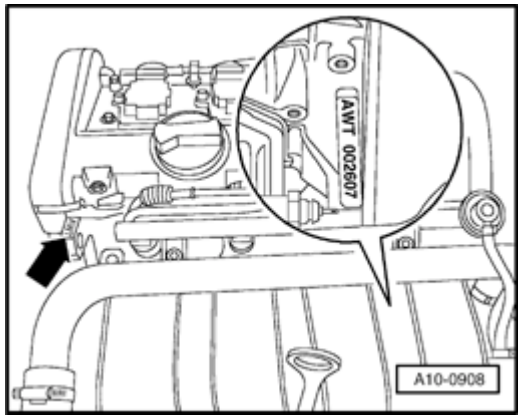
Technical data

Engine number



The engine number ("Engine code number" and "serial number") is on the left rear of the cylinder block.

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

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

Note:

Furthermore, the engine code is stamped onto the front engine lifting eye (visible after removal of engine cover).

cardiagn.com

Engine data

Code letters		AWM
Production		04.2000 >
Capacity	ltrs.	1.781
Output	kW at rpm	125/5900
Torque	Nm at rpm	225/1950 - 5000
Bore	diameter mm	81.0
Stroke	mm	86.4
Compression		9.3
RON		95 [1)]
Injection-/Ignition system		Bosch Motronic
Knock control		yes
On Board Diagnositc (OBD)		yes
Oxygen sensor control		yes
Catalytic converter		yes
Charging		yes

[1)] Regular unleaded petrol RON 91 can be used but will cause a slight loss of power.

cardiagn.com

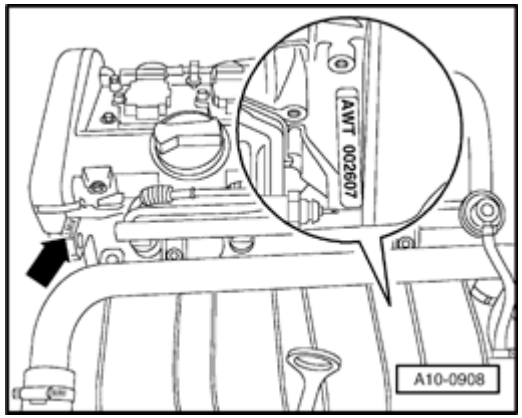
Code letters	AWM
Exhaust gas recirculation system	no
Intake manifold changeover	no
Camshaft timing control	yes
Secondary air inlet	yes
Valve timing	
with 1 mm valve lift and 0 mm valve clearance	
Inlet opens after TDC	18 °
Inlet closes after BDC	28 °
Exhaust opens before BDC	28 °
Exhaust closes before TDC	8 °

cardiagn.com

01-1

Technical data

Engine number



The engine number ("Engine code number" and "serial number") is on the left rear of the cylinder block.

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

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

Note:

Furthermore, the engine code is stamped onto the front engine lifting eye (visible after removal of engine cover).

cardiagn.com

01-2

Engine data

Code letters		AWM
Production		04.2000 >
Capacity	ltrs.	1.781
Output	kW at rpm	125/5900
Torque	Nm at rpm	225/1950 - 5000
Bore	diameter mm	81.0
Stroke	mm	86.4
Compression		9.3
RON		95 1)
Injection-/Ignition system		Bosch Motronic
Knock control		yes
On Board Diagnositc (OBD)		yes
Oxygen sensor control		yes
Catalytic converter		yes
Charging		yes

1) Regular unleaded petrol RON 91 can be used but will cause a slight loss of power.

cardiagn.com

Code letters	AWM
Exhaust gas recirculation system	no
Intake manifold changeover	no
Camshaft timing control	yes
Secondary air inlet	yes
Valve timing	
with 1 mm valve lift and 0 mm valve clearance	
Inlet opens after TDC	18 °
Inlet closes after BDC	28 °
Exhaust opens before BDC	28 °
Exhaust closes before TDC	8 °

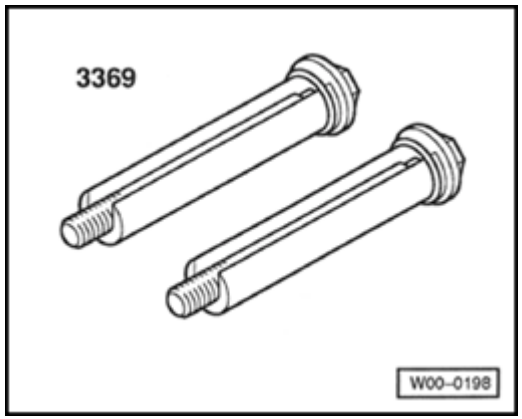
cardiagn.com

13-1

Engine, disassembling and assembling

Lock carrier, moving into service position

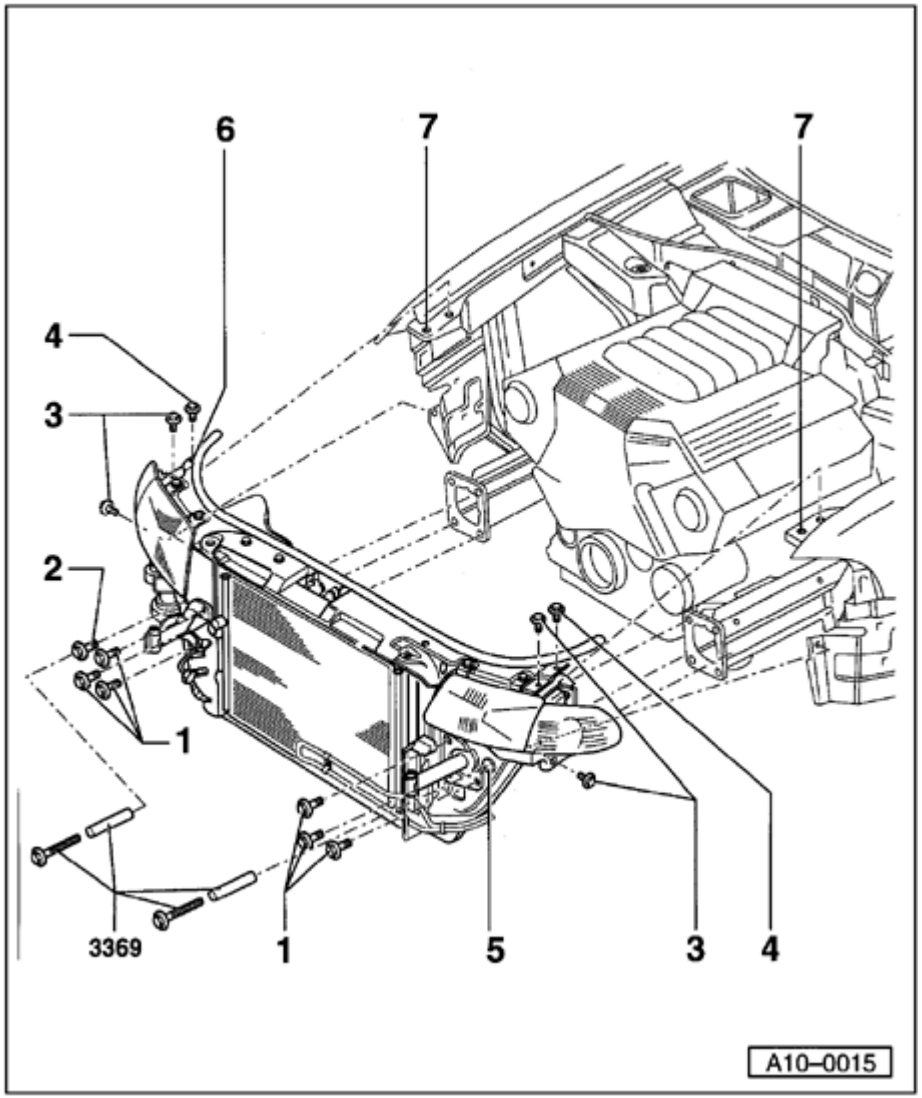
Special tools and equipment



- Special tool 3369

cardiagn.com

13-2



1 - 45 Nm

2 - 45 Nm

3 - 10 Nm

4 - 10 Nm

5 - Bore

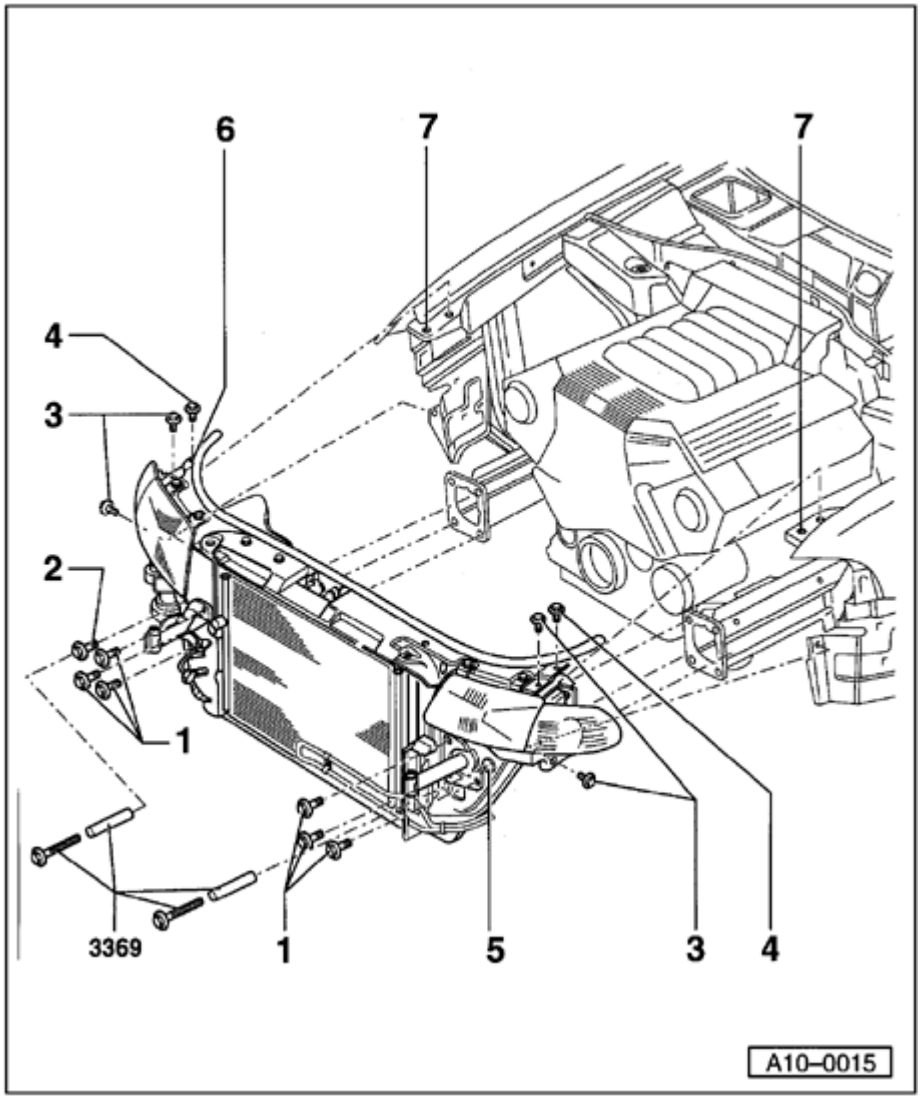
- For special tool 3369

6 - Hole in lock carrier

7 - Bore in fender panel

cardiagn.com

13-3



Removing

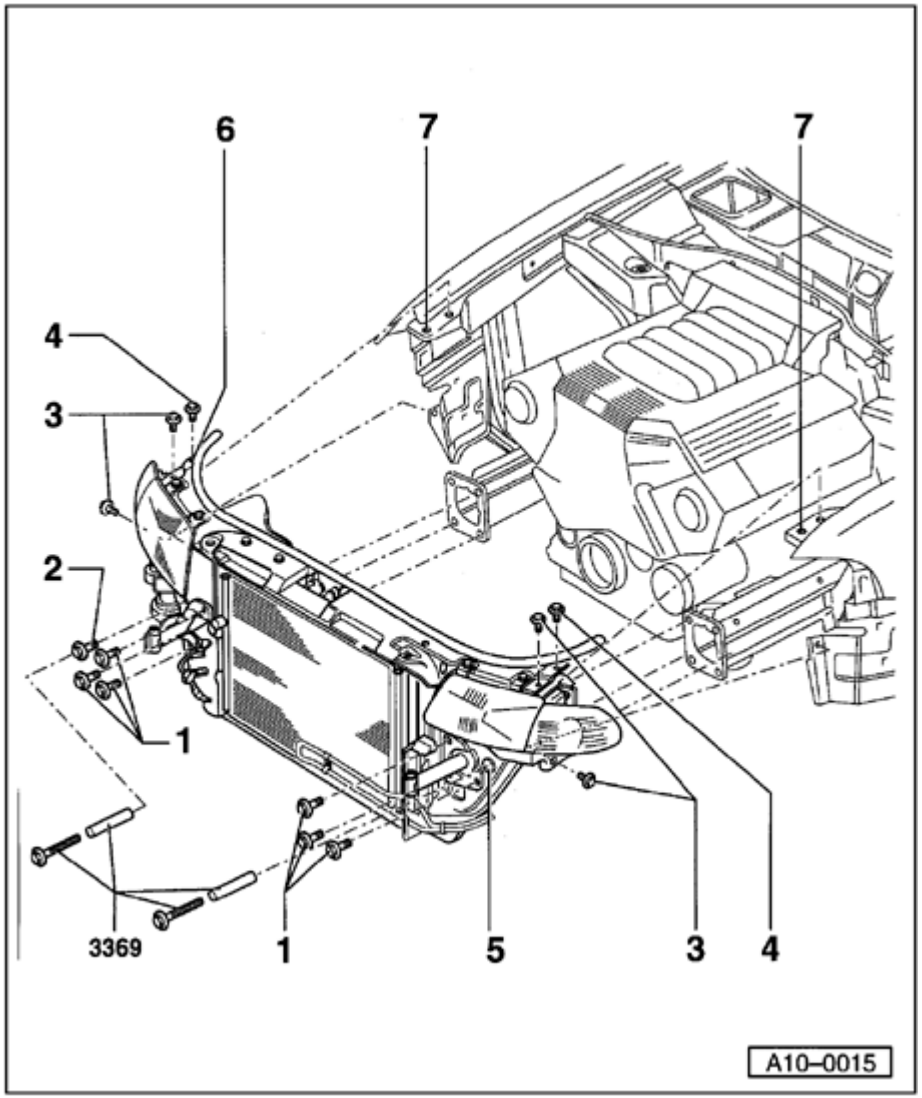
- Remove sound insulation ⇒ Fig. ⇒ 1 , ⇒ Page 13-6
- Remove front bumper:

⇒ *Repair Manual, Body Exterior, Repair Group 63*

- Remove lower air duct hose to charge air cooler ⇒ Fig. ⇒ 2 , ⇒ Page 13-6
- Remove air duct between lock carrier and air filter ⇒ Fig. ⇒ 3 , ⇒ Page 13-7
- Remove retaining clips (if installed) for wiring harness on left at radiator shroud.

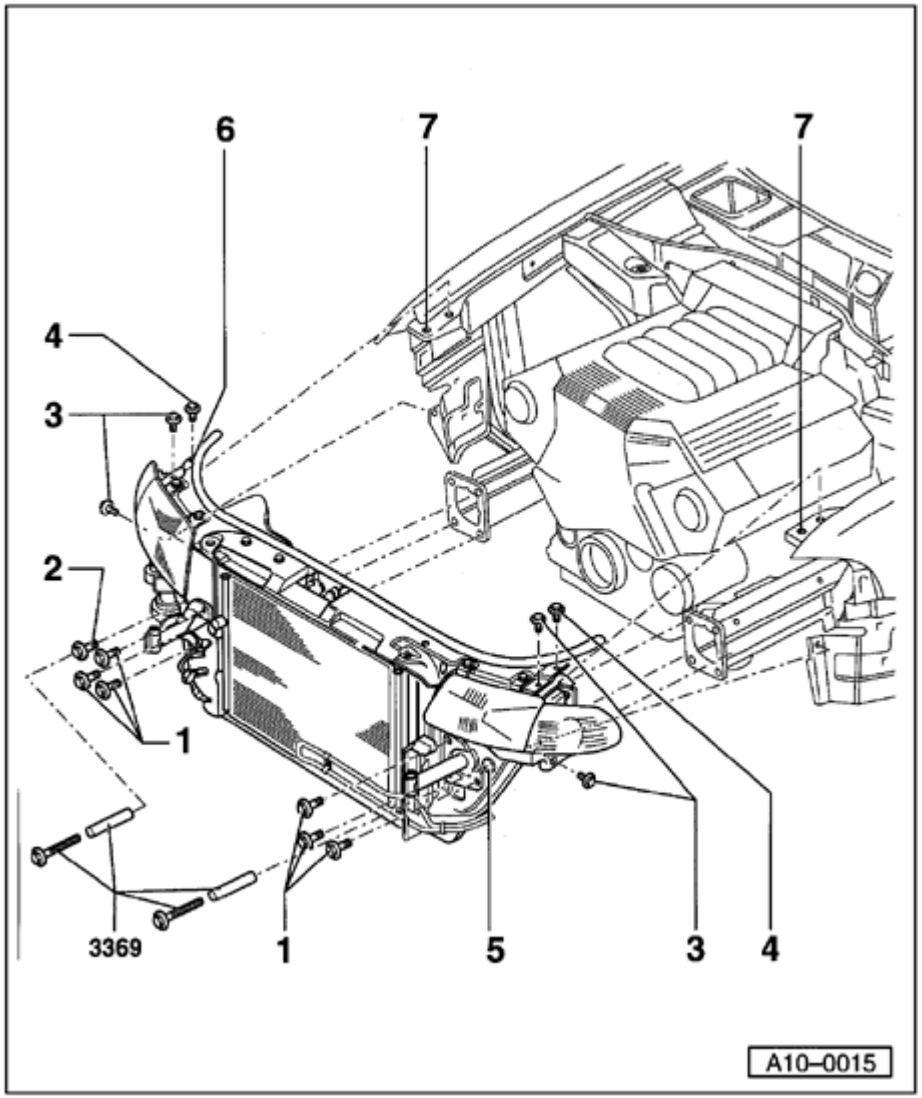
cardiagn.com

13-4



- Remove bolt -2- and screw in special tool 3369.
- Screw in special tool 3369 into bore -5-.
- Remove bolts -1- and -3-.
- Remove bolts -4- and pull lock carrier out as far as it will go.
- Secure lock carrier with suitable M6 bolts in hole -6- (lock carrier) and hole -7- (fender panel).

cardiagn.com



Installing

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

- When lock carrier has been installed, check that wiring next to radiator is correctly routed.
- Adjust limit stop for torque reaction support ⇒ Fig. ⇒ 4 , ⇒ Page 13-7 .
- Install front bumper.

⇒ *Repair Manual, Body Exterior, Repair Group 63*

- Adjust headlights.

⇒ *Repair Manual, Electrical Equipment, Repair Group 94*

cardiagn.com

13-6

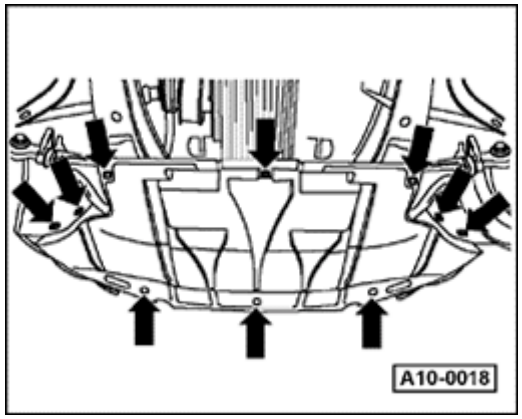


Fig. 1 Remove front sound insulation

- Remove sound insulation -arrows-.

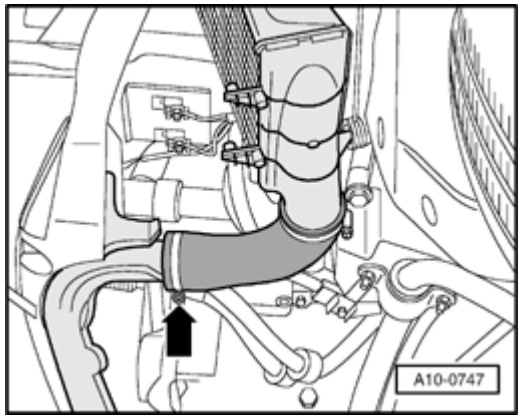


Fig. 2 Remove air duct hose

- Remove air duct hose to bottom left charge air cooler from lock carrier - arrow-.

cardiagn.com

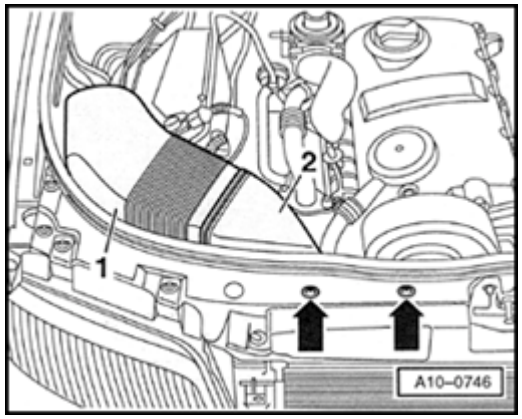


Fig. 3 Remove air duct between lock carrier and air filter

- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.

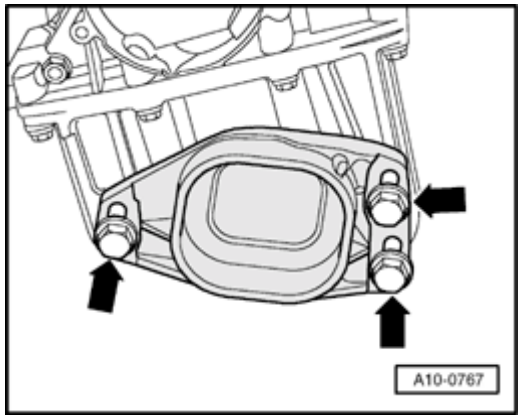
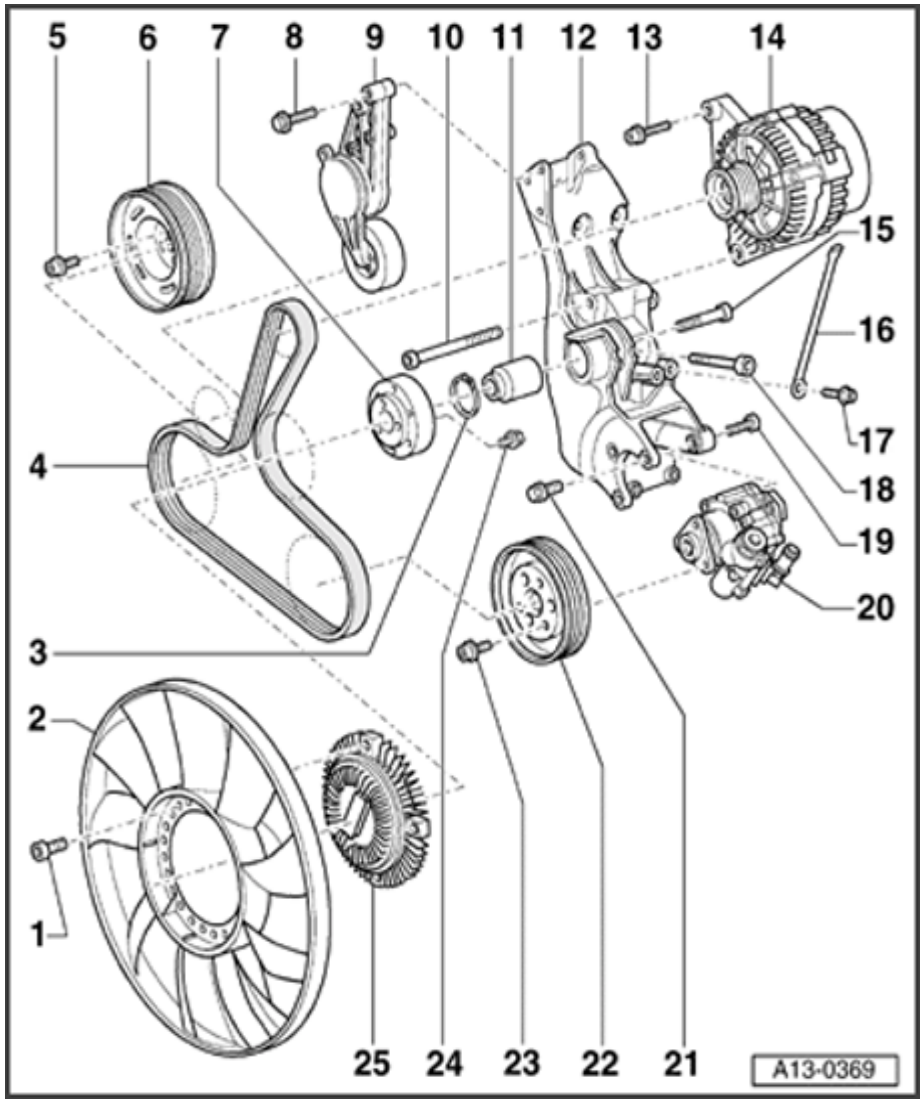


Fig. 4 Adjust stop for torque reaction support

- Attach limit stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight, and tighten bolts -arrows- to 28 Nm.

cardiagn.com

13-8



Ribbed belt drive for power steering pump, Generator and viscous fan

Note:

Mark the direction of rotation with chalk or felt pen before removing the ribbed belt. If the belt rotates in the wrong direction when it is reinstalled, belt breakage may result. Ensure that the belt is properly seated on the pulleys when installing.

1 - 10 Nm.

2 - Fan wheel

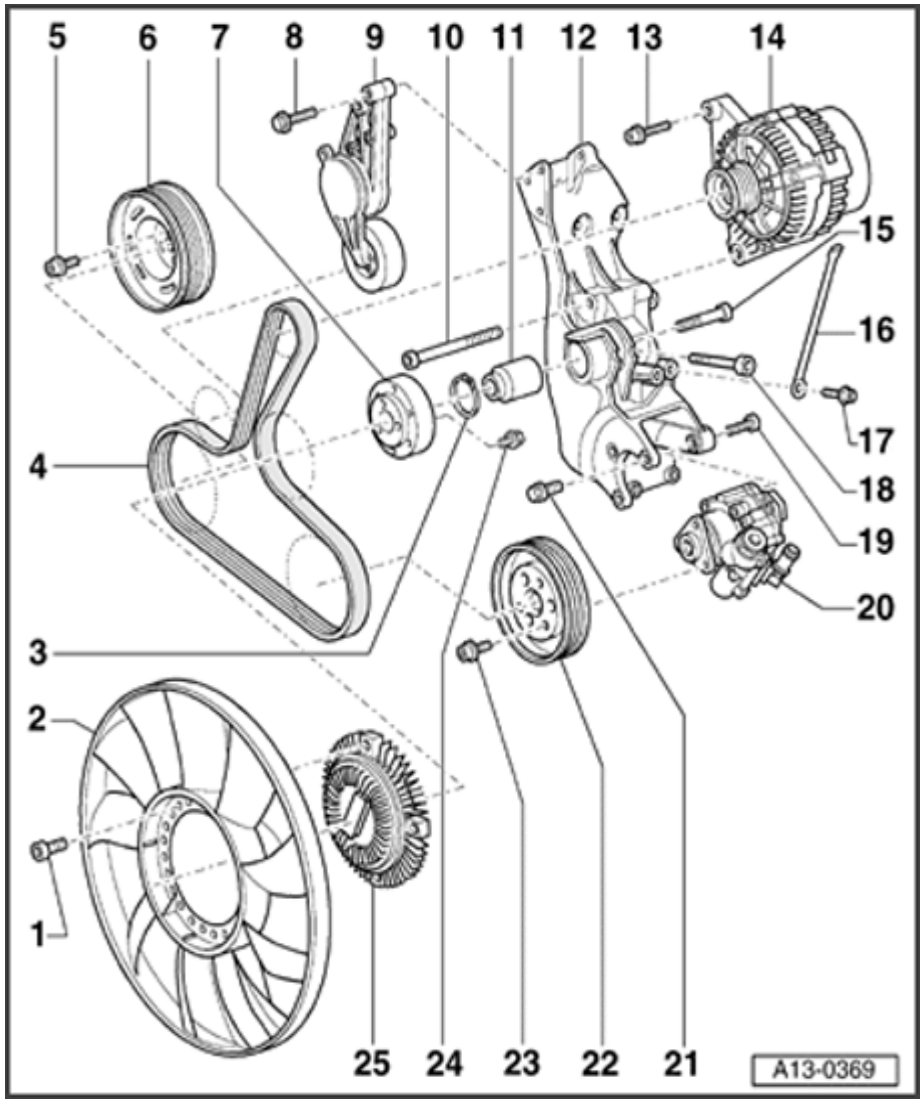
- For viscous fan
- Removing and installing ⇒ Page 13-21 .

3 - Circlip

- For viscous fan bearing
- Removing and installing ⇒ Page 13-23 .

cardiagn.com

13-9



4 - Ribbed V-belt

- Removing and installing ⇒ Page 13-18 .
- Check for wear
- Routing of ribbed belt⇒Fig. ⇒ 2 , ⇒ Page 13-17

5 - Bolt (special type)

- Always replace
- Use only genuine bolts

⇒ *Parts List*

- Torque: 10 Nm + 90° (1/4 turn)

6 - Vibration damper

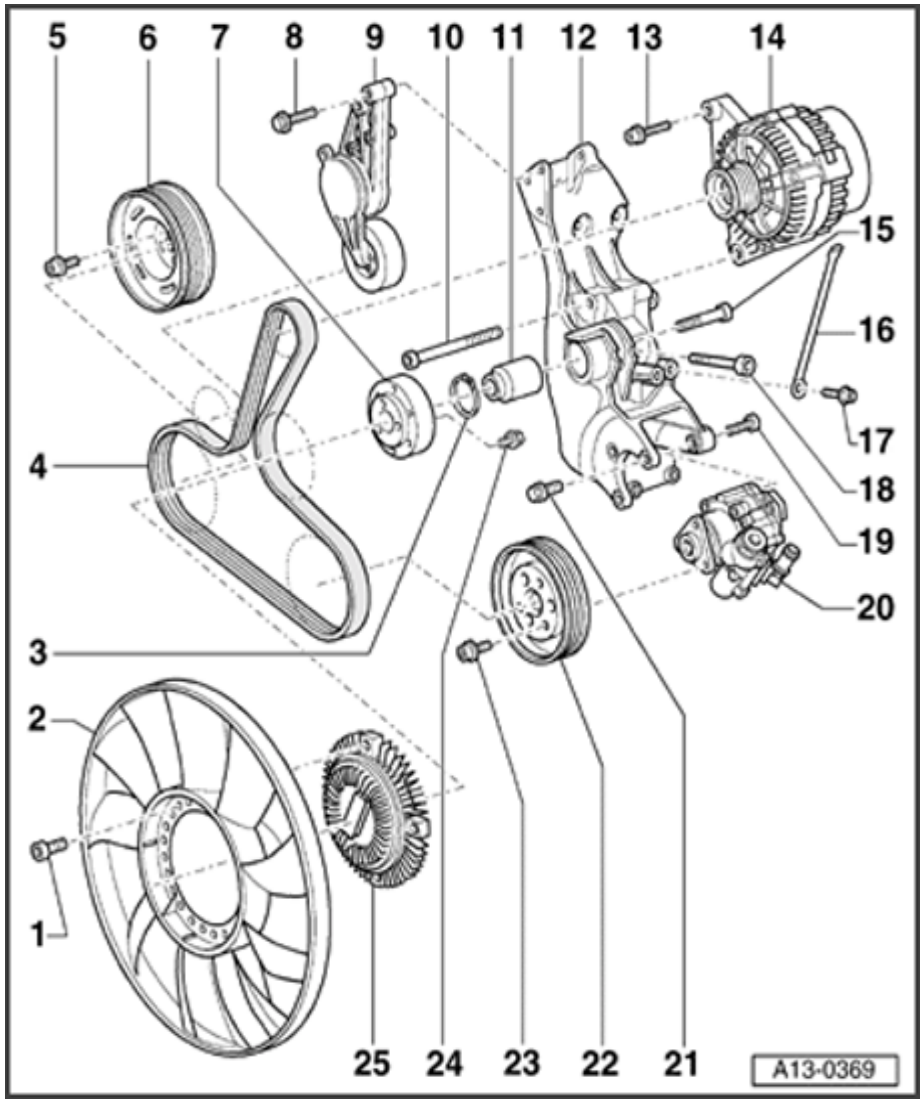
- With pulley for ribbed belt
- Can only be installed in one position ⇒ Fig. ⇒ 1 , ⇒ Page 13-17

7 - Pulley

- For viscous fan
- Removing and installing ⇒ Page 13-21 .

cardiagn.com

13-10



8 - 23 Nm

9 - Tensioner for ribbed belt

- Turn with open end spanner to loosen ribbed belt ⇒ Page 13-18 .
- Hold in position by inserting a suitable pin or Allen key in holes.

10 - 46 Nm

11 - Mounting

- For viscous fan
- Removing and installing ⇒ Page 13-23 .

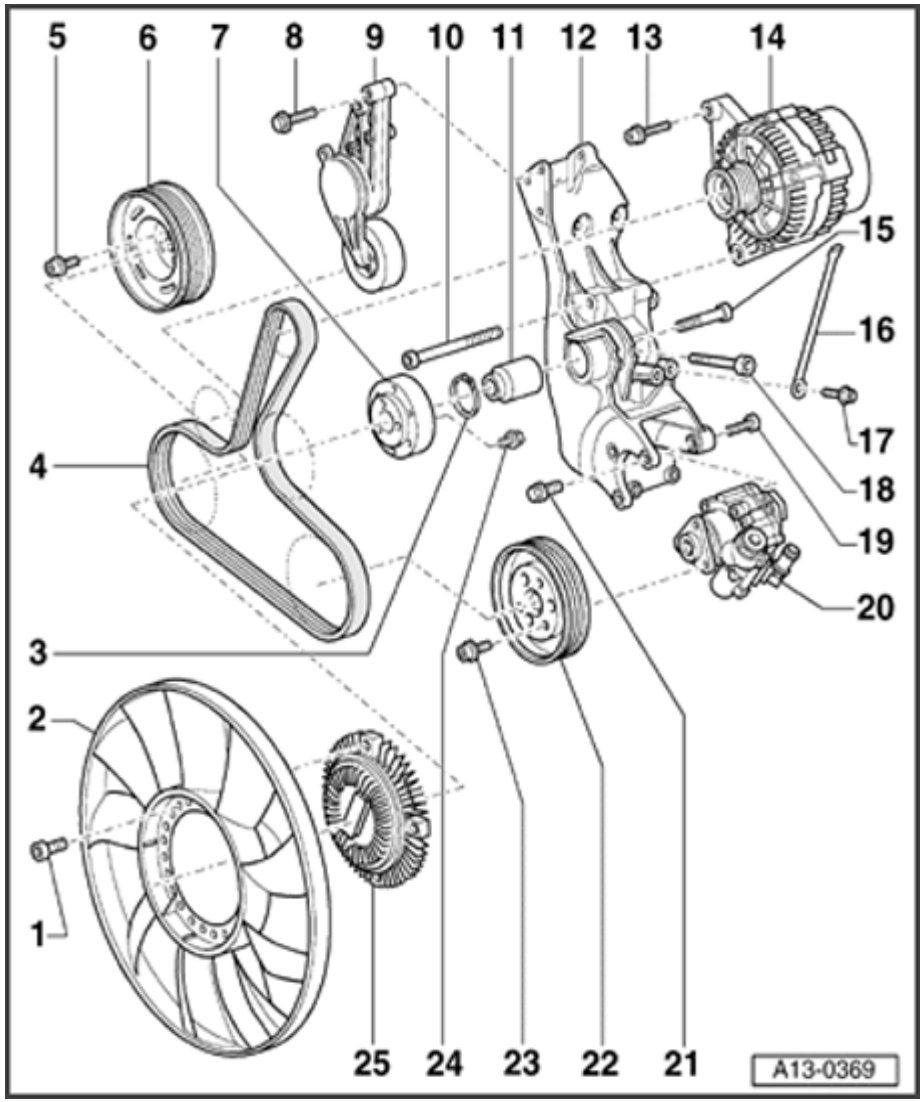
12 - Bracket

- For Generator, power steering pump and viscous fan
- Removing and installing ⇒ Page 13-28 .

13 - 23 Nm

cardiagn.com

13-11

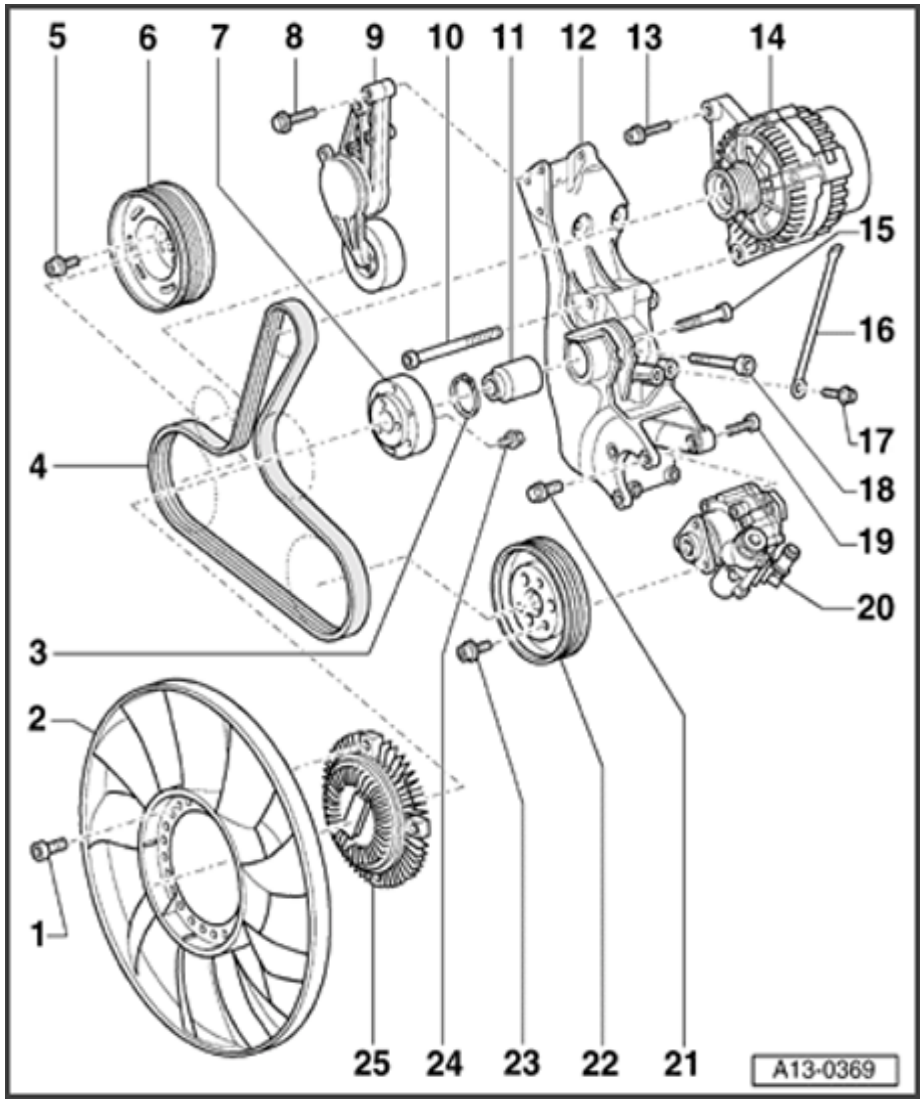


14 - Generator

- Removing:
  - Disconnect battery Ground strap
  - Remove air duct hose to charge air cooler.
  - Loosen ribbed belt and take belt off Generator ⇒ Page 13-18 .
  - Remove viscous fan and put into radiator cowl.
  - Remove electrical wiring from Generator.
  - Loosen connections for Generator from top and bottom and remove Generator.
- Installing:
  - To facilitate attachment of Generator slightly drive back thread bushing for securing bolt at bracket.

cardiagn.com

13-12



15 - 45 Nm

16 - Support

- For intake manifold

17 - 20 Nm

18 - 52 Nm

- Apply D 000 600 when installing
- Bolts have different lengths. For positions and tightening sequence ⇒ Page 13-33

19 - 23 Nm

20 - Power steering pump

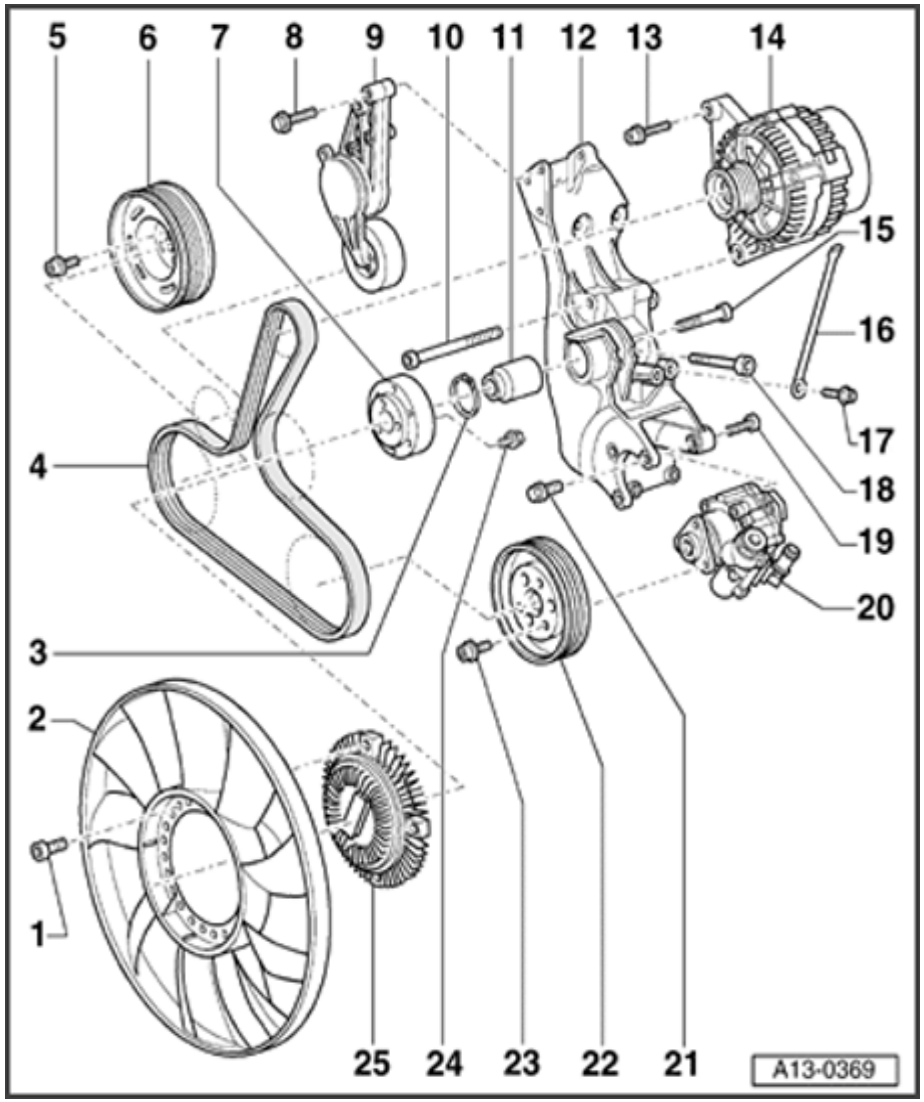
- Removing and installing:

⇒ *Repair Manual, Suspension, Wheels, Steering, Repair Group 48*

21 - 23 Nm

cardiagn.com

13-13



22 - Pulley

- For power steering pump
- Installation position: Open side faces to front of vehicle

23 - 23 Nm

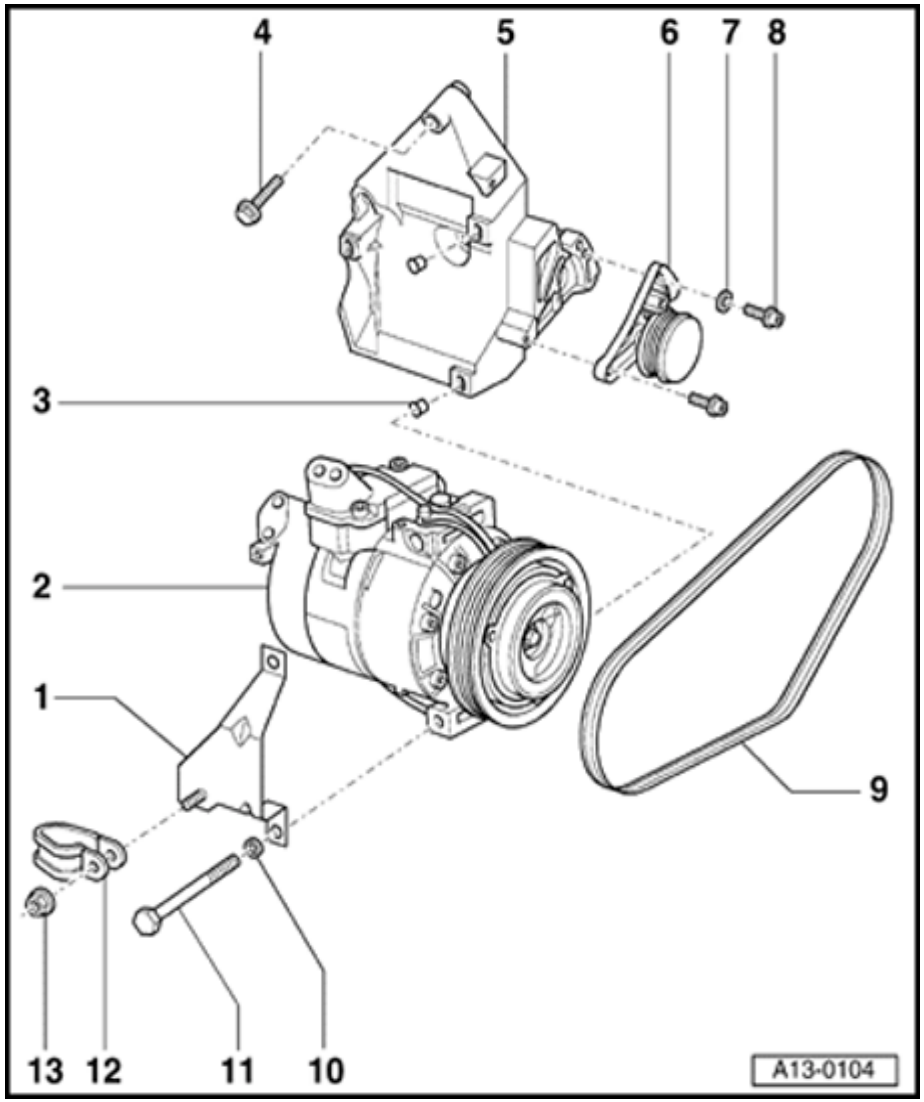
24 - Ribbed bolt - 28 Nm

25 - Viscous coupling

- Removing and installing ⇒ Page 13-21

cardiagn.com

13-14



Ribbed belt drive for air conditioner - assembly overview

CAUTION!

The air conditioner refrigerant circuit must not be opened.

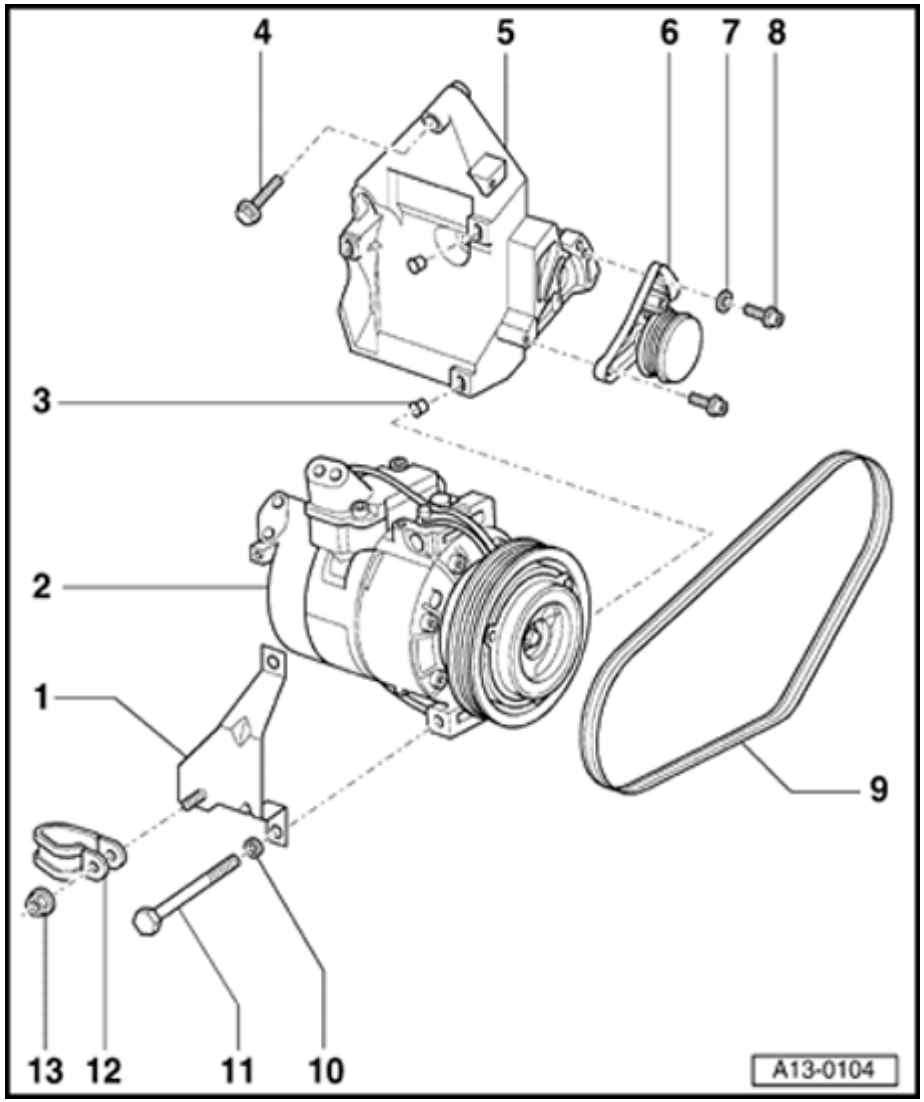
Note:

Mark the direction of rotation with chalk or felt pen before removing the ribbed belt. If the belt rotates in the wrong direction when it is reinstalled, belt breakage may result. Ensure that the belt is properly seated on the pulleys when installing.

1 - Bracket

cardiagn.com

13-15



2 - Air conditioner compressor

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

3 - Dowel sleeve

- Check sleeve is correctly seated in bracket

4 - 33 Nm

5 - Bracket

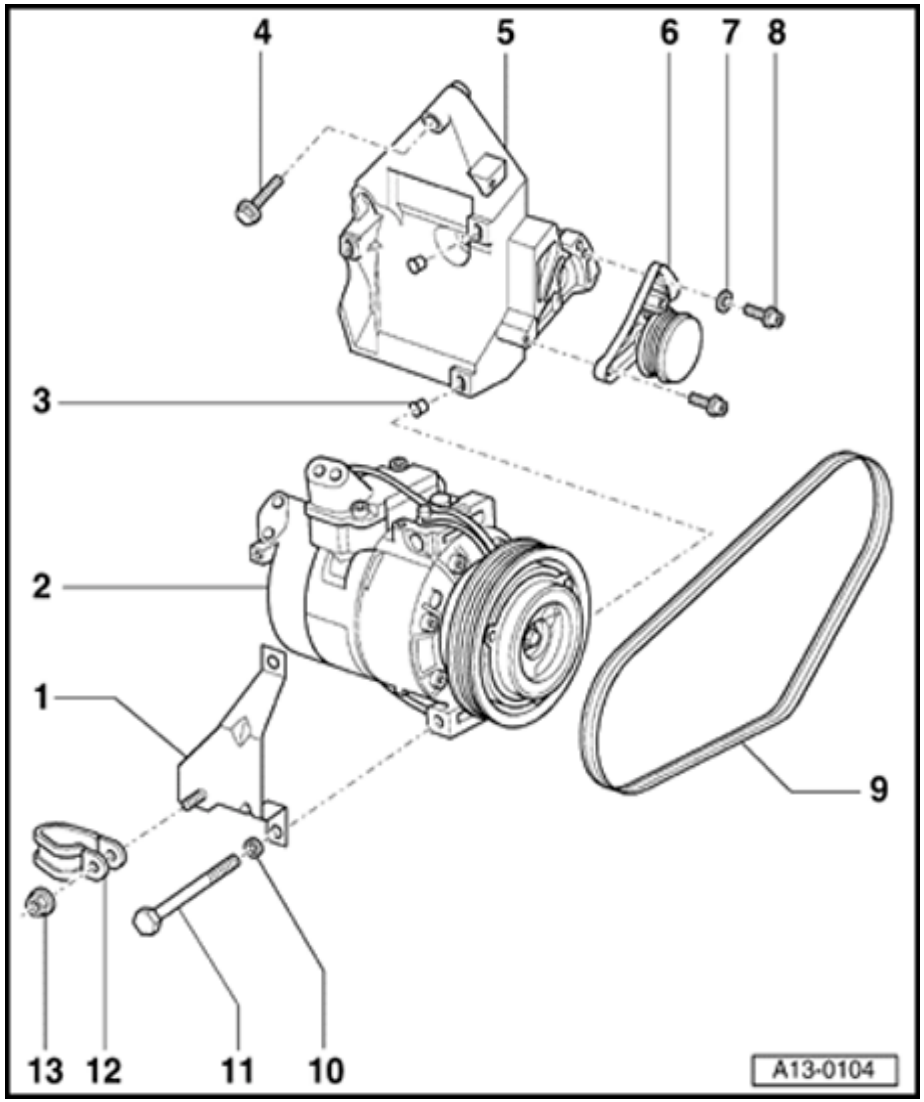
- For A/C compressor

6 - Tensioner

- For ribbed belt
- Removing and installing ribbed belt ⇒ Page 13-18

cardiagn.com

13-16



7 - Washer

8 - 23 Nm

9 - Ribbed V-belt

- Removing and installing ⇒ Page 13-18 .
- Check for wear
- Do not kink
- Routing of ribbed belt⇒Fig. ⇒ 2 , ⇒ Page 13-17

10 - Washer

11 - 25 Nm

12 - Retaining clip

13 - 20 Nm

cardiagn.com

13-17

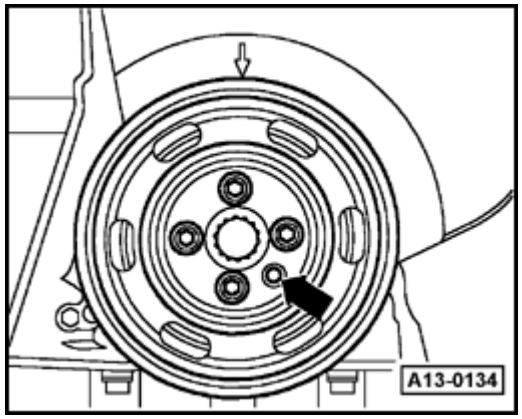


Fig. 1 Installing vibration damper

- Lock carrier must be in service position ⇒ Page 13-1 .
- Ribbed belt must be removed ⇒ Page 13-18 .
- Always replace bolts. Only use original type bolts to install the vibration damper.

⇒ *Parts List*

The vibration damper can only be installed in one position. The hole - arrow- in the vibration damper must fit over the projection on the toothed belt sprocket.

- Tighten bolts of vibration damper to 10 Nm + 90° ($^1/_4$ turn).

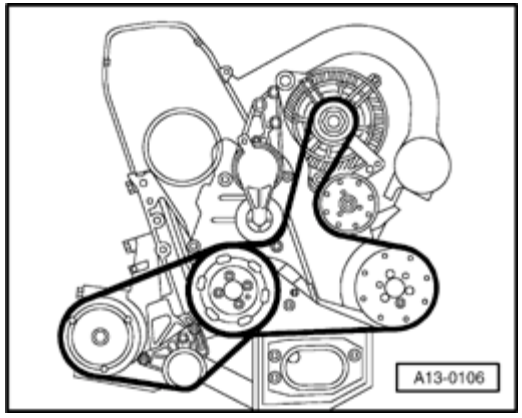


Fig. 2 Ribbed belt routing

cardiagn.com

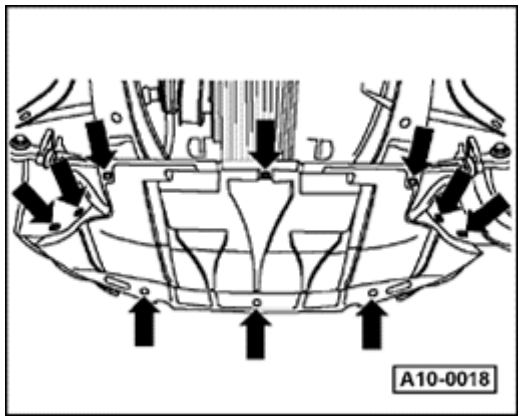
13-18

Ribbed belt, removing and installing

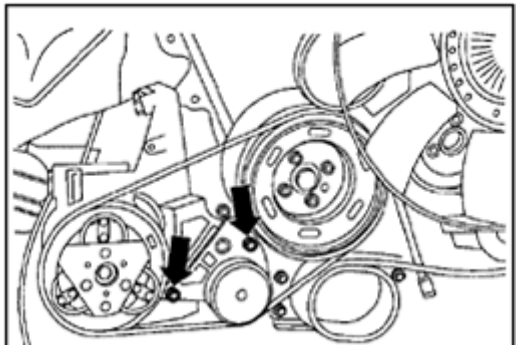
Note:

Mark the direction of rotation with chalk or felt pen before removing the ribbed belt. If the belt rotates in the wrong direction when it is refitted, belt breakage may result. Ensure that the belt is properly seated on the pulleys when installing.

Removing

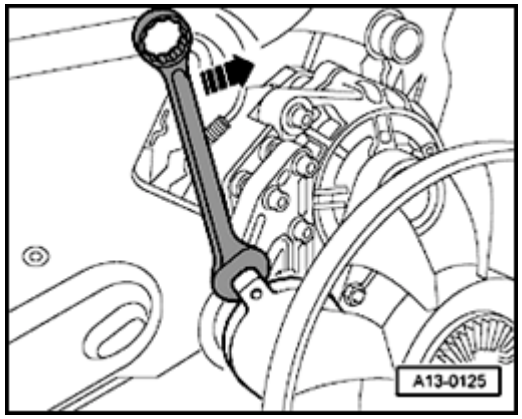


- Remove sound insulation -arrows-.



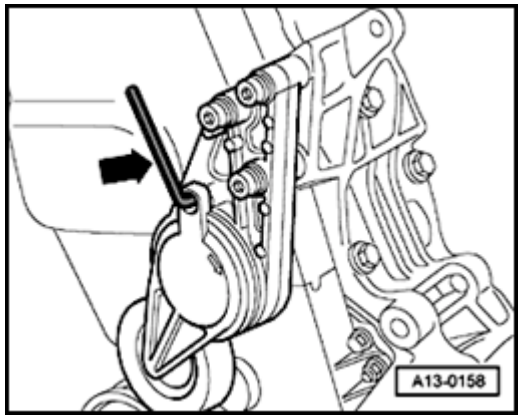
- Loosen bolts securing ribbed belt tensioning roller for A/C compressor -arrows-.

cardiagn.com



- Turn tensioner in direction of arrow to loosen ribbed belt.
- Remove ribbed belt from Generator and release tensioner.

Note:



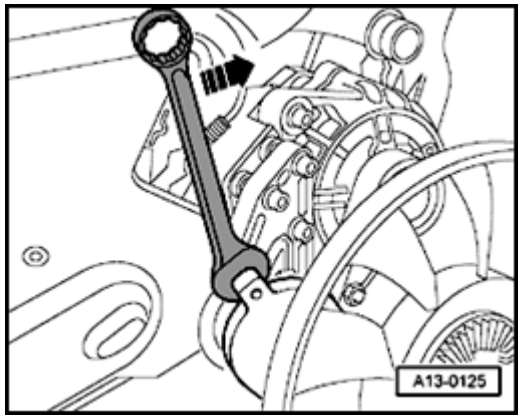
When the lock carrier is in the service position, the ribbed belt tensioner can be secured to prevent it from turning by inserting a suitable pin or Allen key -arrow- into the holes.

cardiagn.com

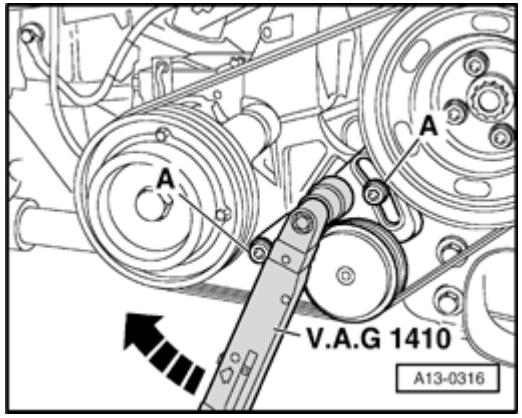
13-20

Installing

- Attach ribbed belt to pulleys from crankshaft and vane pump and, if necessary, pull up with auxiliary tool.



- Swivel tensioner for ribbed belt in direction of arrow.
- Install ribbed belt over Generator pulley last. Release tensioner.
- Check that ribbed belt is properly seated.
- Fit ribbed belt for A/C compressor.
  - ♦ Ribbed belt routing ⇒ Fig. ⇒ 2 , ⇒ Page 13-17



- Attach torque wrench at "7 o'clock position" as illustrated to hex on tensioner and pretension to 30 Nm.
- While tensioning, tighten bolts -A- to 23 Nm.
- Start engine and check belt running.

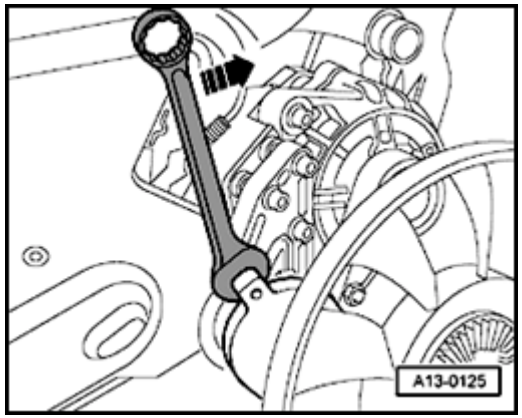
cardiagn.com

13-21

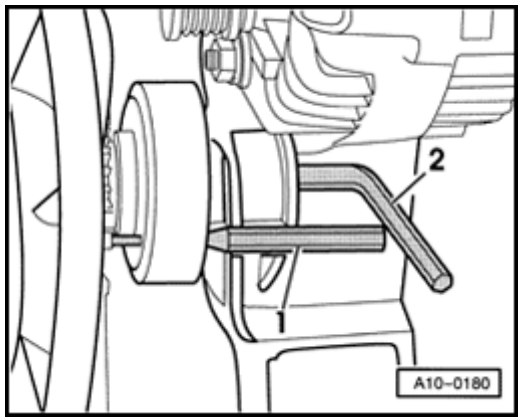
Viscous fan, removing and installing

Removing

- Lock carrier must be in service position ⇒ Page 13-1 .



- To loosen ribbed belt, turn tensioner in direction of arrow.
- Remove ribbed belt from Generator pulley.



- Secure pulley for viscous fan with pin punch -1- and remove using Allen key -2-.
- Remove viscous fan.

cardiagn.com

Installing

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

- Install ribbed belt ⇒ Page 13-20 .

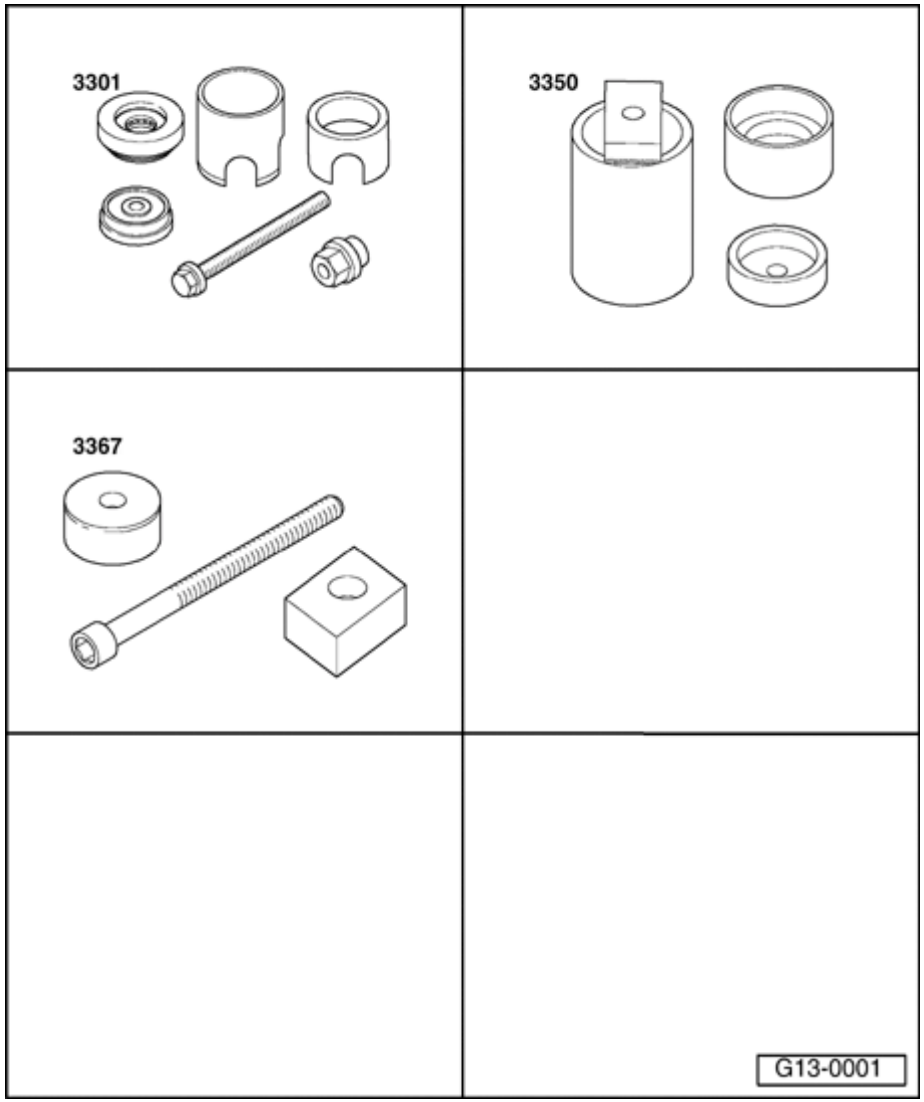
- Install lock carrier ⇒ Page 13-1 .

Tightening torque

Component		Nm
Viscous fan to bearing		45

cardiagn.com

13-23



Bearing for viscous fan, removing and installing

Special tools and equipment

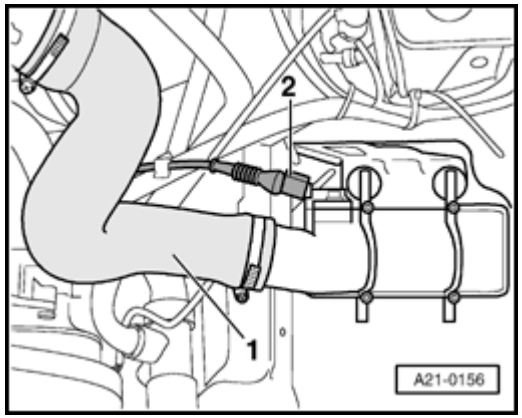
- Special tool 3301
- Special tool 3350
- Special tool 3367

cardiagn.com

13-24

Removing

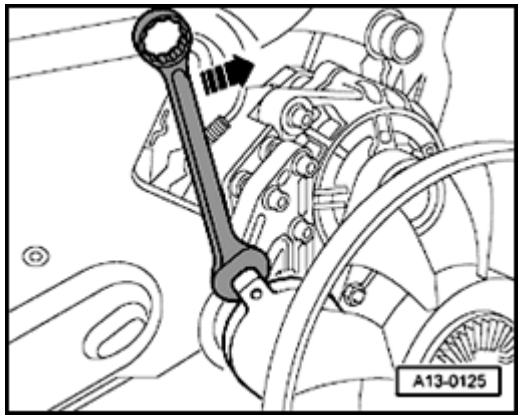
- Lock carrier must be in service position ⇒ Page 13-1 .



- Remove air duct hose -1-.

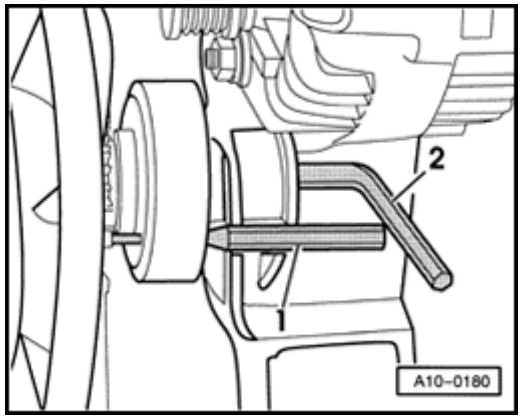
Note:

Connector -2- remains plugged in.

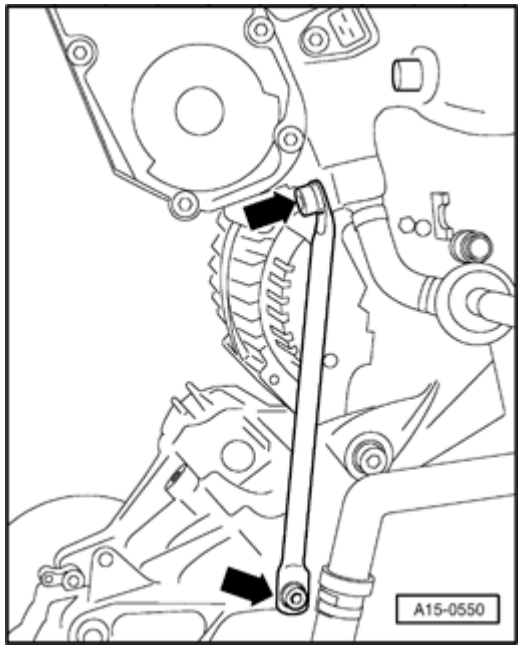


- Turn tensioner in direction of arrow to loosen ribbed belt.
- Remove ribbed belt from Generator pulley.

cardiagn.com



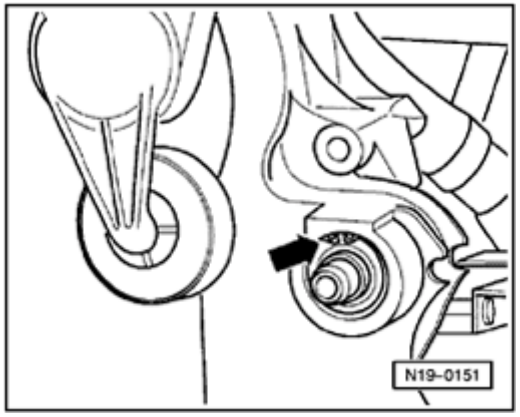
- Secure pulley for viscous fan with pin punch -1- and remove using Allen key -2-.
- Remove viscous fan from mounting.



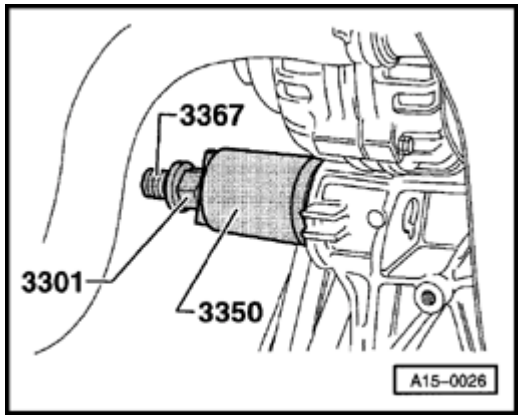
- Remove intake pipe support -arrows-.

cardiagn.com

13-26



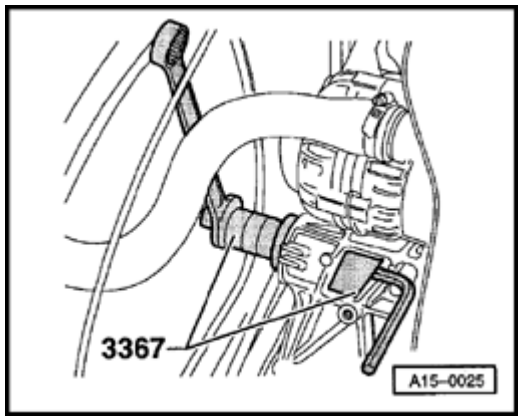
- Remove circlip -arrow- from bearing bushing using angled circlip pliers.



- Remove bearing from housing with nut from assembly mounting 3301, bolt 3367/3 and pipe 3350.

cardiagn.com

13-27



Installing

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

- Press in bearing with tool 3367 and nut from assembly mounting 3301.
- Install circlip in housing for viscous fan using angled circlip pliers.
- Install viscous fan ⇒ Page 13-21 .

cardiagn.com

13-28

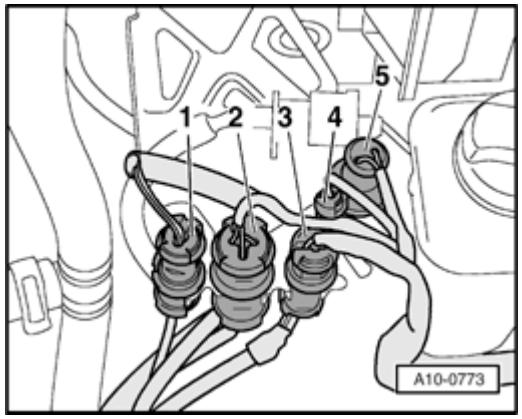
Bracket for Generator, power steering pump and viscous fan, removing and installing

Removing

- Observe or obtain radio anti-theft code on vehicles with coded radio.

- Disconnect Ground strap at battery with ignition switched off.

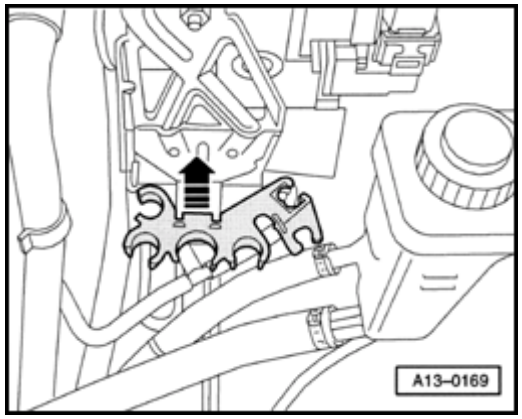
- Remove cover from power steering fluid reservoir.



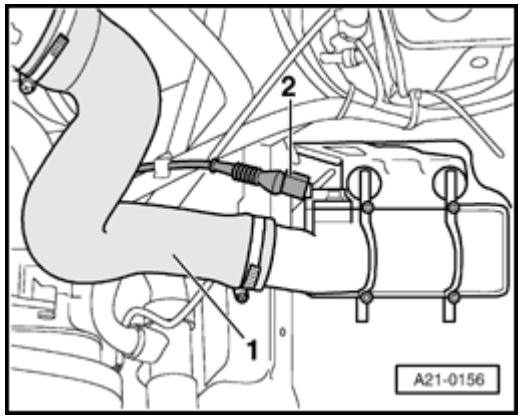
- Mark connectors -1 to 5- and remove from bracket.

cardiagn.com

13-29



- Unclip connector bracket at ABS unit console and lift up to remove.

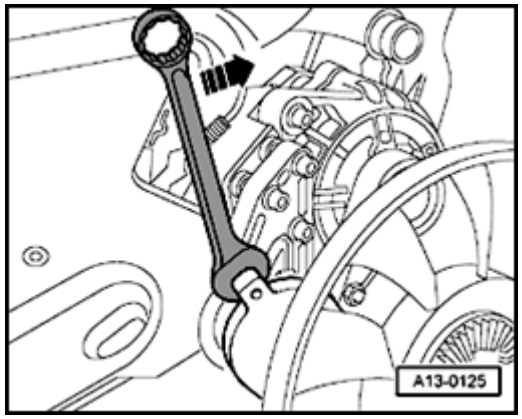


- Remove air duct hose -1-.

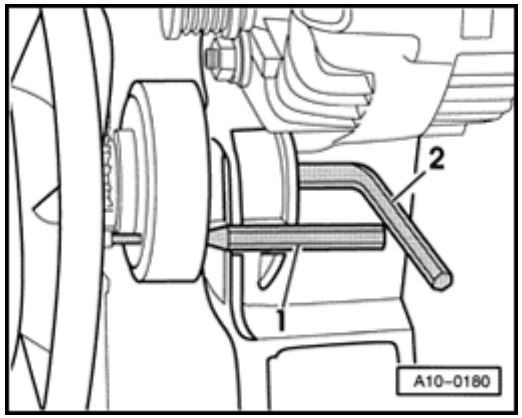
Note:

Connector -2- remains plugged in.

cardiagn.com



- To loosen ribbed belt, turn tensioner in direction of arrow.
- Remove ribbed belt from Generator pulley.



- Secure pulley for viscous fan with pin punch -1- and remove using Allen key -2-.
- Remove viscous fan from mounting and put in front of radiator cowl.
- Remove wiring from rear of Generator.
- Loosen connections for Generator from top and bottom and remove Generator.

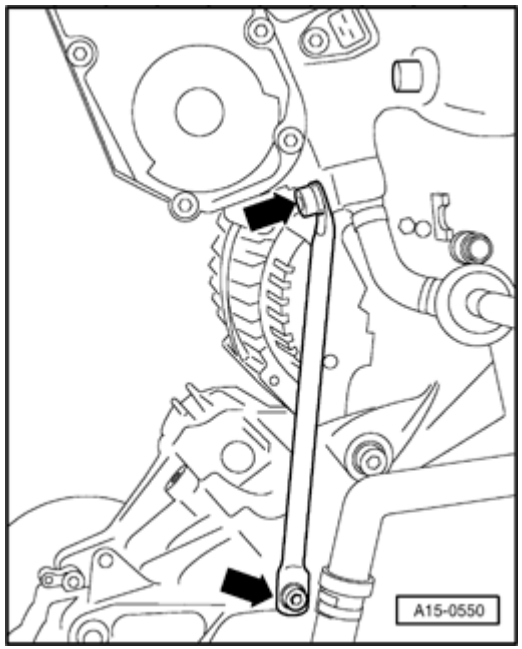
cardiagn.com

13-31

- Remove tensioner for ribbed belt from bracket.

- Remove pulley from power steering pump.

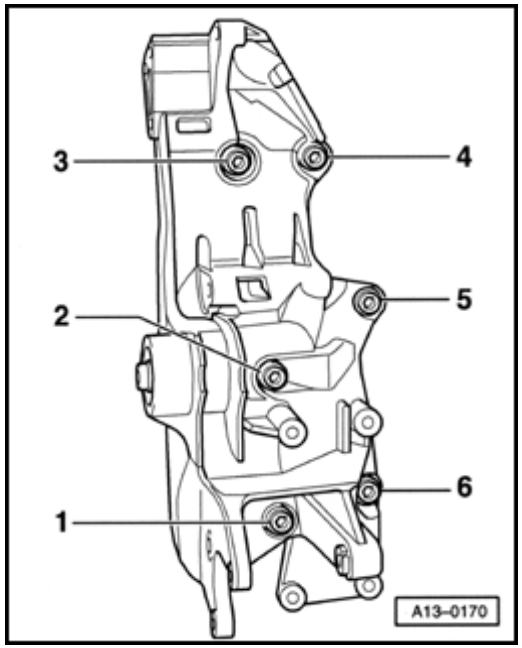
- Unbolt power steering pump, move clear to one side and tie in place. Do not open hydraulic connections.



- Remove intake pipe support -arrows-.

cardiagn.com

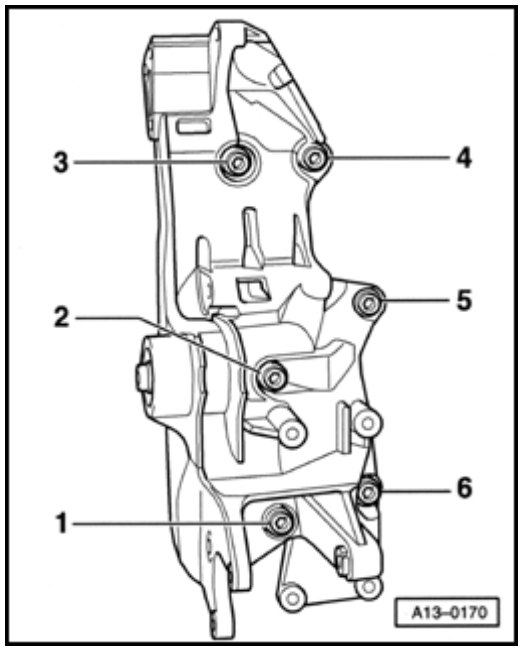
13-32



- Unbolt bracket for Generator, steering pump and viscous fan -bolts 1 to 6-.

cardiagn.com

13-33



Installing

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

- Install bolts -1 to 6- with locking fluid "D 000 600" and tighten bolts diagonally.

  1, 2 - Bolt M10 x 85

  3 to 6 - Bolt M10 x 45

- To help install Generator knock back bushing on bottom securing bolt slightly.
- Remove viscous fan ⇒ Page 13-21 .
- Install ribbed belt ⇒ Page 13-20 .
- After connecting battery, enter anti-theft code for radio.

⇒ *Radio operating instructions*

- Close windows fully using window switches.

cardiagn.com

- Actuate all window switches again for at least one second in the "close" direction to activate the automatic open/close function.

- Set clock to correct time.

Tightening torques

Component		Nm
Bracket for Generator, power steering pump and viscous fan to cylinder block		52 1)
Support for intake manifold		
	to intake manifold	20
	to bracket	20
Power steering pump to bracket		23
Pulley to coolant pump		23
Generator at bracket		
	M8	23
	M10	46
Ribbed belt tensioner to bracket		23

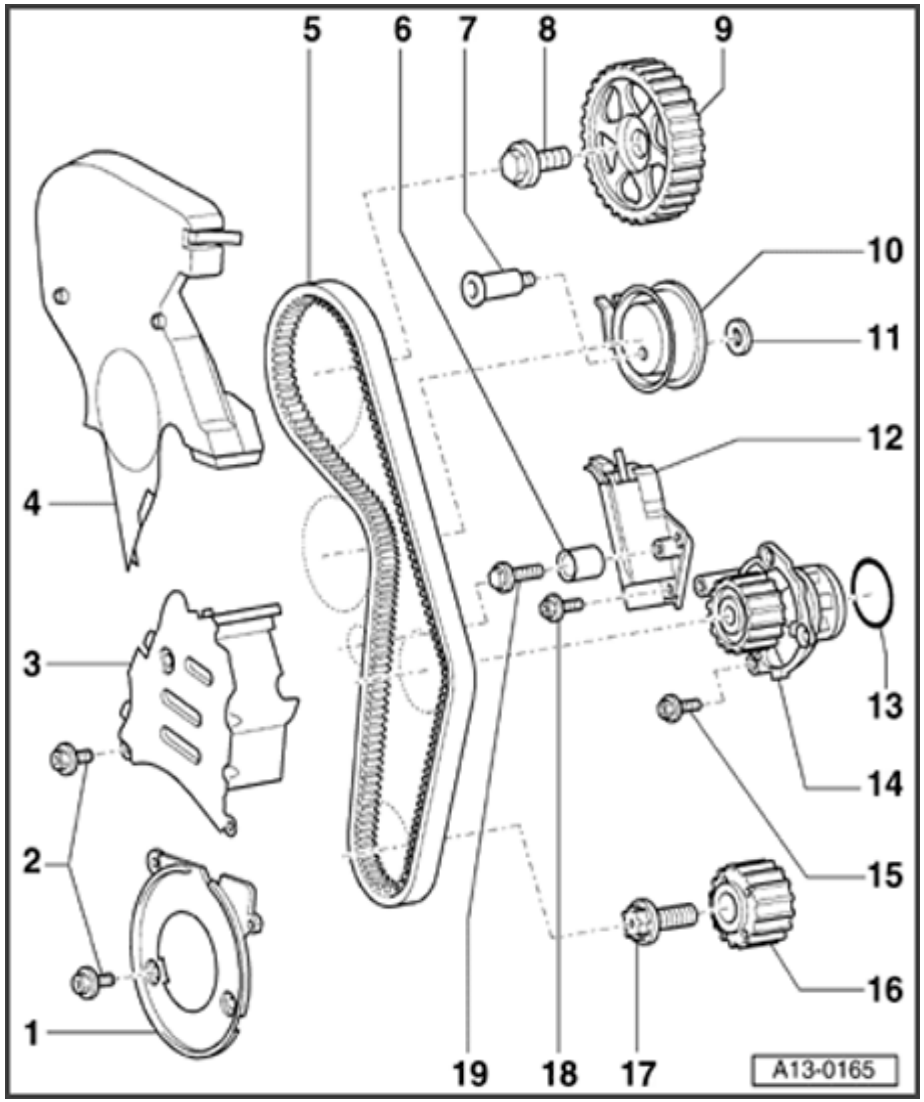
cardiagn.com

Viscous fan to bearing	45

1) Install with locking fluid D 000 600 A2

cardiagn.com

13-35



Toothed belt drive

Note:

Mark the direction of rotation with chalk or felt pen before removing the toothed belt. If the belt rotates in the wrong direction when it is reinstalled, belt breakage may result.

1 - Toothed belt guard - lower

- To remove, unbolt vibration damper

2 - 10 Nm

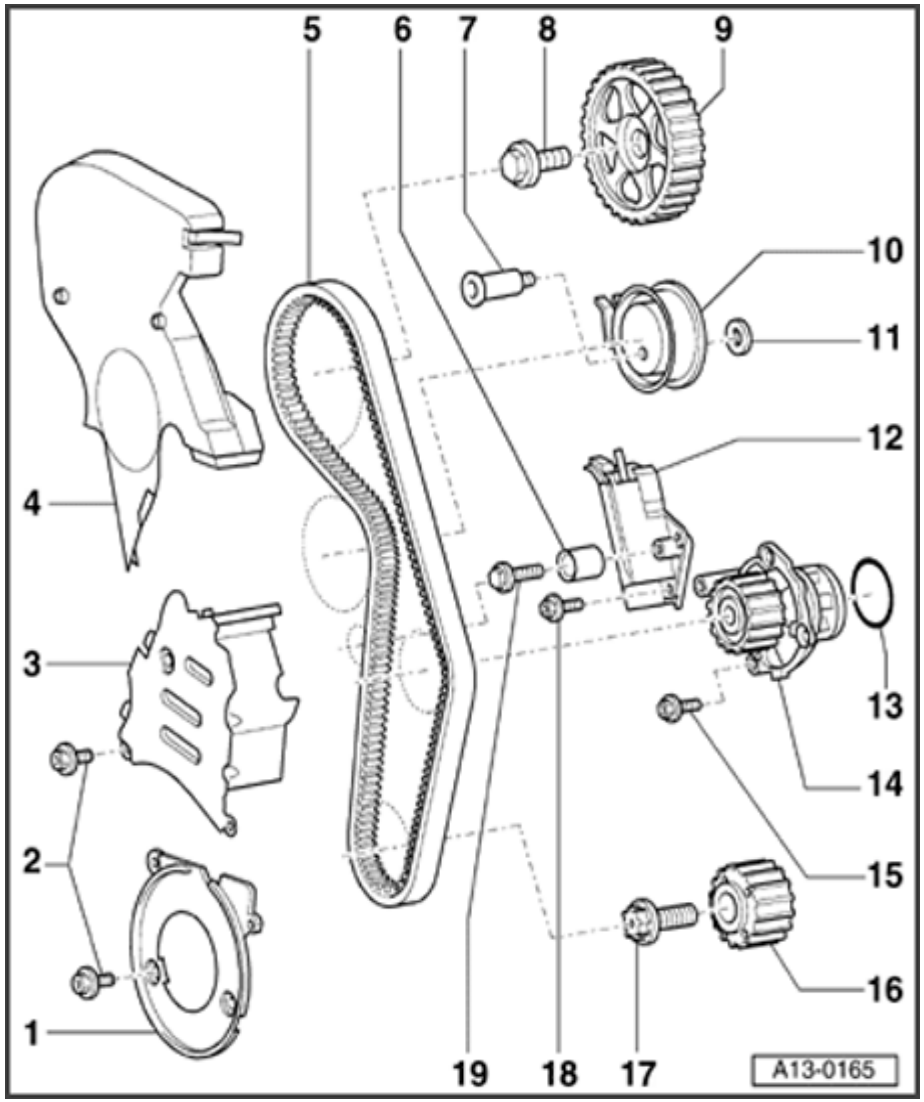
- Apply D 000 600 when installing

3 - Toothed belt guard - center

- Unbolt tensioner before removing center section of toothed belt guard

cardiagn.com

13-36



4 - Toothed belt guard - top

- When installing, engage carefully in center toothed belt guard

5 - Toothed belt

- Mark direction of rotation with chalk or felt pen before removing.
- Check for wear
- Removing ⇒ Page 13-40
- Install (adjust valve timing) ⇒ Page 13-44

6 - Idler roller

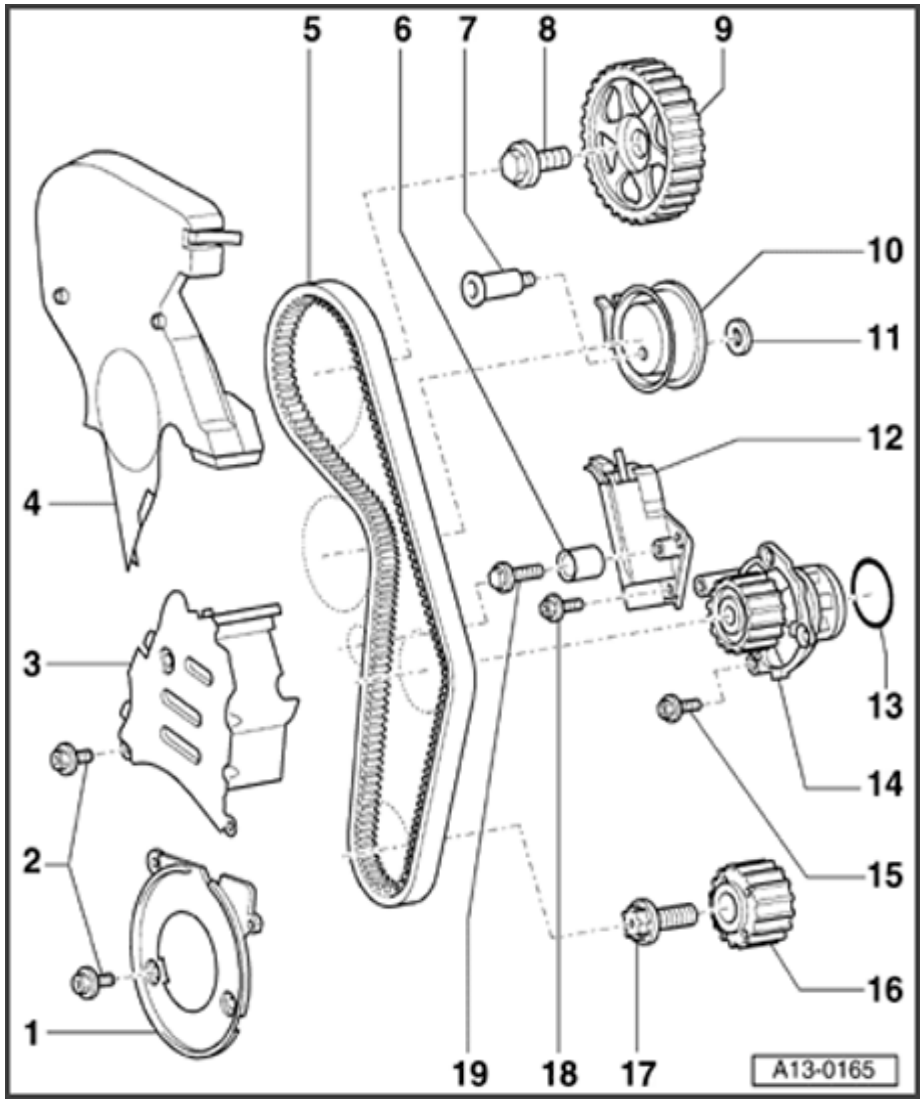
7 - 27 Nm

8 - 65 Nm

- Counter hold with 3036 to loosen and tighten

cardiagn.com

13-37



9 - Camshaft sprocket

- For exhaust camshaft
- Take off toothed belt before removing and installing ⇒ Page 13-40
- Installation position ⇒Fig. ⇒ 1 , ⇒ Page 13-39

10 - Tensioner

11 - Washer

12 - Tensioner for toothed belt

13 - O-ring

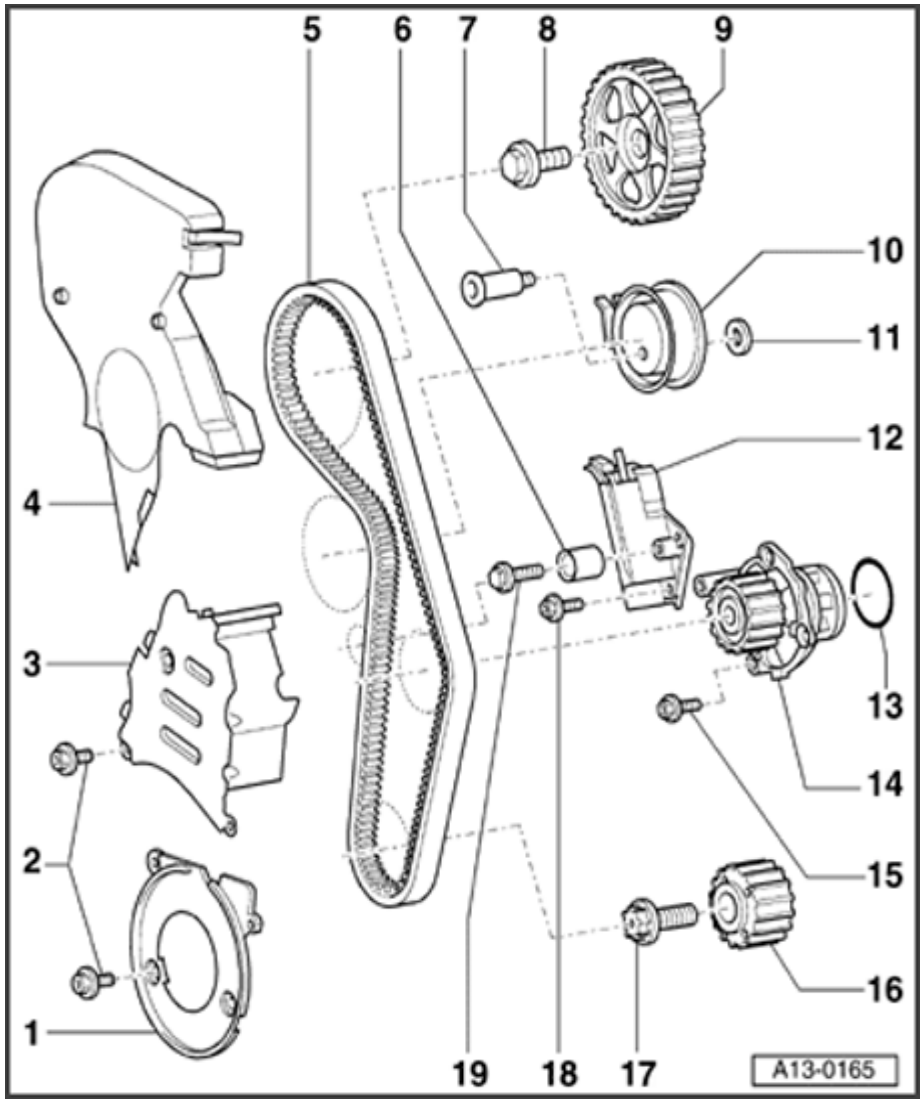
- Always replace
- Lightly coat with coolant G 012 A8 D before installing

14 - Coolant pump

- Removing and installing ⇒ Page 19-12

cardiagn.com

13-38



15 - 15 Nm

16 - Crankshaft sprocket

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

17 - 90 Nm + $^{1}/_{4}$ turn (90 °) further

- Always replace
- Do not use oil
- Counter hold with 3415 to loosen and tighten
- Fasten counterhold 3415 ⇒ Fig. ⇒ 2 , ⇒ Page 13-39

18 - 15 Nm

19 - 25 Nm

cardiagn.com

13-39

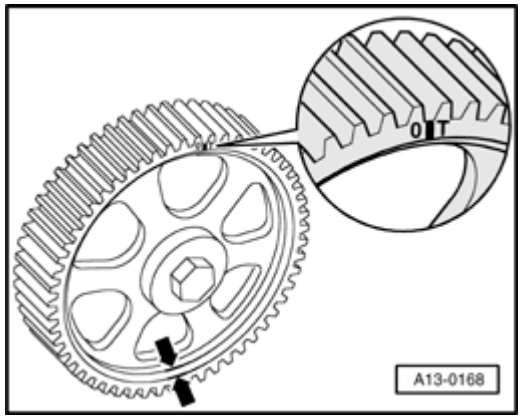


Fig. 1 Location of camshaft sprocket

- The narrow web of the camshaft sprocket faces outward -arrows- and the marking for TDC of cylinder 1 is visible from front.

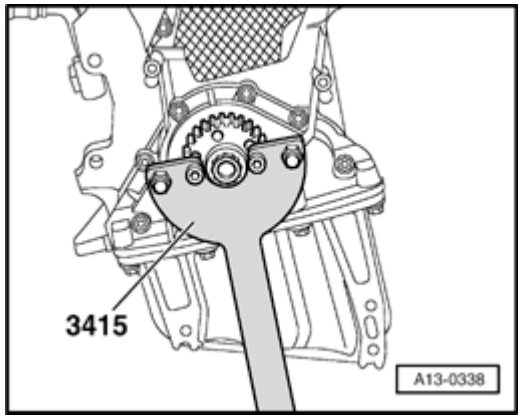


Fig. 2 Removing and installing toothed belt crankshaft

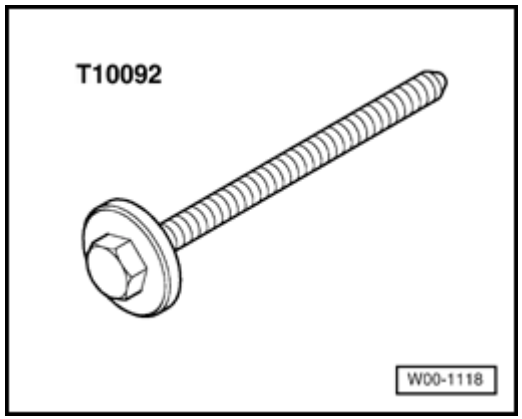
- Use counter-hold tool 3415 to loosen and tighten the central bolt.

cardiagn.com

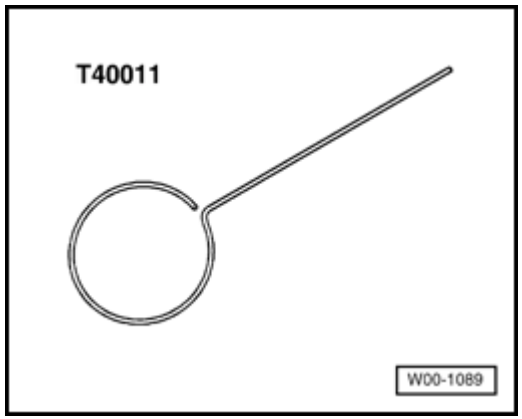
13-40

Toothed belt, removing and installing

Special tools and equipment



- Socket head fastener T10092



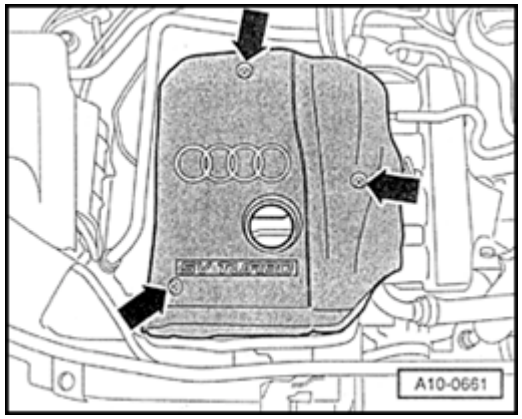
- Pin T40011

cardiagn.com

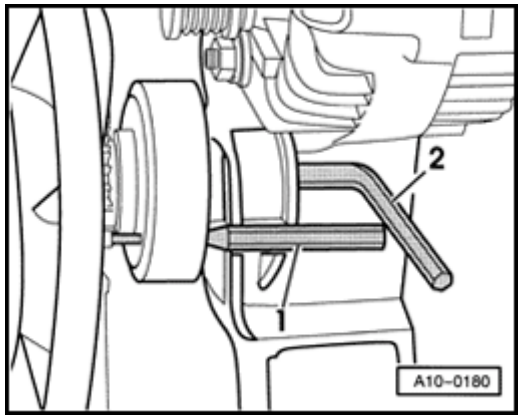
13-41

Removing

- Engine in vehicle.
- Lock carrier must be in service position ⇒ Page 13-1 .



- Remove engine cover -arrows-.
- Remove ribbed belt and tensioner for ribbed belt ⇒ Page 13-18 .

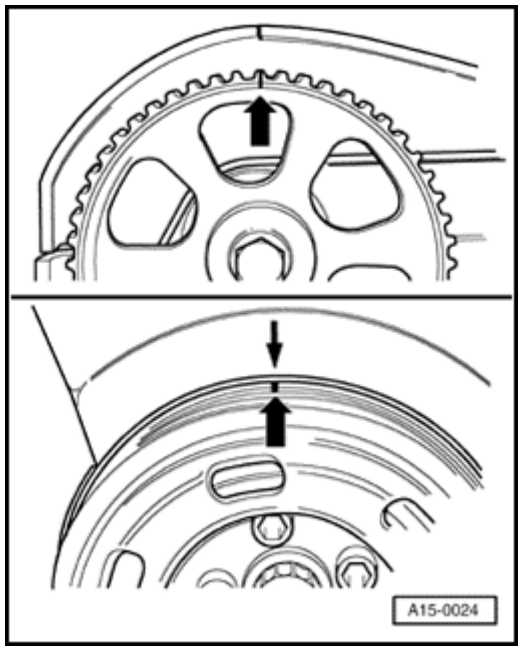


- Secure pulley for viscous fan with pin punch -1- and remove using Allen key -2-.
- Remove viscous fan from mounting.
- Remove upper toothed belt guard.

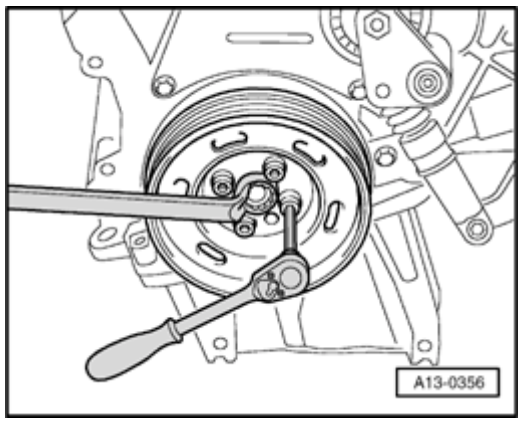
cardiagn.com

13-42

- Mark direction of rotation of belt with chalk or felt pen.



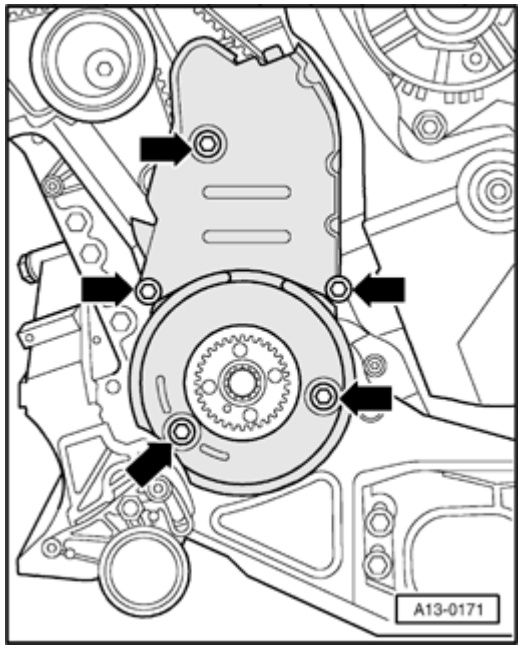
- Set crankshaft to markings for TDC of No. 1 cylinder by turning central bolt on crankshaft sprocket in direction of rotation -arrows-.



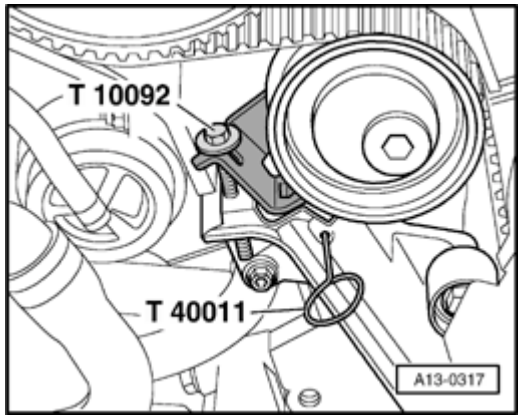
- Unbolt vibration damper.

cardiagn.com

13-43



- Unbolt lower and center section of toothed belt guard -arrows-.



- Attach socket head fastener T10092 into the tensioner for toothed belt.
- Only tension pressure piston of tensioner until pressure piston is secured with pin T40011.
- Take off toothed belt.

cardiagn.com

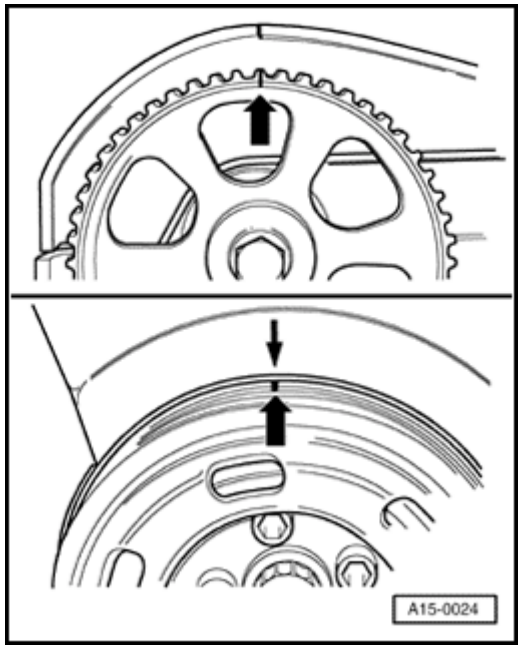
13-44

Installing (adjusting valve timing)

Note:

- *The position of the toothed belt must be set as described below, even after repairs in which the belt is only taken off the camshaft sprocket.*

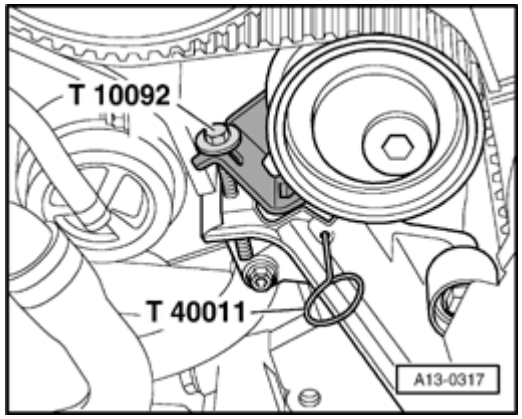
- *When turning the camshaft, the crankshaft must not be at TDC at any cylinder. There is a danger of damage to valves/piston crown.*



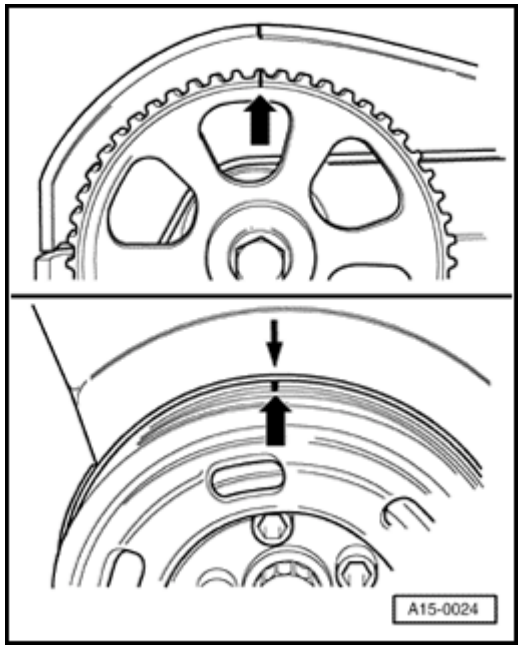
- Align marking on camshaft sprocket with marking at cylinder head cover.
- Place toothed belt on crankshaft sprocket (observe direction of rotation).
- Install toothed belt guard - lower part.
- Secure vibration damper/belt pulley with one bolt (note installation arrangement).
- Set crankshaft to TDC for cylinder No. 1.
- Install toothed belt onto coolant pump, then tensioning roller, and finally camshaft sprocket.

cardiagn.com

13-45



- Unscrew socket head fastener T10092.
- Pull out pin T40011 from tensioner.
  - ♦ The pressure piston of the tensioner for the toothed belt loosens.



- Turn crankshaft two full turns in direction of rotation (by turning central bolt on crankshaft sprocket) and check that camshaft and crankshaft marks align with their reference points.
- Install vibration damper/belt pulley.
- Install toothed belt guard (center and top sections).
- Install viscous fan ⇒ Page 13-21 .
- Install ribbed belt and tensioner for ribbed belt ⇒ Page 13-20 .

cardiagn.com

Tightening torques

Component		Nm
Lower section of toothed belt guard to cylinder block		10 1)
Center section of toothed belt guard to cylinder block		10 1)
Vibration damper/belt pulley to crankshaft		10 + 90 ° 2)3)
Ribbed belt tensioner to bracket		23

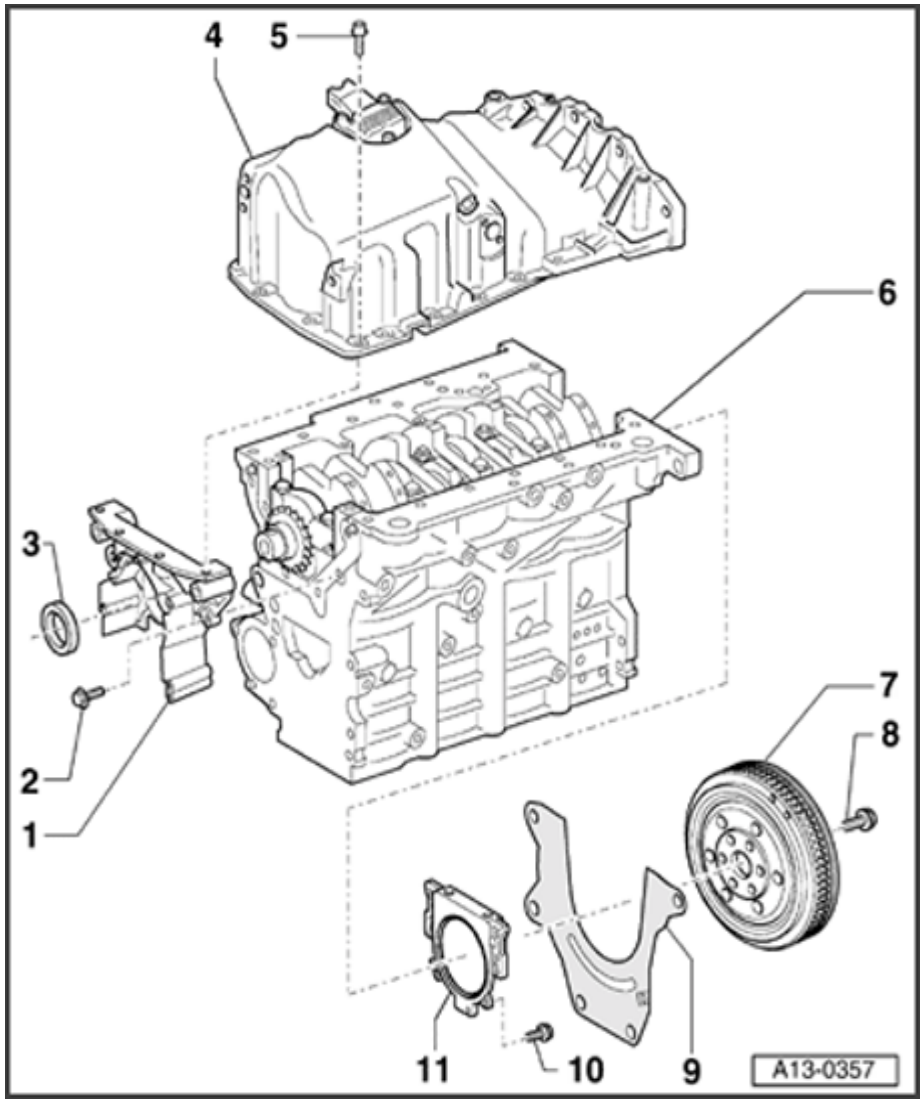
1) Install with locking fluid D 000 600 A2

2) Replace bolts

3) 90 ° corresponds to a quarter turn

cardiagn.com

13-47



Sealing flanges and flywheel/drive plate, removing and installing

Note:

For repairs to the clutch:

⇒ *Repair Manual, 5 Spd. Manual Transmission 012/01W Front Wheel Drive, Repair Group 30*

⇒ *Repair Manual, 5 Spd. Manual Transmission 01A All Wheel Drive, Repair Group 30*

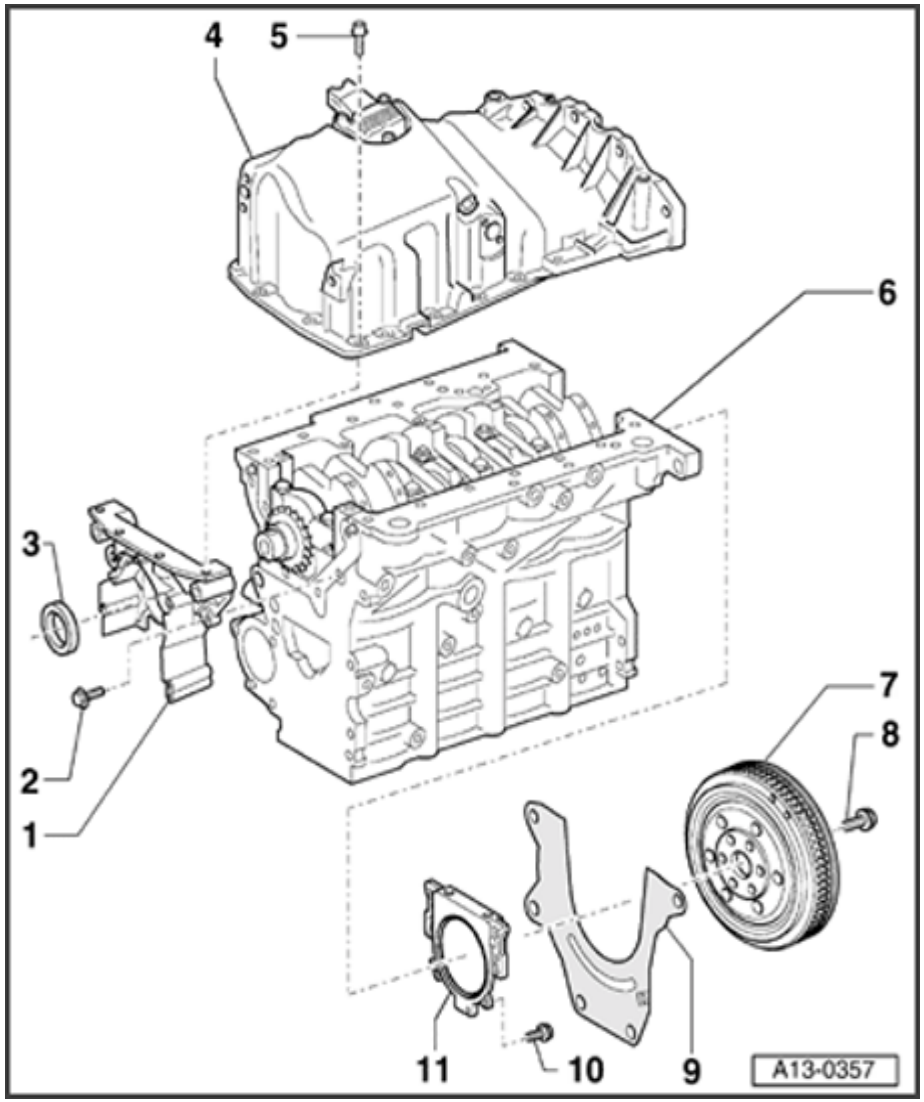
1 - Sealing flange - front

- Must be located on dowel sleeves
- Removing and installing ⇒ Page 13-56 .

2 - 15 Nm

cardiagn.com

13-48



3 - Sealing ring

- Replacing ⇒ Page 13-51
- Do not oil sealing lip of oil seal

4 - Sump

- Removing and installing ⇒ Page 17-11

5 - 15 Nm

6 - Cylinder block

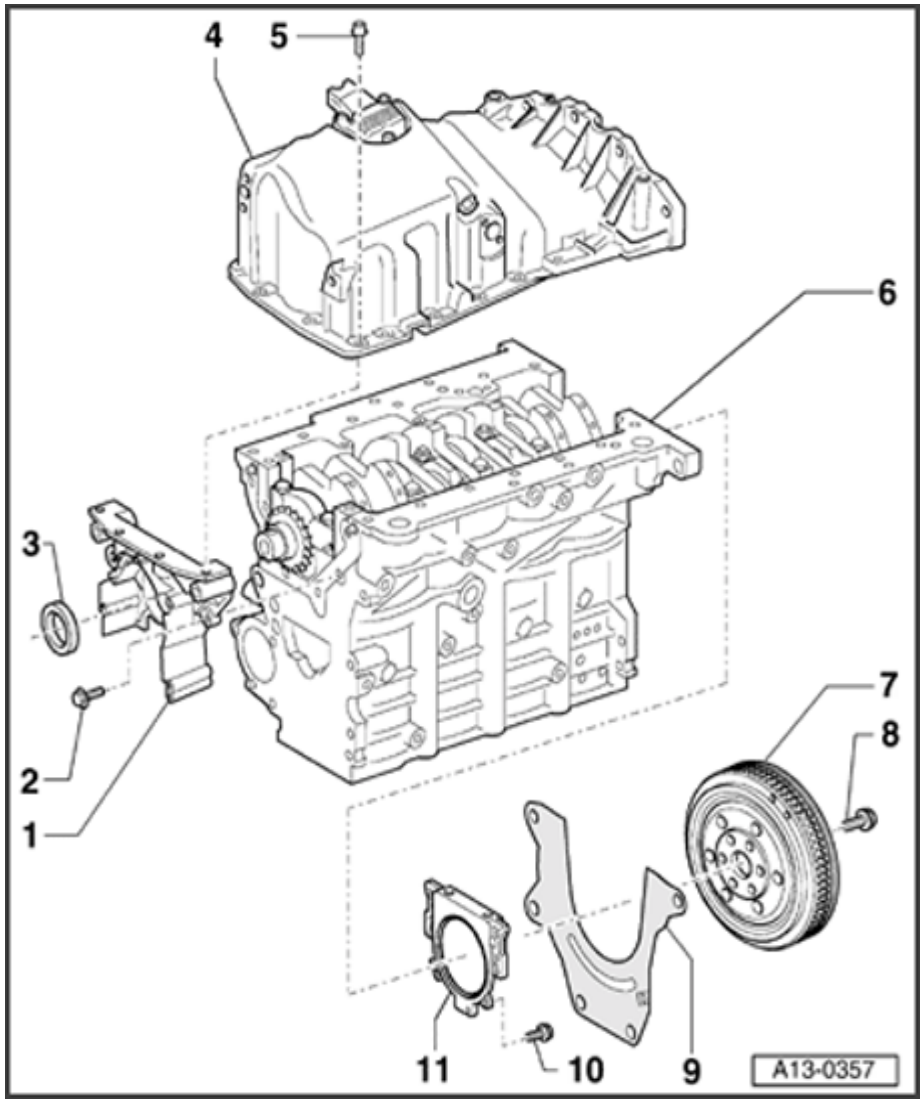
- Removing and installing crankshaft ⇒ Page 13-67 .
- Dismantling and assembling pistons and conrods ⇒ Page 13-79 .

7 - Dual-mass flywheel/drive plate

- Removing and installing dual mass flywheel ⇒ Page 13-62
- Removing and installing drive plate ⇒ Page 13-64
- Can only be installed in one position. Holes are offset.

cardiagn.com

13-49



8 - Securing bolt for dual-mass flywheel or drive plate

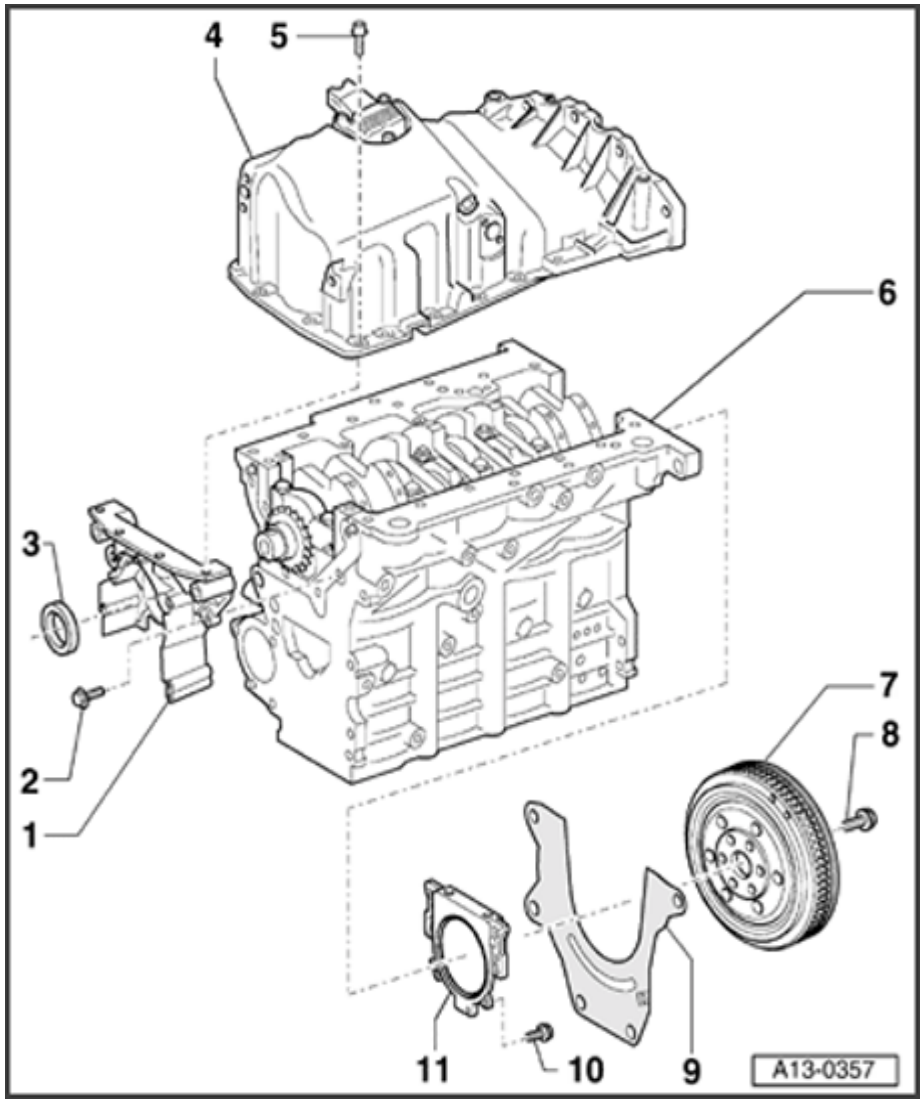
- Always replace
- Tightening torque for dual mass flywheel ⇒ Page 13-63
- Tightening torque for drive plate (vehicles with automatic gearbox) ⇒ Page 13-66

9 - Intermediate plate

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

cardiagn.com

13-50

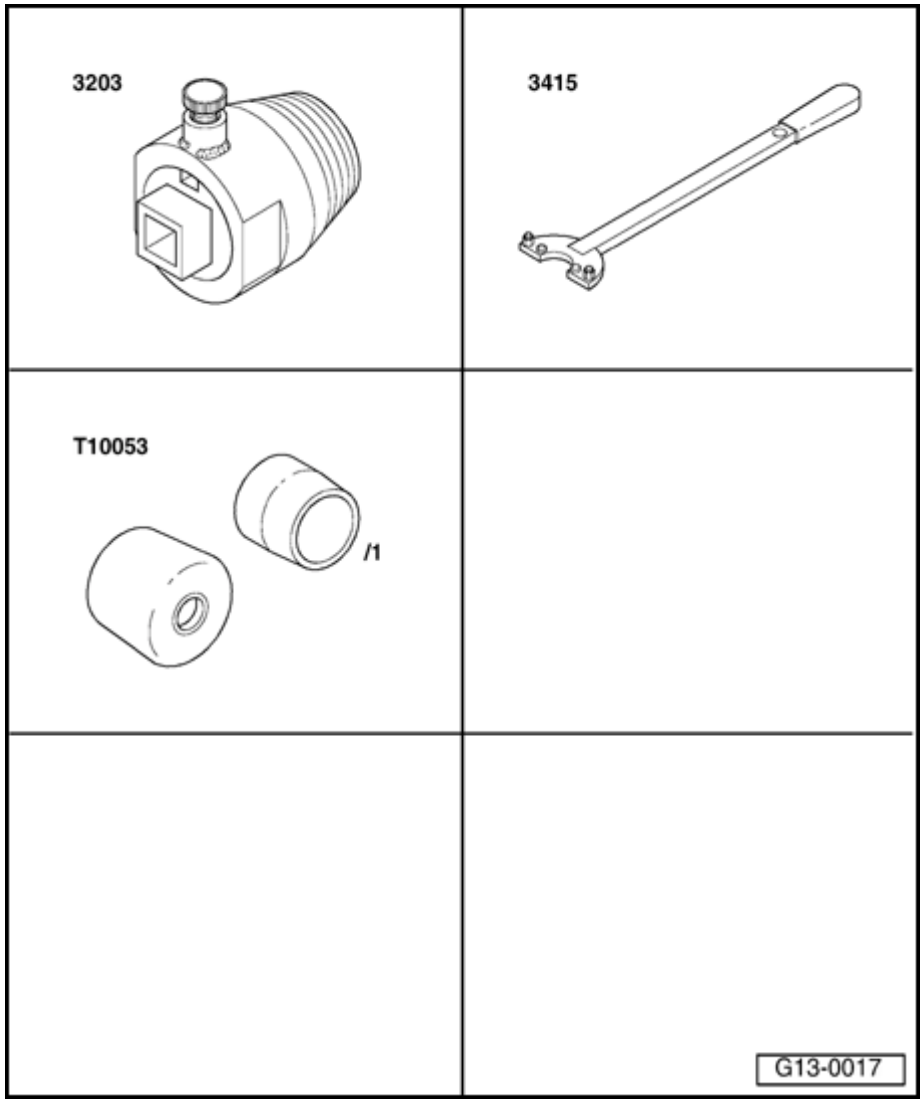


10 - 15 Nm

11 - Rear sealing flange with oil seal

- With gasket for cylinder block
- Do not oil sealing lip of oil seal
- Make sure that the sealing lip of the sealing ring is not folded back or damaged when installing
- Removal and installation, removing sump ⇒ Page 17-11
- When installing, push guide sleeve from repair kit onto crankshaft

cardiagn.com



Crankshaft oil seal on pulley end, replacing

Special tools and equipment

- Oil seal extractor 3203
- Holding tool 3415
- Assembly tool T10053

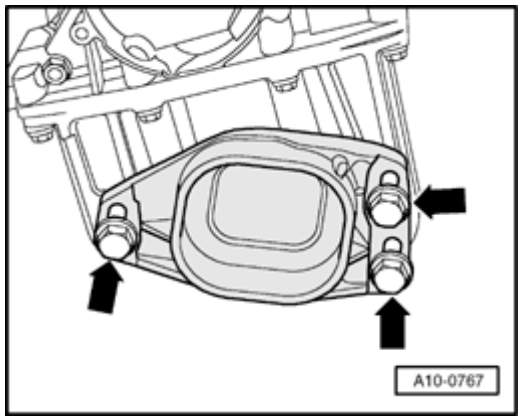
cardiagn.com

13-52

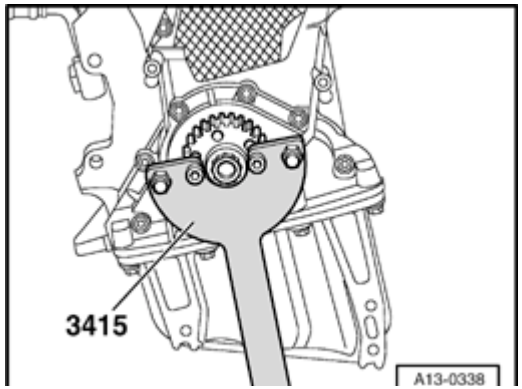
Removing

- Engine in vehicle
- Lock carrier must be in service position ⇒ Page 13-1 .

- Remove toothed belt ⇒ Page 13-40 .



- Unbolt stop for torque reaction support -arrows-.

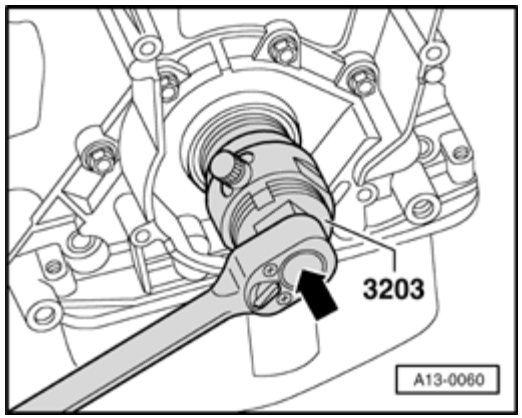


- Remove toothed belt sprocket from crankshaft. To do this, counter hold sprocket with 3415.

cardiagn.com

- Before applying oil seal extractor, thread central bolt for toothed belt sprocket into crankshaft as far as it will go.

- Remove inner section of oil seal extractor 3203 one turn out of outer section and lock with knurled screw.



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

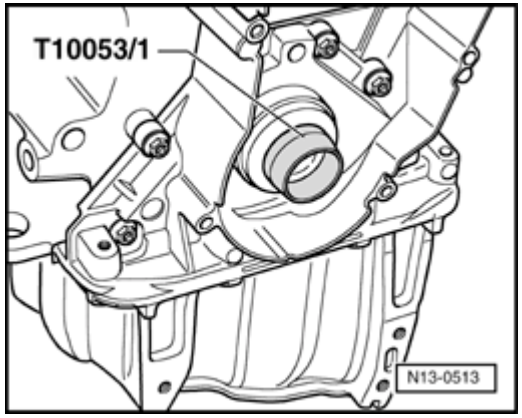
cardiagn.com

13-54

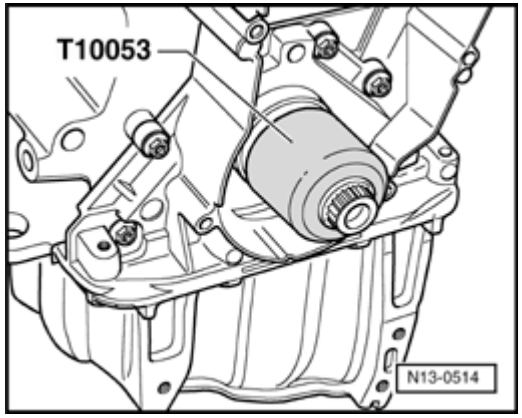
Installing

Note:

Do not lubricate sealing lip or outer circumference of seal before pressing in.

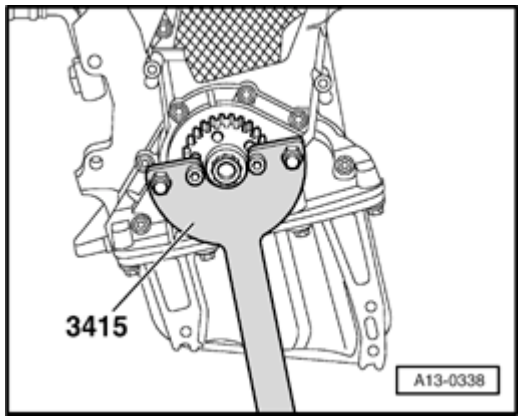


- Place guide sleeve T10053/1 onto crankshaft journal.
- Slide oil seal over guide sleeve.



- Press sealing ring flush with central bolt of toothed belt sprocket and pressure sleeve from T10053.

cardiagn.com



- Replace central bolt for toothed belt sprocket.

- Remove crankshaft toothed belt sprocket. To do this, counter-hold toothed belt sprocket with 3415.

Note:

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

- Install toothed belt (adjust valve timing) ⇒ Page 13-44 .
- Install ribbed belt and tensioner for ribbed belt ⇒ Page 13-20 .
- Install lock carrier ⇒ Page 13-1 .

Tightening torque

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

1) Replace bolt

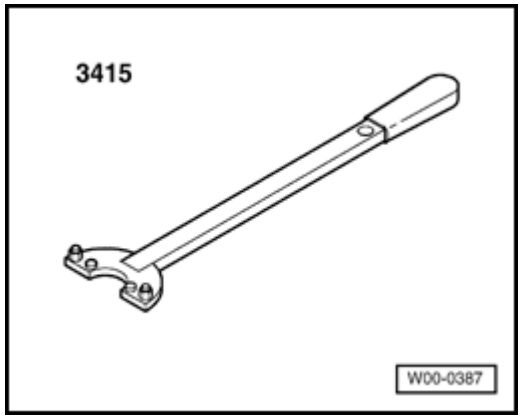
2) 90° corresponds to a quarter turn

cardiagn.com

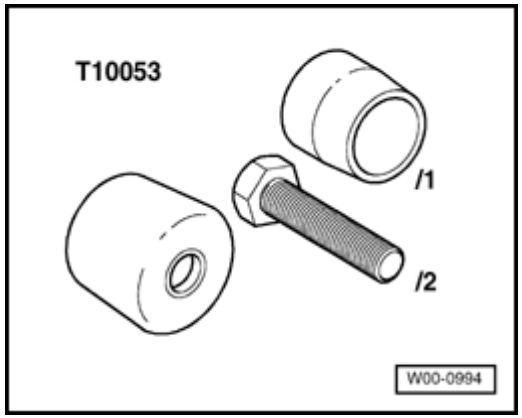
13-56

Front sealing flange, removing and installing

Special tools, material and equipment



- Holding tool 3415



- Assembly tool T10053
- Electric drill with plastic brush attachment
- Protective goggles
- Silicone sealant D 176 404 A2

cardiagn.com

13-57

Removing

- Engine in vehicle
- Lock carrier must be in service position ⇒ Page 13-1 .

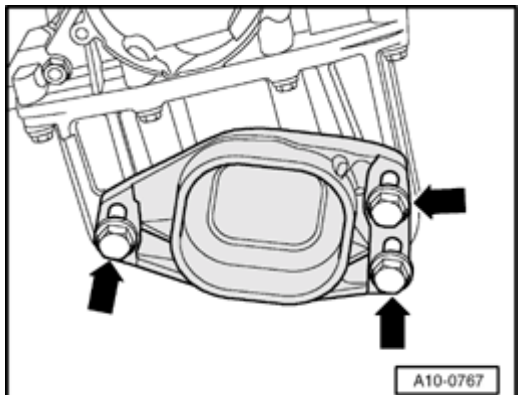
- Remove toothed belt ⇒ Page 13-40 .

CAUTION!

The air conditioner refrigerant circuit must not be opened.

- Disconnect A/C compressor from bracket and secure to body with wire.

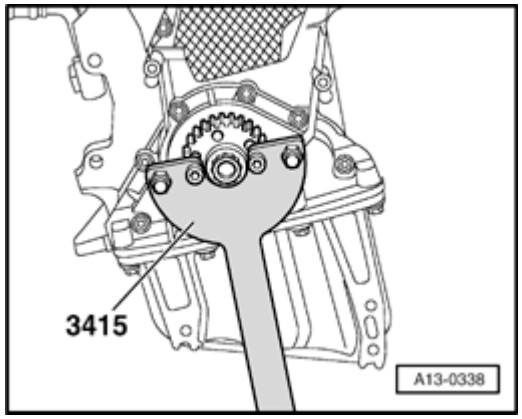
- Unbolt bracket for A/C compressor -Item 5 -, ⇒ Page 13-15



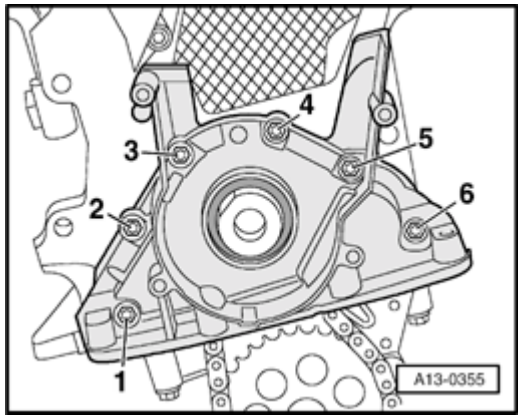
- Unbolt stop for torque reaction support -arrows-.

cardiagn.com

13-58



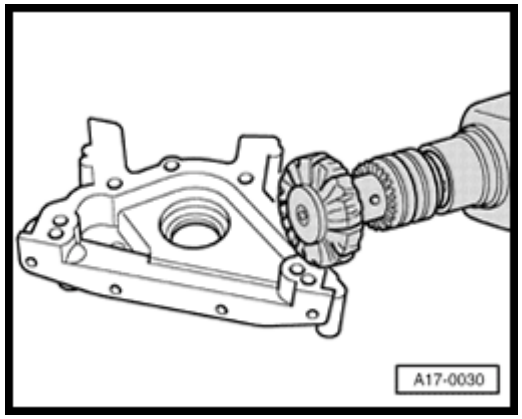
- Remove toothed belt sprocket from crankshaft. To do this, counter hold sprocket with 3415.
- Remove oil pan ⇒ Page 17-11



- Remove bolts -1 to 6-.
- Pry sealing flange loose and remove.
- Carefully remove any remains of sealant from cylinder block.

cardiagn.com

13-59



- Remove remaining sealant from sealing flange with rotating plastic brush.

WARNING!

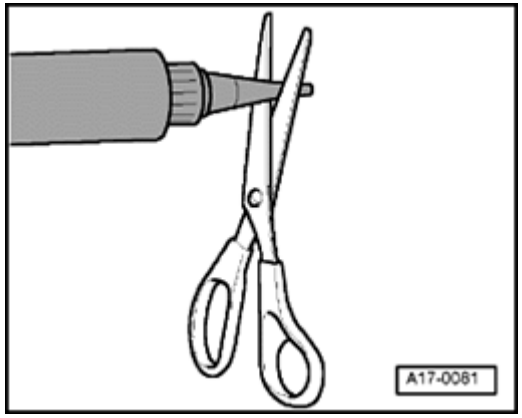
Wear protective glasses.

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

Installing

Note:

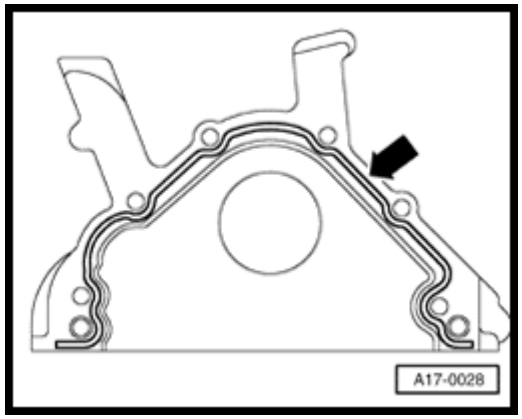
The sealing flange must be installed within 5 minutes after applying silicone sealant.



- Cut off nozzle of silicon sealant tube at front marking (diameter of nozzle = approx. 3 mm).
  - Silicone sealant D 176 404 A2

cardiagn.com

13-60



- Apply bead of silicone sealant -arrow-onto clean sealing surface of sealing flange, as illustrated (arrow).

• Sealant bead width -arrows-: 2 to 3 mm

Note:

The bead of sealant must not be thicker than 3 mm, otherwise excess sealant will enter the oil pan and obstruct the strainer in the oil intake line.

- Install sealing flange immediately, and tighten all bolts lightly.

Note:

Use guide sleeve T10053/1 to attach the sealing flange with sealing ring installed.

- Tighten sealing flange bolts in diagonal sequence.
- Install oil pan ⇒ Page 17-23 .

Note:

After assembly, the sealant must dry for approx. 30 min. Only then may the engine be filled with oil.

cardiagn.com

- Install crankshaft oil seal ⇒ Page 13-54 .

- Install toothed belt (adjust valve timing) ⇒ Page 13-44 .

- Install bracket for A/C compressor -Item 5 -, ⇒ Page 13-15 .

- Install lock carrier ⇒ Page 13-1 .

Tightening torques

Component		Nm
Sealing flange to cylinder block		15
Bracket for air conditioner compressor on cylinder block		33
A/C compressor to bracket		25

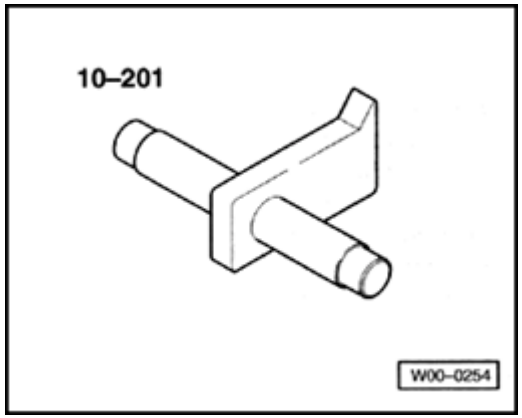
cardiagn.com

13-62

Dual mass flywheel/drive plate, removing and installing

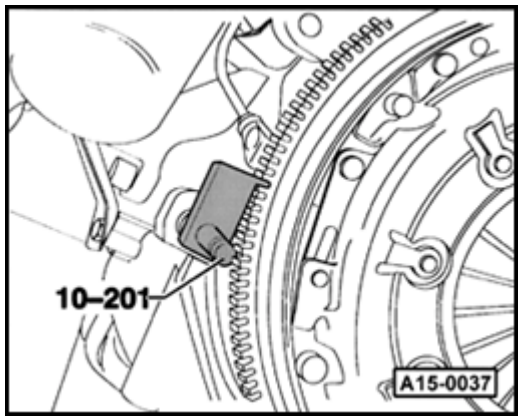
Dual-mass flywheel

Special tools and equipment



- Counter-hold tool 10-201

Removing



- Reverse position of counter-hold tool 10-201 for loosening/tightening bolts.
- Mark position of flywheel relative to engine.
- Unbolt flywheel.

cardiagn.com

Installing

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

- Replace bolts.

Tightening torque

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

1) Bolt length

2) 90° corresponds to a quarter turn

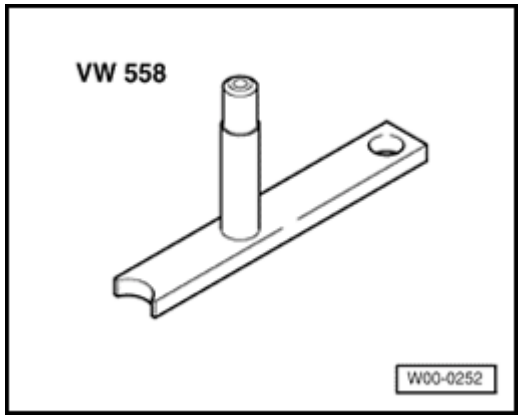
3) 180° = 1/2 turn

cardiagn.com

13-64

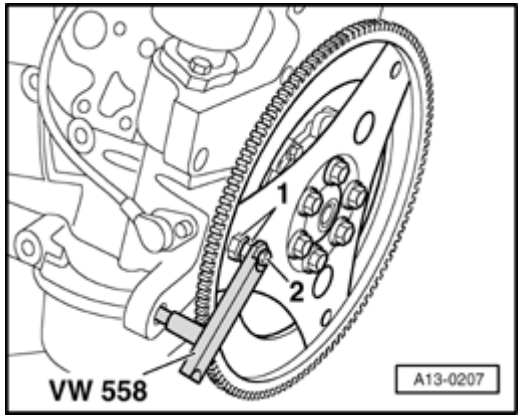
Drive plate

Special tools and equipment



- Counter hold VW 558
- Hex bolt M8 x 45 and two M10 hex nuts
- Caliper gauge or depth measure

Removing

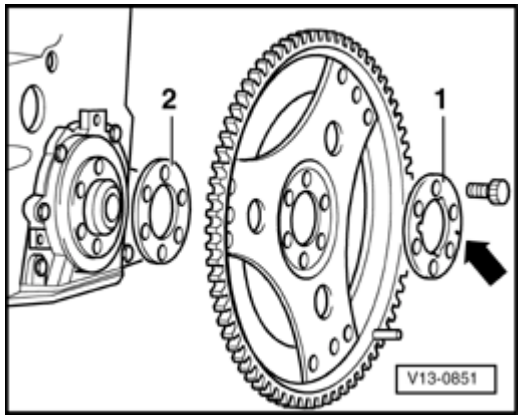


- Secure counter hold tool VW 558 to drive plate with hex bolt M8 x 45 - Item 2-. Place two M10 hex nuts between counter-hold tool and drive plate.
- Mark position of drive plate relative to engine.
- Unbolt drive plate.

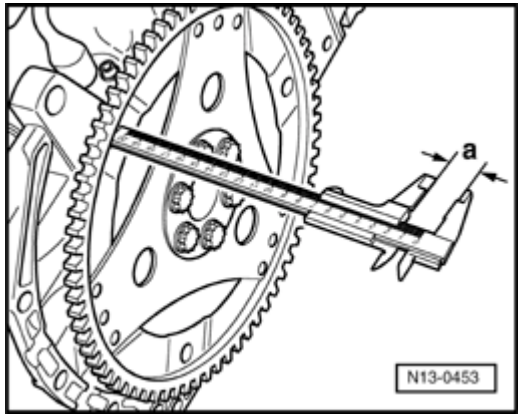
cardiagn.com

13-65

Installing

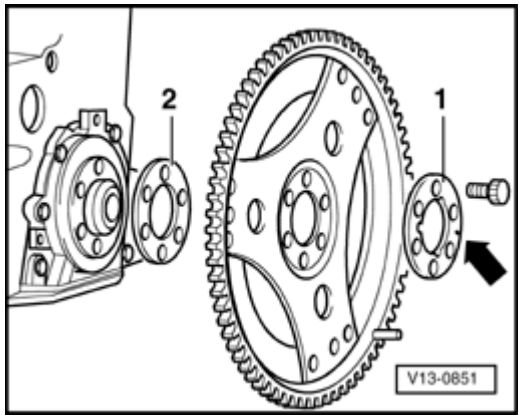


- Place drive plate in position with shim -2- and washer -1-. Lug -arrow- must face towards torque converter.
- Insert at least 3 old securing bolts and tighten to 30 Nm.



- Measure distance -a- at three points and calculate average value.
  - Specified value: 18.9 to 20.5 mm

cardiagn.com



If nominal value is exceeded:

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

If specified value is attained:

- Install new bolts and tighten.

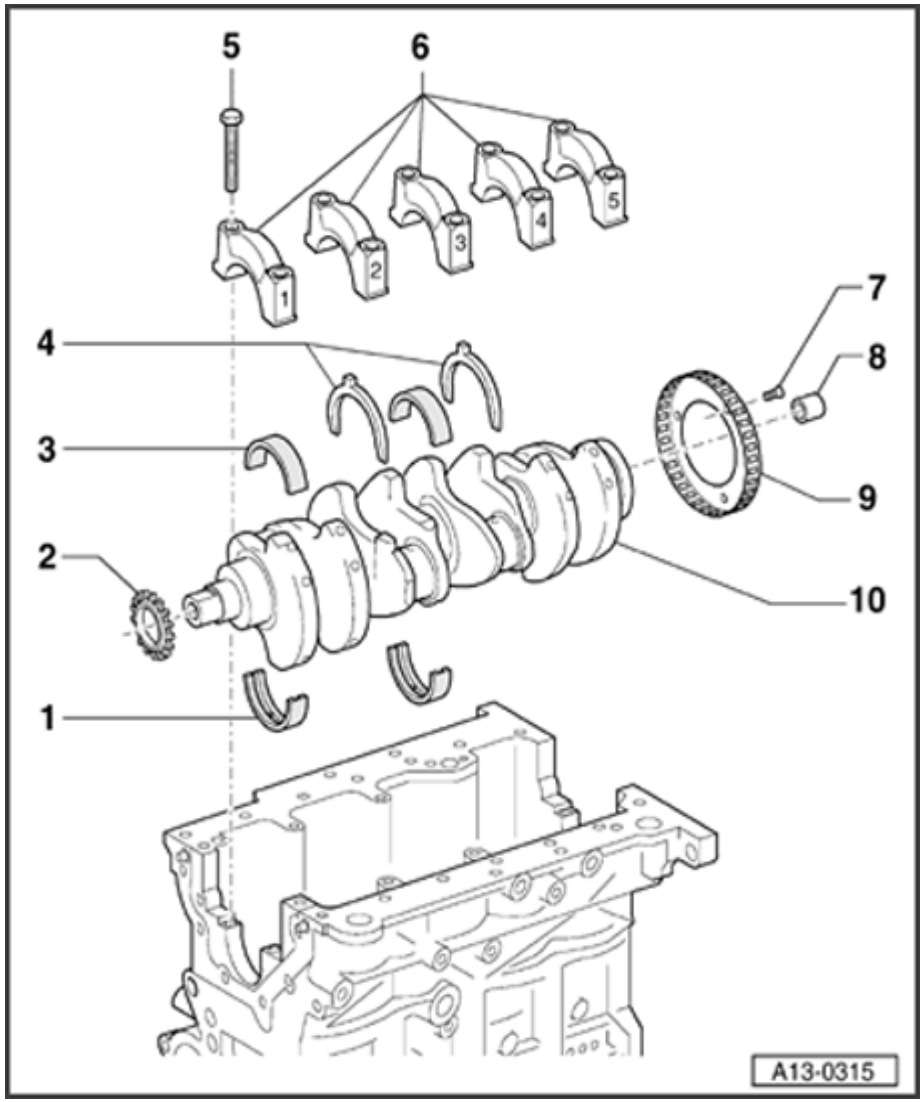
Tightening torque

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

1) 90° corresponds to a quarter turn

cardiagn.com

13-67



Crankshaft, removing and installing

Note:

When working on the engine, it should be secured to the engine stand using the engine bracket VW 540 ⇒ *Page 10-27* .

1 - Bearing shell

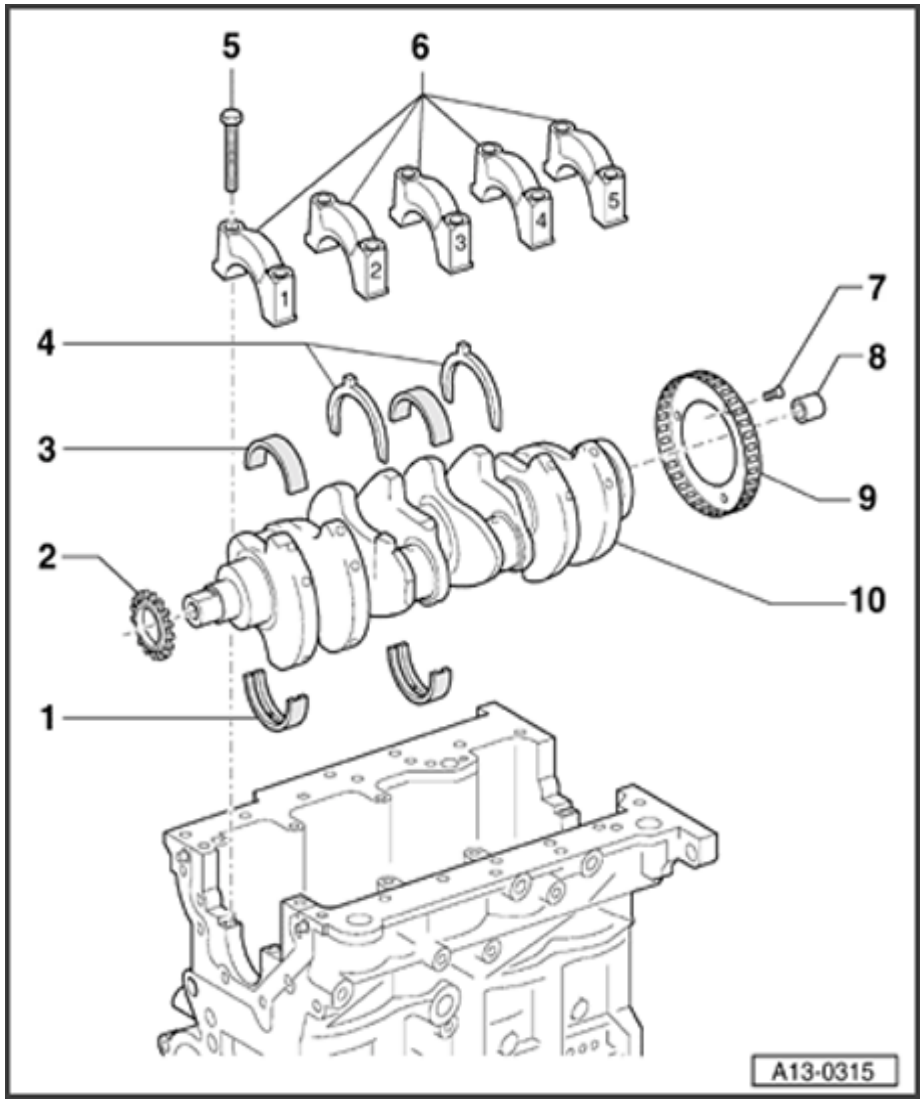
- For cylinder block with oil groove
- Do not interchange used bearing shells (mark).
- Install new bearing plates for cylinder block with the correct color coding ⇒Fig. ⇒ 2 , ⇒ Page 13-72

2 - Chain sprocket

- For oil pump drive chain
- Replacing ⇒ Page 13-77

cardiagn.com

13-68



3 - Bearing shell

- For bearing cap without oil groove
- Do not interchange used bearing shells (mark).
- The crankshaft bearing plates in the bearing covers are supplied as spare part with the color coding "yellow"

4 - Thrust washers

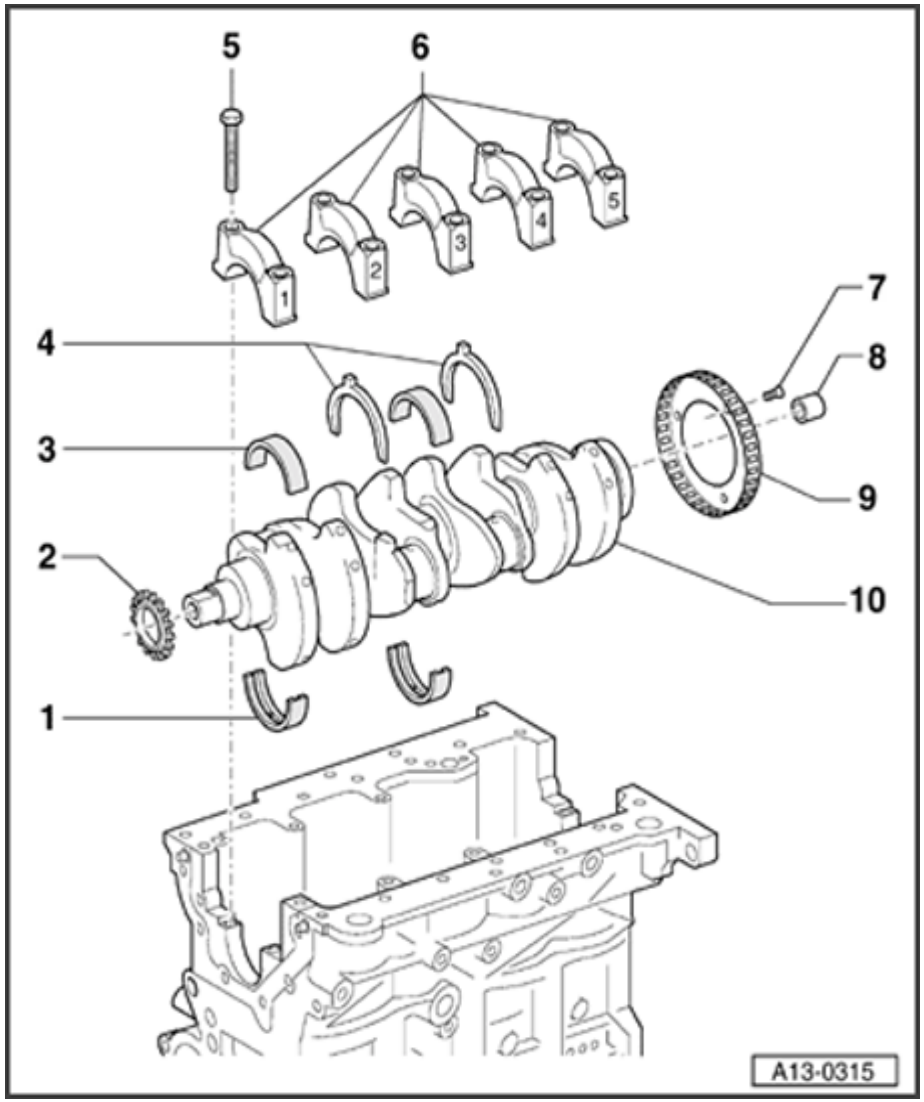
- For bearing 3
- Different types for cylinder block and bearing cap
- Note locating arrangement

5 - 65 Nm + $^{1}/_{4}$ turn (90 °) further

- Always replace
- When measuring radial clearance of crankshaft, tighten to 65 Nm but do not turn further.

cardiagn.com

13-69



6 - Bearing cap

- Bearing cap 1: Pulley end
- Bearing cap 3 with recesses for thrust washers
- Bearing shell retaining lugs (cylinder block/bearing cap) must be on the same side

7 - 10 Nm + $^1/_4$ turn (90 °) further

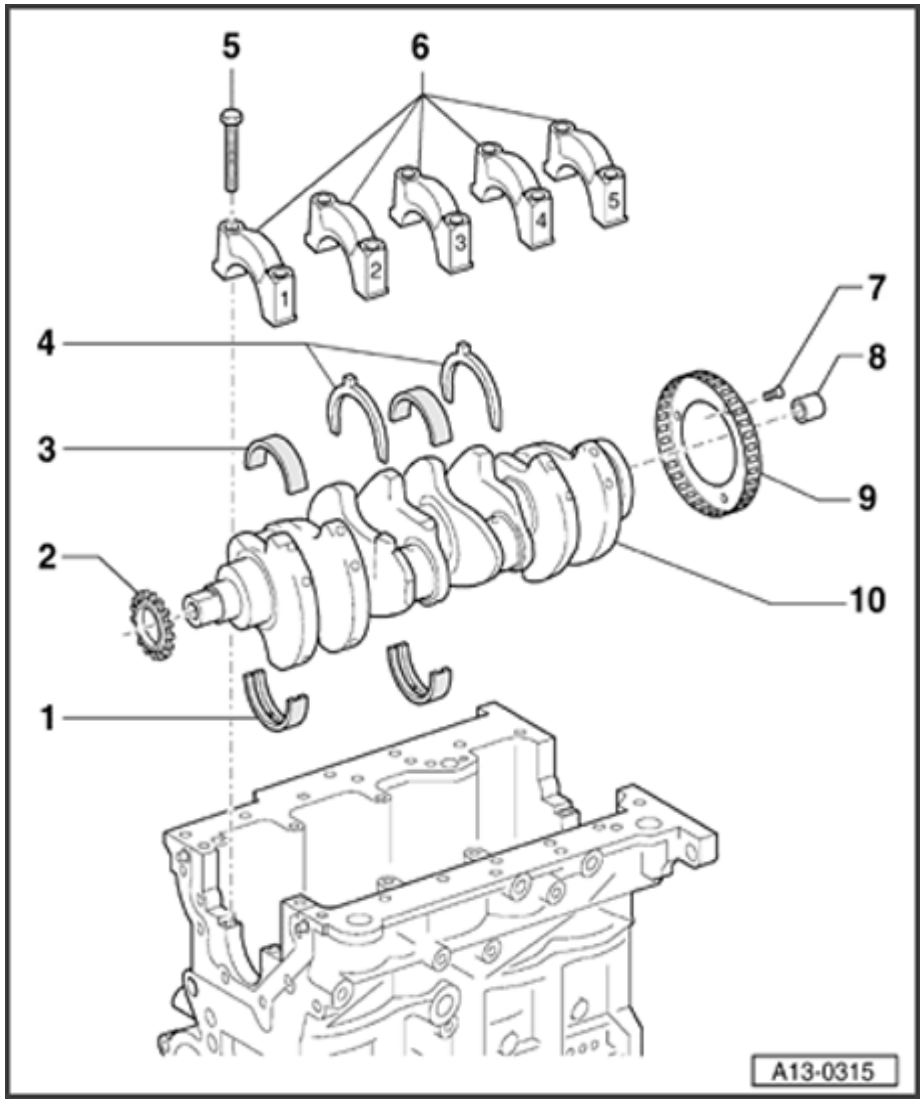
- Always replace
- After each removal of the bolts replace sensor wheel ⇒Fig. ⇒ 1 , ⇒ Page 13-71

8 - Needle bearing

- For vehicles with manual transmission
- Pulling out and driving in ⇒ Page 13-73

cardiagn.com

13-70



9 - Sensor wheel

- For engine speed sensor -G28-
- Can only be installed in one position. Holes are offset
- Always replace sensor wheel if securing bolts have been loosened.
- Removing and installing ⇒Fig. ⇒ 1 , ⇒ Page 13-71

10 - Crankshaft

- Axial clearance new: 0.07 to 00.23 mm, Wear limit: 0.30 mm
- Check radial clearance with Plastigage™, New: 0.02 to 0.04 mm, Wear limit: 0.15 mm
- Do not rotate the crankshaft when checking the radial clearance.
- Crankshaft dimensions ⇒ Page 13-76

cardiagn.com

13-71

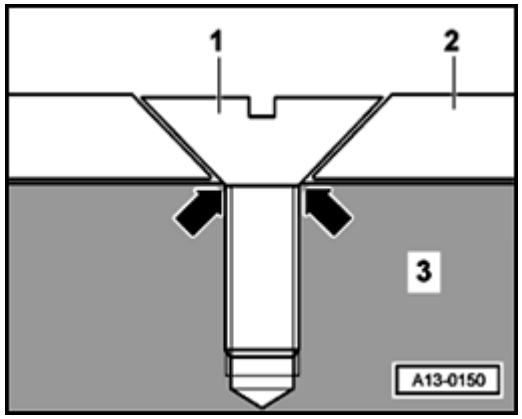


Fig. 1 Removing and installing sensor wheel

Note:

- *Always replace sensor wheel -2- if securing bolts -1- have been loosened..*
- *If the securing bolts are tightened a second time, the seats for the countersunk bolt heads in the sensor wheel will be distorted to such an extent that the bolt heads will come into direct contact with the crankshaft -3- (-arrows-) and the sensor wheel will only fit loosely under the bolts.*
- *The mounting holes are asymmetrically spaced, so it is only possible to install the sensor wheel in one position.*

Tightening torque

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

1) Replace bolts

2) 90 ° corresponds to a quarter turn

cardiagn.com

13-72

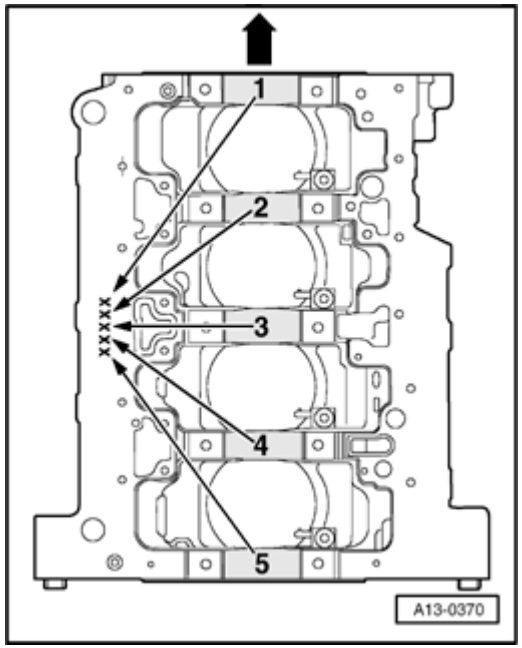


Fig. 2 Allocation of crankshaft bearing plates for cylinder block

The bearing plates with the correct thickness are allocated to the cylinder block at the factory. Colored dots are used to mark the thickness of the bearing plates.

Note:

Arrow points in direction of travel.

The position of each bearing thickness is marked with letters on the lower sealing area of the cylinder block.

Letter on cylinder block		Color of bearing
S	=	Black
R	=	Red
G	=	Yellow

Note:

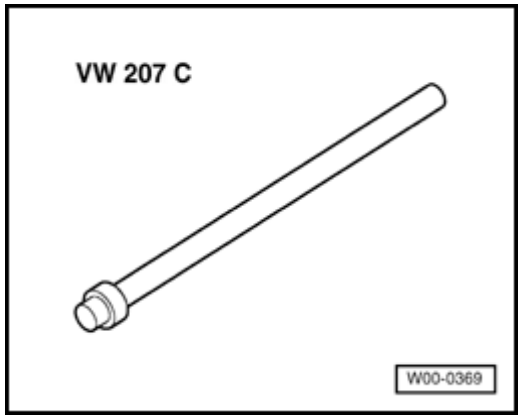
The crankshaft bearing cups in the bearing covers are supplied as spare part with the color coding "yellow".

cardiagn.com

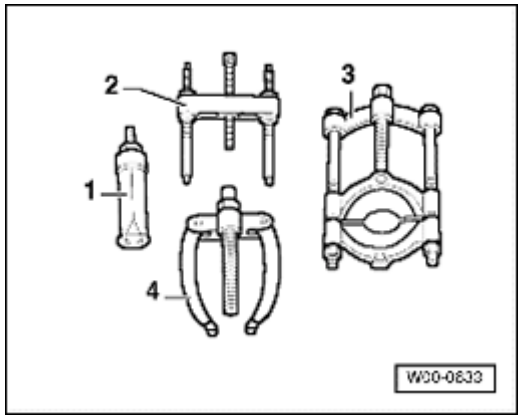
13-73

Crankshaft needle bearing, removing and installing

Special tools and equipment



- Special tool VW 207 C



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

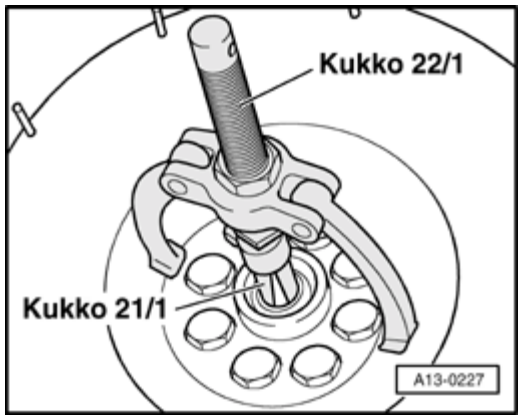
cardiagn.com

13-74

Note:

- *A needle bearing must be installed in the crankshaft on vehicles with a manual transmission. Install needle bearing if necessary.*
- *The needle bearing must not be installed in the crankshaft on vehicles with an automatic transmission. Remove needle bearing if necessary.*

Removing

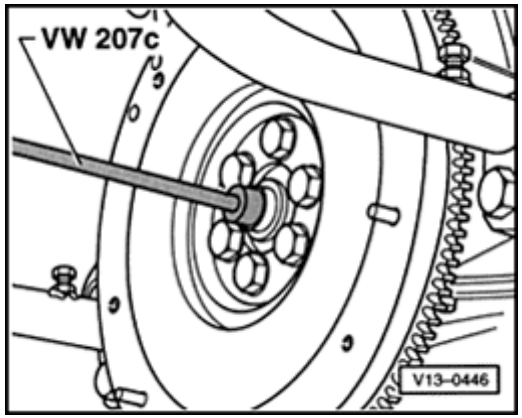


- Pull out needle bearing with Kukko 21/1 and Kukko 22/1.

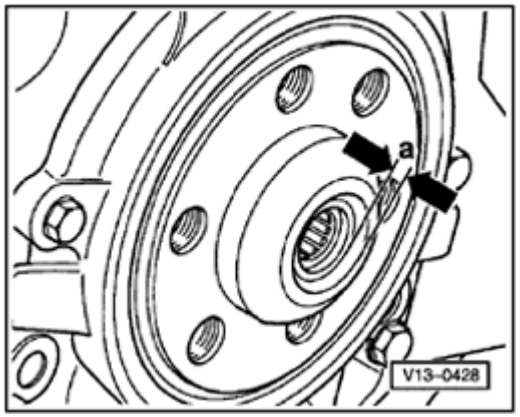
cardiagn.com

13-75

Installing



- Drive in using 207c or centralizing pin 3176.
  - Lettering on needle bearing must be visible when installed



Installation depth of needle bearing

- Distance a = 1.5 mm

cardiagn.com

Crankshaft dimensions

(in mm)

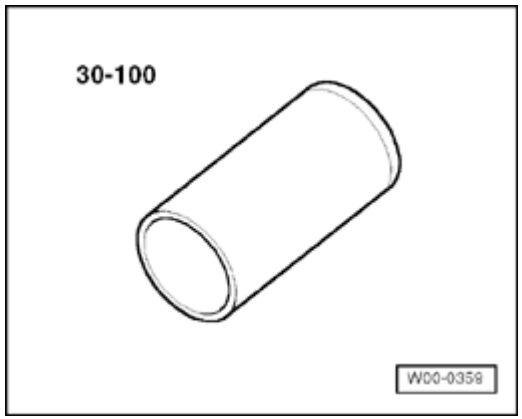
Honing dimension	Crankshaft bearing main journal diameter	Conrod journal main journal diameter
	-0.017	-0.022
Basic dimension	54.00	47.80
	-0.037	-0.042
	-0.017	-0.022
1st undersize	53.75	47.55
	-0.037	-0.042
	-0.017	-0.022
2nd undersize	53.50	47.30
	-0.037	-0.042
	-0.017	-0.022
3rd undersize	53.25	47.05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

cardiagn.com

13-77

Chain sprocket, removing and installing

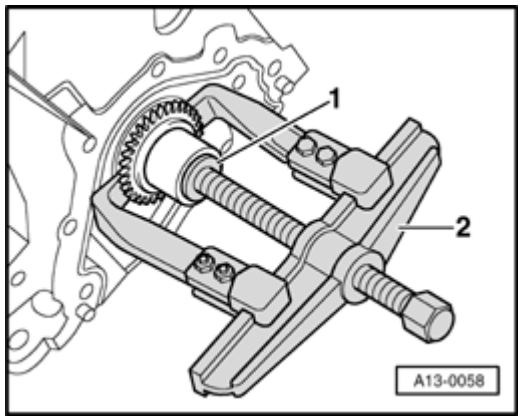
Special tools and equipment



- Sleeve 30-100
- Two-arm puller, commercially available.
- Protective gloves

Removing

- Remove oil pan ⇒ Page 17-11 .
- Removing front sealing flange ⇒ Page 13-56 .
- Disconnect chain wheel of oil pump, remove chain tensioner and chain ⇒ -Item 5 -, ⇒ Page 17-3 .



- Pull chain sprocket off crankshaft with puller -2- (Use a suitable washer -1- to protect end of crankshaft).

cardiagn.com

Installing

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

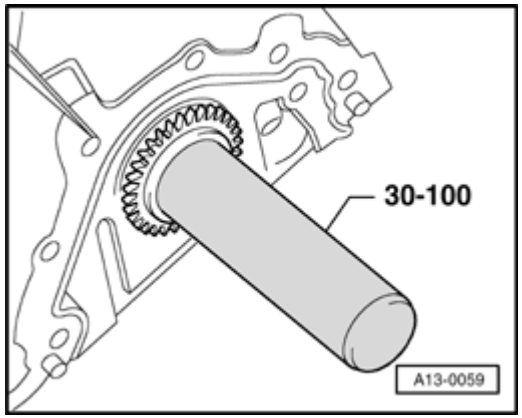
WARNING!

Wear protective gloves!

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

Note:

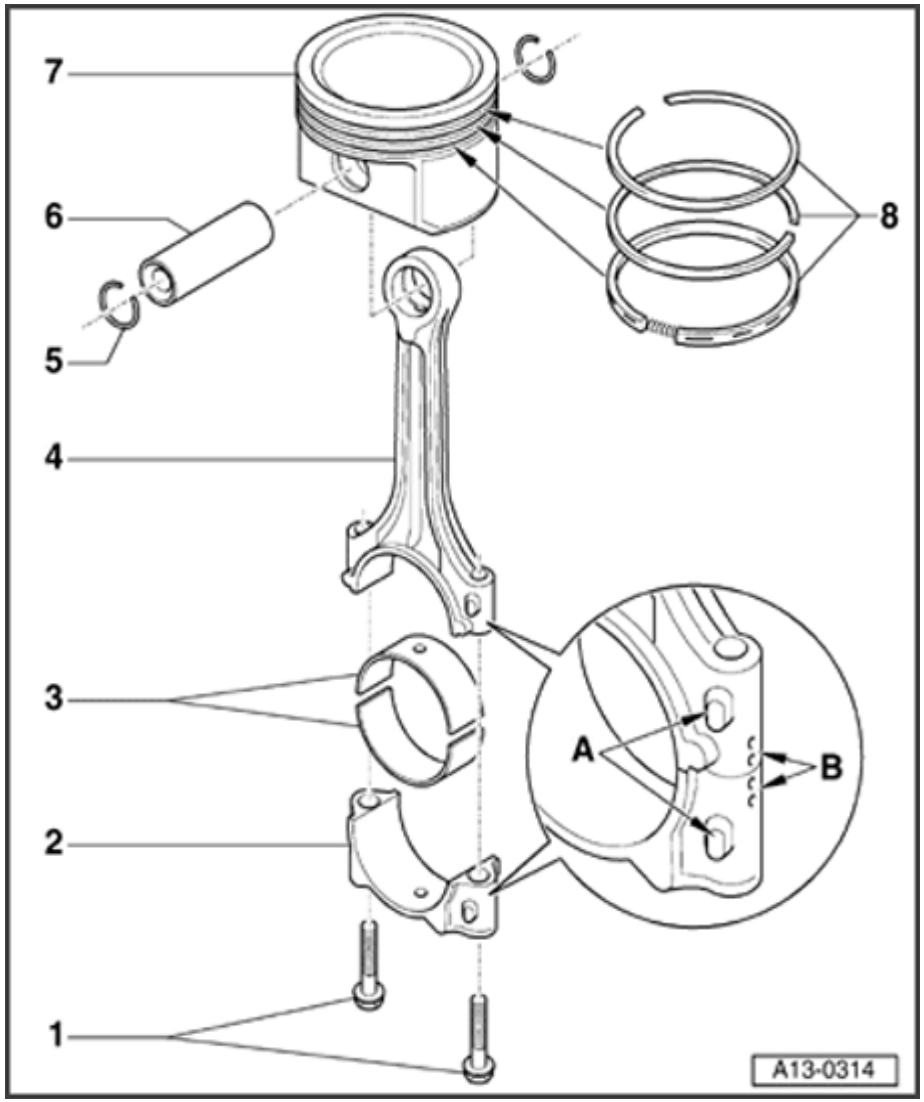
Installation position: wide collar on sprocket facing toward engine



- Install chain sprocket on end of crankshaft using pliers and push onto seat on crankshaft with drift sleeve 30-100.

cardiagn.com

13-79



Pistons and connecting rods, disassembling and assembling

Note:

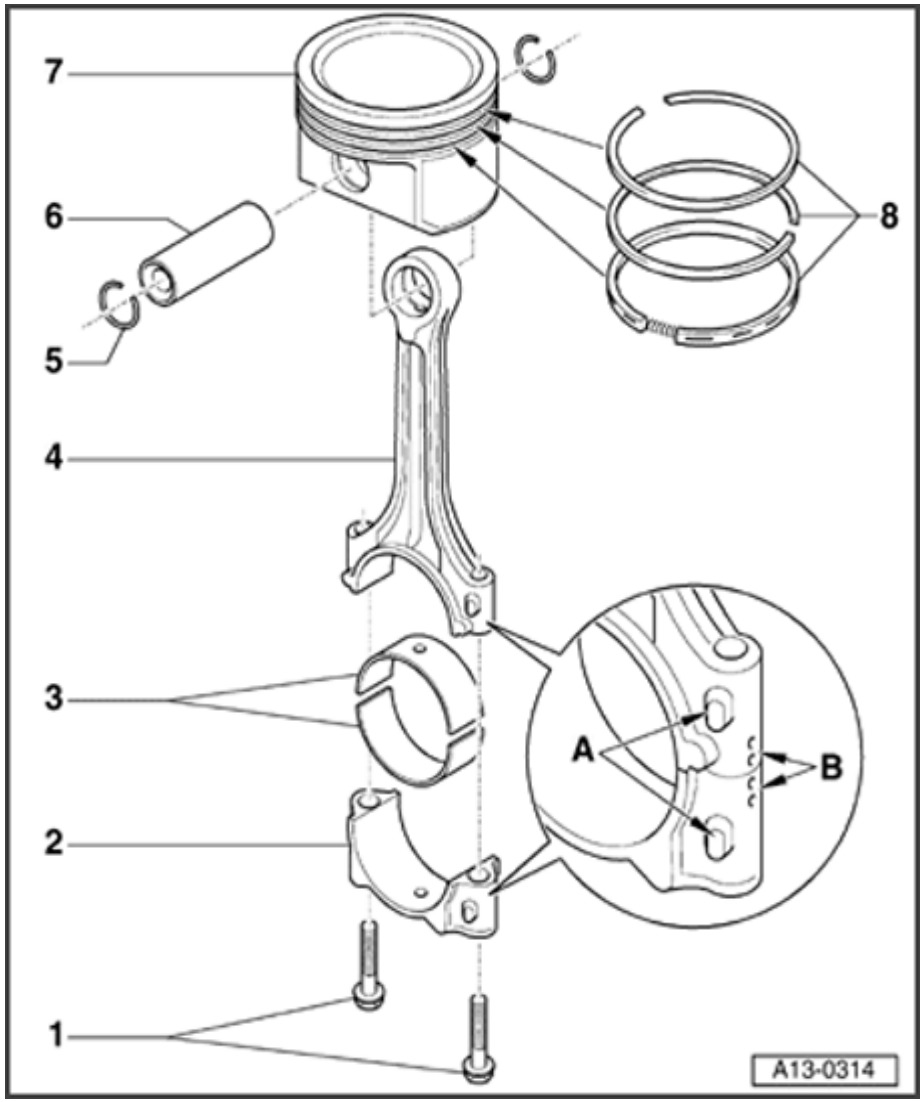
Oil spray jet and pressure relief valve⇒Fig. ⇒ 6 , ⇒ Page 13-85

1 - Conrod bolt - 30 Nm + $^{1}/_{4}$ turn (90 °) further

- Always replace
- Oil threads and contact surface
- To measure radial clearance use old bolt
- To measure radial clearance tighten to 30 Nm but not further

cardiagn.com

13-80



2 - Connecting rod bearing cap

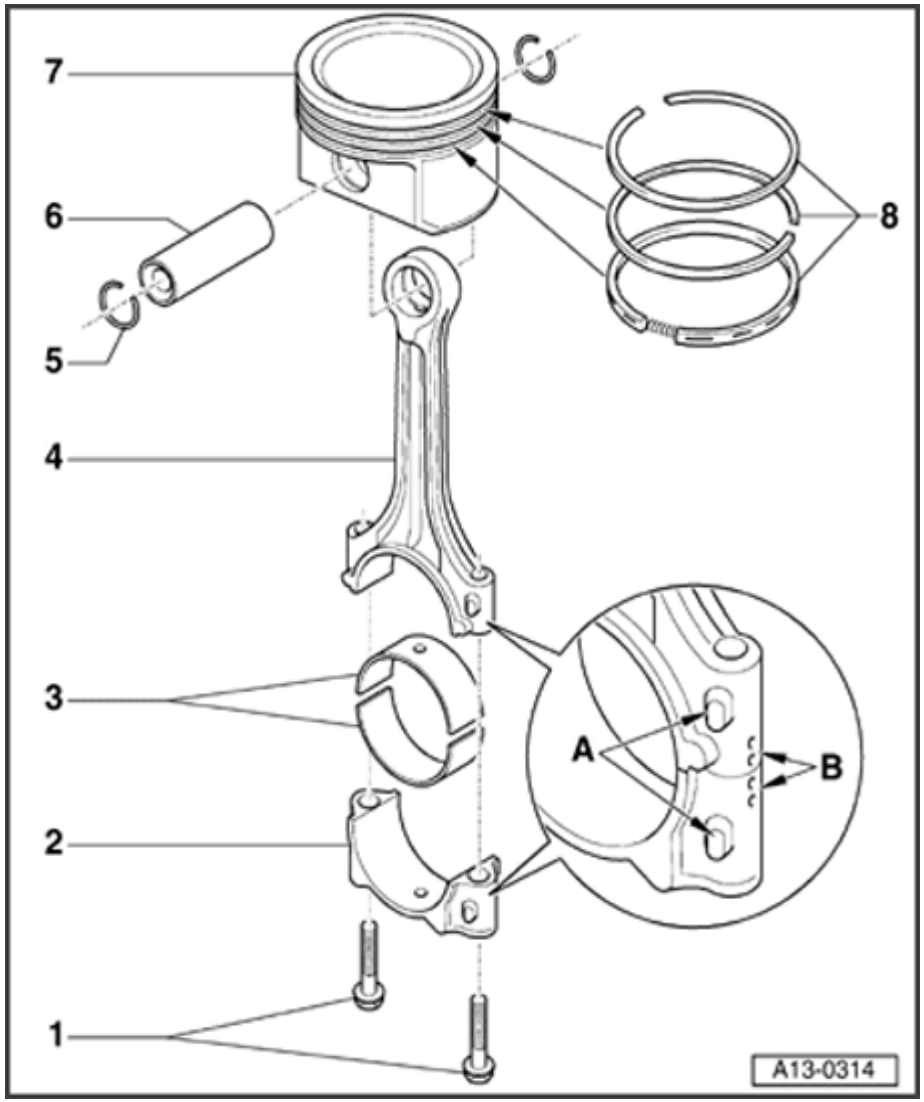
- Mark cylinder number -B-
- Installation position: Markings -A- face towards pulley side

3 - Bearing shells

- Upper bearing shell with oil bore for piston bolt lubrication
- Installation position ⇒Fig. ⇒ 5 , ⇒ Page 13-85
- Do not interchange used bearing shells (mark).
- Axial clearance New: 0.10 to 0.35 mm, Wear limit: 0.40 mm
- Check radial clearance with Plastigage ™ : New: 0.01 to 0.05 mm, Wear limit: 0.12 mm. Do not rotate crankshaft when checking radial clearance

cardiagn.com

13-81



4 - Connecting rod

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

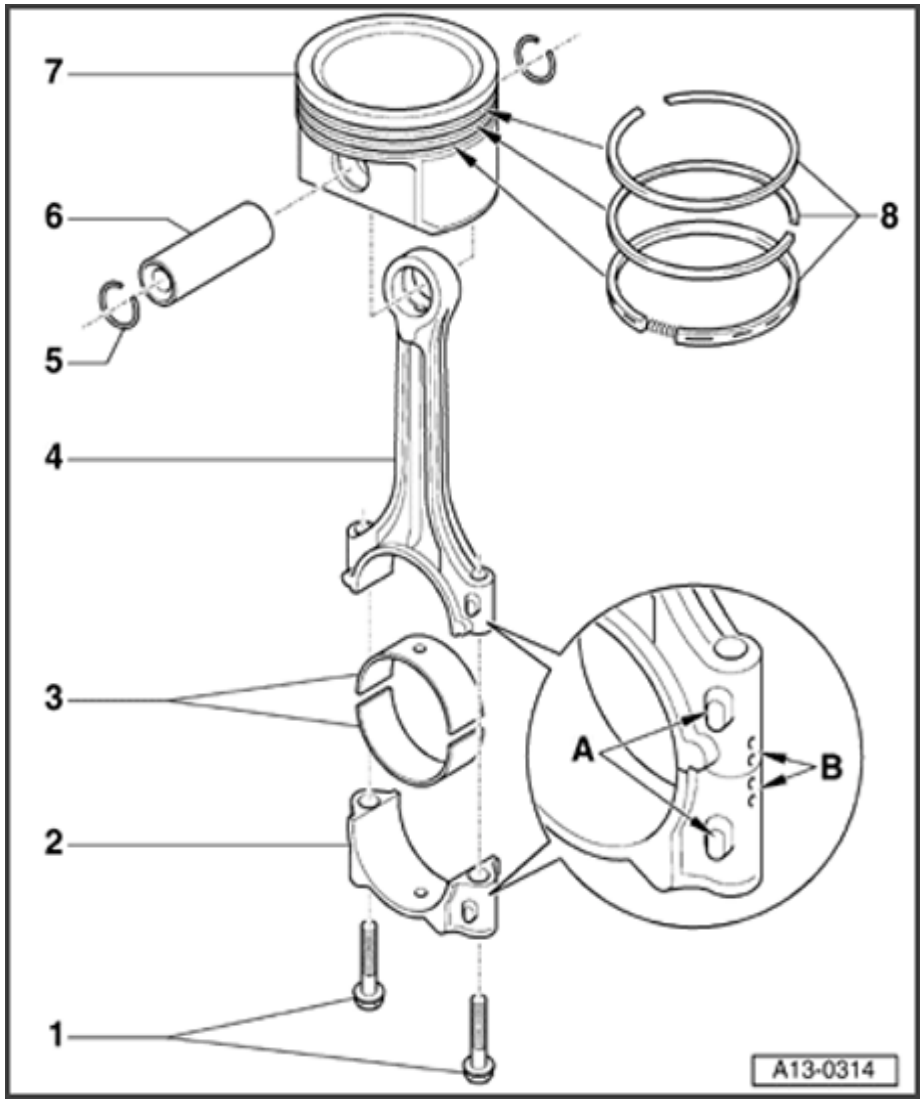
5 - Circlip

6 - Piston pin

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

cardiagn.com

13-82



7 - Piston

- Checking ⇒ Fig. ⇒ 3 , ⇒ Page 13-84
- Mark installation position and cylinder number.
- Arrow on piston crown points to pulley end
- Install using piston ring clamp.
- Piston and cylinder dimensions ⇒ Page 13-86

8 - Piston rings

- Offset gaps by 120°
- Remove and install with piston ring pliers.
- "TOP" must face piston crown
- Check ring gap⇒Fig. ⇒ 1 , ⇒ Page 13-83
- Check ring to groove clearance⇒Fig. ⇒ 2 , ⇒ Page 13-83

cardiagn.com

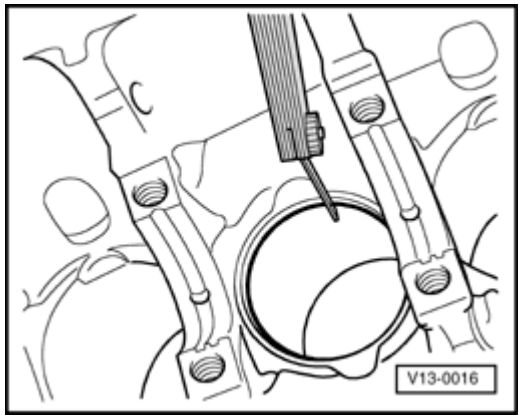


Fig. 1 Checking piston ring gap

- Push ring squarely from above down to approx. 15 mm from bottom end of cylinder. To do this, use a piston without rings.

Piston ring Dimensions in mm	New	Wear limit
1. compression ring	0.20 to 0.40	0.8
2. compression ring	0.20 to 0.40	0.8
Oil scraper ring	0.25 to 0.50	0.8

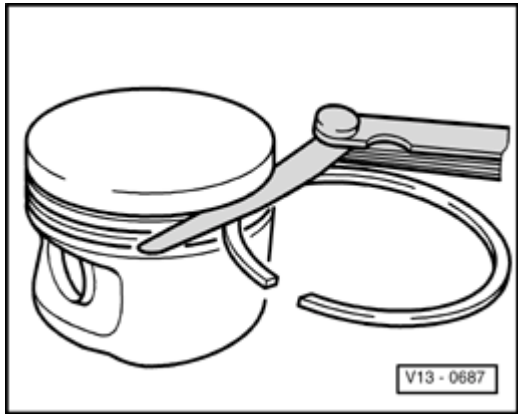


Fig. 2 Checking ring to groove clearance

- Clean groove before checking clearance.

Piston ring Dimensions in mm	New	Wear limit
1. compression ring	0.06 to 0.09	0.20
2. compression ring	0.05 to 0.08	0.20
Oil scraper ring	0.03 to 0.06	0.15

cardiagn.com

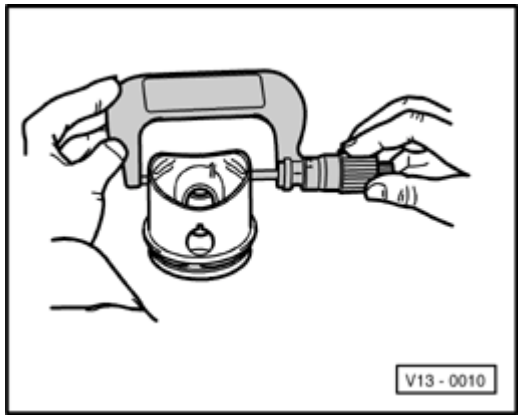


Fig. 3 Checking piston

- Measure pistons approx. 10 mm from lower edge of skirt, at 90° to piston pin axis.

• Permissible deviation from nominal dimension: no more than 0.04 mm

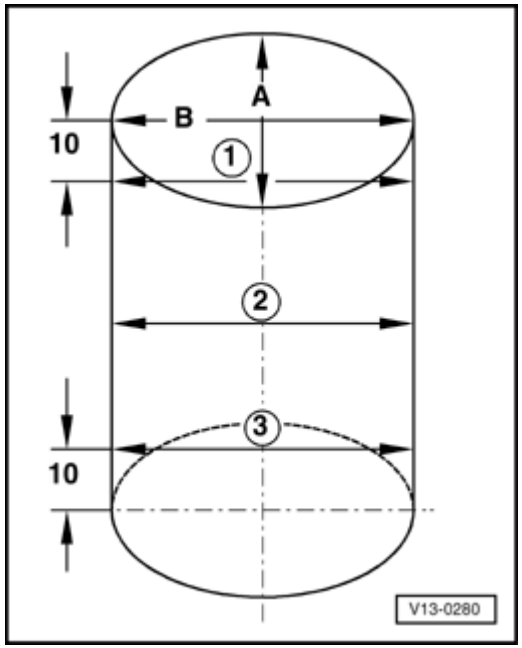


Fig. 4 Checking cylinder bores

Special tools and equipment

♦ Use internal dial gauge 50 to 100 mm

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

• Permissible deviation from nominal dimension: no more than 0.08 mm

cardiagn.com

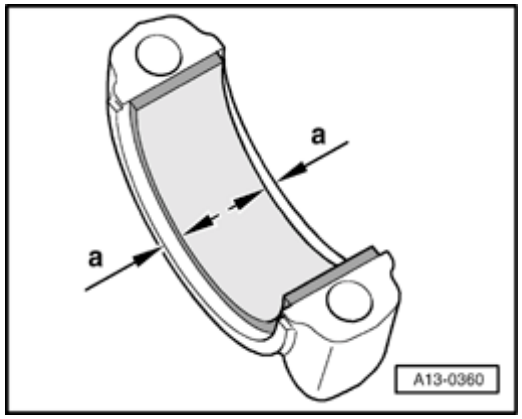


Fig. 5 Location of bearing shell

- Install bearing shells centrally into connecting rod or into connecting rod bearing cap.
  - ♦ Distance a = 3.0 mm

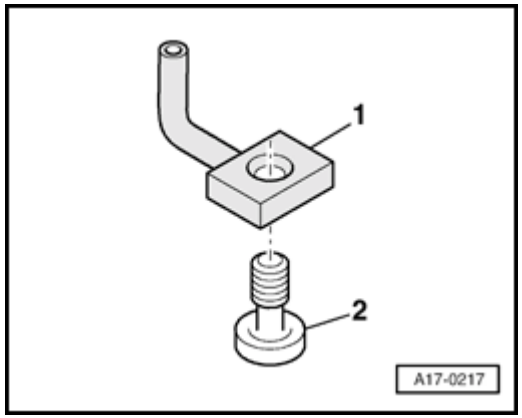


Fig. 6 Oil spray jet and pressure relief valve

1 - Oil spray jet (for piston cooling)

2 - Bolt with pressure relief valve - 27 Nm
  - ♦ Opening pressure 1.3 to 1.6 bar

cardiagn.com

Piston and cylinder dimensions

Honing dimension		Piston diameter	Bore diameter
Basic dimension	mm	80.950 1)	81.01
Oversize	mm	81.450 1)	81.51

1) Dimension without graphite coating (thickness 0.02 mm). The graphite coating on the piston skirts wears away.

cardiagn.com

15-1

Cylinder head, removing and installing

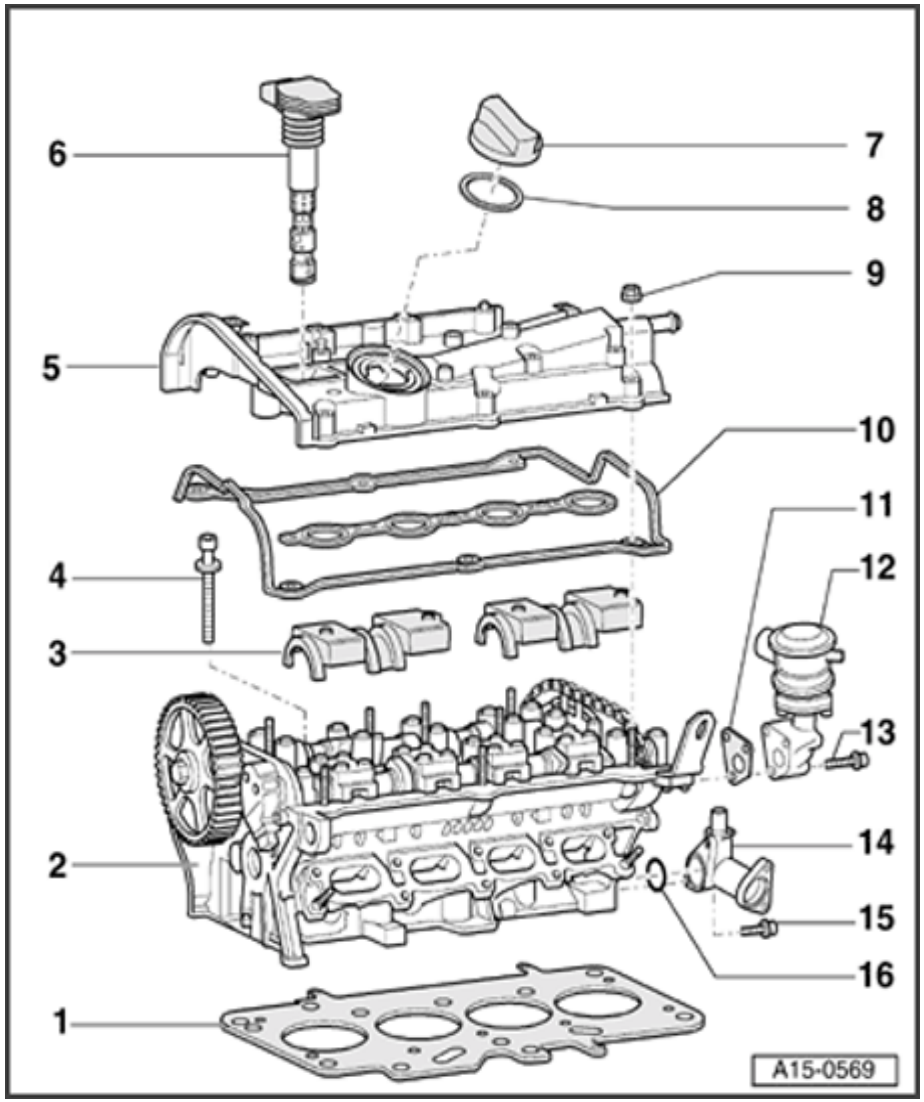
Note:

- *Always replace the cylinder head bolts.*
- *When performing repairs, replace seals, gaskets, self-locking nuts and bolts which have a specified tightening angle.*
- *The hose connectors and hoses of charge air system must be free of oil and grease before assembling.*
- *When installing an exchange cylinder head with the camshafts installed, the contact surfaces between bucket tappet and cam running surface must be oiled after installation of the cylinder head.*
- *The plastic protectors fitted to protect the open valves must only be removed immediately before installing the cylinder head.*
- *When installing a new cylinder head or cylinder head gasket, drain off all the old coolant and re-fill with new coolant.*

cardiagn.com

- *Cylinder heads which have cracks between the valve seats or between valve seat inserts and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first 4 turns of the spark plug threads are cracked.*

cardiagn.com



Part I - Cylinder head components

1 - Cylinder head gasket

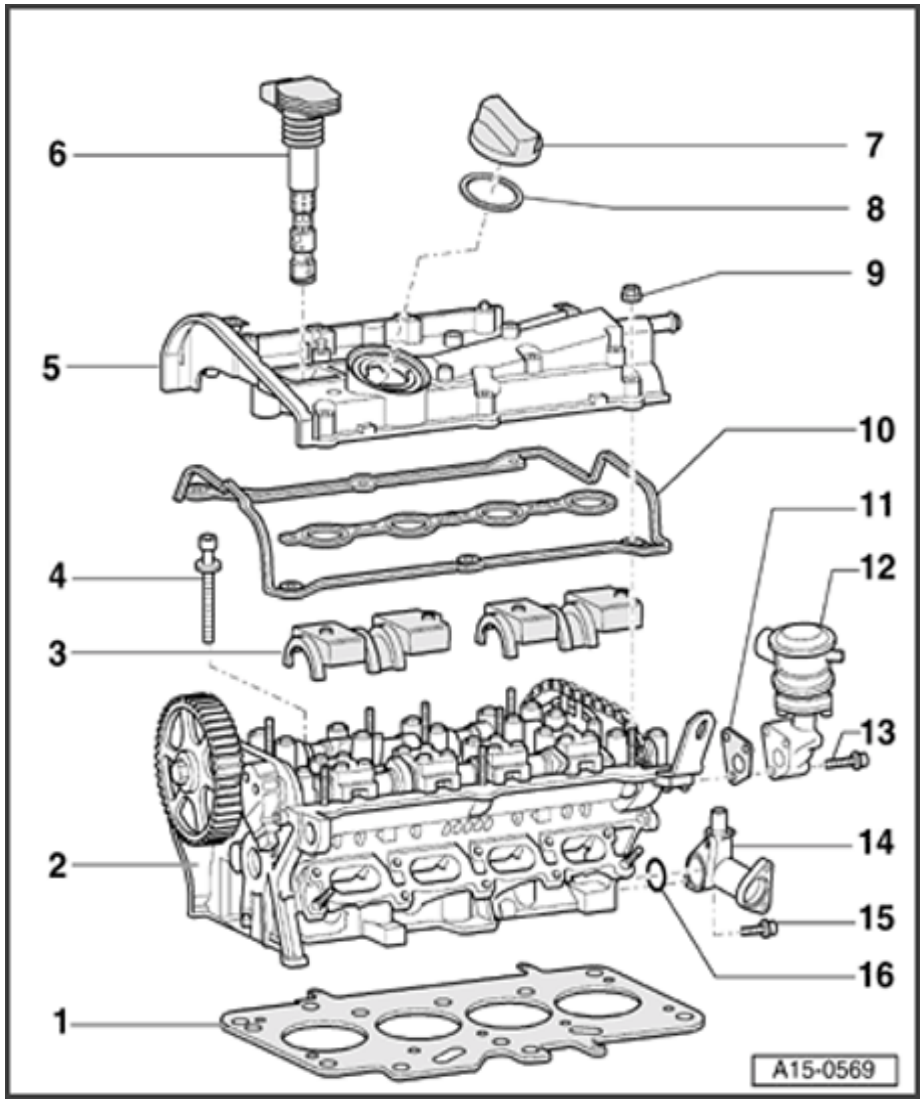
- Replacing ⇒ Removing cylinder head, ⇒ Page 15-20
- Installation position: Part No. to cylinder head
- After replacing, fill with fresh coolant

2 - Cylinder head

- Removing ⇒ Page 15-20
- Check for distortion⇒ Fig. ⇒ 1 , ⇒ Page 15-7
- Reworking dimension⇒Fig. ⇒ 2 , ⇒ Page 15-7
- Installing ⇒ Page 15-28 .
- After replacing, fill with fresh coolant

cardiagn.com

15-3



3 - Oil deflector

- Note installation position

4 - Cylinder head bolt

- Always replace
- Note sequence when loosening ⇒ Page 15-27
- Note sequence when tightening ⇒ Page 15-30

5 - Cylinder head cover

- Removing and installing ⇒ Page 15-15

6 - Ignition coil

7 - Cap

8 - Gasket

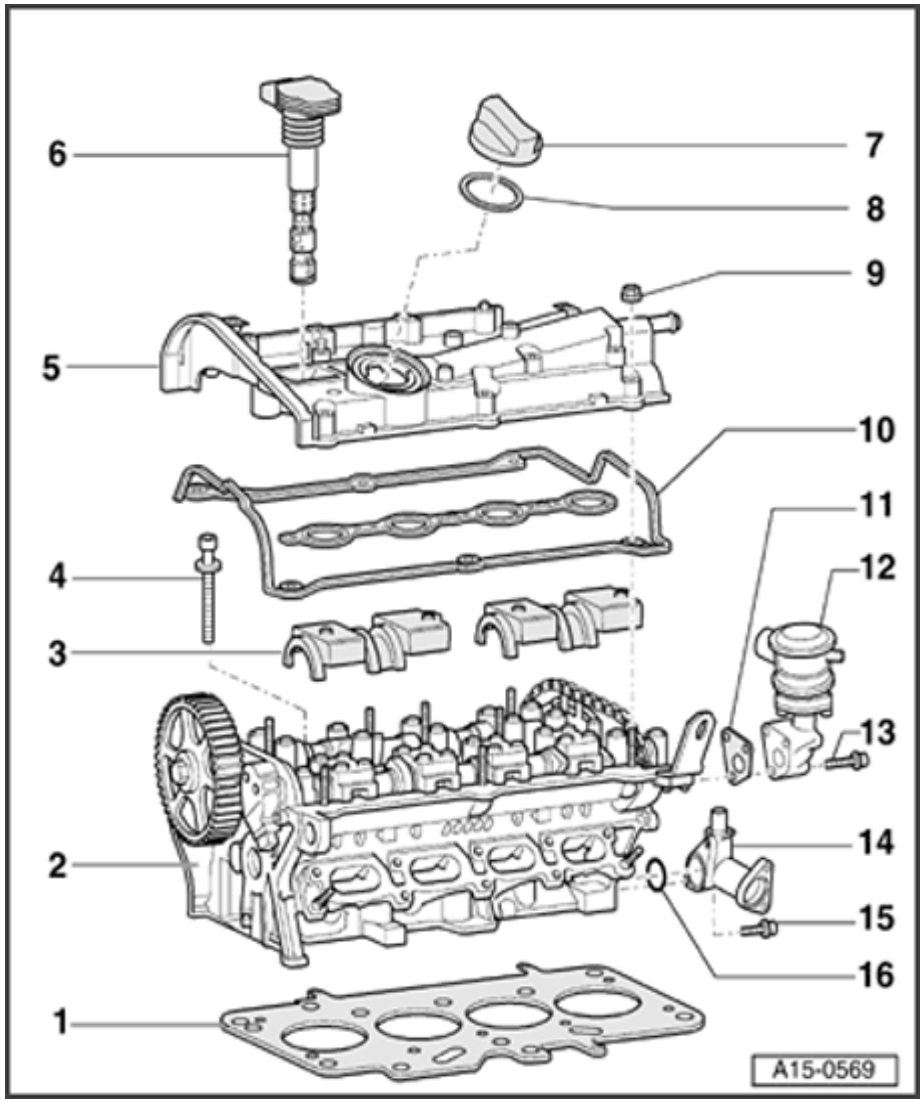
- Replace if damaged or leaking

9 - 10 Nm

- First tighten inner nuts
- Tighten outer nuts diagonally

cardiagn.com

15-4



10 - Cylinder head cover gasket

- Replace if damaged or leaking
- Before installing gasket apply "AMV 174 004 01" to sealing points ⇒Fig. ⇒ 3 and Fig. ⇒ 4 , ⇒ Page 15-8

11 - Gasket

- Always replace

12 - Combi valve for secondary air inlet

- With screw connection

13 - 10 Nm

14 - Coolant flange

- With coolant temperature sensor

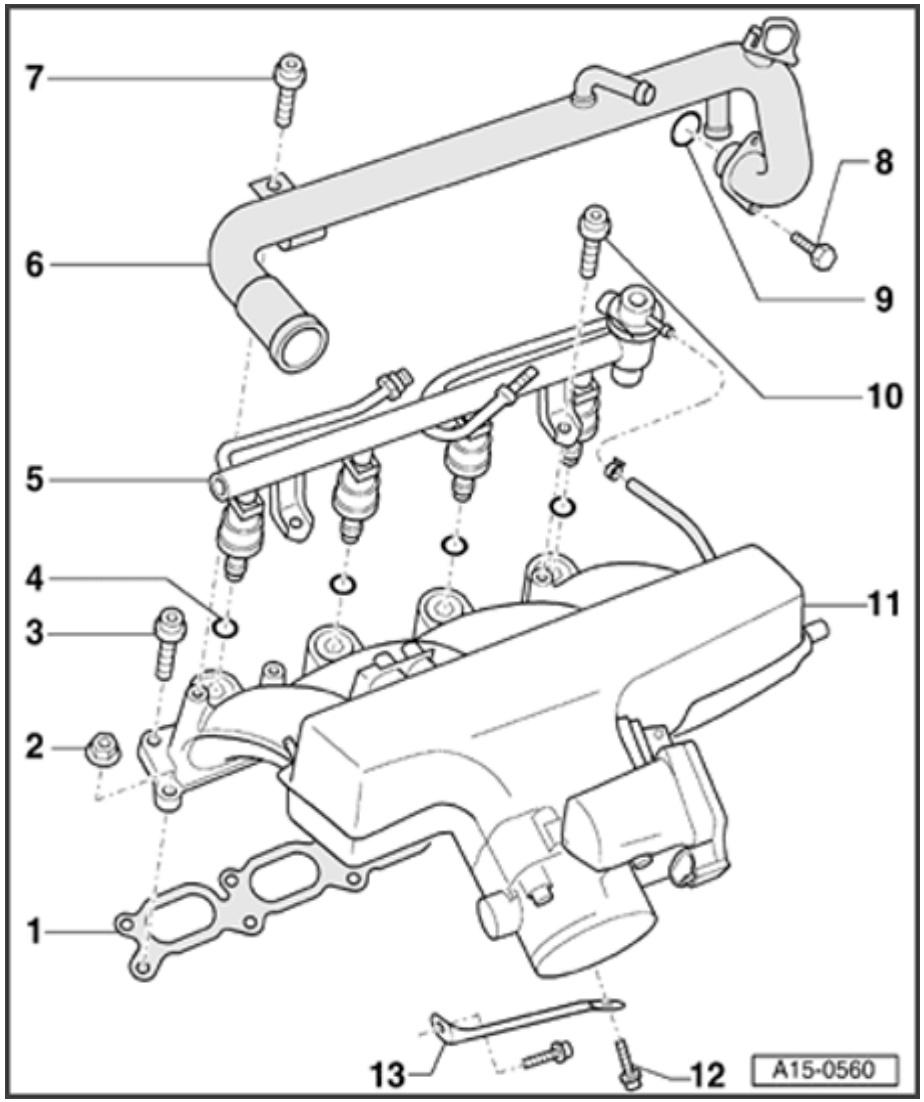
15 - 10 Nm

16 - O-ring

- Always replace

cardiagn.com

15-5



Part II - Intake manifold components

1 - Gasket

- Note installation position
- Always replace

2 - 10 Nm

3 - 10 Nm

4 - O-ring

- For injector
- Always replace

5 - Fuel rail

- With injectors

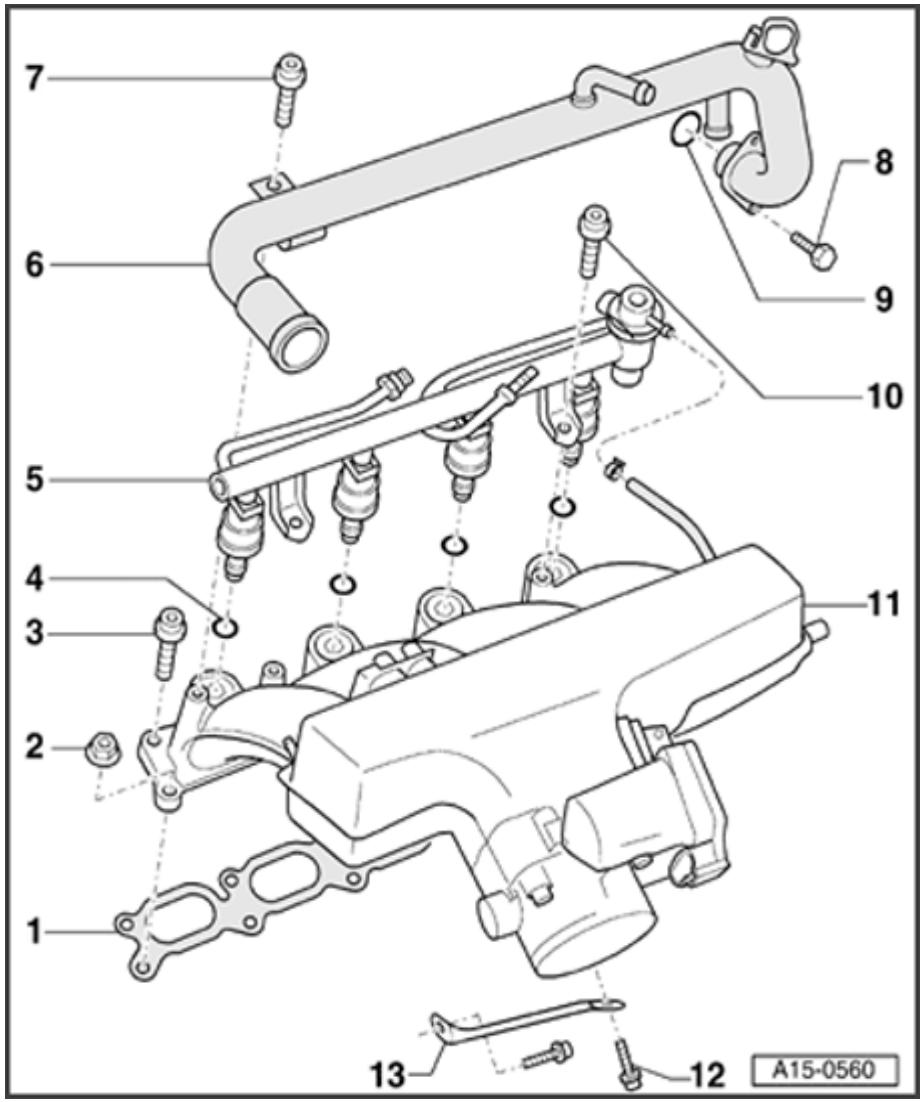
6 - Top coolant line

7 - 10 Nm

8 - 10 Nm

cardiagn.com

15-6



9 - O-ring

- For top coolant line
- Always replace

10 - 10 Nm

11 - Intake manifold

- Removing and installing ⇒ Page 15-9

12 - 20 Nm

13 - Support

- For intake manifold

cardiagn.com

15-7

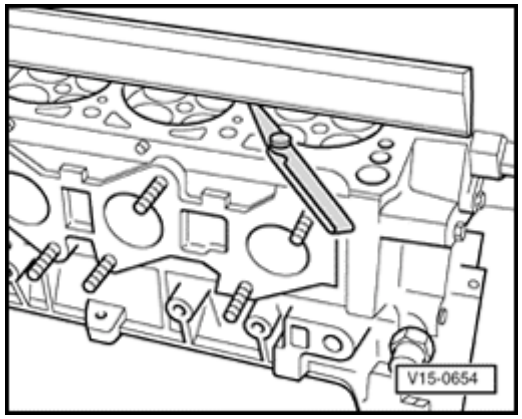


Fig. 1 Check cylinder head for distortion.

- Use knife edge, straightedge and feeler gauge to measure at several points.

• Max. permissible distortion: 0.1 mm

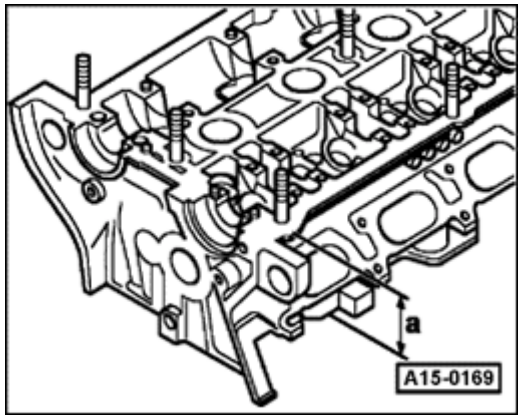


Fig. 2 Reworking dimension for cylinder head

Reworking the cylinder head (shaving) is only permitted down to minimum dimension -a-.

♦ Minimum dimension -a- = 139.20 mm

cardiagn.com

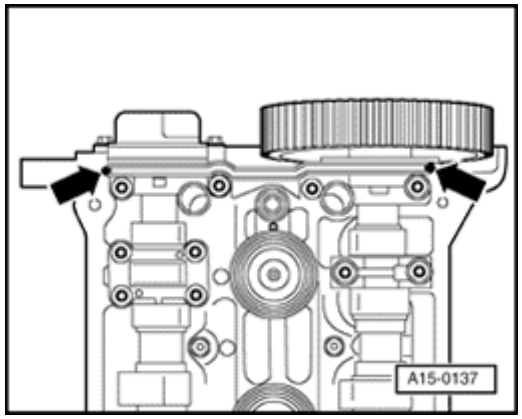


Fig. 3 Seal connections between double bearing cap and cylinder head

- Apply a small quantity of sealant AMV 174 004 01 to sides of joints - arrows- on upper sealing surface of cylinder head.

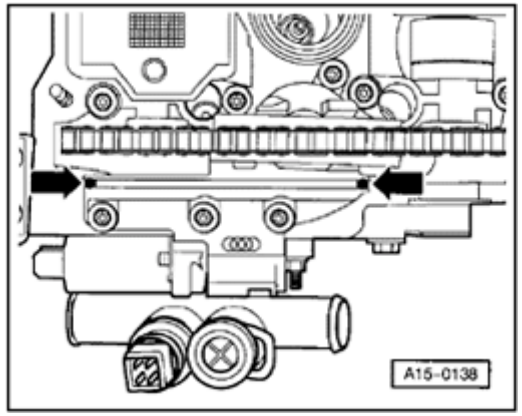


Fig. 4 Seal connections between camshaft adjuster and cylinder head

- Apply a small quantity of sealant AMV 174 004 01 to sides of joints - arrows- on upper sealing surface of cylinder head.

cardiagn.com

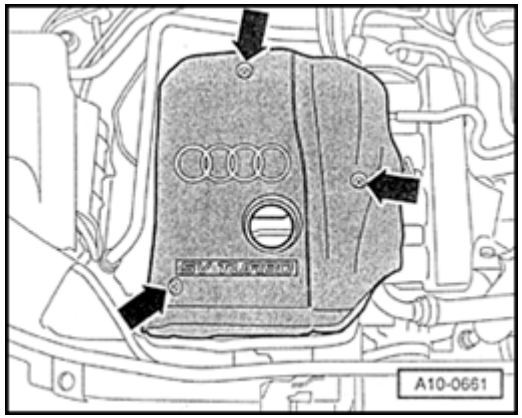
15-9

Intake manifold, removing and installing

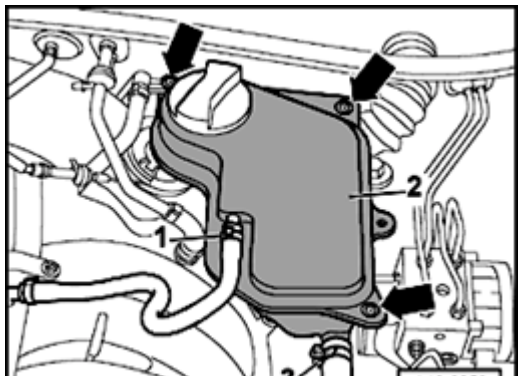
Removing

- Observe or obtain radio anti-theft code on vehicles with coded radio.

- Disconnect Ground strap at battery with ignition switched off.



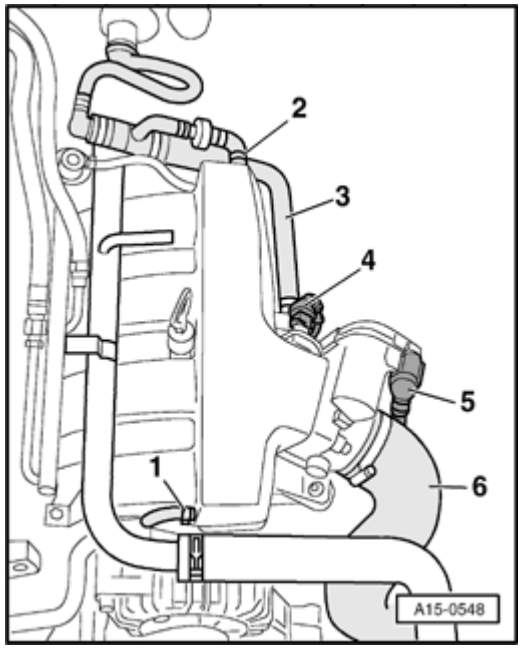
- Remove engine cover -arrows-.
- Drain coolant ⇒ Page 19-4 .



- Disconnect coolant hoses -1- and -3-.
- Unbolt coolant expansion tank -2- (-arrows-).
- Disconnect electrical wiring to coolant level display switch -F66- on bottom of expansion tank.

cardiagn.com

15-10

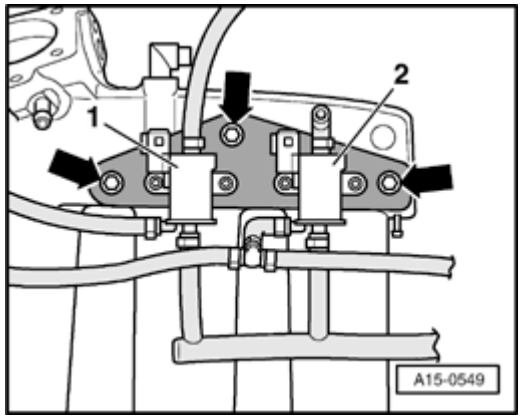


- Unplug vacuum hoses -1 to 3-.
- Disconnect connectors as follows:

4 - on intake air temperature sensor -G42-

5 - for throttle valve control module -J338-

- Remove the air duct hose -6- from throttle valve control module.



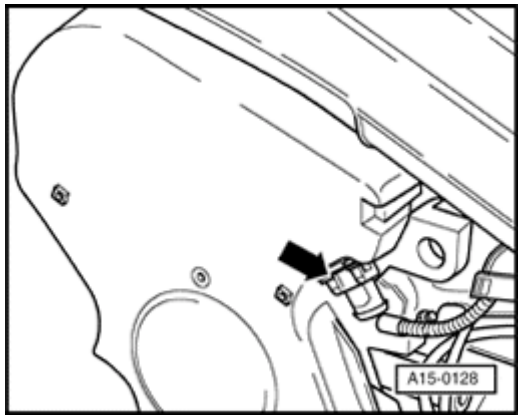
- Remove retaining plate for recirculation valve for turbocharger -N249- -1- from underneath intake line and secondary air inlet valve -N112 -2- -arrows-.

Note:

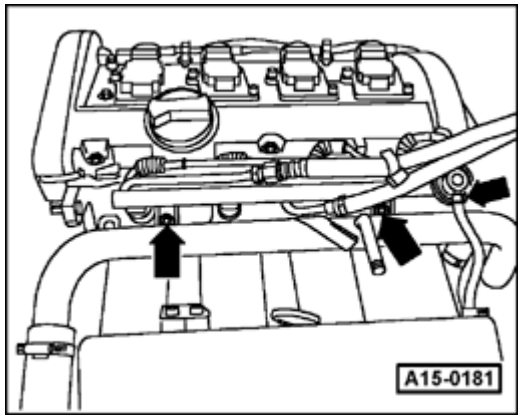
The electrical connectors and vacuum hoses do not have to be disconnected.

cardiagn.com

15-11



- Disconnect connector for Camshaft Position sensor -arrow-.



- Remove retaining bolts for fuel manifold and disconnect vacuum line from fuel pressure regulator -arrows-.
- Remove fuel manifold together with injectors from intake manifold and place it on a clean cloth at back of engine compartment.

Note:

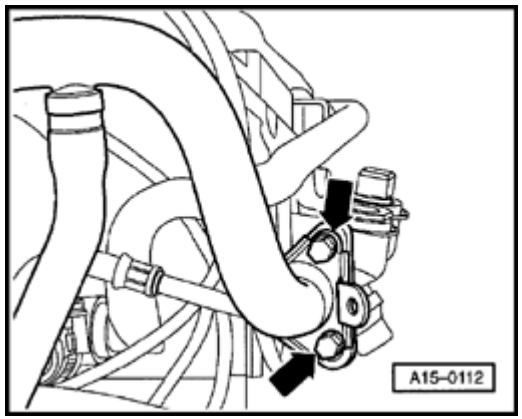
Carefully protect the removed injectors from contamination.

cardiagn.com

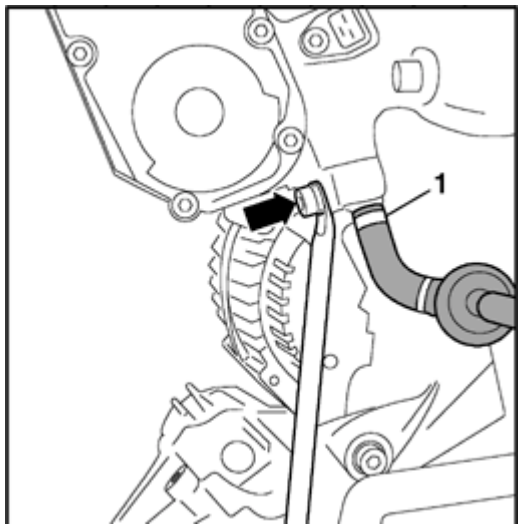
15-12

- Disconnect coolant hoses from upper coolant line.

- Move electrical wiring at top of coolant line aside.



- Unbolt upper coolant line from intake manifold and coolant flange -arrows- at back of cylinder head.



- Remove intake line support -arrows-.
- Disconnect hose -1- to ACF valve on intake line.
- Pull out oil dipstick.
- Remove bracket of guide line for oil dipstick.

cardiagn.com

- Remove suction hose from flange and remove.

Note:

Plug intake ports on cylinder head with clean cloths.

Installing

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

Note:

- *All cable ties which are released or cut open when removing must be located in the same position when installing.*
- *Hose connections and hoses of charge air system must be free of oil and grease before assembling.*
- *Replace seals and gaskets.*

- Top up coolant ⇒ Page 19-7 .

- After connecting battery, enter anti-theft code for radio.

cardiagn.com

⇒ *Radio operating instructions*

- Close windows fully using window switches.

cardiagn.com

- Actuate all power window switches again for at least one second in the "close" direction to activate automatic open/close function.

- Set clock to correct time.

- Perform throttle-valve control module adaption:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM , Repair Group 24*

Tightening torques

Component		Nm
Intake manifold to cylinder head		10
Support for intake manifold	to intake manifold	20
	to bracket	20
Fuel manifold to intake manifold		10
Coolant line to coolant flange		10
Coolant line on intake line		10
Hose clamps for coolant hoses		

cardiagn.com

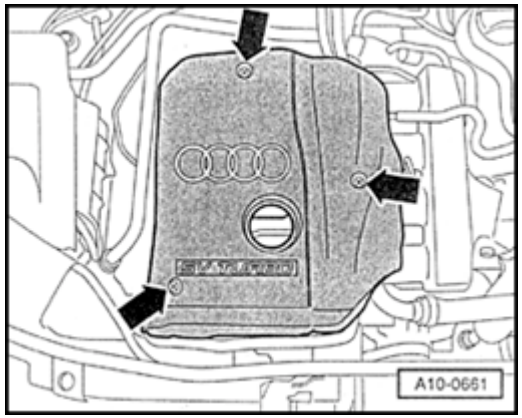
	2
Hose clamps for air duct hoses	3.5

cardiagn.com

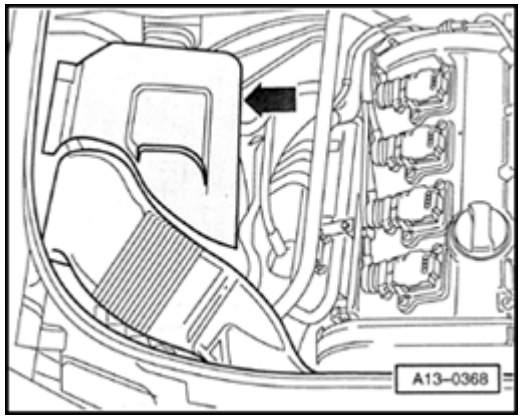
15-15

Cylinder head cover, removing and installing

Removing



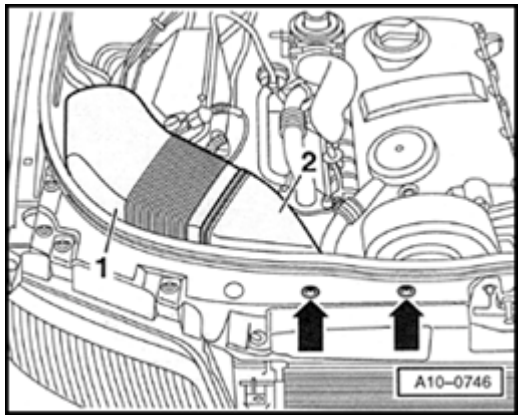
- Remove engine cover -arrows-.



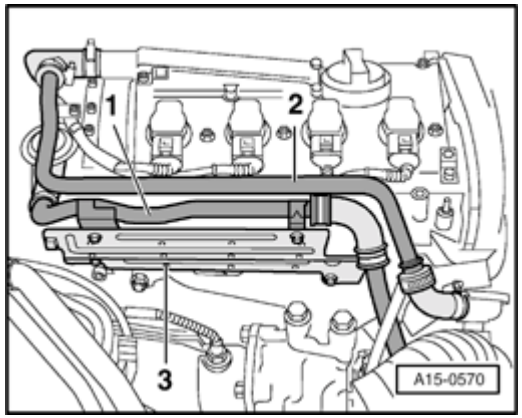
- Remove air filter cover -arrow-.

cardiagn.com

15-16



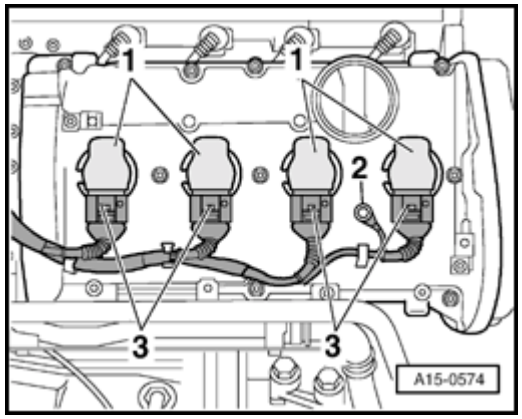
- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.



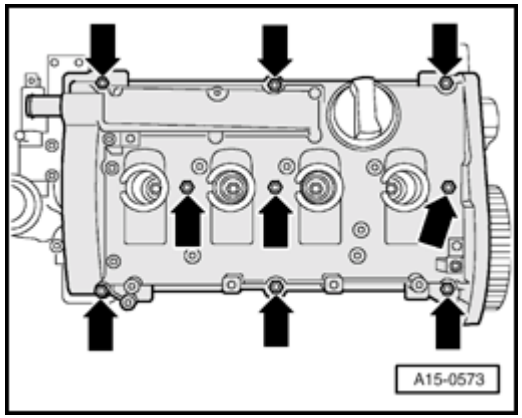
- Remove line of crankcase vent -1-.
- Disconnect hose of crankcase venting from cylinder head cover.
- Remove line -1- from combination valve for secondary air inlet on cylinder head cover and from heat shield -3- (engine code ANB only).
- Slightly swivel secondary air inlet line to side.

cardiagn.com

15-17



- Disconnect Ground wire -2-.
- Disconnect connectors -3-.
- Move lines and hoses aside.
- Remove ignition coils -1-.
- Loosen 2 top retaining clamps for toothed belt guard.



- Loosen nuts -arrows- for cylinder head cover and remove cylinder head cover.

cardiagn.com

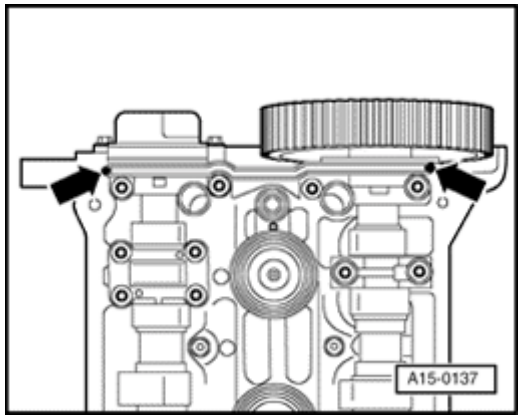
15-18

Installing

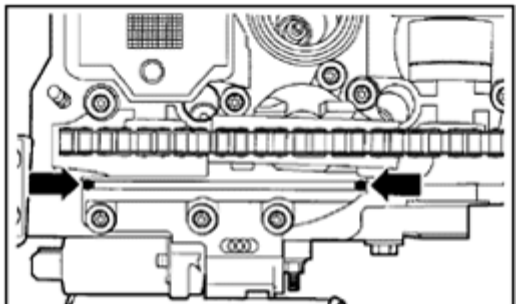
Installation is carried out in the reverse order of removal; note the following:

Note:

- *Replace seals and gaskets.*
- *Replace cylinder head cover gaskets if damaged.*



- Apply a small quantity of sealant AMV 174 004 01 to sides of joints - arrows- on upper sealing surface of cylinder head.



- Apply a small quantity of sealant AMV 174 004 01 to sides of joints - arrows- on upper sealing surface of cylinder head.
- First tighten inner nuts for cylinder head cover then tighten outer nuts diagonally.
- Check that upper toothed belt guard is correctly seated.

cardiagn.com

15-19

Tightening torques

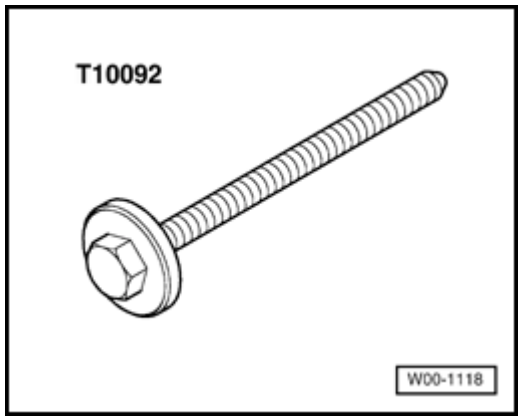
Component	Nm
Cylinder head cover to cylinder head	10
Line of crankcase vent to cylinder headcover	10
Line of secondary air inlet to cylinder head cover	10
Hose clamps	2

cardiagn.com

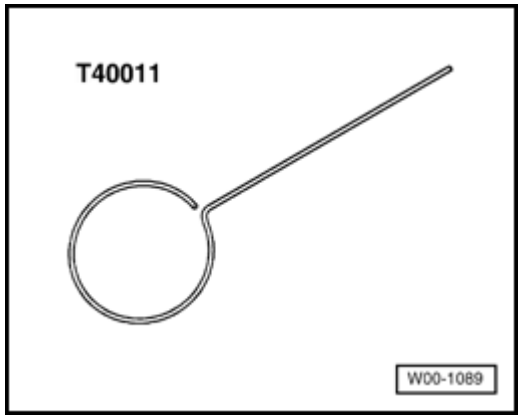
15-20

Cylinder head, removing

Special tools and equipment



- Socket head fastener T10092



- Pin T40011

cardiagn.com

15-21

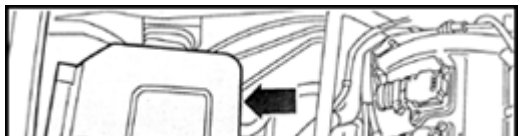
Procedure

- Engine in vehicle
- Lock carrier must be in service position ⇒ Page 13-1 .

Note:

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

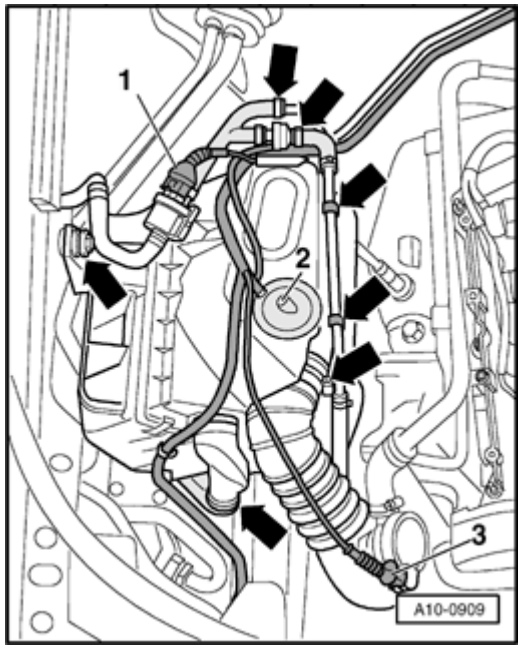
- Observe or obtain radio anti-theft code on vehicles with coded radio.
- Disconnect Ground strap at battery with ignition switched off.
- Drain coolant ⇒ Page 19-4 .
- Remove intake line ⇒ Page 15-9 .
- Remove ribbed belt and tensioner for ribbed belt ⇒ Page 13-18 .



- Remove air filter cover -arrow-.

cardiagn.com

15-22



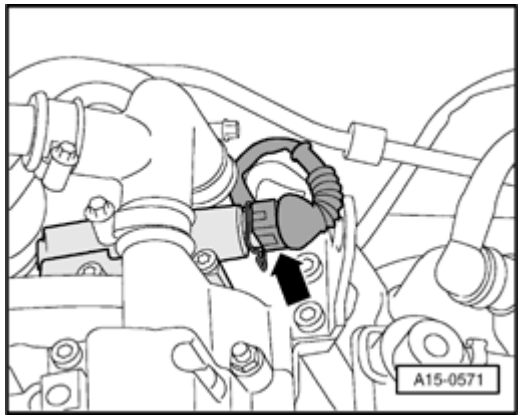
- Disconnect connectors as follows:

1 - on ACF valve (in addition, remove ACF valve from air filter housing)

2 - on air mass meter

3 - on solenoid valve for charge pressure control -N75-

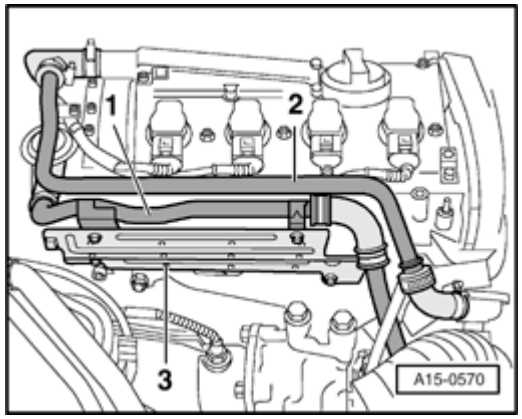
- Disconnect hose connections, move wiring aside and remove air filter housing -arrows-.



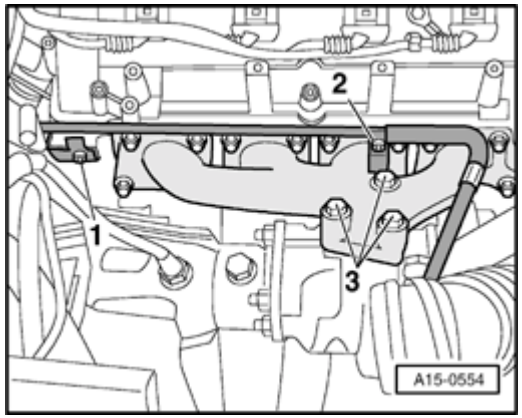
- Disconnect connector -arrow- from camshaft adjuster.

cardiagn.com

15-23



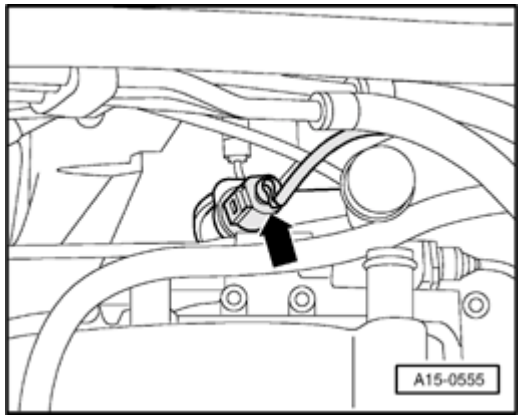
- Remove line of crankcase vent -1-.
- Remove hose of crankcase venting from cylinder head cover.
- Remove line -1- from combination valve for secondary air inlet on cylinder head cover and from heat shield -3- (engine code ANB only).
- Slightly swivel secondary air inlet line to side.
- Remove heat shield.



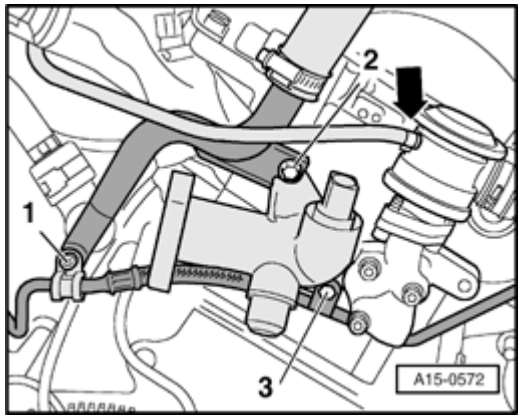
- Remove bolts -1- and -2- of oil feed line.
- Remove bolts -3- for exhaust turbocharger.

cardiagn.com

15-24



- Disconnect connector -arrow- at coolant temperature sensor -G2-/-G62-.

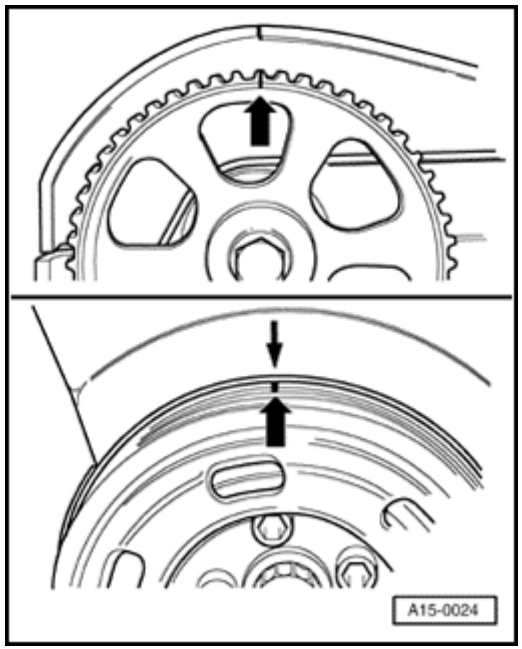


- Disconnect vacuum hose -arrow- from combination valve.
- Remove bolts -2- and -3- and remove coolant flange.
- Remove bracket -1- for oil feed line.
- Unclip all wiring from cylinder head and move clear to one side.
- Remove coolant hose going to heat exchanger (heater unit) at back of cylinder head (first release retainers on connecting flange).

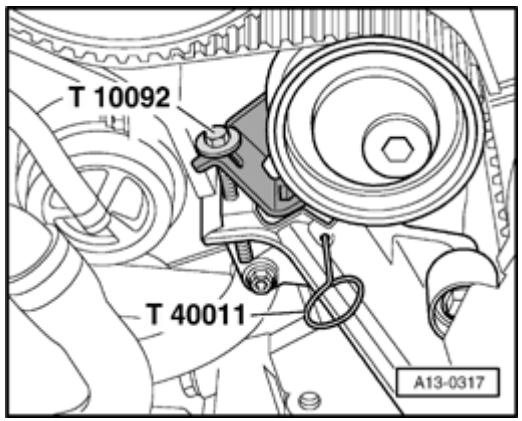
cardiagn.com

15-25

- Remove upper toothed belt guard ⇒ Page 13-35 .



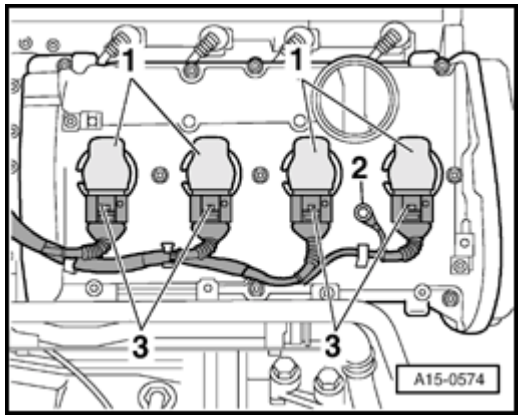
- Set crankshaft to markings for TDC of No. 1 cylinder by turning central bolt on crankshaft sprocket in direction of rotation -arrows-.



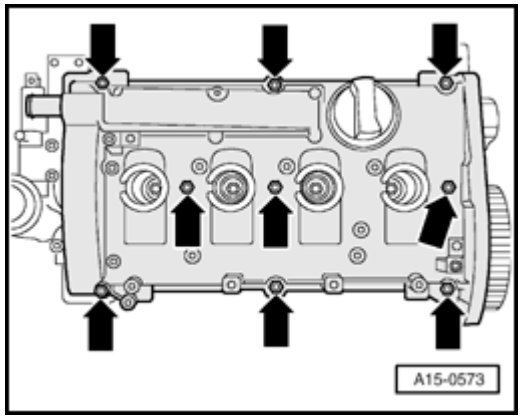
- Attach socket head fastener T10092 into tensioner.
- Only tension pressure piston of tensioner until piston is secured with pin T40011.
- Remove toothed belt from camshaft sprocket.

cardiagn.com

15-26



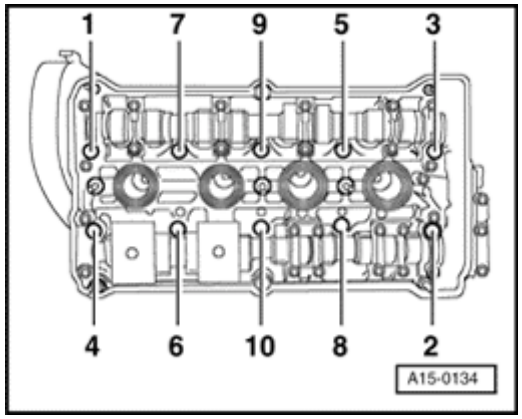
- Disconnec Ground wire -2-.
- Disconnect connectors -3-.
- Move lines and hoses aside.
- Remove ignition coils -1-.



- Loosen nuts -arrows- for cylinder head cover and remove cylinder head cover.
- Remove both oil deflectors.

cardiagn.com

15-27



- Loosen cylinder head bolts in correct sequence.
- Remove cylinder head.

cardiagn.com

15-28

Cylinder head, installing

Note:

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

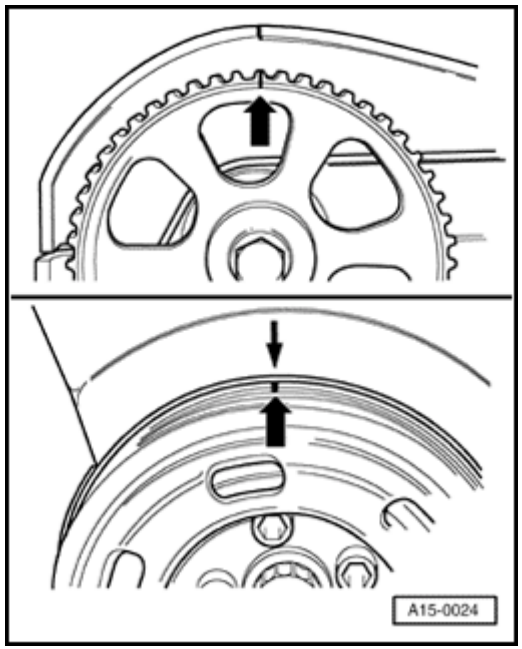
⇒ *Parts List*

- *If repairing, carefully remove any remains of gasket material from the cylinder head and cylinder block. Make sure that no long scores or scratches are made on the surfaces.*
- *Carefully remove any remaining emery and abrasive material.*
- *Remove new cylinder head gasket from packaging, just before installation.*
- *Handle gasket extremely carefully. Damaging*

cardiagn.com

the silicone layer or the indented area will lead to leaks.

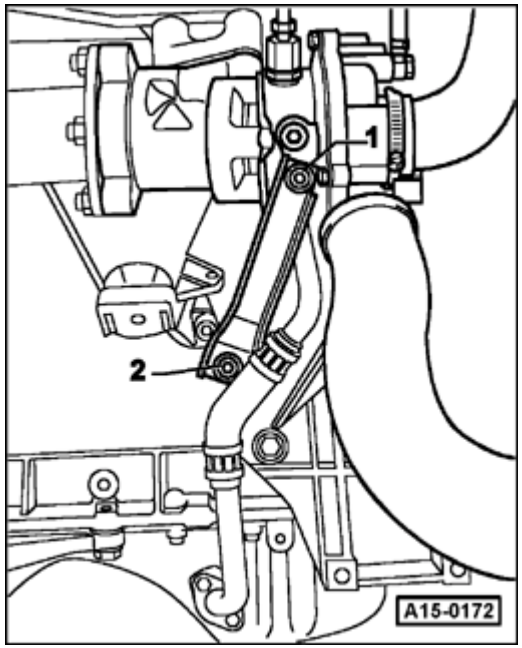
- *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder head.*



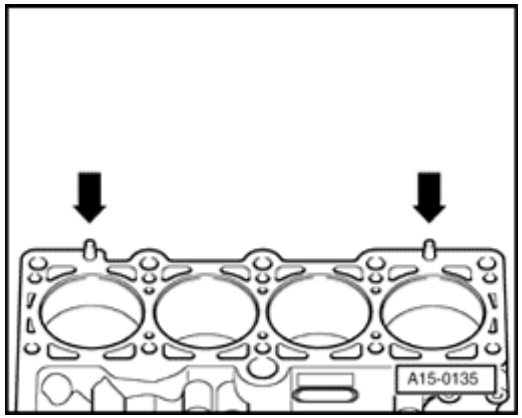
- Before positioning cylinder head, set crankshaft and camshaft to TDC of cylinder 1.

cardiagn.com

15-29



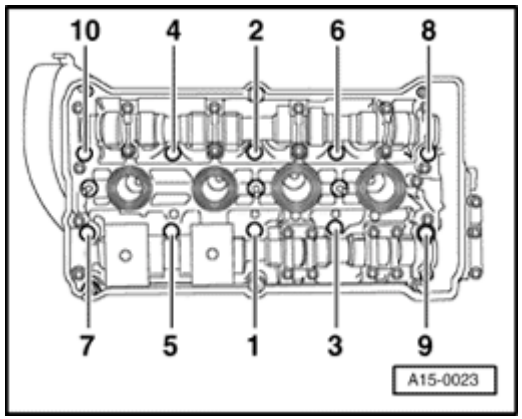
- Loosen bolts -1- and -2- on turbocharger bracket (about 2 full turns each) to avoid stressing when installing cylinder head.



- Place cylinder head gasket in position.
  - Note position of centralizing pins in cylinder block -arrows-.
  - Check installation position of cylinder head gasket. The Part No. should be legible from intake side.
- Position cylinder head.

cardiagn.com

15-30



- Insert cylinder head bolts and tighten by hand.

- Tighten cylinder head bolts in two stages in sequence shown as follows:
- Tighten using torque wrench:
  - Stage 1: 40 Nm
- Tighten with rigid wrench:
  - Stage 2: 180° ($^1/_2$turn) further (2 turns of 90° further is permissible)

Note:

It is not necessary to retighten cylinder head bolts after repairs have been performed.

- Tighten exhaust turbocharger to exhaust manifold with new seal and attach bracket to cylinder block ⇒ Page 21-45 .
- Install cylinder head cover ⇒ Page 15-18 .
- Install toothed belt (adjust valve timing) ⇒ Page 13-44 .

Note:

Observe all instructions on removing and installing the toothed belt ⇒ Page 13-40 .

cardiagn.com

15-31

- Install ribbed belt and tensioner for ribbed belt ⇒ Page 13-20 .

- Install intake line ⇒ Page 15-13 .

- Replace coolant ⇒ Page 19-7 .

- After connecting battery, enter anti theft code for radio.

⇒ *Radio operating instructions*

- Close windows fully using window switches.

- Actuate all power window switches again for at least one second in the "close" direction to activate the automatic open/close function.

- Set clock to correct time.

- Perform throttle-valve control module adaption:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel*

cardiagn.com

Injection & Ignition, Engine Code(s): AWM , Repair Group 24

cardiagn.com

Tightening torques

Component		Nm
Support for intake manifold	to intake manifold	20
	to bracket	20
Turbocharger to exhaust manifold		35 [1] [2]
Turbocharger bracket to cylinder block		25
Turbocharger bracket to turbocharger		30
Hose clamps for coolant hoses		2
Hose clamps for air duct hoses		3.5

[1] Replace bolts

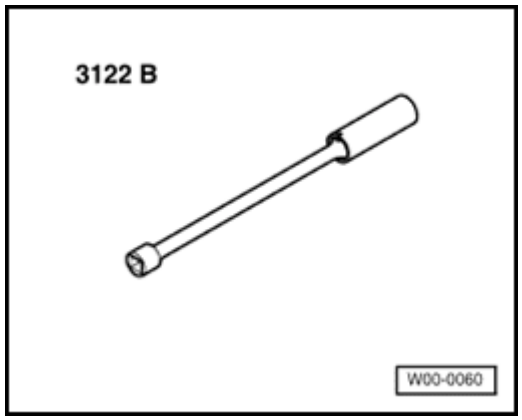
[2] Coat thread and head attachment area with high temperature lubricant G 052 112 A3

cardiagn.com

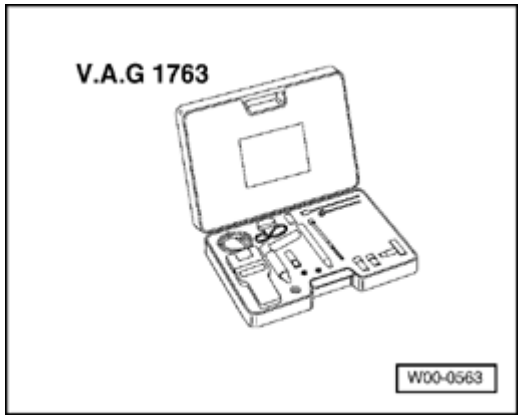
15-33

Compression, checking

Special tools and equipment



- Spark plug spanner 3122 B



- Compression tester VAG VAG 1763

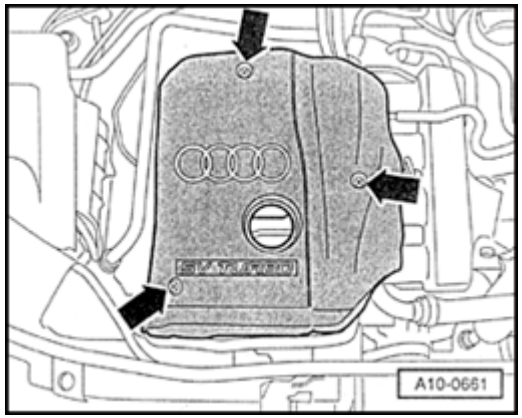
cardiagn.com

15-34

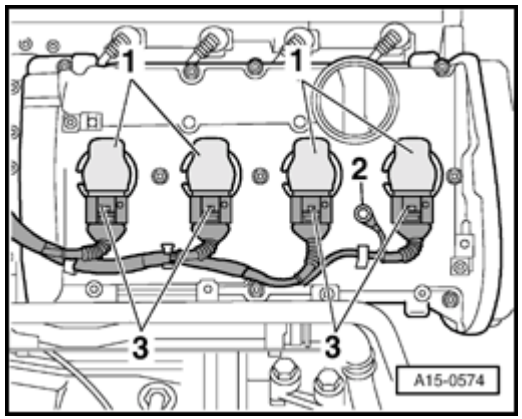
Test conditions:

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

Test sequence



- Remove engine cover -arrows-.
- Switch ignition off.



- Disconnect connectors -3-.
- Remove ignition coils -1-.

cardiagn.com

- Remove spark plugs with spark plug spanner 3122B.

- Disconnect connectors from all injectors.

- Fully open throttle valve.

- Check compression with compression tester VAG VAG 1763.

Note:

Using the compression tester

⇒ *Operating instructions*

- Operate starter until tester shows no further pressure increase.

Compression pressure values:

New	Wear limit	Permissible difference between cylinders

cardiagn.com

bar excess pressure	bar excess pressure	bar excess pressure
9.0 to 14.0	7.5	max. 3.0

cardiagn.com

- Install spark plugs and ignition coils.

Note:

Replace gaskets for ignition coils if damaged.

- Check Diagnostic Trouble Code (DTC) memory:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM , Repair Group 01*

Note:

DTCs will have been recorded in the DTC memory because the connectors have been unplugged. Check and, if necessary, erase the DTC memory after completing the test.

Tightening torques

Component	Nm
Spark plugs in cylinder head	30

cardiagn.com

15-37

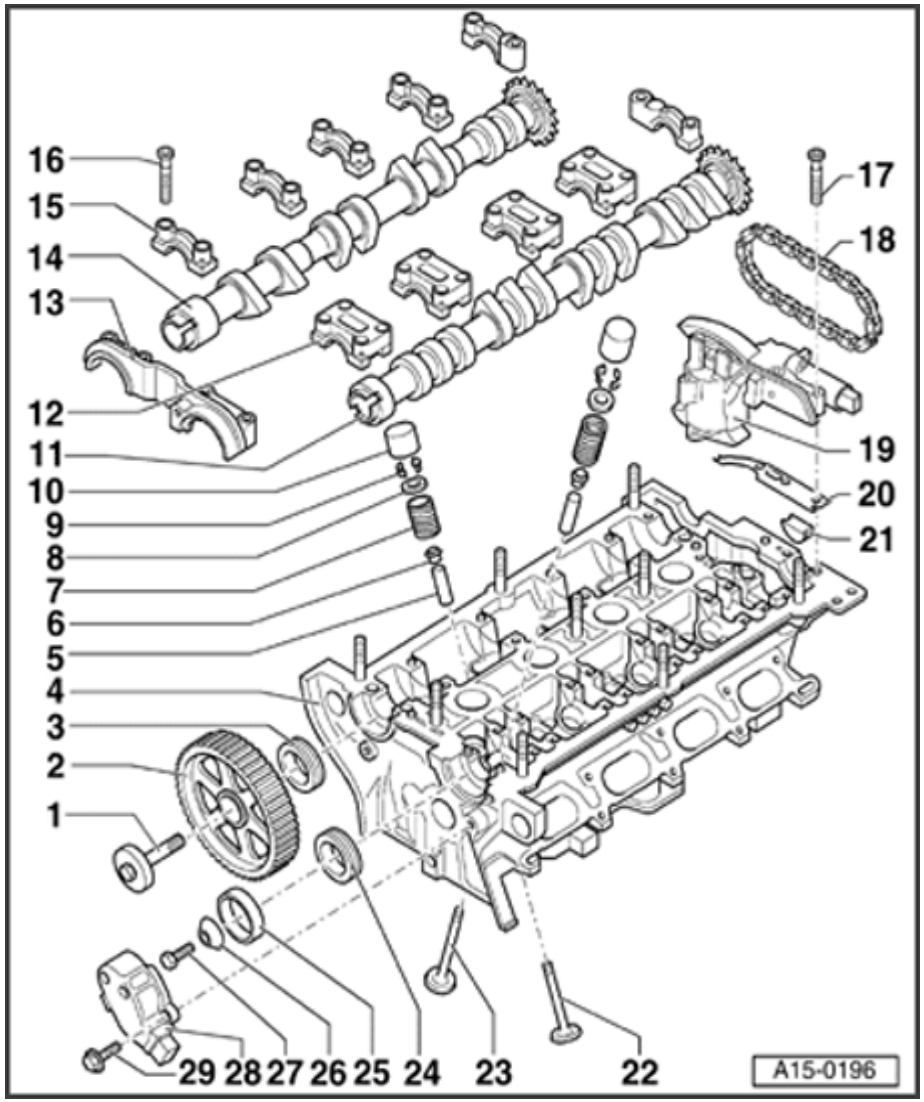
Valve gear, servicing

Note:

- *Cylinder heads that have cracks between the valve seats or between valve seat inserts and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first 4 turns of the spark plug threads are cracked.*
- *Wait about 30 minutes after installing the camshafts before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*
- *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*
- *Replace all gaskets and seals.*

cardiagn.com

15-38



1 - 65 Nm

- Counterhold with 3036 to loosen and tighten

2 - Camshaft sprocket

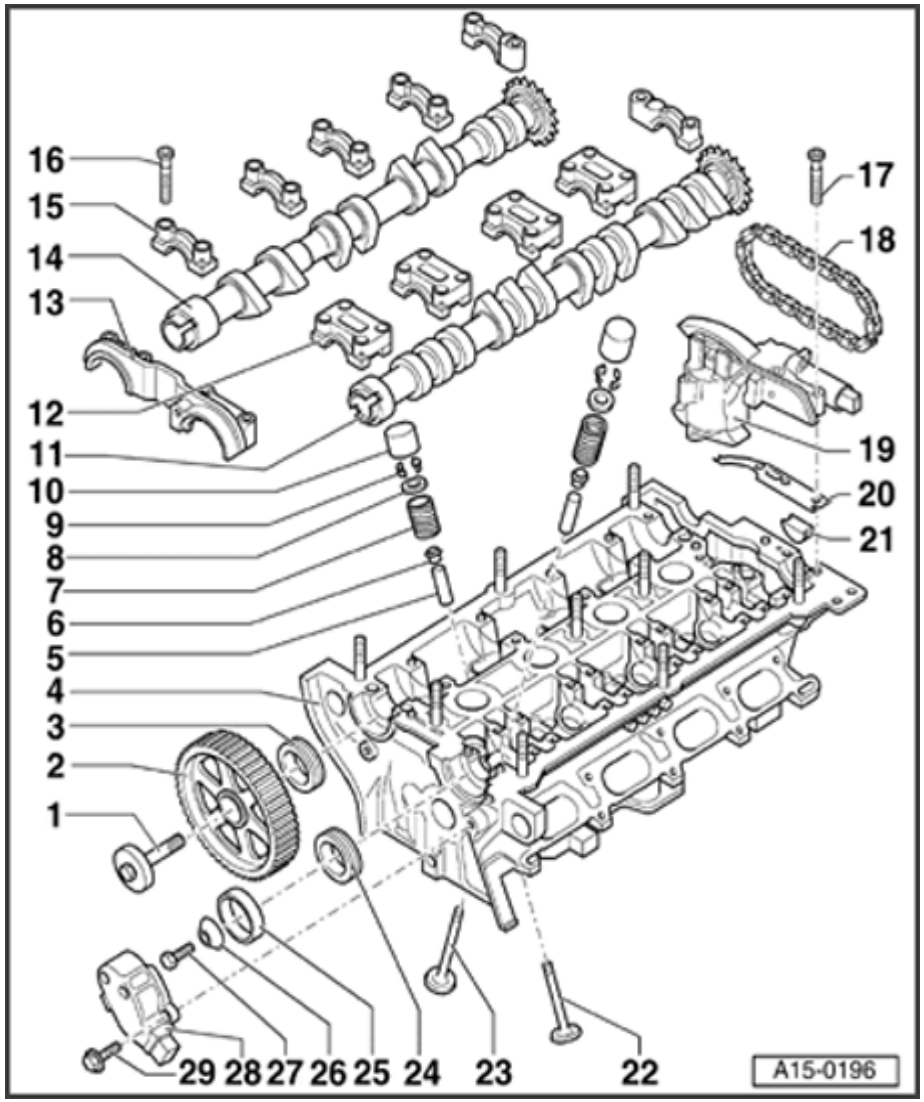
- For exhaust camshaft
- Note correct installation position: The narrow web of the camshaft sprocket faces forward and the marking for No. 1 cylinder is visible from the front ⇒ Page 15-55

3 - Sealing ring

- For exhaust camshaft
- Replacing ⇒ Page 15-50

cardiagn.com

15-39



4 - Cylinder head

- See note ⇒ Page 15-37
- Checking valve guides ⇒ Page 15-86
- Reworking valve seats ⇒ Page 15-88
- Dowel sleeves for bearing caps must be located in cylinder head.
- Seal joints⇒ Fig. ⇒ 3 and Fig. ⇒ 4 , ⇒ Page 15-8

5 - Valve guide

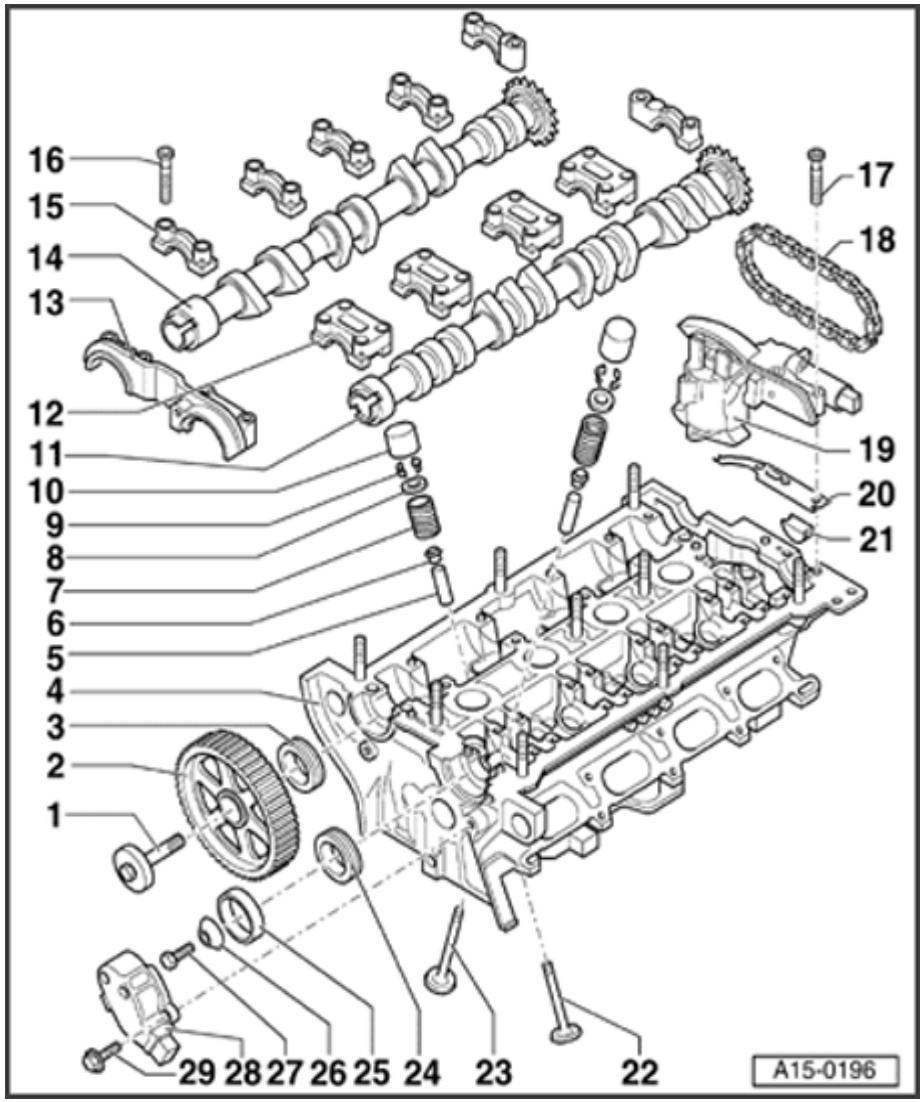
- Checking ⇒ Page 15-86

6 - Valve stem seal

- Replacing ⇒ Page 15-77

cardiagn.com

15-40



7 - Valve springs

- Removing and installing ⇒ Page 15-77

8 - Valve spring plate

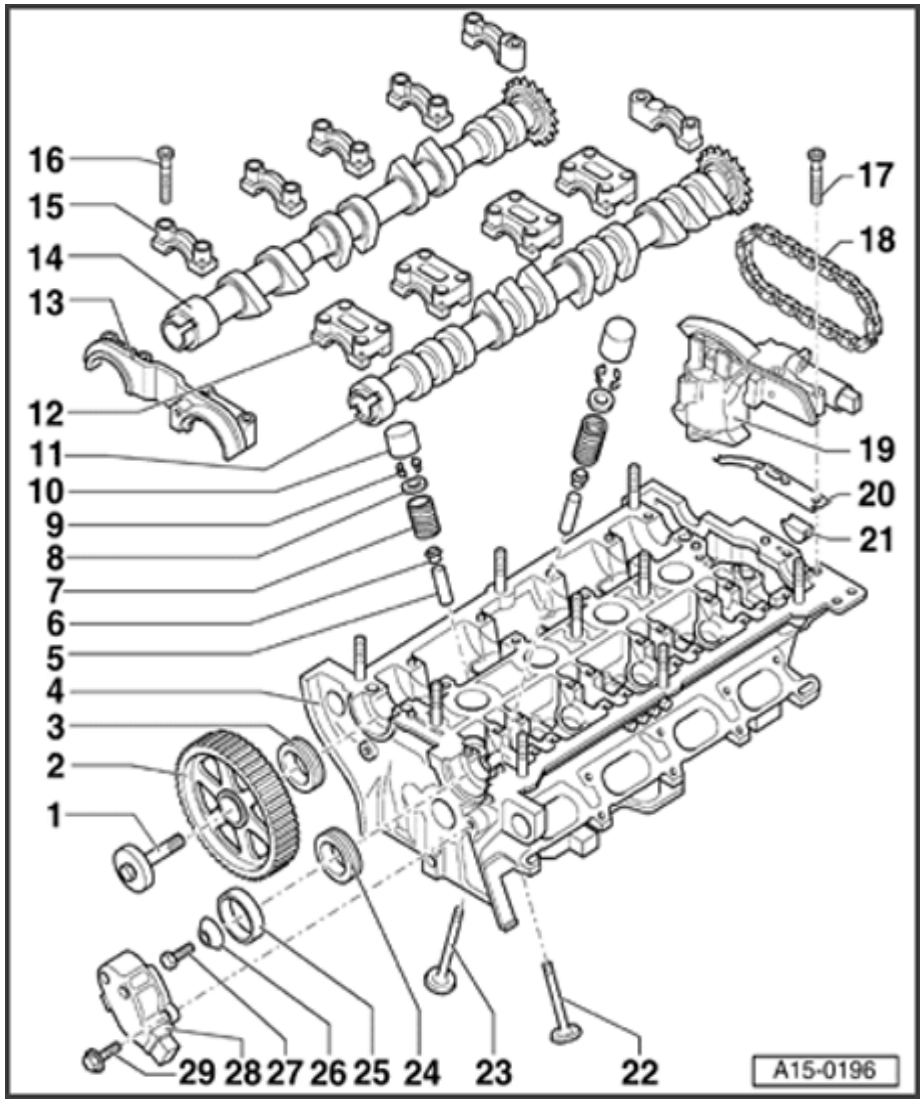
9 - Valve keepers

10 - Hydraulic valve lifter

- Checking ⇒ Page 15-74
- Removing and installing ⇒ Page 15-77
- Do not interchange
- Store with cam contact surface downward
- Before installing check camshaft axial clearance ⇒ Page 15-48
- Oil contact surface

cardiagn.com

15-41



11 - Intake camshaft

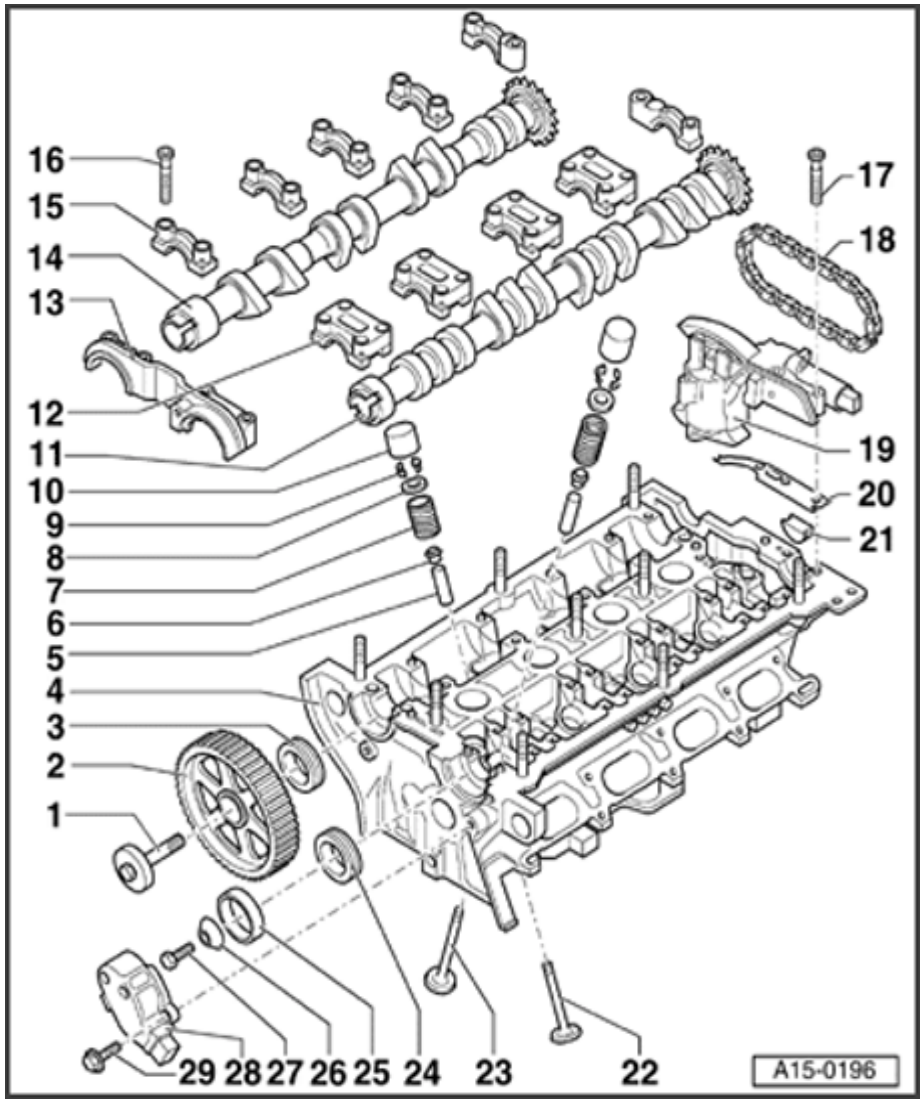
- Check radial clearance with Plastigage ™ (hydraulic lifters not installed). Wear limit: 0.1 mm
- Run-out: no more than 0.035 mm
- Checking axial clearance ⇒ Page 15-48
- Removing and installing camshafts ⇒ Page 15-62

12 - Bearing cap for intake camshaft

- Must be located on dowel sleeves
- Dowel sleeves must be located in cylinder head.
- Note installation position
- Installation sequence ⇒ Page 15-67

cardiagn.com

15-42



13 - Double bearing cap

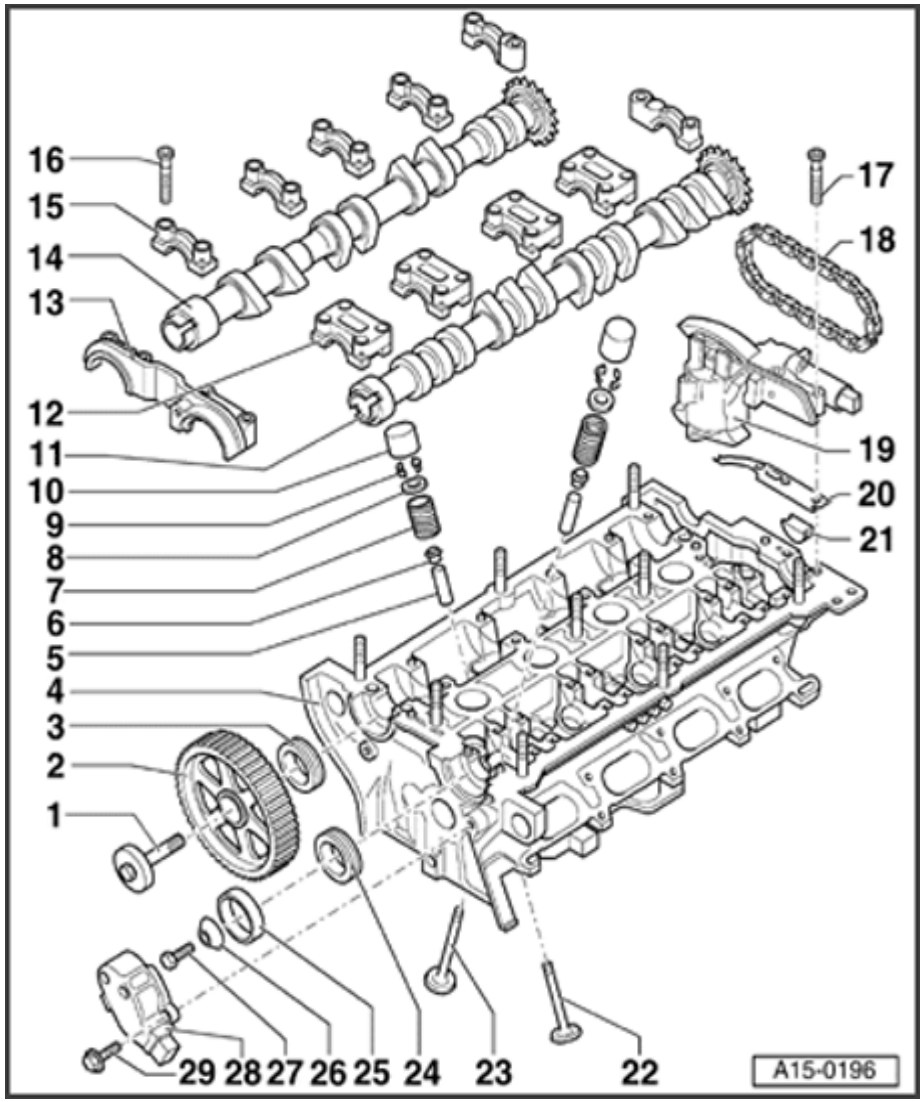
- Must be located on dowel sleeves
- Dowel sleeves must be located in cylinder head
- Coat sealing surface lightly with AMV 188 001 02 before installation ⇒ Page 15-71
- Seal connections between double bearing cap and cylinder head⇒Fig. ⇒ 3 , ⇒ Page 15-8

14 - Exhaust camshaft

- Check radial clearance with Plastigage ™ (hydraulic lifters not installed). Wear limit: 0.1 mm
- Run-out: no more than 0.035 mm
- Checking axial clearance ⇒ Page 15-48
- Removing and installing camshafts ⇒ Page 15-62

cardiagn.com

15-43



15 - Bearing cap for exhaust camshaft

- Must be located on dowel sleeves
- Dowel sleeves must be located in cylinder head
- Note installation position
- Installation sequence ⇒ Page 15-67

16 - 10 Nm

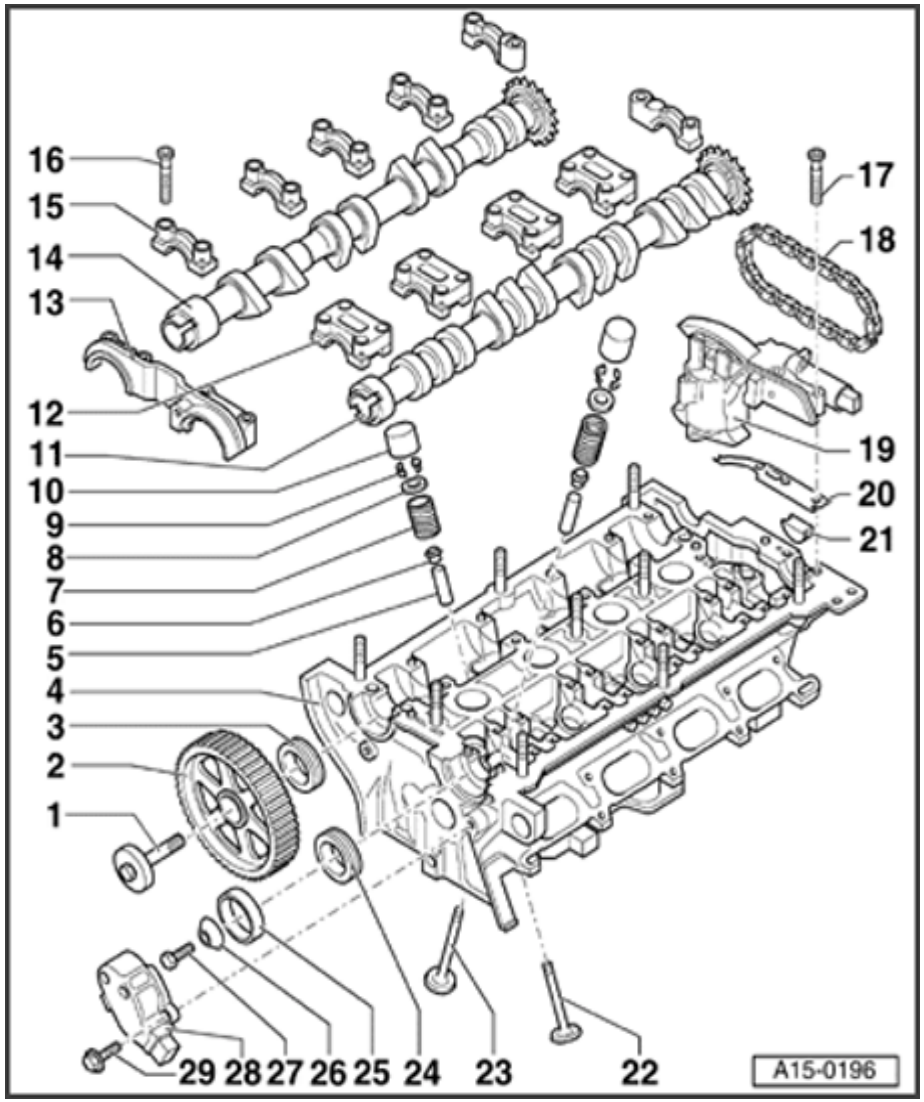
17 - 10 Nm

18 - Drive chain

- Check for wear
- Before removing, mark installation position ⇒ Page 15-66
- Removing and installing camshaft ⇒ Page 15-62

cardiagn.com

15-44



19 - Camshaft adjuster

- With solenoid valve for camshaft adjustment -N205-
- Checking ⇒ Page 15-92
- Hold in position with retainer for chain tensioner 3366 before removing
- Removing and installing ⇒ Page 15-62
- Seal sides of joints between camshaft adjuster and cylinder head ⇒ Fig. ⇒ 4 , ⇒ Page 15-8

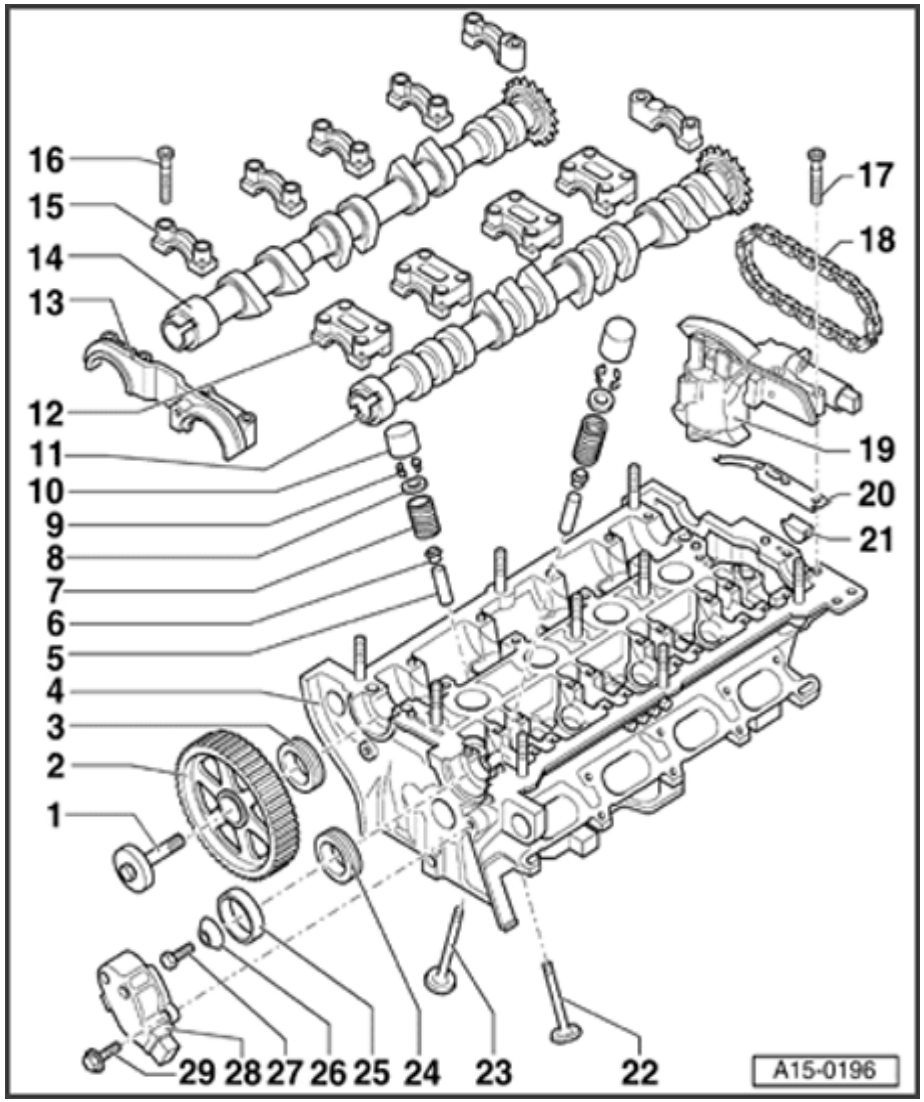
20 - Metal/rubber gasket

- Before installation coat sealing surface lightly with AMV 188 001 02 ⇒ Page 15-67

21 - Gasket

- Always replace

cardiagn.com



22 - Exhaust valve

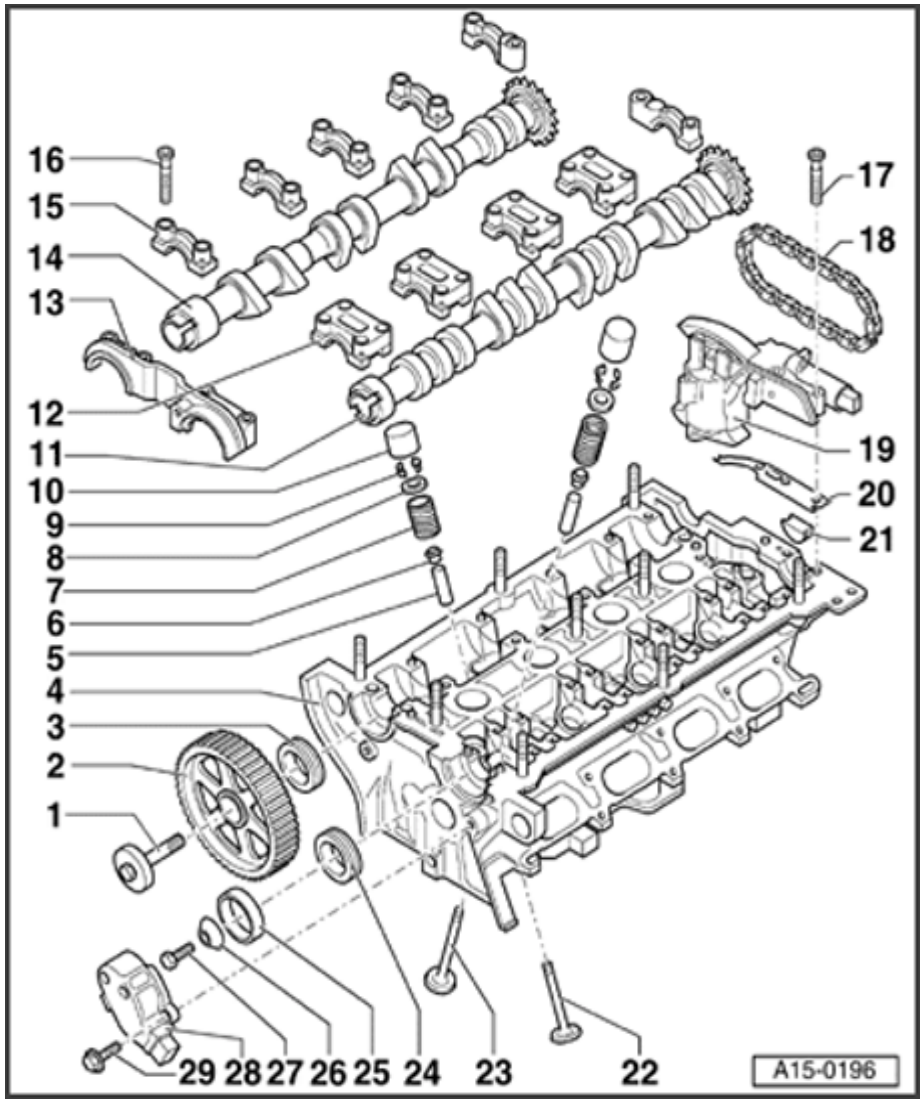
- With sodium filling
- Note instructions on scrapping valves with a sodium filling ⇒ Page 15-47
- Do not rework, only lapping in is permitted
- Valve dimensions⇒Fig. ⇒ 1 , ⇒ Page 15-47
- Checking valve guides ⇒ Page 15-86
- Reworking valve seats ⇒ Page 15-88

23 - Intake valve

- Do not rework, only lapping in is permitted
- Valve dimensions⇒Fig. ⇒ 1 , ⇒ Page 15-47
- Checking valve guides ⇒ Page 15-86
- Reworking valve seats ⇒ Page 15-88

cardiagn.com

15-46



24 - Sealing ring

- For intake camshaft
- Replacing ⇒ Page 15-57

25 - Rotor for Camshaft Position sensor

- Note correct installation position: Insert tab in notch of camshaft

26 - Washer

- With cone
- Note installation position

27 - 25 Nm

28 - Housing for Camshaft Position sensor - G40-

29 - 10 Nm

cardiagn.com

15-47

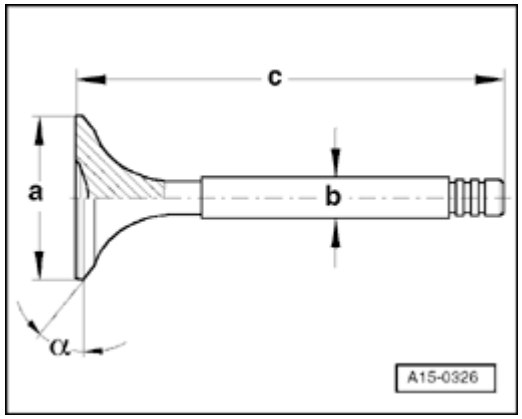


Fig. 1 Valve dimensions

Note:

Intake and exhaust valves must not be reworked. Only lapping in is permitted.

Dimension		Intake valve	Exhaust valve
Diameter -a-	mm	26.80 to 27.00	29.80 to 30.00
Diameter -b-	mm	5.95...5.97	5.94 to 5.95
-c-	mm	104.84 to 105.34	103.64 to 104.14
α	∠ °	45	45

CAUTION!

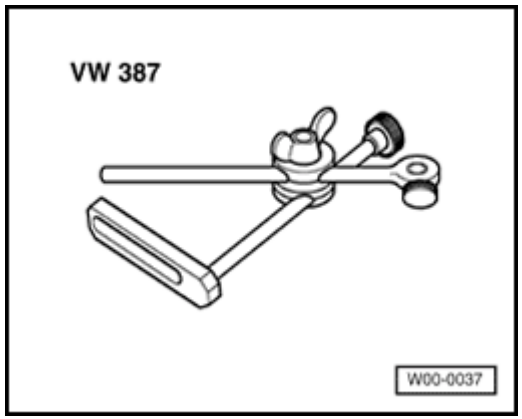
- ***Worn exhaust valves with sodium filling must not be disposed of until they have been treated as follows:***
- ***The valves must be sawn into two sections with a metal saw at a point between the center of the shaft and the valve head. They must not come into contact with water while this is done.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

cardiagn.com

15-48

Camshaft axial clearance, checking

Special tools and equipment



- Universal dial indicator bracket VW 387
- Dial indicator

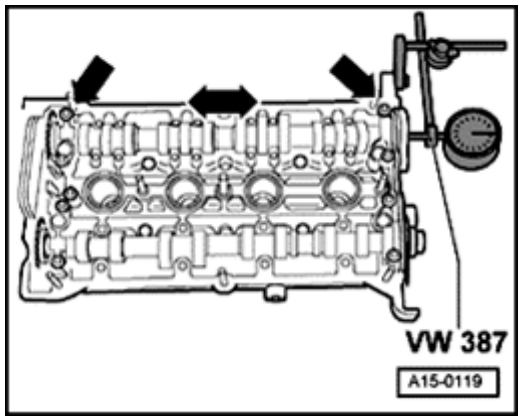
cardiagn.com

15-49

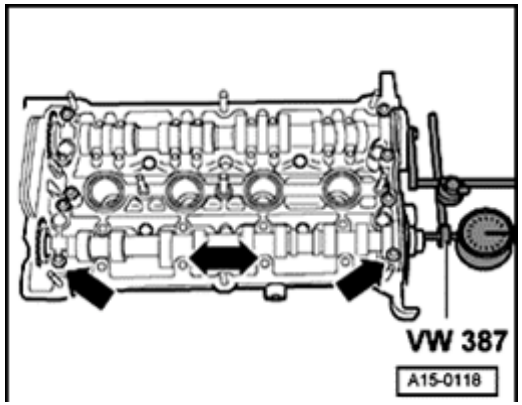
Test sequence

Perform measurement with hydraulic lifters removed and with bearing cap at chain sprocket end and double bearing cap at camshaft sprocket end installed.

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



➢ Intake camshaft



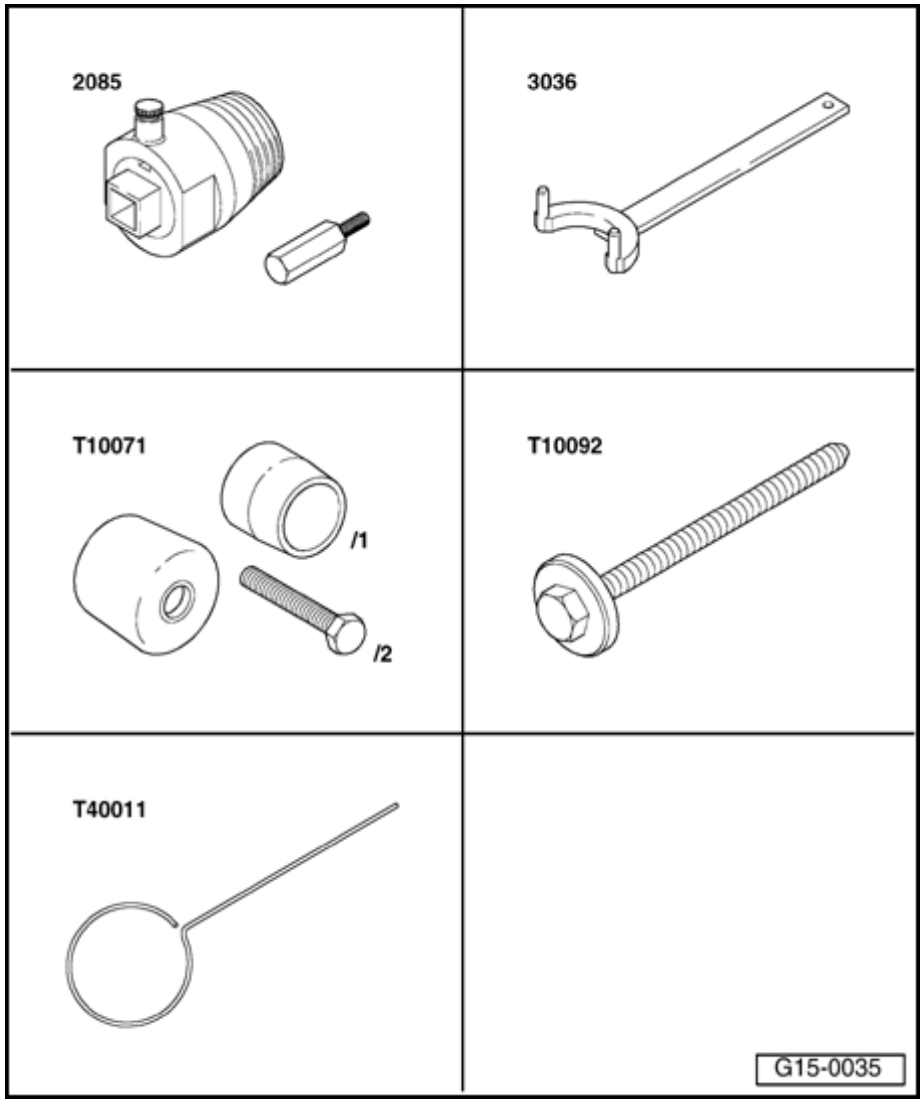
➢ Exhaust camshaft

Wear limit for intake and exhaust camshafts.

- Axial clearance: no more than 0.20 mm

cardiagn.com

15-50



Exhaust camshaft oil seal, replacing

Special tools and equipment

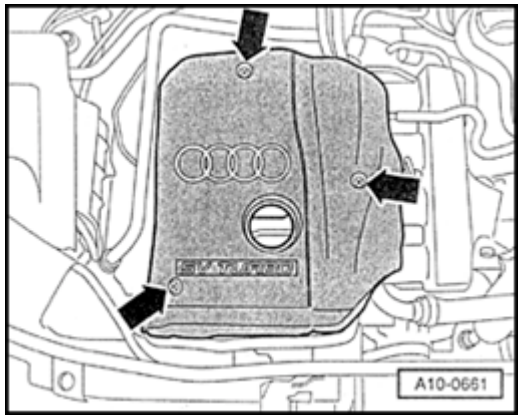
- Oil seal extractor 2085
- Holding tool 3036
- Assembly tool T10071
- Socket head fastener T10092
- Pin T40011

cardiagn.com

15-51

Removing

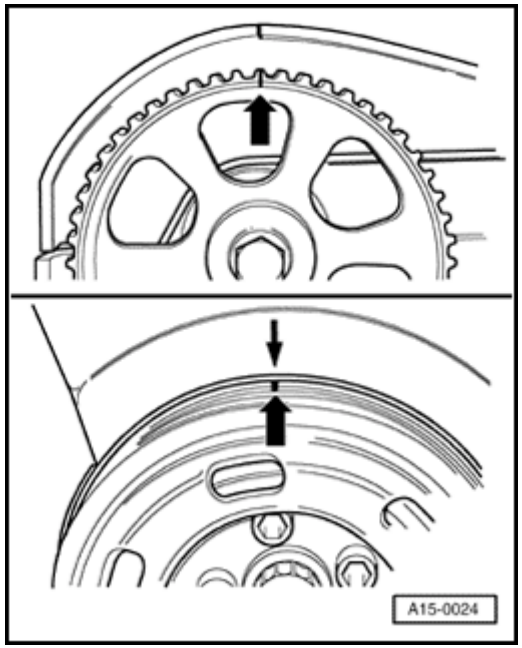
- Cylinder head installed
- Lock carrier must be in service position ⇒ Page 13-1 .



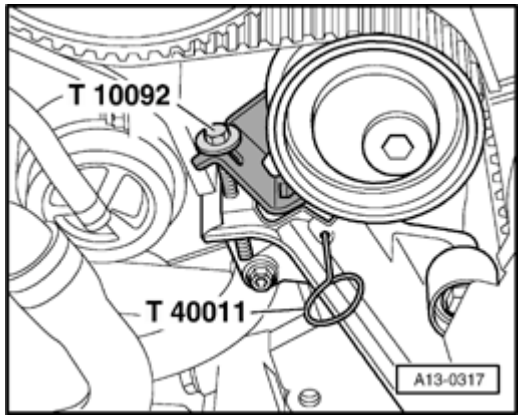
- Remove engine cover -arrows-.
- Remove upper toothed belt guard ⇒ Page 13-35 .

cardiagn.com

15-52



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



- Attach socket head fastener T10092 into tensioner for toothed belt.

Note:

Only tension piston of tensioner until pressure piston is secured with pin T40011.

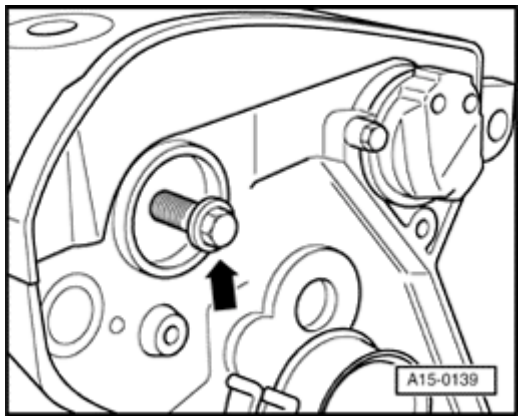
- Take toothed belt off camshaft sprocket.

cardiagn.com

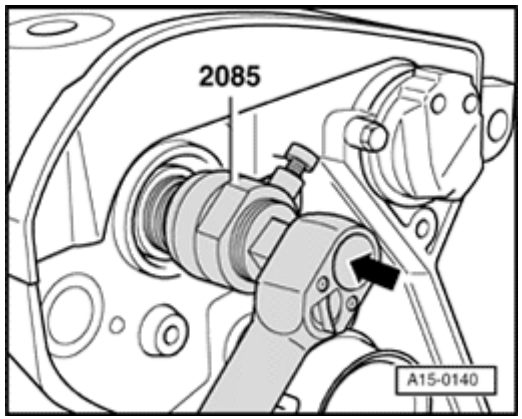
15-53

- Loosen camshaft sprocket (counter hold with 3036).

- Remove camshaft sprocket.



- To guide oil seal extractor, thread securing bolt for camshaft sprocket - arrow- into camshaft as far as it will go by hand.
- Adjust inner part of oil seal extractor 2085 two turns (approx. 3 mm) from outer part and lock in position with knurled screw.



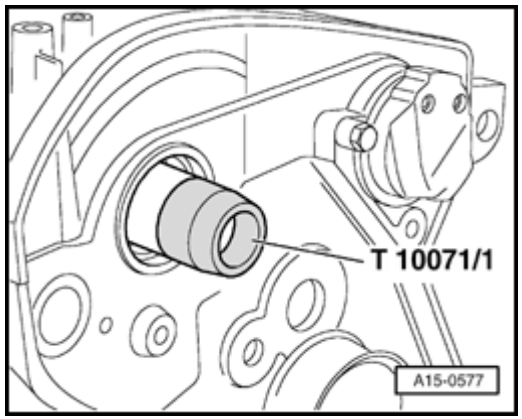
- Lubricate threaded head of oil seal extractor 2085, place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.
- Clamp flats of oil seal extractor in vice. Remove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

cardiagn.com

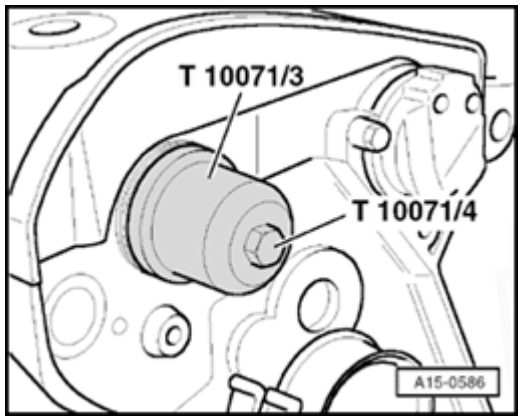
Installing

Note:

Do not oil sealing lip of oil seal.



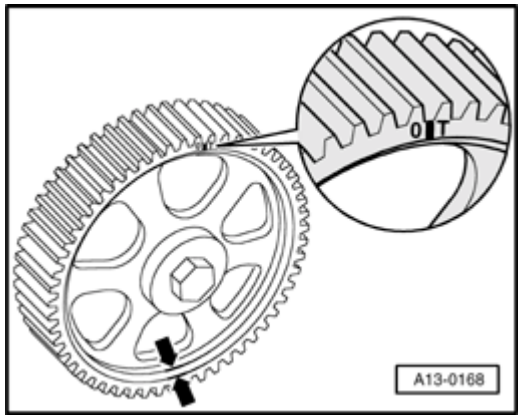
- Place guide sleeve T10071/1 onto crankshaft journal.
- Push sealing ring via guide sleeve onto shaft journal.
- Remove guide sleeve.



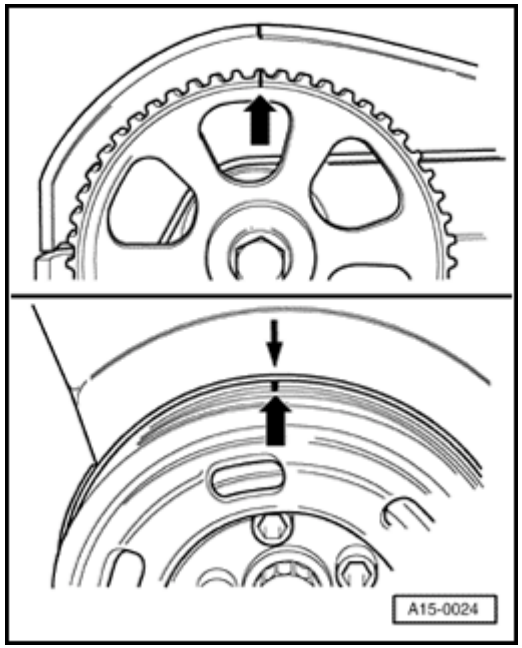
- Press in sealing ring with pressure sleeve T10071/3 and bolt T10071/4.

cardiagn.com

15-55



- Install camshaft sprocket.
  - Note correct installation position: Narrow web of camshaft sprocket faces outward -arrows- and marking for No. 1 is visible from front.
- Install securing bolt for camshaft sprocket (use counter hold tool 3036).



- Align markings on camshaft sprocket with marking on cylinder head cover.
- Align marking on vibration damper with marking on lower part of toothed belt guard.

Note:

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

cardiagn.com

- Install toothed belt (adjust valve timing) ⇒ Page 13-44 .

Note:

Observe all instructions on removing and installing the toothed belt ⇒ Page 13-40 .

Tightening torque

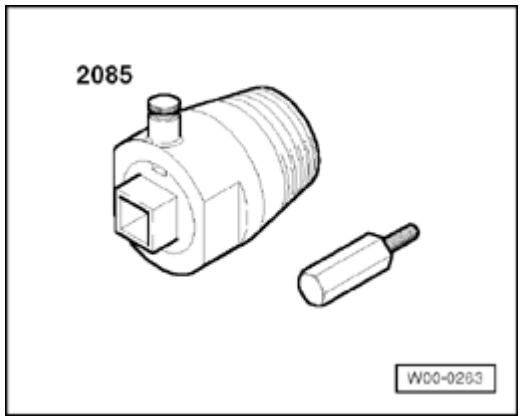
Component	Nm
Camshaft sprocket to camshaft	65

cardiagn.com

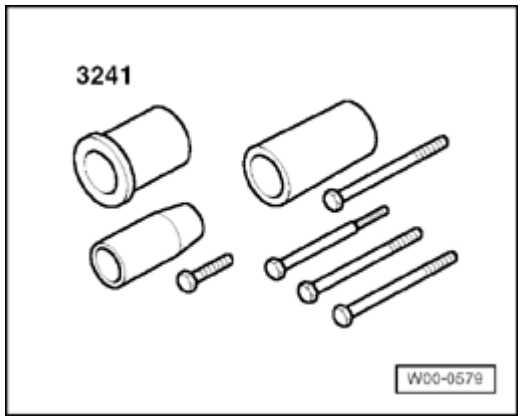
15-57

Intake camshaft seal, replacing

Special tools and equipment



- Oil seal extractor 2085



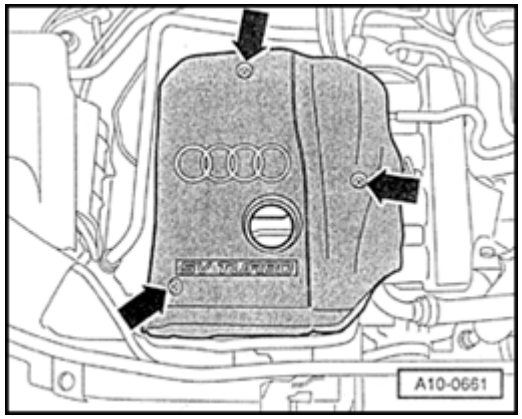
- Installation tool 3241

cardiagn.com

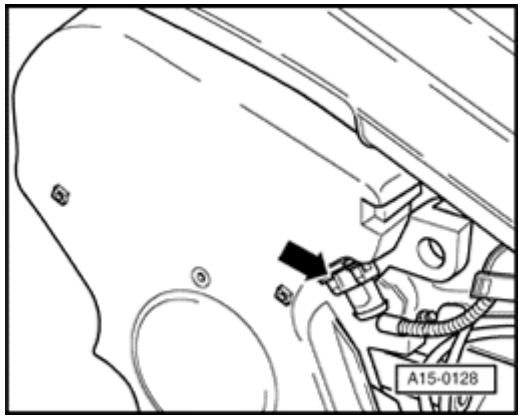
15-58

Removing

- Cylinder head installed
- Lock carrier must be in service position ⇒ Page 13-1 .



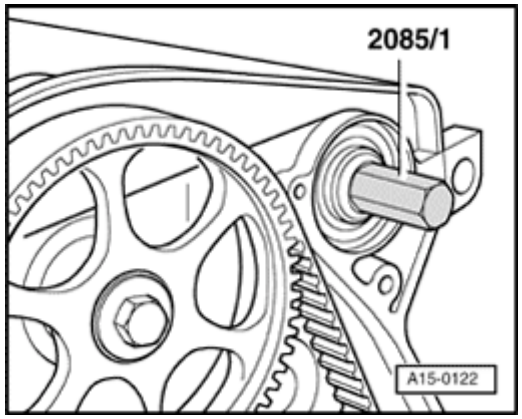
- Remove engine cover -arrows-.
- Remove upper toothed belt guard ⇒ Page 13-35 .



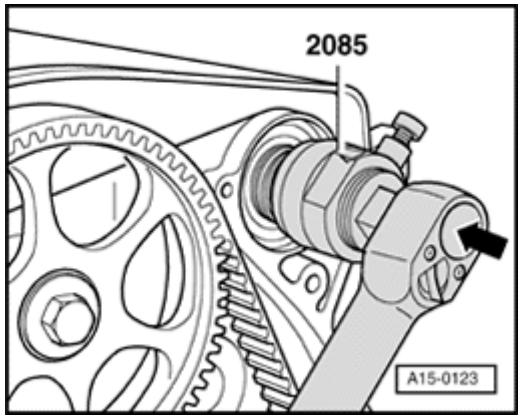
- Disconnect connector from camshaft position sensor -arrow-.
- Remove sensor housing.
- Remove sensor rotor and washer.

cardiagn.com

15-59



- Insert camshaft sprocket bolt 2085/1 by hand into camshaft as far as it will go.
- Adjust inner part of oil seal extractor 2085 two turns (approx. 3 mm) from outer part and lock in position with knurled screw.



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

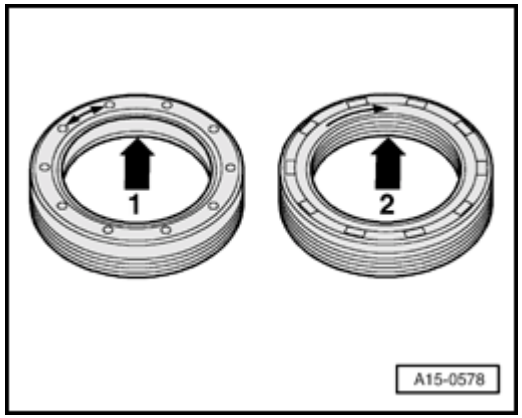
cardiagn.com

15-60

Installing

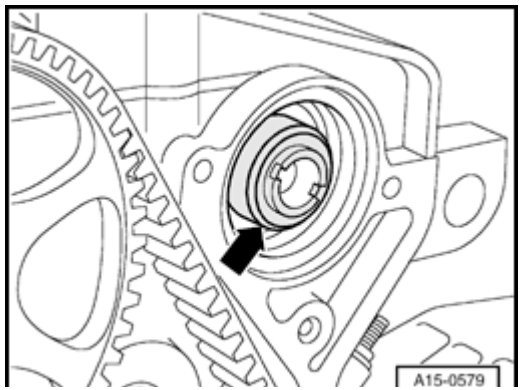
Note:

- *Production variations may have the shaft sealing rings with ring spring or PTFE sealing rings used at the intake camshaft.*



- *Difference: The regular shaft sealing ring has only one sealing lip - arrow 1- which is tensioned by a spring. The PTFE sealing ring has a thread-like sealing area -arrow 2- but no spring.*
- *When installing, the sealing surface of the PTFE sealing ring must not be stretched. For this reason it is not permitted to install the PTFE sealing ring together with the guide sleeve for sealing rings with spring.*
- *The PTFE sealing rings must be aligned to the rotation direction of the shaft (see arrow marking on sealing ring). The wrong rotation direction causes oil leakage.*

Installing PTFE sealing ring:



- Check edge of chamfer -arrow- on shaft end of intake camshaft for burrs or sharp edges. If necessary, smooth edge with an oil stone.

Note:

Do not oil sealing lip of oil seal.

- Push PTFE sealing ring carefully onto shaft end by hand.

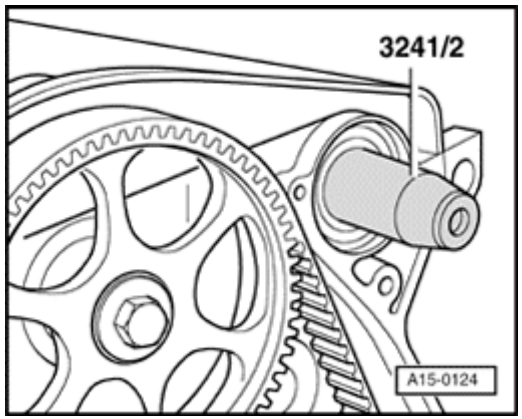
cardiagn.com

15-61

Installing sealing ring with spring:

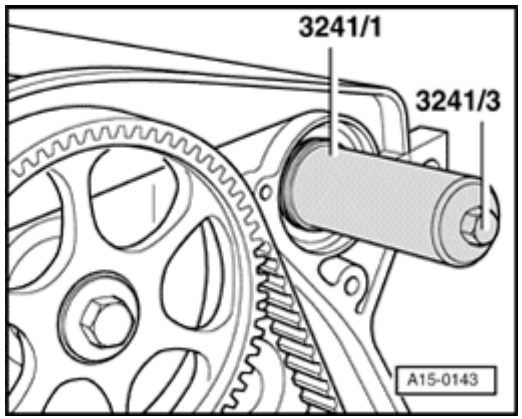
Note:

Do not oil sealing lip of oil seal.



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

All models:



- Press in sealing ring with pressure sleeve 3241/1 as far as it will go. To do this use bolt 3241/3.
- Install camshaft position sensor ⇒ Page 15-46 .
- Install toothed belt guard (upper section).
- Install lock carrier ⇒ Page 13-1 .

Tightening torques

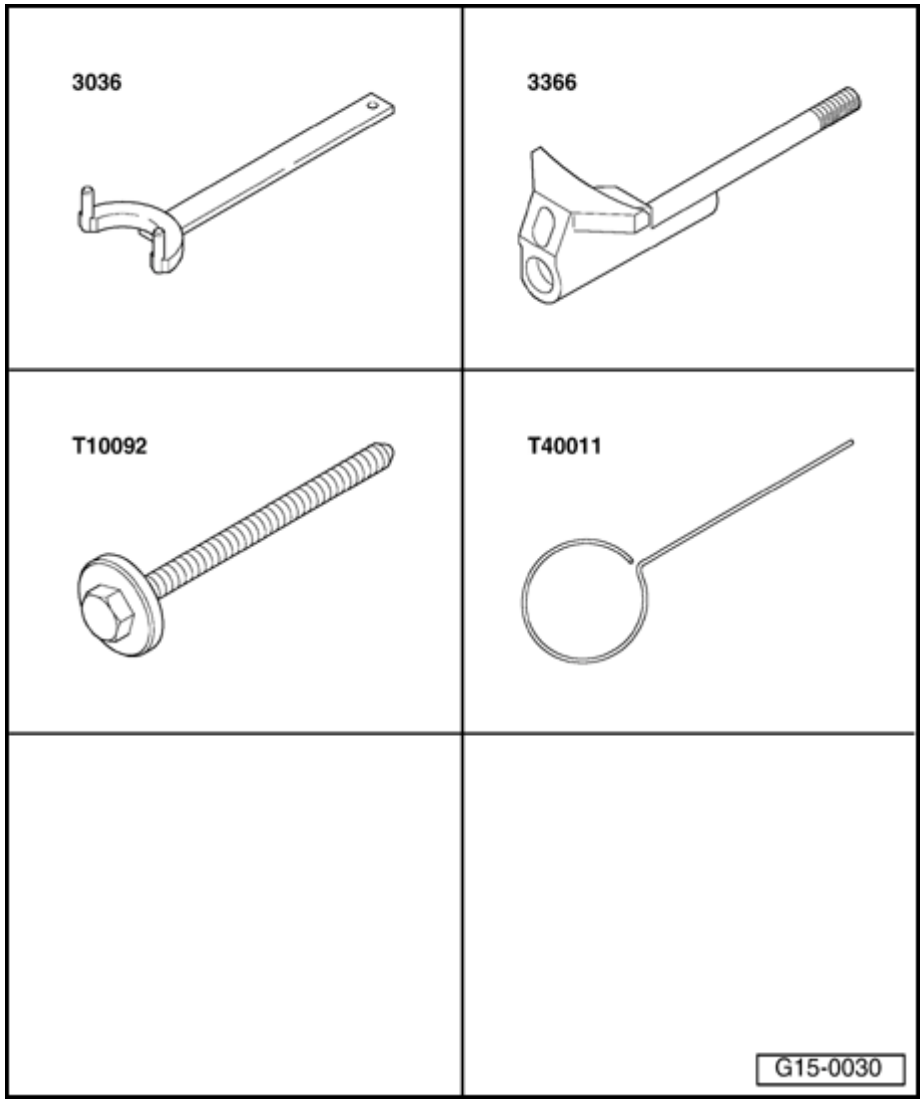
Component	Nm
Camshaft position sensor rotor to camshaft	25

cardiagn.com

Camshaft position sensor housing to cylinder head	10

cardiagn.com

15-62



Camshafts and camshaft adjuster, removing and installing

Special tools and equipment

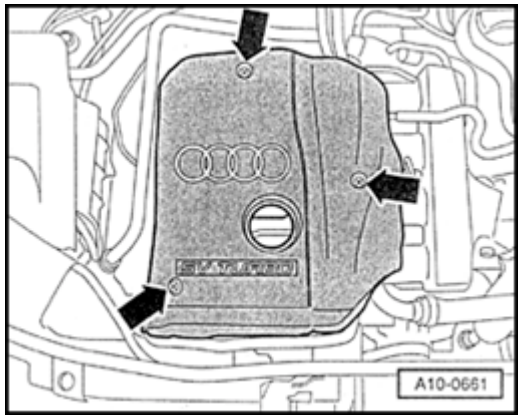
- Holding tool 3036
- Retainer for chain tensioner 3366
- Tensioning screw T10092
- Guide pin T40011

cardiagn.com

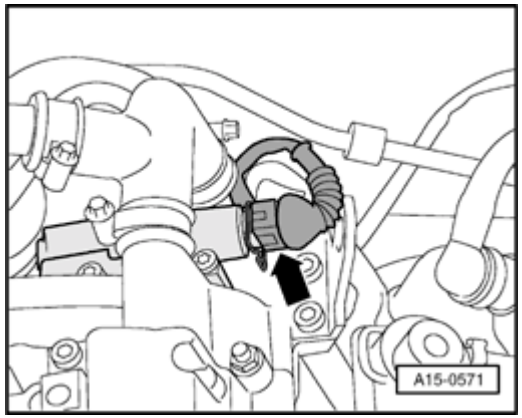
15-63

Removing

- Cylinder head installed
- Lock carrier must be in service position ⇒ Page 13-1 .



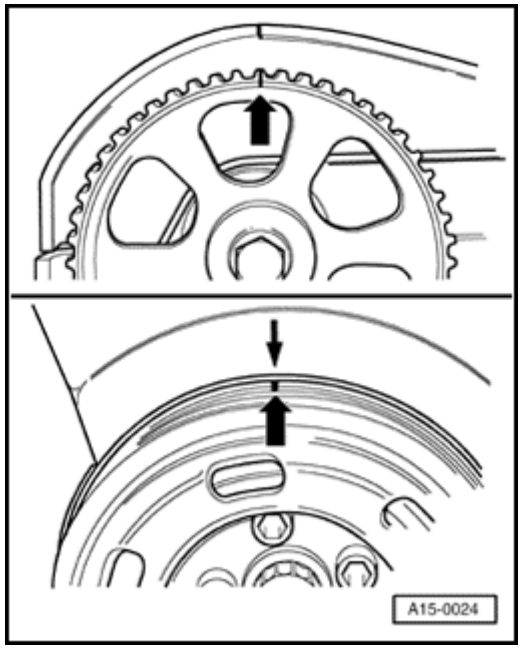
- Remove engine cover -arrows-.
- Remove combination valve for secondary air inlet ⇒ Page 26-64 .



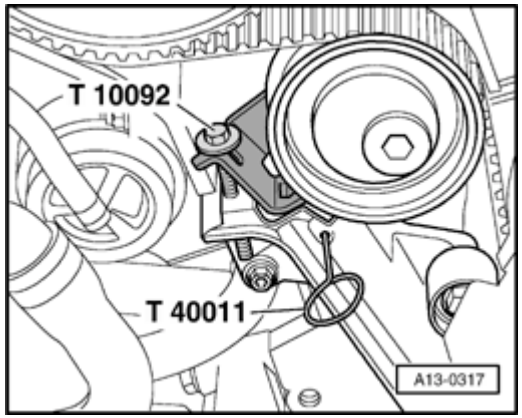
- Disconnect connector -arrow- from camshaft adjuster.
- Remove upper toothed belt guard ⇒ Page 13-35 .

cardiagn.com

15-64



- Set crankshaft to markings for TDC of No. 1 cylinder by turning central bolt on crankshaft sprocket in direction of rotation -arrows-.
- Remove cylinder head cover ⇒ Page 15-15 .



- Thread socket head fastener T10092 into tensioner for toothed belt.
- Tension pressure piston of tensioner until piston is secured with pin T40011.
- Remove toothed belt from camshaft sprocket.

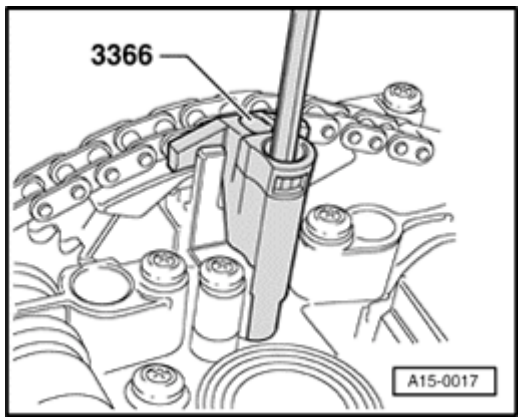
cardiagn.com

15-65

- Loosen camshaft sprocket (counter hold with 3036).

- Remove camshaft sprocket.

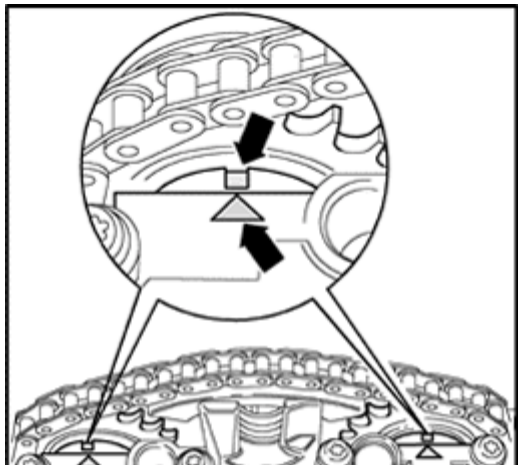
- Remove camshaft position sensor completely.



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

Note:

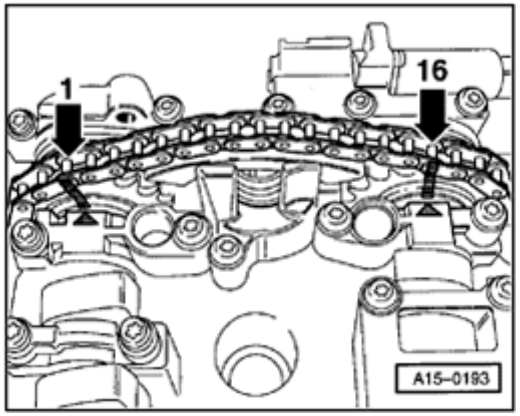
If the retainer for chain tensioner is tightened excessively, this can damage the camshaft adjuster.



- Re-check TDC position of camshafts.
  - Marks on two camshafts must be in line with arrows on bearing caps.

cardiagn.com

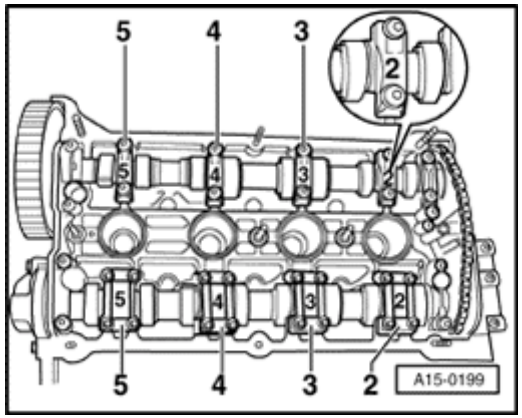
- Clean chain and camshaft sprockets opposite two arrows on bearing caps and mark installation position with color marks.



- Distance between two arrows or color markings are 16 rollers on drive chain.
- Notch on exhaust camshaft is offset slightly toward inside in relation to chain roller -1-.

Note:

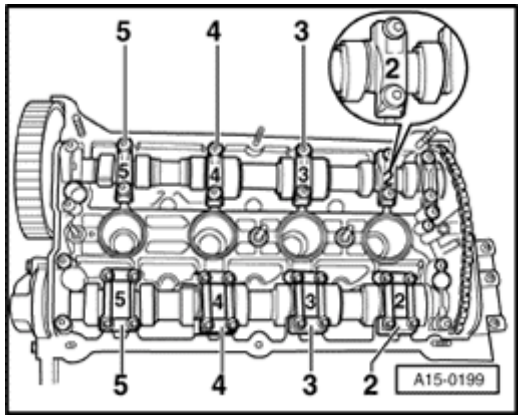
Do not mark chain with a center punch or by making a notch or similar marking.



- Remove bearing caps 3 and 5 on intake and exhaust camshafts.
- Remove double bearing cap.
- Remove both bearing caps next to intake and exhaust camshaft chain sprockets.
- Remove securing bolts for camshaft adjuster.

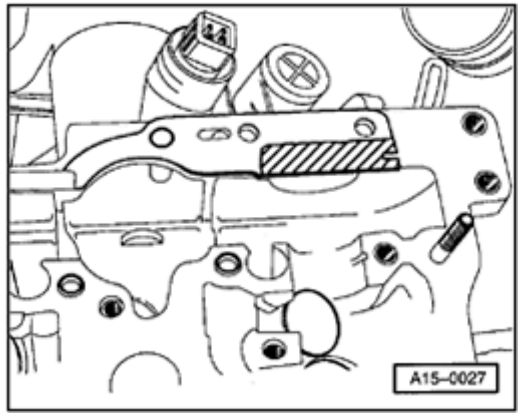
cardiagn.com

15-67



- Loosen bearing caps 2 and 4 of intake and exhaust camshafts alternately and diagonally, and remove.
- Remove intake and exhaust camshafts with camshaft adjuster.

Installing

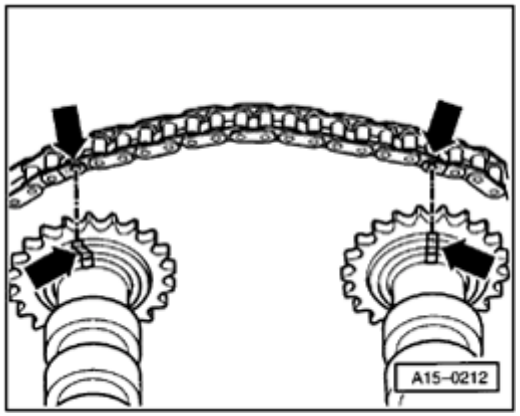


- Replace rubber/metal gasket for hydraulic chain tensioner and apply a thin coat of sealant AMV 188 001 02 to shaded area.

cardiagn.com

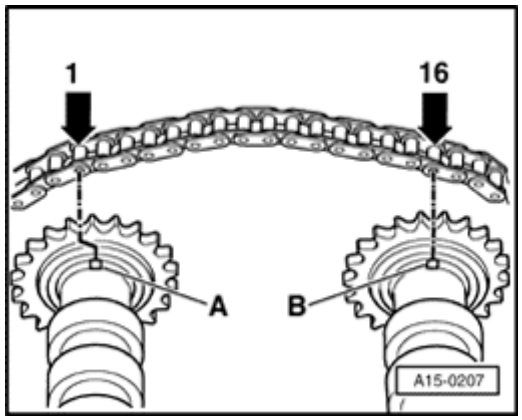
15-68

- Install drive chain on camshaft sprockets as follows:



➢

- When old chain is being re-installed, install so that colored markings are in line -arrows-.



➢

- When a new chain is being installed, distance between notches -A- and -B- on camshafts must be 16 rollers on chain. The illustration shows exact positions of 1st and 16th rollers on sprockets.
- Notch -A- is offset slightly toward inside in relation to chain roller -1-.

- Push camshaft adjuster between drive chain (2nd mechanic required).

cardiagn.com

15-69

- Position camshafts together with drive chain and camshaft adjuster on cylinder head.

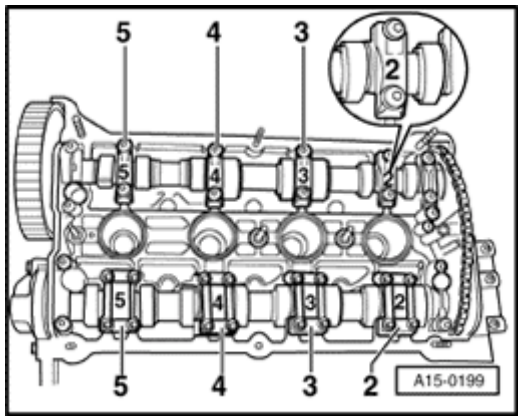
- Oil running surfaces of both camshafts.

Note:

- *Dowel sleeves for bearing caps and camshaft adjuster must be located in cylinder head.*

- *When installing bearing caps ensure that the identification mark is readable from the intake side of the cylinder head.*

- Tighten mountings of camshaft adjuster (watch position of dowel sleeves).

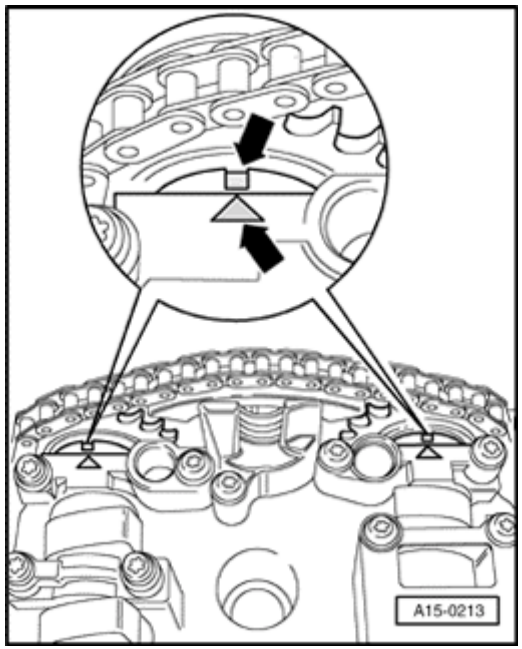


- Tighten bearing caps 2 and 4 of intake and exhaust camshafts in stages and in diagonal sequence (watch position of dowel sleeves).
- Install two bearing caps next to chain sprockets on intake and exhaust camshafts.

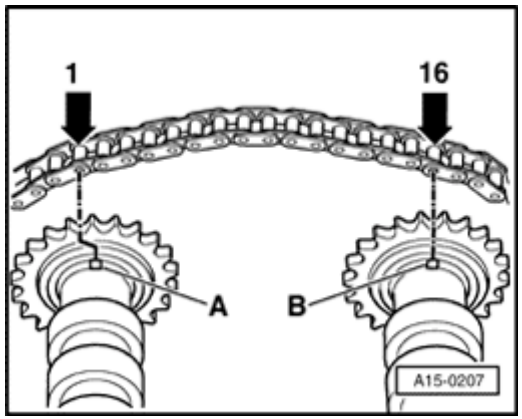
cardiagn.com

15-70

- Check correct setting of camshafts:



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

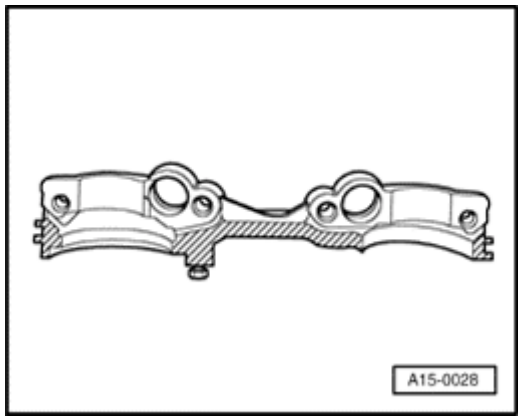


- Distance between two arrows on bearing caps or color markings are 16 rollers on drive chain.
- Notch on exhaust camshaft is offset slightly toward inside in relation to chain roller -1-.

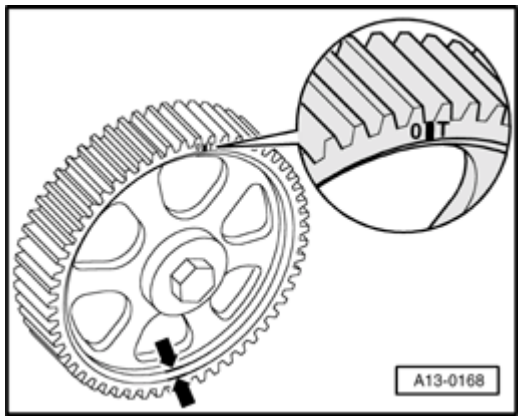
cardiagn.com

15-71

- Remove holder for chain tensioner 3366.



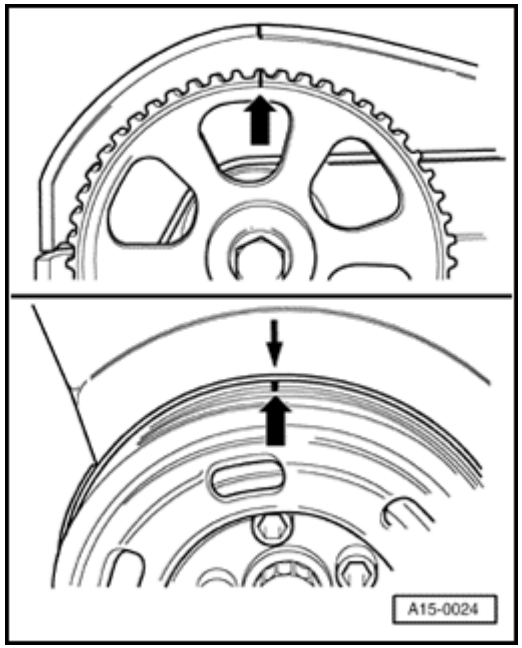
- Slightly coat shaded area of dual bearing cap with sealant AMV 188 001 02 and install bearing cap (observe position dowel sleeves).
- Install remaining bearing caps (watch position of dowel sleeves).
- Replace sealing rings for intake and exhaust camshafts ⇒ as of ⇒ Page 15-50 .



- Install camshaft sprocket.
  - ♦ Note correct installation position: Narrow web of camshaft sprocket faces outward -arrows- and marking for No. 1 is visible from front.
- Install securing bolt for camshaft sprocket (use counter hold tool 3036).
- Install camshaft position sensor ⇒ Page 15-46 .
- Install cylinder head cover ⇒ Page 15-18 .

cardiagn.com

15-72



- Align markings on camshaft sprocket with marking on cylinder head cover.
- Align marking on vibration damper with marking on lower part of toothed belt guard.

Note:

When turning the camshaft the crankshaft must not be at TDC. There is a danger of damage to the valves/piston crown.

- Install toothed belt (adjust valve timing) ⇒ Page 13-44 .

Note:

- *Observe all instructions on removing and installing the toothed belt ⇒ Page 13-40 .*
- *Wait about 30 minutes after installing the camshafts before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*
- *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

cardiagn.com

Tightening torques

Component	Nm
Bearing cap to cylinder head	10
Camshaft adjuster to cylinder head	10
Camshaft position sensor rotor to camshaft	25
Camshaft position sensor housing to cylinder head	10
Camshaft sprocket to camshaft	65

cardiagn.com

Hydraulic valve lifters, checking

Special tools and equipment

- Feeler gauge
- Wood or plastic wedge

Note:

- *Hydraulic valve lifters cannot be adjusted or repaired.*
- *Irregular valve noise during starting is normal.*

Test sequence

- Start engine and let run until coolant temperature has reached approx. 80 ° C.
- Increase engine speed to about 2500 rpm for 2 minutes (perform road test if necessary).

Note:

If the irregular valve noises stop but recur repeatedly during short journeys, a new oil retention valve must be fitted. Oil retention valve location: In oil filter bracket ⇒ -Item 6 -, ⇒ Page

cardiagn.com

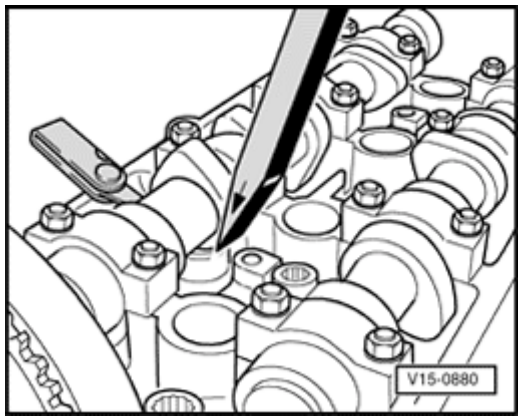
17-7 .

cardiagn.com

15-75

If the hydraulic lifters are still noisy, locate faulty lifters as follows:

- Remove cylinder head cover ⇒ Page 15-15 .
- Rotate crankshaft until cams of lifters to be checked are pointing upward:
  - Vehicles with manual gearbox: push vehicle forward with 4th gear engaged and ignition switched off.
  - Vehicles with automatic gearbox: remove sound insulation and turn crankshaft clockwise by applying wrench to central bolt on crankshaft sprocket.
- Determine play between cam and lifter.



- Press down lifter with a wooden or plastic wedge. If an 0.20 mm feeler gauge can be inserted between camshaft and lifter, replace lifter.
- Replacing lifter ⇒ Removing and installing camshafts and camshaft adjuster, ⇒ Page 15-62 .

cardiagn.com

15-76

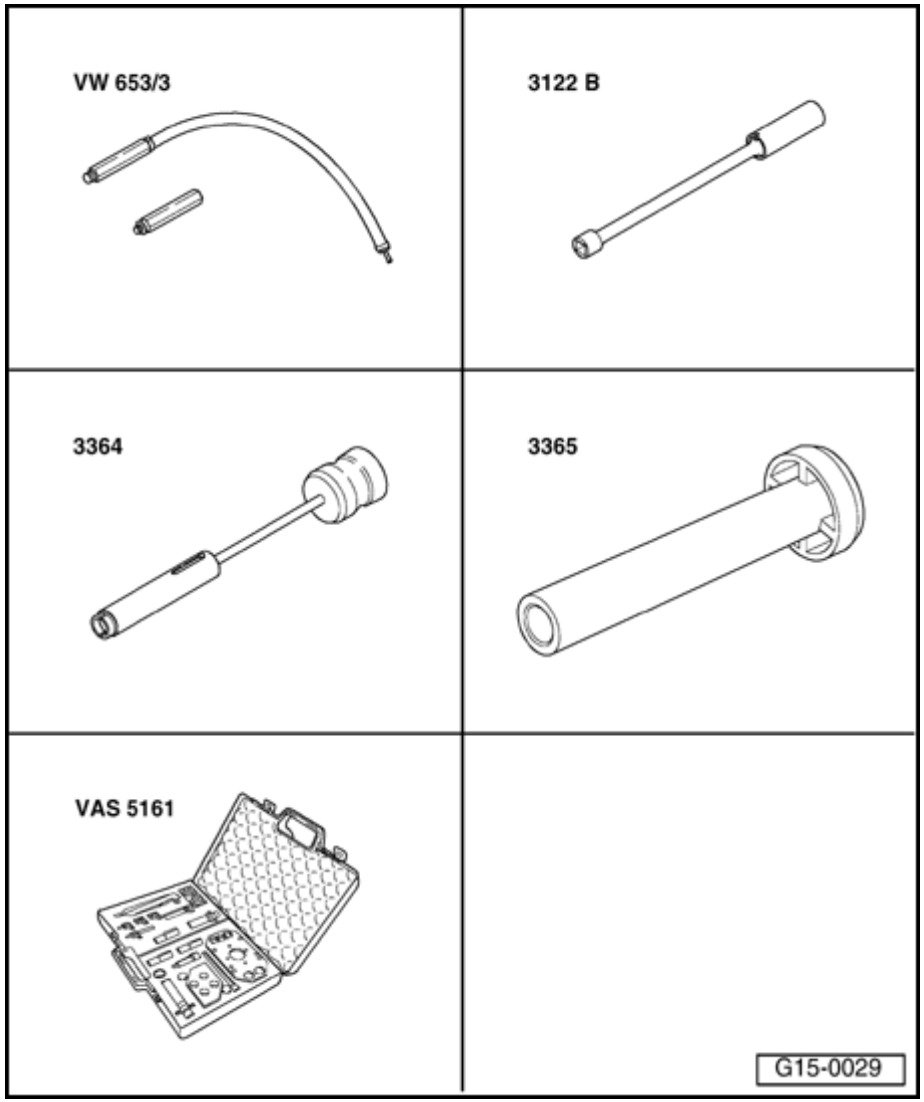
Note:

- *Wait about 30 minutes after installing the camshafts before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*

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

cardiagn.com

15-77



Valve stem seals, replacing

Special tools and equipment

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

cardiagn.com

Removing

- Cylinder head in vehicle.

- Remove camshafts and camshaft adjuster ⇒ Page 15-62 .

Note:

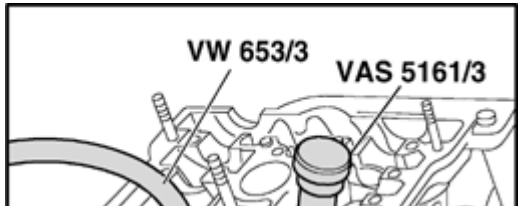
- *Ensure that the valve lifters are not interchanged.*

- *Mark position of valve lifters on rear of lifter with a waterproof felt-tip pen.*

- Remove lifters from guides and put them down with contact surface downward.

- Remove spark plugs with spark plug spanner 3122B.

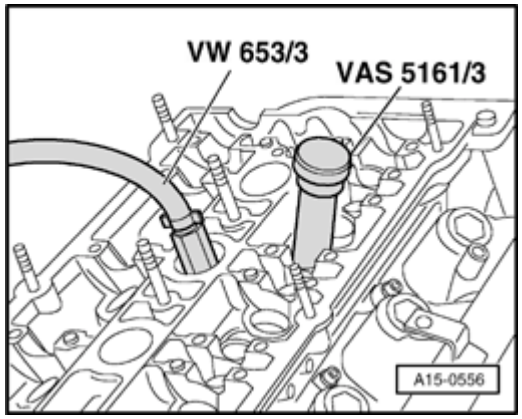
- Set piston of appropriate cylinder to bottom dead center.



- Thread pressure hose VW 653/3 into spark plug threaded hole and apply constant pressure of at least 6 bar.

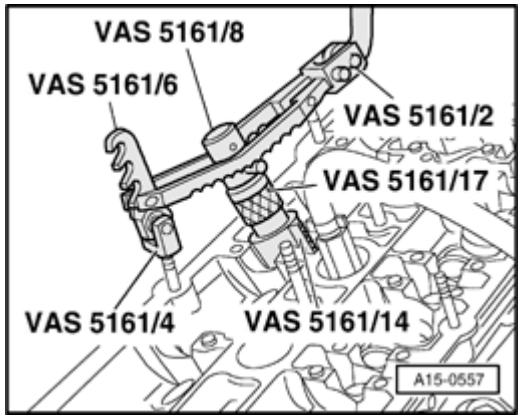
cardiagn.com

15-79



- Install knock journal VAS 5161/3 into valve lifter guide.
- Loosen solid valve keepers on all five valves with a plastic hammer.

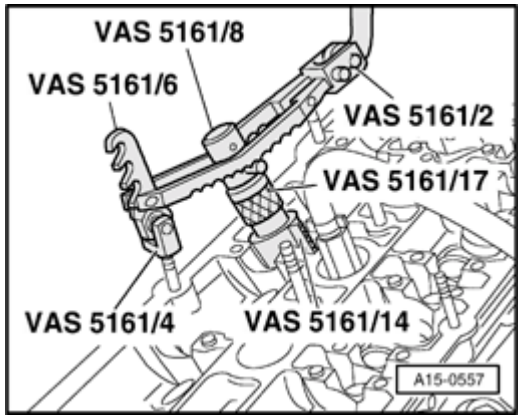
Exhaust side



- Thread catch part VAS 5161/6 with insertion fork VAS 5161/4 onto a stud of cylinder head.
- Push guide bushing VAS 5161/14 as far as it will go into lifter guide at valve to be removed.
  - Installation position: Shaded areas point across to driving direction.
- Push knurled distance ring VAS 5161/17 onto assembly cartridge VAS 5161/8.

cardiagn.com

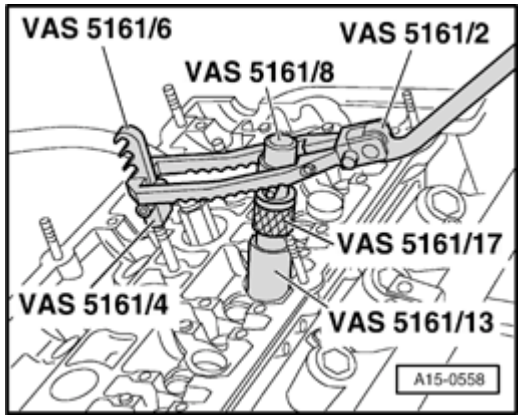
15-80



- Push assembly cartridge into guide sleeve.
- Attach pressure fork VAS 5161/2 to catch part VAS 5161/6 and press assembly cartridge downward.
- At same time turn knurled screw of assembly cartridge toward right until tips engage in valve keepers.
- Slightly move knurled screw back and forth. This causes valve keepers to be pressed apart and taken into cartridge.
- Release pressure fork.
- Remove assembly cartridge with spacer ring, guide bushing, valve plate and valve spring.

cardiagn.com

15-81

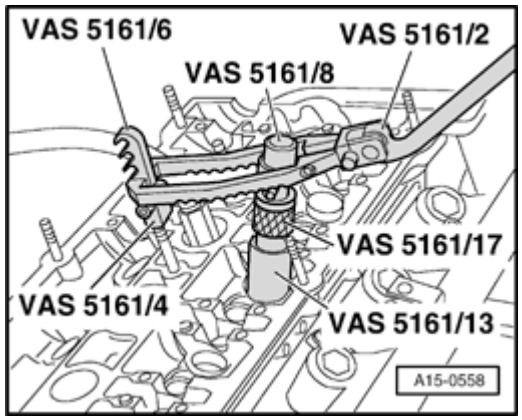


Intake side:

- Thread catch part VAS 5161/6 with insertion fork VAS 5161/4 onto a stud of cylinder head.
- Push in guide bush VAS 5161/13 as far as it will go into lifter guide at valve to be removed.
  - ♦ Installation position: Shaded areas point across to driving direction.
- Push distance ring VAS 5161/17 onto assembly cartridge VAS 5161/8.
- Push assembly cartridge into guide sleeve.
- Attach pressure fork VAS 5161/2 to catch part VAS 5161/6 and press assembly cartridge downward.
- At same time turn knurled screw of assembly cartridge towards right until the tips engage in valve keepers.
- Slightly move knurled screw back and forth. This causes valve keepers to be pressed apart and taken into cartridge.

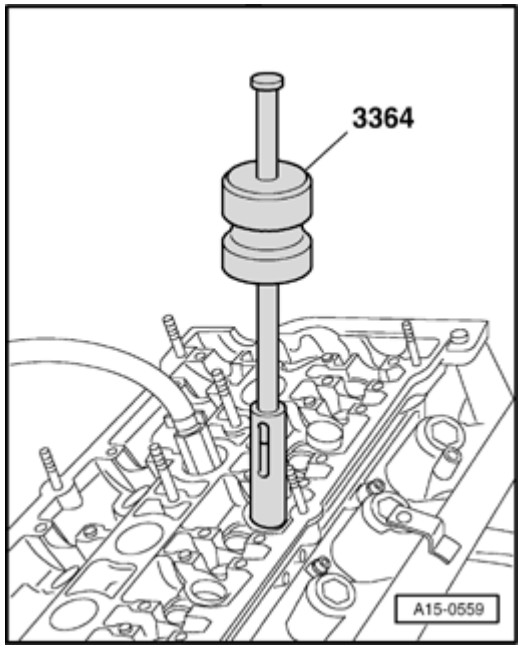
cardiagn.com

15-82



- Release pressure fork.
- Remove cartridge with spacer ring, guide bushing, valve plate and valve spring.

All models:



- Use 3364 to pull off valve stem seals.

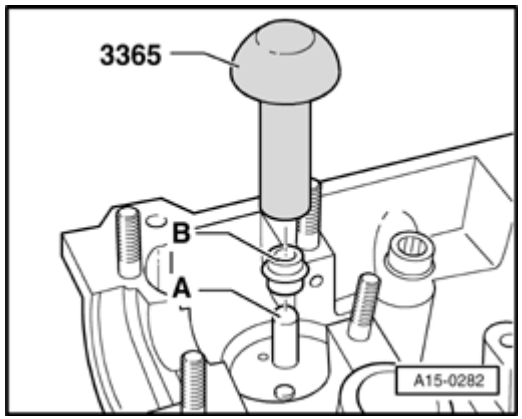
cardiagn.com

15-83

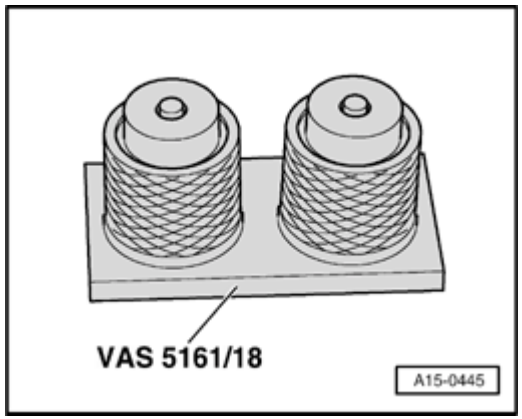
Installing

Note:

A plastic sleeve -A- is enclosed with new valve shaft seals.



- To prevent damage to new valve stem seals -B-, place plastic sleeve -A- on valve stem.
- Lightly oil sealing lip of valve stem seal.
- Push valve stem seal onto plastic sleeve.
- Carefully press valve stem seal onto valve guide using presser tool 3365.
- Remove plastic sleeve again.



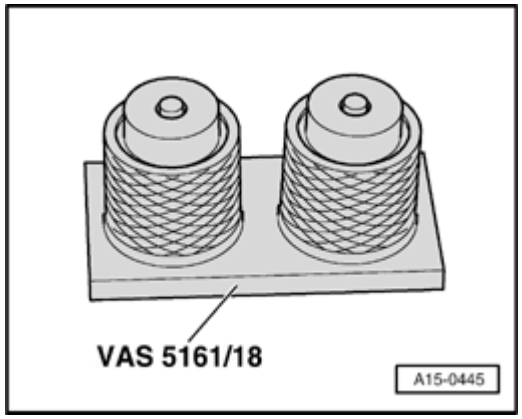
- If valve keepers were taken out of assembly cartridge they must first be inserted into tool VAS 5161/18.

Note:

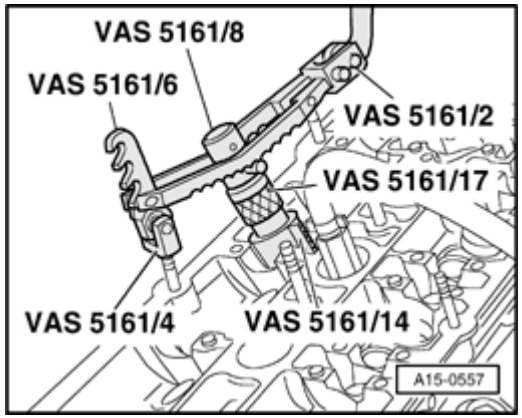
The large diameter of the valve keepers points upward.

cardiagn.com

15-84



- Press assembly cartridge VAS 5161/8 onto insert tool from top and take up valve keepers.



- Insert assembly cartridge VAS 5161/8 into guide bushing VAS 5161/13 or VAS 5161/14 again.
- Push pressure fork down and pull knurled screw with left-hand and right-hand thread upward. The valve keepers are now installed.
- Take load off pressure fork when knurled screw is still pulled.
- Install valve lifters.

cardiagn.com

15-85

- Install camshafts and camshaft adjuster ⇒ Page 15-67

Note:

- *Wait about 30 minutes after installing the camshafts before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*

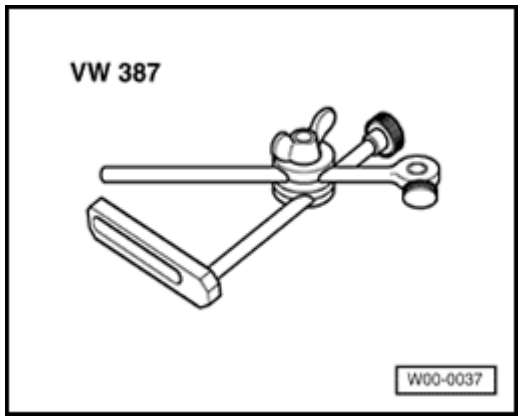
- *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

cardiagn.com

15-86

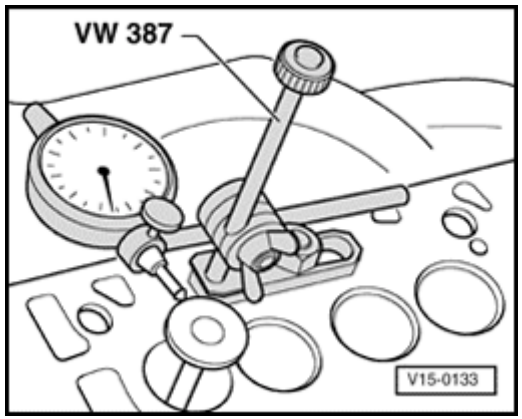
Valve guides, checking

Special tools and equipment



- Universal dial indicator bracket VW 387
- Dial indicator

Test sequence



- Set valve in guide. Valve stem end must be flush with guide.

Note:

Due to the slight difference in stem diameters, ensure that only an intake valve is used in an intake guide and an exhaust valve in an exhaust guide.

cardiagn.com

- Determine lateral play.

Wear limit

Intake valve guide	Exhaust valve guide
0.80 mm	0.80 mm

Note:

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

cardiagn.com

15-88

Valve seats, reworking

Note:

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

Special tools and equipment

- Depth gauge
- Valve seat machining tool

Note:

- *When repairing engines with leaking valves, it is not sufficient to reface the valve seats and replace the valves. The valve guides must also be checked for wear. This is particularly important on high mileage engines* ⇒ *Page 15-86* .
- *Only rework the valve seats as far as is necessary to ensure a good seating pattern.*
- *Before starting to rework the valve seats, calculate the maximum permissible reworking dimension.*

cardiagn.com

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

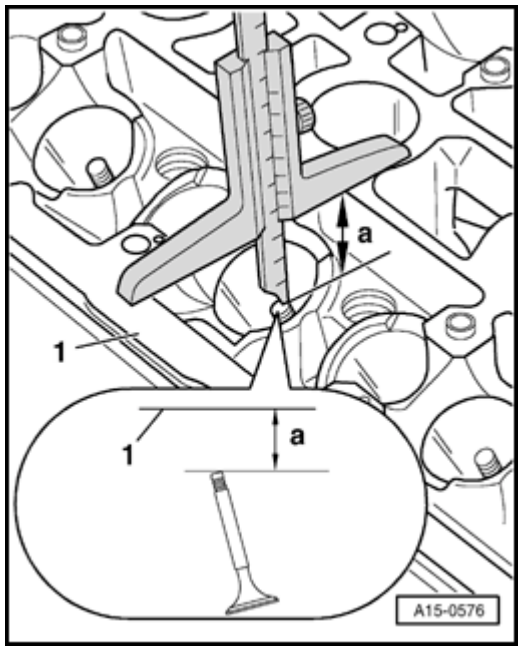
cardiagn.com

Calculating maximum permissible reworking dimension

- Insert valve and press firmly against valve seat.

Note:

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



- Measure distance -a- between valve stem end (upper edge) and upper cylinder head surface -1- with a depth gauge.
- Calculate max. permissible reworking dimension from measured distance and minimum dimension.

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

cardiagn.com

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

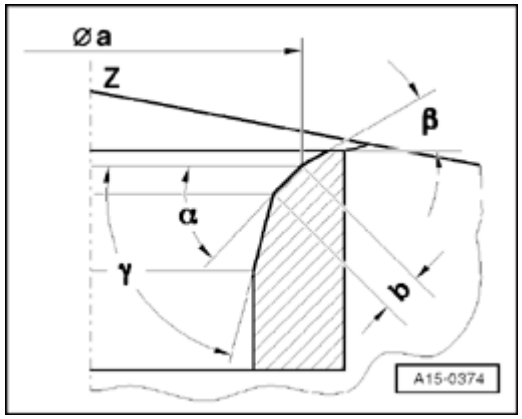
Example (for outer intake valve):		
	Measured distance	31.4 mm
-	Minimum dimension	-31.0 mm
=	max. permissible reworking dim.	= 0.4 mm

Note:

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

cardiagn.com

15-91



Rework valve seats

Dim.		Intake valve seat
Dia. a	mm	26.2
b	mm	1.5 to 1.8
Z		Lower edge of cylinder head
α	45°	Valve seat angle
β	30°	Upper correction angle
γ	60°	Lower correction angle
Dim.		**Exhaust valve seat**
Dia. a	mm	29.0
b	mm	1.8
Z		Lower edge of cylinder head
α	45°	Valve seat angle
β	30°	Upper correction angle
γ	60°	Lower correction angle

cardiagn.com

Camshaft timing control, checking

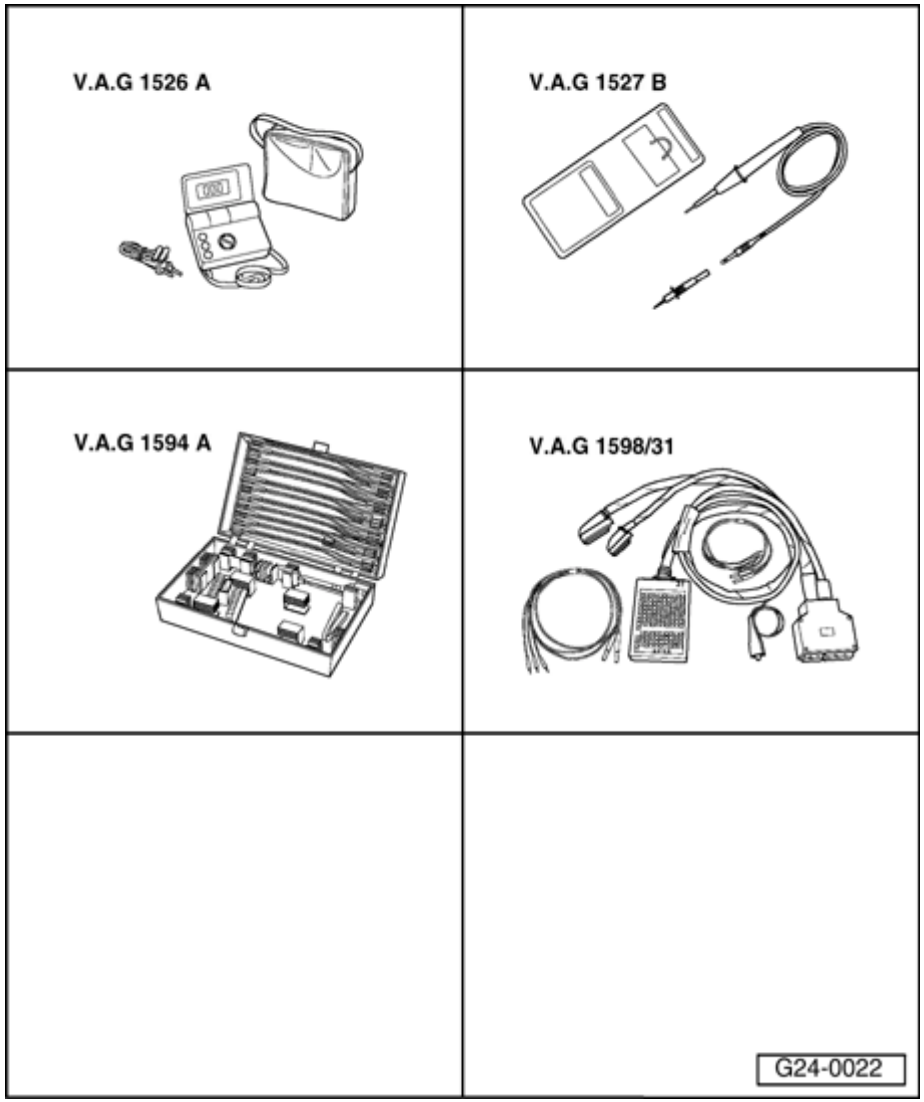
The adjustment of the intake camshaft is dependent on the engine load and engine speed. Oil pressure is applied to the camshaft adjuster (mechanical adjustment device) via the electrical solenoid valve for camshaft adjustment.

Note:

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

cardiagn.com

15-93



Camshaft adjustment solenoid valves, checking

Special tools and equipment

- VAG 1526 A
- VAG 1527 B
- VAG 1594 A
- VAG 1598/31

cardiagn.com

15-94

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551 Scan Tool connected

Test sequence

- Initiate output Diagnostic Test Mode (DTM) and activate solenoid valve for camshaft adjuster.

Output Diagnostic Test Mode →

Camshaft timing control

➢ Display

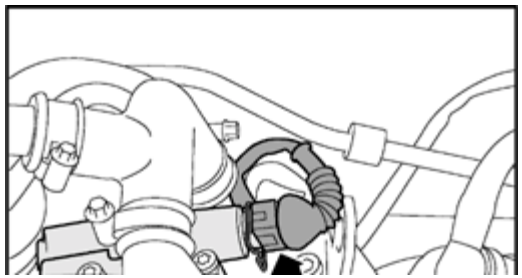
♦ This valve is actuated (clicks) for approx. one minute if the operation is not switched to the next component by pressing the → key.

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

- Check internal resistance of solenoid valve for camshaft adjuster.

Checking internal resistance

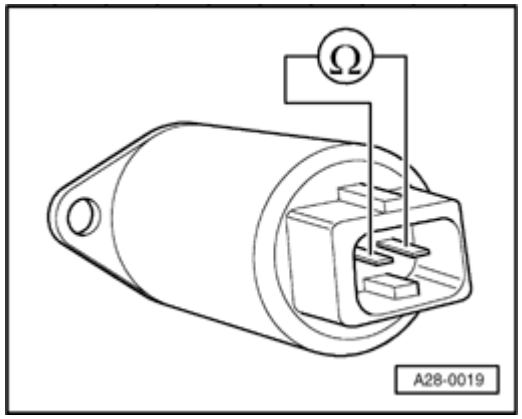
- Switch ignition off.



➢ - Disconnect connector -arrow- from camshaft adjuster.

cardiagn.com

15-95



- Connect multimeter to valve to measure resistance.
  - Specified value: 10 to 18 Ω

If specified value is not attained:

- Replace solenoid valve for camshaft adjuster.

If specified value is attained:

- Check power supply.

Checking power supply

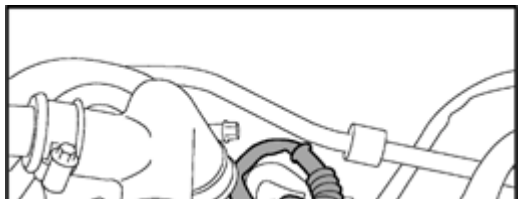
Test requirements:

- Fuse for solenoid valve for camshaft adjustment OK

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Fuel pump relay OK.

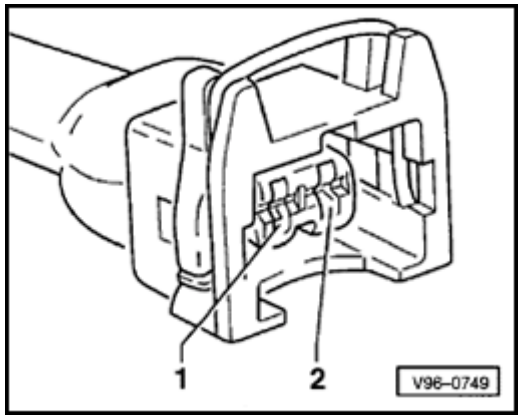
⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



- Disconnect connector -arrow- from camshaft adjuster.

cardiagn.com

15-96



- Connect voltage tester VAG 1527 B as follows:

Connector contact	Measure to
1	Engine Ground

- Operate starter briefly.

• LED should light up.

If the LED does not light up:

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

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Correct open circuit, if necessary.

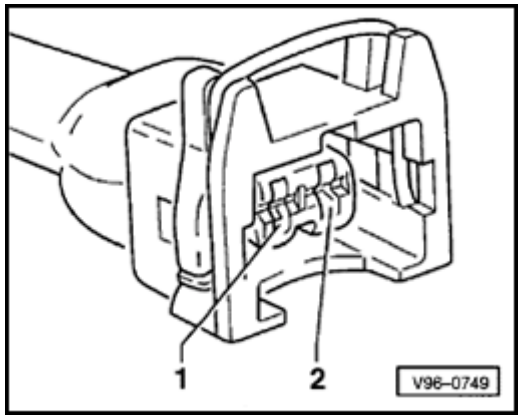
If the LED lights up:

- Check actuation.

cardiagn.com

15-97

Checking actuation



Output Diagnostic Test Mode →

Camshaft timing control

- Connect voltage tester VAG 1527 B to contacts 1 (positive) and 2 of connector.
- Initiate output Diagnostic Test Mode (DTM) and activate solenoid valve for camshaft adjuster.

Display

- LED should flash.

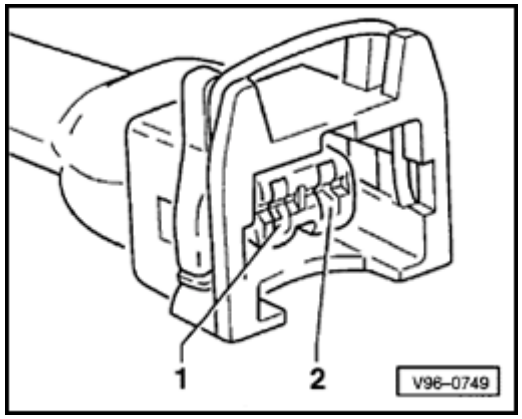
If the LED lamp does not flash or if it lights up continuously:

- Connect the VAG 1598/31 test box to wiring harness leading to engine control module (the engine control module should not be connected):

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

cardiagn.com

15-98



- Check for open circuit and short to positive or Ground in following wiring connection:

Connector Contact	Test box VAG 1598/31
2	115

- If necessary, correct short circuit to Ground or open circuit.

If the wiring is OK:

- Replace engine control module.

If no fault is found:

- Replace mechanical camshaft adjuster.

cardiagn.com

17-1

Lubrication system components, removing and installing

Note:

- *If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, all oil passages must be cleaned carefully, and the oil cooler replaced in order to prevent further damage occurring later.*

- *The oil level must not be above max. mark on dipstick - danger of damage to catalytic converter!*

- *Oil spray jet and pressure relief valve⇒ Fig. ⇒ 1 , ⇒ Page 17-6*

Viscosity grades and oil specifications:

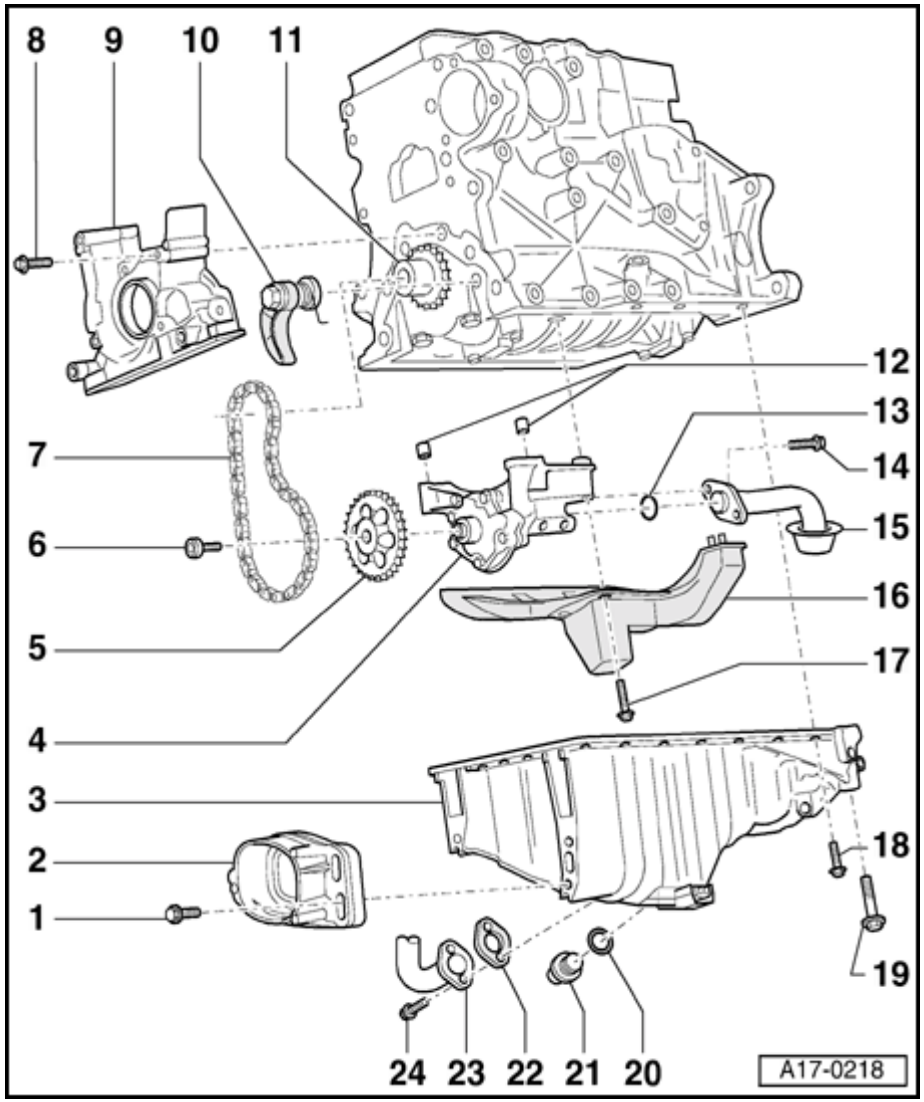
⇒ *Repair Manual, Maintenance*

Oil system capacity:

⇒ *Repair Manual, Maintenance*

cardiagn.com

17-2



Part I - Oil pump/oil pan components

1 - 28 Nm

2 - Limit stop for torque reaction support

3 - Oil pan

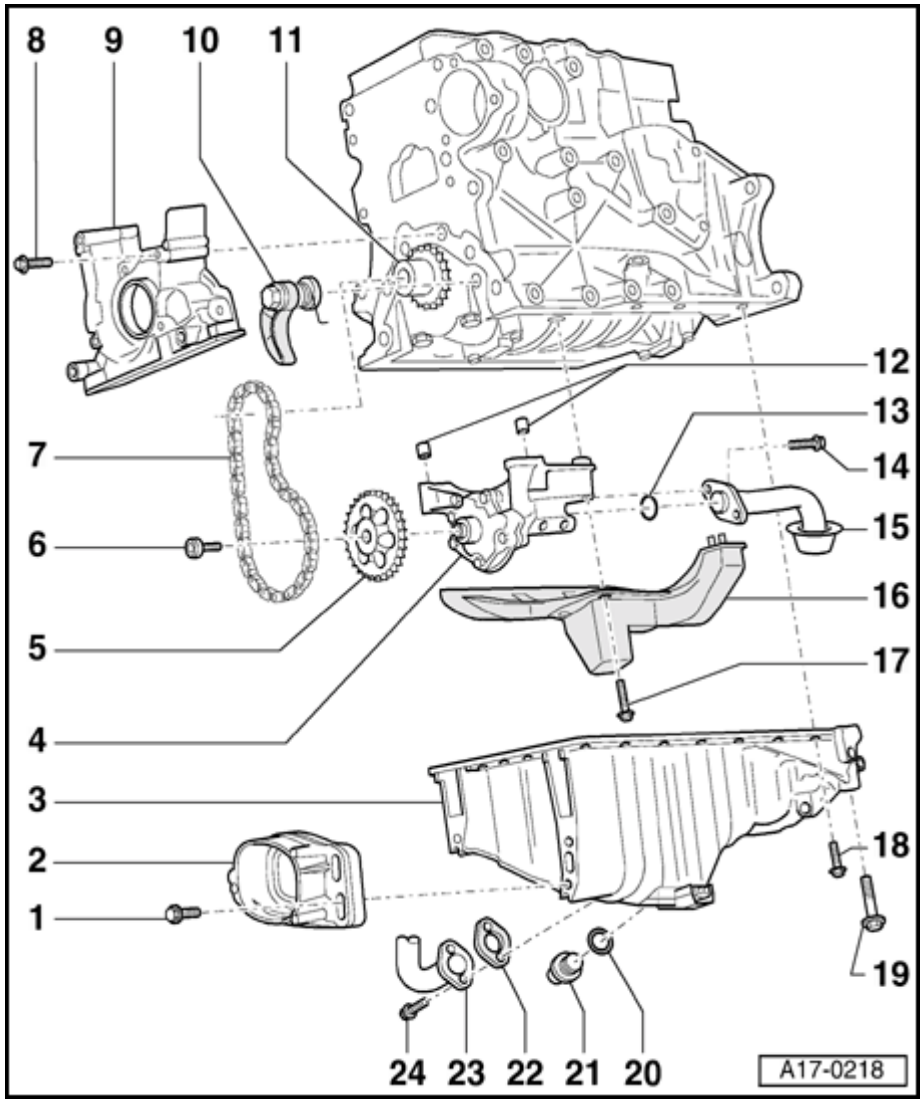
- Apply silicone sealant D 176 404 A2 before installing
- Removing and installing ⇒ Page 17-11

4 - Oil pan

- With pressure relief valve (12 bar)
- Removing and installing ⇒ Page 17-28
- Before installation check whether the two dowel sleeves -Pos. 12 - for the centralizing of the oil pump/cylinder block are present
- Replace pump if there is scoring on moving surfaces and gear teeth
- Tightening torque for oil pump cover to oil pump housing: 10 Nm

cardiagn.com

17-3



5 - Chain sprocket for oil pump

- Sprocket can only be installed on oil pump shaft in one position

6 - 22 Nm

7 - Drive chain for oil pump

- Mark direction of rotation before removing
- Check for wear

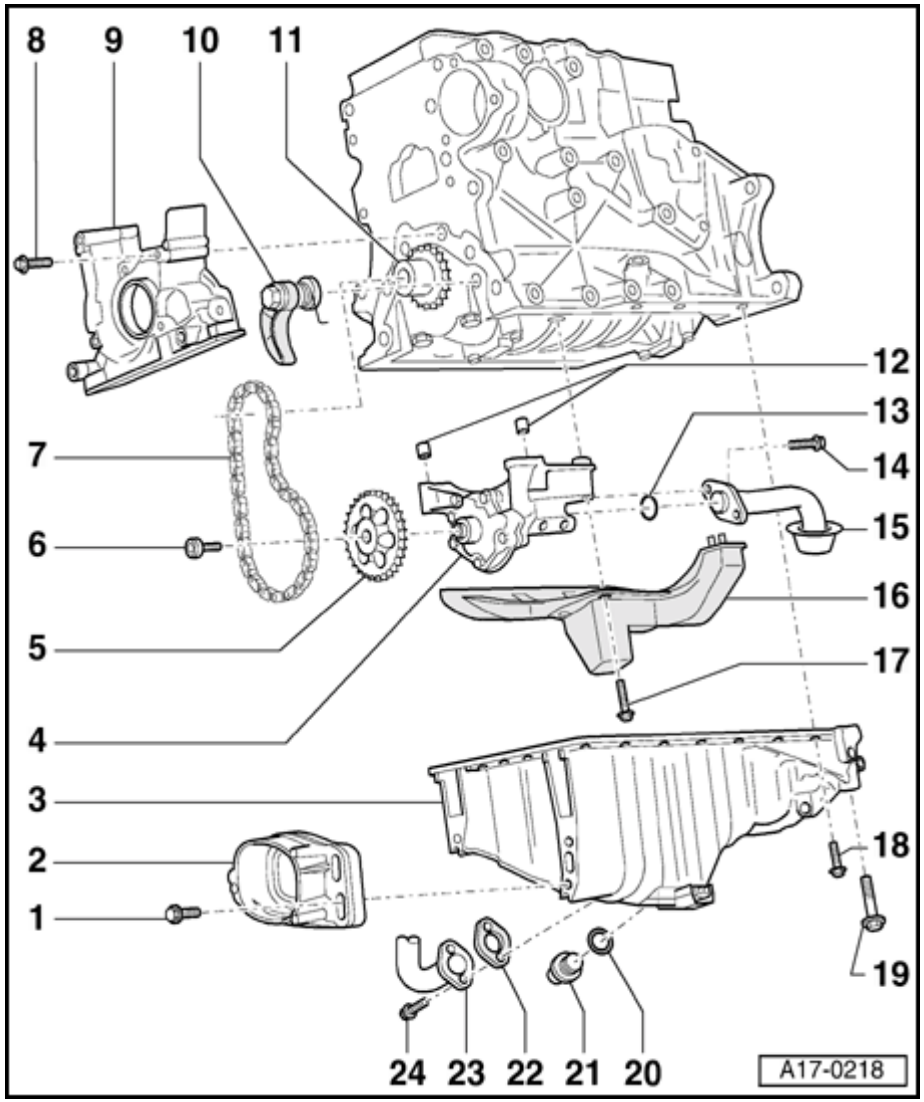
8 - 15 Nm

9 - Sealing flange - front

- Apply silicone sealant D 176 404 A2 ⇒ Page 13-56
- Replacing crankshaft oil seal on pulley end ⇒ Page 13-51

cardiagn.com

17-4



10 - Chain tensioner

- Tighten to 16 Nm
- Do not disassemble
- Note installation position
- Pre tension spring and engage before installing
- If spring is broken replace chain tensioner complete

11 - Chain sprocket for oil pump

- Removing and installing ⇒ Page 13-77

12 - Dowel sleeves

- 2 pieces

13 - O-ring

- Always replace

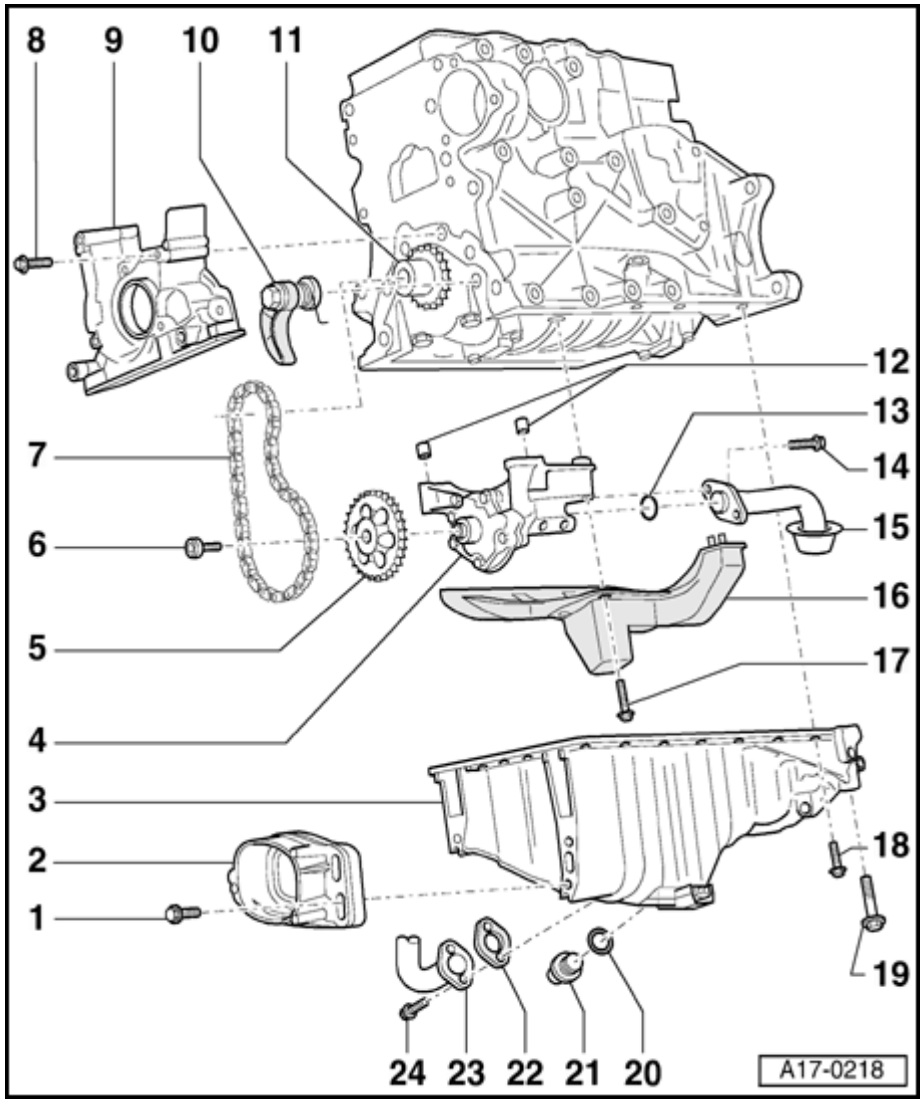
14 - 16 Nm

15 - Suction pipe

- Clean strainer if soiled

cardiagn.com

17-5



16 - Baffle plate

17 - 16 Nm

18 - 15 Nm

- Tighten in stages and in diagonal sequence
- Observe tightening sequence ⇒ Page 17-25

19 - 40 Nm

20 - Sealing ring

- Always replace

21 - Oil drain plug, 30 Nm

22 - Gasket

- Always replace

23 - 10 Nm

24 - Oil return pipe

- From exhaust turbocharger

cardiagn.com

17-6

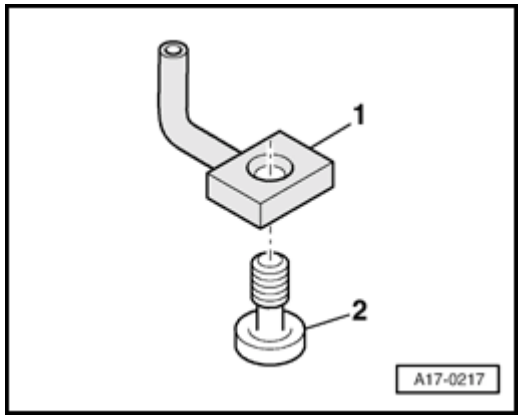


Fig. 1 Oil spray jet and pressure relief valve

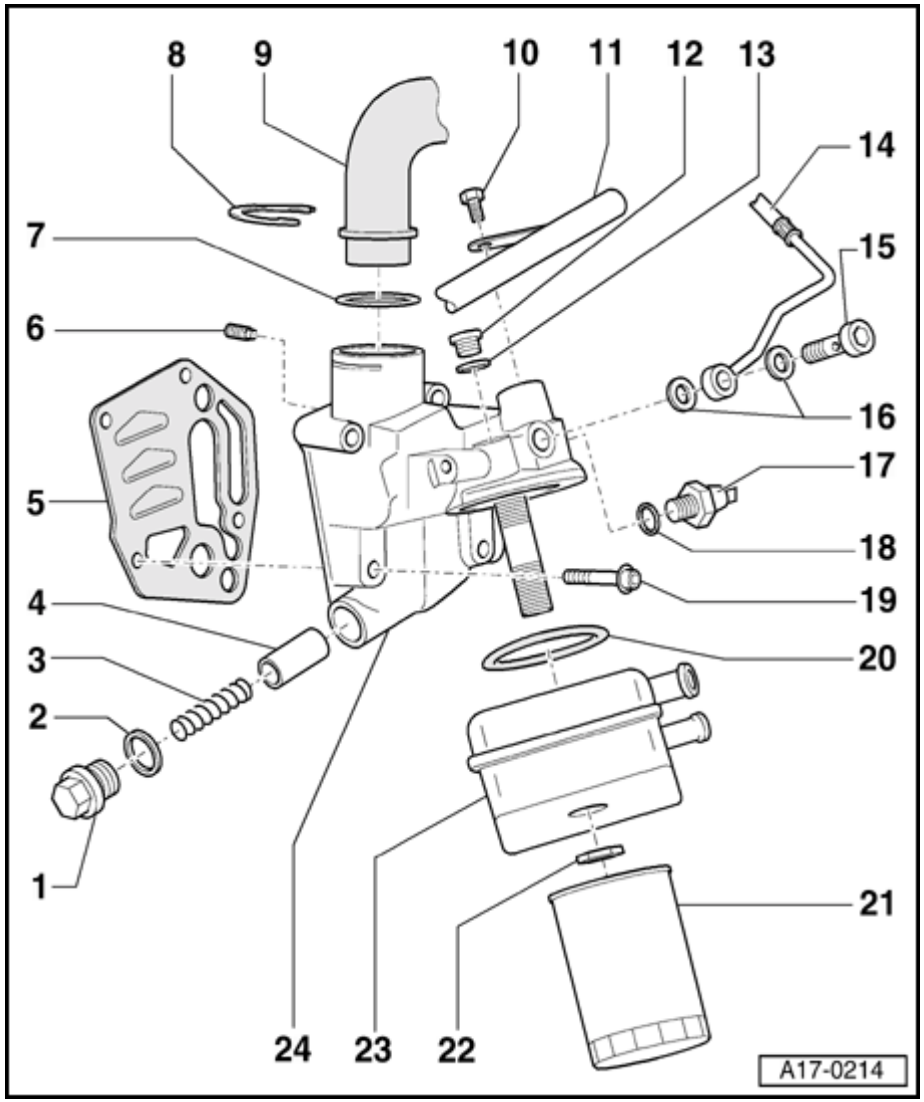
1 - Oil spray jet (for piston cooling)

2 - Bolt with pressure relief valve - 27 Nm

- Opening pressure 1.3 to 1.6 bar

cardiagn.com

17-7



Part II - Oil filter bracket components

1 - Screw plug - 40 Nm

2 - Sealing ring

- Always replace

3 - Spring

- For pressure relief valve, approx. 4 bar

4 - Piston

- For pressure relief valve, approx. 4 bar

5 - Gasket

- Always replace

6 - Oil retention valve

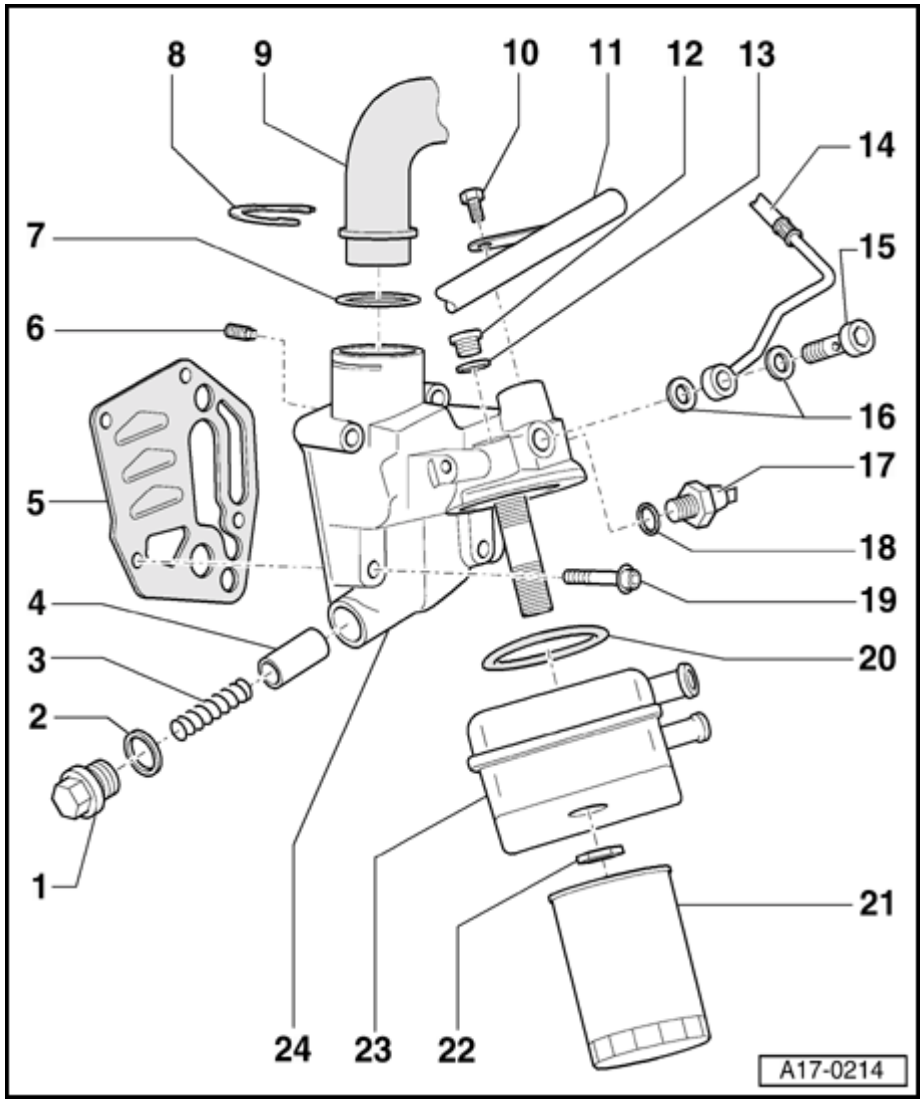
- Tighten to 8 Nm
- Built into oil filter bracket

7 - O-ring

- Always replace
- Slide on until flush with collar on pipe -Item 9 -

cardiagn.com

17-8



8 - Locking clip

9 - Pipe

- For crankcase breather

10 - 20 Nm

- Install with locking fluid D 000 600 A2

11 - Bottom coolant pipe

12 - Screw plug - 15 Nm

13 - Sealing ring

- If seal is leaking, cut open and replace

14 - Oil supply pipe

- To turbocharger

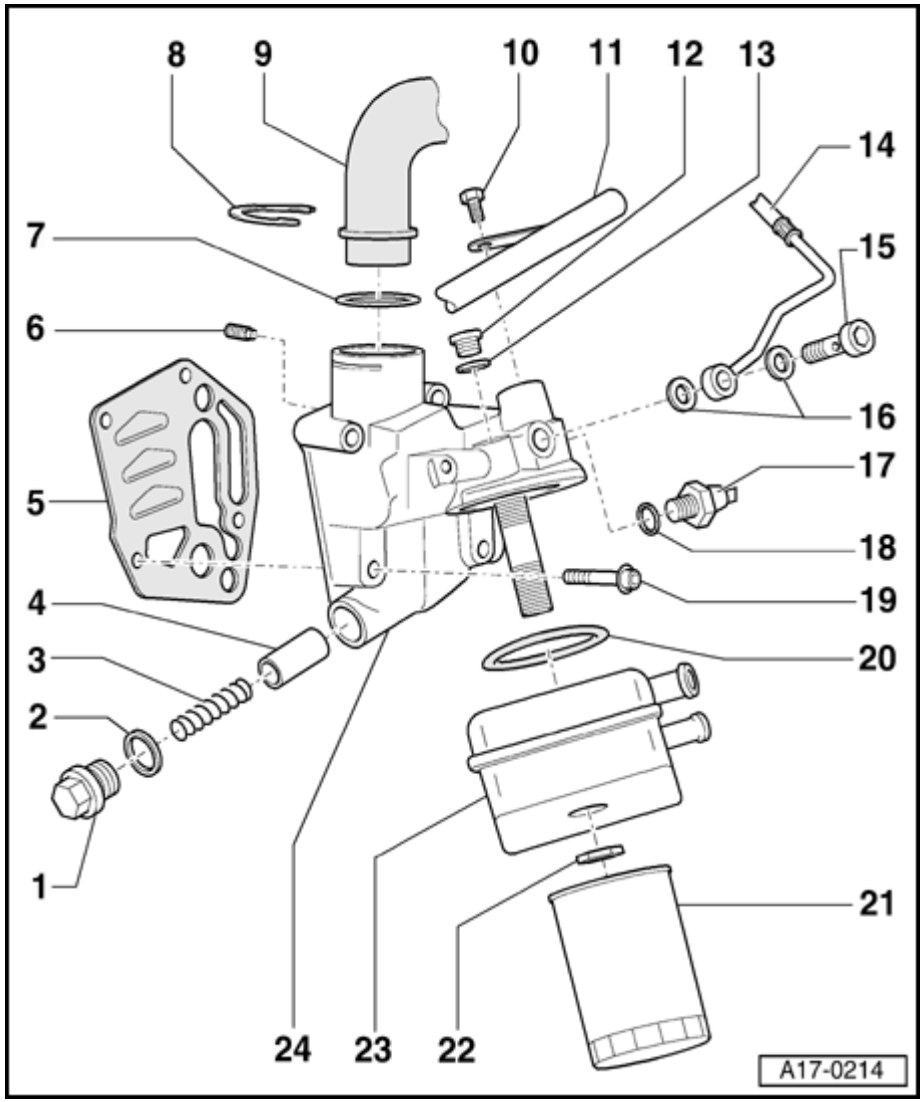
15 - Banjo bolt - 30 Nm

16 - Seals

- Always replace

cardiagn.com

17-9



17 - Oil pressure switch -F1-, 1.4 bar - 25 Nm

- Black insulation
- Checking ⇒ Page 17-30

18 - Sealing ring

- If seal is leaking, cut open and replace

19 - 15 Nm + $^{1}/_{4}$ turn (90°) further

- Always replace

20 - Gasket

- Always replace
- Engage in projections on oil cooler

21 - Oil filter

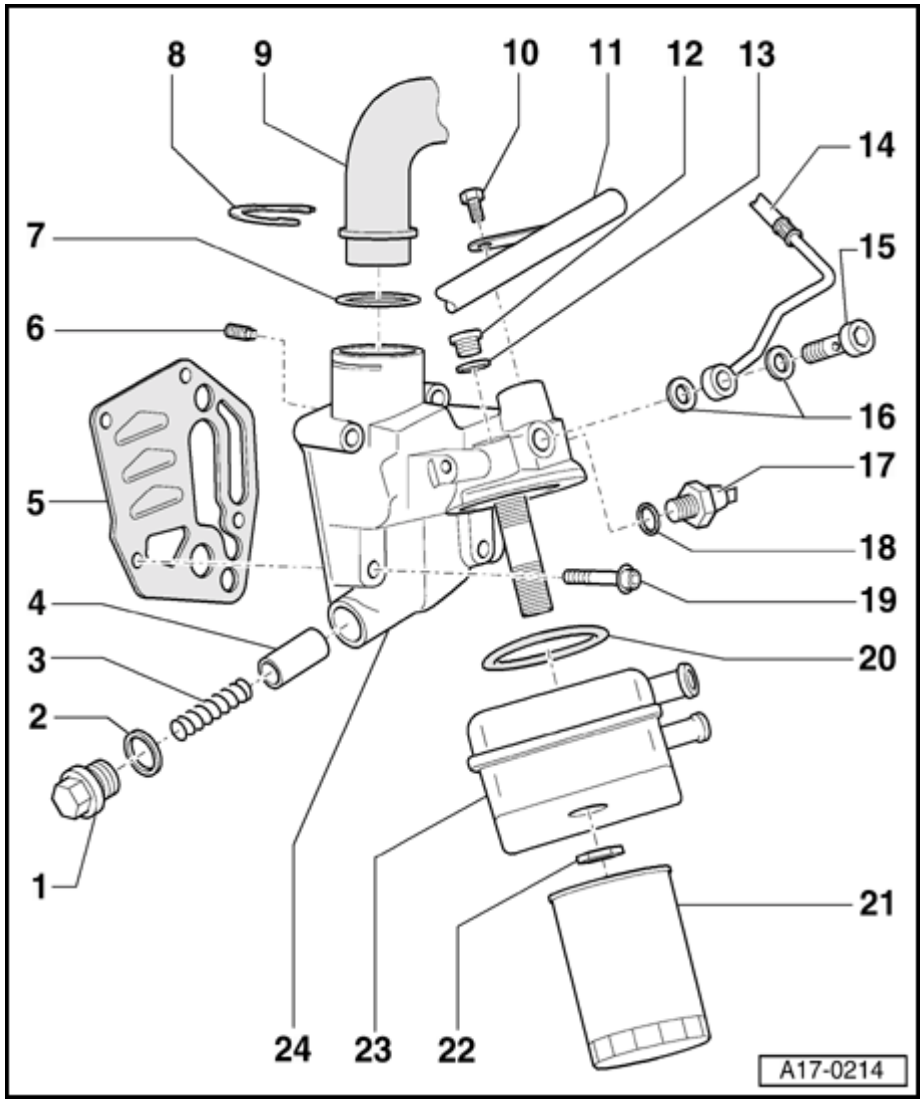
- Observe change intervals

⇒ *Repair Manual, Maintenance*

- Observe installation instructions on oil filter
- Tighten to 20 Nm

cardiagn.com

17-10



22 - 25 Nm

23 - Oil cooler

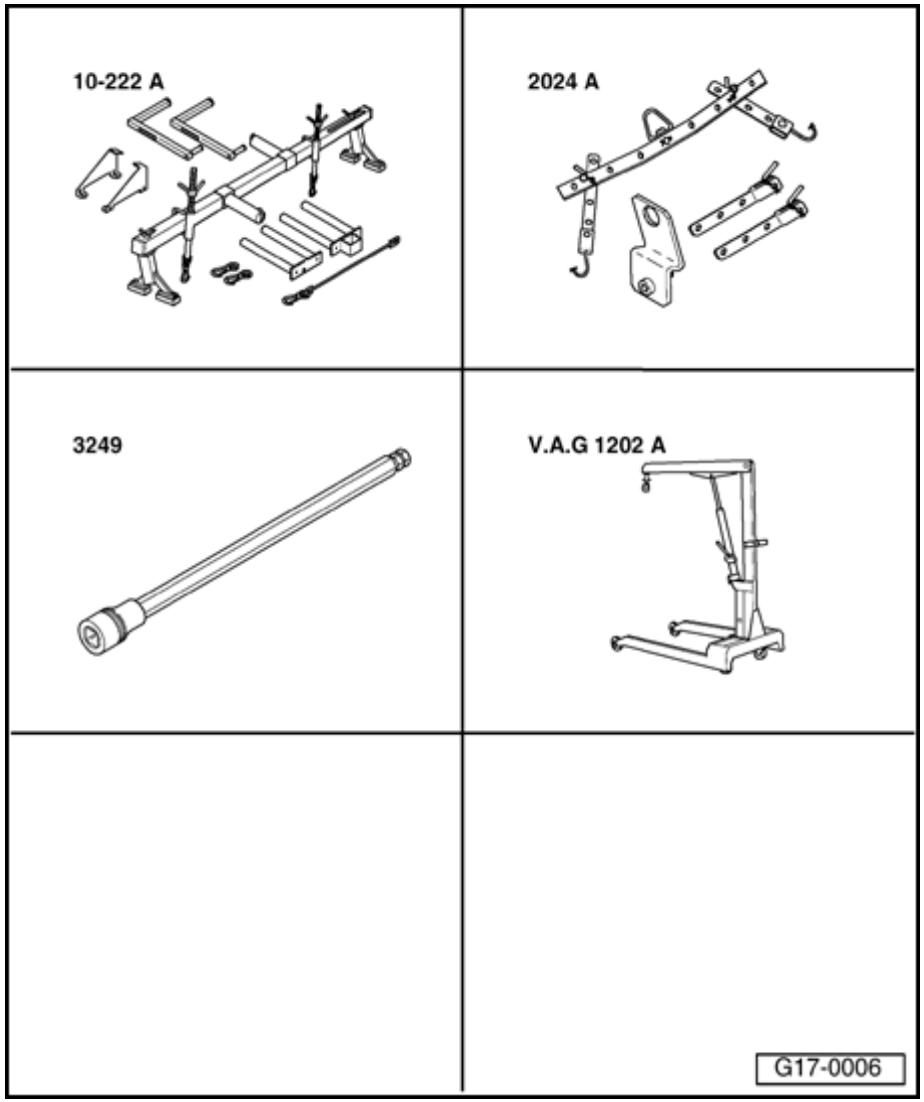
- See note ⇒ Page 17-1
- Ensure clearance to adjacent components
- Coolant hose connection diagram ⇒ Page 19-2

24 - Oil filter bracket

- With pressure relief valve, approx. 4 bar

cardiagn.com

17-11



Oil pan, removing and installing

Special tools and equipment

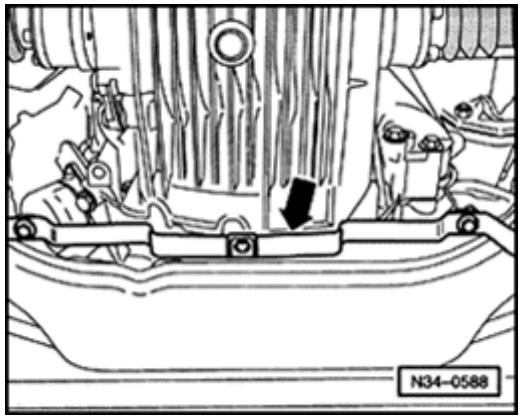
- Support bar 10-222A
- Lifting tackle 2024 A
- Socket 3249
- Workshop crane VAG 1202 A
- Electric drill with plastic brush attachment
- Protective goggles

cardiagn.com

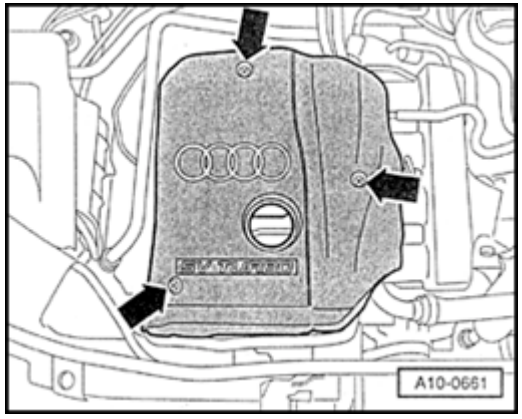
17-12

Removing

- Engine in vehicle
- Lock carrier must be in service position ⇒ Page 13-1 .



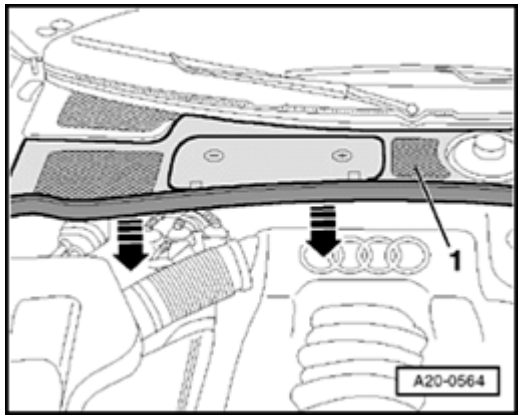
- Unbolt bracket for sound insulation -arrow-.
- Remove air duct hose on bottom left on charge air cooler.



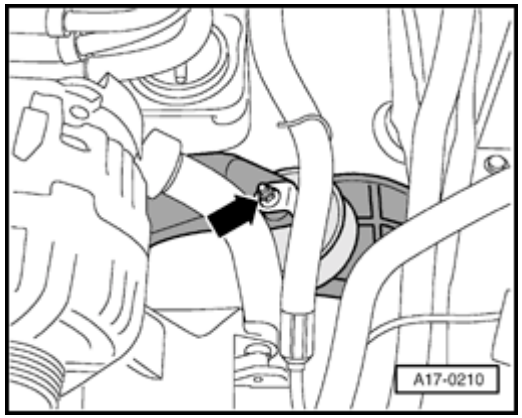
- Remove engine cover -arrows-.

cardiagn.com

17-13



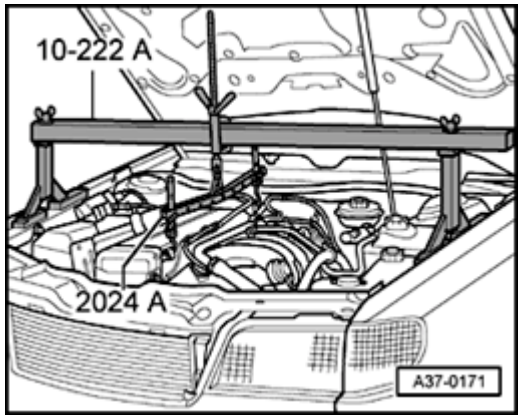
- Remove seal from plenum chamber cover in direction of arrow.
- Remove plenum chamber cover -1- from front.



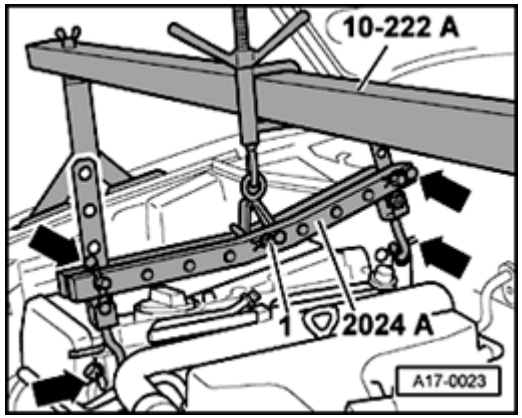
- Remove nut -arrow- from top of left engine mounting.

cardiagn.com

17-14



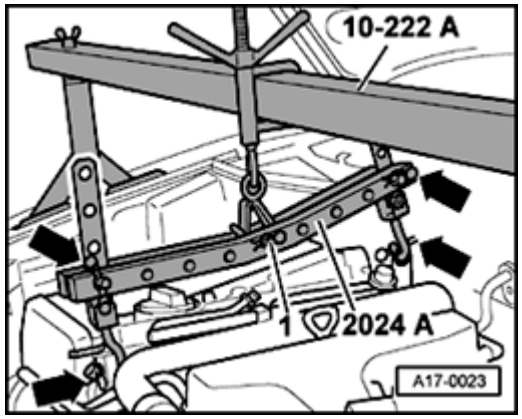
- Set up support bar 10-222 A on fender panel flanges.



- Remove lifting eye from lifting tackle 2024 A.
- Replace pin -1- in center hole on lifting tackle and secure with locking pin.
- Engage pin on lifting tackle 2024 A on spindle of support bar 10-222 A.

cardiagn.com

17-15

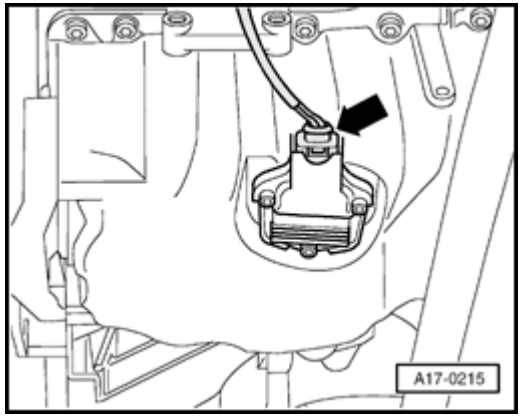


- Engage lifting tackle 2024 A in front and rear lifting eyes on engine.

CAUTION!

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

- Pretension engine with spindle of support bar, do not lift.
- Drain engine oil.
- Remove oil return line of exhaust turbocharger from oil pan.



- Disconnect electrical connector -arrow- from oil level sender.

cardiagn.com

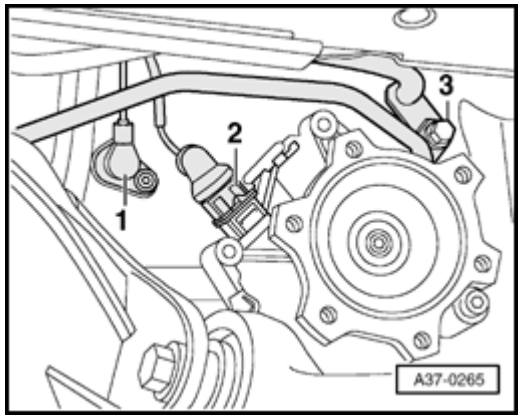
17-16

Vehicles with automatic transmission:

Note:

Observe cleanliness rules when working on the automatic transmission:

⇒ *Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37*



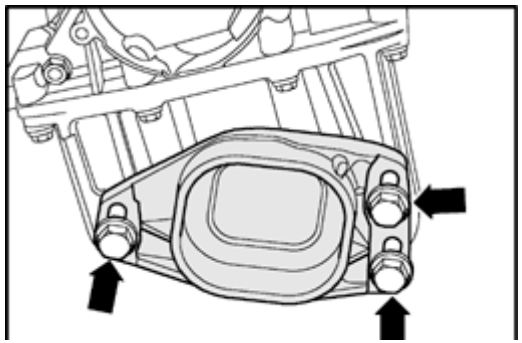
- Remove bolt -3- and disconnect ATF lines from transmission.

Note:

Ignore positions -1- and -2-.

- Remove bracket for ATF lines from engine.
- Move ATF lines aside.

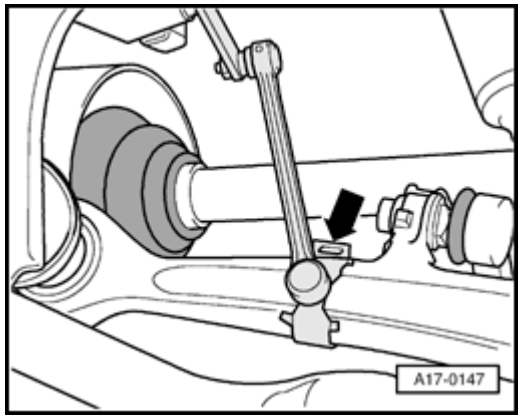
All models:



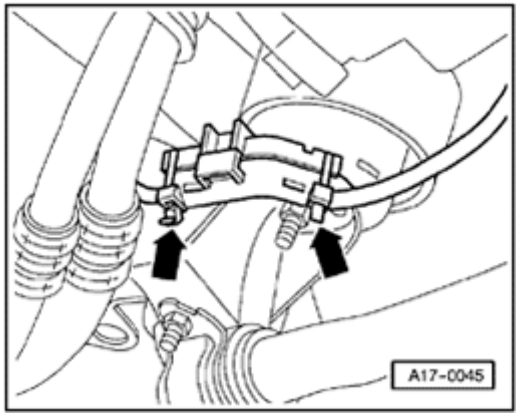
- Remove stop for torque reaction support -arrows-.

cardiagn.com

17-17



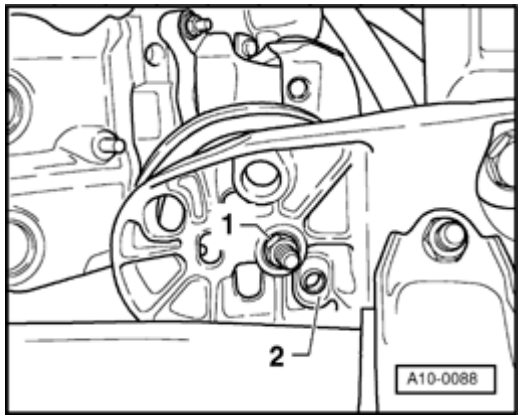
- Where present unclip operating rod of vehicle level sender from lower transverse link -arrow-.



- Cut through cable ties -arrows-. Open retainer for starter cable and take out electrical wiring.

cardiagn.com

17-18

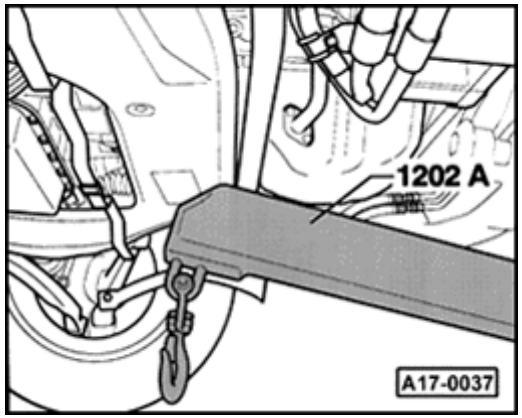


- Mark positions of mountings -1- and locating sleeves -2- on left and right engine mountings (lower).

Note:

Different mounting holes are provided for the different engine versions.

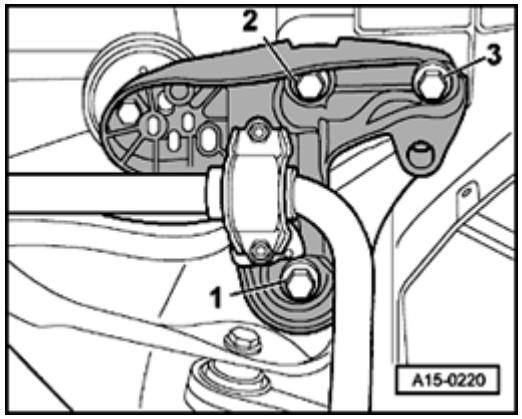
- Remove nut -1- from lower right of engine mounting.
- Completely remove left engine mounting.



- Support subframe with workshop crane VAG 1202 A.

cardiagn.com

17-19

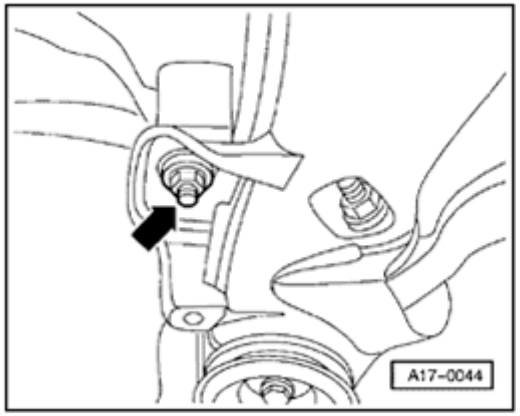


- Remove front subframe bolts -2- and -3- (left and right) and loosen bolts -1-.

Note:

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

Vehicles with manual transmission

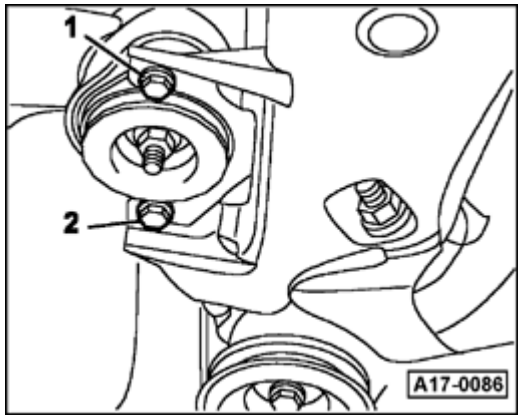


- Loosen nut -arrow- on left transmission mounting until it is flush with end of bolt (approx. four turns on the thread).

cardiagn.com

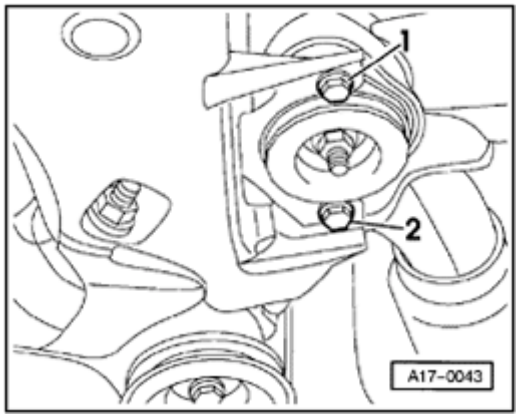
17-20

Vehicles with automatic transmission:



- Loosen rear bolt -2- on left transmission mounting a few turns; remove front bolt -1- on left transmission mounting.

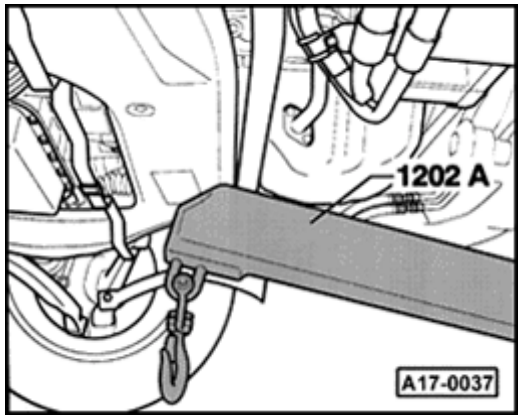
All models:



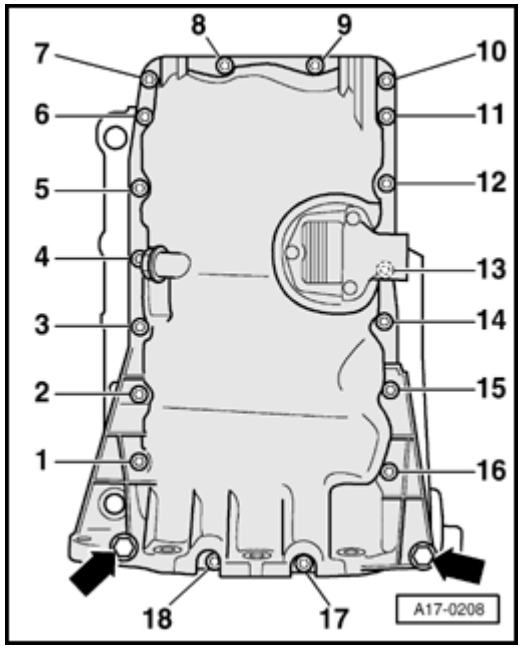
- Loosen rear bolt -2- on right transmission mounting a few turns; remove front bolt -1- on right transmission mounting.

cardiagn.com

17-21



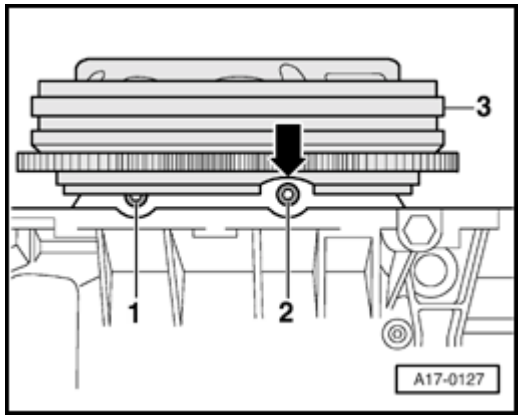
- Lower subframe slowly using workshop crane 1202 A.
- Take out workshop crane VAG 1202 A.
- Remove bolts for oil pan/transmission:



- Remove M10 bolts -arrows-.
- Loosen bolts -1 to 18- diagonally.

cardiagn.com

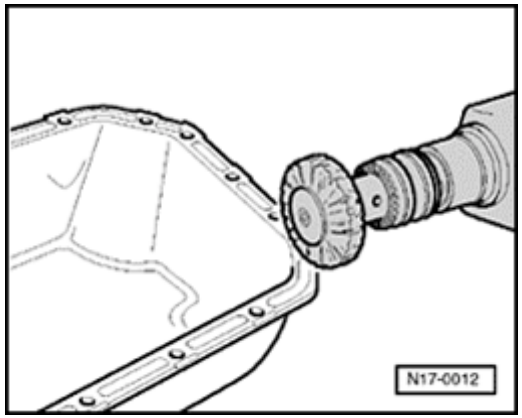
17-22



Note:

➢ *Unscrew both rear oil pan bolts -1- and -2- with attachment 3249. Turn the flywheel on vehicles with a manual transmission -3- until the notch -arrow- is aligned with the bolt.*

- Take off oil pan. If necessary loosen it by striking lightly with a rubber hammer.
- Carefully remove sealant residues from cylinder block (remove baffle plate).



➢

- Remove remaining sealant from oil pan, e.g. with a rotating plastic brush.

WARNING!

Wear protective glasses.

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

cardiagn.com

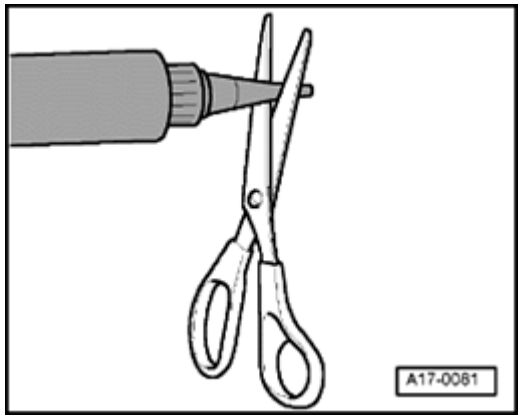
17-23

Installing

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

Note:

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



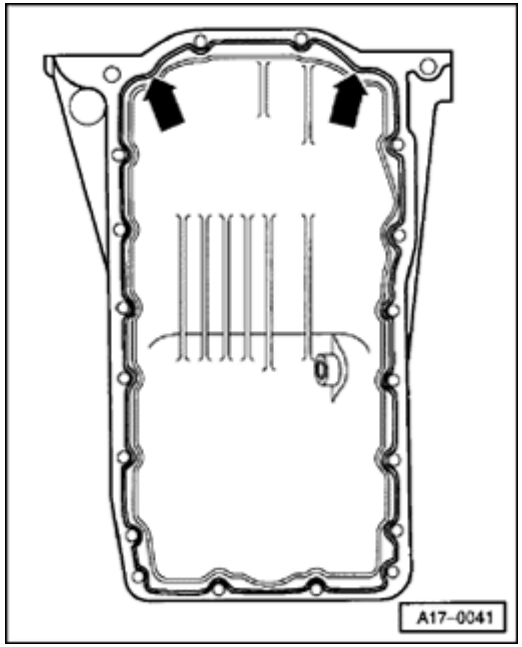
- Cut off nozzle of tube at front marking (diameter of nozzle approx. 3 mm).
  - Silicone sealant D 176 404 A2
  - Thickness of sealant bead: 2 to 3 mm

cardiagn.com

17-24

Note:

The bead of sealant must not be thicker than 3 mm, as otherwise excess sealant will enter the oil pan and obstruct the strainer in the oil intake pipe.



- Apply bead of silicone sealant onto clean sealing surface of oil pan, as illustrated. (Illustration shows position of sealant bead on cylinder block).

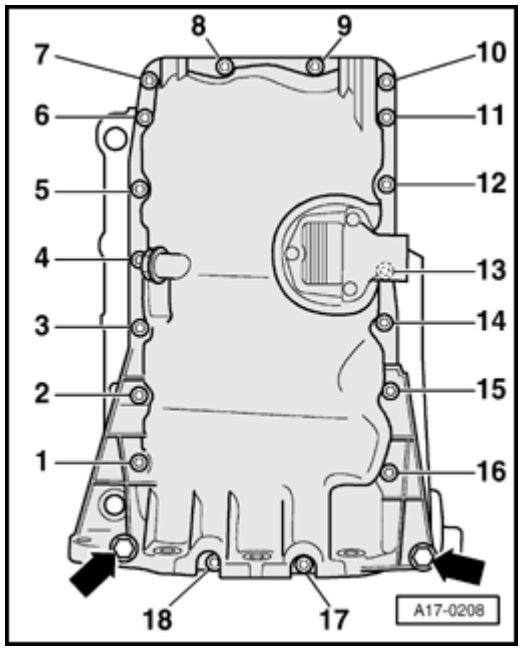
Note:

Be particularly careful when applying the bead of sealant around the rear sealing flange (arrows in illustration).

cardiagn.com

17-25

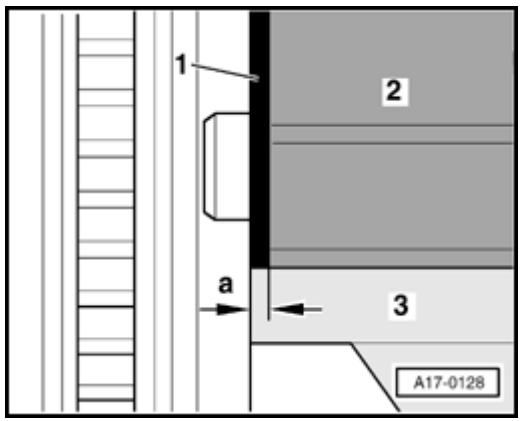
- Immediately attach oil pan and tighten bolts in described sequence:



- Tighten bolts -1 to 18- diagonally to 5 Nm.
- Tighten bolts securing oil pan to transmission to 45 Nm.
- Tighten bolts M10 -arrows- to 40 Nm.
- Tighten bolts -1 to 18- tighten diagonally to 15 Nm.

Note:

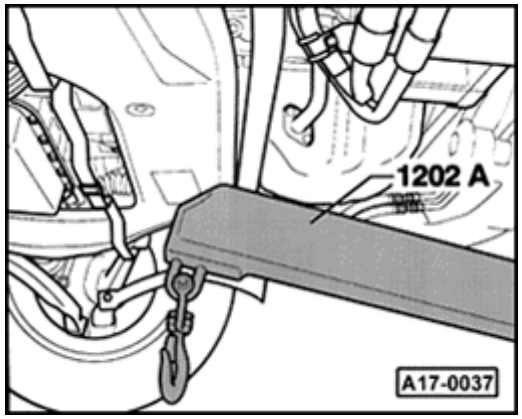
- *Replace seals and gaskets.*



- *When installing the oil pan with the engine removed from the vehicle, ensure that the oil pan -3- is positioned flush with the intermediate plate -1- at the flywheel end (i.e. oil pan should protrude dimension "a" = 0.8 mm from cylinder block with respect to the cylinder block -2-).*
- *After installing oil pan assembly, the sealant must dry for approx. 30 minutes. Only then may the engine be filled with oil.*

cardiagn.com

17-26



- Support subframe with workshop crane VAG 1202 A.
- Installing subframe:

⇒ *Repair Manual, Suspension, Wheels, Steering, Repair Group 40*

Vehicles with automatic transmission:

- Secure ATF lines.

⇒ *Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37*

All models:

- Install lock carrier ⇒ Page 13-1 .
- Fill engine with oil and check oil level.

Vehicles with automatic transmission:

- Check ATF level:

⇒ *Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37*

cardiagn.com

Tightening torques

Component		Nm
Oil pan to cylinder block	M7	15
	M10	40
Oil pan to transmission		45
Limit stop for torque reaction support on oil pan		28
Engine mounting to subframe		25
Engine mounting to engine support		25
Transmission support to transmission support	M10	40
Transmission mounting to subframe	M8	25
Oil return pipe to oil pan		10
Oil drain plug		30
Hose clamps for air duct hoses		3.5

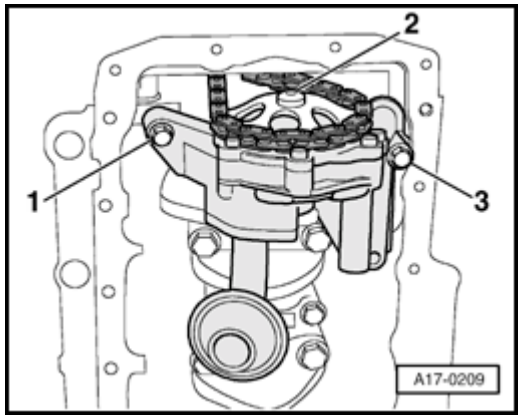
cardiagn.com

17-28

Oil pump, removing and installing

Removing

- Remove oil pan and baffle plate ⇒ Page 17-11 .



- Remove bolt -2-.
- Remove sprocket wheel from oil pump shaft.
- Remove bolts -1- and -3- and remove oil pump.

cardiagn.com

Installing

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

- Insert dowel sleeves -Item 12 -, ⇒ Page 17-4 on top of oil pump.

  - Oil pump shaft/sprocket wheel location: Can only be installed in one position.

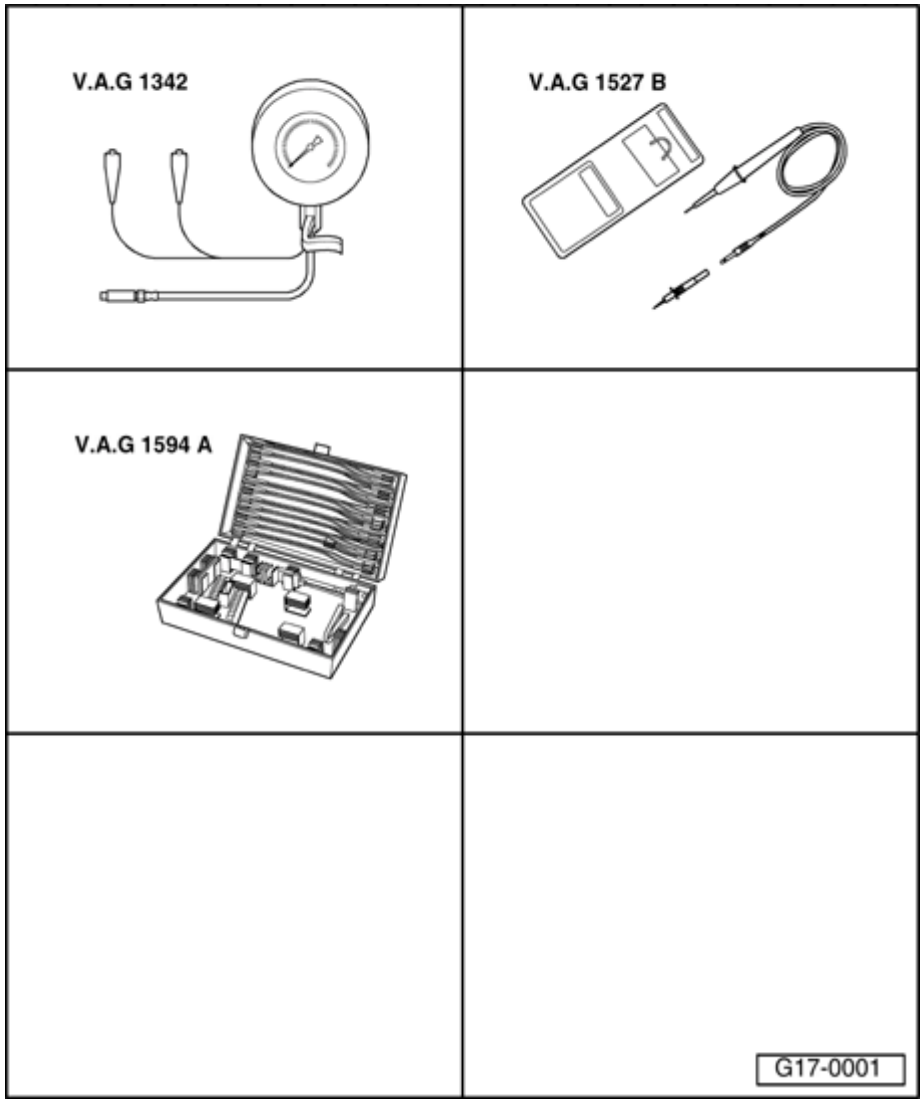
- Installing oil pan ⇒ Page 17-23

Tightening torques

Component	Nm
Chain sprocket to oil pump shaft	22
Oil pump to cylinder block	16

cardiagn.com

17-30



Oil pressure and oil pressure switch, checking

Special tools and equipment

- VAG 1342
- VAG 1527 B
- VAG 1594 A

cardiagn.com

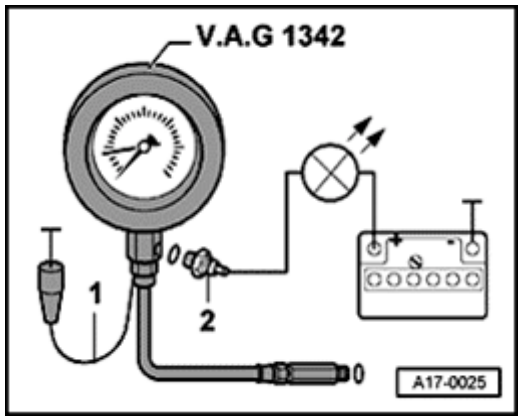
17-31

Test requirements:

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

Testing oil pressure switch

- Disconnect wire from oil pressure switch.



- Remove oil pressure switch and screw in oil pressure tester VAG 1342.
- Thread oil pressure switch -2- intoVAG 1342.
- Connect brown wire -1- of tester to Ground (-).

cardiagn.com

- Connect voltage tester VAG 1527 B to oil pressure switch and positive side of battery (+) using test leads from VAG 1594 A.

  - Test lamp should not light up.

- If test lamp lights up, install new oil pressure switch.

- Start engine.

Note:

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

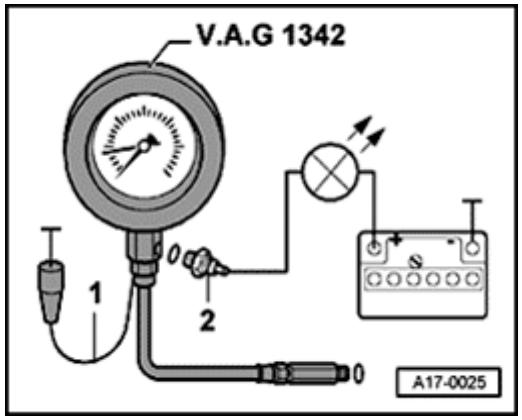
Black oil pressure switch:

  - LED must light up at 1.2 to 1.6 bar.

- If test lamp does not light up, install new oil pressure switch.

cardiagn.com

17-33



Check oil pressure

- Disconnect wire from oil pressure switch.

- Remove oil pressure switch and screw in oil pressure tester VAG 1342.
- Thread oil pressure switch -2- intoVAG 1342.
- Start engine (engine oil temperature approx. 80 ° C).
  - Oil pressure at idling speed: at least 1.3 bar
  - Oil pressure at 2000 rpm: 3.5 to 4.5 bar

If specified values are not attained:

- Pressure relief valve or oil pump faulty, replace oil pump ⇒ Page 17-28 .

cardiagn.com

17-34

Engine oil

The engine is filled with a high quality multigrade oil at the factory. This oil may be used all year round, except in extremely cold climates.

Viscosity grades and oil specifications

Viscosity grades and oil specifications:

⇒ *Repair Manual, Maintenance*

cardiagn.com

17-35

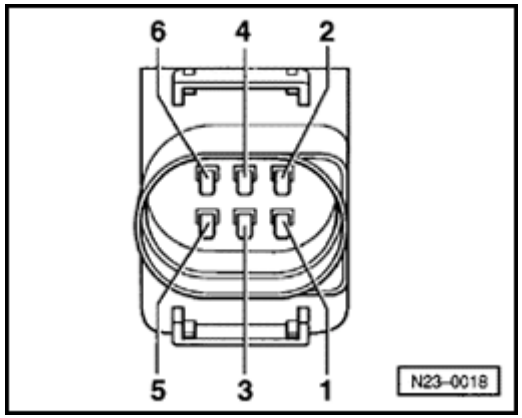
Engine oil level, checking

Test requirements:

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

- Pull out dipstick, wipe with a clean cloth and insert again to stop.

- Pull out dipstick again and read oil level.



Markings on oil dipstick:

a - Oilmust not be topped up.

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

c - Oilmustbe topped up. The oil level is sufficient if somewhere in area -b- (grooved area) after topping up.

Note:

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

cardiagn.com

19-1

Cooling system components, removing and installing

WARNING!

Hot steam can escape when opening the cap on the expansion tank: Cover the cap with a cloth and open carefully.

Note:

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

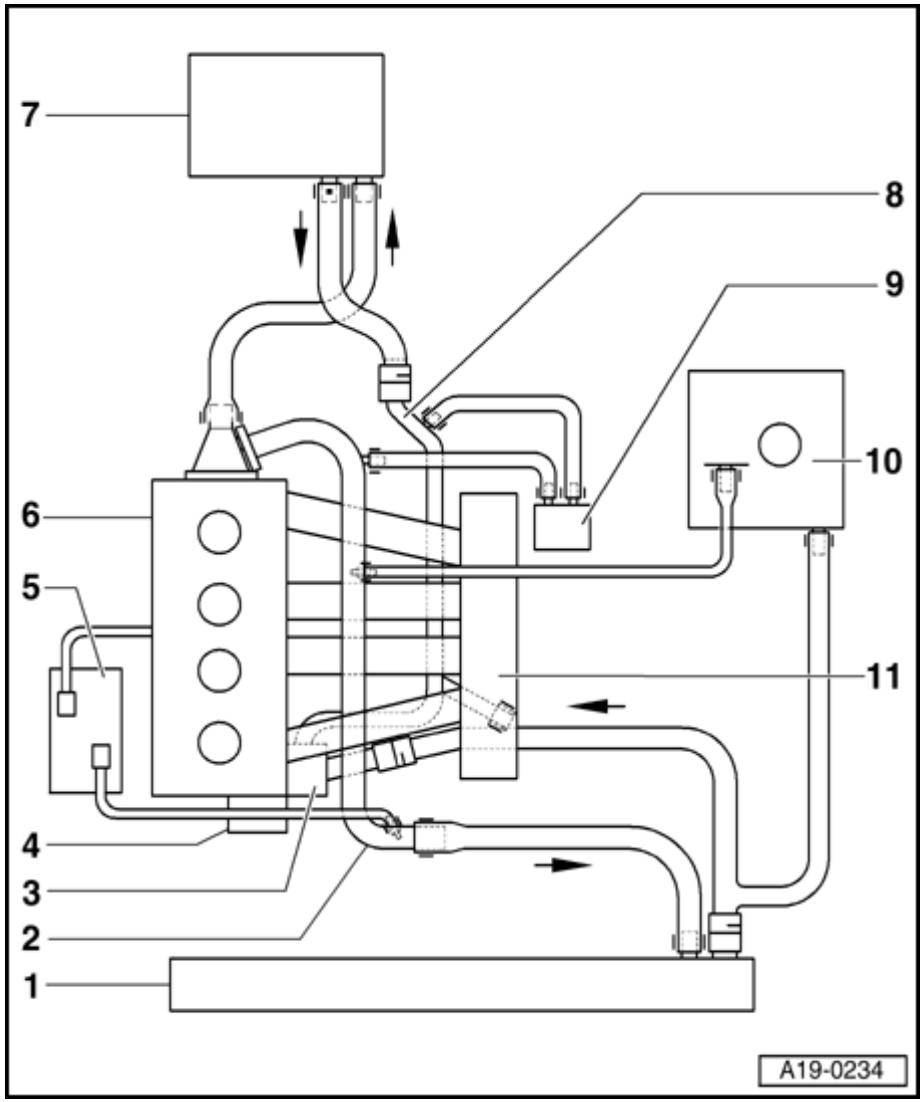
⇒ *Parts Catalog*

- *Hose clip pliers VAG 1921 are recommended when installing spring type clips.*
- *Replace all gaskets and seals.*
- *The arrow markings on the coolant lines and on the ends of the hoses must be aligned with each other.*

cardiagn.com

- *Removing and installing viscous fan ⇒ Page 13-21 .*

cardiagn.com



Cooling system diagram

1 - Radiator

- Removing and installing ⇒ Page 19-26
- After replacing, fill with fresh coolant

2 - Upper coolant line

3 - Thermostat

- Removing and installing coolant pump ⇒ Page 19-12
- Checking ⇒ Page 19-22

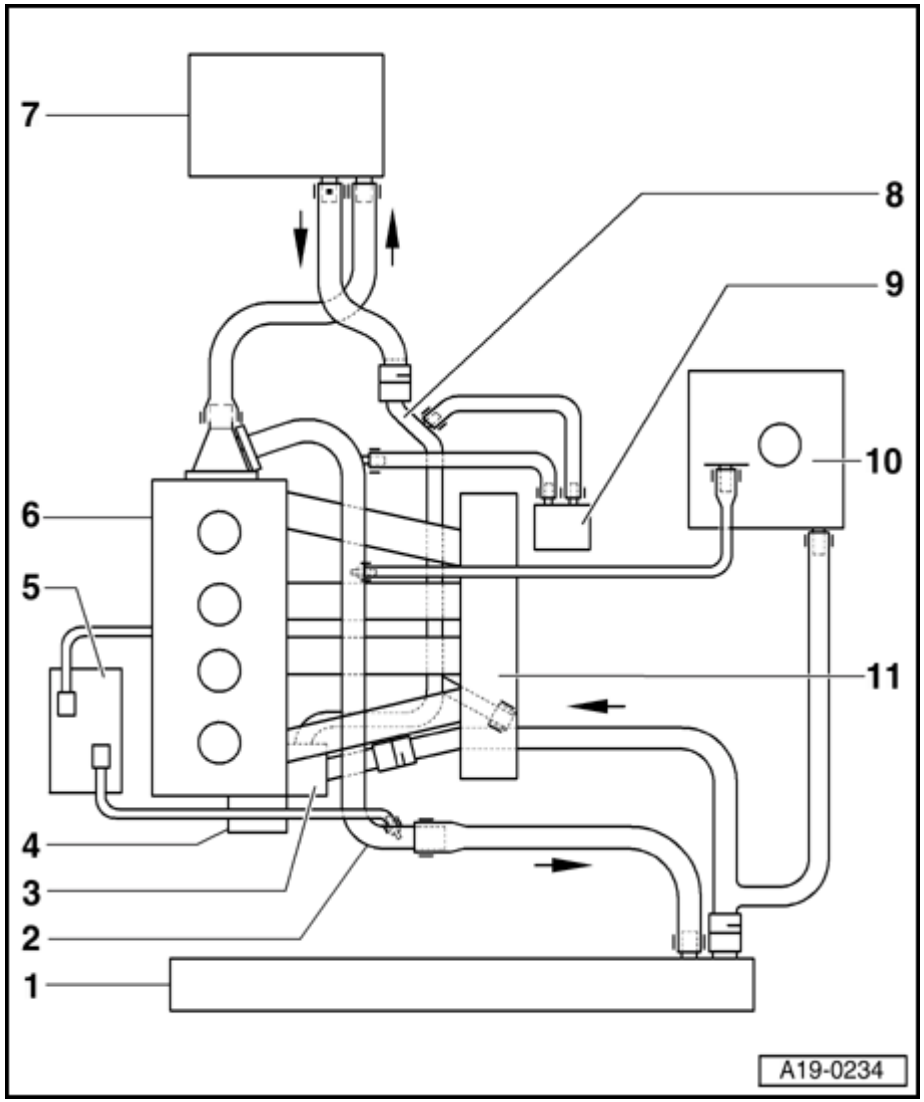
4 - Coolant pump

- Removing and installing ⇒ Page 19-12
- Check for ease of movement

5 - Turbocharger

cardiagn.com

19-3



6 - Cylinder head/cylinder block

- After replacing, fill with fresh coolant

7 - Heating system heat exchanger

- After replacing, fill with fresh coolant

8 - Lower coolant line

- Removing and installing ⇒ Page 19-23

9 - Oil cooler

- Removing and installing ⇒Item 23 , ⇒ Page 17-10

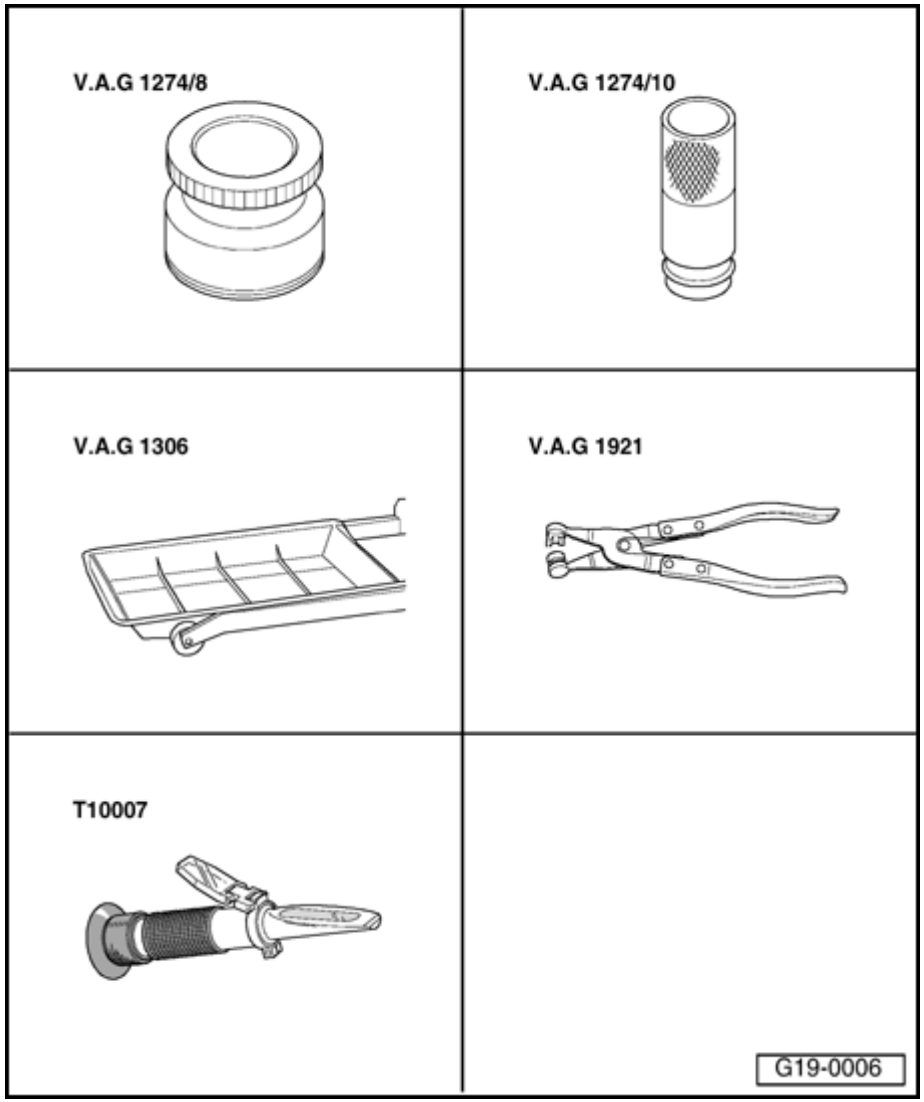
10 - Expansion tank

- With filler cap
- Testing pressure relief valve in filler cap ⇒ Page 19-33

11 - Intake manifold

cardiagn.com

19-4



Cooling system, draining and filling

Special tools and equipment

- Adapter 1274/8
- Line VAG 1274/10
- Drip tray VAG 1306
- Hose clamp pliers VAG 1921
- Special tool T10007

cardiagn.com

19-5

Draining

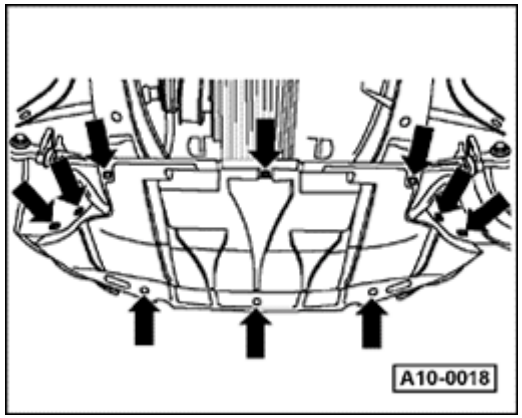
Note:

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

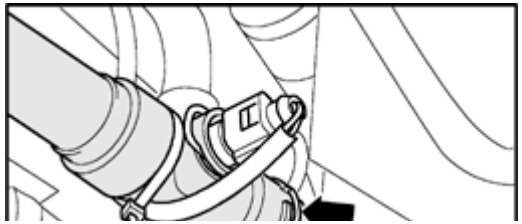
WARNING!

Hot steam can escape when opening the cap on the expansion tank: Cover the cap with a cloth and open carefully.

- Open cover of coolant expansion tank



- Remove sound insulation -arrows-.
- Place drip tray VAG 1306 below engine.

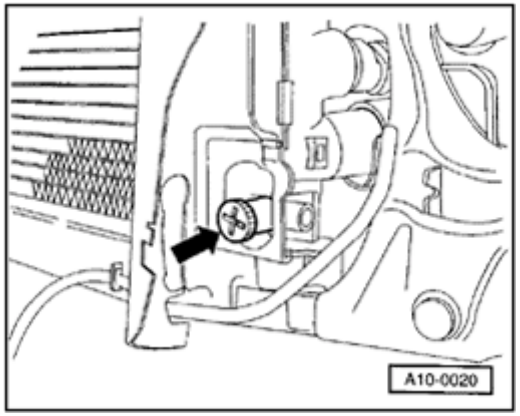


- Remove lower coolant hose retaining clip -arrow- and remove coolant hose from radiator.

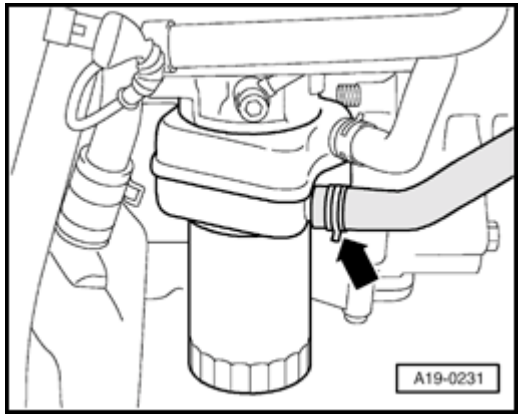
cardiagn.com

19-6

Note:



➢ *With bumper and air duct in front of charge air cooler removed, the coolant can also be drained from the radiator via the drain screw -arrow-. If necessary use an auxiliary hose.*



➢ - Disconnect lower coolant hose on oil cooler -arrow-, and drain off remaining coolant.

cardiagn.com

19-7

Filling

Note:

- *The cooling system is filled all year round with a mixture of water and an antifreeze/corrosion protection agent.*

- *Only use coolant additive G 012 A8 D meeting specification TL VW 774 D. Identification color: red*

CAUTION!

G 012 A8 D and other coolant additives cannot be mixed. Otherwise, serious damage to the engine may result.

- *If the fluid in the expansion tank is brown, this means G 012 A8 D has been mixed with another type of coolant. In this case, flush out the cooling system and fill with fresh coolant. To flush the system, fill it with clean water and run the engine for about 2 minutes. This should remove as much of the old coolant as possible.*

- *G 012 A8 D and coolant additives marked "meeting specification TL VW 774 D" prevent frost and corrosion damage and stop scaling while at the same time raising the boiling point of the coolant. For these reasons the cooling*

cardiagn.com

system must be filled all year round with the correct anti-freeze and anti-corrosion additive.

cardiagn.com

19-8

- *Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- *Protection against frost must be assured to about -25° C (in arctic climatic countries to about -35° C).*
- *The coolant concentration must not be reduced by adding water, even in warmer seasons and in warmer countries. The anti-freeze ratio must be at least 40 %.*
- *If greater frost protection is required in very cold climates, the amount of G 012 A8 D can be increased, but only up to 60% (this gives frost protection to about -40° C). Otherwise, frost protection is reduced again and cooling effectiveness is also reduced.*
- *Only use clean drinking water for mixing the coolant.*
- *If radiator, heat exchanger, cylinder head or cylinder head gasket is replaced, do not reuse old coolant.*
- *Use special tool T10007 to check frost protection of coolant additive G012 A8 D in*

cardiagn.com

cooling system.

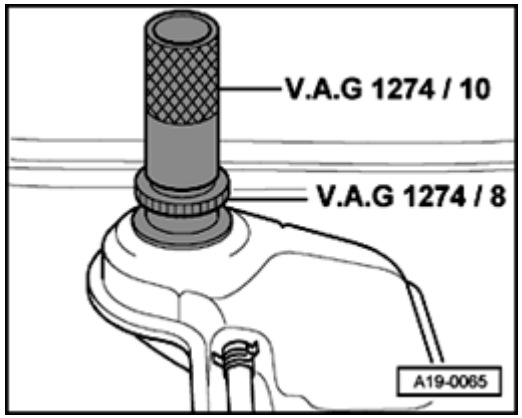
cardiagn.com

Recommended mixture ratios:

Frost protection to	Anti-freeze concentration	G 012A8 D [1)]	Water[1)]
-25 ° C	40%	3.0 l	4.0 l
-35 ° C	50%	3.5 l	3.5 l

[1)] Coolant quantity: 7.0 liters (may vary depending upon the vehicle equipment)

- Install lower coolant hose and secure.



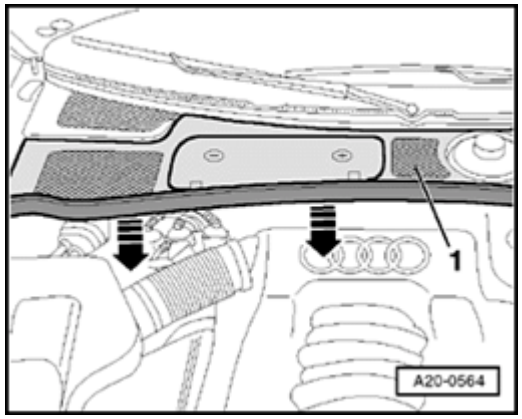
- Screw adapter VAG 1274/8 onto coolant expansion tank.
- Fit special tool VAG 1274/10 onto adapter.

Note:

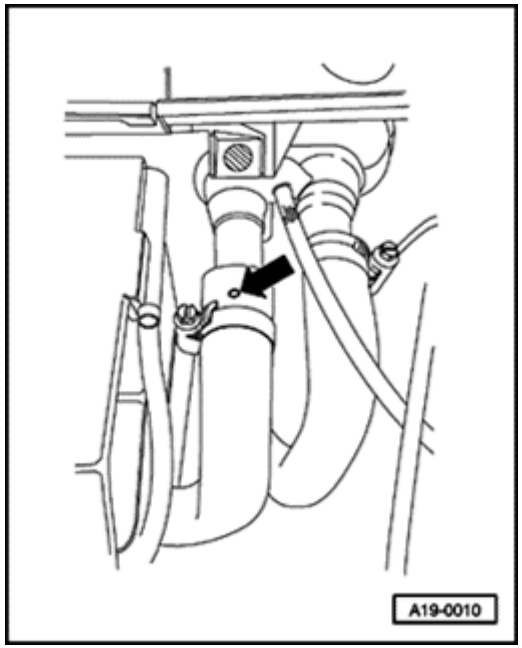
To fill expansion tank without special tools, remove expansion tank and temporarily raise it about 100 mm.

cardiagn.com

19-10



- Remove seal from plenum chamber cover in direction of arrow.
- Remove plenum chamber cover -1- from front.
- Push back protective cover for coolant hose at connection of heat exchanger.



- Release coolant hose to heat exchanger and pull back hose until bleeder hole in coolant hose -arrow- is no longer covered by connection.
- Top up coolant until it flows out at bleeder hole in coolant hose.
- Push coolant hose on connection and tighten.
- Install expansion tank cap.

cardiagn.com

- Start engine and maintain an engine speed of about 2000 rpm for approx. 3 minutes.

- Allow engine to run at idling speed until lower hose on radiator becomes hot.

WARNING!

Hot steam can escape when opening the cap on the expansion tank: Cover cap with a cloth and open carefully.

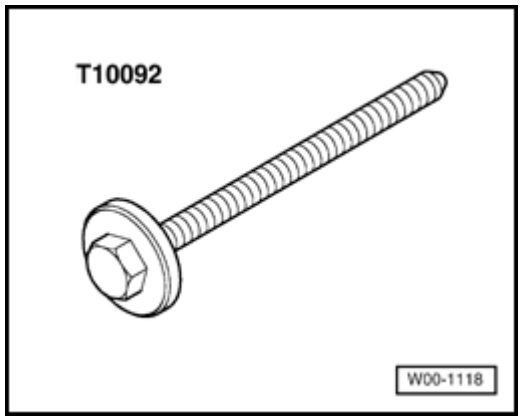
- Check coolant level and top up if necessary. If engine is warm, coolant level must be at max. mark; if cold, between min. and max. marks.

- Stop engine.

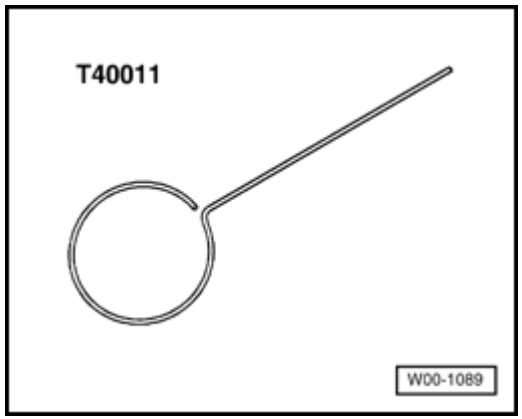
cardiagn.com

Coolant pump, removing and installing

Special tools and equipment



- Socket head fastener T10092



- Pin T40011

cardiagn.com

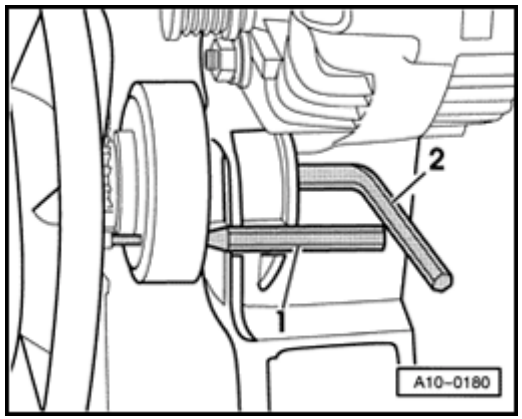
19-13

Removing

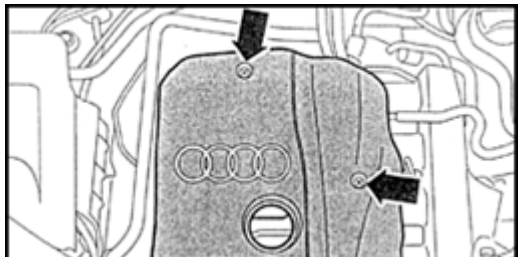
- Engine in vehicle.
- Lock carrier must be in service position ⇒ Page 13-1 .

- Drain coolant ⇒ Page 19-4 .

- Remove ribbed belt and tensioner for ribbed belt ⇒ Page 13-18 .



- Secure pulley for viscous fan with pin punch -1- and unfasten using Allen key -2-.
- Remove viscous fan from mounting.



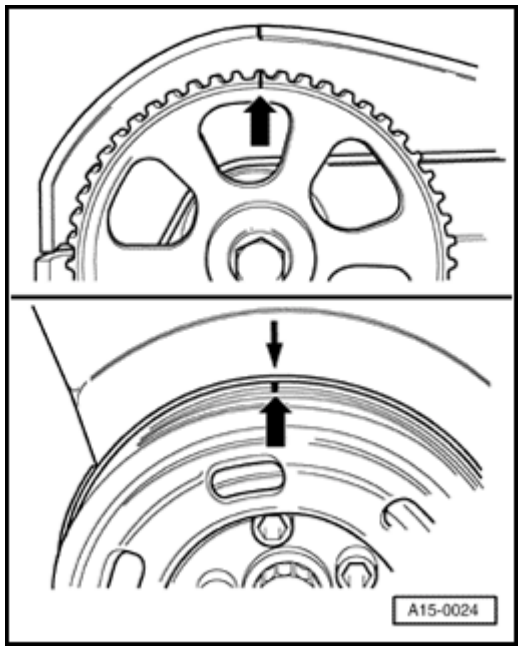
- Remove engine cover -arrows-.

cardiagn.com

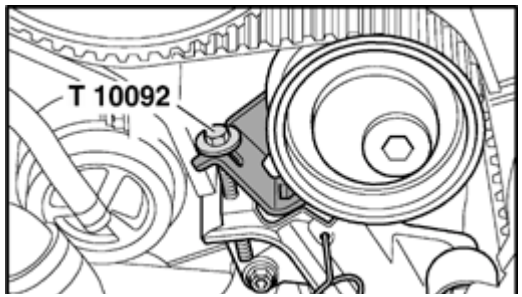
19-14

- Mark direction of rotation of belt with chalk or felt pen.

- Remove top and center toothed belt guard ⇒ Page 13-35 .



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



- Thread socket head fastener T10092 into tensioner for toothed belt.

Note:

Only tension pressure piston of tensioner until the piston is secured with pin T40011.

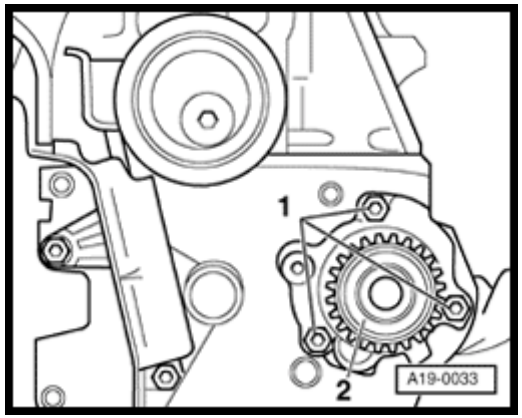
cardiagn.com

19-15

- Take toothed belt off camshaft sprocket and coolant pump.

Note:

- *The vibration damper and lower toothed belt guard do not have to be removed.*
- *The toothed belt should be left in position on the crankshaft sprocket.*
- *Before removing the coolant pump, cover toothed belt with a cloth to protect from coolant.*



- Remove coolant pump securing bolts -1- and remove coolant pump -2-.

cardiagn.com

19-16

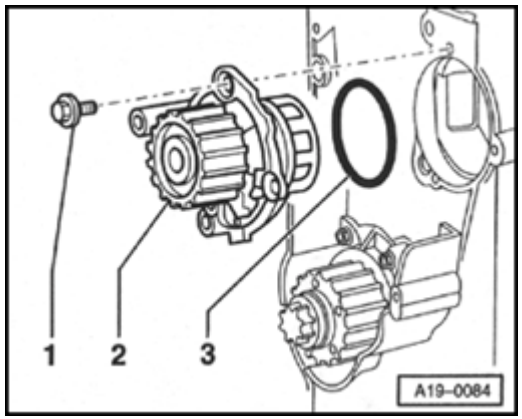
Installing

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

Note:

Always replace seals and gaskets.

- Clean and smooth down sealing surface for O-ring as required.



- Lightly coat new O-ring -3- with coolant G 012 A8 D.
- Install coolant pump -2-.
  - Installation position: Sealing plug in housing faces downward.
- Tighten bolts -1- of coolant pump to 15 Nm.
- Install toothed belt (adjust valve timing) ⇒ Page 13-44 .

Note:

Observe all instructions on removing and installing the toothed belt ⇒ Page 13-40 .

cardiagn.com

- Install ribbed belt and tensioner for ribbed belt ⇒ Page 13-20 .

- Install viscous fan ⇒ Page 13-21 .

- Install lock carrier ⇒ Page 13-1 .

- Top up coolant ⇒ Page 19-7 .

Tightening torque

Component	Nm
Coolant pump to cylinder block	15
Center section of toothed belt guard to cylinder block	10 1)
Hose clamps for coolant hoses	2

1) Install with locking fluid D 000 600 A2

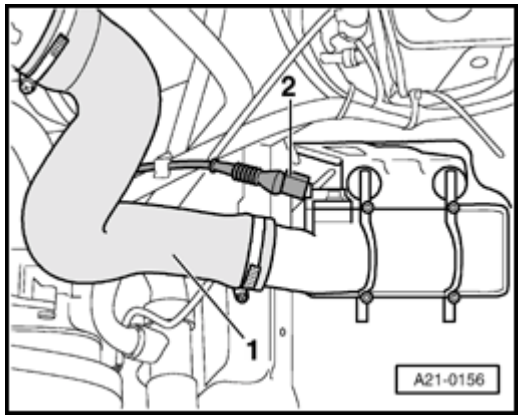
cardiagn.com

19-18

Coolant thermostat, removing and installing, checking

Removing

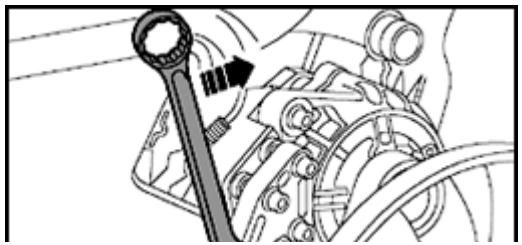
- Observe or obtain radio code on vehicles with coded radio.
- Disconnect Ground strap at battery with ignition switched off.
- Drain coolant ⇒ Page 19-4 .



- Remove air duct hose -1-.

Note:

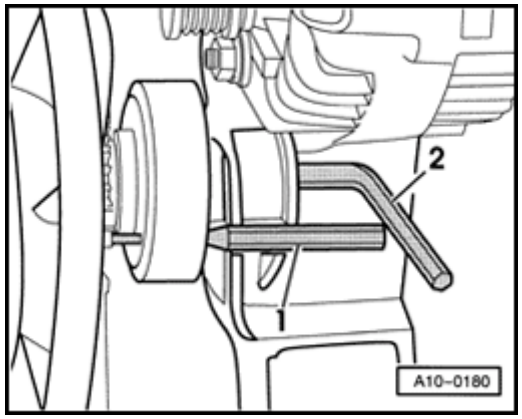
Connector -2- remains plugged in.



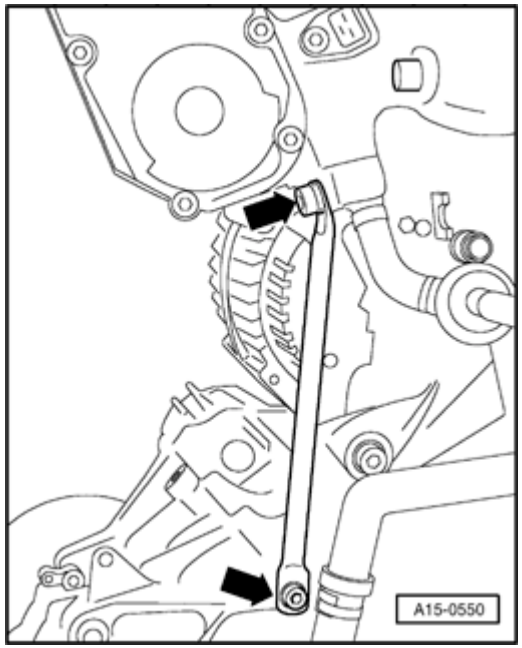
- Loosen ribbed belt by turning tensioner in direction of arrow.
- Remove ribbed belt from Generator pulley.

cardiagn.com

19-19



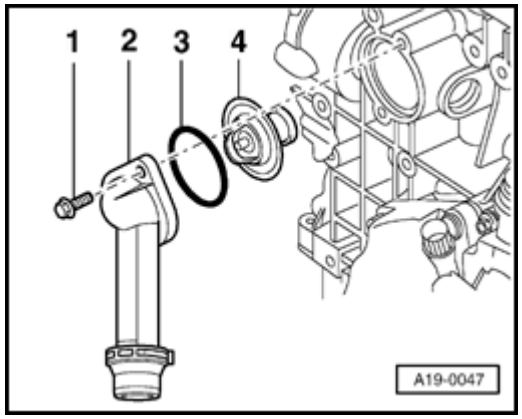
- Secure pulley for viscous fan with pin punch -1- and unfasten using Allen key -2-.
- Remove viscous fan from mounting and place in front of radiator cowl.
- Disconnect wiring from rear of Generator.
- Loosen connections for Generator from top and bottom and remove Generator.



- Remove intake line support -arrows-.

cardiagn.com

19-20



- Release clip and disconnect coolant hose from connection -2-.
- Remove bolts -1- remove connection, O-Ring -3- and coolant thermostat -4-.

Installing

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

Note:

Always replace seals and gaskets.

- Clean and smooth down sealing surface for O-ring as required.
- Lightly coat new O-ring with coolant G 012 A8 D.
- Insert coolant thermostat.
  - ♦ Installation position: Cross-piece on thermostat should be vertical.

cardiagn.com

- Install viscous fan ⇒ Page 13-21 .

- Install ribbed belt and tensioner for ribbed belt ⇒ Page 13-20 .

- After connecting battery, enter anti-theft code for radio.

⇒ *Radio operating instructions*

- Close windows fully using power window switches.

- Actuate all power window switches again for at least one second in the "close" direction to activate automatic open/close function.

- Set clock to correct time.

- Top up coolant ⇒ Page 19-7 .

cardiagn.com

19-22

Tightening torques

Component	Nm
Connection to cylinder block	15
Support for intake manifold	
to intake manifold	20
to bracket	20
Generator at bracket	
M8	23
M10	46
Hose clamps for air duct hoses	3.5

Check coolant thermostat

- Heat thermostat in water bath.

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

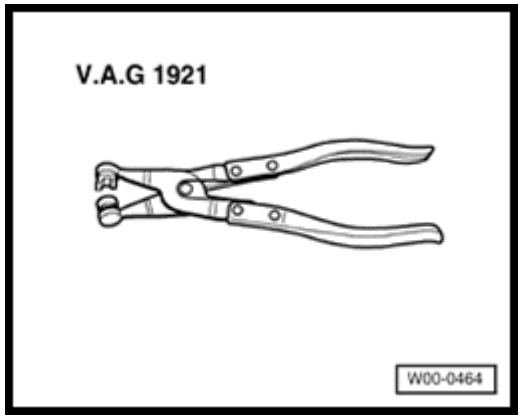
1) cannot be tested

cardiagn.com

19-23

Lower coolant line, removing and installing

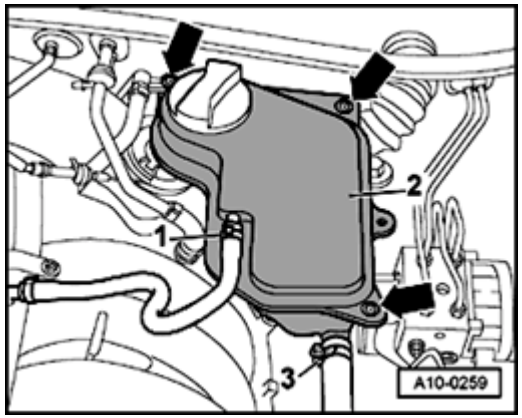
Special tools and equipment



- VAG 1921

Removing

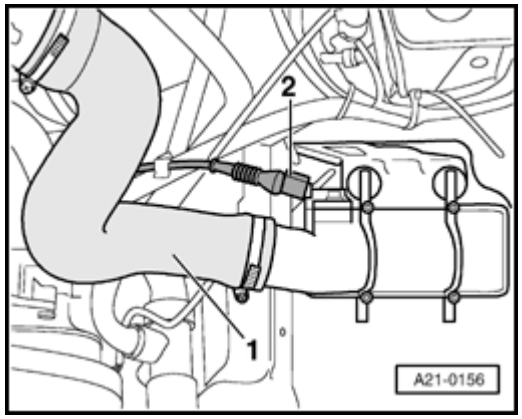
- Drain coolant ⇒ Page 19-4 .



- Disconnect coolant hoses -1- and -3-.
- Unbolt coolant expansion tank -2- (-arrows-).
- Disconnect electrical wiring to coolant level display switch -F66- on underside of expansion tank.

cardiagn.com

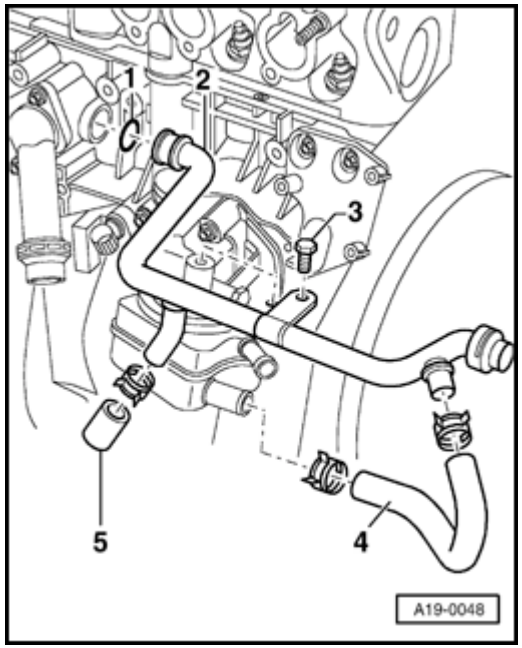
19-24



- Remove air duct hose -1-.

Note:

Connector -2- remains plugged in.



- Disconnect heater hose at rear of coolant line -2-. To do this, release retaining clip on connecting flange.
- Pull off coolant hose to oil cooler -4- at coolant line.
- Remove bolt -3-.
- Push lower coolant line toward rear of vehicle and remove.
- Remove plug -5- if necessary.

cardiagn.com

19-25

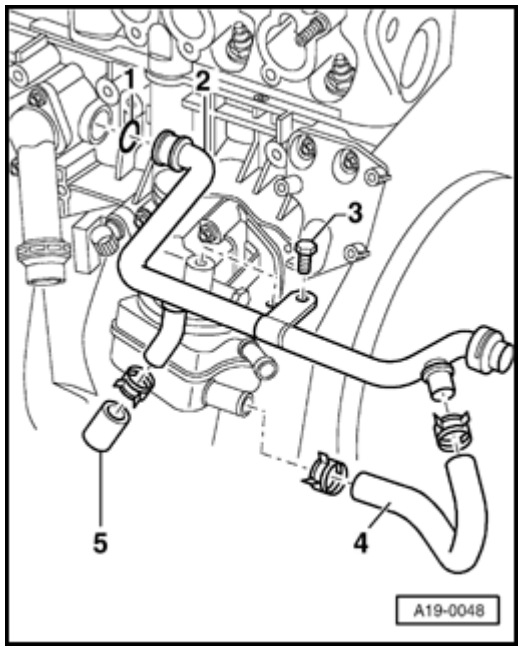
Installing

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

Note:

Always replace seals and gaskets.

- Before installing, clean and smooth down sealing surface for O-ring.



- Moisten new O-ring -1- with G 012 A8 D coolant and slide onto coolant line -2-.
- Push coolant line into opening in cylinder block.
- Top up coolant ⇒ Page 19-7 .

Tightening torques

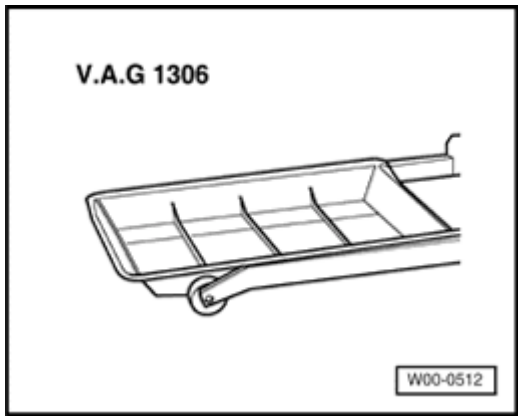
Component	Nm
Coolant line to oil filter bracket	20
Hose clamps for coolant hoses	2
Hose clamps for air duct hoses	3.5

cardiagn.com

19-26

Radiator, removing and installing

Special tools and equipment

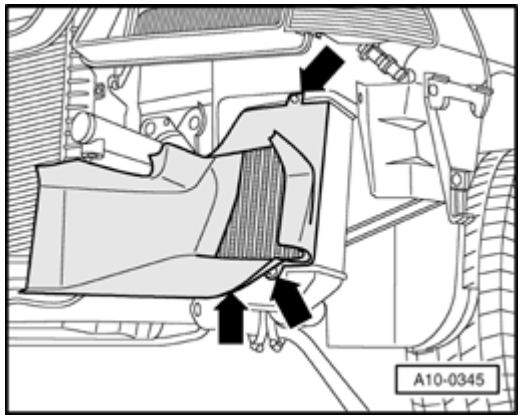


- VAG 1306

Removing

- Remove front bumper:

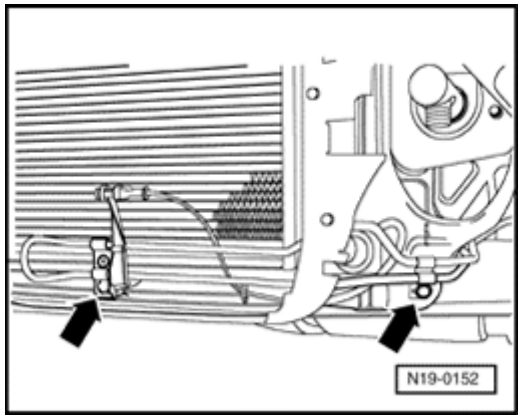
⇒ *Repair Manual, Body Exterior, Repair Group 63*



- Remove air cowl in front of charge air cooler -arrows-.

cardiagn.com

19-27

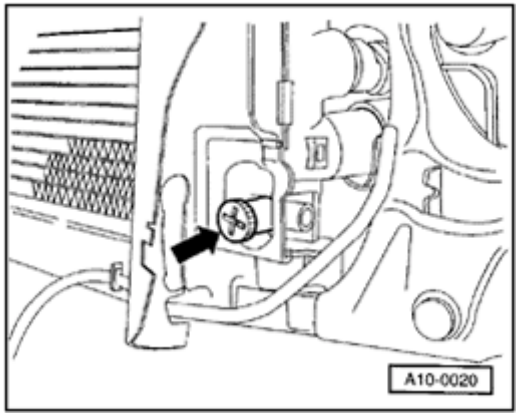


- Disconnect cooling lines for power steering hydraulic fluid -arrows-.

WARNING!

Hot steam can escape when opening the cap on the expansion tank: Cover cap with a cloth and open carefully.

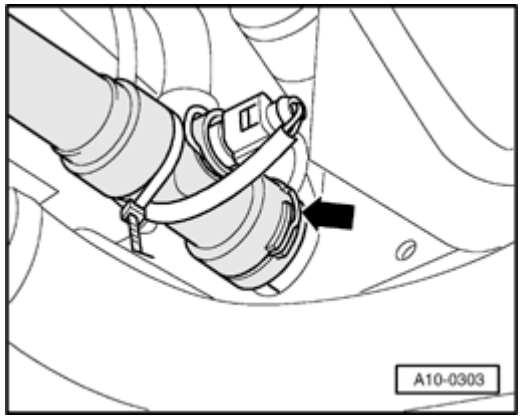
- Open cover of coolant expansion tank
- Place drip tray VAG 1306 below engine.



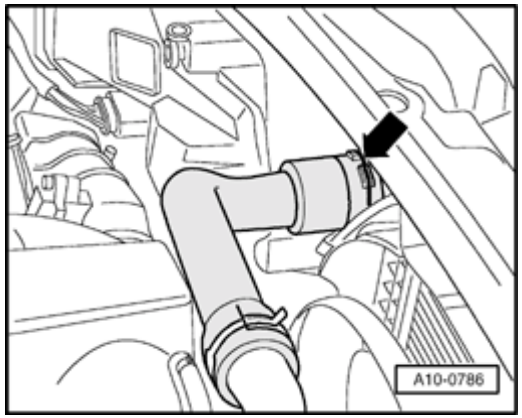
- Turn drain screw -arrow- on radiator counter-clockwise. If necessary, install a drain hose on connection.

cardiagn.com

19-28



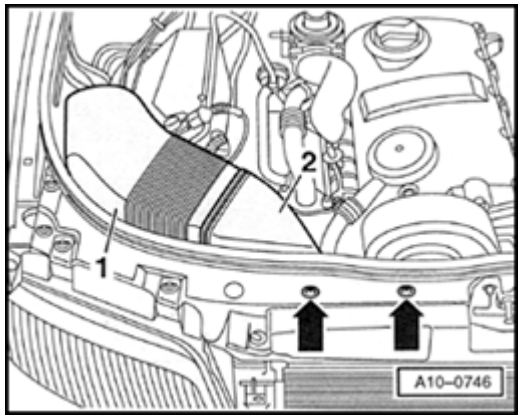
- Release coolant hose retaining clip -arrow- and remove coolant hose from radiator.



- Disconnect coolant hose from top of radiator -arrow-.

cardiagn.com

19-29



Vehicles with automatic transmission:

- Remove bolts -arrows-.
- Remove air duct -1- and -2-.

Note:

Observe cleanliness rules when working on the automatic transmission:

⇒ *Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37*

- Place drip tray underneath to collect oil.
- Remove ATF lines/hoses from radiator:

⇒ *Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37*

- Tie ATF lines to longitudinal member to avoid leakage of fluids.

All models:

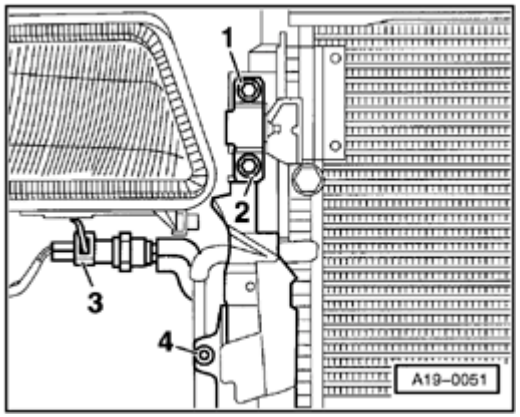
CAUTION!

The air conditioner refrigerant circuit must not be opened.

cardiagn.com

Note:

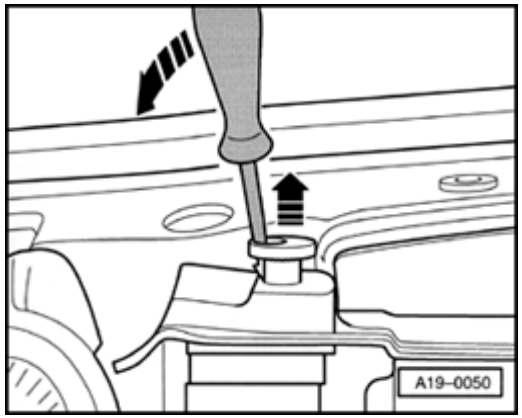
To prevent damage to the condenser and refrigerant lines/hoses, ensure that the lines and hoses are not stretched, kinked or bent.



- Remove air cowls from radiator -4- (left and right).
- Remove securing bolts -1- and -2- for condenser.
- Disconnect connector -3- from air conditioner pressure switch -F129-.
- Pull condenser up out of its bracket, pivot toward side and secure to right-hand front wheel with wire.

Note:

Protect fender panel from damage.



- Release two retaining pins for radiator and pull out upward -arrows-.
- Pivot radiator toward front and lift out.

cardiagn.com

Installing

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

- Install front bumper:

⇒ *Repair Manual, Body Exterior, Repair Group 63*

- Top up coolant ⇒ Page 19-7 .

Vehicles with automatic transmission:

- Attach ATF lines.

⇒ *Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37*

- Check ATF level:

⇒ *Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37*

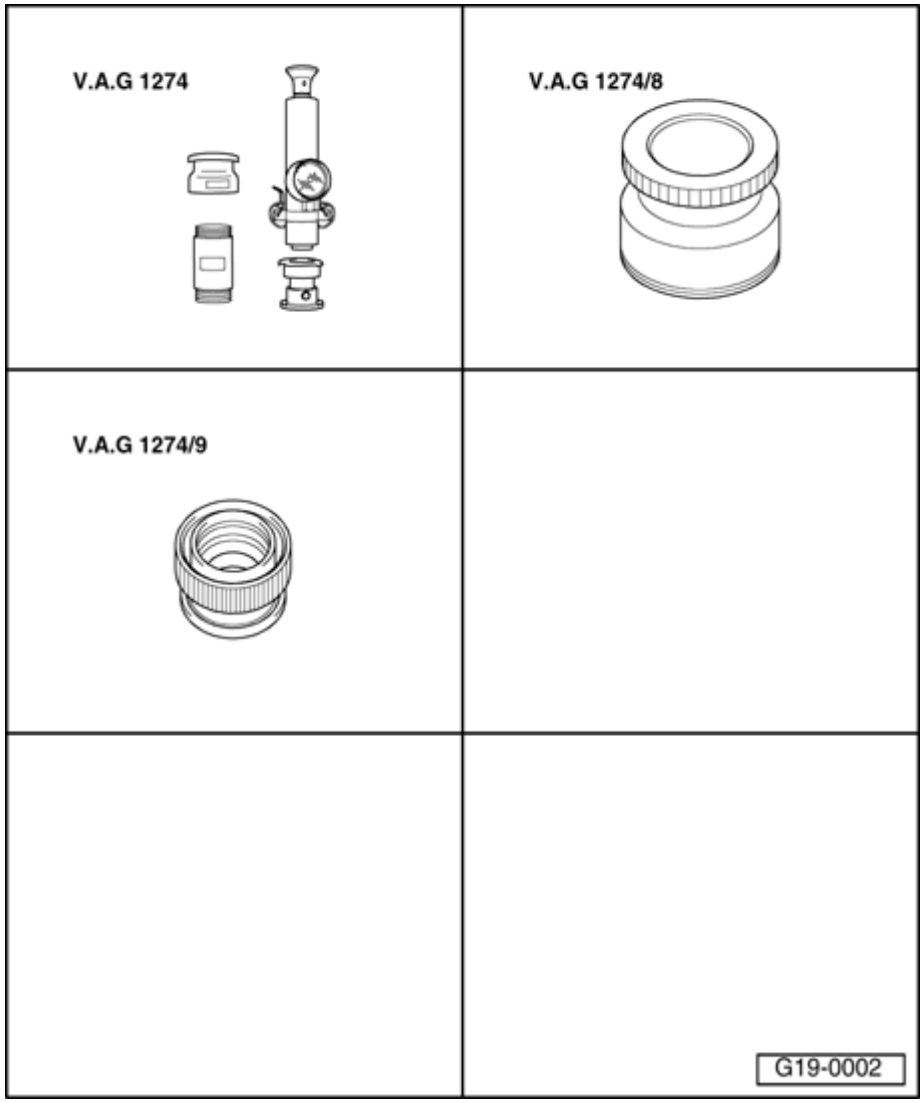
Tightening torques

cardiagn.com

Component	Nm
Condenser to radiator	10
Cooling lines to radiator	10
Hose clamps for coolant hoses	2

cardiagn.com

19-32



Cooling system, checking for leaks

Special tools and equipment

- VAG 1274
- Adapter 1274/8
- Adapter 1274/9

cardiagn.com

19-33

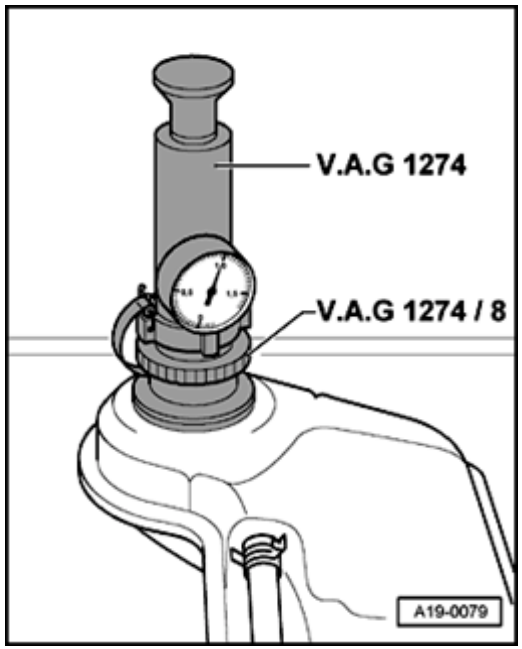
Test requirements:

- Engine at operating temperature.

WARNING!

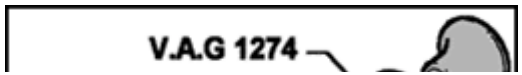
Hot steam can escape when opening the cap on the expansion tank: Cover cap with a cloth and open carefully.

- Open cover of coolant expansion tank



- Install tester VAG 1274 with adapter VAG 1274/8 onto expansion tank.
- Using hand pump on tester, build up a pressure of approx. 1.0 bar.
- If this pressure is not maintained, locate and repair leaks.

Testing pressure relief valve in filler cap



cardiagn.com

- Install tester VAG 1274 with adapter VAG 1274/9 onto sealing cover.
- Operate hand pump.

• Pressure relief valve must open at a pressure of 1.4 to 1.6 bar.

cardiagn.com

21-1

Charge air system with turbocharger, checking

Notes:

- *For cleanliness rules, see ⇒ Page 21-44 .*
- *Secure all hose connections with the correct hose clips (same as original equipment):*

⇒ *Parts Catalog*

- *Before performing a check or repair, all hoses and lines must be checked for tight seating and leaks.*
- *Always replace seals, gaskets and self-locking nuts.*

cardiagn.com

Safety precautions

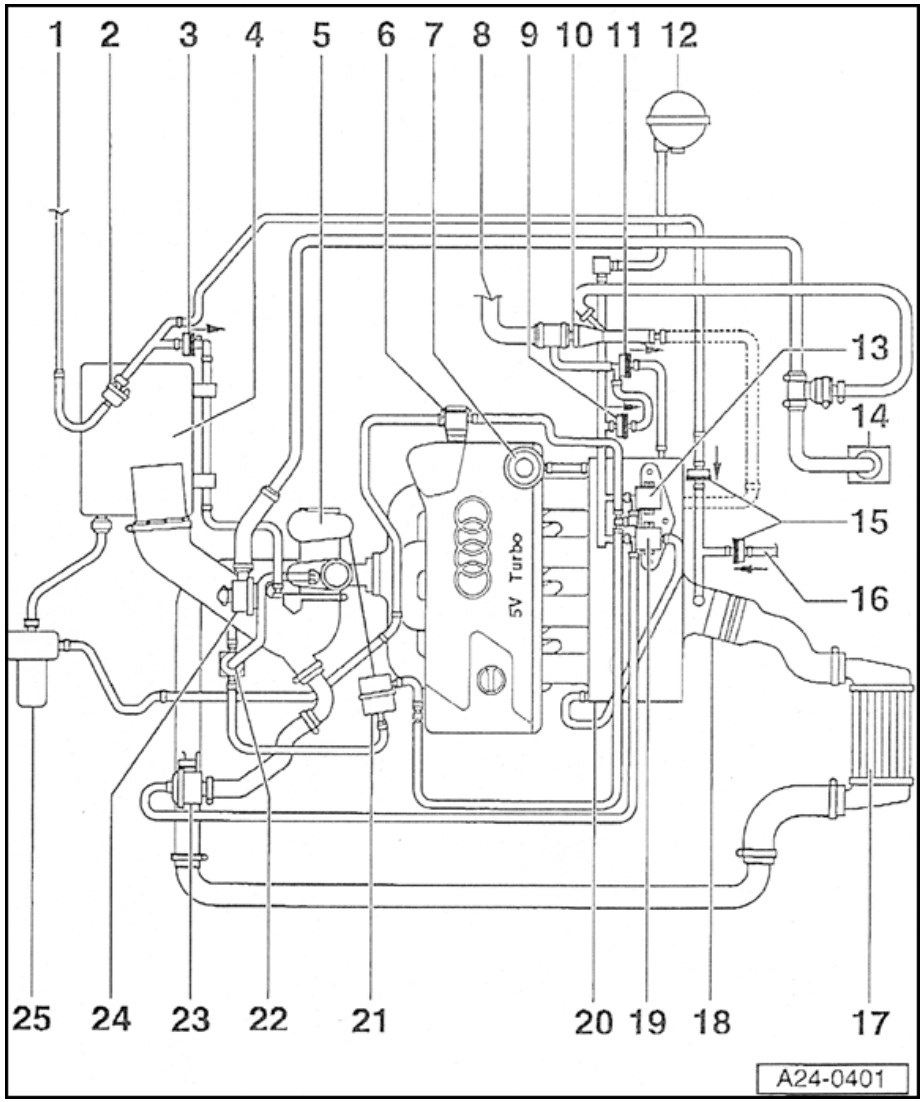
Note the following points if testers and measuring instruments have to be used during a road test:

WARNING!

- ***Always attach testers and measuring instruments to the back seat and have a second person operate them from there.***

- ***If test equipment were operated from the front passenger seat, the person sitting there could be injured if the front passenger airbag were triggered in the event of an accident.***

cardiagn.com



Connection diagram for charge air control and vacuum pressure control

1 - Activated charcoal filter (ACF)

2 - EVAP Canister Purge Regulator valve - N80-

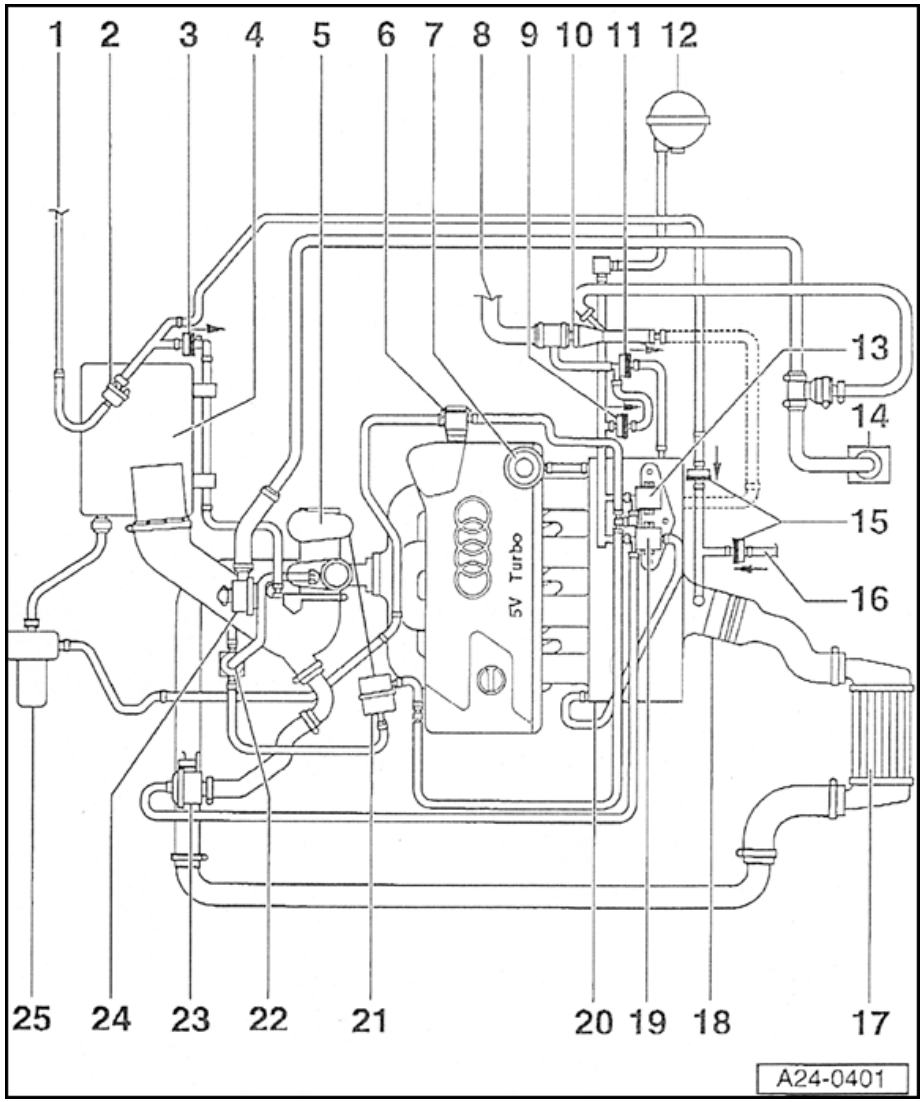
3 - Non return valve for ACF

- Between ACF container and intake line in front of exhaust turbocharger
- Note position (light side/ dark side) as shown in Fig; arrow faces in direction of flow

4 - Air cleaner

- With Mass Air Flow (MAF) sensor -G70-

cardiagn.com



5 - Turbocharger

- Check charge pressure ⇒ Page 21-8

6 - Combination valve for secondary air inlet

7 - Fuel pressure regulator

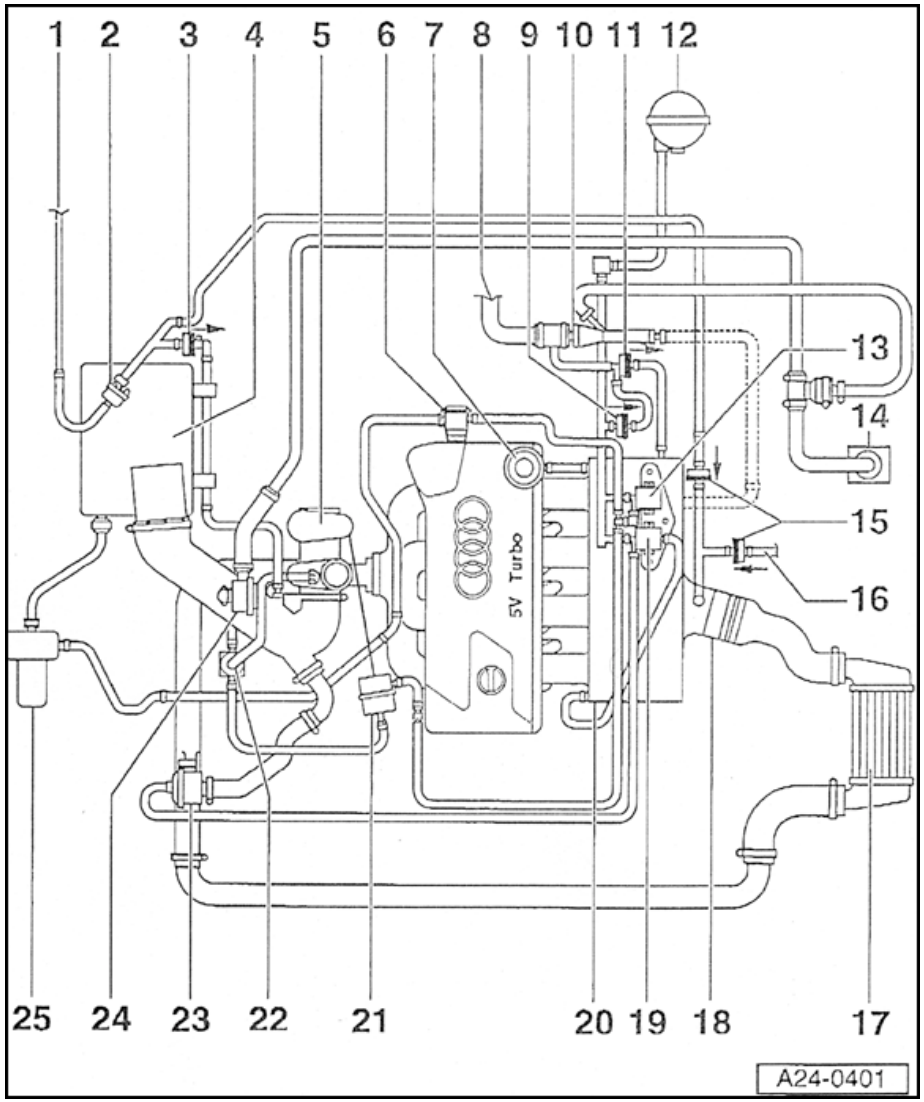
8 - To brake servo

9 - Non-return valve

- Between brake servo and intake line
- Note position (light side/ dark side) as shown in Fig; arrow faces in direction of flow

10 - Suction jet pump

cardiagn.com



11 - Non-return valve

- Between brake servo and intake line
- Note position (light side/ dark side) as shown in Fig; arrow faces in direction of flow

12 - Vacuum reservoir

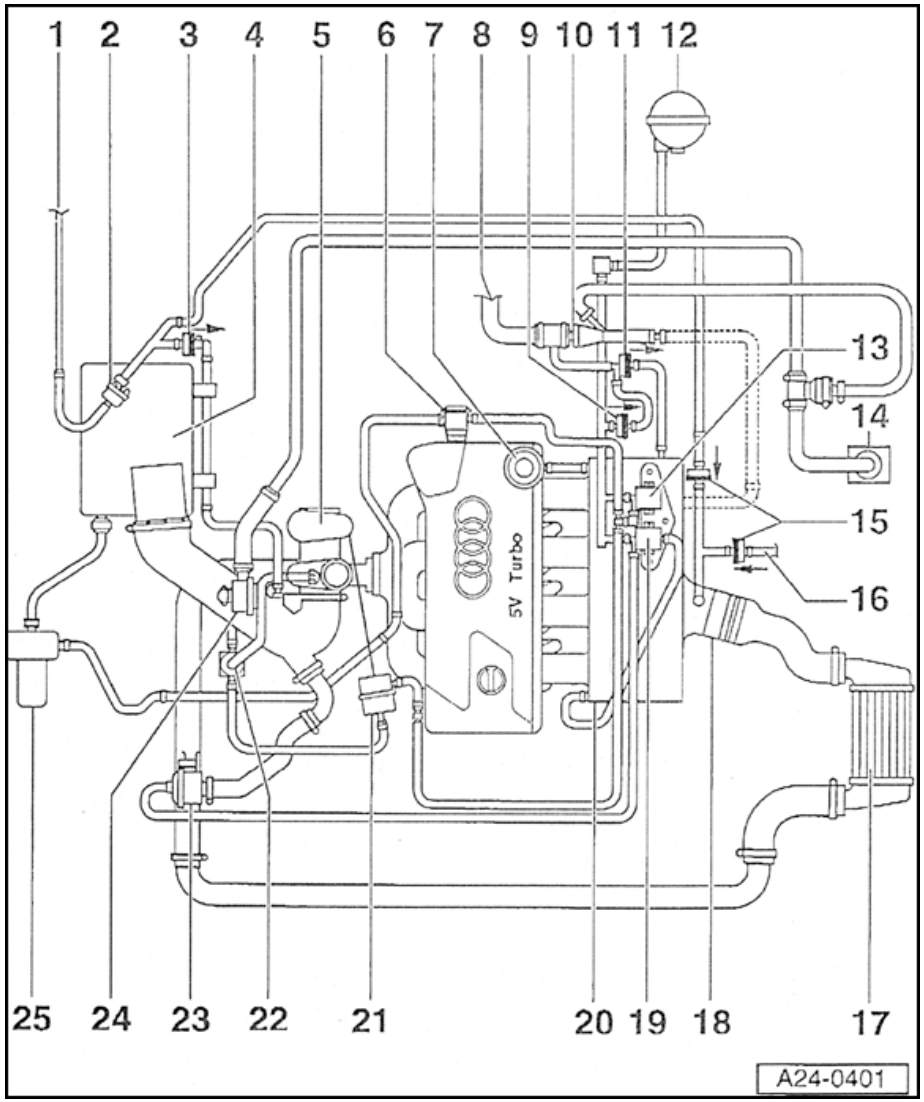
- Location: In front left wheel housing beneath wheel housing liner

13 - Secondary Air Injection (AIR) Solenoid valve -N112-

- Location: Below intake line

14 - Crankcase breather

cardiagn.com



15 - Non-return valve

- Between ACF container and intake line
- Note position (light side/ dark side) as shown in Fig; arrow faces in direction of flow

16 - From Leak Detection Pump (LDP) -V144-

17 - Charge air cooler

- With Charge Air Pressure sensor -G31-

18 - Throttle Valve Control Module -J338-

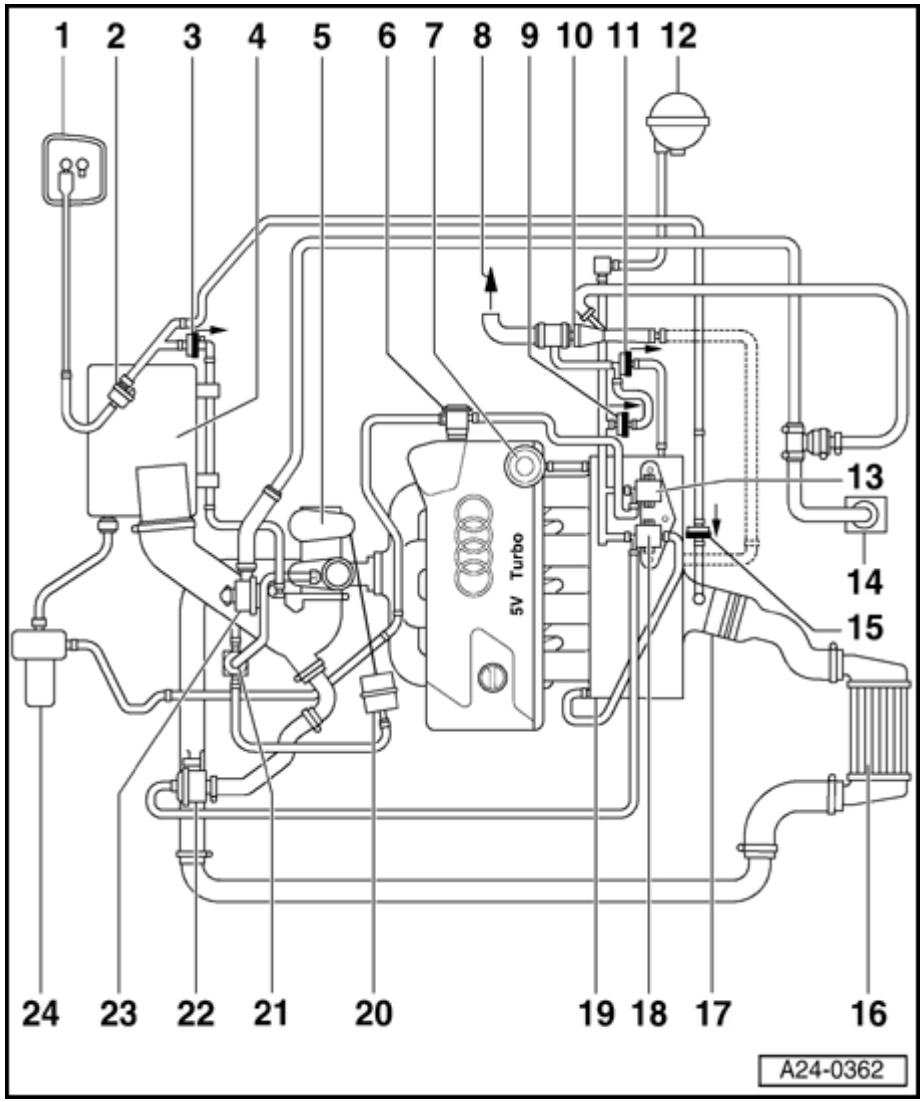
19 - Recirculating valve for turbocharger -N249-

- Location: below intake line

20 - Intake manifold

- With Intake Air Temperature (IAT) sensor -G42-

cardiagn.com



21 - Vacuum unit for charge pressure control

22 - Wastegate Bypass Regulator valve -N75-

- Checking ⇒ Page 21-33

23 - Mechanical air recirculation valve

- Checking ⇒ Page 21-24

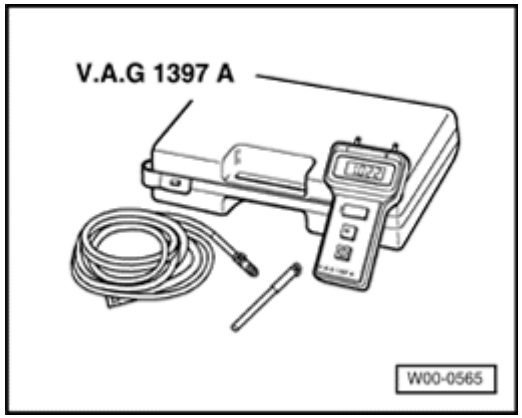
24 - Crankcase breather pressure regulating valve

25 - Secondary Air Injection (AIR) Pump motor -V101-

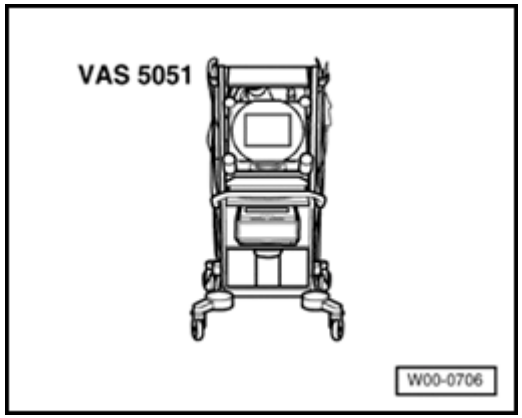
cardiagn.com

Turbocharger and charge pressure regulating valve, checking

Special tools and equipment



- Turbocharger tester VAG 1397 A



- VAS 5051 with VAS 5051/1

or

- VAG 1551 with VAG 1551/3 A

cardiagn.com

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551 Scan Tool connected.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 01*

- All hoses and lines must be checked for correct seating and leaks.

- Diagnostic Trouble Code (DTC) memory has been checked:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 01*

- Output Diagnostic Test Mode (DTM) has been performed:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM,*

cardiagn.com

Repair Group 01

Test sequence

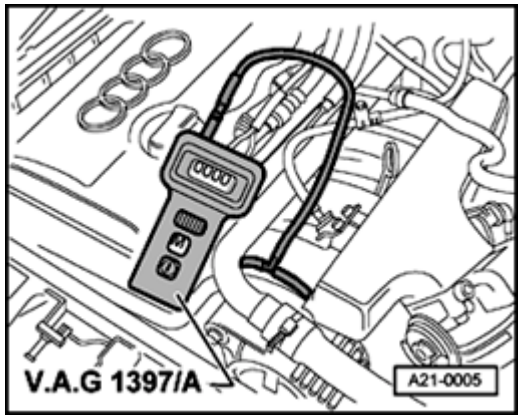
WARNING!

- ***Always attach testers and measuring instruments to the back seat and have a second person operate them from there.***

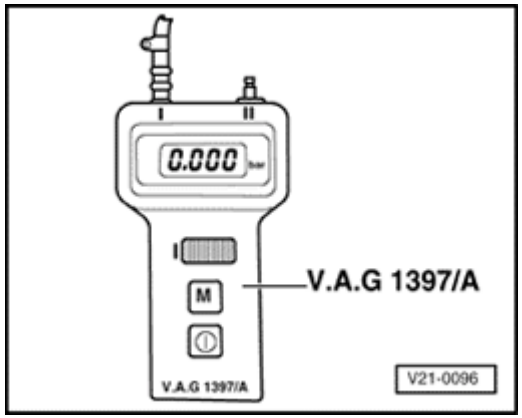
- ***If test equipment were operated from the front passenger seat, the person sitting there could be injured if the front passenger airbag were triggered in the event of an accident.***

cardiagn.com

21-10



- Connect T piece and measuring hose of turbocharger tester VAG 1397 A to intake manifold (front).
- Route measuring hose under rear edge of hood and into passenger compartment via right hand window.



- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Connect measuring hose to connection -I-.

cardiagn.com

21-11

Note:

- *Hose connections must be completely airtight, otherwise measurements will not be correct.*
- *Ensure that measuring hose is not pinched at hood or side window.*
- *Pressing memory key M on turbocharger tester will store the last measured value until memory key M is pressed again or tester is switched off.*
- *The decimal point in the display flashes to indicate that the value is being stored.*
- *If the battery voltage of the turbocharger tester drops below the minimum level, an arrow will appear at the top left of the display.*
- *Before checking, drive vehicle quickly for at least 3 km (choose a safe route that does not include stopping).*
- *A second mechanic is required to note readings with the vehicle moving.*

cardiagn.com

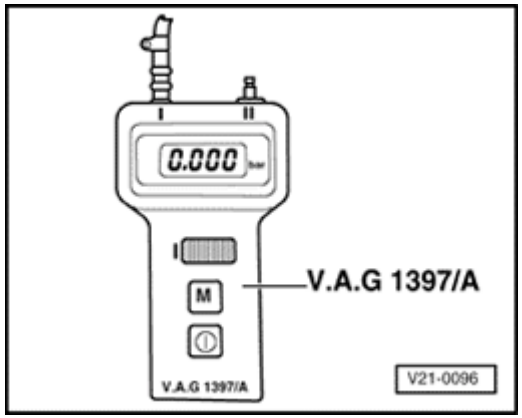
21-12

Read measured value block 115 →
1 2 3 4

- Read measured value block Display group 115, engine idling.
- Accelerate vehicle from 2000 rpm at wide open throttle in third gear, and observe rev counter.
- At approx. 2500 rpm press print key on VAS 5051 or PRINT key on VAG 1551 and at same time press recall button -M- on VAG 1397 A.

Note:

The charge pressure level is measured with turbocharger tester VAG 1397/A. The vehicle diagnostic, measuring and information system VAS 5051 or the VAG 1551 Scan Tool is used to check whether the charge pressure is being registered by the control module.



- Specified value on VAG 1397 A: 1.700 to 1.800 bar

Read measured value block 115 →
1 2 3 4

- Specified value on VAG 1551 or on VAS 5051 in display zone 4: 1700 to 1800 mbar

If specified value not attained ⇒ table, ⇒ Page 21-13

cardiagn.com

Charge air pressure control malfunctions

Malfunction	Possible causes
Charge air pressure below specified value	♦ Wastegate Bypass Regulator valve -N75- faulty ⇒checking, ⇒ Page 21-33 ♦ Hose connection to Wastegate Bypass Regulator valve -N75- faulty ⇒Connection diagram, ⇒ Page 21-3 ♦ Wastegate bypass regulator valve in turbocharger stuck open ♦ Leak between exhaust turbocharger and intake hose ⇒Effects, ⇒ Page 21-14 ♦ Mechanical air recirculation valve faulty ⇒checking, ⇒ Page 21-24 ♦ Recirculating valve for turbocharger -N249- faulty ⇒checking, ⇒ Page 21-26 ♦ Exhaust turbocharger faulty ⇒replacing, ⇒ Page 21-51
Charge air pressure above specified value [1)]	♦ Vacuum unit for wastegate bypass regulator valve faulty ⇒Replacing exhaust turbocharger, ⇒ Page 21-51 ♦ Hose connection to vacuum unit for charge air pressure limiter (above -N75-) leaks ⇒Connection diagram, ⇒ Page 21-3 ♦ When in closed position wastegate bypass regulator valve in exhaust turbocharger sticks ⇒replacing exhaust turbocharger, ⇒ Page 21-51

1) If the charge air pressure is too high the fuel supply will be interrupted in order to protect the engine. This results in misfiring at high engine speeds.

cardiagn.com

Effects of leaks in intake or exhaust system

Leak downstream of mass air flow sensor

- Effect: Loss of power

Possible malfunction sources:

1 - Connection hoses between mass air flow sensor and exhaust turbocharger

2 - Connection hose for crankcase vent

3 - Connection hose to mechanical air recirculation valve

cardiagn.com

Leak downstream of exhaust turbocharger

- Effect: Charge pressure too low

Possible malfunction sources:

1 - Connection hoses and line between exhaust turbocharger and charge air cooler

2 - Hose between charge air cooler and intake line

3 - Charge air cooler

4 - Seal of Charge Air Pressure sensor -G31- (in charge air cooler)

5 - Sealing between throttle valve control module and intake line

6 - Sealing between intake line and cylinder head

Effects of leaks on exhaust side

- Effect: Charge air pressure too low, possible exhaust smell, soot traces in engine compartment

cardiagn.com

Possible malfunction sources:

1 - Exhaust turbocharger /exhaust manifold connection

2 - Exhaust manifold/cylinder head connection

cardiagn.com

Charge pressure leak test with VAG 1687

Intake system, checking for leaks using VAG 1687 Diagnostic Tool

Diagnostic trouble codes (DTCs) related to fuel trim, charge pressure or mass air flow (MAF) may be caused by:

- Leaking (worn/torn) intake hoses during charge conditions
- Incorrectly torqued or improperly placed clamps on intake hoses etc. causing leaks during charge conditions



➢ Check the charge air pressure system using the VAG 1687 Charge air system tester.

Special tool VAG 1687 Charge air system tester preliminary set-up



➢ - Back off pressure regulator knob -2- of VAG 1687 fully to protect gauge when shop air supply is applied to assembly.

cardiagn.com

- Close valve -3- before gauge.
- Close valve -4- after gauge.

The shop air supply line will later be attached to the inlet of VAG 1687.

- Remove female fitting from tester (arrow) and install an appropriate "male" air fitting that will connect to your shop air supply line (⇒WARNING!).

cardiagn.com

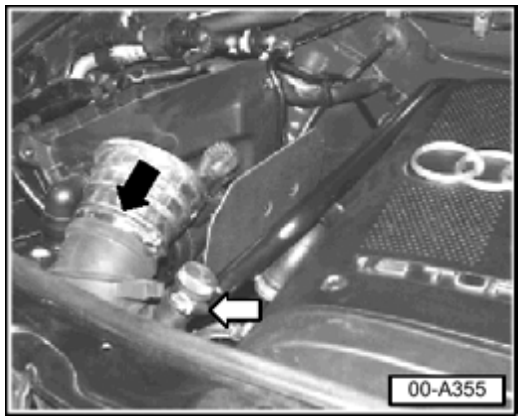
21-17

WARNING!

Use only approved air fittings to adapt shop air supply line to VAG 1687 tester.

Special tool VAG 1687/1 pressure adapter, installing (1.8L Turbo)

- Separate intake hose from Mass Air Flow (MAF) sensor assembly.

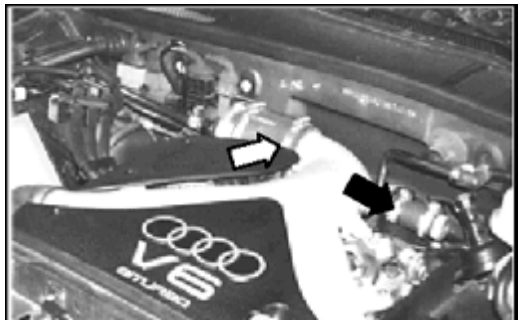


- Insert VAG 1687/1 pressure adapter in intake hose -black arrow- using existing clamp (as shown).
- Remove crankcase ventilation tube from intake hose at -white arrow-.

Special tool VAG 1687/1 pressure adapter, installing (2.7L BiTurbo)

- Remove upper air cleaner housing and hoses to intake manifold as necessary

⇒ *Repair Manual, Maintenance; Air cleaner housing, cleaning; Air cleaner element, replacing*



- Insert VAG 1687/1 pressure adapter in intake hose -white arrow- using existing clamp (as shown).
- Disconnect engine crankcase ventilation hose from intake manifold - black arrow-.
- Plug intake manifold fitting (for crankcase ventilation hose) with appropriate hose and metal plug using clamps supplied with VAG

cardiagn.com

1687/1 special tool kit.

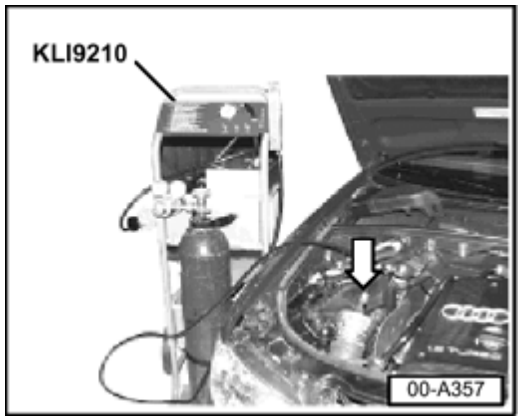
cardiagn.com

Note:

- *To help find small leaks, BEFORE pressurizing the system fill system with smoke using special tool KLI9210 and adapter KLI9210/50 as described on ⇒ Page 21-18 .*
- *An ultrasonic detector may also be used to detect extremely small leaks where smoke may not be visible.*

Special tool KLI9210 (Evaporative system leak detector), connecting to 1.8L Turbo

- Install optional fitting LKI9210/50 on hose of special tool KLI9210.



- Connect KLI9210 to VAG 1687/1 adapter (KLI9210 is shown attached to VAG 1687/1 at arrow on 1.8L Turbo).

Special tool KLI9210 (Evaporative system leak detector), connecting to 2.7L BiTurbo

- Install optional fitting LKI9210/50 on hose of special tool KLI9210.



- Connect KLI9210 to VAG 1687/1 adapter (KLI9210 is shown attached

cardiagn.com

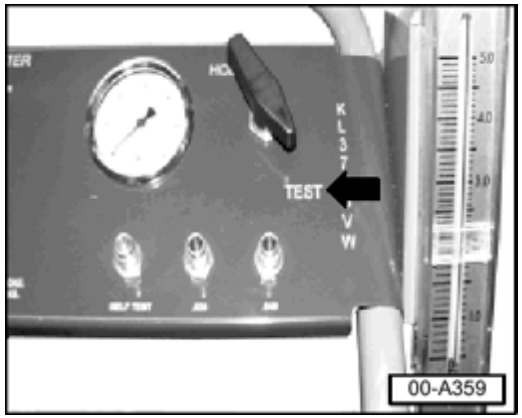
to VAG 1687/1 at arrow on 2.7L BiTurbo).

cardiagn.com

21-19

Special tool LKI9210 (Evaporative system leak detector), preliminary set-up

- Connect smoke generator leads to vehicle battery.



- Turn valve to test -black arrow-.
- Press smoke generator button to fill system with smoke (see instructions printed on tester).

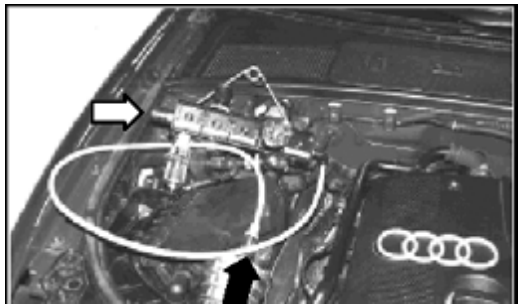
With system filled with smoke:

- Remove smoke generator hose and connect VAG1687 quickly to prevent smoke from leaking out ⇒ Page 21-19 .

Special tool VAG 1687, connecting to pressure adapter VAG 1687/1 (1.8L Turbo)

For illustrations purposes VAG is shown lying in the engine compartment. In practice the tool should be hung from the hood.

- Connect VAG 1687 quickly to prevent smoke from leaking out.



VAG 1687 is shown connected to VAG 1687/1 -black arrow-

Shop air supply will be connected to VAG 1687 -at white arrow-

- Perform pressure test ⇒ Page 21-21 .

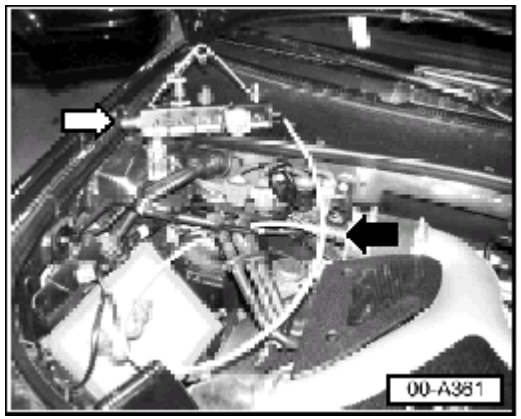
cardiagn.com

21-20

Special tool VAG 1687, connecting to pressure adapter VAG 1687/1 (2.7L BiTurbo)

For illustrations purposes VAG is shown lying in the engine compartment. In practice the tool should be hung from the hood.

- Connect VAG 1687 quickly to prevent smoke from leaking out.



VAG 1687 is shown connected to VAG 1687/1 -black arrow-

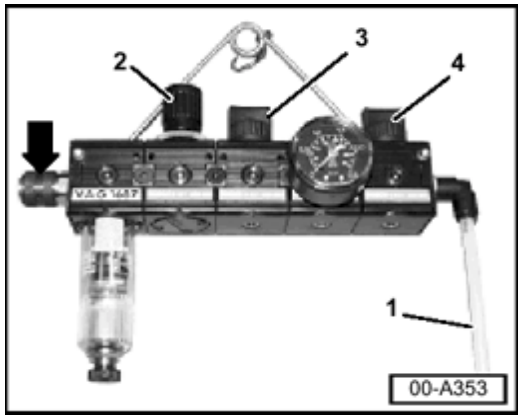
Shop air supply will be connected to VAG 1687 -at white arrow-

- Perform pressure test ⇒ Page 21-21 .

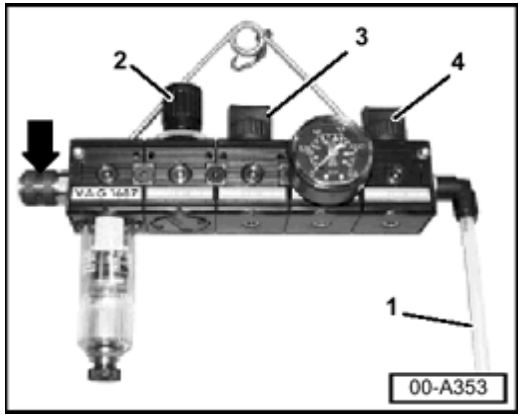
cardiagn.com

21-21

Performing pressure test:



- With outlet hose -1- of VAG 1687 connected to air pressure adapter:
- Attach shop air supply line to previously installed male fitting ⇒ Page 21-16 .



- Open valve -3- between regulator valve and gauge.
- Adjust test pressure up to 0.5 bar (⇒CAUTION below) by turning regulator valve -2-.

CAUTION!

- ***DO NOT pressurize the system above 0.5 bar!***
- ***Doing so may force oil into the intake system which can damage the engine.***

- Slowly open outlet valve -4- (after gauge) to test hose connections.
- Observe pressure gauge for a drop in pressure.

cardiagn.com

Note:

Some pressure will be lost past the throttle plate.

- Readjust test pressure to 0.5 bar (⇒CAUTION above) by turning regulator valve -2-.

- Listen for any very large intake leaks.

If smoke generator was used to fill the system with smoke:

- Inspect intake system connections for smoke at leaks.

Note:

An ultrasonic detector may also be used to detect extremely small leaks where smoke may not be visible.

- Repair any leaks found.

- Remove tester.

- Remove plug from crankcase ventilation hose.

- Remove air pressure adapter.

cardiagn.com

With VAS 5051 diagnostic tool connected:

- Erase DTC memory.

If smoke generator was not used to fill the system with smoke:

- Apply soapy water solution or equivalent to intake system connections.

cardiagn.com

21-23

Note:

An ultrasonic detector may also be used to detect extremely small leaks.

- Inspect intake system connections for leaks.
- Repair any leaks found.
- Remove tester.
- Remove plug from crankcase ventilation hose.
- Remove air pressure adapter.

With VAS 5051 diagnostic tool connected:

- Erase DTC memory.

cardiagn.com

21-24

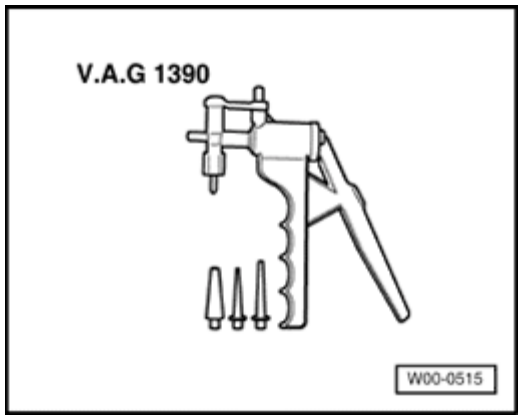
Mechanical air recirculation valve, checking

Note:

- *The mechanical air recirculation valve is upstream of the exhaust turbocharger. It is opened via vacuum by the recirculating valve for turbocharger -N249- under conditions of overrun, idling and partial load. This reduces the charge pressure upstream of the throttle valve. A high turbocharger speed is thus maintained.*

- *Check the air recirculation valve if the engine is not producing full power, or jerking when the throttle is opened and closed.*

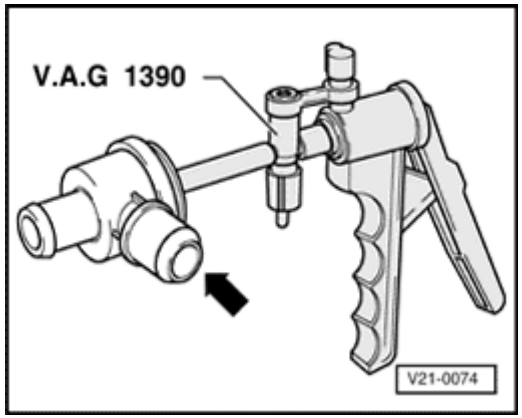
Special tools and equipment



- Hand vacuum pump VAG 1390

cardiagn.com

21-25



Test sequence

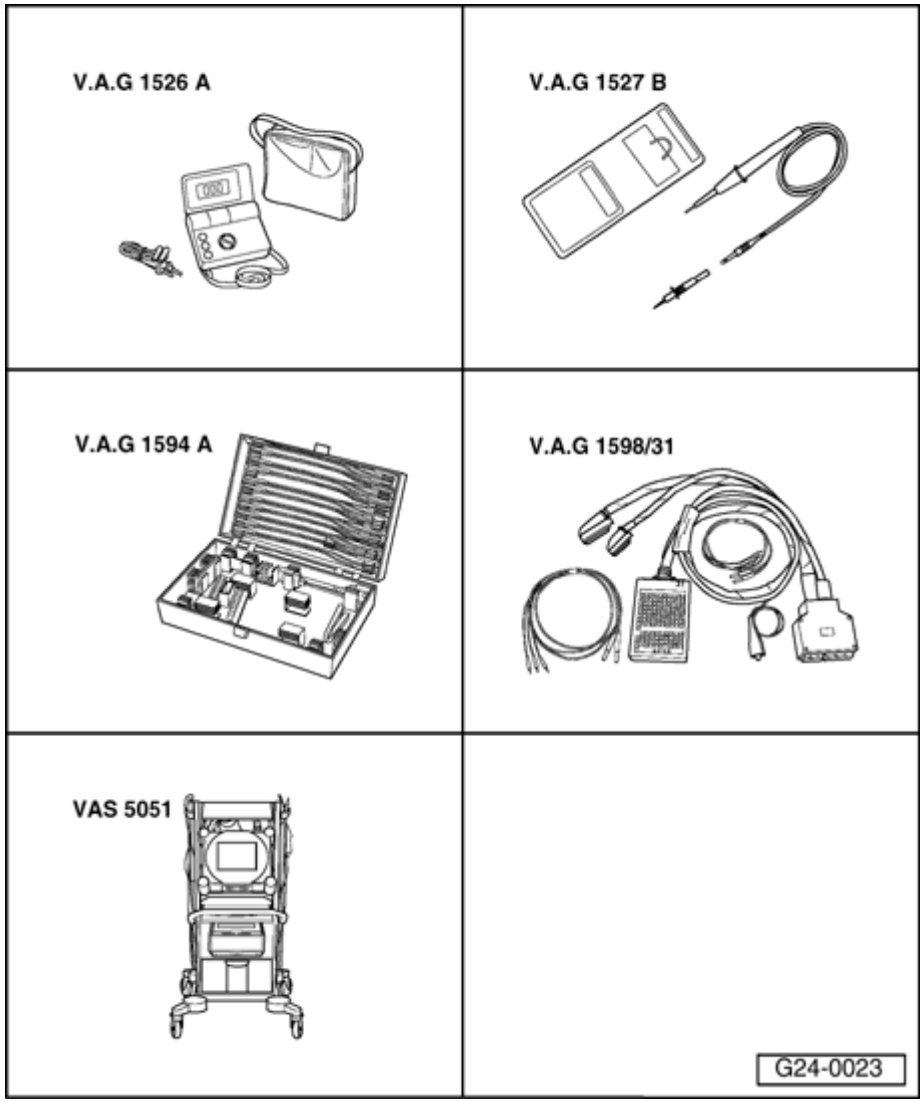
- Attach vacuum pump VAG 1390 to air recirculation valve.
- Actuate hand vacuum pump.
  - Air recirculation valve should open -arrow-
- Operate air vent valve on vacuum pump after about 30 seconds.
  - Air recirculation valve should close -arrow-

If the air recirculation valve does not open and close as specified, or if the valve plate does not seal properly when the valve is closed:

- Replace air recirculation valve and attach hose connections with hose clamps.

cardiagn.com

21-26



Recirculating valve for turbocharger - N249-, checking

Special tools and equipment

- VAG 1526 A
- VAG 1527 B
- VAG 1594 A
- VAG 1598/31
- VAS 5051 with VAS 5051/1

- or

- VAG 1551 with VAG 1551/3 A

cardiagn.com

21-27

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551 Scan Tool connected.

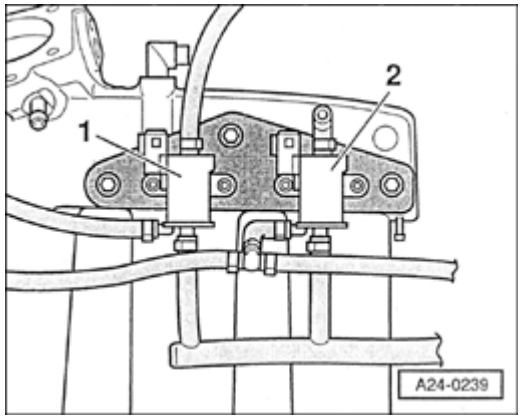
Test sequence

Note:

The recirculating valve for turbocharger -N249- and the wiring connections are monitored by the engine control module.

- Read Diagnostic Trouble Code (DTC) memory of engine control module.

If a DTC relating to the recirculating valve for turbocharger -N249- is displayed:



- Remove hoses of recirculating valve for turbocharger -N249- (-1-). The electrical connector remains plugged in.

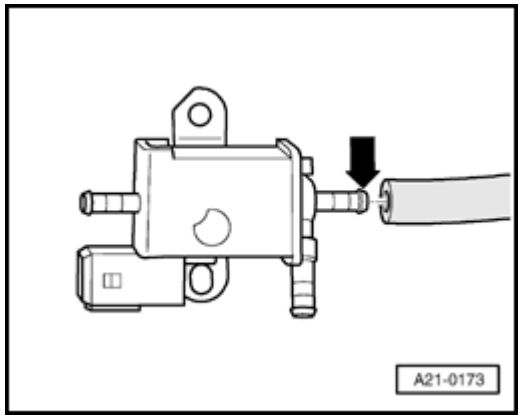
♦ Location: below intake line

Note:

The illustration shows bottom view of removed intake line.

cardiagn.com

21-28



Output Diagnostic Test Mode →

Recircul. valve for turbocharger -N249-

- Connect auxiliary hose to valve connector marked with an arrow.
- Initiate output Diagnostic Test Mode (DTM) and activate recirculating valve for turbocharger -N249-.

Display:

- The valve should click ...
- ... and must open and close (check by blowing into the auxiliary hose).

If the injector does not click:

- Check internal resistance of valve.

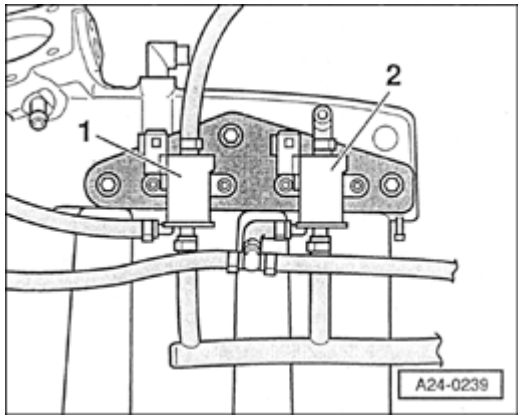
If valve does not open or close properly:

- Replace recirculation valve for turbocharger -N249-.

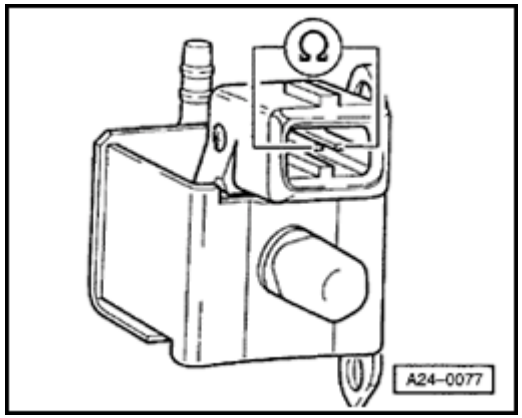
cardiagn.com

21-29

Checking internal resistance



- Disconnect connector from recirculation valve for turbocharger -N249- (-1-).



- Connect multimeter to injector to measure resistance.
  - Specified value: 27 to 30 Ω

If specified value is not attained:

- Replace recirculating valve for turbocharger -N249-.

If specified value is attained:

- Check power supply.

cardiagn.com

21-30

Checking power supply

Note:

The power supply for the recirculating valve is via the fuel pump relay.

Test requirements:

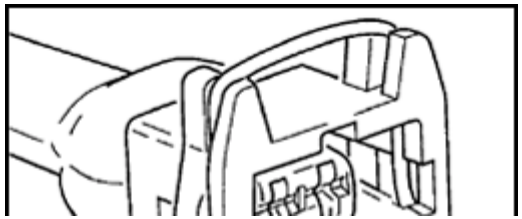
- Fuse for recirculating valve OK.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Fuel pump relay OK.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

- Disconnect wiring connector from valve.



- Connect voltage tester VAG 1527 B as follows:

Connector	Measure to

cardiagn.com

contact	
1	Engine Ground

- Operate starter briefly.

  - The LED must light up.

cardiagn.com

21-31

If the LED does not light up:

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

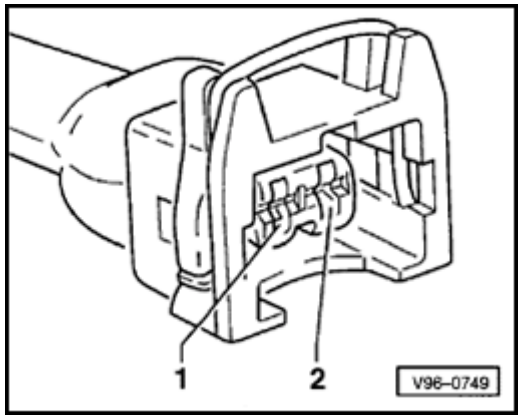
⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Repair open circuit, if necessary.

If the LED lights up:

- Check actuation.

Checking actuation



- Connect voltage tester VAG 1527 B to contacts 1 (positive) and 2 of connector.
- Initiate output Diagnostic Test Mode (DTM) and activate recirculatiing valve for turbocharger -N249-.
  - The LED must flash.

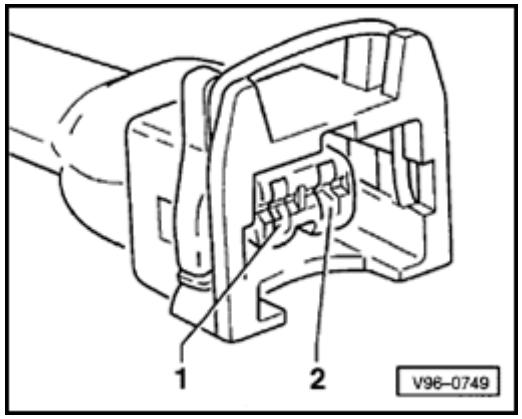
cardiagn.com

21-32

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

- Connect VAG 1598/31 test box to wiring harness leading to engine control module; engine control module should not be connected:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



- Check for open circuit and short to positive or Ground in following wiring connection:

Connector Contact	Test box VAG 1598/31
2	105

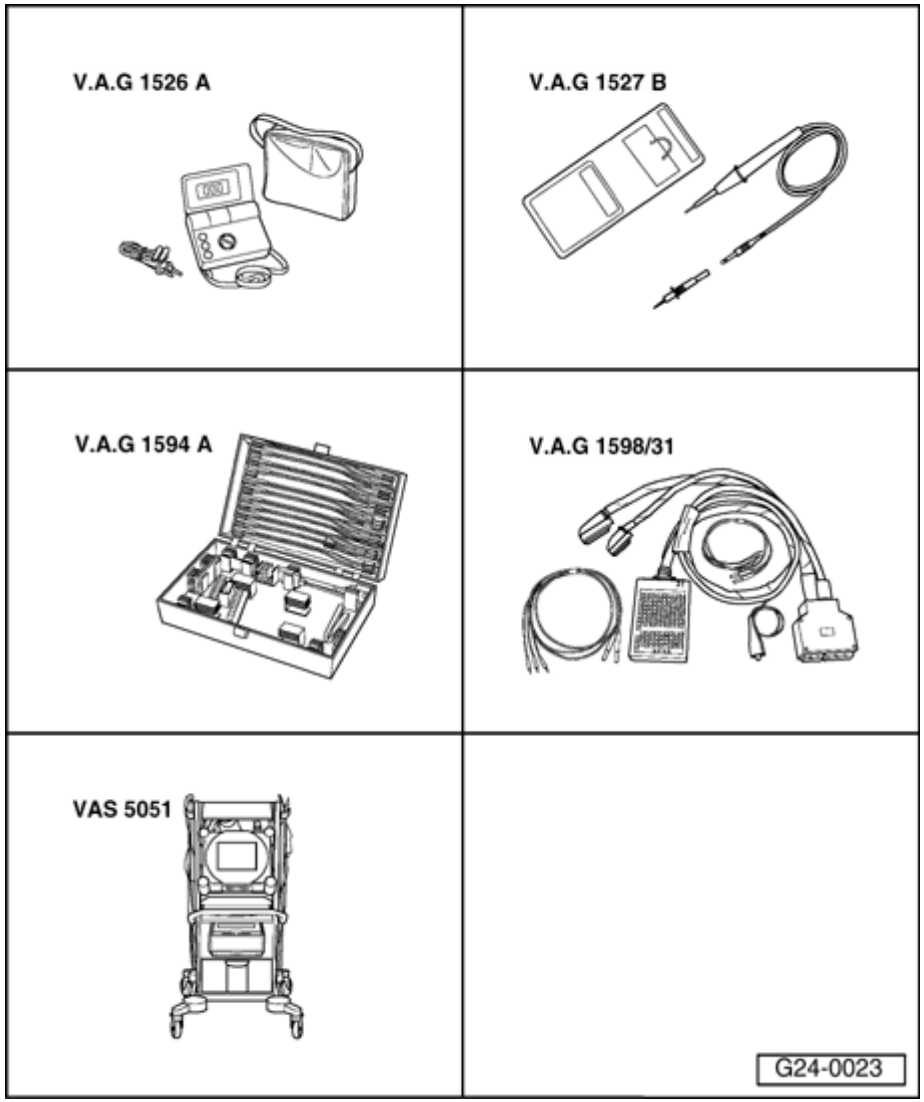
- Repair any open/short circuit as necessary.

If the wiring is OK:

- Replace engine control module.

cardiagn.com

21-33



Wastegate Bypass Regulator valve -N75-, checking

Special tools and equipment

- ♦ VAG 1526 A
- ♦ VAG 1527 B
- ♦ VAG 1594 A
- ♦ VAG 1598/31
- ♦ VAS 5051 with VAS 5051/1

- or

- ♦ VAG 1551 with VAG 1551/3 A

cardiagn.com

21-34

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551 Scan Tool connected.

Test sequence

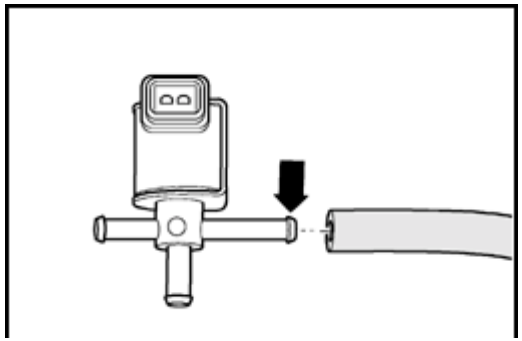
Note:

The Wastegate Bypass Regulator valve -N75- and the wiring connections are monitored by the engine control module.

- Read Diagnostic Trouble Code (DTC) memory of engine control module.

If a DTC relating to the Wastegate Bypass Regulator valve -N75 is displayed:

- Disconnect hoses from valve but leave electrical connector attached.



- Connect auxiliary hose to valve connector marked with an arrow.
- Initiate output Diagnostic Test Mode (DTM) and actuate Wastegate Bypass Regulator valve -N75-.

cardiagn.com

21-35

Output Diagnostic Test Mode →

-N75- wastegate bypass regulator valve

Display

- The valve must click ...
- ... and must open and close (check by blowing into the auxiliary hose).

If the injector does not click:

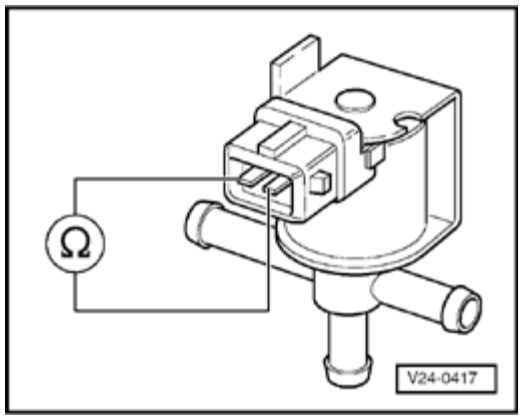
- Check internal resistance of valve.

If valve does not open or close properly:

- Replace Wastegate Bypass Regulator valve -N75-.

Checking internal resistance

- Disconnect connector from valve.



- Connect multimeter to injector to measure resistance.
  - Specified value: 25 to 35 Ω

If specified value is not attained:

- Replace Wastegate Bypass Regulator valve -N75-.

If specified value is attained:

- Check power supply.

cardiagn.com

21-36

Checking power supply

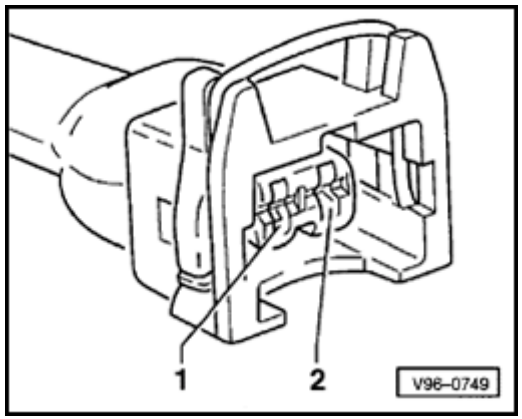
Test requirements:

- Fuse for wastegate bypass regulator valve OK

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Fuel pump relay OK.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



- Connect voltage tester VAG 1527 B as follows:

Connector contact	Measure to
1	Engine Ground

- Operate starter briefly.
  - ♦ LED must light up.

cardiagn.com

21-37

If the LED does not light up:

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

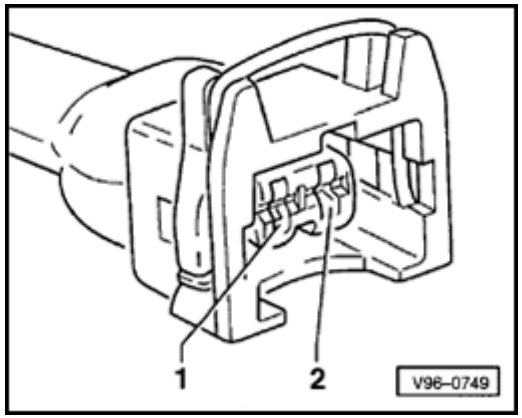
⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Repair open circuit, if necessary

If the LED lights up:

- Check actuation.

Checking actuation

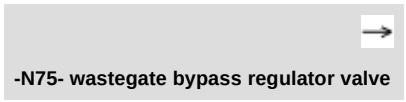


Output Diagnostic Test Mode

- Connect voltage tester VAG 1527 B to contacts 1 (positive) and 2 of connector.
- Initiate output Diagnostic Test Mode (DTM) and actuate Wastegate Bypass Regulator valve -N75-.

Display

cardiagn.com



- LED must flash.

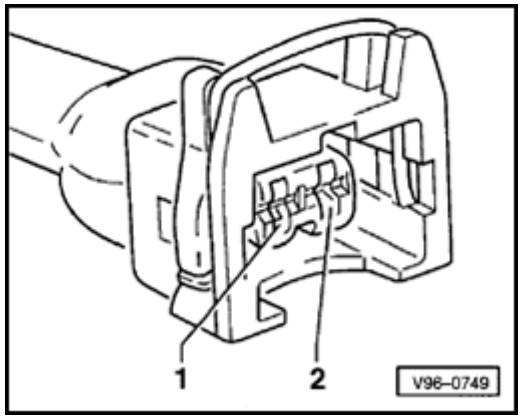
cardiagn.com

21-38

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

- Connect VAG 1598/31 test box to wiring harness leading to engine control module; engine control module should not be connected:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



- Check for open circuit and short to positive or Ground in following wiring connection:

Connector Contact	Test box VAG 1598/31
2	104

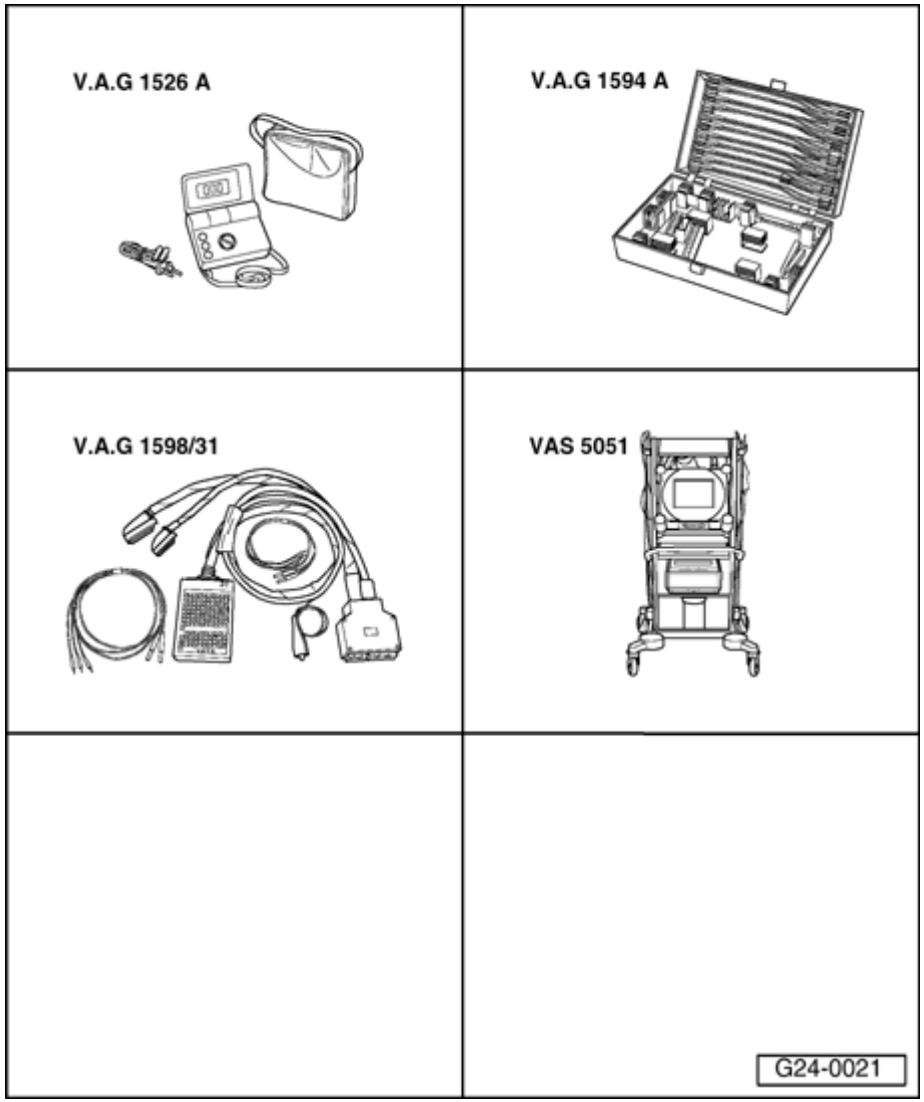
- Repair any open/short circuit as necessary.

If the wiring is OK:

- Replace engine control module.

cardiagn.com

21-39



Charge Air Pressure sensor -G31-, checking

Special tools and equipment

- VAG 1526 A
- VAG 1594 A
- VAG 1598/31
- VAS 5051 with VAS 5051/1

- or

- VAG 1551 with VAG 1551/3 A

cardiagn.com

21-40

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551Scan Tool connected.

Test sequence

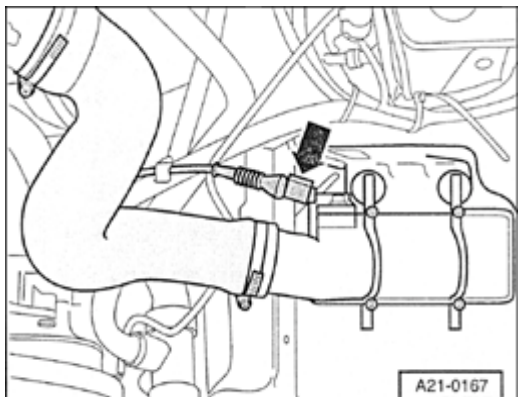
Note:

The Charge Air Pressure sensor -G31- and the wiring connections are monitored by the engine control module.

- Read Diagnostic Trouble Code (DTC) memory of engine control module.

If a DTC relating to the Charge Air Pressure sensor -G31- is displayed:

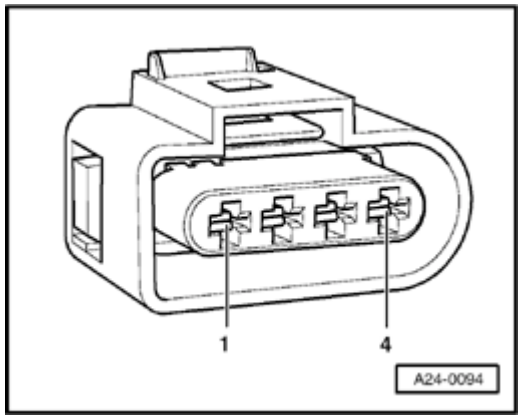
Checking power supply



- Disconnect connector -arrow- on charge pressure sender.

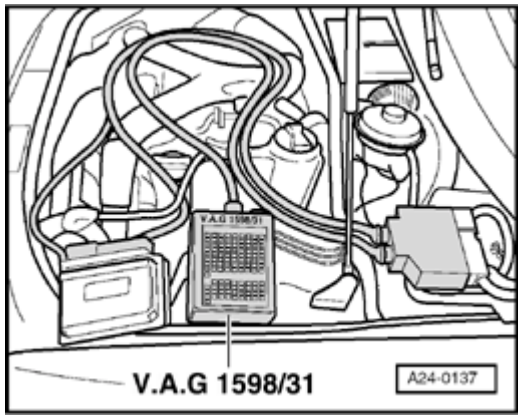
cardiagn.com

21-41



- Connect multimeter between contacts 1 and 3 of connector to measure voltage.
- Switch ignition on.
  - Specified value: approx. 5 V

If specified value is not attained:

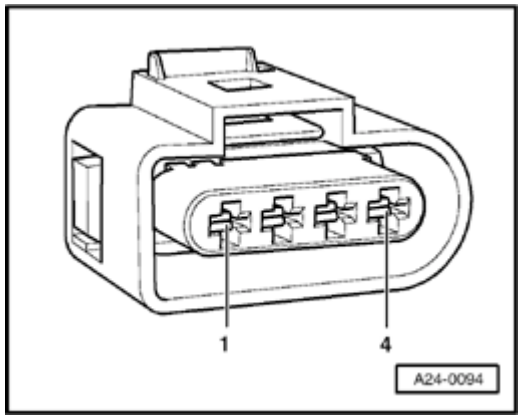


- Connect VAG 1598/31 test box to wiring harness leading to engine control module; engine control module must also be connected.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

cardiagn.com

21-42



- Check for open circuit and short to positive or Ground in following wiring connections:

Connector contact	Test box VAG 1598/31
1	108
3	98

- Repair any open/short circuit as necessary.

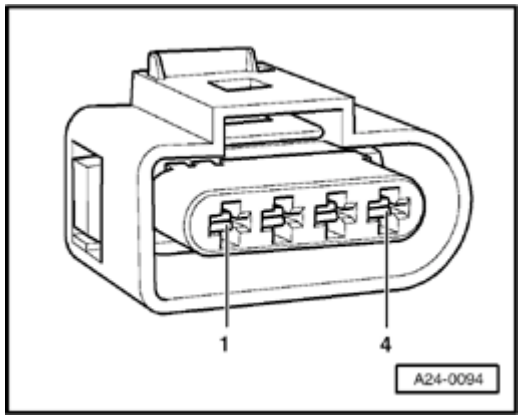
If specified value is attained:

Checking signal wire

- Attach connector from charge air pressure sensor.
- Attach multimeter for voltage test to socket 101 and socket 108 of test box.
- Start engine and run at idling speed.
  - Specified value: approx. 1.90 V
- Bring engine to speed by spontaneous acceleration.
  - Specified value: 2.00...3.00 V

cardiagn.com

21-43



If specified values are not attained:

- Check for open circuit and short to positive or Ground in following wiring connection:

Connector contact	**Test box VAG 1598/31**
4	101

- Repair any open/short circuit as necessary.

If the wiring is OK:

- Replace Charge Air Pressure sensor -G31-.

cardiagn.com

21-44

Charge pressure system with exhaust turbocharger, servicing

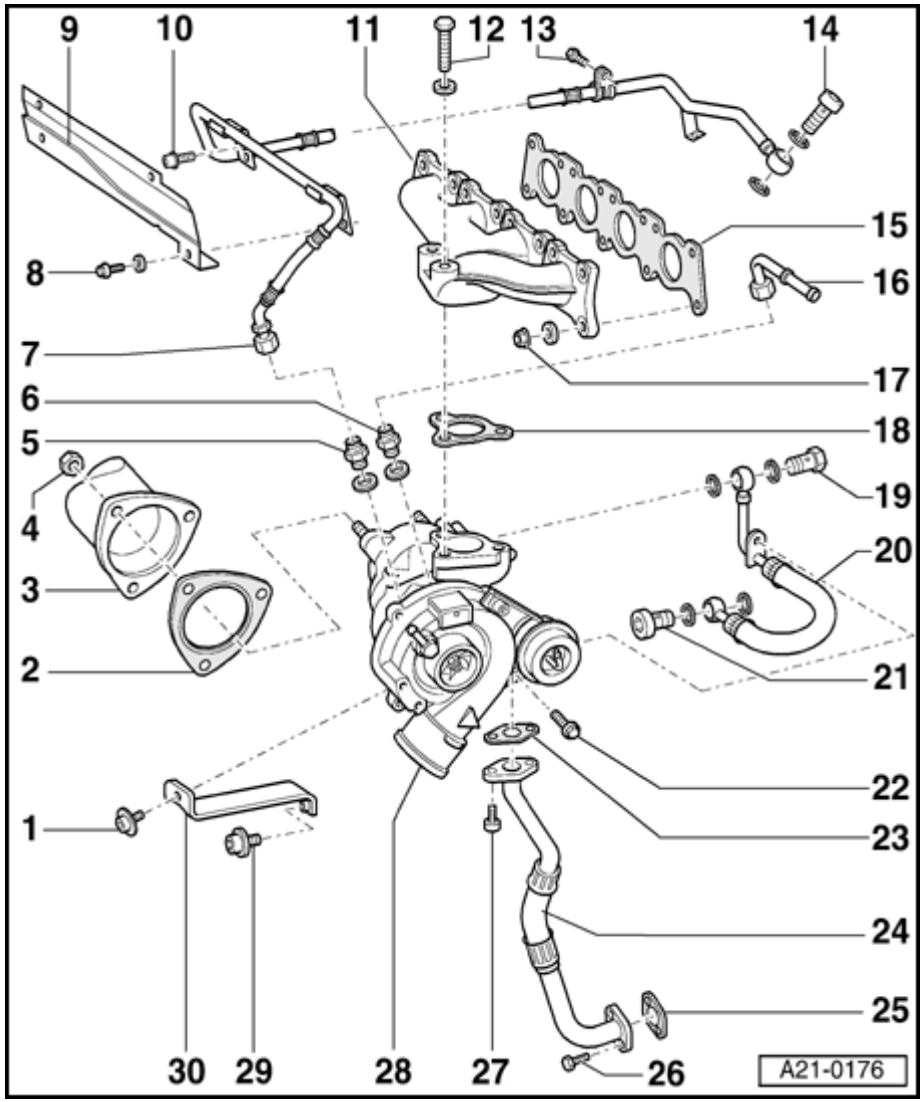
Rules for cleanliness

When working on the exhaust gas turbocharger, pay careful attention to the following 5 rules:

- Thoroughly clean all unions and the adjacent areas before disconnecting.
- Place removed parts on a clean surface and cover. Use lint-free cloths.
- Carefully cover or seal open components if repairs cannot be carried out immediately.
- Only install clean components: Only remove replacement parts from packaging immediately prior to installation. Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- When the system is open: Do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.

cardiagn.com

21-45



Turbocharger, removing and installing - Overview

Part I

1 - 30 Nm

- ♦ Only use original bolt

⇒ *Parts Catalog*

2 - Gasket

- ♦ Always replace

3 - Catalytic converter

4 - 30 Nm

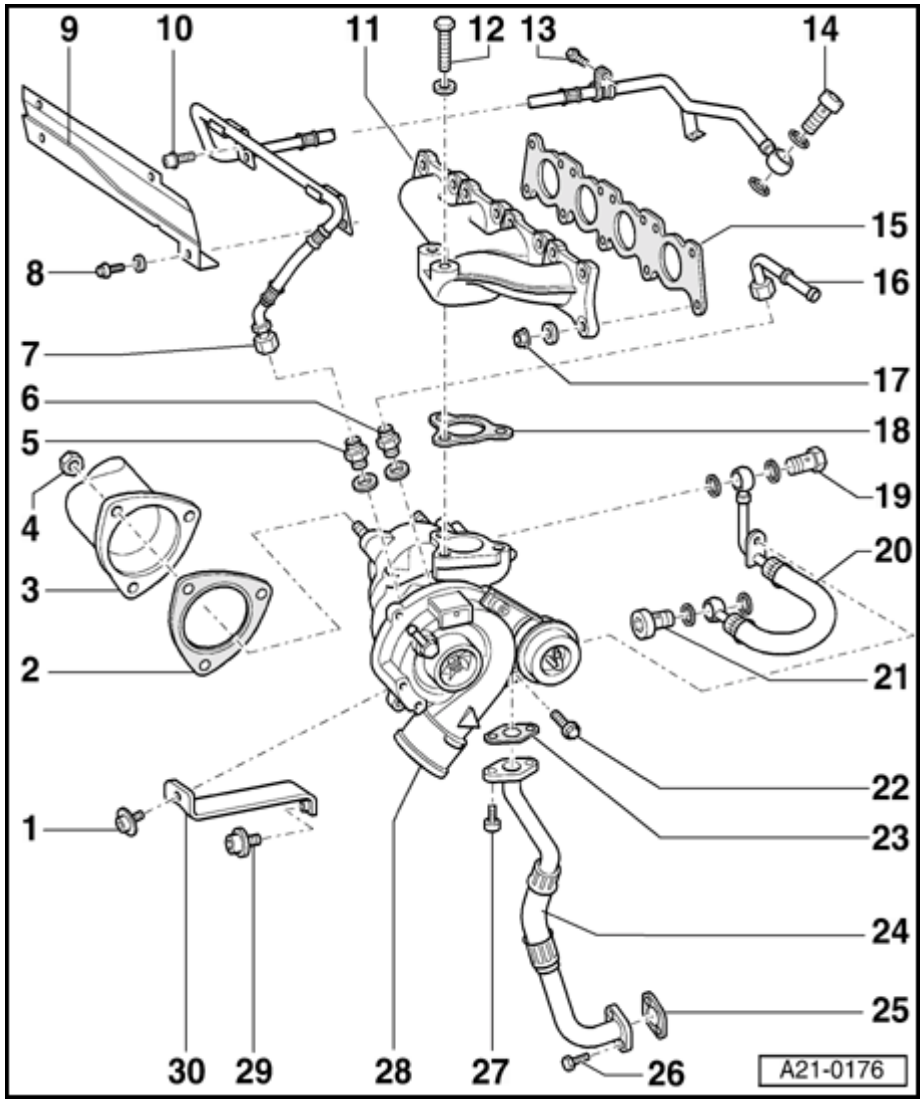
- ♦ Always replace

5 - 30 Nm

6 - 35 Nm

cardiagn.com

21-46



7 - Oil supply line

- Tighten union nut to 23 Nm
- From oil filter bracket ⇒ -Item 24 -, ⇒ Page 17-10

8 - 3.5 Nm

9 - Heat shield

10 - 23 Nm

11 - Exhaust manifold

- Removing and installing ⇒ Page 26-21

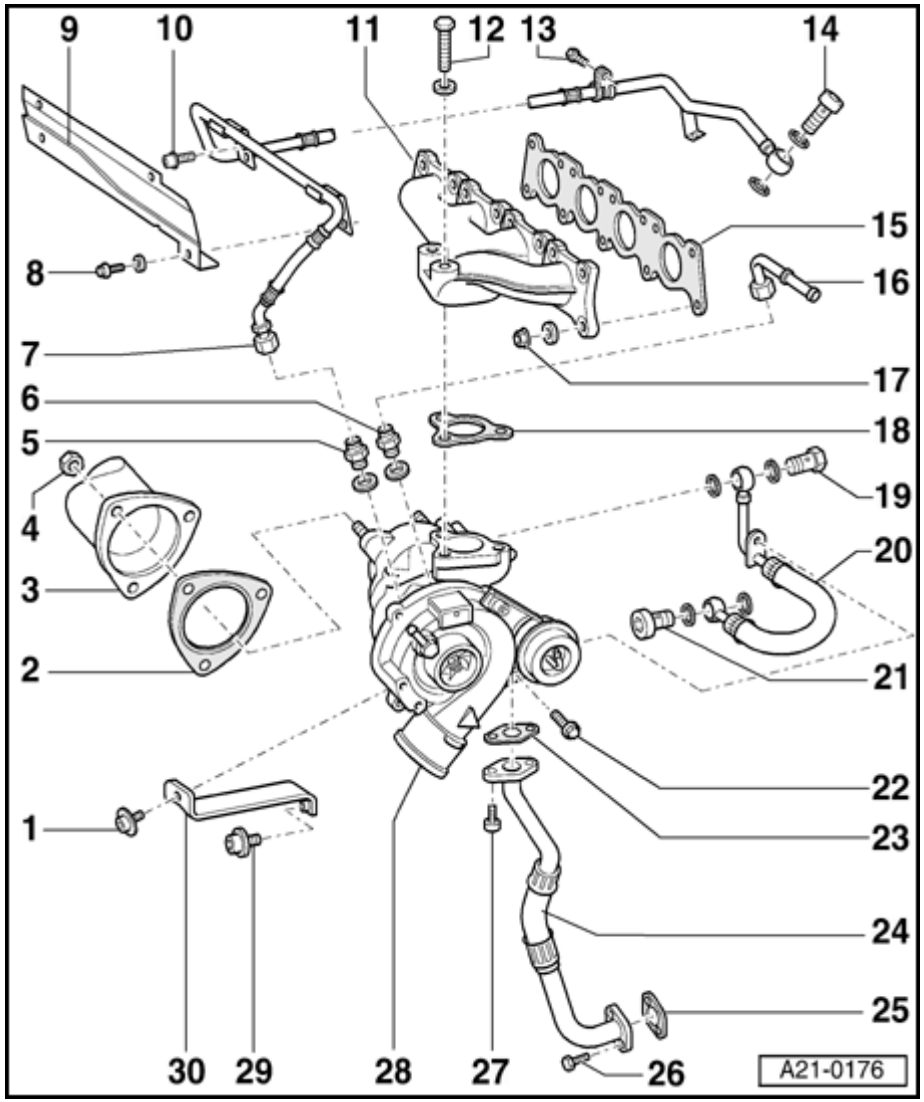
12 - 35 Nm

- Always replace
- Coat thread and head attachment area with high temperature lubricant G 052 112 A3

13 - 10 Nm

cardiagn.com

21-47



14 - Banjo bolt - 30 Nm

15 - Gasket

- Always replace
- Note installation position

16 - Coolant return line

- Tighten union nut to 30 Nm

17 - 30 Nm

- Always replace

18 - Gasket

- Always replace
- Note installation position

19 - Banjo bolt - 35 Nm

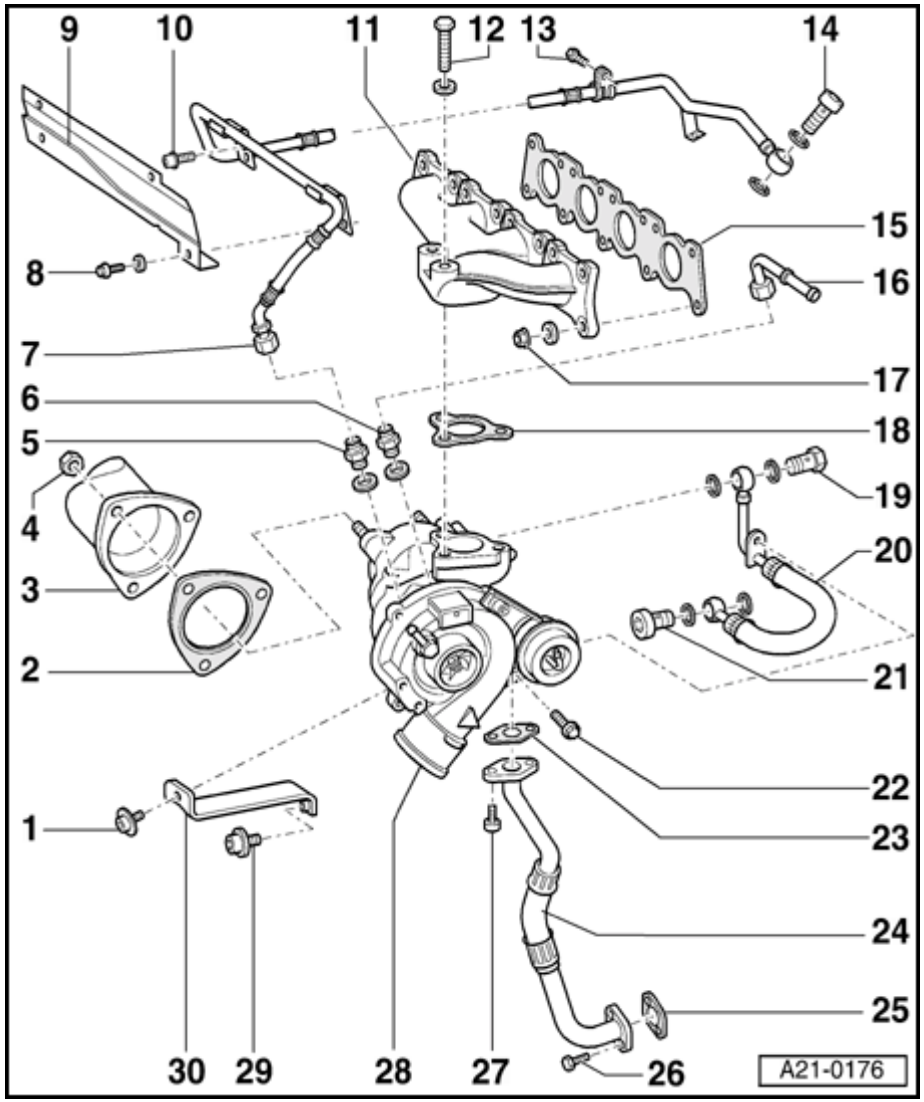
20 - Coolant supply hose/line

21 - Banjo bolt - 35 Nm

- Apply D 000 600 when installing

cardiagn.com

21-48



22 - 10 Nm

- Apply D 000 600 when installing

23 - Gasket

- Always replace

24 - Oil return line

- To oil pan

25 - Gasket

- Always replace

26 - 10 Nm

27 - 10 Nm

28 - Turbocharger

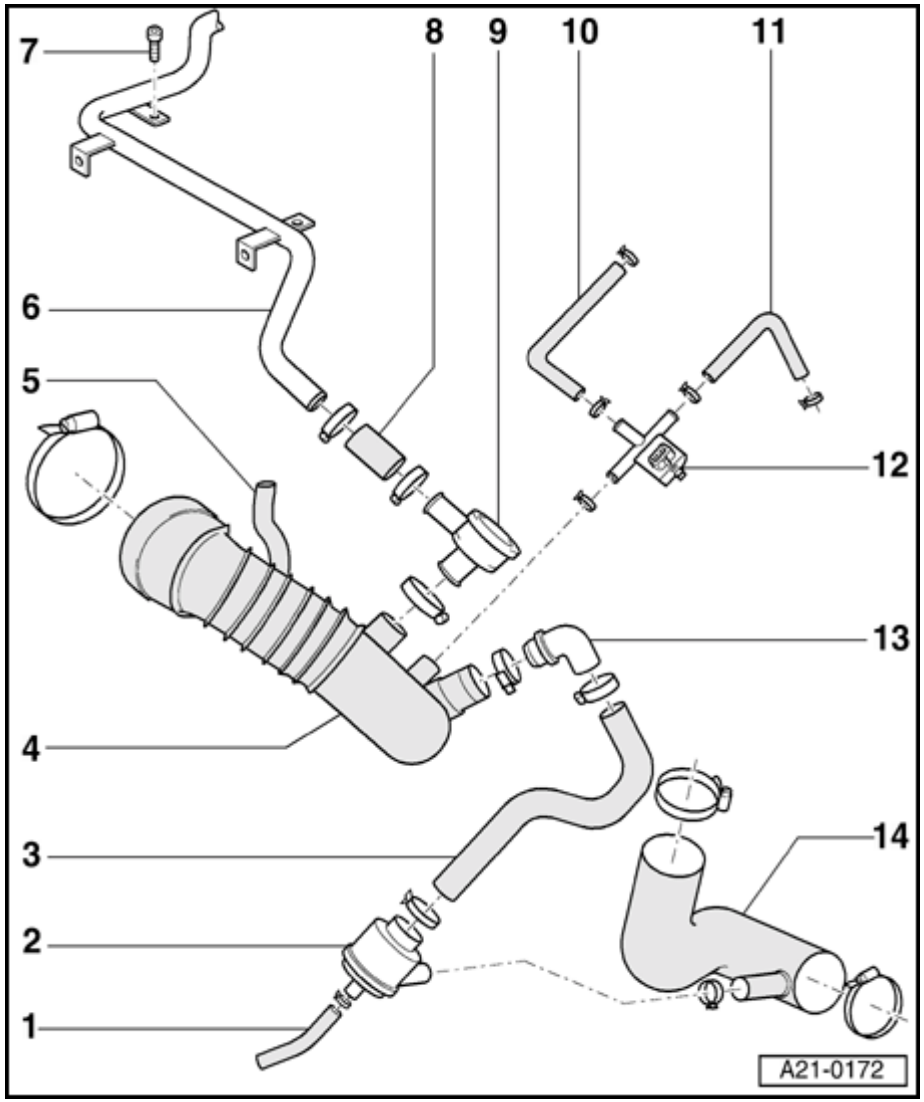
- Checking ⇒ Page 21-8

29 - 25 Nm

30 - Bracket

cardiagn.com

21-49



Part II

1 - Vacuum hose

- To Recirculatiing valve for turbocharger - N249-

2 - Recirculating valve

- Checking ⇒ Page 21-24

3 - Hose

- To recirculating valve

4 - Air duct hose

- To connection on turbocharger

5 - Hose

- To ACF valve

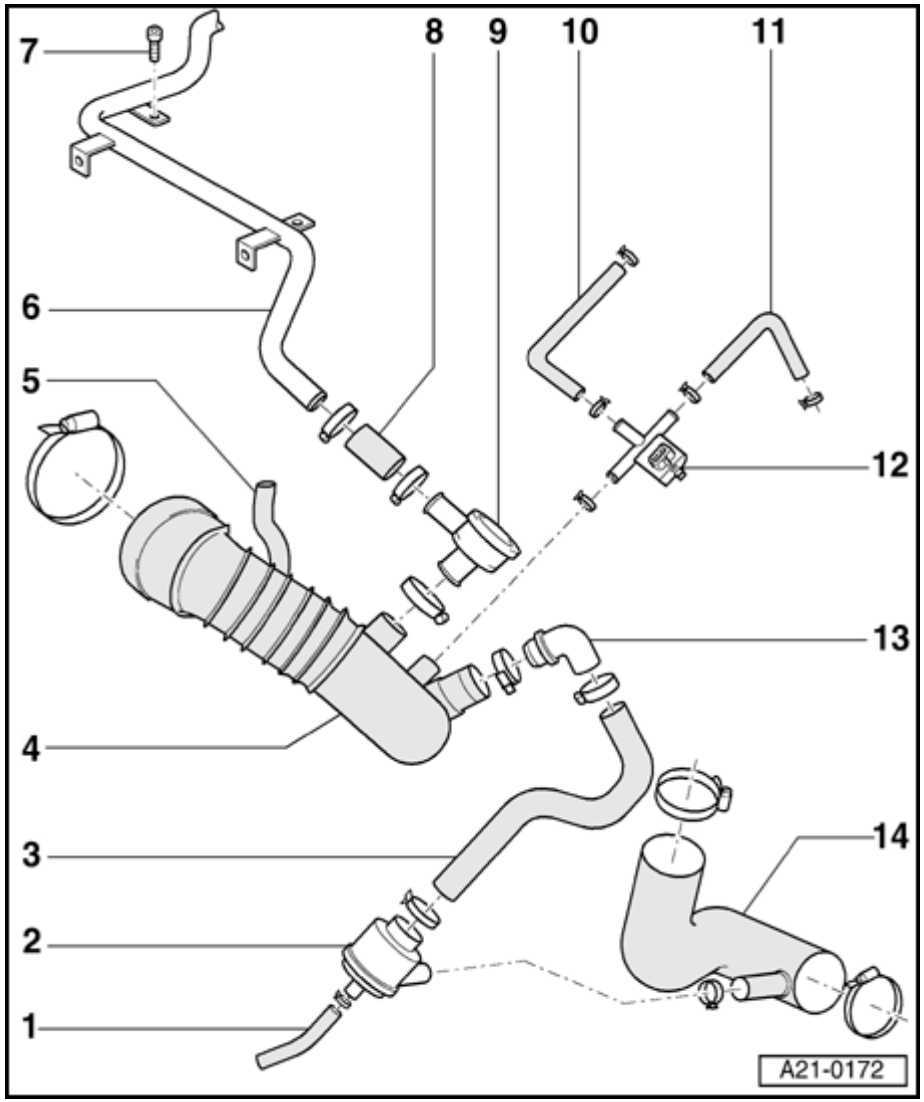
6 - line

- To crankcase vent

7 - 10 Nm

cardiagn.com

21-50



8 - Hose

- To crankcase breather line

9 - Pressure regulating valve

- For crankcase breather

10 - Hose

- To turbocharger

11 - Hose

- To vacuum unit for charge pressure regulating valve

12 - Wastegate Bypass Regulator valve -N75-

13 - Angled connector

14 - Hose

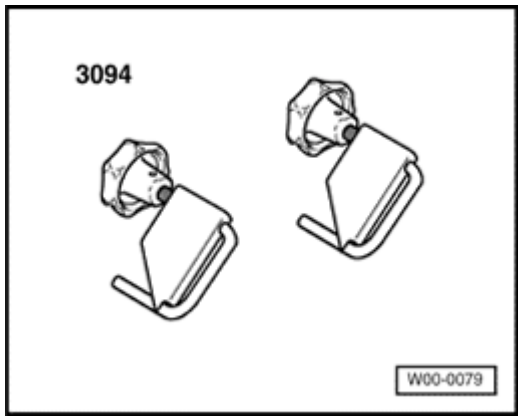
- To turbocharger

cardiagn.com

21-51

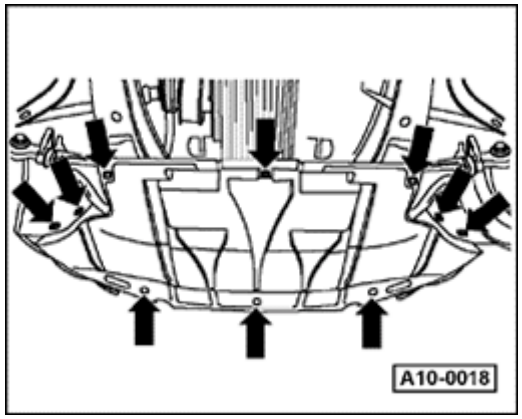
Turbocharger, removing and installing

Special tools and equipment



- Hose clamps 3094

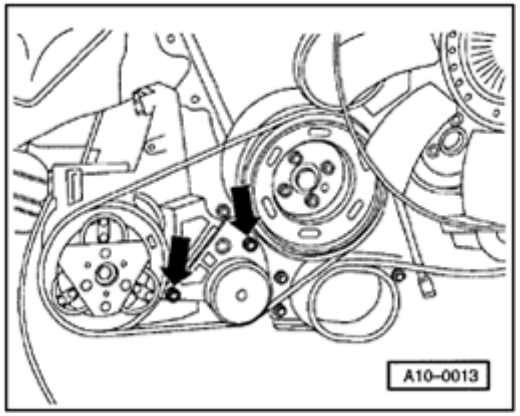
Removing



- Remove sound insulation -arrows-.

cardiagn.com

21-52

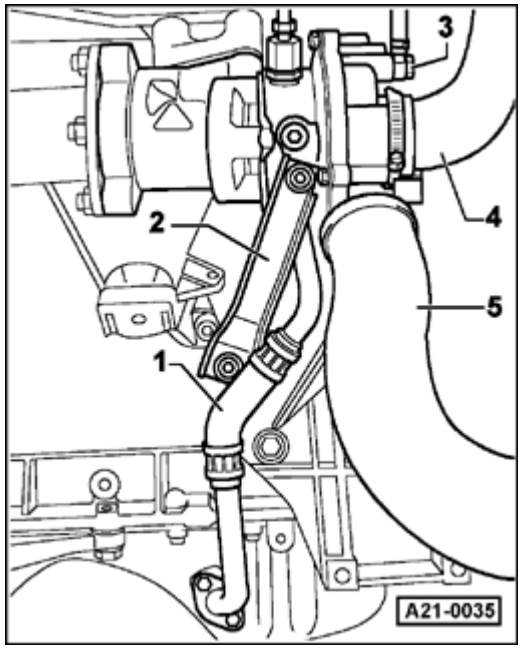


- Loosen bolts securing ribbed belt tensioning roller for A/C compressor -arrows-. Loosen belt and remove.

CAUTION!

The air conditioner refrigerant circuit must not be opened.

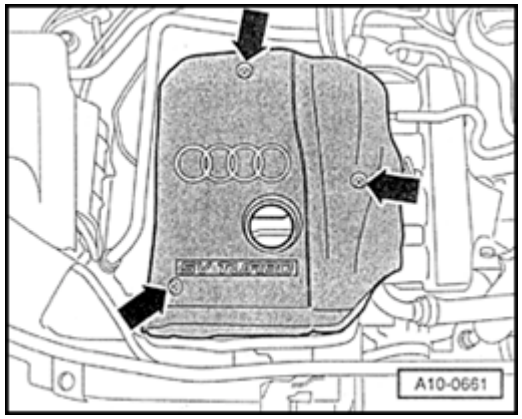
- Disconnect A/C compressor from bracket and secure to body with wire.



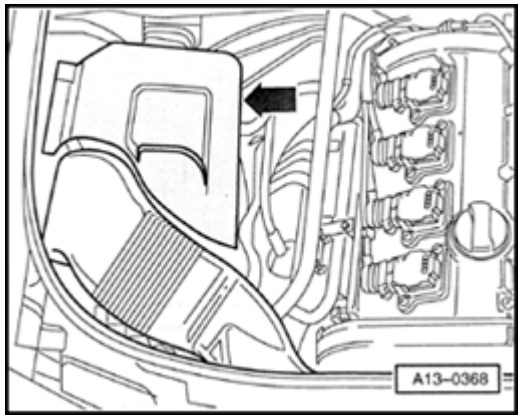
- Remove bracket for exhaust turbocharger -2-.
- Unscrew oil return line -1- from exhaust turbocharger and set aside.
- Loosen air duct hoses -4- and -5- on exhaust turbocharger.
- Remove banjo bolt -3- for pressure line.

cardiagn.com

21-53



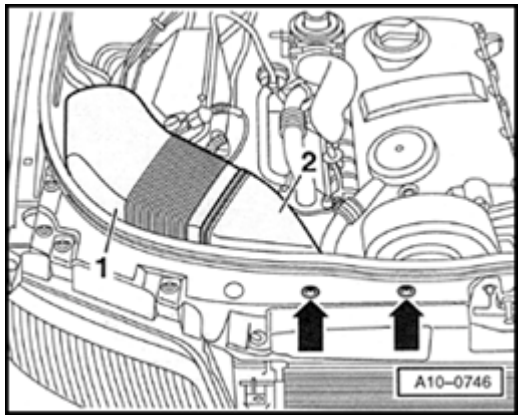
- Remove engine cover -arrows-.



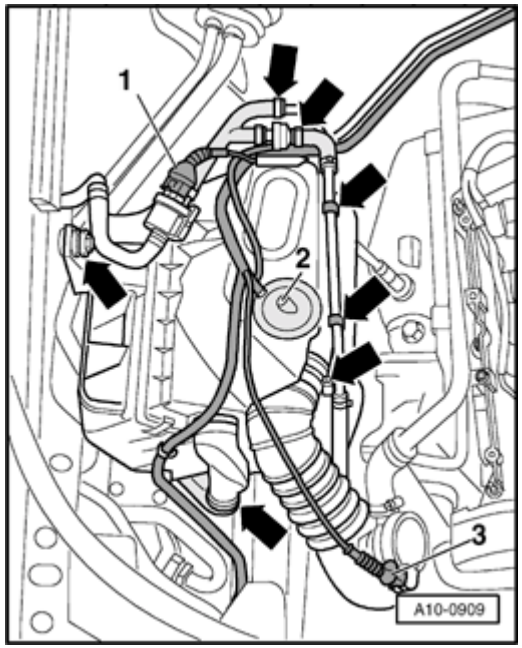
- Remove air filter cover -arrow-.

cardiagn.com

21-54



- Remove bolts -arrows-.
- Remove air duct -1- and -2-.



- Disconnect wiring connectors as follows:

1 - on ACF valve (in addition, remove ACF valve from air filter housing)

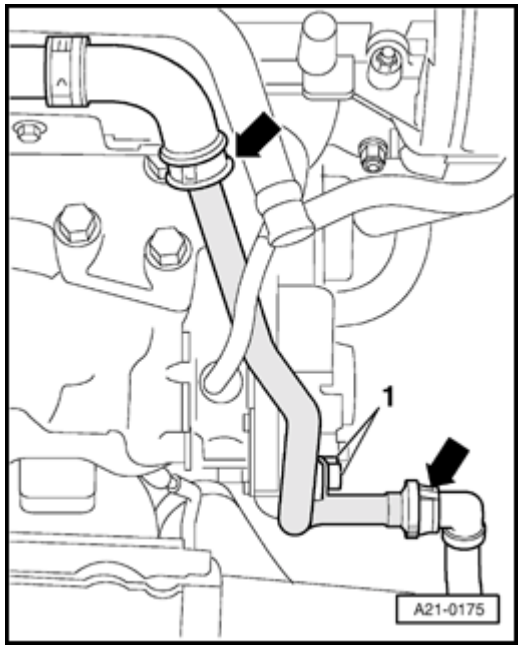
2 - on mass air flow sensor

3 - on Wastegate Bypass Regulator valve -N75-

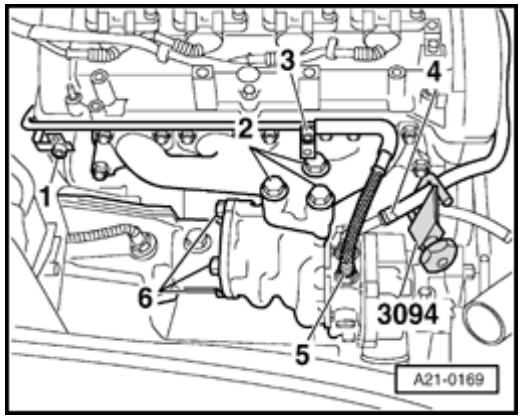
- Move wiring aside and remove air filter housing -arrows-.

cardiagn.com

21-55



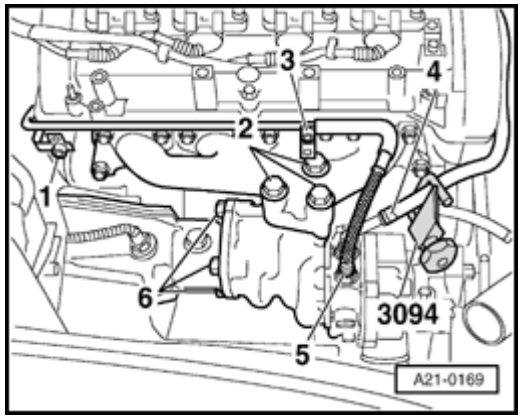
- Remove secondary air inlet line by disconnecting hoses -arrows- and removing bolts -1-.
- Remove right-hand heat shield on cylinder head.
- Remove hose of vacuum unit for wastegate bypass regulator valve - N75- on exhaust turbocharger.
- Unbutton sleeve on coolant return hose.



- Clamp coolant return hose to exhaust turbocharger with hose clamp 3094.
- Loosen hose clamp -4- and remove coolant return hose from exhaust turbocharger line.

cardiagn.com

21-56



- Loosen bolts -1- and -3- of oil feed line.
- Remove oil feed line -5- at exhaust turbocharger.

Note:

The isolating element in the exhaust system must not be bent more than 10° or it may be damaged.

- Remove catalytic converter from exhaust turbocharger -6-.
- Remove exhaust turbocharger from exhaust manifold -2-.
- Swivel exhaust turbocharger to side, loosen mounting angle and banjo bolt of coolant feed line on exhaust turbocharger.
- Remove exhaust turbocharger.

cardiagn.com

21-57

Installing

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

Note:

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

- *Secure all hose connections with the correct hose clips (same as original equipment):*

⇒ *Parts Catalog*

- *The hose connectors and hoses must be free of oil and grease before assembling.*

- *Always replace seals, gaskets and self-locking nuts.*

- Perform following operating steps before tightening exhaust turbocharger:

  -
    Fasten coolant feed line loosely to bracket on vacuum unit for wastegate bypass regulator

cardiagn.com

valve.

- Tighten banjo bolt to 35 Nm and then tighten securing bolt of bracket to 10 Nm.

cardiagn.com

Note:

Fill the exhaust turbocharger with engine oil via the oil supply connection.

- Install ribbed belt for A/C compressor ⇒ Page 13-20 .

- Top up coolant ⇒ Page 19-7 .

- Check oil level ⇒ Page 17-35 .

Note:

After installing the turbocharger, run engine for approx. 1 minute at idling speed; do not rev. up immediately. This ensures the turbocharger is properly lubricated.

Tightening torques

Component	Nm
Coolant feed line to exhaust turbocharger	35
Bracket for coolant feed line to exhaust turbocharger	10
Turbocharger to exhaust manifold	

cardiagn.com

	35 1) 2)

1) Replace bolts

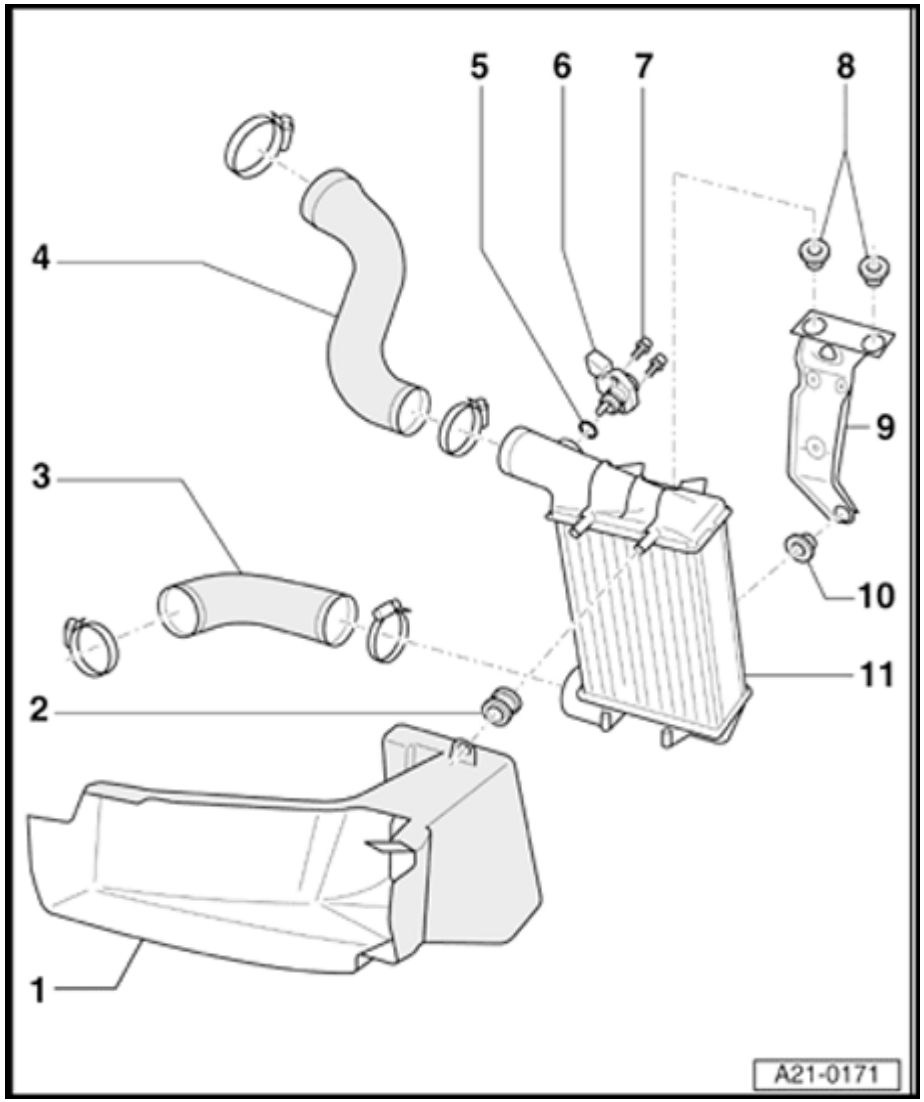
2) Coat thread and head attachment area with high temperature lubricant G 052 112 A3

cardiagn.com

Component	Nm
Turbocharger bracket to cylinder block	25
Turbocharger bracket to turbocharger	30
Catalytic converter to exhaust turbocharger	30
Oil return line to turbocharger	10
Oil supply line to turbocharger	23
Bracket for oil feed line to cylinder head	23
Heat shield to line for secondary air inlet	3.5
Hose clamps for coolant hoses	2
Hose clamps for air duct hoses	3.5

cardiagn.com

21-60



Charge air cooling system components, removing and installing

Note:

- *Secure all hose connections with the correct hose clips (same as original equipment):*

⇒ *Parts Catalog*

- *Before a check or repair all hoses and lines must be checked for correct seating and leaks.*

1 - Air duct

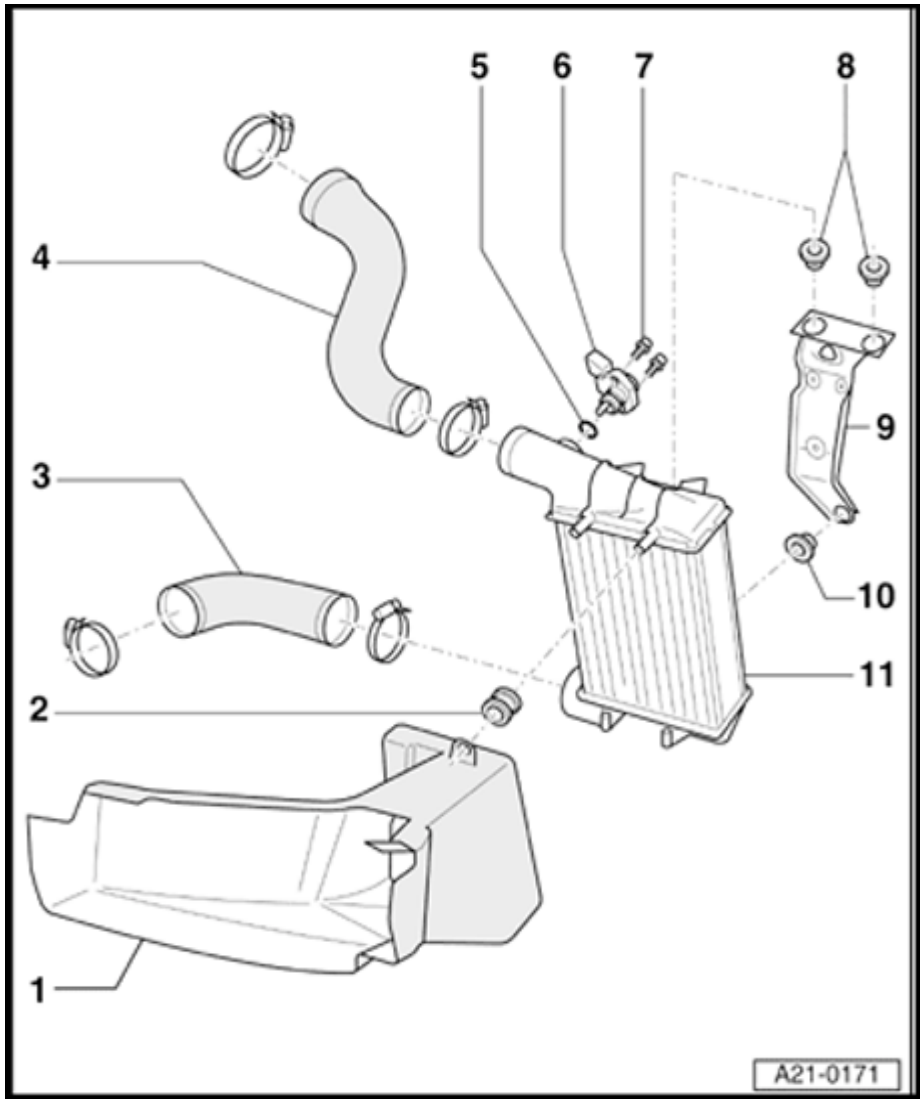
2 - Rubber grommet

3 - Hose

- Between charge air cooler and air ducting in front apron

cardiagn.com

21-61



4 - Air duct hose

- Between intake manifold and charge air cooler (intercooler)

5 - O-ring

- Replace, if damaged

6 - Charge Air Pressure sensor -G31-

7 - 3 Nm

8 - Rubber grommet

9 - Bracket

- Riveted to body

10 - Rubber grommet

11 - Charge air cooler

- Removing and installing ⇒ Page 21-62

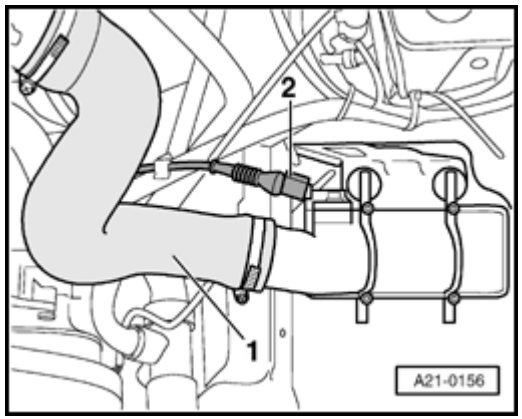
cardiagn.com

21-62

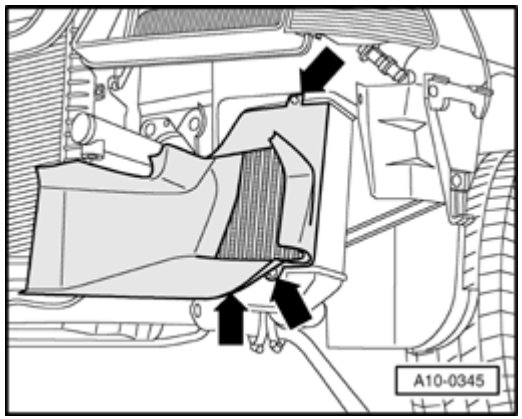
Charge air cooler (intercooler), removing and installing

Removing

- Lock carrier must be in service position ⇒ Page 13-1 .



- Remove air duct hose -1-.
- Disconnect connector -2- at Charge Air Pressure sensor -G31-.



- Remove air cowl in front of charge air cooler -arrows-.

cardiagn.com

- Remove lower air duct hose to charge air cooler.

- Take out charge air cooler from underneath.

Installing

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

- Install lock carrier ⇒ Page 13-1 .

Tightening torque

Component	Nm
Hose clamps for air duct hoses	3.5

cardiagn.com

26-1

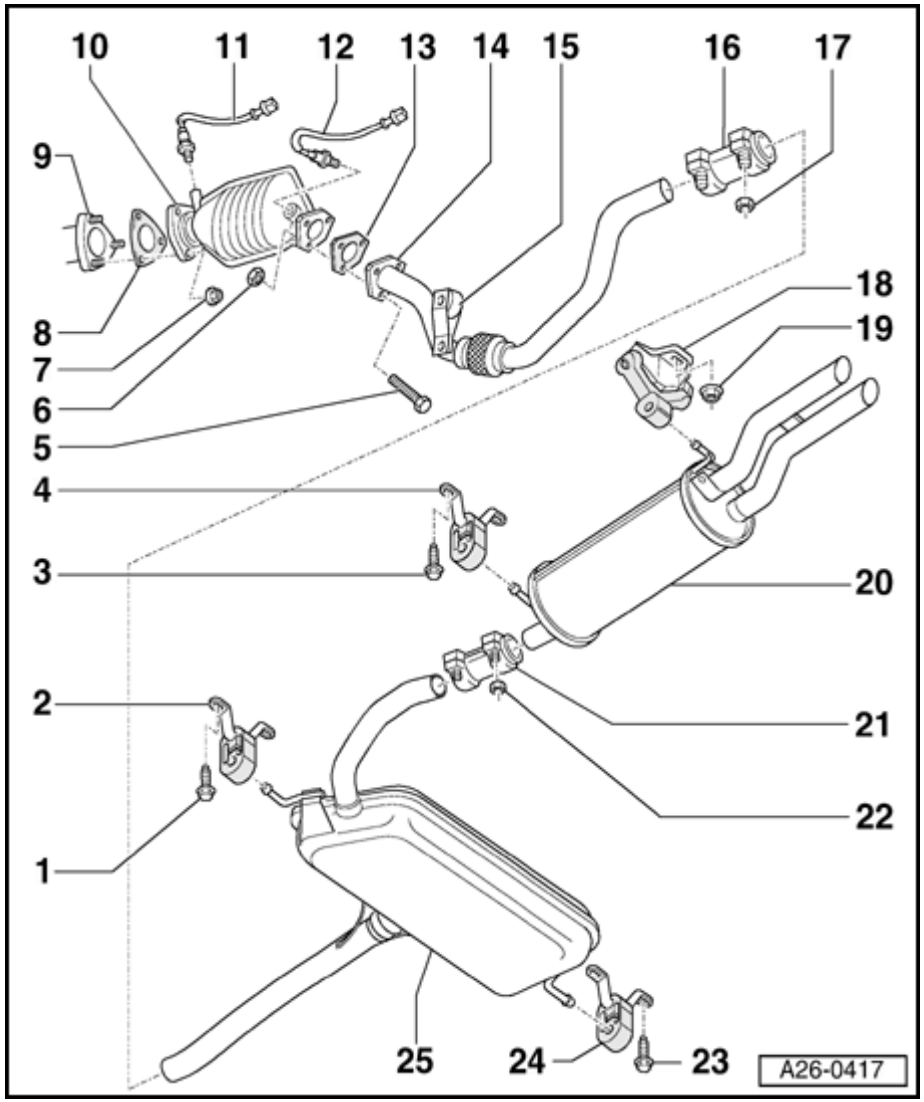
Exhaust system components, removing and installing

Note:

- *Always replace seals, gaskets and self-locking nuts.*
- *After working on the exhaust system ensure that the system is not under stress, and that it has sufficient clearance from the bodywork. If necessary, loosen clamps and align mufflers and exhaust pipes so that sufficient clearance is maintained to the bodywork at all points and the mountings are evenly loaded.*
- *The flexible connection in the front exhaust pipe must not be deflected more than 10° or it may be damaged..*

cardiagn.com

26-2



Vehicles with front-wheel drive

1 - 25 Nm

2 - Mounting

3 - 25 Nm

4 - Mounting

5 - 25 Nm

6 - 25 Nm

- Replace

7 - 30 Nm

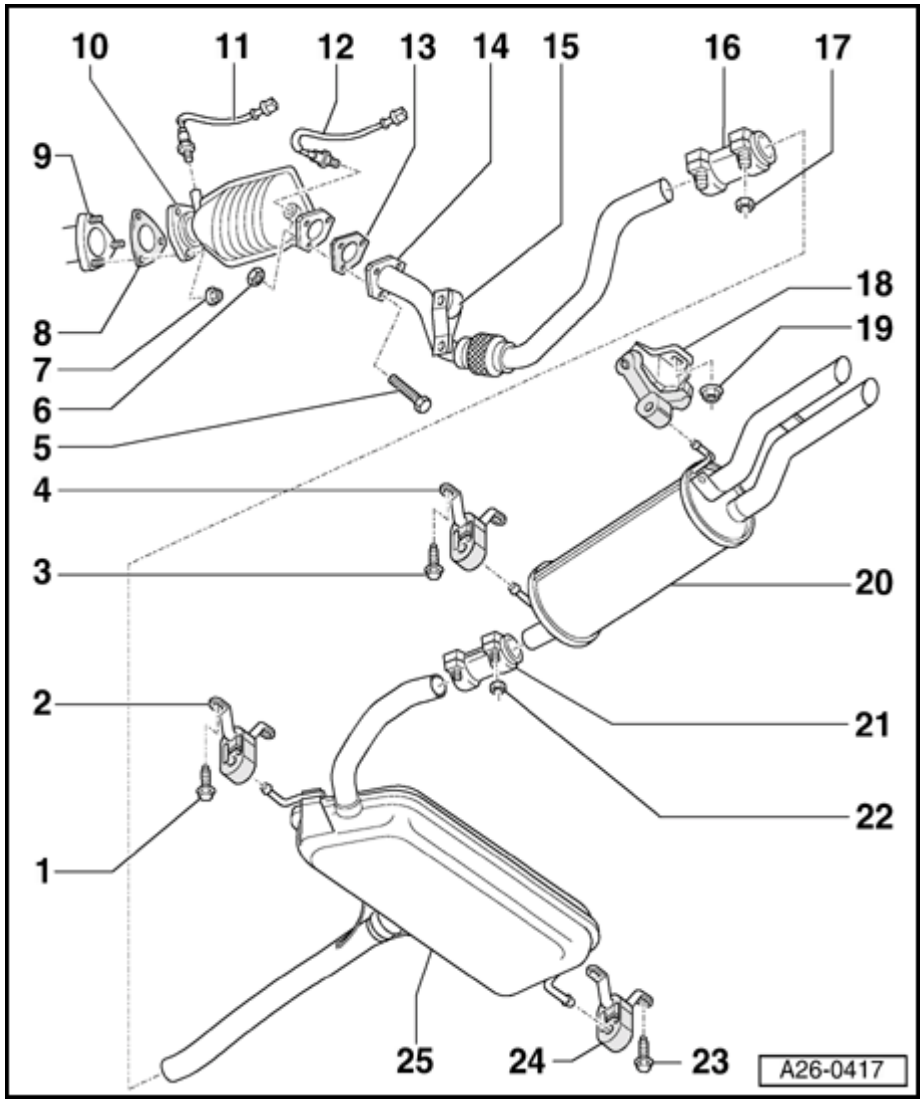
- Always replace

8 - Gasket

- Always replace

cardiagn.com

26-3



9 - Turbocharger

- Removing and installing ⇒ Page 21-51

10 - Catalytic converter

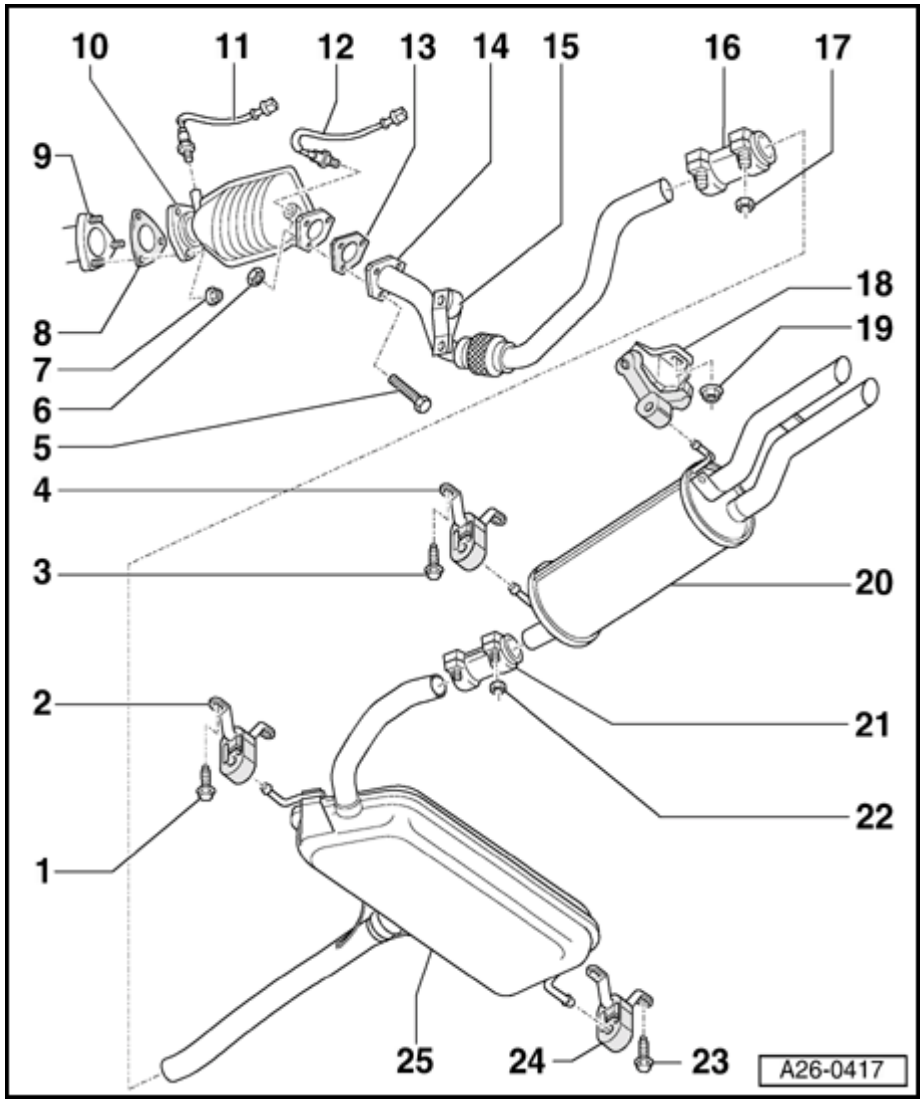
- Protect from damage by impact
- Removing and installing ⇒ Page 26-27

11 - Oxygen sensor - 55 Nm

- Upstream of catalytic converter
- Grease only the threads with high-temperature lubricant G 052 112 A3. The lubricant must not get into the slots on the sensor body.
- Checking:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

cardiagn.com



12 - Oxygen sensor - 55 Nm

- Downstream of catalytic converter
- Grease only the threads with high-temperature lubricant G 052 112 A3. The lubricant must not get into the slots on the sensor body.
- Checking:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

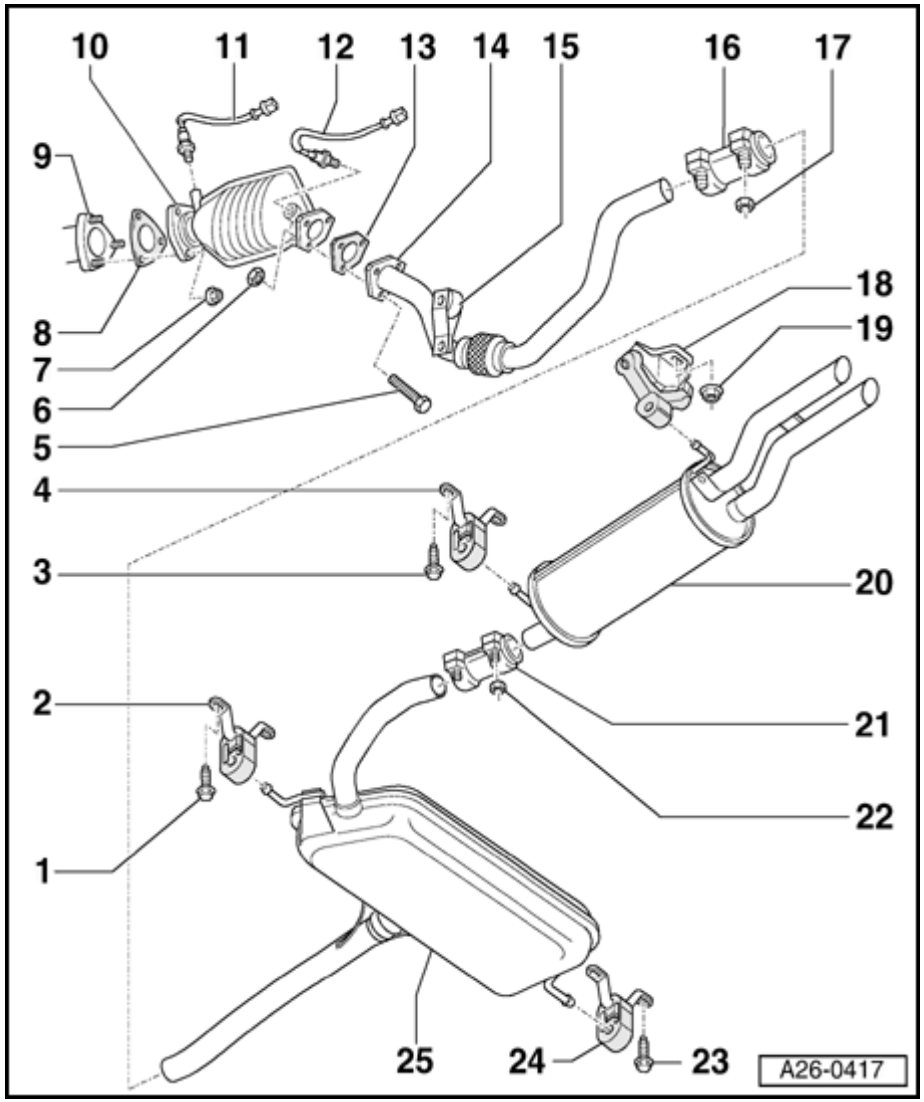
13 - Gasket

- Always replace

14 - Front exhaust pipe

- With flexible connection (de coupling element)
- Do not bend flexible connection more than 10° - otherwise it can be damaged.
- Removing and installing ⇒ Page 26-32
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-34

cardiagn.com



15 - Mounting

- Individual parts of mounting for manual transmission⇒Fig. ⇒ 3 , ⇒ Page 26-16
- Individual parts of mounting for automatic 5 speed transmission ⇒Fig. ⇒ 4 , ⇒ Page 26-17

16 - Front clamp

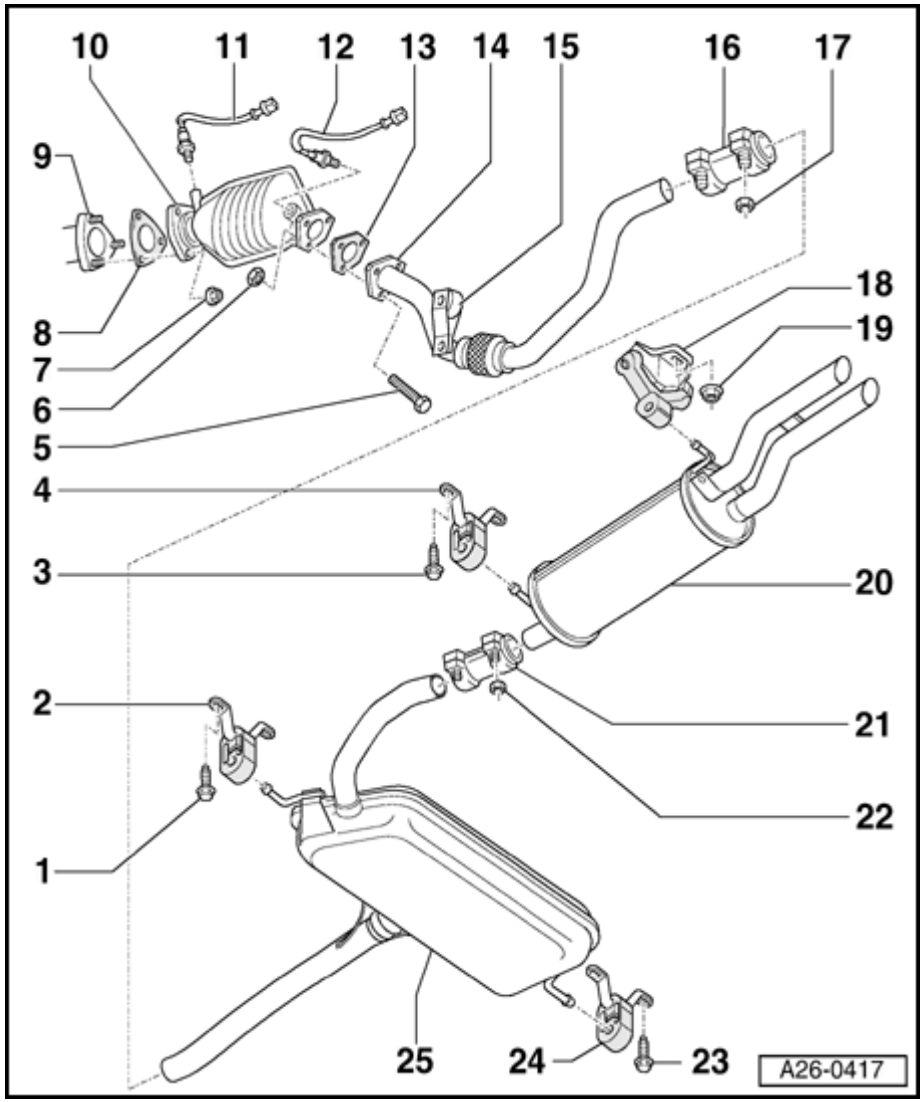
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-34
- Installation position ⇒Fig. ⇒ 1 , ⇒ Page 26-8
- Tighten bolted connections evenly.

17 - 40 Nm

18 - Mounting

19 - 25 Nm

cardiagn.com



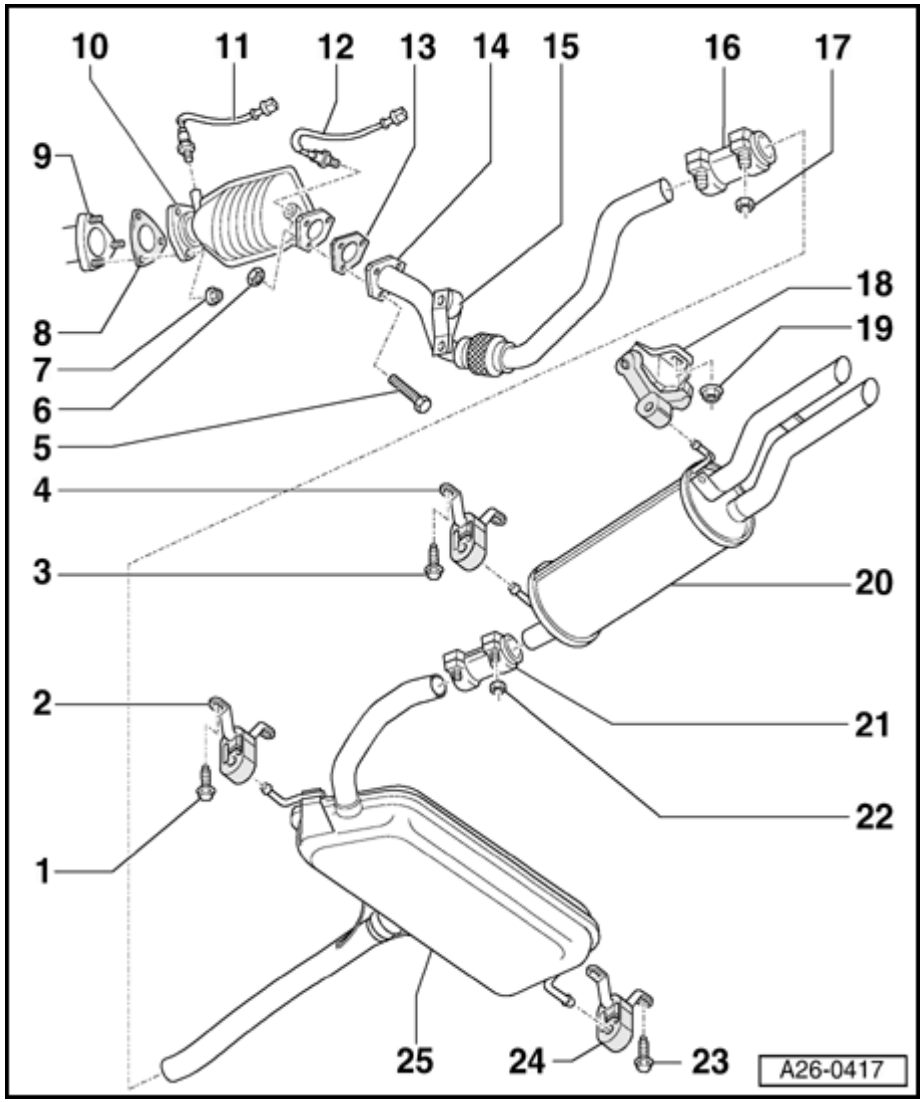
20 - Rear muffler

- Rear and center mufflers are one unit as original equipment. In cases of repair replace individually
- Cutting point ⇒ Page 26-19
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-34

21 - Rear clamp

- For separate replacement of center and rear mufflers
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-34
- Installation position ⇒Fig. ⇒ 2 , ⇒ Page 26-8
- Tighten bolted connections evenly.

cardiagn.com



22 - 40 Nm

23 - 25 Nm

24 - Mounting

25 - Center muffler

- Center and rear mufflers are one unit as original equipment. In cases of repair replace individually
- Cutting point ⇒ Page 26-19
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-34

cardiagn.com

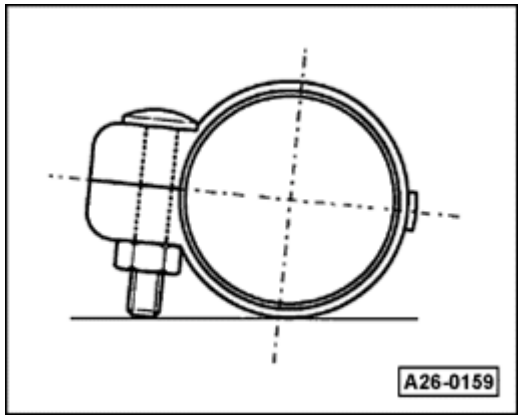


Fig. 1 Installation position of front clamp

- Align clamps so that ends of bolts do not protrude over lower edge of clamp.
  - ♦ Bolted connection facing to the left

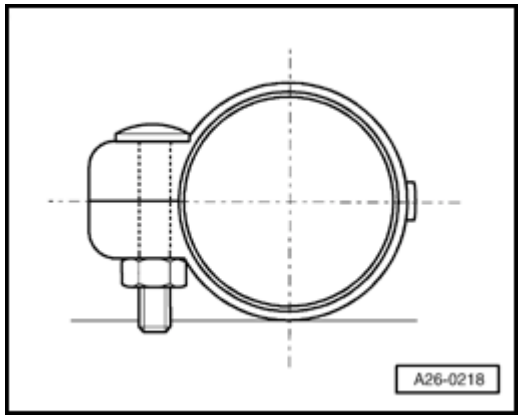
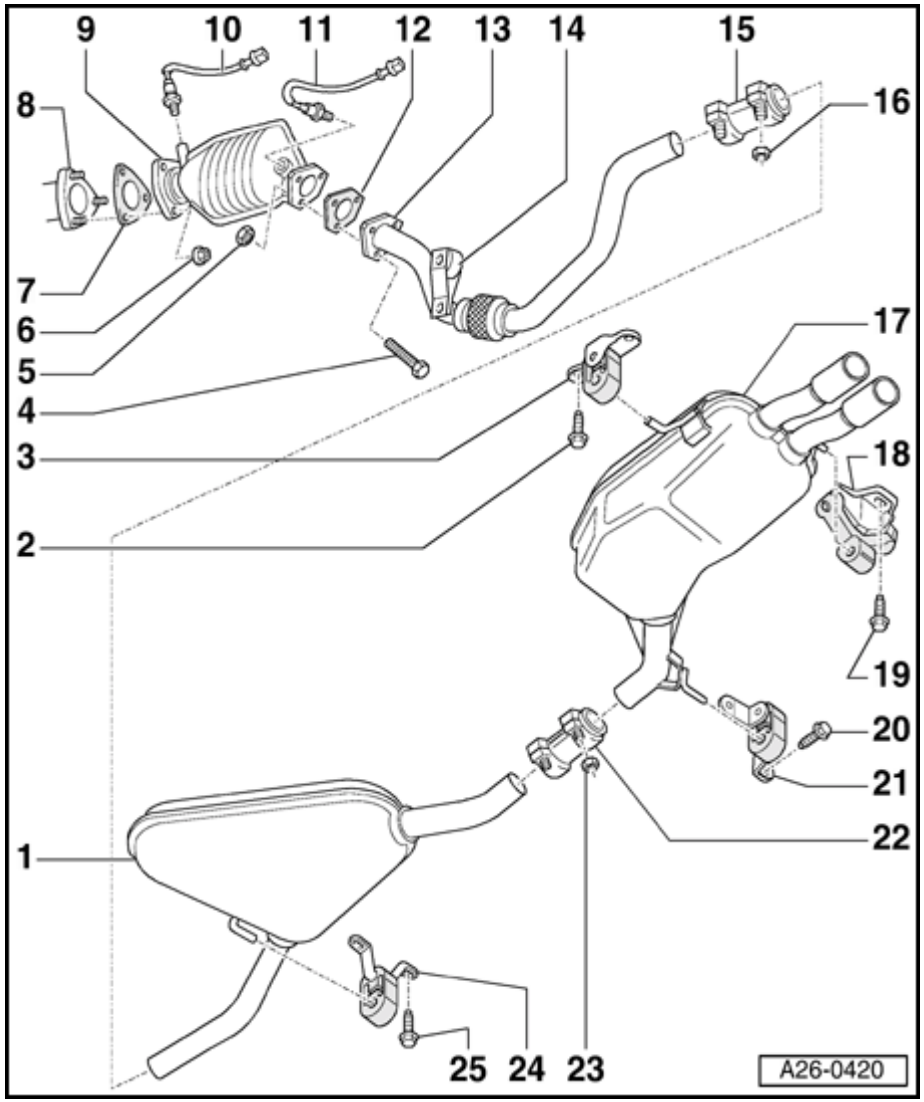


Fig. 2 Installation position of rear clamp

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

cardiagn.com



Vehicles with all-wheel drive

1 - Center muffler

- Center and rear mufflers are one unit as original equipment. In cases of repair replace individually
- Cutting point ⇒ Page 26-20
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-37

2 - 25 Nm

3 - Mounting

4 - 25 Nm

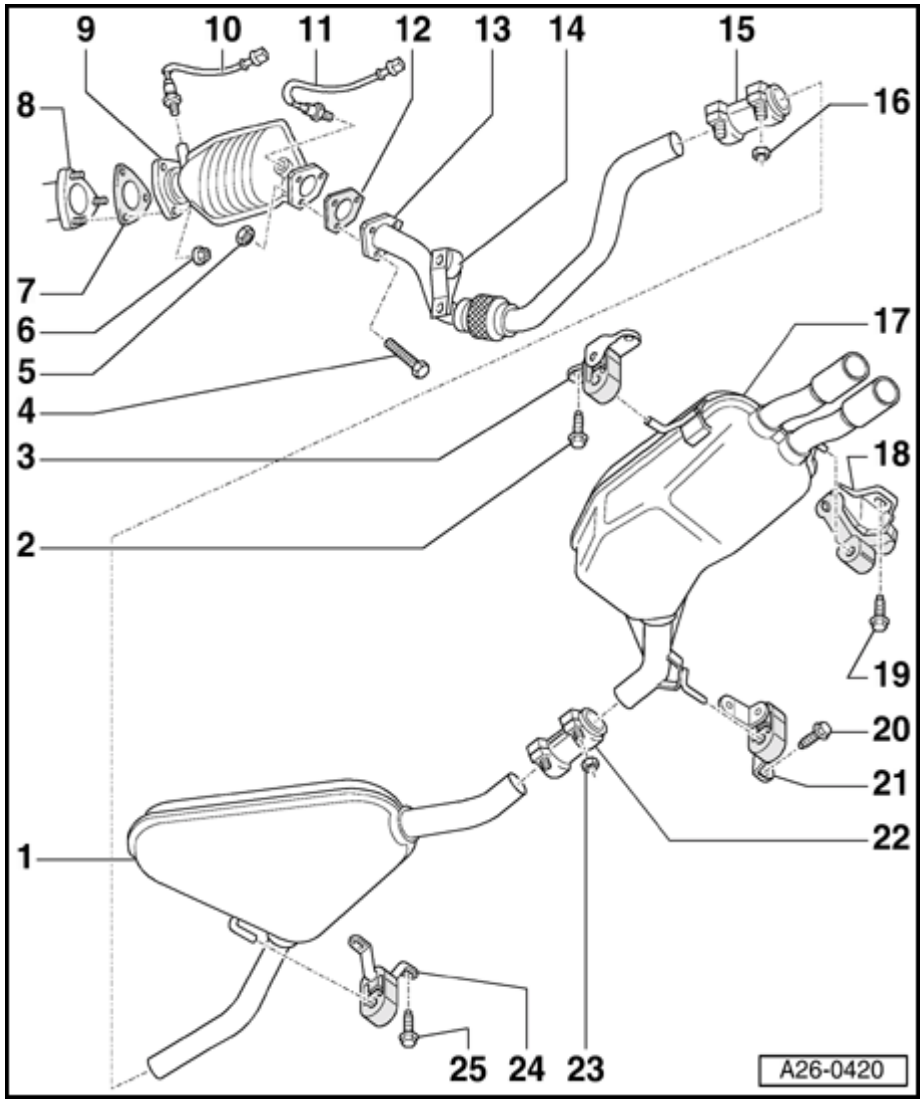
5 - 25 Nm

- Always replace

6 - 30 Nm

- Always replace

cardiagn.com



7 - Gasket

- Always replace

8 - Turbocharger

- Removing and installing ⇒ Page 21-51

9 - Catalytic converter

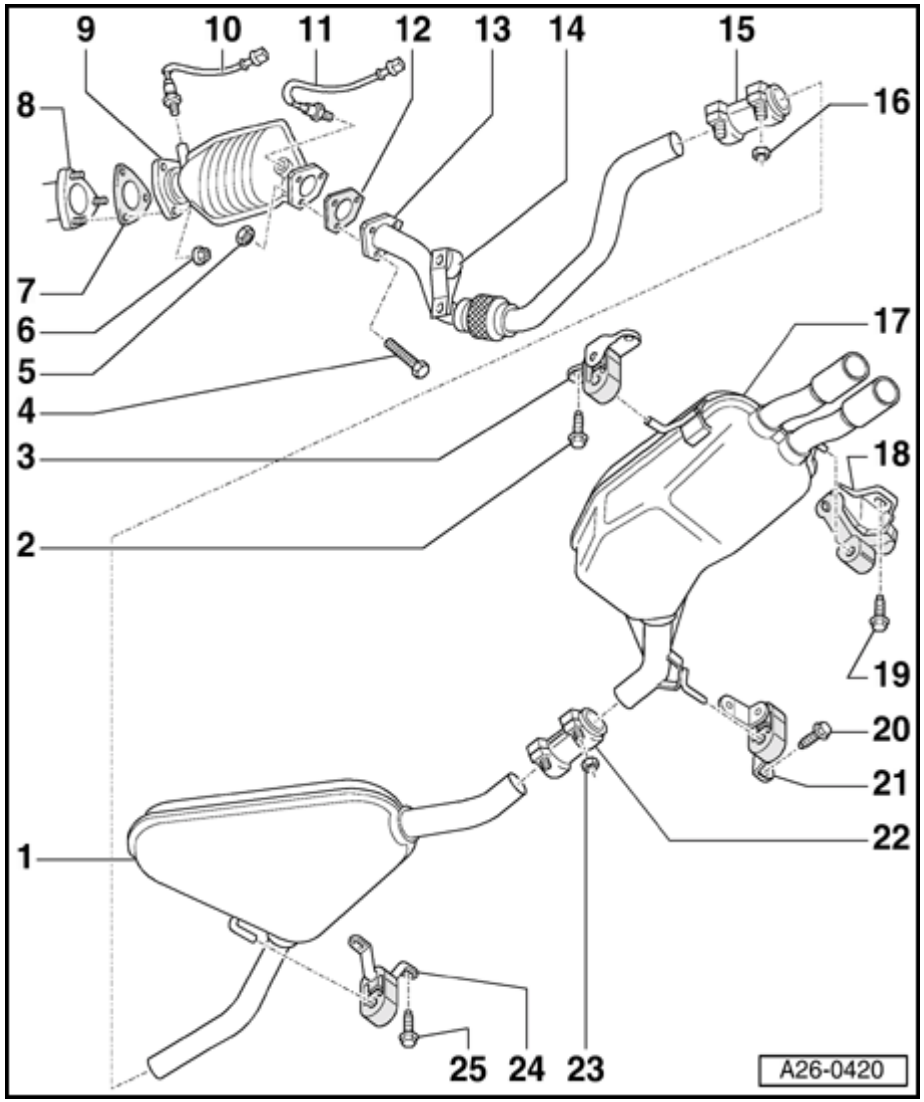
- Protect from damage by impact
- Removing and installing ⇒ Page 26-27

10 - Oxygen sensor - 55 Nm

- Upstream of catalytic converter
- Grease only the threads with high-temperature lubricant G 052 112 A3. The lubricant must not get into the slots on the sensor body.
- Checking:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

cardiagn.com



11 - Oxygen sensor - 55 Nm

- Downstream of catalytic converter
- Grease only the threads with high-temperature lubricant G 052 112 A3. The lubricant must not get into the slots on the sensor body.
- Checking:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

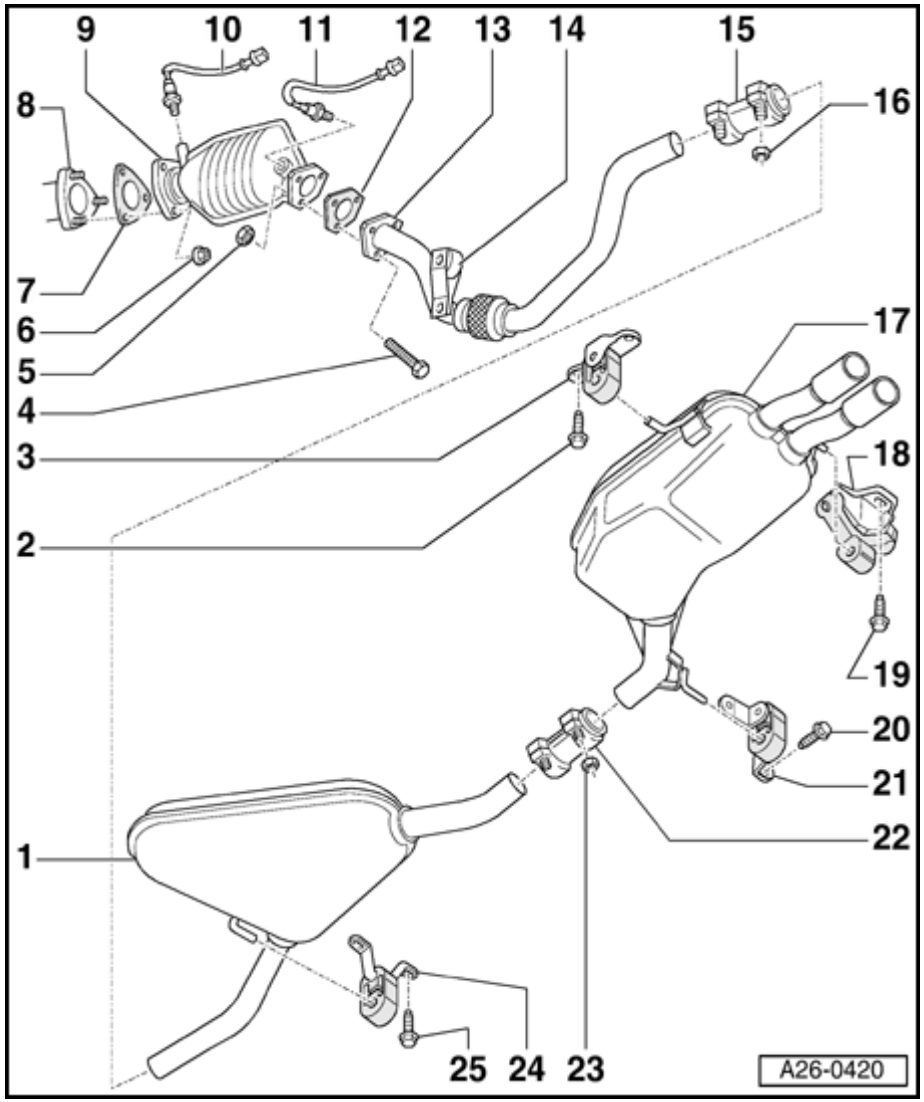
12 - Gasket

- Always replace

13 - Front exhaust pipe

- With flexible connection (de coupling element)
- Do not bend flexible connection more than 10° - otherwise it can be damaged.
- Removing and installing ⇒ Page 26-32
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-37

cardiagn.com



14 - Mounting

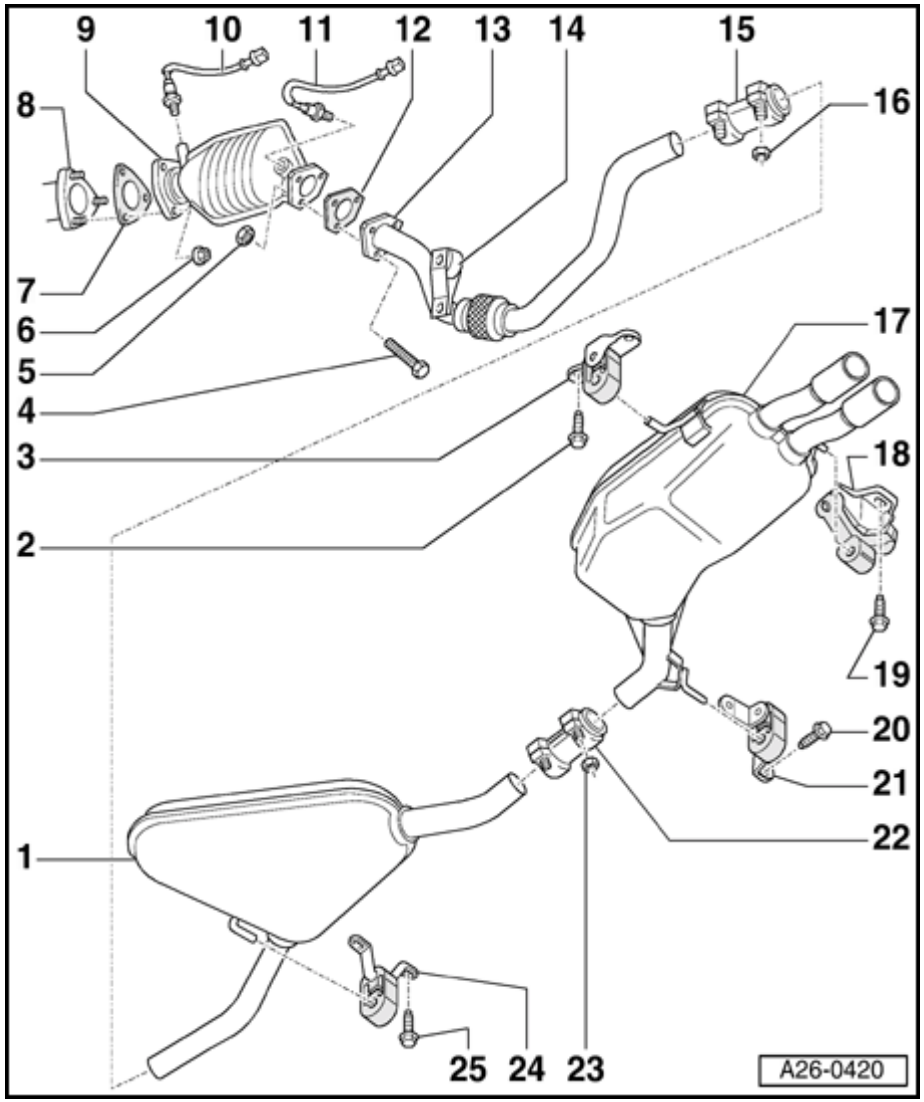
- Individual parts of mounting for manual transmission⇒Fig. ⇒ 3 , ⇒ Page 26-16
- Individual parts of mounting for automatic transmission ⇒Fig. ⇒ 4 , ⇒ Page 26-17

15 - Front clamp

- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-37
- Installation position ⇒Fig. ⇒ 1 , ⇒ Page 26-15
- Tighten bolted connections evenly

16 - 40 Nm

cardiagn.com



17 - Rear muffler

- Rear and center mufflers are one unit as original equipment. In cases of repair replace individually
- Cutting point ⇒ Page 26-20
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-37

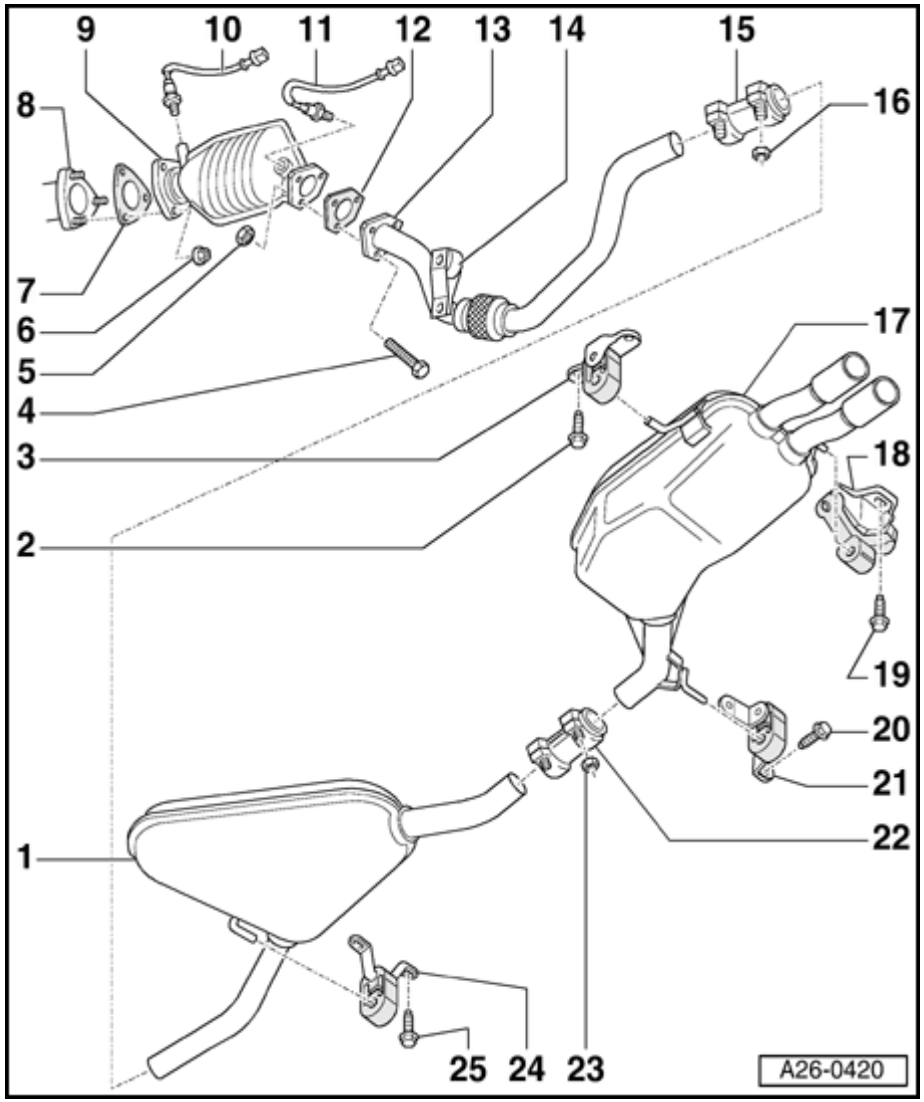
18 - Mounting

19 - 25 Nm

20 - 25 Nm

21 - Mounting

cardiagn.com



22 - Rear clamp

- For separate replacement of center and rear mufflers
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-37
- Installation position ⇒Fig. ⇒ 2 , ⇒ Page 26-15
- Tighten bolted connections evenly

23 - 40 Nm

24 - Mounting

25 - 25 Nm

cardiagn.com

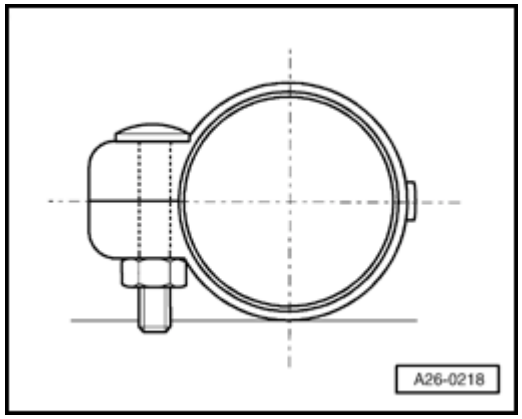


Fig. 1 Installation position of front clamp

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

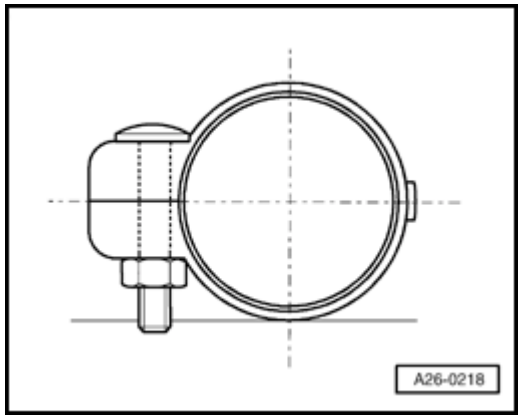


Fig. 2 Installation position of rear clamp

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

cardiagn.com

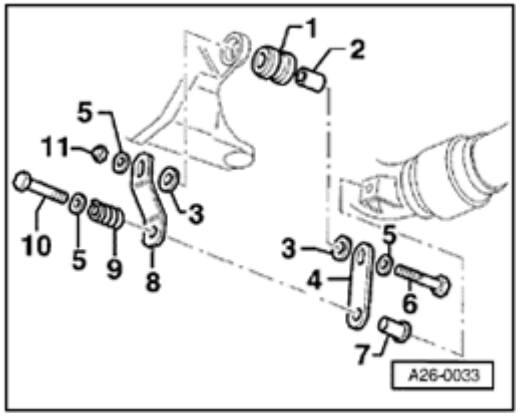


Fig. 3 Individual parts of mounting for vehicles with manual transmission

1 - Buffer

2 - Spacer pipe

3 - Washer

4 - Lug, right

5 - Disc

6 - Bolt - 25 Nm

7 - Spacer

8 - Lug, left

9 - Compression spring

10 - Bolt - 25 Nm

11 - Nut, self-locking - 25 Nm

cardiagn.com

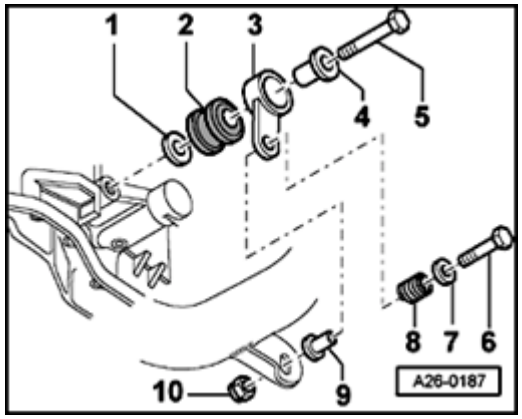


Fig. 4 Individual parts of mounting for vehicles with automatic transmission

1 - Disc

2 - Buffer

3 - Link

4 - Spacer

5 - Bolt - 25 Nm

6 - Bolt

7 - Disc

8 - Compression spring

9 - Spacer

10 - Nut, self-locking - 25 Nm

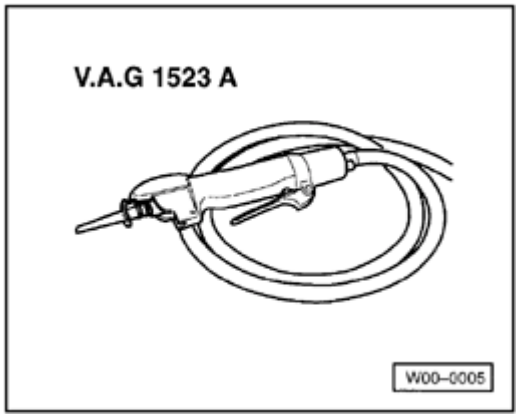
cardiagn.com

Center and rear mufflers, separating

For individual replacement of the center or rear muffler, a cutting point is marked on the connecting pipe.

The cutting point is marked with an indentation on the outside of the exhaust pipe.

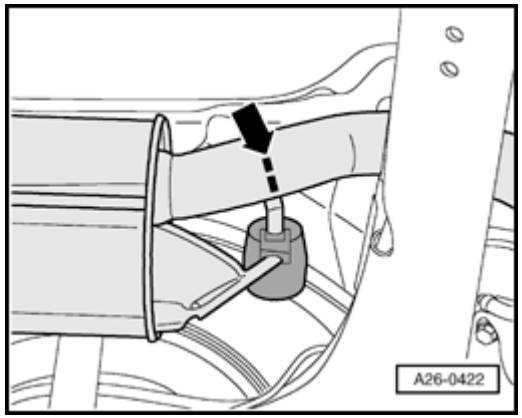
Special tools and equipment



- Body saw VAG 1523 A
- Protective goggles

cardiagn.com

Vehicles with front wheel drive:

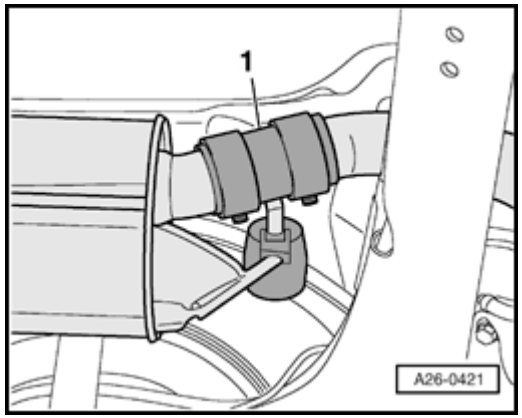


- Cut exhaust pipe at right angles using body saw, e.g. VAG 1523 A, at position marked -arrow-.

WARNING!

Wear protective goggles.

- When installing, position clamp centrally over saw cut.

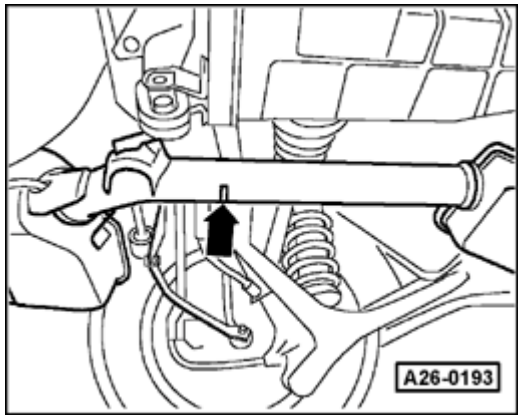


- ♦ Installation position of clamp -1-: Horizontally, bolted connections face rear left wheel ⇒ Fig. ⇒ 2 , ⇒ Page 26-8
- Ensure exhaust system is aligned stress-free ⇒ Page 26-34 .
- Tighten bolted connections on clamp evenly to 40 Nm.

cardiagn.com

26-20

Vehicles with all-wheel drive:

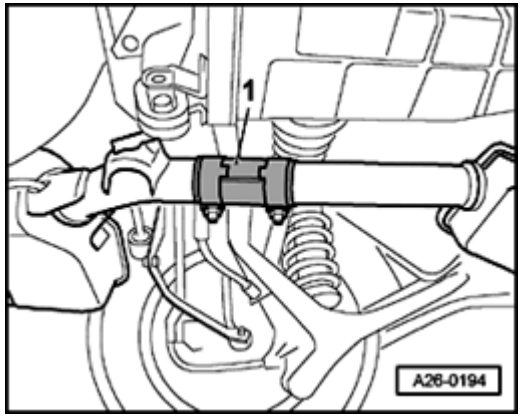


- Cut exhaust pipe at right angles using body saw, e.g. VAG 1523 A, at position marked -arrow-.

WARNING!

Wear protective goggles.

- When installing, position clamp centrally over saw cut.



- ♦ Installation position of clamp -1-: Horizontally, bolted connections face rear left wheel ⇒ Fig. ⇒ 2 , ⇒ Page 26-15
- Ensure exhaust system is aligned stress-free ⇒ Page 26-37 .
- Tighten bolted connections on clamp evenly to 40 Nm.

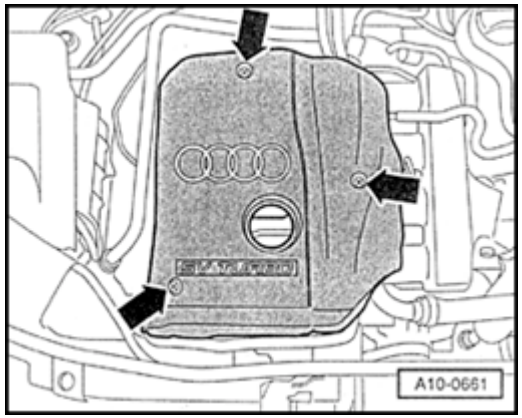
cardiagn.com

Exhaust manifold, removing and installing

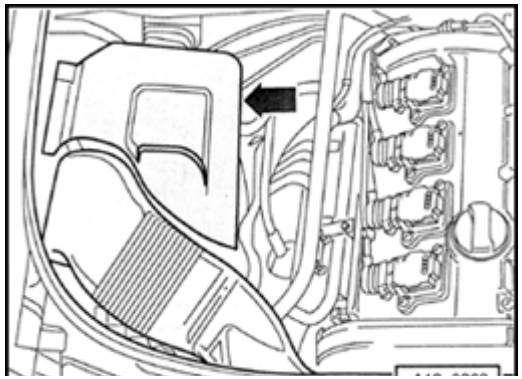
Removing

Note:

The flexible connection in the front exhaust pipe must not be deflected more than 10° or it may be damaged.



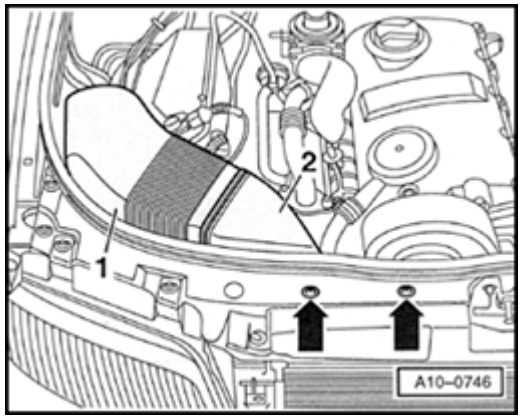
- Remove engine cover panel -arrows-.



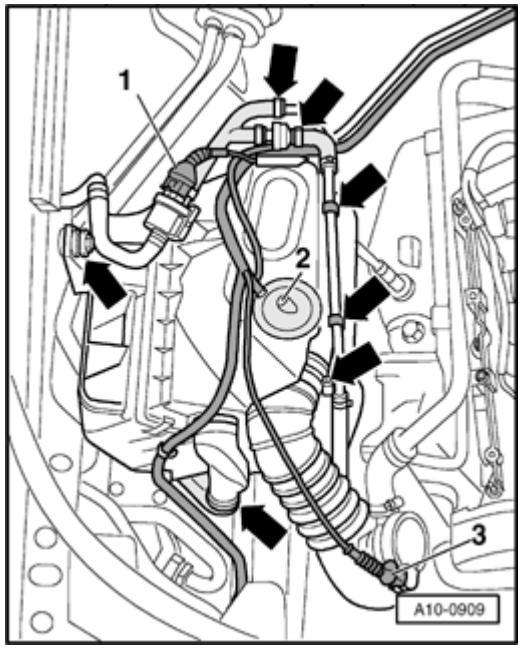
- Remove air filter cover -arrow-.

cardiagn.com

26-22



- Remove bolts -arrows-.
- Remove air duct -1- and -2-.



- Disconnect wiring connectors as follows:

1 - on ACF valve (in addition, remove ACF valve from air filter housing)

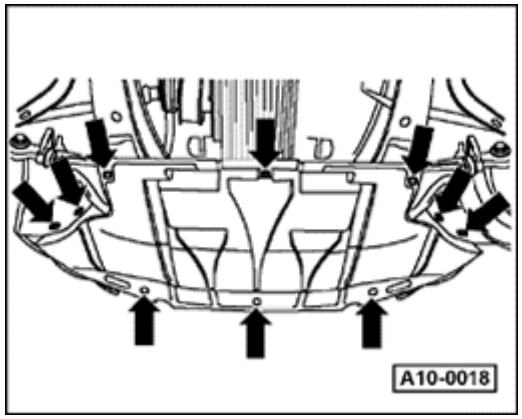
2 - on mass air flow sensor

3 - on Wastegate Bypass Regulator valve -N75-

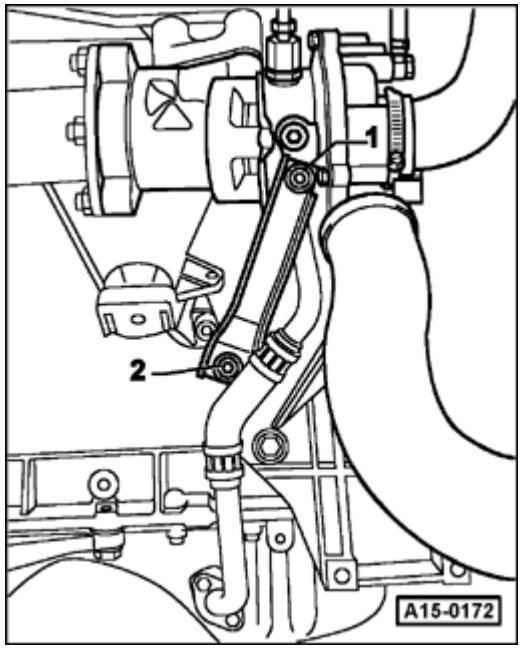
- Remove hose connections, move wiring aside and remove air filter housing -arrows-.

cardiagn.com

26-23



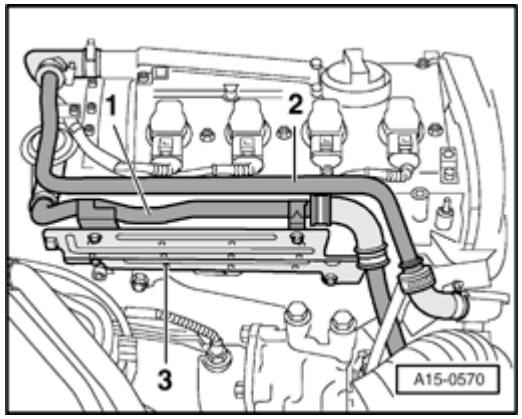
- Remove sound insulation -arrows-.



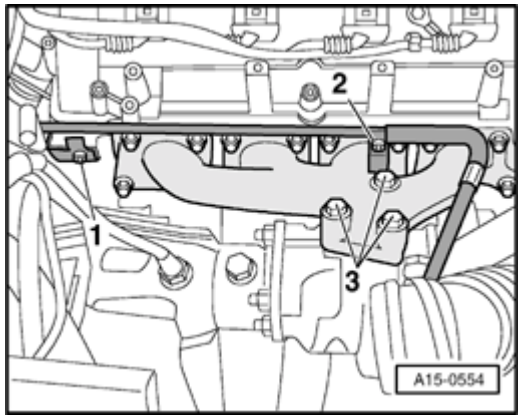
- Loosen bolts -1- and -2- by several turns.

cardiagn.com

26-24

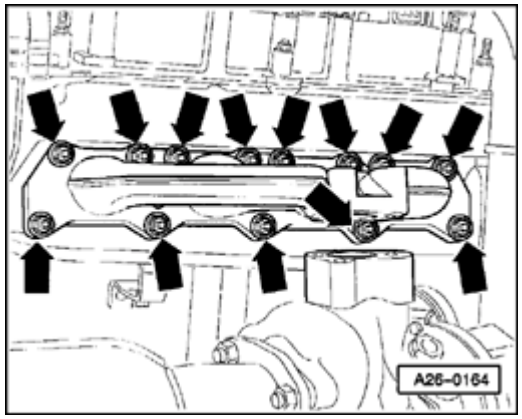


- Remove front hose from line of crankcase vent -2-.
- Disconnect front hose from line -1- of secondary air inlet.
- Remove heat shield -3-.



- Remove bolts -1- and -2- of oil feed line.
- Remove bolts -3- for exhaust turbocharger.
- Remove seal between exhaust turbocharger and exhaust manifold.
- Plug opening in suction duct of turbocharger with a clean cloth.

cardiagn.com



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

Installing

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

Note:

Always replace seals, gaskets and self-locking nuts.

- Adhere to the following sequence:
  - Exhaust manifold to cylinder head
  - Exhaust turbocharger on exhaust manifold
  - Turbocharger bracket to cylinder block
  - Turbocharger bracket to turbocharger

cardiagn.com

Tightening torques

Component	Nm
Exhaust manifold to cylinder head	30
Turbocharger to exhaust manifold	35 1) 2)
Turbocharger bracket to cylinder block	25
Turbocharger bracket to turbocharger	30
Oil feed line to cylinder head	23
Line of crankcase vent to cylinder head	10
Hose clamps for air duct hoses	3.5

1) Replace bolts

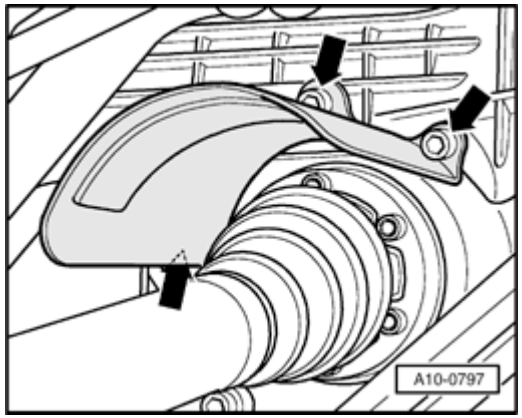
2) Coat thread and head attachment area with high temperature lubricant "G 052 112 A3"

cardiagn.com

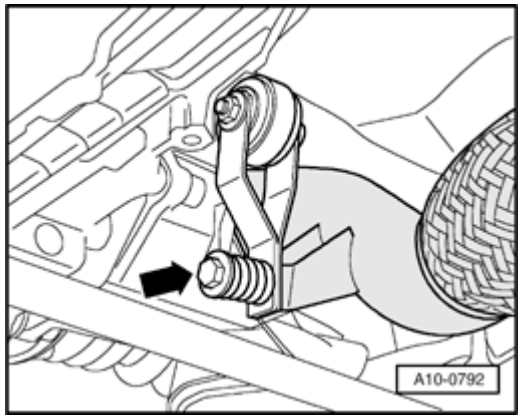
26-27

Catalytic converter, removing and installing

Removing



- Remove heat shield -arrows- above right-hand drive shaft.
- Loosen bolted connection front exhaust pipe/catalytic converter accessible from below.



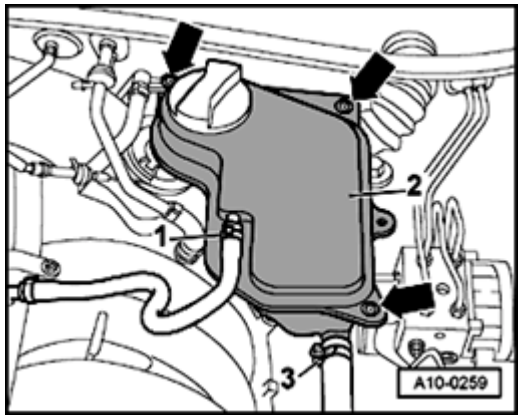
- Remove bolt for transmission bracket to exhaust system -arrow-.

Note:

The flexible connection in the front exhaust pipe must not be deflected more than 10° to avoid damage.

cardiagn.com

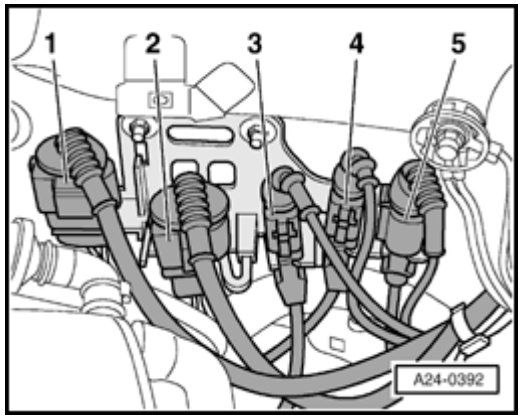
26-28



- Unbolt coolant expansion tank -2-, -arrows-.
- Disconnect wire to Engine Coolant level (ECL) Warning switch -F66- and move coolant expansion tank to one side.

Note:

Coolant hoses -1- and -3- do not have to be disconnected.



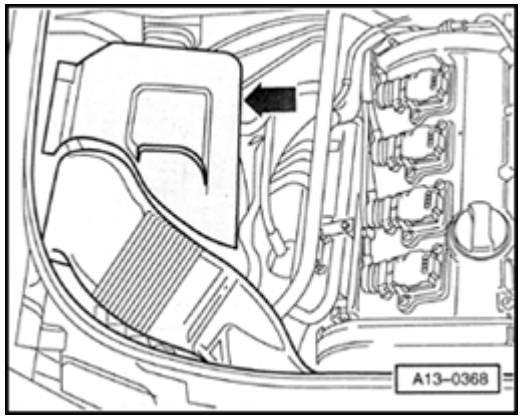
- Disconnect wiring connector for oxygen sensors and move wiring aside.

1 - (brown) to oxygen sensor downstream of catalytic converter -G130-

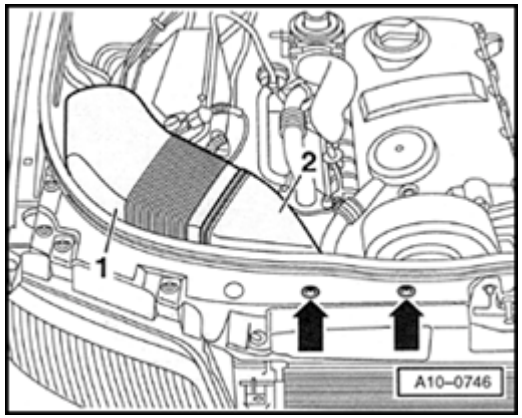
2 - (black) to oxygen sensor upstream of catalytic converter -G39-

cardiagn.com

26-29



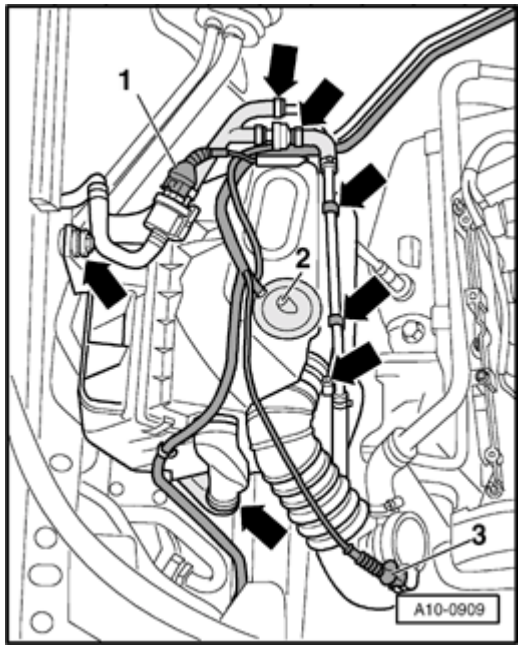
- Remove air filter cover -arrow-.



- Remove bolts -arrows-.
- Remove air duct -1- and -2-.

cardiagn.com

26-30



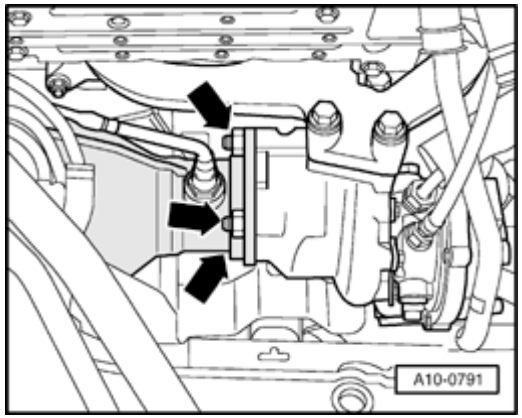
- Disconnect wiring connectors as follows:

1 - on ACF valve (in addition, remove ACF valve from air filter housing)

2 - on mass air flow sensor

3 - on Wastegate Bypass Regulator valve -N75-

- Disconnect hose connections, move wiring aside and remove air filter housing -arrows-.
- Loosen bolted connection of front exhaust pipe/catalytic converter accessible from above.



- Undo bolts -arrows- of exhaust turbocharger/catalytic converter.
- Remove catalytic converter upward.

cardiagn.com

Installing

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

Note:

Always replace seals, gaskets and self-locking nuts.

- Grease threads of oxygen sensors with high temperature lubricant G 052 112 A3. Apply lubricant only to threads of sensors; the lubricant must not get into the slots on the sensor body.

- Align exhaust system stress-free ⇒ Page 26-34 or ⇒ Page 26-37 .

Tightening torques

Components	Nm
Oxygen sensor to catalytic converter	55
Catalytic converter to exhaust turbocharger	30
Front exhaust pipe to catalytic converter	25
Front exhaust pipe to mountings on transmission	25
Heat shield to transmission	23
Hose clamps for air duct hoses	

cardiagn.com

	3.5

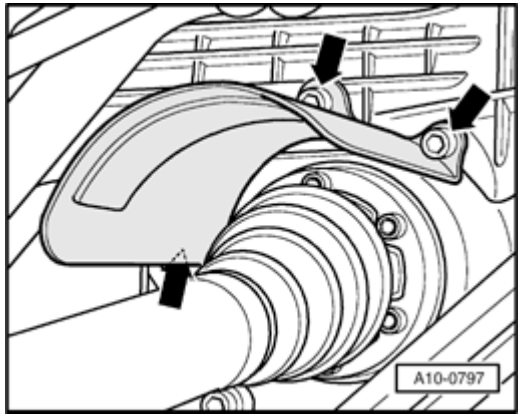
cardiagn.com

26-32

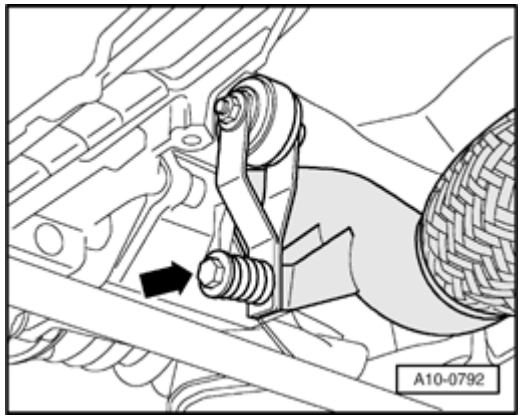
Front exhaust pipe, removing and installing

Removing

- Loosen bolted connection of front exhaust pipe/catalytic converter accessible from above.



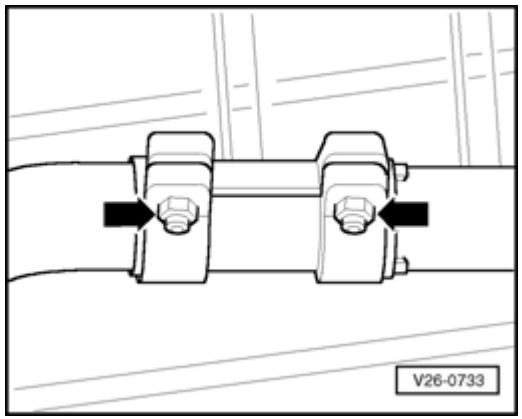
- Remove heat shield -arrows- above right-hand drive shaft.
- Remove crosspiece for underfloor.



- Unbolt transmission bracket for exhaust system -arrow-.

cardiagn.com

26-33



Note:

The flexible connection in the front exhaust pipe must not be deflected more than 10° or it may be damaged.

- Separate exhaust system at clamp -arrows-.
- Loosen bolted connection of front exhaust pipe/catalytic converter accessible from below.
- Remove front exhaust pipe.

Installing

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

Note:

Always replace seals, gaskets and self-locking nuts.

- Align exhaust system stress-free ⇒ Page 26-34 or ⇒ Page 26-37 .

Tightening torques

Components	Nm
Front exhaust pipe to catalytic converter	25
Crosspiece for underbody to body	20
Heat shield to transmission	23

cardiagn.com

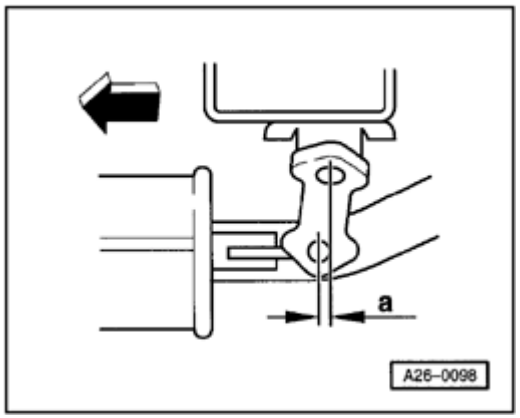
26-34

Stress-free alignment of the exhaust system - Vehicles with front wheel drive

Vehicles without clamp between center muffler and rear muffler

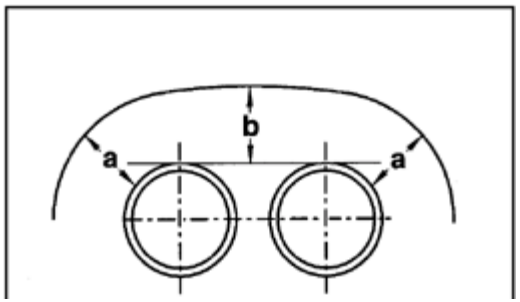
- The exhaust system must be aligned when cold.

- Loosen bolted connections on front clamp -Item 16 -, ⇒ Page 26-5 .



- Push exhaust system toward front of vehicle -arrow- so that rear mounting of rear muffler is pre-loaded by amount -a- = 9 to 11 mm.
- Tighten bolted connections on clamp evenly to 40 Nm.

Aligning tailpipes



Align tailpipes so that the distance -a- is the same on both sides.

At the same time, distance -b- must be obtained between the bumper cut-out and the tailpipe:

- Dimension b = min. 24 mm

cardiagn.com

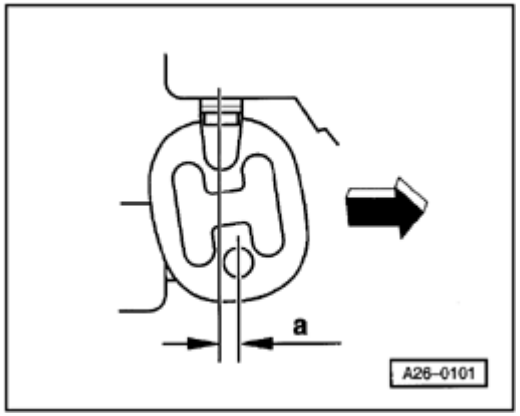
Vehicles with clamp between center muffler and rear muffler

- The exhaust system must be aligned when cold.

Note:

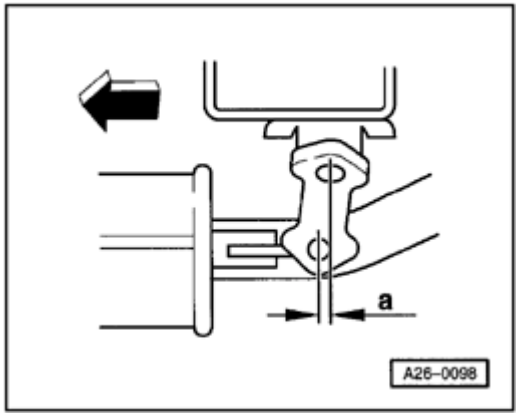
It is only necessary to additionally align the center muffler on vehicles with a clamp installed between the center and rear mufflers.

- Loosen bolted connections on front -Item 16 -, ⇒ Page 26-5 and rear clamps -Item 21 -, ⇒ Page 26-6 .



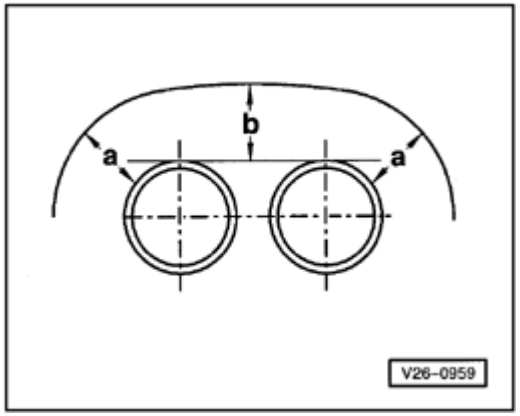
- Push front section of exhaust system toward front of vehicle -arrow- until preloading at right-hand mounting of center muffler is -a- = 7 to 9 mm.
- Tighten bolts on front clamp -Item 16 -, ⇒ Page 26-5 evenly to 40 Nm.

cardiagn.com



- Push rear part of exhaust system towardsfront of vehicle -arrow- so that rear mounting on rear muffler is preloaded by -a- = 9 to 11 mm.
- Tighten bolts on rear clamp -Item 21 -, ⇒ Page 26-6 evenly to 40 Nm.

Aligning tailpipes



Align tailpipes so that distance -a- is the same on both sides.

At the same time, distance -b- must be obtained between the bumper cut-out and the tailpipe:

- Dimension b = min. 24 mm

cardiagn.com

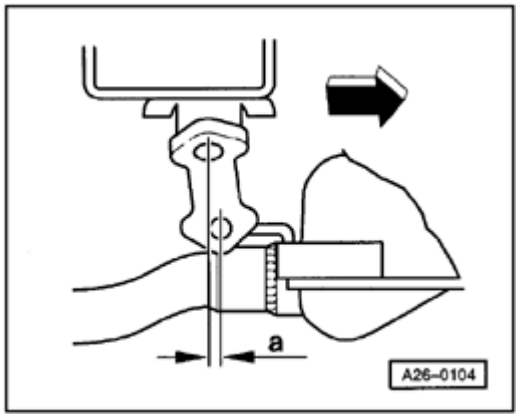
26-37

Stress-free alignment of exhaust system - Vehicles with all-wheel drive

- Vehicles without clamp between centre silencer and rear silencer

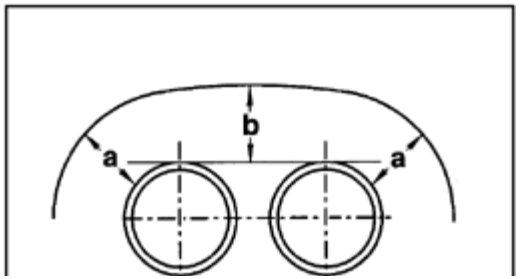
- The exhaust system must be aligned when cold.

- Loosen bolted connections on clamp -Item 15 -, ⇒ Page 26-12



- Push rear silencer towards front of vehicle -arrow- so that rear right mounting on rear silencer is preloaded by a = 9...11 mm.
- Tighten bolted connections on clamp evenly to 40 Nm.

Aligning tailpipes



- Align tailpipes so that distance -a- is the same on both sides.
- At the same time, distance -b- must be obtained between bumper cut-out and tailpipe:
  - Dimension b = min. 24 mm

cardiagn.com

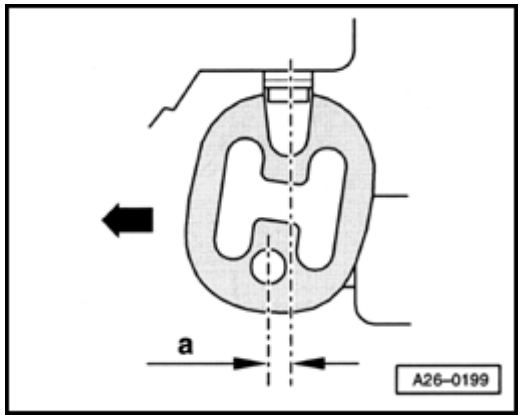
- Vehicles with clamp between centre silencer and rear silencer

- The exhaust system must be aligned when cold.

Note:

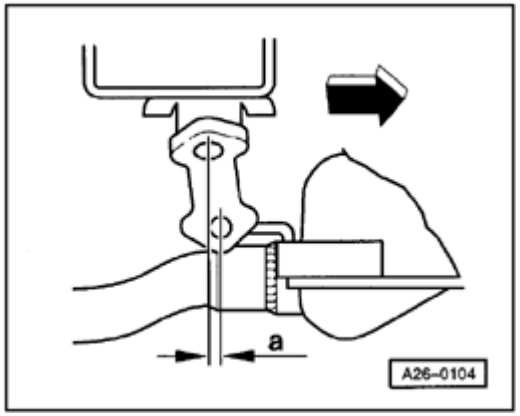
It is only necessary to additionally align the centre silencer on vehicles with clamp fitted between centre silencer and rear silencer.

- Slacken bolted connections on clamp -Item 15 -, ⇒ Page 26-12 and -Item 22 -, ⇒ Page 26-14 .



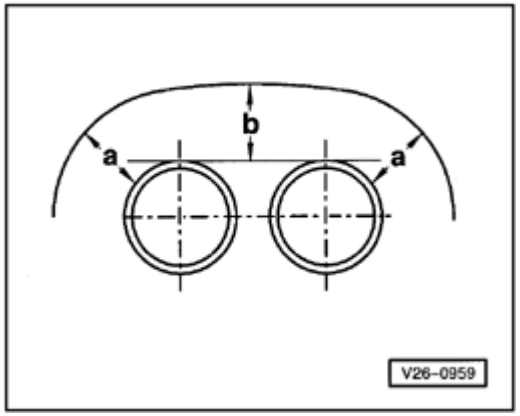
- Push exhaust system towards front of vehicle -arrow- so that rear right mounting on centre silencer is preloaded by a = 7...9 mm.
- Tighten bolts on front clamp -Item 15 -, ⇒ Page 26-12 evenly to 40 Nm.

cardiagn.com



- Push rear silencer towards front of vehicle -arrow- so that rear right retainer on rear silencer is preloaded by a = 9...11 mm.
- Tighten bolts on rear clamp -Item 22 -, ⇒ Page 26-14 evenly to 40 Nm.

Aligning tailpipes



- Align tailpipes so that distance -a- is the same on both sides.
- At the same time, distance -b- must be obtained between bumper cut-out and tailpipe:
  - Dimension b = min. 24 mm

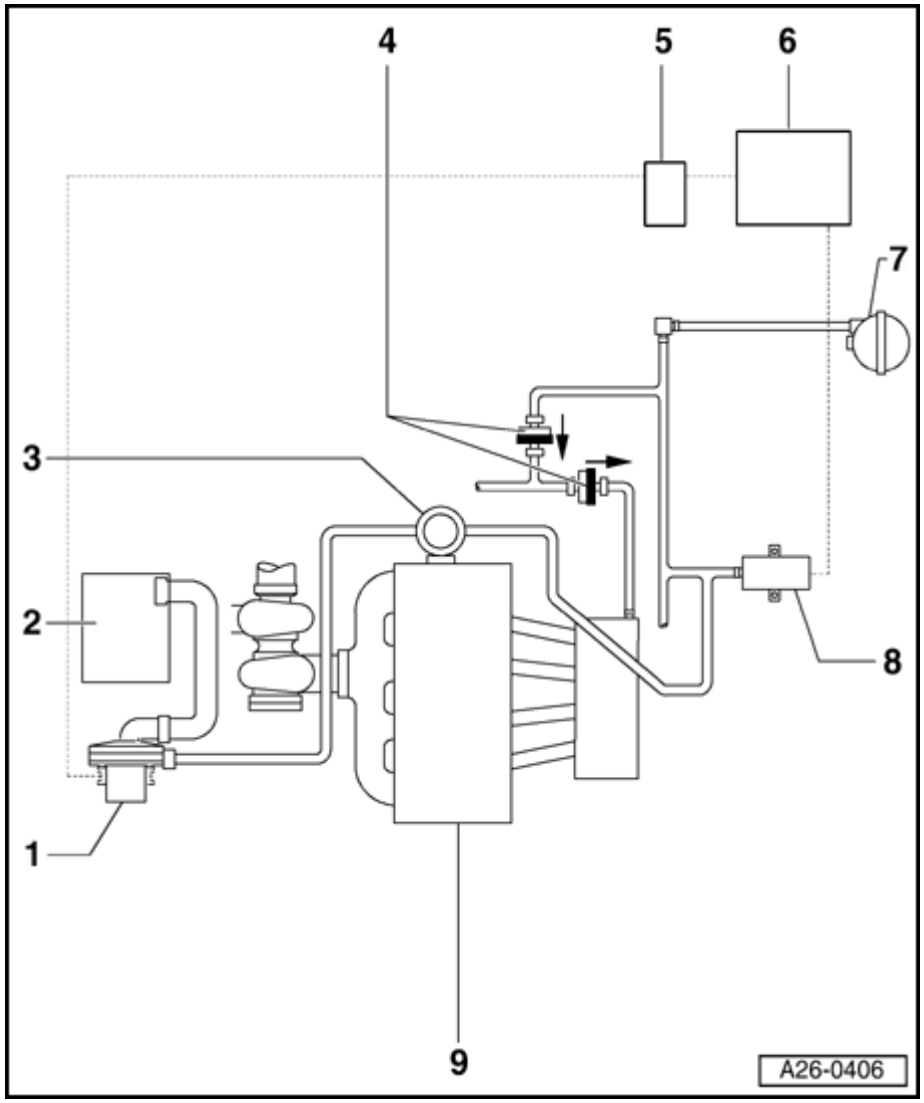
cardiagn.com

Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug tailpipes with cloths or stoppers, etc. until leakage check is completed.
- Listen for noise at the connection points (cylinder head/manifold, manifold/turbocharger, turbocharger/catalytic converter, etc.) to locate any leaks.
- Repair any leaks that are found.

cardiagn.com

26-41



Secondary air system

Secondary air system, function/components

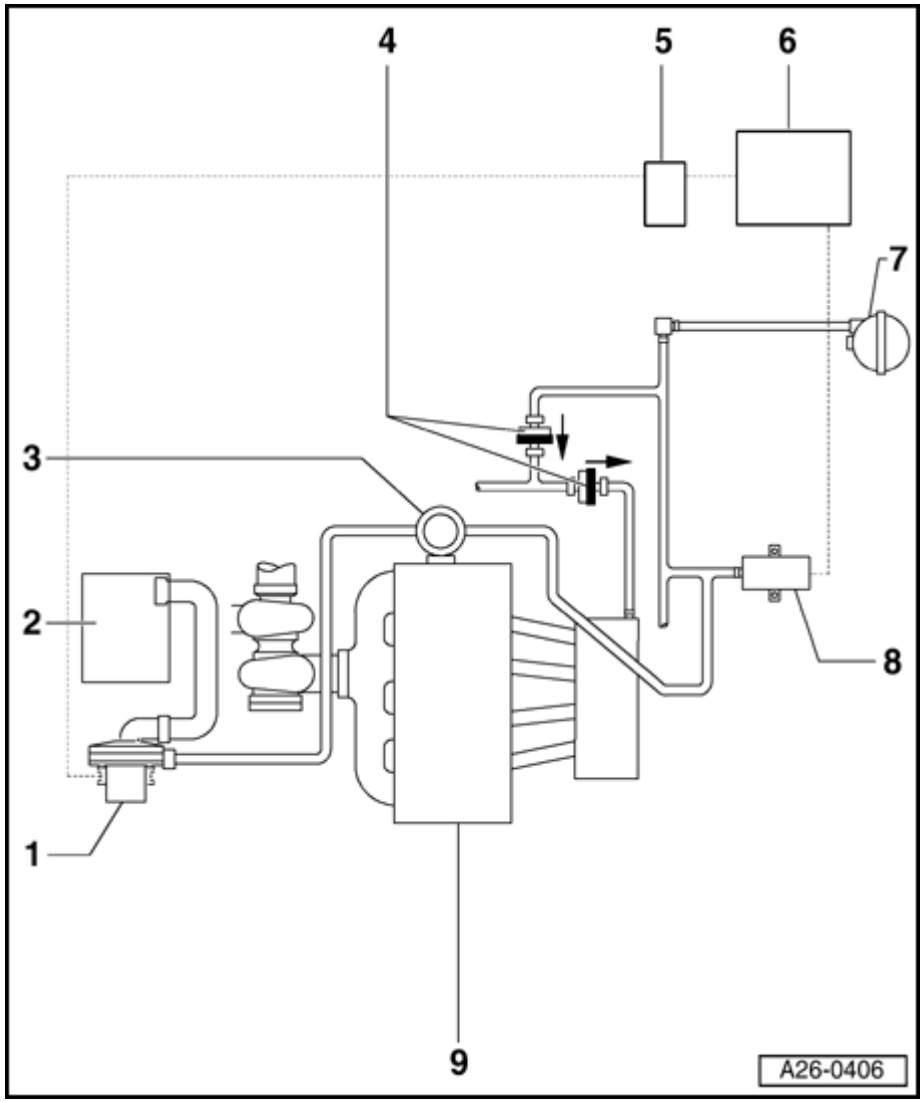
The secondary air system permits faster warm-up and thus makes the catalytic converter ready for operation sooner after cold starting.

Principle

Due to over-enrichment of the mixture in the cold start phase, there is an increased amount of unburned hydrocarbons in the exhaust gas. The injection of secondary air improves the oxidation in the catalytic converter and thus reduces emissions. The heat produced by secondary oxidation reduces start-up time for the catalytic converter therefore improving the emission quality in the cold-running phase.

cardiagn.com

26-42

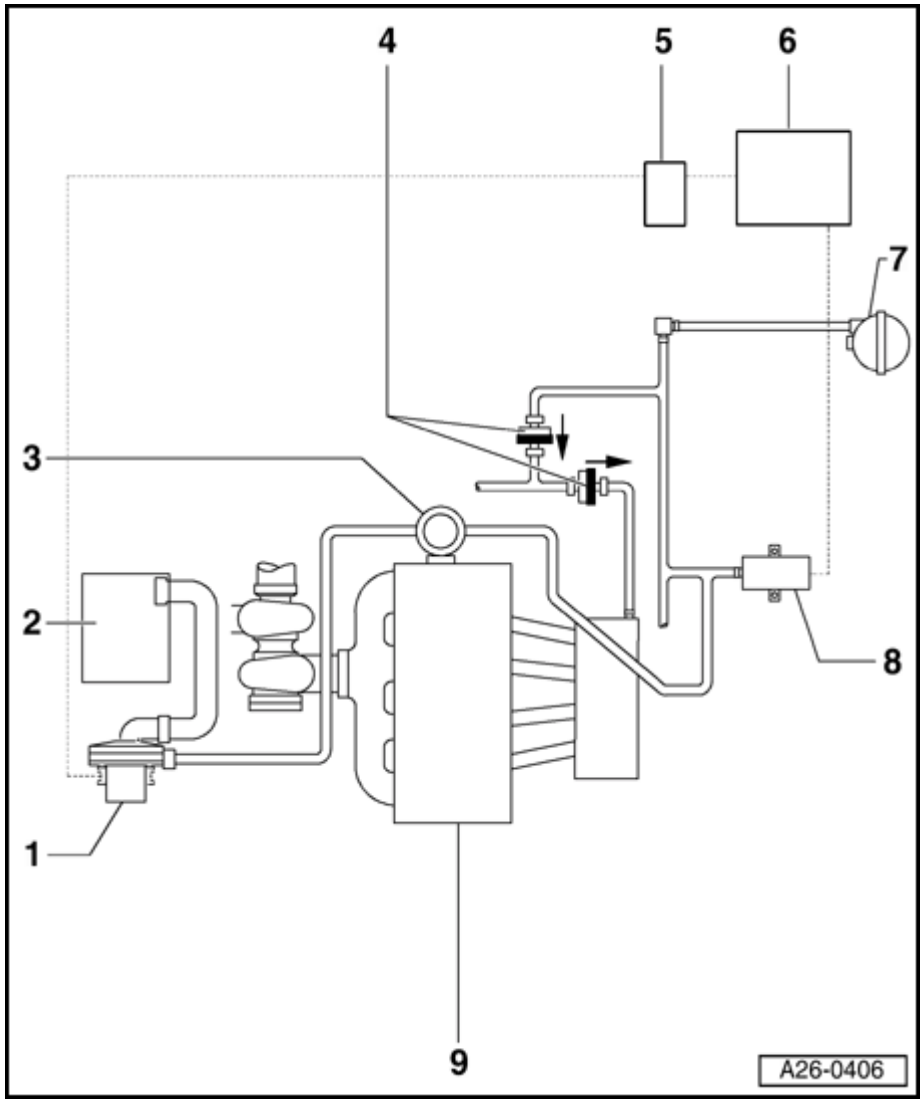


Function

- During the cold running phase, the engine control module -6- actuates the secondary air injection pump -1- via the secondary air injection pump relay -5-. Air reaches the combination valve for the secondary air inlet -3-.
- Parallel to this the secondary air inlet valve -8- is actuated, which allows the vacuum to reach the combination valve for secondary air inlet -3-. The combination valve for secondary air inlet thus allows the secondary air to enter the exhaust ducts of the cylinder head -9-.

cardiagn.com

26-43



1 - Secondary Air Injection (AIR) Pump motor -V101-

- Location ⇒Fig. ⇒ 2 , ⇒ Page 26-45

2 - Air cleaner

3 - Combination valve for secondary air inlet

- Location ⇒Fig. ⇒ 4 , ⇒ Page 26-46

4 - Non-return valve

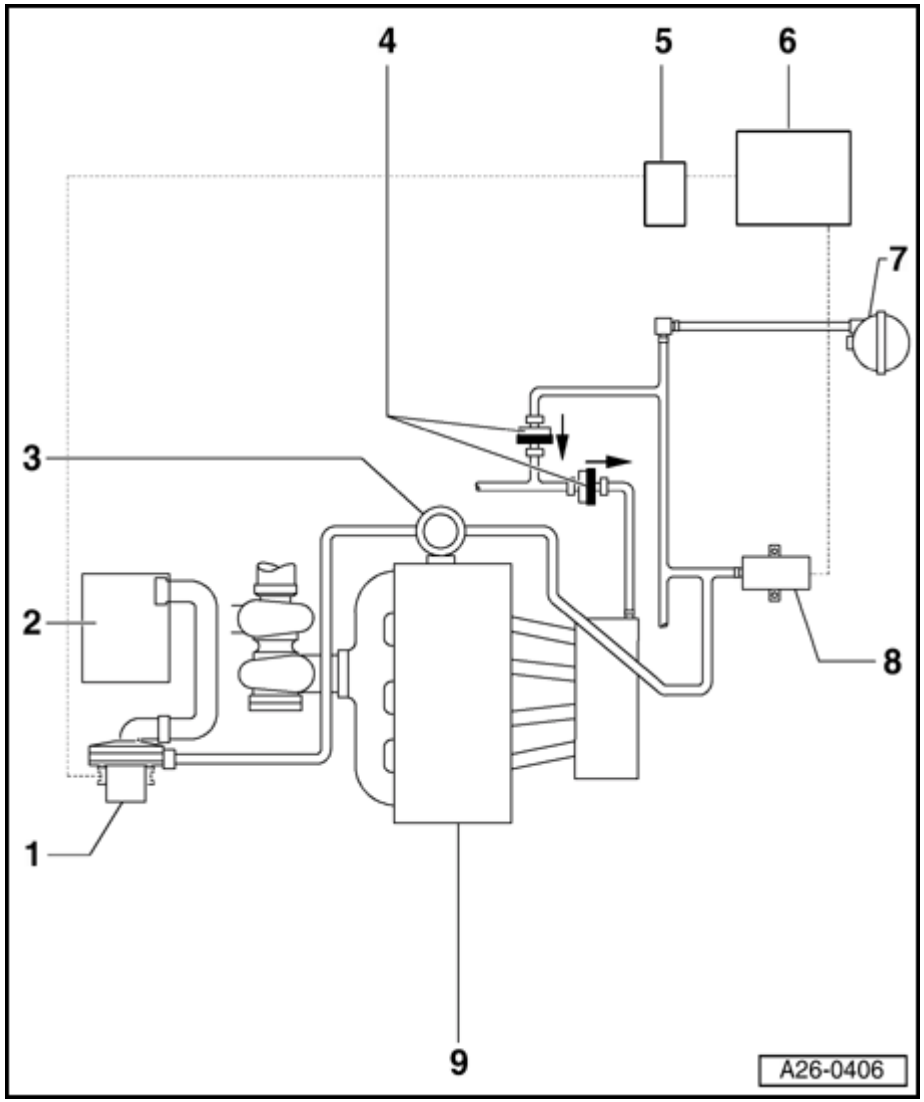
- Position (light side/ dark side or direction of arrow) as shown in illustration, arrow faces in direction of flow

5 - Secondary Air Injection (AIR) Pump relay -J299-

- Location ⇒Fig. ⇒ 3 , ⇒ Page 26-46

cardiagn.com

26-44



6 - Engine Control Module -J220-

7 - Vacuum reservoir

- Location: In front left wheel housing beneath wheel housing liner

8 - Secondary Air Injection (AIR) Solenoid valve -N112-

- Location ⇒Fig. ⇒ 1 , ⇒ Page 26-45

9 - Cylinder head

cardiagn.com

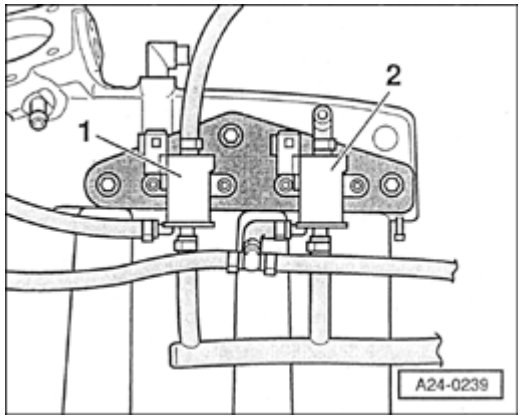


Fig. 1 Installation position Secondary Air Injection (AIR) valve - N112-

- Location: below intake pipe

1 - Recirculating valve for turbocharger -N249- (green connection)

2 - Secondary air injection valve -N112- (brown connection)

Note:

The illustration shows bottom view of intake pipe.

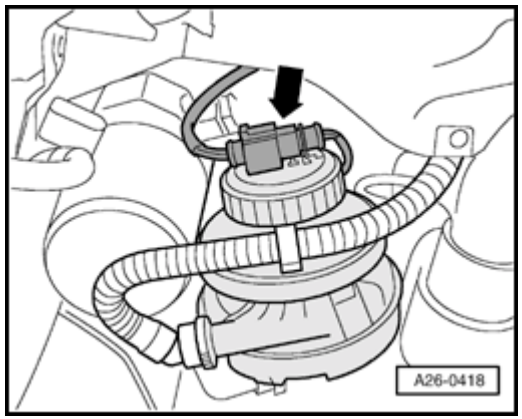


Fig. 2 Installation position for Secondary Air Injection (AIR) Pump motor -V101-

- Front right in engine compartment beneath air filter housing

cardiagn.com

26-46

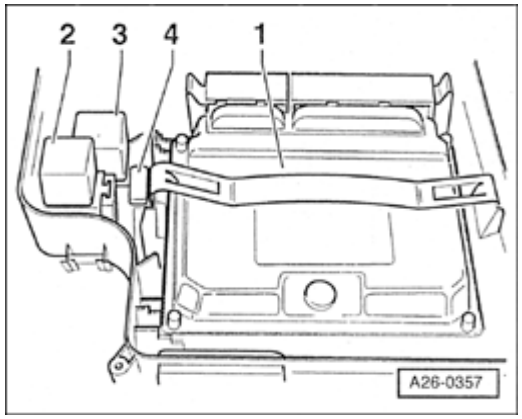


Fig. 3 Installation position Secondary Air Injection (AIR) Pump relay -J299-

- In E-box in plenum chamber

1 - Engine control module

2 - Secondary air pump relay -J299-

3 - Power supply relay for Motronic -J271-

4 - Fuse S130 for secondary air pump

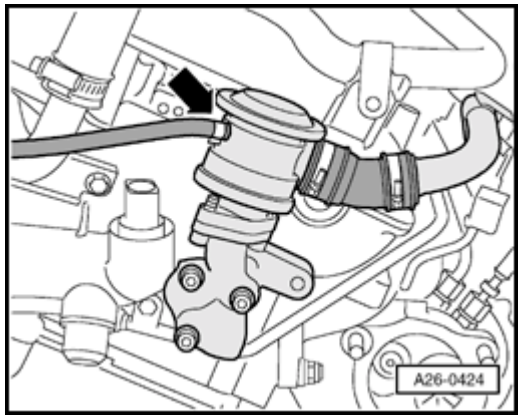
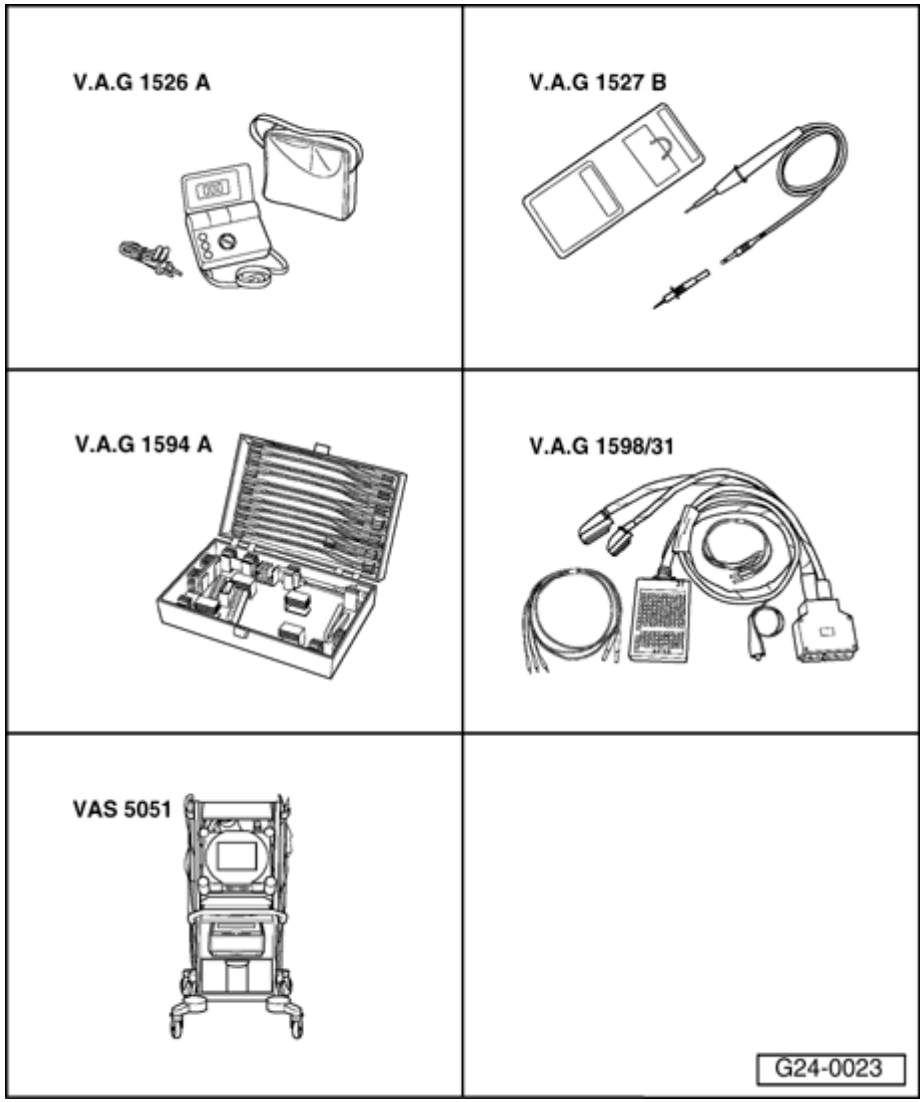


Fig. 4 Combination valve for secondary air injection

- Right rear on cylinder head

cardiagn.com

26-47



Secondary Air Injection (AIR) Solenoid valve -N112-, checking

Special tools and equipment

- VAG 1526 A
- VAG 1527 B
- VAG 1594 A
- VAG 1598/31
- VAS 5051 with VAS 5051/1

- or

- VAG 1551 with VAG 1551/3 A

cardiagn.com

26-48

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551 Scan Tool connected.

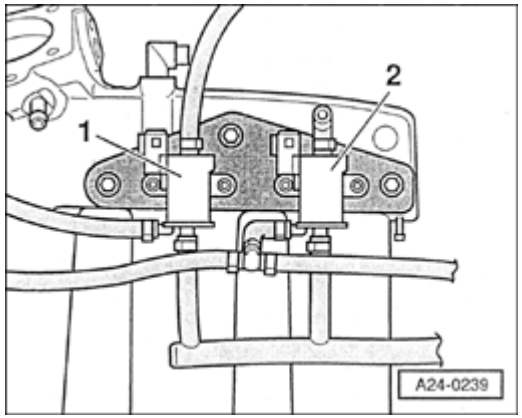
Test sequence

Note:

The secondary air injection solenoid valve - N112- and the wiring connections are monitored by the engine control module.

- Read out Diagnotic Trouble Code (DTC) memory of engine control module.

If a DTC relating to the secondary air injection solenoid valve -N112- is displayed:



- Remove hoses from secondary air injection solenoid valve -N112- (-2-) but leave electrical connector plugged in.

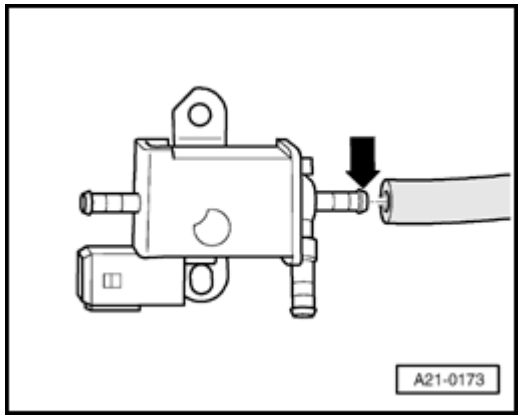
♦ Location: below intake line

Note:

The illustration shows bottom view of intake line.

cardiagn.com

26-49



Output Diagnostic Test Mode →

Secondary air injection solenoid valve -N112-

- Connect auxiliary hose to valve connector marked with an arrow.
- Initiate output Diagnostic Test Mode (DTM) and activate secondary air injection solenoid valve -N112-.

Display:

- The valve should click ...
- ... and should open and close (check by blowing into the auxiliary hose).

If the injector does not click:

- Check internal resistance of valve.

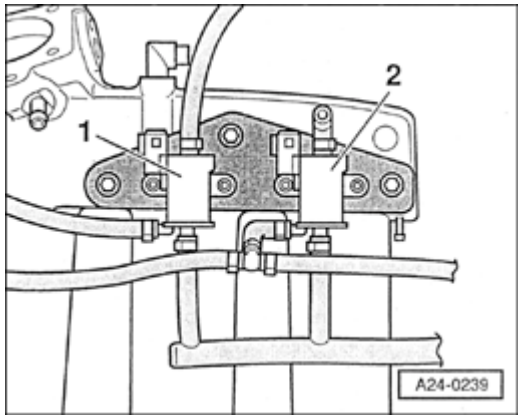
If valve does not open or close properly:

- Replace secondary air injection solenoid valve -N112-.

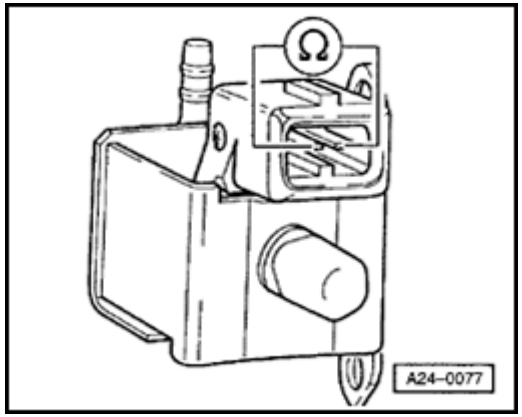
cardiagn.com

26-50

Checking internal resistance



- Disconnector connector of secondary air injection solenoid valve -N112- (-Item 2-).



- Connect multimeter to injector to measure resistance.
  - Specified value: 27 to 30 Ω

If specified value is not attained:

- Replace secondary air injection solenoid valve -N112-.

If specified value is attained:

- Check power supply.

cardiagn.com

26-51

Checking power supply

Note:

The power supply for the secondary air injection solenoid valve -N112- is via the fuel pump relay.

Test requirements:

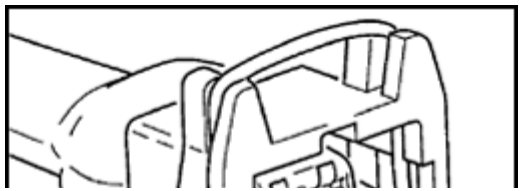
- Fuse for secondary air injection solenoid valve OK.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Fuel pump relay OK.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

- Disconnect connector from valve.



- Connect voltage tester VAG 1527 B as follows:

Connector	Measure to

cardiagn.com

contact	
1	Engine Ground

- Operate starter briefly.

- LED must light up.

cardiagn.com

26-52

If the LED does not light up:

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

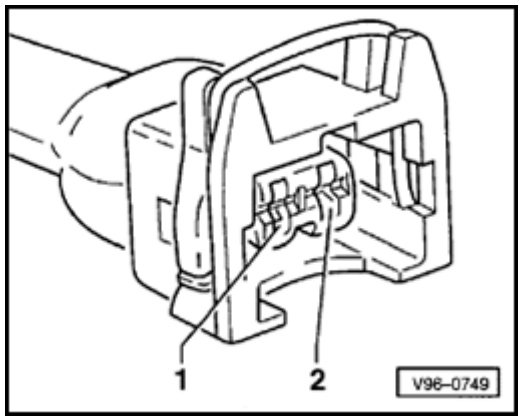
⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Repair open circuit, if necessary

If the LED lights up:

- Check actuation.

Checking actuation



- Connect voltage tester VAG 1527 B to contacts 1 (positive) and 2 of connector.
- Initiate output Diagnostic Test Mode (DTM) and activate secondary air injection solenoid valve -N112-.
  - ♦ LED must flash.

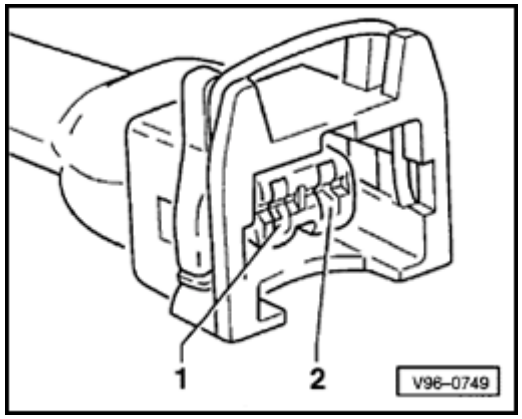
cardiagn.com

26-53

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

- Connect VAG 1598/31 test box to wiring harness leading to engine control module; engine control module should not be connected:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



- Check for open circuit and short to positive or Ground in following wiring connection:

Connector contact	Test box VAG 1598/31
2	9

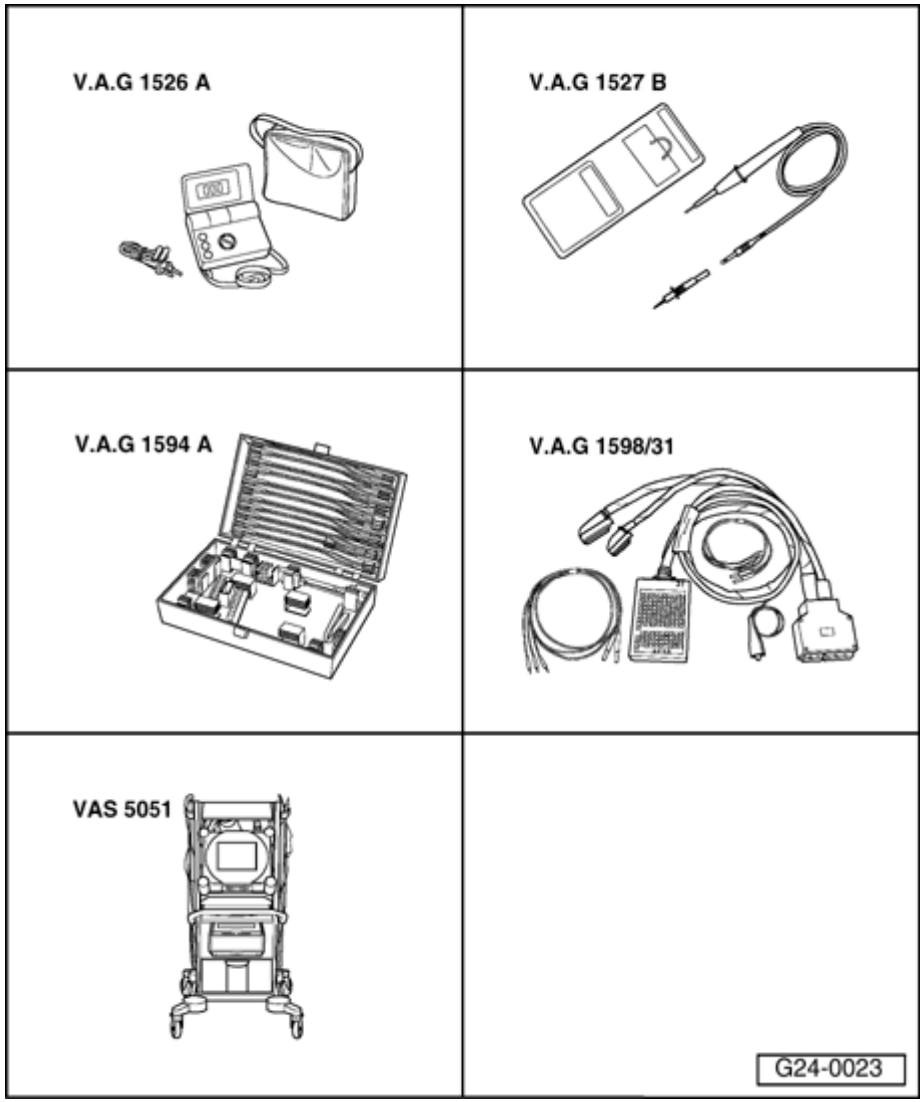
- Repair any open/short circuit as necessary.

If the wiring is OK:

- Replace engine control module.

cardiagn.com

26-54



Secondary Air Injection (AIR) Pump relay -J299- / Secondary Air Injection (AIR) Pump motor -V101-, checking

Special tools and equipment

- VAG 1526 A
- VAG 1527 B
- VAG 1594 A
- VAG 1598/31
- VAS 5051 with VAS 5051/1

- or

- VAG 1551 with VAG 1551/3 A

cardiagn.com

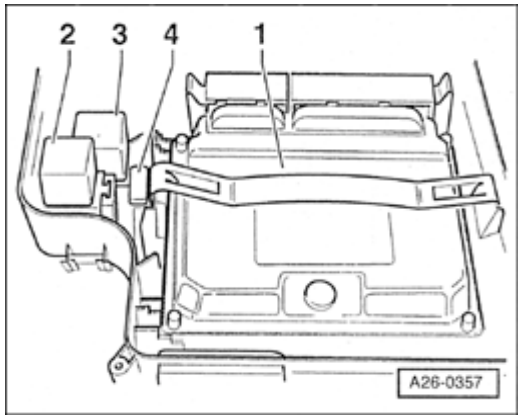
26-55

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551 Scan Tool.

Test sequence

- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection Pump relay -J299-.



- The secondary air injection pump relay-2- (in electronics box of plenum chamber, left) must respond and secondary air injection pump motor -V101- must run intermittently.

A - If relay does not respond:

- Check voltage supply of secondary air pump relay ⇒ Page 26-56 .
- Check actuation of secondary air injection pump relay ⇒ Page 26-58 .

B - If relay responds but secondary air injection pump motor does not run:

- Check voltage supply of secondary air injection pump motor ⇒ Page 26-60 .

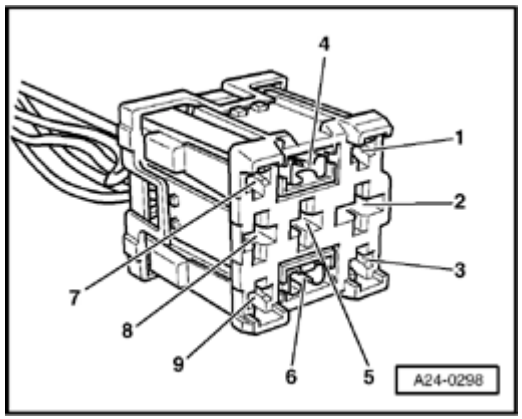
cardiagn.com

26-56

Check voltage supply of secondary air injection pump relay

- Switch ignition off.

- Remove secondary air injection pump relay.



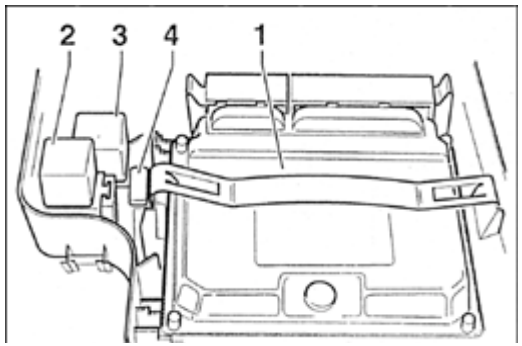
- Connect multimeter as follows to measure voltage.

3-position relay carrier in E-box in plenum chamber, position 2 Contact	Measure to
8	Engine Ground

- Specified value: approx. battery voltage

If specified value is not attained:

- Carry out following tests:



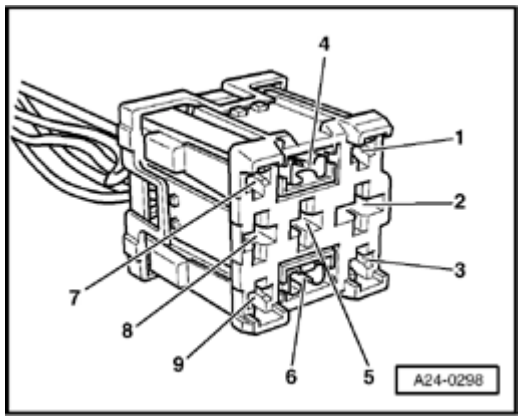
- Check fuse S130 (40 A) in electronics box of plenum chamber, (Pos. 4).

cardiagn.com

26-57

- Check for open circuit in wiring from battery + (terminal 30) to fuse S130 for secondary air injection pump relay (in 3-position in E-box of plenum chamber, position 2).

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*



- Connect multimeter as follows to measure voltage.

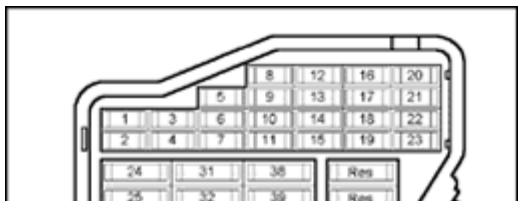
3-position relay carrier in E-box in plenum chamber, position 2 **contact**	**Measure to**
4	Engine Groung

- Operate starter briefly.

• Specified value: approx. battery voltage

If specified value is not attained:

- Carry out following tests:



- Check fuse S234 (in fuse box, position 34).

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

cardiagn.com

26-58

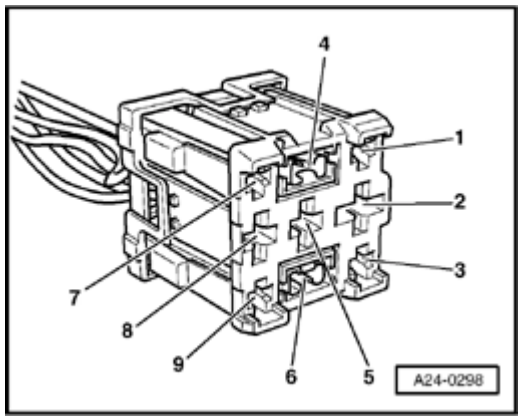
- Check for open circuit in wiring from secondary air injection pump relay (in 3-position relay carrier in E-box of plenum chamber) via fuse S234 (in fuse box, position 34) to fuel pump relay.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

Check actuation of secondary air pump relay

- Switch ignition off.

- Remove secondary air injection pump relay.



- Connect voltage tester VAG 1527 B as follows:

3-position relay carrier in E-box in plenum chamber, position 2 contact	Measure to
6	Engine Ground

- Initiate output Diagnostic Test Mode (DTM) and activate secondary air injection pump relay.
  - ♦ LED must flash.

cardiagn.com

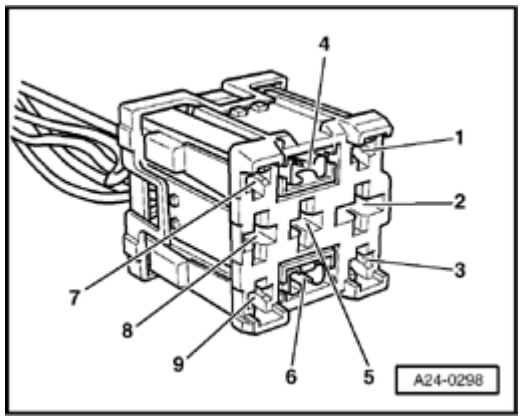
26-59

If LED does not flash:

- Switch ignition off.

- Connect VAG 1598/31 test box to wiring harness leading to engine control module; engine control module should not be connected:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



- Check for open circuit and short to positive or Ground in following wiring connection:

3-position relay carrier in E-box in plenum chamber, position 2 **Contact**	**Test box VAG 1598/31**
6	66

- Repair any open/short circuit as necessary.

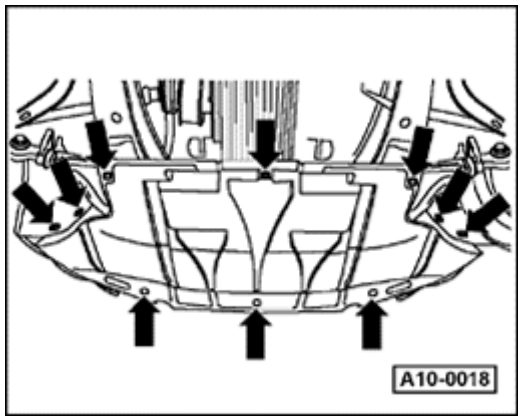
If no malfunction is found:

- Replace Secondary Air Injection Pump relay -J299-.

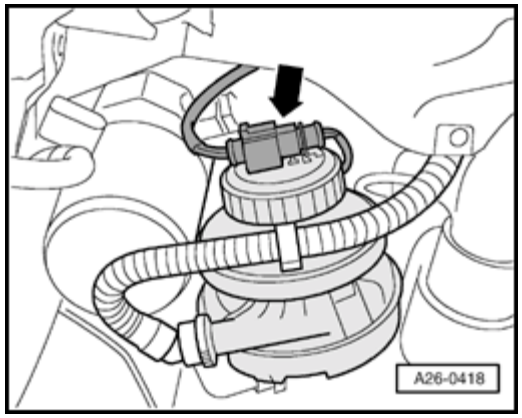
cardiagn.com

26-60

Check voltage supply for secondary air injection pump motor



- Remove sound insulation -arrows-.

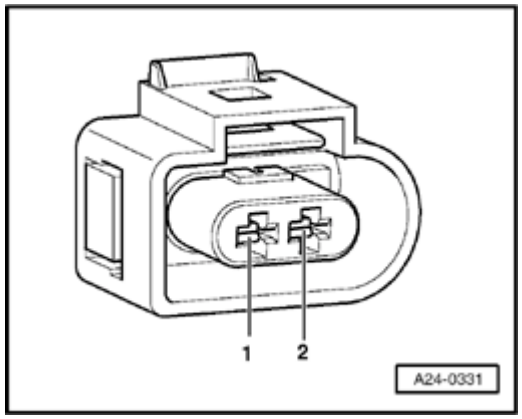


- Disconnect connector from Secondary Air Injection (AIR) Pump motor - V101- (-arrow-).

♦ Location: Right front in engine compartment below air filter housing

cardiagn.com

26-61



- Connect voltage tester VAG 1527 B between contacts 1 and 2.
- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection (AIR) Pump relay -J299-.
  - ♦ LED must flash.

If LED does not flash:

- Carry out following tests:
  - Check wiring connection from contact 1 of connector to secondary air injection pump relay (in 3-pin relay carrier in electronic box (plenum chamber), for open circuit.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

  - Check wiring connection of contact 2 of connector to Ground for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

If no malfunction is found:

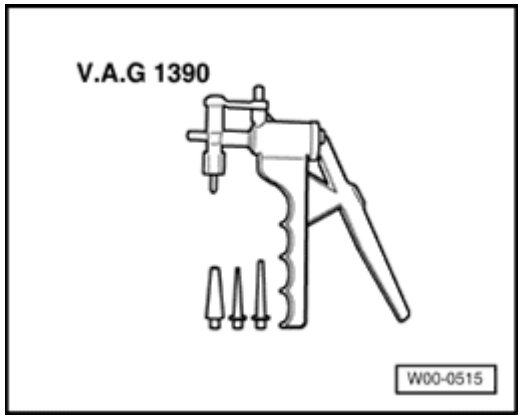
- Replace Secondary Air Injection (AIR) Pump motor -V101-.

cardiagn.com

26-62

Combination valve for secondary air inlet, checking function and for leaks

Special tools and equipment

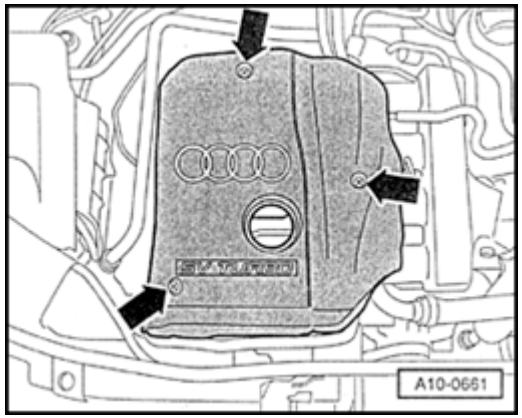


- Vacuum hand pump VAG 1390

Test requirements:

- Vacuum lines and hose connections do not leak.
- Vacuum lines not blocked.

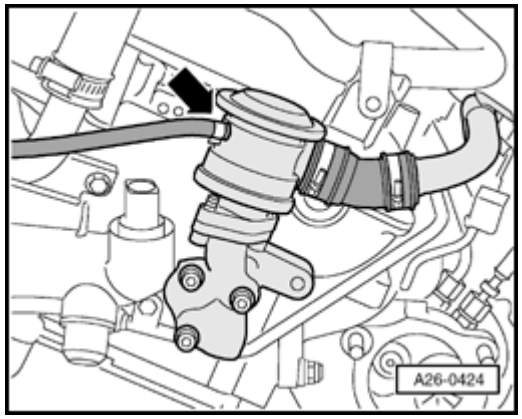
Test sequence



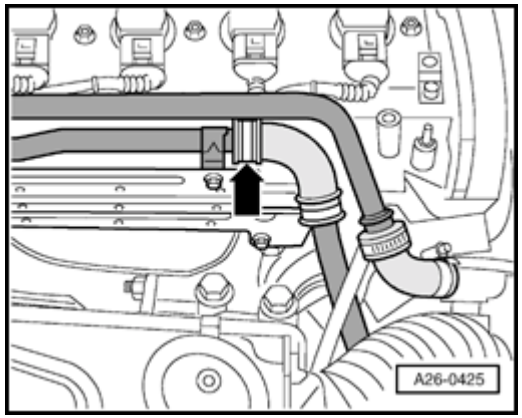
- Remove engine cover -arrows-.

cardiagn.com

26-63



- Remove vacuum hose -arrow- from combination valve.
- Connect hand vacuum pump VAG 1390 to vacuum unit of combination valve.



- Disconnect hose -arrow- to combination valve for secondary air inlet.
- Blow into line with slight pressure (do not use compressed air).
  - Combi valve must be closed; blowing through must NOT be possible.
- Actuate hand vacuum pump.
  - Combi valve must open; blowing through must be possible

If the combi valve does not open:

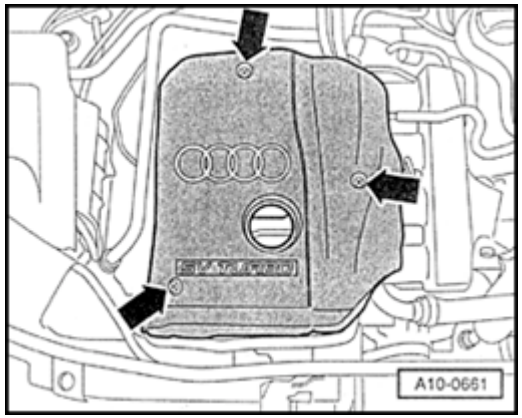
- Replace combination valve ⇒ Page 26-64 .

cardiagn.com

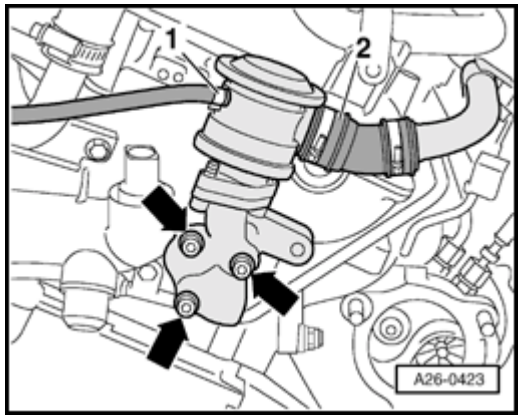
26-64

Combination valve for secondary air inlet, removing and installing

Removing



- Remove engine cover -arrows-.



- Disconnect hoses -1- and -2- from combination valve.
- Unbolt combination valve -arrows-.

cardiagn.com

Installing

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

Note:

Replace gaskets and seals.

Tightening torque

Component	Nm
Combination valve for secondary air inlet at cylinder head	10

cardiagn.com