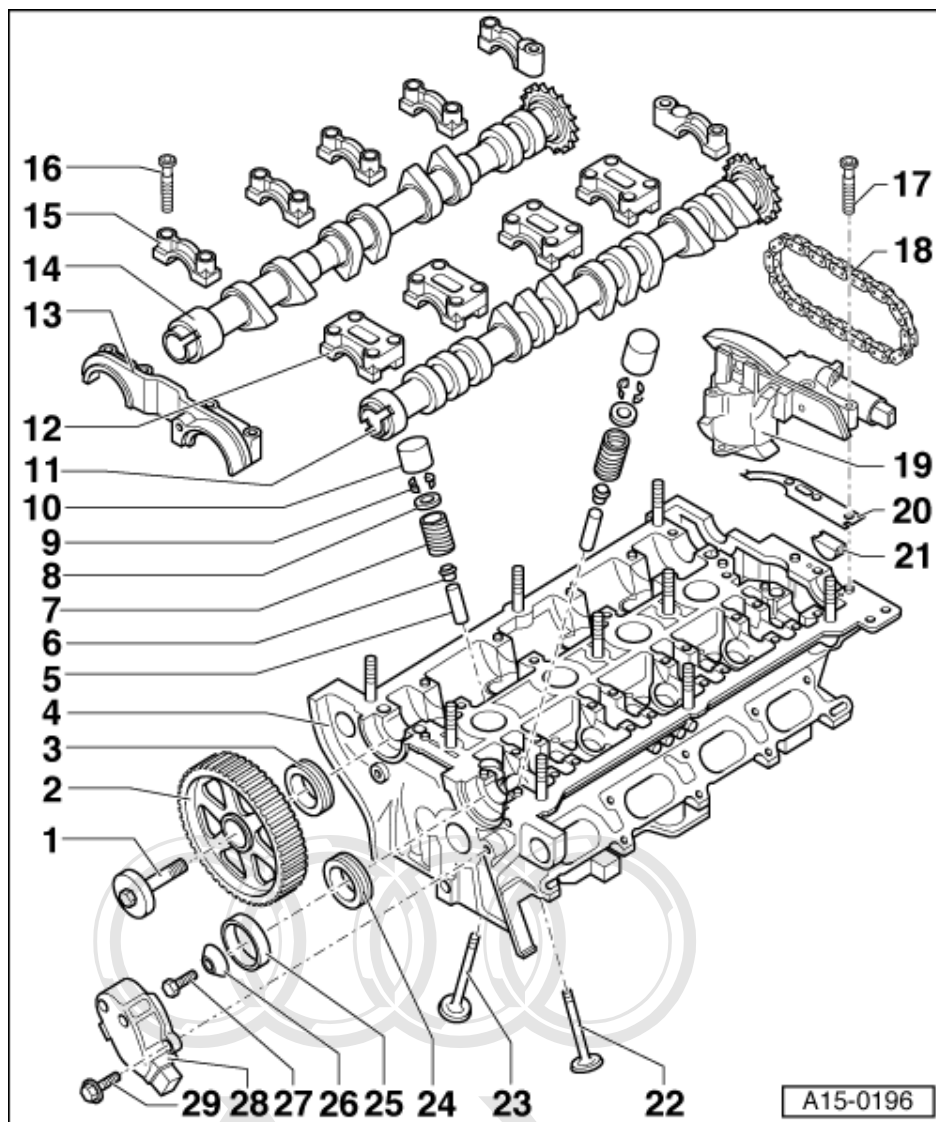
- ♦ For exhaust camshaft
- ♦ Note correct installation position:
The small web on the camshaft gear faces forward and the TDC mark on cylinder 1 is visible from the front =>Page 100

3 Oil seal

- ♦ For exhaust camshaft
- ♦ Replacing => Page 97 .

4 Cylinder head

- ♦ See note =>Page 89 .
- ♦ Checking valve guides =>Page 115 .
- ♦ Reworking valve seats =>Page 116 .
- ♦ Dowel sleeves for bearing caps must be located in cylinder head.



5 Valve guide

- ♦ Checking => Page 115

6 Valve stem seal

- ♦ replacing => Page 111
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7 Valve springs

- ♦ Removing and installing
=>Page 111 .

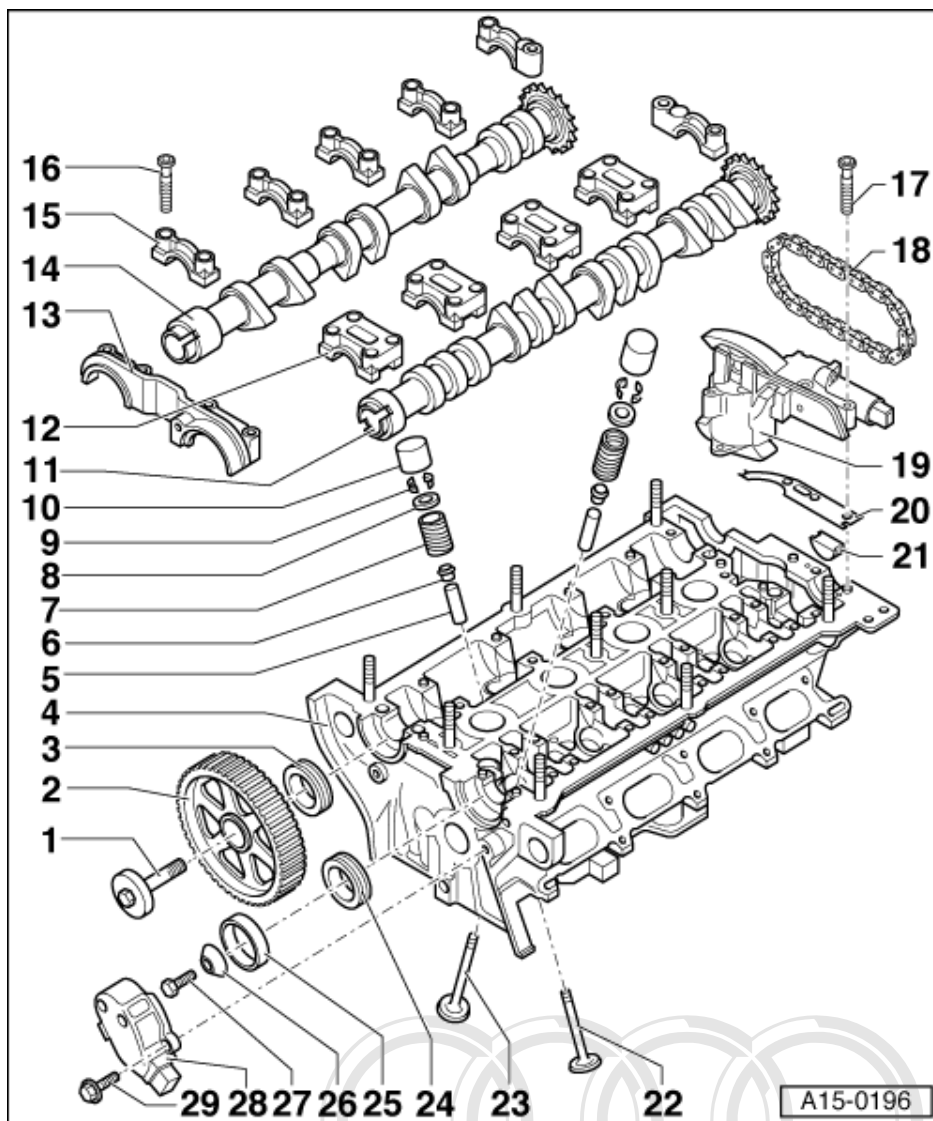
8 Valve spring plate

9 Valve cotters

10 Hydraulic bucket tappet

- ♦ Checking => Page 110
- ♦ Removing and installing
=>Page 111 .
- ♦ Do not interchange
- ♦ Store with cam contact surface downwards
- ♦ Before installing check camshaft axial play =>Page 95 .

- ♦ Oil contact surface



11 Inlet camshaft

- ♦ Check radial play with plastigage (bucket tappets not installed).
Wear limit: 0.1 mm
- ♦ Run-out: no more than 0.035 mm
- ♦ Checking axial play
=>Page 95 .
- ♦ Removing and installing camshafts => Page 103

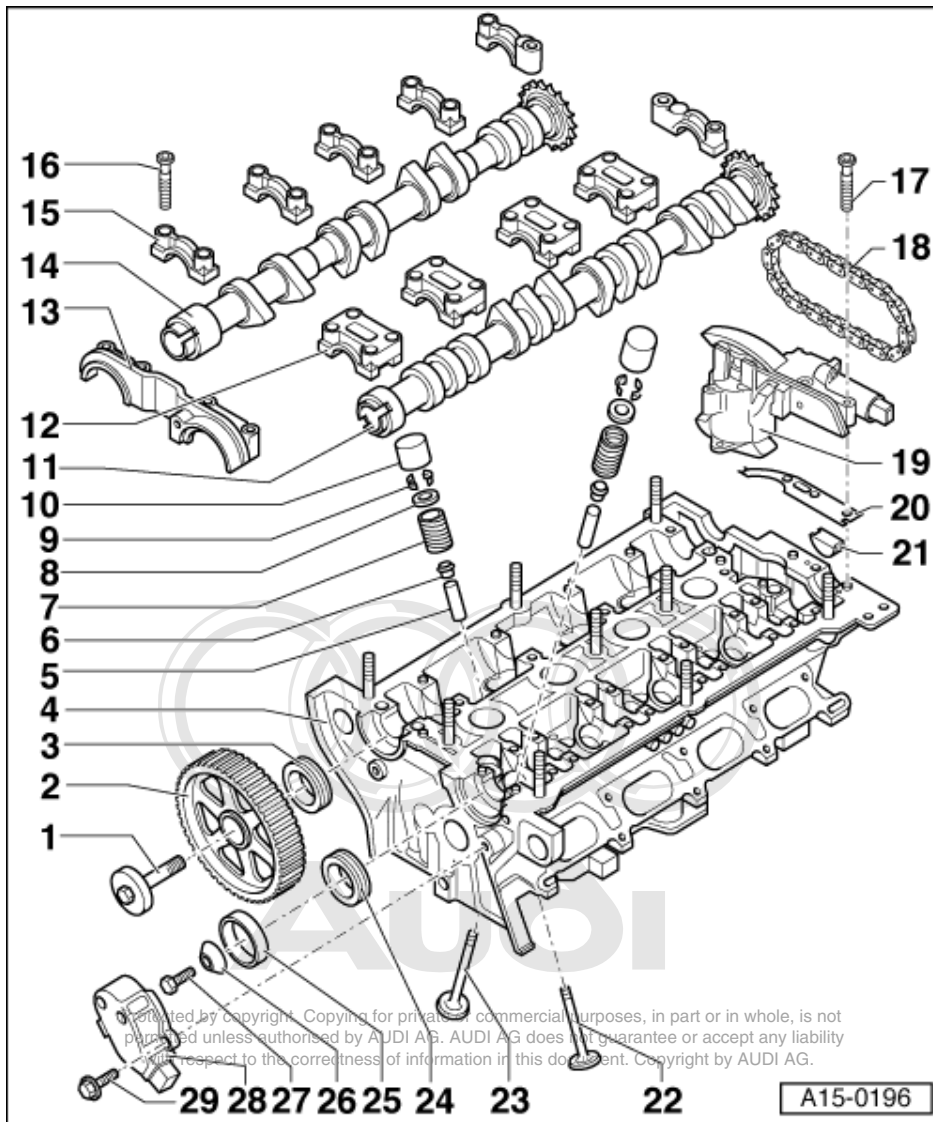
12 Bearing cap for inlet camshaft

- ♦ Must be located on dowel sleeves
- ♦ Dowel sleeves must be located in cylinder head.
- ♦ Note installation position
- ♦ Installation sequence
=>Page 106 .

13 Double bearing cap

- ♦ Must be located on dowel sleeves
- ♦ Dowel sleeves must be located in cylinder head.
- ♦ Coat sealing surface lightly with sealant before installation => Page 108
- ♦ Sealants

=> Parts List



14 Exhaust camshaft

- ♦ Check radial play with plastigage (bucket tappets not installed).
Wear limit: 0.1 mm
- ♦ Run-out: no more than 0.035 mm
- ♦ Checking axial play =>Page 95 .
- ♦ Removing and installing camshafts => Page 103

15 Bearing cap for exhaust camshaft

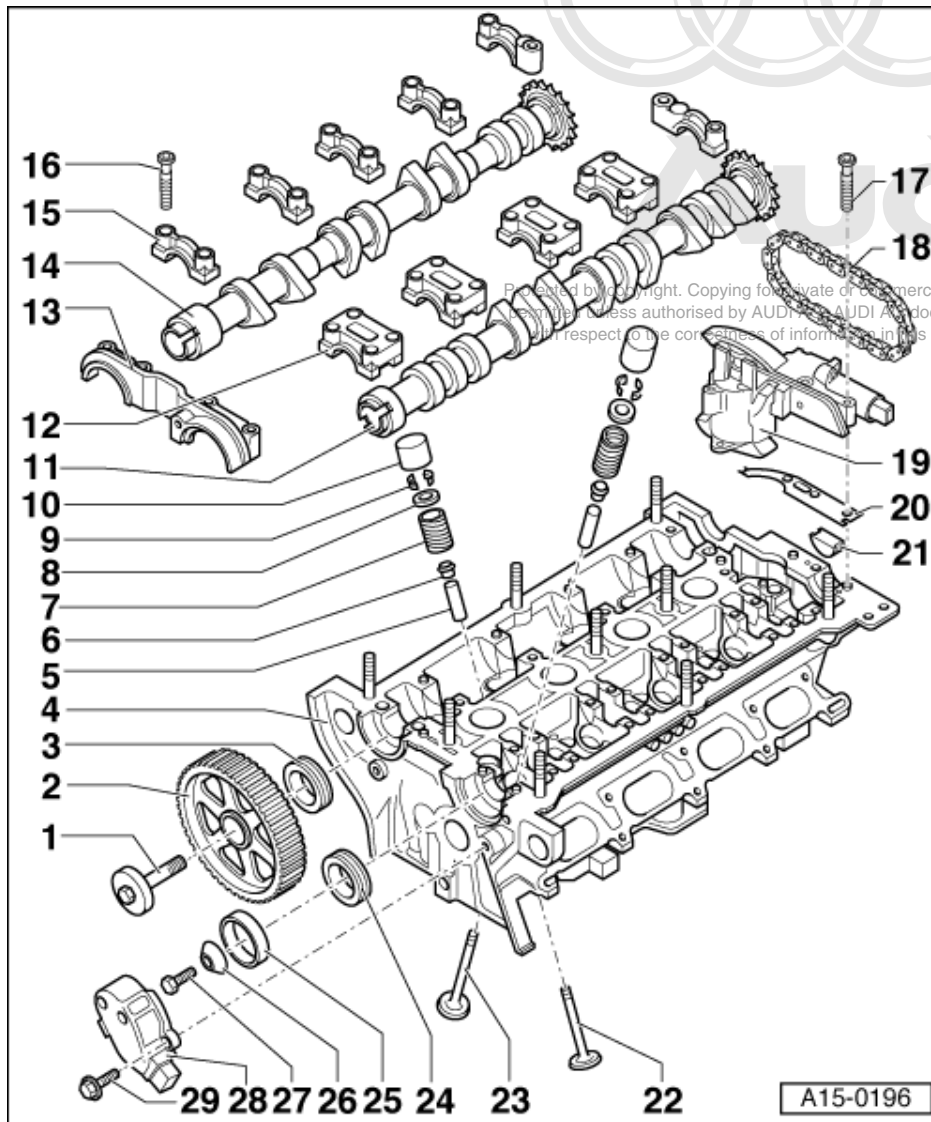
- ♦ Must be located on dowel sleeves
- ♦ Dowel sleeves must be located in cylinder head.
- ♦ Note installation position
- ♦ Installation sequence =>Page 106 .

16 10 Nm

17 10 Nm

18 Drive chain

- ♦ Check for wear
- ♦ Before removing mark installation position =>Page 105
- ♦ Removing and installing => Removing and installing camshafts, Page 103

**19 Camshaft adjuster**

- ♦ With solenoid valve for camshaft adjustment -N205
- ♦ Checking => Page 118
- ♦ Hold in position with retainer for chain tensioner 3366 before removing.
- ♦ Removing and installing
=>Page 103.

20 Metal/rubber gasket

- ♦ Coat with sealant before installation => Page 106
- ♦ Sealants

=> Parts List

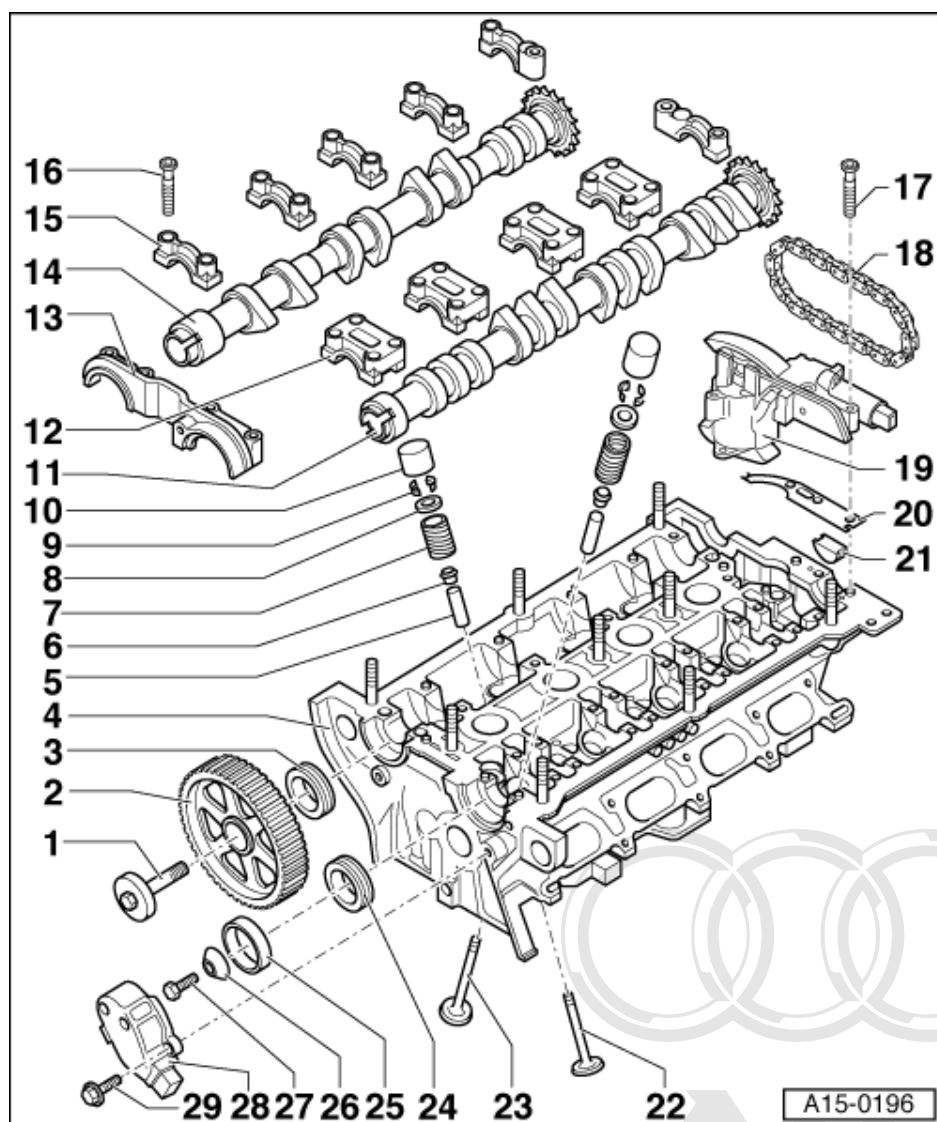
21 Seal

- ♦ Replace

22 Exhaust valve

- ♦ With sodium filling
- ♦ Note disposal instructions for valves with nitride filling => Page 95
- ♦ Do not rework, only grinding in is permitted
- ♦ Valve dimensions
=> Fig. 95
- ♦ Checking valve guides =>Page 115.

- ♦ Reworking valve seats =>Page 116 .



23 Inlet valve

- ♦ Do not rework, only grinding in is permitted
- ♦ Valve dimensions
=> Fig. 95
- ♦ Checking valve guides
=>Page 115 .
- ♦ Reworking valve seats
=>Page 116 .

24 Oil seal

- ♦ For inlet camshaft
- ♦ Replacing => Page 100 .

25 Hall sender rotor

- ♦ Note correct installation position:
Insert lug in notch of camshaft

26 Washer

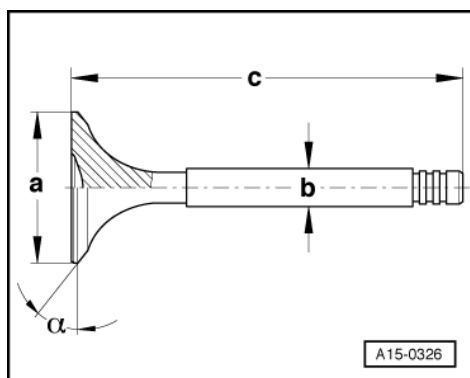
- ♦ With cone
- ♦ Note installation position

27 25 Nm

28 Housing for hall sender -G40

29 10 Nm

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-> Fig.1 Valve dimensions

Note:

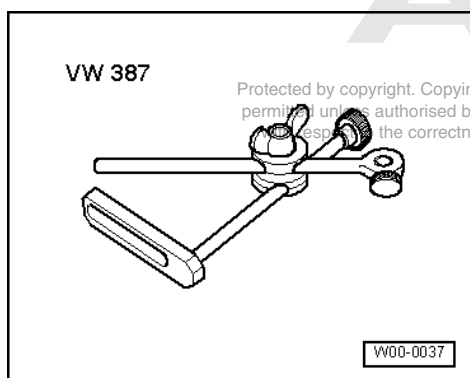
Inlet and exhaust valves must not be reworked. Only grinding in is permitted.

Dim.	Inlet valve	Exhaust valve
øa mm	26.80...27.00	29.80...30.00
øb mm	5.95...5.97	5.94...5.95
c mm	104.84...105.34	103.64...104.14
α <°	45	45

Important

- ♦ Worn exhaust valves with sodium filling must not be disposed of until they have been treated as follows:
- ♦ The valves must be sawn into two sections with a metal saw at a point between the centre of the shaft and the valve head. They must not come into contact with water when this is done. Then throw the valves into a bucket of water (not more than ten at a time). Then step back because a chemical reaction occurs when the sodium filling burns.
- ♦ After this treatment the valves can be disposed of in the normal way.

2.2 - Checking camshaft axial play



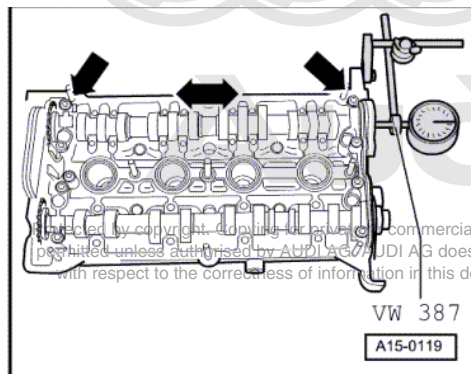
Special tools and workshop equipment required

- ♦ Universal dial gauge bracket VW 387



- ♦ Dial gauge

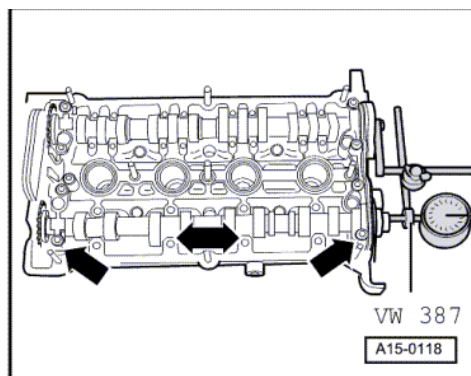
Test sequence



Perform measurement with bucket tappets removed and with bearing cap at chain sprocket end and double bearing cap at camshaft sprocket end installed.

- Attach dial gauge with universal dial gauge holder VW 387 to cylinder head:

-> Inlet camshaft

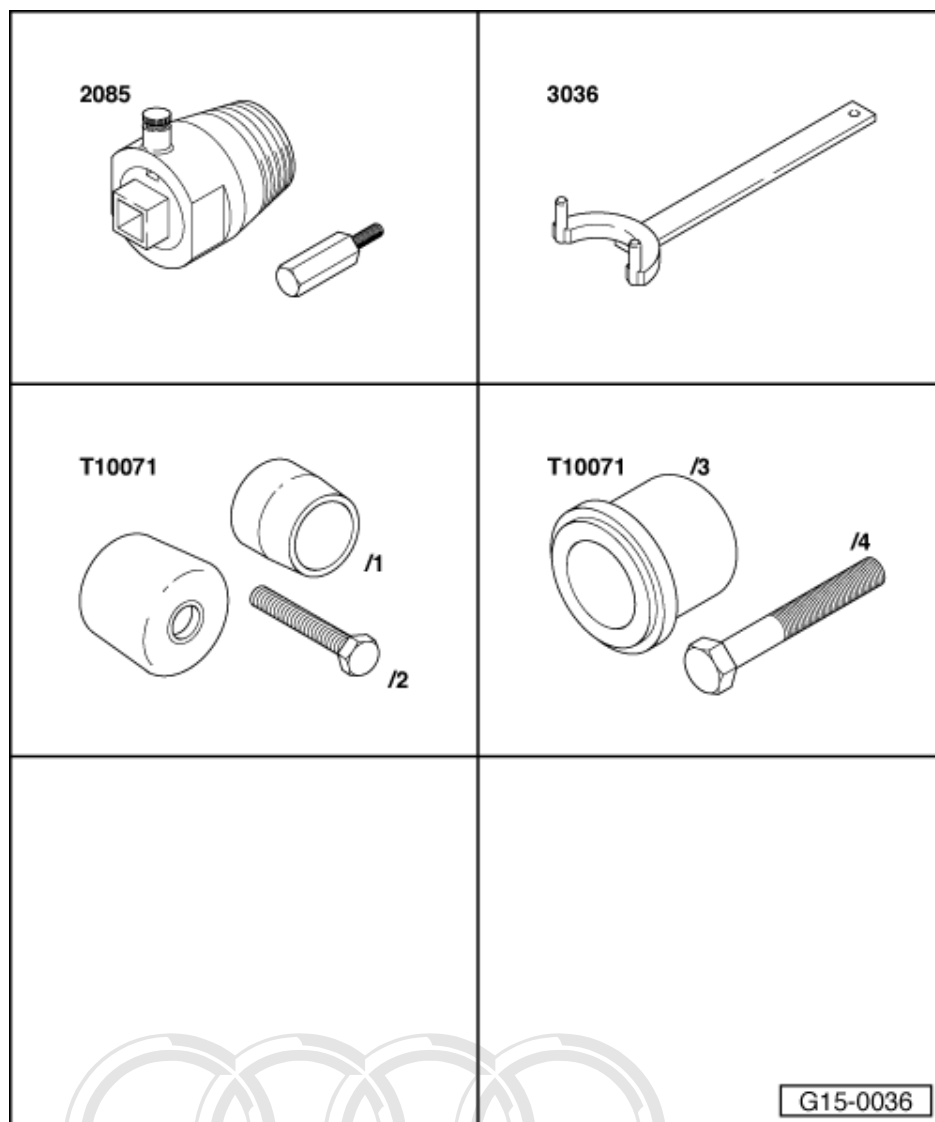


-> Exhaust camshaft

Wear limit for inlet and exhaust camshaft.

- ♦ Axial play: no more than 0.20 mm

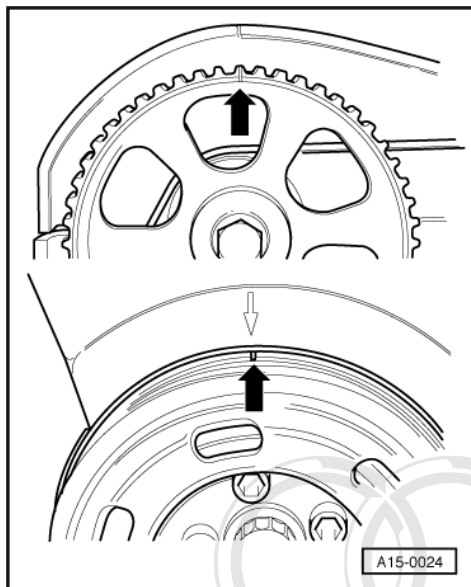
2.3 - Replacing exhaust camshaft oil seal



Special tools and workshop equipment required

- ◆ Oil seal extractor 2085
- ◆ Counterhold 3036
- ◆ Assembly tool T10071

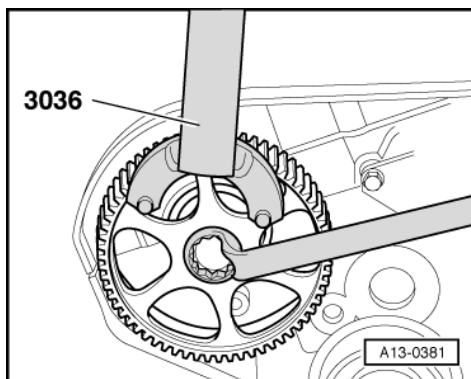
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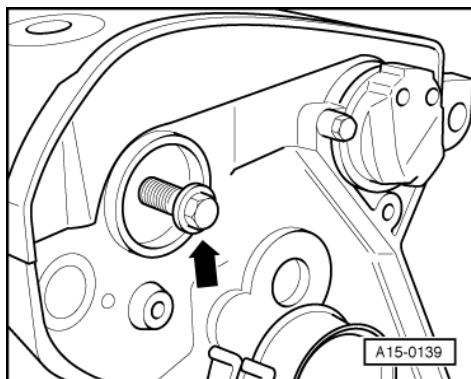
Removing

- Cylinder head installed
- Remove ribbed belt and tensioner for ribbed belt => Page 30 .
- Remove upper toothed belt protection => Page 37
- -> Set crankshaft to markings for TDC of No. 1 cylinder -arrows- by turning central bolt on crankshaft sprocket in direction of rotation.
- Remove toothed belt from camshaft sprocket => Page 41.

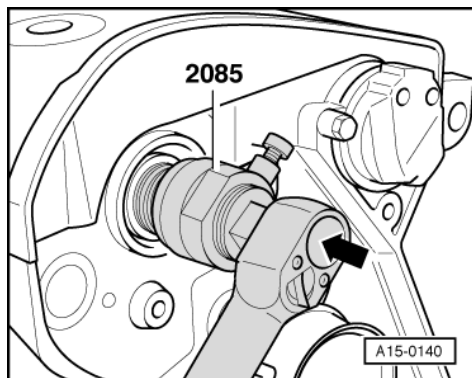
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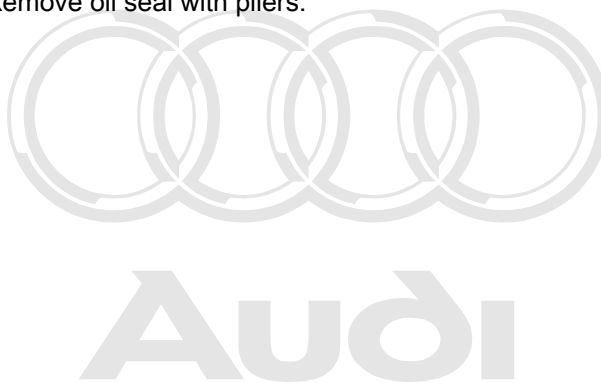
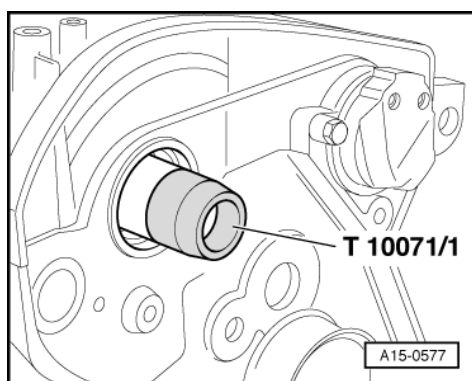
- -> Detach camshaft sprocket (use counterhold 3036).
- Remove camshaft sprocket.



- -> Insert securing bolt for camshaft sprocket by hand into camshaft as far as it will go -arrow- in order to guide the oil seal extractor.
- 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.



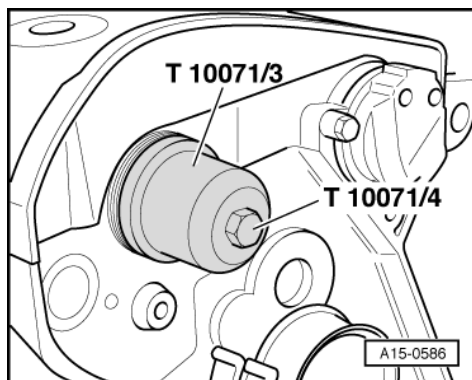
- -> Lubricate threaded head of oil seal extractor 2085, place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.
- Clamp flats of oil seal extractor in vice.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



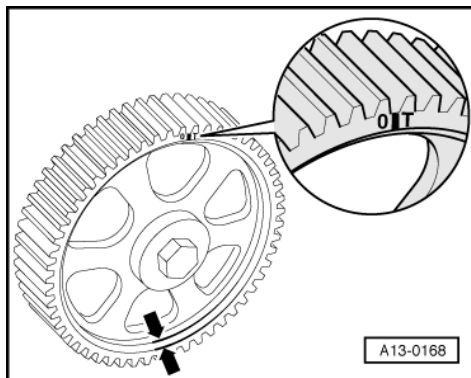
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Installing

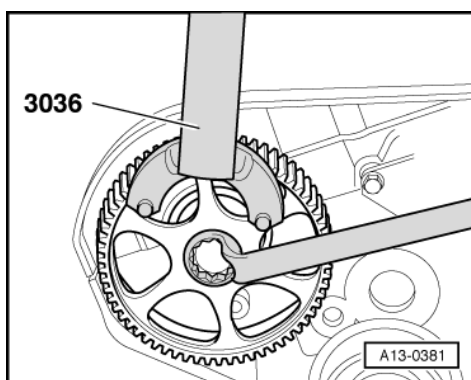
- Do not lubricate sealing lip of oil seal.
- -> Place guide sleeve T10071/1 onto crankshaft journal.
- Push oil seal via guide sleeve onto shaft journal.
- Remove guide sleeve.



- -> Press oil seal in onto stop using press sleeve T10071/3 and bolt T10071/4.



- -> Install camshaft sprocket.
- Note correct installation position:
Narrow web on camshaft sprocket faces outwards -arrows- and marking for No. 1 cylinder TDC is visible.



- -> Install securing bolt of camshaft sprocket (use counterhold 3036).

Note:

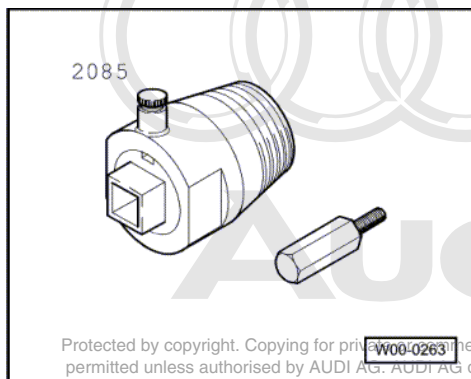
If a piston is at TDC the valves could strike the piston when turning the camshaft. To avoid damage to valves and pistons the pistons must not be at TDC. Danger of damaging valves/pistons.

- Install toothed belt (adjust valve timing) => Page 43 .

Tightening torque

Component	Nm
Camshaft sprocket to camshaft	65

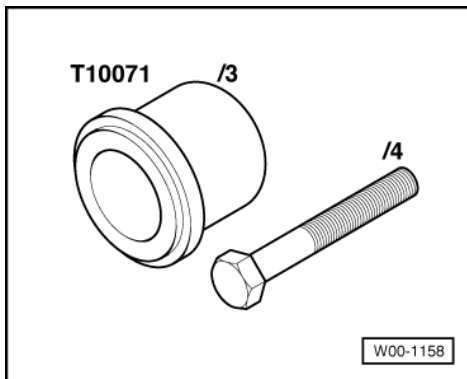
2.4 - Replacing oil seal for inlet camshaft



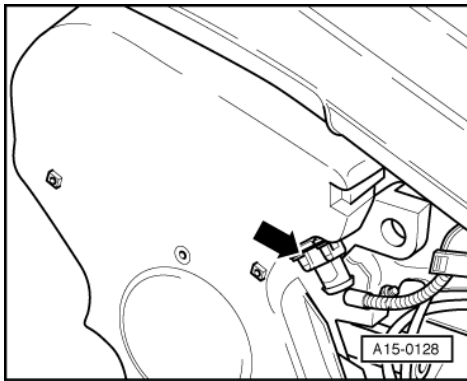
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Special tools and workshop equipment required

- ♦ Oil seal extractor 2085

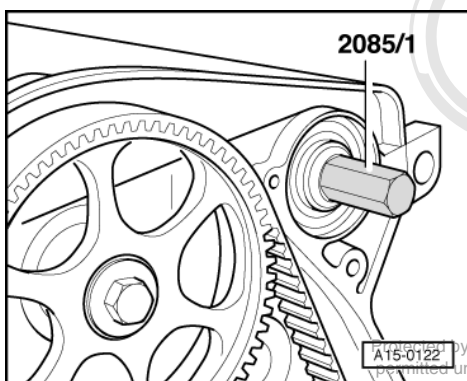


- ♦ Thrust sleeve T10071/3
- ♦ Guide sleeve T10071/5
- ♦ Bolt M8 x 60:



Removing

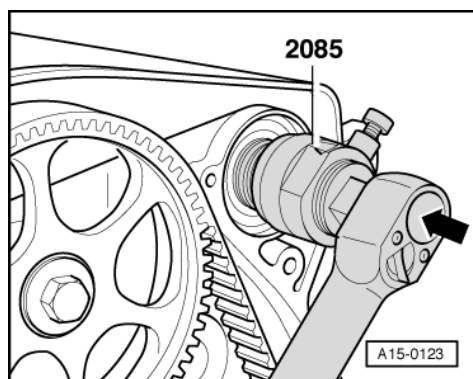
- Cylinder head installed
- -> Unplug connector -arrow- at Hall sender -G40.
- Remove upper toothed belt guard.
- Remove Hall sender housing.
- Remove Hall sender rotor and washer.



- -> Insert bolt 2085/1 for camshaft sprocket by hand into camshaft as far as it will go.

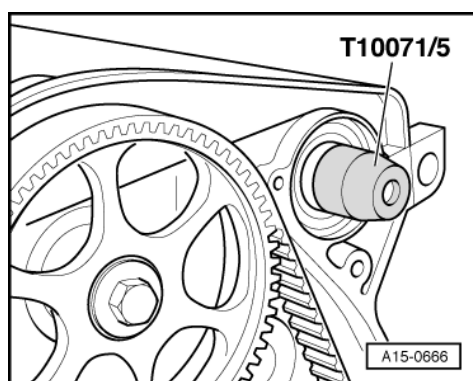


- Adjust inner part of oil seal extractor 2085 two turns (ca. 3 mm) from the outer part and lock in position with the knurled screw.



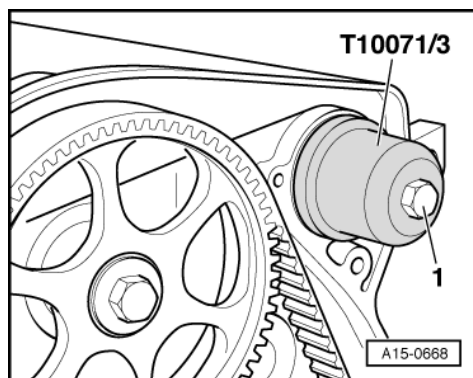
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- -> Lubricate threaded head of oil seal extractor 2085, place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.



Installing

- Do not lubricate sealing lip of oil seal.
- -> Place guide sleeve T10071/5 onto crankshaft journal.
- Push oil seal via guide sleeve onto shaft journal.
- Remove guide sleeve.

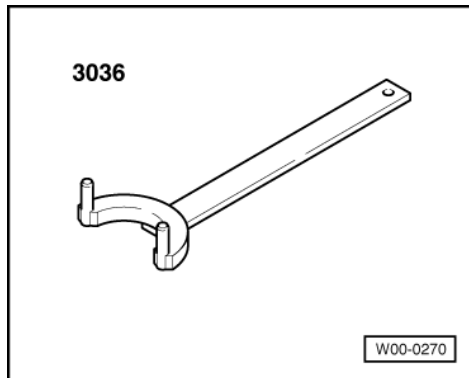


- -> Press oil seal in using thrust sleeve T10071/3 and bolt M8 x 60 up to stop.
- Install Hall sender =>Page 94 .
- Install toothed belt guard (upper section).

Tightening torques

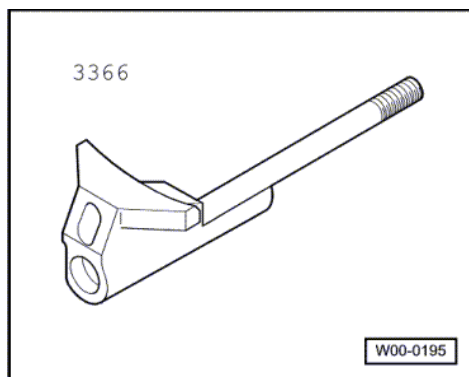
Component	Nm
Hall sender rotor to camshaft	25
Hall sender housing to cylinder head	10

2.5 - Removing and installing camshafts and camshaft adjuster



Special tools and workshop equipment required

- ♦ Counterhold 3036

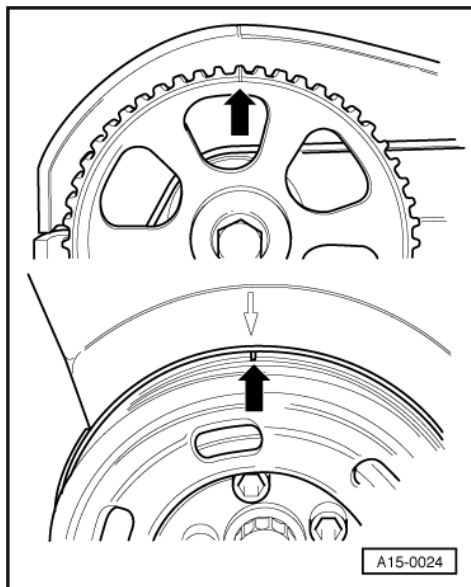


- ♦ Retainer for chain tensioner 3366
- ♦ Sealants

=> Parts List

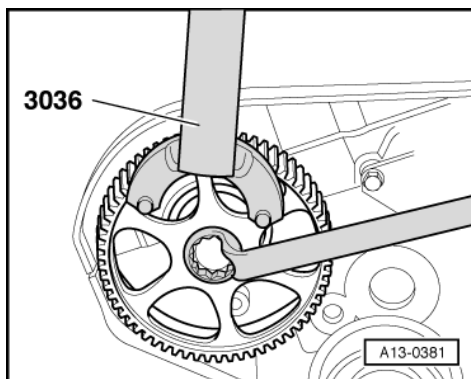


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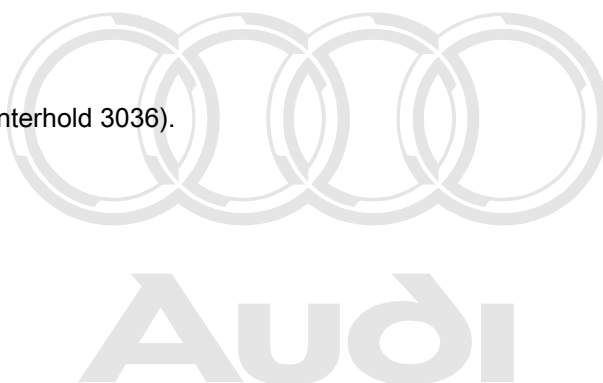
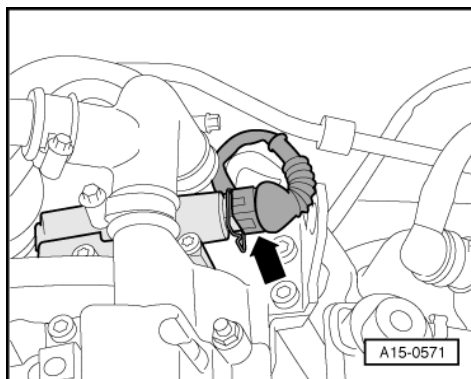


Removing

- Cylinder head installed
- Remove ribbed belt and tensioner for ribbed belt => Page 30 .
- Remove upper toothed belt guard => Page 37
- -> Set crankshaft to markings for TDC of No. 1 cylinder -arrows- by turning central bolt on crankshaft sprocket in direction of rotation.
- Remove toothed belt from camshaft sprocket => Page 41 .

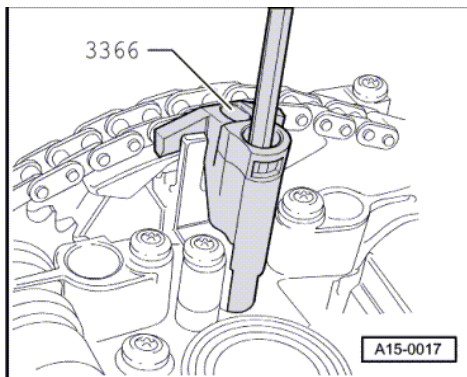


- -> Detach camshaft sprocket (use counterhold 3036).
- Remove camshaft sprocket.



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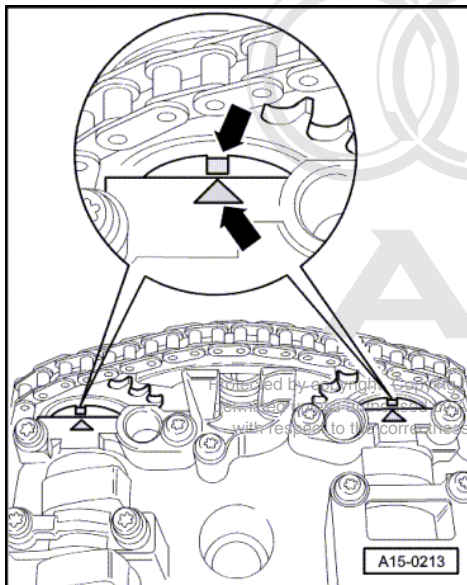
- -> Unplug connector -arrow- from camshaft adjuster.
- Remove cylinder head cover => Page 81 .
- Remove both oil deflectors.
- Detach Hall sender completely.



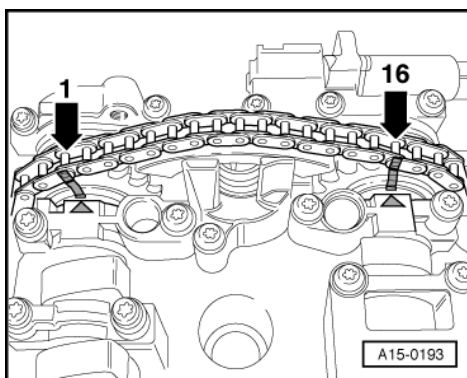
- -> Hold camshaft adjuster in position with bracket for chain tensioner 3366.

Note:

If the bracket for chain tensioner is tightened excessively, this can damage the camshaft adjuster.



- -> Re-check TDC position of camshafts:
 - The marks on the two camshafts must align with the arrows on the bearing caps.
- Clean chain and camshaft sprockets opposite the two arrows on the bearing caps and mark installation position with colour marks.

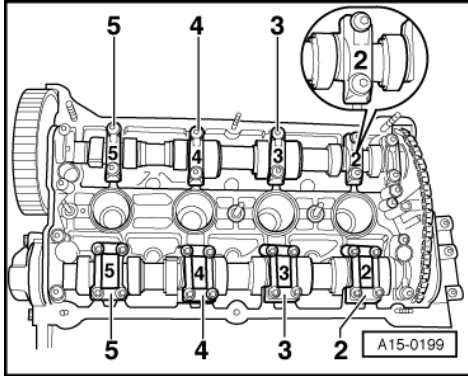




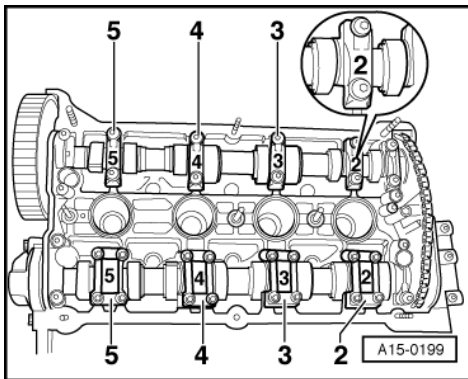
- -> The distance between the two arrows or the colour markings are 16 rollers on the drive chain.
- The notch on the exhaust camshaft is offset slightly towards the inside in relation to chain roller -1-.

Note:

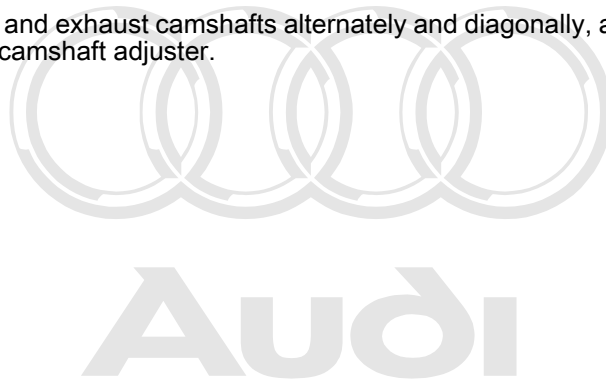
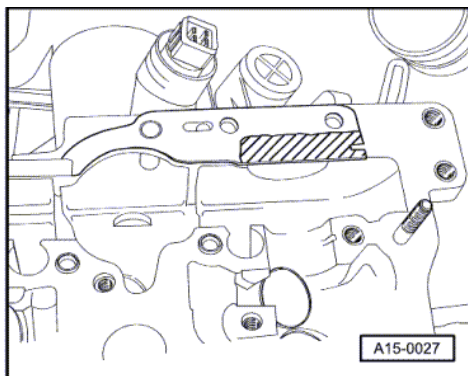
Do not mark chain with a centre punch or by making a notch or similar!



- -> Remove bearing cap 3 and 5 of inlet and exhaust camshaft.
- Remove double bearing cap.
- Remove both bearing caps next to inlet and exhaust camshaft chain sprockets.
- Unscrew securing bolts of camshaft adjuster.



- -> Slacken off bearing caps 2 and 4 of inlet and exhaust camshafts alternately and diagonally, and remove.
- Remove inlet and exhaust camshafts with camshaft adjuster.

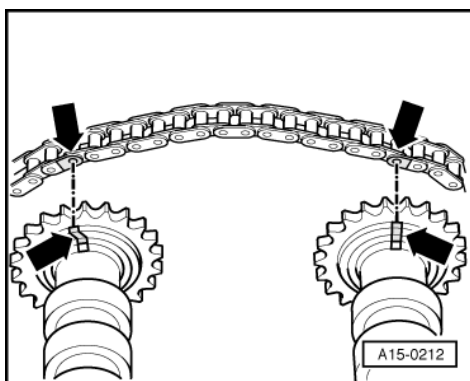


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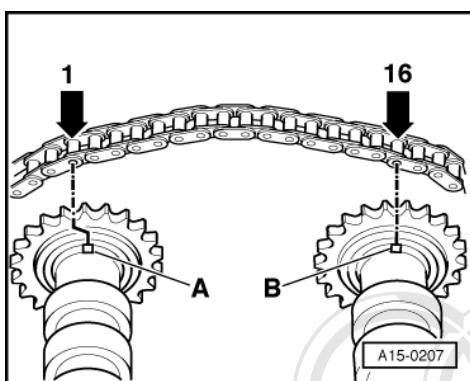
Installing

- -> Replace rubber/metal gasket for camshaft adjuster and apply a thin coat of sealant to the hatched area.
- Sealants

=> Parts List



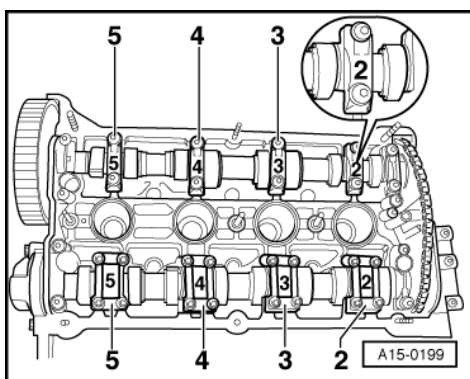
- Fit drive chain on camshaft sprockets as follows:
 - -> When reusing the old drive chain align colour markings -arrows- with cover.



- -> When a new chain is being installed, the distance between the notches -A- and -B- on the camshafts must be 16 rollers on the chain. The illustration shows the exact positions of the 1st and 16th rollers on the sprockets.
 - Notch -A- is offset slightly towards the inside in relation to chain roller -1-.
- Push camshaft adjuster between drive chain (2nd mechanic required).
Position camshafts together with drive chain and camshaft adjuster on cylinder head.
Oil running surfaces of both camshafts.

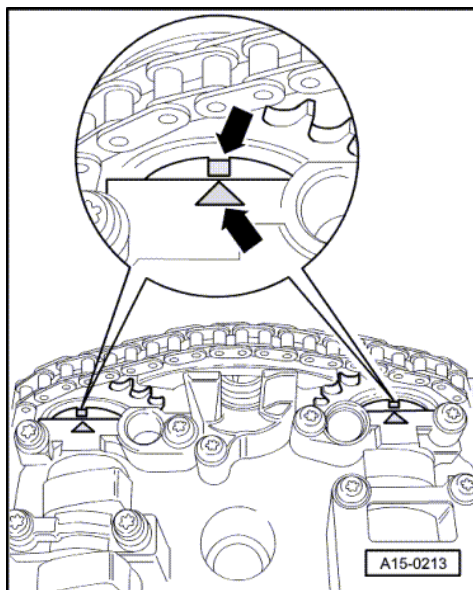
Notes:

- ♦ Dowel sleeves for bearing caps and camshaft adjuster must be located in cylinder head.
 - ♦ When installing bearing caps ensure that the identification mark is readable from the inlet side of cylinder head.
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- Tighten mountings of camshaft adjuster (watch position of dowel sleeves).

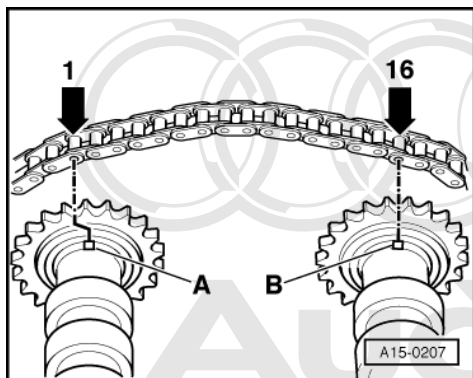


- -> Tighten bearing caps 2 and 4 of inlet and exhaust camshafts in stages and in diagonal sequence (watch position of dowel sleeves).

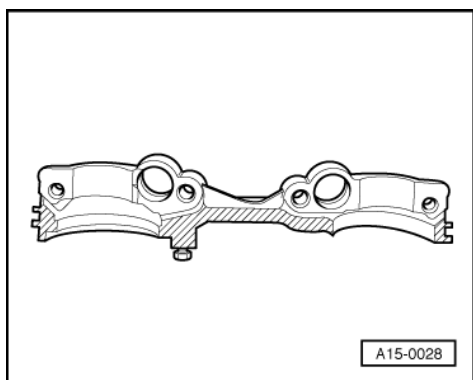
- Install the two bearing caps next to the chain sprockets on the inlet and exhaust camshafts.



- Check correct setting of camshafts:
 - -> The two markings on the camshafts must align with the two arrows on the bearing caps -arrows-.



- -> The distance between the two arrows on the bearing caps or the colour markings are 16 rollers on the drive chain.
- The notch on the exhaust camshaft is offset slightly towards the inside in relation to chain roller -1-.

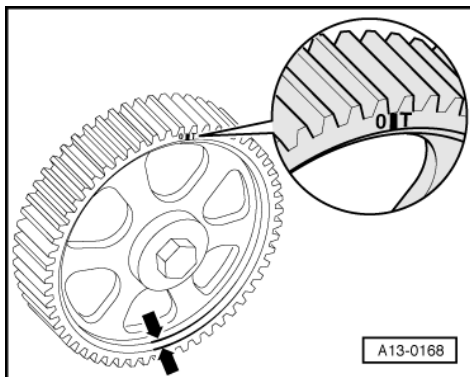


- Remove holder for chain tensioner 3366.
- -> Lightly coat the shaded area of dual bearing cap with sealant and install bearing cap (observe position of dowel sleeves).

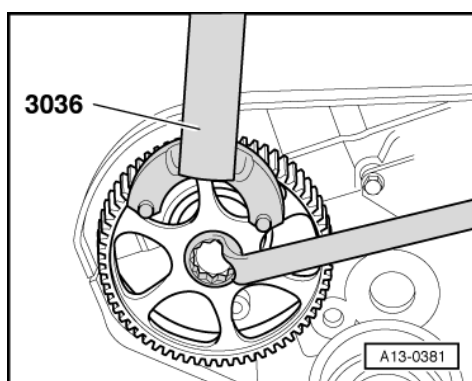
- Sealants

=> Parts List

- Fit the remaining bearing caps (note position of dowel sleeves).
- Replace sealing rings for inlet and exhaust camshafts => as of Page 97 .



- -> Install camshaft sprocket.
- Note correct installation position:
Narrow web on camshaft sprocket faces outwards -arrows- and marking for No. 1 cylinder TDC is visible.



- -> Install securing bolt of camshaft sprocket (use counterhold 3036).
- Install Hall sender =>Page 94 .
- Install cylinder head cover => Page 82 .

Note:

If a piston is at TDC the valves could strike the piston when turning the camshaft. To avoid damage to valves and pistons the pistons must not be at TDC. Danger of damaging valves/pistons.

- Install toothed belt (adjust valve timing) => Page 43 .

Notes:

- ♦ Wait about 30 minutes after installing the camshafts 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.

Tightening torques

Component	Nm
Bearing cap to cylinder head	10
Camshaft adjuster to cylinder head	10
Hall sender rotor to camshaft	25

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Component	Nm
Hall sender housing to cylinder head	10
Camshaft sprocket to camshaft	65

2.6 - 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.

Test sequence

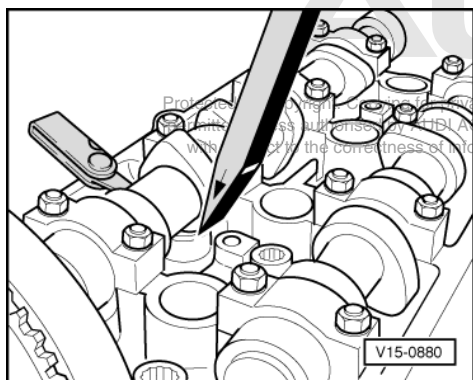
- Start engine and run until the radiator fan has switched on once.
- Increase engine speed to about 2500 rpm for 2 minutes (perform road test if necessary).

Note:

If the irregular valve noises stop but recur repeatedly during short journeys, a new oil retention valve must be fitted. Oil retention valve fitting location: In oil filter retainer => -Item 128.

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

- Remove cylinder head cover => Page 81.
- 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: Turn crankshaft clockwise at crankshaft toothed belt sprocket central bolt.
- Determine play between cam and tappet.

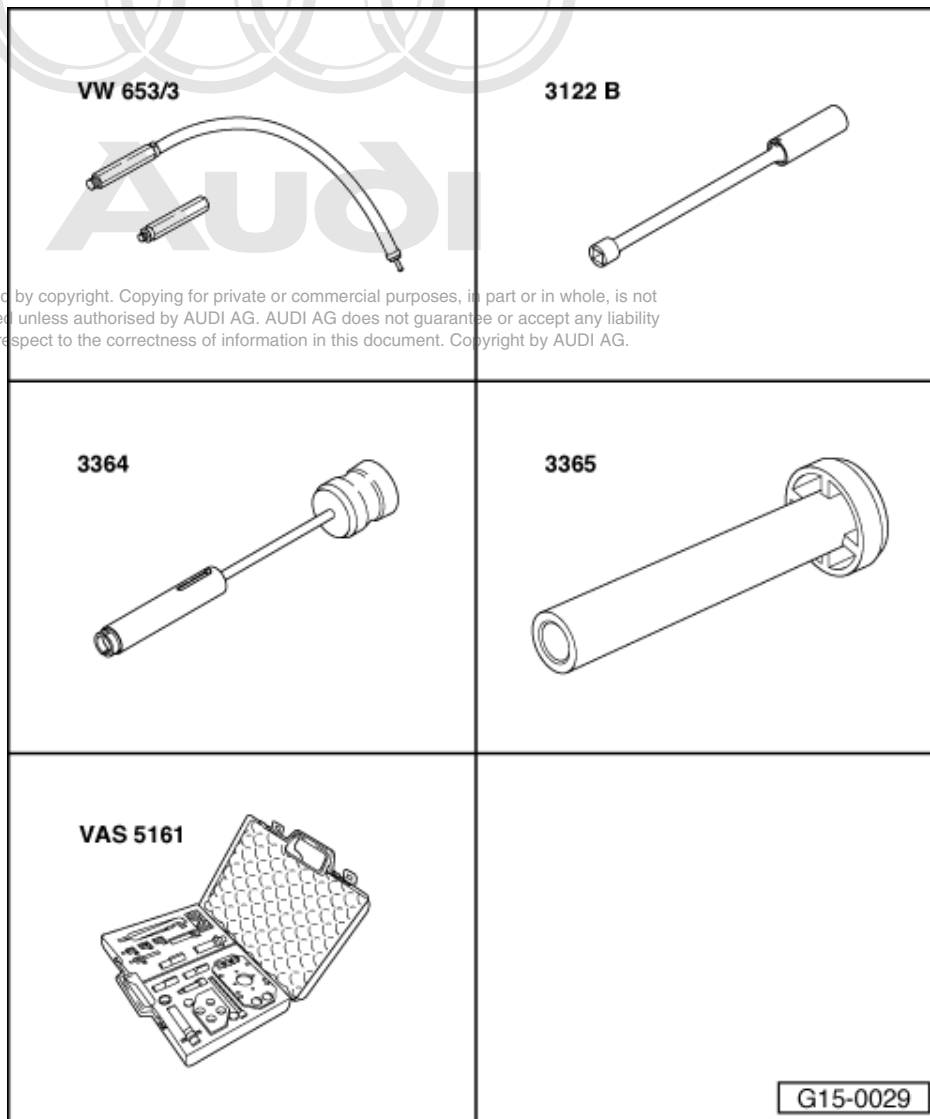


- -> Use a wooden or plastic wedge to push down bucket tappet. If an 0.20 mm feeler gauge can be inserted between camshaft and tappet, replace tappet.
- Replacing tappet => Removing and installing camshafts and camshaft adjuster, Page 103.

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.

2.7 - Replacing valve stem seals



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Special tools and workshop equipment required

- ◆ Pressure hose VW 653/3
- ◆ Spark plug socket 3122 B
- ◆ Puller 3364
- ◆ Fitting tool 3365
- ◆ Disassembly and assembly tool VAS 5161

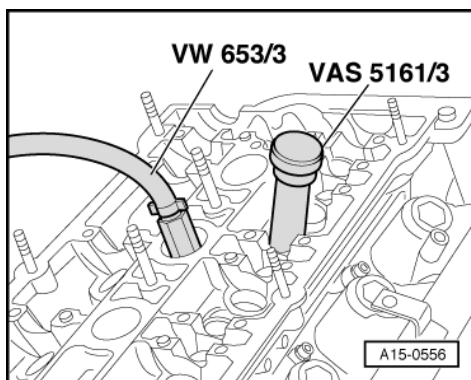
Removing

- Cylinder head installed
- Remove camshafts and camshaft adjuster => Page 103 .

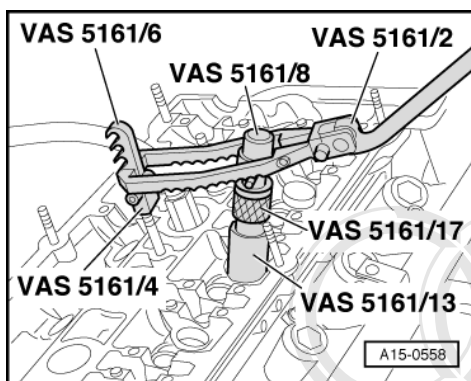
Notes:

- ◆ 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 with spark plug spanner 3122B.

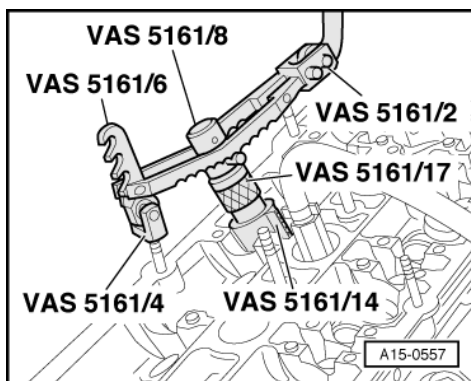


- Set piston of appropriate cylinder to "bottom dead centre".
- -> Screw in the pressure hose VW 653/3 into spark plug thread and put under constant pressure; at least 6 bar pressure.
- Install pin VAS 5161/3 into bucket tappet guide.
- Knock valve wedges of all valves loose using a plastic hammer.



Inlet side:

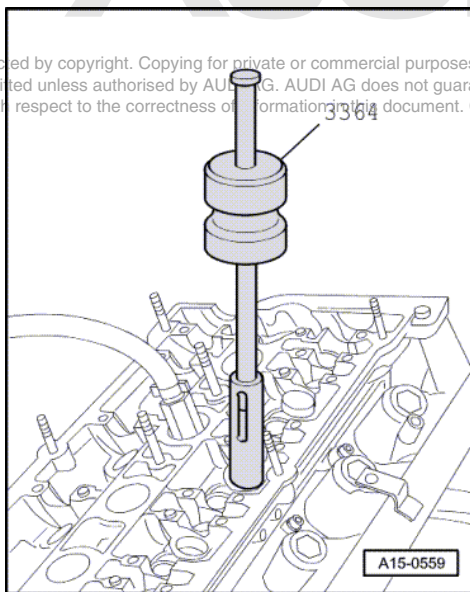
- -> Screw the catch part VAS 5161/6 with insertion fork VAS 5161/4 onto a stud on the cylinder head.
- Push guide bush VAS 5161/13 into bucket tappet guide of the valve to be removed until limit stop.
- Installation position: Corrugated surfaces are transverse to the driving direction.
- Push knurled spacer ring VAS 5161/17 onto the assembly cartridge VAS 5161/8.
- Push the assembly cartridge into the guide sleeve.
- 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.
- Remove assembly cartridge with spacer ring, guide bush, valve plate and valve spring.



Exhaust side

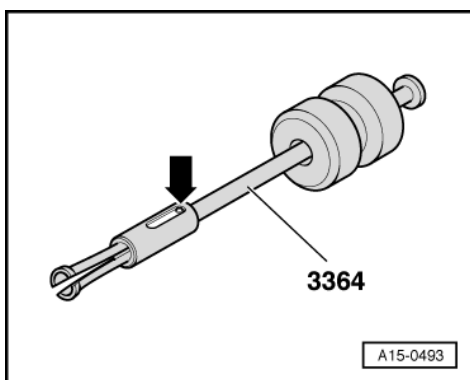
- -> Screw the catch part VAS 5161/6 with insertion fork VAS 5161/4 onto a stud on the cylinder head.
- Push guide bush VAS 5161/14 into bucket tappet guide of the valve to be removed until limit stop.
 - Installation position: Corrugated surfaces are transverse to the driving direction.
- Push knurled spacer ring VAS 5161/17 onto the assembly cartridge VAS 5161/8.
- Push the assembly cartridge into the guide sleeve.
- 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.
- Remove assembly cartridge with spacer ring, guide bush, valve plate and valve spring.

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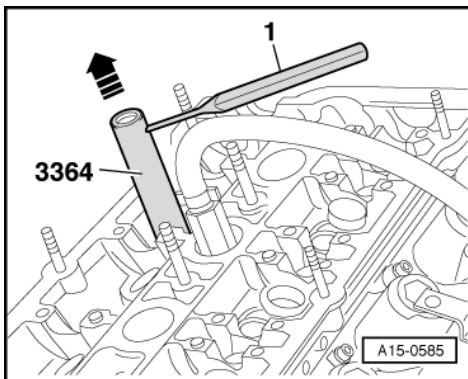
Continued for both sides of the vehicle:

- -> Use 3364 to remove valve stem seals.

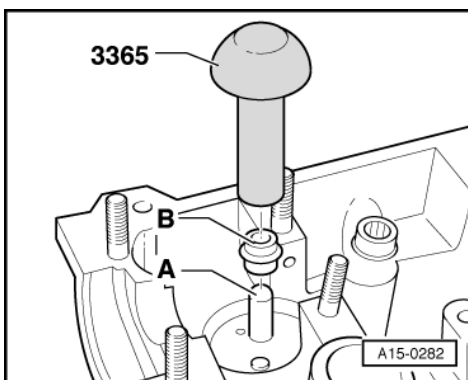


If the puller tool 3364 cannot be used due to tight space in some of the valve stem seals proceed as follows:

- -> Drive out spring pin -arrow- of the puller tool 3364 using a drift and remove puller attachment.



- -> Attach lower part of puller tool 3364 to valve stem seal.
- Secure puller tool 3364 with a drift or pin punch -1-, as illustrated.
- Attach an assembly lever at puller tool 3364 and remove valve stem seal -arrow-.

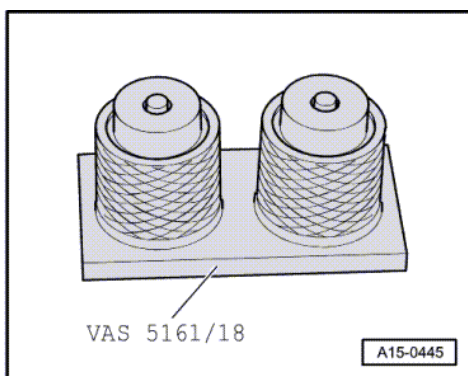


Installing

Note:

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

- -> 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 valve guide using press tool 3365.
- Remove plastic sleeve again.

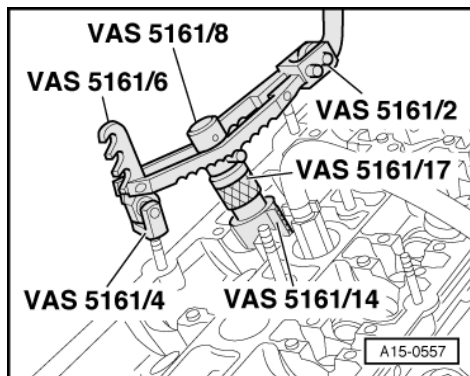


- -> If the valve wedges were taken out of the assembly cartridge they must first be inserted into the installing tool VAS 5161/18.

Note:

The large diameter of the valve wedges points upwards.

- Push assembly cartridge VAS 5161/8 from the top onto installing tool and take up the valve wedges.

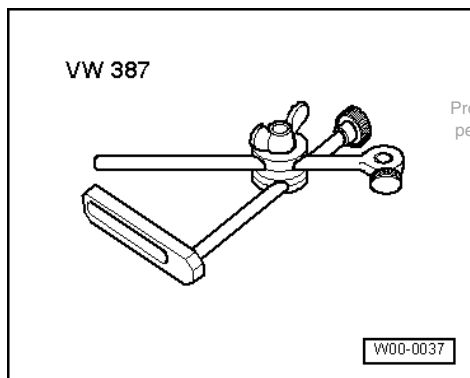


- -> Insert the assembly cartridge VAS 5161/8 into guide bush VAS 5161/13 or VAS 5161/14 again.
- Push pressure fork down and pull knurled screw upwards by turning to left and right - thus the valve wedges are installed.
- Take load of the pressure fork when knurled screw is still tight.
- Insert bucket tappet.
- Removing and installing camshafts and camshaft adjuster => Page 106

Notes:

- ♦ Wait about 30 minutes after installing the camshafts 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.

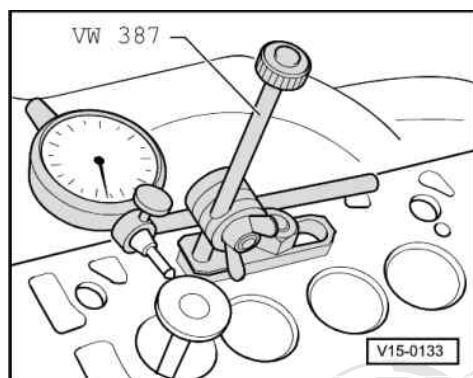
2.8 - Checking valve guides



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Special tools and workshop equipment required

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



Test sequence

- -> Set valve in guide. The end of the valve stem is flush with guide.
- Determine rock.

Wear limit

Inlet valve guide	Exhaust valve guide
0.80 mm	0.80 mm

Notes:

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- ♦ If the wear limit is exceeded, repeat the measurement with new valves. If the wear limit is again exceeded, replace the cylinder head. The valve guides cannot be replaced.
- ♦ If the valve must be replaced as part of a repair, use a new valve for the calculation.

2.9 - Checking valves

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

2.10 - 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 replace the valves. The valve guides must also be checked for wear. This is particularly important on high mileage engines => Page 115 .
- ♦ 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.

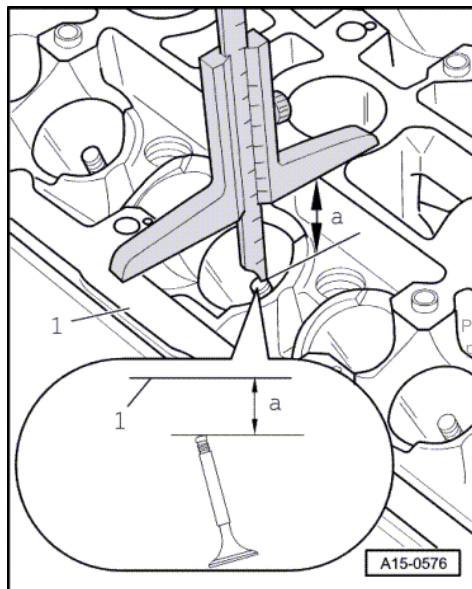
- ♦ If the maximum reworking dimension is exceeded, the hydraulic tappets will not work properly and the cylinder head will have to be replaced.

Calculating maximum permissible reworking dimension

- Insert valve and press firmly against valve seat.

Note:

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



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- -> Measure distance -a- between valve shaft end (upper edge) and upper cylinder head area with a depth gauge.
- Calculate max. permissible reworking dimension from measured distance and minimum dimension.

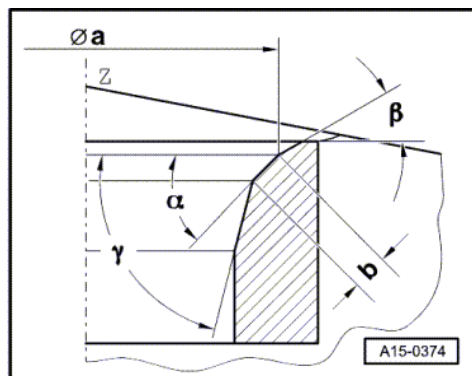
Minimum dimensions		
Outer inlet valves	Central inlet valve	Exhaust valves
31.0 mm	32.2 mm	31.9 mm

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

Example (for outer inlet valve):	
Measured distance	31.4 mm
- Minimum dimension	-31.0 mm
= Max. permissible reworking dim.	= 0.4 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, replace the cylinder head.



**-> Reworking valve seats**

Dim.		Inlet valve seat
øa	mm	26.2
b	mm	1.5...1.8
Z		Lower edge of cylinder head
α	45°	Valve seat angle
β	30°	Upper correction angle
γ	60°	Lower correction angle

Dim.		Exhaust valve seat
øa	mm	29.0
b	mm	1.8
Z		Lower edge of cylinder head
α	45°	Valve seat angle
β	30°	Upper correction angle
γ	60°	Lower correction angle

3 - Checking camshaft timing control

3.1 - Checking camshaft timing control

By adjusting the timing, the engine control unit can adapt the cylinder filling capacity to the instantaneous load and speed status.

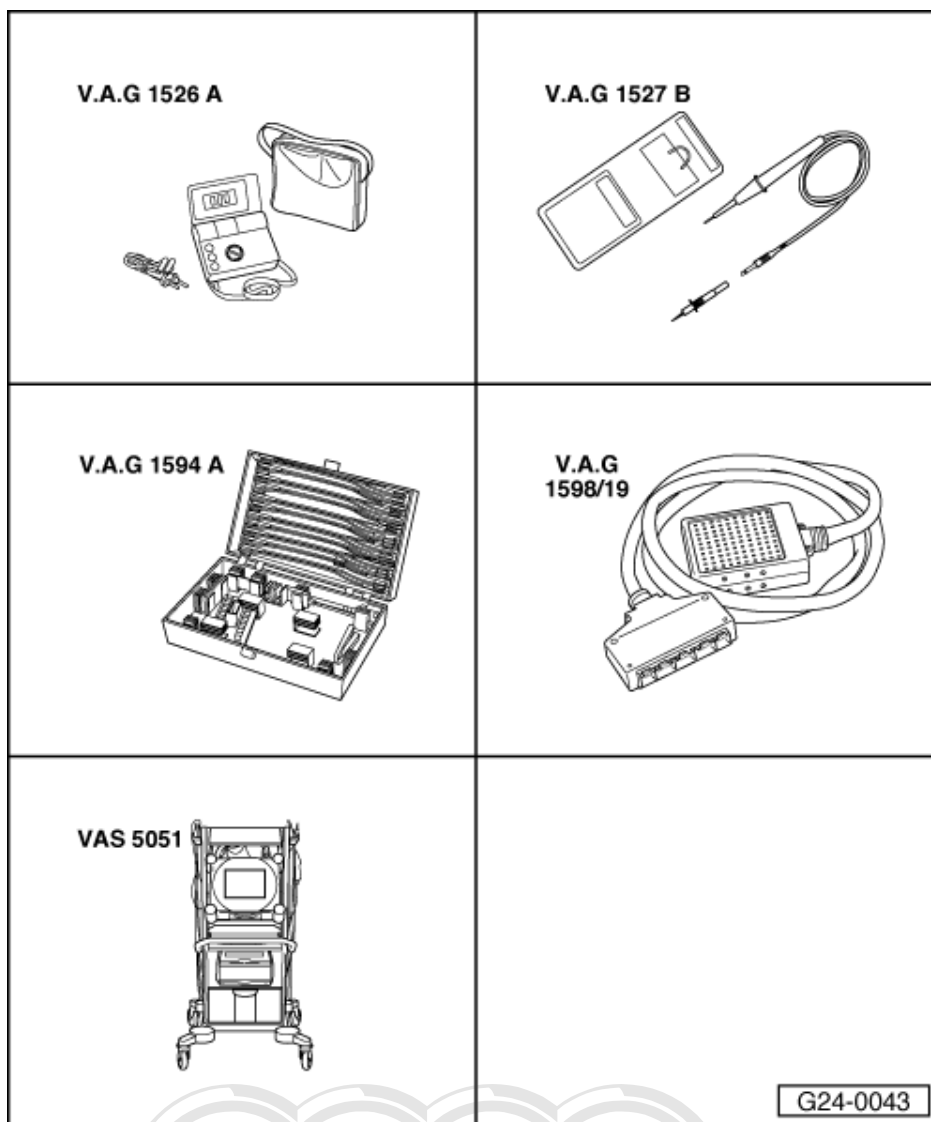
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The adjustment of the intake camshaft is dependent on the engine load and engine speed. Oil pressure is applied to the camshaft adjuster (mechanical adjustment device) via the electrical solenoid valve for camshaft adjustment.

Note:

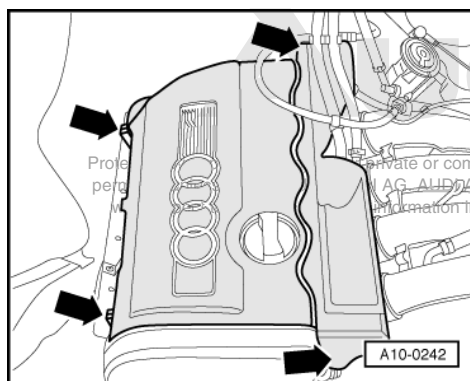
Camshaft timing control only becomes active 25 seconds after starting engine.

3.2 - Checking camshaft adjustment solenoid valve -N205



Special tools and workshop equipment required

- ◆ V.A.G 1526 A
- ◆ V.A.G 1527 B
- ◆ V.A.G 1594 A
- ◆ V.A.G 1598/19
- ◆ VAS 5051 with VAS 5051/1



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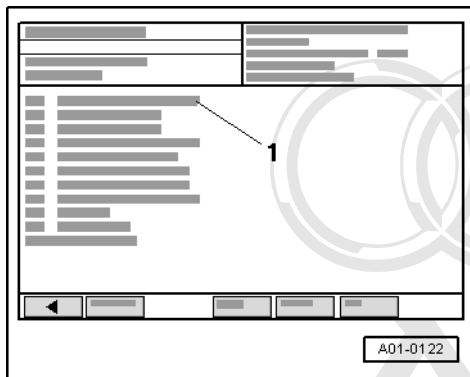


Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 connected, vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected.

Test sequence

- -> Remove engine cover -arrows-.

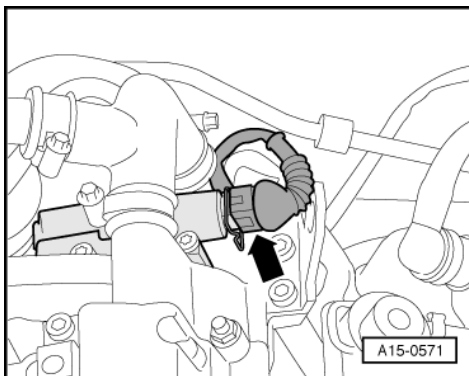


-> Display on VAS 5051:

- Under -1- select the diagnostic function "03 - Final control diagnosis".
- Actuate the solenoid valve for camshaft adjuster.

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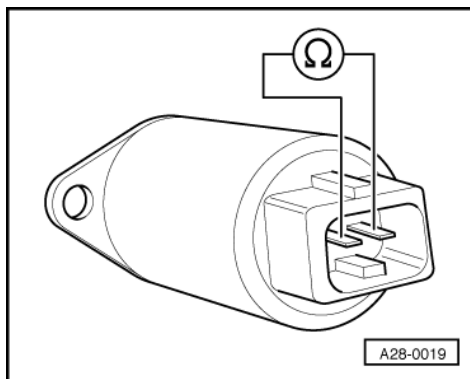
- ♦ This valve is actuated (clicks) for approx. one minute if the operation is not switched to the next control element by pressing the ➤ key.
- Exit function "03 - Final control diagnosis" by pressing the ◀ key.
- Press "06 - End output".



If the valve is not actuated (does not click).

Checking internal resistance

- Switch ignition off.
- -> Unplug connector -arrow- from camshaft adjuster.



- -> Connect multimeter to injector to measure resistance.
- Specification: 10...18 Ω

If specification is not attained:

- Replace valve.

If specification is attained:

Checking power supply

Test requirements:

- Fuse for solenoid valve for camshaft adjustment OK

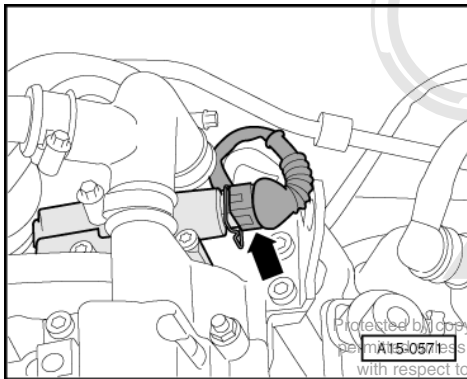
=> Current Flow Diagrams, Electrical Fault-finding and Fitting Locations binder

- Fuel pump relay OK.

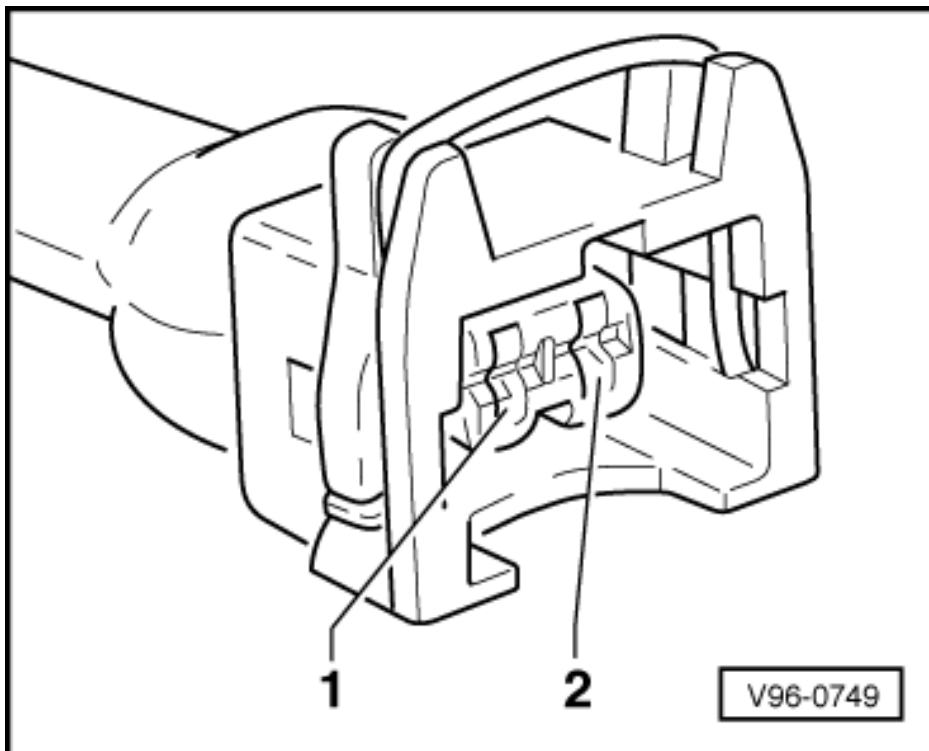
=> Motronic Injection and Ignition System (4-cylinder, 5-valve); Repair group 24

Note:

The power supply of the solenoid valve for camshaft adjustment is via the fuel pump relay.



- -> Unplug connector -arrow- from camshaft adjuster.





- -> Connect voltage tester V.A.G 1527 B as follows:

Connector Contact	Measure to
1	Engine earth

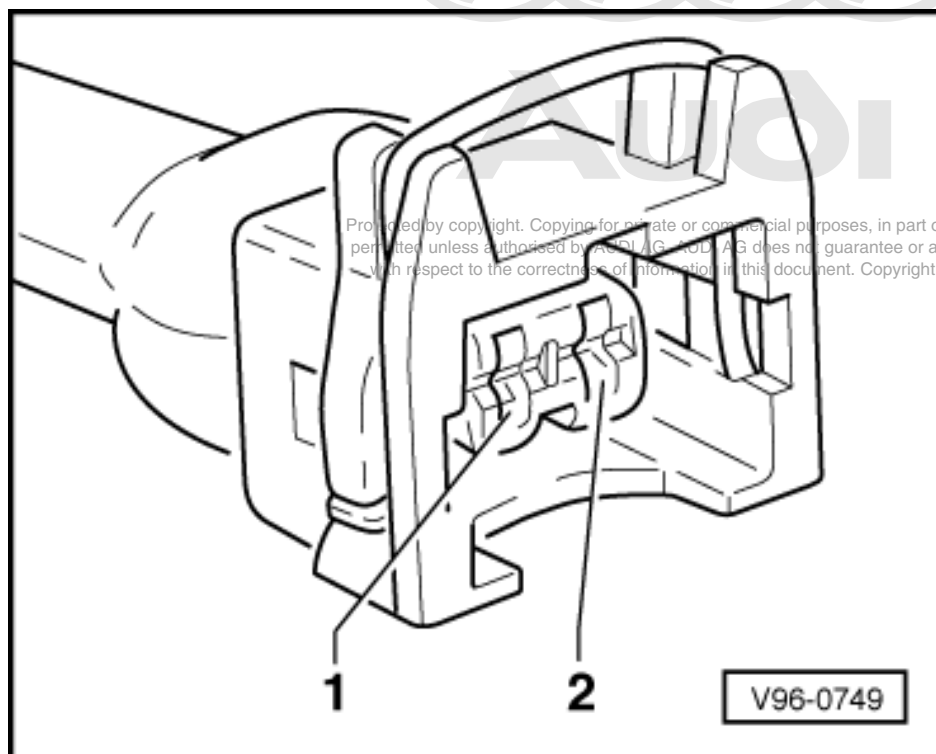
- Operate starter briefly.
- The LED should illuminate.

If the LED does not illuminate:

- Check the wiring from contact 1 on the connector via the fuse to the fuel pump relay for an open circuit:

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

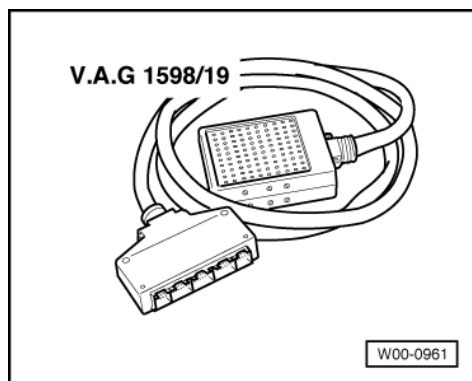
- Rectify open circuit, if necessary.



If the LED illuminates:

Checking actuation

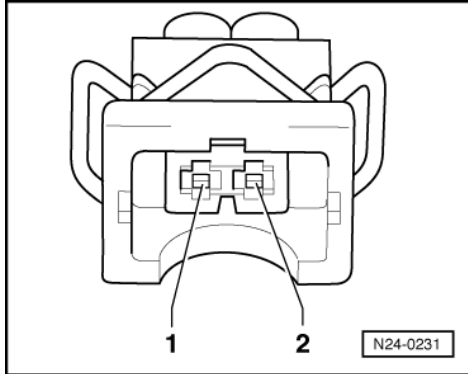
- -> Connect voltage tester V.A.G 1527 B to contacts 1 (positive) and 2 of the connector.
- Initiate the final control diagnosis and activate solenoid valve for camshaft adjuster.
- The LED should flash.



If the LED lamp does not flash or if it illuminates continuously:

- -> Connect the test box V.A.G 1598/19 to wiring harness connectors; the engine control unit must not be connected.

=> Motronic Injection and Ignition System (4-cylinder, 5-valve); Repair group 24



- -> Check for open circuit and short to positive or earth in the following wiring connection:

Connector Contact	Test box V.A.G 1598/19 Socket
2	E7

- Rectify any open/short circuit as necessary.

If the wiring is OK:

- Replace engine control unit.

If no fault is found:

- Replace mechanical camshaft adjuster => Page 103.

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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

Notes:

- ♦ If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully, and the oil cooler replaced in order to prevent further damage occurring later.
- ♦ The oil level must not be above max. mark on dipstick - danger of damage to catalytic converter.

Viscosity grades and oil specifications:

=> Maintenance Manual

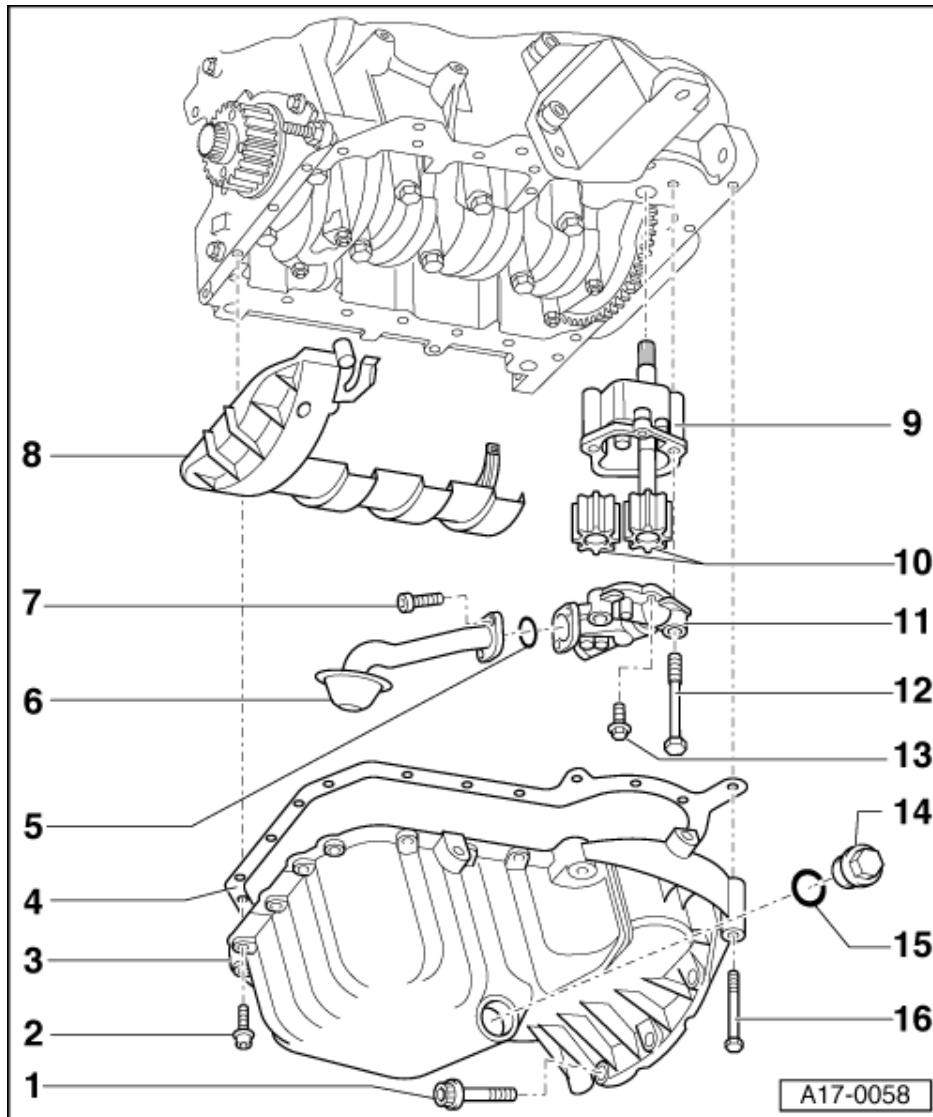
Oil system capacity:

=> Exhaust Emission Test binder



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1.2 - Part I



1 45 Nm

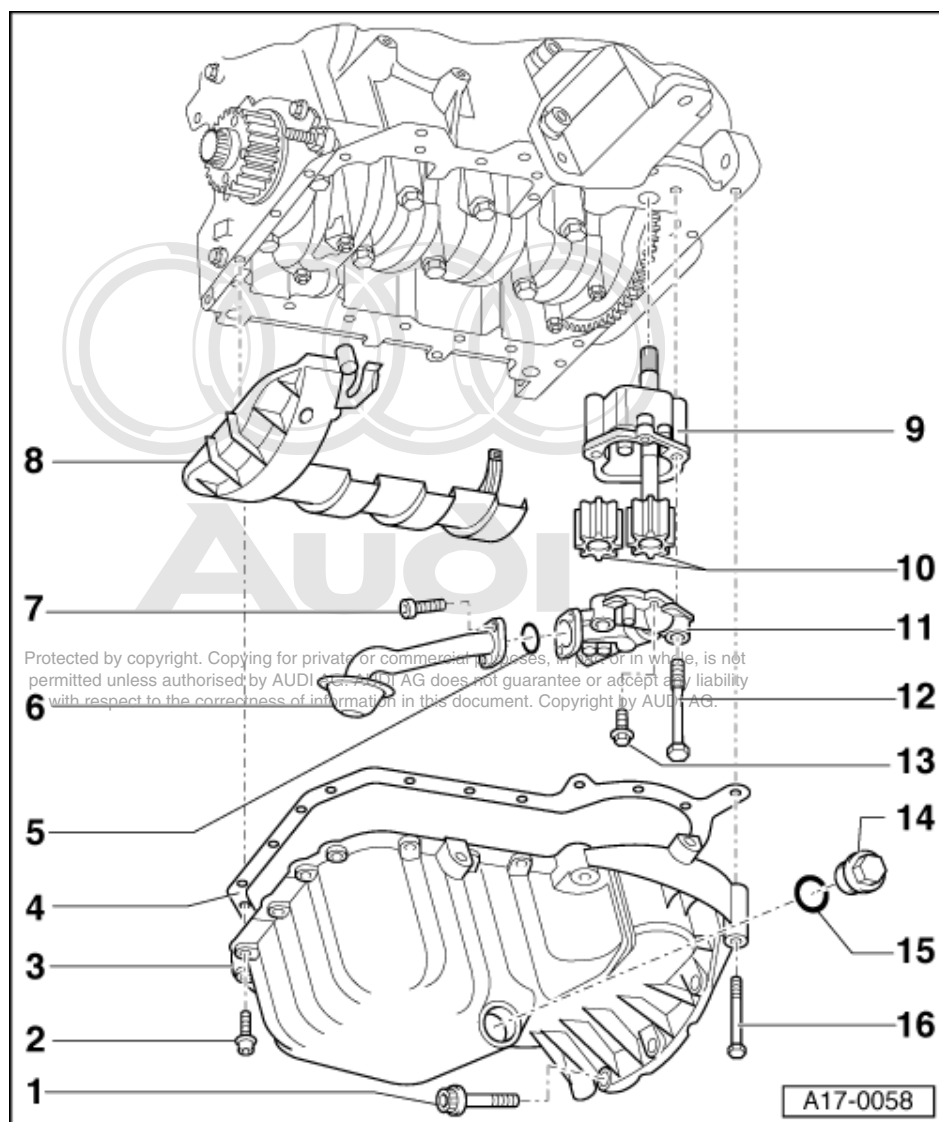
2 10 Nm

- ◆ Remove and install the two rear bolts (oil pan/gearbox) with socket attachment 3249
- ◆ Tighten in stages and in diagonal sequence

3 Oil pan

- ◆ Removing and installing=>Page 131
- ◆ Clean sealing surface before installing
- ◆ When installing oil pan with engine removed from vehicle, ensure that oil pan is positioned flush with intermediate plate at flywheel end (i.e. oil pan should protrude 0.8 mm from cylinder block).
- ◆ Before fitting oil pan, apply a small amount of sealant to sealing points between sealing flange and cylinder block
- ◆ Sealants

=> Parts List

**4 Seal**

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

=> Parts List

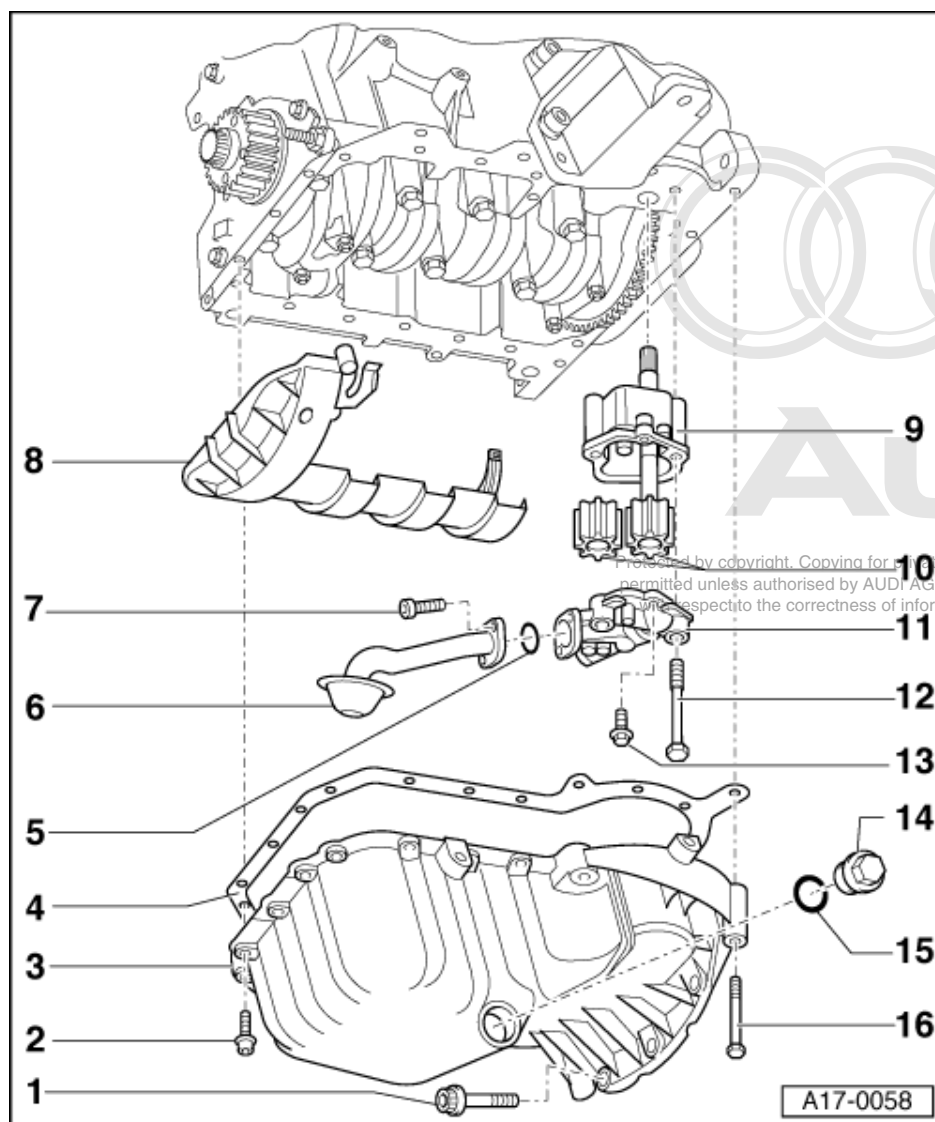
5 O-ring

- ◆ Replace

6 Suction pipe

- ◆ Clean strainer if soiled

7 10 Nm**8 Baffle plate****9 Oil pump housing**



10 Gears

- ♦ Checking backlash
=> Fig. 130
- ♦ Checking axial play
=> Fig. 131

11 Oil pump cover with pressure relief valve

- ♦ Opening pressure: 5.7 ... 6.7 bar

12 25 Nm

13 10 Nm

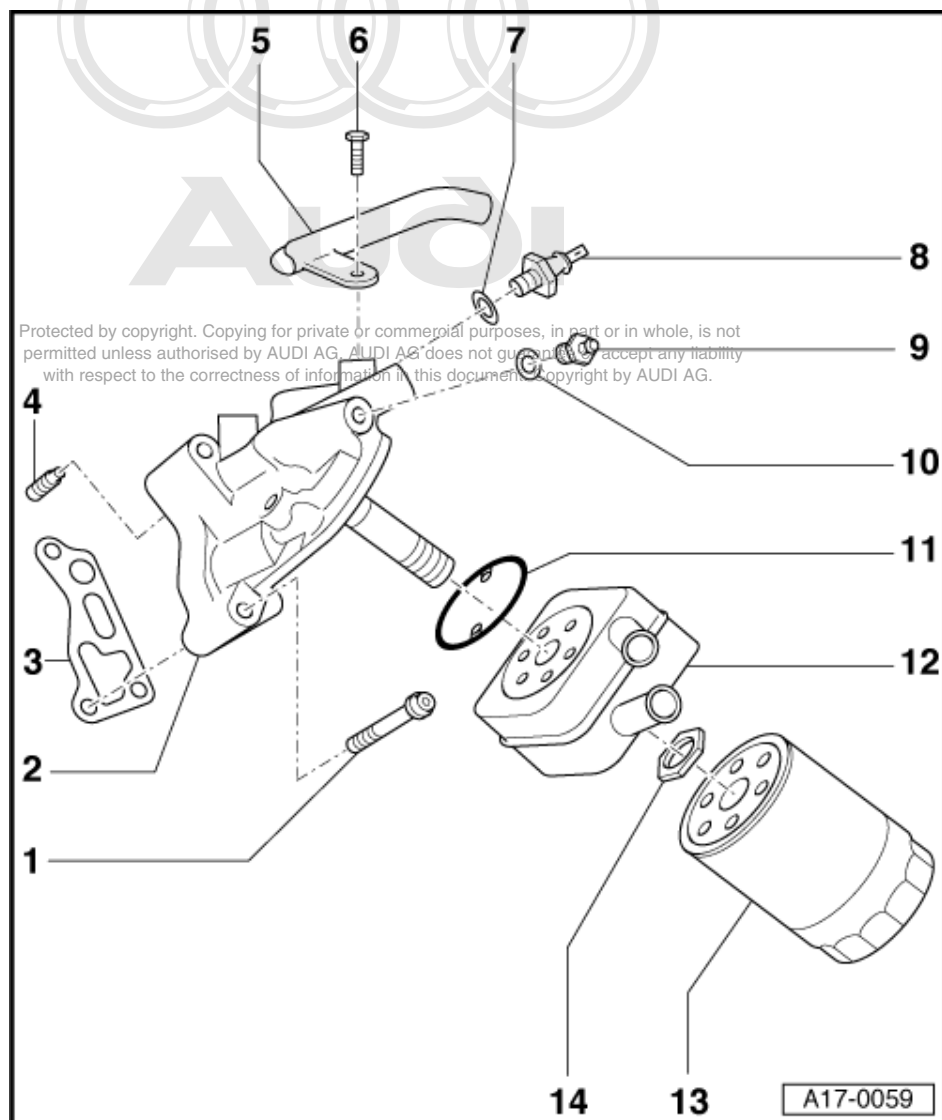
14 Oil drain plug, 50 Nm

15 Sealing ring

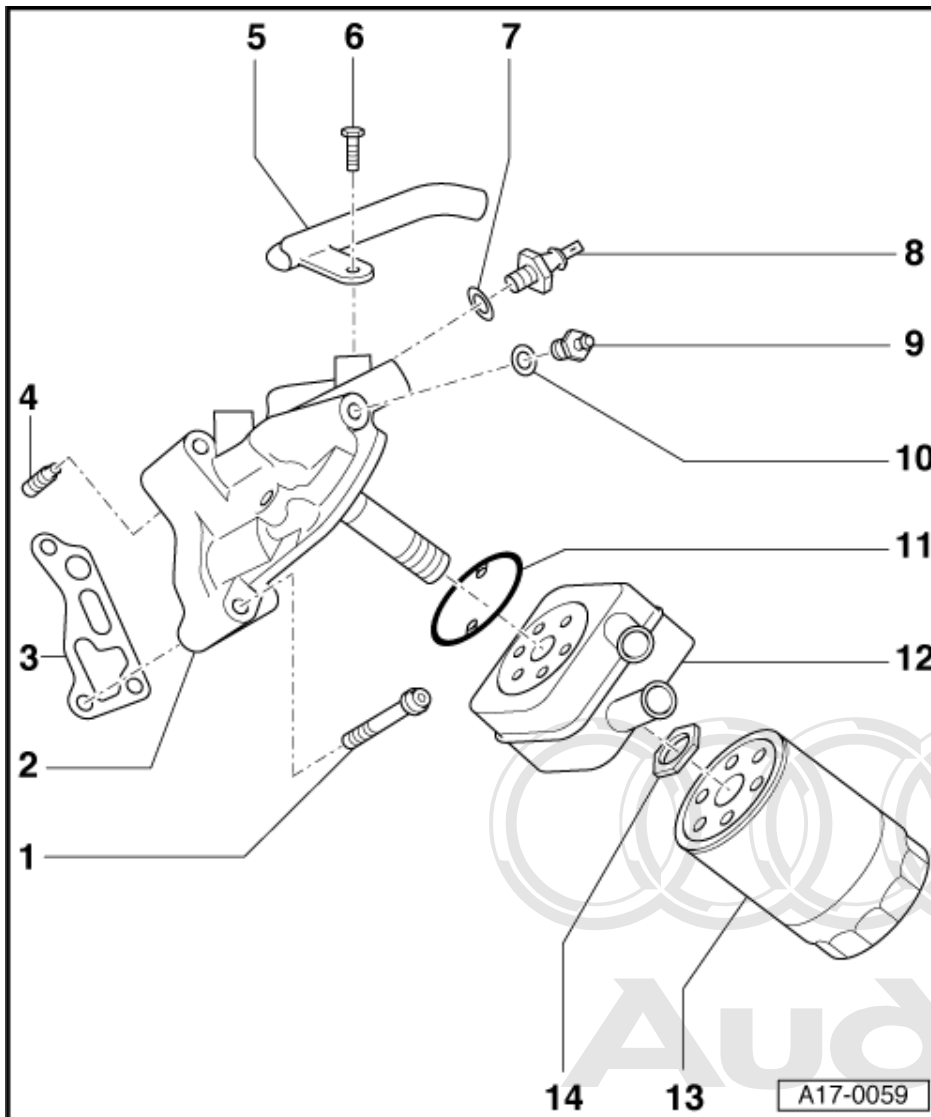
- ♦ Replace

16 45 Nm

1.3 - Part II



- 1 25 Nm
- 2 Oil filter bracket
- 3 Seal
 - ♦ Replace
- 4 Oil retention valve
 - ♦ Tighten to 8 Nm
- 5 Lower coolant pipe
- 6 20 Nm
- 7 Sealing ring
 - ♦ If seal is leaking, cut open and replace.
- 8 Oil pressure switch -F1, 1.4 bar
- 25 Nm
 - ♦ Black insulation
 - ♦ Checking => Page 135
- 9 Oil temperature sender -G8 - 10 Nm

**10 Sealing ring**

- ♦ If seal is leaking, cut open and replace.

11 Seal

- ♦ Replace
- ♦ Engage in projections on oil cooler

12 Fluid cooler

- ♦ See note =>Page 124 .
- ♦ Coolant hose connection diagram => Page 139

13 Oil filter

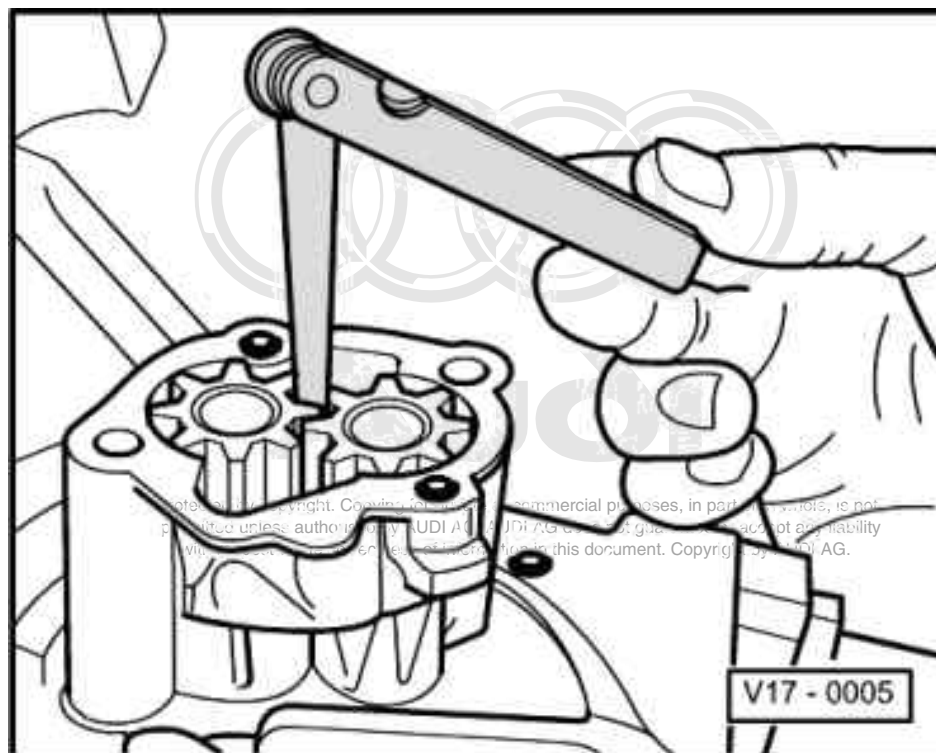
- ♦ Observe change intervals

=> Maintenance Manual

- ♦ Loosen with oil filter wrench 3417
- ♦ Observe installation instructions on oil filter
- ♦ Tighten to 20 Nm

14 25 Nm

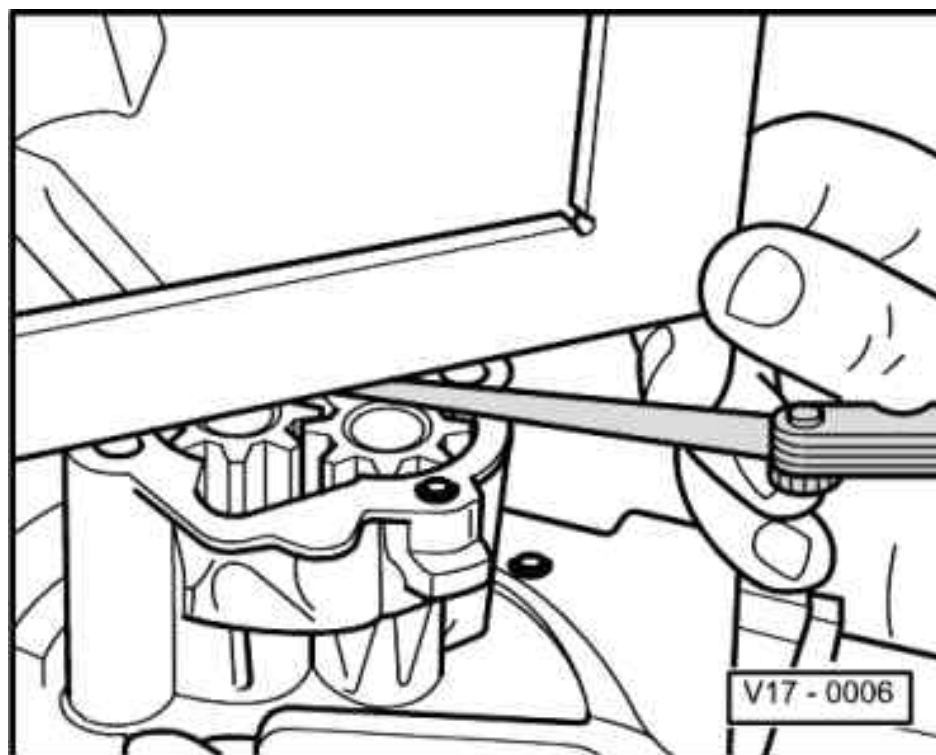
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-> Fig.1 Checking oil pump backlash

New: 0.05 mm

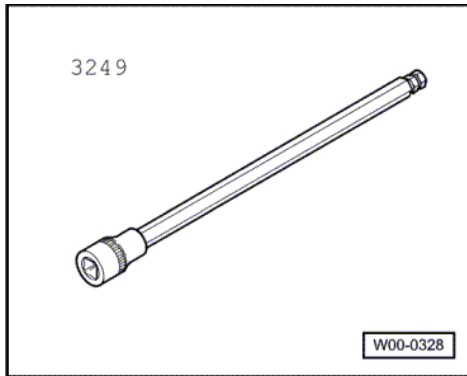
Wear limit: 0.20 mm



-> Fig.2 Checking oil pump axial play

Wear limit: 0.15 mm

1.4 - Removing and installing oil pan



Special tools and workshop equipment required

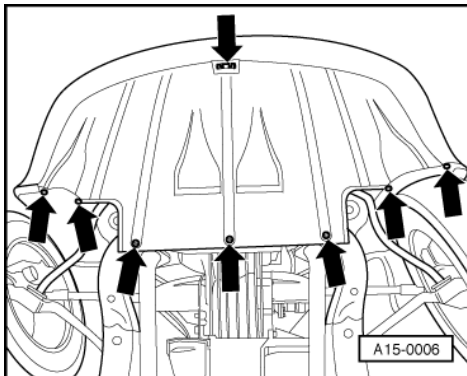
- ♦ Socket 3249



- ♦ Workshop crane VAS 6100

or

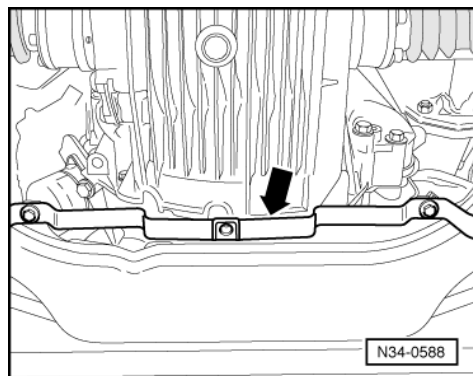
- ♦ Workshop crane V.A.G 1202 A
- ♦ Drip tray



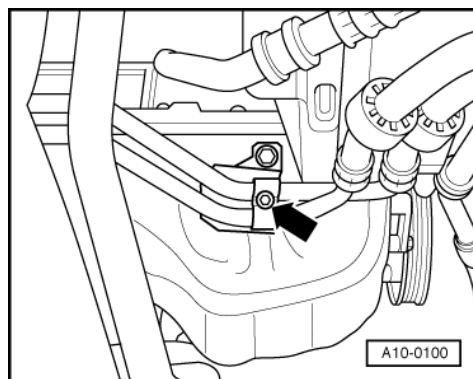


Removing

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

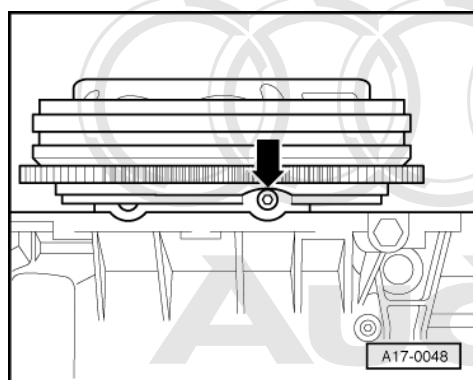


- -> Unbolt bracket for noise insulation -arrow-.



Vehicles with automatic gearbox:

- -> Unscrew bracket -arrow- for ATF line at engine oil pan.



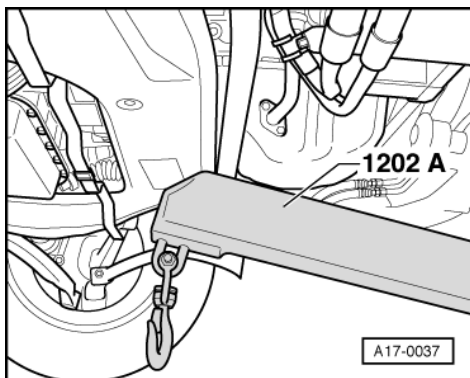
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- Slacken both rear bolts of oil pan.

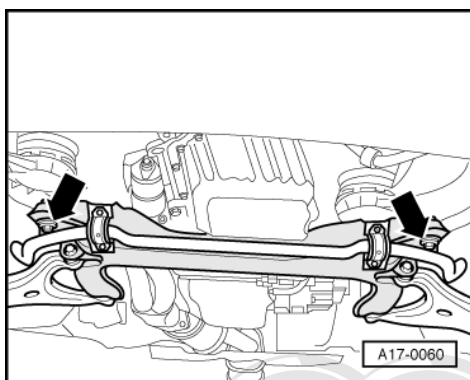
Notes:

- ♦ -> The two rear oil pan bolts are accessible via the recess -arrow- on the flywheel (turn flywheel as required).
- ♦ Use socket attachment 3249 to unscrew the rear oil pan bolts.

- ♦ For vehicles with automatic gearbox, the assembly apertures to oil pan/gearbox must be reworked in order to be able to remove/insert the bolts.



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



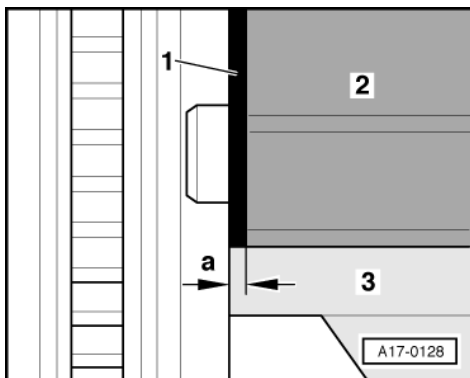
- -> Unscrew front bolts -arrows- of subframe.
- Slowly lower subframe with workshop crane VAS 6100 or V.A.G 1202 A.

Important
 The subframe is lowered by releasing the bolts approx. 100 mm.

Note:

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

- Loosen the remaining bolts of oil pan.
 - Detach oil pan with gasket.
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Installing

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

Notes:

- ♦ Replace seals and gaskets.
- ♦ -> When installing oil pan with engine removed from vehicle, ensure that oil pan -3- is positioned flush with intermediate plate -1- at flywheel end (i.e. oil pan should protrude dimension "a" = 0.8 mm from cylinder block) opposite the cylinder block -2-.
- Clean sealing surfaces before installing oil pan.
- Apply a thin coating of sealant to front and rear sealing flange/cylinder block sealing points at sealing surface to oil pan.
 - Sealants

=> Parts List

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- Fit oil pan and tighten all bolts securing oil pan to cylinder block to 5 Nm initially.
- Tighten bolts securing oil pan to gearbox.
- M6-Tighten bolts securing oil pan to cylinder block in two stages in diagonal sequence.
- Tighten M10 bolts securing oil pan to cylinder block.
- Fitting subframe with new bolts:

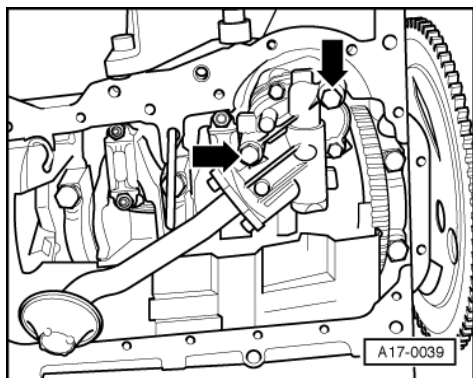
=> Running Gear, FWD and 4WD; Repair group 40

Tightening torques

Component		Nm
Oil pan to cylinder block	M6	10
	M10	45
Oil pan to gearbox		45
Oil drain plug		50

1.5 - Removing and installing oil pump

Removing



- Remove oil pan => Page 131 .
- Disengage and remove baffle plate.
- -> Loosen bolts -arrow-.
- Detach oil pump downwards.

Installing

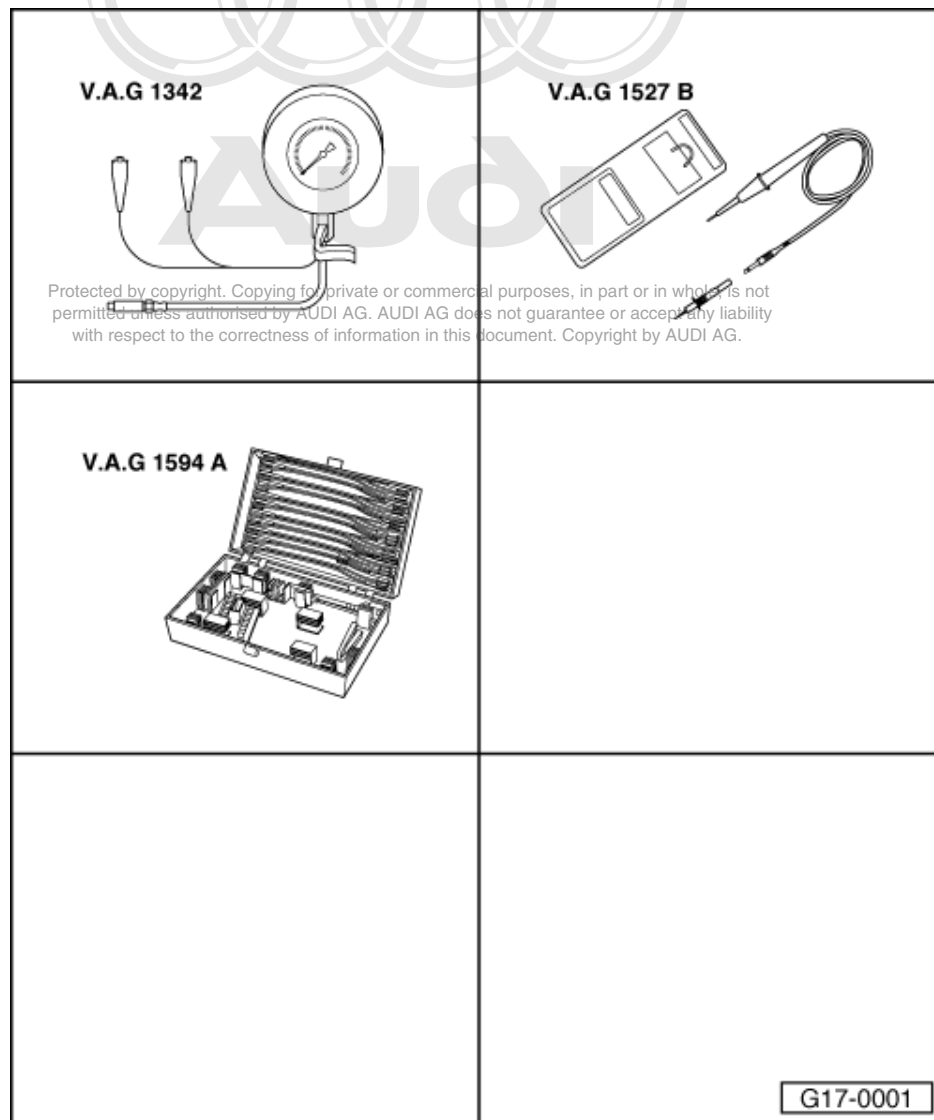
Installation is carried out in the reverse order; note the following:

- Installing oil pan => Page 134

Tightening torque

Component	Nm
Oil pump to cylinder block	25

1.6 - Checking oil pressure and oil pressure switch



Special tools and workshop equipment required

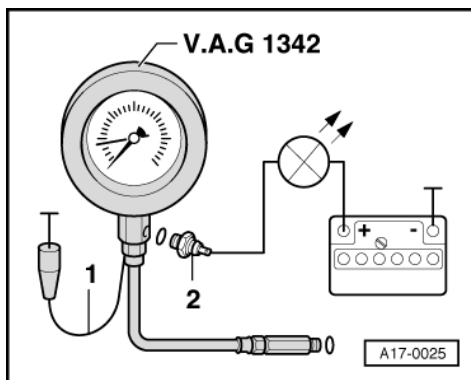
- ♦ V.A.G 1342
- ♦ V.A.G 1527 B
- ♦ V.A.G 1594 A

Test requirements:

- Oil level OK.
- Oil pressure warning lamp K3 must illuminate 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 illuminates 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

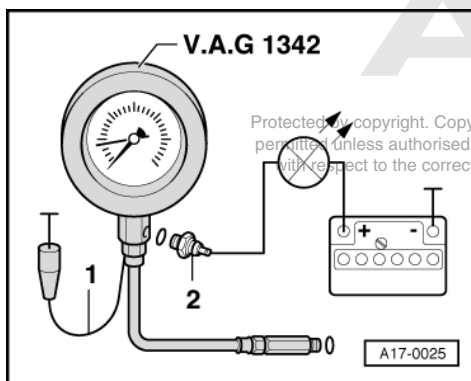
- Disconnect wire from oil pressure switch.
- -> Unscrew oil pressure switch and screw in oil pressure tester V.A.G 1342.
- Screw oil pressure switch -2- into V.A.G 1342.
- Connect brown wire 1 of tester to earth (-).
- Connect voltage tester V.A.G 1527 B to oil pressure switch and positive side of battery (+) using test leads from V.A.G 1594 A.
- LED should not illuminate.
- If the LED illuminates, 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 1.2... 1.6 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 idling speed: 1.0 ... 3.5 bar
 - Oil pressure at 3000 rpm: 5.0 ... 7.0 bar

If the specifications are not obtained:

- Pressure relief valve or oil pump defective, replace oil pump => Page 134 .

1.7 - Engine oil
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Viscosity grades and oil specifications

=> Maintenance Manual

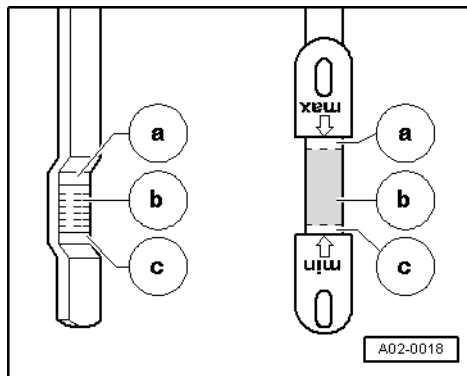
1.8 - Checking oil level

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 oil pan.

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.



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.
- ♦ Replace seals and gaskets.
- ♦ The arrow markings on the coolant pipes and on the ends of the hoses must align.



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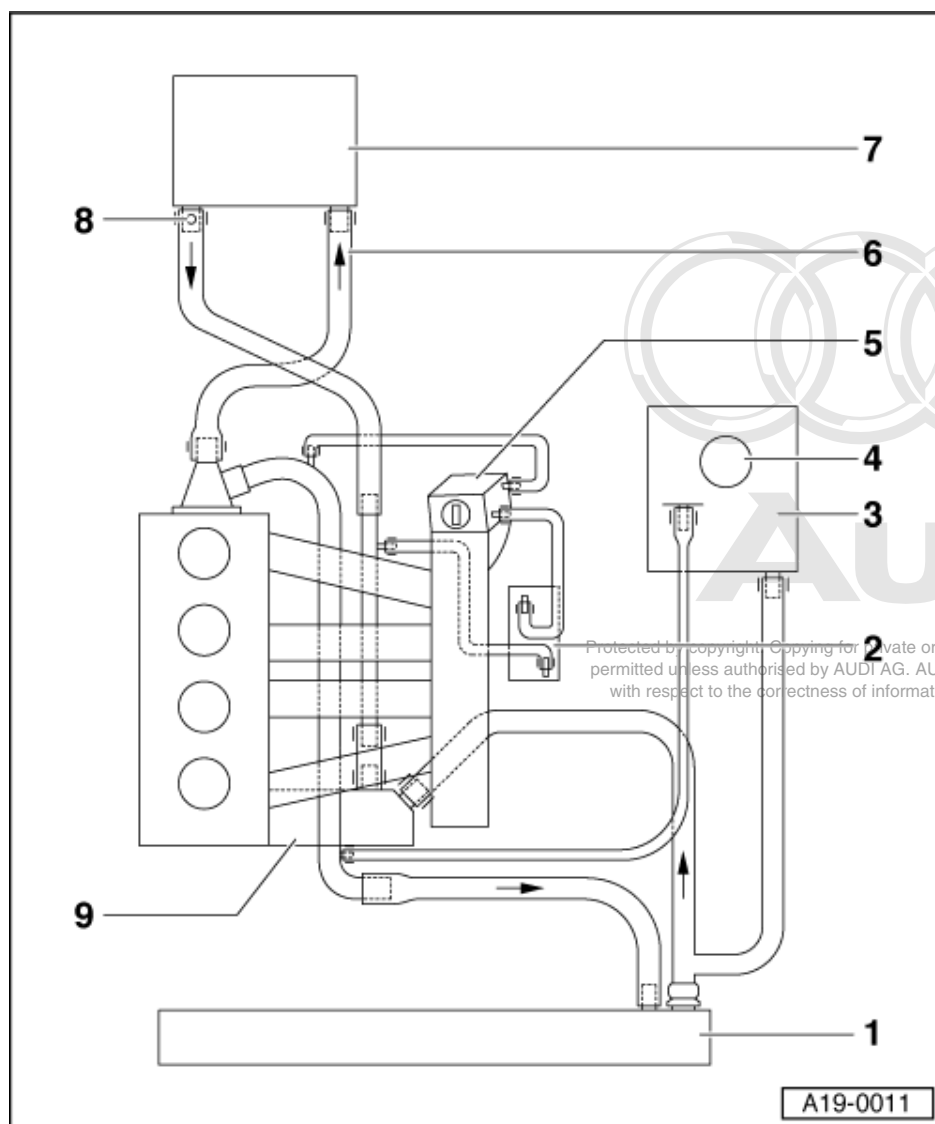
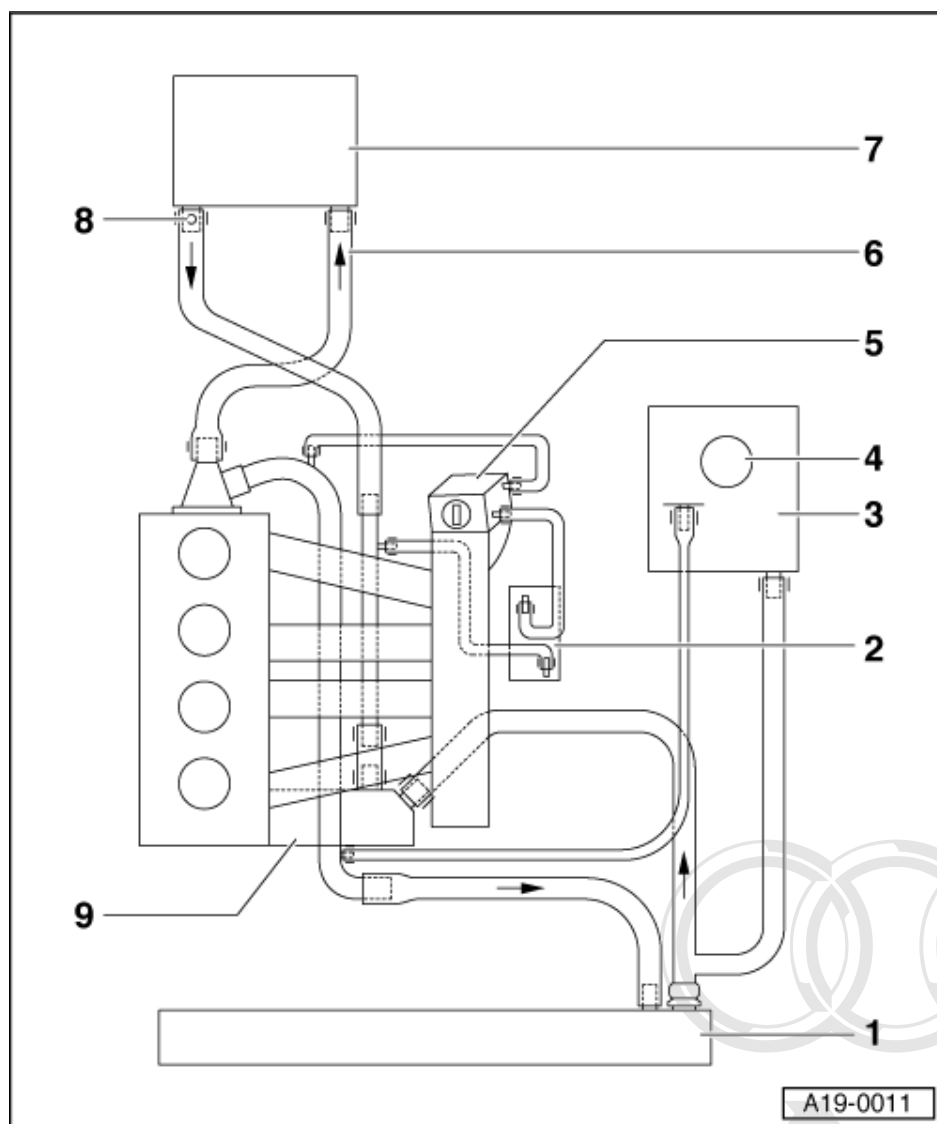


Diagram of coolant hose connections

- 1 Radiator
 - ♦ Removing and installing =>Page 151 .
 - ♦ After replacing, fill with fresh coolant
- 2 Fluid cooler
 - ♦ Removing and installing => Item 129
- 3 Expansion tank
- 4 Cap
 - ♦ Check pressure relief valve in sealing cap => Page 156
- 5 Throttle valve connection
- 6 Supply pipe



7 Heating system heat exchanger

- ◆ After replacing, fill with fresh coolant

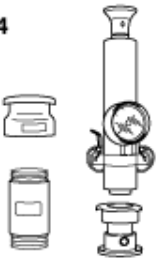
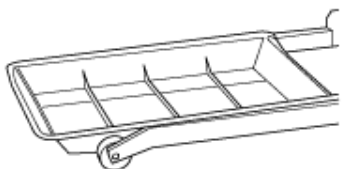
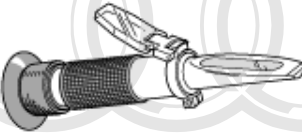
8 Return line

9 Coolant pump

- ◆ Removing and installing
=> Page 146
- ◆ Check for ease of movement

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1.2 - Draining and filling cooling system

V.A.G 1274 	V.A.G 1274/10 
V.A.G 1306 	T10007 
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Special tools and workshop equipment required

- ◆ V.A.G 1274/1
- ◆ V.A.G 1274/10
- ◆ V.A.G 1306
- ◆ Special tool T10007

Draining

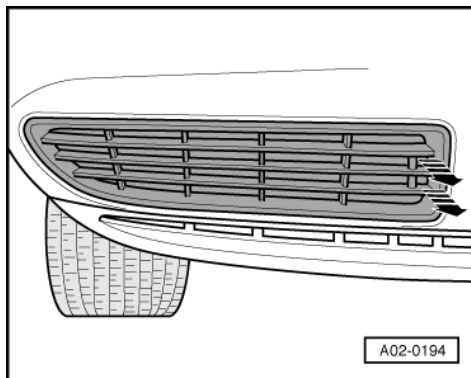
Notes:

- ◆ Collect drained coolant in a clean container for re use or disposal.
- ◆ Only use clean drinking water to mix the coolant.

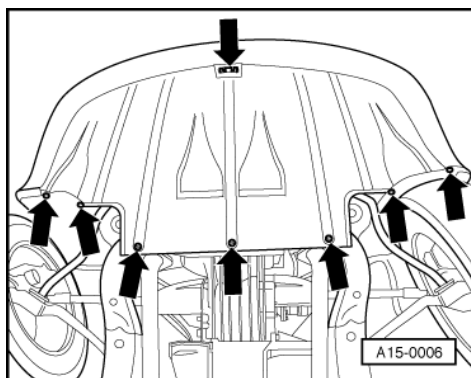
Important

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

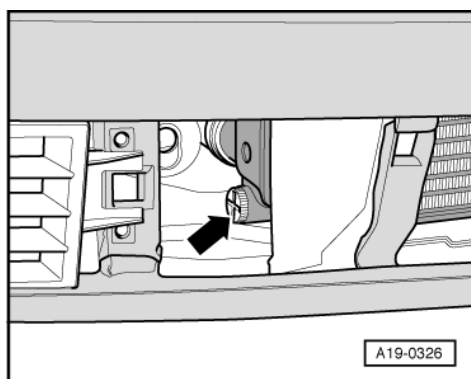
- Open the cover of the coolant expansion tank



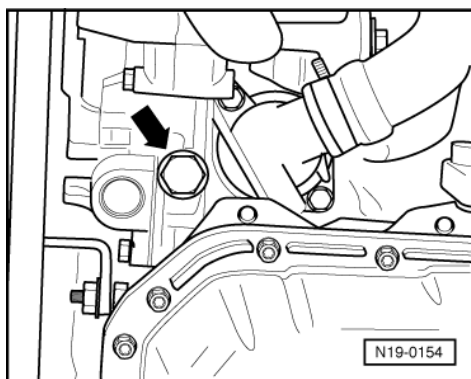
- -> Pull back retainer catch -arrows- and remove air intake grille.



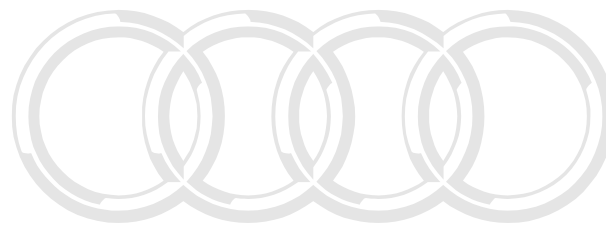
- -> Remove the noise insulation -arrows-.



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



- -> Also open the drain plug -arrow- on bearing housing of coolant pump.



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Filling

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.

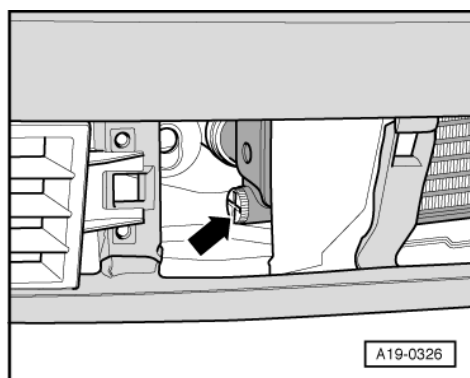
- ♦ If the fluid in the expansion tank is brown, this means G 012 A8 D has been mixed with another type of coolant. In this case, flush out the cooling system and fill with fresh coolant. To flush the system, fill it with clean water and run the engine for about 2 minutes. This should remove as much of the old coolant as possible.
- ♦ G 011 A8 C and G 012 A8 D and coolant additives marked meeting specification 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.
- ♦ If radiator, heat exchanger, cylinder head or cylinder head gasket is replaced, do not reuse old coolant.

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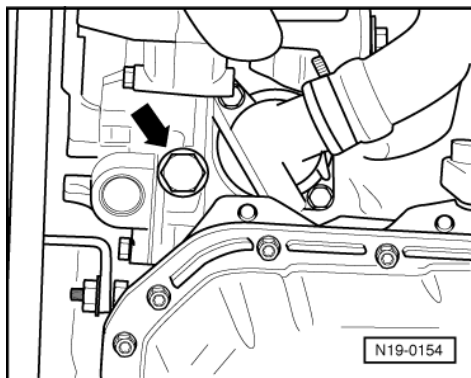
Recommended mixture ratios:

Frost protection to	Antifreeze concentration	G11/G12 1)	Water 1)
-25 °C	40 %	3.0 l	4.0 l
-35 °C	50 %	3.5 l	3.5 l

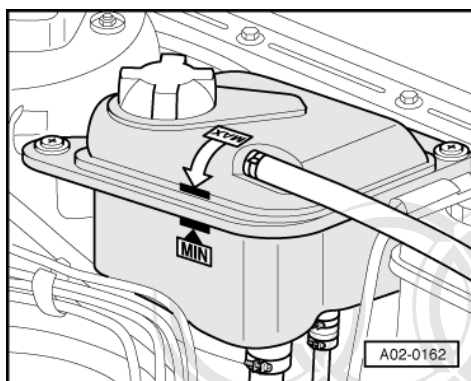
1) Coolant quantity: 7.0 litres (may vary depending upon the vehicle equipment)



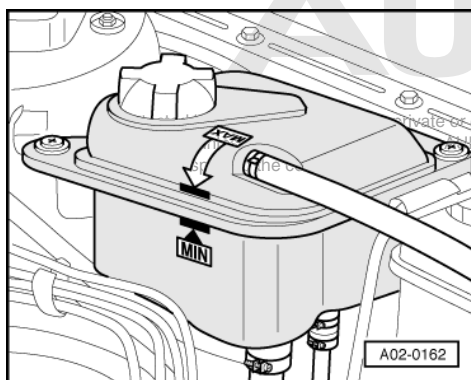
- -> Close drain plug -arrow- on radiator.



- -> Connect coolant drain plug to coolant pump -arrow- (30 Nm).



- -> Pour in coolant as far as top edge of expansion tank.
- Fit expansion tank cap.
- Run engine until operating temperature is attained (coolant temperature gauge reading approx. 80 °C).



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Important

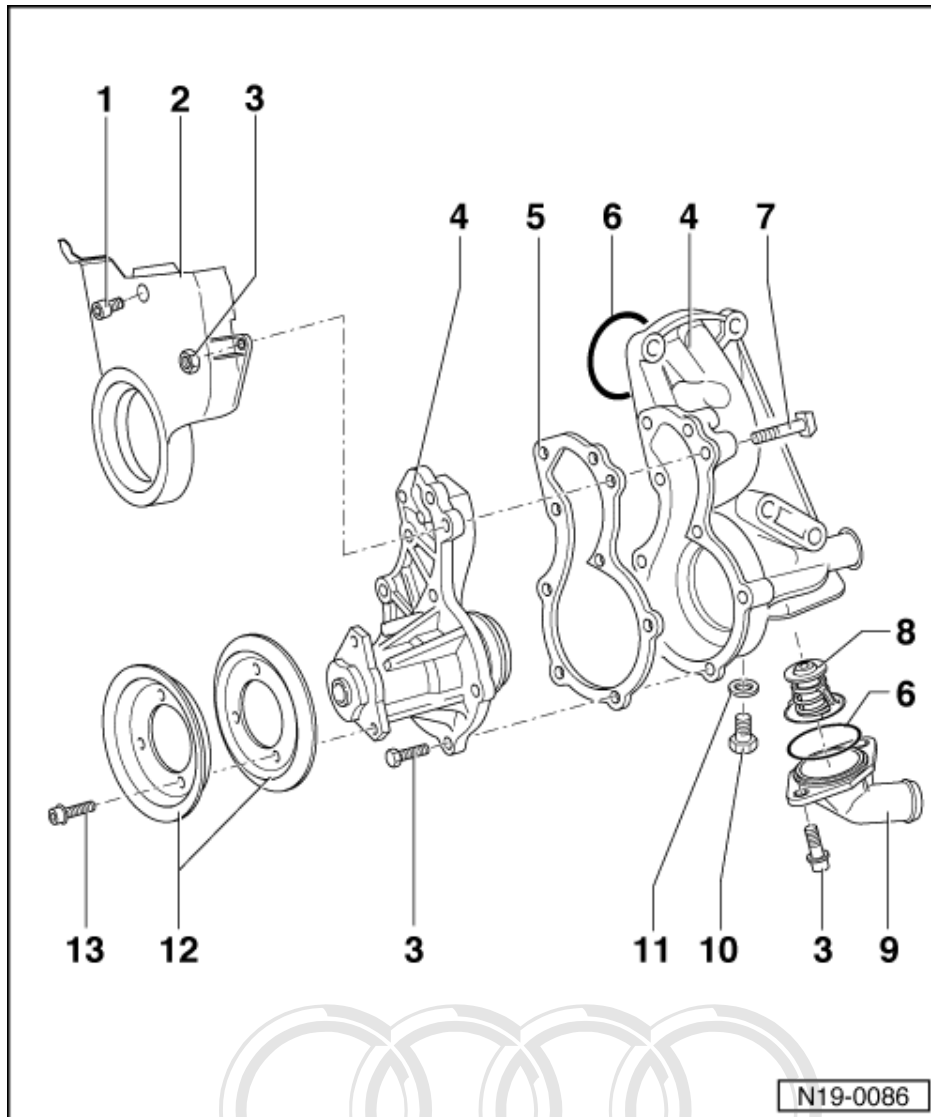
Hot steam or hot coolant can escape when opening expansion tank. Cover cap with a cloth and open carefully.

- -> 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
- Stop engine.

Tightening torque

Component	Nm
Drain plug to coolant pump	30

1.3 - Removing and installing coolant pump and coolant thermostat



1 M6 - 10 Nm
 M8 - 20 Nm

2 Toothed belt guard - lower

♦ Removing and installing => as of Page 41

3 10 Nm

4 Coolant pump

♦ Removing and installing
 => Page 146
 ♦ Check for ease of movement

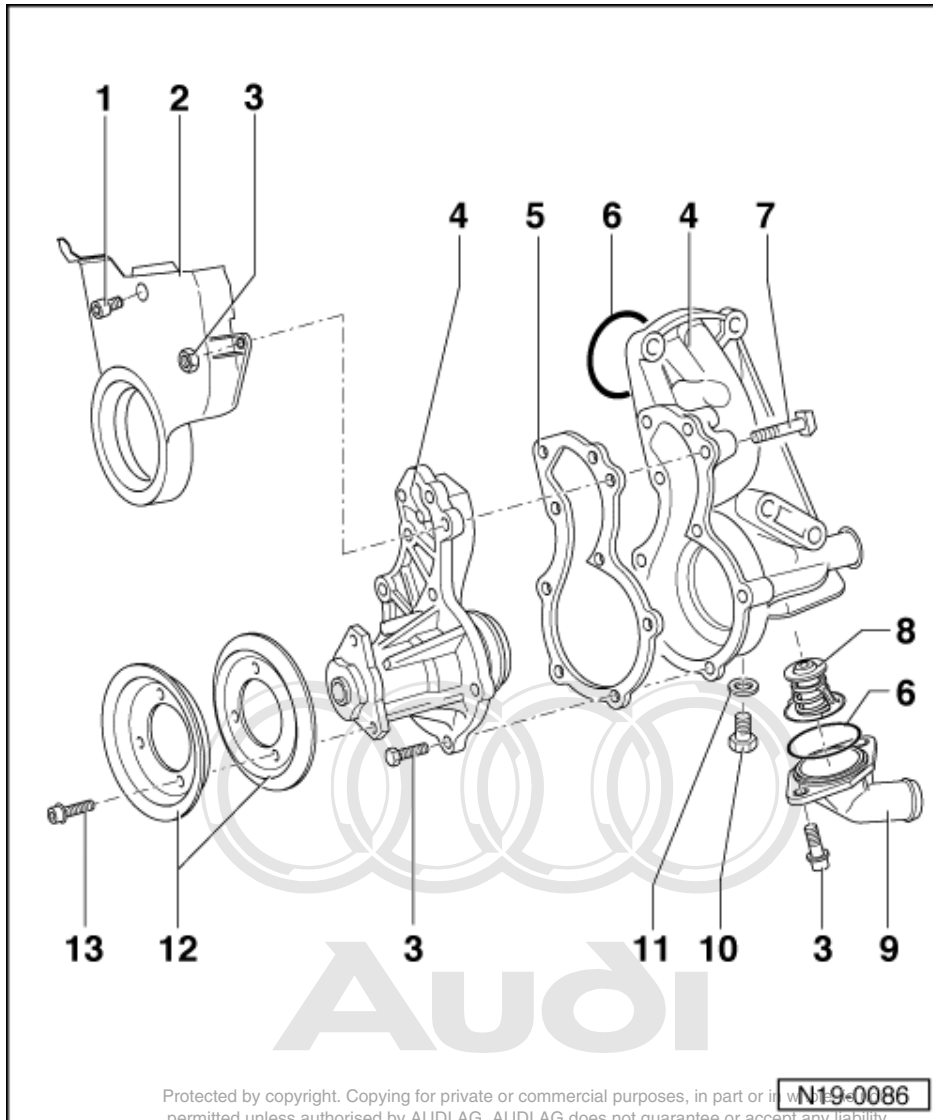
5 Seal

♦ Replace

6 O-ring

♦ Replace

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N19-0086

7 Hammer head bolt

- ♦ Insert before installing

8 Thermostat

- ♦ Removing and installing
=>Page 150 .
- ♦ Checking => Page 150

9 Pipe union

10 Drain plug - 30 Nm

11 Sealing ring

- ♦ Replace

12 Belt pulley

- ♦ Installation position: flat section of pulley towards coolant pump

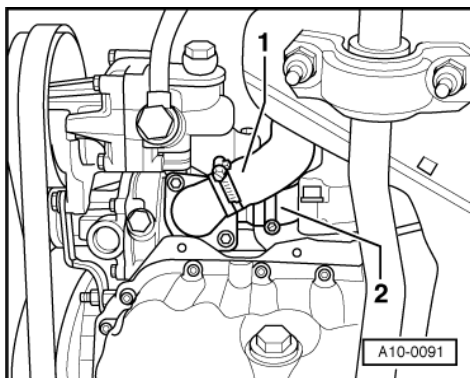
13 25 Nm

1.4 - Removing and installing coolant pump

Removing

- Observe or obtain radio code on vehicles with coded radio.
- Disconnect earth strap at battery with ignition switched off.

- Drain coolant => Page 141 .

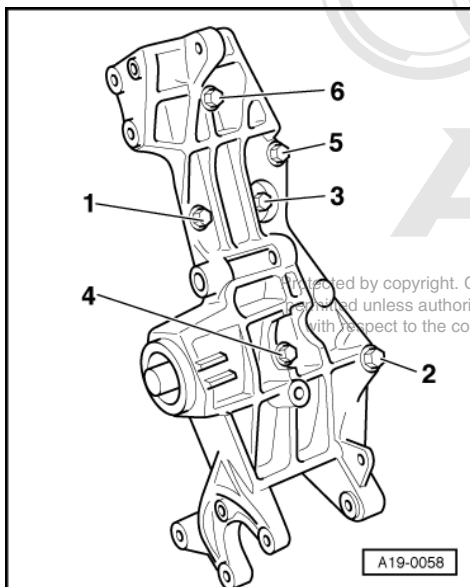


- -> Detach coolant hoses -1- and -2- from the coolant pump.
- Detach ribbed belt from vane pump belt pulley => Page 30 .

Note:

Ribbed belt for A/C compressor does not have to be removed.

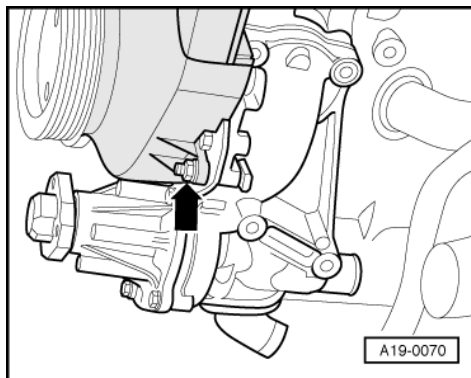
- Unscrew alternator securing bolts.
- Remove alternator from the front.
- Disconnect wiring from alternator after removal.
- Remove V-belt => Page 32
- Unbolt the following supports and struts from retainer for alternator, vane pump and idler wheel:
 - Support for intake manifold
 - Bracket for upper coolant pipe
 - Upper brace to cylinder block
 - Lower bracket to cylinder block



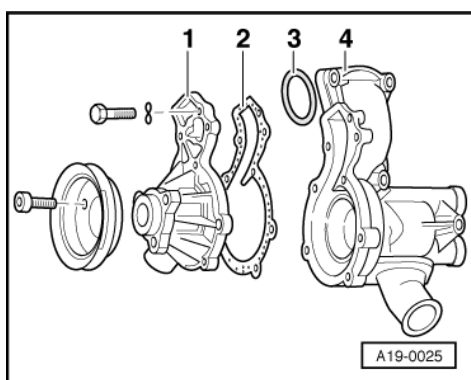
- -> Unscrew retainer for alternator, vane pump and idler wheel -bolts 1 ... 6-.
- Move retainer for alternator, vane pump and idler wheel clear to the left side and tie up with wire.

Note:

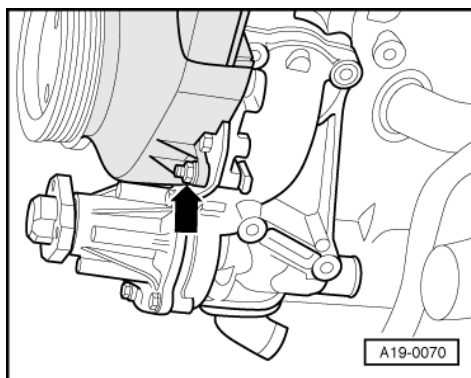
The vane pump does not have to be removed.



- -> Unbolt coolant pump housing from toothed belt guard -arrows-.
- Remove coolant pump.



- -> Unbolt bearing housing -1- from pump housing -4-.

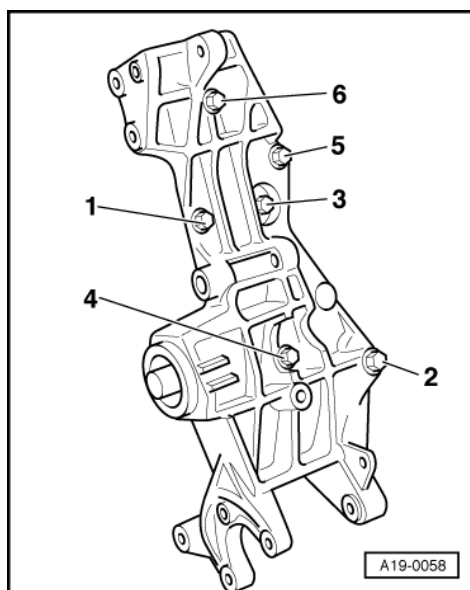


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Installing

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

- Clean sealing surfaces on both sections of housing.
- Replace gasket and O ring.
- -> Insert hammer head bolt in hole of coolant pump and tighten -arrow-.



- -> Attach retainer for alternator, vane pump and idler wheel with coolant pump to cylinder block and tighten bolts in numerical sequence.

- 1) - Bolt M8 x 70
- 2) - Bolt M8 x 110
- 3) - Bolt M8 x 50
- 4) - Bolt M8 x 90
- 5) - Bolt M8 x 70
- 6) - Bolt M8 x 100

- Install ribbed belt =>Page 32 .
- Install V-belt =>Page 33 .
- Top up coolant => Page 143 .

Notes:

- ◆ When the battery is reconnected make sure that the vehicle equipment (radio, clock, electrical window lifter) is activated according to the operating instructions.
- ◆ Further measures after reconnection of voltage supply:

=> Motronic Injection and Ignition System (4-cylinder, 5-valve); Repair group 24

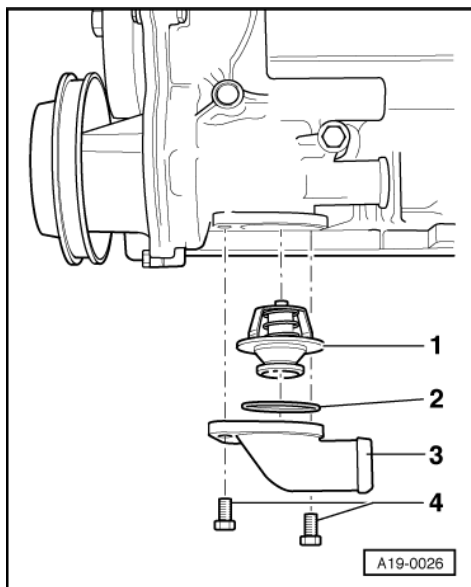
Tightening torques

Component	Nm
Bearing housing to pump housing	10
Pump housing to toothed belt guard	10
Retainer for alternator, vane pump and idler wheel to cylinder block	25
Strut on cylinder block (left) / retainer for alternator, vane pump and idler wheel	
to cylinder block	25
to retainer (M10)	40
Retainer on cylinder block (bottom) / retainer for alternator, vane pump and idler wheel	
to cylinder block	25
to retainer	20
Support for intake pipe to intake pipe	20
Alternator to retainer for alternator, vane pump and idler wheel	



Component	Nm
M8	20
M10	40
Pulley to power steering vane pump	25

1.5 - Removing, installing and checking coolant thermostat



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Removing

- Drain coolant => Page 141 .
- -> Unscrew bolts -1- remove connection -2-, O-Ring -3- and coolant thermostat -4-.

Installing

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

- Clean and smooth down sealing surface for O-ring as required.
- Insert coolant thermostat.
- Top up coolant => Page 143 .

Tightening torque

Component	Nm
Connection to pump housing	10

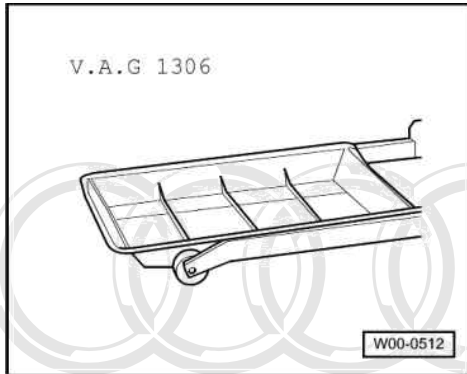
Checking coolant thermostat

- 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

1.6 - Removing and installing radiator



Special tools and workshop equipment required

- ♦ Drip tray V.A.G 1306

Removing

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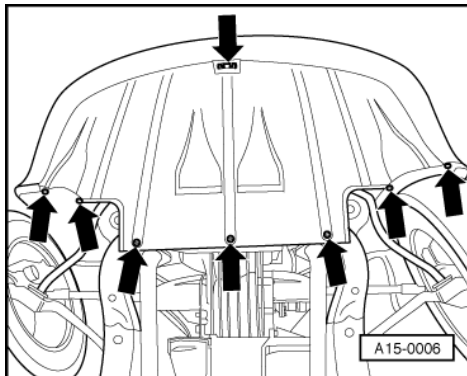
Note:

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

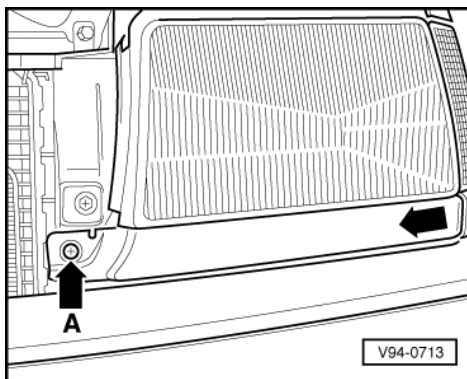
Important

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



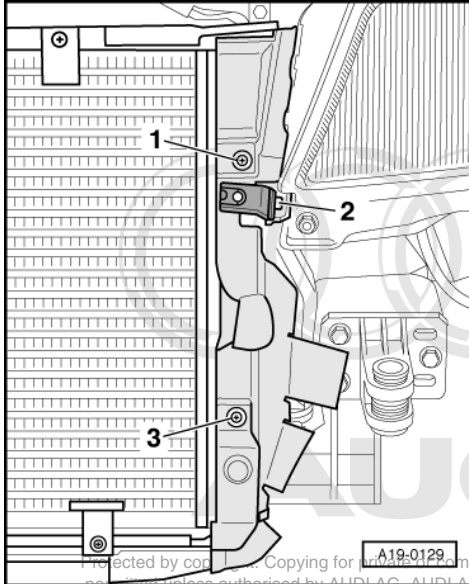
- -> Remove the noise insulation -arrows-.



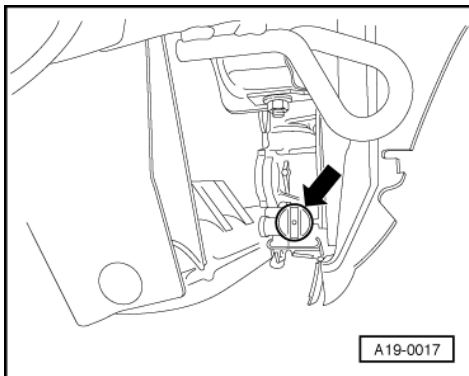
- Remove the front bumper:

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

- Remove rubber sealing lip from top of lock carrier.
- -> Remove securing bolt -arrow A- and pull out headlight trim in direction of arrow.



- -> Unscrew the retaining bracket 2 for headlight trim.
- Unscrew air ducts from radiator -1- and -3- (left and right).



- 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 coolant hose from bottom of radiator.

Vehicles with air conditioner:

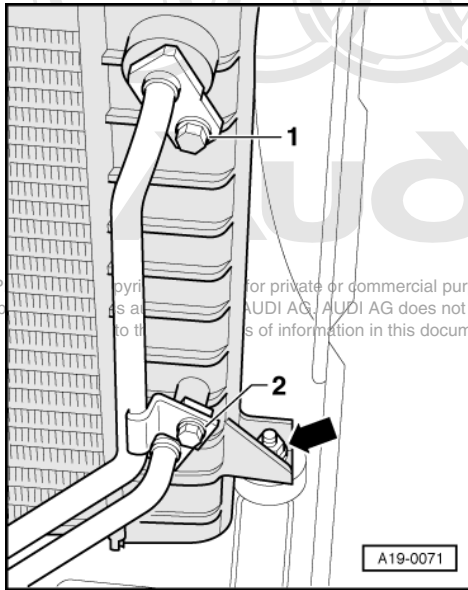
Important
The air conditioner refrigerant circuit must not be opened.

- Remove refrigerant pipe under radiator from brackets.

All models:

- Detach connector from thermoswitch for radiator fan -F54.
- Detach top left coolant hose from radiator.

- Remove air duct to air cleaner at lock carrier.



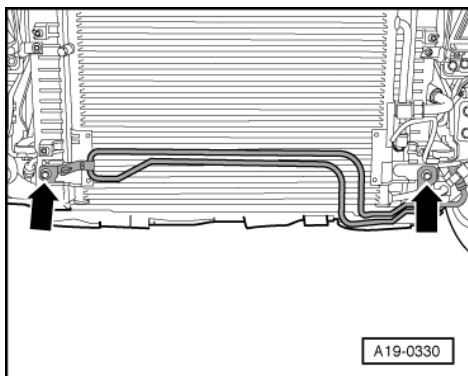
Vehicles with automatic gearbox:

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

=> Automatic Gearbox; Repair group 37

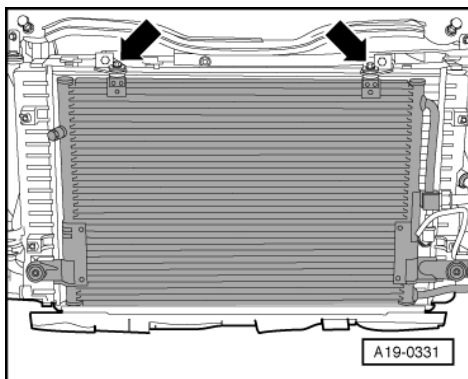
Note:

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



All models:

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



Vehicles with air conditioner:**Important**

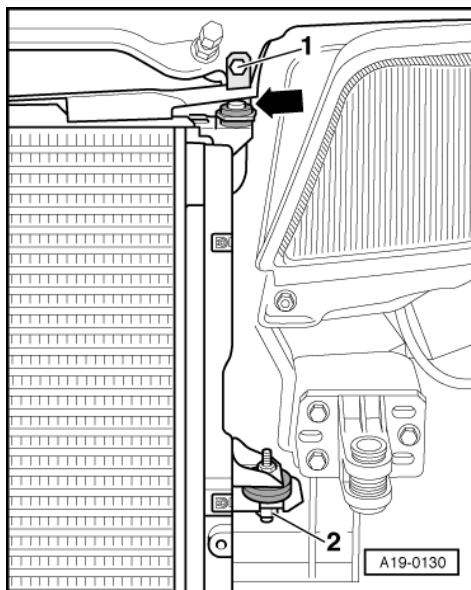
The air conditioner refrigerant circuit must not be opened.

- -> 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.



- -> Unscrew nuts -2- at bonded rubber mounting.
- Pull radiator forwards at lower edge, so that it can be removed from the support at the top -arrow-.

Note:

On vehicles with air conditioner also unscrew bolt -1- at the top, if applicable.

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 143 .

Note:

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

Vehicles with automatic gearbox:

- Attach ATF lines.

=> Automatic Gearbox; Repair group 37

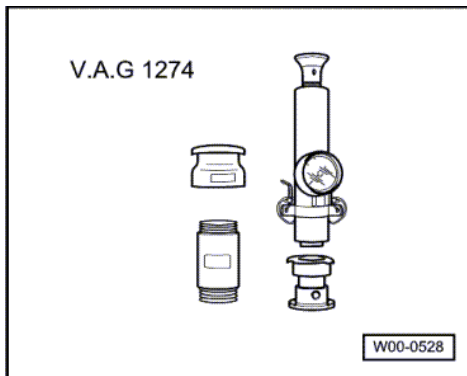
- Check ATF level:

=> 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 cooling coil to radiator		10

1.7 - Checking cooling system for leaks

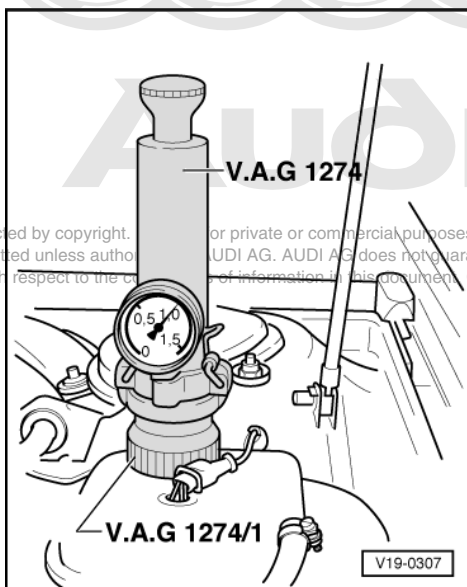


Special tools and workshop equipment required

- ♦ V.A.G 1274 with V.A.G 1274/1

Test requirements:

- Engine at operating temperature.



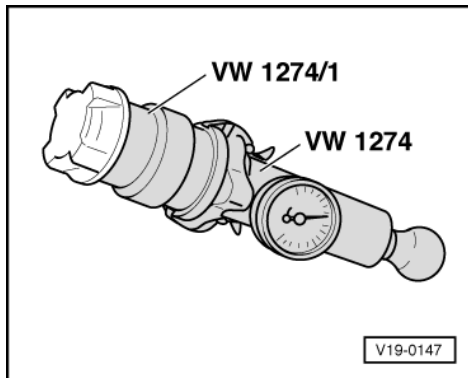
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Test sequence

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.



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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.

26 - Exhaust system

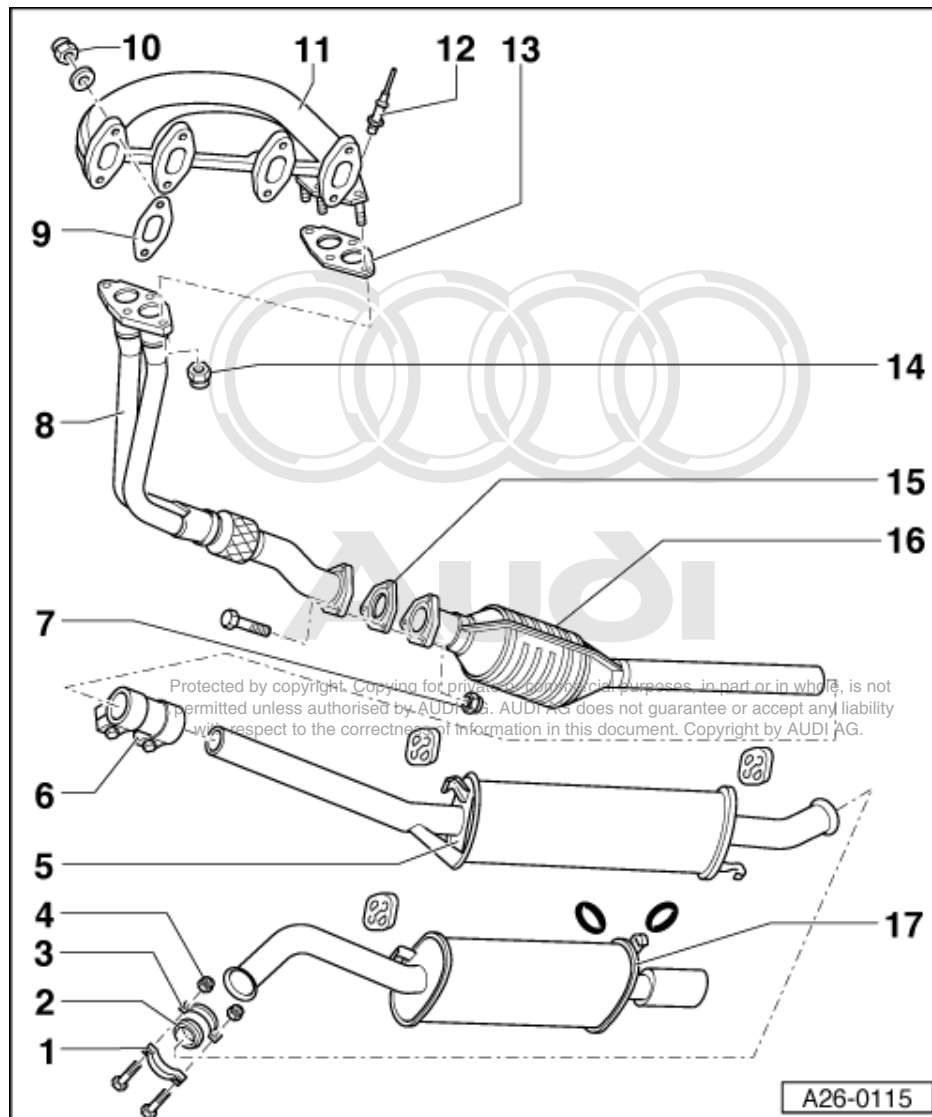
1 - Removing and installing parts of exhaust system

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.
- ♦ The isolating element in exhaust system must not be bent more than 10° to avoid damage.

1.2 - Vehicles with front-wheel drive



Note:

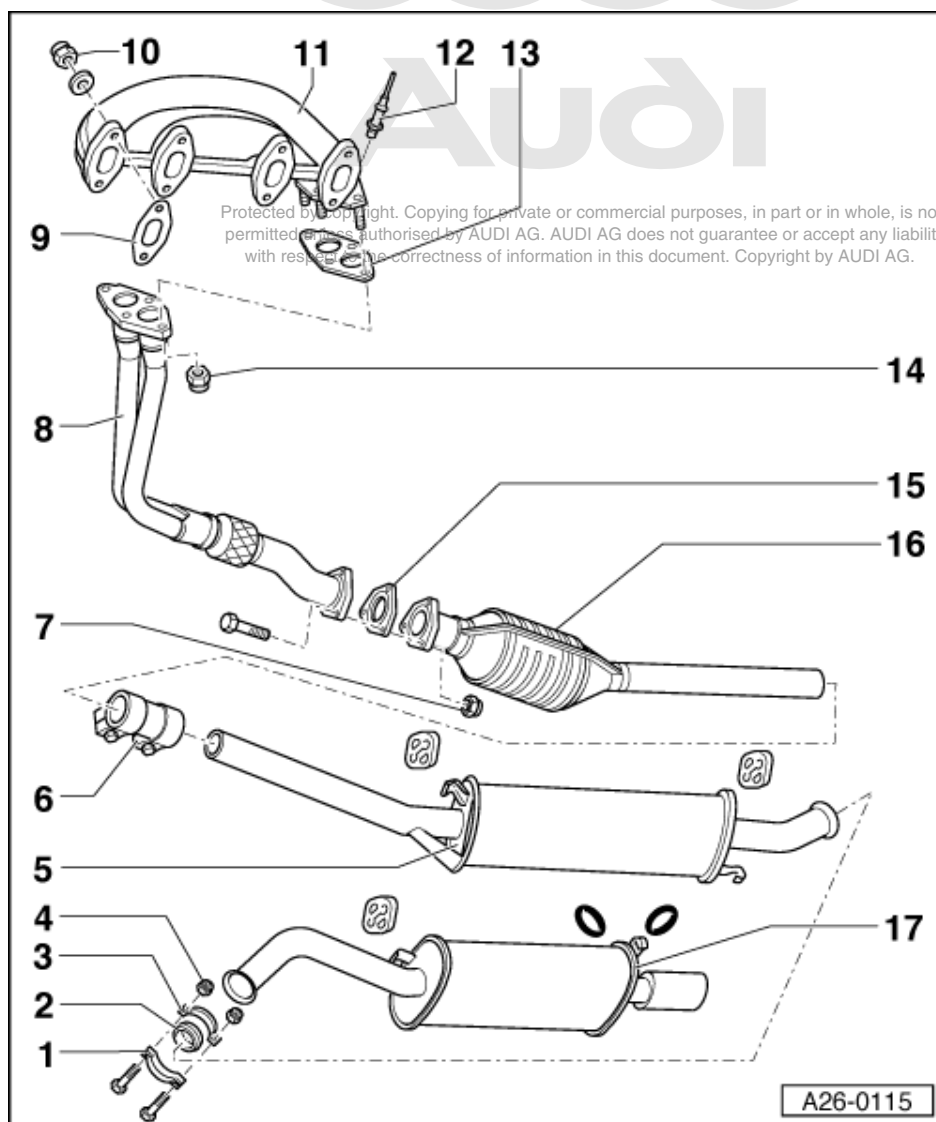
Removing and installing floor cross member => Fig. 161

1 Clip
2 Sealing ring

- ♦ Sensitive to impact; take care not to drop

3 Clip
4 15 Nm
5 Centre silencer

- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 169


6 Clamp

- ♦ Replace each time after removing
- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 169
- ♦ Installation position
=> Fig. 160
- ♦ Tighten bolted connections evenly to 40 Nm

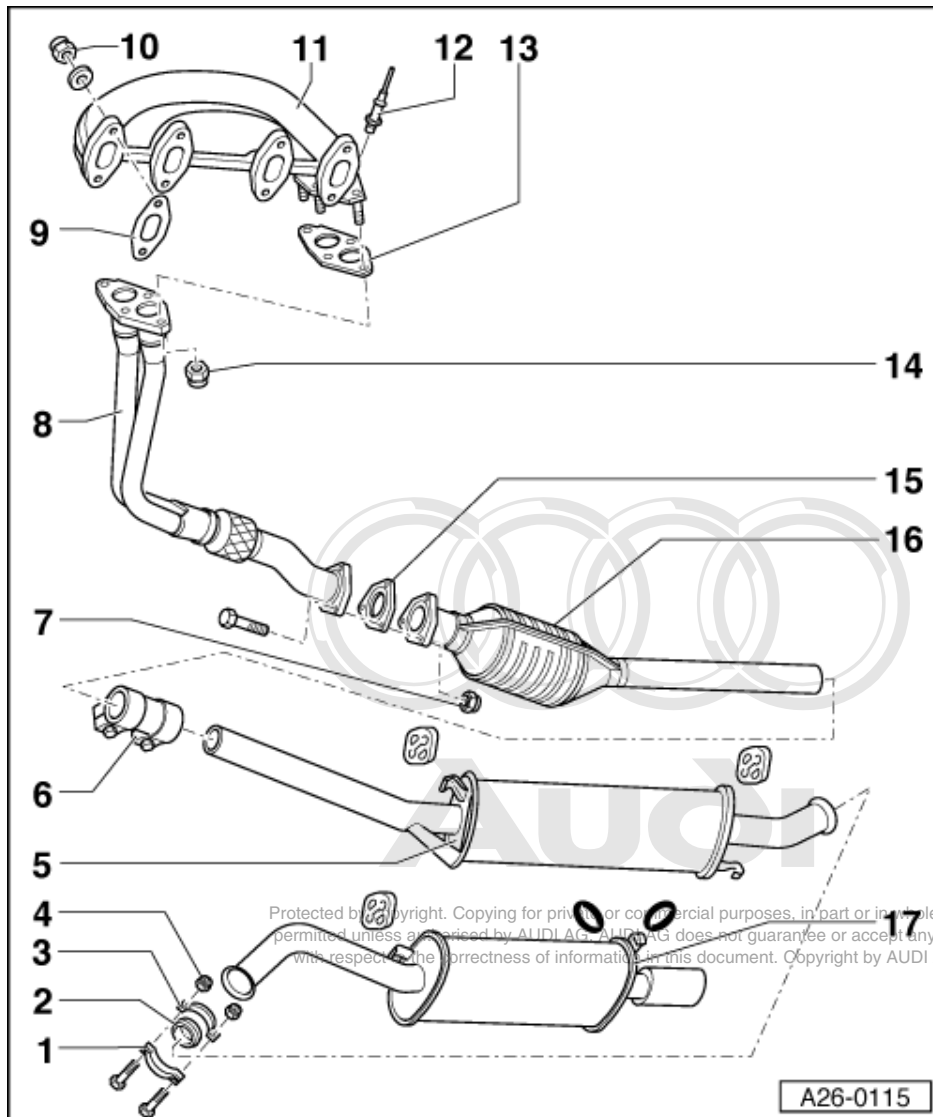
7 25 Nm

- ♦ Replace

8 Front exhaust pipe

- ♦ With flexible connection (de coupling element)
- ♦ Do not bend flexible connection more than 10°- otherwise it can be damaged.

- ♦ Protect from damage by knocks and impact
- 9 Seal**
 - ♦ Replace
- 10 25 Nm**
 - ♦ Replace
- 11 Exhaust manifold**



12 Lambda probe - 55 Nm

- ♦ Grease only the threads with high-temperature lubricant. The lubricant must not penetrate into the slots on the probe body.
- ♦ High-temperature lubricant

=> Parts List

- ♦ Checking:

=> Motronic Injection and Ignition System (4-cylinder, 5-valve); Repair group 24; Checking lambda control
Checking lambda control

13 Seal

- ♦ Replace

14 30 Nm

- ♦ Replace

15 Seal

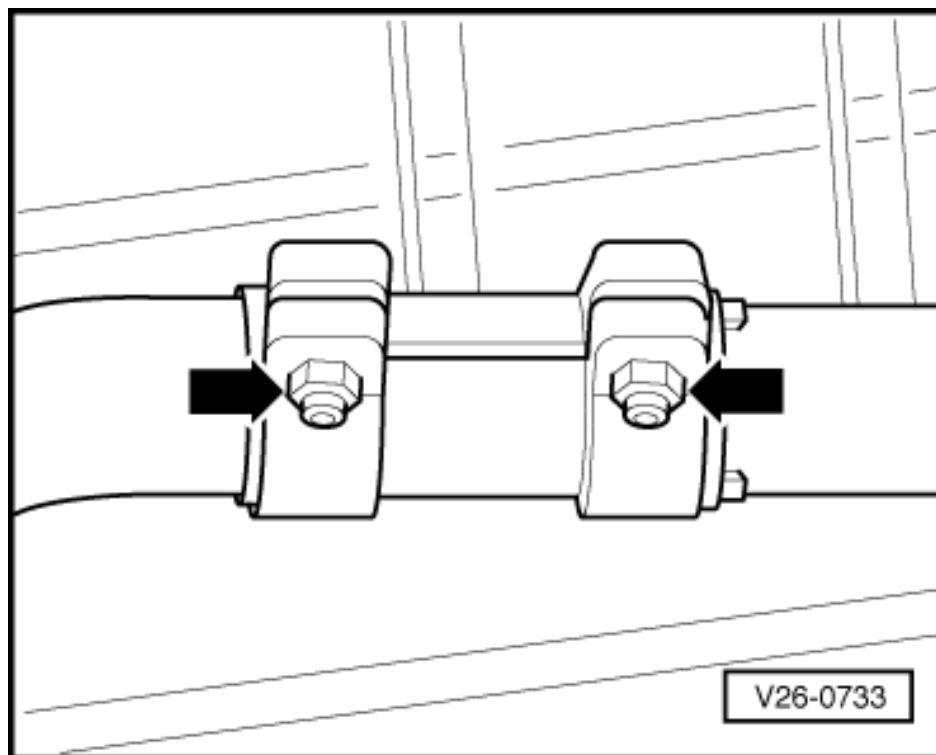
- ♦ Replace

16 Catalytic converter

- ♦ Protect from damage by knocks and impact

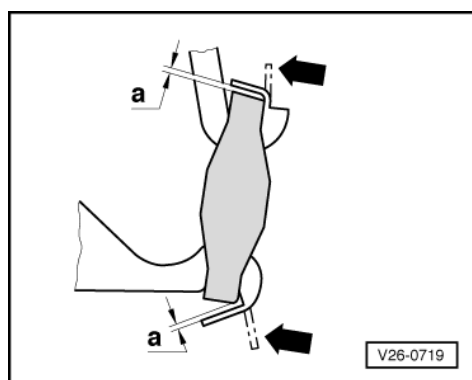
17 Rear silencer

- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 169



-> Fig.1 Installation position of the clamping sleeve

- Fit clamp in horizontal position.
- Replace clamping sleeve after loosening union -arrows-



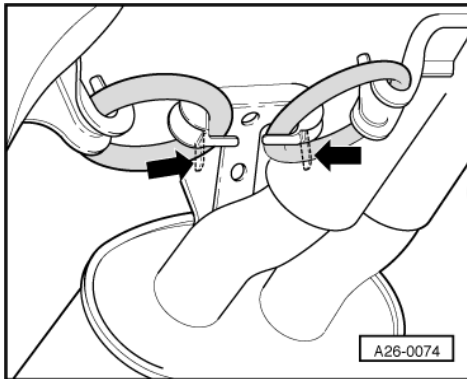
-> Fig.2 Bending over securing tabs on brackets of front mounting

- 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

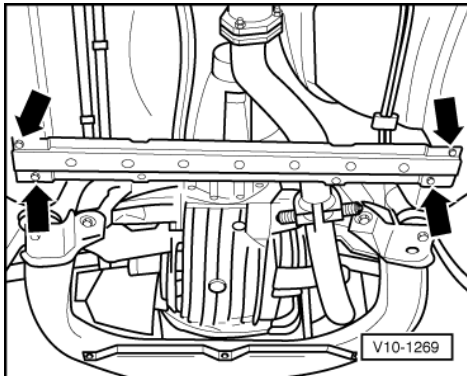


-> Fig.3 Bending over securing tabs on brackets of rear mounting

- Rear silencer

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

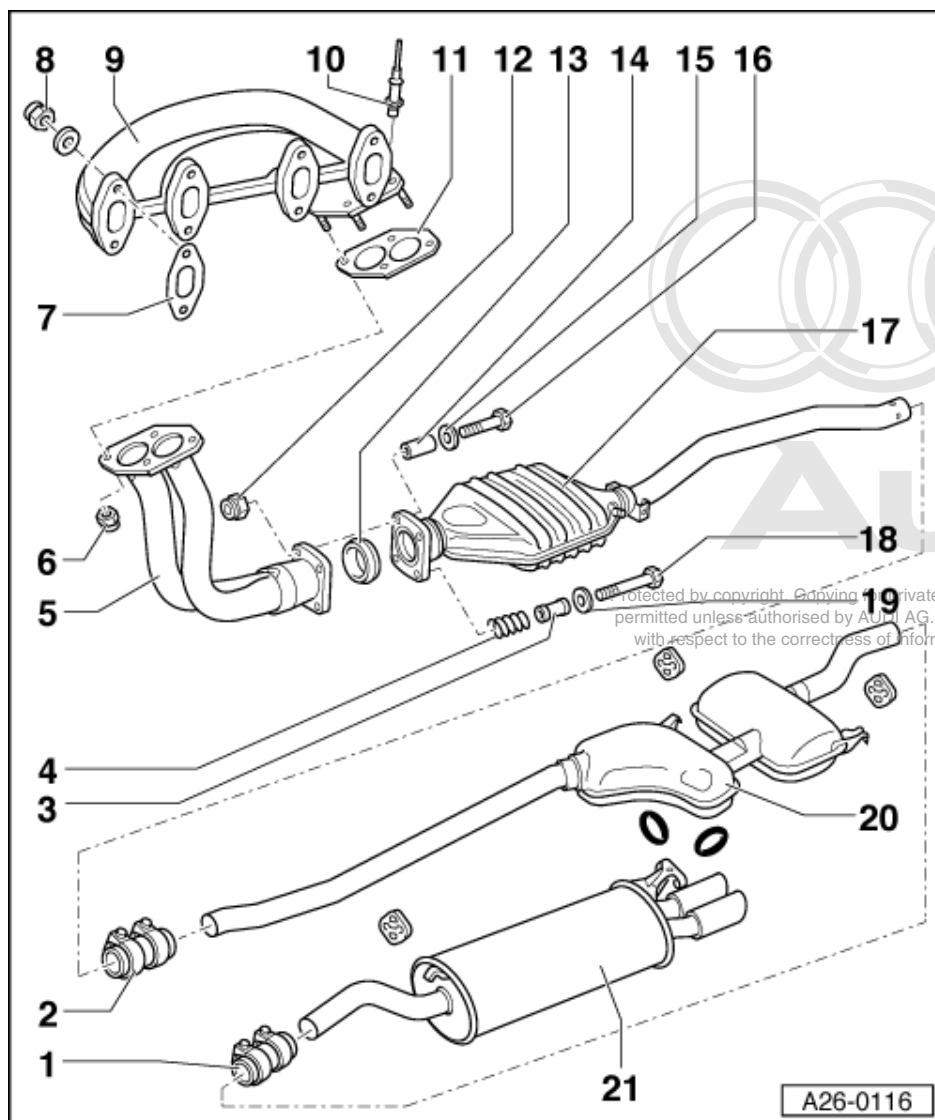
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-> Fig.4 Removing and installing floor cross member

- ♦ Tightening torque: 20 Nm

1.3 - Vehicles with four-wheel drive

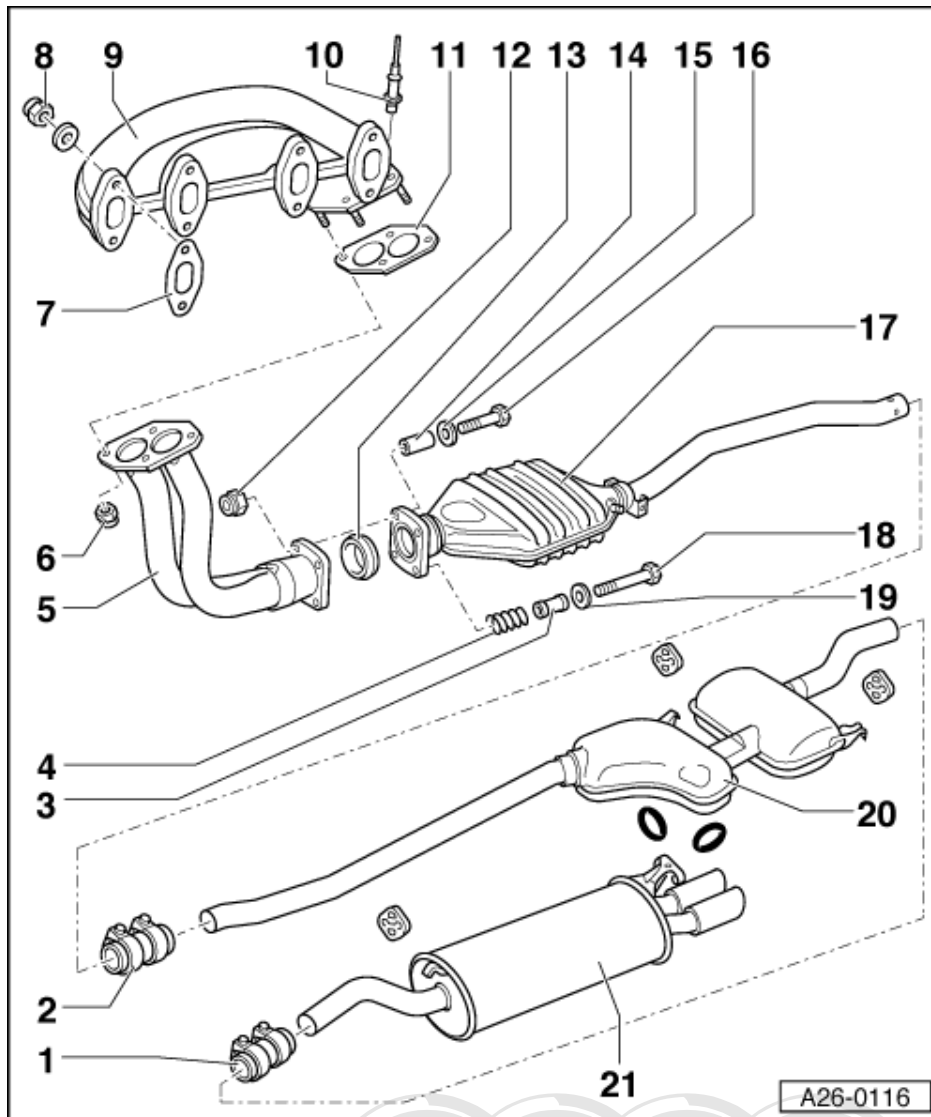


Note:

Removing and installing floor crossmember => Fig. 168.

1 Rear clamping sleeve

- ♦ For separate replacement of centre and rear silencers
- ♦ Replace each time after removing
- ♦ Align exhaust system so it is free of stress before tightening clamp => Page 169
- ♦ Installation position
=> Fig. 167
- ♦ Tighten bolted connections evenly to 40 Nm

**2 Front clamping sleeve**

- ◆ Replace each time after removing
- ◆ Align exhaust system so it is free of stress before tightening clamp => Page 169
- ◆ Installation position
=> Fig. 167
- ◆ Tighten bolted connections evenly to 40 Nm

3 Spacer bush

- ◆ 3 x fitted on this flange

4 Spring

- ◆ 3 x fitted on this flange

5 Front exhaust pipe

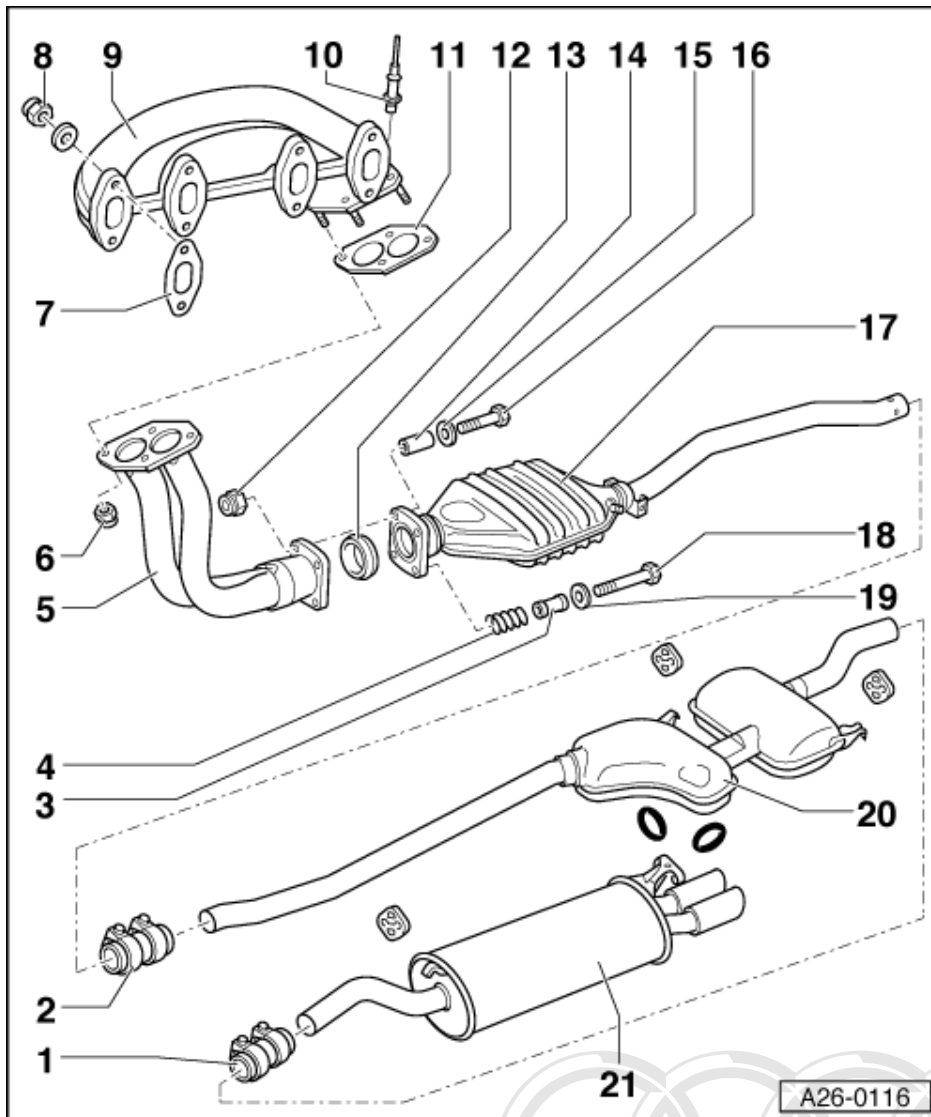
- ◆ With flexible connection (de coupling element)
- ◆ Do not bend flexible connection more than 10° - otherwise it can be damaged.

6 30 Nm

- ◆ Replace

7 Seal

- ◆ Replace



8 25 Nm

- ♦ Replace

9 Exhaust manifold

10 Lambda probe - 55 Nm

- ♦ Grease only the threads with high-temperature lubricant. The lubricant must not penetrate into the slots on the probe body.
- ♦ High-temperature lubricant

=> Parts List

- ♦ Checking:

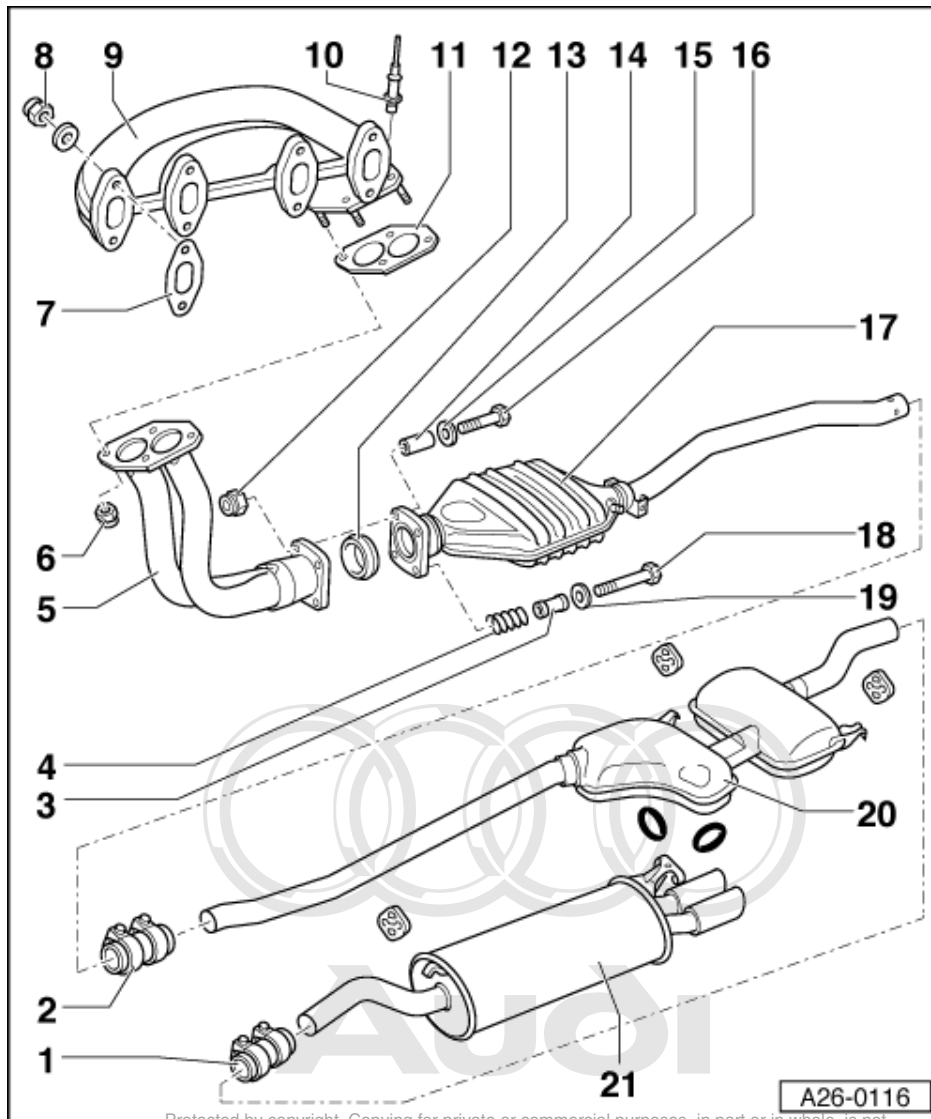
=> Motronic Injection and Ignition System (4-cylinder, 5-valve); Repair group 24; Checking lambda control
Checking lambda control

11 Seal

- ♦ Replace

12 25 Nm

- ♦ Replace



13 Sealing ring

- ♦ Sensitive to impact; take care not to drop

14 Spacer bush

- ♦ 1 x fitted on this flange

15 Washer

16 Bolt -25 Nm

- ♦ M8 x 45
- ♦ 1 x fitted on this flange

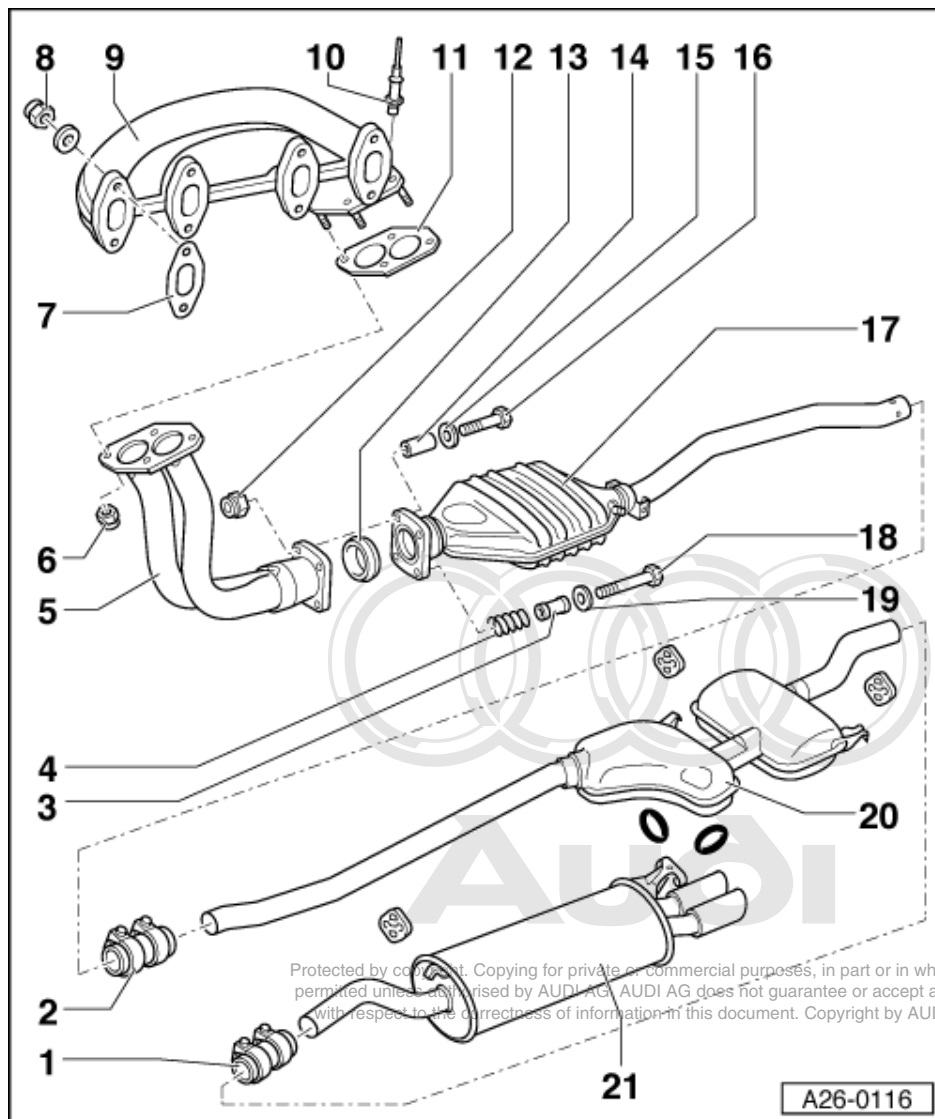
17 Catalytic converter

- ♦ Protect from damage by knocks and impact

18 Bolt -25 Nm

- ♦ M8 x 70
- ♦ 3 x fitted on this flange

19 Washer

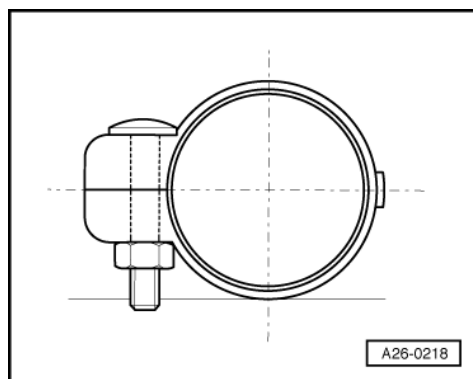


20 Centre silencer

- ◆ Centre and rear silencers are one unit as original equipment. In cases of repair, replace individually
- ◆ Cutting point => Page 169
- ◆ Align exhaust system so it is free of stress before tightening clamp => Page 169

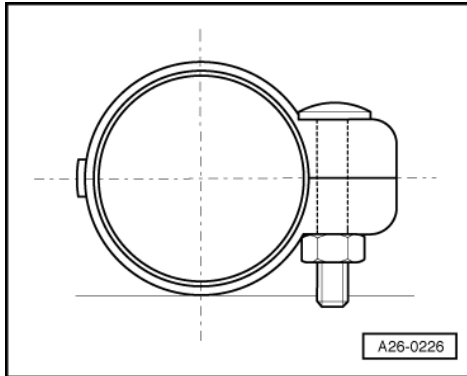
21 Rear silencer

- ◆ Rear and centre silencer are one unit as original equipment. In cases of repair, replace individually
- ◆ Cutting point => Page 169
- ◆ Align exhaust system so it is free of stress before tightening clamp => Page 169



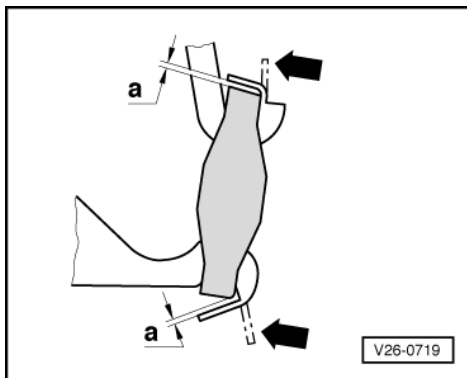
-> Fig.1 Installation position of front clamp

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



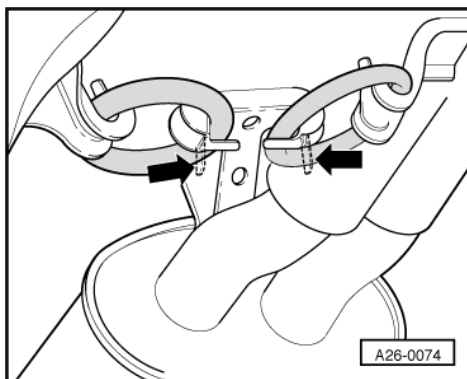
-> Fig.2 Installation position of rear clamp

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



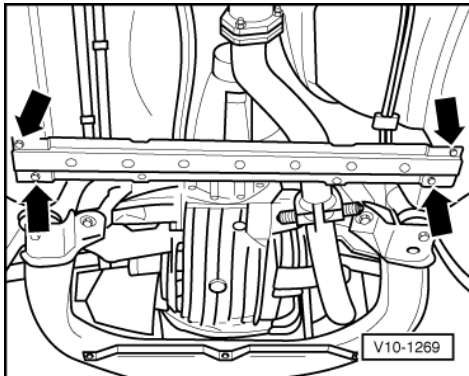
-> Fig.3 Bending over securing tabs on brackets of front mounting

- 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 retaining ring and securing tab.
- Dimension a = 2 mm



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

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



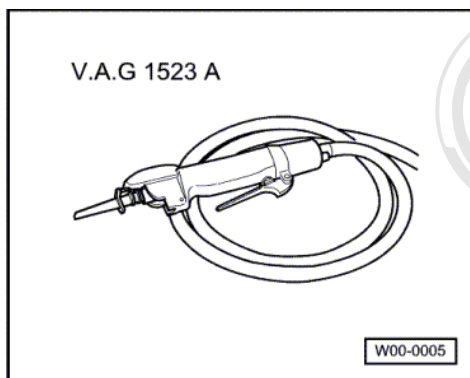
-> Fig.5 Removing and installing floor cross member

- ♦ Tightening torque: 20 Nm

1.4 - Separating centre and rear silencers

Vehicles with four-wheel drive:

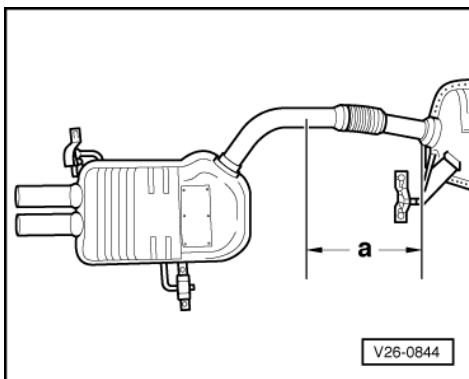
- ♦ The connecting pipe can be cut through at the cutting point in order to replace the centre and rear silencers separately.



Special tools and workshop equipment required

- ♦ V.A.G 1523 A

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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:

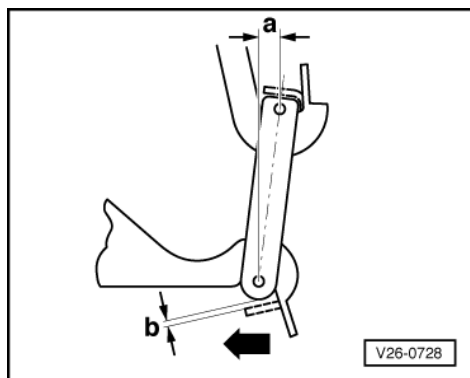
A short clamp is provided for connecting the main and rear silencers when performing repairs.

- When installing, position clamping sleeve centrally over saw cut.
- Installation position of clamp => Fig. 167
- Stress-free alignment of exhaust system => Page 169

1.5 - Stress free alignment of exhaust system

Note:

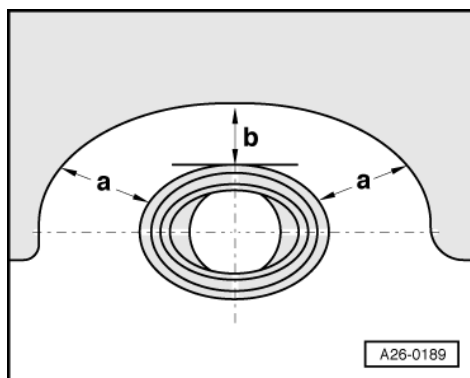
The exhaust system must be aligned when cold.



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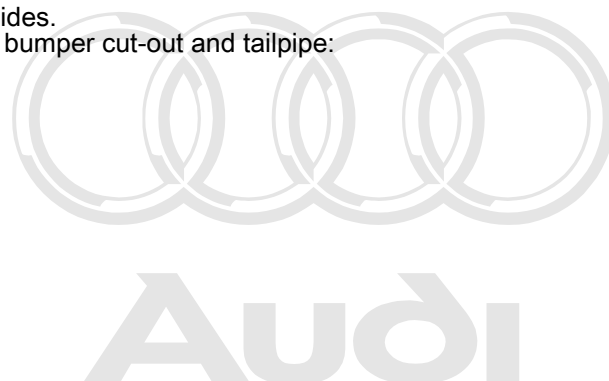
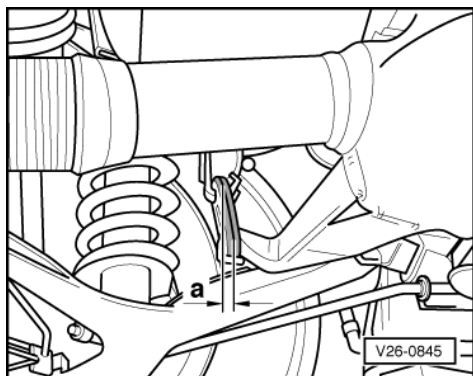
Vehicles with front-wheel drive:

- Loosen bolted connections on clamp -Item 158
- -> 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. 160



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



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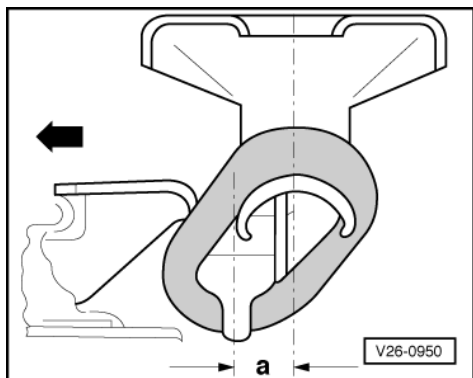
Vehicles with four-wheel drive:

- Vehicles with clamping sleeve between centre silencer and rear silencer

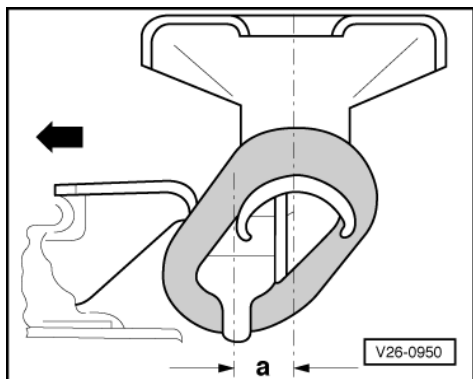
Note:

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

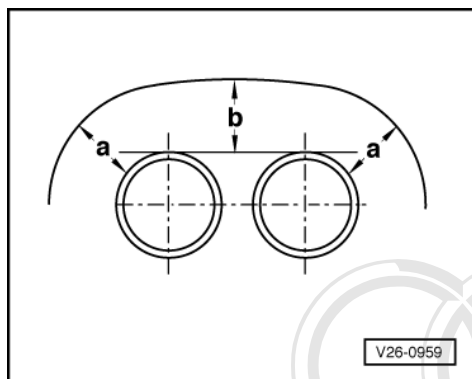
- Loosen bolted connections on clamp -Item 162 .
- -> Push exhaust system towards front of vehicle until rear mounting of centre silencer is preloaded by a = 7 ... 10 mm.
- Tighten bolts on front clamping sleeve -Item 163 evenly to 40 Nm.



- Note installation position of front clamp=> Fig. 167
- -> Push rear silencer towards front of vehicle -arrow- until rear mounting on rear silencer is preloaded by a = 12 ... 14 mm.
- Tighten bolts on rear clamp -Item 162 evenly to 40 Nm.
- Note installation position of front clamp=> Fig. 167



- Vehicles without clamping sleeve between centre silencer and rear silencer
- Slacken bolted connections on front clamping sleeve -Item **163** .
- -> Push rear silencer towards front of vehicle -arrow- until rear mounting on rear silencer is preloaded by a = 12 ... 14 mm.
- Tighten bolts on front clamping sleeve -Item **163** evenly to 40 Nm.
- Note installation position of front clamp=> Fig. **167**



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

1.6 - Checking exhaust system for leaks

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- 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.