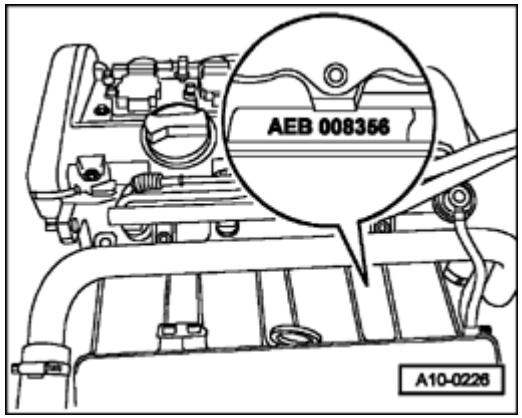
00-1

Technical data

Engine identification



The engine code and serial number are stamped on the left side on the cylinder block above the oil filter.

A sticker with the engine code and serial number is attached to the cylinder head cover.

The engine code is also listed on the vehicle data label.

Note:

The engine identification is also stamped on the front engine mounting bracket (visible after removing cover above fuel injectors).

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00-2

Engine specifications

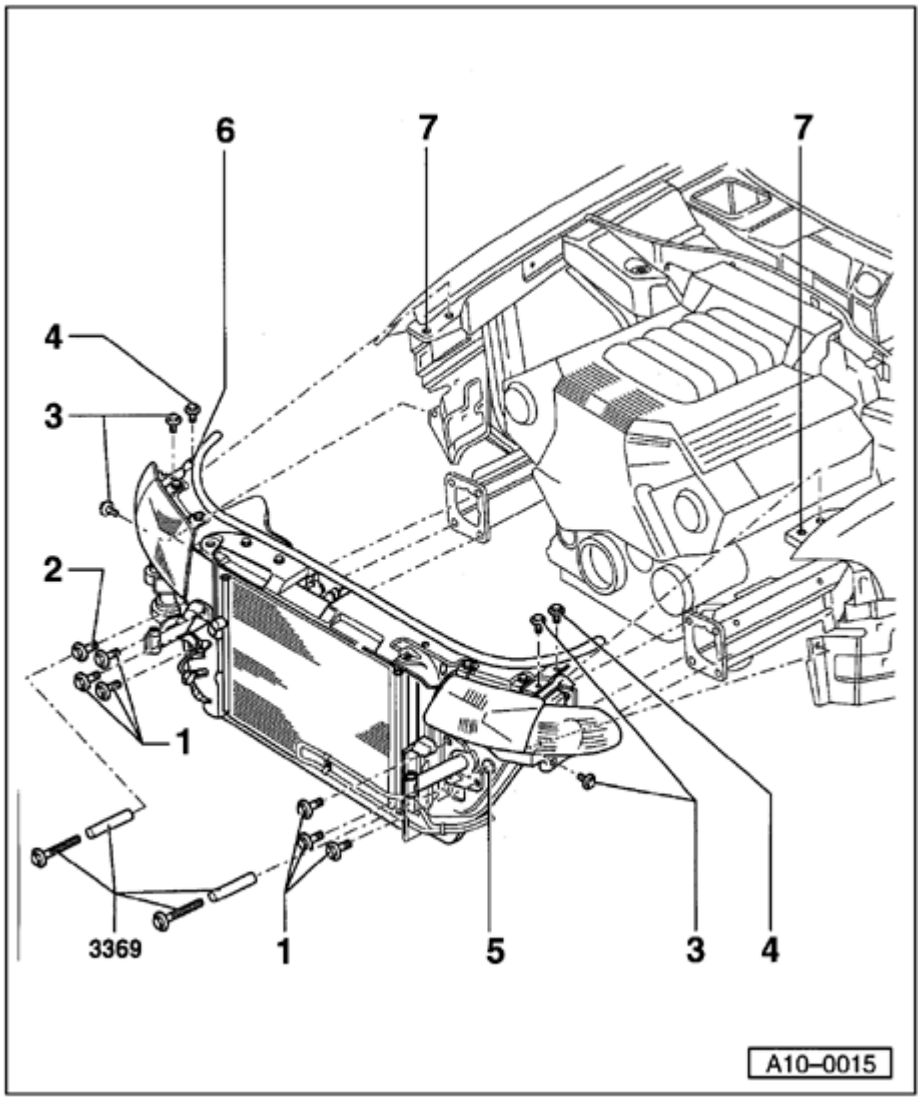
Engine code		AEB	ATW
Manufactured		11.94 ➢	tbd
Displacement	liters	1.781	1.781
Output	kW @ RPM	110/5700	110/5700
	HP @ RPM	150/5700	150/5700
Torque	Nm @ RPM	210/1750	210/1750
	Ft lb @ RPM	155/1750	155/1750
Bore diameter	mm (in.)	81.0 (3.189)	81.0 (3.189)
Stroke	mm (in.)	86.4 (3.402)	86.4 (3.402)
Compression ratio		9.5:1	9.5:1
RON	minimum	95	tbd
Fuel injection and ignition system		Bosch Motronic	Bosch Motronic
Knock sensor control		Yes	Yes
On Board Diagnostic (OBD)		OBD II	OBD II
Oxygen sensor control		Yes	Yes
Three Way Catalytic Converter (TWC)		Yes	Yes
Turbocharger		Yes	Yes
Exhaust Gas Recirculation (EGR)		No	tbd
Intake manifold change-over valve		No	tbd

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Engine code		AEB	ATW
Camshaft adjustment		No	No
Valve timing: at 1mm valve lift and 0 mm valve lash:			
	Intake valve opens after TDC	18 °	tbd
	Intake valve closes after BDC	28 °	tbd
	Exhaust valve opens before BDC	28 °	tbd
	Exhaust valve closes before TDC	8 °	tbd

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13-1



Engine, disassembling and assembling

Lock carrier, moving into service position

Special tools and equipment

3369 support tool

1 - Bolts

- 45 Nm (33 ft lb)

2 - Bolts

- 45 Nm (33 ft lb)

3 - Bolts

- 10 Nm (7 ft lb)

4 - Bolts

- 10 Nm (7 ft lb)

5 - Bore

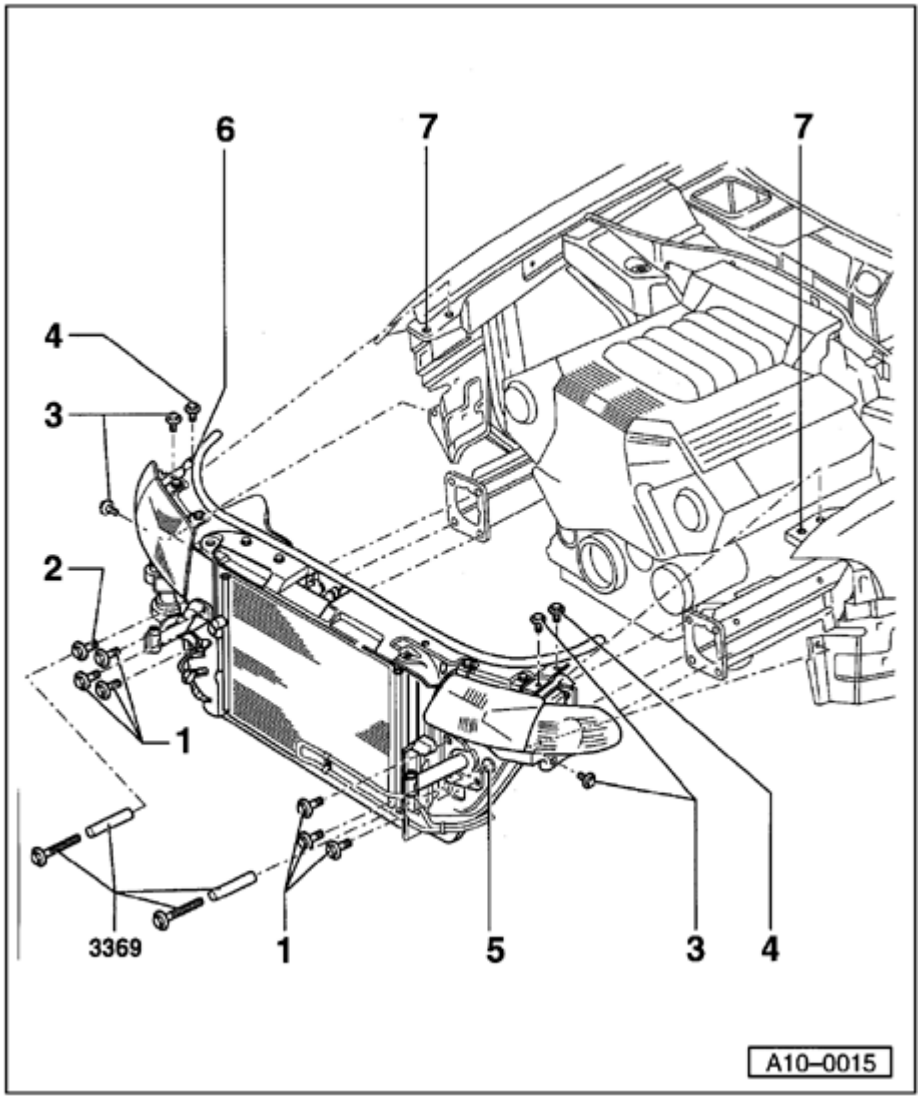
- For 3369 support tool

6 - Lock carrier bore

7 - Fender bore

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13-2



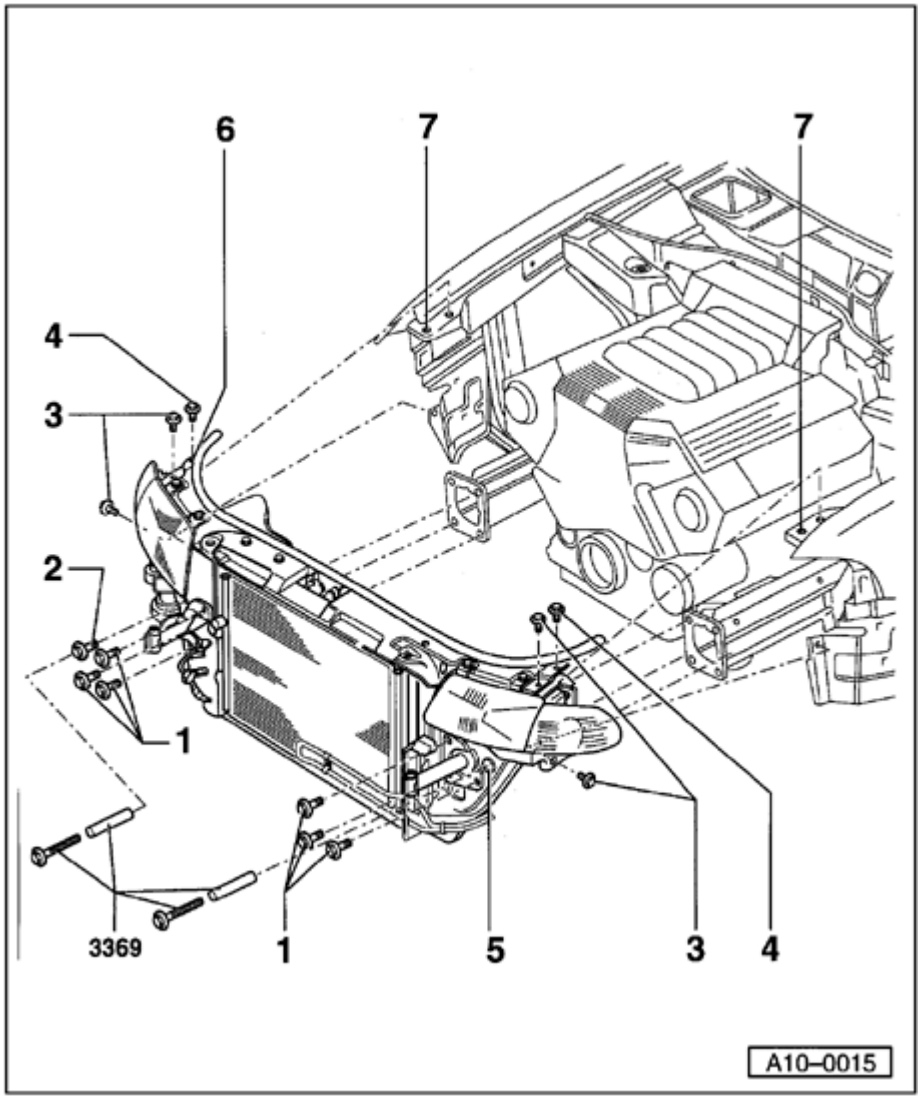
- Remove front bumper.

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

- Remove 3 quick-release screws on front of noise insulation panel.
- Unbolt air guide between lock carrier and air filter at lock carrier.
- If installed, remove retaining clamps for wiring harness on left side of radiator frame.
- Remove bolt -2- and install 3369 support tool.
- Install 3369 support tool into left bore -5-.
- Remove bolts -1- and -3-.
- Remove bolts -4- and pull lock carrier out to stop.
- To secure lock carrier, install appropriate M6 bolts into rear bored holes of lock carrier -6- and fender -7-.

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13-3

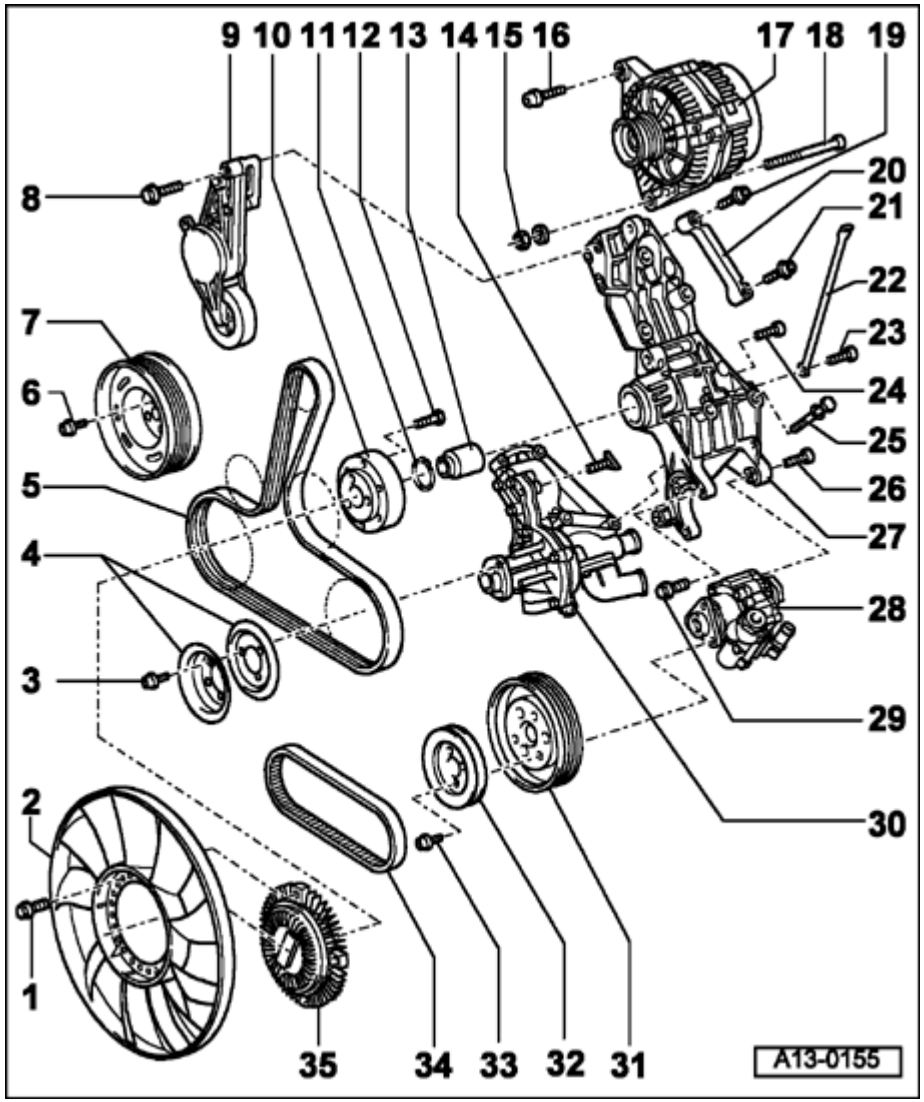


- After installing lock carrier, check wiring for proper routing near coolant fan.
- Install front bumper.

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

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13-4



Ribbed belt for power steering pump, generator and viscous fan, and V-belt for coolant pump

CAUTION!

Before removing ribbed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt. When installing the ribbed belt, make sure it is seated correctly on the pulley.

1 - Fan wheel bolt

- 10 Nm (7 ft lb)

2 - Fan wheel

- For viscous fan
- Removing and installing ⇒ Page 13-14 , Fig. ⇒ 1

3 - Coolant pump pulley bolt

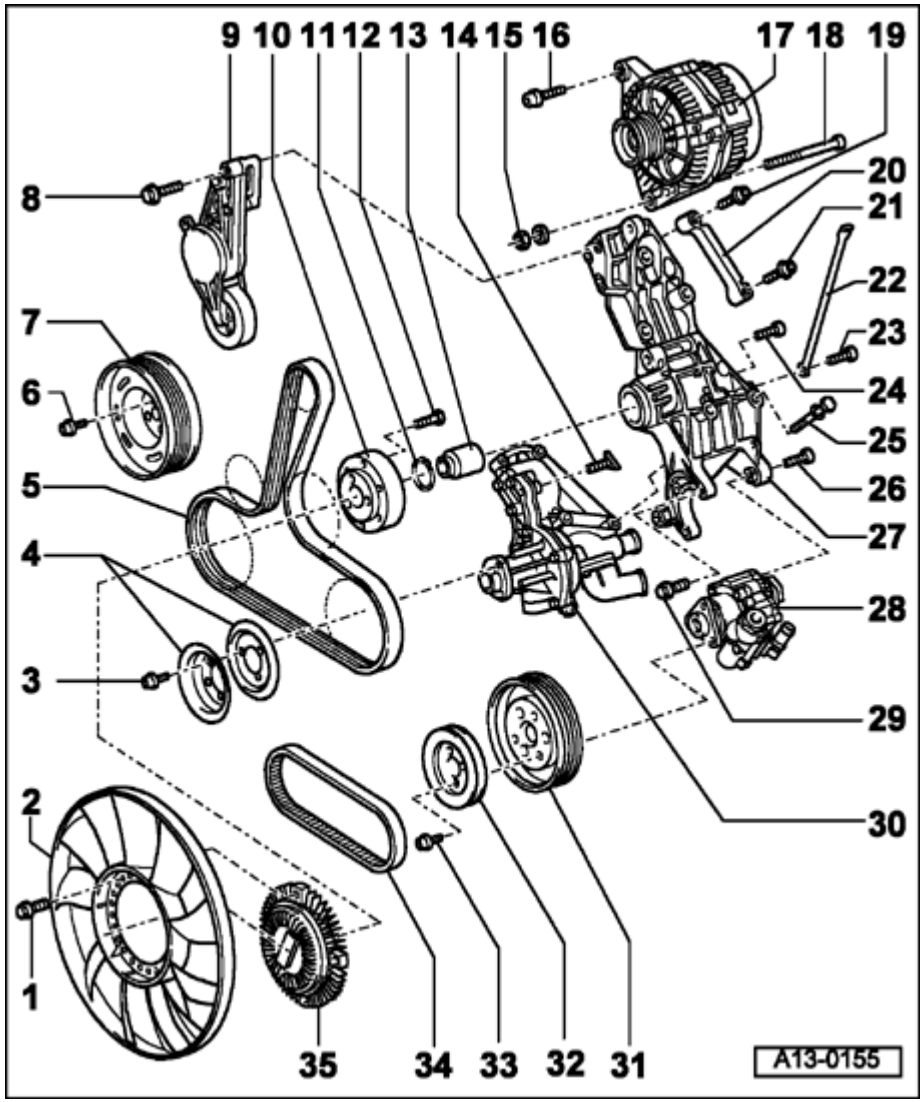
- 25 Nm (18 ft lb)

4 - Belt pulley

- For coolant pump
- V-belt design
- Installed position: straight side toward coolant pump

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13-5



5 - Ribbed belt

- Removing and installing ⇒ Page 13-15
- Check for wear

6 - Special bolt

- Tighten to 40 Nm (30 ft lb)
- Only use VW bolts, bolt strength grade 10.9 ⇒ parts catalog

7 - Vibration damper

- With pulley for ribbed belt
- Installation only possible in one position ⇒ Page 13-14 , Fig. ⇒ 2

8 - Bolt for ribbed belt tensioner

- 25 Nm (18 ft lb)

9 - Ribbed belt tensioner

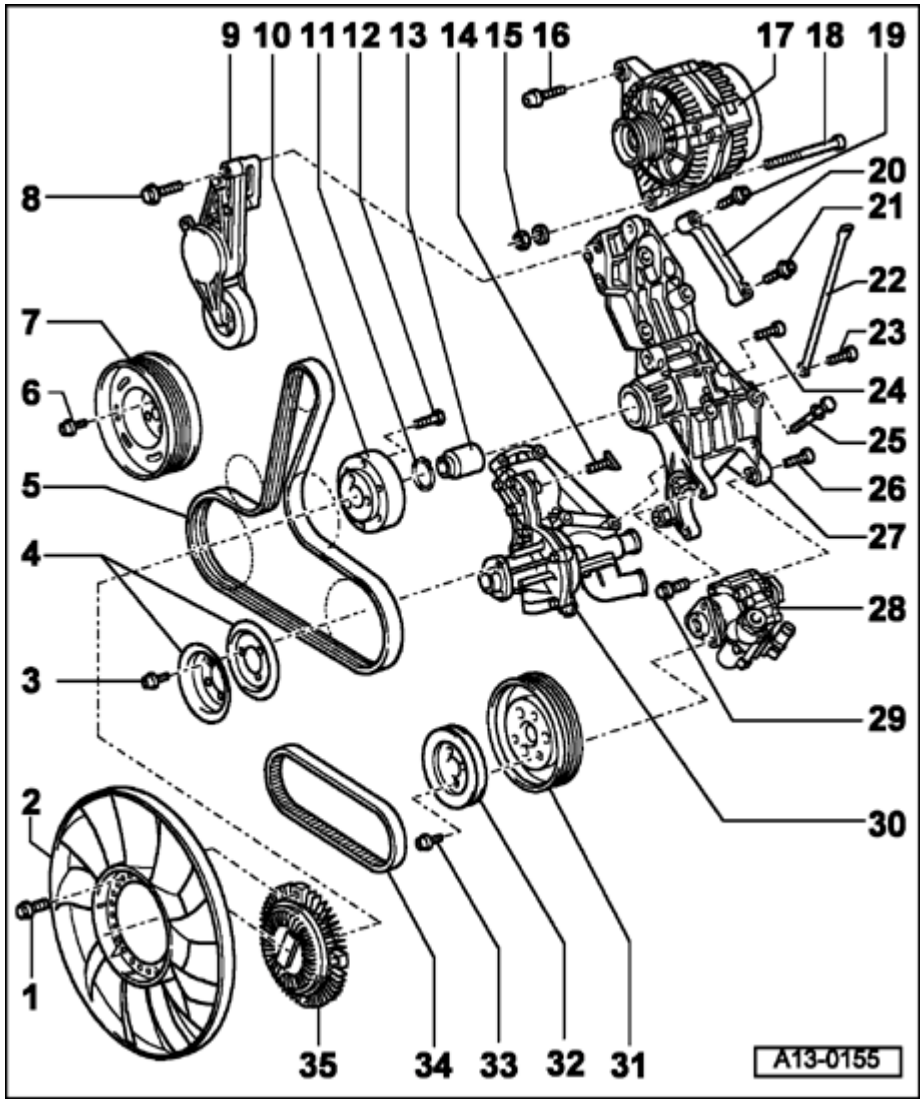
- To release tension on the ribbed belt, use open-end wrench ⇒ Page 13-15
- Secure with appropriate hex socket or 3204 drift in positioning bore

10 - Belt pulley

- For viscous fan
- Removing and installing ⇒ Page 13-14 , Fig. ⇒ 1

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13-6



11 - Circlip

- For viscous fan bearing
- Removing and installing ⇒ Page 13-20

12 - Bolt for belt pulley

- 10 Nm (7 ft lb)

13 - Bearing

- For viscous fan
- Removing and installing ⇒ Page 13-20

14 - T-head bolt

- Insert before installing bracket for generator, power steering pump and viscous fan

15 - Nut

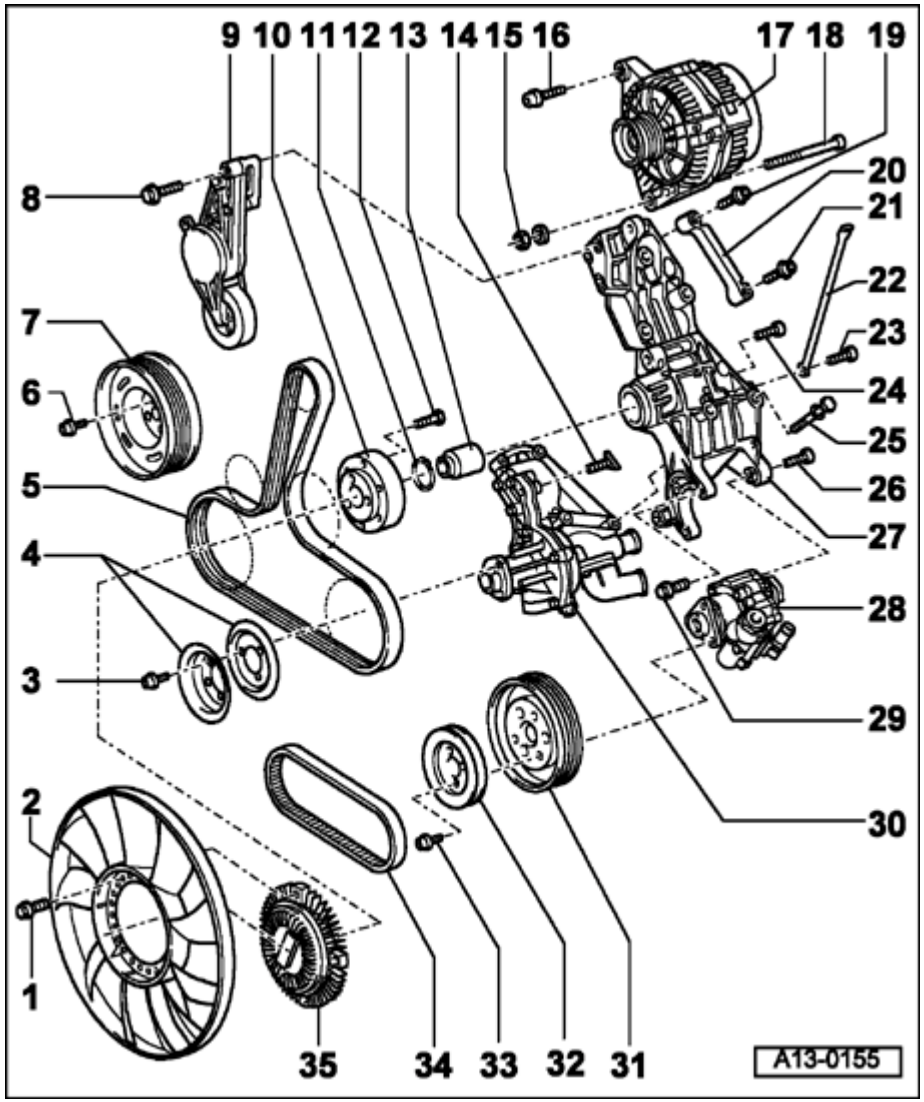
- 40 Nm (30 Nm)

16 - Bolt

- 25 Nm (18 ft lb)

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13-7



17 - Generator

Removing:

- Disconnect battery Ground (GND) strap.
- Loosen ribbed belt and remove from generator ⇒ Page 13-15 .
- Remove air guide at throttle body.
- Remove upper and lower threaded assemblies.
- Swing generator slightly to side and remove lower bolt.
- Remove wiring from generator.
- Remove generator.

Note:

For easier installation of generator into the bracket, push back lower bolt bushing slightly.

18 - Bolt

- ♦ 40 Nm (30 ft lb)

19 - Bolt

- ♦ 40 Nm (30 ft lb)

20 - Brace

- ♦ To cylinder block

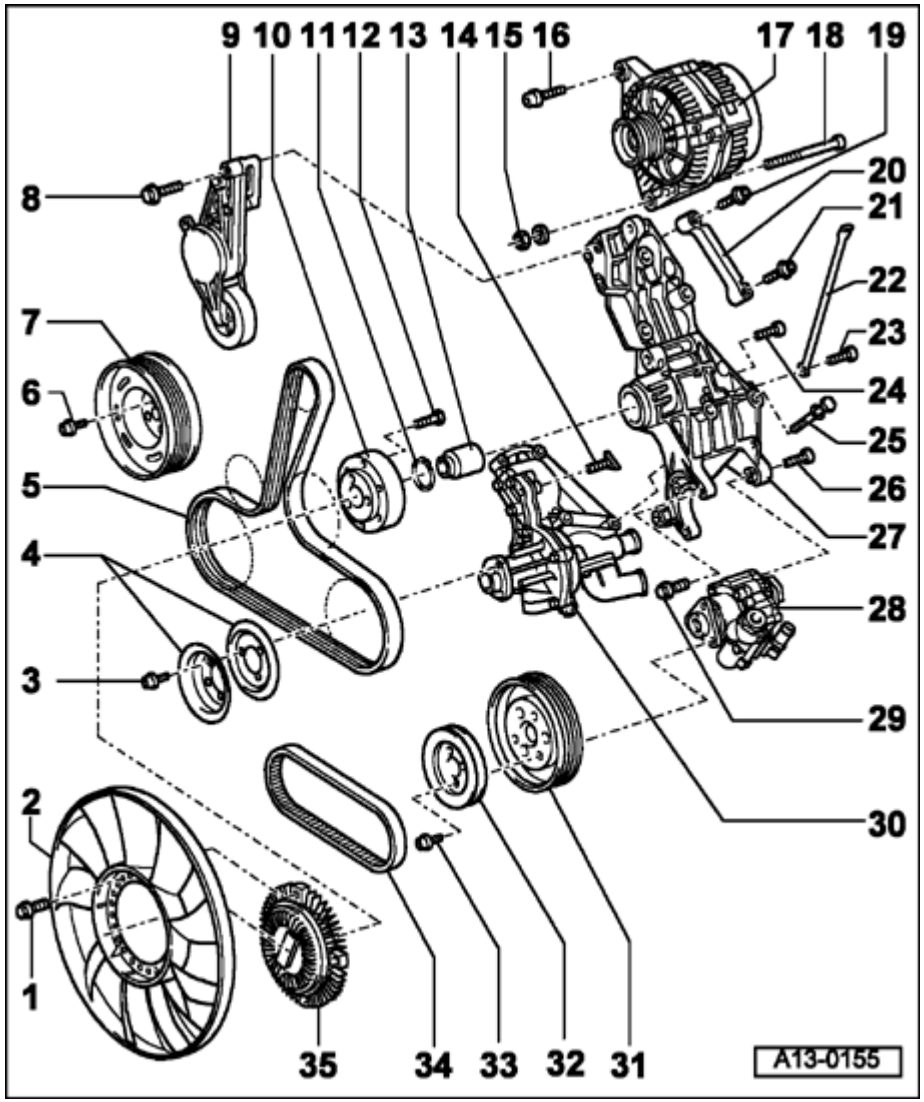
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21 - Bolt

- 25 Nm (18 ft lb)

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13-8



22 - Brace

- For intake manifold

23 - Bolt

- 20 Nm (15 ft lb)

24 - Bolt

- 40 Nm (30 ft lb)

25 - Bolt

- 25 Nm (18 ft lb)

26 - Bolt

- 25 Nm (18 ft lb)

27 - Bracket

- For generator, power steering pump and viscous fan
- Removing and installing ⇒ Page 13-22
- Different length bolts
- Arrangement and tightening sequence ⇒ Page 19-16

28 - Power steering pump

- Removing and installing ⇒ *Repair Manual, Suspension, Wheels, Steering, Repair Group 48*

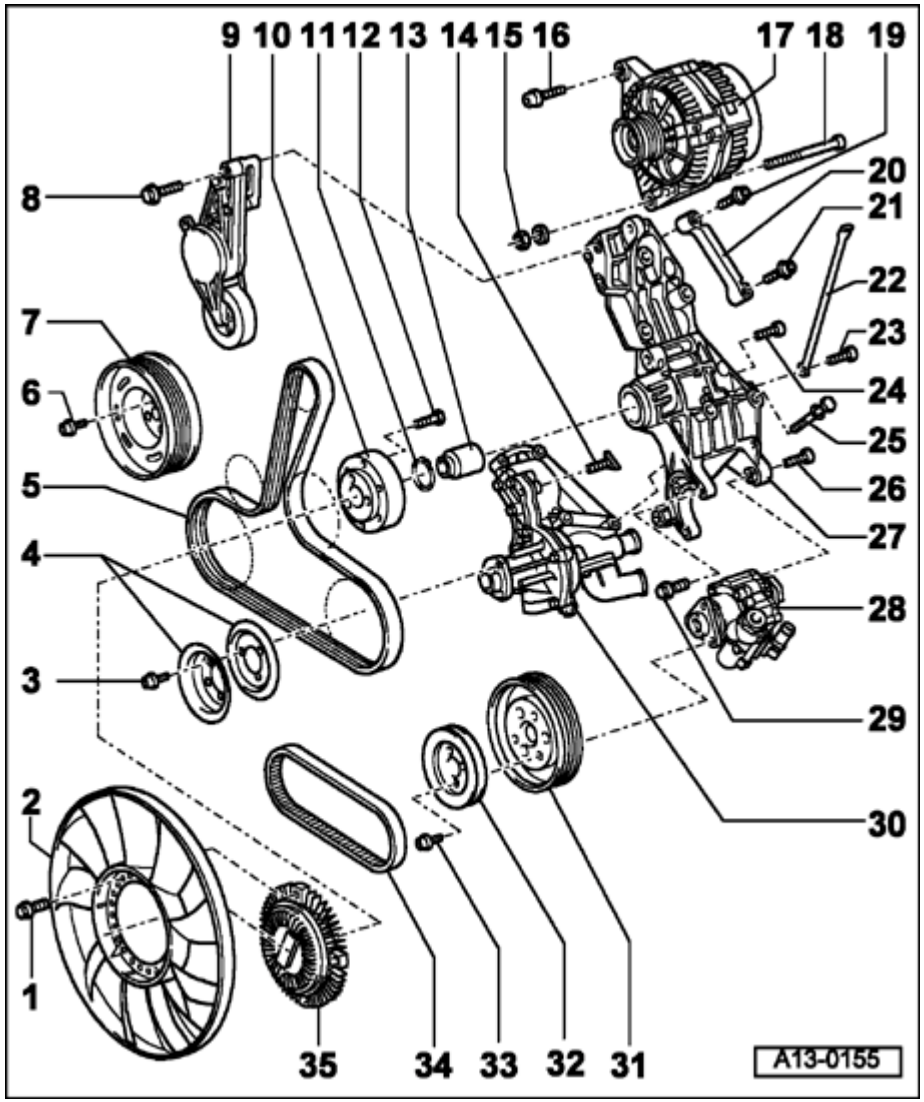
29 - Bolt

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- 25 Nm (18 ft lb)

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13-9



30 - Coolant pump

- With coolant regulator
- Removing and installing ⇒ Page 19-13

31 - Belt pulley

- For power steering pump
- Designed for ribbed belt
- Install with bulged side facing in driving direction

32 - Belt pulley

- For power steering pump
- Designed for ribbed belt

33 - Bolt

- 25 Nm (18 ft lb)

34 - V-belt

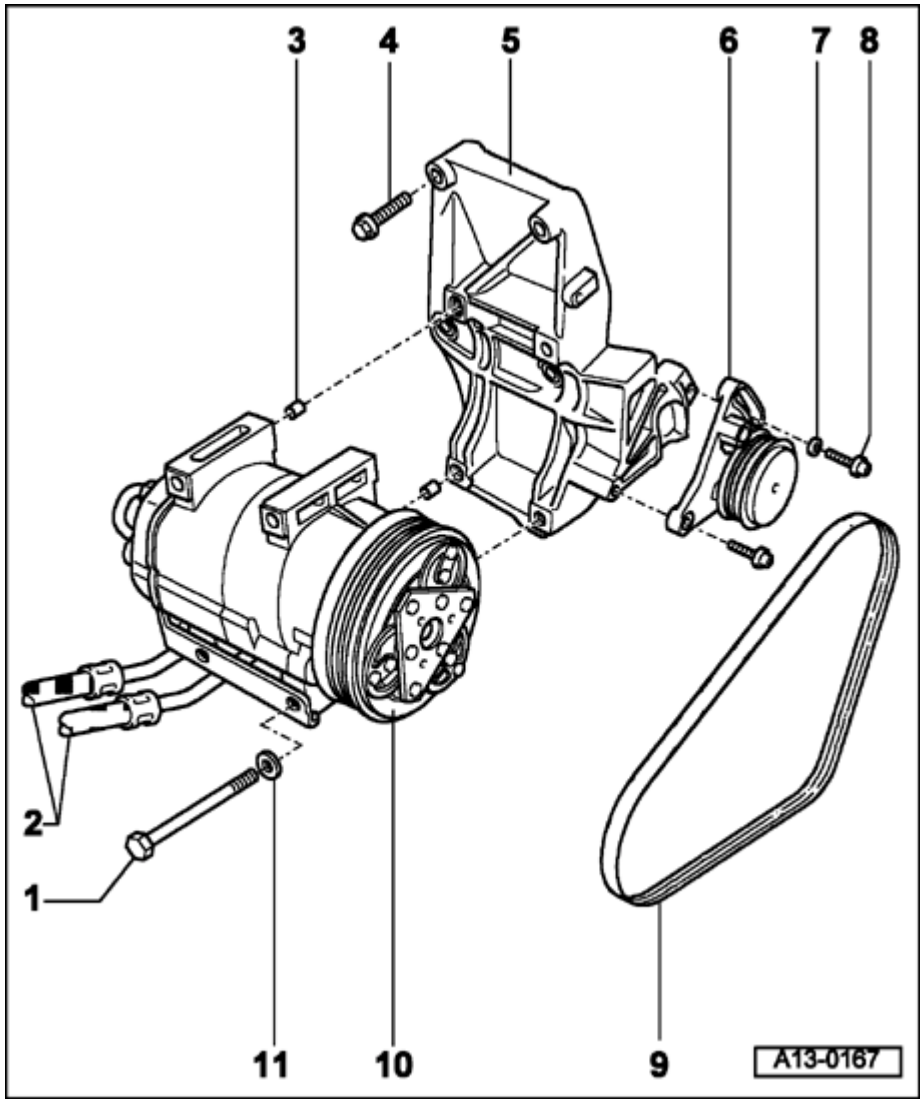
- For coolant pump
- Removing and installing ⇒ Page 13-18

35 - Viscous clutch

- Removing and installing ⇒ Page 13-14 , Fig. ⇒ 1

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13-10



Ribbed belt for air conditioning

CAUTION!

- ***The A/C refrigerant circuit must not be opened.***
- ***Before removing ribbed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt. When installing the ribbed belt, make sure it is seated correctly on the pulley.***

1 - Bolt

- 25 Nm (18 ft lb)

2 - Refrigerant lines

- Do not unbolt or separate

3 - Bushing

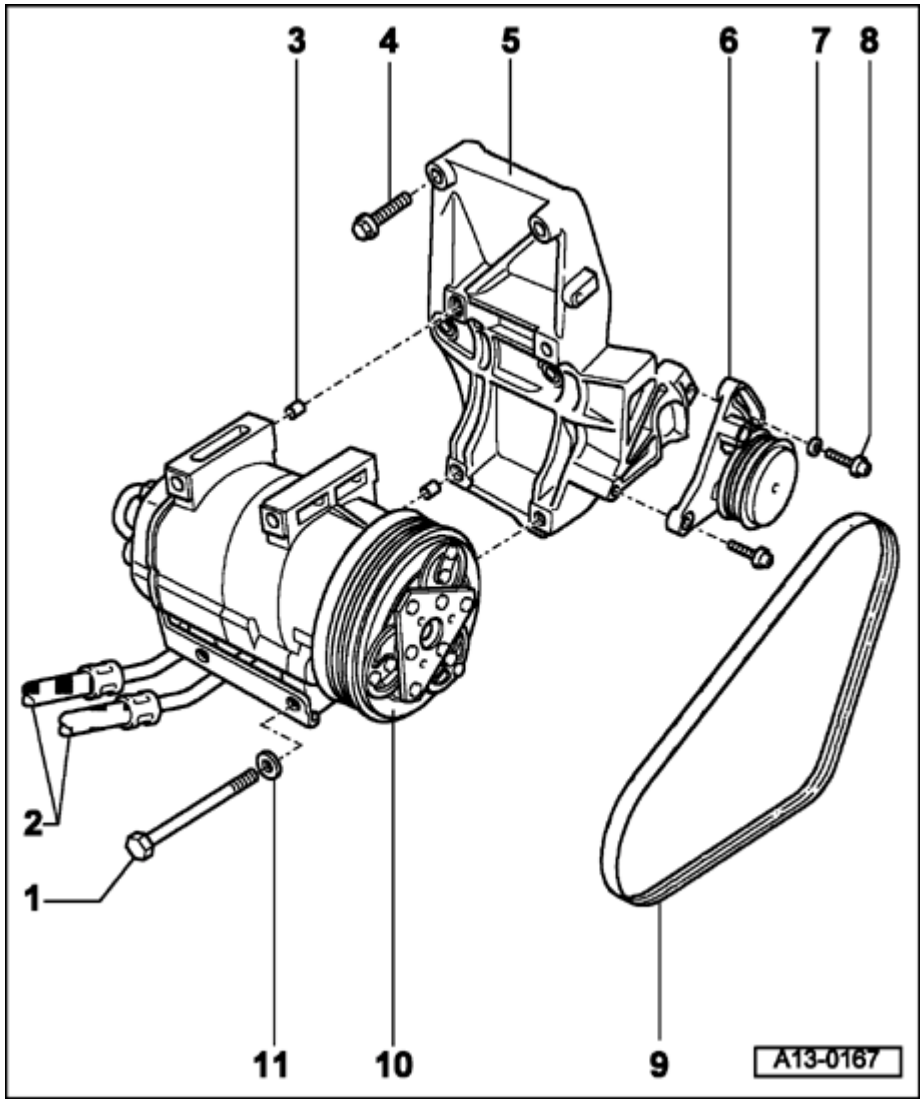
- Verify proper seating in bracket

4 - Bolt

- For bolt strength grade 8.8, tighten to 25 Nm (18 ft lb) ⇒parts catalog
- For bolt strength grade 10.9, tighten to 30 Nm (22 ft lb) ⇒parts catalog

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13-11



5 - Bracket

- For A/C compressor

6 - Ribbed belt tensioner

- Removing and installing ⇒ Page 13-15

7 - Washer

8 - Bolt

- 20 Nm (15 ft lb)

9 - Ribbed belt

- Removing and installing ⇒ Page 13-15
- Check for wear

10 - A/C compressor

- After removing, secure A/C compressor to long member (i.e. using wire).

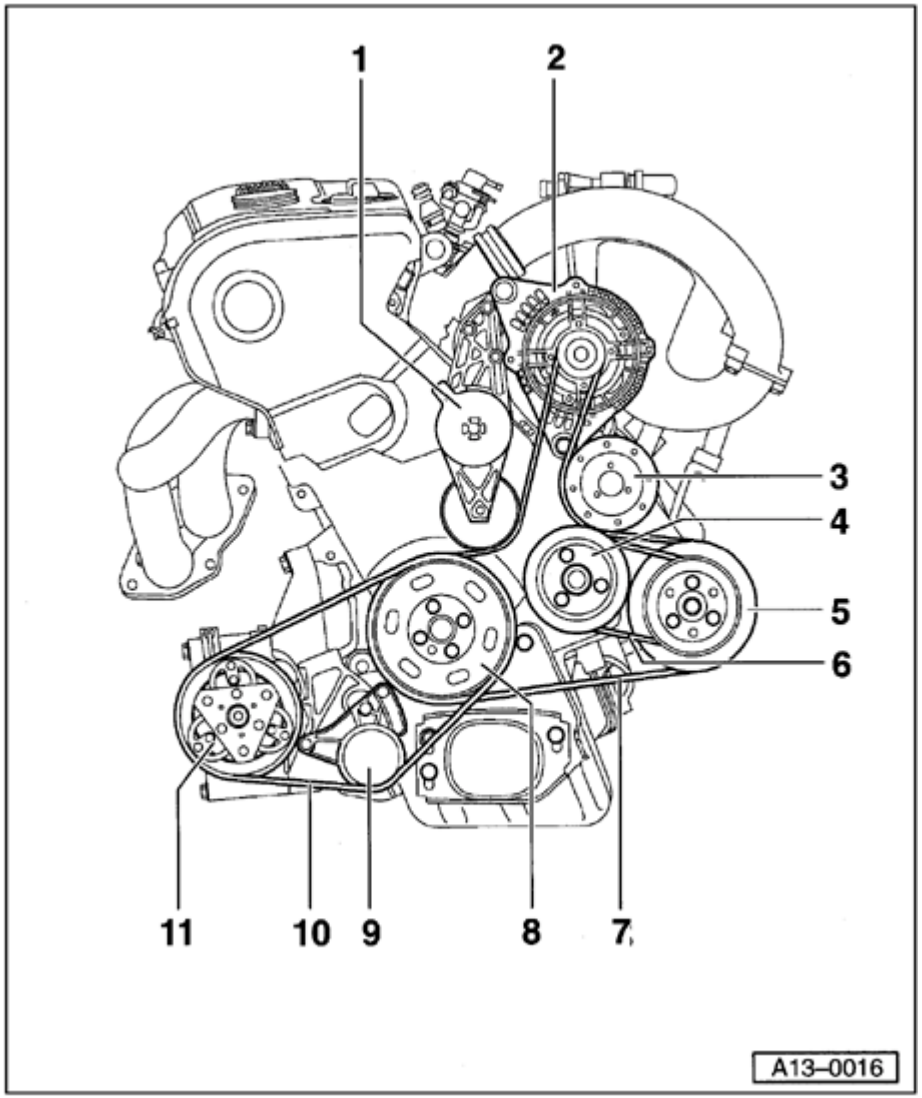
CAUTION!

Do not let A/C compressor hang by refrigerant lines.

11 - Washer

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13-12



V-belt and ribbed belt, routing overview

1 - Ribbed belt tensioner

2 - Generator

3 - Viscous clutch

4 - Coolant pump

5 - Power steering pump

6 - V-belt

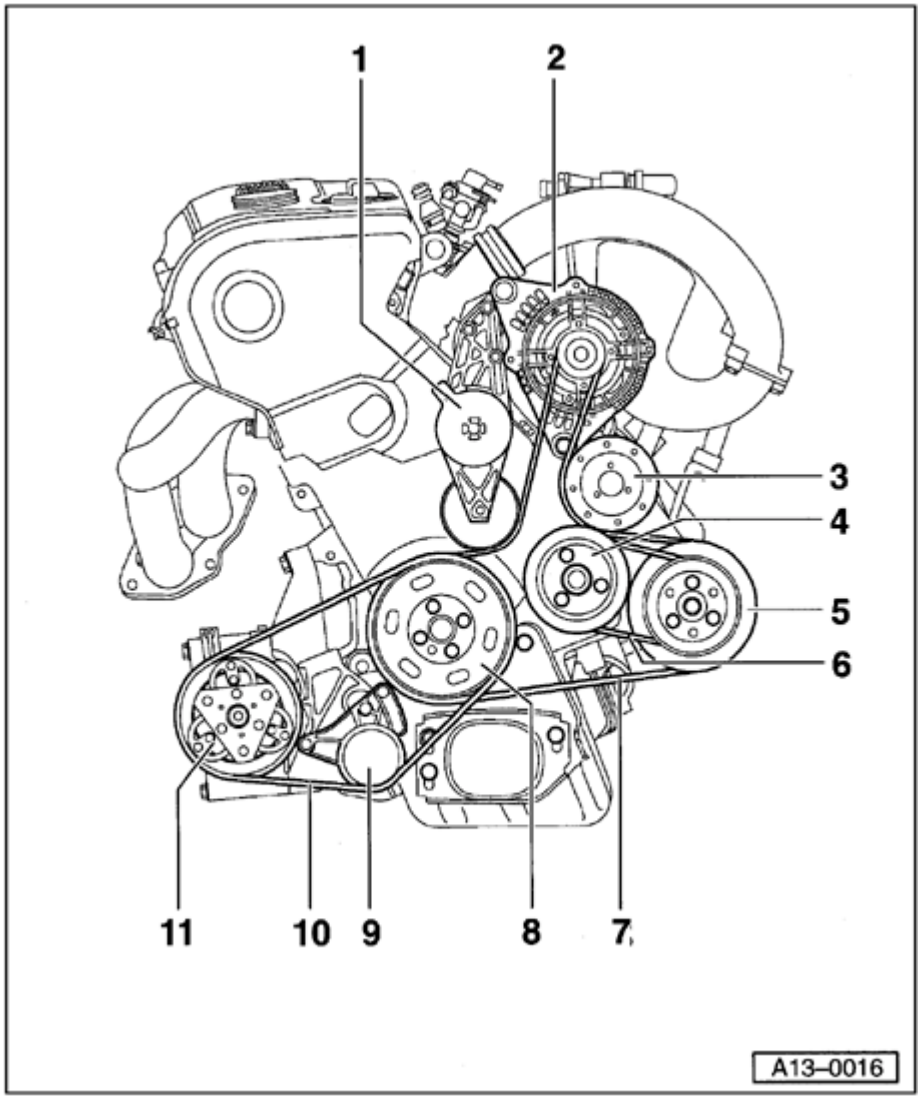
- For coolant pump
- Removing and installing ⇒ Page 13-18

7 - Ribbed belt

- For generator, power steering pump and viscous fan
- Removing and installing ⇒ Page 13-15

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13-13



8 - Vibration damper

9 - Ribbed belt tensioner

- For A/C compressor

10 - Ribbed belt

- For A/C compressor
- Removing and installing ⇒ Page 13-15

11 - A/C compressor

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13-14

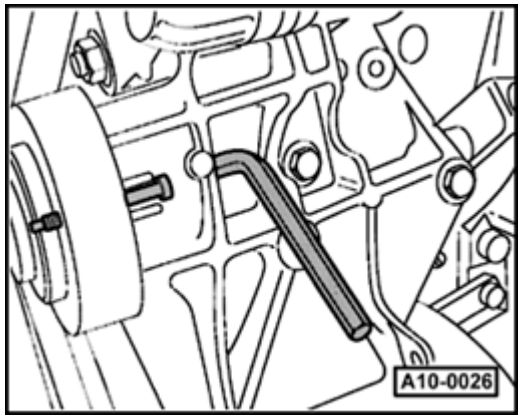


Fig. 1 Viscous fan, removing and installing

- Lock carrier in service position ⇒ Page 13-1
- Ribbed belt free of tension ⇒ Page 13-15

- Secure belt pulley for viscous fan with 5 x 60 mm bolt and remove using hex socket wrench.
- Remove viscous fan.
- When installing viscous fan, tighten to 45 Nm (33 ft lb).

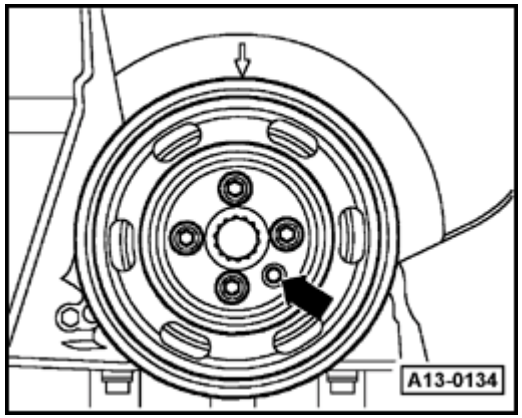


Fig. 2 Install vibration damper

- Lock carrier in service position ⇒ Page 13-1
- Ribbed belt removed ⇒ Page 13-15

- Install vibration damper using only original equipment bolts (bolt strength grade 10.9) ⇒parts catalog.

Installation is only possible in one position: the bore hole of the vibration damper (arrow) must align with raised portion of toothed belt gear.

- Tighten vibration damper bolts to 40 Nm (30 ft lb).

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13-15

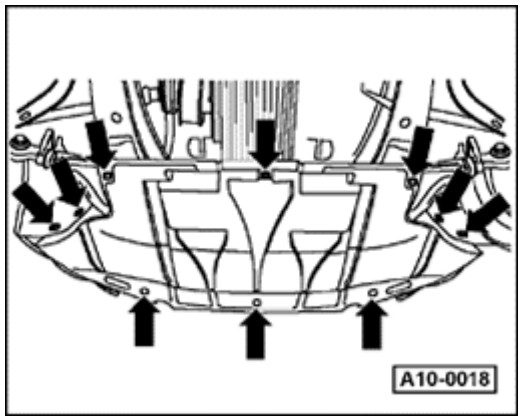
Ribbed belt, removing and installing

- Lock carrier in service position ⇒ Page 13-1

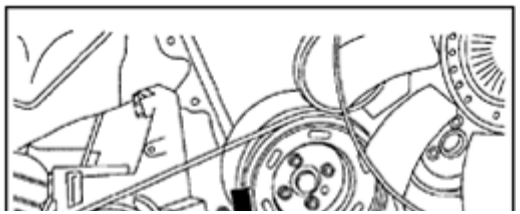
CAUTION!

Before removing ribbed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt. When installing the ribbed belt, make sure it is seated correctly on the pulley.

Removing



- Remove noise insulation panel (arrows).

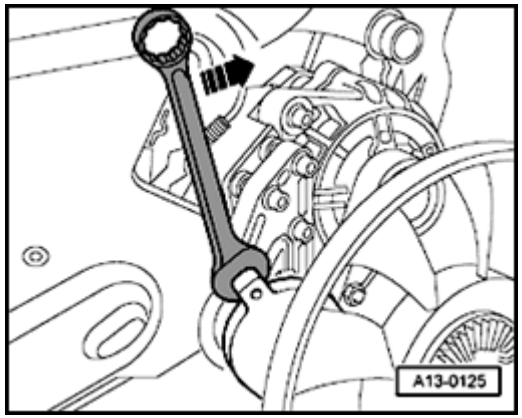


- Loosen bolts for ribbed belt tensioner for A/C compressor (arrows).
- Release tension on ribbed belt and remove belt.

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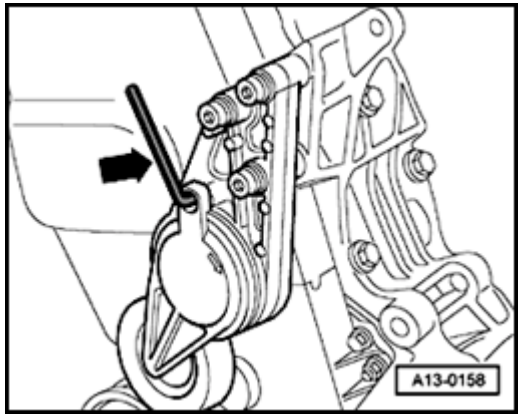
13-16

All models



- Move ribbed belt tensioner in direction of arrow to release tension on ribbed belt.

Note:



Ribbed belt tensioner can be locked in place by inserting a proper sized angled hex socket wrench (arrow) or 3204 drift into locating bore.

- Remove ribbed belt and release tension on ribbed belt tensioner.

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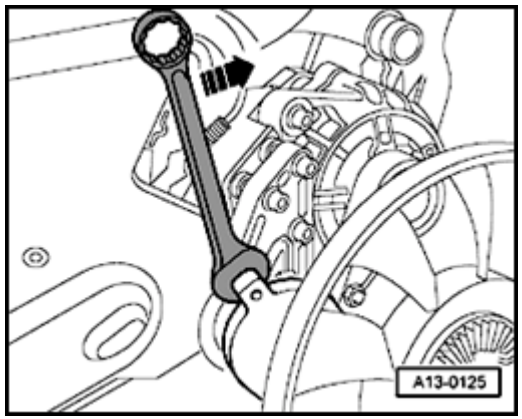
13-17

Installing

Note:

When installing ribbed belt, make sure it is seated correctly on the pulley.

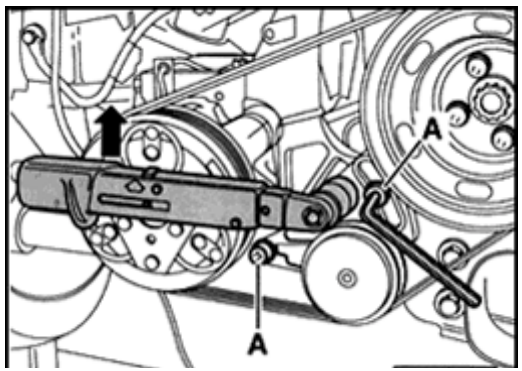
- Place ribbed belt on belt pulleys for crankshaft, viscous fan and power steering pump, (use tools to pull up if necessary).



- Move ribbed belt tensioner in direction of arrow.
- Install ribbed belt on belt pulley for generator last and release tension on belt tensioner.
- Check ribbed belt for proper installation.

  Ribbed belt routing ⇒ Page 13-12
- Install ribbed belt for A/C compressor.

  Ribbed belt routing ⇒ Page 13-12



- Use torque wrench to pre-tighten belt tensioner hex screw to 25 Nm (18 ft lb).
- Tighten bolts -A- to 20 Nm (15 ft lb) at same time.
- Start engine and check running of belt.

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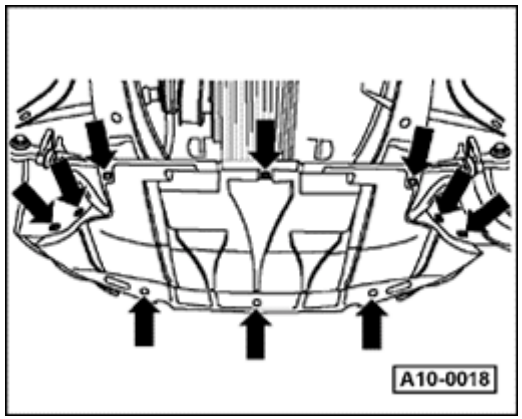
13-18

V-belt, removing and installing

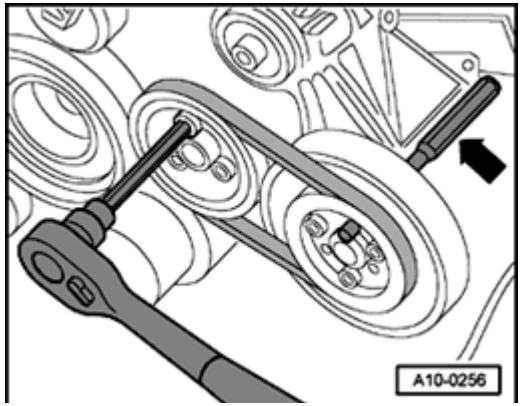
- Lock carrier in service position ⇒ Page 13-17

- Ribbed belt free of tension ⇒ Page 13-15

Removing



- Remove noise insulation panel (arrows).
- Remove viscous fan (with belt pulley) from bearing ⇒ Page 13-14 , Fig. ⇒ 1 .



- Remove belt pulley for coolant pump. Use drift (arrow) to counterhold at belt pulley for power steering pump.
- Remove V-belt.

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13-19

Installing

Installation is the reverse of removal, noting the following:

- Install V-belt and loosely bolt both halves of belt pulley to coolant pump.

- Slowly bring belt pulley halves together by turning coolant pump and tightening bolts for belt pulley in stages.

  While tightening pulley halves, the V-belt must move outward and sit correctly on belt pulley.

- Tighten bolts to 25 Nm (18 ft lb).

Note:

Adjustment of V-belt tension for coolant pump is not possible.

- Install ribbed belt and release tension on tensioner.

- Start engine and check running of belt.

- Check tightening torque of bolts for coolant pump belt pulley.

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13-20

Bearing for viscous fan in mounting bracket, removing and installing

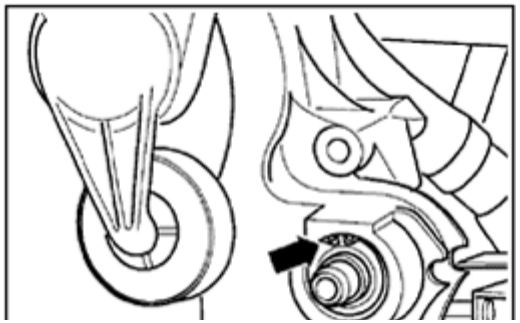
- Lock carrier in service position ⇒ Page 13-1

Special tools and equipment

- Hex nut from 3301 assembly tool
- Extractor pipe from 3350 installation device
- 3367 press out tool for viscous clutch fan bearing bushing

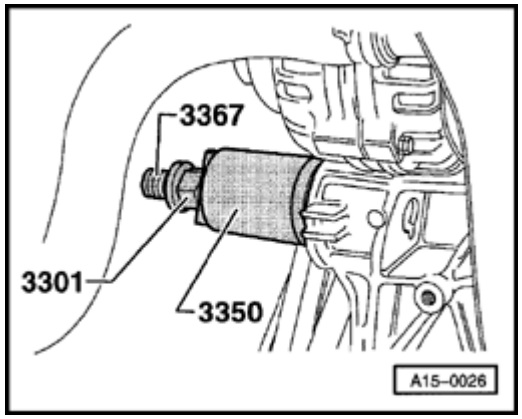
Removing

- Remove ribbed belt ⇒ Page 13-15 .
- Remove viscous fan (together with belt pulley) ⇒ Page 13-14 , Fig. ⇒ 1 .
- Remove circlip (arrow) from bearing bushing.



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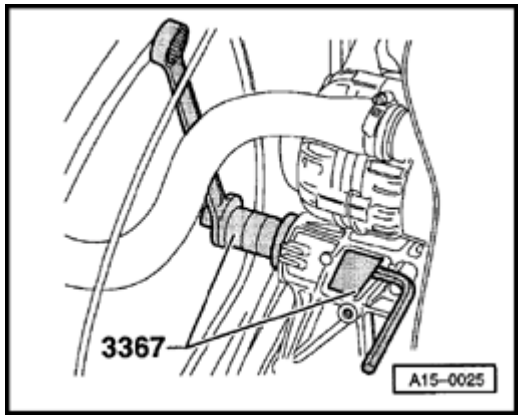
13-21



- Pull bearing from bracket using hex nut from 3301 assembly tool, bolt from 3367 press out tool for viscous fan bearing bushing and 3350 extractor pipe.

Installing

Installation is the reverse of removal, noting the following:



- Press in bearing using 3367 press out tool for viscous fan and hex nut from 3301 assembly tool.
- Using circlip pliers, install circlip in viscous fan bracket.
- Install viscous fan ⇒ Page 13-14 , Fig. ⇒ 1 .

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13-22

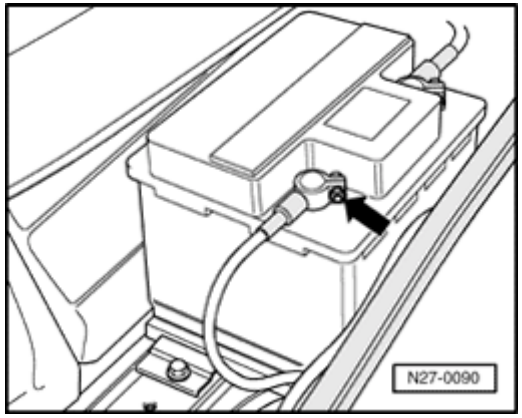
Mounting bracket for generator, power steering pump and viscous fan, removing and installing

- Lock carrier in service position ⇒ Page 13-1

Removing

CAUTION!

Before disconnecting the battery, determine the correct coding for the anti-theft radio.



- Switch ignition off and disconnect battery Ground (GND) strap.
- Remove ribbed belt and ribbed belt tensioner ⇒ Page 13-18 .

Note:

Ribbed belt for A/C remains installed.

Ribbed belt, removing ⇒ Page 13-15 .

- Remove belt pulley for power steering pump.
- Unbolt power steering pump from mounting bracket for generator, power steering pump and viscous fan and tie to side.

- All lines remain connected

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- Follow procedures for "Coolant pump, removing and installing" ⇒ Page 19-13 .

Note:

Coolant pump is bolted to mounting bracket for generator, power steering pump and viscous fan.

Installing

Installation is the reverse of removal, noting the following:

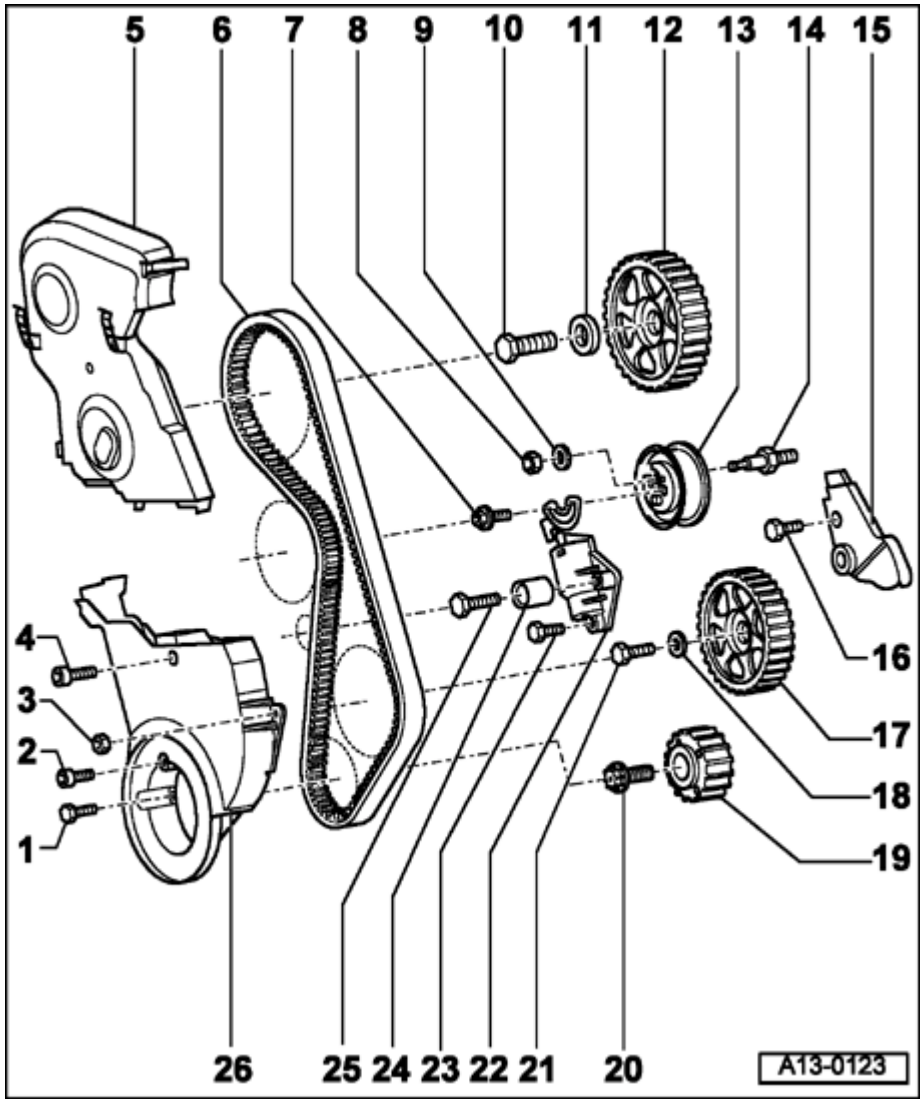
- Replace O-ring for coolant pump (to guard against leakage).

Tightening torques

Component	Tightening torque
Belt pulley to power steering pump	25 Nm (18 ft lb)
Power steering pump to mounting bracket for generator, power steering pump and viscous fan	25 Nm (18 ft lb)

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13-24



Toothed belt, overview

CAUTION!

Before removing toothed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt. When installing the ribbed belt, make sure it is seated correctly on the pulley.

1 - Bolt

- 10 Nm (7 ft lb)

2 - Bolt

- 10 Nm (7 ft lb)

3 - Bolt

- 10 Nm (7 ft lb)

4 - Bolt

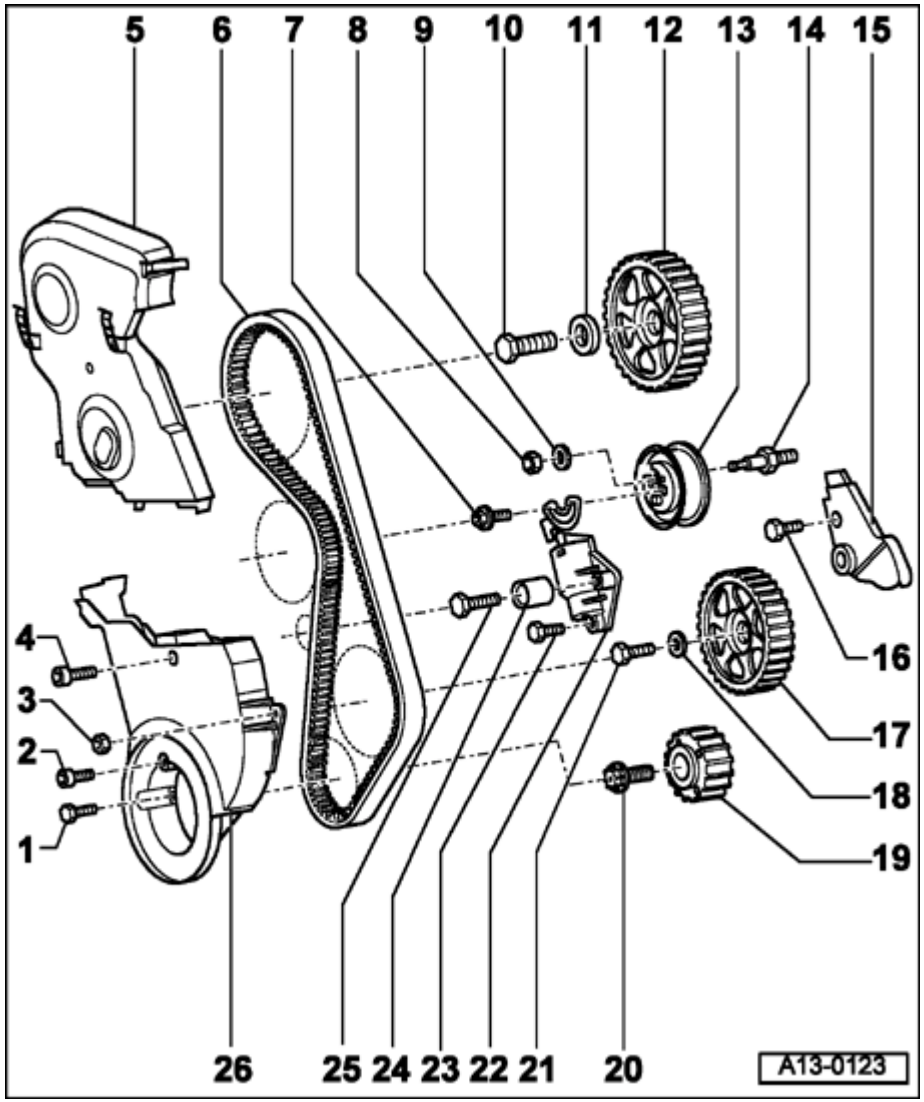
- 20 Nm (15 ft lb)

5 - Upper toothed belt cover

- To remove, unbolt ribbed belt tensioner
- When installing, carefully hook into lower toothed belt cover

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6 - Toothed belt

- Before removing, note direction of rotation using chalk or felt-tip marker
- Check for wear
- Removing ⇒ Page 13-29
- Installing (adjusting valve timing) ⇒ Page 13-32

7 - Bolt for tensioner

- 25 Nm (18 ft lb)

8 - Nut

- 10 Nm (7 ft lb)

9 - Washer

10 - Bolt

- 65 Nm (48 ft lb)
- Use 3036 retainer for loosening and tightening

11 - Washer

12 - Camshaft gear

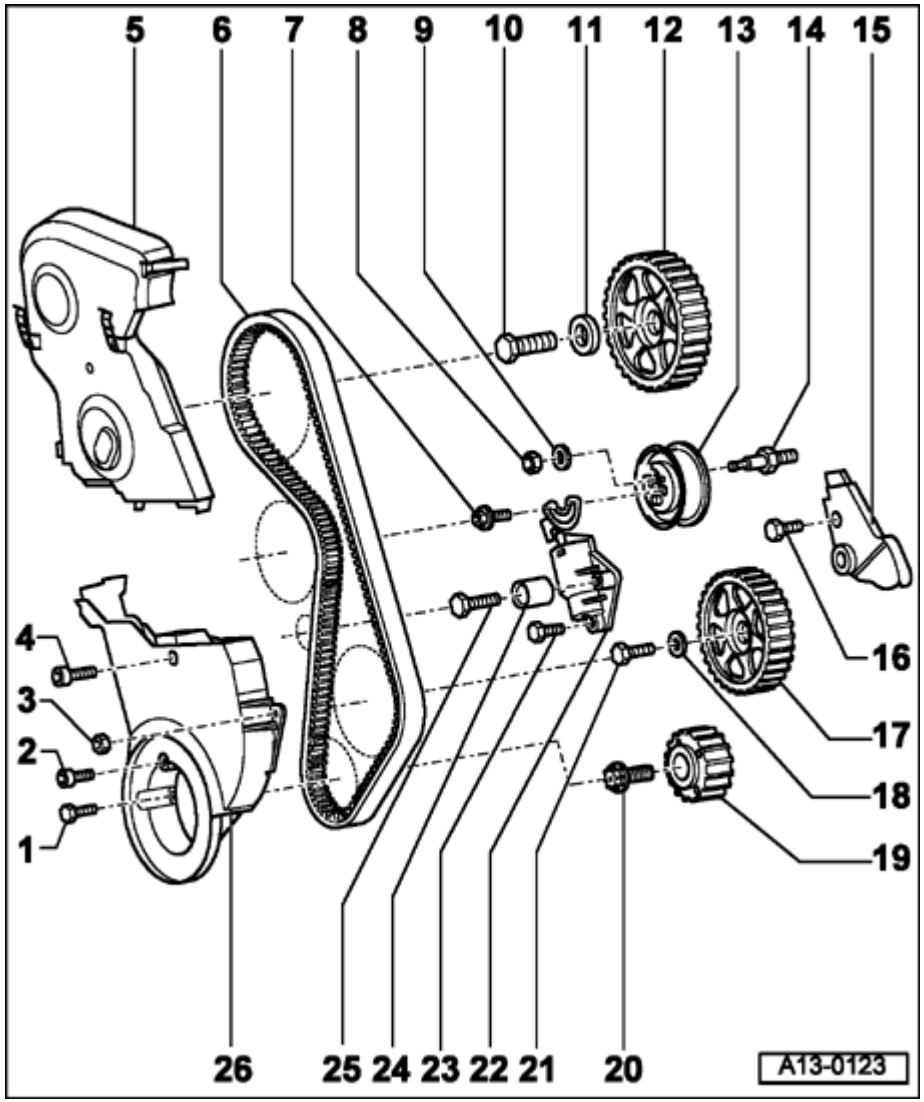
- For exhaust camshaft
- For removing and installing, remove toothed belt ⇒ Page 13-29
- Installation position ⇒Fig. ⇒ 1

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13 - Tensioner

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14 - Connecting bolt

- 25 Nm (18 ft lb)
- For tensioner

15 - Rear toothed belt cover

16 - Bolt

- 20 Nm (15 ft lb)

17 - Intermediate shaft gear

18 - Washer

19 - Toothed belt gear for crankshaft

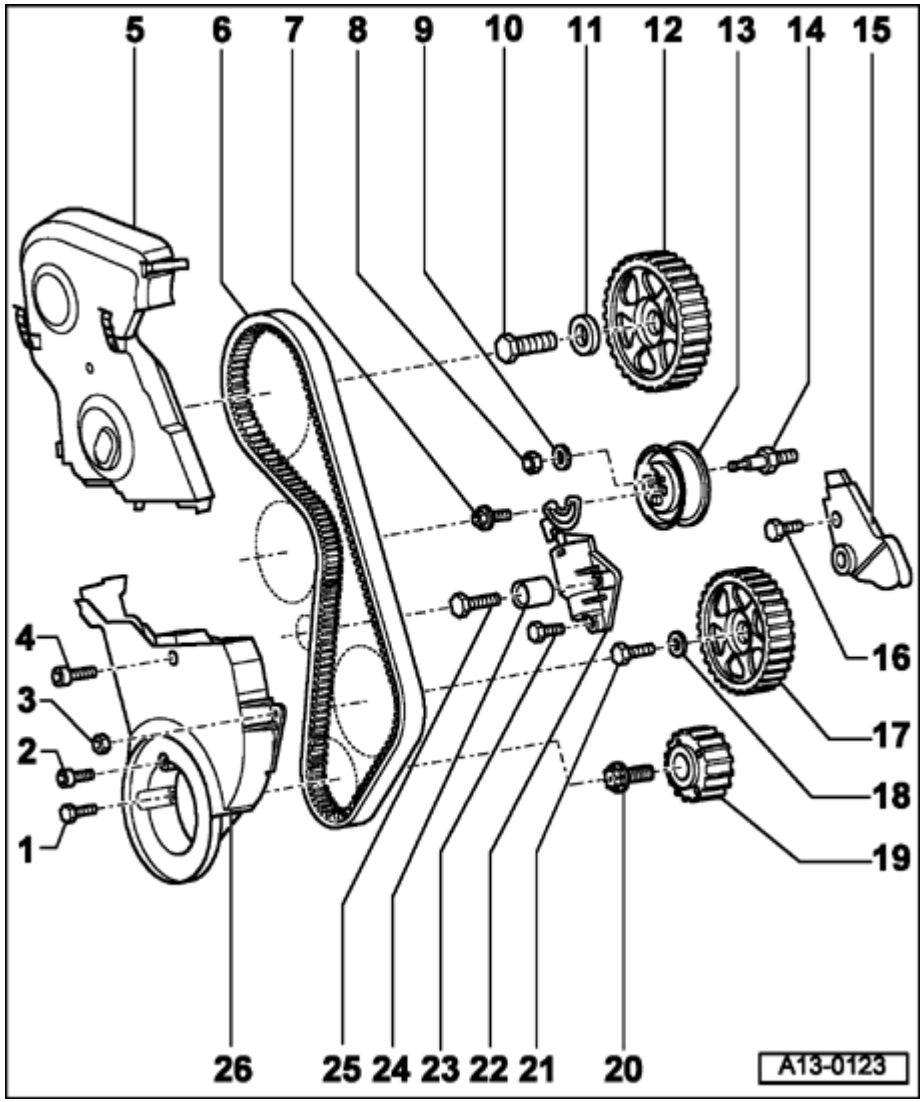
- Contact surface between toothed belt gear and crankshaft must be free of oil
- Installation only possible in one position

20 - Bolt for toothed belt gear for crankshaft

- Always replace
- 90 Nm (66 ft lb) + additional 1/4 turn (90°)
- Do not oil
- Use 3099 retainer for loosening or tightening
- Attach 3099 retainer ⇒ Page 13-39
- To secure retainer, remove torque support bracket ⇒ Page 17-2 , item 5

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21 - Bolt

- 65 Nm (48 ft lb)
- Use 3036 retainer when loosening or tightening

22 - Toothed belt tensioner

23 - Bolt

- 10 Nm (7 ft lb)

24 - Idler pulley

25 - Bolt

- 25 Nm (18 ft lb)

26 - Lower toothed belt cover

- To remove, remove vibration damper

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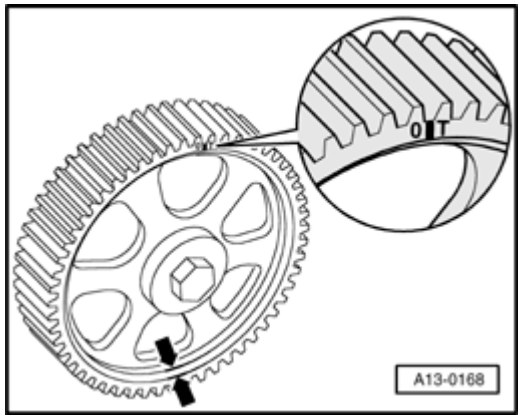


Fig. 1 Installation position for camshaft gear

Thin rib of camshaft gear points outward (arrows) and TDC Cyl. 1 marking is visible.

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Toothed belt, removing and installing

Removing

- Engine installed

- Lock carrier in service position ⇒ Page 13-1

Special tools and equipment

V159 pin wrench

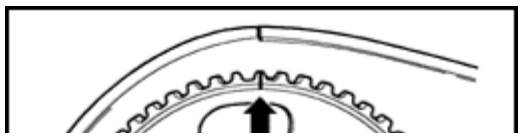
- Remove ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .

- Remove viscous clutch (with belt pulley) ⇒ Page 13-14 , Fig. ⇒ 1 .

- Remove upper toothed belt cover.

CAUTION!

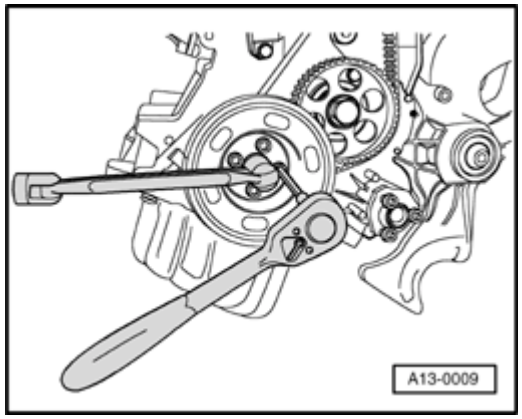
Before removing toothed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt.



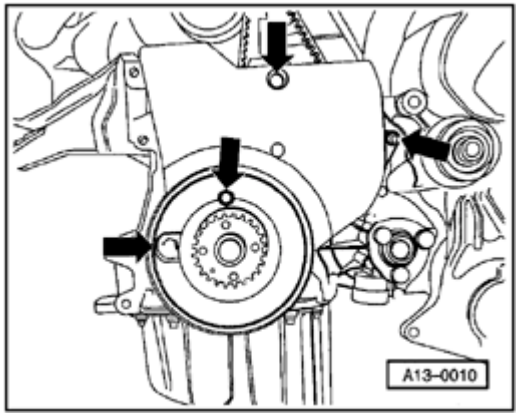
- Turn crankshaft at central bolt of toothed belt gear in direction of engine rotation to TDC Cyl.1 marking (arrows).

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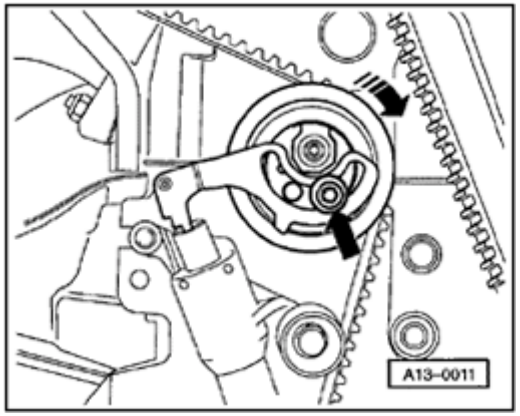
- Remove vibration damper.



- Remove lower toothed belt cover (arrows).

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- Using Torx® wrench T45, loosen toothed belt tensioner (lower arrow).
- Push toothed belt tensioner downward.
- Remove toothed belt.

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13-32

Installing (adjust valve timing)

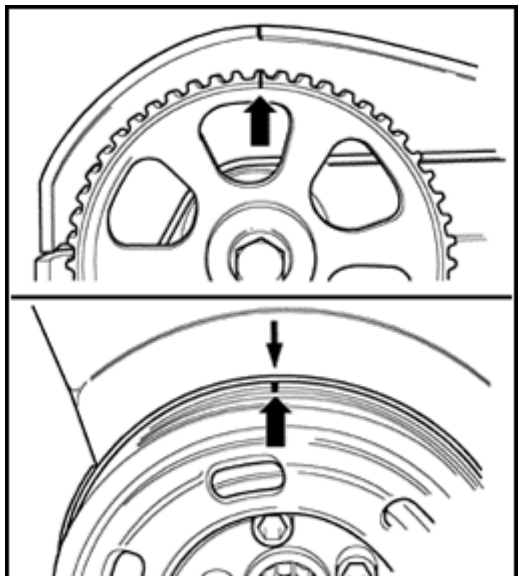
Note:

- *Use the following procedure to adjust toothed belt, even for repairs that only require removal of toothed belt from camshaft gear.*

- *Adjustments can be made on a hot or cold engine.*

CAUTION!

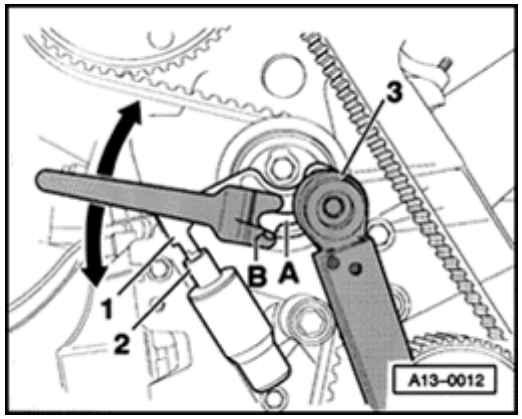
When turning camshaft, crankshaft may not be at TDC for any cylinder. Valves and/or piston heads may be damaged.



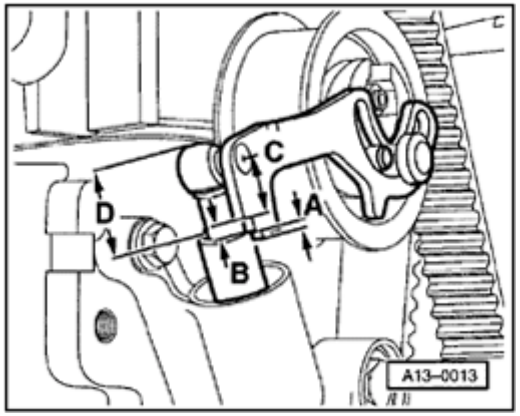
- Align marking on camshaft gear to marking on cylinder head cover.
- Place toothed belt on crankshaft gear noting direction of rotation.
- Install lower toothed belt cover.
- Using a bolt, secure vibration damper/belt pulley (note locating point).
- Set crankshaft to TDC Cyl. 1 position.
- Place toothed belt on belt tensioner and camshaft gear.

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- Tighten toothed belt by turning tensioner -A- to right using 2 pin spanner (i.e. Matra V159 pin wrench) until cylinder -1- is fully extended and tensioner -2- is raised by approx. 1 mm.
- Tighten mounting bolt -3- hand tight.
- Turn crankshaft 2 rotations in running direction.



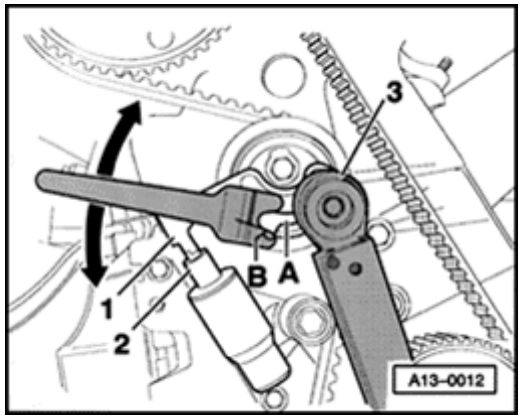
- Check area -A- for proper alignment with the upper edge of piston -2- (Fig. A13-0012) and adjust if necessary.
  - Area -A-: adjustment OK
  - Area -B-: wear limit
  - Area -C-: re-adjust and check belt drive including tensioner for wear

Note:

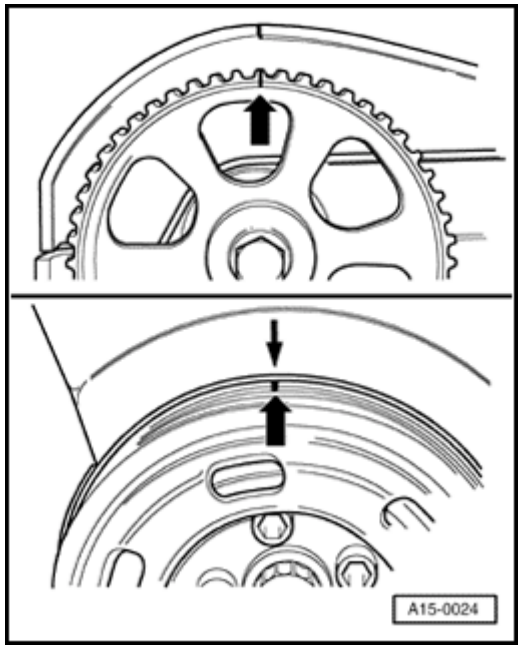
If edge of piston is located in area -A-, measurement -D- is between 25-29 mm (0.984-1.142 in.).

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- Counterhold toothed belt tensioner using 2 pin spanner -B- and tighten mounting screw -3-.



- Turn crankshaft at central bolt for toothed belt gear two rotations in direction of engine rotation, until camshaft and crankshaft markings align with their respective reference points.
- Install vibration damper/belt pulley.
- Install upper toothed belt cover.
- Install ribbed belt and ribbed belt tensioner ⇒ Page 13-17 .

Note:

When installing the ribbed belt, make sure it is seated correctly on the pulley.

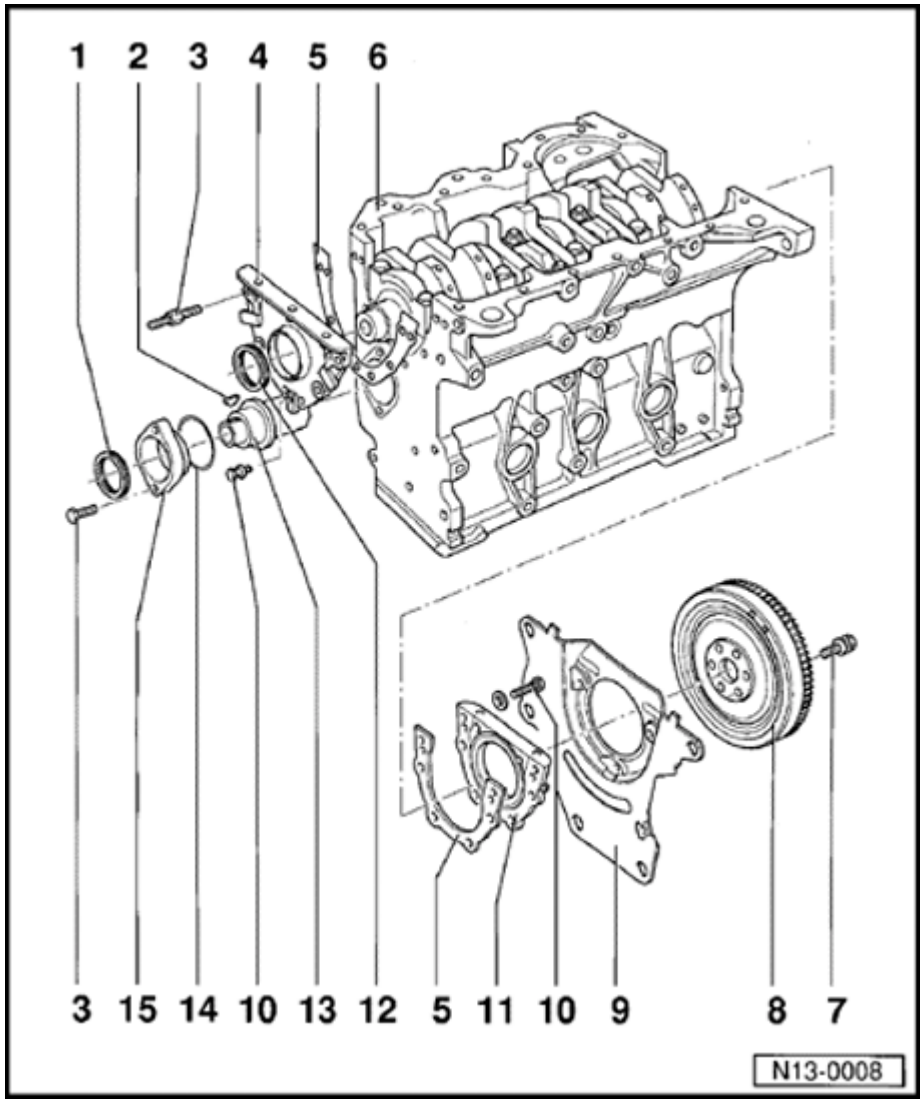
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Tightening torques

Component		Tightening torque
Toothed belt tensioner to tensioner assembly		25 Nm (18 ft lb)
Lower toothed belt cover to cylinder block	M6	10 Nm (7 ft lb)
	M8	20 Nm (15 ft lb)
Vibration damper/belt pulley to crankshaft		40 Nm (30 ft lb) [1)]
Ribbed belt tensioner to mounting bracket		25 Nm (18 ft lb)
[1)] Bolt strength grade: 10.9		

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Sealing flange and flywheel/drive plate, removing and installing

Note:

Servicing 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 - Oil seal

- To remove, remove oil seal carrier, item - 15 -
- Install using 10-203
- Lightly oil lip of seal

2 - Woodruff key

- Check for proper installation

3 - Connecting bolt

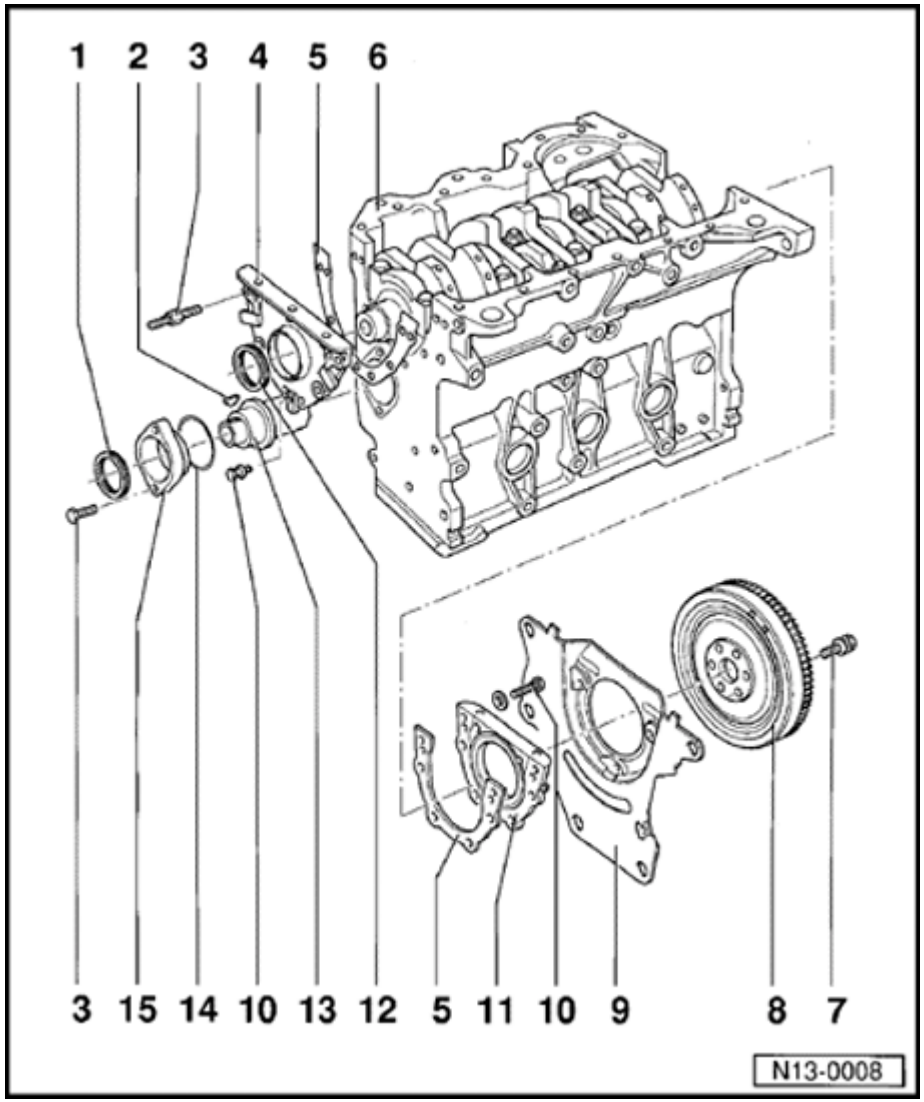
- 25 Nm (18 ft lb)

4 - Front oil seal flange

- Before installing oil pan, spread sealant AMV174 004 01 on joint between oil seal flange and cylinder block.

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5 - Gasket

- Always replace

6 - Cylinder block

- Crankshaft, removing and installing ⇒ Page 13-46
- Pistons and connecting rods, disassembling and assembling ⇒ Page 13-53

7 - Mounting bolt for dual-mass flywheel/drive plate

- Always replace
- Tightening torque for dual-mass flywheel: 60 Nm (44 ft lb) + additional 1/2 turn (180 °)
- Tightening torque for drive plate (vehicles with automatic transmission): 60 Nm (44 ft lb) + additional 1/4 turn (90 °)

8 - Dual-mass flywheel or drive plate

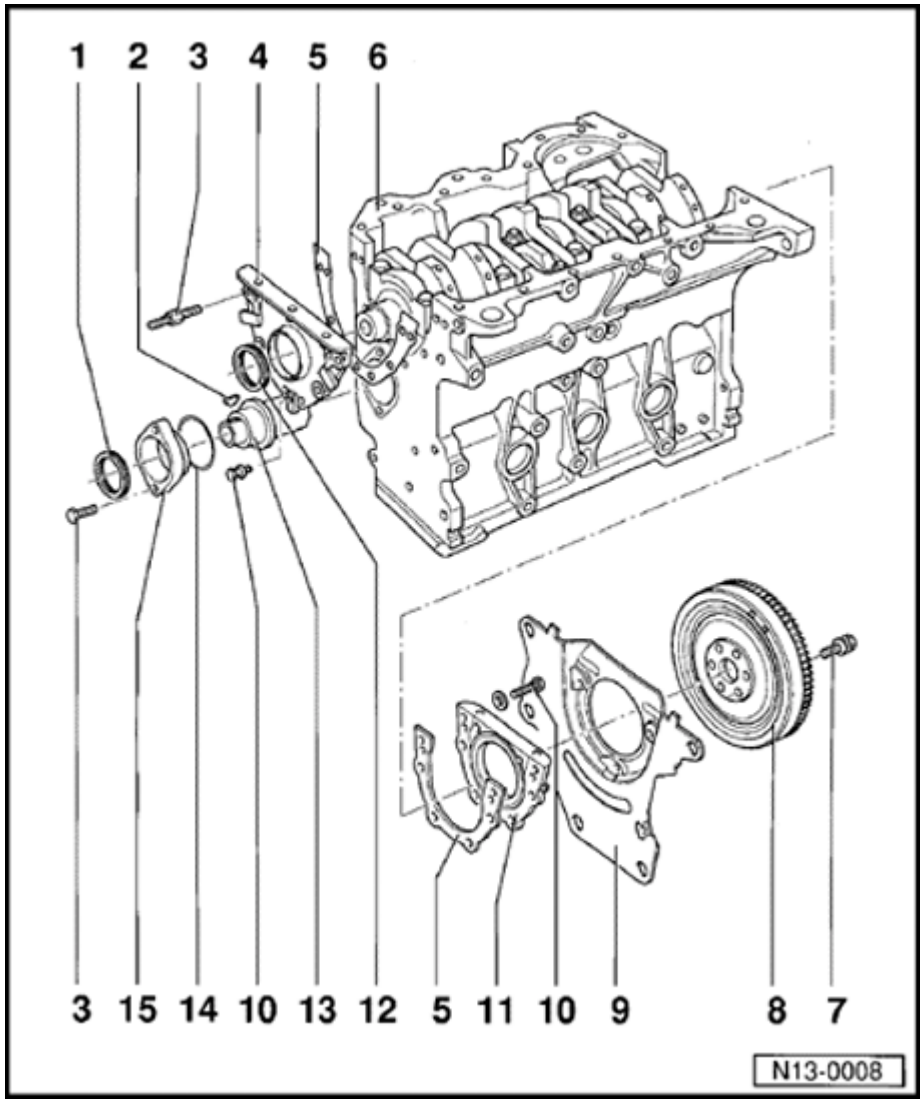
- Removing and installing ⇒ Page 13-43

9 - Intermediate plate

- Must fit on bushings
- Do not damage or bend while performing repairs

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10 - Bolt

- 10 Nm (7 ft lb)

11 - Rear oil seal flange

- With oil seal
- Replace as complete unit
- Lightly oil lip of seal
- Before installing oil pan, spread sealant AMV 174 004 01 on joint between oil seal flange and cylinder block

12 - Oil seal

- Replacing ⇒ Page 13-39

13 - Intermediate shaft

- Axial play, max: 0.25 mm (0.010 in.)

14 - O-ring

- Always replace

15 - Oil seal carrier for intermediate shaft

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Crankshaft oil seal (toothed belt side), replacing

- Engine installed
- Lock carrier in service position ⇒ Page 13-1

Special tools and equipment

- 2085 seal puller
- 3083 arbor
- 3099 spur belt spreading

Removing

- Remove ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .
- Remove toothed belt ⇒ Page 13-29 .
- Remove mounting bracket for torque arm ⇒ Page 17-2 , item - 5 -.



- Remove crankshaft toothed belt gear. Secure toothed belt gear using 3099 spur belt spreading.

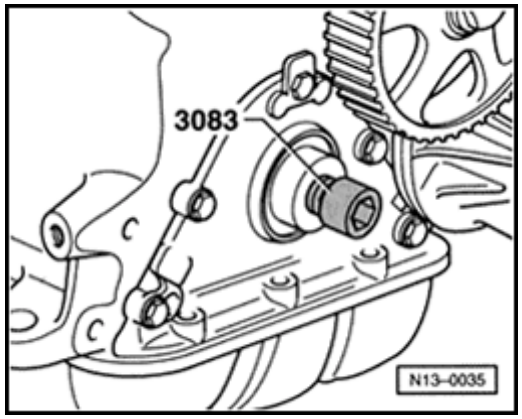
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Note:

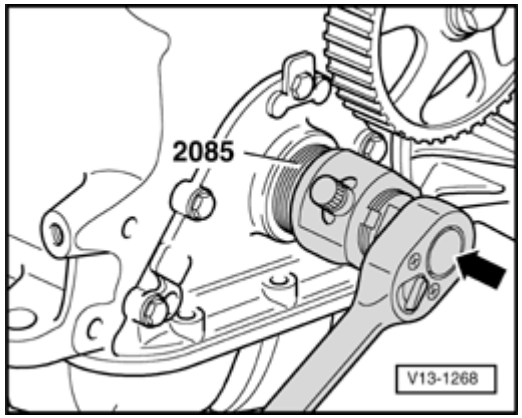
3415 special tool can also be used.

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- Before attaching seal puller, insert socket head cap bolt from 3083 arbor into crankshaft to stop.
- Unscrew inner part of 2085 seal puller two turns (approx. 3 mm 0.118 in.) and secure using knurled bolt.



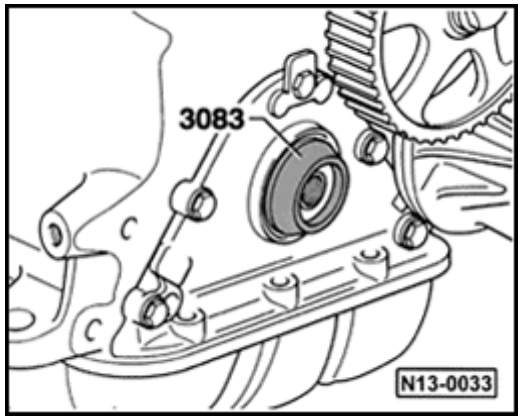
- Grease threaded head of 2085 seal puller, position and with forced pressure screw into oil seal as far as possible.
- Loosen knurled bolt and turn inner part against crankshaft until oil seal is removed.

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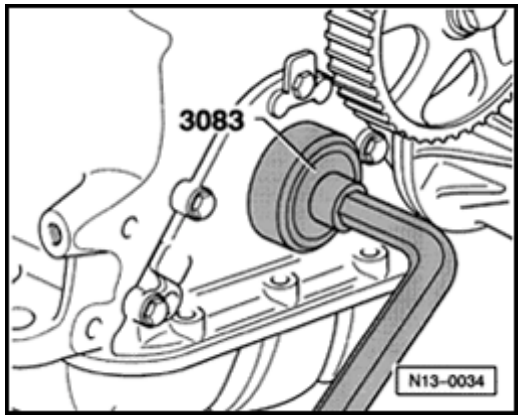
13-41

Installing

- Lightly oil lip of oil seal.



- Place guide sleeve from 3083 arbor on crankshaft.
- Slide oil seal over guide sleeve.



- Press in oil seal to stop together with pressure bushing and bolt from 3083 arbor.
- Replace bolt for toothed belt gear.
- Install toothed belt gear for crankshaft and secure using 3099 spur belt spreading.

Note:

- *Contact surface between toothed belt gear and crankshaft must be free of oil.*
- *Do not grease crankshaft bolt for toothed belt gear.*

- Install toothed belt (adjust valve timing) ⇒ Page 13-32 .

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- Place torque arm on rubber buffer for torque arm and tighten bolts to 25 Nm (18 ft lb).

- Install ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .

Note:

When installing the ribbed belt, make sure it is seated correctly on the pulley.

Tightening torque

Component	Tightening torque
Toothed belt gear to crankshaft	90 Nm (66 ft lb) + 90° 1)2)
1) Replace bolt.	
2) 90° are equivalent to 1/4 turn.	

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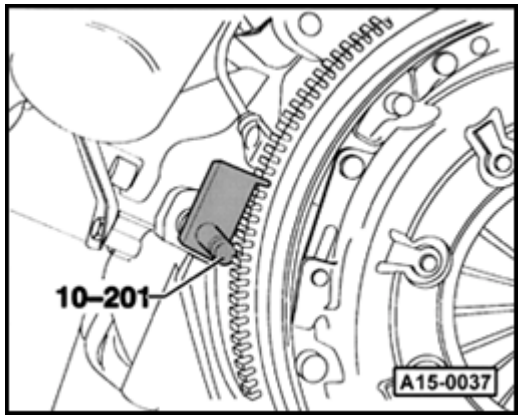
13-43

Dual-mass flywheel/drive plate, removing and installing

Special tools and equipment

10-201 flywheel retainer

Dual-mass flywheel



- Relocate 10-201 flywheel retainer to loosen and tighten bolts.
- Mark installed position (flywheel to crankshaft) to reinstall in same position.
- Always replace bolts.

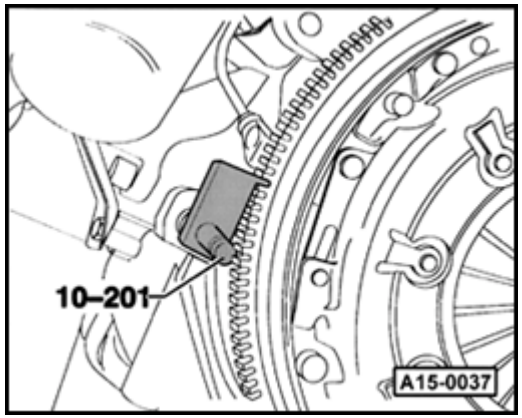
Tightening torque

Component	Tightening torque
Dual-mass flywheel to crankshaft	60 Nm (44 ft lb) + 180° 1)
1) 180° are equivalent to 1/2 turn.	

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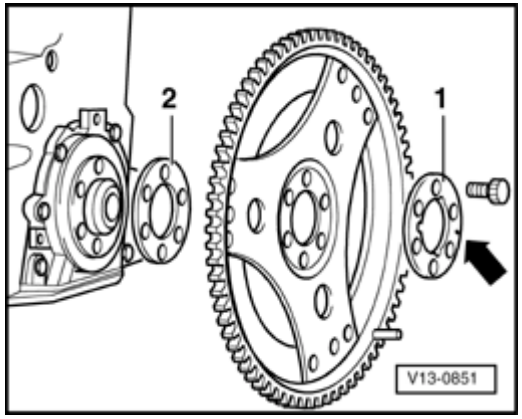
Drive plate

Removing



- Relocate 10-201 flywheel retainer to loosen and tighten bolts.
- Mark drive plate to engine.

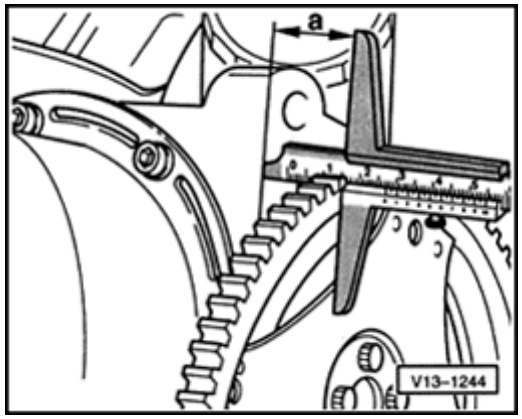
Installing



- Install drive plate with shim -2- and mounting washer -1-. Lug (arrow) must point toward torque converter.
- Insert at least three used mounting bolts and tighten.

  Tightening torque: 30 Nm (22 ft lb)

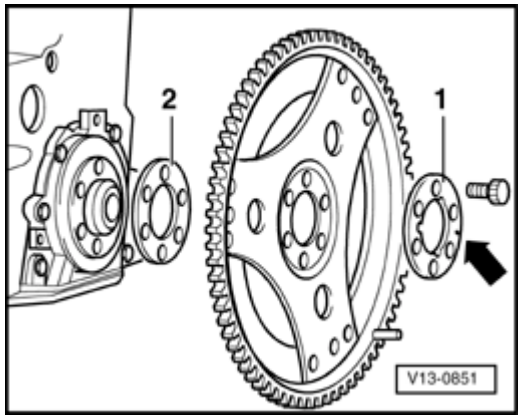
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- Measure distance -a- at three places and calculate average.

  Specification for Automatic Transmission 01V: 26-28 mm (1.024-1.102 in.).

If the specified value is exceeded:



- Remove drive plate and reinstall without shim -2-.
- Re-tighten bolts to 30 Nm (22 ft lb).
- Repeat measurement procedure.

If specified value is obtained:

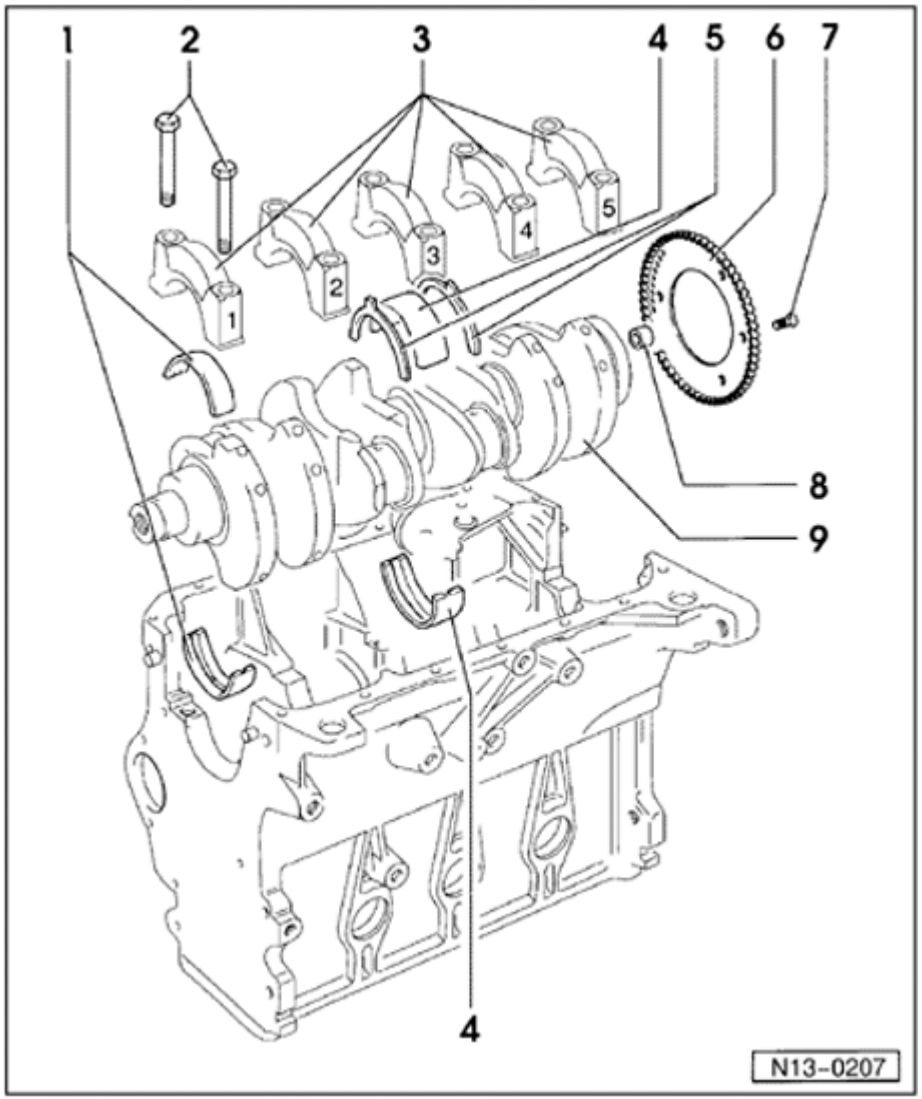
- Replace bolts and tighten.

Tightening torque

Component	Tightening torque
Drive plate to crankshaft	60 Nm (44 ft lb) + 90° 1)
1) 90° are equivalent to 1/4 turn.	

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Crankshaft, removing and installing

Note:

For engine disassembly and assembly, mount engine to an assembly stand using VW540 holding fixture.

1 - Main bearing shells 1, 2, 4 and 5

- Install shell without lubrication groove in main bearing cap
- Install shell with lubrication groove in cylinder block
- Do not interchange used main bearing shells (mark accordingly)

2 - Main bearing cap bolts

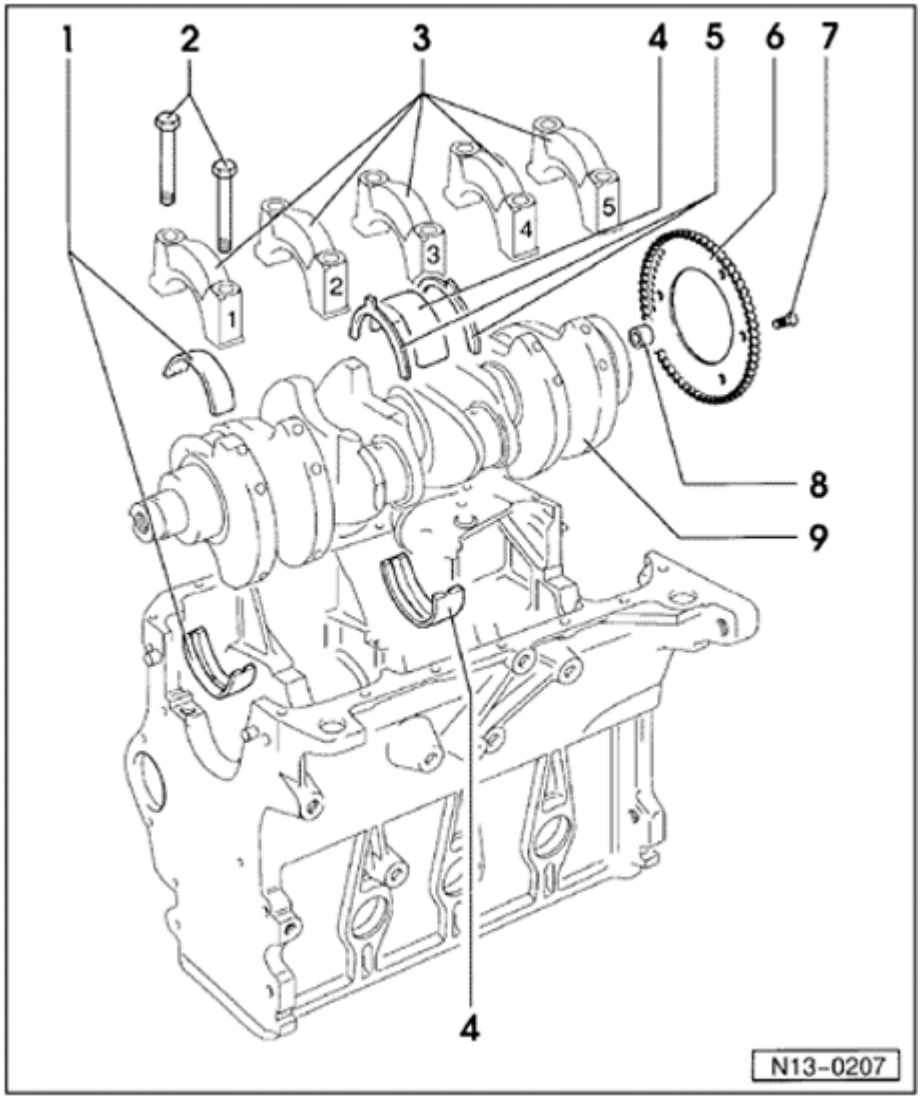
- Always replace
- 65 Nm (48 ft lb) + additional 1/4 turn (90°)
- To measure radial play in crankshaft, tighten to 65 Nm (48 ft lb) but not any further

3 - Main bearing caps

- Bearing cap 1: belt pulley side
- Retaining tabs for cylinder block/bearing cap must overlap

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4 - Main bearing shell 3

- Install shell without lubrication groove in main bearing cap
- Install shell with lubrication groove in cylinder block
- Do not interchange used main bearing shells (mark accordingly)

5 - Thrust plates

- For bearing cap, bearing 3
- Check location point

6 - Sensor wheel

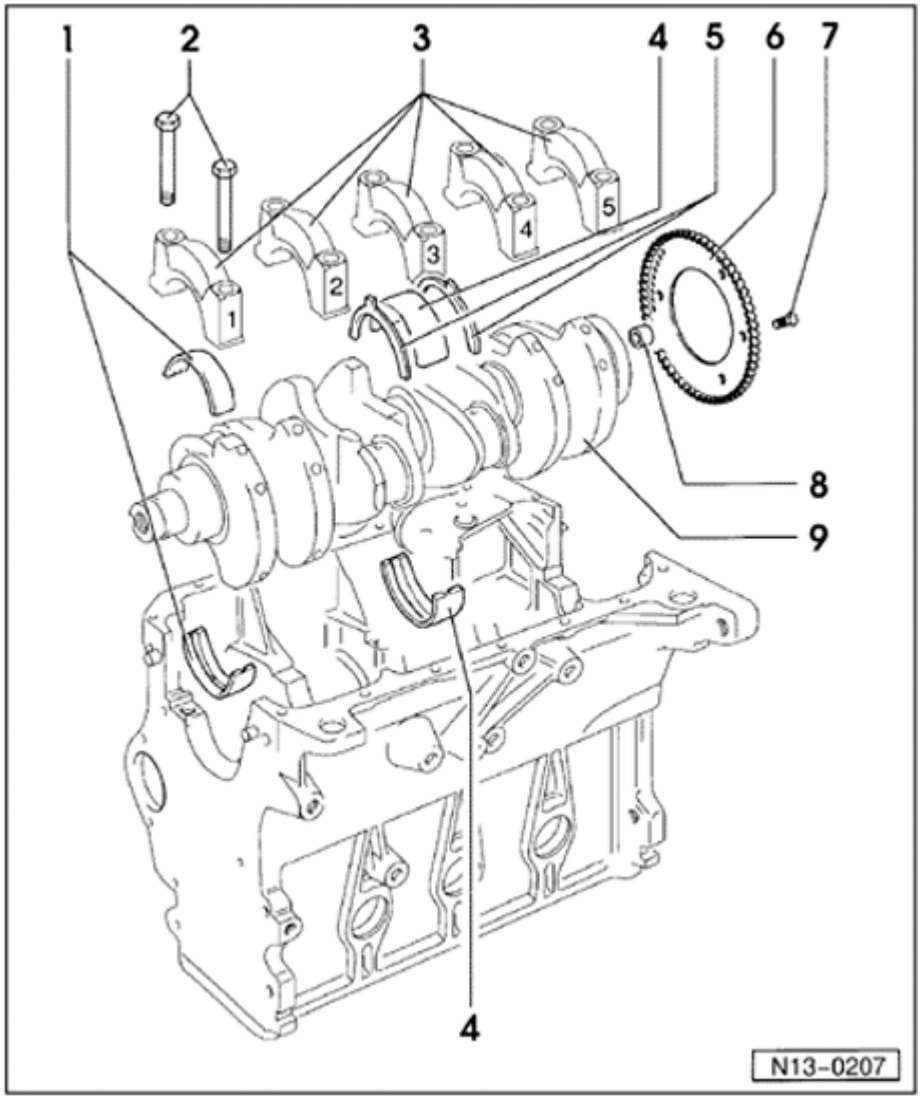
- Always replace when bolts are removed
- For engine speed (RPM) sensor -G28-
- Installation only possible in one position; bore holes are offset
- Removing and installing⇒ Fig. ⇒ 1

7 - Sensor wheel screws

- Always replace
- Always replace sensor wheel when bolts are removed
- 10 Nm (7 ft lb) + additional 1/4 turn (90 °)

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8 - Needle bearing

- Removing and installing ⇒ Page 13-50

9 - Crankshaft

- Axial play when new: 0.07-0.23 mm (0.003-0.009 in.)
- Wear limit: 0.30 mm (0.012 in.)
  - Radial clearance is measured using Plastigage®
- New: 0.02-0.04 mm (0.0008-0.0016 in.)
- Wear limit: 0.15 mm (0.006 in.)
- Do not turn crankshaft when measuring radial play
- Crankshaft dimensions ⇒ Page 13-52

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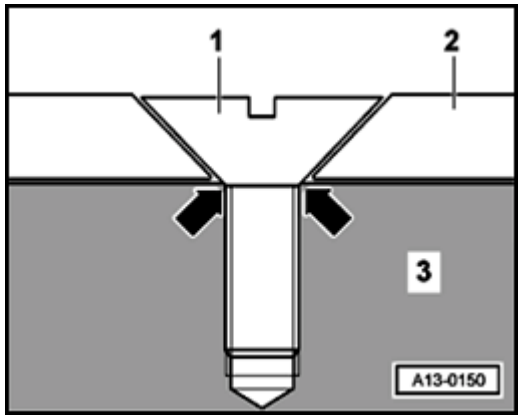


Fig. 1 Removing and installing sensor wheel

- Always replace sensor wheel -2- when screws -1- are removed.

Note:

- *After tightening a second time, the attachment point of the countersunk screws of the sensor wheel are so deformed that the screw heads sit against crankshaft (arrows) -3- and the sensor wheel is loose underneath the screws.*
- *Installation of the sensor wheel is only possible in one position; bore holes are offset.*

Tightening torque

Component	Tightening torque
Sensor wheel to crankshaft	10 Nm (7 ft lb) + 90° 1) 2)
1) Replace bolts.	
2) 90° are equivalent to 1/4 turn.	

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Crankshaft needle bearing, removing and installing

Note:

- *A pilot needle bearing must be installed in the crankshaft of engines for vehicles with manual transmission. Install if necessary.*
- *A pilot needle bearing must not be installed in the crankshaft of engines for vehicles with automatic transmission. Remove if necessary.*

Special tools and equipment

- 21/1 Kukko puller and 22/1 Kukko support

or

- 10-202 puller
- VW207C drift

or

- 3176 centering mandrel

Removing



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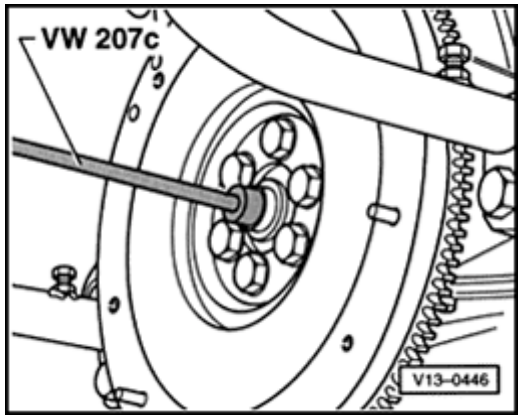


- Pull out using puller -A-, e.g. 21/2 Kukko extractor and 22/1 Kukko support or 10-202 puller.

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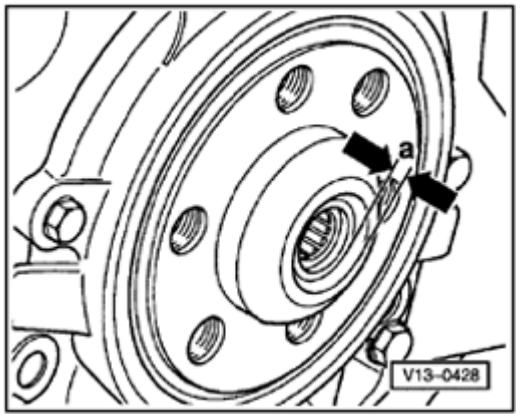
13-51

Installing



- Drive in using VW207C drift and/or 3176 centering mandrel.

  When needle bearing is installed, side with inscription must be visible.



Installation of needle bearing:

Dimension -a- = 1.5 mm (0.059 in.)

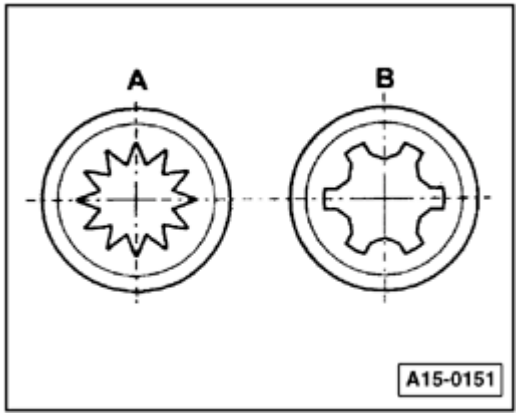
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Crankshaft dimensions

Reconditioning dimension	Crankshaft journal diameter - mm (in.)	Connecting rod journal diameter - mm (in.)
maximum size (from nominal)	-0.017 (0.0007)	-0.022 (0.0009)
Basic dimension (nominal)	54.00 (2.126)	47.80 (1.882)
minimum size (from nominal)	-0.037 (0.0015)	-0.042 (0.0017)
maximum size (from nominal)	-0.017 (0.0007)	-0.022 (0.0009)
1st undersize (nominal)	53.75 (2.116)	47.55 (1.872)
minimum size (from nominal)	-0.037 (0.0015)	-0.042 (0.0017)
maximum size (from nominal)	-0.017 (0.0007)	-0.022 (0.0009)
2nd undersize (nominal)	53.50 (2.106)	47.30 (1.862)
minimum size (from nominal)	-0.037 (0.0015)	-0.042 (0.0017)
maximum size (from nominal)	-0.017 (0.0007)	-0.022 (0.0009)
3rd undersize (nominal)	53.25 (2.096)	47.05 (1.852)
minimum size (from nominal)	-0.037 (0.0015)	-0.042 (0.0017)

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Cylinder head bolts, conversion from inner 12-point to Polydrive



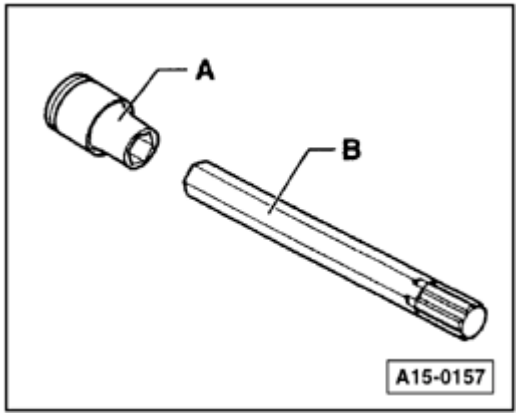
Conversion of cylinder head bolts from inner 12-point to Polydrive bolts. Conversion is a running-change

A - Bolt with inner 12-point (old version). Remove and install using socket insert 3410

B - Bolt with Polydrive head (new version). Remove and install using Polydrive key 3452

Note:

Before removing or installing the cylinder head bolts, check which version of the bolt is installed.



Special tool -B- is inserted in a socket insert -A- for assembly.

A - 10 mm socket insert (locally available)

B - Polydrive key 3452

Cylinder head bolts tightening sequence and torques remain unchanged ⇒ Page 15-25 .

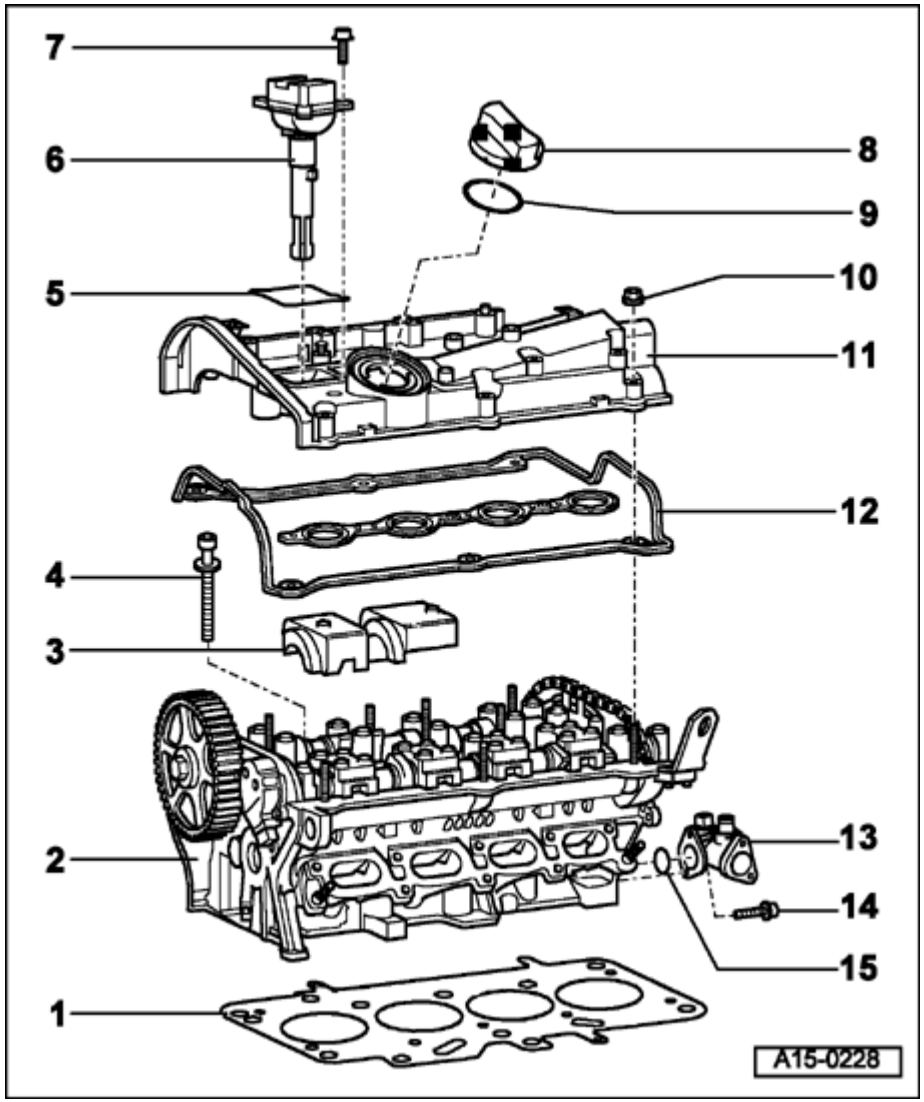
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Cylinder head, removing and installing

Note:

- *Replace cylinder head bolts.*
- *Always replace self-locking nuts, bolts as well as gaskets and O-rings.*
- *After installing a replacement cylinder head with camshafts attached, grease contact surfaces between valve lifters and cam lubricating surfaces.*
- *Do not remove plastic covers protecting exposed valves until immediately before installing cylinder head.*
- *When replacing the cylinder head or cylinder head gasket, coolant must be completely replaced.*
- *Cylinder heads with small cracks between the valve seats that are less than 0.3 mm (0.012 in.) wide and/or between one valve seat and only the first 4 threads of the spark plug thread, can continue to be used without reduced service life.*

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Part I

1 - Cylinder head gasket

- Replacing ⇒ page 15-20 cylinder head, removing
- Installed position: part number faces cylinder head
- After replacing, replace coolant

2 - Cylinder head

- Removing ⇒ Page 15-20
- Check for distortion ⇒ Page 15-8 , Fig. ⇒ 1
- Refacing measurement ⇒ Page 15-8 , Fig. ⇒ 2
- Installing ⇒ Page 15-25
- After replacing, replace coolant

3 - Oil deflector

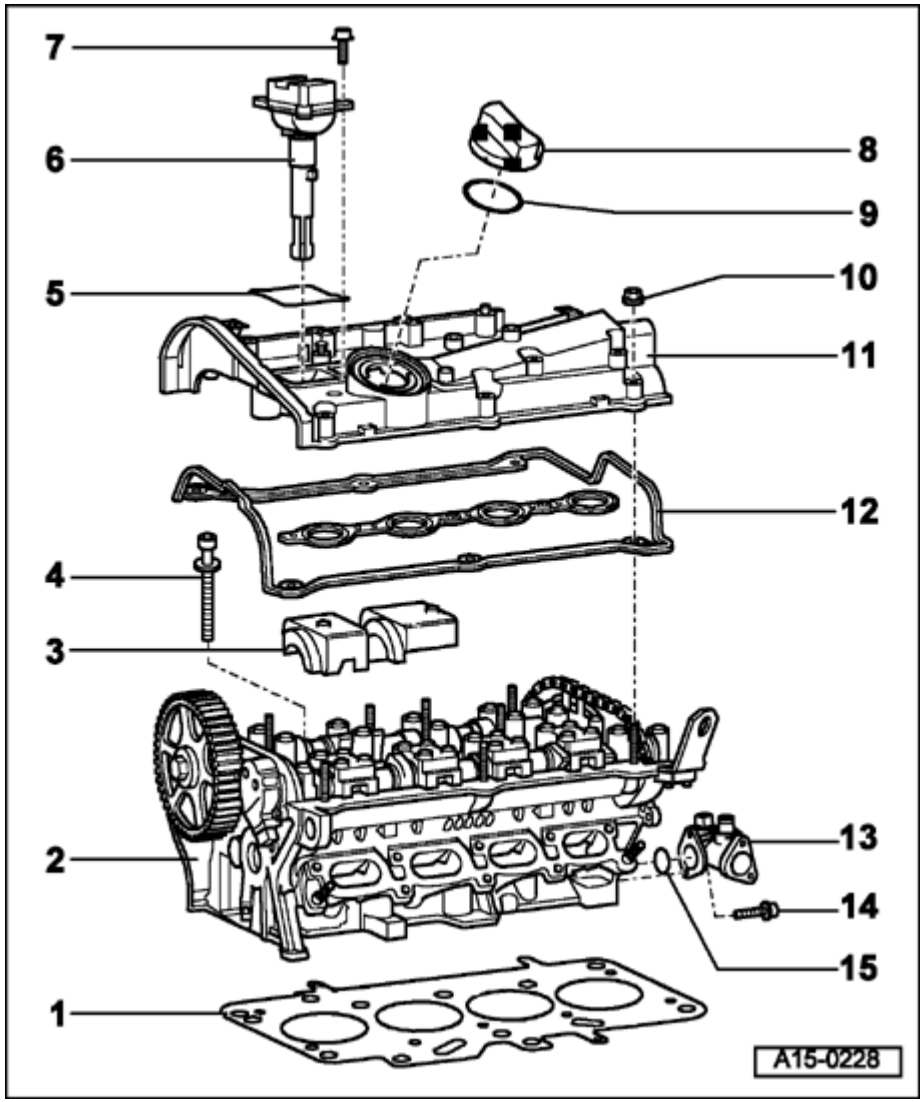
- Verify correct installation position above intake camshaft between cylinders 1 and 2

4 - Cylinder head bolt

- Always replace
- Follow sequence of removal ⇒ Page 15-20
- Follow torque sequence ⇒ Page 15-25

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15-4



5 - Gasket

- For ignition coil
- Replace if damaged

6 - Ignition Coil

- Check

⇒ *Repair Manual, 1.8 Liter 5V Turbo Fuel Injection & Ignition, Repair Group 28*

7 - Bolt

- 10 Nm (7 ft lb)

8 - Oil filler cap

9 - Gasket

- Replace if damaged or leaking

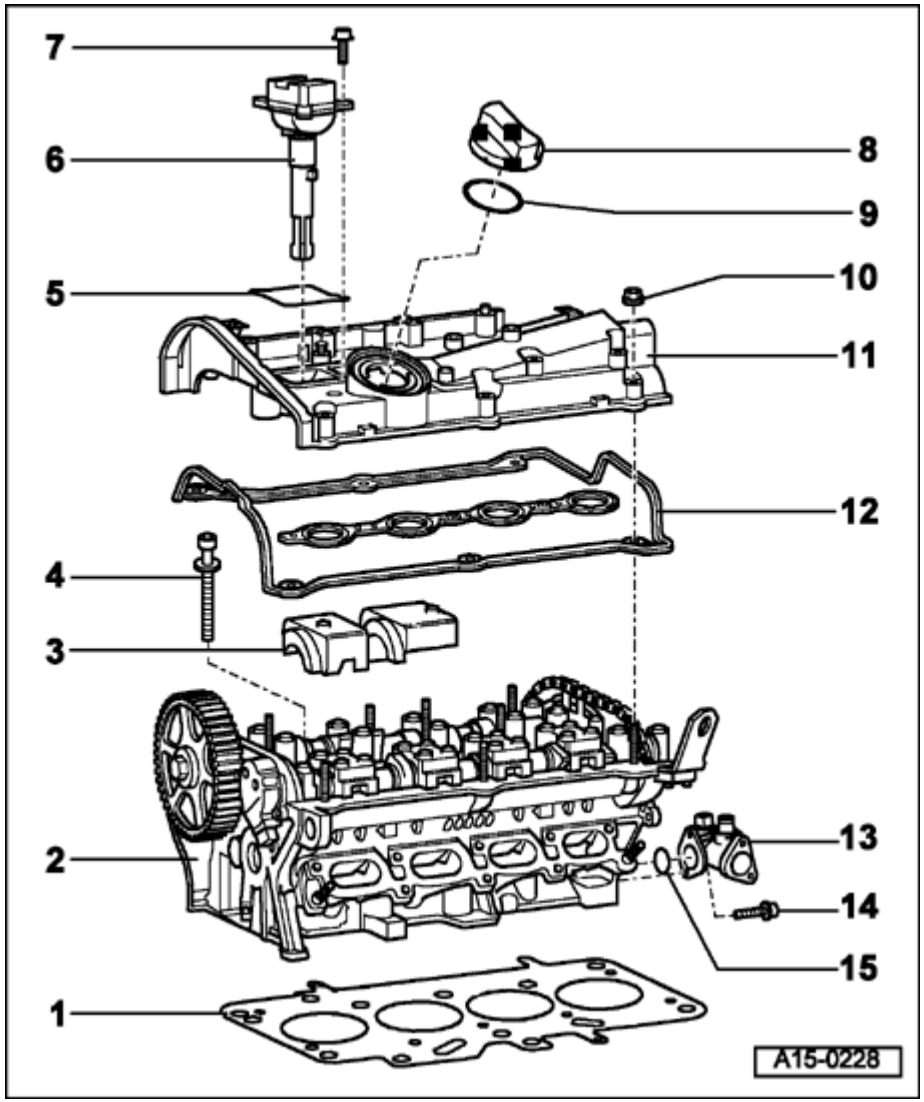
10 - Nut

- 10 Nm (7 ft lb)

11 - Cylinder head cover

- Removing and installing ⇒ Page 15-17

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12 - Cylinder head cover gaskets

- Replace if damaged or leaking
- Before installing, seal contact surfaces with sealant D 454 300 A2 ⇒Fig. ⇒ 3 and ⇒Fig. ⇒ 4

CAUTION!

Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

13 - Coolant flange

- With coolant temperature sensor

14 - Bolt

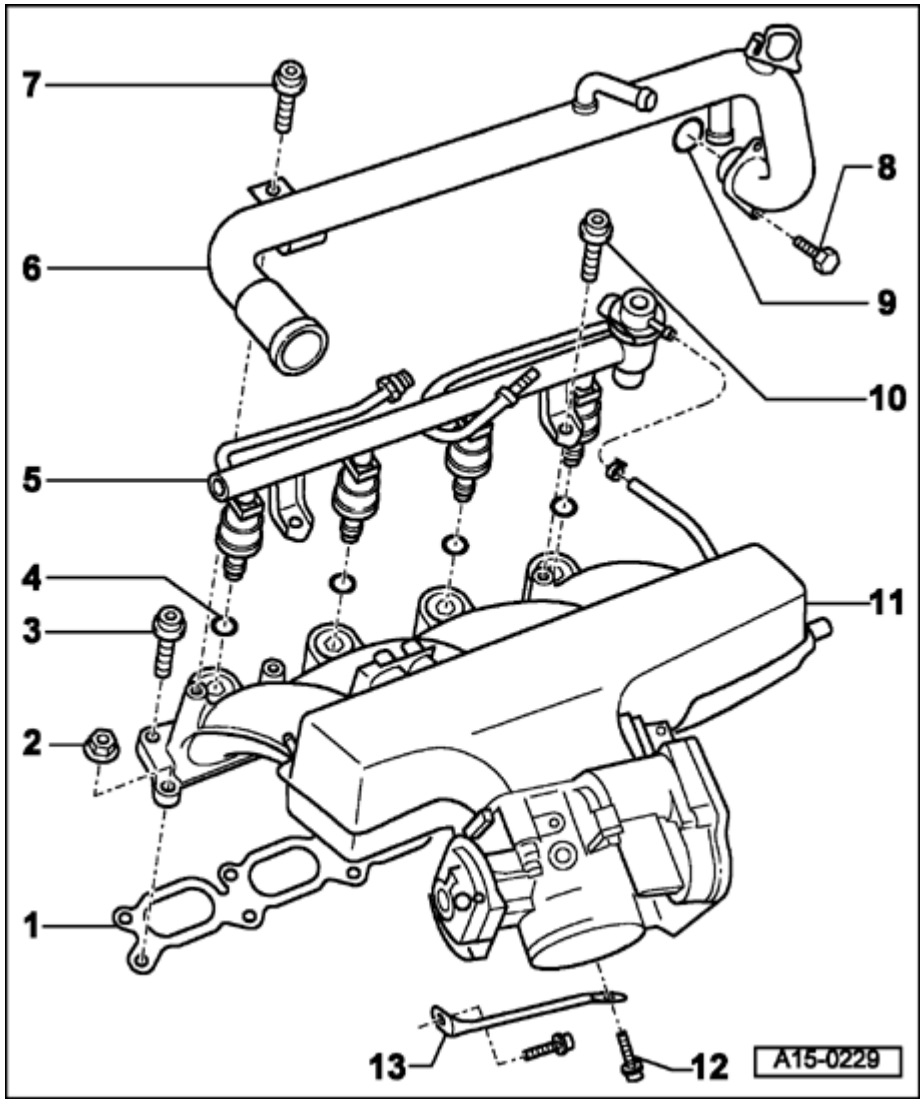
- 10 Nm (7 ft lb)

15 - O-Ring

- Always replace

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15-6



Part II

1 - Gasket

- Always replace

2 - Nut

- 10 Nm (7 ft lb)

3 - Socket-head bolt

- 10 Nm (7 ft lb)

4 - O-Ring

- For injector
- Always replace

5 - Fuel rail

- With injectors

6 - Upper coolant line

7 - Socket-head bolt

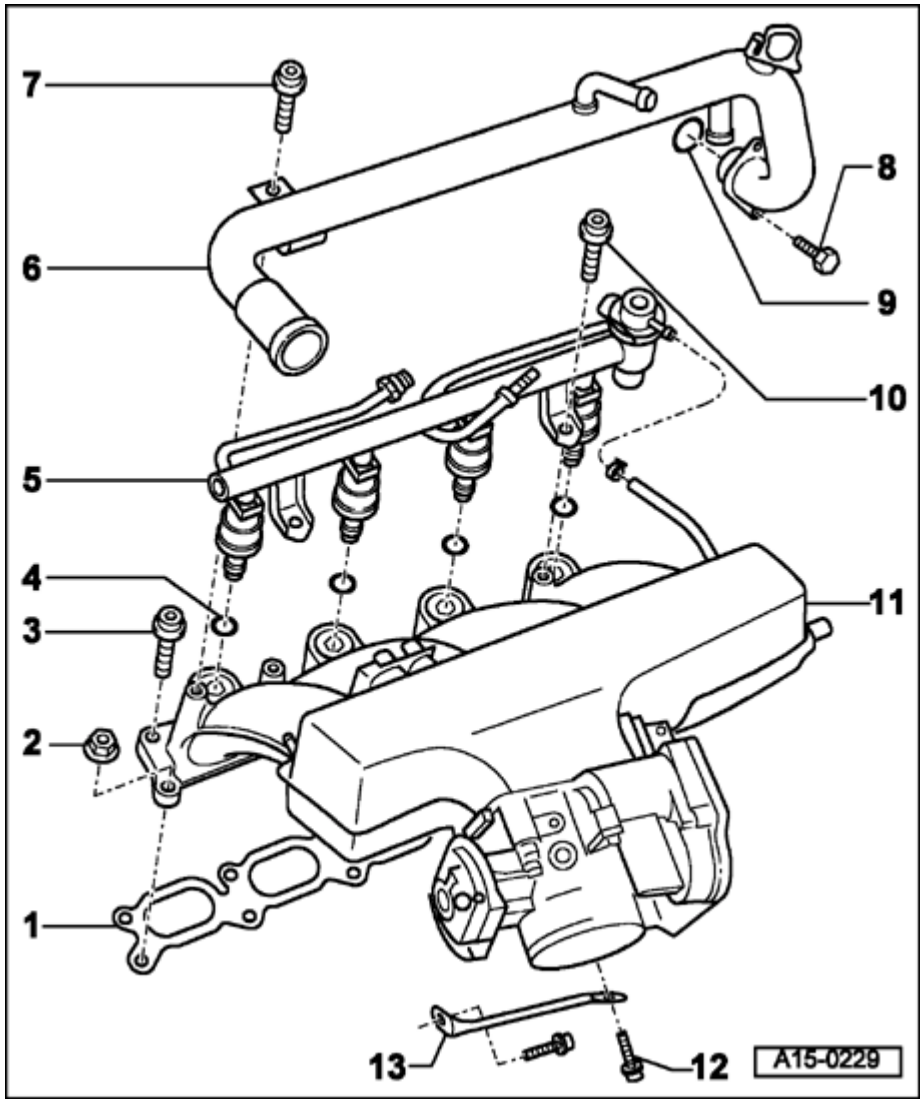
- 10 Nm (7 ft lb)

8 - Bolt

- 10 Nm (7 ft lb)

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15-7



9 - O-Ring

- For upper coolant line
- Always replace

10 - Socket-head bolt

- 10 Nm (7 ft lb)

11 - Intake plenum

- Removing and installing ⇒ Page 15-10

12 - Socket-head bolt

- 20 Nm (15 ft lb)

13 - Brace

- For intake manifold

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15-8

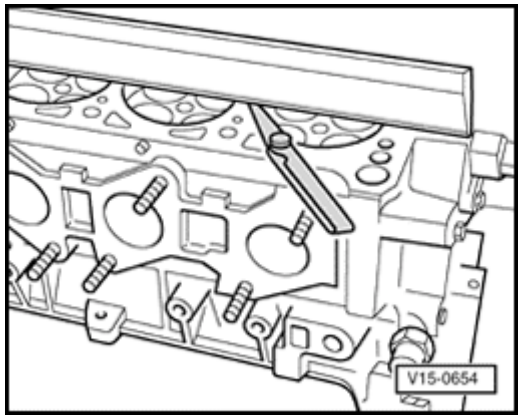


Fig. 1 Check cylinder head for distortion

- Using straightedge and feeler gauge, check cylinder head for distortion at multiple points.

  Cylinder head distortion must not exceed 0.1 mm (0.004 in.)

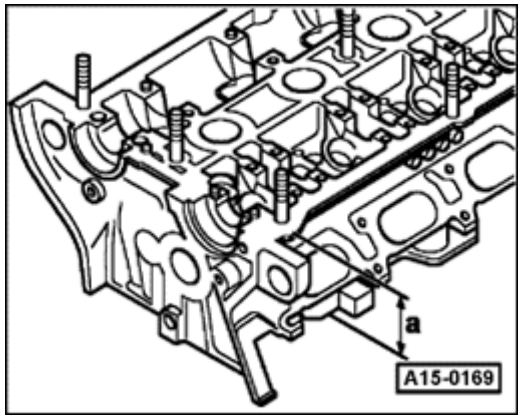


Fig. 2 Refacing cylinder head

Refacing cylinder head can only be done to a minimum dimension -a-.

Minimum dimension -a-: 139.25 mm (5.482 in.)

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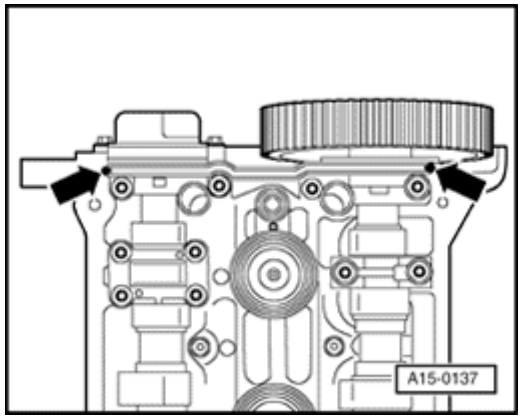


Fig. 3 Sealing contact surfaces between double bearing cap and cylinder head

- Using small screwdriver, carefully apply thin layer of sealant D 454 300 A2 to both corners of sealing surface between double bearing cap and cylinder head (arrows).

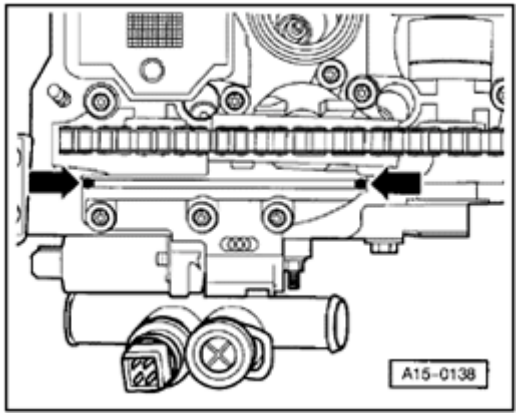


Fig. 4 Sealing contact surfaces between hydraulic chain tensioner and cylinder head

- Using small screwdriver, carefully apply thin layer of sealant D 454 300 A2 to both corners of sealing surface between hydraulic chain tensioner and cylinder head (arrows).

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15-10

Intake manifold, removing and installing

Removing

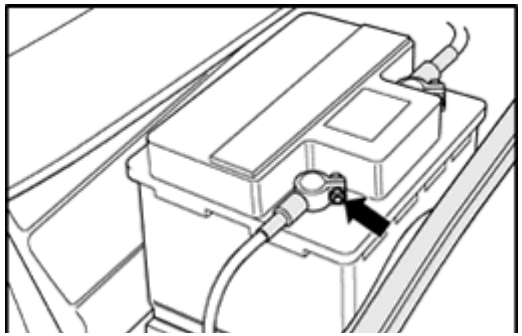
Note:

All tie wraps opened or cut during removal must be reinstalled at the same locations.

CAUTION!

BEFORE disconnecting the battery:

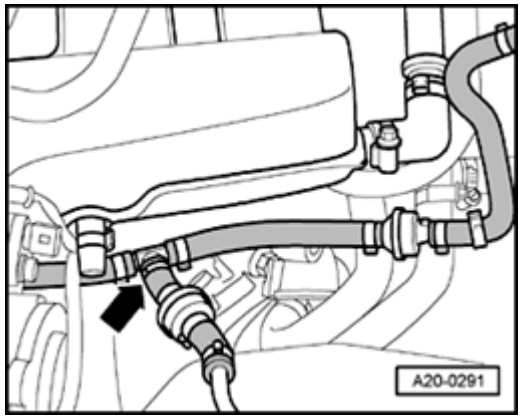
- ***Stop the engine.***
- ***Be sure the ignition is switched OFF (also applies when connecting the battery). Failure to do so may damage the Engine Control Module (ECM).***
- ***Determine the correct coding for the anti-theft radio.***



- Disconnect battery Ground (GND) strap.
- Remove engine covers.
- Drain coolant ⇒ Page 19-4 .

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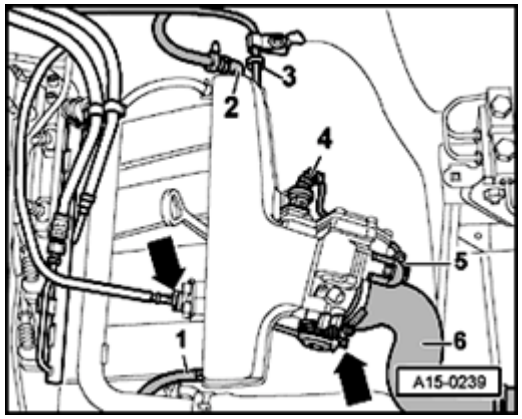
15-11



- Remove hose (arrow) for Leak Detection Pump (LDP) -V144-.

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15-12



- Disconnect Accelerator Pedal (AP) cable from throttle valve control module -J338- and mounting flange (arrows) without removing positioning clip.
- Remove air guide hose -6- at throttle valve control module.
- Remove vacuum hose -1-.
- Disconnect vacuum line -3- to Evaporative Emissions (EVAP) canister.
- Disconnect vacuum hose -2- at brake servo.

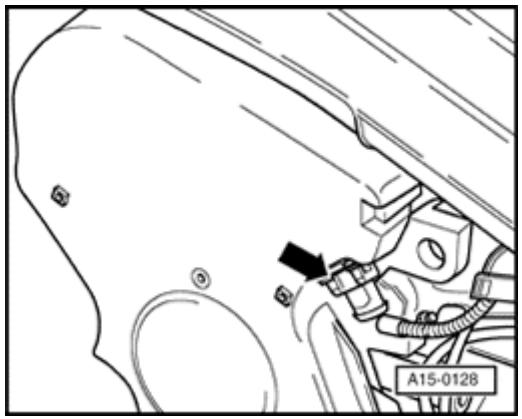
Note:

For vehicles with automatic transmission, remove vacuum hose -2- from behind vacuum booster.

- Disconnect the following harness connectors:

4 - For Intake Air Temperature (IAT) sensor -G42-

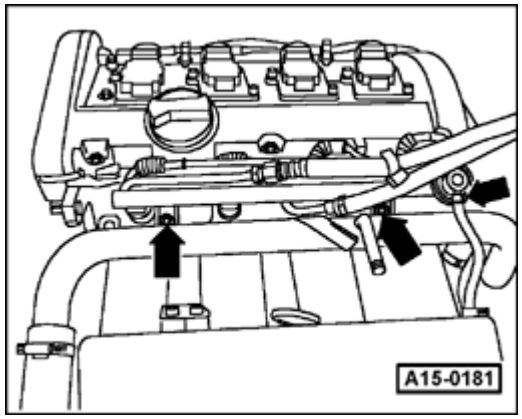
5 - For throttle valve control module -J338-



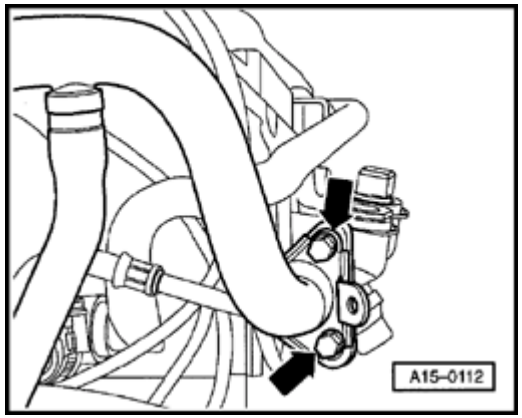
- Disconnect harness connector from Camshaft Position (CMP) sensor -G40- (arrow).

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15-13



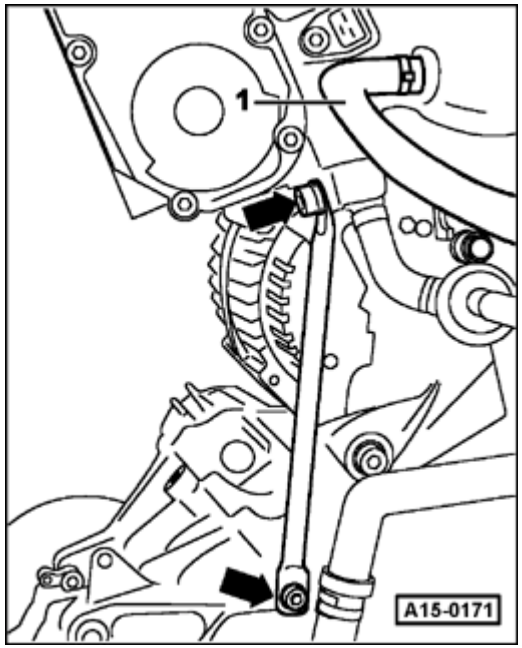
- Unbolt fuel supply rail retaining bolts and disconnect vacuum line at fuel pressure regulator (arrows).
- Disconnect fuel supply rail with injectors from intake manifold and lay aside in rear of engine compartment on clean cloth.
- Disconnect coolant hoses at upper coolant line.



- Disconnect upper coolant line at intake line and rear coolant flange at rear of cylinder head (arrows).

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15-14



- Disconnect crankcase ventilation hose -1- at intake manifold.
- Remove intake manifold brace (arrows).
- Remove dipstick.
- Unbolt intake manifold at flange and remove.

Note:

Stuff clean cloths into cylinder head intake ports.

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15-15

Installing

Installation is the reverse of removal, noting the following:

Note:

Replace gaskets and O-rings.

- Adjust Accelerator Pedal (AP) cable.

⇒ *Repair Manual, Fuel Supply System, Repair Group 20*

- Top up coolant ⇒ Page 19-6 .

CAUTION!

Be sure the ignition is switched OFF. Failure to do so may damage the Engine Control Module (ECM).

- Switch ignition off and reconnect battery Ground (GND) strap.

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

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⇒ *Radio operating manual*

- Fully close power windows to stop.

- Operate all power window switches again for at least one second in "close" direction to activate "one touch" opening/closing function.

- Set clock to correct time.

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- Perform throttle valve control module adaptation to Engine Control Module (ECM).

⇒ *Repair Manual, 1.8 Liter 5V Turbo Fuel Injection & Ignition, Repair Group 24*

Tightening torques

Component	Tightening torques
Intake manifold to cylinder head	10 Nm (7 ft lb)
Intake manifold brace to intake manifold	20 Nm (15 ft lb)
Intake manifold to bracket	20 Nm (15 ft lb)
Fuel supply rail to intake manifold	10 Nm (7 ft lb)
Coolant line to coolant flange	10 Nm (7 ft lb)
Coolant line to intake manifold	10 Nm (7 ft lb)

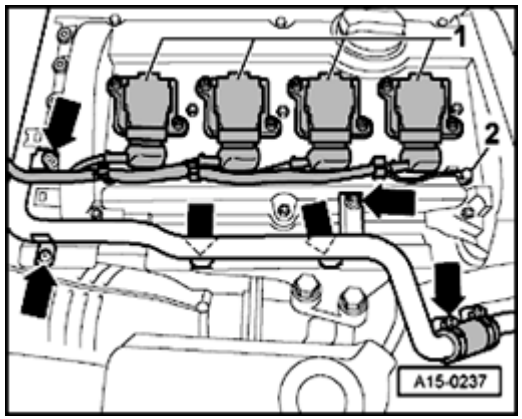
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15-17

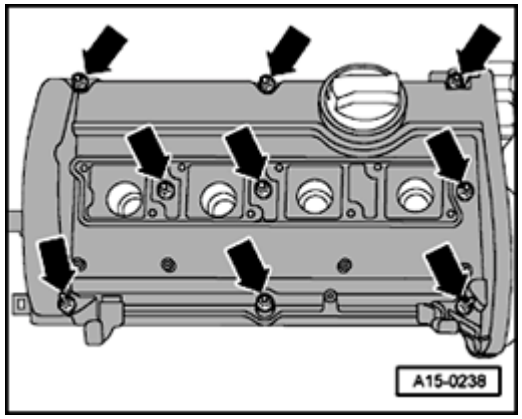
Cylinder head cover, removing and installing

Removing

- Remove engine covers.



- Unbolt crankcase ventilation line from heatshield and cylinder head cover and disconnect line from front hose (arrows).
- Swing crankcase ventilation line to side.
- Remove 2 retaining clamps for upper toothed belt cover.
- Disconnect harness connectors at ignition coils -1- and unbolt Ground (GND) connection -2-.
- Unbolt ignition coils.



- Remove cylinder head cover nuts (arrows) and remove cylinder head cover.

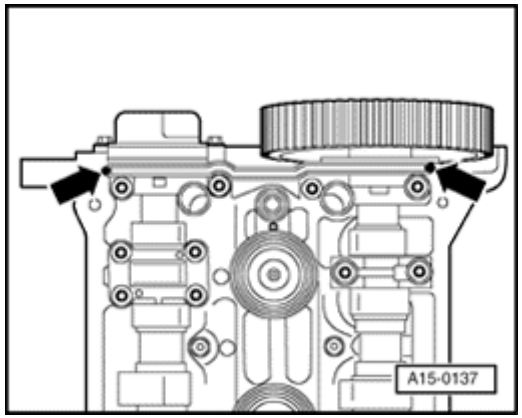
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Installing

Installation is the reverse of removal, noting the following:

Note:

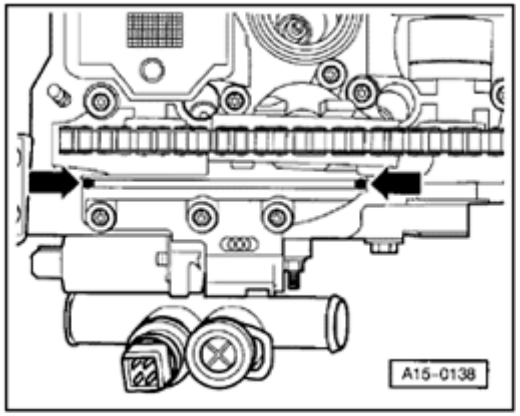
Replace cylinder head cover gaskets if damaged.



- Using small screwdriver, carefully apply thin layer of sealant D 454 300 A2 to both corners of sealing surface between double bearing cap and cylinder head (arrows).

CAUTION!

Part numbers are listed here for reference only. Always check with your Parts department for the latest information.



- Using small screwdriver, carefully apply thin layer of sealant D 454 300 A2 to both corners of sealing surface between hydraulic chain tensioner and cylinder head (arrows).
- Tighten cylinder head cover nuts alternately in diagonal sequence.
- Make sure toothed belt cover is installed properly.

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15-19

Tightening torques

Component	Tightening torques
Cylinder head cover to cylinder head	10 Nm (7 ft lb)
Ignition coils to cylinder head cover	10 Nm (7 ft lb)
Crankcase ventilation line to cylinder head cover	10 Nm (7 ft lb)

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15-20

Cylinder head, removing

- Engine installed
- Lock carrier in service position ⇒ Page 13-1

Note:

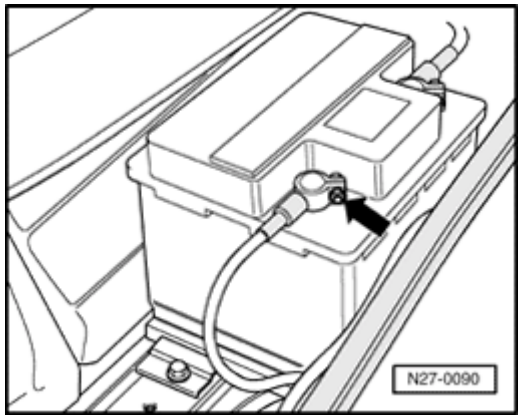
- *Secure all hose connections with original equipment clamps ⇒parts catalog.*
- *All tie wraps opened or cut during removal must be reinstalled at the same locations.*

CAUTION!

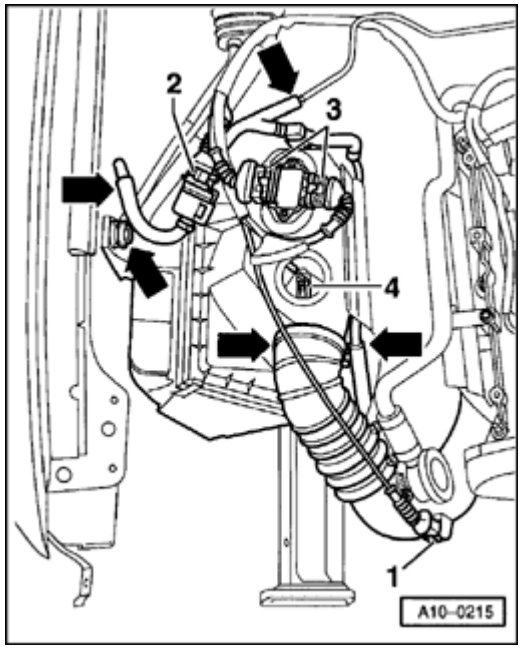
BEFORE disconnecting the battery:

- ***Stop the engine.***
- ***Be sure the ignition is switched OFF (also applies when connecting the battery). Failure to do so may damage the Engine Control Module (ECM).***
- ***Determine the correct coding for the anti-theft radio.***

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- Remove Ground (GND) connection.
- Drain coolant ⇒ Page 19-4 .
- Remove intake manifold ⇒ Page 15-10 .
- Remove ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .



- Remove the following lines/harness connectors:

1 - At Wastegate Bypass Regulator Valve -N75-

2 - At Evaporative Emission (EVAP) Canister Purge Regulator Valve -N80-

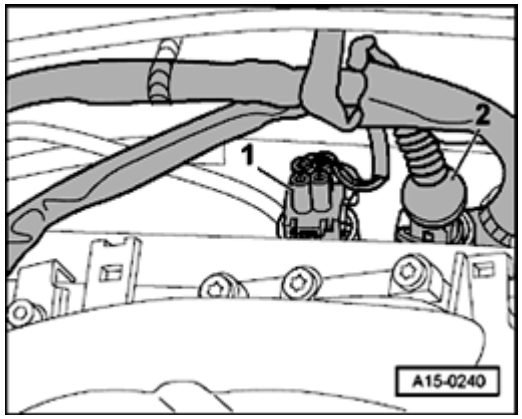
3 - At Power outage stage -N122-

4 - At Mass Air Flow (MAF) sensor -G70-

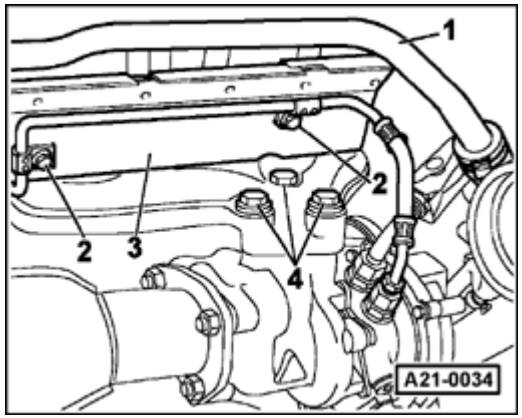
- Pull off hose connections and remove air cleaner element housing (arrows).

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15-22



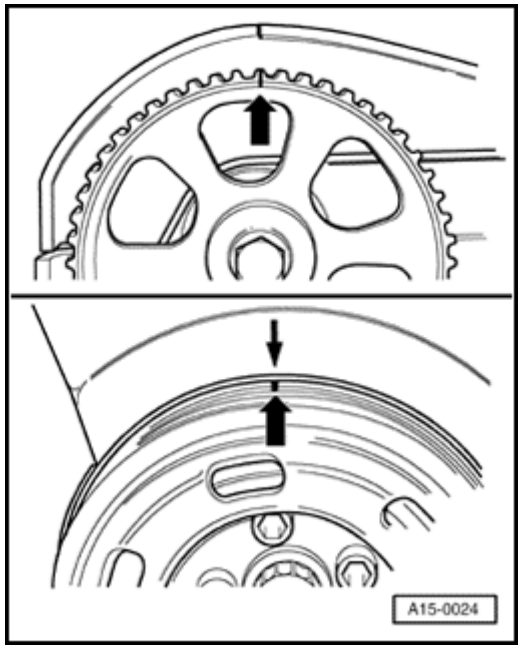
- Disconnect harness connector -1- at Engine Coolant Temperature (ECT) sensor -G2-/-G62-.
- Disconnect harness connector -2- at temperature sensor II -G18-.
- Unclip all connections from cylinder head and move clear.



- Remove crankcase ventilation line -1-.
- Remove oil supply line at cylinder head -2-.
- Remove heat shield -3-.
- Unbolt turbocharger from exhaust manifold -4-.
- Disconnect coolant hose to heat exchanger at rear of cylinder head, also detach retaining clamps at connecting flange.
- Remove upper toothed belt cover ⇒ Page 13-29 .

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15-23

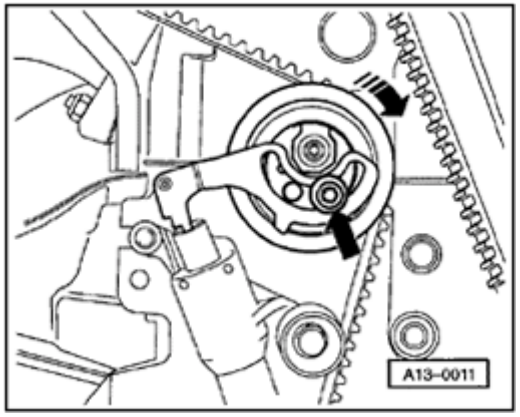


- Turn crankshaft at central bolt of toothed belt gear in direction of engine rotation to TDC Cyl. 1 marking (arrows).

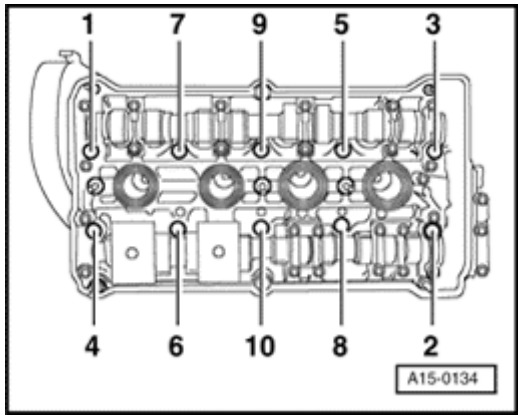
CAUTION!

Before removing toothed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt.

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- Using Torx® wrench T45, loosen toothed belt tensioner (lower arrow).
- Push down on toothed belt tensioner.
- Remove toothed belt from camshaft gear.
- Remove TORX® bolt and swing belt tensioner assembly bracket forward.
- Remove cylinder head cover ⇒ Page 15-17 .



- Remove cylinder head bolts in sequential order as shown in illustration.
- Remove cylinder head.

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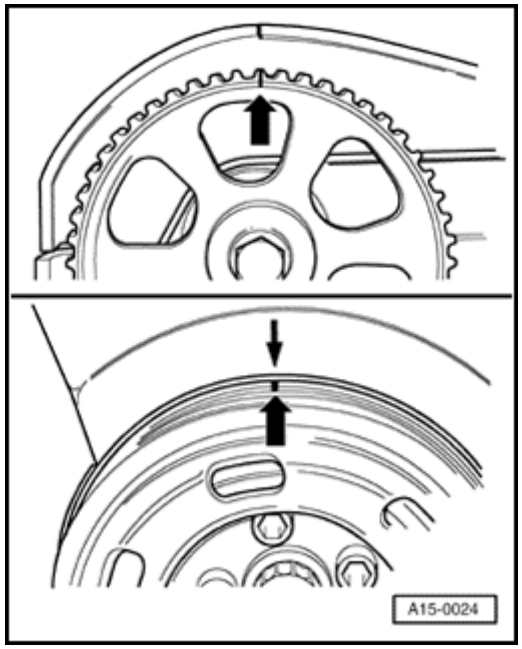
15-25

Cylinder head, installing

Note:

- *Always replace cylinder head bolts.*
- *Note inner 12-point or Polydrive versions of cylinder head bolts ⇒ Page 15-1 .*
- *Always replace self-locking nuts, bolts, gaskets and O-rings.*
- *Carefully remove any sealant residue from cylinder head or engine block repairs. Avoid any scratches or scoring.*
- *Thoroughly remove all sanding and grinding residue.*
- *Do not remove new cylinder head gasket from package until immediately before installing.*
- *Handle gasket with extra care. Silicon layer and grooved areas can be damaged leading to leakage.*
- *Pocket holes in engine block for cylinder head bolts must be free of oil and coolant.*

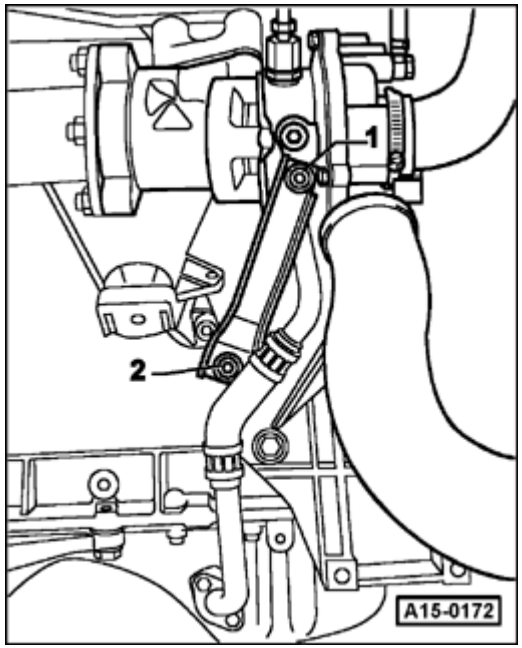
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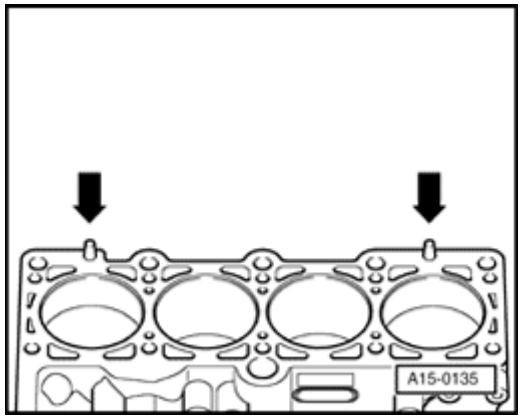
- Before installing cylinder head, set crankshaft and camshaft to TDC Cyl. 1 marking (arrows).

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15-26



- Loosen bolts -1- and -2- at turbocharger bracket two turns to reduce likelihood of any tension while installing cylinder head.



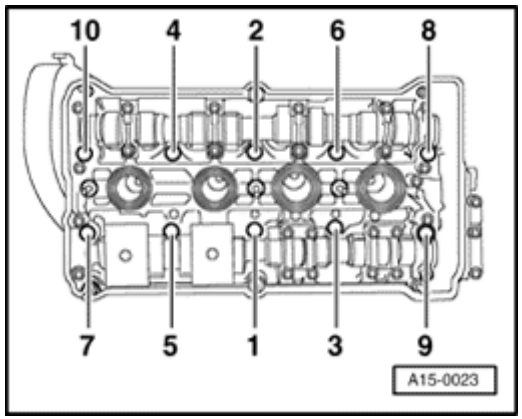
- Install cylinder head gasket.

Note:

- *Pay close attention to pilot pins (arrows) in engine block.*
- *Pay attention to installation position marking for cylinder head gasket: Part number must be visible from intake side.*

- Install cylinder head.

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- Insert cylinder head bolts and hand tighten.

- Tighten cylinder head bolts in sequential order, in two stages:
  - Step 1 = 60 Nm (44 ft lb)
  - Step 2 = additional 1/2 turn using rigid wrench (180 ° is equivalent to two 90 ° turns)

Note:

It is not necessary to re-tighten the bolts.

- Using new gasket, bolt turbocharger to exhaust manifold and bolt bracket to engine block ⇒ Page 21-24 .
- Install cylinder head cover ⇒ Page 15-18 .
- Install toothed belt (adjust valve timing) ⇒ Page 13-32 .

Note:

Follow all procedures for removing and installing toothed belt ⇒ Page 13-29 .

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- Install ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .

Note:

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

- Adjust Accelerator Pedal (AP) cable.

⇒ *Repair Manual, Fuel Supply System, Repair Group 20*

- Replace coolant ⇒ Page 19-6 .

CAUTION!

Be sure the ignition is switched OFF. Failure to do so may damage the Engine Control Module (ECM).

- Switch ignition off and reconnect battery Ground (GND) strap.

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

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⇒ *Radio operating manual*

- Using power window switch, raise windows to stop.

- Operate all power window switches again for at least one second in "close" direction to activate "one touch" opening/closing function.

- Set clock to correct time.

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- Perform throttle valve control module adaptation to Engine Control Module (ECM).

⇒ *Repair Manual, 1.8 Liter 5V Turbo Fuel Injection & Ignition, Repair Group 24*

Tightening torques

Component	Tightening torque
Intake manifold brace to intake manifold	20 Nm (15 ft lb)
Intake manifold brace to bracket	20 Nm (15 ft lb)
Turbocharger to exhaust manifold	35 Nm (26 ft lb)
Turbocharger bracket to turbocharger (bolt and washer assembly M8)	40 Nm (30 ft lb)
Turbocharger bracket to cylinder block	45 Nm (33 ft lb)
Retainer straps for oil supply line to cylinder head	20 Nm (15 ft lb)

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15-30

Compression, checking

Special tools and equipment

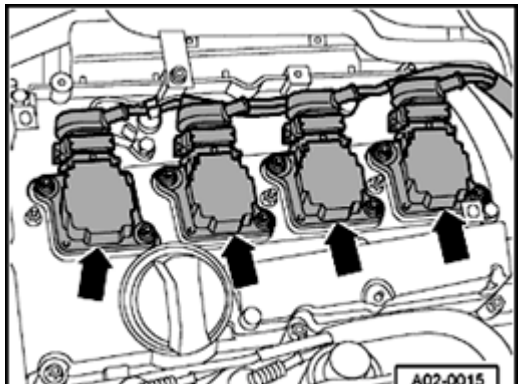
- VAG1381 or VAG1763 compression tester
- 3122B spark plug removal tool

Test condition

- Minimum engine oil temperature: 30 °C (86 °F)

Test procedure

- Remove engine covers.
- Switch ignition off and remove harness connectors to ignition coils.



- Unbolt ignition coils (arrows).
- Remove all harness connectors to fuel injectors.
- Using 3122B spark plug removal tool, remove all spark plugs.
- Open throttle to Wide Open Throttle (WOT) position.
- Using VAG1381 or VAG1763 compression tester, test engine compression.

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Note:

Use VAG1381 or VAG1763 compression tester ⇒ user manual.

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- Activate starter until no further pressure increases are indicated by VAG1381 or VAG1763 compression tester.

Compression pressure

Engine code	New	Wear limit
AEB	10.0-13.0 bar (145-188.5 psi)	7.0 bar (101.5 psi)

Permissible difference between all cylinders: 3 bar (43 psi)

- Install spark plugs and ignition coils.

- Check DTC memory.

⇒ *Repair Manual, 1.8 Liter 5V Turbo Fuel Injection & Ignition, Repair Group 01*

Note:

Diagnostic Trouble Codes (DTCs) are stored when harness connectors are disconnected. After testing, check DTC memory and erase.

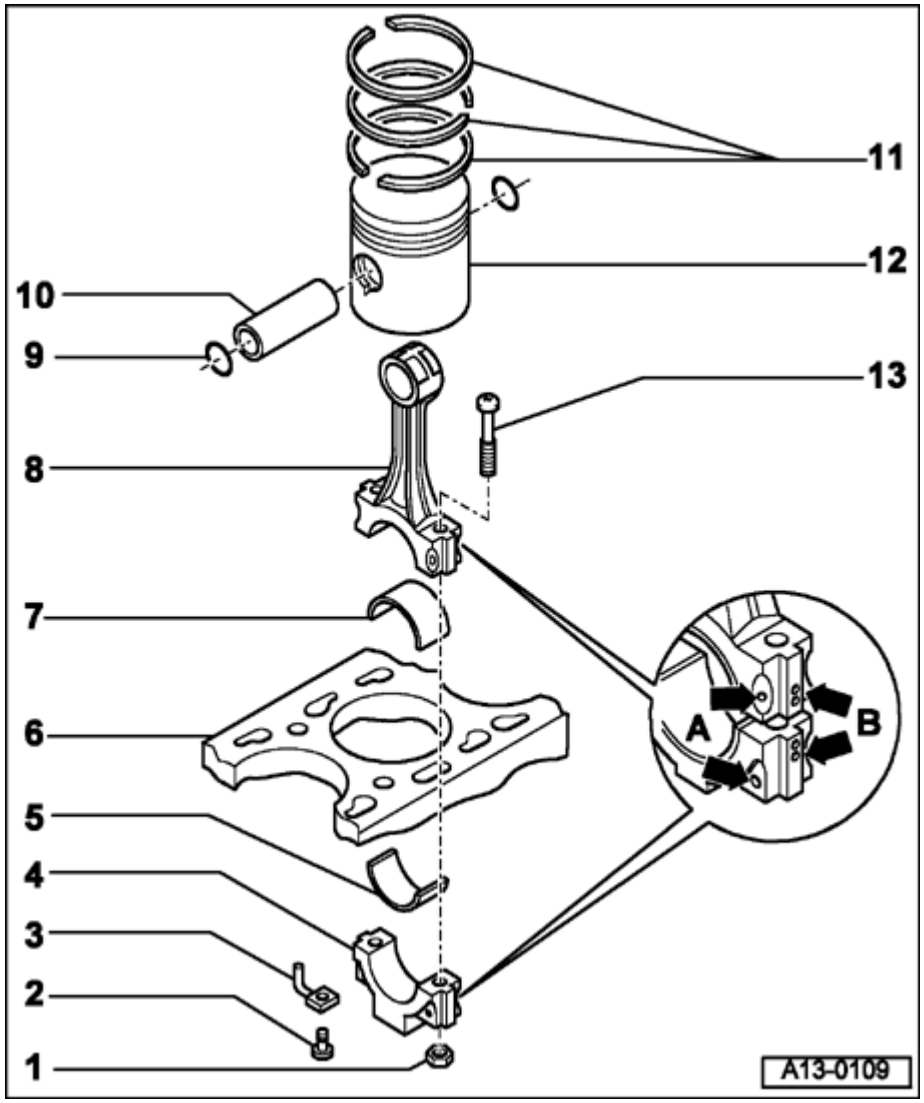
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Tightening torques

Component	Tightening torques
Spark plugs into cylinder head	30 Nm (22 ft lb)
Ignition coils to cylinder head cover	10 Nm (7 ft lb)

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13-53



Pistons and connecting rods, disassembling and assembling

1 - Nut for connecting rod bolt

- 30 Nm (22 ft lb) + additional 1/4 turn (90°)
- Always replace connecting rod bolt -13-
- Grease thread and contact surface
- To measure radial play, tighten to 30 Nm (22 ft lb) but not any further

2 - Pressure relief valve

- Tightening torque: 27 Nm (20 ft lb)
- Opening pressure: 2.5-3.2 bar (36.25-46.4 psi)

3 - Oil spray nozzle

- For piston cooling

4 - Connecting rod bearing cap

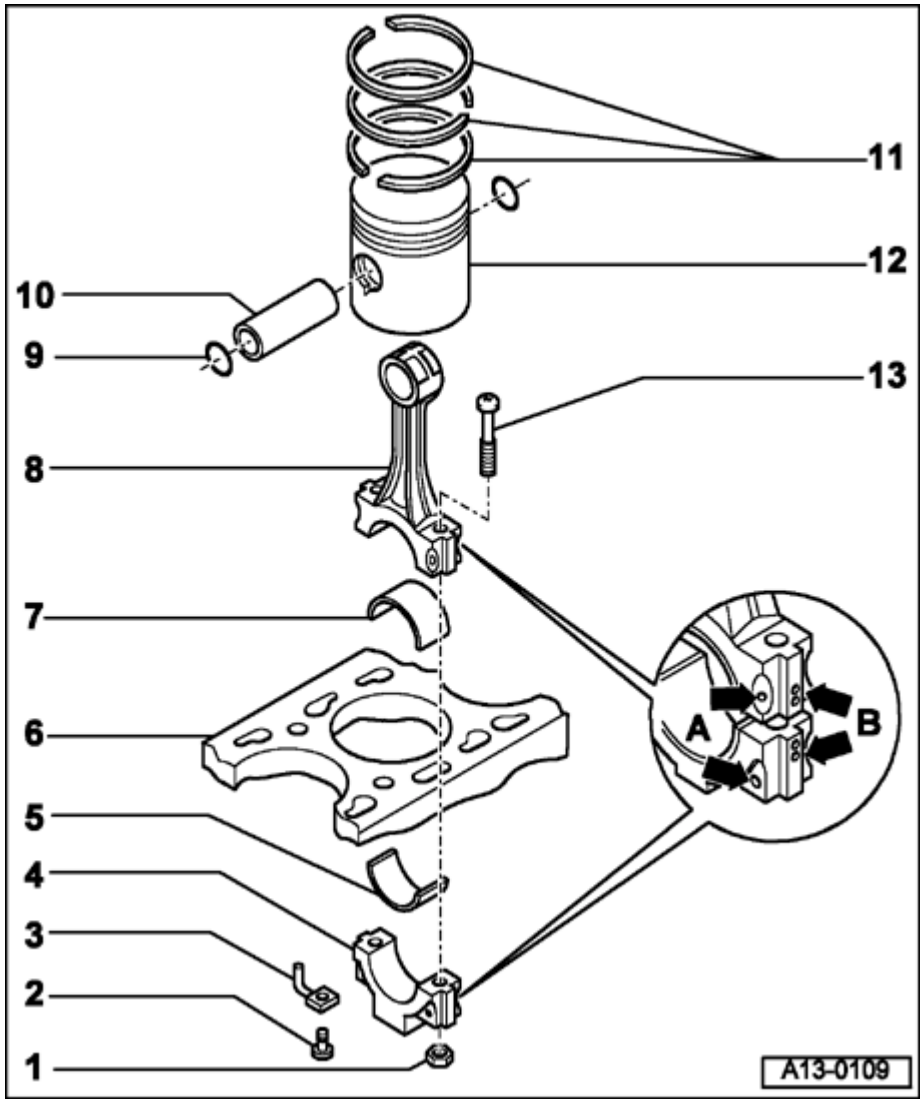
- Mark -B- to indicate which cylinder each cap belongs to

Installed position:

- Marks -A- point toward belt pulley side

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13-54



5 - Bearing shell

- Verify correct installation position
- Do not interchange used connecting rod bearing shells (mark accordingly)
- Check for proper securing in retaining tabs

Axial play:

- New: 0.10-0.35 mm (0.004-0.014 in.)
- Wear limit: 0.40 mm (0.016 in.)

Measure radial play using Plastigage®:

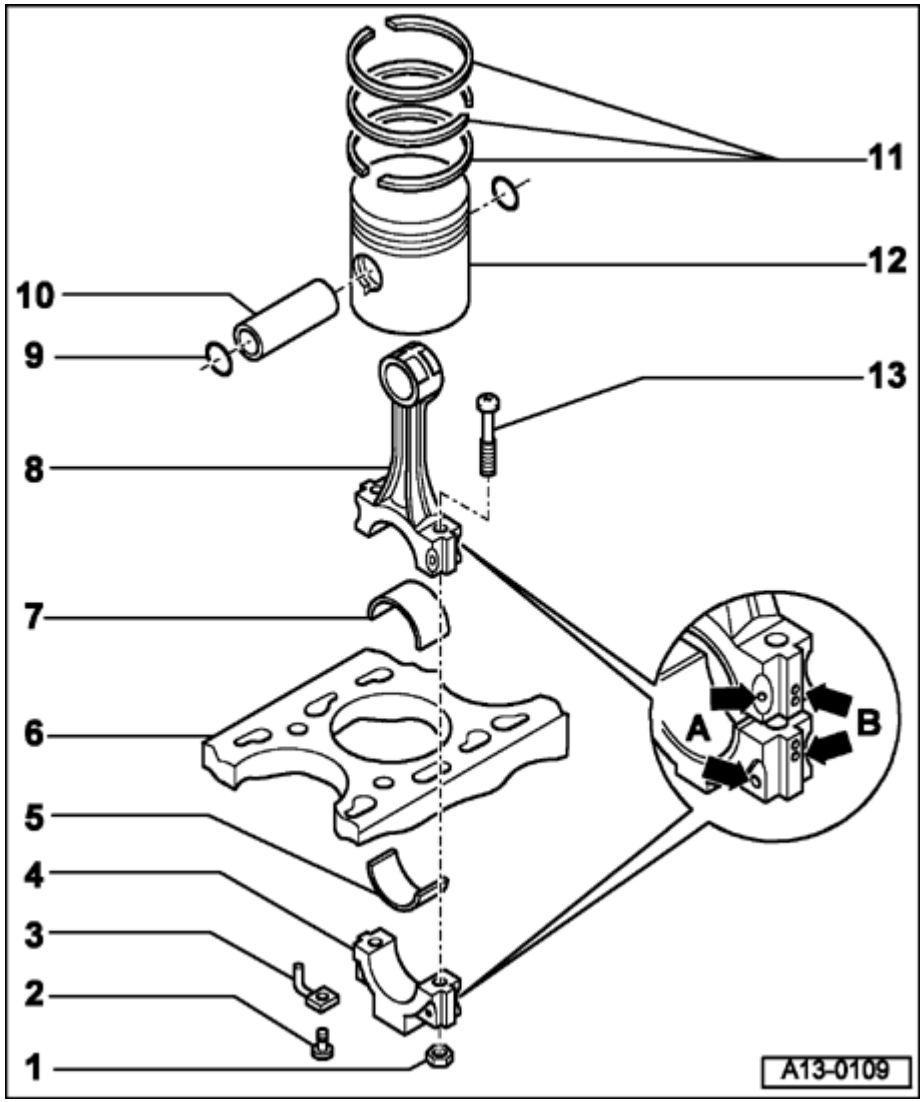
- New: 0.01-0.05 mm (0.0004-0.0020 in.)
- Wear limit: 0.12 mm (0.0047 in.)
- Do not turn crankshaft when measuring radial play with Plastigage® in place
  - To measure radial play, tighten nut -1- to 30 Nm (22 ft lb) but not any further

6 - Cylinder block

- Check bore ⇒ Fig. ⇒ 4
- Piston and cylinder bore dimensions ⇒ Page 13-60

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13-55



7 - Bearing shell

- With oil bore for piston pin lubrication
- Verify correct installation position
- Do not interchange used connecting rod bearing shells (mark accordingly)

Axial play:

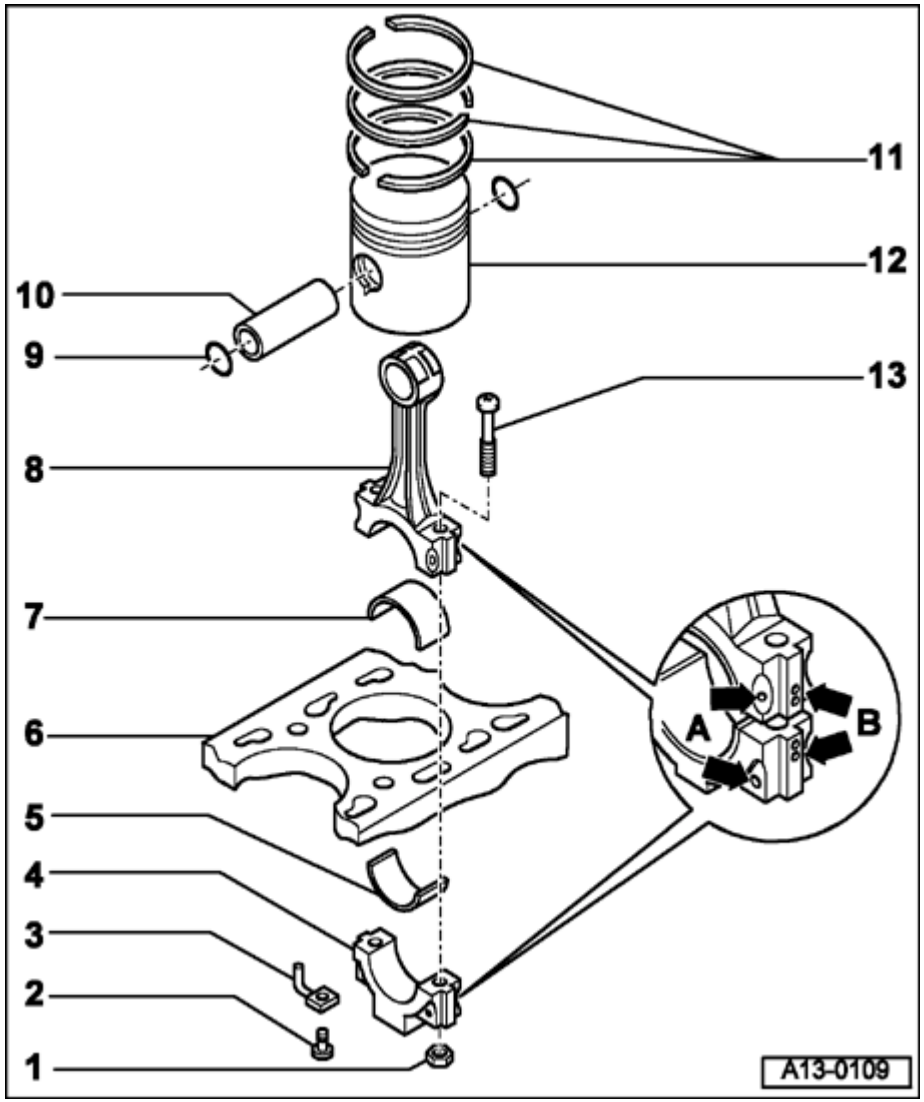
- New: 0.10-0.35 mm (0.004-0.014 in.)
- Wear limit: 0.40 mm (0.016 in.)

Measure radial play using Plastigage®:

- New: 0.01-0.05 mm (0.0004-0.0020 in.)
- Wear limit: 0.12 mm (0.0047 in.)
- Do not turn crankshaft when measuring radial play with Plastigage® in place
- To measure radial play, tighten nut -1- to 30 Nm (22 ft lb) but not any further

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13-56



8 - Connecting rod

- Replace only as a set
- Markings -B- indicate which cylinder each rod belongs to

Installed position:

- Marks -A- point toward belt pulley side
- With oil bore for piston pin lubrication

9 - Circlip

10 - Piston pin

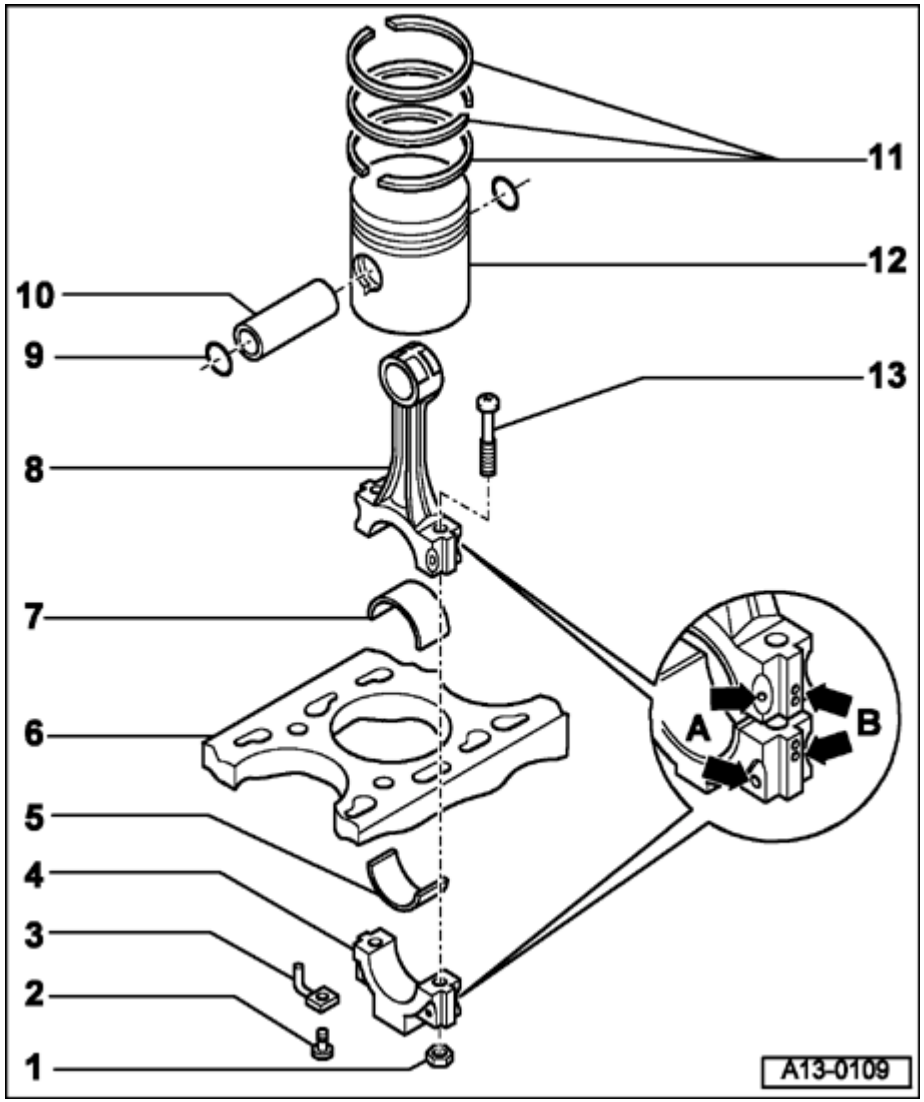
- If stiff, warm pistons to approx. 60 ° C (140 ° F)
- When removing and installing, use VW222a pilot drift

11 - Piston rings

- Offset by 120 °
- Use piston ring pliers to remove and install
- Marking "TOP" must point to piston head
- Checking piston ring end gap ⇒Fig. ⇒ 1
- Checking piston ring side clearance ⇒ Fig. ⇒ 2

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12 - Pistons

- Checking
- Mark installation position and matching cylinder
- Arrow on piston head points toward belt pulley side
- Install using piston ring compressor

13 - Connecting rod bolt

- Always replace

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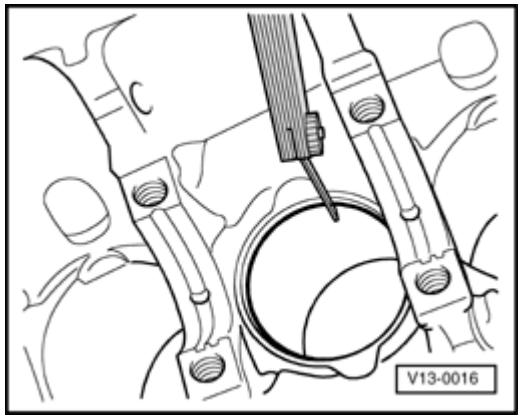


Fig. 1 Checking piston ring end gap

- Insert ring at right angle from top and slide down until approx. 15 mm (19/32 in.) from lower edge of cylinder. To insert, use piston without rings.

Piston ring	End gap, new mm (in.)	Wear limit mm (in.)
1. Compression ring	0.20-0.40 (0.0078-0.0157)	0.8 (0.0315)
2. Compression ring	0.20-0.40 (0.0078-0.0157)	0.8 (0.0315)
3. Oil scraper ring	0.25-0.50 (0.0098-0.0197)	0.8 (0.0315)

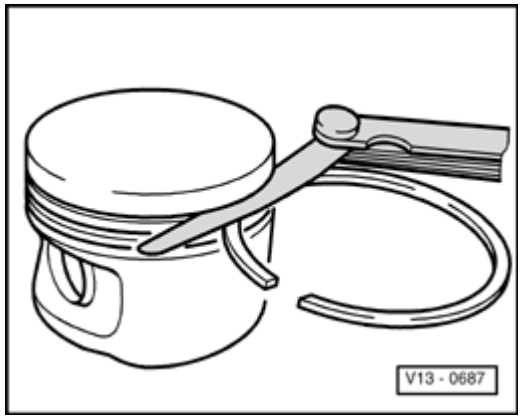


Fig. 2 Checking piston ring side clearance

- Before checking, clean ring groove.

Piston ring	Side clearance, new mm (in.)	Wear limit mm (in.)
1. Compression ring	0.06-0.09 (0.0023-0.0035)	0.20 (0.0078)

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2. Compression ring	0.05-0.08 (0.0019-0.0315)	0.20 (0.0078)
3. Oil scraper ring	0.03-0.06 (0.0011-0.0023)	0.15 (0.0059)

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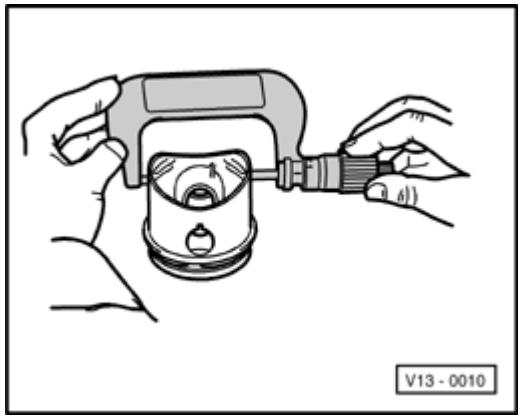


Fig. 3 Checking piston diameter

- Measure approx. 10 mm (3/8 in.) from bottom edge, at points offset by 90° from piston pin axis.

  Deviation from nominal size: max. 0.04 mm (0.0016 in.)

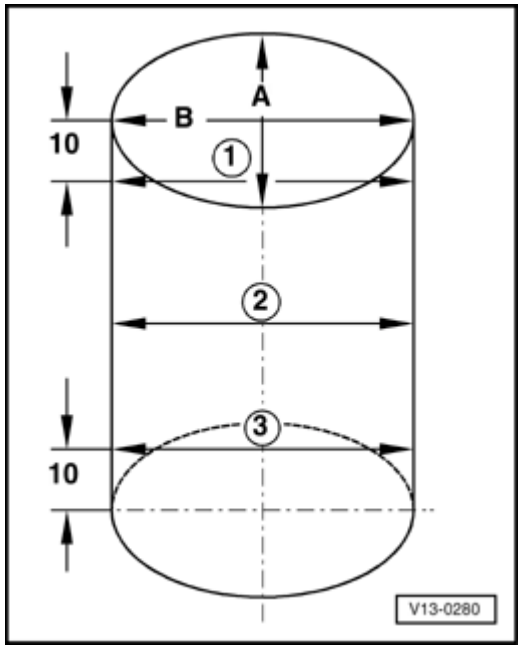


Fig. 4 Checking cylinder bore

Special tools and equipment

Inner bore gauge 50-100 mm (2-4 in.)

CAUTION!

DO NOT have the cylinder block mounted to the assembly stand while measuring the cylinder bores. The block is deformed by its own weight under these conditions and this stress will result in false measurements that are not accurate after the tension has been relieved.

- Measure at three locations diagonally in crosswise direction -A- and lengthwise direction -B-.

  Deviation from nominal size: max. 0.08 mm (0.0031 in.)

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Piston and cylinder bore dimensions

Reconditioning dimension	Piston diameter	Cylinder bore diameter
Basic dimension	80.975mm[1)] (3.1180 in.)	81.01 mm (3.1894 in.)
Repair step	81.475mm[1)] (3.2076 in.)	81.51 mm (3.2090 in.)

[1)] Measurement does not include graphite coating, thickness 0.02 mm (0.0008 in.). The graphite coating wears away.

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Valvetrain, servicing

Note:

- *Cylinder heads with small cracks between the valve seats that are less than 0.3 mm (0.012 in.) wide and/or between one valve seat and only the first 4 threads of the spark plug thread, can continue to be used without reduced service life.*

- *Always replace gaskets, seals and O-rings.*

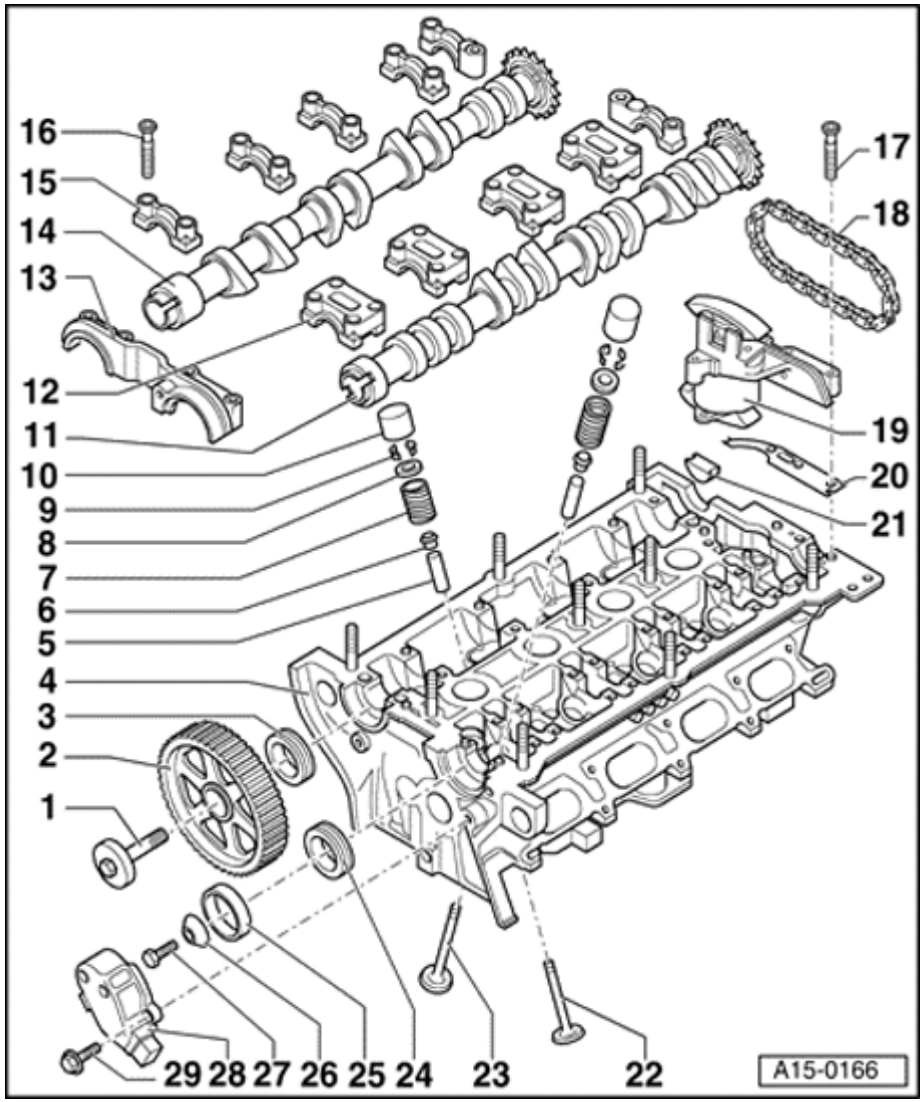
CAUTION!

- ***After installing the camshafts, the engine must not be started for approx. 30 minutes. The hydraulic valve lifters have to settle (otherwise valves will strike the pistons).***

- ***After installing the valvetrain and lifters, carefully rotate the crankshaft by hand at least 2 full revolutions before starting to be sure that valves do not strike the pistons.***

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15-33



1 - Bolt

- 65 Nm (48 ft lb)
- Use 3036 retainer when loosening or tightening

2 - Camshaft gear

- For exhaust camshaft
- Verify correct installation position: thin rib of camshaft gear points forward and TDC Cyl. 1 marking is visible from front ⇒ Page 15-45

3 - Oil seal

- For exhaust camshaft
- Always replace ⇒ Page 15-42

4 - Cylinder head

- Note ⇒ Page 15-32
- Check valve guides, reface valve seats ⇒ Page 15-66
- Bearing cap bushings must be installed in cylinder head
- Seal contact surfaces ⇒ Page 15-9 , Fig. ⇒ 3 and ⇒Fig. ⇒ 4
- Reface valve seats ⇒ Page 15-71

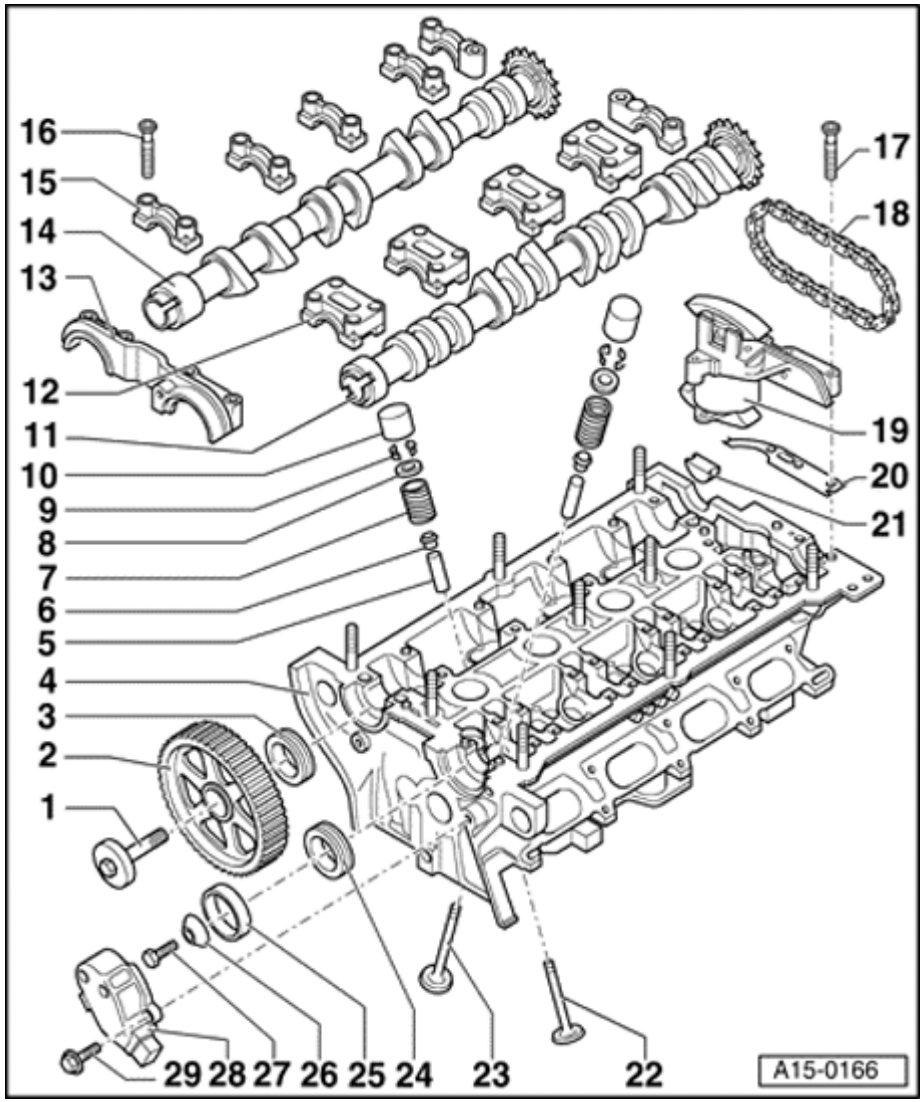
5 - Valve guide

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- Check ⇒ Page 15-66
- Replace ⇒ Page 15-67

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15-34



6 - Valve stem oil seal

- Replace ⇒ Page 15-62

7 - Valve spring

- Removing and installing ⇒ Page 15-62

8 - Valve spring retainer

9 - Valve keeper

10 - Hydraulic valve lifter

- Check ⇒ Page 15-60
- Removing and installing ⇒ Page 15-62
- Do not interchange
- When removed, store with contact surfaces facing down
- Before installing, check axial play in camshafts ⇒ Page 15-41
- Oil contact surface

11 - Intake camshaft

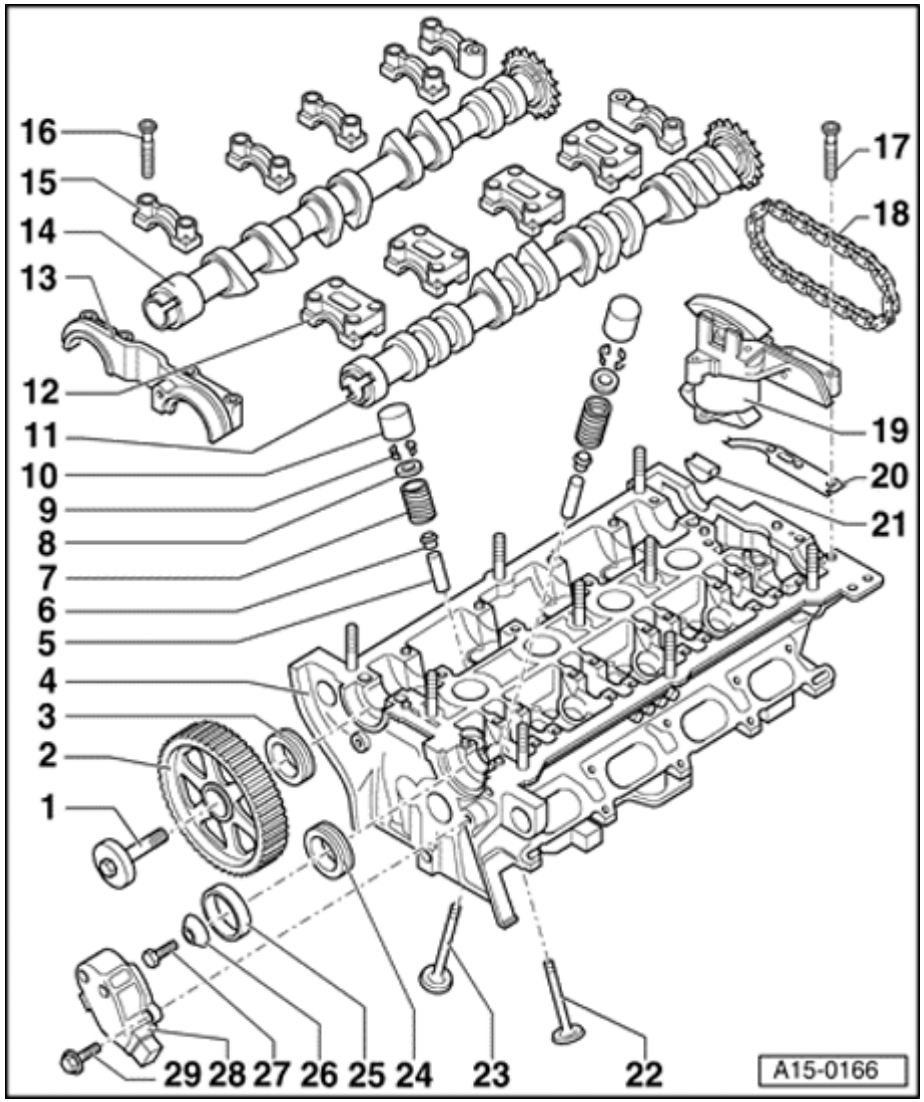
- Using Plastigage® check radial play (valve lifters removed)

  Wear range: 0.1 mm (0.004 in.)
- Max. run-out: 0.01 mm (0.0004 in.)
- Axial play, checking ⇒ Page 15-41

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- Camshafts, removing and installing ⇒ Page 15-50

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12 - Bearing cap for intake camshaft

- Must fit on bushing
- Bushings must be installed in cylinder head
- Verify correct installation position
- Installation sequence ⇒ Page 15-50

13 - Double bearing cap

- Must fit on bushing
- Bushings must be installed in cylinder head
- Before installing, seal contact surfaces lightly with sealant D 454 300 A2 ⇒ Page 15-57
- Sealing contact surfaces between double bearing cap and cylinder head ⇒ Page 15-9 , Fig. ⇒ 3

14 - Exhaust camshaft

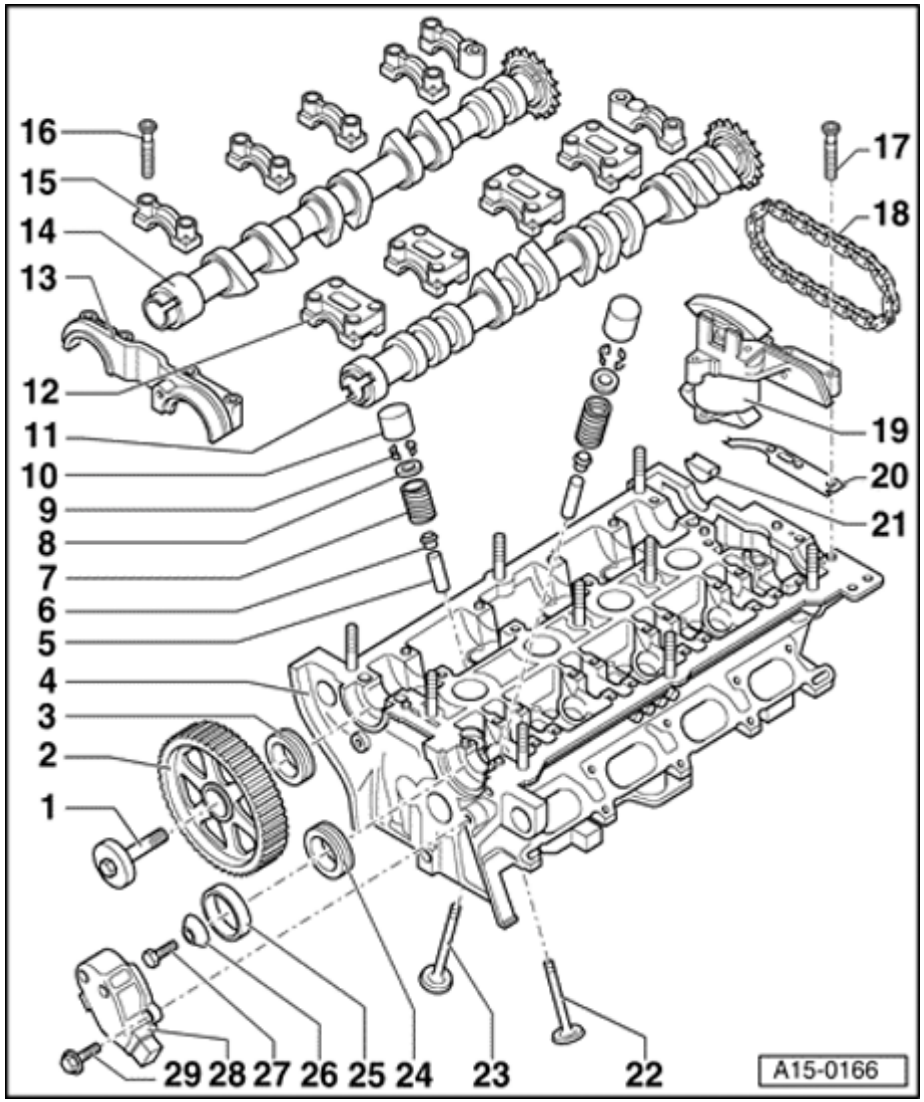
- Using Plastigage® check radial play (valve lifters removed)

  Wear range: 0.1 mm (0.004 in.)

- Max. run-out: 0.01 mm (0.0004 in.)
- Axial play, checking ⇒ Page 15-41
- Camshafts, removing and installing ⇒ Page 15-50

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15-36



15 - Bearing cap for exhaust camshaft

- Must fit on bushing
- Bushings must be installed in cylinder head
- Verify correct installation position
- Installation sequence ⇒ Page 15-50

16 - Bolt

- 10 Nm (7 ft lb)

17 - Bolt

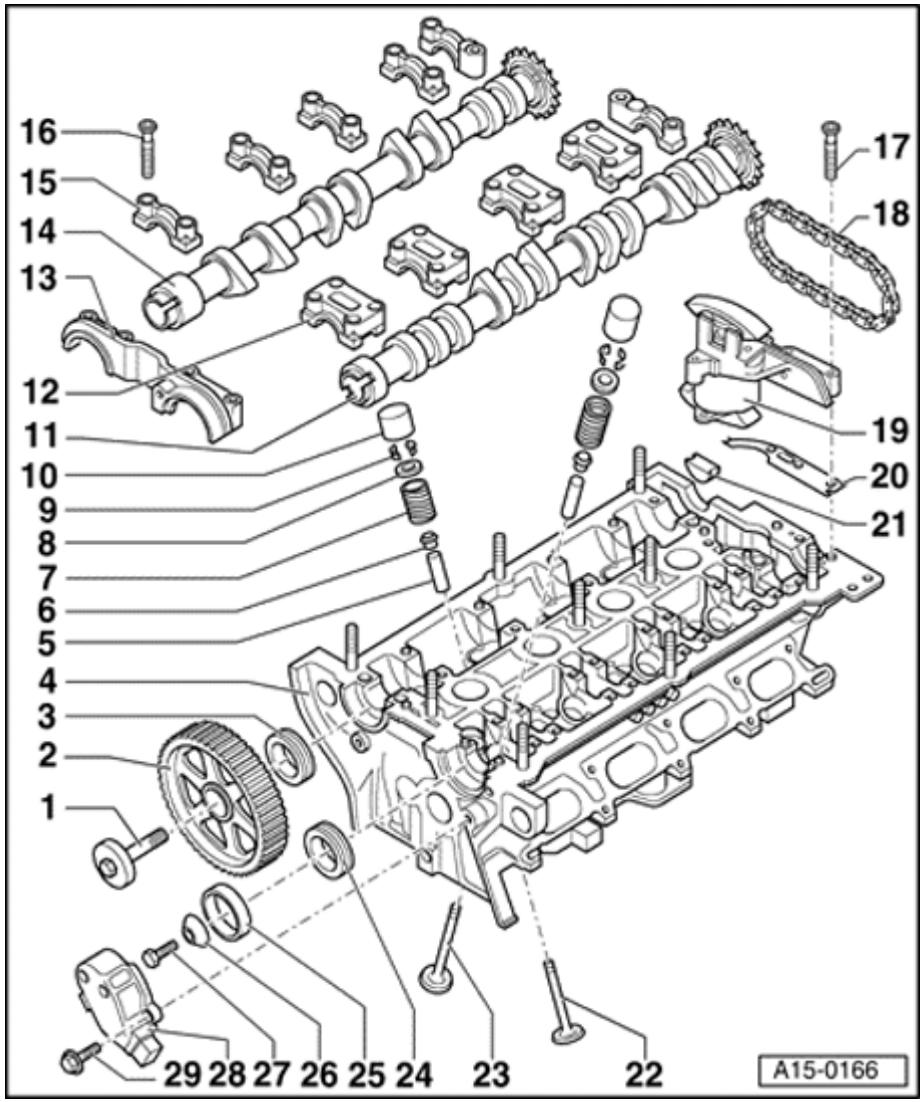
- 10 Nm (7 ft lb)

18 - Drive chain

- Check for wear
- Before removing, mark installed position ⇒ Page 15-52
- Camshafts, removing and installing ⇒ Page 15-50

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15-37



19 - Hydraulic chain tensioner

- Before removing, secure with VAG3366 chain tensioner bracket
- Removing and installing ⇒ Page 15-50
- Seal contact surfaces between hydraulic chain tensioner and cylinder head ⇒ Page 15-9 , Fig. ⇒ 4

20 - Rubber/metal seal

- Replacing ⇒ Page 15-53

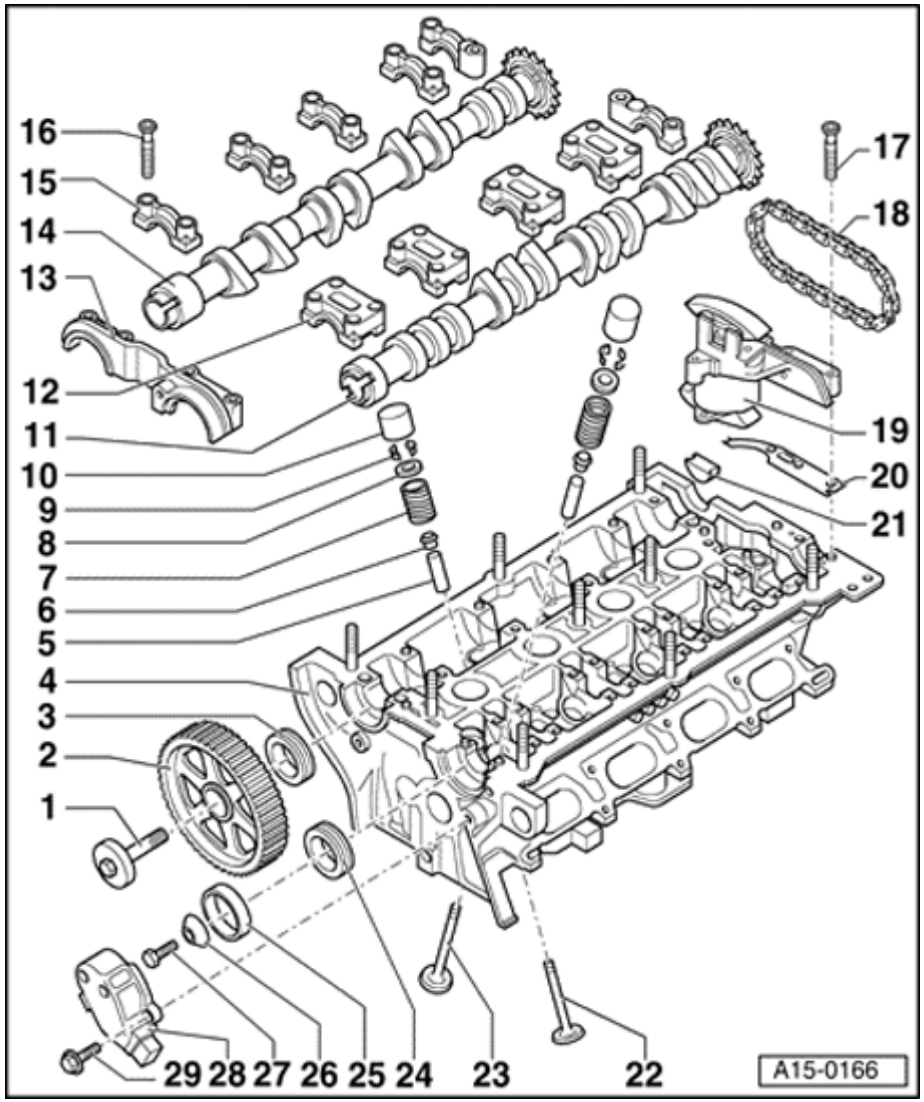
21 - Gasket

- Always replace

22 - Exhaust valve

- Sodium-filled
- Follow disposal procedures for sodium-filled valves ⇒ Page 15-40
- Do not reface by grinding, only hand lapping is permitted
- Valve dimensions ⇒ Page 15-39 , Fig. ⇒ 1
- Checking valve guides ⇒ Page 15-66
- Refacing valve seats ⇒ Page 15-71

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23 - Intake valve

- Do not reface by grinding; only hand lapping is allowed
- Valve dimensions ⇒ Page 15-39 , Fig. ⇒ 1
- Checking valve guides ⇒ Page 15-66
- Refacing valve seats ⇒ Page 15-71

24 - Oil seal

- For intake camshaft
- Replacing ⇒ Page 15-42

25 - Shutter wheel for Camshaft Position (CMP) sensor -G40-

- Note position: insert lug in camshaft notch

26 - Washer

- Conical
- Note position

27 - Bolt

- 25 Nm (18 ft lb)

28 - Camshaft Position (CMP) sensor -G40- housing

29 - Bolt

- 10 Nm (7 ft lb)

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15-39

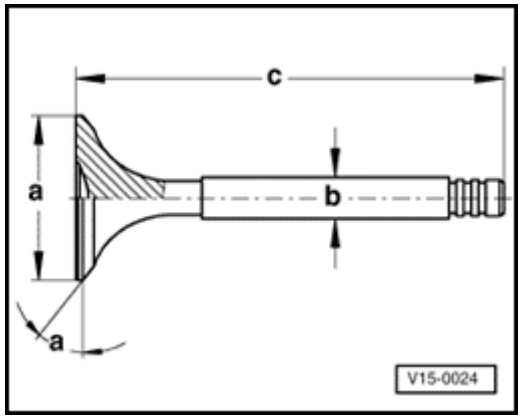


Fig. 1 Valve dimensions

WARNING!

- ***Valves must not be refaced by cutting or grinding.***
- ***Only hand lapping is permitted.***

Dimension		Intake valve	Exhaust valve
Diameter -a-	mm (in.)	26.80-27.00(1.055-1.063)	29.80-30.00(1.173-1.181)
Diameter -b-	mm (in.)	5.95-5.97 (0.2339-0.2350)	5.94-5.95 (0.2339-0.2343)
Length -c-	mm (in.)	104.84-105.34 (4.127-4.147)	103.64-104.14 (4.080-4.099)
Angle -a-	∠ °	45 °	45 °

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15-40

WARNING!

- ***Sodium-filled exhaust valves must not be scrapped without first being properly treated.***
- ***The valves must be cut open using a hacksaw, by hand, between the valve head and the middle of the stem.***
- ***The valves must not come into any contact with water while being cut.***
- ***After cutting open the valves, throw not more than 10 at a time into a bucket of water and step back. A sudden chemical reaction will occur during which the sodium filling is consumed.***
- ***Valves that have been treated in this way can be disposed of as normal waste.***

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15-41

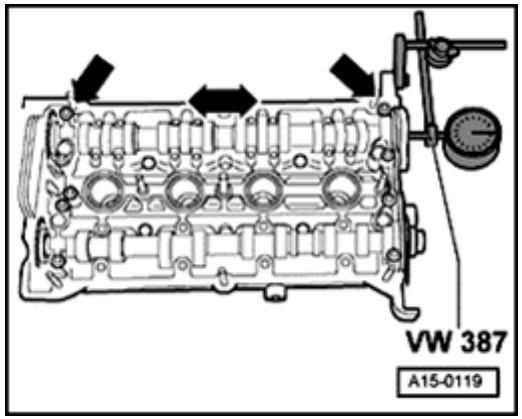
Camshafts axial play, checking

Special tools and equipment

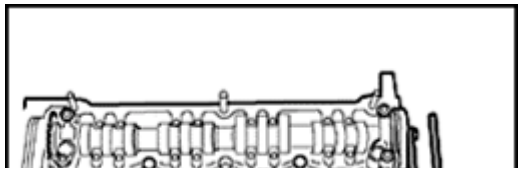
- VW387 dial gauge holder
- Dial indicator

Measure with installed bearing cap on chain sprocket side and double bearing cap on camshaft side with valve lifters removed.

- Secure VW387 dial gauge holder with dial indicator to cylinder head.



➢ Intake camshaft



➢ Exhaust camshaft

Wear limit for intake and exhaust camshafts:

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Axial play max.: 0.20 mm (0.008 in.)

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15-42

Oil seals for camshafts, replacing

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

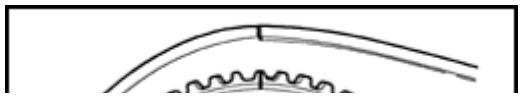
Special tools and equipment

- 2085 seal puller
- 3241 seal installer
- 3036 retainer

Replacing exhaust camshaft oil seal

Removing

- Remove ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .
- Remove engine covers.
- Remove upper toothed belt cover ⇒ Page 13-29 .



- Turn crankshaft at central bolt of toothed belt gear in direction of

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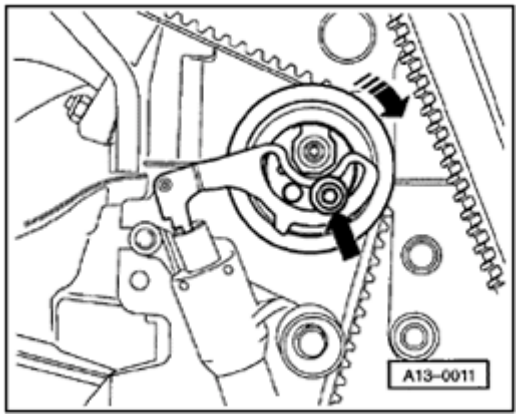
engine rotation to TDC Cyl. 1 marking (arrows).

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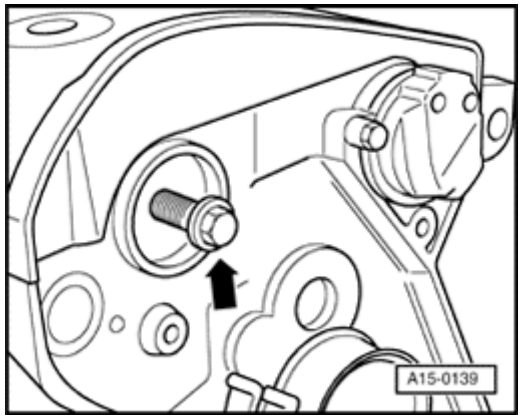
15-43

CAUTION!

Before removing toothed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt.



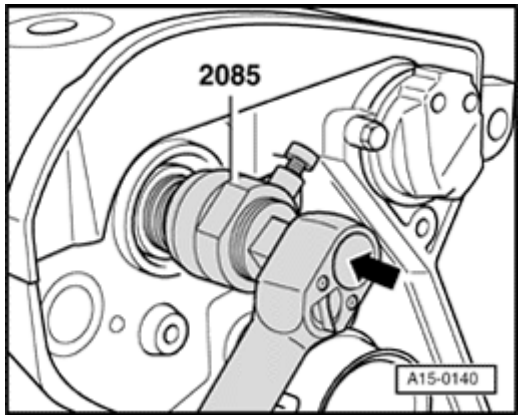
- Loosen tensioner (arrows) and lift toothed belt from camshaft gear.
- Use 3036 Retainer to loosen camshaft gear.
- Remove camshaft gear.



- Thread camshaft gear retaining bolt (arrow) into camshaft by hand until stop to guide 2085 seal puller.
- Unthread inner part of 2085 seal puller two turns (approx. 3 mm or 0.12 in.) and secure using knurled bolt.

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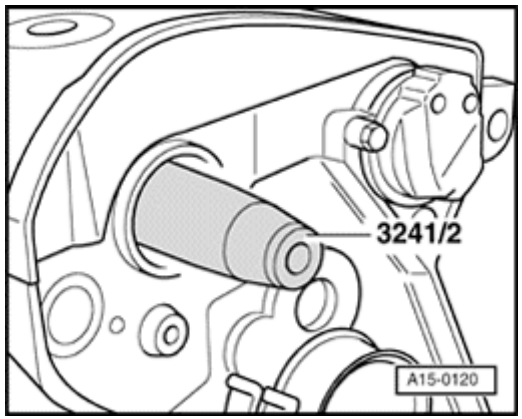
15-44



- Grease threaded head of 2085 seal puller, attach and with forced pressure screw into oil seal as far as possible.
- Loosen knurled bolt and turn inner part against crankshaft until oil seal is removed.
- Clamp 2085 seal puller in vise at flat surfaces. Remove oil seal using pliers.

Installing

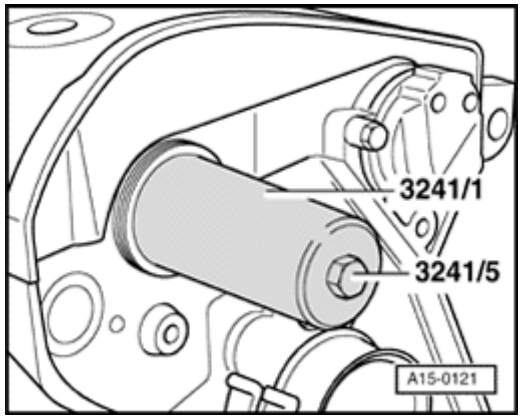
- Lightly oil lip of oil seal.



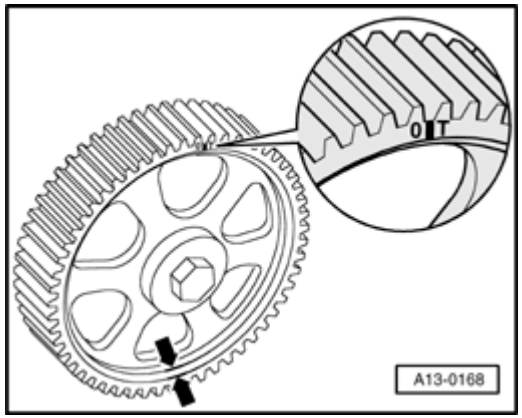
- Place 3241/2 guide sleeve on end of camshaft.
- Slide oil seal over guide sleeve.

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15-45



- Using 3241/5 camshaft fitting tool and 3241/1 pressure sleeve, press oil seal in to stop.

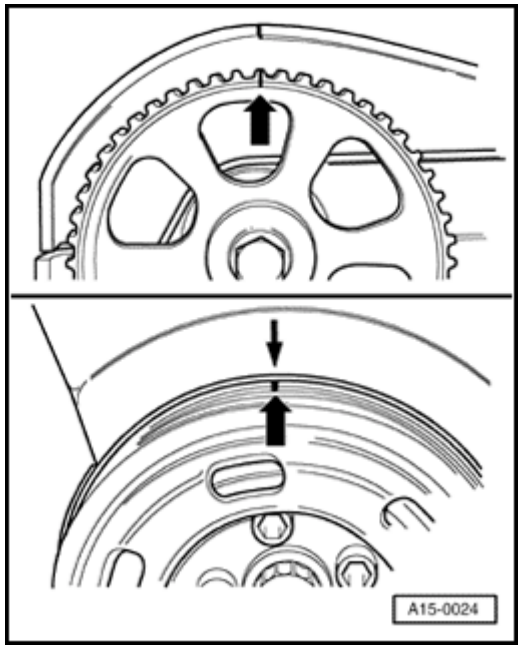


- Install camshaft gear.

  Note position: thin rib of camshaft gear points outward (arrows) and TDC Cyl. 1 marking is visible from the front.

- Using 3036 retainer, install camshaft gear retaining bolt.

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- Align marking on camshaft gear with marking on cylinder head cover.
- Align marking on vibration damper to that on lower toothed belt cover.

Note:

While turning camshaft, valves could hit pistons that are at TDC. Verify that no piston is at TDC. Valves and/or pistons may be damaged.

- Install toothed belt (adjust valve timing) ⇒ Page 13-32 .

Note:

Follow all procedures for removing and installing toothed belt ⇒ Page 13-29 .

- Install ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .

Note:

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

Tightening torques

Component	Tightening torques
Camshaft gear to camshaft	65 Nm (48 ft lb)
Ribbed belt tensioner to mounting bracket	25 Nm (18 ft lb)

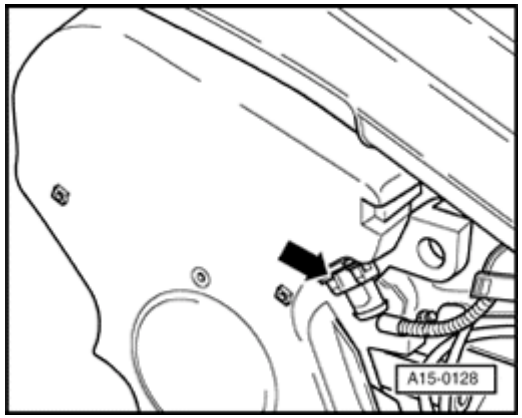
cardiagn.com

15-47

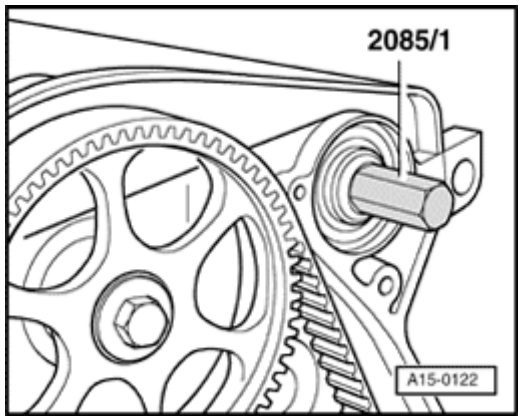
Replacing intake camshaft oil seal

Removing

- Remove ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .



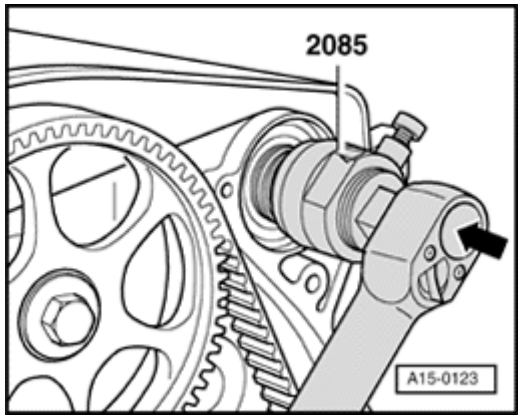
- Disconnect harness connector from Camshaft Position (CMP) sensor -G40-.
- Remove upper toothed belt cover ⇒ Page 13-29 .
- Remove housing for Camshaft Position (CMP) sensor -G40-.
- Remove shutter wheel and washer for Camshaft Position (CMP) sensor -G40-.



- Insert 2085/1 adapter into camshaft by hand until stop to guide seal puller.
- Unscrew inner part of 2085 seal puller two turns (approx. 3 mm or 0.12 in.) and secure using knurled bolt.

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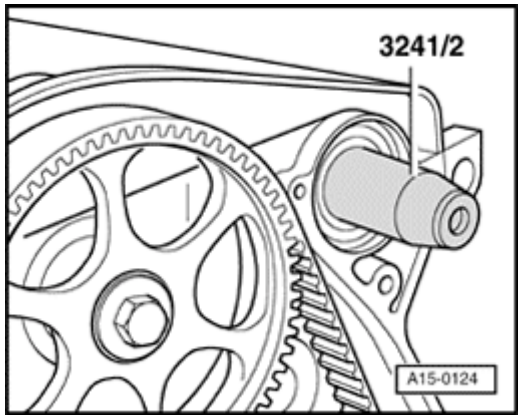
15-48



- Grease threaded head of 2085 seal puller, attach and with forced pressure screw into oil seal as far as possible.
- Loosen knurled bolt and turn inner part against crankshaft until oil seal is removed.

Installing

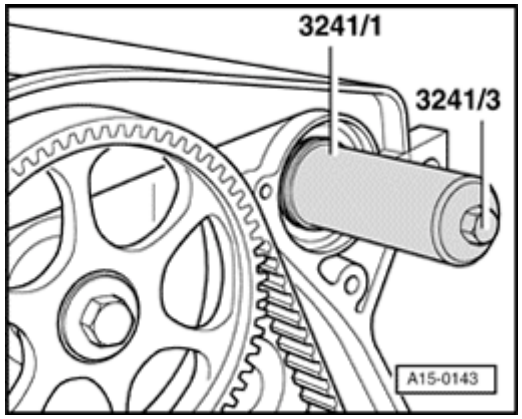
- Lightly oil lip of oil seal.



- Place 3241/2 guide sleeve on end of camshaft.
- Slide oil seal over guide sleeve.

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15-49



- Using 3241/3 camshaft fitting tool and 3241/1 pressure sleeve, press oil seal in to stop.
- Install Camshaft Position (CMP) sensor -G40- ⇒ Page 15-38 .
- Install upper toothed belt cover.
- Install ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .

Note:

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

Tightening torques

Component	Tightening torques
Shutter wheel for Camshaft Position (CMP) sensor -G40- to camshaft	25 Nm (18 ft lb)
Housing for Camshaft Position (CMP) sensor -G40- to cylinder head	10 Nm (7 ft lb)

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15-50

Camshafts and hydraulic chain tensioner, removing and installing

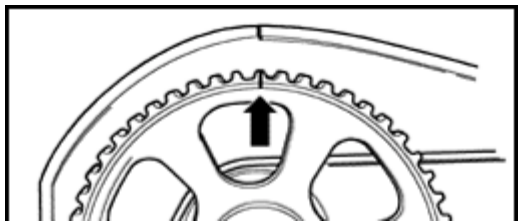
- Cylinder head installed
- Lock carrier in service position ⇒ Page 13-1

Special tools and equipment

- 3036 retainer
- 3366 bracket-tensioner

Removing

- Remove ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .
- Remove engine covers.
- Remove upper toothed belt cover ⇒ Page 13-29 .



- Turn crankshaft at central bolt of toothed belt gear in direction of engine rotation to TDC Cyl. 1 marking (arrows).
- Remove cylinder head cover ⇒ Page 15-17 .

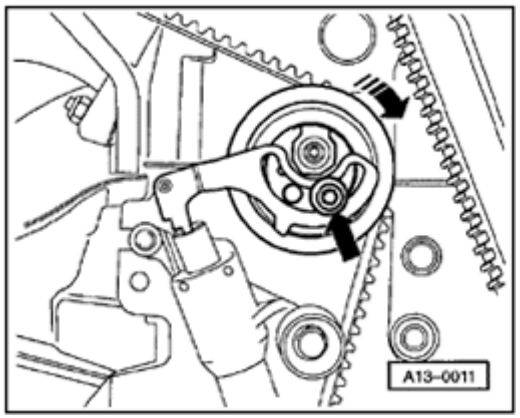
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CAUTION!

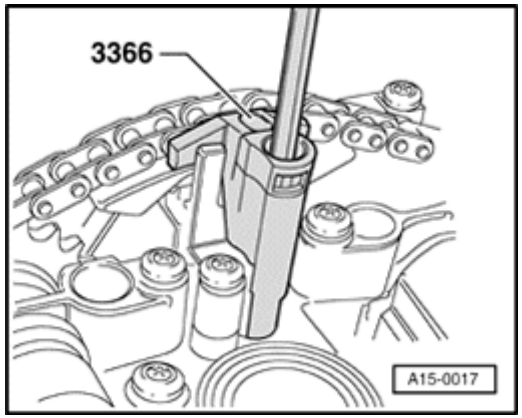
Before removing toothed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt.

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15-51



- Loosen tensioner (arrows) and remove toothed belt from camshaft gear.
- Use 3036 retainer to loosen camshaft gear.
- Remove camshaft gear.
- Remove housing for Camshaft Position (CMP) sensor -G40-.
- Remove shutter wheel for Camshaft Position (CMP) sensor -G40-.



- Secure hydraulic chain tensioner using 3366 bracket-tensioner.

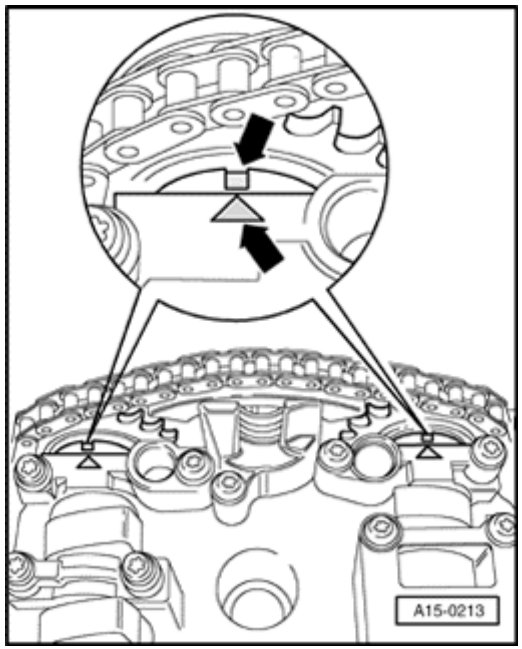
CAUTION!

If over-tightened, the chain tensioner will be damaged.

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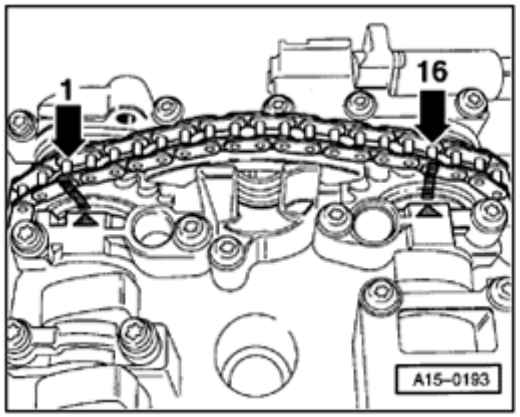
15-52

- Verify that camshafts are at TDC Cyl 1.



Both camshaft markings must align with arrows on bearing caps.

- Clean drive chain and camshaft chain gears opposite both arrows on bearing caps. Mark installed position using paint.



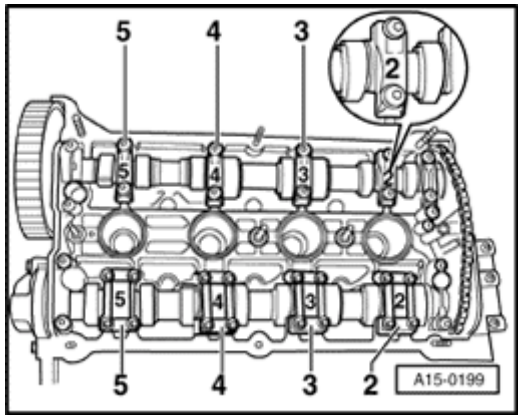
- The distance between the two arrows/paint marks is equivalent to 16 drive chain rollers.
- The notch on the exhaust camshaft is slightly offset inward toward drive chain roller (arrow-1-).

Note:

Do not mark chain using punch, filing a notch or similar procedures.

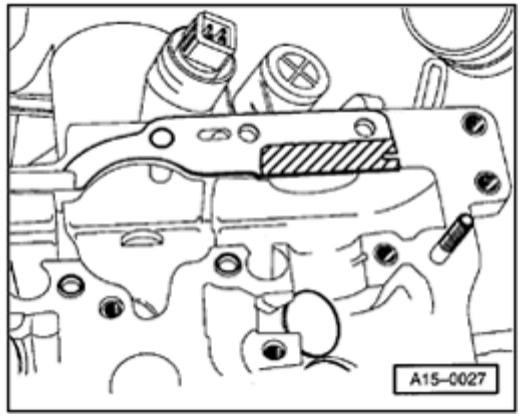
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15-53



- First remove bearing caps -3- and -5- from intake and exhaust camshafts.
- Remove double bearing cap.
- Remove both bearing caps from chain gears on intake and exhaust camshafts.
- Remove hydraulic chain tensioner retaining bolts.
- Alternating in diagonal sequence, loosen bearing caps -2- and -4- of intake and exhaust camshafts and remove.
- Remove intake and exhaust camshafts with hydraulic chain tensioner.

Installing



- Replace rubber/metal chain tensioner gasket and spread sealant D 454 300 A2 on hatched surface.

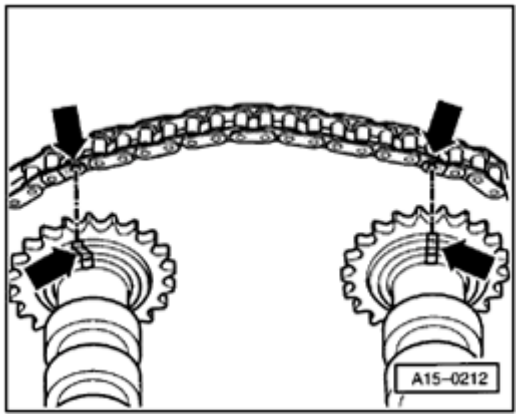
CAUTION!

Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

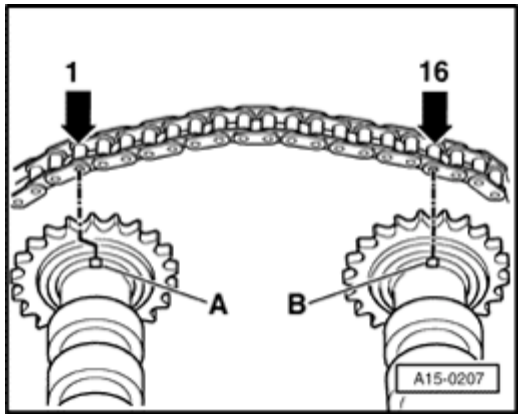
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15-54

Install drive chain on camshaft chain gear as follows:



- When installing old drive chain, line up paint markings (arrows).



- ♦ If a new drive chain is installed, distance between notches -A- and -B- on camshafts must equal the distance between 16 drive chain rollers. Illustration shows where first and sixteenth drive chain rollers must be installed on chain gears.
- ♦ Notch -A- is slightly offset inward toward drive chain roller -1-.
- Slide in hydraulic chain tensioner between drive chain.

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15-55

- Install camshafts with drive chain and hydraulic chain tensioner into cylinder head.

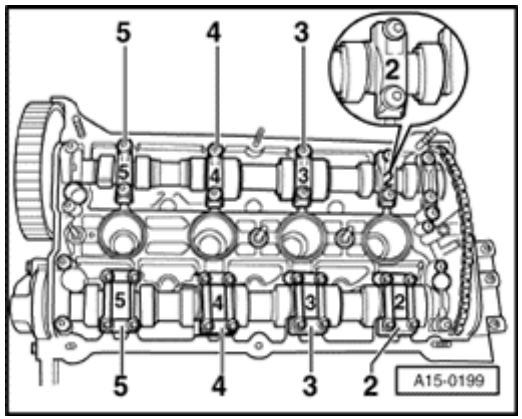
- Oil camshaft contact surfaces.

Note:

- *Alignment bushings for bearing caps and hydraulic chain tensioner must be installed in cylinder head.*

- *When installing bearing caps, verify marking on cap is readable from intake side of cylinder head.*

- Tighten hydraulic chain tensioner (pay attention to alignment bushings).

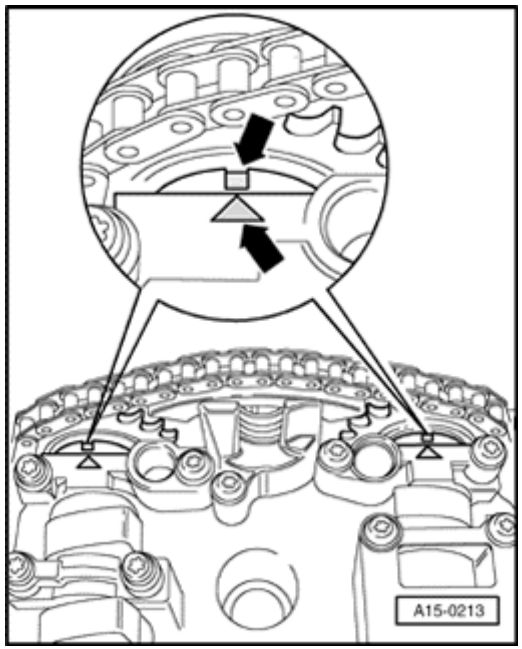


- Tighten bearing caps -2- and -4- of intake and exhaust camshafts in alternating diagonal sequence (pay attention to alignment bushings).
- Install both bearing caps on chain sprockets of intake and exhaust camshafts.

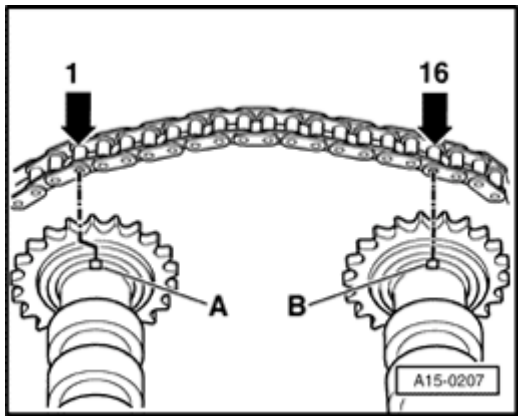
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15-56

- Verify correct position of both camshafts.



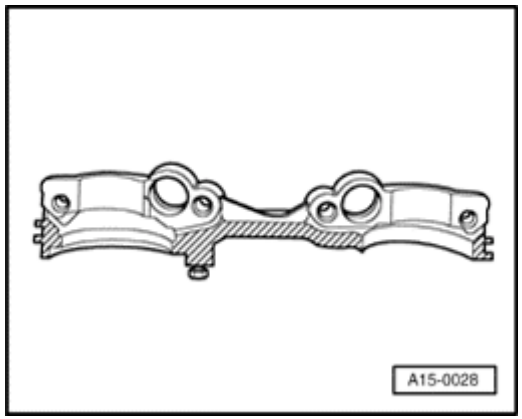
- Both camshaft markings must align with arrows on bearing caps (arrows).



- The distance between the two arrows/paint markings is equivalent to 16 drive chain rollers.
- The notch on exhaust camshaft is slightly offset inward toward drive chain roller -1-.

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- Remove 3366 bracket-tensioner.

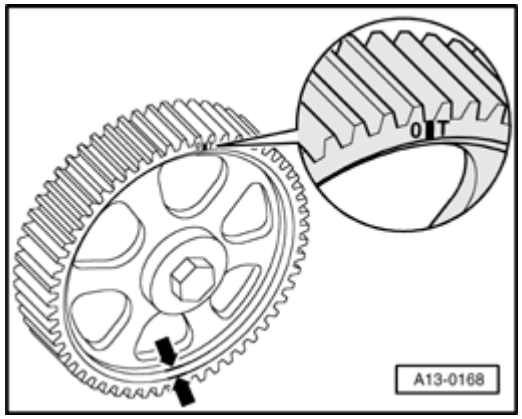


- Lightly coat hatched surface of double bearing cap with sealant D 454 300 A2 and install bearing cap (pay attention to alignment bushings).

CAUTION!

Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

- Install remaining bearing caps (pay attention to alignment bushings).
- Replace oil seals for intake and exhaust camshafts ⇒ Page 15-42 .



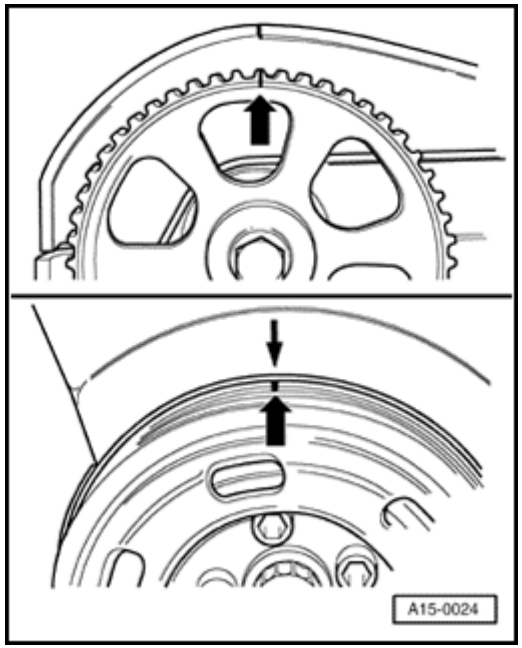
- Install camshaft gear.

  Note position: thin rib of camshaft gear points outward (arrows) and TDC Cyl. 1 marking is visible from the front.

- Using 3036 retainer, install camshaft gear retaining bolt.
- Install Camshaft Position (CMP) sensor -G40- ⇒ Page 15-38 .
- Install cylinder head cover ⇒ Page 15-18 .

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15-58



- Align marking on camshaft gear with marking on cylinder head cover.
- Align marking on vibration damper with marking on lower toothed belt cover.

Note:

When turning camshaft, crankshaft must not be at TDC Cyl. 1 for any cylinder. Valves and/or pistons may be damaged.

- Install toothed belt (adjust valve timing) ⇒ Page 13-32 .

Note:

Follow all procedures for removing and installing toothed belt ⇒ Page 13-29 .

CAUTION!

- ***After installing the camshafts, the engine must not be started for approx. 30 minutes. The hydraulic valve lifters have to settle (otherwise valves will strike the pistons).***
- ***After installing the valvetrain and lifters, carefully rotate the crankshaft by hand at least 2 full revolutions before starting to be sure that valves do not strike the pistons.***

- Install ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .

Note:

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

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15-59

Tightening torques

Component	Tightening torques
Bearing cap to cylinder head	10 Nm (7 ft lb)
Hydraulic chain tensioner to cylinder head	10 Nm (7 ft lb)
Shutter wheel for Camshaft Position (CMP) sensor -G40- to camshaft	25 Nm (18 ft lb)
Housing for Camshaft Position (CMP) sensor -G40- to cylinder head	10 Nm (7 ft lb)
Ribbed belt tensioner to mounting bracket	25 Nm (18 ft lb)
Camshaft gear to camshaft	65 Nm (48 ft lb)

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15-60

Hydraulic valve lifters, checking

Special tools and equipment

- Feeler gauge
- Wood or plastic wedge

Note:

- *Hydraulic valve lifters cannot be serviced.*
- *Irregular valve noise when starting engine is normal.*

- Start engine and let run until coolant temperature reaches at least 80 ° C (176 ° F).
- Increase RPM to 2500 for about 2 minutes; if necessary test drive vehicle.

Note:

If irregular valve noises disappear but then reappear during drive, replace oil retaining valve. Oil retaining valve is located in oil filter bracket ⇒ *Page 17-6* .

If hydraulic valve lifters are still loud, locate faulty

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valve lifter as follows:

- Remove cylinder head cover ⇒ Page 15-17 .
- Turn crankshaft until cams of valve lifters to be tested point up.

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15-61

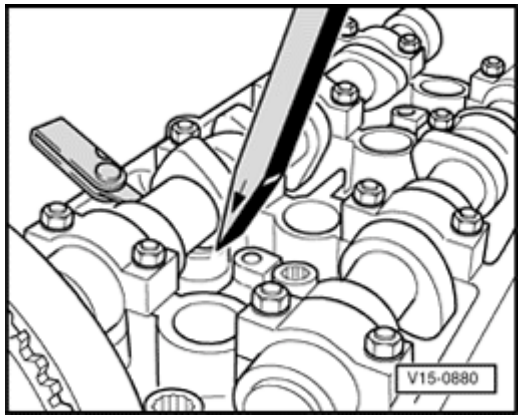
Vehicles with manual transmission

- Switch ignition off, shift into fourth gear and push vehicle forward.

Vehicles with automatic transmission

- Remove noise insulation panel and turn central bolt of toothed belt gear for crankshaft in clockwise direction.

- Determine play between cams and valve lifters.



- Push down on valve lifters using wood or plastic wedge. If 0.20 mm (0.008 in.) feeler gauge can be inserted between camshaft and valve lifter, replace valve lifter.

  Valve lifter, replacing ⇒ Page 15-50 .

CAUTION!

- ***After installing the camshafts, the engine must not be started for approx. 30 minutes. The hydraulic valve lifters have to settle (otherwise valves will strike the pistons).***
- ***After installing the valvetrain and lifters, carefully rotate the crankshaft by hand at least 2 full revolutions before starting to be sure that valves do not strike the pistons.***

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15-62

Valve stem oil seals, replacing

- Cylinder head installed

Special tools and equipment

- VW653/3 pressure hose
- 3122B spark plug removal tool
- 3362 valve spring tool and 3362/1 pressure piece
- 3364 valve seat tool
- 3365 valve stem seat fitting tool

Removing

- Remove camshafts and hydraulic chain tensioner ⇒ Page 15-50 .
- Remove valve lifters and lay aside with camshaft contact surface facing down. Be careful not to interchange valve lifters.
- Using 3122B spark plug removal tool, remove all

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spark plugs.

- Move piston for individual cylinder to Bottom Dead Center (BDC) position.

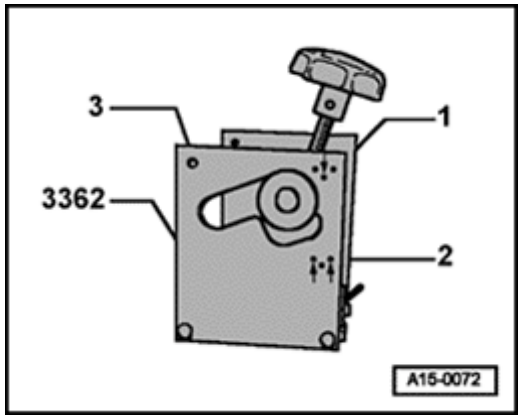
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15-63

- Thread VW653/3 pressure hose into spark plug hole.

Note:

Lightly tap valve spring retainer to loosen stuck valve keepers.

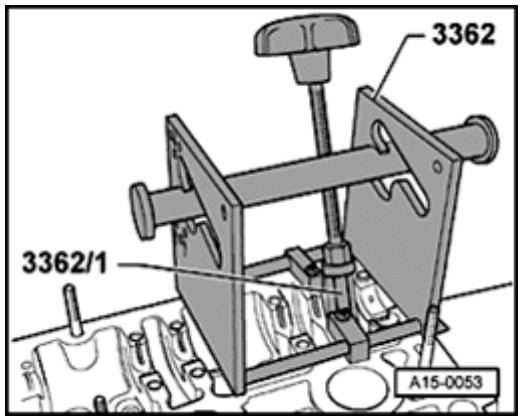


Intake and exhaust valves have different installation angles in cylinder head. 3362 valve spring tool can be used in two different positions:

1 - Top position for the center intake valve

2 - Lower position for both outer intake valves and both exhaust valves

3 - Threaded bores with M6 x 25 retaining bolts on the left and right are used to secure the lower bracket to cylinder head

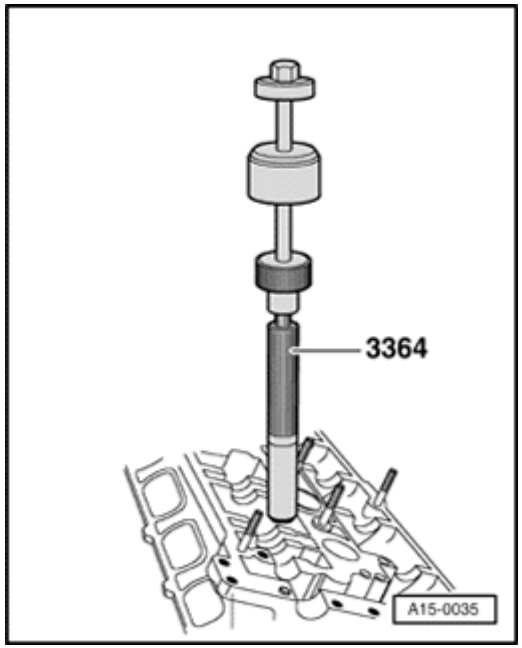


- Using retaining bolts bolted into tool, secure 3362 valve spring tool to cylinder head.
- Adjust tool to correct position for corresponding valve.
- Attach pressure hose to compressor.

  Minimum pressure: 6 bar (87 psi)
- Using threaded spindle and 3362/1 pressure piece, press valve springs downward and remove.

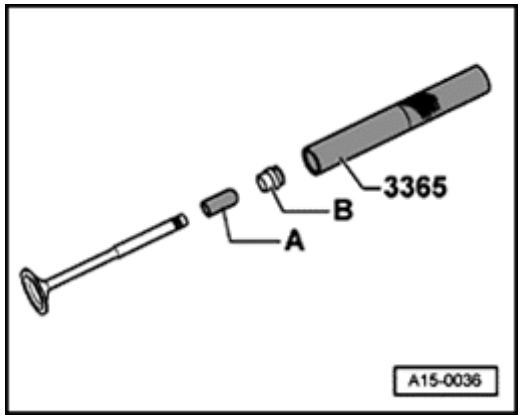
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15-64



- Using 3364 valve seat tool, remove valve stem oil seals.

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Installing

- Place plastic sleeve -A- on valve stem to prevent damage to new valve stem oil seals.
- Lightly oil lip of valve stem oil seal -B-.
- Insert valve stem oil seal into 3365 valve stem seal fitting tool and carefully slide onto valve guide.
- Remove plastic sleeve.
- Install camshafts ⇒ Page 15-53 .

CAUTION!

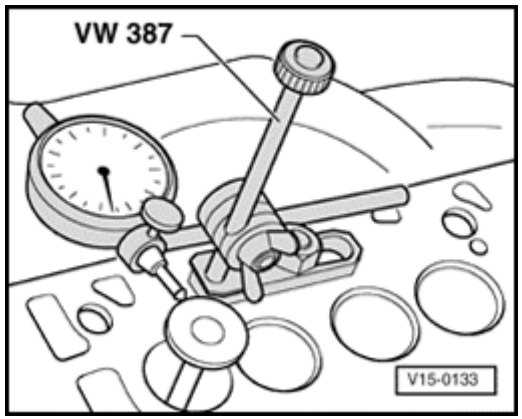
- ***After installing the camshafts, the engine must not be started for approx. 30 minutes. The hydraulic valve lifters have to settle (otherwise valves will strike the pistons).***
- ***After installing the valvetrain and lifters, carefully rotate the crankshaft by hand at least 2 full revolutions before starting to be sure that valves do not strike the pistons.***

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Valve guides, checking

Special tools and equipment

- VW387 dial gauge holder
- Dial indicator



- Install valve into guide so end of valve stem is flush with end of guide.

CAUTION!

Due to differences in valve stem diameter, make sure that only intake valves are used to check intake guides, and only exhaust valves are used to check exhaust guides.

- Measure side play.

Wear limit

Intake valve guide	Exhaust valve guide
0.80 mm (0.031 in.)	0.80 mm (0.031 in.)

Note:

- *If wear limit is exceeded, remeasure using new valves. If wear limit is still exceeded, replace valve guide.*
- *If valve is replaced during repair, use new valve for measurement.*

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Valve guides, replacing

Special tools and equipment

- VW411 punch
- 3120 reamer (7mm) and cutting fluid
- 3360 driver
- 3361 press-in pad

Removing

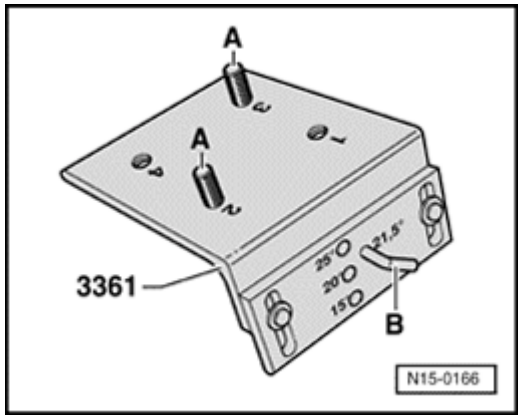
- Clean cylinder head and check.

Note:

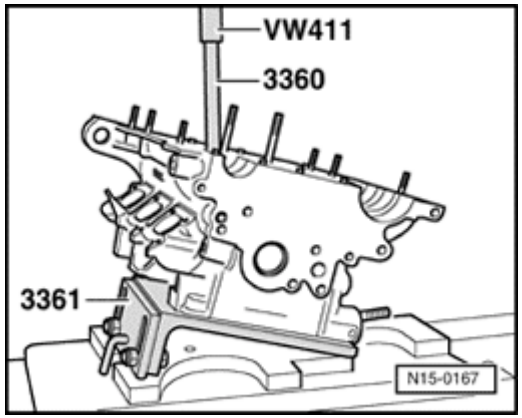
Cylinder heads with valve seats that cannot be refaced or cylinder heads that have been resurfaced to the minimum dimension are not suited for valve guide replacement.

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- Insert 3361 press-in pad as follows:
- Install mounting pins for cylinder head bolt holes -A- into threaded hole position -2- and -3-.
- Install pin -B- into relevant hole for valve angle.
  - Outer intake valves: 21.5°
  - Center intake valve: 15°
  - Exhaust valves: 20°



- Using 3360 driver, press out worn valve guides as follows:

  Valve guide without collar: from camshaft side

  Valve guide with collar (replacement valve guide): from combustion chamber side

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Installing

- Using 3360 driver, press new, oiled valve guides from camshaft side to collar into cold cylinder head.

Note:

After valve guide with collar is seated, insertion pressure may not exceed 10kN (2248 lbs = approx 1.0t), as collar may break off.

- Using 3363 reamer -7 mm, ream valve guide. Use cutting fluid.

- Reface valve seats ⇒ Page 15-71 .

- Replace valve stem oil seals ⇒ Page 15-62 .

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WARNING!

- ***Valves must not be refaced by cutting or grinding.***
- ***Only hand lapping is permitted.***

WARNING!

- ***Sodium-filled exhaust valves must not be scrapped without first being properly treated.***
- ***The valves must be cut open using a hacksaw, by hand, between the valve head and the middle of the stem.***
- ***The valves must not come into any contact with water while being cut.***
- ***After cutting open the valves, throw not more than 10 at a time into a bucket of water and step back. A sudden chemical reaction will occur during which the sodium filling is consumed.***
- ***Valves that have been treated in this way can be disposed of as normal waste.***

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Valve seats, refacing

Note:

If a perfect contact pattern isn't obtained after hand lapping valves, reface valve seats.

Special tools and equipment

- Depth gauge
- Valve seat refacing tool

Note:

- *When servicing engines with low compression due to leaking valves, it is not sufficient to reface or replace the valve seats and valves. It is especially important to check valve guides for signs of wear on high-mileage engines* ⇒ *Page 15-66* .
- *Only reface valve seats enough until a perfect contact pattern is obtained.*
- *Before refacing, determine maximum refacing dimension.*
- *If refaced dimension is exceeded, hydraulic*

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valve lifter function is no longer guaranteed and cylinder head must be replaced.

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Determining maximum allowable refacing dimension

- Insert valve and press tightly against valve seat.

Note:

If valve is replaced during repair, use new valve for measurement.

- Measure distance between end of valve stem and camshaft center axis (camshaft center axis is located at the level of cylinder head upper edge).

- Determine maximum allowable refaced dimension using distance measured and minimum dimension.

Minimum dimensions		
Outer intake valves	Center intake valve	Exhaust valves
34.0 mm (1.338 in.)	33.7 mm (1.236 in.)	34.4 mm (1.354 in.)

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Distance measured minus minimum dimension = maximum allowable refacing dimension.

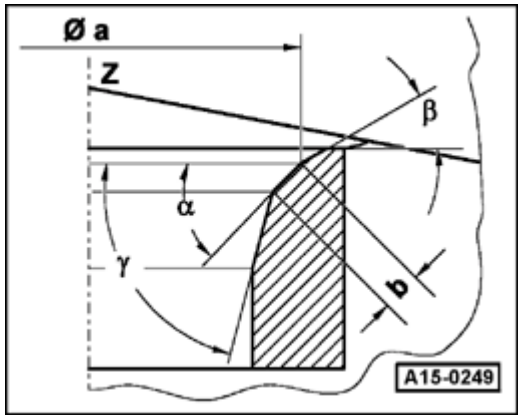
Example for outer intake valve:		
	Distance measured	34.4 mm (1.354 in.)
-	Minimum dimension	- 34.0 mm (1.338 in.)
=	maximum allowable refacing dimension	= 0.4 mm (0.016 in.)

Note:

If the maximum allowed refaced dimension is 0 mm or less than 0 mm, repeat measurement using new valve. If measurement is still 0 mm or less than 0 mm , replace cylinder head.

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Valve seats, refacing

Intake valve seat		
Diameter -a-	=	26.2 mm (1.031 in.)
Dimension -b-	=	1.5-1.8 mm (0.059-0.070 in.)
Z	=	Cylinder head lower edge
Angle -a-	=	45° valve seat angle
Angle -b-	=	30° upper correction angle
Angle -g-	=	60° lower correction angle

Exhaust valve seat		
Diameter -a-	=	29.0 mm (1.142 in.)
Dimension -b-	=	approx. 1.8 mm (0.070 in.)
Z	=	Cylinder head lower edge
Angle -a-	=	45° valve seat angle
Angle -b-	=	30° upper correction angle
Angle -g-	=	60° lower correction angle

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17-1

Lubrication system components, removing and installing

WARNING!

- ***Do not re-use any fasteners that are worn or deformed in normal use.***

- ***Some fasteners are designed to be used only once, and are unreliable and may fail if used a second time. This includes, but is not limited to, nuts, bolts, washers, circlips and cotter pins. Always follow the recommendations in this manual-replace these fasteners with new parts where indicated, and any other time it is deemed necessary by inspection.***

CAUTION!

- ***If large quantities of metal particles or other deposits (caused, for example, by partial seizure of the crankshaft or connecting rod bearings) are found in the engine oil, the oil passages must be cleaned thoroughly and the oil cooler replaced in order to prevent further damage from re-occurring.***

- ***Do not overfill with oil past the MAX mark on***

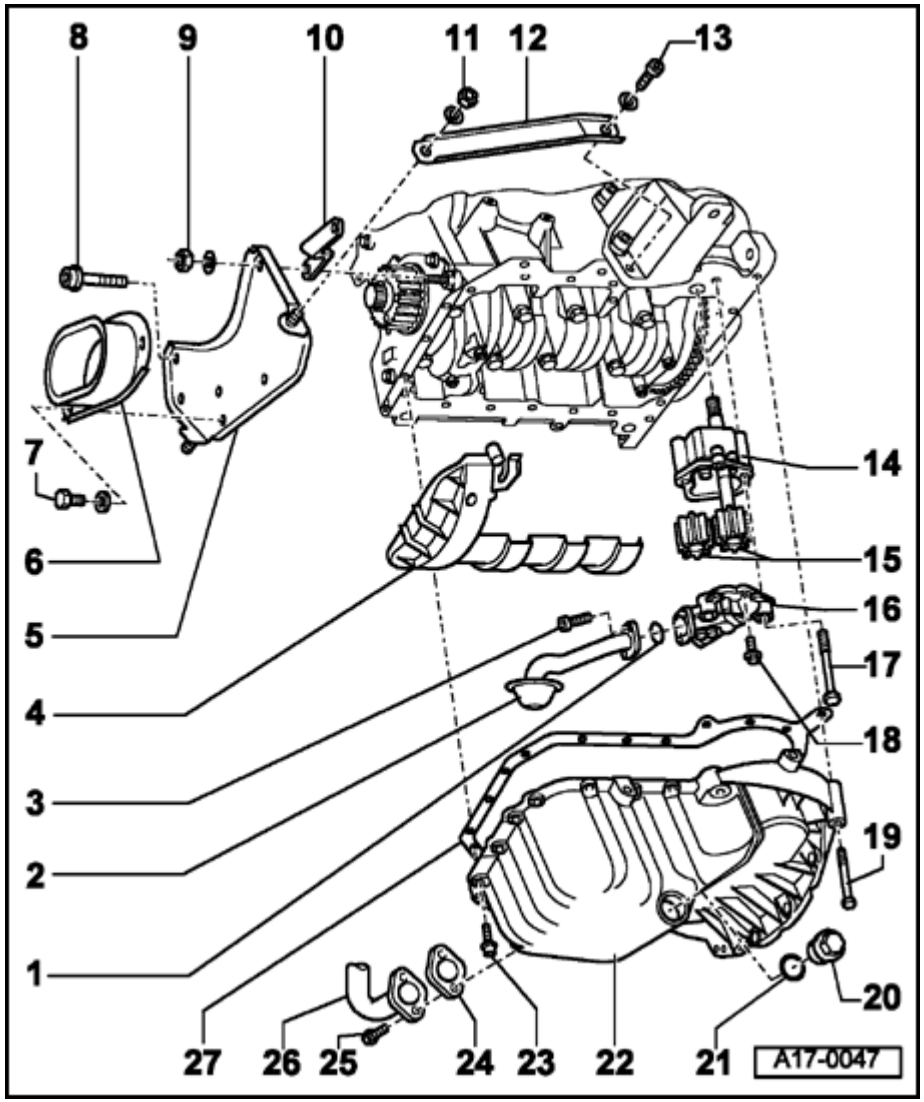
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the oil dipstick. Damage to the Three Way Catalytic Converter (TWC) could result. Markings, refer to illustration ⇒ Page 17-27 .

Viscosity classes and oil specifications ⇒ Page 17-26 .

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17-2



Part I

CAUTION!

Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

1 - O-ring

- Always replace

2 - Suction pipe

- Clean strainer if dirty

3 - Bolt

- 10 Nm (7 ft lb)

4 - Baffle plate

5 - Bracket

- For torque support

6 - Stop

- For torque support
- Adjusting:
  - Place stop for torque support on rubber buffer for torque support and tighten bolts to 25 Nm (18 ft lb)

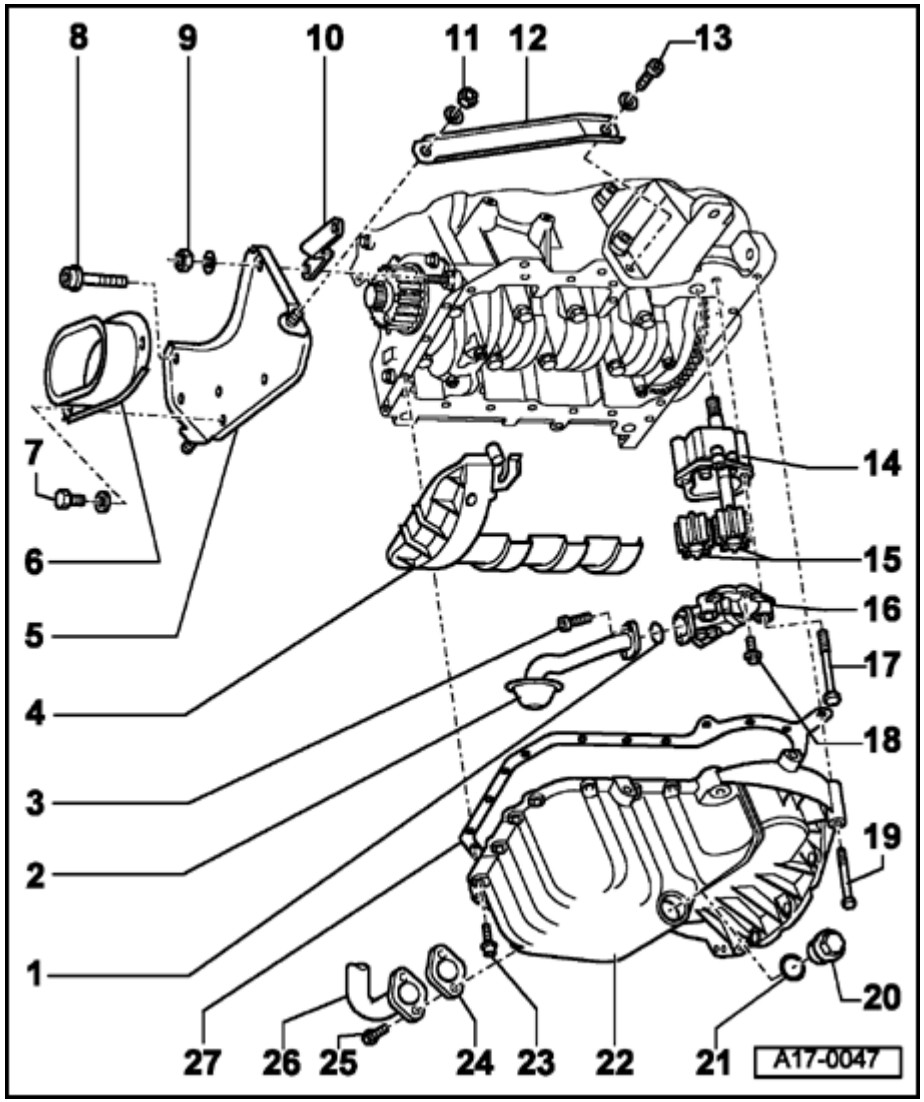
7 - Bolt

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- 25 Nm (18 ft lb)

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17-3



8 - Bolt

- 25 Nm (18 ft lb)

9 - Nut

- 25 Nm (18 ft lb)

10 - Brace

11 - Nut

- 25 Nm (18 ft lb)

12 - Side brace

13 - Bolt

- 20 Nm (15 ft lb)

14 - Oil pump housing

15 - Gears

- Backlash, checking ⇒ Fig. ⇒ 1
- Axial clearance, checking ⇒ Fig. ⇒ 2

16 - Oil pump cover with pressure relief valve

- Opening pressure: 5.7-6.7 bar (82.65-97.15 psi)

17 - Bolt

- 25 Nm (18 ft lb)

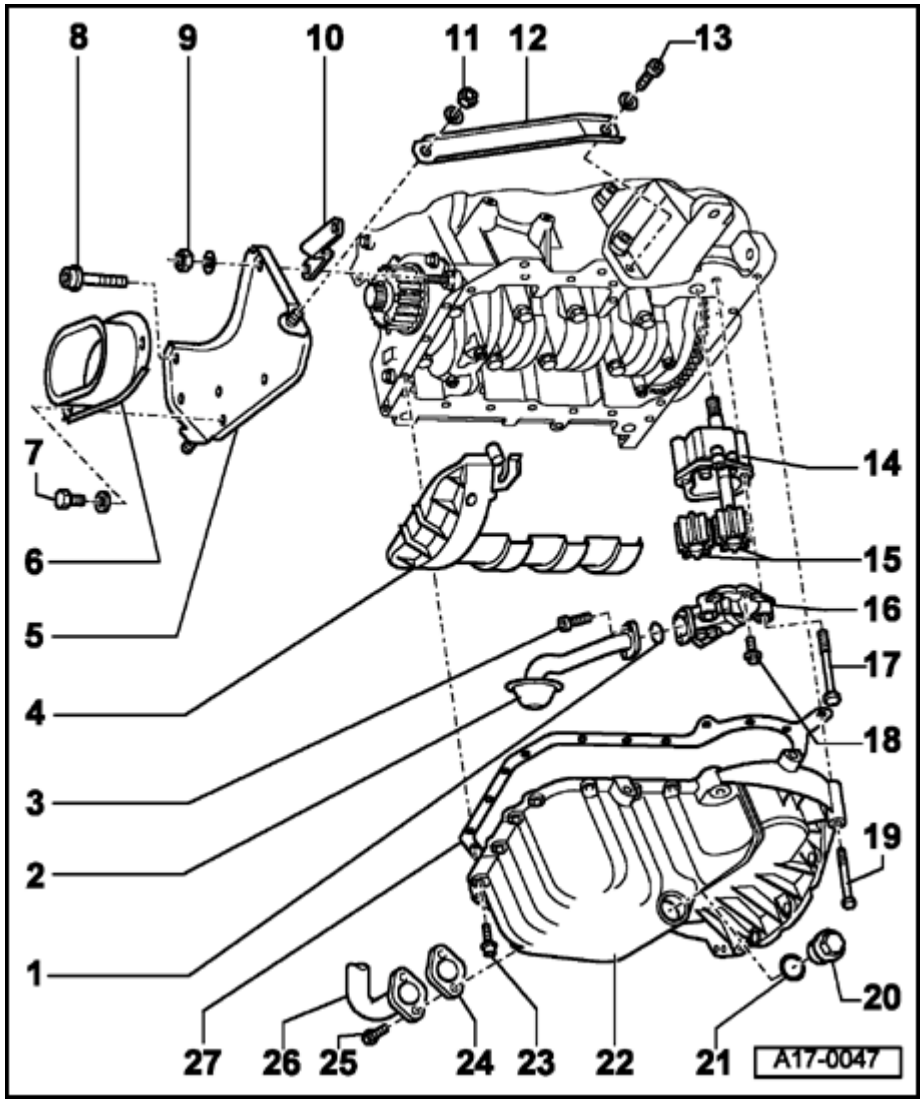
18 - Bolt

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- 10 Nm (7 ft lb)

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17-4



19 - Bolt

- 45 Nm (33 ft lb)

20 - Oil drain plug

- 50 Nm (37 ft lb)

21 - Sealing washer

- Always replace

22 - Oil pan

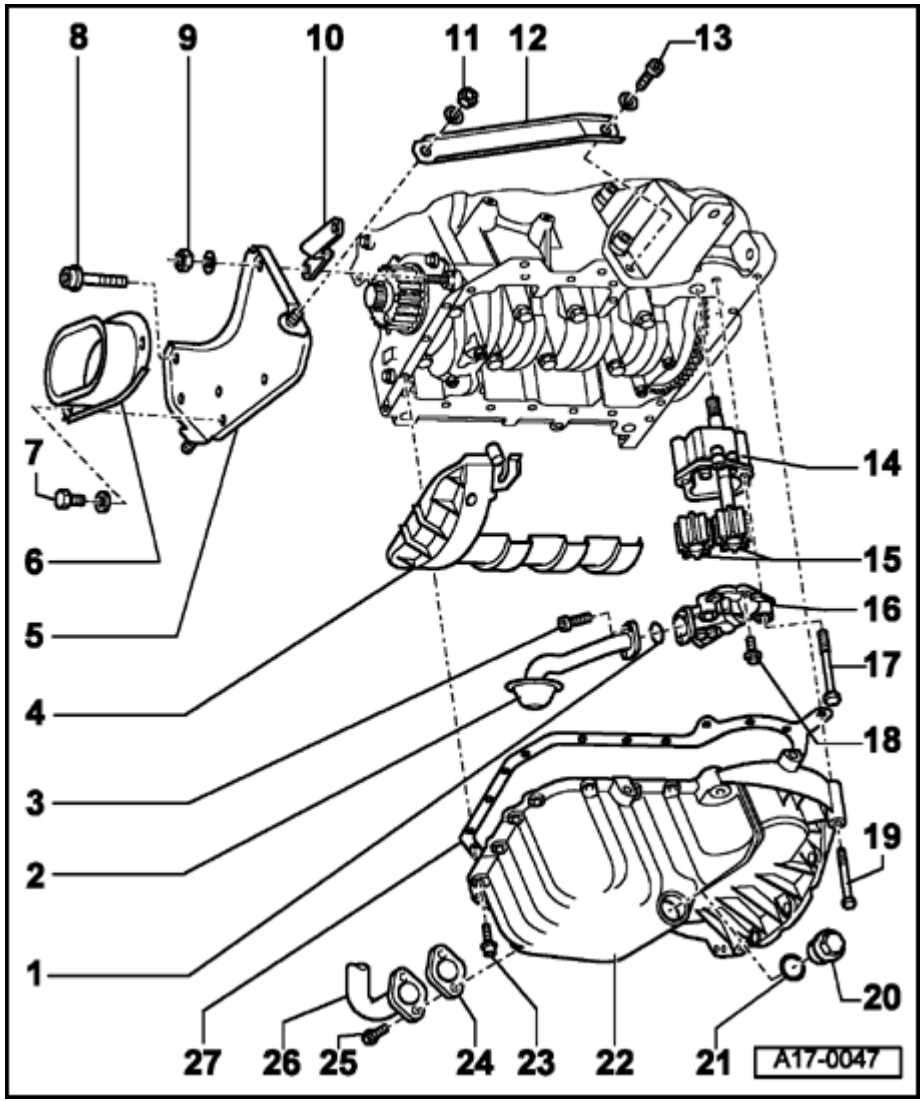
- Removing and installing ⇒ Page 17-9
- Clean contact surface before installing
- When installing oil pan on removed engine, note that oil pan is aligned with metal plate on flywheel side (i.e. oil pan projects out over engine block 0.8 mm 0.031 in.)
- Before installing oil pan, spread thin coat of sealant AMV 174 004 01 on sealing surface between oil seal carrier and engine block

23 - Bolt

- 10 Nm (7 ft lb)
- Use 3249 hex ball socket to remove and install two rear bolts on transmission
- Tighten diagonally in sequence

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17-5



24 - Gasket

- Always replace

25 - Bolt

- 10 Nm (7 ft lb)

26 - Oil return line

- From turbocharger

27 - Gasket

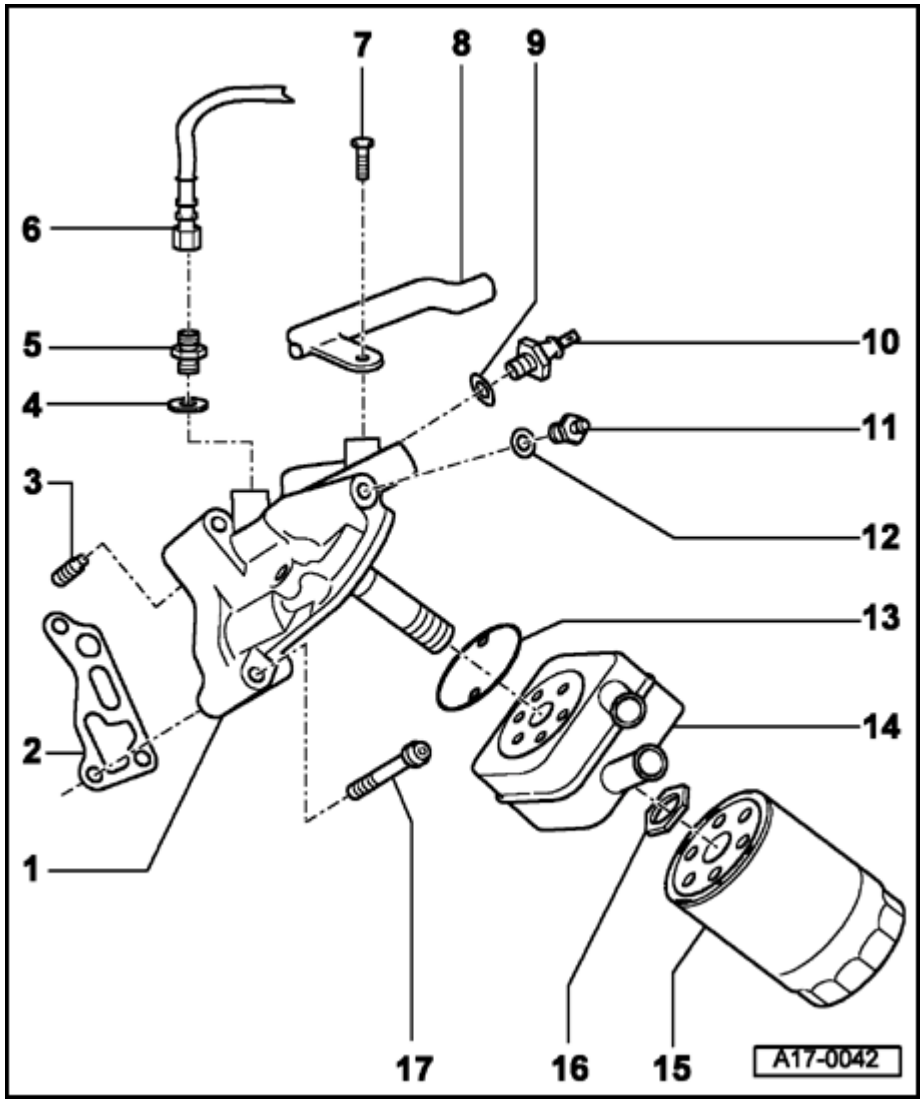
- Always replace
- Install dry
- Only spread thin coat of sealant AMV 174 004 01 on front and rear sealing surfaces between oil seal carrier and engine block

CAUTION!

Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

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17-6



Part II

1 - Oil filter bracket

2 - Gasket

- Always replace

3 - Oil retaining valve

- 8 Nm (71 in. lb)

4 - Gasket

- Always replace

5 - Coupling

- 30 Nm (22 ft lb)

6 - Oil feed line

- 25 Nm (18 ft lb)
- To turbocharger

7 - Bolt

- 20 Nm (15 ft lb)

8 - Lower coolant pipe

9 - Sealing washer

- If leaking, cut open and replace

10 - Oil pressure switch -F1-, 1.4 bar (20.3 psi)

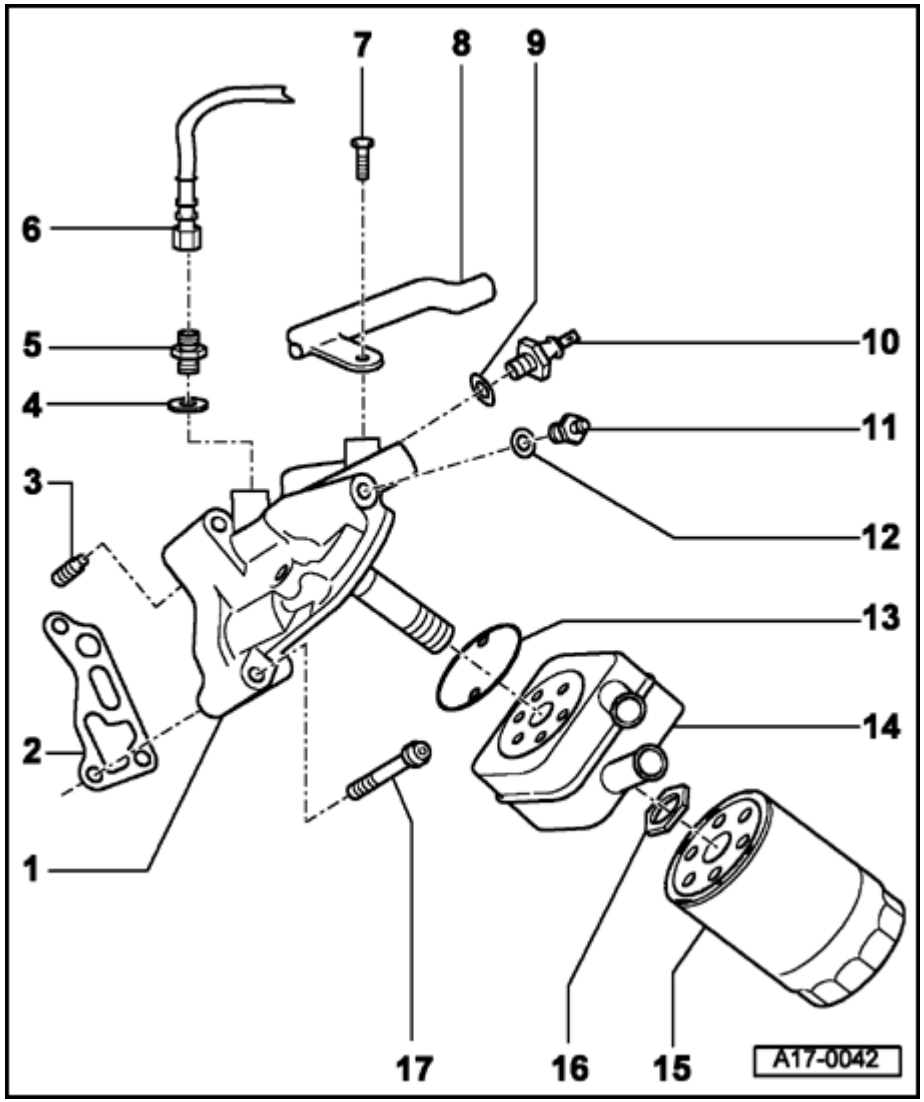
- 25 Nm (18 ft lb)

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- Black insulation
- Check ⇒ Page 17-22

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17-7



11 - Engine oil temperature sensor -G8-

- 10 Nm (7 ft lb)

12 - Sealing washer

- If leaking, cut open and replace

13 - O-ring

- Always replace
- Snap into grooves on oil cooler

14 - Oil cooler

- Refer to "CAUTION!" ⇒ Page 17-1
- Coolant hose connection diagram ⇒ Page 19-2

15 - Oil filter

- Follow filter change intervals
- Use 3417 oil filter wrench to remove
- Follow installation notes found on oil filter
- Tightening torque: 20 Nm (15 ft lb)

16 - Nut

- 25 Nm (18 ft lb)

17 - Hex socket bolt

- 25 Nm (18 ft lb)

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17-8

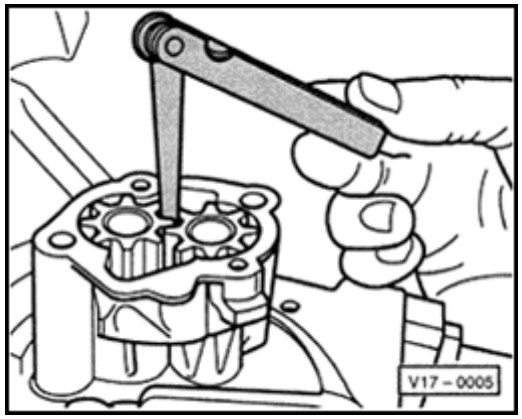


Fig. 1 Checking oil pump backlash

- New: 0.05 mm (0.002 in.)
- Wear limit: 0.20 mm (0.008 in.)

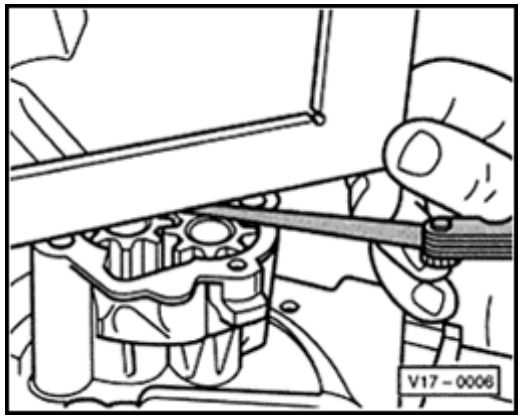


Fig. 2 Checking oil pump axial clearance

Wear limit: 0.15 mm (0.006 in.)

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17-9

Oil pan, removing and installing

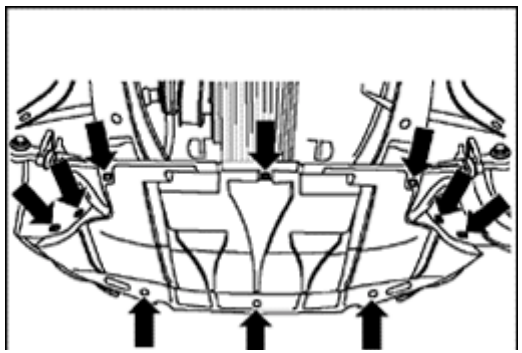
Special tools and equipment

- 10-222A engine support bridge with 10-222A/1 bracket for engine
- 2024A engine sling
- 3249 puller
- VAG1202A engine hoist
- AMV 174 004 01 sealant

Note:

Always replace gaskets.

Removing



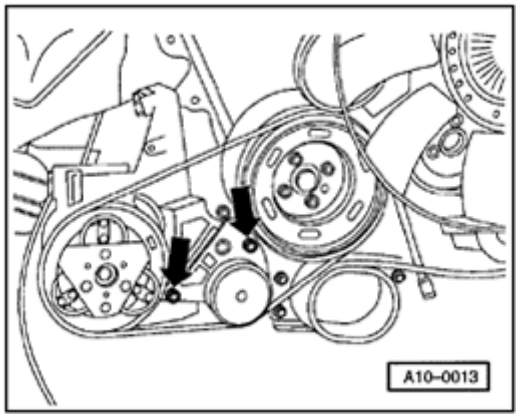
- Remove noise insulation panel (arrows).
- Drain engine oil.

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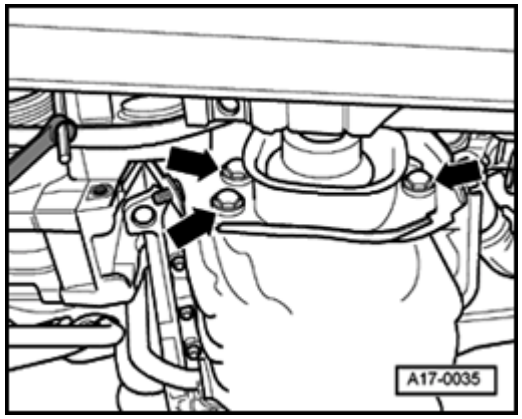
17-10

CAUTION!

Before removing ribbed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt.



- Remove bolts for ribbed belt tensioner for A/C compressor (arrows).
- Release tension on ribbed belt and remove.
- Remove belt pulley.

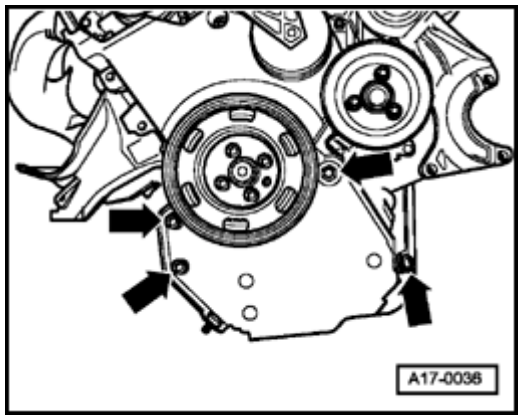


- Remove torque support stop (arrows).

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17-11

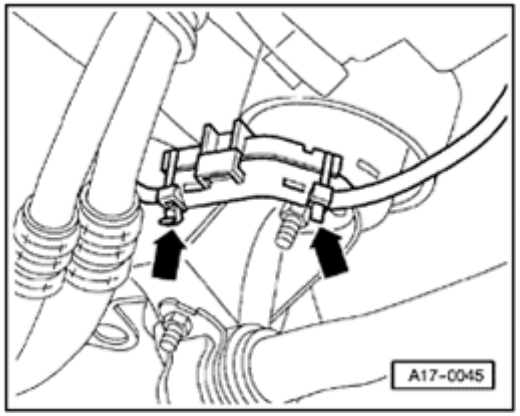
- Remove side brace from left side of torque support bracket.



- Remove torque support bracket from engine (arrows).

Note:

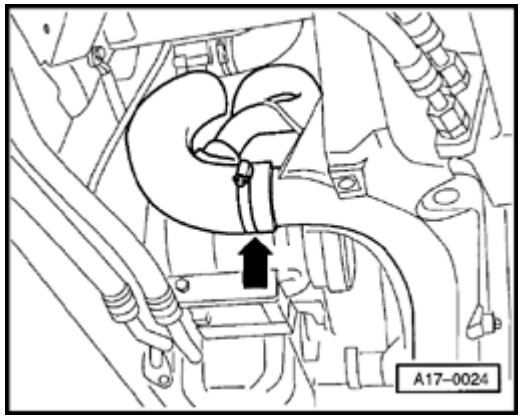
Illustration is shown with engine removed.



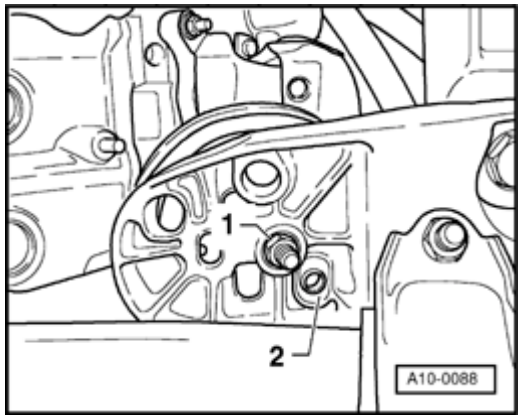
- Cut tie wraps (arrows), open bracket for starter wiring and remove wiring.

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17-12



- Remove hose from turbocharger at air guide tube in lock carrier (arrow).

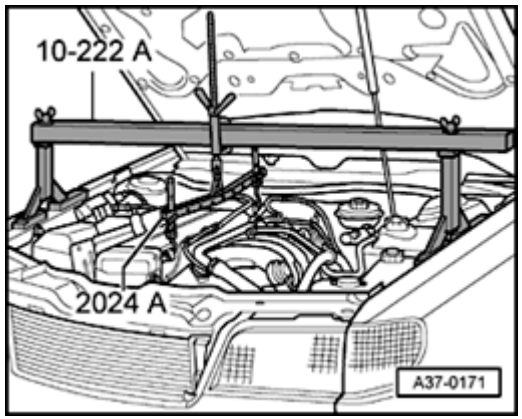


- Remove both nuts -1- from lower engine mount.

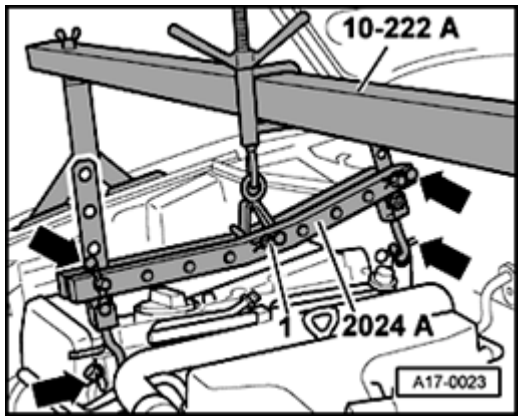
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17-13

- Remove engine covers.



- Set 10-222A engine support bridge on fender mounting edges.



- Remove mounting eye from 2024A engine sling.
- Insert bolt -1- in center bore of 2024A engine sling and secure using cotter pin.
- Attach 2024A engine sling bolt to 10-222A engine support bridge spindle.
- Attach 2024A engine sling to mounting eyes at front and rear of engine.

WARNING!

Mounting hooks and pins on the engine sling must be secured with the positioning lock (arrows).

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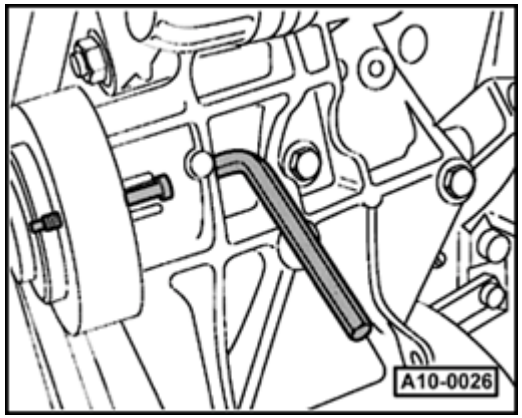
17-14

- Using 10-222A engine support bridge spindle, lift up engine as far as possible.

Note:

Lift engine only as far as possible without over-stretching or damaging any pipes or coolant hoses. Check for clearance of viscous fan; if necessary remove.

- Release tension on ribbed belt ⇒ Page 13-15 .



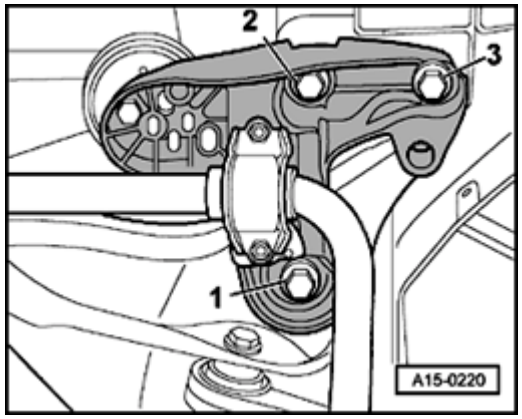
- Secure belt pulley for viscous fan using M5 x 60 mm bolt and unbolt using 8mm hex socket wrench.
- Remove viscous fan and place forward in fan frame.



- Use VAG1202A engine hoist to support subframe.

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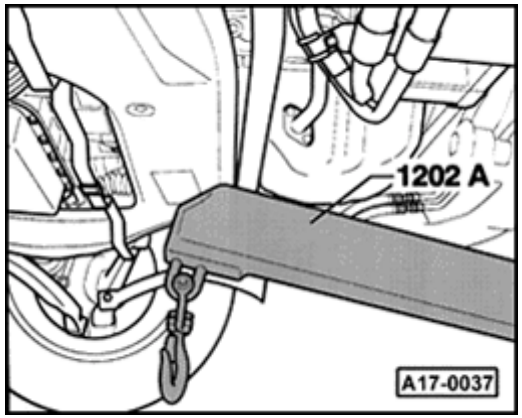
17-15



- First remove front bolts -2- and -3- from subframe, then remove bolt -1- .

Note:

Only loosen or lower subframe at front to avoid changing wheel alignment.

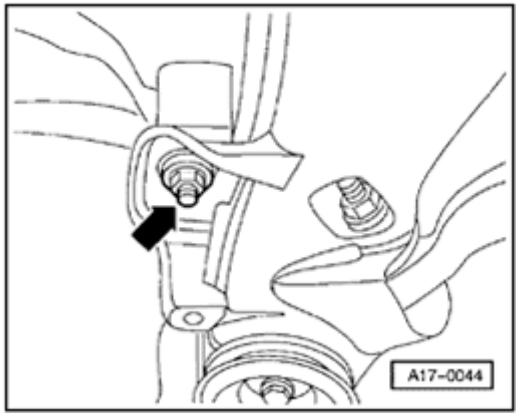


- Using VAG1202A engine hoist slowly lower subframe.
- Pull out VAG1202A engine hoist and swing stabilizer down.

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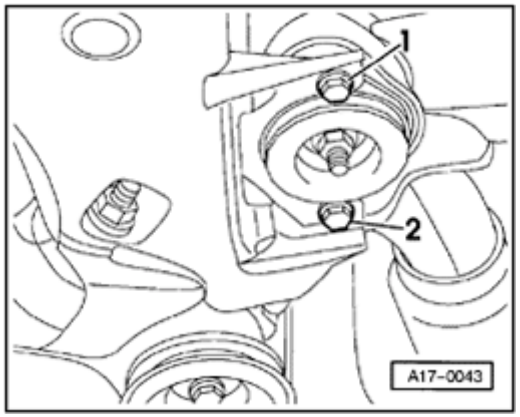
17-16

Vehicles with manual transmission



- Loosen left transmission mount nut (arrow) until it is aligned with lower edge of bolt (approx. 4 turns).

Vehicles with automatic transmission

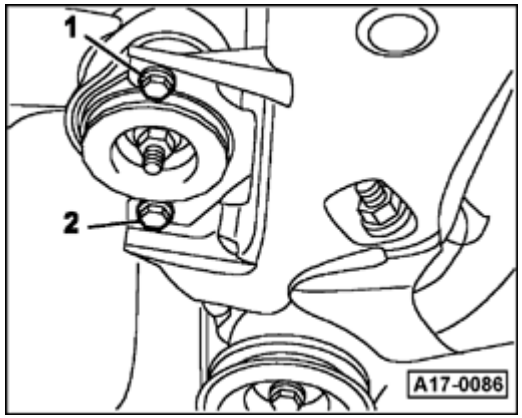


- Loosen rear bolt -2- for left transmission mount several turns. Remove front bolt -1- for left transmission mount.

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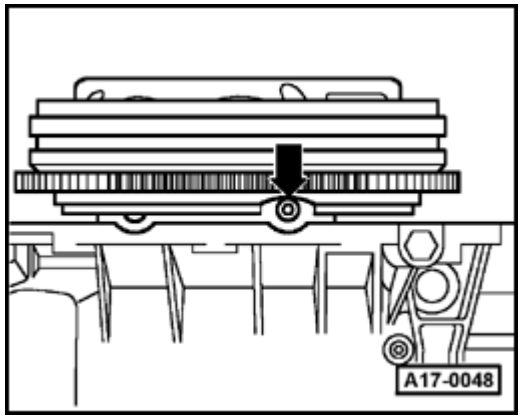
17-17

All models



- Loosen rear bolt -2- for right transmission mount several turns. Remove front bolt -1- for right transmission mount.
- Remove oil return line for turbocharger at oil pan.
- Unbolt oil pan.

Note:



- *For vehicles with manual transmission: both rear bolts on oil pan can be reached through opening on flywheel (arrow). Turn flywheel as needed.*
- *Use 3249 hex ball socket to remove rear oil pan bolts.*
- Remove oil pan (if necessary tap lightly using rubber hammer to remove).

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17-18

Installing

Installation is the reverse of removal, noting the following:

Note:

- *Replace gaskets and O-rings.*
- *When installing oil pan on removed engine, note that oil pan is aligned with metal plate on flywheel side (i.e. oil pan projects out over engine block 0.8 mm, or 0.0315 in.).*

- Clean sealing surfaces before installing oil pan.

- Lightly spread AMV 174 004 01 sealant on front and rear contact surfaces of oil seal carrier.

- Tighten bolts between oil pan and engine block in 2 stages and diagonal sequence.

- Install oil pan and tighten all bolts between oil pan and engine block to 5 Nm (44 in. lb) (stage 1).

- Tighten bolts between oil pan and transmission.

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Tightening torque: 45 Nm (33 ft lb)

- Tighten M10 bolts between oil pan and engine block.

Tightening torque: 45 Nm (33 ft lb)

- Tighten all M6 bolts between oil pan and engine block to 10 Nm (7 ft lb) (stage 2).

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17-19

- Install subframe ⇒ Repair Manual, Suspension, Wheels, Steering,Repair Group 40.

- Place torque support on rubber buffer for torque support and tighten bolts to 25 Nm (18 ft lb).

- Install ribbed belt ⇒ Page 13-15 .

Note:

When installing ribbed belt, check for correct seating on belt pulley.

- Add engine oil and check oil level.

CAUTION!

Do not overfill with oil past the MAX mark on the oil dipstick. Damage to the Three Way Catalytic Converter (TWC) could result.

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17-20

Tightening torques

Component		Tightening torques
Oil pan to engine block	M6	10 Nm (7 ft lb)
	M10	45 Nm (33 ft lb)
Oil pan to transmission		45 Nm (33 ft lb)
Engine mount to subframe		25 Nm (18 ft lb)
Torque support to bracket on engine		25 Nm (18 ft lb)
Torque support bracket to engine		25 Nm (18 ft lb)
Side brace to bracket for torque support		25 Nm (18 ft lb)
Side brace to engine support		20 Nm (15 ft lb)
Oil drain plug		50 Nm (37 ft lb)
Oil return line to oil pan		10 Nm (7 ft lb)
Transmission mount to subframe		23 Nm (17 ft lb)

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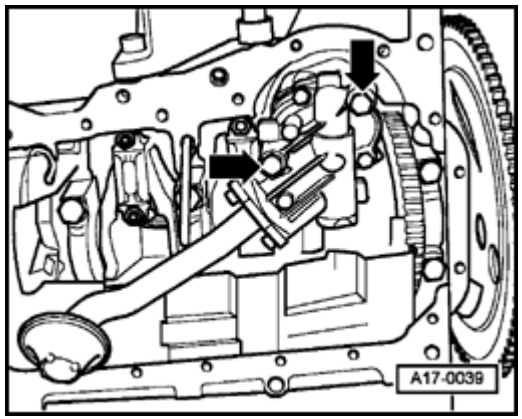
17-21

Oil pump, removing and installing

Removing

- Remove oil pan ⇒ Page 17-9 .

- Unhinge baffle plate and remove.



- Remove bolts (arrows).
- Press down on subframe and remove oil pump.

Installing

Installation is the reverse of removal, noting the following:

Installing oil pan ⇒ Page 17-18 .

Tightening torque

Component	Tightening torques
Oil pump to engine block	25 Nm (18 ft lb)

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Oil pressure and oil pressure switch, checking

Function of dynamic oil pressure warning system

Warning lamp, checking

With engine switched off and ignition on (terminal 15 on), oil pressure warning lamp will be lit (not for vehicles with Auto Check system).

Warning criteria

- Engine switched off and oil pressure switch closed.
- Coolant temperature less than 60 ° C (140 ° F), engine speed higher than 300 RPM and oil pressure switch open.
- Coolant temperature greater than 60 ° C (140 ° F).
- At engine speeds greater than 5000 RPM, an active oil warning won't be erased independent of oil pressure switch setting.
- A Diagnostic Trouble Code (DTC) is recognized when oil pressure switch is open

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for more than 0.5 seconds at engine speeds greater than 1500 RPM. If condition occurs more than three times during a drive, warning will remain active even at engine speeds less than 1300 RPM.

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17-23

Special tools and equipment

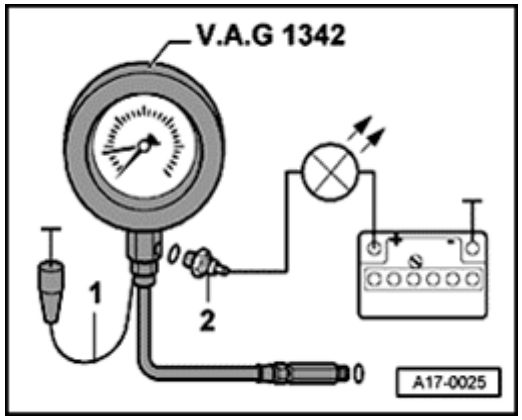
- VAG1342 oil pressure tester
- VAG1527B voltage tester
- VAG1594A measuring appliance adapter

Test conditions

- Oil level OK
- Oil pressure warning light -K3- must light up when ignition is switched on.
- For vehicles with Auto Check system, "i.O" indicator must be lit (call up symbol)
- Engine oil temperature approximately 80 °C (176 °F)

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17-24



Oil pressure switch, checking

- Disconnect line from oil pressure switch.

- Remove oil pressure switch and install VAG1342 oil pressure tester.
- Install oil pressure switch into VAG1342 oil pressure tester.
- Connect brown wire -1- of tester to Ground (GND).
- Using VAG1594 adapter, connect VAG1527B voltage tester to oil pressure switch and Battery Positive Voltage (B+).

  LED must not be lit.
- If LED is lit, replace oil pressure switch.
- Start engine.

Note:

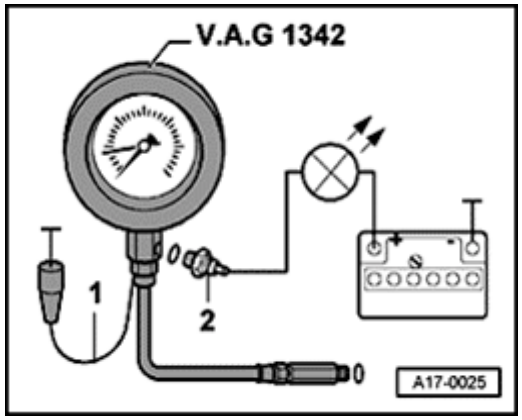
While starting engine, watch pressure tester and LED as oil pressure switch may open during start.

  At 1.2-1.6 bar (17.4-23.2 psi) LED must be lit.
- If LED does not light, replace oil pressure switch.

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17-25

Oil pressure, checking



- Disconnect line from oil pressure switch.

- Remove oil pressure switch and install VAG1342 oil pressure tester.
- Install oil pressure switch into VAG1342 oil pressure tester.
- Start engine.

• Engine oil temperature approximately 80 °C (176 °F).

♦ Oil pressure at idle: 1.0-3.5 bar (14.5-50.75 psi)

♦ Oil pressure at 3000 RPM: 5.0-7.0 bar (72.5-101.5 psi)

If specified values are not obtained, the pressure relief valve or the oil pump is faulty.

- Replace oil pump ⇒ Page 17-21 .

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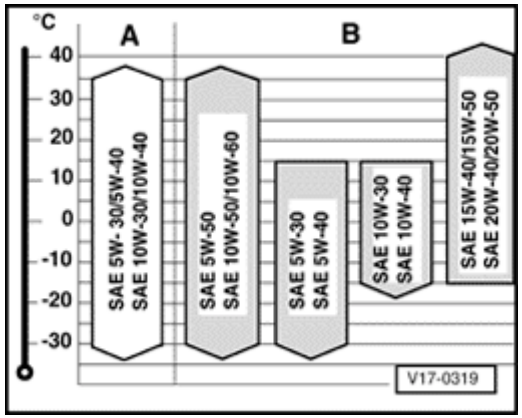
17-26

Engine oil

Engine oil capacity (w/filter): 3.5 L (3.7 qt.).

The engine is factory-filled with a high quality multi-grade oil that can be used as an all-season oil, except in extremely cold climates.

Viscosity classes and oil specifications



Select the viscosity according to the chart shown. The oil does not need to be changed if the outside temperature only briefly exceeds the specified ranges.

The specifications stated on these pages must be indicated on the container either individually or in combination with other specifications.

A - Multi-grade oil, specification VW 500 00[1)]

B - Multi-grade oil, specification VW 501 01[1)]

- Multi-grade oil, specification API-SF- or -SG-[2)]

[1)] This VW specification must have a date of 10/91 or later.

[2)] These oils may only be used in exceptional cases if no approved engine oil is available.

Mixing oils when topping up is permissible.

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17-27

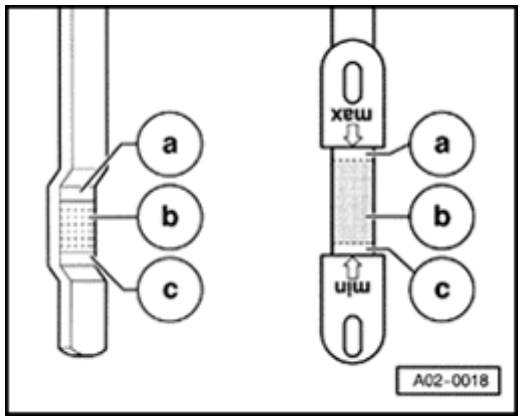
Oil level, checking

Test conditions

- Minimum engine oil temperature: 60 ° C (140 ° F)
- Vehicle on level ground
- After stopping engine, wait a few minutes to allow oil to flow back into oil pan

- Withdraw dipstick, wipe off using clean cloth and reinsert fully.

- Withdraw dipstick again and read oil level.



➢ Range of markings on dipstick:

a - Oil MUST NOT be topped off.

b - Oil may be topped off. After topping off, oil may reach range -a-.

c - Oil MUST BE topped off. After topping off, it is sufficient if oil level is somewhere in range -b- (shaded area).

CAUTION!

Do not overfill with oil past the MAX mark on the oil dipstick. Damage to the Three Way Catalytic Converter (TWC) could result.

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19-1

Cooling system components, removing and installing

WARNING!

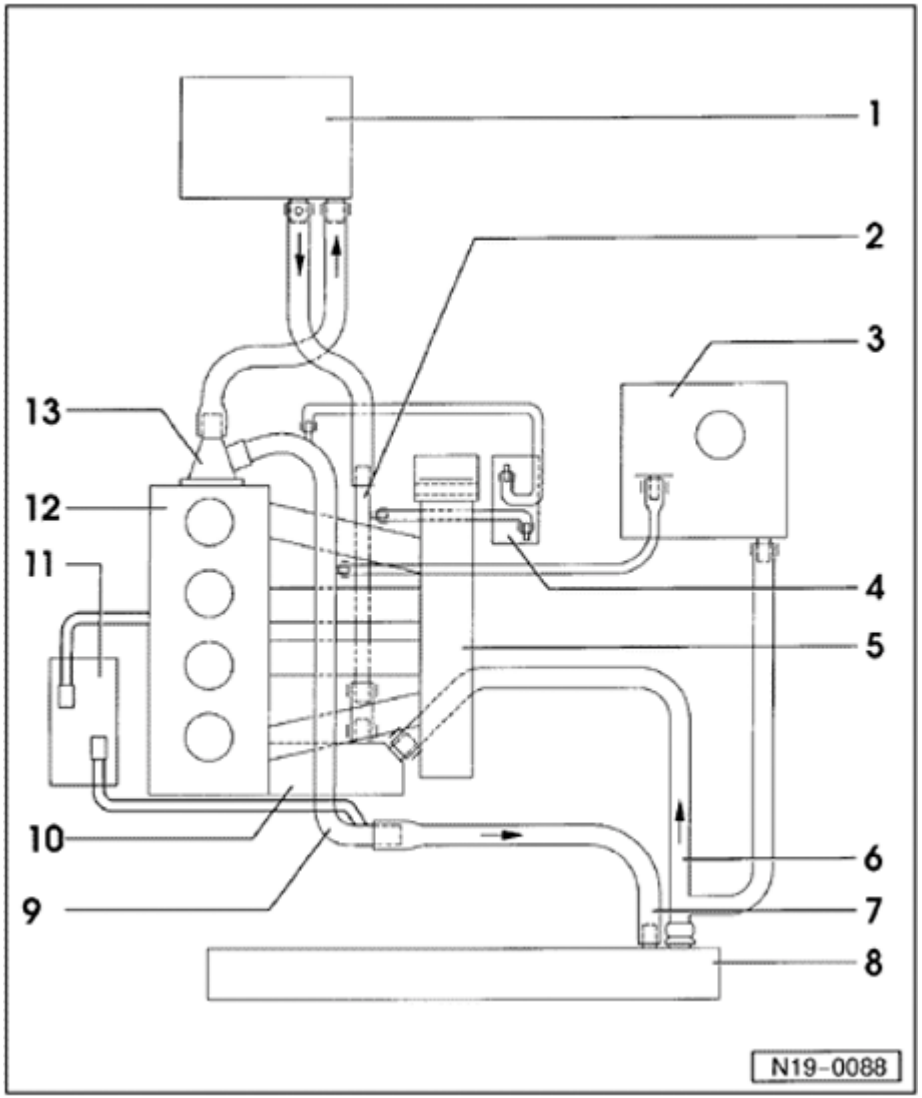
The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap using a cloth, and open carefully to relieve system pressure slowly.

Note:

- *Cooling system is under pressure when engine is warm. If necessary reduce pressure before repair.*
- *Secure all hose connections using production-type clamps ⇒ parts catalog.*
- *VAG1921 pliers are recommended for installing spring clips.*
- *Always replace gaskets, seals and O-rings.*
- *Arrows on coolant lines and hoses must align.*

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19-2



Cooling system components

Coolant hose connection diagram

1 - Heater core

- After replacing, replace coolant

2 - Lower coolant line

- Removing and installing ⇒ Page 19-22

3 - Expansion tank

- With cap
- Pressure relief valve in cap, checking ⇒ Page 19-30

4 - Oil cooler

- Removing and installing ⇒ Page 17-7 , item 14

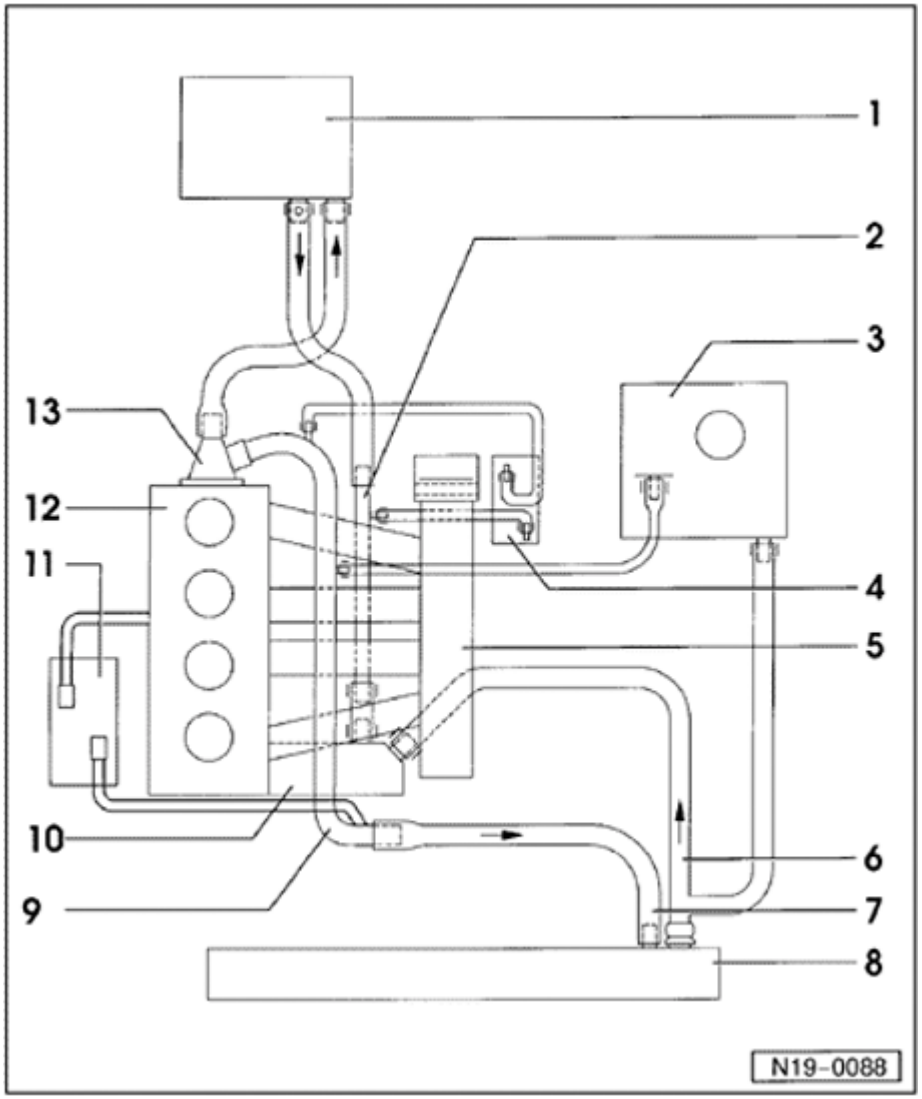
5 - Intake manifold

6 - Lower coolant hose

7 - Upper coolant hose

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19-3



8 - Radiator

- Removing and installing ⇒ Page 19-24
- After replacing, replace coolant

9 - Upper coolant line

10 - Coolant pump/coolant thermostat

- Coolant pump, removing and installing ⇒ Page 19-13
- Check for ease of movement
- Coolant thermostat, removing and installing ⇒ Page 19-20
- Checking ⇒ Page 19-21

11 - Turbocharger

12 - Cylinder head/cylinder block

- After replacing, replace coolant

13 - Connector

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19-4

Cooling system, draining and filling

Special tools and equipment

- VAG1306 drip tray
- VAG1274/10 with VAG1274/1 adapter or VAG1274/8
- T40007 refractometer

Draining

Note:

Drain coolant into a clean container for recycling or reuse.

WARNING!

The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap using a cloth, and open carefully to relieve system pressure slowly.

- Open coolant expansion tank cap.



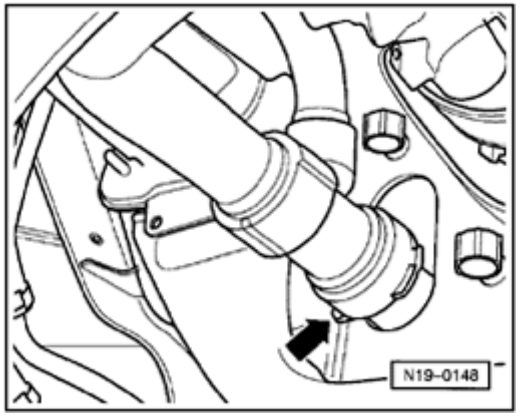
- Remove noise insulation panel (arrows).

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- Place VAG1306 drip tray underneath engine.

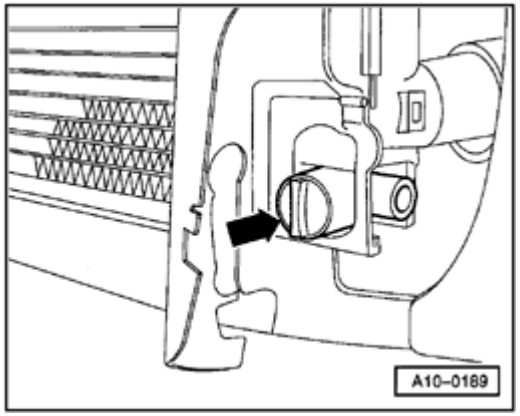
CAUTION!

Observe disposal regulations for coolant!



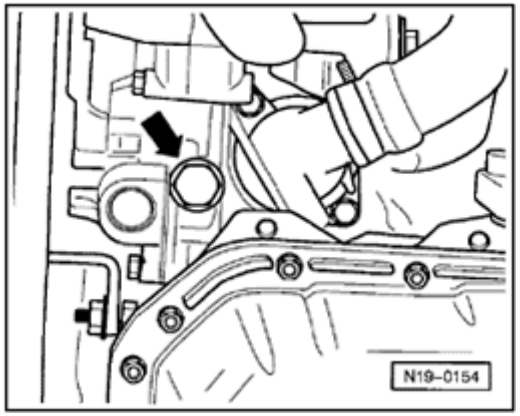
- Remove retaining clip (arrow) from lower coolant hose and remove coolant hose from radiator.

Note:



With bumper removed, coolant can be drained through radiator drain plug (arrow).

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- Remove drain plug from coolant pump (arrow).

Filling

Note:

- *The cooling system is filled year-round with frost and corrosion protection additives.*
- *Until 6/96, G 011 A8 C coolant (green color) was used.*
- *From 7/96 on, only G 012 A8 D coolant (red color) is used.*

CAUTION!

- ***Coolants G 011 A8 C and G 012 A8 D CANNOT be mixed. Mixing them will cause severe engine damage.***
- ***Part numbers are for reference only. Always check with your Parts department for the latest information.***
- *If the fluid in the expansion tank is brown, G012 A8 D has been mixed with other coolant. In this case, flush cooling system and change coolant. To flush, fill cooling system with clear water and run engine for approx. 2 minutes. Flushing the system should remove most of the coolant residue.*

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Note (continued from page ⇒ Page 19-6):

- *G 011 A8 C or G 012 A8 D and coolant additives marked with "according to TL VW 774C" or "according to TL VW 774 D", prevent frost and corrosion damage as well as calcium deposits. They also raise the boiling point. Therefore, cooling system must be filled year-round with frost and corrosion protection additives.*

- *A higher boiling point improves engine reliability under heavy load, particularly in countries with tropical climates.*

- *Frost protection additives must protect against frost to about -25° C (-13° F) and to about -35° C (-31° F) in arctic climates.*

- *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%.*

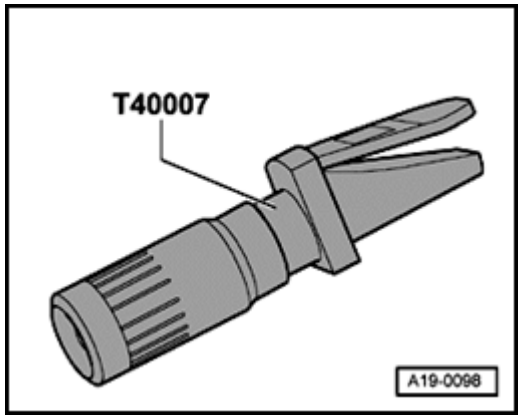
- *If for climatic reasons greater frost protection is required, the amount of G 011 A8 C or G 012 A8 D can be increased, but only up to 60% to obtain frost protection to about -40° C (-40° F). Otherwise frost protection and cooling effectiveness will be reduced.*

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- *If the radiator, heater core, cylinder head or cylinder head gasket is replaced, completely replace the engine coolant.*

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19-8



For coolant G 012 A8 D, use T40007 refractometer to test frost protection in cooling system.

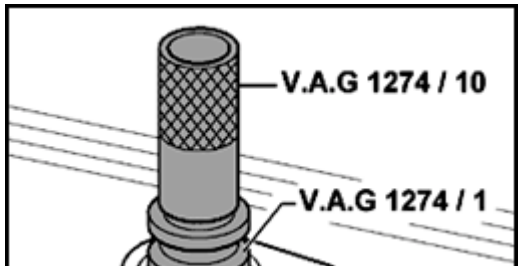
Recommended mixture ratios:

Frost protection to	Anti-freeze amount	G 012 A8 D[1)]	Water[1)]
-25 ° C	40 %	3.0 ltr.	4.0 ltr.
(-13 ° F)		(3.2 qts.)	(4.2 qts.)
-35 ° C	50 %	3.5 ltr.	3.5 ltr.
(-13 ° F)		(3.7 qts.)	(3.7 qts.)
1) The quantity of coolant: 7.0 liters (7.4 qts.) can vary depending upon vehicle options.			

- Install lower radiator hose and secure.
- Replace O-ring and install coolant pump drain plug.

  Tightening torque: 30 Nm (22 ft lb)

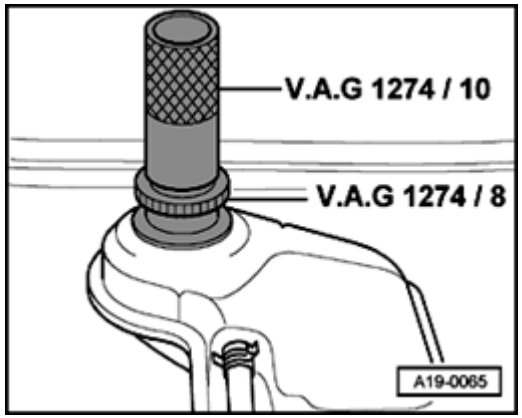
Vehicles with small cap



- Screw VAG1274/1 adapter onto coolant expansion tank.
- Attach VAG1274/10 special tool to VAG1274/1 adapter.

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19-9



Vehicles with large cap

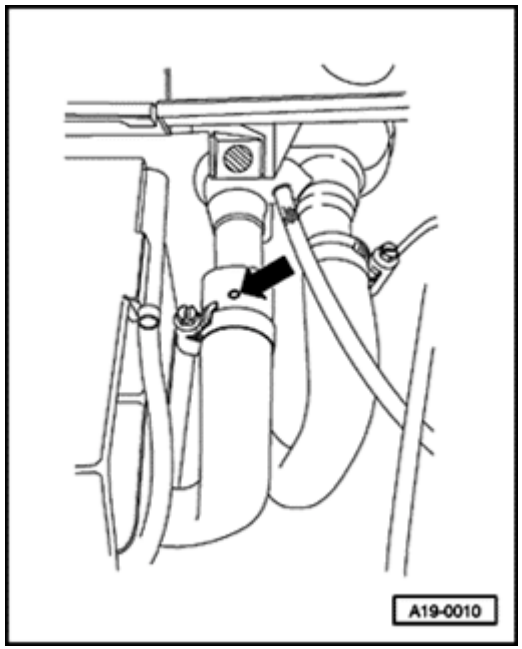
- Screw VAG1274/8 adapter onto coolant expansion tank.
- Attach VAG1274/10 special tool to VAG1274/1 adapter.

All models

Note:

To fill without using special tools, loosen coolant expansion tank and lift approx. 100 mm (approx. 4 in.).

- Remove grommet holding clip at heater core and pull back grommet.



- Loosen coolant hose on heater core and pull back hose sufficiently so that bleeder hole (arrow) is no longer sealed by connection.
- Top up coolant until it flows out of coolant hose bleeder hole.
- Push coolant hose on connection and tighten.
- Install coolant expansion tank cap.

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

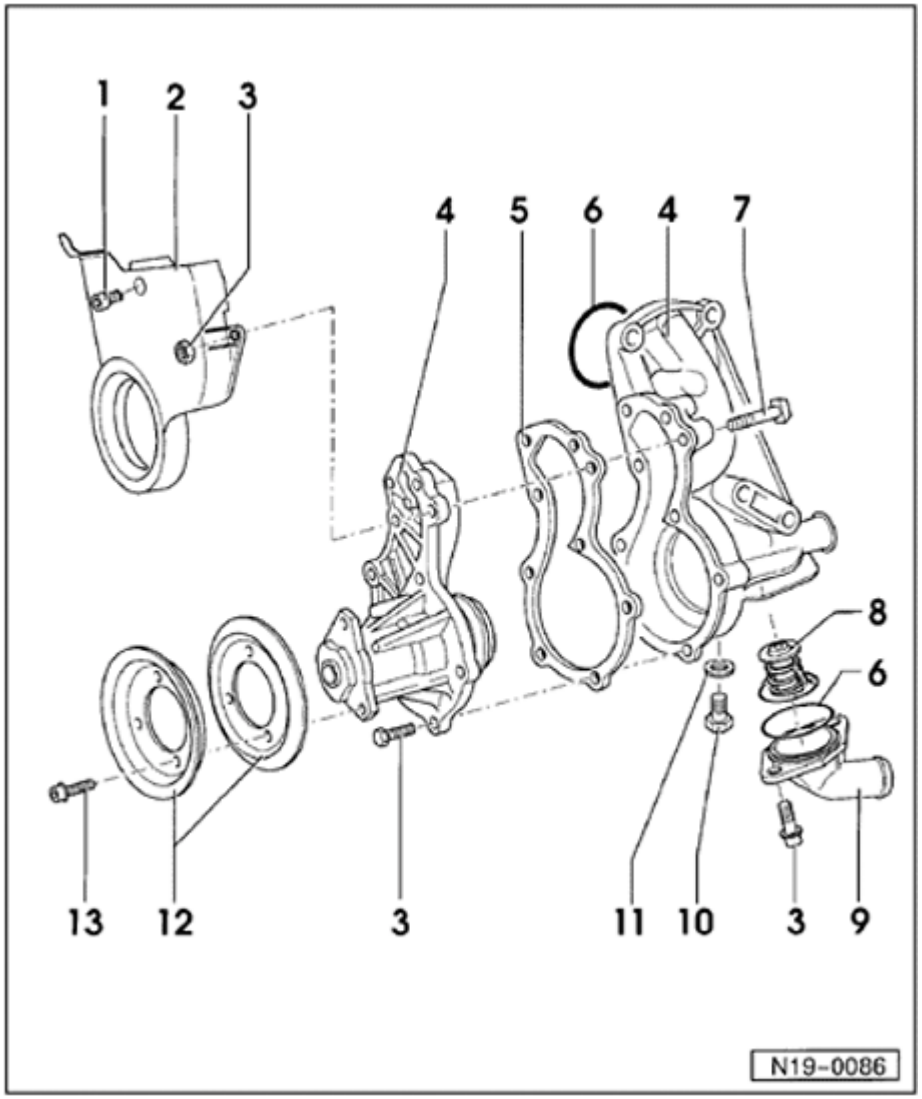
- Allow engine to idle until the lower radiator hose is hot.Check coolant level and top up if necessary. When engine is at normal operating temperature, coolant level must be at max. mark; when engine is cold, between min. and max. marks.

WARNING!

The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap using a cloth, and open carefully to relieve system pressure slowly.

- Switch engine off.

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Coolant pump and coolant thermostat, servicing

1 - Bolt

- M6: 10 Nm (7 ft lb)
- M8: 20 Nm (15 ft lb)

2 - Lower toothed belt cover

- Removing and installing ⇒ Page 13-29

3 - Nut

- 10 Nm (7 ft lb)

4 - Coolant pump

- Removing and installing ⇒ Page 19-13
- Check for ease of movement

5 - Gasket

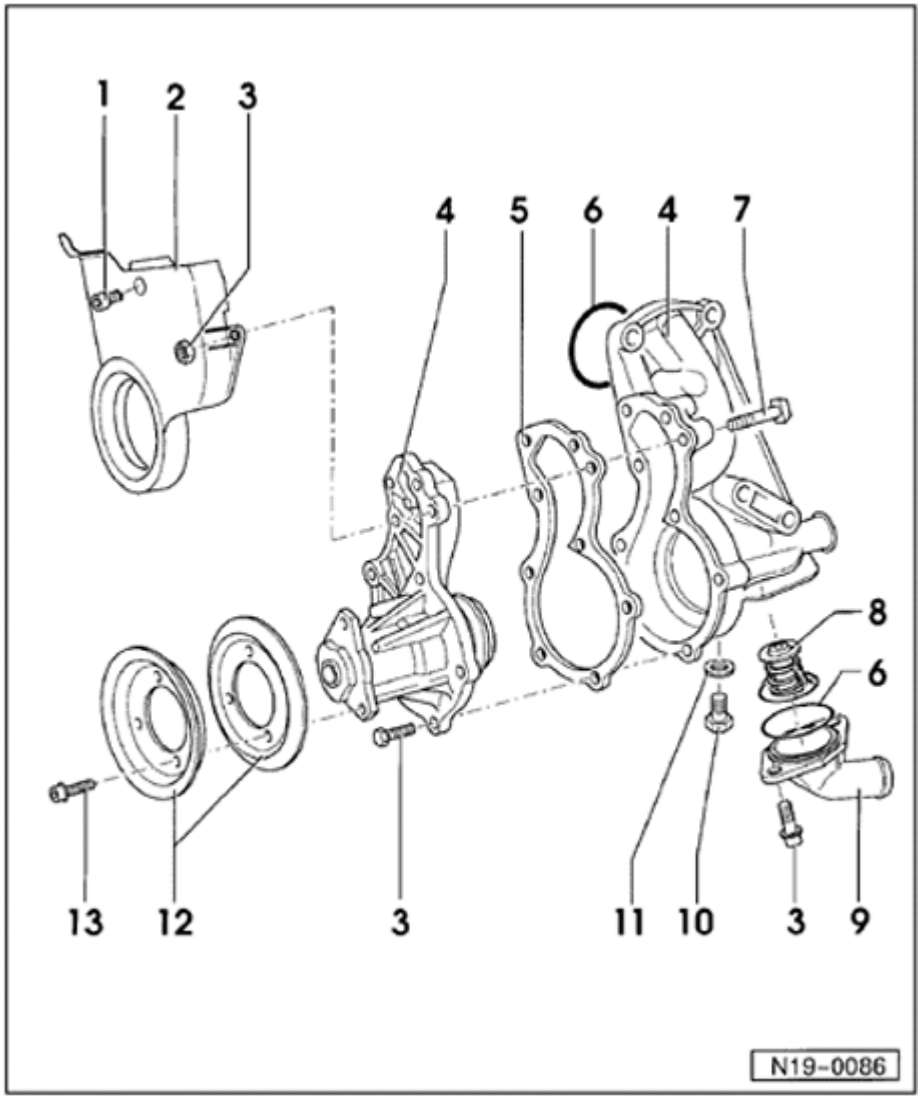
- Always replace

6 - O-ring

- Always replace

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19-12



7 - T-head bolt

- Insert before installation

8 - Coolant thermostat

- Removing and installing ⇒ Page 19-20
- Checking ⇒ Page 19-20

9 - Connector

10 - Drain plug

- 30 Nm (22 ft lb)

11 - O-ring

- Always replace

12 - Belt pulley

- Installed position: flat pulley half faces coolant pump

13 - Socket-head bolt

- 25 Nm (18 ft lb)

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19-13

Coolant pump, removing and installing

Note:

Coolant pump is bolted to bracket for generator, power steering pump and viscous fan.

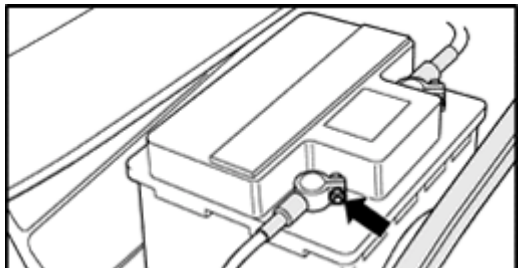
- Lock carrier in service position ⇒ Page 13-1

Removing

CAUTION!

Before disconnecting the battery:

- ***Stop the engine.***
- ***Determine the correct coding for the anti-theft radio.***
- ***Switch the ignition off (also applies when connecting the battery). Failure to do so may damage the Engine Control Module (ECM).***



- Switch ignition off and disconnect battery Ground (GND) strap.
- Remove ribbed belt ⇒ Page 13-15 .
- Remove viscous fan (with belt pulley) ⇒ Page 13-14 , Fig. ⇒ 1 .
- Remove V-belt ⇒ Page 13-18 .

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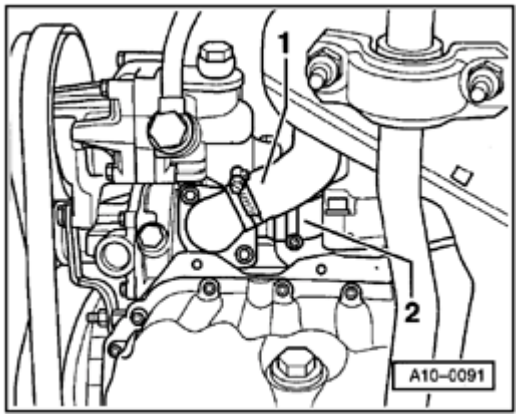
Note:

Ribbed belt for A/C compressor and torque support remains installed.

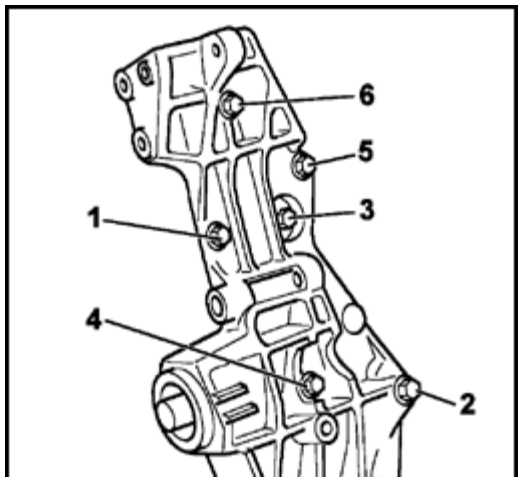
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19-14

- Drain coolant ⇒ Page 19-4 .



- Loosen clamps for coolant hoses -1- and -2-.
- Remove coolant hose to radiator at coolant line.
- Remove intake air duct between intake manifold and charge air cooler.
- Remove mounting bolts for generator.
- Remove generator toward front.
- Disconnect wiring from removed generator.
- Unbolt following supports and braces from bracket for generator, power steering pump and viscous fan:
  - Intake manifold support
  - Support for torque support bracket
  - Brace to cylinder block (remove completely)



- Remove bracket for generator, power steering pump and viscous fan bolts -1- through -6-.
- Secure bracket for generator, power steering pump and viscous fan to left side using wire.

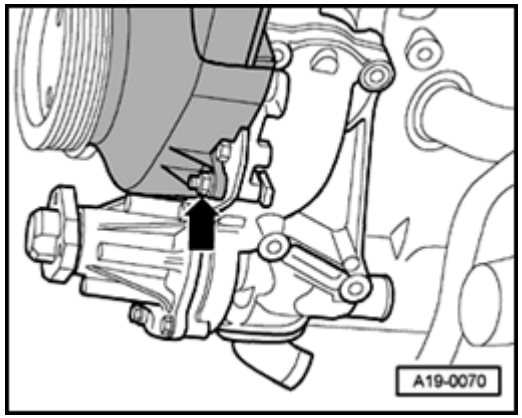
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19-15

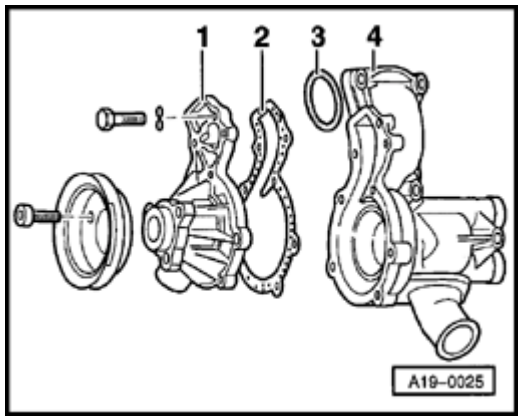
Note:

Power steering pump remains installed.

- Pull off coolant hoses from coolant pump and coolant thermostat housing.



- Unbolt coolant pump housing from toothed belt cover (arrow).
- Remove coolant pump.



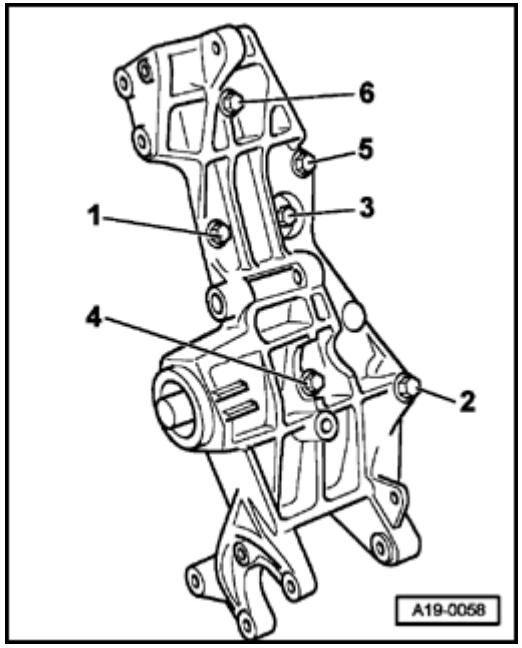
- Unbolt impeller housing -1- from pump housing -4-.

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Installing

Installation is the reverse of removal, noting the following:

- Clean sealing surfaces of both housings.
- Replace gasket and O-ring.
- Insert T-head bolt into coolant pump bore.



- Mount bracket for generator, power steering pump and viscous fan with coolant pump on cylinder block and tighten bolts in numerical sequence.

1 - M8 x 70 bolt

2 - M8 x 110 bolt

3 - M8 x 50 bolt

4 - M8 x 90 bolt

5 - M8 x 70 bolt

6 - M8 x 100 bolt

- Install viscous fan ⇒ Page 13-14 , Fig. ⇒ 1 .
- Install ribbed belt ⇒ Page 13-17 .

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19-17

Note:

When installing ribbed belt, check for correct seating on belt pulley.

- Install V-belt ⇒ Page 13-18 .

- Fill up with coolant ⇒ Page 19-6 .

WARNING!

The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap using a cloth, and open carefully to relieve system pressure slowly.

CAUTION!

Be sure the ignition is switched OFF. Failure to do so may damage the Engine Control Module (ECM).

- Switch ignition off and reconnect battery Ground (GND) strap.

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

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⇒ *Radio Operating Manual*

- Fully close power windows to stop.

- Operate all power window switches again for at least one second in "close" direction to activate "one-touch" opening/closing function.

- Set clock to correct time.

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Tightening torques

Component	Tightening torques
Impeller to pump housing	10 Nm (7 ft lb)
Pump housing to toothed belt cover	10 Nm (7 ft lb)
Bracket for generator, power steering pump and viscous fan to cylinder block	25 Nm (18 ft lb)
Left brace for cylinder block/bracket for generator, power steering pump and viscous fan	
to cylinder block	25 Nm (18 ft lb)
to bracket M10	40 Nm (30 ft lb)
Brace for torque support/bracket for generator, power steering pump and viscous fan	
to torque support	25 Nm (18 ft lb)
to bracket	20 Nm (15 ft lb)
Intake duct support	

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to intake duct	20 Nm (15 ft lb)
to bracket	20 Nm (15 ft lb)

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Component	Tightening torques
Generator to bracket for generator, power steering pump and viscous fan	
M8	25 Nm (18 ft lb)
M10	40 Nm (30 ft lb)
Belt pulley to coolant pump	25 Nm (18 ft lb)
Viscous fan to bearing	45 Nm (33 ft lb)

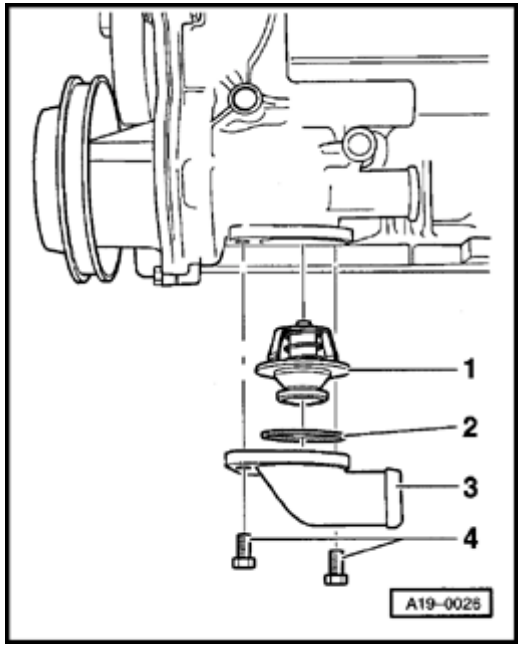
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19-20

Coolant thermostat, removing, installing and checking

Removing

- Drain coolant ⇒ Page 19-4 .



- Remove bolts -4-, remove connector -3-, O-ring -2- and coolant thermostat -1-.

Installing

- Clean and/or smooth O-ring sealing surface.
- Install coolant thermostat.
- Fill up with coolant ⇒ Page 19-6 .

WARNING!

The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap using a cloth, and open carefully to relieve system pressure slowly.

Tightening torque

Component	Tightening torque
Connector to pump housing	10 Nm (7 ft lb)

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19-21

Coolant thermostat, checking

- Warm thermostat in hot water bath.

Starts to open	Fully open	Stroke
approx. 87 °C (189 °F)	approx. 102 °C 1) (216 °F)	min. 8 mm (0.315 in.)
1) Cannot be tested.		

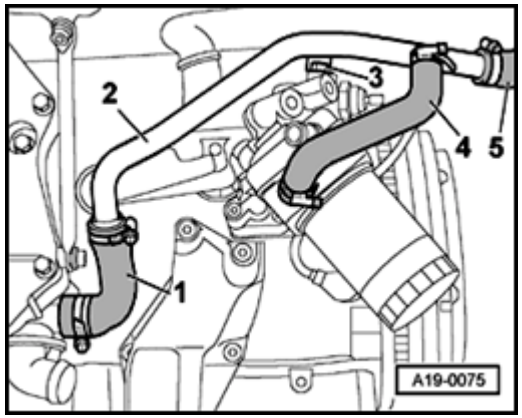
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Coolant line (lower), removing and installing

Removing

- Drain coolant ⇒ Page 19-4 .

- Remove intake air duct between intake manifold and charge air cooler.



- Remove hose -4- to oil cooler at lower coolant line -2-.
- Remove hose -5- to heater core at lower coolant line.
- Remove lower coolant line from hose -1- at coolant pump.
- Unbolt lower coolant line from oil filter bracket -3-.

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19-23

Installing

Installation is the reverse of removal, noting the following:

- Fill with coolant ⇒ Page 19-6 .

WARNING!

The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap using a cloth, and open carefully to relieve system pressure slowly.

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19-24

Radiator, removing and installing

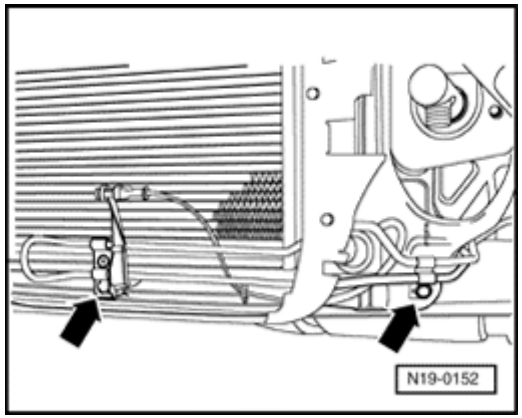
Special tools and equipment

VAG1306 drip tray

Removing

- Remove front bumper.

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



- Unbolt cooling pipe for power steering hydraulic oil (arrows).
- Place VAG1306 drip tray underneath engine.

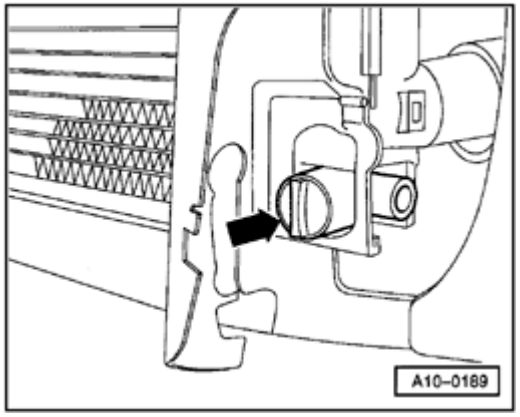
WARNING!

The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap using a cloth, and open carefully to relieve system pressure slowly.

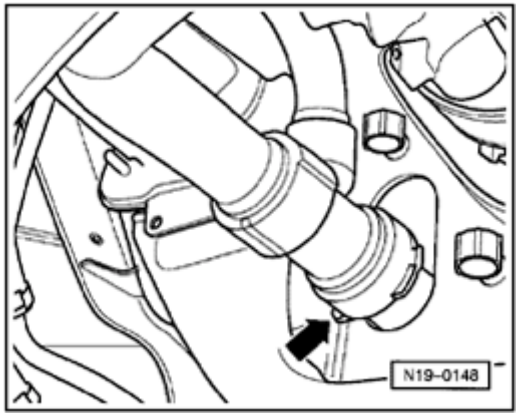
- Open coolant expansion tank cap.

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19-25



- Turn radiator drain plug (arrow) counterclockwise; if needed attach accessory hose to connection flange.



- Remove coolant hoses at radiator and remove clip from connecting flange (arrow).

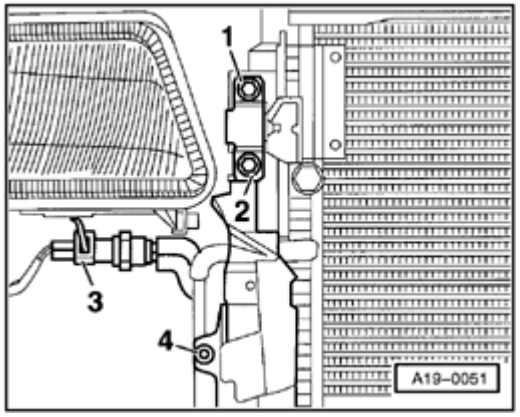
Vehicles with automatic transmission

- Remove ATF lines from radiator.

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

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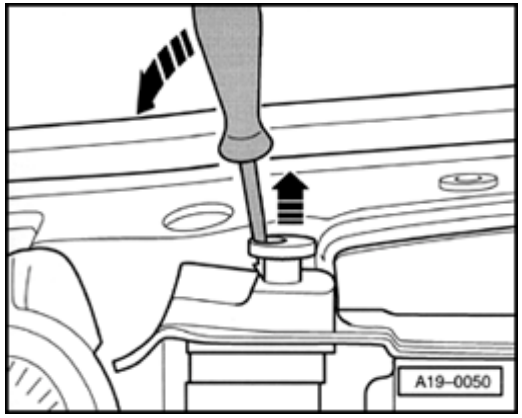
19-26



- Remove bolts -4- for air guides at radiator on left and right sides.
- Remove retaining bolts -1- and -2- from condenser.
- Disconnect harness connector -3- at A/C pressure switch -F129-.
- Pull condenser upward, out of retaining bracket, swing to side and hang at right-front wheel using wire loop.

Note:

Make sure fender is protected against possible damage.



- Unlock both radiator retaining bolts and pull upward to remove (arrows).
- Tilt radiator forward and remove toward top.

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Installing

Installation is the reverse of removal, noting the following:

- Fill up with coolant ⇒ Page 19-6 .

WARNING!

The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap using a cloth, and open carefully to relieve system pressure slowly.

Tightening torques

Component	Tightening torques
Condenser to radiator	10 Nm (7 ft lb)
Coolant line to radiator	10 Nm (7 ft lb)

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19-28

Cooling system, pressure test

Special tools and equipment

- VAG1274 cooling system tester
- VAG1274/1 adapter or VAG1274/8 with VAG1274/9

Test condition:

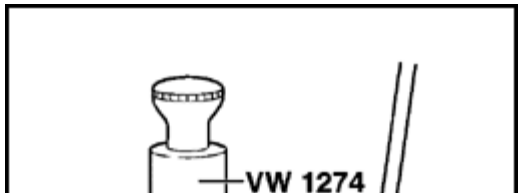
- Engine at operating temperature

WARNING!

The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap using a cloth, and open carefully to relieve system pressure slowly.

- Open coolant expansion tank cap.

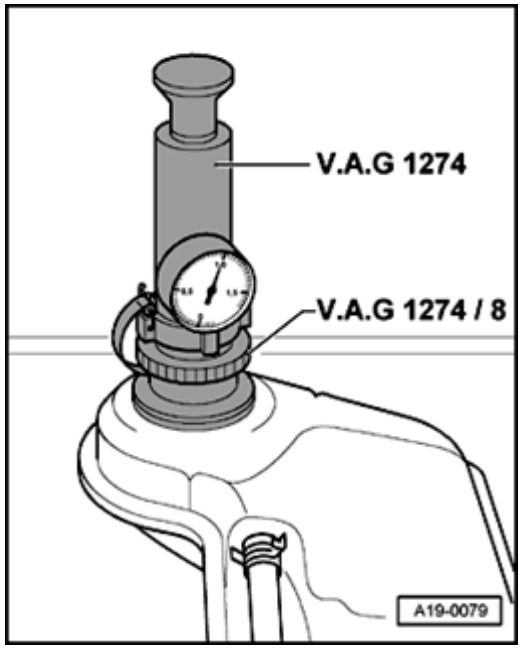
Vehicles with small cap



- Using VAG1274/1 adapter, attach VAG1274 cooling system tester to coolant expansion tank.

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19-29



Vehicles with large cap

- Using VAG1274/8 adapter, attach VAG1274 cooling system tester to coolant expansion tank.

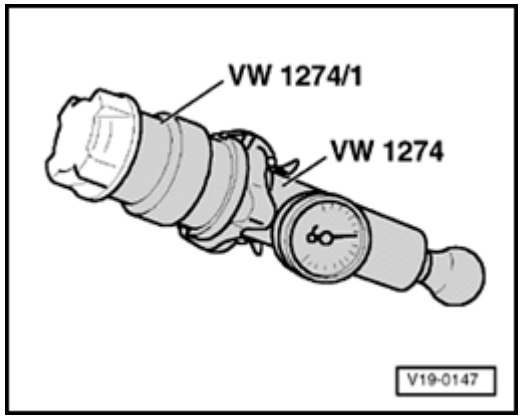
All models

- Use tester hand pump to create approx. 1.0 bar (14.5 psi) pressure.
- If pressure drops, check for leaks and repair.

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Pressure relief valve in cap, checking

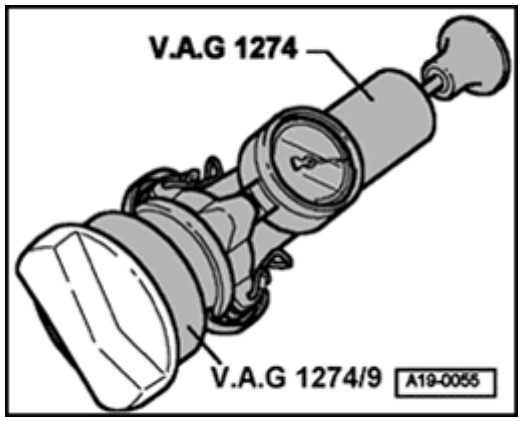
Vehicles with small cap



- Using VAG1274/1 adapter (2 parts), attach VAG1274 cooling system tester to coolant expansion tank cap.
- Pump using hand pump.

  Pressure relief valve must open at 1.2-1.5 bar (17.4-21.75 psi).

Vehicles with large cap



- Using VAG1274/9 adapter attach VAG1274 cooling system tester to coolant expansion tank cap.
- Pump using hand pump.

  Pressure relief valve must open at 1.4-1.6 bar (20.3-23.2 psi).

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21-1

Turbocharger system

Note:

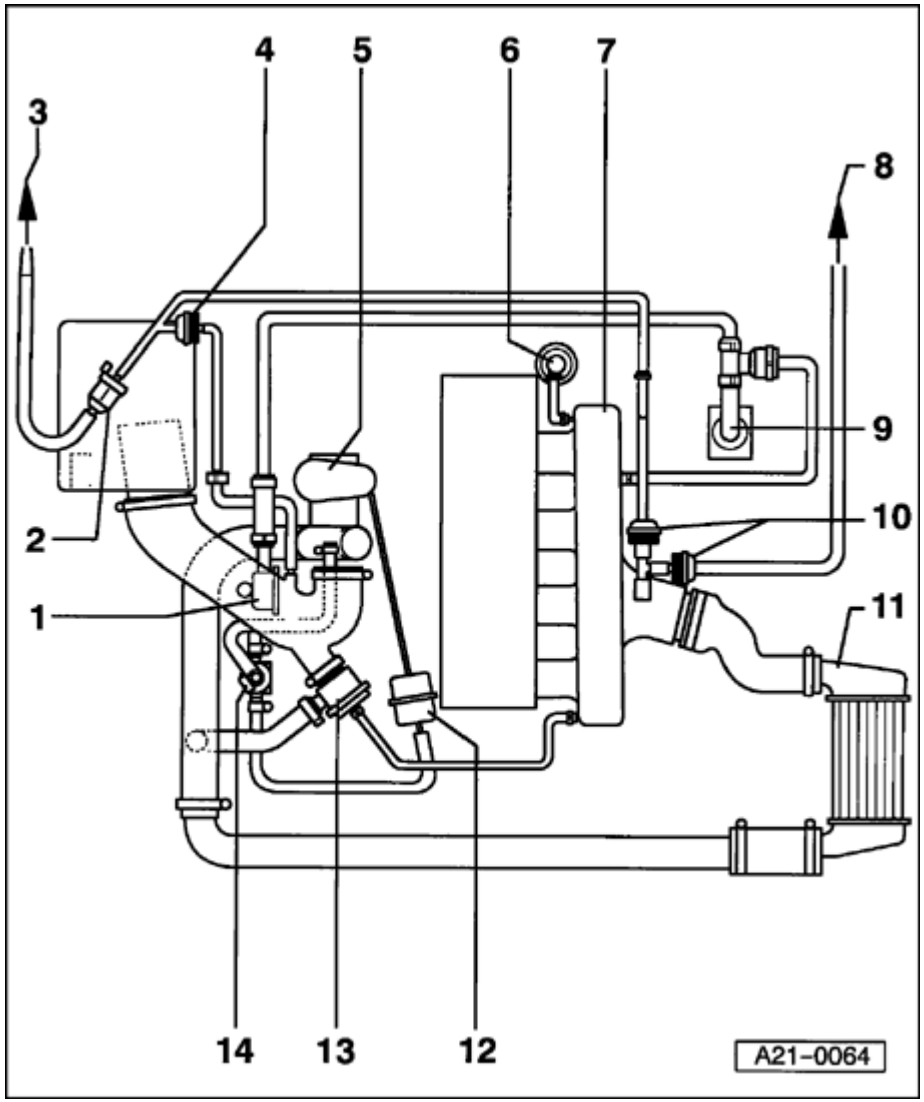
- *Observe rules of cleanliness ⇒ Page 21-22 .*
- *Charge air pressure control connection diagram ⇒ Page 21-2 .*
- *All hose connections are secured with hose clamps:*

⇒ parts catalog.

- *charge air pressure system must be free of leaks.*
- *Replace self-locking nuts.*
- *Always replace gaskets.*

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21-2



Charge air pressure control, system overview

Vehicles with manual transmission

1 - PCV valve

- For crankcase ventilation

2 - Evaporative Emission (EVAP) canister purge regulator valve -N80-

3 - To Evaporative Emission (EVAP) canister

4 - Check valve for Evaporative Emission (EVAP) canister

- Installed position (light/dark): as shown in illustration

5 - Turbocharger

6 - Fuel pressure regulator

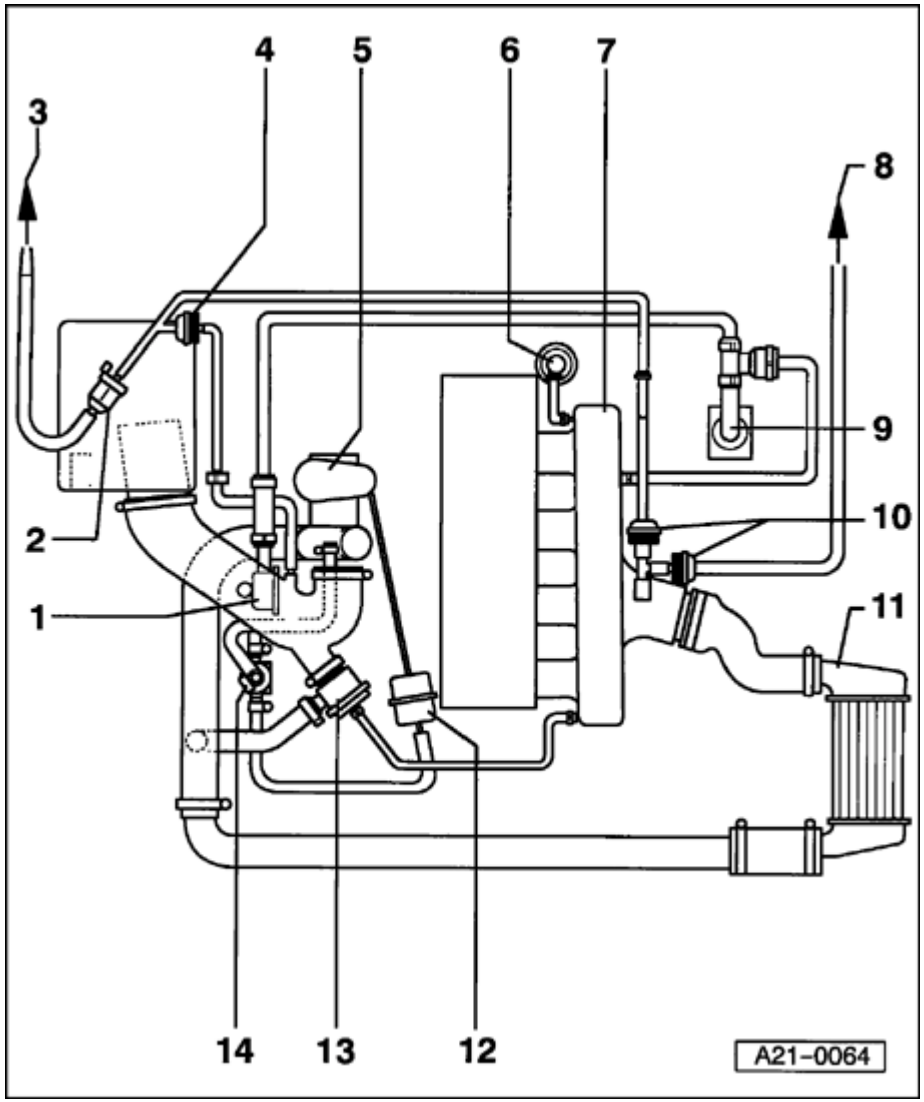
7 - Intake manifold

8 - To Leak Detection Pump (LDP) -V144-

9 - Crankcase ventilation

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21-3



10 - Check valve for Evaporative Emission (EVAP) canister

- Installed position (light/dark): as shown in illustration

11 - Charge air cooler

12 - Vacuum diaphragm

- For wastegate

13 - Charge pressure bypass valve

- Checking ⇒ Page 21-4

14 - Wastegate bypass regulator valve -N75-

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21-4

Charge pressure bypass valve, checking

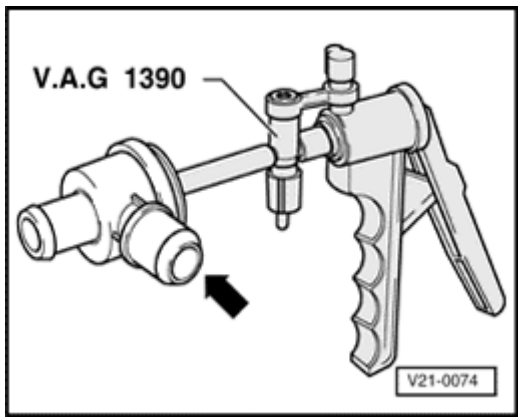
Note:

- *The charge pressure bypass valve is located in front of the turbocharger. It is opened by vacuum during deceleration and when under partial load at idle. This reduces charge air pressure in front of the throttle valve and keeps the turbocharger spinning at higher RPMs.*

- *Check the charge pressure bypass valve if experiencing reduced performance or turbo lag.*

Special tools and equipment

VAG1390 hand vacuum pump



- Connect VAG1390 hand vacuum pump to vacuum connection on recirculation valve.
- Operate hand vacuum pump.

  Recirculation valve must open (arrow).
- After approx. 30 seconds, operate vent valve on hand vacuum pump.

  Recirculation valve must close (arrow).

If valve does not open/close or valve plate does not seal correctly when valve is closed:

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- Replace valve and secure recirculation shut-off valve connections using hose clamps.

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21-5

Turbocharger and wastegate, checking

If special testing equipment is required during test drive, heed the following WARNING:

WARNING!

- ***When driving or riding in an airbag-equipped vehicle, NEVER hold the scan tool or other test equipment in your hands or lap while in motion. Objects between you and the airbag increase the risk of injury in an accident.***

- ***During a test drive in an airbag-equipped vehicle, test equipment must always be fastened to and operated from the rear seat by a second technician.***

Special tools and equipment

- VAG1397A turbocharger tester

- VAG1551 scan tool with VAG1551/3 adapter

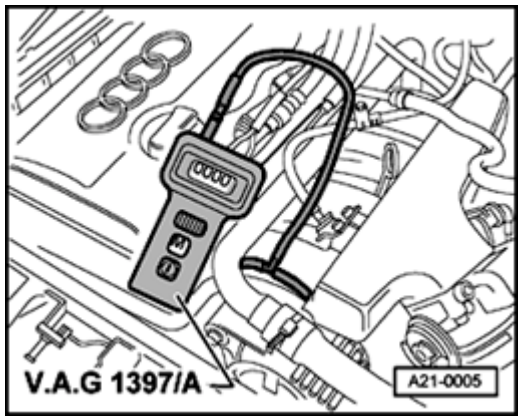
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21-6

Test conditions:

- Check DTC memory Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01
- Perform output diagnostic test mode (function 03)
- Minimum engine oil temperature: 60 ° C (140 ° F)
- All vacuum connections are free of leaks

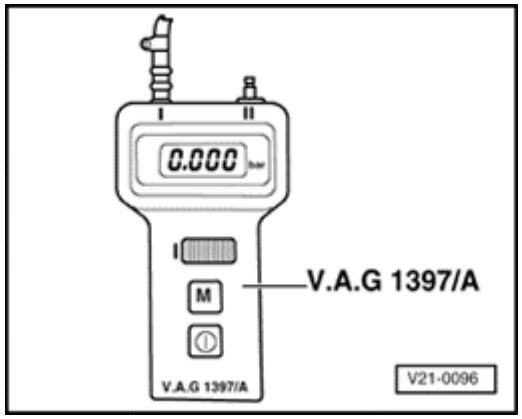
Test procedure



- Using T-fitting, connect VAG1397A turbocharger tester test hose to front of intake manifold.
- Guide test hose over rear corner of hood through right window opening into vehicle interior.

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21-7



- Turn turbocharger tester on and select measuring range -I- (absolute pressure).
- Connect test hose to connection flange -I-.

Note:

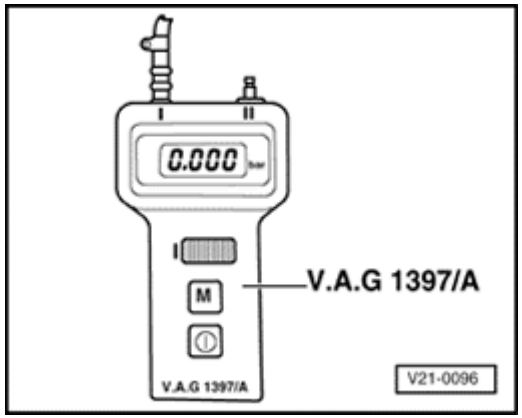
- *Hoses must be connected so there is no possibility of leaks, otherwise incorrect readings may result.*
- *Ensure test hose is not pinched at the hood and/or window.*
- *By pressing the memory button "M" on the turbocharger tester, the last test value is stored until either memory button "M" is pressed again or the turbocharger tester is shut off.*
- *A blinking comma in the display field indicates a value has been stored.*
- *An arrow appears in the top left corner of the display field if the turbocharger tester battery voltage drops below the allowed specification.*
- *Before testing, drive vehicle briskly for at least 3 km (approx. 2 miles) without frequent stops.*

WARNING!

- ***Always use a second technician to take measurements via the VAG1397A turbocharger tester when test-driving vehicle for this test.***
- ***Follow "WARNING!"*** ⇒ ***Page 21-5*** .

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Vehicles with manual transmission:

- Accelerate vehicle in 3rd gear at full throttle from 2000 RPM and watch tachometer.
- At 3000 RPM press memory button "M" on turbocharger tester.

  Specification: 1.37-1.47 bar (19.865-21.315 psi)

Vehicles with automatic transmission:

- Drive with selector lever in range 2.
- Accelerate to 3000 RPM and wait for transmission to shift into 2nd gear.
- Press accelerator pedal to kickdown position (transmission will not shift down at this vehicle/engine speed).
- At 4500 RPM, press memory button "M" on turbocharger tester.

  Specification: 1.3-1.4 bar (18.85-20.30 psi)

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Note:

For vehicles with automatic transmission the charge air pressure test may not always provide a definitive reading of proper charge air pressure regulation. If pressure readings are at the lower end of the specified range, measure charge air pressure control via load signal ⇒ Page 21-10 .

All vehicles:

If measured value is above or below specification Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 24.

Note:

If no charge air exists and a rumbling sound is heard from the engine compartment, the causes are as follows:

- *Charge pressure bypass valve malfunctioning.*
- *Vacuum line to charge pressure bypass valve leaking or disconnected.*

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21-10

Charge air pressure control (via load signal), checking

WARNING!

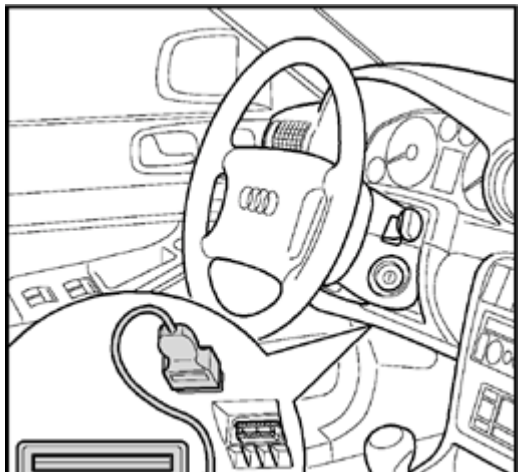
- ***Always use a second technician to take measurements via the VAG1397A turbocharger tester when test-driving vehicle for this test.***

- ***Follow "WARNING!"*** ⇒ ***Page 21-5*** .

Note:

If VAG1551 scan tool is not available, use VAG1552 mobile scan tool instead.

- Unclip Data Link Connector (DLC) cover.



- Using VAG1551/3 adapter, connect VAG1551 Scan Tool (ST) or VAG1552 mobile scan tool.

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VAG - ON BOARD DIAGNOSTIC HELP

1 - Rapid data transfer

2 - Blink code output

➢ Indicated on display[1)]

[1)] Operating modes 1 and 2 are displayed alternately

Note:

If nothing appears on display:

⇒ *Scan tool operating instructions*

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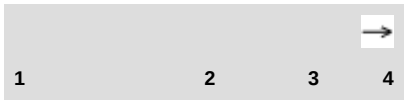
21-11

- Press button 1 to select "Rapid data transfer" operating mode 1.

- Start engine.

Rapid data transfer HELP **Select function XX**	⮜	Indicated on display
Rapid data transfer Q **01 - Engine Electronics**	⮜	- Press buttons -0- and -1- to insert "Engine Electronics" address word 01. - Press -Q- button to confirm input.
06A906018.. 1.8l R4/5T MOTR HS 0.. → **Coding 04000 WSC 12345**	⮜	VAG1551 scan tool display indicates control module coding. - Press →button.
Rapid data transfer HELP **Select function XX**	⮜	Indicated on display - Press buttons -0- and -8- to select "Read Measuring Value Block" function 08. - Press -Q- button to confirm input.
Read Measuring Value Block HELP **Input display group number XXX**	⮜	Indicated on display - Press buttons -1-, -1- and -4- to input display group number 114 (114). - Press -Q- button to confirm input.
Read Measuring Value Block 114	⮜	The "Read Measuring Value Block" displays four display fields.

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Interpreting values 1-4 in each display field ⇒ Page 21-12 .

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Interpreting display fields

Indicated on display:

Display field	Description
1	Not applicable
2	Specified engine load (after correction)
3	Current engine load
4	Duty cycle (actuation of wastegate bypass regulator valve -N75-)

- Note values in display field 2 and 3 while vehicle is under steady acceleration.

Specification

Deviation between display field 2 and 3: 0.3 ms (max.)

Note:

If the OBD for the Engine Control Module (ECM) recognizes Diagnostic Trouble Codes (DTCs) in charge air pressure regulation, duty cycle (display field 4) will indicate a constant 5%.

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21-13

Diagnostic Trouble Codes (DTC) for charge air pressure regulation

Diagnostic Trouble Code (DTC)	VAG1397A Display	VAG1551 Display	Possible causes
Charge air pressure too low	• Measured value below 1.37 bar (19.9 psi) (vehicles with manual transmission) • Measured value below 1.30 bar (18.9 psi) (vehicles with automatic transmission)	• Current engine load (display field 3) less than specified engine load (display field 2) • Duty cycle (display field 4) close to 99%	♦ Wastegate bypass regulator valve -N75- malfunctioning ♦ Wiring to wastegate bypass regulator valve -N75- malfunctioning ♦ Wastegate in turbocharger stuck in open position ♦ Leak between turbocharger and intake manifold ♦ Turbocharger malfunctioning
Charge air pressure too high [1)]	• Measured value above 1.47 bar (21.3 psi) (vehicles with manual transmission) • Measured value above 1.40 bar (20.3 psi) (vehicles with automatic transmission)	• Current engine load (display field 3) higher than specified engine load (display field 2) • Duty cycle (display field 4) close to 0%	♦ Vacuum diaphragm for wastegate malfunctioning ♦ Hoses to vacuum diaphragm (for wastegate) over wastegate bypass regulator valve -N75- leaking ♦ Vacuum diaphragm wastegate in turbocharger stuck in closed position

[1)] If charge air pressure is too high, the fuel supply is shut off to protect the engine. The engine misfires at high engine speeds.

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21-14

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.

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- 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!).

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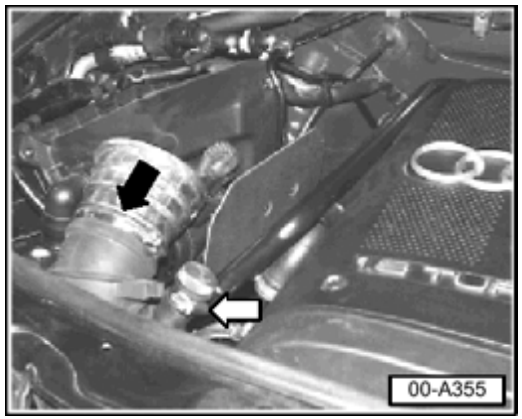
21-15

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.

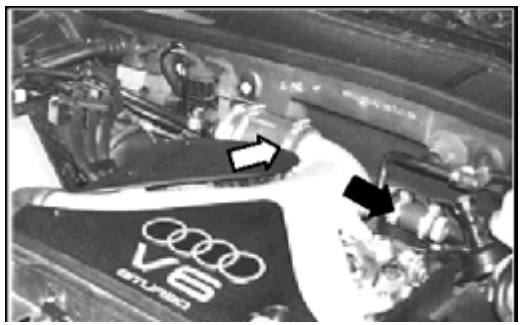


- Insert VAG 1687/1 pressure adapter in intake hose -black arrow- using existing clamp (as shown).
- Remove crankcase ventilation tube from intake hose at -white arrow-.

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

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1687/1 special tool kit.

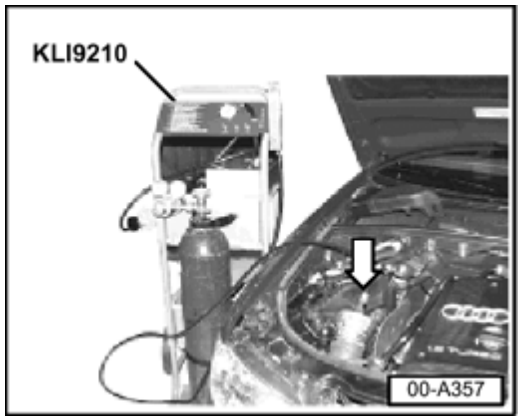
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Note:

- *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 ⇒ ⇒ Page 21-16 .*
- *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

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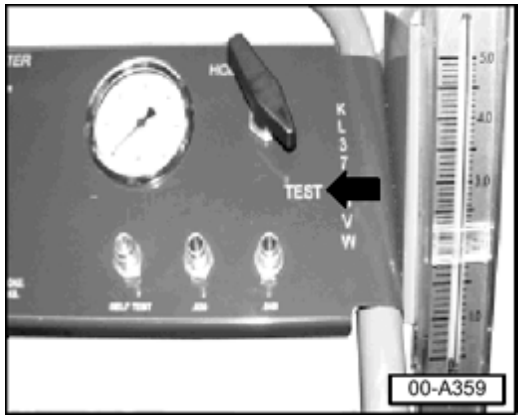
to VAG 1687/1 at arrow on 2.7L BiTurbo).

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21-17

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).

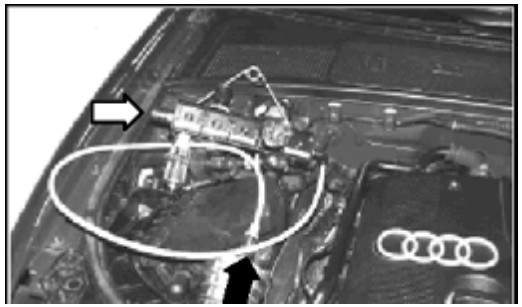
With system filled with smoke:

- Remove smoke generator hose and connect VAG1687 quickly to prevent smoke from leaking out ⇒ Page 21-17 .

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 21-19 .

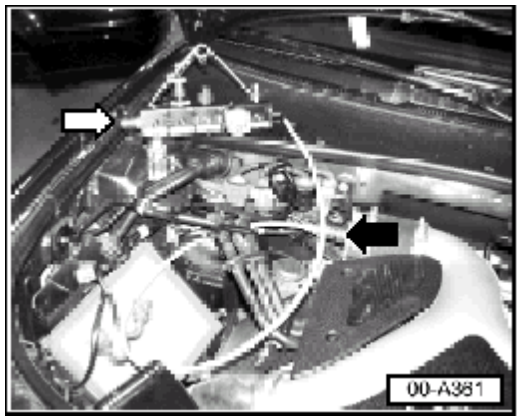
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21-18

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-

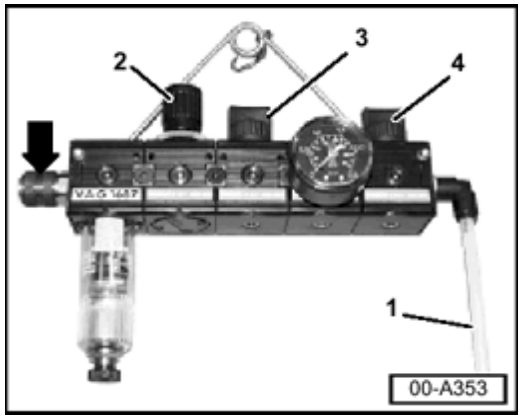
Shop air supply will be connected to VAG 1687 -at white arrow-

- Perform pressure test ⇒ Page 21-19 .

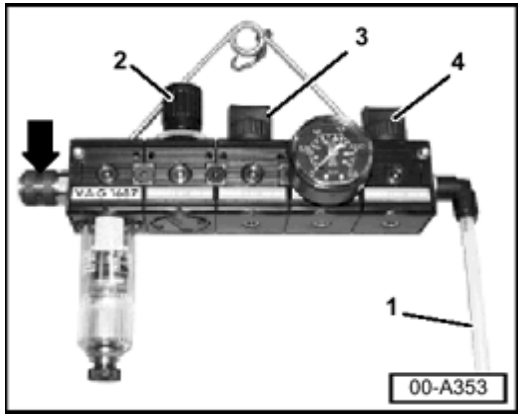
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21-19

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 21-14 .



- 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.

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21-20

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.

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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.

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21-21

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.

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21-22

Rules of cleanliness

CAUTION!

Whenever carrying out any work on the fuel supply or fuel injection systems, always observe the following rules of cleanliness.

1. Thoroughly clean fuel system line and hose connections and the surrounding area before disconnecting.

2. Place removed components on a clean surface and cover. Use plastic sheeting or paper. Do not use fluffy rags that could leave lint!

3. Carefully cover over or seal any components that have been opened if repairs are not carried out immediately.

4. Install only clean parts:

- Do not remove replacement parts from the packaging until immediately before they are to be installed.
- Do not use parts that have been stored without packaging (e.g. in toolboxes, etc.).

5. When the fuel system is opened:

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- Avoid working with compressed air whenever possible.
- Avoid moving the vehicle if possible.

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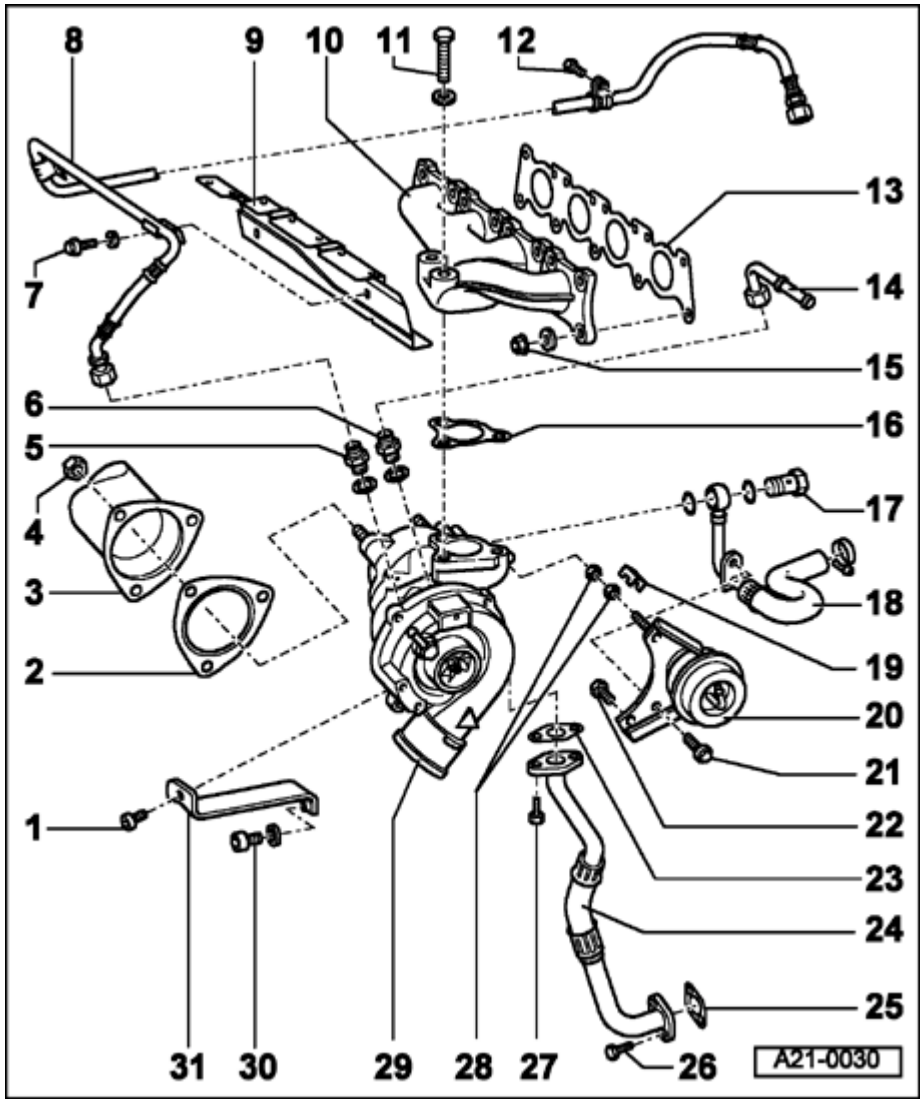
21-23

Note:

- *Observe rules of cleanliness ⇒ Page 21-22 .*
- *Charge air pressure control connection diagram ⇒ Page 21-2 .*
- *All hose connections are secured with hose clamps that comply with factory specifications ⇒ parts catalog.*
- *Charge air pressure system must be free of leaks.*
- *Always replace gaskets and self-locking nuts.*

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21-24



Turbocharger, removing, installing and overview

Part I

1 - Bolt with collar

- 40 Nm (30 ft lb)
- Only use genuine equipment bolts ⇒ parts catalog

2 - Gasket

- Always replace

3 - Three Way Catalytic Converter (TWC)

4 - Nut

- Always replace
- 30 Nm (22 ft lb)

5 - Connection

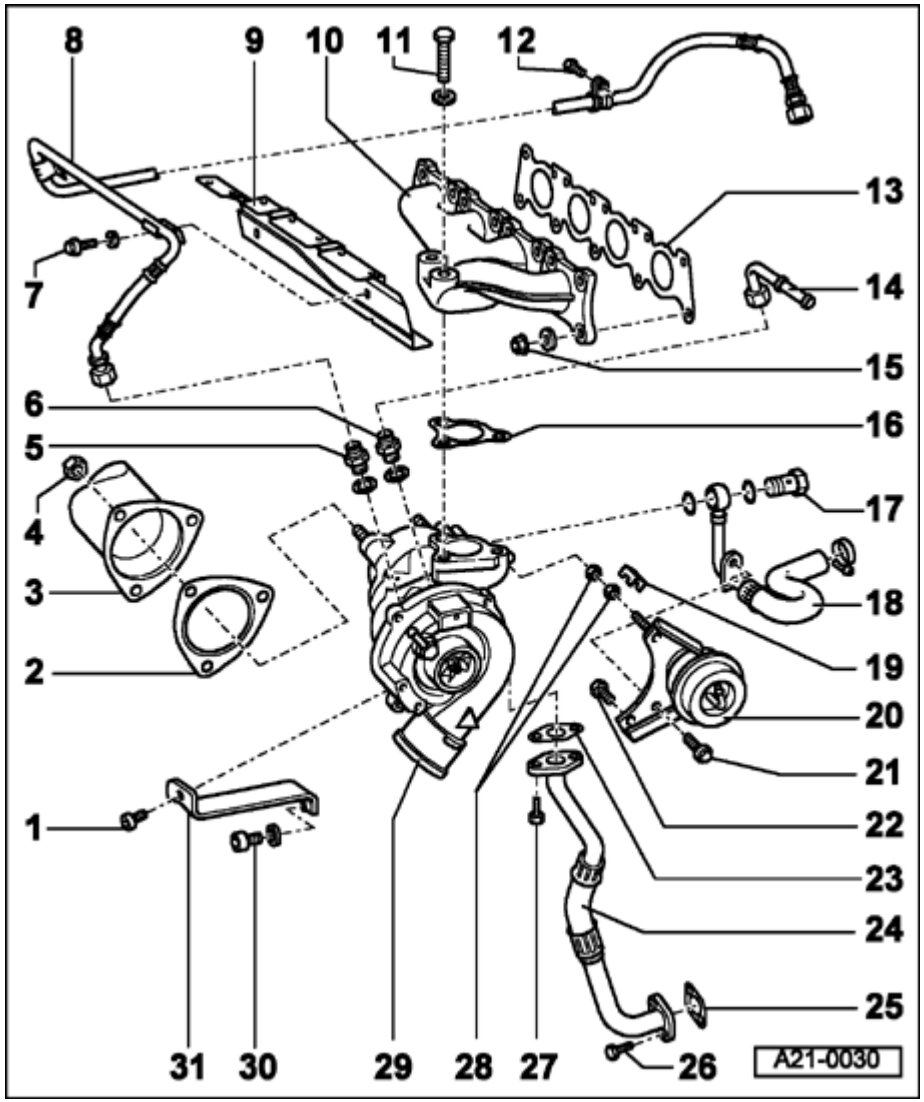
- 30 Nm (22 ft lb)

6 - Connection

- 35 Nm (26 ft lb)

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21-25



7 - Bolt

- 20 Nm (15 ft lb)

8 - Oil supply line

- Tightening torque for union nut: 25 Nm (18 ft lb)
- From oil filter bracket ⇒ item - 1 -, page ⇒ Page 17-6

9 - Heat shield

10 - Exhaust manifold

11 - Bolt

- Always replace
- 35 Nm (26 ft lb)
- Coat thread and bolt head seating surface with "G 052 112 A3" hot bolt paste.

CAUTION!

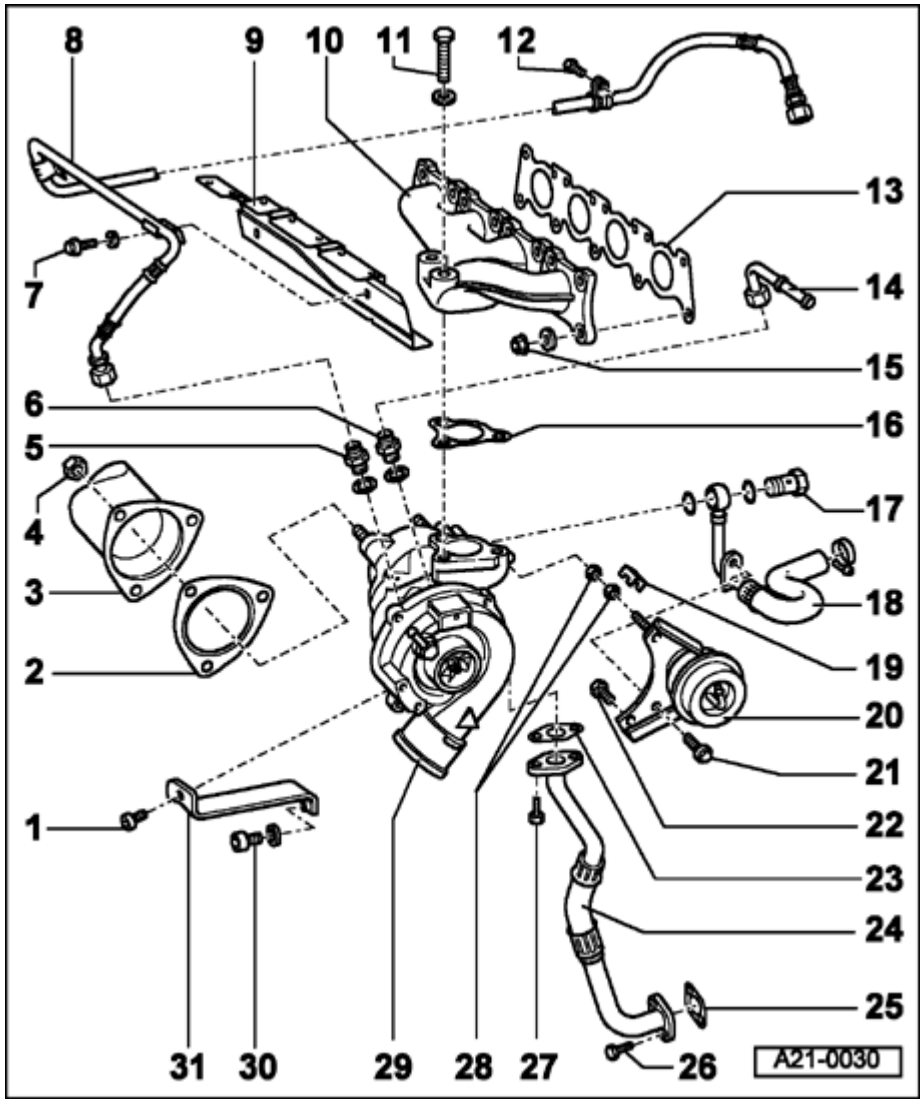
Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

12 - Bolt

- 10 Nm (7 ft lb)

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21-26



13 - Gasket

- Always replace
- Note installed position

14 - Coolant return line

- Union nut tightening torque: 30 Nm (22 ft lb)

15 - Nut

- Always replace
- 25 Nm (18 ft lb)

16 - Gasket

- Always replace
- Note installed position

17 - Banjo bolt

- 25 Nm (18 ft lb)

18 - Coolant supply line

19 - Fuse

20 - Vacuum diaphragm

- For wastegate

21 - Bolt

- 10 Nm (7 ft lb)

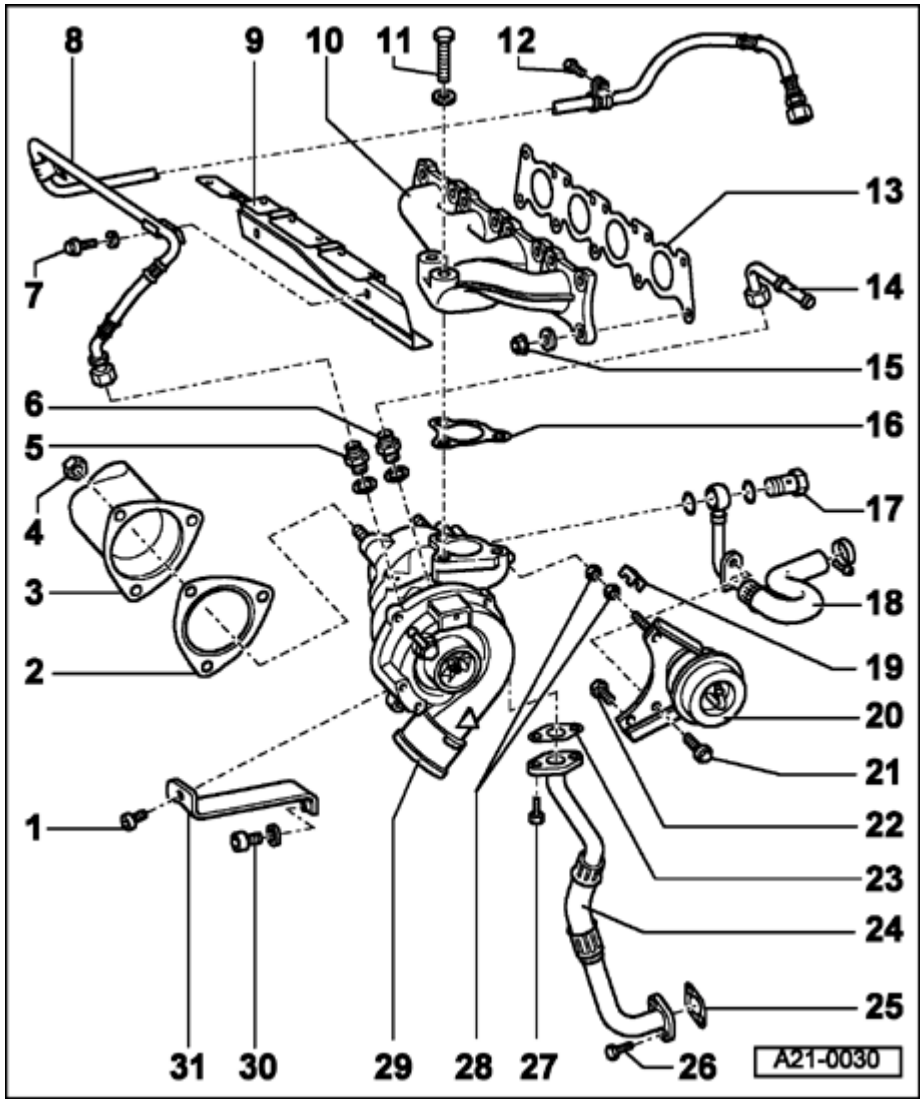
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22 - Bolt

- 10 Nm (7 ft lb)
- Install with D 000 600

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21-27



23 - Gasket

- Always replace

24 - Oil return line

- To oil pan

25 - Gasket

- Always replace

26 - Bolt

- 10 Nm (7 ft lb)

27 - Bolt

- 10 Nm (7 ft lb)

28 - Nuts

- 10 Nm (7 ft lb)
- Install with D 000 600
- Do not change adjustment

29 - Turbocharger

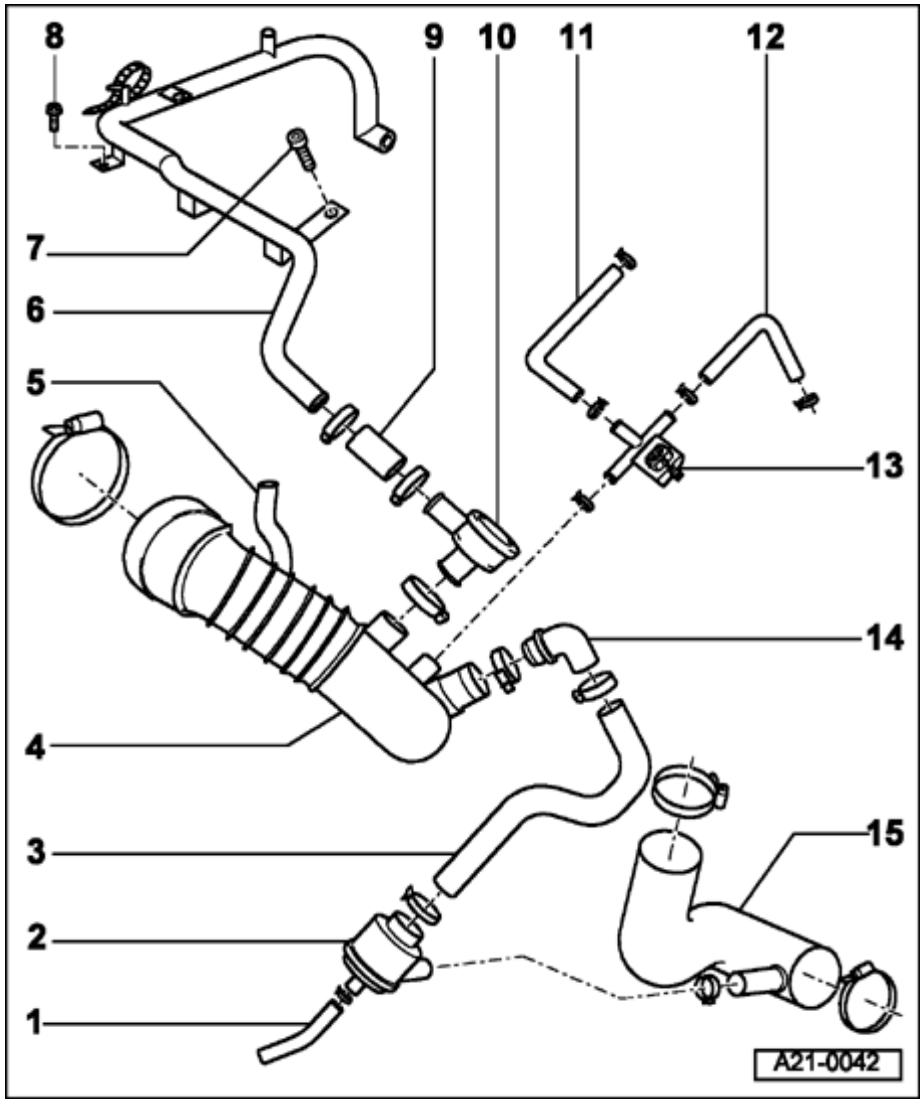
- Check ⇒ Page 21-5

30 - Bolt

- 45 Nm (33 ft lb)

31 - Bracket

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Part II

1 - Vacuum hose

- To intake manifold

2 - Charge pressure bypass valve

- Check ⇒ Page 21-4

3 - Hose

- To charge pressure bypass valve

4 - Intake air duct

- To connection at turbocharger

5 - Hose

- To Evaporative Emissions (EVAP) purge regulator valve

6 - Line

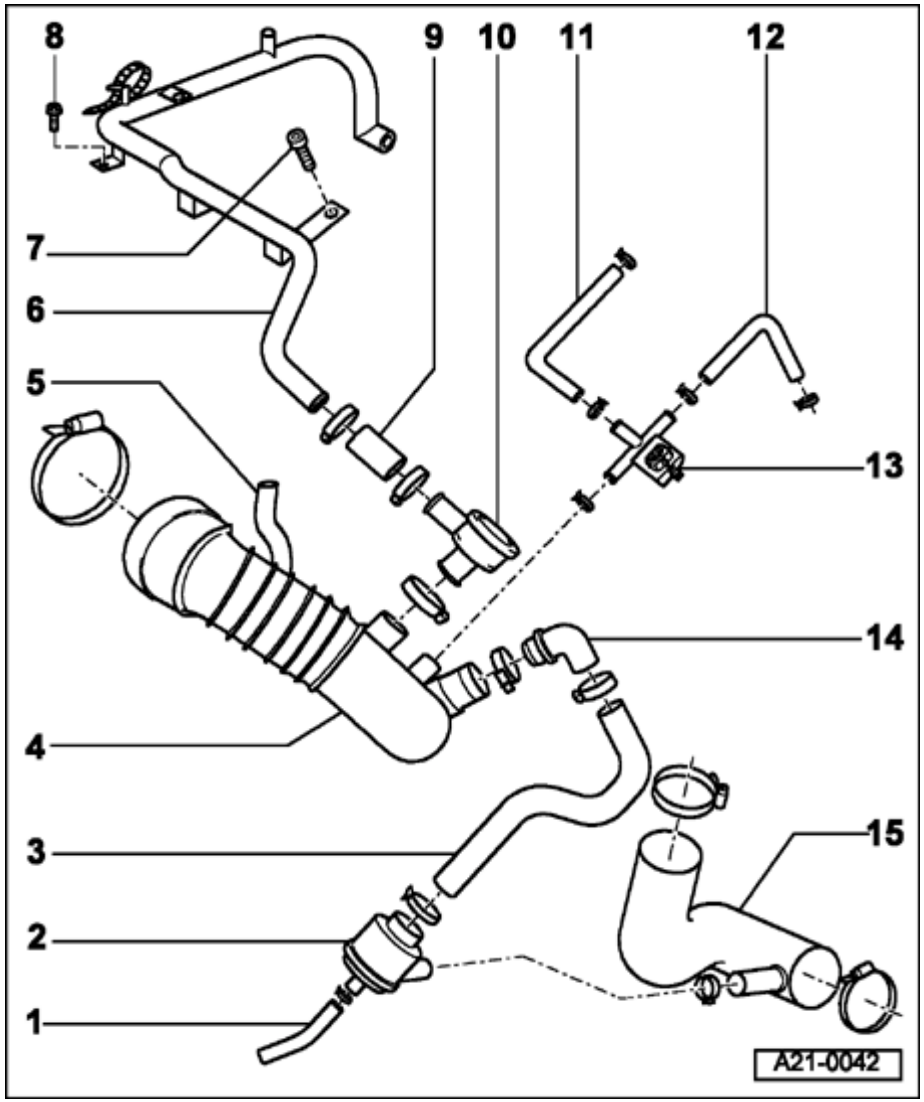
- To crankcase ventilation

7 - Socket-head bolt

- 10 Nm (7 ft lb)

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21-29



8 - Sheet metal screw

9 - Hose

- To crankshaft ventilation line

10 - PCV valve

- For crankcase ventilation

11 - Hose

- To turbocharger

12 - Hose

- To vacuum diaphragm for wastegate

13 - Wastegate bypass regulator valve -N75-

14 - Elbow

15 - Hose

- To turbocharger

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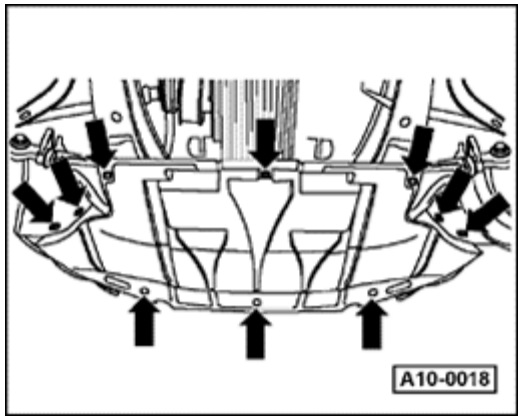
21-30

Turbocharger, removing and installing

Note:

Replace gaskets and self-locking nuts.

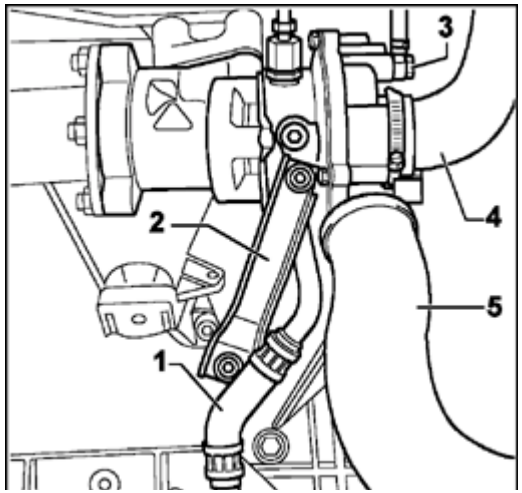
Removing



- Remove noise insulation panel (arrows).
- Unbolt A/C compressor.

WARNING!

Do NOT open A/C refrigerant circuit.



- Unbolt turbocharger bracket -2-.
- Disconnect oil return line -1- at turbocharger and lay aside.
- Remove air guide ducts -4- and -5- at turbocharger.
- Remove pressure line banjo fitting -3-.
- Disconnect hose from support for charge air pressure regulation valve vacuum diaphragm.
- Unbolt bracket for coolant supply line at charge air pressure regulation valve vacuum diaphragm.

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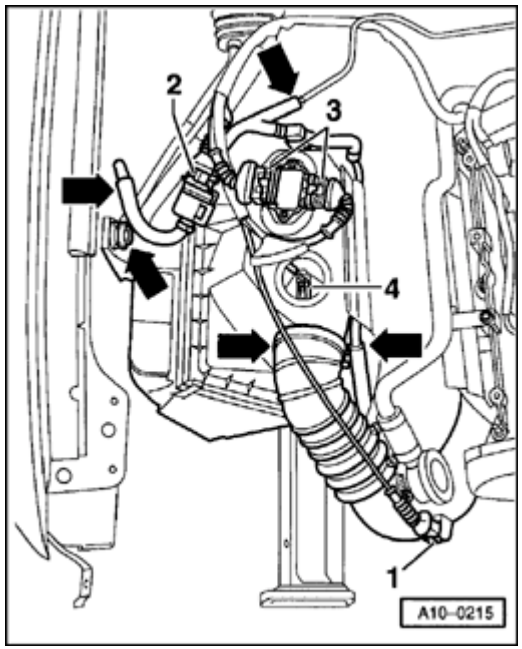
- Use 3094 hose clamp to pinch off coolant supply hose.

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21-31

- Remove intake air duct between cowl and air cleaner housing.

- Remove air cleaner housing cover.



- Remove the following lines/harness connectors:

1 - At wastegate bypass regulator valve -N75-

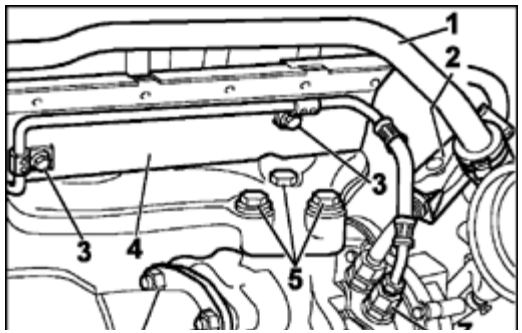
2 - At Evaporative Emissions (EVAP) purge regulator valve -N80-

3 - At power output stage -N122-

4 - At Mass Air Flow (MAF) sensor -G70-

- Remove hose connections and remove air cleaner housing (arrows).

- Remove engine covers.



- Unbolt crankcase ventilation hose -1- at cylinder head cover and heat shield.

- Unbolt both oil supply line bolts -3-.

- Remove heat shield -4-.

- Remove sleeve -2- from coolant return hose.

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- Use 3094 hose clamp to pinch off coolant return hose.

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- Remove coolant return hose at line to turbocharger. Line remains bolted to turbocharger.

- Unbolt oil supply line -7- at turbocharger.

Note:

The exhaust flexpipe must not be bent more than 10° , otherwise it may be damaged.

- Unbolt Three Way Catalytic Converter (TWC) from turbocharger -6-.

- Unbolt turbocharger from exhaust manifold -5- .

- Move turbocharger to side and remove coolant supply line banjo fitting.

- Remove turbocharger.

Installing

Installation is the reverse of removal, noting the following:

- Perform the following steps before tightening turbocharger:

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- Loosely bolt coolant supply line to vacuum diaphragm for charge air pressure regulation valve.

- Tighten banjo fitting, then tighten mounting bolt for bracket to proper torque.

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21-33

Note:

Add oil to turbocharger through oil supply line connection flange.

- Fill up coolant ⇒ Page 19-4 .

WARNING!

The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap with a cloth and open carefully to relieve system pressure slowly.

Note:

After installing the turbocharger, let engine idle for approx. 1 minute without increasing engine speed. This ensures adequate oil supply to the turbocharger.

- Check engine oil level ⇒ Page 17-27 .

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Tightening torques

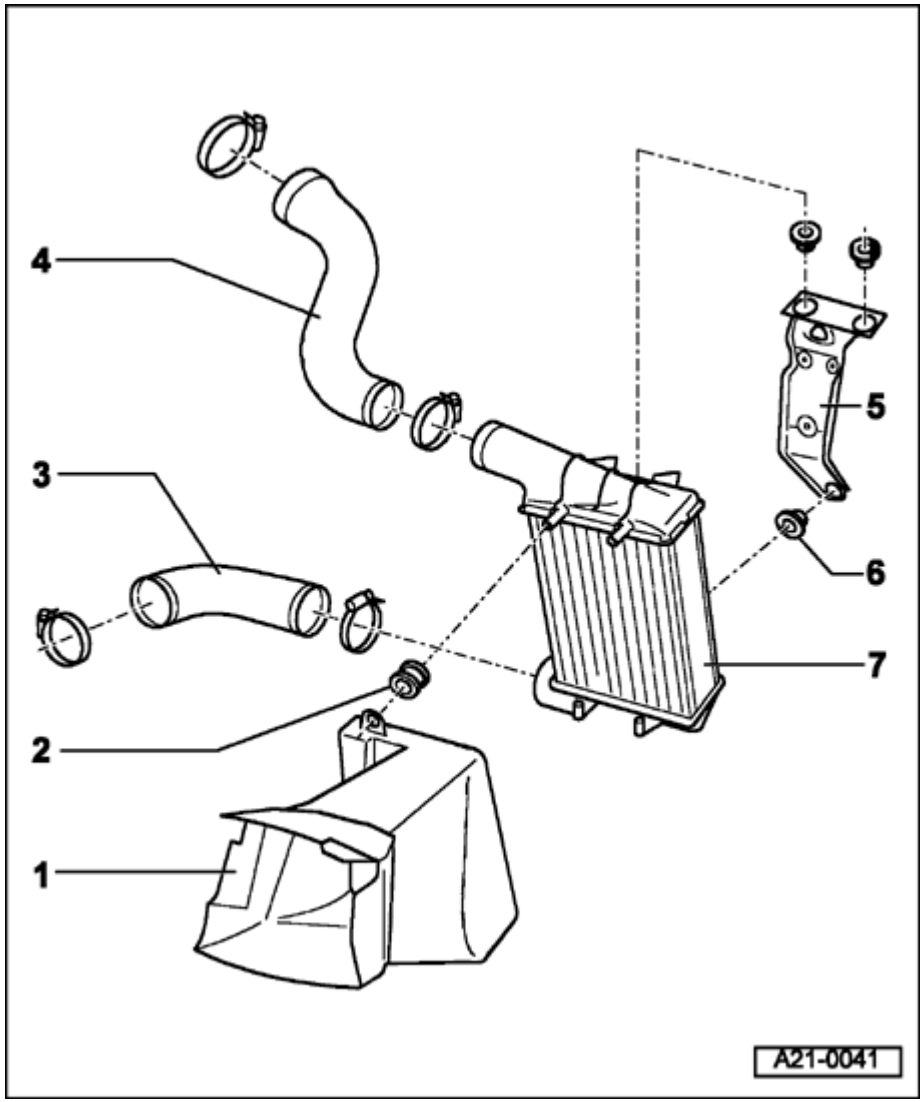
Component	Tightening torques
Oil return line to turbocharger	10 Nm (7 ft lb)
Turbocharger bracket to turbocharger (bolt and washer assembly M8)[1)]	40 Nm (30 ft lb)
Turbocharger bracket to cylinder block	45 Nm (33 ft lb)
Oil feed line to turbocharger	25 Nm (18 ft lb)
Coolant supply pipe bracket to turbocharger	10 Nm (7 ft lb)
Oil supply line bracket to cylinder head	20 Nm (15 ft lb)
Coolant supply line to turbocharger	25 Nm (18 ft lb)
Crankcase ventilation line to cylinder head	10 Nm (7 ft lb)
Coolant return line to turbocharger	30 Nm (22 ft lb)
Turbocharger to exhaust manifold	35 Nm (26 ft lb)
Three Way Catalytic Converter	30 Nm (22 ft

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(TWC) to turbocharger	lb)
1) Bolt strength: 10.9	

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21-35



Charge air cooler components, removing and installing

Note:

- *All hose connections are secured with hose clamps ⇒parts catalog.*
- *charge air pressure system must be free of leaks.*

1 - Air duct

2 - Grommet

3 - Hose

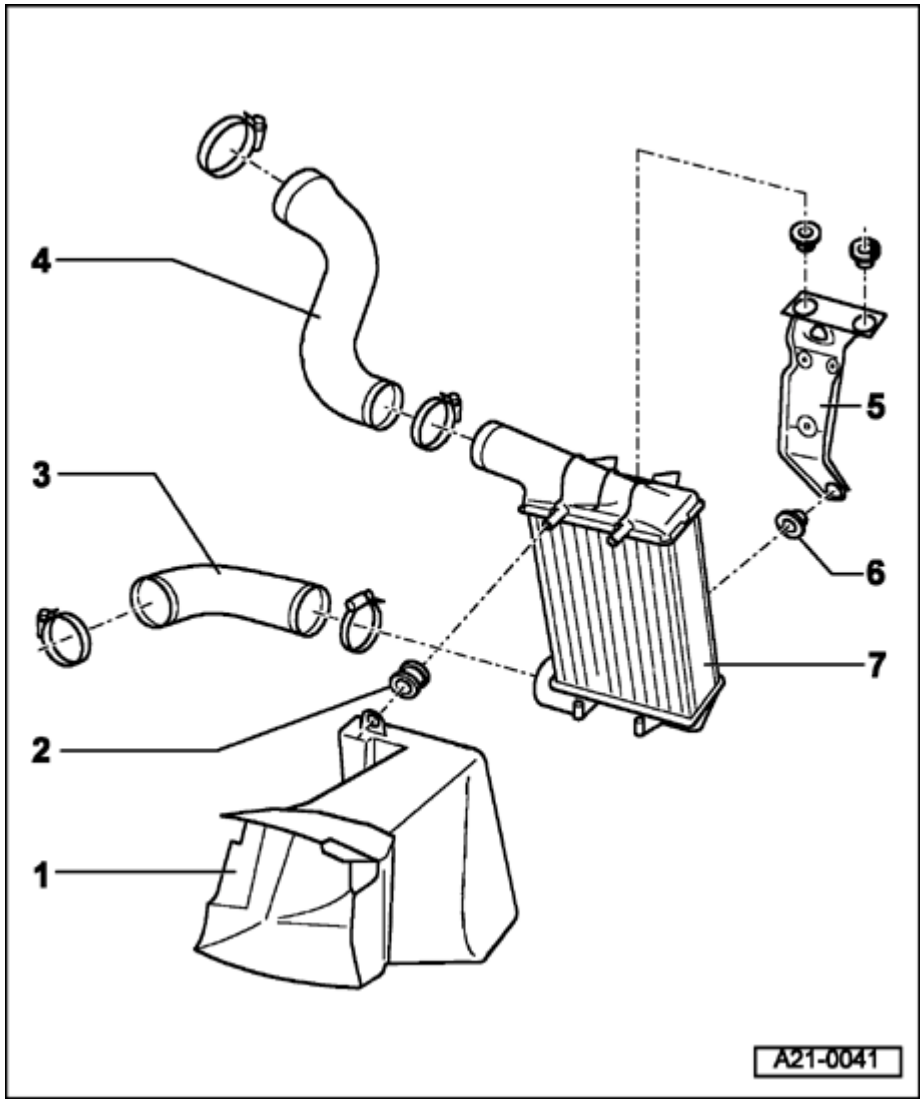
- Between charge air cooler and air guide in cowl

4 - Hose

- Between intake manifold and charge air cooler

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21-36



5 - Bracket

- Riveted to body

6 - Grommet

- With sleeve

7 - Charge air cooler

- Removing and installing ⇒ Page 21-37

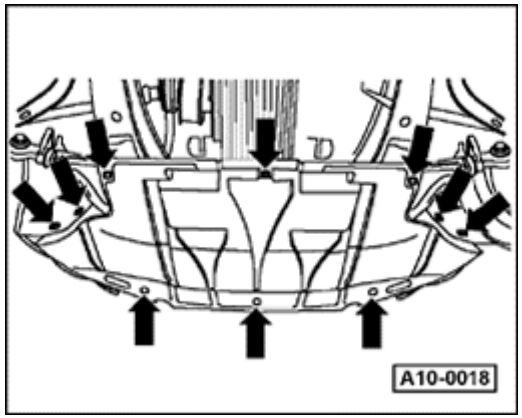
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21-37

Charge air cooler, removing and installing

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

Removing



- Remove upper air duct at charge air cooler.
- Remove noise insulation panel (arrows).
- Disconnect air guide at charge air cooler.
- Remove lower air duct at charge air cooler.
- Remove charge air cooler from below.

Installing

Installation is the reverse of removal.

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Vacuum control system (engine code ATW)

Notes:

- *Observe rules for cleanliness* ⇒ *Page 21-39*
- Observe safety precautions ⇒ Page 21-40
- *Always replace gaskets, O-rings and self-locking nuts and bolts.*
- *Secure all hose connections using original equipment type hose clamps:*

⇒ *Parts catalog*

- *Before performing a test or repair, check all hoses and wires for proper seating and seal.*

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Rules of cleanliness

When working on the vacuum control system, charge air pressure regulation or at the secondary air system hoses, always observe the following rules of cleanliness:

- Thoroughly clean all connections and the surrounding area before disconnecting.
- Place parts that have been removed on a clean surface and cover. Use lint-free cloths only!
- Carefully cover over opened components or seal, if repairs are not 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 (in tool boxes etc.)
- If possible, do not work with pressurized air. Do not move vehicle unless absolutely necessary.

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21-40

Safety precautions

If special testing equipment is required during test drive, note the following:

Do not operate test and measuring equipment from the passenger seat. In the event of an accident involving deployment of the passenger-side airbag, the person seated there could be injured.

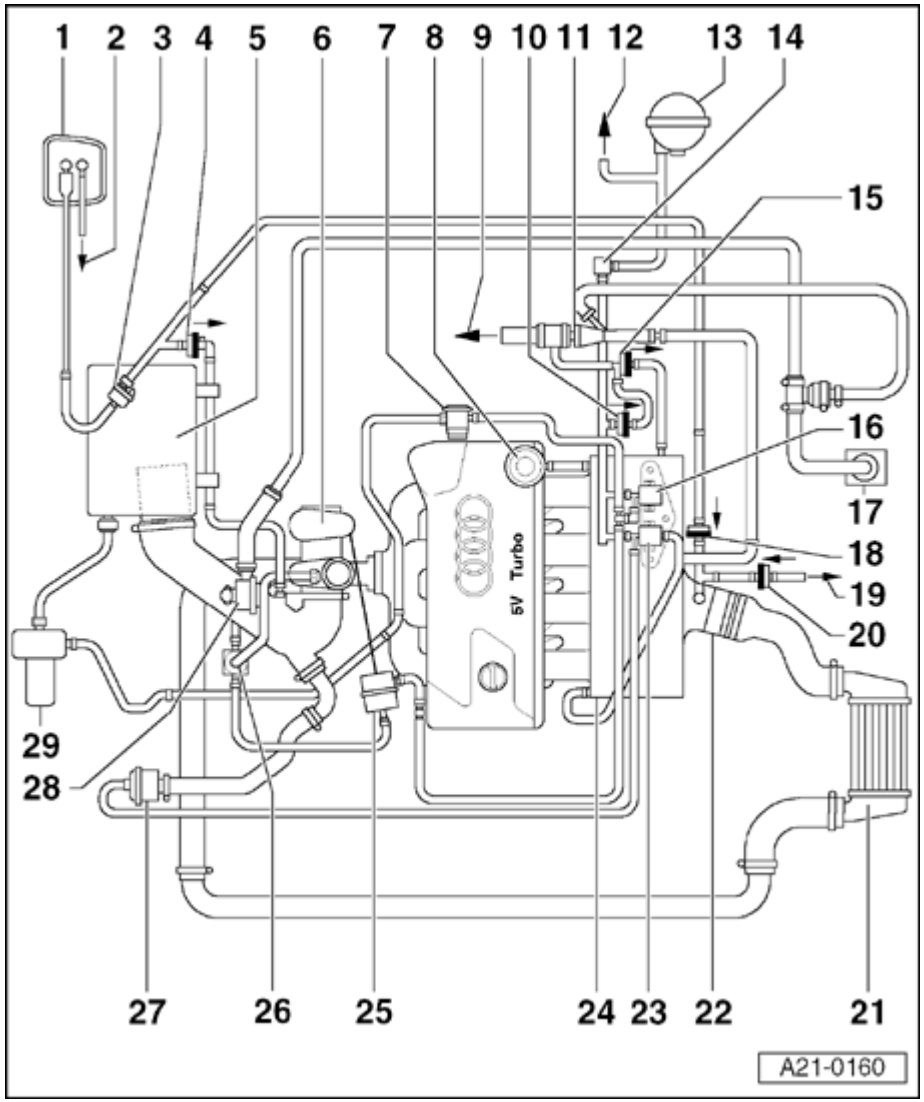
WARNING!

- ***When driving or riding in an airbag-equipped vehicle, NEVER hold the scan tool or other test equipment in your hands or lap while in motion. Objects between you and the airbag increase the risk of injury in an accident.***

- ***During a road test in an airbag-equipped vehicle, test equipment must always be fastened to and operated from the rear seat by a second technician.***

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Charge air pressure regulation and secondary air system vacuum control system

1 - EVAP canister

2 - From fuel tank

3 - Evaporative Emission (EVAP) canister purge regulator valve -N80-

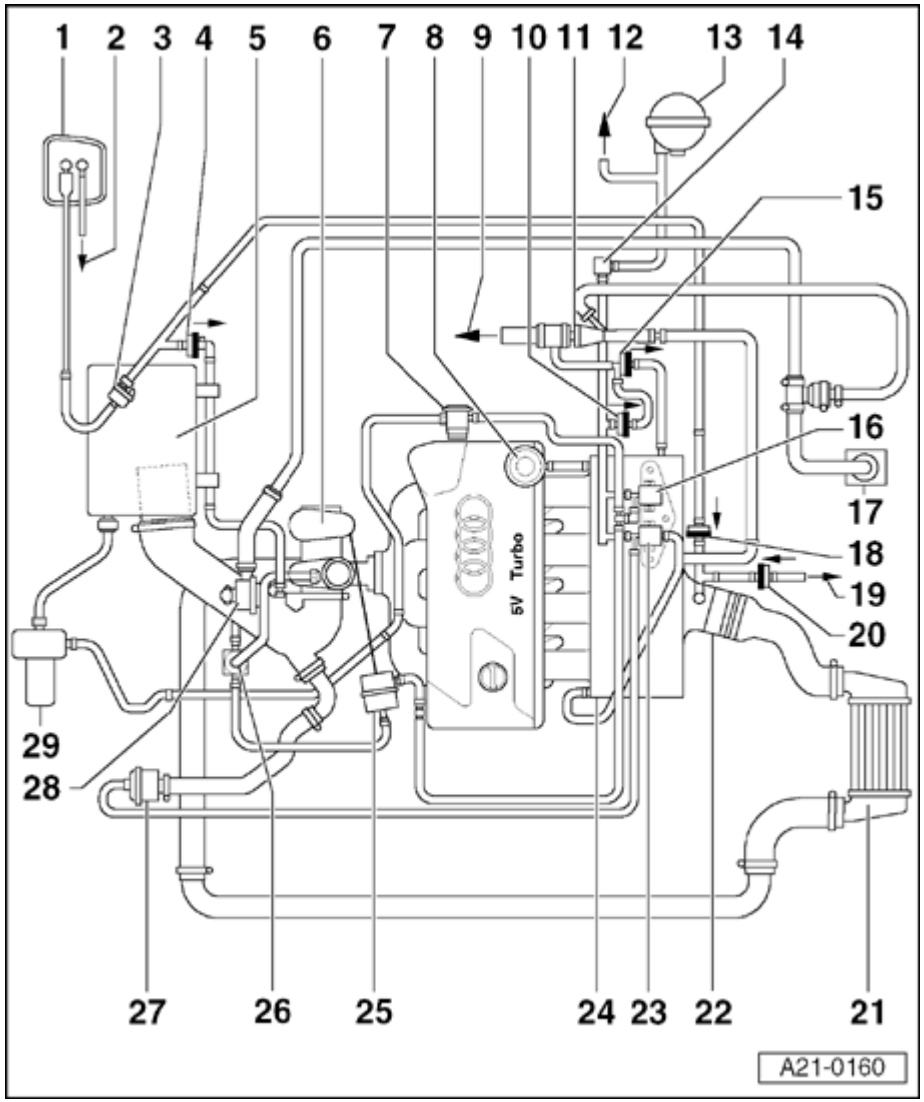
4 - Check-valve for EVAP canister

- Between EVAP canister and intake manifold before turbocharger
- Installation position (light/dark side): Arrow points in direction of flow, as shown

5 - Air cleaner

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21-42



6 - Turbocharger

- Check charge air pressure ⇒ Page 21-54

7 - Combination valve for secondary air injection (AIR)

8 - Fuel pressure regulator

9 - To power brake booster

10 - Check valve

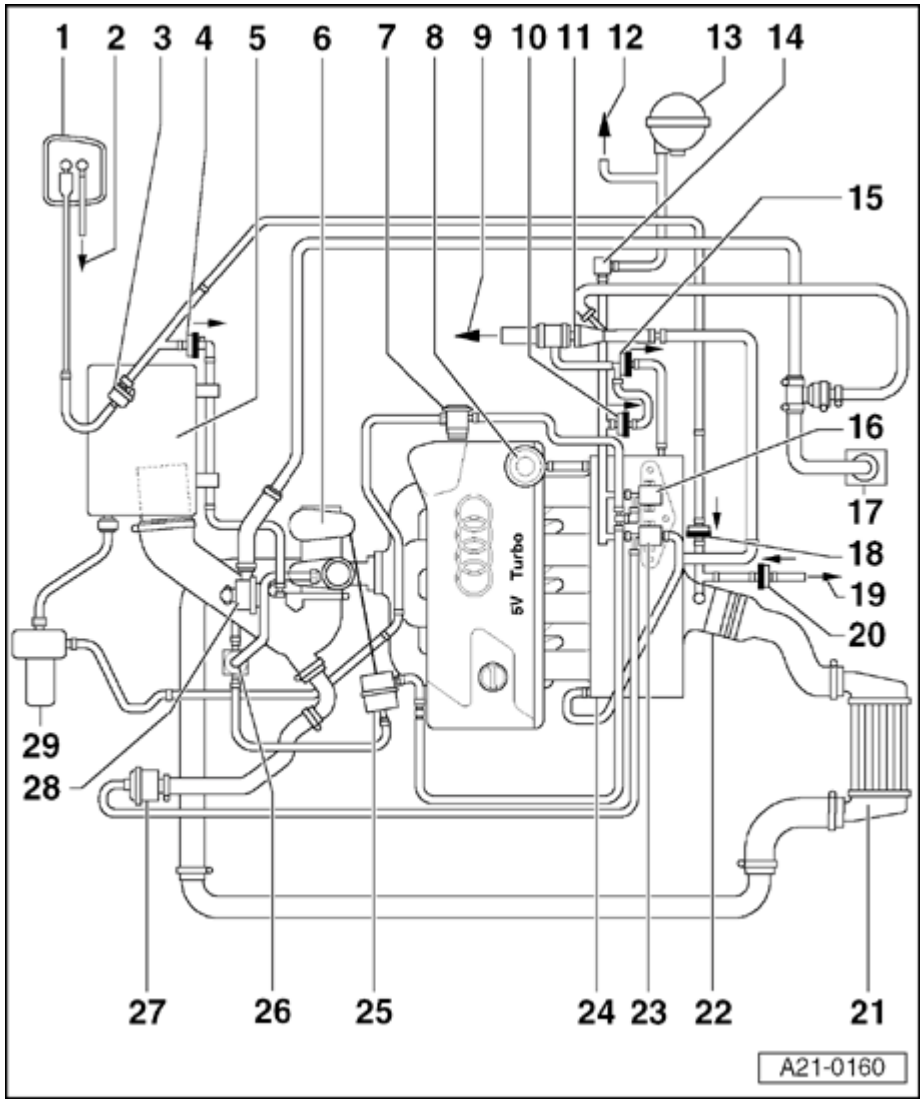
- Installation position (light/dark side): Arrow points in direction of flow, as shown

11 - Vacuum booster

12 - To Leak Detection Pump (LDP)

13 - Vacuum reservoir

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14 - Distributor piece

15 - Check valve

- Installation position (light/dark side): Arrow points in direction of flow, as shown

16 - Secondary Air Injection (AIR) solenoid valve -N112-

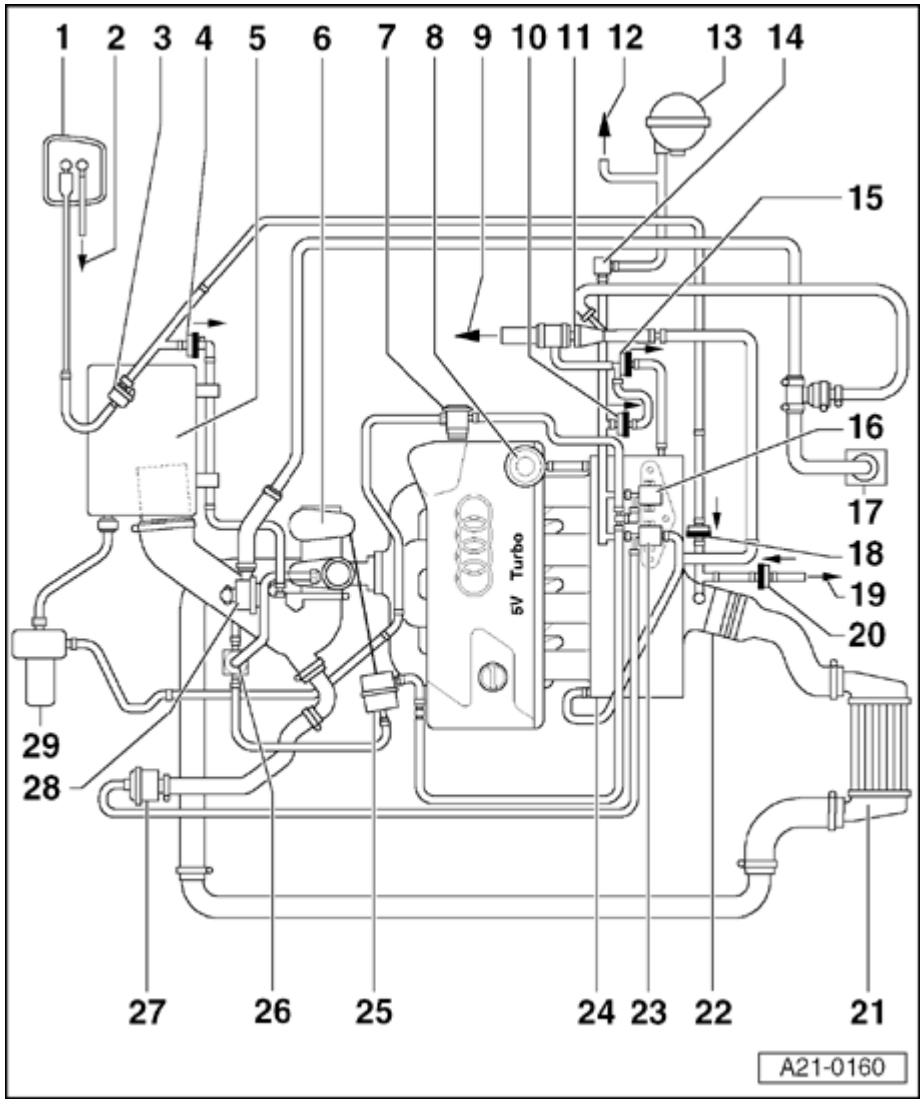
17 - Crankcase vent

18 - Check valve

- Installation position (light/dark side): Arrow points in direction of flow, as shown

19 - To tank Leak Detection Pump (LDP) - V144-

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20 - Check valve

- Installation position (light/dark side): Arrow points in direction of flow, as shown

21 - Charge air cooler

- With charge air pressure sensor -G31-

22 - Throttle valve control module -J338-

23 - Recirculating valve for turbocharger - N249-

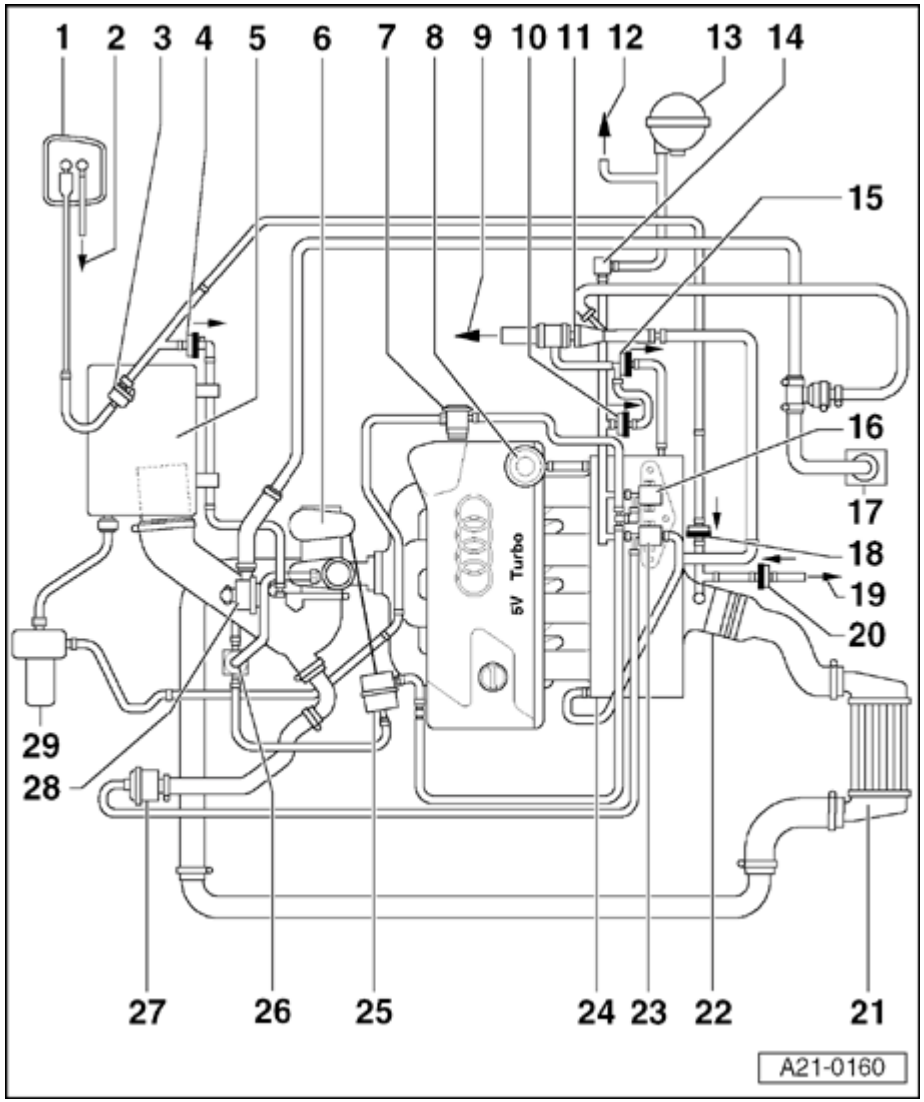
- Checking ⇒ Page 21-48

24 - Intake manifold

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

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21-45



25 - Pressure unit for charge air pressure regulation

26 - Wastegate bypass regulator valve -N75-

27 - Mechanical recirculation valve

- Checking ⇒ Page 21-46

28 - Pressure control valve for crankcase ventilation

29 - Secondary Air Injection (AIR) pump motor -V101-

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Charge air system with turbocharger (engine code ATW)

Checking mechanical recirculation valve

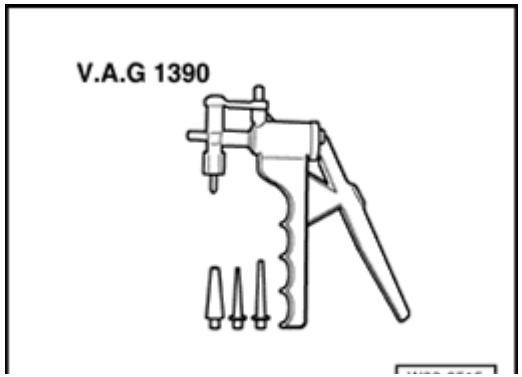
Notes:

- *The mechanical recirculation valve is located in front of the turbocharger. It is opened by vacuum via the recirculating valve for turbocharger -N249- during deceleration, idle and part throttle. This produces a reduction of the charge air pressure in front of the throttle valve which keeps the turbocharger spinning at a higher RPM.*

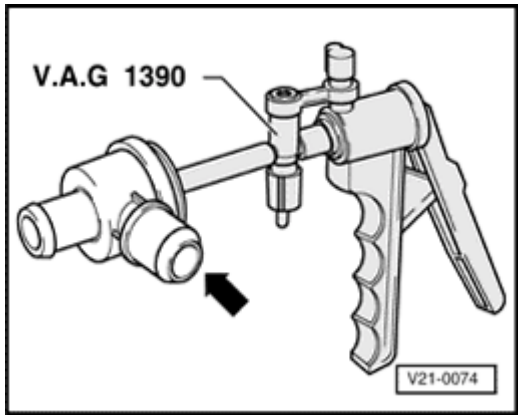
- *Check the recirculation valve in case of reduced performance or part throttle hesitation.*

Special tools and equipment

- VAG1390



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Test sequence

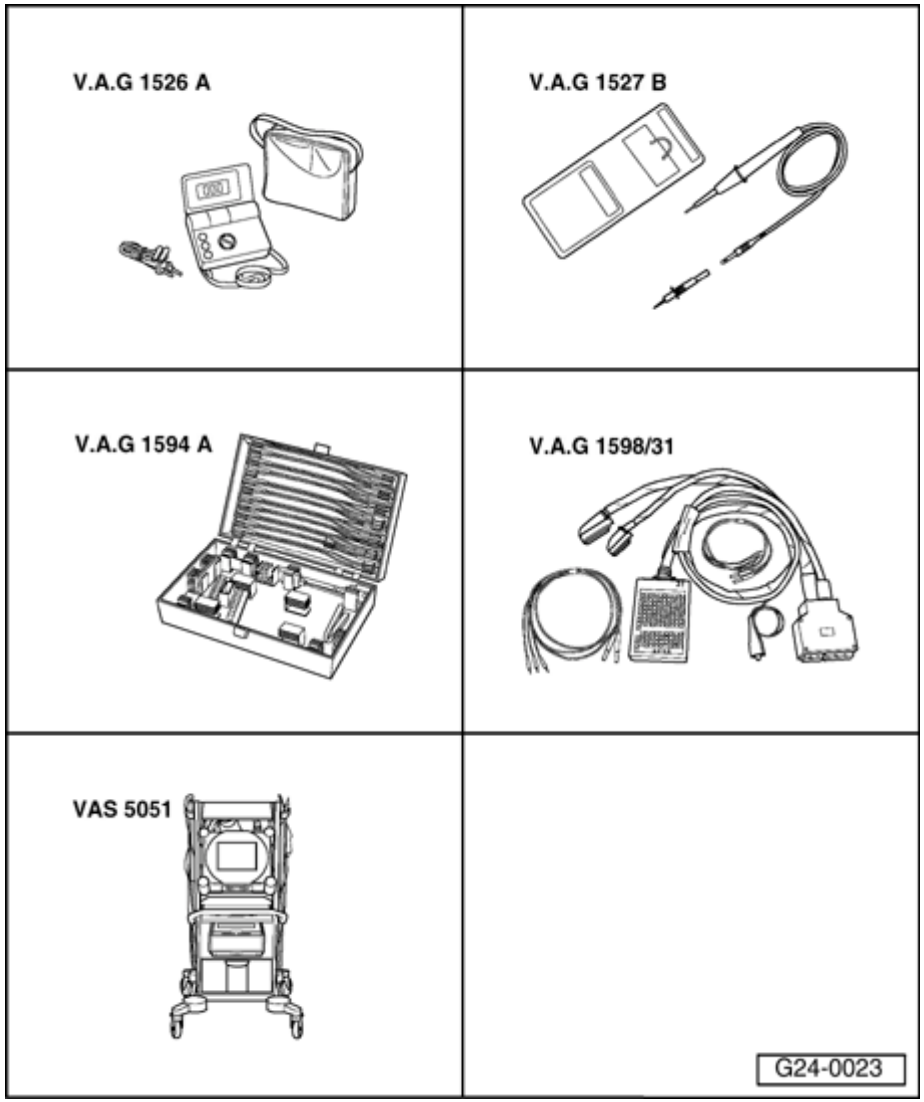
- Attach VAG1390 vacuum pump to recirculation valve.
- Operate vacuum pump.
  - ♦ Recirculation valve must open (arrow)
- After approx. 30 seconds, operate vent valve on vacuum pump.
  - ♦ Recirculation valve must close (arrow)

If recirculation valve does not open or close or valve plate does not seal correctly when valve is closed:

- Replace recirculation valve. Secure connections of recirculation valve using screw type clamps.

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21-48



Recirculating valve for turbocharger - N249-, checking

Special tools and equipment

- VAG1526A
- VAG1527B
- VAG1594A
- VAG1598/31
- VAS5051 with VAG5051/1

- or

- VAG1551 with VAG1551/3A

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Note:

The recirculating valve for turbocharger -N249- and wire connections are monitored by the Engine Control Module (ECM).

- Connect VAS5051 tester or VAG1551 scan tool and select control module for engine electronics using "address word 01". Engine must run at idle for this:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

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

- Disconnect hoses from valve; harness connector remains connected.

- Attach assisting hose to one connection of valve.

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21-50

- Initiate output Diagnostic Test Mode (DTM) and activate the recirculating valve for turbocharger -N249-:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

Output Diagnostic Test Mode →

Recirc. valve for turbocharger -N249

➢ Indicated on display

Valve must click...

...and must open and close (can be tested by blowing into assisting hose).

If valve does not click:

- Check internal resistance of valve.

If valve does not open and close properly:

- Replace recirculating valve for turbocharger -N249-.

Checking internal resistance

- Disconnect harness connector at valve.



➢

- Connect multimeter at valve for resistance measurement.
  - ♦ Specified value: 27-30 Ω

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If specified value is not obtained:

- Replace recirculating valve for turbocharger -N249-.

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21-51

If the specified value is attained:

- Check voltage supply

Checking voltage supply

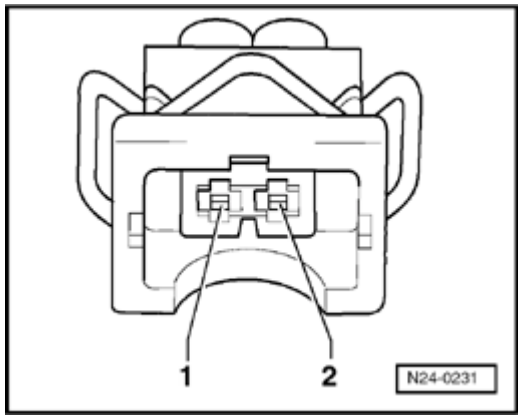
Note:

Voltage is supplied to the recirculation valve via the Fuel Pump (FP) relay.

Test requirement

- Fuse for recirculation valve OK

- Disconnect harness connector at valve.



- Connect VAG1527B voltage tester as follows:

Harness connector terminal	Measure to
1	Engine Ground (GND)

- Operate starter briefly.
  - ♦ LED must light.

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If LED does not light:

- Check wire connection from terminal 1 to Fuel Pump (FP) relay via fuse for an open circuit":

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Repair open circuit if necessary.

If wire connection is OK:

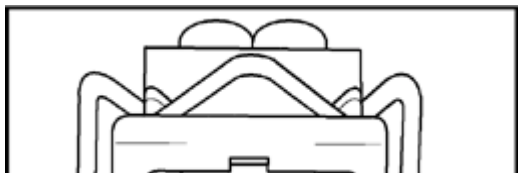
- Check Fuel Pump (FP) relay:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 24*

If LED lights:

- Check activation:

Checking activation



- Connect VAG1527B voltage tester to connector terminals 1 (B+) and 2.
- Initiate output Diagnostic Test Mode (DTM) and activate the

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recirculating valve for turbocharger -N249-:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

- LED must blink.

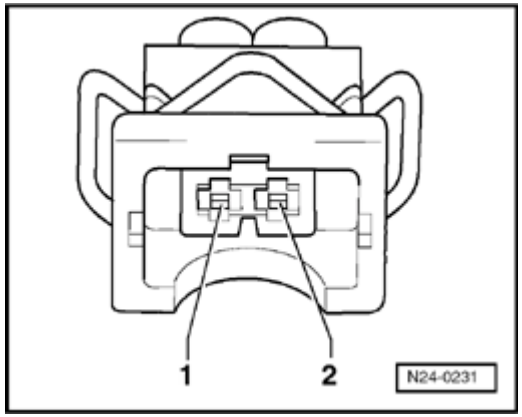
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21-53

If LED does not blink or if it remains constantly lit:

- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 24*



- Check the following wire connection for open circuit and short circuit to Ground (GND) and B+:

Harness connector terminal	VAG1598/31 test box socket
2	105

- Repair open circuit or short circuit if necessary.

If wire connection is OK:

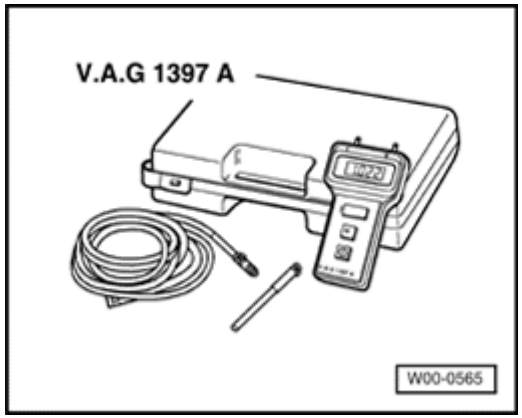
- Replace Engine Control Module (ECM):

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 24*

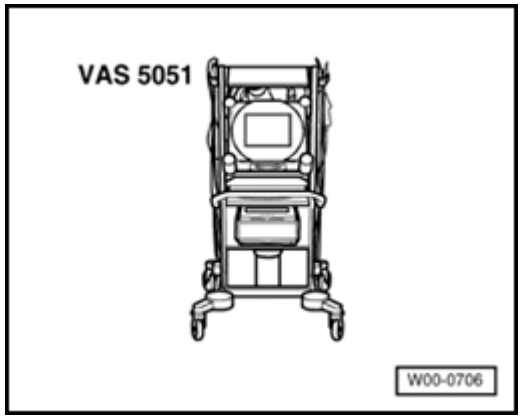
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Turbocharger and charge air pressure regulator valve, checking

Special tools and equipment



- VAG1397A



- VAS5051 with VAG5051/1

or

- VAG1551 with VAG1551/3A

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Test requirements

- All hoses and wires have been checked for proper seating and seal.
- DTC memory checked

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

- Output Diagnostic Test Mode (DTM) performed

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

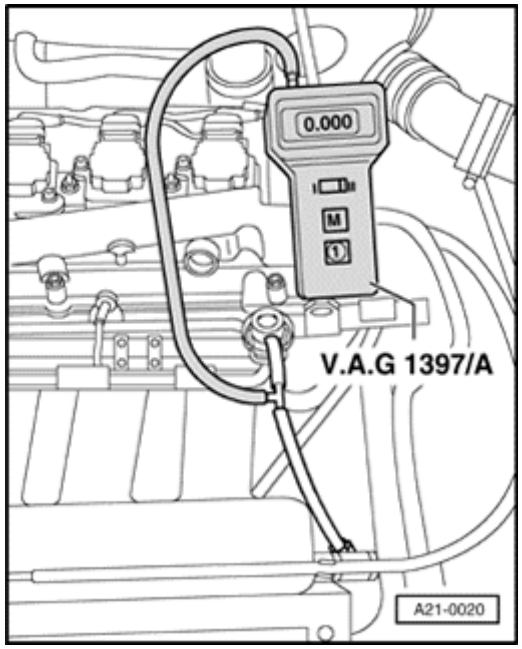
- Vehicle tester VAS 5051 or VAG 1551 connected.

Test sequence

WARNING!

To reduce the risk of accident or injury while carrying out tests and measurements during a road test, observe safety precautions ⇒ ***Page 21-40*** ***.***

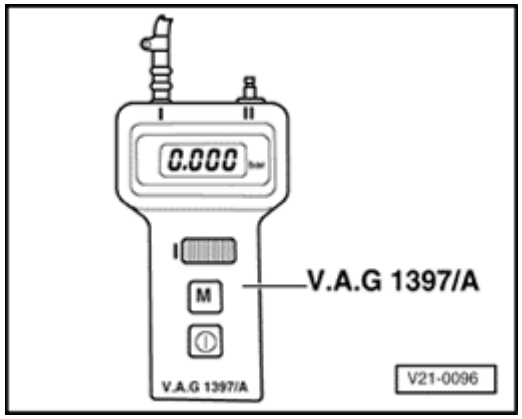
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- Using T-piece connect test hose from VAG1397A Turbocharger Tester between intake manifold and fuel pressure regulator.
- Guide test hose over rear corner of hood, through passenger side window and into vehicle interior.

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- Turn turbocharger tester on and select measuring range -I- (absolute pressure).
- Connect test hose to connection barb -I-.

Notes:

- *Hoses must be properly connected and there must be no possibility of leaks, otherwise incorrect readings may result.*
- *Make sure that the test hose is not pinched at the hood or at the side window.*
- *By pressing memory button "M" on turbocharger tester, the last test value is saved until either memory button "M" is pressed again or the turbocharger tester is shut-off.*
- *A blinking comma in the display field indicates that a value has been saved.*
- *An arrow appears in the top left corner of the display field if the turbocharger tester battery voltage drops below the permitted threshold.*
- *Before testing, drive vehicle rapidly for at least 3 km on a road that does not require stopping (i.e. traffic lights or similar).*
- *A second technician is required because the indicated values must be read out while the vehicle is being driven.*

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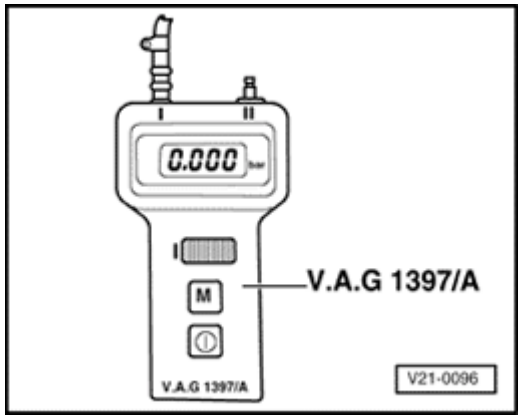
Rapid data transfer **Select function XX**	When indicated on display: - Press buttons -0- and -8- to select "Read Measuring Value Block" and press -Q- button to confirm input.
Read Measuring Value Block Q **Input display group number XXX**	When indicated on display: - Press buttons -0-, -0- and -4- to select "display group number 004" and press -Q- button to confirm input.
Read Measuring Value Block 4 → **1 2 3 4**	Indicated on display Do not continue with test until intake air temperature in display field 4 is 20-50 °C if necessary, warm up vehicle by driving. - Press -C- button.
Read Measuring Value Block Q **Input display group number XXX**	When indicated on display: - Press buttons -1-, -1- and -5- to select "display group number 115" and press -Q- button to confirm input.
Read Measuring Value Block 115 → **1 2 3 4**	Indicated on display (1-4 = display fields) - Accelerate vehicle in 3rd gear at full throttle from 2000 RPM and observe tachometer. - At approx. 3000 RPM, press the print button on the VAS5051 or VAG1551 and simultaneously press the memory button -M- on the VAG1397A.

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Note:

The height of the charge air pressure should be determined using the VAG1397/A turbocharger test tool, the VAS5051 tester or the VAG1551 Scan Tool is used to determine whether the charge air pressure is also being recognized in the control module.



➢ ♦ Specification on VAG1397A: 1.450-1.700 bar

Read Measuring Value Block 115 →

3000 RPM 42% 1770 mbar 1770 mbar

➢ ♦ Specified value on VAS 5051 or VAG 1551 Display field 4: 1450-1700 mbar

If the specification is exceeded or not met:

- Check DTC memory of Engine Control Module (ECM):

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

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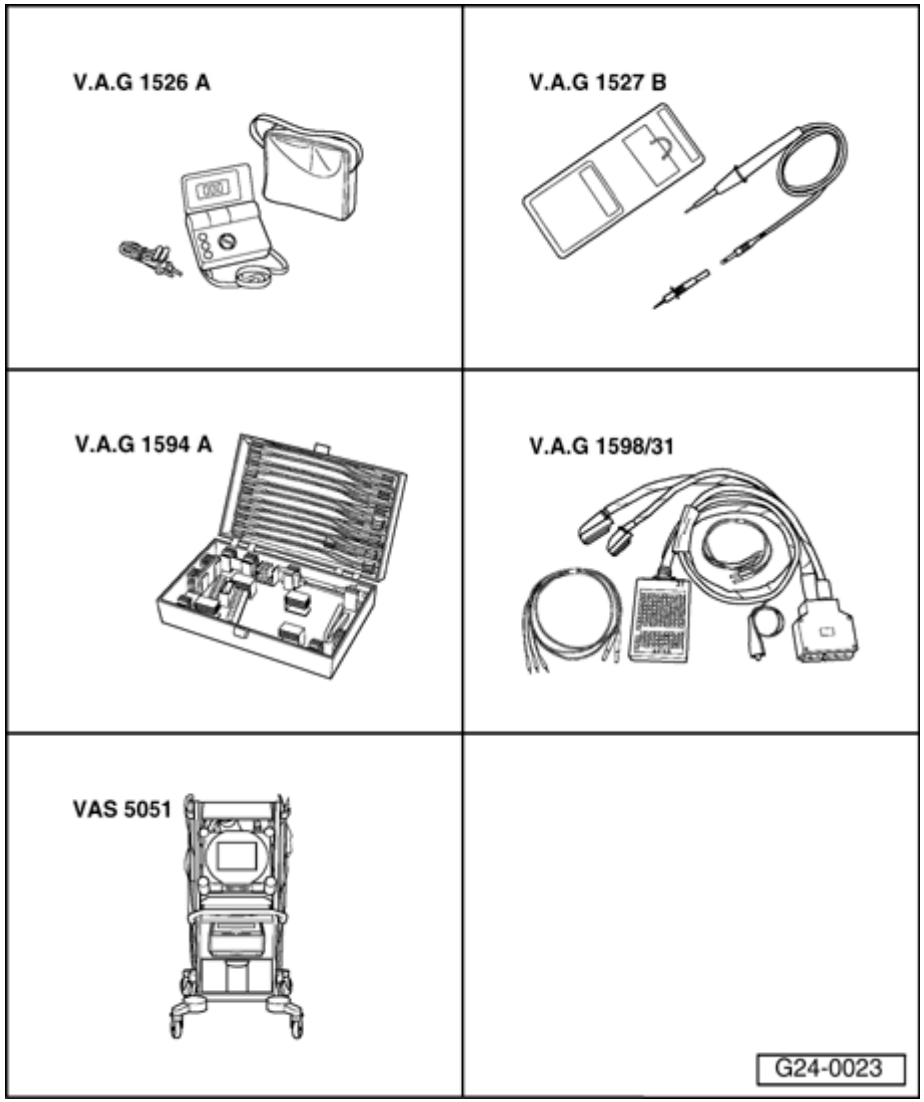
charge air pressure regulation Diagnostic Trouble Codes (DTC)

Diagnostic Trouble Code (DTC)	Charge air pressure	Possible causes
Charge air pressure too low	• Measured value below 1.450 bar or 1450 mbar	♦ Wastegate bypass regulator valve -N75- faulty ♦ Wire to wastegate bypass regulator valve -N75- faulty ♦ Charge air pressure regulator valve in turbocharger is stuck in open position ♦ Leak between turbocharger and intake manifold ♦ Mechanical recirculation valve faulty ♦ Turbocharger malfunctioning
Charge air pressure too high [1)]	• Measured value above 1.700 bar or 1700 mbar	♦ Vacuum diaphragm for charge air pressure regulator valve faulty ♦ Hoses to vacuum diaphragm for charge air pressure regulation valve (via wastegate bypass regulator valve -N75-) leaky ♦ Charge air pressure regulator valve in turbocharger is stuck in closed position

1) If charge air pressure is too high, the fuel supply is shutoff to protect the engine. The engine misfires at high engine speeds.

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Wastegate bypass regulator valve -N75-, checking

Special tools and equipment

- VAG1526A
- VAG1527B
- VAG1594A
- VAG1598/31
- VAS5051 with VAG5051/1

- or

- VAG1551 with VAG1551/3A

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Note:

The wastegate bypass regulator valve -N75- and wire connections are monitored by the Engine Control Module (ECM).

- Connect VAS5051 tester or VAG1551 scan tool and select control module for engine electronics using "address word 01". Engine must run at idle for this:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

- Check DTC memory of Engine Control Module (ECM):

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

If a malfunction relating to the wastegate bypass regulator valve -N75- is indicated:

- Disconnect hoses from valve; harness connector remains connected.

- Attach assisting hose to one connection of

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valve.

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- Initiate output Diagnostic Test Mode (DTM) and activate the wastegate bypass regulator valve -N75-.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

Output Diagnostic Test Mode →

Wastegate Bypass Regulator Valve -N75

➢ Indicated on display

Valve must click...

...and must open and close (can be tested by blowing into assisting hose).

If valve does not click:

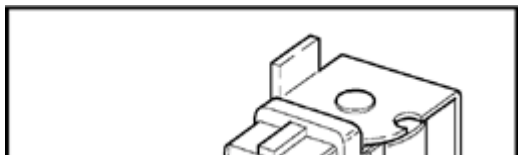
- Check internal resistance of valve.

If valve does not open and close properly:

- Replace wastegate bypass regulator valve -N75-.

Checking internal resistance

- Disconnect harness connector at valve.



➢

- Connect multimeter at valve for resistance measurement.
  - ♦ Specified value: 25-35 Ω

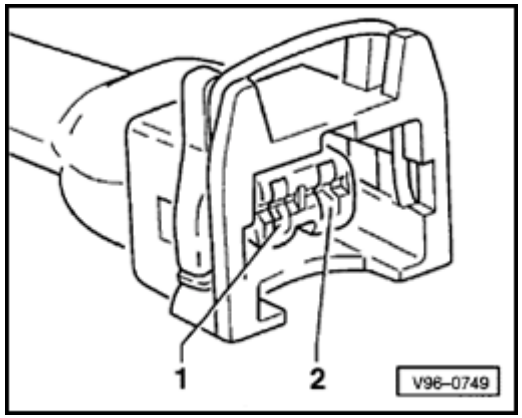
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If specified value is not obtained:

- Replace wastegate bypass regulator valve -N75- .

If the specified value is met:

Checking voltage supply



- Connect VAG1527B voltage tester as follows:

Harness connector terminal	Measure to
1	Engine Ground (GND)

- Operate starter briefly.
  - ♦ LED must light.

If LED does not light:

- Check wire connection from terminal 1 to Fuel Pump (FP) relay via fuse for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Repair open circuit if necessary.

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21-64

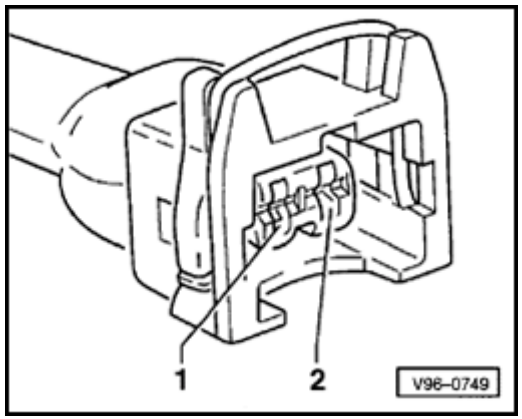
If wire connection is OK:

- Check Fuel Pump (FP) relay:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 24*

If LED lights:

Checking activation



- Connect VAG1527B voltage tester to harness connector terminals 1 (B+) and 2.
- Initiate output Diagnostic Test Mode (DTM) and activate the wastegate bypass regulator valve -N75-.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

- ♦ LED must blink.

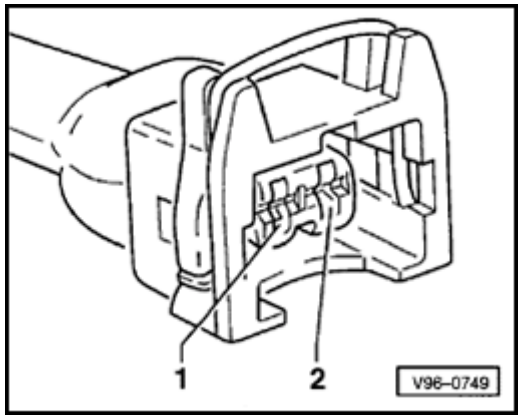
If LED does not blink or if it remains constantly lit:

- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 24*

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- Check the following wire connection for open circuit and short circuit to Ground (GND) and B+:

Harness connector terminal	VAG1598/31 test box socket
2	104

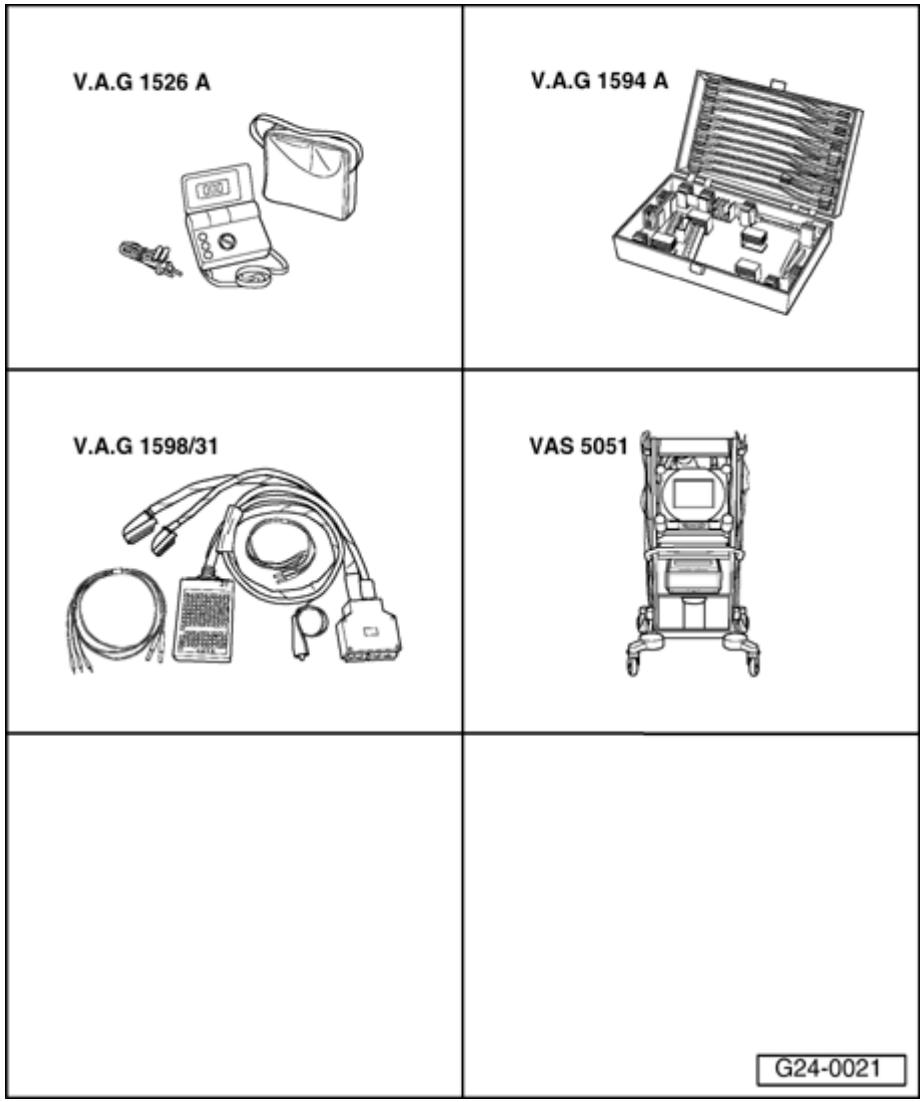
- Repair open circuit or short circuit if necessary.

If wire connection is OK:

- Replace Engine Control Module (ECM):

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 24*

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Charge air pressure sensor -G31-, checking

Special tools and equipment

- VAG1526A
- VAG1594A
- VAG1598/31
- VAS5051 with VAG5051/1

- or

- VAG1551 with VAG1551/3A

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Note:

The charge air pressure sensor -G31- and wire connections are monitored by the Engine Control Module (ECM).

- Connect VAS5051 tester or VAG1551 scan tool and select control module for engine electronics using "address word 01". Engine must run at idle for this:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

- Check DTC memory of Engine Control Module (ECM):

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

If a malfunction relating to the charge air pressure sensor -G31- is indicated:

Checking voltage supply

- Disconnect harness connector at charge air pressure sensor.

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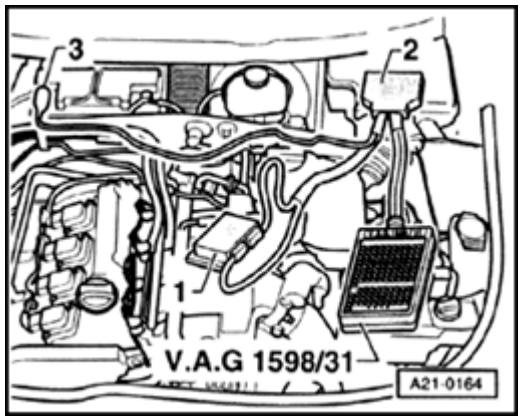
- Connect multimeter between terminals 1 and 3 of harness connector for voltage measurement.

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- Switch ignition on.

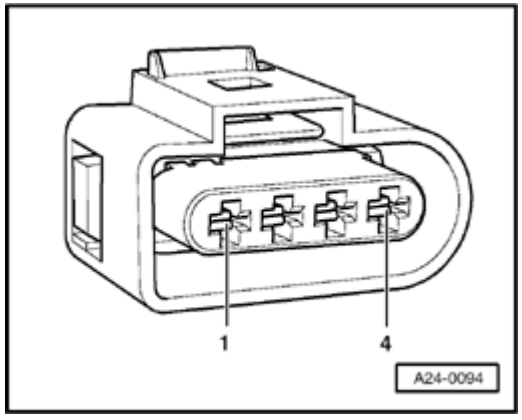
♦ Specified value: approx. 5 V

If specified value is not obtained:



- Connect VAG1598/31 test box to wiring harness -2- for Engine Control Module (ECM), also connect ECM -1-. Connect Ground (GND) clamp -3- to negative battery post.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 24*



- Check the following wire connections for open circuit and short circuit to Ground (GND) and B+:

Harness connector terminal	VAG1598/31 test box socket
1	108
3	98

- Repair open circuit or short circuit if necessary.

If the specified value is met:

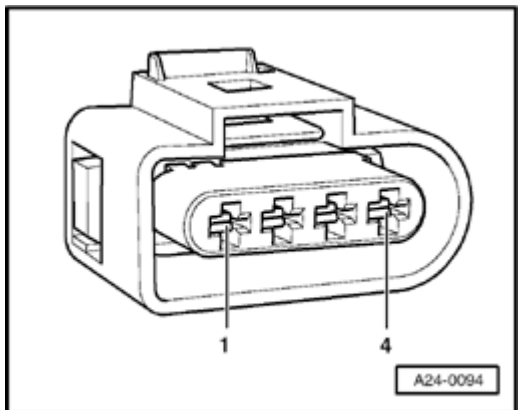
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Checking signal wire

- Connect harness connector at charge air pressure sensor.
- Connect multimeter to socket 101 and socket 108 of test box for voltage measurement.
- Start engine and run at idle.
  - ♦ Specified value: approx. 1.90 V
- Bring up engine RPM by suddenly depressing pedal.
  - ♦ Specified value: 2.00-3.00 V

If specified values are not obtained:



- Check the following wire connection for open circuit and short circuit to Ground (GND) and B+:

Harness connector terminal	VAG1598/31 test box socket
4	101

- Repair open circuit or short circuit if necessary.

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If wire connection is OK:

- Replace charge air pressure sensor -G31-.

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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.

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- 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!).

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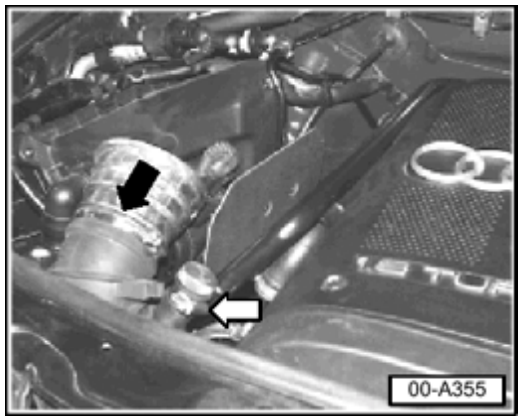
21-71

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.

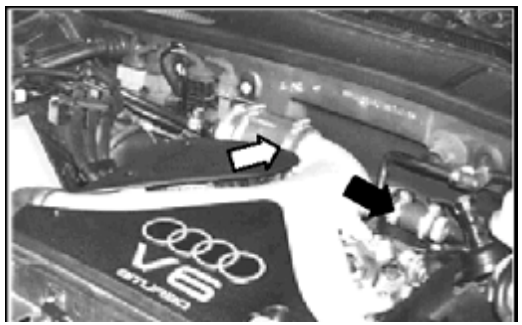


- Insert VAG 1687/1 pressure adapter in intake hose -black arrow- using existing clamp (as shown).
- Remove crankcase ventilation tube from intake hose at -white arrow-.

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

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1687/1 special tool kit.

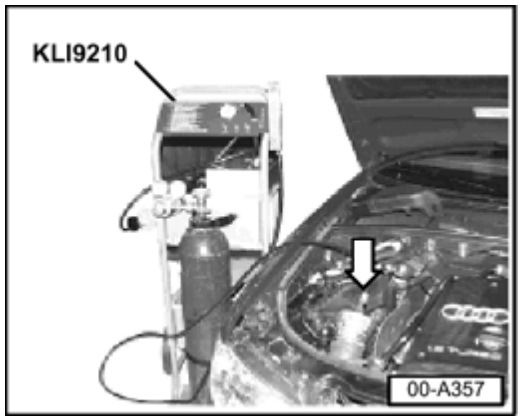
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Note:

- *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 21-72 .*
- *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

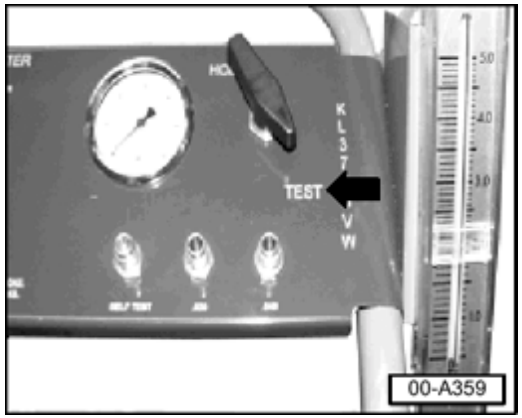
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to VAG 1687/1 at arrow on 2.7L BiTurbo).

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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).

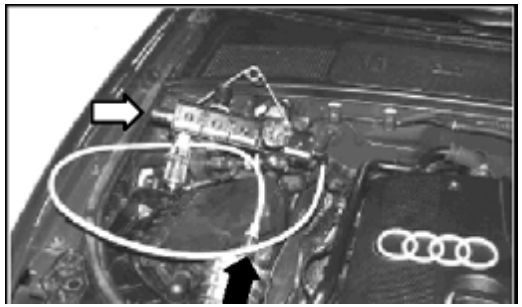
With system filled with smoke:

- Remove smoke generator hose and connect VAG1687 quickly to prevent smoke from leaking out ⇒ Page 21-73 .

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-

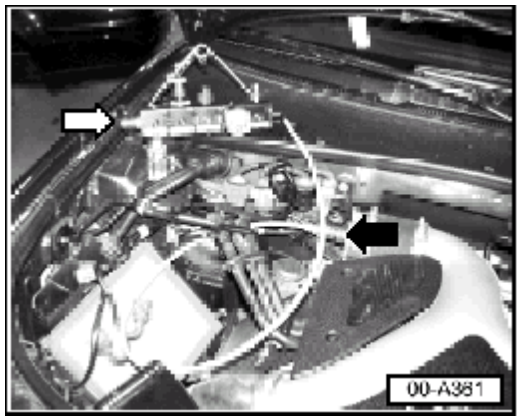
- Perform pressure test ⇒ Page 21-75 .

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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-

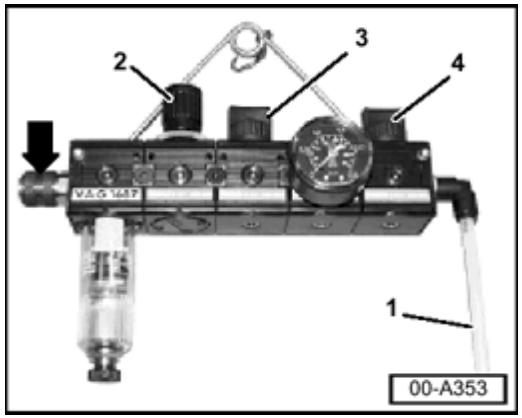
Shop air supply will be connected to VAG 1687 -at white arrow-

- Perform pressure test ⇒ Page 21-75 .

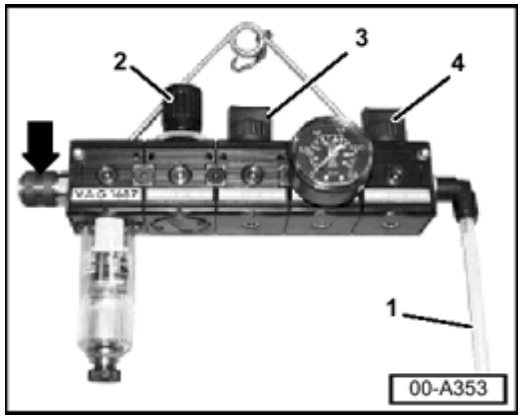
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21-75

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 21-70 .



- 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.

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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.

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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.

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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.

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26-1

Exhaust system components, removing and installing

WARNING!

- ***Do not re-use any fasteners that are worn or deformed in normal use.***

- ***Some fasteners are designed to be used only once, and are unreliable and may fail if used a second time. This includes, but is not limited to, nuts, bolts, washers, circlips and cotter pins. Always follow the recommendations in this manual-replace these fasteners with new parts where indicated, and any other time it is deemed necessary by inspection.***

Note:

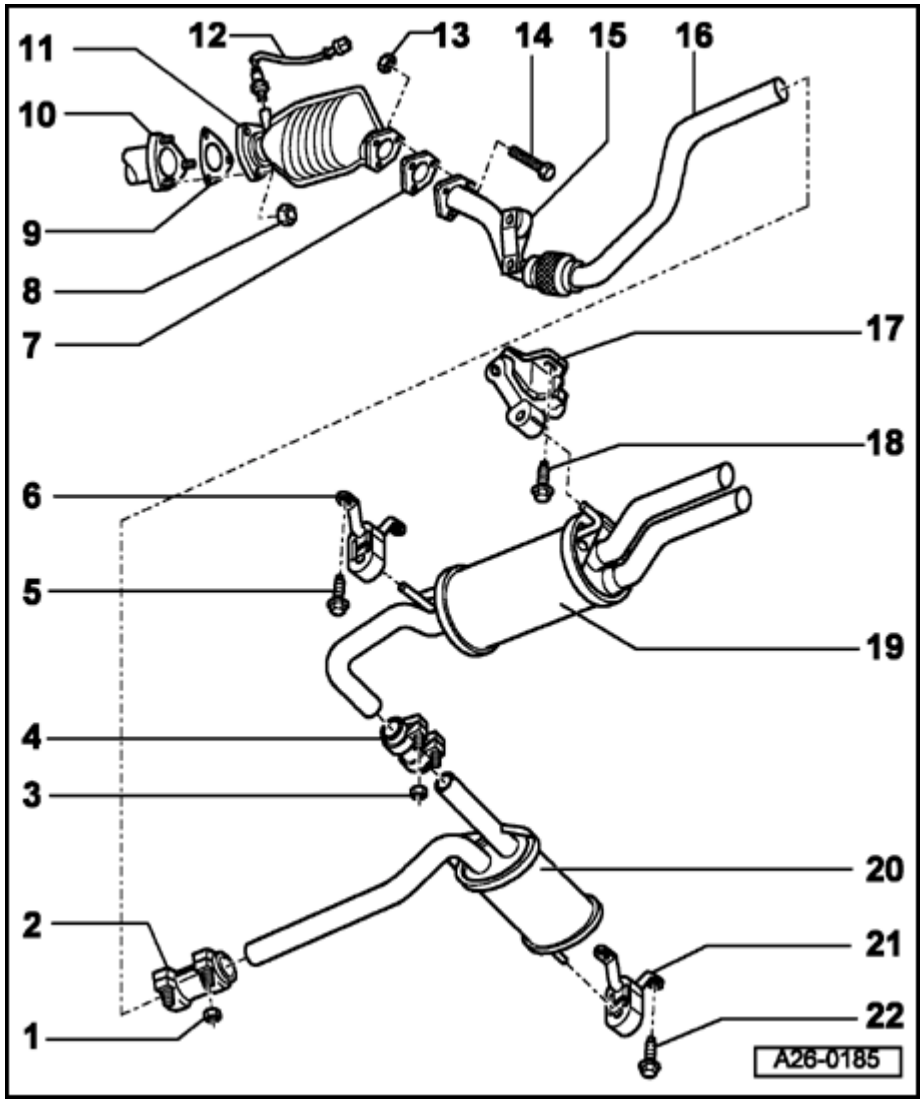
- *Always replace gaskets and self-locking nuts.*

- *After exhaust system repairs, make sure exhaust system is not under stress and that it has sufficient clearance from the bodywork. If necessary, loosen double clamps and align muffler and exhaust pipe so that sufficient clearance is maintained to the bodywork and the support rings are evenly loaded.*

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- *The exhaust flexpipe must not be bent more than 10° , otherwise it may be damaged.*

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Front-wheel-drive vehicles

1 - Nut

- 40 Nm (30 ft b)

2 - Double clamp

- Before tightening, ensure exhaust system is free of stress ⇒ Page 26-24
- Installation position: bolt ends point toward left
- Installation position of bolt ends ⇒ Page 26-13 , Fig. ⇒ 3
- Tighten bolts evenly

3 - Nut

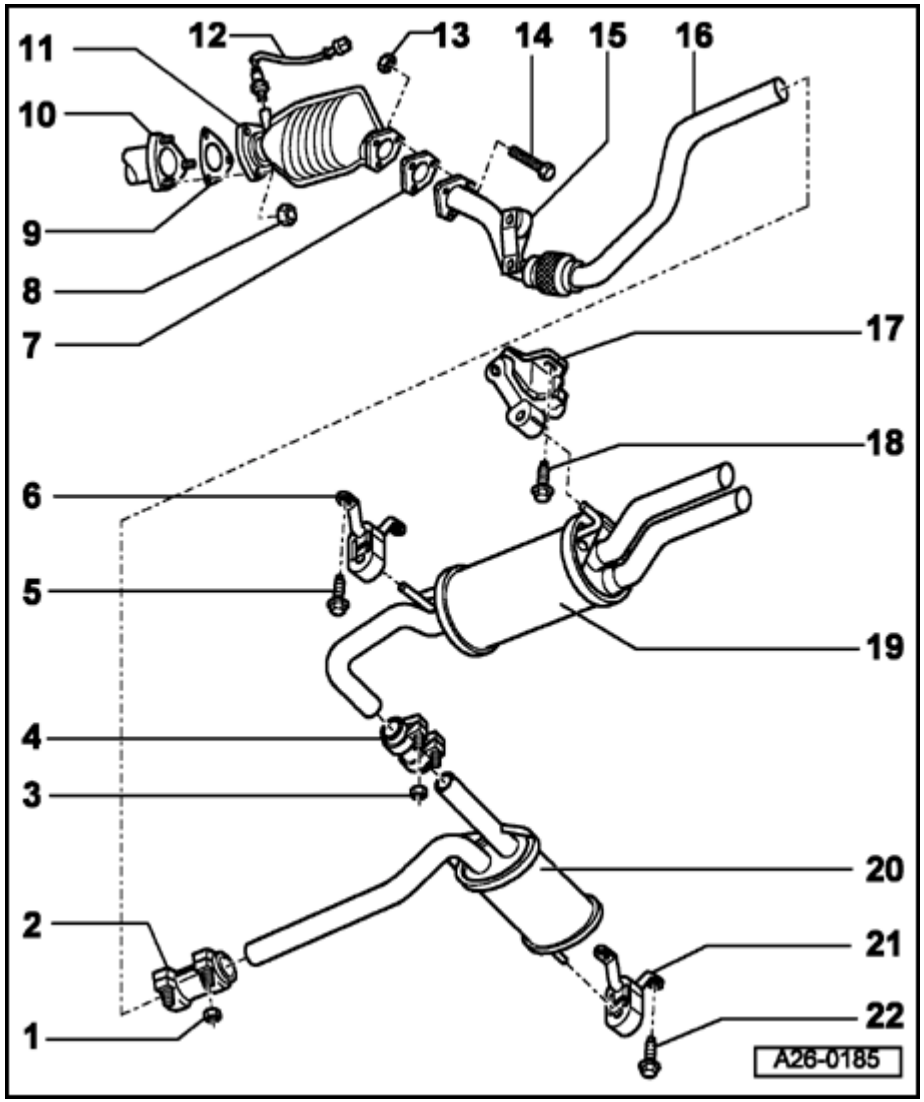
- 40 Nm (30 ft b)

4 - Double clamp

- Used when front or rear muffler is replaced separately
- Before tightening, ensure exhaust system is free of stress ⇒ Page 26-24
- Installation position: bolt ends point toward rear
- Installation position of bolt ends %page ⇒ Page 26-13 , Fig. ⇒ 3
- Tighten bolts evenly

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26-3



5 - Bolt

- 25 Nm (18 ft lb)

6 - Mount

7 - Gasket

- Always replace

8 - Nut

- Always replace
- 30 Nm (22 ft lb)

9 - Gasket

- Always replace

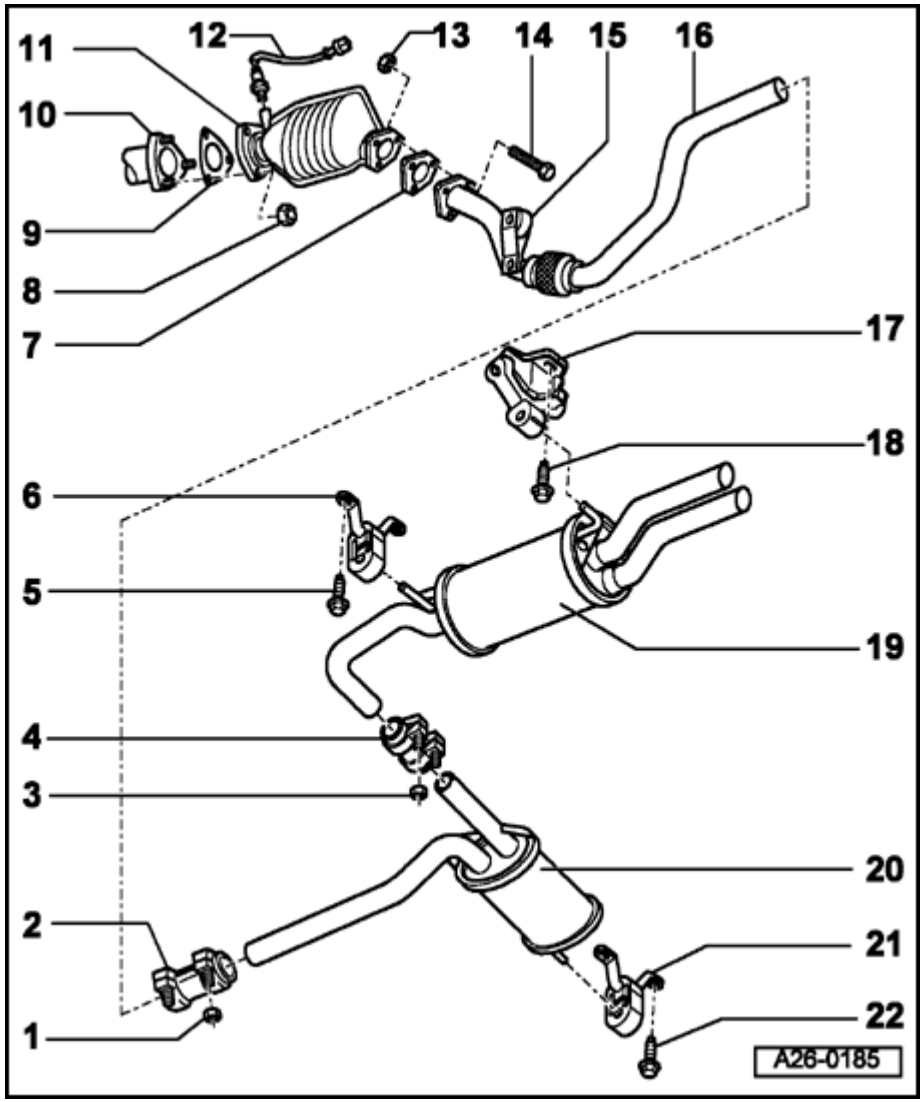
10 - Turbocharger

- Removing and installing ⇒ Page 21-30

11 - Three Way Catalytic Converter (TWC)

- Protect from damage
- Removing and installing ⇒ Page 26-21
- Disconnect Heated Oxygen Sensor (HO2S) harness connector ⇒ Page 26-21

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12 - Heated Oxygen Sensor (HO2S)

- 50 Nm (37 ft lb)
- Only grease threads with "G 052 112 A3." Do NOT allow grease to get into slots on sensor body

CAUTION!

Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

- Checking Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection &Ignition, Repair Group 24

13 - Nut

- Always replace
- 25 Nm (18 ft lb)

14 - Bolt

- 25 Nm (18 ft lb)

15 - 16Mount

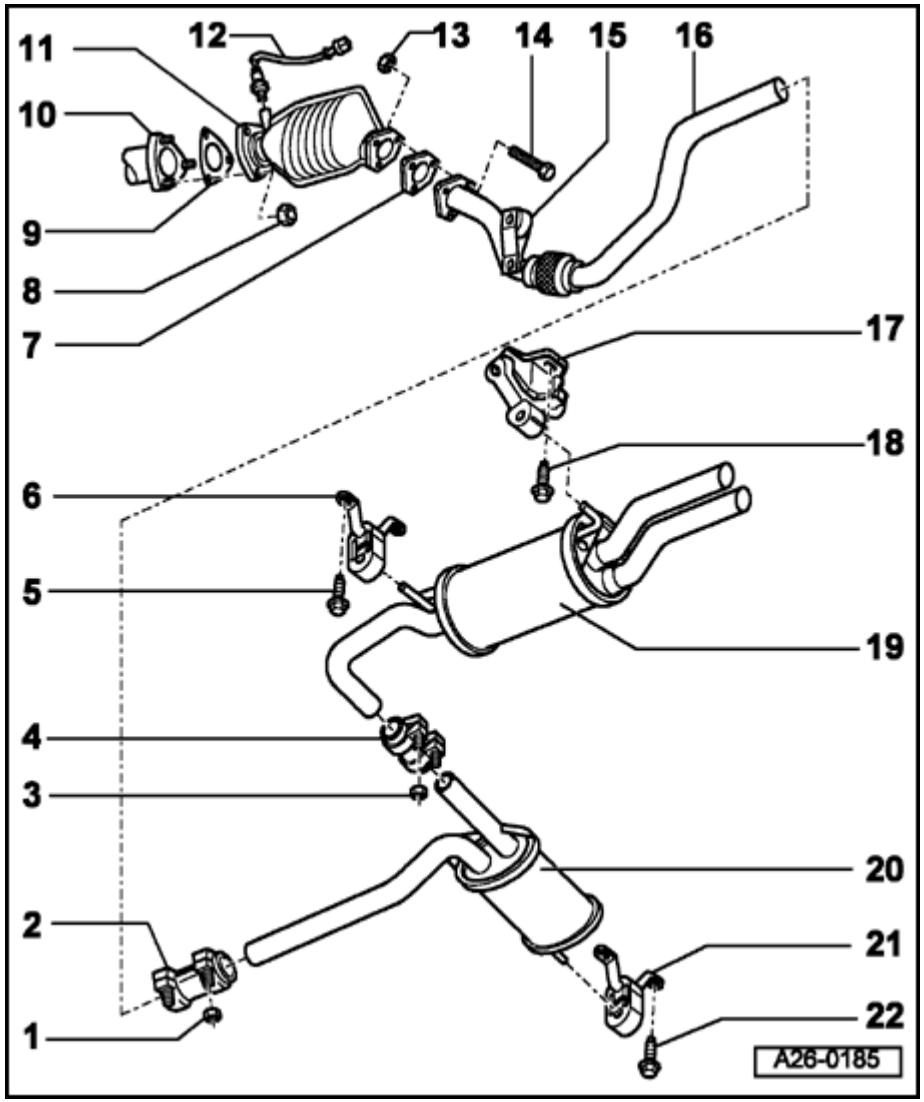
Different versions for manual and automatic transmissions

- Manual transmission ⇒ Page 26-12 , Fig. ⇒ 1
- Automatic transmission ⇒ Page 26-13 ,

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Fig. ⇒ 2

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17 - Front exhaust pipe

- With flexpipe
- Flexpipe must not be bent more than 10°, otherwise it may be damaged
- To remove, unbolt floor crossmember (20 Nm/15 ft lb)
- Align exhaust system free of stress ⇒ Page 26-24

18 - Mount

19 - Bolt

- 25 Nm (18 ft lb)

20 - Rear muffler

- Factory-installed with front muffler as one unit. If repair is necessary, replace separately
- Separating point ⇒ Page 26-14
- Align exhaust system free of stress ⇒ Page 26-24

21 - Front muffler

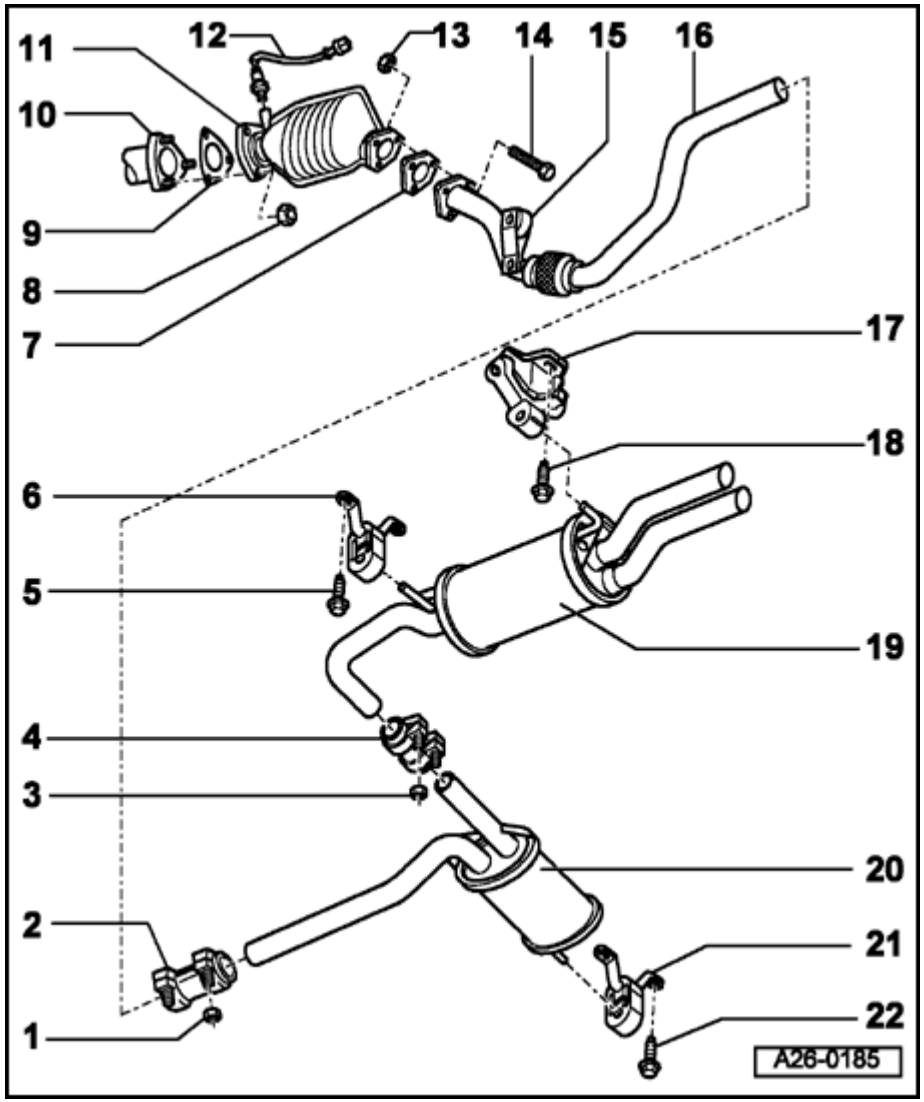
- Factory-installed with rear muffler as one unit. If repair is necessary, replace separately
- Separating point ⇒ Page 26-14

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- Align exhaust system free of stress ⇒ Page 26-24

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26-6

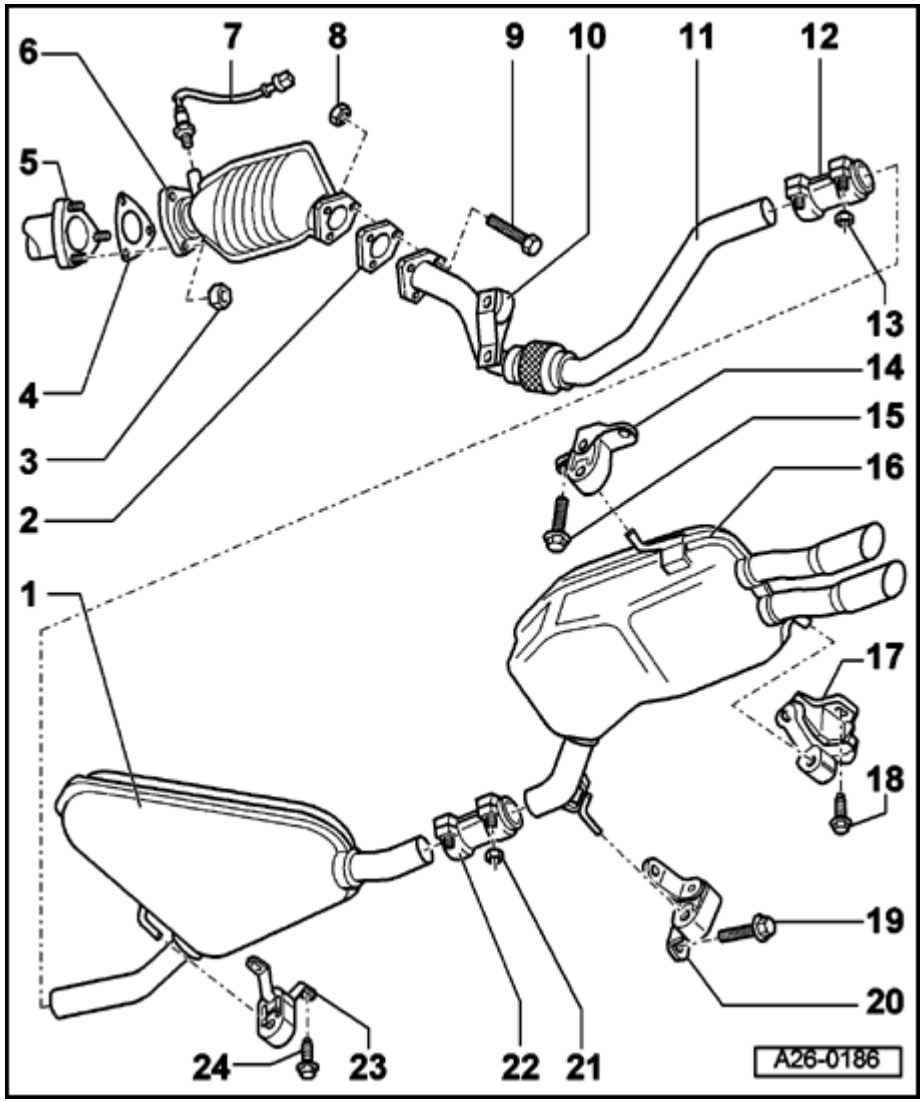


22 - Support ring

23 - Bolt

- ♦ 25 Nm (18 ft lb)

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All-wheel-drive vehicles

1 - Front muffler

- Factory-installed with rear muffler as one unit. If repair is necessary, replace separately
- Separating point ⇒ Page 26-16
- Align exhaust system free of stress ⇒ Page 26-24

2 - Gasket

- Always replace

3 - Nut

- Always replace
- 30 Nm (22 ft lb)

4 - Gasket

- Always replace

5 - Turbocharger

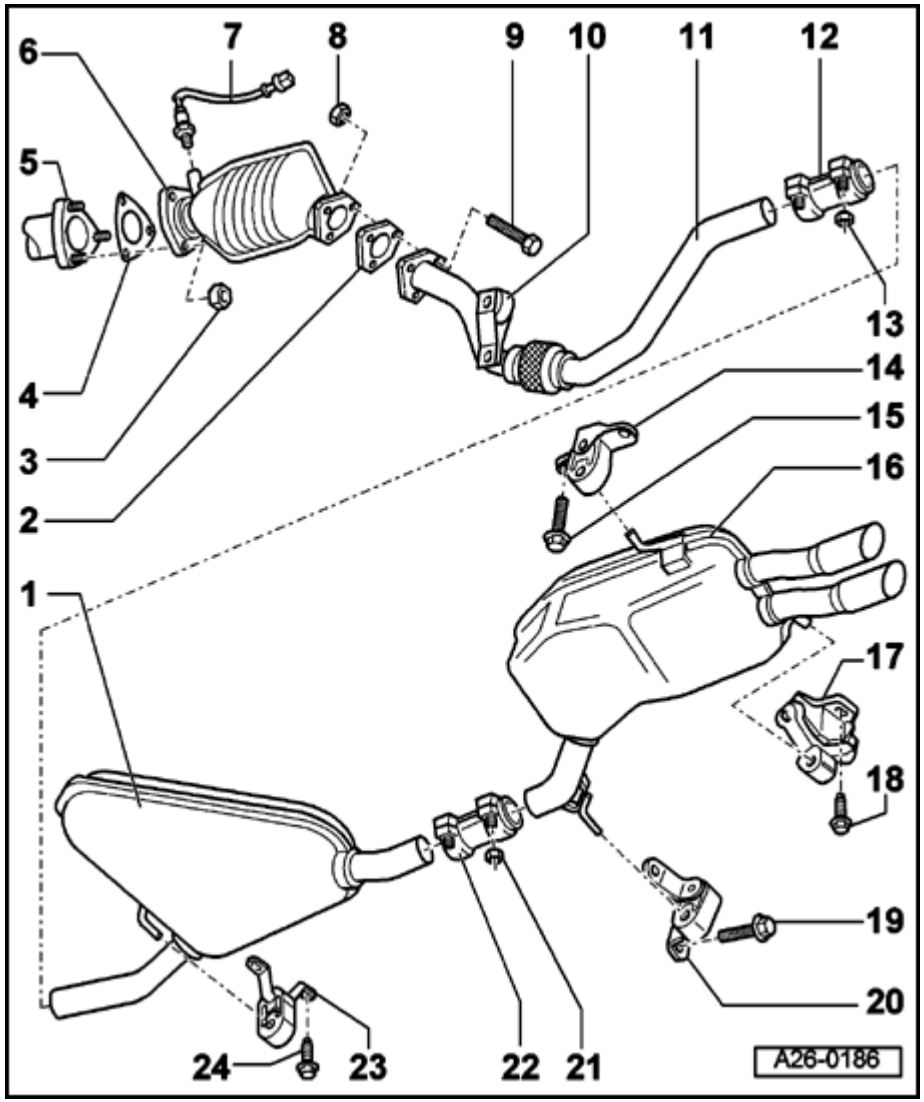
- Removing and installing ⇒ Page 21-30

6 - Three Way Catalytic Converter (TWC)

- Protect from damage
- Removing and installing ⇒ Page 26-21

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26-8



7 - Heated Oxygen Sensor (HO2S)

- 50 Nm (37 ft lb)
- Only grease threads with "G 052 112 A3." Do NOT allow grease to get into slots on sensor body
- Checking Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection &Ignition, Repair Group 24
- Disconnect Heated Oxygen Sensor (HO2S) harness connector ⇒ Page 26-21

8 - Nut

- Always replace
- 25 Nm (18 ft lb)

9 - Bolt

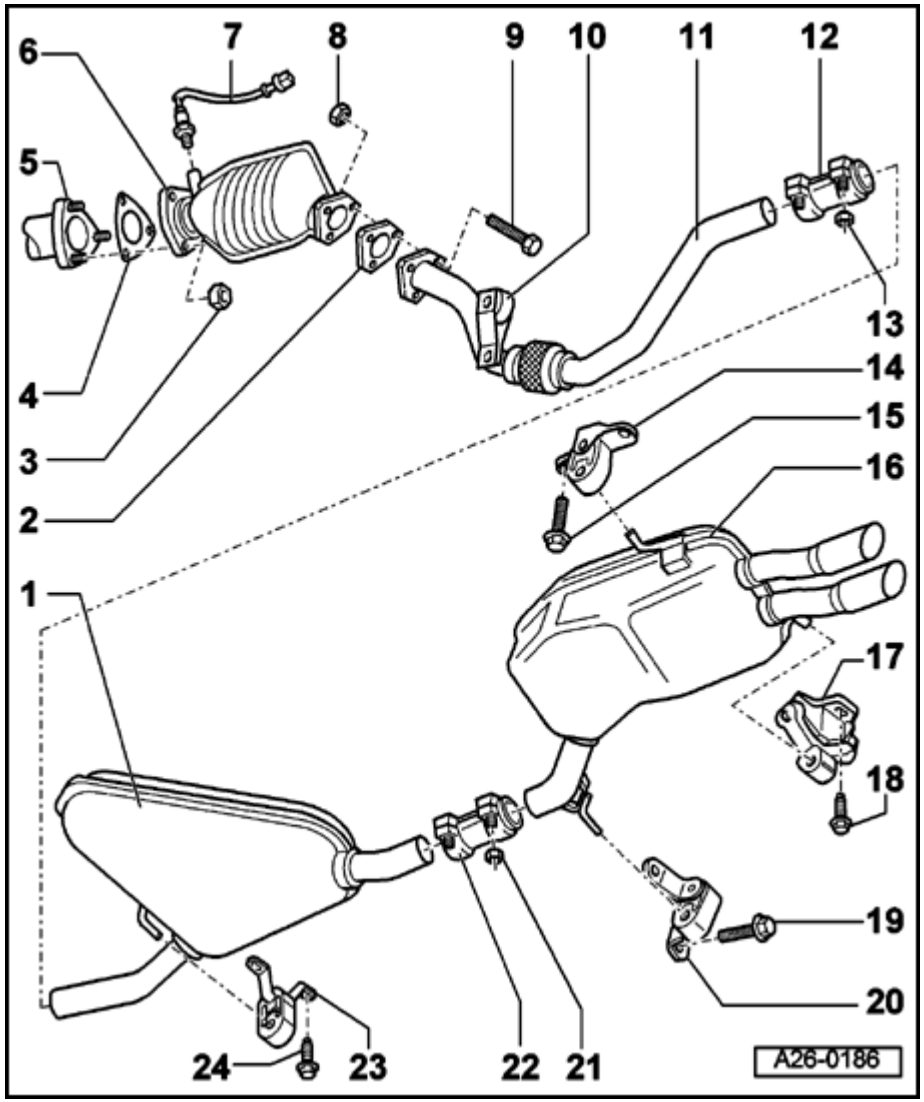
- 25 Nm (18 ft lb)

10 - Mount

Different versions for manual and automatic transmissions

- Manual transmission ⇒ Page 26-12 , Fig. ⇒ 1
- Automatic transmission ⇒ Page 26-13 , Fig. ⇒ 2

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11 - Front exhaust pipe

- With flexpipe

CAUTION!

Flexpipe must not be bent more than 10° , otherwise it may be damaged.

- To remove, unbolt floor crossmember (20 Nm/15 ft lb)
- Align exhaust system free of stress ⇒ Page 26-24

12 - Double clamp

- Before tightening, ensure exhaust system is free of stress ⇒ Page 26-24
- Installation position: bolt ends point toward left
- Installation position of bolt ends ⇒ Page 26-13 , Fig. ⇒ 3
- Tighten bolts evenly

13 - Nut

- 40 Nm (30 ft lb)

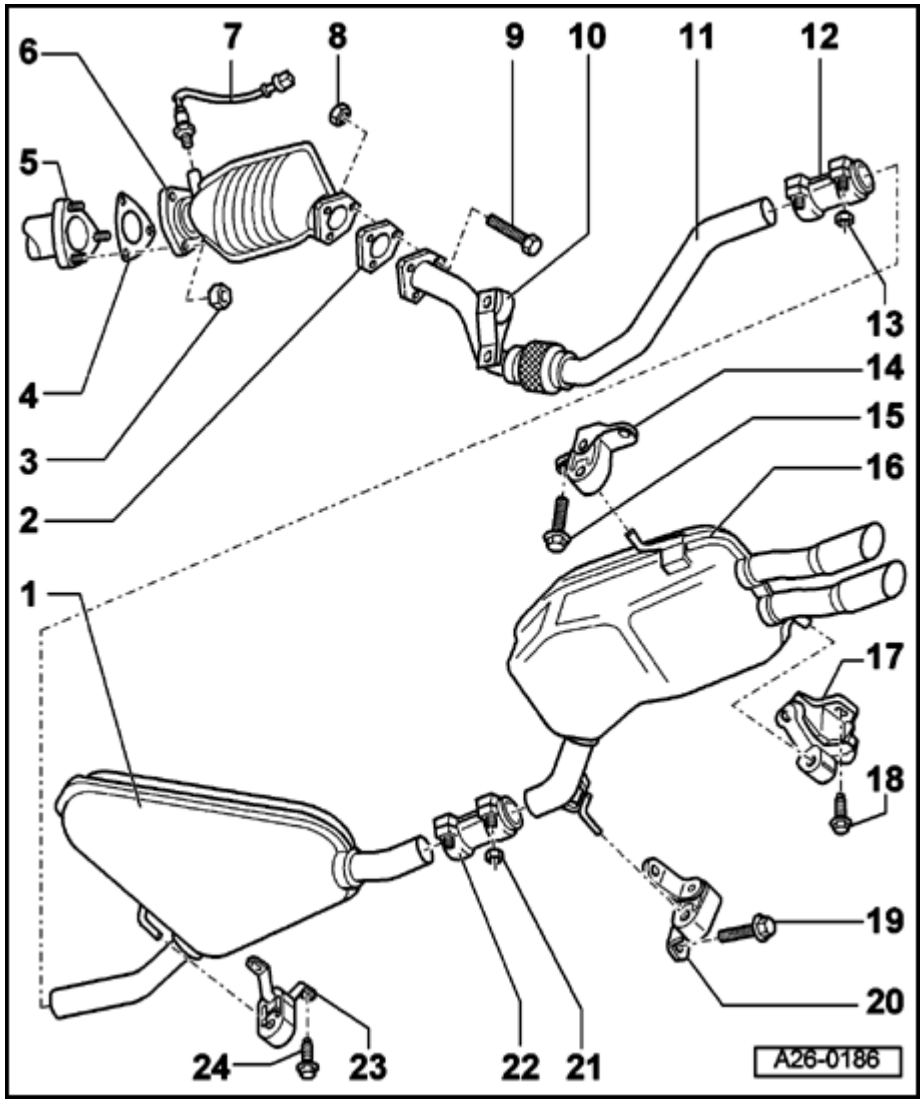
14 - Mount

15 - Bolt

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- 25 Nm (18 ft lb)

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16 - Rear muffler

- Factory-installed with front muffler as one unit. If repair is necessary, replace separately
- Separating point ⇒ Page 26-16
- Align exhaust system free of stress ⇒ Page 26-24

17 - Mount

18 - Bolt

- 25 Nm (18 ft lb)

19 - Bolt

- 25 Nm (18 ft lb)

20 - Mount

21 - Nut

- 40 Nm (30 ft lb)

22 - Double clamp

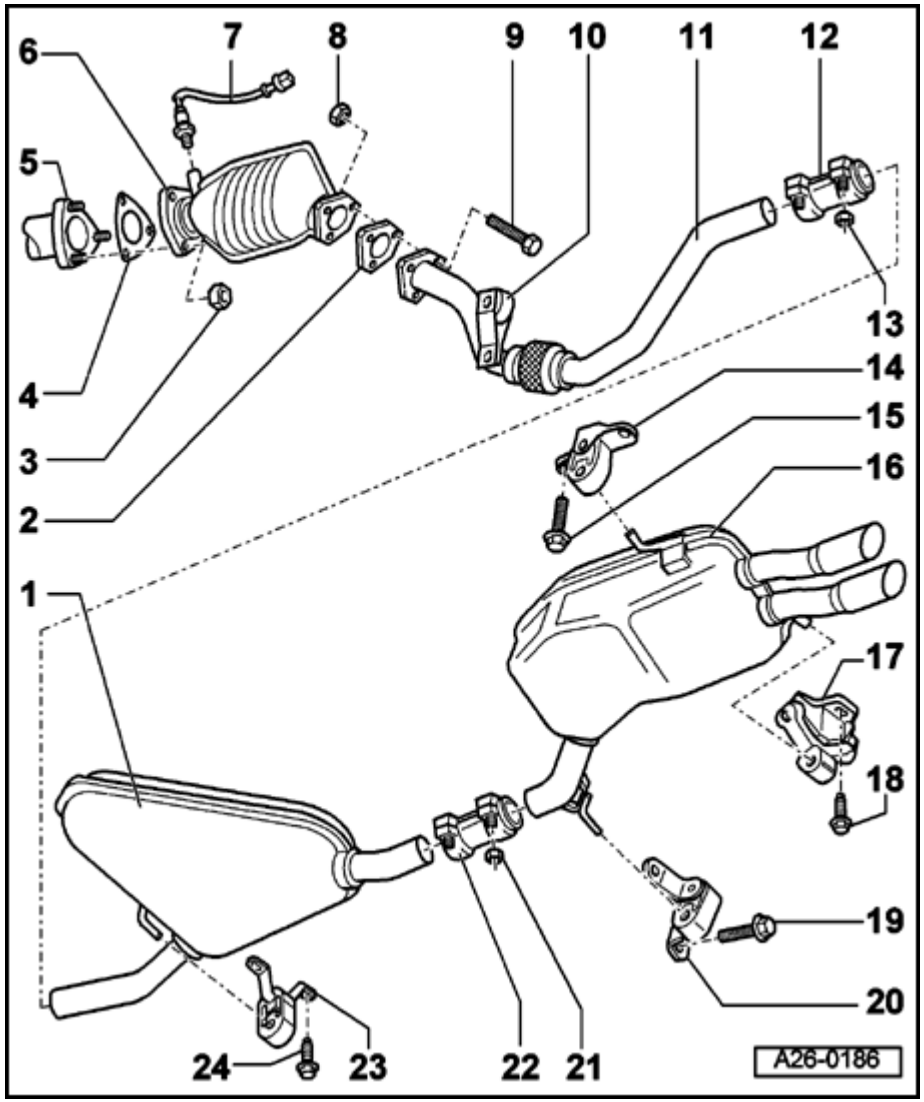
- Used when front or rear muffler is replaced separately.
- Before tightening, ensure exhaust system is free of stress ⇒ Page 26-24
- Installation position: bolt ends point toward left

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- Installation position of bolt ends ⇒ Page 26-13 , Fig. ⇒ 3
- Tighten bolts evenly

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26-11



23 - Support ring

24 - Bolt

- ♦ 25 Nm (18 ft lb)

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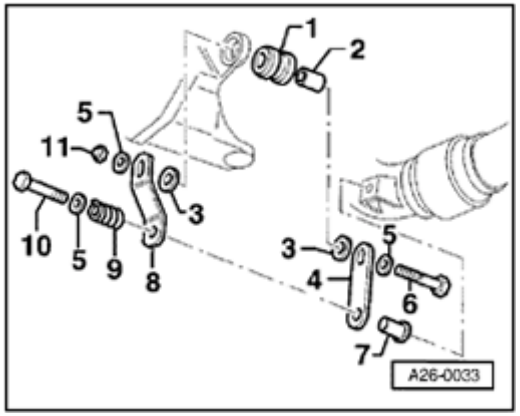


Fig. 1 Individual mounting components for vehicles with manual transmission

1 - Buffer

2 - Spacer sleeve

3 - Washer

4 - Strap, right

5 - Washer

6 - Bolt (25 Nm/18 ft lb)

7 - Spacer sleeve

8 - Strap, left

9 - Compression spring

10 - Bolt (25 Nm/18 ft lb)

11 - Self-locking nut (25 Nm/18 ft lb)

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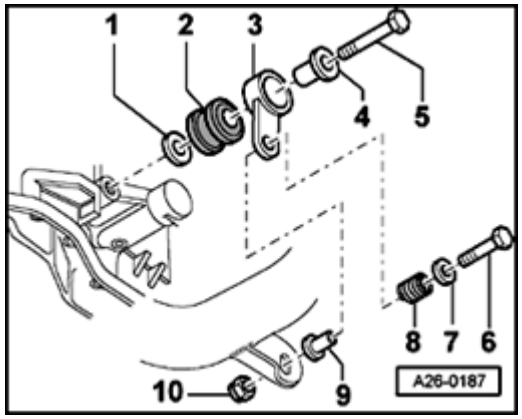


Fig. 2 Individual mounting components for vehicles with automatic transmission

1 - Washer

2 - Buffer

3 - Strap

4 - Spacer sleeve

5 - Bolt (25 Nm/18 ft lb)

6 - Bolt

7 - Washer

8 - Compression spring

9 - Spacer sleeve

10 - Self-locking nut (25 Nm/18 ft lb)

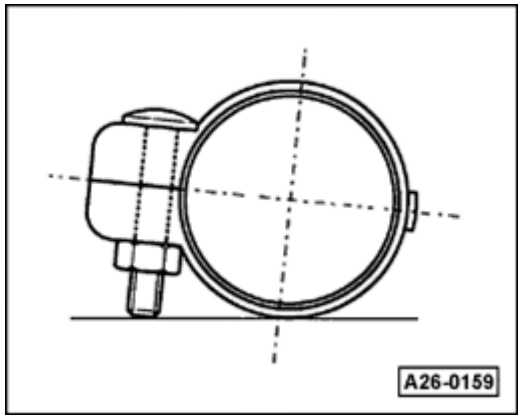


Fig. 3 Double clamp installation position

- Install double clamp so bolt ends do not project over lower edge of double clamp.

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Front and rear muffler, separating

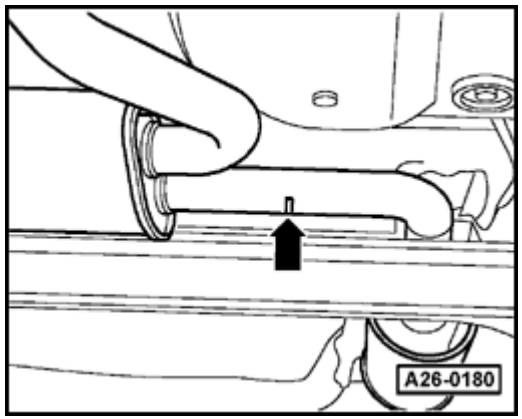
- Connecting pipe has a designated separating point on connecting pipe for separate replacement of front and/or rear muffler.

- Separating point is marked by a depression in the pipe.

Special tools and equipment

VAG1523 saw

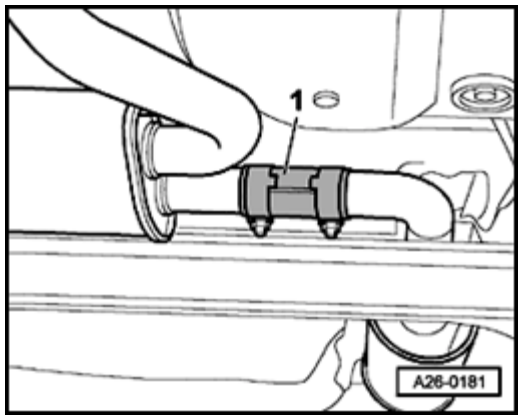
Front-wheel-drive vehicles



- Using VAG1523 saw, cut exhaust pipe at separating point (arrow) at right angle.

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26-15



- When installing, center double clamp over separating point.

➢

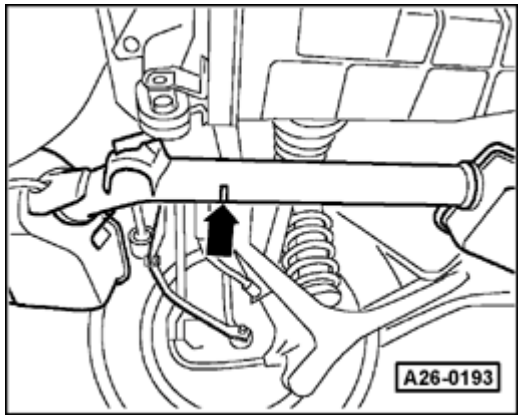
- Double clamp -1- installation position: level, bolt ends pointing downward
- Install double clamp so that bolt ends don't project over lower edge of double clamp ⇒ Page 26-13 , Fig. ⇒ 3

- Install exhaust system free of stress ⇒ Page 26-24 .
- Tighten double clamp bolts evenly to 40 Nm (30 ft lb).

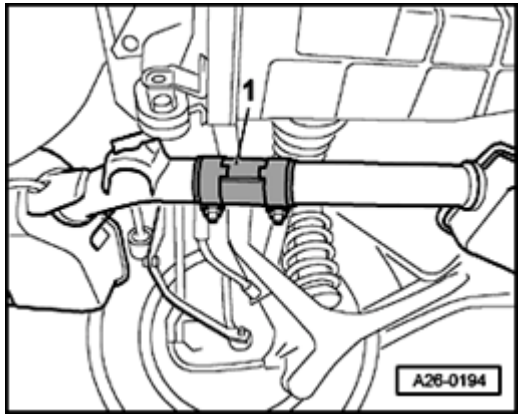
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26-16

All-wheel-drive vehicles



- Using VAG1523 saw, cut exhaust pipe at separating point (arrow) at right angle.
- When installing, center double clamp over separating point.



Double clamp installation position: level with bolts in clamp -1- pointing toward left-rear wheel

- Install double clamp so that bolts don't project over lower edge of double clamp ⇒ Page 26-13 , Fig. ⇒ 3 .
- Align exhaust system free of stress ⇒ Page 26-24 .
- Tighten double clamp bolts evenly to 40 Nm (30 ft lb).

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26-17

Exhaust manifold, removing and installing

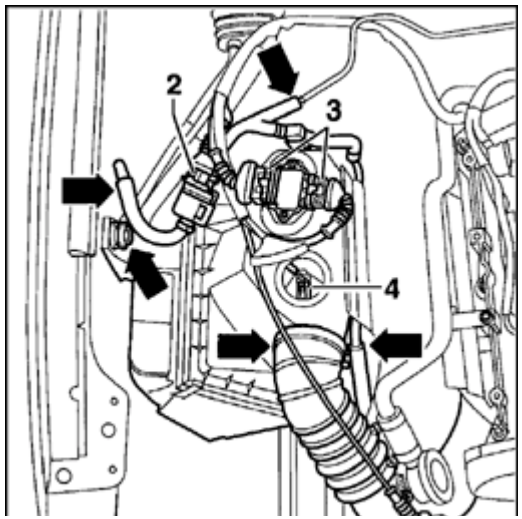
Removing

Note:

- *Replace gaskets and self-locking nuts.*
- *Flexpipe in front exhaust pipe must not be bent more than 10° , otherwise it may be damaged.*

- Remove air guide duct between cowl and air cleaner housing.

- Remove air cleaner housing cover.



- Remove the following lines/harness connectors:

1 - At wastegate bypass regulator valve -N75-

2 - At Evaporative Emissions (EVAP) purge regulator valve -N80-

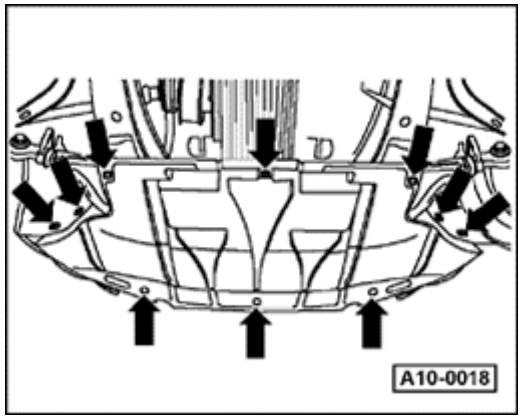
3 - At power output stage -N122-

4 - At Mass Air Flow (MAF) sensor -G70-

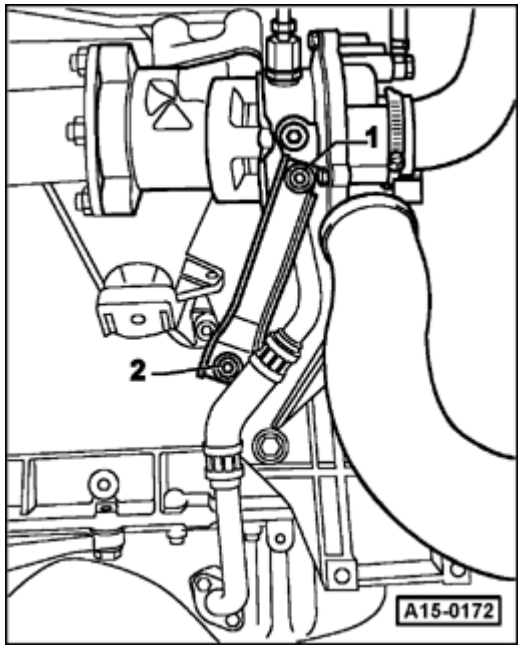
- Pull off hose connections and remove air cleaner housing (arrows).

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26-18



- Remove noise insulation panel (arrows).

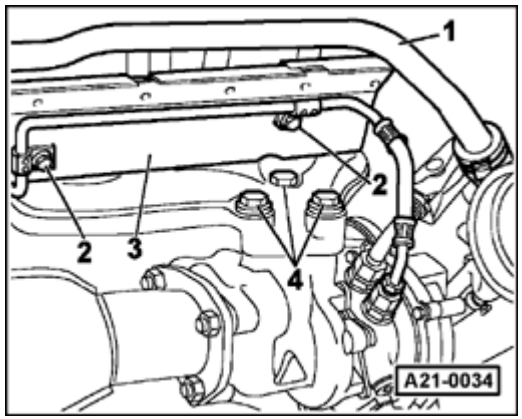


- Unthread bolts -1- and -2- several turns.

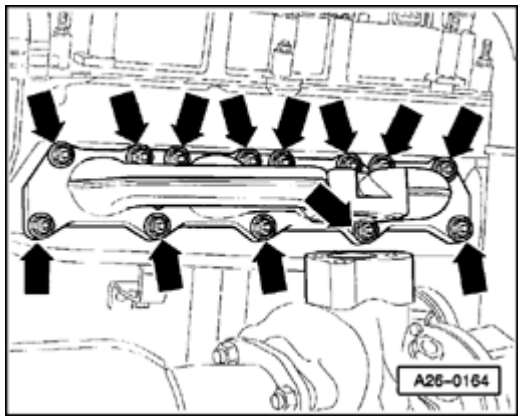
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26-19

- Remove engine covers.



- Unbolt crankcase ventilation hose -1- at cylinder head cover and heat shield.
- Unbolt both oil supply line bolts -2-.
- Remove heat shield -3-.
- Remove bolts -4-.
- Remove seal between turbocharger and exhaust manifold.
- Seal opening in turbocharger using clean cloth.



- Remove all nuts (arrows) from exhaust manifold.
- Remove washers and exhaust manifold.

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Installing

Installation is the reverse of removal, noting the following:

- Install in sequential order as follows:
  - Exhaust manifold to cylinder head
  - Turbocharger to exhaust manifold
  - Turbocharger bracket to cylinder block

Tightening torques

Component	Tightening torques
Turbocharger bracket to turbocharger (bolt and washer assembly M8)	40 Nm (30 ft lb)
Turbocharger bracket to cylinder block	45 Nm (33 ft lb)
Turbocharger to exhaust manifold	35 Nm (26 ft lb)
Exhaust manifold to cylinder head	25 Nm (18 ft lb)
Oil supply line to cylinder head	20 Nm (15 ft

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	lb)
Crankcase ventilation line to cylinder head	10 Nm (7 ft lb)

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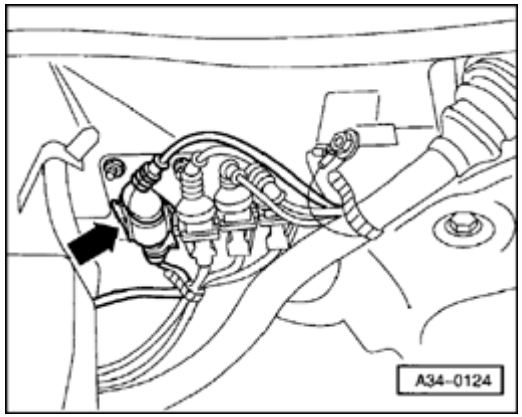
26-21

Three Way Catalytic Converter (TWC), removing and installing

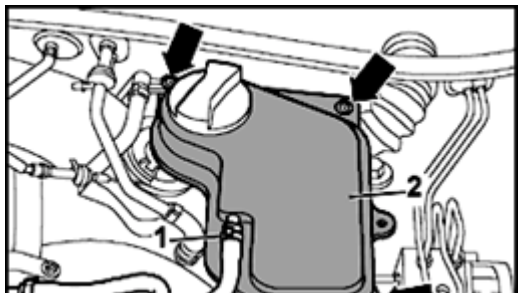
Removing

Note:

- *Replace gaskets and self-locking nuts.*
- *Flexpipe in front exhaust pipe must not be bent more than 10° , otherwise it may be damaged.*



- Disconnect harness connector for heated oxygen sensor (arrow) and set aside.



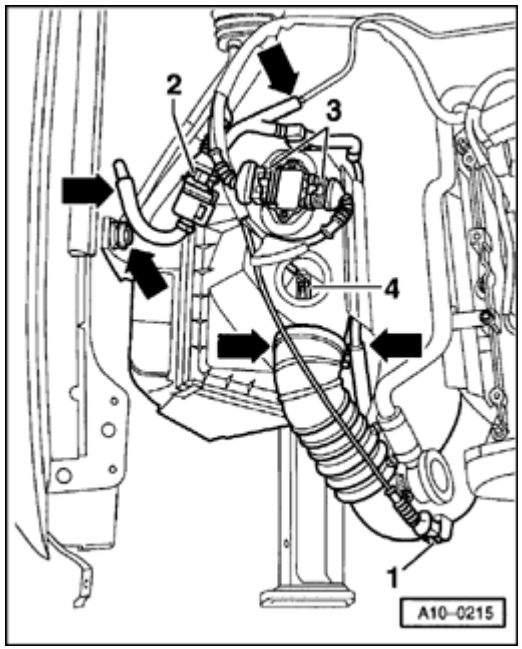
- Remove coolant expansion tank -2- (arrows)
- Remove wiring from Engine Coolant Level (ECL) warning switch -F66- and lay coolant expansion tank to side.

Note:

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Coolant hoses -1- and -3- remain connected.

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- Remove air guide duct between cowl and air cleaner housing.

- Remove air cleaner housing cover.

- Remove the following lines/harness connectors:

1 - At wastegate bypass regulator valve -N75-

2 - At Evaporative Emissions (EVAP) purge regulator valve -N80-

3 - At power output stage -N122-

4 - At Mass Air Flow (MAF) sensor -G70-

- Pull off hose connections and remove air cleaner housing (arrows).
- Remove Heated Oxygen Sensor (HO2S) from Three Way Catalytic Converter (TWC).
- Remove bolts between front exhaust pipe and Three Way Catalytic Converter (TWC).
- Unbolt transmission mount for exhaust system at exhaust system.
- Remove bolts between three Three Way Catalytic Converter (TWC) and turbocharger.
- Remove Three Way Catalytic Converter (TWC) toward top.

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Installing

Installation is the reverse of removal, noting the following:

- Only grease threads of oxygen sensor with "G 052 112 A3." Do NOT allow grease to get into slots on sensor body.
- Align exhaust system free of stress ⇒ Page 26-24 .

Tightening torques

Components	Tightening torques
Front exhaust pipe to three way catalytic converter	25 Nm (18 ft lb)
Front exhaust pipe to transmission mount	25 Nm (18 ft lb)
Three way catalytic converter to turbocharger	30 Nm (22 ft lb)
Heated oxygen sensor to three way catalytic converter	50 Nm (37 ft lb)

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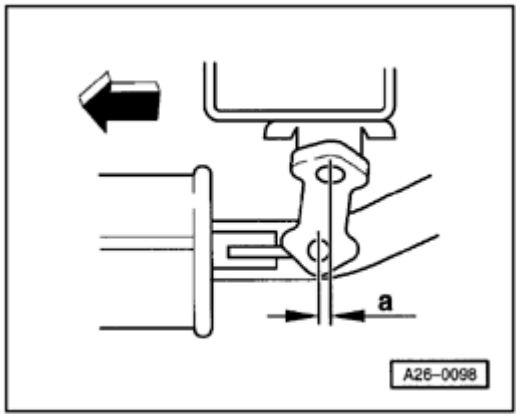
26-24

Exhaust system, aligning free of stress

- Align exhaust system when cold

Front-wheel-drive vehicles

- Remove double clamp bolts ⇒ Page 26-2 , item 2 .

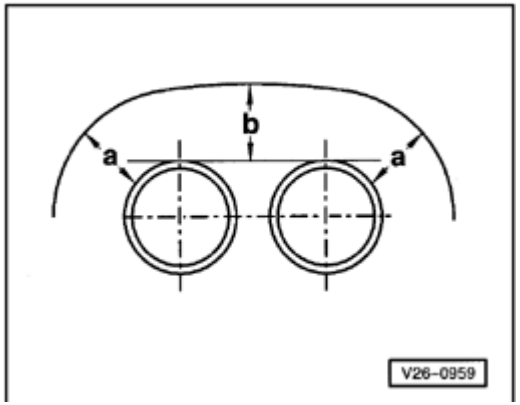


- Push exhaust system forward (arrow) until tension on rear mount equals dimension -a-.

  Dimension -a- = 7-9 mm (0.275-0.354 in.)

- Tighten double clamp bolts evenly to 40 Nm (30 ft lb).

Aligning tailpipes:



- Align tailpipes so distance -a- on left and right side is equal.
- Distance -b- between bumper cutout and tailpipes must equal specification.

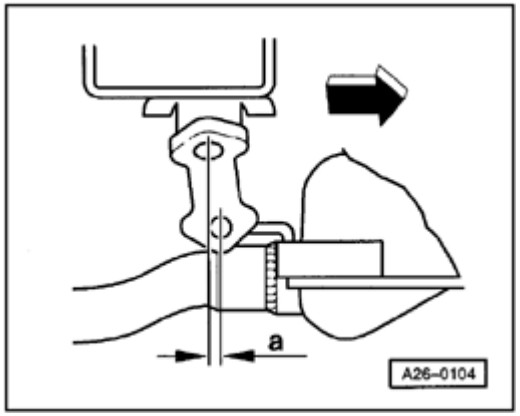
  Distance -b- = 40-46 mm (1.57-1.81 in.)

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26-25

All-wheel-drive vehicleswithout double clamp between front and rear mufflers

- Remove double clamp bolts ⇒ Page 26-9 , item - 12 -.

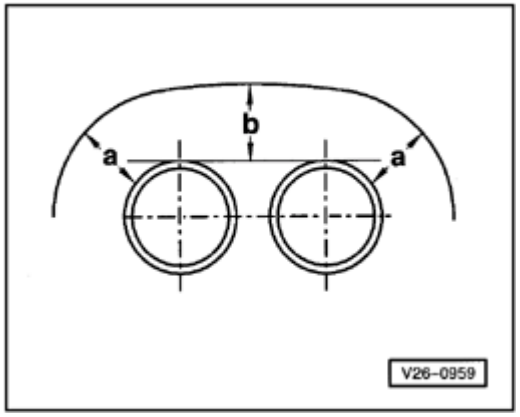


- Push exhaust system forward (arrow) until initial preload on right rear mount equals dimension -a-.

  Dimension -a- = 7-11 mm (0.275-0.433 in.)

- Tighten double clamp bolts evenly to 40 Nm (30 ft lb).

Aligning tailpipes:



- Align tailpipes so distance -a- on left and right-sides is equal.
- Distance -b- between bumper cutout and tailpipes must equal specification.

  Distance -b- = 41-47 mm (1.614-1.850 in.)

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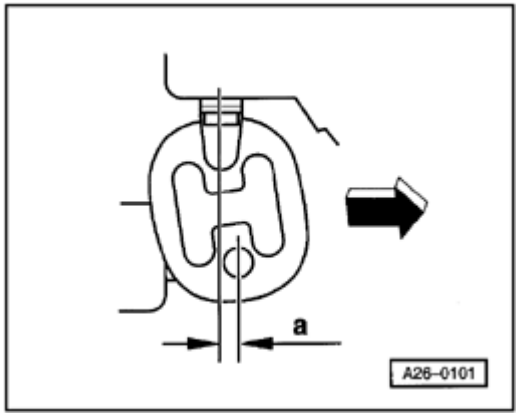
26-26

All-wheel-drive vehicleswith double clamp between front and rear mufflers

Note:

Only for vehicles with double clamp between front and rear mufflers: also align front muffler.

- Remove double clamp bolts ⇒ Page 26-9 , item - 12 - and ⇒ Page 26-10 , item - 22 -.



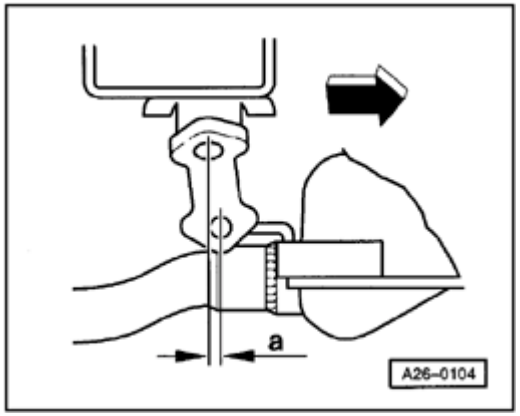
- Push exhaust system forward (arrow) until initial preload on left rear mount equals dimension -a-.

  Dimension -a- = 7-9 mm (0.275-0.354 in.)

- Tighten front double clamp bolts evenly to 40 Nm (30 ft lb) ⇒ Page 26-9 , item - 12 -.

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26-27

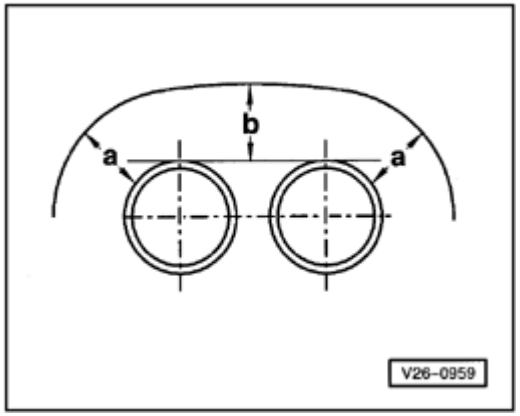


- Push exhaust system forward (arrow) until initial preload on right-rear mount equals dimension -a-.

  Dimension -a- = 7-11 mm (0.275-0.433 in.)

- Tighten rear double clamp bolts evenly to 40 Nm (30 ft lb) ⇒ Page 26-10 , item - 22 -.

Aligning tailpipes:



- Align tailpipes so distance -a- on left and right side is equal.

Distance -b- between bumper cutout and tailpipes must equal specification.

Specification:

Distance -b- = 41-47 mm (1.614-1.850 in.)

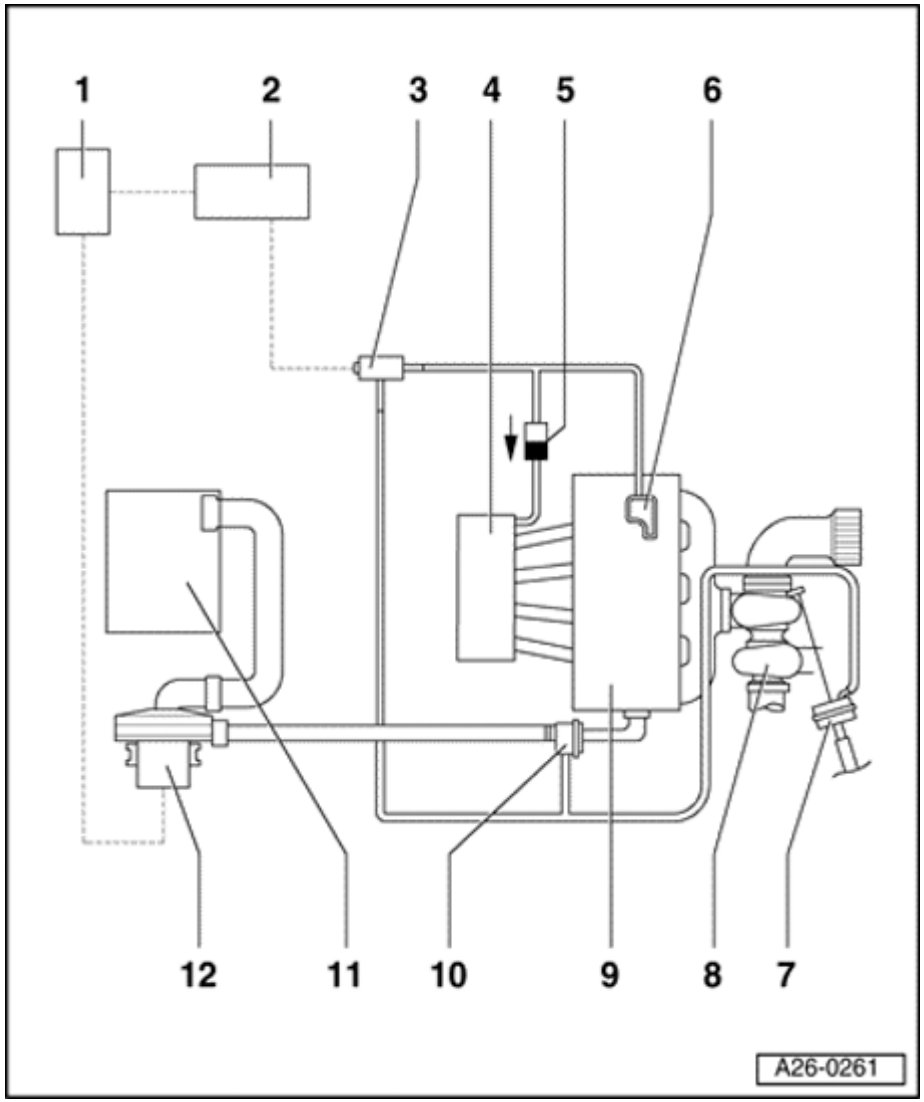
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Exhaust system, checking for leaks

- Start engine and run at idle.
- Seal tailpipes with cloths or equivalent for duration of leak test.
- Listen for leaks at following connections: cylinder head/exhaust manifold, exhaust manifold/turbocharger, turbocharger/Three Way Catalytic Converter (TWC), etc.
- Repair leaks.

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Secondary air system, checking (engine code ATW)

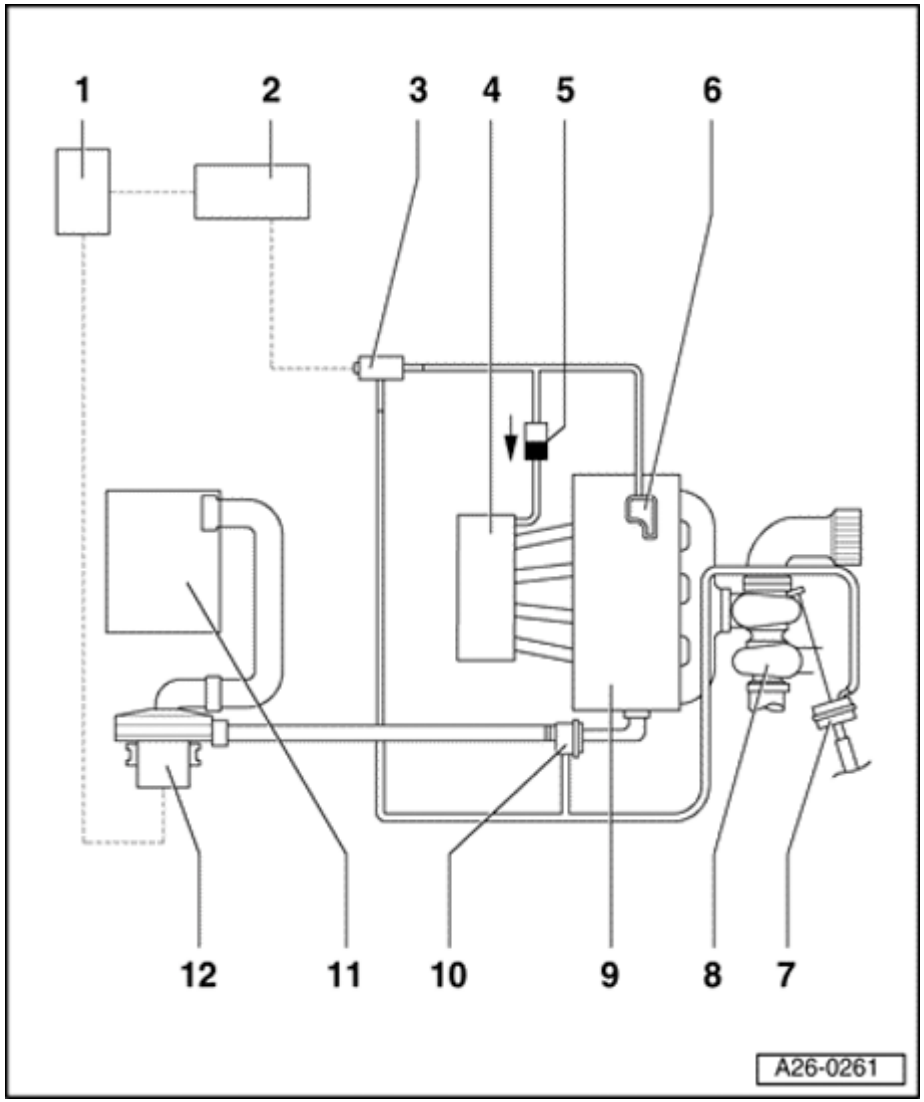
Following a cold start, the secondary air system helps to quickly heat the catalytic converter for quicker operating readiness.

Principle

Due to over-enrichment of the mixture during the cold start phase, there is an increased amount of uncombusted carbon monoxide in the exhaust. Secondary Air Injection (AIR) improves secondary oxidation in the catalytic converter and therefore reduces emissions. The heat produced by secondary oxidation greatly reduces start-up time for the catalytic converter which significantly improving exhaust quality during the cold start phase.

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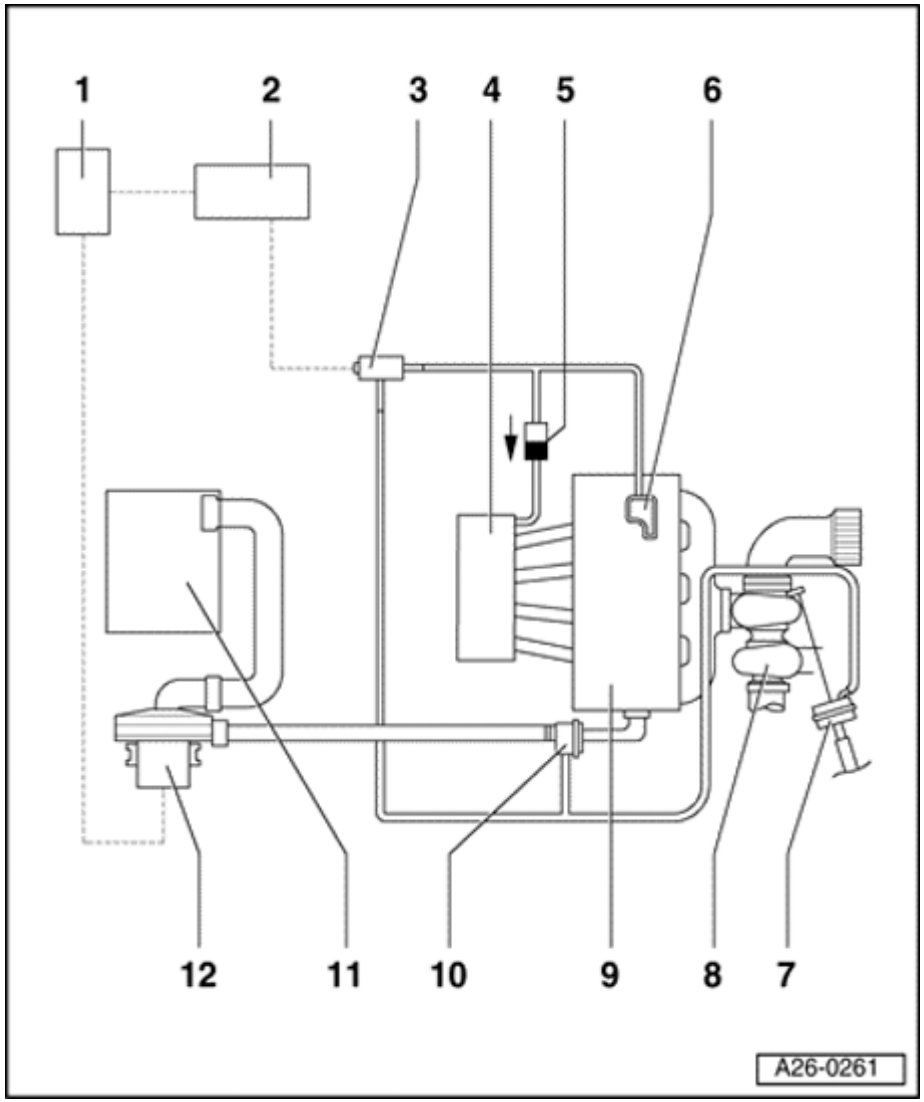


Function:

- In the cold start phase, the ECM -2- activates the secondary air pump -12- via the relay for secondary air pump -1-. Air is supplied to the combination valve for Secondary Air Injection (AIR) -10-.
- The Secondary Air Injection (AIR) valve -3- is activated in parallel, which allows the vacuum to reach the combination valve for Secondary Air Injection (AIR) -10- and the vacuum diaphragm for charge air pressure regulation -7-. The combination valve for Secondary Air Injection (AIR) thereby opens the path for secondary air to the exhaust channels of the cylinder head.

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- To prevent unnecessary heating, the secondary air is diverted past the turbocharger -7-. For this, the charge air pressureregulation pressure unit opens the charge air pressure valve. The pressure unit, designed as a double reservoir, has a vacuum connection for this on the intake side.

1 - Secondary Air Injection (AIR) pump relay - J299-

2 - Motronic Engine Control Module (ECM) - J220-

3 - Secondary Air Injection (AIR) solenoid valve -N112-

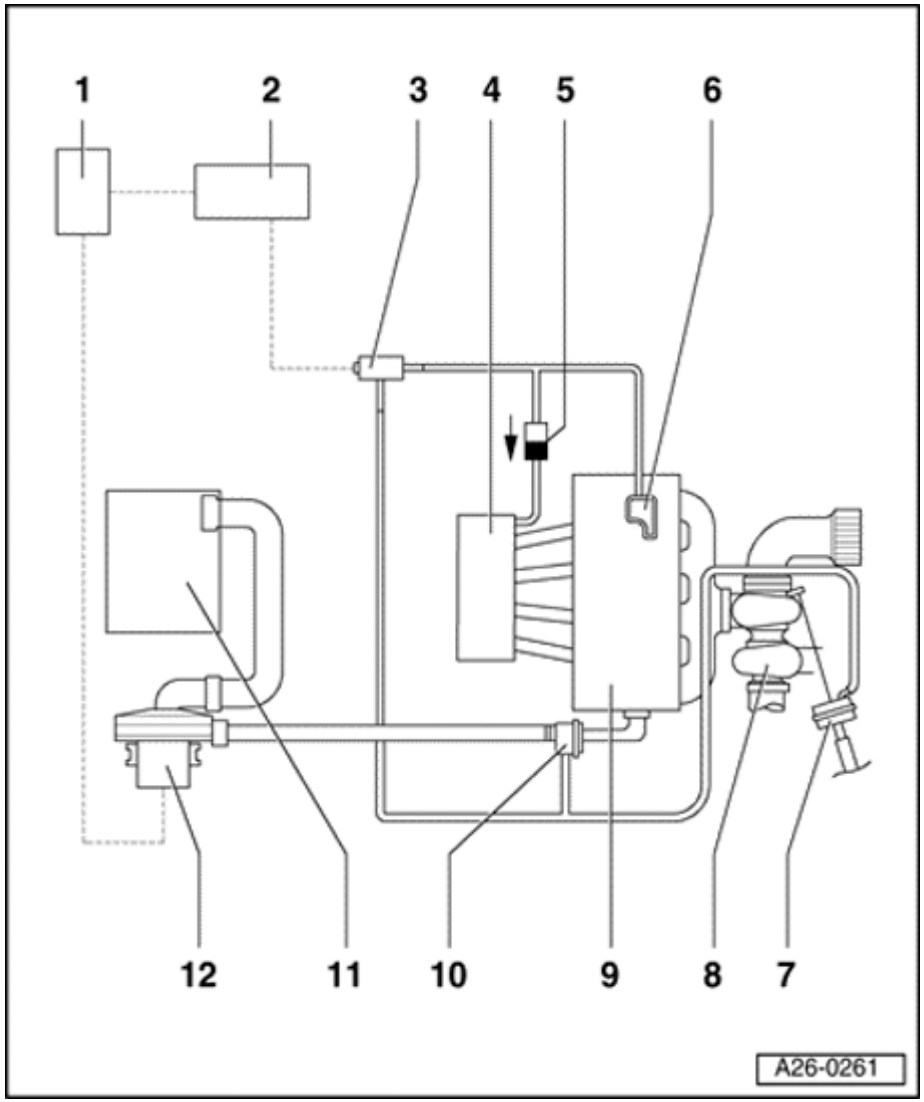
4 - Intake manifold

5 - Check valve

- Installation position (light/dark side): Arrow points in direction of flow, as shown

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6 - Vacuum reservoir

7 - Pressure unit for charge air pressure regulation

8 - Turbocharger

9 - Cylinder head

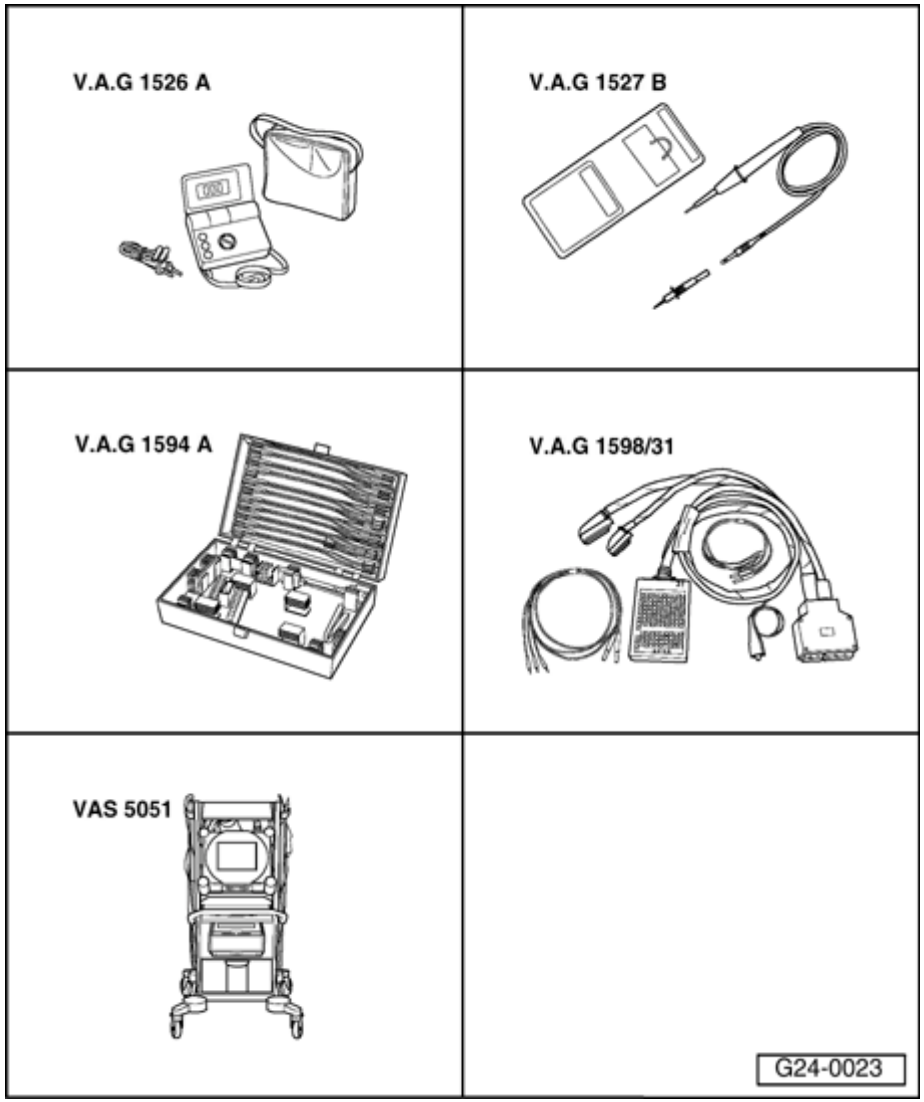
10 - Combination valve for secondary air injection (AIR)

11 - Air cleaner

12 - Secondary Air Injection (AIR) pump motor -V101-

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Secondary Air Injection (AIR) solenoid valve -N112-, checking

Special tools and equipment

- VAG1526A
- VAG1527B
- VAG1594A
- VAG1598/31
- VAS 5051

- or

- VAG1551 with VAG1551/3A

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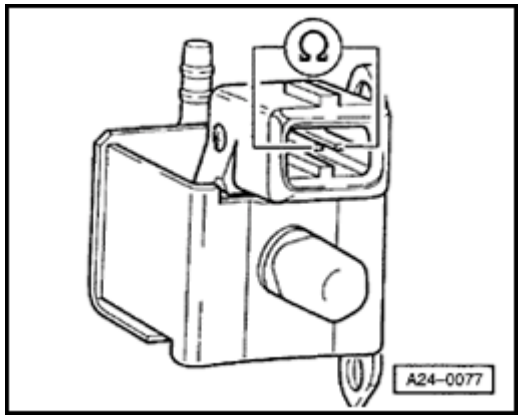
26-34

Test requirement

- Output Diagnostic Test Mode (DTM) performed

Checking internal resistance

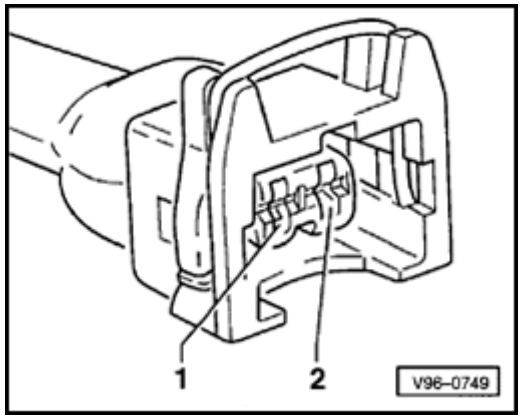
- Disconnect green harness connector from Secondary Air Injection (AIR) solenoid valve - N112-.



- Connect multimeter at valve for resistance measurement.
  - Specified value: 25-35 Ω
- If specified value is not obtained, replace Secondary Air Injection (AIR) solenoid valve -N112-.

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Checking voltage supply

- Disconnect harness connector from Secondary Air Injection (AIR) solenoid valve -N112-.

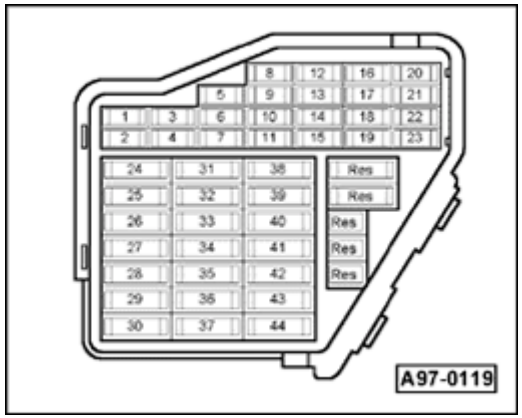
- Connect VAG1527B voltage tester as follows:

Harness connector terminal	Measure to
1	Engine Ground (GND)

- Operate starter briefly.
  - ♦ LED must light.

If LED does not light:

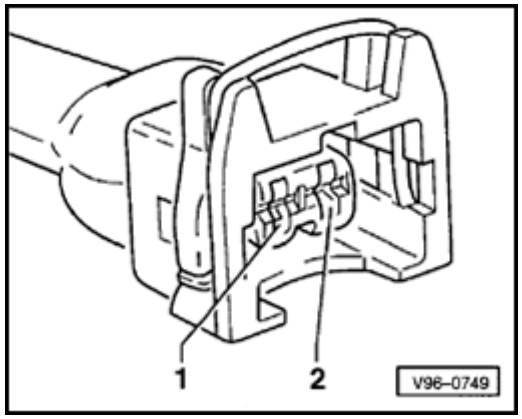
- Perform the following tests marked with dots:



- Check fuse S234 (in fuse holder, position 34).

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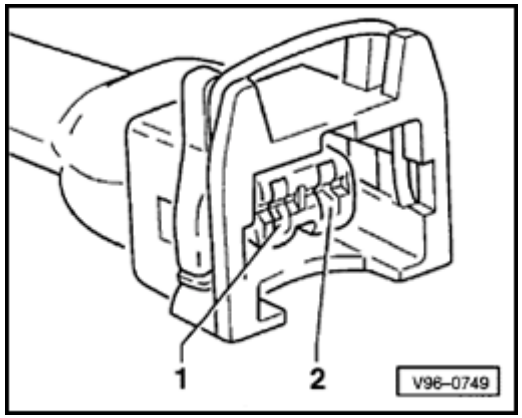
- Check wire connection from terminal 1 of connector via fuse S234 (in fuse holder, socket 34) to Fuel Pump (FP) relay for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Check Fuel Pump (FP) relay

⇒ *Repair Manual, Fuel Supply System, Repair Group 20*

Checking activation



- Connect VAG1527B voltage tester between terminals 1 and 2 using test leads from VAG1594A.
- Connect VAG1551 scan tool.
- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection (AIR) solenoid valve -N112-.

Output Diagnostic Test Mode →

Secondary Air Inj. Solenoid Valve -N112

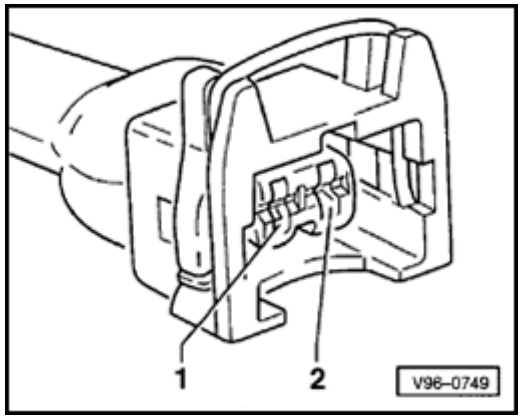
Indicated on display

- ♦ LED must blink.

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If LED does not blink or if it remains constantly lit:

- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM.



- Check the following wire connections for open circuit and short circuit to Ground (GND) and B+:

Harness connector terminal	VAG1598/31 test box socket
2	44

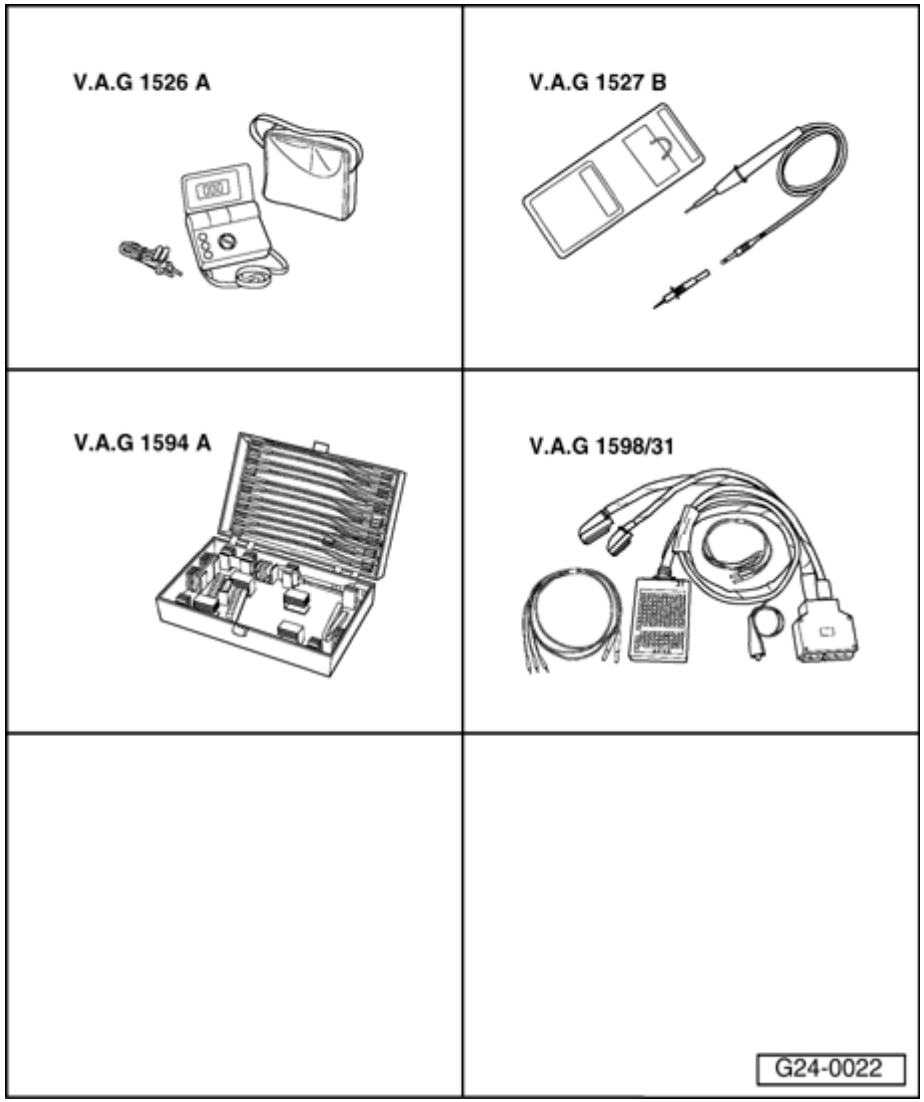
- Repair open circuit or short circuit if necessary.

If wire connection is OK:

- Replace Engine Control Module (ECM).

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Secondary Air Injection (AIR) pump relay - J299-, checking activation

Special tools and equipment

- VAG1526A
- VAG1527B
- VAG1594A
- VAG1598/31

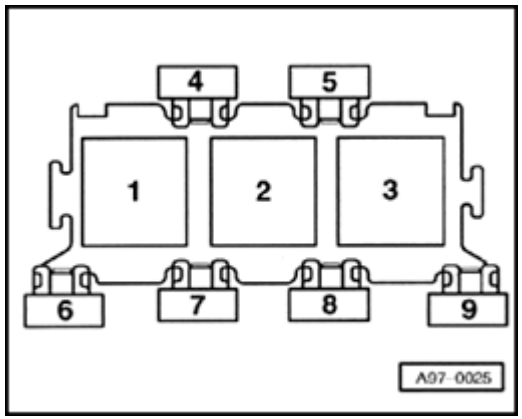
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Installation location:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 24*

- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection (AIR) pump relay -J299-.



- The Secondary Air Injection (AIR) pump relay (in 3-socket relay carrier in the E-box, at left in plenum chamber, position 2) must trigger and the Secondary Air Injection (AIR) pump motor -V101- must run in intervals

A - If relay does not trigger:

- Check voltage supply of Secondary Air Injection (AIR) relay ⇒ Page 26-40 .
- Checking activation of Secondary Air Injection (AIR) relay ⇒ Page 26-42 .

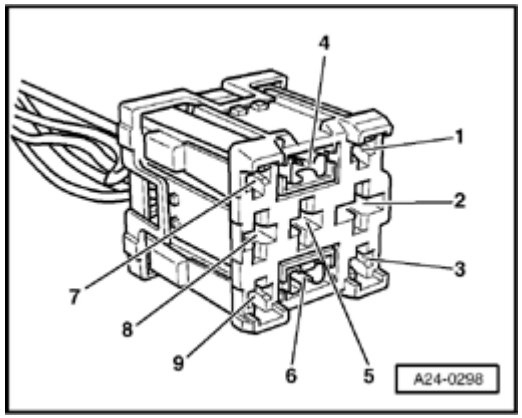
B - If relay triggers, but Secondary Air Injection (AIR) pump does not run:

- Check voltage supply for Secondary Air Injection (AIR) pump ⇒ Page 26-43 .

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Checking voltage supply of Secondary Air Injection (AIR) pump relay

- Remove Secondary Air Injection (AIR) pump relay.



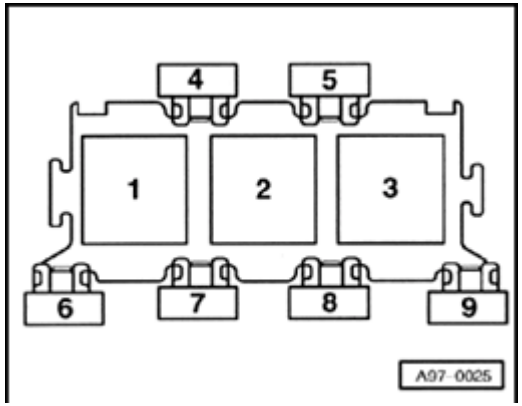
- Connect multimeter for voltage measurement as follows.

3-socket relay carrier in E-box, plenum chamber, position 2 terminal	Measure to
8	Engine Ground (GND)

♦ Specified value: approx. battery voltage

If specified value is not obtained:

- Perform the following tests marked with dots:

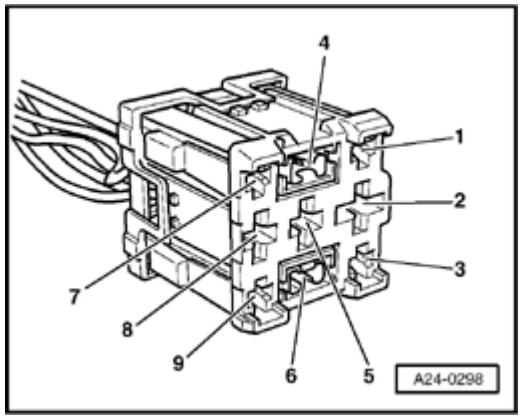


- Check fuse S130 (40 A) in 3-socket relay carrier in E-Box, plenum chamber, position 7.
- Check wire connection from Battery (B+) (terminal 30) to Secondary Air Injection (AIR) pump relay -J299- (in 3-socket relay carrier in E-Box, plenum chamber, position 2) for open circuit.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

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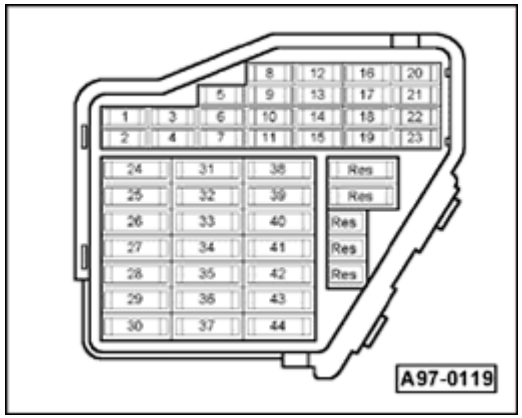
- Connect multimeter for voltage measurement as follows.

3-socket relay carrier in E-box, plenum chamber, position 2 **terminal**	**Measure to**
4	Engine Ground (GND)

- Operate starter briefly.
  - ♦ Specified value: approx. battery voltage

If specified value is not obtained:

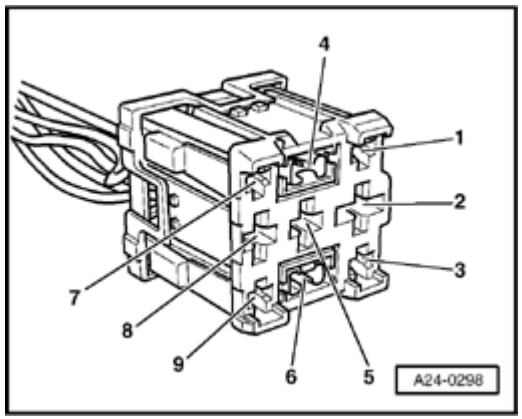
- Perform the following tests marked with dots:



- Check fuse S234 (in fuse holder, position 34).
- Check wire connection from Secondary Air Injection (AIR) pump relay -J299- (in 3-socket relay carrier in E-box, plenum chamber) via fuse S234 (in fuse holder, position 34) to Fuel Pump (FP) relay for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

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Checking activation of the Secondary Air Injection (AIR) pump relay

- Switch ignition off.
- Remove Secondary Air Injection (AIR) pump relay.
- Connect VAG1527B voltage tester as follows:

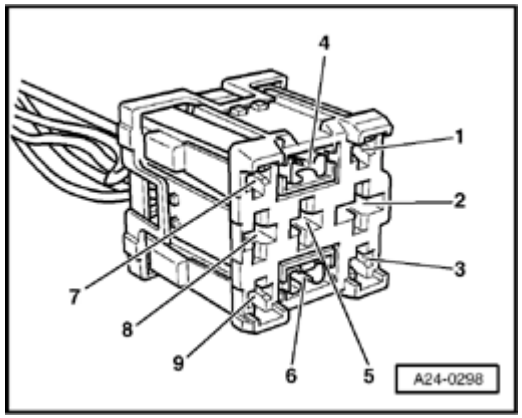
3-socket relay carrier in E-box, plenum chamber, position 2 **terminal**	**Measure to**
6	Engine Ground (GND)

- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection (AIR) pump relay -J299-.
  - ♦ LED must blink.

If LED does not blink:

- Switch ignition off.
- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM.

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- Check the following wire connection for open circuit and short circuit to Ground (GND) and B+:

3-socket relay carrier in E-box, plenum chamber, position 2 terminal	VAG1598/31 test box socket
6	46

- Repair open circuit or short circuit if necessary.

If no malfunctions are detected:

- Replace Secondary Air Injection (AIR) pump relay -J299-.

Checking voltage supply of the Secondary Air Injection (AIR) pump motor

- Remove harness connector for Secondary Air Injection (AIR) pump motor -V101-.
- Connect VAG1527B voltage tester between terminals 1 and 2.
- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection (AIR) pump relay -J299- ⇒ Page 26-42 .
  - ♦ LED must light.

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If LED does not light:

- Perform the following tests marked with dots:

  - Check wire connection from harness connector at Secondary Air Injection (AIR) pump motor -V101- to Secondary Air Injection (AIR) pump relay -J299- (in 3-socket relay carrier in E-Box, plenum chamber, position 2) for open circuit.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

  - Check wire connection from harness connector at Secondary Air Injection (AIR) pump motor -V101- to Ground (GND) connection 1 in engine compartment wiring harness for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If no malfunctions are detected:

- Replace Secondary Air Injection (AIR) pump motor -V101-.

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