

Audi 100 1991 ➤

5-cylinder engine (4-valve, turbo), Mechanics								
Engine ID	AAN							

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List of Workshop Manual Repair GroupsList of Workshop Manual Repair Groups

Audi 100 1991 ➤

5-cylinder engine (4-valve, turbo), Mechanics

Repair Group

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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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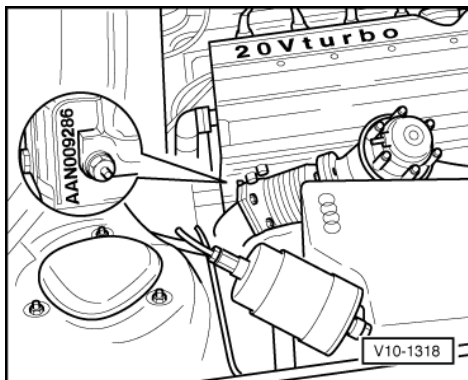
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00 - Technical data

1 - Technical data

1.1 - Technical data

1.2 - Engine number



-> The engine number ("engine code" and "serial number") can be found on the rear right of the cylinder head.

"Engine code" and "serial number" are also given on a sticker on the toothed belt guard.

The engine code letters are also indicated on the vehicle data sticker.

1.3 - Engine features

Code letters	AAN
Capacity l	2.226
Output kW at rpm	169/5900
Torque Nm at rpm	350/1950 ... 3000
Bore ø mm	81.0
Stroke mm	86.4
Compression ratio	9.3
RON min.	98 1)
Injection/ignition system	Bosch Motronic
Firing order	1-2-4-5-3
Knock control	yes
Lambda control	yes
Catalytic converter	yes
Charging	yes
Charge air cooling	yes

1) Unleaded premium RON 95 also permitted, but reduced power

Code letters	AAN
Valve timing 2)	



Code letters	AAN
Inlet opens after TDC	3°
Inlet closes after BDC	25°
Exhaust opens before BDC	42°
Exhaust closes before TDC	9°

2) with 1 mm valve lift and valve clearance 0 mm

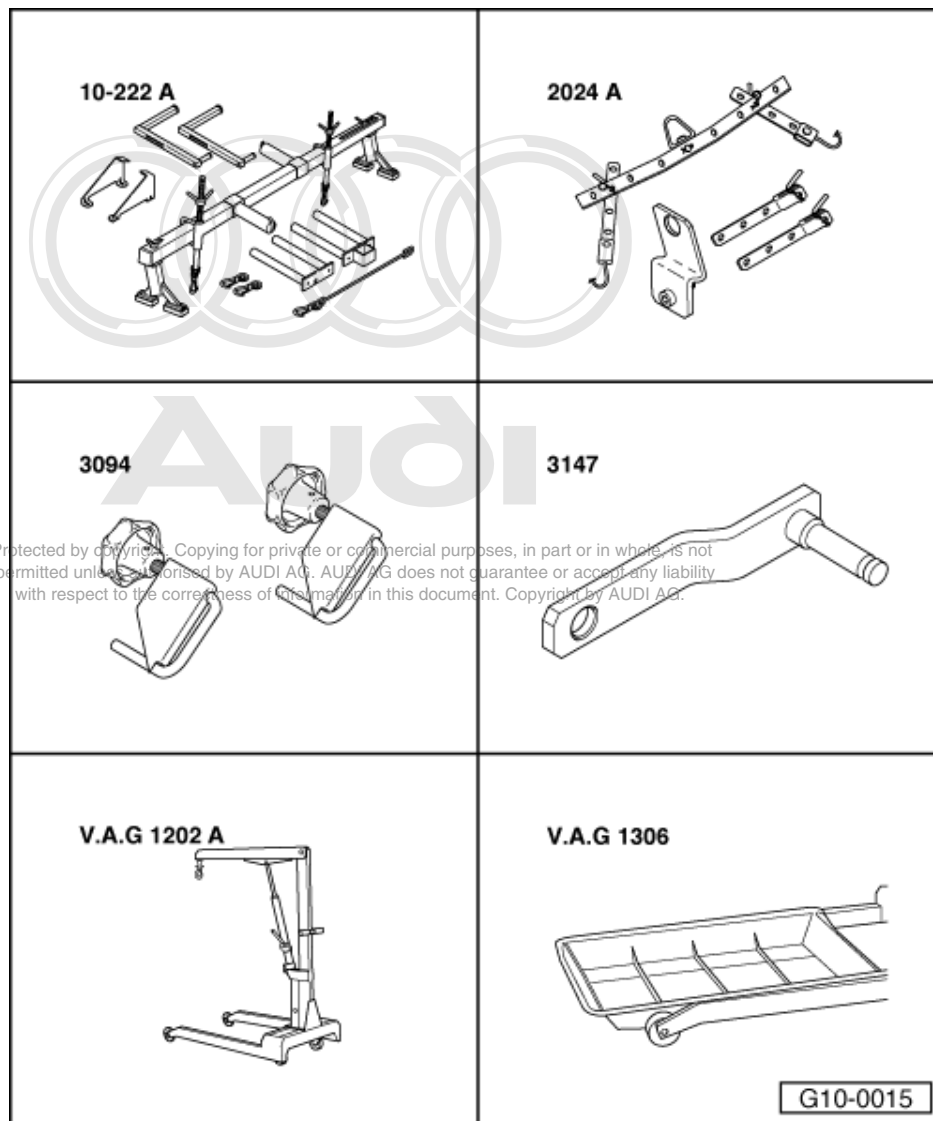


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10 - Removing and installing engine

1 - Removing and installing engine

1.1 - Removing and installing engine



Special tools and workshop equipment required

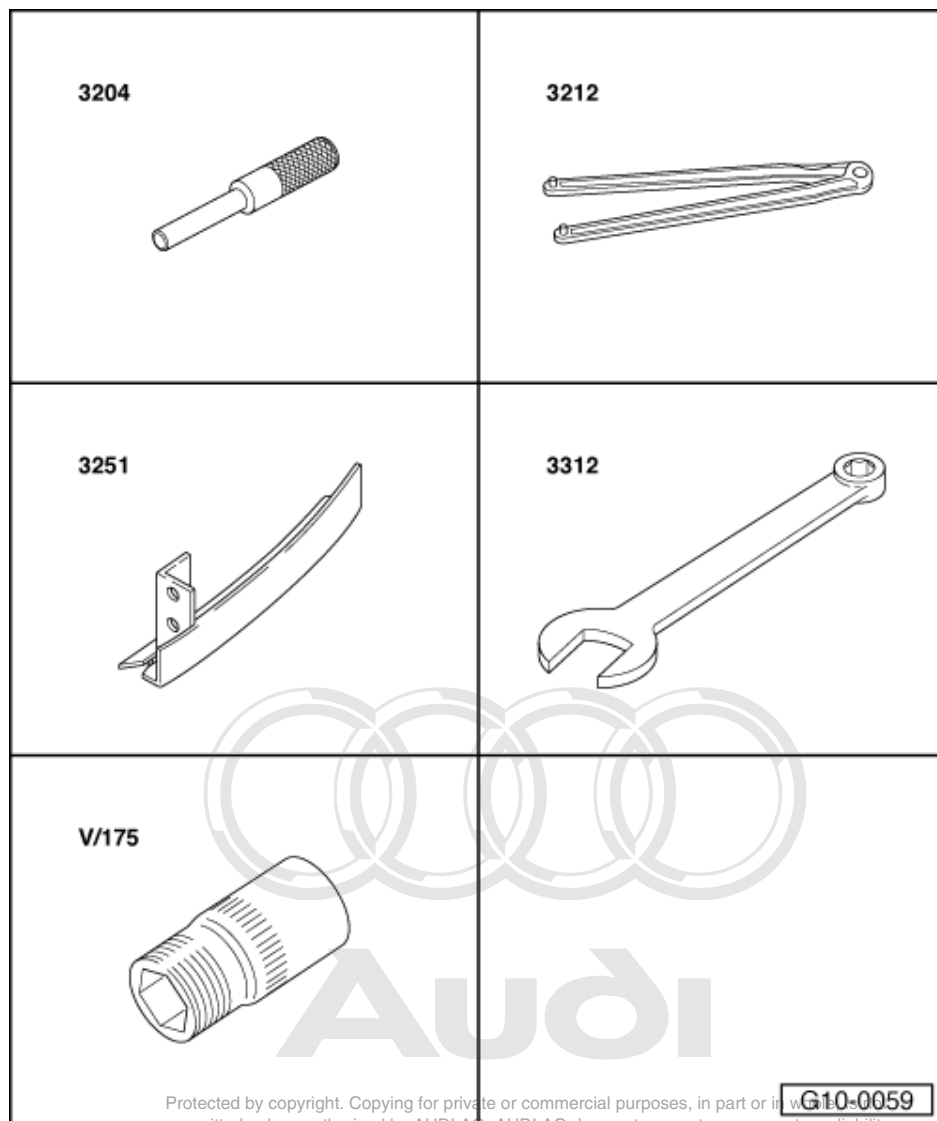
- ♦ Support bar 10-222 A with 10-222 A/2
- ♦ Lifting tackle 2024 A
- ♦ Hose clamps 3094
- ♦ Gearbox mount 3147
- ♦ V.A.G 1202 A

Or

- ♦ Workshop crane VAS 6100



- ♦ Drip tray V.A.G 1306



- ♦ Mandrel 3204
- ♦ Pin wrench 3212
- ♦ Support 3251
- ♦ Open-ended wrench 3312

1.2 - Removing

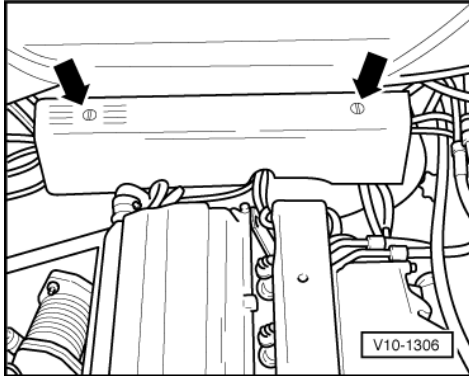
Notes:

- ♦ Engine is removed upwards without gearbox.
- ♦ Coolant drained off must be collected in a clean container for disposal/re-use.
- ♦ All cable ties unfastened or cut open on removing engine are to be re-attached in same position on installation.
- Heed (if necessary obtain) radio code for vehicles with encoded radio.
- Disconnect battery earth strap with ignition switched off.

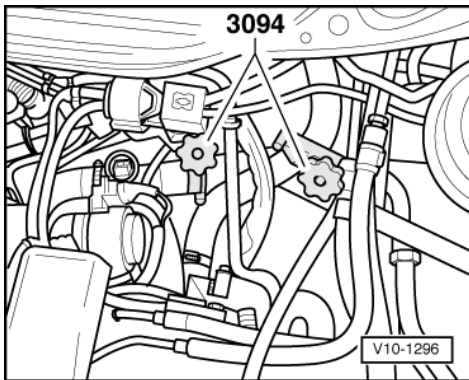
Attention:

Hot vapour/hot coolant may escape when opening expansion tank. Cover cap with cloth and open carefully.

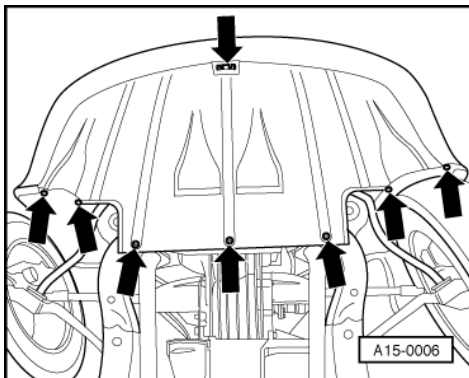
- Unscrew cap of coolant expansion tank.



- -> Remove cover for connectors in engine compartment -arrows-.



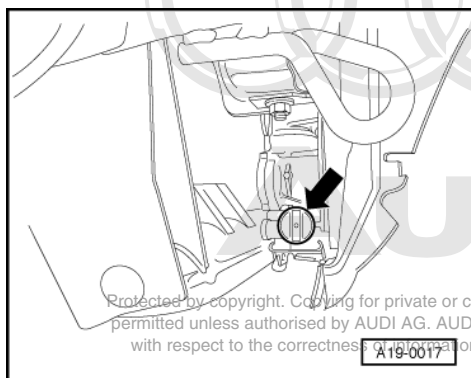
- -> Pinch off coolant hoses to heater with hose clamps 3094.



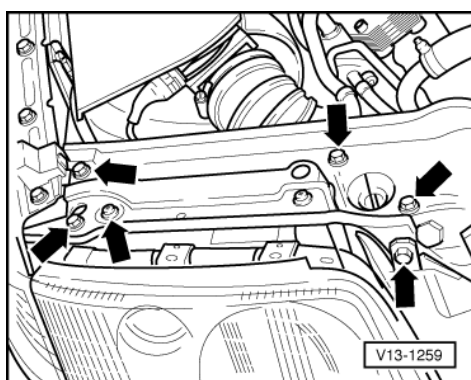
- -> Detach noise insulation -arrows-.
- Remove front bumper.

=> General Body Repairs; Repair Group 63; Front Bumper Front Bumper

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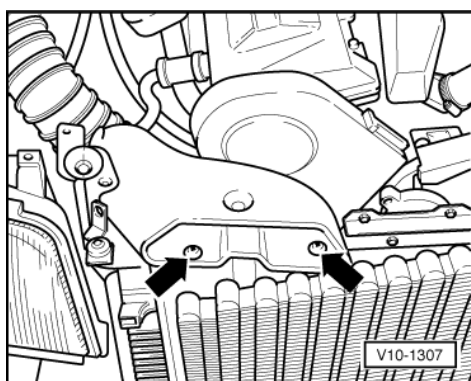
- Position drip tray V.A.G 1306 beneath engine.
- -> Turn drain plug -arrow- at radiator anti-clockwise; attach test hose to connection if necessary.



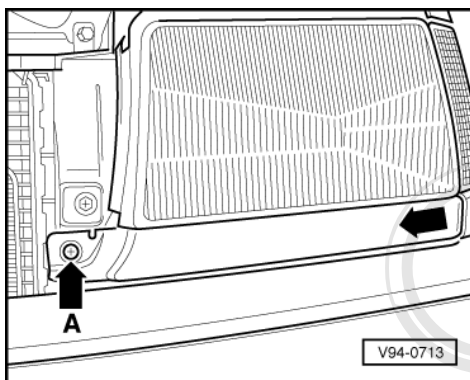
- -> Screw out bolts on left and right marked with -arrows- as well as one at top of headlight.
- Disengage bonnet cable at lock carrier.

=> General Body Repairs; Repair Group 55; Bonnet Bonnet

- Detach lock carrier.

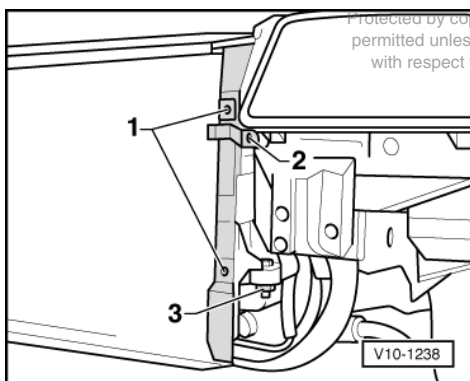


- -> Unfasten and remove air intake connection -arrows-.



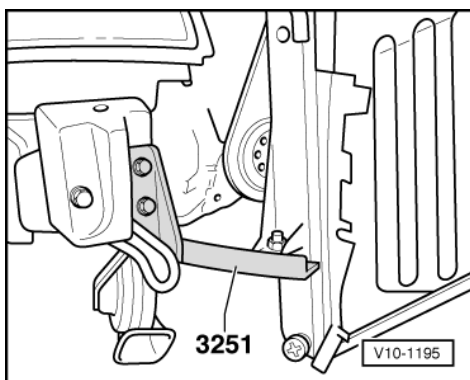
Audi S6:

- -> Screw out bolt -arrow A- and pull out headlight trim in direction of arrow.

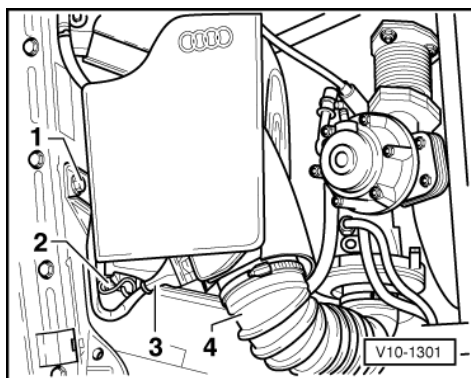


All models:

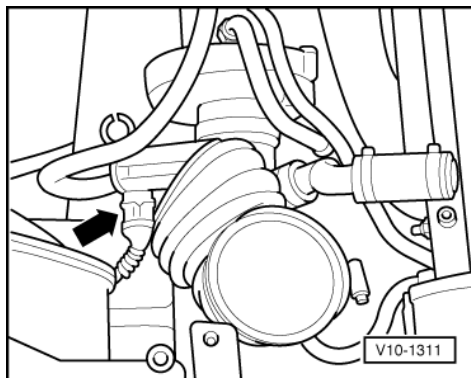
- -> Screw out bolt -2- of retainer for right headlight trim.
- Screw out bolts -1- of air duct on left of radiator and detach air duct.
- Slacken off bolts -3- on left and right of radiator.



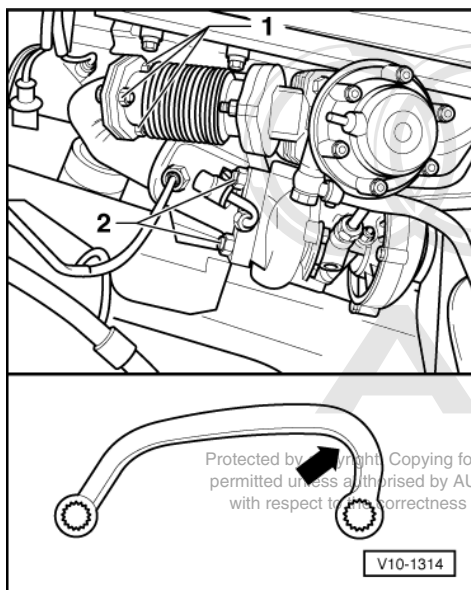
- -> Attach support 3251 to right bumper mount; swivel radiator to front.



- -> Detach air hose -4- at air-mass meter.
- Unplug connector -3- at air-mass meter.
- Unfasten clamps -2- all round air cleaner housing.
- Detach top section of air cleaner housing with filter element.
- Screw out bolt -1-.
- Detach wiring harness at air cleaner housing.
- Take out bottom part of air cleaner housing.



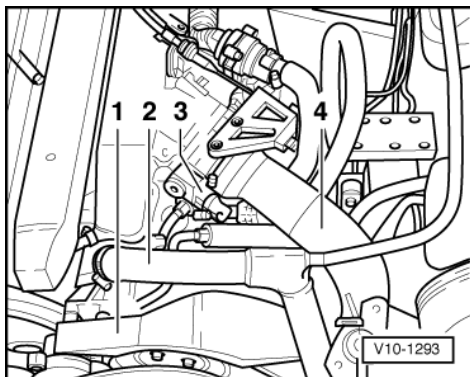
- -> Unplug connector -arrow- at charge pressure control solenoid valve -N75.



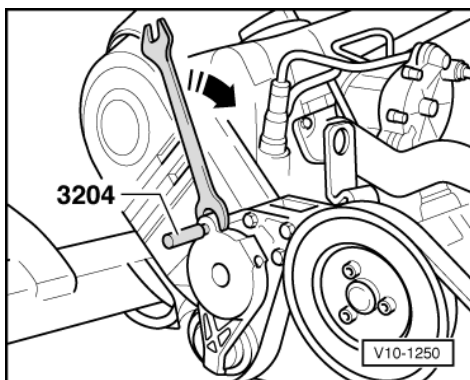
- -> Unfasten three bolted joints -1- at corrugated pipe.
- Unscrew 4 nuts -2- at turbocharger/front exhaust pipe flange.

Notes:

- ◆ A flat 15 mm ring spanner must be bent to appropriate shape -bottom arrow in Fig.- for unfastening lower rear nut at turbocharger/front exhaust pipe flange.
- ◆ Other nuts at turbocharger/front exhaust pipe flange are of size 17 mm.



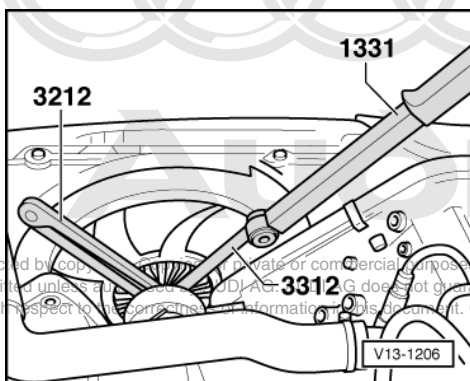
- -> Detach coolant hose -2- at coolant collecting pipe and radiator. Lay coolant hose aside.
- Remove ribbed belt cover -1-.
- Remove air hose -4-.
- Unplug connector -3- at throttle valve potentiometer -G69.



Note:

Before removing, mark direction of ribbed belt with chalk or felt-tipped pen. Running a used belt in the opposite direction could destroy it.

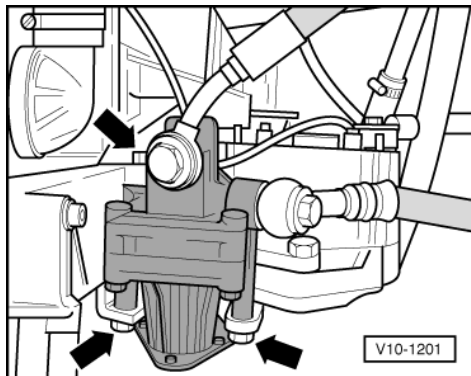
- -> Swivel tensioner in direction of arrow to slacken off ribbed belt.
- Secure tensioner with mandrel 3204.
- Remove secured tensioner for ribbed belt.



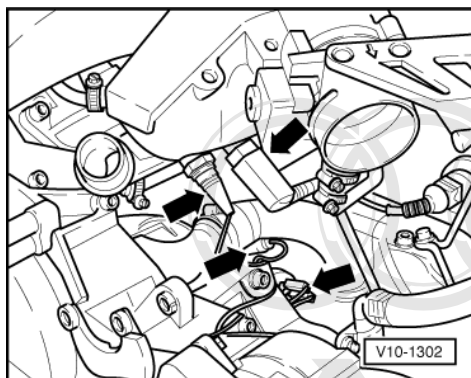
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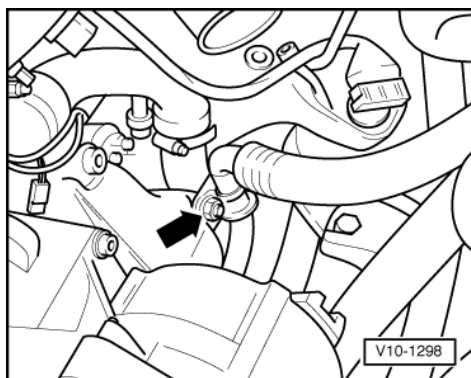
- -> Support pulley for viscous fan with pin wrench 3212 and unscrew viscous fan with open-ended wrench 3312.
- Take out viscous fan.



- Unscrew power steering vane pump pulley.
- -> Unscrew power steering vane pump -arrows- and lay aside. Leave wires/pipes connected.



- -> Unplug the following connectors -arrows- at the engine.
 - Electronic thermal switch -F76 (4-pole)
 - Thermal switch -F98 (2-pole)
 - Oil pressure switch -F1
 - Oil pressure switch -F22/oil pressure sender -G10
- Unscrew wires at alternator.
 - B+ wire
 - D+ wire
 - Clip for wires

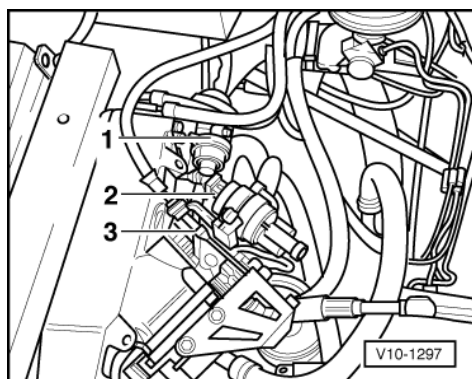


Attention:
Refrigerant circuit of air conditioner is never to be opened.

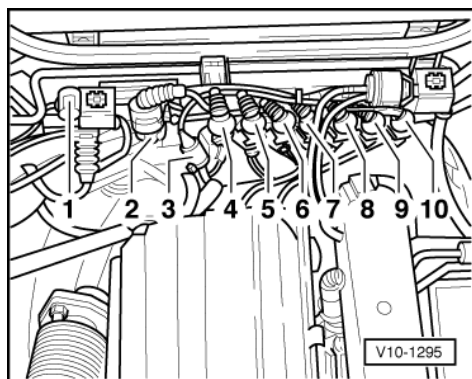
- -> Unscrew retainer for coolant pipe/clip for refrigerant pipe at top -arrow-.

Note:

Fig. shows vehicle with air conditioner.



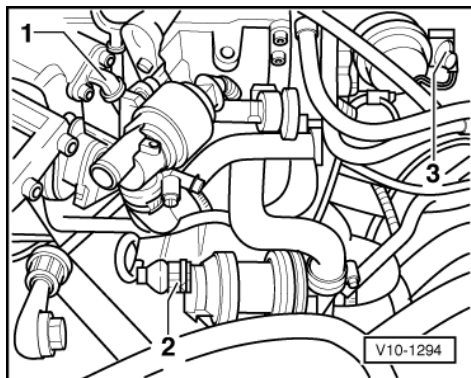
- Remove fasteners for throttle cable.
- -> Disengage throttle cable -3- at throttle valve assembly and support bracket (do not remove throttle cable retainer). Lay throttle cable aside.
- Unplug connector -2- at idling-speed stabilisation valve.
- Unplug connector and disconnect hose at activated charcoal filter system solenoid valve 1 -N80 -Item 1-.



- -> Unplug the following connectors in the centre of the bulkhead:

- 1 - Black connector for right output stage
- 2 - Brown connector for left output stage
- 3 - Black connector for Lambda probe -G39
- 4 - Black connector for Lambda probe heater -Z19
- 5 - White connector for ignition coils
- 6 - White connector for ignition coils
- 7 - Black connector for firing point sender -G4
- 8 - Grey connector for engine speed sender -G28
- 9 - Green connector for knock sensor 1 -G61 (front)
- 10 - Blue connector for knock sensor 2 -G66 (rear)

- Take connectors -3 ... 10- out of holder and lay bare wires.



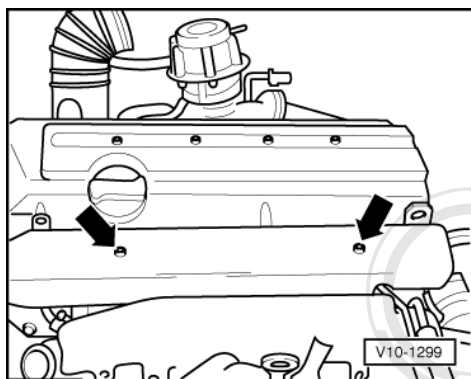
- -> Unplug connector at intake air temperature sender -G42 -Item 1-.
- Unplug connector -2- for continued coolant circulation pump -V51.

Model Year 1991 vehicles:

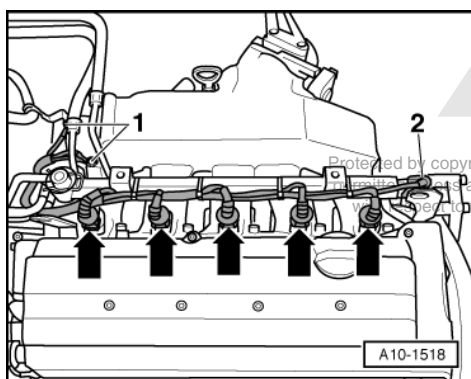
- Unplug connector -3- at Hall sender -G40.

All models:

- Unplug connector at coolant temperature sender -G62 on back of cylinder head.
- Lay bare wires.
- Detach coolant hose to heating system heat exchanger on back of engine.



- -> Unscrew cover for injectors -arrows-.



- -> Unplug connectors at all injectors -arrows-.

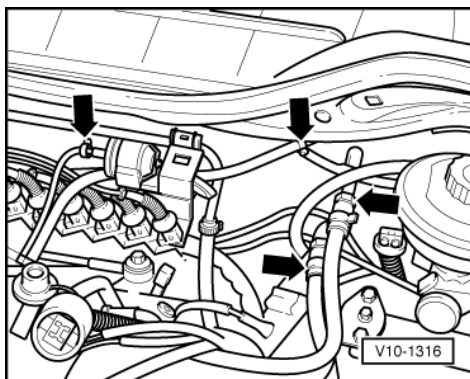
Vehicles as of Model Year 1992:

- Unplug connector -2- at Hall sender -G40.

All models:

- Unfasten cable ties and lay bare wires.

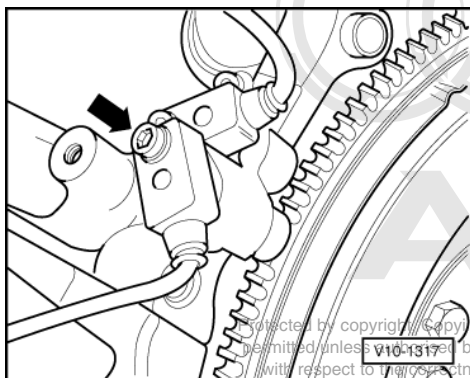
- Unscrew earth wires -1-.



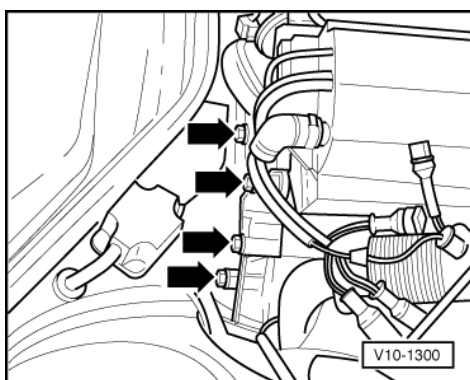
Attention:

Fuel system is pressurised. Wrap cloth around joint before opening system. Then dissipate pressure by carefully unfastening joint.

- -> Detach vacuum hoses and disconnect fuel supply and return pipe at joint -arrows-.



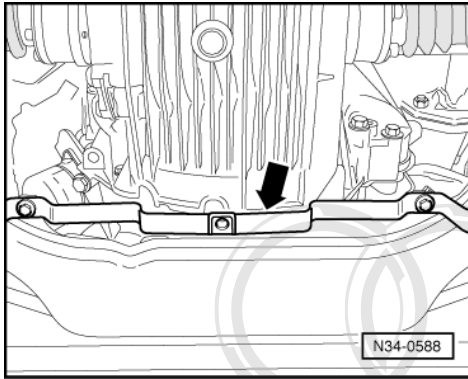
- -> To avoid damage, unscrew engine speed sender -arrow- above flywheel.



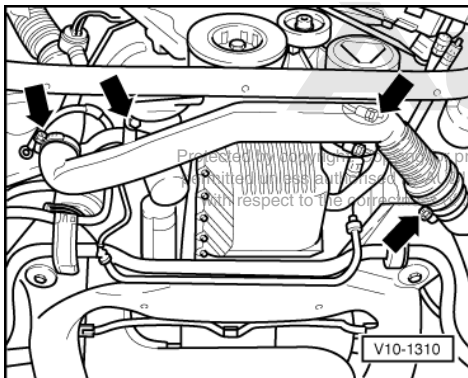
- -> Screw out engine/gearbox connecting bolts accessible from above -arrows-. Leave one bolt screwed in hand-tight.

Note:

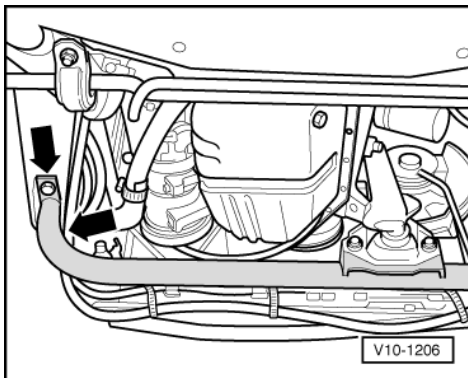
On removal, note down bolt lengths and assignment for re-installation.



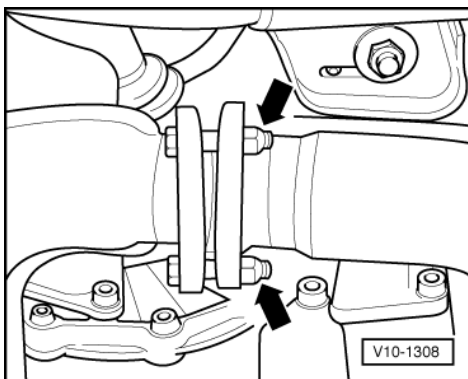
- -> Unscrew holder for noise insulation -arrow-.



- -> Remove air pipe between turbocharger and charge-air cooler -arrows-.



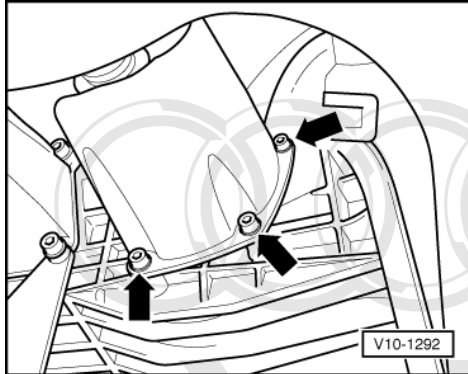
- -> Unscrew cross member -arrows- with stop for torque reaction support.



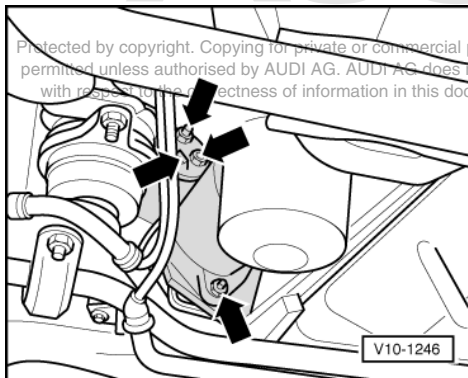
- -> Unscrew front exhaust pipe from catalytic converter on left and right -arrows-.
- Take out front exhaust pipe downwards.

Note:

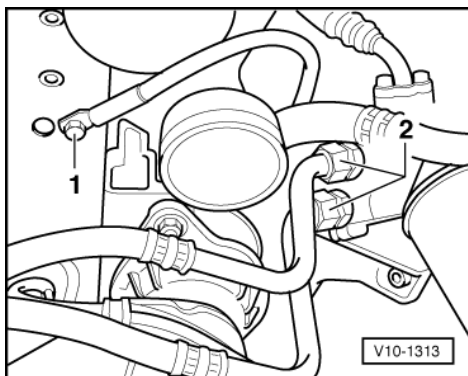
Pay attention to Lambda probe wire.



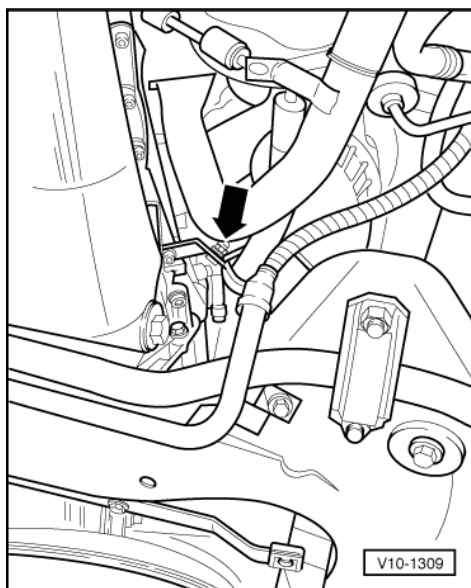
- -> Unscrew heat shield for drive shaft on right of gearbox -arrows-.



- -> Remove starter -arrows-.

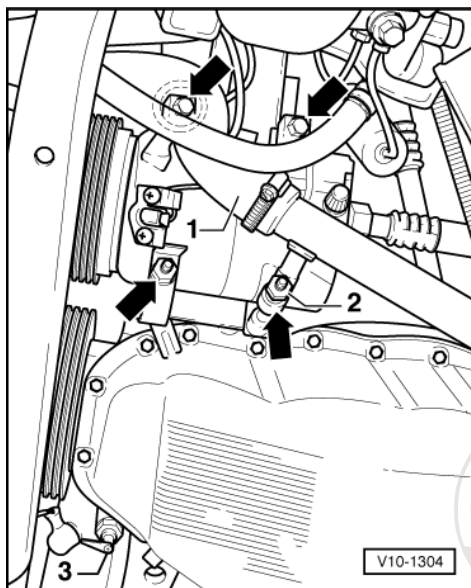


- -> Screw out bolt -1- for earth wire at longitudinal member on right.
- Mark oil supply and return pipe -2- to oil cooler and disconnect at oil filter bracket.



Vehicles with air conditioner:

- -> Unscrew clip -arrow- for refrigerant pipe.



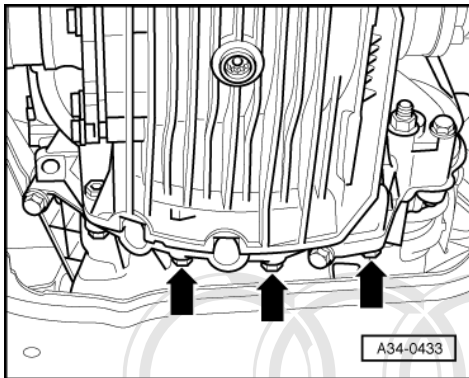
- -> Unscrew nut -2- and detach coolant pipe.

Attention:
Refrigerant circuit of air conditioner is never to be opened.

- Unscrew air-conditioner compressor from holder -arrows-.
 - Suspend air-conditioner compressor with connected wires/pipes from longitudinal member.
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All models:

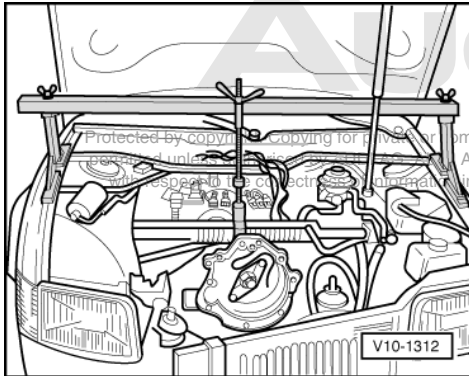
- Remove lower coolant hose -1- to radiator.
- Unscrew wire -3- from oil temperature gauge sender.



- -> Screw out engine/gearbox connecting bolts accessible from underneath.

Note:

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



- -> Position support bar 10-222 A on wing mounting flange.

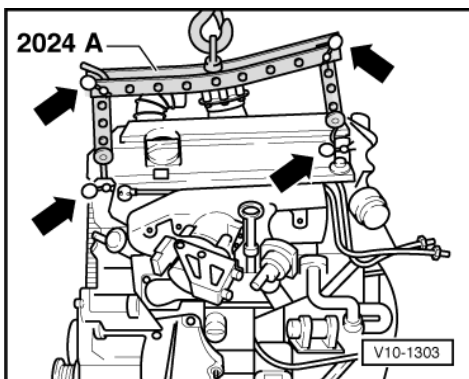
Note:

Support bar must be positioned in front of bonnet gas-filled strut; spindle faces rear.

- Engage gearbox support 3147 in bolt hole of bell housing as shown.
- Connect gearbox support 3147 and support bar 10-222 A.

Notes:

- ◆ Height of gearbox can be adjusted at wing nut of hook.
- ◆ Do not excessively pre-tension to avoid damaging steering box.
- ◆ Illustration shows engine removed.



- -> Engage lifting tackle 2024 A at engine and workshop crane VAS 6100 or V.A.G 1202 A.

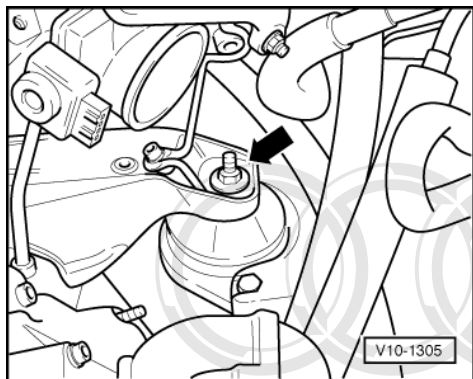


Note:

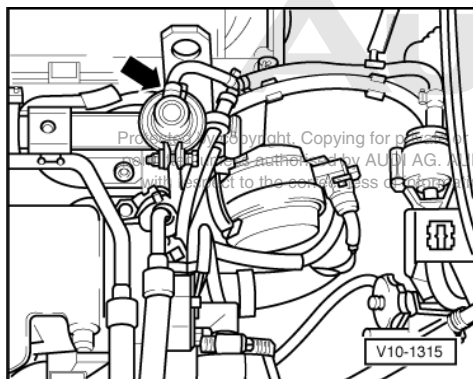
For adjustment to centre of gravity of assembly, perforated rails of support hooks must be positioned as shown.

Attention:

Support hooks and setting pins on lifting tackle must be secured with retainers -arrows in illustration-.



- -> Unscrew top nuts -arrow- at engine mountings on right and left.



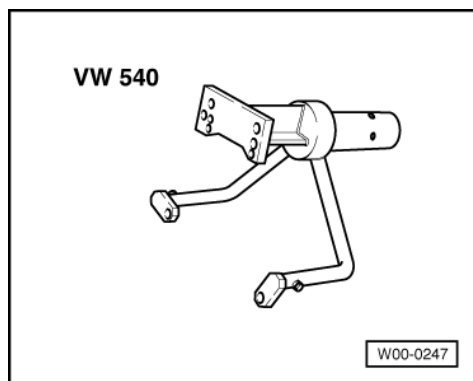
- -> Make sure hook of support bar does not damage vacuum hose -arrow- at fuel pressure regulator. If necessary, detach vacuum hose.
- Lift engine over studs of engine mountings.
- Turn spindle of support bar 10-222 A.
- Screw out last engine/gearbox bolt.

Note:

Check whether all hose and pipe/wire connections between engine and body have been detached.

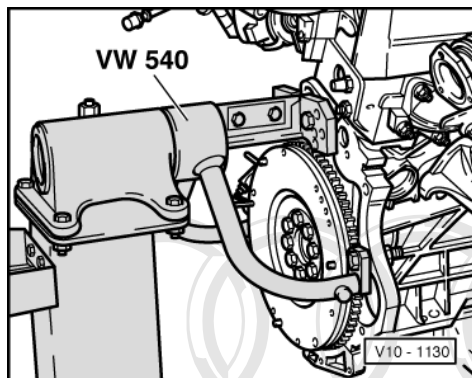
- Pull engine off gearbox and lift it out of engine compartment.

1.3 - Attaching engine to repair stand



Special tools and workshop equipment required

- ♦ Engine and gearbox holder VW 540



Sequence of operations

-> For performing assembly work, engine is to be attached with engine holder VW 540 to repair stand.

1.4 - Installing

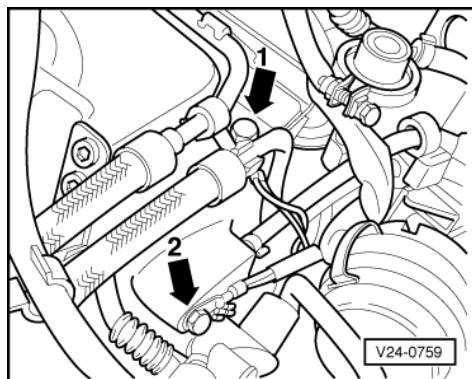
Install in reverse order, paying attention to the following:

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- ♦ On assembly, replace self-locking nuts, bolts tightened to torque, oil seals and gaskets.
- ♦ Re-attach all cable ties at the same locations when re-installing.
- ♦ Hose connections and hoses for charge air system must be free from oil and grease before fitting. Never use lubricant.
- ♦ Secure all hose connections with standard hose clamps.

=> Parts List

- Check clutch release bearing for wear and replace if necessary.
- Lubricate splines of gearbox input shaft slightly with G 000 100. Do not lubricate guide sleeve for release bearing.
- If necessary, check centring of clutch plate.
- Engines for vehicles with manual gearbox must be fitted with a needle bearing in the flywheel. Install needle bearing if necessary=>Page 62 .
- Install engine mountings such that they are stress-free. To do so, shake engine before tightening engine mountings to provide alignment.
- Fit air-conditioner compressor and vane pump for power steering.
- Set stop for torque reaction support. To do so, allow stop to settle on rubber buffer for torque reaction support and tighten bolts to 40 Nm.
- Fit ribbed belt => Page 29 .
- Fit viscous fan => Page 151 .





- -> Screw on earth wires at intake manifold.
- -Arrow 1- (brown/white wires)
- -Arrow 2- (brown/red wires)
- Install lock carrier with attachments.

=> General Body Repairs; Repair Group 50; Front Body Front Body

- Install front bumper.

=> General Body Repairs; Repair Group 63; Front Bumper Front Bumper

- Perform stress-free alignment of exhaust system => Page **193** .
- Fill with coolant=> Page **143** .

Notes:

- ♦ Coolant drained off is only to be re-used if neither cylinder head nor cylinder block has been replaced.
- ♦ Never re-use contaminated coolant.
- Attach vacuum hoses => Page **163** onwards.
- Check throttle cable adjustment.

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

- Electrical connections and routing

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

Note:

On re-connecting battery, remember to activate vehicle equipment (radio, clock, electric window lifters) in line with owner's manual.

Attention:

Never use charger for boost starting, as vehicle control units could be damaged.

- Check oil level before starting engine.
- Adjust headlights.

=> Electrical System; Repair Group 94; Servicing headlights; Headlight adjustment Servicing headlights Headlight adjustment

Note:

Unplugging connectors causes faults to be stored. Interrogate and if necessary erase fault memory following installation.

=> Motronic Injection and Ignition System (5-cyl.); Repair Group 01; Interrogating and erasing fault memory Interrogating and erasing fault memory

1.5 - Tightening torques

Notes:

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- ♦ Tightening torques only apply to lightly greased, oiled, phosphated or blackened nuts and bolts.
- ♦ Additional lubricants, such as engine or gear oil are permitted, however not lubricants which contain graphite.
- ♦ Use is never to be made of degreased parts.
- ♦ Tolerance for tightening torques $\pm 15\%$

Component		Nm
Bolts/nuts	M6	10
	M8	20
	M10	45
	M12	65
Exceptions:		
Engine mount to engine support		40
Front exhaust pipe to corrugated pipe		25
Front exhaust pipe to turbocharger		30
Front exhaust pipe to catalytic converters		25

Component	Nm
Heat shield for drive shaft to gearbox	23
Oil supply and return pipe to oil filter bracket	40
Fuel supply and return pipe	25
Air-conditioner compressor to holder	20
Cross member with torque reaction support stop to body	40
Cover for injectors	10
Holder for noise insulation	10
Vane pump to holder	20
Pulley to vane pump	20
Radiator to front end	20
Clamps for coolant hoses	2
Clamps for air hoses	3.5

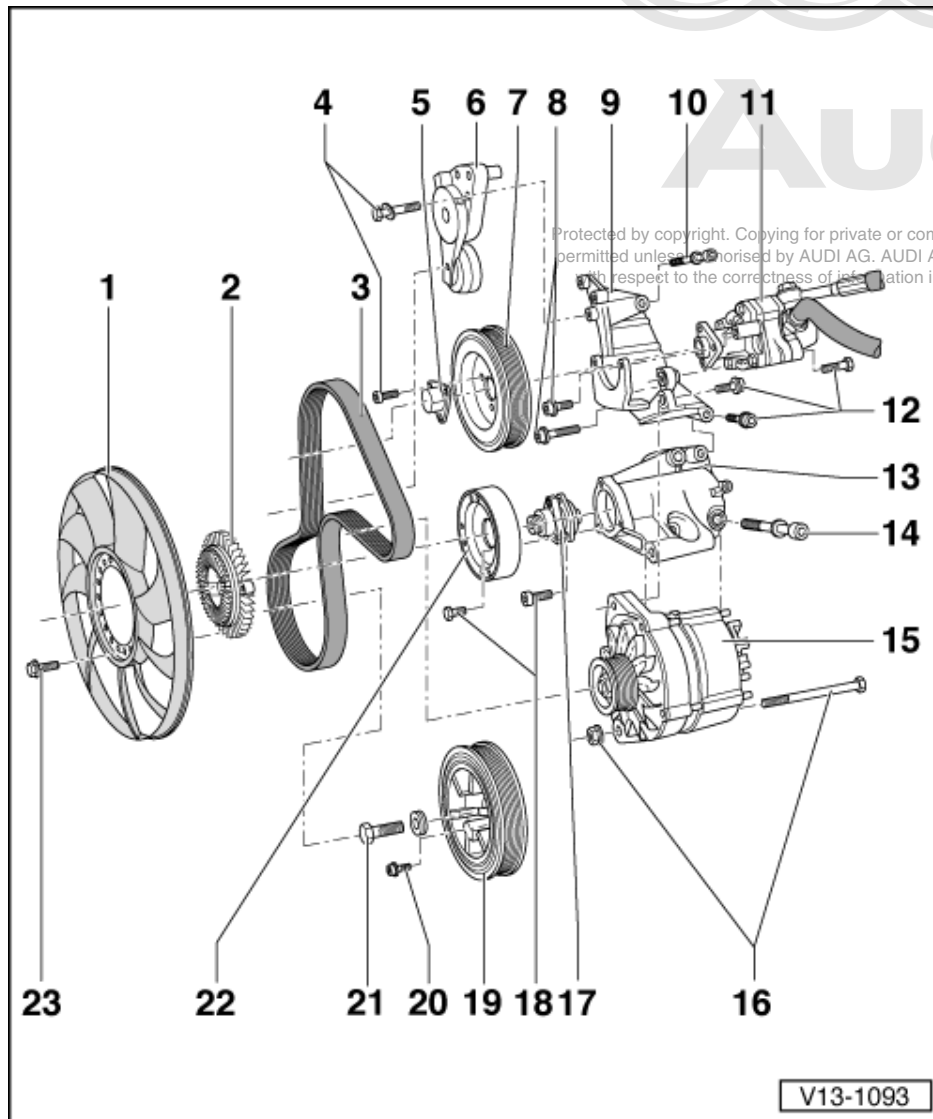


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13 - Crankshaft group

1 - Dismantling and assembling engine

1.1 - Dismantling and assembling engine



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

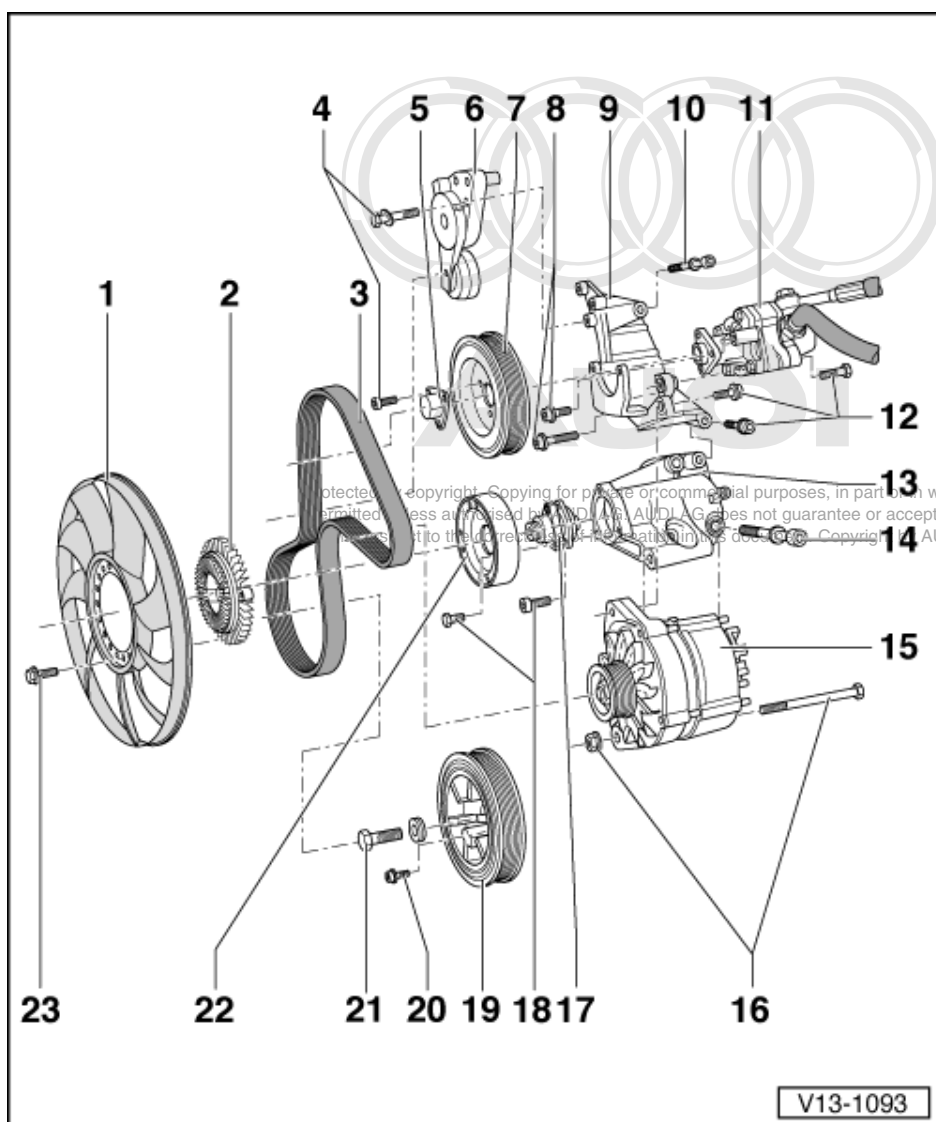
Note:

Mark direction of ribbed belt with chalk or felt-tip pen prior to removal. Running a used belt in the opposite direction could destroy it.

1 Fan impeller

- ♦ For viscous fan
- ♦ "FRONT" mark on outer ring must face in direction of travel
- ♦ Removing and installing

=> Page 151



2 Viscous coupling

- ◆ Cut-in temperature: 72 ... 80 °C ambient temperature at viscous coupling
- ◆ Checking =>Page 153
- ◆ Removing and installing
=> Page 151

3 Ribbed belt

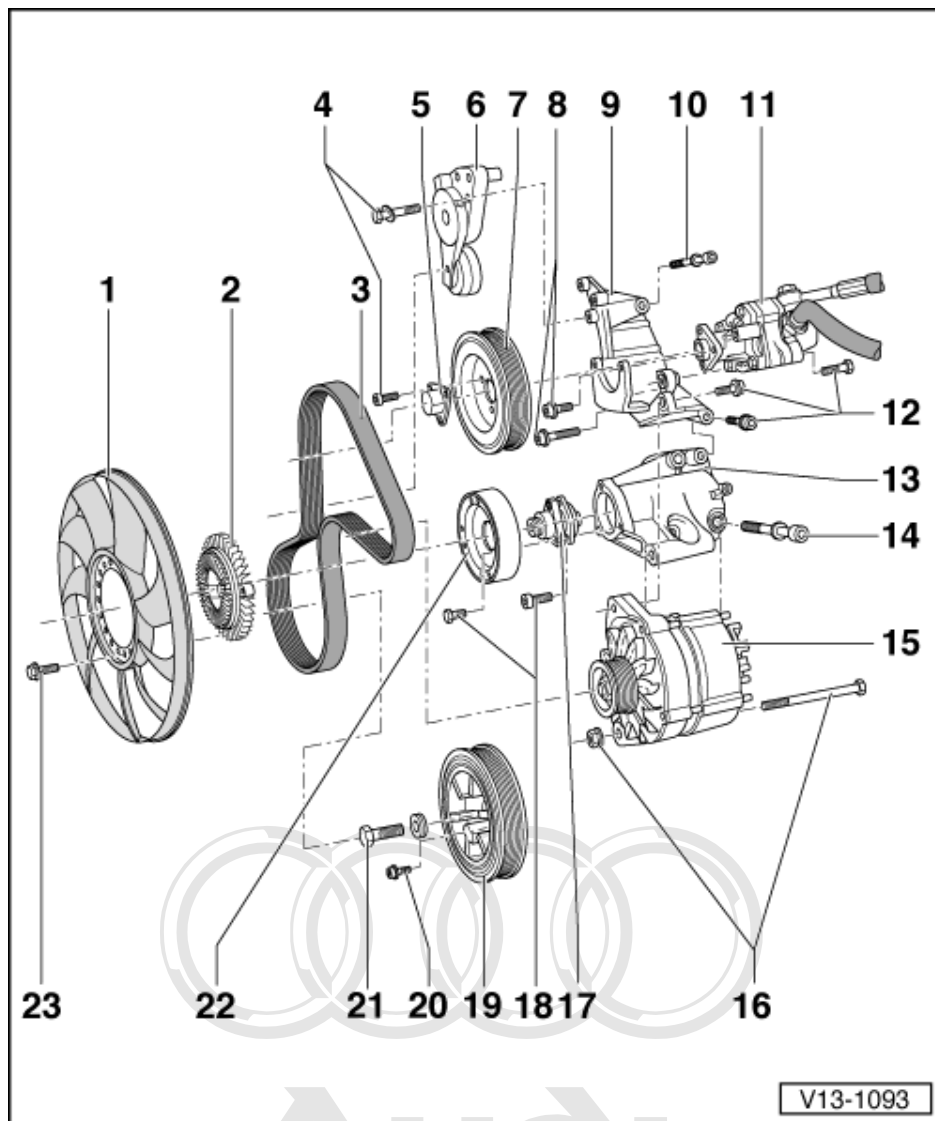
- ◆ Check for wear
- ◆ Do not kink
- ◆ Removing and installing
=> Page 28
- ◆ Ribbed belt routing
=> Fig. 28
- ◆ Ribbed belt routing on vehicles with air conditioner=>Fig. 28

4 20 Nm

- ◆ If necessary, support pulley with oil filter strap wrench when slackening off and tightening

5 Hexagon flange

- ◆ For cranking engine by hand with
32 mm wrench

**6 Tensioner for ribbed belt**

- ◆ Swivel with open-ended wrench to slacken off ribbed belt => Page 29
- ◆ Secure with mandrel 3204

7 Pulley

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- ◆ For vane pump

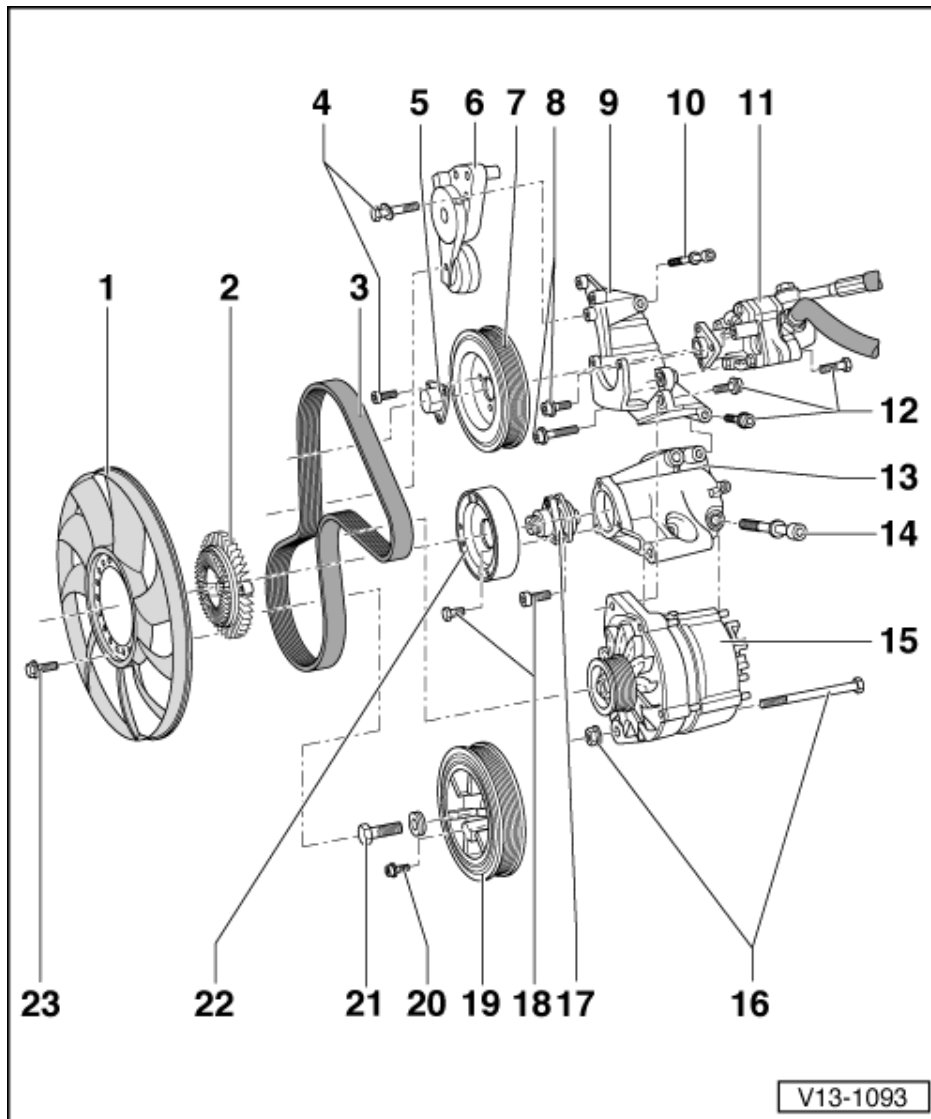
8 20 Nm**9 Holder**

- ◆ For vane pump

10 20 Nm**11 Vane pump**

- ◆ For power steering
- ◆ Removing and installing:

=> Running Gear, Front-wheel Drive and Four-wheel Drive; Repair Group 48; Exploded View: Vane pumps
Exploded View: Vane pumps



12 20 Nm

13 Holder

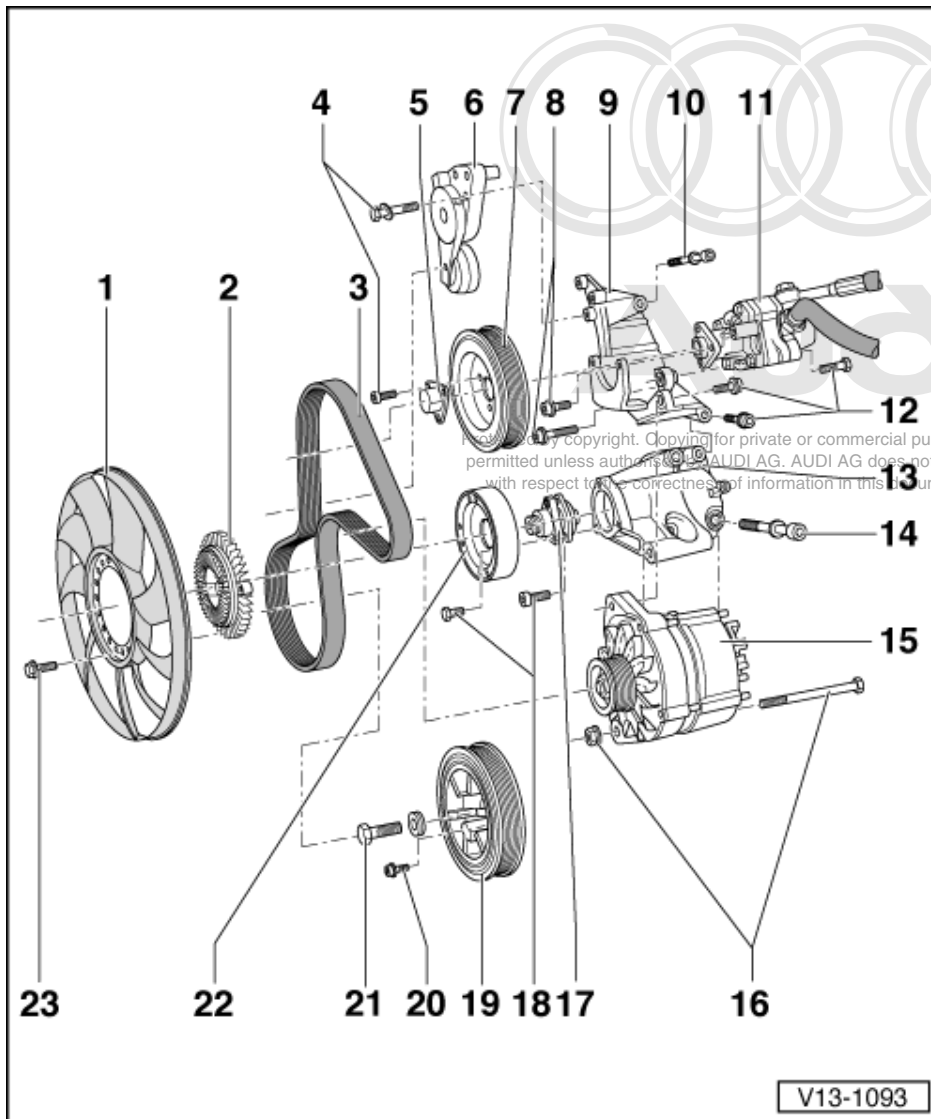
- ♦ For alternator

14 45 Nm

15 Alternator

- ♦ Removing:
 - Disconnect battery earth strap
 - Detach ribbed belt
 - => Page 28
 - Unscrew wire at alternator
 - Unplug connector, lay bare wire
 - Screw out bolts at top and bottom of holder
 - Detach alternator
- ♦ To facilitate positioning of alternator, drive back bushing for lower retaining bolt at holder slightly

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16 45 Nm

17 Mount

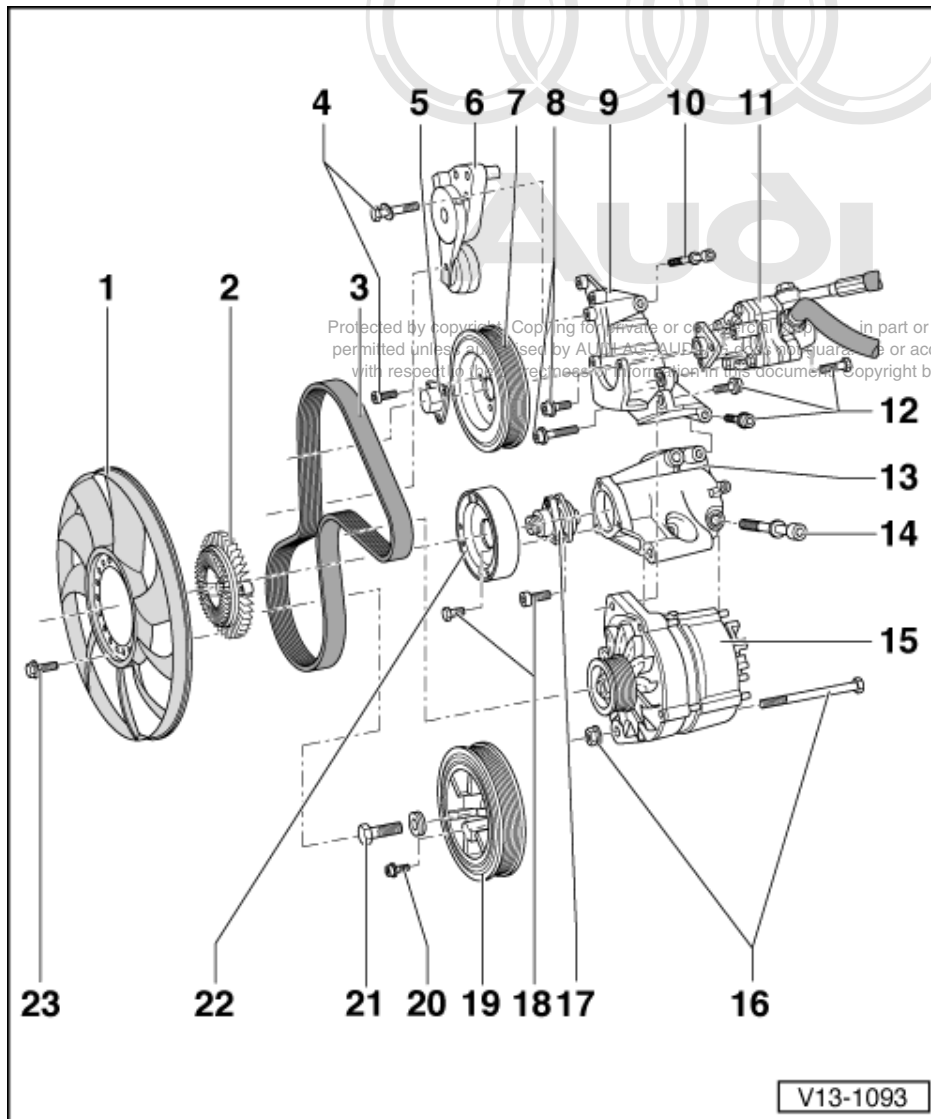
- ◆ For viscous fan
- ◆ Check for smooth running
- ◆ Removing and installing
=> Page 151

18 10 Nm

19 Pulley/vibration damper

- ◆ Can only be fitted in one position at toothed belt sprocket/crankshaft: Raised section at toothed belt sprocket must engage in blind hole of pulley
- ◆ Removing and installing
=> Page 31

20 25 Nm

**21 Central bolt**

- ◆ Replace
- ◆ Apply sealing paste to threads and contact surface of bolt head
- ◆ Sealing paste

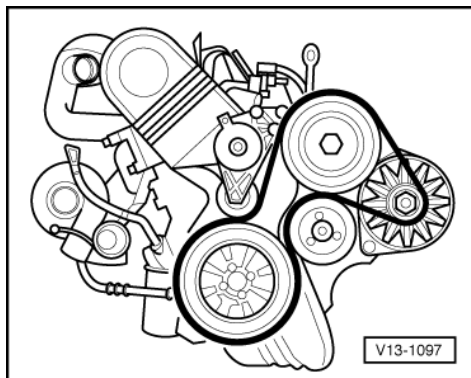
=> Parts List

- ◆ Use counterhold 3256 when slackening off and tightening
- ◆ Removing and installing
=> Page 31

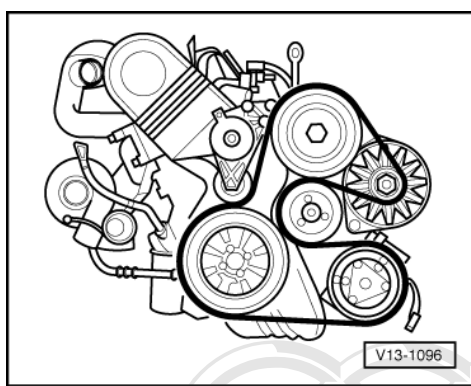
22 Pulley

- ◆ For viscous fan
- ◆ Removing and installing
=> Page 151

23 10 Nm

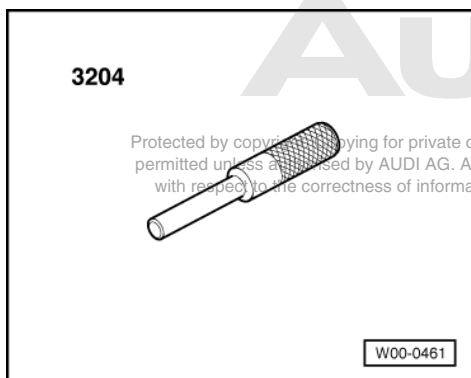


-> Fig.1 Ribbed belt routing on vehicles with no air conditioner



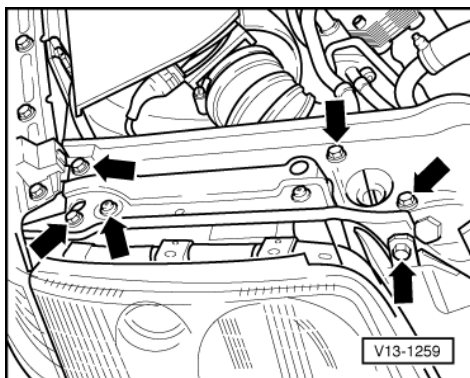
-> Fig.2 Ribbed belt routing on vehicles with air conditioner

1.3 - Removing and installing ribbed belt



Special tools and workshop equipment required

- ♦ Mandrel 3204

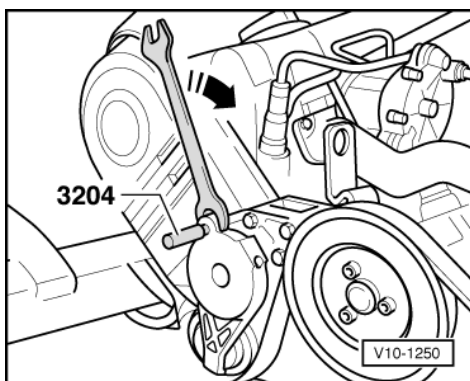


Removing

- -> Screw out bolts on left and right marked with -arrows- as well as one at top of headlight.
- Disengage bonnet cable at lock carrier.

=> General Body Repairs; Repair Group 55; Bonnet Bonnet

- Detach lock carrier.



Note:

Before removing, mark direction of ribbed belt with chalk or felt-tipped pen. Running a used belt in the opposite direction could destroy it.

- Remove ribbed belt cover.
- -> Swivel tensioner in direction of arrow to slacken off ribbed belt.
- Secure tensioner with mandrel 3204.
- Remove secured tensioner for ribbed belt.
- Take out ribbed belt.

Installing

Install in reverse order, paying attention to the following:

Note:

When installing ribbed belt, make sure it is properly seated on pulleys.

- Insert ribbed belt.
- Tighten tensioner secured with mandrel 3204.

- Fit ribbed belt.

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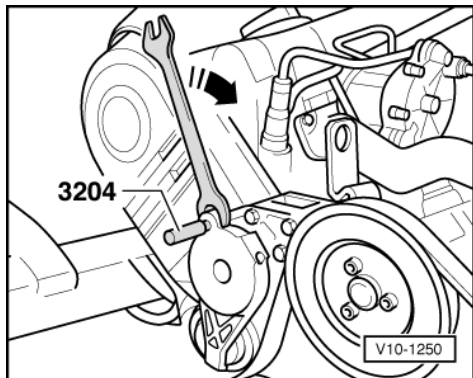
- Check that ribbed belt is correctly positioned.

Vehicles with no air conditioner:

- Ribbed belt routing => Fig. 28

Vehicles with air conditioner:

- Ribbed belt routing => Fig. 28



All models:

- -> Remove mandrel 3204 and tension ribbed belt.
- Install lock carrier with attachments.

=> General Body Repairs; Repair Group 50; Front Body Front Body

- Start engine and check belt routing.
- Adjust headlights.

=> Electrical System; Repair Group 94; Servicing headlights; Headlight adjustment Servicing headlights Headlight adjustment

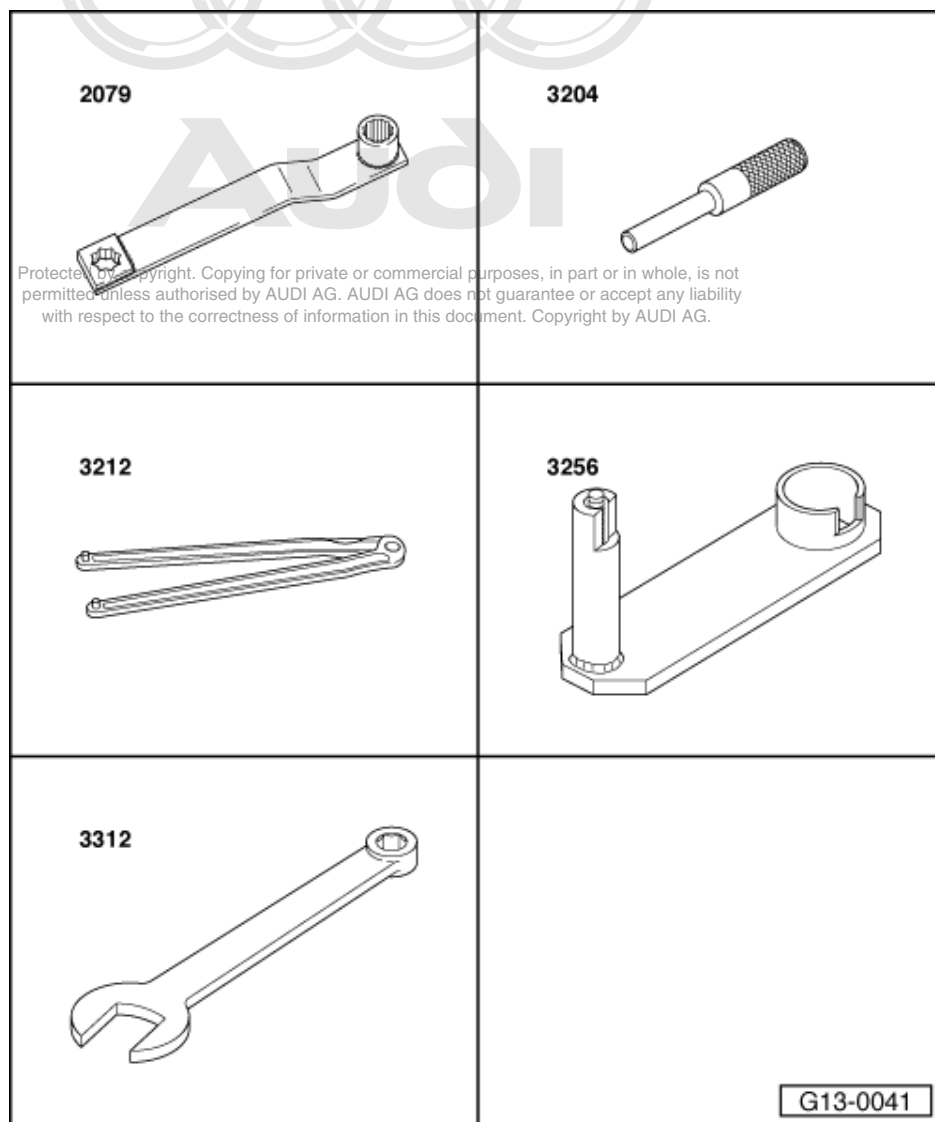
Tightening torques

Component	Nm
Ribbed belt tensioner to holder	20
Cover for ribbed belt	10



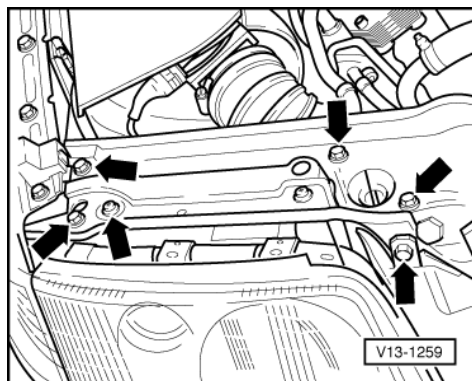
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1.4 - Removing and installing vibration damper



Special tools and workshop equipment required

- ◆ Wrench for vibration damper 2079
- ◆ Mandrel 3204
- ◆ Pin wrench 3212
- ◆ Counterhold for vibration damper 3256
- ◆ Open-ended wrench 3312



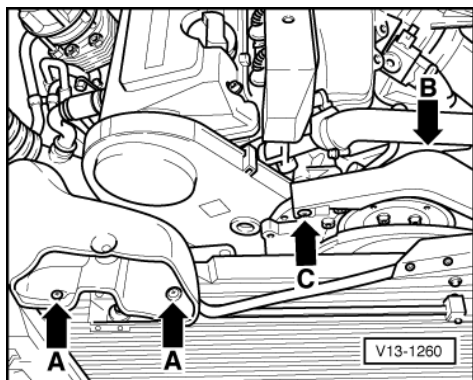


Removing

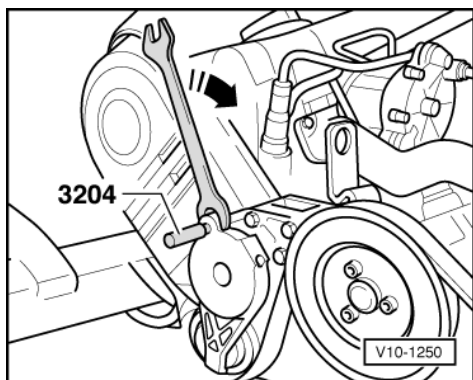
- -> Screw out bolts on left and right marked with -arrows- as well as one at top of headlight.
- Disengage bonnet cable at lock carrier.

=> General Body Repairs; Repair Group 55; Bonnet Bonnet

- Detach lock carrier.



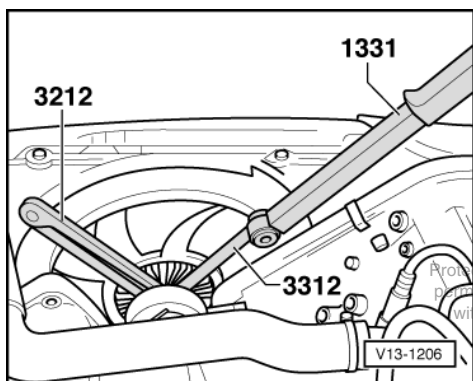
- -> Unfasten and remove air intake connection -arrows A-.
- Screw out bolt -arrow B- and disengage ribbed belt cover -arrow C-.



Note:

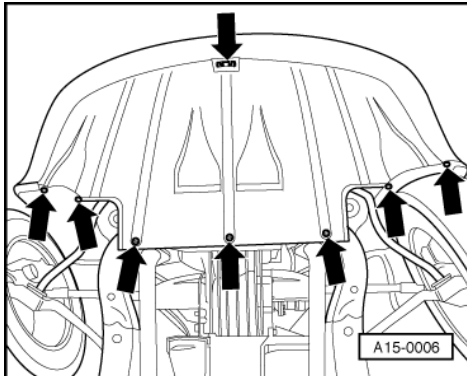
Before removing, mark direction of ribbed belt with chalk or felt-tipped pen. Running a used belt in the opposite direction could destroy it.

- -> Swivel tensioner in direction of arrow to slacken off ribbed belt.
- Secure tensioner with mandrel 3204.
- Remove secured tensioner for ribbed belt.
- Take out ribbed belt.

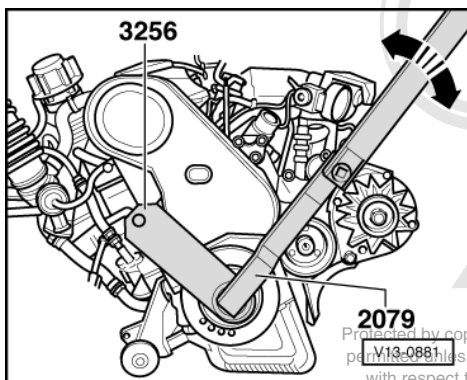


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- -> Support pulley for viscous fan with pin wrench 3212 and unscrew viscous fan with open-ended wrench 3312.
- Detach viscous fan from mount and move it forwards into radiator cowl.
- If necessary, unclip wiring harness at bottom of radiator cowl.
- Unscrew radiator cowl at radiator and lift it out together with viscous fan.
- Unscrew radiator cowl with electric fan motor at radiator and lift out.



- -> Detach noise insulation -arrows-.

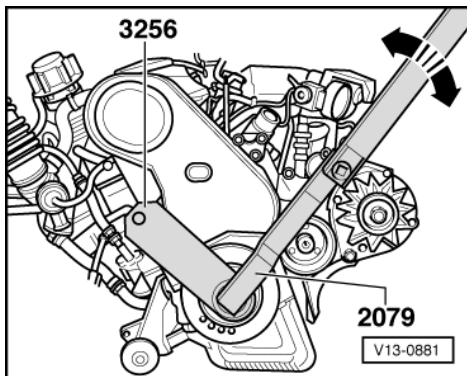


- -> Insert counterhold for vibration damper 3256 as shown and screw out central bolt.

Note:

Before attaching counterhold 3256, unscrew holder for hose to overrun shutoff valve at cylinder block.

- Screw out the 4 vibration damper bolts (M8) and detach vibration damper with pulley.





Installing

Install in reverse order, paying attention to the following:

- Apply sealing paste to threads and contact surface of central bolt head.
 - Sealing paste

=> Parts List

- -> Tighten central bolt for vibration damper (use counterhold 3256).
 - Tightening torque when using special tool 2079: 350 Nm

Attention:

Tightening torque of 350 Nm only applies in conjunction with special tool 2079. Tool must be in alignment with torque wrench.

- Tightening torque if use is not made of special tool 2079: 450 Nm
- Fit viscous fan => Page 151 .
Fit ribbed belt => Page 29 .

Tightening torques

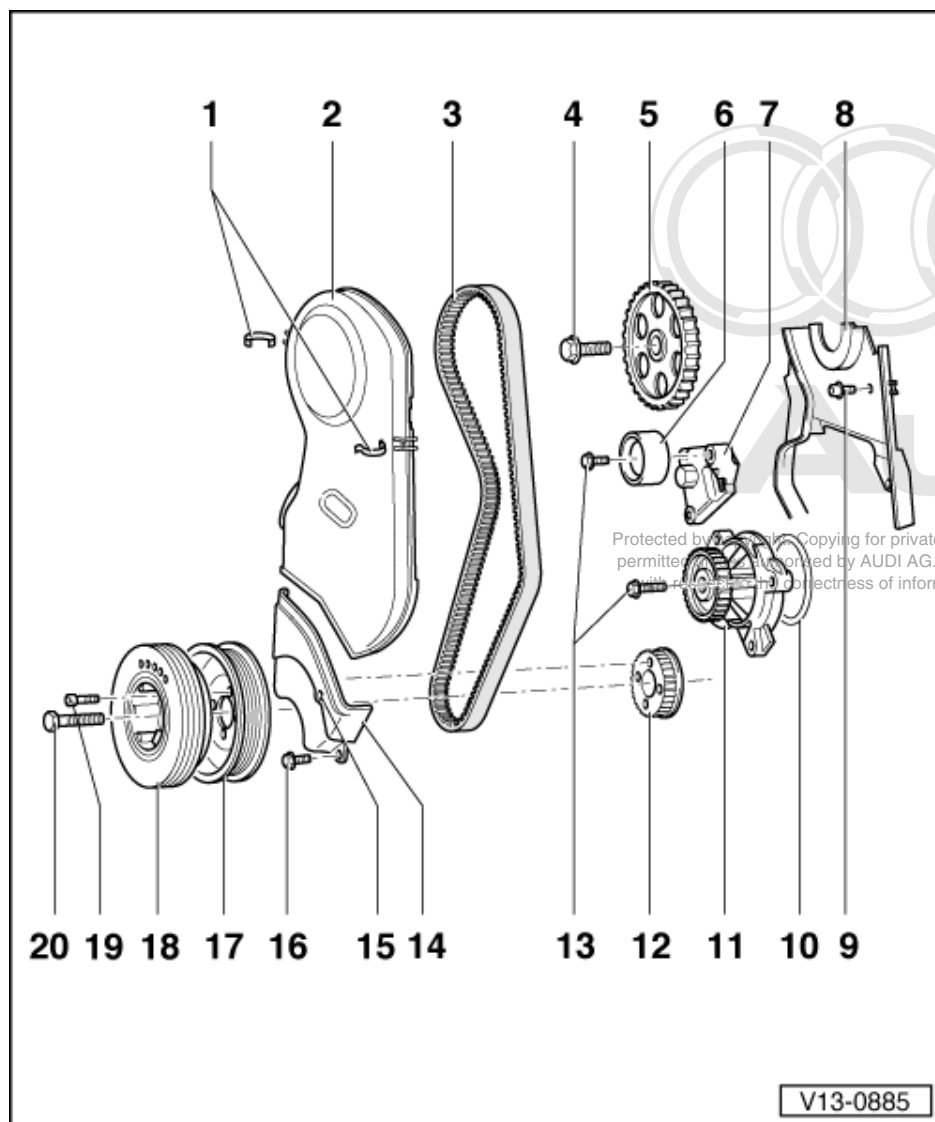
Component	Nm
Vibration damper with toothed belt sprocket to crankshaft 1)	
With special tool 2079	350
Without special tool 2079	450
Vibration damper to toothed belt sprocket (M8)	25

- 1) Always replace central bolt



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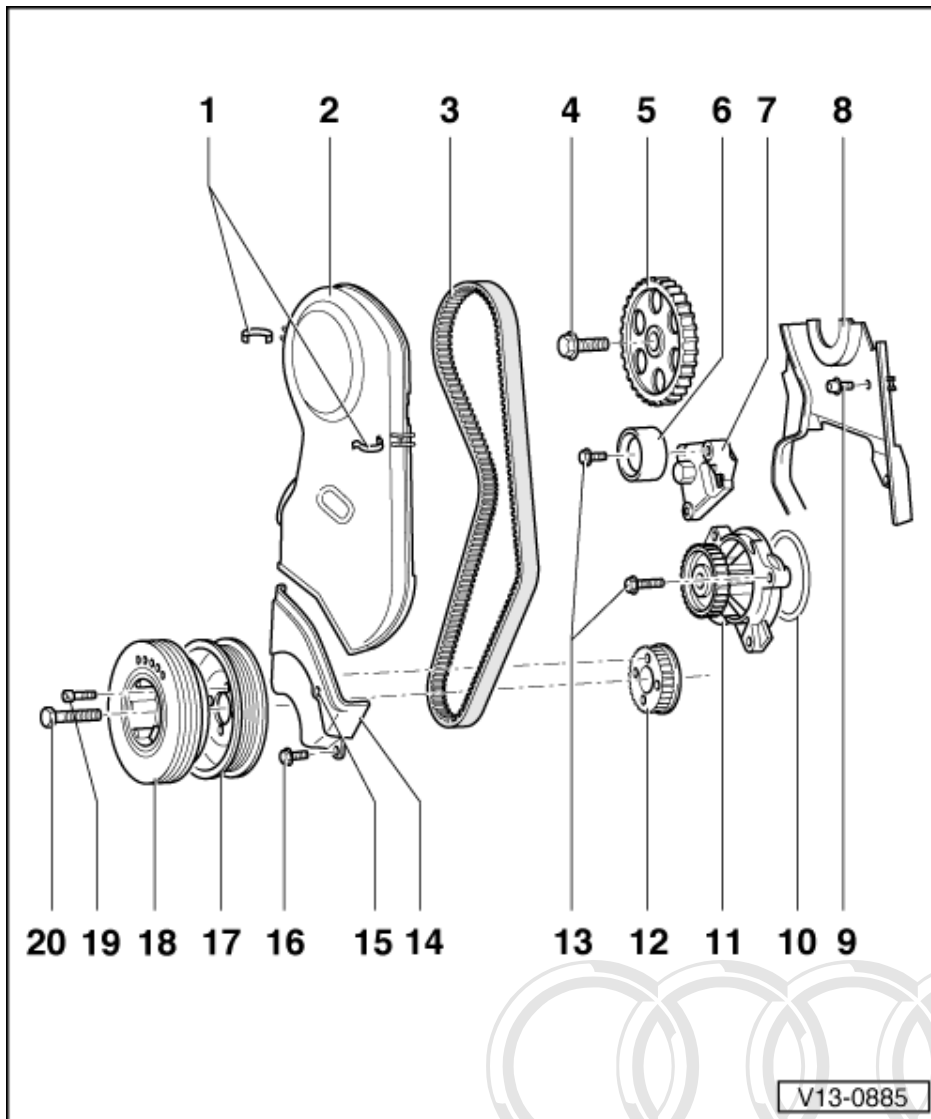
1.5 - Toothed belt drive



Note:

Mark direction of toothed belt with chalk or felt-tip pen prior to removal. Running a used belt in the opposite direction could destroy it.

- 1 Clip
 - ◆ 2x
- 2 Upper toothed belt guard
- 3 Toothed belt
 - ◆ Mark direction with chalk or felt-tip pen before removing
 - ◆ Check for wear
 - ◆ Removing =>Page 39
 - ◆ Installing (adjusting valve timing)
=> Page 43
 - ◆ Only adjust toothed belt tension when engine is cold

**4 65 Nm**

- ♦ Use counterhold 3036 when slackening off and tightening

5 Camshaft sprocket

- ♦ Detaching toothed belt from camshaft sprocket for removal and installation => Page 45
- ♦ Installation position fixed by Woodruff key

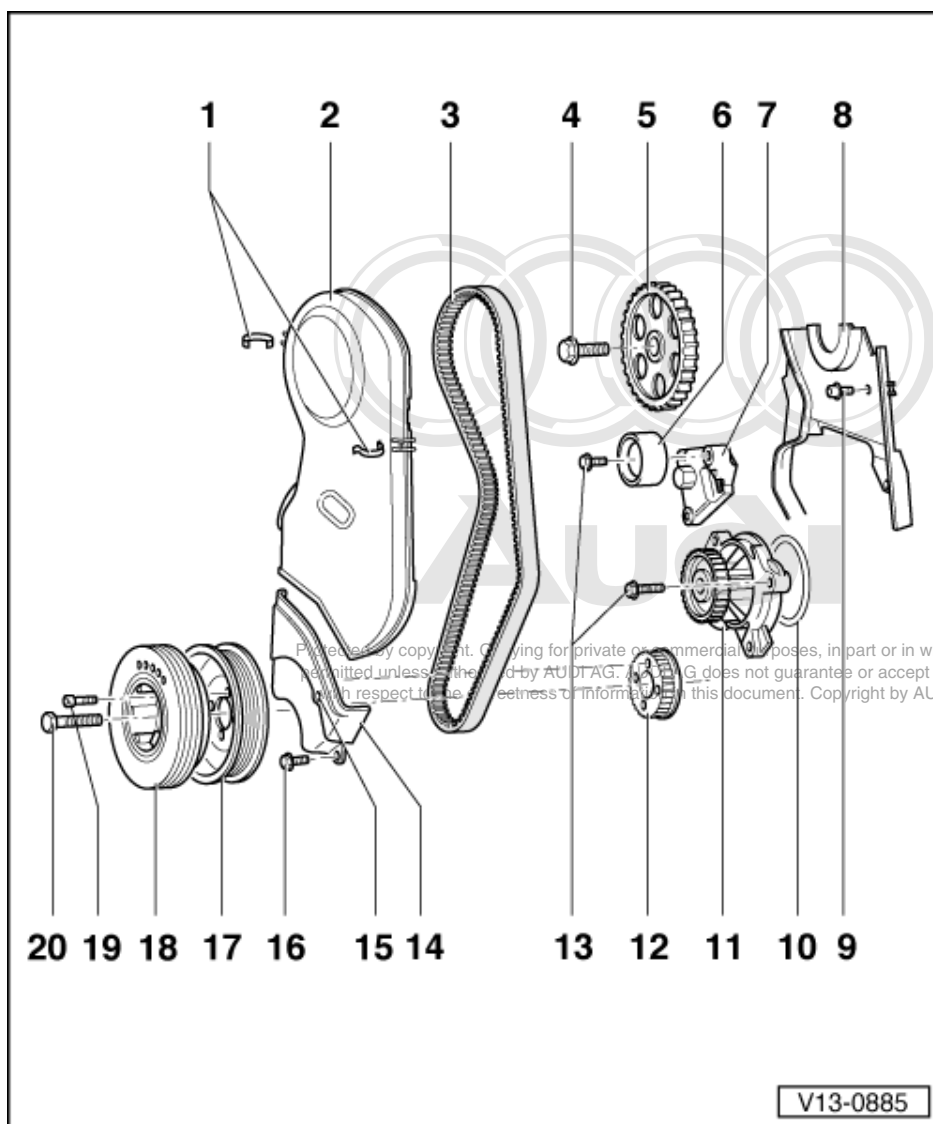
6 Tensioning roller**7 Tensioner for toothed belt**

- ♦ Only adjust toothed belt tension when engine is cold

8 Rear toothed belt guard**9 10 Nm****10 O-ring**

- ♦ Replace
- ♦ Moisten with coolant

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11 Coolant pump

- ♦ Removing and installing
=> Page 144

12 Crankshaft toothed belt sprocket

- ♦ There must not be any oil on contact surface between toothed belt sprocket and crankshaft
- ♦ Can only be fitted in one position

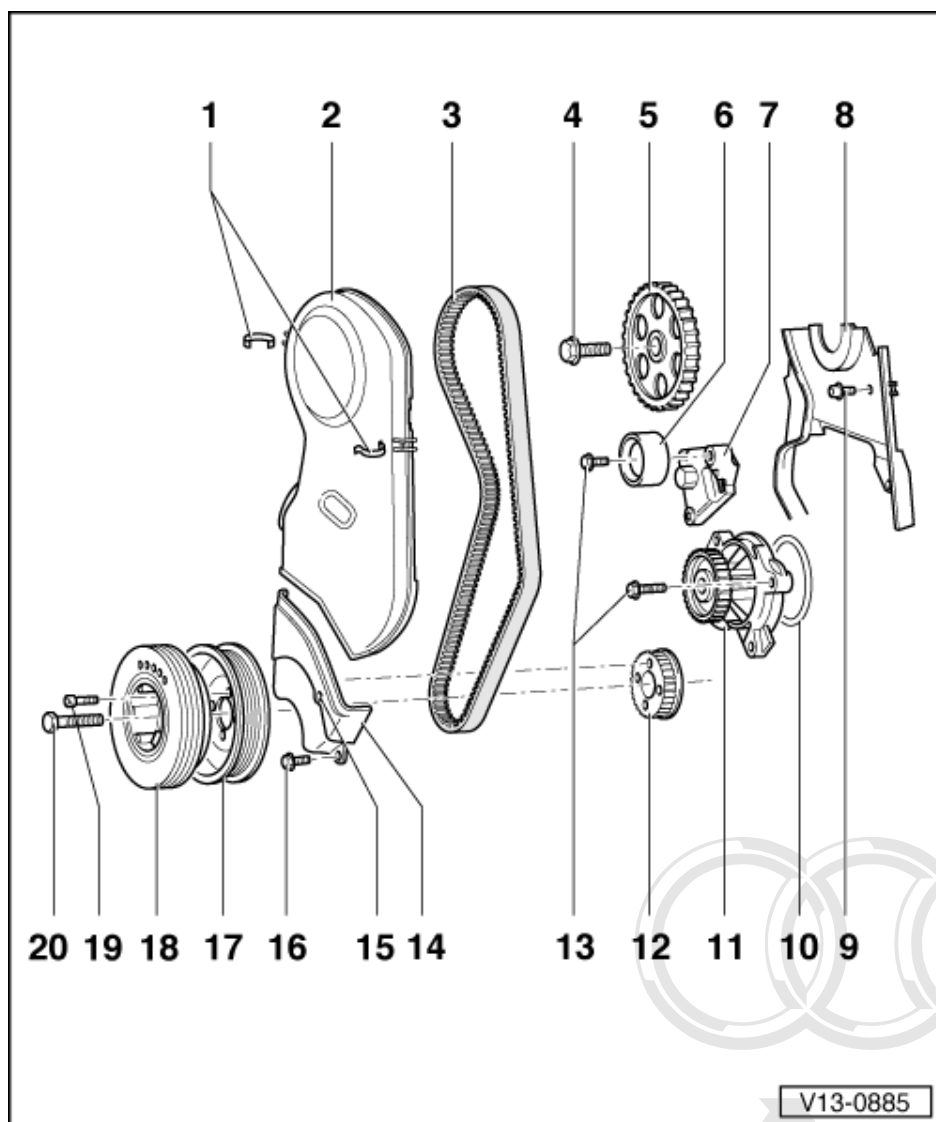
13 Bolt

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

14 Lower toothed belt guard

15 TDC mark

16 10 Nm



17 Pulley

- ◆ Pay attention to locator at toothed belt sprocket when fitting
- ◆ Can only be fitted in one position

18 Vibration damper

- ◆ Can only be fitted in one position
- ◆ Removing and installing
=> Page 31

=> Page 31

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19 20 Nm

20 Central bolt

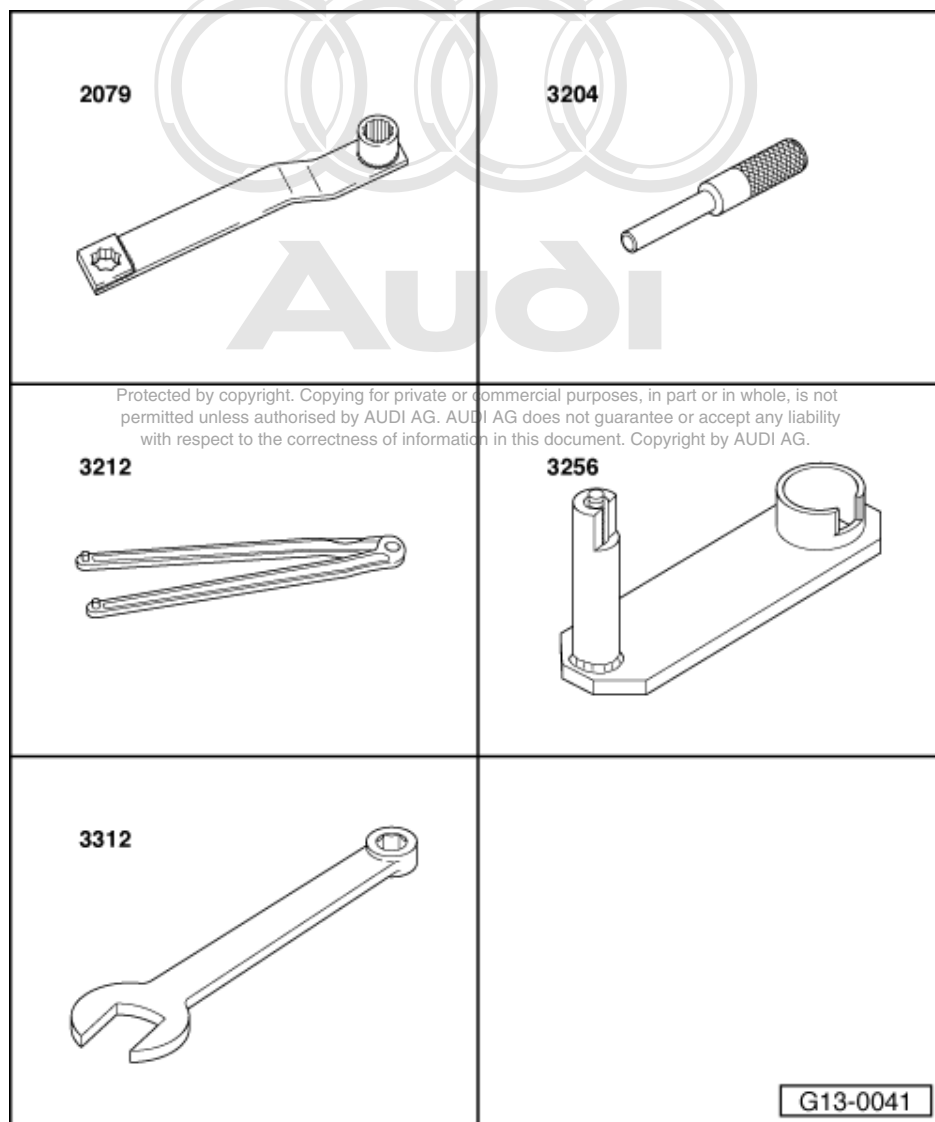
- ◆ Replace
- ◆ Apply sealing paste to threads and contact surface of bolt head
- ◆ Sealing paste

=> Parts List

- ◆ Use counterhold 3256 when slackening off and tightening
- ◆ Removing and installing
=> Page 31

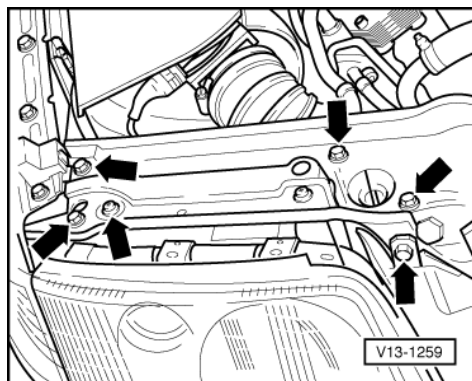
=> Page 31

1.6 - Removing and installing toothed belt



Special tools and workshop equipment required

- ◆ Wrench for vibration damper 2079
- ◆ Mandrel 3204
- ◆ Pin wrench 3212
- ◆ Counterhold for vibration damper 3256
- ◆ Open-ended wrench 3312



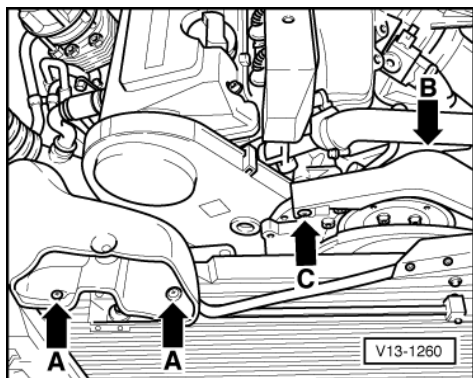


Removing

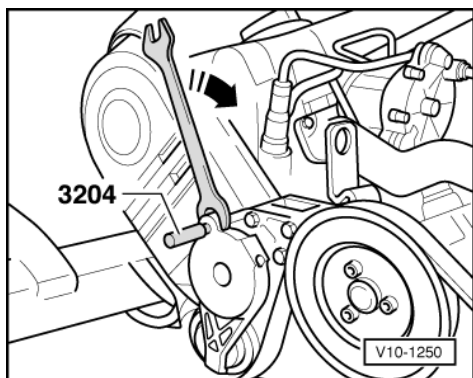
- -> Screw out bolts on left and right marked with -arrows- as well as one at top of headlight.
- Disengage bonnet cable at lock carrier.

=> General Body Repairs; Repair Group 55; Bonnet Bonnet

- Detach lock carrier.



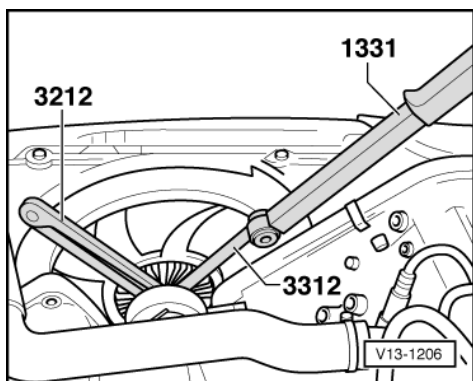
- -> Unfasten and remove air intake connection -arrows A-.
- Screw out bolt -arrow B- and disengage ribbed belt cover -arrow C-.



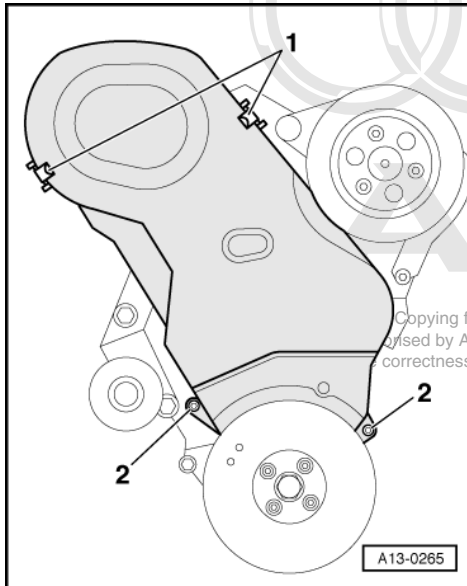
Note:

Before removing, mark direction of ribbed belt with chalk or felt-tipped pen. Running a used belt in the opposite direction could destroy it.

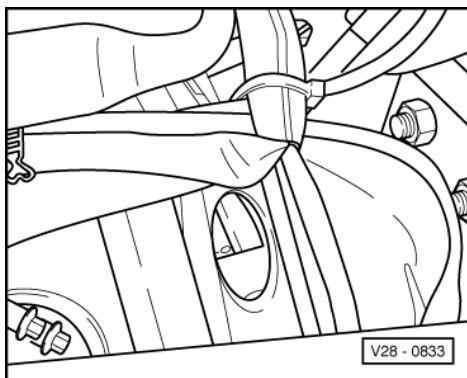
- -> Swivel tensioner in direction of arrow to slacken off ribbed belt.
- Secure tensioner with mandrel 3204.
- Remove secured tensioner for ribbed belt.
- Take out ribbed belt.



- -> Support pulley for viscous fan with pin wrench 3212 and unscrew viscous fan with open-ended wrench 3312.
- Detach viscous fan from mount and move it forwards into radiator cowl.
- If necessary, unclip wiring harness at bottom of radiator cowl.
- Unscrew radiator cowl at radiator and lift it out together with viscous fan.



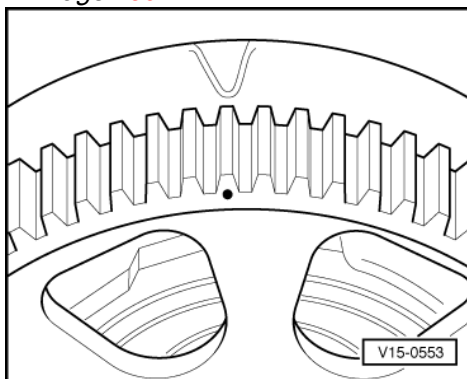
- Unscrew radiator cowl with electric fan motor at radiator and lift out.
- -> Remove upper and lower toothed belt guard. To do so, unfasten clips -1-/screw out bolts -2-.



- -> Set crankshaft at central bolt of crankshaft toothed belt sprocket in direction of engine rotation to no. 1 cyl. TDC mark ...

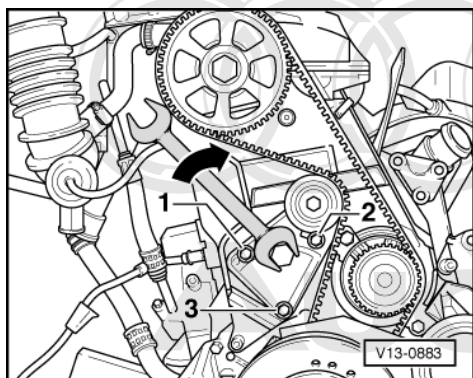
Note:

Turning crankshaft to no. 1 cylinder TDC with engine removed
=> Page 50.

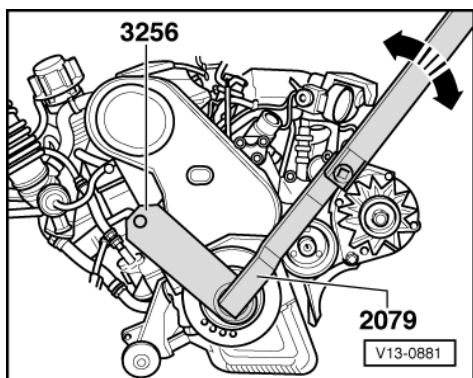




- -> ... at the same time, mark at camshaft sprocket must coincide with arrow mark at cylinder head cover. If necessary, give crankshaft 1 further turn.
- Mark direction of toothed belt with chalk or felt-tip pen.



- Slacken off both upper bolts -1- and -2- of tensioner (elongated holes) by 1 turn.
- Slacken off lower bolt -3- until tensioner can be moved.

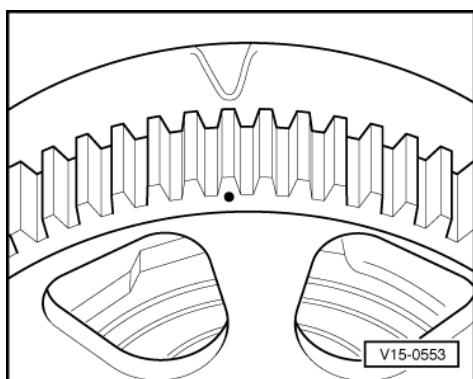


- -> Remove vibration damper with crankshaft toothed belt sprocket; to do so, lock vibration damper with counterhold 3256.

Note:

Before attaching counterhold 3256, unscrew holder for hose to overrun shutoff valve at engine block.

- Detach vibration damper and toothed belt.

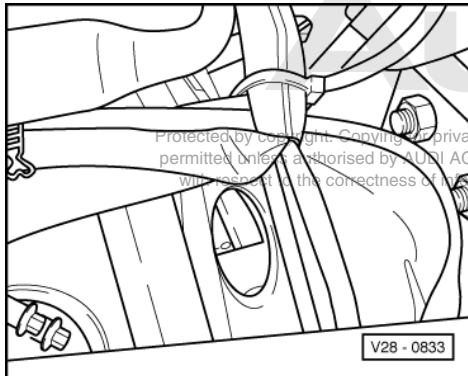


Installing (adjusting valve timing)

Install in reverse order, paying attention to the following:

Notes:

- ◆ When turning camshaft, none of the crankshaft cylinders should be at TDC, as this could result in valve/piston crown damage.
 - ◆ Toothed belt tension is to be adjusted when engine is cold.
- -> Align mark at camshaft sprocket with arrow mark at cylinder head cover.

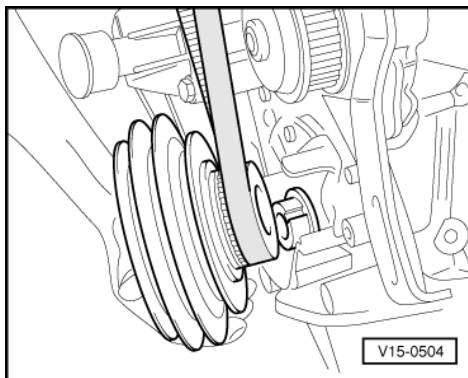


- -> Check again to establish whether crankshaft is at no. 1 cylinder TDC.

Note:

Turning crankshaft to no. 1 cylinder TDC with engine removed

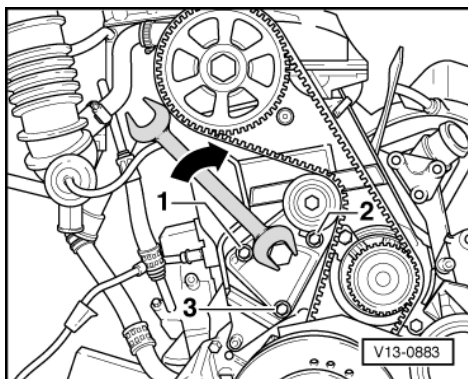
=> Page 50.



- -> Position toothed belt on crankshaft toothed belt sprocket and fit with vibration damper/pulley at crankshaft.
- Apply sealing paste to threads and contact surface of central bolt head.
- Sealing paste

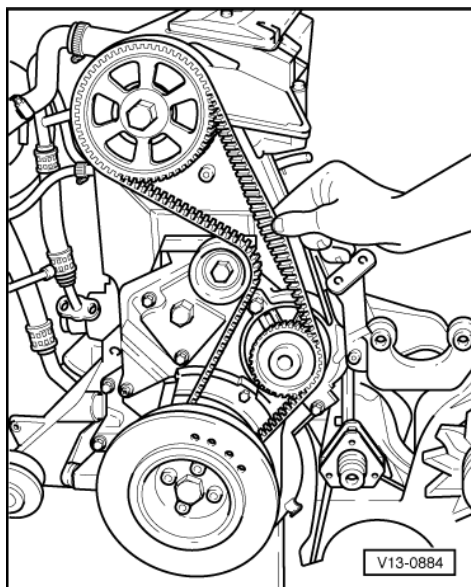
=> Parts List

- Tighten central bolt slightly.





- Position toothed belt on tensioning roller, coolant pump and camshaft sprocket.
- -> Tension toothed belt. To do so, turn tensioner at hexagon in clockwise direction -arrow-, hold in position and tighten bolts -1 ... 3- to 10 Nm.

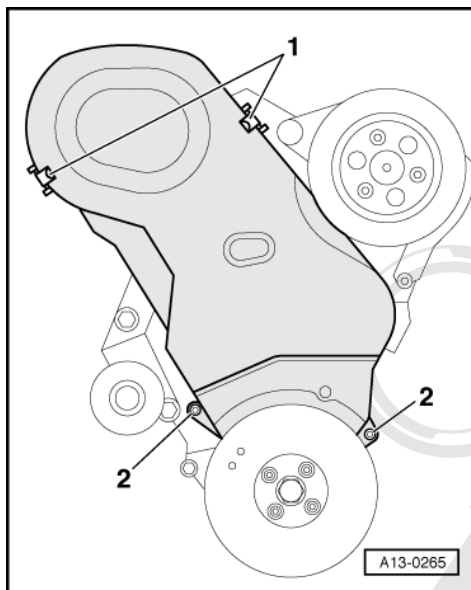


- -> It must just be possible to turn toothed belt by 1/4 of a turn (90°) between camshaft sprocket and coolant pump with thumb and index finger
- Give crankshaft two turns in direction of engine rotation and check whether camshaft and crankshaft marks coincide with their reference points.
Check toothed belt tension again.
Re-tension toothed belt if necessary.
Tighten central bolt for vibration damper =>Page 31 onwards.

Model Year 1991 vehicles:

- Check basic setting of Hall sender.

=> Motronic Injection and Ignition System (5-cylinder); Repair Group 28



All models:

- -> Fit upper and lower toothed belt guards -1- and -2-

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- Fit ribbed belt => Page 29 .
- Fit viscous fan => Page 151 .
- Install lock carrier with attachments.

=> General Body Repairs; Repair Group 50; Front Body Front Body

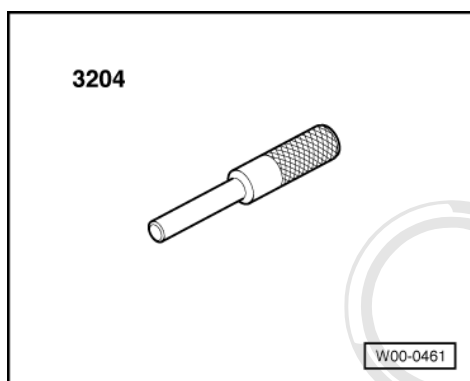
- Adjust headlights.

=> Electrical System; Repair Group 94; Servicing headlights; Headlight adjustment Servicing headlights Headlight adjustment

Tightening torques

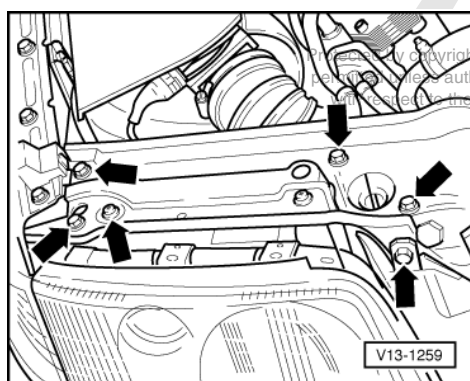
Component	Nm
Tensioner for toothed belt to cylinder block	10
Lower toothed belt guard	10

1.7 - Detaching toothed belt from camshaft sprocket



Special tools and workshop equipment required

- ♦ Mandrel 3204



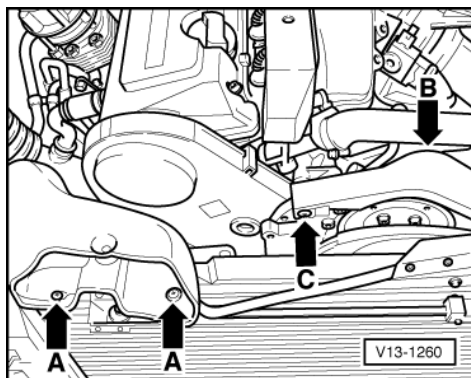
Removing

- -> Screw out bolts on left and right marked with -arrows- as well as one at top of headlight.
- Disengage bonnet cable at lock carrier.

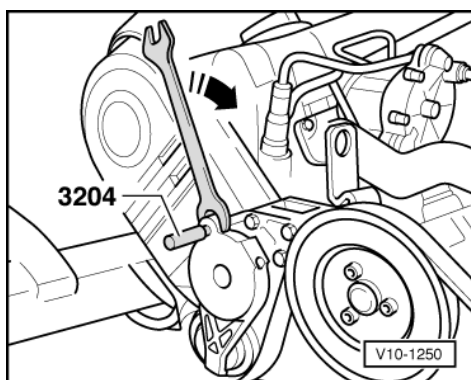
=> General Body Repairs; Repair Group 55; Bonnet Bonnet



- Detach lock carrier.



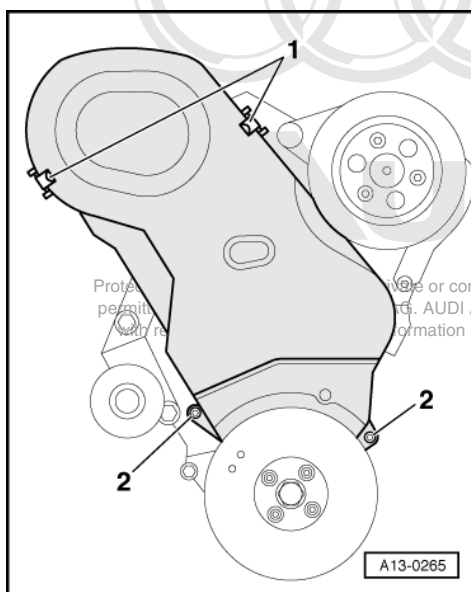
- -> Unfasten and remove air intake connection -arrows A-
- Screw out bolt -arrow B- and disengage ribbed belt cover -arrow C-.



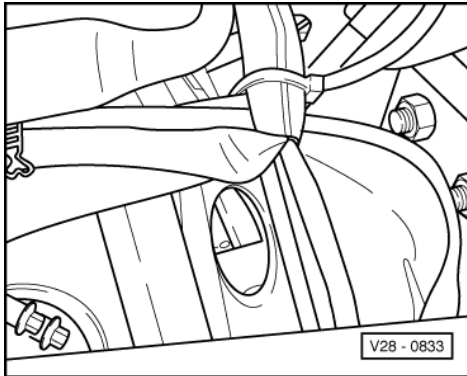
Note:

Before removing, mark direction of ribbed belt with chalk or felt-tipped pen. Running a used belt in the opposite direction could destroy it.

- -> Swivel tensioner in direction of arrow to slacken off ribbed belt.
- Secure tensioner with mandrel 3204.
- Remove secured tensioner for ribbed belt.



- -> Unfasten clips -1- and remove upper toothed belt guard. Leave lower toothed belt guard -2- in position.

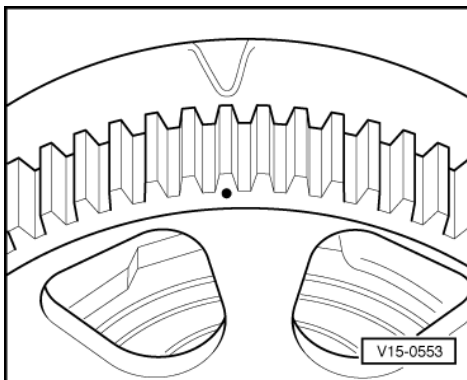


- -> Set crankshaft at central bolt of crankshaft toothed belt sprocket in direction of engine rotation to no. 1 cyl. TDC mark ...

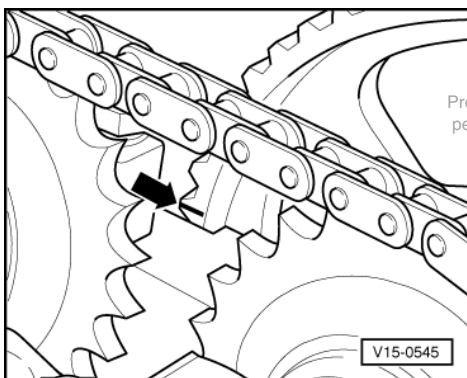
Note:

Turning crankshaft to no. 1 cylinder TDC with engine removed

=> Page 50.



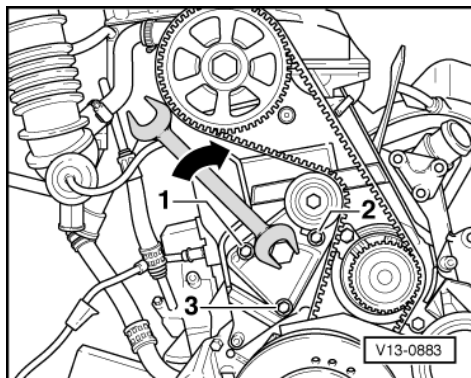
- -> ... at the same time, mark at camshaft sprocket must coincide with arrow mark at cylinder head cover. If necessary, give crankshaft 1 further turn.



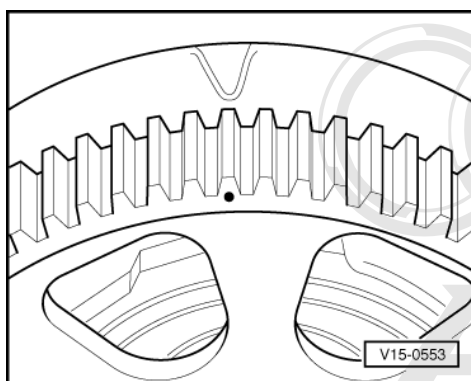
Note:

-> With cylinder head cover removed, mark -arrow- at camshaft sprocket must also coincide with top edge of cylinder head. If necessary, give crankshaft 1 further turn.

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- -> Slacken off both upper bolts -1- and -2- of tensioner (elongated holes) by 1 turn.
- Slacken off lower bolt -3- until tensioner can be moved.
- Detach toothed belt from camshaft sprocket.



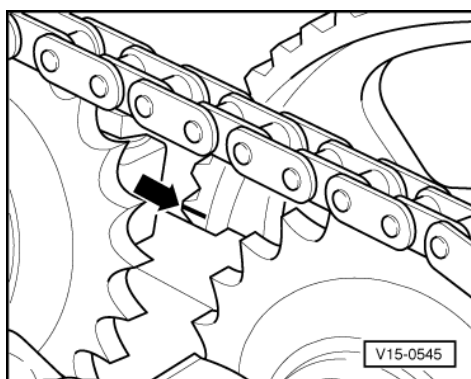
Installing (adjusting valve timing)

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Install in reverse order, paying attention to the following:

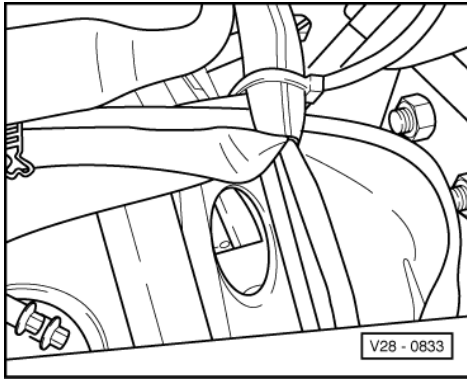
Notes:

- ♦ When turning camshaft, none of the crankshaft cylinders should be at TDC, as this could result in valve/piston crown damage.
 - ♦ Toothed belt tension is to be adjusted when engine is cold.
- -> Align mark at camshaft sprocket with arrow mark at cylinder head cover.



Note:

-> With cylinder head cover removed, align mark -arrow- at camshaft sprocket with top edge of cylinder head.

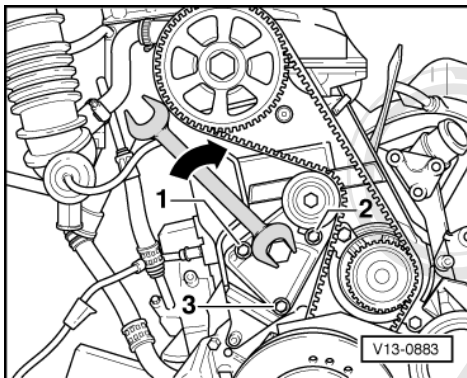


- -> Check again to establish whether crankshaft is at no. 1 cylinder TDC.

Note:

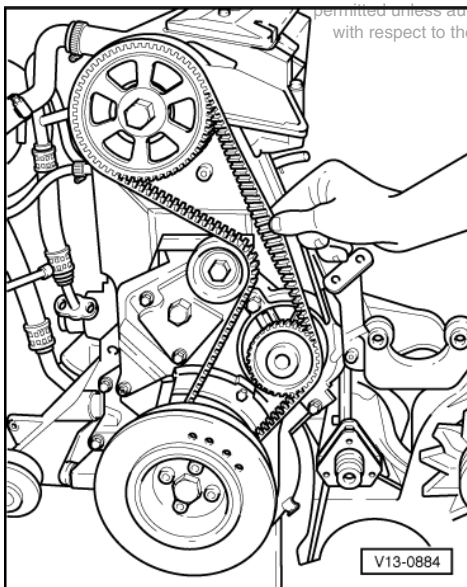
Turning crankshaft to no. 1 cylinder TDC with engine removed

=> Page 50.



- Position toothed belt on tensioning roller, coolant pump and camshaft sprocket.
- -> Tension toothed belt. To do so, turn tensioner at hexagon in clockwise direction -arrow-, hold in position and tighten bolts -1 ... 3- to 10 Nm.

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- -> It must just be possible to turn toothed belt by 1/4 of a turn (90°) between camshaft sprocket and coolant pump with thumb and index finger
Give crankshaft two turns in direction of engine rotation and check whether camshaft and crankshaft marks coincide with their reference points.

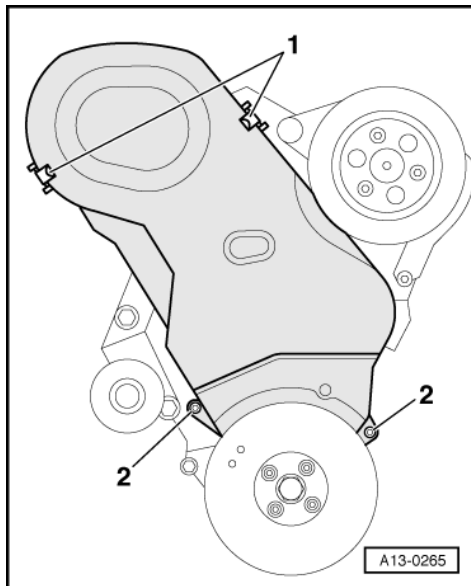


Check toothed belt tension again.
Re-tension toothed belt if necessary.

Model Year 1991 vehicles:

- Check basic setting of Hall sender.

=> Motronic Injection and Ignition System (5-cylinder); Repair Group 28



All models:

- -> Fit upper toothed belt guard -1-.
- Fit ribbed belt => Page 29 .
- Install lock carrier with attachments.

=> General Body Repairs; Repair Group 50; Front Body Front Body

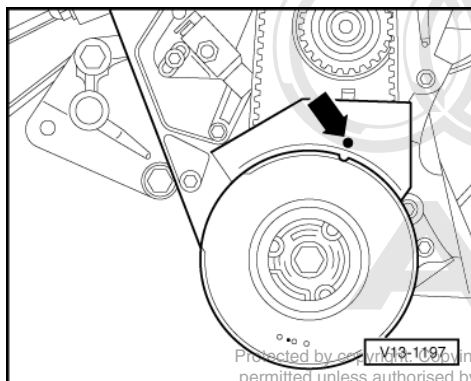
- Adjust headlights.

=> Electrical System; Repair Group 94; Servicing headlights; Headlight adjustment Servicing headlights Headlight adjustment

Tightening torque

Component	Nm
Tensioner for toothed belt to cylinder block	10

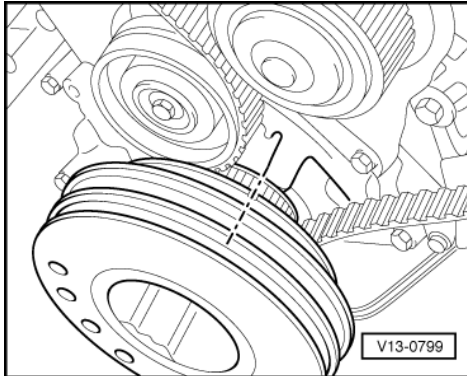
1.8 - Turning crankshaft to TDC with engine removed



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Lower toothed belt guard fitted:

- -> Align notch of vibration damper with adjustment mark -arrow- at lower toothed belt guard.



Lower toothed belt guard removed:

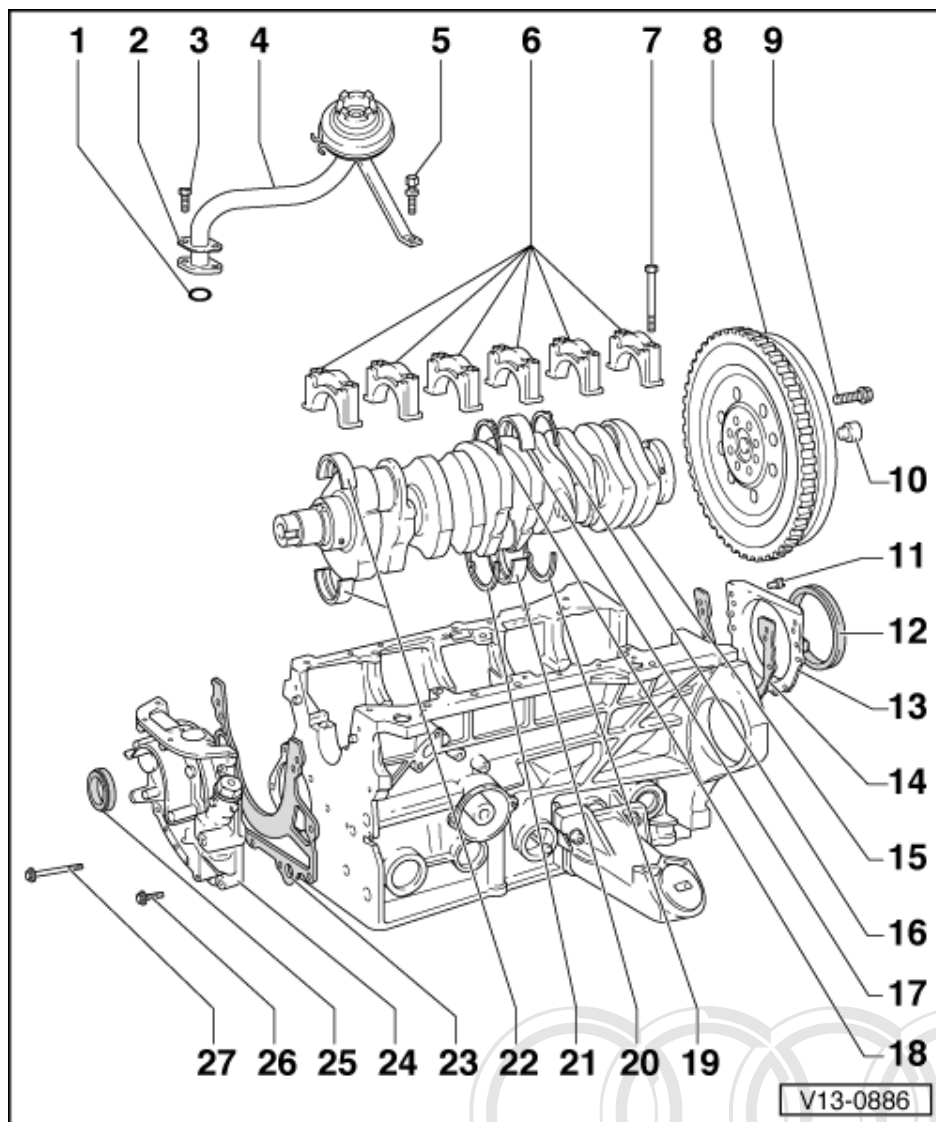
- -> Align notch of vibration damper with adjustment mark at oil pump housing.



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2 - Removing and installing crankshaft, flywheel and sealing flanges

2.1 - Removing and installing crankshaft, flywheel and sealing flanges



Notes:

- ♦ Servicing clutch

=> 5 and 6-speed Manual Gearbox 01E Four-wheel Drive; Repair Group 30; Servicing clutch Servicing clutch

- ♦ For performing assembly work, engine is to be attached with engine holder VW 540 to repair stand.

1 O-ring

- ♦ Replace

2 Lock washer

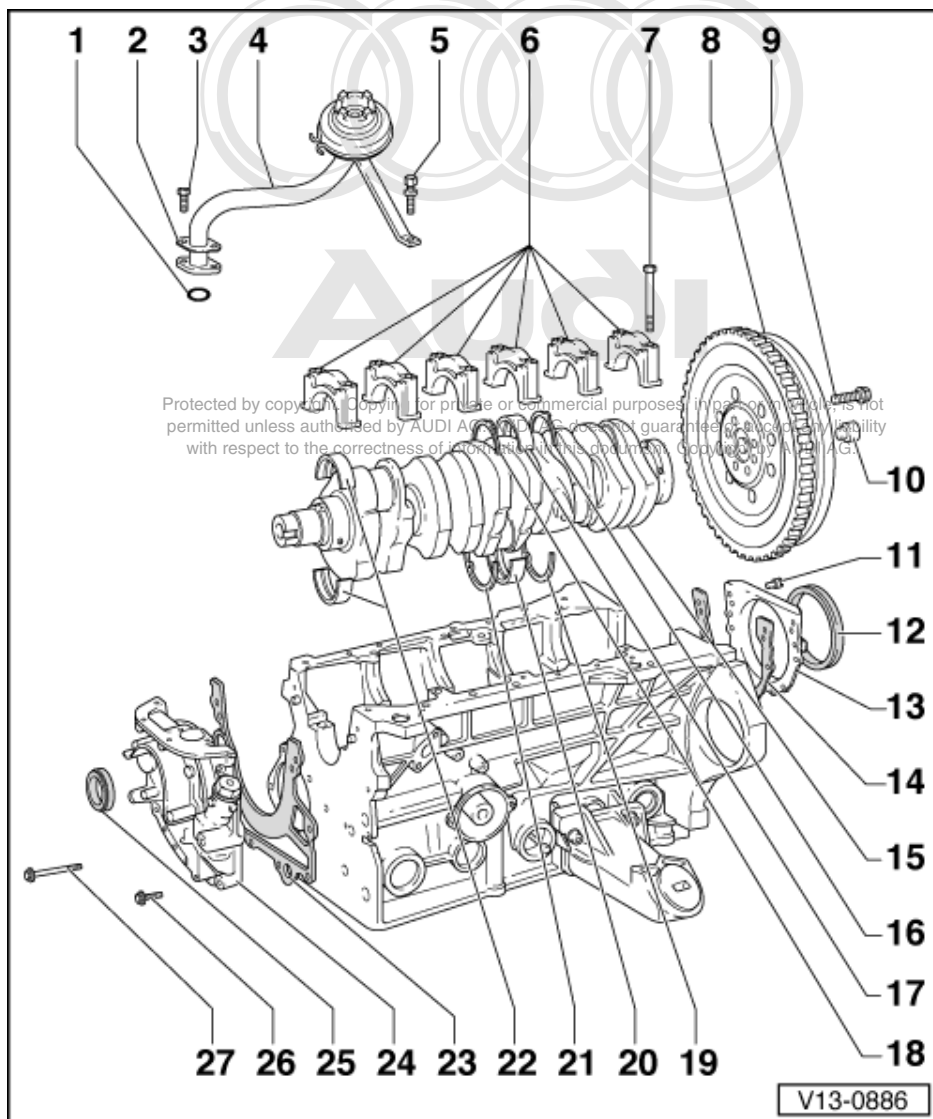
- ♦ Depending on design status
- ♦ Replace

3 10 Nm

- ♦ Apply locking fluid when fitting
- ♦ Locking fluid

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=> Parts List



4 Suction pipe

- ♦ Attach to oil pump first

5 10 Nm

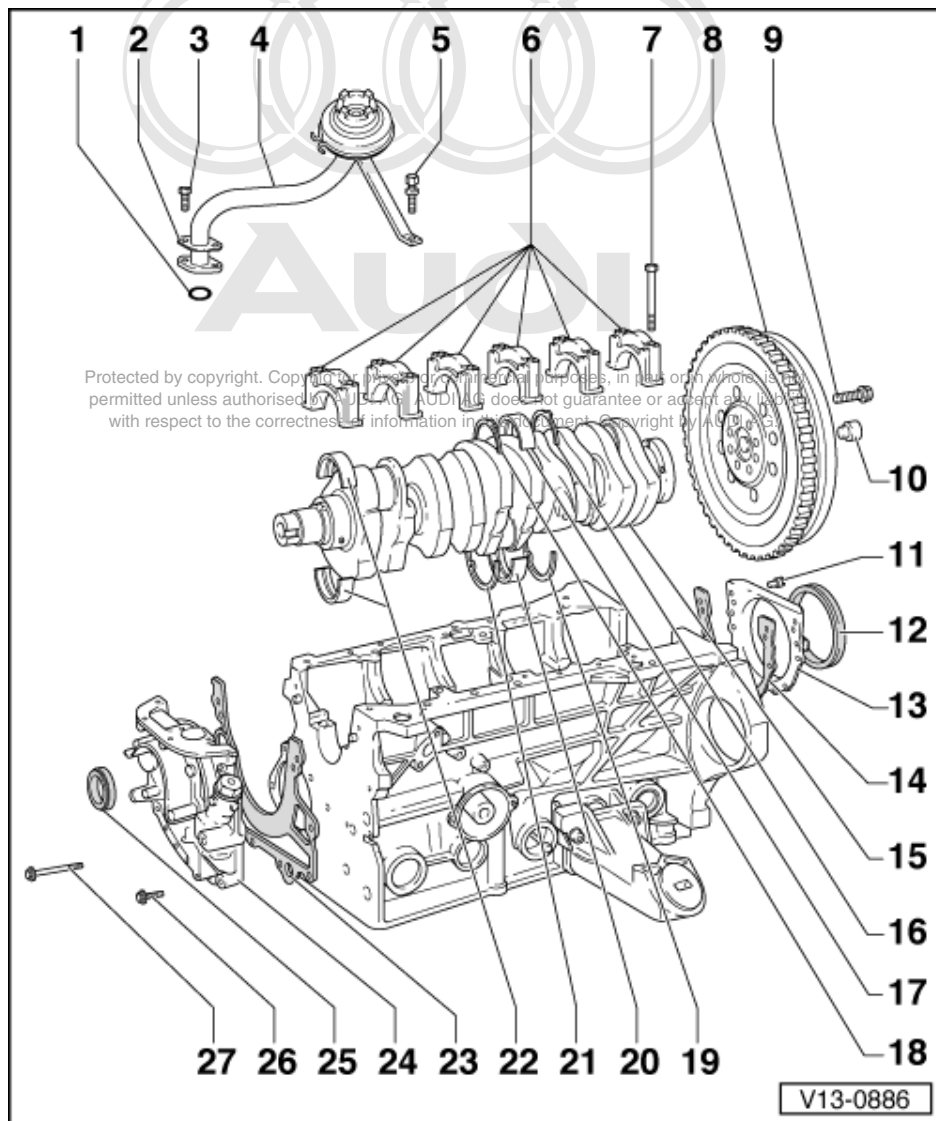
6 Bearing cap

- ♦ Bearing cap 1: Pulley end
- ♦ Retainer tabs of cylinder block/bearing cap bearing shells must coincide

7 65 Nm

8 Dual-mass flywheel

- ♦ Removing and installing dual-mass flywheel => Page 61
- ♦ Can only be fitted in one position
-offset holes-
- ♦ Checking distance between engine speed sender -G28 and dual-mass flywheel => Fig. 1
- ♦ With welded-on lugs for ignition point and timing => Fig. 2
- ♦ Checking distance between firing point sender -G4 and lugs at dual-mass flywheel=> Fig. 3



9 40 Nm + further 180° (1/2) turn

- ◆ Replace

10 Needle bearing

- ◆ Extracting and driving in=>Page 62

11 10 Nm

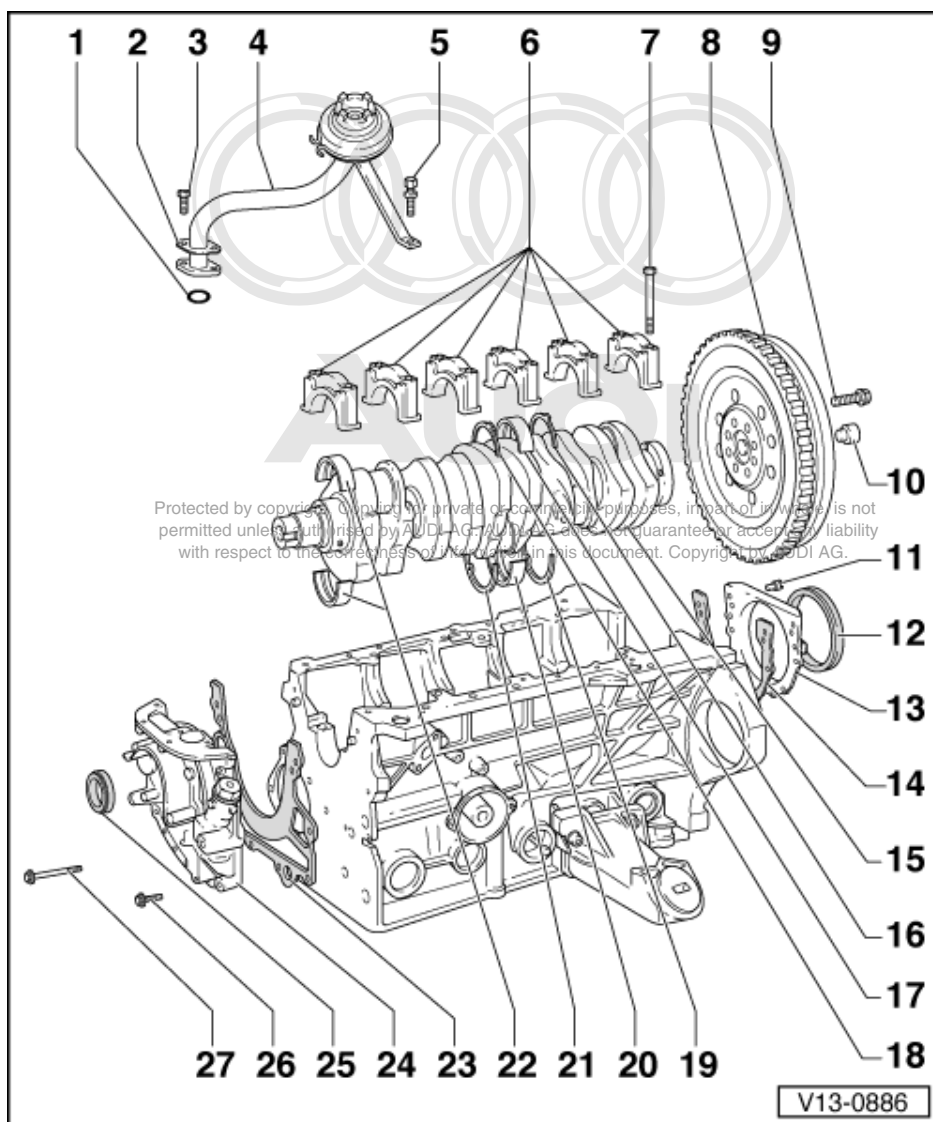
12 Oil seal

- ◆ Only available together with -item 13 -

13 Rear sealing flange

- ◆ With oil seal
- ◆ Removal and installation involve taking out sump => Page 125
- ◆ Before fitting sump, apply thin coat of sealant to sealing flange/cylinder block transitions
- ◆ Sealant

=> Parts List



14 Gasket

- ◆ Replace
- ◆ Fit only if sealing flange has no sealing lip on cylinder block end

15 Crankshaft

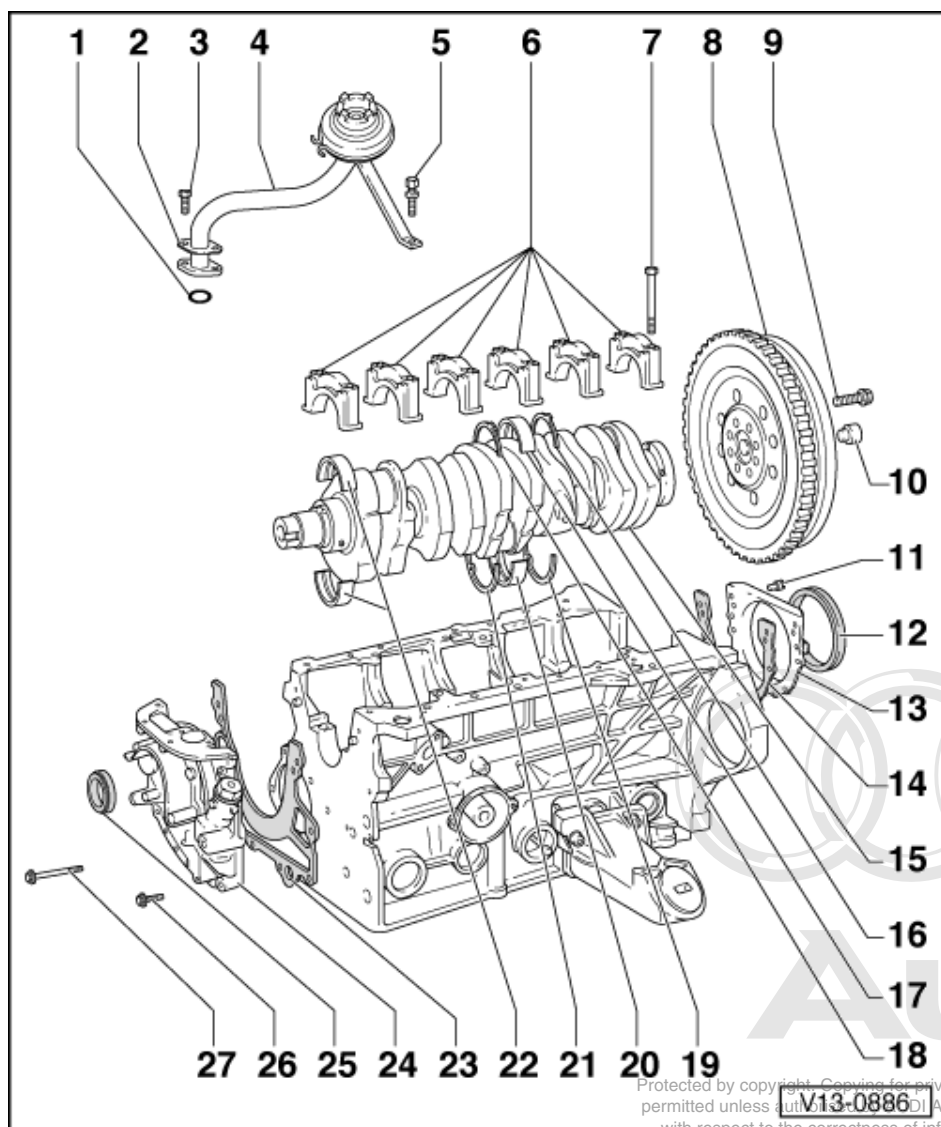
- ◆ As-new axial clearance: 0.07...0.23 mm Wear limit: 0.30 mm
- ◆ Measure radial clearance with Plastigage
As-new: 0.018...0.058 mm
Wear limit: 0.16 mm
- ◆ Do not turn crankshaft when measuring radial clearance
- ◆ Crankshaft dimensions
=> Page 63

16 Thrust washer

- ◆ For bearing cap
- ◆ Pay attention to locator

17 Bearing shell

- ◆ For bearing cap with no oil groove
- ◆ Do not interchange used bearing shells (mark)



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18 Thrust washer

- ◆ For bearing cap
- ◆ Pay attention to locator

19 Thrust washer

- ◆ For cylinder block (without retainer tabs)

20 Bearing shell

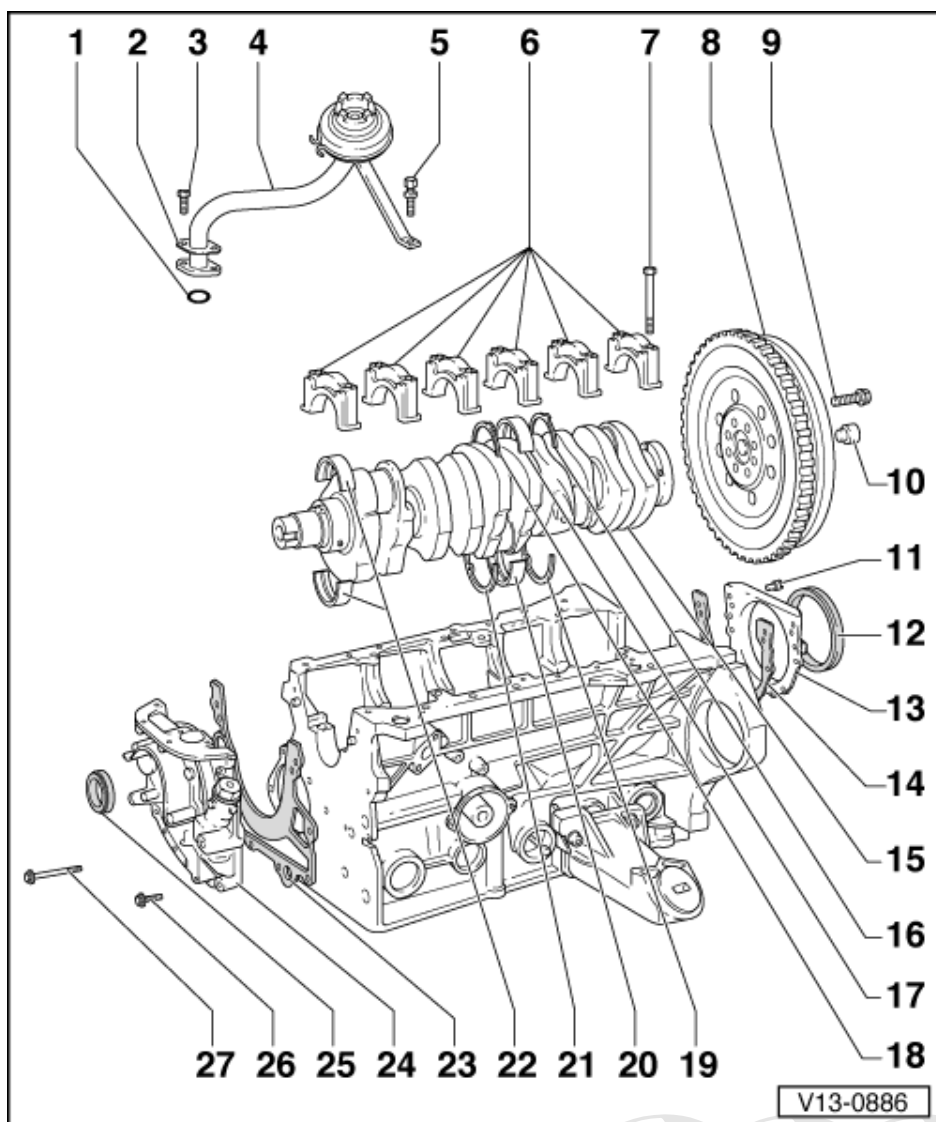
- ◆ For cylinder block with oil groove
- ◆ Do not interchange used bearing shells (mark)

21 Thrust washer

- ◆ For cylinder block (without retainer tabs)

22 Bearing shell

- ◆ For bearing cap with no oil groove
- ◆ For cylinder block with oil groove
- ◆ Do not interchange used bearing shells (mark with waterproof felt-tip pen)



23 Gasket

- ◆ Replace

24 Oil pump

- ◆ Removing and installing
=> Page 128
- ◆ Watch out for driver at crankshaft on installation

25 Oil seal

- ◆ For crankshaft
- ◆ Removing and installing
=> Page 59

26 10 Nm

27 20 Nm

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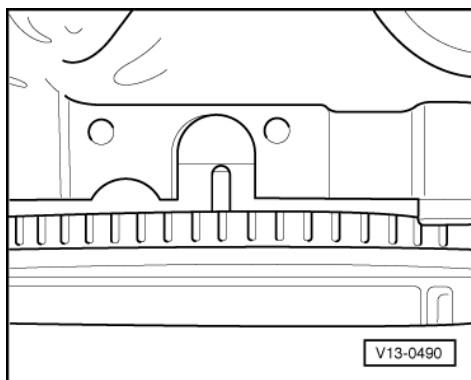
**-> Fig.1 Checking distance between engine speed sender -G28 and dual-mass flywheel**

- Screw in engine speed sender -G28.
- Use feeler gauge to check distance between splines of dual-mass flywheel and engine speed sender.
 - Specification: 0.50 ... 1.25 mm

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-> Fig.2 Lugs at dual-mass flywheel

- ♦ Lugs -1- and -2- for ignition timing (for ignition tester)
- ♦ Lug -3- for ignition point (for firing point sender -G4)

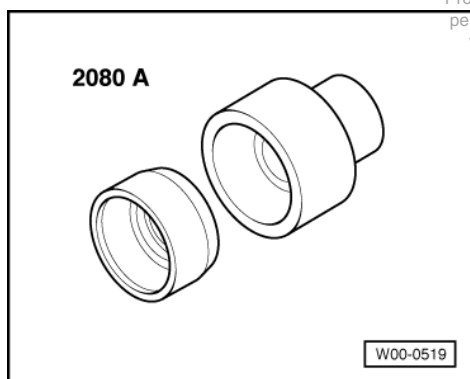
**Fig.3 Checking distance between firing point sender -G4 and lugs at dual-mass flywheel**

- -> Turn dual-mass flywheel until lug is positioned beneath opening of firing point sender.

- Screw in firing point sender -G4.
- -> Use feeler gauge to check distance between lug and firing point sender.
 - Specification: 0.45 ... 1.25 mm

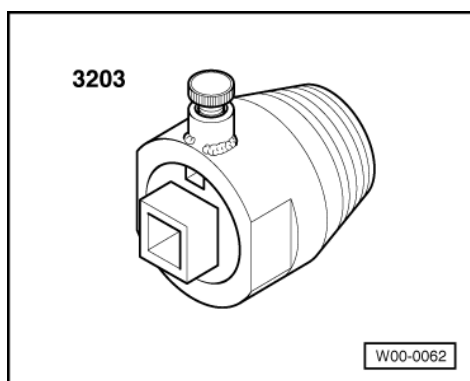
2.2 - Replacing crankshaft oil seal on pulley end

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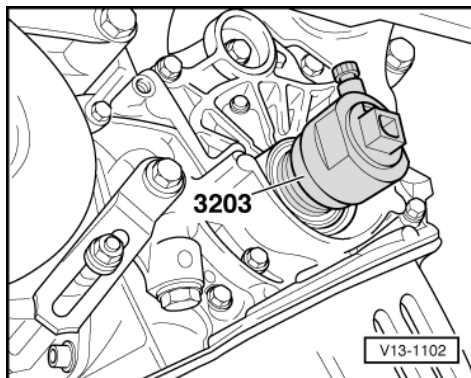


Special tools and workshop equipment required

- ♦ Fitting sleeve for oil seal 2080 A



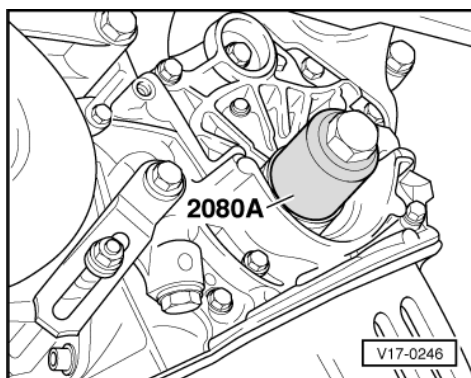
- ♦ Oil seal extractor 3203



Removing

- Engine in position
- Remove toothed belt => Page 39 .
- Screw inner section of oil seal extractor 3203 out of outer section by one turn (approx. 2 mm) and lock with knurled screw.
- -> Lubricate threaded end of oil seal extractor, fit in position and screw firmly into oil seal as far as possible.
- Slacken off knurled screw and turn inner section against crankshaft until oil seal is pulled out.

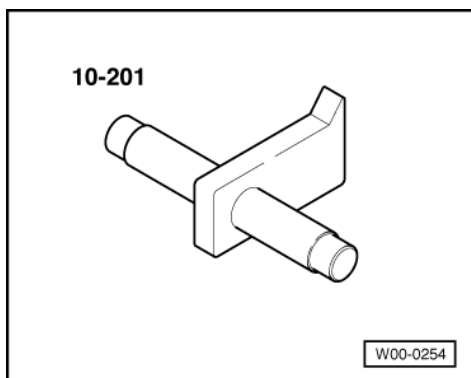
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Installing

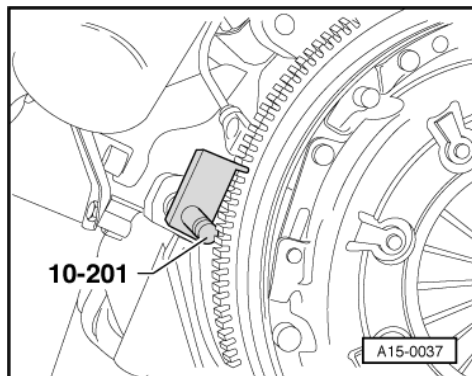
- Position guide sleeve from 2080 A on crankshaft journal.
- Slip oil seal carefully over guide sleeve.
- -> Press home oil seal with fitting sleeve and cleaned bolt for vibration damper.
- Fit toothed belt (adjust valve timing) => Page 43 .

2.3 - Removing and installing dual-mass flywheel



Special tools and workshop equipment required

- ♦ Counterhold 10-201



- Mark dual-mass flywheel with respect to engine.
- -> Re-position counterhold 10-201 for slackening off and securing bolts.
- Use new bolts for attachment.

Tightening torque

Component	Nm
Dual-mass flywheel to crankshaft	40 + 180°1)

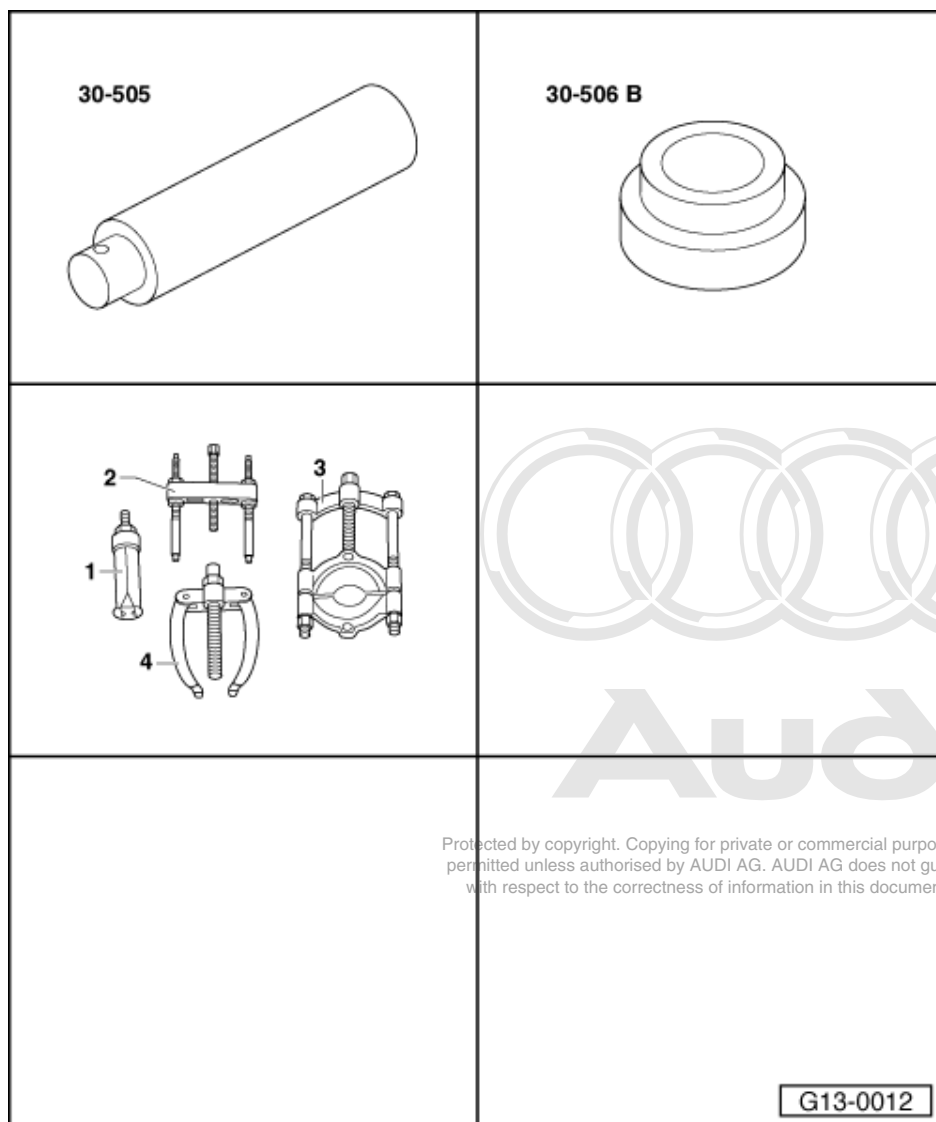
- 1) 180° corresponds to a half turn



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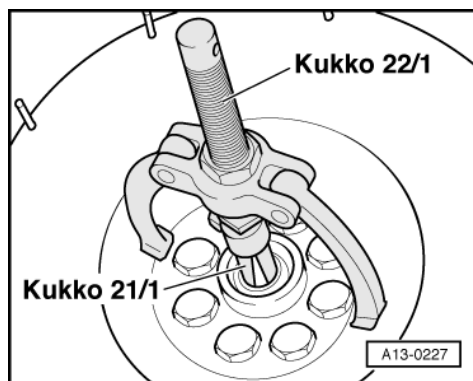


2.4 - Extracting needle bearing from flywheel/driving in



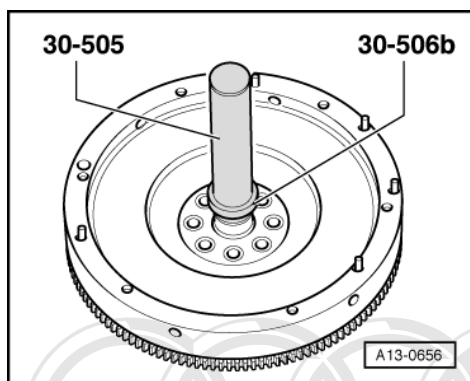
Special tools and workshop equipment required

- ♦ Fitting mandrel 30-505
- ♦ Pressing-in tool 30-506 B
- ♦ 1 - Internal puller Kukko 21/1
- ♦ 4 - Counter-support Kukko 22/1



Removing

- -> Use Kukko 21/1 and Kukko 22/1 to extract needle bearing.



Installing

- -> Use fitting mandrel 30-505 and pressing-in tool 30-506 B to drive in needle bearing flush with flywheel.

2.5 - Crankshaft dimensions

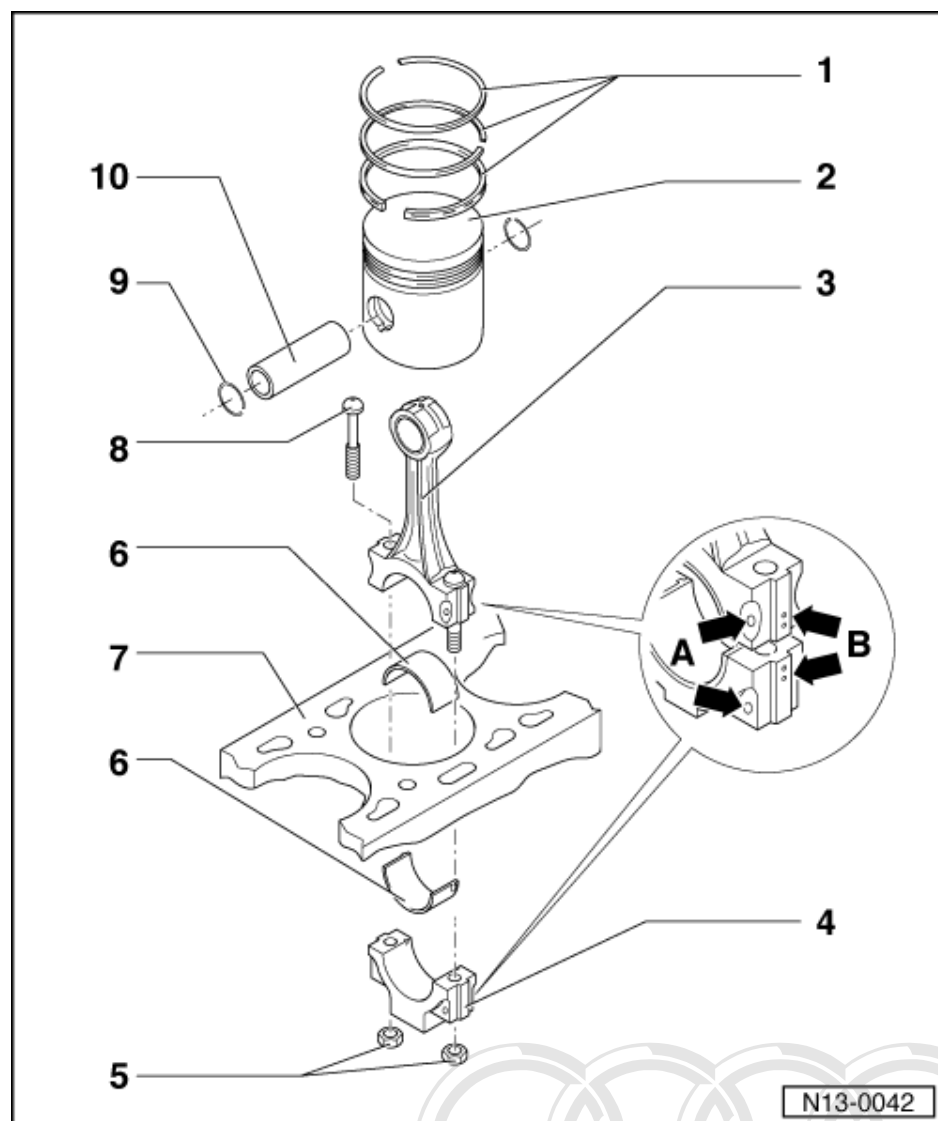
(dimensions in mm)

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Grinding dimension	Crankshaft bearing journal $\varnothing$	Conrod bearing journal $\varnothing$
Basic dimension	-0.022 58.00 -0.042	-0.022 47.80 -0.042
Stage I	-0.022 57.75 -0.042	-0.022 47.55 -0.042
Stage II	-0.022 57.50 -0.042	-0.022 47.30 -0.042
Stage III	-0.022 57.25 -0.042	-0.022 47.05 -0.042

3 - Dismantling and assembling piston and conrod

3.1 - Dismantling and assembling piston and conrod



Note:

Oil spray jet and pressure relief valve

=> Fig. 69

1 Piston rings

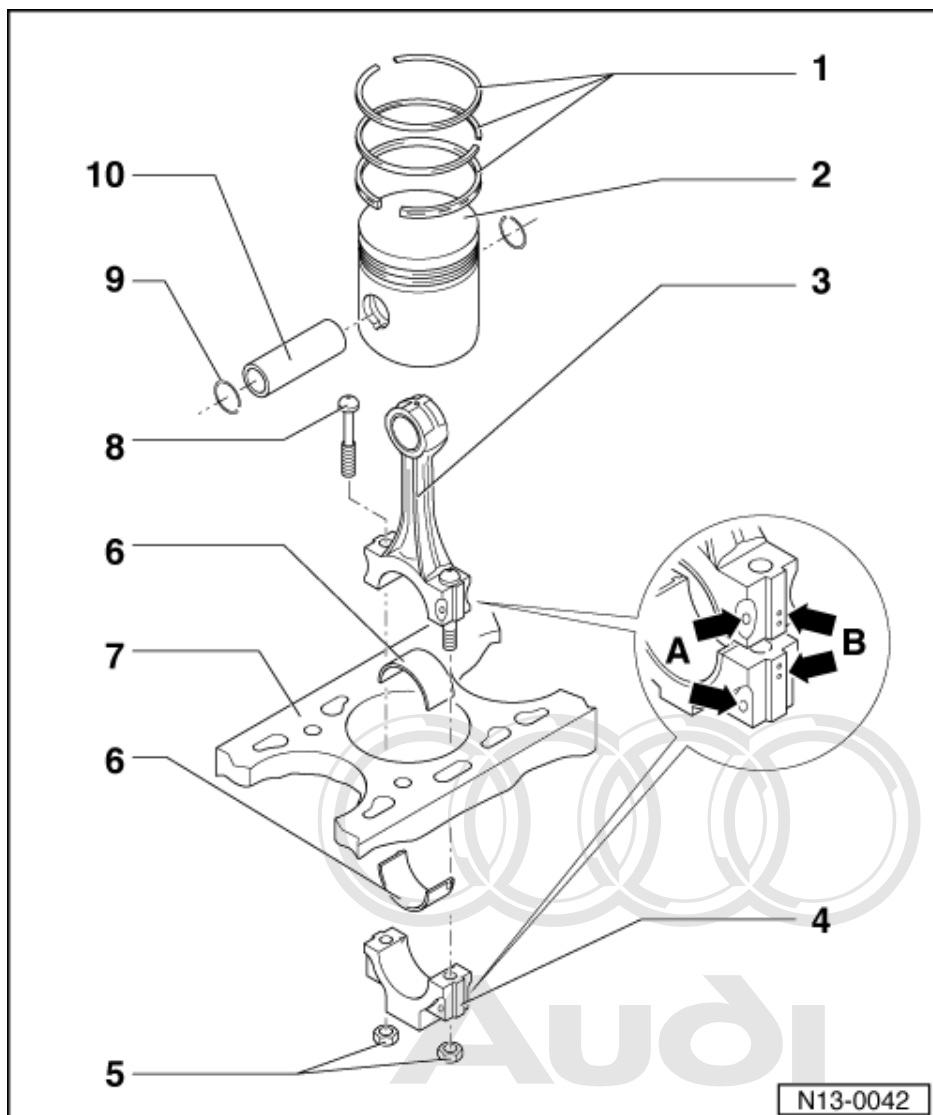
- ◆ Offset gap by 120 °
- ◆ Use piston ring pliers for removal and installation
- ◆ "TOP" mark must point towards piston crown
- ◆ Checking end clearance
=> Fig. 67
- ◆ Checking side clearance
=> Fig. 67

2 Piston

- ◆ Checking => Fig. 68
- ◆ Installation position and piston/cylinder assignment
=> Fig. 68
- ◆ Install using piston ring strap wrench
- ◆ Piston and cylinder dimensions

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=>Page 69



3 Conrod

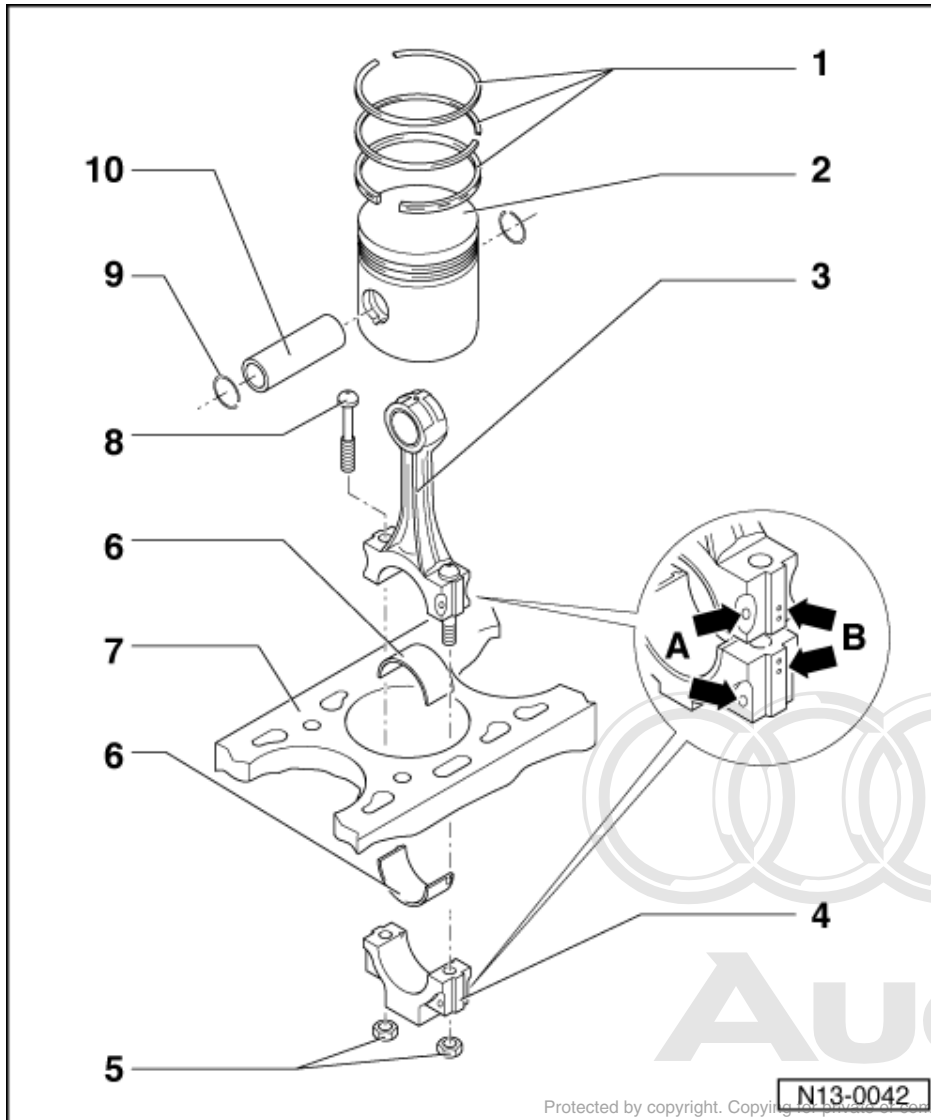
- ♦ Replace only as a set
- ♦ Mark cylinder assignment -B-
- ♦ Installation position:
Marks -A- facing pulley end

4 Conrod bearing cap

- ♦ Mark cylinder assignment -B-
- ♦ Installation position:
Marks -A- facing pulley end

5 30 Nm + further 1/4 (90°) turn

- ♦ Replace conrod bolt -Item 8 -
- ♦ Lubricate thread and resting surface
- ♦ For measuring radial clearance tighten to 30 Nm but do not give further turn



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6 Bearing shell

- ♦ Pay attention to installation position
- ♦ Do not interchange used bearing shells (mark with waterproof felt-tip pen)
- ♦ Ensure firm fit in retainer tabs
- ♦ Measuring radial clearance
=> Page 69

7 Cylinder block

- ♦ Checking cylinder bore
=> Fig. 69
- ♦ Piston and cylinder dimensions
=>Page 69

8 Conrod bolt

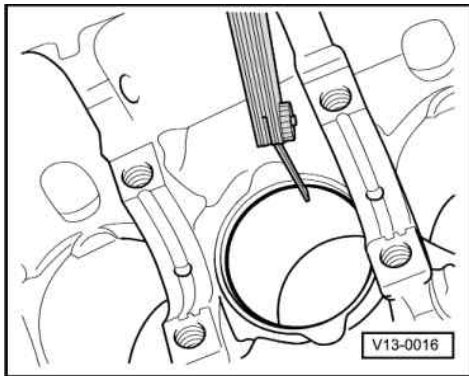
- ♦ Replace

9 Circlip

- ♦ Use circlip pliers for removing and installing
- ♦ Installation position: Opening facing upwards

10 Piston pin

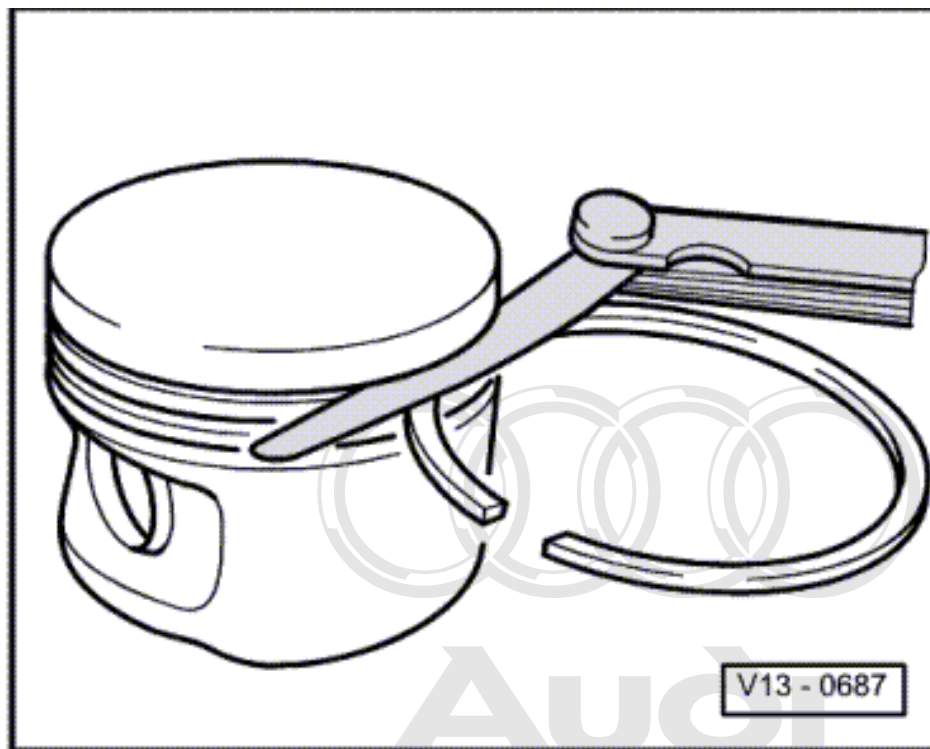
- ♦ Heat piston to approx. 60°C if pin stiff
- ♦ Use VW 222a for removing and installing



-> Fig. 1 Checking piston ring end clearance

- Insert ring at right angles from above into lower cylinder opening approx. 15 mm from edge of cylinder.

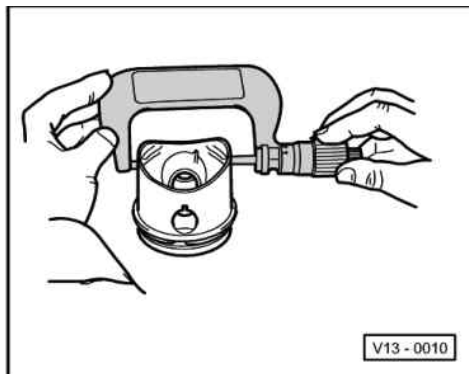
Piston ring	As-new	Wear limit
Dimensions in mm	0.15...0.35	1.0



-> Fig. 2 Checking piston ring side clearance

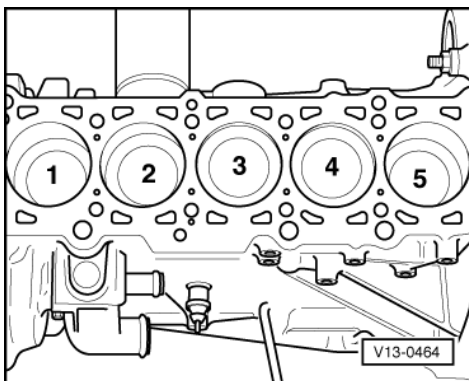
- Clean annular groove of piston before checking.

Piston ring	As-new	Wear limit
Dimensions in mm	0.04...0.072	0.1



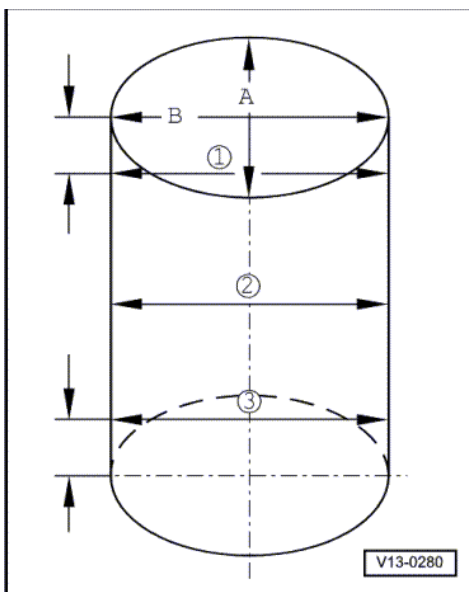
-> Fig. 3 Checking piston

- Measure approx. 10 mm from lower edge at a 90° angle to axis of piston pin.
 - Deviations from rated dimension max. 0.04 mm



-> Fig.4 Piston installation position and piston/cylinder assignment

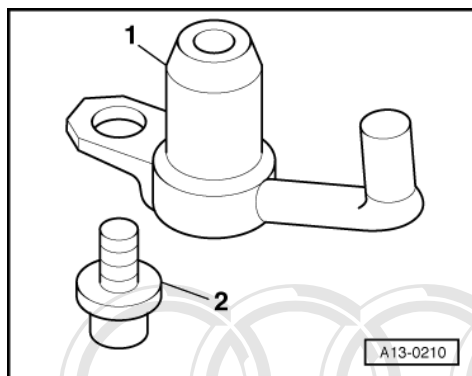
- Mark installation position and assignment on inside of pistons (not on piston crown) with an electric marker or felt-tip pen.
 - Installation position:
 - Arrow on piston crown faces pulley end
- Mark piston assignment to cylinders -1 ... 5-.



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-> Fig. 5 Checking cylinder bore

- Use 50...100 mm internal dial gauge to take measurements at 3 locations diagonally in transverse -A- and longitudinal -B- direction.
 - Deviations from rated dimension
max. 0.08 mm



-> Fig.6 Oil spray jet with pressure relief valve

- 1 - Oil spray jet with pressure relief valve
- 2 - Bolt - 10 Nm
- Apply locking fluid when fitting
- Locking fluid

=> Parts List

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3.2 - Piston and cylinder dimensions

(dimensions in mm)

Grinding dimension	Piston- $\varnothing$	Cylinder bore $\varnothing$
Basic dimension	80.98	81.01
Stage I	81.23	81.26
Stage II	81.48	81.51

3.3 - Checking conrod radial clearance

Notes:

- ♦ Do not interchange used bearings.
- ♦ Do not turn crankshaft when measuring radial clearance.

Items required

- ♦ Plastigage

Test sequence

- Remove conrod bearing cap. Clean bearing cap and bearing journal.
- Position Plastigage thread of bearing width accordingly on journal/in bearing shells.
- Fit conrod bearing cap and tighten to 30 Nm. Do not turn crankshaft.
- Remove conrod bearing cap again.



- Compare width of Plastigage thread to measurement scale.

As-new clearance	Wear limit
0.010 ... 0.050 mm	0.12 mm



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15 - Cylinder head, Valve gear

1 - Removing and installing cylinder head

1.1 - Removing and installing cylinder head

Notes:

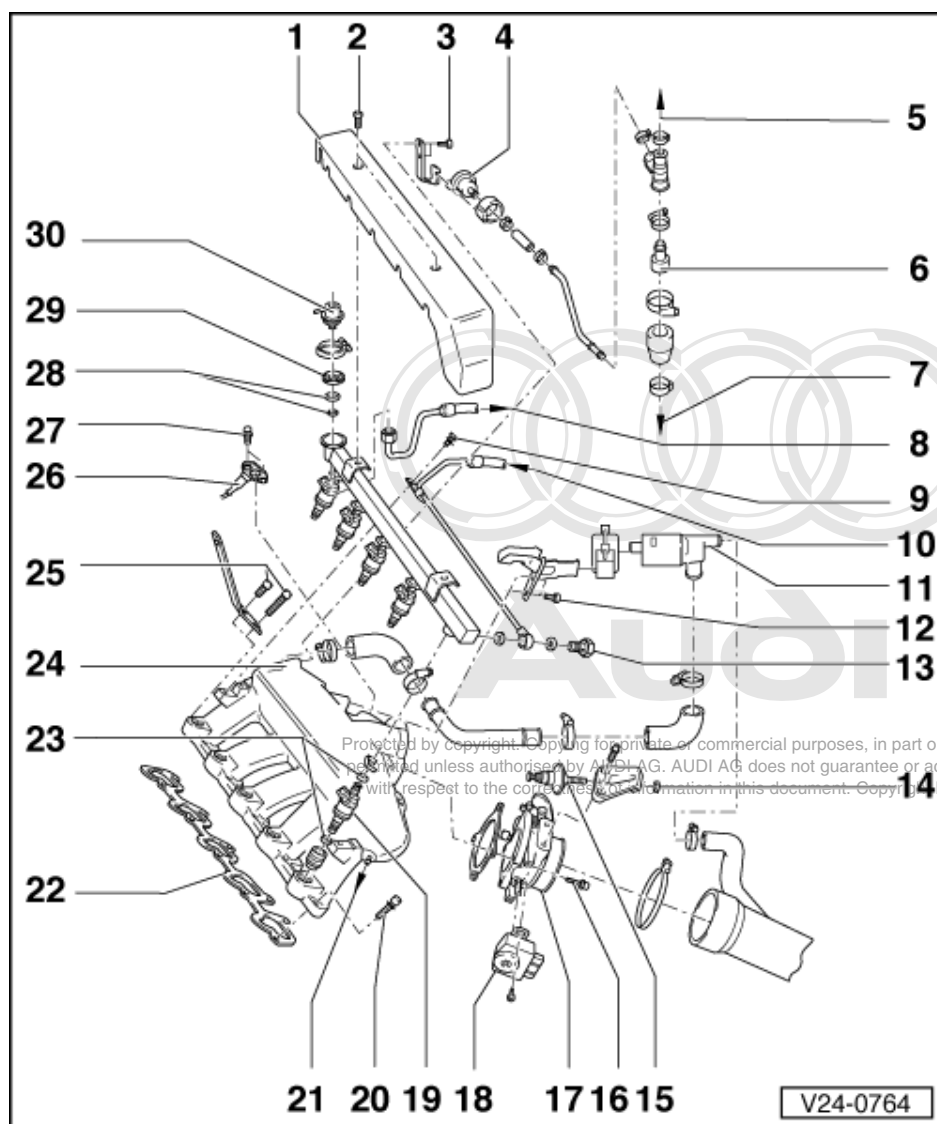
- ◆ Replace cylinder head bolts.
- ◆ On assembly, replace self-locking nuts, bolts tightened to torque, oil seals and gaskets.
- ◆ On installing reconditioned cylinder head with camshafts fitted, contact surfaces between bucket tappet and cam surface must be lubricated after fitting head.
- ◆ The plastic pads supplied for protection of the open valves are not to be removed until immediately prior to fitting cylinder head.
- ◆ The entire coolant is to be renewed on replacing cylinder head or cylinder head gasket.
- ◆ Cylinder heads with cracks between valve seats or between one valve seat ring and spark plug thread can be re-used without shortening service life if cracks are only minor (max. 0.3 mm wide) or if only the first 4 turns of the spark plug thread are cracked.



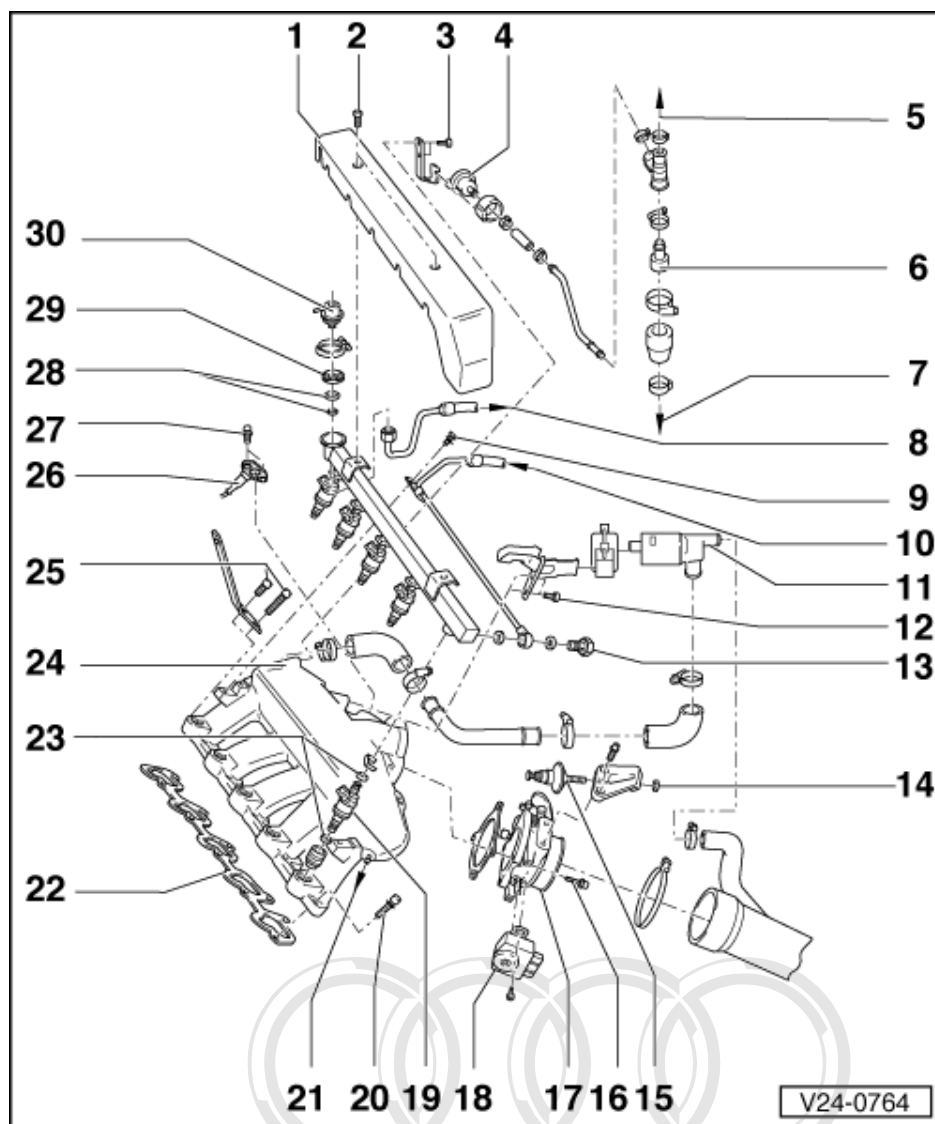
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1.2 - Exploded view of intake manifold



- 1 Cover
 - ♦ For injectors
- 2 10 Nm
- 3 10 Nm
- 4 Activated charcoal filter system solenoid valve 1 -N80
- 5 To intake manifold
- 6 Non-return valve
- 7 To crankcase breather
- 8 Fuel return pipe
 - ♦ Tighten to 25 Nm
- 9 10 Nm
- 10 Fuel supply pipe
 - ♦ Tighten to 25 Nm



11 Idling-speed stabilisation valve -N71

12 10 Nm

13 Banjo bolt, 25 Nm

14 10 Nm

15 Throttle damper

16 10 Nm

17 Throttle valve unit

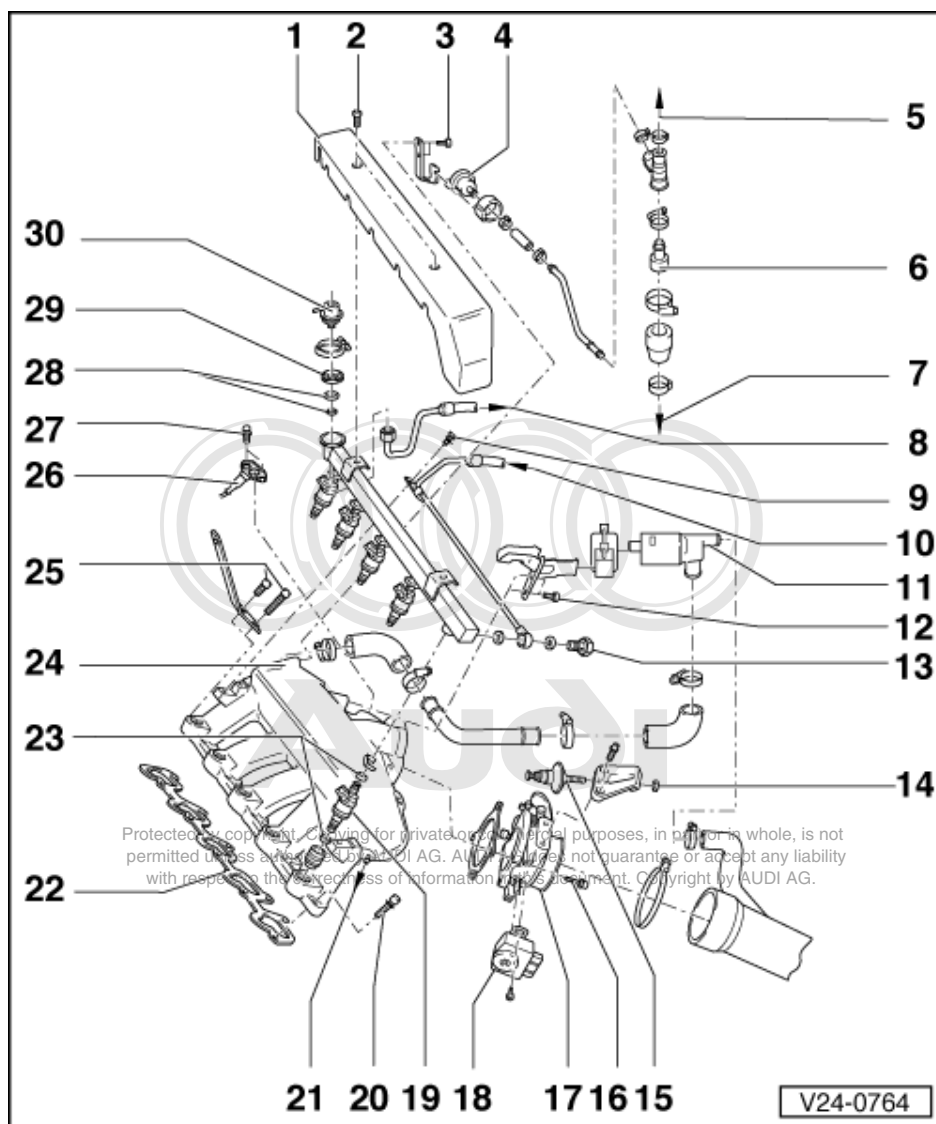
18 Throttle valve potentiometer -G69

♦ With idling switch -F60

19 Injector

20 25 Nm

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21 Vacuum connection

- ♦ For overrun shutoff valve

22 Gasket

- ♦ Replace

23 O-ring

- ♦ Replace

24 Intake manifold

25 25 Nm

26 Intake air temperature sender -G42

27 10 Nm

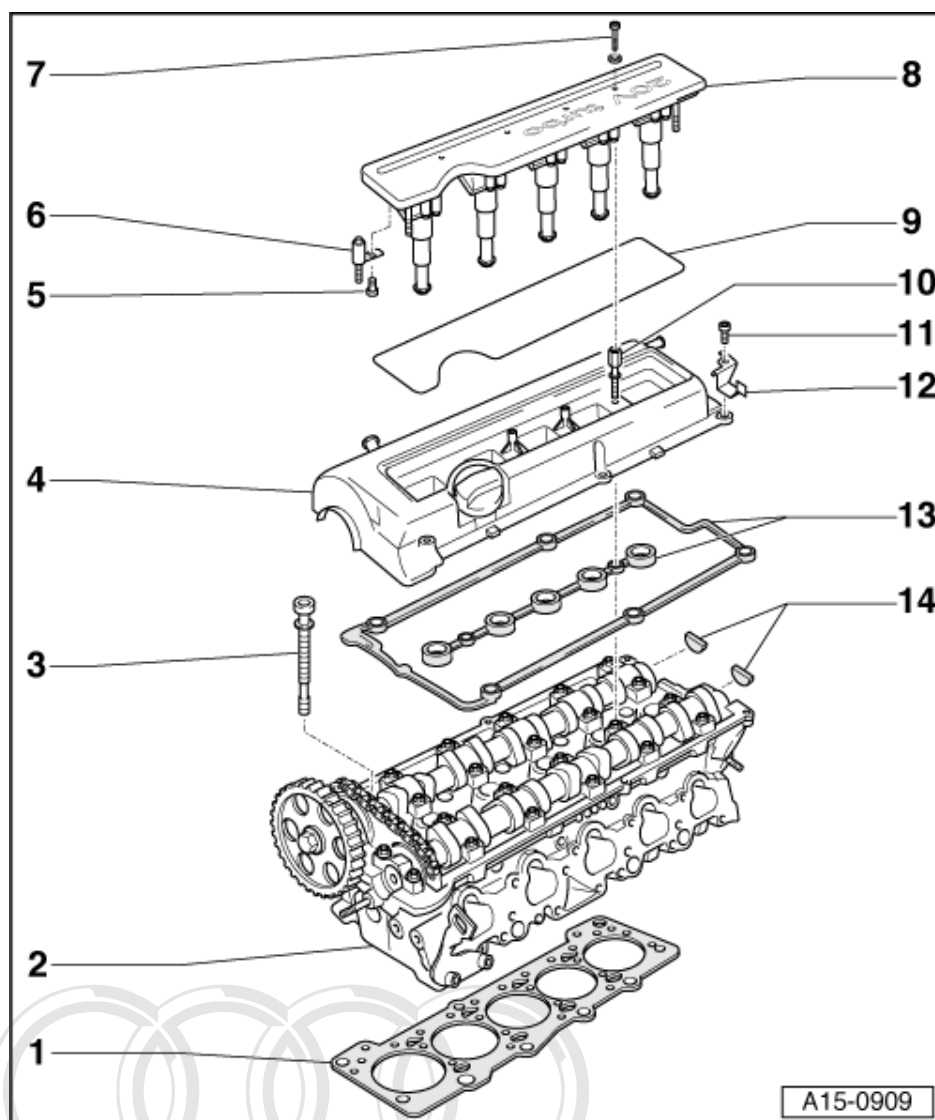
28 O-ring

- ♦ Replace

29 Strainer

30 Fuel pressure regulator

1.3 - Exploded view of cylinder head



1 Cylinder head gasket

- ◆ Replacing => Removing cylinder head, Page 81
- ◆ Installation position: "Top" mark or part number must face cylinder head
- ◆ Use fresh coolant after replacement

2 Cylinder head

- ◆ Removing => Page 81
- ◆ Checking for torsion
=> Fig. 78
- ◆ Reworking dimension
=> Fig. 78

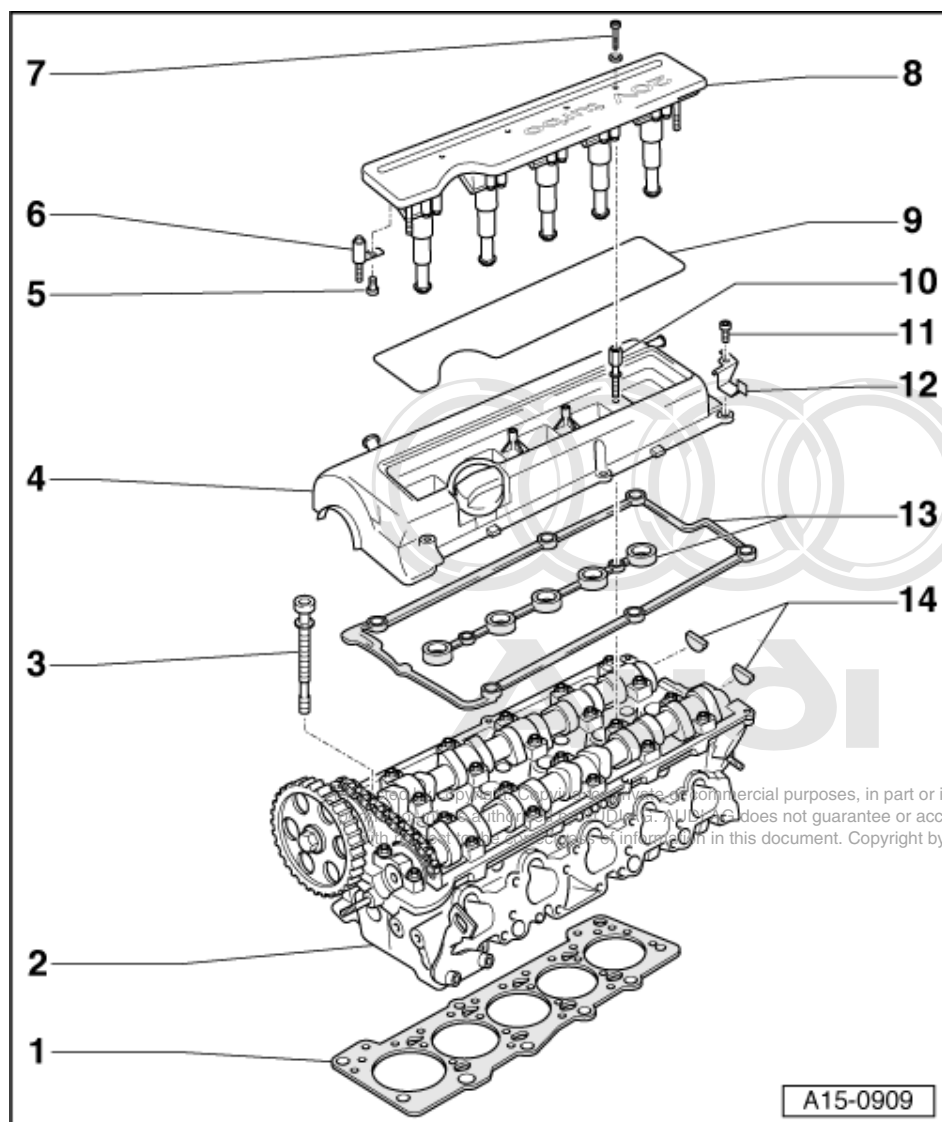
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- ◆ Installing => Page 87

- ◆ Use fresh coolant after replacement

3 Cylinder head bolt

- ◆ Replace
- ◆ Head slackening off sequence
=> Page 87
- ◆ Head tightening sequence
=> Page 88



4 Cylinder head cover

- ♦ Removing and installing
=> Page **79**

5 10 Nm

6 Spring

- ♦ With holder

7 10 Nm

8 Cover

- ♦ With ignition coils

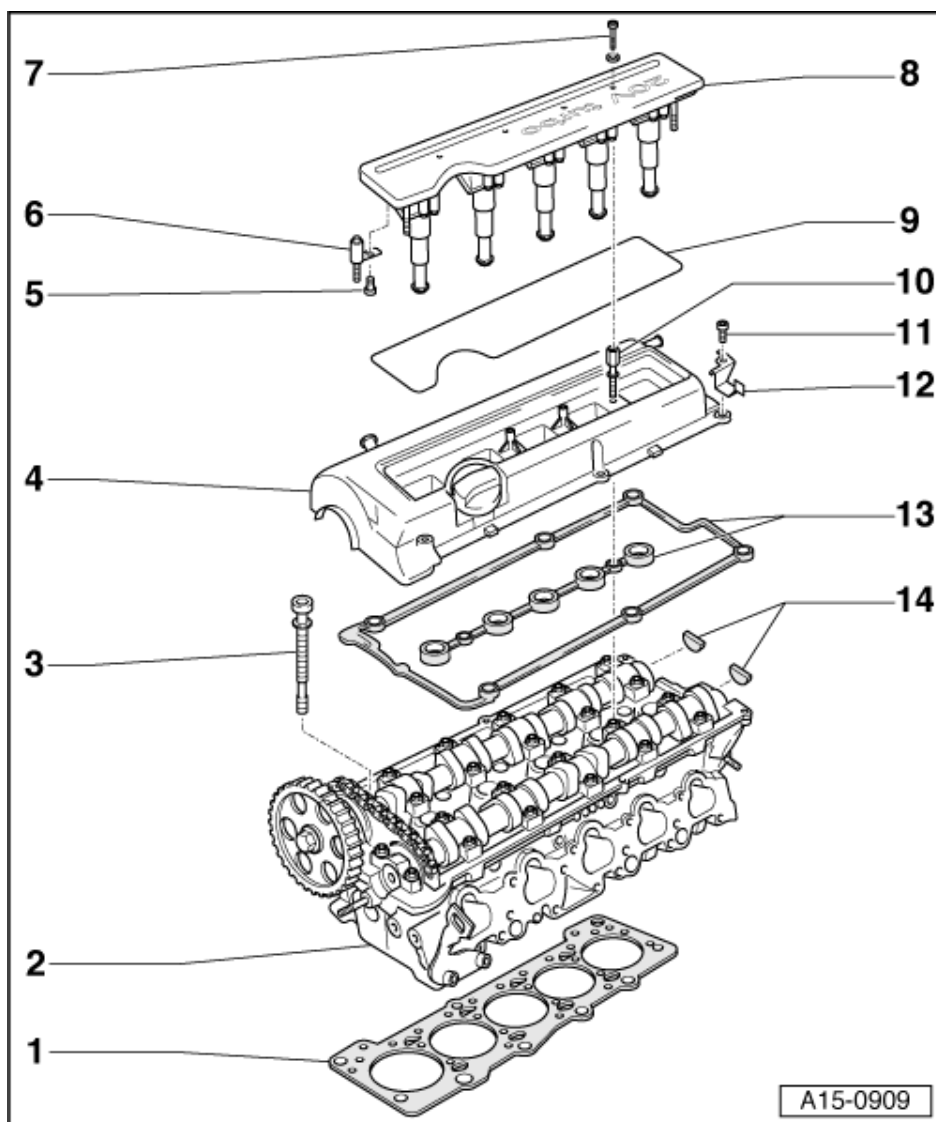
9 Gasket

- ♦ Replace if damaged
- ♦ Insert in groove in cover

10 10 Nm

11 10 Nm

- ♦ Tighten diagonally

**12 Holder**

- ♦ For vacuum hoses

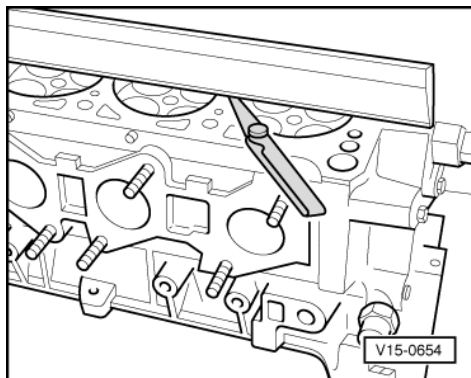
13 Gasket for cylinder head cover

- ♦ Replace if damaged or leaking
- ♦ Removing and installing
=> Page 79
- ♦ Before fitting, seal transitions
=> Fig. 78
- ♦ Insert in groove at cylinder head cover

14 Half-round gaskets

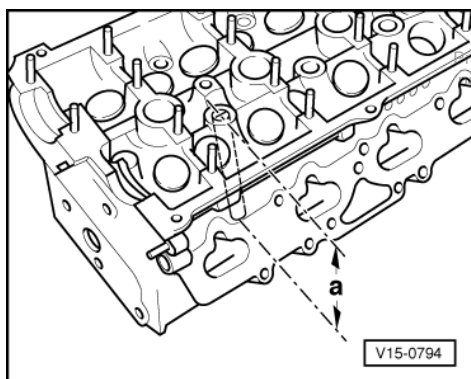
- ♦ Replace if damaged or leaking

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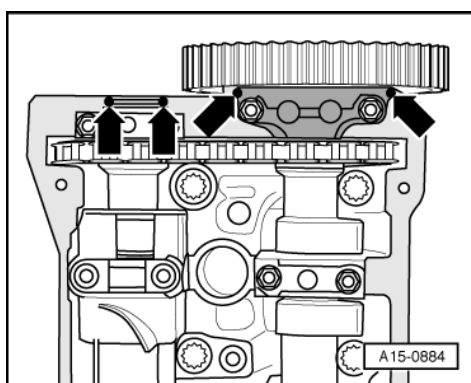
-> Fig. 1 Checking cylinder head for torsion

- Check cylinder head for torsion at several locations using bevelled straightedge and feeler gauge.
 - Max. perm. torsion: 0.1 mm



-> Fig.2 Reworking dimension for cylinder head

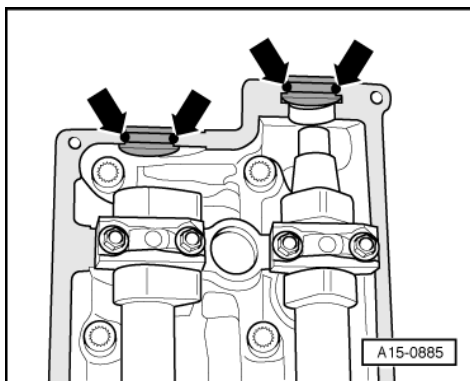
- Cylinder head is only to be reworked (face-ground) down to minimum dimension -a- (measured through bolt hole).
 - Minimum dimension: $a = 118.1 \text{ mm}$



-> Fig.3 Sealing bearing cap/cylinder head transitions

- Apply small quantity of sealing compound to transitions -arrows- at upper sealing surface of cylinder head.
 - Sealing compound

=> Parts List

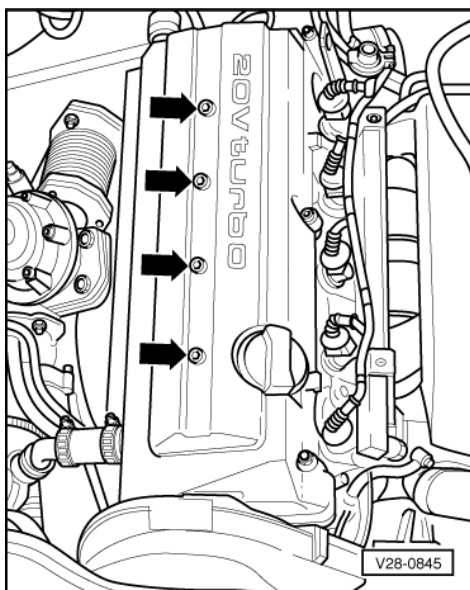


→ Fig. 4 Sealing transitions

- Apply small quantity of sealing compound to transitions to half-round gaskets -arrows- at upper sealing surface of cylinder head.
- Sealing compound

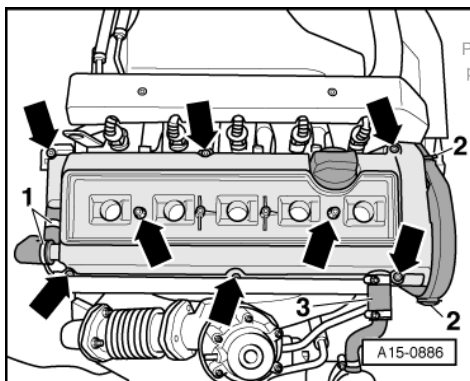
=> Parts List

1.4 - Removing and installing cylinder head cover



Removing

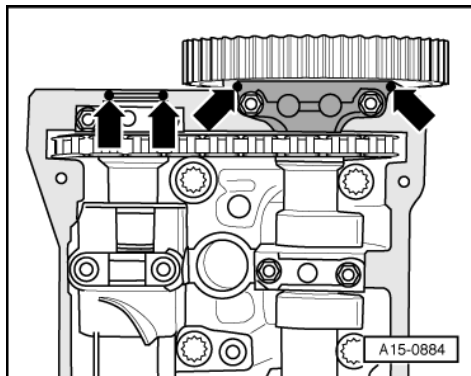
- -> Unscrew ignition coil holder -arrows- and lift off evenly.



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- -> Detach crankcase breather hoses -1- and -3- at cylinder head cover.
- Unfasten clips -2- for upper toothed belt guard. Upper toothed belt guard does not have to be removed.
- Screw out bolts -arrows- and detach cylinder head cover.



Installing

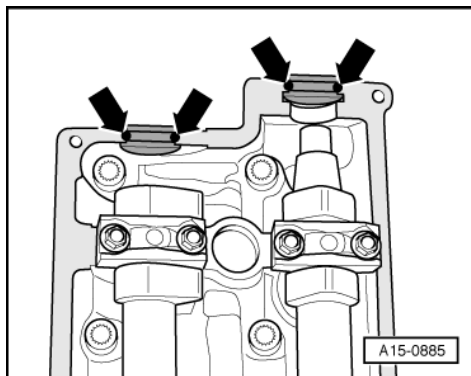
Install in reverse order, paying attention to the following:

Note:

Replace gaskets.

- -> Apply small quantity of sealing compound to transitions -arrows- at upper sealing surface of cylinder head
- Sealing compound

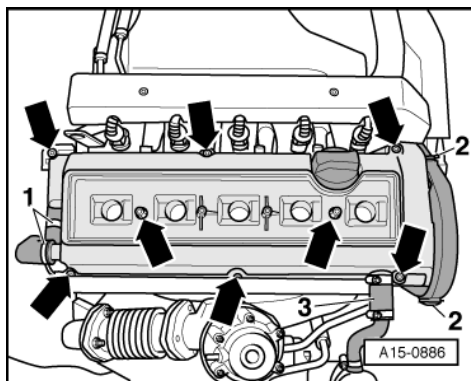
=> Parts List



- -> Apply small quantity of sealing compound to transitions to half-round gaskets -arrows- at upper sealing surface of cylinder head.
- Sealing compound

=> Parts List

- Fit gaskets and cylinder head cover.



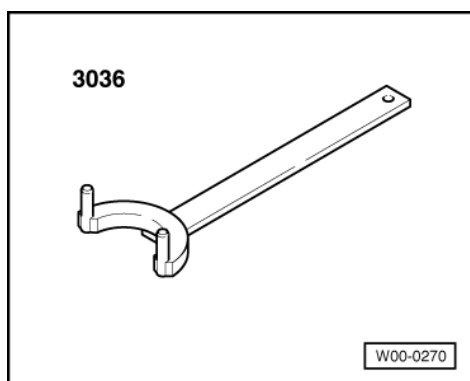
- -> Tighten bolts -arrows- for cylinder head cover diagonally and in stages.
- Fit ignition coil holder. Replace gasket if damaged.

Tightening torques

Component	Nm
Cylinder head cover to cylinder head	101)
Ignition coil holder to cylinder head cover	10
Hose clamps	2

- 1) Tighten diagonally

1.5 - Removing cylinder head



Special tools and workshop equipment required

- ♦ Counterhold 3036

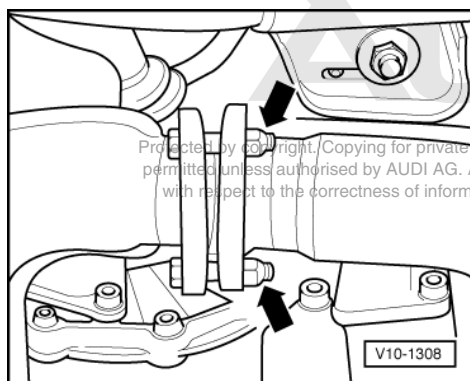
Sequence of operations

Notes:

- ♦ Secure all hose connections with standard hose clamps.

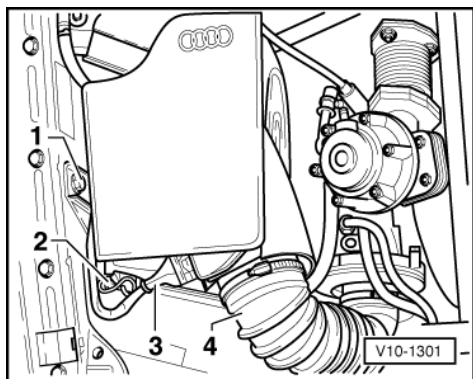
=> Parts List

- ♦ All cable ties unfastened or cut open on removal are to be re-attached in same position on installation.
- Heed (if necessary obtain) radio code for vehicles with encoded radio.
- Disconnect battery earth strap with ignition switched off.
- Drain coolant=> Page 140 .

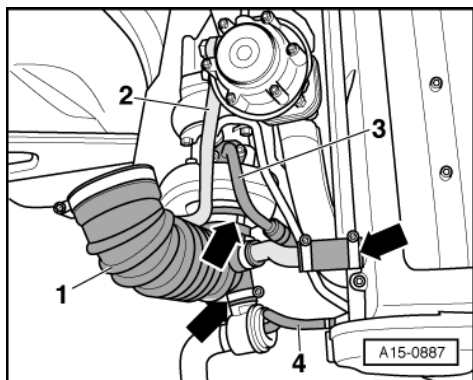




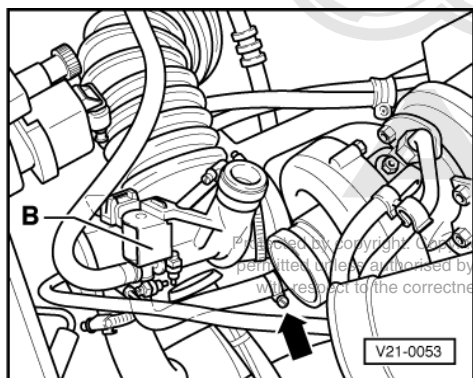
- -> Unscrew front exhaust pipe from catalytic converter on left and right -arrows-.



- -> Detach air hose -4- at air-mass meter.
- Unplug connector -3- at air-mass meter.
- Unfasten clamps -2- all round air cleaner housing.
- Detach top section of air cleaner housing with filter element.
- Screw out bolt -1-.
- Detach wiring harness at air cleaner housing.
- Take out bottom part of air cleaner housing.

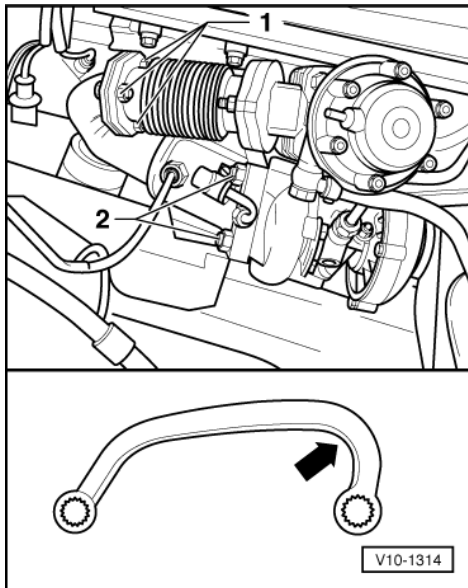


- -> Detach control pipe -2- from mechanical charge pressure control valve.
- Remove air hose -1- -arrows-.
- Unscrew oil supply pipe -3- from turbocharger.
- Disconnect vacuum hose -4- for overrun shutoff valve.



- -> Detach hose -arrow- to charge pressure control solenoid valve at turbocharger.

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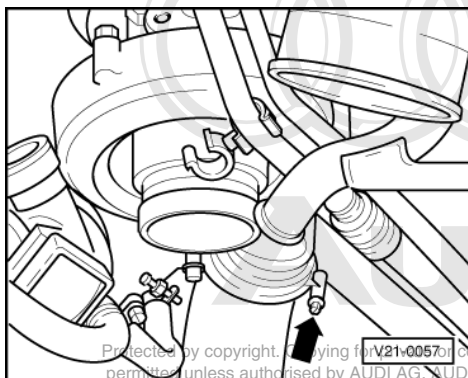
- -> Unfasten three bolted joints -1- at corrugated pipe.
- Unscrew 4 nuts -2- at turbocharger/front exhaust pipe flange.

Notes:

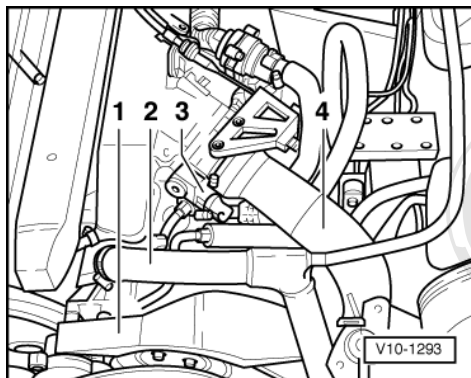
- ◆ A flat 15 mm ring spanner must be bent to appropriate shape -bottom arrow in Fig.- for unfastening lower rear nut at turbocharger/front exhaust pipe flange.
- ◆ Other nuts at turbocharger/front exhaust pipe flange are of size 17 mm.
- Press exhaust system to rear until studs at turbocharger are free.

Note:

Pay attention to Lambda probe wire.

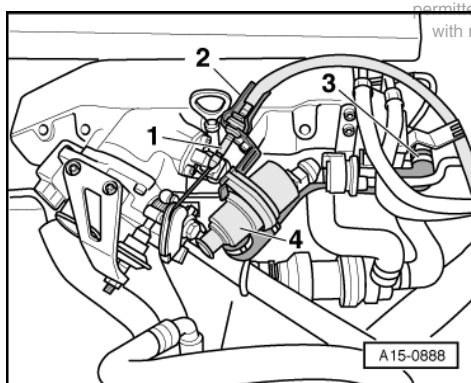


- -> Remove air hose from charge air cooler to turbocharger -arrow-.
- Place drip tray in position.
- Unscrew oil return pipe at bottom of turbocharger.
- Unscrew coolant return pipe at turbocharger.

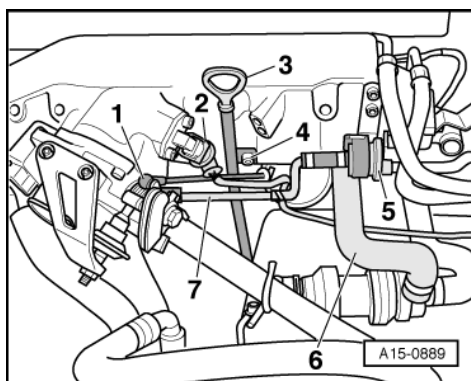


- -> Detach coolant hose -2- at coolant collecting pipe and radiator. Lay coolant hose aside.
- Remove ribbed belt cover -1-.
- Remove air hose -4-.
- Unplug connector -3- at throttle valve potentiometer -G69.

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- Remove fasteners for throttle cable.
- -> Disengage throttle cable -1- at throttle valve assembly and support bracket -2- (do not remove throttle cable retainer). Lay throttle cable aside.
- Detach hose -3- for idling-speed stabilisation valve at intake manifold.
- Disengage idling-speed stabilisation valve -4- at holder.
- Unscrew support bracket -2-.



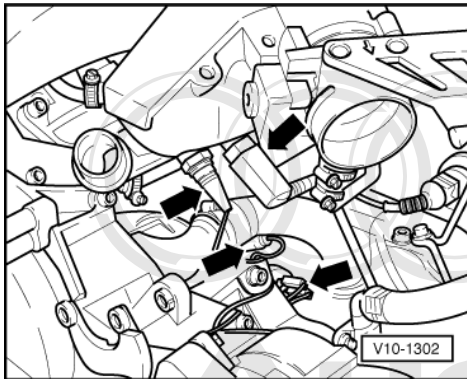
Vehicles with cruise control system:

- -> Remove securing spring of ball socket and disengage operating rod -1- at throttle valve lever.

All models:

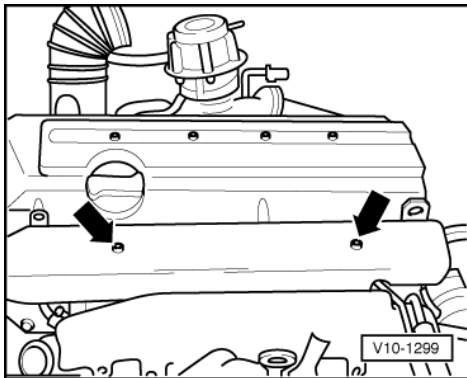
- Pull out dipstick -3-.
- Unplug connector at intake air temperature sender -G42 -Item 2-.
- Screw out bolt -4- for dipstick guide tube.
- Detach hose -7- at bottom of intake manifold.
- Disengage solenoid valve -5- for activated charcoal filter at holder.

- Remove coolant hose -6- at coolant collecting pipe.

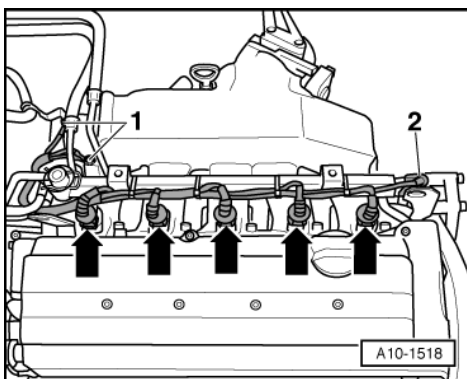


- -> Unplug the following connectors -arrows- at coolant collecting pipe.
 - Electronic thermal switch -F76 (4-pole)
 - Thermal switch -F98 (2-pole)

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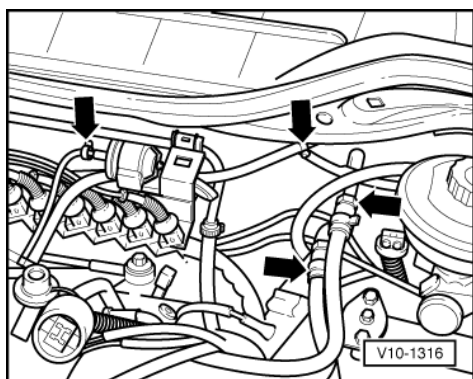
- -> Unscrew cover for injectors -arrows-.



- -> Unplug connectors at all injectors -arrows-.
- Unplug connector -2- at Hall sender -G40.
- Unfasten cable ties and lay bare wires.
- Unscrew earth wires -1-.

Note:

Fig. shows vehicle as of Model Year 1992.



Attention:

F

- -> Detach vacuum hoses and disconnect fuel supply and return pipe at joint -arrows-.
- Unplug connector at coolant temperature sender -G62 on back of cylinder head.
- Detach toothed belt from camshaft sprocket
=> Page 45 .

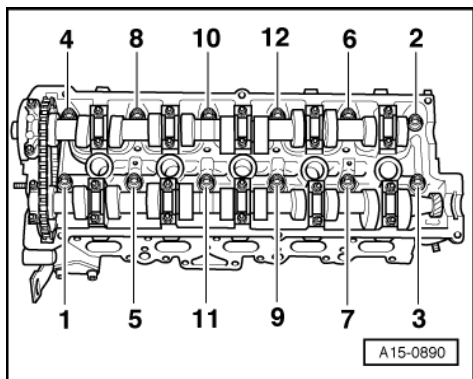


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As of Model Year 1992 Hall sender is located beneath camshaft sprocket. To avoid damaging Hall sender, carefully unfasten camshaft sprocket from camshaft and detach.

- -> Slacken off bolt of camshaft sprocket whilst providing support with 3036.
- Remove Woodruff key from camshaft.
- Unscrew rear toothed belt guard.

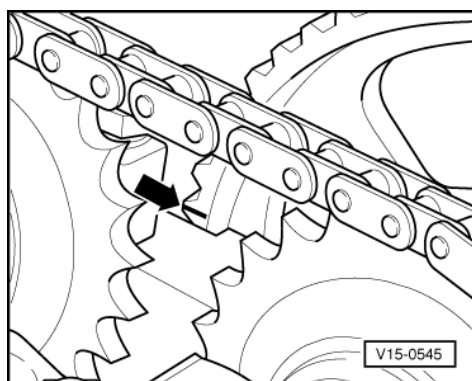


- Remove cylinder head cover => Page 79.
- -> Slacken off cylinder head bolts in sequence 1 ... 12.
- Detach cylinder head.

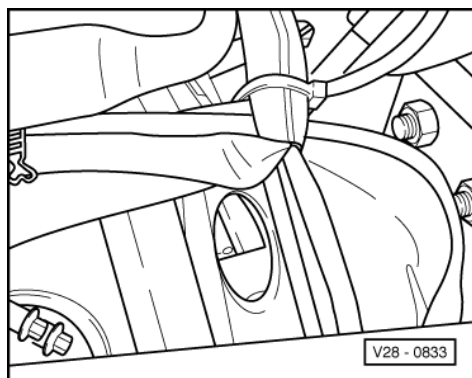
1.6 - Installing cylinder head

Notes:

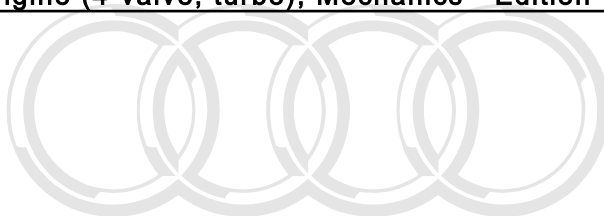
- ◆ Replace cylinder head bolts.
- ◆ On assembly, replace self-locking nuts, bolts tightened to torque, oil seals and gaskets.
- ◆ When performing repair work, carefully remove remnants of gasket from cylinder head and cylinder block. Take care to avoid scoring or scratches.
- ◆ Carefully remove abrasive and grinding residue.
- ◆ Do not remove new cylinder head gasket from wrapping until immediately prior to installation.
- ◆ Gasket is to be handled with extreme care. Damage to silicone coat and in bead area will lead to leakage.
- ◆ There must not be any oil or coolant in blind holes for cylinder head bolts in cylinder block.



- -> Before fitting cylinder head, set crankshaft and camshafts to no. 1 cylinder TDC: Align mark -arrow- at camshaft sprocket with top edge of cylinder head ...



- -> ... at the same time, TDC mark must be at reference edge.
- Fit cylinder head gasket.
 - Pay attention to centring pins in cylinder block.
 - Pay attention to installation position of cylinder head gasket; "top" mark/part number must face cylinder head.
- Fit cylinder head.
- Insert and hand-tighten cylinder head bolts.



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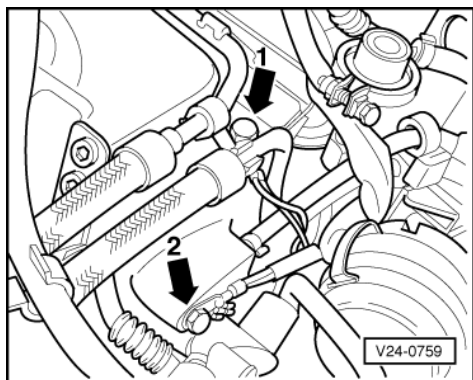
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- ➔ Tighten cylinder head as follows in four stages in sequence shown:
 - 1st stage: 40 Nm
 - 2nd stage: 60 Nm
- Use fixed wrench to tighten:
 - 3rd stage: 90°(1/4) further turn
 - 4th stage: 90°(1/4) further turn

Note:

Re-tightening of cylinder head bolts is not necessary on completion of repair work.

- Install cylinder head cover => Page 79 .



- ➔ Screw on earth wires at intake manifold.
 - -Arrow 1- (brown/white wires)
 - -Arrow 2- (brown/red wires)
- Fit toothed belt (adjust valve timing) => Page 43 .

Note:

Heed all instructions for removing and installing toothed belt

=> Page 39 .

- Check throttle cable adjustment.

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

- Replace coolant => Page 143 .

Note:

On re-connecting battery, remember to activate vehicle equipment (radio, clock, electric window lifters) in line with owner's manual.

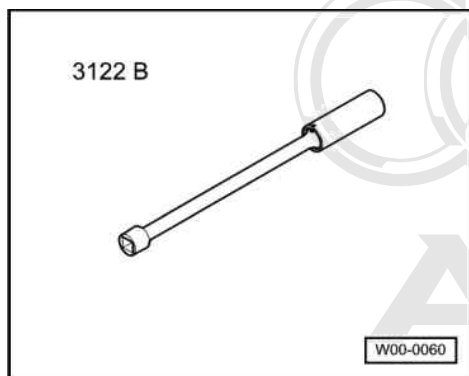
Tightening torques

Component	Nm
Front exhaust pipe to turbocharger	30
Front exhaust pipe to corrugated pipe	25
Front exhaust pipe to catalytic converters	25
Camshaft sprocket to camshaft	65
Rear toothed belt guard to cylinder head	101)
Dipstick guide tube to intake manifold	10
Support bracket for throttle cable to intake manifold	10
Cover for injectors	10
Coolant return pipe to turbocharger	25
Oil return pipe to turbocharger	10
Oil supply pipe to turbocharger	10
Fuel supply and return pipe	25
Clamps for coolant hoses	2
Clamps for air hoses	3.5

- 1) Apply locking fluid when fitting
Locking fluid

=> Parts List

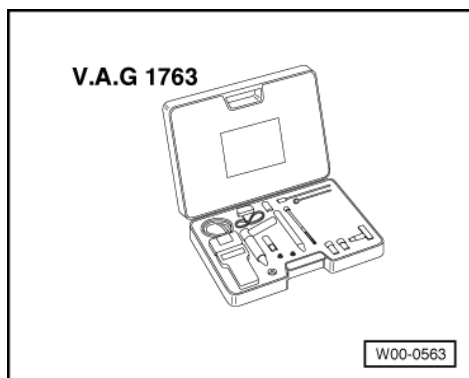
1.7 - Checking compression



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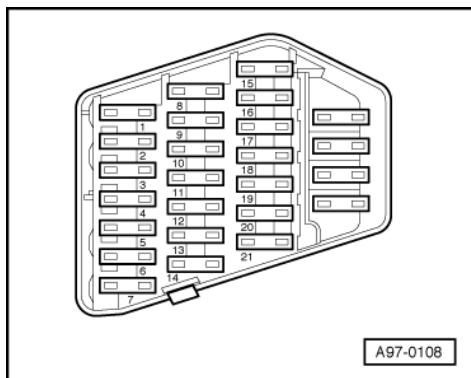
Special tools and workshop equipment required

- ◆ Spark plug wrench 3122 B





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

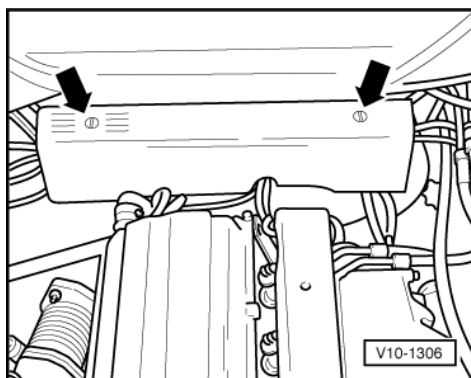


Test condition

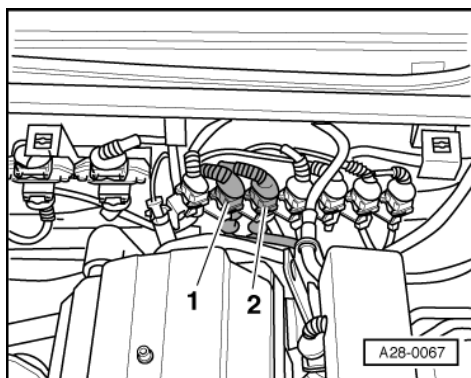
- Engine oil temperature at least 30 °C
- Battery voltage at least 12.7 V

Test sequence

- Open lid of fuse box at left side of instrument panel.
- -> Pull out fuse S17.



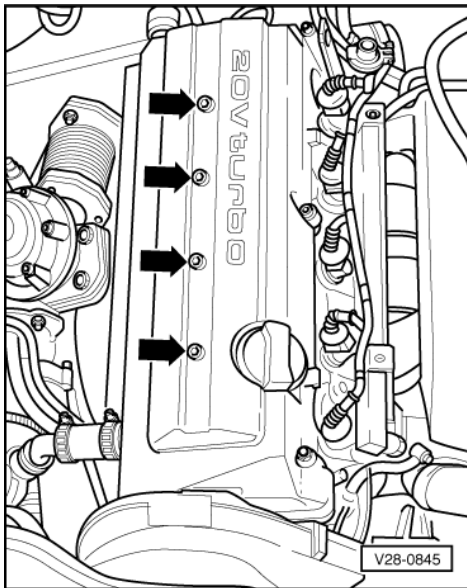
- -> Remove cover for connectors in engine compartment -arrows-.



- -> Unplug connectors -1- and -2- (white) to ignition coils.



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- -> Unscrew ignition coil holder -arrows- and lift off evenly.
- Use spark plug wrench 3122B to screw out spark plugs.
- Fully open throttle valve.
- Use compression tester V.A.G 1381 or V.A.G 1763 to check compression pressure.

Note:

How to use tester:

=> Operating instructions

- Operate starter until no further increase in pressure is indicated by tester.

Compression values:

As-new bar	Wear limit bar	Difference between cylinders bar
9.0 ... 13.0	7.0	max. 3.0

- Fit spark plugs.
- Re-insert fuse S17.

Note:

Unplugging connectors causes faults to be stored. Interrogate and if necessary erase fault memory after measurement.

=> Motronic Injection and Ignition System (5-cyl.); Repair Group 01; Interrogating and erasing fault memory
Interrogating and erasing fault memory

Tightening torques

Component	Nm
Spark plugs in cylinder head	30
Ignition coil holder to cylinder head cover	10

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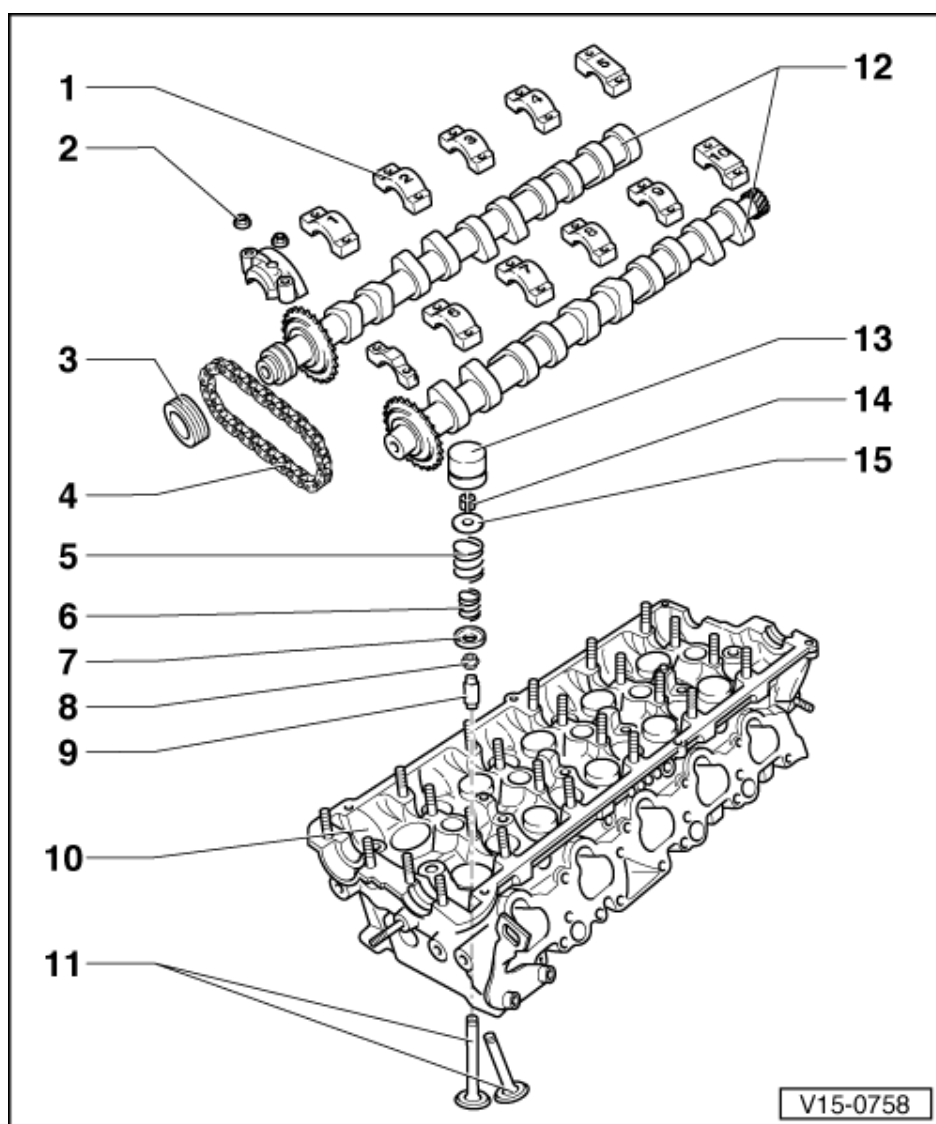


2 - Servicing valve gear

2.1 - Servicing valve gear

Notes:

- ♦ Cylinder heads with cracks between valve seats or between one valve seat ring and spark plug thread can be re-used without shortening service life if cracks are only minor (max. 0.3 mm wide) or if only the first 4 turns of the spark plug thread are cracked.
- ♦ Engine is not to be started for approx. 30 minutes after installing camshafts, so as to allow hydraulic valve lifters to settle (valves would otherwise strike piston).
- ♦ After working on valve gear, carefully crank engine through at least 2 revolutions to ensure that no valves make contact on starting.
- ♦ Always replace gaskets and oil seals.



1 Bearing cap

- ♦ Installation position
=> Fig. 96
- ♦ Installation sequence
=> Page 100, removing and installing camshaft

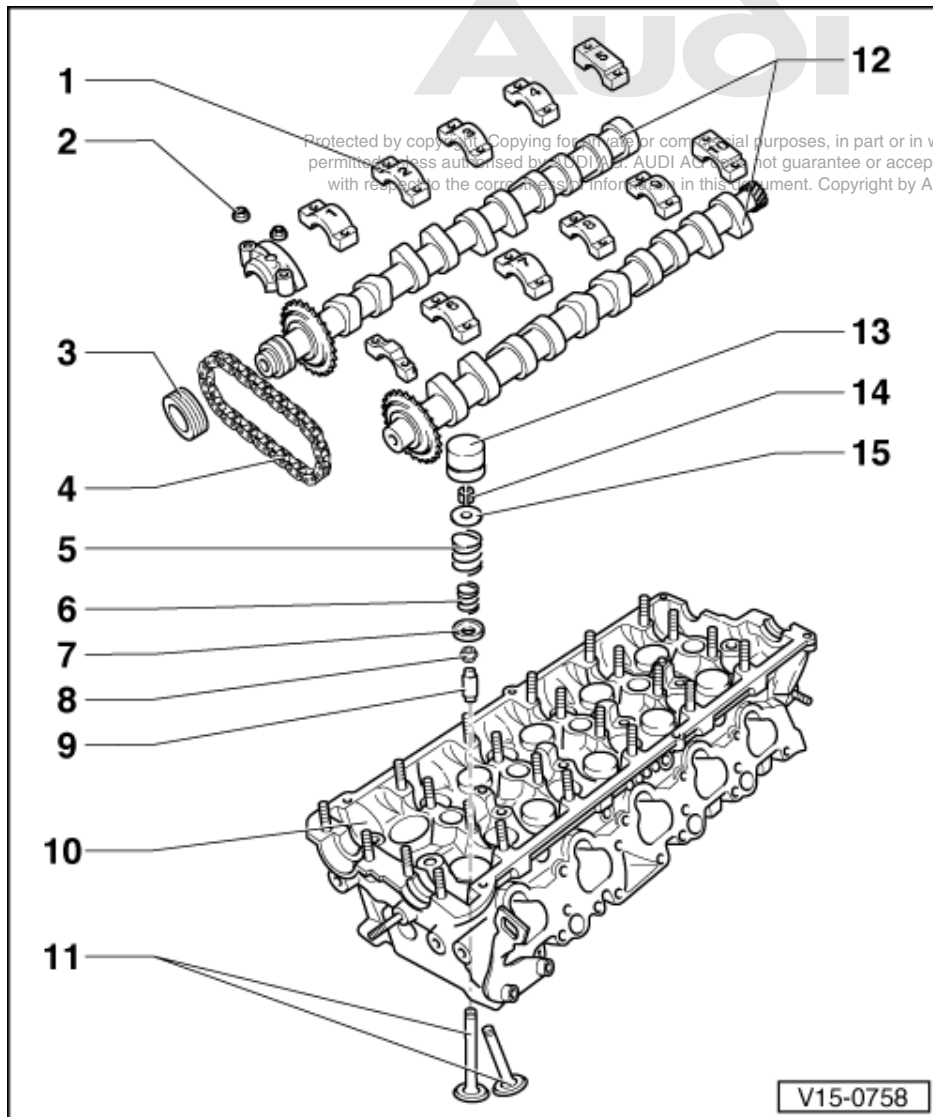
2 15 Nm

3 Oil seal

- ♦ Replacing => Page 98

4 Drive chain

- ♦ Check for wear
- ♦ Mark installation position prior to removal=> Page 101
- ♦ Removing and installing => Removing and installing camshafts, Page 100

**5 Outer valve spring**

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

6 Inner valve spring

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

7 Lower valve spring plate

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

8 Valve stem seal

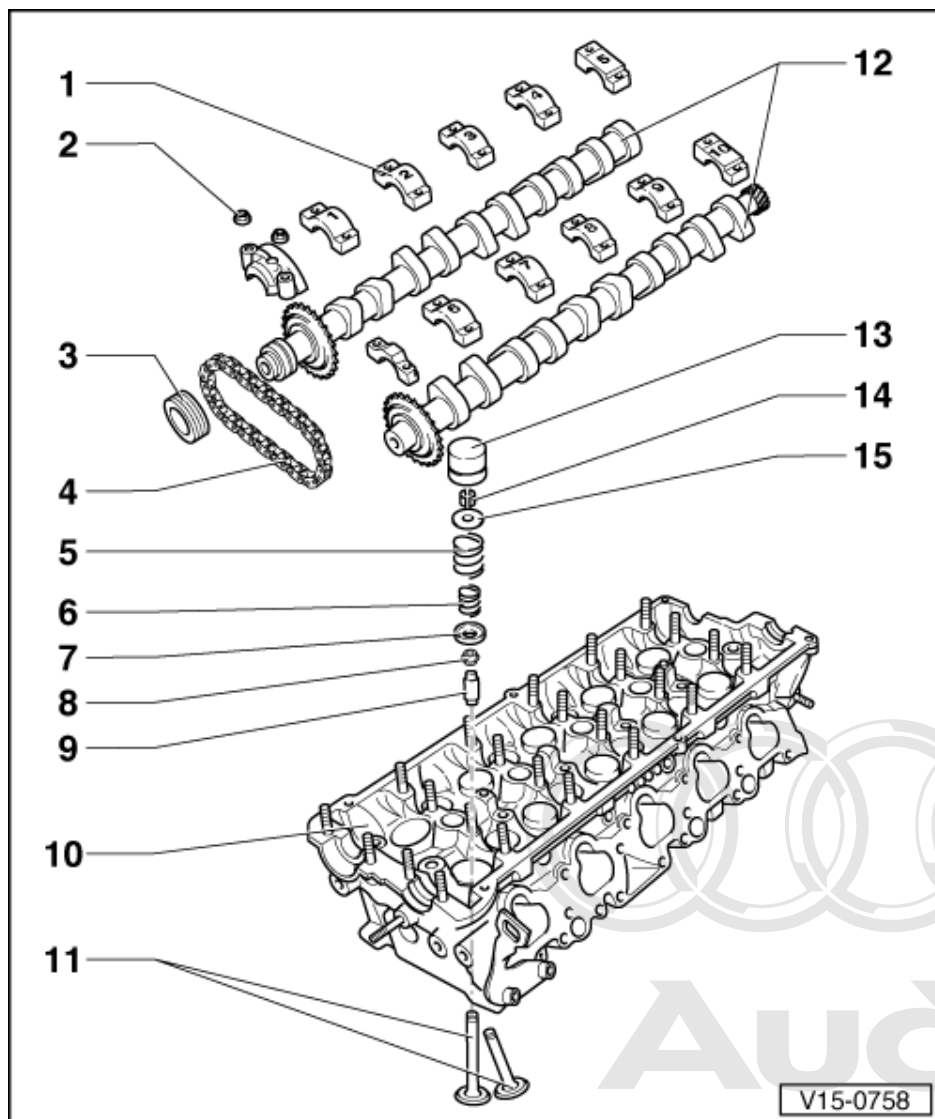
- ♦ Replacing => Page 105

9 Valve guide

- ♦ Checking => Page 108



♦ Replacing => Page 110



10 Cylinder head

- ♦ Heed notes
=> Page 92
- ♦ Removing => Page 81
- ♦ Installing => Page 87
- ♦ Checking for torsion
=> Fig. 78
- ♦ Checking valve guides
=> Page 108
- ♦ Reworking valve seats
=> Page 112

11 Valves

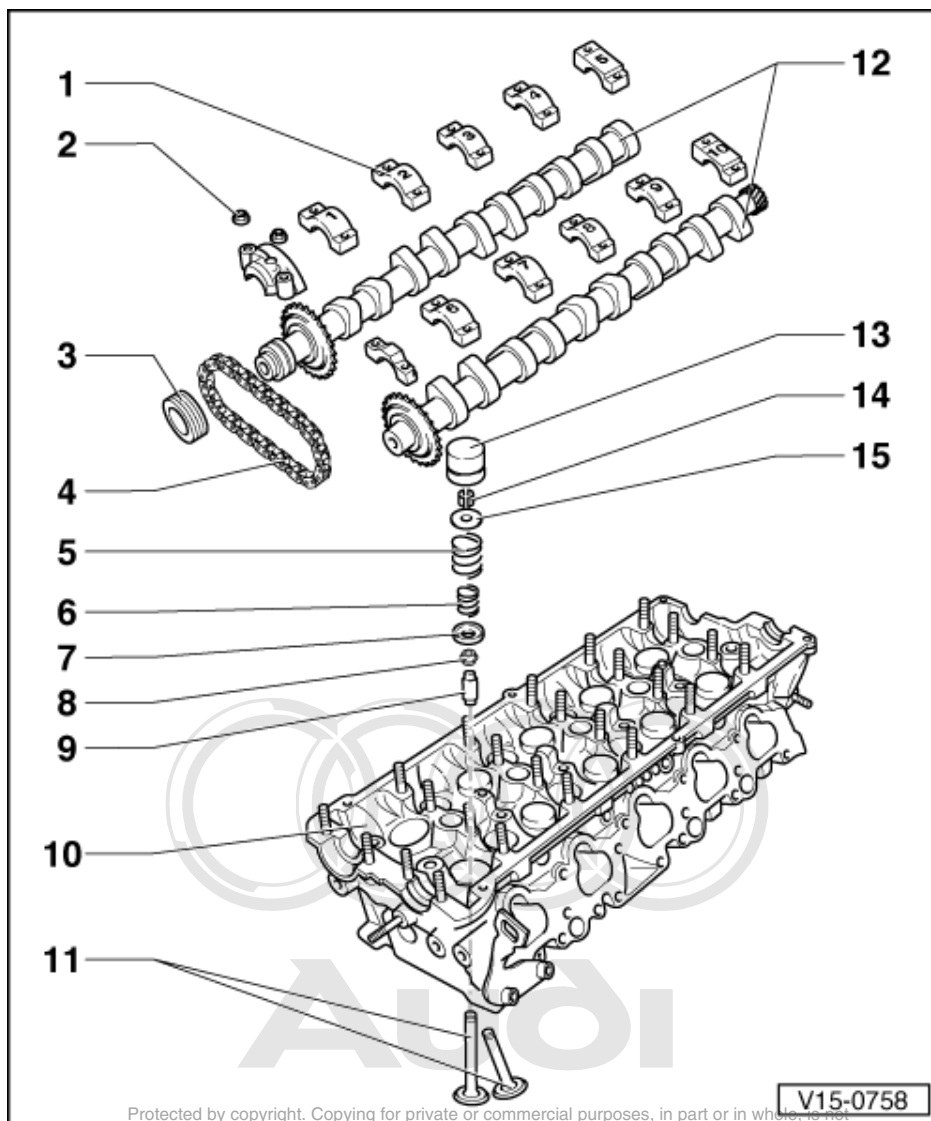
- ♦ Not to be reworked; only grinding-in permissible
- ♦ Valve dimensions
=> Fig. 96

12 Camshafts

- ♦ Checking axial clearance
=> Page 97
- ♦ Removing and installing
=> Page 100
- ♦ Check radial clearance with Plastigage
Wear limit: 0.1 mm

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- ♦ Run-out: Max. 0.01 mm



13 Hydraulic bucket tappet

- ♦ Checking => Page 103
- ♦ Removing and installing
=> Page 105
- ♦ Not to be interchanged
- ♦ Set down with bearing surface downwards
- ♦ Lubricate bearing surface

14 Valve cotters

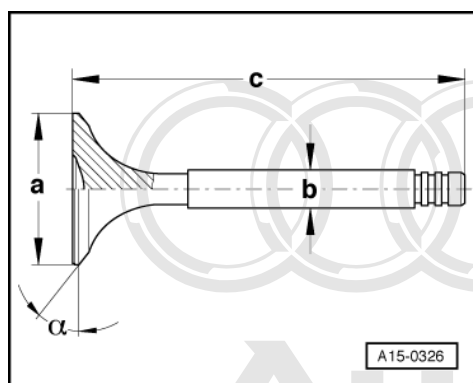
- ♦ Removing and installing:
Cylinder head
removed: Use 2037
installed: => Page 105

15 Upper valve spring plate

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

-> Fig. 1 Installation position of camshaft bearing cap

Recesses -arrow- at corners of bearing caps must face intake end of cylinder head.



-> Fig. 2 Valve dimensions

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Note:

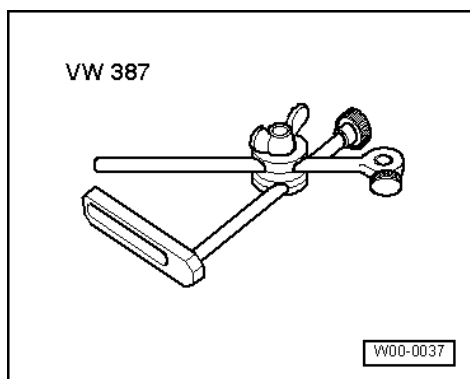
Valves are not to be reworked. Only grinding-in is permitted.

Dimension		Inlet valve	Exhaust valve
øa	mm	32.00	28.00
øb	mm	6.97	6.94
c	mm	95.50	98.20
α	<°	45	45

Attention:

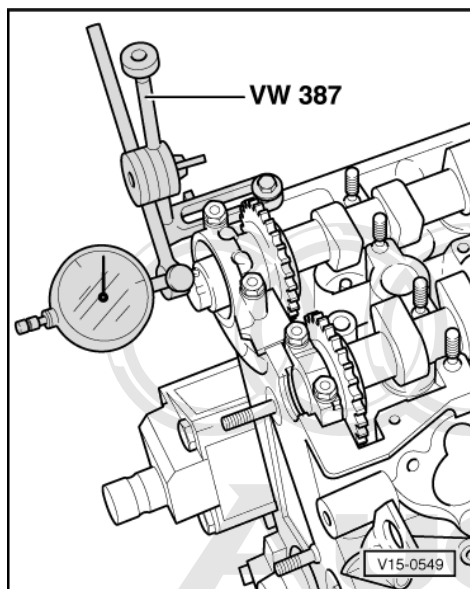
- ♦ **W**
- ♦ The valves must be sawn in two with an iron saw between centre of stem and valve plate. When doing so, valves must not come into contact with water. Following the above valve preparation, throw a maximum of ten into a bucket of water, then step well back out of the way of the abrupt chemical reaction involving combustion of the sodium fill.
- ♦ After being treated in this manner, the parts can be disposed of as normal scrap.

2.2 - Checking axial clearance of camshafts



Special tools and workshop equipment required

- ◆ Universal dial gauge holder VW 387
- ◆ Dial gauge

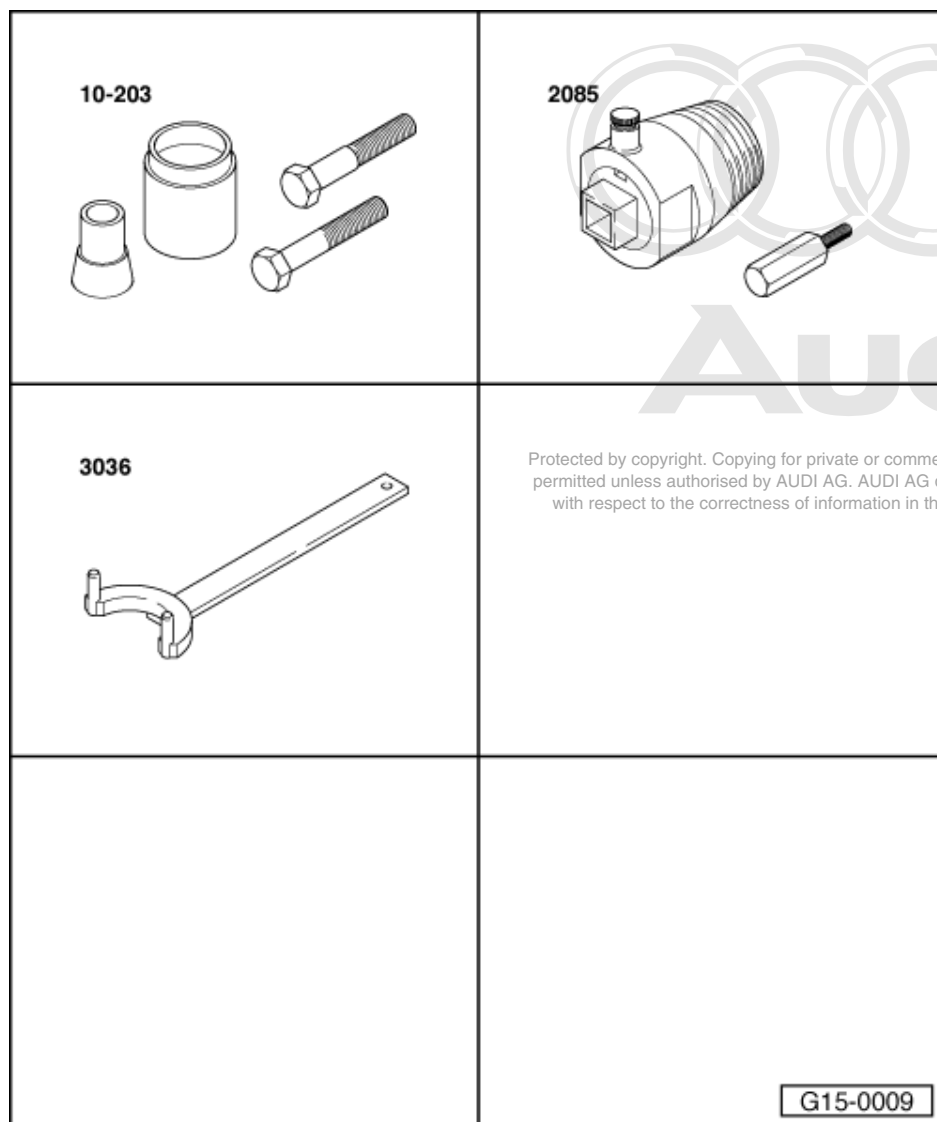


Test sequence

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- -> Take measurement with bucket tappets removed and first and last bearing caps -arrows- fitted.
 - Attach universal dial gauge holder VW 387 with dial gauge to cylinder head.
 - Wear limit for inlet and exhaust camshaft: Max. 0.20 mm



2.3 - Replacing camshaft oil seal



Special tools and workshop equipment required

- ♦ Fitting tool 10-203
- ♦ Oil seal extractor 2085
- ♦ Counterhold 3036

Removing

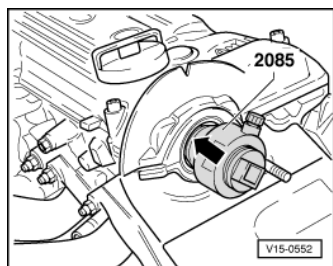
- Cylinder head fitted
- Detach toothed belt from camshaft sprocket
=> Page 45 .



Note:

As of Model Year 1992 Hall sender is located beneath camshaft sprocket. To avoid damaging Hall sender, carefully unfasten camshaft sprocket from camshaft and detach.

- -> Slacken off bolt of camshaft sprocket whilst providing support with 3036.
- Remove Woodruff key from camshaft.
- Screw home bolt for camshaft sprocket with washer in camshaft.
- Screw inner section of oil seal extractor 2085 out of outer section by two turns (approx. 3 mm) and lock with knurled screw.



- -> Lubricate threaded end of oil seal extractor 2085, fit in position and screw firmly into oil seal as far as possible.
- Slacken off knurled screw and turn inner section against camshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice. Use pliers to remove oil seal.

Installing

- Do not lubricate sealing lip of oil seal.
- Fit oil seal in position with guide sleeve from 10-203 and press in flush with thrust sleeve 10-203.

Note:

Do not press in oil seal as far as stop, as this would conceal oil return hole.

- Fit Woodruff key.
- Fit camshaft sprocket.



Note:

As of Model Year 1992 Hall sender is located beneath camshaft sprocket. To avoid damaging Hall sender, carefully mount camshaft sprocket on camshaft and secure.

- -> Fit bolt of camshaft sprocket (use counterhold 3036).
- Fit toothed belt (adjust valve timing) => Page 43 .

Note:

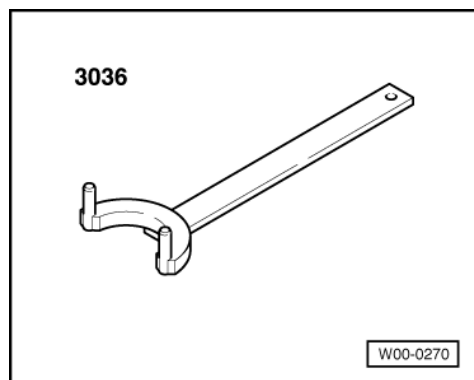
Heed all instructions for removing and installing toothed belt

=> Page 39 .

Tightening torque

Component	Nm
Camshaft sprocket to camshaft	65

2.4 - Removing and installing camshafts



Special tools and workshop equipment required

- ♦ Counterhold 3036



Removing

- Cylinder head fitted

- Detach toothed belt from camshaft sprocket

=> Page 45 .

Note:

As of Model Year 1992 Hall sender is located beneath camshaft sprocket. To avoid damaging Hall sender, carefully unfasten camshaft sprocket from camshaft and detach.

- -> Slacken off bolt of camshaft sprocket whilst providing support with 3036.
- Remove Woodruff key from camshaft.
- Remove cylinder head cover => Page 79 .

Model Year 1991 vehicles:

- Remove housing for Hall sender.

=> Motronic Injection and Ignition System (5-cylinder); Repair Group 28

All models:

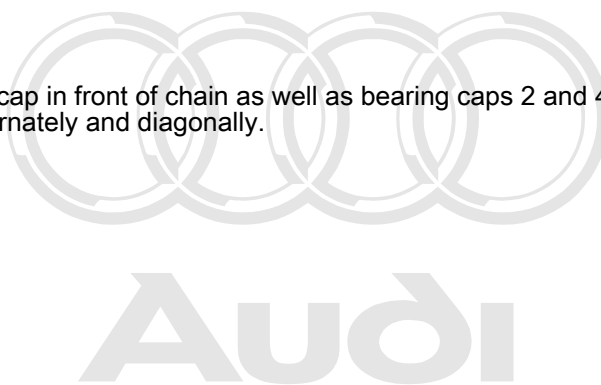
- Make coloured identification mark on drive chain and chain sprockets of camshafts.

Note:

Do not mark chain by way of centre punch, notch or the like.

Exhaust camshaft:

- -> Start by unfastening outer bearing cap in front of chain as well as bearing caps 2 and 4 diagonally.
- Unfasten bearing caps 1, 3 and 5 alternately and diagonally.



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Inlet camshaft:

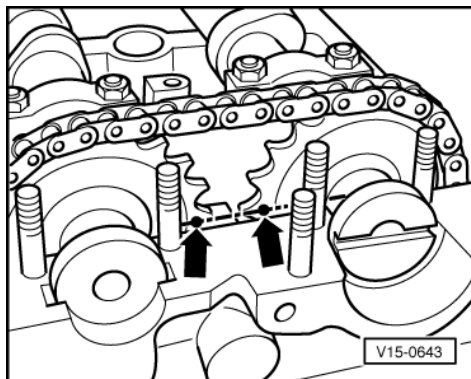
- -> Start by unfastening outer bearing cap in front of chain as well as bearing caps 7 and 9 diagonally.



- Unfasten bearing caps 6, 8 and 10 alternately and diagonally.

All models:

- Remove inlet and exhaust camshaft with drive chain.



Installing

Install in reverse order, paying attention to the following:

- Lubricate camshaft contact surfaces.
- -> Insert camshafts with drive chain in cylinder head.
 - Identification marks on camshaft sprockets must be opposite one another on inside -arrows-
 - Pay attention to coloured mark if old drive chain is re-used



Notes:

- ♦ Replace camshaft oil seal.
- ♦ Hall sender housing must have been removed on Model Year 1991 vehicles for installation of camshafts.

=> Motronic Injection and Ignition System (5-cylinder); Repair Group 28

- ♦ -> Recesses -arrow- at corners of bearing caps must face intake end of cylinder head.

Inlet camshaft:

- Tighten bearing caps 6, 8 and 10 alternately and diagonally.
- Install remaining bearing caps (pay attention to dowel sleeves).

Exhaust camshaft:

- Tighten bearing caps 1, 3 and 5 alternately and diagonally.

- Install remaining bearing caps (pay attention to dowel sleeves).
- Replace oil seal for inlet camshaft. Installing => Page 98 .

Model Year 1991 vehicles:

- Install housing for Hall sender.

=> Motronic Injection and Ignition System (5-cylinder); Repair Group 28

All models:

- Insert Woodruff key in camshaft.
- Fit camshaft sprocket.

Note:

As of Model Year 1992 Hall sender is located beneath camshaft sprocket. To avoid damaging Hall sender, carefully mount camshaft sprocket on camshaft and secure.

- -> Fit bolt of camshaft sprocket (use counterhold 3036).
- Fit toothed belt (adjust valve timing) => Page 43 .

Notes:

- ♦ Heed all instructions for removing and installing toothed belt => Page 39 .
- ♦ Engine is not to be started for approx. 30 minutes after installing camshafts, so as to allow hydraulic valve lifters to settle (valves would otherwise strike piston).
- ♦ After working on valve gear, carefully crank engine through at least 2 revolutions to ensure that no valves make contact on starting.
- Fit cylinder head cover => Page 79 .

Tightening torques

Component	Nm
Bearing cap to cylinder head	15
Camshaft sprocket to camshaft	65

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2.5 - Checking hydraulic bucket tappets

Special tools and workshop equipment required

- ♦ Feeler gauge



- ♦ Wooden or plastic wedge

Notes:

- ♦ Hydraulic bucket tappets cannot be serviced.
- ♦ Irregular valve noise on starting is normal.
- Start engine and leave it running until coolant temperature is approx. 80 °C.
- Increase engine speed for 2 minutes to approx. 2500 rpm; perform test drive if necessary.

Note:

If irregular valve noise disappears but repeatedly re-occurs when travelling short distances, replace oil retention valve. Fitting location of oil retention valve: In cylinder block => Page 118

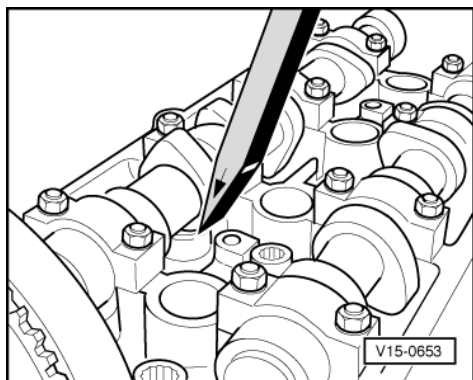
If hydraulic bucket tappets are still noisy, determine defective tappet as follows:

- Remove cylinder head cover => Page 79.
- Turn crankshaft until cams of bucket tappets to be tested are at top.

Note:

A hexagon (32 mm) is provided at the hydraulic pump for cranking the engine.

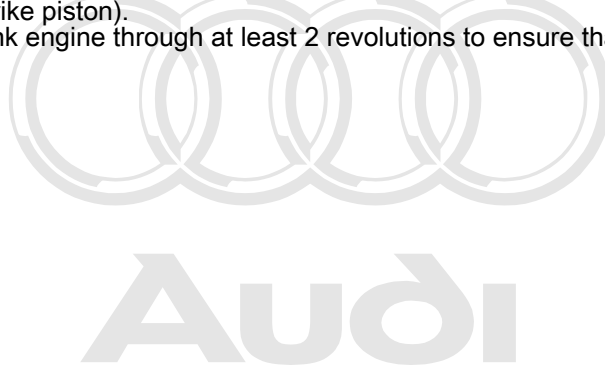
- Determine clearance between cam and bucket tappet.



- -> Press bucket tappet down with a wooden or plastic wedge. Replace tappet if a 0.20 mm feeler gauge can be inserted between camshaft and bucket tappet.
- Replacing bucket tappet => Removing camshafts, Page 100

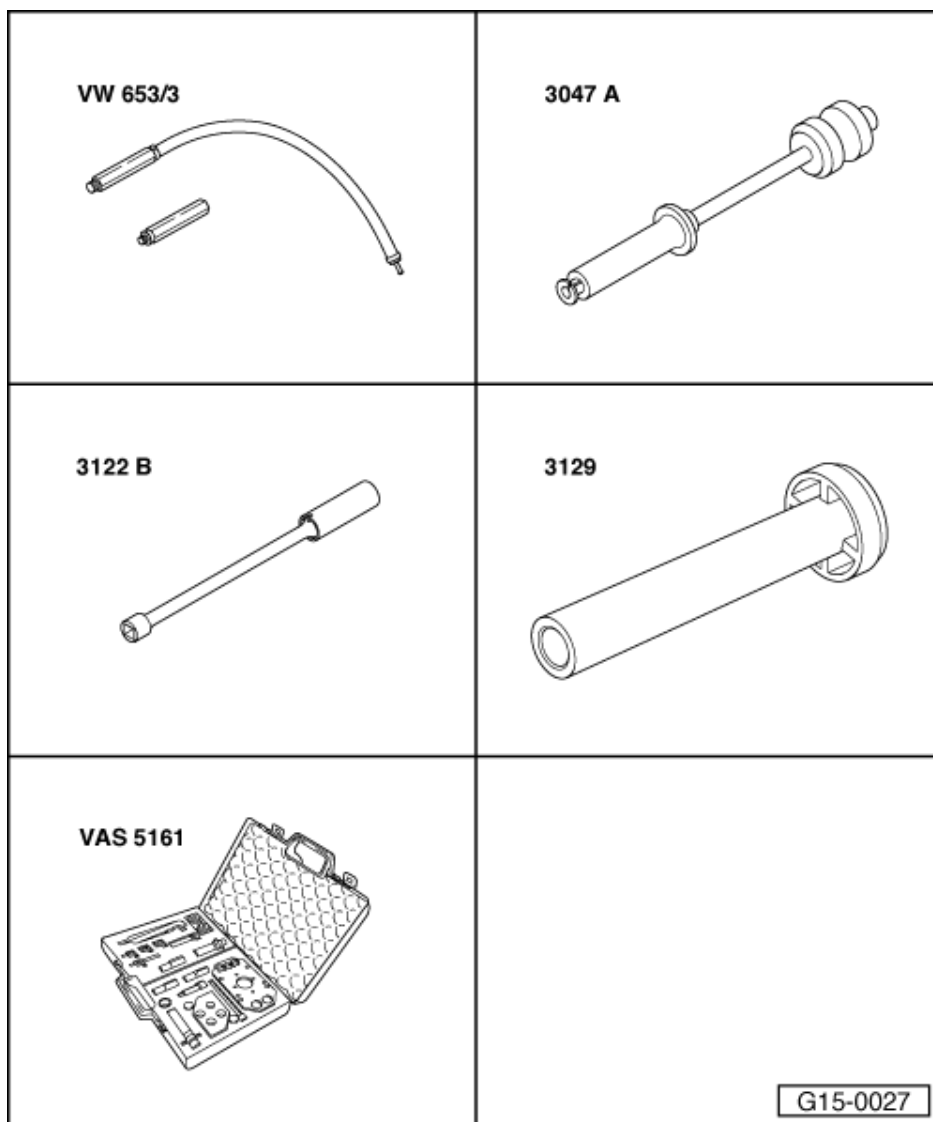
Notes:

- ♦ Engine is not to be started for approx. 30 minutes after installing camshafts, so as to allow hydraulic valve lifters to settle (valves would otherwise strike piston).
- ♦ After working on valve gear, carefully crank engine through at least 2 revolutions to ensure that no valves make contact on starting.



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2.6 - Replacing valve stem seals



Special tools and workshop equipment required

- ◆ Pressure hose VW 653/3
- ◆ Puller 3047 A
- ◆ Spark plug wrench 3122 B
- ◆ Pressing-on tool 3129
- ◆ Dismantling and assembly tool VAS 5161

Removing

- Cylinder head fitted

Note:

With cylinder head removed, valve springs can be removed using special tool 2037.

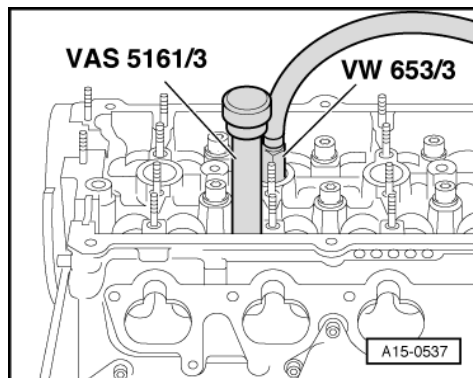
- Remove camshafts => Page 100 .

Notes:

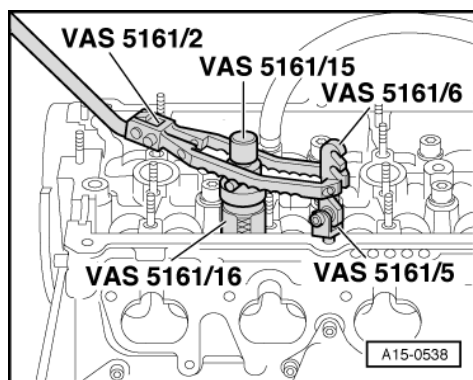
- ◆ Take care not to interchange bucket tappets.



- ♦ Use waterproof felt-tip pen to mark assignment of bucket tappets on back.
- Take bucket tappets out of guides and set them down with bearing surface facing downwards.
- Use spark plug wrench 3122B to screw out spark plugs.
- Set piston of appropriate cylinder to "bottom dead centre".



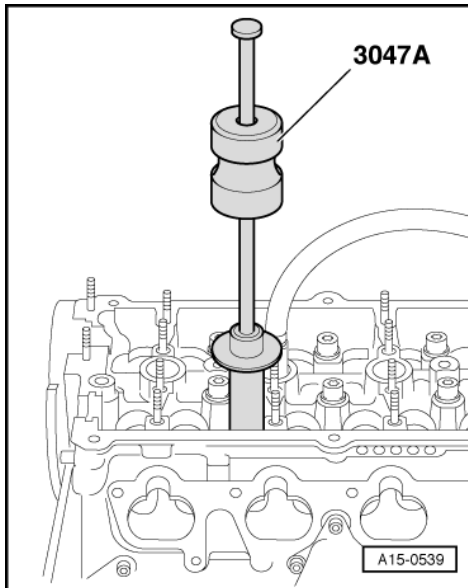
- -> Screw pressure hose VW 653/3 into spark plug thread and apply constant pressure (min. 6 bar).
- Insert tool VAS 5161/3 in bucket tappet guide.
- Use plastic-headed hammer to release seized valve cotters at all four valves.



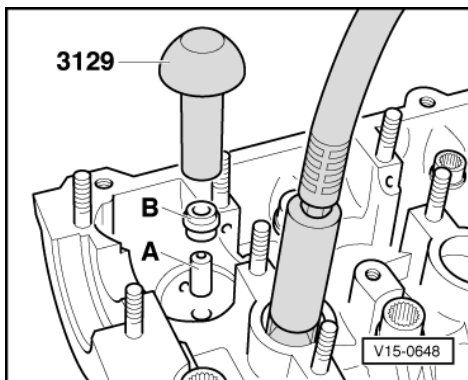
- -> Screw locking element VAS 5161/6 with engaging piece (M6) VAS 5161/5 into tapped hole at cylinder head.
- Press home guide bushing VAS 5161/16 in bucket tappet guide at valve to be removed.
 - Installation position: Ribbed surfaces at right angles to direction of travel
- Slide assembly cartridge VAS 5161/15 into guide bush.
- Engage VAS 5161/2 at VAS 5161/6 and press down assembly cartridge.
- At the same time, turn knurled screw of assembly cartridge clockwise until ends engage in valve cotters.
- Turn knurled screw back and forth slightly; valve cotters are thus forced apart and enter into cartridge.
- Release VAS 5161/2.
- Take out assembly cartridge, guide bush, valve plate and valve springs.



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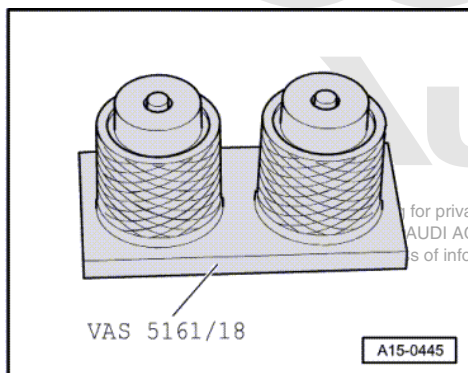


- -> Pull off valve stem seals using 3047 A.



Installing

- -> So as not to damage new valve stem seals -B-, attach plastic sleeve -A- to valve stem.
- Lubricate sealing lip of valve stem seal slightly.
- Slip valve stem seal over plastic sleeve.
- Use pressing-on tool 3129 to carefully press valve stem seal onto valve guide.
- Detach plastic sleeve again.



- -> If valve cotter pins are removed from assembly cartridge, they must first be placed in insertion tool VAS 5161/18.

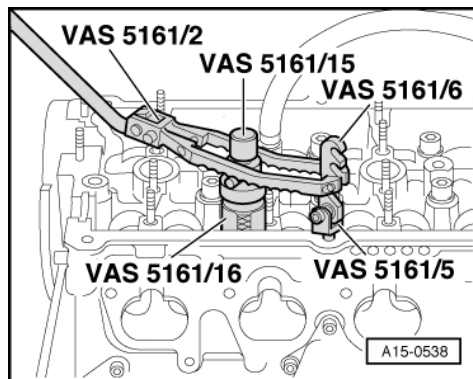
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Note:

Large valve cotter diameter faces upwards.

- Press assembly cartridge VAS 5161/15 onto insertion device from above to accommodate valve cotters.



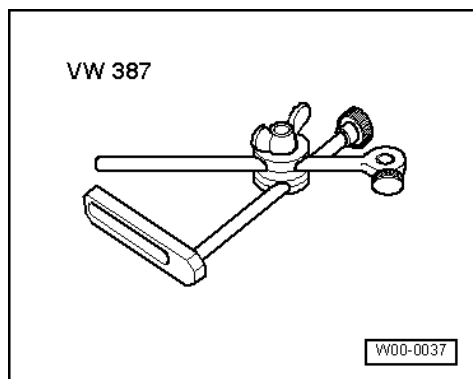
- -> Re-insert assembly cartridge VAS 5161/15 in guide bush VAS 5161/16.
- Press down VAS 5161/2 and pull up knurled screw by twisting it in both directions, thus inserting the valve cotters.
- Release VAS 5161/2 with knurled screw still in pulled position.
- Insert bucket tappets.
- Fit camshafts => Page 102 .

Notes:

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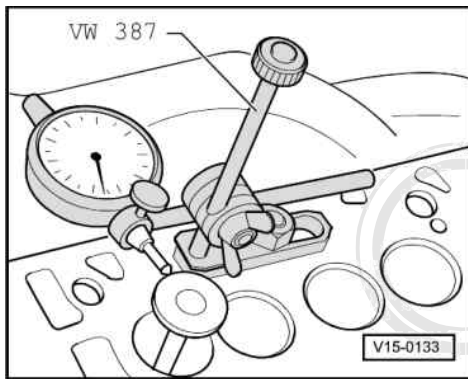
- ♦ Engine is not to be started for approx. 30 minutes after installing camshafts, so as to allow hydraulic valve lifters to settle (valves would otherwise strike piston).
- ♦ After working on valve gear, carefully crank engine through at least 2 revolutions to ensure that no valves make contact on starting.

2.7 - Checking valve guides



Special tools and workshop equipment required

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



Sequence of operations

- -> Insert valve in guide. End of valve stem must be flush with guide. On account of differing stem diameters, use inlet valve in inlet guide and exhaust valve in exhaust guide only.

- Determine sideways play

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Wear limit

Inlet valve guide	Exhaust valve guide
1.0 mm	1.3 mm

Notes:

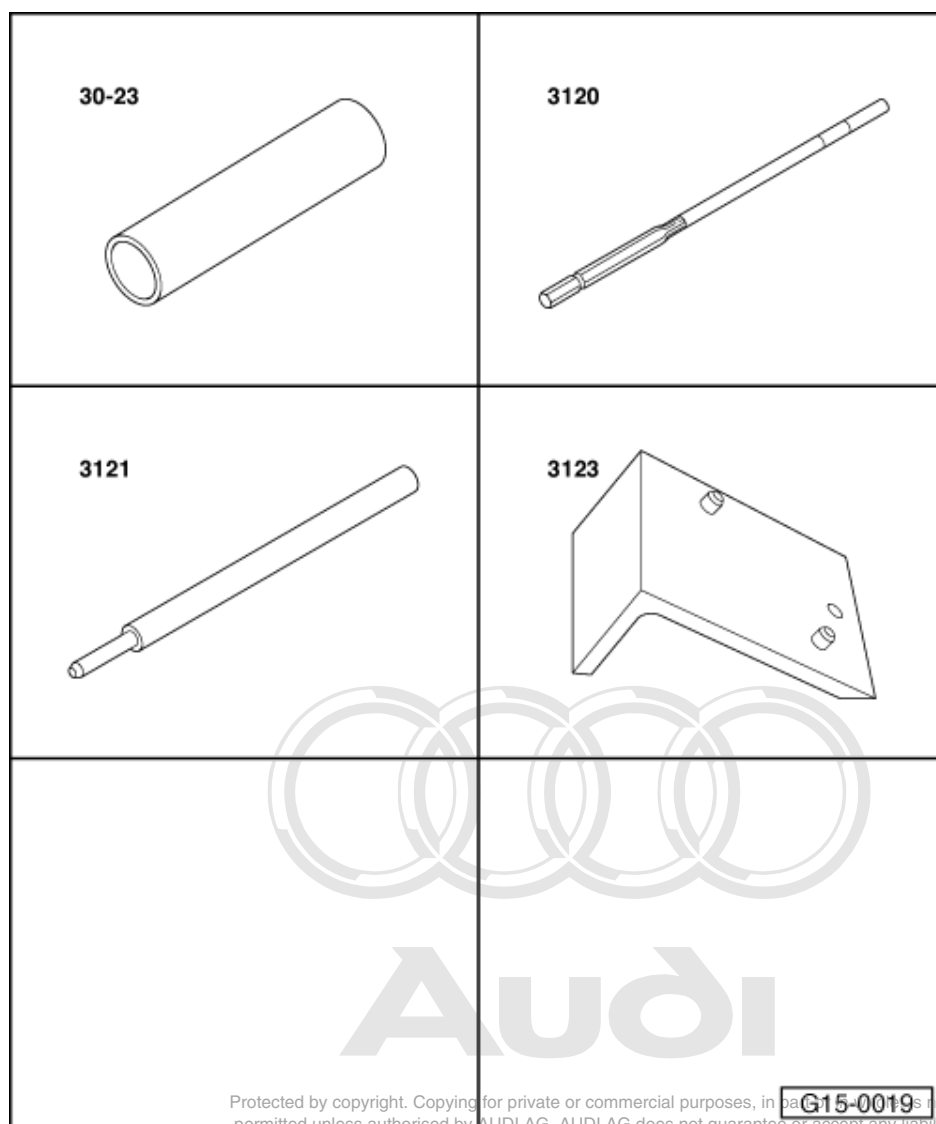
- ♦ If wear limit is exceeded, repeat measurement with new valves. Replace valve guide if wear limit is still exceeded.
- ♦ Use new valve for measurement purposes if valve is replaced as part of repair work.

2.8 - Checking valves

- Visually inspect for scoring at stem and surface of seat. Replace valves in the event of distinct scoring.



2.9 - Replacing valve guides

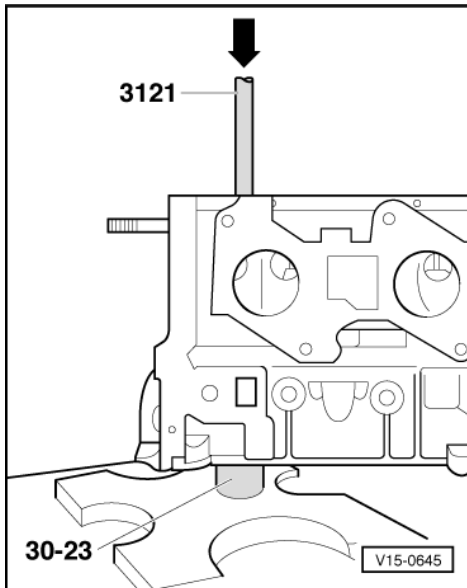


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G15-0019

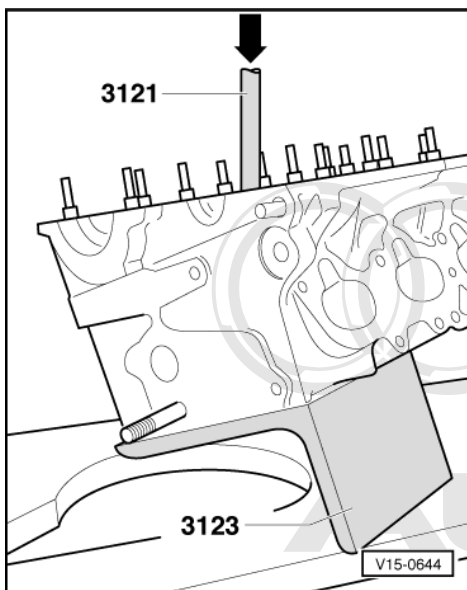
Special tools and workshop equipment required

- ♦ Attachment 30-23
- ♦ Hand reamer 3120
- ♦ Drift 3121
- ♦ Pressing-in support 3123
- ♦ Cutting solution



Removing

- Clean and check cylinder head. Heads on which valve seat rings can no longer be reworked/cylinder heads already machined to the minimum dimension are unsuitable for valve guide replacement.
- -> Support cylinder head in area of valve guide with attachment 30-23.
- Use 3121 to press out worn valve guides from combustion chamber side.



Installing

- -> Position cylinder head on pressing-in support 3123.
- Moisten new valve guides with oil and press into cold cylinder head as far as collar from camshaft side using 3121.

Note:

Once valve guide is resting on collar, pressing-in force must not exceed 10 kN (approx. 1.0 t), as otherwise collar could break off.

- Ream valve guide with hand reamer 3120. When doing so, always use cutting solution.
- Rework valve seats => Page 112.



- Replace valve stem seals => Page 105 .

2.10 - Reworking valve seats

Note:

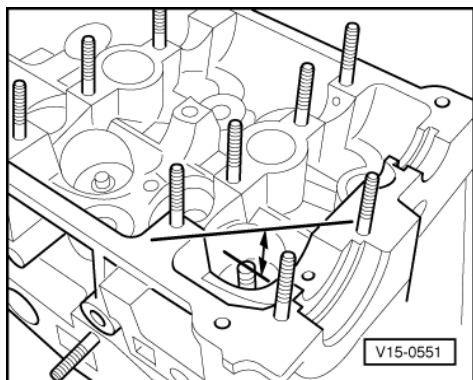
Rework valve seats if grinding-in does not yield proper surface appearance.

Special tools and workshop equipment required

- ♦ Depth gauge
- ♦ Valve seat machining device

Notes:

- ♦ When servicing engines where valves are leaking, it is not sufficient to machine/replace valve seats and valves. Particularly in the case of high-mileage engines, it is necessary to check the valve guides for wear => Page 108 .
- ♦ Valve seats are only to be reworked to the extent required to yield a proper surface appearance.
- ♦ Max. perm. reworking dimension is to be calculated before starting work.
- ♦ If reworking dimension is exceeded, proper hydraulic valve lifter operation can no longer be guaranteed and cylinder head is to be replaced.



Calculating max. perm. reworking dimension

- Insert valve and press it firmly against valve seat.

Note:

Use new valve for measurement purposes if valve is replaced as part of repair work.

- -> Measure distance between end of valve stem and centre axis of camshaft (centre axis of camshaft is on a level with top edge of cylinder head).
- Calculate max. perm. reworking dimension from distance measured and minimum dimension.

Minimum dimensions	
Inlet valves	Exhaust valves
36.0 mm	36.3 mm

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

Example for inlet valve:	
Measured distance	37.0 mm
- Minimum dimension	-36.3 mm

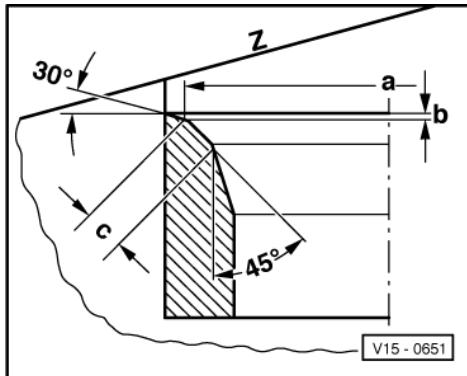
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Example for inlet valve:

= max. perm. reworking dimension = 0.7 mm

Note:

If max. perm. reworking dimension is 0 mm or less than 0 mm, repeat measurement with new valve. Replace cylinder head if result obtained is still 0 mm or less than 0 mm.



-> Reworking inlet valve seat

Inlet valve seat

a = $\varnothing$ 31.2 mm

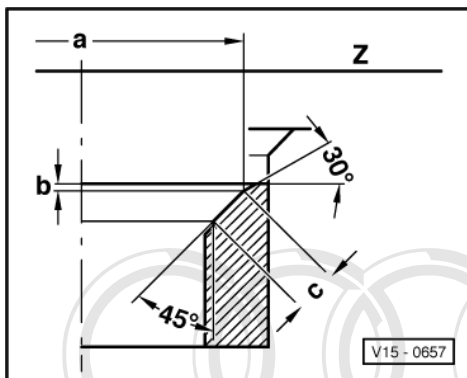
b = max. perm. reworking dimension 1)

c = 1.5 ... 1.8 mm 2)

Z = Bottom edge of cylinder head

45° = Valve seat angle

30° = Upper correction angle



-> Reworking exhaust valve seat

Exhaust valve seat

a = $\varnothing$ 27.6 mm

b = max. perm. reworking dimension 1)

c = approx. 1.8 mm

Z = Bottom edge of cylinder head

45° = Valve seat angle

30° = Upper correction angle

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- 1) Calculating max. perm. reworking dimension => Page **112**
- 2) If necessary, rework valve seat ring with 75° correcting cutter

Note:

Exhaust valve seat rings are additionally provided with a constriction. When reworking, take care not to damage radius of constriction.



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17 - Lubrication

1 - Removing and installing lubrication system components

1.1 - Removing and installing lubrication system components

Notes:

- ♦ If large quantities of metal swarf or abrasion particles are found in the engine oil in the course of engine repair work, the oil pump must be dismantled and checked, the oil ducts carefully cleaned and the oil cooler replaced so as to prevent further damage.
- ♦ Oil level must not be above max. mark as otherwise catalytic converter could be damaged.
- ♦ Note the latest information on the use of sealants.

=> Parts List

- ♦ Oil spray jet and pressure relief valve
=> Fig. 125

Viscosity classes and oil specifications:

=> Maintenance

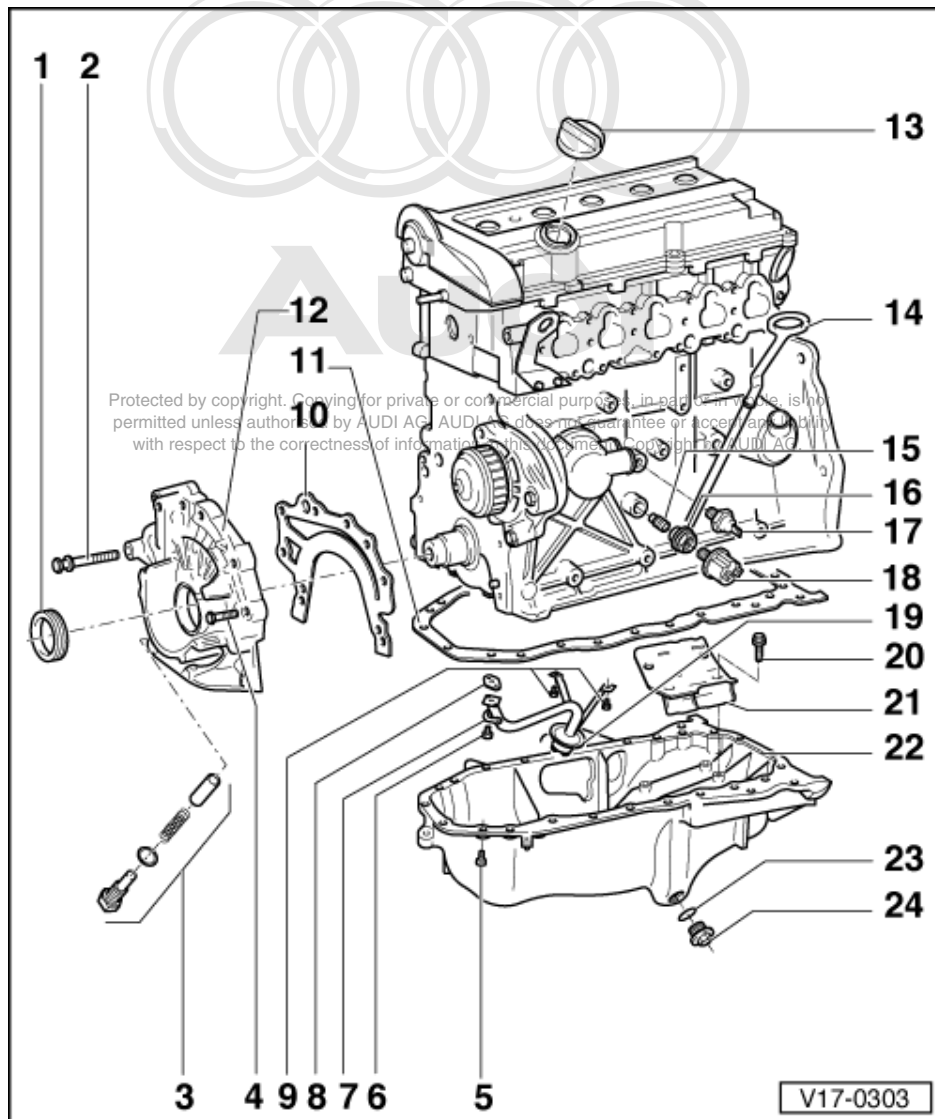
Oil capacities

=> Exhaust emission test



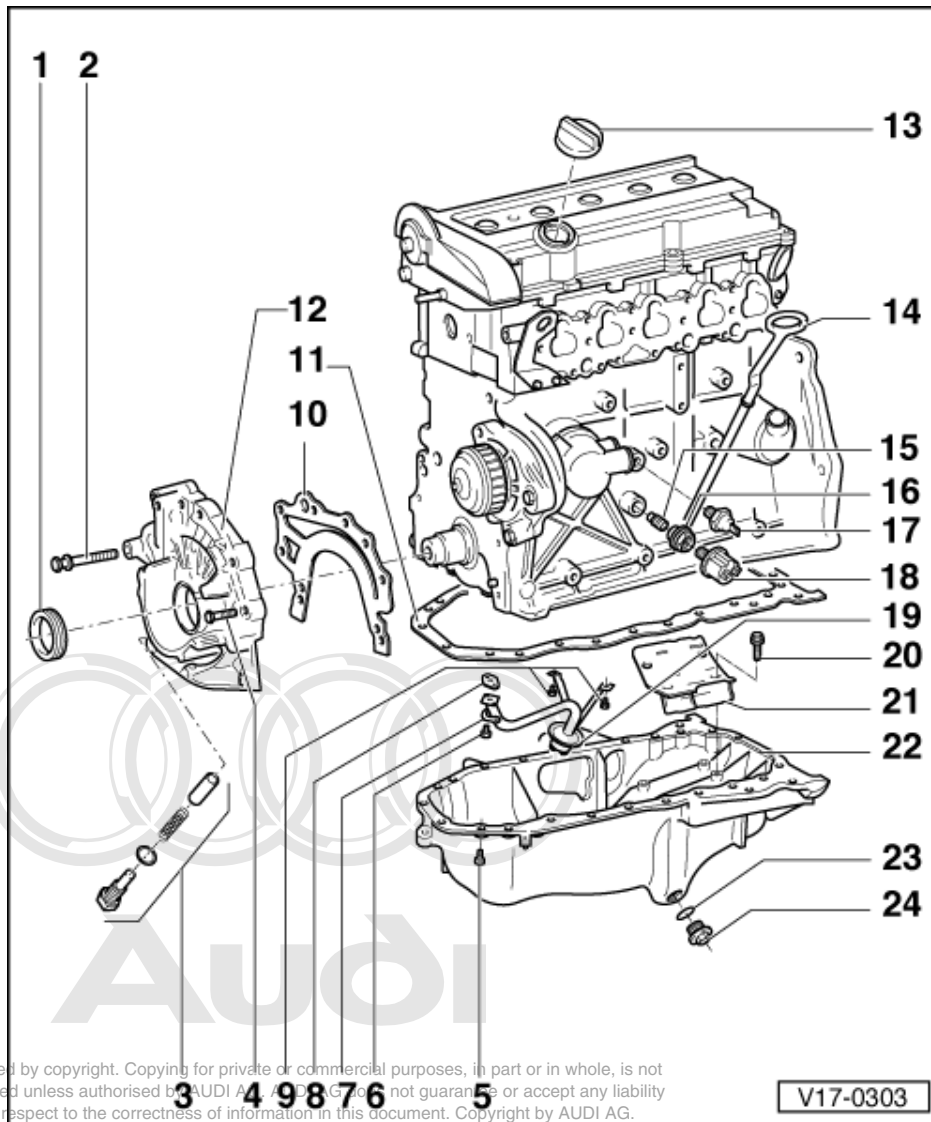
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1.2 - Exploded view of components



Part 1

- 1 Oil seal
 - ◆ For crankshaft
 - ◆ Removing and installing
=> Page 59
- 2 20 Nm
- 3 Pressure relief valve
 - ◆ Opening pressure: 3.0...4.5 bar
 - ◆ Screw plug with oil-temperature sender -G8
 - ◆ Tighten screw plug to 30 Nm
- 4 10 Nm
- 5 M6 = 10 Nm
M8 = 20 Nm
 - ◆ Heed tightening sequence
=> Page 127



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V17-0303

6 10 Nm

- ♦ Fit with lock washer -Item 7 - or locking fluid depending on design status
- ♦ Locking fluid

=> Parts List

7 Lock washer

- ♦ Depending on design status
- ♦ Replace

8 O-ring

- ♦ Replace

9 10 Nm

10 Gasket

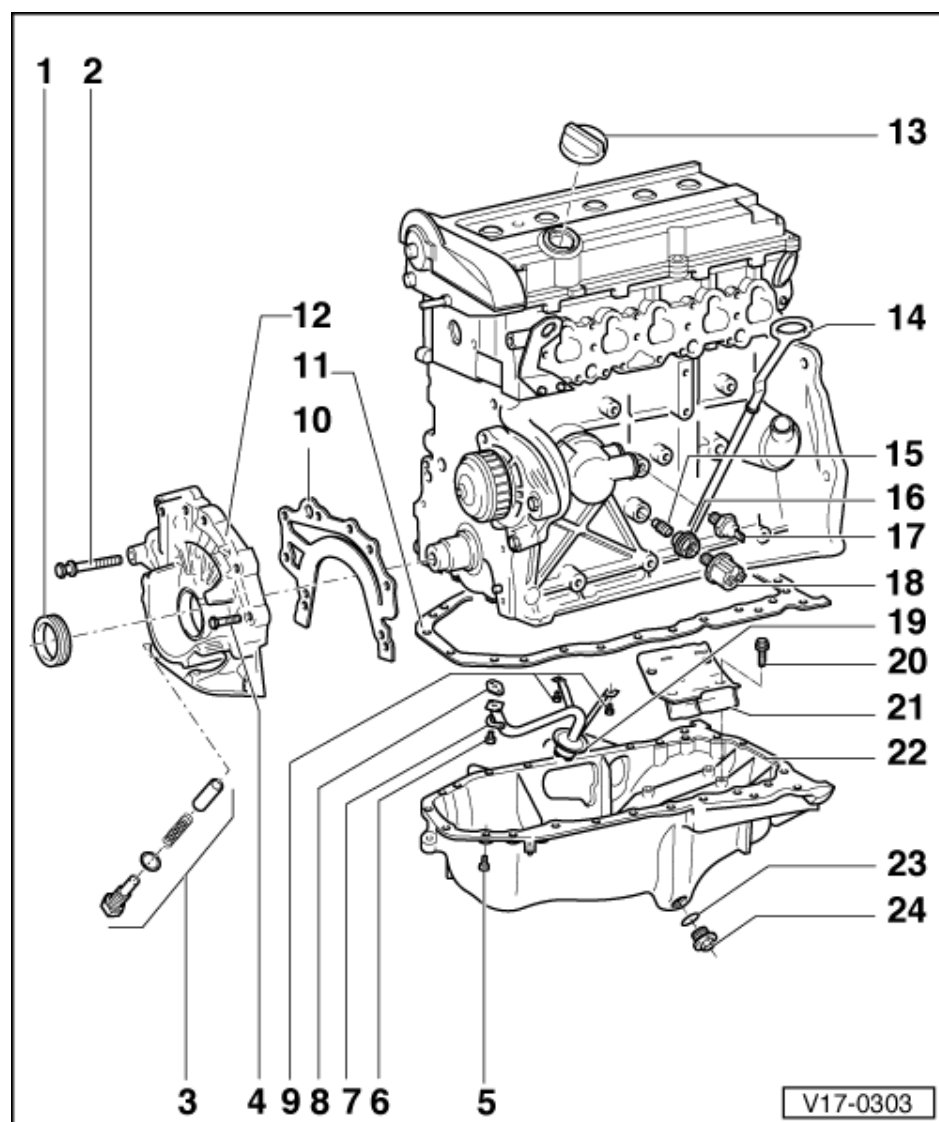
- ♦ Replace

11 Gasket

- ♦ 2x
- ♦ Replace
- ♦ Gasket must be dry when fitting
- ♦ Apply thin coat of sealant to sealing flange/cylinder block transitions
- ♦ Sealant



=> Parts List

**12 Oil pump**

- ◆ Removing and installing
=> Page **128**
- ◆ Replace only as complete assembly
- ◆ Watch out for driver at crankshaft on installation

13 Cap

- ◆ Replace gasket if damaged or leaking

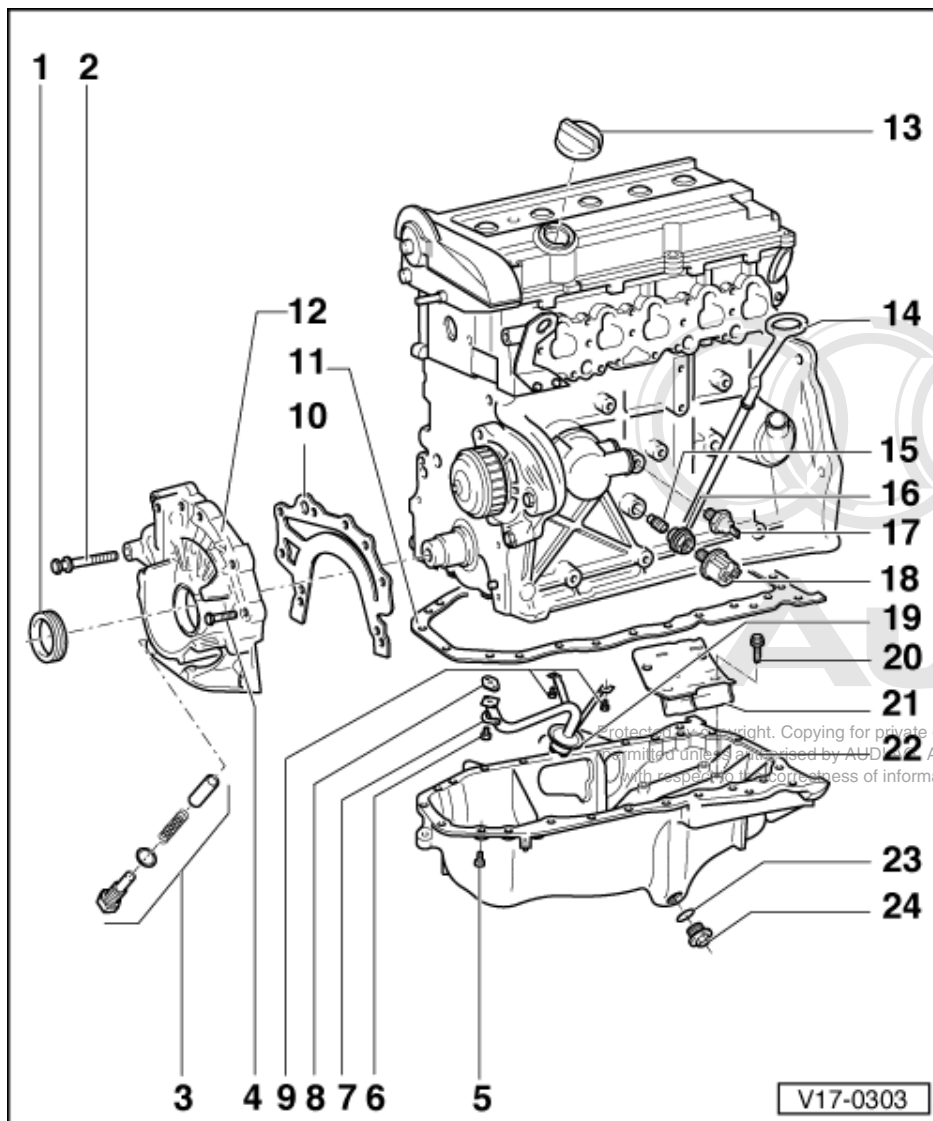
14 Dipstick**15 Oil retention valve**

- ◆ Removing and installing: Use 8 mm multi-point socket wrench
- ◆ Apply locking fluid when fitting
- ◆ Locking fluid

=> Parts List

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- ◆ Tighten to 6 Nm



16 Adapter

- ♦ Tighten to 50 Nm

17 Oil pressure switch -F1, 25 Nm

- ♦ 1.8 bar - white
- ♦ Checking =>Page **132**

18 Oil pressure sender -G10, 25 Nm

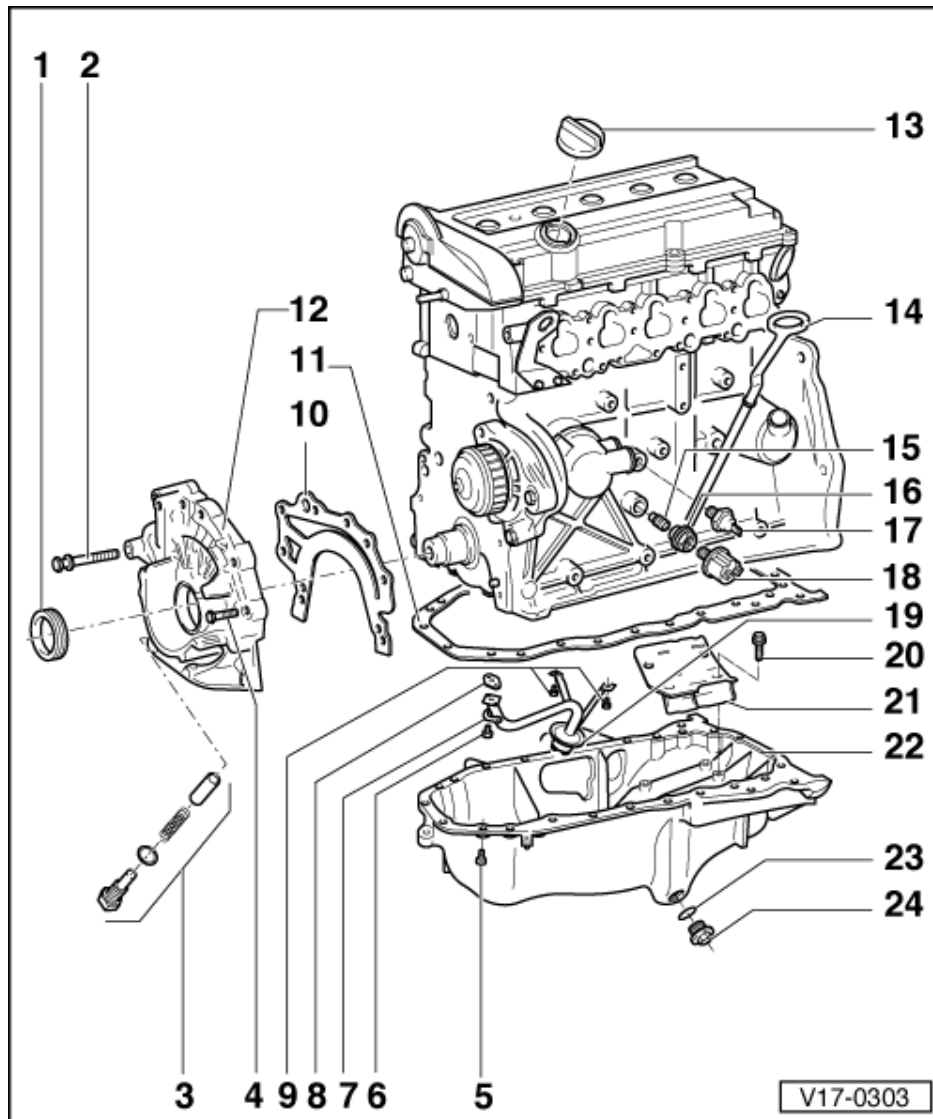
19 Suction pipe

- ♦ Clean strainer if contaminated
- ♦ Tighten at oil pump first

20 10 Nm

21 Baffle plate

- ♦ Fit with gasket -Item **11** - at cylinder block



22 Sump

- ◆ Removing and installing=>Page 125
- ◆ Clean sealing surfaces before fitting
- ◆ Apply thin coat of sealant to sealing flange/cylinder block transitions
- ◆ Sealant

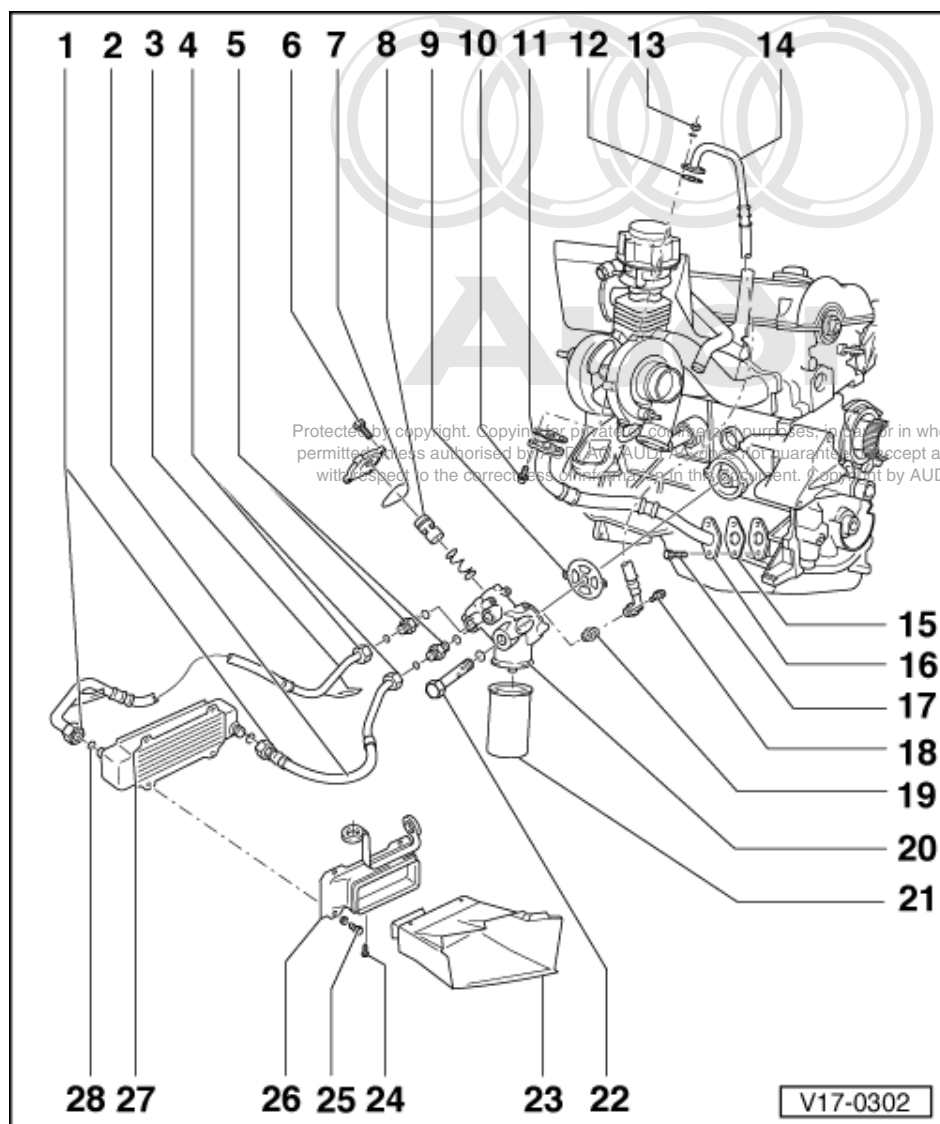
=> Parts List

23 Oil seal

- ◆ Replace

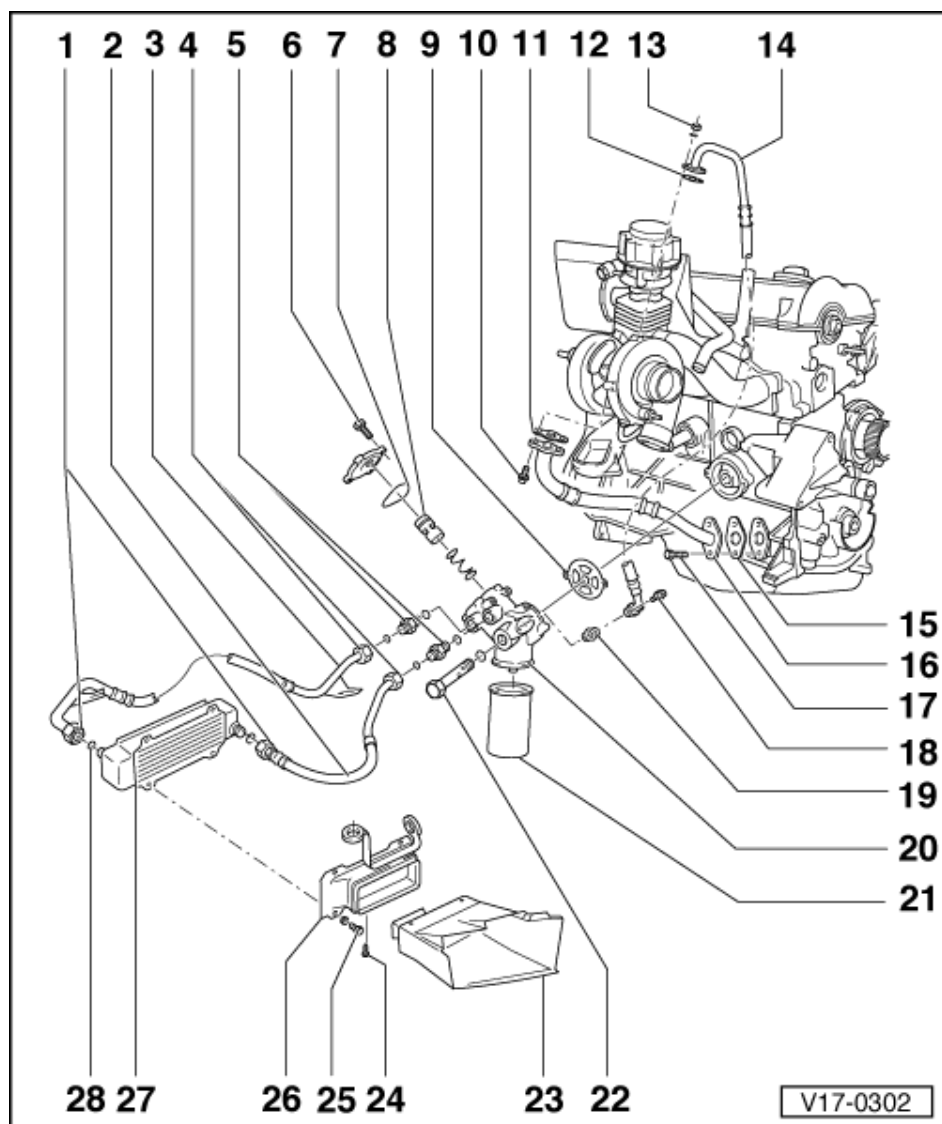
24 Drain plug - 30 Nm

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Part 2

- 1 40 Nm
- 2 Oil supply pipe
 - ♦ To oil cooler
- 3 Oil return pipe
 - ♦ To oil filter bracket
- 4 40 Nm
 - ♦ Mark connections; do not interchange
- 5 Adapter
 - ♦ Tighten to 50 Nm
- 6 10 Nm
- 7 Gasket
 - ♦ Replace

**8 Oil temperature regulator**

- ◆ Start of opening: approx. 110°C
- ◆ End of opening: approx. 125°C
- ◆ Opening stroke: 8 mm
- ◆ Checking operation: Oil temperature less than 110°C: Oil cooler at ambient temperature
- ◆ Above 110°C: Oil cooler warm

9 Gasket

- ◆ Replace
- ◆ Installation position: Fitted pins act as locators

10 10 Nm**11 Gasket**

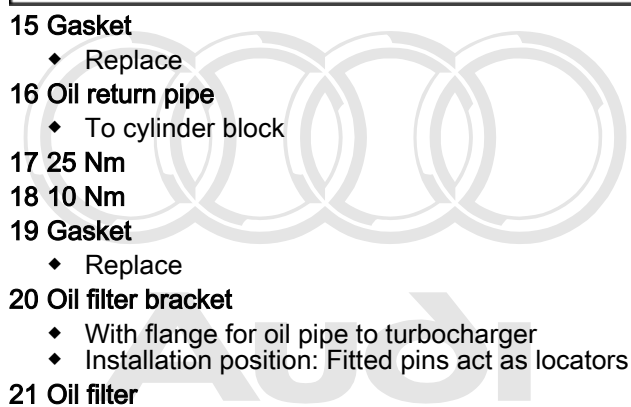
- ◆ Replace

12 Gasket

- ◆ Replace

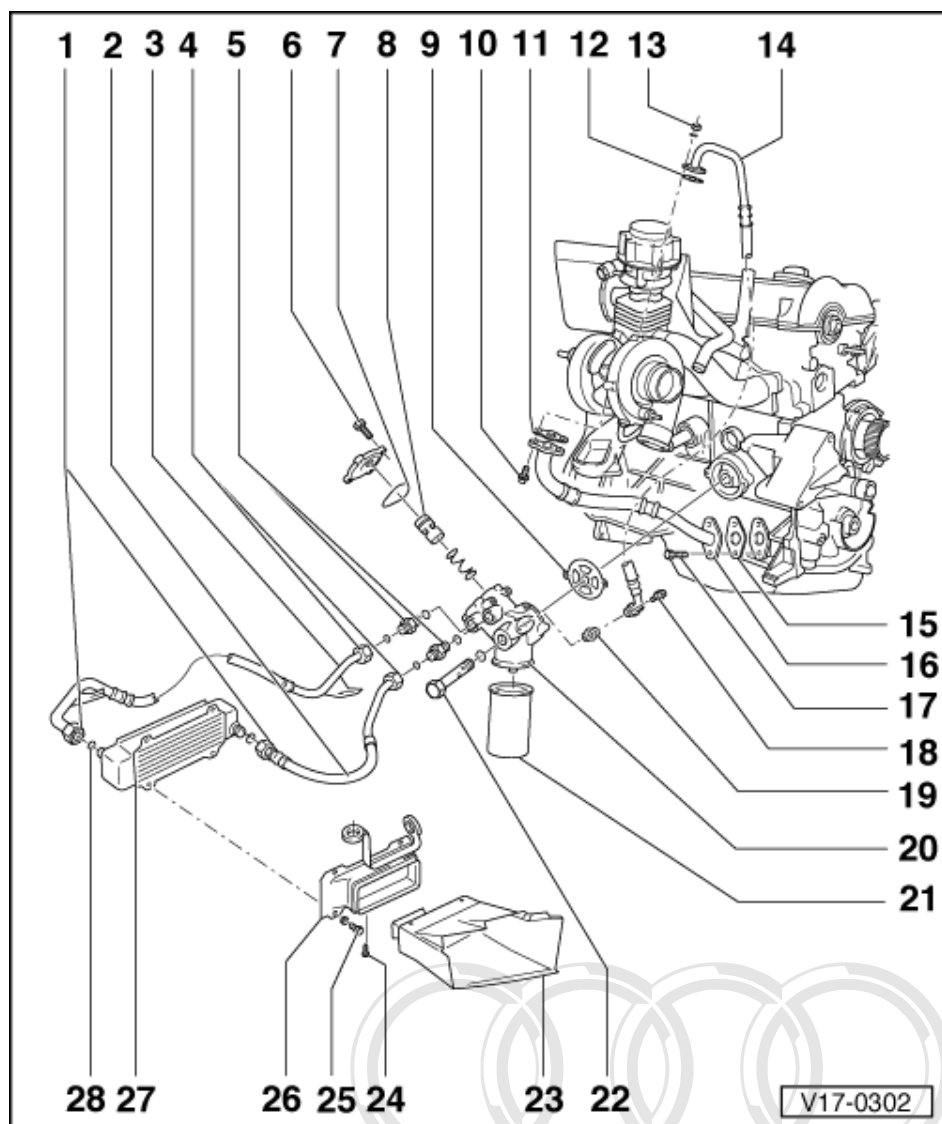
13 10 Nm**14 Oil supply pipe**

- ◆ To turbocharger



=> Maintenance

- 1.2 - Exploded view of components 123

**22 Banjo bolt, 70 Nm**

- ♦ Replace O-ring on banjo bolt

23 Air duct**24 Self-tapping screw****25 10 Nm****26 Holder**

- ♦ For oil cooler

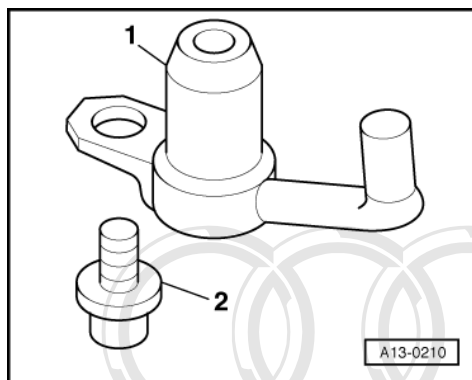
27 Oil cooler

- ♦ Replace following engine damage such as piston, crankshaft or conrod bearing damage
- ♦ Heed note
=> Page 115

28 O-ring

- ♦ Replace

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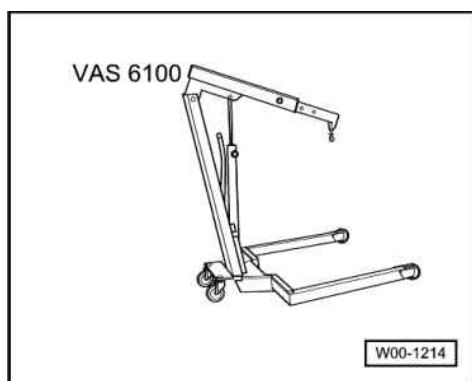
-> Fig.1 Oil spray jet and pressure relief valve

- 1 - Oil spray jet with pressure relief valve
- 2 - Bolt - 10 Nm
- Apply locking fluid when fitting
- Locking fluid

=> Parts List

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1.3 - Removing and installing sump

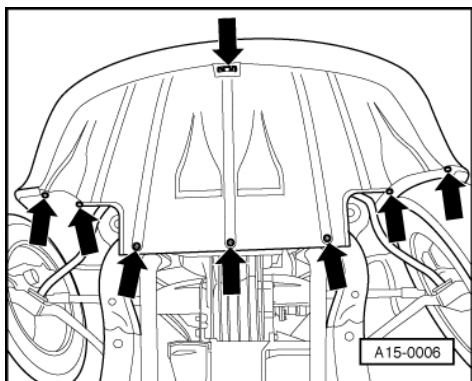


Special tools and workshop equipment required

- ♦ Workshop crane VAS 6100

Or

- ♦ Workshop crane V.A.G 1202 A

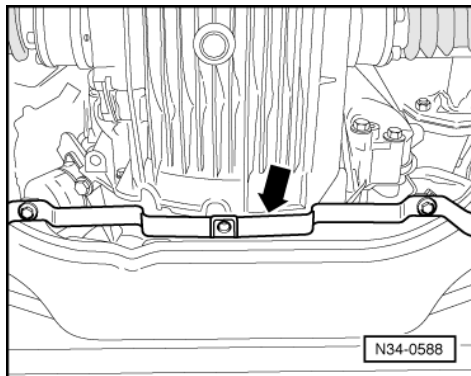




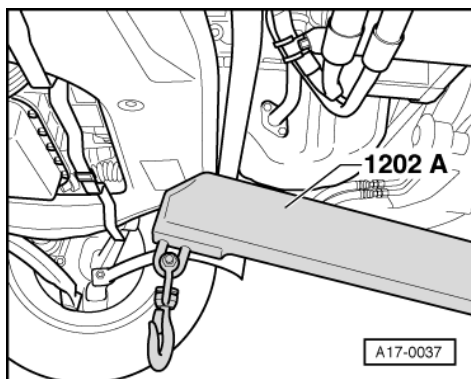
Removing

- -> Detach noise insulation -arrows-.
- Drain off engine oil.

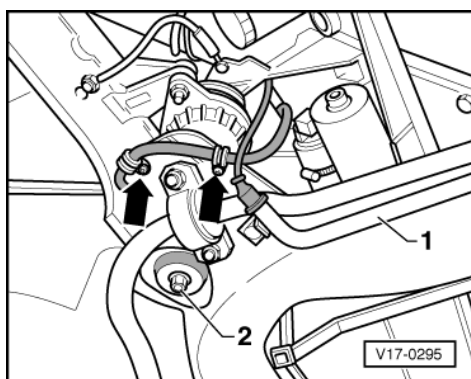
=> Maintenance



- -> Unscrew holder for noise insulation -arrow-.



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



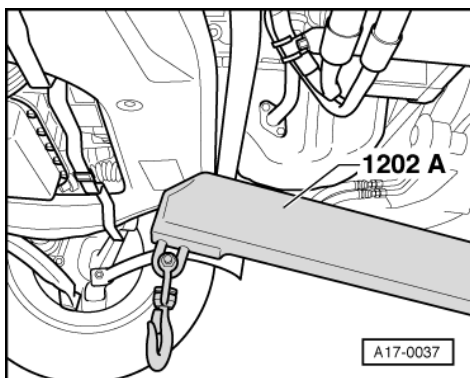
- -> Unscrew clips -arrows- for starter wire at subframe.
- Unscrew wire -1- for alternator at subframe.
- Screw out front bolts -2- of subframe on left and right.

Note:

To avoid the need for wheel alignment, subframe is only to be unfastened/lowered at front.

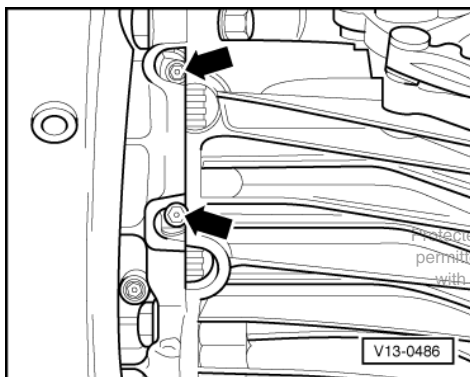


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- -> Slowly lower subframe with workshop crane VAS 6100 or V.A.G 1202 A.

Attention:
S



- -> Turn crankshaft until the two sump bolts -arrows- are visible at the recesses.
- Unscrew and detach sump; if necessary, release by tapping gently with a rubber-headed hammer.
- Detach baffle plate and gasket.

Installing

Install in reverse order, paying attention to the following:

Note:

Replace gaskets and oil seals.

- Clean sealing surfaces at sump and baffle plate before installing sump.
- Apply thin coat of sealant to front and rear sealing flange/cylinder block transitions at sump sealing surface.
 - Sealant

=> Parts List

- Fit gasket, baffle plate, 2nd gasket and sump and pre-tighten all bolts diagonally to 5 Nm.
- Secure sump to gearbox.
 - Tightening torque for M8 bolts: 25 Nm
 - Tightening torque for M10 bolts: 45 Nm
- Diagonally tighten bolts attaching sump to cylinder block.
 - Tightening torque for M6 bolts: 10 Nm
 - Tightening torque for M8 bolts: 20 Nm
- Fit subframe with new bolts.

=> Running Gear, Front-wheel Drive and Four-wheel Drive; Repair Group 40



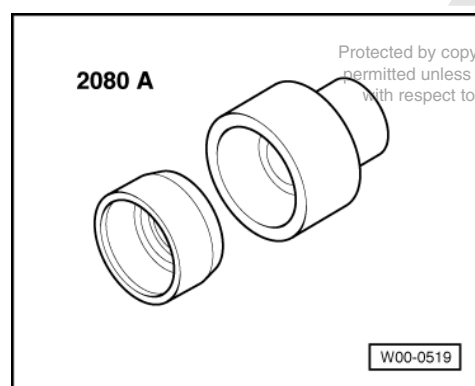
- Pour in engine oil and check oil level.

=> Maintenance

Tightening torques

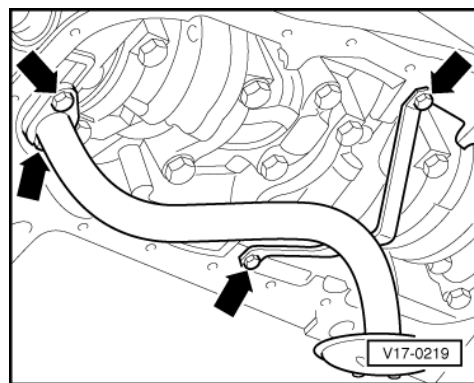
Component		Nm
Sump to cylinder block	M6	10
	M8	20
Sump to gearbox	M8	25
	M10	45
Holder for noise insulation		10

1.4 - Removing and installing oil pump



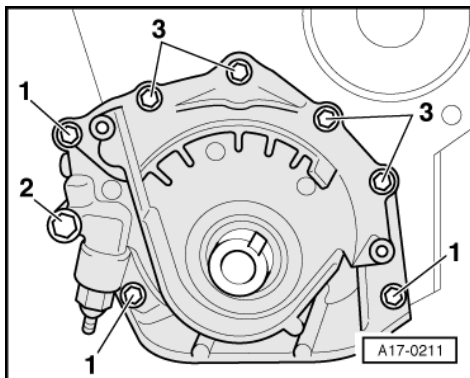
Special tools and workshop equipment required

- ♦ Fitting sleeve for oil seal 2080 A



Removing

- Remove toothed belt => Page 39 .
- Remove sump => Page 125 .
- -> Remove oil intake pipe -arrows-.



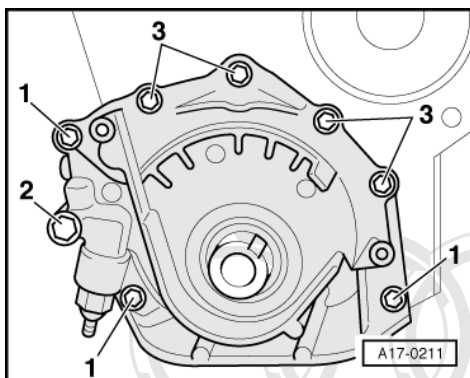
- -> Screw out bolts -1-, -2- and -3-.
- Detach oil pump to front.
- Drive out oil seal with oil pump removed.

Installing

Install in reverse order, paying attention to the following:

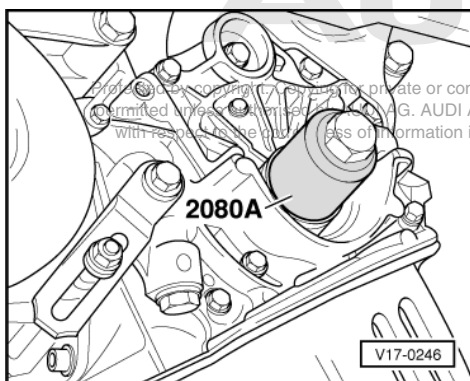
Notes:

- ◆ Replace gaskets and oil seals.
- ◆ If oil pump is fitted with oil seal installed, guide sleeve from 2080 A must be attached to end of crankshaft before fitting oil pump.
- Clean sealing surfaces before installing oil pump.
- Mount oil pump such that it engages in drivers at crankshaft.



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

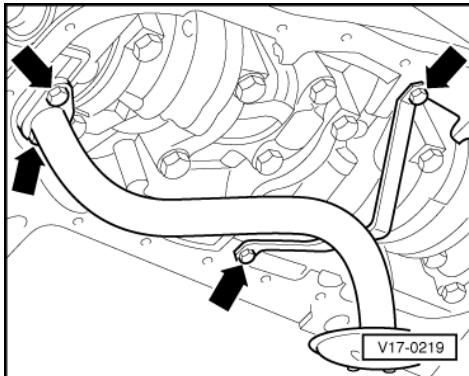
=> Parts List



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- Position guide sleeve from 2080 A on crankshaft journal.
- Slip oil seal carefully over guide sleeve.
- -> Press home oil seal with fitting sleeve and cleaned bolt for vibration damper.



- -> Fit oil intake pipe -arrows-.

Notes:

- ♦ Depending on design status, bolts at oil intake pipe flange must be secured with locking fluid or a new lock washer.
- ♦ There must not be any oil on contact surface between toothed belt sprocket and crankshaft.
- Install sump => Page **127** .
- Fit toothed belt (adjust valve timing) => Page **43** .

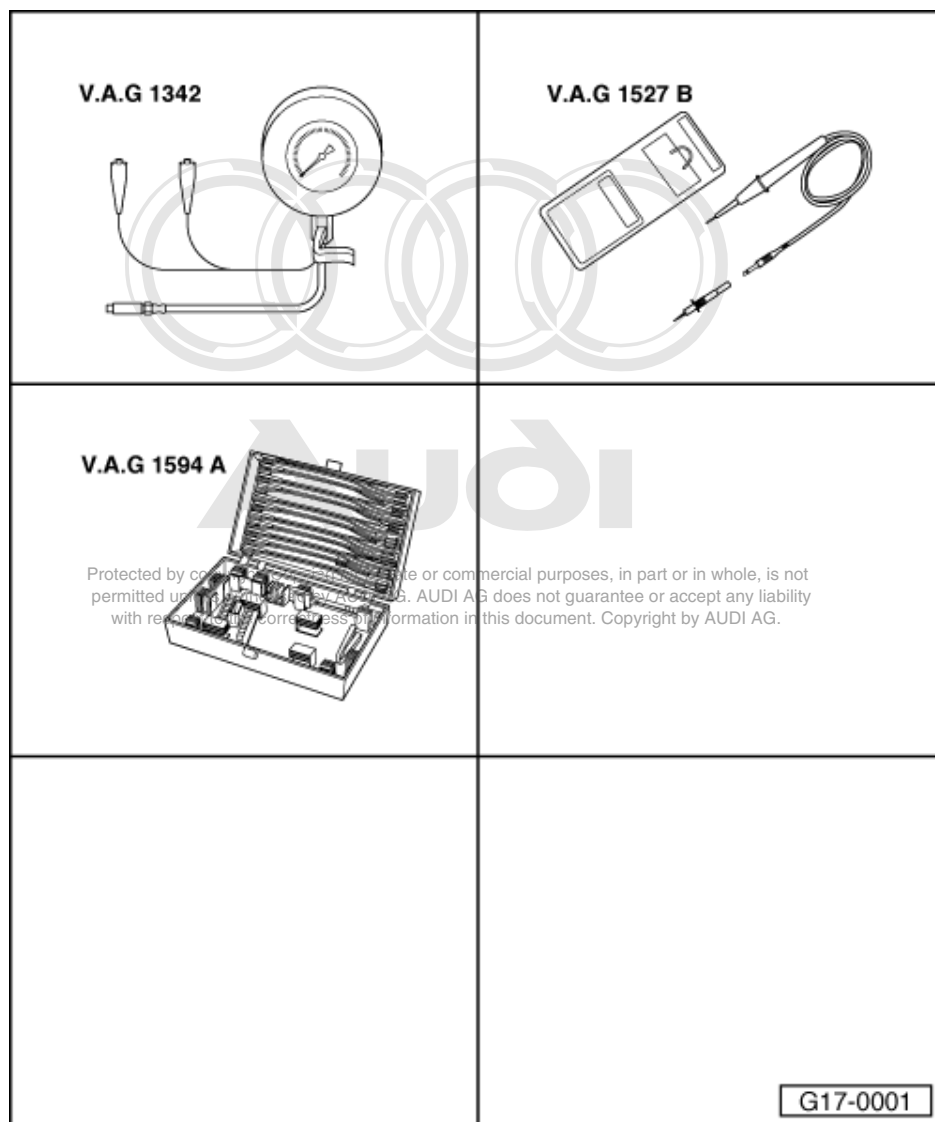
Tightening torques

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



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1.5 - Checking oil pressure and oil pressure switch



Special tools and workshop equipment required

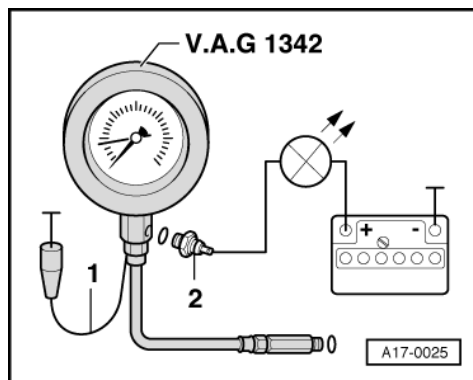
- ◆ V.A.G 1342
- ◆ V.A.G 1527 B
- ◆ V.A.G 1594 A

Test requirements:

- Oil level OK
- Oil pressure warning lamp -K3 must light with ignition on
- "OK" display must light on vehicles with auto check system (select symbol)
- Engine oil temperature approx. 80°C

Checking warning lamp

After switching on ignition ("terminal 15 on"), oil pressure warning lamp lights with engine stopped (not on vehicles with auto check system).



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

- Disconnect wire from oil pressure switch.
- Screw out oil pressure switch.
- -> Connect oil pressure tester V.A.G 1342 to bore for oil pressure switch.
- 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 with test leads from V.A.G 1594 A to oil pressure switch and battery positive (+).
 - LED must light
- If LED does not light, replace oil pressure switch.
- Start engine.

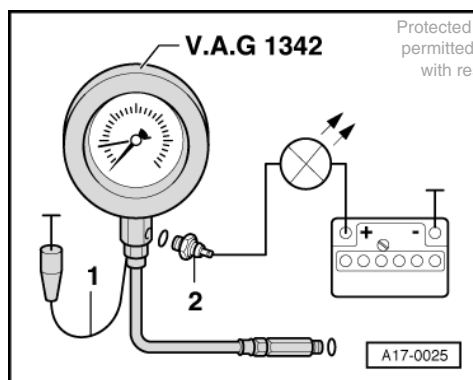
Note:

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

- LED must go out at 0.15 ... 0.45 bar
- If LED does not go out, replace oil pressure switch.

Note:

0.25 bar (blue) oil pressure switch is supplied as replacement for 0.3 bar (brown) oil pressure switch.

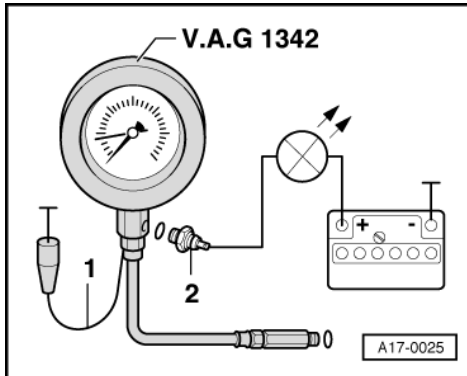


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Checking 1.8 bar (white) oil pressure switch

- Disconnect wire from oil pressure switch.
- Screw out oil pressure switch.
- -> Connect oil pressure tester V.A.G 1342 to bore for oil pressure switch.
- 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 with test leads from V.A.G 1594 A to oil pressure switch and battery positive (+).
 - LED must not light
- If LED lights, replace oil pressure switch.

- Start engine.
 - LED must light at 1.6 ... 2.0 bar
- If LED does not light, replace oil pressure switch.



Checking oil pressure

- Disconnect wire from oil pressure switch.
- Screw out oil pressure switch.
- -> Connect oil pressure tester V.A.G 1342 to bore for oil pressure switch.
- Start engine (engine oil temperature approx. 80°C).
 - Oil pressure at 2000 rpm: min. 2.0 bar
 - Oil pressure at higher engine speed: max. 4.5 bar

If readings do not match specifications:

- Pressure relief valve/oil pump defective; replace oil pump
=> Page **128**.

Note:

If oil pressure is far too high, hydraulic tappets will be subject to excessive pressure. Engine cuts out soon after starting and, the next time starting is attempted, it is cranked at a conspicuously high rate by the starter due to a lack of compression. The engine will no longer start.

1.6 - Engine oil

Viscosity classes and oil specifications

Viscosity classes and oil specifications:

=> Maintenance

1.7 - Checking oil level

Test requirements:

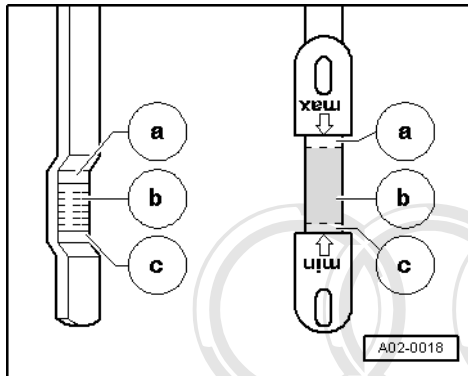
- Engine oil temperature at least 60 ° C
- Vehicle on a flat surface
- Wait a few minutes after switching off engine to allow oil to flow back into sump

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Test sequence

- Pull out dipstick, wipe off with a clean cloth and insert it again as far as it will go.
- Then pull out dipstick again and read off oil level.



-> Markings on dipstick:

- a - Do not top up oil.
- b - Oil can be topped up. Oil level may then rise as far as area -a-.
- c - Oil must be topped up. After topping up, it is sufficient for oil level to be somewhere in area -b- (hatched area).

Note:

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Oil level must not be above mark -a- on dipstick.

19 - Cooling system

1 - Removing and installing cooling system components

1.1 - Removing and installing cooling system components

Attention:
Hot vapour/hot coolant may escape when opening expansion tank. Cover cap with cloth and open carefully.

Notes:

- ♦ Cooling system is pressurised when engine is warm. Dissipate pressure if necessary before starting repair work.
- ♦ Secure all hose connections with standard hose clamps.

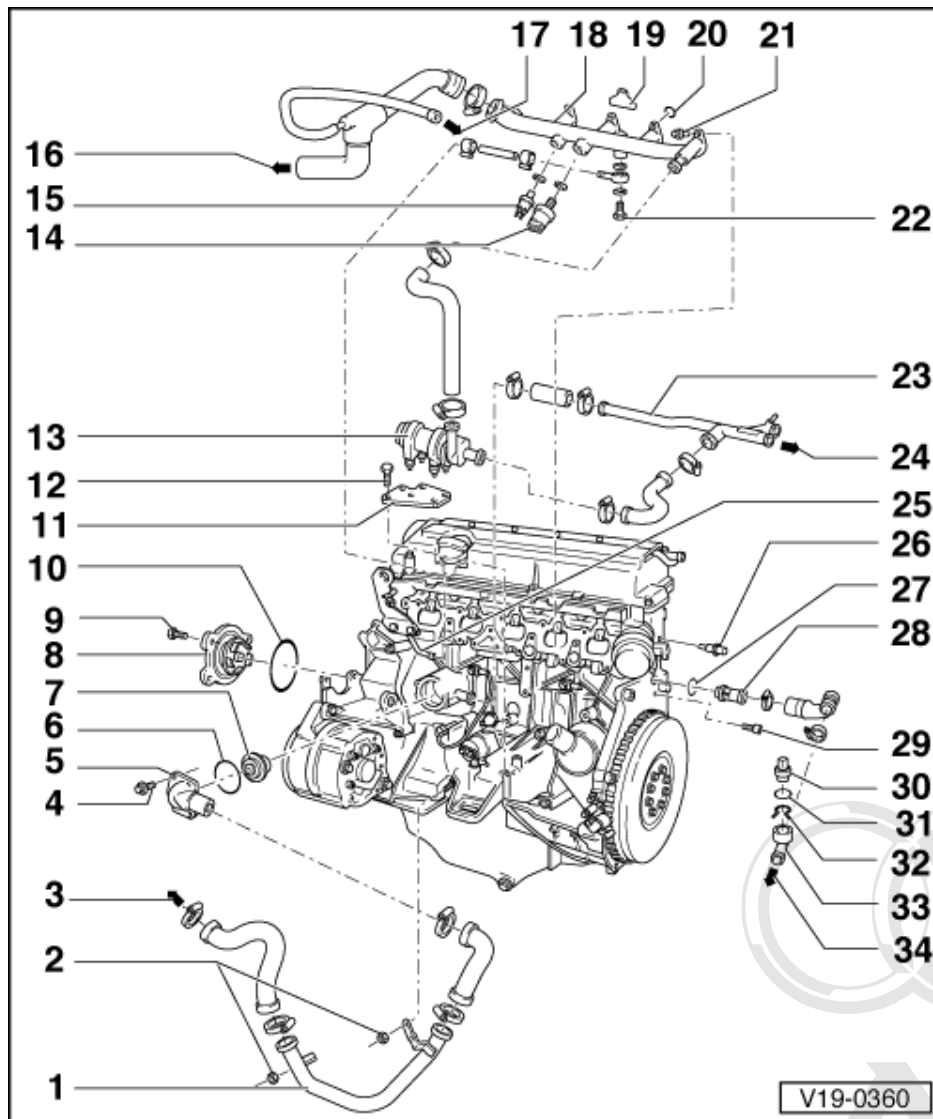
=> Parts List

- ♦ Special tool V.A.G 1921 is recommended for fitting spring clips.
- ♦ Always replace gaskets and sealing rings.
- ♦ The arrows on the coolant pipes and the ends of the coolant hoses must be aligned.

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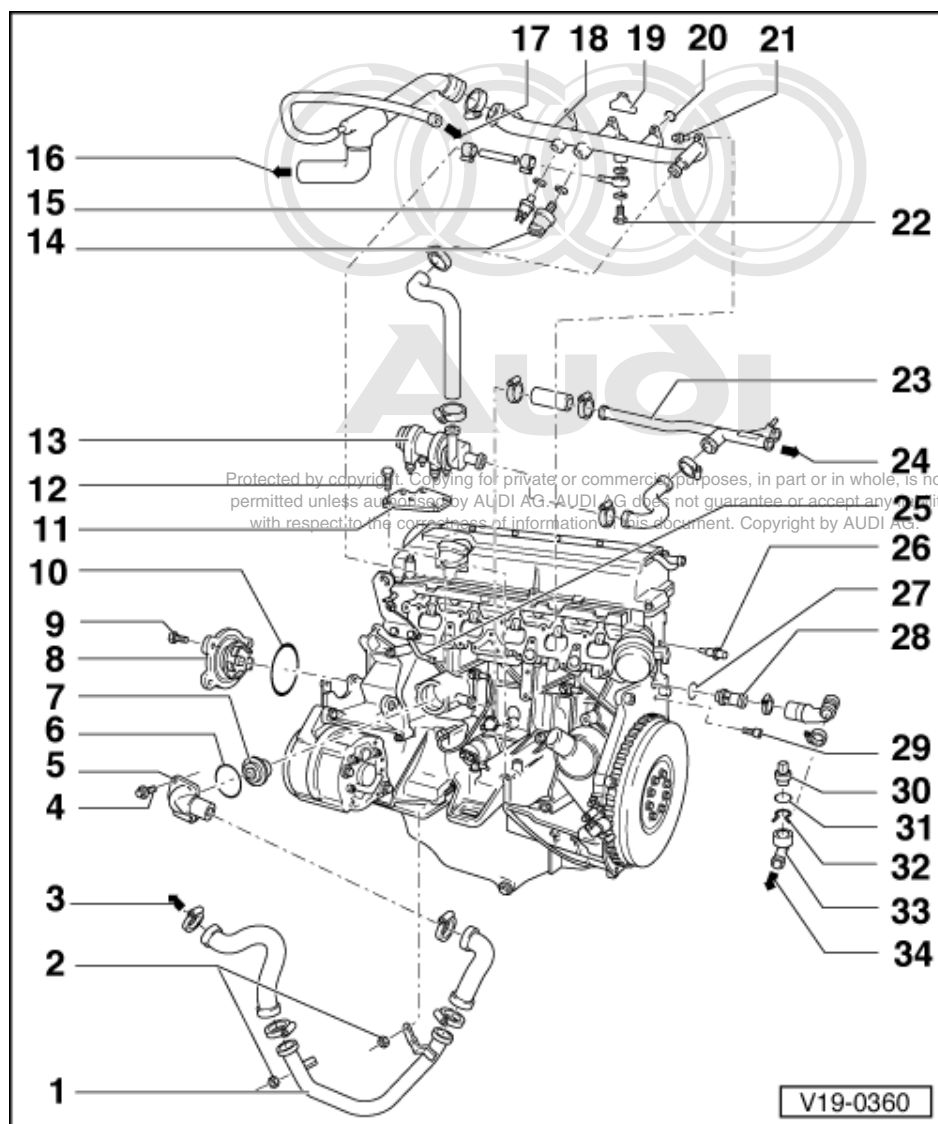


1.2 - Cooling system components



- 1 Coolant pipe
 - ♦ For vehicles with air conditioner
- 2 20 Nm
- 3 To bottom of radiator
 - ♦ Installation position of bottom coolant hose=>Fig. 140
- 4 10 Nm
- 5 Connection
- 6 O-ring
 - ♦ Replace
 - ♦ Moisten with coolant
- 7 Thermostat
 - ♦ Removing and installing
=> Page 145
 - ♦ Checking => Page 146
 - ♦ Installation position
=> Fig.19-6

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8 Coolant pump

- ♦ Removing and installing coolant pump=>Page 144

9 20 Nm

10 O-ring

- ♦ Replace
- ♦ Moisten with coolant

11 Holder

- ♦ For continued coolant circulation pump
- ♦ Fitted at engine support on left

12 20 Nm

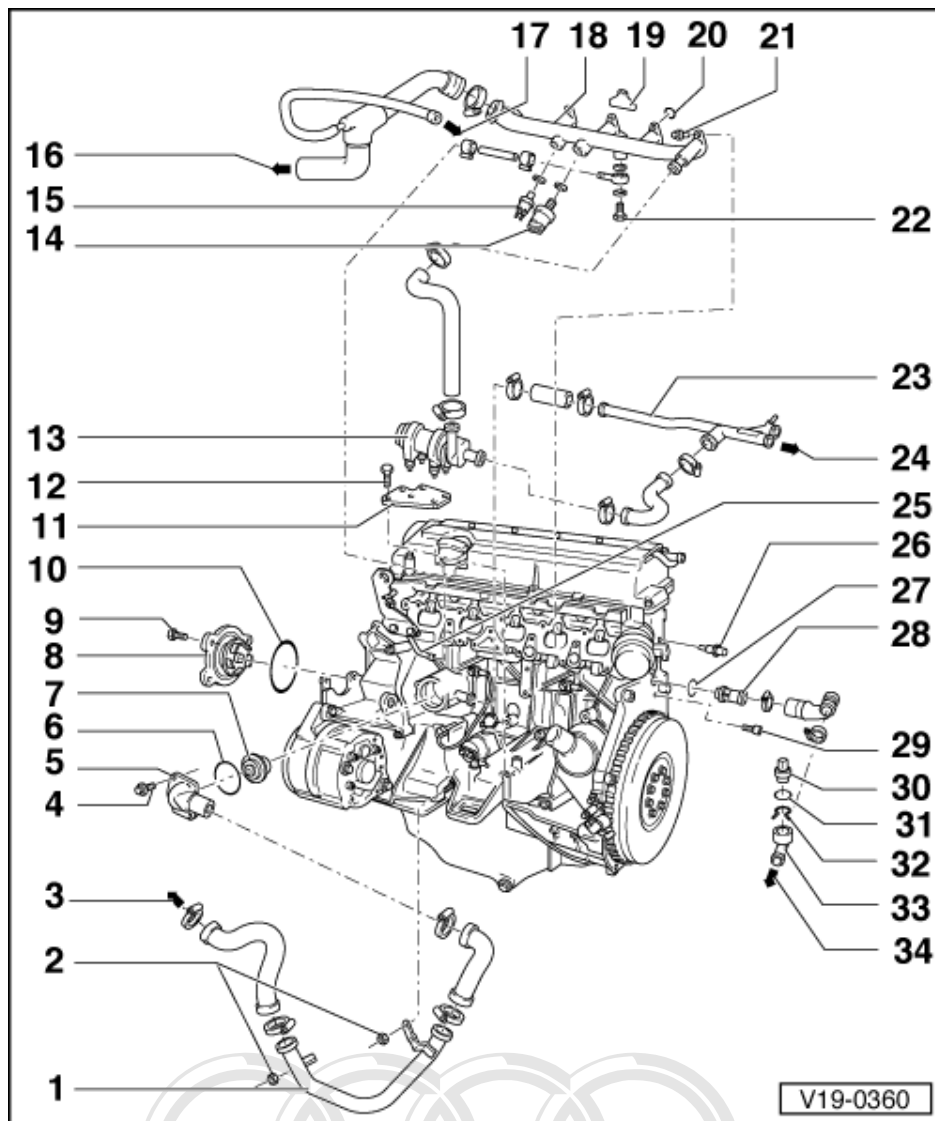
13 Continued coolant circulation pump -V51

- ♦ For turbocharger
- ♦ Checking

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

14 Electronic thermal switch -F76

- ♦ Fit sealing ring on installation
- ♦ Tighten to 25 Nm



15 Thermal switch -F98

- ◆ For continued coolant circulation pump
- ◆ Switching temperatures:
On: 106...112 °C
Off: 94...105 °C
- ◆ Tighten to 15 Nm

16 To top of radiator

17 To expansion tank

18 Coolant collecting pipe

19 Gasket

- ◆ Replace

20 O-ring

- ◆ Replace
- ◆ Moisten with coolant

21 10 Nm

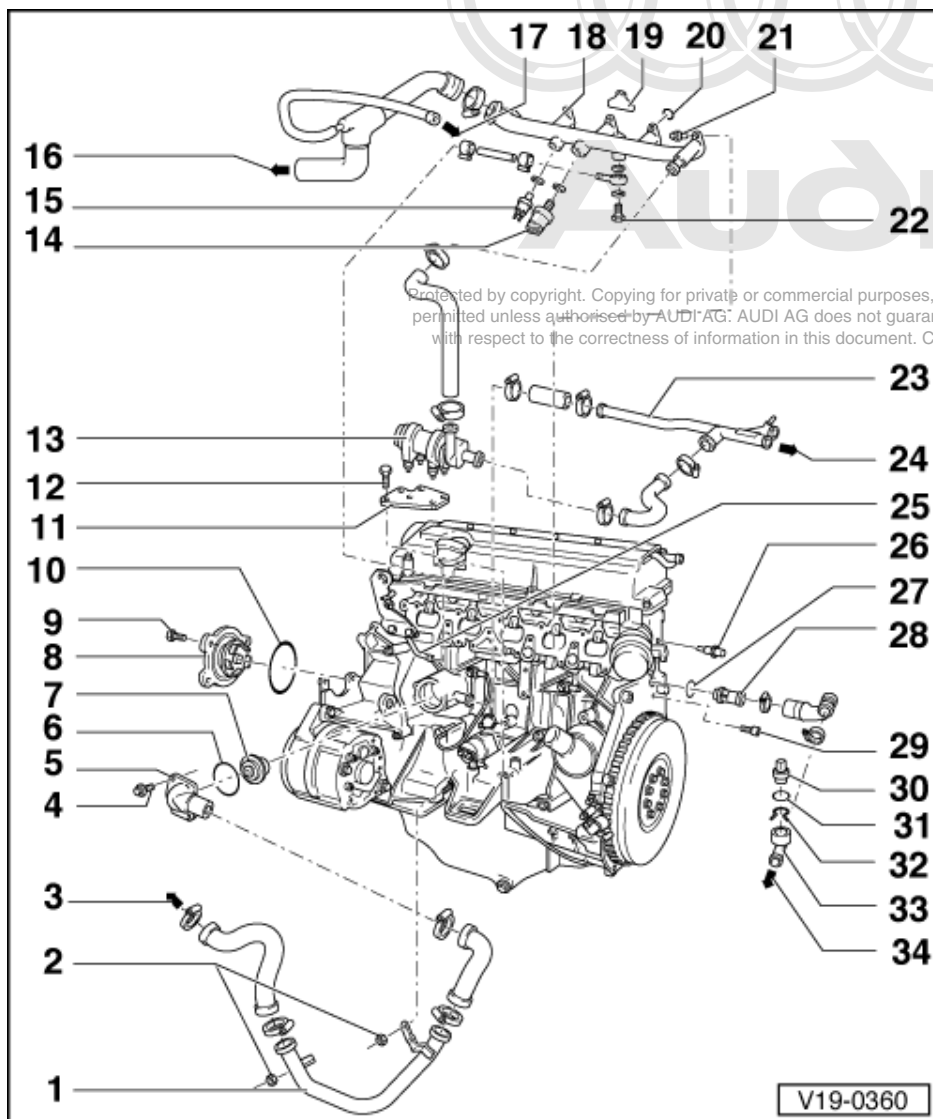
22 Banjo bolt, 30 Nm

23 Coolant pipe

24 To heat exchanger

25 Coolant supply pipe

- ♦ To turbocharger



26 Coolant temperature sender -G62

- ♦ Tighten to 15 Nm

27 O-ring

- ♦ Replace
- ♦ Moisten with coolant

28 Connection

29 20 Nm

30 Air conditioner system coolant temperature sender -G110

- ♦ For vehicles with air conditioner
- ♦ Not always fitted

31 O-ring

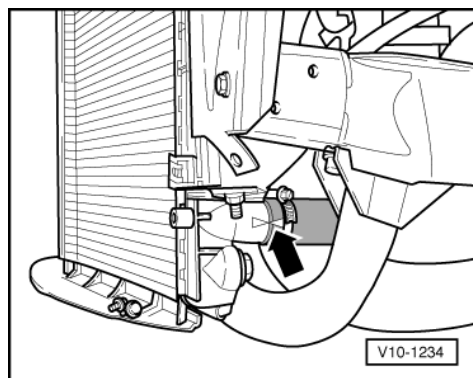
- ♦ Replace
- ♦ Moisten with coolant

32 Clip

33 Connection

- ♦ For vehicles with air conditioner

34 To heat exchanger



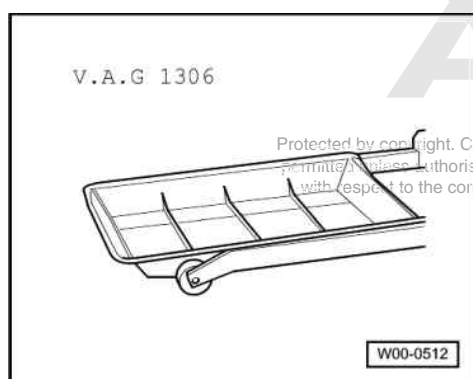
-> Fig.1 Installation position of bottom coolant hose

- ♦ Marks must coincide -arrow-

-> Fig.2 Installation position of thermostat

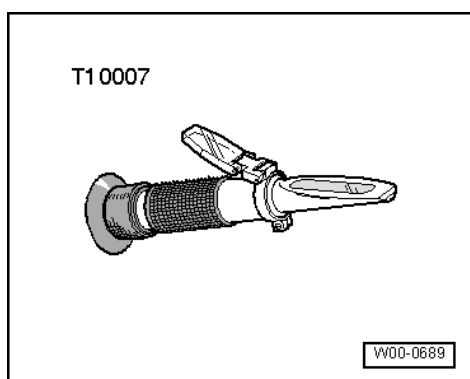
- ♦ Bracket of thermostat must be in vertical position

1.3 - Draining off and topping up coolant



Special tools and workshop equipment required

- ♦ Drip tray V.A.G 1306



- ◆ Refractometer T10007

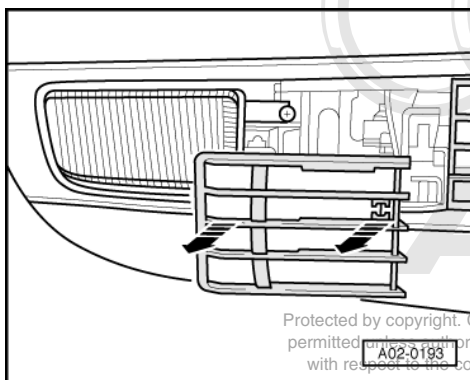
Draining off

Note:

Coolant drained off must be collected in a clean container for disposal/re-use.

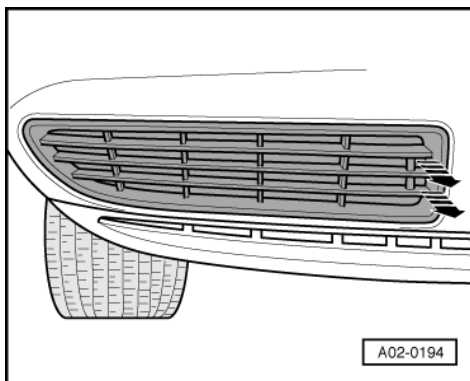
Attention:
Hot vapour/hot coolant may escape when opening expansion tank. Cover cap with cloth and open carefully.

- Unscrew cap of coolant expansion tank.



Audi 100:

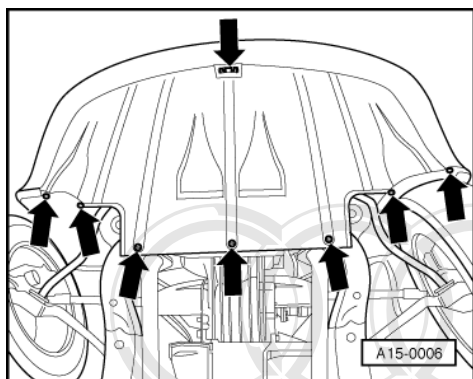
- -> Unclip air grille at bottom right of bumper -arrows-.





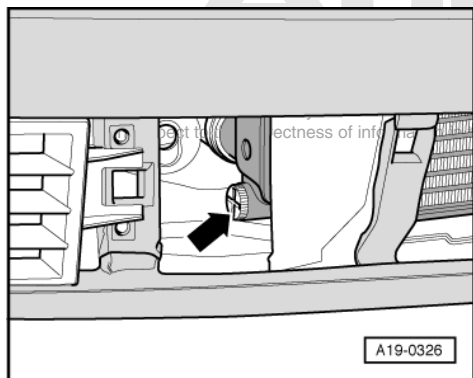
Audi S6:

- -> Detach air grille after pulling off retainer tabs -arrows-.

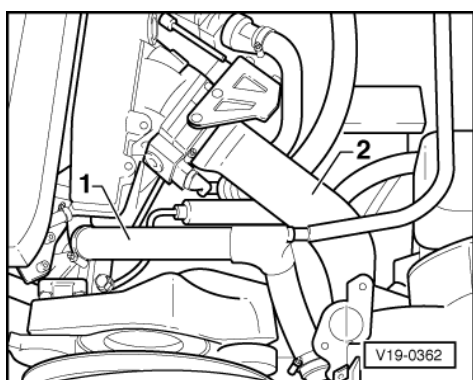


All models:

- -> Detach noise insulation -arrows-.



- Position drip tray V.A.G 1306 beneath engine.
- -> Turn drain plug -arrow- at radiator anti-clockwise; attach test hose to connection if necessary.



- -> Detach coolant hose -1- at coolant collecting pipe and radiator. Lay coolant hose aside.
- Remove air hose -2-.

- -> Unscrew connection -arrows- to drain off remaining coolant.
- Detach O-ring and thermostat. Allow remaining coolant to drain off.

Filling

Notes:

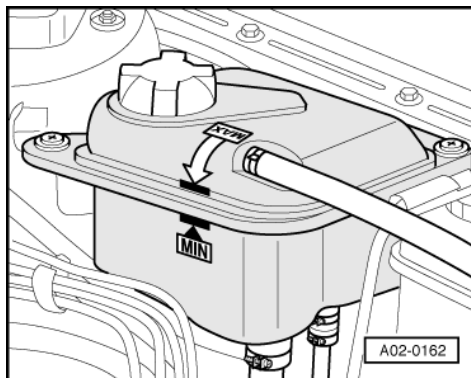
- ◆ The cooling system is filled all year round with a mixture of water and radiator anti-freeze/anti-corrosion agent.
- ◆ Exclusive use is to be made as coolant additive of G12+ as per TL VW 774 F. Other coolant additives could considerably impair anti-corrosion action in particular. The resultant damage could lead to loss of coolant and consequently to serious engine damage.
- ◆ Coolant additive G12+ can be mixed with additives G11 and G12.
- ◆ G12+ and coolant additives marked "meeting specification TL VW 774 F" prevent frost and corrosion damage, stop scale forming and at the same time also increase the boiling point. The cooling system must therefore be filled all year round with anti-freeze and anti-corrosion additive.
- ◆ On account of the higher boiling point, the coolant helps to enhance engine reliability under heavy loads particularly in countries with tropical climates.
- ◆ Frost protection must be guaranteed to around -25 °C (in countries with arctic climate to around -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 G12+ can be increased, however only up to 60 % (giving frost protection to around -40 °C) as otherwise frost protection decreases again and cooling efficiency is also impaired.
- ◆ Exclusive use is to be made of clean drinking water for mixing coolant.
- ◆ Old coolant is not to be re-used following replacement of radiator, heat exchanger, cylinder head or cylinder head gasket.
- ◆ For checking anti-freeze protection in cooling system, use must be made for coolant additive G12+ of the special tool T10007.

Recommended mixing ratios:

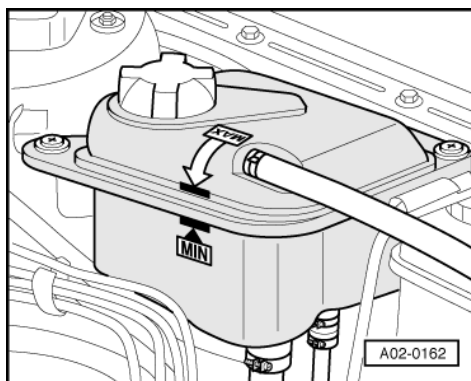
Frost protection to	Anti-freeze concentration	G12+ 1)	Water 1)
-25 °C	40 %	3.6 l	5.4 l
-35 °C	50 %	4.5 l	4.5 l

1) Coolant quantity 9.0 litres; may vary depending on vehicle equipment.

- Fit thermostat with new O-ring => Page 145 .
- Fit air hose.
- Fit and secure coolant hoses.



- Close drain plug at radiator.
- -> Pour in coolant as far as max. mark on expansion tank.
- Seal expansion tank.
- Start engine.
- Run engine until it reaches operating temperature (coolant temperature gauge reading approx. 80 °C).



Attention:

Hot vapour/hot coolant may escape when opening expansion tank. Cover cap with cloth and open carefully.

- -> Check coolant level and top up coolant if necessary. Coolant level must be on max. mark with warm engine and between min. and max. mark with cold engine.
- Switch off engine.

Tightening torques

Component	Nm
Clamps for coolant hoses	2
Clamps for air hoses	3.5

1.4 - Removing and installing coolant pump

Removing

- Drain coolant=> Page 140 .
- Detach toothed belt from camshaft sprocket
=> Page 45 .
- Screw out bolts for coolant pump and detach coolant pump.

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Installing

Install in reverse order, paying attention to the following:

Note:

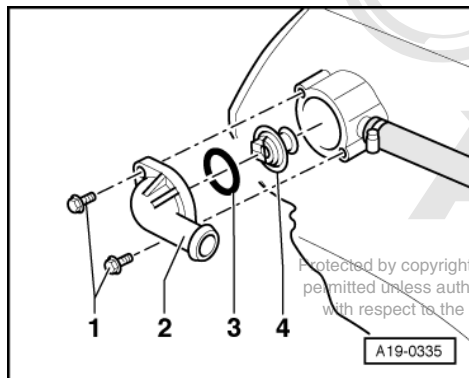
Replace coolant pump O-ring.

- Clean/smooth sealing surface for O-ring before fitting.
- Moisten new O-ring with G12+ and apply at coolant pump.
- Screw on coolant pump.
- Fit toothed belt (adjust valve timing) => Page 43 .
- Fill with coolant=> Page 143 .

Tightening torques

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

1.5 - Removing, installing and checking thermostat



Removing

- Drain coolant=> Page 140 .
- -> Screw out bolts -1-; detach connection -2-, O-ring -3- and thermostat -4-.



Installing

Install in reverse order, paying attention to the following:

Note:

Replace gaskets and oil seals.

- Clean/smooth sealing surface for O-ring.
- -> Insert thermostat.
 - Installation position: Bracket of thermostat must be in vertical position
- Moisten new O-ring with G12+.
- Fill with coolant=> Page **143**.

Tightening torque

Component	Nm
Connection to cylinder block	10

Checking thermostat

- Heat thermostat in water bath.

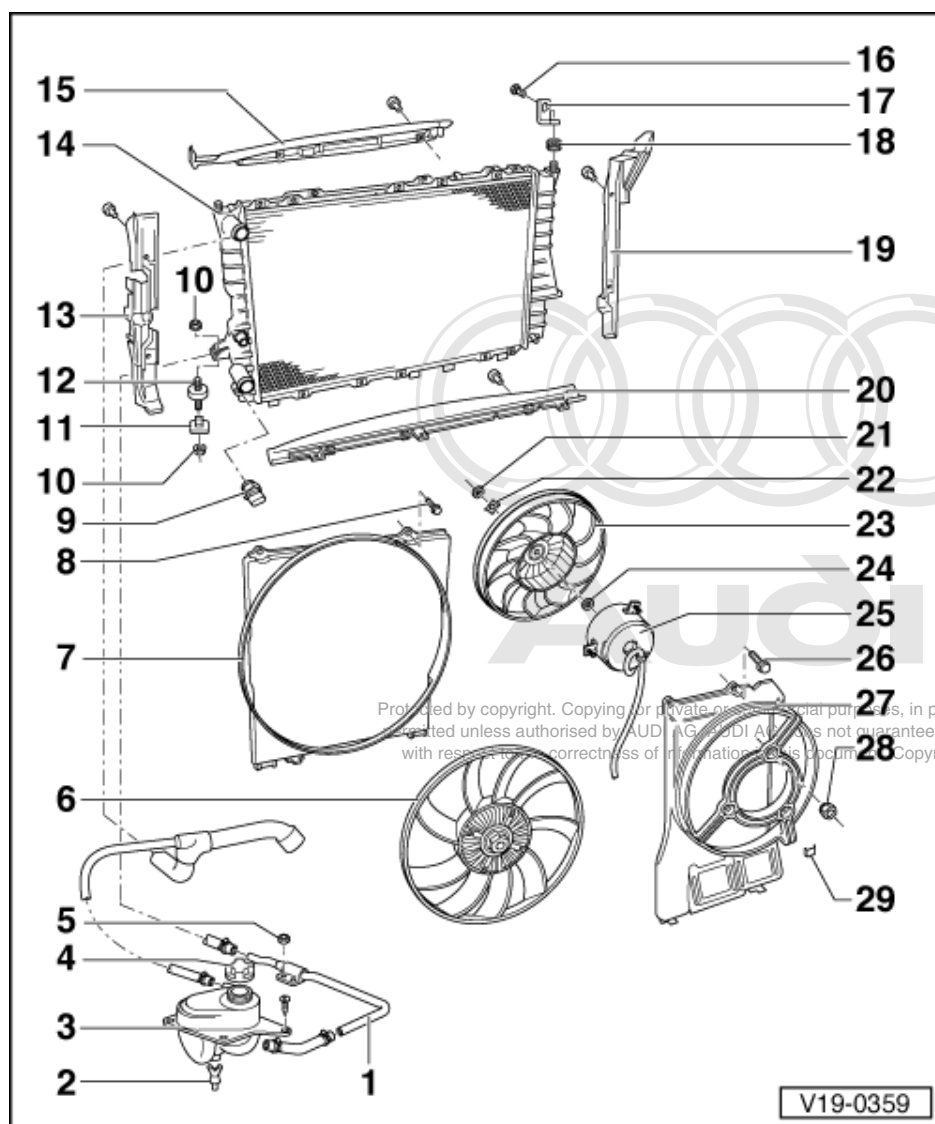
Start of opening	End of opening	Opening stroke
approx. 87°C	approx. 102°C1)	min. 8 mm

- 1) Cannot be checked

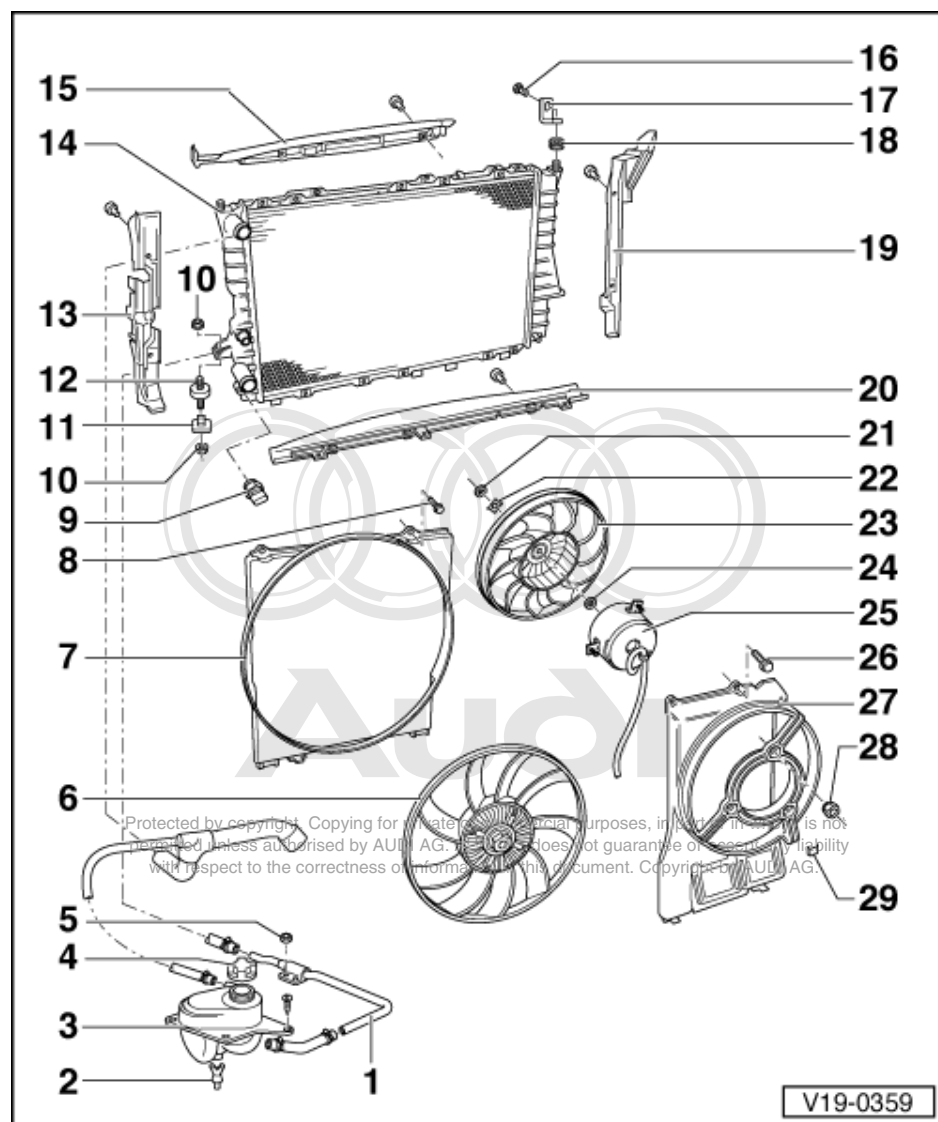


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1.6 - Exploded view of radiator and radiator fan



- 1 Coolant pipe
- 2 Connector
 - ♦ For coolant shortage indicator switch -F66
- 3 Expansion tank
 - ♦ With coolant shortage indicator switch -F66
- 4 Cap
 - ♦ With pressure relief valve
 - ♦ Checking pressure relief valve in cap => Page 158
- 5 10 Nm



6 Fan impeller

- ◆ With viscous coupling
- ◆ "FRONT" mark on outer ring must face in direction of travel
- ◆ Cut-in temperature: 72 ... 80 °C ambient temperature at viscous coupling
- ◆ Checking =>Page 153
- ◆ Removing and installing
=> Page 151

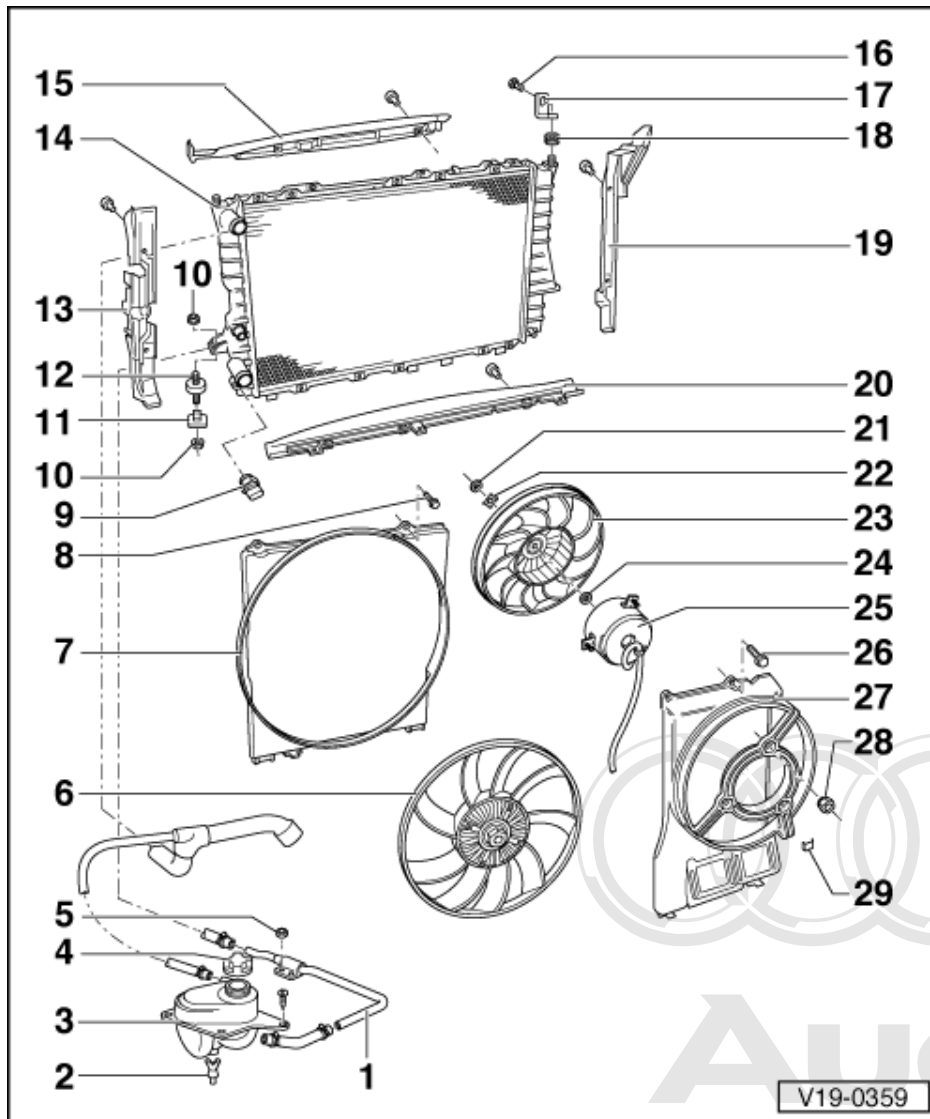
7 Radiator cowl

- ◆ Removing and installing
=> Page 153

8 10 Nm

9 Radiator fan thermal switch -F18, 25 Nm

- ◆ Switching temperatures:
 - 1st speed
 - On: 92...97 °C
 - Off: 84...91 °C
 - 2nd speed
 - On: 99...105 °C
 - Off: 91...98 °C
 - + = wire



10 10 Nm

11 Packing plate

12 Bonded rubber bush

13 Air duct

14 Radiator

- ♦ Removing and installing
=> Page 153
- ♦ Use fresh coolant after replacement
- ♦ Installation position of bottom coolant hose => Fig. 140

15 Air duct

16 10 Nm

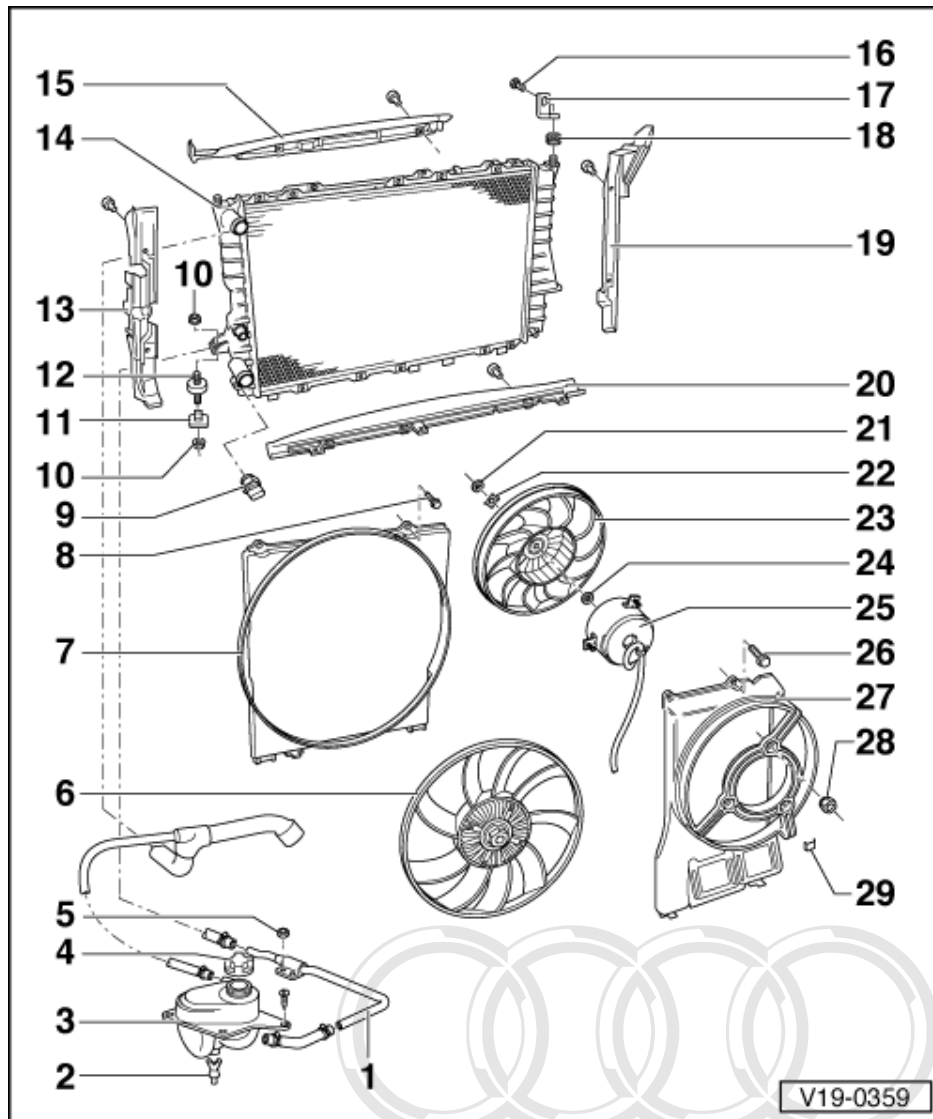
17 Bracket

18 Rubber grommet

19 Air duct

20 Air duct

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21 10 Nm

- ◆ Left-hand thread

22 Circlip

- ◆ Engages in fan impeller
- ◆ Bend over one toothed segment to secure nut

23 Fan impeller

24 Washer

25 Fan motor

- ◆ Different versions
- ◆ Assignment

=> Parts List

26 10 Nm

27 Radiator cowl

- ◆ For electric fan
- ◆ Removing and installing
=> Page 153

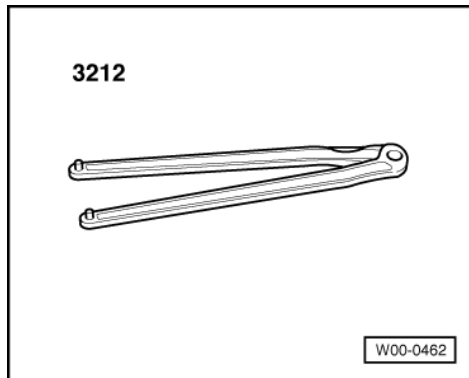
28 10 Nm

29 Clip

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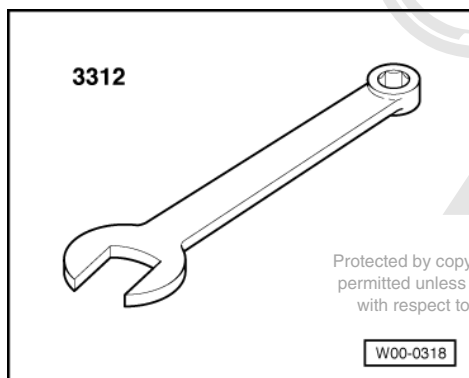
- ♦ For wire to fan motor

1.7 - Removing and installing viscous fan



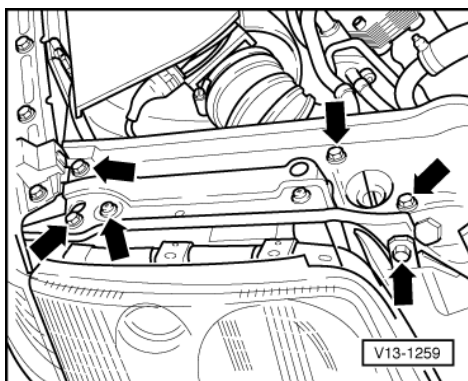
Special tools and workshop equipment required

- ♦ Pin wrench 3212



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- ♦ Open-ended wrench 3312

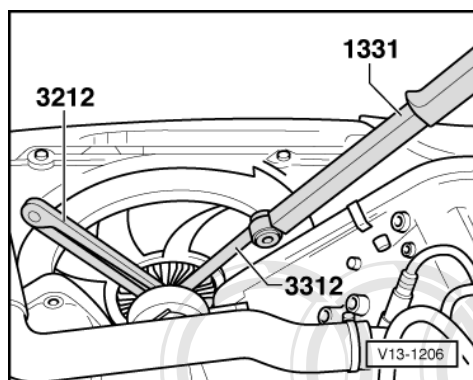


Removing

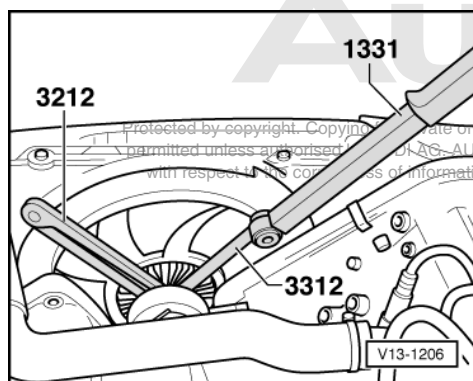
- -> Screw out bolts on left and right marked with -arrows- as well as one at top of headlight.
- Disengage bonnet cable at lock carrier.

=> General Body Repairs; Repair Group 55; Bonnet Bonnet

- Detach lock carrier.



- -> Support pulley for viscous fan with pin wrench 3212 and unscrew viscous fan with open-ended wrench 3312.
- Detach viscous fan from mount and move it forwards into radiator cowl.
- If necessary, unclip wiring harness at bottom of radiator cowl.
- Unscrew radiator cowl at radiator and lift it out together with viscous fan.



Installing

Install in reverse order, paying attention to the following:

- -> Secure viscous fan using open-ended wrench 3312 and torque wrench V.A.G 1331.
- Provide support with pin wrench 3212 when tightening.
- Install lock carrier with attachments.

=> General Body Repairs; Repair Group 50; Front Body Front Body

- Adjust headlights.

=> Electrical System; Repair Group 94; Servicing headlights; Headlight adjustment Servicing headlights Headlight adjustment

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

Note:

If use is made of torque wrench other than V.A.G 1331, tightening torque is governed by length of torque wrench (measured from square head to centre of handle):

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

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

1.8 - Checking viscous fan

Note:

Operation of viscous fan coupling cannot be checked with workshop equipment.

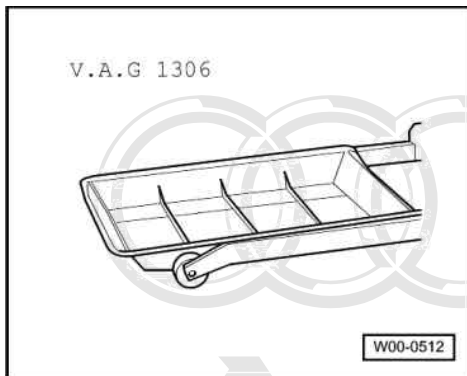
Visual inspection

- Check viscous fan for escape of oil. Back of coupling housing must be clean and dry.
- Check freedom of movement of fan with engine stopped. It must be possible to turn fan impeller without noticeable resistance.

Checking axial clearance

- Measure at outer periphery of fan impeller.
 - Axial clearance: Max. 15 mm

1.9 - Removing and installing radiator



Special tools and workshop equipment required

- ♦ Drip tray V.A.G 1306

Removing

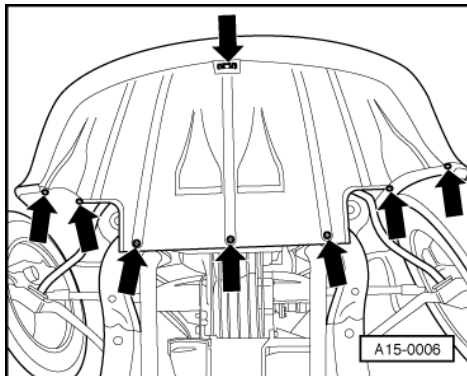
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Coolant drained off must be collected in a clean container for disposal/re-use.

Attention:

Hot vapour/hot coolant may escape when opening expansion tank. Cover cap with cloth and open carefully.

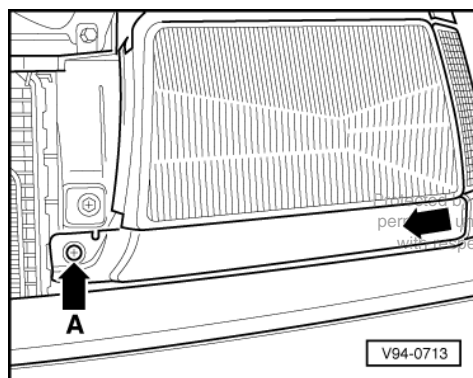
- Unscrew cap of coolant expansion tank.





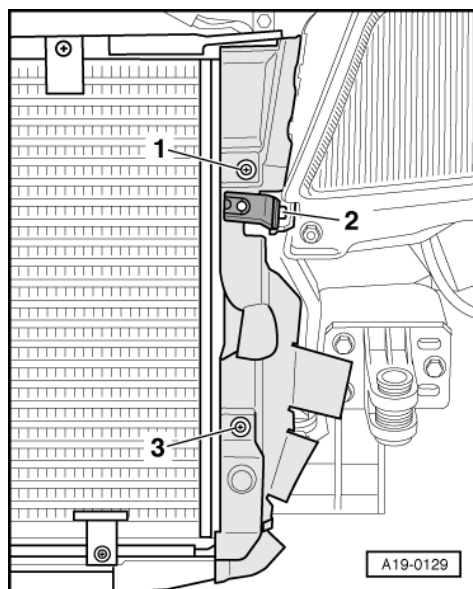
- -> Detach noise insulation -arrows-.
- Remove front bumper.

=> General Body Repairs; Repair Group 63; Front Bumper Front Bumper



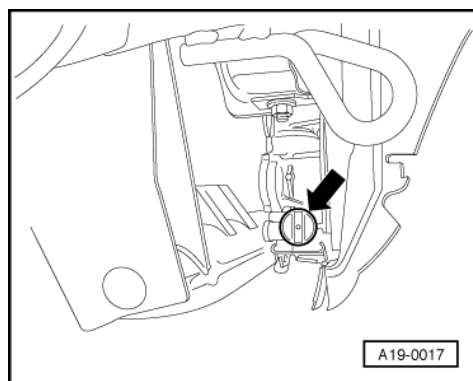
Audi S6:

- -> Screw out bolt -arrow A- and pull out headlight trim in direction of arrow.

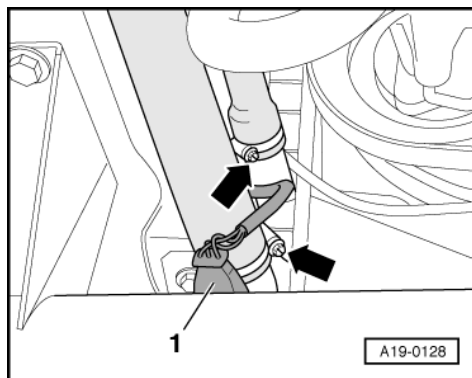


All models:

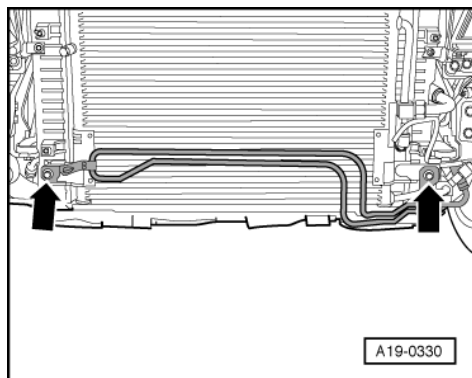
- -> Screw out bolt -2- of retainer for headlight trim at housing.
- Screw out bolts -1- and -3- of air ducts on left and right of radiator and detach air ducts.



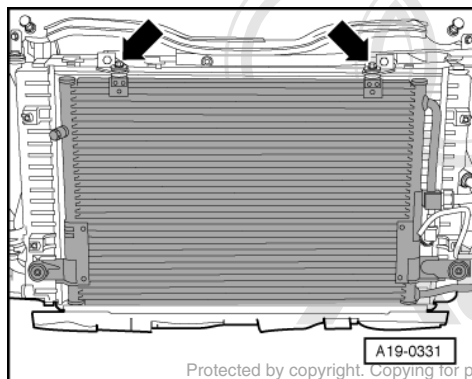
- Position drip tray V.A.G 1306 beneath engine.
- -> Turn drain plug -arrow- at radiator anti-clockwise; attach test hose to connection if necessary.



- -> Detach both coolant hoses at bottom of radiator -arrows-.
- Unplug connector -1- at radiator fan thermo-switch.



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



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Vehicles with air conditioner:

Attention:
Refrigerant circuit of air conditioner is never to be opened.

- -> Screw out condenser bolts -arrows-.

Note:

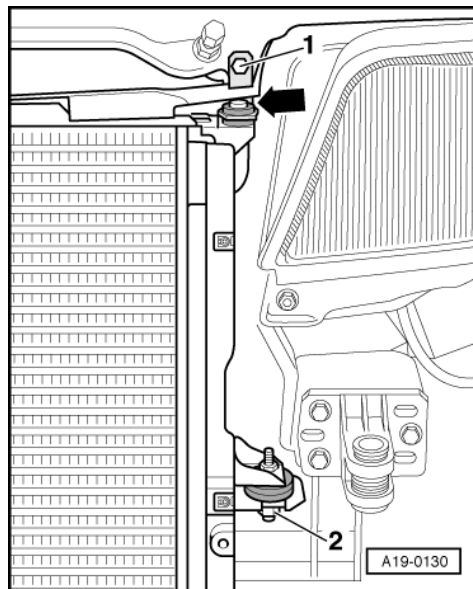
So as not to damage condenser and refrigerant pipes/hoses, take care to avoid straining, kinking or bending pipes and hoses.



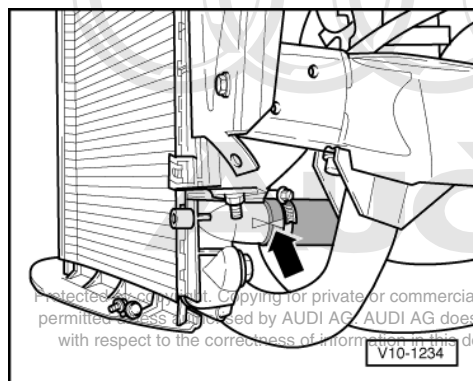
- Leave condenser hanging in installation position with refrigerant pipes/hoses connected.

All models:

- Unscrew air duct to air cleaner at radiator.
- Detach coolant hose at top left of radiator.
- Unscrew radiator cowl on back of radiator.
- Pull radiator cowl out of holders and tie it to lock carrier.



- -> Unscrew nuts -2- at bonded rubber bush.
- Pull bottom of radiator forwards out of mount for bonded rubber bush.
- Disengage upper radiator fastener -arrow- downwards (if necessary, screw out bolt -1- at radiator support).



Installing

Install in reverse order, paying attention to the following:

- -> Fit coolant hoses such that marks on coolant hose and connection coincide -arrow-.
- Install front bumper.

=> General Body Repairs; Repair Group 63; Front Bumper Front Bumper

- Fill with coolant=> Page 143 .

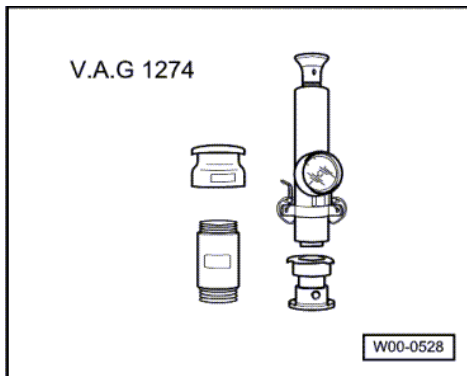
Note:

Entire coolant must be replaced following radiator replacement.

Tightening torques

Component		Nm
Radiator to front end	M6	10
	M8	20
Radiator cowl to radiator		10
Condenser to radiator		10
Power steering cooling coil to radiator		10
Clamps for coolant hoses		2

1.10 - Checking cooling system for leaks

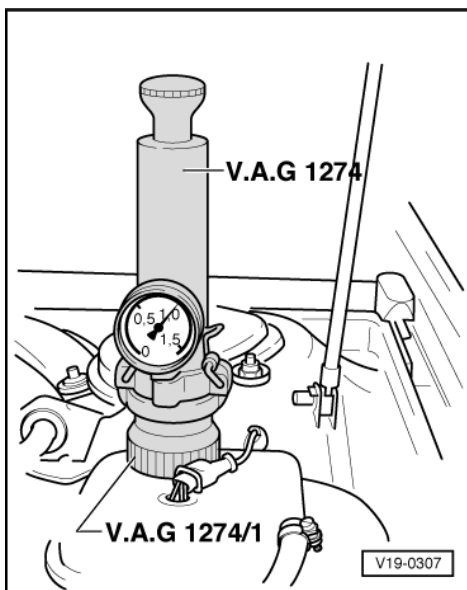


Special tools and workshop equipment required

- ♦ V.A.G 1274 with V.A.G 1274/1

Test requirement:

- Engine warm



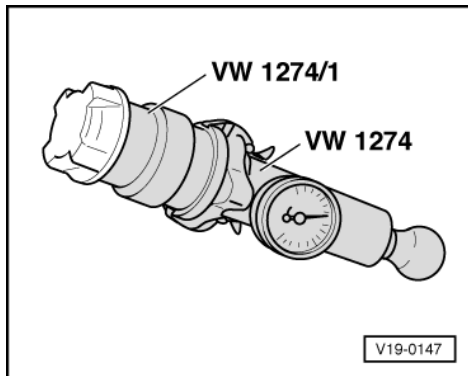


Test sequence

Attention:

Hot vapour/hot coolant may escape when opening expansion tank. Cover cap with cloth and open carefully.

- Unscrew cap of coolant expansion tank.
- -> Position tester V.A.G 1274 with adapter V.A.G 1274/1 on expansion tank.
- Use hand pump of tester to generate a pressure of approx. 1.0 bar.
- Locate leak and eliminate fault if there is a drop in pressure.



Checking pressure relief valve in cap

- -> Position tester V.A.G 1274 with adapter V.A.G 1274/1 (2 parts) on cap.
- Operate hand pump.
- Pressure relief valve must open at a pressure of 1.2 ... 1.5 bar

Audi

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21 - Charging

1 - Checking charge air system with turbocharger

1.1 - Checking charge air system with turbocharger

Notes:

- ◆ Observe rules for cleanliness => Page 172 .
- ◆ Secure all hose connections with standard hose clamps.

=> Parts List

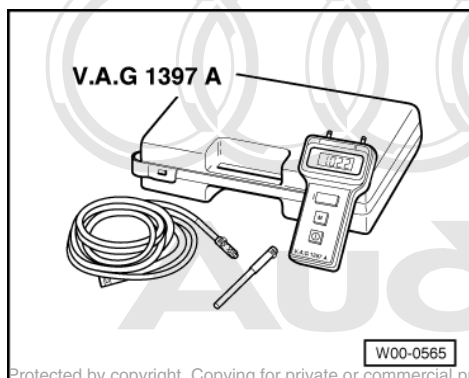
- ◆ Hose connections and hoses for charge air system must be free from oil and grease before fitting. Never use lubricant.

Safety precautions

Pay attention to the following if testers and measuring instruments have to be used in the course of a test drive:

Attention:

- ◆ Always attach testers and measuring instruments to back seat and have them operated from there by a second person.
- ◆ If testers and measuring instruments were to be operated from front passenger's seat, person sitting there could suffer injury in the event of an accident due to triggering of front passenger's airbag.



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Special tools and workshop equipment required

- ◆ Turbocharger tester V.A.G 1397 A

1.2 - Test requirements for checking turbocharging

1. - Coolant temperature min. 85 ° C
2. - Engine control unit fault memory interrogated
3. - No leaks on intake and exhaust end; effects of leaks => Page 160
4. - Control pipe to charge pressure control valve not clogged, loose or leaking



1.3 - Effects of leakage at intake and exhaust end

A - Leakage downstream of air-mass meter

Possible causes of trouble:

- 1 - Connecting hose between air-mass meter and turbocharger
- 2 - Connecting hose to crankcase breather
- 3 - Connecting hose to overrun shutoff valve

Effect:

- Lack of power

B - Leakage downstream of turbocharger (intake end)

Possible causes of trouble:

- 1 - Connecting hoses between turbocharger, charge air cooler and intake manifold
- 2 - Charge air cooler
- 3 - Hose to charge pressure control solenoid valve -N75
- 4 - Gasket between intake connection and intake manifold
- 5 - Gasket between intake manifold and cylinder head

Effect:

- Insufficient charge pressure

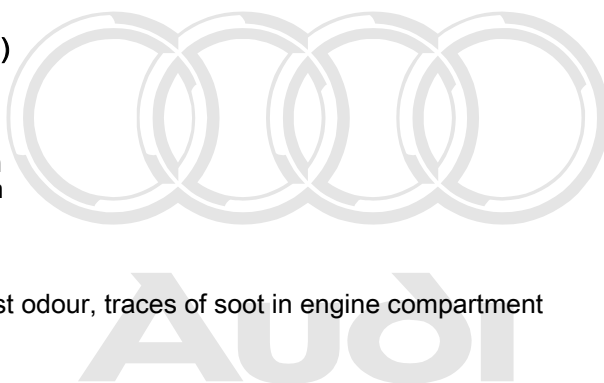
C - Leakage downstream of turbocharger (exhaust end)

Possible causes of trouble:

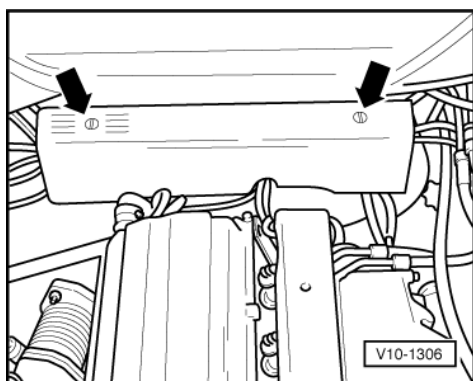
- 1 - Turbocharger/exhaust manifold connection
- 2 - Exhaust manifold/cylinder head connection

Effect:

- Insufficient charge pressure; possibly exhaust odour, traces of soot in engine compartment



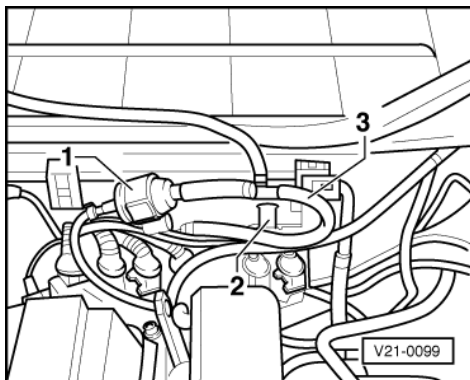
1.4 - Checking charge pressure



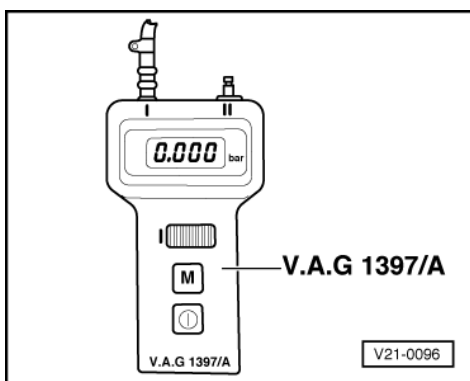
Test sequence

- -> Remove cover for connectors in engine compartment -arrows-.

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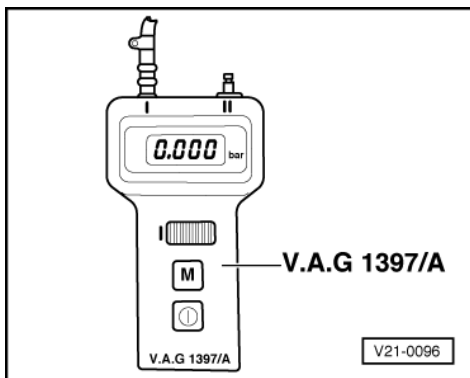
- -> Disengage water separator -1- at holder -2-.
- Connect T-piece with test hose of turbocharger tester V.A.G 1397 A between water separator -1- and hose -3-.
- Route test hose over rear edge of bonnet and through right window into passenger compartment.



- -> Switch on turbocharger tester and set range switch to position -I- (absolute pressure).
- Attach test hose to connection -I-.

Notes:

- ◆ Ensure absolute leakproof connection of hoses to avoid measurement errors.
- ◆ Take care not to trap test hose at bonnet and side window.
- ◆ Pressing memory button M on turbocharger tester causes last measured value to be stored until memory button M is pressed again or tester is switched off.
- ◆ Storage is indicated by flashing of decimal point in display zone.
- ◆ An arrow appears in the top left corner of the display if battery voltage of turbocharger tester drops below permitted specification.
- ◆ Prior to testing, drive vehicle at good speed for at least 3 km (avoiding traffic lights or the like).
- ◆ Second person is required to read out values displayed whilst driving.
- ◆ Observe safety precautions => Page 159 .



- Accelerate vehicle in 4th gear from approx. 60 km/h at full throttle while a second mechanic observes the rev counter.



- -> Second mechanic should press memory button -M- on V.A.G 1397 A at approx. 3000 rpm.

Specifications

Height above sea level	Ambient temperature	Charge pressure in bar
0 ... 1800 m	-10 ... 0 °C	1.808
	0 ... 10 °C	1.939
	10 ... 20 °C	1.995
	20 ... 30 °C	2.016
	Above 30 °C	2.054
1800 ... 2300 m	-10 ... 0 °C	1.701
	0 ... 10 °C	1.824
	10 ... 20 °C	1.877
	20 ... 30 °C	1.897
	Above 30 °C	1.932

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Height above sea level	Ambient temperature	Charge pressure in bar
2300 ... 3000 m	-10 ... 0 °C	1.585
	0 ... 10 °C	1.700
	10 ... 20 °C	1.749
	20 ... 30 °C	1.768
	Above 30 °C	1.801

Note:

Charge pressure values may deviate in the event of intermediate ambient temperature values.

If reading matches specification, but there is a lack of power in engine speed range below 2500 rpm:

- Check control pipe for overrun shutoff valve and control pipe connection at intake manifold for blockage.
- Check overrun shutoff valve => Page 171 .

If charge pressure is not attained:

- ♦ Leak between turbocharger and intake manifold => Page 160
- ♦ Try replacing mechanical charge pressure control valve and repeat test.

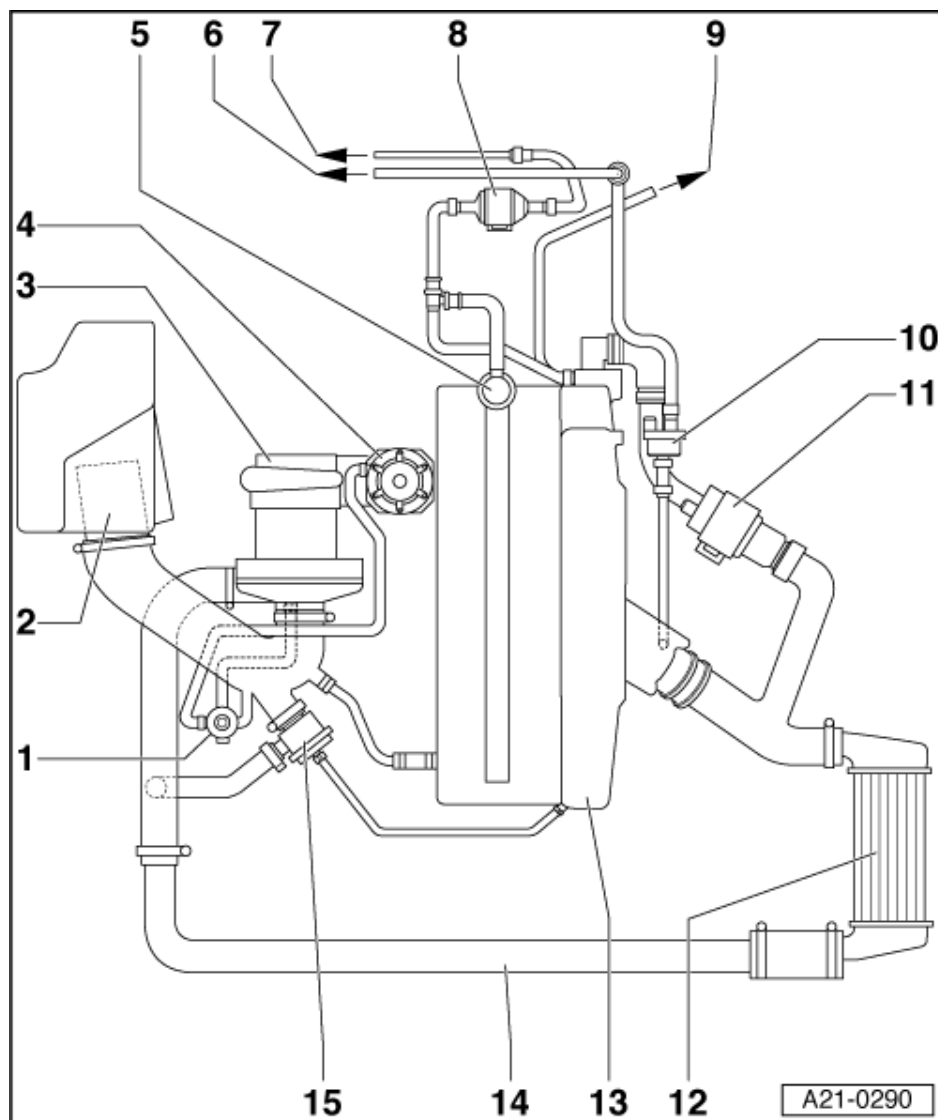
If charge pressure is still not attained:

- ♦ Turbocharger defective

If charge pressure is exceeded:

- ♦ Charge pressure control hose disconnected, leaking or clogged
- ♦ Charge pressure control solenoid valve clogged

1.5 - Connection diagram for charge pressure control



1 Charge pressure control solenoid valve -N75

- ◆ Installation position: At front right of engine compartment
- ◆ Checking =>Page 165

2 Air-mass meter -G70

3 Turbocharger

4 Mechanical charge pressure control valve

5 Fuel pressure regulator

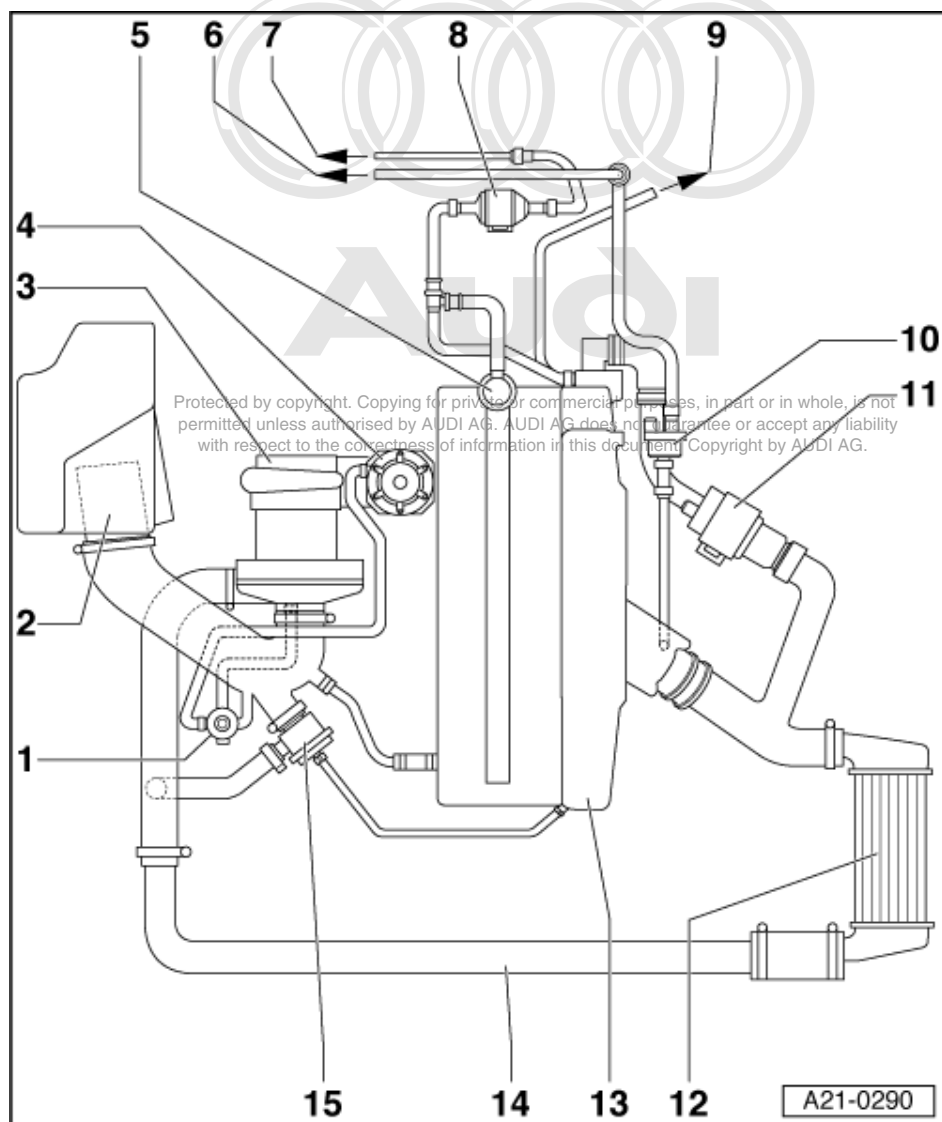
6 To activated charcoal filter

7 To engine control unit

8 Water separator

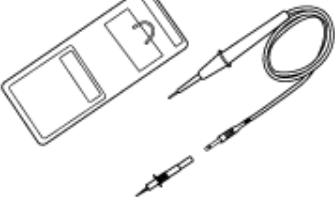
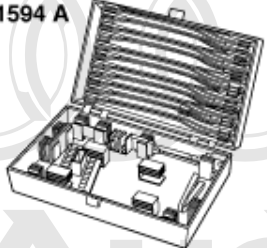
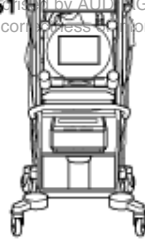


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- 9 Connection for differential lock and air conditioner
- 10 Activated charcoal filter system solenoid valve 1 -N80
- 11 Idling-speed stabilisation valve -N71
- 12 Charge air cooler
- 13 Intake manifold
- 14 Pressure pipe
- 15 Overrun shutoff valve
 - ♦ Checking =>Page 171

1.6 - Checking charge pressure control solenoid valve -N75

V.A.G 1527 B 	V.A.G 1594 A 
V.A.G 1598 A 	VAS 5051 
	G24-0016

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Special tools and workshop equipment required

- ◆ V.A.G 1526 A
- ◆ V.A.G 1594 A
- ◆ V.A.G 1598 with V.A.G 1598/5
- ◆ VAS 5051 with VAS 5051/1 and VAS 5051/2

Test sequence

Note:

Charge pressure control solenoid valve -N75 and wiring are monitored by engine control unit.

- Connect up vehicle diagnostic, testing and information system VAS 5051 and select vehicle system "01 - Engine electronics" from list. Ignition must be on.

=> Motronic Injection and Ignition System (5-cylinder); Repair Group 01

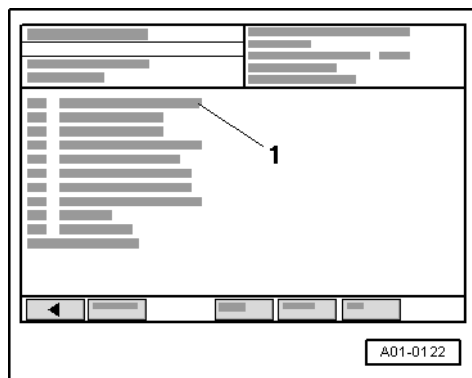
- Read out fault memory of engine control unit.



=> Motronic Injection and Ignition System (5-cyl.); Repair Group 01; Interrogating and erasing fault memory
Interrogating and erasing fault memory

If fault relating to charge pressure control solenoid valve -N75 is displayed:

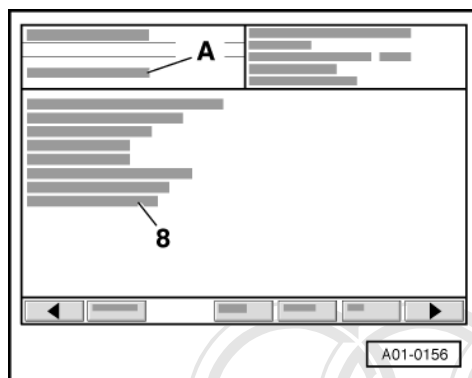
- Detach hoses from charge pressure control solenoid valve -N75; leave connector attached.
- Connect test hose to long valve connection.



- Vehicle diagnostic, testing and information system VAS 5051 connected up; vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected. Ignition must be on.

-> Indicated on VAS 5051:

- From list -1- select diagnostic function "03 - Final control diagnosis".



- Keep touching ▶ key until following display appears:

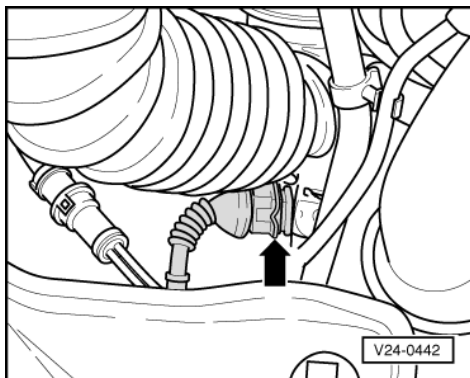
-> Indicated on VAS 5051:

- A - 8th control element being tested
- 8 - Charge pressure control solenoid valve -N75

- ♦ Valve must click...
- ♦ ...and must open and close (can be checked by blowing into test hose).
- Terminate function "03 - Final control diagnosis" by touching ◀ key.

If valve does not open or close properly:

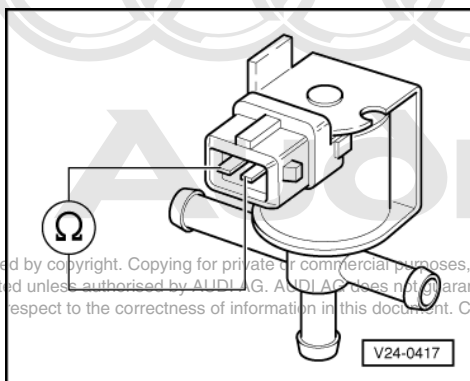
- Replace charge pressure control solenoid valve -N75.



If valve does not click:

Checking internal resistance

- Switch off ignition.
- -> Unplug connector -arrow- at charge pressure control solenoid valve.



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- -> Connect multimeter to valve for resistance measurement.
- Specification: 25 ... 35 Ω

If reading does not match specification:

- Replace charge pressure control solenoid valve -N75.

If reading matches specification:

Checking power supply

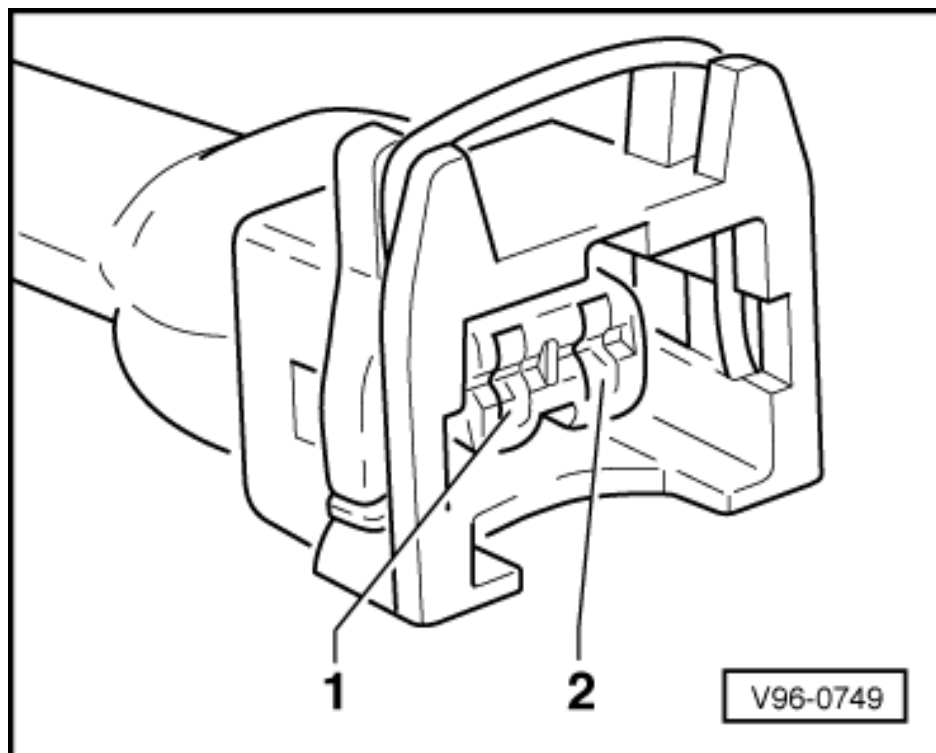
Test requirements:

- Fuse for charge pressure control solenoid valve OK

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

- Fuel pump relay OK

=> Motronic Injection and Ignition System (5-cylinder); Repair Group 24



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

Connector Contact	Measure to
1	Engine earth

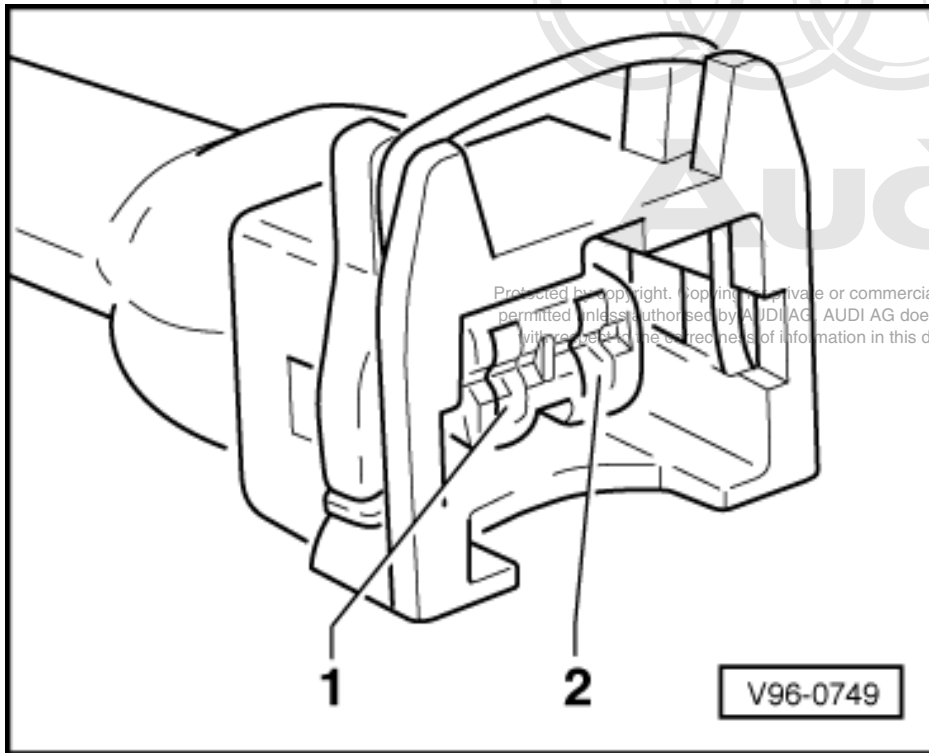
- Briefly operate starter.
 - LED must light

If LED does not light:

- Use current flow diagram to check for open circuit in wiring from contact 1 of connector via fuse to fuel pump relay.



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If LED lights:

Checking actuation

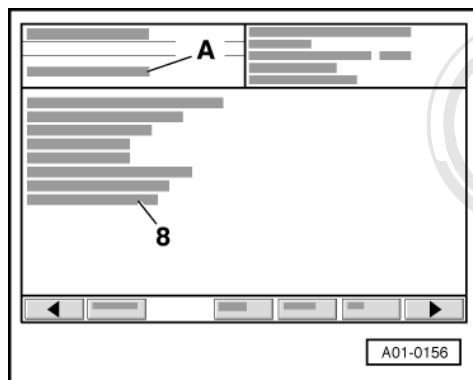
- -> Connect up voltage tester V.A.G 1527 B to contacts 1 (positive) and 2 of connector.



- Vehicle diagnostic, testing and information system VAS 5051 connected up; vehicle self-diagnosis and vehicle system "01 - Engine electronics" selected. Ignition must be on.

-> Indicated on VAS 5051:

- From list -1- select diagnostic function "03 - Final control diagnosis".



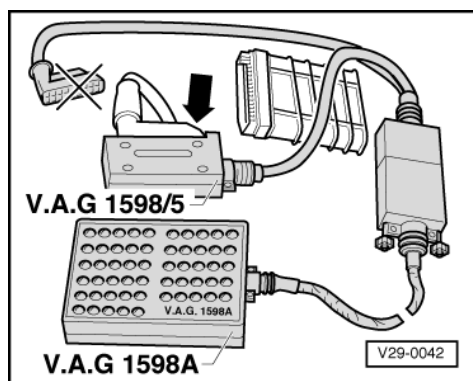
- Keep touching ▶ key until following display appears:

-> Indicated on VAS 5051:

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- A - 8th control element being tested
- 8 - Charge pressure control solenoid valve -N75

- LED must flash
- Terminate function "03 - Final control diagnosis" by touching ◀ key.



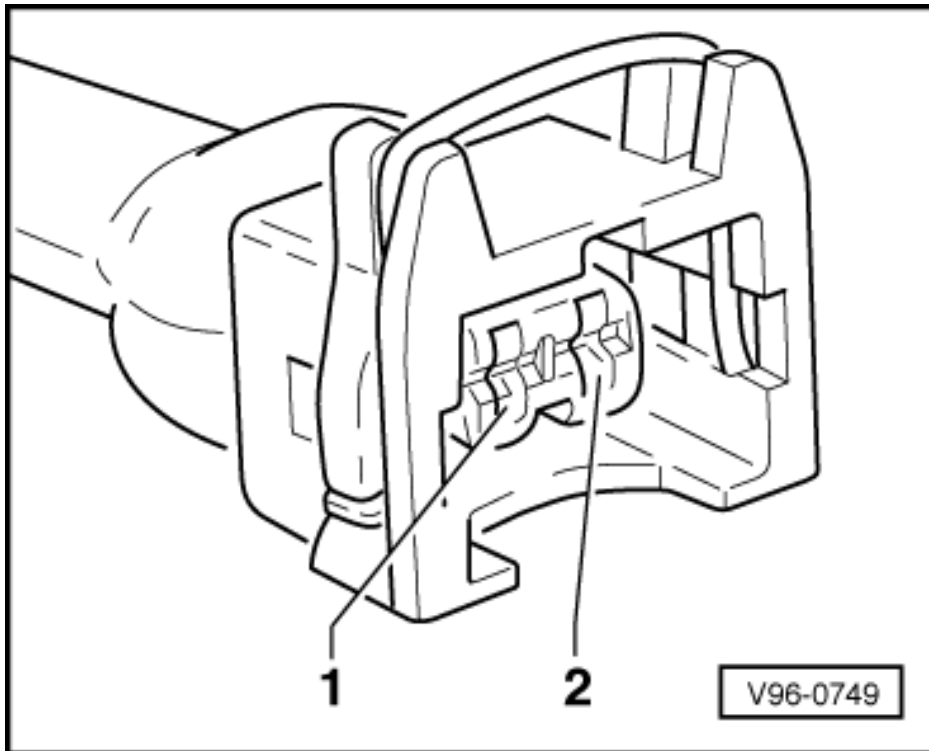
If LED does not flash or if it is permanently lit:

- -> With ignition switched off, use adapter V.A.G 1598/5 to connect test box V.A.G 1598A to engine control unit connector only (not to control unit).

=> Motronic Injection and Ignition System (5-cylinder); Repair Group 24

Attention:

So as not to destroy electronic components, select required measuring range before connecting test leads and observe test conditions.



- -> Check for open circuit and short to earth/positive in the following wiring.

Connector Contact	Test box V.A.G 1598 A Socket
2	33

- Use current flow diagram to eliminate open circuit in wiring/short circuit.

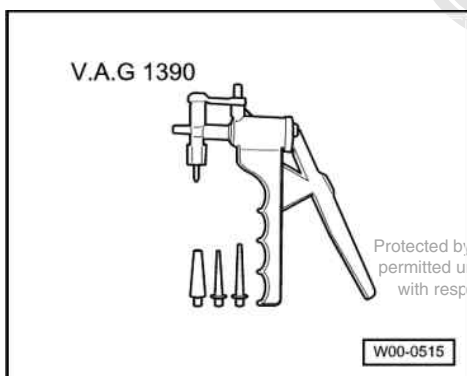
If wiring is OK:

- Replace engine control unit.

1.7 - Checking overrun shutoff valve

Notes:

- ◆ Overrun shutoff valve is located in front of turbocharger. It is opened by vacuum in the overrun phase and with part throttle at idle. This dissipates the charge pressure upstream of the throttle valve and maintains a higher turbocharger speed.
- ◆ Check overrun shutoff valve in the event of loss of power or load change jolts.

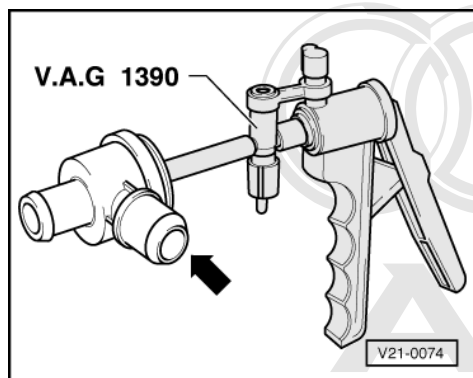


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Special tools and workshop equipment required

- ♦ Vacuum hand pump V.A.G 1390



- -> Connect vacuum hand pump V.A.G 1390 to vacuum connection of overrun shutoff valve.
- Operate vacuum hand pump.
- Overrun shutoff valve must open -arrow-
- Operate vent valve on vacuum hand pump after approx. 30 seconds.
- Overrun shutoff valve must close -arrow-

If overrun shutoff valve does not open/close or if valve plate does not form a tight seal when overrun shutoff valve is closed:

- Replace overrun shutoff valve and secure hose connections with clamps.

2 - Servicing charge air system with turbocharger

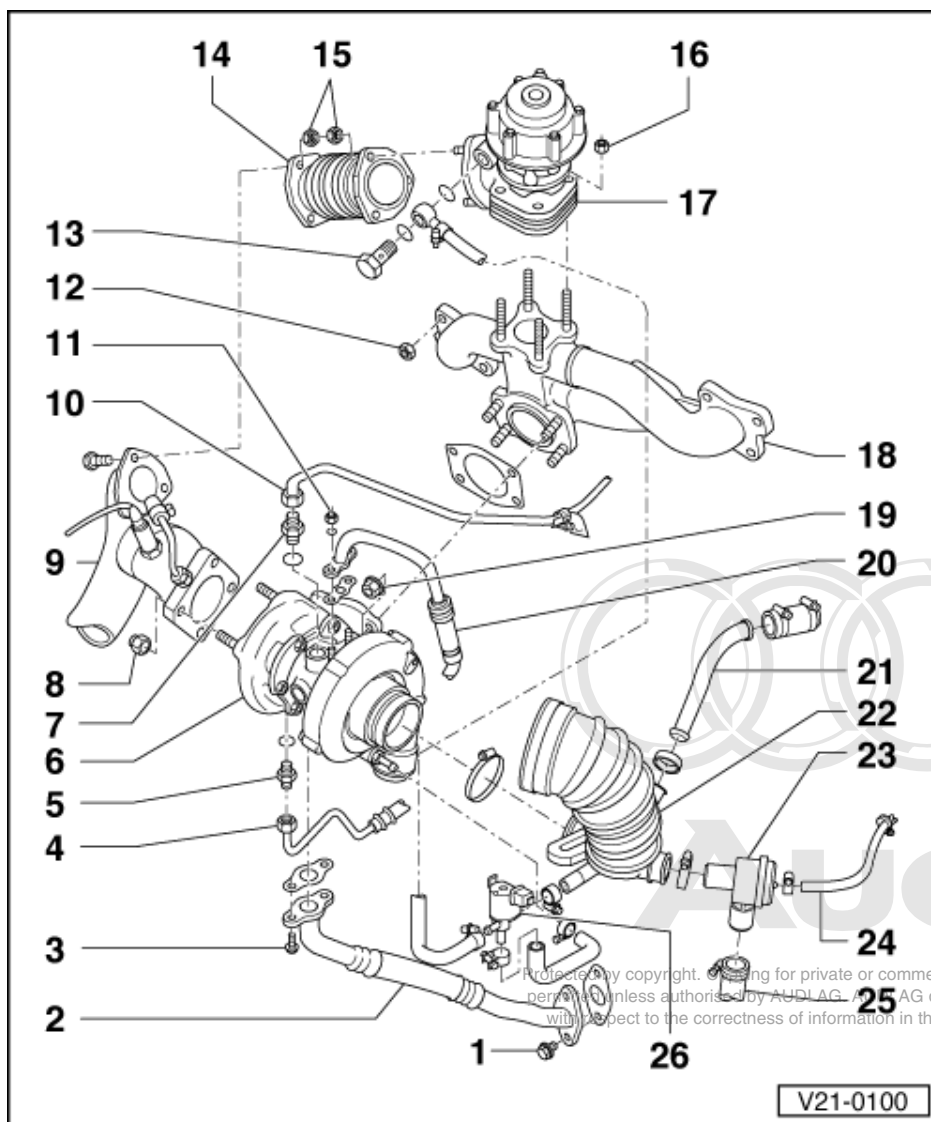
2.1 - Servicing charge air system with turbocharger

2.2 - Rules for cleanliness

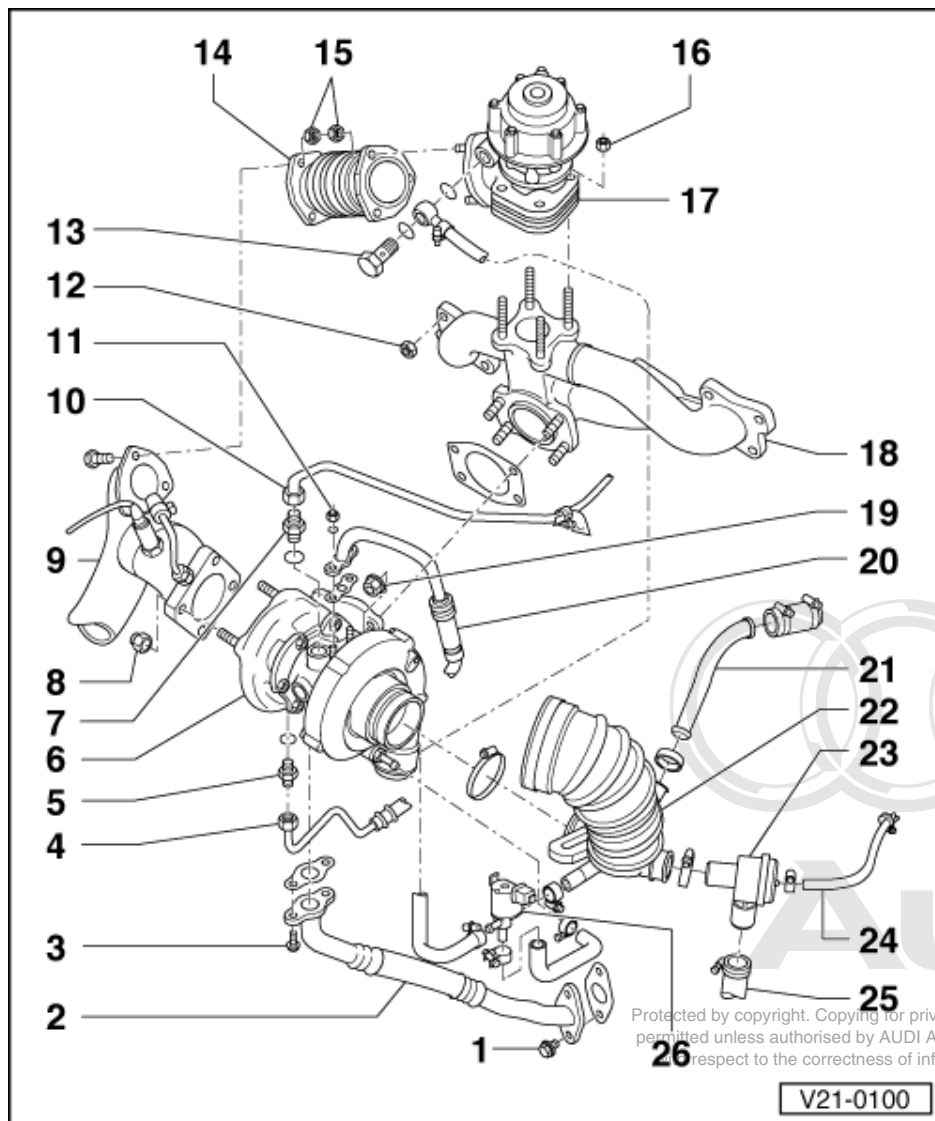
Pay careful attention to the following rules for cleanliness when working on turbocharger:

- ♦ Carefully clean all joints and adjacent areas before disconnecting.
- ♦ Place parts removed on a clean surface and cover them over. Do not use fluffy cloths.
- ♦ Carefully cover or seal opened components if repairs are not to be performed immediately.
- ♦ Only install clean components:
Do not remove replacement parts from wrapping until immediately prior to installation.
Do not use parts which have been stored loose (e.g. in tool boxes).
- ♦ When system is open:
Do not work with compressed air if at all possible.
Do not move vehicle unless absolutely necessary.

2.3 - Exploded view of turbocharger removal and installation



- 1 10 Nm
- 2 Oil return pipe
 - ♦ To cylinder block
- 3 10 Nm
- 4 Coolant return pipe
 - ♦ Tighten to 25 Nm
 - ♦ Seal with suitable plug after unscrewing
- 5 Adapter
 - ♦ Tighten to 30 Nm
- 6 Turbocharger
 - ♦ Checking => Page 159 onwards
 - ♦ Removing and installing
=> Page 177
 - ♦ Fill with engine oil at oil supply pipe connection



7 Adapter

- ♦ Tighten to 35 Nm

8 30 Nm

- ♦ Replace

9 Front exhaust pipe

10 Coolant supply pipe

- ♦ Tighten to 30 Nm
- ♦ Seal with suitable plug after unscrewing

11 10 Nm

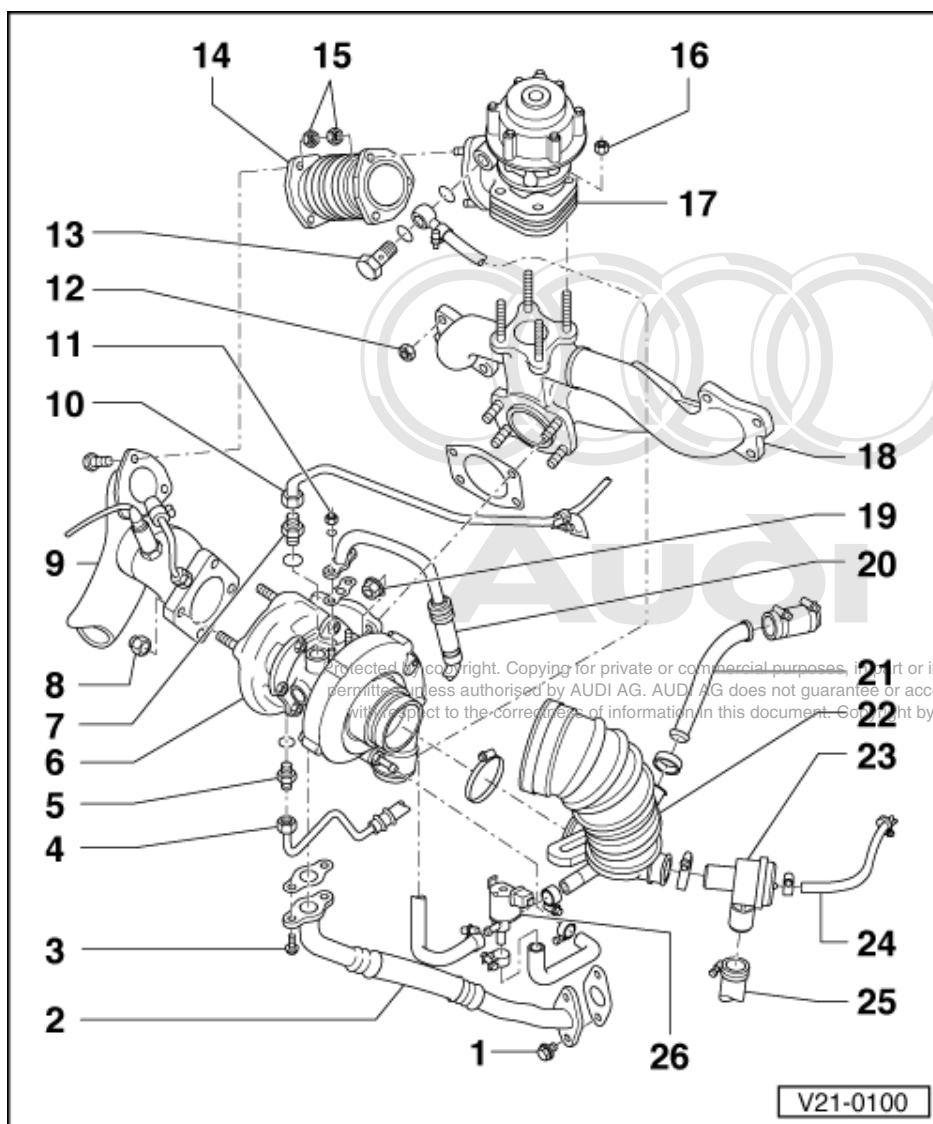
12 25 Nm

- ♦ Replace

13 Banjo bolt, 25 Nm

14 Corrugated pipe

- ♦ Installation position
=> Fig. 191
- ♦ Use new gaskets on installation



15 25 Nm

- ♦ Replace

16 25 Nm

- ♦ Replace

17 Mechanical charge pressure control valve

- ♦ Checking => Page 159 onwards
- ♦ Removing and installing
=> Page 177

18 Exhaust manifold

19 60 Nm

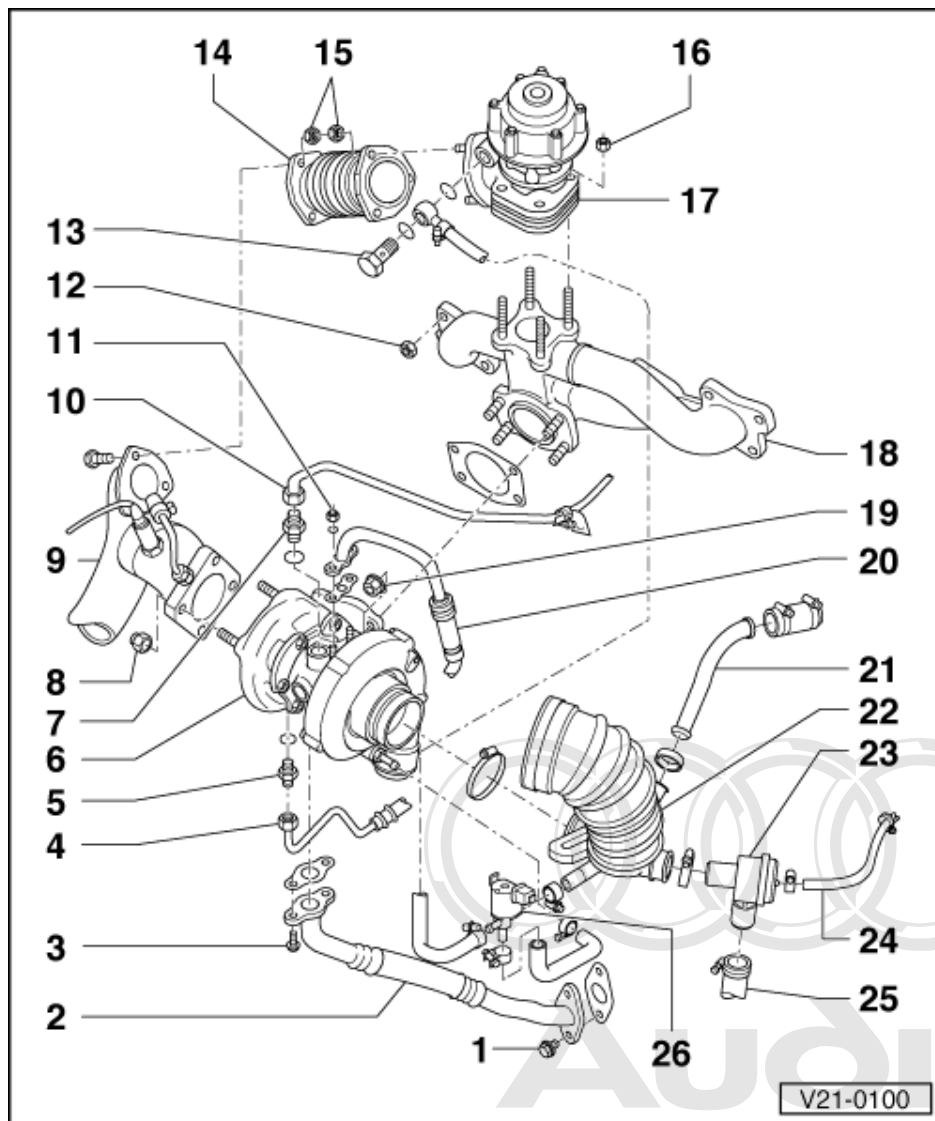
- ♦ Replace

20 Oil supply pipe

- ♦ From oil filter bracket to turbocharger
- ♦ Fill with engine oil at oil supply pipe connection

21 Hose

- ♦ For crankcase breather
- ♦ To cylinder head cover



22 Air hose

- ♦ To air-mass meter

23 Overrun shutoff valve

- ♦ Checking =>Page 171

24 Vacuum hose

- ♦ Via connecting pipe to intake manifold

25 Hose

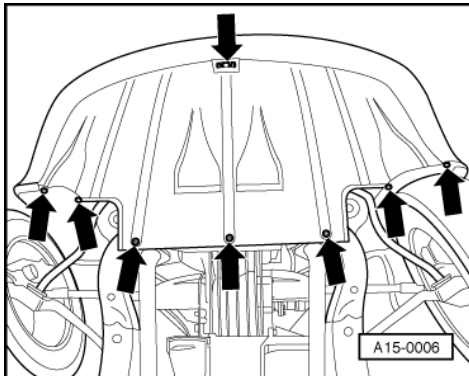
- ♦ To pressure pipe

26 Charge pressure control solenoid valve -N75

- ♦ Checking =>Page 165

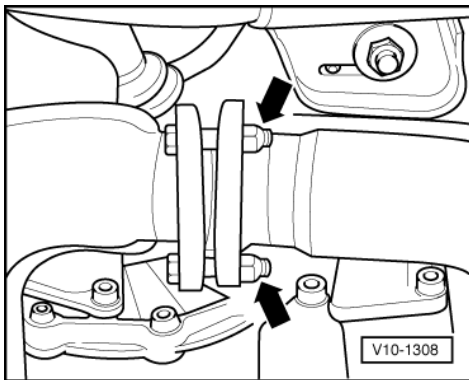
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2.4 - Removing and installing turbocharger

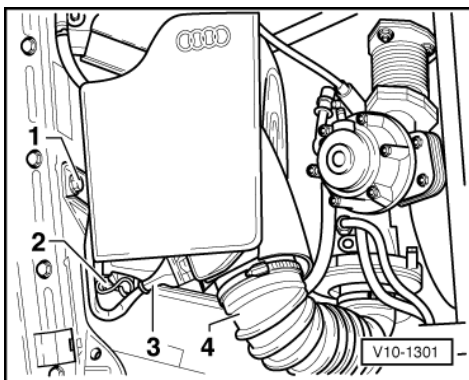


Removing

- -> Detach noise insulation -arrows-.

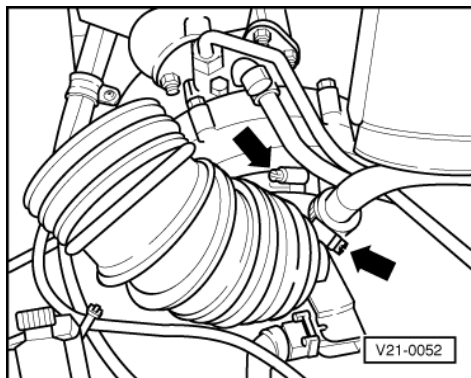


- -> Unscrew front exhaust pipe from catalytic converter on left and right -arrows-.

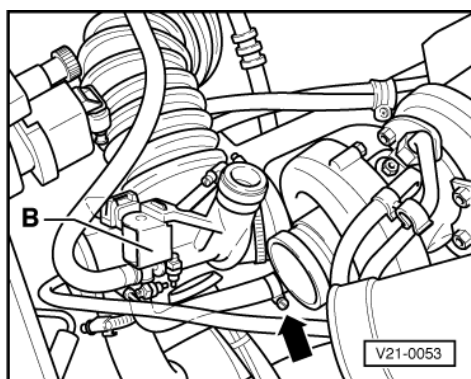


- -> Detach air hose -4- at air-mass meter.
- Unplug connector -3- at air-mass meter.
- Unfasten clamps -2- all round air cleaner housing.
- Detach top section of air cleaner housing with filter element.
- Screw out bolt -1-.
- Detach wiring harness at air cleaner housing.
- Take out bottom part of air cleaner housing.

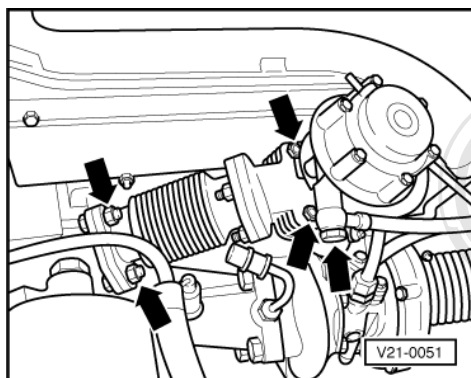
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- -> Remove air hose at turbocharger and crankcase breather pipe -arrows-.
- Disconnect vacuum hose and hose to pressure pipe from overrun shutoff valve.

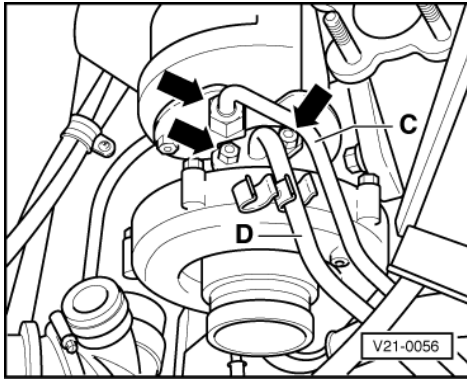


- -> Remove charge pressure control solenoid valve -B- from mount.
- Detach hose from charge pressure control solenoid valve to turbocharger -arrow-.



- -> Unscrew mechanical charge pressure control valve with corrugated pipe -arrows-.

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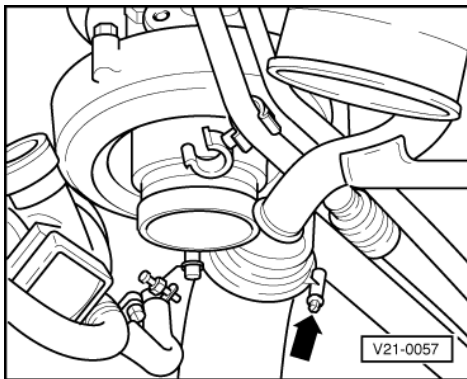


Note:

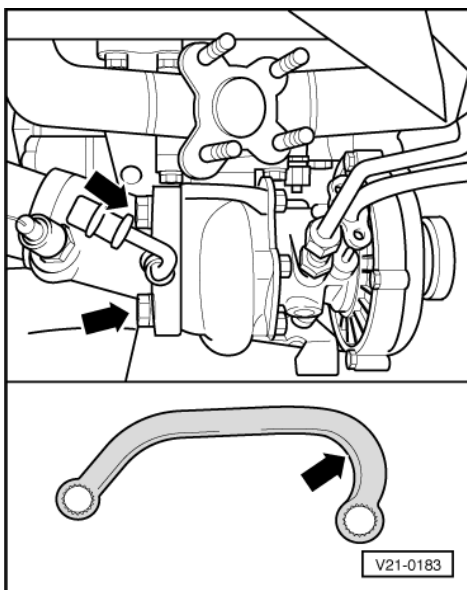
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When performing the following work, make sure coolant does not ingress into oil bores of turbocharger.

- -> Unscrew coolant supply pipe -C- and seal with suitable plug.
- Place drip tray in position.
- Unscrew oil supply pipe -D- at turbocharger.



- -> Remove air hose from charge air cooler to turbocharger -arrow-.
- Place drip tray in position.
- Unscrew oil return pipe at bottom of turbocharger.
- Unscrew coolant return pipe at turbocharger.

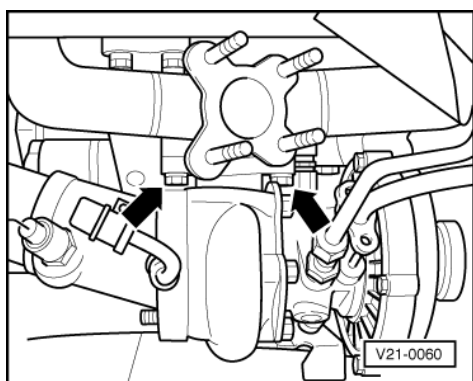




- -> Unscrew front exhaust pipe at turbocharger connection -arrows-.

Notes:

- ♦ Aflat 15 mm ring spanner must be bent to appropriate shape -bottom arrow in Fig.- for unfastening lower rear nut at turbocharger/front exhaust pipe flange.
- ♦ Other nuts at turbocharger/front exhaust pipe flange are of size 17 mm.
- Press exhaust system to rear until studs at turbocharger are free.



- -> Unscrew turbocharger/exhaust manifold nuts -arrows-.
- Detach turbocharger.

Installing

Install in reverse order, paying attention to the following:

Notes:

- ♦ Always replace gaskets, oil seals and self-locking nuts.
- ♦ Coat threads and head contact surfaces of bolts for turbocharger with hot bolt paste. Hot bolt paste:

=> Parts List

- ♦ Fill turbocharger with engine oil at oil supply pipe connection.
- ♦ Secure all hose connections with standard hose clamps.

=> Parts List

- ♦ Charge-air system must be free from leaks.
- ♦ Hose connections and hoses for charge air system must be free from oil and grease before fitting. Never use lubricant.
- ♦ After installing turbocharger, allow engine to idle for approx. 1 minute and do not rev up immediately so as to ensure turbocharger oil supply.
- Perform stress-free alignment of exhaust system => Page 193 .
- Check oil level => Page 133 .
- Check coolant level => Page 143 .

Tightening torques

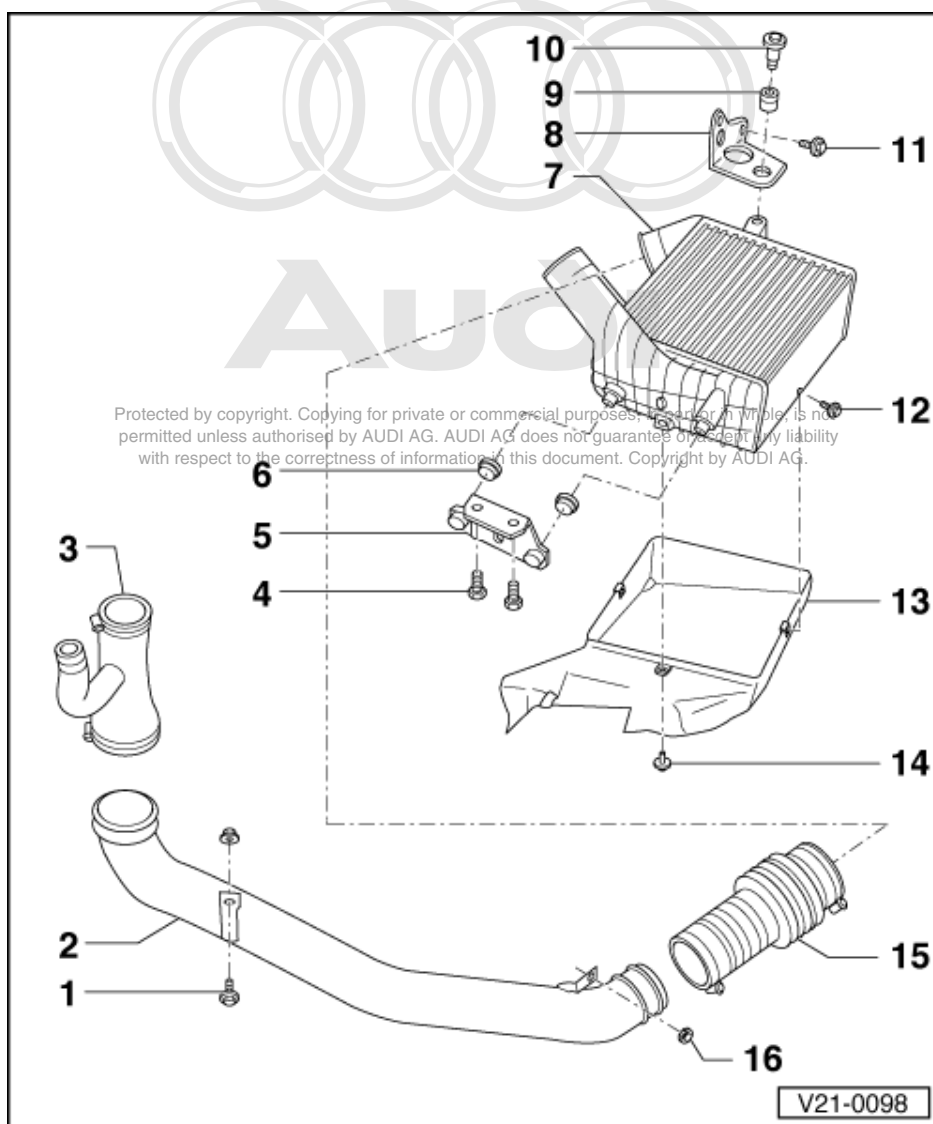
Component	Nm
Turbocharger to exhaust manifold	60 1)
Mechanical charge pressure control valve to ex-haust manifold	25
Front exhaust pipe to turbocharger	30

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Component	Nm
Front exhaust pipe to corrugated pipe	25
Front exhaust pipe to catalytic converters	25
Oil return pipe to turbocharger	10
Oil supply pipe to turbocharger	10
Coolant return pipe to turbocharger	25
Coolant supply pipe to turbocharger	30
Control pipe to mechanical charge pressure control valve	25
Clamps for air hoses	3.5

- 1) Replace nuts

2.5 - Removing and installing charge air cooling system components



Notes:

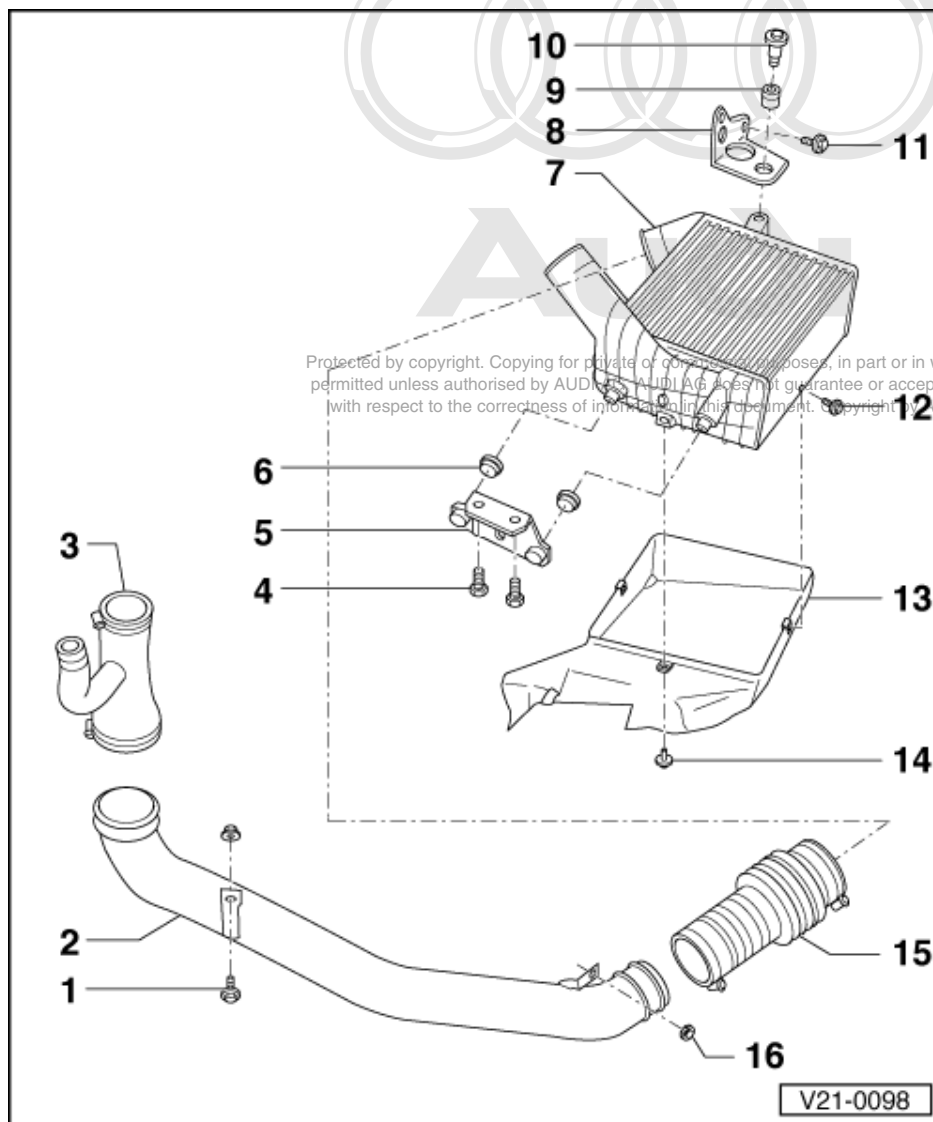
- ◆ Secure all hose connections with standard hose clamps.



=> Parts List

- ♦ Charge-air system must be free from leaks.
- ♦ Hose connections and hoses for charge air system must be free from oil and grease before fitting. Never use lubricant.

- 1 20 Nm
- 2 Pressure pipe
- 3 Air hose
 - ♦ To turbocharger
 - ♦ With branch to overrun shutoff valve
- 4 20 Nm
- 5 Front bracket



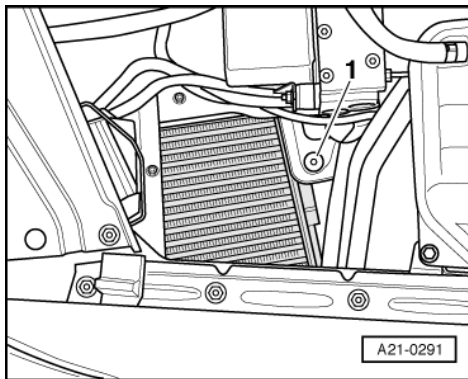
- 6 Rubber grommet
 - ♦ For front bracket
- 7 Charge air cooler
 - ♦ Removing and installing
=> Page 183
- 8 Rear bracket
- 9 Rubber grommet
 - ♦ For rear bracket
- 10 Cheese-head bolt, 20 Nm

- ♦ With collar
- 11 20 Nm
- 12 Self-tapping screw
- 13 Air duct
- 14 Self-tapping screw
- 15 Air hose
 - ♦ To charge air cooler
- 16 20 Nm

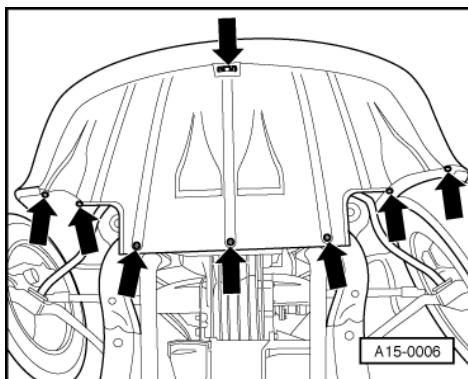
2.6 - Removing and installing charge air cooler

Removing

- Unplug connector for hydraulic fluid warning contact.
- Pull hydraulic fluid reservoir out of holder at splash plate and lay aside together with connected pipes.
- Unscrew holder for hydraulic fluid reservoir at splash plate.
- Remove windscreen washer fluid reservoir.

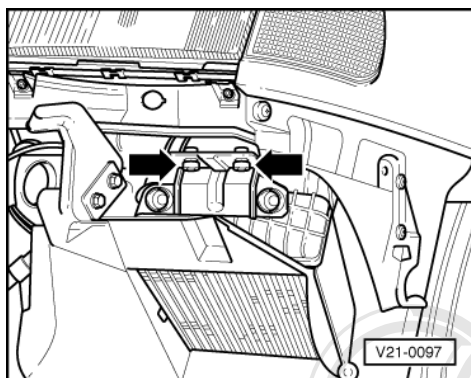


- -> Screw out bolt -1-.



- -> Detach noise insulation -arrows-.
- Remove front bumper.

=> General Body Repairs; Repair Group 63; Front Bumper Front Bumper



- Detach both air hoses at charge air cooler.
- -> Unscrew charge air cooler at front of holder -arrows-.
- Detach charge air cooler downwards.

Installing

Install in reverse order, paying attention to the following:

Notes:

- ♦ Secure all hose connections with standard hose clamps.

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=> Parts List

- ♦ Charge-air system must be free from leaks.
- ♦ Hose connections and hoses for charge air system must be free from oil and grease before fitting. Never use lubricant.

Tightening torques

Component	Nm
Charge air cooler to holder	20
Windscreen washer fluid reservoir to body	5
Holder for hydraulic fluid reservoir to body	10
Clamps for air hoses	3.5

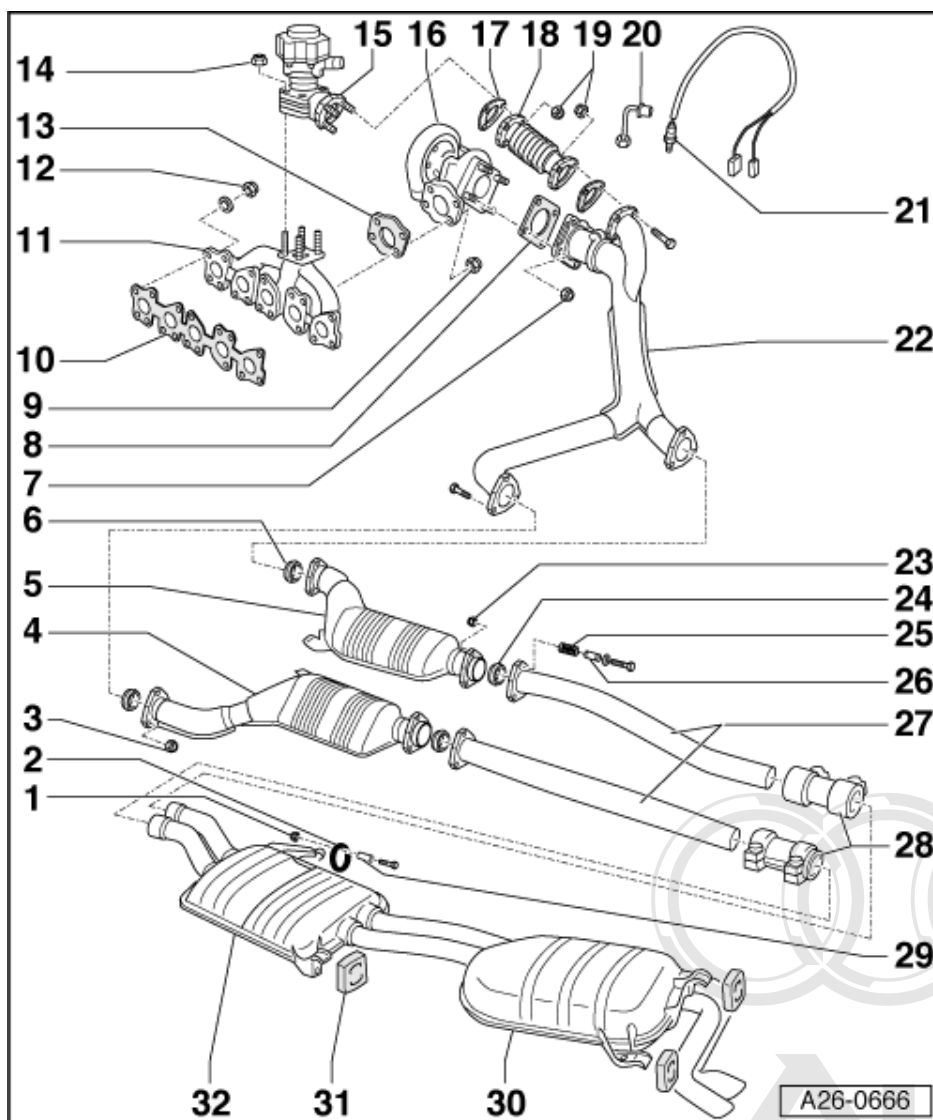
26 - Exhaust system

1 - Removing and installing exhaust system components

1.1 - Removing and installing exhaust system components

Notes:

- ♦ Always replace gaskets and self-locking nuts.
- ♦ Following exhaust system assembly work, make sure exhaust system is not subject to torsion and that there is an adequate gap between exhaust system and body. If necessary, unfasten clamp and align silencer and exhaust pipe such that there is sufficient distance from body all round and that mountings are subject to uniform load.
- ♦ Removing and installing floor cross member
=> Fig. 192



1 25 Nm

- ♦ Replace

2 Retaining ring

- ♦ Replace if damaged

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3 25 Nm

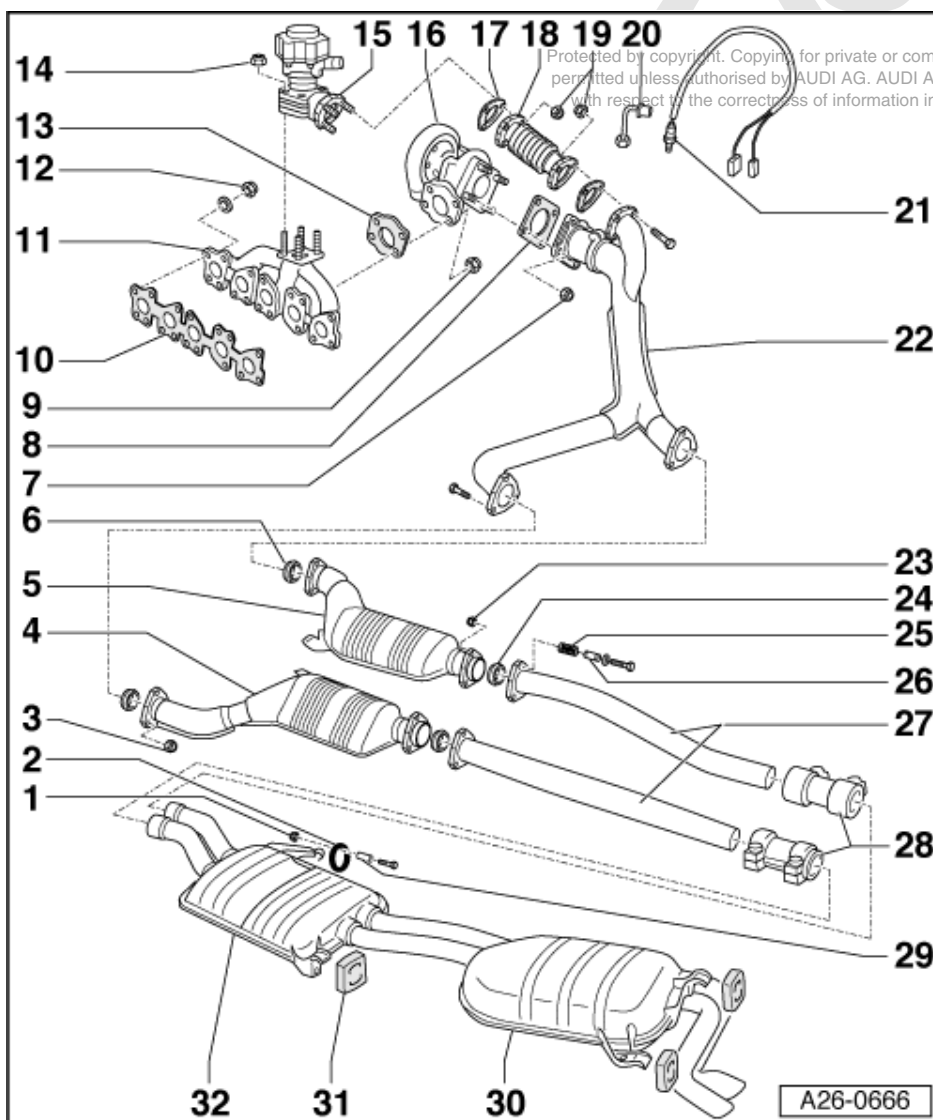
- ◆ Replace
- ◆ Observe tightening sequence
=> Page 193

4 Catalytic converter

- ◆ For left side of vehicle
- ◆ Protect against jolts and impact
- ◆ Mounting components
=> Fig. 190
- ◆ Stress-free alignment of exhaust system => Page 193

5 Catalytic converter

- ◆ For right side of vehicle
- ◆ Protect against jolts and impact
- ◆ Mounting components
=> Fig. 190
- ◆ Stress-free alignment of exhaust system => Page 193



6 Oil seal

- ◆ Sensitive to impact; not to be dropped

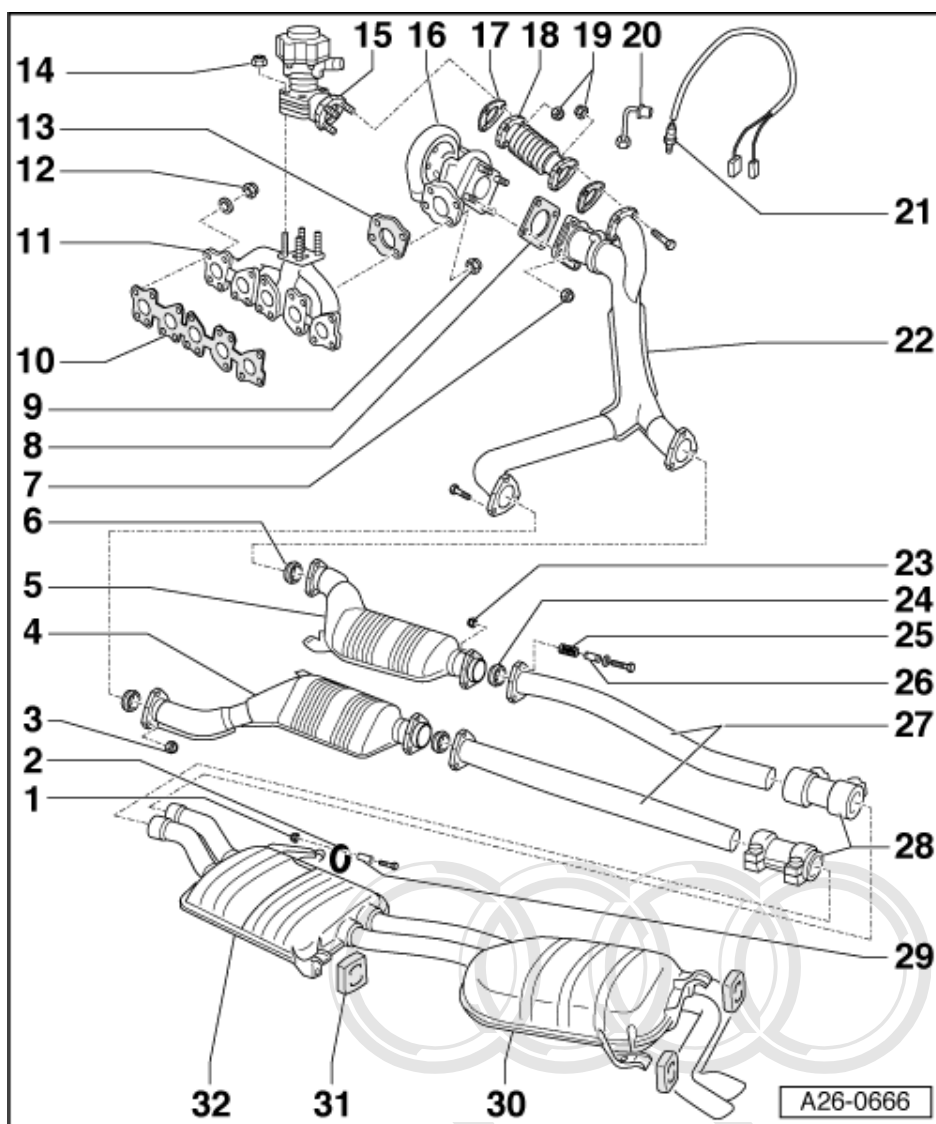
7 30 Nm

- ◆ Replace

8 Gasket

- ◆ Replace

- 9 60 Nm
 - ♦ Replace
- 10 Gasket
 - ♦ Replace
- 11 Exhaust manifold
 - ♦ Removing and installing
=> Page 192
- 12 25 Nm
 - ♦ Replace
- 13 Gasket
 - ♦ Replace
- 14 25 Nm
 - ♦ Replace



15 Mechanical charge pressure control valve

- ♦ Removing and installing
=> Page 177

16 Turbocharger

- ♦ Removing and installing
=> Page 177

17 Gasket

- ♦ Replace



18 Corrugated pipe

- ♦ Installation position
=> Fig. 191

19 25 Nm

- ♦ Replace

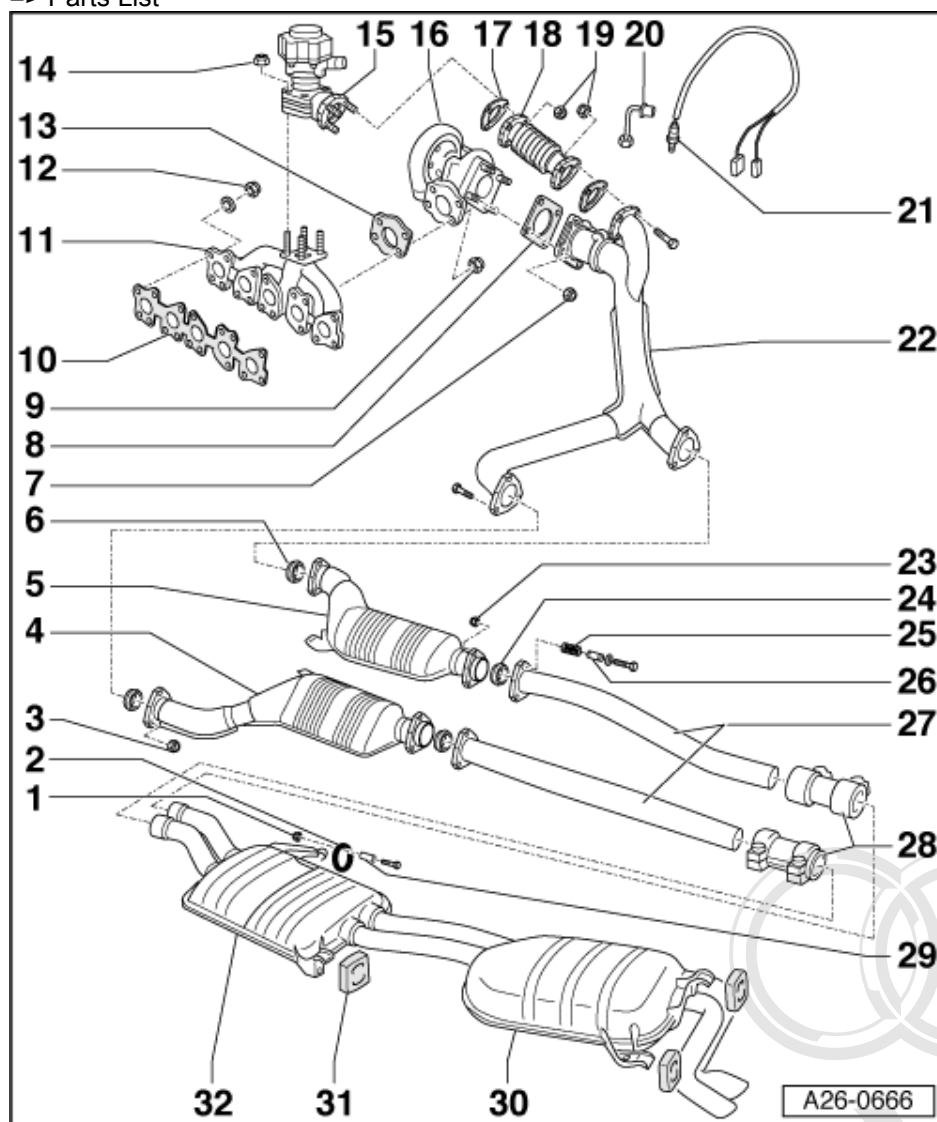
20 CO measurement pipe

- ♦ Not always fitted
- ♦ Tighten to 20 Nm

21 Lambda probe, 55 Nm

- ♦ Grease thread only with hot bolt paste; paste must not be allowed to come into contact with slits in probe body
- ♦ Hot bolt paste

=> Parts List



22 Front exhaust pipe

23 25 Nm

- ♦ Replace

24 Oil seal

- ♦ Sensitive to impact; not to be dropped

25 Spring

26 Spacer

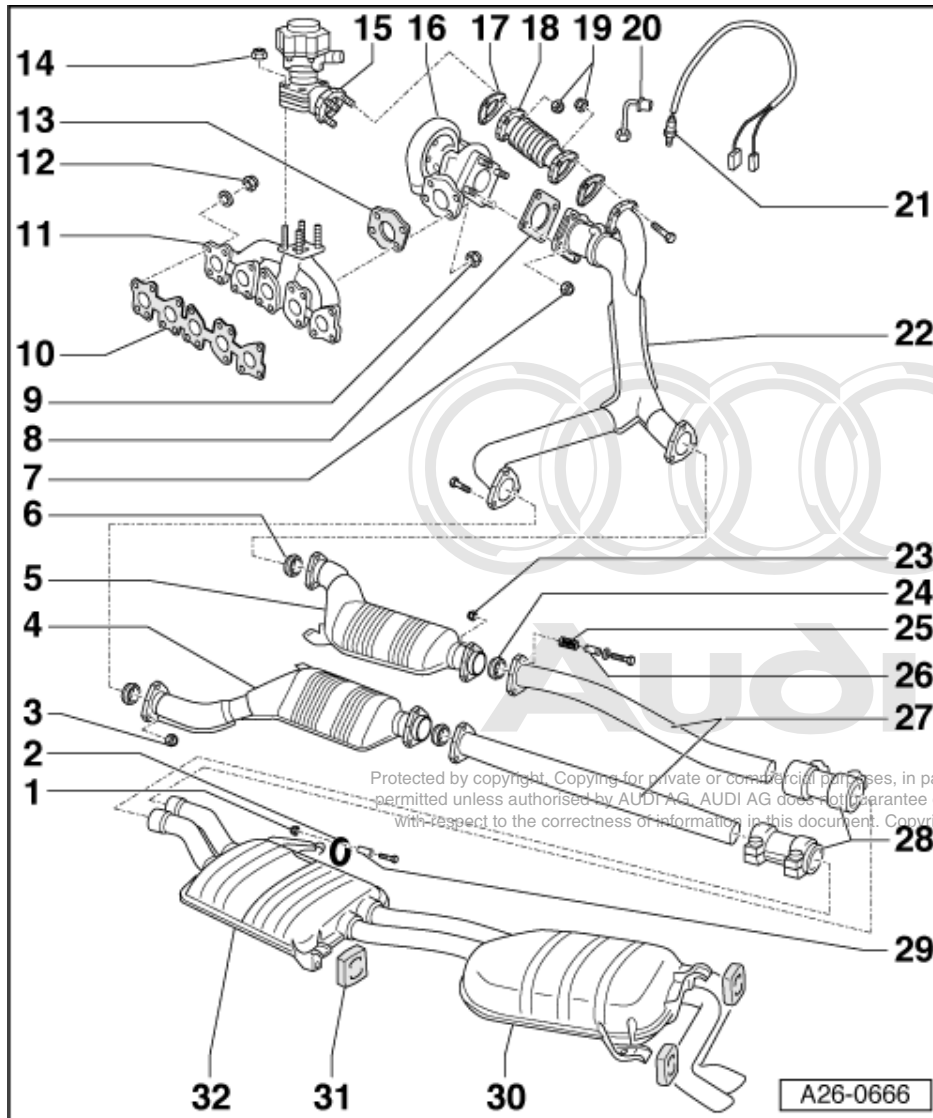
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27 Intermediate pipes

- ♦ Installation position
=> Fig. 191
- ♦ Stress-free alignment of exhaust system => Page 193

28 Clamps

- ♦ Installation position
=> Fig. 191
- ♦ Replace each time bolted joint is unfastened
- ♦ Tighten bolted joints evenly to 40 Nm



29 Spacer

30 Rear silencer

- ♦ Combined with centre silencer as original equipment; replace separately when performing repair work
- ♦ Cutting point => Page 193
- ♦ Stress-free alignment of exhaust system => Page 193

31 Rubber mount

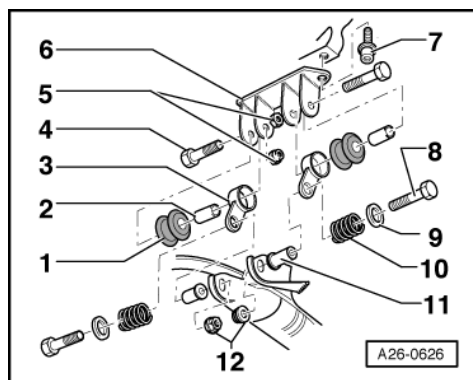
- ♦ Replace if damaged
- ♦ Check pre-tensioning
=> Stress-free alignment of exhaust system, Page 193

32 Centre silencer

- ♦ Combined with rear silencer as original equipment; replace separately when performing repair work
- ♦ Cutting point => Page 193

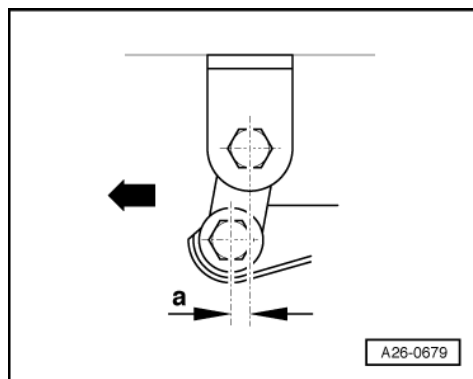


- ♦ Stress-free alignment of exhaust system => Page 193



-> Fig.1 Mounting components

- 1 - Buffer
- 2 - Spacer
- 3 - Link plate - installation position => Fig. 2
- 4 - Bolt - 25 Nm
- 5 - Nut, self-locking - 25 Nm
- 6 - Holder
- 7 - Combi bolt - 25 Nm
- 8 - Bolt - 25 Nm
- 9 - Washer
- 10 - Spring
- 11 - Spacer sleeve
- 12 - Nut, self-locking - 25 Nm

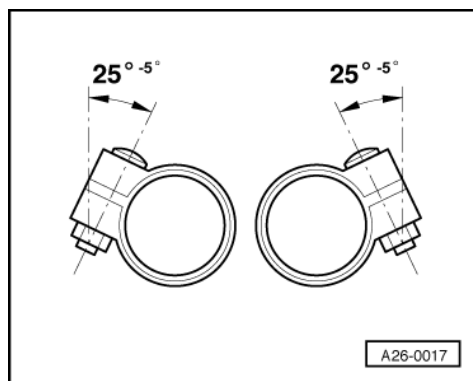


-> Fig.2 Installation position of link plate

- ♦ When cold, dimension -a- = 0.5 ... 4.5 mm

Note:

Arrow faces in direction of travel.



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-> Fig.3 Installation position of clamps

- Bolted joints face outwards
- Angle = 20° ... 25°

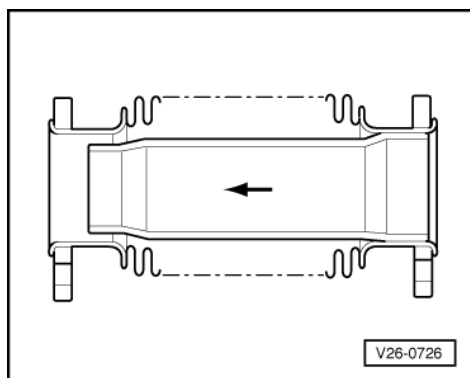
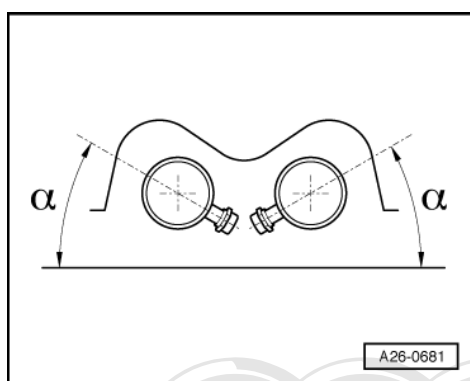


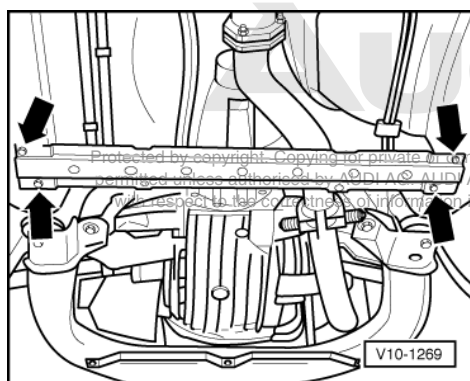
Fig.4 -> Installation position of corrugated pipe

- Direction of flow -arrow-: From exhaust manifold to exhaust system



-> Fig.5 Installation position of intermediate pipes

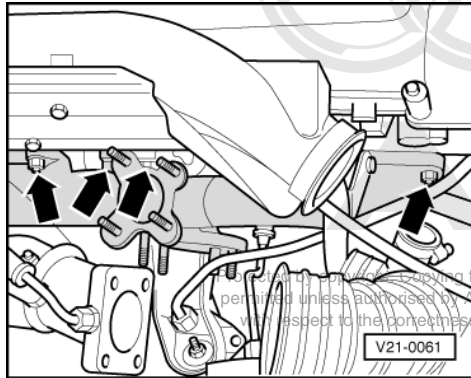
- Fit intermediate pipes such that they are horizontal.
 - $\alpha = 25^\circ \dots 35^\circ$
 - CO connections face inwards



-> Fig.6 Removing and installing floor cross member

- ♦ Tightening torque: 20 Nm

1.2 - Removing and installing exhaust manifold



Removing

- Remove turbocharger => Page 177 .
- -> Unscrew all nuts -arrows- of exhaust manifold.
- Detach exhaust manifold and gasket.

Installing

Install in reverse order, paying attention to the following:

Note:

Replace gaskets and self-locking nuts.

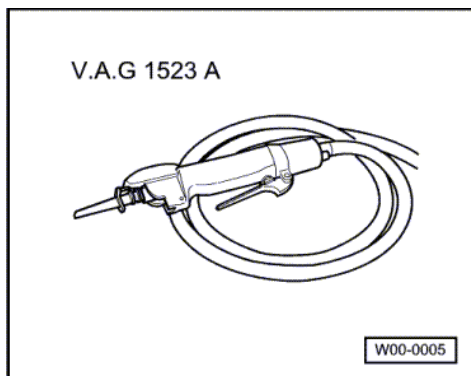
- Install turbocharger => Page 177 .
- Perform stress-free alignment of exhaust system => Page 193 .

Tightening torque

Component	Nm
Exhaust manifold to cylinder head	25

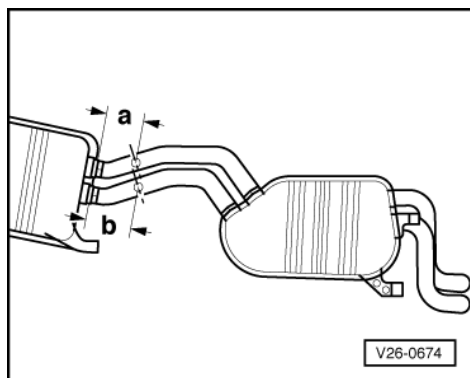
1.3 - Separating centre and rear silencer

- ♦ For separate replacement of centre/rear silencer, a cutting point is provided in the connecting pipe.
- ♦ Cutting point is marked by an indentation on circumference of exhaust pipe.



Special tools and workshop equipment required

- ◆ Body saw V.A.G 1523 A
- ◆ Safety goggles



Sequence of operations

Attention:
Use safety goggles.

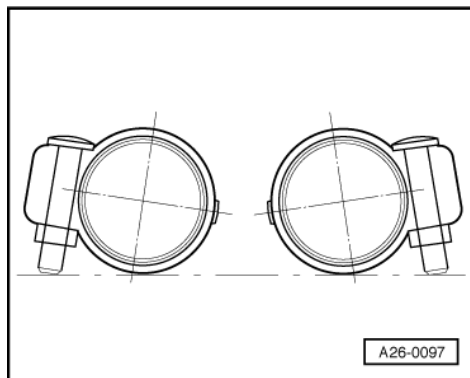
- -> Separate exhaust pipe at right angles at cutting point indicated using body saw, e.g. V.A.G 1523 A.
 - Dimension a = 130 mm
 - Dimension b = 130 mm

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Note:

A short clamp is provided for connecting main and rear silencer when performing repair work.

- On installation, centre clamp with respect to saw cut.



- -> Fit clamps such that ends of bolts do not protrude beyond bottom edge of clamp.
 - Bolted joints face outwards
- Perform stress-free alignment of exhaust system => Page 193 .
- Tighten bolted joints of clamps evenly to 40 Nm.

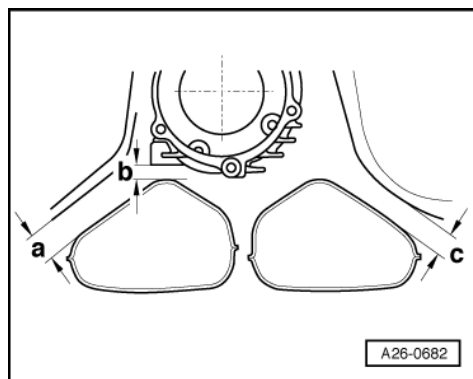
1.4 - Stress-free alignment of exhaust system

Note:

Exhaust system alignment is performed when cold.



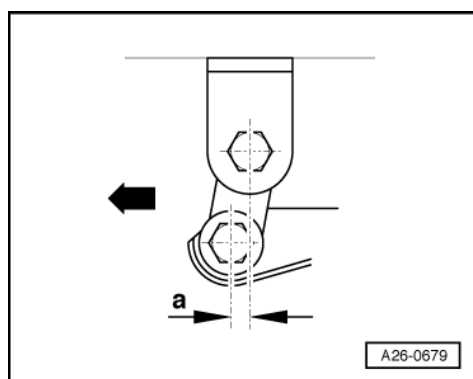
- Centre and rear silencer in position
- Mountings for exhaust system at gearbox fitted=>Fig. 190
- Slacken off the following bolted joints to the extent required to permit mutual movement of the exhaust system components concerned.
 - Front exhaust pipe/catalytic converter (left and right)
 - Intermediate exhaust pipe/catalytic converter (left and right)
 - Clamps between intermediate exhaust pipes and centre silencer
 - Rear clamps (if applicable)



- -> Align catalytic converters to dimensions -a ... c-.
 - Dimension a = approx. 31 mm
 - Dimension b = approx. 13 mm
 - Dimension c = approx. 26 mm

Note:

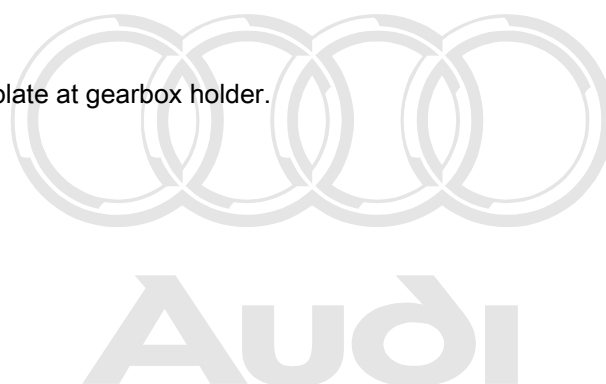
Illustration shows catalytic converters from rear.



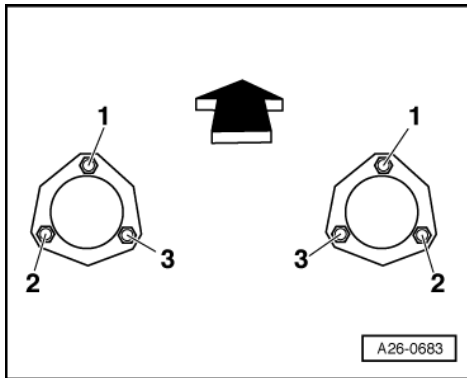
- -> Check installation position of link plate at gearbox holder.
 - Dimension a = 0.5 ... 4.5 mm

Note:

Arrow faces in direction of travel.



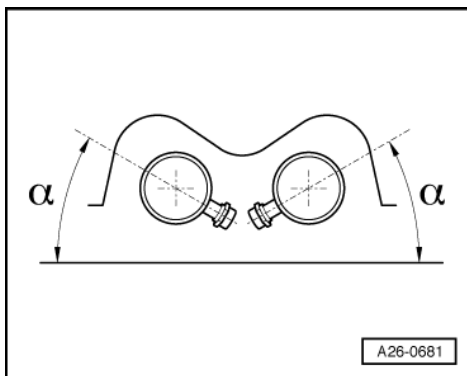
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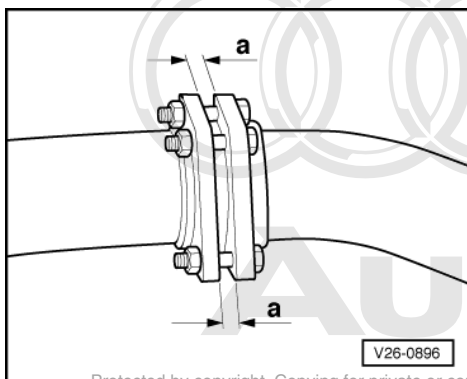
- -> Initially pre-tighten bolts -1...3- at left and then at right catalytic converter/front exhaust pipe to 10 Nm before finish-tightening in same sequence to 25 Nm.

Note:

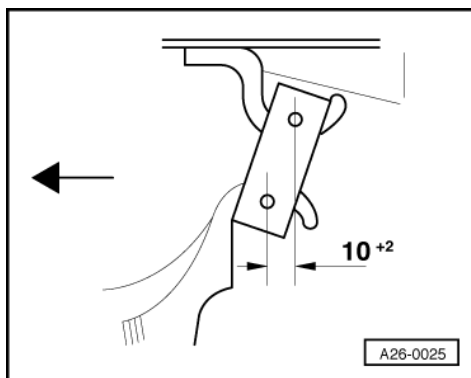
Arrow faces in direction of travel.



- -> Align intermediate pipes such that CO connections face inwards.
- $\alpha = 25^\circ \dots 35^\circ$



- -> Tighten (25-Nm) bolted joint at flange connection of catalytic converter/intermediate exhaust pipe (on left and right). Spacing between webs of flanges must be equal all round.
- Dimension a = dimension a

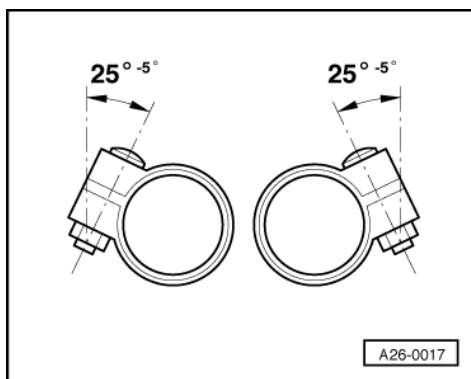


- ➔ Slide exhaust system forwards until pre-tension at rear mounting of centre silencer is 10 ... 12 mm.

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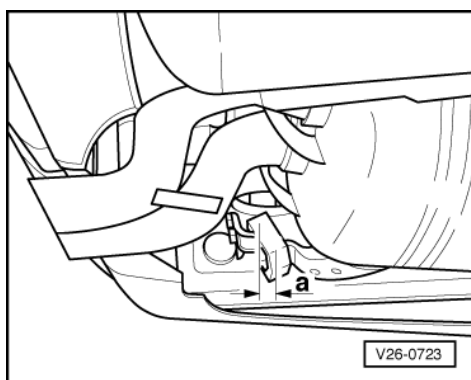
Note:

Arrow faces in direction of travel.



Align front clamps as follows:

- ➔ Bolted joints of clamps face outwards.
- Angle = 20° ... 25°
- Tighten bolted joints of front clamps evenly to 40 Nm.

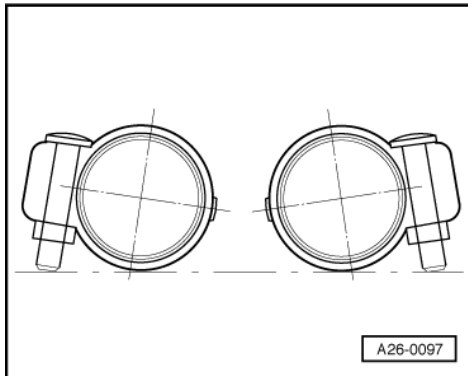


Vehicles with clamps between centre and rear silencer:

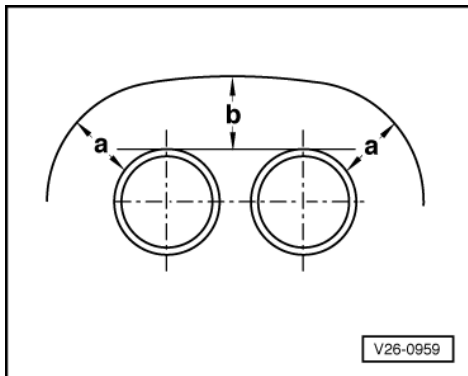
Note:

Additional alignment of rear silencer is only necessary on vehicles with clamps between centre and rear silencer.

- -> Slide rear silencer forwards until pre-tension at rear mount at rear silencer is $a = 10 \dots 12 \text{ mm}$.



- -> Fit clamps such that ends of bolts do not protrude beyond bottom edge of clamp.
- Bolted joints face outwards
- Tighten bolted joints of rear clamps evenly to 40 Nm.



All models:

Tailpipe alignment

- -> Align tailpipes such that distance -a- on left is equal to distance -a- on right.
- At the same time, gap -b- must be maintained between bumper opening and top of tailpipes.
- Dimension $b = 30 \dots 36 \text{ mm}$

1.5 - Checking exhaust system for leaks

- Start engine and leave it idling.
- Seal tailpipe(s) during leak test (e.g. with cloth or plug).
- Listen for leaks at connection points between cylinder head/exhaust manifold, exhaust manifold/turbocharger and turbocharger/catalytic converter etc.
- Eliminate any leaks found.

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