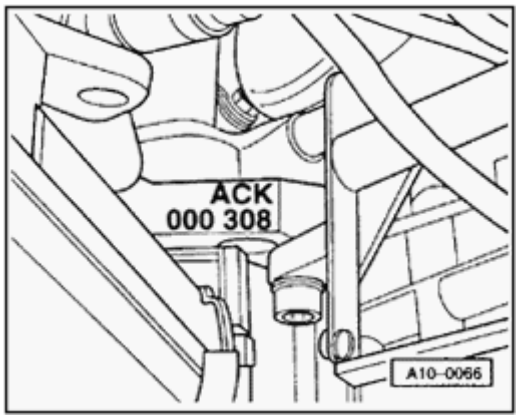
00-1

Technical data

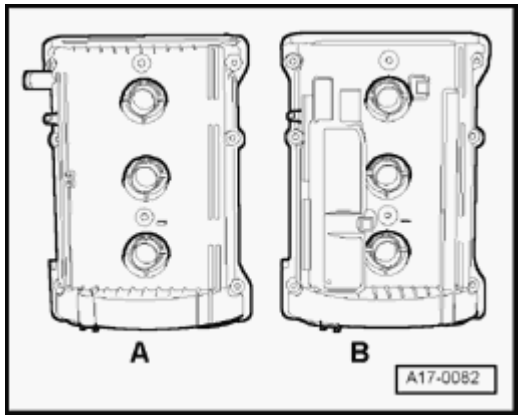
Engine identification



The engine code and serial number are located on the flat surface of the cylinder block in front of the right cylinder head.

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

Identifying engine with modified oil pump (engine code AHA)



In vehicles with VINs up to 8D-V-205 000 the oil pump is mounted on the front of the engine and driven directly by the crankshaft. These engines can be identified by cylinder head cover -A-.

In vehicles with VINs from 8D-V-205 001 on, the oil pump is driven via a chain by the crankshaft and mounted inside the oil pan. In addition, oil supply lines are mounted on the camshaft bearing caps. These engines can be identified by cylinder head cover -B-.

Engine specifications

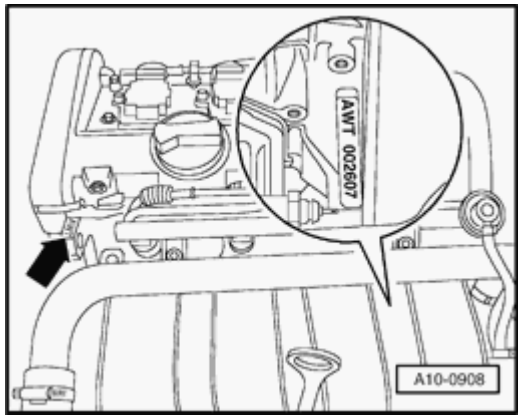
Engine code		AHA	ATQ
Manufactured		02/97 ➢	
Displacement	liters (cm3)	2771	2771
Output	kw @ RPM	142/6000	142/6000
	HP @ RPM	190/6000	193/6000
Torque	Nm @ RPM	280/3200	280/3200
	Ft lb @ RPM	207/3200	207/3200
Bore diameter	mm (in.)	82.5 (3.25)	82.5 (3.25)
Stroke	mm (in.)	86.4 (3.40)	86.4 (3.40)
Compression ratio		10.6:1	9.9:1
RON	minimum	98 unleaded 1)	
Fuel injection and ignition system		Bosch Motronic	
Knock sensor control		Yes	Yes
On Board Diagnostic (OBD)		Yes	Yes
Oxygen sensor control		Yes	Yes

1) In emergencies, fuel with a RON of 95 may be used. Engine performance will be diminished.

Engine code	AHA	ATQ
Exhaust Gas Recirculation (EGR)	No	No
Three Way Catalytic (TWC) converter	Yes	Yes
Turbocharger	No	No
Secondary air injection	Yes	Yes
Valve timing: at 1 mm valve lift and 0 mm valve lash 2)		
Intake valve opens after TDC	12°	12°
Intake valve closes after BDC	42°	42°
Exhaust valve opens before BDC	38°	38°
Exhaust valve closes before BDC	8°	8°
2) Camshaft adjustment not active.		

Technical data

Engine number



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

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

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

Note:

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

Engine data

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

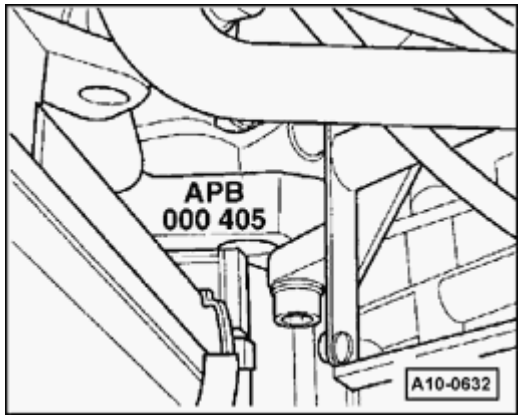
[1)] Regular unleaded petrol RON 91 can be used but will cause a slight loss of power.

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

00-1

Technical data

Engine number



The engine number (engine code and serial number) is on the machined surface on the cylinder block, at the front of the right cylinder bank.

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

Engine data

Engine code		APB
Manufactured		09.99 ➢
Capacity	cm^3	2671
Power output	Hp at RPM	250/5800
Torque	ft lb at RPM	258/1800-4500
Bore	dia. mm	81
Stroke	dia. mm	86.4
Compression ratio		9.3
RON	min.	98 RON[1)]
Firing order		1-4-3-6-2-5
Fuel injection system		Motronic
On Board Diagnostic		yes
Oxygen sensor closed-loop control		yes
Secondary air injection		no
Camshaft timing control		yes

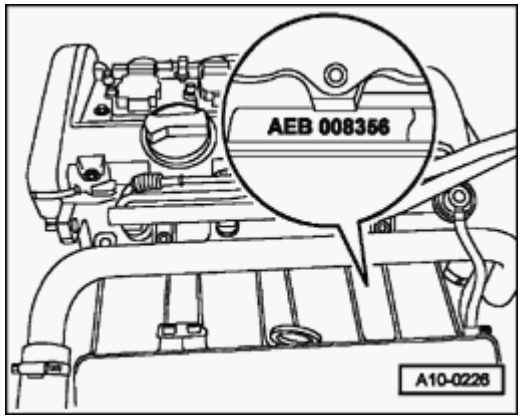
1) Fuel with less than 95 RON can also be used, but this will cause a loss of power.

Engine code	**APB**
Catalytic converter	yes
Exhaust gas recirculation	no
Turbo charging	yes
Valve timing	
At 1 mm valve lift and 0 mm valve clearance, camshaft timing control not active	
Inlet opens after TDC	10°
Inlet closes after BDC	20°
Exhaust opens before BDC	38°
Exhaust closes before TDC	8°

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).

Engine specifications

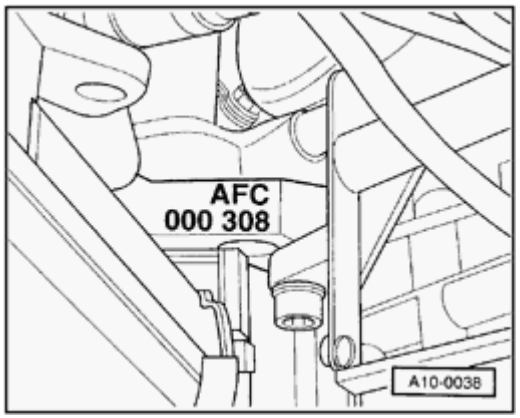
Engine code		AEB	ATW
Manufactured		11.94 ➢	tbd
Displacement	liters	1.781	1.781
Output	kW @ RPM	110/5700	110/5700
	HP @ RPM	150/5700	150/5700
Torque	Nm @ RPM	210/1750	210/1750
	Ft lb @ RPM	155/1750	155/1750
Bore diameter	mm (in.)	81.0 (3.189)	81.0 (3.189)
Stroke	mm (in.)	86.4 (3.402)	86.4 (3.402)
Compression 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

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

00-1

Technical data

Engine number



The engine code letters as well as the serial number are stamped on the right hand side of the engine block between the cylinder head and the power steering pump.

In addition, an adhesive label on the drive belt cover lists the engine code and engine number (serial number).

The engine code is also found on the vehicle data plate.

00-2

Engine specifications

Engine code		AFC
Manufactured	from:to:	05.95 -
No. of cylinders		6
Displacement	liters	2.771
Output [1)]	kW @ RPM Hp @ RPM	128 @ 5500 174 @ 5500
Torque [1)]	Nm @ RPM Ft.lb @ RPM	245 @ 3000 180 @ 3000
Bore diameter	mm	82.5
Stroke	mm	86.4
Compression ratio		10.0:1
Valve timing: at 1 mm valve lift and 0 mm valve clearance		
Intake opens after TDC Intake closes after BDC Exhaust opens before BDC Exhaust closes before TDC		10.50° 45.45° 37.50° 2.55°

RON	minimum	91	

[1)] Performance with RON 98 super (premium) lead-free gasoline

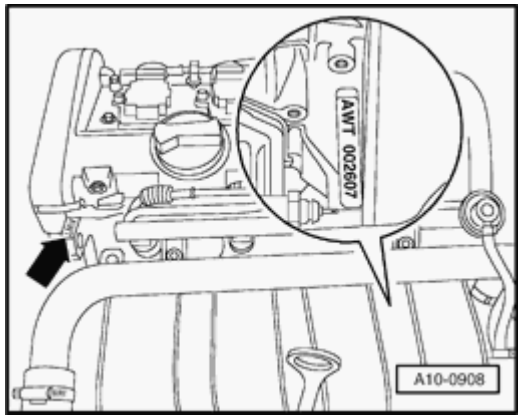
00-3

Fuel injection system	Multiport Fuel Injection (MFI)
On Board Diagnostic	Yes
Oxygen Sensor (O2S) control	Yes
Knock sensor control	Yes
Three Way Catalytic Converter(s)	Yes
Exhaust gas turbocharger	No
Exhaust Gas Recirculation (EGR)	Yes

01-1

Technical data

Engine number



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

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

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

Note:

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

Engine data

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

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

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

Engine, removing and installing

Rules of cleanliness

CAUTION!

Whenever carrying out work on the fuel supply and fuel injection systems, carefully observe the following five 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:

Avoid working with compressed air whenever possible.

Avoid moving the vehicle if possible.

Safety precautions

WARNING!

Be sure the ignition is switched OFF, when:

- ***Disconnecting ignition wires***
- ***Disconnecting fuel injection system wiring***
- ***Connecting or disconnecting test equipment leads***
- ***Disconnecting the battery***
- ***Washing the engine or engine compartment.***

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).***

- ***Be sure of the proper radio code (for vehicles equipped with coded anti-theft radio).***

10-3

Removing

The engine is removed from the front, after being separated from the transmission.

CAUTION!

Determine correct radio anti-theft coding before disconnecting the battery.

Note:

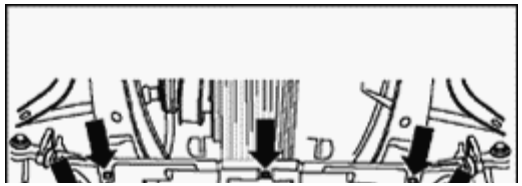
All tie wraps that are loosened or removed in order to remove the engine must be replaced or reinstalled in the same place when the engine is installed.

- Ignition switched off

- Disconnect battery Ground (GND) strap.

- Unbolt bumper by unclipping vent grille at left and right and removing from bumper

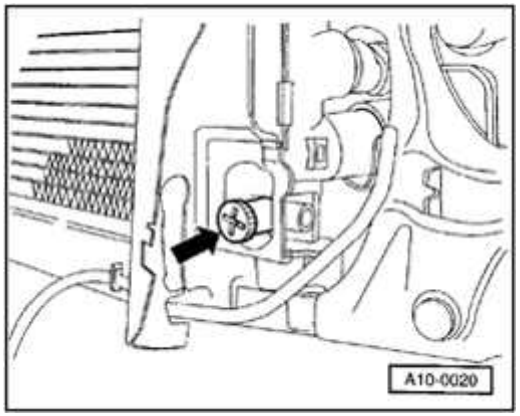
⇒ *Repair Manual, Body Exterior, Repair Group 63* .



- Remove noise insulation panel.

10-4

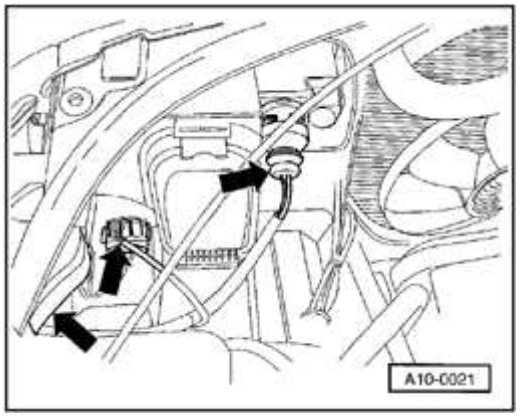
- Unbolt cooling coil for power steering fluid at bottom left of radiator.



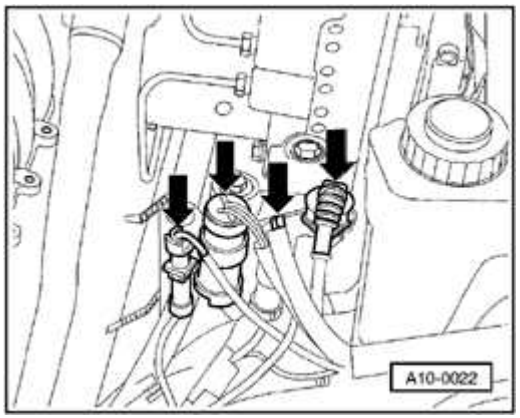
- Drain coolant at radiator.
- Remove locking element for connection flange of coolant hose at bottom of radiator; pull off connection flange.

10-5

- Remove intake air duct to air cleaner at air scoop and lift out.



- Disconnect harness connectors for headlights and turn signal lights.
- Disconnect harness connector of engine coolant temperature sensor near bottom coolant hose at left of radiator.



- Disconnect four harness connectors at ABS hydraulic unit.
- Disconnect harness connectors for anti-theft warning system at upper left of front end.
- Disconnect coolant hose at top left of engine.
- Unclip and disconnect A/C clutch harness connectors at radiator air guide on lower right.
- Disconnect harness connectors at both horns, let cables hang free.
- Remove air scoop.

10-6

- Disconnect harness connectors at Mass Air Flow (MAF) sensor and Idle Air Control (IAC) valve, unbolt hose from plenum chamber and unclip.

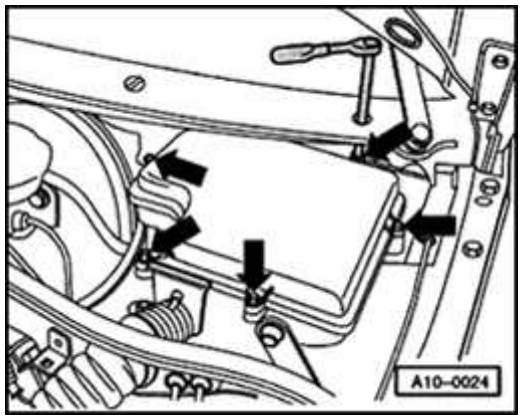
- Disconnect hose connection at IAC valve.

- Remove air guide between air cleaner and throttle body.

- Remove air cleaner housing.

- Disconnect fuel supply and return lines.

- Remove coolant expansion tank.



- Remove cover for electronics box.
- Unclip engine control module and disconnect harness connectors.
- Disconnect harness connectors at connector station below engine control module.
- Disconnect ground connection and bracket for harness connectors at plenum chamber.
- Disconnect both coolant lines to heater core between plenum chamber and engine.
- Disconnect accelerator pedal cable and let hang free.

- Disconnect both harness connectors at top of transmission.

- Loosen V-belt for hydraulic pump, viscous fan and generator and secure with special tool 3204.

- Use screwdriver to counter-hold belt pulley for viscous fan and unbolt with open-end wrench 3312.

  Tightening torque with torque wrench 1331 and open-end wrench 3312 is 37 Nm (27 ft lb); without open-end wrench 3312 tightening torque is 70 Nm (52 ft lb).

Note:

Refer to table for torque wrenches of a different length; length of torque wrench from socket drive to center of handle.

Length of torque wrench	**Tightening torques**	
220 mm	33 Nm	(24 ft lb)
280 mm	37 Nm	(27 ft lb)
300 mm	39 Nm	(29 ft lb)
440 mm	45 Nm	(33 ft lb)

10-8

- Unbolt hydraulic pump from mounting bracket.

CAUTION!

Hydraulic lines should remain connected.

- Unscrew bolts and secure A/C compressor to one side with wire.

CAUTION!

- ***Disconnect at mounting points only.***
- ***DO NOT open the air conditioning refrigerant circuit.***
- ***Set the A/C compressor aside carefully. Refrigerant lines kink easily.***
- ***The A/C refrigerant circuit must only be opened by specially trained technicians using the proper tools and equipment.***

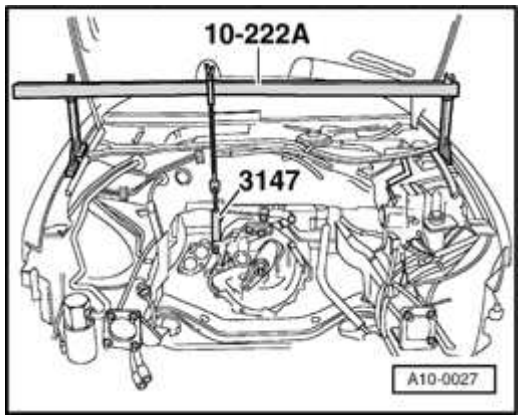
- Remove bolts securing exhaust manifold and front exhaust pipe at top.

- Disconnect battery positive (B+) cable from starter at right of engine below exhaust manifold.

- Remove starter, take off insulator at starter positive (B+) connection, unbolt fixture at engine block, disconnect ground wire from engine support.

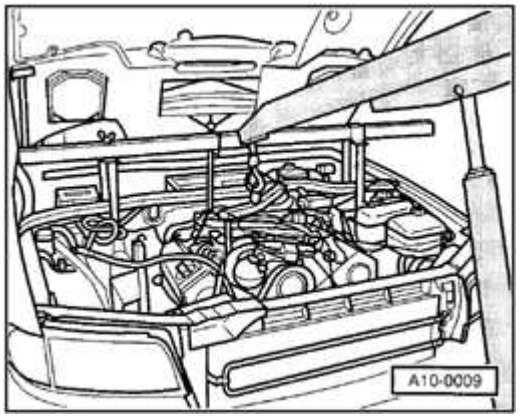
- Unscrew four engine mounting bolts.

- Support weight of transmission using engine support bridge 10-222A.



- Attach engine support adapter 3147 to bolt hole of transmission bell housing.

  (Adapter installation shown with engine removed)

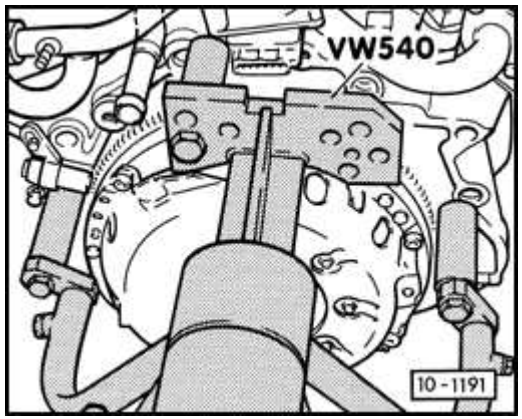


- Attach engine sling 2024A to engine and workshop crane 1202A.

CAUTION!

The mounting hooks and pins on the lifting device must be secured with locking pins.

10-10



Mounting engine cylinder block on assembly stand

- Mount engine to stand using holding fixture VW 540 along with VW 540/2.

CAUTION!

DO NOT have the cylinder block mounted to the assembly stand while measuring the cylinder bores (Repair Group 13). The cylinder block is deformed by its own weight under these conditions and such stress will result in false measurements that are not accurate after the tension has been relieved.

10-11

Installing

The engine is installed in the reverse order of removal, with the addition of the following special conditions and steps:

WARNING!

Do not re-use any fasteners that are worn or deformed in normal use. Many fasteners are designed to be used only once and become unreliable and may fail when used a second time. This includes, but is not limited to, nuts, bolts, washers, self-locking nuts or bolts, circlips and cotter pins. Always follow recommendations given in this publication. Always replace these fasteners with new parts.

- Check that alignment sleeves for centering engine and transmission are properly installed in cylinder block. Install sleeves if necessary.

- Always install new seals and gaskets.

- Check centering of clutch disc, if necessary.

- Check clutch release bearing for wear and replace if necessary.

- Clean transmission input shaft splines. Lightly lubricate clutch release bearing and transmission input shaft splines with G 000 100 grease. Do not grease guide sleeve for release bearing.

- Install engine mounts free of stress. To do so, align engine by shaking before tightening engine mounts.

- Allow stop of torque support to move down onto rubber block under its own weight; tighten bolts to 45 Nm (33 ft lb).

- Align exhaust system free of stress ⇒ Repair Group 26.

- Adjust accelerator pedal cable ⇒ Repair Group 20.

- Re-fill engine cooling system ⇒ Repair Group 19.

- Drained coolant may only be re-used provided the cylinder block or the cylinder head was not replaced.

- Check oil level before starting engine.

- Short blocks are supplied without bushing in crankshaft. For vehicles with automatic transmission, tap bushing into place before installing drive plate.

- Check reconditioned engines with manual gearbox to determine whether needle bearing is installed in crankshaft; install if necessary.

- Observe tightening torque specifications.

Tightening torques

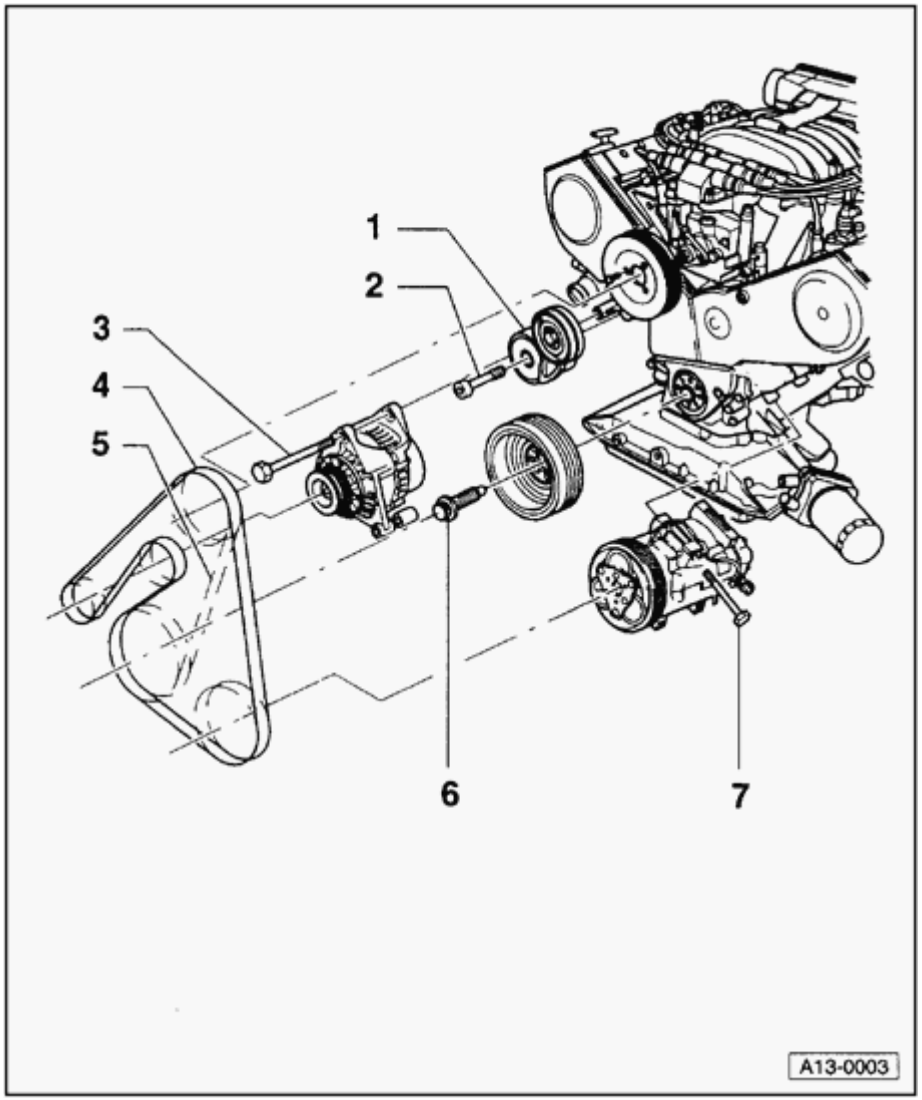
Notes:

- *The tightening torques apply only to lightly greased, oiled, plated or specially treated nuts and bolts.*
- *It is permissible to use additional lubricants such as engine or gear oils, but do not use Molykote and do not use degreased parts.*
- *Permissible tolerance for tightening torques ± 15%.*

Bolts, nuts	M6	10 Nm	(7 ft lb)
	M8	20 Nm	(15 ft lb)
	M10	45 Nm	(33 ft lb)
	M12	60 Nm	(44 ft lb)
Exhaust pipe to manifold	M8	25 Nm	(18 ft lb)
AC compressor to bracket	M8	25	(18 ft

		Nm	lb)
Torque converter to drive plate	M8	35 Nm	(26 ft lb)
Engine support to engine mount	M10	45 Nm	
Viscous coupling to bracket	M10	45 Nm	(33 ft lb)
Hydraulic pump to bracket	M8	25 Nm	(18 ft lb)
Generator to mounting bracket	M8	35 Nm	(28 ft lb)

13-3



Ribbed belt and pulley, assembly

1 - Tensioner

- Loosening ⇒ page 13-9

2 - 55 Nm (41 ft lb)

3 - 20 Nm (15 ft lb)

4 - Ribbed belt

- Removing and installing ⇒ page 13-9

5 - Belt routing for vehicles w/o A/C

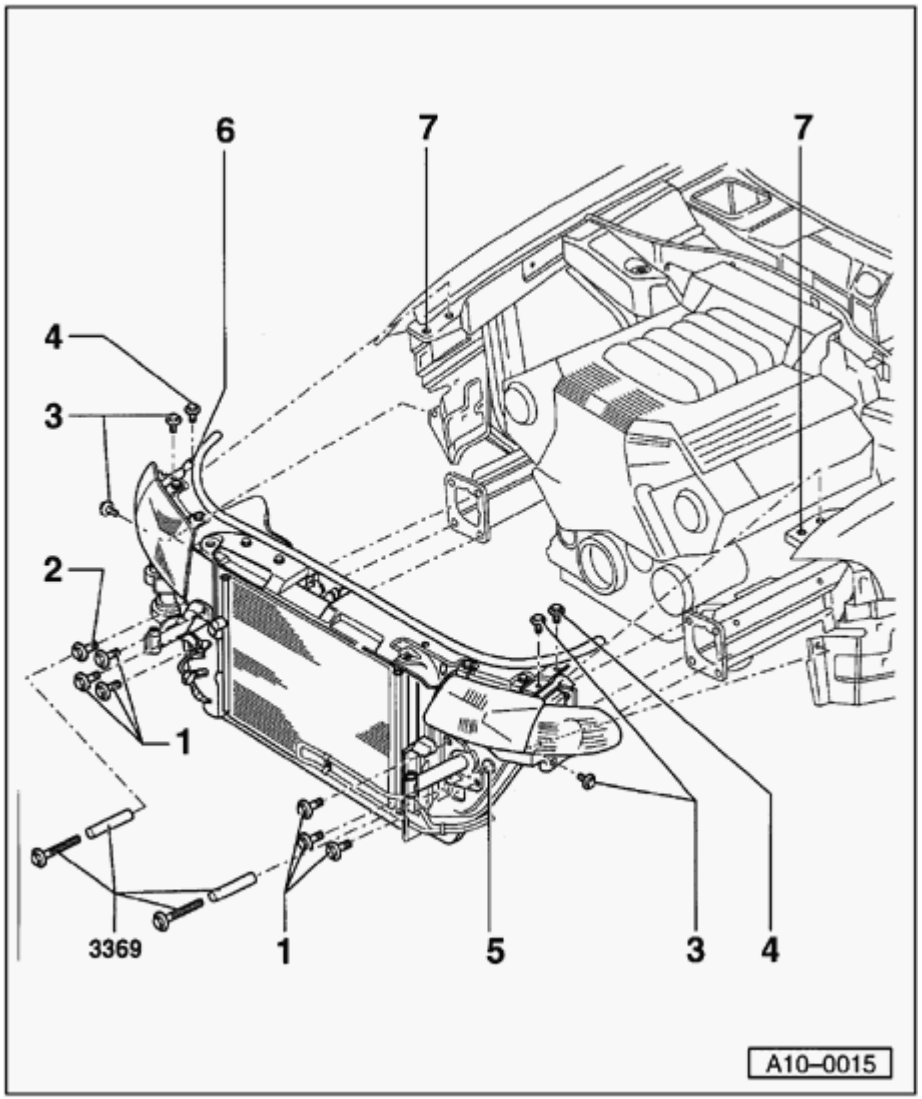
- Not applicable for USA/Canada

6 - Bolt

- Always replace
- Oil threads
- Use only new double hex head (12-pt.) cap screw grade 9.8
- Tightening torque (bolt oiled): 200 Nm (148 ft lb) plus additional 1/2-turn (180°); two 1/4-turns (90°) are permissible

7 - 20 Nm (15 ft lb)

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)

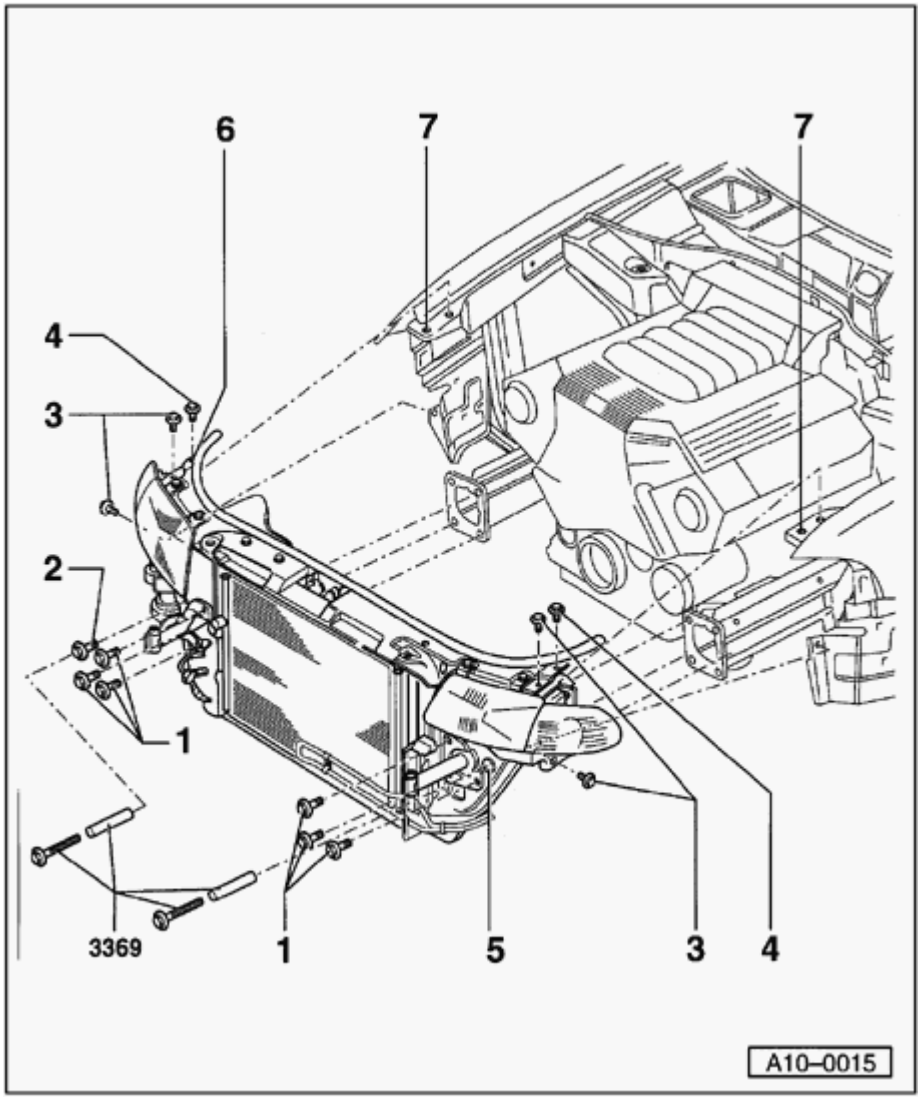
5 - Bore

- For 3369 support tool

6 - Lock carrier bore

7 - Fender bore

13-2

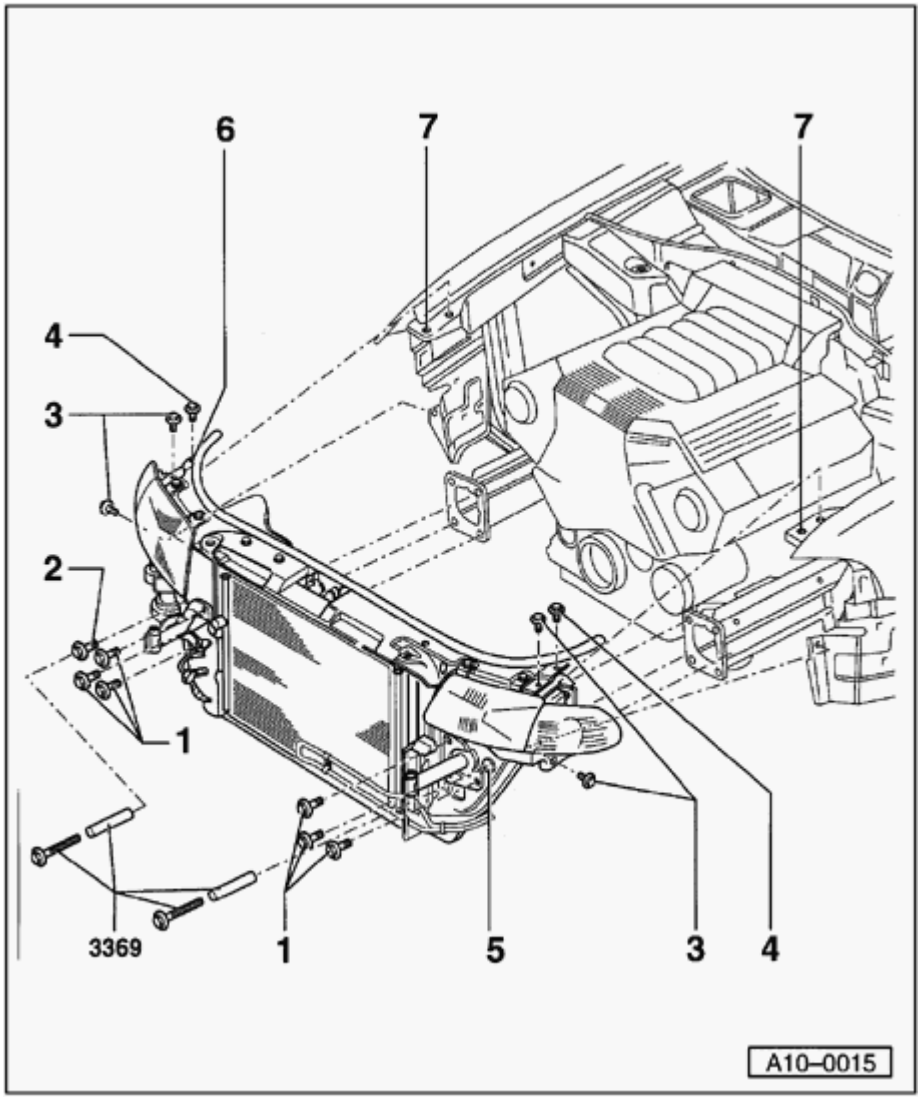


- Remove front bumper.

⇒ *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-.

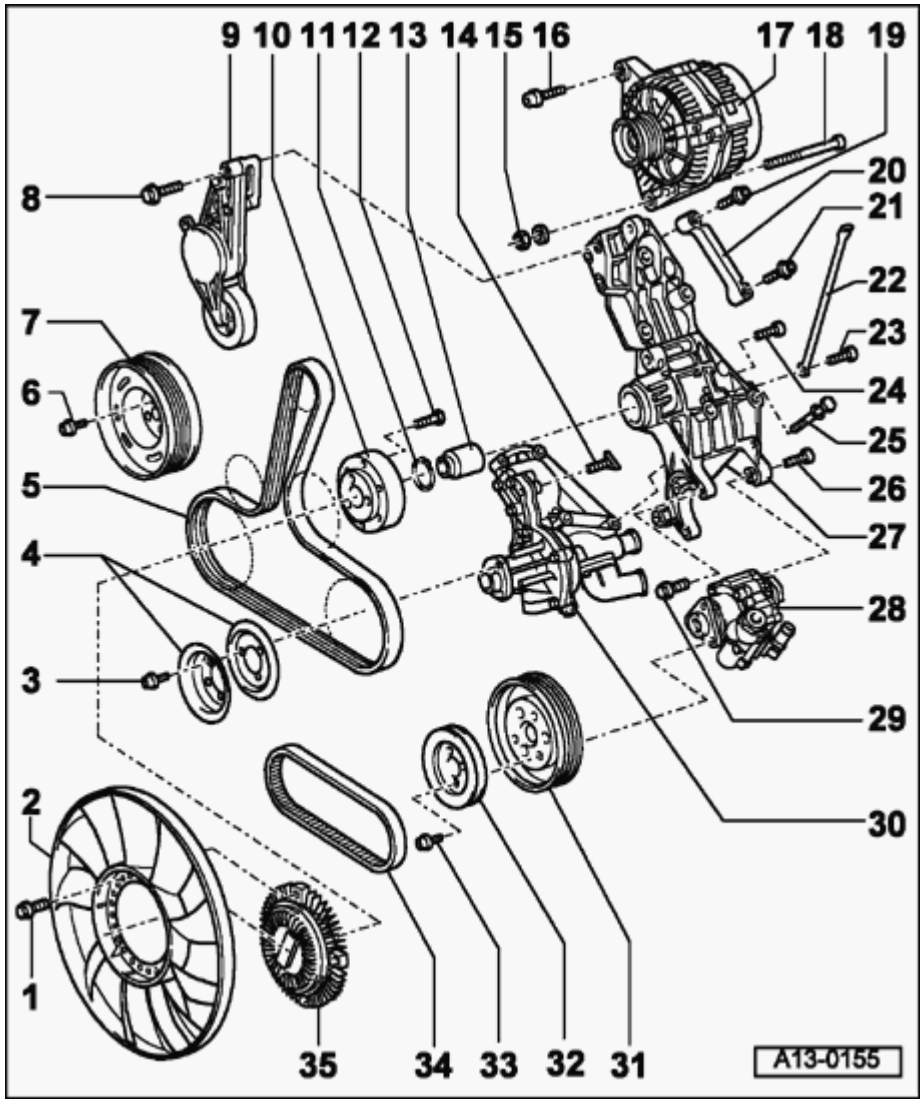
13-3



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

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

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

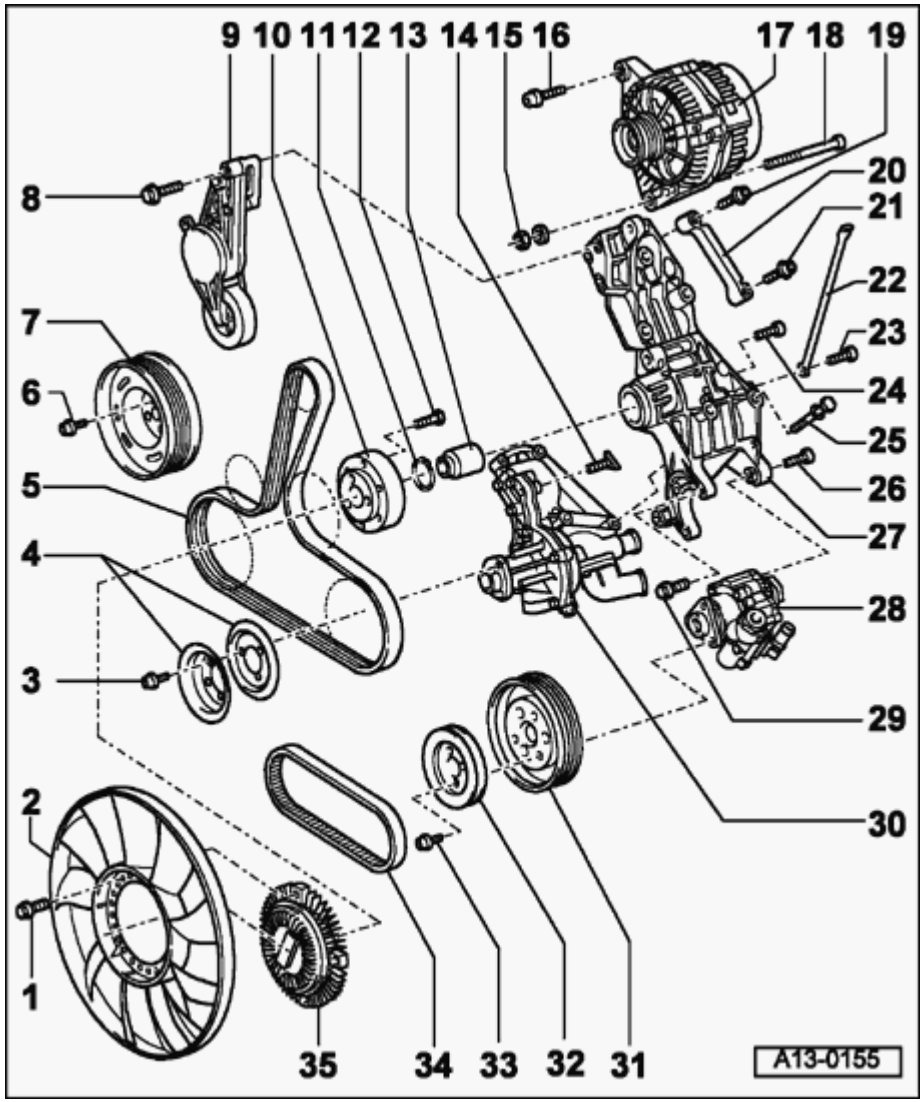
3 - Coolant pump pulley bolt

- 25 Nm (18 ft lb)

4 - Belt pulley

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

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)

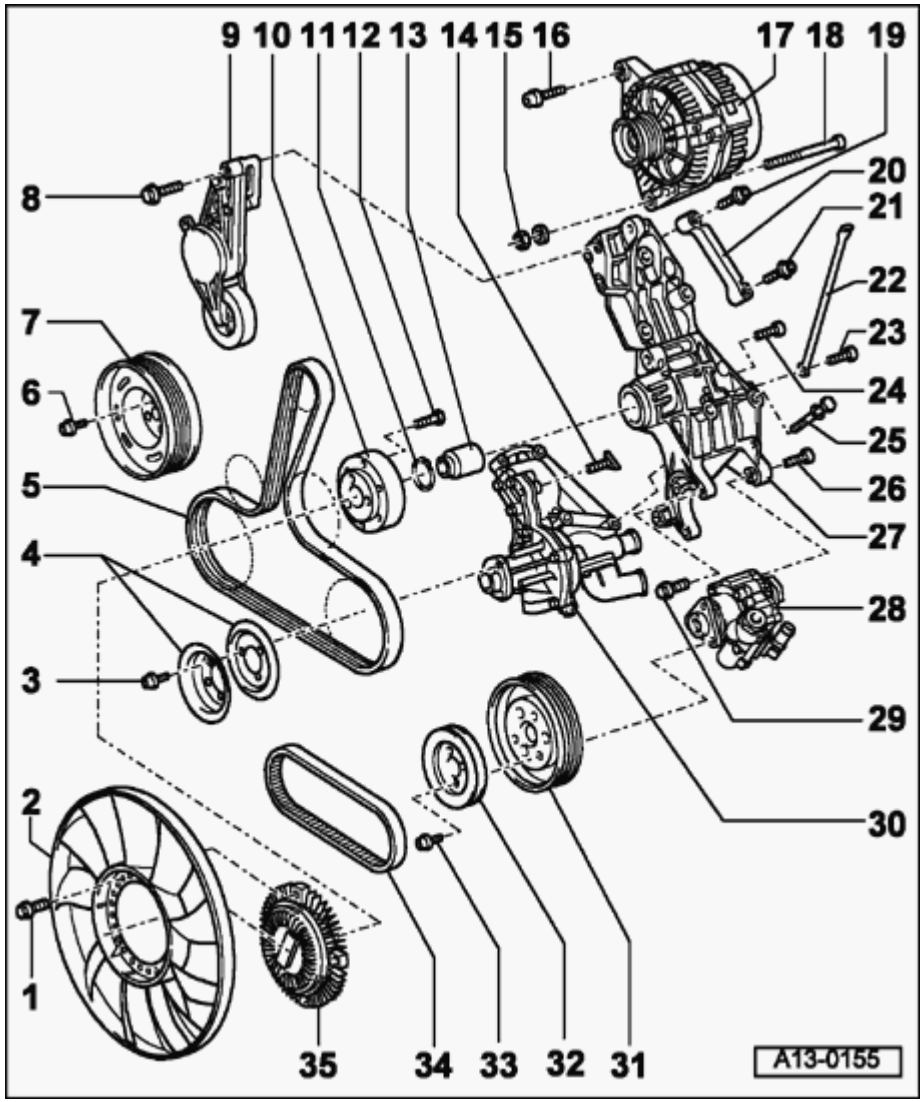
9 - Ribbed belt tensioner

- 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

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

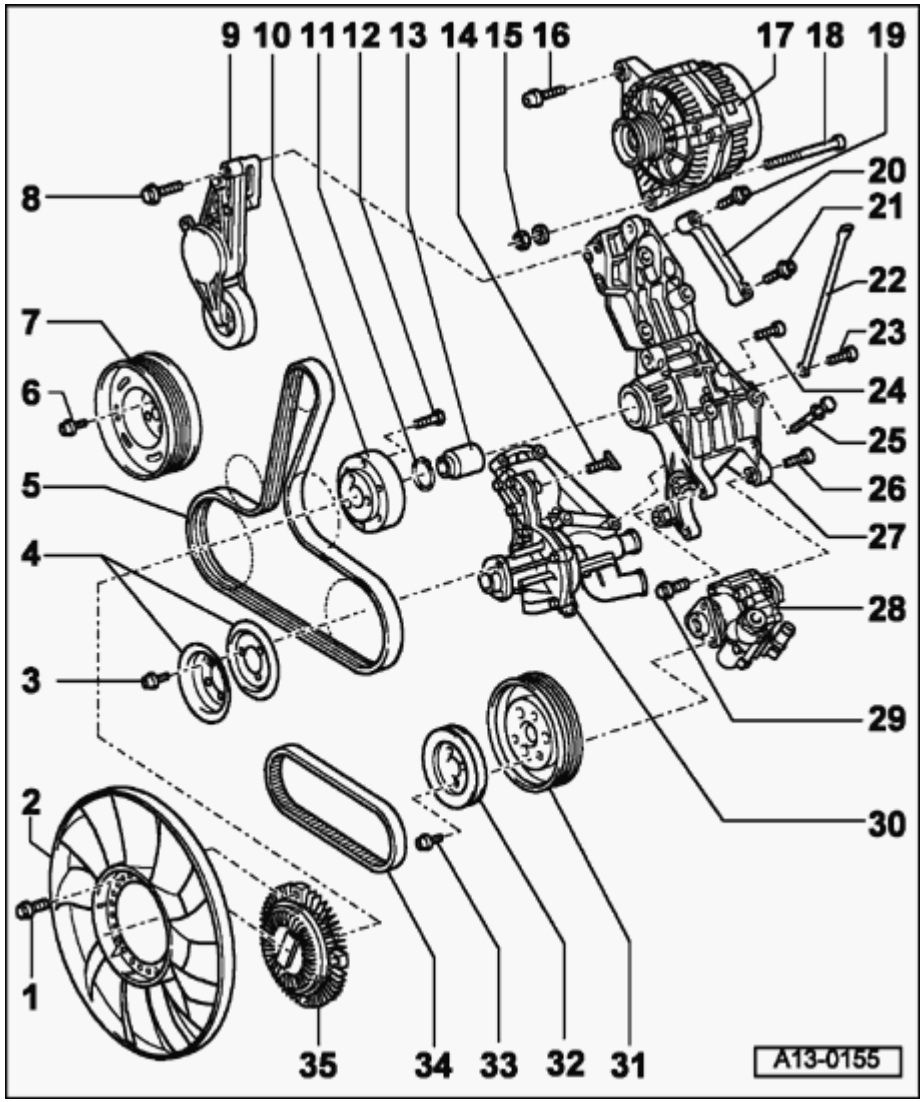
15 - Nut

- 40 Nm (30 Nm)

16 - Bolt

- 25 Nm (18 ft lb)

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)

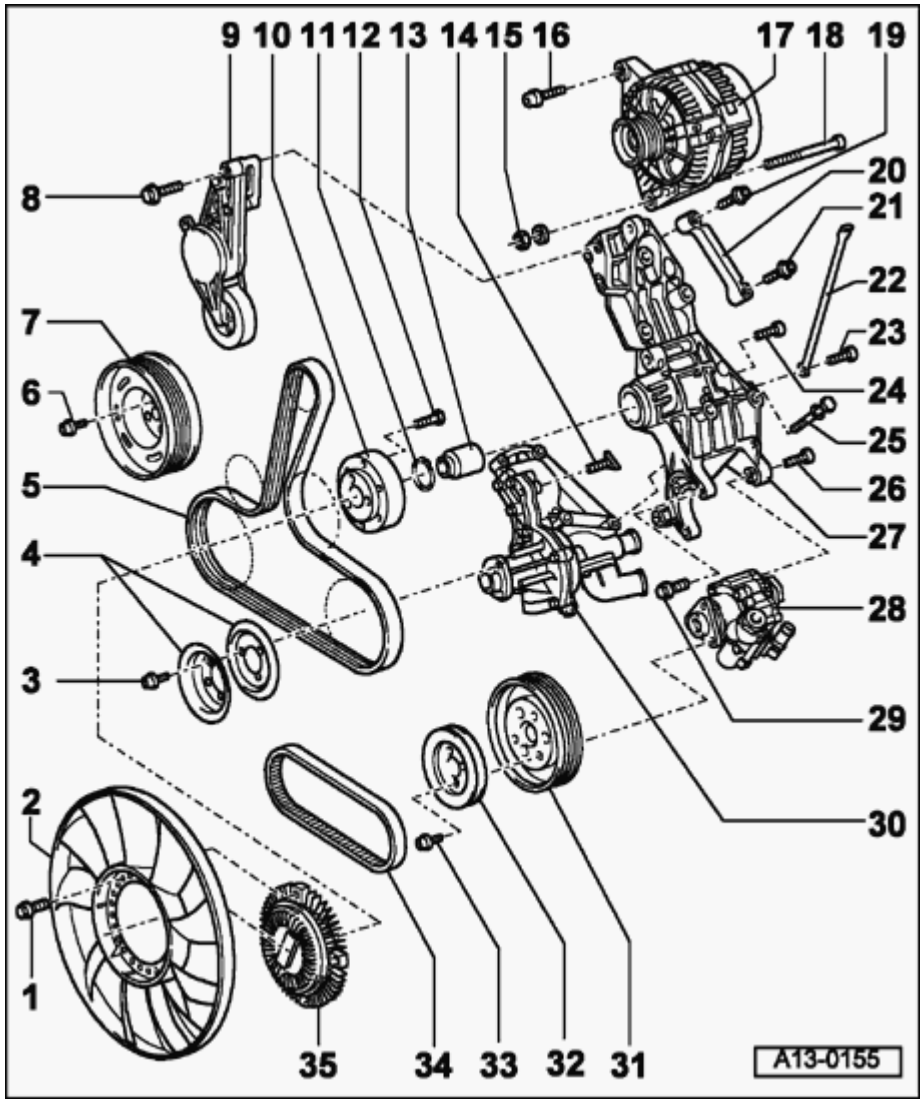
20 - Brace

- ♦ To cylinder block

21 - Bolt

- 25 Nm (18 ft lb)

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

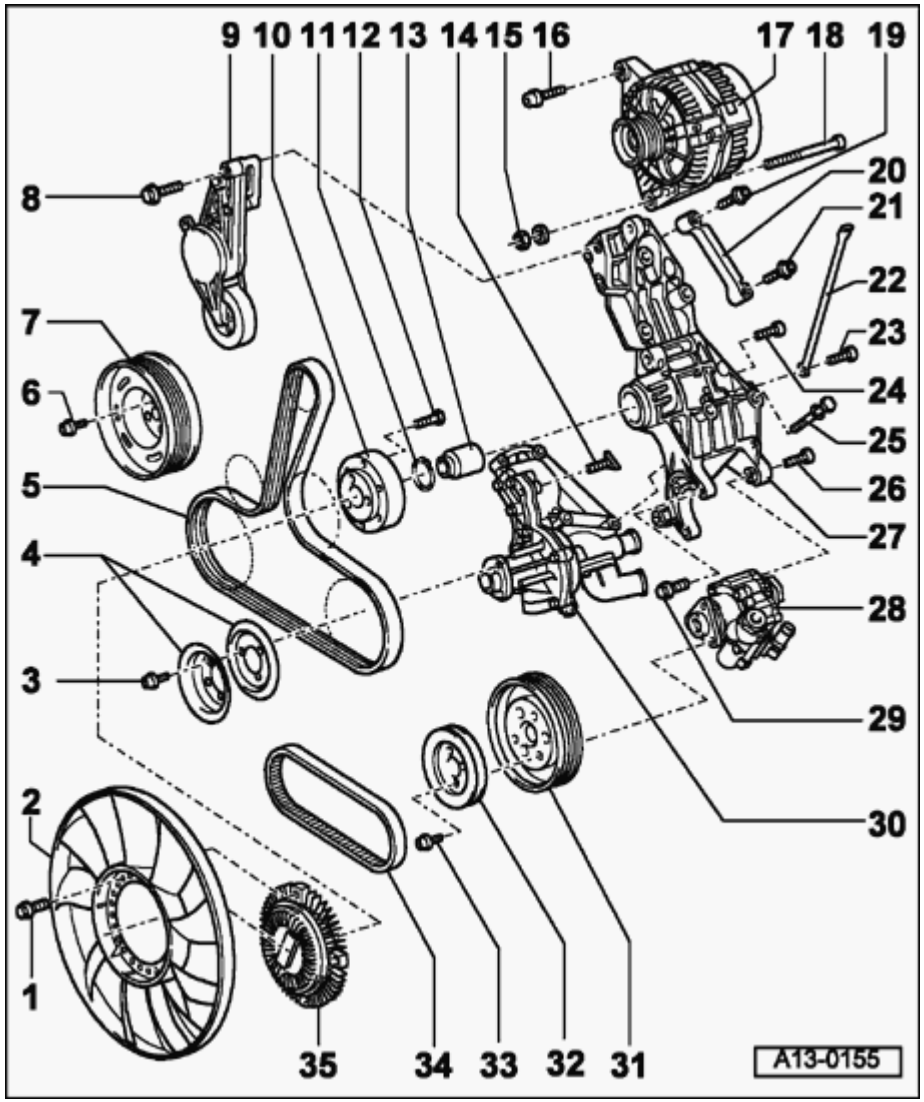
28 - Power steering pump

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

29 - Bolt

- 25 Nm (18 ft lb)

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)

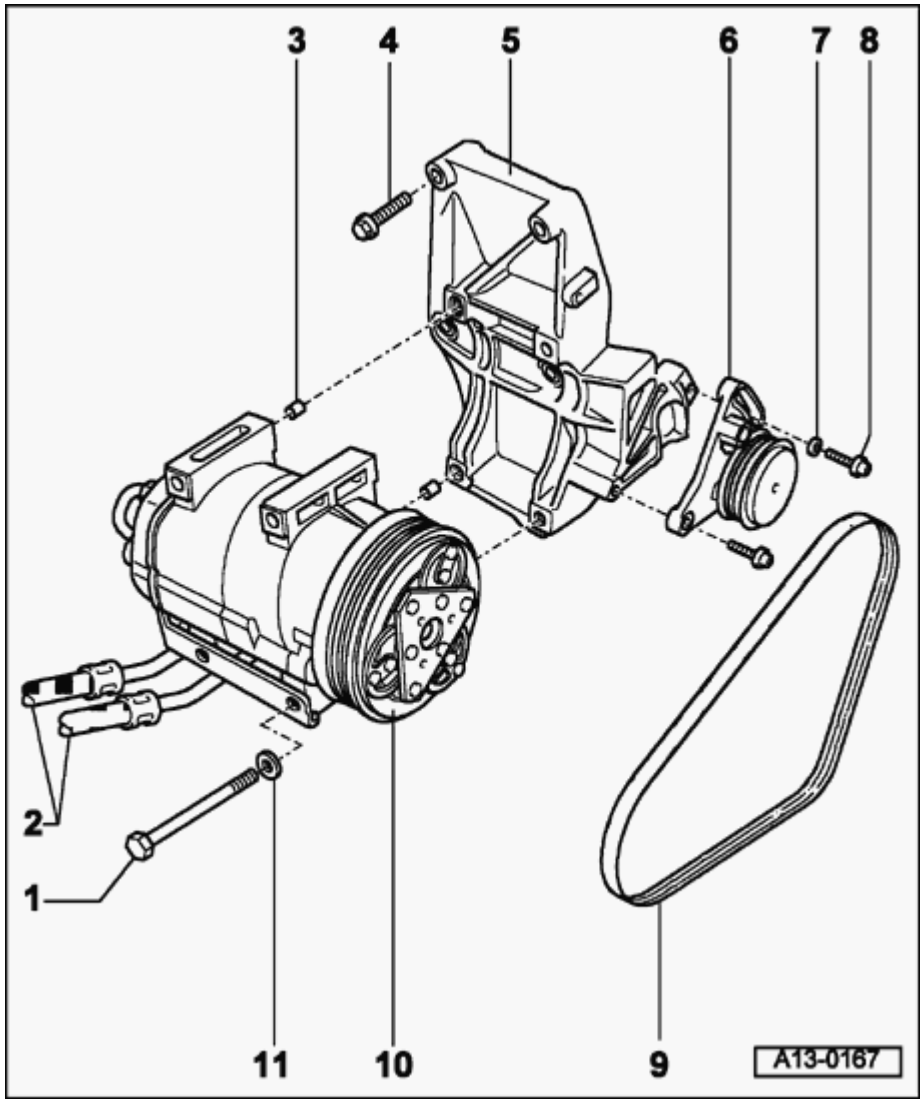
34 - V-belt

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

35 - Viscous clutch

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

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

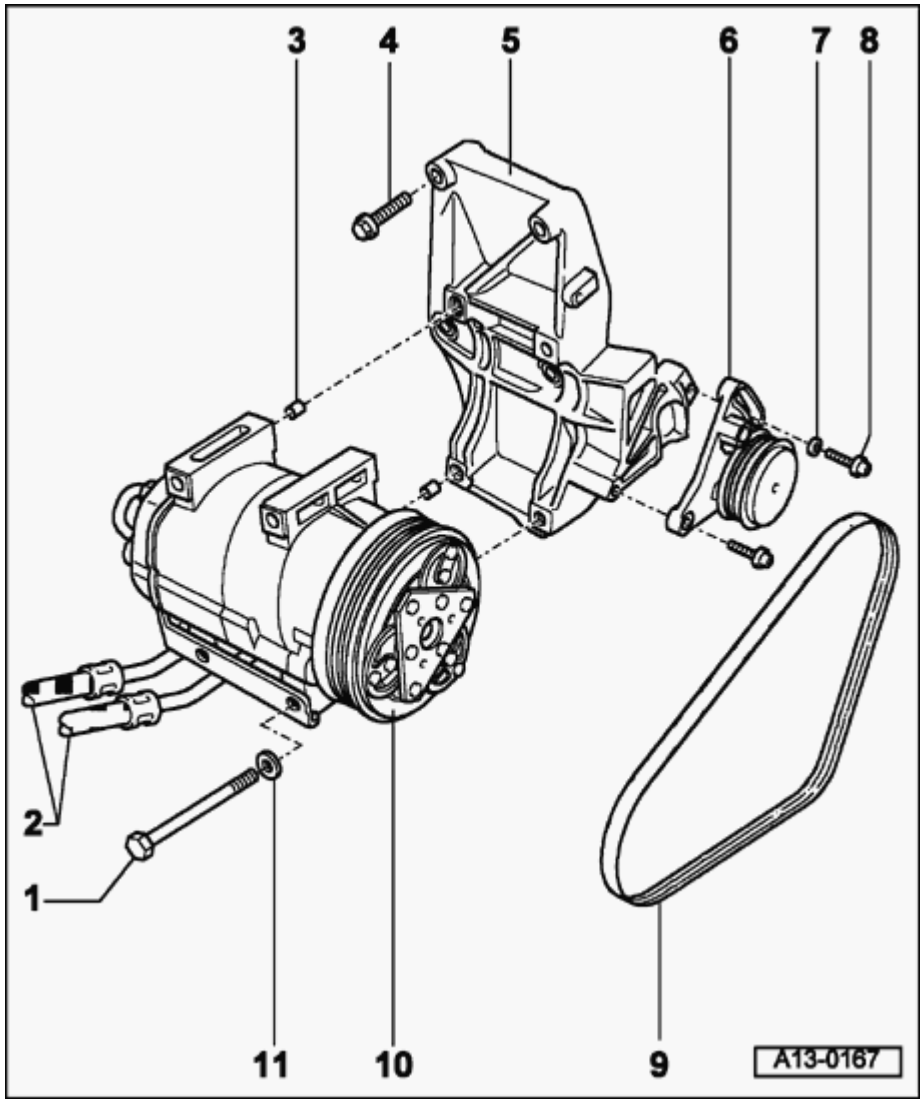
3 - Bushing

- 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

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

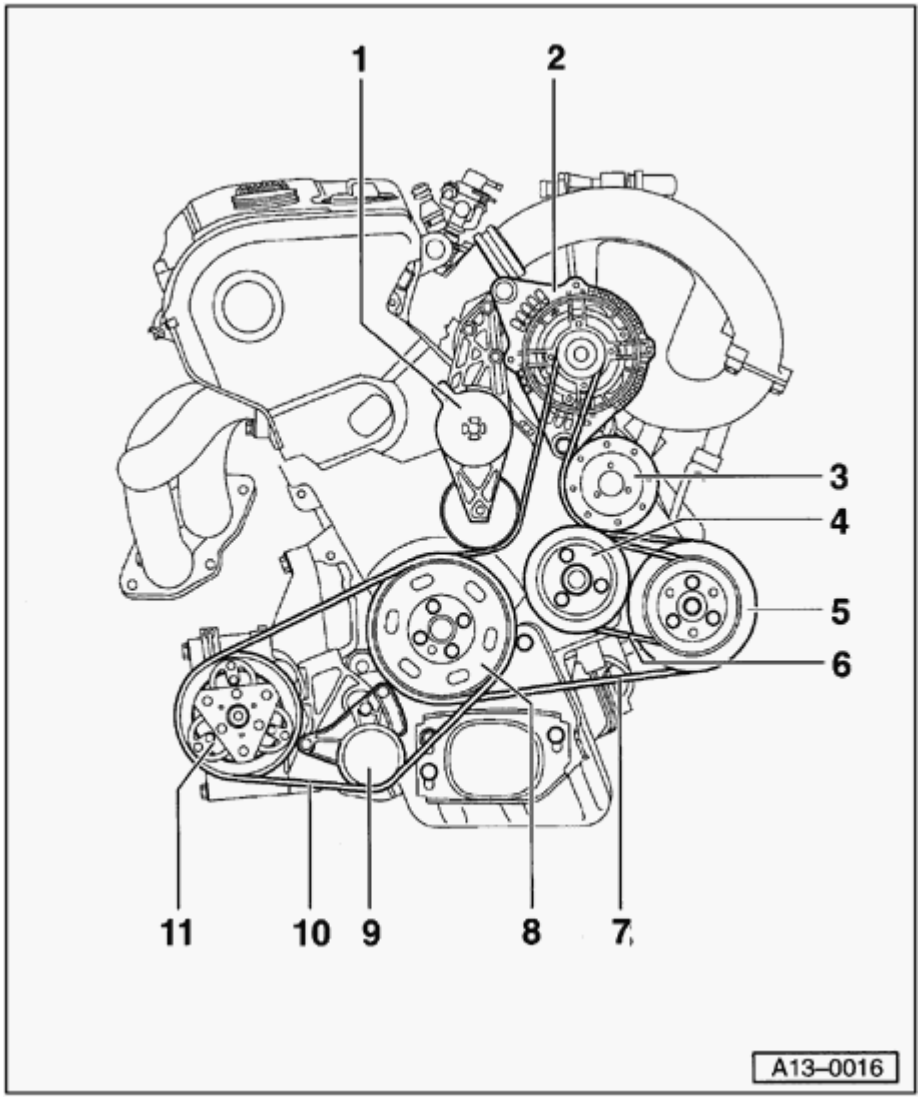
- After removing, secure A/C compressor to long member (i.e. using wire).

CAUTION!

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

11 - Washer

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

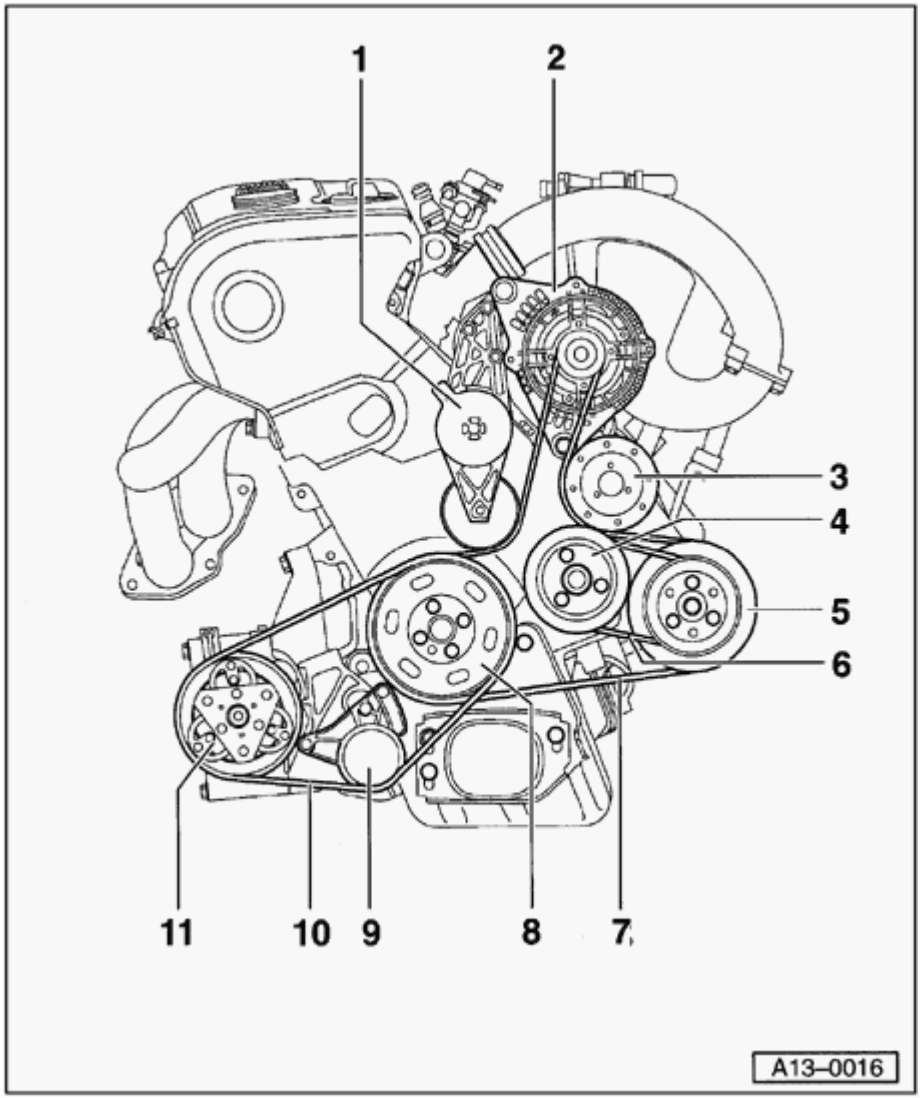
6 - V-belt

- 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

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

13-14

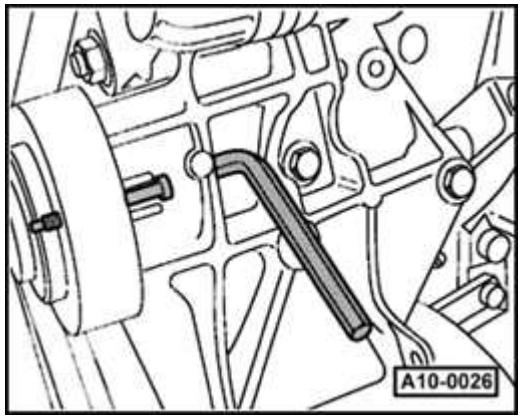


Fig. 1 Viscous fan, removing and installing

- 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).

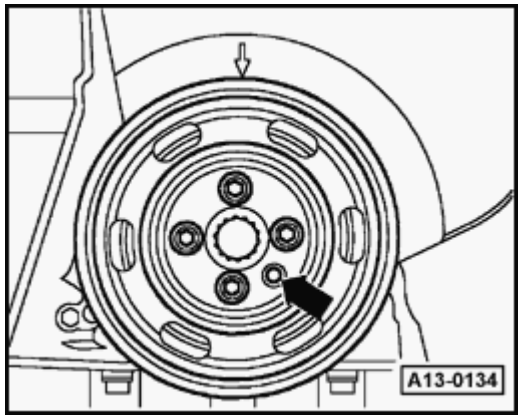


Fig. 2 Install vibration damper

- 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).

13-15

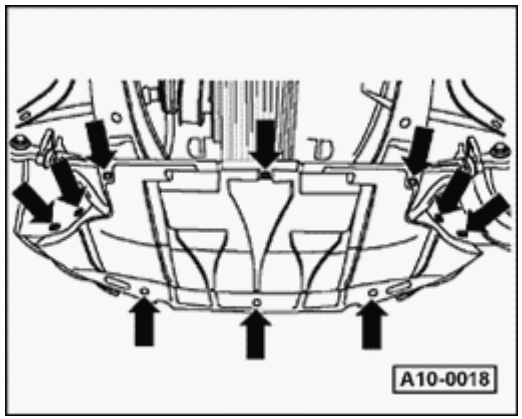
Ribbed belt, removing and installing

- Lock carrier in service position ⇒ Page 13-1

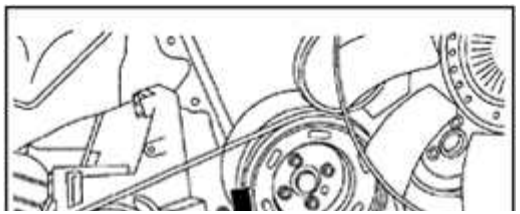
CAUTION!

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



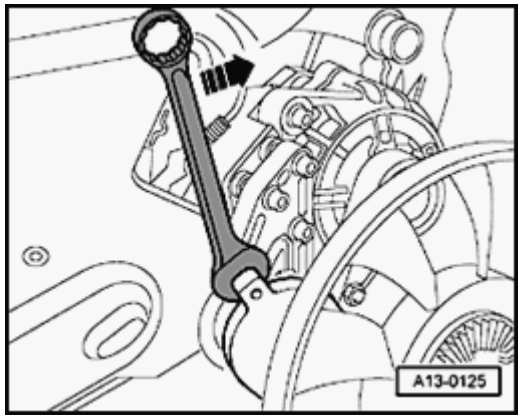
- Remove noise insulation panel (arrows).



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

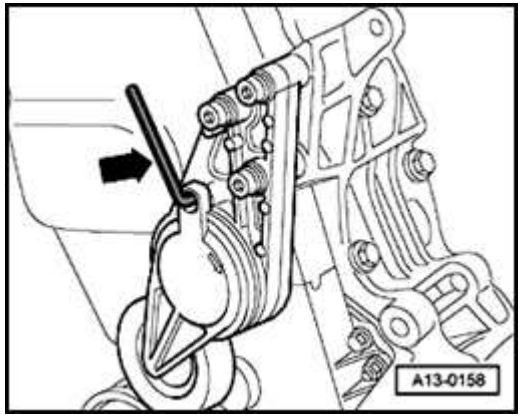
13-16

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.

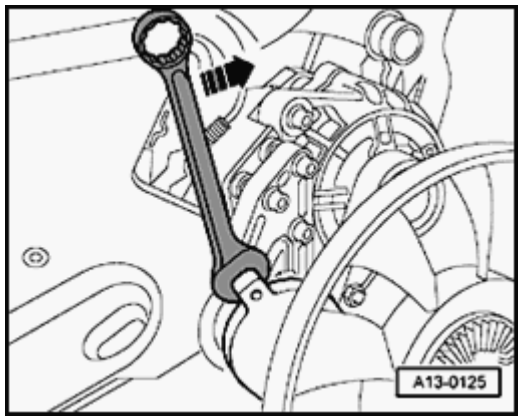
13-17

Installing

Note:

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

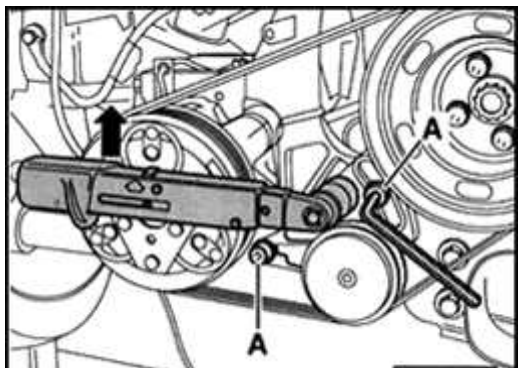
- Place ribbed belt on belt pulleys for crankshaft, viscous fan and power steering pump, (use tools to pull up if necessary).



- 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.

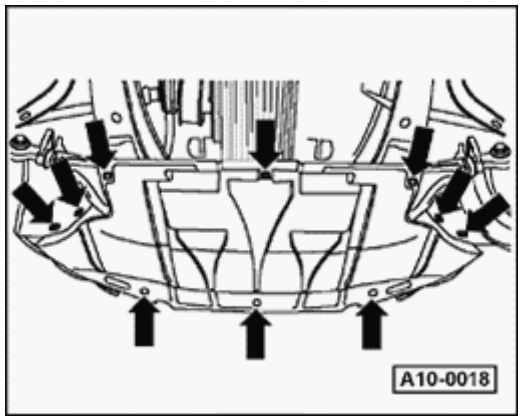
13-18

V-belt, removing and installing

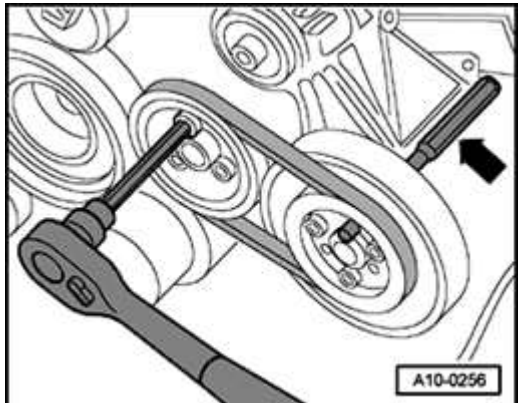
- Lock carrier in service position ⇒ Page 13-17

- 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.

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.

13-20

Bearing for viscous fan in mounting bracket, removing and installing

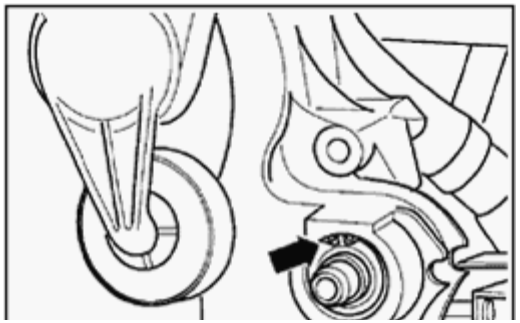
- Lock carrier in service position ⇒ Page 13-1

Special tools and equipment

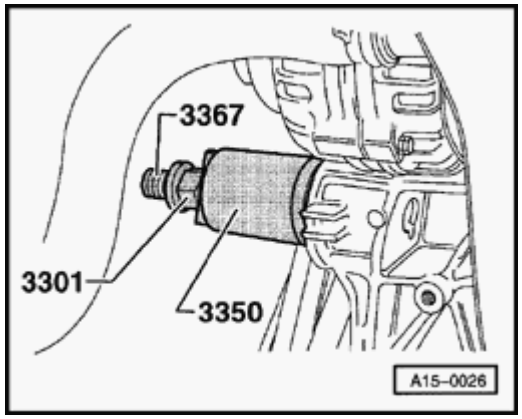
- Hex nut from 3301 assembly tool
- Extractor pipe from 3350 installation device
- 3367 press out tool for viscous clutch fan bearing bushing

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.



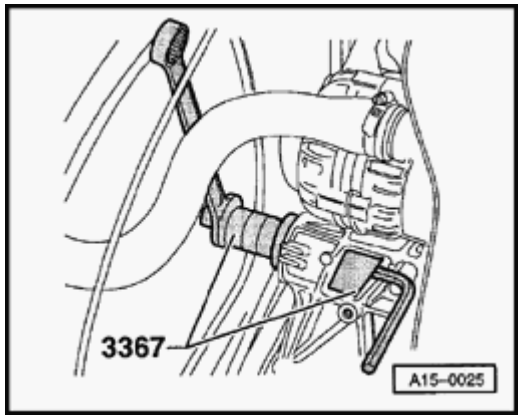
13-21



- 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 .

13-22

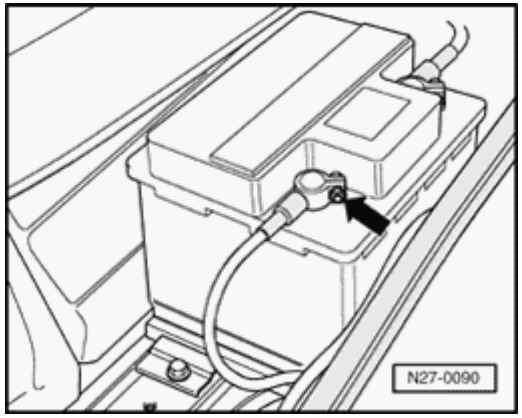
Mounting bracket for generator, power steering pump and viscous fan, removing and installing

- 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

- 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

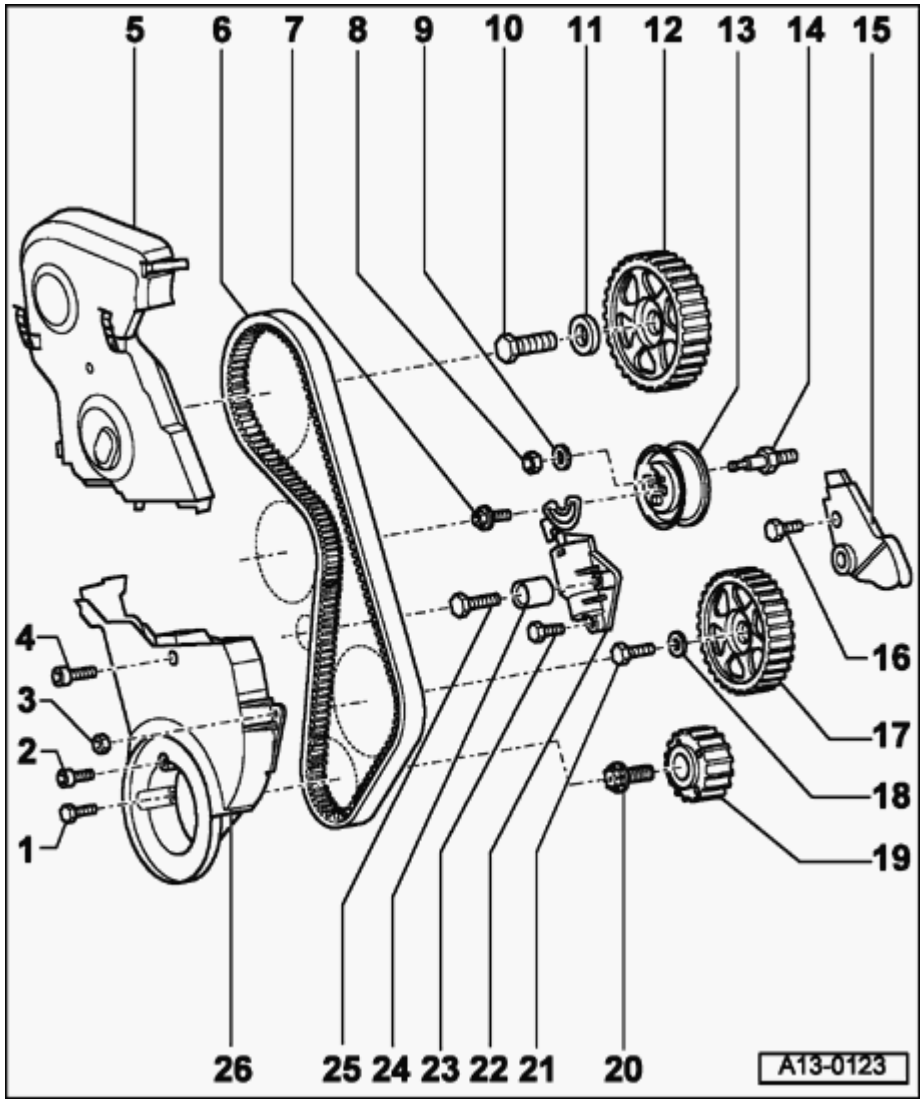
Installation is the reverse of removal, noting the following:

- 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)

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)

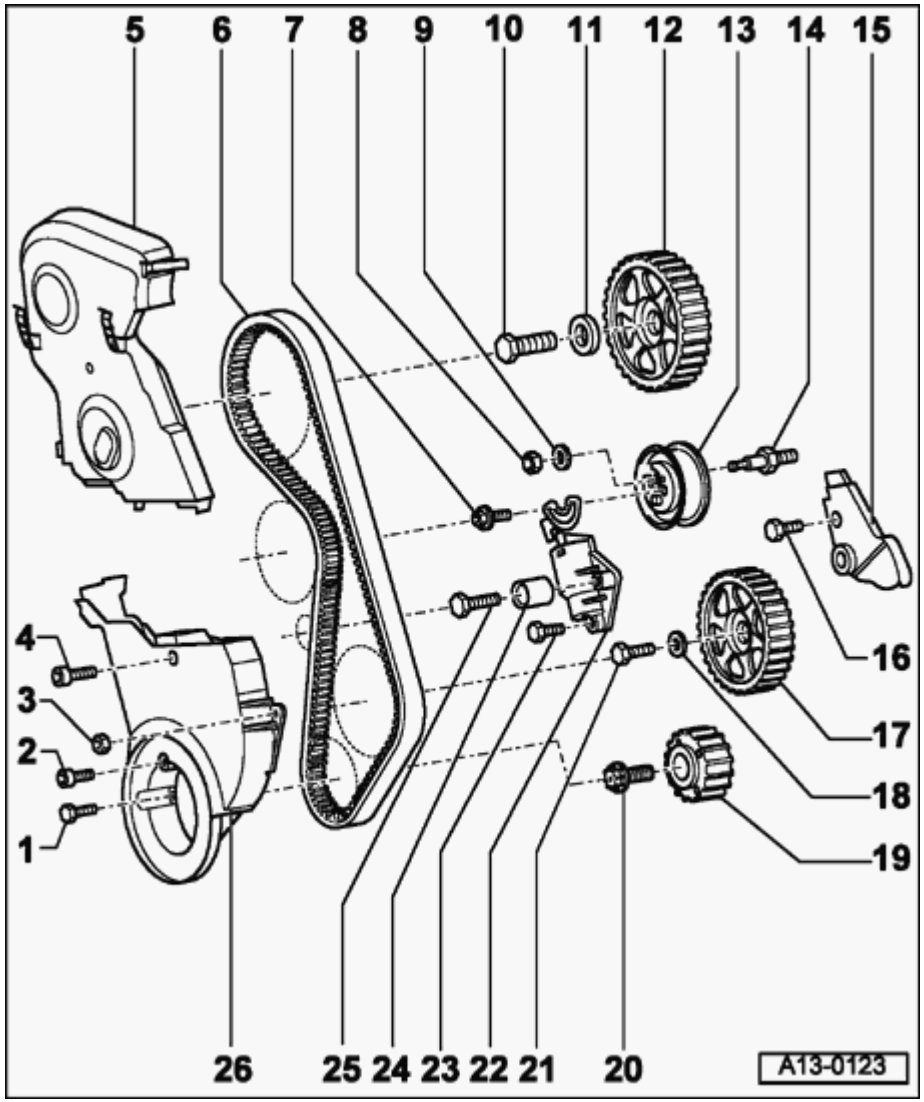
4 - Bolt

- 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

13-25



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

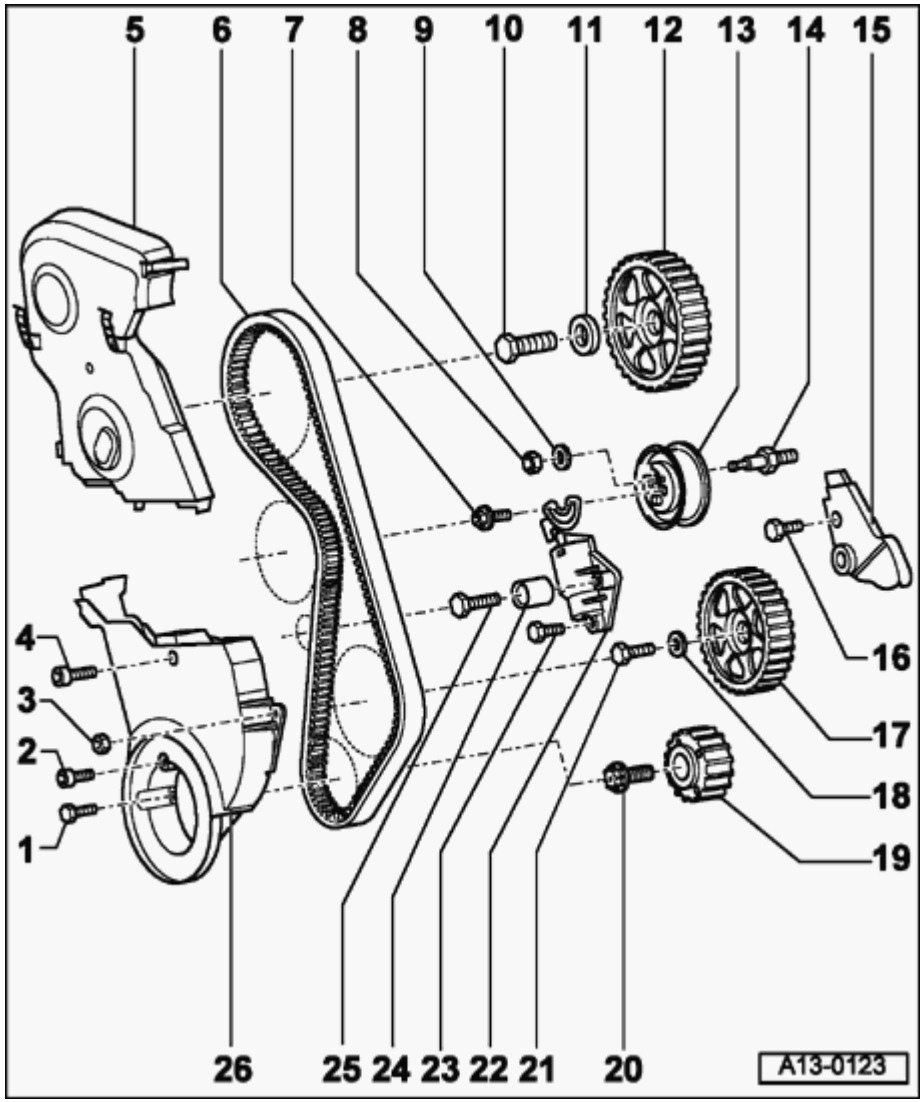
11 - Washer

12 - Camshaft gear

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

13 - Tensioner

13-26



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

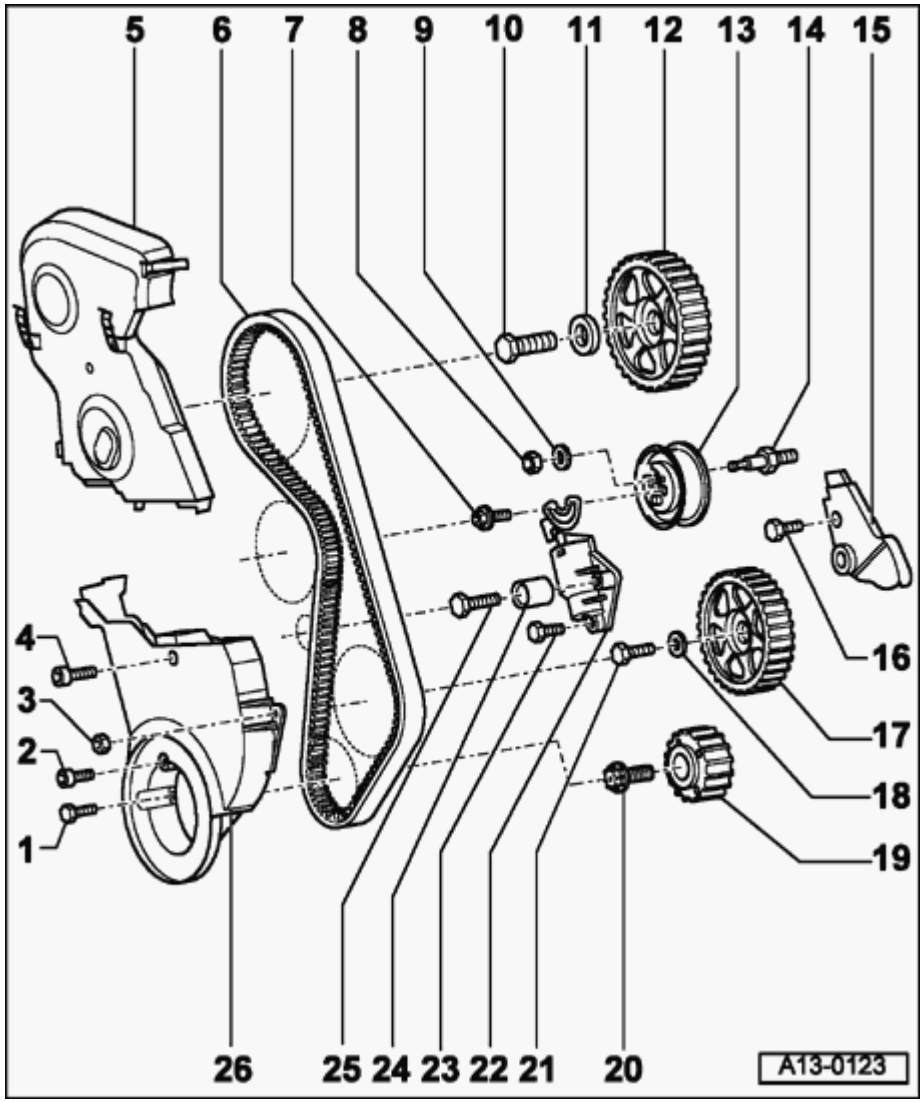
19 - Toothed belt gear for crankshaft

- 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

13-27



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

13-28

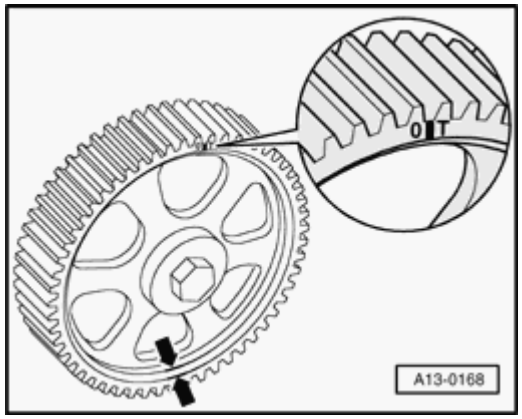


Fig. 1 Installation position for camshaft gear

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

13-29

Toothed belt, removing and installing

Removing

- Engine installed

- Lock carrier in service position ⇒ Page 13-1

Special tools and equipment

V159 pin wrench

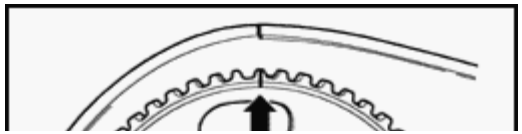
- Remove ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .

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

- Remove upper toothed belt cover.

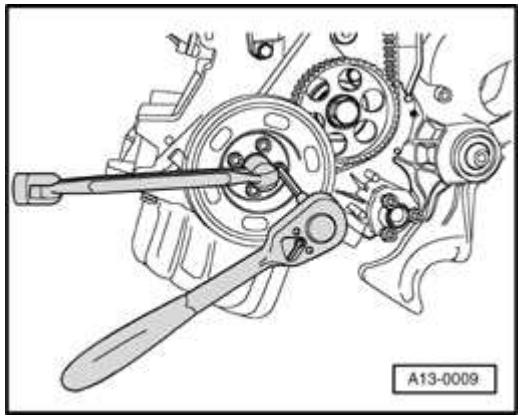
CAUTION!

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.

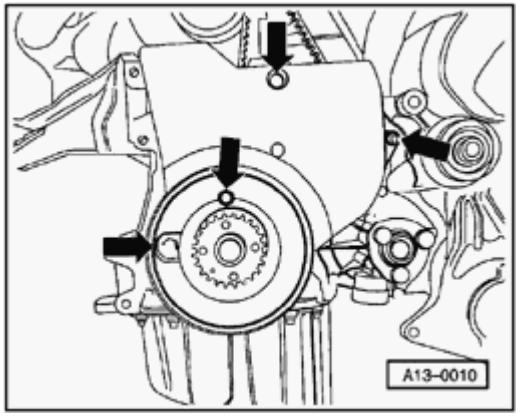


- Turn crankshaft at central bolt of toothed belt gear in direction of engine rotation to TDC Cyl.1 marking (arrows).

13-30

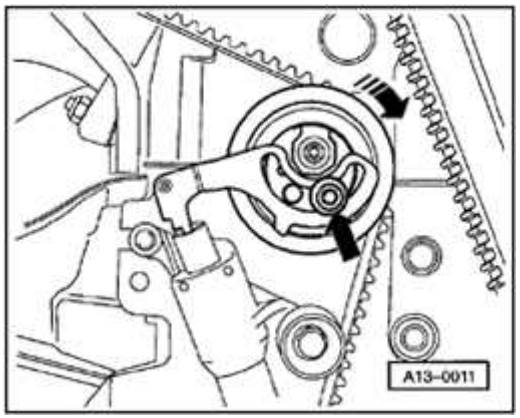


- Remove vibration damper.



- Remove lower toothed belt cover (arrows).

13-31



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

13-32

Installing (adjust valve timing)

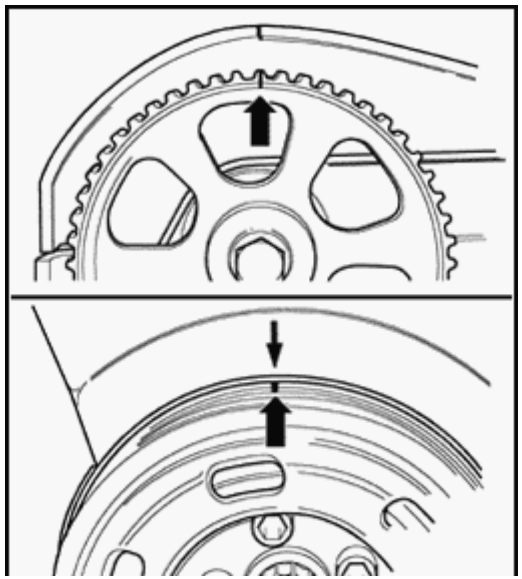
Note:

- *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.*

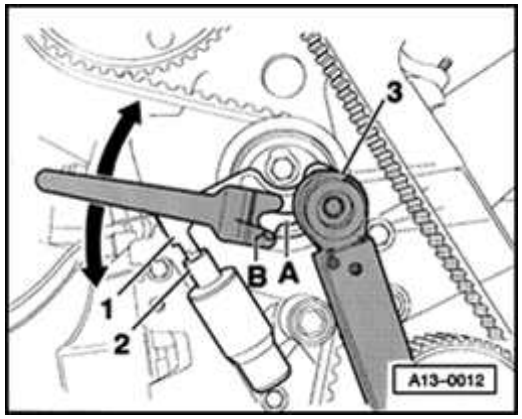
CAUTION!

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

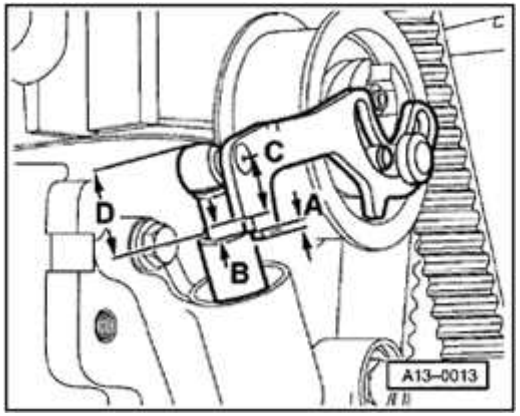


- Align marking on camshaft gear to marking on cylinder head cover.
- Place toothed belt on crankshaft gear noting direction of rotation.
- Install lower toothed belt cover.
- Using a bolt, secure vibration damper/belt pulley (note locating point).
- Set crankshaft to TDC Cyl. 1 position.
- Place toothed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

13-33



- 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.

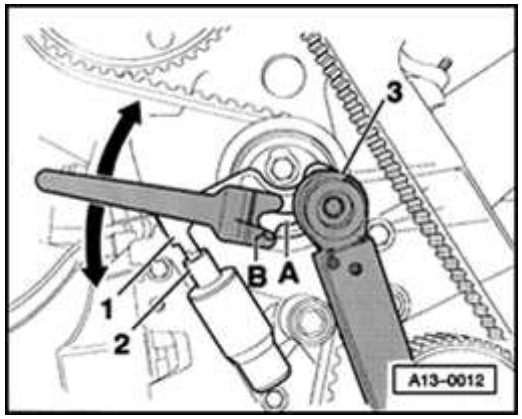


- Check area -A- for proper alignment with the upper edge of piston -2- (Fig. A13-0012) and adjust if necessary.
  - Area -A-: adjustment OK
  - Area -B-: wear limit
  - Area -C-: re-adjust and check belt drive including tensioner for wear

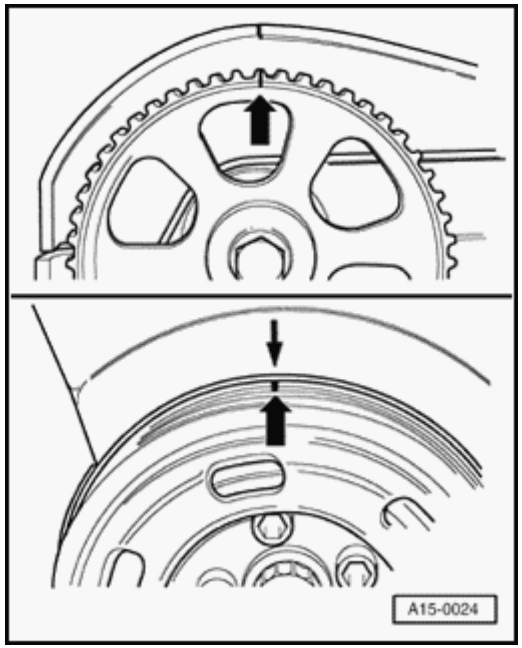
Note:

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

13-34



- 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.

Tightening torques

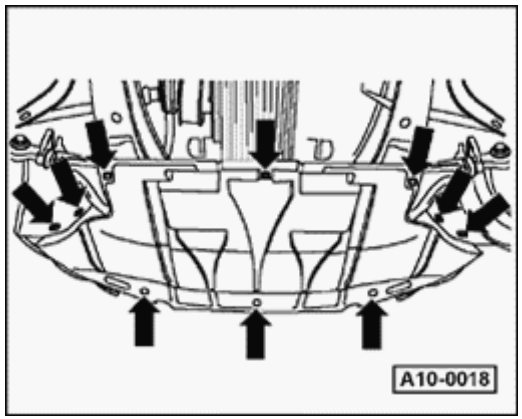
Component		Tightening torque
Toothed belt tensioner to tensioner assembly		25 Nm (18 ft lb)
Lower toothed belt cover to cylinder block	M6	10 Nm (7 ft lb)
	M8	20 Nm (15 ft lb)
Vibration damper/belt pulley to crankshaft		40 Nm (30 ft lb) 1)
Ribbed belt tensioner to mounting bracket		25 Nm (18 ft lb)
1)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

13-1

Engine, disassembly and assembly

Ribbed belt, removing and installing

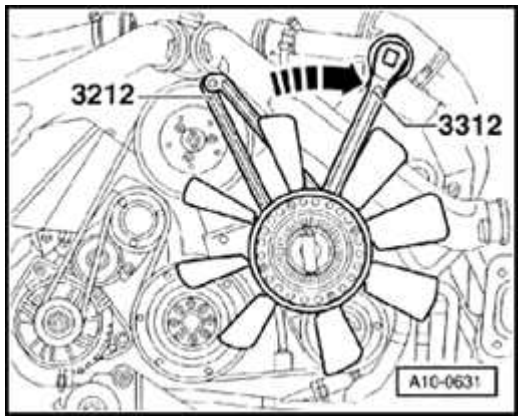
Removing



- Remove noise insulation -arrows-.
- Remove bumper

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

- Move lock carrier to service position

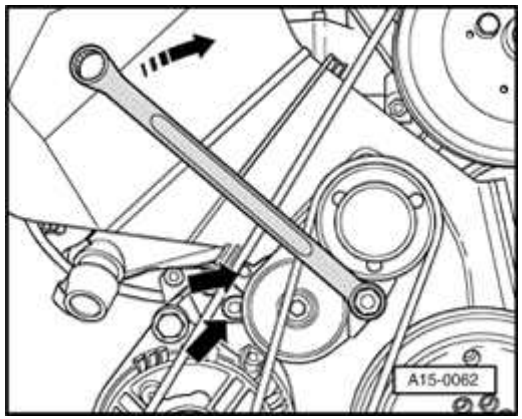


- Remove viscous fan (counter-hold with pin wrench 3212).

Note:

Viscous fan has left-hand thread: turn in direction indicated.

13-2



- Mark direction of rotation of ribbed belt.

- To slacken ribbed belt, turn to the right using a 17 mm ring spanner until the two holes are aligned with each other -arrow- and hold in position with mandrel 3204.

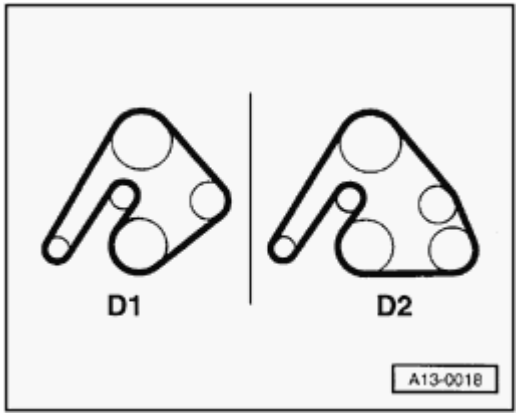
Note:

Mark the direction of rotation of the ribbed belt with chalk or felt pen before removing. A used belt can break if it rotates in the opposite direction when reinstalled.

- Take off ribbed belt.

13-3

Installing

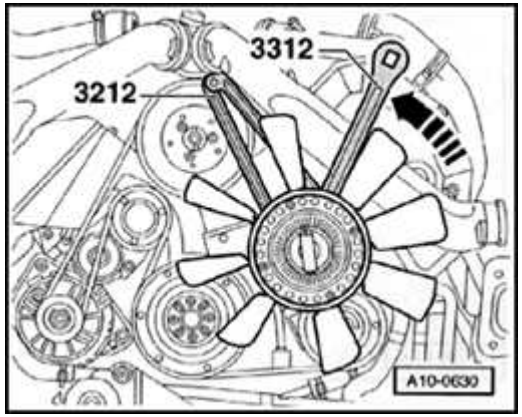


- Install ribbed belt onto crankshaft pulley and idler wheel first, and push belt onto tensioning roller last.

Routing of ribbed belt

- D1 - vehicles without air conditioner
- D2 - vehicles with air conditioner

- Take out mandrel 3204.



- Counter-hold belt pulley for viscous fan using spanner wrench 3212 and tighten viscous fan using open end spanner 3312 and torque wrench 1331 (left hand thread).

Note:

Viscous fan has left-hand thread: turn against direction indicated.

- Install lock carrier.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Install bumper.

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

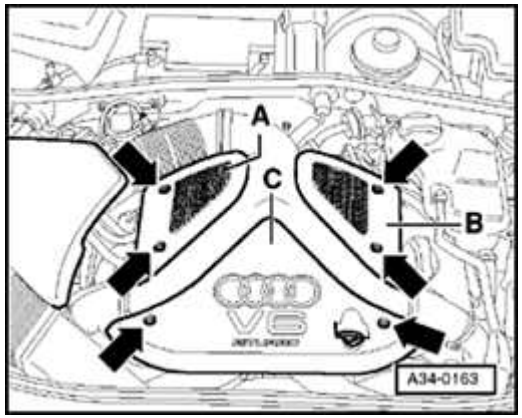
- Install noise insulation.

13-4

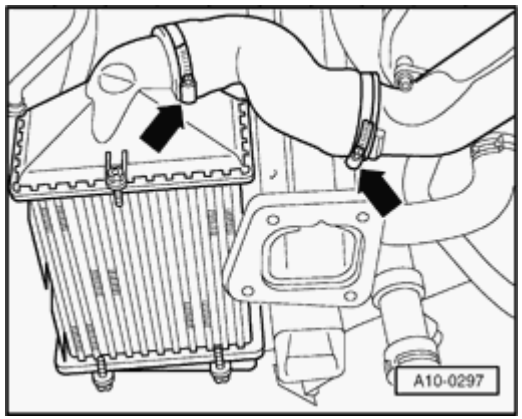
Toothed belt, removing and installing

Removing

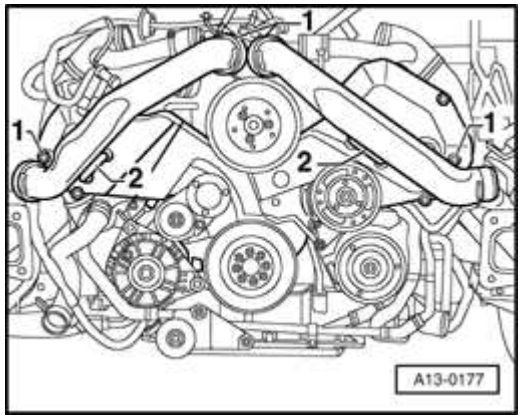
- Remove ribbed belt ⇒ Page 13-1 .



- Remove bolts -arrows- and remove engine cover panel -C-.



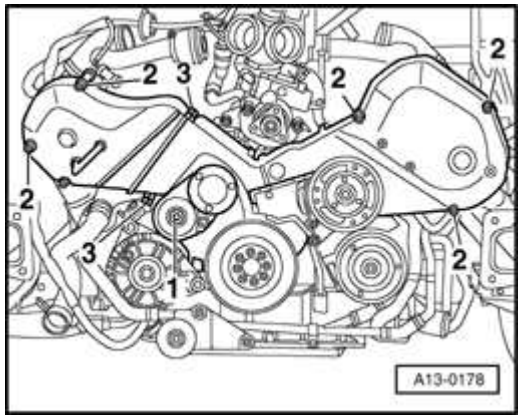
- Remove pressure hoses -arrows- between charge air coolers and pressure pipes (left and right sides).



- Remove pressure pipes -1-.

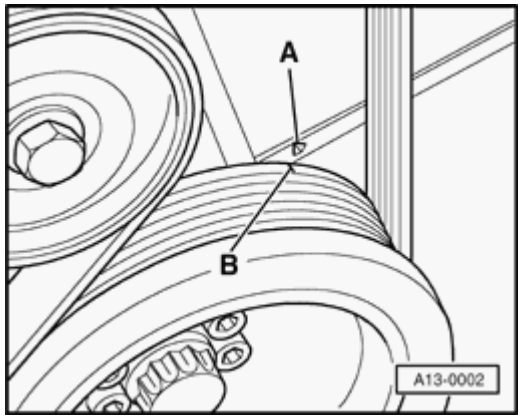
Note:

Watch position of retaining strips -2-.



- Remove tensioner -1- for ribbed belt.
- Remove left and right toothed belt guards -2-.
- Remove center toothed belt guard -3-.

13-6



- Turn crankshaft to TDC by hand. Marks -A- and -B- must be aligned.

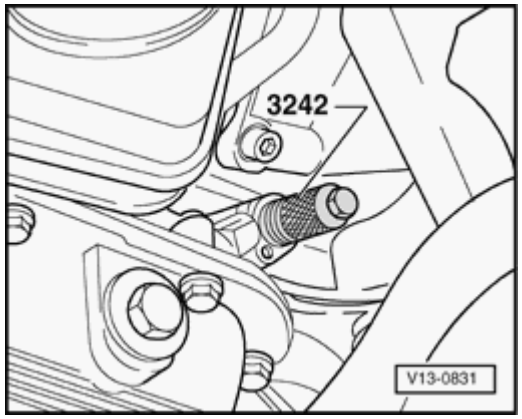
Note:

Turn over the engine at the central bolt on the crankshaft.

- Check position of camshafts: larger holes in securing plates on camshaft sprockets must align opposite one another on inside. If not, turn crankshaft one revolution further.
- Remove sealing plug from cylinder block, left.
- The TDC drilling in the crankshaft must be visible (or able to be felt) in line with the sealing plug hole.

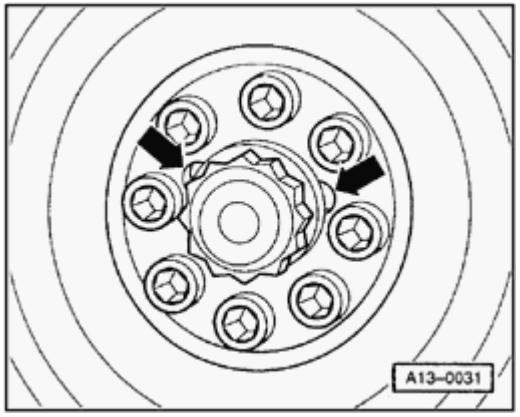
CAUTION!

Injury risk - do not turn engine while feeling for TDC drilling.



- Screw clamping bolt 3242 for crankshaft into sealing plug hole and tighten.

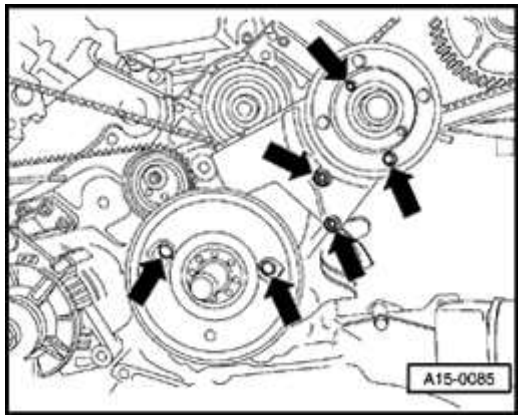
13-7



- Remove vibration damper on crankshaft.

Note:

The central bolt does not have to be loosened to remove the vibration damper.



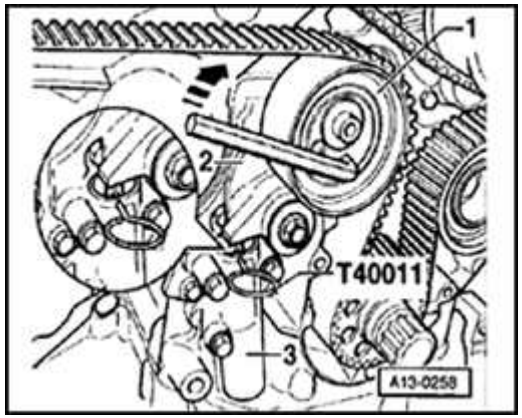
- Remove idler wheel for ribbed belt -arrows-.
- Remove toothed belt guard behind vibration damper -arrows-.

13-8

Note:

- *Mark the direction of rotation of the toothed belt with chalk or felt pen before removing. A used belt can break if it rotates in the wrong direction when reinstalled.*

- *The toothed belt tensioning element is oil-damped and can therefore only be compressed slowly by applying constant pressure.*



- Using a hex key, turn toothed belt tensioning roller -1- clockwise 8 mm in direction of arrow until tensioning lever -2- compresses tensioning element -3- sufficiently to enable special tool T 400 11 to be fitted in drilling and in plunger.
- Insert special tool T 400 11, release toothed belt tensioning roller.
- Take off toothed belt.

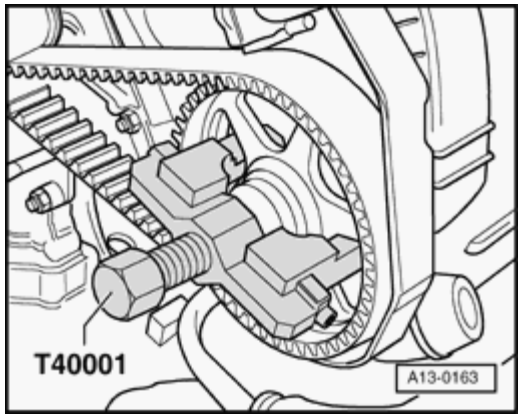
13-9

Installing

- Insert camshaft clamp 3391 in securing plates of two camshafts.

- Slacken both camshaft bolts and remove approx. 5 turns.

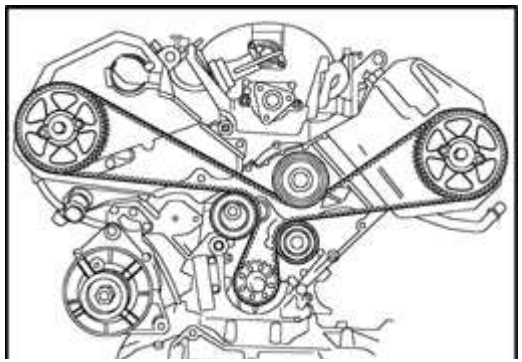
- Take out camshaft clamp 3391.



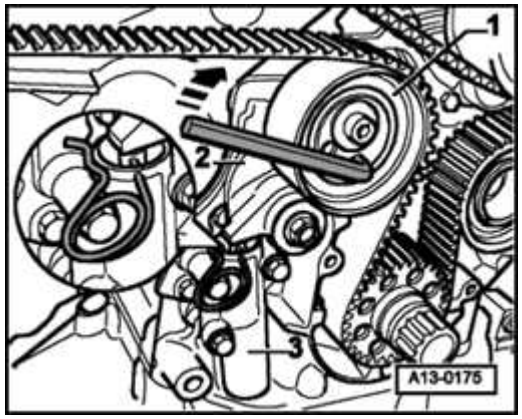
- Pull off both camshaft sprockets with special tool T40001.
- Reinstall both camshaft sprockets with securing plates and tighten hand-tight again.

Note:

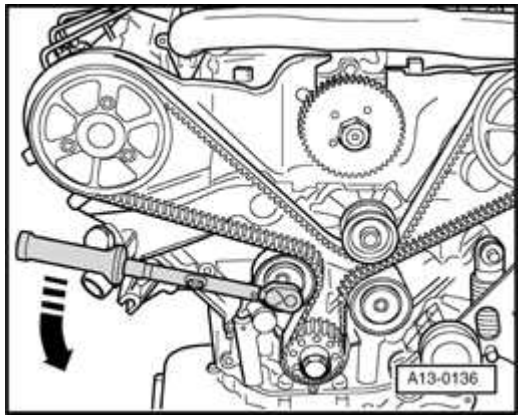
The camshaft sprockets should be just tight enough on the camshaft tapers so that they can still be turned but do not move axially.



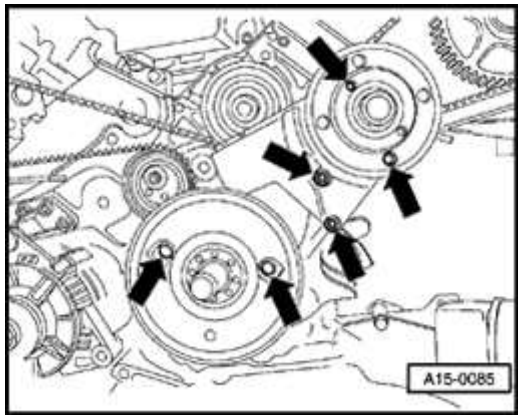
- Install toothed belt on all sprockets as illustrated.
- Install camshaft clamp 3391.



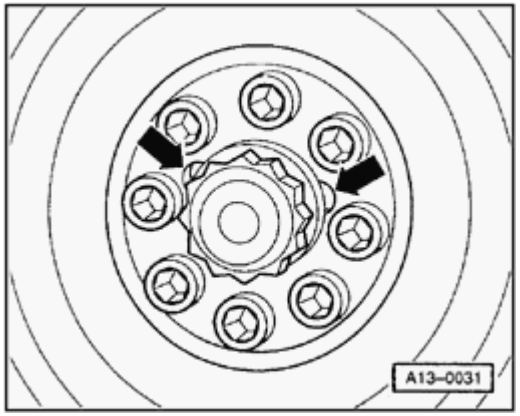
- Using a hex key, turn toothed belt tensioning roller -1- clockwise 8 mm in direction of arrow until special tool T 400 11 can be removed.



- Pre-tension toothed belt by a turning in direction of arrow with a torque of 15 Nm using a torque wrench.
- Tighten bolts on camshaft sprockets.



- Install idler wheel for ribbed belt -arrows-.
- Install toothed belt guard behind vibration damper -arrows-.



- Install vibration damper. Note positions of locating lugs -arrows- on belt sprocket.

- Install toothed belt guard.

- Install ribbed belt ⇒ Page 13-3 .

Tightening torques	
Toothed belt sprocket to camshaft	55 Nm
Idler wheel	45 Nm
Toothed belt tensioning roller	20 Nm
Pulley to crankshaft	20 Nm
Toothed belt tensioning element	10 Nm
Central bolt 1) to crankshaft	200 Nm + 180 ° 2)

1) The central bolt must always be replaced.

2) Turning in two stages of 90 ° is also permissible.

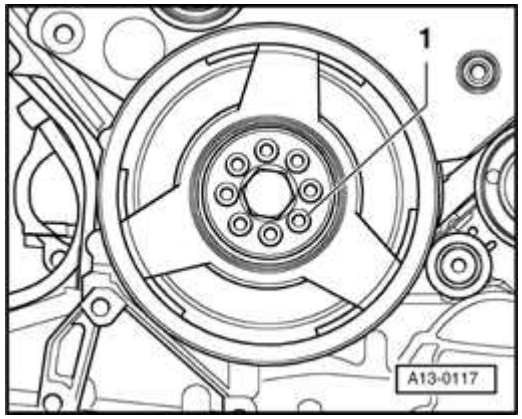
13-13

Vibration damper, removing and installing

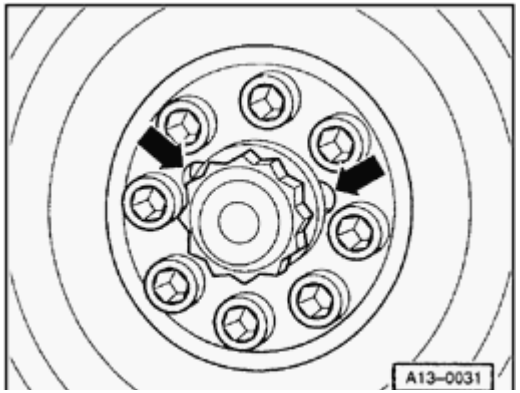
- Remove ribbed belt ⇒ Page 13-1 .

Note:

The central bolt does not have to be loosened to remove the vibration damper.



- Remove vibration damper.



- When installing, ensure that notches -arrows- in vibration damper are aligned with locating lugs on toothed belt sprocket.

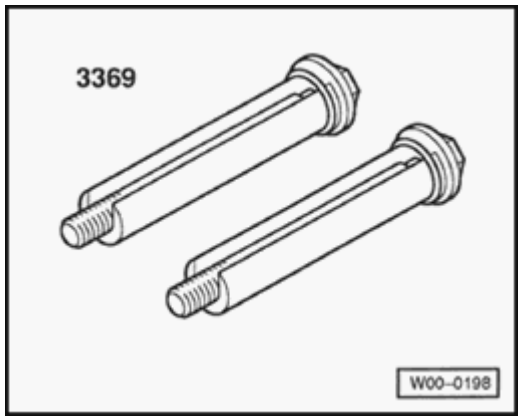
  Tightening torque: 25 Nm

13-1

Engine, disassembling and assembling

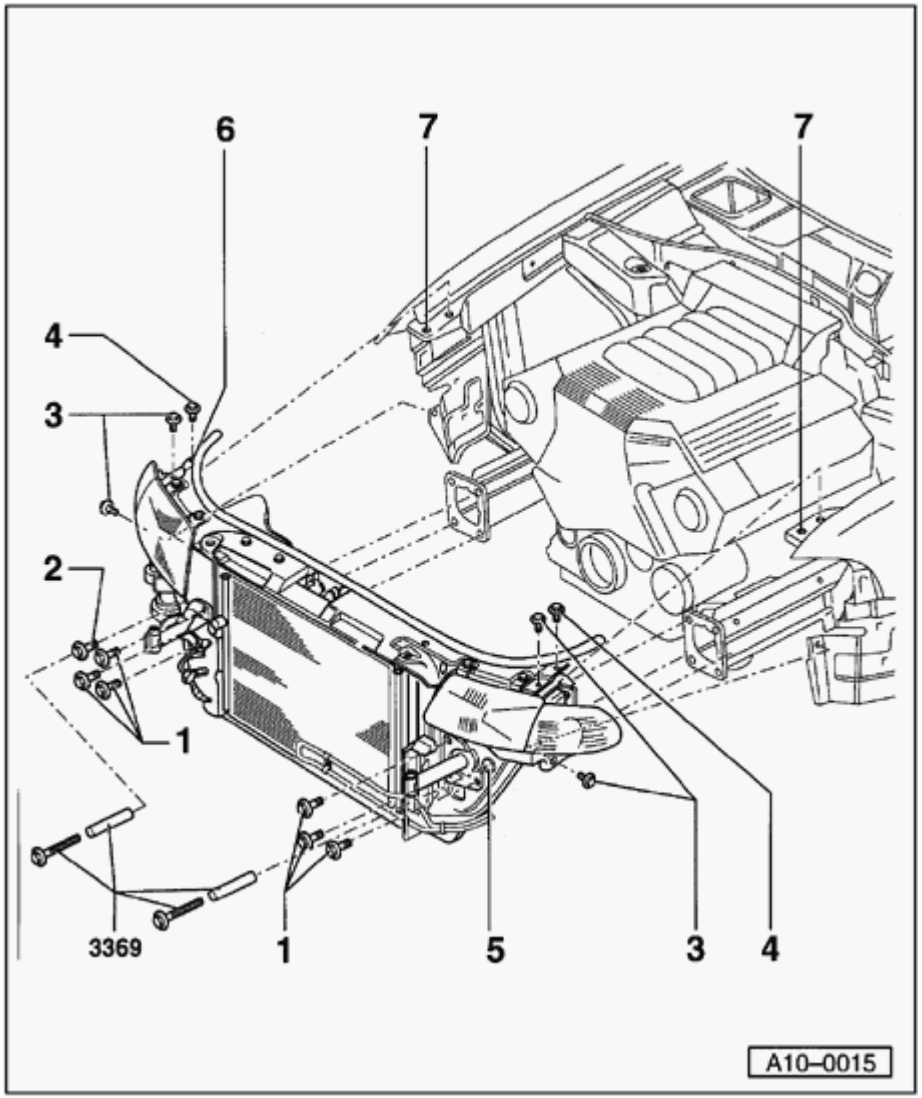
Lock carrier, moving into service position

Special tools and equipment



- Special tool 3369

13-2



1 - 45 Nm

2 - 45 Nm

3 - 10 Nm

4 - 10 Nm

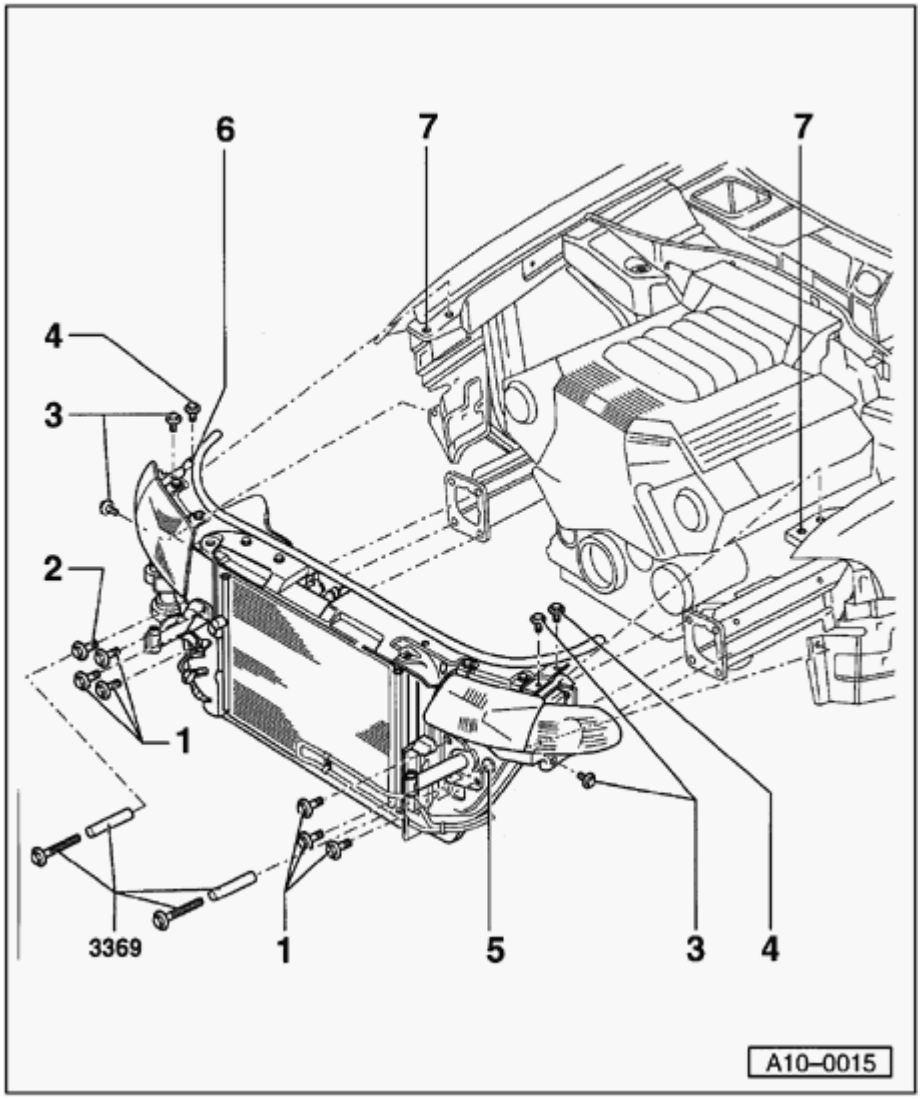
5 - Bore

- For special tool 3369

6 - Hole in lock carrier

7 - Bore in fender panel

13-3



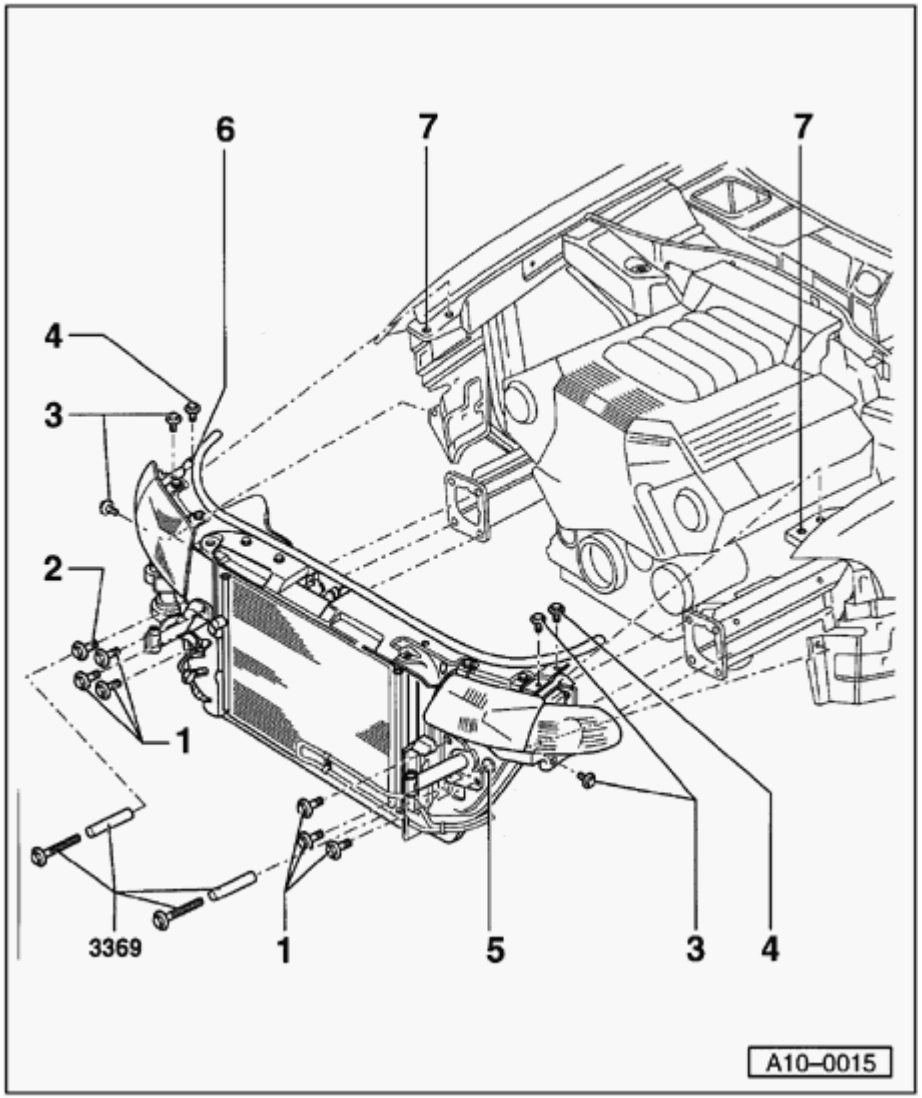
Removing

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

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

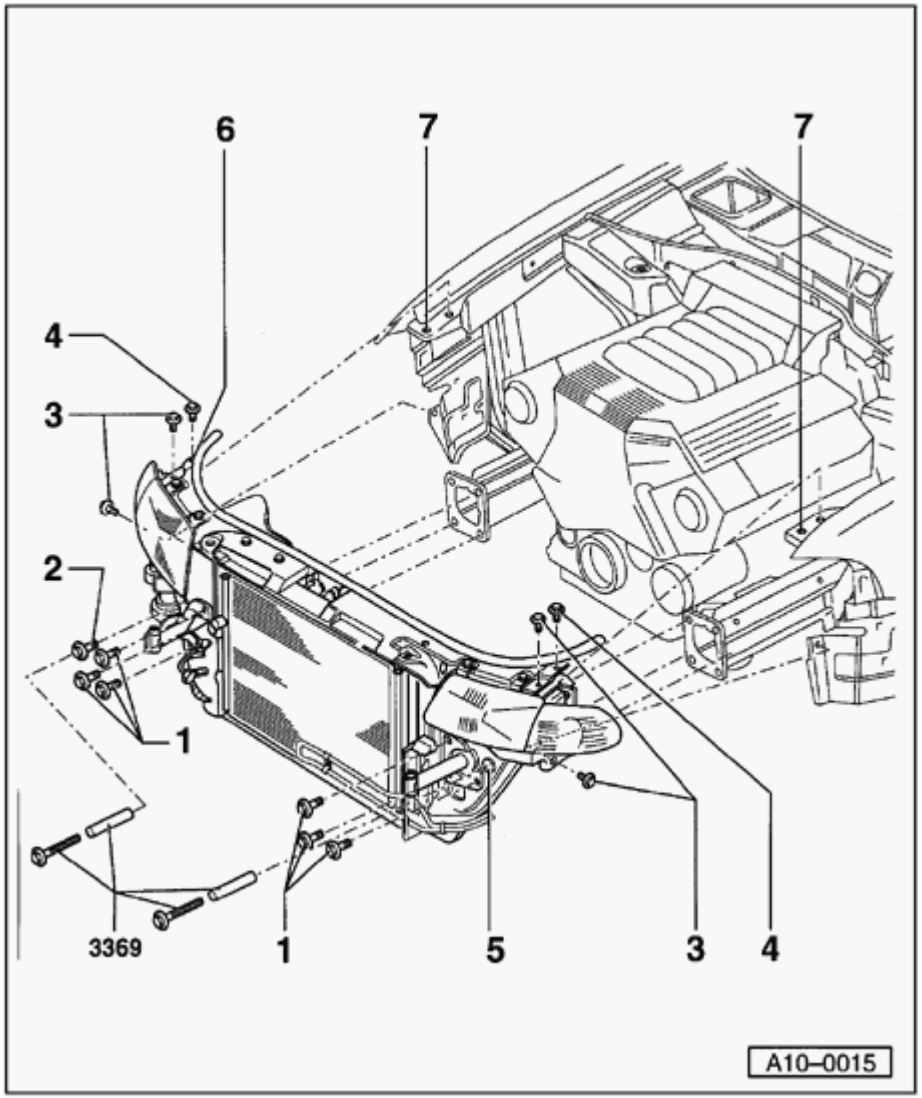
- Remove lower air duct hose to charge air cooler ⇒ Fig. ⇒ 2 , ⇒ Page 13-6
- Remove air duct between lock carrier and air filter ⇒ Fig. ⇒ 3 , ⇒ Page 13-7
- Remove retaining clips (if installed) for wiring harness on left at radiator shroud.

13-4



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

13-5



Installing

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

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

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

- Adjust headlights.

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

13-6

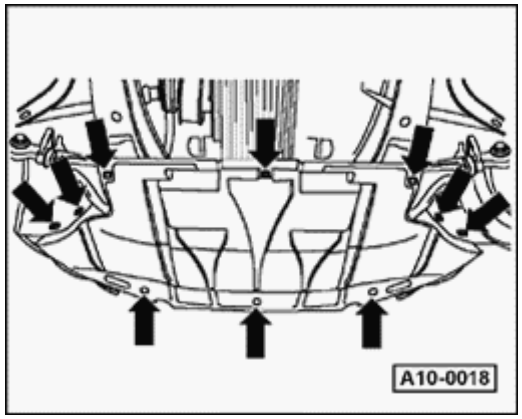


Fig. 1 Remove front sound insulation

- Remove sound insulation -arrows-.

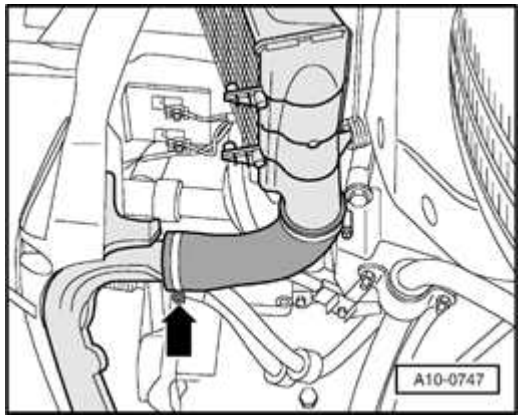


Fig. 2 Remove air duct hose

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

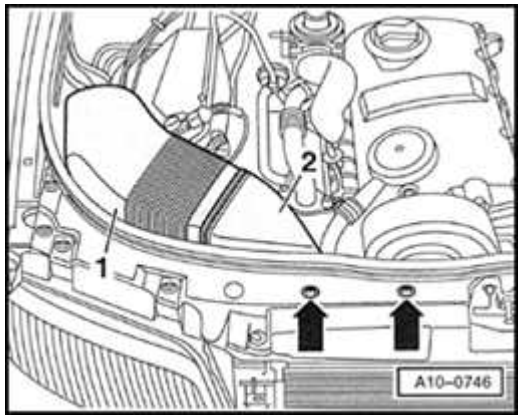


Fig. 3 Remove air duct between lock carrier and air filter

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

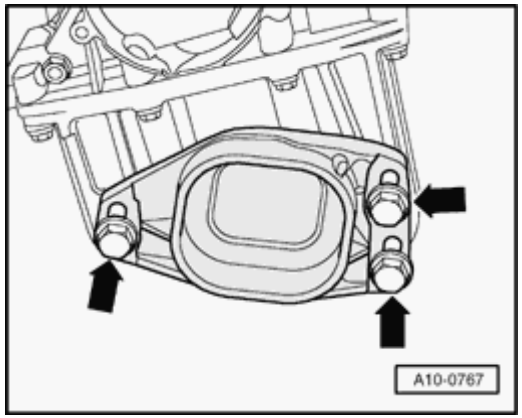
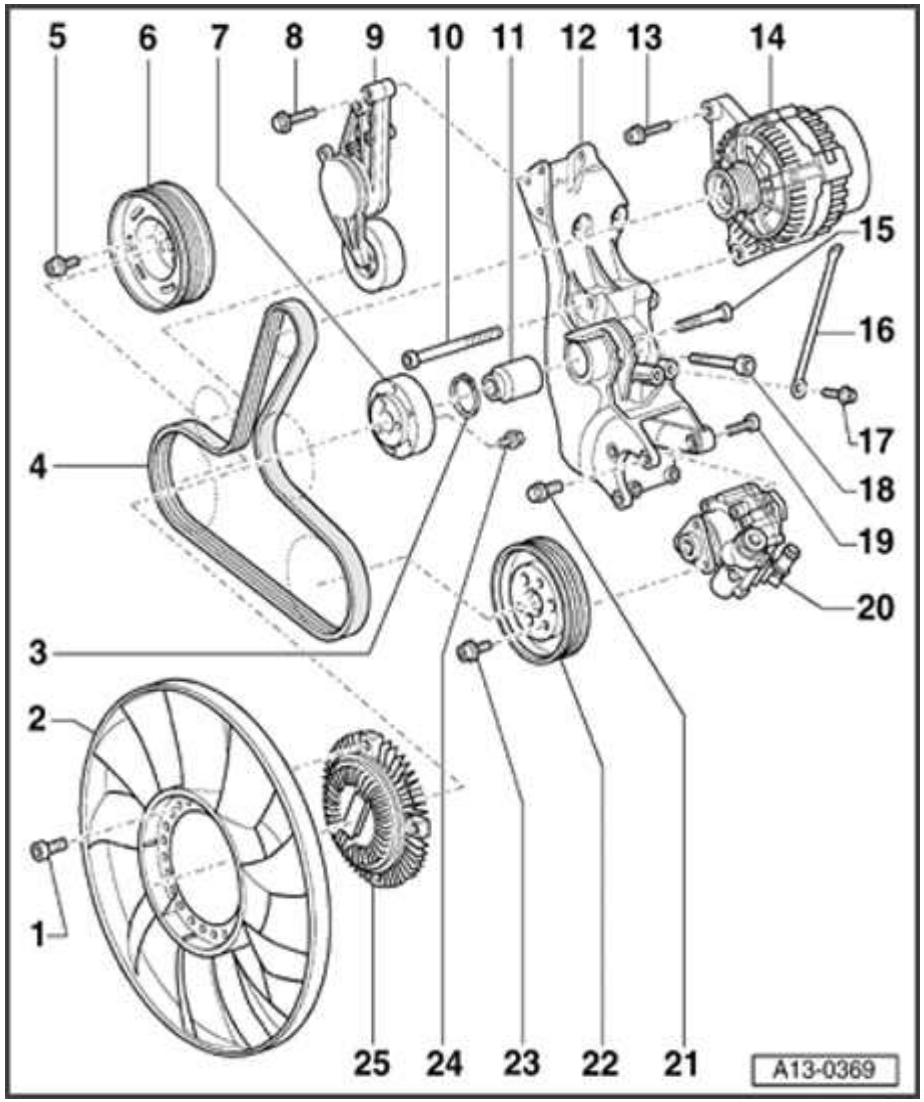


Fig. 4 Adjust stop for torque reaction support

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

13-8



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

Note:

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

1 - 10 Nm.

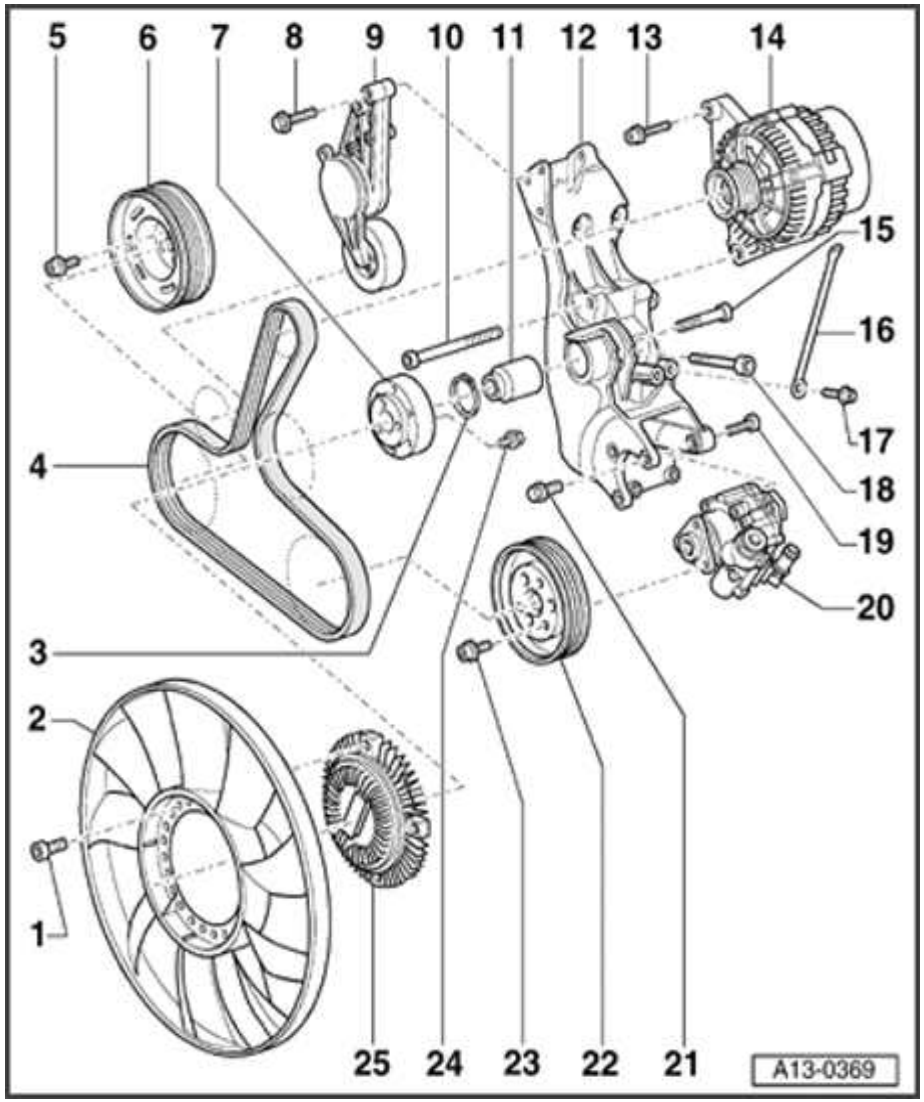
2 - Fan wheel

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

3 - Circlip

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

13-9



4 - Ribbed V-belt

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

5 - Bolt (special type)

- Always replace
- Use only genuine bolts

⇒ *Parts List*

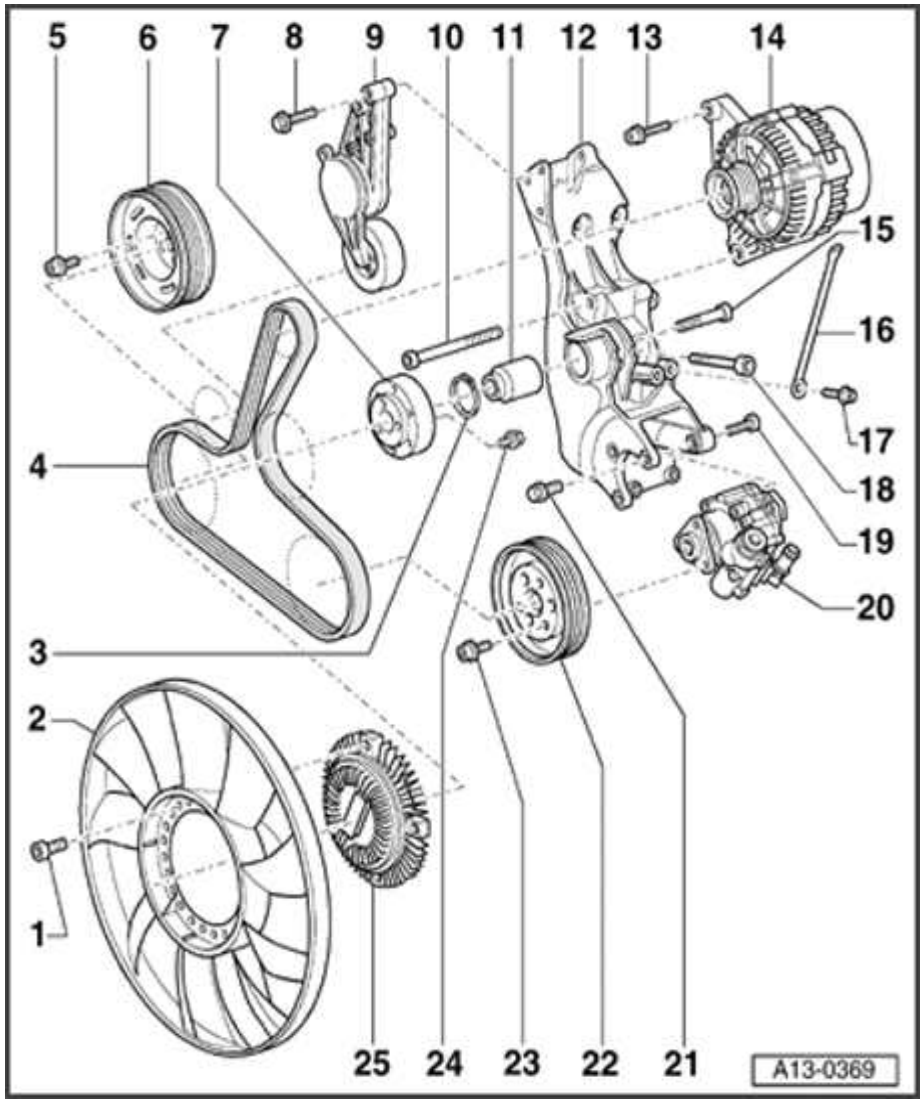
- Torque: 10 Nm + 90° (1/4 turn)

6 - Vibration damper

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

7 - Pulley

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



8 - 23 Nm

9 - Tensioner for ribbed belt

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

10 - 46 Nm

11 - Mounting

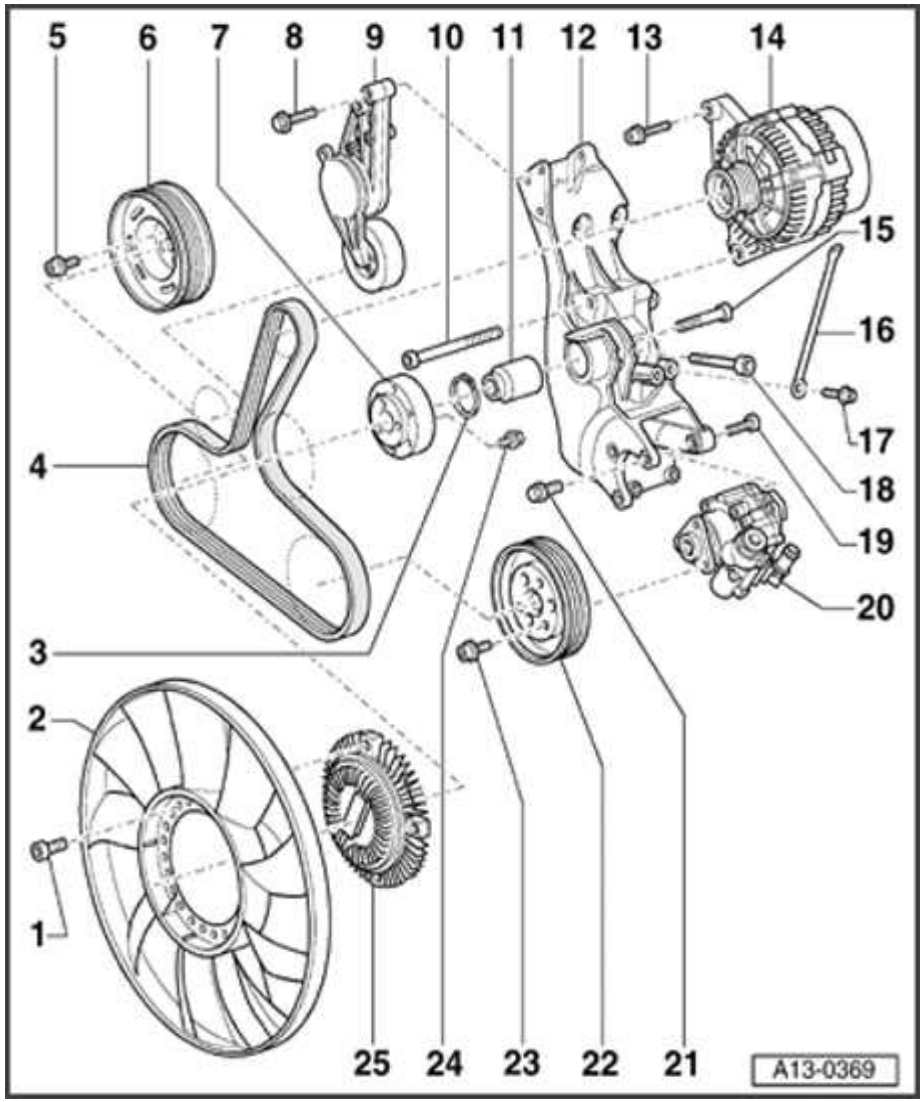
- For viscous fan
- Removing and installing ⇒ Page 13-23 .

12 - Bracket

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

13 - 23 Nm

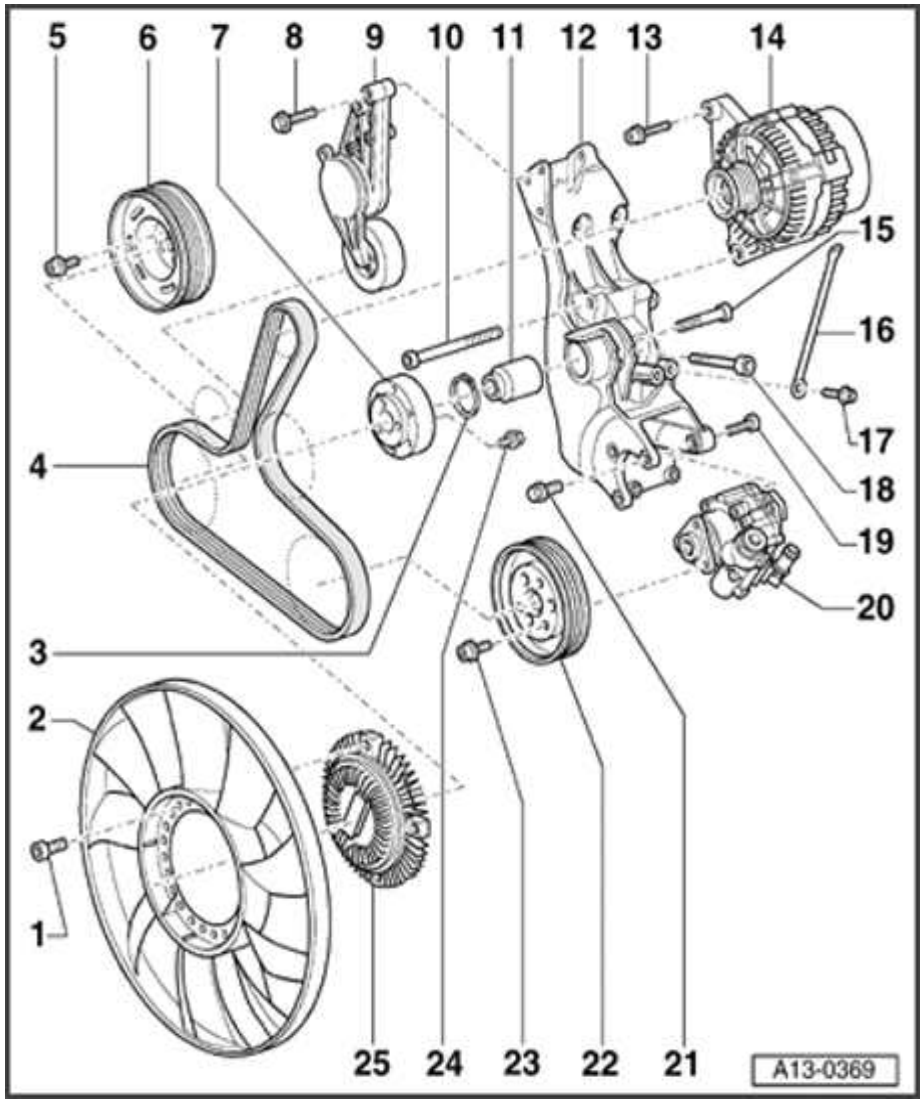
13-11



14 - Generator

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

13-12



15 - 45 Nm

16 - Support

- For intake manifold

17 - 20 Nm

18 - 52 Nm

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

19 - 23 Nm

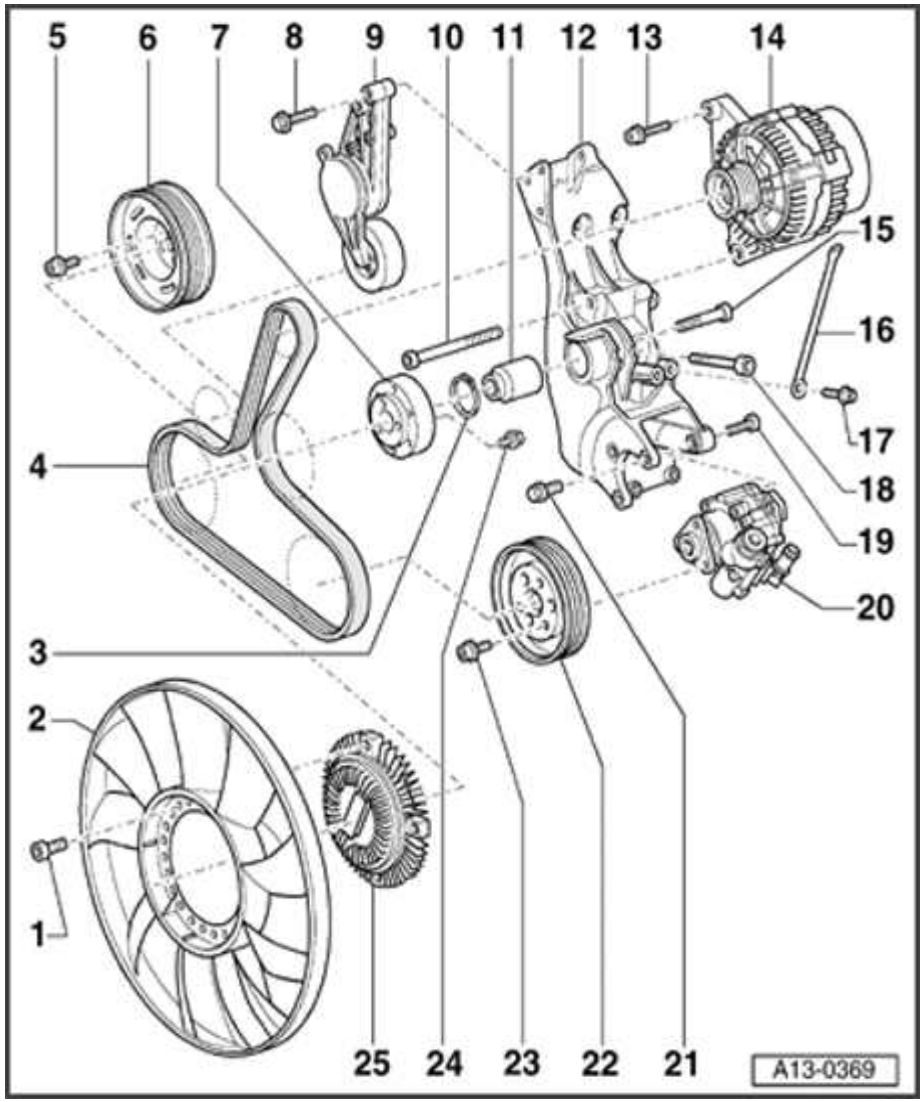
20 - Power steering pump

- Removing and installing:

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

21 - 23 Nm

13-13



22 - Pulley

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

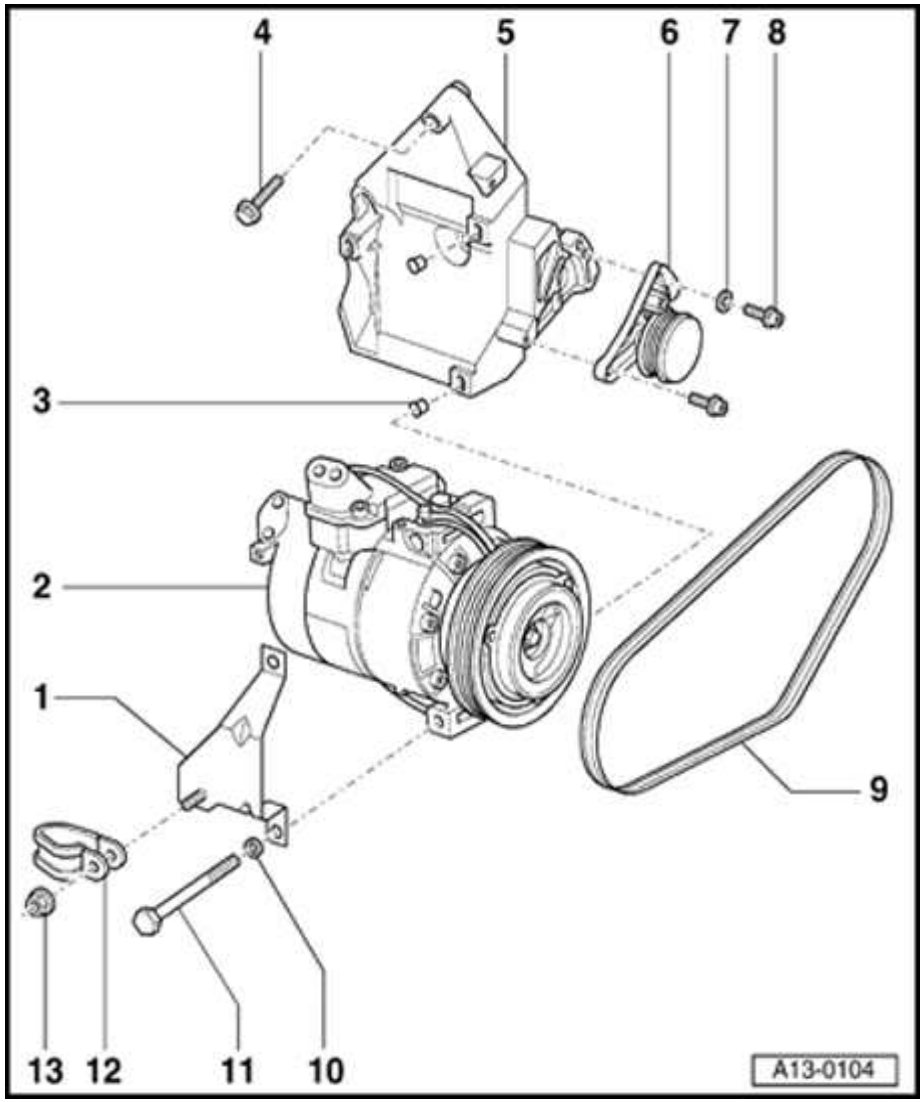
23 - 23 Nm

24 - Ribbed bolt - 28 Nm

25 - Viscous coupling

- Removing and installing ⇒ Page 13-21

13-14



Ribbed belt drive for air conditioner - assembly overview

CAUTION!

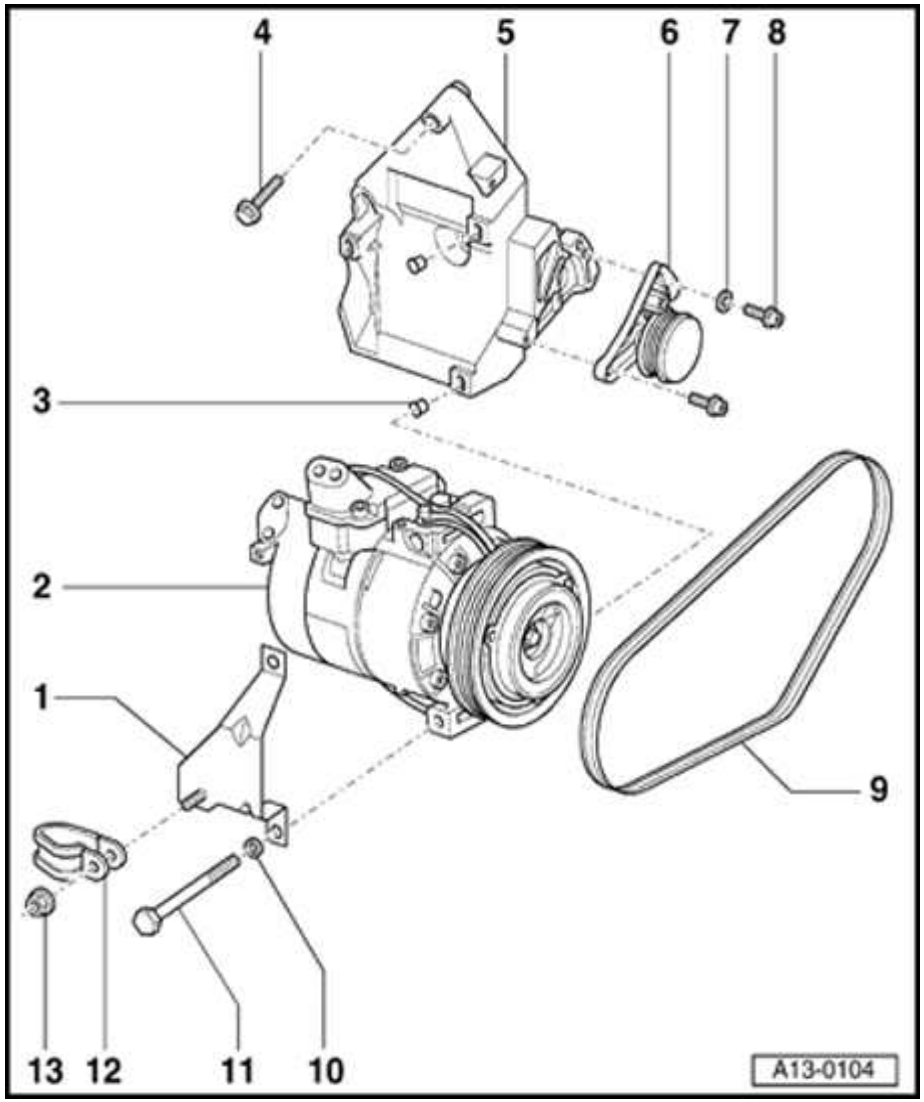
The air conditioner refrigerant circuit must not be opened.

Note:

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

1 - Bracket

13-15



2 - Air conditioner compressor

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

3 - Dowel sleeve

- Check sleeve is correctly seated in bracket

4 - 33 Nm

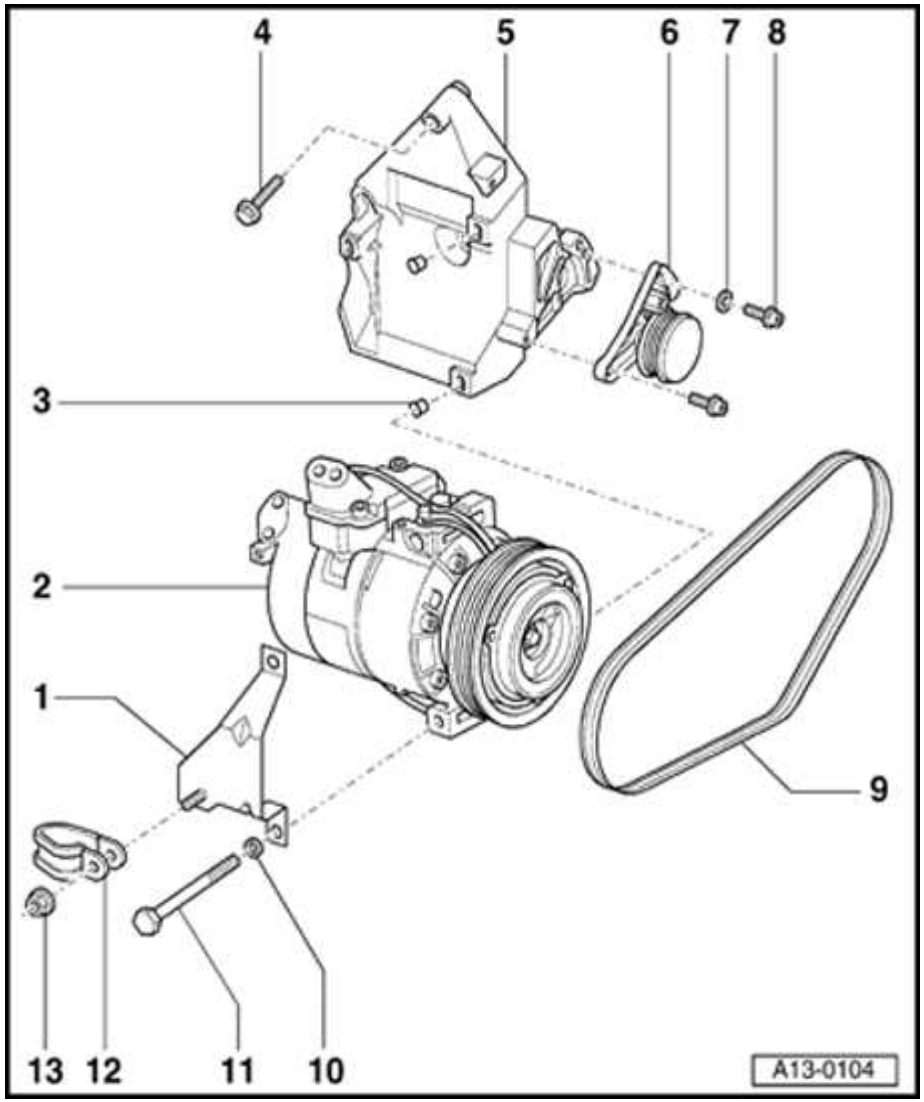
5 - Bracket

- For A/C compressor

6 - Tensioner

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

13-16



7 - Washer

8 - 23 Nm

9 - Ribbed V-belt

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

10 - Washer

11 - 25 Nm

12 - Retaining clip

13 - 20 Nm

13-17

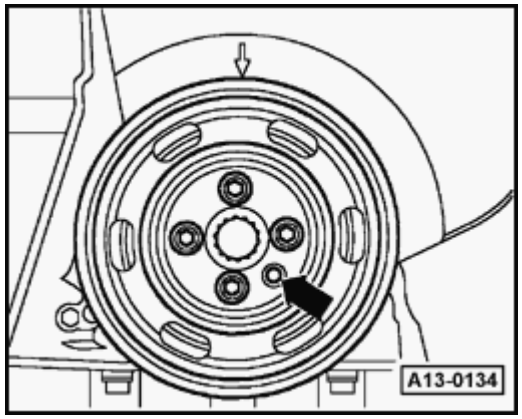


Fig. 1 Installing vibration damper

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

⇒ *Parts List*

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

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

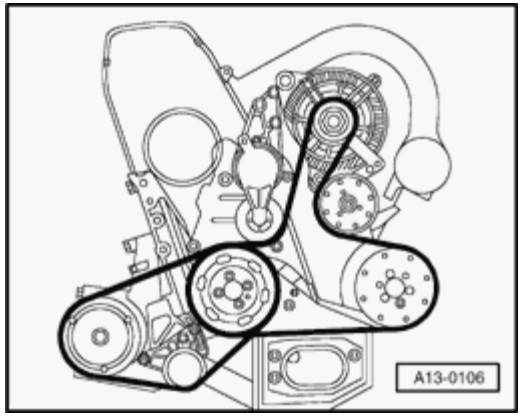


Fig. 2 Ribbed belt routing

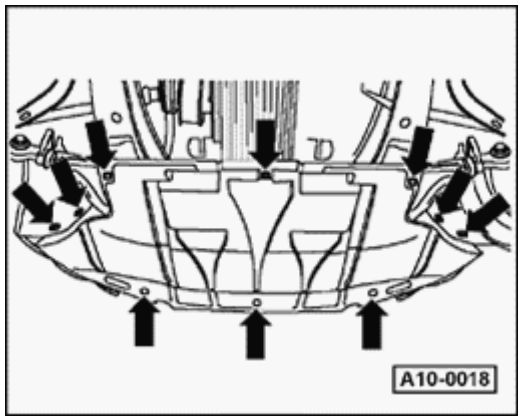
13-18

Ribbed belt, removing and installing

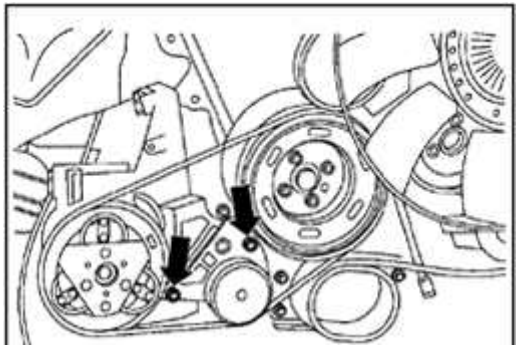
Note:

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

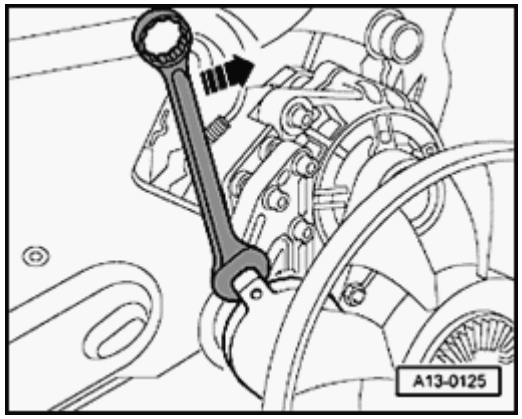
Removing



- Remove sound insulation -arrows-.

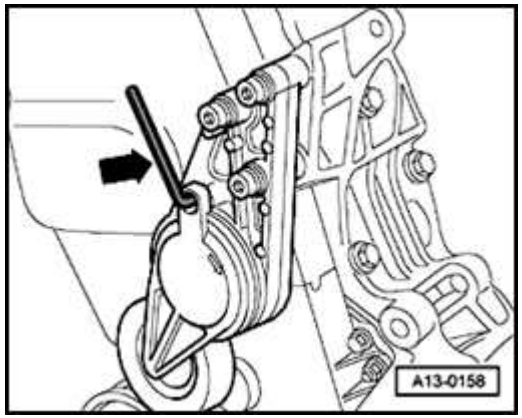


- Loosen bolts securing ribbed belt tensioning roller for A/C compressor -arrows-.



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

Note:

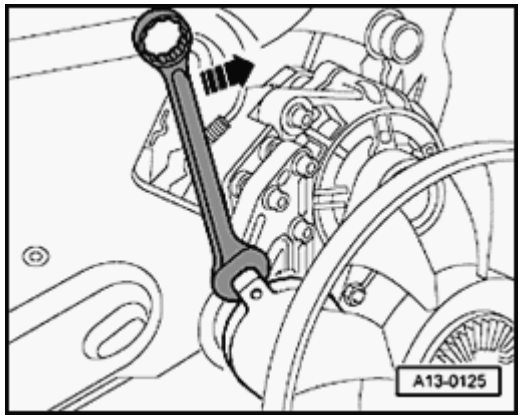


When the lock carrier is in the service position, the ribbed belt tensioner can be secured to prevent it from turning by inserting a suitable pin or Allen key -arrow- into the holes.

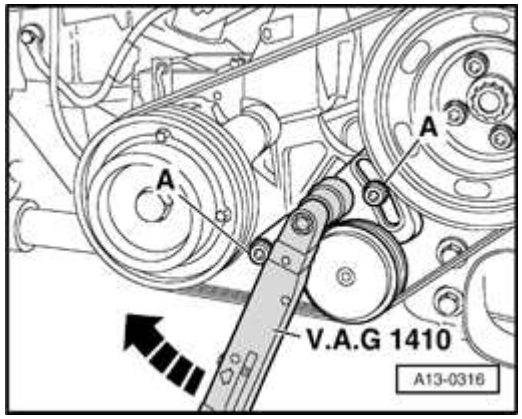
13-20

Installing

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



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



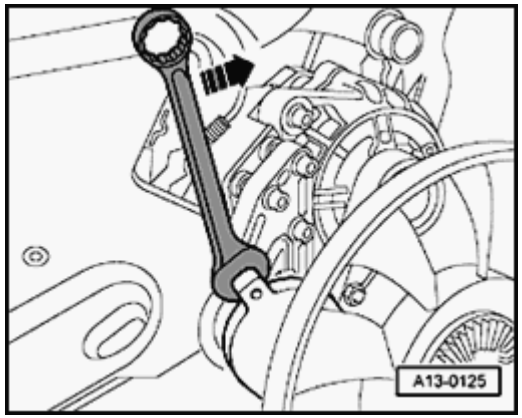
- Attach torque wrench at "7 o'clock position" as illustrated to hex on tensioner and pretension to 30 Nm.
- While tensioning, tighten bolts -A- to 23 Nm.
- Start engine and check belt running.

13-21

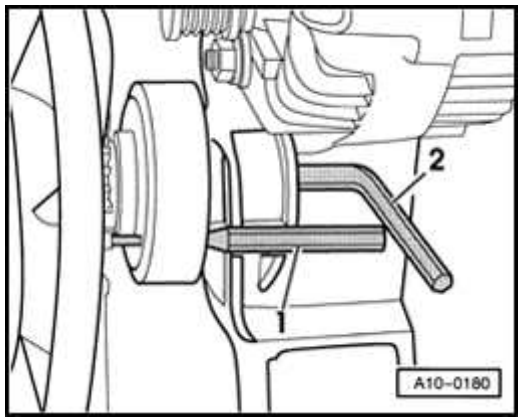
Viscous fan, removing and installing

Removing

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



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



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

13-22

Installing

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

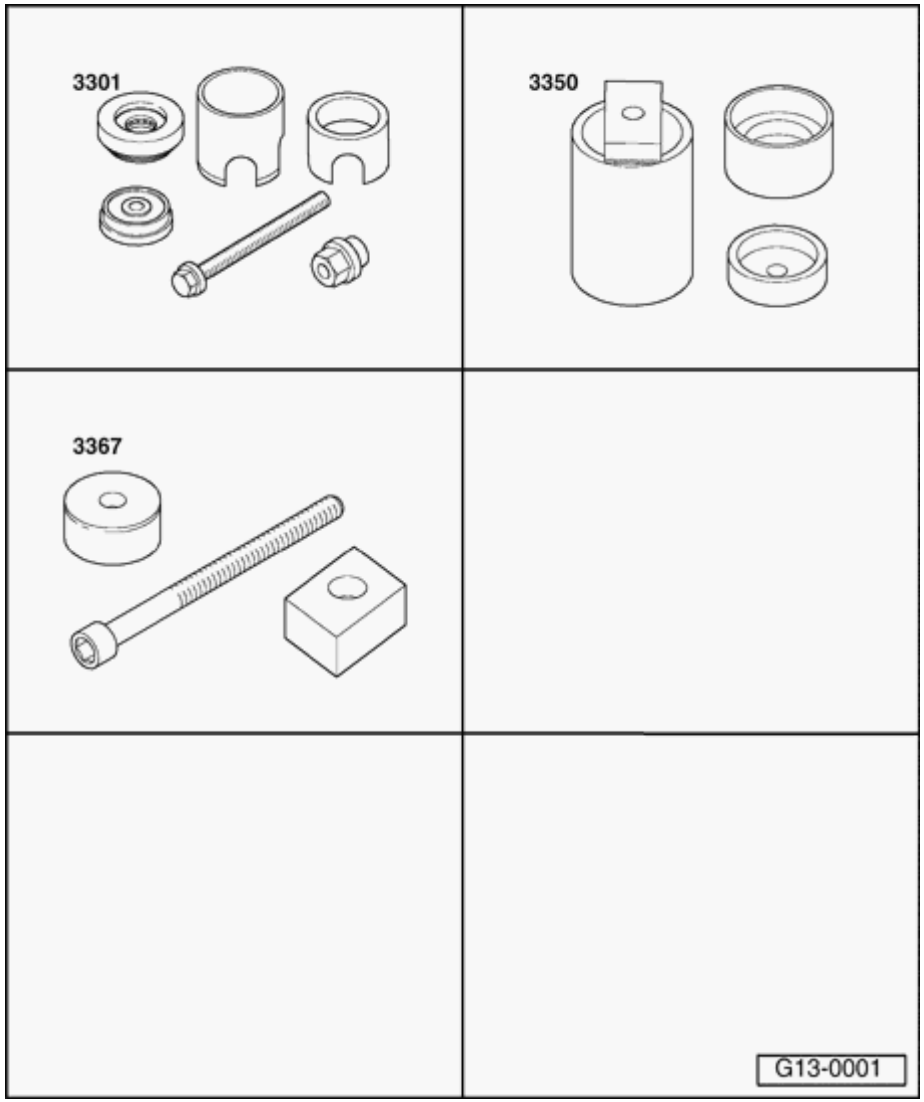
- Install ribbed belt ⇒ Page 13-20 .

- Install lock carrier ⇒ Page 13-1 .

Tightening torque

Component		Nm
Viscous fan to bearing		45

13-23



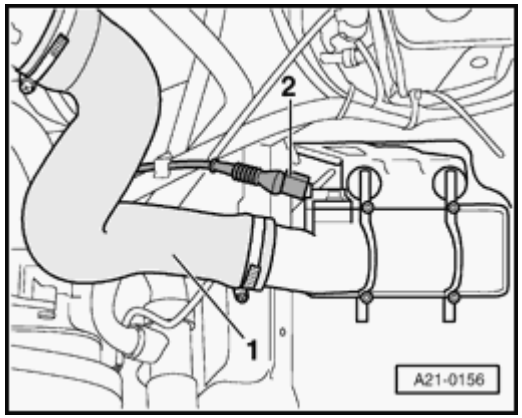
Bearing for viscous fan, removing and installing

Special tools and equipment

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

Removing

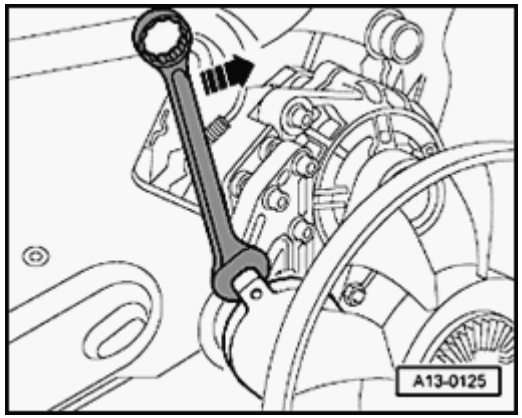
- Lock carrier must be in service position ⇒ Page 13-1 .



- Remove air duct hose -1-.

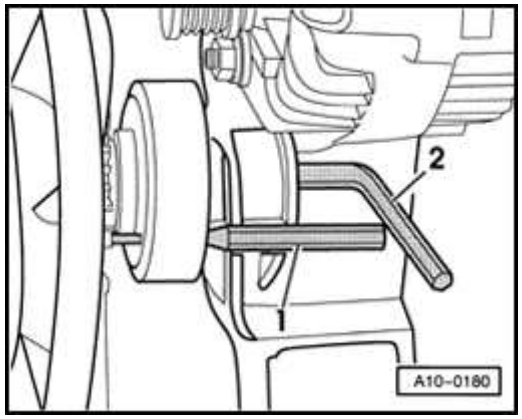
Note:

Connector -2- remains plugged in.

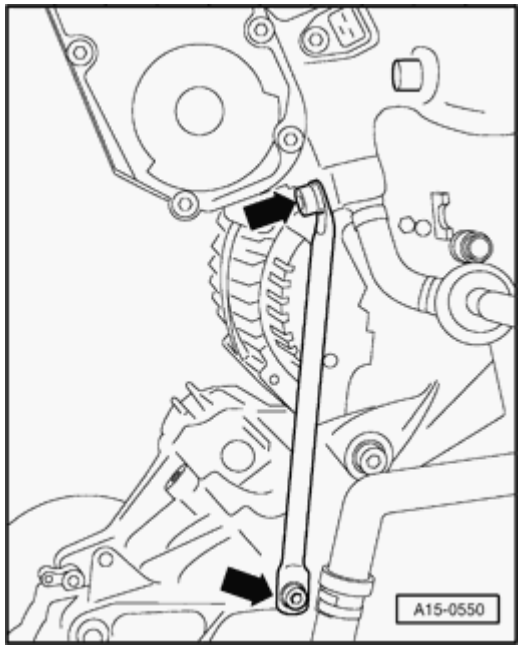


- Turn tensioner in direction of arrow to loosen ribbed belt.
- Remove ribbed belt from Generator pulley.

13-25

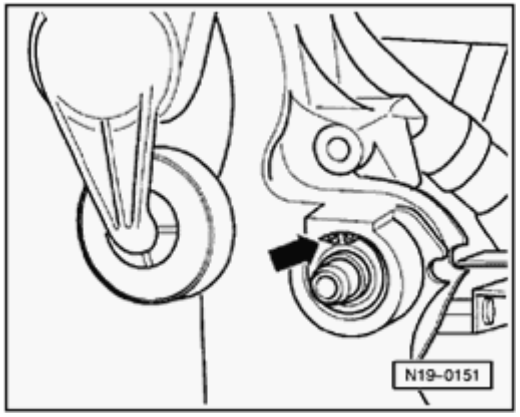


- Secure pulley for viscous fan with pin punch -1- and remove using Allen key -2-.
- Remove viscous fan from mounting.

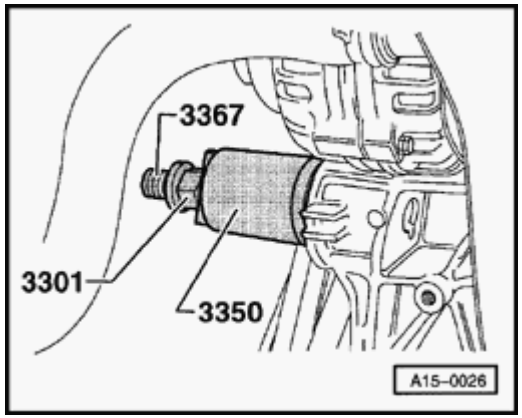


- Remove intake pipe support -arrows-.

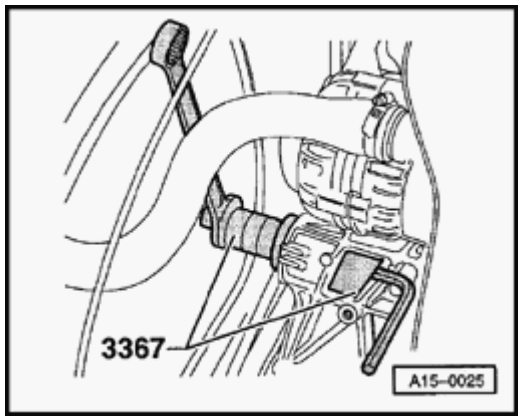
13-26



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



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



Installing

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

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

13-28

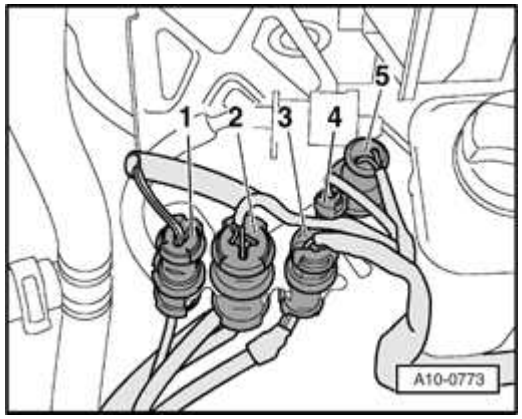
Bracket for Generator, power steering pump and viscous fan, removing and installing

Removing

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

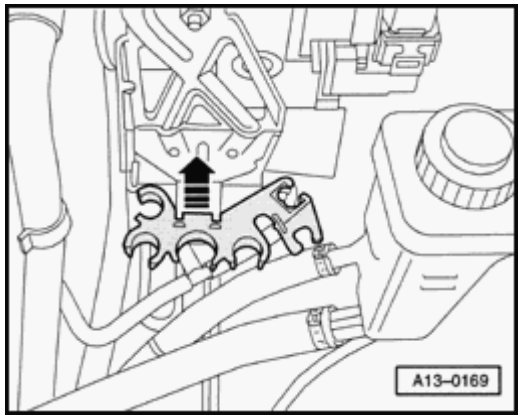
- Disconnect Ground strap at battery with ignition switched off.

- Remove cover from power steering fluid reservoir.

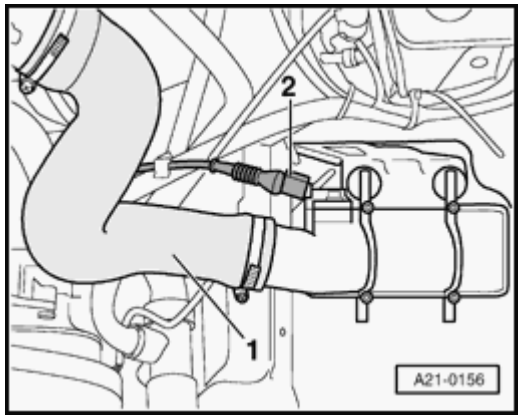


- Mark connectors -1 to 5- and remove from bracket.

13-29



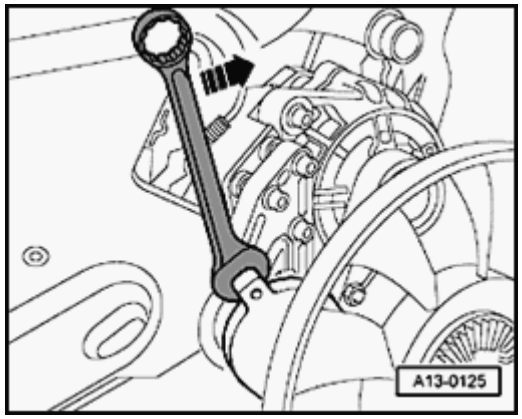
- Unclip connector bracket at ABS unit console and lift up to remove.



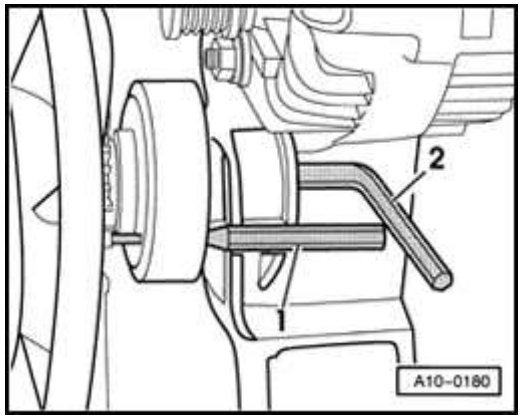
- Remove air duct hose -1-.

Note:

Connector -2- remains plugged in.



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



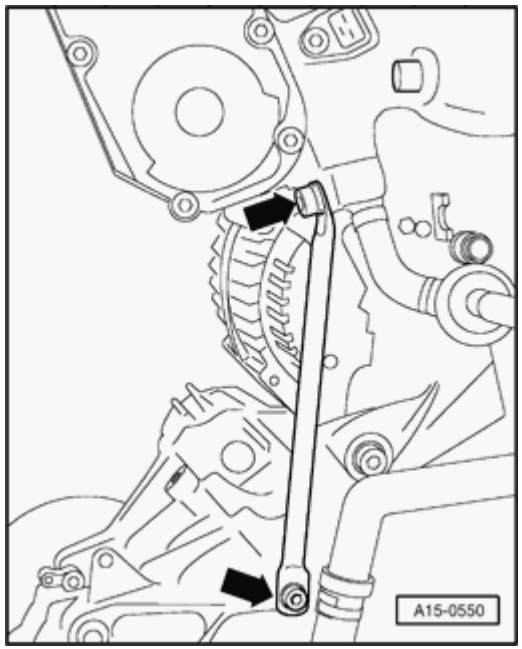
- Secure pulley for viscous fan with pin punch -1- and remove using Allen key -2-.
- Remove viscous fan from mounting and put in front of radiator cowl.
- Remove wiring from rear of Generator.
- Loosen connections for Generator from top and bottom and remove Generator.

13-31

- Remove tensioner for ribbed belt from bracket.

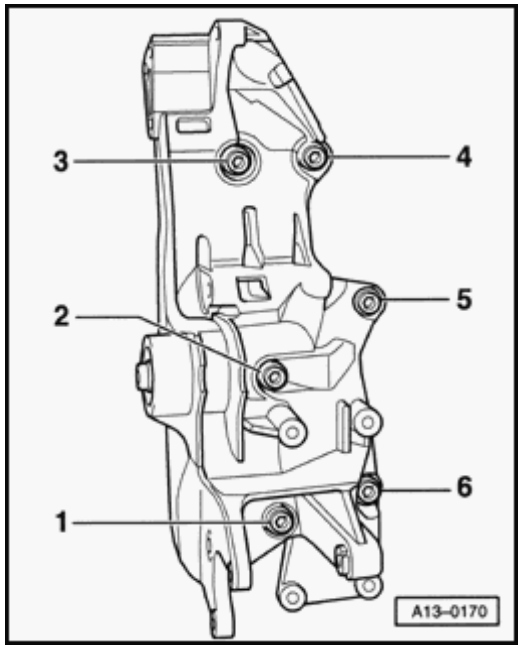
- Remove pulley from power steering pump.

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



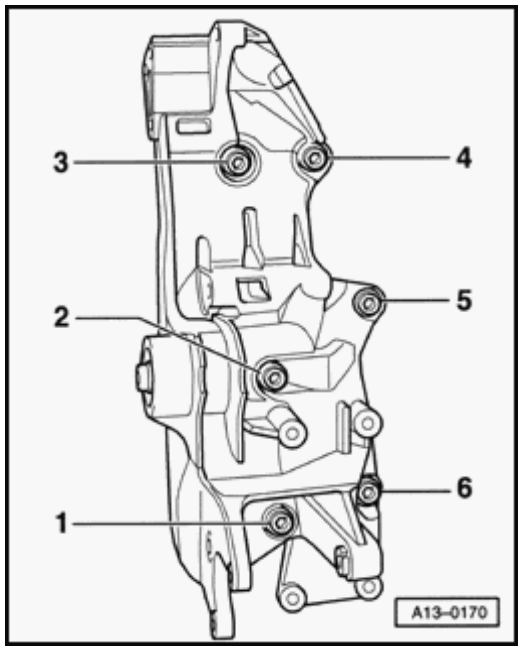
- Remove intake pipe support -arrows-.

13-32



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

13-33



Installing

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

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

  1, 2 - Bolt M10 x 85

  3 to 6 - Bolt M10 x 45

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

⇒ *Radio operating instructions*

- Close windows fully using window switches.

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

- Set clock to correct time.

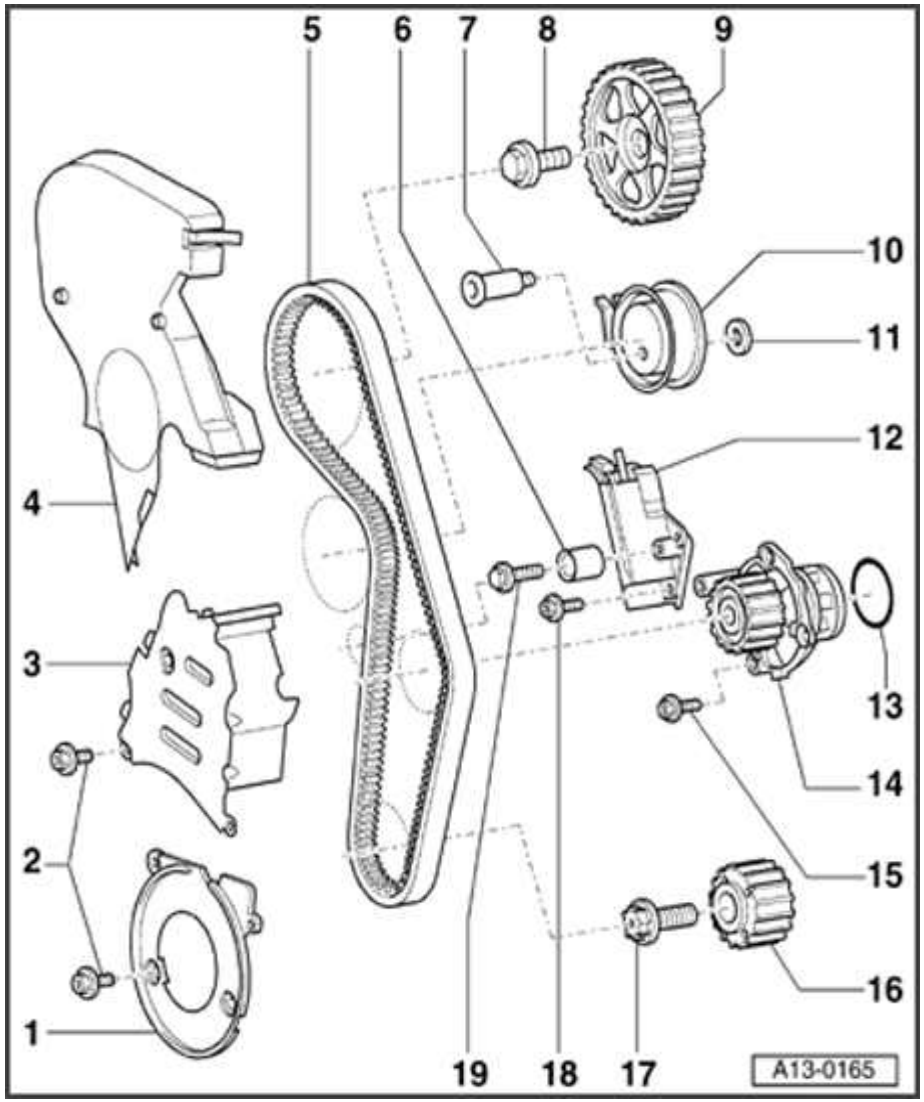
Tightening torques

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

Viscous fan to bearing	45

1) Install with locking fluid D 000 600 A2

13-35



Toothed belt drive

Note:

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

1 - Toothed belt guard - lower

- To remove, unbolt vibration damper

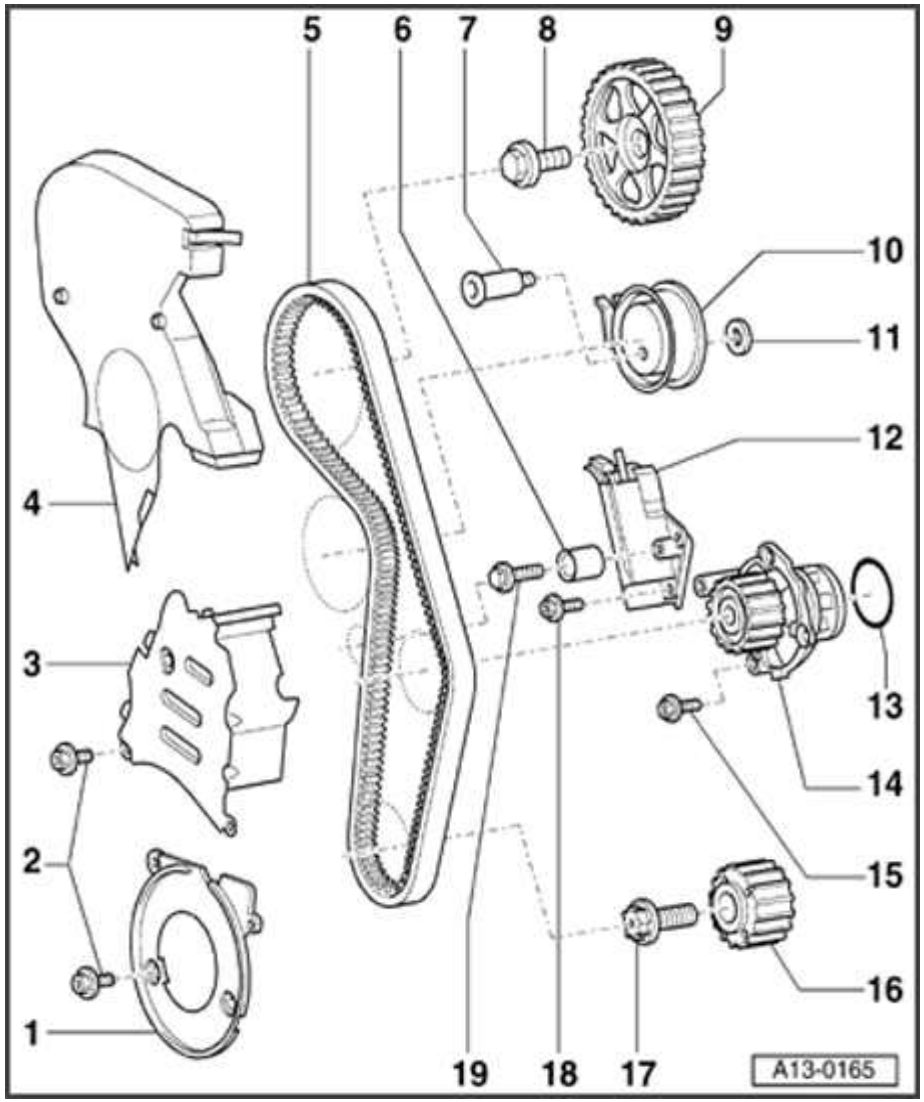
2 - 10 Nm

- Apply D 000 600 when installing

3 - Toothed belt guard - center

- Unbolt tensioner before removing center section of toothed belt guard

13-36



4 - Toothed belt guard - top

- When installing, engage carefully in center toothed belt guard

5 - Toothed belt

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

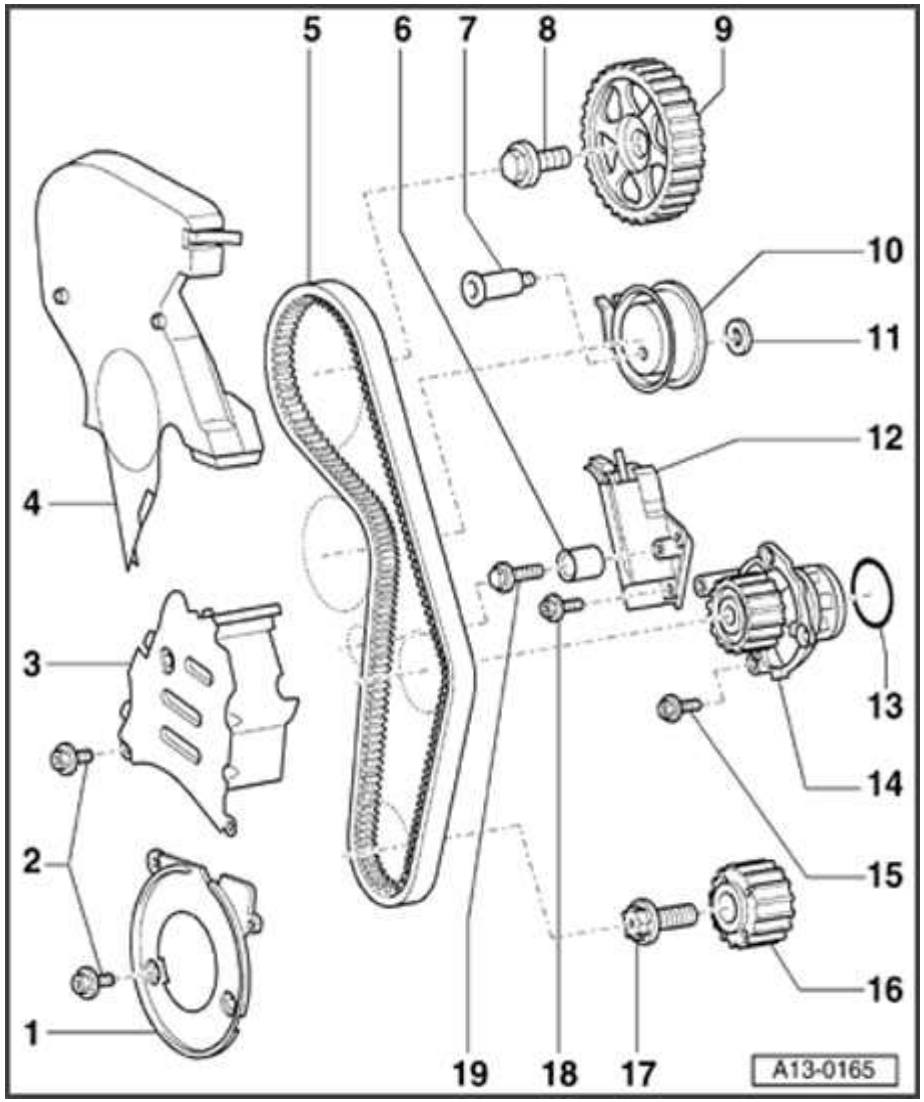
6 - Idler roller

7 - 27 Nm

8 - 65 Nm

- Counter hold with 3036 to loosen and tighten

13-37



9 - Camshaft sprocket

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

10 - Tensioner

11 - Washer

12 - Tensioner for toothed belt

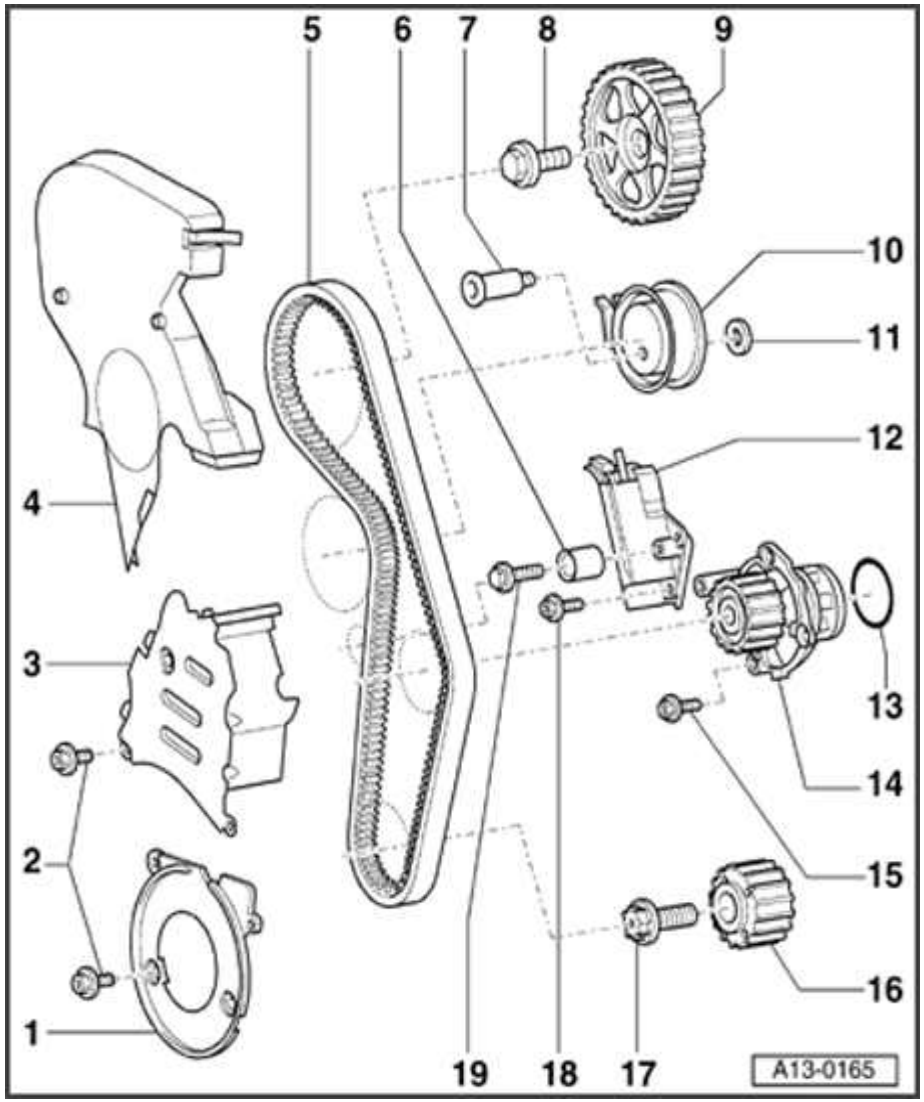
13 - O-ring

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

14 - Coolant pump

- Removing and installing ⇒ Page 19-12

13-38



15 - 15 Nm

16 - Crankshaft sprocket

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

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

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

18 - 15 Nm

19 - 25 Nm

13-39

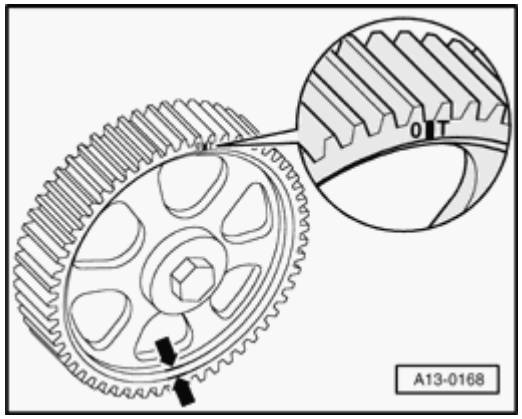


Fig. 1 Location of camshaft sprocket

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

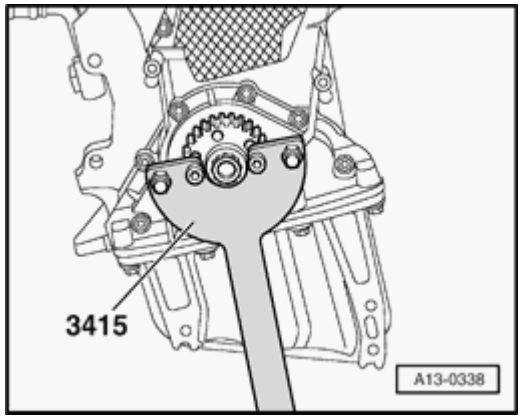


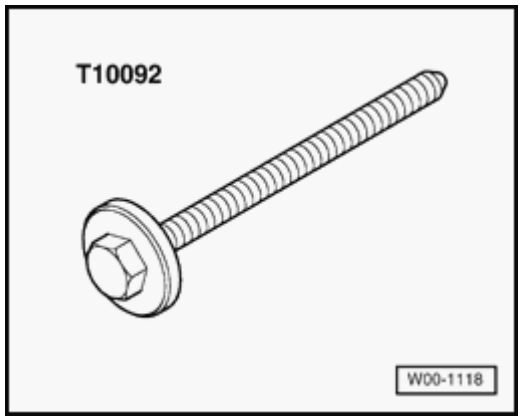
Fig. 2 Removing and installing toothed belt crankshaft

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

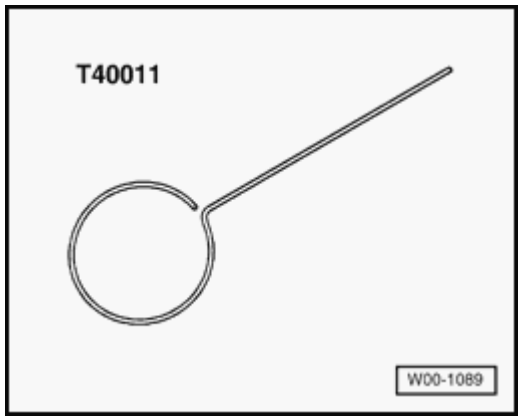
13-40

Toothed belt, removing and installing

Special tools and equipment



- Socket head fastener T10092

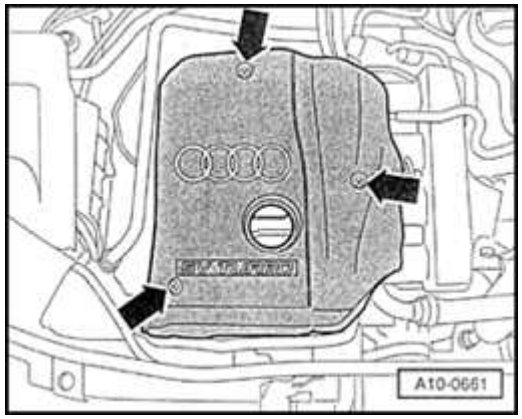


- Pin T40011

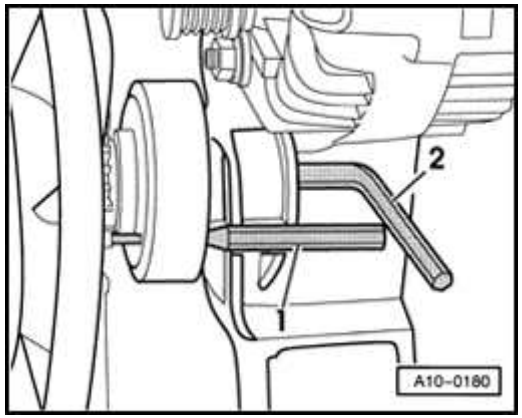
13-41

Removing

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



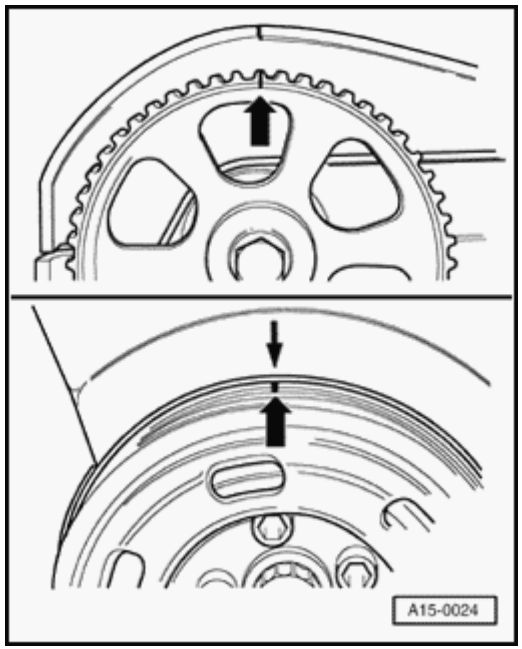
- Remove engine cover -arrows-.
- Remove ribbed belt and tensioner for ribbed belt ⇒ Page 13-18 .



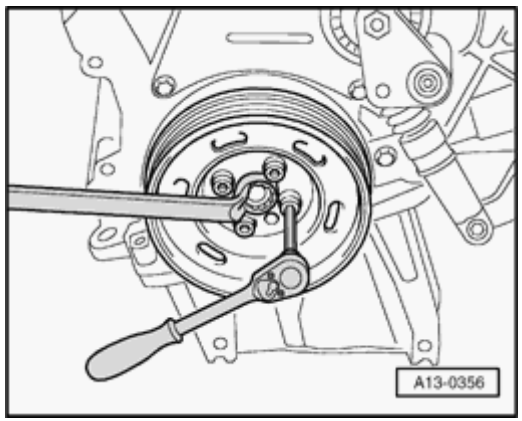
- Secure pulley for viscous fan with pin punch -1- and remove using Allen key -2-.
- Remove viscous fan from mounting.
- Remove upper toothed belt guard.

13-42

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

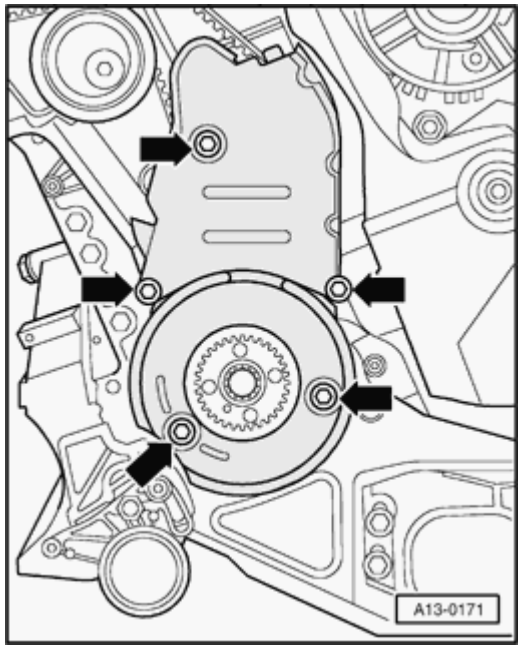


- Set crankshaft to markings for TDC of No. 1 cylinder by turning central bolt on crankshaft sprocket in direction of rotation -arrows-.

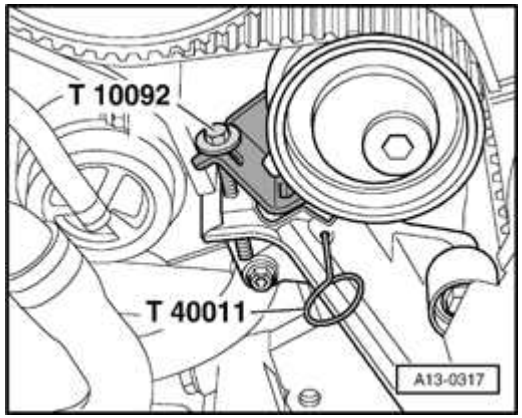


- Unbolt vibration damper.

13-43



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



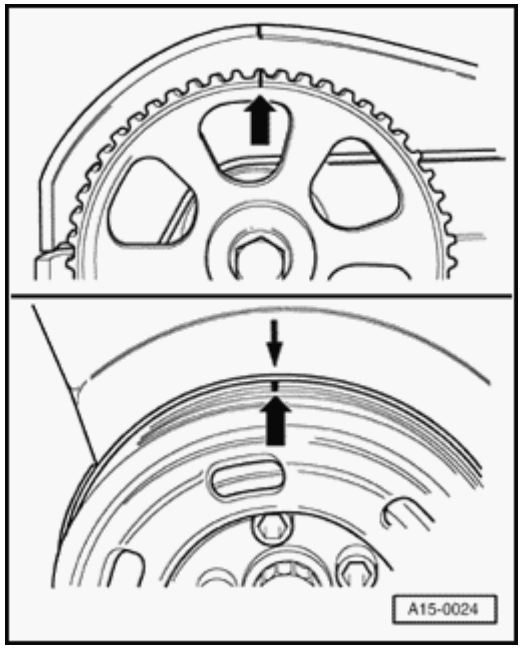
- Attach socket head fastener T10092 into the tensioner for toothed belt.
- Only tension pressure piston of tensioner until pressure piston is secured with pin T40011.
- Take off toothed belt.

Installing (adjusting valve timing)

Note:

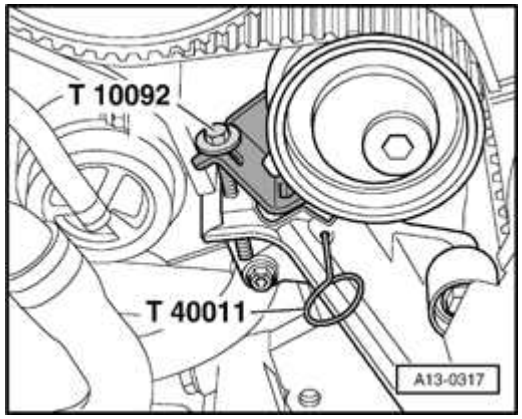
- *The position of the toothed belt must be set as described below, even after repairs in which the belt is only taken off the camshaft sprocket.*

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

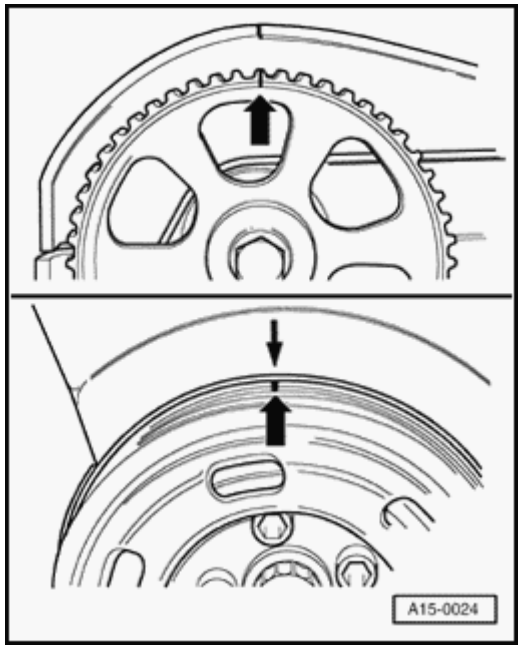


- Align marking on camshaft sprocket with marking at cylinder head cover.
- Place toothed belt on crankshaft sprocket (observe direction of rotation).
- Install toothed belt guard - lower part.
- Secure vibration damper/belt pulley with one bolt (note installation arrangement).
- Set crankshaft to TDC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

13-45



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



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

Tightening torques

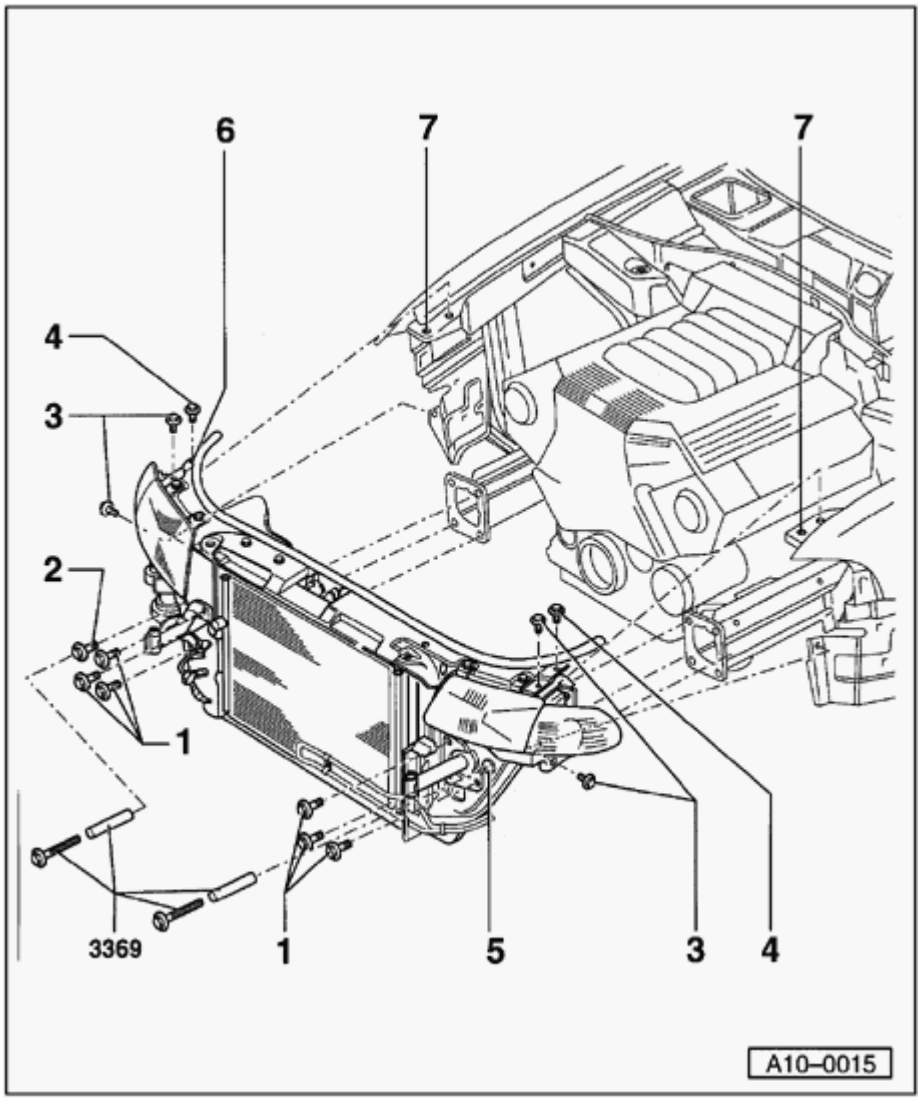
Component		Nm
Lower section of toothed belt guard to cylinder block		10 1)
Center section of toothed belt guard to cylinder block		10 1)
Vibration damper/belt pulley to crankshaft		10 + 90 ° 2)3)
Ribbed belt tensioner to bracket		23

1) Install with locking fluid D 000 600 A2

2) Replace bolts

3) 90 ° corresponds to a quarter turn

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)

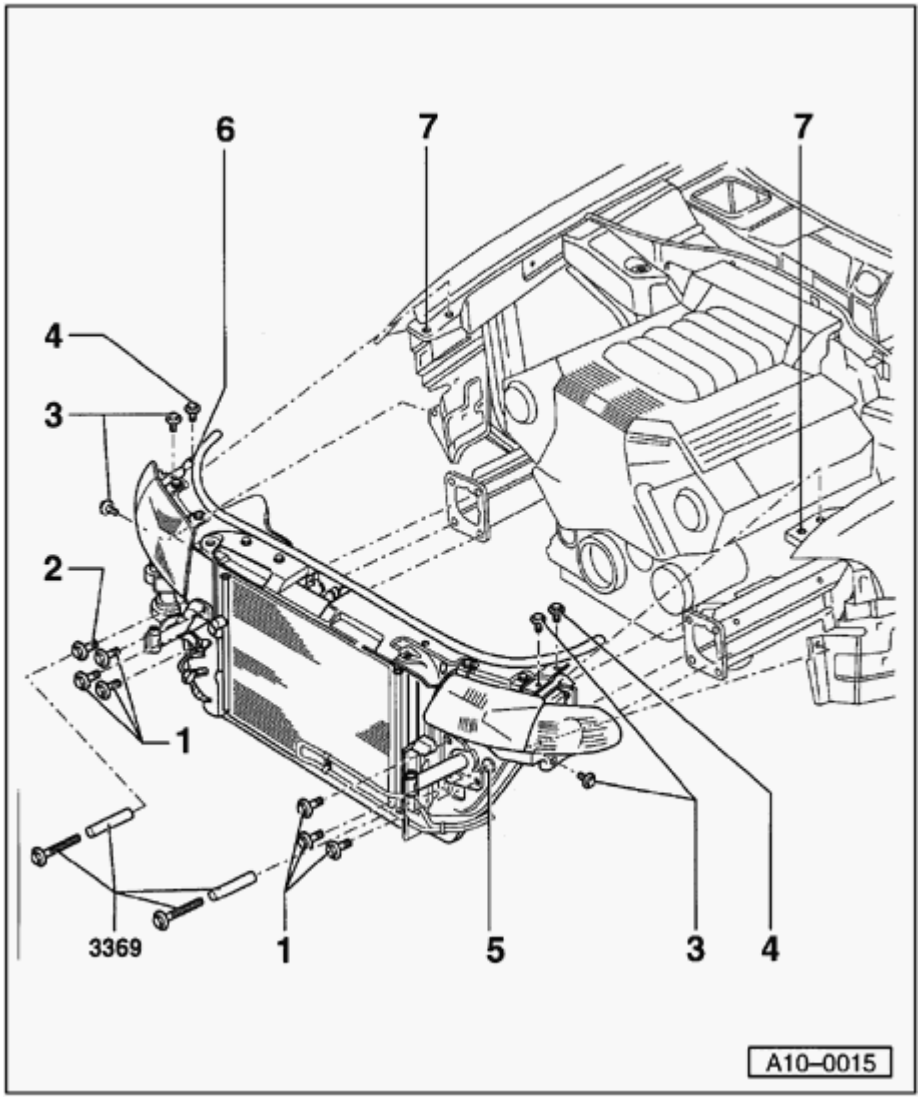
5 - Bore

- For 3369 support tool

6 - Lock carrier bore

7 - Fender bore

13-2

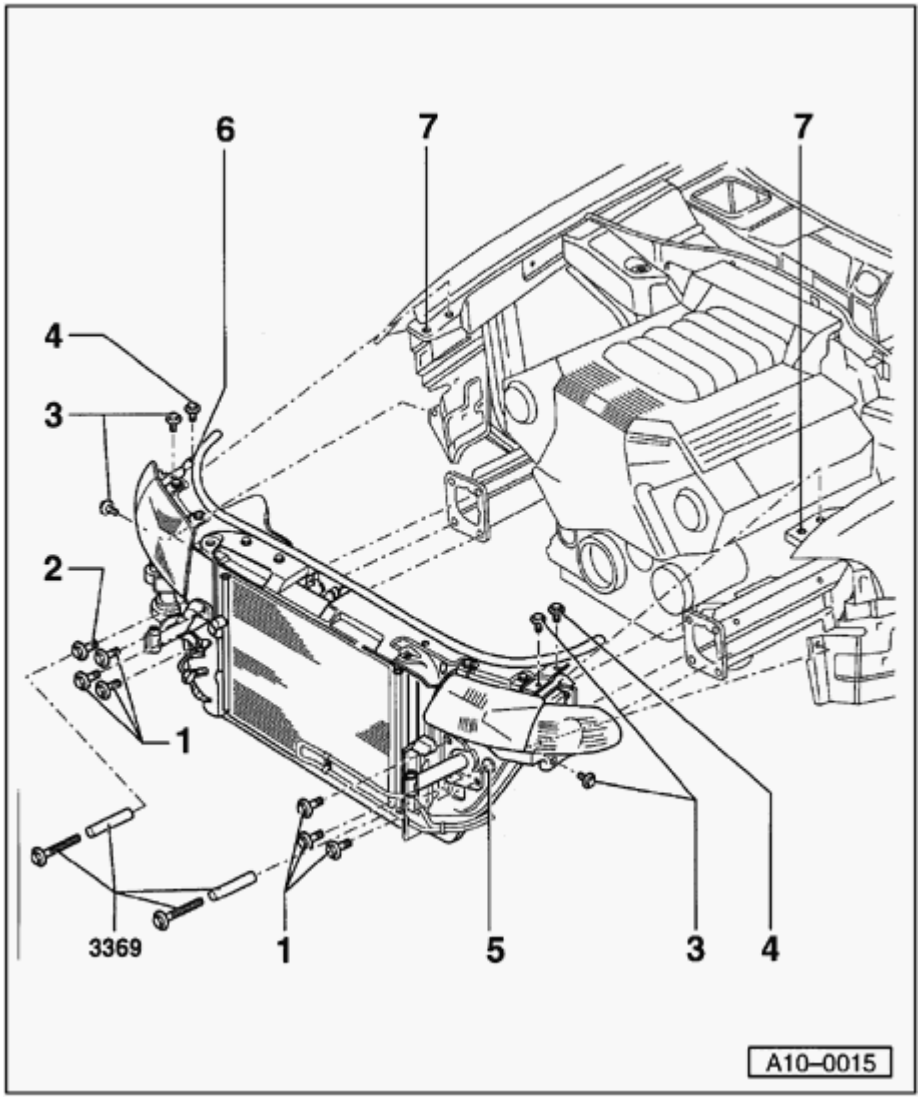


- Remove front bumper.

⇒ *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 cleaner 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-.

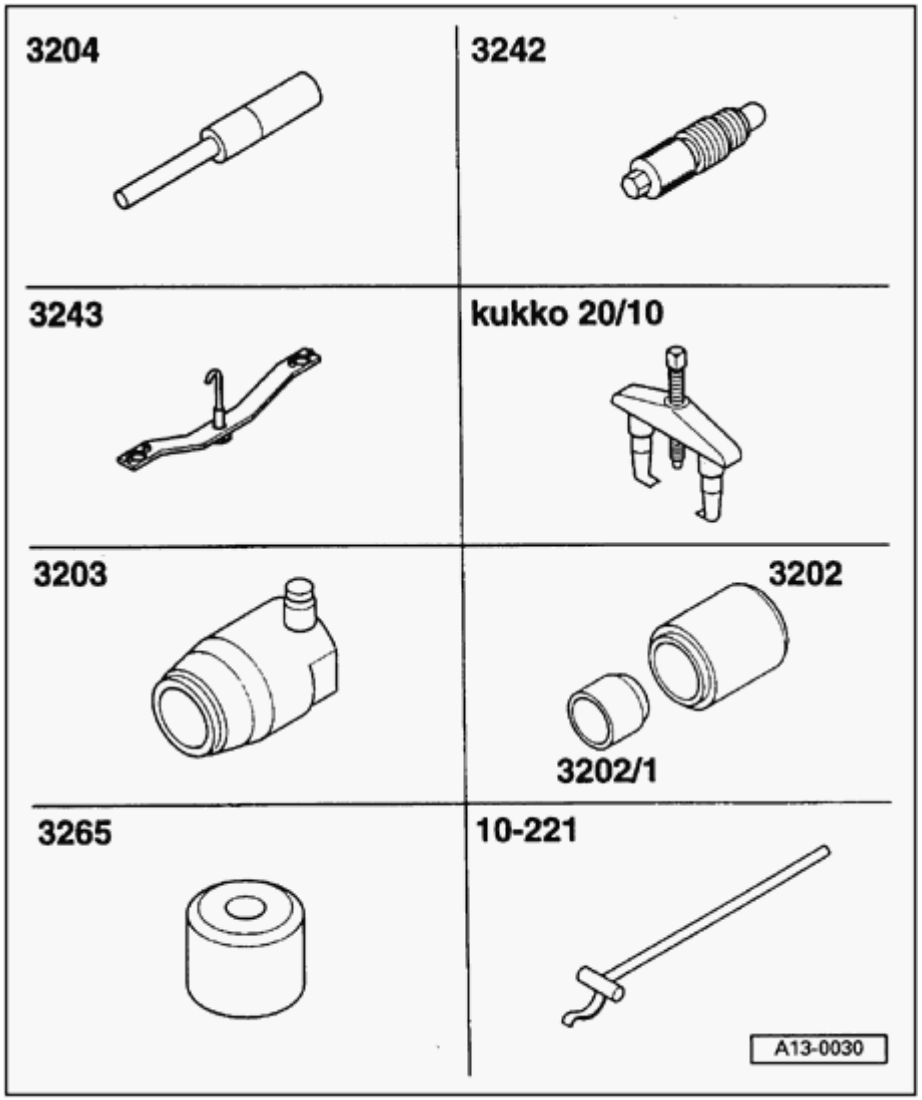
13-3



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

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

13-1

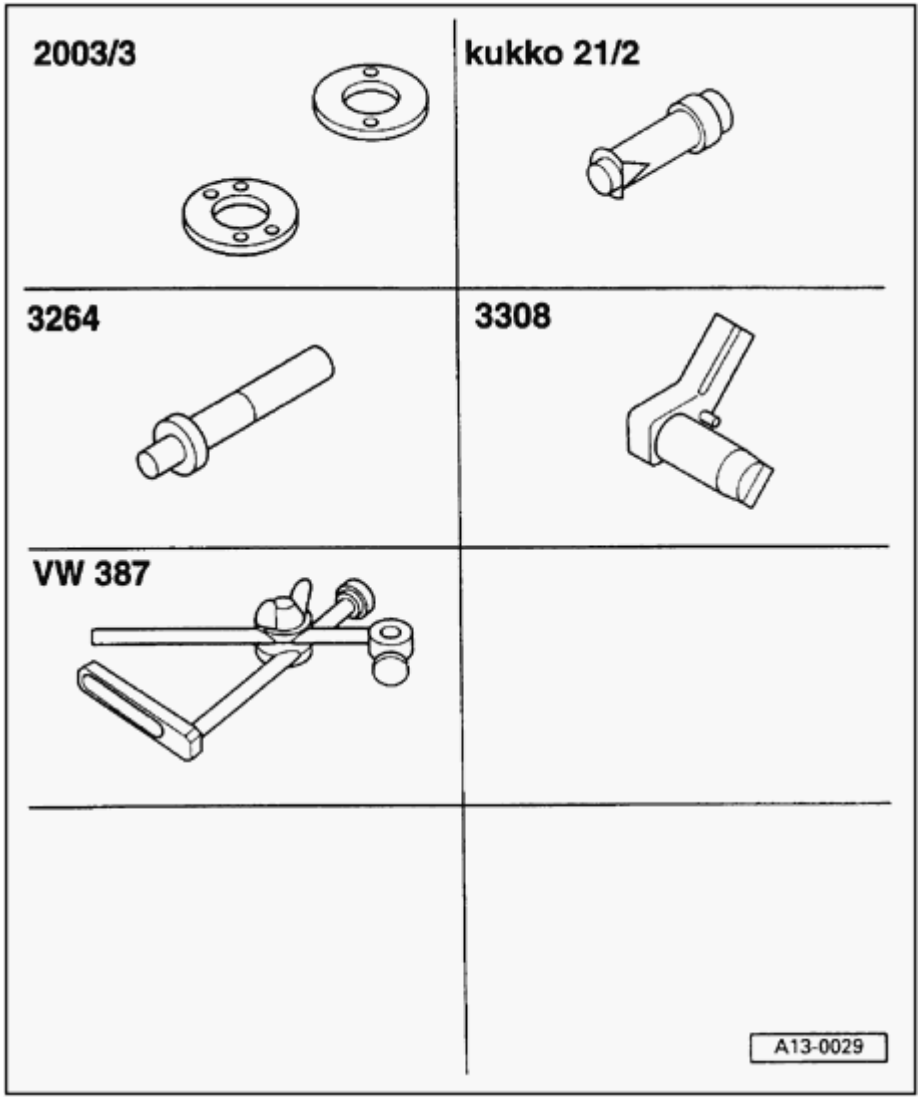


Special tools

The following special tools and test equipment are required for these operations:

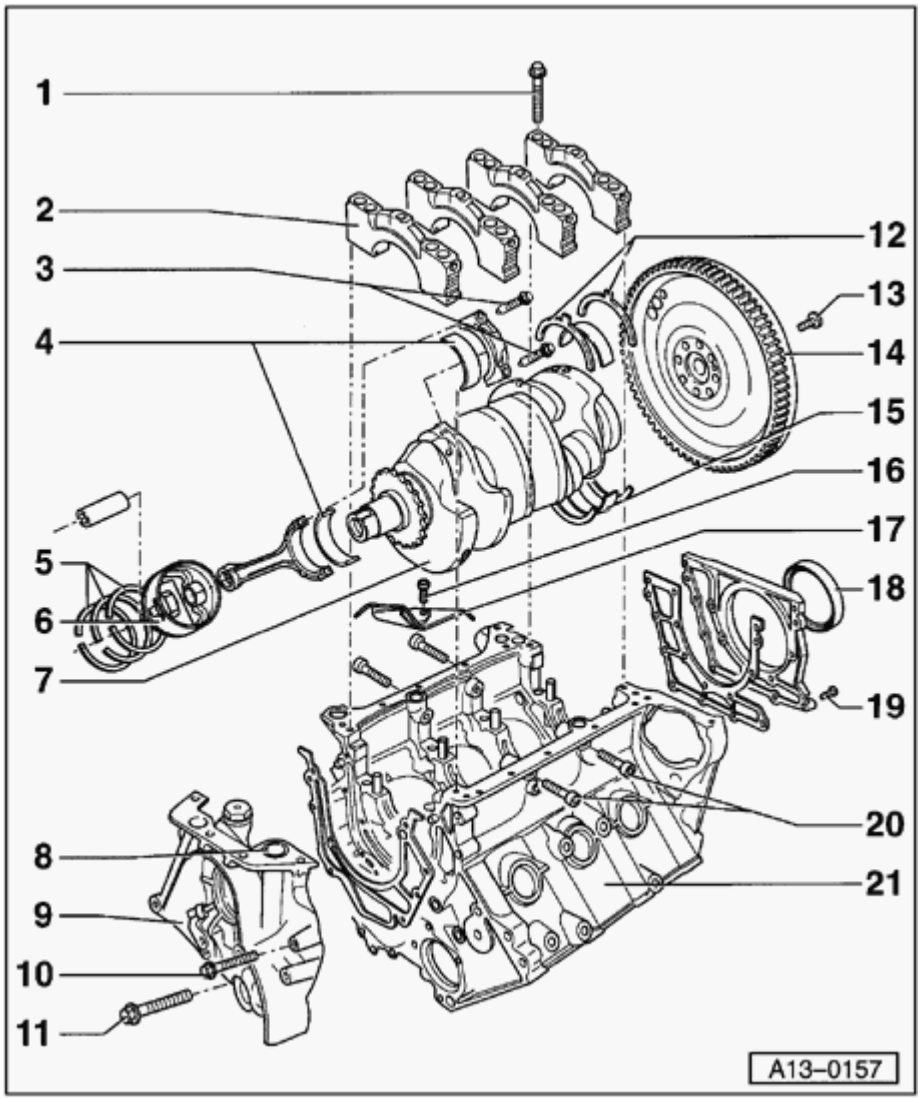
3204	**Drift**
3242	**Crankshaft holder**
3243	**Camshaft holder tool**
20-10	**Kukko 2-arm puller**
3203	**Seal remover**
3202	**Retractor**
3265	**Seal installer**
10-221	**Extractor**

13-2



2003/3	**Seal installer**
21/2	**Kukko extractor**
	14.5 - 18.5mm
3264	**Adjusting driver**
3308	**RPM sensor adjusting device**
VW 387	**Dial gauge holder**

13-4



Cylinder block, crankshaft and flywheel, servicing

Notes:

- *Always replace seals and O-rings.*
- *The engine speed sensor is installed in the transmission bellhousing with a spacer washer underneath.*

1 - Main bearing cap bolts

- Always replace
- 60 Nm (44 ft lb) + additional 180° (1/2 turn)

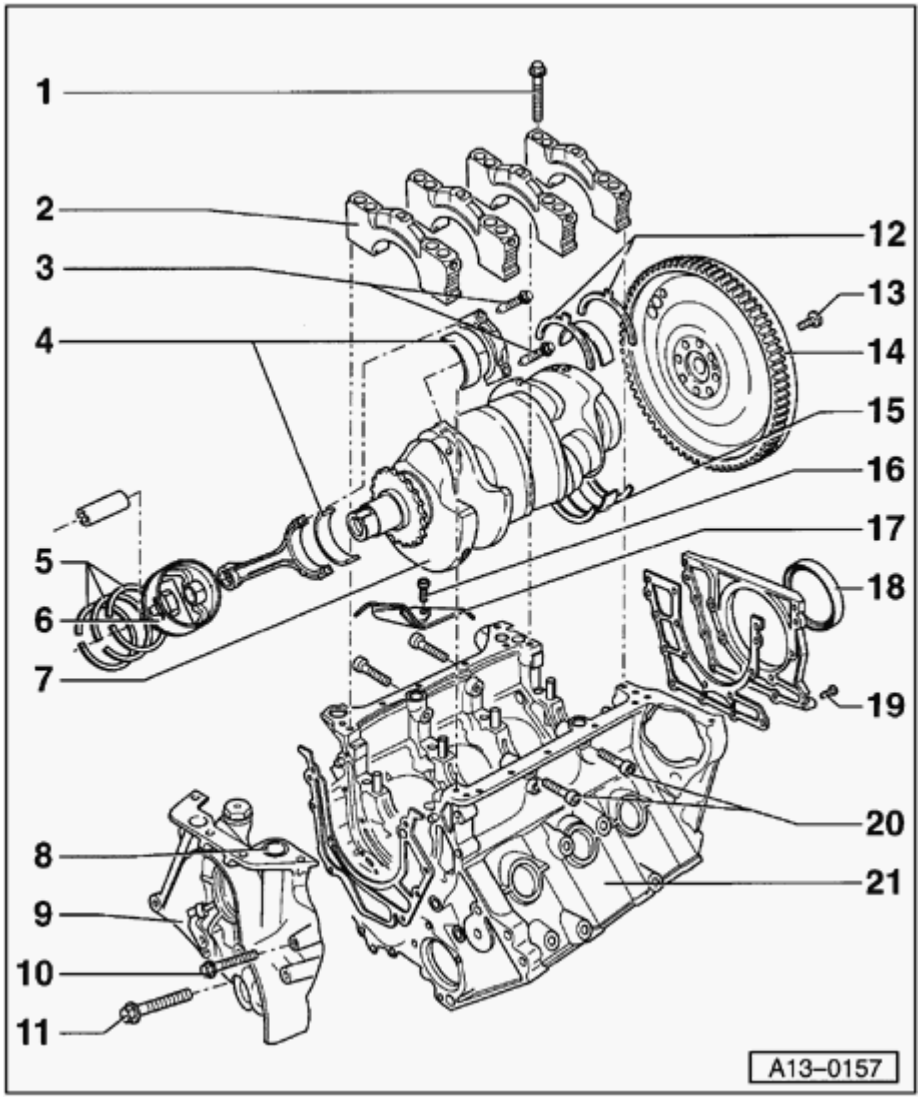
2 - Main bearing caps

- Always replace bolts
- Marking -1- on oil pump side
- Checking bearing clearance ⇒ page 13-25

3 - Connecting rod bearing bolts

- Always replace
- 30 Nm (22 ft lb) + additional 90° (1/4 turn)
- When measuring radial clearance, tighten to 20 Nm (15 ft lb), but do not turn further

13-5



4 - Connecting rod bearings

- Do not interchange used bearing shells
- Connecting rods, connecting rod bearings ⇒ page13-33

5 - Piston rings

- Checking ⇒ page 13-29

6 - Pistons

- Checking ⇒ page 13-29

7 - Crankshaft

- Checking ⇒ page 13-25
- Chain gear for oil pump, removing and installing ⇒ page 17-29
- For vehicles with automatic transmission, always install bushing as pilot for converter
- Remove bushing using KUKKO 21/2 and 22/1

8 - Oil passage with seal

- Always replace seal

9 - Sealing flange, front

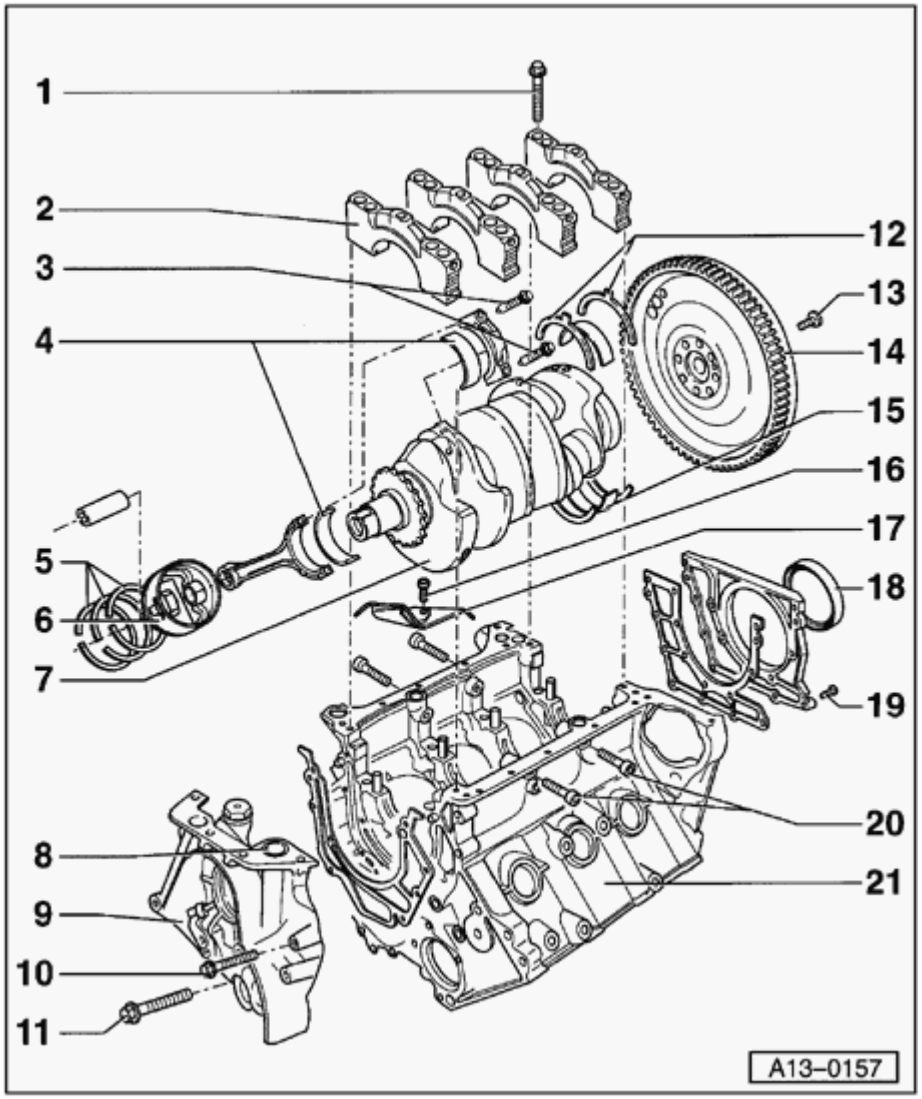
10 - Bolt

- 10 Nm (7 ft lb)

11 - Collar bolt

♦ 30 Nm (22 ft lb)

13-6



12 - Thrust washer

- Measuring crankshaft axial clearance ⇒ page 13-25
- Only on 4th crankshaft bearing

13 - Special bolt (12-sided)

- Always replace
- Driveplate: 60 Nm (44 ft lb) + additional 90° (1/4 turn)
- Dual-mass flywheel: 60 Nm (44 ft lb) + additional 180° (1/2 turn)

14 - Dual-mass flywheel or driveplate

- Removing and installing ⇒ page 13-22
- Needle bearing, removing and installing ⇒ page 13-21

15 - Crankshaft bearing

- Axial and radial clearance, checking ⇒ page 13-25

16 - Bolt

- 10 Nm (7 ft lb)

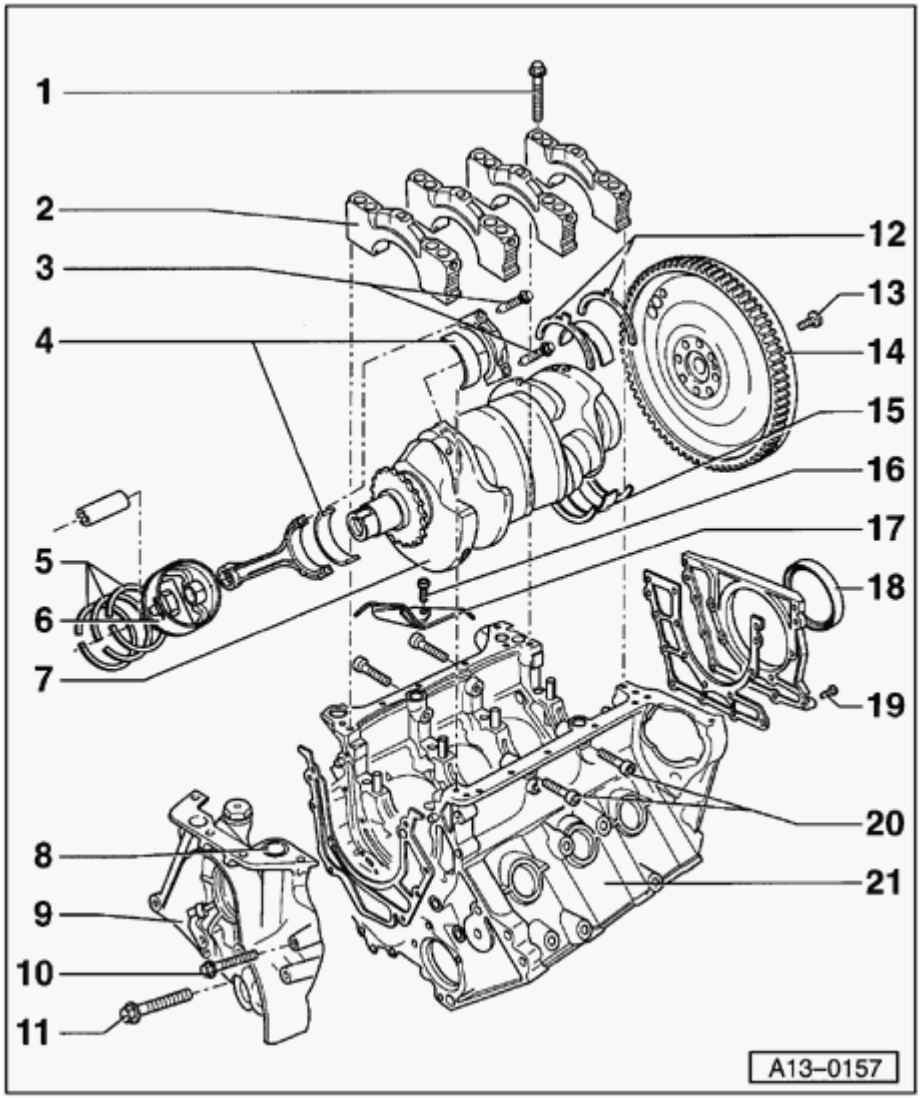
17 - Oil jet

- To cool pistons

18 - Seal for rear flange

♦ Replacing ⇒ page 13-18

13-7



19 - Bolt

- 10 Nm (7 ft lb)

20 - Bolt

- 25 Nm (18 ft lb)
- Install hand-tight before fully tightening

21 - Cylinder block

13-8

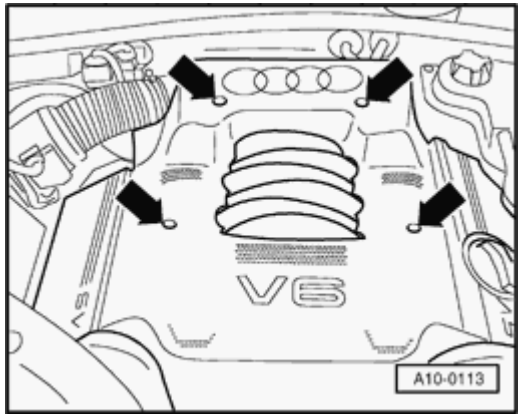
Ribbed belt, removing and installing

- Lock carrier in service position ⇒ page 13-1

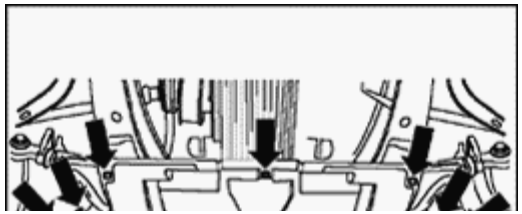
CAUTION!

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

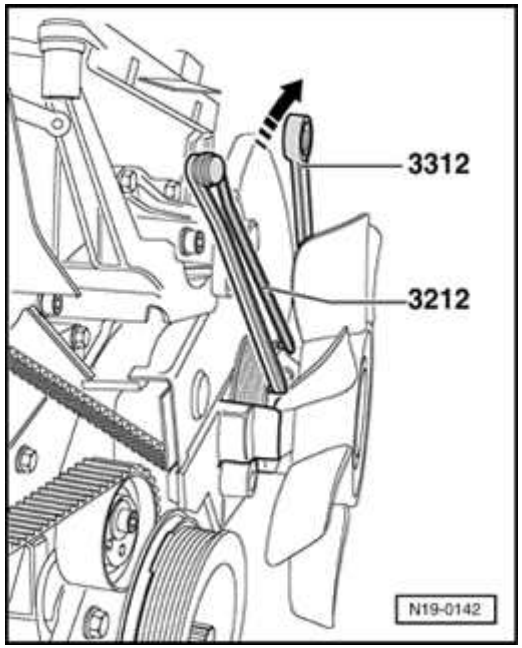


- Remove engine cover (arrows).



- Remove noise insulation panel (arrows).

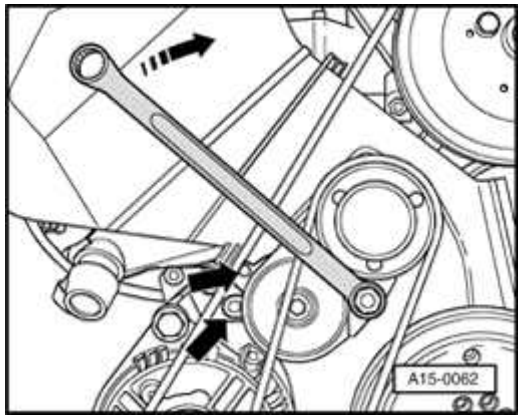
13-9



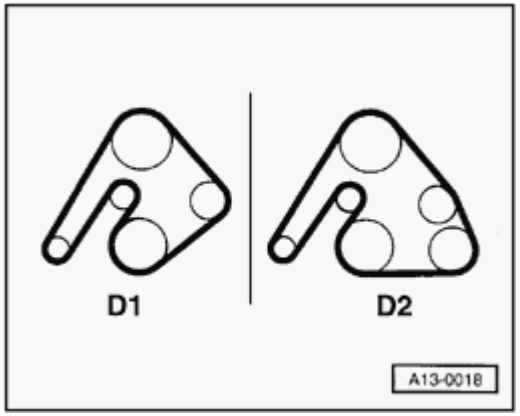
- Counterhold pulley for viscous fan using 3212 spanner wrench and remove viscous fan using 3312 open-end spanner (left thread).
- Carefully lift out viscous fan.

Note:

Observe previously marked direction of rotation of belt and that it is seated correctly on the pulley.



- To loosen ribbed belt, turn tensioner clockwise using 17 mm box wrench until two holes are aligned (arrows). Counterhold in position using 3204 drift.
- Remove ribbed belt.



Installing

- First install ribbed belt onto crankshaft pulley and idler wheel. Push belt onto tensioning roller last.

Note:

Observe previously marked direction of rotation of belt and that it is seated correctly on the pulley.

Routing of ribbed belt:

D1 - without air conditioning

D2 - with air conditioning

- Remove 3204 drift.
- Install engine cover.

Tightening torque for viscous fan	**Tightening torque**
1331 torque wrench and 3312 open-end spanner	37 Nm (27 ft lb)
1331 torque wrench without 3312 open-end spanner	70 Nm (52 ft lb)

Vibration damper, removing and installing

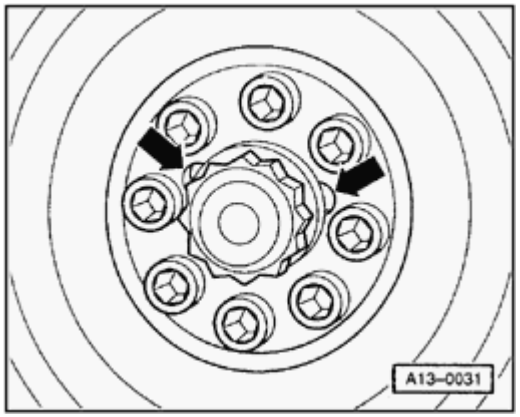
- Lock carrier in service position ⇒ page 13-1

Ribbed belt, removing and installing ⇒ page 13-8 .

Note:

To remove the vibration damper, it is not necessary to remove the center bolt.

- Remove vibration damper.



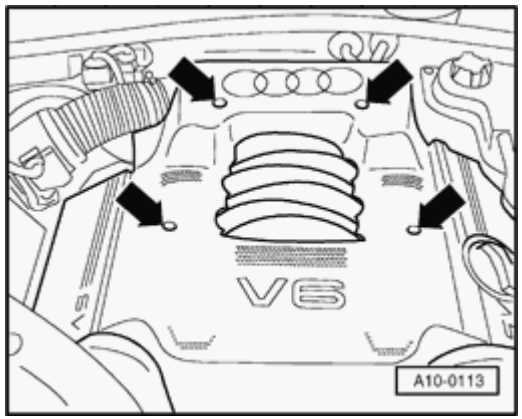
- When installing, make sure notches (arrows) in vibration damper are aligned with locating lugs on toothed belt sprocket.

  Tightening torque (vibration damper to crankshaft): 20 Nm (15 ft lb)

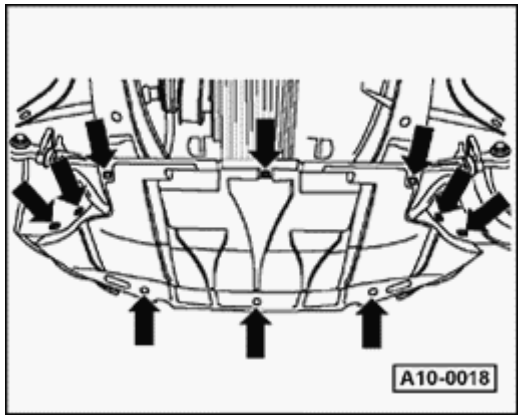
13-12

Toothed belt, removing and installing

Removing



- Remove engine cover.



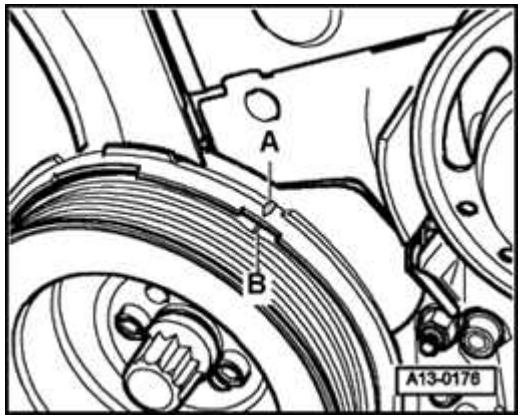
- Remove noise insulation panel (arrows).

• Lock carrier in service position ⇒ page 13-1

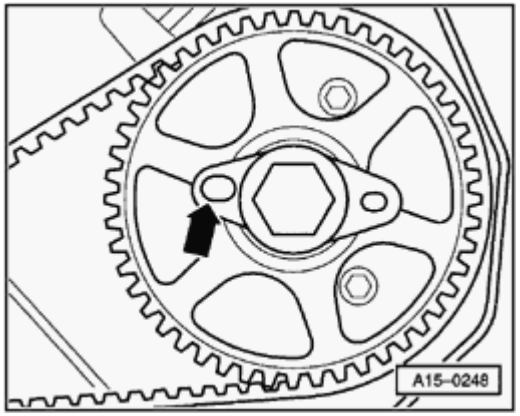
Ribbed belt, removing and installing ⇒ page 13-8 .

- Unclip toothed belt guard on both sides and remove.

13-13



- Turn crankshaft at central bolt of toothed belt gear in direction of engine rotation to cyl. 1 TDC. Timing marks -A- and -B- must be aligned.



- Check position of camshafts. Large holes (arrow) of securing plates on camshaft sprockets must face toward inside and align.

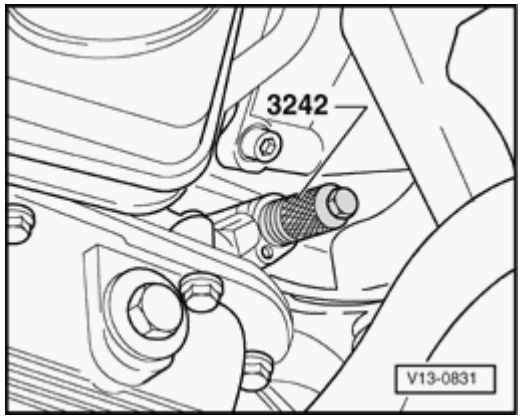
  If not, turn crankshaft one revolution further.

- Remove sealing plug from left-side of cylinder block.
- Top Dead Center (TDC) mark on crankshaft must be visible or be felt behind bore of removed sealing plug.

WARNING!

DO NOT turn crankshaft while checking for TDC mark. Personal injury may result.

13-14



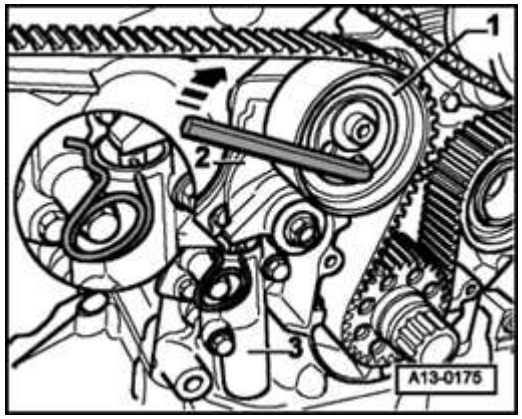
- Install 3242 crankshaft holder into sealing plug opening.
- Remove tensioner for ribbed belt.
- Remove center and right toothed belt guards.

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.

Notes:

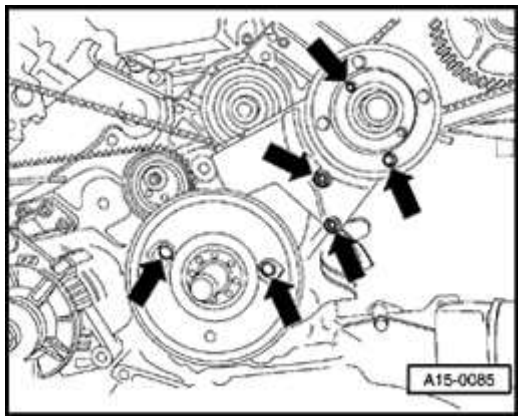
- *The toothed belt tensioner is oil dampened. Compress it by slowly applying constant pressure.*
- *Use spring clamp from 2024A.*



- Using 8 mm hex wrench, turn toothed belt tensioning roller -1- counter-clockwise, opposite direction shown (arrow), until tensioning lever -2- compresses tensioner -3- so that spring clamp (2 mm dia.) can be inserted into bore and lifter.

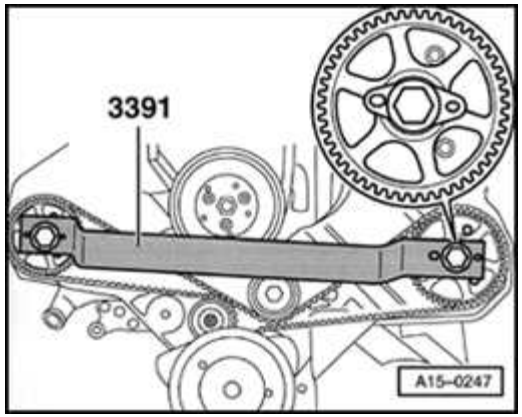
13-15

- Insert pin and release tension.
- Remove vibration damper ⇒ page 13-11 .



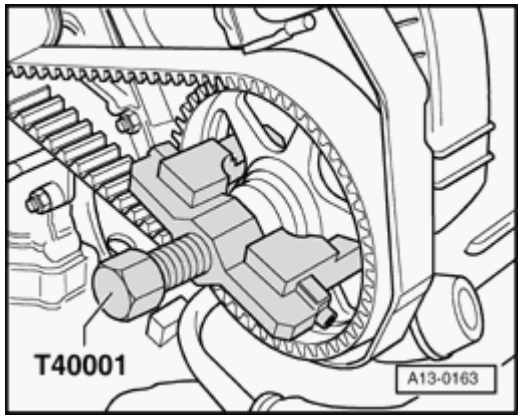
- Remove idler wheel for ribbed belt (arrows).
- Remove toothed belt.

Installing



- Install 3391 camshaft locator bar onto camshaft locking plates.
- Loosen both bolts for camshafts and back out bolts approx. 5 turns.
- Remove 3391 camshaft locator bar.

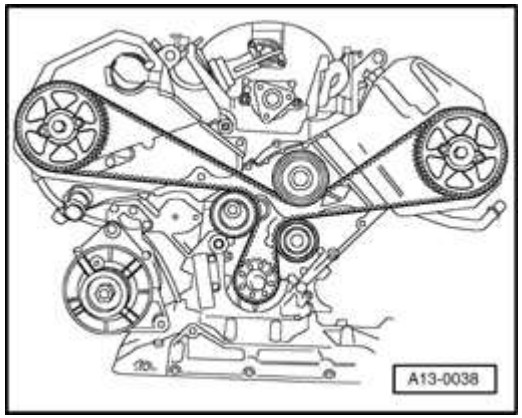
13-16



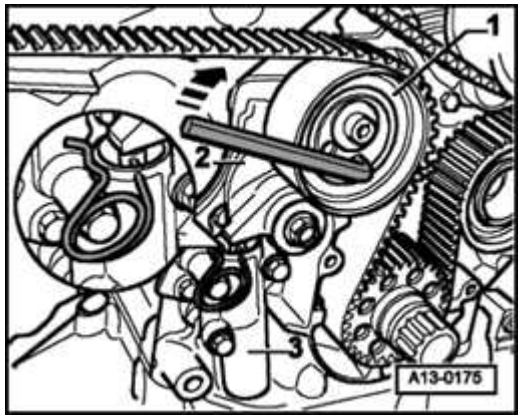
- Remove both camshaft sprockets using T40001 special tool.
- Reinstall both camshaft sprockets together with locking plates and hand-tighten.

Note:

The camshaft sprockets should be loose enough on the cone to be turned, but not so loose as to be tipped.



- Install toothed belt on all sprockets as shown in illustration.
- Install 3391 camshaft locator bar.



- Using 8 mm hex wrench, turn toothed belt tensioner roller -1- counter-clockwise, opposite direction shown (arrow) until tensioning lever -2- compresses tensioner -3- so that spring clamp can be removed and then remove clamp.
- Before starting engine, pre-load timing tensioning roller as follows:
  - Using a torque wrench with 8 mm hex bit, apply tension to toothed belt clockwise in direction shown (arrow) until a torque of 15 Nm is attained. This ensures tensioner has expanded completely and is properly engaging toothed belt.

Component	Tightening torque
Toothed belt sprocket to camshaft	55 (41 ft lb)
Idler wheel	45 (33 ft lb)
Toothed belt tensioning roller	20 (15 ft lb)
Belt pulley to crankshaft	20 (15 ft lb)
Toothed belt tensioner	10 (7 ft lb)
Center bolt 1) to crankshaft	200 (148 ft lb) + 180° 2)

1) Always replace the center bolt.

2) Two turns of 90° are permissible.

Crankshaft seal, replacing

Toothed belt side

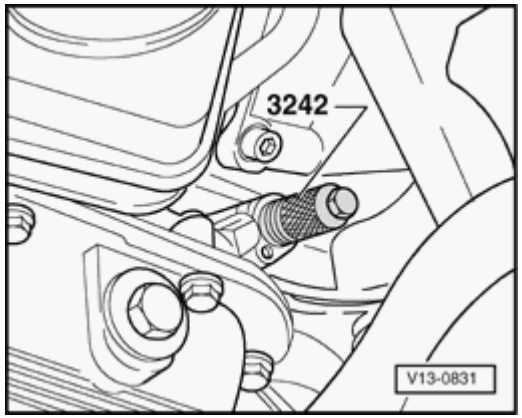
- Lock carrier in service position ⇒ page 13-1

Ribbed belt, removing and installing ⇒ page 13-8 .

Toothed belt, removing and installing ⇒ page 13-12 .

- Remove sealing plug from left-side of cylinder block.

- Turn crankshaft to TDC for cylinder 3. The TDC mark on crankshaft must be visible or felt behind bore for sealing plug.

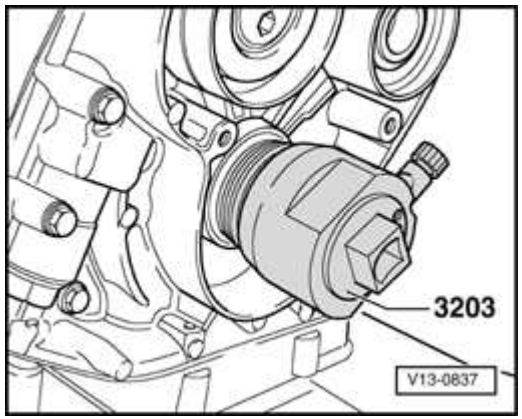


- Install 3242 crankshaft holder in bore to secure crankshaft.

13-19

- Remove crankshaft/toothed belt gear.

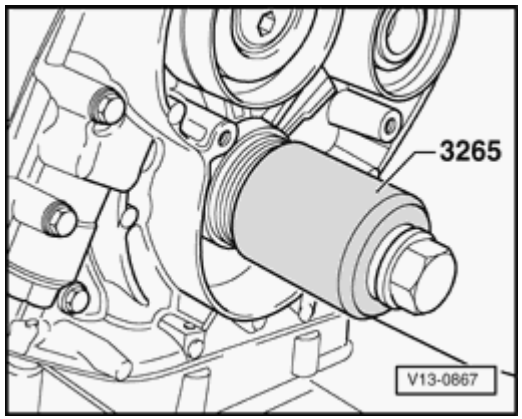
- Unscrew inner part of 3203 seal puller two turns (approx. 3 mm) and secure using knurled bolt.



- 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.

Installing

- Place 3202/1 guide sleeve on crankshaft pin.
- Slide dry oil seal over guide sleeve.



- Press in oil seal to stop using 3265 seal installer.

The rest of the installation follows is the reverse of removal.

13-20

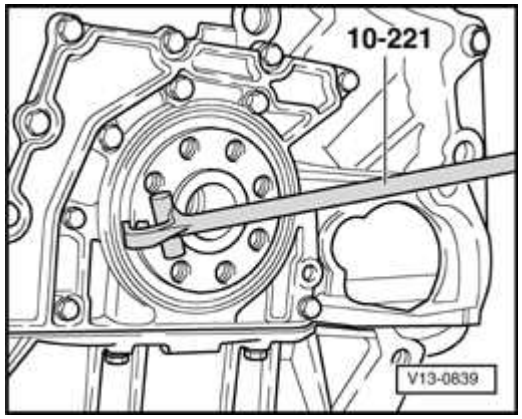
Dual-mass flywheel

Notes:

- *Only replace oil seal with sealing flange.*
- *Drain coolant before removing sealing flange* ⇒ *page 19-11* .

If sealing flange is not available, proceed as follows:

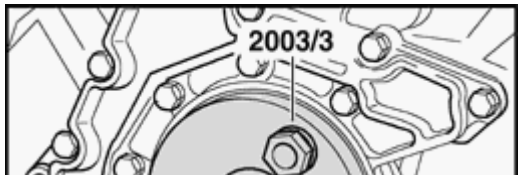
- Remove clutch and dual-mass flywheel or driveplate.



- Pry out seal using 10-221 extractor.
- Clean running and sealing surfaces.
- Push seal onto crankshaft using assembly aid.

Notes:

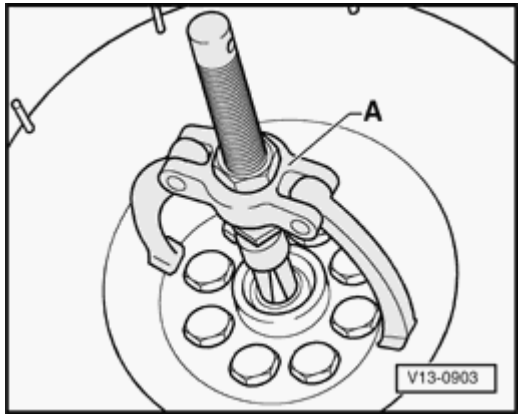
- *Do not lubricate sealing lip or outer edge of seal before pressing in.*
- *The assembly aid is supplied with the seal.*



- Press in seal up to stop using 2003/3 seal installer and bolts for dual-mass flywheel or driveplate.

13-21

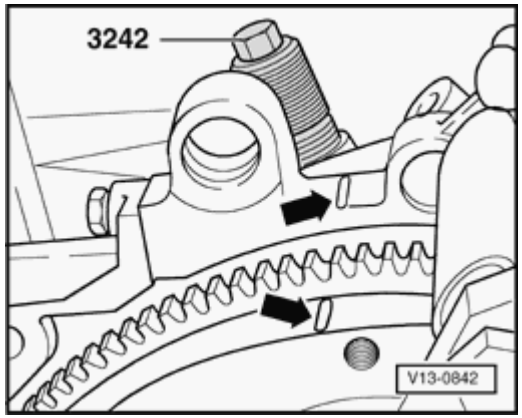
Dual-mass flywheel pilot needle bearing, removing and installing



- Remove pilot needle bearing using puller -A- (e.g. KUKKO 21/2 and KUKKO 22/1).
- Install bearing using 3264 bearing driver.

Dual-mass flywheel or driveplate, removing and installing, installation dimensions

Dual-mass flywheel



- With crankshaft at Top Dead Center (TDC), install 3242 crankshaft holder.
- Mark position of dual-mass flywheel and engine housing (arrows).
- Remove bolts and replace.

Note:

A pilot needle bearing is in the dual-mass flywheel and must be inserted when dual-mass flywheel is replaced.

Component	Tightening torque
Dual-mass flywheel to crankshaft	60 Nm (44 ft lb) + 180°
Clutch to dual-mass flywheel	20 Nm (15 ft lb)

Note:

Always replace dual-mass flywheel mounting bolts.

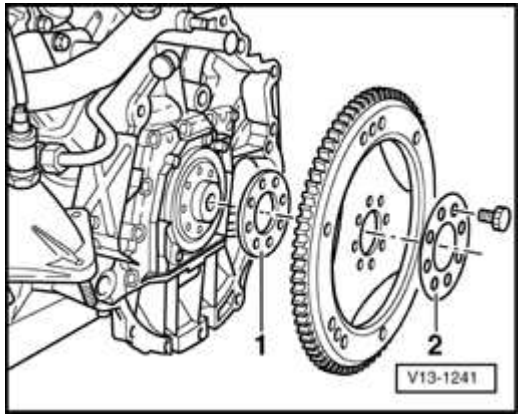
13-23

Driveplate

- Hold crankshaft in position using 3242 crankshaft holder ⇒ page 13-12 .

- Mark hole pattern of driveplate, shim -1- and washer -2- to crankshaft.

- Mark positions of shim -1- and washer -2- (behind driveplate).



- Install driveplate with washer -2- (Part No. 035 105 303 A) and shim -1- 3.0 mm (Part No. 054 105 301) or 4.0 mm (Part No. 054 105 202).

CAUTION!

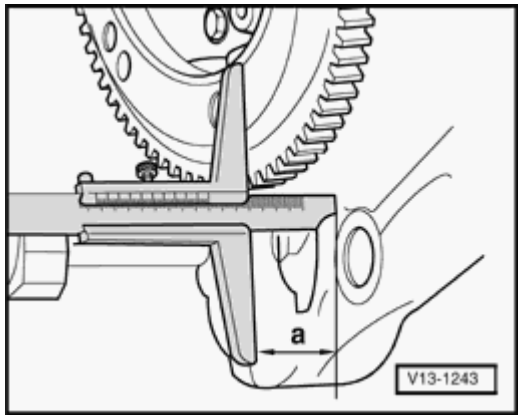
Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

Notes:

- *Short engines and exchange engines are supplied without a bushing in the crankshaft. Always install a new bushing before installing the driveplate.*
- *Remove bushing using 21/1 Kukko puller and 21/2 Kukko support.*
- *Always replace driveplate mounting bolts.*

Component	Tightening torque
Driveplate to crankshaft	30 Nm (22 ft lb) + 90 °

13-24



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

  Distance -a-: approx. 12.3 mm.

  - If necessary, install different shim.

Note:

Before installing the engine, make sure the engine to transmission centering sleeves are installed in the engine flange.

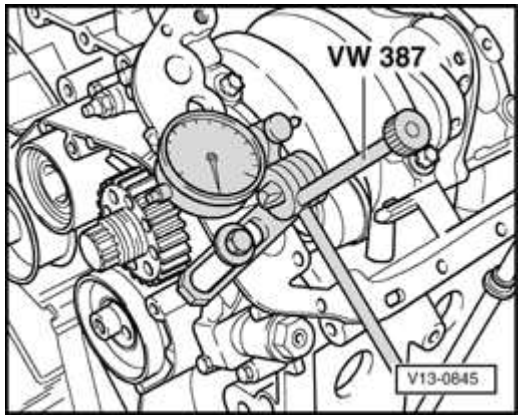
13-25

Crankshaft axial and radial clearance, measuring

Axial clearance

CAUTION!

Bearing shells must be reinstalled in their original location and orientation. Always label the bearing shells according to their installed position before removing. Never interchange used bearing shells.



- Attach dial indicator together with VW387 dial indicator holder to oil pump and set indicator against crankshaft counterweight.
- Press crankshaft against dial indicator by hand and set indicator to zero.
- Press crankshaft away from dial indicator.
- Read gauge.

Clearance when new	Wear limit
0.07-0.23 mm (0.0028-0.0091 in.)	0.25 mm (0.0098 in.)

13-26

Radial clearance

- Measure radial clearance using Plastigage®.

- Read clearance.

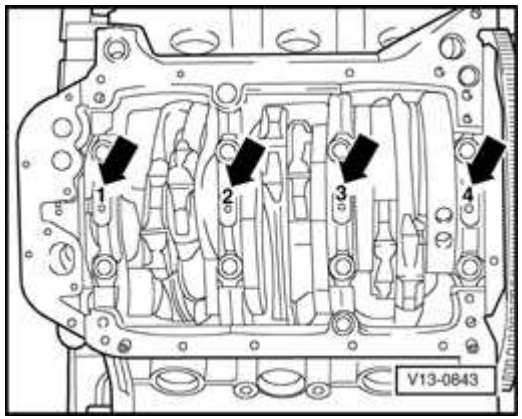
Clearance when new	Wear limit
0.018-0.045 mm (0.0007-0.0018 in.)	0.10 mm (0.0039 in.)

CAUTION!

DO NOT turn the crankshaft or allow it to rotate while measuring with Plastigage® in place.

13-27

Crankshaft bearing cap, installing



- Bearing -1- is installed on the oil pump side of the cylinder block, and bearing -4- on the dual-mass flywheel side of the cylinder block.

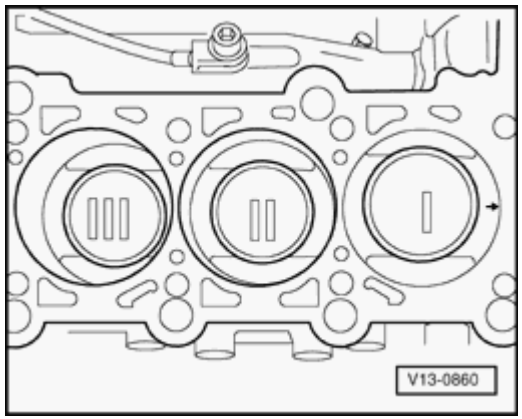
Crankshaft dimensions

Engine codes AHA, ATQ

Reconditioning dimension	Crankshaft journal diameter mm (in.)	Connecting rod journal diameter mm (in.)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
Standard (nominal dimension)	65.00 (2.559)	54.00 (2.126)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
1st undersize (nominal dimension)	64.75 (2.549)	53.75 (2.116)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
2nd undersize (nominal dimension)	64.50 (2.539)	53.50 (2.106)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
3rd undersize (nominal dimension)	64.25 (2.530)	53.25 (2.096)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)

Pistons and piston rings

Pistons



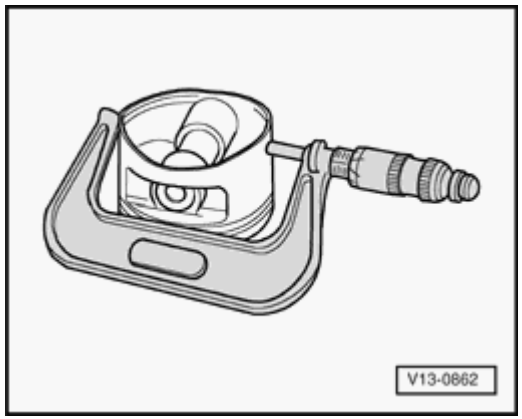
➢ Installation position: arrow on piston crown must point in driving direction.

- Mark cylinder number on piston crown using waterproof felt pen.

CAUTION!

DO NOT scratch or scribe on piston crown. The surface has a coating that must not be damaged.

Checking piston diameter



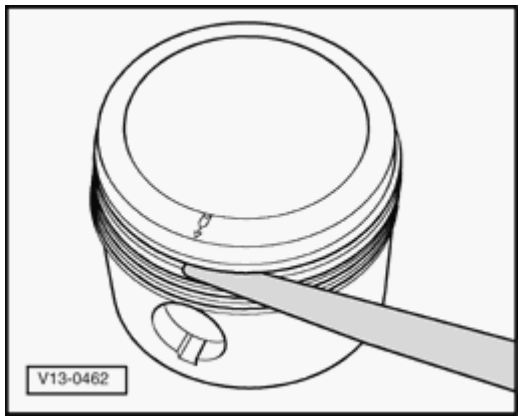
➢

- Measure pistons approx. 10 mm (3/8 in.) from bottom edge at right angle (90 °) to piston pin.

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

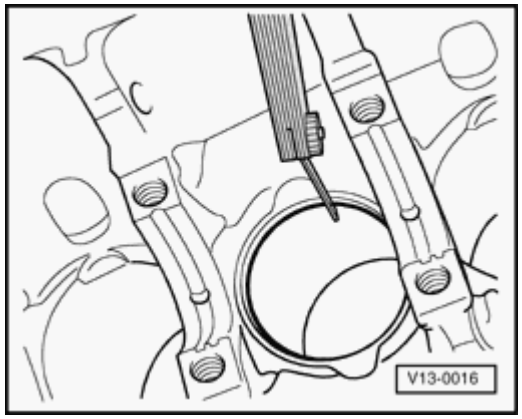
Piston and cylinder bore dimensions

Reconditioning dimension	Piston diameter
Basic dimension	82.48 mm (3.247 in.)
1st oversize	82.74 mm (3.257 in.)



Checking piston ring side clearance

Clearance when new	Wear limit
0.02-0.08 mm (0.0008-0.0031 in.)	0.10 mm (0.004 in.)



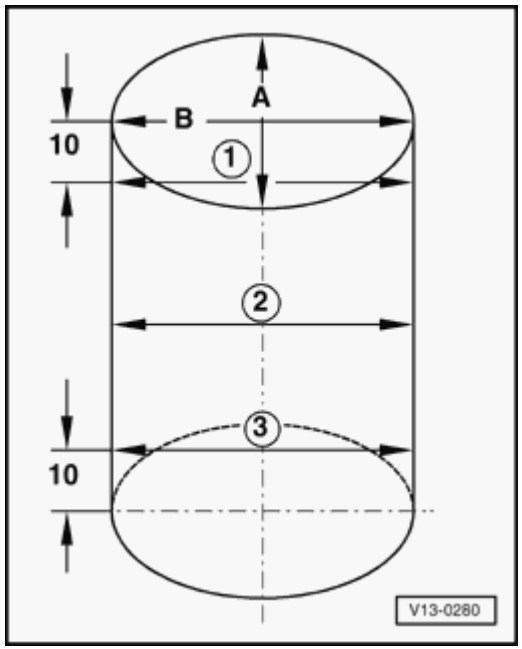
Checking piston ring end gap

- Insert ring at right angle from top and slide down into lower cylinder opening until approx. 15 mm from lower edge of cylinder.

Engine codes AHA, ATQ

Piston ring	End gap, new mm. (in.)	Wear limit mm. (in.)
1 (compression)	0.35-0.50 mm (0.014-0.020 in.)	1.0 mm (0.039 in.)
2 (compression)	0.50-0.70 mm (0.020-0.028 in.)	1.4 mm (0.043 in.)
3 (oil scraper)	0.25-0.50 mm (0.010-0.020 in.)	0.8 mm (0.031 in.)

13-32



Cylinder bore, checking

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

  Inner bore gauge: 50-100 mm (1.96-3.94 in.)

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

Piston and cylinder bore dimensions

Engine codes AHA, ATQ

Reconditioning dimension	Piston diameter	Cylinder bore diameter
Basic dimension	82.48 mm (3.2472 in.)	82.51 mm (3.2484 in.)
1st oversize	82.74 mm (3.2575 in.)	82.76 mm (3.2578 in.)

Note:

Replacement pistons are only available in the basic dimension.

CAUTION!

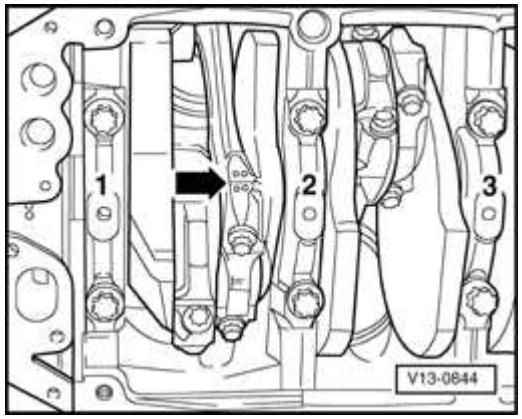
DO NOT measure cylinder bore dimensions while the cylinder block is mounted on the engine stand. The cylinder block is stressed and deformed by its own weight under these conditions and the measurements will not be accurate.

13-33

Connecting rod and connecting rod bearings, checking clearance

Notes:

- *Replace the connecting rods only as a set.*
- *Do not interchange connecting rod bearings.*



- Mark connecting rod bearing caps with light center punch marks before removing.

Checking radial clearance

- Remove connecting rod bearing caps. Clean bearing shells and journals.
- Place Plastigage® over entire width of bearing journal or bearing cap.
- Install connecting rod bearing cap and tighten to 20 Nm (15 ft lb).

CAUTION!

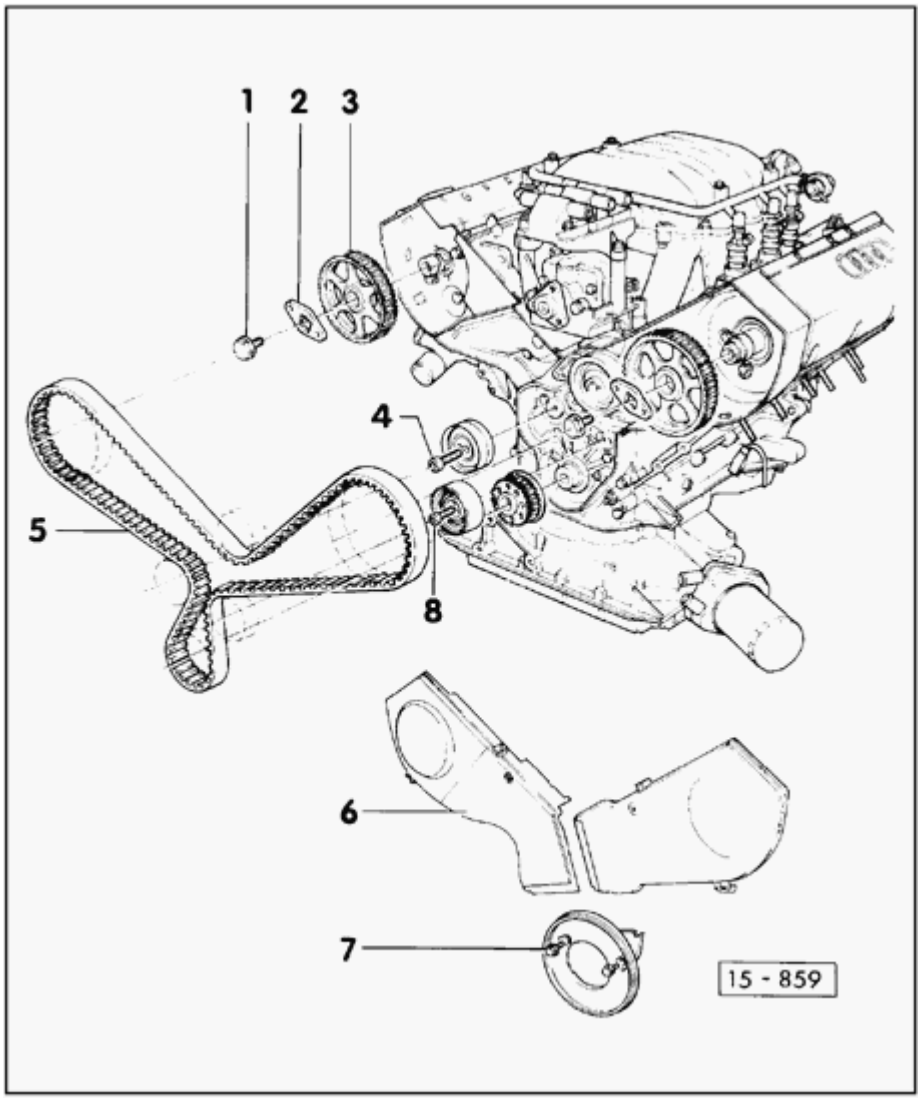
DO NOT turn the crankshaft or allow it to rotate while measuring with Plastigage® in place.

- Remove connecting rod bearing cap again.
- Compare width of Plastigage® with calibrated scale.

Clearance when new	Wear limit
0.015-0.062 mm (0.0006-0.0024 in.)	0.12 mm (0.0047 in.)

- Always replace connecting rod bolts.

13-4



Toothed drive belt, assembly

1 - Bolt

- 70 Nm (52 ft lb)

2 - Locking plate

- Side with inscribed lettering always faces camshaft

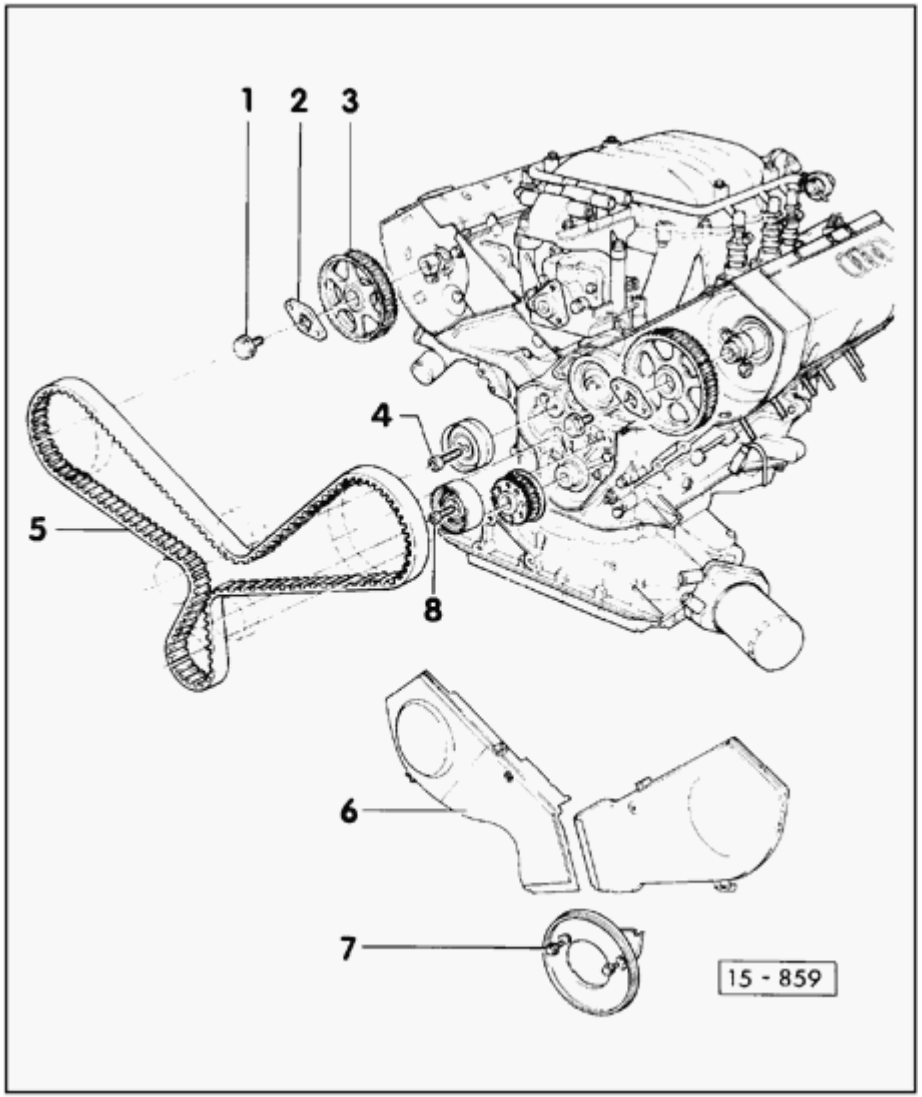
3 - Camshaft sprocket

- Removing ⇒ page 13-12
- Tighten camshaft sprockets after toothed belt tension is adjusted

CAUTION!

- ***Camshaft holder 3243 must be installed before attaching camshaft sprockets.***
- ***Do not tighten the camshaft sprockets until after toothed belt tension has been adjusted.***

13-5



4 - Toothed belt tensioner

- ♦ 45 Nm (33 ft lb)

5 - Toothed belt

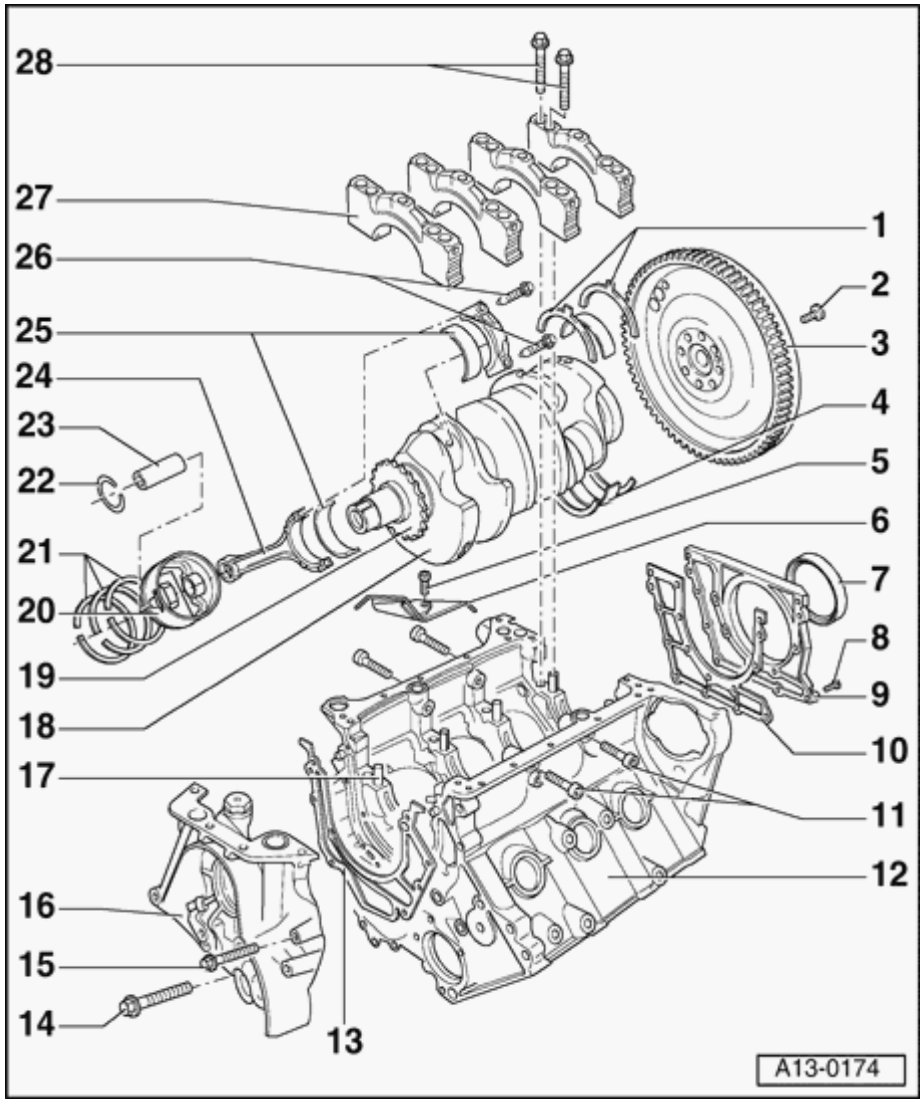
- ♦ Removing and installing ⇒ page 13-11

6 - Toothed belt cover

7 - 10 Nm (7 ft lb)

8 - 25 Nm (18 ft lb)

13-14



Cylinder block, crankshaft and flywheel, disassembly and assembly

Note:

Replace all gaskets and seals.

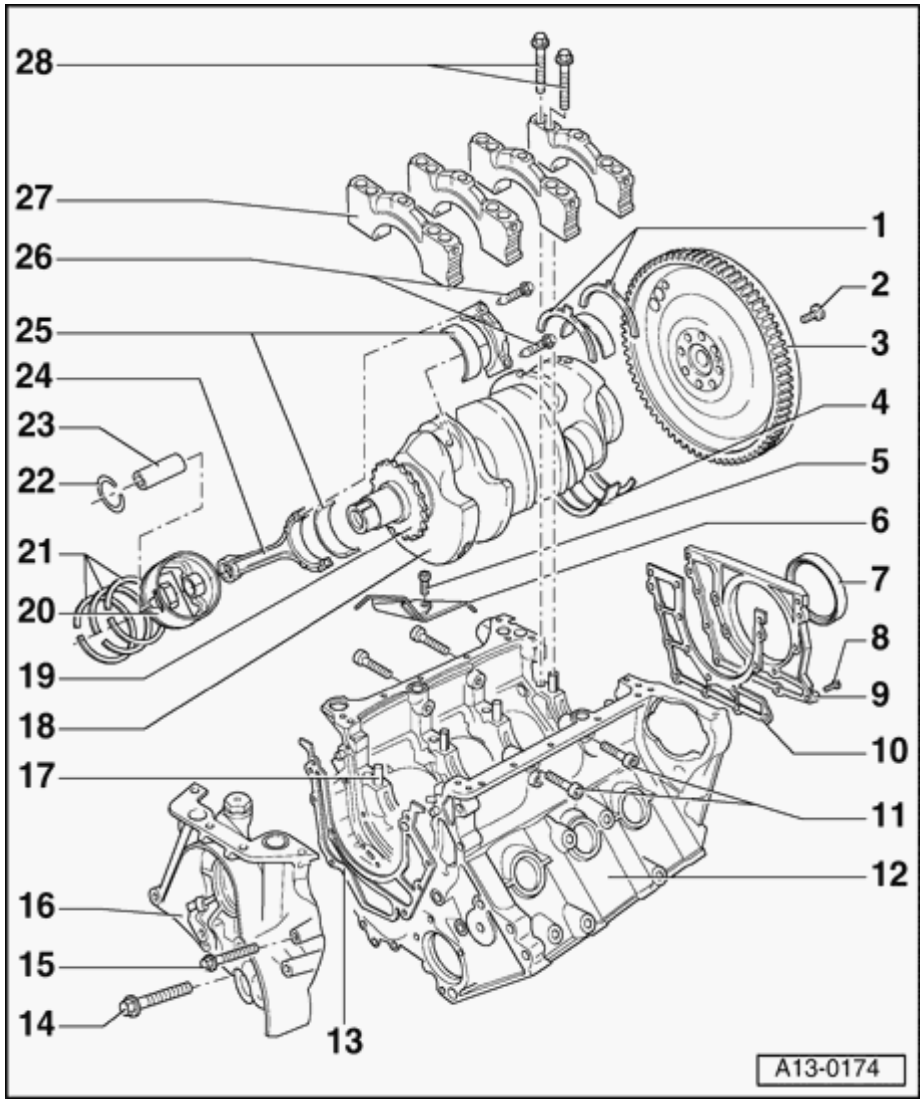
1 - Thrust washers

- Measuring axial clearance of crankshaft ⇒ Page 13-21
- Thrust washer only fitted on 4th crankshaft bearing

2 - Special bolt (double hex)

- Replace
- Dual-mass flywheel: 60 Nm + 180 ° (1/2 turn)

13-15



3 - Dual-mass flywheel

- Removing and installing ⇒ Page 13-29
- Removing and installing needle bearing ⇒ Page 13-35

4 - Crankshaft bearing

- Checking axial and radial clearance ⇒ Page 13-21

5 - Bolt, tightening torque 10 Nm

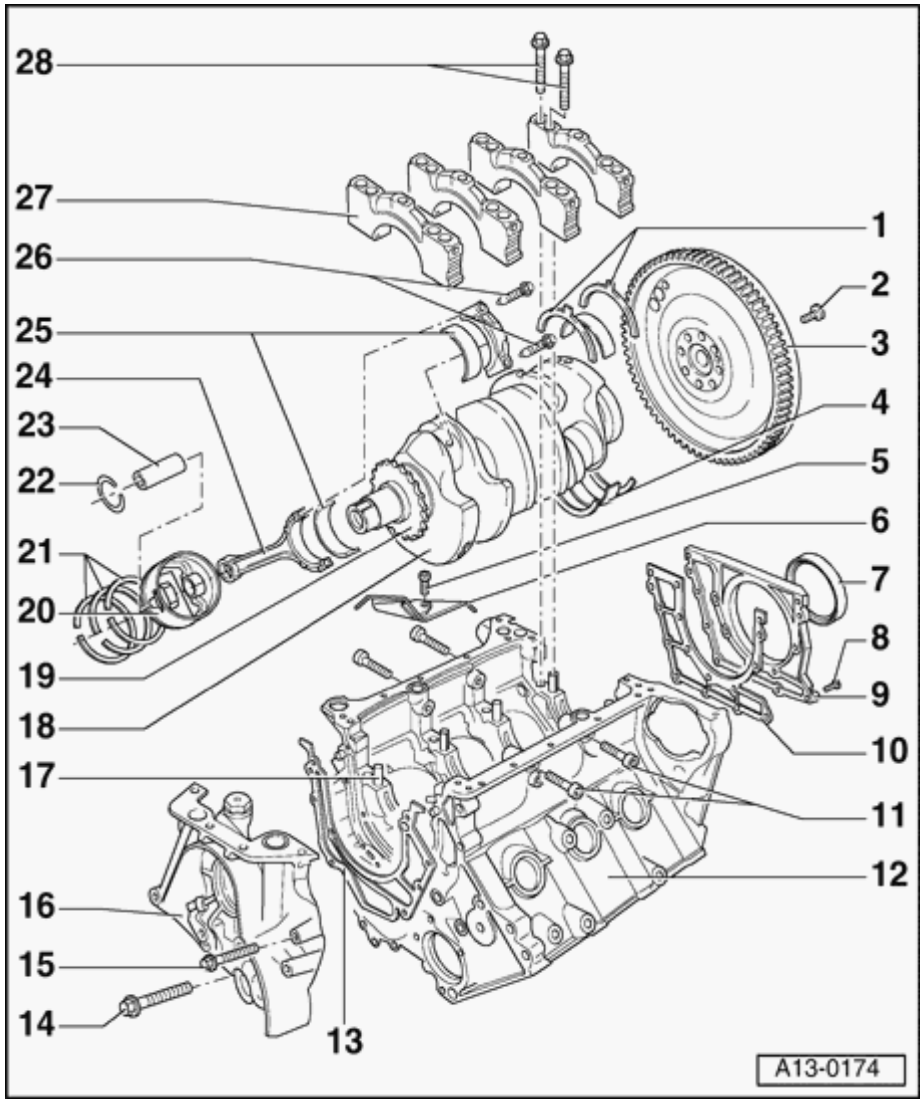
6 - Oil spray jet

- For piston cooling

7 - Oil seal for rear sealing flange

- Replacing ⇒ Page 13-23

13-16



8 - Bolt, tightening torque 10 Nm

9 - Rear sealing flange

10 - Gasket

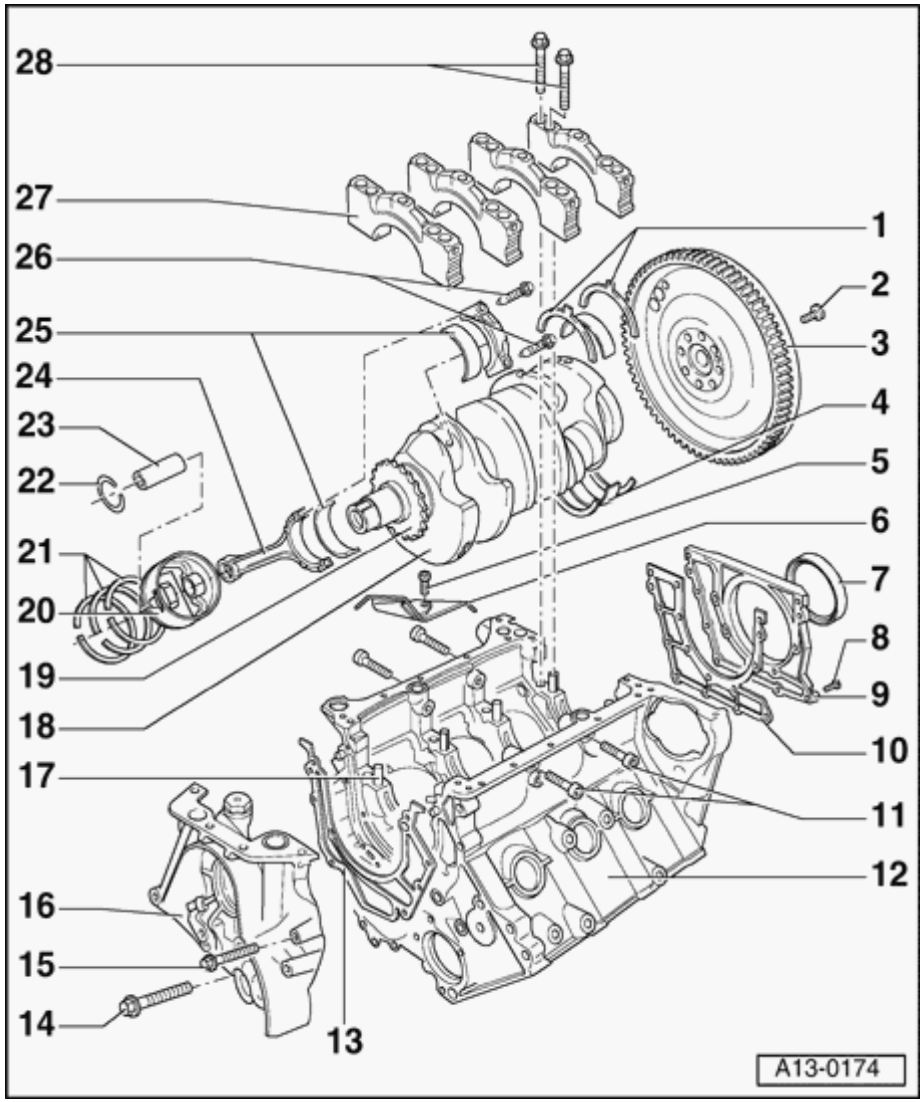
11 - Bolt, tightening torque 25 Nm

- Screw in bolts on left and right sides finger-tight before tightening bolts on main bearing caps.

12 - Cylinder block

13 - Gasket

13-17



14 - Collar bolt, tightening torque 30 Nm

- Apply Loctite ™ when installing

15 - Bolt, tightening torque 10 Nm

16 - Front sealing flange

17 - Expansion pins

18 - Crankshaft

- Checking ⇒ Page 13-21

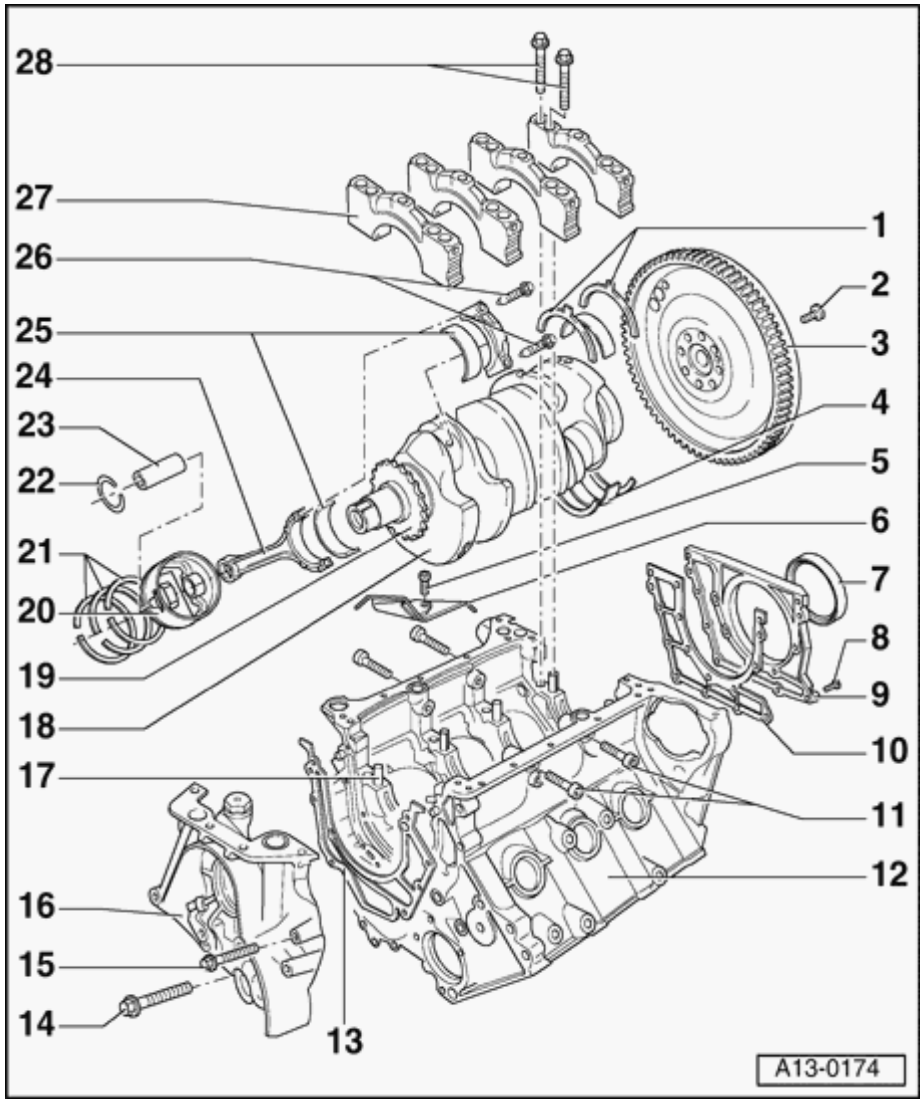
19 - Chain sprocket for oil pump

- Removing and installing ⇒ Page 17-62 .

20 - Pistons

- Checking ⇒ Page 13-36

13-18



21 - Piston rings

- Checking ⇒ Page 13-36

22 - Circlip for piston pin

23 - Piston pin

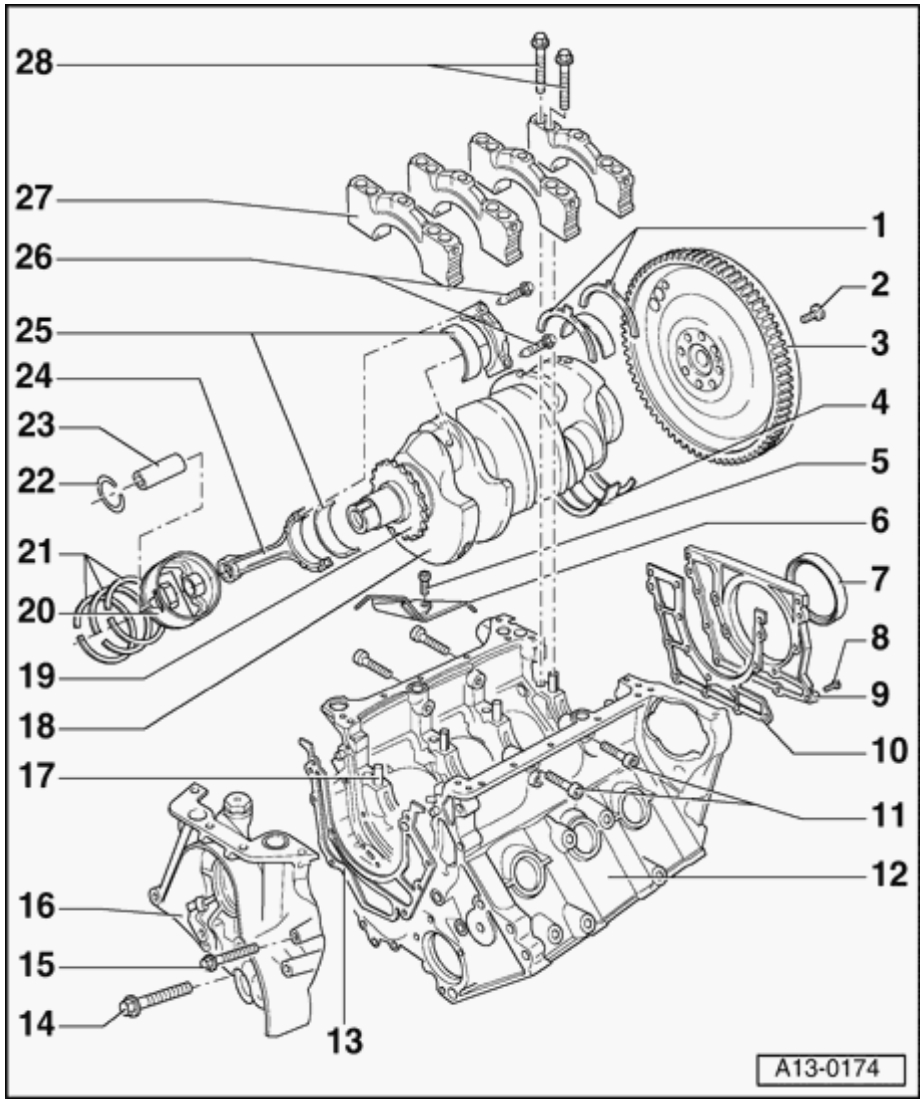
24 - Connecting rod

- Mark cylinder number and installation position of matching connecting rods and bearing caps before removing
- Installation position: wider, slightly convex machined surfaces on the same side

25 - Connecting rod bearing

- Do not interchange used bearing shells.
- Connecting rods, connecting rod bearings ⇒ Page 13-39

13-19



26 - Connecting rod bearing bolts

- Always replace
- Tightening torque: 30 Nm + 90° ($^1/_4$turn)
- When measuring radial clearance, tighten to 20 Nm but do not turn further.

27 - Main bearing cap

- Marking -1- on oil pump side
- Replace bolts for main bearing caps
- Watch position of dowel sleeves
- Checking bearing clearance ⇒ Page 13-21

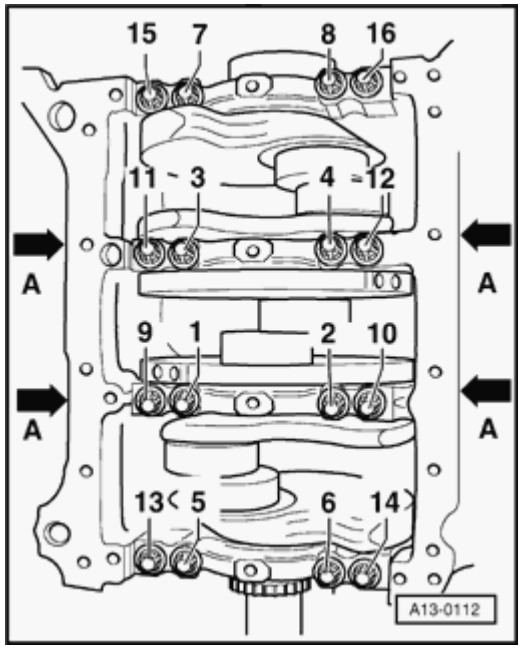
28 - Bolts for main bearing caps

- Always replace
- Tightening torque ⇒ Page 13-20
- Tightening sequence ⇒ Page 13-20

13-20

Crankshaft bearing caps, installing

- Bearing -1- is at the toothed belt end; bearing -4- is at the flywheel end.



Tightening sequence:

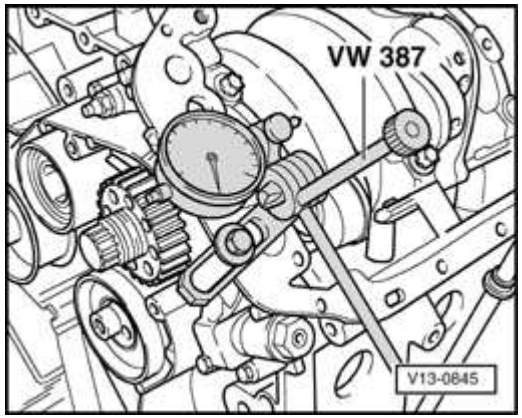
- Stage 1 Tighten all bolts in the sequence shown (1 - 16) to 30 Nm.
- Stage 2 Tighten all bolts in the sequence shown (1 - 16) to 60 Nm.
- Stage 3 Using a fixed wrench, turn all bolts in the sequence shown (1 - 16) 90° further.
- Tighten bolts -A- to 25 Nm.

Crankshaft axial and radial clearance, measuring

Axial clearance

Note:

Do not interchange used bearings.



- Attach dial gauge with universal dial gauge bracket VW 387 to oil pump and bring it into contact with crank web.
- Press crankshaft against dial gauge by hand and set gauge to -0-.
- Press crankshaft away from dial gauge.
- Note reading:

Clearance when new	Wear limit
0.090 ... 0.251 mm	0.28 mm

13-22

Radial clearance

Measure radial clearance with Plastigage ™.

- Read value:

Clearance when new	Wear limit
0.018 ... 0.045 mm	0.10 mm

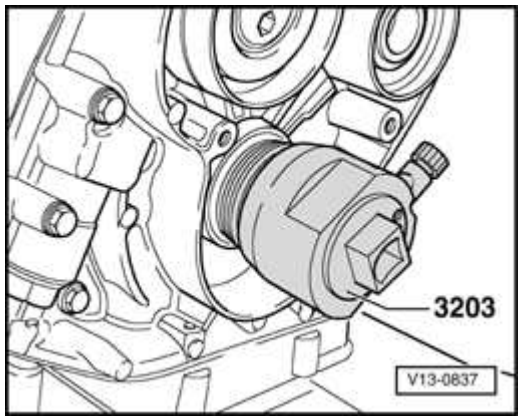
13-23

Crankshaft oil seals, replacing

A - Toothed belt end

- Remove toothed belt ⇒ Page 13-4 .

- Remove toothed belt sprocket from crankshaft

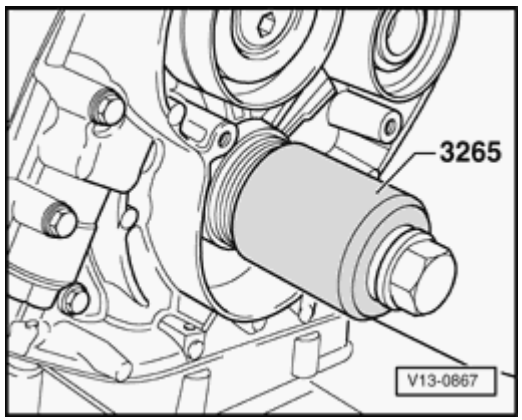


- Pull out oil seal with oil seal extractor 3203.
- Clean contact surface and sealing surface.

Note:

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

- Push on seal using fitting sleeve 3202/1.



- Press in seal until flush using fitting sleeve 3265 and central bolt.

13-24

B - Flywheel end

Note:

Replace oil seal together with sealing flange.

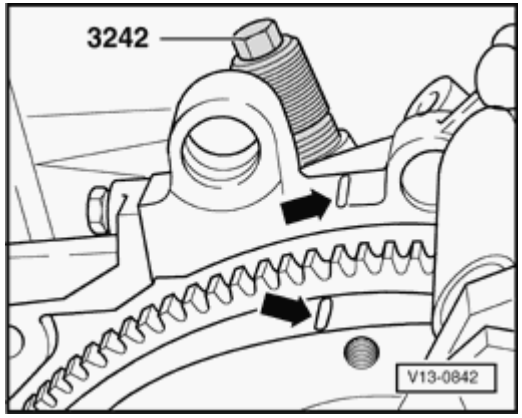
Vehicles with manual transmission

- Drain off coolant ⇒ Page 19-19 .

- Remove transmission.

⇒ *Repair Manual, 6 Spd. Manual Transmission 01E, Repair Group 34*

- Remove clutch.



- With crankshaft at TDC, screw in clamping bolt 3242.
- Mark position of flywheel relative to engine -arrows-.
- Remove dual-mass flywheel.
- Remove sealing flange.

13-25

Installing

- Install sealing flange.

- Install dual-mass flywheel with new bolts.

Note:

Always replace securing bolts for dual-mass flywheel.

- Install clutch.

⇒ *Repair Manual, 6 Spd. Manual Transmission 01E, Repair Group 30*

Tightening torques	
Dual-mass flywheel to crankshaft	60 Nm + 180°
Clutch to dual-mass flywheel	20 Nm

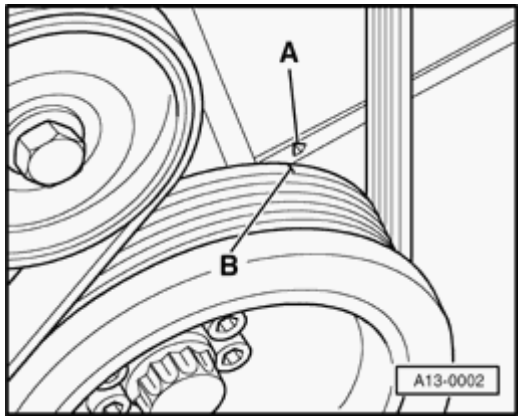
13-26

Vehicles with automatic transmission

- Remove transmission.

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

- Drain off coolant ⇒ Page 19-19 .



- Turn crankshaft to TDC by hand. Marks -A- and -B- must be aligned.

Note:

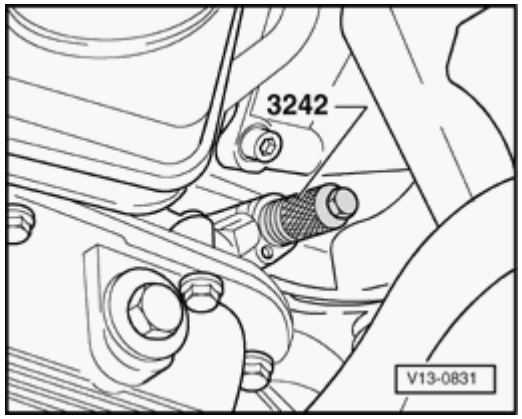
Turn over the engine at the central bolt on the crankshaft.

- Check position of camshafts: larger holes in securing plates on camshaft sprockets must align opposite one another on inside. If this is not the case, turn crankshaft one revolution further.
- Remove sealing plug from cylinder block, left.
- The TDC drilling in crankshaft must be visible (or able to be felt) in line with sealing plug hole.

CAUTION!

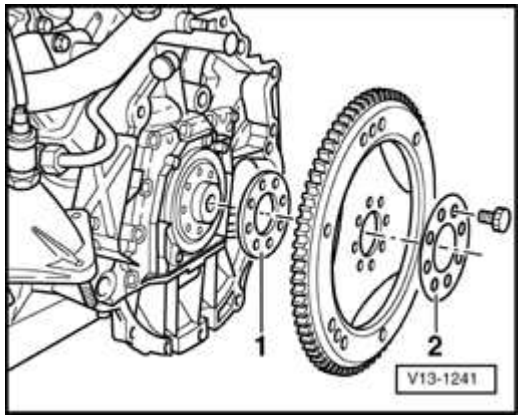
Injury risk - do not turn engine while feeling for TDC drilling.

13-27



- Screw clamping bolt 3242 for crankshaft into sealing plug hole and tighten.
- Mark positions of holes in drive plate, shim -1- and washer -2- in relation to crankshaft.
- Mark positions of shim -1- in front of drive plate and washer -2- behind drive plate.

Installing



- Install drive plate with washer -2- and shim -1- (3.0 mm or 4.0 mm).

Note:

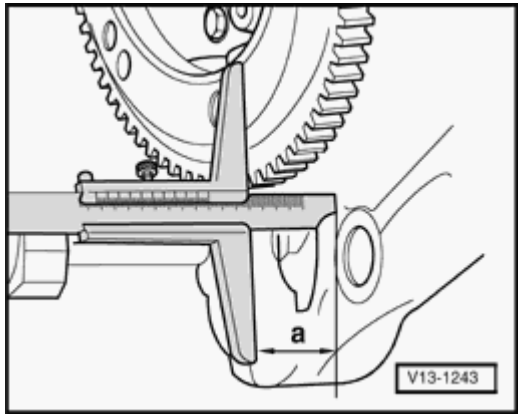
- *Short engines and exchange engines are supplied without bush in crankshaft. On vehicles with automatic transmission, always knock in new bush before installing drive plate.*
- *Always replace drive plate securing bolts.*

13-28

Tightening torques	
Drive plate to crankshaft	60 Nm + 90°

Note:

Always replace securing bolts for drive plate.



- Measure distance -a- at three points and calculate average value.
  - ♦ Distance -a- = approx. 29.9 mm.
- Install a different shim if necessary.

Note:

Before installing the transmission, check that the dowel sleeves for locating engine/transmission are fitted in the engine flange.

- Install transmission.

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

13-29

Dual-mass flywheel / drive plate, installation dimensions, removing and installing

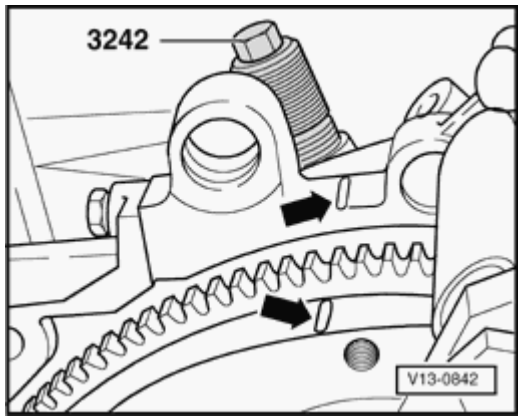
A - Flywheel

Removing

- Remove transmission.

⇒ Repair Manual, 6 Spd. Manual Transmission 01V, Repair Group 34

- Remove clutch.



- With crankshaft at TDC, screw in clamping bolt 3242.
- Mark position of flywheel relative to engine -arrows-.
- Remove bolts (bolts must be replaced).

13-30

Note:

The needle bearing is located in the flywheel and must be pressed in if a new flywheel is installed ⇒ *Page 13-35* .

Installing

- Install dual-mass flywheel.

Note:

Always replace flywheel securing bolts.

- Install clutch.

⇒ *Repair Manual, 6 Spd. Manual Transmission 01E, Repair Group 30*

- Install transmission.

⇒ *Repair Manual, 6 Spd. Manual Transmission 01E, Repair Group 34*

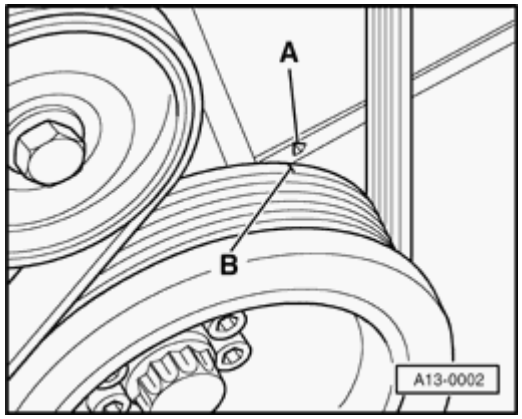
Tightening torques	
Dual-mass flywheel to crankshaft	60 Nm + 180°
Clutch to dual-mass flywheel	20 Nm

B - Drive plate

Removing

- Remove transmission.

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



- Turn crankshaft to TDC by hand. Marks -A- and -B- must be aligned.

Note:

Turn over the engine at the central bolt on the crankshaft.

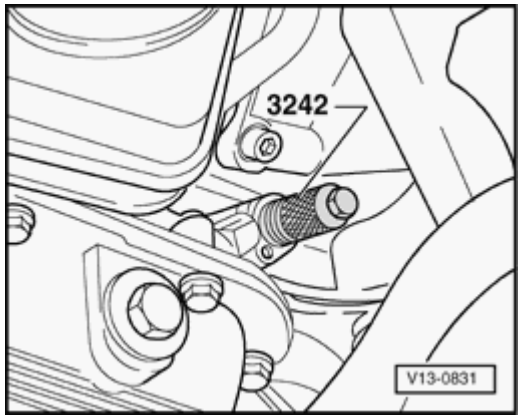
- Check position of camshafts: larger holes in securing plates on camshaft sprockets must align opposite one another on inside. If this is not the case, turn crankshaft one revolution further.
- Remove sealing plug from cylinder block, left.

13-32

- TDC drilling in crankshaft must be visible (or able to be felt) in line with sealing plug hole.

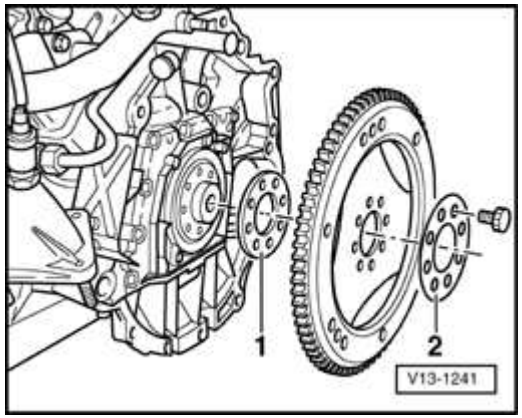
CAUTION!

Injury risk - do not turn engine while feeling for TDC drilling.



- Screw clamping bolt 3242 for crankshaft into sealing plug hole and tighten.
- Mark positions of holes in drive plate, shim -1- and washer -2- in relation to crankshaft.
- Mark positions of shim -1- in front of drive plate and washer -2- behind drive plate.

13-33



Installing

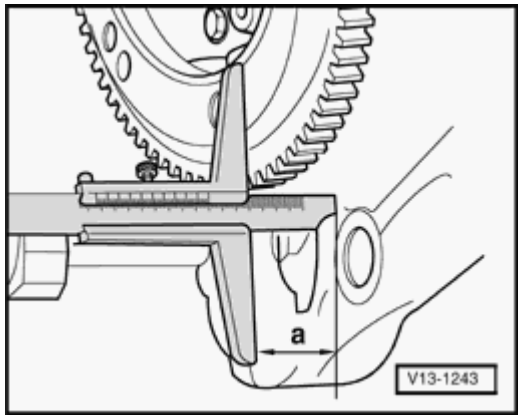
- Install drive plate with washer -2- and shim -1- (3.0 mm or 4.0 mm).

Note:

- *Short engines and exchange engines are supplied without bush in crankshaft. On vehicles with automatic transmission, always knock in new bush before installing drive plate.*
- *Always replace drive plate securing bolts.*

Tightening torques	
Drive plate to crankshaft	60 Nm + 90°

13-34



- Measure distance -a- at three points and calculate average value.
  - ♦ Distance -a- = approx. 12.3 mm.
- Install a different shim if necessary.

Note:

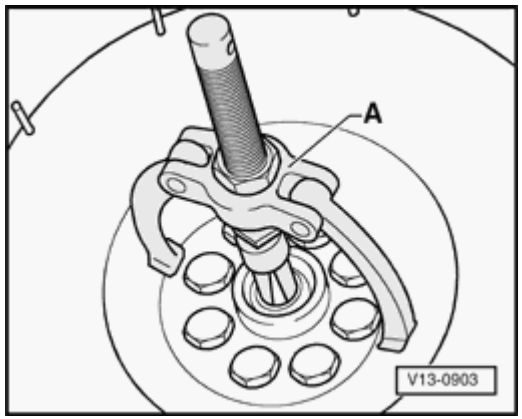
Before installing the transmission, check that the dowel sleeves for locating engine/transmission are fitted in the engine flange.

- Install transmission.

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

13-35

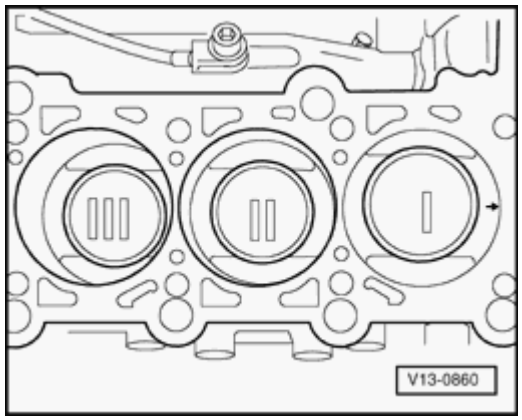
Needle bearing in dual-mass flywheel, removing and installing



- Pull out with puller, such as KUKKO 21/2 and KUKKO 22-1.
- Drive in with drift 3264.

Pistons and piston rings, installing

Pistons



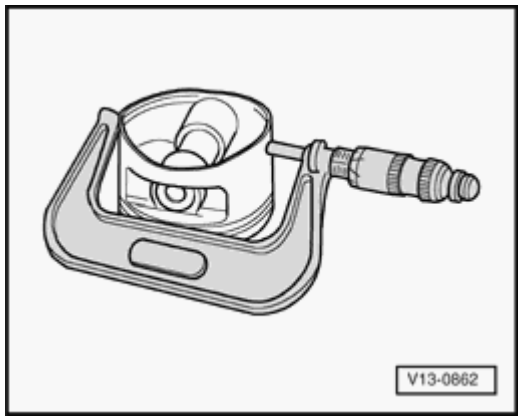
➢ Position: arrow on piston crown must always face in direction of travel.

- Mark cylinder number on piston crown with waterproof felt pen.

Note:

Do not use a center-punch or similar, as pistons have a special coating.

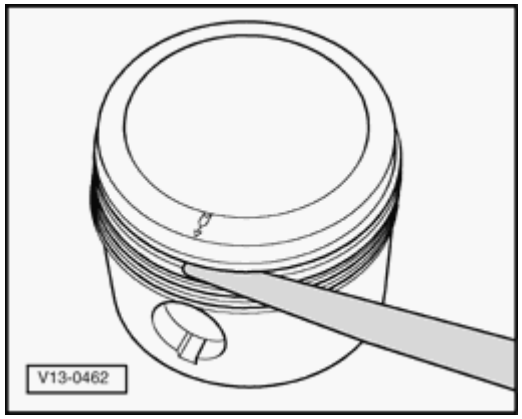
Checking piston diameter



➢

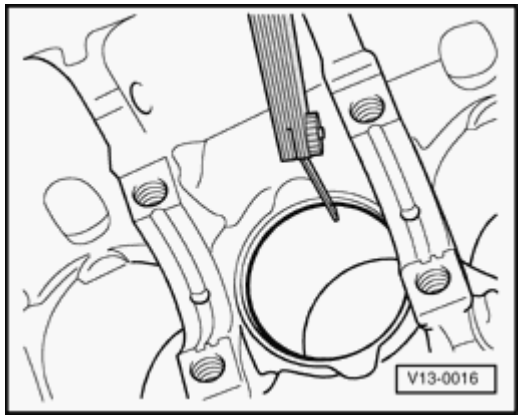
- Measure pistons approx. 10 mm from bottom of skirt, at 90° to piston pin axis.
  - ♦ Difference between actual and nominal diameter: not more than 0.04 mm.

13-37



Ring-to-groove clearance

Clearance when new	Wear limit
0.02 ... 0.08 mm	0.10 mm

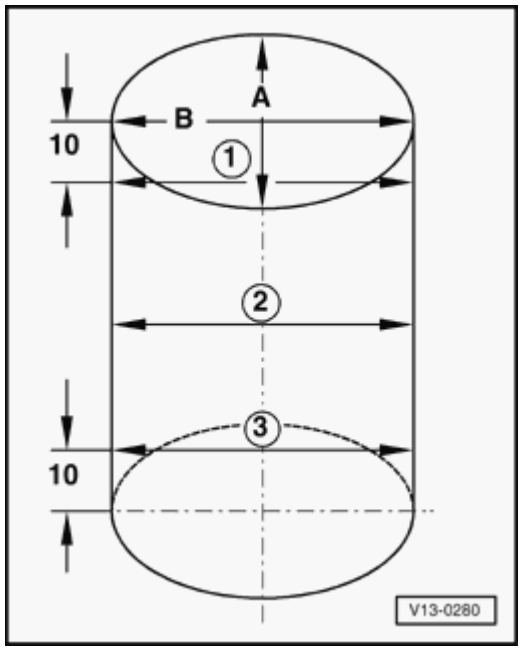


Checking piston ring gap

- Push ring in squarely to a position approx. 15 mm from bottom end of cylinder.

Piston ring	Gap when new	Wear limit
1	0.35 ... 0.50 mm	1.0 mm
2	0.50 ... 0.70 mm	1.4 mm
3	0.25 ... 0.50 mm	0.8 mm

13-38



Cylinder bores, checking

- Measure bores at three points in both directions: across engine -A- and in line with crankshaft -B-.

  Use internal dial gauge 50 to 100 mm.

  - Difference between actual and nominal diameter: not more than 0.08 mm.

Piston and cylinder dimensions

Honing dimension	Piston dia.	Cyl. bore dia.
Basic dimension	80.95 mm	81.01 mm

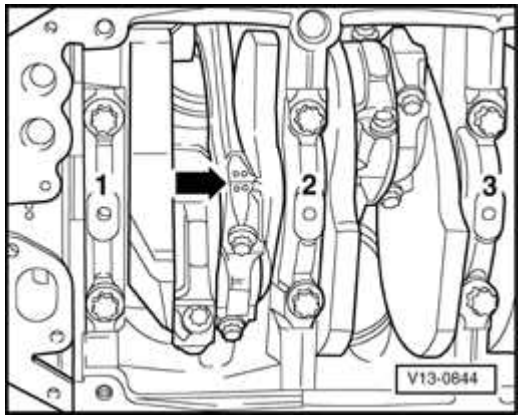
Note:

Replacement pistons are only available with basic dimension.

Connecting rods and connecting rod bearings, installing

Note:

- *Only replace complete sets of connecting rods*
- *Do not interchange connecting rod bearings.*



- Before removing, mark positions of connecting rod bearing caps with a felt pen or similar.

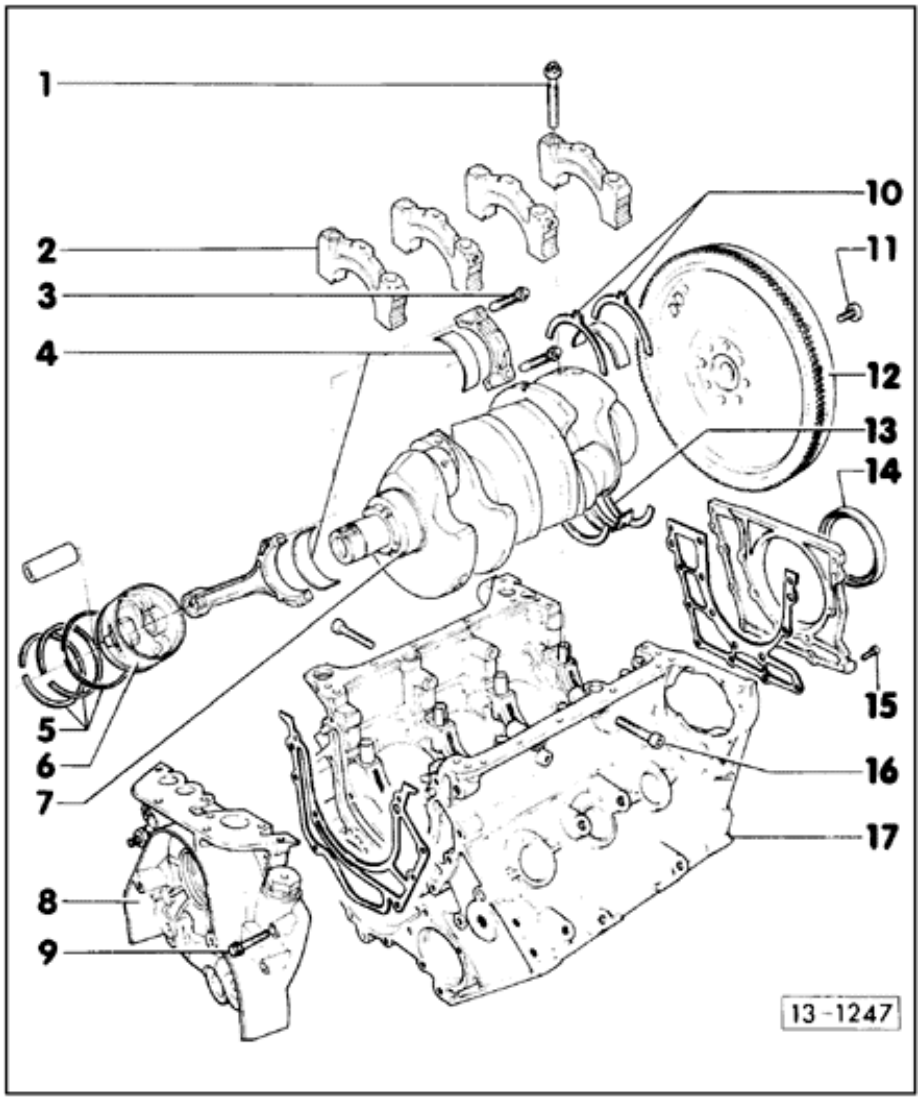
Checking radial clearance

- Remove connecting rod bearing cap. Clean bearing cap and bearing journal.
- Place a length of Plastigage corresponding to width of bearing on bearing journal or bearing shell.
- Install connecting rod bearing cap and tighten to 20 Nm. Do not rotate crankshaft.
- Remove connecting rod bearing cap again.
- Compare width of Plastigage with calibrated scale.

Clearance when new	Wear limit
0.015 ... 0.062 mm	0.12 mm

- Install new connecting rod bearing bolts.

13-6



Cylinder block, crankshaft and flywheel, component layout

Note:

Always replace gaskets and seals.

1 - Main bearing cap bolts

- Always replace
- Tightening torque: 60 Nm (44 ft lb) plus 1/2-turn (180°)

2 - Main bearing cap

- ID: "1" on side facing oil pump
- Always replace bolts
- Checking bearing clearance ⇒ page 13-21

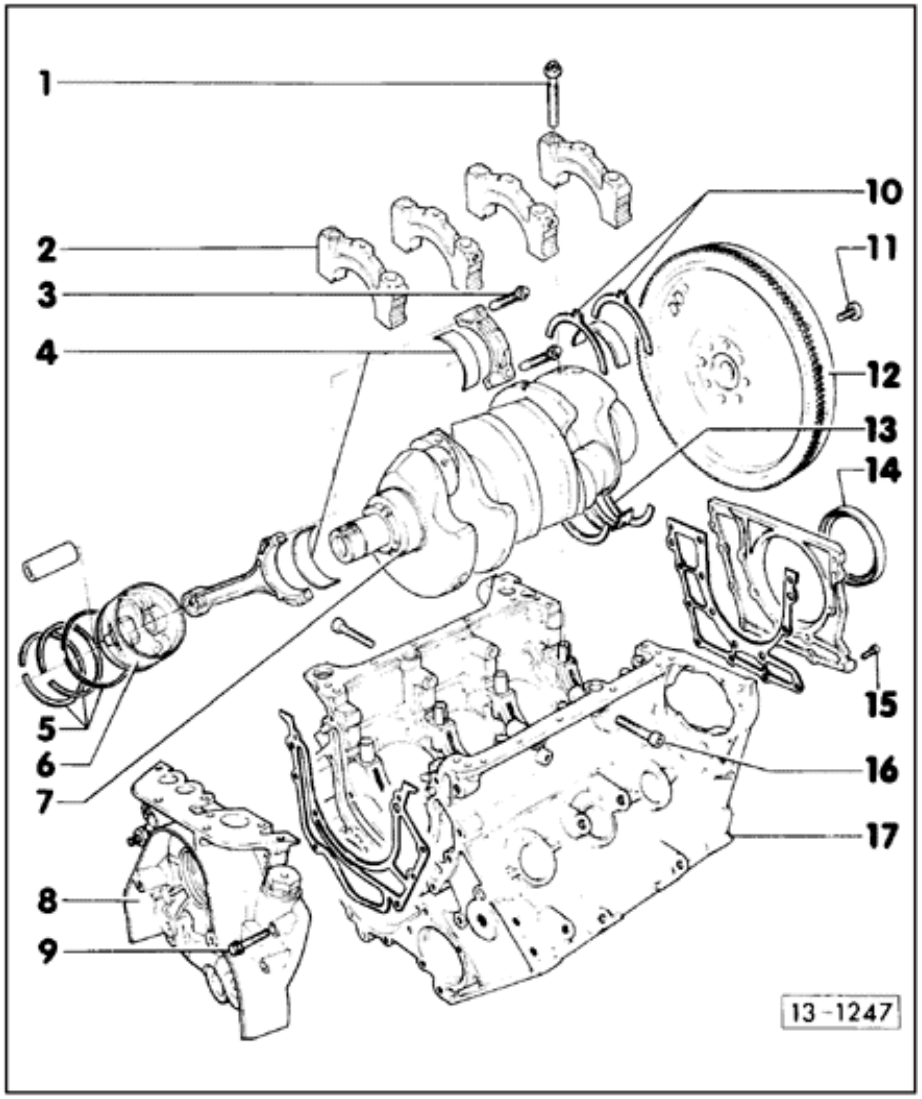
3 - Connecting rod bearing cap bolts

- Always replace
- Tightening torque: 30 Nm (22 ft lb) plus 1/4-turn (90°)
- Tighten to 20 Nm (15 ft lb) for measuring radial clearance, but do NOT tighten further

4 - Connecting rod bearing shells

- Never interchange used connecting rod bearing shells

- Checking connecting rods and bearings ⇒ page 13-31



5 - Piston rings

- Checking ⇒ page 13-25

6 - Piston

- Checking ⇒ page 13-26

7 - Crankshaft

- Checking ⇒ page 13-21
- Dimensions ⇒ page 13-24

8 - Oil pump

- Check drive gear on crankshaft when installing
- Removing ⇒ Repair Group 17

9 - 10 Nm (7 ft lb)

10 - Thrust washers

- Installed only at 4th crankshaft main bearing
- Checking crankshaft axial clearance ⇒ page 13-21

11 - Bolt

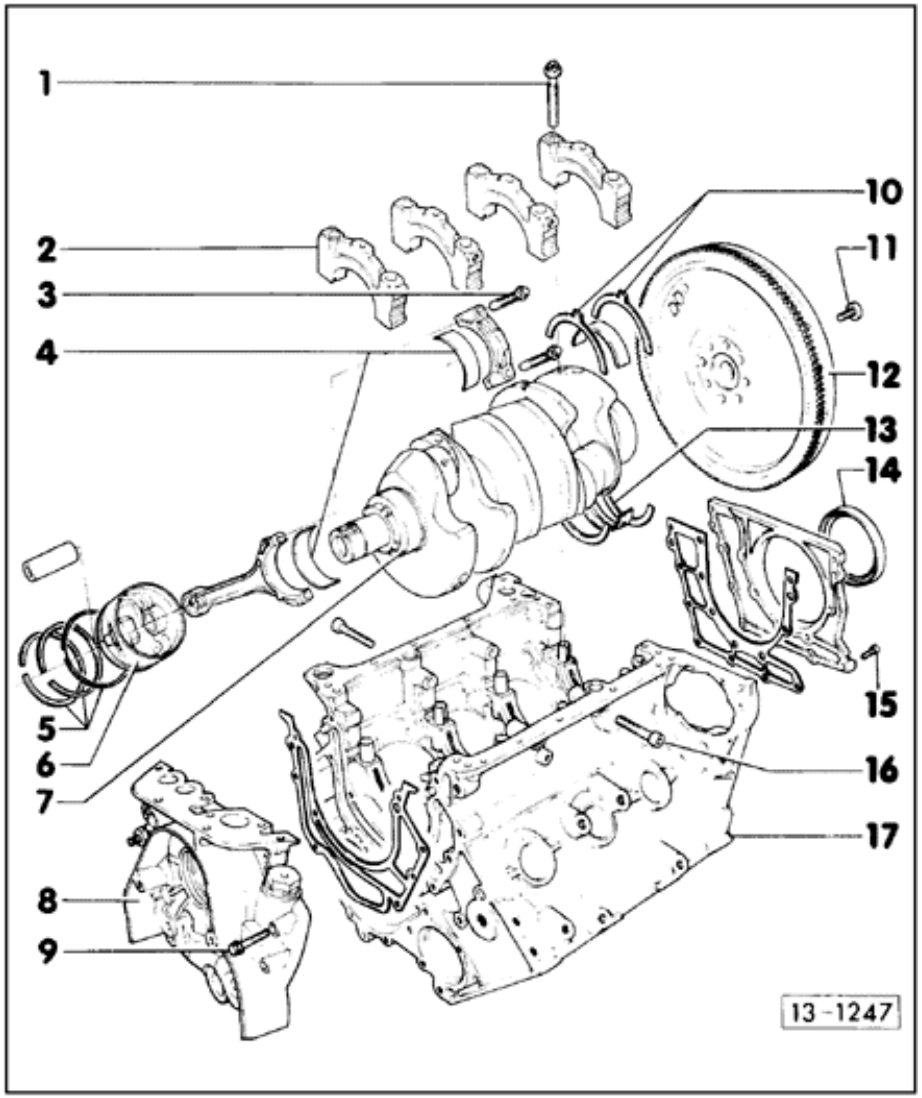
Automatic trans. (drive plate)

- Always replace
- Tightening torque: 60 Nm (44 ft lb) plus 1/4-turn (90°)

Manual trans. (flywheel)

- Always replace
- Tightening torque: 40 Nm (30 ft lb) plus 1/2-turn (180°)

13-8



12 - Dual mass flywheel or drive plate

- Removing and installing, installation dimensions ⇒ page 13-17
- Removing and installing pilot needle bearing ⇒ page 13-16
- Adjusting engine speed (RPM) sensor bracket -G28- ⇒ page 13-20

13 - Main bearing shell

- Checking radial clearance ⇒ page 13-21

14 - Seal

- Replacing ⇒ page 13-14

15 - 10 Nm (7 ft lb)

16 - 25 Nm (18 ft lb)

- Thread bolts in hand-tight before tightening crankshaft main bearing caps

17 - Cylinder block

13-9

Ribbed belt, removing and installing

CAUTION!

Mark the direction of belt travel before removing, using a crayon or marker. Reinstalling a used belt in the opposite direction could damage the belt.

Removing

- Remove engine and ribbed-belt guard.
- Loosen ribbed-belt tensioner using 17 mm wrench and secure with locking drift 3204.
- Remove ribbed belt.

Installing

- Install ribbed belt over the crankshaft belt pulley and guide pulley first, and then push it onto the tensioning pulley.
- Remove locking drift 3204.
- Install engine and ribbed belt guard.



Routing of ribbed belt drive -D-

D1 - Without air conditioner

D2 - With air conditioner

Vibration damper, removing and installing

Removing

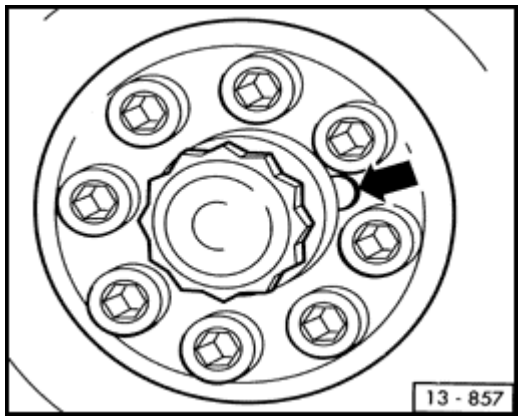
Removing ribbed belt ⇒ page 13-9 .

Note:

The center bolt does not have to be loosened to remove the vibration damper.

- Remove vibration damper.

Installing



- When installing, make sure that notch (arrow) in vibration damper is aligned with locking lug on toothed belt sprocket.

  Tightening torque: 25 Nm (15 ft lb)

13-11

Toothed belt, removing and installing

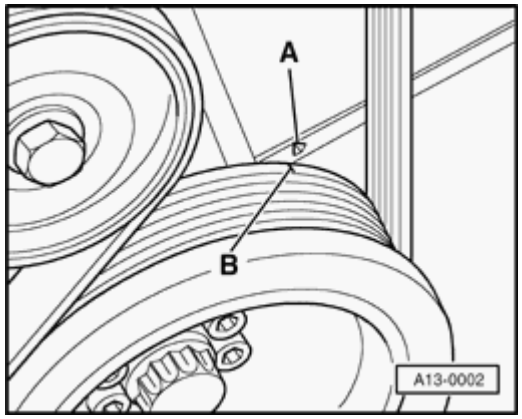
Removing

CAUTION!

Mark the direction of belt travel before removing, using a crayon or marker. Reinstalling a used belt in the opposite direction could damage the belt.

- Remove ribbed belt ⇒ page 13-9 .

- Unclip toothed belt guard on both sides.



- Crank engine by hand to Top Dead Center (TDC) position.
- Check camshaft position. Large holes in camshaft sprocket locking plates must face toward each other. If not, turn crankshaft one more revolution.
- Remove Crankshaft Position (CKP) sensor from left-hand side of cylinder block.
  - The TDC hole in the crankshaft must be aligned with the hole for the removed crankshaft position sensor (check by looking and feeling).

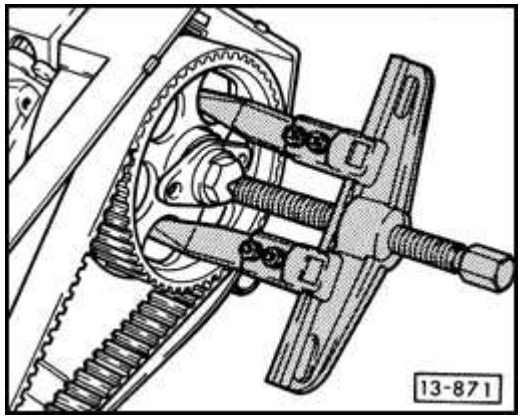


- Thread crankshaft holder 3242 into hole left by crankshaft position sensor, and tighten slightly.
- Remove ribbed-belt tensioner.

13-12

- Remove left and right toothed-belt guards.
- Remove vibration damper ⇒ page 13-10 .
- Remove lower toothed-belt guard.
- Loosen toothed-belt tensioning pulley, and remove belt.

Installing

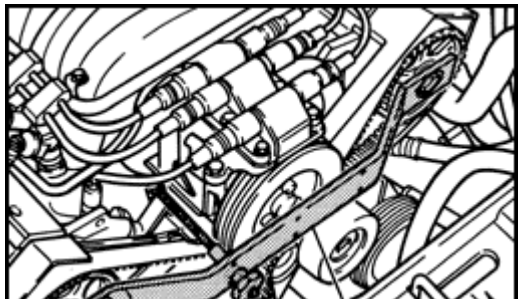


- Loosen right and left camshaft sprockets from tapered ends of camshafts using puller (Kukko 20-10 or equivalent).

Note:

The arms of the puller must engage on the rear hub of the sprocket.

- Install toothed belt over both camshaft sprockets first, then over remaining sprockets, and over tensioning roller last.



- Install camshaft holder 3243.

Note:

The camshaft sprockets must be loose enough on the tapered ends of the shafts so that the camshafts can still be turned, but tight enough that the sprockets do not tilt out of alignment.

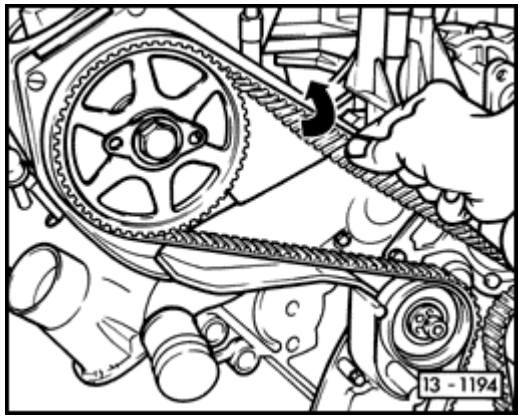
- Adjust belt tension ⇒ page 13-13 .

13-13

Toothed belt, adjusting tension

- Adjust toothed belt tension by turning tensioning roller to right and holding using 8 mm hex socket wrench.

- Tighten tensioning roller center bolt with another 8 mm hex socket wrench.



- Check toothed belt tension between right camshaft sprocket and coolant pump.

  Holding toothed belt half way between camshaft sprocket and coolant pump with thumb and index finger, it must be just possible to twist toothed belt by 90°.

  Tightening torque (tensioning roller): 45 Nm (33 ft lb)

Center crankshaft bolt: Always replace, using new double hex head (12-pt.) cap screw grade 9.8

Component	Tightening torque
Toothed belt sprocket to camshaft	70 (52 ft lb)
Idler roller	25 (18 ft lb)
Toothed belt tensioner	45 (33 ft lb)
Belt cog to crankshaft	25 (18 ft lb)
Center bolt 1) to crankshaft	200 (148 ft lb) + 180° 2)

1) Always replace the center bolt.

2) Two turns of 90° are permissible.

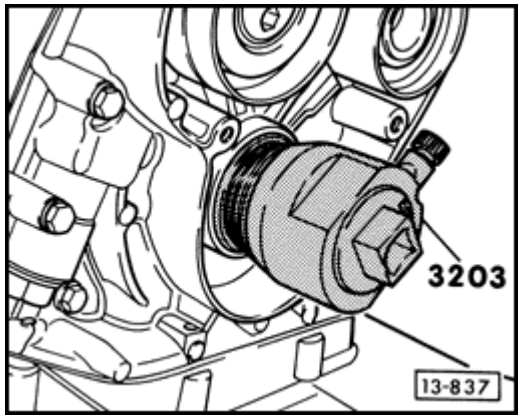
13-14

Crankshaft oil seals, replacing

Toothed belt end (front)

- Remove toothed belt ⇒ page 13-11 .

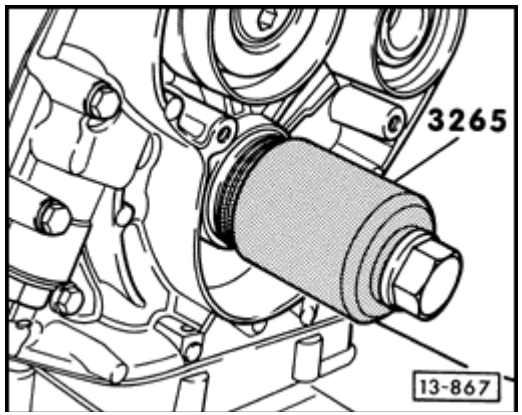
- Remove toothed belt sprocket from crankshaft.



- Remove oil seal using seal remover 3203.
- Clean running and sealing surfaces.

Note:

Do not oil sealing lip or outer edge of seal before pressing in.



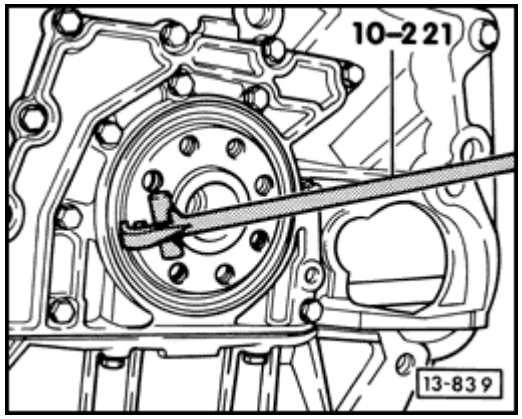
- Push oil seal over 3202/1 from retractor 3202.
- Press in oil seal flush with seal installer 3265 and center crankshaft bolt.

Flywheel/drive plate end (rear)

CAUTION!

Always replace the seal with the flange, if available. Drain engine coolant before removing flange (⇒ Repair Group 19). Replace only seal as described below if oil seal with flange is not available.

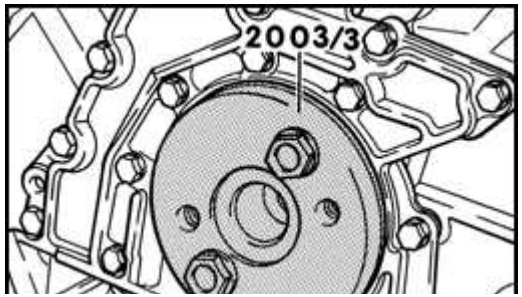
- Remove clutch and flywheel, or drive plate, as necessary.



- Pry out oil seal with extractor 10-221.
- Clean running and sealing surfaces.

Note:

Do not oil sealing lip or outer edge of seal before pressing in.



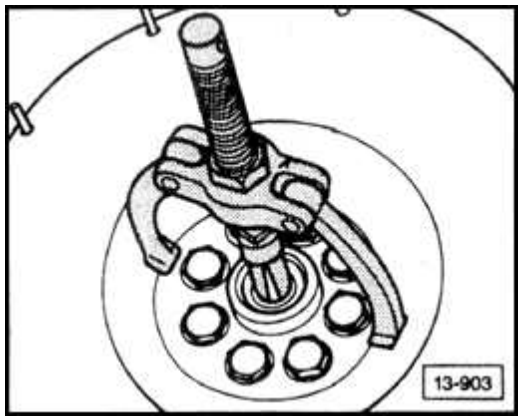
- Using assembly aid supplied with new oil seal, slide seal onto crankshaft.

  Assembly aid is supplied with oil seal

- Press in oil seal as far as possible using seal installer 2003/3 and flywheel or drive plate mounting screws.

13-16

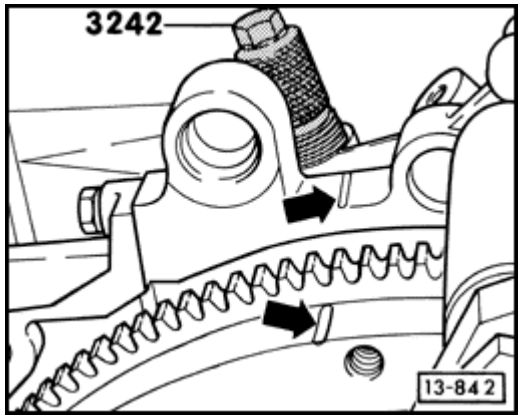
Flywheel pilot needle bearing, removing and installing



- Remove bearing with puller assembly such as Kukko 21/2 and Kukko 22-1, as shown
- Install bearing with drift 3264.

Dual mass flywheel or drive plate, removing and installing

Flywheel



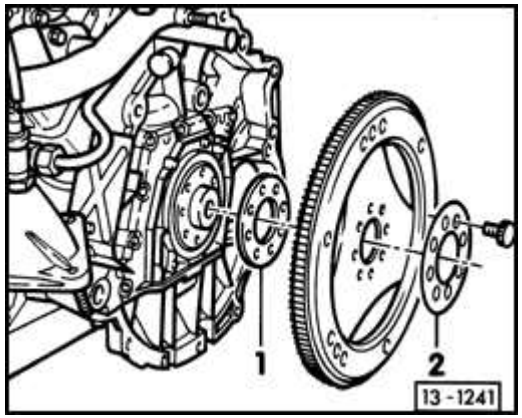
- Install crankshaft holder 3242 with crankshaft at Top Dead Center (TDC) position.
- Mark relationship between flywheel and engine cylinder block (arrows).
- Remove flywheel.

Note:

The needle roller bearing is in the flywheel and must be pressed in when replacing the flywheel.

Tightening torque

- Dual mass flywheel: 40 Nm (30 ft lb) plus 1/2-turn (180 °)



Drive plate

- Hold crankshaft in position using crankshaft holder 3242 ⇒ page 13-11

- Mark bolt hole pattern of drive plate and washers -1- and -2- relative to crankshaft. Mark position of shim in front and shim behind drive plate.

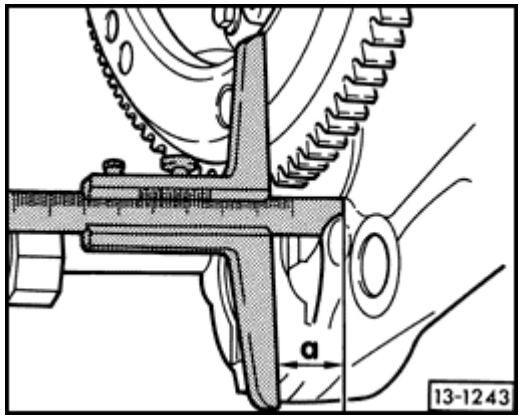
CAUTION!

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

- Install drive plate with 3.0 mm shim -1- (Part no. 054 105 301) or 4.0 mm shim -1- (Part no. 054 105 202), and spacer -2- (Part no. 035 105 303A).

Note:

Short blocks are supplied without a bushing in the crankshaft. For vehicles with automatic transmission, tap the bushing into place before installing the drive plate.



- Check clearance -a- between drive plate and cylinder block in three places and calculate average value.

  Dimension -a-:

  - Transmission 01V: 18.1-19.7 mm (0.713-0.776 in.)

- If necessary, install other shims to achieve correct clearance dimension.

Tightening torque: 60 Nm (44 ft lb) plus 1/4-turn (90°)

Note:

Before installing the engine, make sure that the engine-to-transmission dowel sleeves are installed in the cylinder block flange.

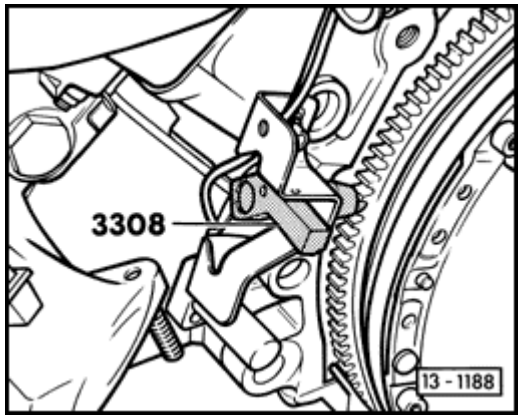
Engine speed (RPM) sensor mounting bracket, adjusting

Note:

The crankshaft must be at TDC and locked in position with crankshaft holder 3242 ⇒ page 13-11 .

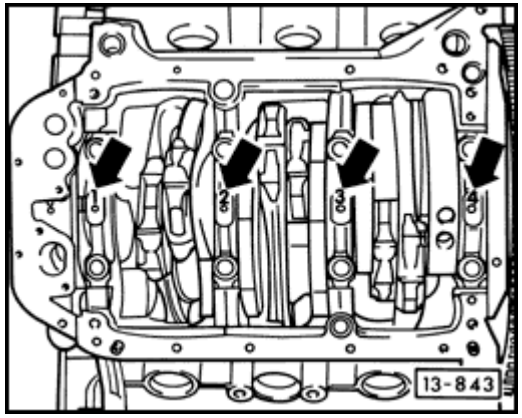
- Remove heat shield for RPM sensor, and then remove RPM sensor.

- Loosen bracket.



- Insert adjustment tool 3308 in place of sensor.
  - Adjustment tool must engage in flywheel ring gear.
- Tighten bracket securely.
- Install RPM sensor.

Crankshaft axial and radial clearance, checking



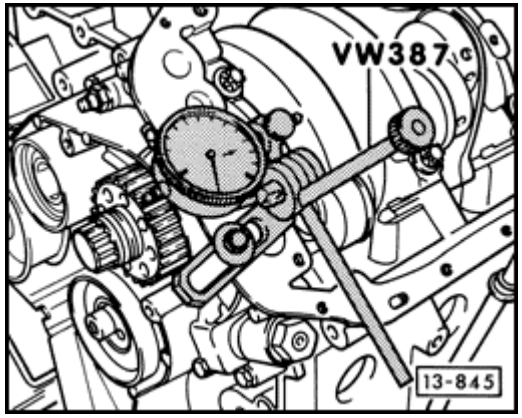
Orientation of crankshaft bearing caps

CAUTION!

Bearing shells must be reinstalled in their original location and orientation. Always label the bearing shells according to their installed position before removing. NEVER interchange used bearing shells.

- Main bearing cap -1- is at the oil pump end (front).
- Main bearing cap -4- is at the flywheel end (rear).

Checking axial clearance



- Install dial indicator with holder VW 387 on oil pump and set indicator against crankshaft counterweight.
- Press crankshaft against dial indicator by hand.
- Set dial gauge to zero.
- Press crankshaft away from dial indicator and read gauge.

  Specifications:

  - New: 0.07-0.23 mm (0.0027-0.0091 in.)
  - Wear limit: 0.25 mm (0.0098 in.)

Checking radial clearance

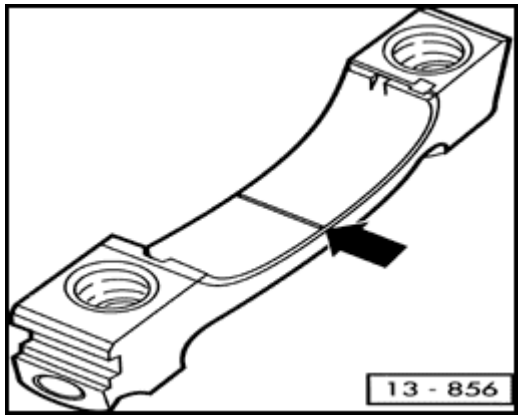
Note:

Radial clearance is measured using Plastigage®.

Plastigage® type	Color	Measuring range
PG-1	Green	0.025 - 0.076 mm
PR-1	Red	0.050 - 0.150 mm

- Remove crankshaft bearing cap.

- Clean bearing shell and crankshaft journal.

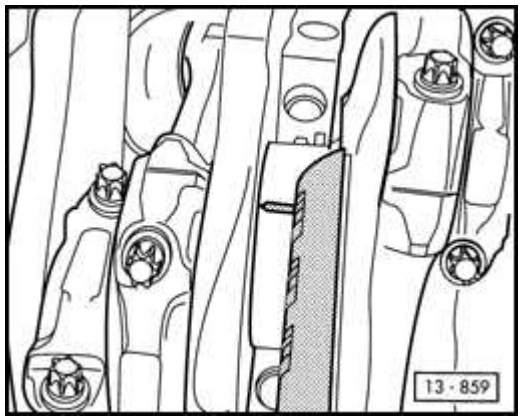


- Place Plastigage® on crankshaft journal over entire width of bearing, or in bearing shell (arrow).
- Install crankshaft bearing cap with bearing shell and new bolts.
- Tighten to 60 Nm (44 ft lb) plus1/2-turn 180°.

CAUTION!

Do NOT turn the crankshaft or allow it to rotate during the measurement with Plastigage® in place.

13-23



- Remove crankshaft bearing cap again.

- Compare width of Plastigage® with measuring scale.

  Specifications:

  - New: 0.018-0.045 mm (0.0007-0.0018 in.)
  - Wear limit: 0.10 mm (0.0039 in.)

Crankshaft dimensions

Reconditioning dimension	Crankshaft journal diameter - mm (in.)	Connecting rod journal diameter - mm (in.)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
Basic dimension (nominal)	65.00 (2.559)	54.00 (2.126)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
1st undersize (nominal)	64.75 (2.549)	53.75 (2.116)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
2nd undersize (nominal)	64.50 (2.539)	53.50 (2.106)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)
maximum size (from nominal)	-0.022 (0.00087)	-0.022 (0.00087)
3rd undersize (nominal)	64.25 (2.530)	53.25 (2.096)
minimum size (from nominal)	-0.042 (0.00165)	-0.042 (0.00165)

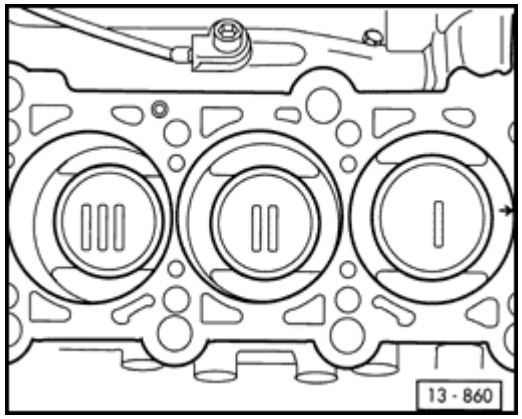
13-25

Pistons and piston rings, checking and installing

Note:

Before removing the pistons, mark their installation positions clearly on the piston crowns (as shown in illustration 13-860) using a waterproof felt-tipped pen.

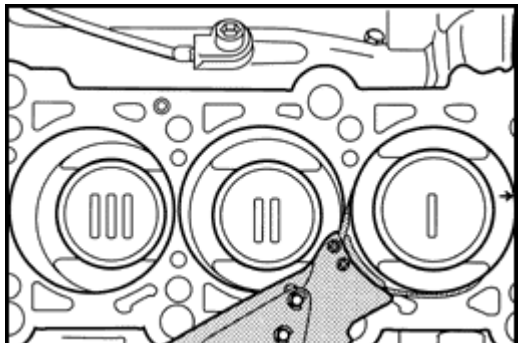
Piston installed position



- Arrow marking must point toward oil pump (front).
- Mark position clearly on piston crown with waterproof felt pen.

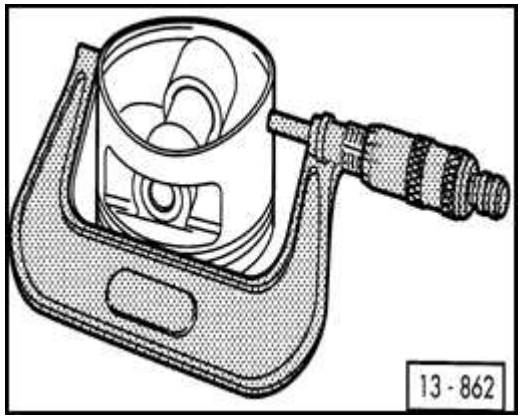
CAUTION!

Do NOT scratch or scribe the piston surface. This surface has a coating on it that must not be disturbed.



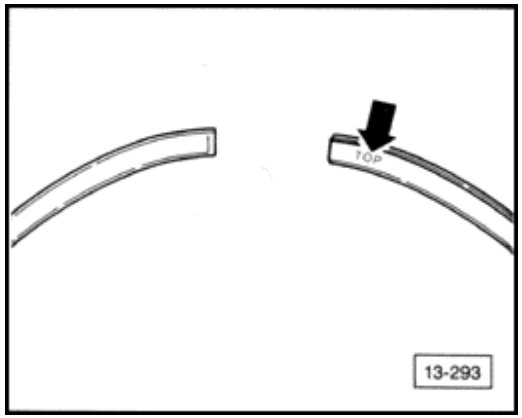
- Install piston using piston ring compressor.

Checking pistons



- Measure piston approx. 10 mm (0.39 in.) from bottom of skirt, at right angle (90 °) to piston pin.

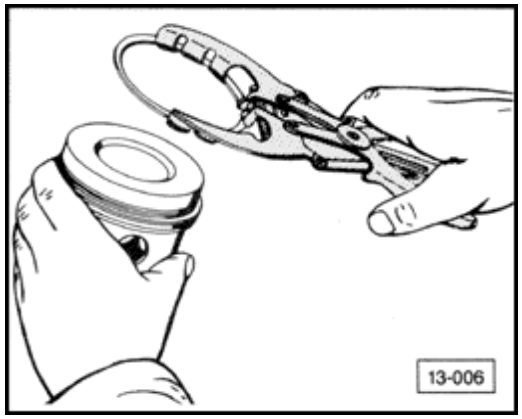
  Maximum deviation from nominal dimension: 0.04 mm (0.0016 in.)



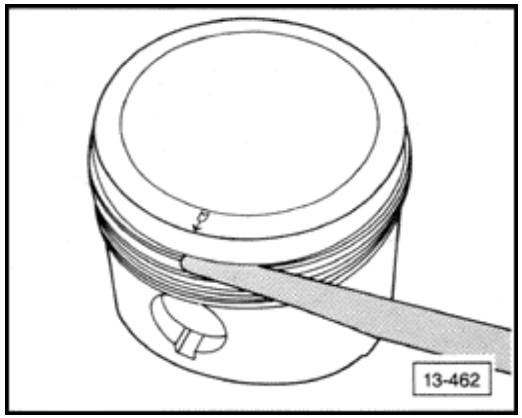
Checking and installing piston rings

- "TOP" inscription must point toward piston crown
- Inner chamfer on plain ring must point toward piston crown
- Outer chamfer of stepped ring must point toward piston crown

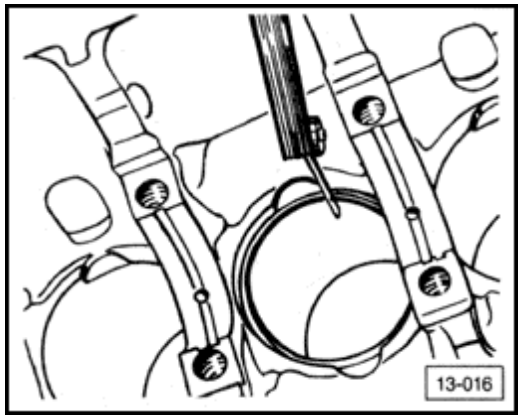
13-27



- Remove and install piston rings using ring expander as shown.



- Check piston ring clearance in groove.
  - New: 0.02-0.08 mm (0.001-0.003 in.)
  - Wear limit: 0.10 mm (0.004 in.)



- Check piston ring gap.
  - Push piston ring into lower end of cylinder at right angle until approx. 15 mm (0.59 in.) from bottom edge.

Piston ring	End gap	Wear limit
1	0.35 - 0.50 mm (0.014 - 0.020 in.)	1.0 mm (0.039 in.)
2	0.50 - 0.70 mm (0.020 - 0.028 in.)	1.4 mm (0.055 in.)
3	0.25 - 0.50 mm (0.010 - 0.020 in.)	0.8 mm (0.032 in.)

13-29

Checking cylinder bore

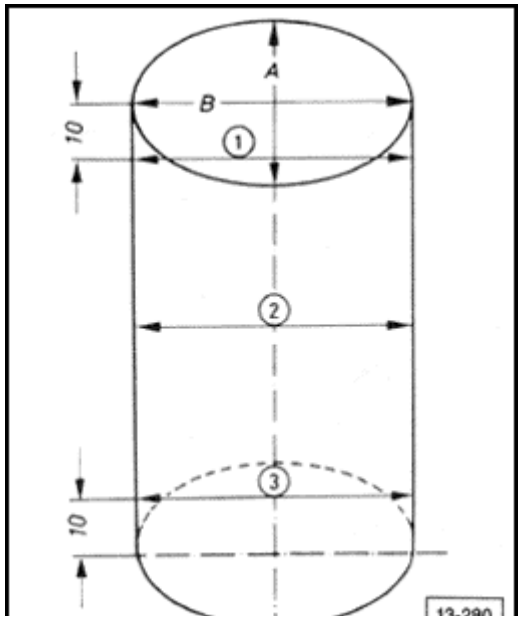
1 - Approx. 10 mm from top

2 - Center

3 - Approx. 10 mm from bottom

A - Across cylinder block (perpendicular to crankshaft)

B - In line with cylinder block (parallel to crankshaft)



- Measure diagonally at three points in transverse direction -A- and in longitudinal direction -B-.
  - Use internal dial gauge 50-100 mm (2-4 in.)
  - Maximum deviation from nominal dimension: 0.08 mm (0.0031 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.

Piston and cylinder dimensions

Reconditioning dimension	Piston diameter	Cylinder bore diameter
Basic dimension	82.48 mm (3.2472 in.)	82.51 mm (3.2484 in.)
1st oversize	82.74 mm (3.2575 in.)	82.76 mm (3.2583 in.)
2nd oversize	82.98 mm (3.2669 in.)	83.01 mm (3.2681 in.)

Note:

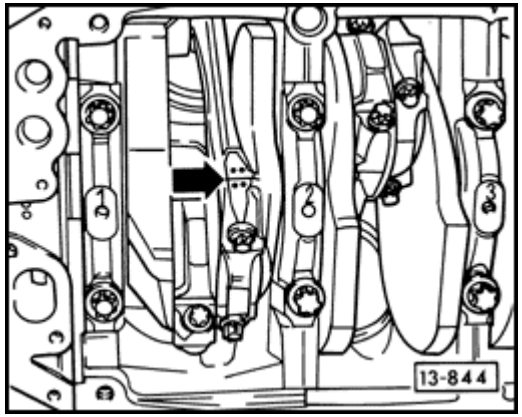
Only pistons of the "basic dimension" size are available from the Parts Department.

13-31

Connecting rods and connecting rod bearings, checking

- Replace connecting rods only as a complete set.
- Do not interchange connecting rod bearings.
- Always replace connecting rod bearing cap bolts.

Checking radial clearance



- Mark connecting rod bearing caps with light punch marks (arrow) before removing.
- Remove connecting rod bearing caps.
- Clean bearing caps and journals.
- Place Plastigage® over entire width of bearing journal or in bearing shell.
- Re-install connecting rod bearing cap and tighten to 20 Nm (15 ft lb) only; do NOT tighten further.

CAUTION!

Do NOT turn the crankshaft or allow it to rotate during the measurement with Plastigage® in place.

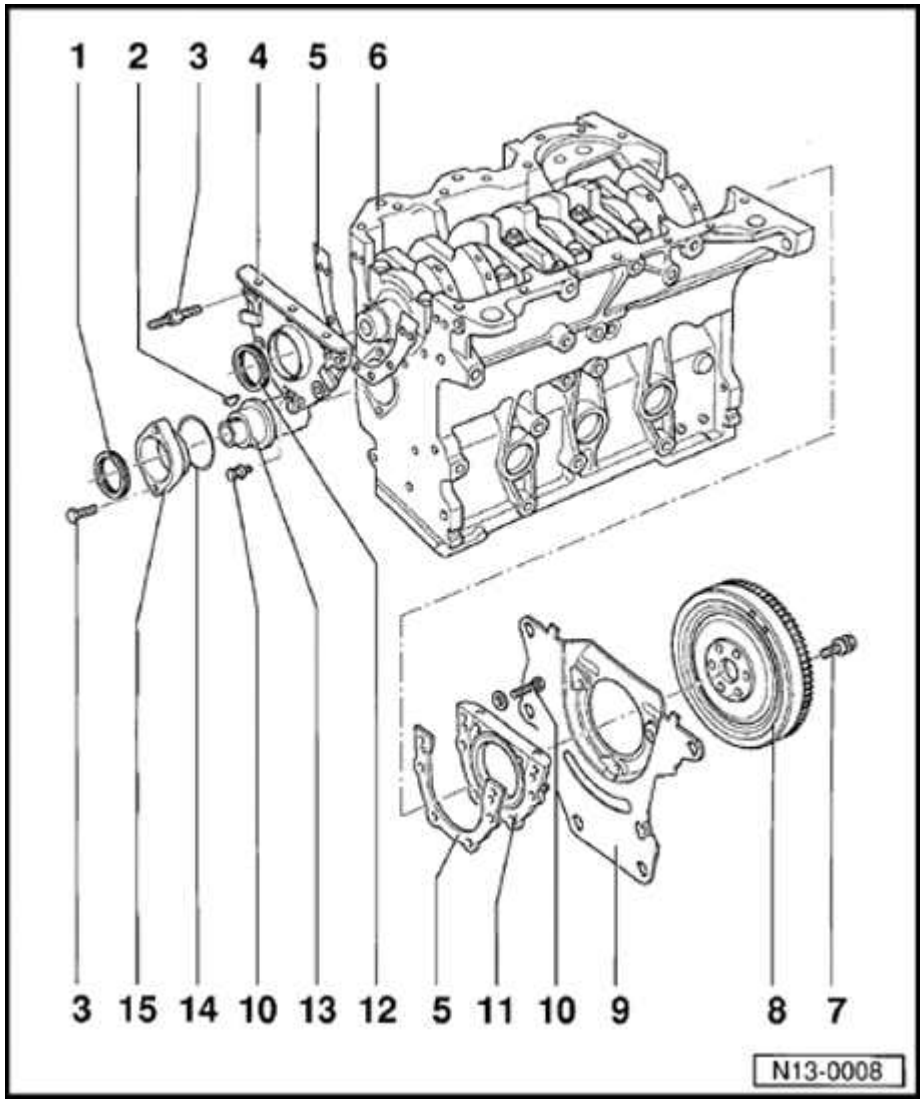
- Remove connecting rod bearing caps again.

- Compare width of Plastigage® with measuring scale.

Specifications:

♦ New:	0.015 to 0.062 mm (0.00059 to 0.00244 in.)
♦ Wear limit:	0.12 mm (0.0047 in.)

13-36



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

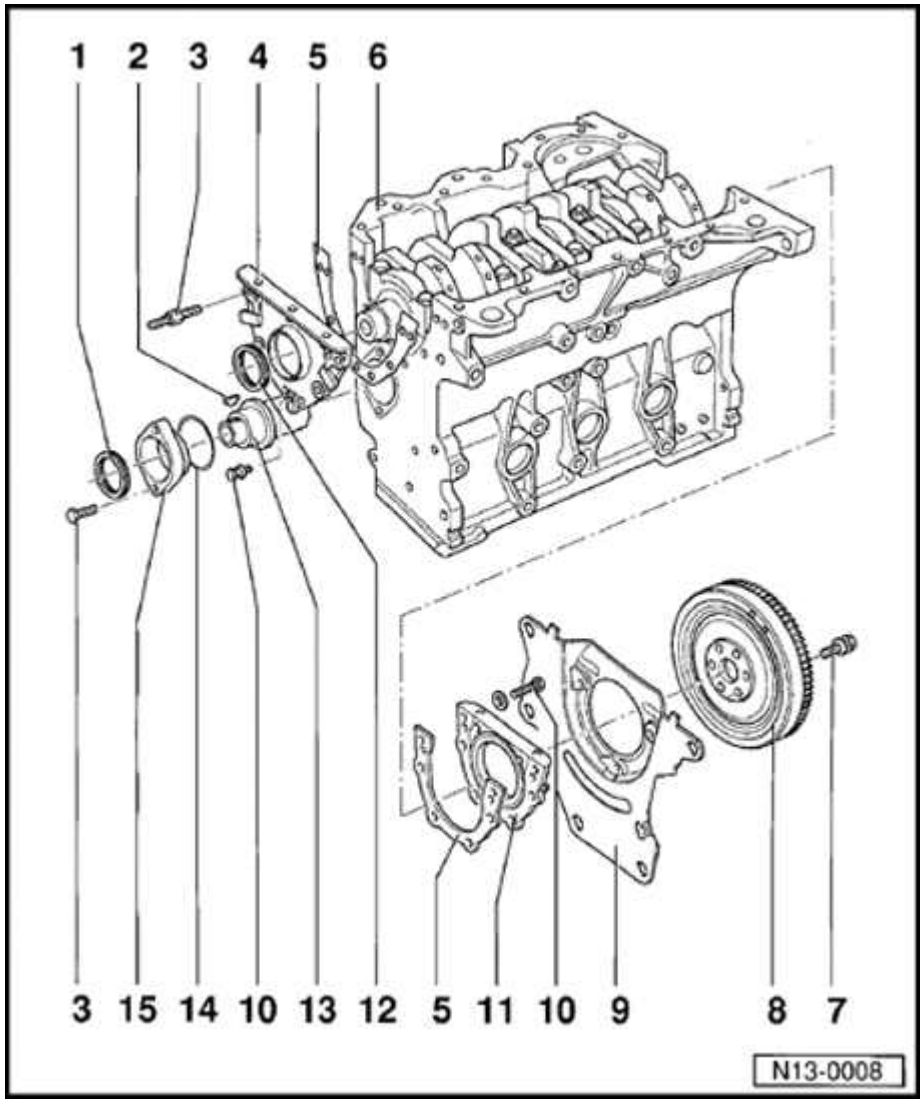
3 - Connecting bolt

- 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.

13-37



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 °)

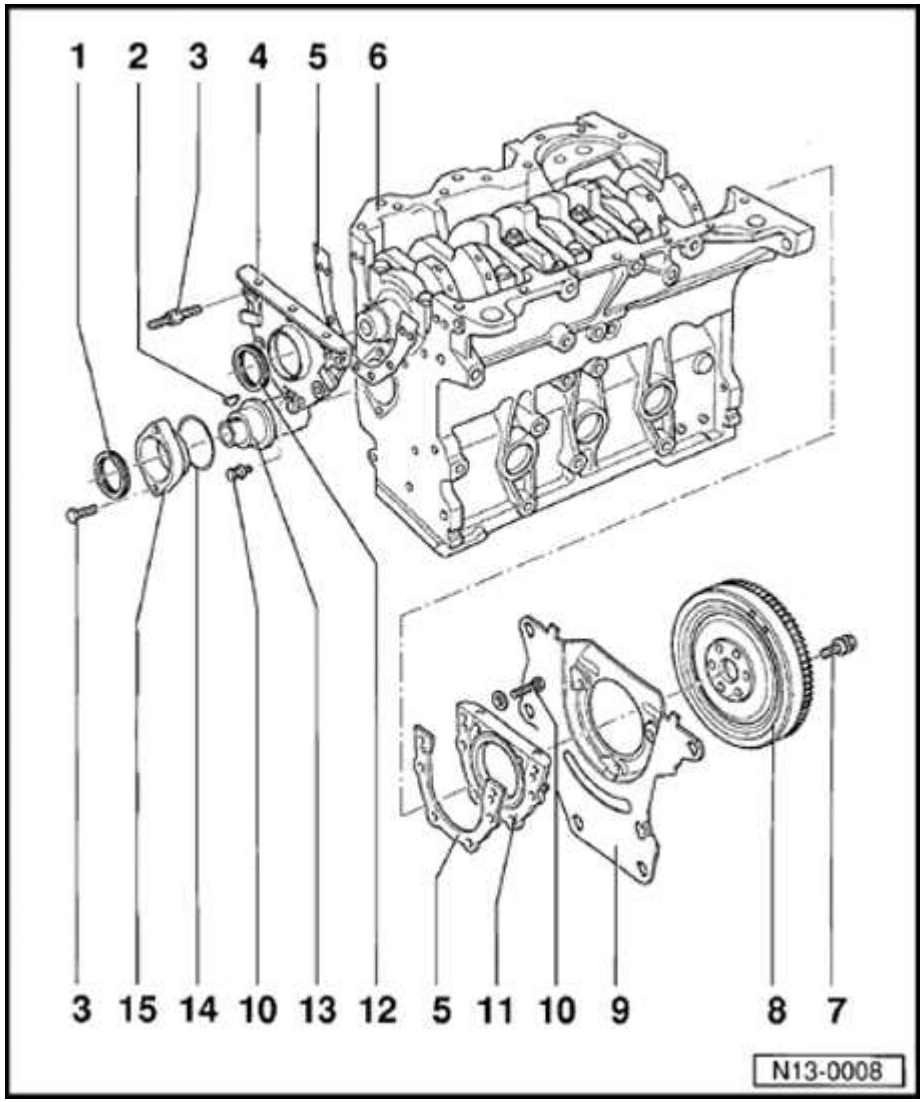
8 - Dual-mass flywheel or drive plate

- Removing and installing ⇒ Page 13-43

9 - Intermediate plate

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

13-38



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

13-39

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

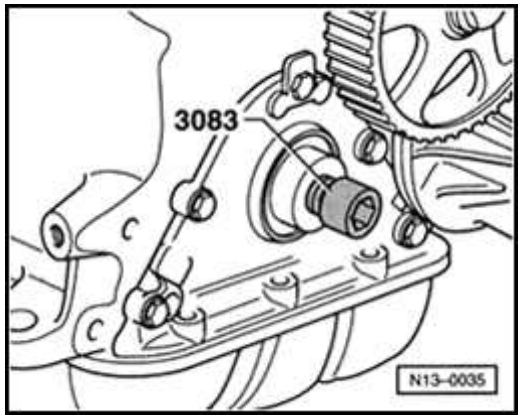
- Remove ribbed belt and ribbed belt tensioner ⇒ Page 13-15 .
- Remove toothed belt ⇒ Page 13-29 .
- Remove mounting bracket for torque arm ⇒ Page 17-2 , item - 5 -.



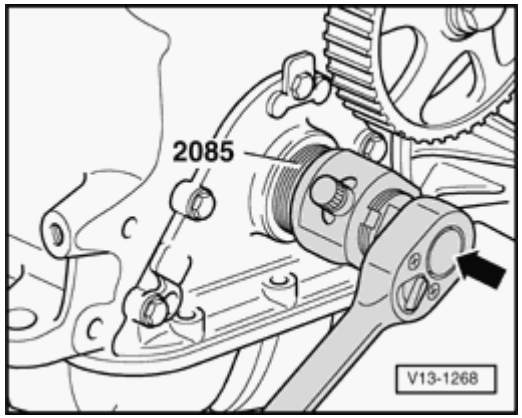
- Remove crankshaft toothed belt gear. Secure toothed belt gear using 3099 spur belt spreading.

Note:

3415 special tool can also be used.



- 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.

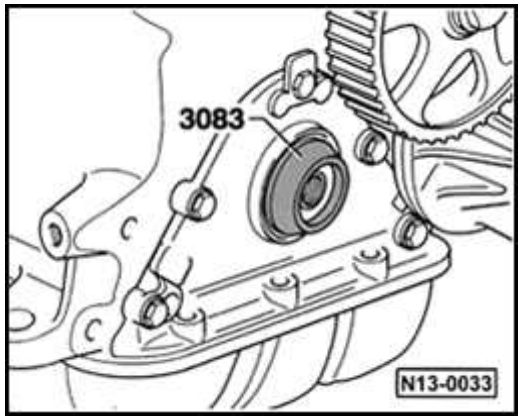


- Grease threaded head of 2085 seal puller, position and with forced pressure screw into oil seal as far as possible.
- Loosen knurled bolt and turn inner part against crankshaft until oil seal is removed.

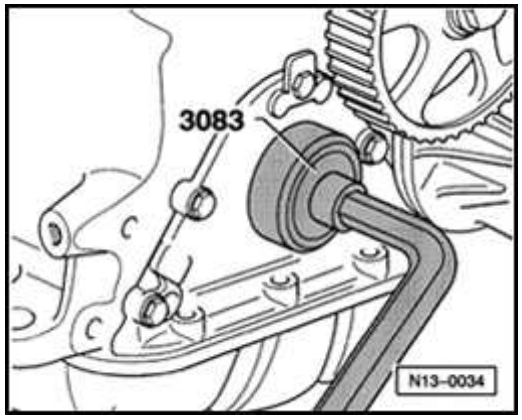
13-41

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 .

- 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.	

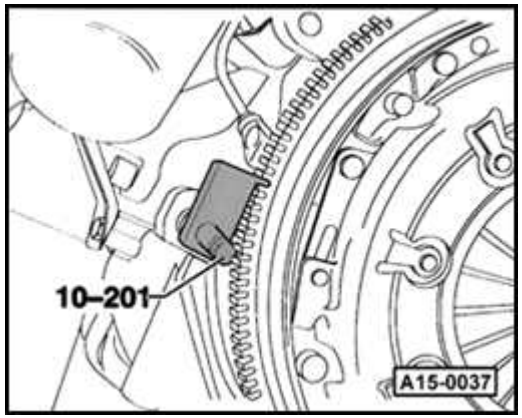
13-43

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.

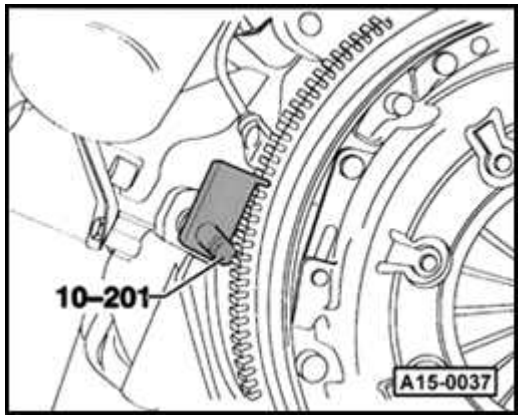
Tightening torque

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

13-44

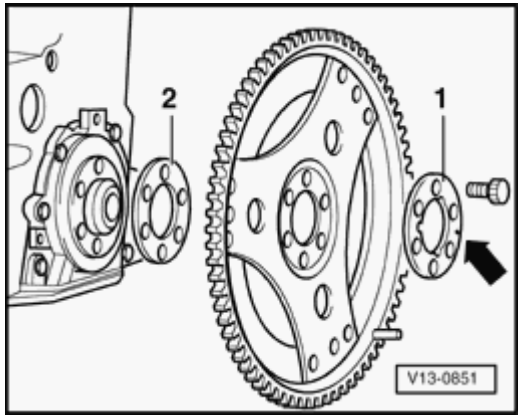
Drive plate

Removing



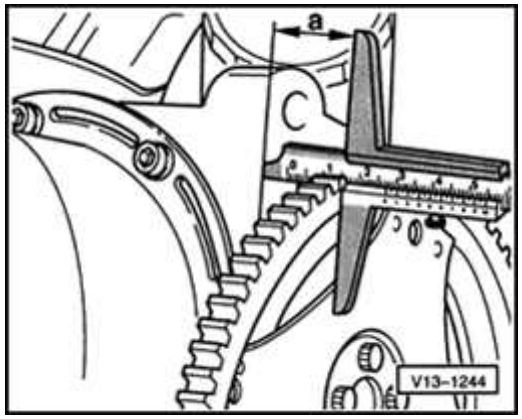
- Relocate 10-201 flywheel retainer to loosen and tighten bolts.
- Mark drive plate to engine.

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.

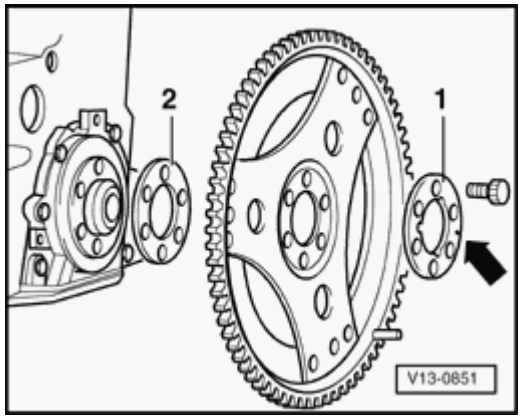
  Tightening torque: 30 Nm (22 ft lb)



- 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.

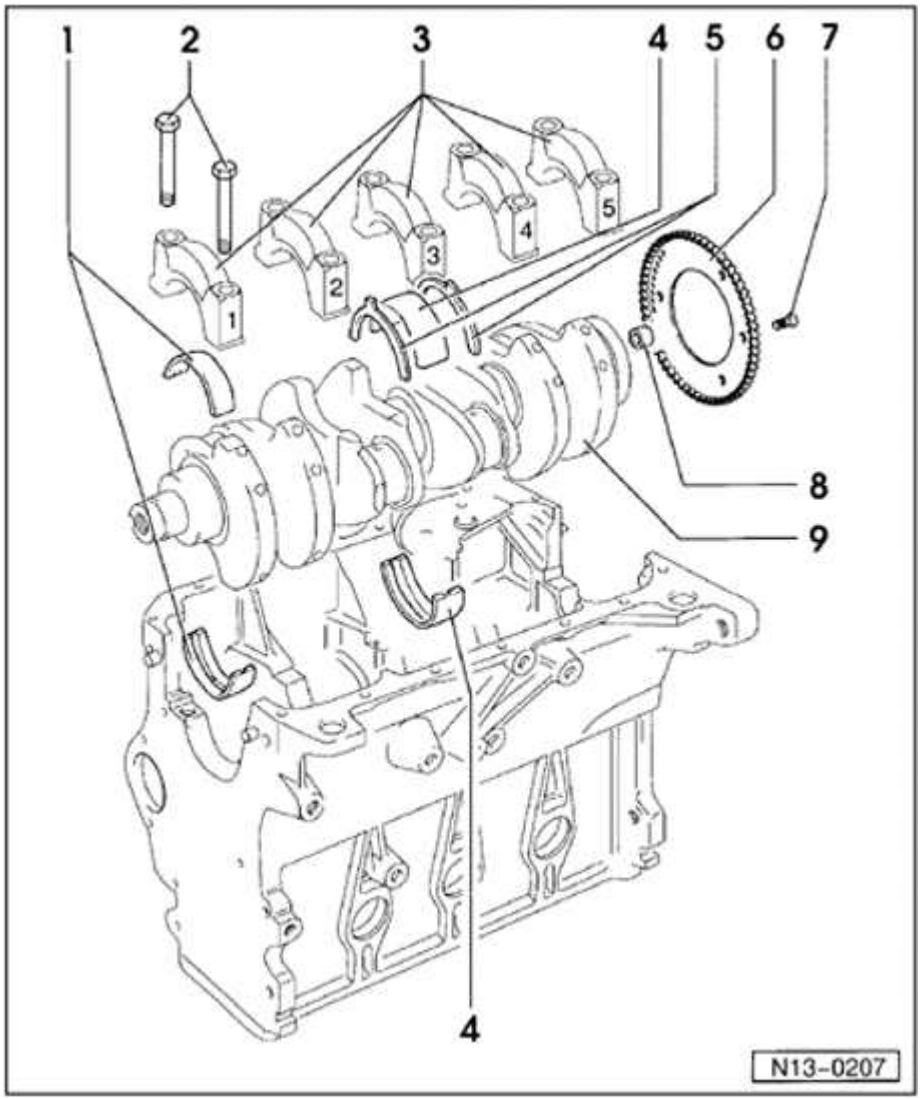
If specified value is obtained:

- 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.	

13-46



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)

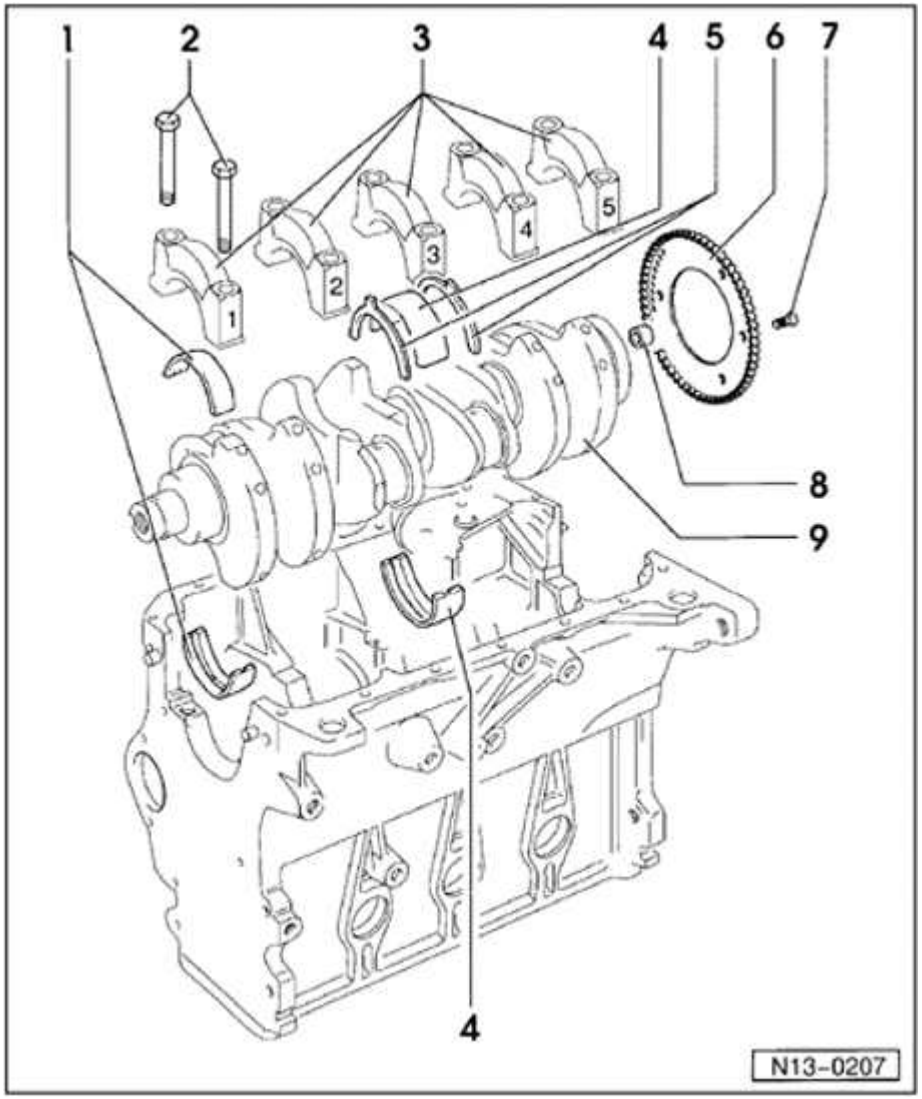
2 - Main bearing cap bolts

- 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

13-47



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

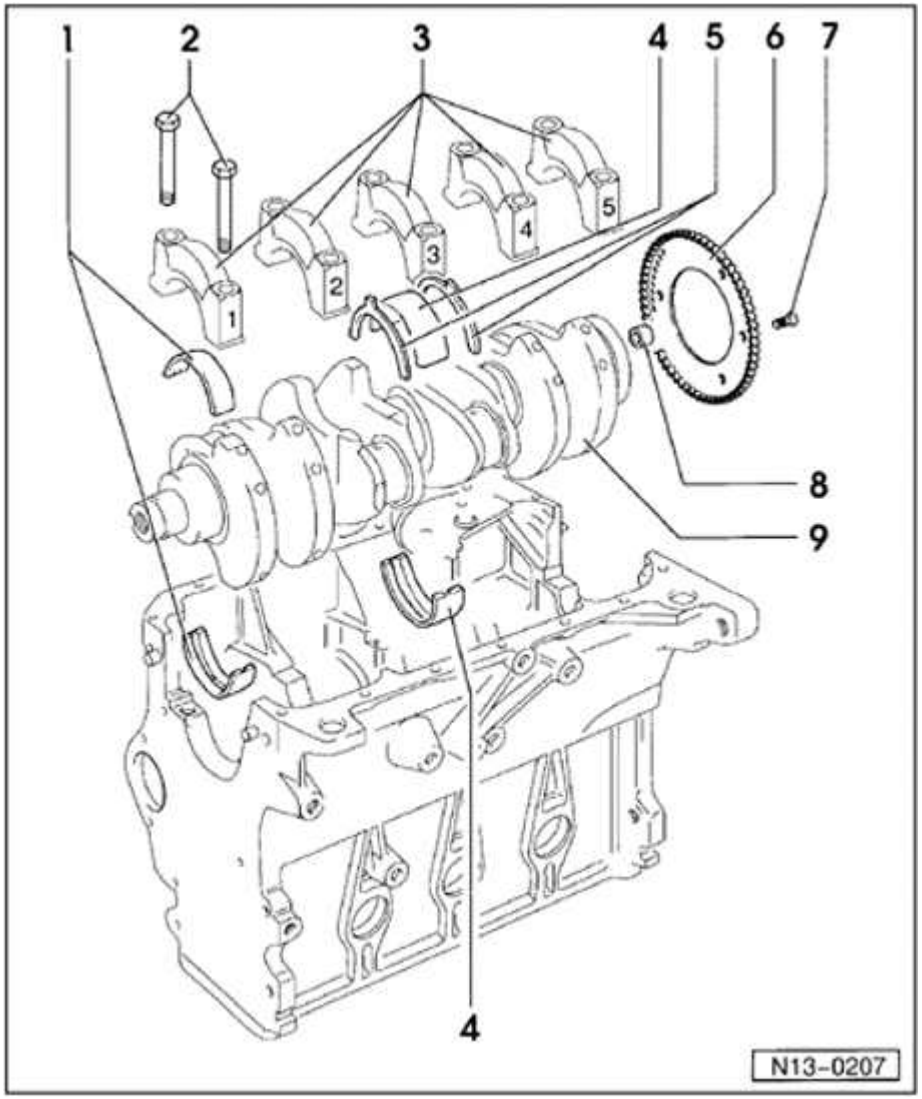
- For bearing cap, bearing 3
- Check location point

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 °)



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

13-49

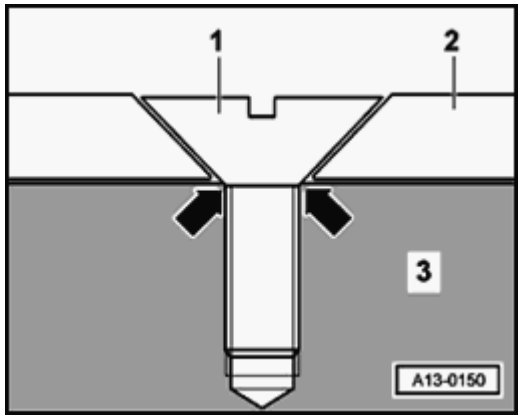


Fig. 1 Removing and installing sensor wheel

- 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.	

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

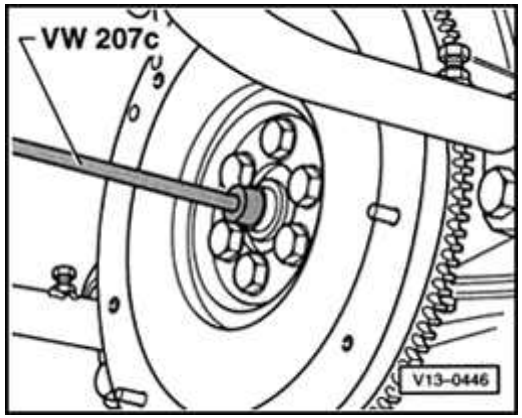




- Pull out using puller -A-, e.g. 21/2 Kukko extractor and 22/1 Kukko support or 10-202 puller.

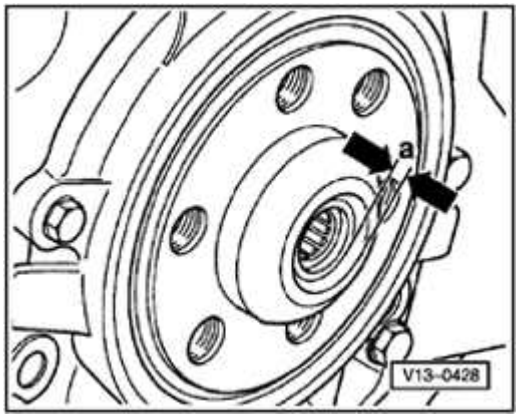
13-51

Installing



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

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



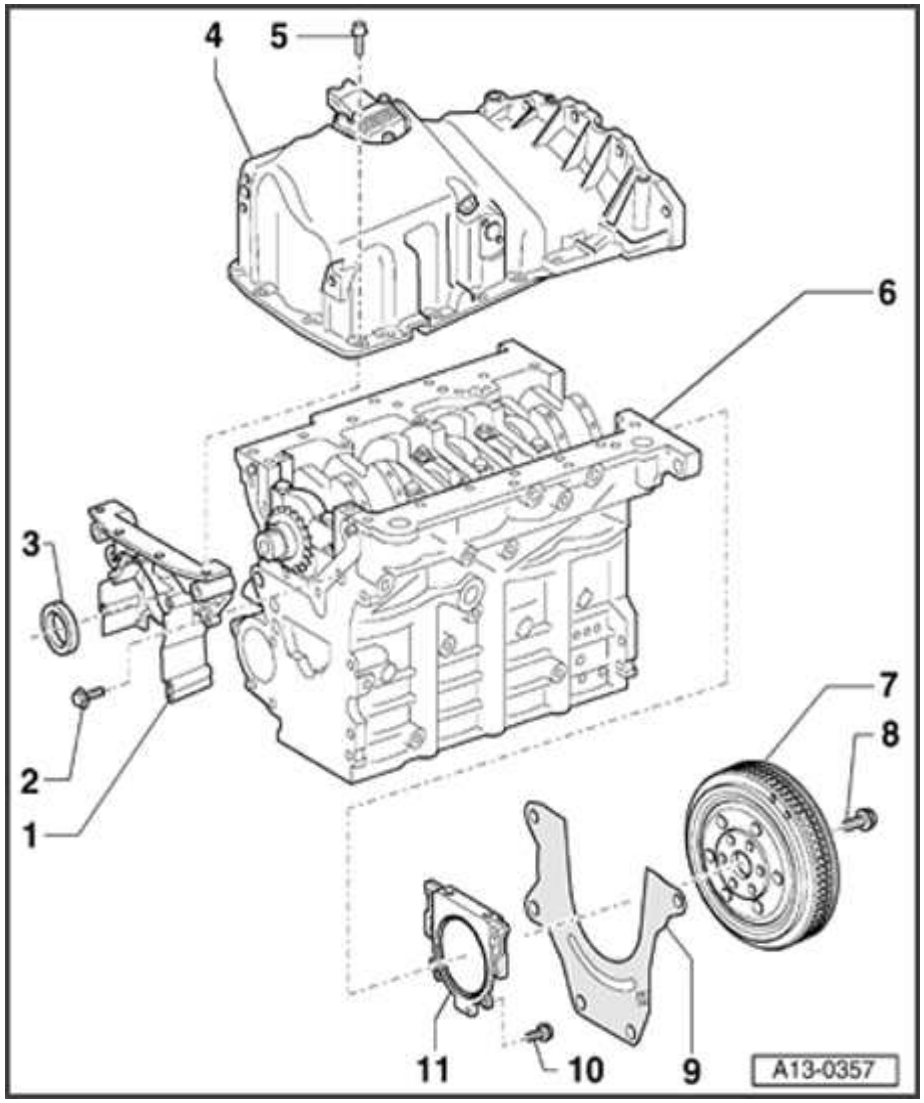
Installation of needle bearing:

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

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)

13-47



Sealing flanges and flywheel/drive plate, removing and installing

Note:

For repairs to the clutch:

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

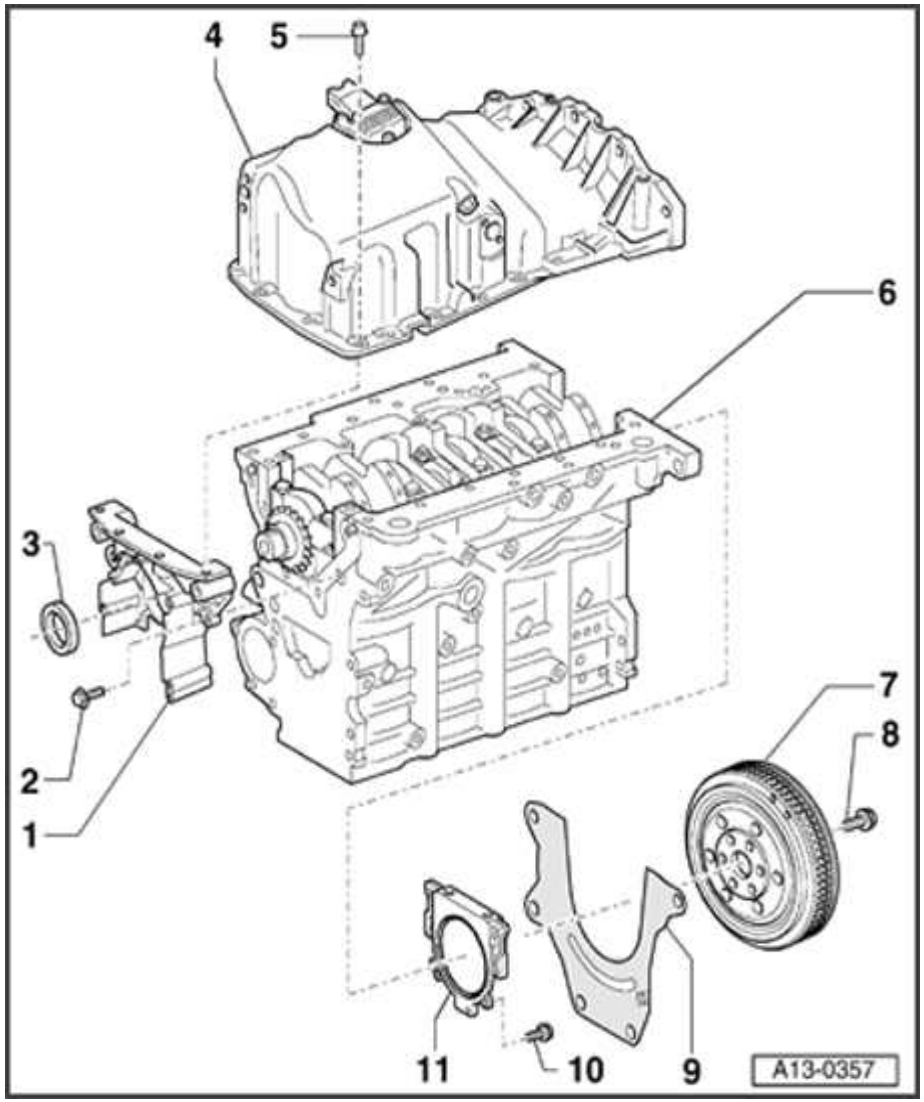
⇒ *Repair Manual, 5 Spd. Manual Transmission 01A All Wheel Drive, Repair Group 30*

1 - Sealing flange - front

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

2 - 15 Nm

13-48



3 - Sealing ring

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

4 - Sump

- Removing and installing ⇒ Page 17-11

5 - 15 Nm

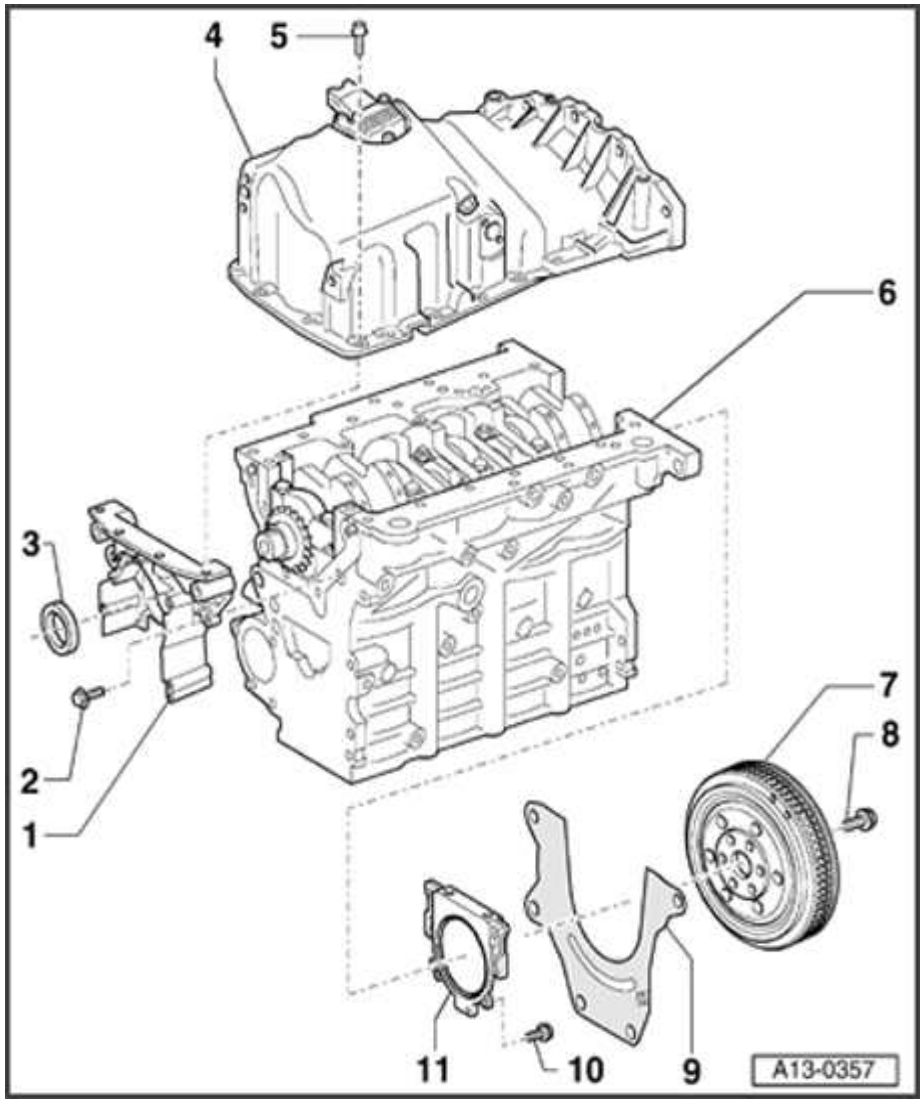
6 - Cylinder block

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

7 - Dual-mass flywheel/drive plate

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

13-49



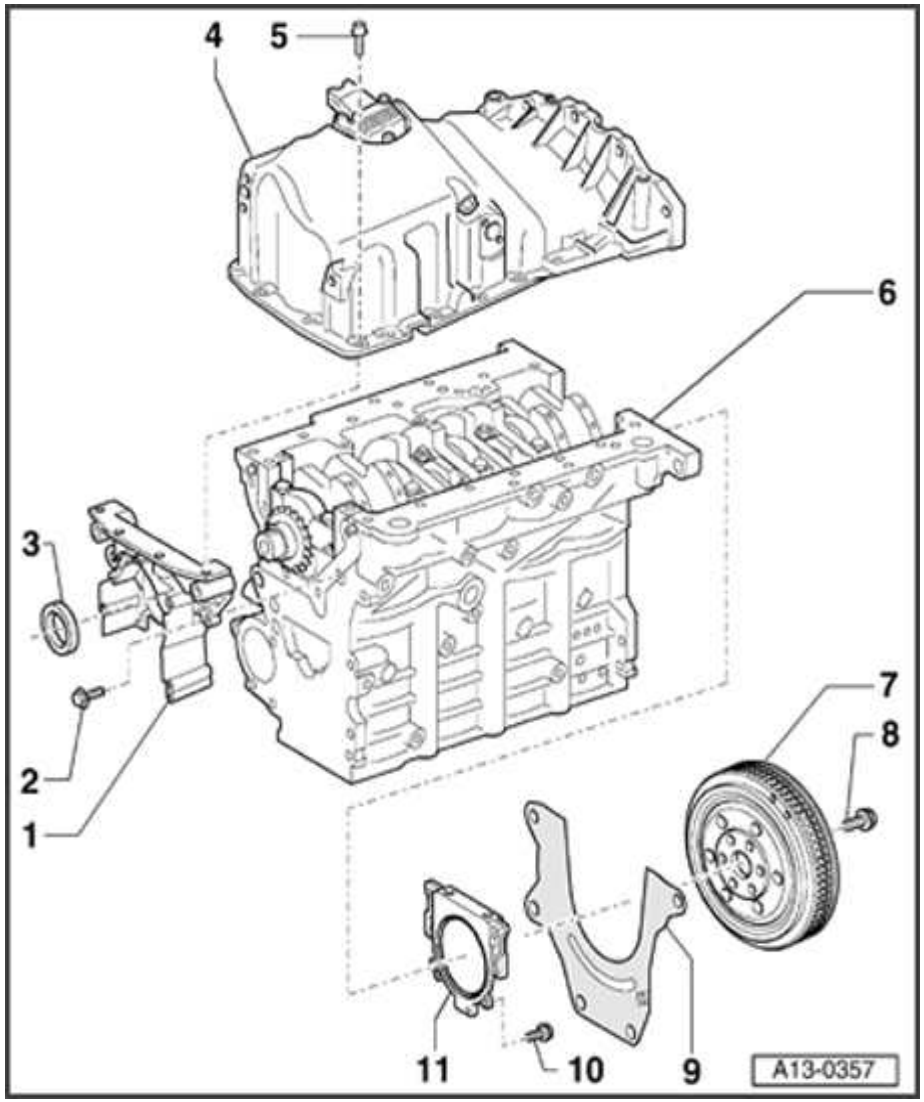
8 - Securing bolt for dual-mass flywheel or drive plate

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

9 - Intermediate plate

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

13-50

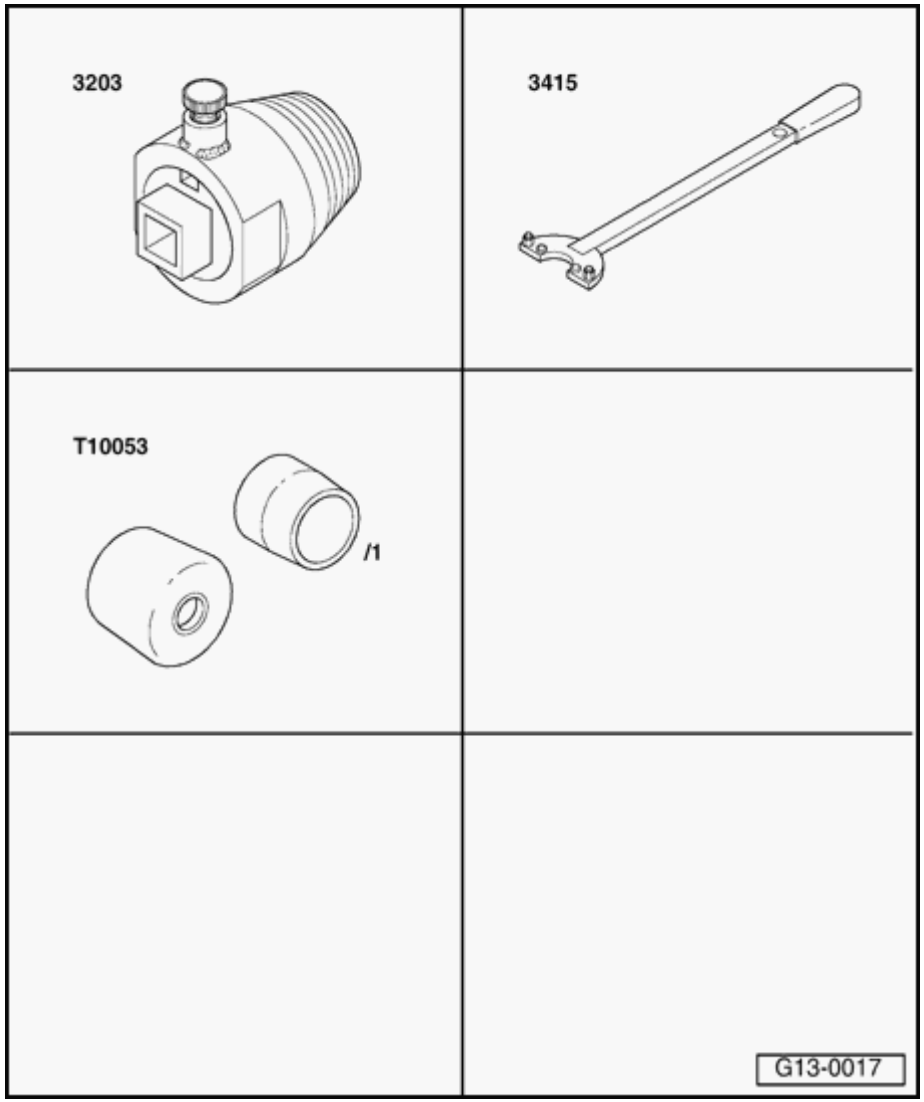


10 - 15 Nm

11 - Rear sealing flange with oil seal

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

13-51



Crankshaft oil seal on pulley end, replacing

Special tools and equipment

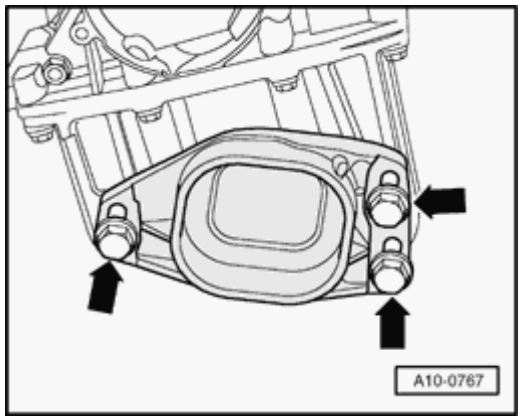
- Oil seal extractor 3203
- Holding tool 3415
- Assembly tool T10053

13-52

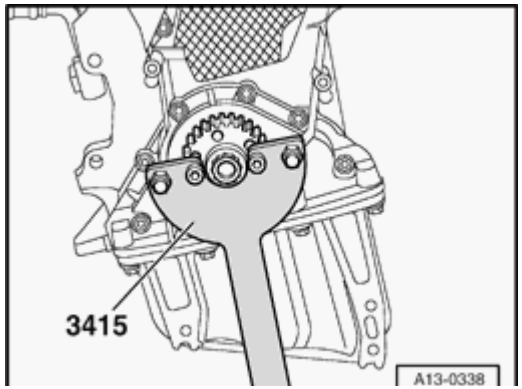
Removing

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

- Remove toothed belt ⇒ Page 13-40 .



- Unbolt stop for torque reaction support -arrows-.

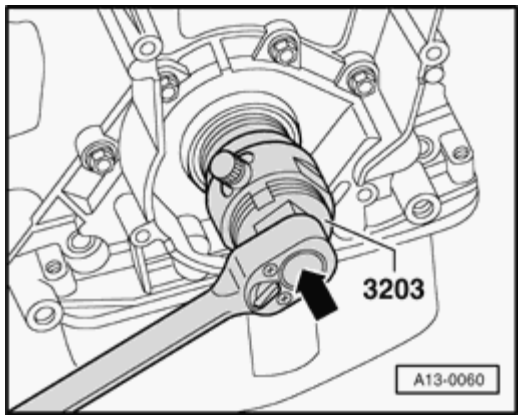


- Remove toothed belt sprocket from crankshaft. To do this, counter hold sprocket with 3415.

13-53

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

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

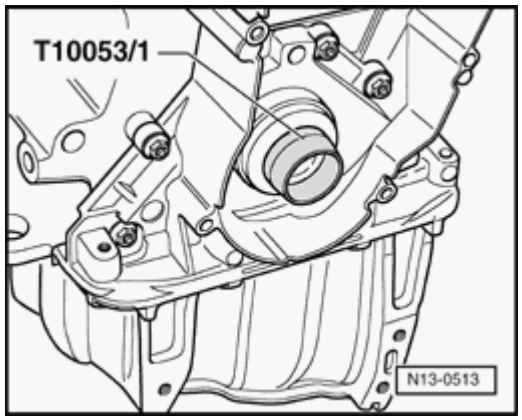


- Lubricate threaded head of oil seal extractor, place it in position and exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice. Remove oil seal with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

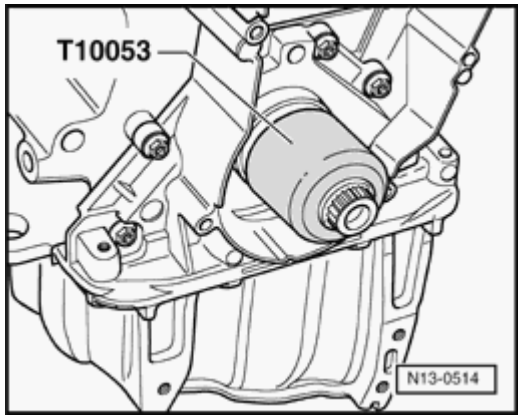
Installing

Note:

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

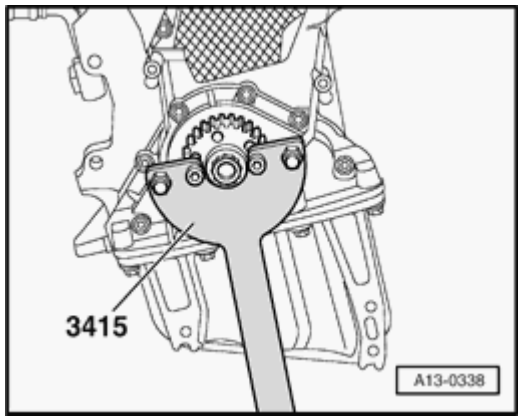


- Place guide sleeve T10053/1 onto crankshaft journal.
- Slide oil seal over guide sleeve.



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

13-55



- Replace central bolt for toothed belt sprocket.

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

Note:

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

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

Tightening torque

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

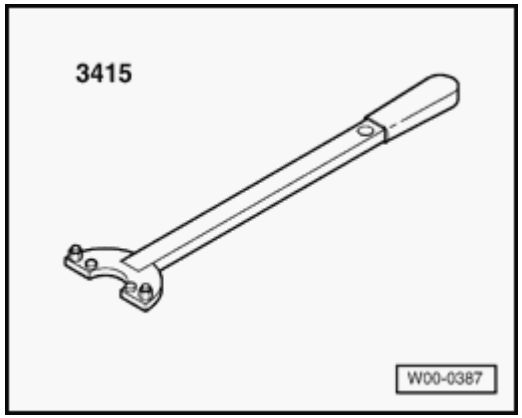
1) Replace bolt

2) 90° corresponds to a quarter turn

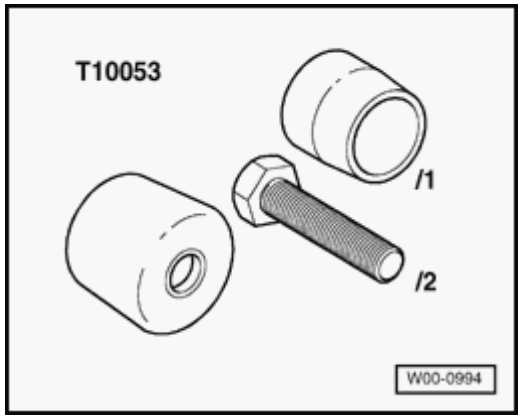
13-56

Front sealing flange, removing and installing

Special tools, material and equipment



- Holding tool 3415



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

13-57

Removing

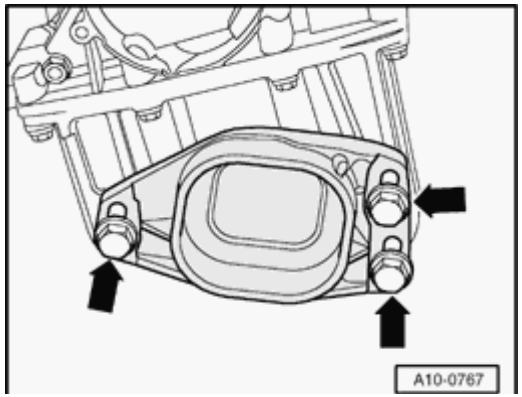
- Engine in vehicle
- Lock carrier must be in service position ⇒ Page 13-1 .

- Remove toothed belt ⇒ Page 13-40 .

CAUTION!

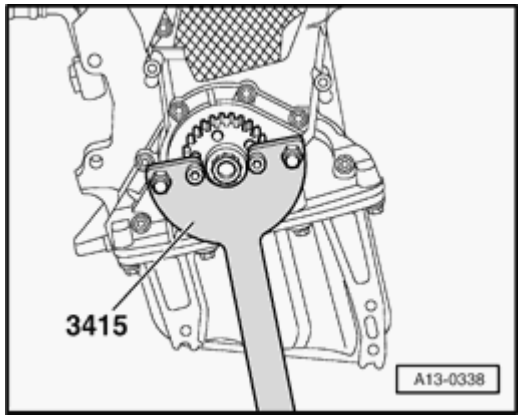
The air conditioner refrigerant circuit must not be opened.

- Disconnect A/C compressor from bracket and secure to body with wire.
- Unbolt bracket for A/C compressor -Item 5 -, ⇒ Page 13-15

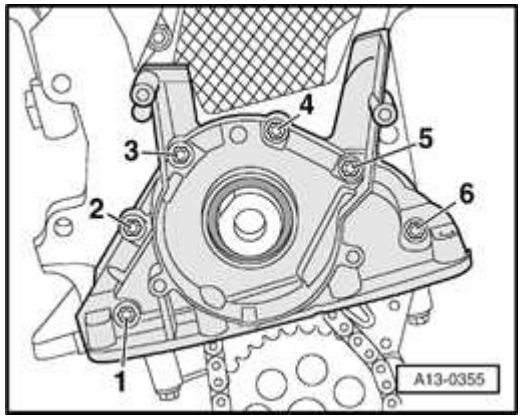


- Unbolt stop for torque reaction support -arrows-.

13-58

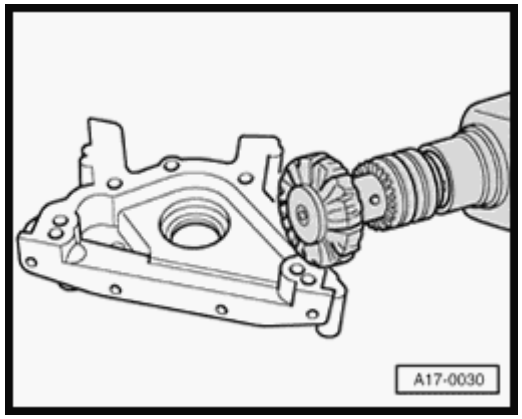


- Remove toothed belt sprocket from crankshaft. To do this, counter hold sprocket with 3415.
- Remove oil pan ⇒ Page 17-11



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

13-59



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

WARNING!

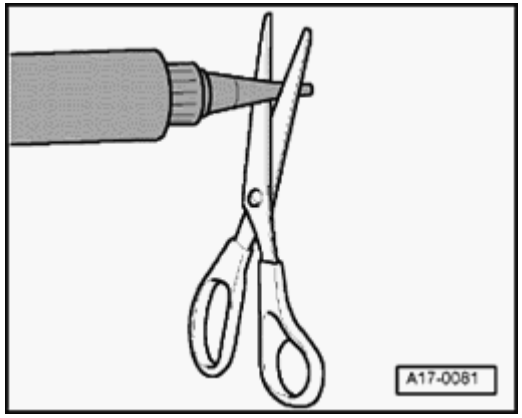
Wear protective glasses.

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

Installing

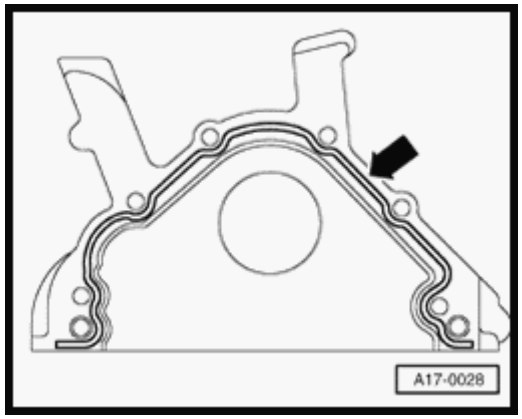
Note:

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



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

13-60



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

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

Note:

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

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

Note:

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

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

Note:

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

- Install crankshaft oil seal ⇒ Page 13-54 .

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

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

- Install lock carrier ⇒ Page 13-1 .

Tightening torques

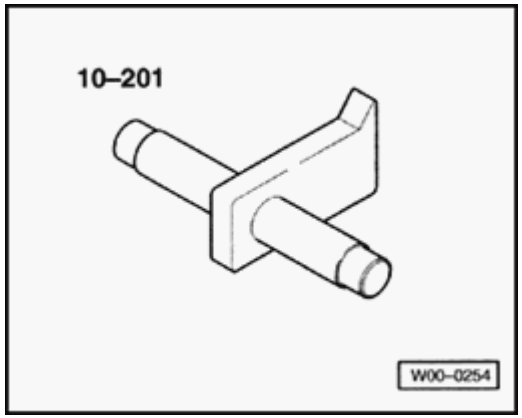
Component		Nm
Sealing flange to cylinder block		15
Bracket for air conditioner compressor on cylinder block		33
A/C compressor to bracket		25

13-62

Dual mass flywheel/drive plate, removing and installing

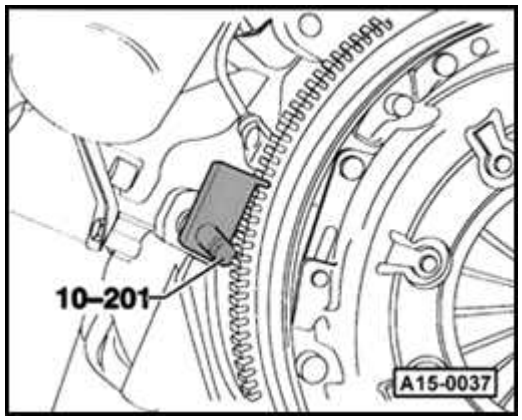
Dual-mass flywheel

Special tools and equipment



- Counter-hold tool 10-201

Removing



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

Installing

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

- Replace bolts.

Tightening torque

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

1) Bolt length

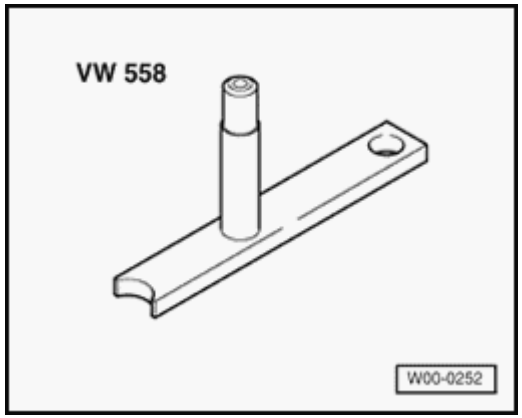
2) 90° corresponds to a quarter turn

3) 180° = 1/2 turn

13-64

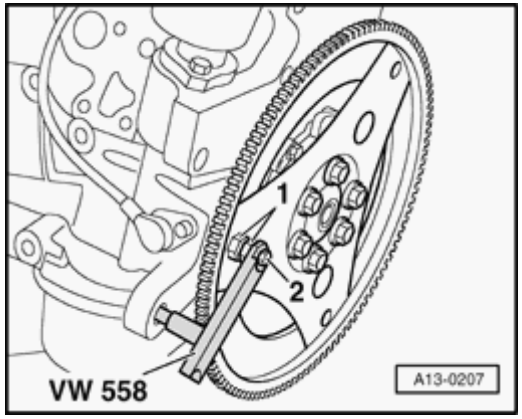
Drive plate

Special tools and equipment



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

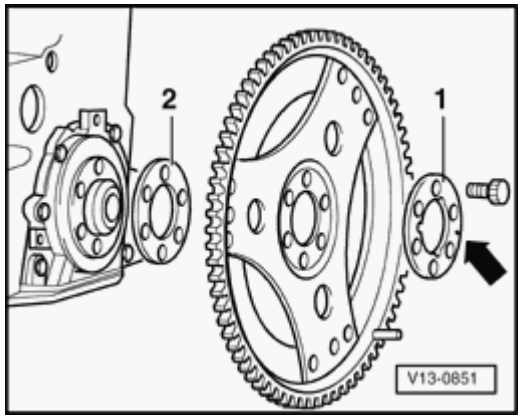
Removing



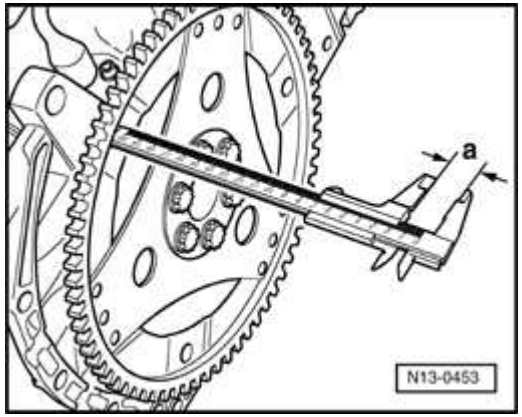
- Secure counter hold tool VW 558 to drive plate with hex bolt M8 x 45 - Item 2-. Place two M10 hex nuts between counter-hold tool and drive plate.
- Mark position of drive plate relative to engine.
- Unbolt drive plate.

13-65

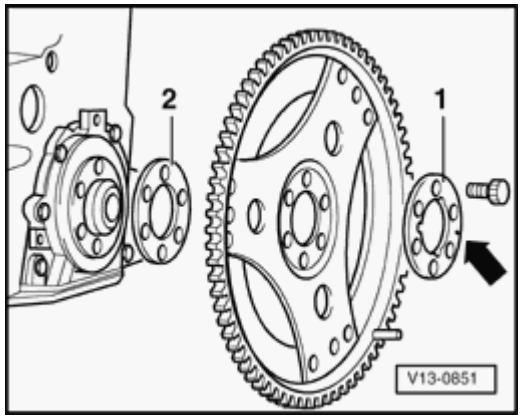
Installing



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



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



If nominal value is exceeded:

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

If specified value is attained:

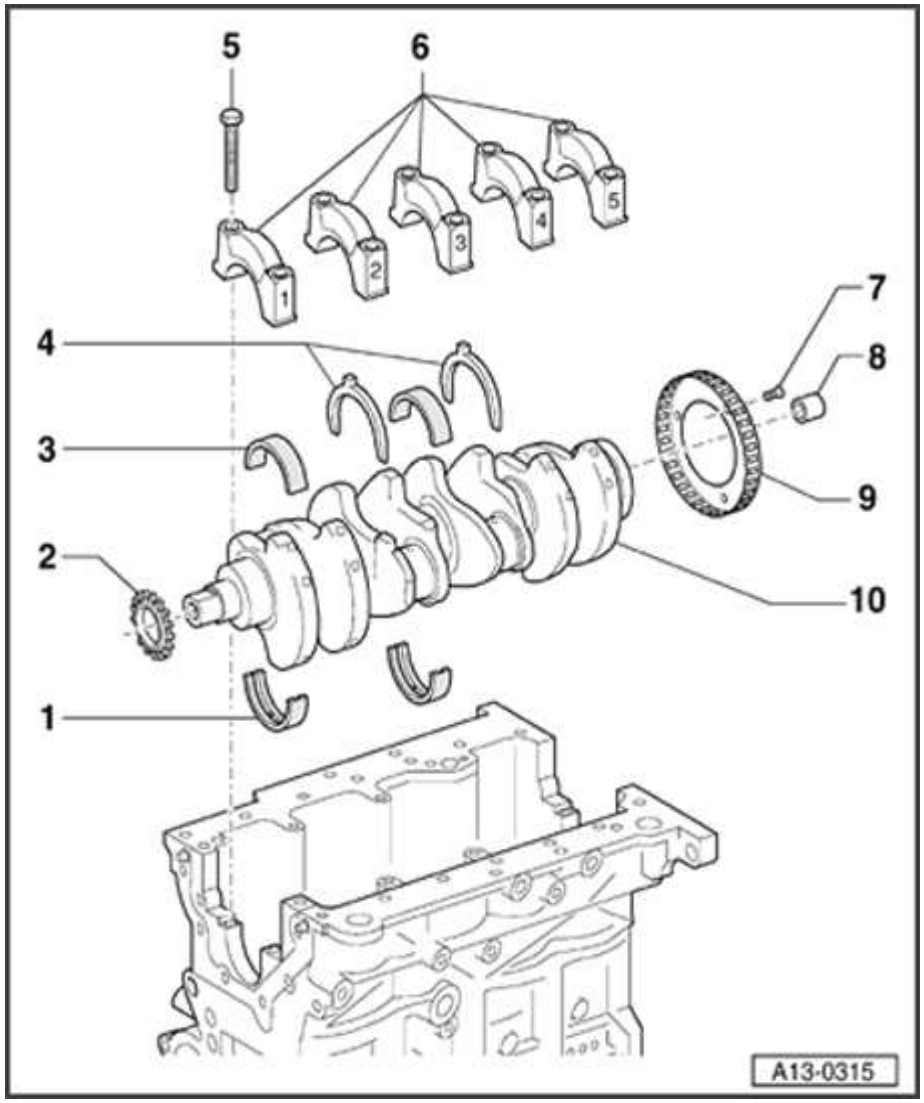
- Install new bolts and tighten.

Tightening torque

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

1) 90° corresponds to a quarter turn

13-67



Crankshaft, removing and installing

Note:

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

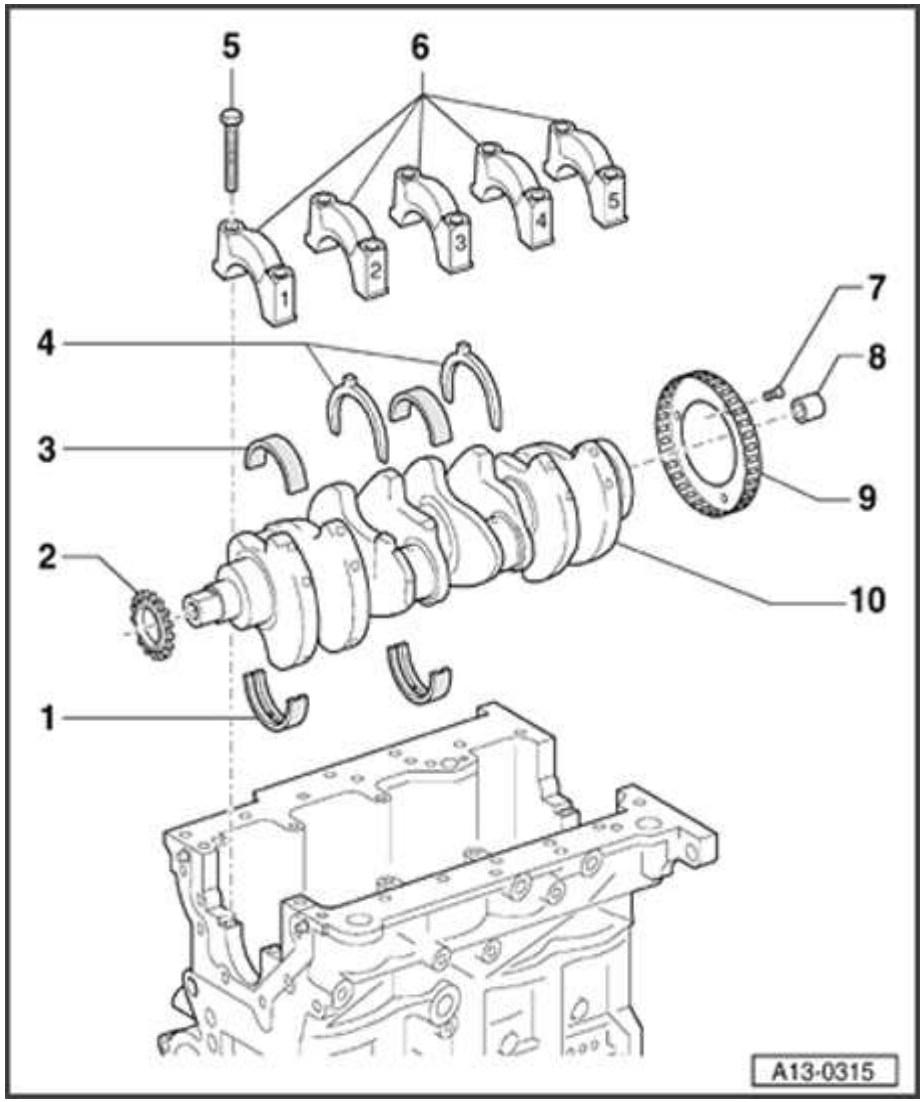
1 - Bearing shell

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

2 - Chain sprocket

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

13-68



3 - Bearing shell

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

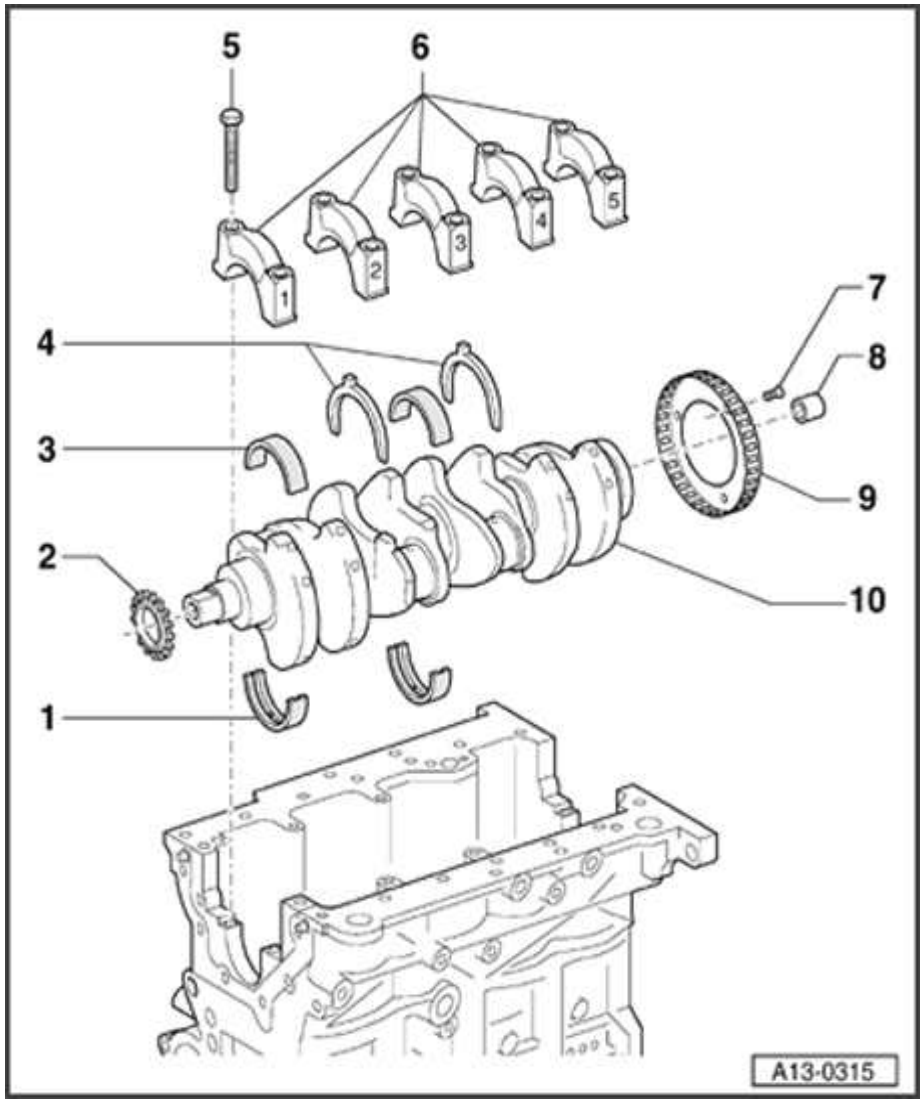
4 - Thrust washers

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

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

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

13-69



6 - Bearing cap

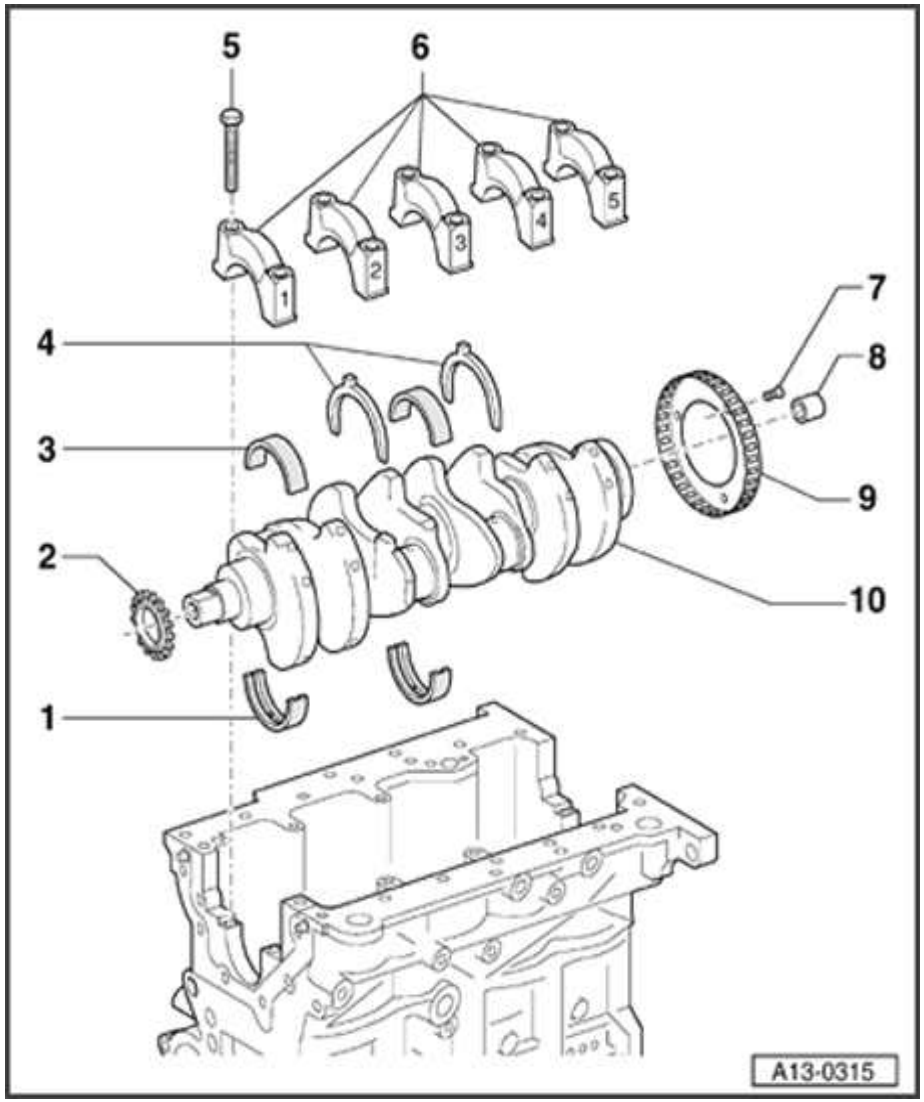
- Bearing cap 1: Pulley end
- Bearing cap 3 with recesses for thrust washers
- Bearing shell retaining lugs (cylinder block/bearing cap) must be on the same side

7 - 10 Nm + $^{1}/_{4}$ turn (90 °) further

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

8 - Needle bearing

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



9 - Sensor wheel

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

10 - Crankshaft

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

13-71

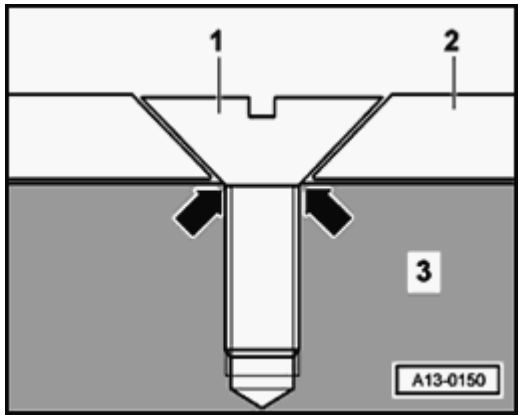


Fig. 1 Removing and installing sensor wheel

Note:

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

Tightening torque

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

1) Replace bolts

2) 90 ° corresponds to a quarter turn

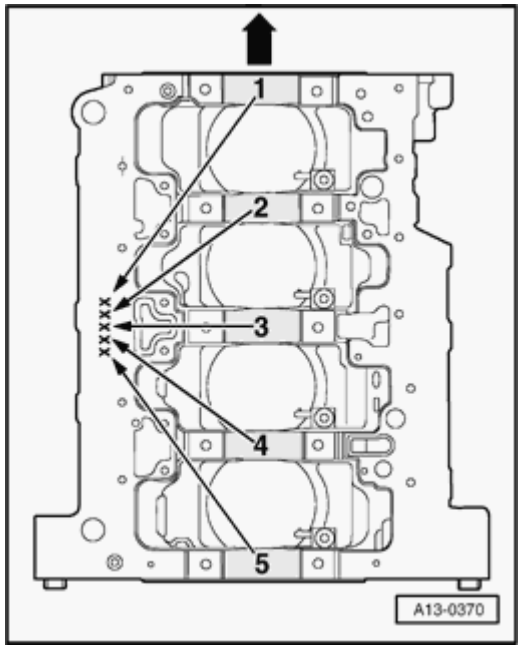


Fig. 2 Allocation of crankshaft bearing plates for cylinder block

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

Note:

Arrow points in direction of travel.

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

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

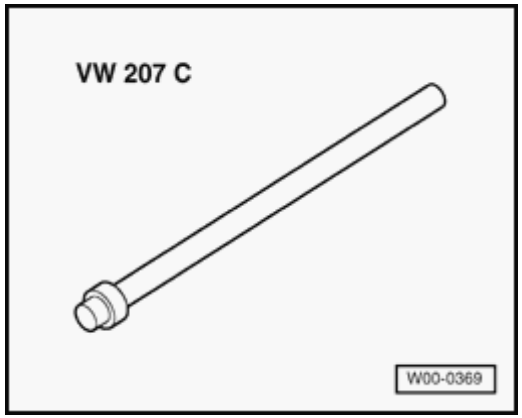
Note:

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

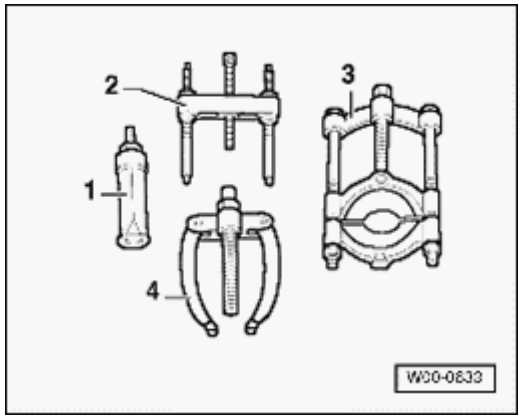
13-73

Crankshaft needle bearing, removing and installing

Special tools and equipment



- Special tool VW 207 C



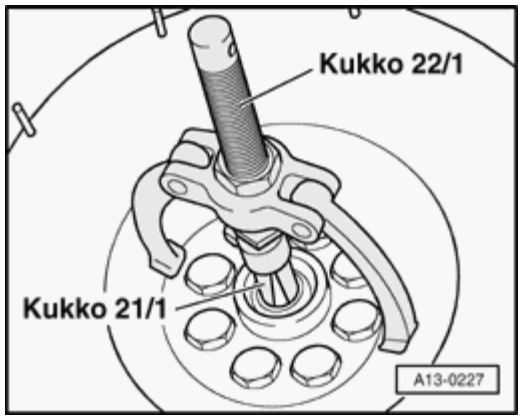
- Special tool Kukko 21/1 (Item 1) and Kukko 22/1 (Item 4)
- Depth gauge

13-74

Note:

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

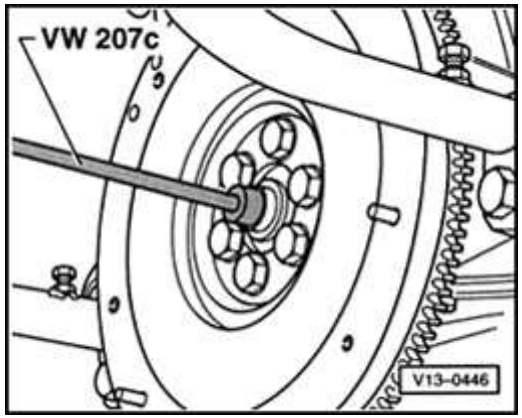
Removing



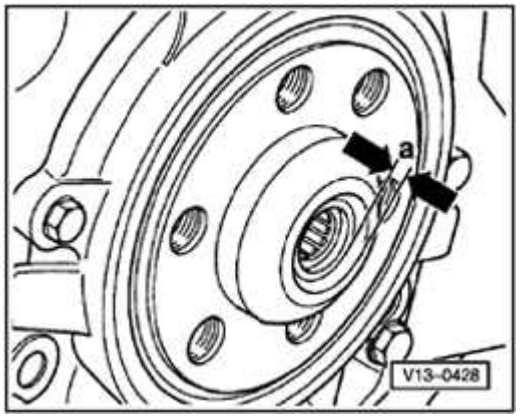
- Pull out needle bearing with Kukko 21/1 and Kukko 22/1.

13-75

Installing



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



Installation depth of needle bearing

- Distance a = 1.5 mm

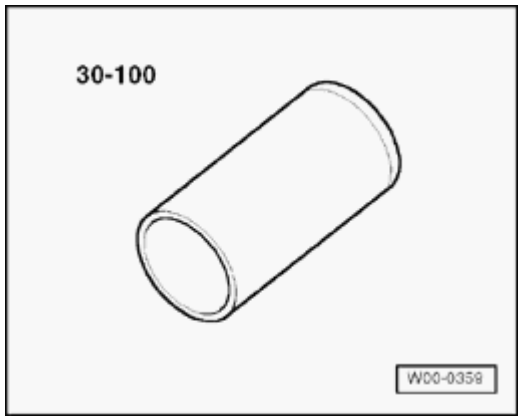
Crankshaft dimensions

(in mm)

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

Chain sprocket, removing and installing

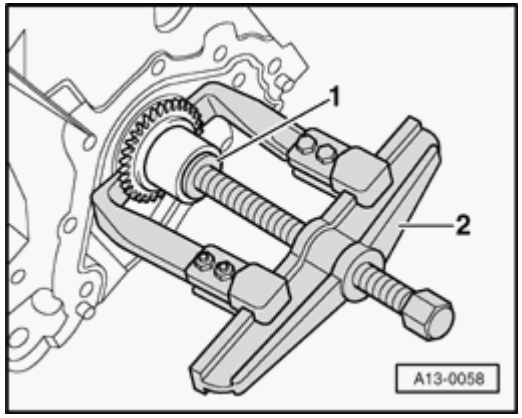
Special tools and equipment



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

Removing

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



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

Installing

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

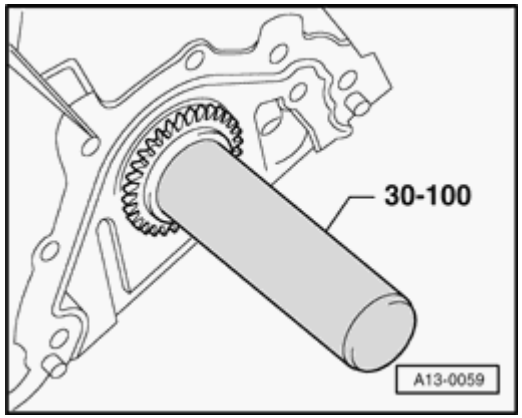
WARNING!

Wear protective gloves!

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

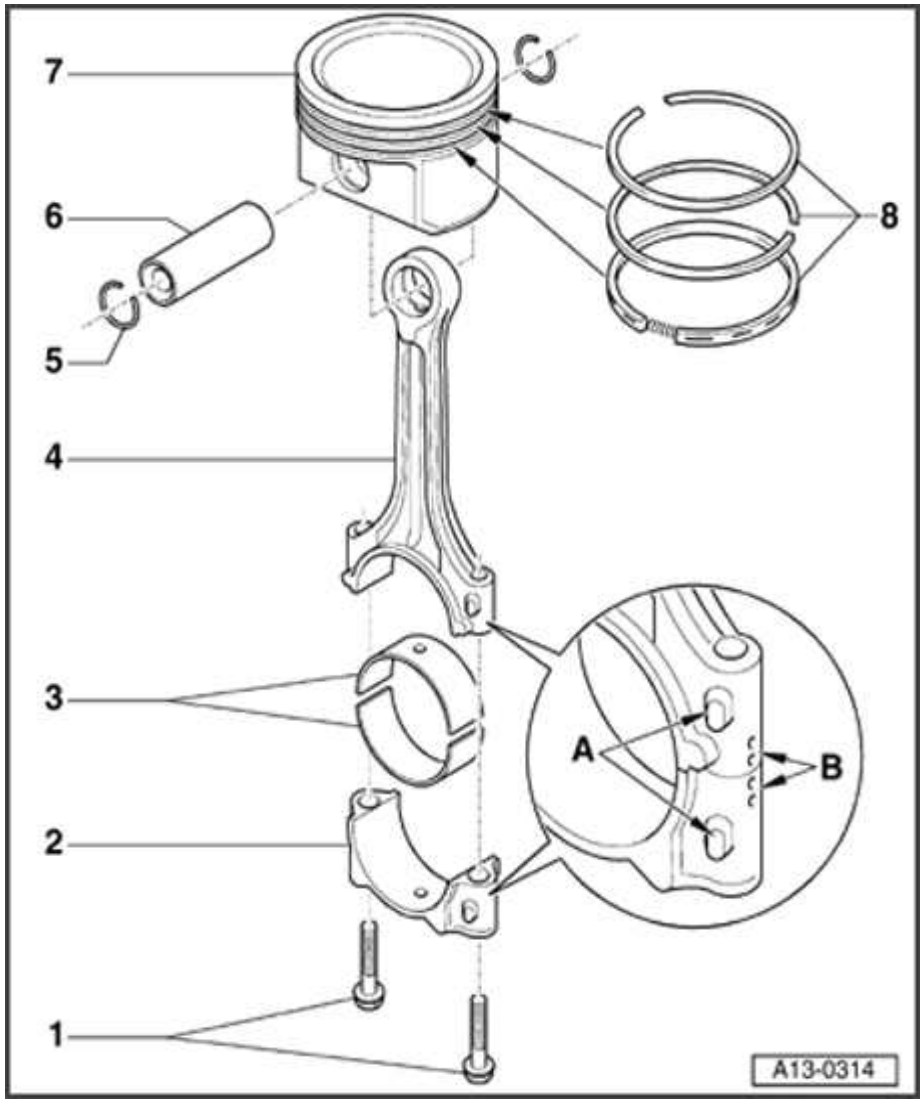
Note:

Installation position: wide collar on sprocket facing toward engine



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

13-79



Pistons and connecting rods, disassembling and assembling

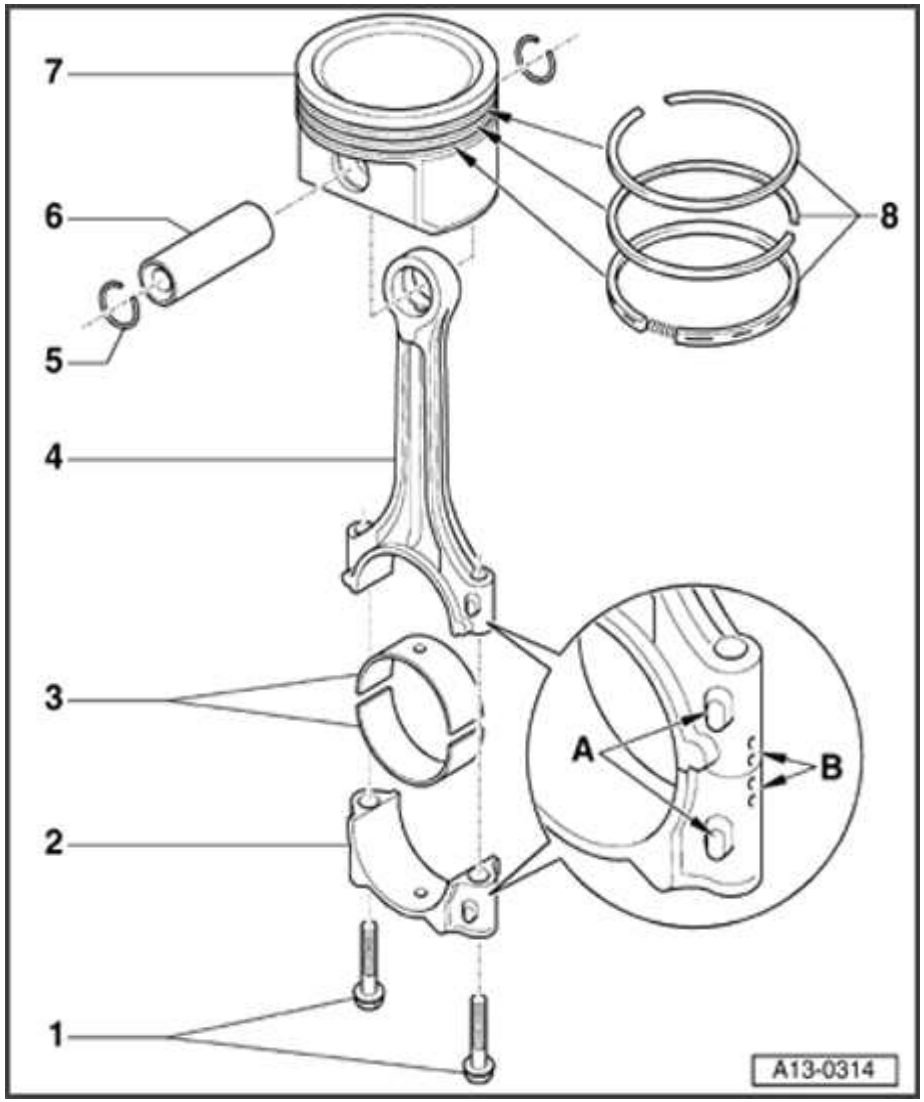
Note:

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

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

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

13-80



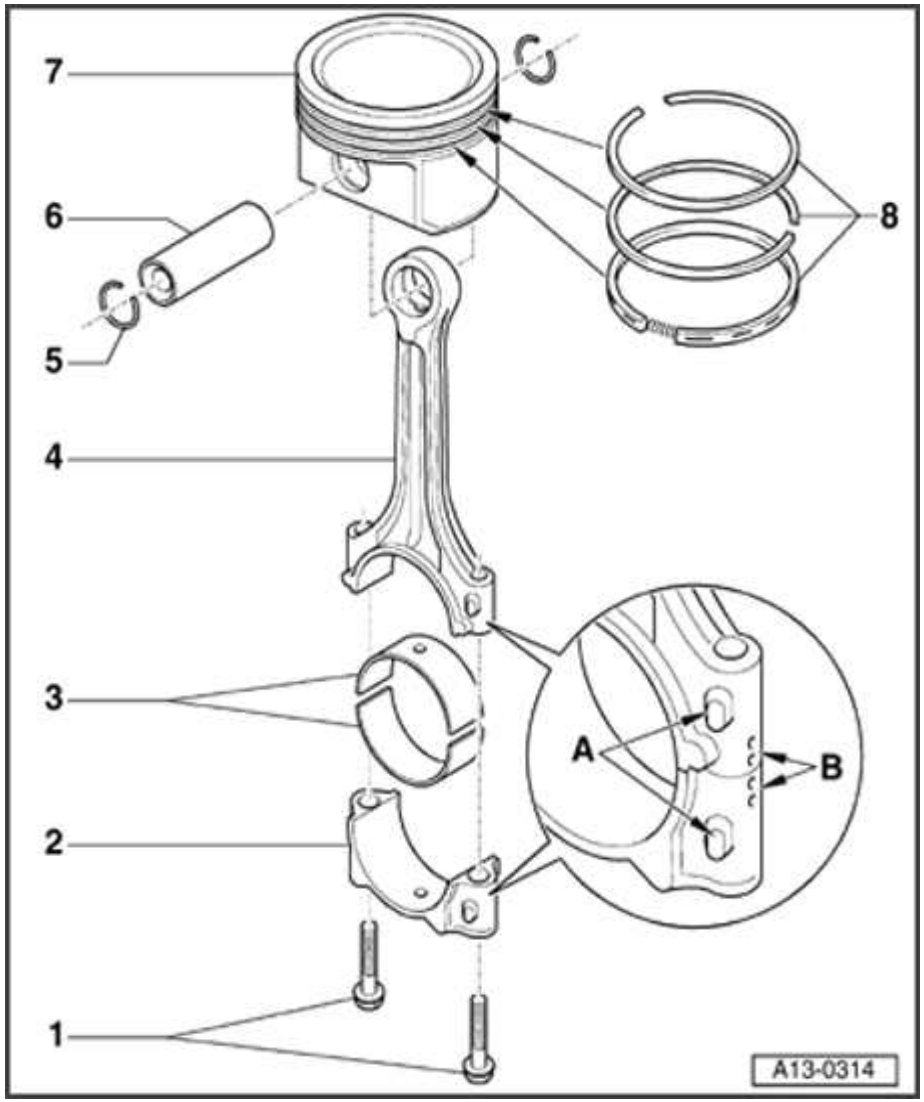
2 - Connecting rod bearing cap

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

3 - Bearing shells

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

13-81



4 - Connecting rod

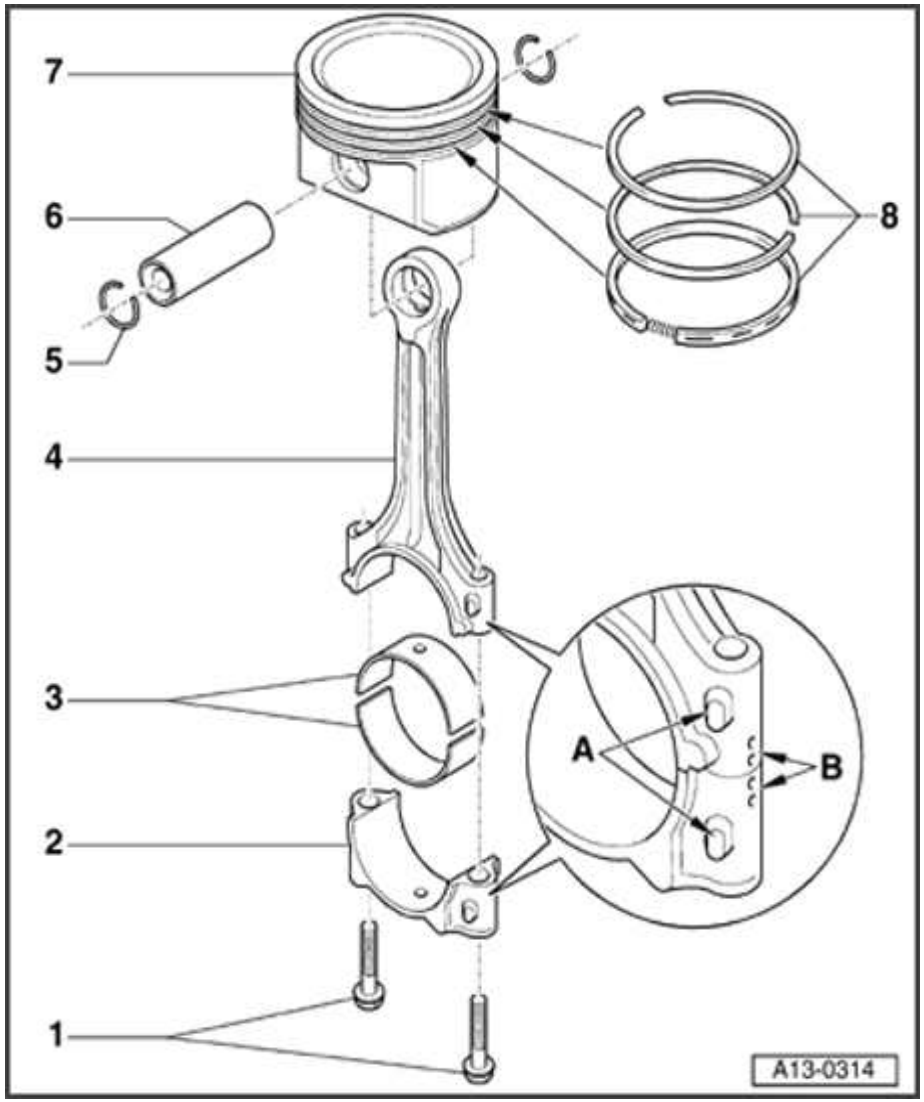
- Only replace as a set
- Mark cylinder number -B-
- Installation position: Markings -A- face toward pulley side
- With oil bore for piston pin lubrication

5 - Circlip

6 - Piston pin

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

13-82



7 - Piston

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

8 - Piston rings

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

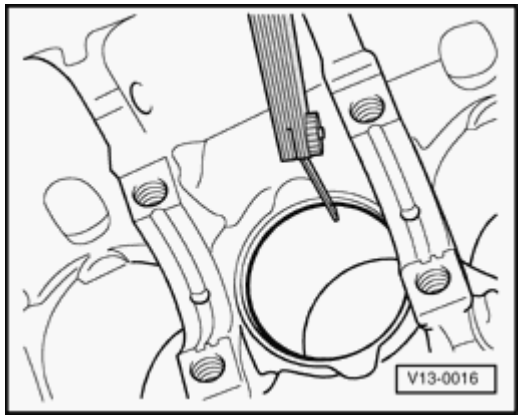


Fig. 1 Checking piston ring gap

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

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

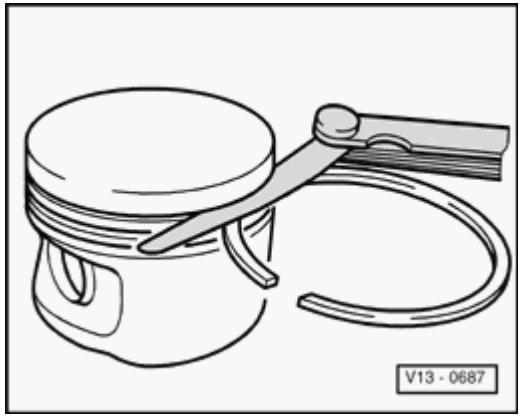


Fig. 2 Checking ring to groove clearance

- Clean groove before checking clearance.

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

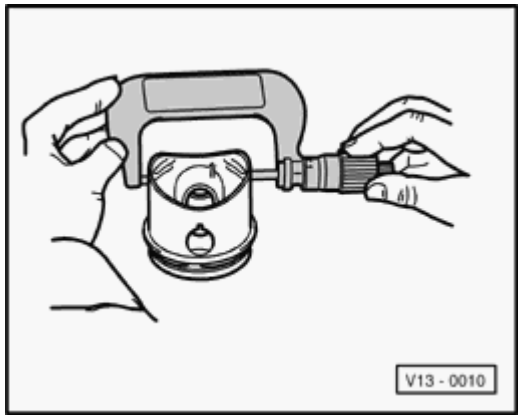


Fig. 3 Checking piston

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

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

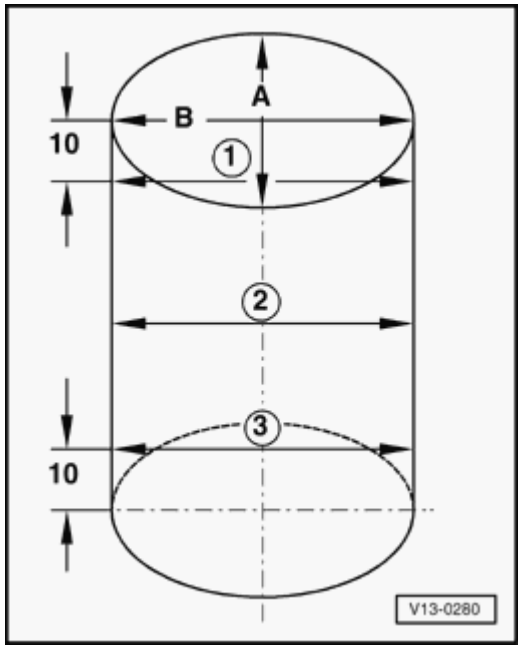


Fig. 4 Checking cylinder bores

Special tools and equipment

♦ Use internal dial gauge 50 to 100 mm

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

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

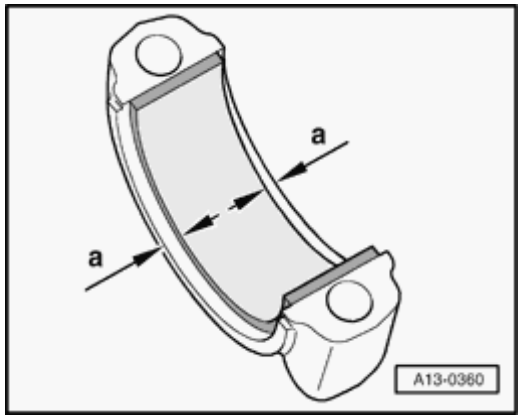


Fig. 5 Location of bearing shell

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

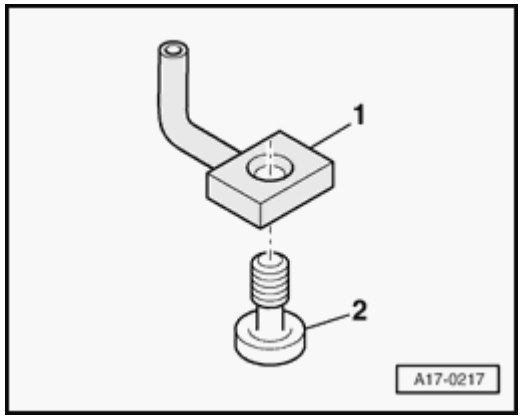


Fig. 6 Oil spray jet and pressure relief valve

1 - Oil spray jet (for piston cooling)

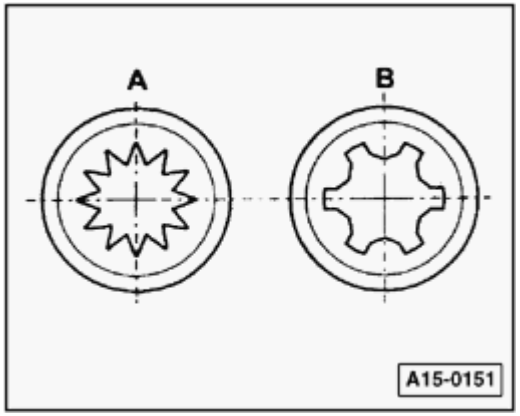
2 - Bolt with pressure relief valve - 27 Nm
  - ♦ Opening pressure 1.3 to 1.6 bar

Piston and cylinder dimensions

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

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

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



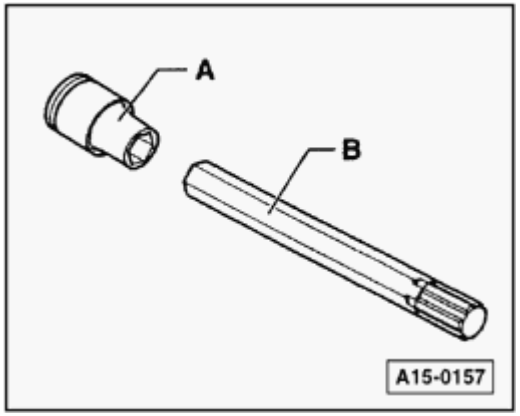
Conversion of cylinder head bolts from inner 12-point to Polydrive bolts. Conversion is a running-change

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 .

15-1

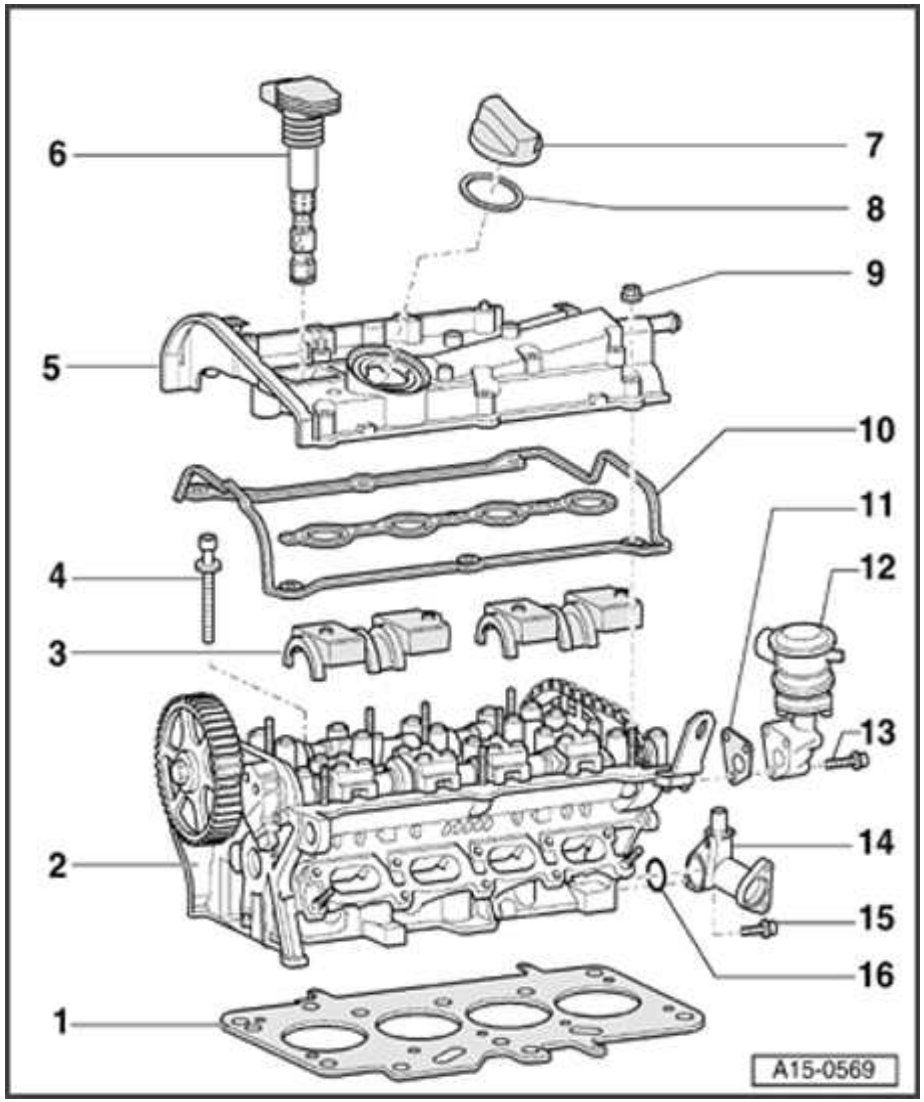
Cylinder head, removing and installing

Note:

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

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

15-2



Part I - Cylinder head components

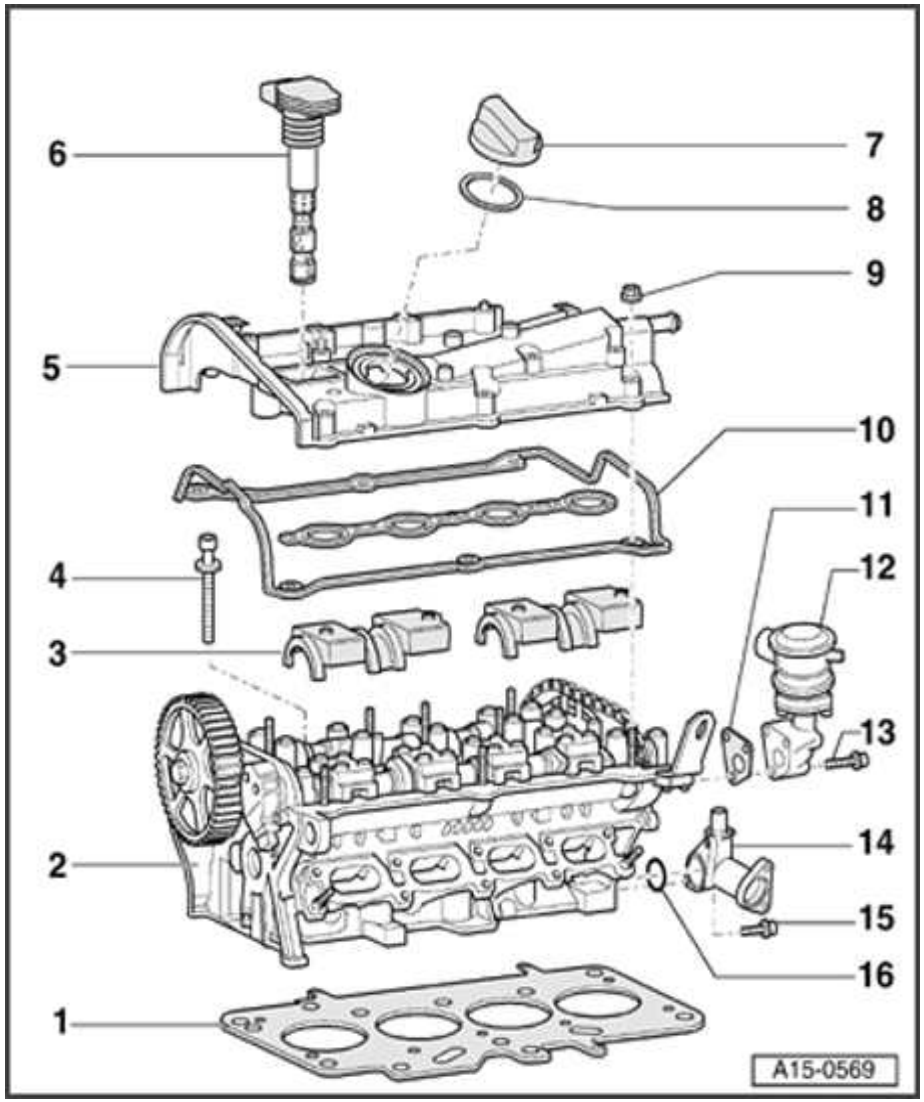
1 - Cylinder head gasket

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

2 - Cylinder head

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

15-3



3 - Oil deflector

- Note installation position

4 - Cylinder head bolt

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

5 - Cylinder head cover

- Removing and installing ⇒ Page 15-15

6 - Ignition coil

7 - Cap

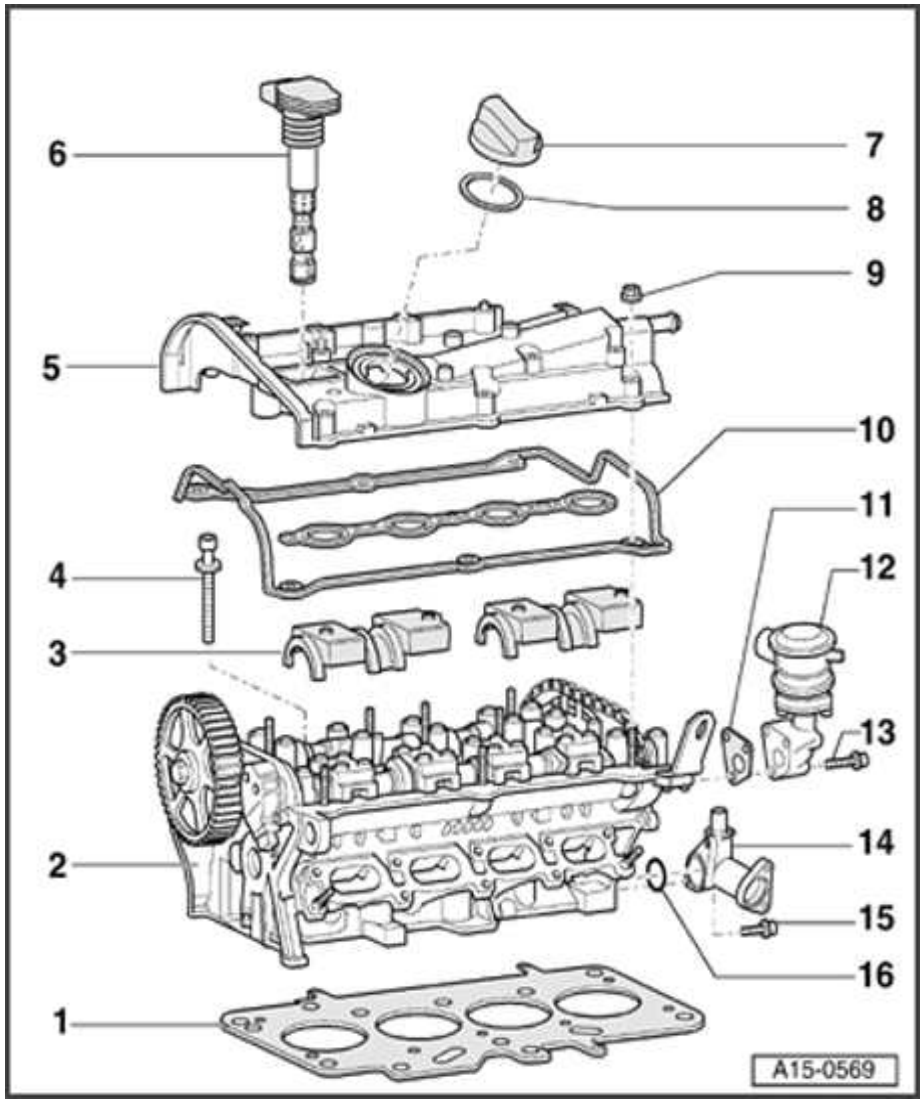
8 - Gasket

- Replace if damaged or leaking

9 - 10 Nm

- First tighten inner nuts
- Tighten outer nuts diagonally

15-4



10 - Cylinder head cover gasket

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

11 - Gasket

- Always replace

12 - Combi valve for secondary air inlet

- With screw connection

13 - 10 Nm

14 - Coolant flange

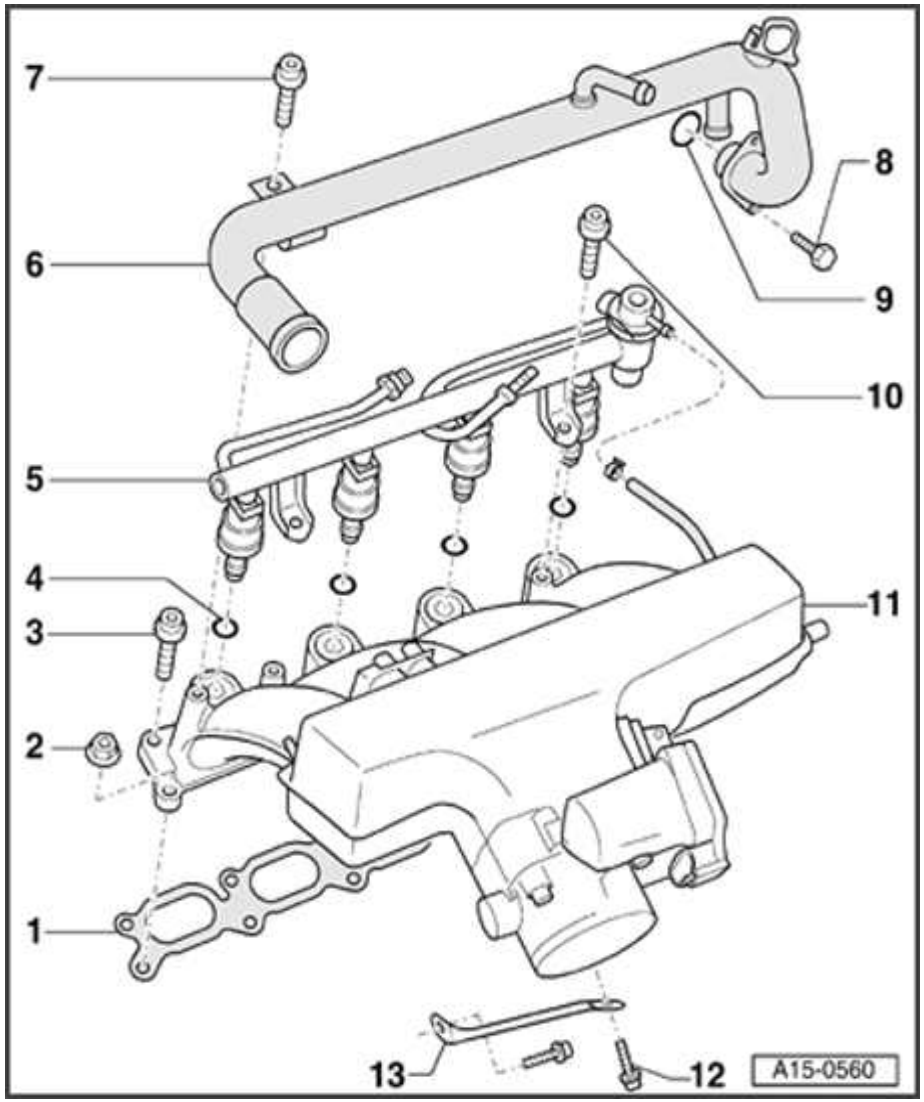
- With coolant temperature sensor

15 - 10 Nm

16 - O-ring

- Always replace

15-5



Part II - Intake manifold components

1 - Gasket

- Note installation position
- Always replace

2 - 10 Nm

3 - 10 Nm

4 - O-ring

- For injector
- Always replace

5 - Fuel rail

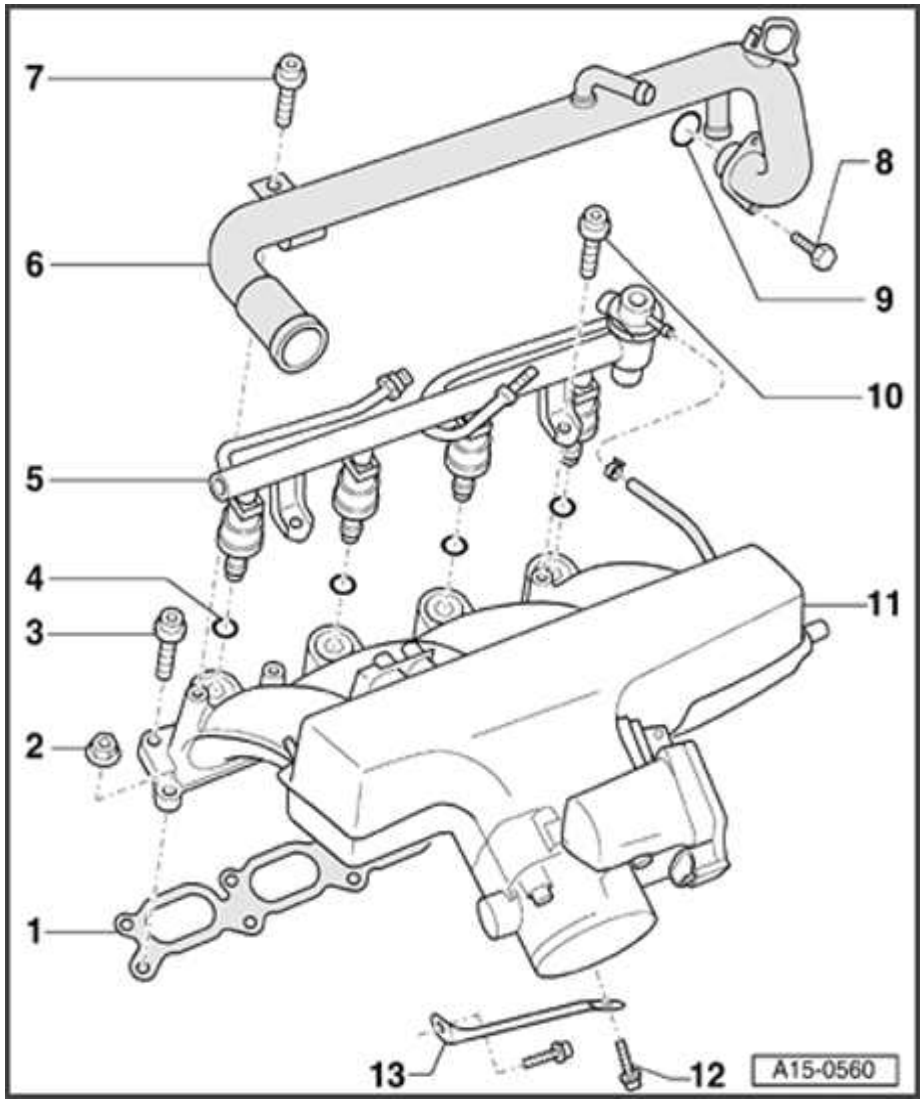
- With injectors

6 - Top coolant line

7 - 10 Nm

8 - 10 Nm

15-6



9 - O-ring

- For top coolant line
- Always replace

10 - 10 Nm

11 - Intake manifold

- Removing and installing ⇒ Page 15-9

12 - 20 Nm

13 - Support

- For intake manifold

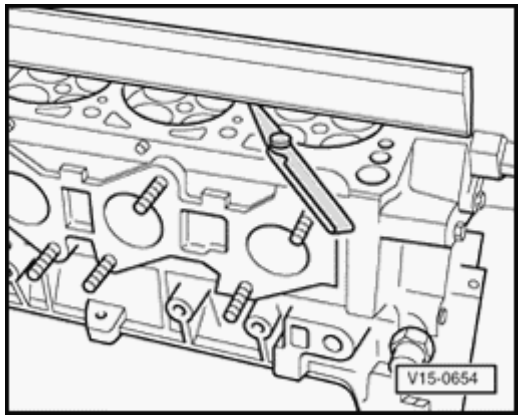


Fig. 1 Check cylinder head for distortion.

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

• Max. permissible distortion: 0.1 mm

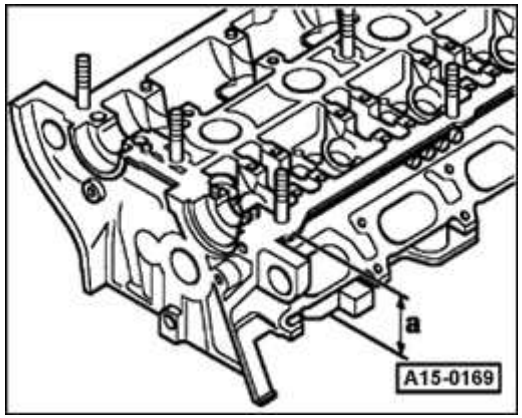


Fig. 2 Reworking dimension for cylinder head

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

♦ Minimum dimension -a- = 139.20 mm

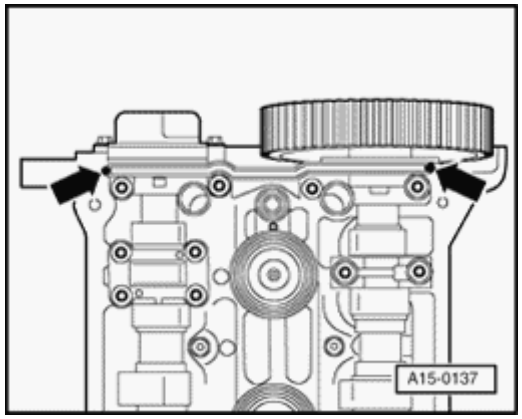


Fig. 3 Seal connections between double bearing cap and cylinder head

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

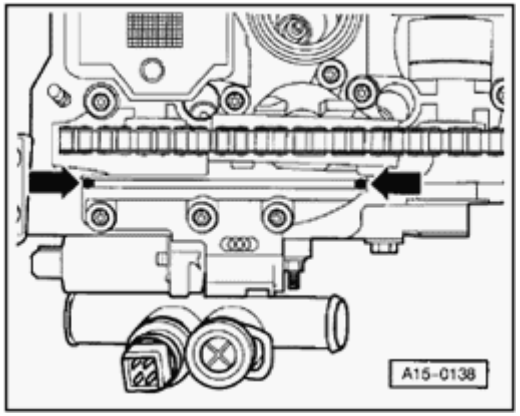


Fig. 4 Seal connections between camshaft adjuster and cylinder head

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

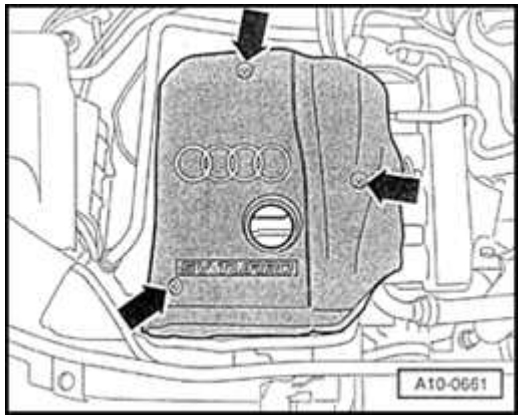
15-9

Intake manifold, removing and installing

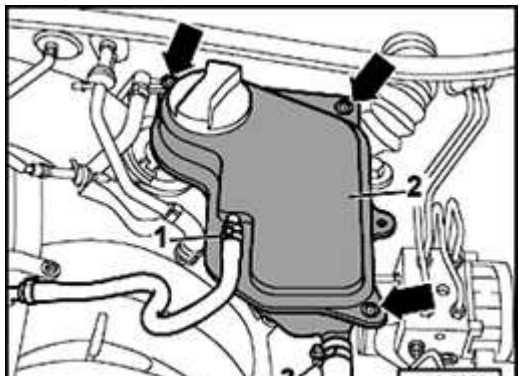
Removing

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

- Disconnect Ground strap at battery with ignition switched off.

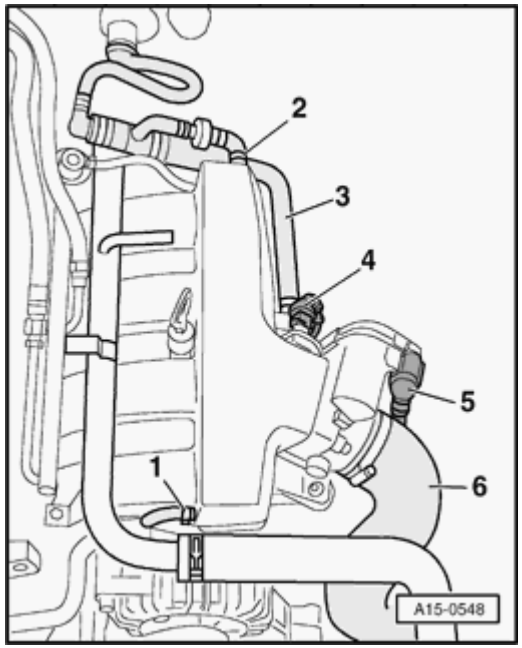


- Remove engine cover -arrows-.
- Drain coolant ⇒ Page 19-4 .



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

15-10

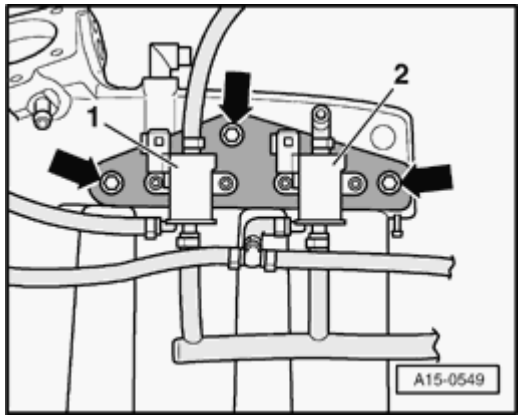


- Unplug vacuum hoses -1 to 3-.
- Disconnect connectors as follows:

4 - on intake air temperature sensor -G42-

5 - for throttle valve control module -J338-

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

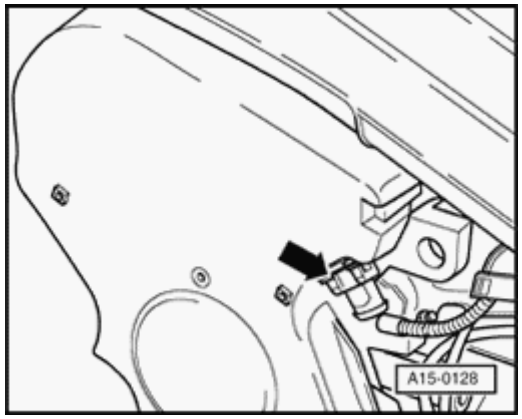


- Remove retaining plate for recirculation valve for turbocharger -N249- -1- from underneath intake line and secondary air inlet valve -N112 -2- -arrows-.

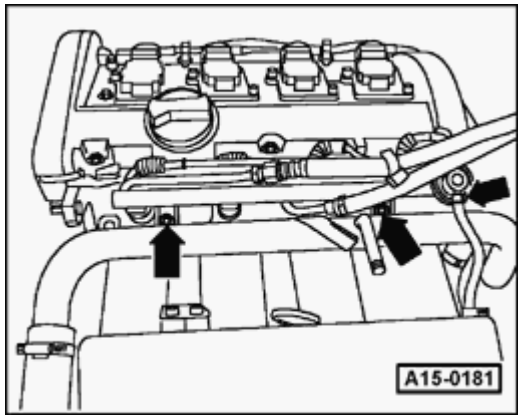
Note:

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

15-11



- Disconnect connector for Camshaft Position sensor -arrow-.



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

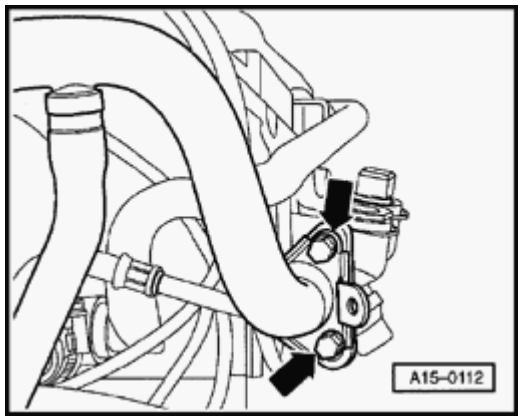
Note:

Carefully protect the removed injectors from contamination.

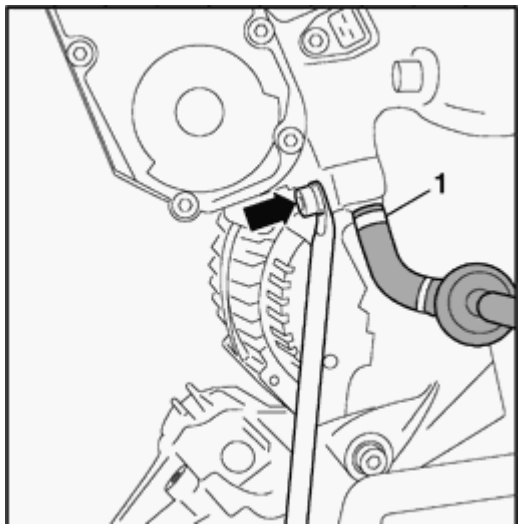
15-12

- Disconnect coolant hoses from upper coolant line.

- Move electrical wiring at top of coolant line aside.



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



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

- Remove suction hose from flange and remove.

Note:

Plug intake ports on cylinder head with clean cloths.

Installing

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

Note:

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

- Top up coolant ⇒ Page 19-7 .

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

⇒ *Radio operating instructions*

- Close windows fully using window switches.

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

- Set clock to correct time.

- Perform throttle-valve control module adaption:

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

Tightening torques

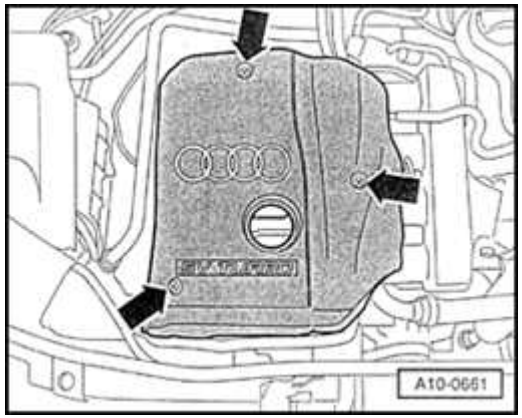
Component		Nm
Intake manifold to cylinder head		10
Support for intake manifold	to intake manifold	20
	to bracket	20
Fuel manifold to intake manifold		10
Coolant line to coolant flange		10
Coolant line on intake line		10
Hose clamps for coolant hoses		

	2
Hose clamps for air duct hoses	3.5

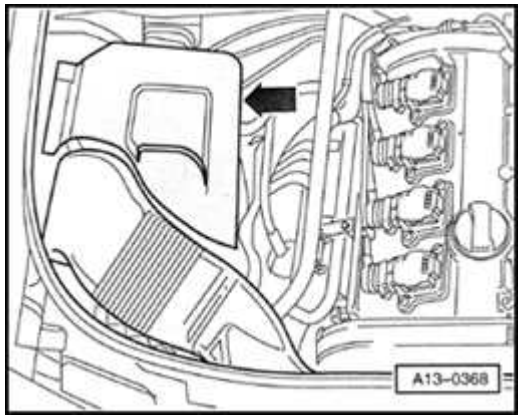
15-15

Cylinder head cover, removing and installing

Removing

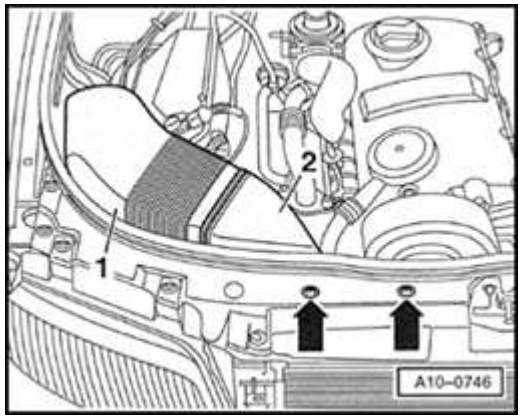


- Remove engine cover -arrows-.

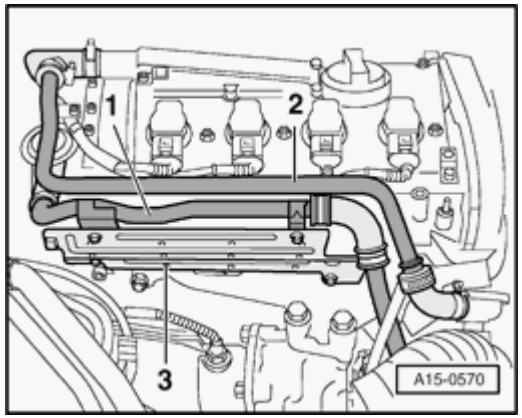


- Remove air filter cover -arrow-.

15-16

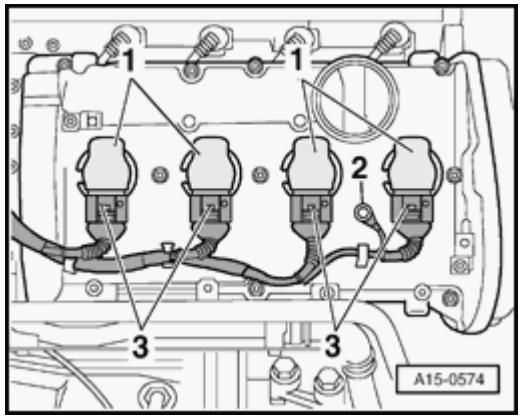


- Remove bolts -arrows-.
- Remove air ducts -1- and -2-.

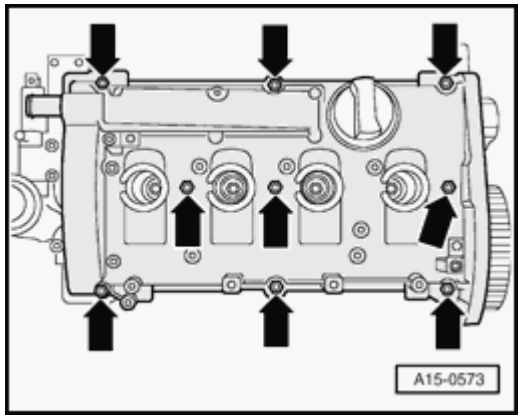


- Remove line of crankcase vent -1-.
- Disconnect hose of crankcase venting from cylinder head cover.
- Remove line -1- from combination valve for secondary air inlet on cylinder head cover and from heat shield -3- (engine code ANB only).
- Slightly swivel secondary air inlet line to side.

15-17



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



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

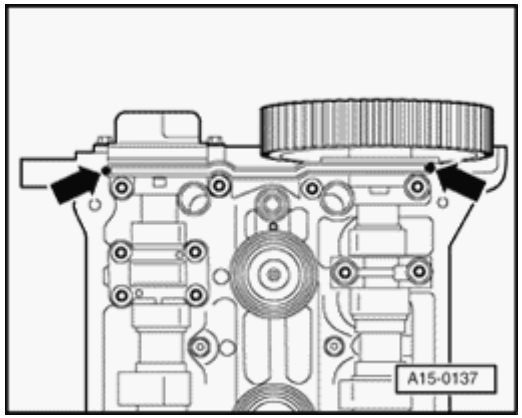
15-18

Installing

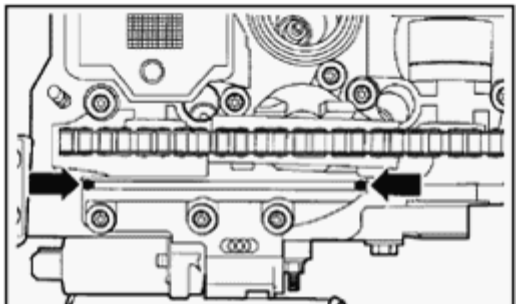
Installation is carried out in the reverse order of removal; note the following:

Note:

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



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



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

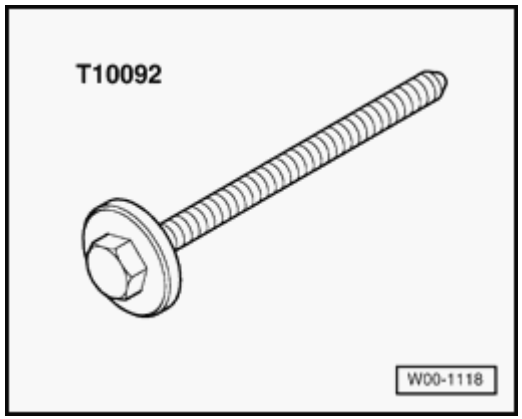
Tightening torques

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

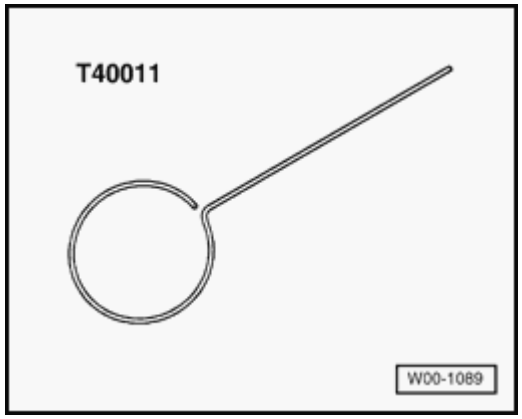
15-20

Cylinder head, removing

Special tools and equipment



- Socket head fastener T10092



- Pin T40011

15-21

Procedure

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

Note:

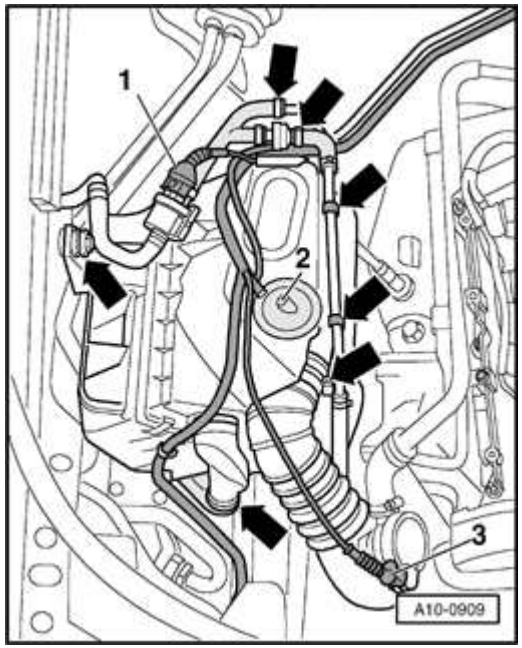
All cable ties which are released or cut open when removing must be located in the same position when installing.

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



- Remove air filter cover -arrow-.

15-22



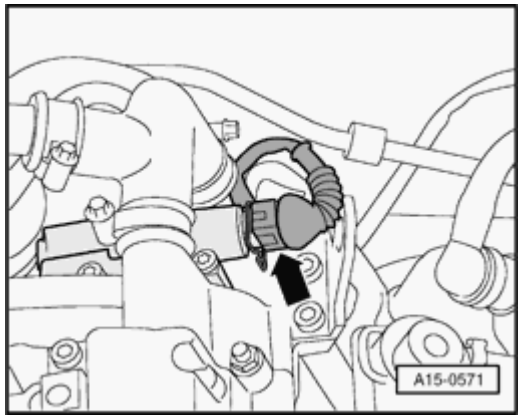
- Disconnect connectors as follows:

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

2 - on air mass meter

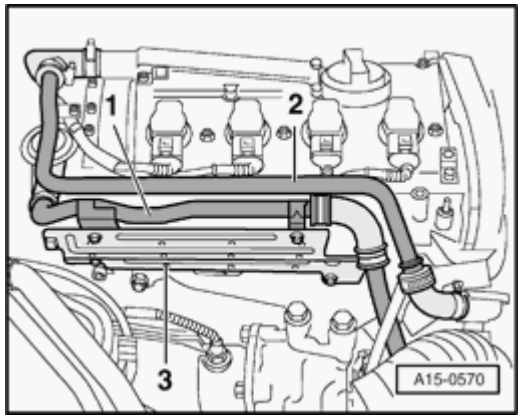
3 - on solenoid valve for charge pressure control -N75-

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

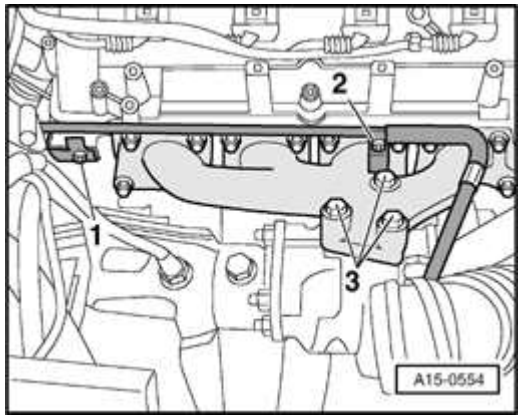


- Disconnect connector -arrow- from camshaft adjuster.

15-23

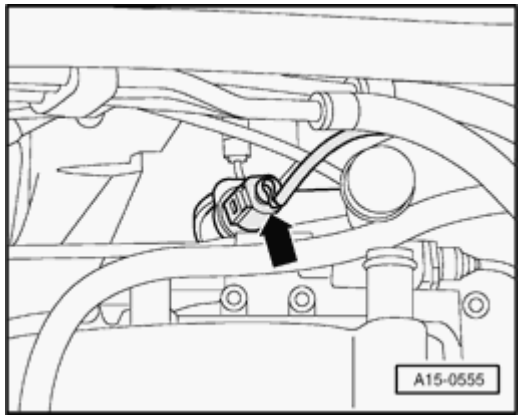


- Remove line of crankcase vent -1-.
- Remove hose of crankcase venting from cylinder head cover.
- Remove line -1- from combination valve for secondary air inlet on cylinder head cover and from heat shield -3- (engine code ANB only).
- Slightly swivel secondary air inlet line to side.
- Remove heat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

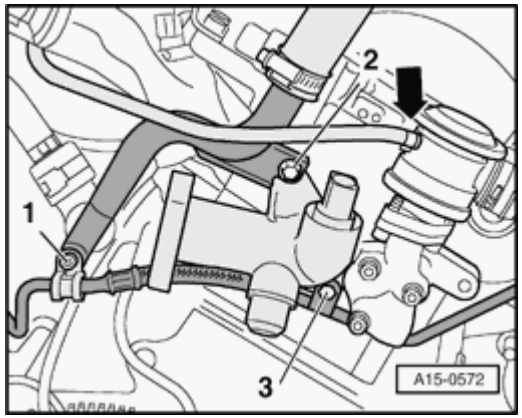


- Remove bolts -1- and -2- of oil feed line.
- Remove bolts -3- for exhaust turbocharger.

15-24



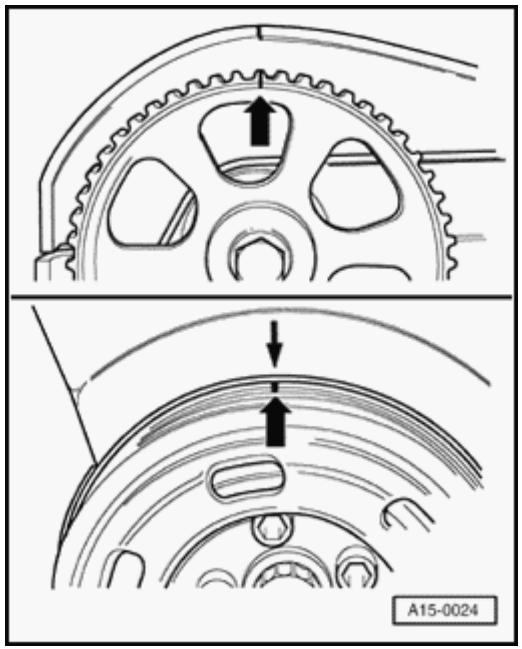
- Disconnect connector -arrow- at coolant temperature sensor -G2-/-G62-.



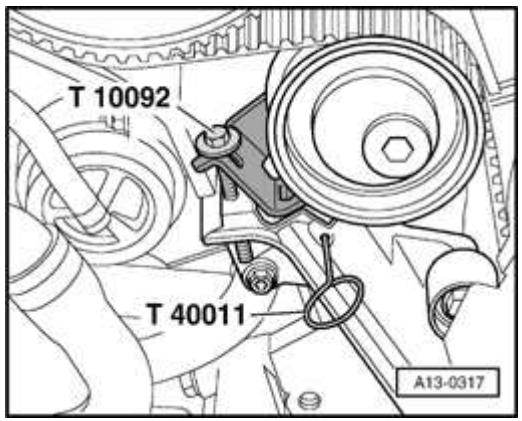
- Disconnect vacuum hose -arrow- from combination valve.
- Remove bolts -2- and -3- and remove coolant flange.
- Remove bracket -1- for oil feed line.
- Unclip all wiring from cylinder head and move clear to one side.
- Remove coolant hose going to heat exchanger (heater unit) at back of cylinder head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

15-25

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

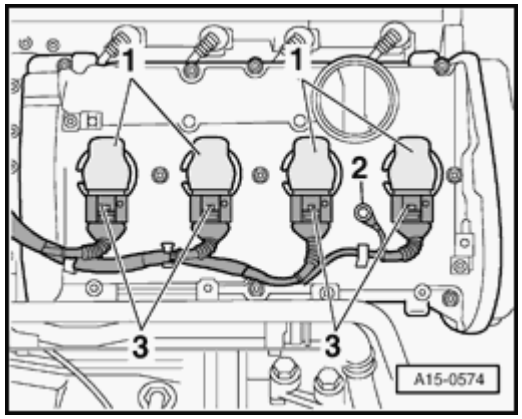


- Set crankshaft to markings for TDC of No. 1 cylinder by turning central bolt on crankshaft sprocket in direction of rotation -arrows-.

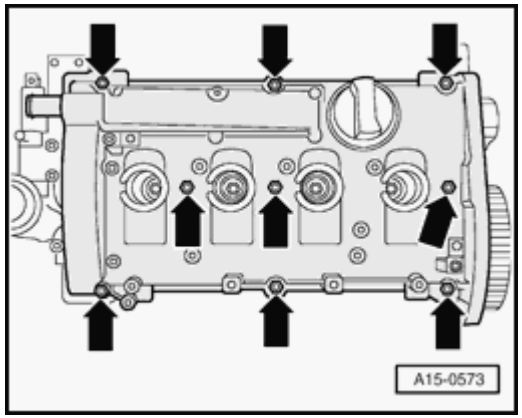


- Attach socket head fastener T10092 into tensioner.
- Only tension pressure piston of tensioner until piston is secured with pin T40011.
- Remove toothed belt from camshaft sprocket.

15-26

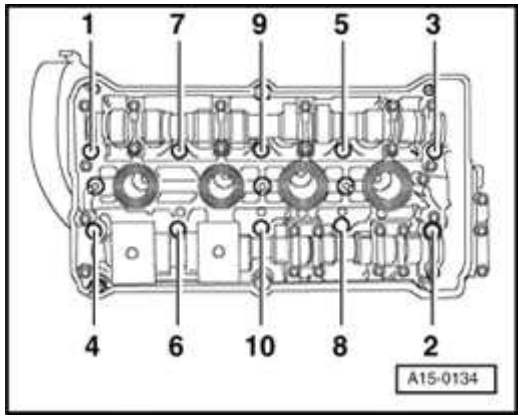


- Disconnec Ground wire -2-.
- Disconnect connectors -3-.
- Move lines and hoses aside.
- Remove ignition coils -1-.



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

15-27



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

15-28

Cylinder head, installing

Note:

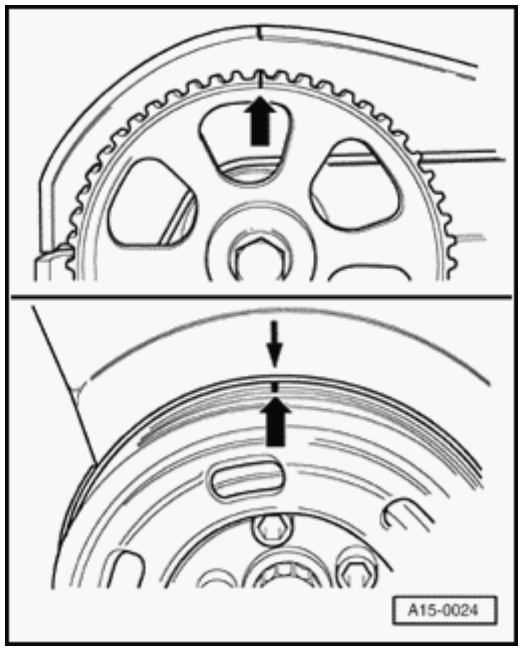
- *Always replace the cylinder head bolts.*
- *When performing repairs, replace seals, gaskets, self-locking nuts and bolts which have a specified tightening angle.*
- *Secure all hose connections with the correct hose clips (same as original equipment):*

⇒ *Parts List*

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

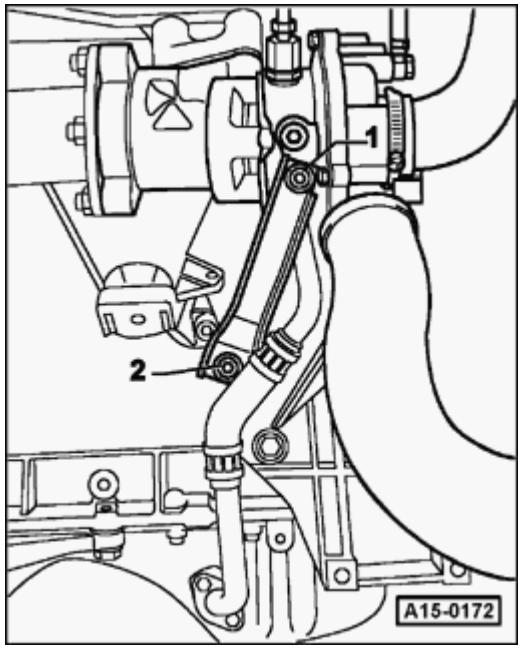
the silicone layer or the indented area will lead to leaks.

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

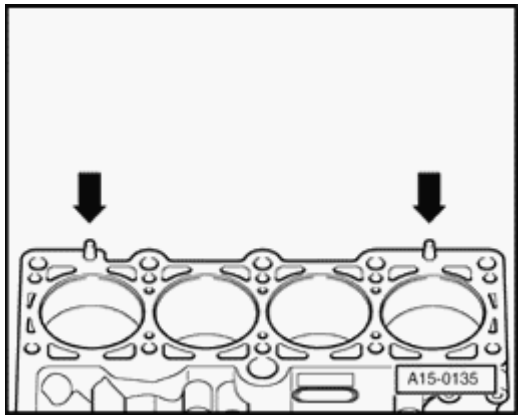


- Before positioning cylinder head, set crankshaft and camshaft to TDC of cylinder 1.

15-29

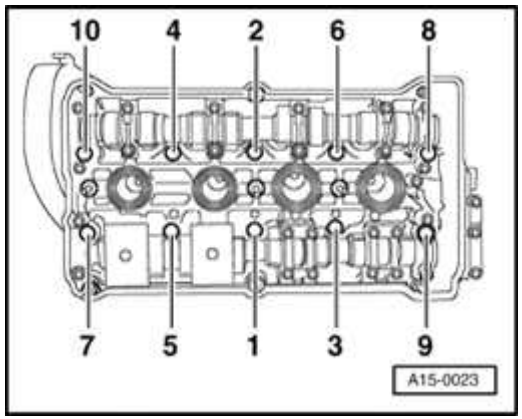


- Loosen bolts -1- and -2- on turbocharger bracket (about 2 full turns each) to avoid stressing when installing cylinder head.



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

15-30



- Insert cylinder head bolts and tighten by hand.

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

Note:

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

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

Note:

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

15-31

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

- Install intake line ⇒ Page 15-13 .

- Replace coolant ⇒ Page 19-7 .

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

⇒ *Radio operating instructions*

- Close windows fully using window switches.

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

- Set clock to correct time.

- Perform throttle-valve control module adaption:

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

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

Tightening torques

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

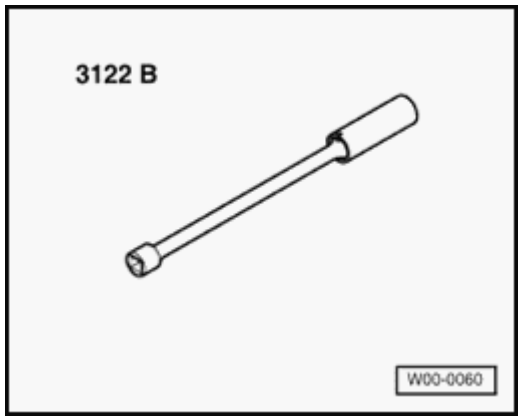
[1] Replace bolts

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

15-33

Compression, checking

Special tools and equipment



- Spark plug spanner 3122 B



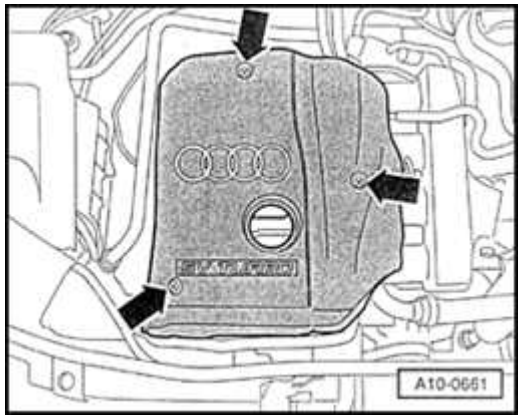
- Compression tester VAG VAG 1763

15-34

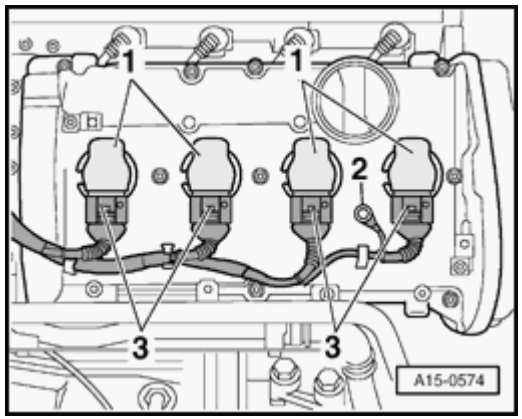
Test conditions:

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

Test sequence



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



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

- Remove spark plugs with spark plug spanner 3122B.

- Disconnect connectors from all injectors.

- Fully open throttle valve.

- Check compression with compression tester VAG VAG 1763.

Note:

Using the compression tester

⇒ *Operating instructions*

- Operate starter until tester shows no further pressure increase.

Compression pressure values:

New	Wear limit	Permissible difference between cylinders

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

- Install spark plugs and ignition coils.

Note:

Replace gaskets for ignition coils if damaged.

- Check Diagnostic Trouble Code (DTC) memory:

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

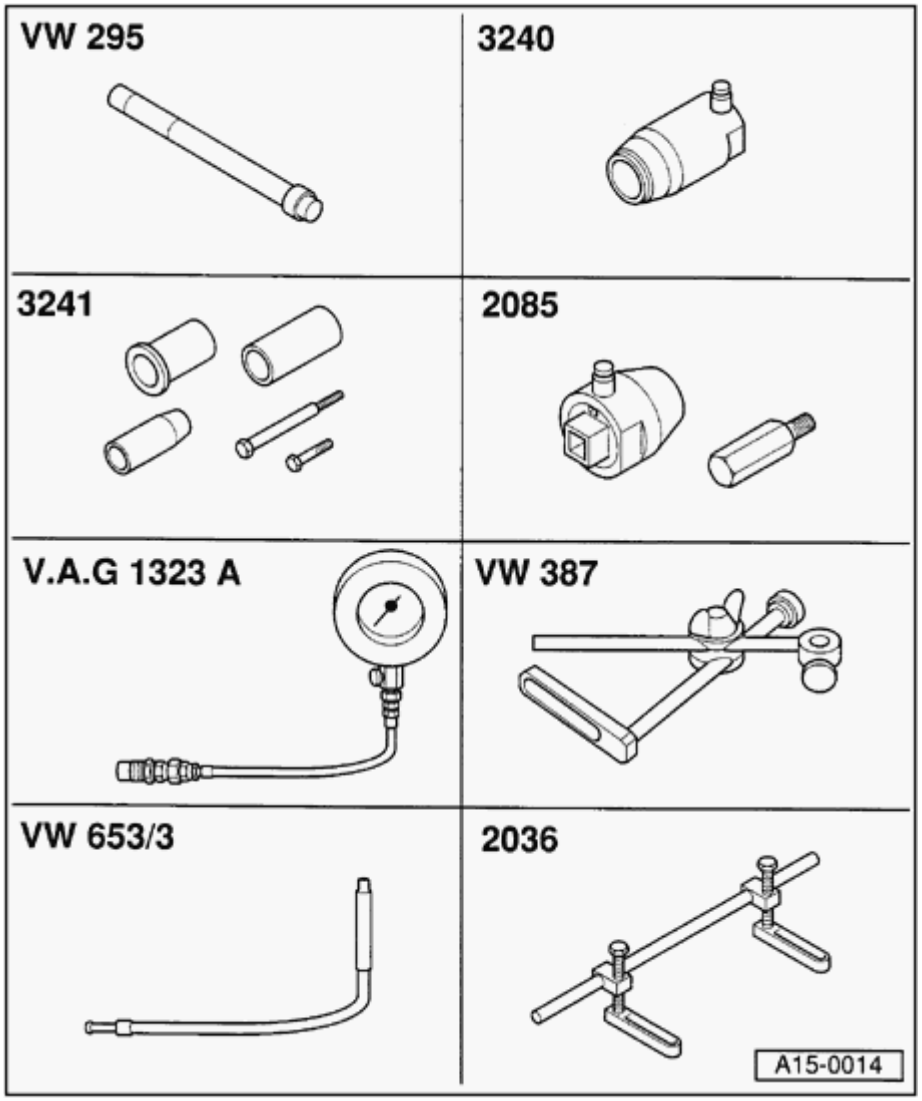
Note:

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

Tightening torques

Component	Nm
Spark plugs in cylinder head	30

15-1

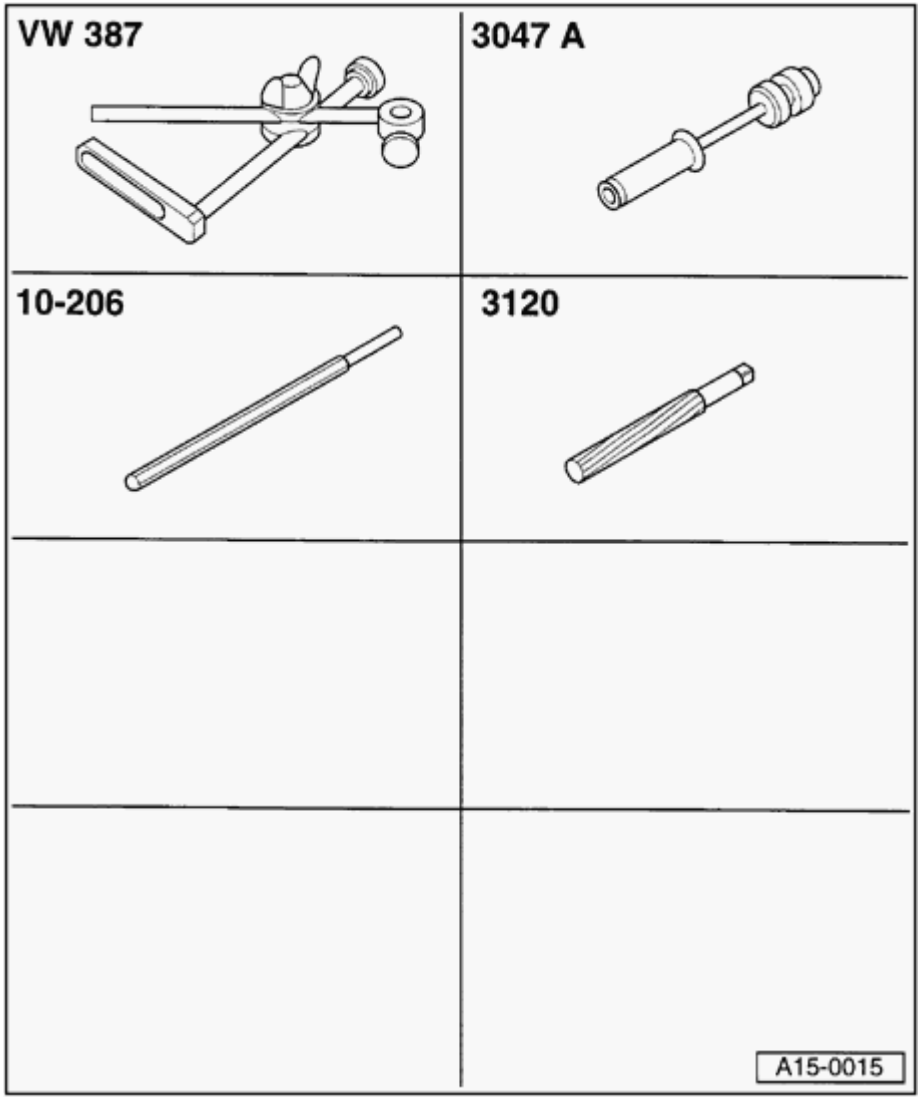


Special tools

The following special tools and test equipment are required for these operations:

VW 295	**Drift**
3240	**Seal extractor**
3241	**Seal installer**
2085	**Puller**
VAG 1381	**Compression recorder**
VW 387	**Dial gauge holder**
VW 653/3	**Pressure hose**
2036	**Adjustable rod**

15-2



VW 541/1	Lever
3047A	Slide hammer
10-206	Drift
3120	Reamer - 7mm

15-1

Valve gear, servicing

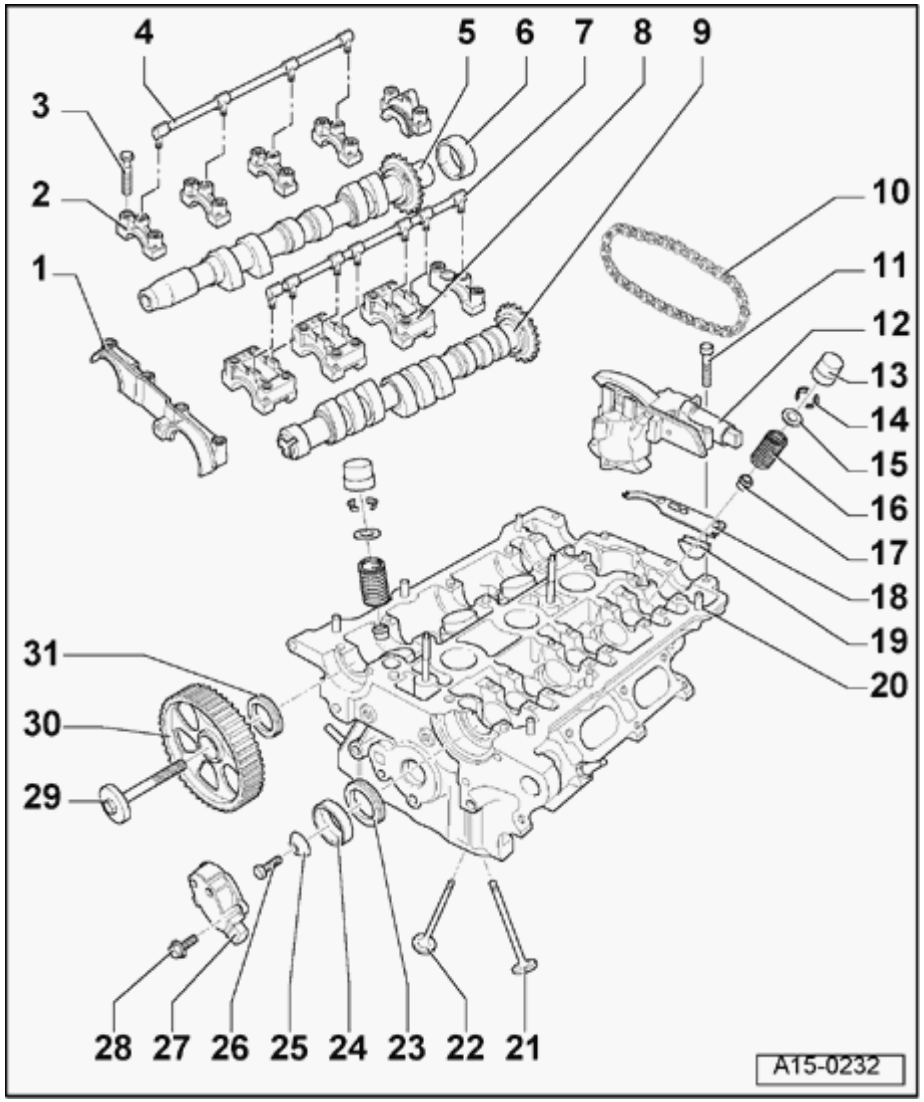
Notes:

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

- *After installing new lifters the engine must not be started for about 30 minutes (otherwise valves will strike pistons). Turn crankshaft two complete revolutions before starting.*

- *Carefully apply a small amount of sealant D 454 300 A2 at the four end points of the sealing surfaces on the cylinder head, using a small screwdriver ⇒ Fig. ⇒ 1 .*

15-2



1 - Double bearing cap

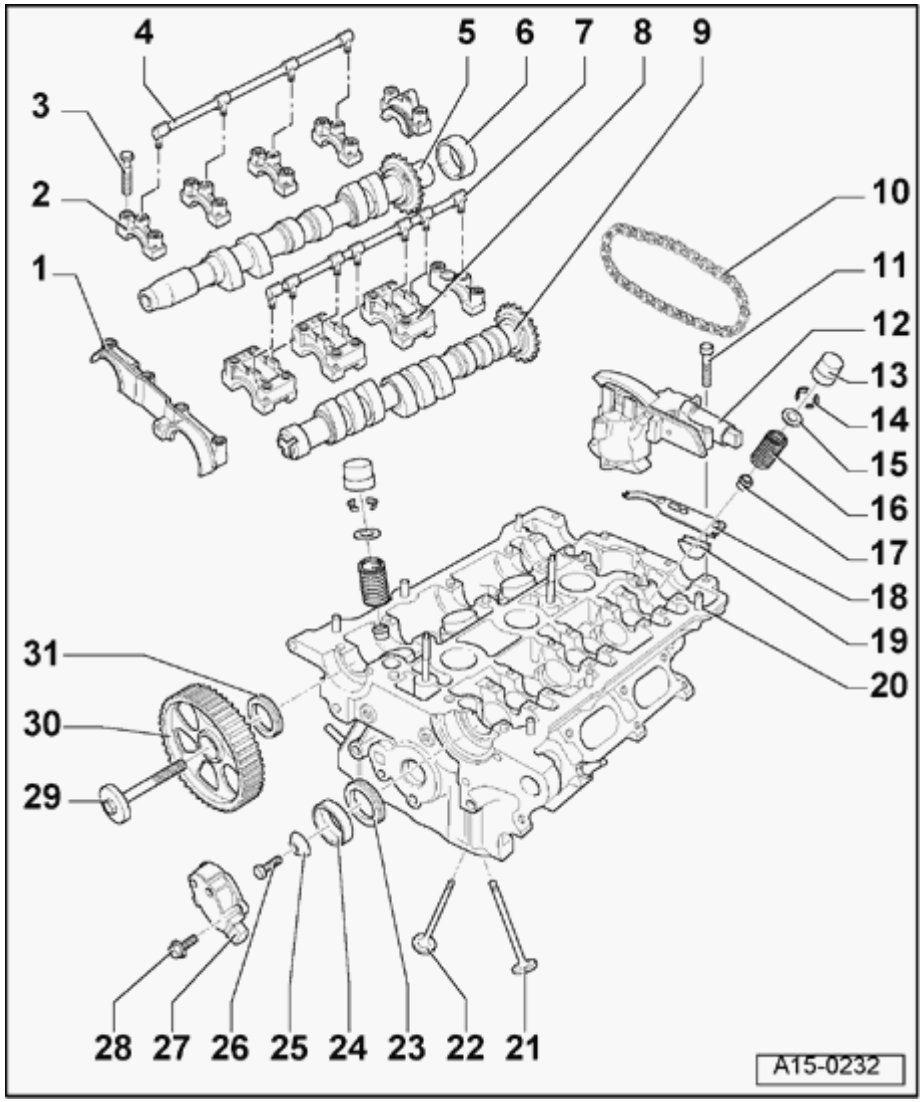
- Lightly coat with sealant 454 300 A2 before installing ⇒from Page ⇒ Page 15-16

2 - Exhaust camshaft bearing cap

- With connection for oil feed line
- Watch position of dowel sleeve
- Note installation position and numbering ⇒ Page 15-75
- Lightly coat last bearing cap (after the chain) with sealant D 454 300 A2 before installing

3 - 10 Nm

15-3



4 - Oil line outlet side

- For lubricating bearing cap
- Note installation position ⇒ Fig. ⇒ 3

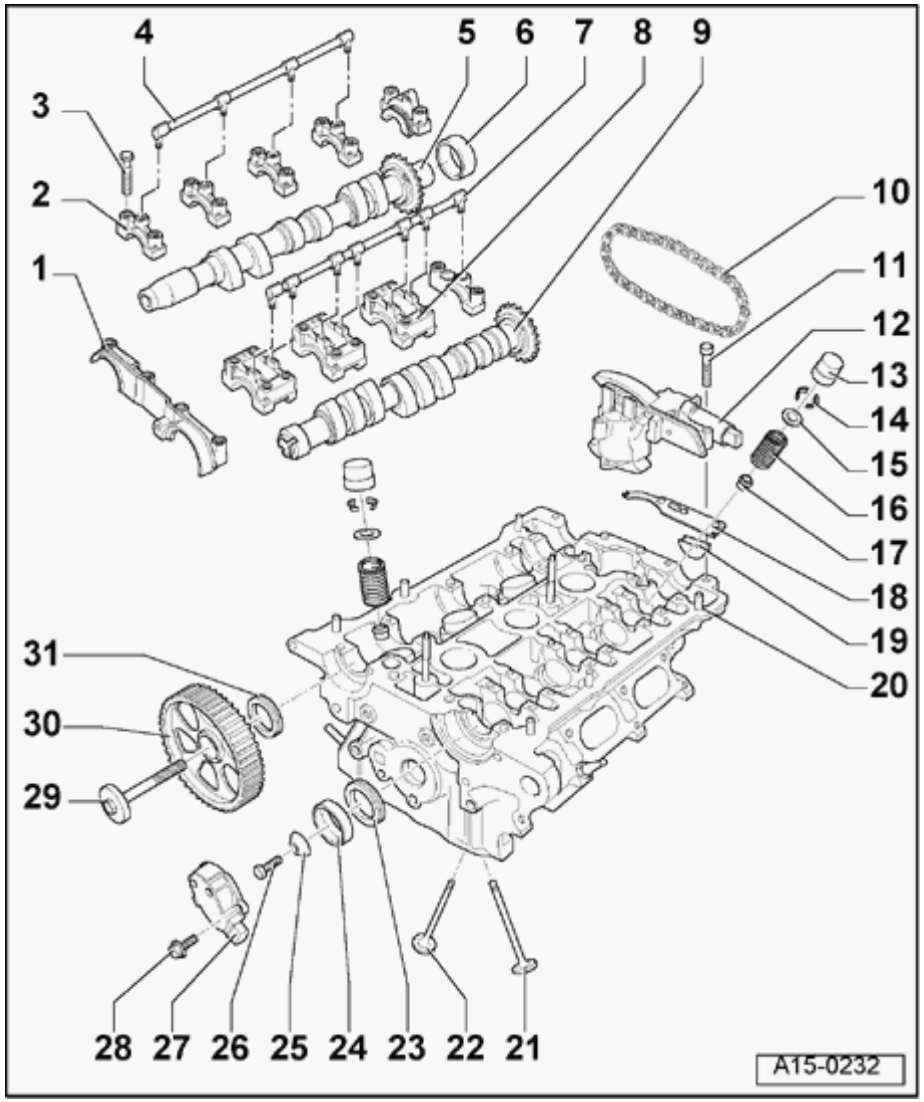
5 - Exhaust camshaft

- Checking axial clearance ⇒ Page 15-86
- Removing and installing ⇒ Page 15-75
- Check radial clearance with Plastigage (lifters removed) Wear limit: 0.1 mm Run-out: 0.01 mm (maximum)

6 - Cap

- Always replace

15-4



7 - Oil line, inlet side

- Note installation position ⇒ Fig. ⇒ 2
- For lubricating bearing cap

8 - Inlet camshaft bearing cap

- With connection for oil feed line
- Note installation position and numbering ⇒ Page 15-75

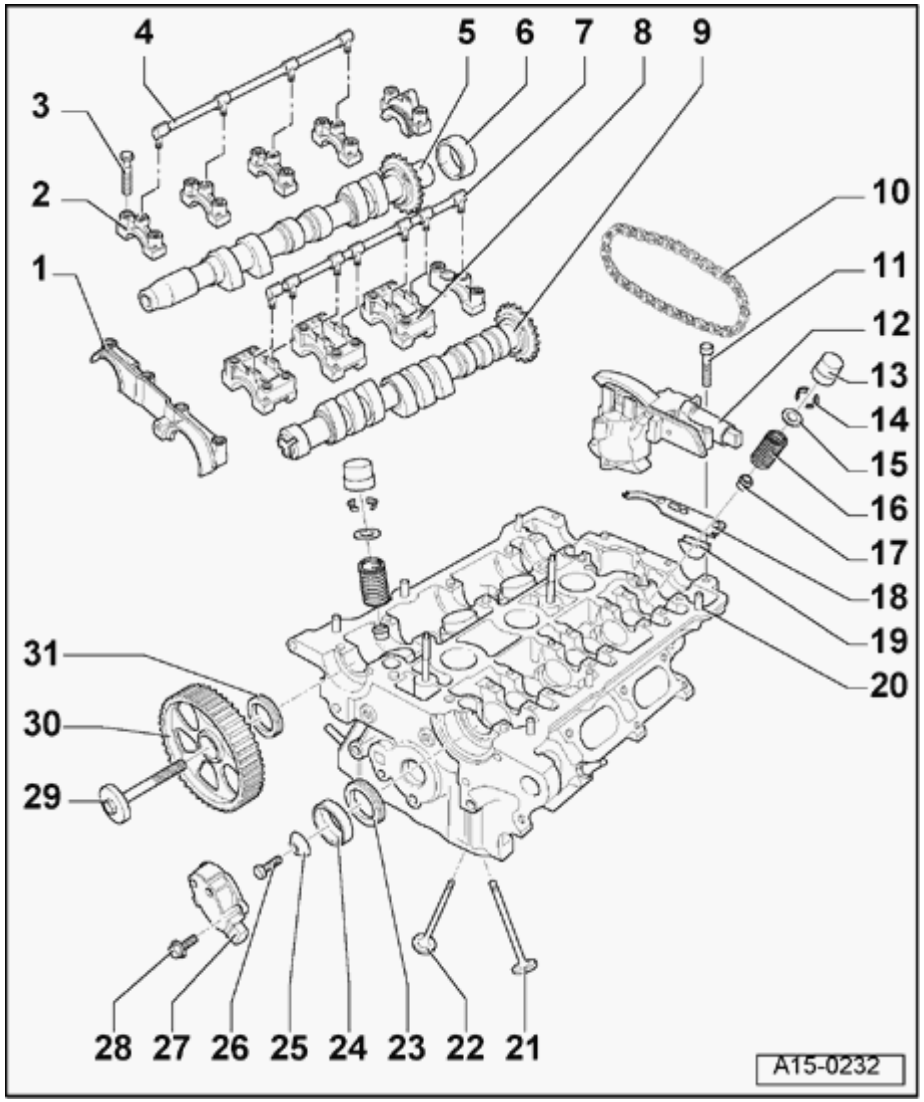
9 - Inlet camshaft

- Checking axial clearance ⇒ Page 15-86
- Removing and installing ⇒ Page 15-75
- Check radial clearance with Plastigage (lifters removed) Wear limit: 0.1 mm Run-out: 0.01 mm (maximum)

10 - Drive chain

- Installing ⇒ Page 15-75

15-5



11 - 10 Nm

12 - Mechanical camshaft adjuster

- With camshaft adjustment valve -N205
- Secure with special tool 3366 before removing ⇒ Page 15-75

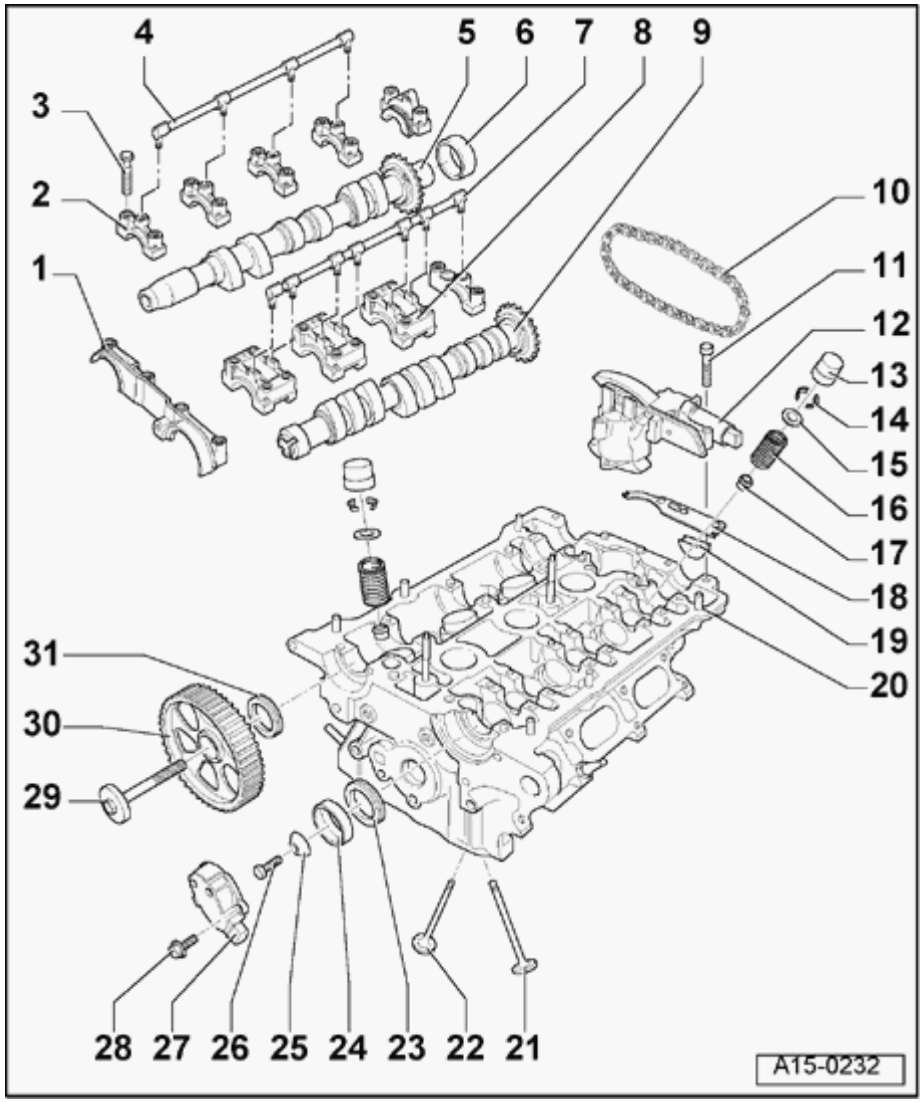
13 - Hydraulic lifter

- Notes ⇒ Page 15-88
- Removing and installing with cylinder head installed ⇒ Page 15-75

14 - Valve cotters

15 - Valve spring plate

16 - Valve spring



17 - Valve stem seal

- Replacing with cylinder head installed ⇒ Page 15-90

18 - Rubber/metal gasket

- Always replace

19 - Seal

- Always replace

20 - Cylinder head

- Checking for distortion ⇒ Page 15-56
- Reworking ⇒ Page 15-57

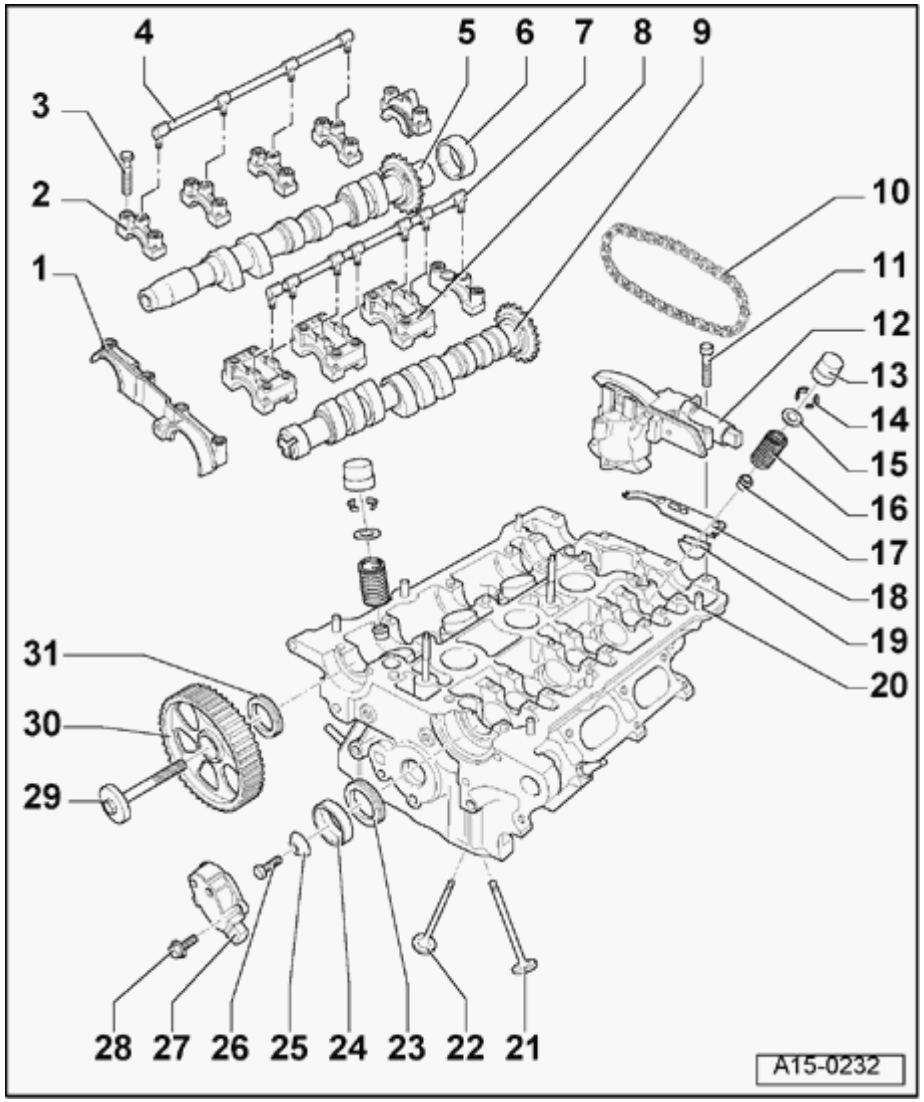
21 - Exhaust valve

22 - Inlet valve

23 - Oil seal (Hall sensor end)

- Always replace ⇒ Page 15-10

15-7



24 - Rotor for Hall sensor

- Note position (notch on camshaft)

25 - Washer

- Conical

26 - 25 Nm

27 - Hall sensor

28 - 10 Nm

29 - 30 Nm +180° (1/2 turn)

30 - Camshaft sprocket

31 - Oil seal (toothed belt end)

- Replacing ⇒ Page 15-10

15-8

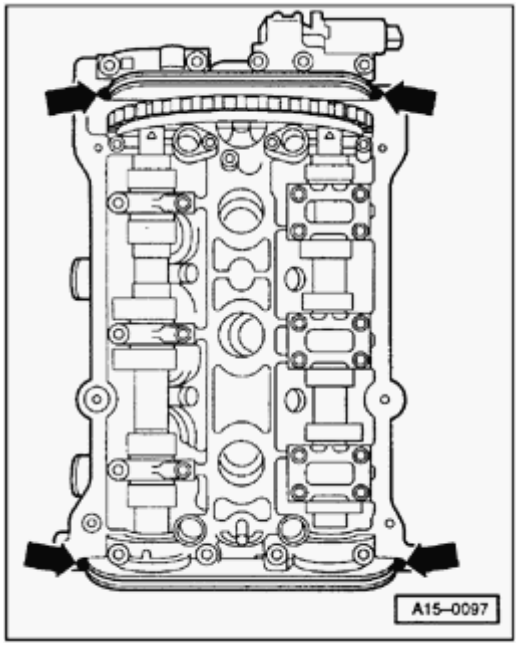


Fig. 1 Sealing end points of joints between bearing caps and cylinder head

Carefully apply a small quantity of sealant D 454 300 A2 at the four end points of the sealing surfaces on the cylinder head -arrows-, using a small screwdriver.

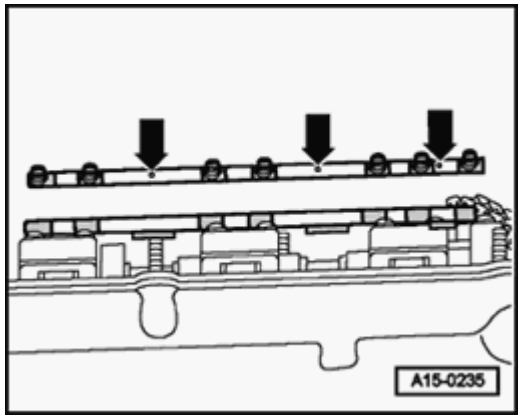


Fig. 2 Installation position of the oil line for the inlet camshaft

When connections are incorrectly allocated, bore holes in the oil line are exposed (arrows).

To mount correctly, turn the oil line 180° and slide connections over bore holes.

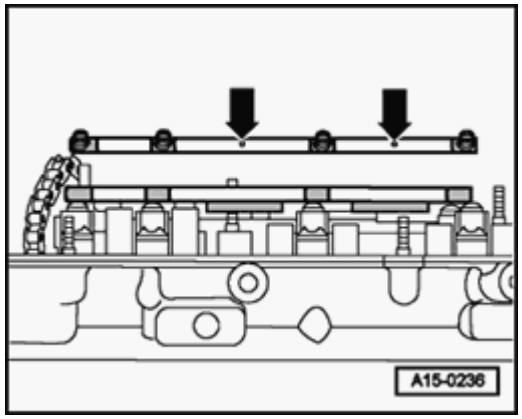


Fig. 3 Installation position of the oil line for the outlet camshaft

When connections are incorrectly allocated, bore holes in the oil line are exposed (arrows).

To mount correctly, turn the oil line 180° and slide connections over bore holes.

CAUTION!

If the oil lines are mounted incorrectly, lubrication of the camshaft bearing is no longer possible and the cylinder head must be replaced.

15-10

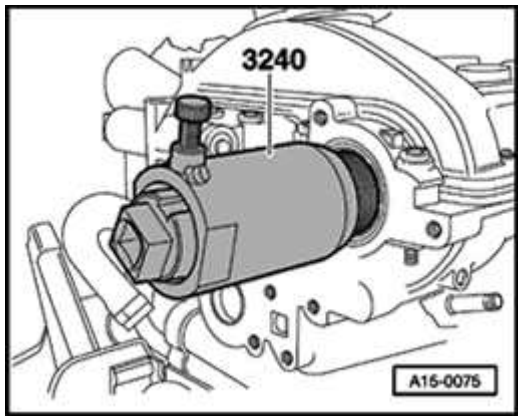
Oil seals in cylinder heads, replacing

Oil seal for camshaft drive (left and right cylinder heads)

Note:

If the oil seal on one side is leaking it is advisable to replace the seals on both sides.

- Remove ribbed belt ⇒ Page 13-1 .
- Remove toothed belt ⇒ Page 13-4 .
- Remove rear toothed belt guard.



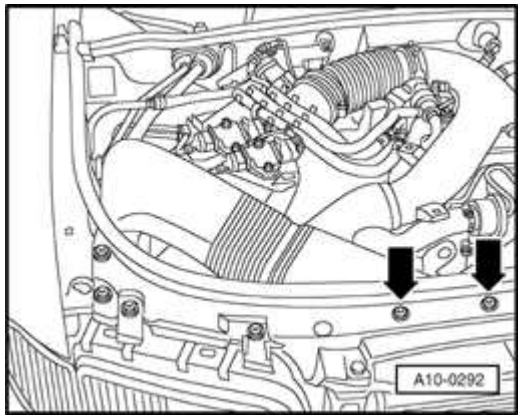
- Pull out oil seal with oil seal extractor 3240.
- Clean contact surface and sealing surface.
- Do not apply oil to sealing lip or outer circumference of seal.
- Install guide sleeve 3241/2 (from tool set 3241) onto camshaft.



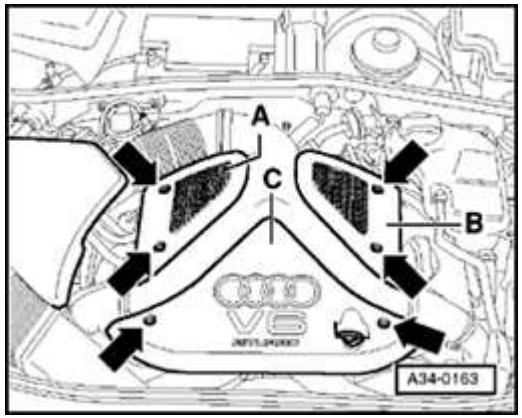
- Press seal flush into cylinder head using press sleeve 3241/1 and bolt 3241/3.

15-11

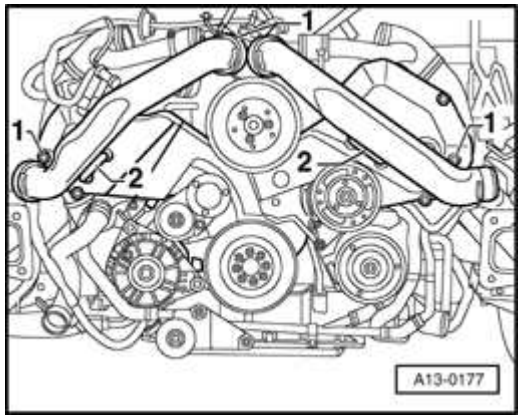
Oil seal at Hall sensor (right cylinder head)



- Remove intake hose going to air cleaner (arrows).



- Remove bolts -arrows- and remove engine cover panel -C-.

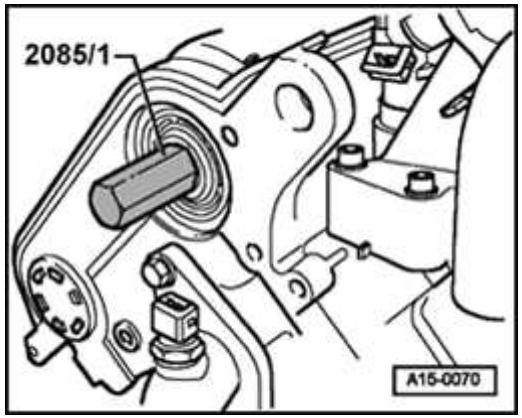


- Remove pressure line -1- (right side).

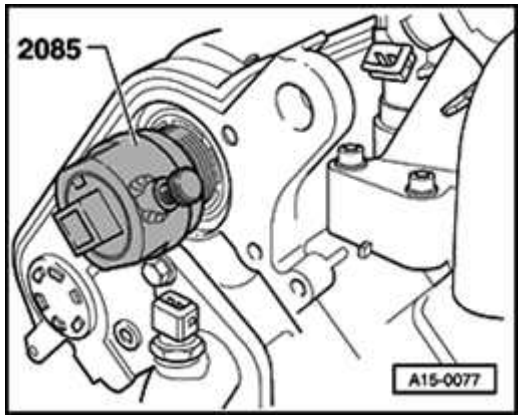
Note:

Watch position of retaining strip -2-.

- Unbolt Hall sensor housing (10 Nm).
- Remove bolt securing Hall sensor rotor (20 Nm) and carefully lever off rotor with a screwdriver.

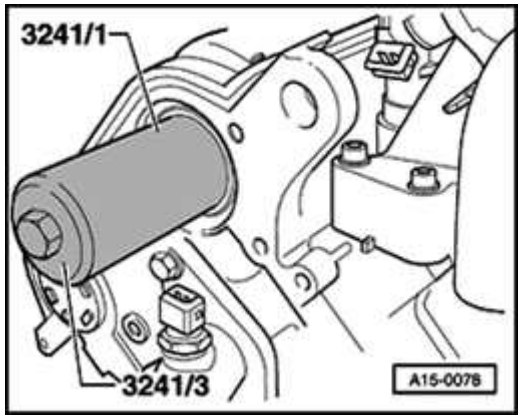


- Screw in bolt from oil seal extractor 2085/1.



- Pull out seal with oil seal extractor 2085 and bolt 2085/1.
- Clean contact surface and sealing surface.

  Do not apply oil to sealing lip or outer circumference of seal before installing.
- Install guide sleeve (from tool set 3241) onto camshaft.



- Press in seal until flush using press sleeve 3241/1 and bolt 3241/3.

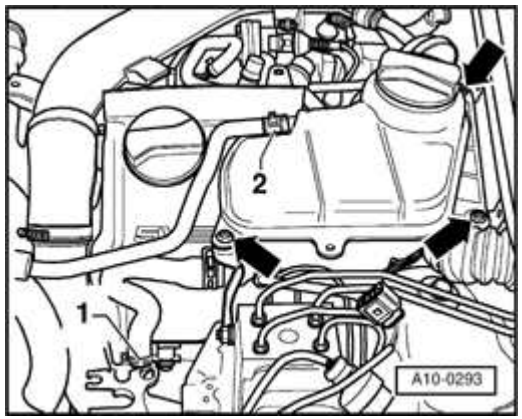
Installing

Install in reverse sequence.

Note:

When installing Hall sensor rotor, ensure that locating lug engages in slot in camshaft.

Removing oil seal at Hall sensor (left cylinder head)

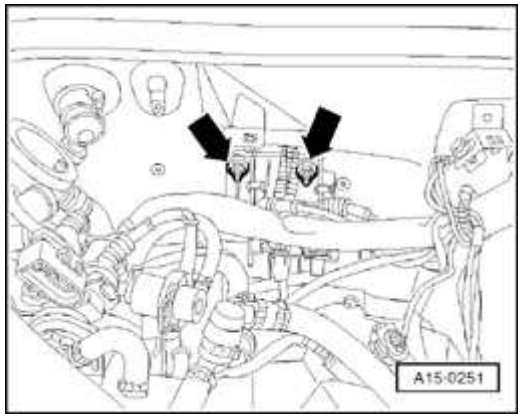


- Detach coolant reservoir -arrows- and move clear to side.

Note:

Leave coolant hoses connected.

- Unplug connector from coolant level monitor.
- Move wiring harness clear at bulkhead.

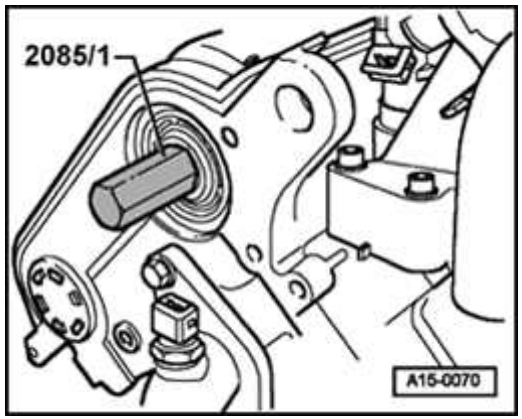


- Unbolt bracket -arrows- for plug connectors on bulkhead and move clear to side.

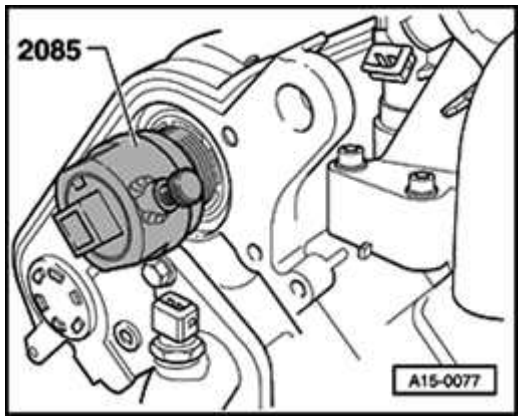
15-15

- Unbolt Hall sensor housing (10 Nm).

- Unbolt Hall sensor rotor (20 Nm) and carefully lever off rotor using a screwdriver.

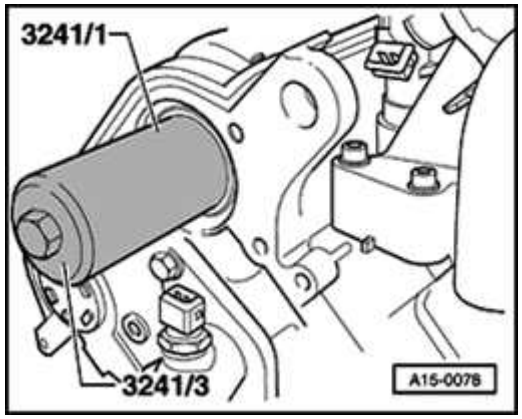


- Screw in bolt from 2085/1 oil ring extractor.



- Pull out seal with oil seal extractor 2085 and bolt 2085/1.
- Clean contact surface and sealing surface.

  Do not apply oil to sealing lip or outer circumference of seal before installing.
- install guide sleeve (from tool set 3241) onto camshaft.



- Press in seal until flush using press sleeve 3241/1 and bolt 3241/3.

Installing

Install in reverse sequence.

Note:

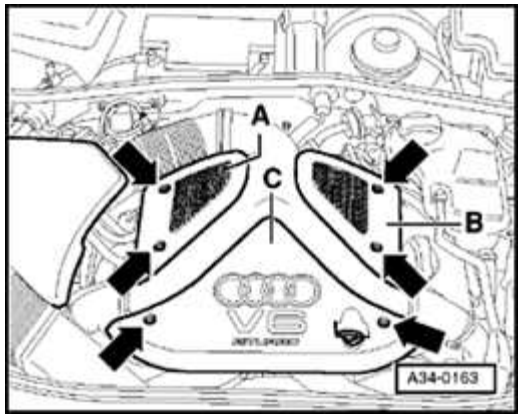
When installing Hall sensor rotor, ensure that locating lug engages in slot in camshaft.

15-17

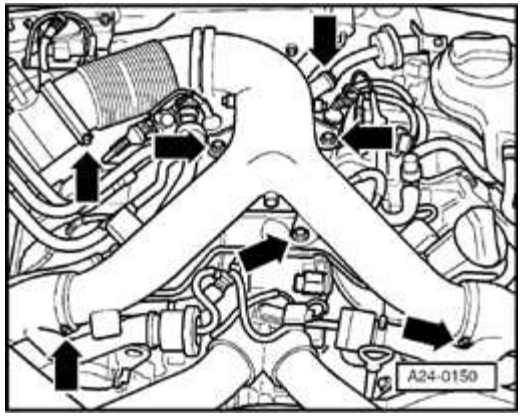
Rear oil seal and sealing flange (left cylinder head)

Note:

Rear sealing flange and oil seal on left-hand cylinder head must be replaceed together as follows:

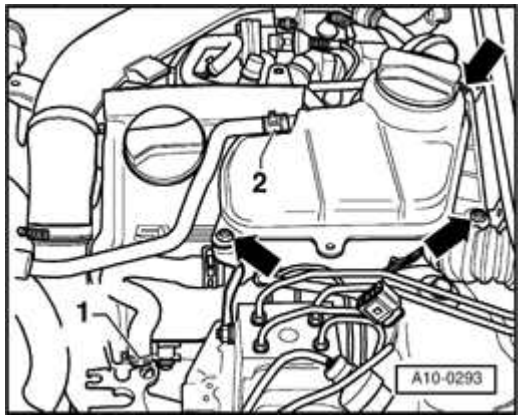


- Remove bolts -arrows- and remove engine cover panels -A...C-.



- Remove air duct -arrows-.

15-18

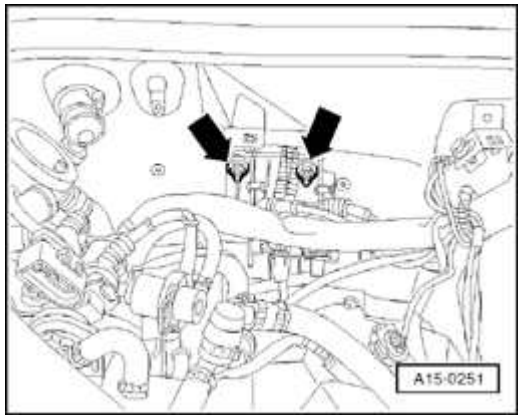


- Remove coolant reservoir -arrows- and move it clear to the side.

Note:

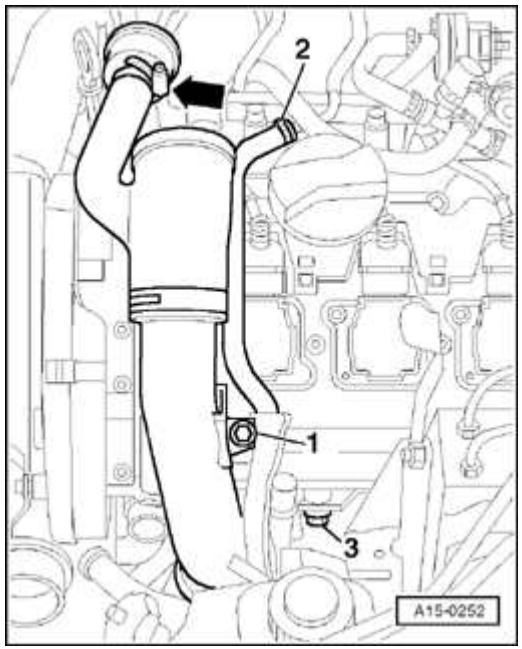
Leave coolant hoses connected.

- Unplug connector from coolant level monitor.
- Move wiring harness clear at bulkhead.

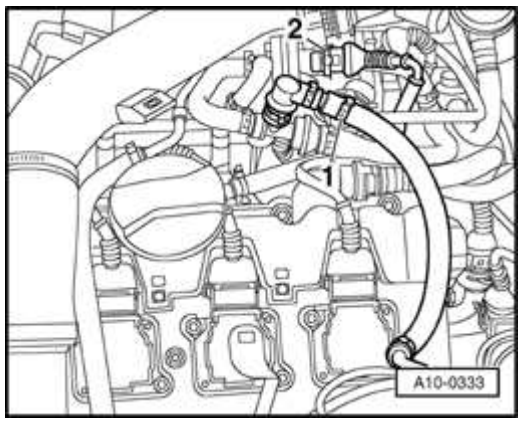


- Unbolt bracket -arrows- for plug connectors on bulkhead and move clear to the side.
- Unbolt Hall sensor housing (10 Nm).
- Remove bolt securing Hall sensor rotor (20 Nm) and carefully lever off rotor using a screwdriver.

- Remove cover panel from cylinder head cover (cylinder bank 4-6).

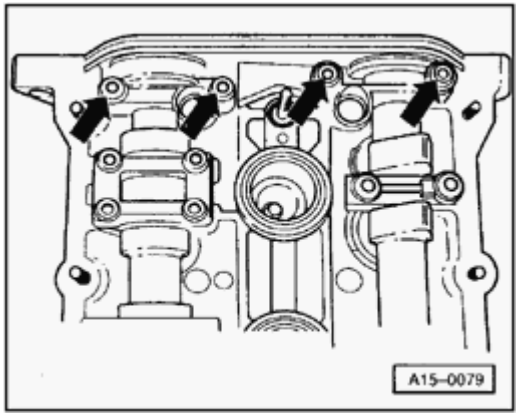


- Release hose clamp -arrow-.
- Remove upper section of intake line -1-.
- Disconnect hose -2-.

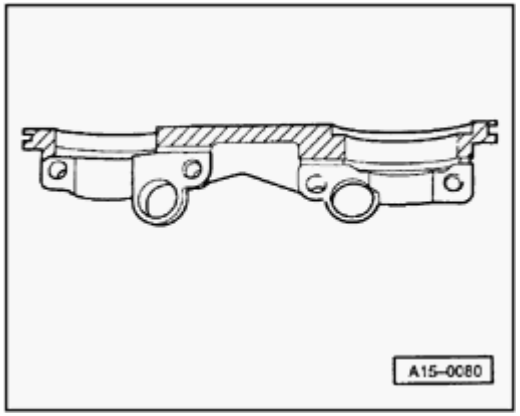


- Disconnect hose (arrow).
- Remove bolt securing toothed belt guard from cylinder head cover.
- Pull plug connectors off ignition coils.
- Pull crankcase breather off cylinder head cover.
- Remove cylinder head cover.

15-20

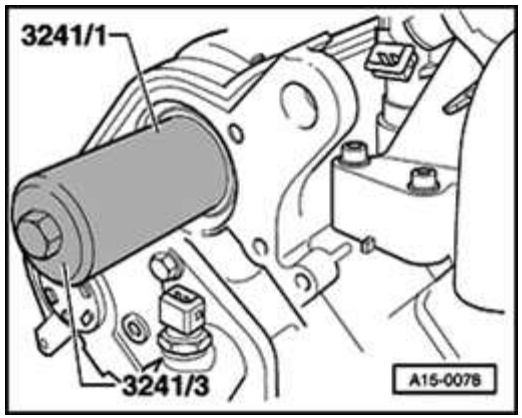


- Remove double bearing cap -arrows-.
- Take out oil seal and sealing flange.
- Clean contact surfaces and sealing surfaces of double bearing cap.



- Apply a thin coating of sealant 454 300 A2 to shaded areas on double bearing cap (see illustration), install bearing cap and tighten bolts to 10 Nm.

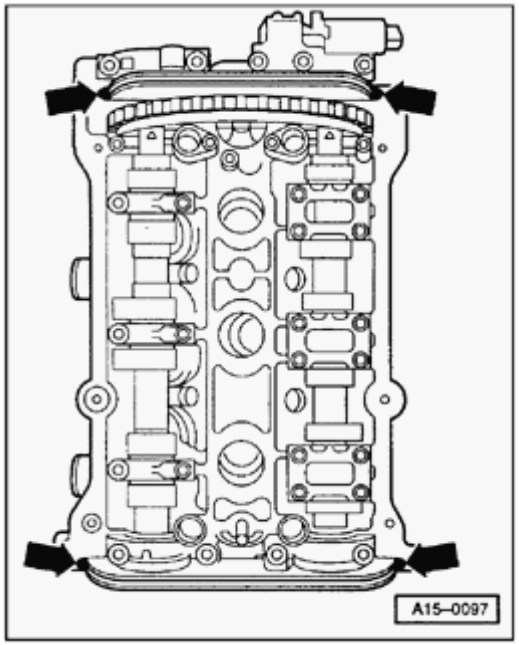
- Install guide sleeve (from tool set 3241) onto camshaft.



- Press in oil seal until flush using press sleeve 3241/1 and bolt 3241/3.
- Carefully knock in sealing flange against stop using 3202 and a plastic hammer.

Installing

Install in reverse sequence; note the following points:



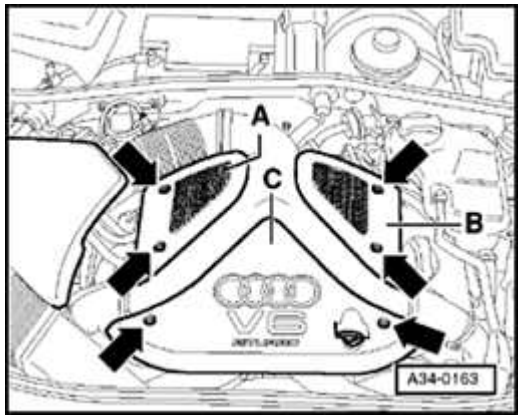
- Seal end points of joints between bearing caps and cylinder head.
- Before installing cylinder head cover and gasket, carefully apply a small quantity of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head -arrows-, using a small screwdriver.

15-22

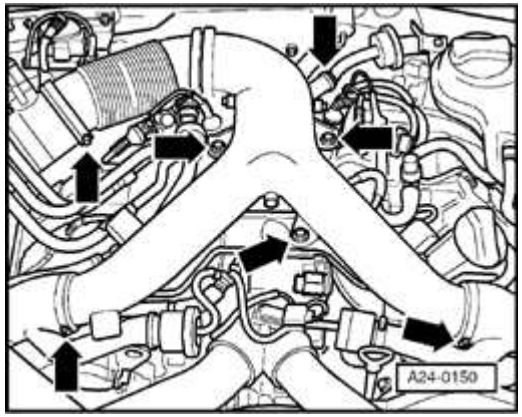
Cylinder head covers, removing and installing

Removing and installing left cylinder head cover

Removing

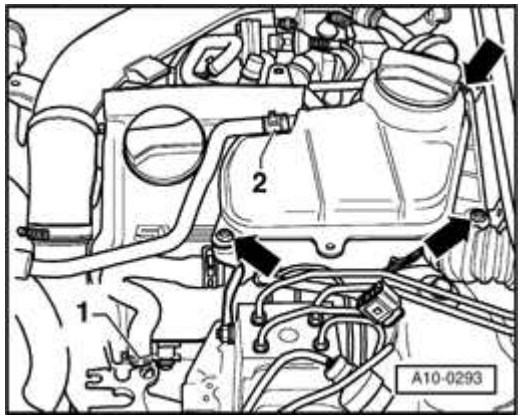


- Remove bolts -arrows- and remove engine cover panels -A...C-.



- Remove air duct -arrows-.

15-23

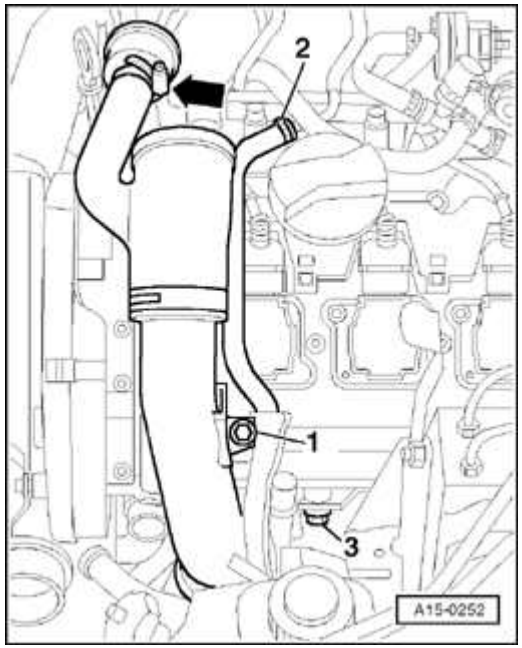


- Remove coolant reservoir -arrows- and move it clear to the side.

Note:

Leave coolant hoses connected.

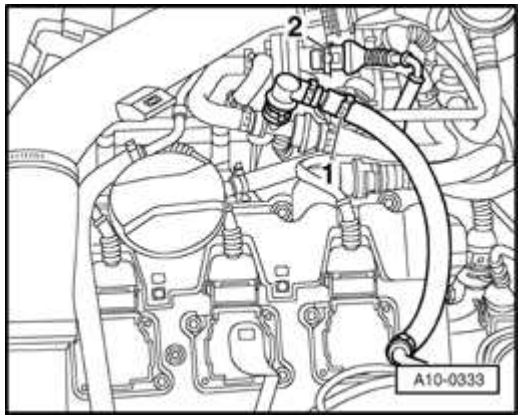
- Unplug connector from coolant level monitor.
- Remove cover panel from cylinder head cover (cylinder bank 4 - 6).



- Release hose clamp -arrow-.
- Remove intake line -1-.
- Disconnect hose -2-.
- Detach water line -3-.

Note:

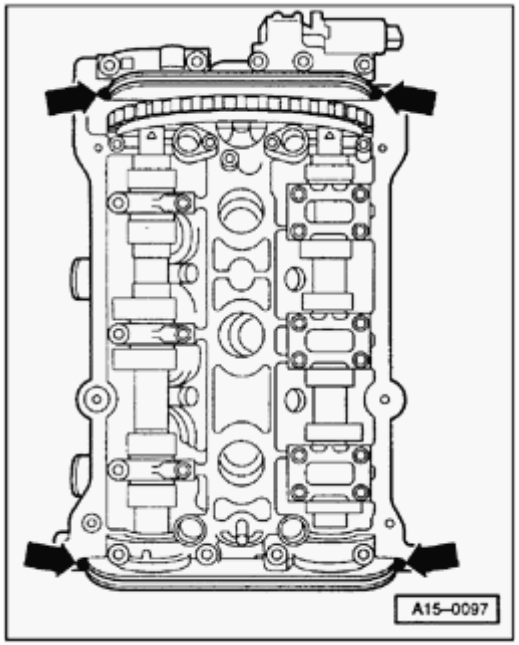
Plug lower section of intake line.



- Pull off hose -1-.
- Pull plug connectors off ignition coils.
- Pull crankcase breather off cylinder head cover.
- Remove ignition coils.
- Remove cylinder head cover.

Installing

Install in reverse sequence; note the following points:

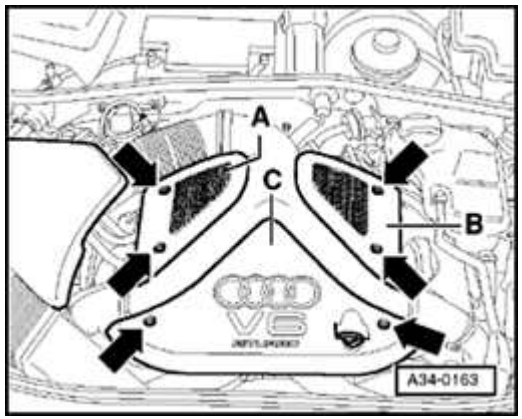


- Seal end points of joints between bearing caps and cylinder head.
- Before installing cylinder head cover and gasket, carefully apply a small quantity of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head -arrows-, using a small screwdriver.

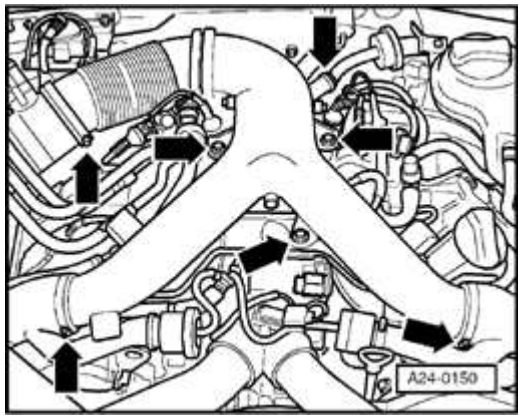
15-25

Removing and installing right cylinder head cover

Removing



- Remove bolts -arrows- and remove engine cover panels -A...C-.
- Remove cover above air cleaner.

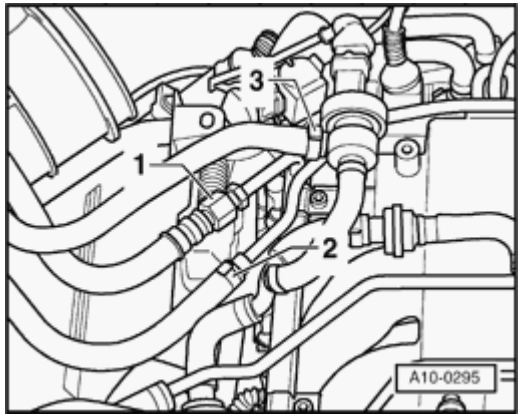


- Remove air duct -arrows-.

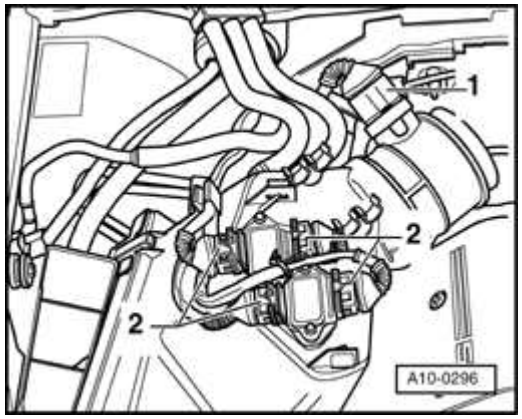
15-26

WARNING!

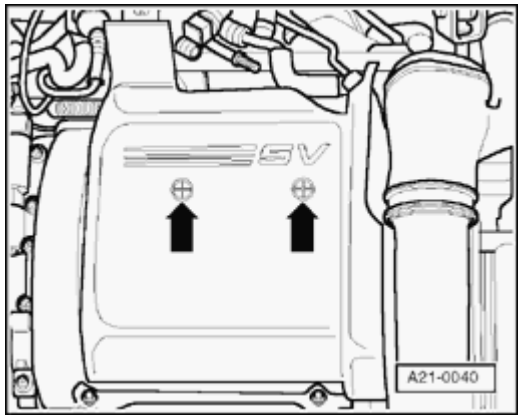
Fuel system is under pressure. Before opening the system, place a cloth around the connection. Then release pressure by carefully loosening the connection.



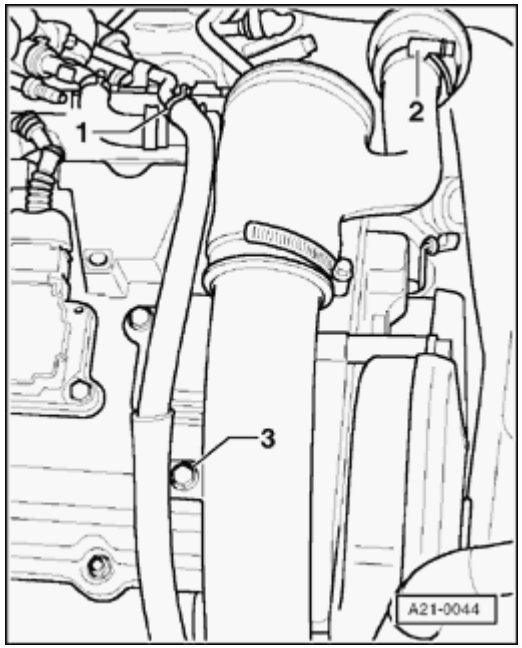
- Disconnect fuel supply line and fuel return line -1- and -2-, and move fuel lines clear.
- Pull hose off EVAP valve -3-.



- Unplug connector -1- from air mass meter.
- Unplug connectors -2- from ignition output stages, and move wiring clear.
- Remove air cleaner.



- Remover cover panel from right-hand cylinder head cover -arrows-.



- Disconnect hose -1-.
- Disconnect hose -2-.
- Detach upper section of intake line -3-.

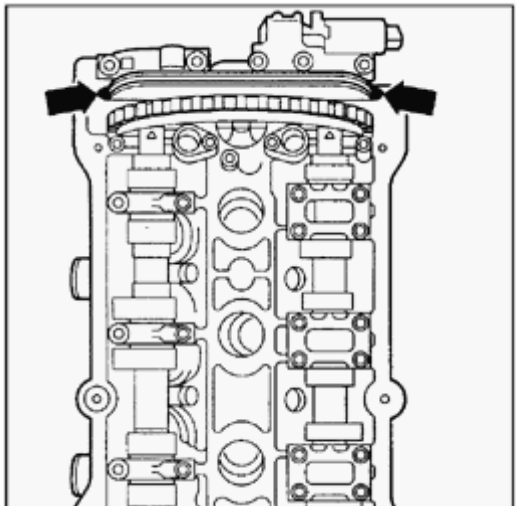
Note:

Plug lower section of intake line.

- Remove bolt securing toothed belt guard from cylinder head cover.
- Unplug connectors from ignition coils.
- Pull crankcase breather off cylinder head cover.
- Remove ignition coils.
- Remove cylinder head cover.

Installing

Install in reverse sequence; note the following points.



- Seal end points of joints between bearing caps and cylinder head.
- Before installing cylinder head cover and gasket, carefully apply a small quantity of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head -arrows-, using a small screwdriver.

15-29

Cylinder head, removing and installing

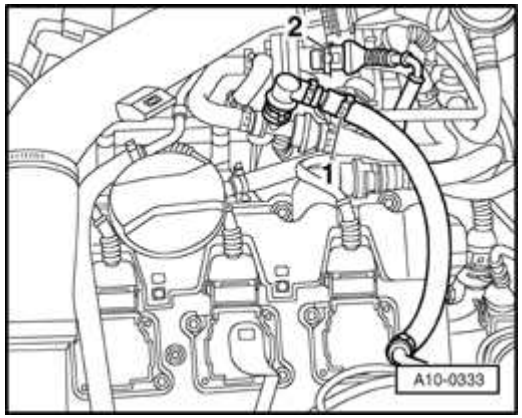
Removing and installing left cylinder head

Notes:

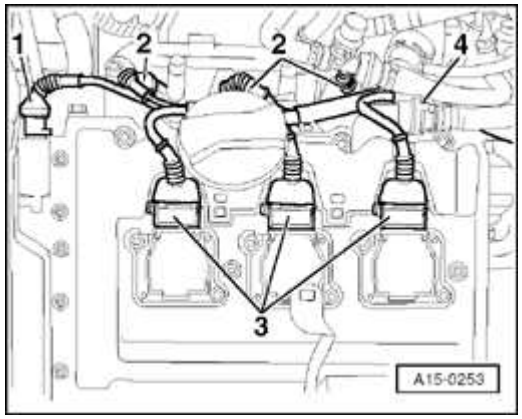
- *All hose connections are secured with clips.*
- *Charge air system must be free of leaks.*
- *Replace all seals and gaskets*

Removing

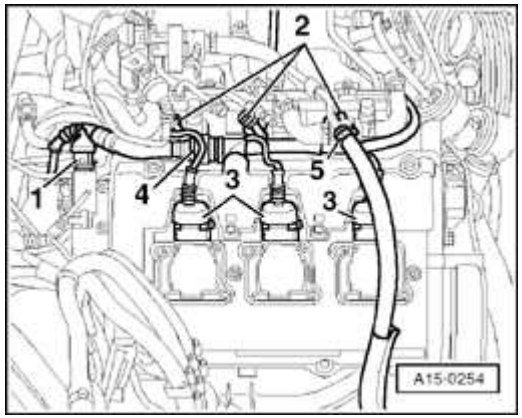
- Remove engine ⇒ Page 10-1 .



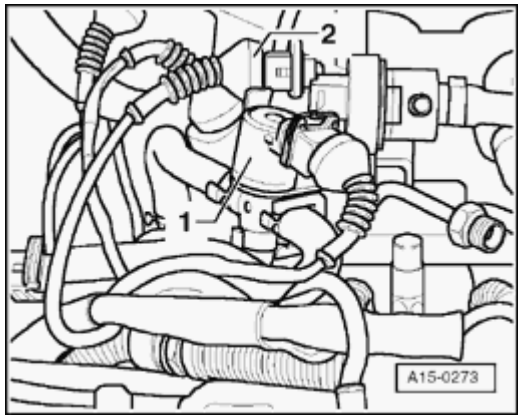
- Unplug connector from air recirculation valve -2-.



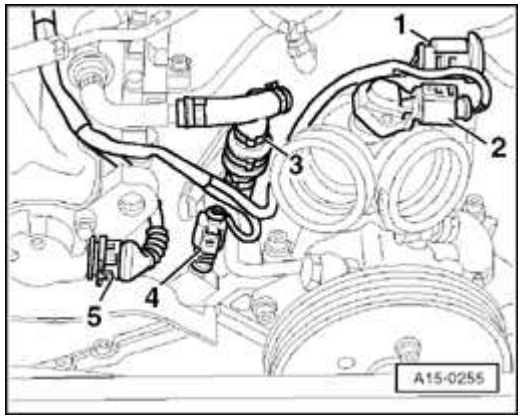
- Unplug connector for camshaft timing control -1- (cylinder bank 4..6).
- Unplug connectors from injectors -2- (cylinder bank 4..6).
- Unplug connectors from ignition coils -3- and move wiring harness clear (cylinder bank 4..6).
- Pull crankcase breather -4- off cylinder head cover (cylinder bank 4..6).
- Remove ignition coils.



- Unplug connectors from injectors -2- (cylinder bank 1..3).
- Pull off hose -5- going to turbocharger intake side.

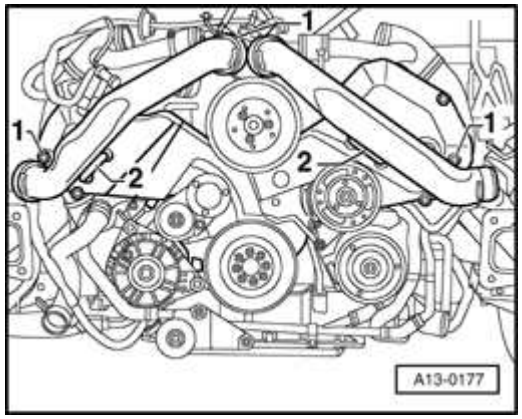


- Unclip solenoid valve for charge pressure control -1-.
- Pull connector off EVAP valve -2-.



- Pull connector off throttle unit -1-.
- Pull connector off charge air sensor -2-.
- Pull off crankcase breather -3-.
- Pull connector off intake air temperature sensor -4-.

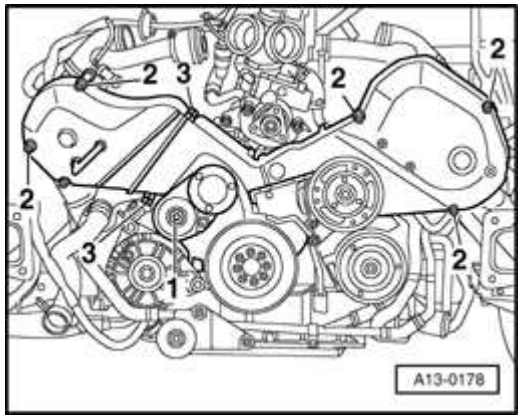
15-32



- Remove pressure lines -1-.

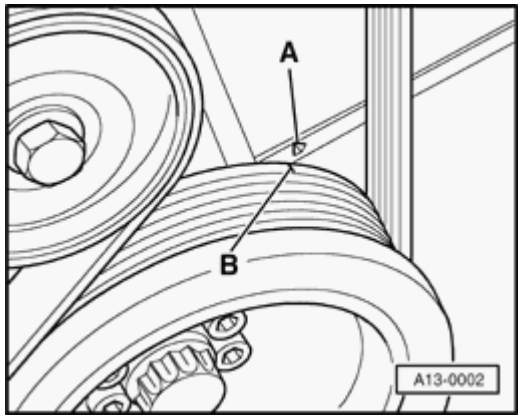
Note:

Watch position of retaining strips -2-.



- Remove tensioner -1- for ribbed belt.
- Remove toothed belt guards -2- (left and right).
- Remove toothed belt guard -3- (center).

15-33



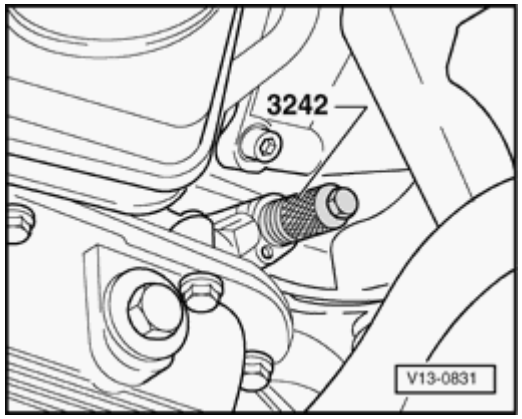
- Turn crankshaft to TDC by hand. Marks -A- and -B- must be aligned.

Note:

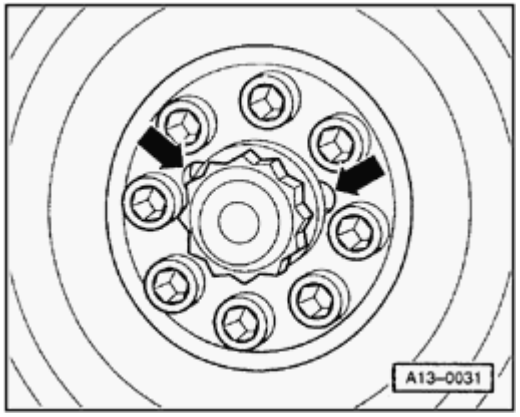
Turn over the engine at the central bolt on the crankshaft.

- Check position of camshafts: larger holes in securing plates on camshaft sprockets must align opposite one another on inside. If this is not the case, turn crankshaft one revolution further.
- Remove sealing plug from cylinder block, left.

  TDC drilling in the crankshaft must be visible (or able to be felt) in line with the sealing plug hole.



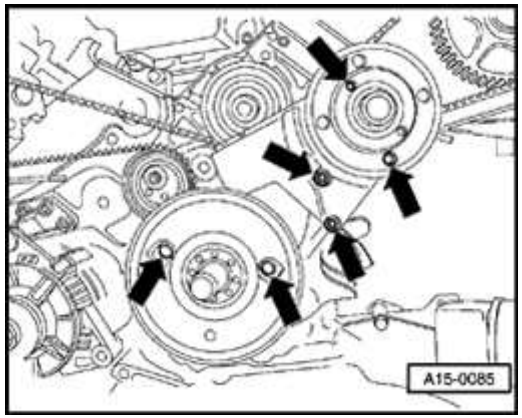
- Screw clamping bolt 3242 for crankshaft into sealing plug hole and tighten.



- Remove vibration damper on crankshaft.

Note:

The central bolt does not have to be loosened to remove the vibration damper.

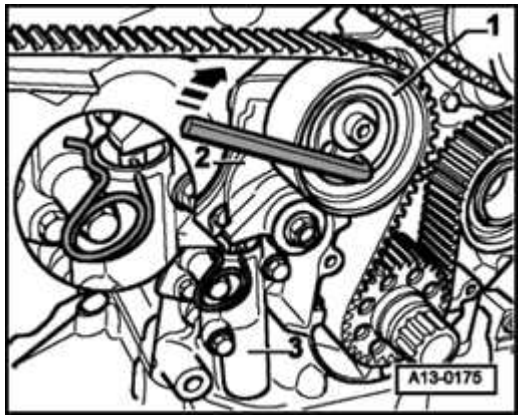


- Remove idler wheel for ribbed belt -arrows-.
- Remove toothed belt guard behind vibration damper -arrows-.

15-35

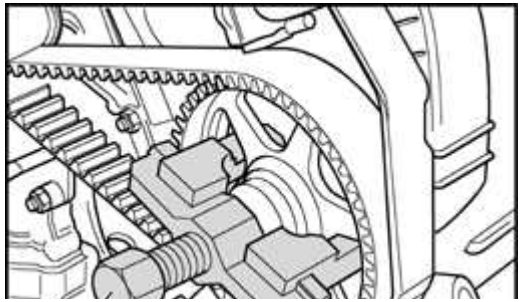
Notes:

- *Mark the direction of rotation of the toothed belt with chalk or felt pen before removing. A used belt can break if it rotates in the wrong direction when reinstalled.*
- *The toothed belt tensioning element is oil-damped and can therefore only be compressed slowly by applying constant pressure.*

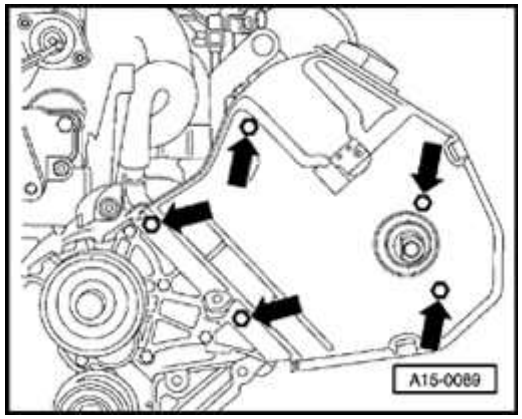


- Using a hexagon key, turn toothed belt tensioning roller -1- clockwise 8 mm in direction of arrow until tensioning lever -2- compresses tensioning element -3- sufficiently to enable a 2mm dia. spring pin to be installed in the drilling and in the plunger.
- Insert spring pin and release toothed belt tensioning roller.

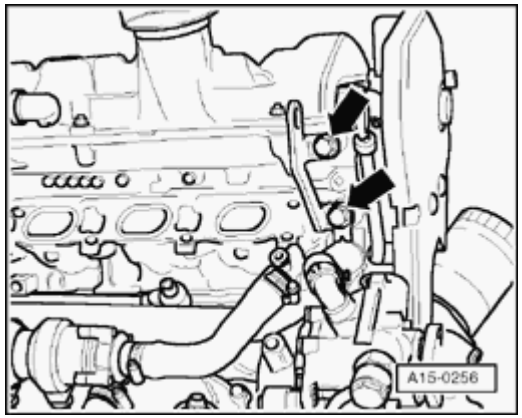
  Use spring pin from 2024 A.
- Insert camshaft clamp 3391 in securing plates of two camshafts.
- Loosen both camshaft bolts and remove approx. 5 turns.
- Take out camshaft clamp 3391.



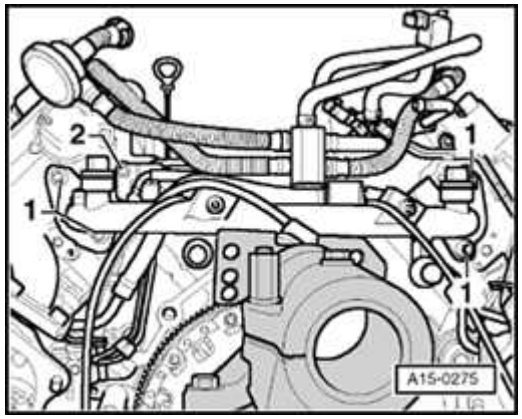
- Pull off both camshaft sprockets with special tool T40001.



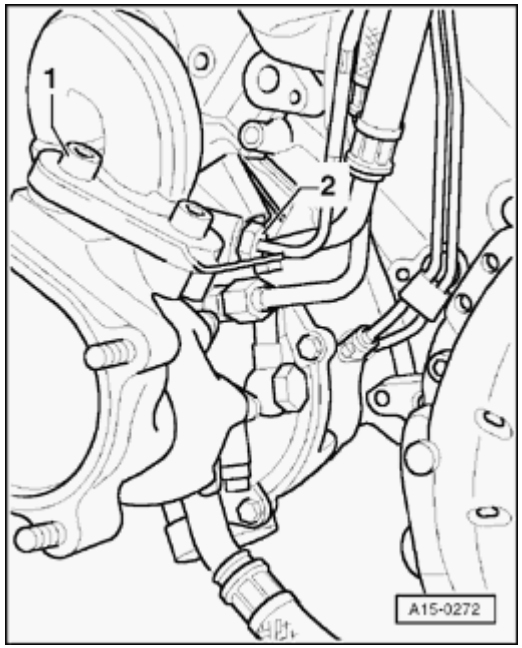
- Unbolt rear left toothed belt guard -arrows-.
- Detach intake manifold using special tool 3249.



- Unbolt cylinder head lifting bracket with coolant line -arrows- from cylinder head.

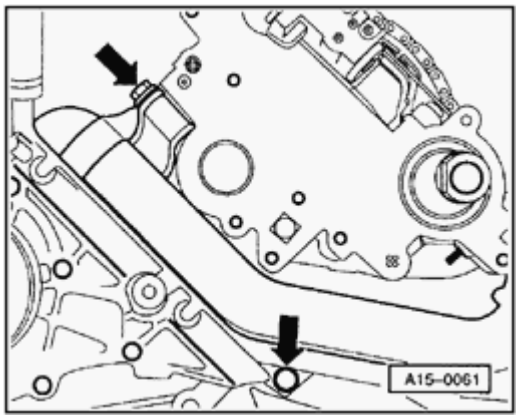


- Unbolt water line -1- and pull it towards the rear.
- Unbolt bracket -2- from cylinder head.
- Remove heat sensor -2-.



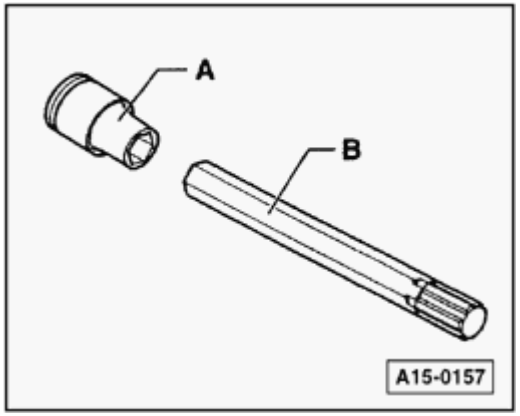
- Unbolt turbocharger -1- from exhaust manifold (3 bolts).

15-38



- Unbolt coolant line at front of cylinder head -arrows-.
- Unbolt cylinder head cover.
- Loosen and remove cylinder head bolts in opposite sequence to tightening sequence using special tool 3452 (Polidrive).
- Carefully lift off cylinder head.

Note:



Use special tool 3452 together with a normal commercial 10 mm socket when removing and installing.

Installing

Notes:

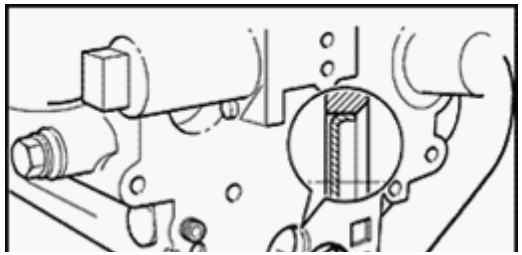
- *Do not allow any oil or coolant to remain in the blind holes for the cylinder head bolts in the cylinder block.*
- *Replace cylinder head bolts.*
- *Connecting vacuum hoses* ⇒ *Page 10-28* .

When installing a new cylinder head:

- Screw in centering pin for intake manifold.

The cylinder head supplied as a replacement part can be used on both sides (left or right). But a sealing cap (core plug) must be installed in the front end of the cylinder head in each case.

- Coat outside circumference of sealing cap (core plug) with sealant AMV 188 001 02.

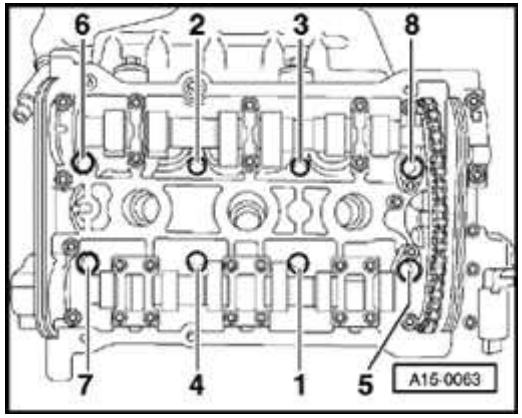


- Using drift VW 295, knock in sealing cap (core plug) until outside rim is flush with end of chamfer in cylinder head.

- Before installing cylinder head in position, turn crankshaft and camshafts to TDC of No. 3 cylinder.

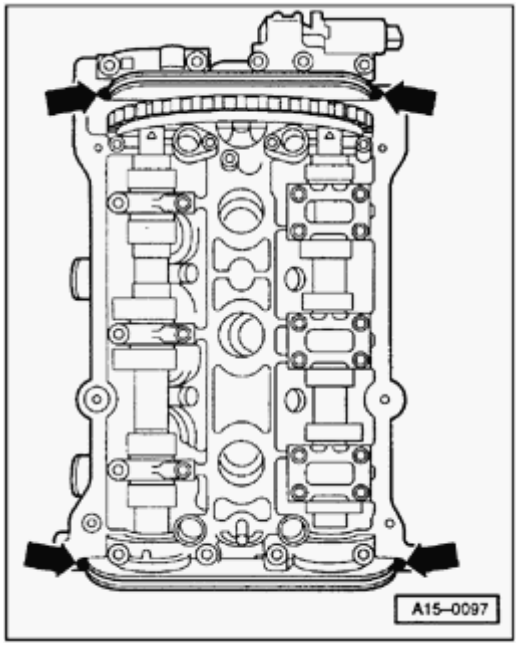
- Install cylinder head gasket on dowel sleeves. The marking "oben" (top) or part number must face towards cylinder head.

- Install cylinder head, insert cylinder head bolts and tighten finger-tight.



- Tighten cylinder head bolts in two stages in sequence shown, as follows:
  - Stage 1 = 60 Nm.
  - Stage 2 = turn a further $^{1}/_{2}$ turn (180 °) with a rigid wrench (turning 2 x 90 ° is also permissible).

It is not necessary to torque down cylinder head bolts again after repairs have been completed.



- Seal end points of joints between bearing caps and cylinder head.
- Before installing cylinder head cover and gasket, carefully apply a small quantity of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head -arrows-, using a small screwdriver.

Tightening torques

Component		Nm
Bolts	M6	10
Bolts	M8	20
Camshaft bearing caps and camshaft adjuster		10
Exhaust manifold to cylinder head		25
Front exhaust pipe to exhaust manifold		25
Oxygen sensor		50
Spark plugs		25
Toothed belt sprocket to camshaft		55
Intake manifold to cylinder head		10
Cylinder head cover		10

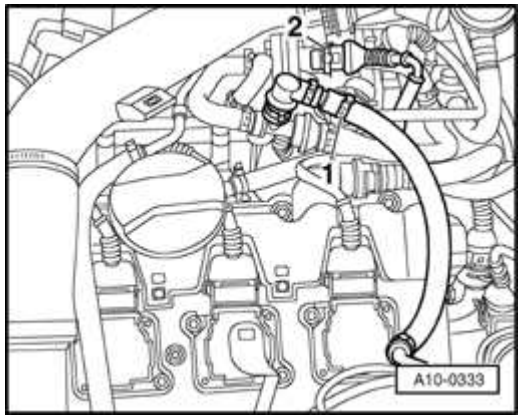
Removing and installing right cylinder head

Notes:

- *All hose connections are secured with clips.*
- *Charge air system must be free of leaks.*
- *Replace all seals and gaskets*

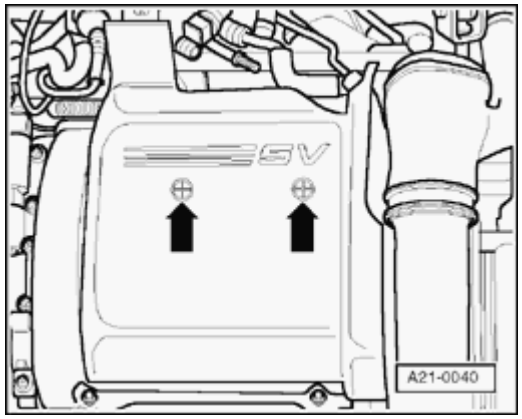
Removing

- Remove engine ⇒ Page 10-1 .

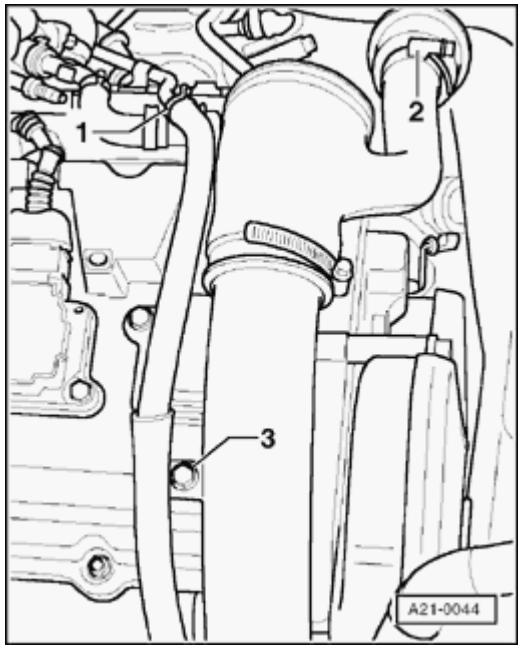


- Unplug connector from air recirculation valve -2-.

15-43



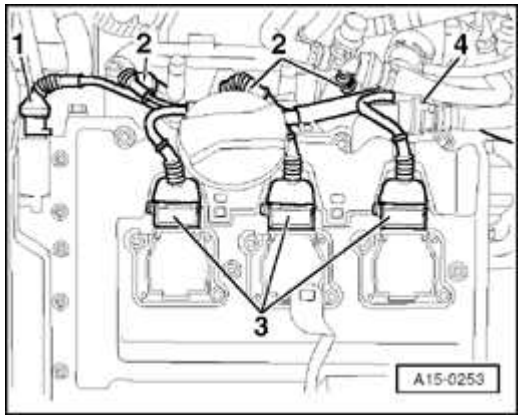
- Remove cover panel from right-hand cylinder head cover -arrows-.



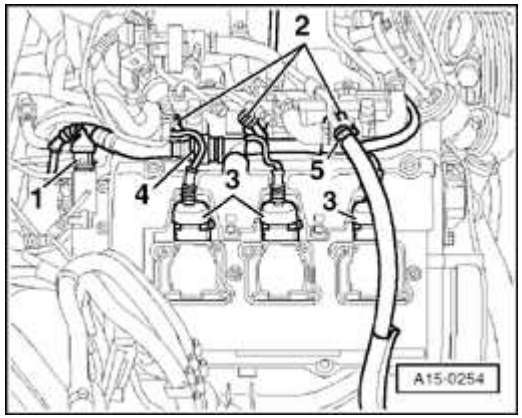
- Disconnect hose -1-.
- Disconnect hose -2-.
- Unbolt upper section of intake line -3-.

Note:

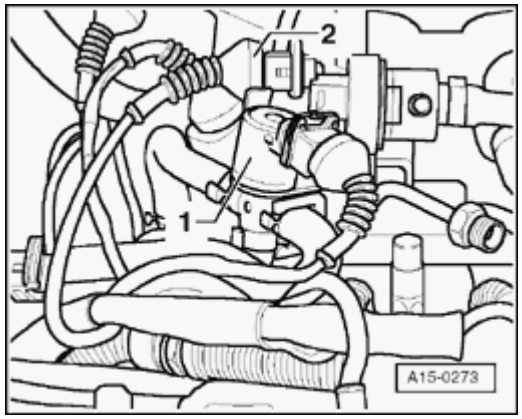
Plug lower section of intake line.



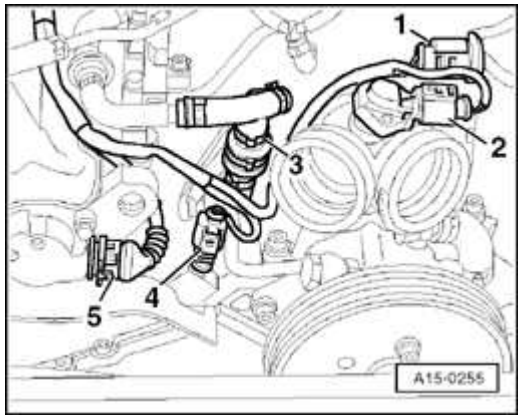
- Unplug connectors from injectors -2- (cylinder bank 4..6).



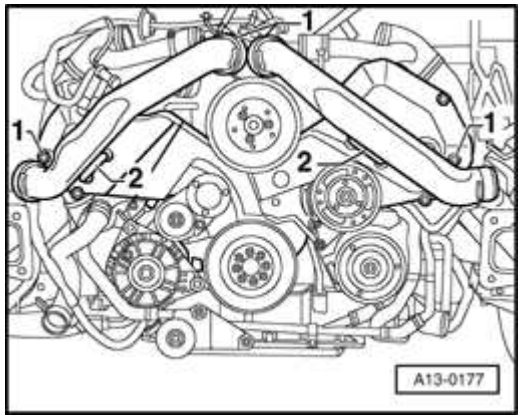
- Unplug connector for camshaft timing control -1- (cylinder bank 1..3).
- Unplug connectors from injectors -2- (cylinder bank 1..3).
- Unplug connectors from ignition coils -3- and move wiring harness clear (cylinder bank 1..3).
- Pull crankcase breather -4- off cylinder head cover (cylinder bank 1..3).
- Pull off hose -5- going to turbocharger intake side.
- Remove ignition coils.



- Unclip solenoid valve for charge pressure control -1-.
- Pull connector off EVAP valve -2-.



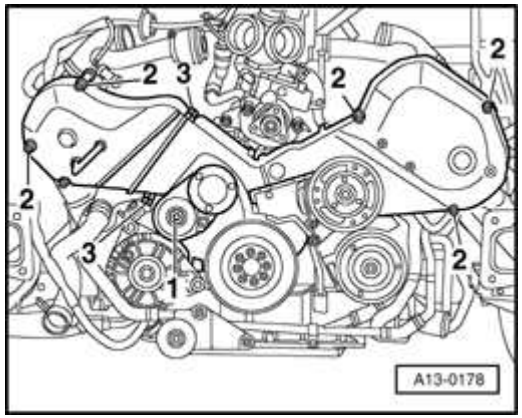
- Pull connector off throttle unit -1-.
- Pull connector off charge air sensor -2-.
- Pull off crankcase breather -3-.
- Pull connector off intake air temperature sensor -4-.
- Pull connector -5- off Hall sensor.



- Remove pressure lines -1-.

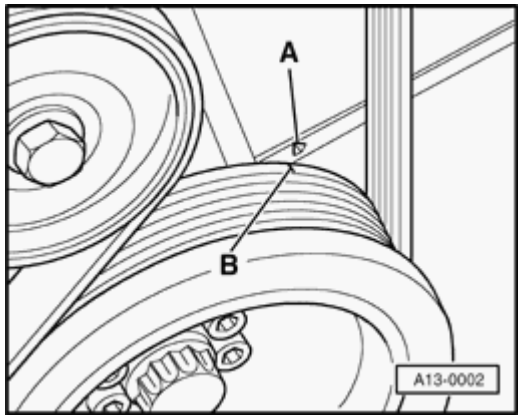
Note:

Watch position of retaining strips -2-.



- Remove tensioner -1- for ribbed belt.
- Remove toothed belt guards -2- (left and right).
- Remove toothed belt guard -3- (center).

15-47



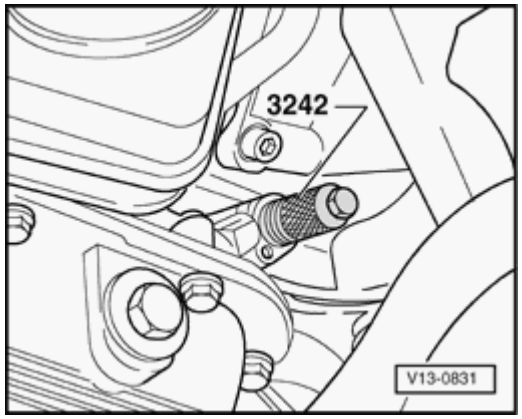
- Turn crankshaft to TDC by hand. Marks -A- and -B- must be aligned.

Note:

Turn over the engine at the central bolt on the crankshaft.

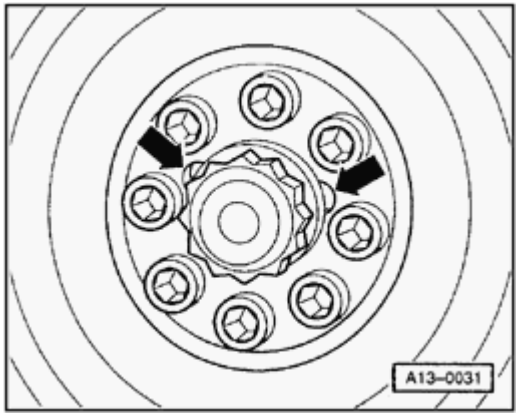
- Check position of camshafts: larger holes in securing plates on camshaft sprockets must align opposite one another on inside. If this is not the case, turn crankshaft one revolution further.
- Remove sealing plug from cylinder block, left.

  The TDC drilling in the crankshaft must be visible (or able to be felt) in line with the sealing plug hole.



- Screw clamping bolt 3242 for crankshaft into sealing plug hole and tighten.

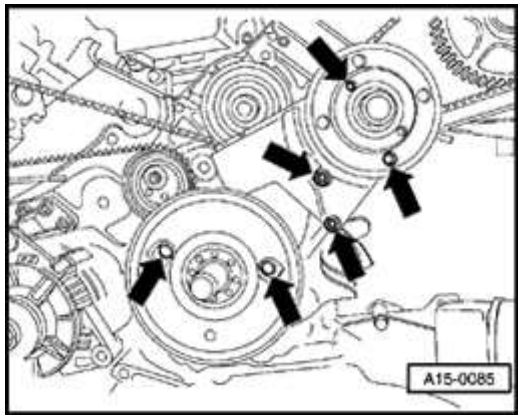
15-48



- Remove vibration damper on crankshaft.

Note:

The central bolt does not have to be loosened to remove the vibration damper.

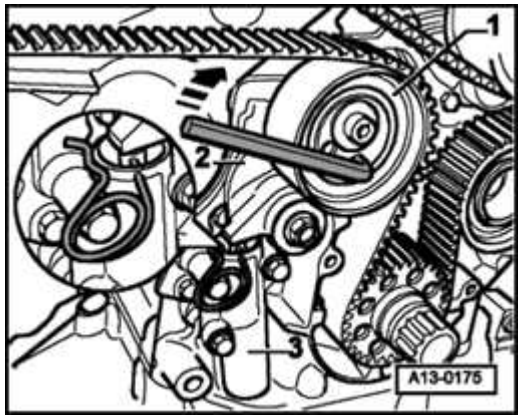


- Remove idler wheel for ribbed belt -arrows-.
- Remove toothed belt guard behind vibration damper -arrows-.

15-49

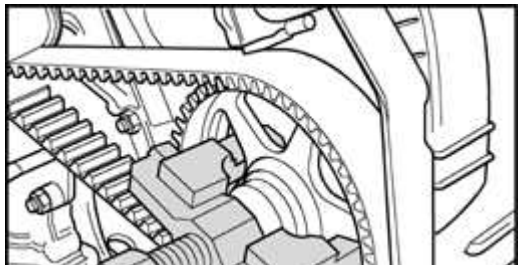
Notes:

- *Mark the direction of rotation of the toothed belt with chalk or felt pen before removing. A used belt can break if it rotates in the wrong direction when reinstalled.*
- *The toothed belt tensioning element is oil-damped and can therefore only be compressed slowly by applying constant pressure.*

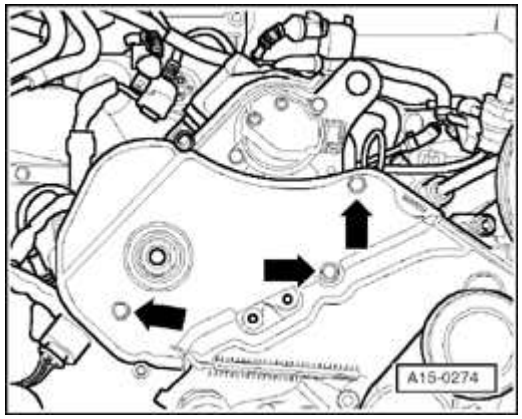


- Using a hexagon key, turn toothed belt tensioning roller -1- clockwise 8 mm in direction of arrow until tensioning lever -2- compresses tensioning element -3- sufficiently to enable a 2mm dia. spring pin to be installed in drilling and in plunger.
- Insert spring pin and release toothed belt tensioning roller.

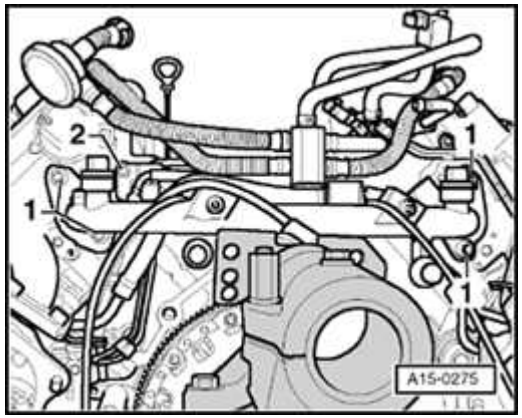
  Use spring pin from 2024 A.
- Insert camshaft clamp 3391 in the securing plates of the two camshafts.
- Loosen both camshaft bolts and remove approx. 5 turns.
- Take out camshaft clamp 3391.



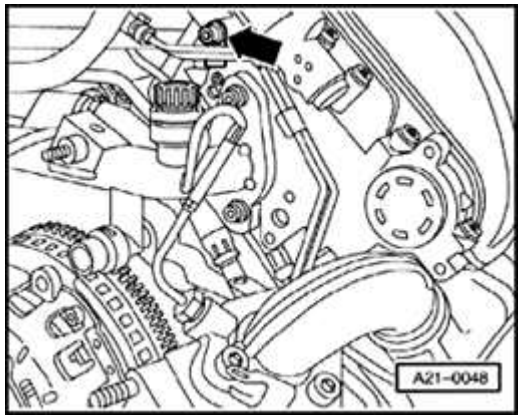
- Pull off both camshaft sprockets with special tool T40001.



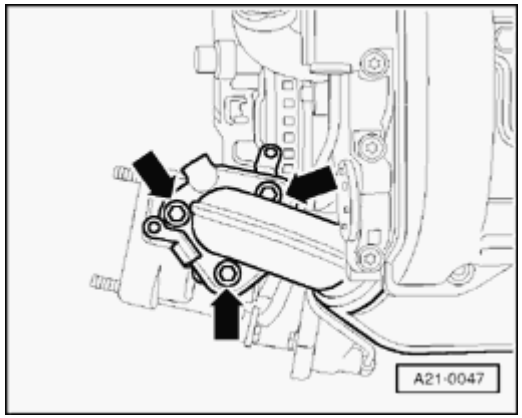
- Unbolt rear right toothed belt guard -arrows-.
- Detach intake manifold using special tool 3249.



- Unbolt water line -1- and pull it towards the rear.
- Unbolt bracket -2- from cylinder head.



- Detach line -arrow- from cylinder head.
- Detach line -2-.



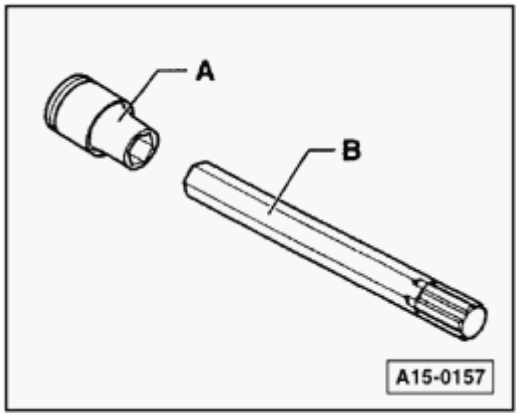
- Remove turbocharger -arrows-.

- Unbolt cylinder head cover.

- Loosen and remove cylinder head bolts in opposite sequence to tightening sequence using special tool 3452 (Polidrive).

- Carefully lift off cylinder head.

Note:



Use special tool 3452 together with a normal commercial 10 mm socket when removing and installing.

15-53

Installing

Notes:

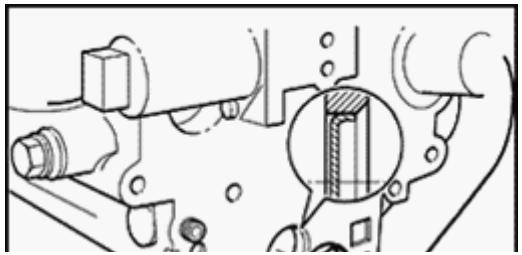
- *Do not allow any oil or coolant to remain in the blind holes for the cylinder head bolts in the cylinder block.*
- *Install new cylinder head bolts.*
- *Connecting vacuum hoses* ⇒ *Page 10-28* .

When installing a new cylinder head:

- Screw in centering pin for intake manifold.

The cylinder head supplied as a replacement part can be used on both sides (left or right). But a sealing cap (core plug) must be installed in the front end of the cylinder head in each case.

- Coat outside circumference of sealing cap (core plug) with sealant AMV 188 001 02.



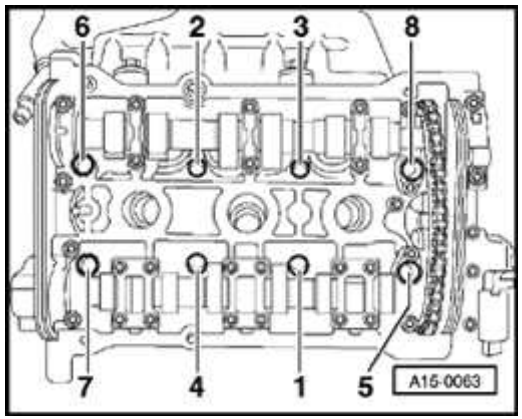
- Using drift VW 295, knock in sealing cap (core plug) until outside rim is flush with end of chamfer in cylinder head.

15-54

- Before installing cylinder head in position, turn crankshaft and camshafts to TDC of No. 3 cylinder.

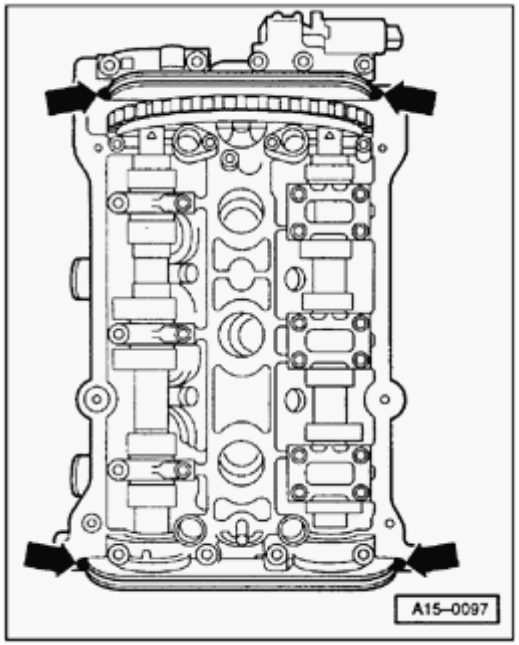
- Install cylinder head gasket on dowel sleeves. Marking "oben" (top) or part number must face towards cylinder head.

- Install cylinder head, insert cylinder head bolts and tighten finger-tight.



- Tighten cylinder head bolts in two stages in sequence shown, as follows:
  - Stage 1 = 60 Nm.
  - Stage 2 = turn a further $^{1}/_{2}$ turn (180°) with a rigid wrench (turning 2 x 90° is also permissible).

It is not necessary to torque down cylinder head bolts again after repairs have been completed.



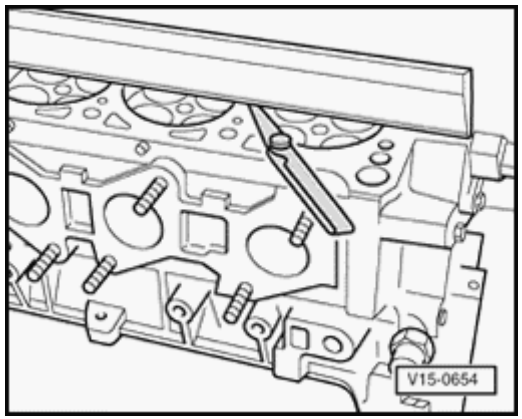
- Seal end points of joints between bearing caps and cylinder head.
- Before installing cylinder head cover and gasket, carefully apply a small quantity of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head -arrows-, using a small screwdriver.

Tightening torques

Component		Nm
Bolts	M6	10
Bolts	M8	20
Camshaft bearing caps and camshaft adjuster		10
Exhaust manifold to cylinder head		25
Front exhaust pipe to exhaust manifold		25
Oxygen sensor		50
Spark plugs		25
Toothed belt sprocket to camshaft		55
Intake manifold to cylinder head		10
Cylinder head cover		10

15-56

Cylinder head, checking for distortion

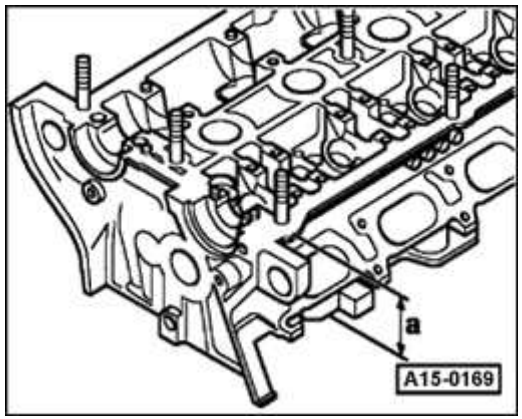


- Measure at several points with straight-edge.

♦ Maximum permissible distortion: 0.1 mm.

15-57

Cylinder head, reworking



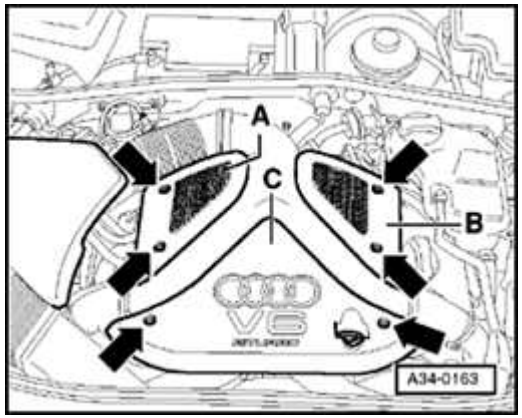
Reworking cylinder head (skimming) is only permissible down to a minimum dimension of a =139.25 mm.

15-58

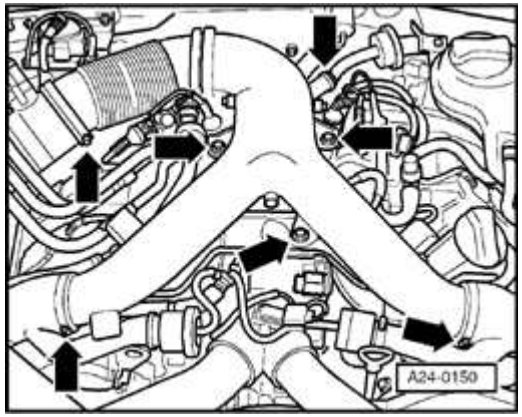
Compression, checking

Test requirements:

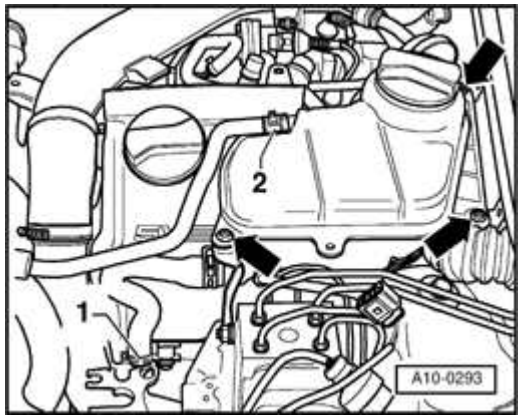
- Engine oil temperature at least 30 ° C.
- Battery fully charged.



➢ - Remove bolts -arrows- and remove engine cover panels -A...C-.



➢ - Remove air duct -arrows-.

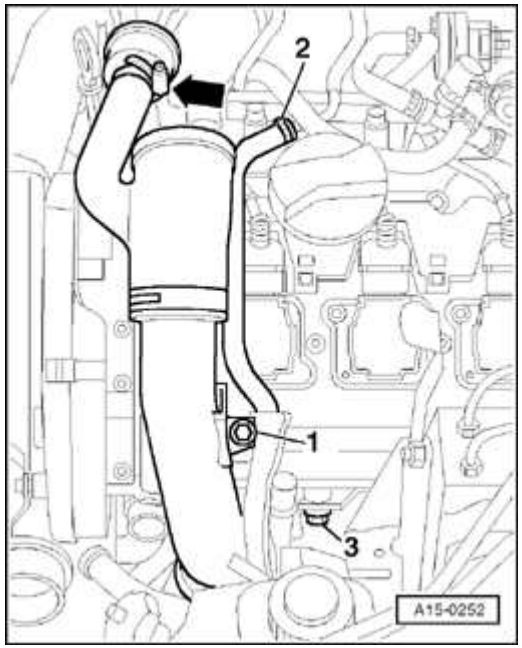


- Remove coolant reservoir -arrows- and move it clear to the side.

Note:

Leave coolant hoses connected.

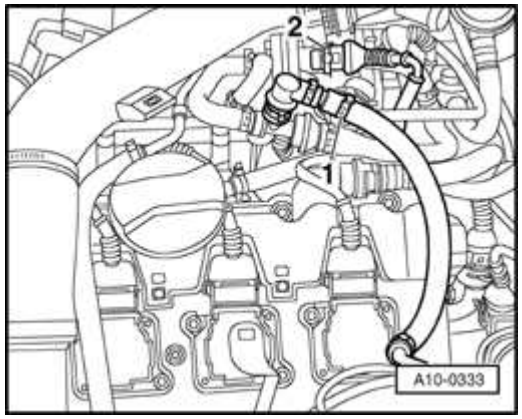
- Unplug connector from coolant level monitor.
- Remove cover panel from cylinder head cover (cylinder bank 4 - 6).



- Release hose clamp -arrow-.
- Remove intake line -1-.
- Disconnect hose -2-.
- Detach water line -3-.

Note:

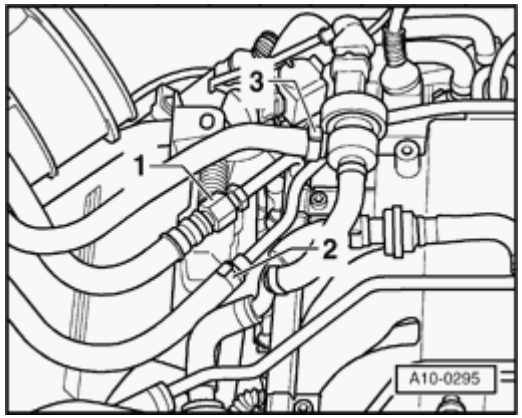
Plug lower section of intake line.



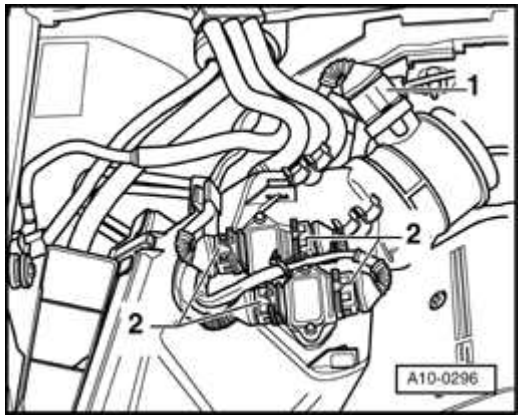
- Pull off hose -1-.

WARNING!

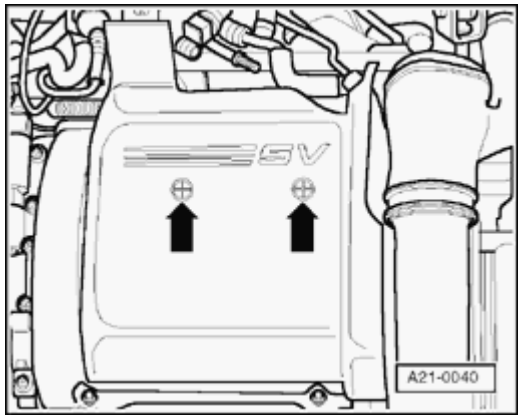
Fuel system is under pressure. Before opening the system, place a cloth around the connection. Then release pressure by carefully loosening the connection.



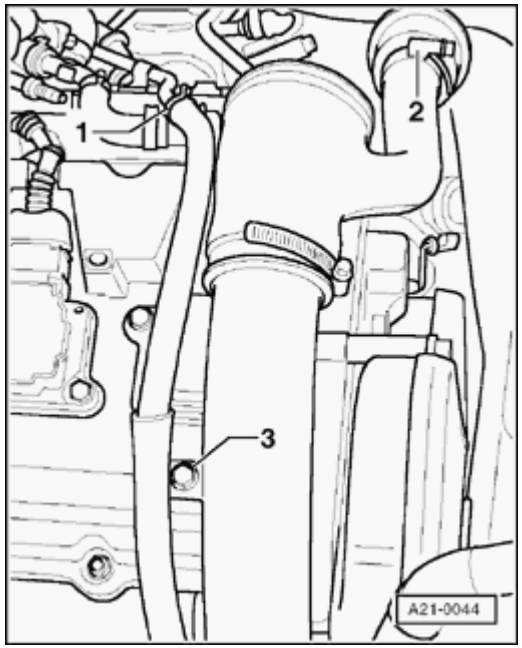
- Disconnect fuel supply line and fuel return line -1- and -2-, and move fuel lines clear.
- Pull hose off EVAP valve -3-.



- Unplug connector -1- from air mass meter.
- Unplug connectors -2- from ignition output stages, and move wiring clear.
- Remove air cleaner.



- Remover cover panel from right-hand cylinder head cover -arrows-.



- Disconnect hose -1-.
- Disconnect hose -2-.
- Detach upper section of pressure line -3-.

Note:

Plug lower section of pressure line.

- Pull crankcase breathers off cylinder head covers.
- Pull plug connectors off ignition coils.
- Remove ignition coils.
- Unplug connectors from all 6 injectors.
- Disconnect 5-pin connecter at power output stage of ignition coils.
- Open throttle fully.
- Use compression tester VAG 1381 or VAG 1763.
- Operate starter until pressure reading on tester no longer rises.

Compression pressure values

New	Wear limit	Max. permissible difference between cylinders
9 ... 13 bar	7 bar	3 bar

Installing

Install in reverse sequence; note the following points.

- install fuse No. 28 (for fuel pump).

- Erase Diagnostic Trouble Code (DTC) memory.

Note:

Malfunctions will have been stored in the memory because the connector to the Hall sensor has been unplugged. Therefore interrogate and erase the DTC memory after the test.

Tightening torque

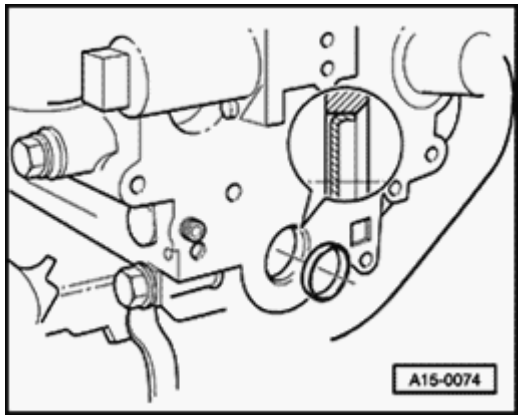
Component	Nm
Ignition coils to cylinder head	10
Spark plugs in cylinder head	30

15-65

Sealing cap (core plug) in cylinder head, installing

The cylinder head supplied as a replacement part can be used on both sides (left or right). But a sealing cap (core plug) must be installed in the front end of the cylinder head in each case.

- Coat outside circumference of sealing cap (core plug) with sealant AMV 188 001 02.

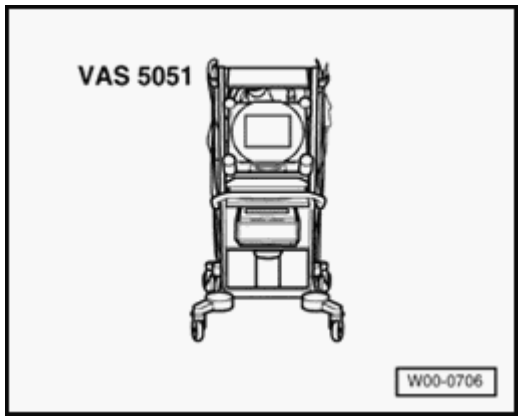


- Using drift VW 295, knock in sealing cap (core plug) until outside rim is flush with end of chamfer in cylinder head.

15-66

Camshaft adjustment, checking function

Special tools and equipment



- VAS 5051 with VAG 5051/1

or

- VAG 1551 with VAG 1551/3A

Test requirement:

- Coolant Temperature at least 80 ° C.

WARNING!

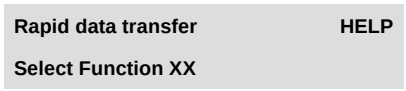
- ***During a road test in an airbag-equipped vehicle, test equipment must always be fastened to and operated from the rear seat by a second technician.***
- ***When driving or riding in an airbag-equipped vehicle, NEVER hold the scan tool or other test equipment in your hands or lap while in motion. Objects between you and the airbag increase the risk of injury in an accident.***

15-67

Test sequence

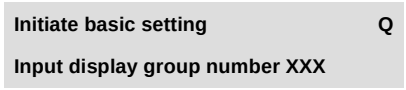
- Connect VAS 5051 tester or VAG 1551 scan tool and select control module for engine electronics using "address word" 01. Engine must run at idle for this.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*



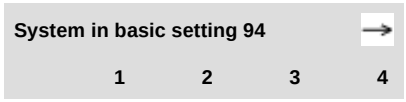
When indicated on display

- Press buttons -0- and -4- to select "Initiate basic setting" and press -Q- button to confirm input.



When indicated on display

- Press buttons -0-, -9- and -4- to select "display group number 094" and press -Q- button to confirm input.



When indicated on display

Camshaft adjustment is checked for function.

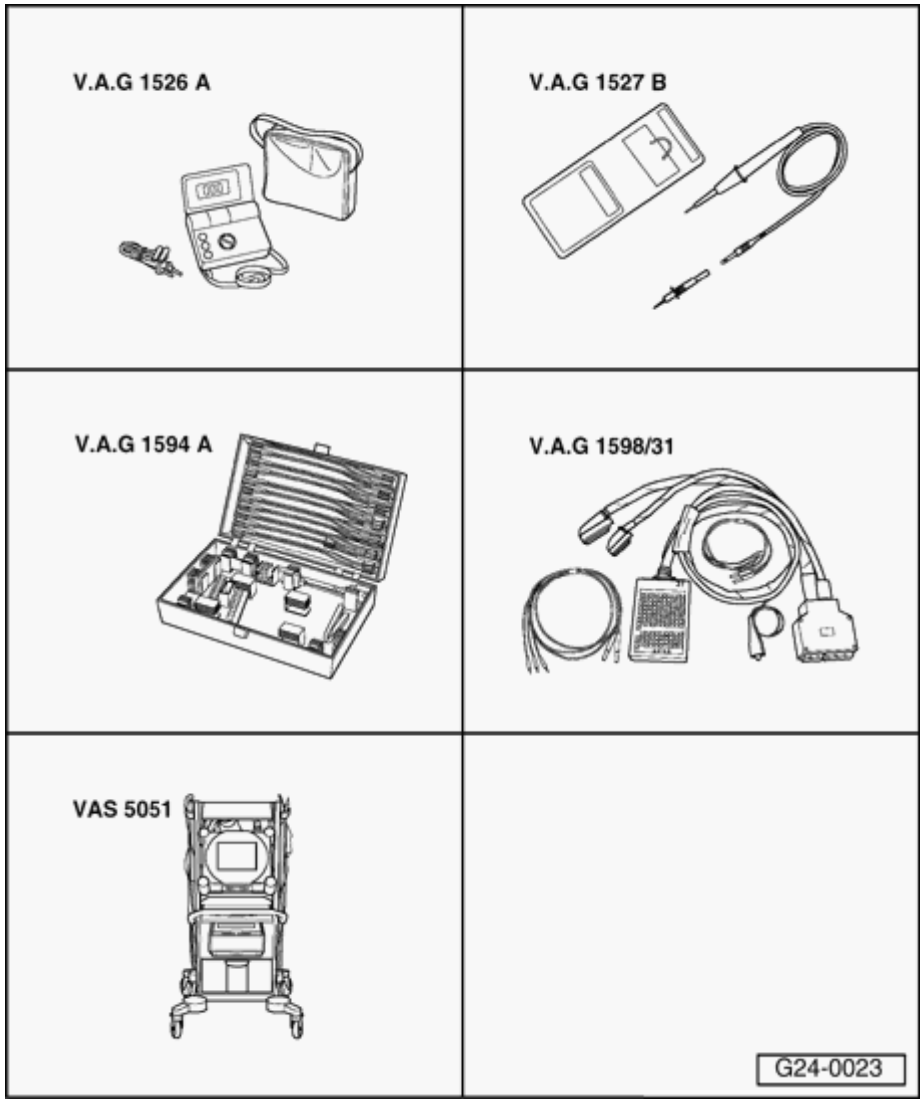
- Increase engine speed to above 2000 RPM.

	Display fields			
	1	2	3	4
Display group 94: Function of camshaft adjustment				
Display	1 RPM	Text	Text	Text
Indicated	Engine speed (RPM)	Camshaft adjustment	Test result, Bank 1	Test result, Bank 2
Specified value	>2000	Cs-CM. ON	Test ON Sys. OK	Test ON Sys. OK
Note:				

If "not OK" is indicated in display field 3 and/or 4:

- Check solenoid valve for camshaft adjustment.

15-69



Solenoid valve for camshaft adjustment, checking

Special tools and equipment

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

- or

- VAG 1551 with VAG 1551/3A

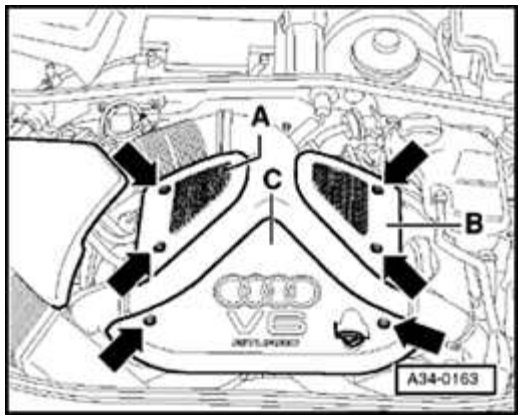
- Initiate output Diagnostic Test Mode (DTM) and activate the valve for camshaft adjustment.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

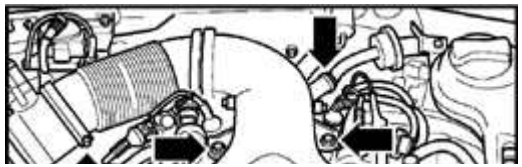
If valves do not click during output Diagnostic Test Mode (DTM):

Checking internal resistance

- Switch ignition off.

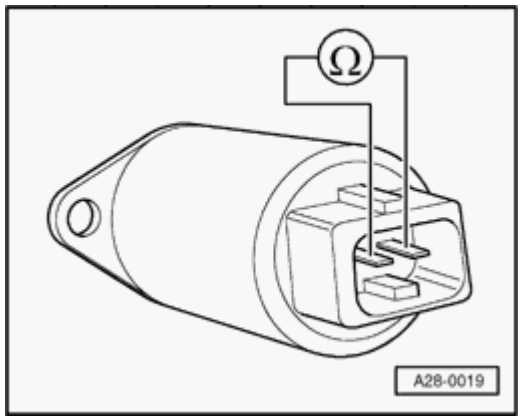


- Remove bolts (arrows) and remove engine covers -A- and -B-.



- Remove air distributor (arrows).

- Disconnect connector from solenoid valve.



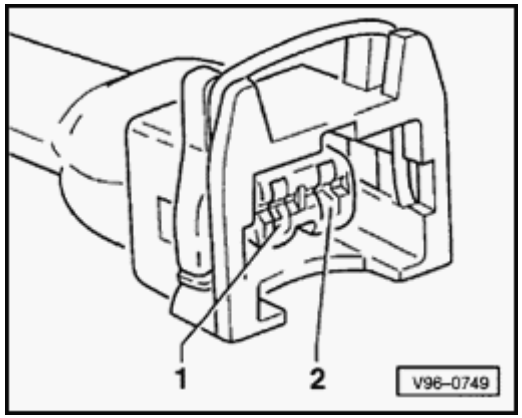
- Connect multimeter at valve for resistance measurement.
  - ♦ Specified value: 10 ... 18 Ω

If specified value is not obtained:

- Replace valve.

Checking voltage supply

- Disconnect connector from solenoid valve.



- Connect VAG 1527B voltage tester as follows:

Harness connector terminal	Measure to
1	Engine Ground (GND)

- Operate starter briefly.
  - ♦ LED must light.

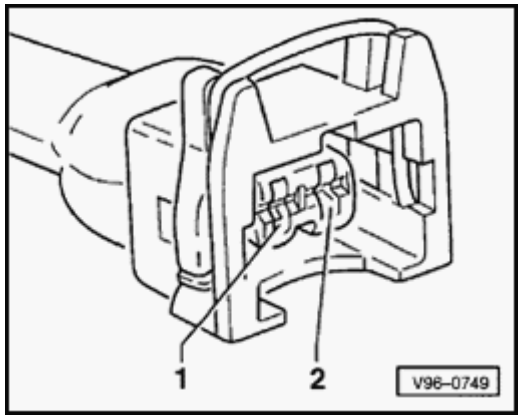
If LED does not light:

- Perform following tests marked with dots:

• Check fuse of solenoid valves for camshaft adjustment.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

15-72



- Check wire connection from terminal 1 of connector via fuse -S234- (in fuse holder, socket 34) to Fuel Pump (FP) relay for open circuit:

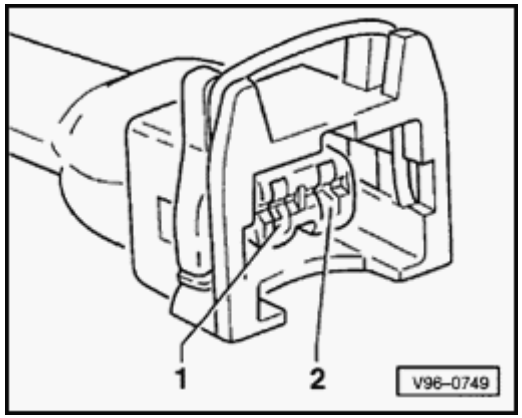
⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Repair open circuit if necessary.

If no malfunctions are detected:

- Check Fuel Pump (FP) relay.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*



Checking activation

- Connect VAG 1527B voltage tester between terminal 1 (+) and 2.
- Initiate output Diagnostic Test Mode (DTM) and activate valve for camshaft adjustment.

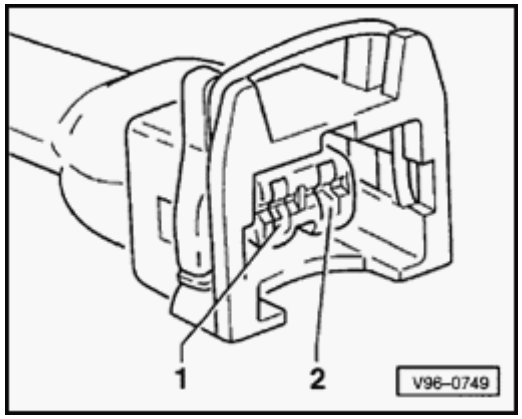
⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

♦ LED must blink.

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

- Connect VAG 1598/31 test box at wiring harness to ECM, do not connect ECM.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*



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

Valve 1 for camshaft adjustment -N205- and valve 2 for camshaft adjustment -N208-

Harness connector terminal	VAG 1598/31 or test box Bushing
2	⇒ *Electrical Wiring Diagrams, Troubleshooting &Component Locations*

- Repair Ground (GND) connection or open circuit if necessary.

If wire connection is OK:

- Replace Engine Control Module (ECM).

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

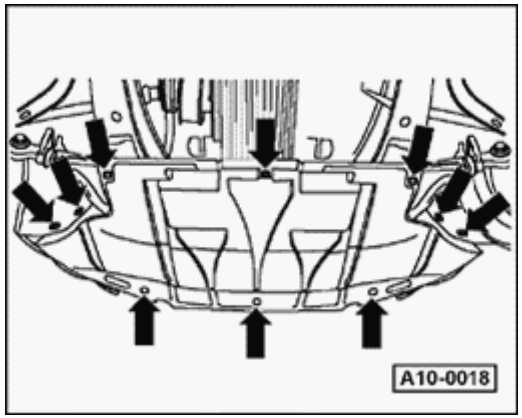
If no malfunctions are detected:

- Replace mechanical camshaft adjuster.

Camshafts and camshaft adjusters, removing and installing

Removing

- Cylinder head installed



- Remove noise insulation panel -arrows-.
- Remove front bumper

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

- Move lock carrier to service position

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Remove ribbed belt ⇒ Page 13-1 .
- Remove toothed belt ⇒ Page 13-4 .

Left cylinder head

- Remove left-hand cylinder head cover ⇒ Page 15-22 .

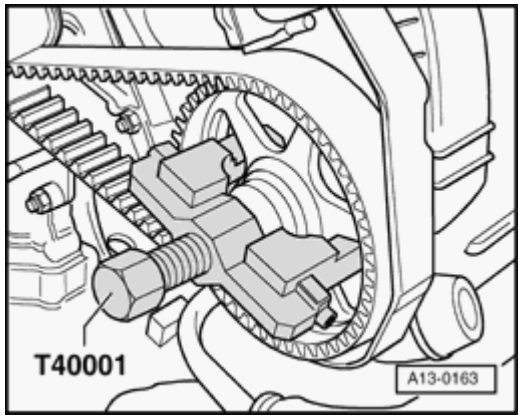
15-76

Right cylinder head

- Remove right-hand cylinder head cover ⇒ Page 15-25

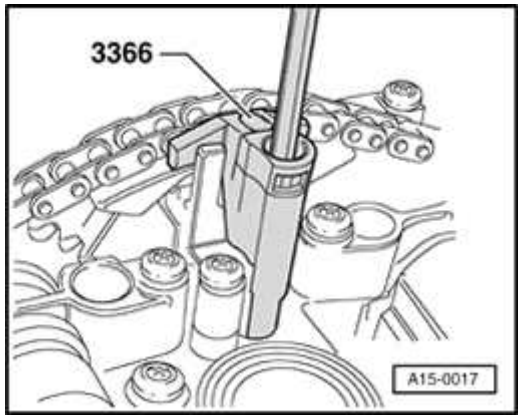
All:

- Unbolt Hall sensor housing (10 Nm).
- Remove bolt securing Hall sensor rotor (20 Nm) and carefully lever off rotor using a screwdriver.
- Insert camshaft clamp 3391 in securing plates of two camshafts.
- Loosen both camshaft bolts and remove approx. 5 turns.
- Take out camshaft clamp 3391.



- Pull off both camshaft sprockets with special tool T40001.
- Using a screwdriver, carefully pry oil feed lines for camshaft bearings out of camshaft bearings.

Make sure that the retaining catches do not break off when levering out the oil lines.

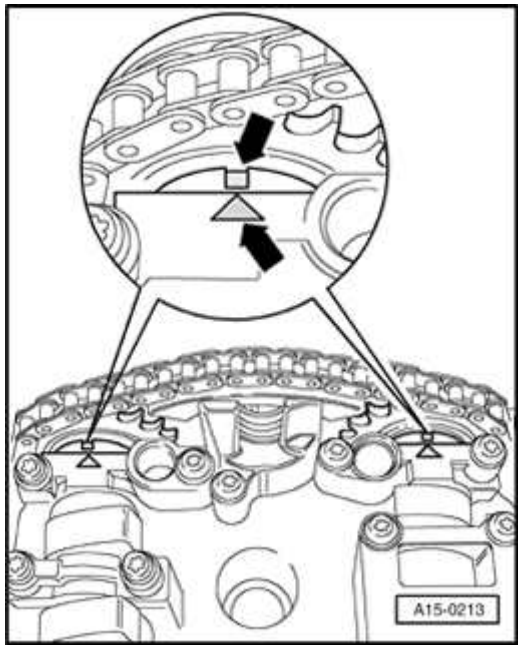


- Secure camshaft adjuster using retainer for chain tensioner 3366.

Note:

Do not over tighten retainer for chain tensioner, otherwise camshaft adjuster can be damaged.

15-78



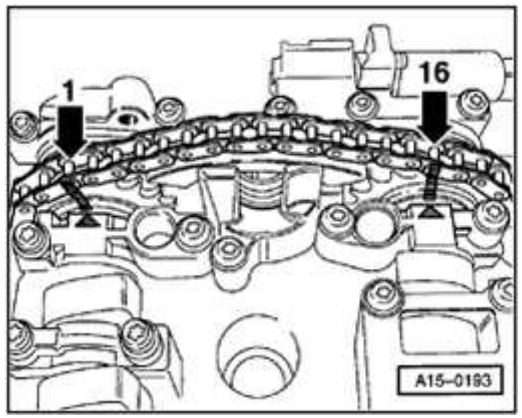
- Check TDC position of camshafts once again.

Note:

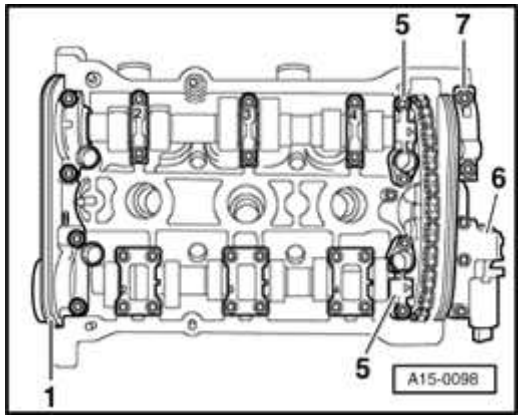
The two markings on the camshafts must be in line with the two arrows on the bearing caps.

- Clean drive chain and camshaft chain sprockets in vicinity of arrows on bearing caps and mark position of chain on sprockets with paint opposite two arrows.

Notes:

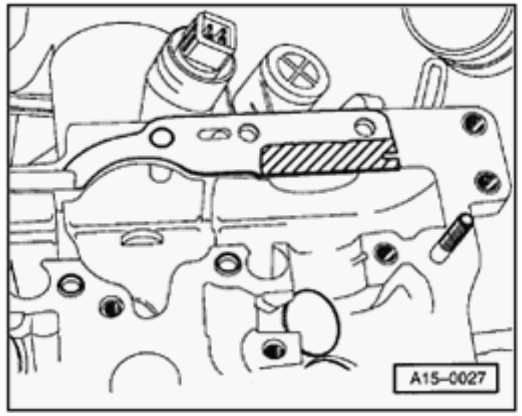


- *The distance between the two arrows (and thus between the paint markings) is 16 rollers on the chain.*
- *The notch on the exhaust camshaft is offset slightly towards the inside in relation to chain roller -1-.*
- *Do not mark the chain with a center punch or by making a notch or similar.*



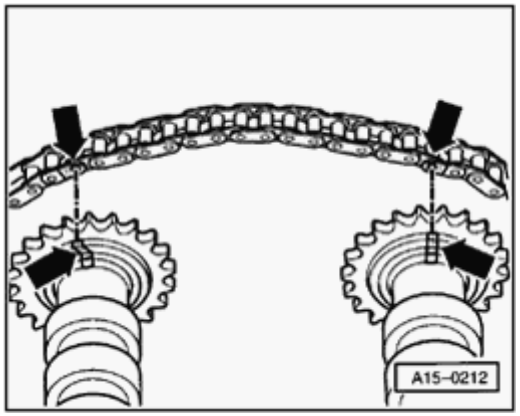
- Remove bolts securing camshaft adjuster -6-.
- Remove bearing caps 1, 3, 5 and 7 from inlet and exhaust camshafts and place them in correct order on a clean surface.
- Loosen bearing caps 2 and 4 alternately and in diagonal sequence, and remove from both camshafts.
- Take out both camshafts together with camshaft adjuster.

Installing



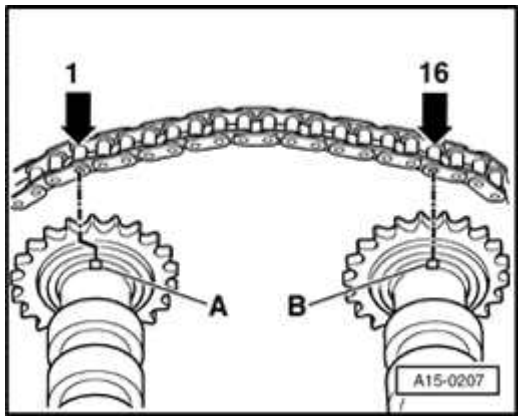
- Replace rubber/metal gasket for camshaft adjuster and apply a thin coat of sealant D 454 300 A2 to the shaded area.

- Install drive chain on camshaft sprockets as follows:



➢

- When the old chain is being used again, install the chain so that the paint markings (arrow) are in line.



➢

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

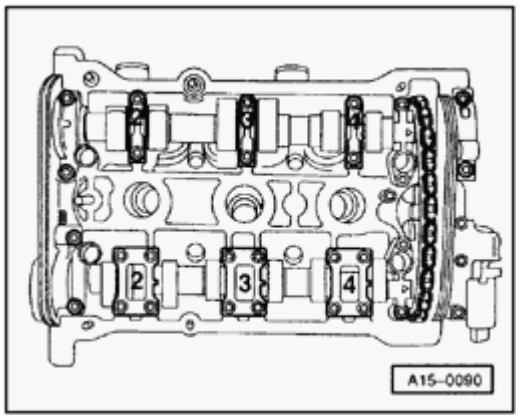
- Insert camshaft adjuster inside chain (second mechanic required).
- Locate camshafts with chain and camshaft adjuster in cylinder head.
- Oil camshaft bearing surfaces.

15-81

Notes:

- *The dowel sleeves for the bearing caps and camshaft adjuster must be in the cylinder head.*
- *Install the bearing caps so that the markings on the bearing caps can be read from the inlet side of the cylinder head.*

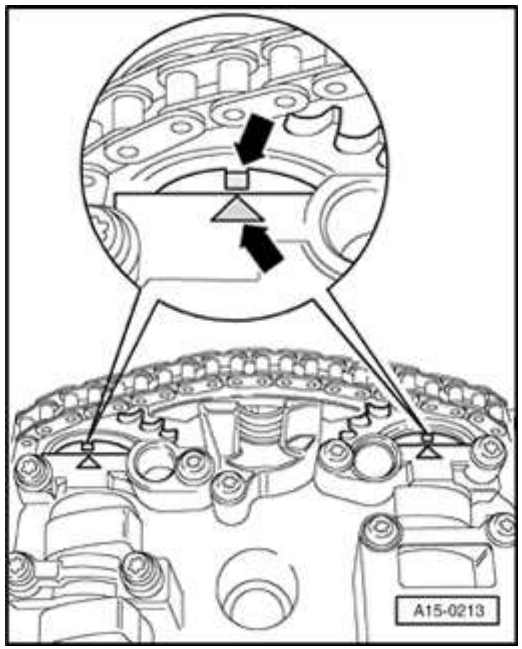
- Tighten bolts securing chain tensioner (watch position of dowel sleeves).



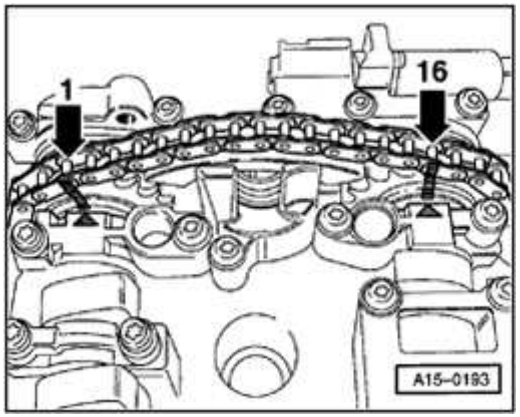
- Tighten bearing caps 2 and 4 of inlet and exhaust camshafts alternately and in diagonal sequence (watch position of dowel sleeves).
- Install two bearing caps next to chain sprockets on inlet and exhaust camshafts.

15-82

- Check correct setting of camshafts:

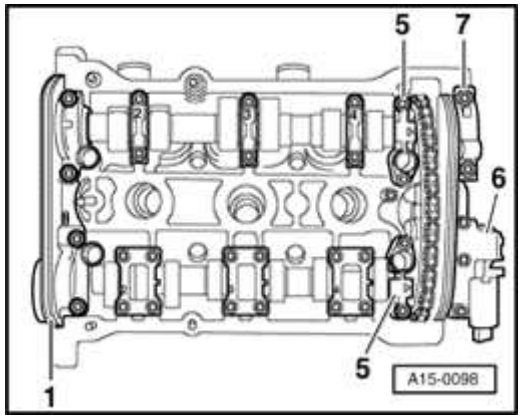


- The two markings on the camshafts must be in line with the two arrows on the bearing caps -arrows-.

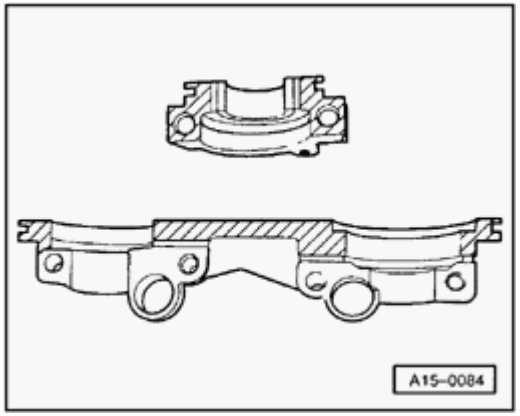


- The distance between the two arrows on the bearing caps (or between the paint markings) is 16 rollers on the chain.
- The notch on the exhaust camshaft is offset slightly towards the inside in relation to chain roller -1-.

15-83



- Prepare shaded areas on double bearing cap -1- and bearing cap -7-.



.... by applying a thin coat of sealant D 454 300 A2 and install bearing caps (watch position of dowel sleeves).

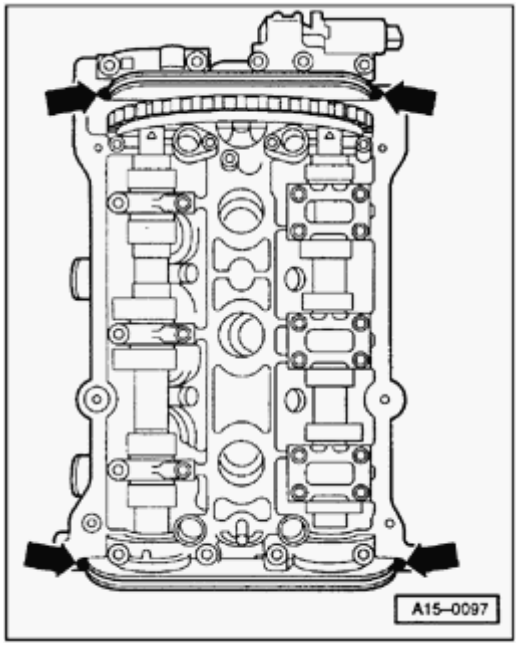
- Install remaining bearing caps (watch position of dowel sleeves).
- Install new oil feed lines for camshaft bearings.
- Install new oil seals for inlet and exhaust camshafts; installing ⇒ Page 15-10 .
- Remove retainer for chain tensioner 3366.

15-84

Notes:

- *When new lifters have been installed the engine must not be started for about 30 minutes. The hydraulic compensation elements must settle (otherwise valves will strike pistons). Then turn crankshaft two full revolutions before starting.*

- *After working on the valve gear, turn over the engine carefully at least two revolutions by hand to ensure that none of the valves make contact when the starter is operated.*



- Seal end points of joints between bearing caps and cylinder head.
- Before installing cylinder head cover and gasket, carefully apply a small quantity of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head -arrows-, using a small screwdriver.

- Install cylinder head covers ⇒ Page 15-22 .

- Install toothed belt ⇒ Page 13-4 .

- Install ribbed belt ⇒ Page 13-1 .

Tightening torques

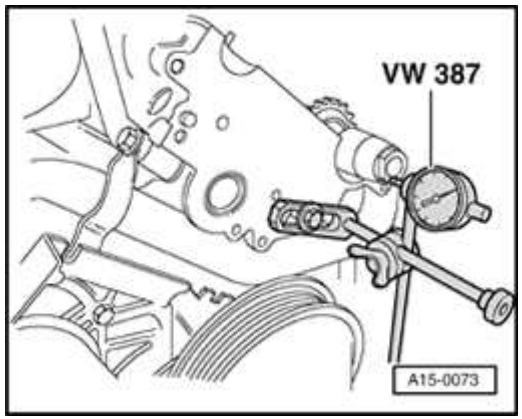
Component		Nm
Bolts	M6	10
	M8	20
Except for the following:		
Bearing caps to cylinder head		10
Camshaft adjuster to cylinder head		10
Hall sensor rotor to camshaft		25
Hall sensor housing to cylinder head		10
Camshaft sprocket to camshaft		55
Camshaft bearing cap and camshaft adjuster		10
Cylinder head cover		10

Camshaft axial clearance, checking

- Remove camshafts ⇒ Page 15-75 .

- Remove lifters.

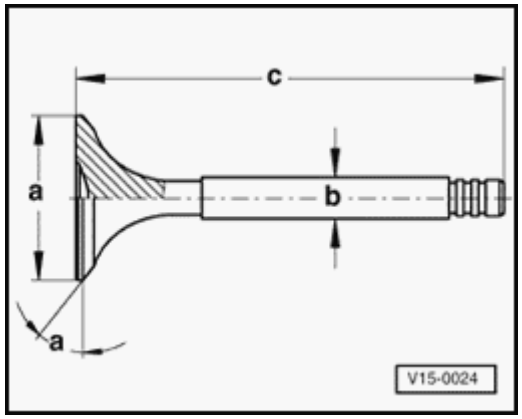
- Install camshafts in cylinder head without drive chain and secure by tightening bearing caps 2 and 4.



- Attach dial gauge to cylinder head with universal dial gauge bracket VW 387.
- Press camshaft against dial gauge by hand.
- Set dial gauge to -0-.
- Press camshaft away from dial gauge.
- Note reading on gauge:

New	Wear limit
0.05 ... 0.15 mm	0.20 mm

15-87



Valve dimensions, checking

Note:

Valves must not be reworked. Only grinding-in (lapping) is permitted.

Dimension	Inlet valve	Exhaust valve
a = diameter mm	26.8 ... 27.0	29.8 ... 30.0
b = diameter mm	5.96 ... 5.97	5.94 ... 5.95
c = mm	104.84 ... 105.34	103.64 ... 104.14
$\alpha = \angle\,^{\circ}$	45	45

WARNING!

Worn sodium-cooled exhaust valves must be treated as follows before disposal:

- ***Saw the valves into two sections with a metal saw at a point between the center of the valve stem and the valve head. The valves must not come into contact with water when this is done. Then throw the valves into a bucket of water (not more than ten at a time) and step back, because a chemical reaction occurs when the sodium filling burns. After this treatment the valves can be disposed of in the normal way.***

15-88

Hydraulic lifters, checking

Notes:

- *Replace malfunctioning lifters completely (lifters cannot be adjusted or repaired).*
- *When new lifters have been installed the engine must not be started for about 30 minutes (otherwise valves will strike pistons).*
- *Irregular valve noises when starting engine are normal.*

- Start engine and run until coolant temperature reaches approx. 80 ° C.

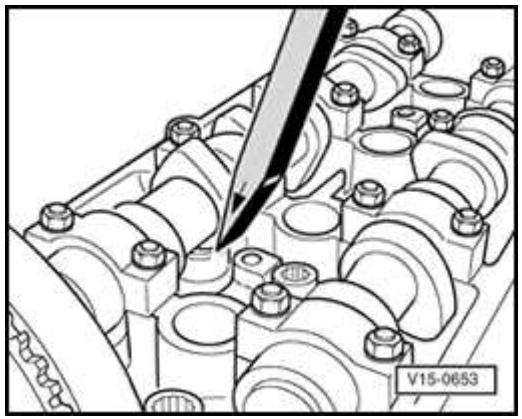
- Increase engine speed to about 2500 RPM for approx. 2 minutes: if necessary, perform road test.

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

- Remove cylinder head cover.

- Rotate crankshaft clockwise by turning securing bolt for toothed belt sprocket until cams of lifters to be checked are pointing upward.

15-89



- Measure clearance between cam and lifter.

- Push lifter down with a wooden or plastic wedge. If a 0.20 mm feeler gauge can then be inserted between camshaft and lifter, replace lifter: removing and installing camshafts and camshaft adjuster ⇒ Page 15-75

Note:

If irregular valve noise occurs repeatedly during short journeys and disappears after extended driving, the oil check valves must be replaceed ⇒ Page 17-12 .

Valve stem seals, replacing

- Cylinder head installed

- Remove ribbed belt ⇒ Page 13-1 .

- Remove toothed belt ⇒ Page 13-4 .

- Remove camshafts ⇒ Page 15-75 .

- Remove lifters and put them down with the contact surface downwards. Ensure that lifters are not interchanged.

- Remove spark plugs.

- Set piston of relevant cylinder to bottom dead center (BDC).

Note:

Tight cotters can be released by tapping lightly on the valve lever with a hammer.

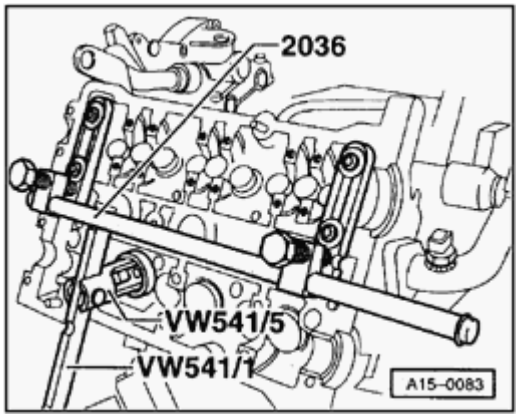
15-91

Exhaust side

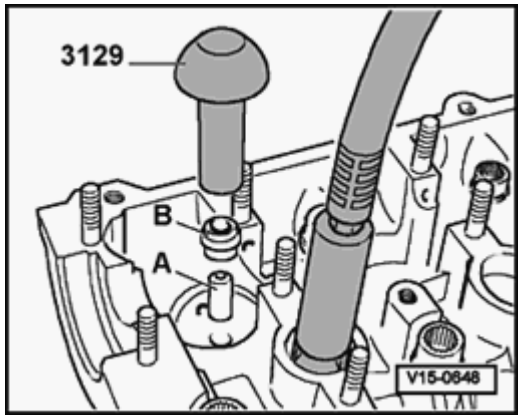
Note:

Before attaching the valve assembly appliance, remove the two studs in the center of the cylinder head and the three upper studs (inlet side) for securing the cylinder head cover.

- Screw pressure hose VW 653/3 with sealing ring finger-tight into spark plug thread of relevant cylinder, and maintain a constant pressure of at least 6 bar.



- Attach valve assembly appliance 2036 as illustrated: use M6 x 40 bolts with large washers.
- Remove valve spring using valve lever VW 541/1 and thrust piece VW 541/5.
- Take out valve spring and valve spring plate.
- Pull off valve stem seal with 3047 A.

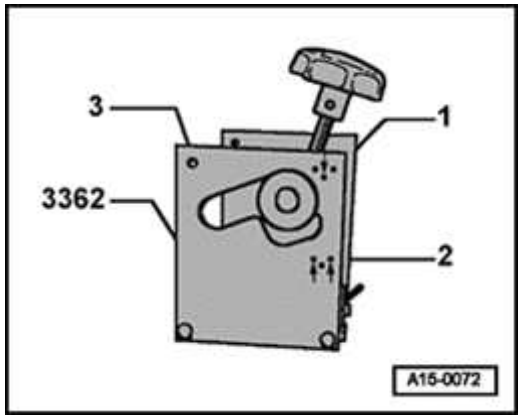


- To prevent damage to the new valve stem seals, place plastic sleeve -A- on the valve stem.
- Lightly oil sealing lip.
- Insert valve stem seal -B- (without oiling outside of seal) into installing tool 3129 and carefully push it down onto the valve guide.
- When installing new valves, lightly oil valve stems before installing.

Inlet side

Note:

The inlet valves are installed in the cylinder head at different angles.



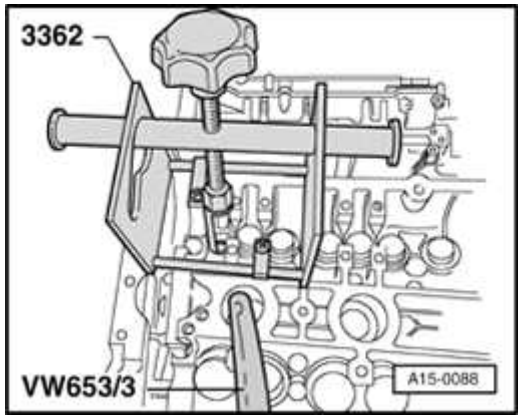
Valve spring compressor 3362 can be set accordingly to two different positions:

1 - Upper position for center valve

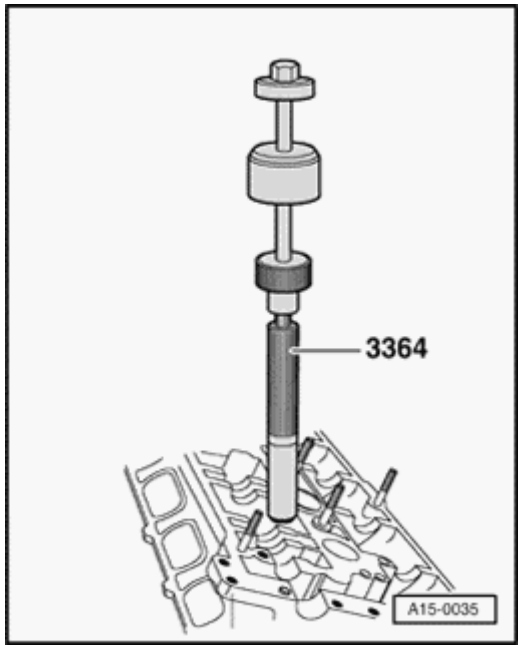
2 - Lower position for the two outer valves

3 - Threads on each side to take M6 x 25 bolts for securing spring compressor to cylinder head

15-93

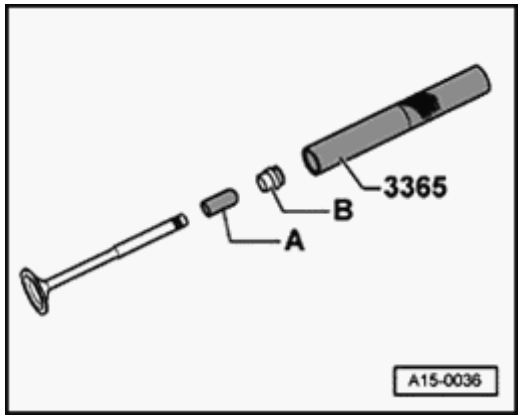


- Mount spring compressor 3362 on cylinder head with two bolts supplied, as in illustration.
- Screw pressure hose VW 653/3 with sealing ring finger-tight into spark plug thread of relevant cylinder, and maintain a constant pressure of at least 6 bar.
- Set position of spring compressor for relevant valve, and remove valve spring using threaded spindle.



- Pull off valve stem seal using 3364.

15-94



- To prevent damage to new valve stem seals, place plastic sleeve -A- on valve stem.
- Lightly lubricate sealing lip with oil.
- Insert valve stem seal -B- (without oiling outside of seal) into installing tool 3365 and carefully push it down onto valve guide.
- When installing new valves, lightly oil valve stems before installing.

Reworking valves

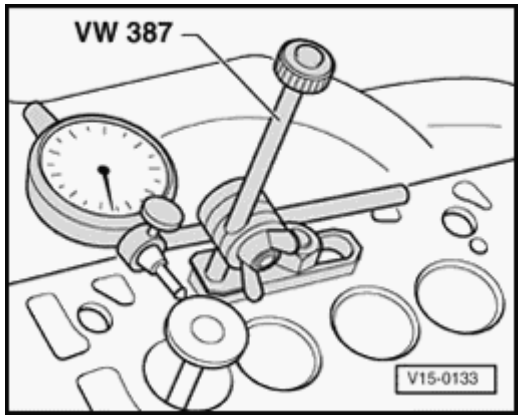
Valves must not be reworked. Only grinding-in (lapping) is permitted.

WARNING!

Note precautions required when disposing of sodium-cooled exhaust valves ⇒ ***Page 15-87*** **.**

Valve guides, checking

When repairing engines or cylinder heads with leaking valves, it is not sufficient to reface the valve seats and replace the valves. The valve guides must also be checked for wear. This is particularly important on high-mileage engines.



- Insert valve into valve guide so that end of valve stem is flush with end of guide. The valve stems have different diameters, so only use an inlet valve in an inlet guide and an exhaust valve in an exhaust guide.
- Measure amount of rock.

Wear limit

Inlet valve guide	Exhaust valve guide
0.8 mm	0.8 mm

If the wear limit is exceeded, replace cylinder head.

15-96

Valve seats, reworking (refacing)

Notes:

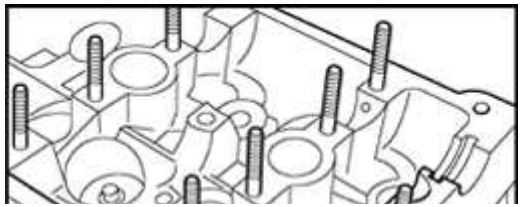
- *The valve seats should only be reworked just enough to produce a good seating pattern.*
- *Calculate the maximum permissible reworking dimension before reworking.*
- *If the reworking dimension is exceeded, the function of the hydraulic lifters can no longer be guaranteed and the cylinder head should be replaced.*

Calculating maximum permissible reworking dimension

- Insert valve and press firmly against valve seat.

Note:

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



- Measure distance between end of valve stem and top surface of cylinder head (illustration shows a 4-valve head).
- Calculate maximum permissible reworking dimension from measured

distance and minimum dimension.

Minimum dimensions		
Outer inlet valve	Center inlet valve	Exhaust valve
32.2 mm	33.2 mm	33.0 mm

Measured distance minus minimum dimension = maximum permissible reworking dimension.

Example	
Center inlet valve	
Measured distance	33.0 mm
Minimum dimension	- 32.2 mm
Maximum permissible reworking dimension	= 0.8 mm

Note:

If the measured distance is less than the minimum dimension, repeat the measurement with new valves, or replace cylinder head.

15-1

Valve gear, servicing

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!

After installing new hydraulic valve lifters the engine must not be started for about 30 minutes (otherwise the valves will strike the pistons). Turn the crankshaft two complete revolutions by hand before starting.

Notes:

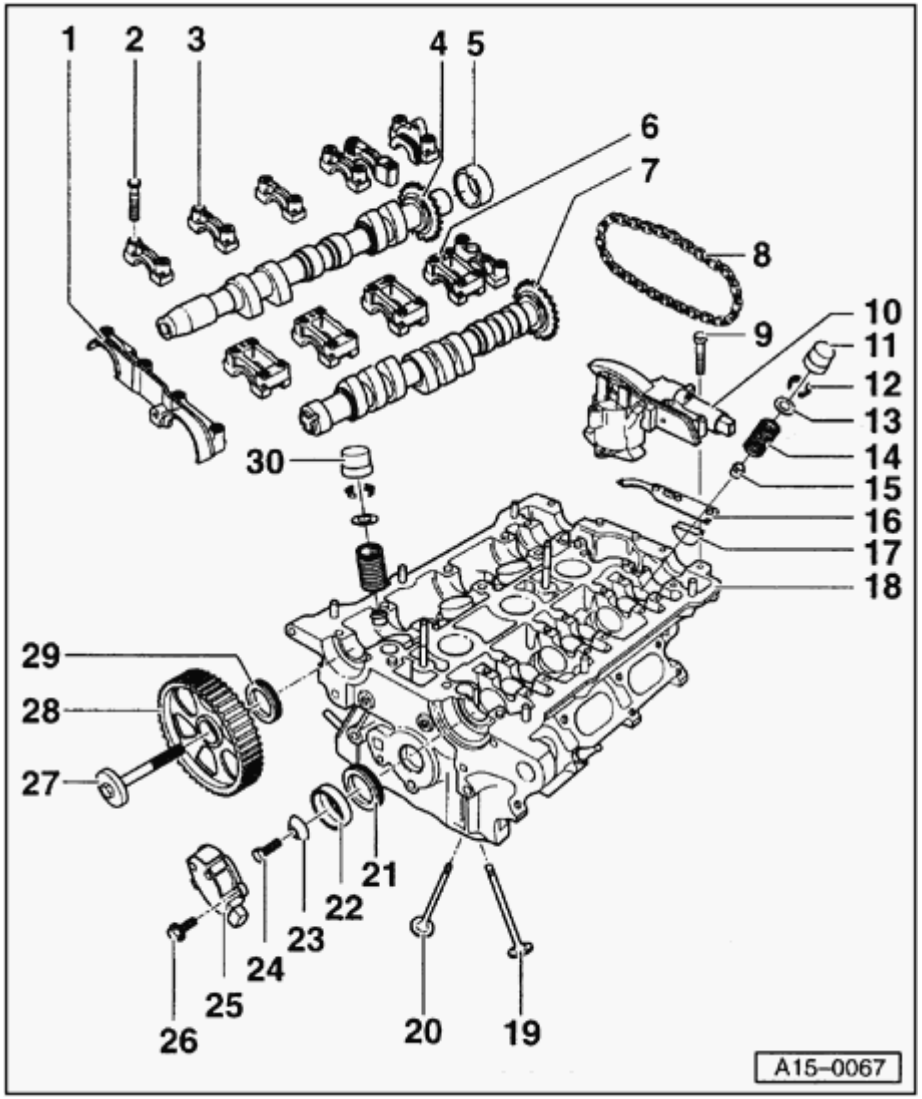
- *Cylinder heads with small cracks between the valve seats that are less than 0.3 mm (0.012 in.) wide and/or between one valve seat and only the first four threads of the spark plug thread, can continue to be used without reduced service life.*

- *Carefully apply a small amount of sealant D 454 300 A2 at the four end points of the sealing surfaces on the cylinder head using a small screwdriver* ⇒ *page 15-13* .

CAUTION!

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

15-3



Cylinder head without oil lines to camshaft bearings

1 - Double bearing cap

- Lightly coat with sealant 454 300 02 A2 before installing ⇒ page 15-36

2 - Bolt

- 10 Nm (7ft lb)

3 - Exhaust camshaft bearing cap

- Watch guide sleeve
- Note installation position and numbering ⇒ page 15-36
- Lightly coat last bearing cap (after chain) with D454 300 A2 sealant before installing

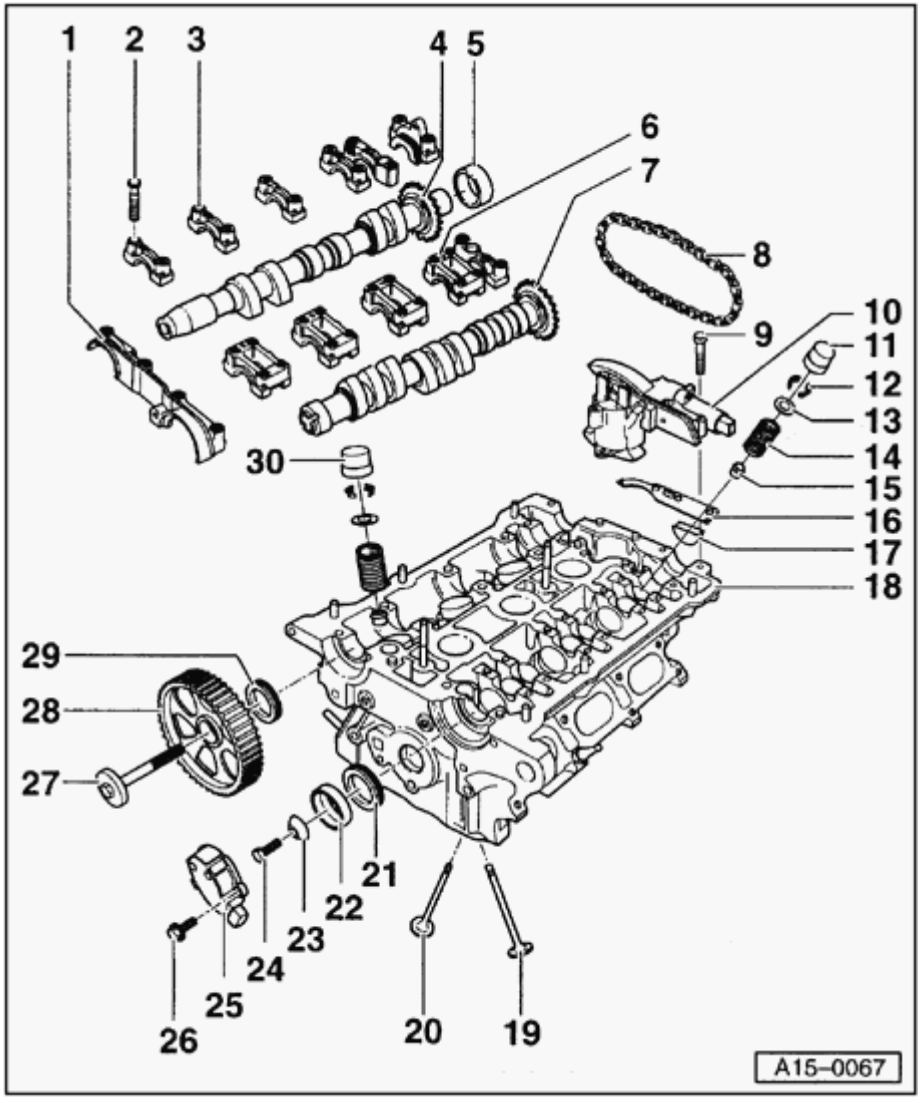
4 - Exhaust camshaft

- Checking axial clearance ⇒ page 15-42
- Removing and installing ⇒ page 15-31

Check radial clearance using Plastigage ® (hydraulic valve lifters removed):

- Wear limit: 0.1 mm (0.004 in.)
- Max. run-out: 0.01 mm (0.0004 in.)

15-4



5 - Cap

- Always replace

6 - Intake camshaft bearing cap

- Note installation position and numbering ⇒ page 15-36

7 - Intake camshaft

- Checking axial clearance ⇒ page 15-42
- Removing and installing ⇒ page 15-31

Check radial clearance using Plastigage ® (hydraulic valve lifters removed):

- Wear limit: 0.1 mm (0.004 in.)
- Max. run-out: 0.01 mm (0.0004 in.)

8 - Drive chain

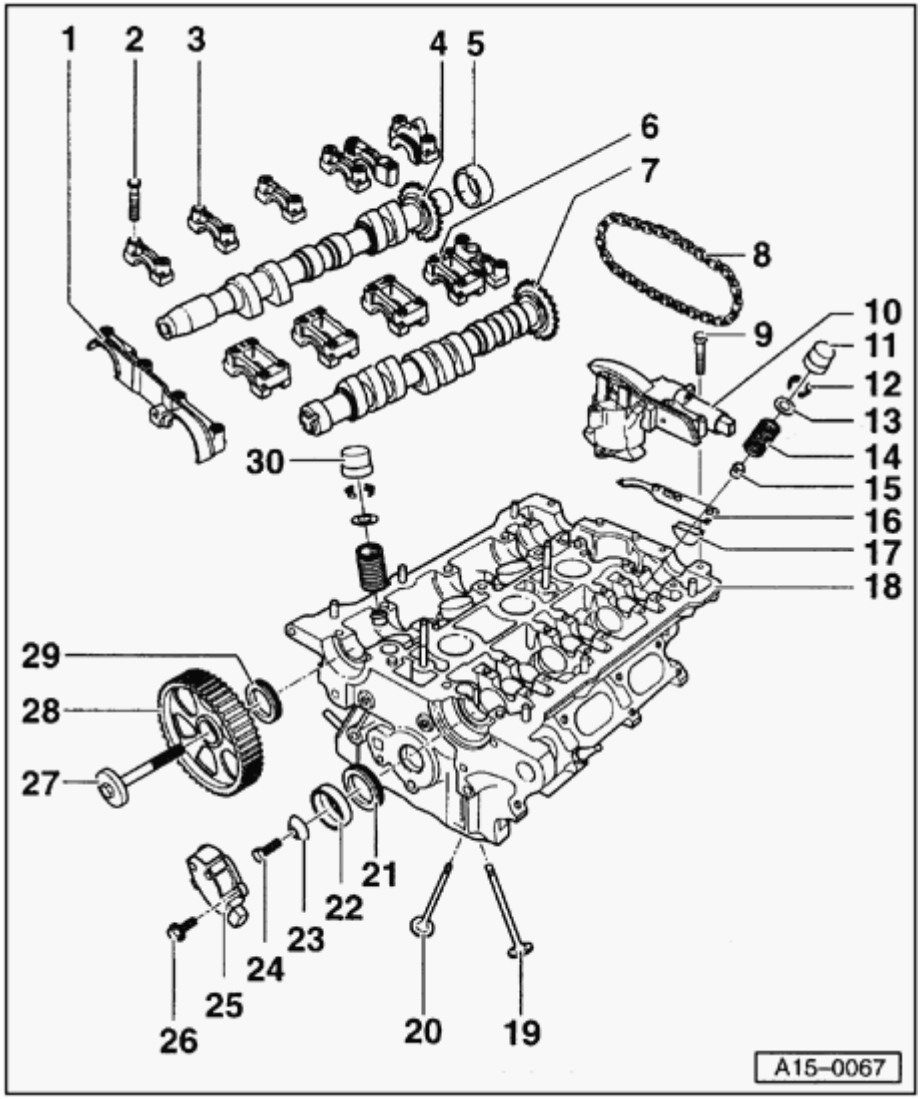
- Installing ⇒ page 15-36

9 - Bolt

- 10 Nm (7ft lb)

10 - Mechanical camshaft adjuster

- With valve -1- for camshaft adjustment - N205-
- Secure using 3366 bracket tensioner before removing ⇒ page 15-31



11 - Hydraulic valve lifter (intake)

- Notes ⇒ page 15-45

12 - Valve keepers

13 - Valve spring retainer

14 - Valve spring

15 - Valve stem oil seal

- Replacing with cylinder head installed ⇒ page 15-47

16 - Rubber/metal seal

- Always replace

17 - Seal

- Always replace

18 - Cylinder head

- Removing and installing ⇒ page 15-18
- Checking for distortion ⇒ page 15-27
- Resurfacing ⇒ page 15-28

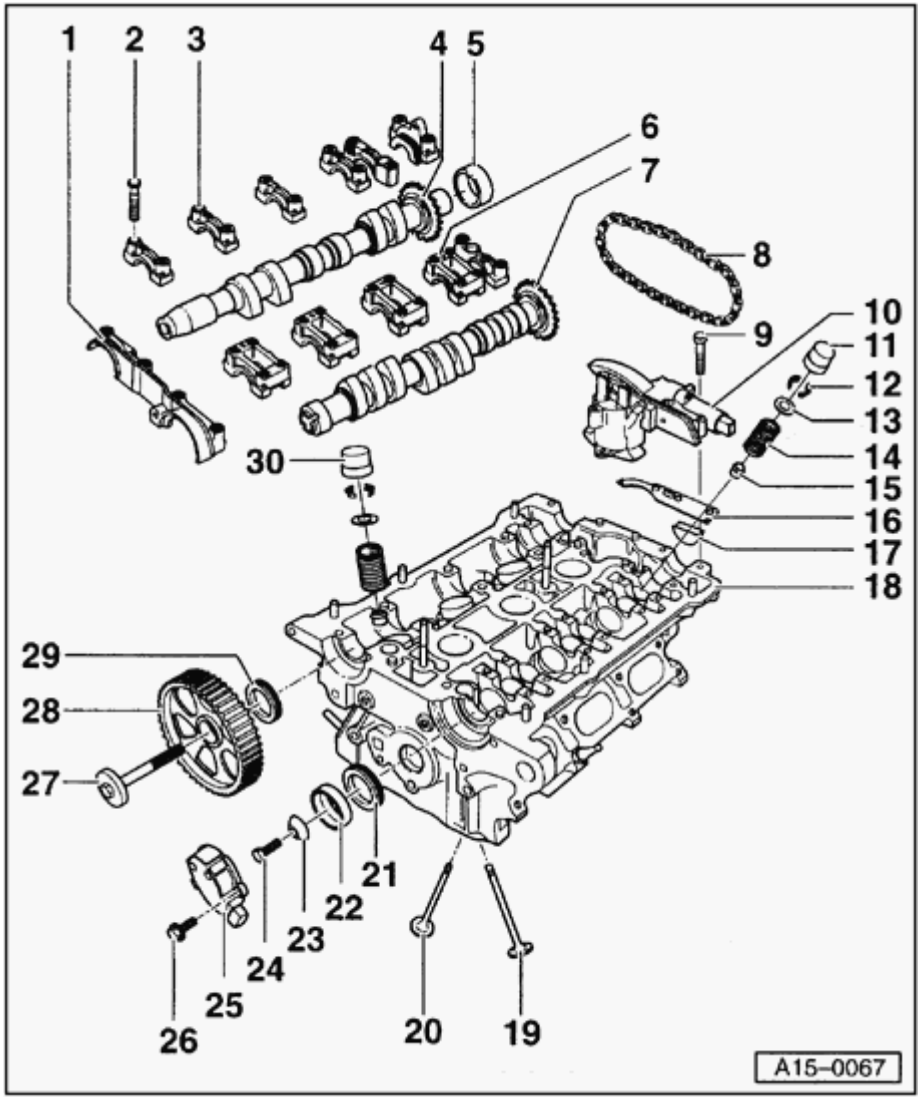
19 - Exhaust valve

20 - Intake valve

21 - Oil seal

- Camshaft Position (CMP) sensor side

♦ Replacing ⇒ page 15-14



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

- Note position (notch on camshaft)

23 - Washer

- Conical

24 - Bolt

- 25 Nm (18 ft lb)

25 - Camshaft Position (CMP) sensor -G40-

26 - Bolt

- 10 Nm (7 ft lb)

27 - Bolt

- 55 Nm (41 ft lb)

28 - Camshaft sprocket

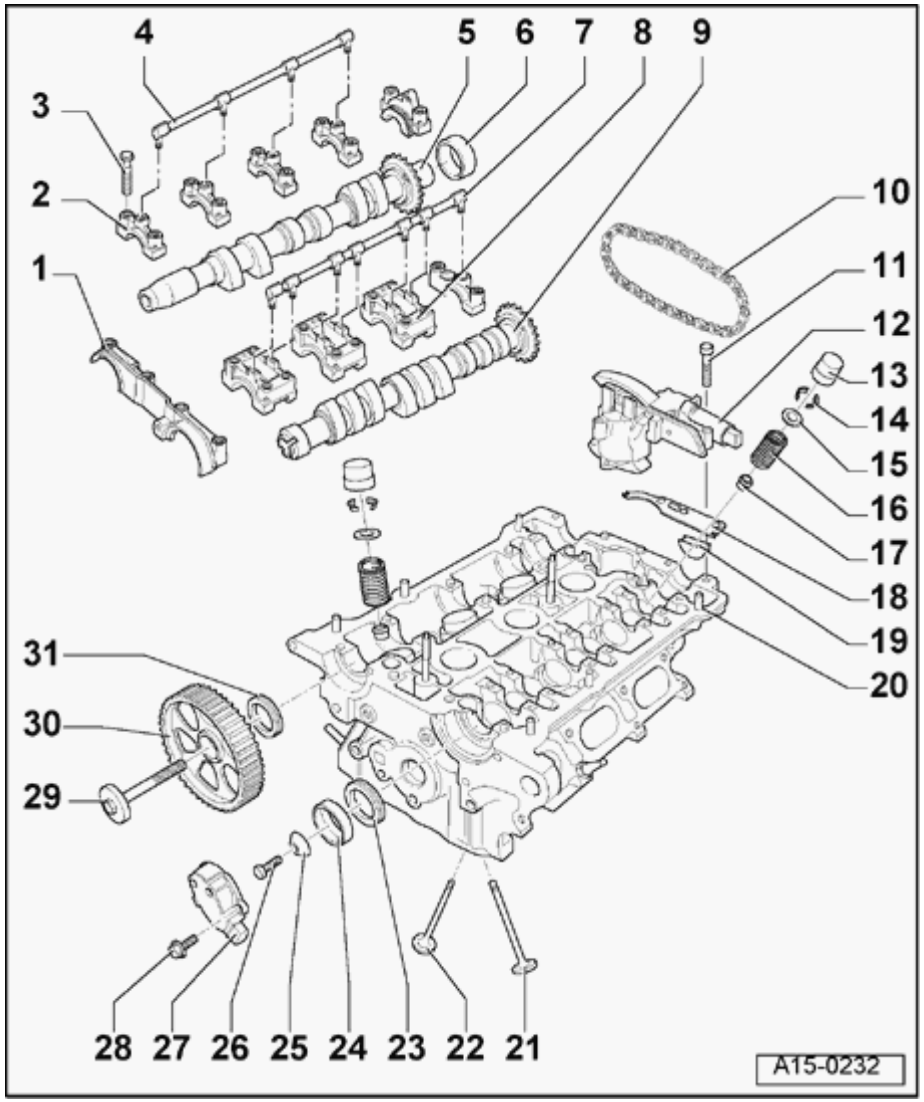
29 - Oil seal

- Toothed belt side
- Replacing ⇒ page 15-14

30 - Hydraulic valve lifter

- Notes ⇒ page 15-45
- Removing and installing with cylinder head installed ⇒ page 15-31

15-7



Cylinder head with oil lines to camshaft bearings

1 - Double bearing cap

- Lightly coat with 454 300 02 A2 sealant before installing ⇒ page 15-17

2 - Exhaust camshaft bearing cap

- With oil line connector
- Watch guide sleeve
- Note installation position and numbering ⇒ page15-31
- Lightly coat last bearing cap (after chain) with D454 300 A2 sealant before installing

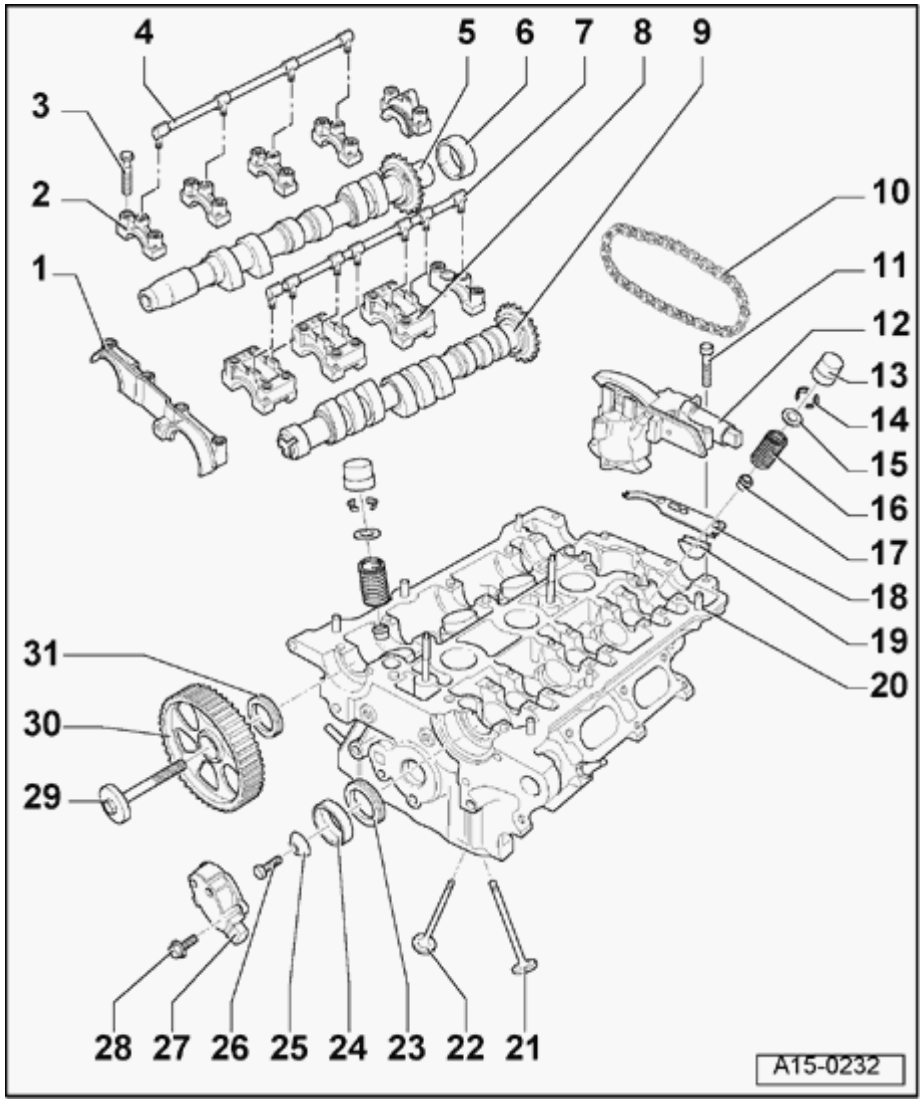
3 - Bolt

- 10 Nm (7 ft lb)

4 - Oil line

- Exhaust side
- From VIN 8D-W-005 001
- For bearing cap lubrication
- Note installed position ⇒ Fig. 4

15-8



5 - Exhaust camshaft

- Checking axial clearance ⇒ page 15-42
- Removing and installing ⇒ page 15-31

Check radial clearance using Plastigage ® (hydraulic valve lifters removed):

- Wear limit: 0.1 mm (0.004 in.)
- Max. run-out: 0.01 mm (0.0004 in.)

6 - Cap

- Always replace

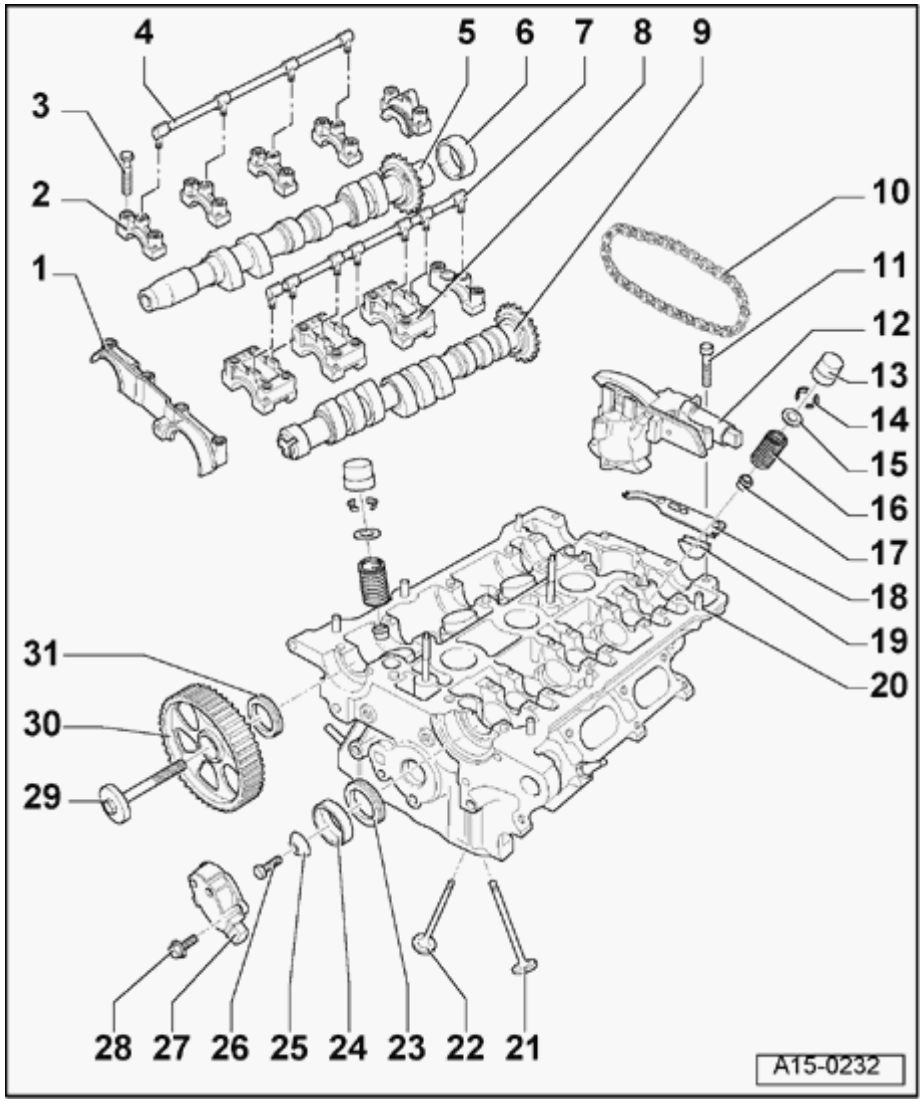
7 - Oil line

- Intake side
- From VIN 8D-W-005 001
- Note installed position ⇒ Fig. 3
- For bearing cap lubrication

8 - Intake camshaft bearing cap

- With oil line connector
- Note installation position and numbering ⇒ page 15-36

15-9



9 - Intake camshaft

- Checking axial clearance ⇒ page 15-42
- Removing and installing ⇒ page 15-31

Check radial clearance using Plastigage ® (hydraulic valve lifters removed):

- Wear limit: 0.1 mm (0.004 in.)
- Max. run-out: 0.01 mm (0.0004 in.)

10 - Drive chain

- Installing ⇒ page 15-36

11 - Bolt

- 10 Nm (7ft lb)

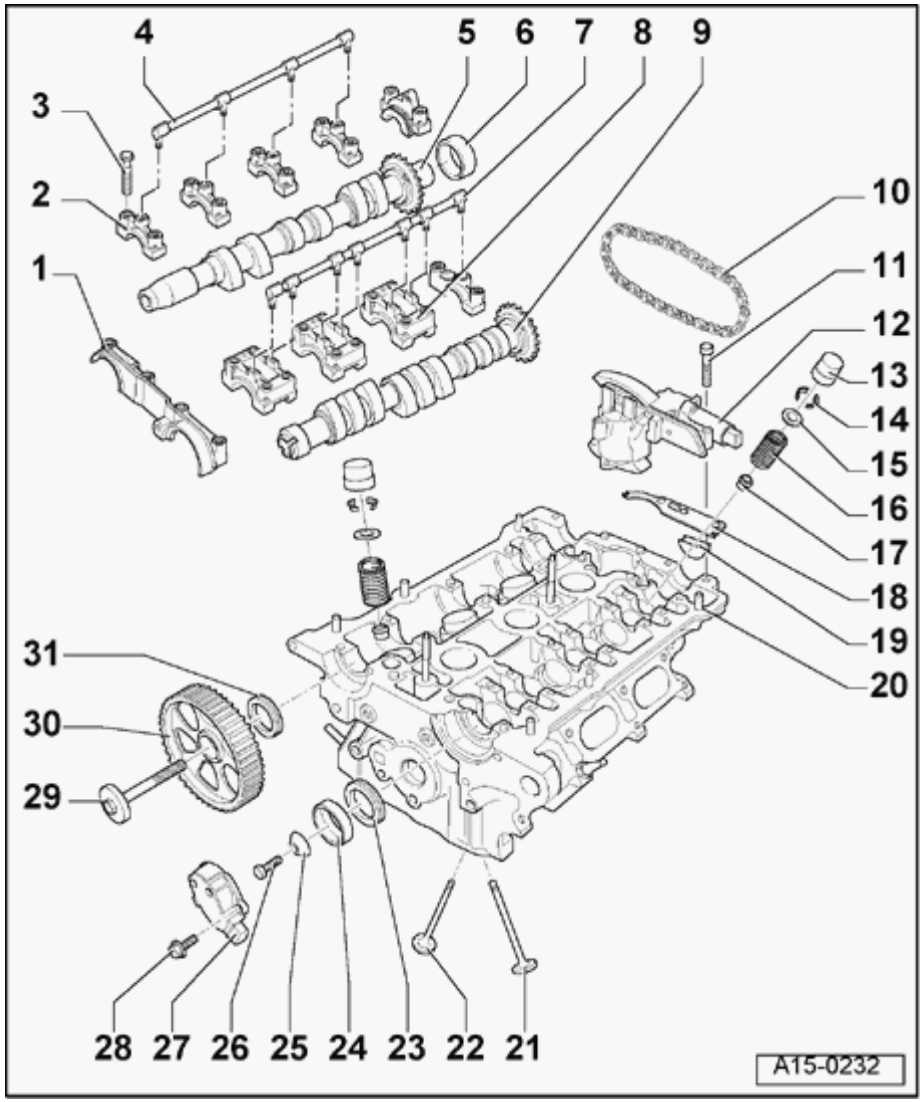
12 - Mechanical camshaft adjuster

- With valve -1- for camshaft adjustment - N205-
- Secure using 3366 bracket tensioner before removing ⇒ page 15-31

13 - Hydraulic valve lifter (intake)

- Refer to notes ⇒ page 15-45
- Removing and installing with cylinder head installed ⇒ page15-31

14 - Valve keepers



15 - Valve spring retainer

16 - Valve spring

17 - Valve stem oil seal

- Replacing with cylinder head installed ⇒ page 15-47

18 - Rubber/metal seal

- Always replace

19 - Seal

- Always replace

20 - Cylinder head

- Removing and installing ⇒ page 15-18
- Checking for distortion ⇒ page 15-27
- Resurfacing ⇒ page 15-28

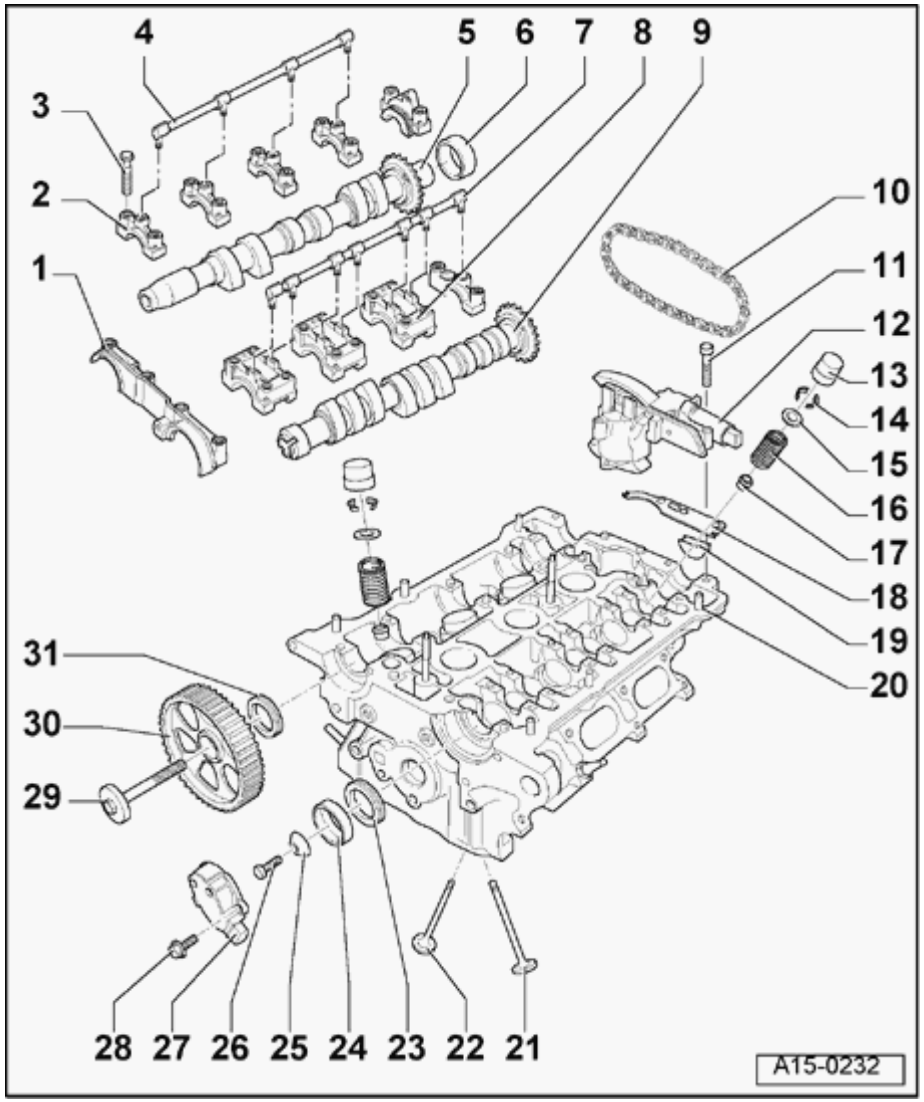
21 - Exhaust valve

22 - Intake valve

23 - Oil seal

- Camshaft Position (CMP) sensor side
- Replacing ⇒ page 15-14

15-11



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

- Note position (notch on camshaft)

25 - Washer

- Conical

26 - Bolt

- 25 Nm (18 ft lb)

27 - Camshaft Position (CMP) sensor -G40-

28 - Bolt

- 10 Nm (7 ft lb)

29 - Bolt

- 55 Nm (41 ft lb)

30 - Camshaft sprocket

31 - Oil seal

- Toothed gear side
- Replacing ⇒ page 15-14

Cylinder head with oil lines on the camshaft bearings

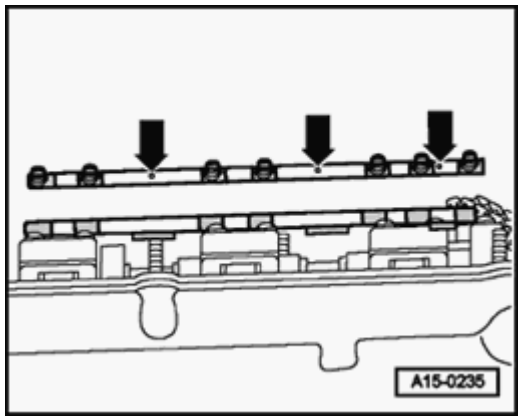


Fig. 3 Installation position of intake camshaft oil line

If connectors are misaligned, oil line bores are exposed (arrows).

- To install correctly, turn oil line 180° and slide connectors over bores.

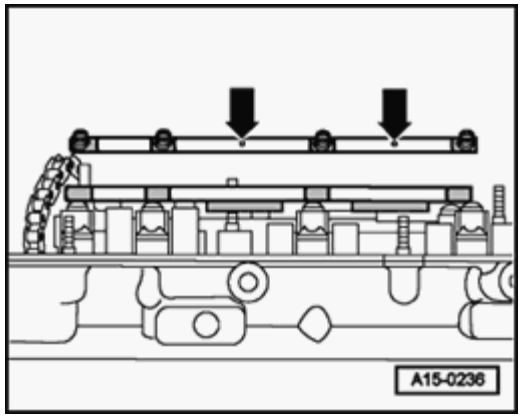


Fig. 4 Installation position of exhaust camshaft oil line

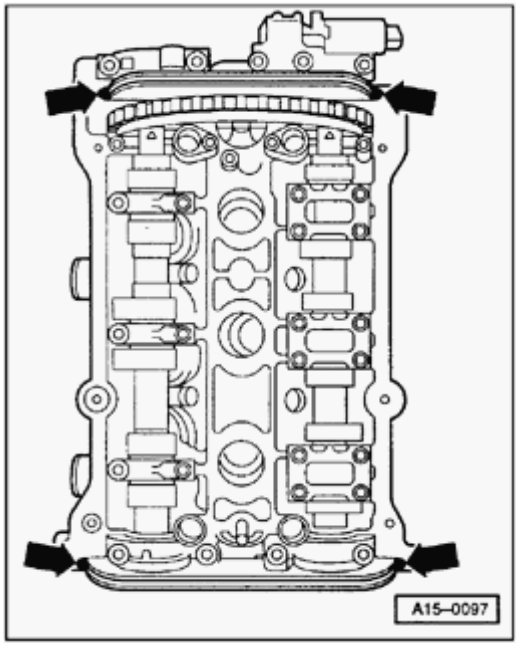
If connectors are misaligned, oil line bores are exposed (arrows).

- To install correctly, turn oil line 180° and slide connectors over bores.

CAUTION!

If the oil lines are incorrectly installed, the camshaft bearings will not be lubricated and the cylinder head will have to be replaced.

15-13



All models

Sealing contact surfaces between bearing cap and cylinder head

- Carefully apply small amount of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head (arrows) using small screwdriver.

CAUTION!

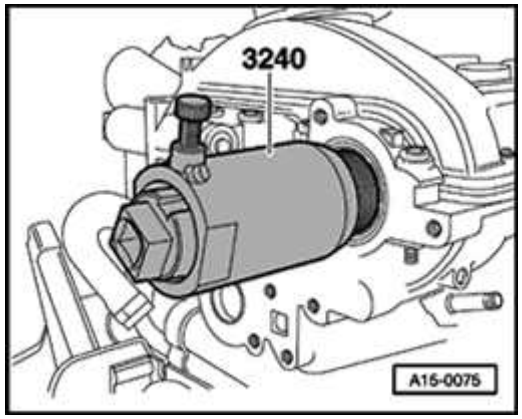
Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

15-14

Cylinder head oil seals, replacing

Oil seal for camshaft drive (left and right cylinder heads)

- Rotate engine to Top Dead Center (TDC).
- Remove toothed belt ⇒ page 13-12 .
- Remove rear toothed belt guard.

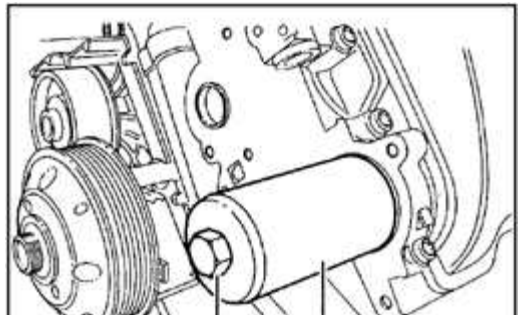


- Remove seal using 3240 seal extractor.
- Clean contact surface and sealing surface.

Note:

Do not apply oil to sealing lip or outer circumference of seal.

- Install 3241/2 pull sleeve from 3241/1 press sleeve onto camshaft.



- Press seal flush into cylinder head using 3241/1 press sleeve and 3241/3 bolt.

15-15

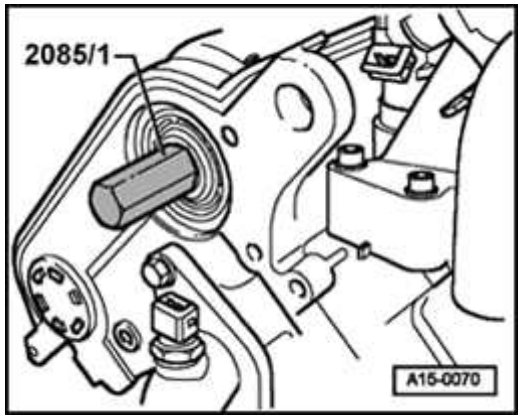
Oil seal on Camshaft Position (CMP) sensor (left and right cylinder head)

- Unbolt Camshaft Position (CMP) sensor.

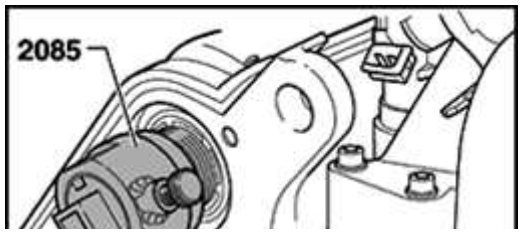
  Tightening torque: 10 Nm (7 ft lb)

- Unbolt shutter wheel for Camshaft Position (CMP) sensor and carefully pry out using screwdriver.

  Tightening torque: 20 Nm (15 ft lb)



- Screw in bolt from 2085/1 adapter.

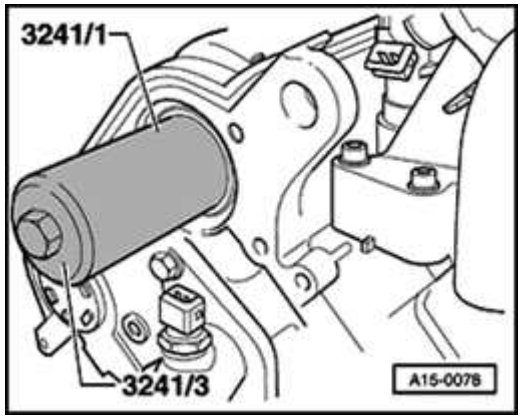


- Remove seal using 2085 seal puller and bolt from 2085/1.
- Clean contact surface and sealing surface.

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

- Install pull sleeve from 3241 seal installer onto camshaft.

15-16



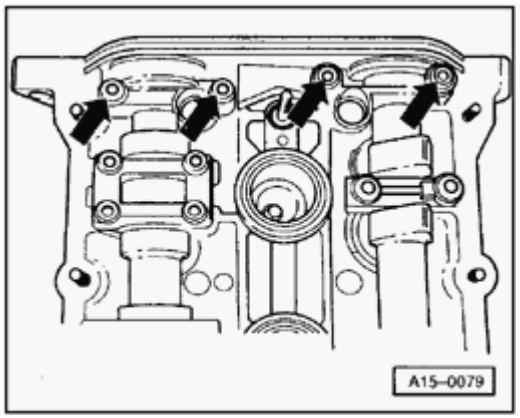
- Press seal flush using 3241/1 press sleeve and 3241/3 bolt.

Rear sealing flange (left cylinder head)

The sealing flange and rear oil seal on the left cylinder head must be replaced together as follows:

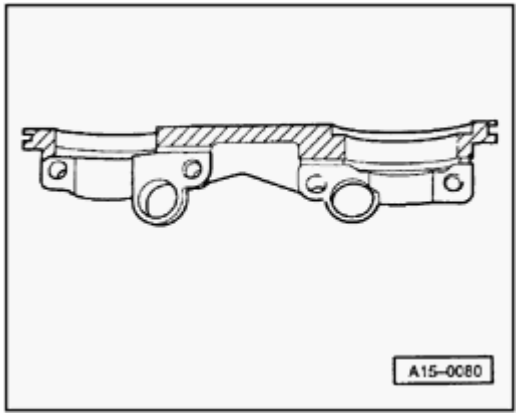
- Unbolt engine coolant expansion tank from bracket.
- Remove crankshaft ventilation line from cylinder head cover.
- Unbolt Camshaft Position (CMP) sensor.

  Tightening torque: 10 Nm (7 ft lb)
- Unbolt shutter wheel for Camshaft Position (CMP) sensor G40 and carefully pry out using screwdriver.
- Remove cylinder head cover.

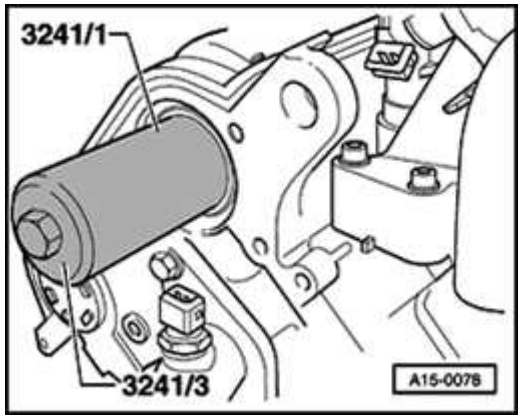


- Remove double bearing cap (arrows).
- Remove seal and sealing flange.
- Clean running and sealing surfaces as well as contact surface of double bearing cap.

15-17



- Apply thin coat of sealant 454 300 A2 to hatched areas on double bearing cap, install and tighten to 10 Nm (7 ft lb).
- Install pull sleeve from 3241 seal installer onto camshaft.



- Press seal flush using 3241/1 press sleeve and 3241/3 bolt.
- Carefully drive in sealing flange to stop using 3202 retractor and plastic hammer.

15-18

Cylinder head, removing and installing

Note:

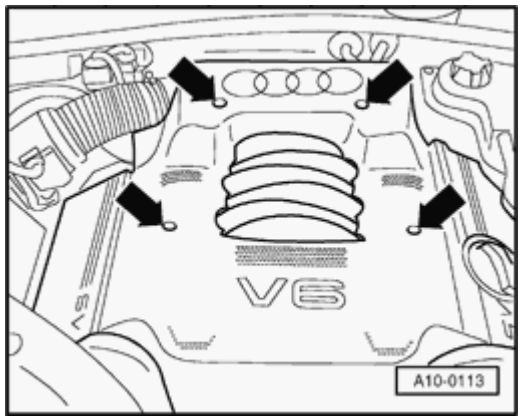
The following instructions apply to the left cylinder head.

Removing

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

- Remove ribbed belt ⇒ page 13-8 .

- Remove toothed belt ⇒ page 13-12 .



- Remove engine cover (arrows).



- Remove noise insulation panel (arrows).
- Unbolt left and right-side front exhaust pipes from exhaust manifold.

- Unbolt exhaust system from transmission bracket.

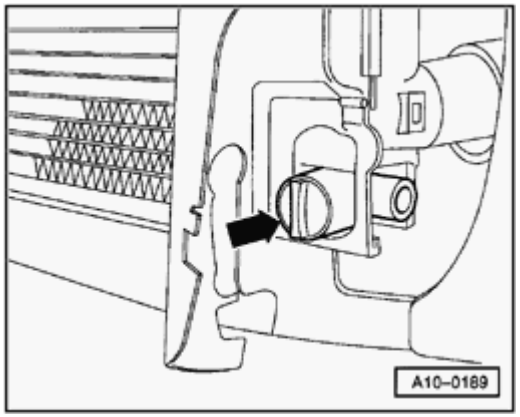
15-19

- Place VAG1306 drip tray beneath engine.

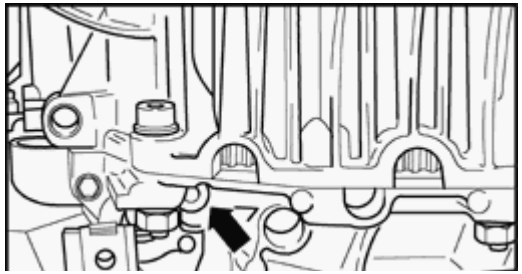
- Open engine coolant expansion tank cap.

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.



- With bumper removed, open coolant drain plug (arrow) on lower left of radiator by turning it counterclockwise. If necessary, attach accessory hose to connection.
- With bumper installed, pull off retaining clamp for lower right radiator hose (from radiator to engine) and disconnect radiator hose from radiator.

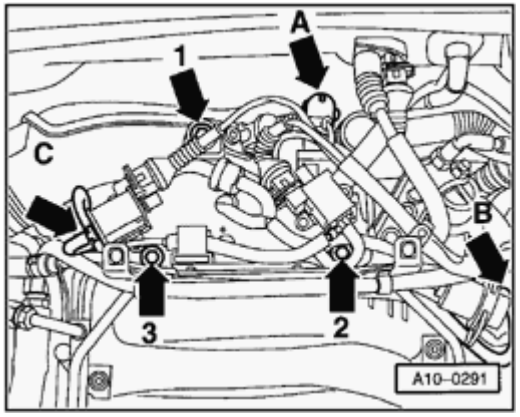


- Using 3247 hex ball socket, open coolant drain plug on engine (arrow) as well.
- Unbolt engine coolant expansion tank from bracket and lay aside (remove if necessary).
- Disconnect crankshaft housing ventilation line from cylinder head

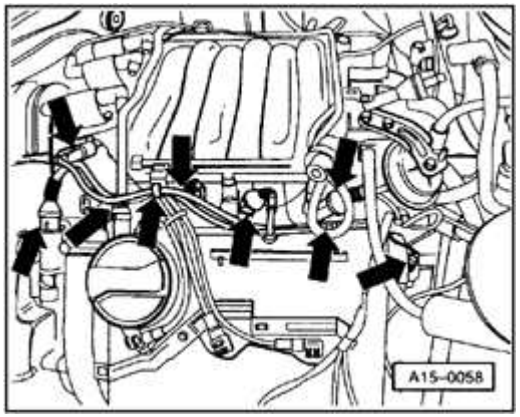
cover.

- Remove intake air duct between Mass Air Flow (MAF) sensor and intake air elbow.

15-20

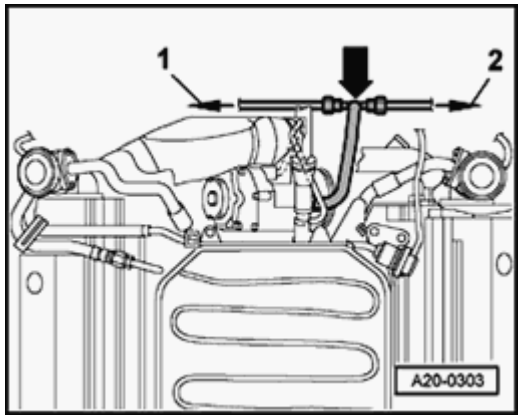


- Disconnect blue harness connector on Intake Manifold Tuning (IMT) valve.
- Disconnect black harness connector for intake air temperature sensor on resonator.
- Cut tie wraps and move wiring to side.
- Disconnect vacuum line at cruise control vacuum diaphragm and at vacuum booster.
- Unbolt cruise control vacuum diaphragm and unhook cruise control vacuum diaphragm linkage at throttle body.
- Disconnect harness connector on throttle body and vacuum lines on fuel pressure regulator.

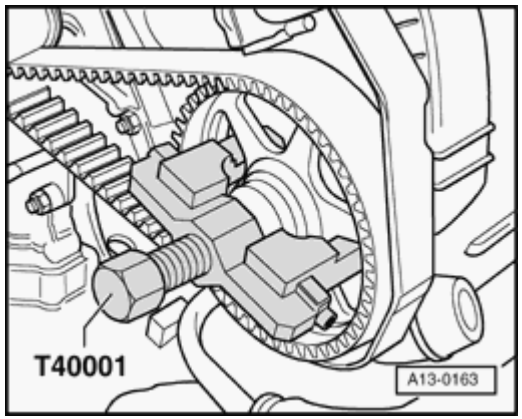


- Disconnect harness connectors from camshaft adjustment valve and from fuel injectors (arrows).
- Disconnect harness connectors from Engine Coolant Temperature (ECT) sensor and Camshaft Position (CMP) sensor (arrows).
- Cut tie wraps on valve cover.
- Unclip wiring retainer on fuel rail and disconnect crankshaft housing ventilation lines from left and right-side valve covers. Move hoses and wiring clear (to rear).

15-21

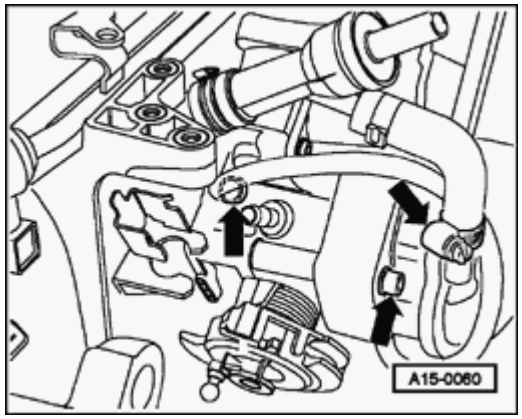


- Disconnect harness connector for tank diagnostic system in engine compartment at arrow.
- Remove 4 bolts for fuel rail on intake manifold.
- Unclip fuel supply and return lines from retainer.
- Move fuel rail together with fuel injectors aside. Cover fuel injectors with clean cloth.
- Install 3391 camshaft locator bar onto camshaft locking plates.
- Loosen both bolts for camshafts and back out bolts approx. 5 turns.
- Remove 3391 camshaft locator bar.

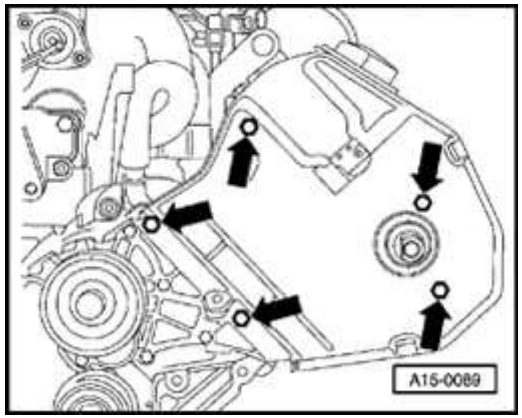


- Remove camshaft gear using T40001 special tool.
- Disconnect left-side spark plug connectors.
- Unbolt bracket for ignition coils (4 bolts) and move to right side together with ignition coils.
- Unhook accelerator pedal cable and pull up out of retaining bracket.

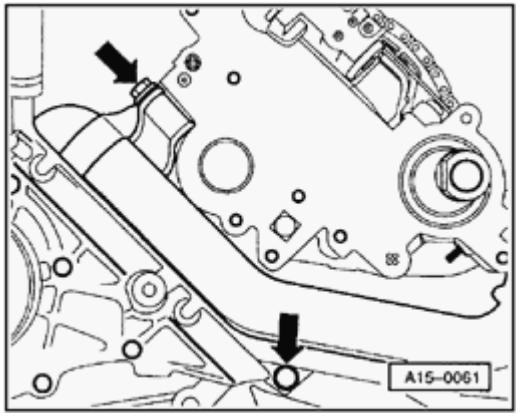
15-22



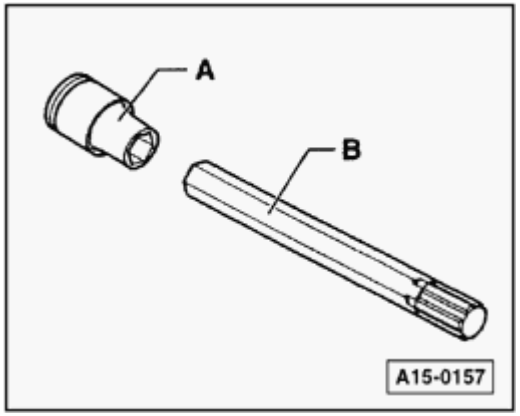
- Disconnect vacuum line at throttle body and line between vacuum booster and intake air elbow (arrows).
- Remove intake air elbow.
- Remove intake manifold.
- Disconnect heated oxygen sensor harness connector at left-side of heater core and set aside.



- Remove left-rear toothed belt guard (arrows).
- Unbolt coolant hose at rear of cylinder head.



- Unbolt coolant hose at front of cylinder head (arrows).
- Using 3452 polydrive special tool, loosen cylinder head bolts in reverse order of tightening sequence and remove.
- Carefully lift off cylinder head.



- When removing and installing, use 3452 polydrive together with normal commercial 10 mm socket.

15-24

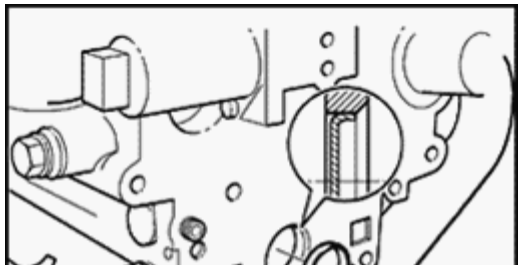
Installing

Notes:

- *Bolt holes in engine block for cylinder head bolts must be free of oil and coolant.*
- *Always replace cylinder head bolts.*
- *Vacuum line connections ⇒ page 10-23*

When installing a new cylinder head:

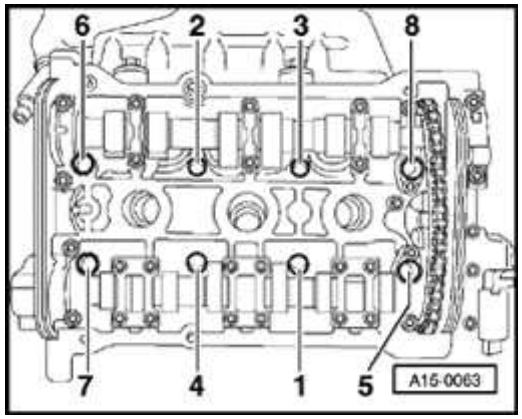
- Install centering pin for intake manifold.
- Replacement cylinder head may be used to replace left or right cylinder head. Install sealing cap at appropriate front end of replacement cylinder head.
- Coat lip of sealing cap with sealant AMV 188 001 02.



- Using VW295 needle bearing drift press in sealing cap until lip of cap seals with chamfer end of cylinder head.
- Before installing cylinder head, set crankshaft and camshafts to TDC for cylinder 3.

- Install cylinder head gasket onto guide sleeves. Marking "oben" or Part No. must face toward cylinder head.
- Install cylinder head, install cylinder head bolts and tighten hand-tight.

15-25

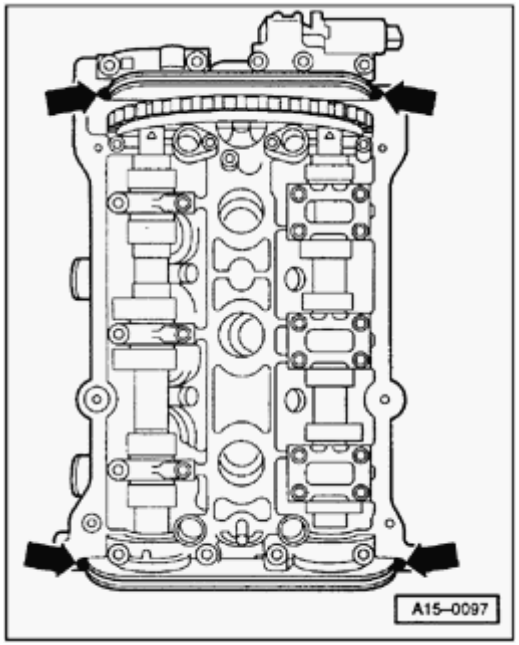


- Tighten cylinder head bolts in two stages in sequence shown, as follows:

♦ Stage 1: 60 Nm (44 ft lb)

♦ Stage 2: additional 1/2 turn (180 °) using rigid wrench (in two 1/4 turns (90 °) if necessary).

It is not necessary to re-torque cylinder head bolts again after repairs have been completed.



Sealing contact surfaces between bearing cap and cylinder head.

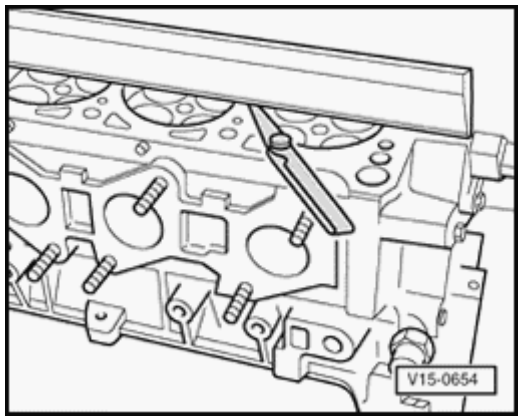
- Carefully apply small amount of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head using small screwdriver.

Tightening torques

Component		Tightening torque
Bolts	M6	10 Nm (7 ft lb)
Bolts	M8	20 Nm (15 ft lb)
Camshaft bearing cap and camshaft adjuster		10 Nm (7 ft lb)
Exhaust manifold to cylinder head		25 Nm (18 ft lb)
Front exhaust pipe to exhaust manifold		25 Nm (18 ft lb)
Heated Oxygen Sensor (HO2S)		50 Nm (37 ft lb)
Spark plugs		25 Nm (18 ft lb)
Toothed belt sprocket to camshaft		55 Nm (41 ft lb)
Intake manifold to cylinder head		10 Nm (7 ft lb)
Cylinder head cover		10 Nm (7 ft lb)

15-27

Cylinder head, checking for distortion

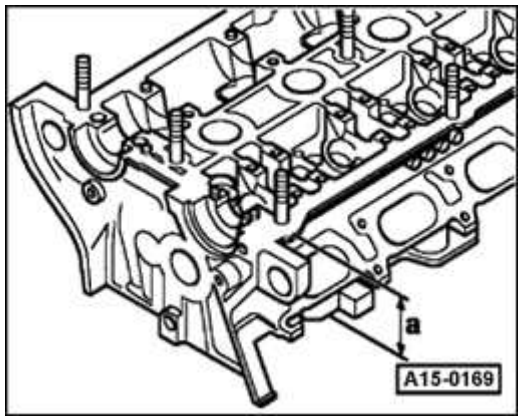


- Measure at several points using straight-edge.

  Maximum permissible distortion: 0.1 mm (0.004 in.)

15-28

Cylinder head, resurfacing



Resurfacing of the cylinder head is only permissable up to minimum dimension -a-.

Dimension -a-: 139.25 mm (5.4823 in.).

15-29

Compression, checking

Test conditions

- Engine oil temperature at least 30° C
- Battery fully charged

- Disconnect harness connectors from all 6 fuel injectors.
- Disconnect 5-pin harness connector from power output stage of ignition coils.
- Open throttle fully.
- Use VAG1381 or VAG1763 compression tester to check compression.
- Operate starter until no further pressure increases are indicated by VAG1381 or VAG1763 compression tester.

Compression pressure

New	Wear limit	Max. permissable difference between cylinders

9-14 bar (131-203 psi)	7.5 bar (109 psi)	3 bar (44 psi)

15-30

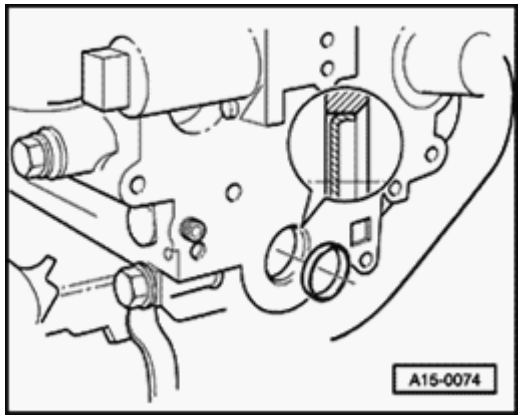
Sealing cap (core plug) in cylinder head, installing

Cylinder heads supplied as replacement parts can be used on either the left or right-sides of the engine. A sealing cap (core plug) must be installed in the front end of the cylinder head in each case.

- Coat outside circumference of sealing cap (core plug) with sealant AMV 188 001 02.

CAUTION!

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

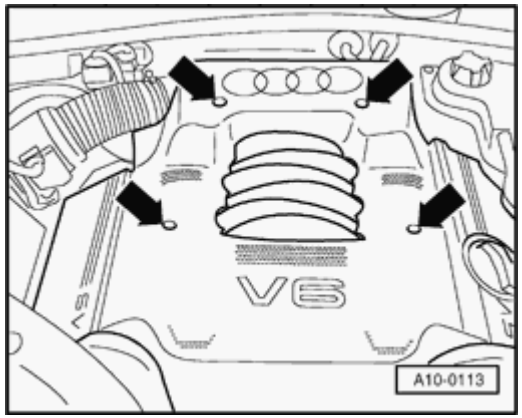


- Using VW295 needle bearing drift, drive in sealing cap (core plug) until outside rim is flush with end of chamfer in cylinder head (see inset).

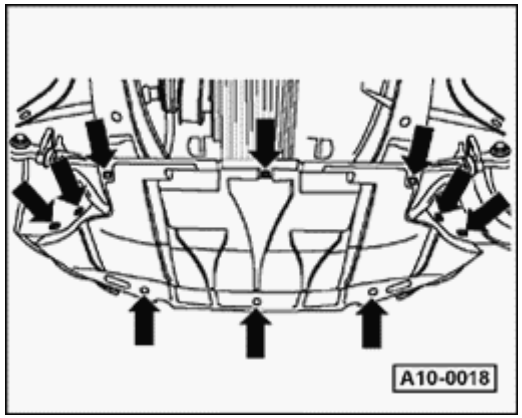
15-31

Camshafts and camshaft adjusters, removing and installing

Removing



- Remove engine cover (arrows).
  - Cylinder head installed
  - Lock carrier in service position ⇒ page 13-1
- Remove ribbed belt ⇒ page 13-8 .
- Remove toothed belt ⇒ page 13-12 .



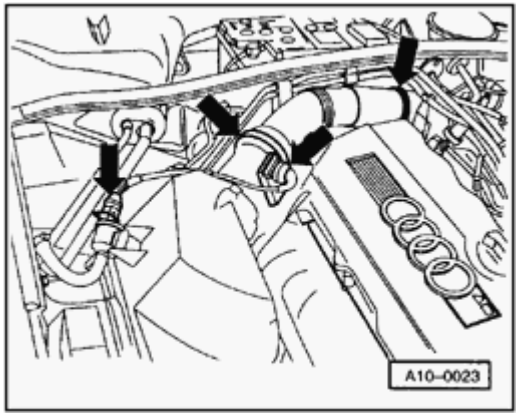
- Remove noise insulation panel (arrows).

Left-side cylinder head

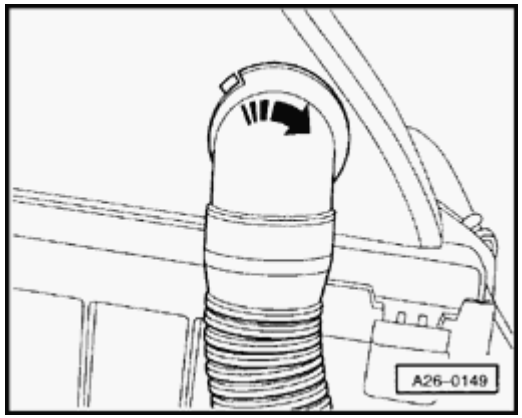
- Unbolt engine coolant expansion tank from bracket and lay aside.
- Remove crankshaft housing ventilation line from valve cover.

15-32

Right-side cylinder head



- Remove intake air duct between Mass Air Flow (MAF) sensor and intake air elbow.
- Disconnect EVAP canister purge regulator valve and remove valve from retainer.
- Disconnect harness connector for mass air flow sensor.



- Turn connection pipe for secondary air injection pump on air cleaner 45° in clockwise direction and pull forward off air cleaner.
- Unbolt air cleaner and remove.

15-33

All models

- Remove Camshaft Position (CMP) sensor housing and shutter wheel.

- Unbolt shutter wheel for Camshaft Position (CMP) sensor -G40- and carefully pry out using screwdriver.

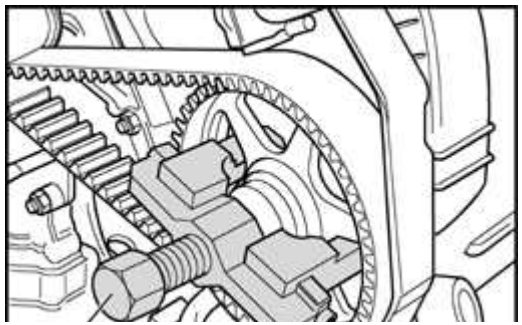
  Tightening torque: 20Nm (15 ft lb)

- Remove cylinder head cover.

- Install 3391 camshaft locator bar into camshaft locking plates.

- Loosen both bolts for camshafts and back out bolts approx. 5 turns.

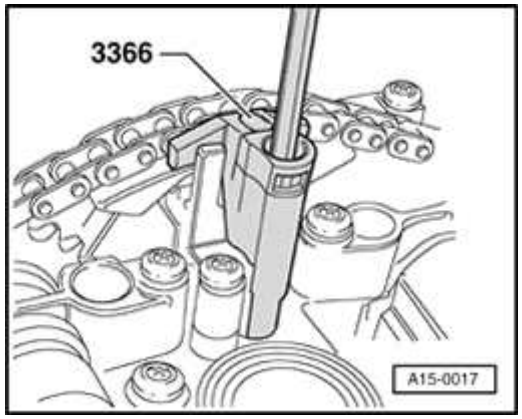
- Remove 3391 camshaft locator bar.



- Remove both camshaft sprockets using T40001 special tool.
- Using screwdriver, carefully lift out oil lines for camshaft bearing lubrication from camshaft bearings.

  When lifting out oil lines, be careful not to damage positioning clips.

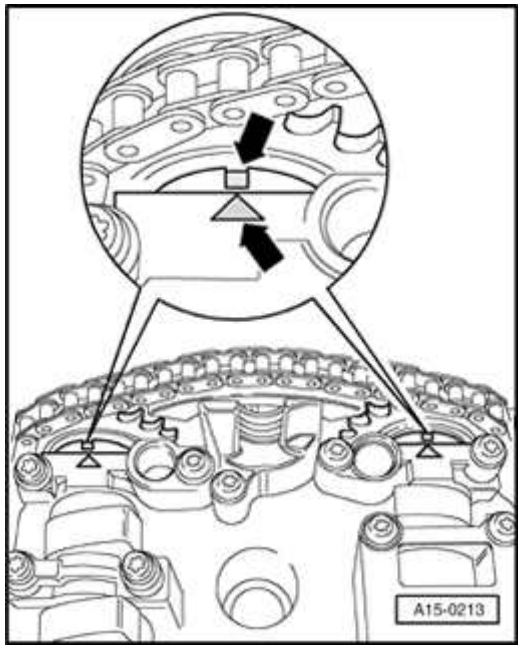
15-34



- Secure camshaft adjuster with 3366 bracket tensioner.

Note:

If the bracket tensioner is tightened too far, the camshaft adjuster may be damaged.

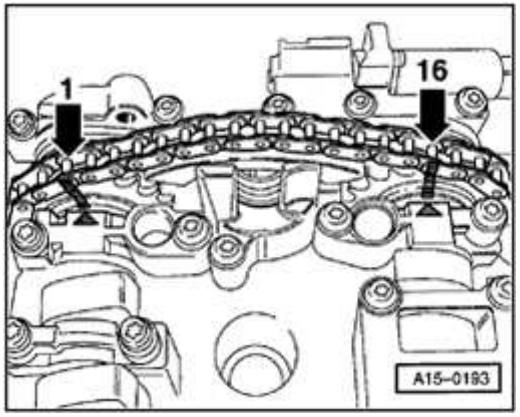


- Verify that camshafts are at TDC.

  Both camshaft markings must align with arrows on bearing caps.

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

15-35

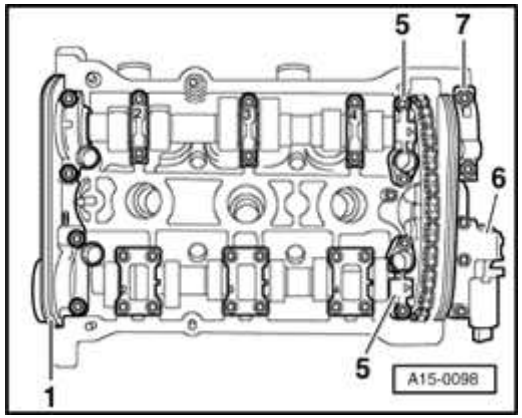


The distance between the two arrows/paint marks is equivalent to 16 drive chain rollers.

The notch on the exhaust camshaft is slightly offset inward toward chain roller -1-.

Note:

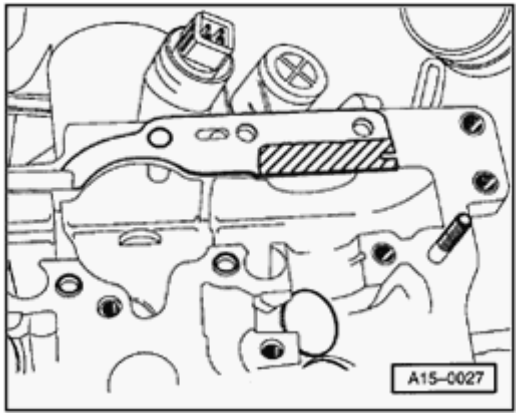
Do not mark chain using punch, filing a notch or similar.



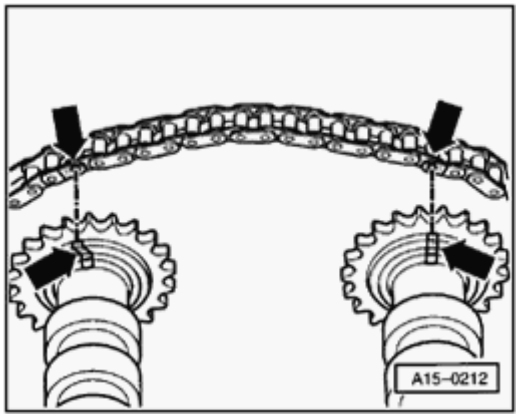
- Remove camshaft adjuster retaining bolts.
- Remove bearing caps -1-,-3-,-5- and -7- and lay on a clean surface in correct order.
- Alternating in diagonal sequence, loosen bearing caps -2- and -4- of intake and exhaust camshafts and remove.
- Remove both camshafts together with camshaft adjuster.

15-36

Installing

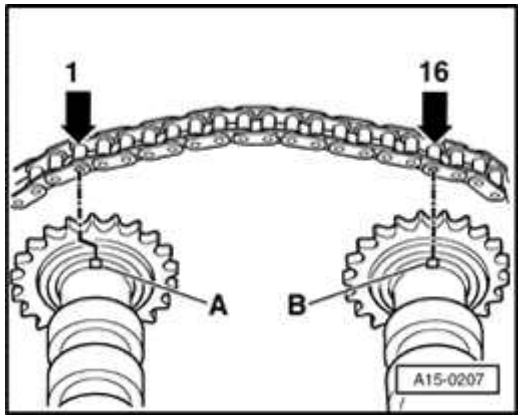


- Replace rubber/metal camshaft adjuster gasket and spread thin layer of sealant D 454 300 A2 on hatched surface.
- Install drive chain on camshaft chain gear as follows:



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

15-37



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.

Note:

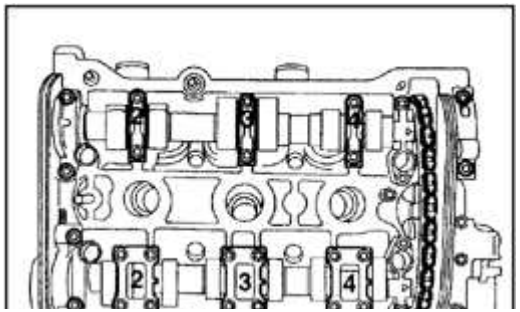
Notch -A- is slightly offset inward toward drive chain roller -1-.

- Slide in camshaft adjuster between drive chain (second technician required).
- Install camshafts with drive chain and camshaft adjuster into cylinder head.
- Oil camshaft journal surface.

Notes:

- *Alignment bushings for bearing caps and camshaft adjuster must be installed in cylinder head.*
- *When installing bearing caps, verify marking on cap is readable from intake side of cylinder head.*

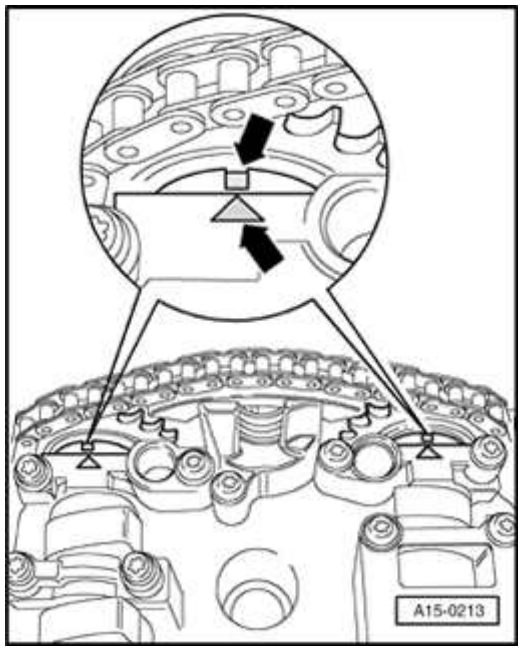
- Tighten camshaft adjuster (pay attention to alignment bushings).



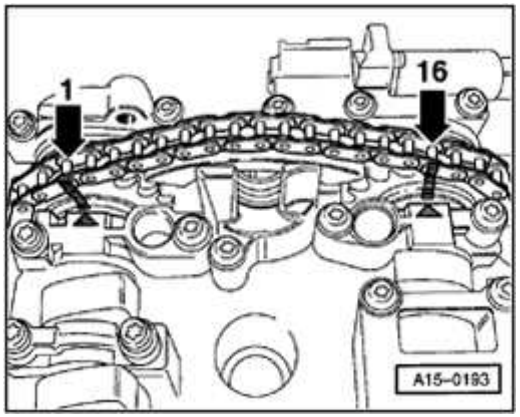
- Tighten bearing caps -2- and -4- in alternating diagonal sequence (pay attention to alignment bushings).
- Install both bearing caps on chain sprockets of intake and exhaust camshafts.

15-38

- Verify correct position of both camshafts.



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

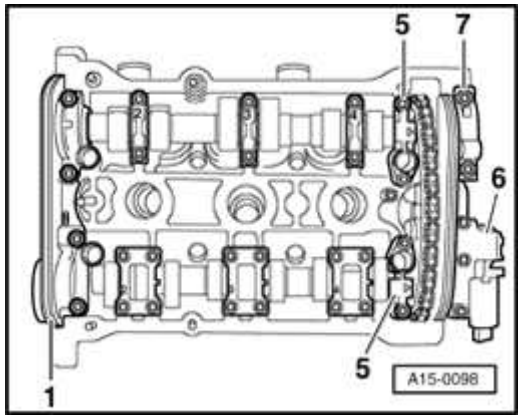


➢ The distance between the two arrows/paint markings is equivalent to 16 drive chain rollers.

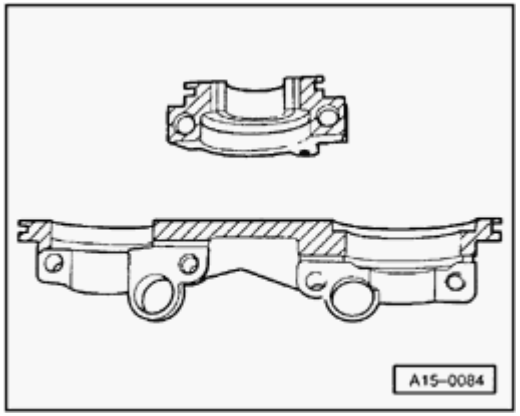
Note:

The notch on exhaust camshaft is slightly offset inward toward drive chain roller -1-.

15-39



- Lightly coat hatched surface of double bearing cap -1- and bearing cap -7-...



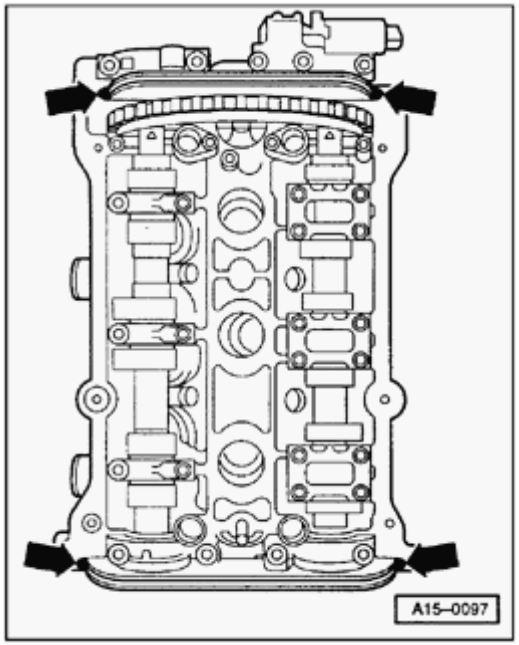
- ...with sealant D 454 300 A2 and install bearing cap (pay attention to alignment bushings).
- Install the other bearing caps (pay attention to alignment bushings).
- Replace oil lines for camshaft bearing lubrication and install.
- Replace oil seal for intake and exhaust camshafts ⇒ page 15-14 .
- Remove 3366 bracket tensioner.

15-40

CAUTION!

- ***After installing new hydraulic lifters, 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.***



Sealing contact surfaces between bearing cap and cylinder head.

- Carefully apply a small amount of sealant D 454 300 A2 at four end points of sealing surfaces on cylinder head (arrows) using small screw driver.
- Install cylinder head cover.
- Install toothed belt ⇒ page 13-15 .
- Remove ribbed belt ⇒ page 13-8 .

Tightening torques

Component		Tightening torque
Bolts	M6	10 Nm (7 ft lb)
	M8	20 Nm (15 ft lb)
Except for the following:		
Bearing cap to cylinder head		10 Nm (7 ft lb)
Camshaft adjuster 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)
Camshaft gear to camshaft		55 Nm (41 ft lb)
Camshaft bearing cap and camshaft adjuster		10 Nm (7 ft lb)
Cylinder head cover		10 Nm (7 ft lb)

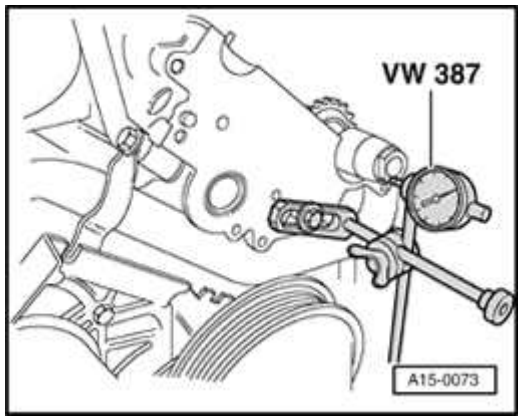
15-42

Camshaft axial play, checking

- Remove camshafts ⇒ page 15-31 .

- Remove hydraulic valve lifters.

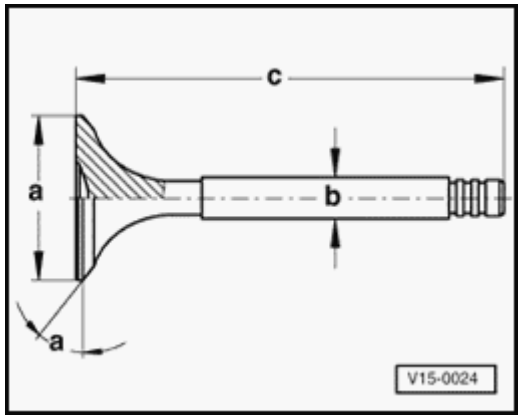
- Install camshafts without chain into cylinder head and tighten with bearing caps 2 and 4.



- Secure VW387 dial indicator holder with dial indicator to cylinder head.
- Press camshaft by hand against dial indicator.
- Set dial indicator to zero.
- Press crankshaft away from dial indicator.
- Read clearance.

New	Wear limit
0.05-0.15 mm (0.0020-0.0059 in.)	0.20 mm (0.0079 in.)

15-43



Valve dimensions

WARNING!

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

Dimension	Intake valve	Exhaust valve
Diameter -a-	26.8 - 27.0 mm (1.055 - 1.063 in.)	29.8 - 30.0 mm (1.173 - 1.181 in.)
Diameter -b-	5.96 - 5.97 mm (.2346 - .2350 in.)	5.94 - 5.95 mm (.2338 - .2342 in.)
Length -c-	104.84 - 105.34 mm (4.1275 - 4.1472 in.)	103.64 - 104.14 mm (4.0803 - 4.0999 in.)
Angle -a-	45°	45°

15-44

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.***

15-45

Hydraulic valve lifters, checking

CAUTION!

After installing new hydraulic valve lifters the engine must not be started for about 30 minutes. The hydraulic valve lifters must settle (otherwise valves will strike pistons). Then turn crankshaft two full revolutions by hand before starting.

Notes:

- *Only replace hydraulic valve lifters in complete sets. Hydraulic valve lifters cannot be adjusted or repaired.*
- *Irregular valve noise when starting engine is normal.*

- Start engine and let run until coolant temperature reaches at least 80 ° C.
- Increase RPM to 2500 for about 2 minutes. If necessary, test drive vehicle.

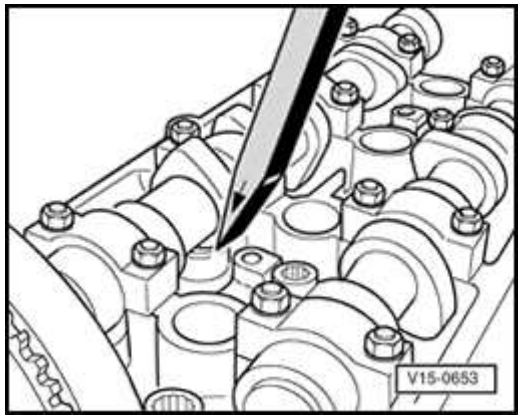
If hydraulic valve lifters are still loud, locate faulty valve lifter as follows:

- Remove cylinder head cover.

- Rotate crankshaft clockwise by turning mounting bolt for toothed belt sprocket until lobes on camshaft of hydraulic valve lifters to be checked are pointing upward.

- Measure clearance between cam and valve lifter.

15-46



- 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.

Note:

If irregular valve noise occurs repeatedly during short journeys and disappears after extended driving, the oil check valves must be replaced ⇒ *page 17-9* .

15-47

Valve stem oil seals, replacing

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

- Remove ribbed belt ⇒ page 13-8 .
- Remove toothed belt ⇒ page 13-12 .
- Remove camshafts ⇒ page 15-31 .
- Remove valve lifters (do not interchange) and lay aside with contact surface facing down.
- Remove spark plugs.
- Move piston for individual cylinder to Bottom Dead Center (BDC) position.

Note:

Lightly tap valve lever to loosen stuck valve keepers.

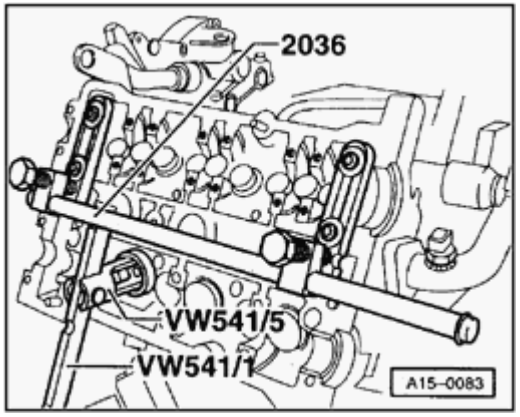
Exhaust side

Note:

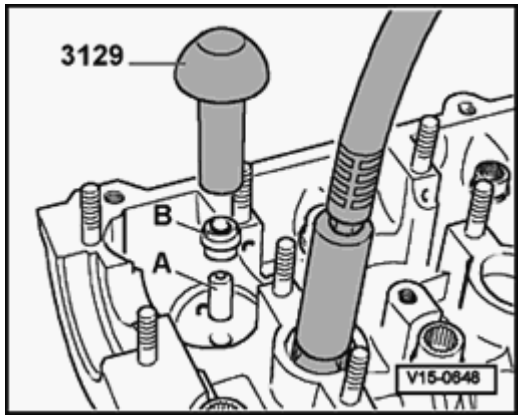
Before attaching the adjustable rod, remove the two studs in the center of the cylinder head and the three upper studs (intake side) for mounting the cylinder head cover.

- Install VW653/3 pressure hose together with seal hand tight into spark plug hole of relevant cylinder and apply constant pressure (at least 6 bar).

15-48



- Attach 2036 adjustable rod (as shown in figure) using M6 x 40 bolts with large washers.
- Remove valve spring using VW541/1 lever and VW541/5 valve spring tensioner.
- Remove valve spring and valve spring plate.
- Remove valve stem oil seal using 3047A slide hammer.



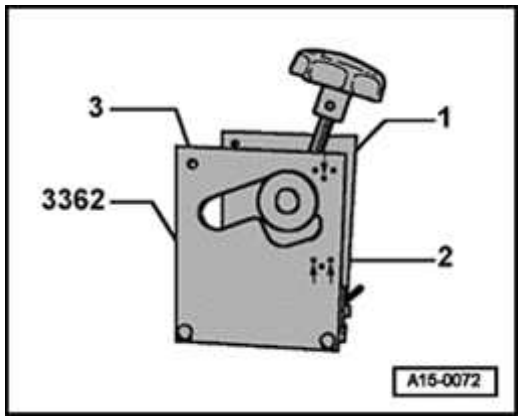
- Place plastic sleeve -A- on valve stem to prevent damage to new valve stem oil seals.
- Lightly lubricate sealing lip with oil.
- Insert valve stem oil seal -B- (without oiling outside of seal) into 3129 seal driver and carefully slide onto valve guide.
- When installing new valve, lightly oil valve stem before installing.

15-49

Intake side

Note:

The intake valves are installed in the cylinder head at different angles.

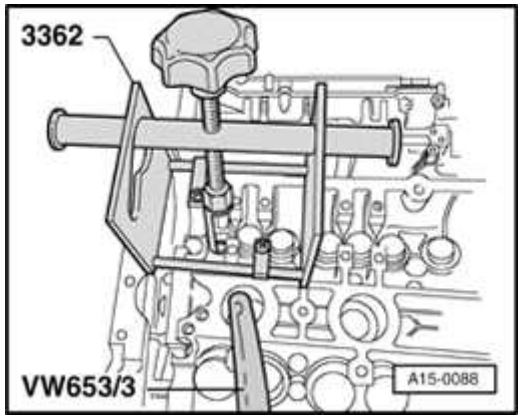


➢ 3362 valve spring tool can be used in two different positions:

1 - Upper position for center valve

2 - Lower position for two outer valves

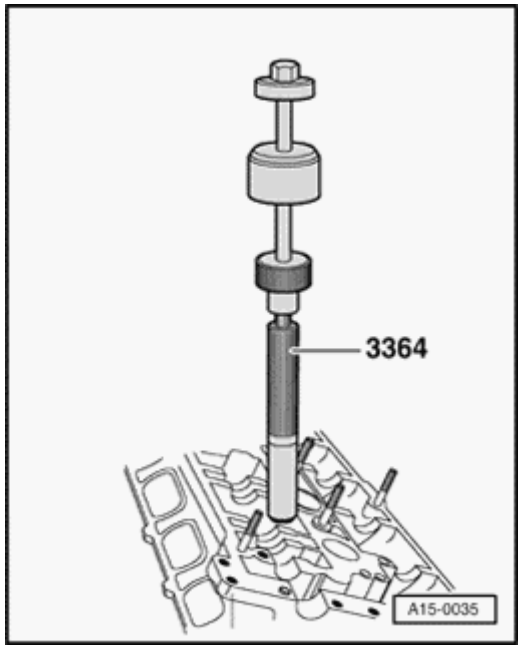
3 - Threaded holes on each side to take M6 x 25 bolts for mounting valve spring tool to cylinder head.



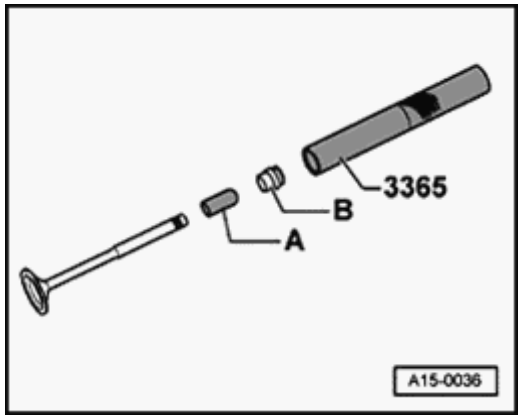
➢

- Attach 3362 valve spring tool to cylinder head using two bolts supplied (as shown in figure).
- Screw VW653/3 pressure hose together with seal hand tight into spark plug hole of relevant cylinder and apply constant pressure (at least 6 bar).
- Set position of valve spring tool for relevant valve and remove valve spring using threaded spindle.

15-50



- Remove valve stem oil seal using 3364 valve seat tool.



- Place plastic sleeve -A- on valve stem to prevent damage to new valve stem oil seals.
- Lightly lubricate sealing lip with oil.
- Insert valve stem oil seal -B- (without oiling outside of seal) into 3365 seal driver and carefully slide onto valve guide.
- When installing new valve, lightly oil valve stem before installing.

15-51

Valves, refacing

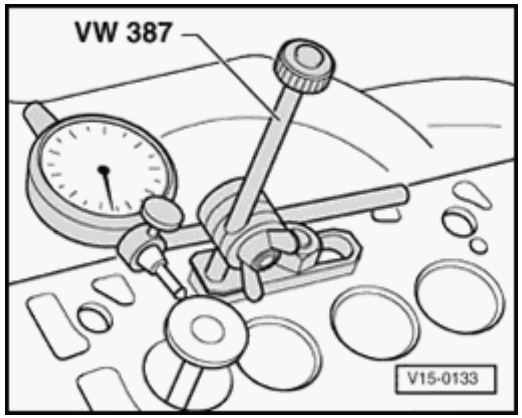
WARNING!

- ***Valves must not be refaced by cutting or grinding.***
- ***Only hand lapping is permitted.***
- ***Observe the WARNING regarding proper disposal of sodium-filled exhaust valves*** ⇒ ***page 15-44*** .

15-52

Valve guides, checking

When servicing engines or cylinder heads with leaking valves, refacing or replacing valve seats and valves is not sufficient. Valve guides must be checked for wear. This is especially important for engines with high mileage.



- Insert valve into guide.

  Valve shaft edge must seal with guide. Due to differences in valve stem diameter, make sure only intake valves are used to check intake guides, and only exhaust valves are used to check exhaust guides.

- Measure axial play.

Wear limit

Intake valve guide	Exhaust valve guide
0.8 mm (0.031 in.)	0.8 mm (0.031 in.)

- If wear limit is exceeded, replace cylinder head.

15-53

Valve seats, refacing

Notes:

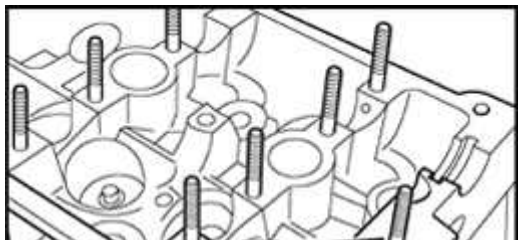
- *Only reface valve seats enough until a perfect contact pattern is obtained.*
- *Before refacing, calculate the maximum refacing dimension.*
- *If refaced dimension is exceeded, hydraulic valve lifter function is no longer guaranteed and cylinder head must be replaced.*

Calculating maximum allowable refacing dimension

- Insert valve and press firmly against valve seat.

Note:

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



- Measure distance between end of valve stem and top surface of cylinder head (four-valve head shown).
- Calculate maximum allowable refacing dimension using distance measured and minimum dimension.

Minimum dimensions		
Outer intake valve	Center intake valve	Exhaust valve
32.2 mm (1.268 in.)	33.2 mm (1.307 in.)	33.0 mm (1.299 in.)

The measured distance minus the minimum dimension equals the maximum permissible refacing dimension.

Example	
Outer intake valve	
Measured distance	33.0 mm (1.299 in.)
Minimum dimension	- 32.2 mm (1.268 in.)
Maximum permissible refacing dimension	= 0.8 mm (0.031 in.)

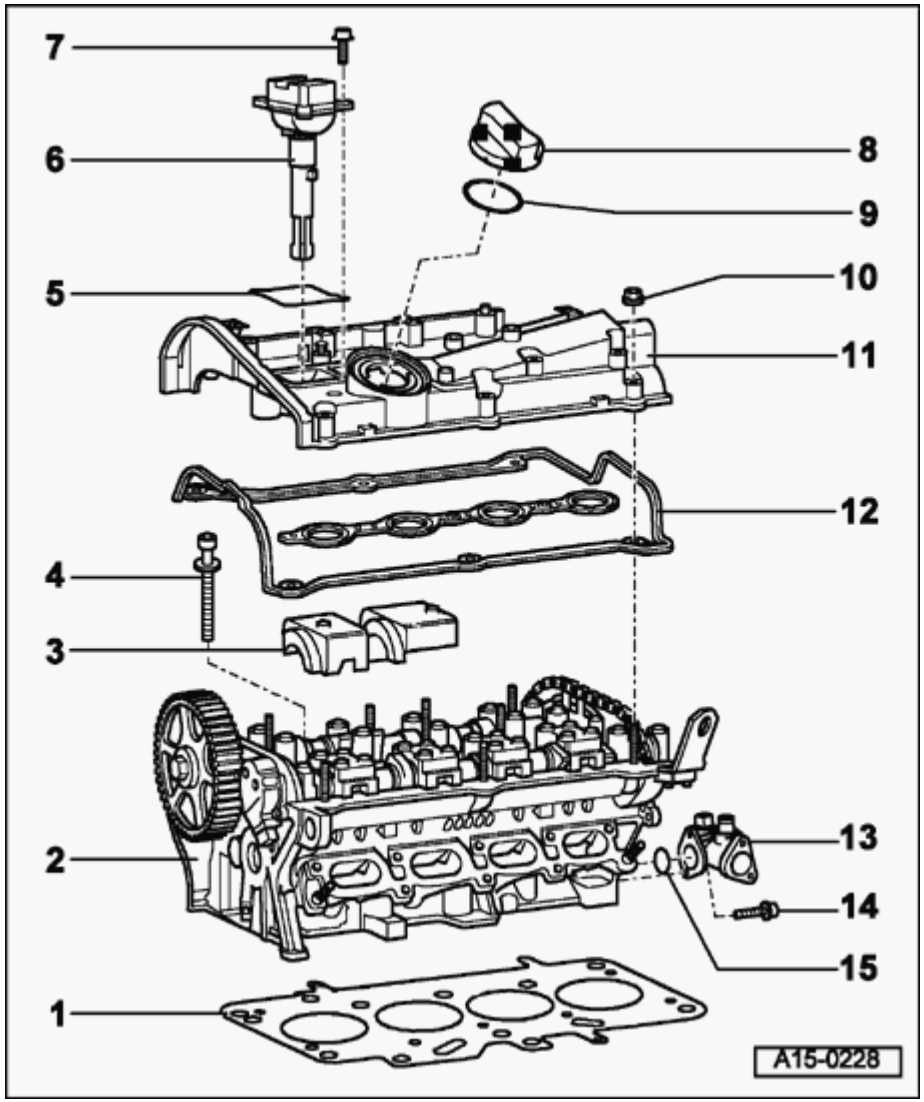
Note:

If the measured distance is less than the minimum dimension, repeat the measurement with new valves, or replace the cylinder head.

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.*



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

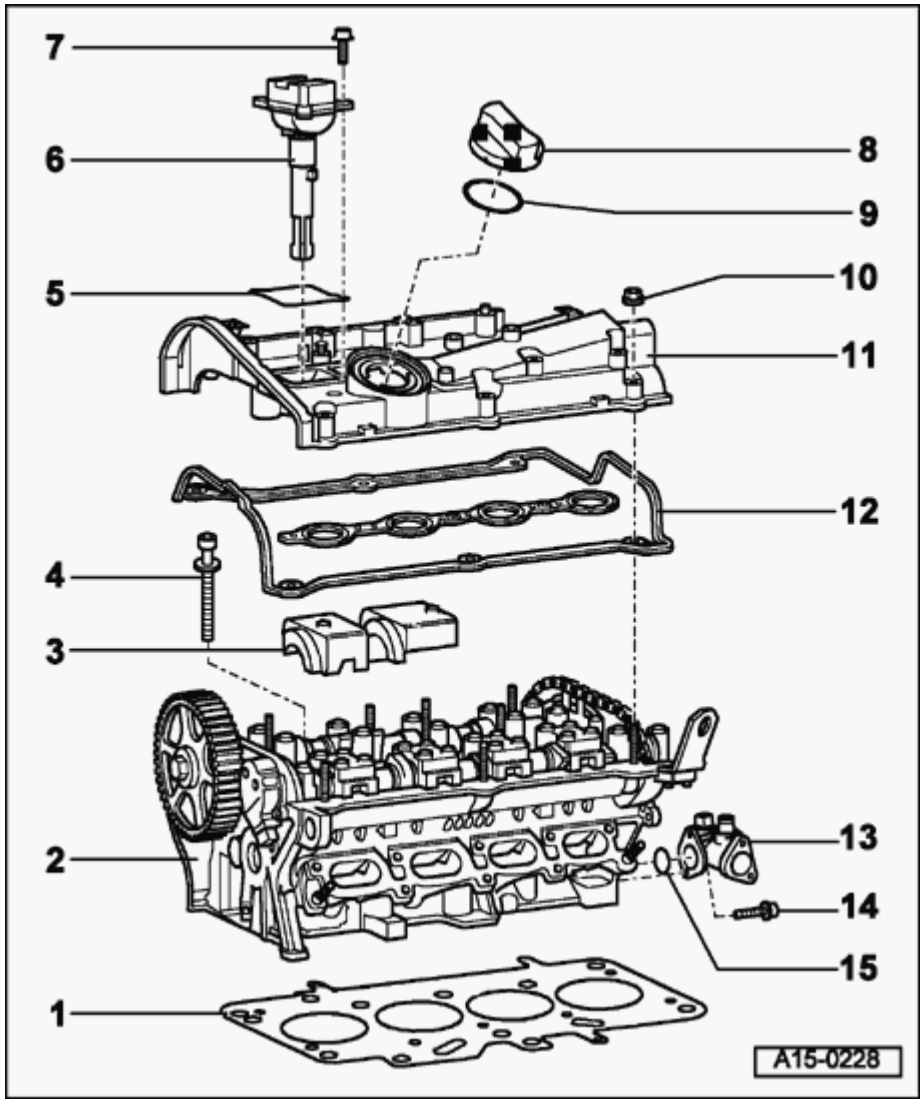
3 - Oil deflector

- 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

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

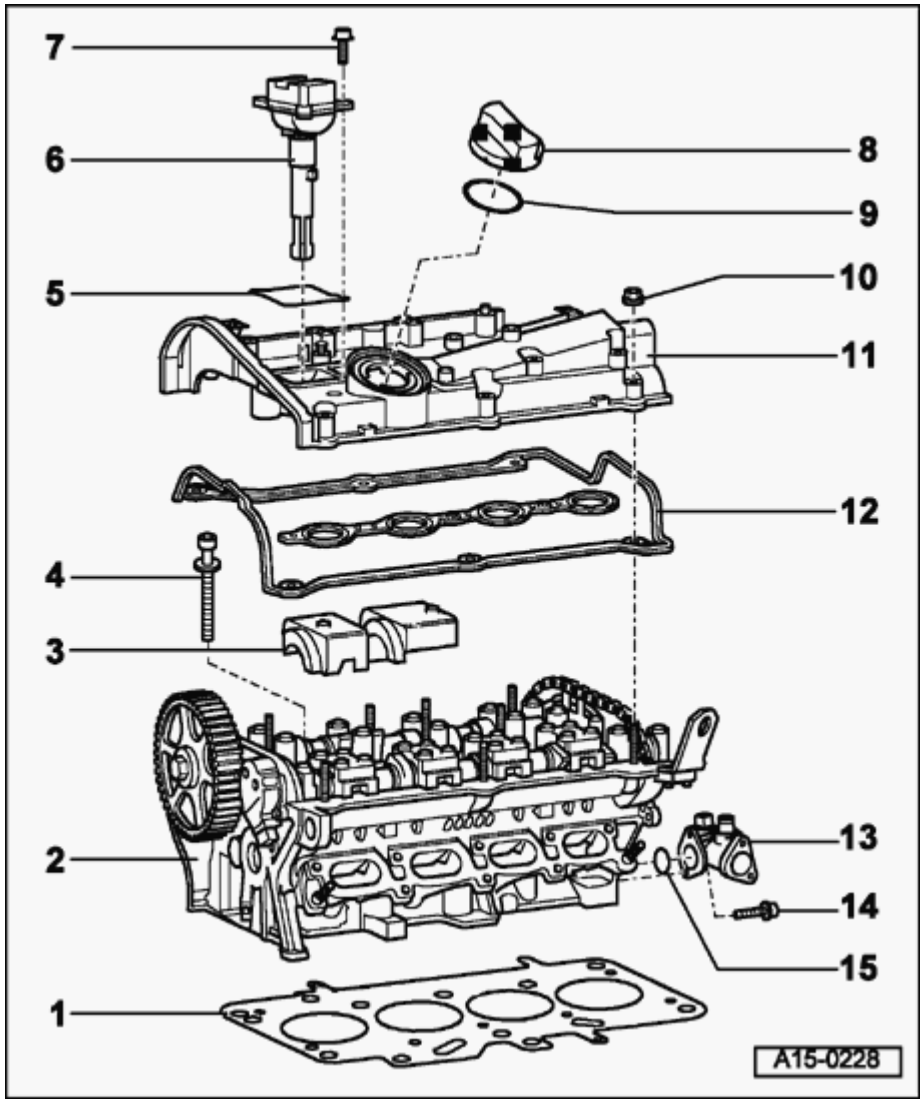
- Replace if damaged or leaking

10 - Nut

- 10 Nm (7 ft lb)

11 - Cylinder head cover

- Removing and installing ⇒ Page 15-17



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

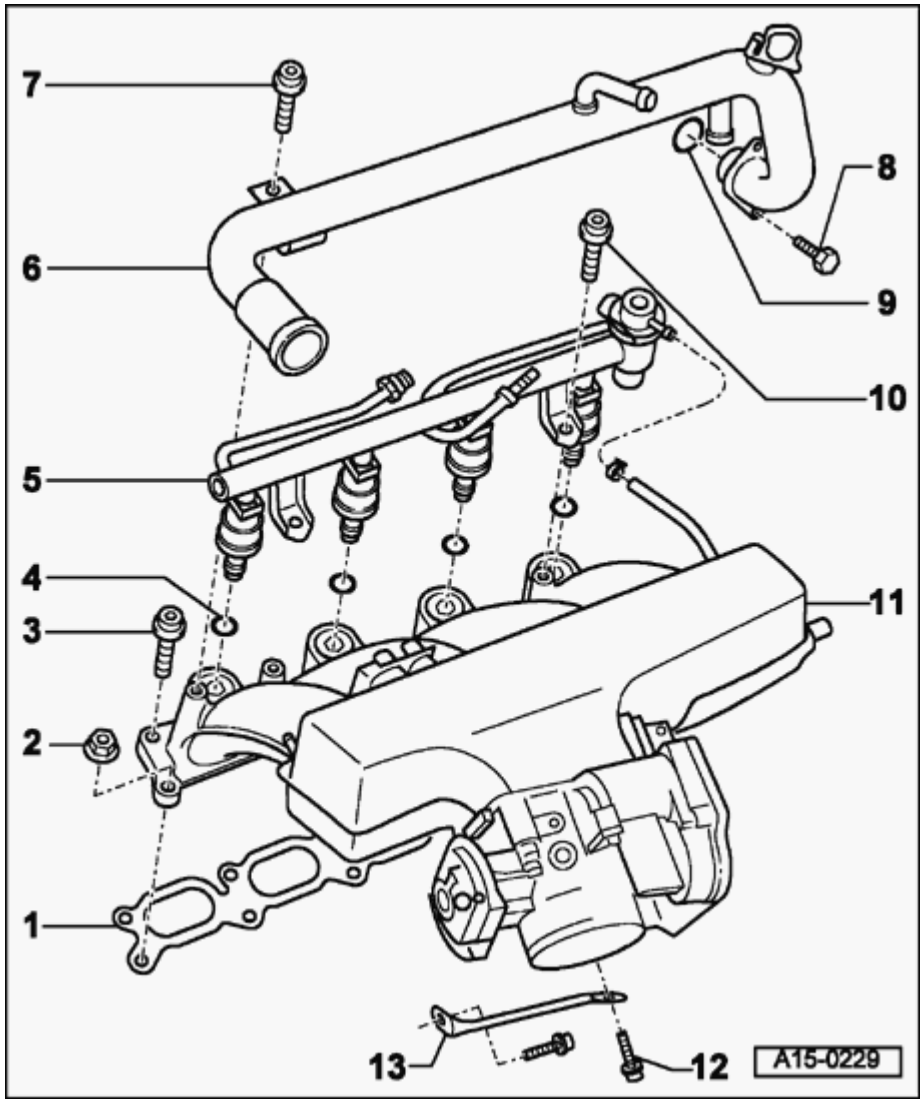
14 - Bolt

- 10 Nm (7 ft lb)

15 - O-Ring

- Always replace

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

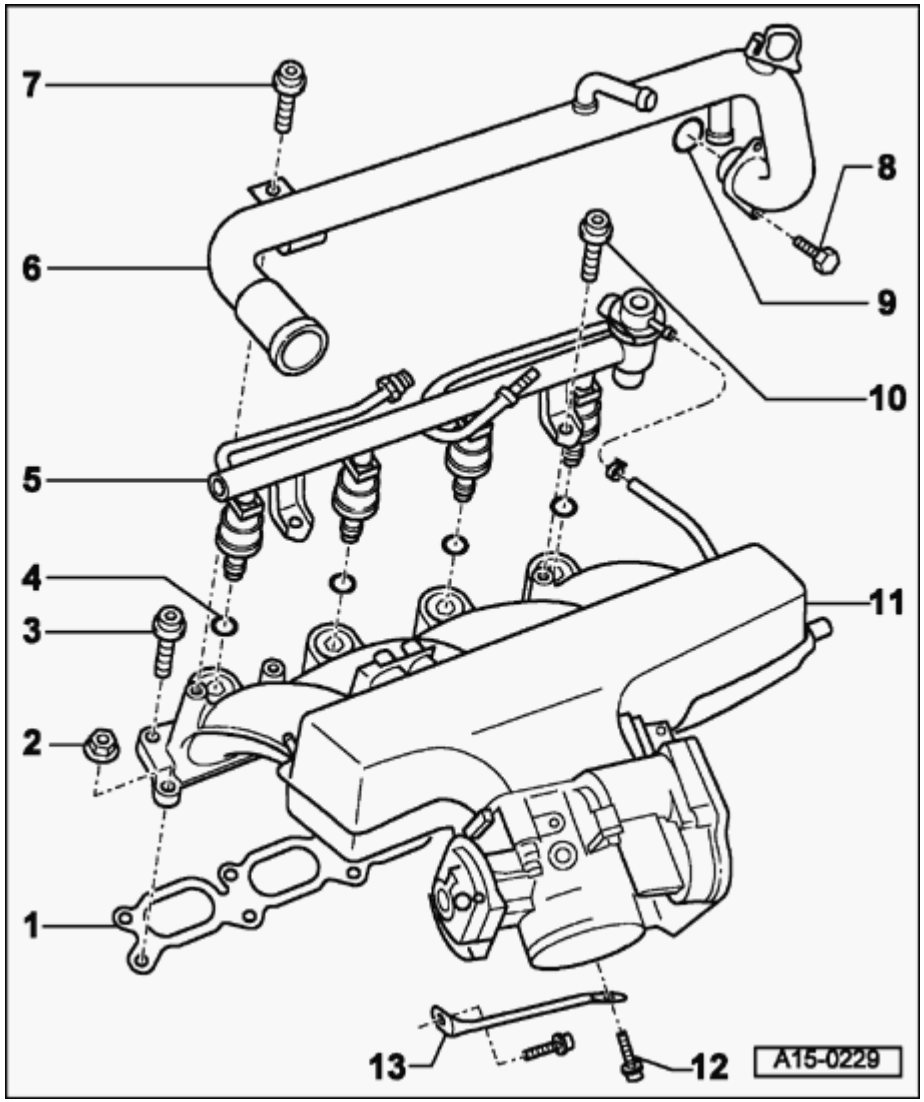
7 - Socket-head bolt

- 10 Nm (7 ft lb)

8 - Bolt

- 10 Nm (7 ft lb)

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

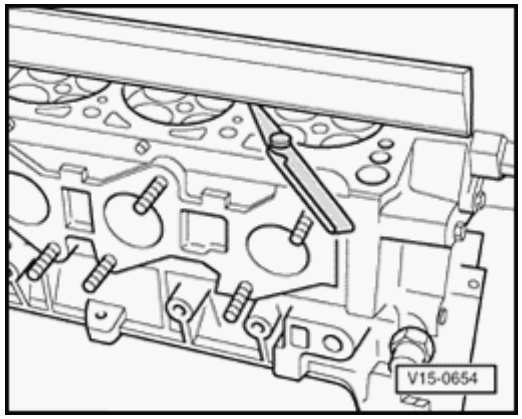


Fig. 1 Check cylinder head for distortion

- 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.)

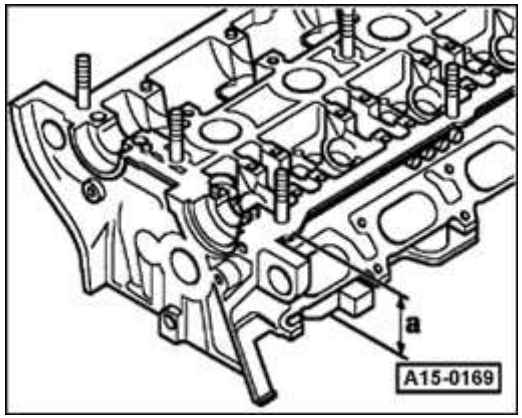


Fig. 2 Refacing cylinder head

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

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

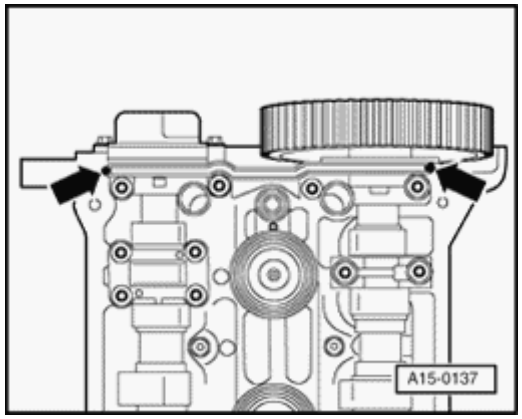


Fig. 3 Sealing contact surfaces between double bearing cap and cylinder head

- 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).

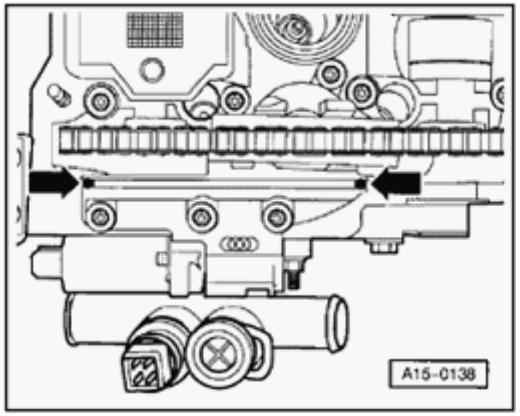


Fig. 4 Sealing contact surfaces between hydraulic chain tensioner and cylinder head

- 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).

Intake manifold, removing and installing

Removing

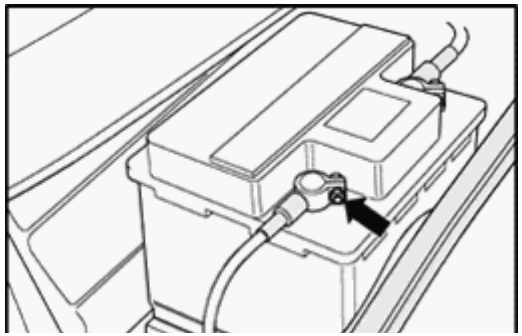
Note:

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

CAUTION!

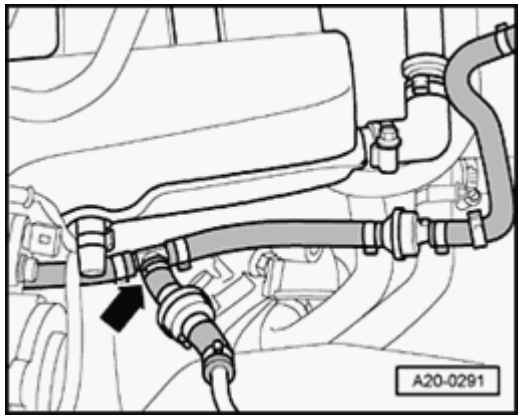
BEFORE disconnecting the battery:

- ***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.***



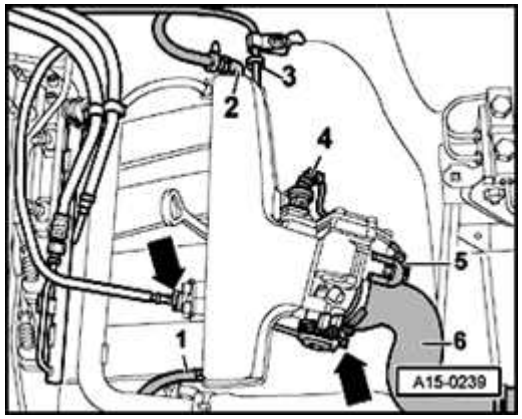
- Disconnect battery Ground (GND) strap.
- Remove engine covers.
- Drain coolant ⇒ Page 19-4 .

15-11



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

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.

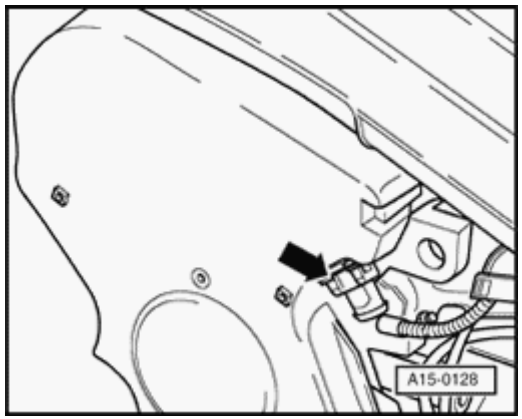
Note:

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

- Disconnect the following harness connectors:

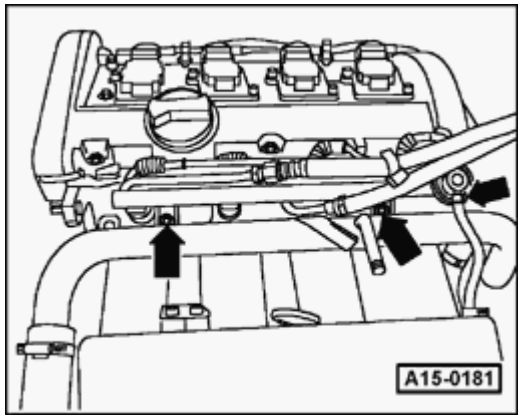
4 - For Intake Air Temperature (IAT) sensor -G42-

5 - For throttle valve control module -J338-

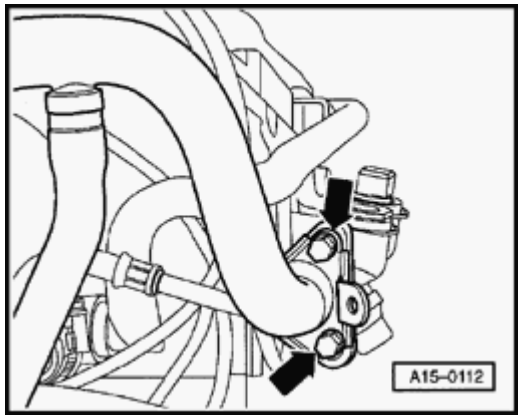


- Disconnect harness connector from Camshaft Position (CMP) sensor -G40- (arrow).

15-13

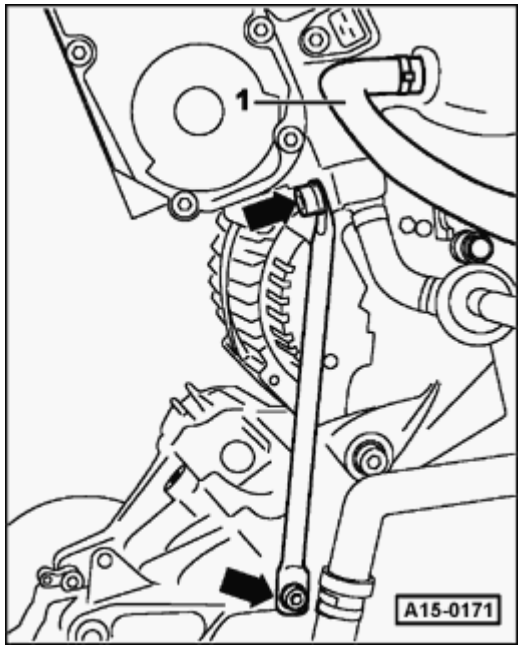


- Unbolt fuel supply rail retaining bolts and disconnect vacuum line at fuel pressure regulator (arrows).
- Disconnect fuel supply rail with injectors from intake manifold and lay aside in rear of engine compartment on clean cloth.
- Disconnect coolant hoses at upper coolant line.



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

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.

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

⇒ *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.

- 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

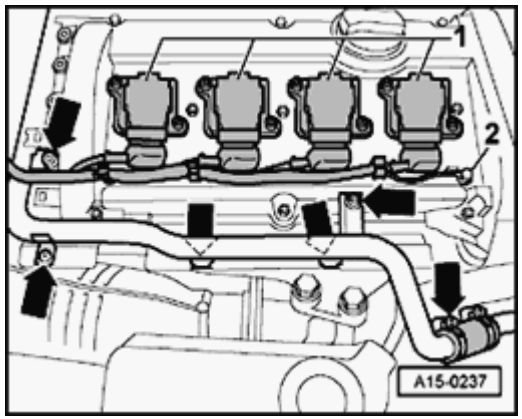
Component	Tightening torques
Intake manifold to cylinder head	10 Nm (7 ft lb)
Intake manifold brace to intake manifold	20 Nm (15 ft lb)
Intake manifold to bracket	20 Nm (15 ft lb)
Fuel supply rail to intake manifold	10 Nm (7 ft lb)
Coolant line to coolant flange	10 Nm (7 ft lb)
Coolant line to intake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

15-17

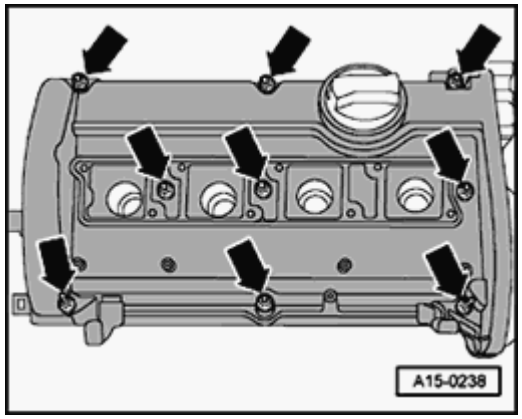
Cylinder head cover, removing and installing

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.



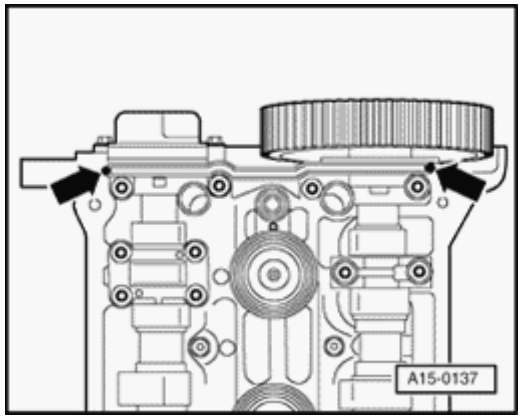
- Remove cylinder head cover nuts (arrows) and remove cylinder head cover.

Installing

Installation is the reverse of removal, noting the following:

Note:

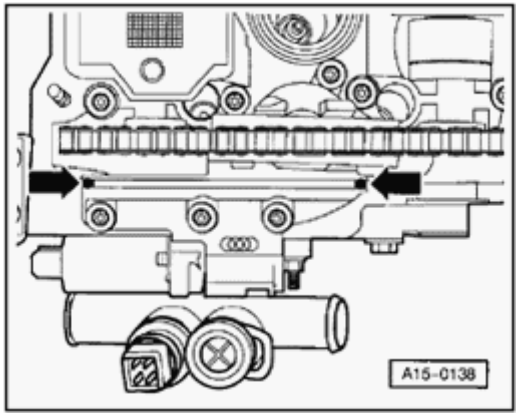
Replace cylinder head cover gaskets if damaged.



- 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.

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)

15-20

Cylinder head, removing

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

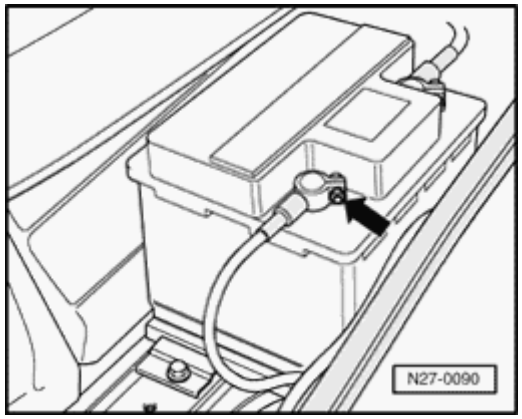
Note:

- *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.*

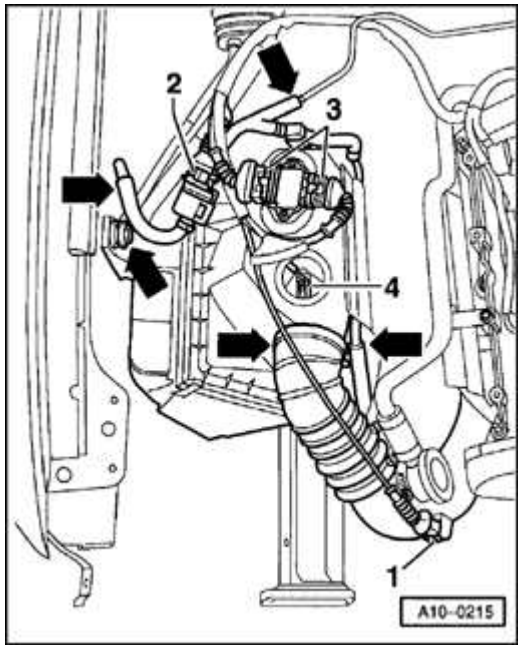
CAUTION!

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.***



- 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-

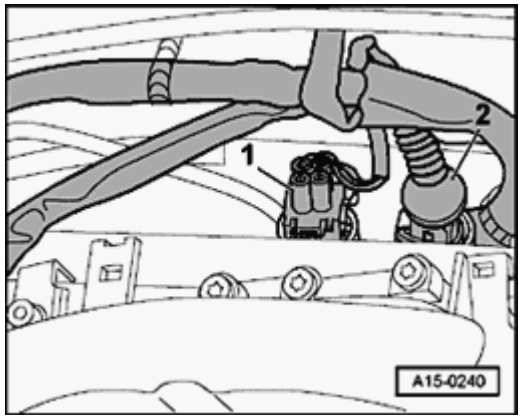
2 - At Evaporative Emission (EVAP) Canister Purge Regulator Valve -N80-

3 - At Power outage stage -N122-

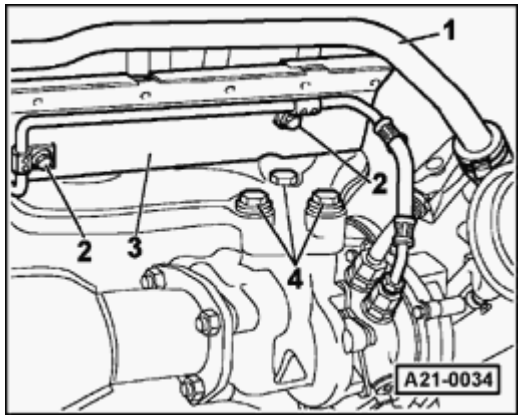
4 - At Mass Air Flow (MAF) sensor -G70-

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

15-22

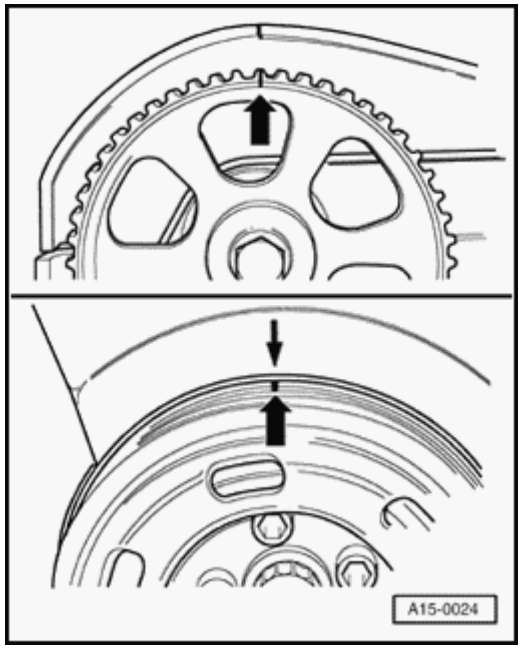


- Disconnect harness connector -1- at Engine Coolant Temperature (ECT) sensor -G2-/-G62-.
- Disconnect harness connector -2- at temperature sensor II -G18-.
- Unclip all connections from cylinder head and move clear.



- 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 .

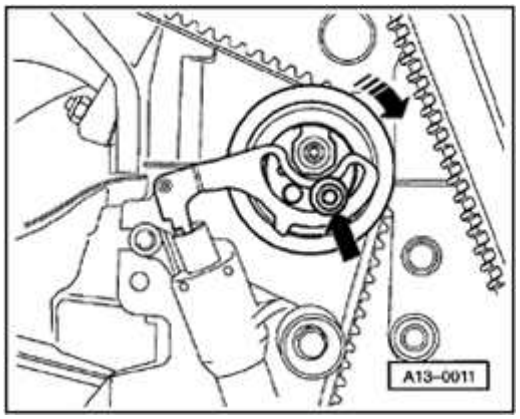
15-23



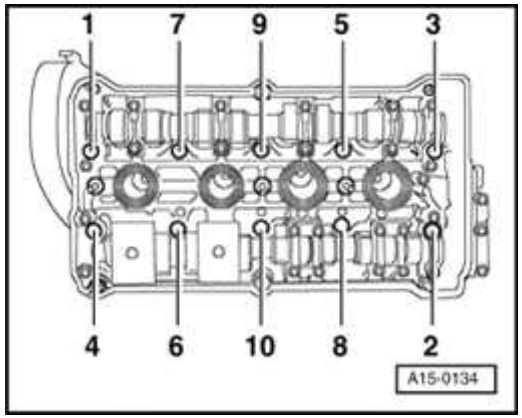
- Turn crankshaft at central bolt of toothed belt gear in direction of engine rotation to TDC Cyl. 1 marking (arrows).

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.



- 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 .

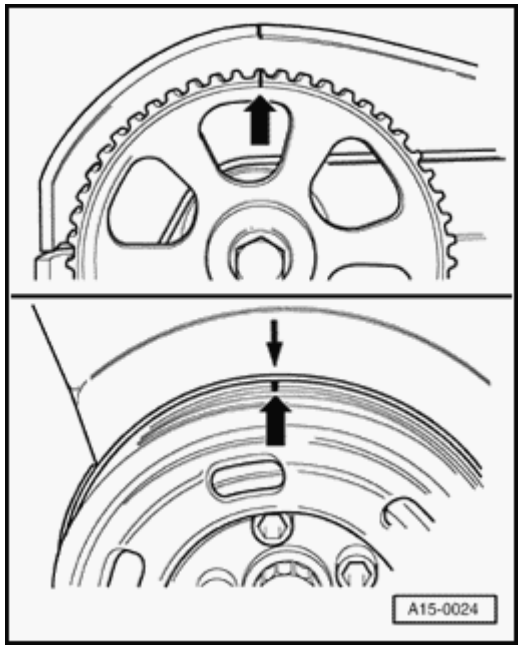


- Remove cylinder head bolts in sequential order as shown in illustration.
- Remove cylinder head.

Cylinder head, installing

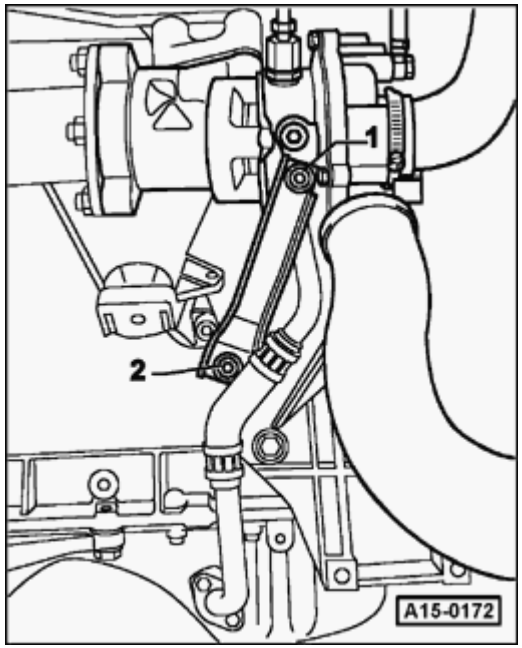
Note:

- *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.*

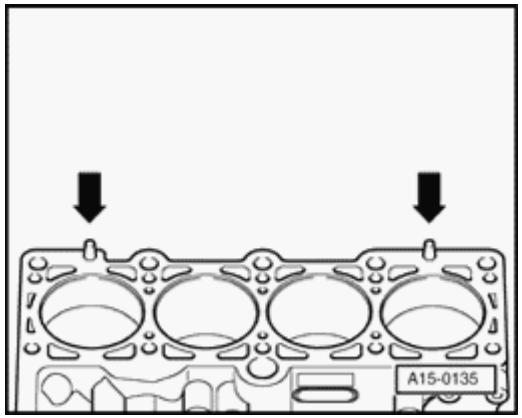


- Before installing cylinder head, set crankshaft and camshaft to TDC Cyl. 1 marking (arrows).

15-26



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

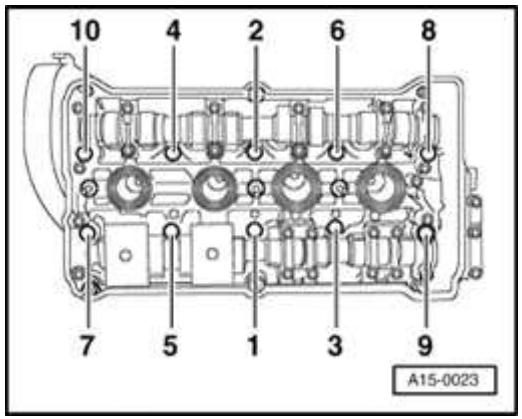


- Install cylinder head gasket.

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.



- 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 .

- 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.

⇒ *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.

- 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)

Compression, checking

Special tools and equipment

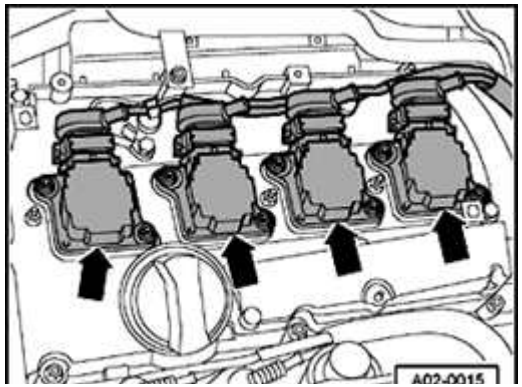
- VAG1381 or VAG1763 compression tester
- 3122B spark plug removal tool

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.

Note:

Use VAG1381 or VAG1763 compression tester ⇒ user manual.

- 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.

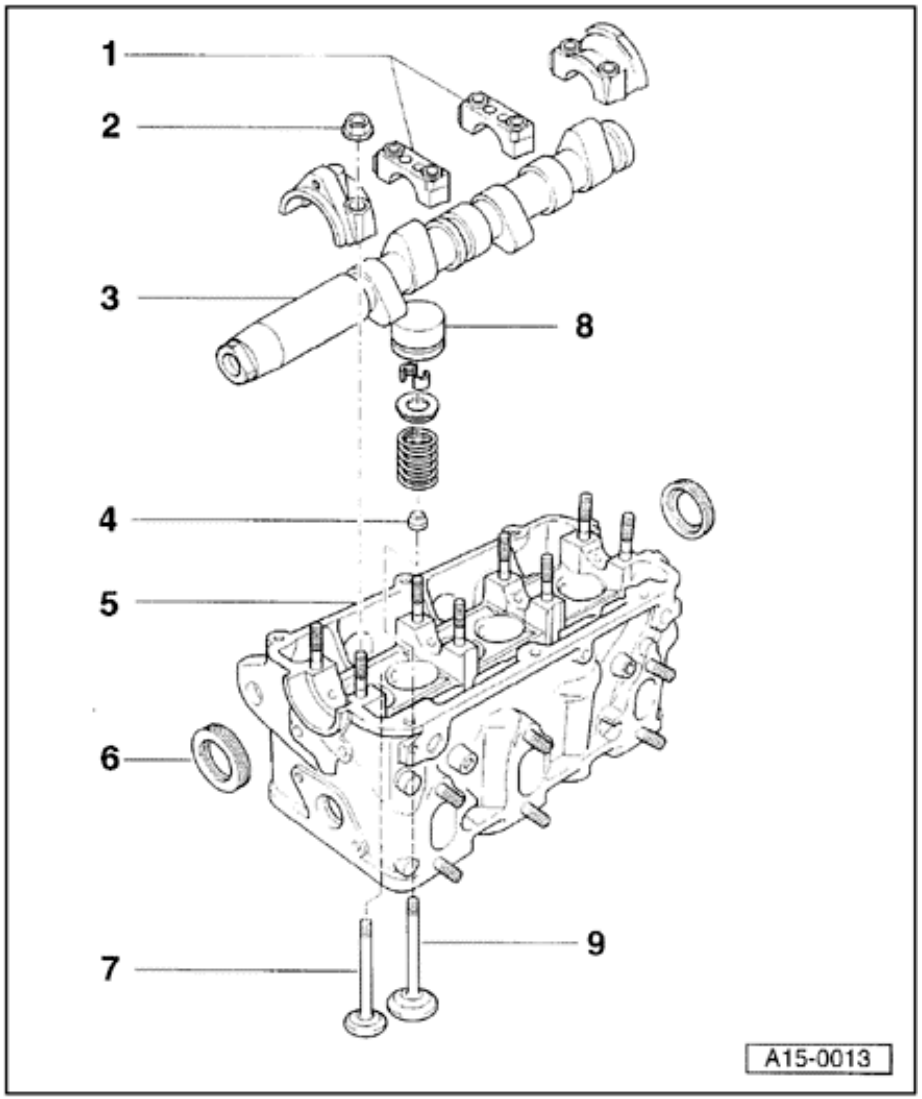
⇒ *Repair Manual, 1.8 Liter 5V Turbo Fuel Injection & Ignition, Repair Group 01*

Note:

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

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)



Cylinder head and valve drive, servicing

Component layout

Note:

Always replace all seals and gaskets.

1 - Bearing cap

- Installation position ⇒ page 15-20

2 - 17 Nm (13 ft lb)

3 - Camshaft

- Removing and installing ⇒ page 15-19
- Checking axial play ⇒ page 15-21
- Maximum runout: 0.01 mm (0.0004 in.)

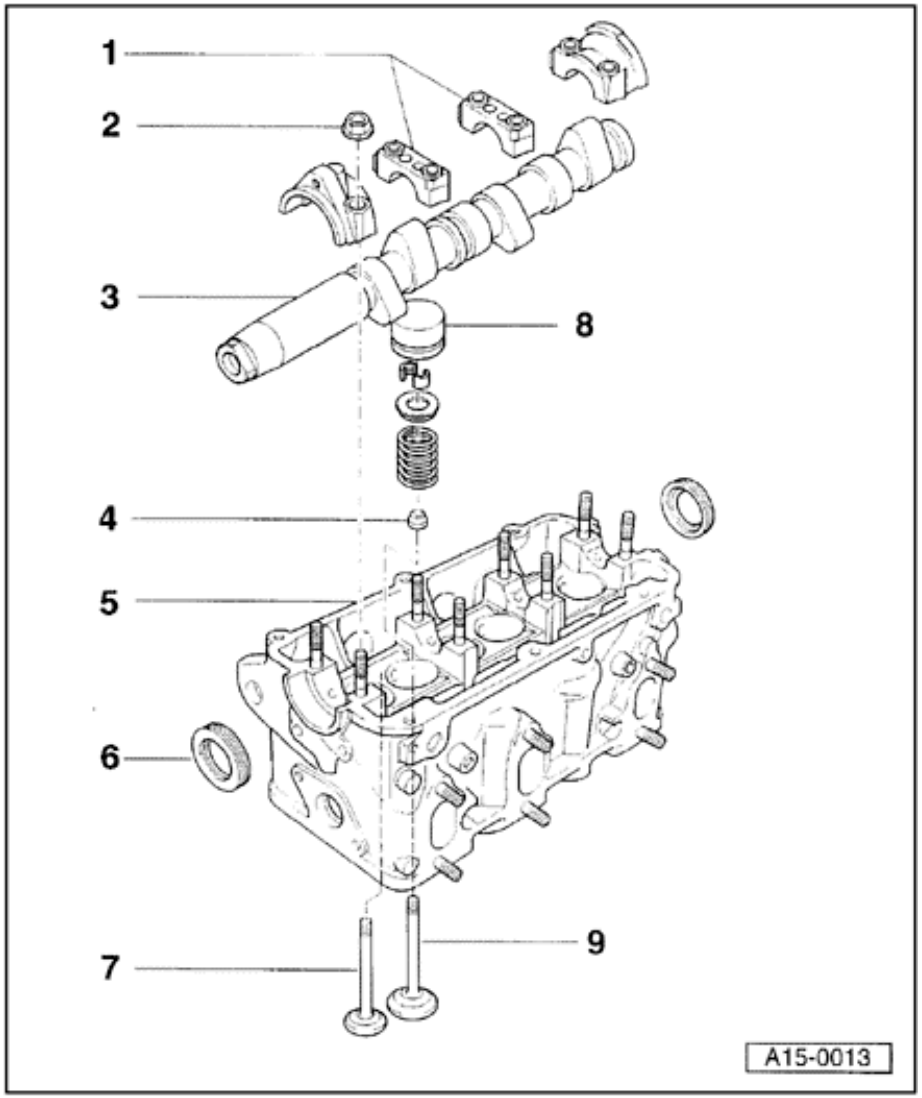
4 - Valve stem seal

- Always replace
- Replacing ⇒ page 15-24

5 - Cylinder head

- Resurfacing ⇒ page 15-26
- Refacing valve seats ⇒ page 15-31

15-4



6 - Oil seal

- Always replace
- Replacing ⇒ page 15-10

7 - Exhaust valve

- Checking ⇒ page 15-27
- Checking and replacing valve guides ⇒ page 15-29

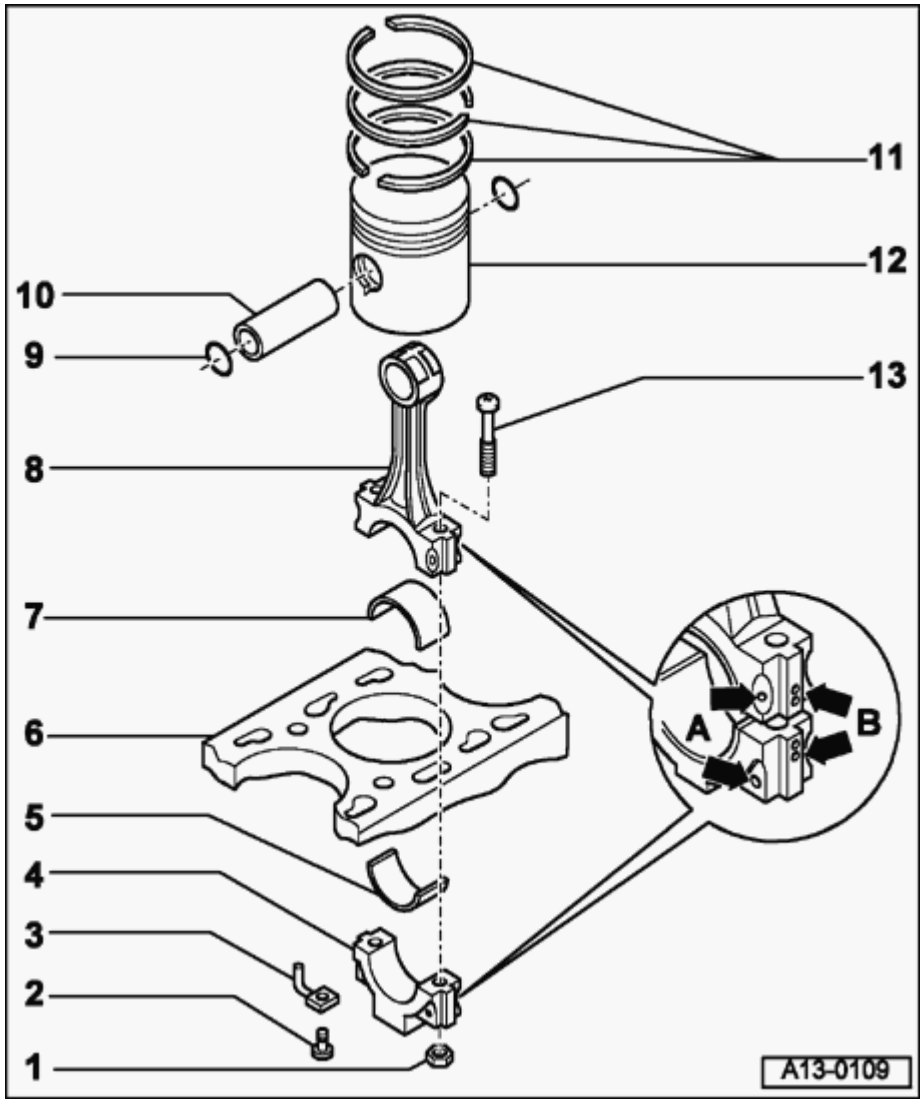
8 - Hydraulic valve lifter

- Oil contact surfaces before installing
- Store with cam lobe contact surface facing downward
- Checking ⇒ page 15-22

9 - Intake valve

- Checking and refacing ⇒ page 15-27
- Checking and replacing valve guides ⇒ page 15-29

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

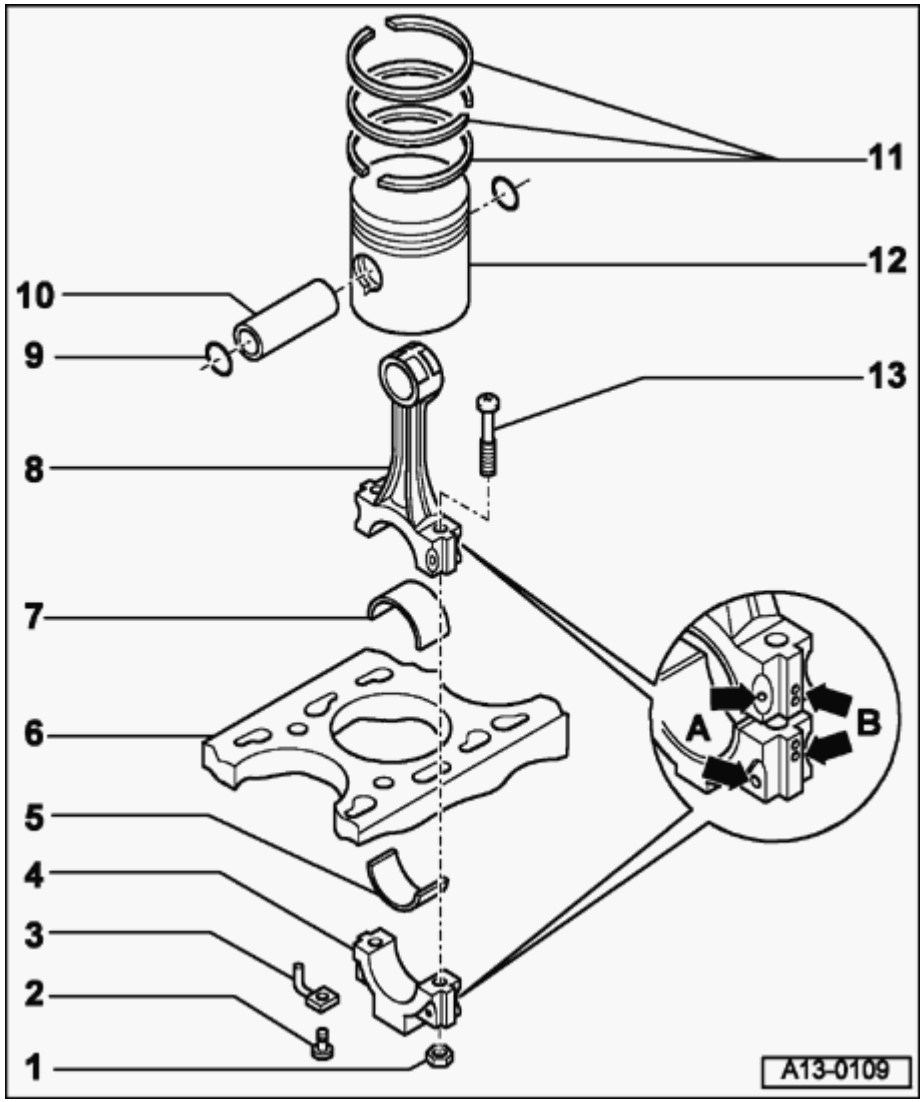
4 - Connecting rod bearing cap

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

Installed position:

- Marks -A- point toward belt pulley side

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.)

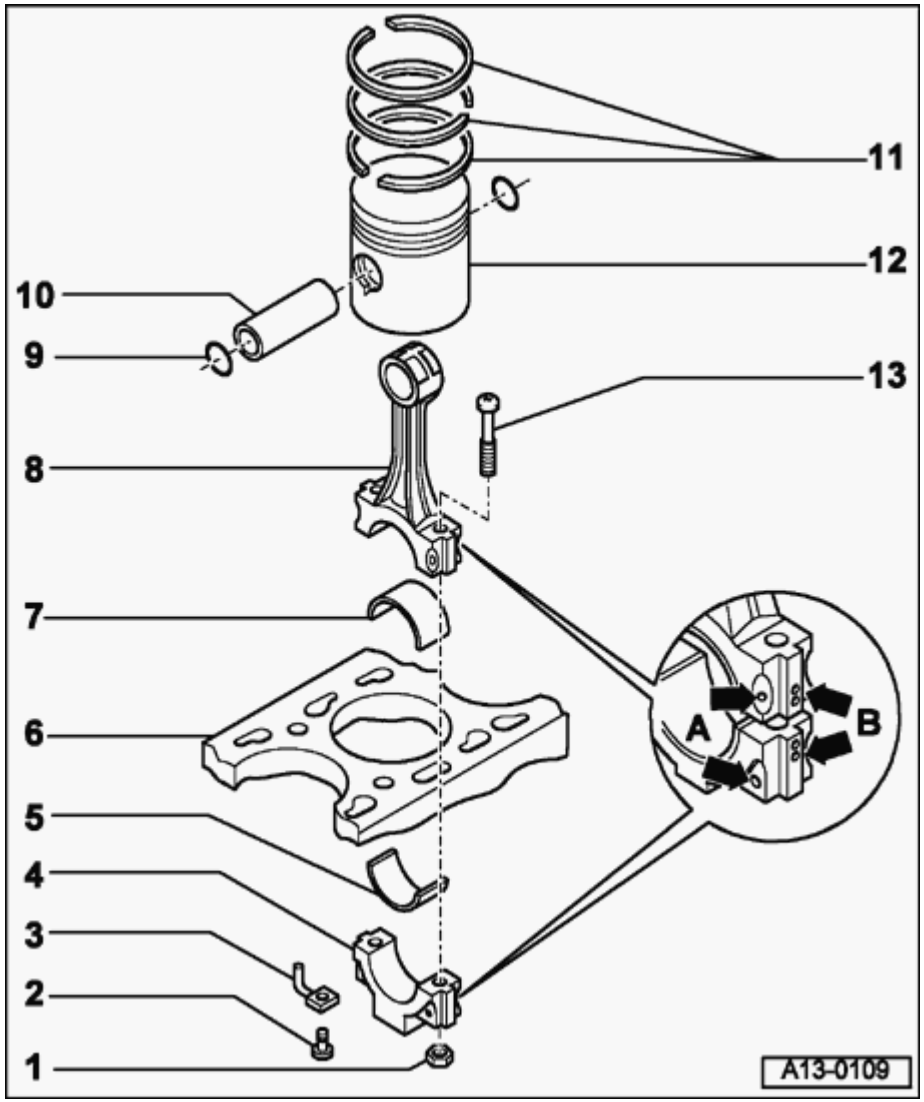
Measure radial play using Plastigage®:

- 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

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)

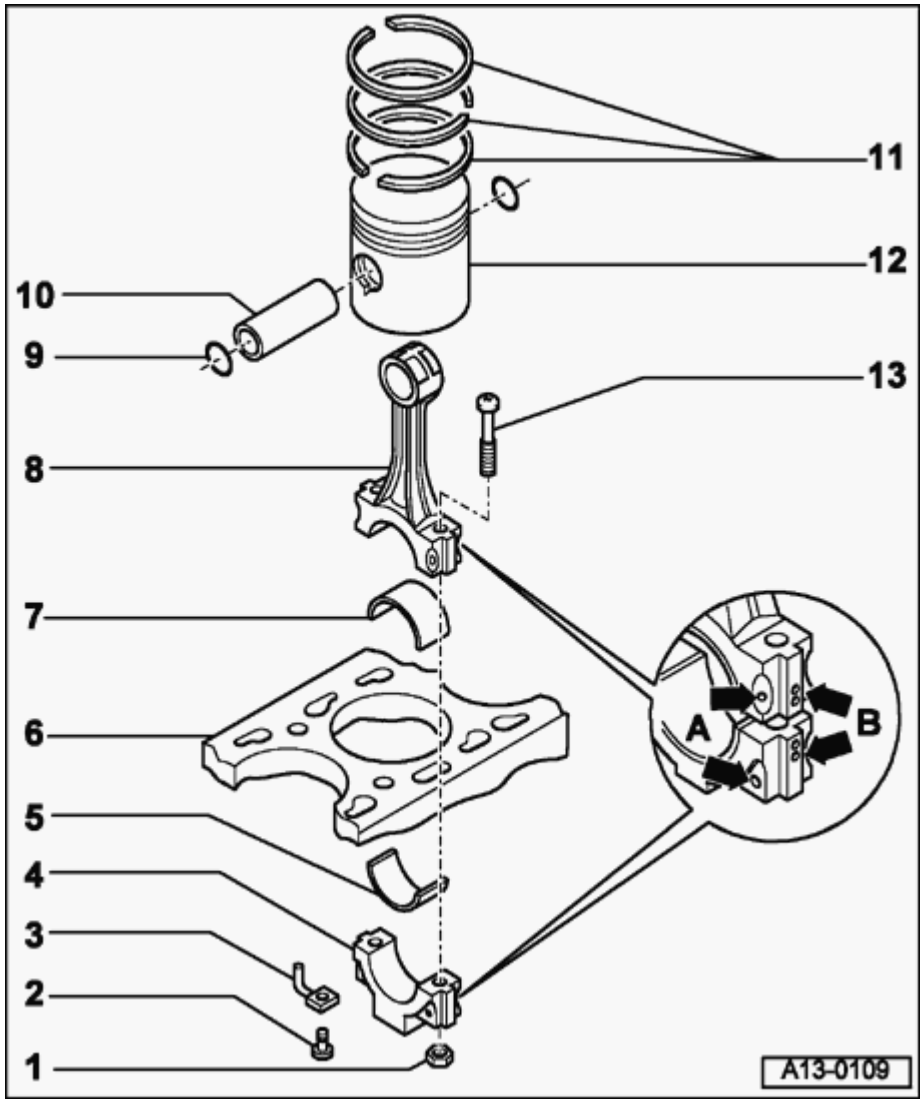
Axial play:

- New: 0.10-0.35 mm (0.004-0.014 in.)
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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

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

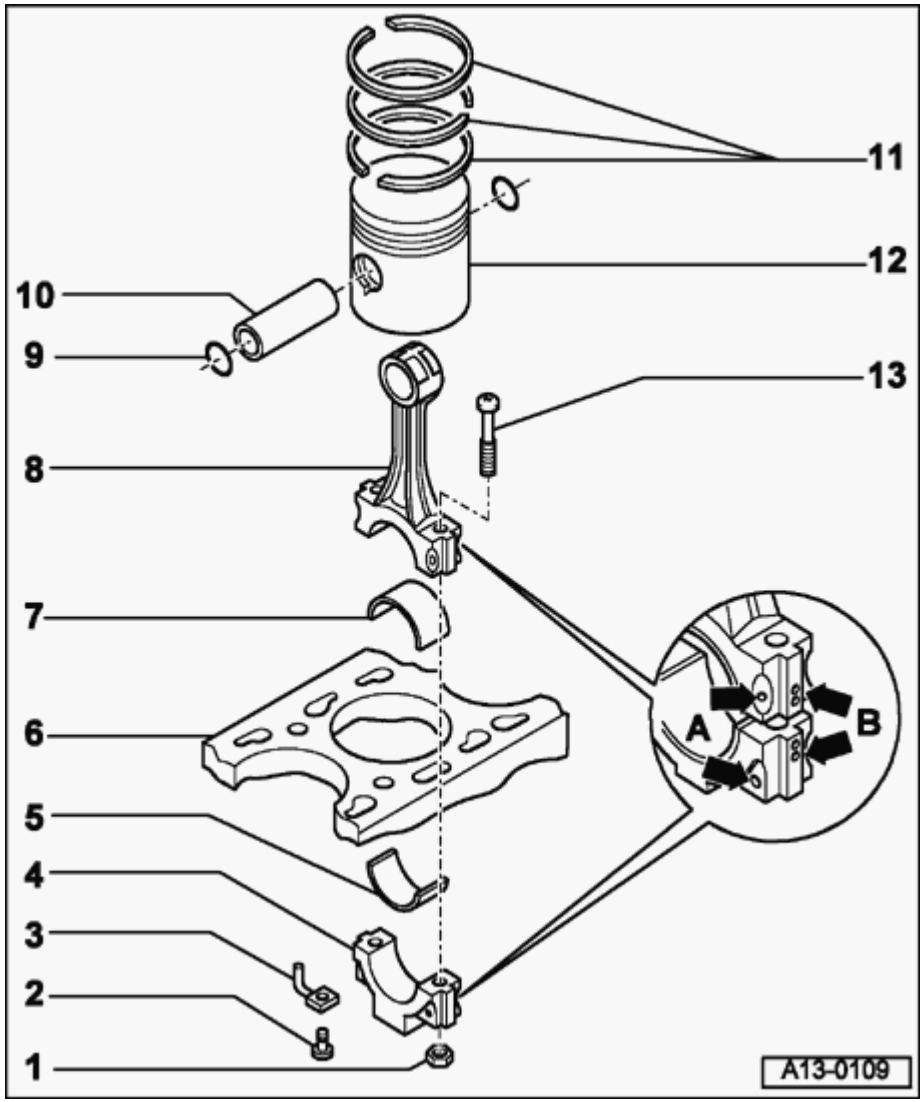
10 - Piston pin

- 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

13-57



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

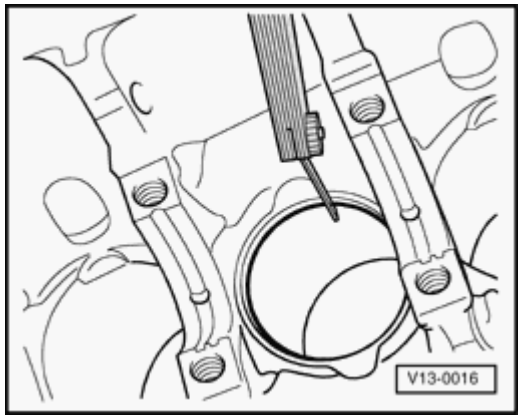


Fig. 1 Checking piston ring end gap

- 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)

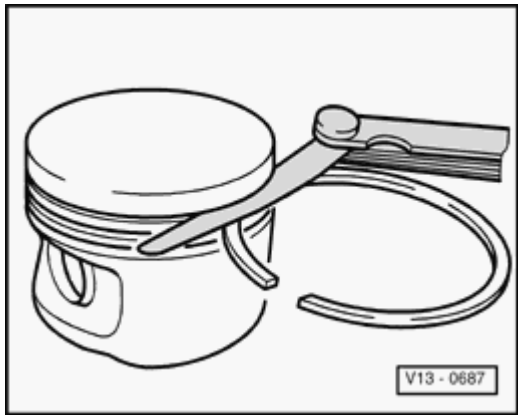


Fig. 2 Checking piston ring side clearance

- 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)

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)

13-59

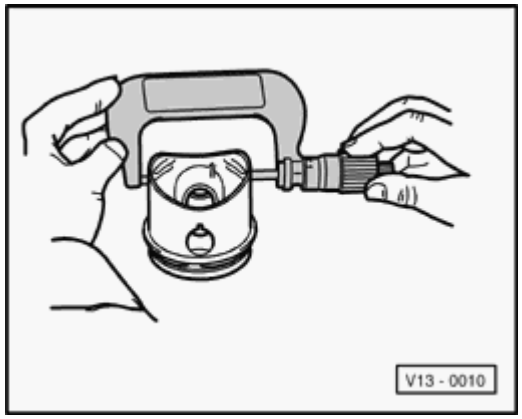


Fig. 3 Checking piston diameter

- 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.)

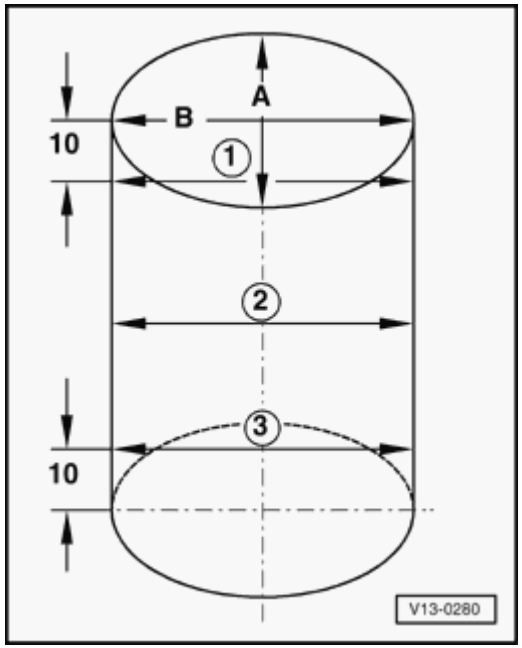


Fig. 4 Checking cylinder bore

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-.

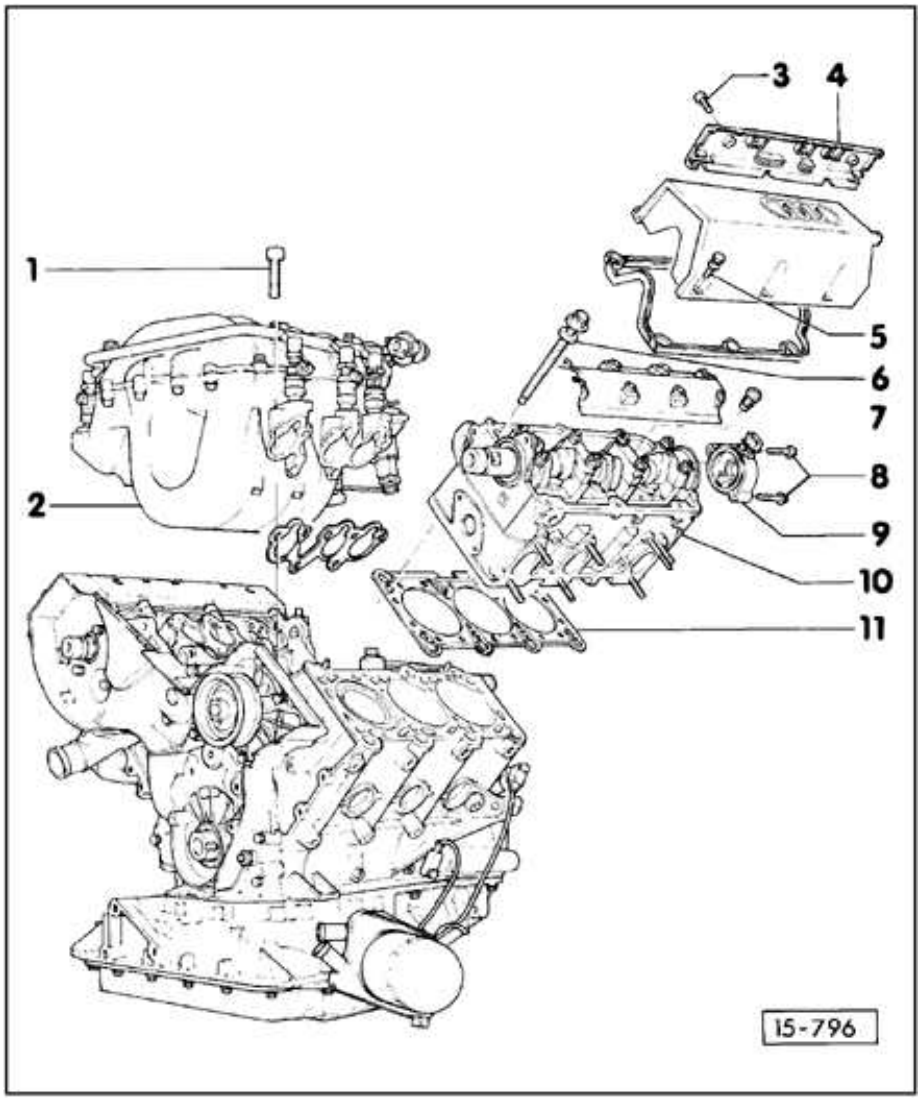
  Deviation from nominal size: max. 0.08 mm (0.0031 in.)

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.

15-5



Cylinder head, assembly

Installing cylinder head cover ⇒ page 15-9 .

1 - 20 Nm (15 ft lb)

2 - Intake manifold

- Removing and installing ⇒ page 15-15

3 - 10 Nm (7 ft lb)

4 - Cover

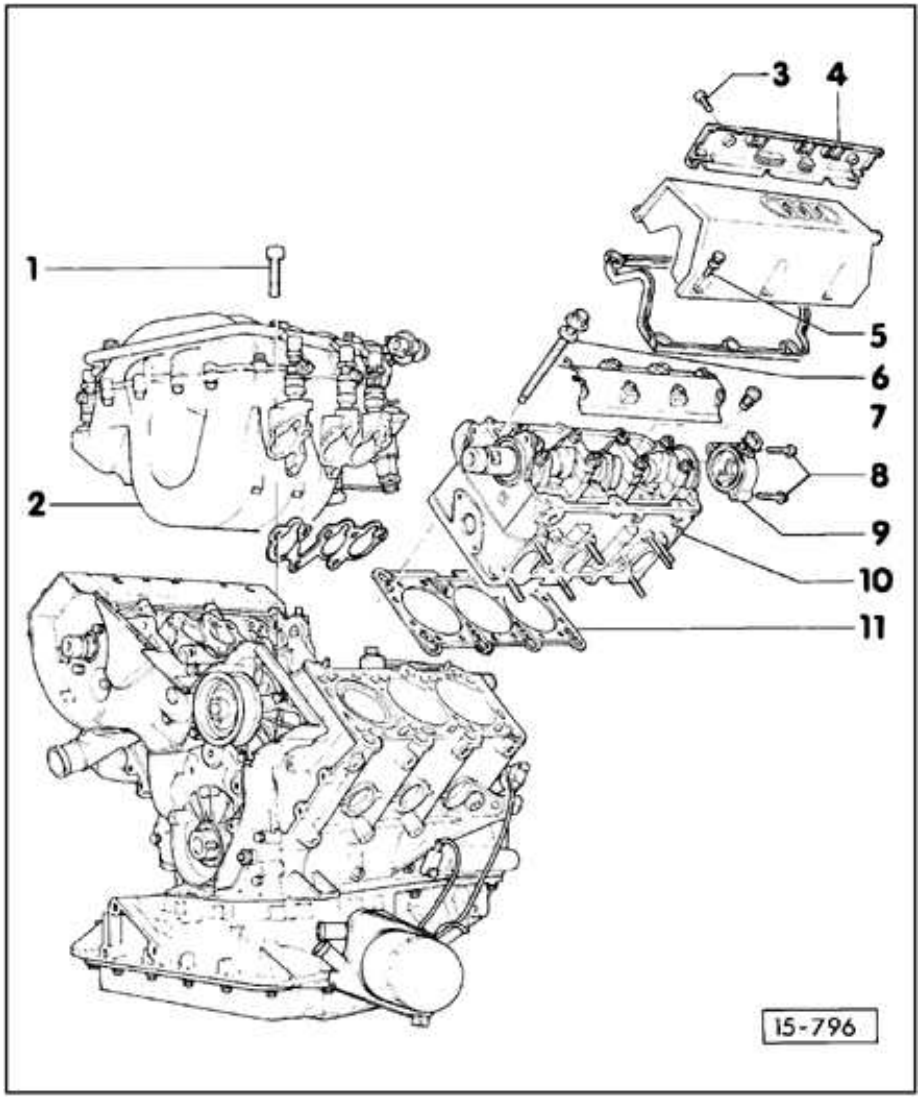
5 - 10 Nm (7 ft lb)

6 - Cylinder head bolt

- Always replace
- Tightening ⇒ page 15-17

7 - Pressure relief valve

- Replace if loud valve noises affecting the entire cylinder head bank can be heard
- Secure with thread locking compound AMV 197 000 01
- Replace valves that have loosened up
- 25 Nm (18 ft lb)



8 - 10 Nm (7 ft lb)

9 - Housing for Camshaft Position (CMP) sensor

10 - Cylinder head

- Checking for distortion ⇒ page 15-16
- Resurfacing dimensions ⇒ page 15-26

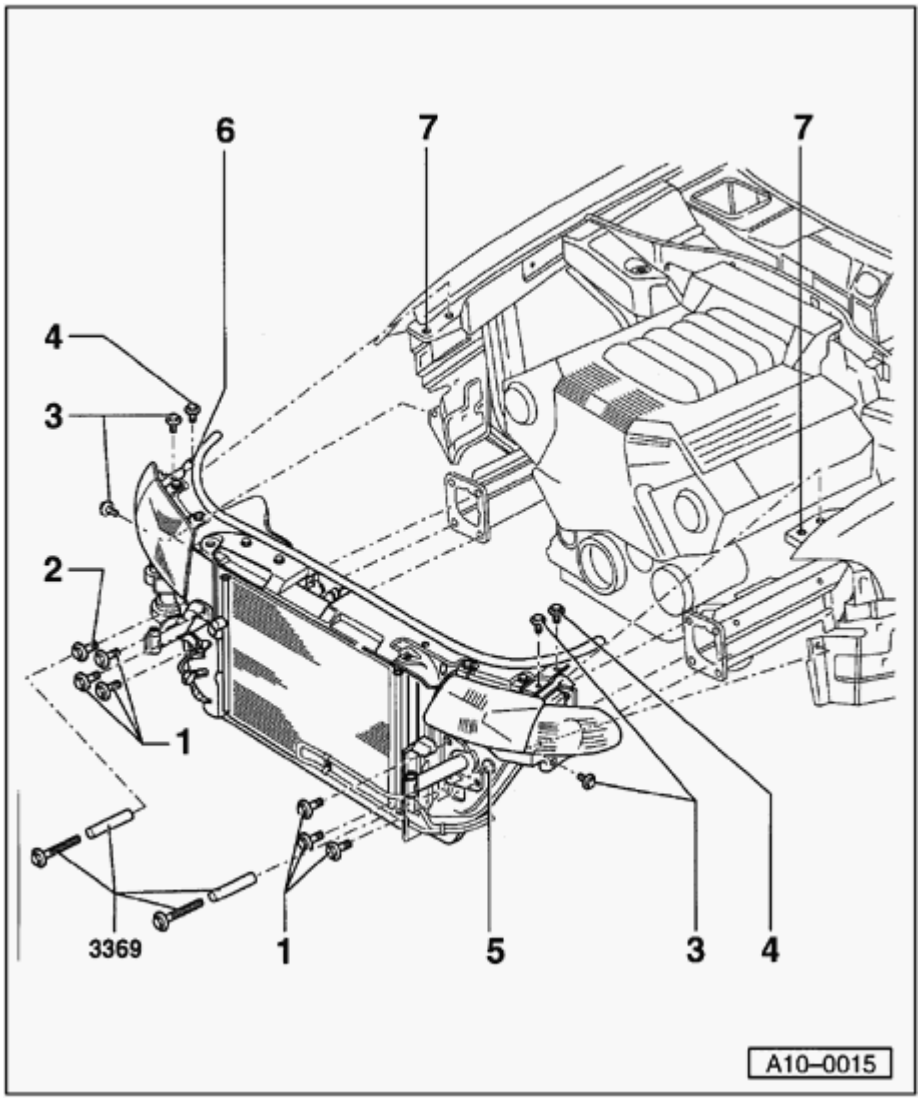
Note:

- *The single cylinder head - 10 - listed in the Parts catalog microfiche can be used on either left or right sides and uses a cap to seal the front.*
- *Installing cylinder head sealing cap ⇒ page 15-9 .*

11 - Cylinder head gasket

- Always replace
- Identification: lettering on gasket must face upward

15-7



Lock carrier, removing for service

1 - Bolt (8 x 45)

- 45 Nm (33 in lb)

2 - Bolt (8 x 45)

- 45 Nm (33 in lb)

3 - Bolt (6 x 20)

- 10 Nm (7 ft lb)

4 - Bolt (6 x 20)

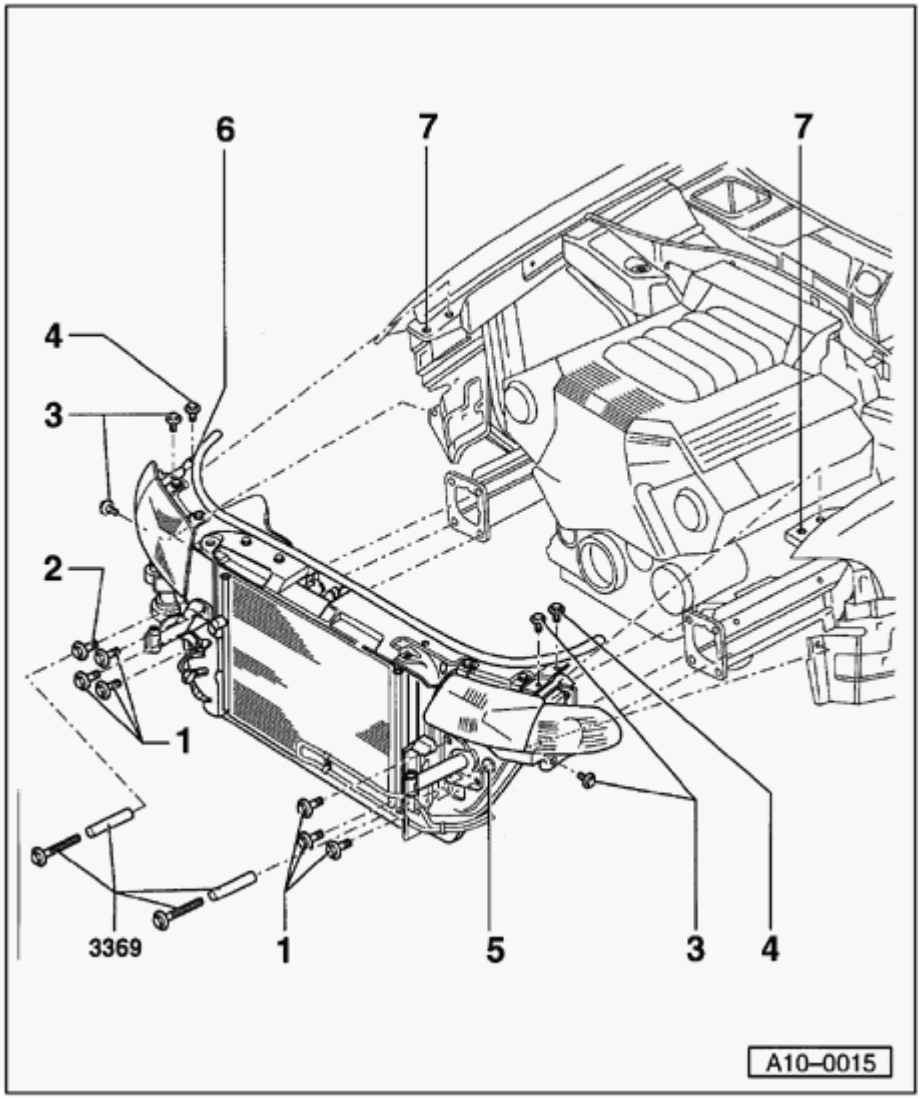
- 10 Nm (7 ft lb)

5 - Hole for special tool VAG 3369

6 - Alignment hole in front end

7 - Hole in side panel

15-8



Removing

- Unbolt air guide at front end, between front end and air cleaner, and remove.
- Remove mounting bolt -2- on right-hand side and thread in VAG 3369.
- Thread VAG 3369 into hole -5- on left-hand side.
- Remove mounting bolts -1- and -3-.
- Remove mounting bolt -4-, pull front end forward and insert mounting bolt -4- through rear alignment hole -6- and side panel alignment hole -7-.

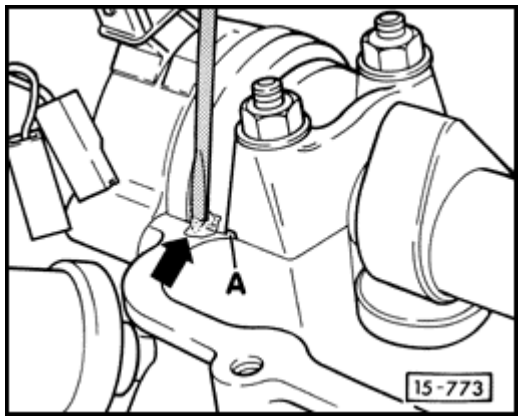
15-9

Cylinder head cover, installing

CAUTION!

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

- ***The inside and outside surfaces of the cylinder head cover gasket must be lightly coated with silicone lubricant D 007 000 04 before installation.***



- Carefully coat four edges on cylinder head sealing surfaces with Silimate, Part No. AMV 174 004 01, using a small screwdriver.

  - Silimate must be kept out of oil opening -A-.

Installing cylinder head sealing cap

Cylinder heads available from the Parts department can be used on either the left and right hand sides and are provided with a sealing cap for use where appropriate.

- Coat edge of sealing cap with sealing paste AMV 188 000 02.



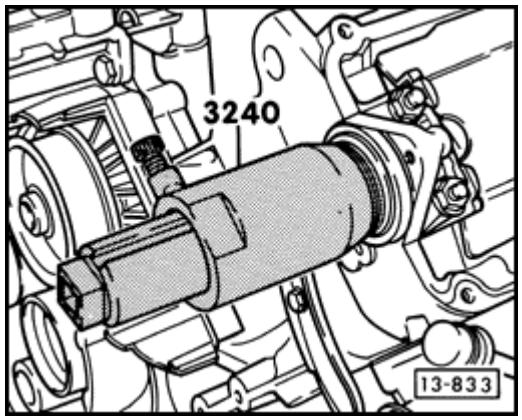
- Tap sealing cap in using drift VW 295, far enough so that outer edge of sealing cap is flush with chamfer on cylinder head.

15-10

Camshaft oil seals, replacing

Front

- Remove toothed belt ⇒ page 13-11 .
- Remove cylinder head cover.
- Remove rear toothed-belt guard.

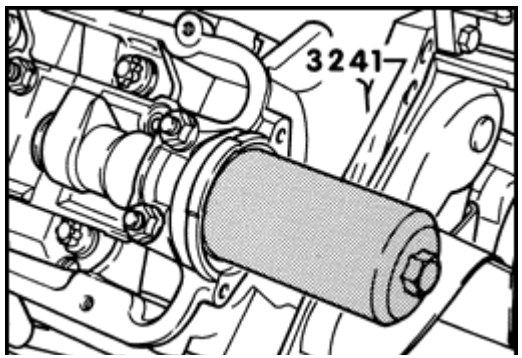


- Remove seal with seal extractor 3240.
- Clean bearing and sealing surfaces.

Note:

Do not oil sealing lip or outer edge of seal before pressing in.

Left front

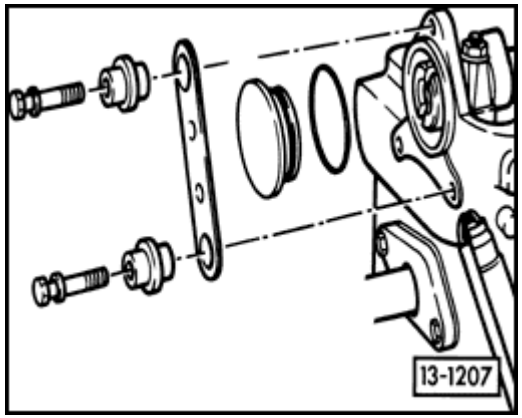


- Press seal in as far as possible using seal installer 3241.

Right front

- Use pulling sleeve on camshaft.
- Press seal in flush using 3241.

15-11



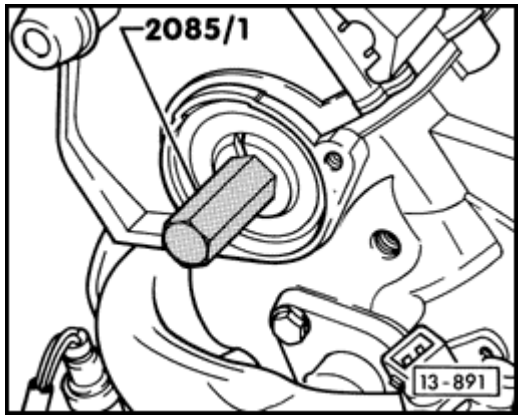
Right rear

- Remove bolts, spacer plate and attachments.
- Remove cap.
- Replace O-ring.

Left rear

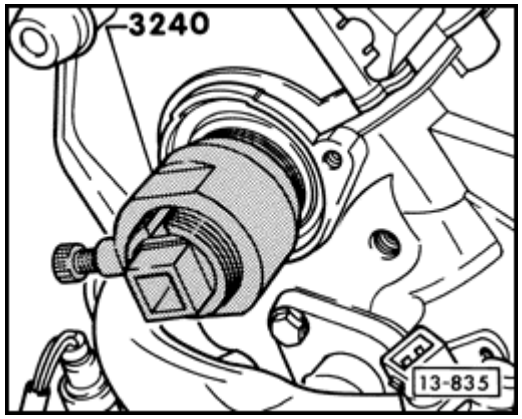
- Remove Camshaft Position (CMP) sensor housing.
- Remove bolt from CMP sensor plate.

  Tightening torque: 20 Nm (15 ft lb)
- Carefully pry out sensor plate using screwdriver.



- Thread in bolt for seal extractor 2085/1.

15-12



- Use seal extractor 3240 or 2085 and bolt 2085/1 to remove seal.
- Clean bearing and sealing surfaces.

Note:

Do not oil sealing lip or outer edge of seal before pressing in.

- Use guide sleeve and insertion tool 3241 to press seal in until fully seated.

Tightening torque:

CMP sensor plate: 20 Nm (15 ft lb)

15-13

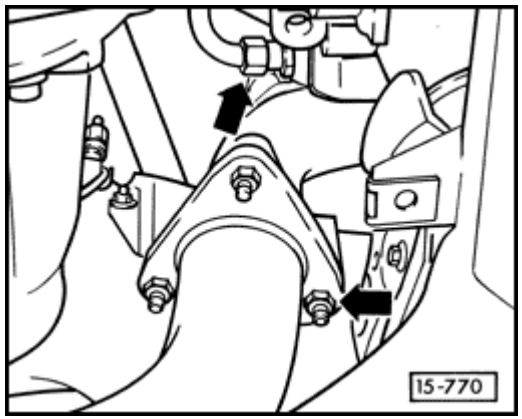
Cylinder head, removing and installing

Engine installed

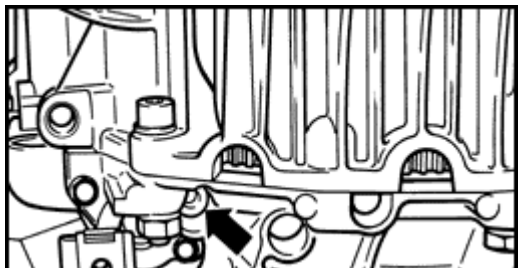
This removal procedure refers to the left cylinder head

Removing

- Remove ribbed belt ⇒ page 13-9
- Remove toothed belt ⇒ page 13-11



- Disconnect exhaust pipe from manifold.
- Disconnect components of EGR system, if applicable.



- Drain engine coolant at drain plug (arrow) using special tool 3247, and at drain plug in bottom of radiator.
- Remove air hose between Mass Air Flow (MAF) sensor and intake manifold.
- Disconnect all spark plug connectors.

- Disconnect all harness connectors on fuel injectors.

15-14

- Disconnect positive crankcase ventilation connections on left and right cylinder head covers.

- Disconnect fuel supply and return lines.

- Unclip cover on intake air housing.

- Remove both screws under cover.

- Push back and lift intake air housing upward.

- Pull vacuum hose off left side and remove housing.

- Remove left-side cover for fuel injector lines.

- Detach accelerator pedal cable and lay clear.

- Disconnect line from Idle Air Control (IAC) valve at throttle body.

- Disconnect harness connector at IAC valve and throttle position sensor.



- Disconnect vacuum pipe at the cruise control vacuum control actuator.

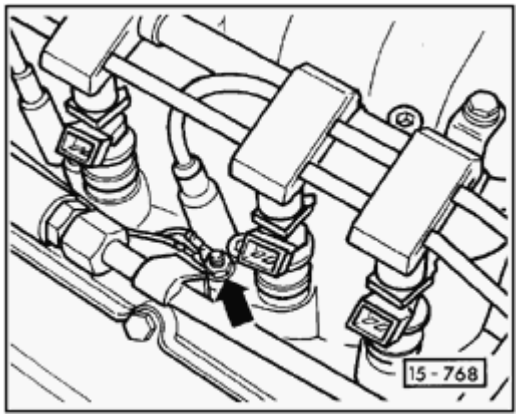
- Disconnect harness connector at oil pressure sensor and at oil pressure switch.
- Disconnect harness connector at the Camshaft Position (CMP) sensor housing.
- Disconnect vacuum pipe at intake manifold changeover valve (blue) and also at EGR valve (brown).

15-15

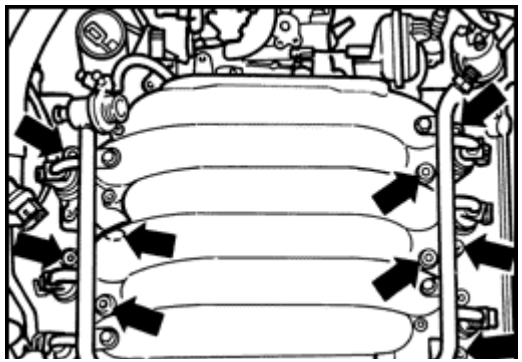
- Disconnect harness connectors for Heated Oxygen Sensors (H02S) and oxygen sensor heaters at engine compartment bulkhead, and move to one side.

- Disconnect vacuum line to EGR vacuum regulator solenoid valve at throttle body.

- Remove EGR valve from intake manifold.



- Remove hydraulic hose bracket and disconnect Ground (GND) wires (arrow) on intake manifold.



- Remove bolts (arrows) and remove intake manifold.
- Seal off openings using clean cloth rags.
- Disconnect coolant line at rear of cylinder head.

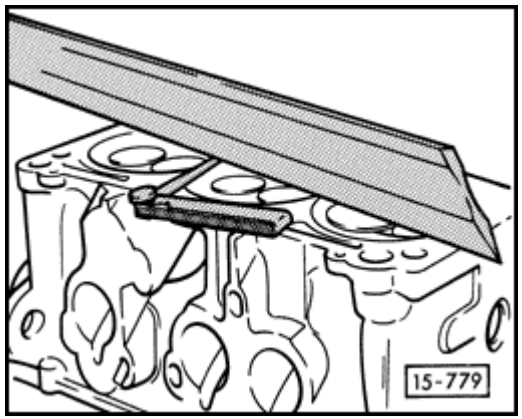
Note:

The intake manifold has two slanting mounting surfaces to the left and

right cylinder heads. The cylinders heads can be warped by removing the manifold. If only the intake manifold is removed, or if only one cylinder head is removed, then the cylinder head bolts of the head(s) that are not removed must be tightened 1/4-turn (90°).

- Remove heated oxygen sensors.
- Remove exhaust manifold heat shield.
- Remove cylinder head cover.
- Remove rear toothed-belt guard.
- Disconnect hose from hydraulic reservoir to pump.
- Remove cylinder head.

Checking cylinder head distortion



- Measure with feeler gauge at several points using straight edge.

  Max. permissible distortion: 0.05 mm (0.0020 in.)

Installing

- Clean sealing surfaces.
- Install cylinder head gasket.

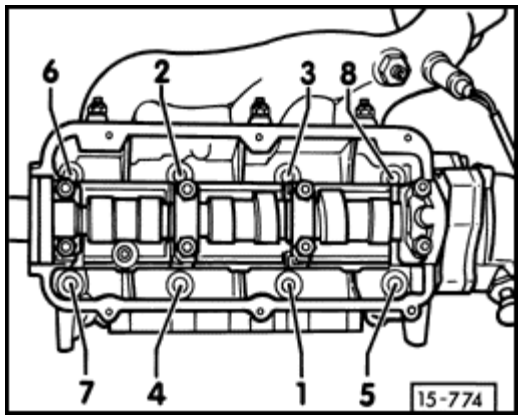
  Lettering on gasket faces toward cylinder head.

- Install cylinder head.

  Pay attention to centering pins in cylinder block.

- Install cylinder head bolts and tighten by hand.

Tightening



- Tighten cylinder head bolts in two stages:
  - Stage 1 60 Nm (44 ft lb)
  - Stage 2 additional 1/2-turn (180°)

Note:

- *For final 1/2-turn, two 1/4-turns (90°) are also permissible if tightening with a fixed wrench.*
- *It is not necessary to retighten the cylinder head bolts after repairs, or*

as part of maintenance service.

Compression pressure, checking

- Engine warm-oil temperature at least 30 ° C (86 ° F)
- Throttle valve fully open during cranking

- Disconnect harness connectors from ignition coil power output stage and from all six fuel injectors.

- Use compression pressure recorder VAG 1381 together with adapter 1381/5 or equivalent to measure compression.

Note:

Refer to operating instructions for use of the recorder.

- Operate starter until tester shows no additional increase in pressure.

Compression pressures

- New: 9-14 bar (131-203 psi)
- Wear limit: 7.5 bar (109 psi)

- Max. permissible pressure difference between all cylinders: 3 bar (44 psi)

CAUTION!

If the test values are not within the specifications, recheck compression pressure after a test drive.

15-19

Camshaft, removing and installing

Removing

- Removing ribbed drive belt ⇒ page 13-9 .
- Remove toothed camshaft drive belt ⇒ page 13-11 .
- Remove cylinder head cover.

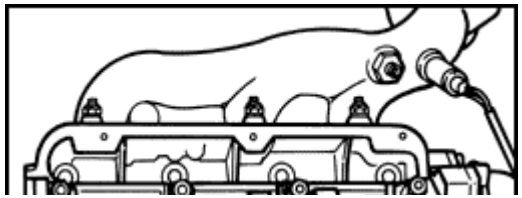
Left side:

- Remove housing for camshaft position sensor.

Right side:

- Remove plug/cover on cylinder head.

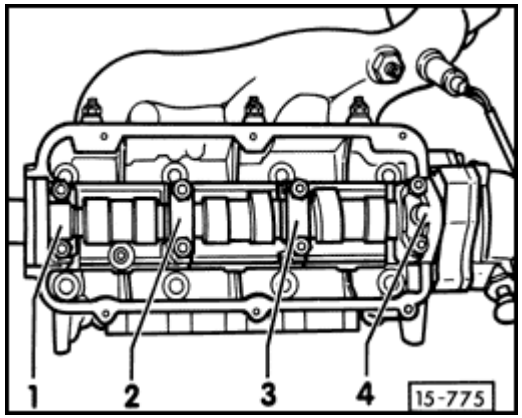
- Remove toothed belt camshaft sprocket.



- Remove camshaft bearing caps -2- and -3-.
- Gradually and evenly loosen nuts for bearing caps -1- and -4-, alternating in diagonal sequence.

CAUTION!

DO NOT allow bearing caps to become mixed up. Identify as necessary using a felt marker.



Installing

- Install bearing caps -1- and -4-.

  Gradually and evenly tighten bearing cap nuts, alternating in diagonal sequence.

- Install bearing caps -2- and -3-.

Tightening torque: 17 Nm (15 ft lb)

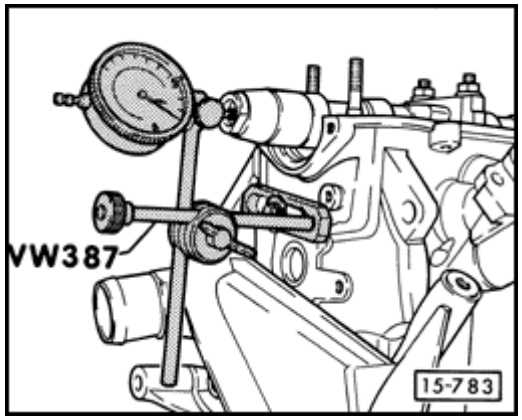
CAUTION!

- ***After installing new or re-installing old lifters, and after installing the camshaft(s), the engine must not be started for at least 30 minutes. Otherwise the valves could strike the pistons.***
- ***After working on the valve train and lifters, crank the engine carefully by hand, at least two full revolutions, to make sure that the valves do not strike the pistons.***

15-21

Camshaft axial play, checking

- Housing for camshaft position sensor removed
- Hydraulic lifters removed
- Camshaft bearing caps 2 and 4 removed



- Mount dial indicator in holder VW 387 on front end of cylinder head.
- Push camshaft by hand against dial indicator.
- Set dial gauge to zero.
- Push camshaft away from dial indicator.
- Read axial play on gauge.

Specifications:

- New: 0.04-0.15 mm (0.0016-0.0059 in.)
- Wear limit: 0.35 mm (0.0138 in.)

Hydraulic valve lifters, checking

Note:

- *Irregular valve noise during cranking is normal.*
- *Do not interchange hydraulic lifters. If necessary mark them when they are being removed.*
- *Place lifters that have been removed on a clean surface with the contact surface (camshaft end) facing downward.*
- *Hydraulic lifters cannot be repaired or adjusted. Faulty lifters must be replaced.*

- Start and run engine until warm-until radiator coolant fan has come on at least once.

- Increase engine speed to approx. 2500 RPM for 2 minutes

If the irregular valve noise stops and then re-occurs again each time vehicle is used in stop and go traffic:

- Replace the oil check valves ⇒ Repair Group

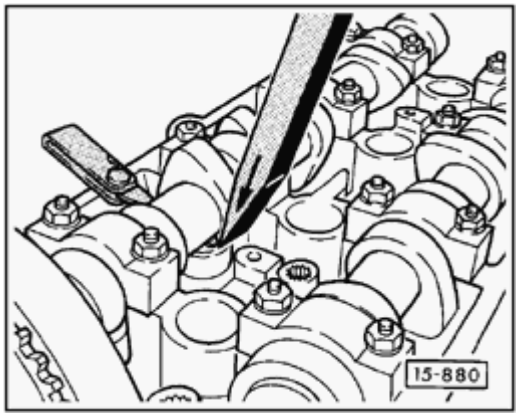
17.

If the irregular noise does NOT stop, locate faulty hydraulic lifter as follows:

- Remove cylinder head cover.

- Turn crankshaft clockwise until cam lobe for lifter being checked is pointing upward.

15-23



- Use a wooden or plastic wedge to press valve lifter down.

- If a 0.20 mm (0.008 in.) feeler gauge can be inserted between camshaft and lifter, replace lifter.

CAUTION!

- ***After installing new or re-installing old lifters, and after installing the camshaft(s), the engine must not be started for at least 30 minutes. Otherwise the valves could strike the pistons.***
- ***After working on the valve train and lifters, crank the engine carefully by hand, at least two full revolutions, to make sure that the valves do not strike the pistons.***

Note:

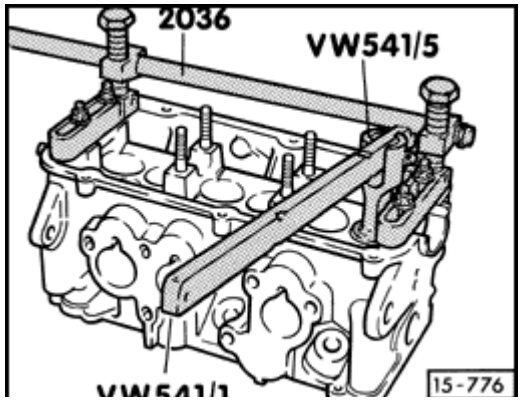
The illustration is used to show an example of pressing down on the lifter checking the clearance with a feeler gauge-it does not specifically show the 2.8 liter V6 engine.

15-24

Valve stem oil seals, replacing

Cylinder head installed

- Remove toothed camshaft drive belt ⇒ page 13-11 .
- Remove camshafts and hydraulic lifters.
- Remove spark plugs.
- Rotate crankshaft by hand to set piston of appropriate cylinder to Bottom Dead Center (BDC).
- Thread VW 653/3 hose, US 1106 cylinder leakdown tester or equivalent with seal into spark plug hole by hand and apply a continuous pressure of at least 6 bar (87psi).



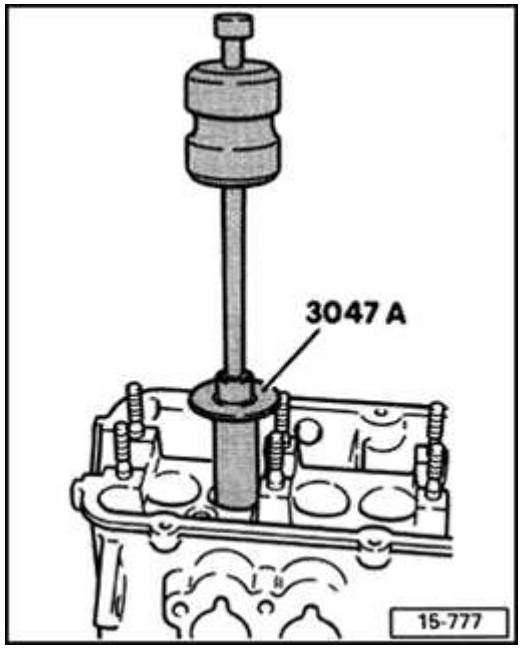
- Install compressor tool 2036 and adjust to height of studs.
- Remove valve spring with valve spring tensioner VW 541/1 and thrust pad VW 541/5 or equivalent.

Note:

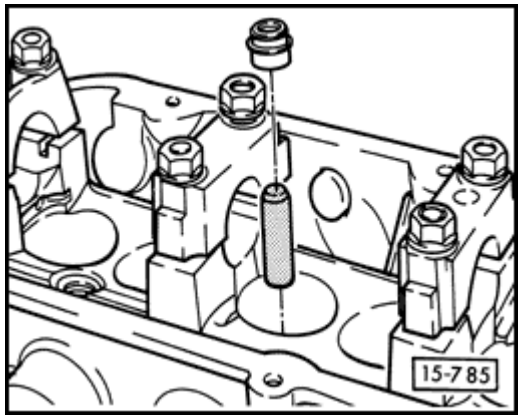
Tight valve keepers can be loosened by tapping lightly on lever VW 541/1 with a hammer.

- Remove valve springs.

15-25



- Remove valve stem oil seal with slide hammer 3047 A.
- Install new valve stem oil seal.



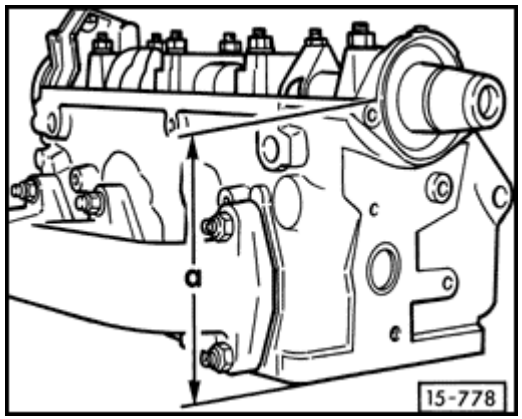
- Fit protective sleeve over valve stem, slide seal carefully onto valve guide.

Note:

Always use the enclosed plastic sleeve for installation of valve stem oil seals to protect the seal from being damaged by the valve keeper grooves.

15-26

Cylinder head, resurfacing



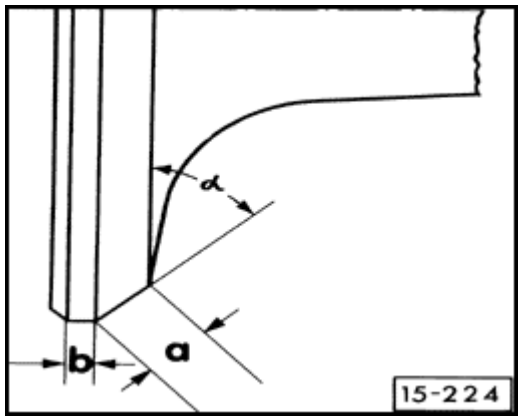
- Minimum dimension -a- = 132.75 mm (5.226 in.)

15-27

Intake and exhaust valves, checking and refacing

Checking

- Inspect visually for scoring on valve stem and valve seat surfaces. If clear signs of wear are present replace valves.



Refacing intake valve

α - 45°

a - max 3.5 mm (0.138 in.)

b - min. 0.5 mm (0.020 in.)

Refacing exhaust valves

WARNING!

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

15-28

WARNING!

Worn sodium-filled exhaust valves must not be scrapped without properly disposing of the sodium.

- ***The valves must be cut into two parts with a hacksaw between the center of the valve stem and the valve head. They must not come into contact with water when being cut open.***

After cutting the valves:

- ***Throw the valves, not more than ten at a time, into a bucket filled with water and STAND BACK. A sudden chemical reaction occurs as the sodium comes into contact with the water.***

- ***Valves that have been processed in this way can then be disposed of in the normal waste.***

Valve guides, checking and replacing

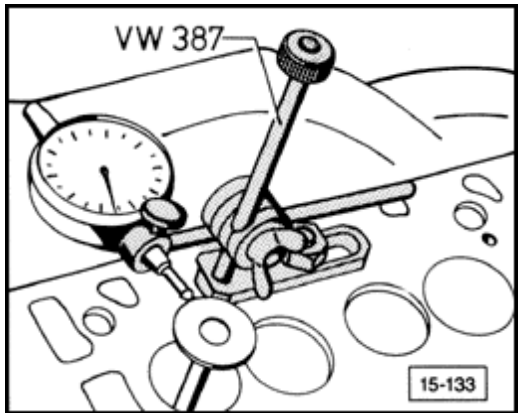
Checking

When repairing engines with low compression due to leaking valves, it is not sufficient to reface or replace the valve seats and valves. It is also necessary to check the valve guides for wear. This is particularly important when checking engines with high mileage.

- Insert new valve into guide until end of valve stem is flush with end of guide.

CAUTION!

Due to the difference in valve stem diameters, make sure that only an intake valve is used to check intake valve guides, and that only an exhaust valve is used to check the exhaust valve guides.



- Determine valve rock-amount that valve can move side-to-side.

Wear limit

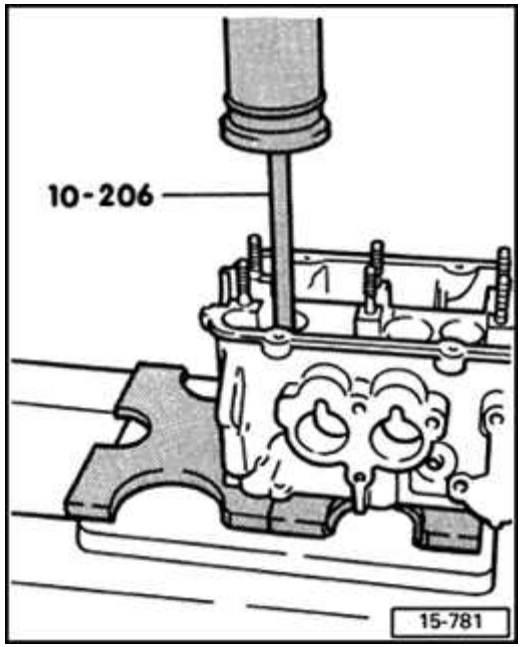
- Intake valve guide 1.0 mm (0.039 in.)
- Exhaust valve guide 1.3 mm (0.051 in.)

15-30

Replacing

CAUTION!

Cylinder heads with valve seats that can no longer be refaced, or which have already been machined to the minimum dimension, should no longer be repaired.



- Press out worn valve guides from camshaft side using drift 10-206. (Replacement guides with shoulder must be pressed out from combustion chamber side.)
- Coat new guides with oil and, using drift 3121, press into cold cylinder head from camshaft side until shoulder makes contact.

CAUTION!

When the shoulder on the new guide makes contact, the pressing force must not exceed 1.0 ton or the guide shoulder could break off.

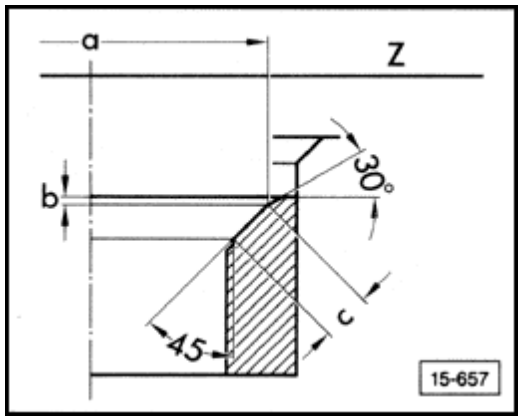
- Use 7mm reamer 3120 to ream new valve guides to size, using plenty of cutting fluid.

15-31

Valve seats, refacing

Note:

- *Pay attention to the cylinder head minimum dimension when refacing valve seats ⇒ page 15-32*
- *Only reface valve seats enough to produce perfect contact.*
- *Before refacing, calculate the maximum permissible refacing dimension. If this dimension is exceeded, correct functioning of hydraulic valve lifters can no longer be guaranteed and the cylinder head must be replaced.*



Intake valve seat

a - Diameter: 39.2 mm (1.543 in.)

b - Max. permissible refacing dimension[1)]

c - Seat width: 2.0 mm (0.079 in.)

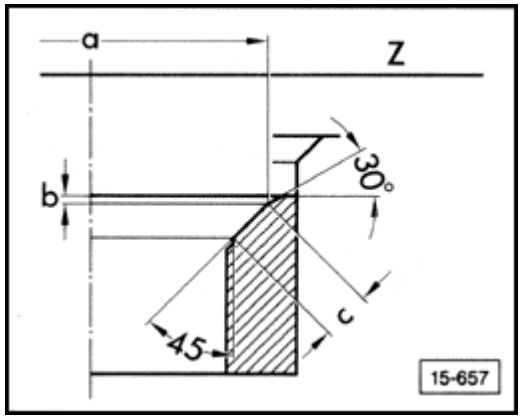
30° - Upper correction angle

45° - Valve seat angle

Z - Bottom surface of cylinder head

[1)] Calculating max. permissible refacing dimensions ⇒ page 15-32

15-32



Exhaust valve seat

a - Diameter: 32.4 mm (1.276 in.)

b - Max. permissible refacing dimension[1)]

c - Seat width: 2.4 mm (0.094 in.)

30 ° - Upper correction angle

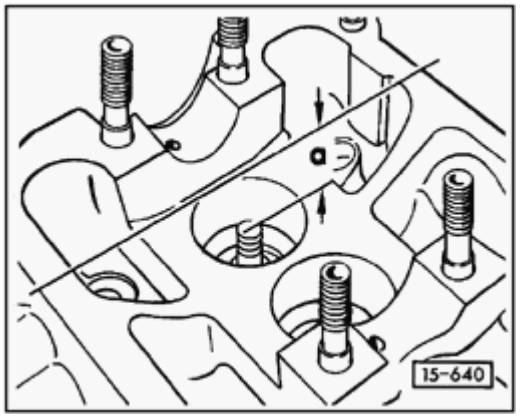
45 ° - Valve seat angle

Z - Bottom surface of cylinder head

[1)] Calculating max. permissible refacing dimensions ⇒ page 15-32

Maximum permissible refacing dimension, calculating

- Insert valve into guide and press firmly against valve seat.



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

The maximum permissible refacing dimension is the difference between the actual distance measured at the cylinder head and the specified minimum dimension.

Minimum dimensions

- At intake valve: 33.8 mm (1.331 in.)
- At exhaust valve: 34.1 mm (1.343 in.)

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.*

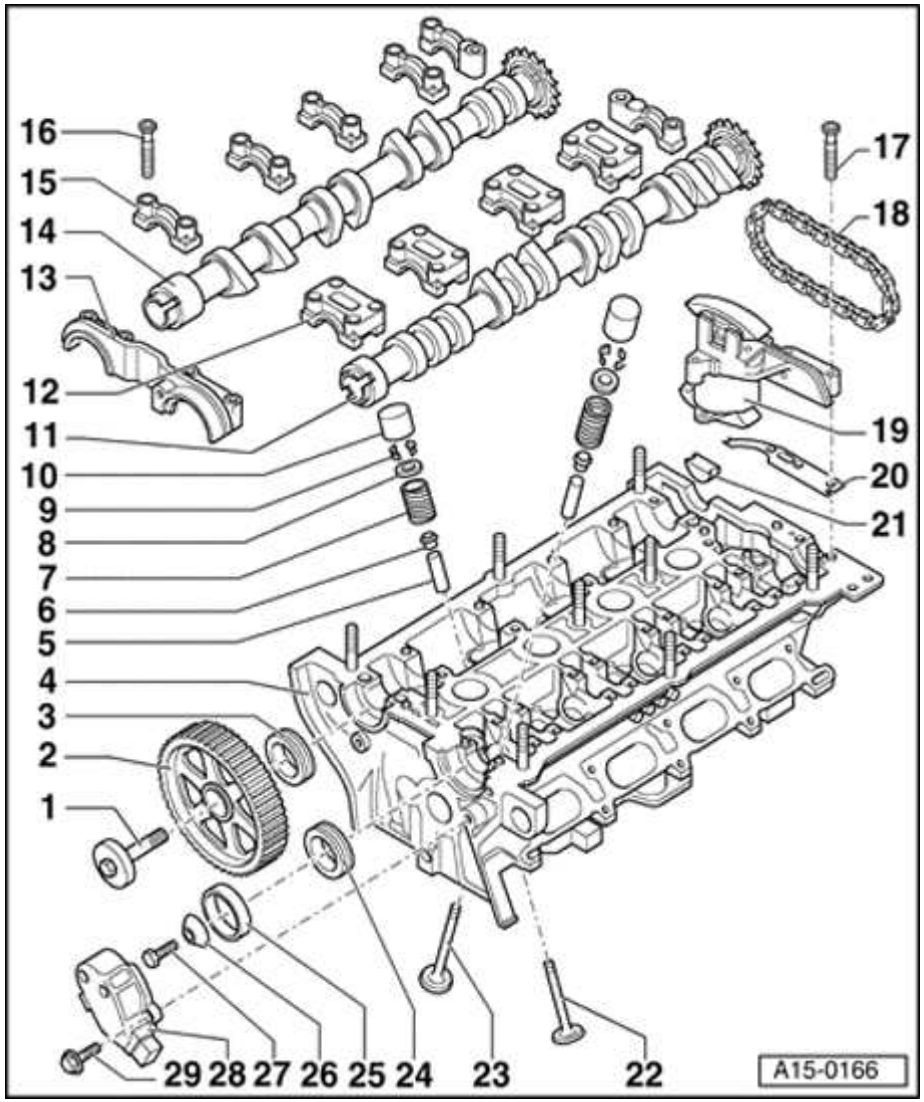
- *Always replace gaskets, seals and O-rings.*

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.***

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

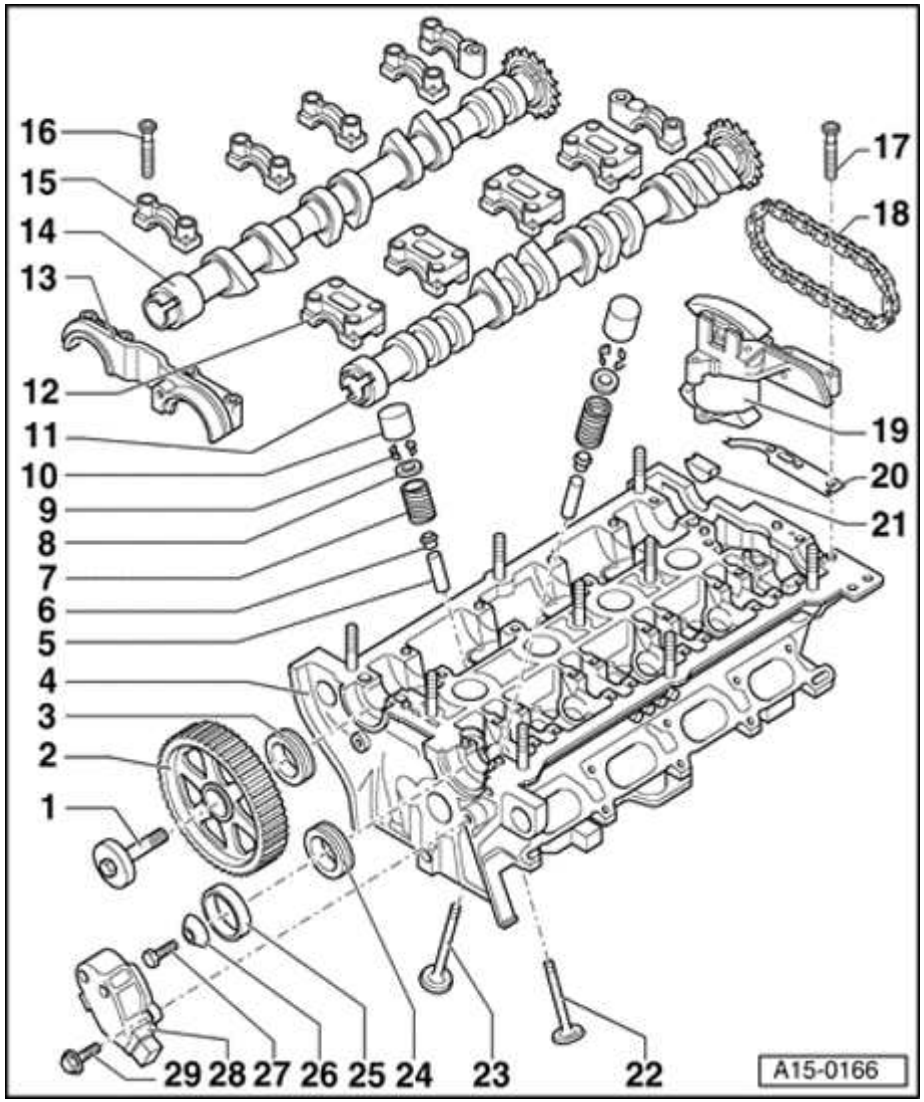
4 - Cylinder head

- 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

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

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

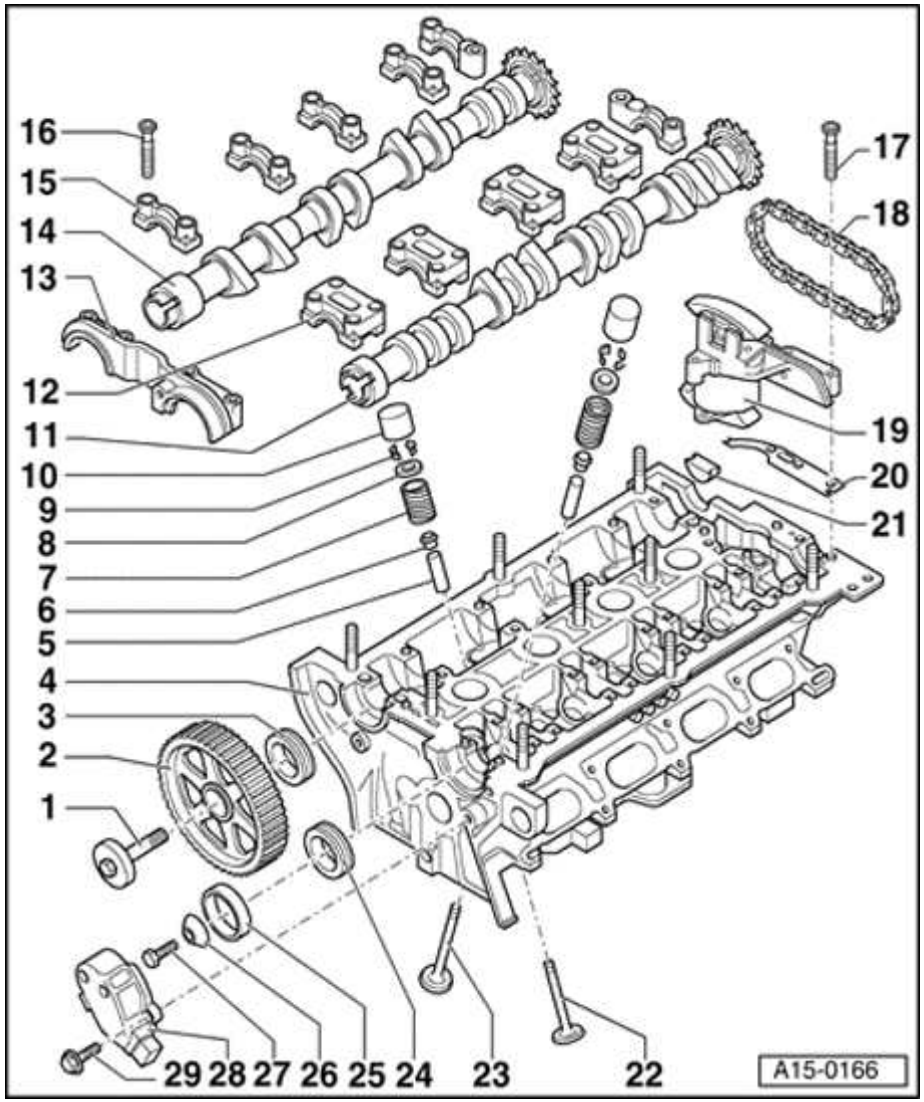
11 - Intake camshaft

- 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

- Camshafts, removing and installing ⇒ Page 15-50

15-35



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

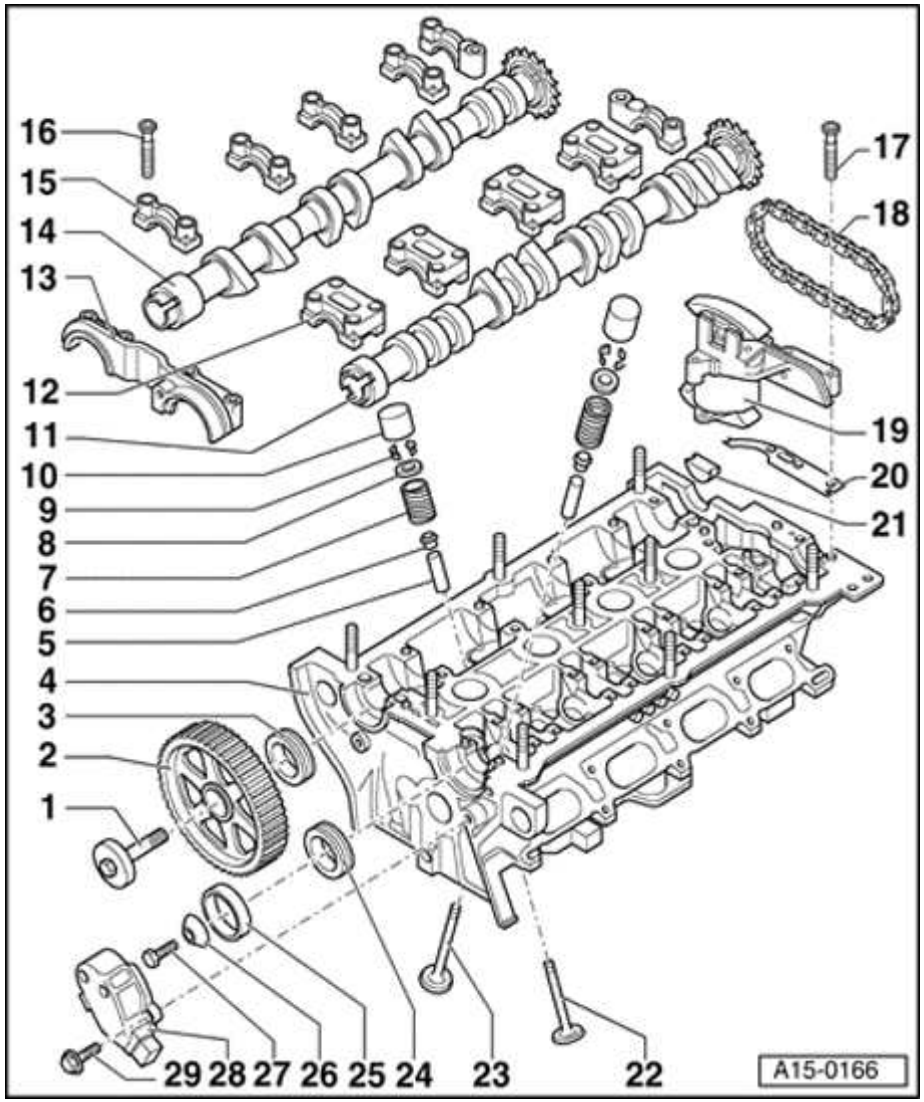
14 - Exhaust camshaft

- 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

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)

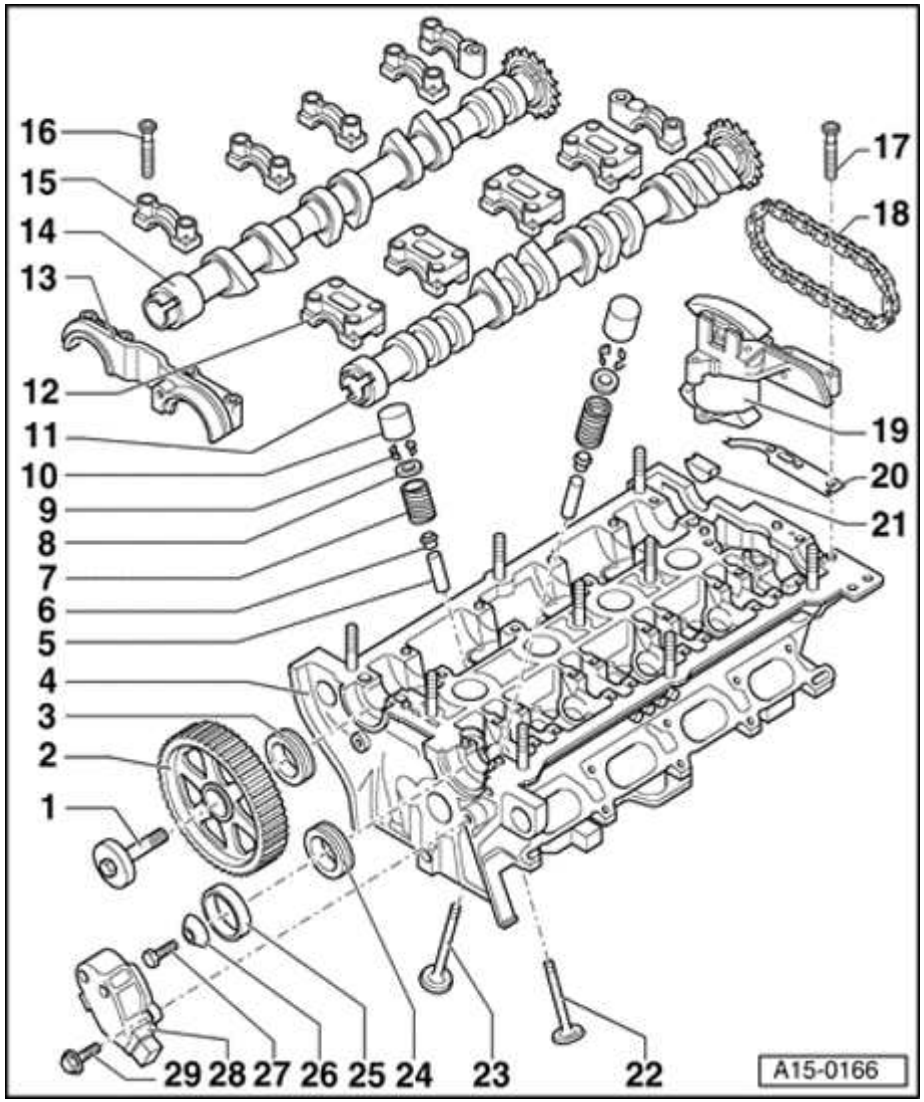
17 - Bolt

- 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

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

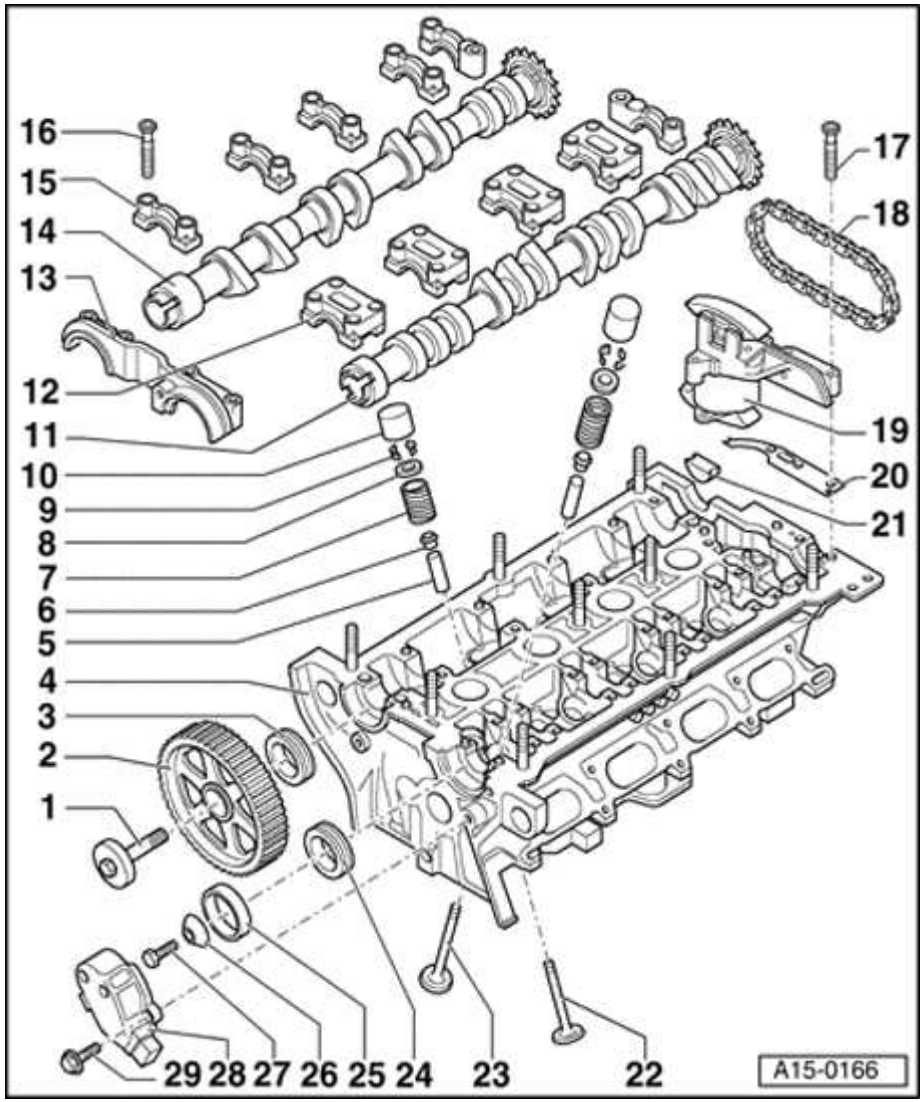
21 - Gasket

- 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

15-38



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)

15-39

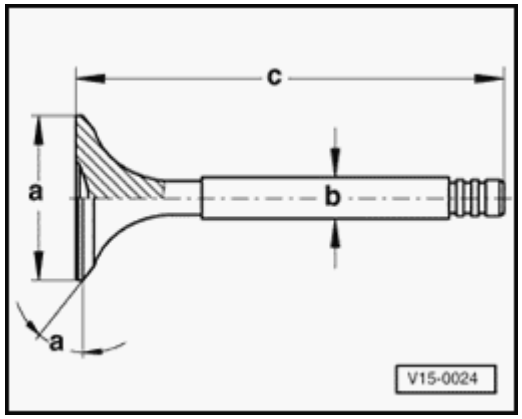


Fig. 1 Valve dimensions

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 °

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.***

15-41

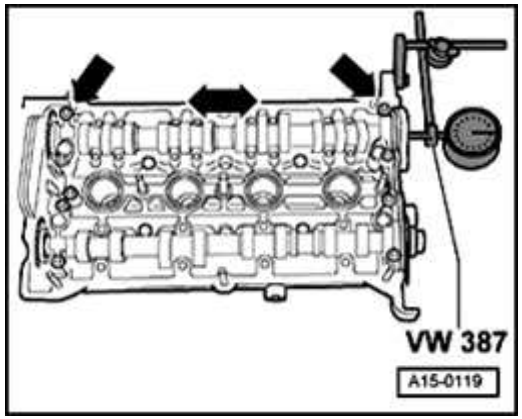
Camshafts axial play, checking

Special tools and equipment

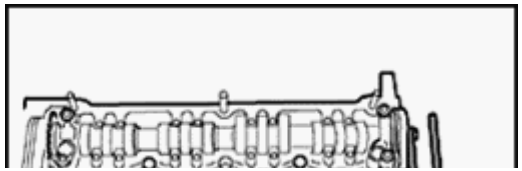
- VW387 dial gauge holder
- Dial indicator

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:

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

15-42

Oil seals for camshafts, replacing

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

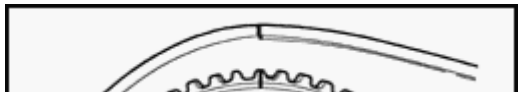
Special tools and equipment

- 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 .



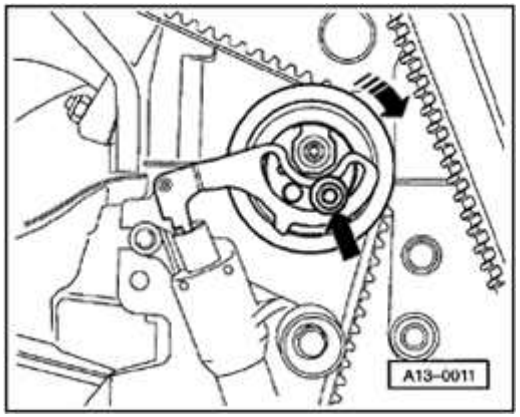
- Turn crankshaft at central bolt of toothed belt gear in direction of

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

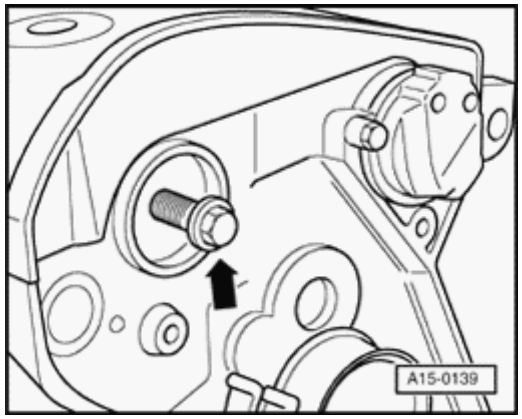
15-43

CAUTION!

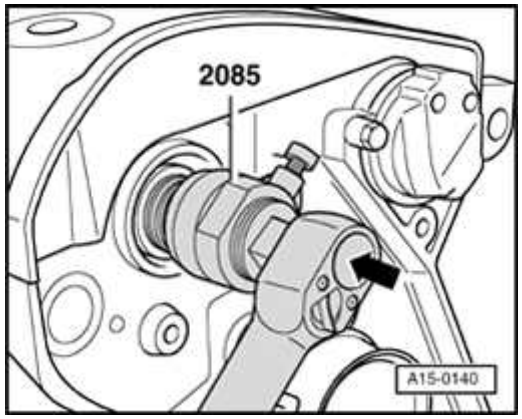
Before removing toothed belt, note direction of rotation with chalk or felt-tip marker. Reversing the direction of rotation of a used belt can destroy the belt.



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



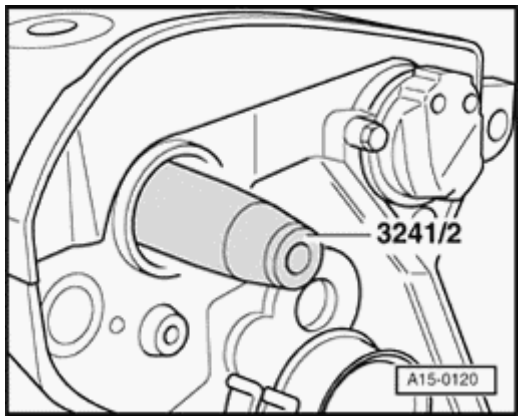
- Thread camshaft gear retaining bolt (arrow) into camshaft by hand until stop to guide 2085 seal puller.
- Unthread inner part of 2085 seal puller two turns (approx. 3 mm or 0.12 in.) and secure using knurled bolt.



- 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.

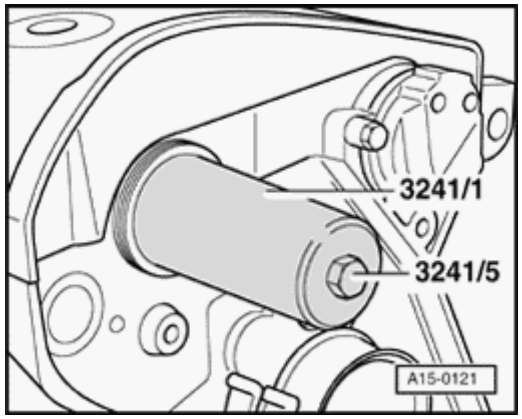
Installing

- Lightly oil lip of oil seal.

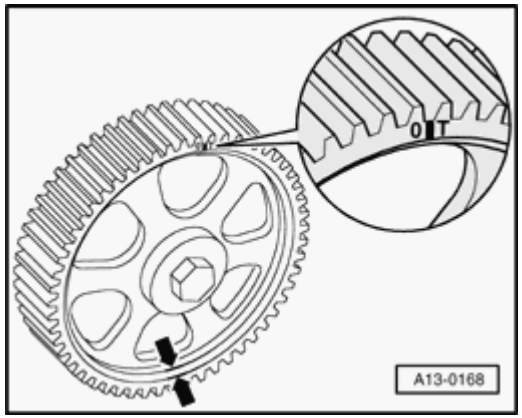


- Place 3241/2 guide sleeve on end of camshaft.
- Slide oil seal over guide sleeve.

15-45



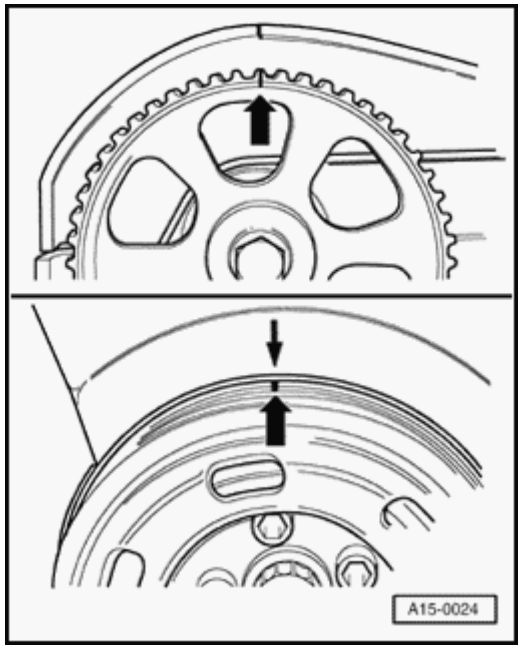
- Using 3241/5 camshaft fitting tool and 3241/1 pressure sleeve, press oil seal in to stop.



- 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.



- 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

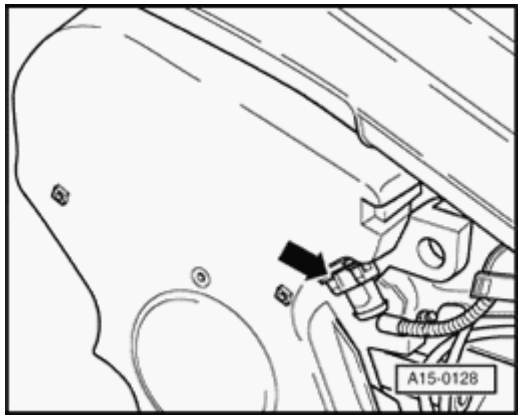
Component	Tightening torques
Camshaft gear to camshaft	65 Nm (48 ft lb)
Ribbed belt tensioner to mounting bracket	25 Nm (18 ft lb)

15-47

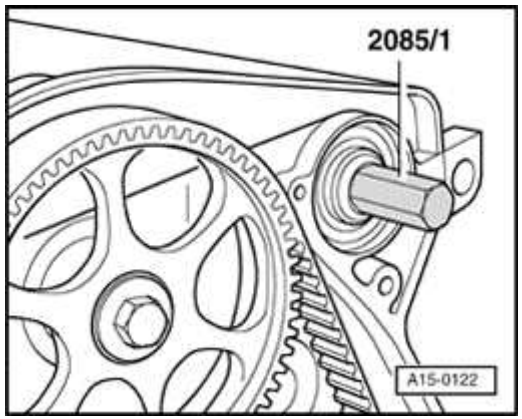
Replacing intake camshaft oil seal

Removing

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

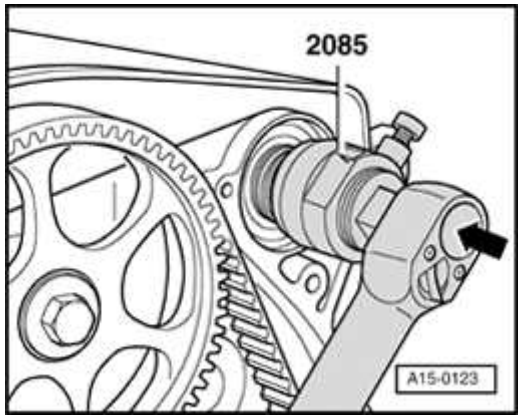


- Disconnect harness connector from Camshaft Position (CMP) sensor -G40-.
- Remove upper toothed belt cover ⇒ Page 13-29 .
- Remove housing for Camshaft Position (CMP) sensor -G40-.
- Remove shutter wheel and washer for Camshaft Position (CMP) sensor -G40-.



- 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.

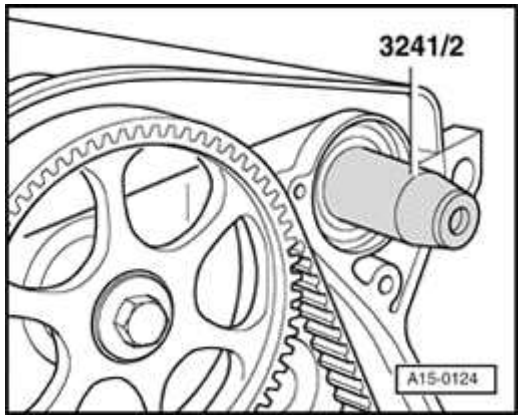
15-48



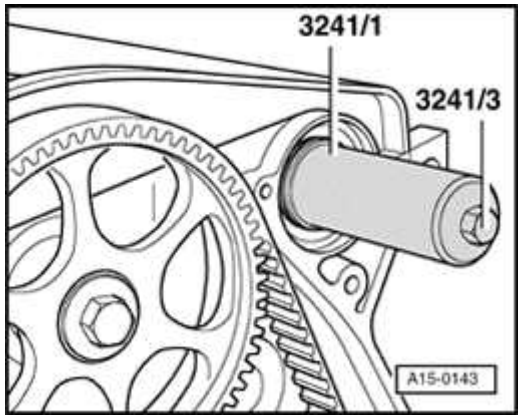
- Grease threaded head of 2085 seal puller, attach and with forced pressure screw into oil seal as far as possible.
- Loosen knurled bolt and turn inner part against crankshaft until oil seal is removed.

Installing

- Lightly oil lip of oil seal.



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



- 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)

15-50

Camshafts and hydraulic chain tensioner, removing and installing

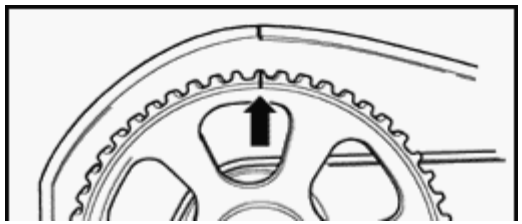
- Cylinder head installed
- Lock carrier in service position ⇒ Page 13-1

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 .

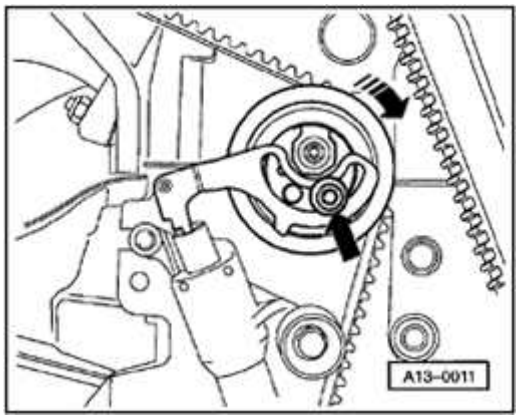


- Turn crankshaft at central bolt of toothed belt gear in direction of engine rotation to TDC Cyl. 1 marking (arrows).
- Remove cylinder head cover ⇒ Page 15-17 .

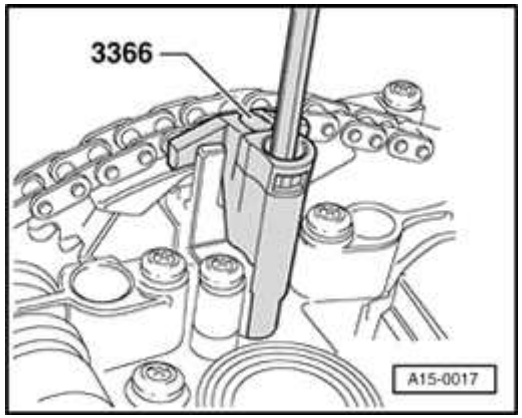
CAUTION!

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.

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-.



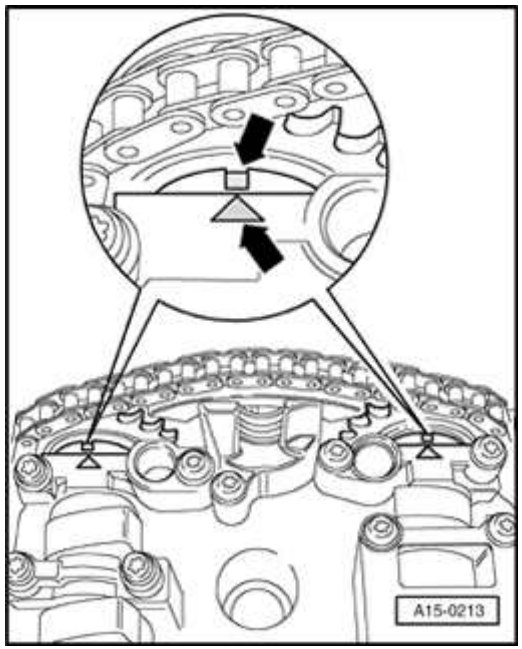
- Secure hydraulic chain tensioner using 3366 bracket-tensioner.

CAUTION!

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

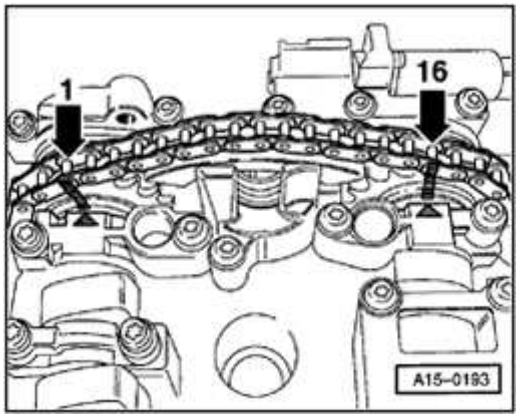
15-52

- 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.

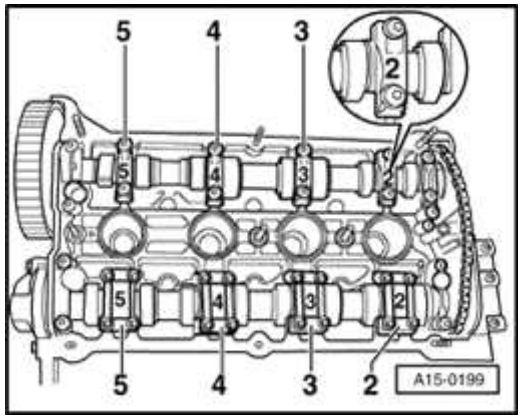


- The distance between the two arrows/paint marks is equivalent to 16 drive chain rollers.
- The notch on the exhaust camshaft is slightly offset inward toward drive chain roller (arrow-1-).

Note:

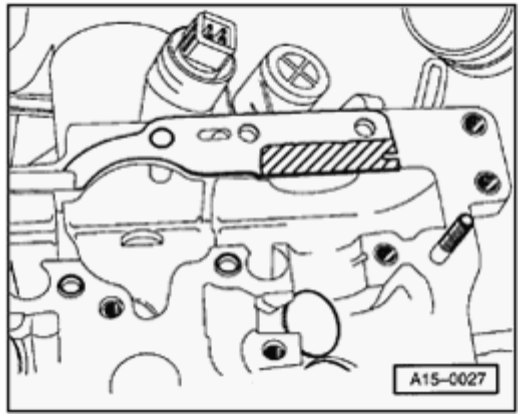
Do not mark chain using punch, filing a notch or similar procedures.

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



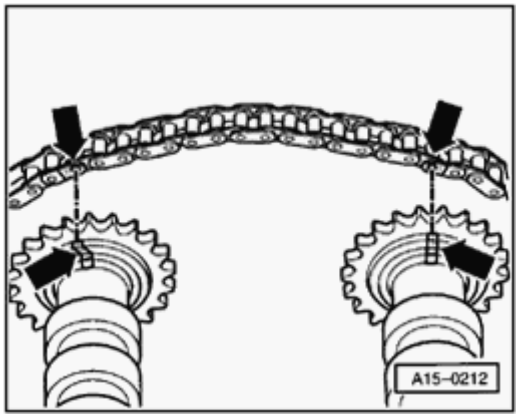
- Replace rubber/metal chain tensioner gasket and spread sealant D 454 300 A2 on hatched surface.

CAUTION!

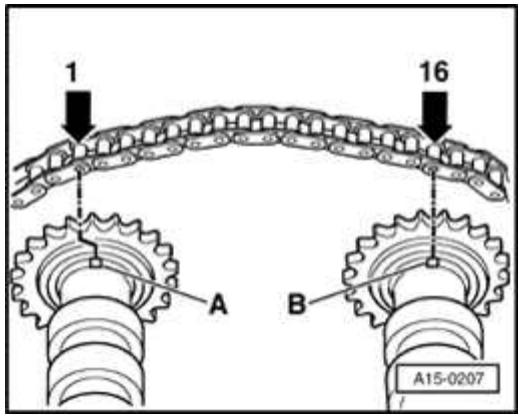
Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

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.

15-55

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

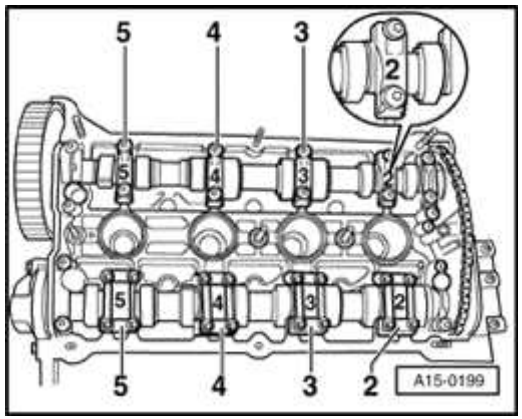
- Oil camshaft contact surfaces.

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.*

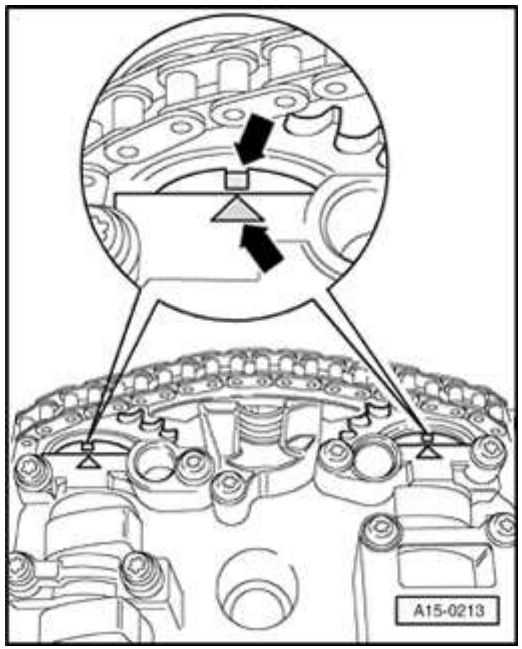
- Tighten hydraulic chain tensioner (pay attention to alignment bushings).



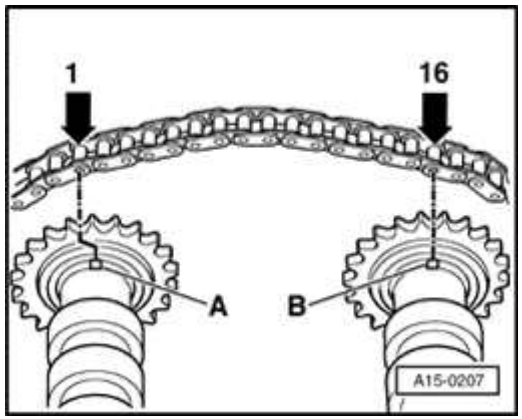
- Tighten bearing caps -2- and -4- of intake and exhaust camshafts in alternating diagonal sequence (pay attention to alignment bushings).
- Install both bearing caps on chain sprockets of intake and exhaust camshafts.

15-56

- Verify correct position of both camshafts.



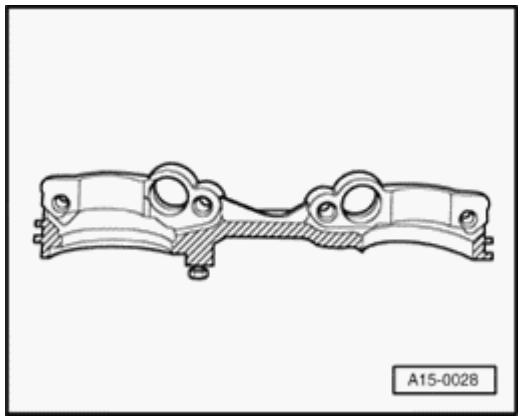
- Both camshaft markings must align with arrows on bearing caps (arrows).



- 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-.

15-57

- Remove 3366 bracket-tensioner.

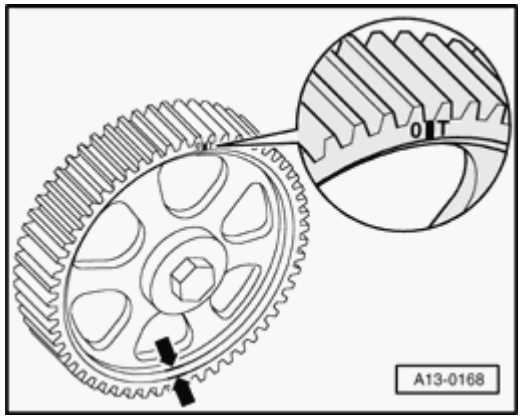


- Lightly coat hatched surface of double bearing cap with sealant D 454 300 A2 and install bearing cap (pay attention to alignment bushings).

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 .

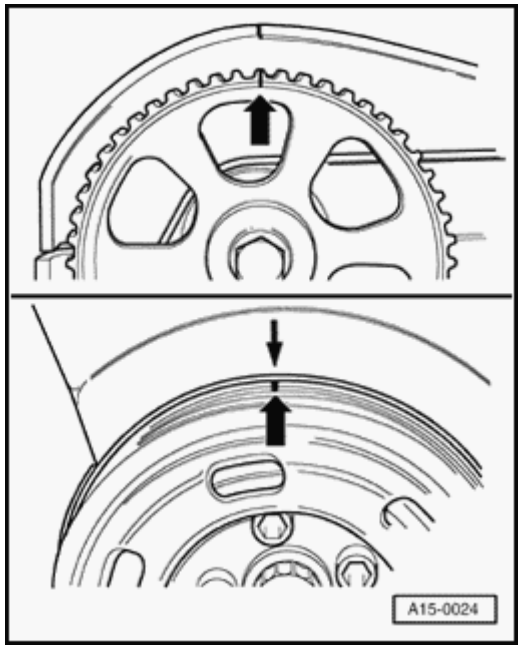


- Install camshaft gear.

  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 .

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.

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)

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

valve lifter as follows:

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

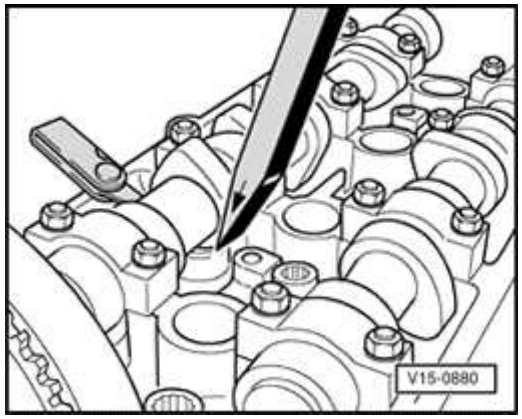
Vehicles with manual transmission

- 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.***

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

spark plugs.

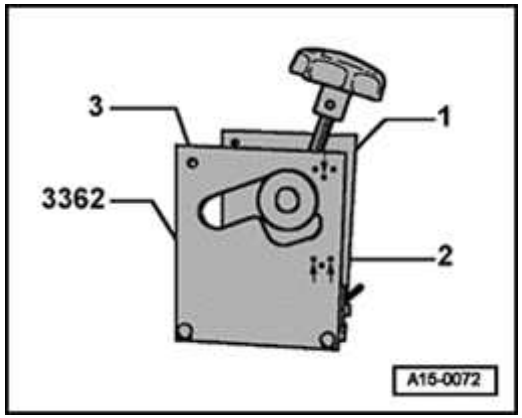
- Move piston for individual cylinder to Bottom Dead Center (BDC) position.

15-63

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

Note:

Lightly tap valve spring retainer to loosen stuck valve keepers.

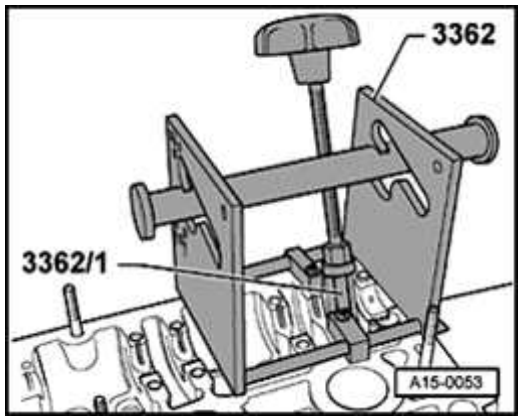


Intake and exhaust valves have different installation angles in cylinder head. 3362 valve spring tool can be used in two different positions:

1 - Top position for the center intake valve

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

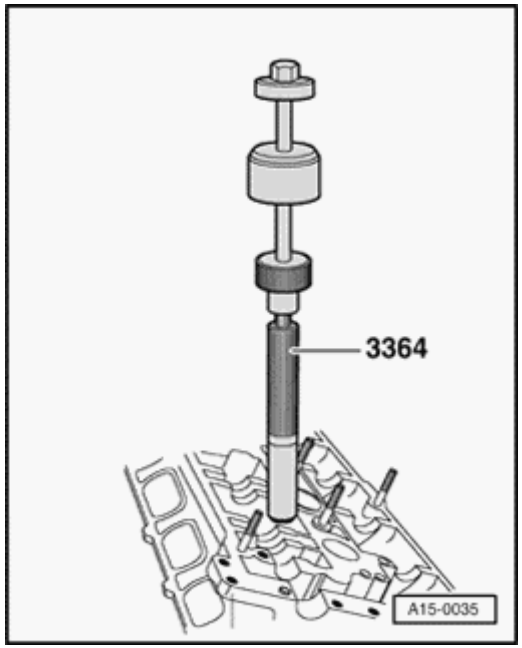
3 - Threaded bores with M6 x 25 retaining bolts on the left and right are used to secure the lower bracket to cylinder head



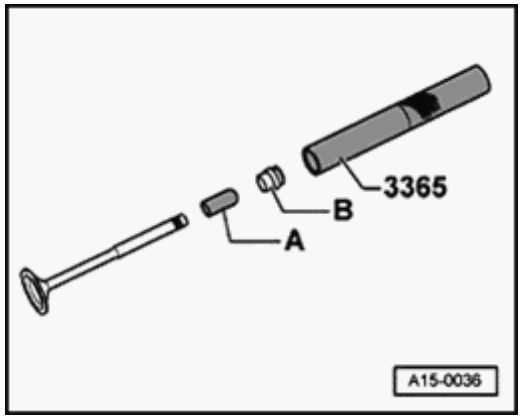
- Using retaining bolts bolted into tool, secure 3362 valve spring tool to cylinder head.
- Adjust tool to correct position for corresponding valve.
- Attach pressure hose to compressor.

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

15-64



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



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!

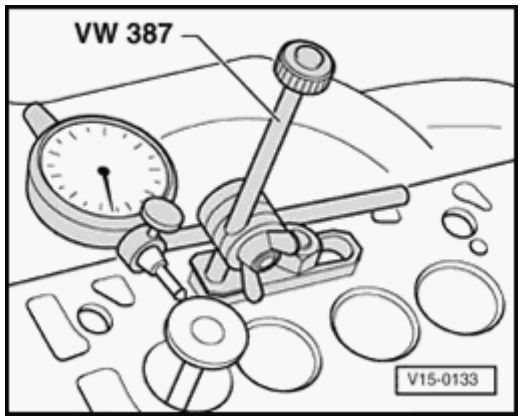
- ***After installing the camshafts, the engine must not be started for approx. 30 minutes. The hydraulic valve lifters have to settle (otherwise valves will strike the pistons).***
- ***After installing the valvetrain and lifters, carefully rotate the crankshaft by hand at least 2 full revolutions before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

15-66

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.*

Valve guides, replacing

Special tools and equipment

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

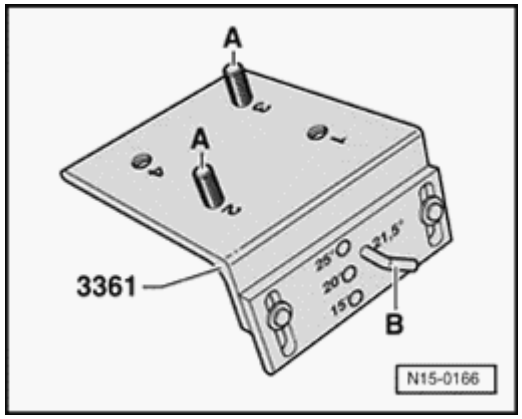
Removing

- Clean cylinder head and check.

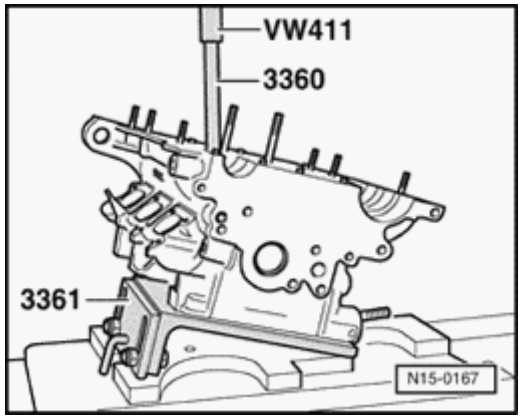
Note:

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.

15-68



- 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

15-69

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 .

15-70

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.***

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*

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

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.

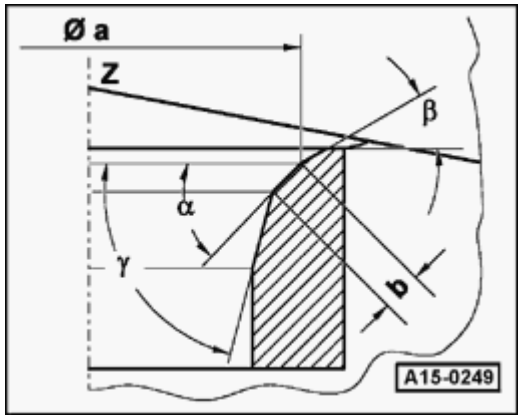
Minimum dimensions		
Outer intake valves	Center intake valve	Exhaust valves
34.0 mm (1.338 in.)	33.7 mm (1.236 in.)	34.4 mm (1.354 in.)

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.



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

Valve gear, servicing

Note:

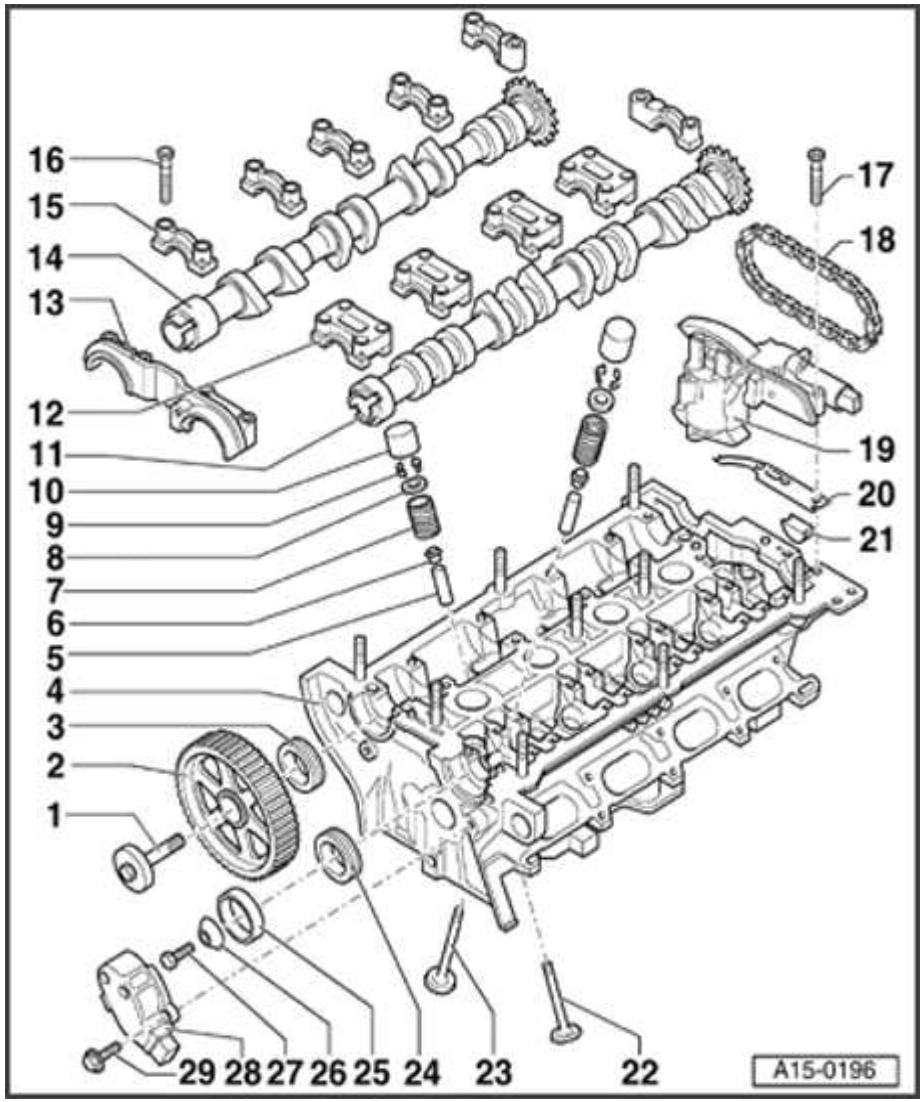
- *Cylinder heads that have cracks between the valve seats or between valve seat inserts and the spark plug thread can be used further without reducing service life, provided the cracks do not exceed a maximum of 0.3 mm in width, or when no more than the first 4 turns of the spark plug threads are cracked.*

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

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

- *Replace all gaskets and seals.*

15-38



1 - 65 Nm

- Counterhold with 3036 to loosen and tighten

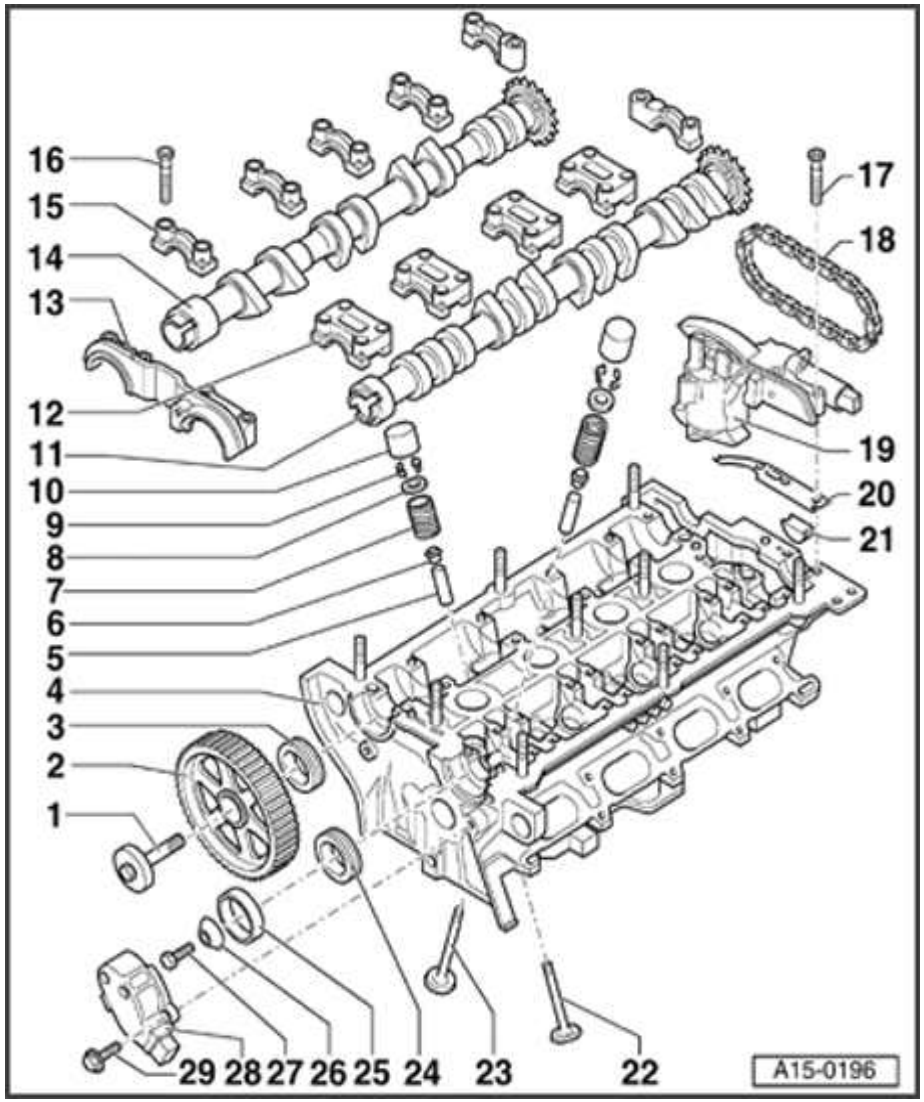
2 - Camshaft sprocket

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

3 - Sealing ring

- For exhaust camshaft
- Replacing ⇒ Page 15-50

15-39



4 - Cylinder head

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

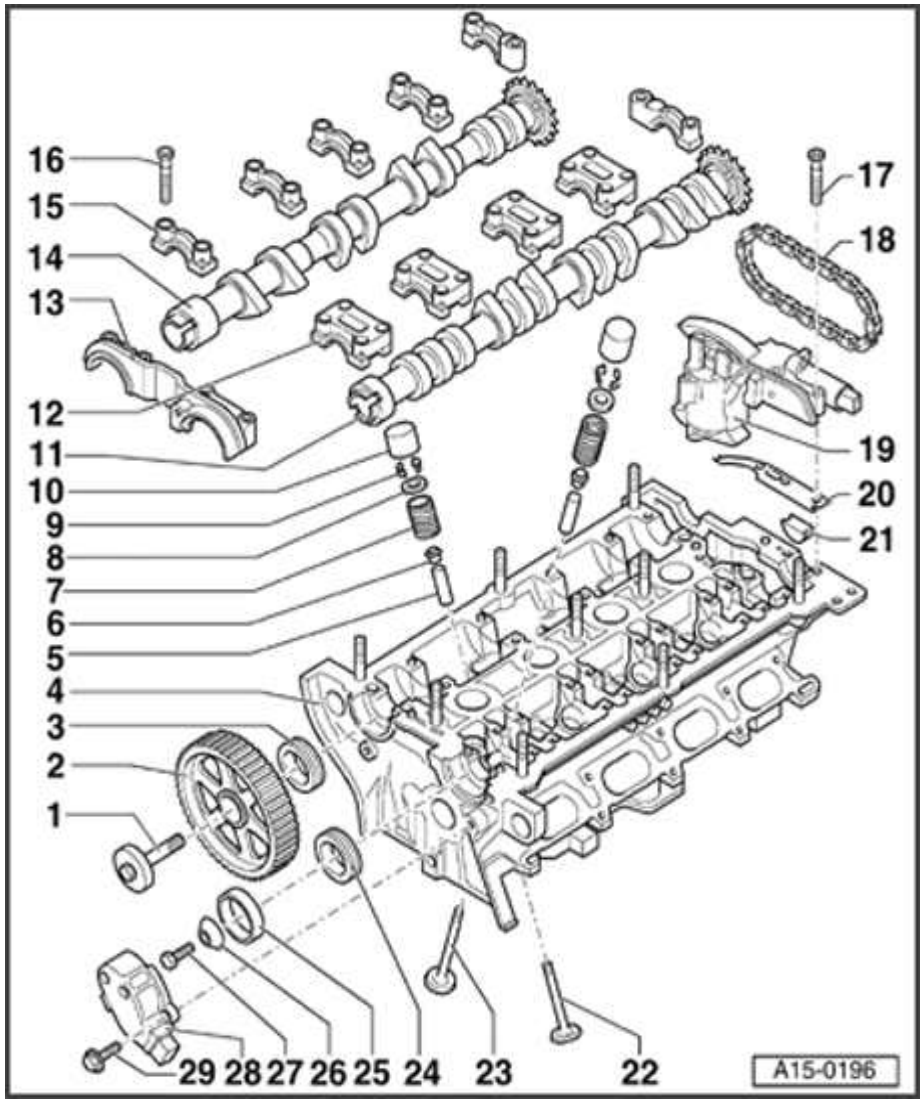
5 - Valve guide

- Checking ⇒ Page 15-86

6 - Valve stem seal

- Replacing ⇒ Page 15-77

15-40



7 - Valve springs

- Removing and installing ⇒ Page 15-77

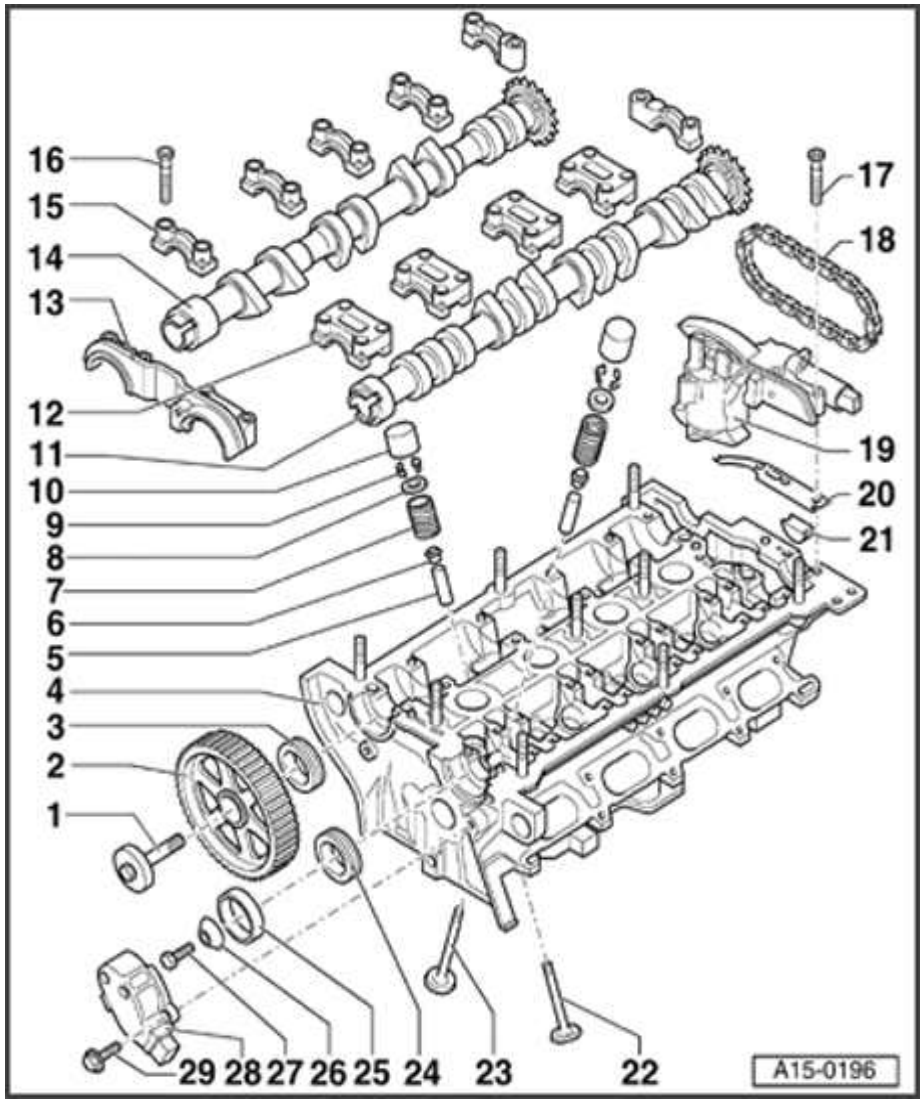
8 - Valve spring plate

9 - Valve keepers

10 - Hydraulic valve lifter

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

15-41



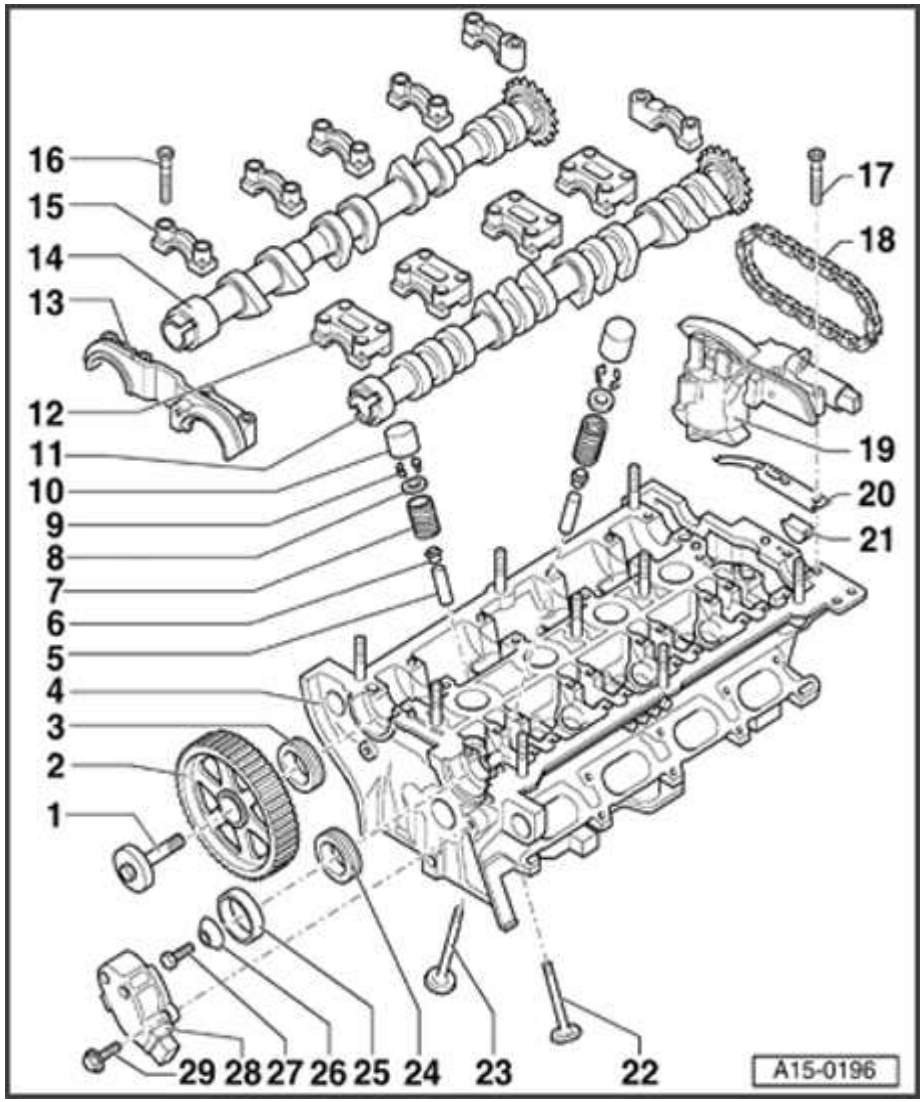
11 - Intake camshaft

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

12 - Bearing cap for intake camshaft

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

15-42



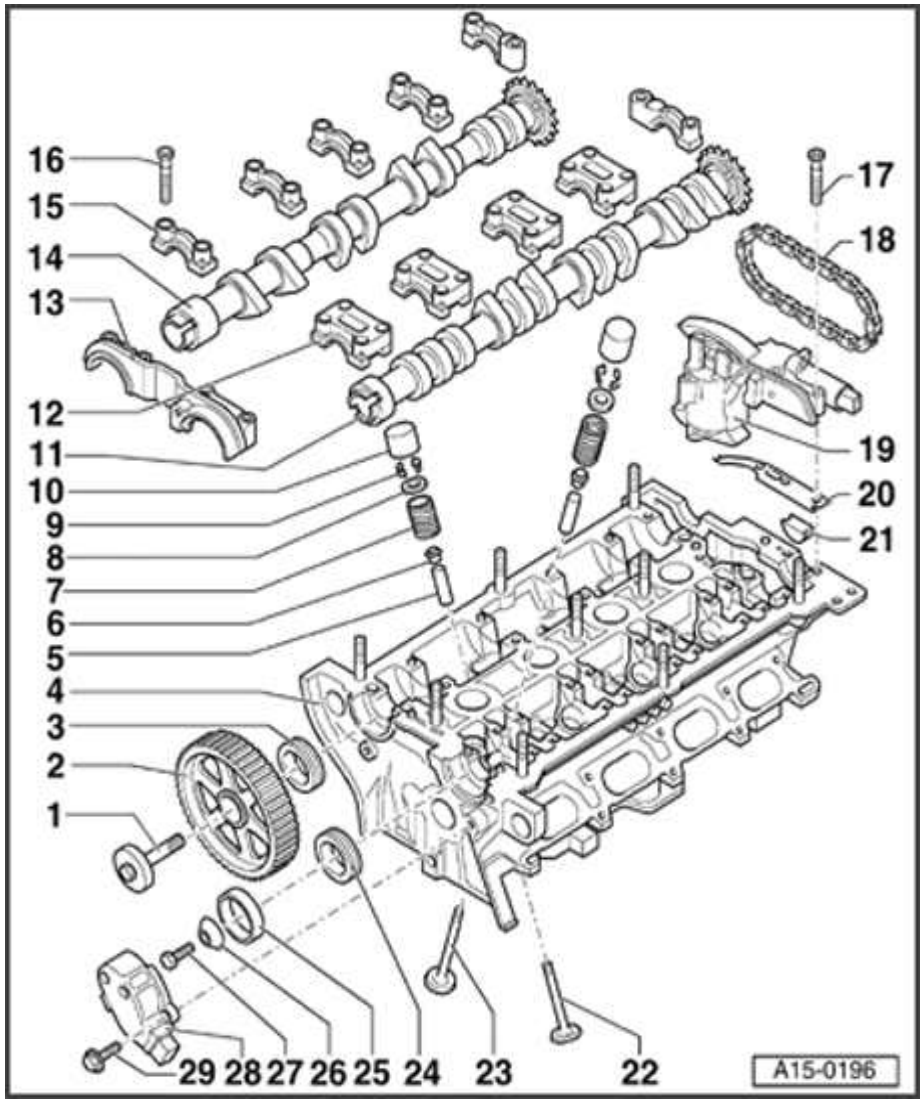
13 - Double bearing cap

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

14 - Exhaust camshaft

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

15-43



15 - Bearing cap for exhaust camshaft

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

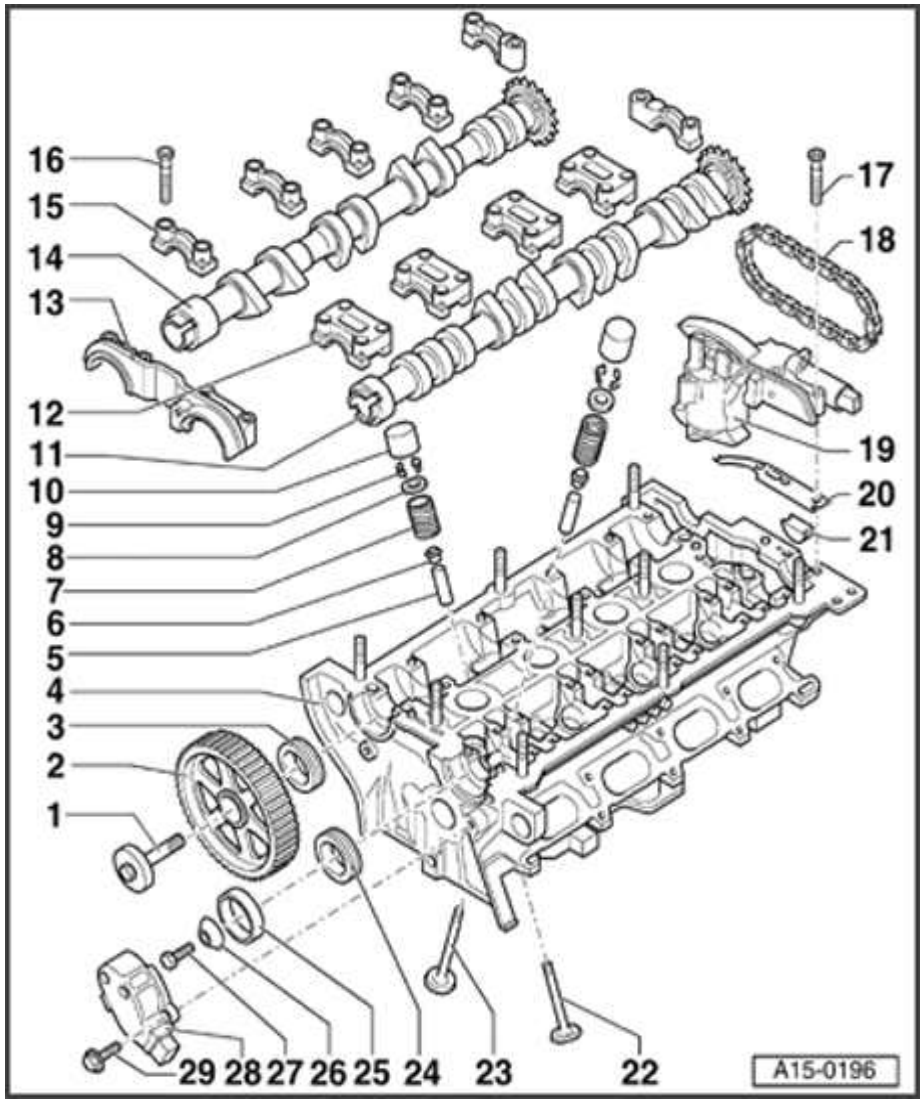
16 - 10 Nm

17 - 10 Nm

18 - Drive chain

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

15-44



19 - Camshaft adjuster

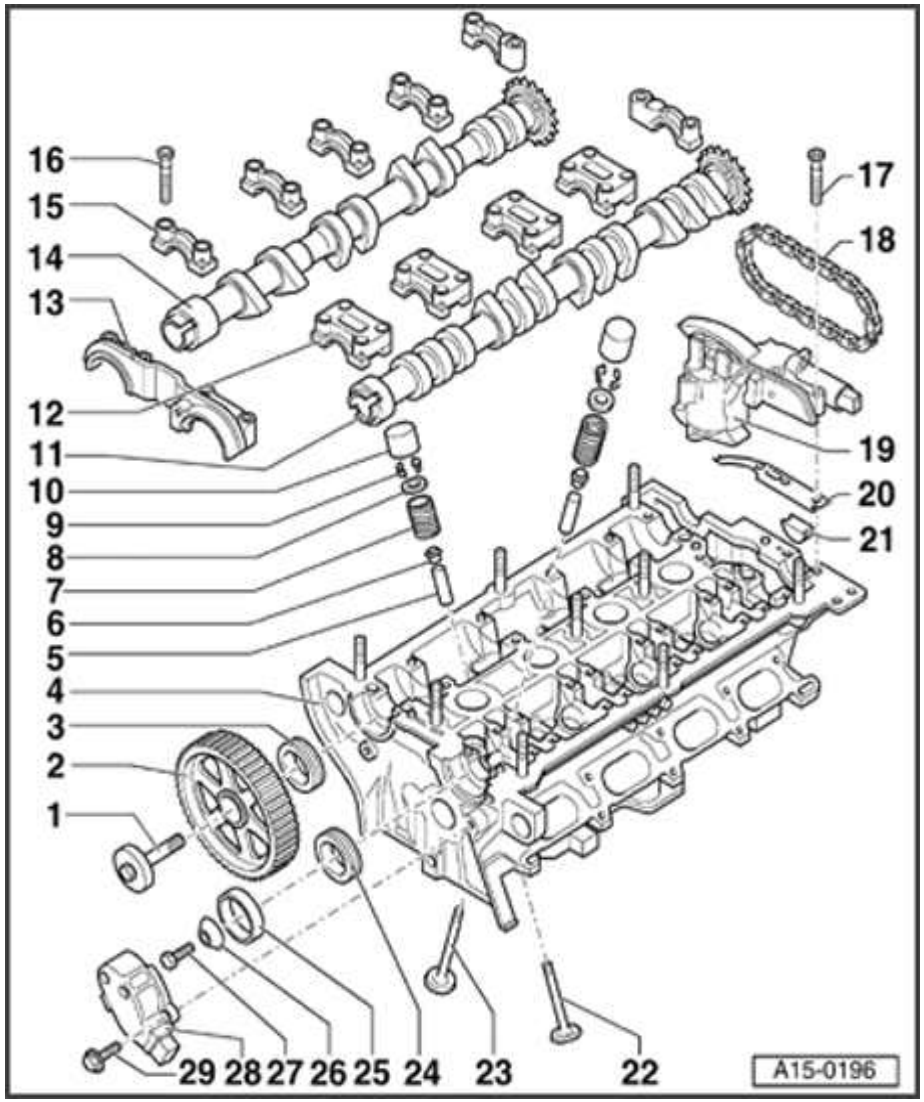
- With solenoid valve for camshaft adjustment -N205-
- Checking ⇒ Page 15-92
- Hold in position with retainer for chain tensioner 3366 before removing
- Removing and installing ⇒ Page 15-62
- Seal sides of joints between camshaft adjuster and cylinder head ⇒ Fig. ⇒ 4 , ⇒ Page 15-8

20 - Metal/rubber gasket

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

21 - Gasket

- Always replace



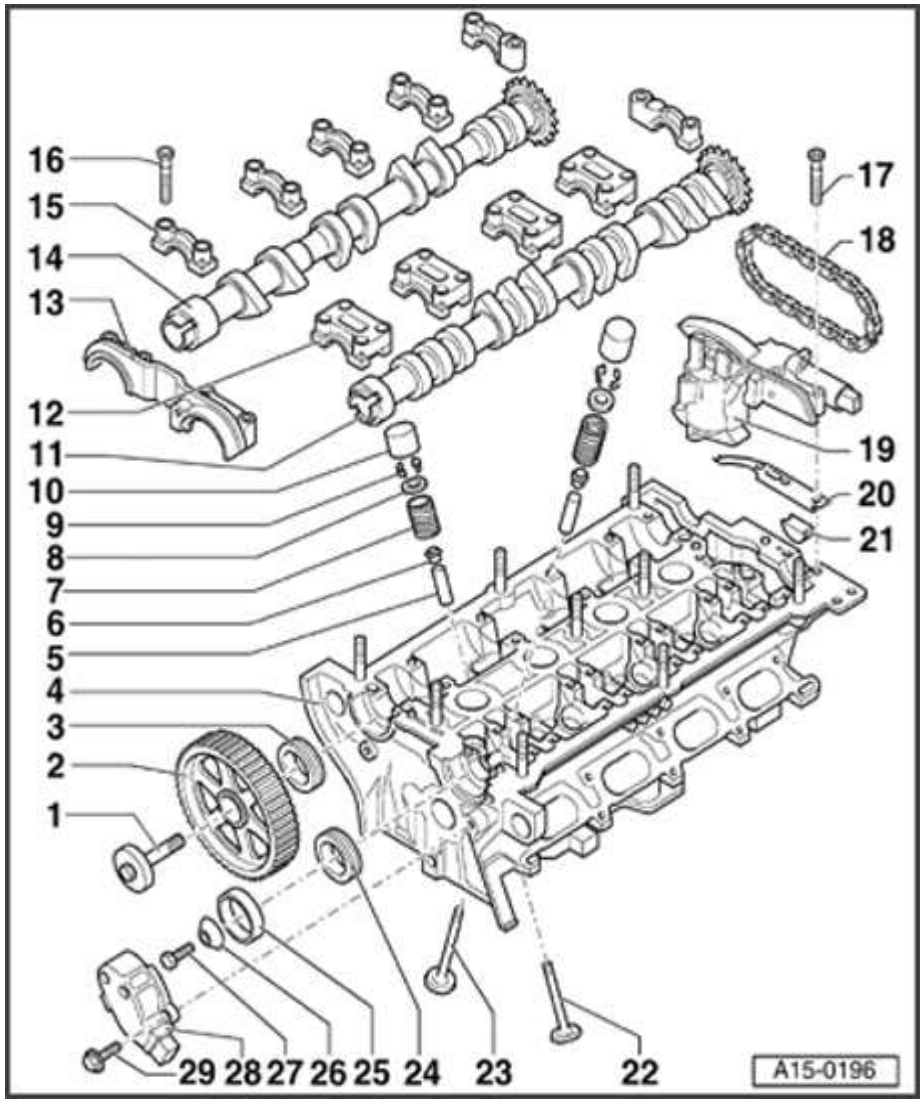
22 - Exhaust valve

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

23 - Intake valve

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

15-46



24 - Sealing ring

- For intake camshaft
- Replacing ⇒ Page 15-57

25 - Rotor for Camshaft Position sensor

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

26 - Washer

- With cone
- Note installation position

27 - 25 Nm

28 - Housing for Camshaft Position sensor - G40-

29 - 10 Nm

15-47

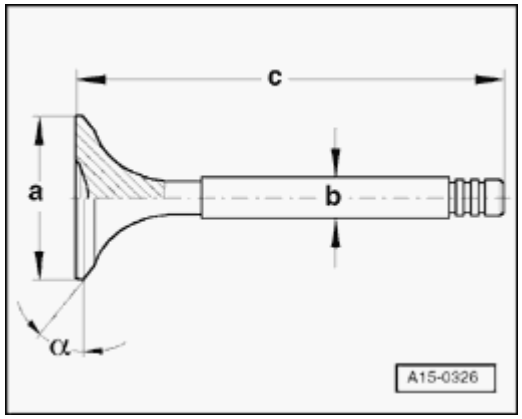


Fig. 1 Valve dimensions

Note:

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

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

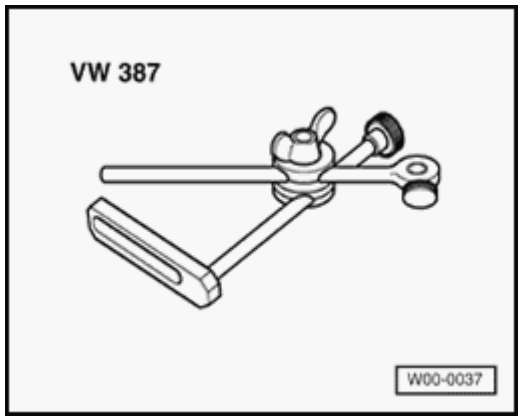
CAUTION!

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

15-48

Camshaft axial clearance, checking

Special tools and equipment



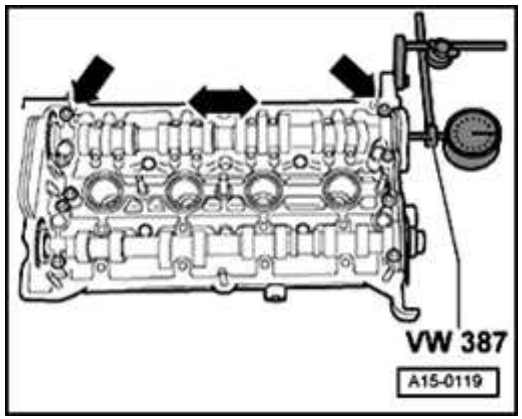
- Universal dial indicator bracket VW 387
- Dial indicator

15-49

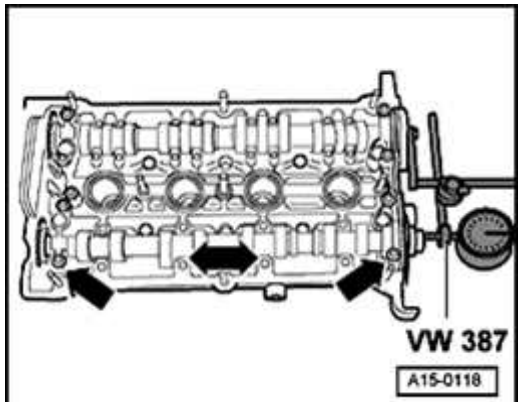
Test sequence

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

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



➢ Intake camshaft

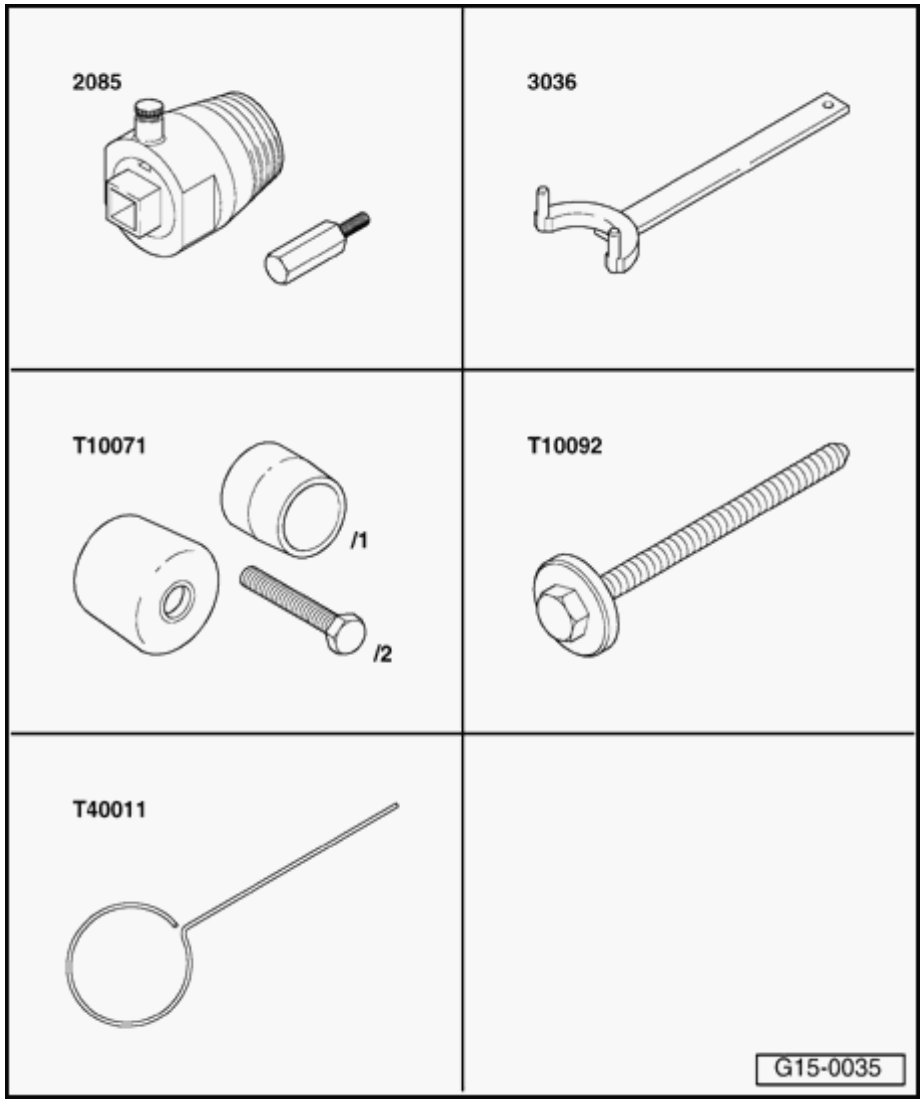


➢ Exhaust camshaft

Wear limit for intake and exhaust camshafts.

- Axial clearance: no more than 0.20 mm

15-50



Exhaust camshaft oil seal, replacing

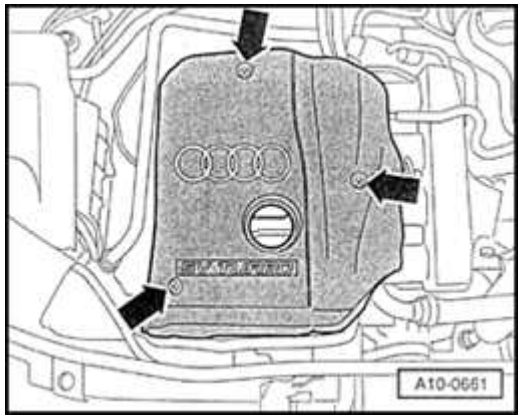
Special tools and equipment

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

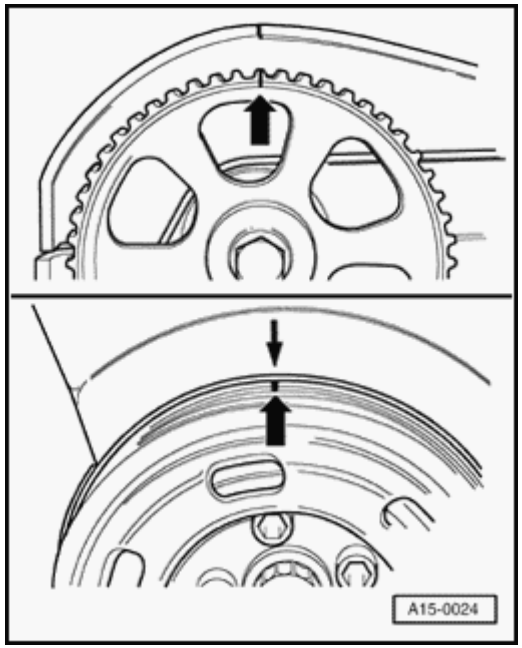
15-51

Removing

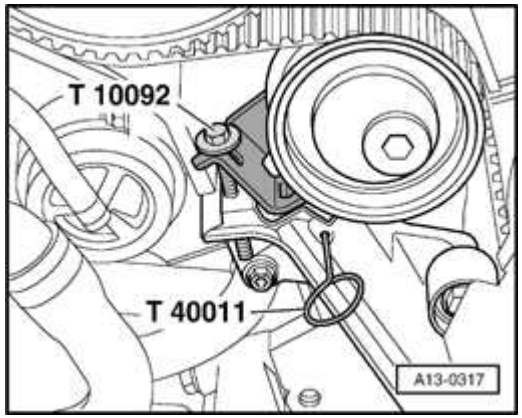
- Cylinder head installed
- Lock carrier must be in service position ⇒ Page 13-1 .



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



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



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

Note:

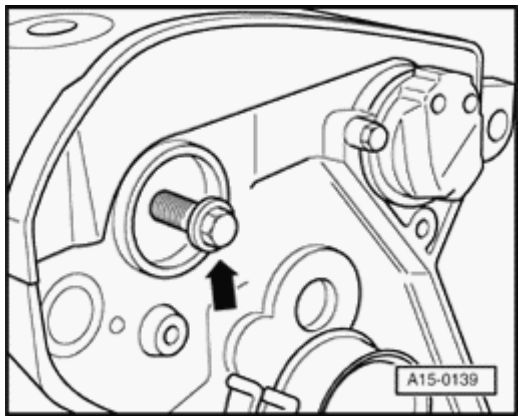
Only tension piston of tensioner until pressure piston is secured with pin T40011.

- Take toothed belt off camshaft sprocket.

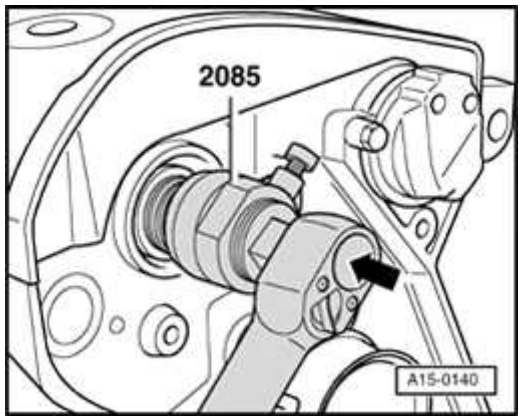
15-53

- Loosen camshaft sprocket (counter hold with 3036).

- Remove camshaft sprocket.



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



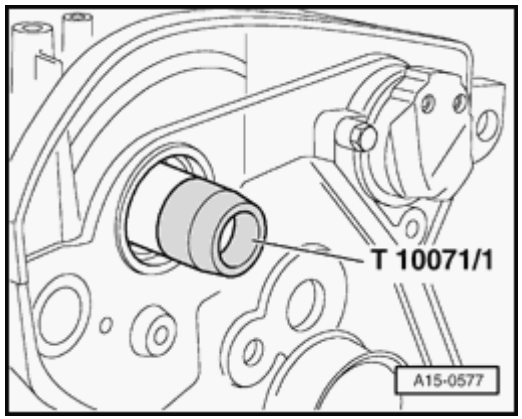
- Lubricate threaded head of oil seal extractor 2085, place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.
- Clamp flats of oil seal extractor in vice. Remove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

15-54

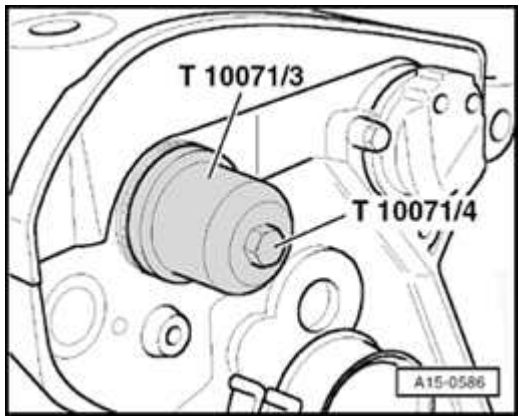
Installing

Note:

Do not oil sealing lip of oil seal.

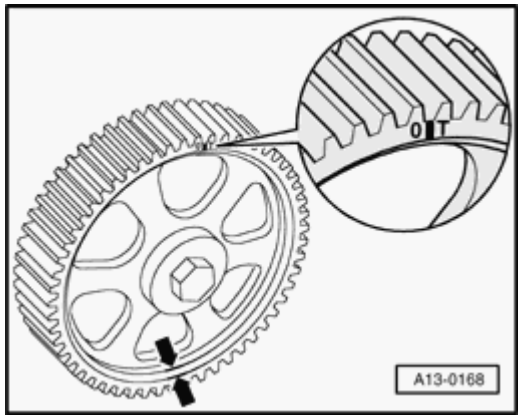


- Place guide sleeve T10071/1 onto crankshaft journal.
- Push sealing ring via guide sleeve onto shaft journal.
- Remove guide sleeve.

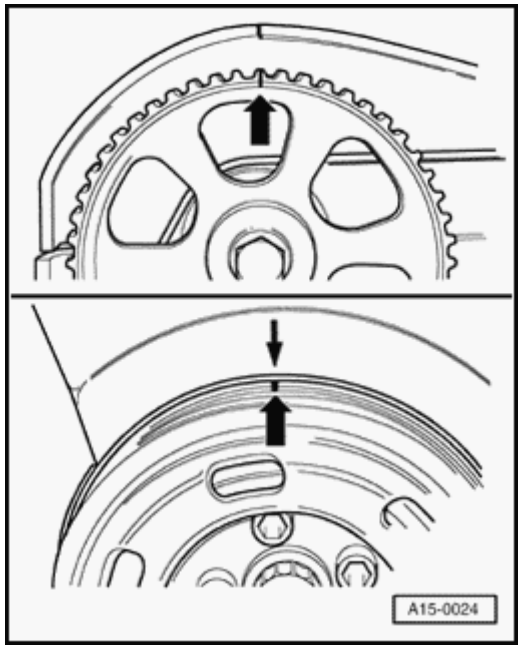


- Press in sealing ring with pressure sleeve T10071/3 and bolt T10071/4.

15-55



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



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

Note:

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

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

Note:

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

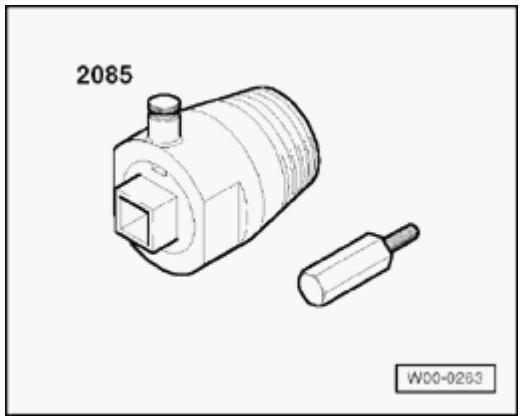
Tightening torque

Component	Nm
Camshaft sprocket to camshaft	65

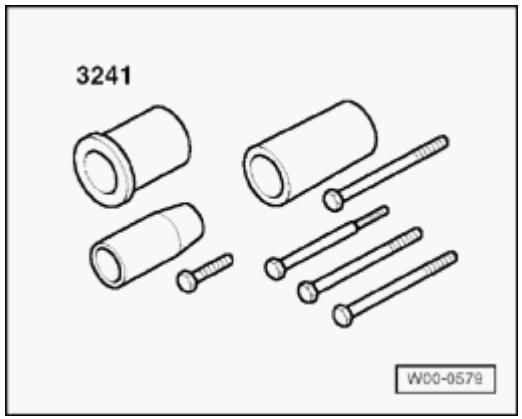
15-57

Intake camshaft seal, replacing

Special tools and equipment



- Oil seal extractor 2085

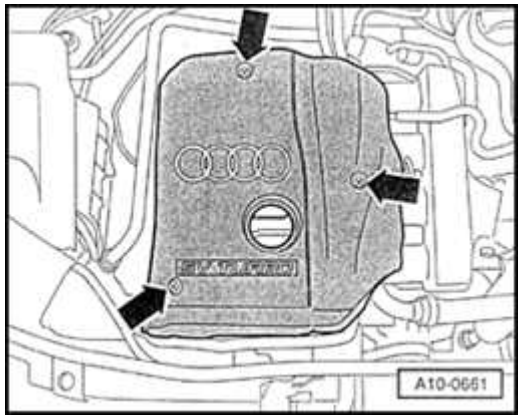


- Installation tool 3241

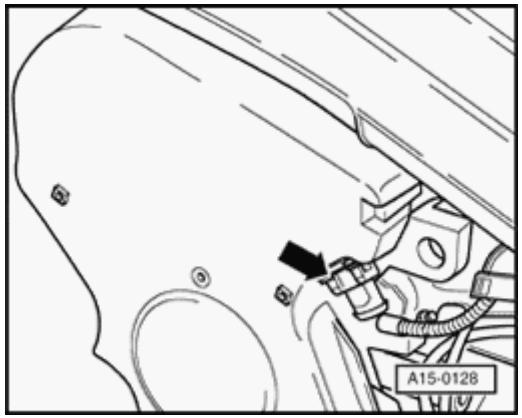
15-58

Removing

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

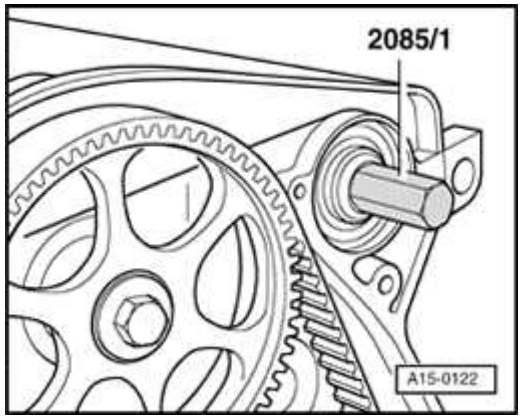


- Remove engine cover -arrows-.
- Remove upper toothed belt guard ⇒ Page 13-35 .

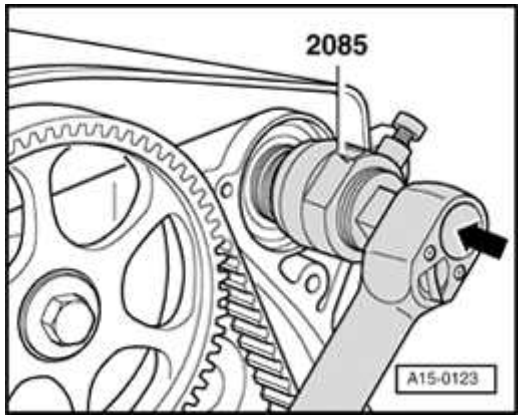


- Disconnect connector from camshaft position sensor -arrow-.
- Remove sensor housing.
- Remove sensor rotor and washer.

15-59



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



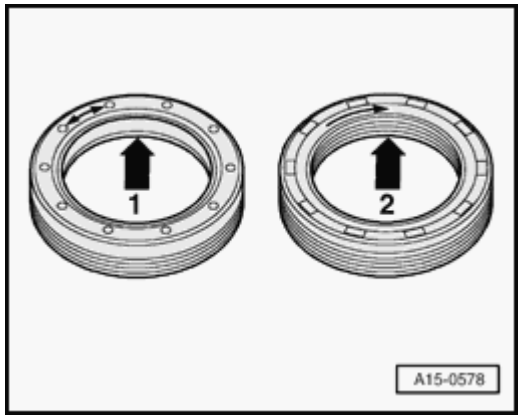
- Lubricate threaded head of oil seal extractor 2085, place it in position and, exerting firm pressure, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part of extractor against camshaft until oil seal has been extracted.

15-60

Installing

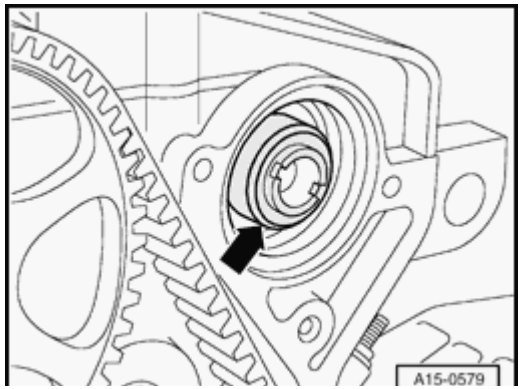
Note:

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



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

Installing PTFE sealing ring:



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

Note:

Do not oil sealing lip of oil seal.

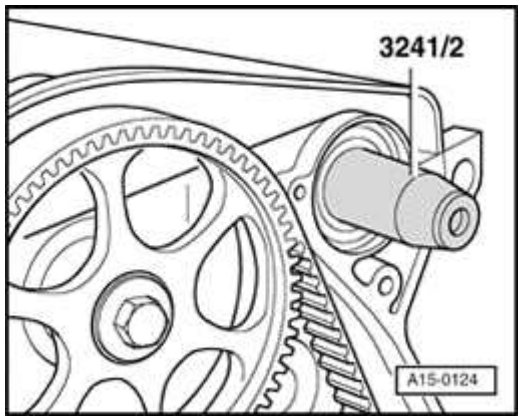
- Push PTFE sealing ring carefully onto shaft end by hand.

15-61

Installing sealing ring with spring:

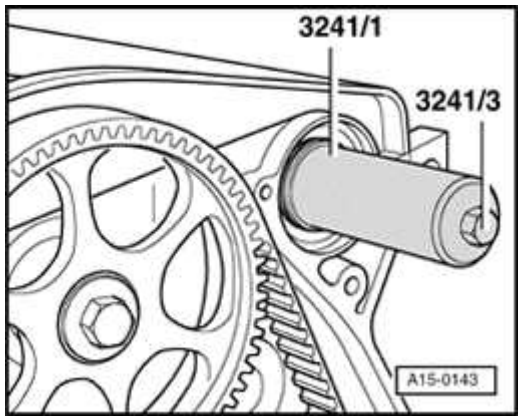
Note:

Do not oil sealing lip of oil seal.



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

All models:



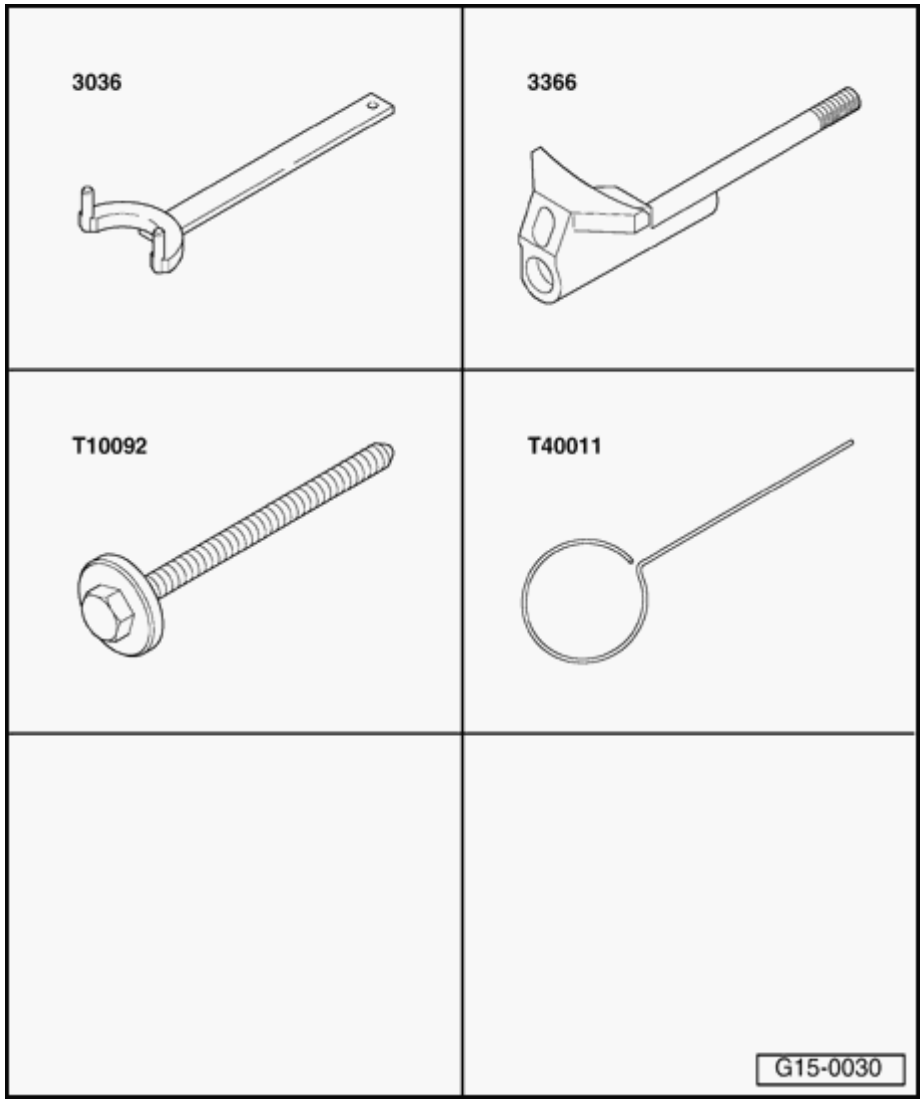
- Press in sealing ring with pressure sleeve 3241/1 as far as it will go. To do this use bolt 3241/3.
- Install camshaft position sensor ⇒ Page 15-46 .
- Install toothed belt guard (upper section).
- Install lock carrier ⇒ Page 13-1 .

Tightening torques

Component	Nm
Camshaft position sensor rotor to camshaft	25

Camshaft position sensor housing to cylinder head	10

15-62



Camshafts and camshaft adjuster, removing and installing

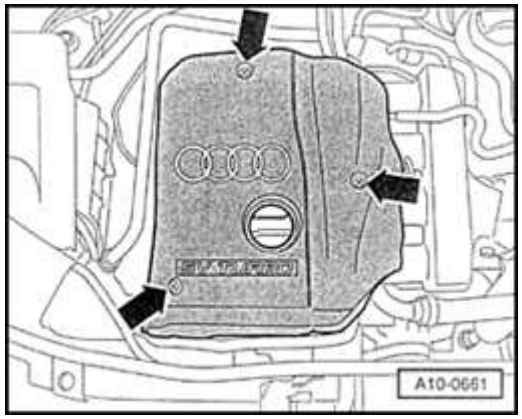
Special tools and equipment

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

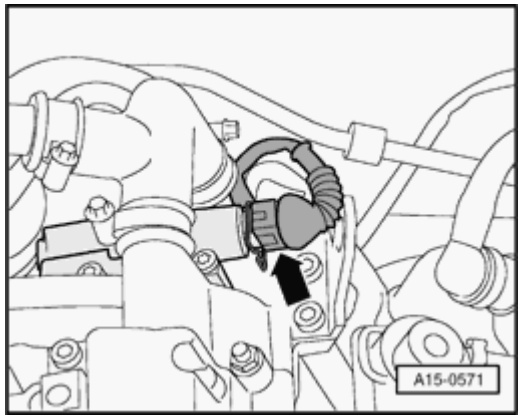
15-63

Removing

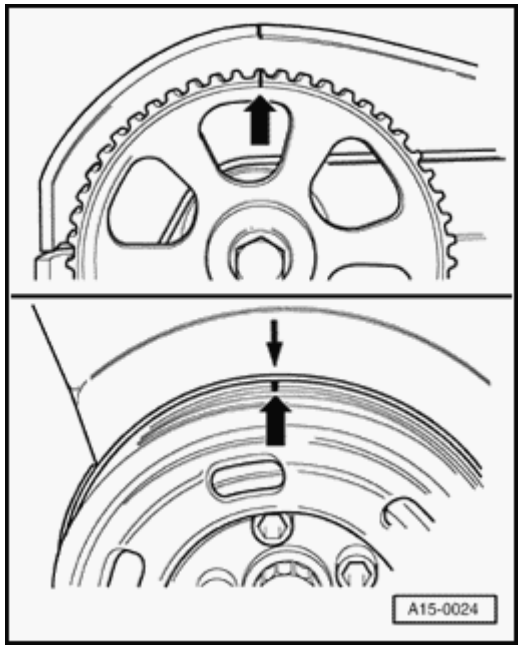
- Cylinder head installed
- Lock carrier must be in service position ⇒ Page 13-1 .



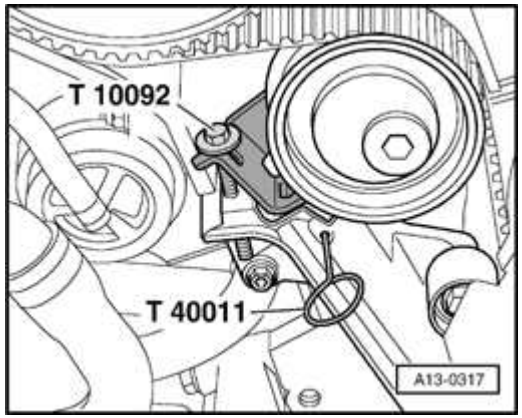
- Remove engine cover -arrows-.
- Remove combination valve for secondary air inlet ⇒ Page 26-64 .



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



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

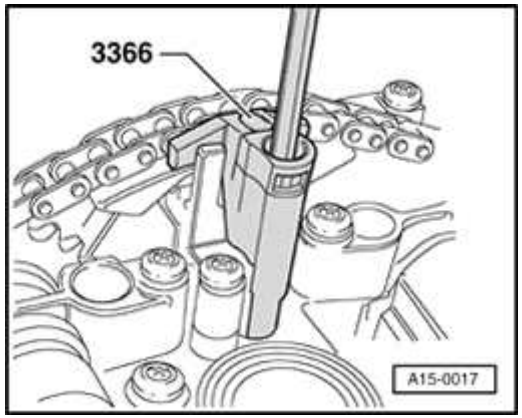


- Thread socket head fastener T10092 into tensioner for toothed belt.
- Tension pressure piston of tensioner until piston is secured with pin T40011.
- Remove toothed belt from camshaft sprocket.

- Loosen camshaft sprocket (counter hold with 3036).

- Remove camshaft sprocket.

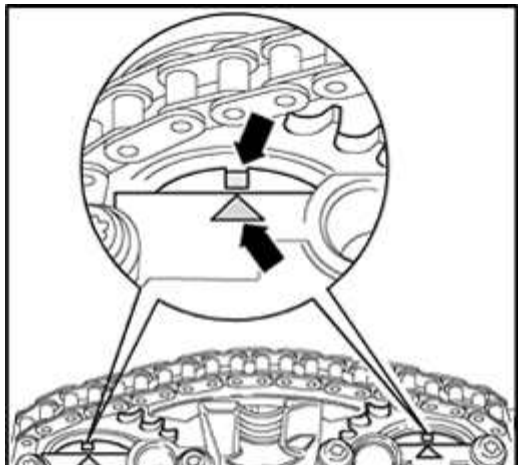
- Remove camshaft position sensor completely.



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

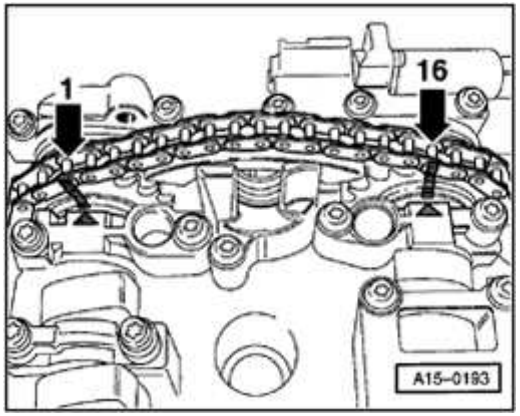
Note:

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



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

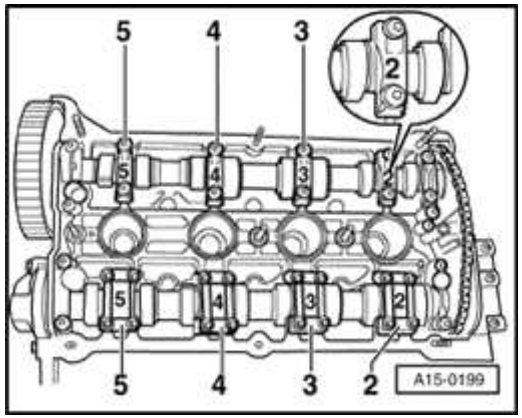
- Clean chain and camshaft sprockets opposite two arrows on bearing caps and mark installation position with color marks.



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

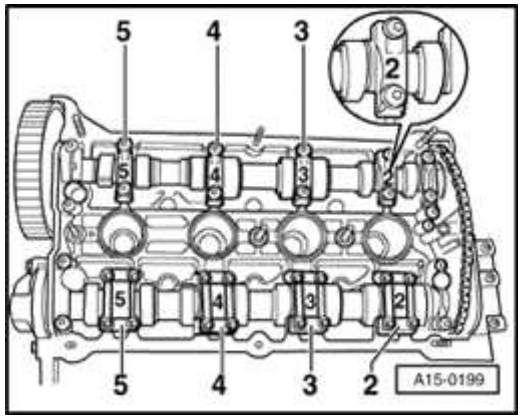
Note:

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



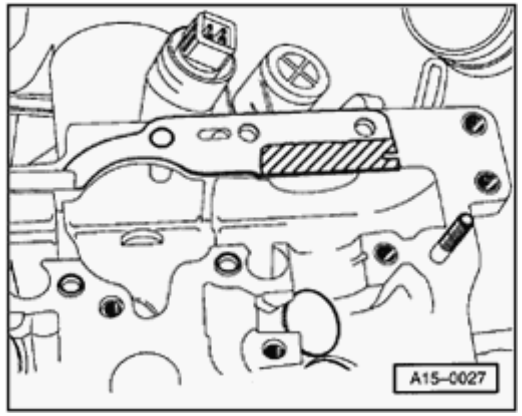
- Remove bearing caps 3 and 5 on intake and exhaust camshafts.
- Remove double bearing cap.
- Remove both bearing caps next to intake and exhaust camshaft chain sprockets.
- Remove securing bolts for camshaft adjuster.

15-67



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

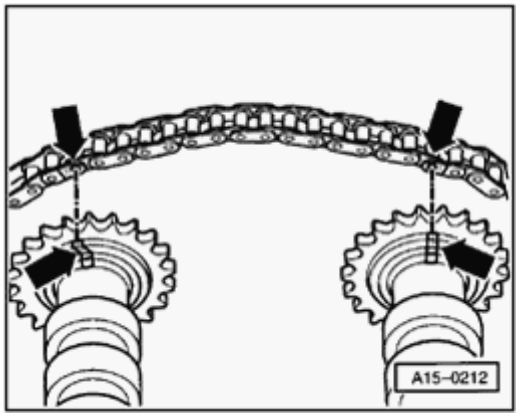
Installing



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

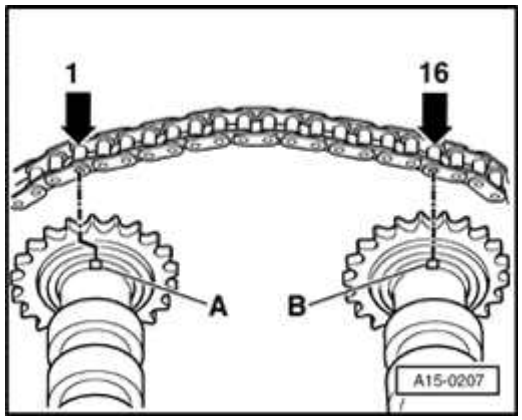
15-68

- Install drive chain on camshaft sprockets as follows:



➢

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



➢

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

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

15-69

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

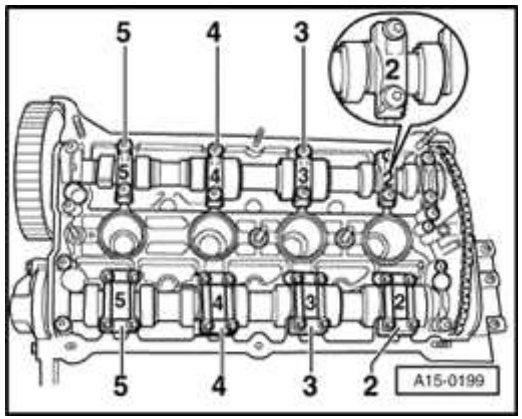
- Oil running surfaces of both camshafts.

Note:

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

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

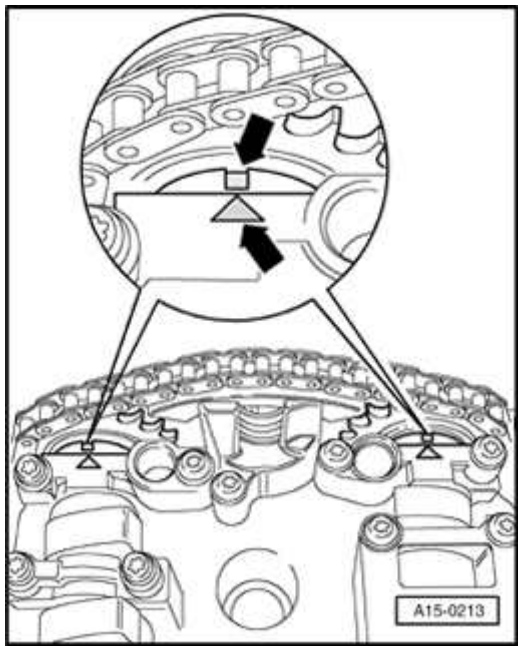
- Tighten mountings of camshaft adjuster (watch position of dowel sleeves).



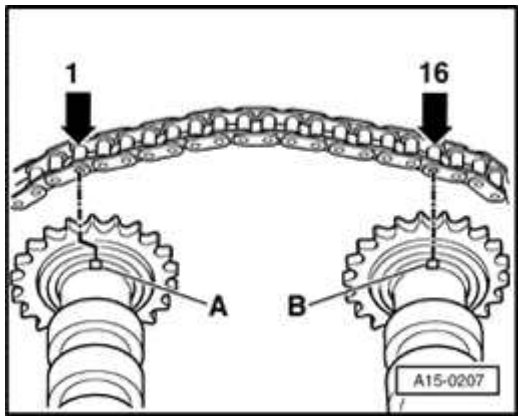
- Tighten bearing caps 2 and 4 of intake and exhaust camshafts in stages and in diagonal sequence (watch position of dowel sleeves).
- Install two bearing caps next to chain sprockets on intake and exhaust camshafts.

15-70

- Check correct setting of camshafts:



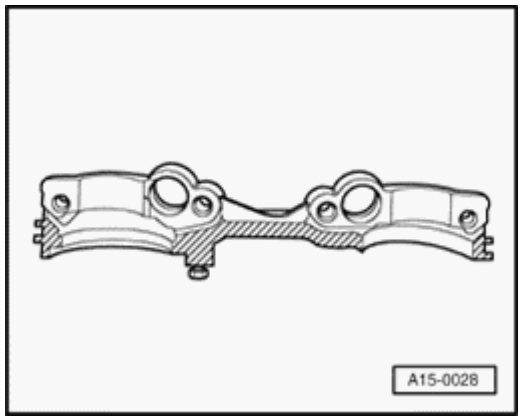
- Two markings on camshafts must be in line with two arrows on bearing caps -arrows-.



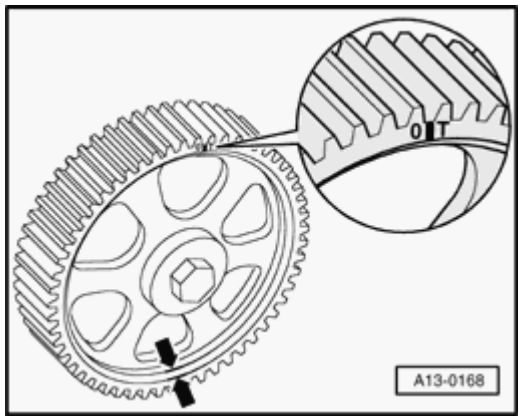
- Distance between two arrows on bearing caps or color markings are 16 rollers on drive chain.
- Notch on exhaust camshaft is offset slightly toward inside in relation to chain roller -1-.

15-71

- Remove holder for chain tensioner 3366.

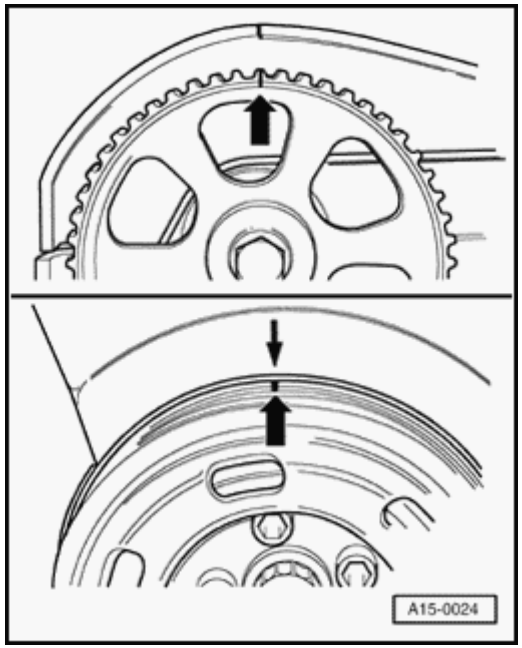


- Slightly coat shaded area of dual bearing cap with sealant AMV 188 001 02 and install bearing cap (observe position dowel sleeves).
- Install remaining bearing caps (watch position of dowel sleeves).
- Replace sealing rings for intake and exhaust camshafts ⇒ as of ⇒ Page 15-50 .



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

15-72



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

Note:

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

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

Note:

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

Tightening torques

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

15-74

Hydraulic valve lifters, checking

Special tools and equipment

- Feeler gauge
- Wood or plastic wedge

Note:

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

Test sequence

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

Note:

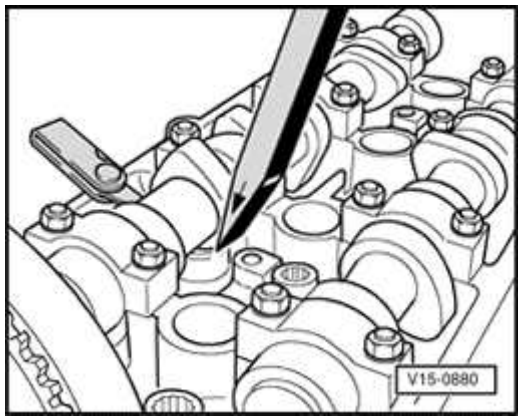
If the irregular valve noises stop but recur repeatedly during short journeys, a new oil retention valve must be fitted. Oil retention valve location: In oil filter bracket ⇒ -Item 6 -, ⇒ Page

17-7 .

15-75

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

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



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

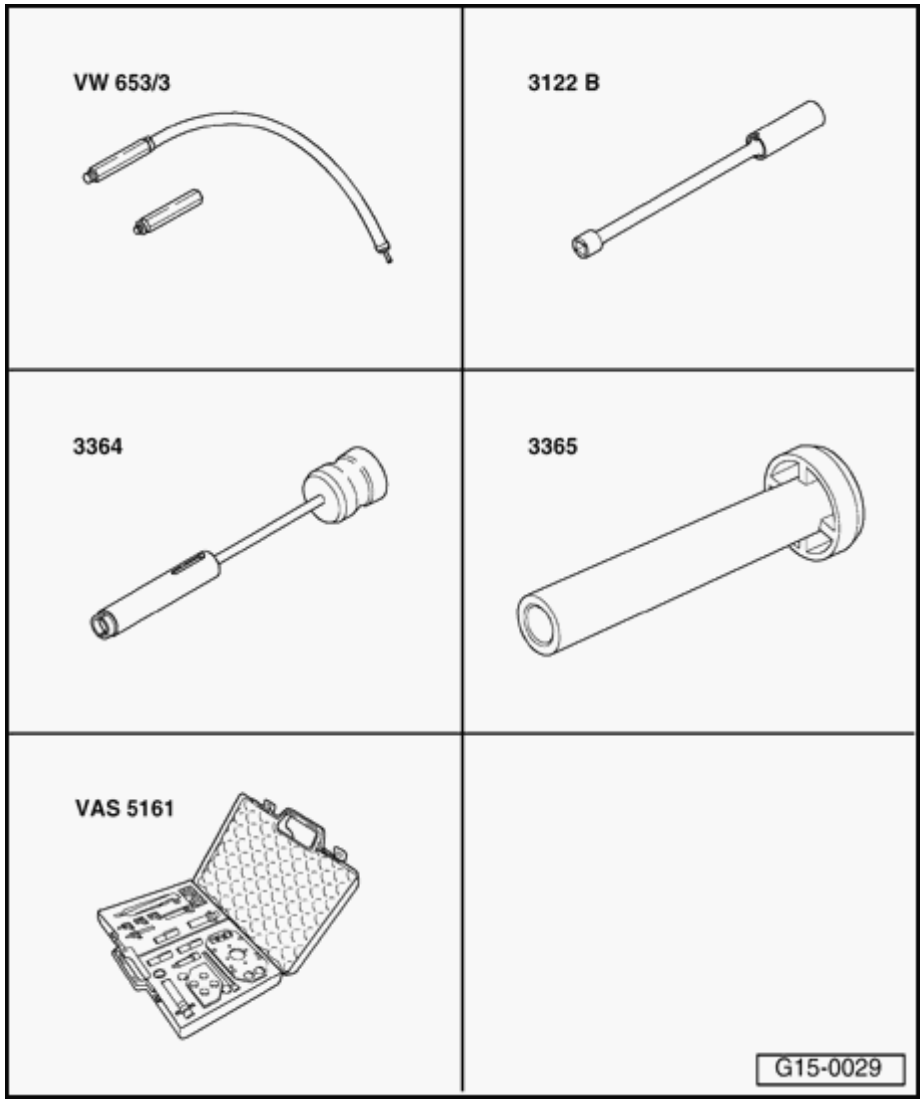
15-76

Note:

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

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

15-77



Valve stem seals, replacing

Special tools and equipment

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

Removing

- Cylinder head in vehicle.

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

Note:

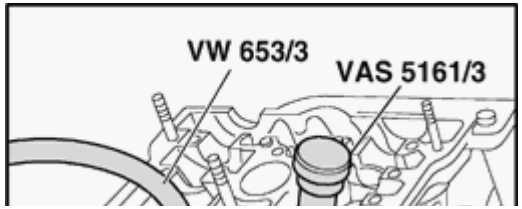
- *Ensure that the valve lifters are not interchanged.*

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

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

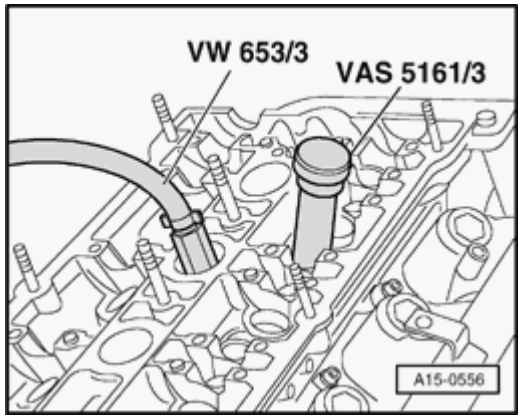
- Remove spark plugs with spark plug spanner 3122B.

- Set piston of appropriate cylinder to bottom dead center.



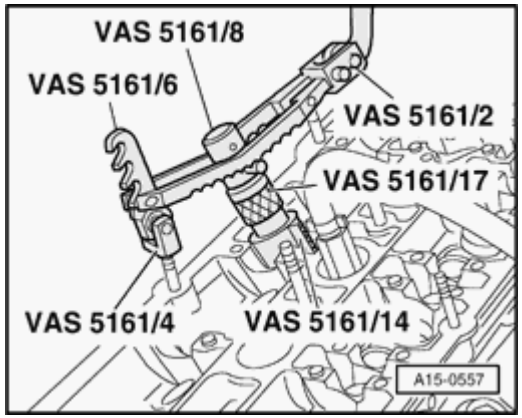
- Thread pressure hose VW 653/3 into spark plug threaded hole and apply constant pressure of at least 6 bar.

15-79



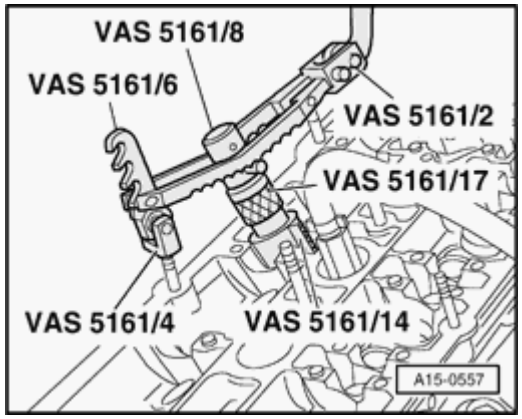
- Install knock journal VAS 5161/3 into valve lifter guide.
- Loosen solid valve keepers on all five valves with a plastic hammer.

Exhaust side



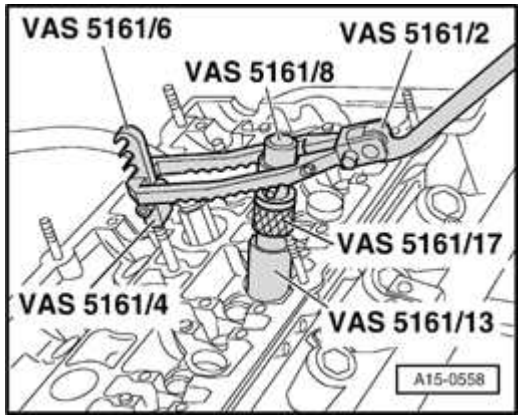
- Thread catch part VAS 5161/6 with insertion fork VAS 5161/4 onto a stud of cylinder head.
- Push guide bushing VAS 5161/14 as far as it will go into lifter guide at valve to be removed.
  - Installation position: Shaded areas point across to driving direction.
- Push knurled distance ring VAS 5161/17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

15-80



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

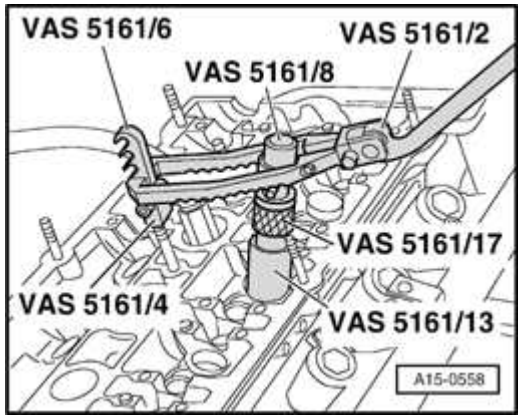
15-81



Intake side:

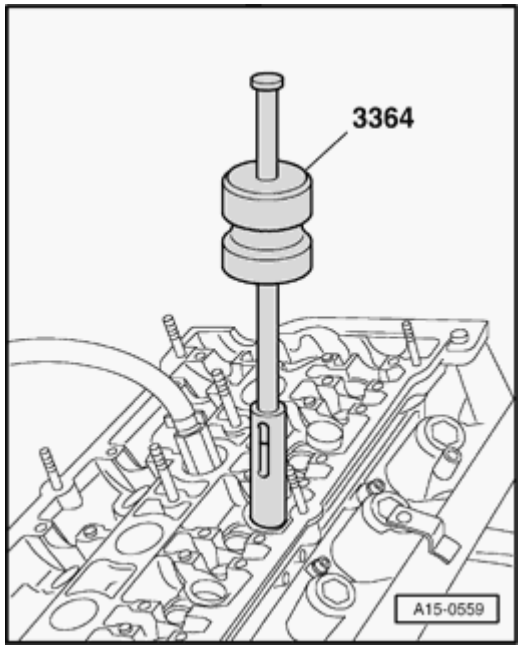
- Thread catch part VAS 5161/6 with insertion fork VAS 5161/4 onto a stud of cylinder head.
- Push in guide bush VAS 5161/13 as far as it will go into lifter guide at valve to be removed.
  - ♦ Installation position: Shaded areas point across to driving direction.
- Push distance ring VAS 5161/17 onto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

15-82



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

All models:



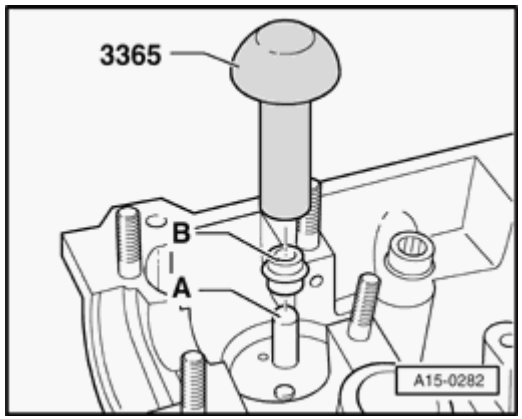
- Use 3364 to pull off valve stem seals.

15-83

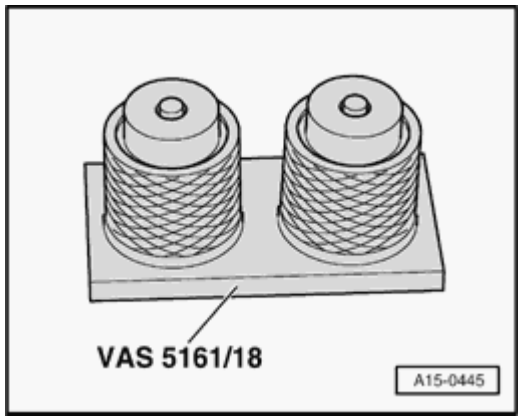
Installing

Note:

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



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

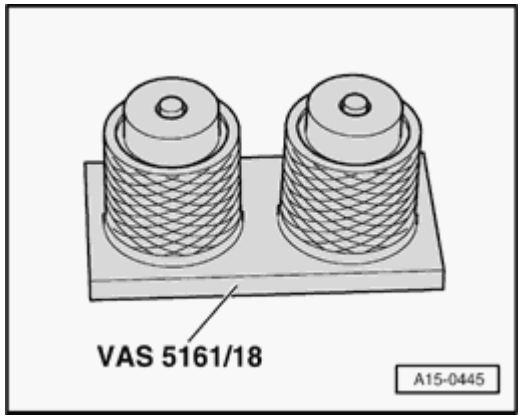


- If valve keepers were taken out of assembly cartridge they must first be inserted into tool VAS 5161/18.

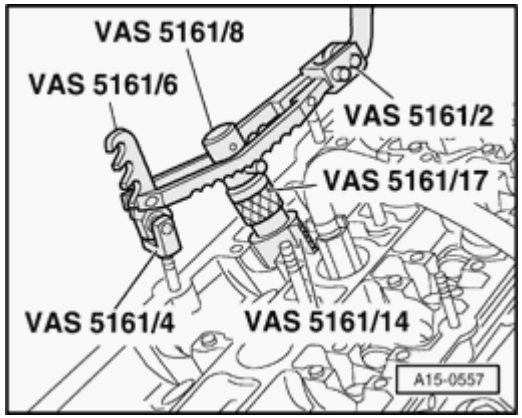
Note:

The large diameter of the valve keepers points upward.

15-84



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



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

15-85

- Install camshafts and camshaft adjuster ⇒ Page 15-67

Note:

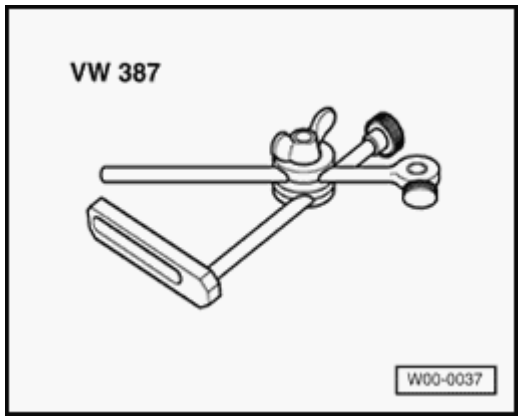
- *Wait about 30 minutes after installing the camshafts before starting the engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*

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

15-86

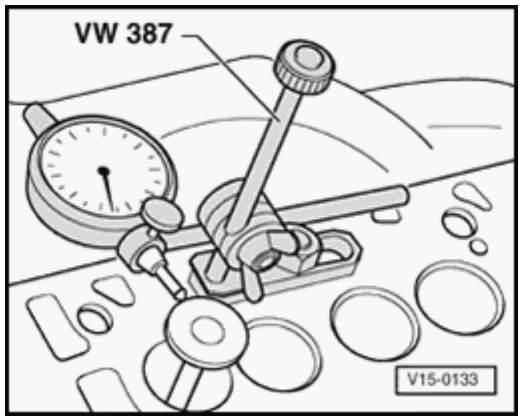
Valve guides, checking

Special tools and equipment



- Universal dial indicator bracket VW 387
- Dial indicator

Test sequence



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

Note:

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

- Determine lateral play.

Wear limit

Intake valve guide	Exhaust valve guide
0.80 mm	0.80 mm

Note:

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

15-88

Valve seats, reworking

Note:

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

Special tools and equipment

- Depth gauge
- Valve seat machining tool

Note:

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

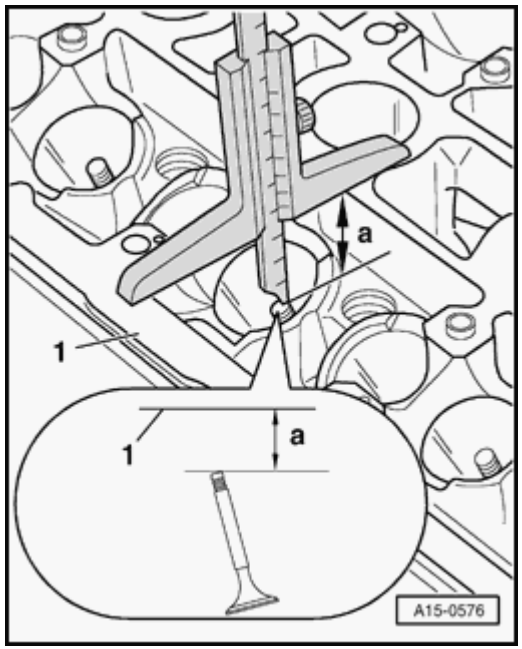
- *If the maximum reworking dimension is exceeded, the hydraulic lifters will not work properly and the cylinder head will have to be replaced.*

Calculating maximum permissible reworking dimension

- Insert valve and press firmly against valve seat.

Note:

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



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

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

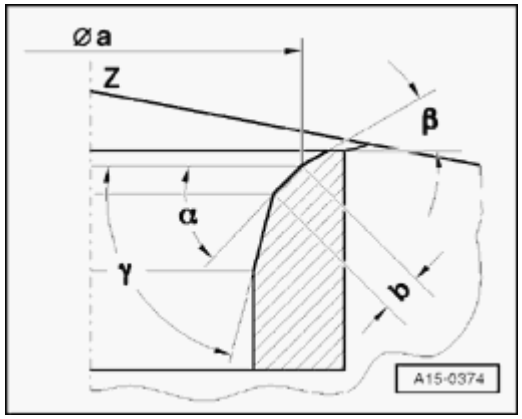
Measured distance minus minimum dimension = max. permissible reworking dimension.

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

Note:

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

15-91



Rework valve seats

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

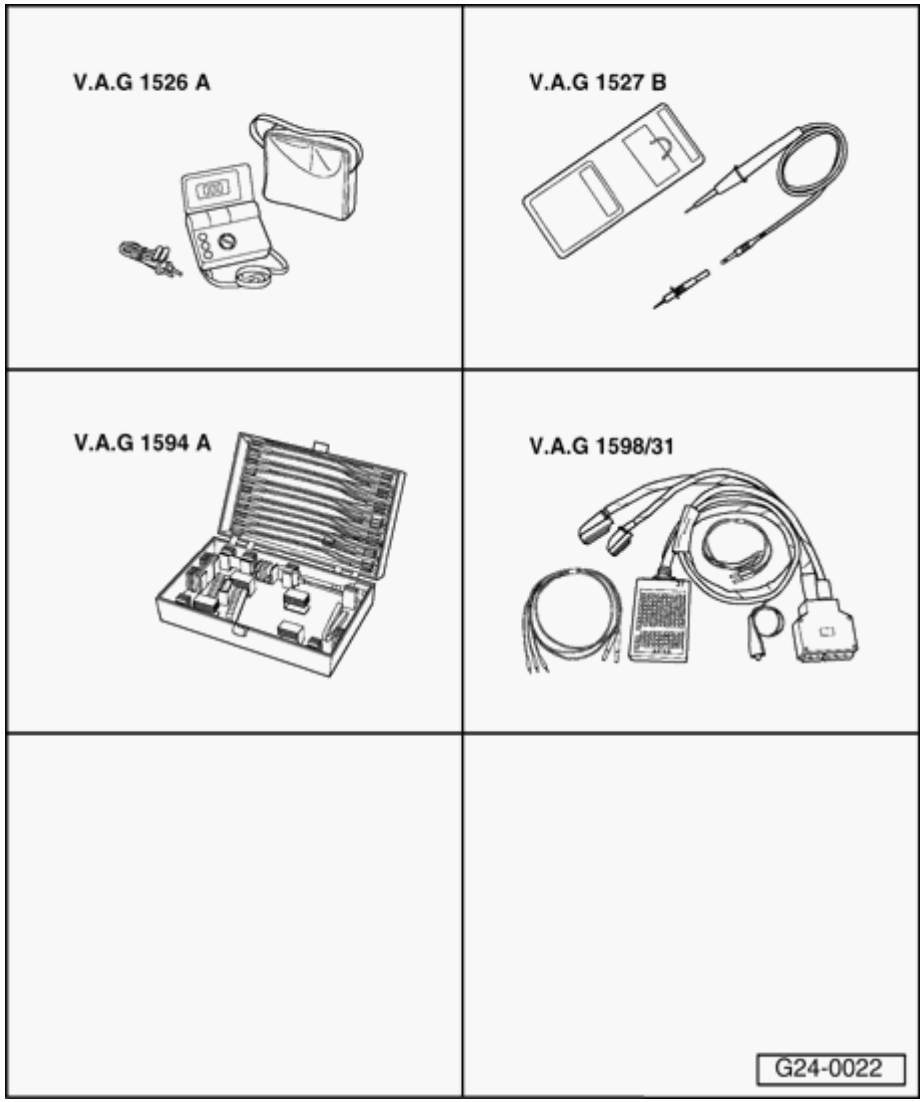
Camshaft timing control, checking

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

Note:

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

15-93



Camshaft adjustment solenoid valves, checking

Special tools and equipment

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

15-94

Test requirements:

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

Test sequence

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

Output Diagnostic Test Mode →

Camshaft timing control

➢ Display

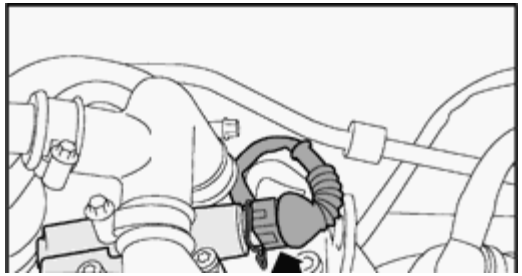
- This valve is actuated (clicks) for approx. one minute if the operation is not switched to the next component by pressing the → key.

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

- Check internal resistance of solenoid valve for camshaft adjuster.

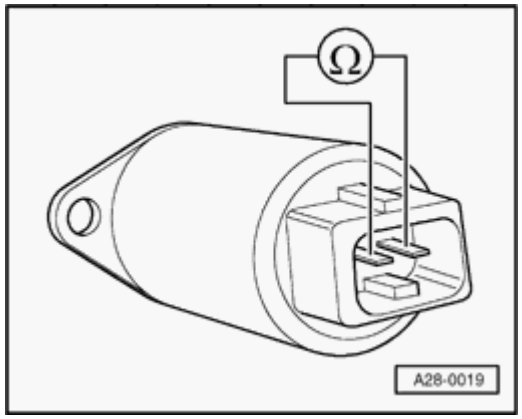
Checking internal resistance

- Switch ignition off.



➢ - Disconnect connector -arrow- from camshaft adjuster.

15-95



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

If specified value is not attained:

- Replace solenoid valve for camshaft adjuster.

If specified value is attained:

- Check power supply.

Checking power supply

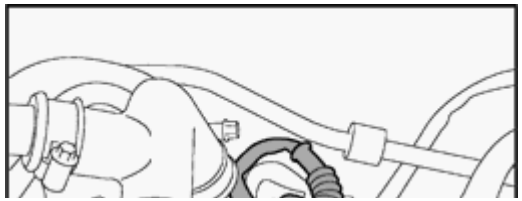
Test requirements:

- Fuse for solenoid valve for camshaft adjustment OK

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

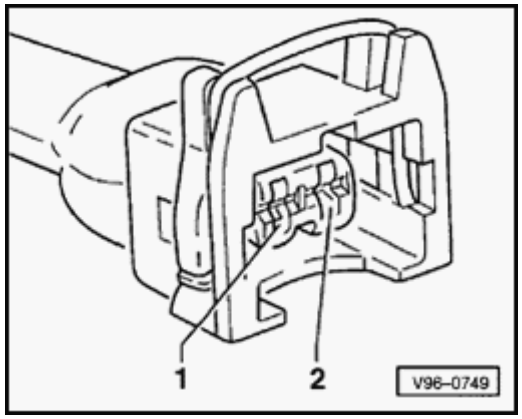
- Fuel pump relay OK.

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



- Disconnect connector -arrow- from camshaft adjuster.

15-96



- Connect voltage tester VAG 1527 B as follows:

Connector contact	Measure to
1	Engine Ground

- Operate starter briefly.

• LED should light up.

If the LED does not light up:

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

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

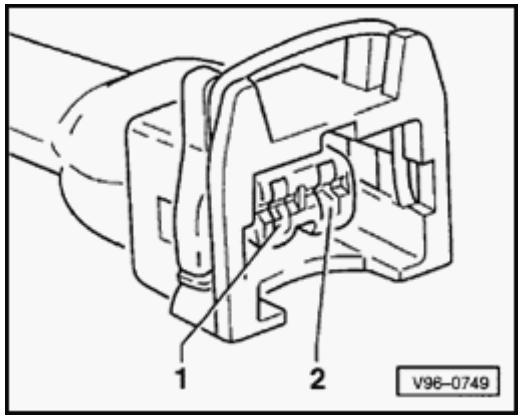
- Correct open circuit, if necessary.

If the LED lights up:

- Check actuation.

15-97

Checking actuation



Output Diagnostic Test Mode →

Camshaft timing control

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

Display

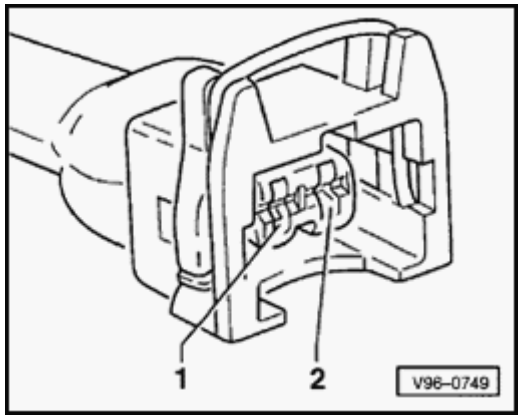
- ♦ LED should flash.

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

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

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

15-98



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

Connector Contact	Test box VAG 1598/31
2	115

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

If the wiring is OK:

- Replace engine control module.

If no fault is found:

- Replace mechanical camshaft adjuster.

17-1

Lubrication system components, removing and installing

Note:

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

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

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

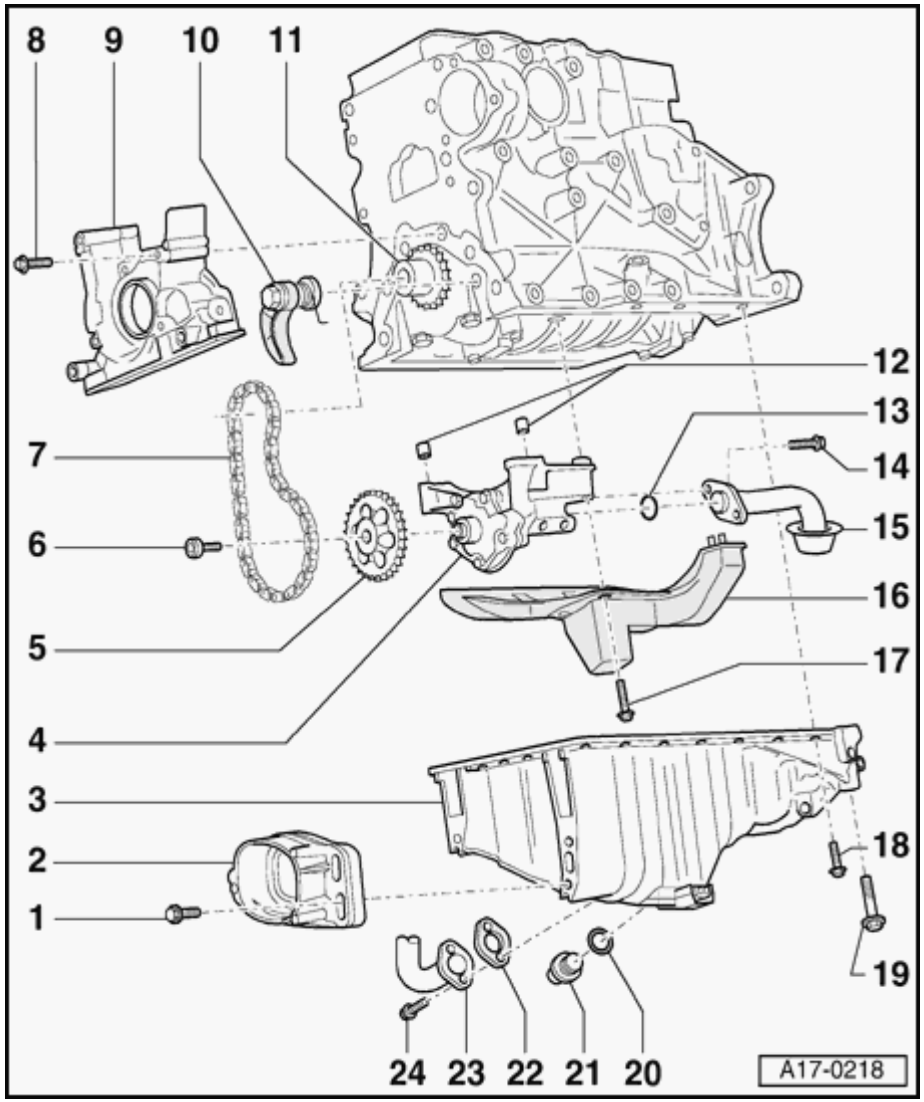
Viscosity grades and oil specifications:

⇒ *Repair Manual, Maintenance*

Oil system capacity:

⇒ *Repair Manual, Maintenance*

17-2



Part I - Oil pump/oil pan components

1 - 28 Nm

2 - Limit stop for torque reaction support

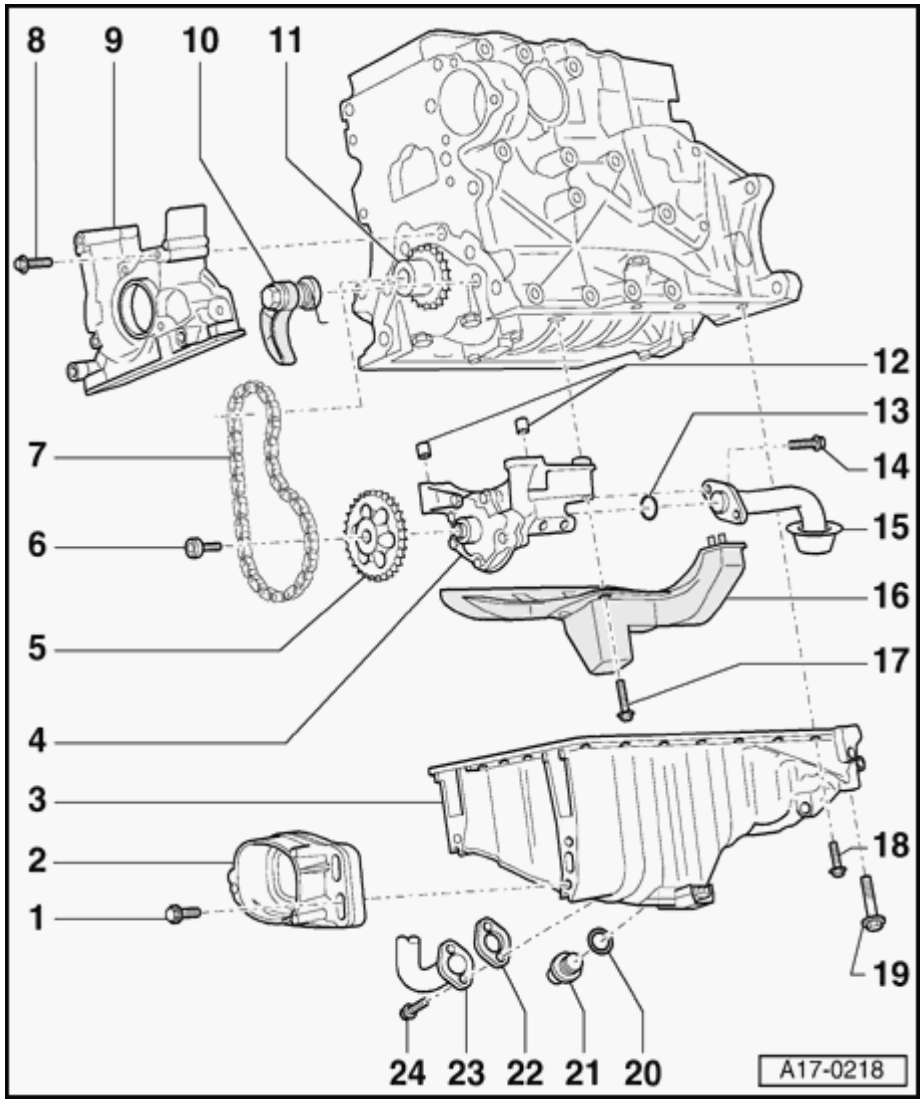
3 - Oil pan

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

4 - Oil pan

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

17-3



5 - Chain sprocket for oil pump

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

6 - 22 Nm

7 - Drive chain for oil pump

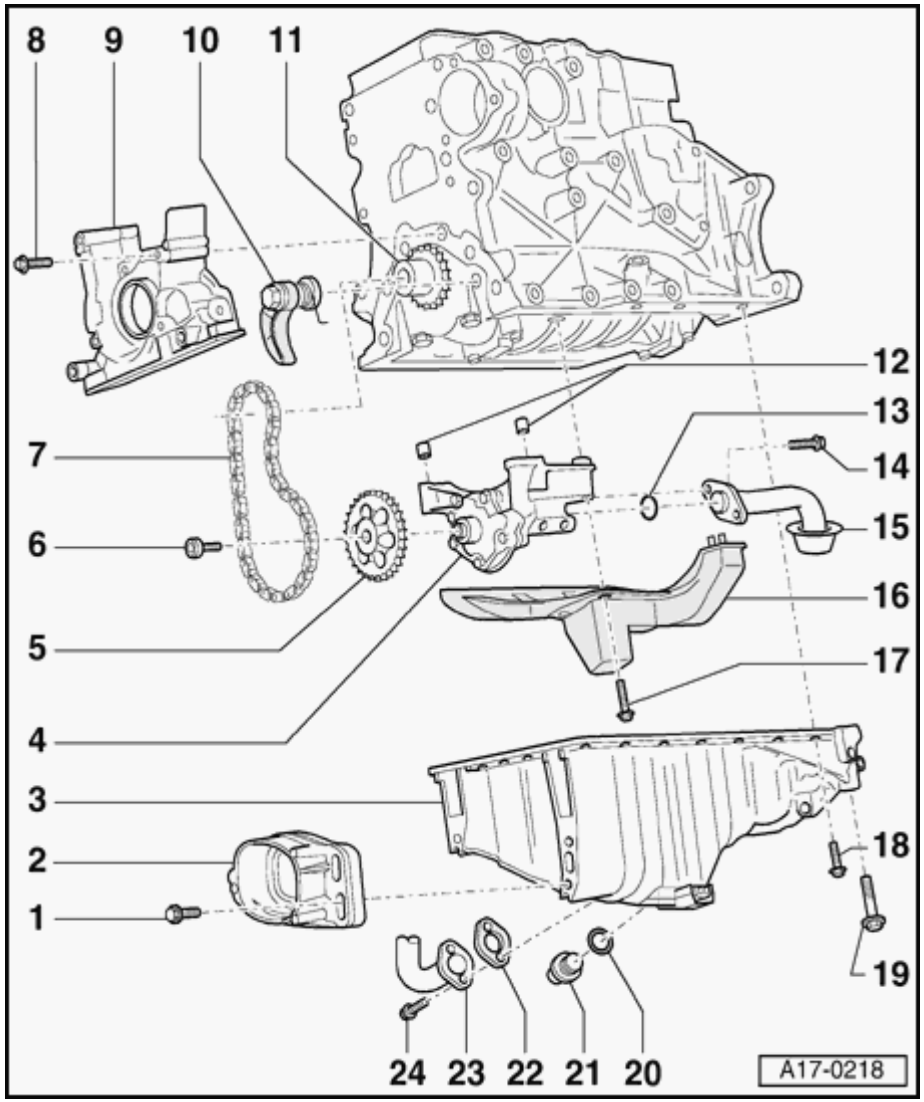
- Mark direction of rotation before removing
- Check for wear

8 - 15 Nm

9 - Sealing flange - front

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

17-4



10 - Chain tensioner

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

11 - Chain sprocket for oil pump

- Removing and installing ⇒ Page 13-77

12 - Dowel sleeves

- 2 pieces

13 - O-ring

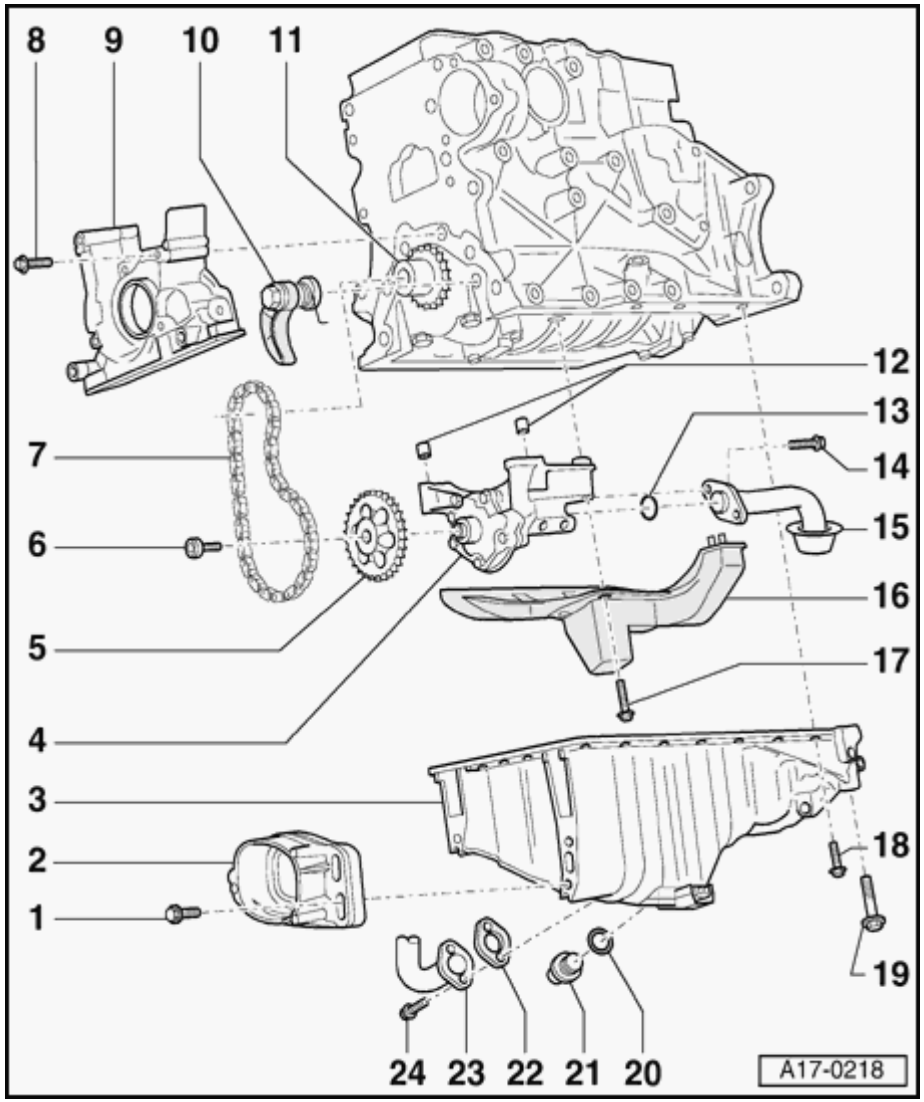
- Always replace

14 - 16 Nm

15 - Suction pipe

- Clean strainer if soiled

17-5



16 - Baffle plate

17 - 16 Nm

18 - 15 Nm

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

19 - 40 Nm

20 - Sealing ring

- Always replace

21 - Oil drain plug, 30 Nm

22 - Gasket

- Always replace

23 - 10 Nm

24 - Oil return pipe

- From exhaust turbocharger

17-6

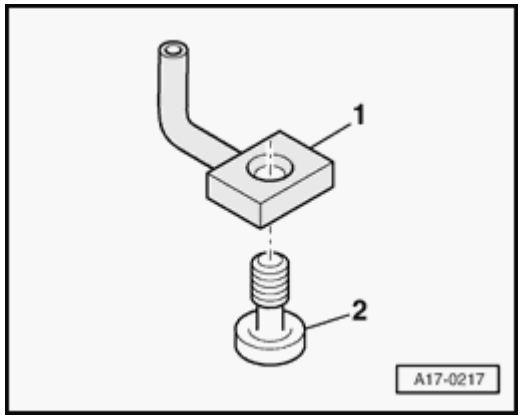


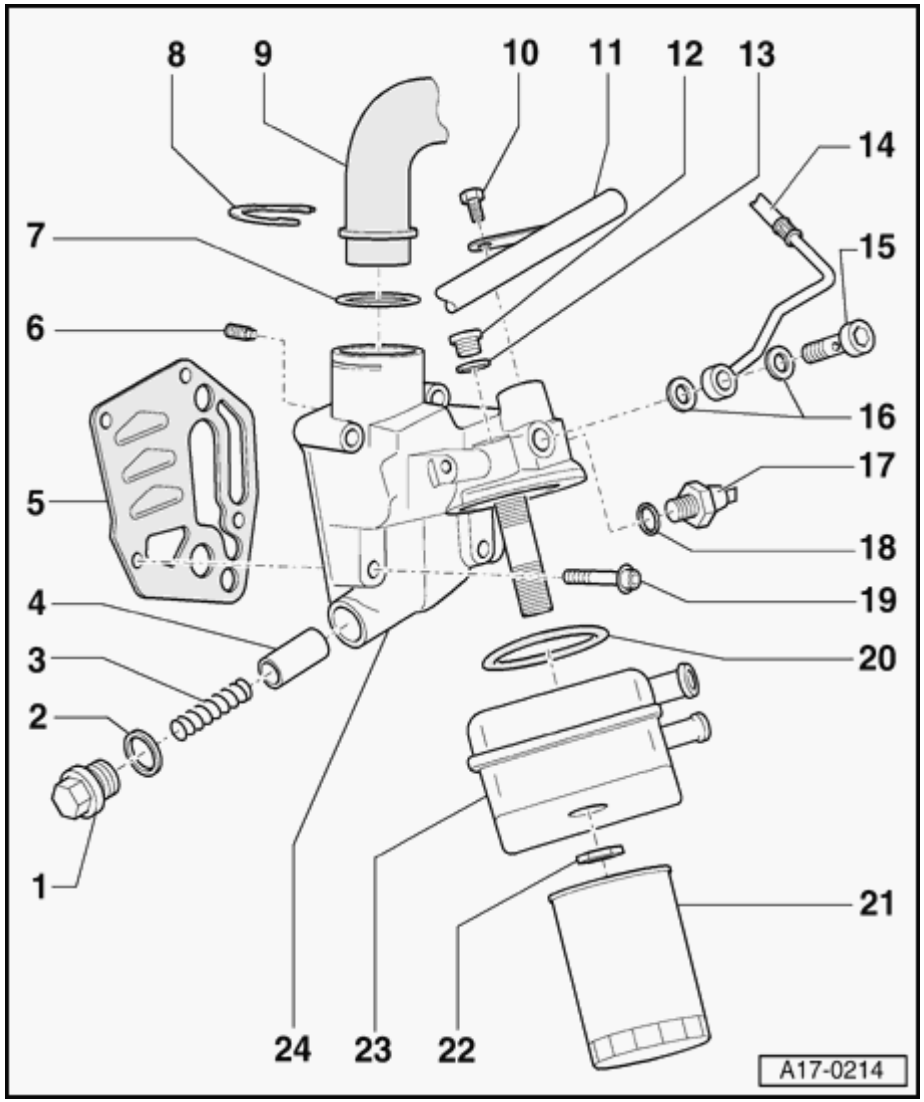
Fig. 1 Oil spray jet and pressure relief valve

1 - Oil spray jet (for piston cooling)

2 - Bolt with pressure relief valve - 27 Nm

- Opening pressure 1.3 to 1.6 bar

17-7



Part II - Oil filter bracket components

1 - Screw plug - 40 Nm

2 - Sealing ring

- Always replace

3 - Spring

- For pressure relief valve, approx. 4 bar

4 - Piston

- For pressure relief valve, approx. 4 bar

5 - Gasket

- Always replace

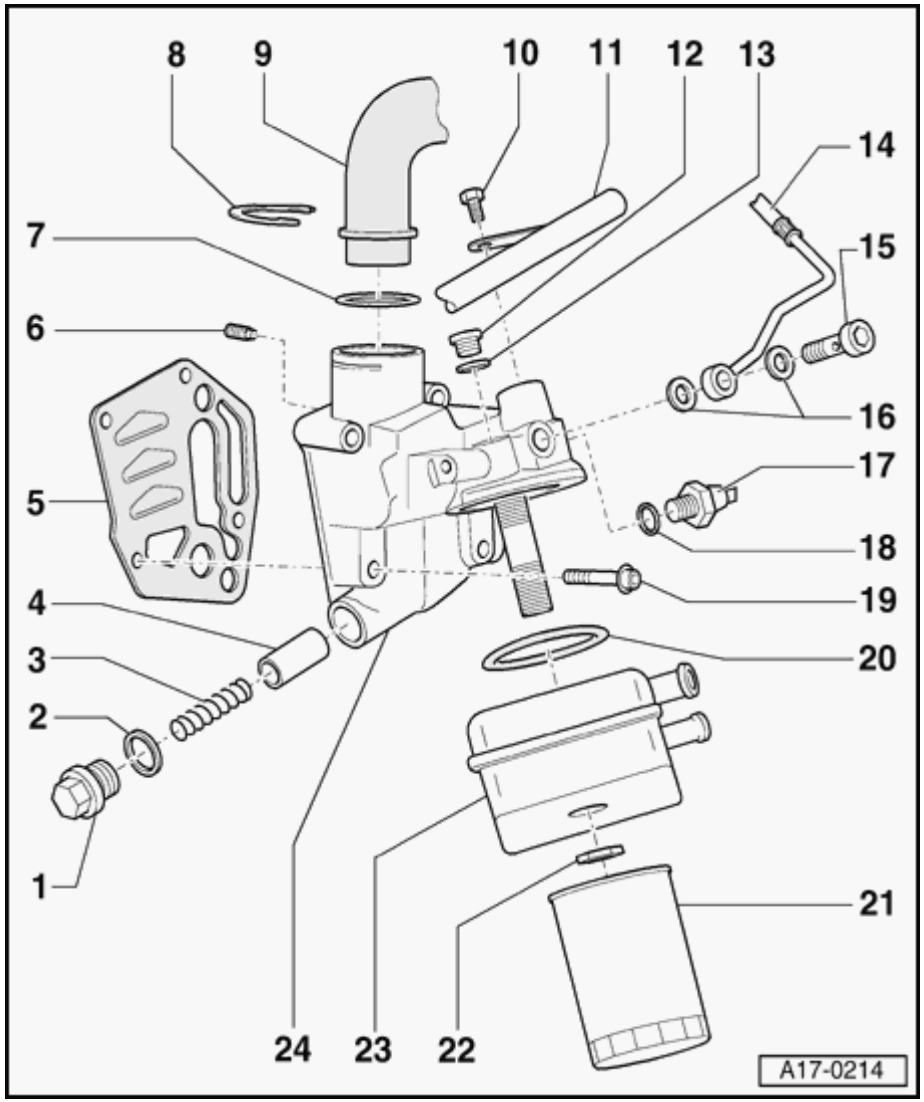
6 - Oil retention valve

- Tighten to 8 Nm
- Built into oil filter bracket

7 - O-ring

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

17-8



8 - Locking clip

9 - Pipe

- For crankcase breather

10 - 20 Nm

- Install with locking fluid D 000 600 A2

11 - Bottom coolant pipe

12 - Screw plug - 15 Nm

13 - Sealing ring

- If seal is leaking, cut open and replace

14 - Oil supply pipe

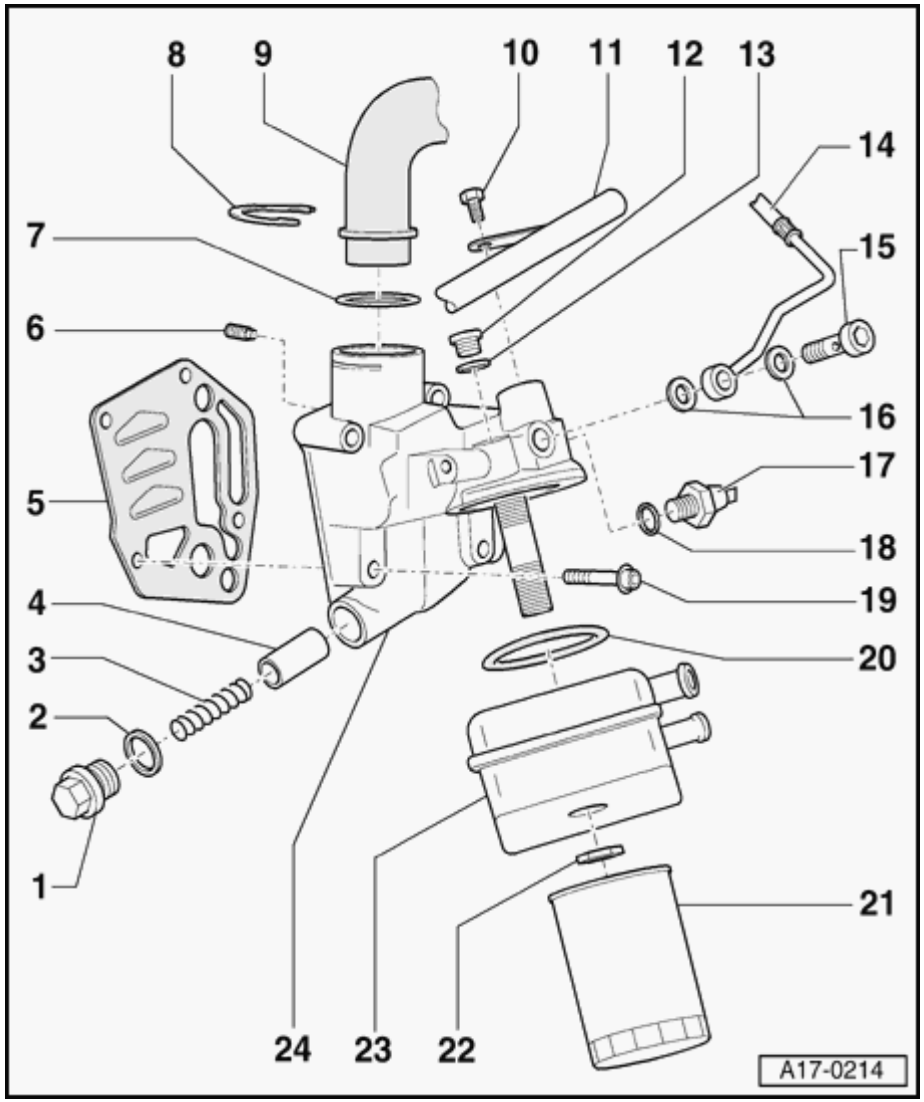
- To turbocharger

15 - Banjo bolt - 30 Nm

16 - Seals

- Always replace

17-9



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

- Black insulation
- Checking ⇒ Page 17-30

18 - Sealing ring

- If seal is leaking, cut open and replace

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

- Always replace

20 - Gasket

- Always replace
- Engage in projections on oil cooler

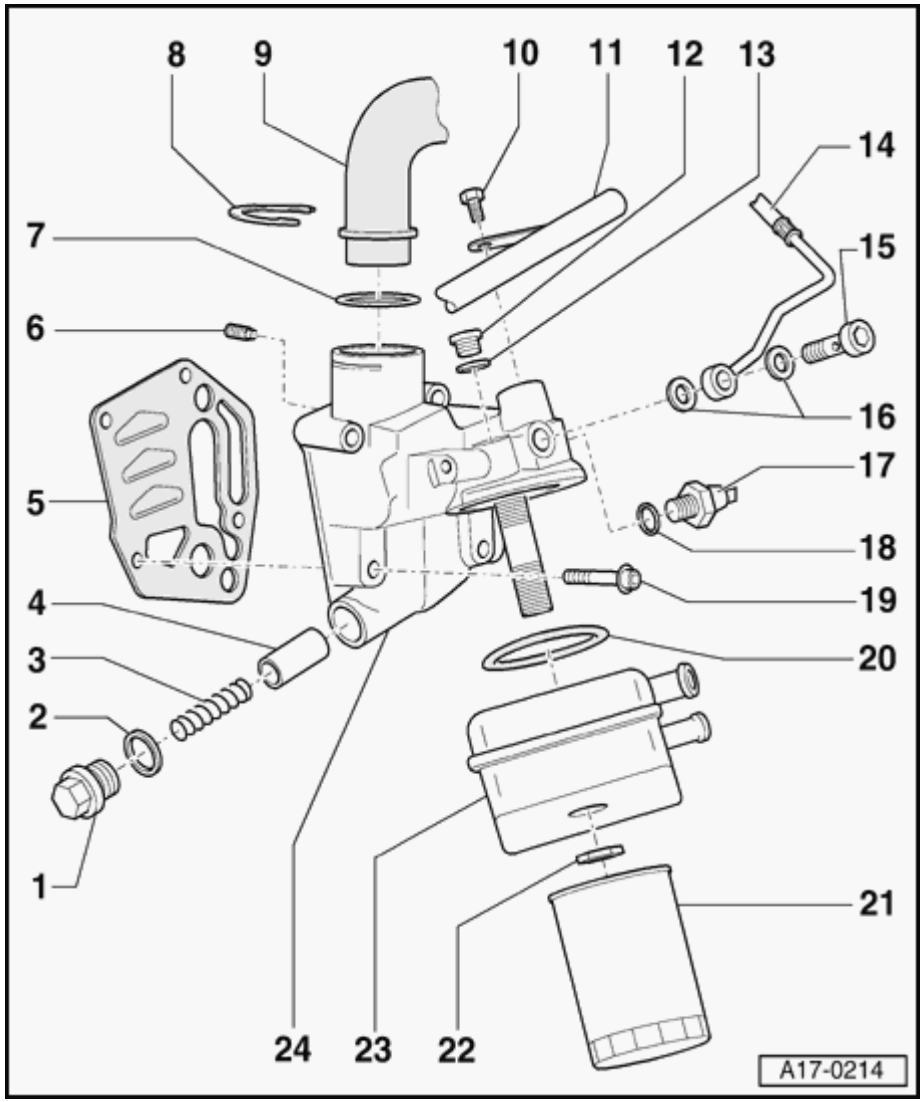
21 - Oil filter

- Observe change intervals

⇒ *Repair Manual, Maintenance*

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

17-10



22 - 25 Nm

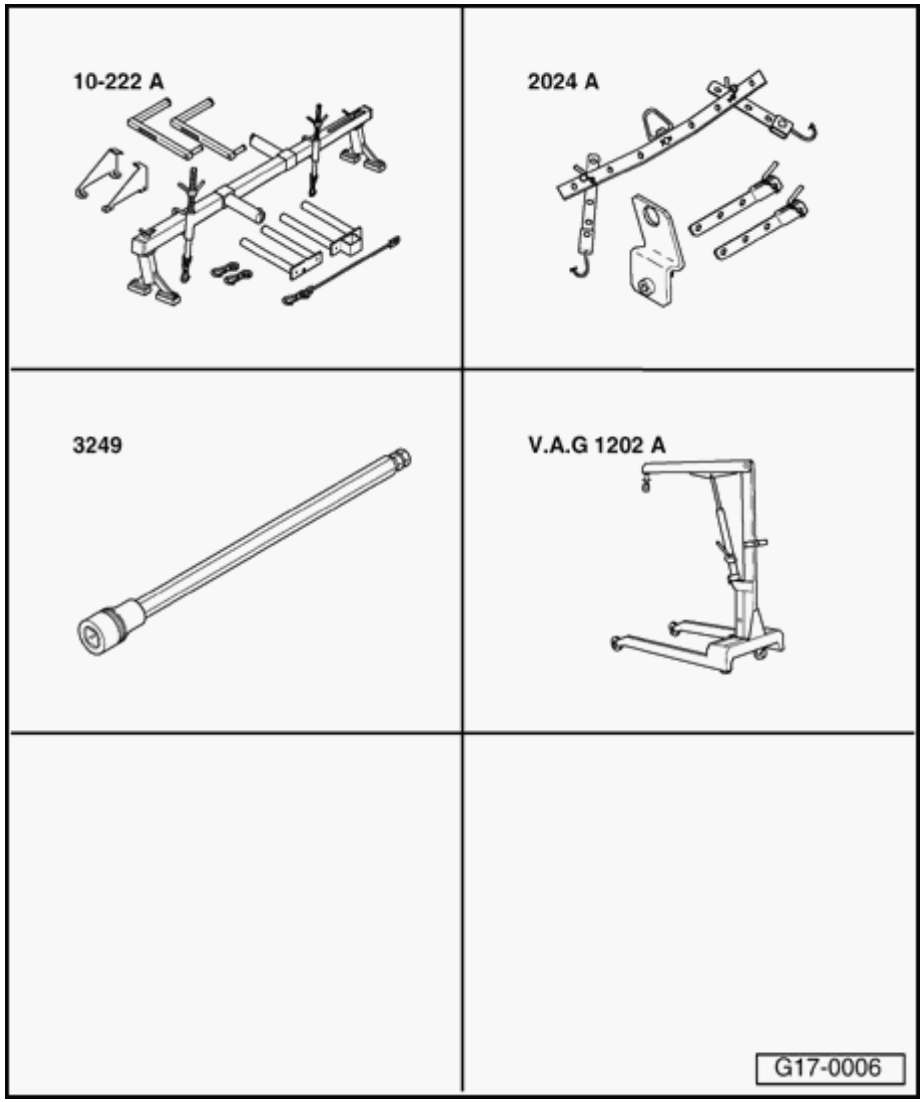
23 - Oil cooler

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

24 - Oil filter bracket

- With pressure relief valve, approx. 4 bar

17-11



Oil pan, removing and installing

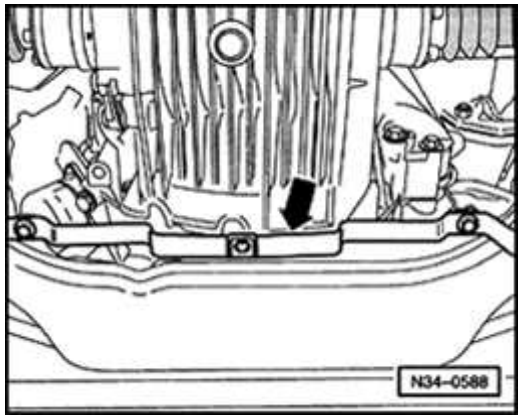
Special tools and equipment

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

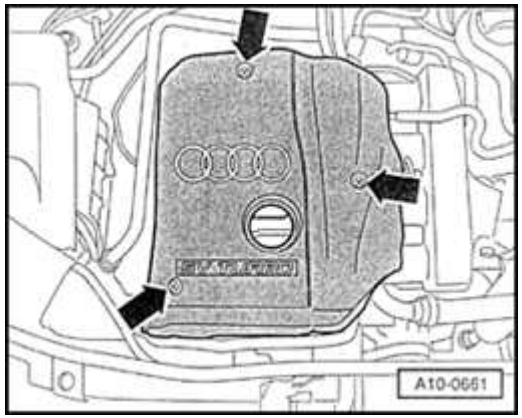
17-12

Removing

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

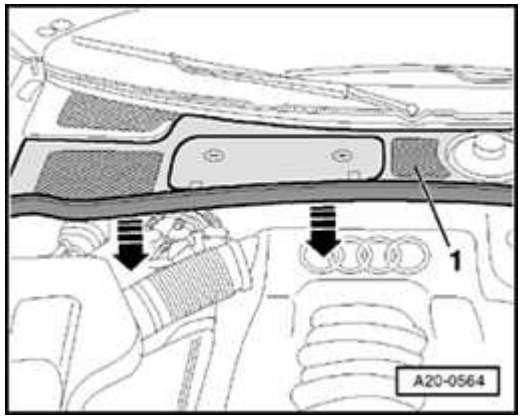


- Unbolt bracket for sound insulation -arrow-.
- Remove air duct hose on bottom left on charge air cooler.

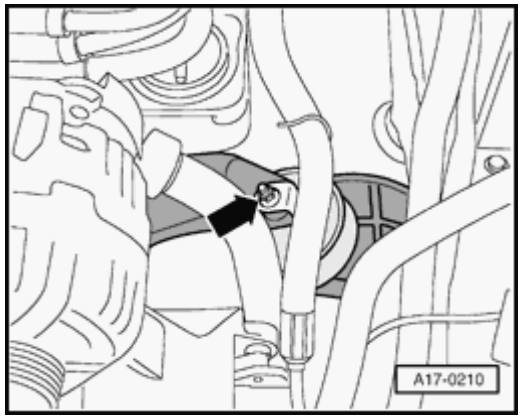


- Remove engine cover -arrows-.

17-13

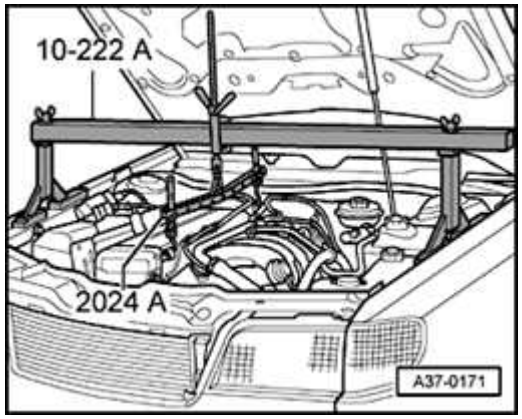


- Remove seal from plenum chamber cover in direction of arrow.
- Remove plenum chamber cover -1- from front.

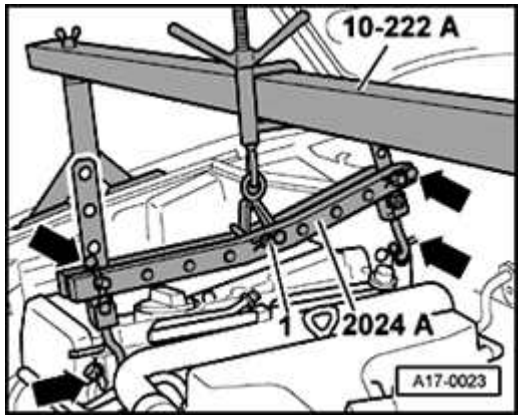


- Remove nut -arrow- from top of left engine mounting.

17-14

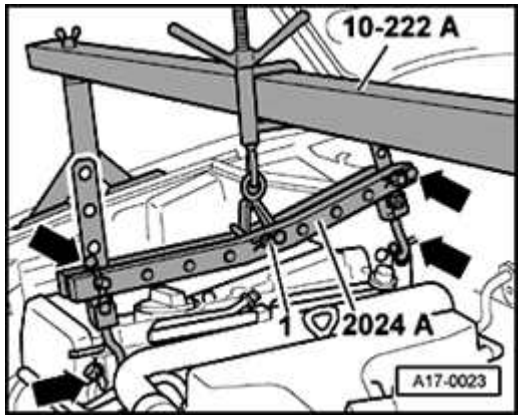


- Set up support bar 10-222 A on fender panel flanges.



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

17-15

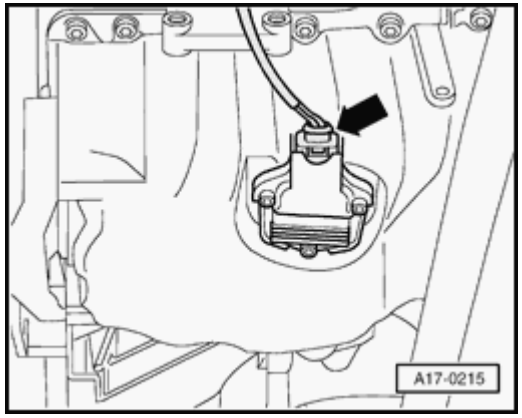


- Engage lifting tackle 2024 A in front and rear lifting eyes on engine.

CAUTION!

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

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



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

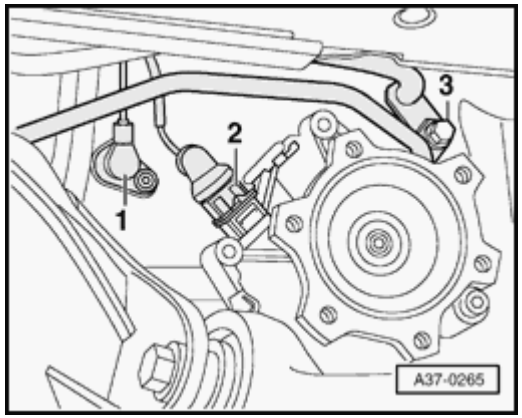
17-16

Vehicles with automatic transmission:

Note:

Observe cleanliness rules when working on the automatic transmission:

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



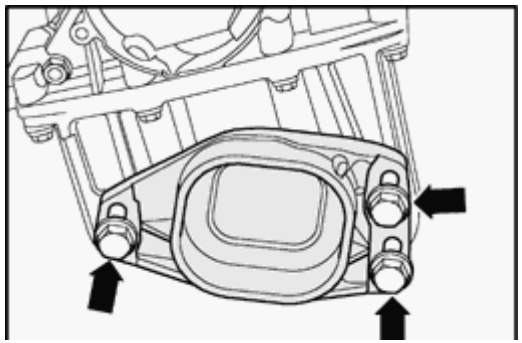
- Remove bolt -3- and disconnect ATF lines from transmission.

Note:

Ignore positions -1- and -2-.

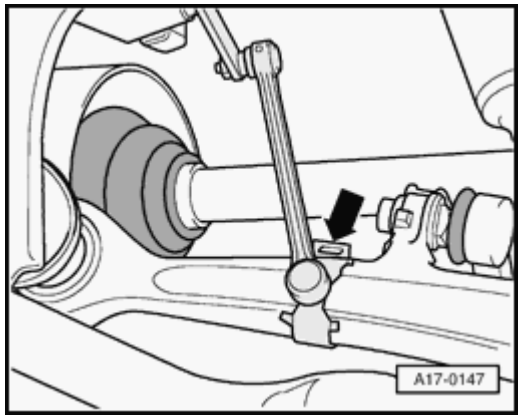
- Remove bracket for ATF lines from engine.
- Move ATF lines aside.

All models:

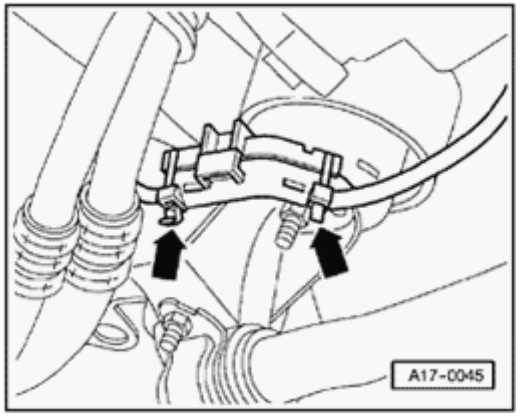


- Remove stop for torque reaction support -arrows-.

17-17

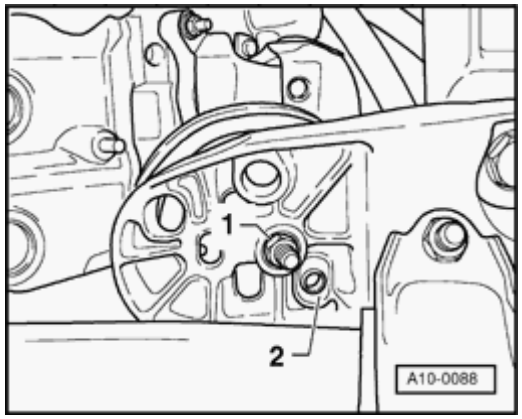


- Where present unclip operating rod of vehicle level sender from lower transverse link -arrow-.



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

17-18

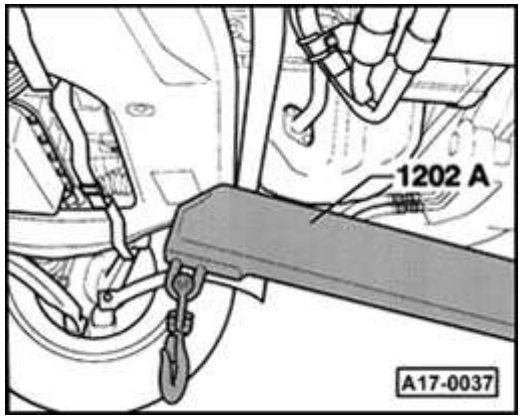


- Mark positions of mountings -1- and locating sleeves -2- on left and right engine mountings (lower).

Note:

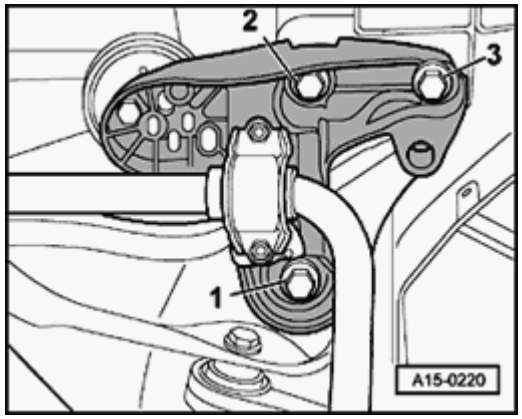
Different mounting holes are provided for the different engine versions.

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



- Support subframe with workshop crane VAG 1202 A.

17-19

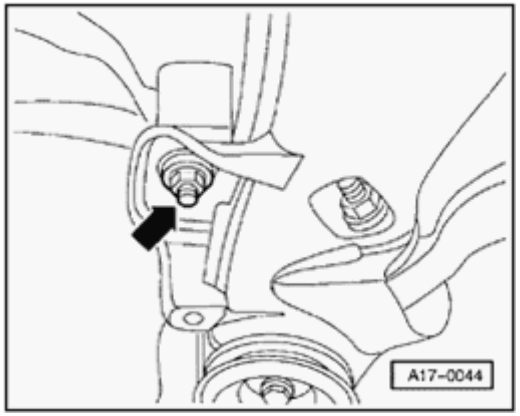


- Remove front subframe bolts -2- and -3- (left and right) and loosen bolts -1-.

Note:

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

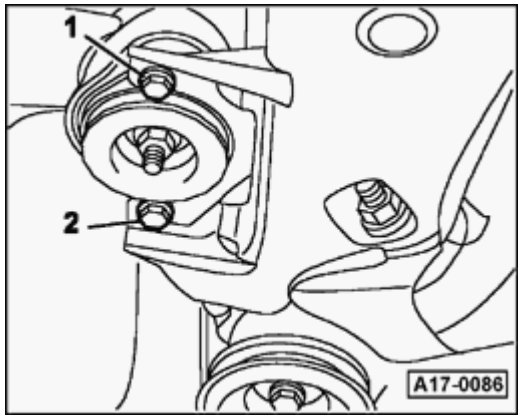
Vehicles with manual transmission



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

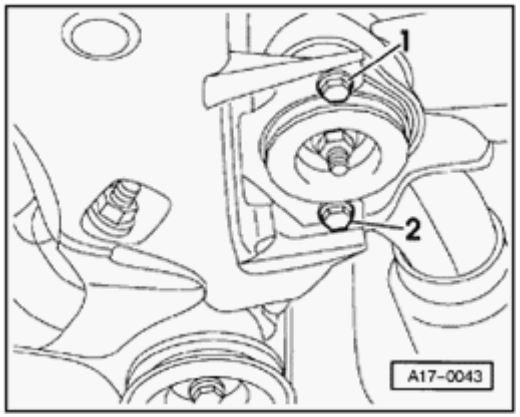
17-20

Vehicles with automatic transmission:



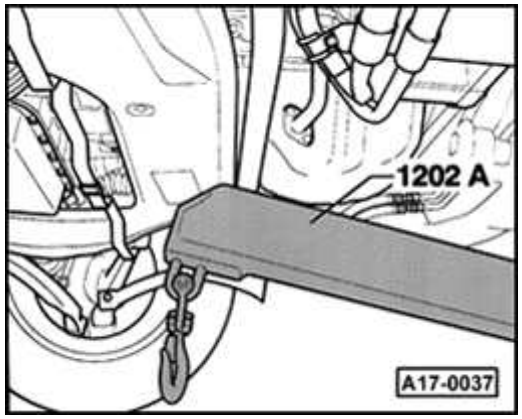
- Loosen rear bolt -2- on left transmission mounting a few turns; remove front bolt -1- on left transmission mounting.

All models:

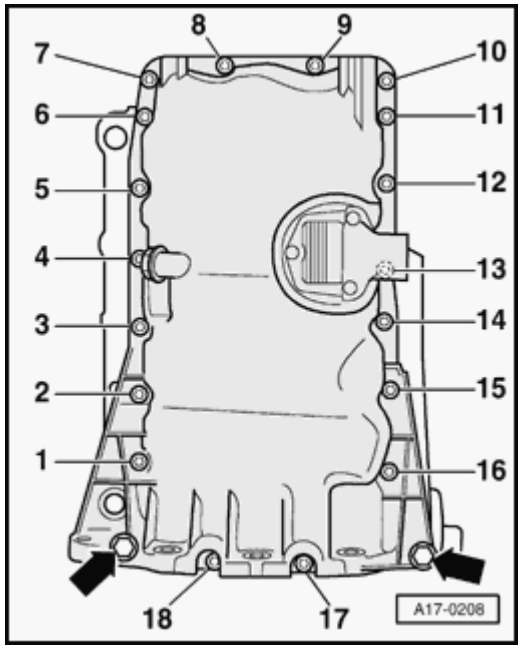


- Loosen rear bolt -2- on right transmission mounting a few turns; remove front bolt -1- on right transmission mounting.

17-21



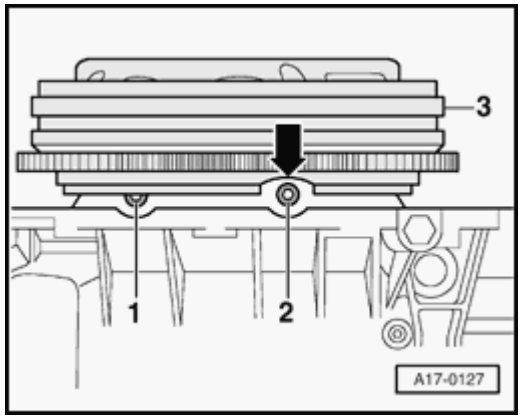
- Lower subframe slowly using workshop crane 1202 A.
- Take out workshop crane VAG 1202 A.
- Remove bolts for oil pan/transmission:



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

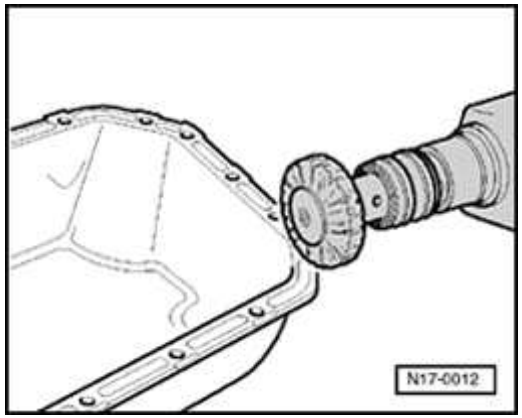
17-22

Note:



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

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



➢

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

WARNING!

Wear protective glasses.

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

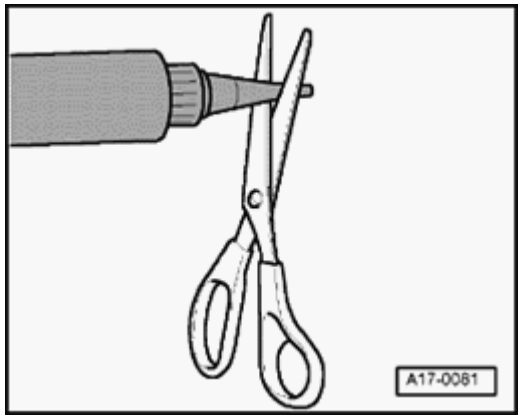
17-23

Installing

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

Note:

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

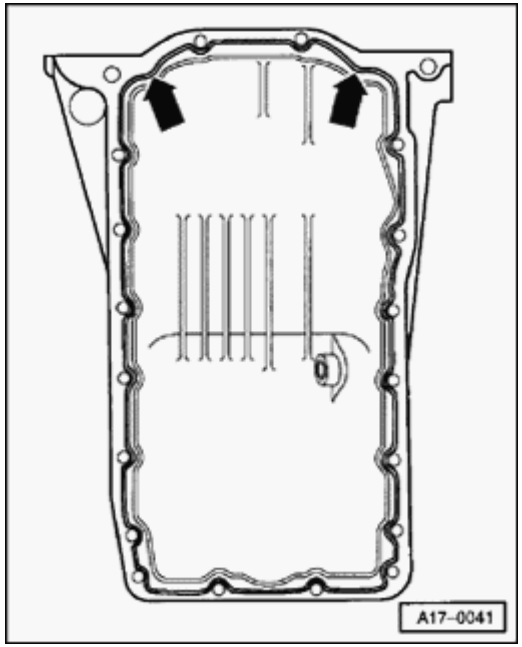


- Cut off nozzle of tube at front marking (diameter of nozzle approx. 3 mm).
  - Silicone sealant D 176 404 A2
  - Thickness of sealant bead: 2 to 3 mm

17-24

Note:

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



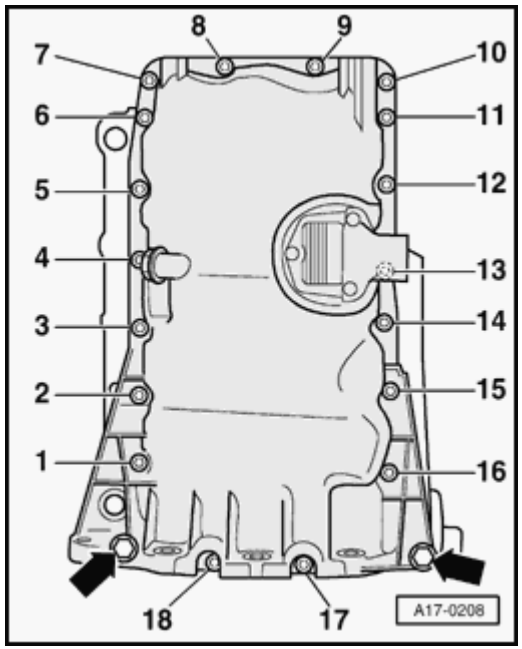
- Apply bead of silicone sealant onto clean sealing surface of oil pan, as illustrated. (Illustration shows position of sealant bead on cylinder block).

Note:

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

17-25

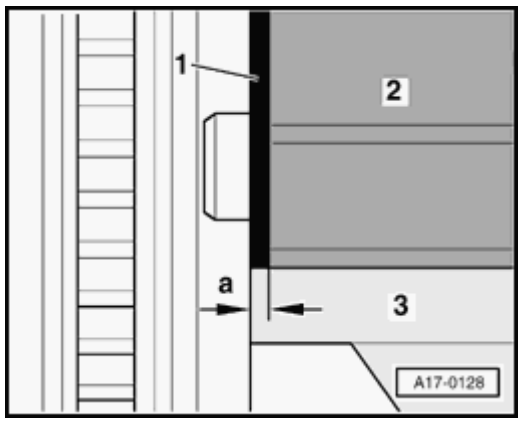
- Immediately attach oil pan and tighten bolts in described sequence:



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

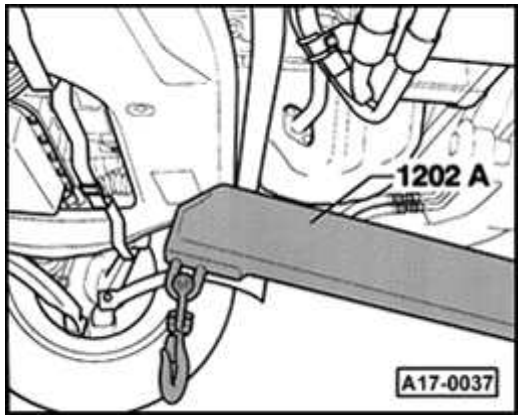
Note:

- *Replace seals and gaskets.*



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

17-26



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

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

Vehicles with automatic transmission:

- Secure ATF lines.

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

All models:

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

Vehicles with automatic transmission:

- Check ATF level:

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

Tightening torques

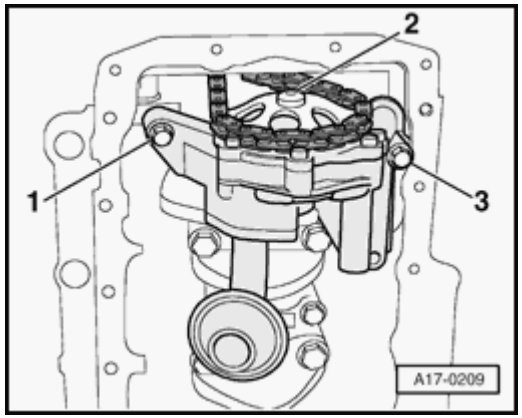
Component		Nm
Oil pan to cylinder block	M7	15
	M10	40
Oil pan to transmission		45
Limit stop for torque reaction support on oil pan		28
Engine mounting to subframe		25
Engine mounting to engine support		25
Transmission support to transmission support	M10	40
Transmission mounting to subframe	M8	25
Oil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

17-28

Oil pump, removing and installing

Removing

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



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

Installing

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

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

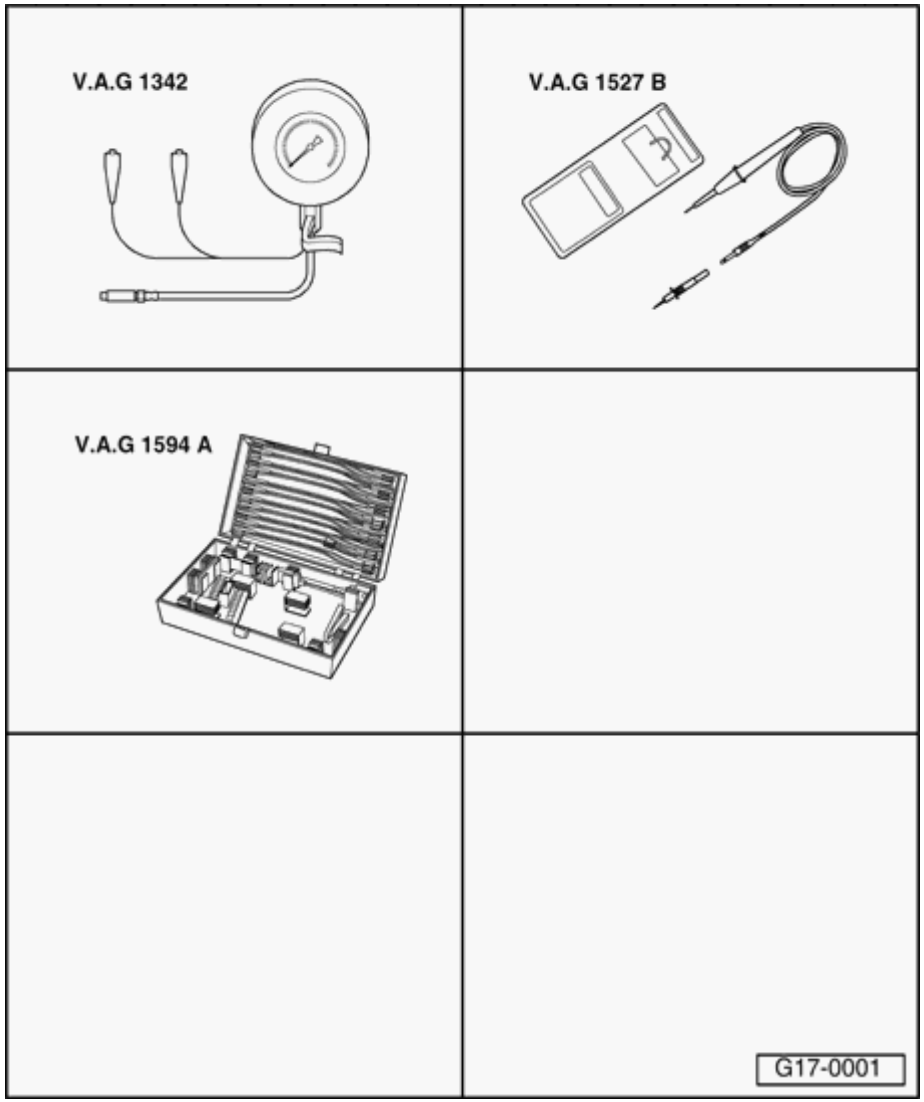
  - ♦ Oil pump shaft/sprocket wheel location: Can only be installed in one position.

- Installing oil pan ⇒ Page 17-23

Tightening torques

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

17-30



Oil pressure and oil pressure switch, checking

Special tools and equipment

- VAG 1342
- VAG 1527 B
- VAG 1594 A

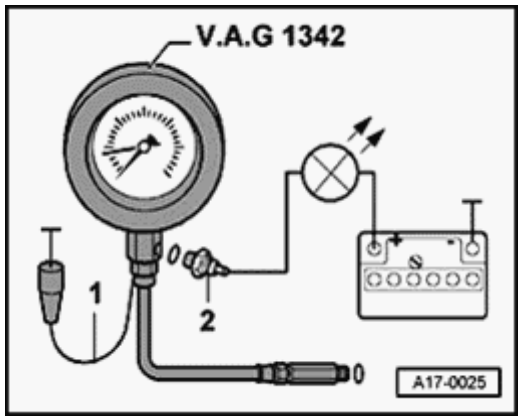
17-31

Test requirements:

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

Testing oil pressure switch

- Disconnect wire from oil pressure switch.



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

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

  - Test lamp should not light up.

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

- Start engine.

Note:

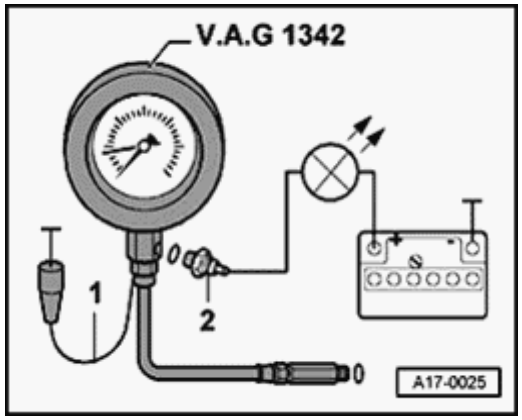
The switching point of the oil pressure switch can be reached when the engine is cranked on the starter motor, so watch the tester and the test lamp while starting the engine.

Black oil pressure switch:

  - LED must light up at 1.2 to 1.6 bar.

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

17-33



Check oil pressure

- Disconnect wire from oil pressure switch.

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

If specified values are not attained:

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

17-34

Engine oil

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

Viscosity grades and oil specifications

Viscosity grades and oil specifications:

⇒ *Repair Manual, Maintenance*

17-35

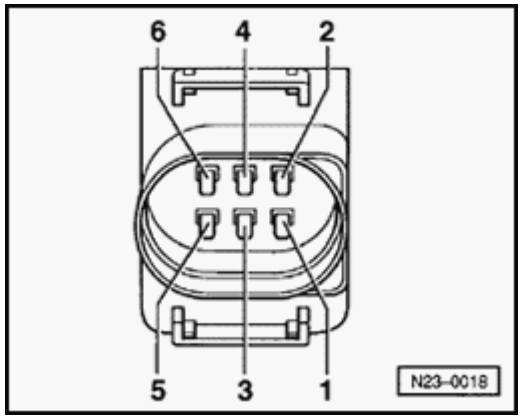
Engine oil level, checking

Test requirements:

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

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

- Pull out dipstick again and read oil level.



Markings on oil dipstick:

a - Oilmust not be topped up.

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

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

Note:

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

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 again. 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, i.e. by partial seizure of the crankshaft or connecting rod bearings) are found in engine oil, thoroughly clean oil passages and replace oil cooler to prevent damage from re-occuring.***

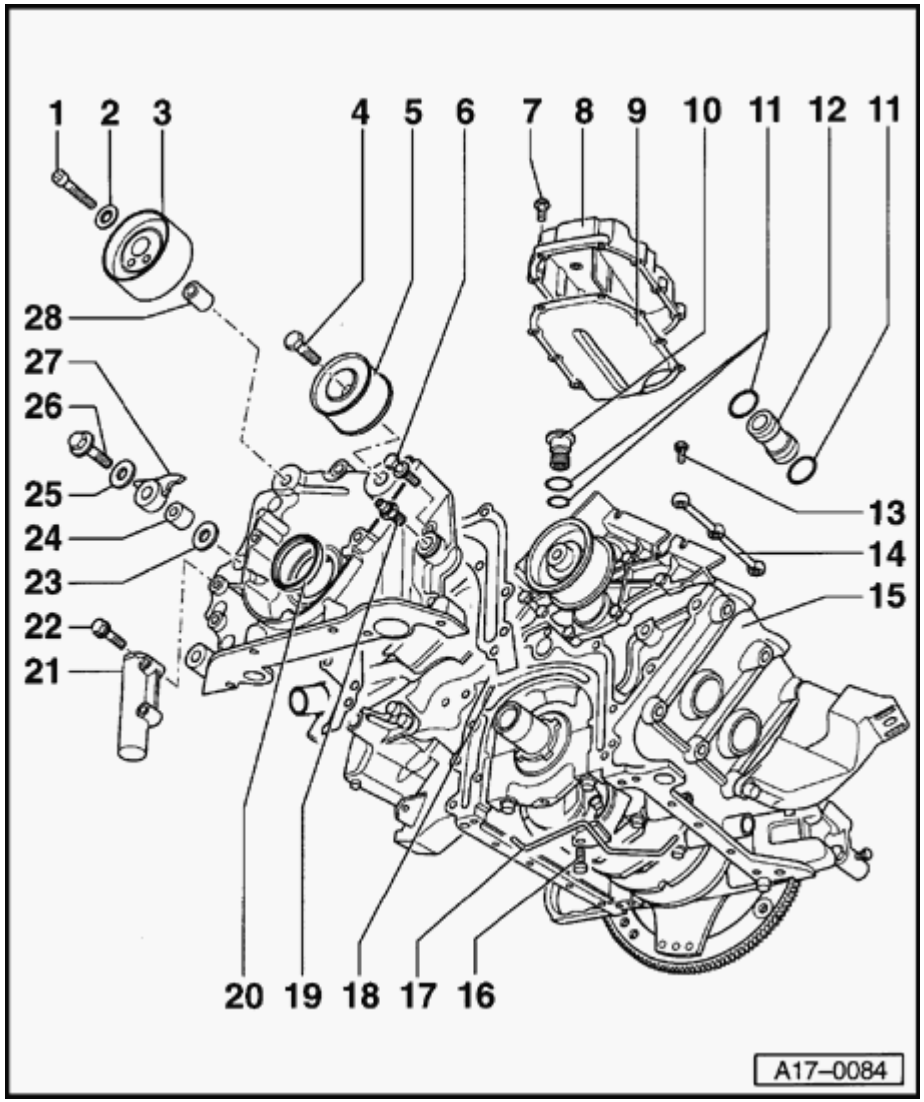
- ***Do not overfill with oil past the MAX mark on the oil dipstick. Damage to the Three Way Catalytic Converter (TWC) could result.***

Checking oil level ⇒ ***page 17-32*** **.**

Notes:

- *Always replace seals and gaskets.*
- *Viscosity classes and oil specifications* ⇒ *page 17-31* .
- *Checking oil pressure* ⇒ *page 17-30* .

17-2



Oil pump, cylinder block breather and oil spray jets, removing and installing

Oil pan (upper part) and oil pan (lower part), removing and installing ⇒ page 17-10 .

1 - Bolt

- 20 Nm (15 ft lb)

2 - Washer

3 - Tensioner roller

- For toothed belt

4 - Bolt

- 45 Nm (33 ft lb)

5 - Bolt

- 10 Nm (7 ft lb)
- For toothed belt

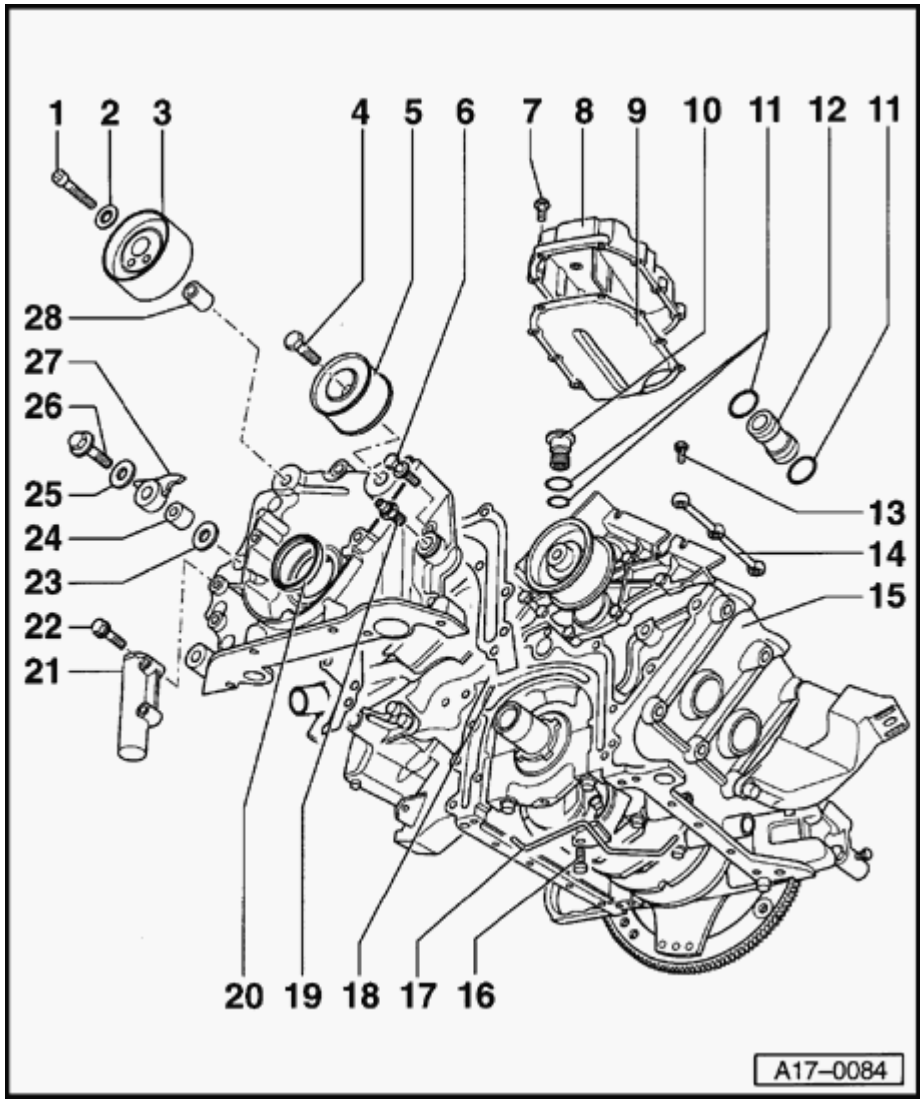
6 - Bolt

- 10 Nm (7 ft lb)

7 - Bolt

- 10 Nm (7 ft lb)

17-3



8 - Breather housing

9 - Gasket/breather plate

- Always replace

10 - Oil check valve

- 25 Nm (18 ft lb)

11 - Oil seal

12 - Connector

13 - Bolt

- 15 Nm (11 ft lb)

14 - 15 Nm

- For oil spray jets for piston cooling

15 - Cylinder block

16 - Bolt

- 10 Nm (7 ft lb)
- Use locking fluid D 000 600 A2 when installing

17 - Oil spray jet

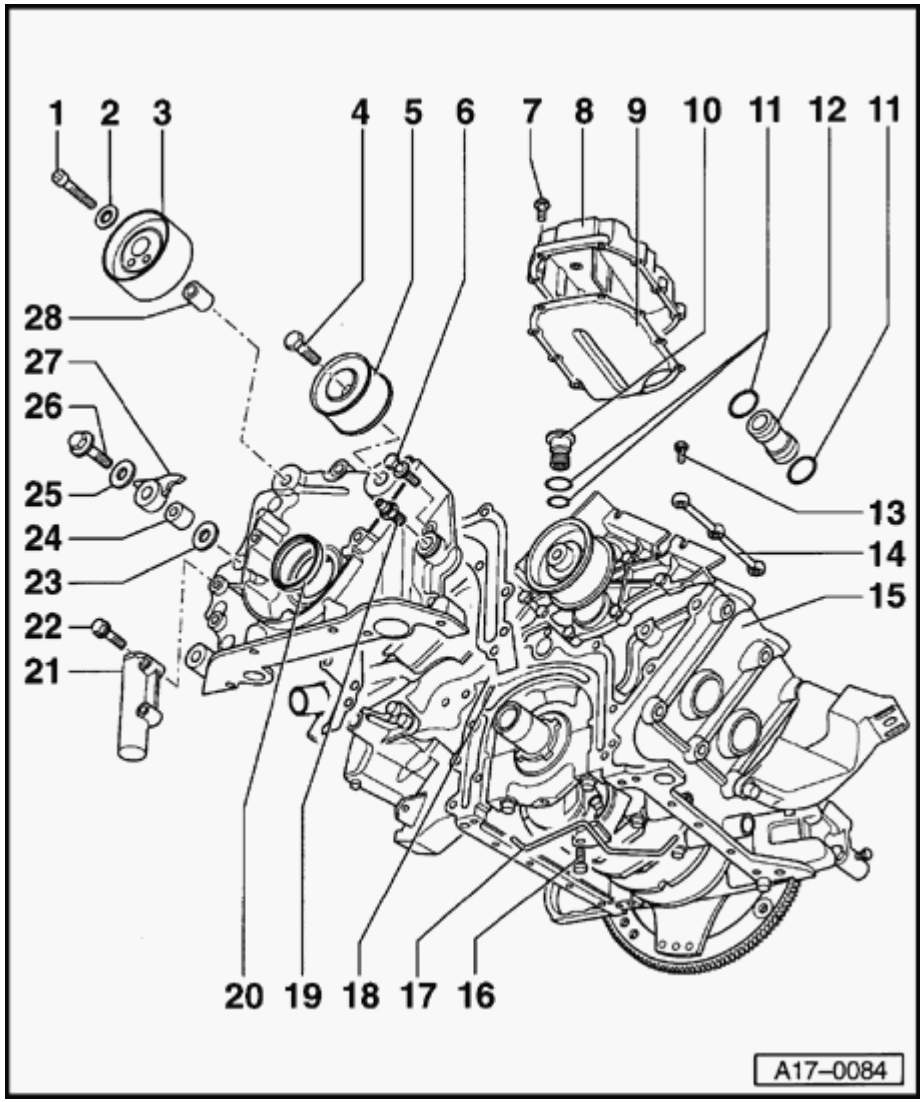
- For piston cooling

18 - Gasket

- Metal gasket

- Always replace

17-4



19 - Engine oil temperature sensor -G8-

- 10 Nm (7 ft lb)
- For oil temperature gauge
- White
- If seal is leaking, replace seal

20 - Oil seal

- Replacing ⇒ page 15-14

21 - Tensioner

- Compress and secure before removing ⇒ page 13-12

22 - 10 Nm

- Use locking fluid D 000 600 A2 when installing

23 - Washer

24 - Bearing bushing

- For tensioner lever

25 - Washer

26 - Bolt

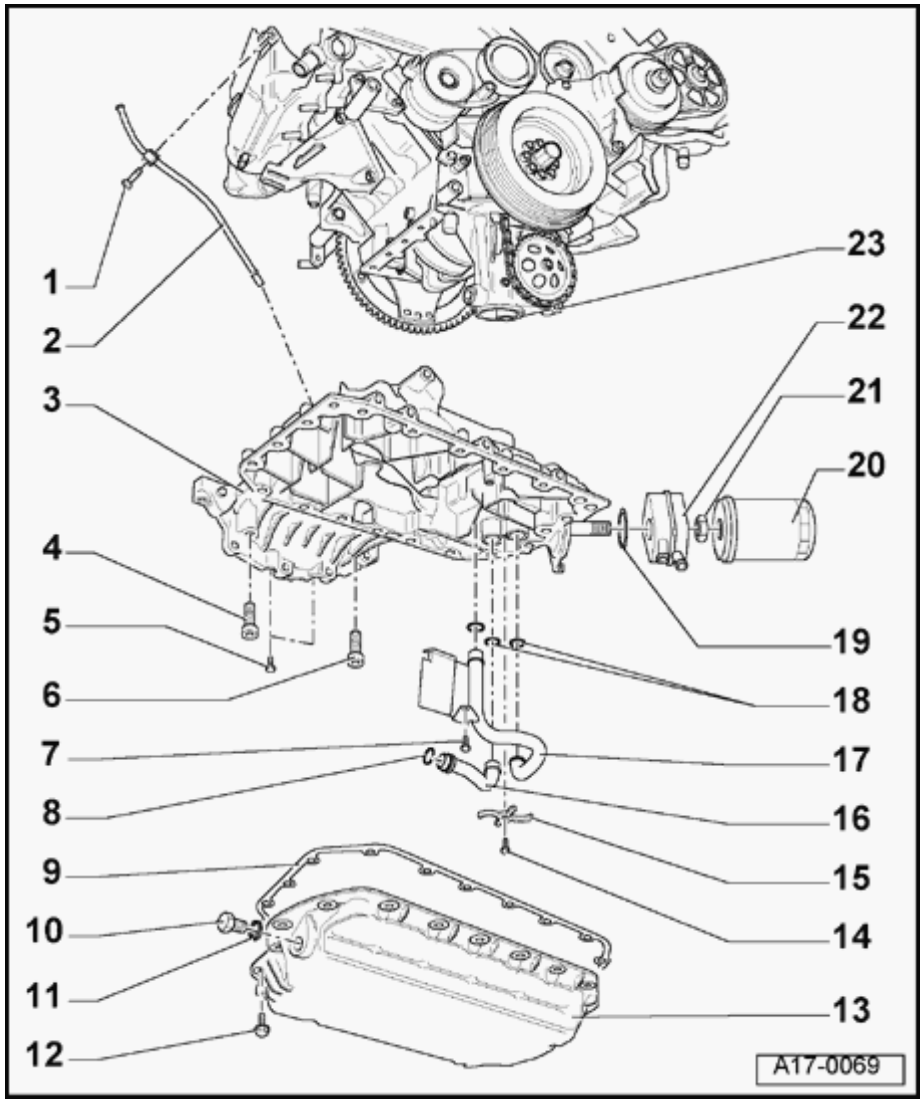
- 25 Nm (18 ft lb)

27 - Tensioning lever

28 - Bearing bushing

- For tensioner roller

17-5



Oil pump, oil pan, oil filter, oil cooler, removing and installing

1 - Bolt for dipstick tube

- 25 Nm (18 ft lb)

2 - Dipstick tube

- Replace O-ring

3 - Oil pan (upper part)

- No gasket is installed between engine block and oil pan (upper part)
- Only use silicon sealant D 454 300 A2

4 - Bolt

- M8
- 20 Nm (15 ft lb)

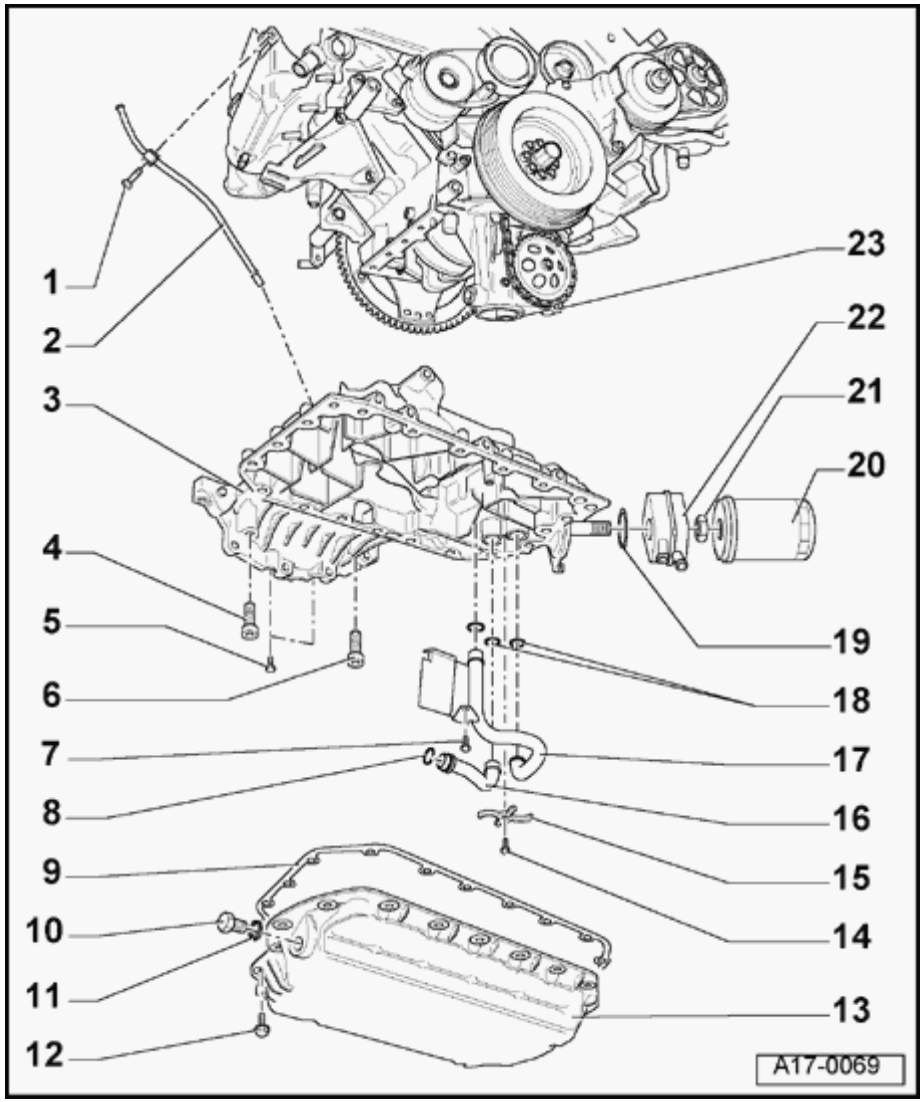
5 - Bolt

- M6
- 15 Nm (11 ft lb)

6 - Bolt

- M8
- 20 Nm (15 ft lb)
- Bolt is next to coolant drain plug

17-6



7 - Bolt

- M6
- 10 Nm (7 ft lb)

8 - O-ring

- Always replace

9 - Gasket for oil pan (lower part)

- Sealing surfaces clean and dry

10 - Oil drain plug

- 30 Nm (22 ft lb)

11 - Gasket for oil drain plug

- Always replace

12 - Bolt

- M6
- 10 Nm (7 ft lb)

13 - Oil pan (lower part)

14 - Bolt

- M6
- 10 Nm (7 ft lb)

15 - Bracket for oil lines

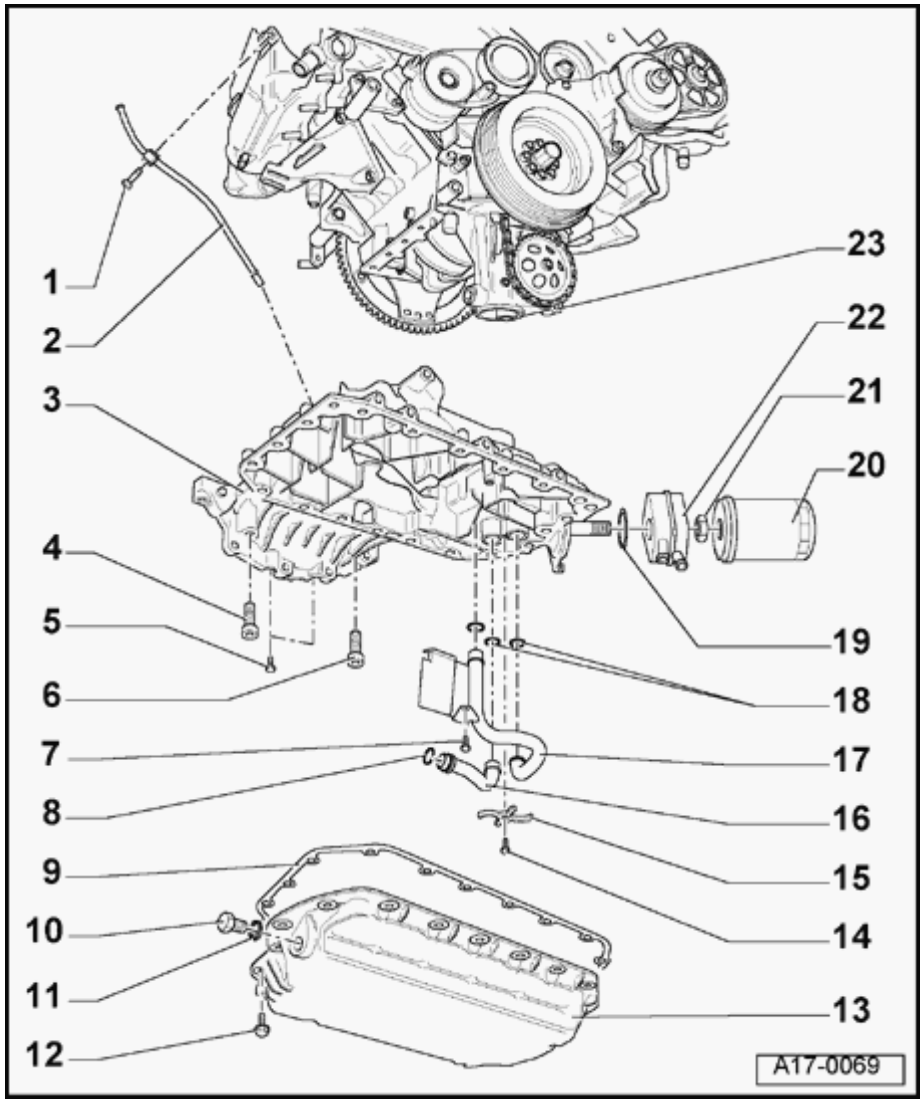
16 - Oil supply line

- From pump to oil filter

17 - Oil supply line

- From oil filter to engine oil circulation

17-7



18 - O-ring

- Always replace

19 - O-ring

- Always replace

20 - Oil filter

21 - Hex nut

- 30 Nm (22 ft lb)
- Threaded pipe for oil cooler and oil filter installed in oil pan (upper part) and tightened to 20 Nm (15 ft lb)

22 - Oil cooler

- When installing, make sure O-ring is seated correctly

23 - Oil pump

- Disassembling and assembling ⇒ Fig. 1
- Driven by chain from crankshaft
- Tightening torque (chain sprocket to oil pump): 25 Nm (18 ft lb)
- Tightening torque (oil pump to engine block): 25 Nm (18 ft lb)

17-8

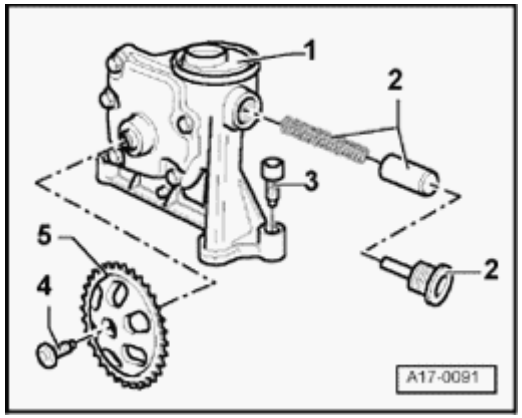


Fig. 1 Removing and installing oil pump

1 - Oil pump

Cannot be disassembled (oil pressure release valve is integrated with oil pump)

2 - Pressure regulation valve

Tightening torque: 40 Nm (30 ft lb)

3 - Tightening torque: 20 Nm (15 ft lb)

4 - Tightening torque: 25 Nm (18 ft lb)

5 - Chain sprocket

When installing, make sure shaft fits chain sprocket

17-9

Oil check valve, replacing

Note:

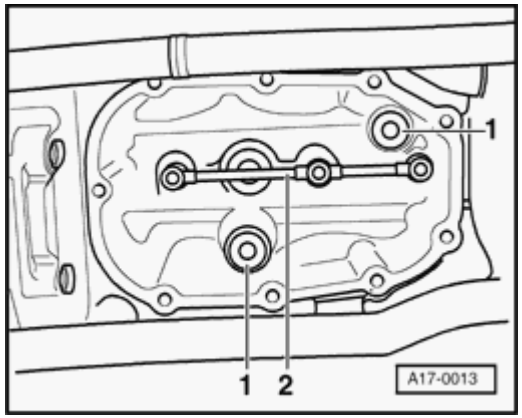
If irregular valve noise occurs repeatedly during short periods of driving and disappears after extended periods of driving, the oil check valves must be replaced.

- Remove intake manifold.

  Tightening torque: 10 Nm (7 ft lb)

- Remover cover under intake manifold.

  Tightening torque: 10 Nm (7 ft lb)



- Replace oil check valves -1-.

  Tightening torque: 25 Nm (18 ft lb)

Note:

The opening also contains distribution line -2- for supplying jets for piston cooling.

17-10

Oil pan (upper part) and oil pan (lower part), removing and installing

Special tools and equipment

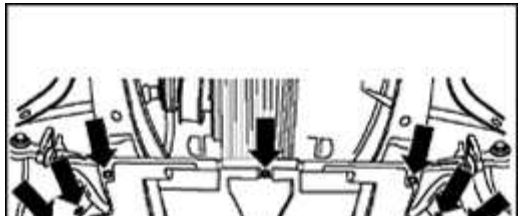
- Drill with plastic brush attachment
- Sealant D 454 300 A2
- Torque wrench 10 Nm - 45 Nm

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

CAUTION!

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

- Withdraw dipstick.
- Unbolt dipstick tube at right-front of cylinder head, pull up and remove.



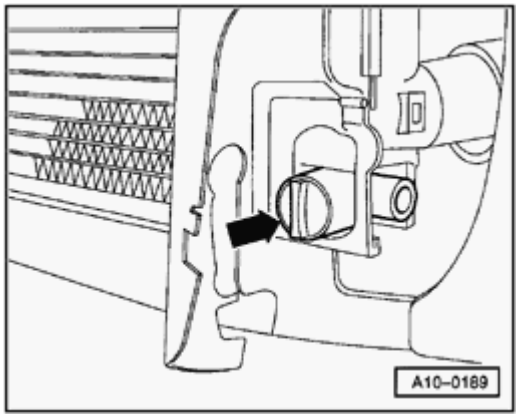
- Remove noise insulation panel (arrows).

17-11

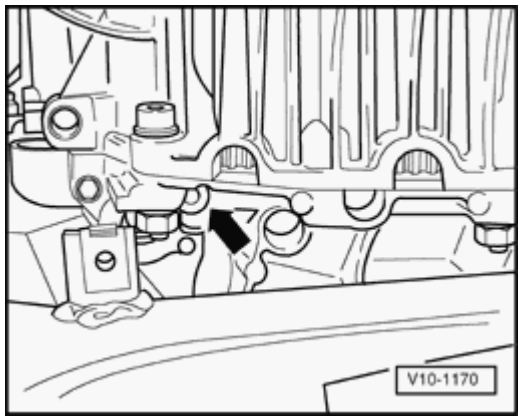
- Lock carrier in service position ⇒ page 13-1

- Open engine coolant expansion tank cap.

- Place VAG1306 drip tray beneath engine.



- Turn radiator drain plug counterclockwise (arrow). If needed, attach tube to connection flange.



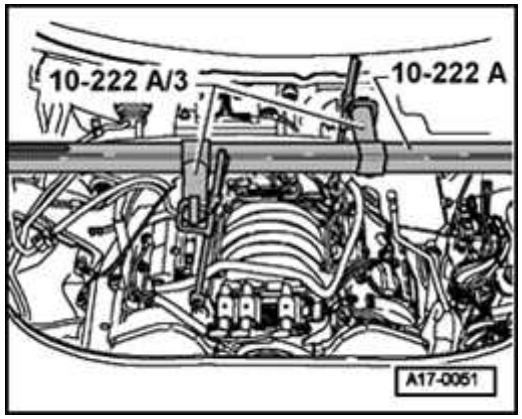
- Open coolant pump bearing housing drain plug as well (arrow).
- Drain engine coolant.
- Drain engine oil.

Collect engine oil in appropriate receptacle.

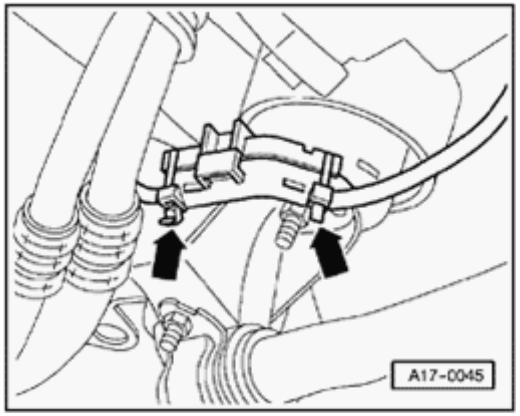
Vehicles with automatic transmission

- Unbolt oil cooler line bracket from right-side of oil pan.

17-12

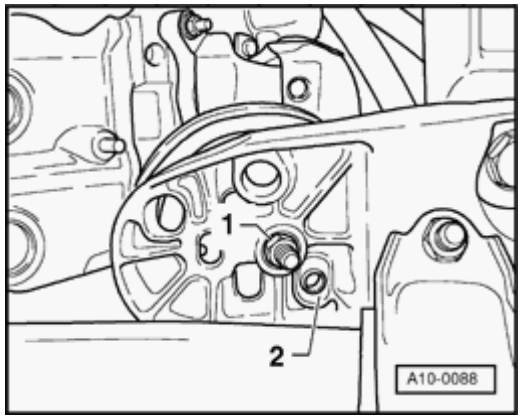


- Set 10-222A engine support bridge together with 10-222A/3 engine support adapter on fender mounting edges.
- Attach 2024A engine sling to mounting eyes at front and rear of engine.
- Using 10-222A engine support bridge spindle, lift up engine as far as possible.

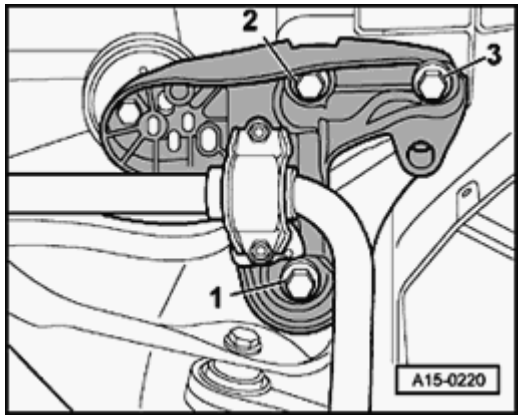


- Cut tie wraps (arrows), open bracket for starter wiring and remove wiring.
- Remove torque support at front of engine.
- Unbolt coolant line at front of engine from oil pan.
- Disconnect harness connector from oil pressure switch on left-side of oil pan.
- Disconnect coolant lines from oil cooler underneath oil filter.

17-13



- Remove left and right nuts from lower engine mount -1-.
- Mark installation positions for threaded assembly -1- and guide sleeves -2- on left and right lower engine mounts.

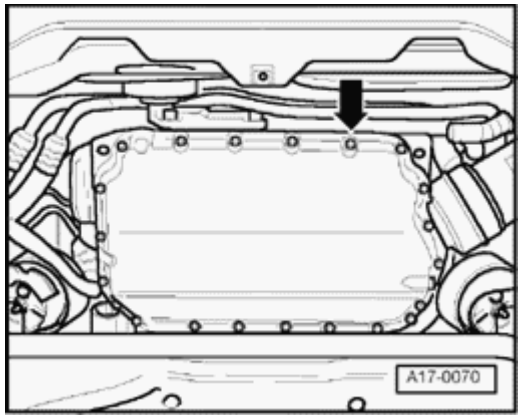


- First remove front bolts -2- and -3- from left and right-sides of subframe. Then remove bolts -1-.
- Swing stabilizer down.
- Remove starter.

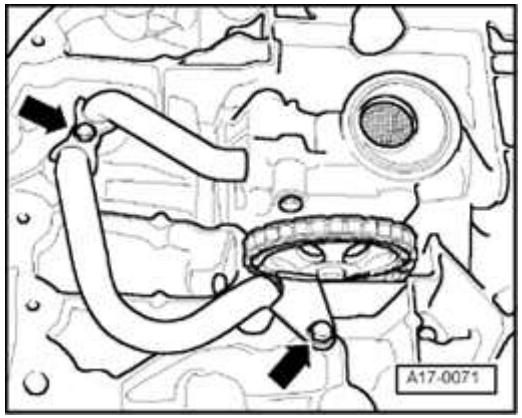
Note:

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

17-14

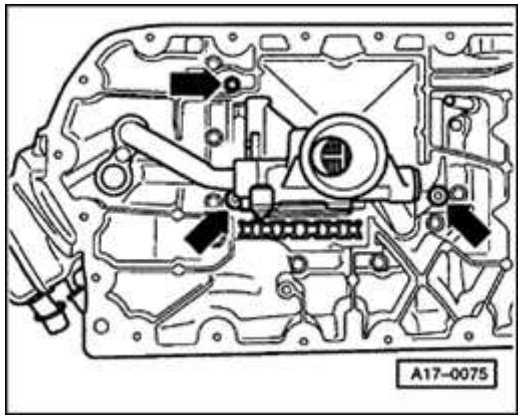


- Remove oil pan (lower part) and oil pan (upper part).



- Unbolt both oil supply lines. Pull longer of two lines down and off oil pan (upper part).

17-15



- Unbolt oil pump from engine to allow removal of shorter oil supply line (do not remove oil pump).
- Remove bolts between oil pan (upper part) and transmission.
- Unbolt oil pan (upper part) from engine.

Note:

Two M6 and two M8 bolts are installed vertically in rear of oil pan (upper part) in front of connection between engine and transmission.

17-16

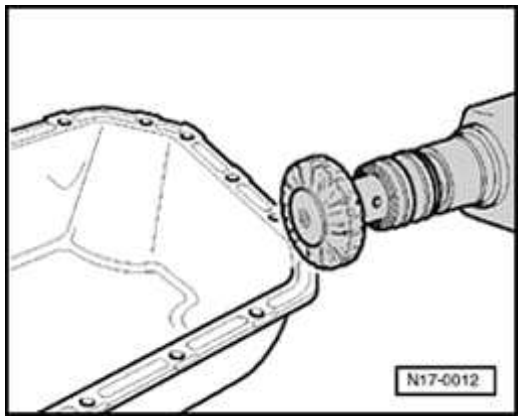
Installing

Installation is the reverse of removal, noting the following:

- Clean sealing surfaces so they are completely free of any oil or grease.

WARNING!

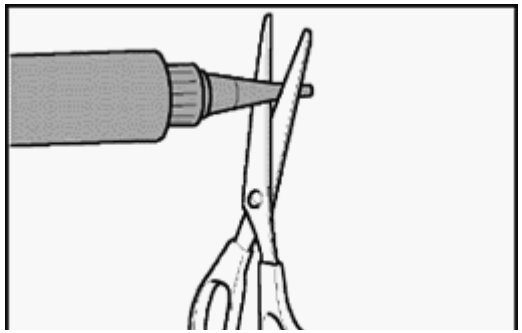
Wear protective glasses.



- Using rotating plastic brush, remove any remaining sealant from oil pan.

Note:

After applying silicon sealant D 454 300 2, oil pan must be installed within 5 minutes.



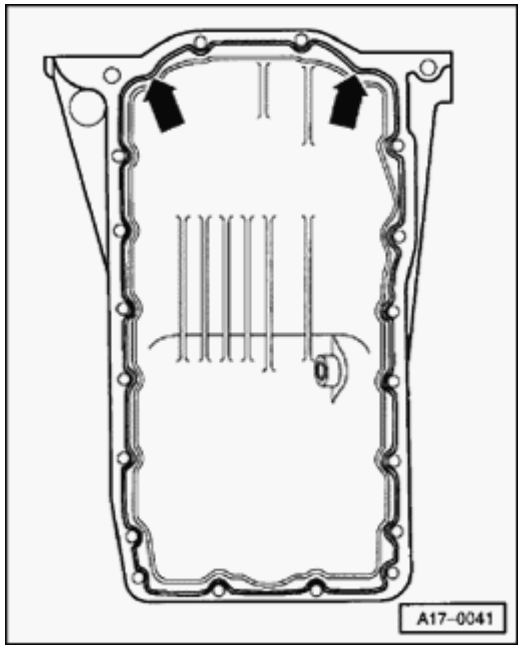
- Cut tube jet at front marking (jet diameter approx. 3 mm).

  Thickness of sealant: 2-3 mm (0.04-0.12 in.)

Note:

Sealant must not be thicker than 3 mm, otherwise excess sealant may get into the oil pan and clog the oil intake strainer.

17-17



- Apply silicon sealant to clean sealing surface as shown in illustration. (The illustration shows placement of sealant on cylinder block.)

Note:

Be especially careful when applying sealant to rear oil seal carrier (arrows in illustration A17-0041).

- Immediately install oil pan and tighten all bolts between oil pan and engine block to 5 Nm (44 in. lb).
- Tighten bolts between oil pan and transmission to 45 Nm (33 ft lb).
- Tighten bolts between oil pan and engine block in 2 stages in diagonal sequence.

  Finally sequence tightening torque: 15 Nm (11 ft lb)
- Tighten M10 bolts between oil pan and cylinder block to 45 Nm (33 ft lb).
- Clean both sealing surfaces on oil pan (lower part) so they are free of oil and grease.

Note:

Do not use glue or sealant.

- Install new gasket on oil pan (lower part) and attach to oil pan (upper part) with two bolts diagonal to each other.
- Tighten all bolts hand tight.

17-18

- Starting in center and moving toward outside, tighten bolts to 10 Nm (7 ft lb).

- Install new seal on oil drain plug and tighten to 30 Nm (22 ft lb).

Notes:

- *When installing oil pan on removed engine, make sure oil pan is aligned with cylinder block on flywheel side.*

- *After installing oil pan, allow sealant to dry for approx. 30 minutes. Only after allowing sealant to dry may engine oil be added.*

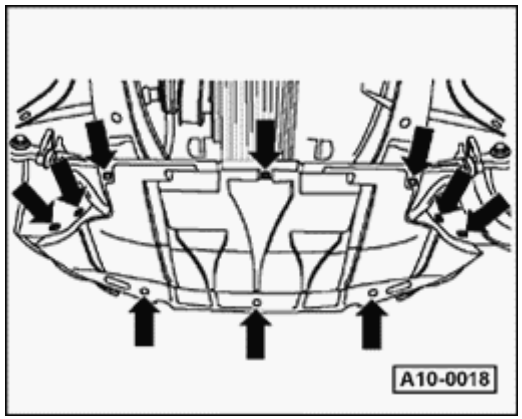
- Install subframe.

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

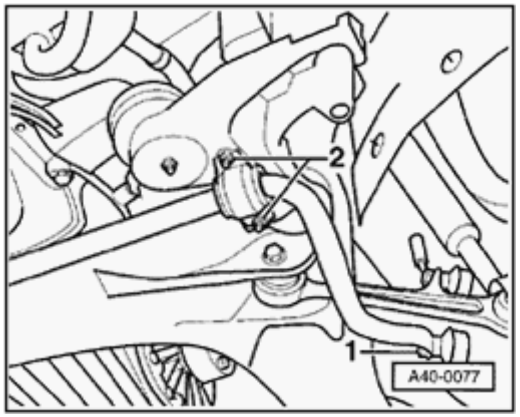
- Install lock carrier.

17-19

Oil pump, removing and installing



- Remove noise insulation panel (arrows).
- Drain engine oil.
- Collect engine oil in appropriate receptacle.

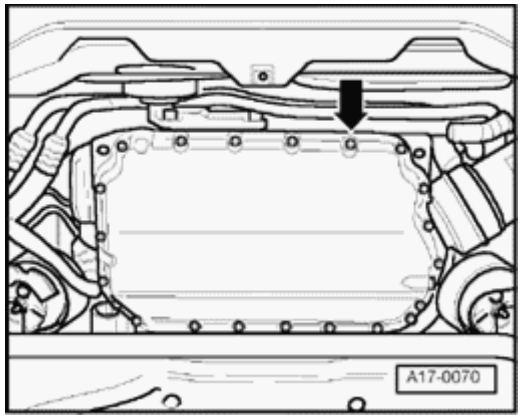


- Unbolt both stabilizer mounting brackets -2- from subframe.
- Lower stabilizer not more than 10 cm (3.94 in.) and secure using wire.

Vehicles with automatic transmission

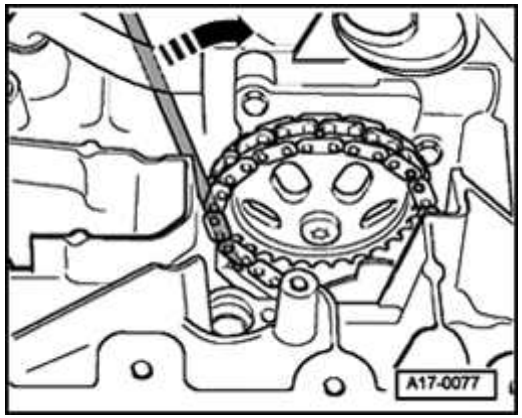
- Unbolt oil cooler line bracket from right-side of oil pan.

17-20



- Remove oil pan (lower part) ⇒ page 17-10 .

Checking chain tensioner

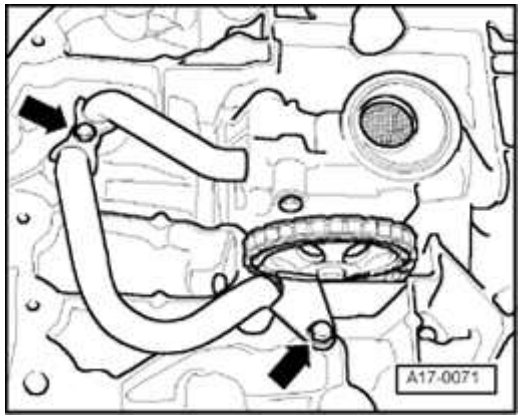


- Insert screwdriver between chain and chain tensioner and lift against chain tensioner.

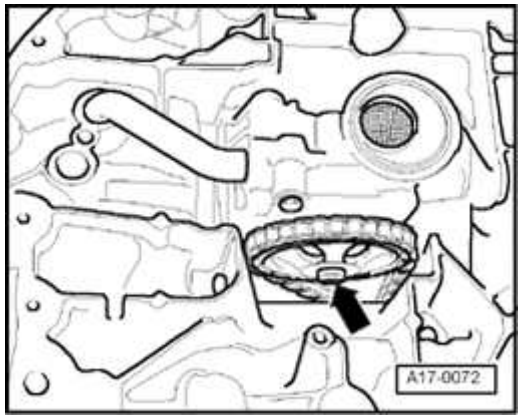
  If no spring tension is evident and chain is not under tension, chain tensioner is damaged and must be replaced.

- Before replacing chain tensioner, remove front oil seal carrier ⇒ page 17-26 .

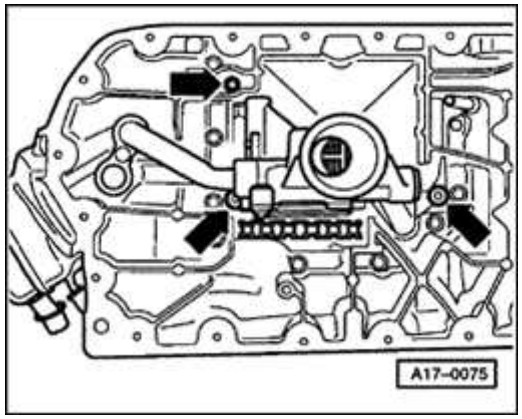
17-21



- Unbolt bracket for oil supply lines (arrows) and pull front oil supply line (longer line) down and remove.



- Using Torx® T45, unbolt chain sprocket from oil pump and pull off oil pump.



- Remove oil pump together with shorter oil supply line.

Installing

Installation is the reverse of removal, noting the following:

- Before installing oil pump, install short oil supply line together with O-rings into pump and into oil pan (upper part).
- Clean both sealing surfaces on oil pan (lower part) so they are free of oil and grease.

Note:

Do not use glue or sealant.

- Install new gasket on oil pan (lower part) and attach to oil pan (upper part) with two bolts diagonal to each other.
- Tighten all bolts hand tight.
- Starting in the center and moving toward the outside, tighten bolts to 10 Nm (7 ft lb).
- Install new seal on oil drain plug and tighten to 30 Nm (22 ft lb).

17-23

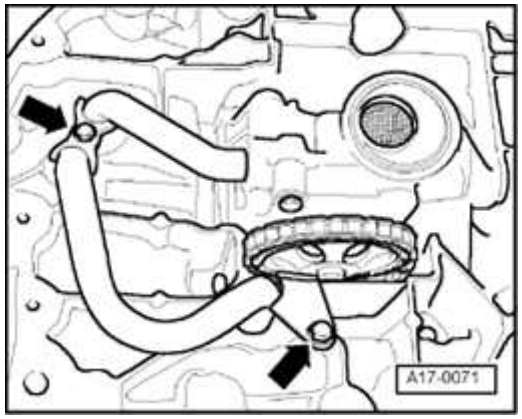
Tightening torques

Component		Tightening torque
Oil pan to cylinder block	M6	10 Nm (7 ft lb)
	M8	20 Nm (15 ft lb)
Oil pan (lower part) to oil pan (upper part)	M6	10 Nm (7 ft lb)
Oil pan to transmission	M8	25 Nm (18 ft lb)
	M10	45 Nm (33 ft lb)
Coolant line to oil pan		10 Nm (7 ft lb)
Oil drain plug in oil pan (lower part)		30 Nm (22 ft lb)

Component		Tightening torque
Dipstick tube to cylinder head	M6	10 Nm (7 ft lb)
	M8	25 Nm (18 ft lb)
Oil pump to engine block		25 Nm (18 ft lb)
Oil supply line for oil pump		10 Nm (7 ft lb)

to oil pan (upper part)		
Oil seal carrier, front	M6	10 Nm (7 ft lb)

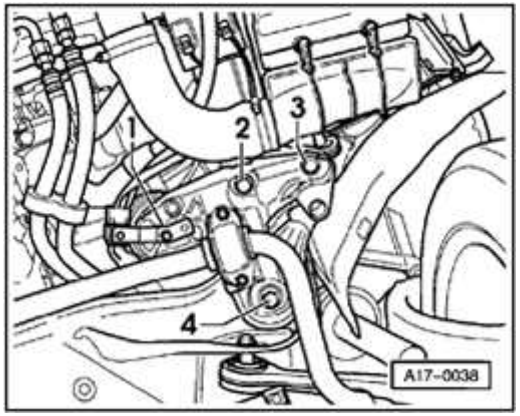
17-24



➢

Component	Tightening torque
Collar screw M8	30 Nm (22 ft lb)
Stabilizer bracket to subframe 1)	25 Nm (18 ft lb)
Coolant drain plug to engine	20 Nm (15 ft lb)
Torque support stop to bracket on engine	25 Nm (18 ft lb)
Engine mount to subframe	25 Nm (18 ft lb)
Torque support to front side of oil pan	25 Nm (18 ft lb)
Engine mount to engine support	25 Nm (18 ft lb)
Chain sprocket to oil pump	25 Nm (18 ft lb)
1) Replace all self-locking nuts after removal.	

17-25



Other tightening torques

Component	Tightening torque
Nut for engine mount -1-	25 Nm (18 ft lb)
Bolts -2- and -3-	60 Nm (44 ft lb)
Combination bolt -4- 2)	110 Nm (81 ft lb) + 90°
2) Replace combination bolt -4- after removing.	

17-26

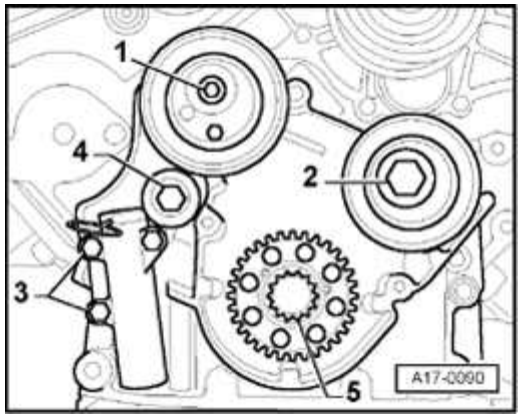
Front oil seal carrier and oil pump chain, removing and installing

Removing

- Remove ribbed belt ⇒ page 13-8 .

- Remove toothed belt ⇒ page 13-12 .

- Remove oil pan (upper part) and oil pan (lower part) ⇒ page 17-10 .



- Before removing front oil seal carrier, remove following components:

1 - Toothed belt tensioner roller

Tightening torque: 20 Nm (15 ft lb)

2 - Idler roller

Tightening torque: 45 Nm (33 ft lb)

3 - Toothed belt tensioner

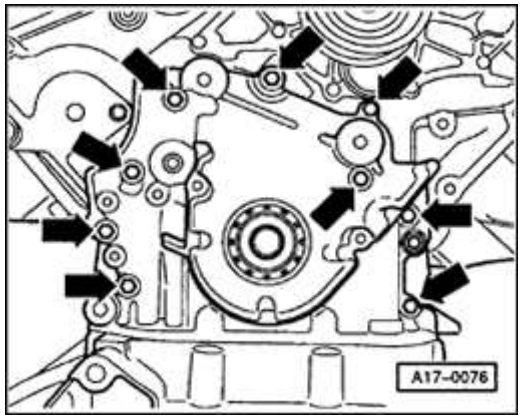
Tightening torque: 20 Nm (15 ft lb)

4 - Toothed belt tensioner lever

Tightening torque: 20 Nm (15 ft lb)

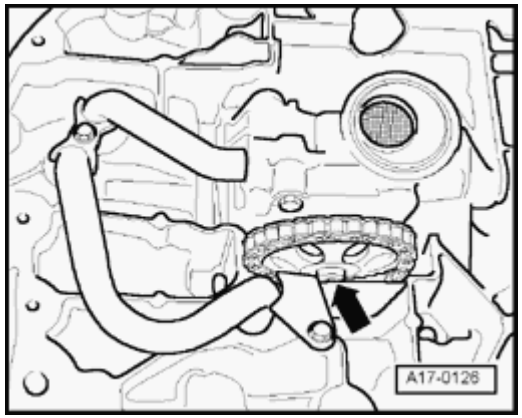
5 - Crankshaft center bolt and toothed belt sprocket

17-27



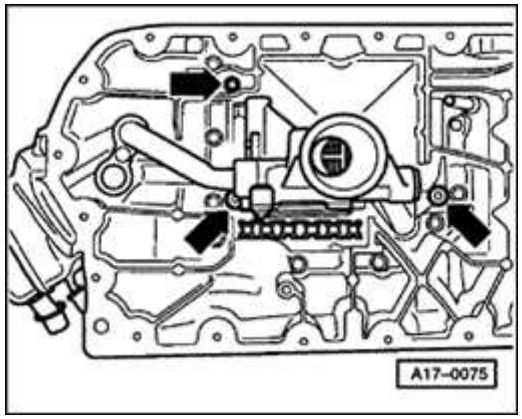
- Remove front oil seal carrier and remove gasket from front oil seal carrier (M6 bolts: 10 Nm, 7 ft lb) (Collar screw M8: 30 Nm 22 ft lb).

Replacing oil pump drive chain



- Using Torx® T45, unbolt chain sprocket from oil pump and pull off oil pump.

17-28



- Remove oil pump together with shorter oil supply line.
- Remove oil pump chain sprocket and remove drive chain from crankshaft ⇒ page 17-26 .

Installing

Installation is the reverse of removal, noting the following:

- Remove any remaining sealant from front oil seal carrier and if necessary, from cylinder block.
- Clean sealing surfaces so they are completely free of any oil or grease.

Note:

Install gasket for front oil seal carrier dry.

- Tighten bolts for oil seal carrier.

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

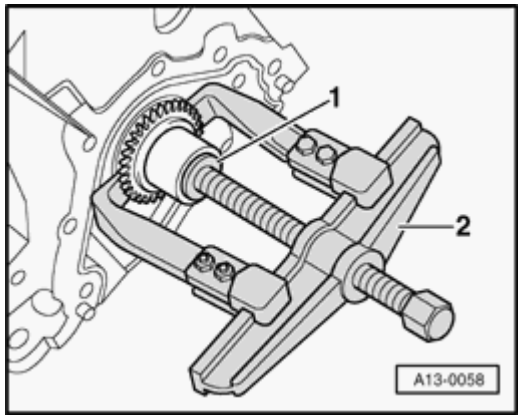
Oil pan (upper part) and oil pan (lower part), removing ⇒ page 17-10 .

17-29

Oil pump chain sprocket on crankshaft, removing and installing

Removing

Front sealing flange and oil pump chain, removing and installing ⇒ page 17-26 .



- Using puller -2-, remove crankshaft chain sprocket, while protecting crankshaft end with appropriate washer -1-.

Installing

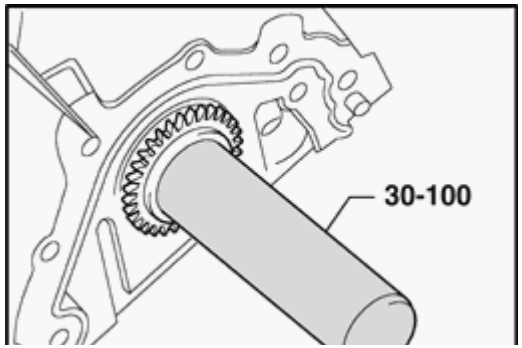
- Warm chain sprocket in 220 ° C (428 ° F) oven for approx. 15 minutes.

WARNING!

Wear protective gloves.

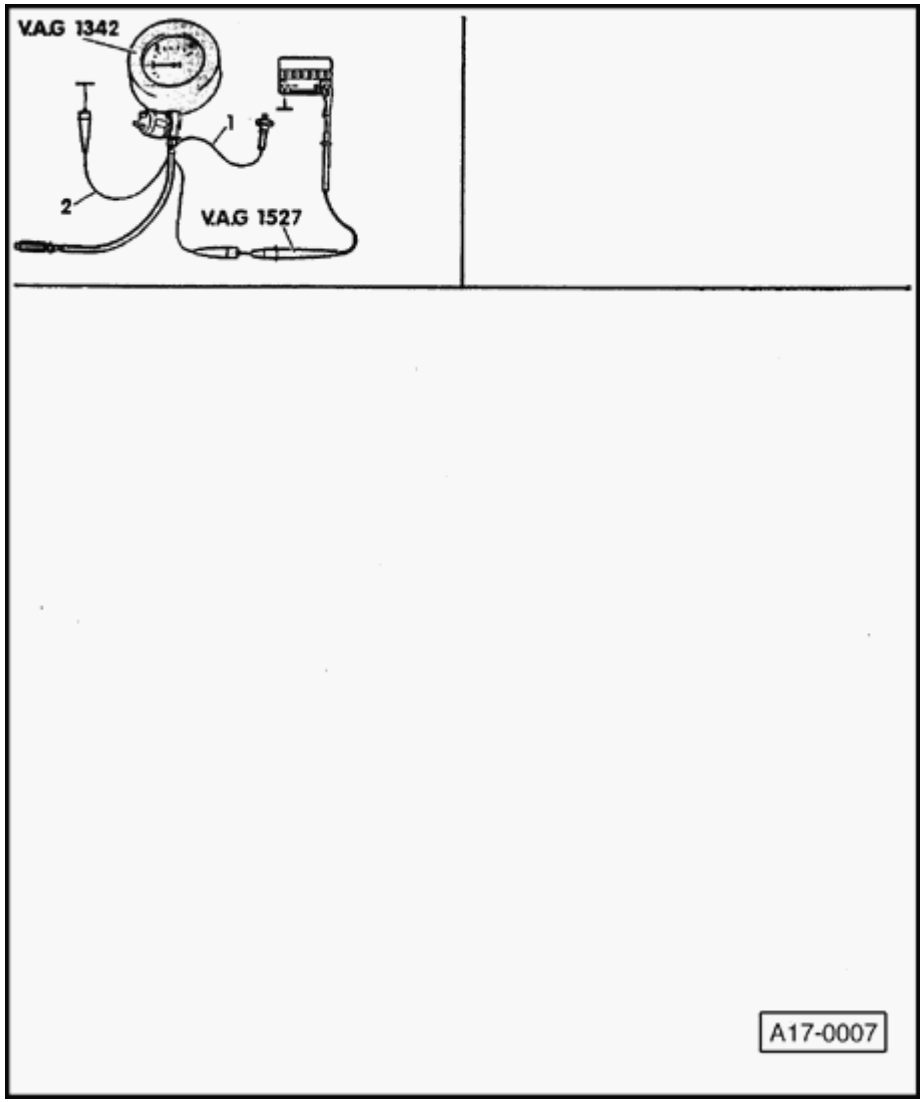
Note:

Installation position: wider collar of chain sprocket points toward engine.



- Using pliers, install chain sprocket on crankshaft end and slide onto crankshaft to stop using 30-100 press tube. If necessary, carefully tap with plastic hammer.

17-1



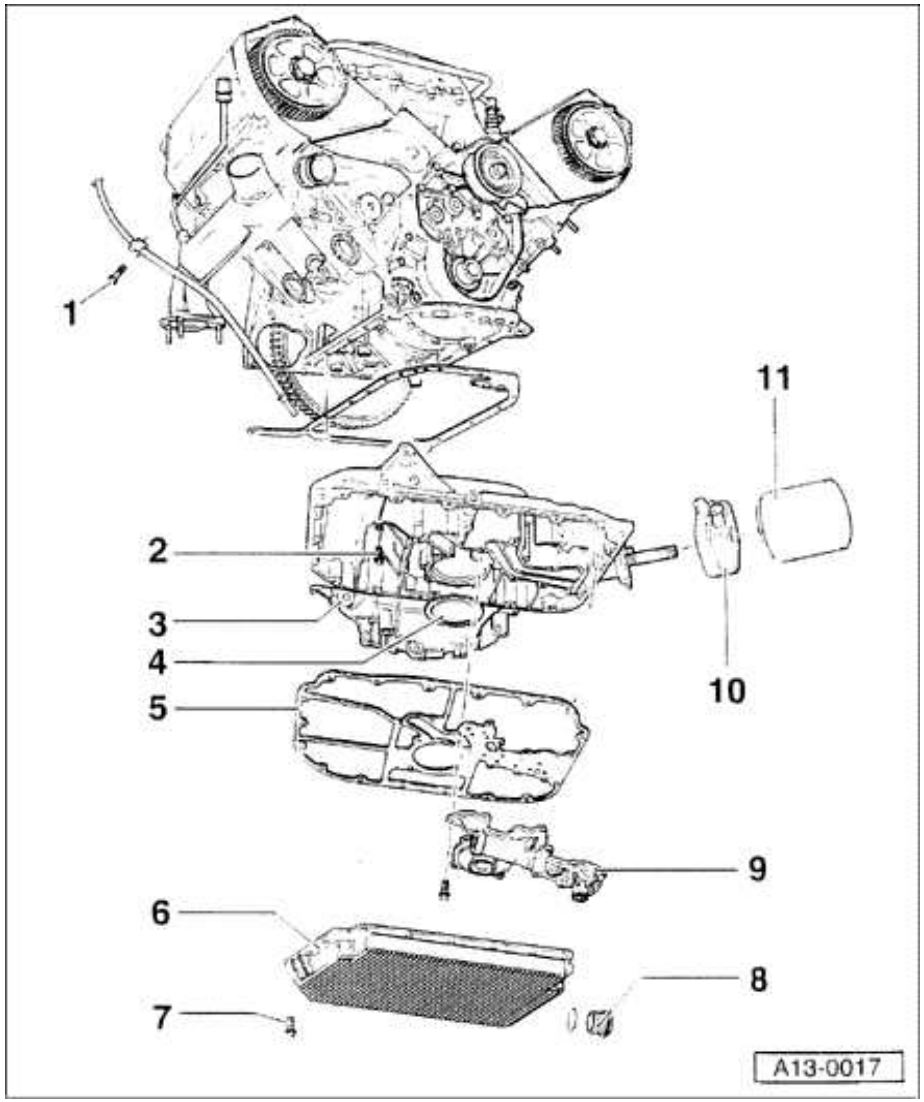
Lubrication system components, removing and installing

Special tools

The following special tools and test equipment are required for these operations

VAG 1342	**Oil pressure tester**
VAG 1527	**Voltage tester**

17-2



Component layout

Modified oil circuit

CAUTION!

Do NOT overfill with oil past the MAX mark on the oil dipstick. Damage to the three way catalytic converter could result.

Note:

- *Always replace gaskets and seals*

1 - 10 Nm (7ft lb)

2 - 10 Nm (7 ft lb)

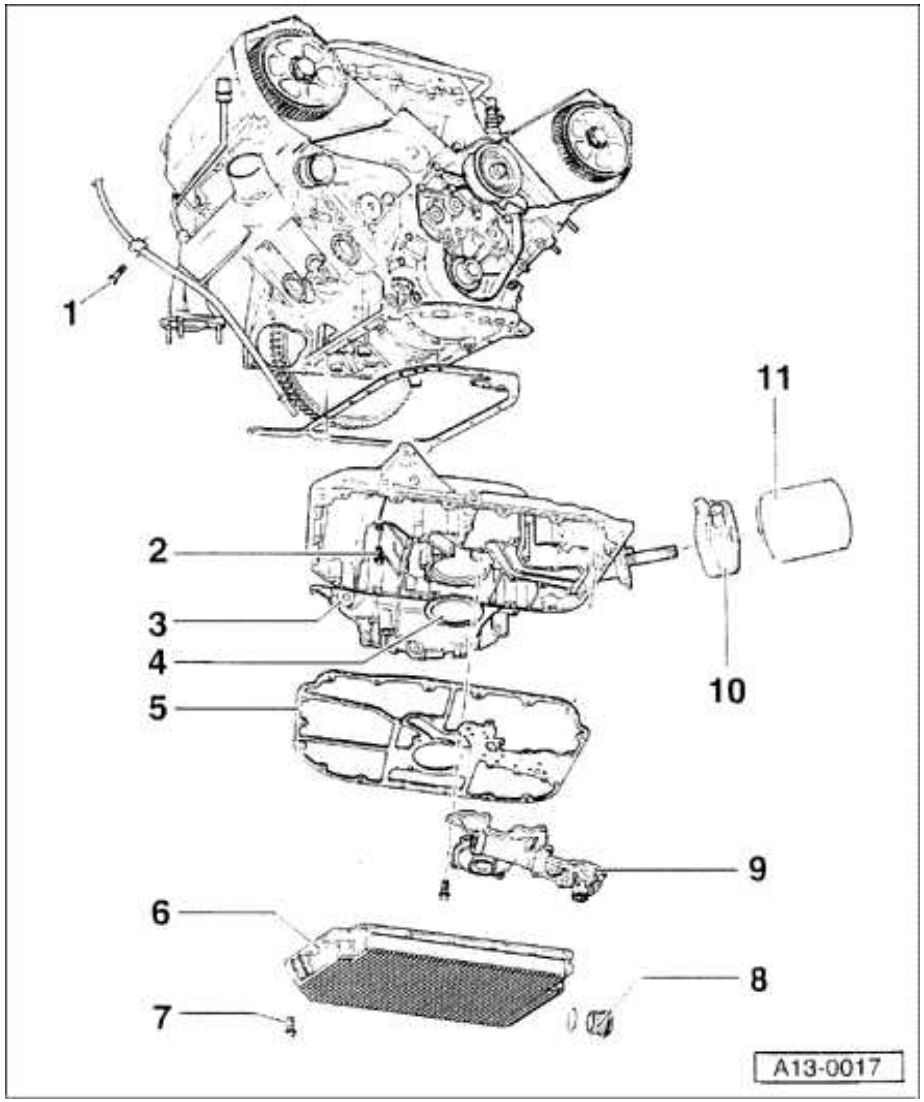
3 - Oil pan, upper

4 - Pick-up strainer

- Locks into upper oil pan with three lock tabs

5 - Gasket

17-3



6 - Oil pan, lower

7 - 10 Nm (7 Nm)

8 - Oil drain plug

- 40 Nm (30 ft lb)

9 - Cover

- With integrated 5 bar (72 psi) and 11 bar (159 psi) pressure relief valves

10 - Oil cooler

11 - Oil filter

- NOT interchangeable with older version
- Revised lubrication system requires different filter: Part no. 078 115 561 D

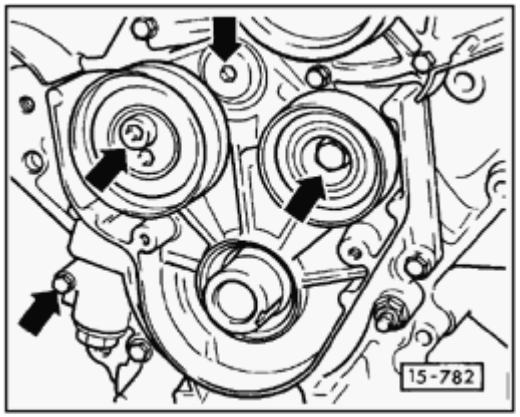
17-4

Oil pump, removing

Note:

If irregular valvetrain noises occur and disappear after a lengthy drive, but always re-occur on short drives, replace the oil retention valves.

- Remove oil dipstick and drain engine oil.
- Remove upper and lower parts of oil pan.



- Remove toothed belt ⇒ page 13-11 .
- Remove toothed-belt tensioner and guide pulley at oil pump.
- Remove screw plug.
- Remove oil pump.

Note:

When installing the oil pump check alignment of oil pump drive

Tightening torques

♦ Oil pump	10 Nm (7 ft lb)
♦ Guide pulley	20 Nm (15 ft lb)
	30 Nm (22 ft lb)

- Screw plug
- Toothed belt tensioner 45 Nm (33 ft lb)

17-5

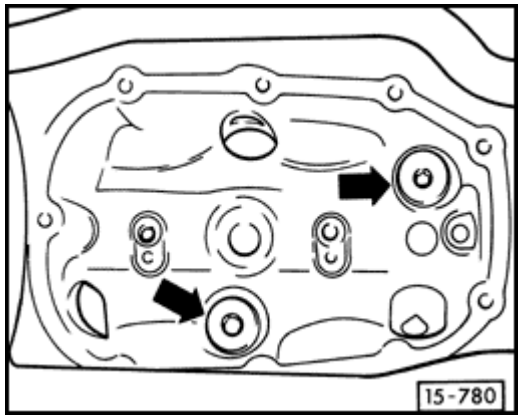
Oil retention valves, replacing

Note:

- *The oil retention valves must be replaced if the valvetrain sounds noisy on short drives, although the noise may go away on longer drives.*
- *When installing the oil pump, ensure that the driver at the crankshaft engages in the oil pump,*

- Remove intake manifold.

- Remove cover plate beneath intake manifold.

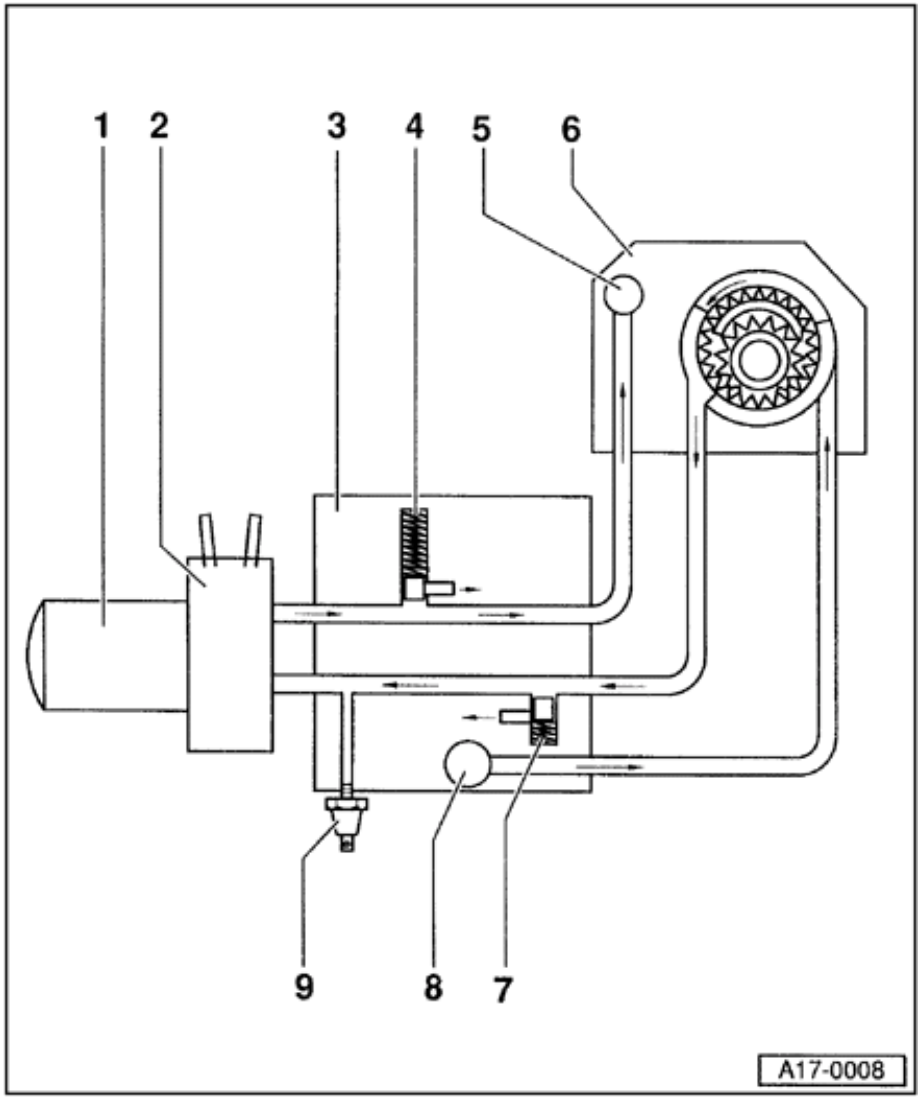


- Replace oil retention valves (arrows).

Tightening torques

♦ Intake manifold	20 Nm	(15 ft lb)
♦ Cover	10 Nm	(7 ft lb)
♦ Oil retention valves	25 Nm	(18 ft lb)

17-6



Revised oil circulation system

Note:

- *Modifications compared to previous 2.8 liter V6 (Audi 90, Audi 100).*
- *Only the modified components should be installed on this engine.*

1 - Oil filter

- Larger outer dimensions

2 - Oil cooler

- Larger cross-sectional flow area

3 - Cover for oil pan

- New

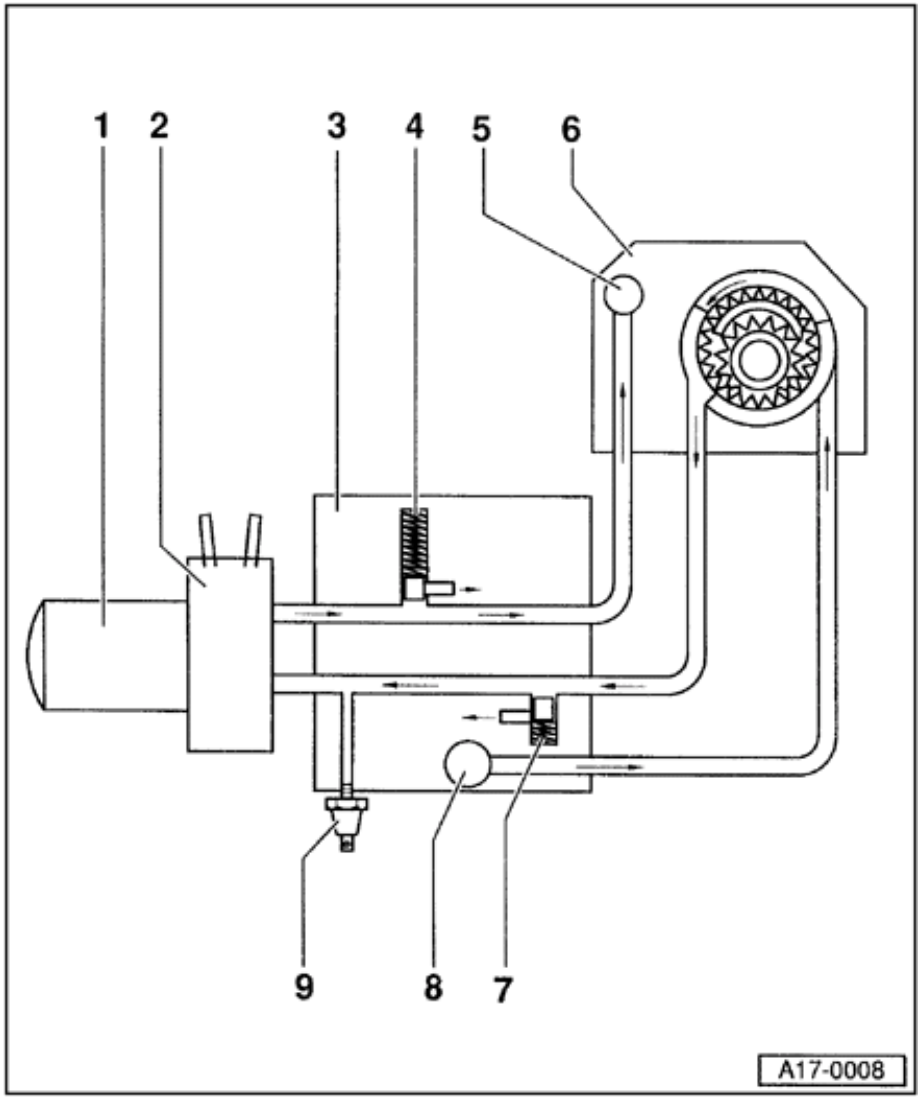
4 - Pressure relief valve

- New

5 - Oil supply to engine

6 - Oil pump

- New



7 - Pressure relief valve 11 bar

- New

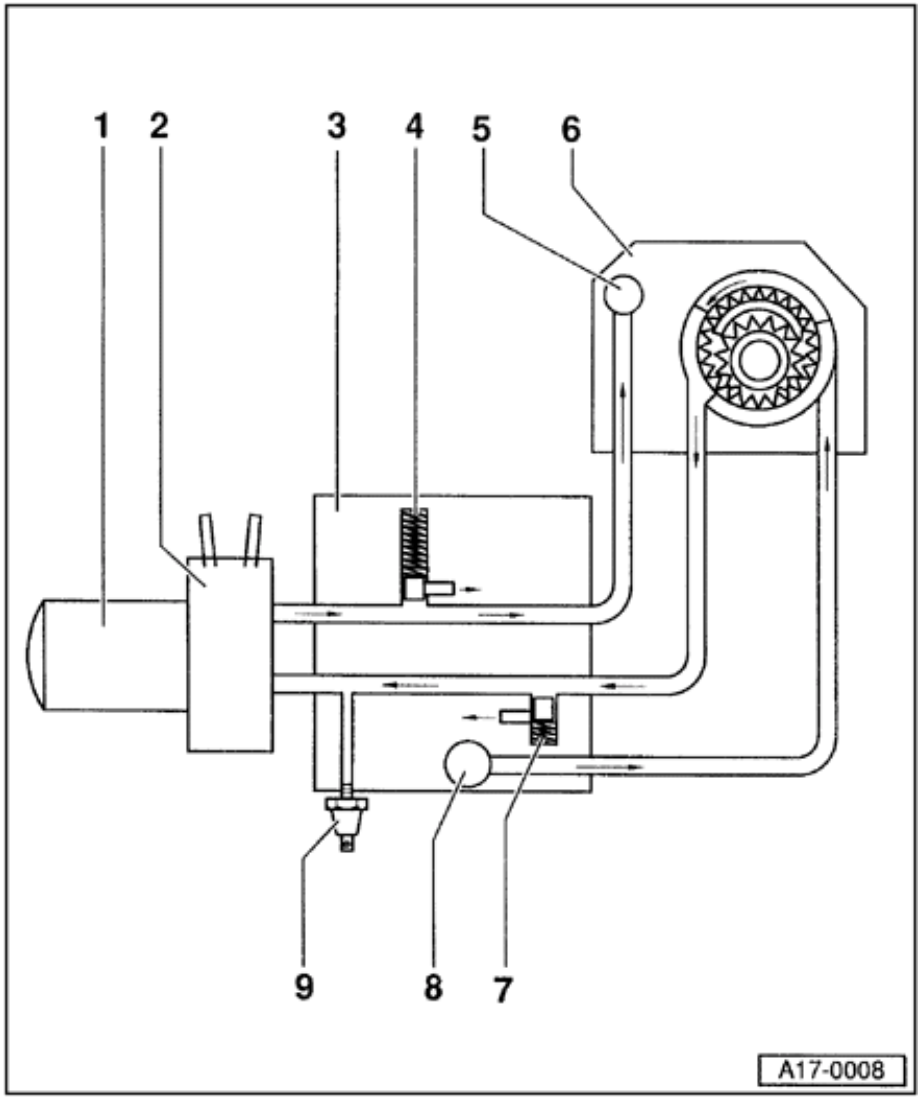
8 - Oil pick-up

- New

9 - Oil pressure switch 1.8 bar

- Color: Brown
- Checking ⇒ page 17-9
- Dynamic oil pressure warning system function ⇒ page 17-11

17-8



Function of revised oil circulation

Intake side

Oil is taken in from the oil pump -6- via the oil pick-up pipe -8-.

Pressure side

Oil pressure comes from the oil pump -6- through the upper part of the oil pan past the pressure relief valve -7-, oil pressure switch -9-, oil cooler -2- and oil filter -1- to the pressure relief valve -4-.

Pressure relief valve -4- controls the oil pressure to the engine.

The pressure relief valve -7- is a safety valve that opens only at high RPM and cold engine temperature.

Advantages

Oil pressure is controlled from the oil filter and oil cooler, so that the oil pressure available at those locations is supplied via the pressure relief valve -4- or from the oil pump.

17-9

Oil pressure and oil pressure switch, checking

Operational test and servicing the visible and audible oil pressure indicator:

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

Test requirements

- Oil level OK
- Oil pressure warning light -K3- comes on with ignition on
- Auto-Check system indication OK, if applicable.
- Engine oil temperature approx. 80 ° C (176 ° F) and radiator coolant fan must have switched on at least once

Checking oil pressure switch

- Disconnect harness connector from oil pressure switch.

- Remove oil pressure switch and install into oil pressure tester VAG 1342.
- Connect cable -2- (brown) to Ground (GND).
- Connect cable -1- (blue) to oil pressure switch.
- Connect VAG 1527B voltage tester to cable -1- and battery positive voltage (B+).

17-10

- Start engine and slowly increase engine speed (RPM).

  - At 1.6-2.0 bar (23-29 psi) pressure, the LED must come on

If not:

- Replace 1.8 bar oil switch.

Operation of dynamic oil pressure warning system, checking

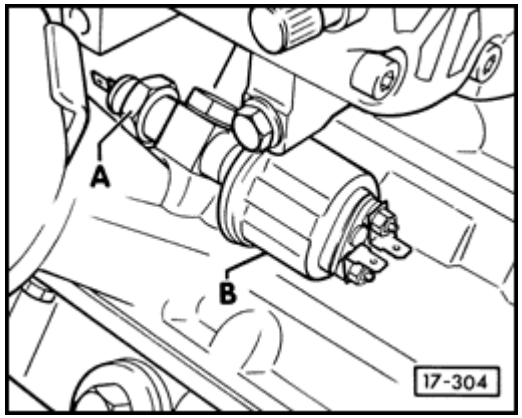
Testing oil pressure warning light:

After ignition is switched on (terminal 15 on) with the engine not running, the oil pressure warning light flashes (not on models with Auto Check System).

Warning criteria:

- Engine not running; oil pressure switch closed
- Engine coolant temperature greater than 60 ° C (140 ° F), engine speed greater than 1500 RPM and oil pressure switch open
- Engine coolant temperature less than 60 ° C (140 ° F), engine speed greater than 300 RPM and oil pressure switch open
- At an engine speed greater than 5000 rpm, an active oil warning is not cancelled, irrespective of the position of the oil pressure switch
- If the voltage supply to the control module (terminal 15) is in order and, when the engine is running, the oil pressure switch is open for

longer than 0.5sec. above 1500 RPM, this event is stored. If this condition occurs three times during "terminal 15 on," the warning also becomes or remains active below 1300 RPM.



Testing oil pressure

- Remove oil pressure switch and screw in VAG 1342 oil pressure gauge.

  (The oil pressure sensor shown in the illustration is not installed on the A4)

- Install oil pressure switch into VAG 1342.
- Start engine.

Oil pressure specifications

- Engine oil temperature at least 80 ° C (176 ° F)
- At idle: 1.0-2.5 bar (15-36 psi)
- At 3000 RPM: 3.0-5.0 bar (44-73 psi)

17-1

Lubrication system components, removing and installing

Notes:

- *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 when performing repairs, clean the oil passages thoroughly and replace the oil cooler in order to prevent further damage from occurring later.*

- *Always replace O-rings, gaskets and oil seals when performing repairs.*

- *The oil level must not be above the max. mark - otherwise this can cause damage to the catalytic converter. Markings* ⇒ *Page 17-67*

Viscosity grades and oil specifications

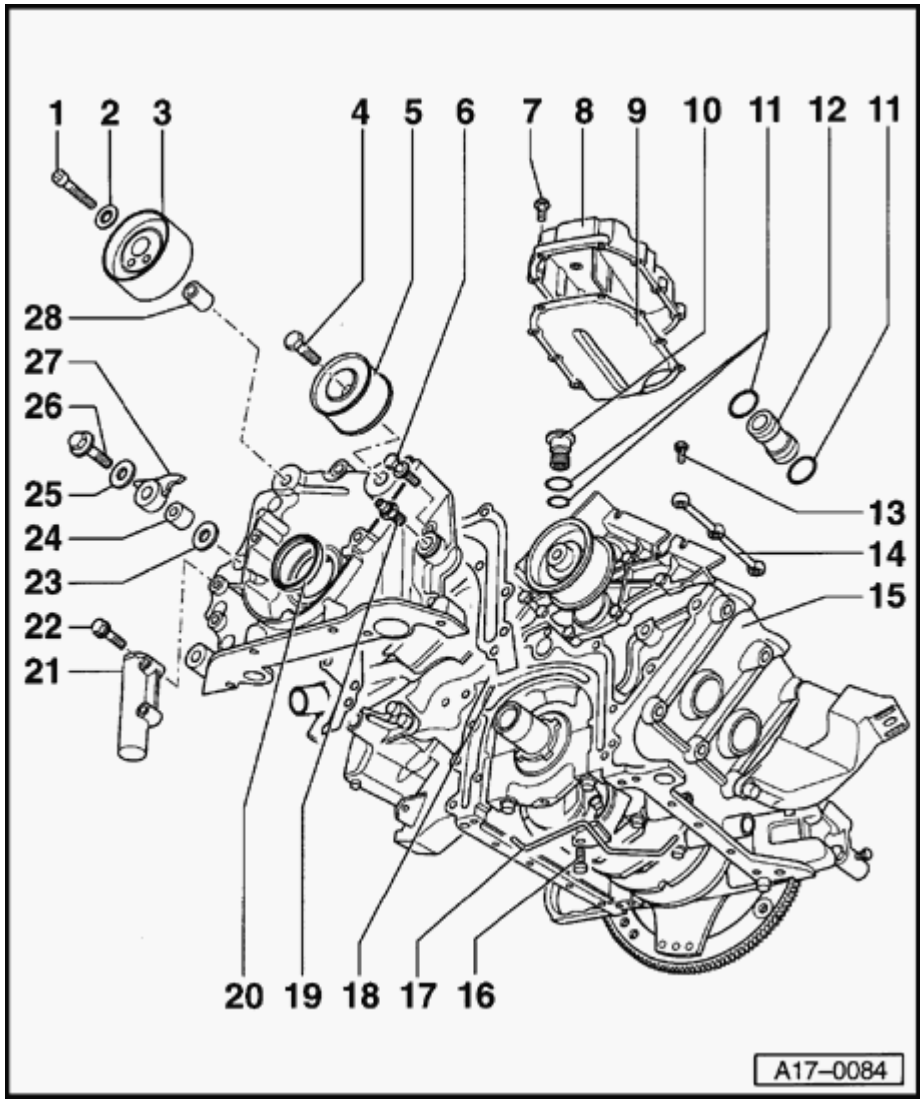
⇒ *Repair Manual, Maintenance*

Oil capacities

⇒ *Repair Manual, Maintenance*

Checking oil pressure ⇒ Page 17-65

17-2



Crankcase breather and oil spray jets, removing and installing

Removing and installing oil pump, oil pan, oil filter and oil cooler ⇒ Page 17-32

1 - Bolt, tightening torque: 20 Nm

2 - Washer

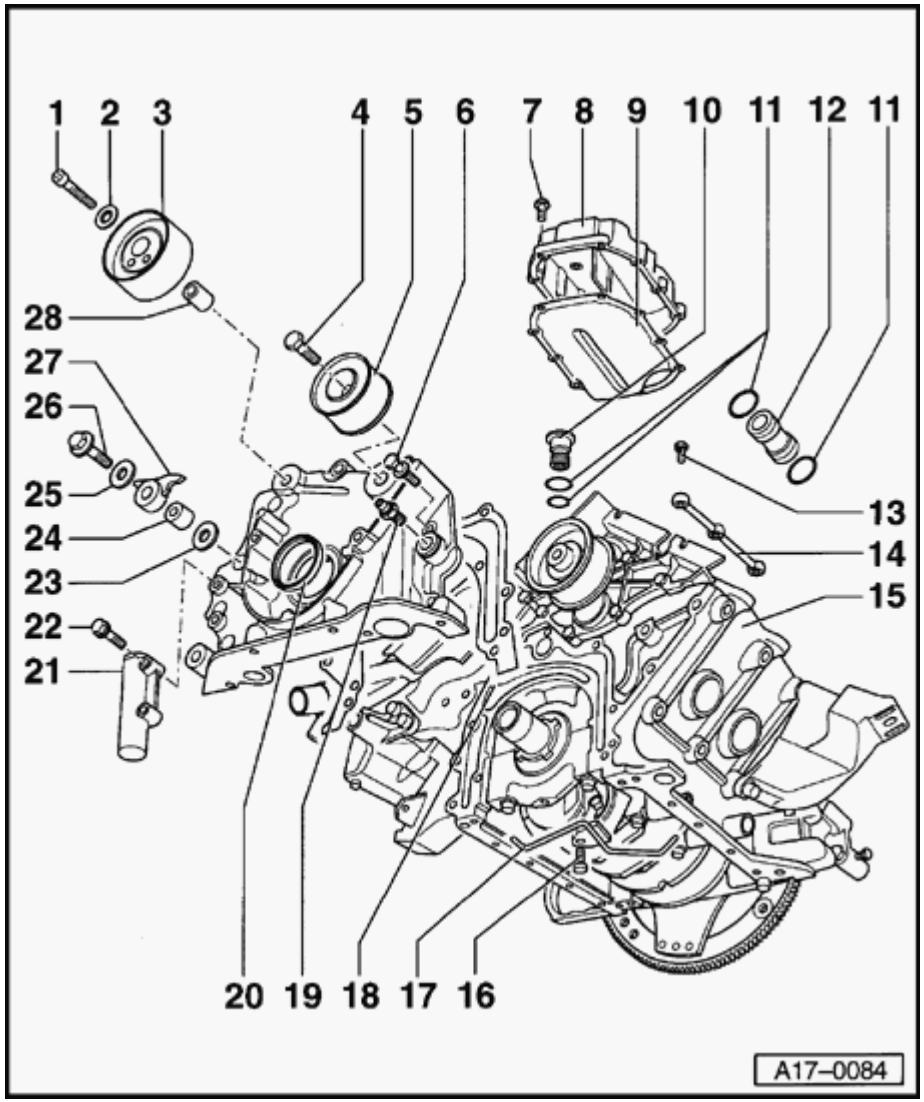
3 - Tensioning roller

4 - Bolt, tightening torque: 45 Nm

5 - Idler wheel

- For toothed belt

17-3



6 - Bolt

- M6 Tightening torque: 10 Nm
- M8 Tightening torque: 20 Nm

7 - Bolt, tightening torque 10 Nm

8 - Breather housing

9 - Gasket/breather plate

- Always replace

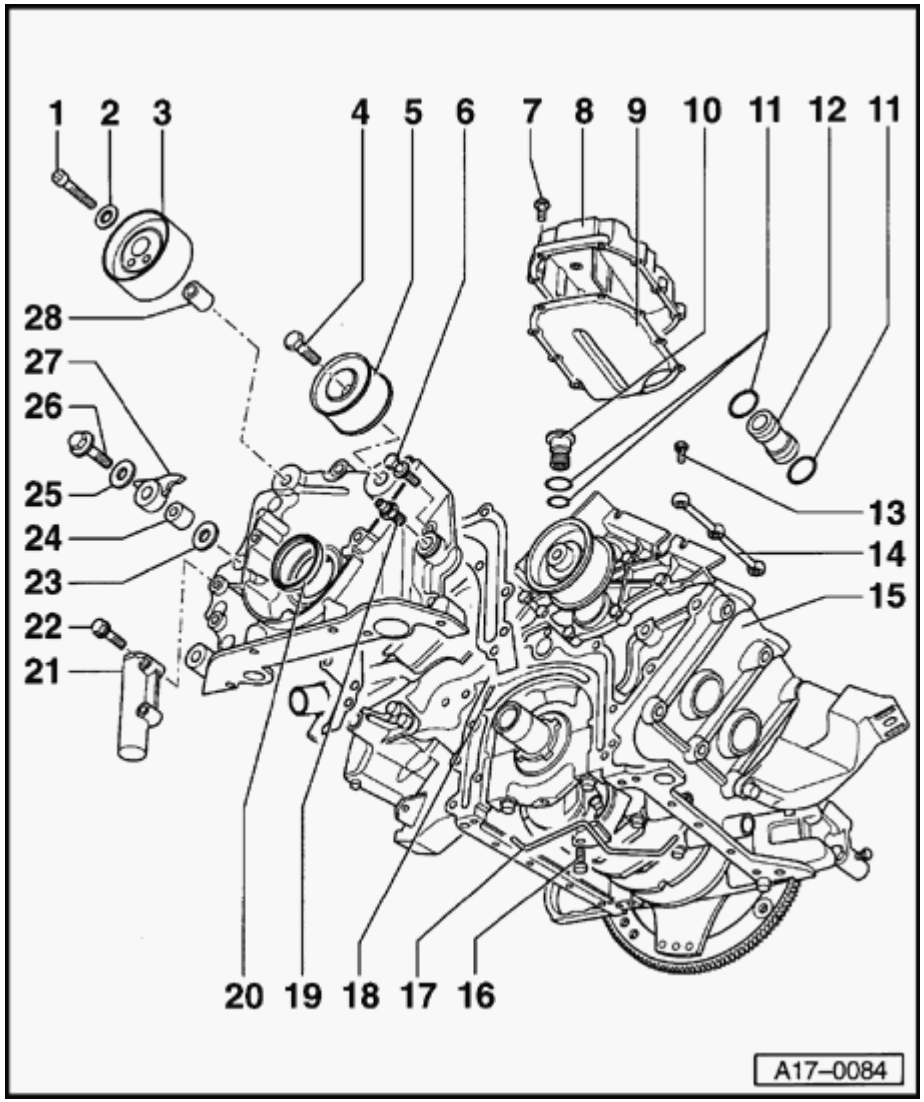
10 - Oil check valve

- Tightening torque: 25 Nm

11 - Oil seal

12 - Connector

17-4



13 - Banjo bolt

- Tightening torque: 15 Nm

14 - Oil distribution line

- For oil spray jets for piston cooling

15 - Cylinder block

16 - Bolt, tightening torque 10 Nm

- Apply locking fluid D6 when installing

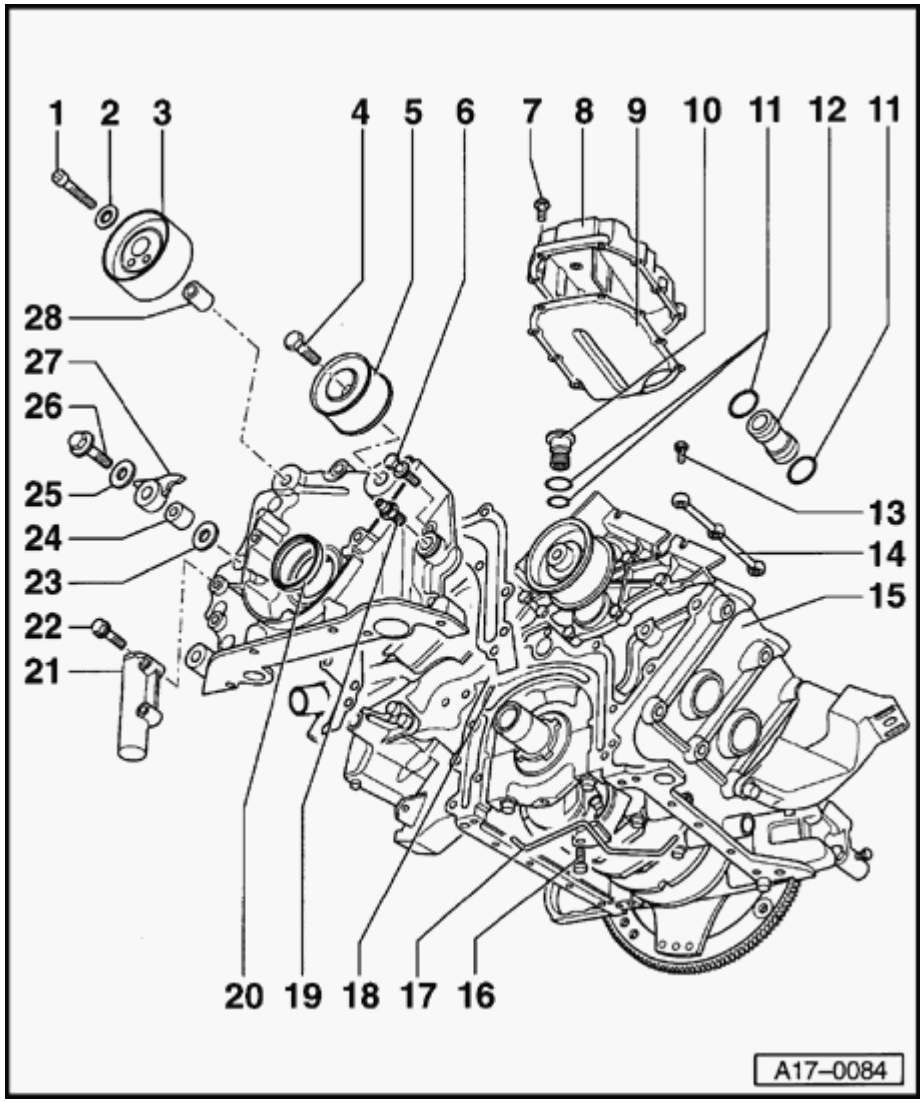
17 - Oil spray jet

- For piston cooling

18 - Gasket

- Metal gasket
- Always replace

17-5



19 - Oil temperature sender (-G8-), tightening torque 10 Nm

- For oil temperature gauge
- White
- If seal is leaking, cut open with pliers and replace.

20 - Oil seal

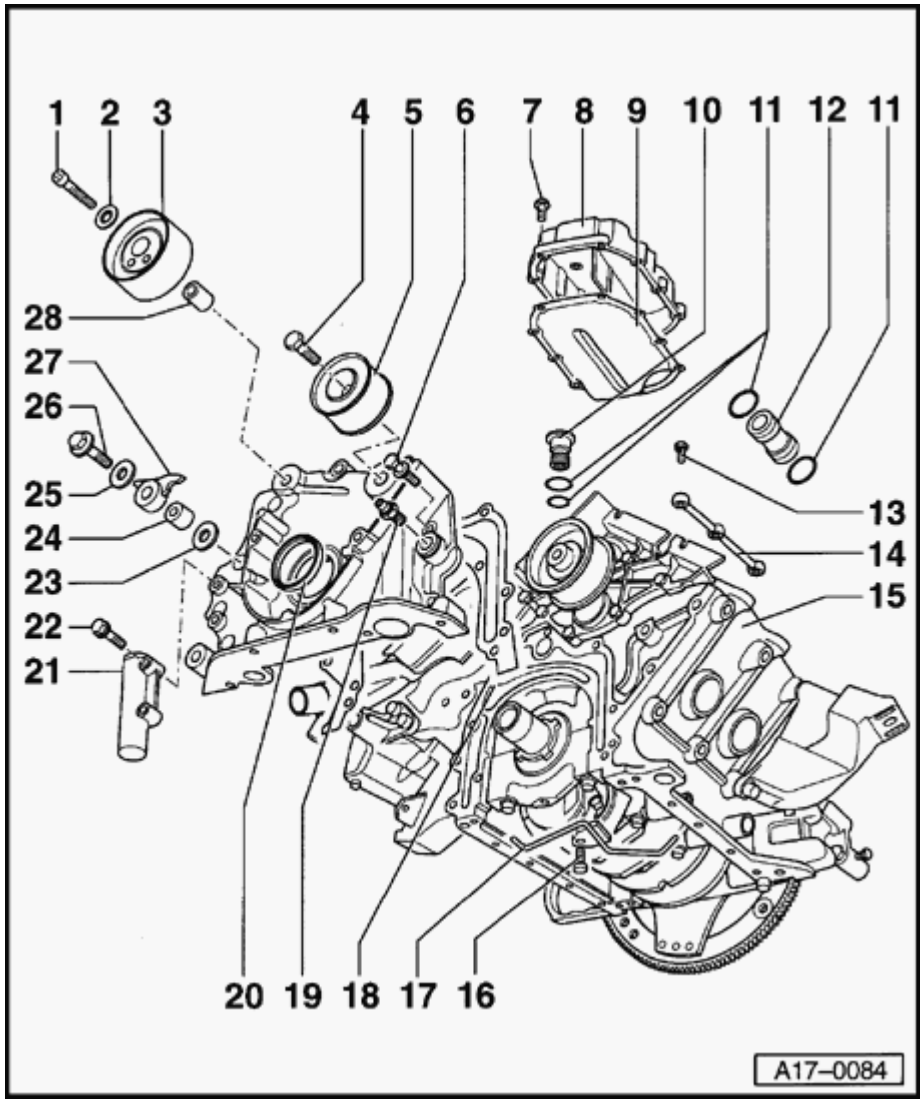
- Replacing ⇒ Page 15-10

21 - Tensioner

- Secure in position before removing ⇒ Fig. ⇒ 1

22 - Bolt, tightening torque: 10 Nm

- Apply locking fluid D6 when installing



23 - Washer

24 - Bearing bush

- For tensioning lever

25 - Washer

26 - Bolt, tightening torque: 25 Nm

27 - Tensioning lever

28 - Bearing bush

- For tensioning roller

17-7

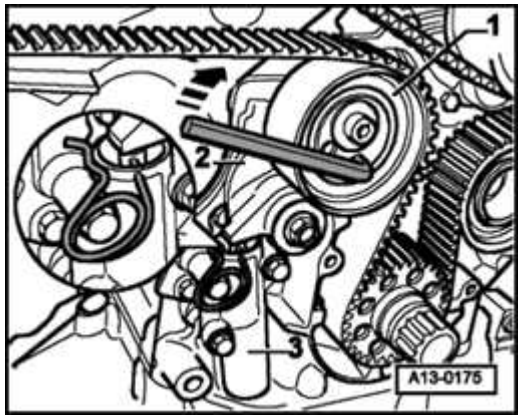


Fig. 1 Securing tensioner in position before removing

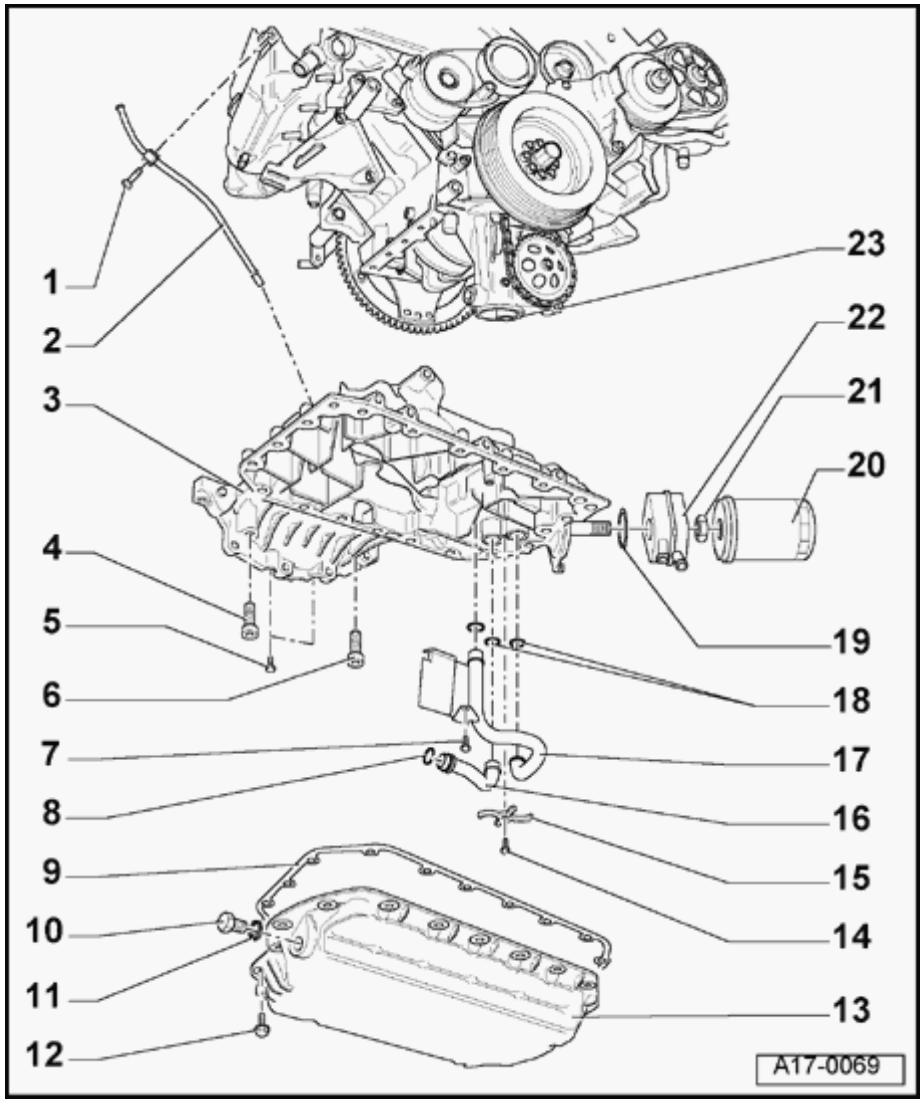
- Using a hex key, turn toothed belt tensioning roller -1- clockwise 8 mm in direction of arrow until tensioning lever -2- compresses tensioner -3- far enough to enable a 2 mm dia. spring pin to be inserted in drilling and in plunger.

Notes:

- *The toothed belt tensioner is oil-damped and can only be compressed slowly by applying gradual pressure.*
- *Use spring pin from 2024 A.*

- Insert spring pin and release toothed belt tensioning roller.

17-8



Oil pump, oil pan, oil filter and oil cooler, removing and installing

1 - Bolt for dipstick guide tube

- Tightening torque: 25 Nm

2 - Dipstick guide tube

- Replace O-ring

3 - Oil pan - upper section

- There is no gasket between engine block and upper section of pan. Only use silicone sealant D 454 300 A2.

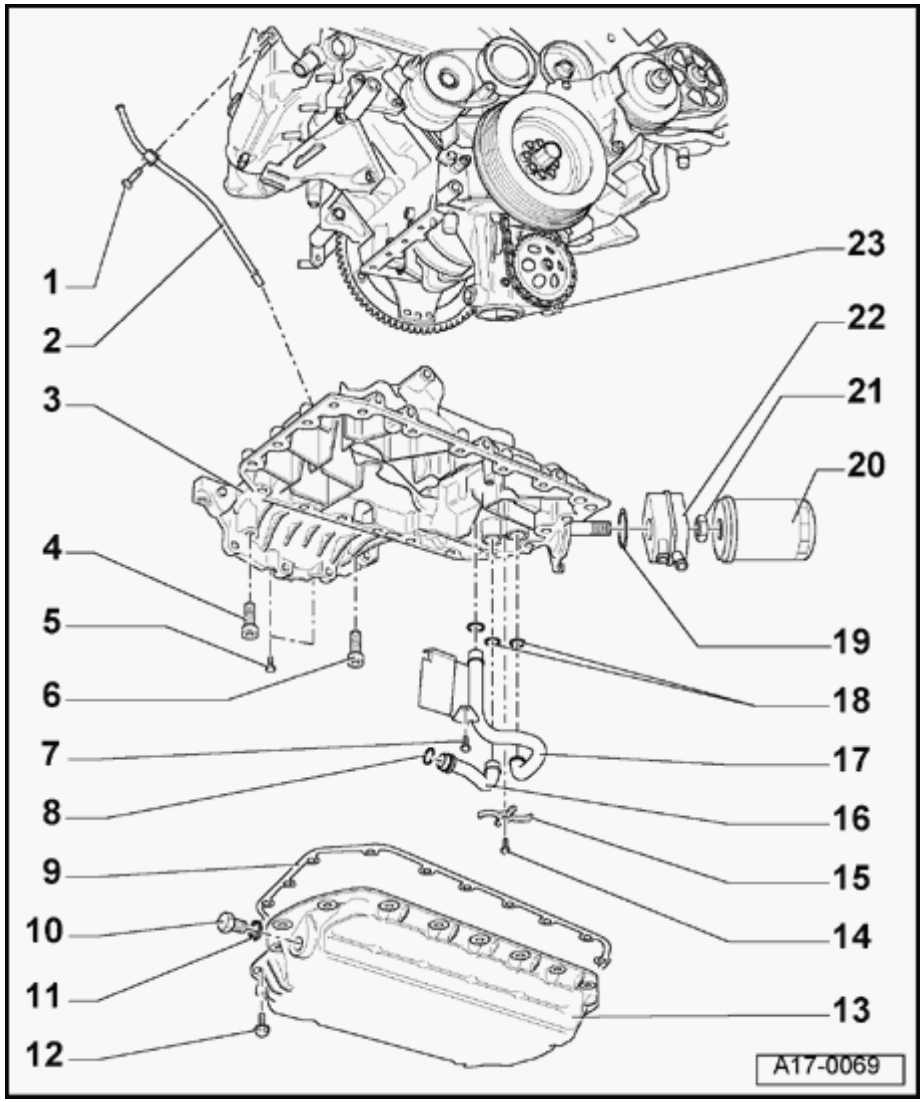
4 - Hex socket head bolt M8

- Tightening torque: 20 Nm

5 - Hex bolt M6

- Tightening torque: 15 Nm

17-9



6 - Hex socket head bolt M8

- Tightening torque: 20 Nm
- The coolant drain screw is next to this bolt

7 - Hex bolt M6

- Tightening torque: 10 Nm

8 - O-ring

- Always replace

9 - Gasket for lower section of pan

- Sealing surfaces should be clean and dry

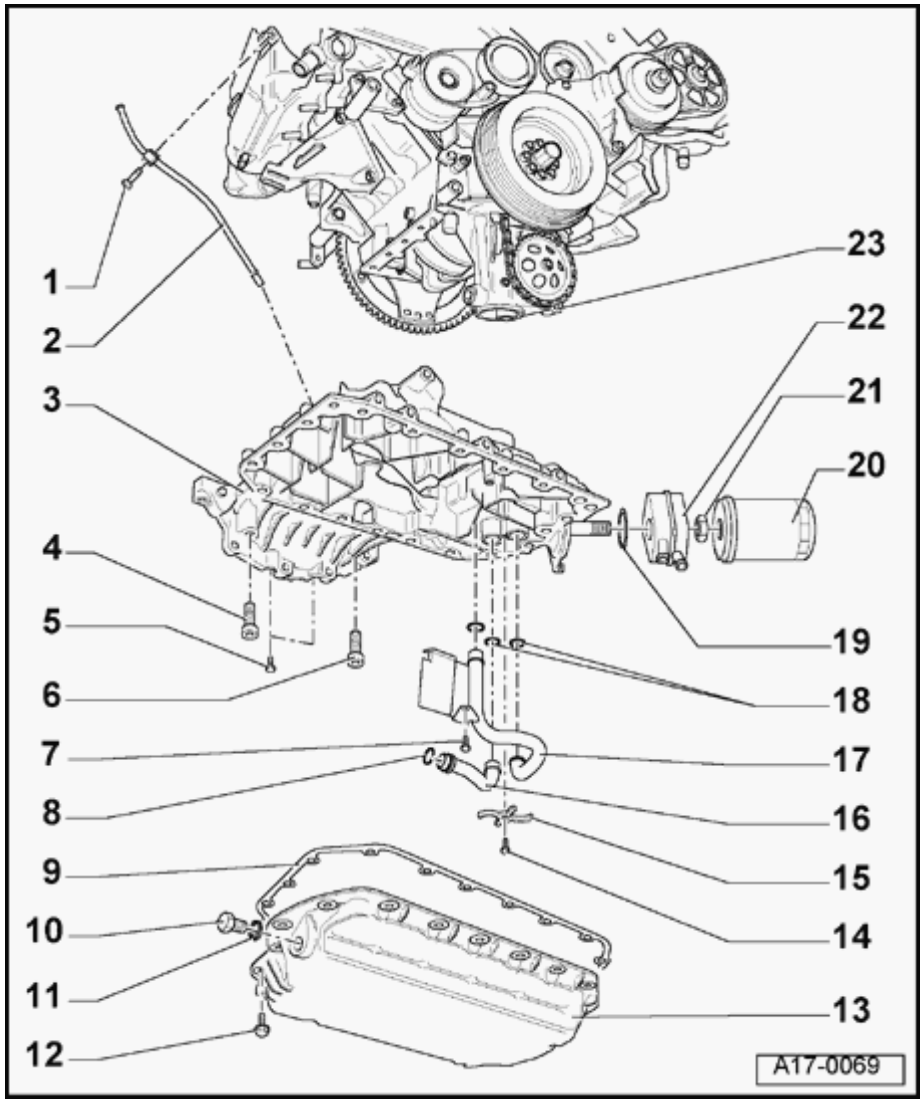
10 - Oil drain plug

- Tightening torque: 30 Nm

11 - Seal for oil drain plug

- Always replace

17-10



12 - Hex bolt M6

- Tightening torque: 10 Nm

13 - Oil pan - lower section

14 - Hex bolt M6

- Tightening torque: 10 Nm

15 - Retainer for oil lines

16 - Oil supply line

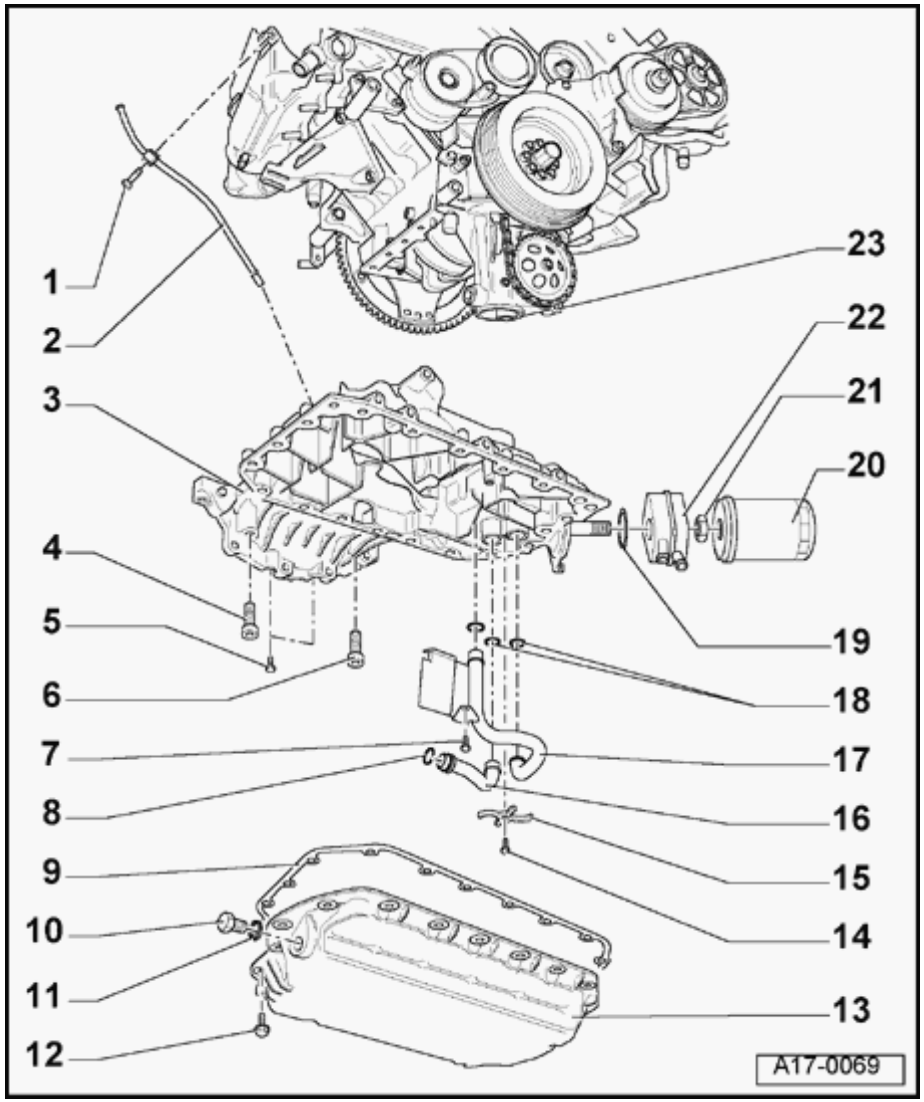
- From pump to oil filter

17 - Oil supply line

- From oil filter to engine oil system

18 - O-ring

- Always replace



19 - O-ring

- Always replace

20 - Oil filter

21 - Hex nut

- Tightening torque: 30 Nm
- Threaded line for oil cooler and oil filter is screwed into upper section of pan with 20 Nm tightening torque.

22 - Oil cooler

- Ensure O-ring is installed correctly when installing

23 - Oil pump

- Driven off crankshaft via chain
- Tightening torque of chain sprocket to oil pump: 25 Nm
- Tightening torque of oil pump to engine block: 25 Nm

17-12

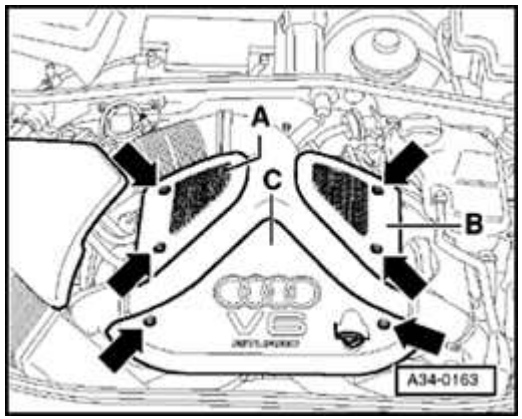
Oil check valves, replacing

Note:

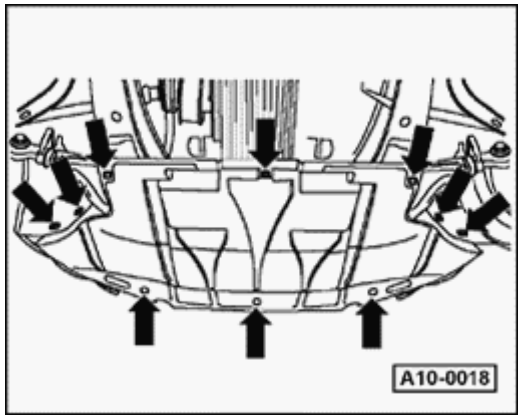
If irregular valve noise occurs repeatedly during short journeys and disappears after extended driving, the oil check valves must be replaced.

- *All cable ties which are released or cut open when removing the engine must be replaced in the same position when installing the engine.*
- *Catch drained-off coolant in a clean container for re-use or disposal.*
- *Replace all gaskets and seals.*

Removing



- Remove bolts -arrows- and remove engine cover panels -A...C-.
- Remove cover above air cleaner.

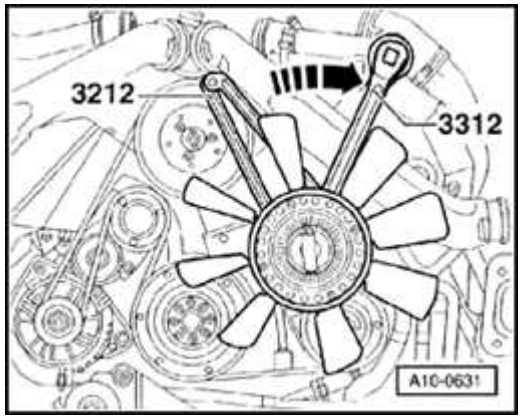


- Remove noise insulation -arrows-.
- Drain coolant ⇒ Page 19-19
- Remove bumper

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

- Move lock carrier to service position

⇒ *Repair Manual, Body Exterior, Repair Group 50*

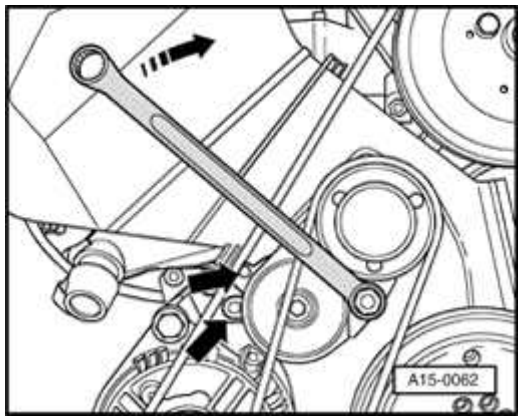


- Remove viscous fan (counter-hold with pin wrench 3212).

Note:

Viscous fan has left-hand thread.

- Mark direction of rotation of ribbed belt.

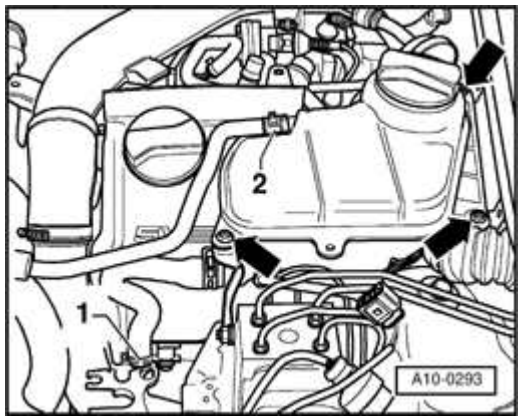


- To slacken ribbed belt, turn to the right using a 17 mm ring spanner until the two holes are aligned with each other -arrow- and hold in position with mandrel 3204.

Note:

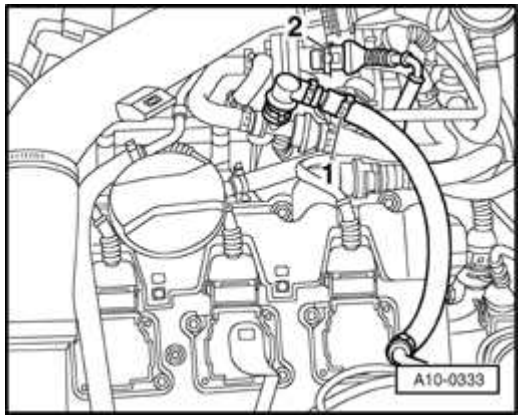
Mark direction of rotation of ribbed belt. The belt can break if it runs in the opposite direction when reinstalled.

- Take off ribbed belt.

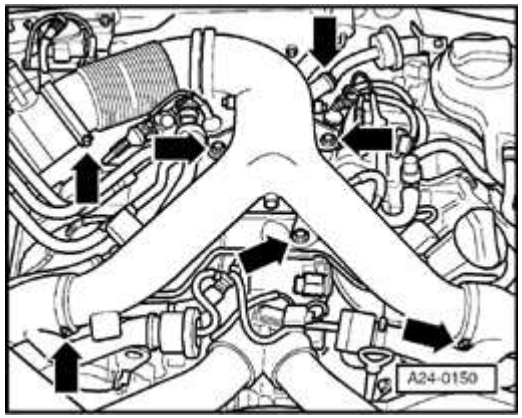


- Disconnect water hoses -1- and -2-.
- Remove coolant reservoir (arrows).
- Disconnect connector for coolant level monitor.
- Remove cover panel from cylinder head cover (cylinder bank 4-6).

17-15



- Pull off hose -1- going to vacuum reservoir.

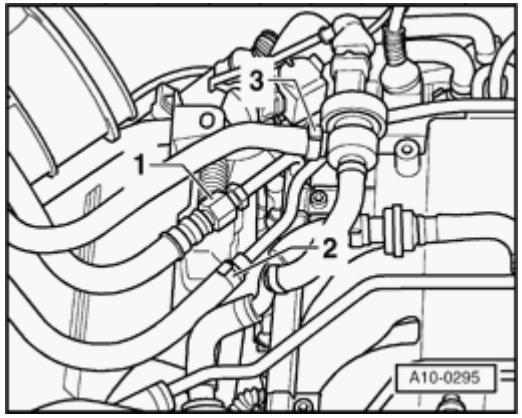


- Remove air duct -arrows-.

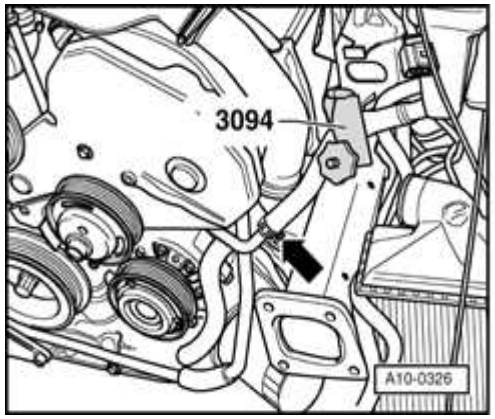
17-16

WARNING!

Fuel system is under pressure. Before opening the system, place a cloth around the connection. Then release pressure by carefully loosening the connection.

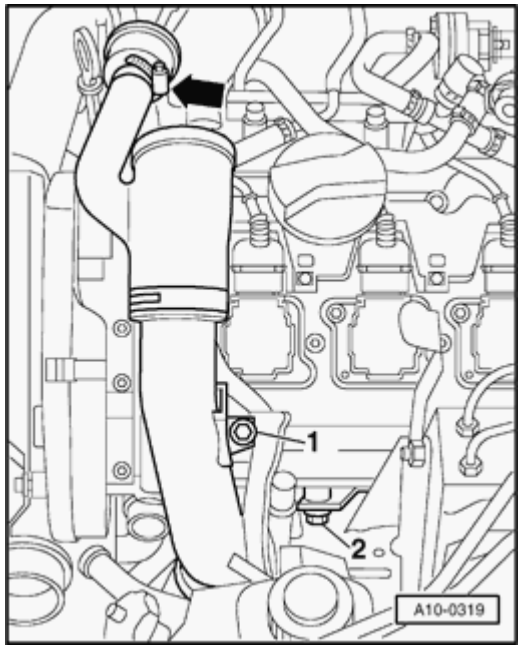


- Disconnect fuel supply line and fuel return line -1- and -2-, and move fuel lines clear.
- Pull hose off EVAP valve -3-.



- install clamp (special tool 3094) on hose from power steering reservoir to power steering pump.
- Disconnect power steering hose -arrow-.

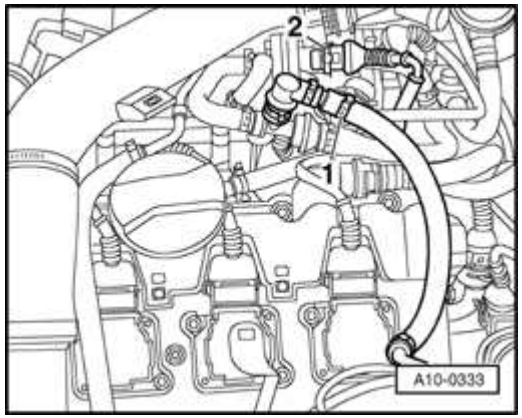
17-17



- Release hose clamp -arrow-.
- Remove intake line -1-.

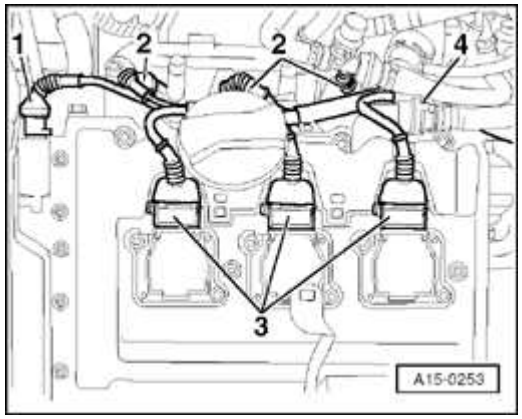
Notes:

- *All hose connections are secured with clips.*
- *Charge air system must be free of leaks.*
- *Replace all seals and gaskets.*

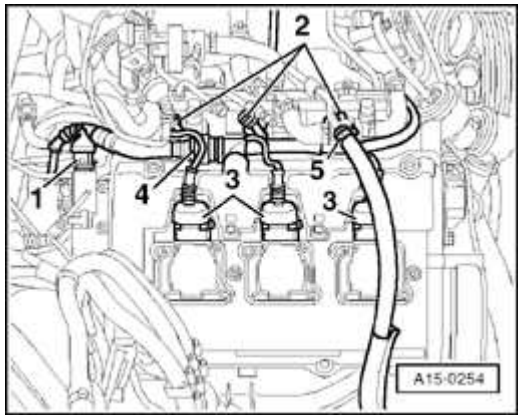


- Disconnect connector from air recirculation valve -2-.

17-18

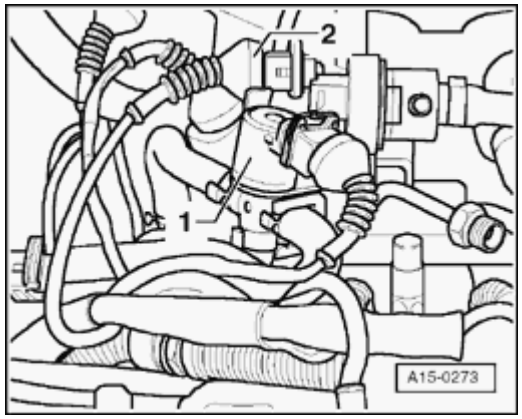


- Disconnect connector for camshaft timing control -1- (cylinder bank 4..6).
- Disconnect connectors from injectors -2- (cylinder bank 4..6).
- Pull crankcase breather -4- off cylinder head cover (cylinder bank 4..6).

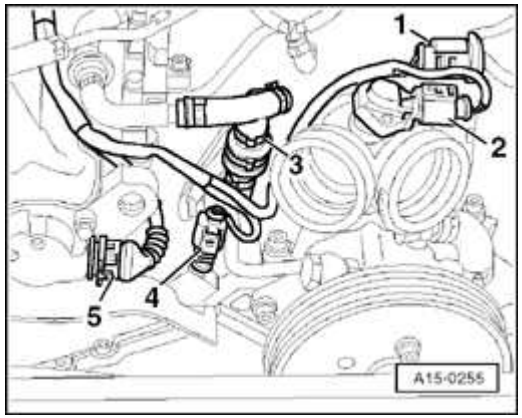


- Disconnect connectors from injectors -2- (cylinder bank 1..3).
- Pull off hose -5- going to turbocharger intake side.

17-19

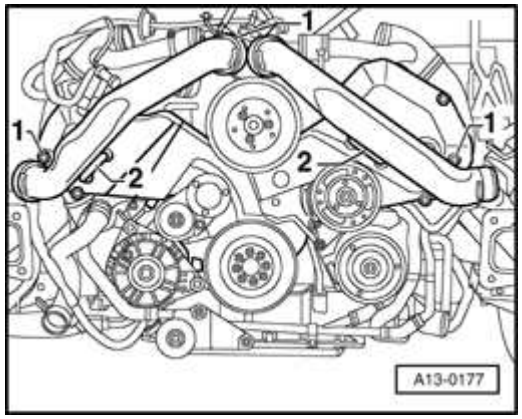


- Unclip solenoid valve for charge pressure control -1-.
- Pull connector off EVAP valve -2-.



- Pull connector off throttle unit -1-.
- Pull connector off charge air sensor -2-.
- Pull off crankcase breather -3-.
- Pull connector off intake air temperature sender -4-.

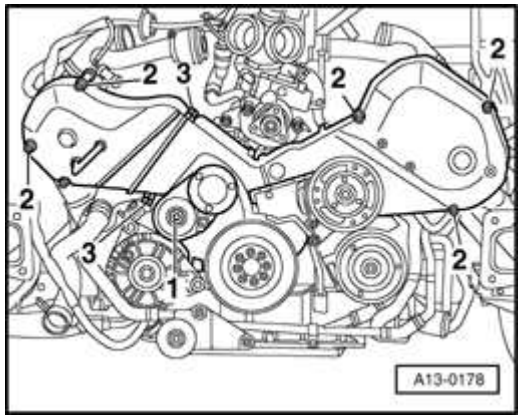
17-20



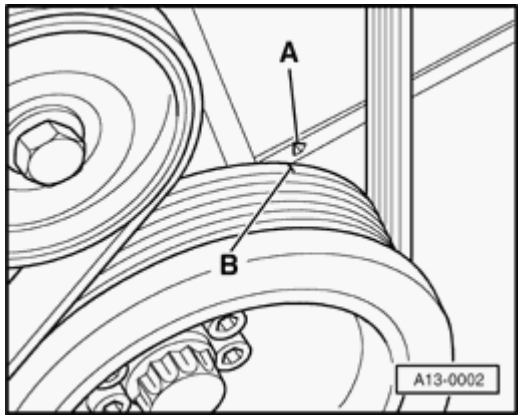
- Remove pressure lines -1-.

Note:

Watch position of retaining strips -2-.



- Remove tensioner -1- for ribbed belt.
- Remove toothed belt guards -2- (left and right).
- Remove toothed belt guard -3- (center).



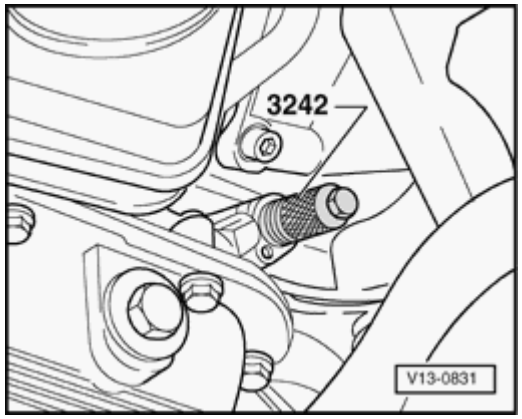
- Turn crankshaft to TDC by hand. Marks -A- and -B- must be aligned.

Note:

Turn over the engine at the central bolt on the crankshaft.

- Check position of camshafts: larger holes in securing plates on camshaft sprockets must align opposite one another on inside. If this is not the case, turn crankshaft one revolution further.
- Remove sealing plug from cylinder block, left.

  The TDC drilling in the crankshaft must be visible (or able to be felt) in line with the sealing plug hole.

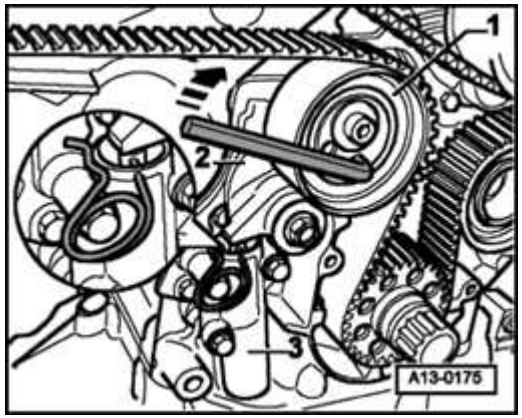


- Screw clamping bolt 3242 for crankshaft into sealing plug hole and tighten.

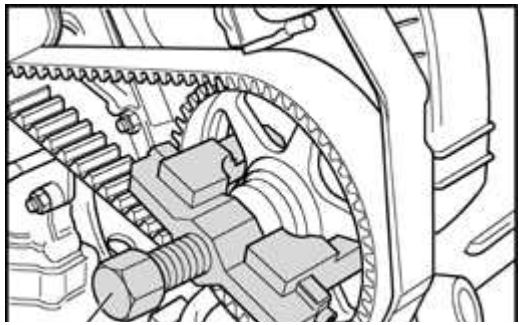
17-22

Notes:

- *Mark the direction of rotation of the toothed belt with chalk or felt pen before removing. A used belt can break if it rotates in the wrong direction when reinstalled.*
- *The toothed belt tensioning element is oil-damped and can therefore only be compressed slowly by applying constant pressure.*

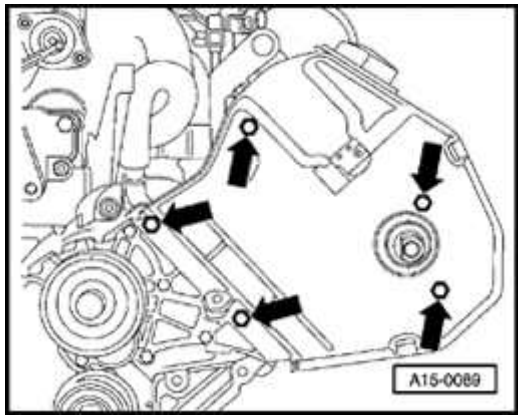


- Using a hex key, turn toothed belt tensioning roller -1- clockwise 8 mm in direction of arrow until tensioning lever -2- compresses tensioning element -3- sufficiently to enable special tool T 400 11 to be installed in drilling and in plunger.
- Insert special tool T 400 11 and release toothed belt tensioning roller.
- Insert camshaft clamp 3391 in the securing plates of the two camshafts.
- Loosen both camshaft bolts and remove approx. 5 turns.
- Take out camshaft clamp 3391.

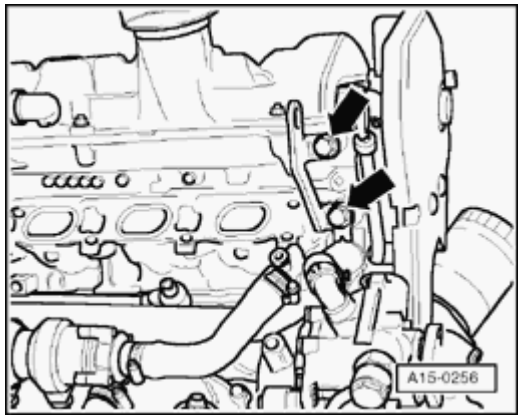


- Pull off both camshaft sprockets with special tool T40001.

17-23

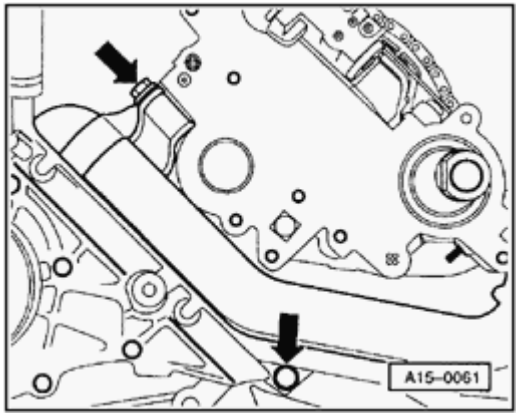


- Unbolt rear left toothed belt guard -arrows-.
- Detach intake manifold using special tool 3249.

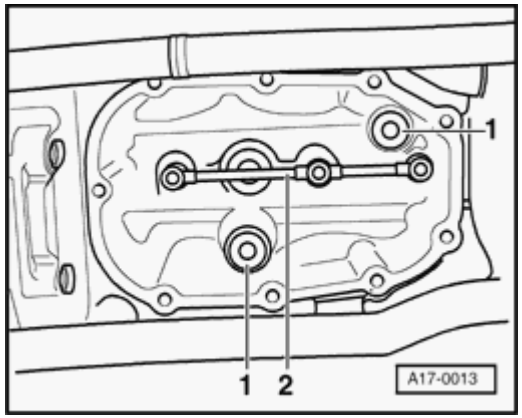


- Unbolt cylinder head lifting bracket with coolant line -arrows- from cylinder head.

17-24



- Unbolt coolant line at front of cylinder head -arrows- and remove.
- Remove water line and auxiliary water pump.
- Remove cover on oil check valves.



- Replace oil check valves -1- (25 Nm).

Note:

The oil distribution line -2- for the spray jets for piston cooling is also located in the opening.

17-25

Installing

Install in the opposite order to removing. When installing, note the following points:

- Install lock carrier

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Install bumper

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

- Fill with coolant ⇒ Page 19-19 .

Component		Nm
Bolts	M6	10
Bolts	M8	20
Toothed belt sprocket to camshaft		55
Intake manifold to cylinder head		10
Oil check valves		25

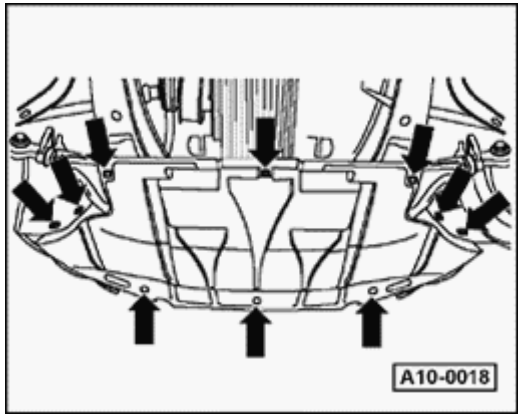
Cover for oil check valves	10

17-26

Lower section of oil pan, removing and installing

Special tools, testers and auxiliary items

- Drip tray VAG 1306



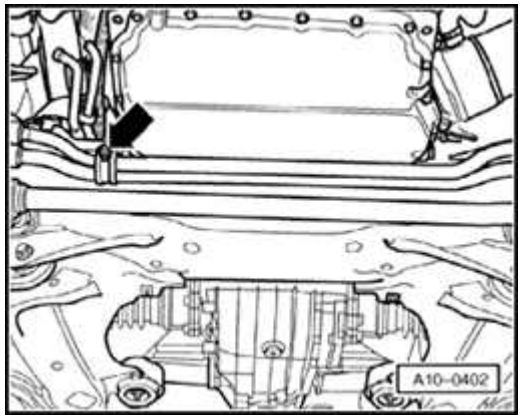
- Remove noise insulation panel -arrows-.
- Remove bumper.

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

- Move lock carrier to service position.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Remove ribbed belt ⇒ Page 13-1 .

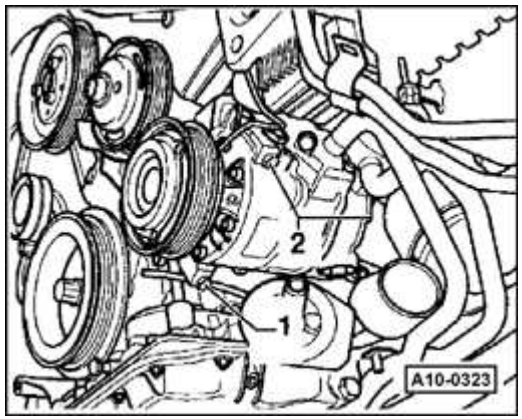


- Unbolt air conditioner lines from pan -arrow-.

17-27

WARNING!

Do not open air conditioner refrigerant circuit.



- Detach air conditioner compressor -1...2-.

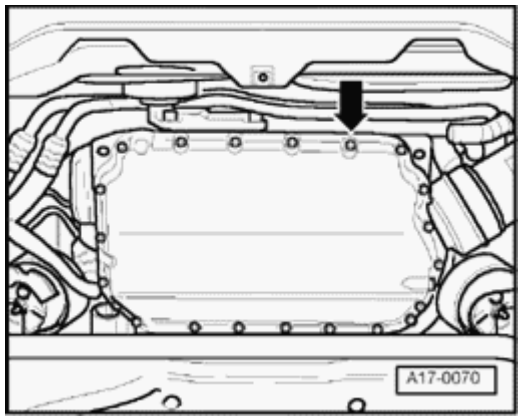
Notes:

- *Watch position of guide bushes when installing.*
- *When installing, insert bolt -1- in the compressor first.*
- *To prevent damage to the condenser and refrigerant lines/hoses, ensure that the lines and hoses are not stretched, kinked or bent.*

- Drain engine oil.

Note:

Use a separate container to collect the engine oil.



- Remove lower section of oil pan.

Installing

Install in the opposite order to removing. When installing, note the following points:

Note:

Do not use any adhesive or sealant.

- Clean sealing surfaces; ensure that they are free of oil and grease.

- Install new gasket on lower section of oil pan and install on upper section of oil pan with two diagonally opposite bolts.

- Tighten all securing bolts hand-tight.

- Tighten bolts to 10 Nm with torque wrench, working from center outward.

- install new seal on oil drain plug and tighten to 30 Nm.

17-29

- Fill engine with oil.

⇒ *Repair Manual, Maintenance*

- Install lock carrier in normal position.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Install bumper.

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

17-30

Chain tensioner for oil pump, checking

The chain tensioner incorporates a leaf spring. To check the spring tension, the lower section of the oil pan must be removed.

- Remove bumper

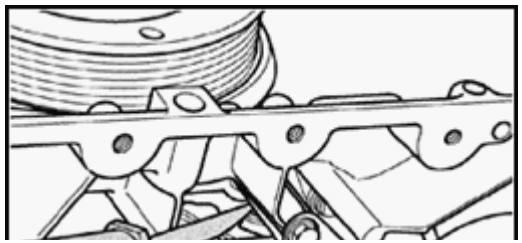
⇒ *Repair Manual, Body Exterior, Repair Group 63*

- Move lock carrier to service position.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Remove ribbed belt ⇒ Page 13-1 .

- Remove lower section of oil pan ⇒ Page 17-26



- Insert a screwdriver between chain and chain tensioner and press screwdriver against chain tensioner.

If no spring tension can be felt and the chain is not being tensioned, this means the chain tensioner is malfunctioning and must be replaced.

To replace oil pump chain tensioner, remove front sealing flange ⇒ Page 17-55 .

17-31

Installing

Install in the opposite order to removing. When installing, note the following points:

- Fill up engine oil.

⇒ *Repair Manual, Maintenance*

- Install lock carrier in normal position.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Install bumper.

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

17-32

Upper and lower sections of oil pan, removing and installing

Special tools, testers and equipment required

- Engine support bracket 10-222A with adapter 10-222A/3
- Drip tray VAG 1306
- Electric drill with plastic brush attachment
- Silicone sealant D 176 404 A2
- Torque wrench 10 Nm/ 45 Nm

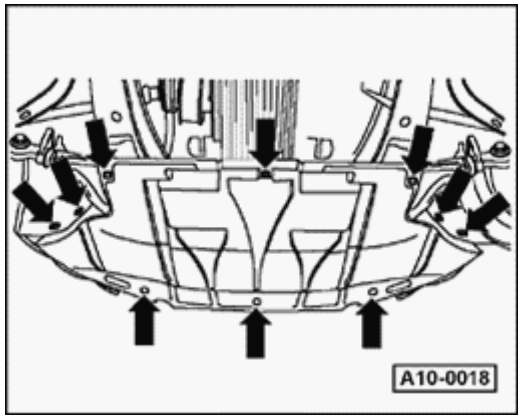
- Obtain radio theft code on vehicles with coded radio.

- With ignition switched off, disconnect battery Ground strap.

- Pull out dipstick.

17-33

- Unbolt dipstick guide tube at front of cylinder head (right side), and pull out of oil pan from the top.



- Remove noise insulation panel -arrows-.
- Remove bumper.

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

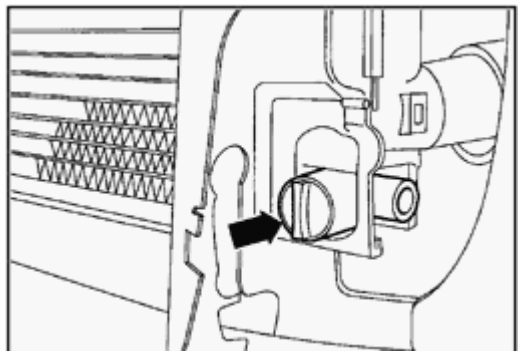
- Move lock carrier to service position.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

WARNING!

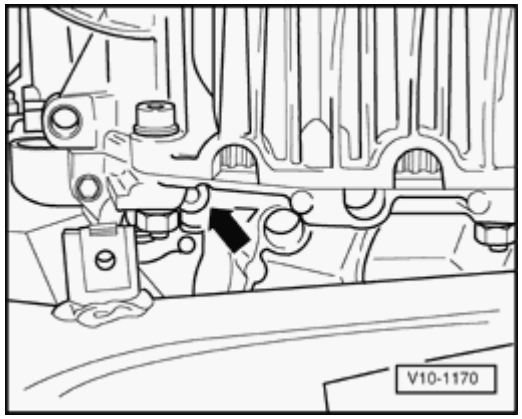
Hot steam can escape from the expansion tank when the filler cap is opened. Cover the filler cap with a cloth and remove it carefully.

- Remove cap on coolant expansion tank.
- Place drip tray VAG 1306 below engine.



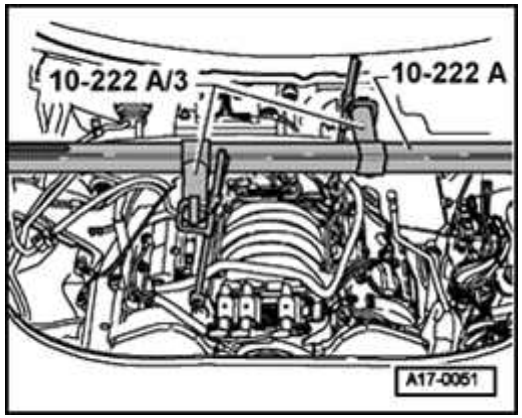
- Turn drain screw -arrow- on radiator anti-clockwise, if necessary install drain hose to connection.

17-34



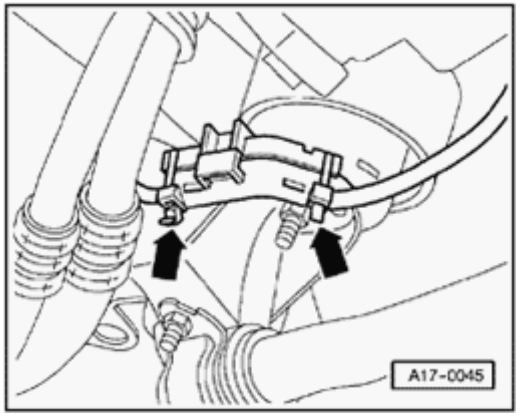
- Also open coolant drain screw -arrow- at rear right of oil pan.
- Draining off and filling up coolant ⇒ Page 19-19 .
- Drain off engine oil.

  Use a separate container to collect the engine oil.

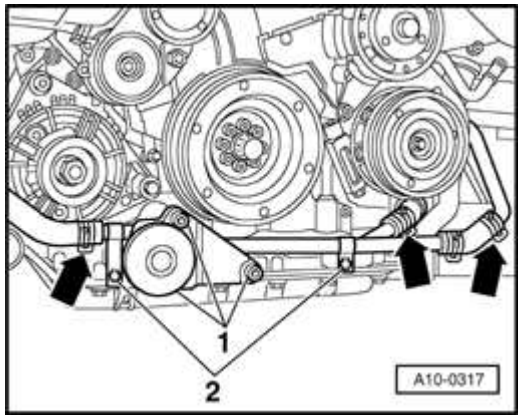


- Set up support bracket 10-222A with adapter 10-222A/3 on bolted flanges for wing panels.
- Attach support bracket to front and rear lifting eyes on engine.
- Raise engine as far as possible with spindles of support bracket.

17-35



- Cut open cable ties -arrows-, open retainer for starter cable and take out cable.
- Unbolt torque reaction support at front of oil pan.
- Unbolt coolant line from oil pan.
- Disconnect connector from oil pressure switch on left of oil pan.

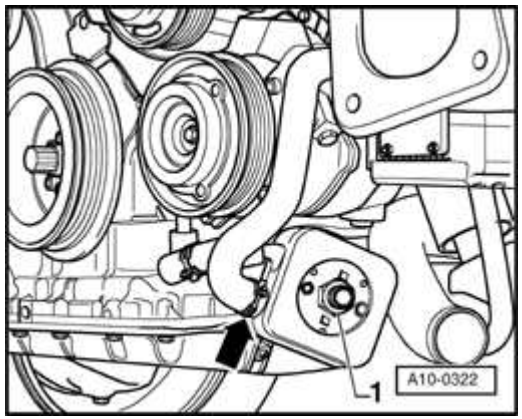


- Remove torque reaction support -1-.
- Release hose clamps -arrows-.
- Remove water line -2-.

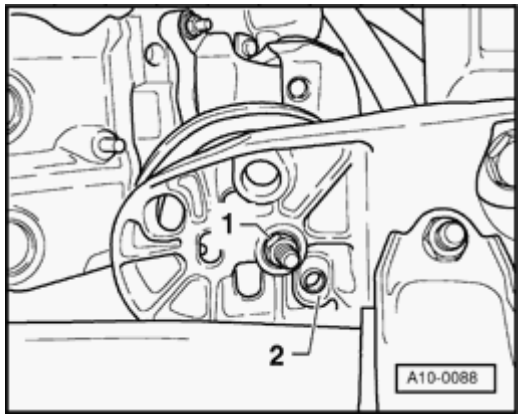
17-36

- Place drip tray VAG 1306 under engine.

- Remove oil filter.

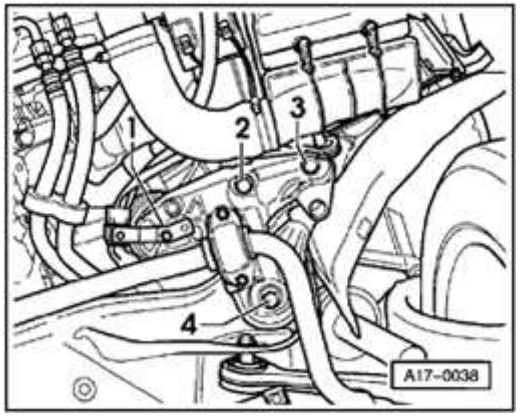


- Release hose clamps -arrows-.
- Remove oil cooler -1-.

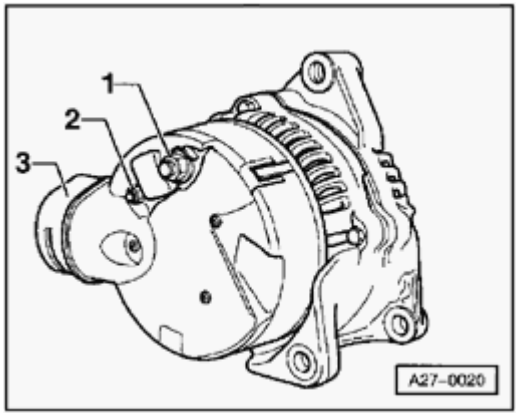


- Remove bottom nuts on engine mountings -1- (left and right sides).
- Mark positions of securing points -1- and locating sleeves -2- under engine mountings on left and right sides.

17-37

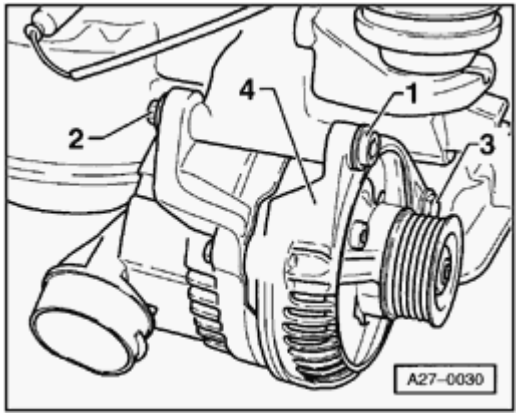


- First remove front subframe bolts -2- and -3- (left and right). Then remove bolts -4-.
- Move anti-roll bar downward.
- Remove charge air cooler -2- on right side (release hose connection at top, and 3 rubber mountings).

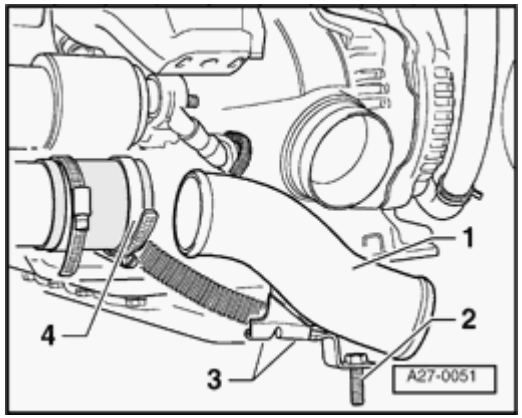


- Remove air duct from connector elbow on alternator -3-.
- Disconnect cable from terminal 30/B+ -1-. Tightening torque: 16 Nm
- Disconnect cable from terminal D+ -2-. Tightening torque: 4 Nm

17-38



- Remove hex socket head bolt -1- and securing nut -2-. Tightening torque: 45 Nm
- Loosen bolt -3-. Tightening torque: 22 Nm.
- Take out alternator -4- from below.



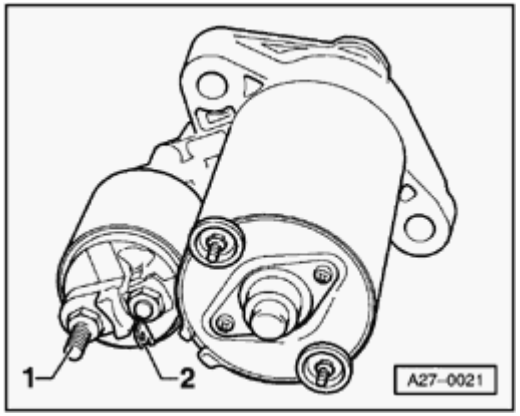
1 - Remove air line -1-.

2 - Mounting for oil line and air conditioner lines

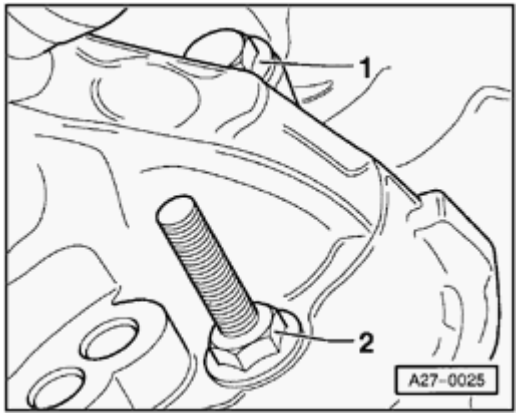
3 - Mounting on cylinder block

4 - Release hose clamp

17-39



- Disconnect cable from terminal 30/B+ -1-. Tightening torque: 16 Nm
- Disconnect connector for terminal 50 -2-.
- Remove right wheel

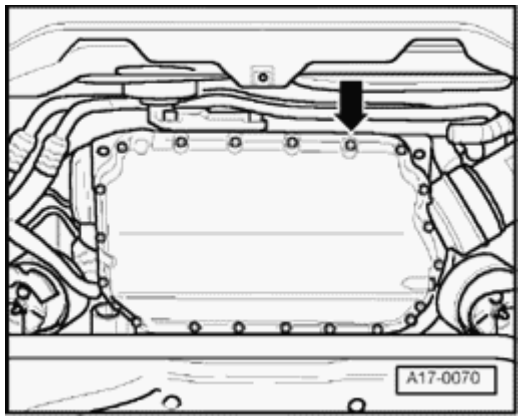


- remove top bolt -1- from right wheel housing. Tightening torque: 65 Nm
- Remove lower bolt (accessible from engine side). Tightening torque: 65 Nm
- Remove starter from front of vehicle.

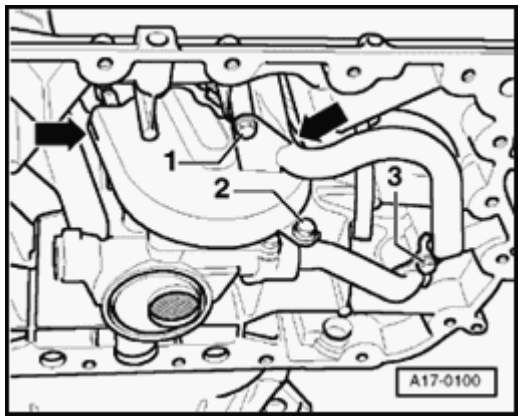
17-40

Note:

To avoid having to check and adjust wheel alignment, only loosen the front subframe mountings and lower the subframe at the front.



- Remove lower section of oil pan.
- Disconnect return lines for turbocharger from upper section of oil pan.

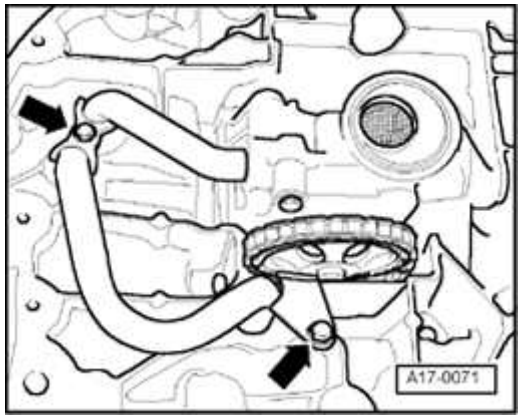


- Unbolt cover plate -2- for oil pump sprocket.

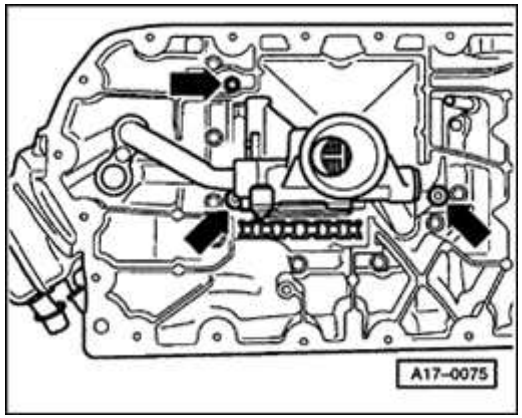
Notes:

- *When loosening bolt -2- securing cover plate, counter-hold at welded nut.*
- *When installing, make sure that the plate engages in position -arrows-.*

17-41



- Unbolt two oil supply lines, and pull longer of two lines downward to disconnect from upper section of oil pan.



- Unbolt oil pump from engine so that shorter oil supply line can be disconnected (do not remove oil pump).
- Remove bolts securing upper section of oil pan to transmission.
- Unbolt upper section of oil pan from engine.

Note:

Two M6 bolts and two M8 bolts are located vertically at rear of oil pan upper section (in front of joint between engine and transmission).

17-42

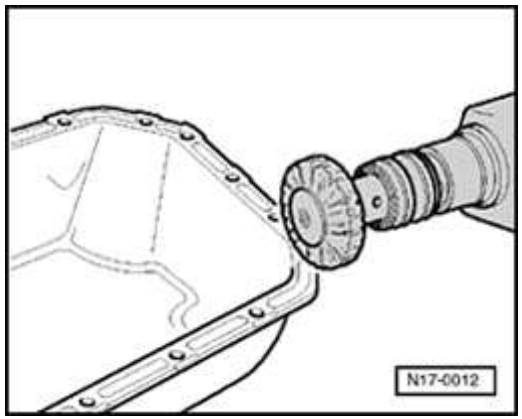
Installing:

Install in the opposite order to removing. When installing, note the following points:

- Clean sealing surfaces; ensure that they are free of oil and grease.

WARNING!

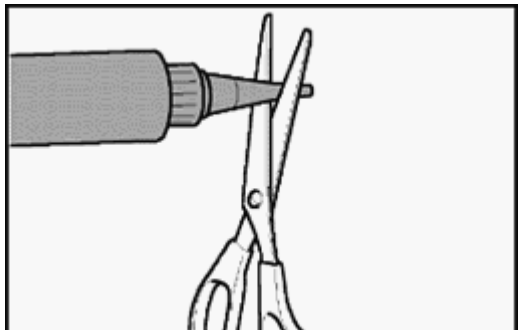
Wear protective goggles.



- Remove any residues of sealant on oil pan and engine block using plastic brush attachment, or similar.

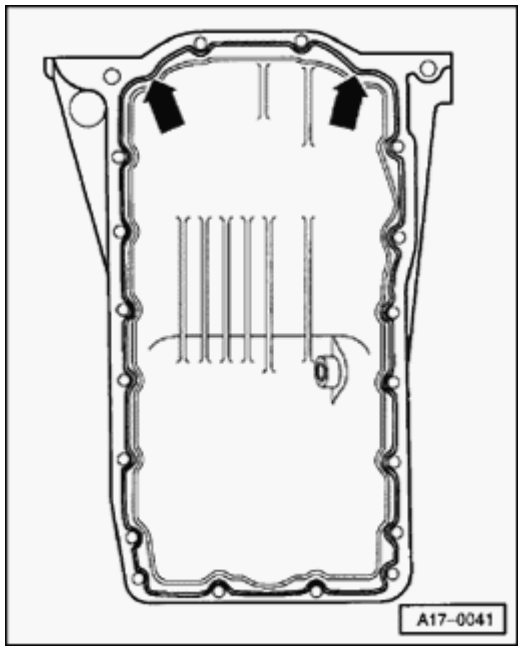
Note:

The oil pan must be installed within 5 minutes after applying silicone sealant D 454 300 A2.



- Cut off nozzle of tube at front marking (diameter of nozzle approx. 3 mm).
  - Thickness of sealant bead: 2 ... 3 mm

17-43



Note:

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

- Make sure sealing surface is clean and then apply silicone sealant on sealing surface of oil pan, as shown in illustration. (Illustration shows position of sealant on cylinder block.)

Note:

Be particularly careful when applying the sealant around the rear sealing flange -arrows in illustration-.

- Locate oil pan in position immediately, and tighten all bolts securing oil pan to cylinder block to 5 Nm initially.
- Tighten bolts securing oil pan to transmission to 45 Nm.
- Tighten bolts securing oil pan to cylinder block in diagonal sequence in 2 stages; tighten to 10 Nm when tightening second time.
- Tighten M10 bolts securing oil pan to cylinder block to 45 Nm.

- Clean both sealing surfaces for lower section of oil pan; ensure that they are free of oil and grease.

Note:

Do not use any adhesive or sealant.

- Install new gasket on lower section of oil pan and install on upper section of oil pan with two diagonally opposite bolts.

- Tighten all securing bolts hand-tight.

- Tighten bolts to 10 Nm with torque wrench, working from center outward.

- Install new seal on oil drain plug and tighten to 30 Nm.

Notes:

- *When installing the upper section of the oil pan with the engine removed from the vehicle, ensure that the oil pan is positioned flush with the cylinder block at the flywheel end.*

- *The sealant must be left to dry for about 30 minutes after installing the oil pan before engine*

oil can be put in.

17-45

- Fill with coolant ⇒ Page 19-19 .

- Fill engine with oil.

⇒ *Repair Manual, Maintenance*

- Install subframe.

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

- Install lock carrier in normal position.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Install bumper.

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

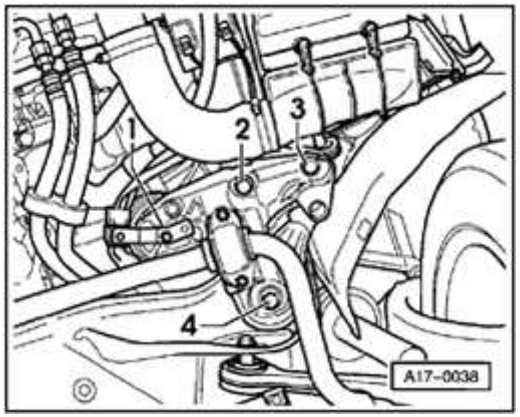
- Install noise insulation.

Tightening torques

Component		Nm
Upper section of oil pan to cylinder block	M6	10
	M8	20
Lower section of oil pan to upper section of oil pan		10
oil pan to transmission	M8	25
	M10	45
Coolant line to oil pan		10
Oil drain plug in lower section of oil pan		30
Dipstick guide tube to cylinder head		25
Oil pump to cylinder block		25
Oil pump supply lines to upper section of oil pan		10
Front sealing flange	M6	10
Collar bolt	M8	30
Bracket for coolant lines to oil pan		10
Coolant drain screw on engine		20

17-47

Component	Nm
Stop for torque reaction support to bracket on engine	25
Engine mounting to subframe	25
Torque reaction support to front of oil pan	25
Engine mounting to engine support	25
Chain sprocket to oil pump	25



Other tightening torques

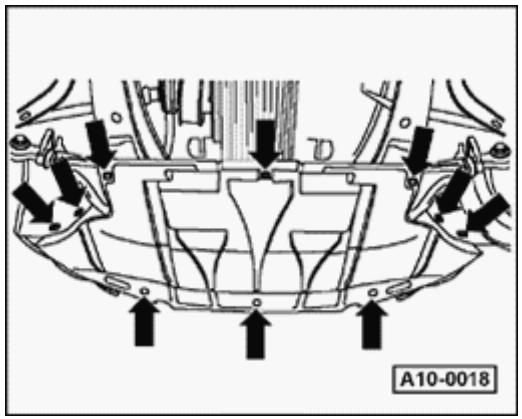
Nut for engine mounting -1-	25
Bolts -2- and -3-	60
Combi bolt -4- **	110 + 90°

** Combi bolt -4- must be replaced after removing.

17-48

Oil pump, removing and installing

Removing

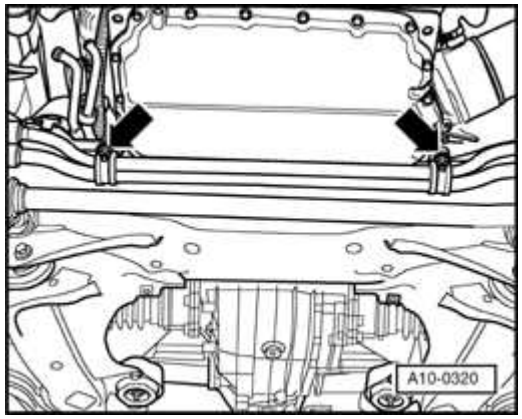


- Remove noise insulation panel -arrows-.
- Remove bumper.

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

- Move lock carrier to service position.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

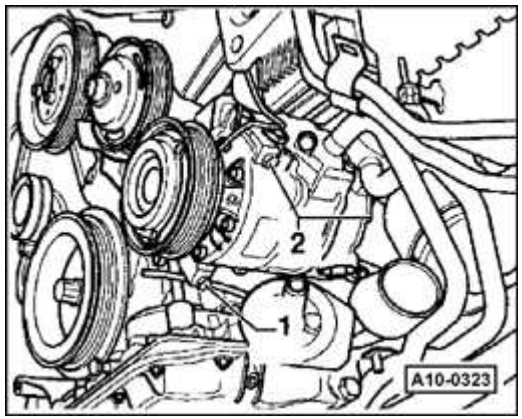


- Unbolt air conditioner lines from oil pan -arrows-.

17-49

WARNING!

Do not open air conditioner refrigerant circuit.



- Detach air conditioner compressor -1...3-.

Notes:

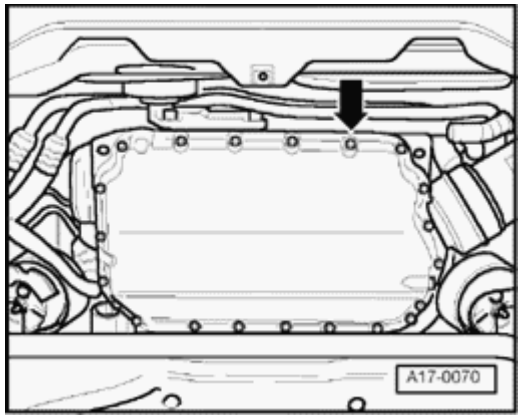
- *Watch position of guide bushes when installing.*
- *When installing, insert bolt -1- in the compressor first.*
- *To prevent damage to the condenser and refrigerant lines/hoses, ensure that the lines and hoses are not stretched, kinked or bent.*

- Drain engine oil.

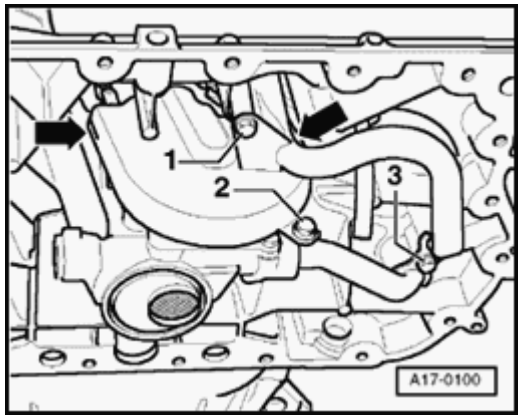
Note:

Use a separate container to collect the engine oil.

17-50



- Remove lower section of oil pan.

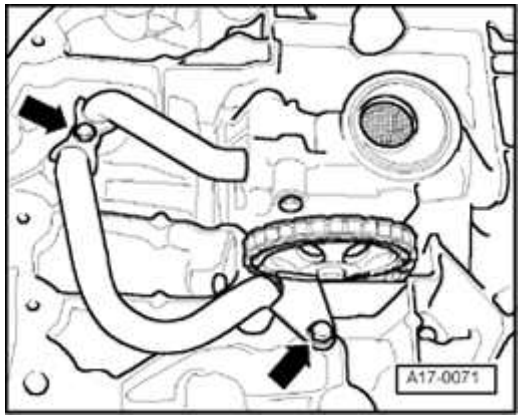


- Unbolt cover plate -2- for oil pump sprocket.

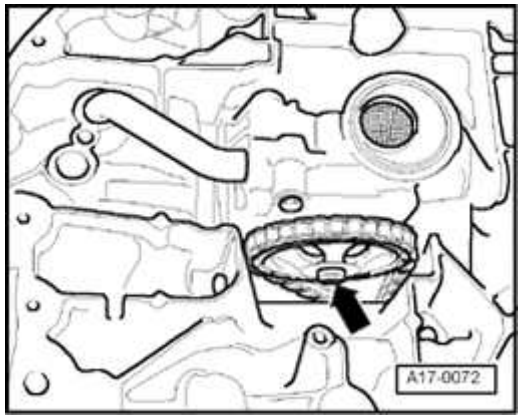
Notes:

- *When loosening bolt -2- securing cover plate, counter-hold at welded nut.*
- *When installing, make sure that the plate engages in position -arrows-.*

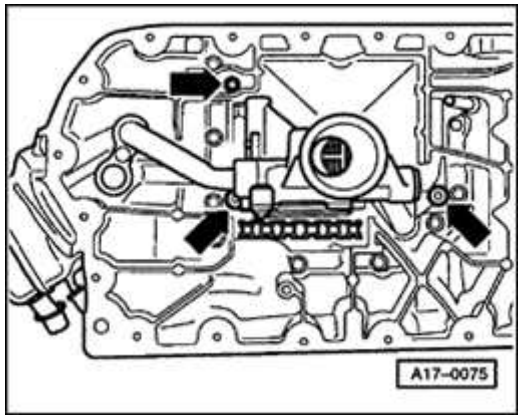
17-51



- Unbolt brackets for oil supply lines -arrows- and pull front (longer) oil supply line away downward.



- Remove bolt securing chain sprocket to oil pump using Torx T45, and pull sprocket off oil pump.

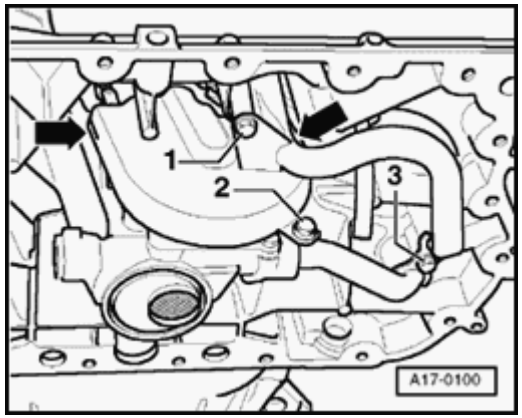


- Remove oil pump together with shorter oil supply line.

Installing

Install in the opposite order to removing. When installing, note the following points:

- Before bolting on oil pump, install short oil supply line into pump and upper section of oil pan with new O-rings.



- Bolt on cover plate -2- for oil pump sprocket.

Notes:

- *When installing, make sure that the plate engages in position -arrows-.*
- *When tightening bolt -2- securing cover plate, counter-hold at welded nut.*

- Clean both sealing surfaces for lower section of oil pan; ensure that they are free of oil and grease.

Note:

Do not use any adhesive or sealant.

- Install new gasket on lower section of oil pan and install on upper section of oil pan with two diagonally opposite bolts.

- Tighten all securing bolts hand-tight.

- Tighten bolts to 10 Nm with torque wrench, working from the center outwards.

- Install new seal on oil drain plug and tighten to 30 Nm.

- Fill up engine oil.

⇒ *Repair Manual, Maintenance*

- Install subframe.

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

- Install lock carrier in normal position.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Install bumper.

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

Tightening torques

Component	Nm
Chain sprocket to oil pump	25
Lower section of oil pan to upper section of oil pan	10
Oil drain plug in lower section of oil pan	30
Oil pump to cylinder block	25
A/C compressor to bracket	25
Oil pump supply lines to upper section of oil pan	10
Bracket for A/C lines to oil pan	10

17-55

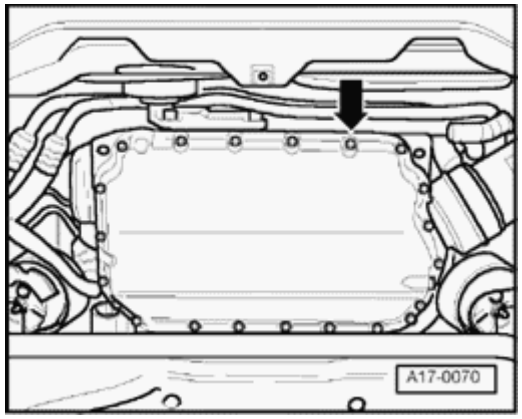
Front sealing flange and oil pump drive chain, removing and installing

Removing

- Remove ribbed belt ⇒ Page 13-1 .
- Remove toothed belt ⇒ Page 13-4 .
- Drain engine oil.

  Use a separate container to collect the engine oil.

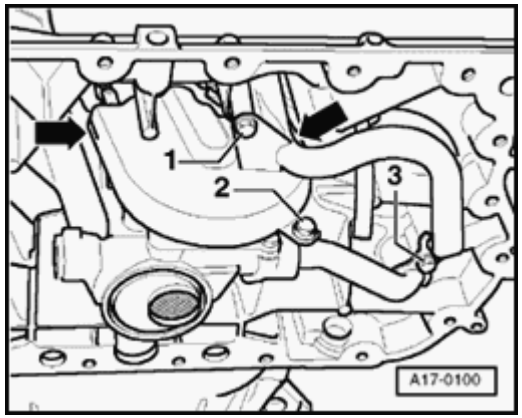
17-56



- Remove lower section of oil pan.
- Unbolt cover plate for oil pump sprocket (-2-).

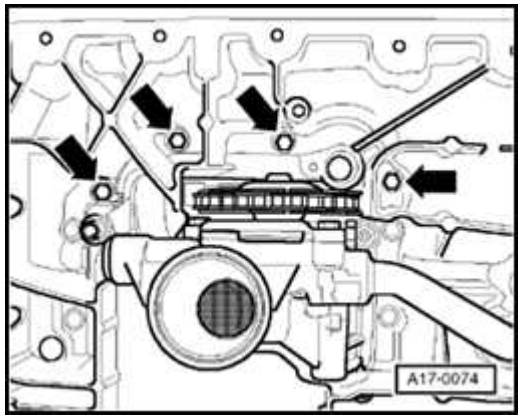
Notes:

- *When loosening bolt -2- securing cover plate, counter-hold at welded nut.*
- *When installing, make sure that the plate engages in position -arrows-.*

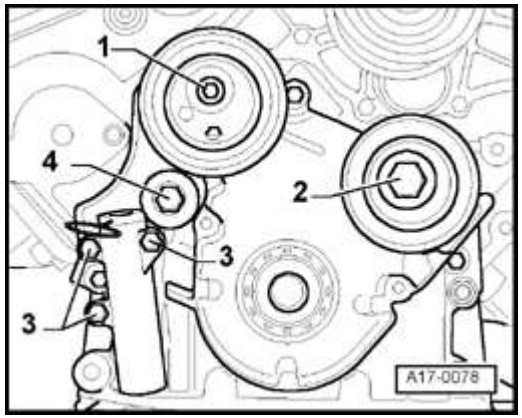


- Unbolt both oil supply lines -1- and -3- from upper section of oil pan and pull longer of two lines away downward.

17-57



- Remove 4 bolts from upper section of oil pan.



- Remove following components before unbolting front sealing flange:

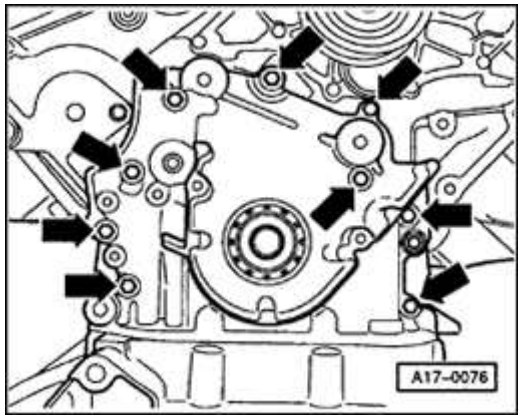
1 - Tensioning roller for toothed belt: 20 Nm

2 - Idler wheel: 45 Nm

3 - Toothed belt tensioner: 10 Nm

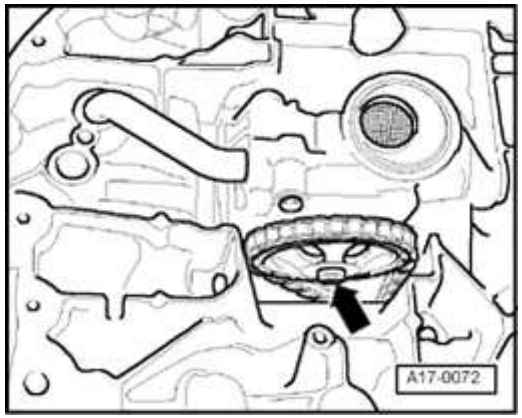
4 - Lever for toothed belt tensioner: 20 Nm

17-58



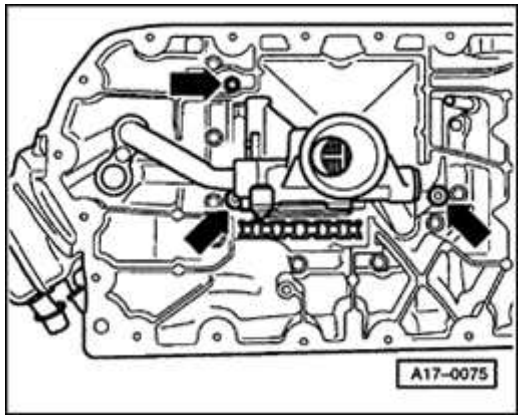
- Unbolt front sealing flange and take off gasket for front sealing flange M6 bolts: 10 Nm M8 collar bolt: 30 Nm

Replacing oil pump drive chain



- Remove bolt securing chain sprocket to oil pump using Torx T45, and pull sprocket off oil pump.

17-59



- Remove oil pump together with shorter oil supply line.
- Take out oil pump sprocket and remove drive chain from crankshaft.

Removing and installing chain sprocket on crankshaft ⇒ Page 17-62 .

Installing

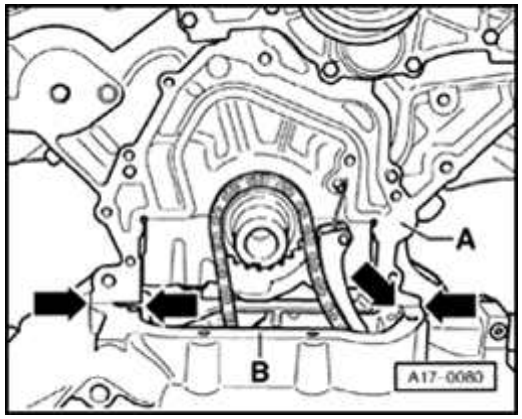
Install in the opposite order to removing. When installing, note the following points:

- Remove any residues of sealant on front of oil pan or engine block, if necessary.
- Clean sealing surfaces; ensure that they are free of oil and grease.

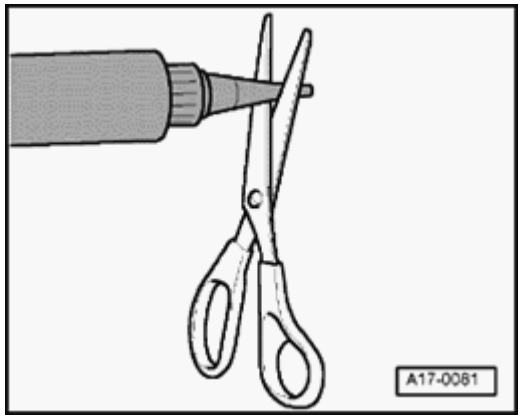
Note:

The front sealing flange must be installed within 5 minutes of applying silicone sealant D 454 300 A2.

17-60



- Do not apply any sealant on sealing surface -A- of the cylinder block.
- After installing gasket on sealing surface -A-, apply a small quantity of sealant to joints between two arrows -left and right-.

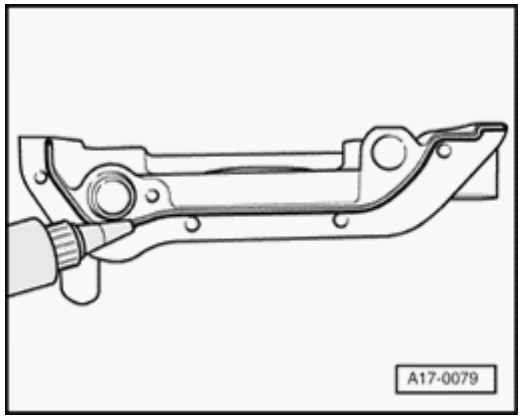


- Cut off nozzle of tube at front marking (diameter of nozzle approx. 3 mm).
  - Thickness of sealant bead: 2 ... 3 mm

Note:

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

17-61



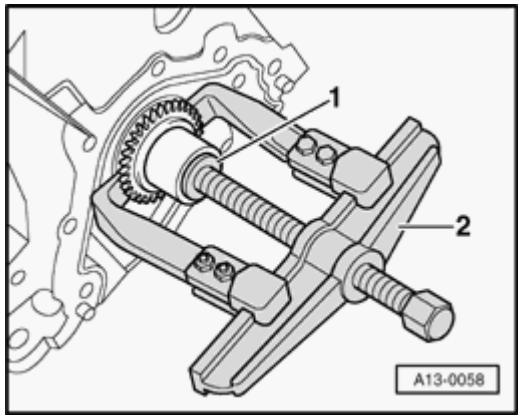
- Make sure sealing surface is clean and then apply silicone sealant on sealing surfaceof front sealing flange, as shown in illustration. (Illustration shows where bead of sealant is applied.)
- Use installing sleeve 3202/1 to install sealing flange. Locate sealing flange in position immediately and tighten all 4 bolts in oil pan hand-tight initially.
- Tighten bolts securing sealing flange Tightening torque: Front sealing flange: M6 10 Nm, M8 20 Nm 4 bolts in oil pan: 10 Nm

17-62

Chain sprocket for oil pump on crankshaft, removing and installing

Removing

Removing and installing front sealing flange and oil pump drive chain ⇒ Page 17-55 .



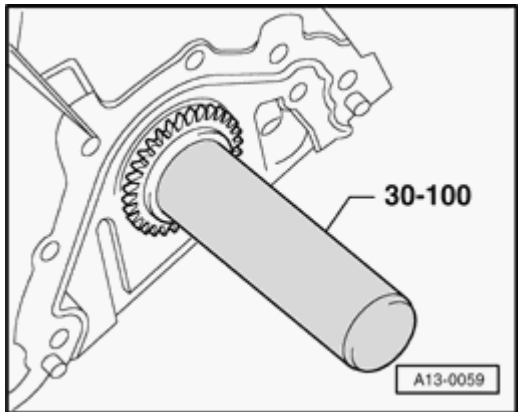
- Pull chain sprocket off crankshaft using a normal commercial-type puller -2-: use a suitable washer -1- to protect end of crankshaft.

Installing

- Heat chain sprocket in oven for about 15 minutes at 220 ° C.

Notes:

- *Wear protective gloves.*
- *Installation position: it should be possible to read the lettering on the chain sprocket.*



- Using pliers, install chain sprocket on end of crankshaft and push against stop on crankshaft with drift sleeve 30-100. If necessary knock on carefully using a plastic hammer.

Removing and installing front sealing flange and oil pump drive chain ⇒ Page 17-55 .

17-63

Crankshaft oil seal - pulley end, replacing

Removing

- Remove bumper.

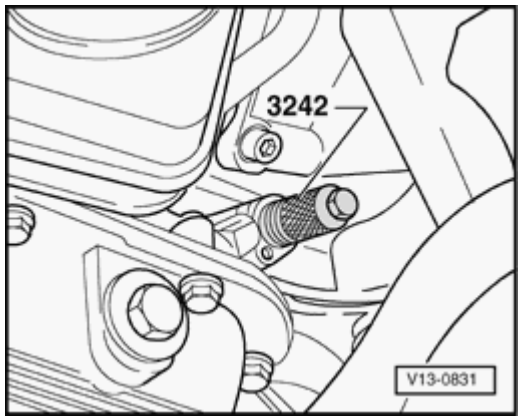
⇒ *Repair Manual, Body Exterior, Repair Group 63*

- Move lock carrier to service position

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Remove ribbed belt ⇒ Page 13-1 .
- Remove toothed belt ⇒ Page 13-4 .
- Remove sealing plug from hole in cylinder block (left side).
- Position crankshaft to TDC of No. 3 cylinder. Crankshaft TDC drilling should be visible (or it should be possible to feel the drilling) in sealing

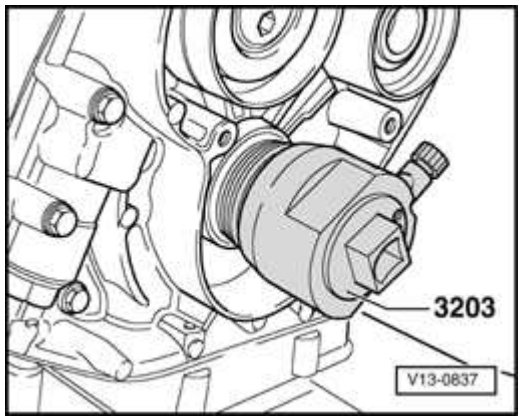
plug hole.



- Screw clamping bolt 3242 into hole so that crankshaft is secured against turning.

- Remove crankshaft toothed belt sprocket.

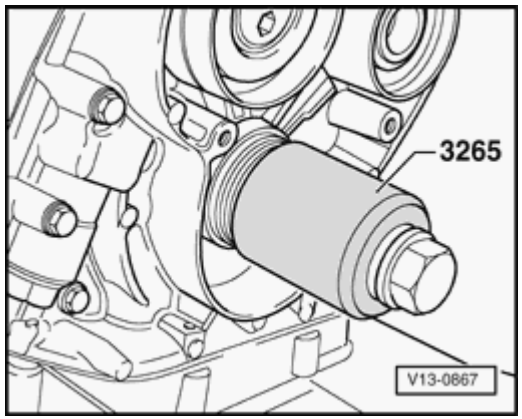
- Remove inner part of oil seal extractor 3203 two turns (approx. 3 mm) out of outer part and lock with knurled screw.



- Lubricate threaded head of oil seal extractor, place it in position and, exerting firm pressure, screw it in as far as possible into oil seal.
- Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.

Installing

- Place guide sleeve 3202/1 onto crankshaft journal.
- Slide dry seal over guide sleeve.



- Press oil seal in flush with installing sleeve 3265.

Then proceed as for removing, performing steps in reverse order.

17-65

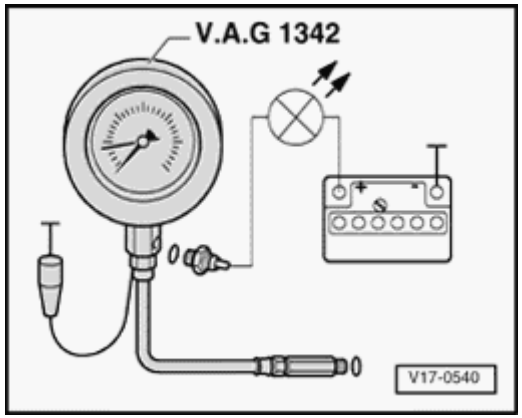
Oil pressure and oil pressure switch, checking

Note:

Servicing and checking function of oil pressure warning lamp and buzzer:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

Test procedure



- Remove oil pressure switch (F1) and screw oil pressure switch into tester.
- Screw tester into oil pan in place of oil pressure switch.
- Connect brown wire of tester to ground (GND) (-).
- Using test leads from VAG 1594, connect diode test lamp VAG 1527 between positive battery terminal (+) and oil pressure switch.
- Start engine and gradually increase engine speed.

  LED should light up at 1.2...1.6 bar, otherwise replace oil pressure switch.
- Increase engine speed further.

  At 2000 RPM and an oil temperature of 80 ° C oil pressure should be at least 2.0 bar.

17-66

Engine oil, specifications

A high-quality multigrade oil is put in at the factory: this can be used all year round, except in extremely cold climates.

Viscosity grades and oil specifications

Viscosity grades and oil specifications

⇒ *Repair Manual, Maintenance*

Oil level, checking

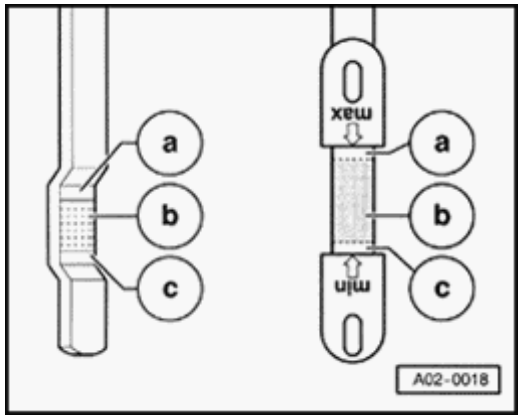
Test conditions

- Oil temperature above 60 ° C.
- Vehicle level.
- The vehicle must be standing on level ground when checking the oil level. Wait for a few minutes after switching off the engine to allow the oil to flow back into the oil pan.

Test sequence

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

17-68



Markings on oil dipstick:

a - Do not top up oil.

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

c - Oil must be topped up. It is sufficient if the oil level is somewhere in area -b- (grooved area on dipstick) after topping up.

Note:

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

Oil capacities ⇒ *Repair Manual, Maintenance*

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!

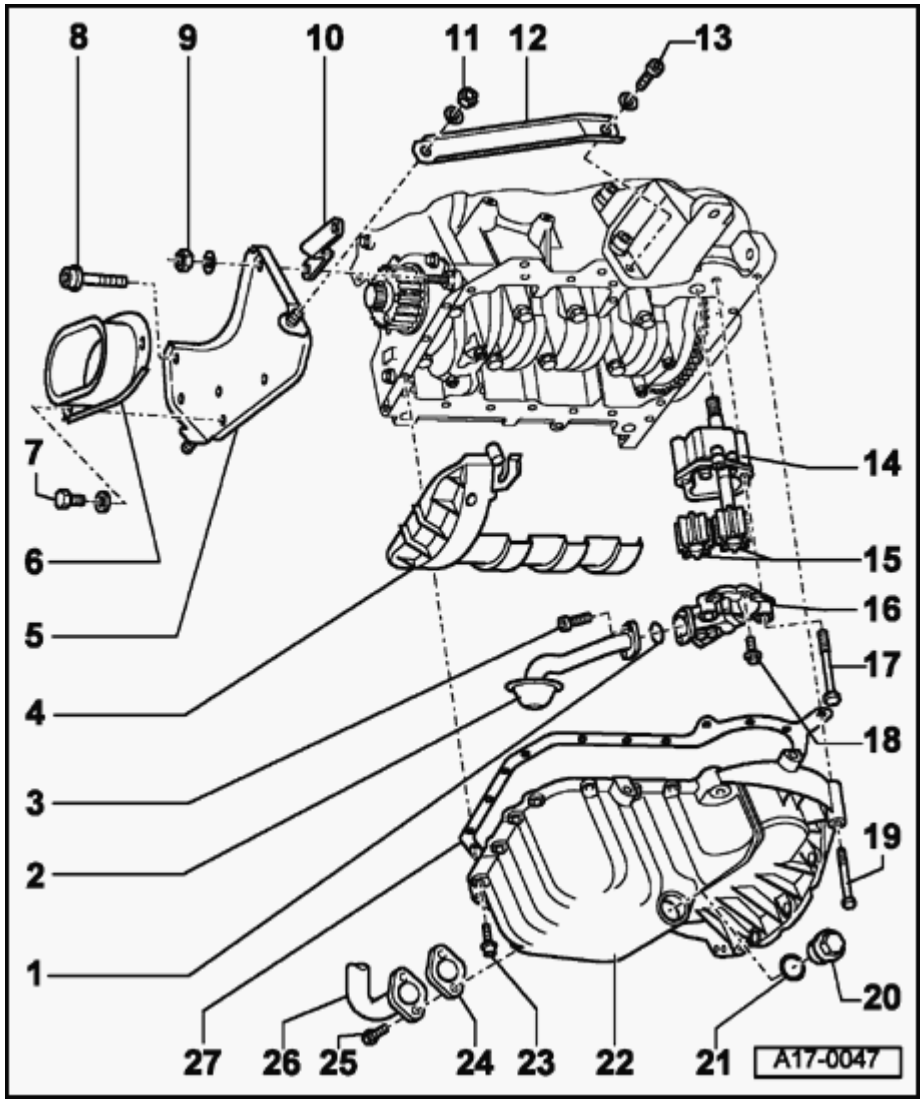
- ***If large quantities of metal particles or other deposits (caused, for example, by partial seizure of the crankshaft or connecting rod bearings) are found in the engine oil, the oil passages must be cleaned thoroughly and the oil cooler replaced in order to prevent further damage from re-occurring.***

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

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 .

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

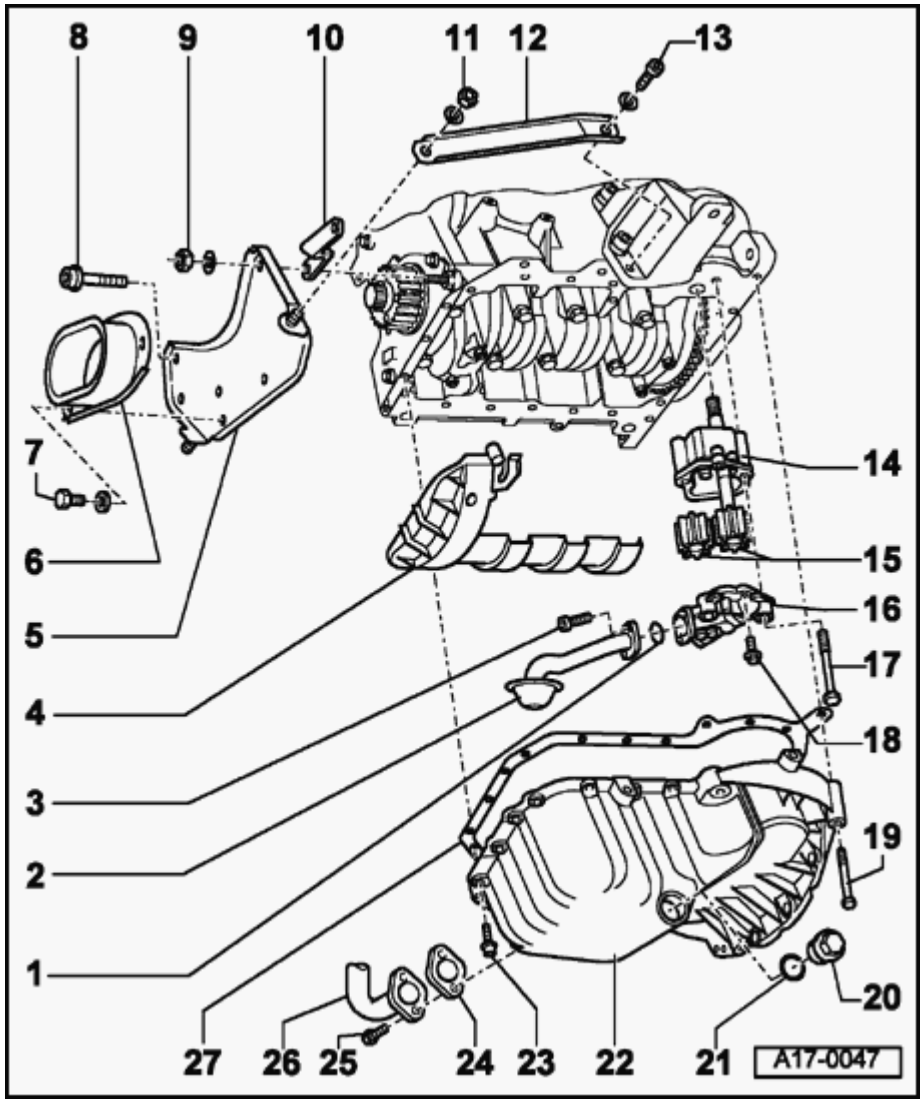
6 - Stop

- 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

- 25 Nm (18 ft lb)

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)

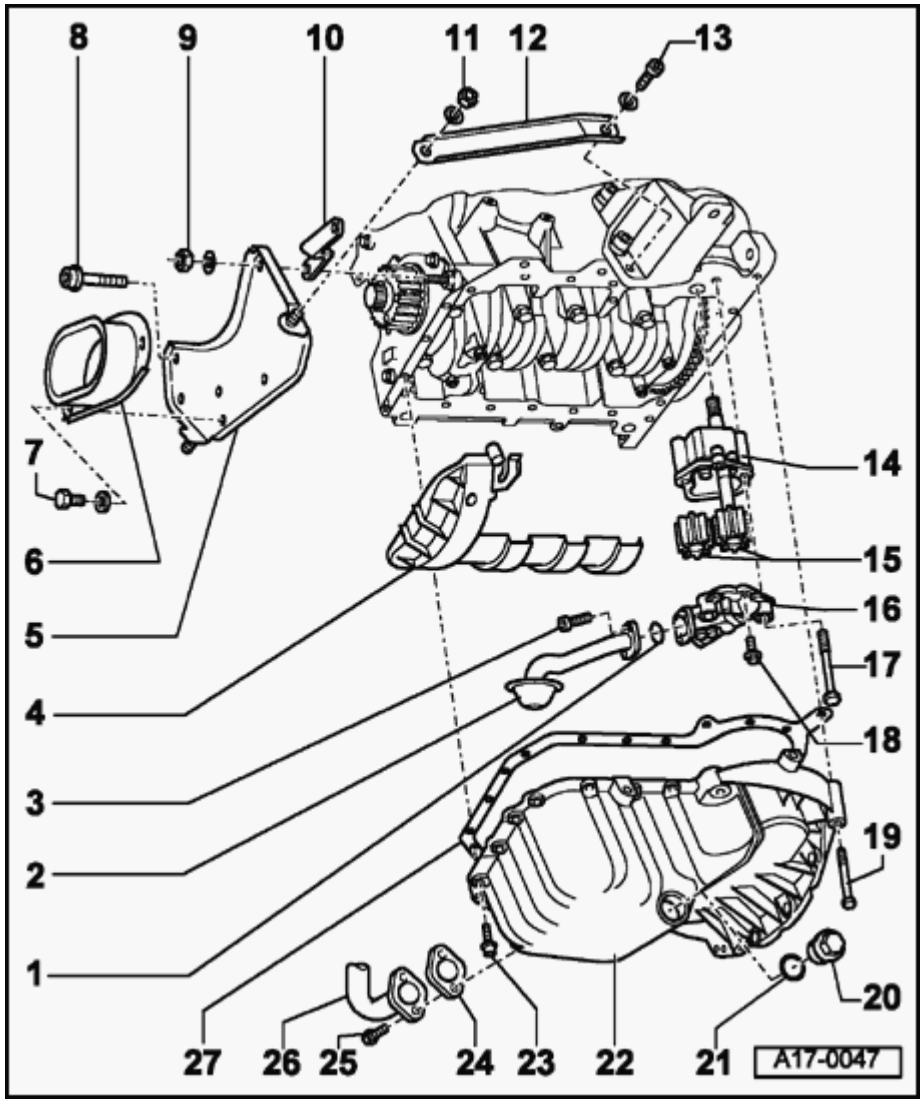
17 - Bolt

- 25 Nm (18 ft lb)

18 - Bolt

- 10 Nm (7 ft lb)

17-4



19 - Bolt

- 45 Nm (33 ft lb)

20 - Oil drain plug

- 50 Nm (37 ft lb)

21 - Sealing washer

- Always replace

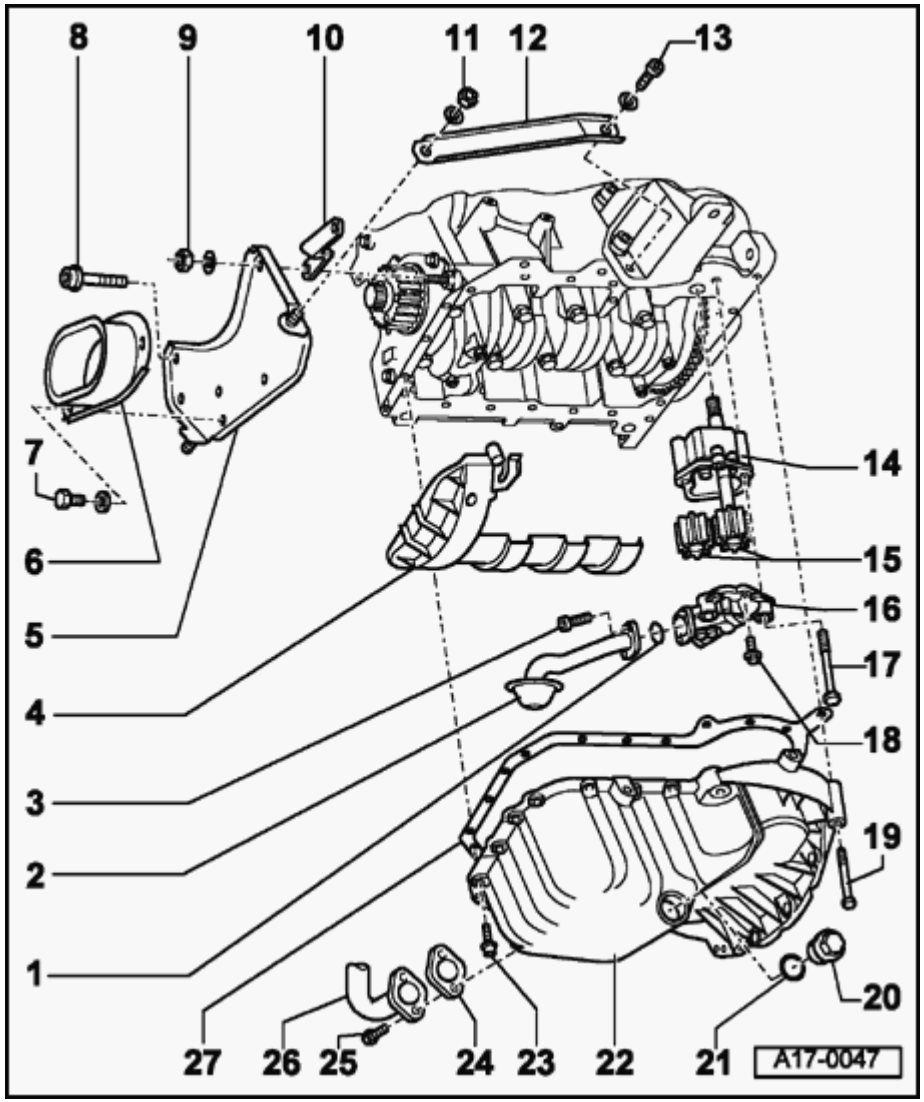
22 - Oil pan

- 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

17-5



24 - Gasket

- Always replace

25 - Bolt

- 10 Nm (7 ft lb)

26 - Oil return line

- From turbocharger

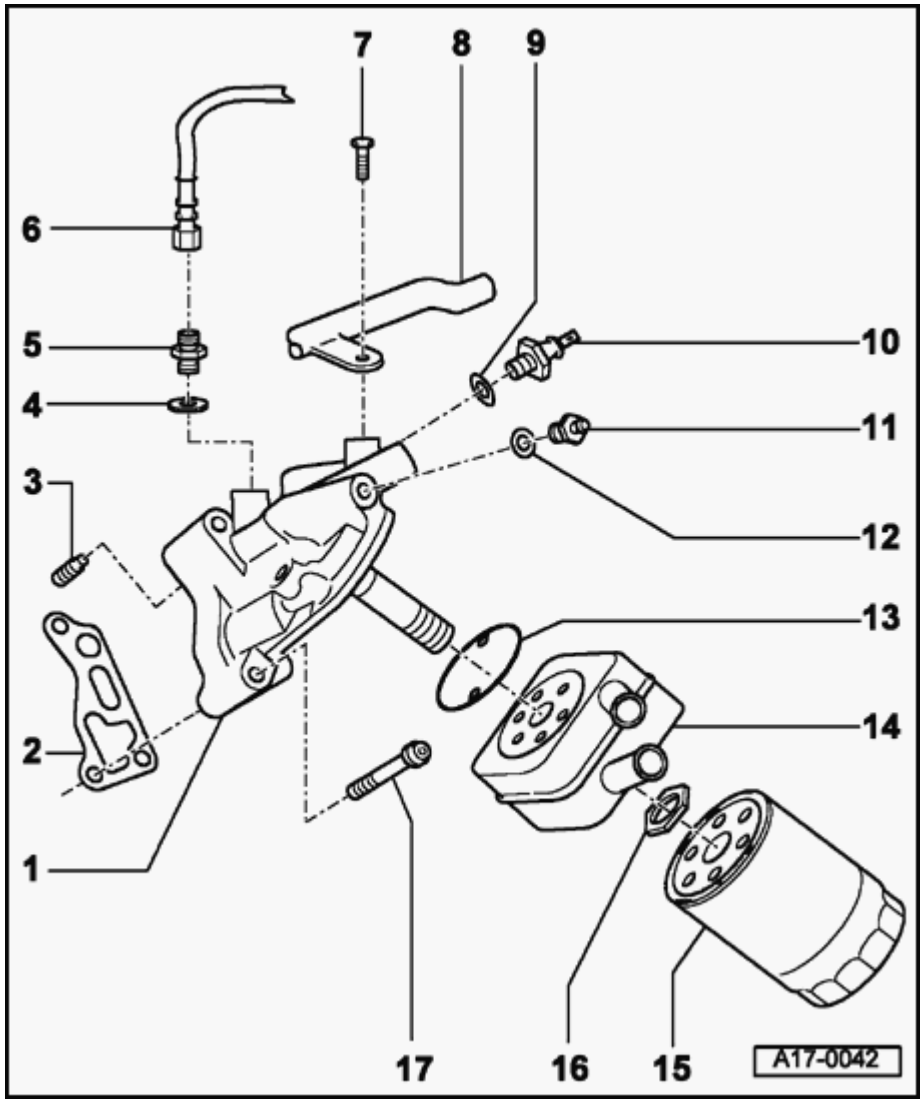
27 - Gasket

- 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.

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

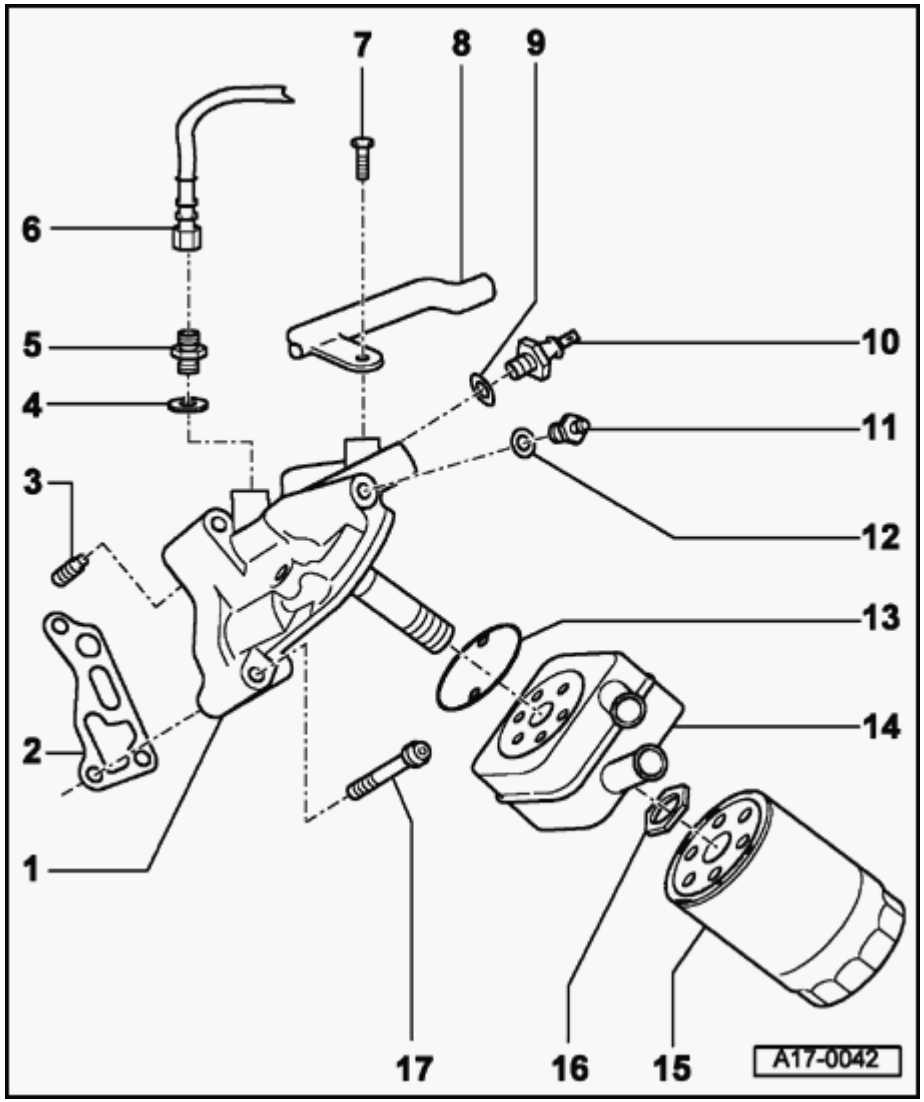
- If leaking, cut open and replace

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

- 25 Nm (18 ft lb)

- Black insulation
- Check ⇒ Page 17-22

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)

17-8

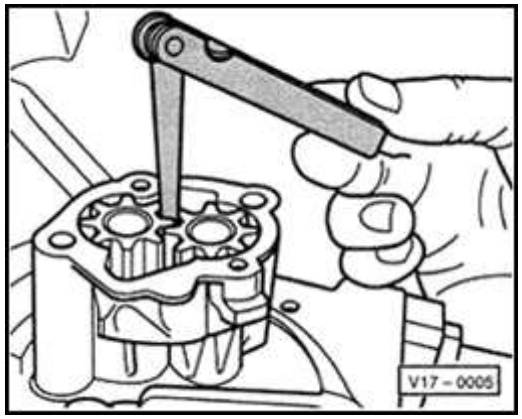


Fig. 1 Checking oil pump backlash

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

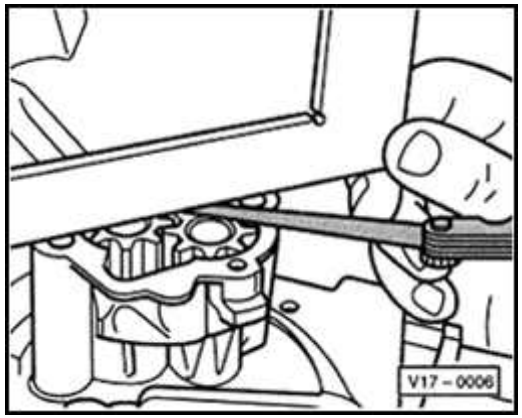


Fig. 2 Checking oil pump axial clearance

Wear limit: 0.15 mm (0.006 in.)

17-9

Oil pan, removing and installing

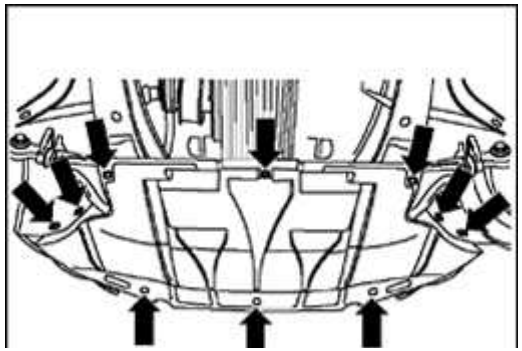
Special tools and equipment

- 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

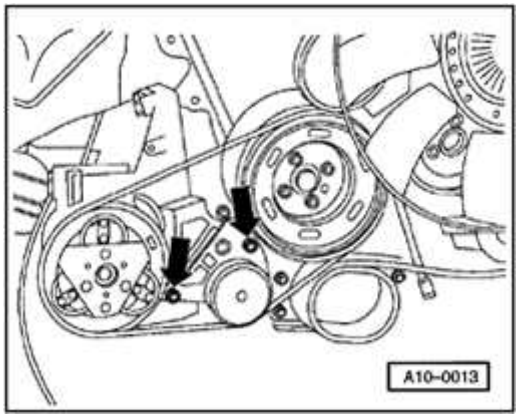


- Remove noise insulation panel (arrows).
- Drain engine oil.

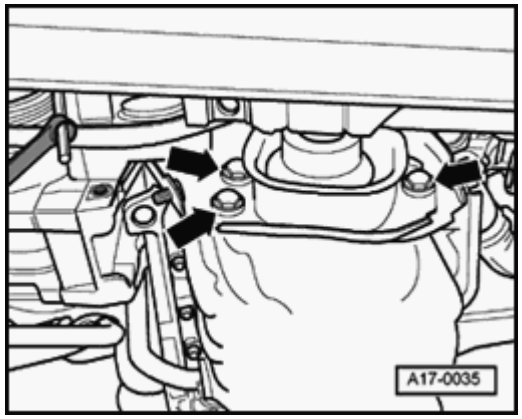
17-10

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.



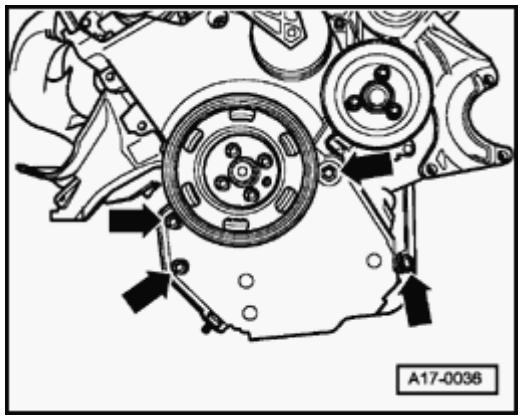
- Remove bolts for ribbed belt tensioner for A/C compressor (arrows).
- Release tension on ribbed belt and remove.
- Remove belt pulley.



- Remove torque support stop (arrows).

17-11

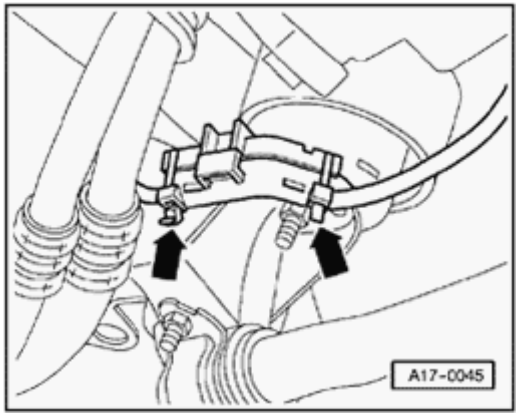
- Remove side brace from left side of torque support bracket.



- Remove torque support bracket from engine (arrows).

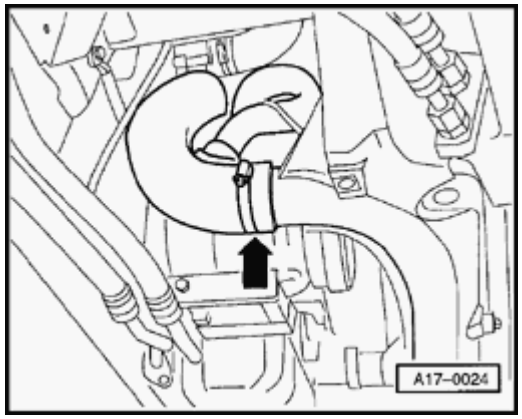
Note:

Illustration is shown with engine removed.

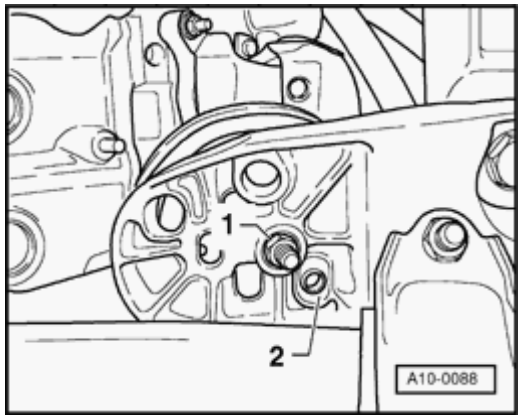


- Cut tie wraps (arrows), open bracket for starter wiring and remove wiring.

17-12



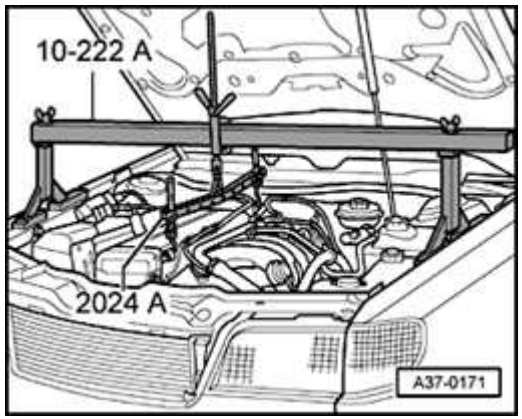
- Remove hose from turbocharger at air guide tube in lock carrier (arrow).



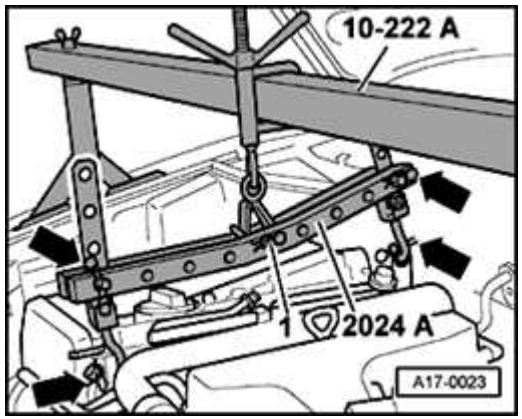
- Remove both nuts -1- from lower engine mount.

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).

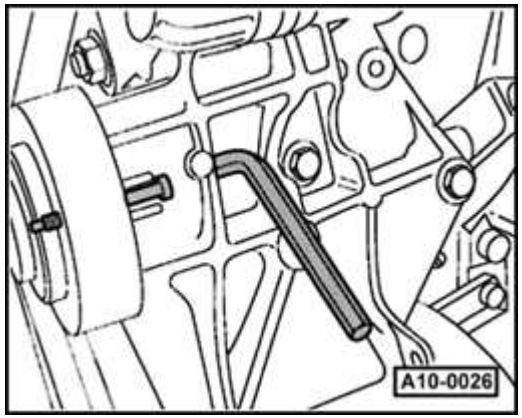
17-14

- 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 .

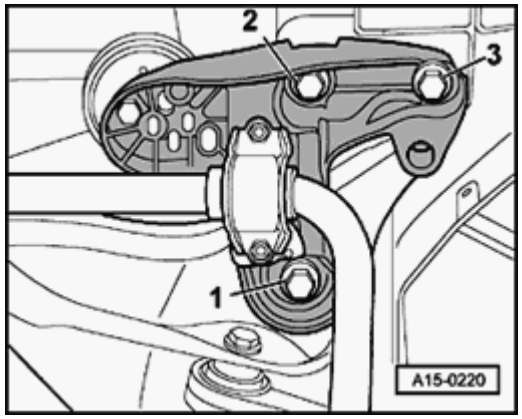


- Secure belt pulley for viscous fan using M5 x 60 mm bolt and unbolt using 8mm hex socket wrench.
- Remove viscous fan and place forward in fan frame.



- Use VAG1202A engine hoist to support subframe.

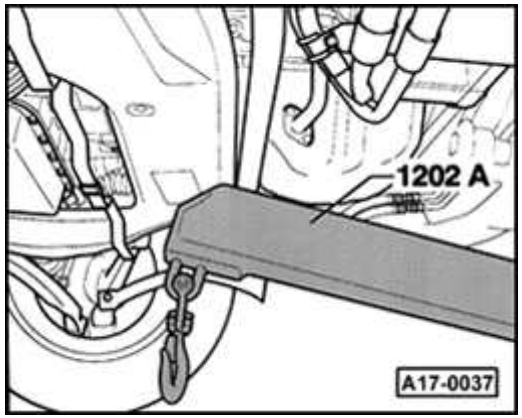
17-15



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

Note:

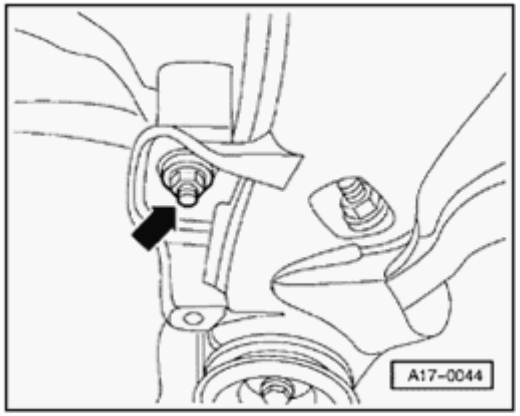
Only loosen or lower subframe at front to avoid changing wheel alignment.



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

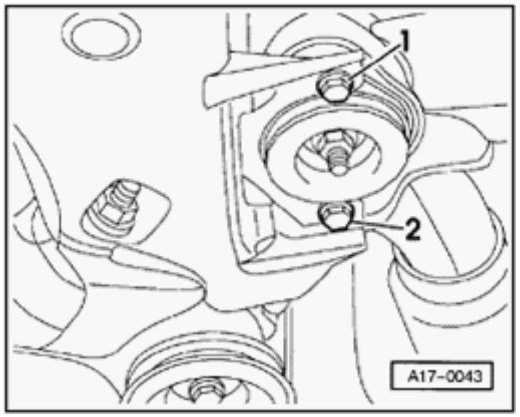
17-16

Vehicles with manual transmission



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

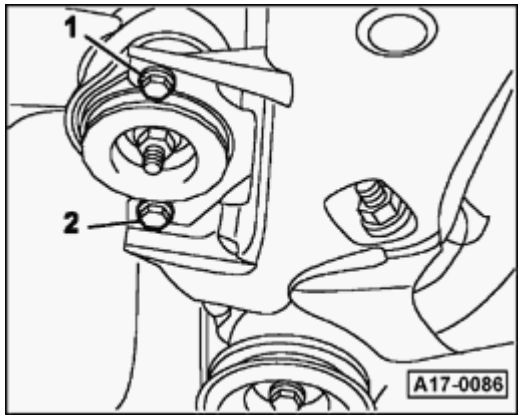
Vehicles with automatic transmission



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

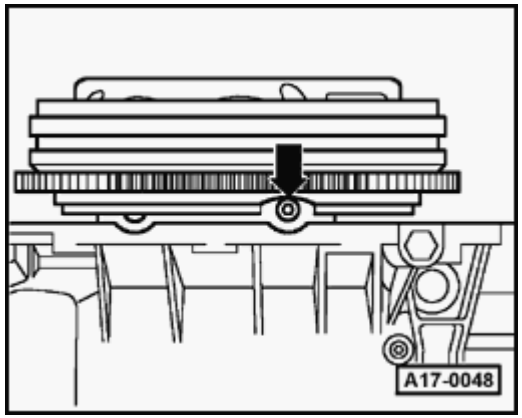
17-17

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).

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.

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).

- 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.

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)

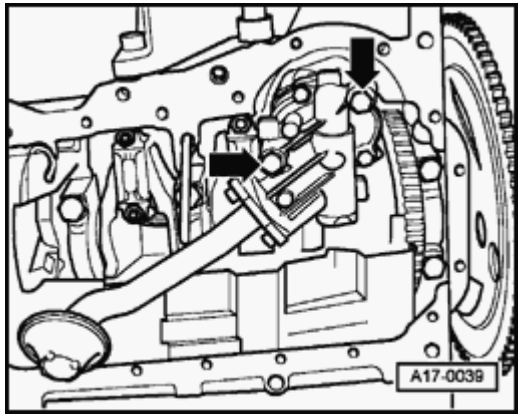
17-21

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)

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

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.

17-23

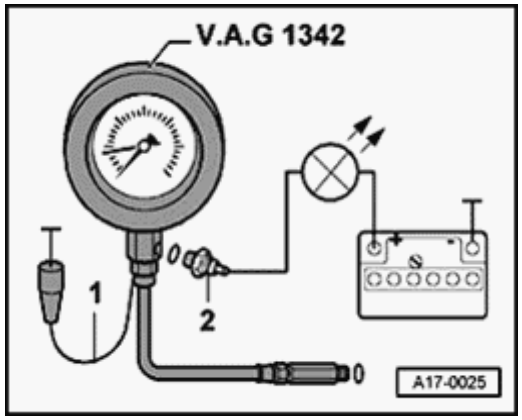
Special tools and equipment

- 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)

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.

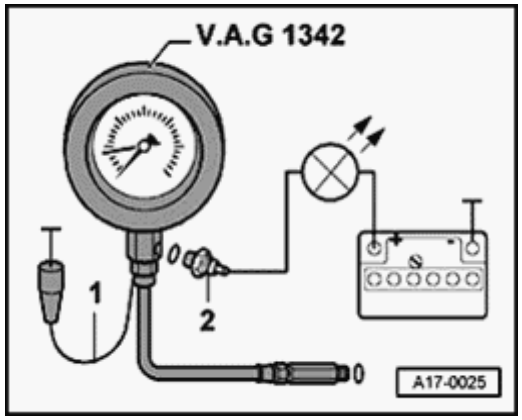
Note:

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.

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 .

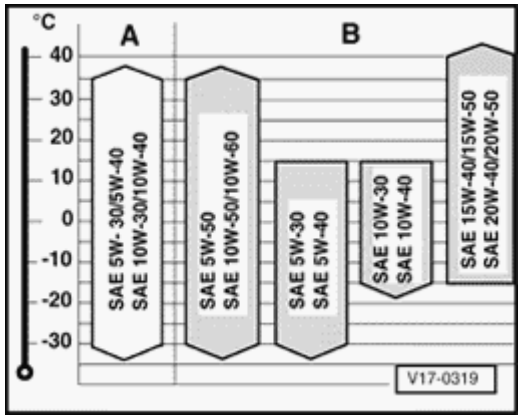
17-26

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.

17-27

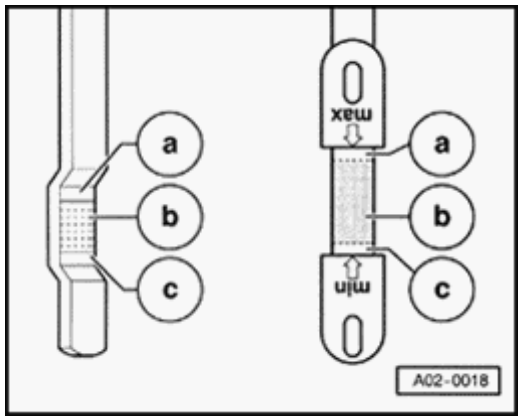
Oil level, checking

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.

17-13

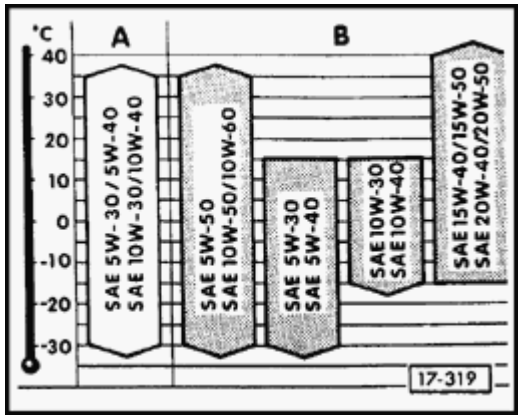
Engine oil

Viscosity and specification

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

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

When topping up and changing the oil use only quality engine oil. Mixing oils when topping up is permissible.



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

A - Multi-grade high lubricity oils

Specification VW 500 00 [1)]

B - Multi-grade high lubricity oils

Specification VW 501 00 [1)]

A - Multi-grade high lubricity oils, minimum API-SF[2)] or API-SG[2)] specification

[1)] A date not older than 10.91 must be indicated after this VW standard.

[2)] These oils may only be used if in exceptional cases no approved

engine oil is available.

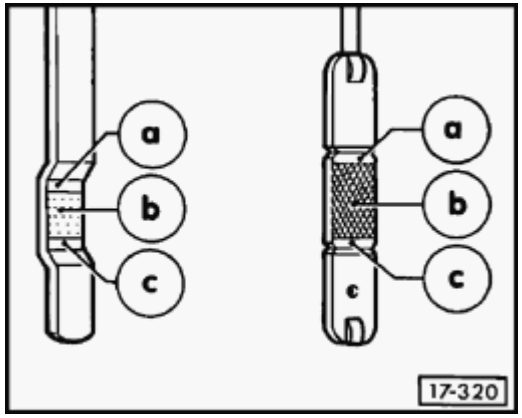
17-14

Checking engine oil level

The vehicle must be on a level surface when checking the engine oil level. Wait a few minutes after stopping the engine so the oil can run back into the pan. Then withdraw the oil dipstick, wipe with a clean cloth and insert again as far as possible. Withdraw dipstick again and read engine oil level.

Check engine oil level only with the engine warm:

- Oil temperature greater than 60 ° C (140 ° F)



Markings on oil dipstick:

a - Oil MUST NOT be topped up past this point

b - Oil may be topped up

c - Oil MUST be topped up. It is sufficient if the oil level, after topping up, is somewhere within range -b- (knurled area)

CAUTION!

The oil level must NOT exceed the max. marking on the dipstick.

17-30

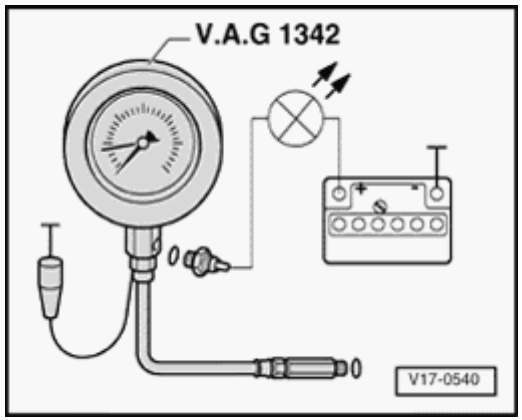
Lubrication system components, checking

Oil pressure and oil pressure switch, checking

Note:

For the functional check and servicing of the optical and acoustic oil pressure warning ⇒ "Electrical Wiring Diagrams, Troubleshooting &Component Locations".

Test sequence



- Remove oil pressure switch -F1- and install in tester.
- Install tester into oil pan in place of oil pressure switch.
- Connect brown wire of tester to Ground (GND).
- Using auxiliary cables from VW1594, connect VAG1527B voltage tester to oil pressure switch and Battery (+).
- Start engine and slowly increase engine speed (RPM).

  At 1.2-1.6 bar pressure LED must light up.
- If not, replace oil pressure switch.
- Increase engine speed (RPM) further.
- At 2000 rpm and an oil temperature of 80 ° C, oil pressure must be at least 2.0 bar.

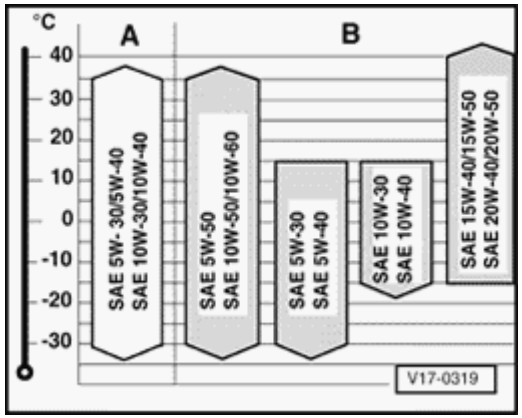
17-31

Engine oil

Engine oil capacity (w/filter): 5.7 L (6.0 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.

17-32

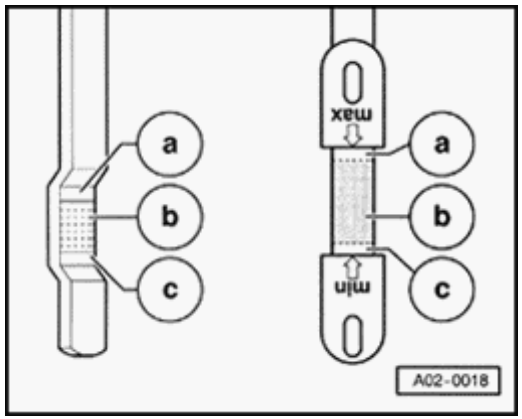
Oil level, checking

Test requirements

- Minimum engine oil temperature 60 ° C
- Vehicle must be standing on level ground when checking oil level
- After stopping engine, wait a few minutes to allow oil to flow back into oil pan

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

- Withdraw dipstick again and read oil level.



Range of markings on dip stick:

a - Oil MUST NOT be topped off.

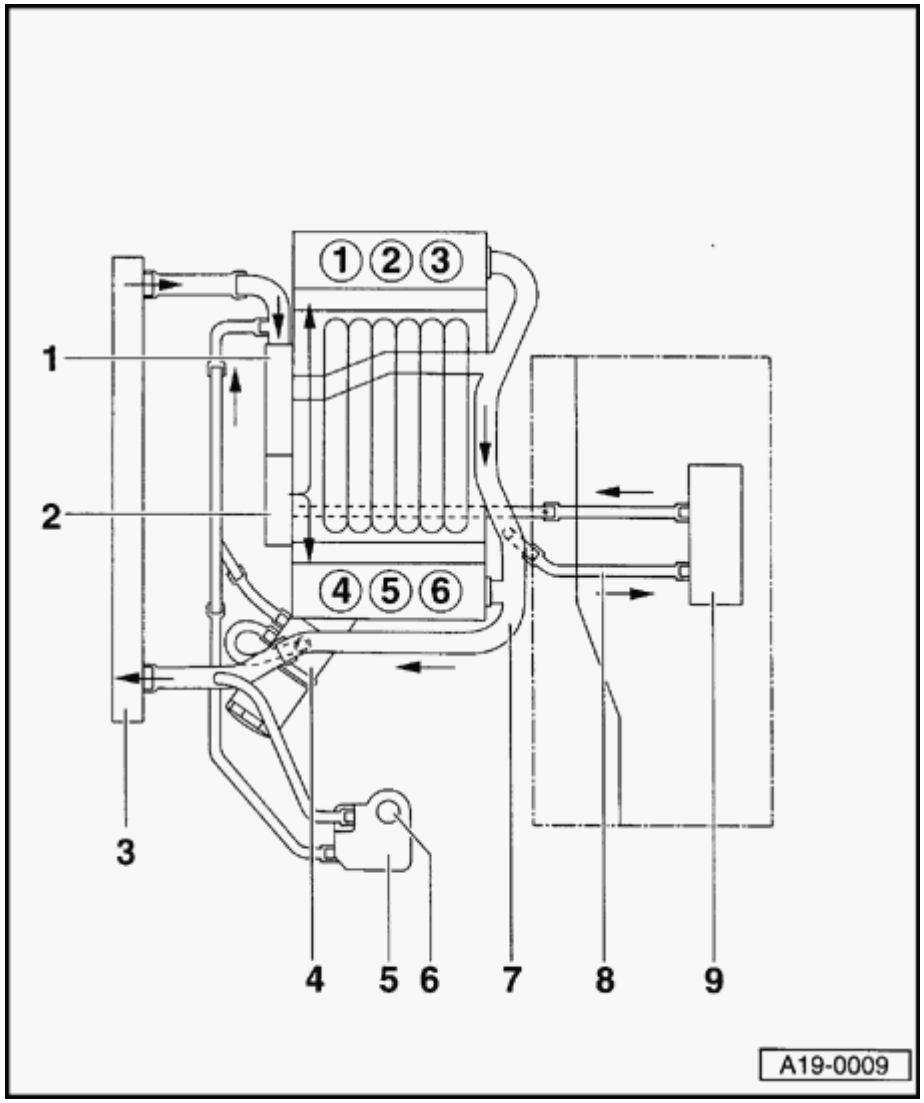
b - Oil may be topped off. After topping off, oil may reach range -a-.

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.

19-1



Cooling system components, removing and installing

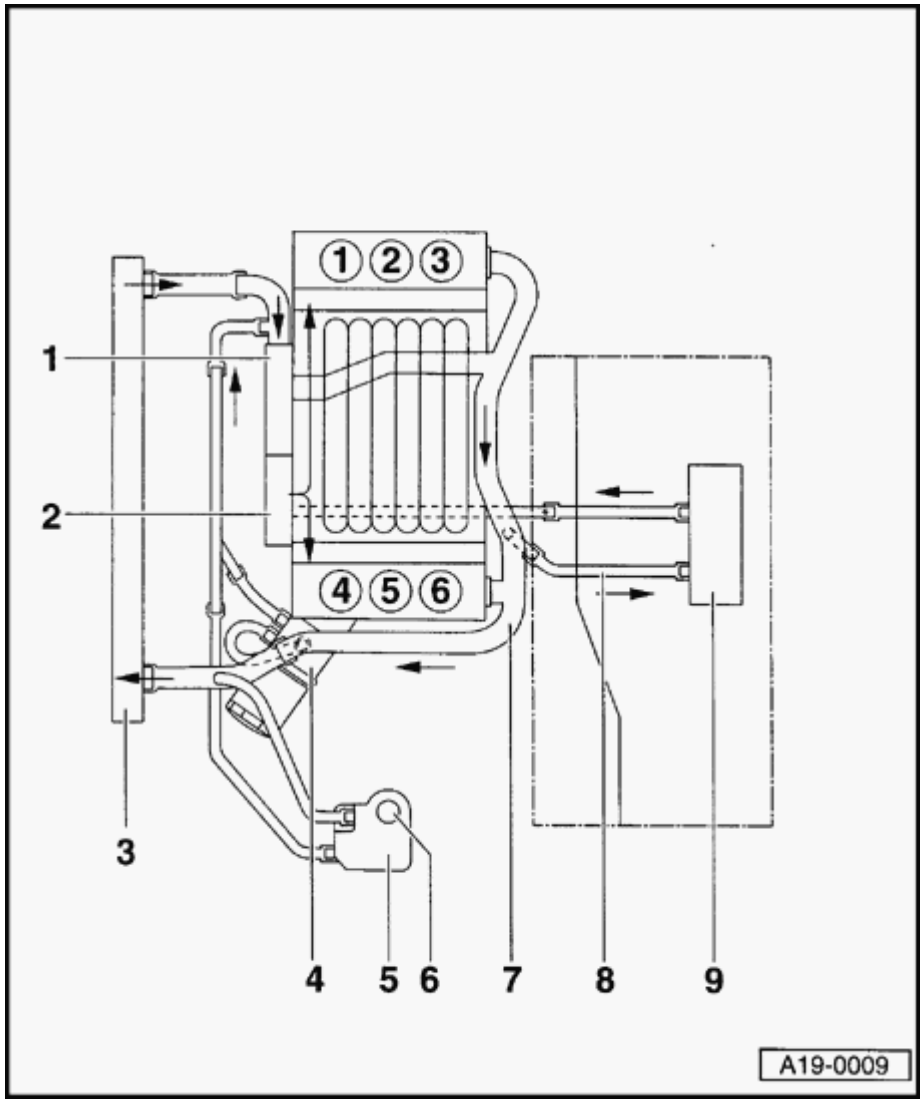
Note:

- *Always replace gaskets and seals.*
- *Draining and filling system with coolant ⇒ page 19-6 .*
- *Testing cooling system for leaks ⇒ page 19-11 .*
- *The toothed belt should NOT be removed in order to take out the coolant thermostat.*
- *The arrow markings on the coolant lines and the ends of the coolant hoses must align with each other.*
- *Tightening torque for coolant pipe hose clamps: 3-3.5Nm (27-31 in lb).*

1 - Thermostat

2 - Coolant pump

3 - Radiator



4 - Oil cooler

5 - Expansion tank

6 - Pressure cap

- Testing ⇒ page 19-12

7 - Coolant line

8 - Feed line

- To heater core

9 - Heater core

10 - Vent bore

- In the return line from heater core

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 with a cloth and open carefully to relieve system pressure slowly.

Notes:

- *Hoses are secured with spring-type clips. If servicing, only use the same type of spring-type clip.*

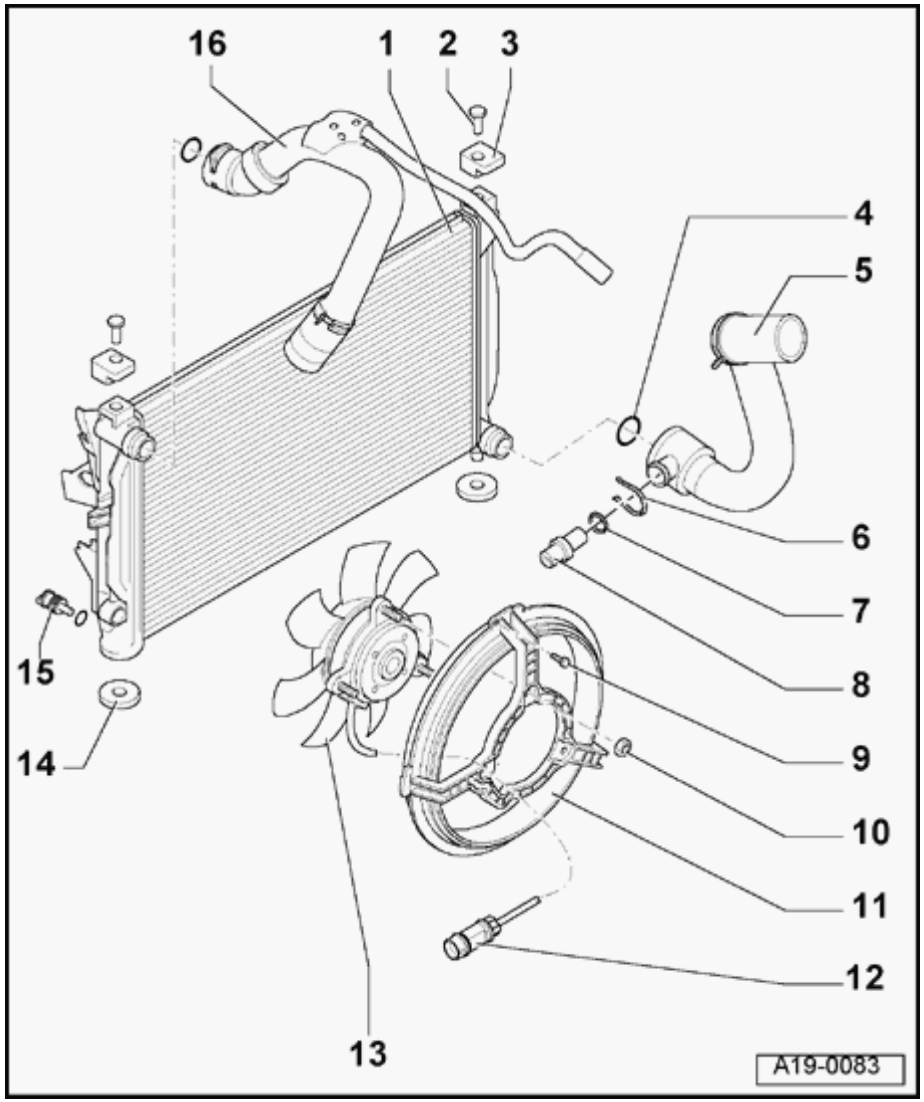
⇒ *Parts catalog*

- *VAG1921 pliers are recommended when installing spring-type clips.*
- *The O-rings installed at the quick-release connections must be replaced if damaged or leaking.*
- *Seals and gaskets must always be replaced.*

- *When installing coolant hoses, make sure they are free of stress and do not come into contact with other components (the arrows which are located on the coolant pipes and coolant hoses must be opposite each other).*

Perform cooling system leakage test using VAG 1274 cooling system tester and 1274/9 adapter.

19-2



Cooling system components (on body)

1 - Radiator

- Removing and installing ⇒ page 19-17
- After replacing, completely replace coolant
- With ATF cooler on vehicles with automatic transmission

2 - Securing clip

3 - Securing rubber

4 - O-ring

- Replace if damaged

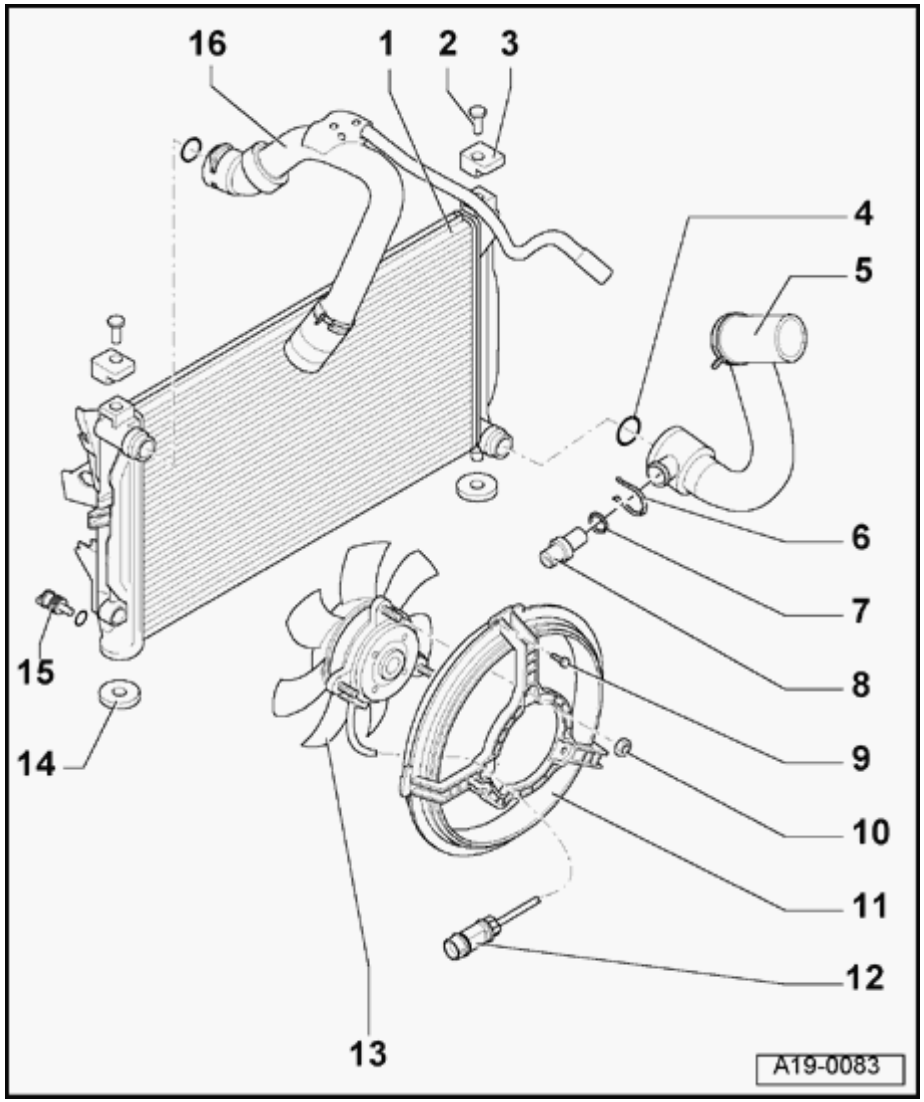
5 - Lower coolant hose

- Secured to radiator with retaining clip
- Make sure hose is securely seated
- Coolant hose connection diagram ⇒ page 19-9

6 - Securing clip

- To secure temperature switch in coolant hose

19-3



7 - O-ring

- Replace if damaged

8 - Coolant Fan Control (FC) thermal switch - F18-

- 35 Nm (26 ft lb)
- For electric coolant fan

Switching temperatures, stage 1:

- On: 92-97 °C (198-207 °F)
- Off: 84-91 °C (183-196 °F)

Switching temperatures, stage 2:

- On: 99-105 °C (210-221 °F)
- Off: 91-98 °C (196-208 °F)

9 - Locking bolt

10 - 10 Nm (7 ft lb)

11 - Fan ring

- Clipped into air ducting and secured with locking 9 bolt

12 - 2-pin harness connector

13 - Coolant fan -V7-

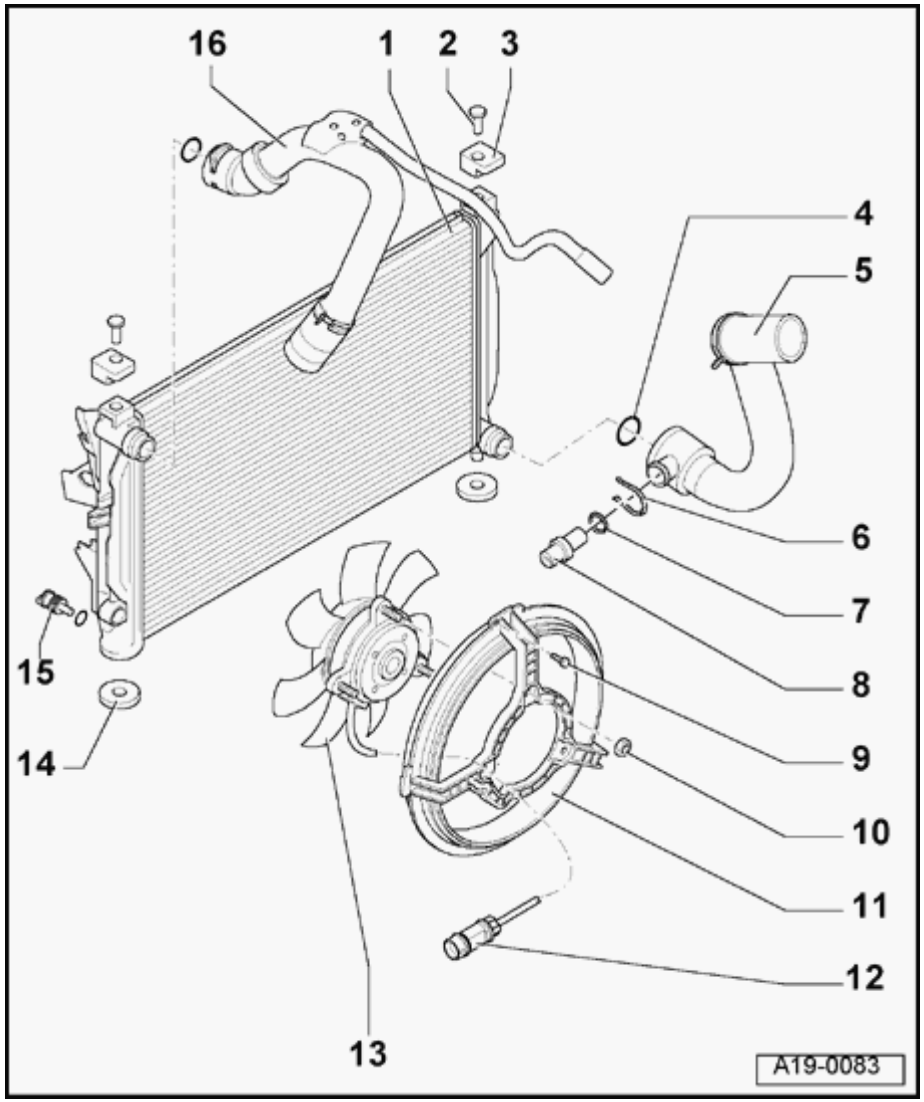
- Checking ⇒ page 19-26

14 - Rubber washer

15 - Coolant drain plug

- 10 Nm (7 ft lb)

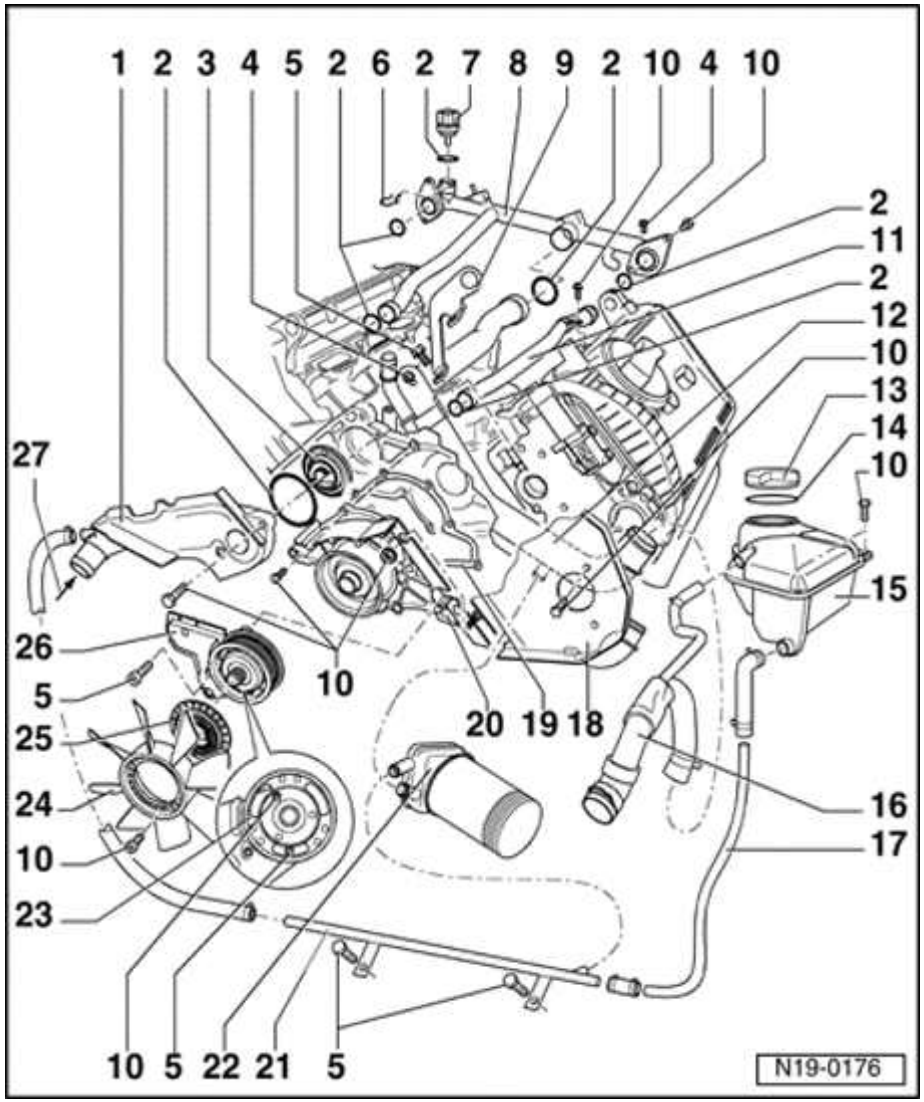
19-4



16 - Upper coolant hose

- Secured to radiator with retaining clip
- Make sure hose is securely seated
- Coolant hose connection diagram ⇒ page 19-9

19-5



Cooling system components (on engine)

1 - Connection

- For thermostat

2 - O-ring

- Always replace

3 - Coolant thermostat

- Removing and installing ⇒ page 19-23
- Note installation position ⇒ page 19-23

Checking:

- Heat thermostat in water
- Opening begins at approx. 86 ° C (187 ° F)
- Min. opening: 7 mm (0.28 in.)

4 - Bleeder screw

- 20 Nm (15 ft lb)

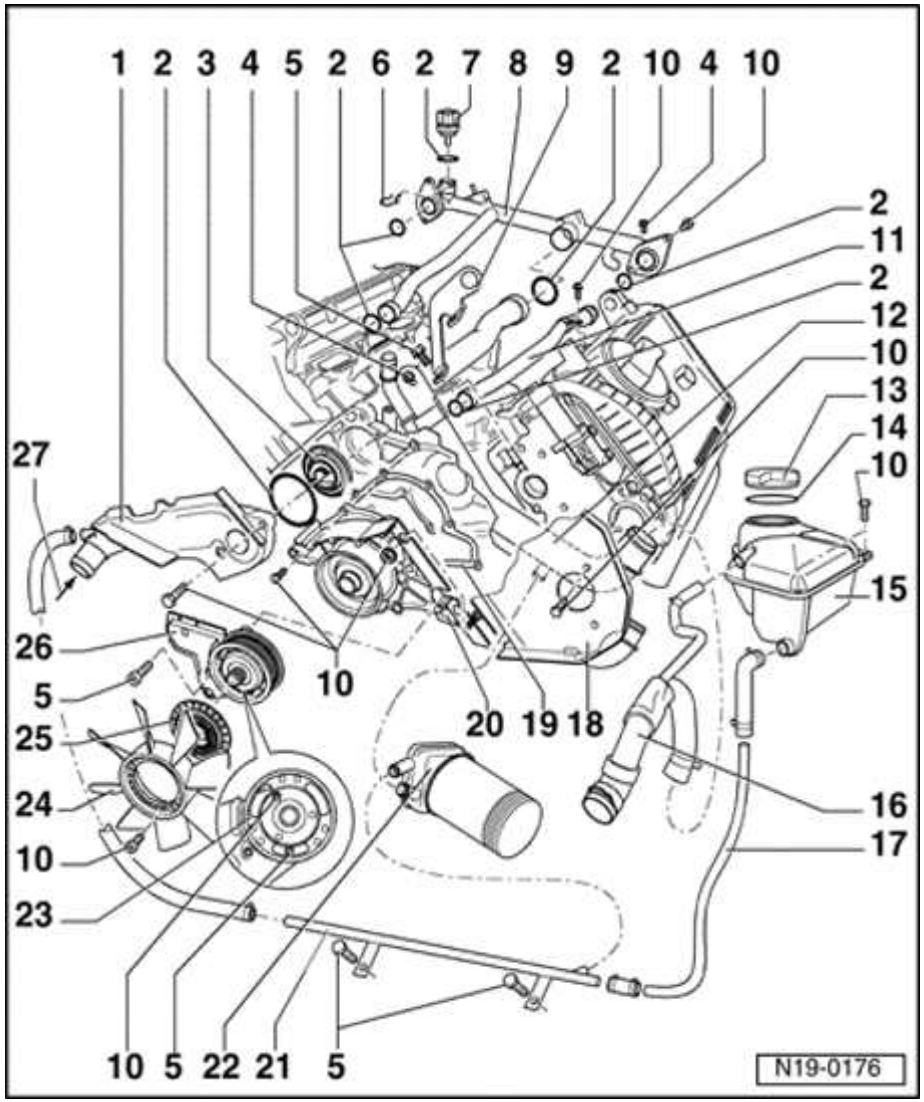
5 - Bolt

- 25 Nm (18 ft lb)

6 - Retaining clip

- Make sure clip is seated securely

19-6



7 - Engine Coolant Temperature (ECT) sensor -G62-

- For Engine Control Module (ECM)
- If necessary, release pressure in cooling system before removing
- Checking ⇒ Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01

8 - Rear coolant line

- Coolant hose connection diagram ⇒ page 19-9

9 - Lifting eye

10 - 10 Nm (7 ft lb)

11 - Coolant line

- Coolant hose connection diagram ⇒ page 19-9

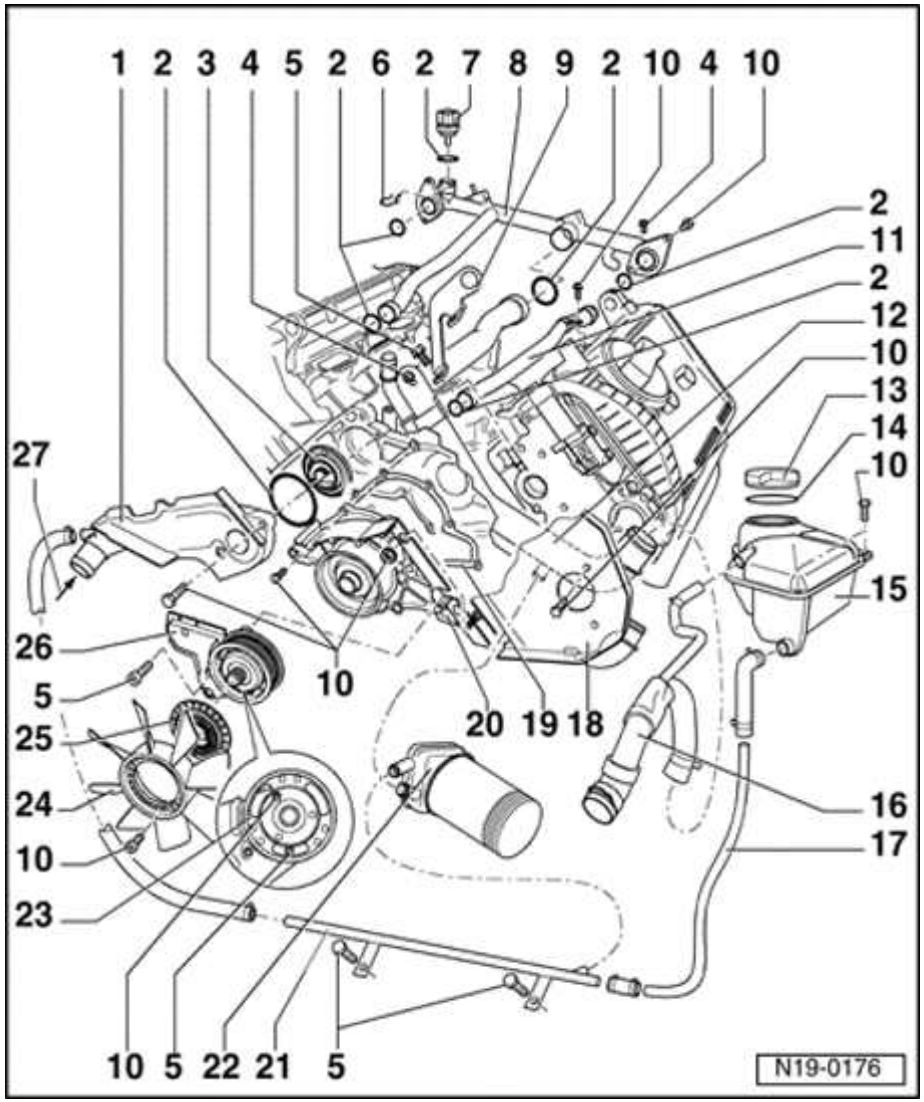
12 - Front coolant hose

- Coolant hose connection diagram ⇒ page 19-9

13 - Sealing cap

- Check using VAG1274 cooling system tester with VAG1274/8 adapter
- Test pressure: 1.4-1.6 bar (20-23 psi)

19-7



14 - O-ring

- Replace if damaged

15 - Expansion tank

- Check using VAG1274 cooling system tester with VAG1274/9 adapter

16 - Upper coolant hose

- Secured to radiator with retaining clip
- Make sure hose is securely seated
- Coolant hose connection diagram ⇒ page 19-9

17 - Coolant line

- Coolant hose connection diagram ⇒ page 19-9

18 - Rear toothed belt guard

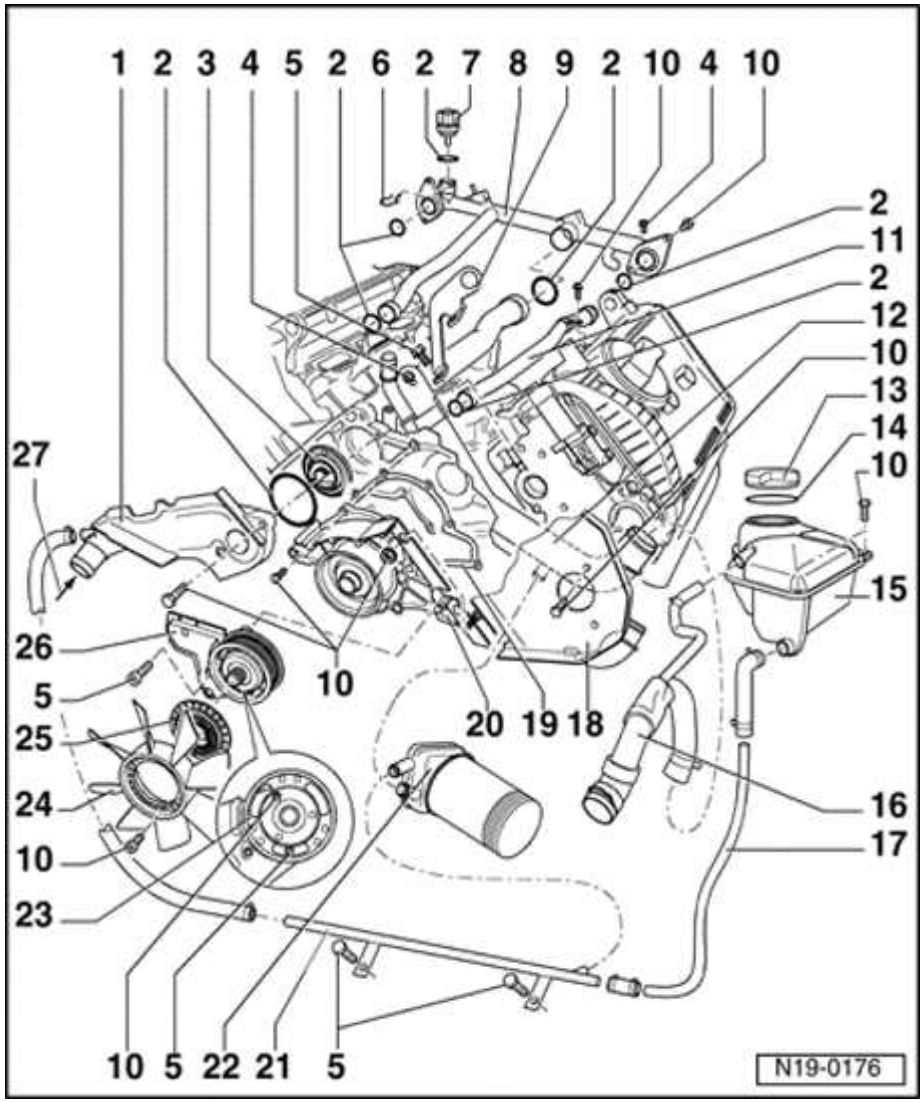
19 - Gasket

- Always replace

20 - Coolant pump

- Check for ease of movement
- Completely replace if damaged or leaking
- Removing and installing ⇒ page 19-20

19-8



21 - Lower coolant line

- Coolant hose connection diagram ⇒ page 19-9

22 - Oil cooler

23 - Belt pulley

- For viscous fan

24 - Fan wheel for viscous fan

25 - Viscous fan coupling

- Note left-hand thread
- Tightening torque only valid when using 3312 open end spanner.
- Tighten to 40 Nm (30 ft lb)
- Removing and installing ⇒ page 19-25

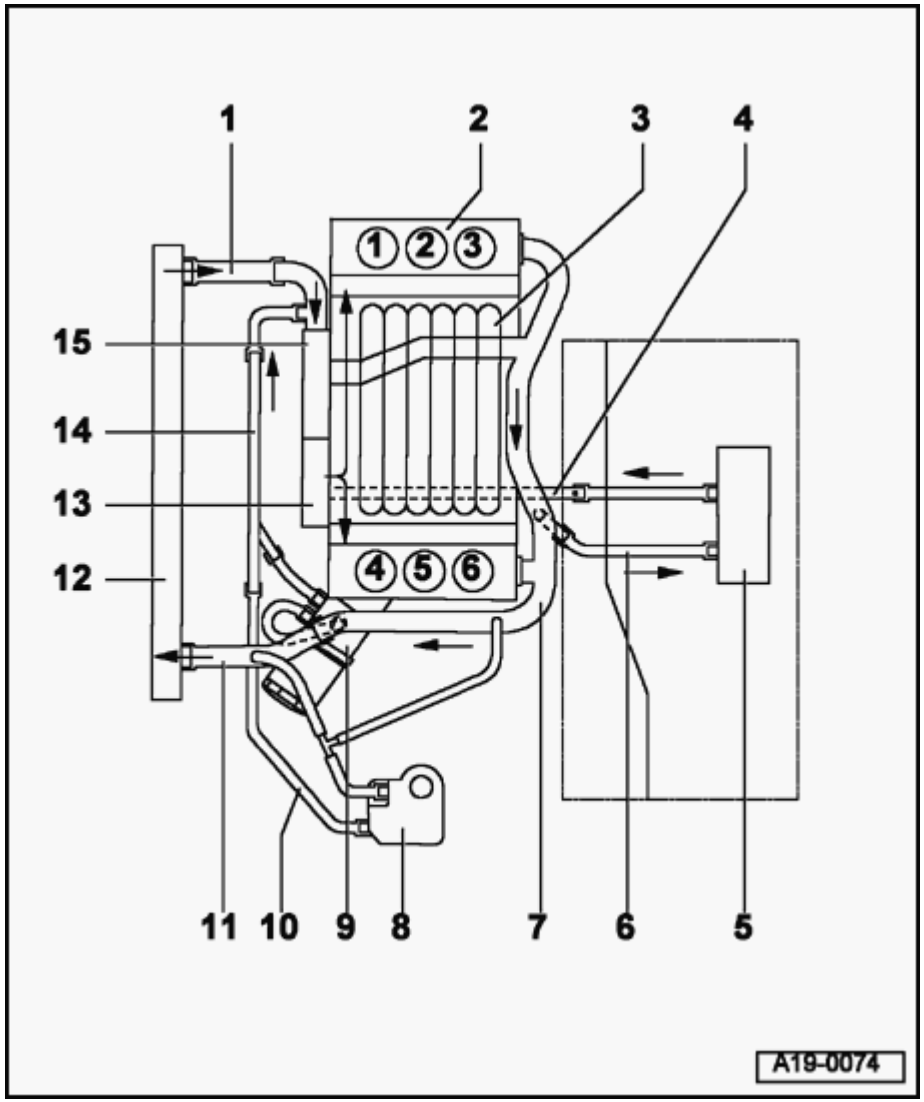
26 - Bracket

- For viscous fan

27 - From bottom of radiator

- Coolant hose connection diagram ⇒ page 19-9

19-9



Coolant hose connection diagram

1 - Lower coolant hose

- From radiator to engine

2 - Cylinder head/cylinder block

3 - Intake manifold

4 - Coolant line

- From heat exchanger to engine block

5 - Heater core

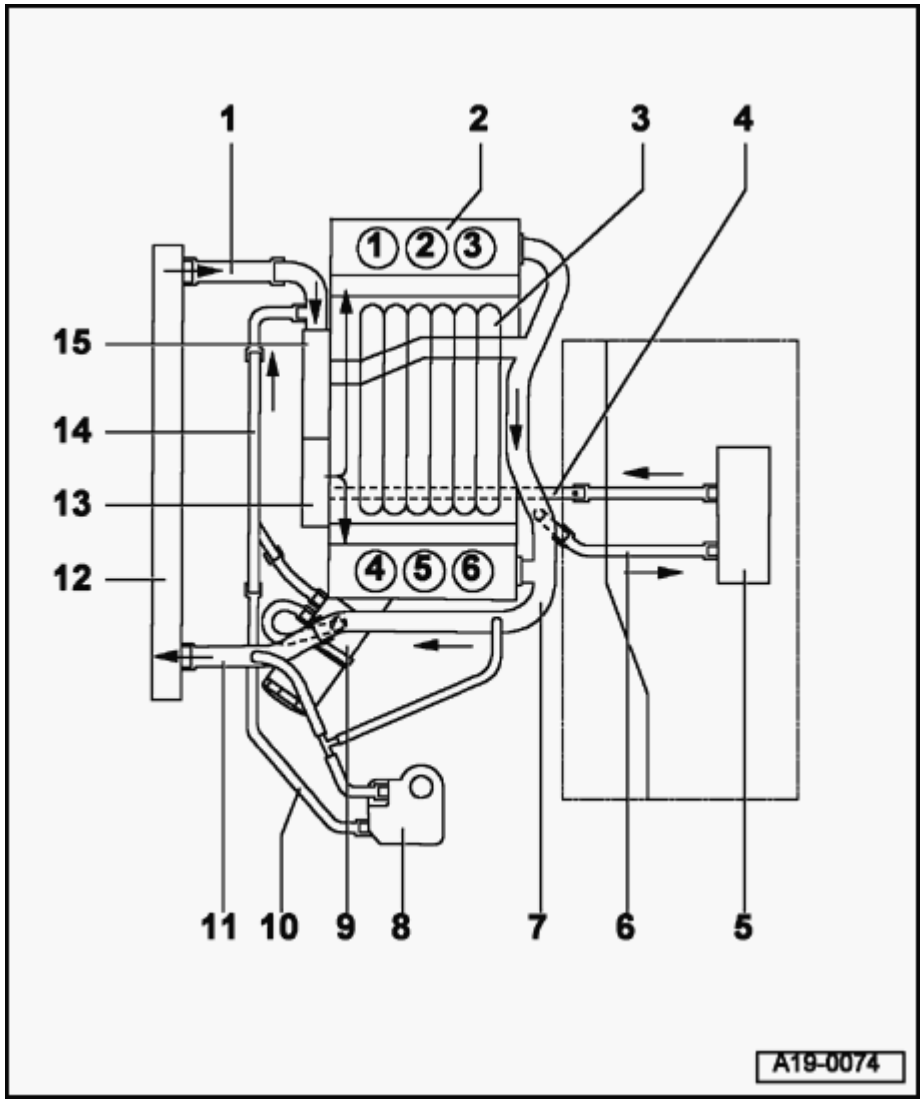
6 - Coolant hose

- To heat exchanger

7 - Rear coolant line

8 - Expansion tank

19-10



9 - Oil cooler

10 - Coolant line

- From expansion tank to lower coolant pipe

11 - Upper coolant hose

12 - Radiator

13 - Coolant pump

14 - Lower coolant line

15 - Connection

- For thermostat

19-11

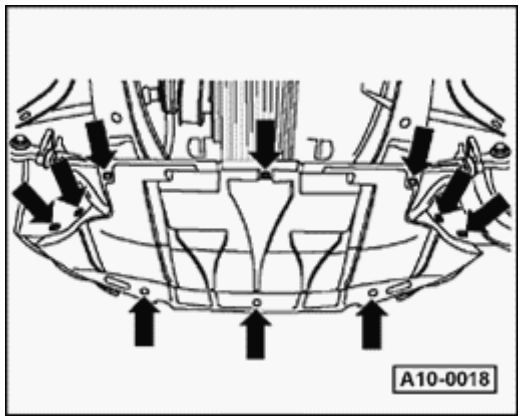
Cooling system, draining and refilling

Draining

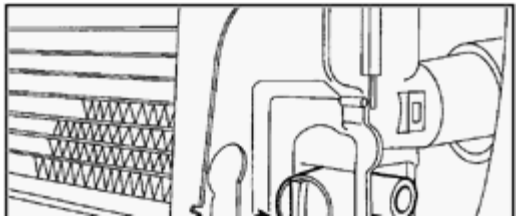
WARNING!

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.

- Open coolant expansion tank cap.



- Remove noise insulation panel.
- Place VAG1306 drip tray underneath engine.

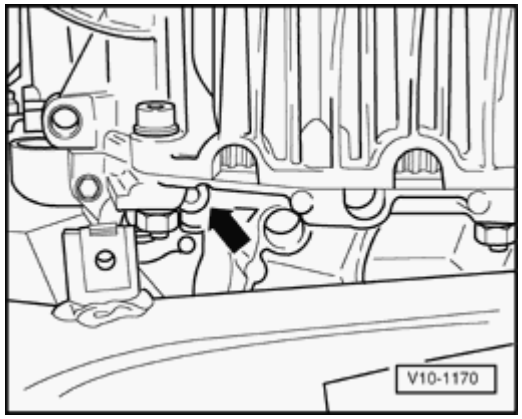


- With bumper removed, open coolant drain plug (arrow) on lower left of radiator by turning it counterclockwise. If necessary, attach accessory hose to connection.
- With bumper installed, pull off retaining clamp for lower right radiator

hose (from radiator to engine) and disconnect radiator hose from radiator.

CAUTION!

Follow disposal regulations for coolant.



- Drain engine coolant at drain plug (arrow).

Filling

Notes:

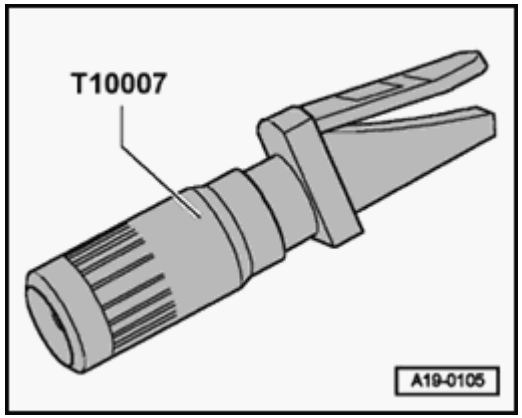
- *Only use coolant additive G12 (according to TL VW 7745 D). G12 is red in color.*
- *Do not mix G12 with any other coolant additive!*
- *If the fluid in expansion tank is brown, G12 has been mixed with other coolant. In this case, the coolant must flushed and replaced.*
- *"G12" and coolant additives marked in accordance with "TL VW 774 D" prevent frost and corrosion damage, scaling and also raise the boiling point of the coolant. Therefore, the 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 protect against frost to about -25° C (about -35° C 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%.*

19-13

Note (continued from page ⇒ Page 19-12):

- *If for climatic reasons greater frost protection is required, the amount of G 12 can be increased, but only up to 60% (frost protection to about -40 ° C), otherwise frost protection and cooling effectiveness will be reduced.*

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



➢ Test coolant frost protection using T10007 special tool.

Recommended mixture ratios:

Frost protection to	Anti-freeze amount	G 12 1)	Water 1)
-25 ° C (-13 ° F)	40 %	2.5 l (2.7 qt.)	3.5 l (3.7 qt.)
-35 ° C (-31 ° F)	50 %	3.0 l (3.2 qt.)	3.0 l (3.2 qt.)

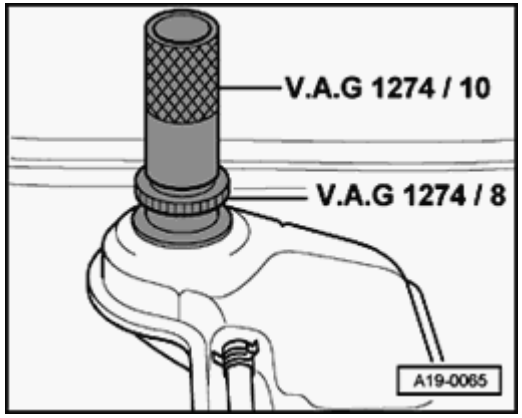
1) The quantity of coolant can vary depending upon the equipment installed in the vehicle.

- Replace coolant drain plug O-ring and install coolant drain plug into engine.

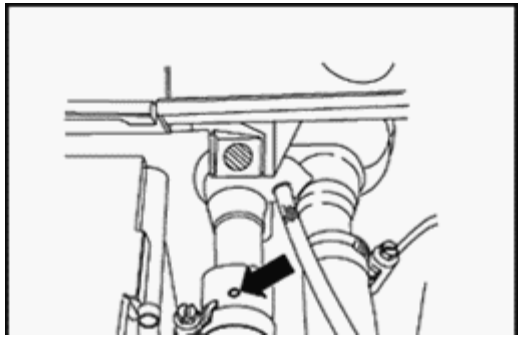
  Tightening torque: 20 Nm (15 ft lb).

- Install lower right coolant hose and secure with retaining clip.

- Secure coolant drain valve to radiator.

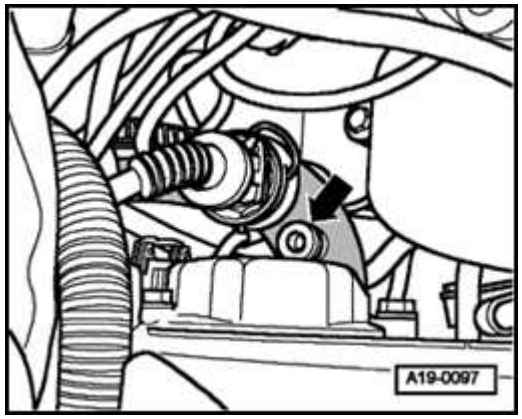


- Screw VAG1274/9 onto expansion tank and insert VAG1274/10 into adapter.

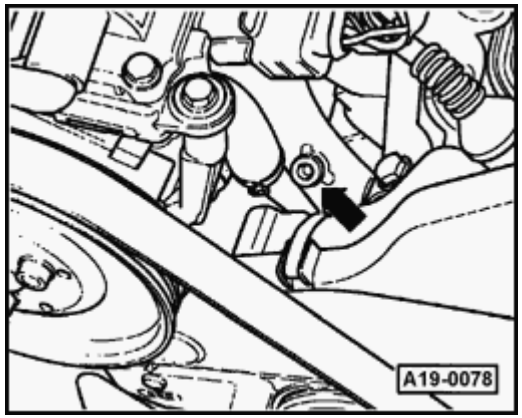


- Loosen clamp on coolant hose on heater core and pull back hose until bleeder hole in coolant hose (arrow) is no longer sealed by connection.
- Top off coolant until it flows out from bleeder hole in coolant hose.
- Push coolant hose onto connection and tighten.

19-15



- Loosen bleeder screw on lower coolant line (arrow) under expansion tank (if necessary, unbolt expansion tank).
- Top off coolant until it flows out from bleeder screw.
- Close bleeder screw and tighten to 20 Nm (15 ft lb).



- Loosen bleeder screw on front coolant line (arrow) between power steering pump and left-side of cylinder head.
- Top off coolant until it flows out from bleeder hole in coolant line.
- Close bleeder screw and tighten to 20 Nm (15 ft lb).
- Top up coolant to MAX mark.
- Install coolant expansion tank cap.
- Set heater controls to maximum heat position.
- Start engine and let run at idle for approx. 10 minutes.

- Raise engine speed to approx. 2000 rpm for approx. 5 minutes.

- Allow engine to idle until lower coolant hose on radiator is hot.

- Check coolant level and top-off if necessary. When engine is at normal operating temperature, coolant level must be on MAX mark. When engine is cold, coolant level must be 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 with a cloth and open carefully to relieve system pressure slowly.

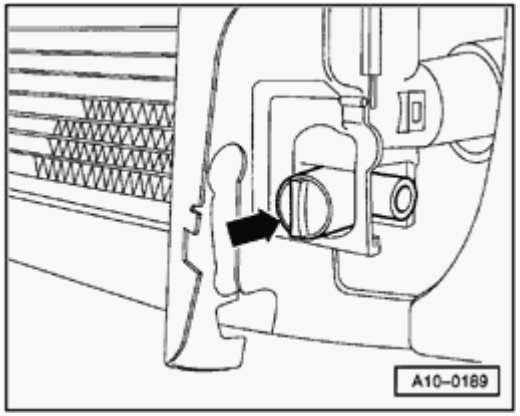
19-17

Radiator, removing and installing

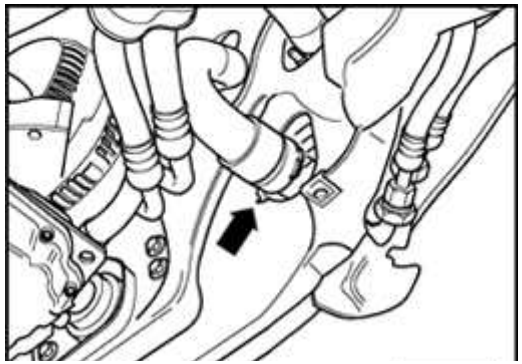
Removing

- Remove front bumper.

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



- Drain coolant at drain plug (arrow) ⇒ page 19-11 .



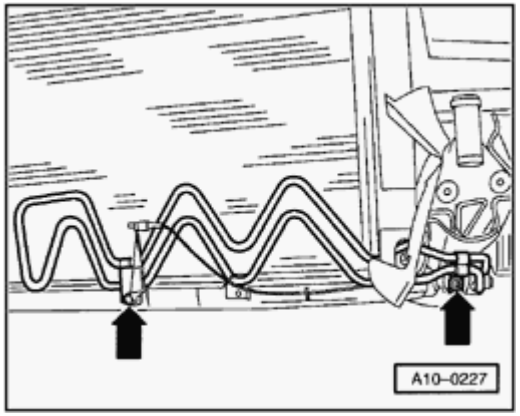
- Disconnect coolant hoses at radiator, unhinge clamp from connection flange (arrow).
- Disconnect connector from temperature switch at bottom-left of radiator.

Vehicles with automatic transmission

- Remove ATF lines from radiator.

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

19-18



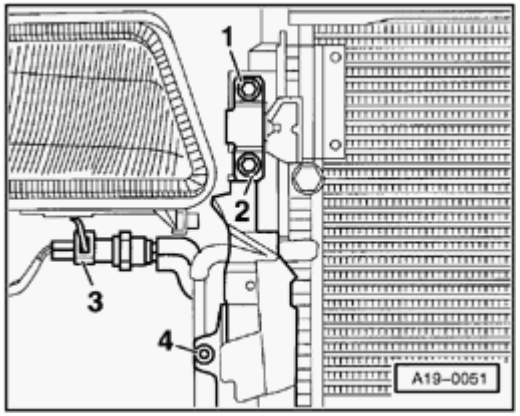
All models

- Unbolt power steering hydraulic oil cooling line (arrows).

Vehicles with air conditioning

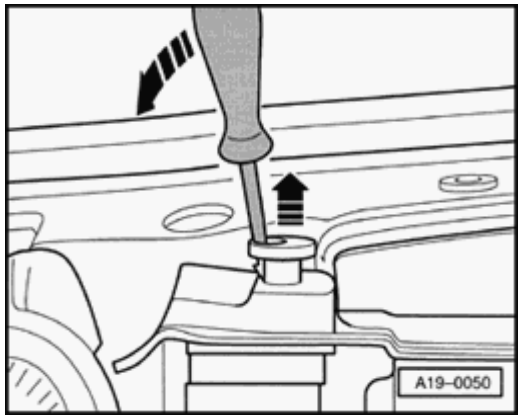
CAUTION!

- ***DO NOT open the air conditioning refrigerant circuit.***
- ***Disconnect A/C refrigerant lines at brackets and support points only.***
- ***Avoid damage from bending. Refrigerant lines kink easily.***



- Unbolt air guides at radiator -4- on left and right-sides.
- Unbolt 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.

19-19



All models

- Release both radiator retaining bolts, pull up and remove (arrows).
- Tilt radiator toward front, lift up and remove.

Installing

Installation is the reverse of removal, noting the following:

- Fill up coolant ⇒ page 19-11 .

Vehicles with automatic transmission

- Check ATF level.

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

Tightening torques

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

19-20

Coolant pump, removing and installing

Notes:

- *Always replace seals and gaskets.*
- *Cover the toothed belt with a cloth to protect it from coolant before removing the coolant pump.*

Removing

- Remove front bumper.

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

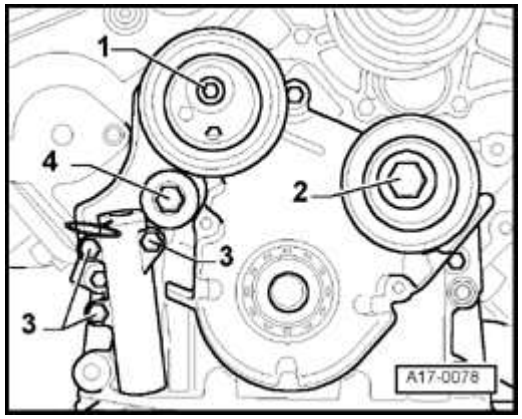
- Move lock carrier into service position.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Remove ribbed belt ⇒ page 13-8 .
- Remove toothed belt ⇒ page 13-12 .

- Drain coolant ⇒ page 19-11 .

19-21



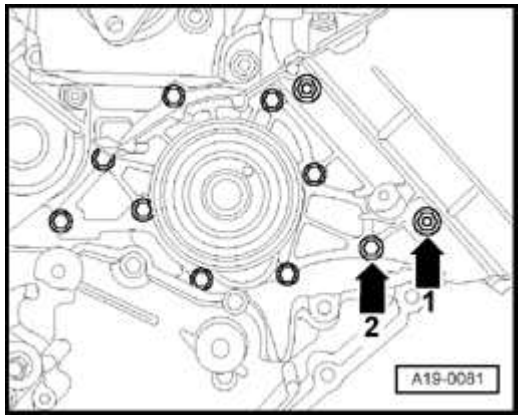
- Remove the following components before removing coolant pump:

1 - Toothed belt tensioner roller

Tightening torque: 20 Nm (15 ft lb)

2 - Idler roller

Tightening torque: 45 Nm (33 ft lb)



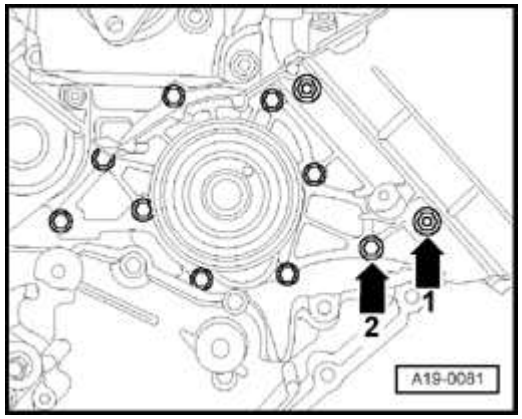
- Remove coolant pump mounting bolts -1- and remove coolant pump -2-.

19-22

Installing

Installation is the reverse of removal, noting the following:

- Remove any remaining sealant from sealing surfaces of coolant pump and cylinder block.
- Clean sealing surfaces so they are completely free of any oil or grease.
- Install new gasket on water pump flange.



- Install coolant pump -2- into cylinder block and tighten all 9 mounting bolts (arrow -2-) to 10 Nm (7 ft lb).
- Install rear toothed belt guard on water pump housing (arrow -1-).

  Tightening torque: 10 Nm (7 ft lb).
- Install and tension toothed belt ⇒ page 13-12 .
- Install toothed belt guard.
- Install ribbed belt ⇒ page 13-8 .
- Fill cooling system with coolant ⇒ page 19-11 .

19-23

Thermostat, removing and installing

Notes:

- *Always replace seals and gaskets.*
- *Cover the toothed belt with a cloth to protect it from coolant before removing thermostat.*

Removing

- Drain coolant ⇒ page 19-11 .
- Remove front bumper.

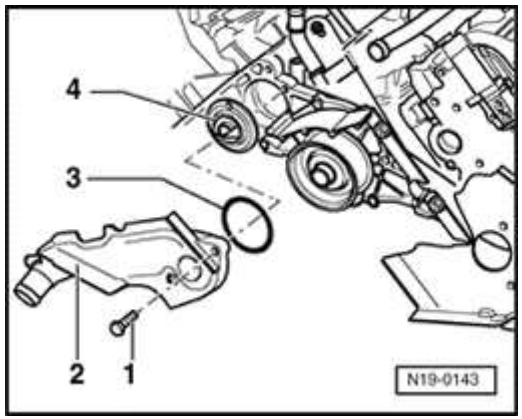
⇒ *Repair Manual, Body Exterior, Repair Group 63*

- Lock carrier in service position

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Remove ribbed belt ⇒ page 13-8 .

- Remove toothed belt ⇒ page 13-12 .

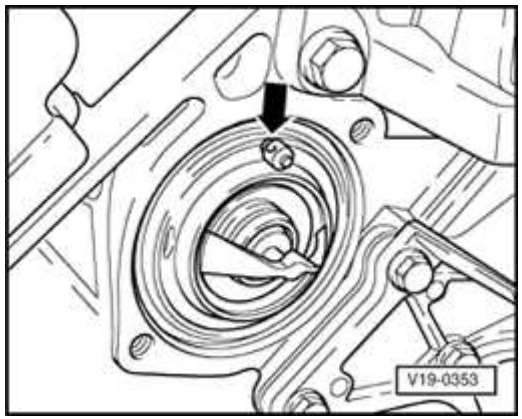


- Remove connection mounting bolts -1- and remove connection -2-.
- Remove thermostat -4-.

19-24

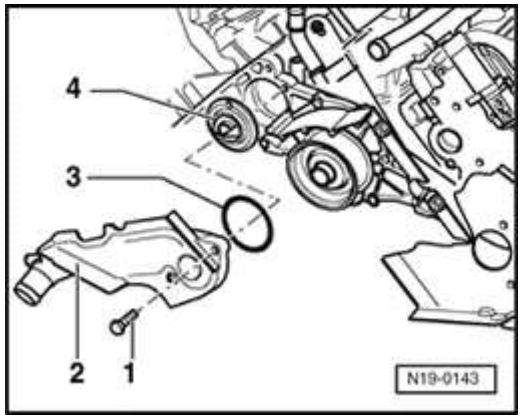
Installing

Installation is the reverse of removal, noting the following:



- Bleeder valve for thermostat (arrow) must be at the top.

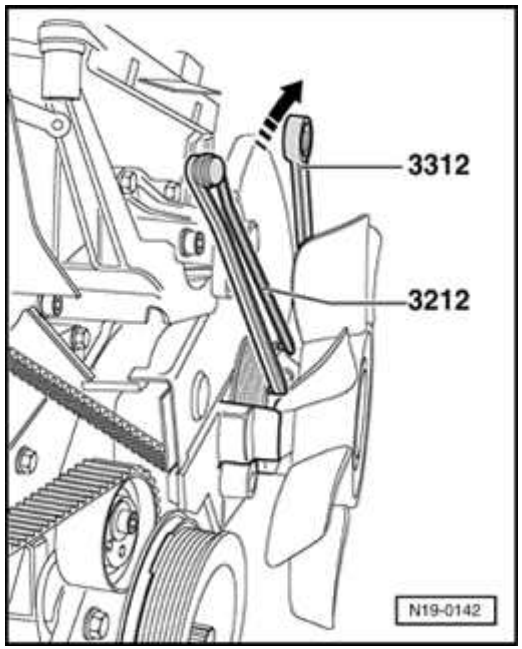
- Install thermostat -4- into engine block.
- Moisten new O-ring -3- with coolant.



- Install connection -2- for thermostat and tighten bolt -1- to 10 Nm (7 ft lb).
- Install and tension toothed belt ⇒ page 13-12 .
- Install ribbed belt ⇒ page 13-8 .
- Fill cooling system with coolant ⇒ page 19-11 .

Viscous fan, removing and installing

Removing



- Counterhold pulley for viscous fan using 3212 spanner wrench and remove viscous fan using 3312 open-end spanner (left thread).
- Carefully lift out viscous fan.

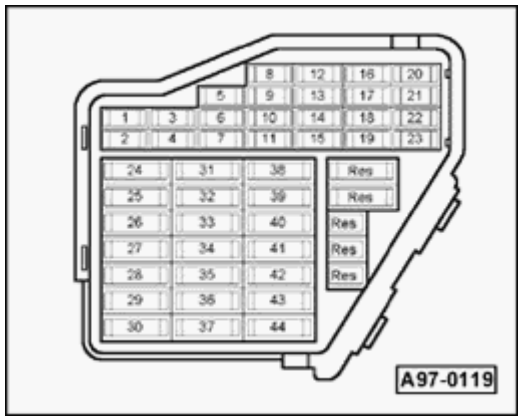
Installing

Installation is the reverse of removal, noting the following:

Tightening torque for viscous fan	Nm
1331 torque wrench and 3312 open-end spanner	37 Nm (27 ft lb)
1331 torque wrench without 3312 open-end spanner	70 Nm (52 ft lb)

Coolant fan, checking

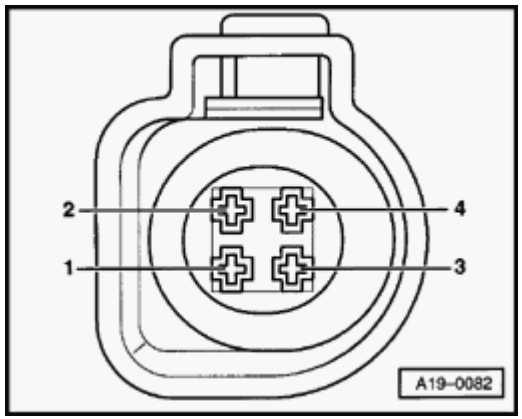
Test requirements



- Fuse No. 34 OK
- Coolant Fan Control (FC) thermal switch -F18- OK

Test procedure

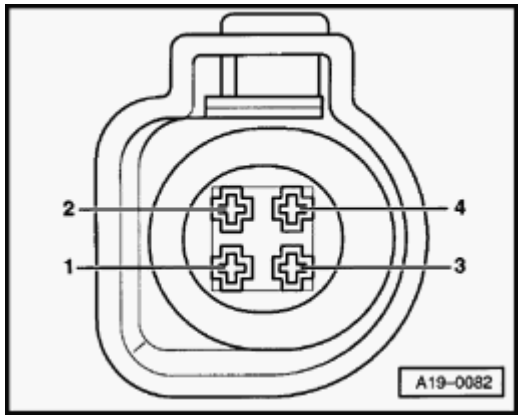
- Disconnect 3-pin harness connector from coolant Fan Control (FC) thermal switch -F18- at bottom left of radiator.
- Switch ignition on.



- Bridge terminal -1- and terminal -2- of harness connector using auxiliary cables from VW1594 connector test kit.

  Coolant fan -V7- must run on 1st speed.

19-27



- Bridge terminal -1- and terminal -3- of harness connector using auxiliary cables from VW1594 connector test kit.

  Coolant fan -V7- must run on 2nd speed.

If 1st or 2nd fan speed does not run:

- Locate and repair open circuit using wiring diagram:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If no open circuit can be found:

- Replace coolant fan -V7-.

19-28

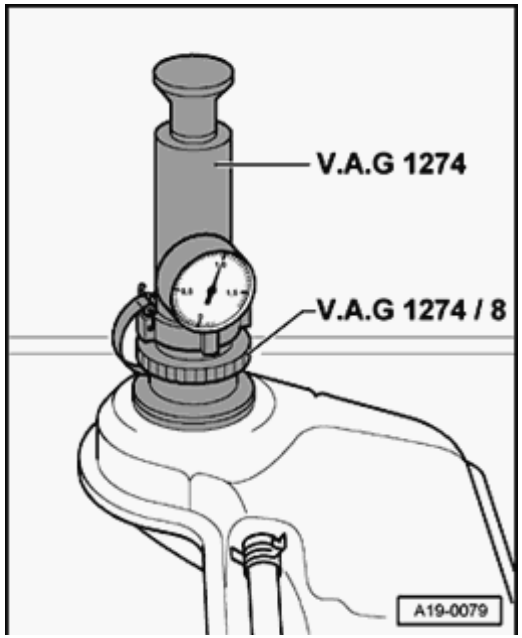
Cooling system, pressure test

- 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 with a cloth and open carefully to relieve system pressure slowly.

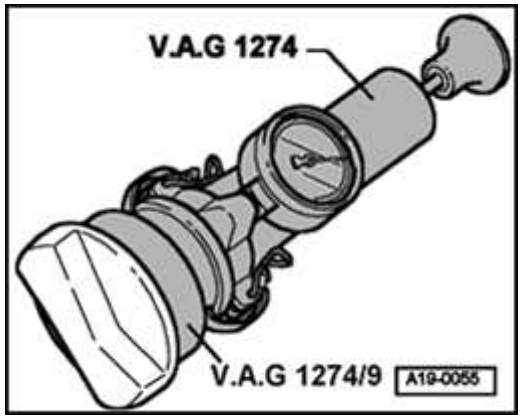
- Open cap on coolant expansion tank.



- Using VAG1274/8 adapter attach VAG1274 cooling system tester to coolant expansion tank.
- Use tester hand pump to create a pressure of approx. 1.0 bar (14.5 psi).
- If pressure falls, check for leaks and repair.

19-29

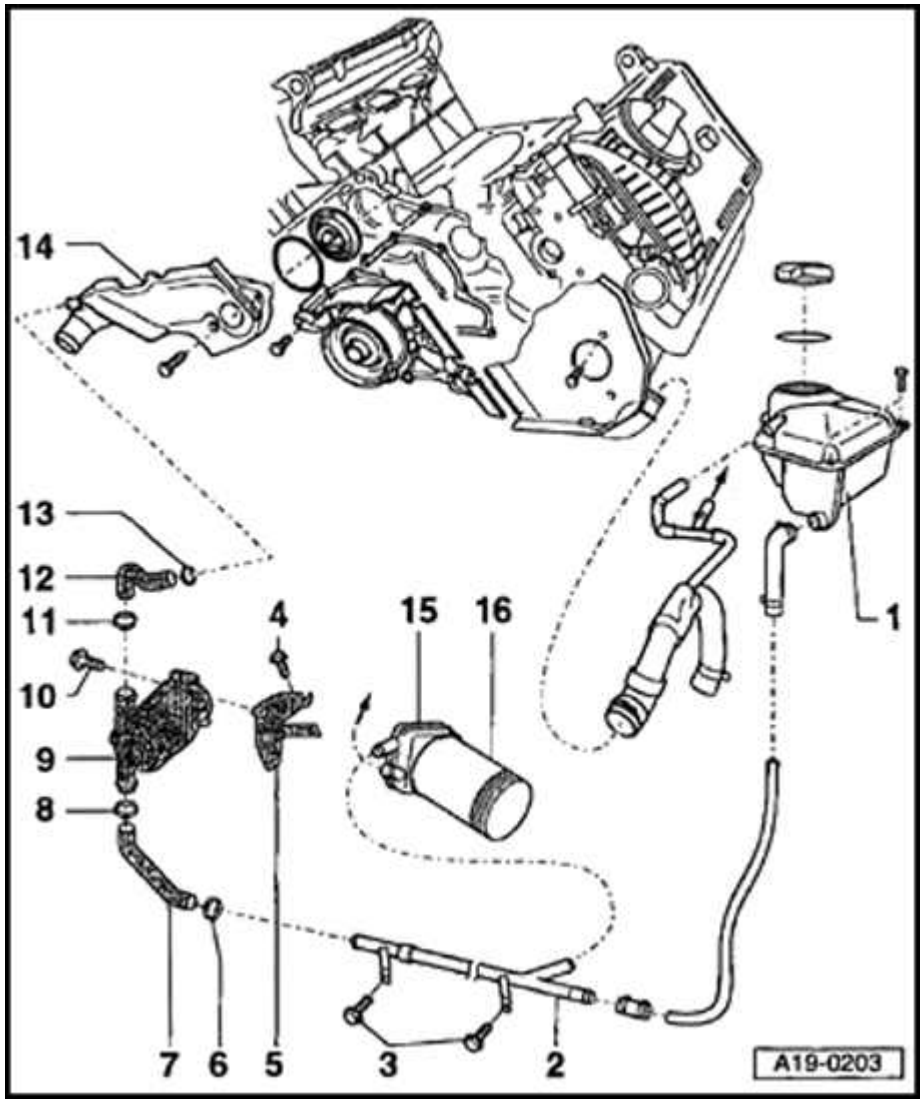
Pressure relief valve in cap, checking



- Attach sealing cap to tester using VAG1274/9 adapter.

- Install hand pump and pump.
- Pressure relief valve must open at pressure between 1.4-1.6 bar (20.3-23.2 psi).

19-30



After-run coolant pump

1 - Coolant reservoir

- Perform coolant system leak test using VAG1274 cooling system tester and VAG1274/9 adapter.

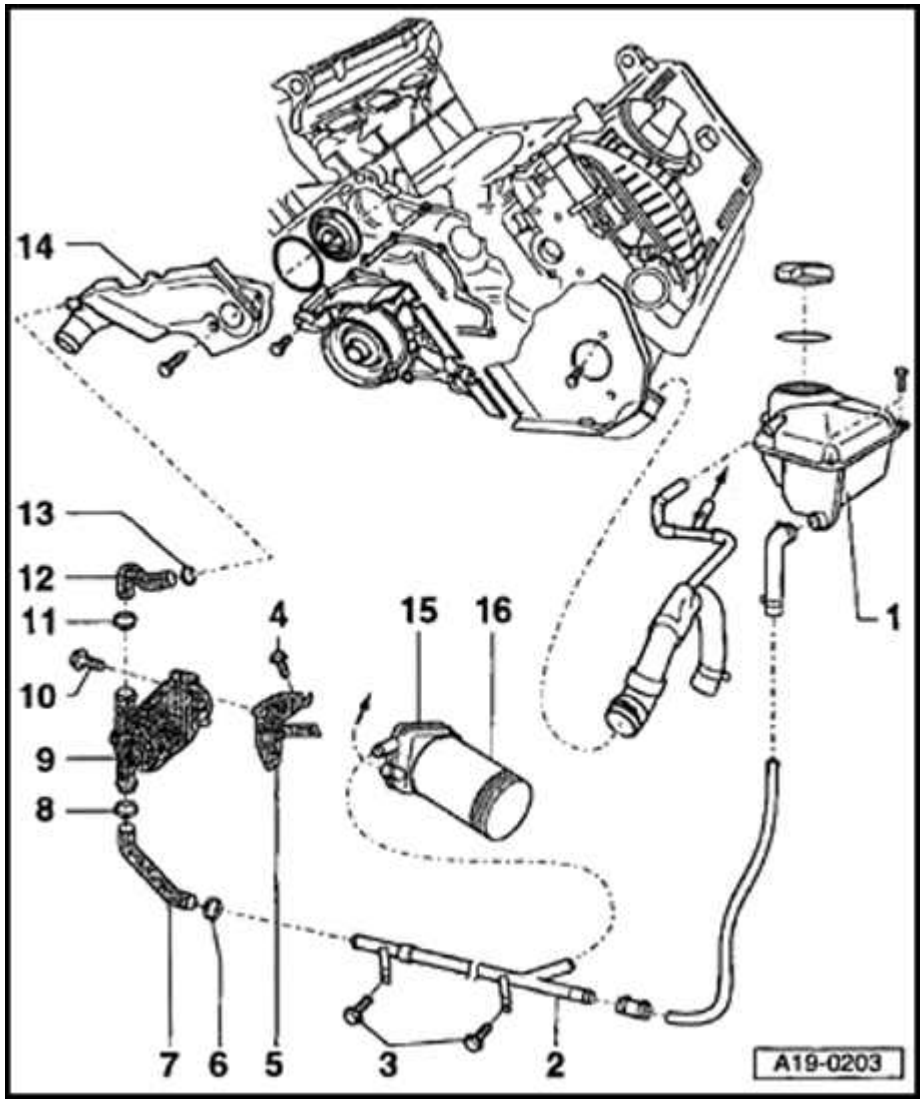
2 - Lower coolant pipe

3 - 25 Nm

4 - 25 Nm

5 - Bracket for after-run coolant pump

19-31



6 - Spring clamp

7 - Coolant hose

8 - Spring clamp

9 - Electrical after-run coolant pump

- Checking ⇒ page 19-32
- Removing and installing ⇒ page 19-34

10 - 10 Nm

11 - Spring clamp

12 - Coolant hose

13 - Spring clamp

14 - Connection

- For thermostat

15 - Oil cooler

16 - Oil filter

19-32

After-run coolant pump, checking

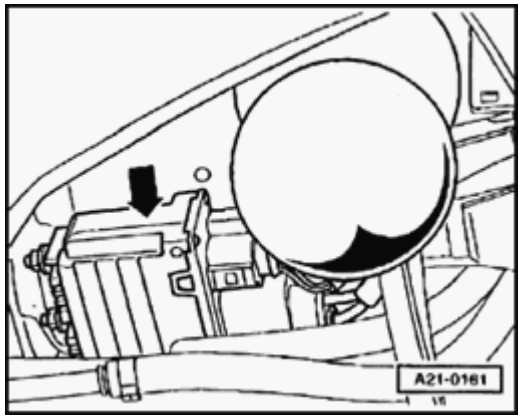
Note:

- *Control modules with an after-run time of 15 seconds after engine is turned off were installed since start of production. As a running change in m.y. 1999, control modules with an after-run time of 3 minutes were installed.*

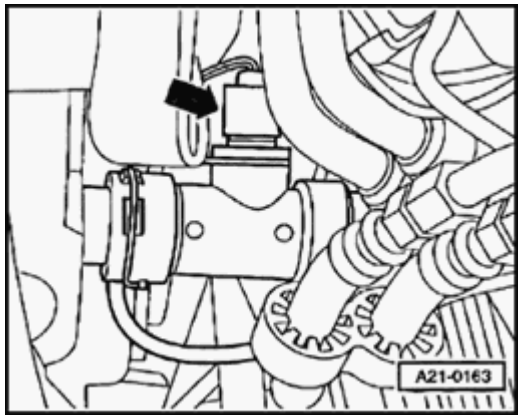
- *The coolant after-run pump also continues to run after the engine is started again before the 15 second or 3 minute cycle is completed.*

- *The coolant after-run pump and the after-run fan are controlled via the same control module.*

After switching off the engine, the after-run pump always runs for 15 seconds or 3 minutes after the engine has been switched off. If during this time the switch-on temperature of 102 ° C (coolant temperature) is reached at the thermostat of the second fan stage, the after-run pump continues to run and the coolant fan continues to run in the after-run stage until the switch-off temperature of 91 ° C of the coolant at thermostat has been reached. The maximum running time of the after-run pump is 10 minutes.

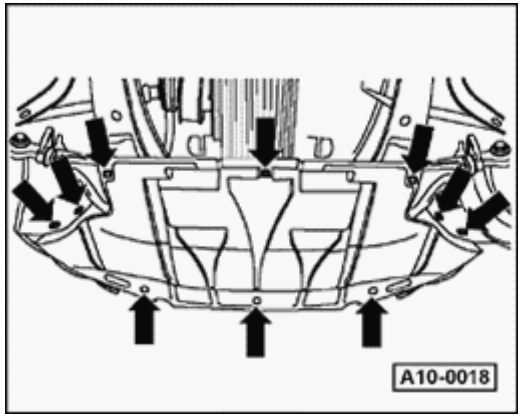


- The control module for the after-run pump and coolant fan is installed below the longmember (left side)



- The thermostat is installed in the coolant return hose.

After-run coolant pump, removing and installing

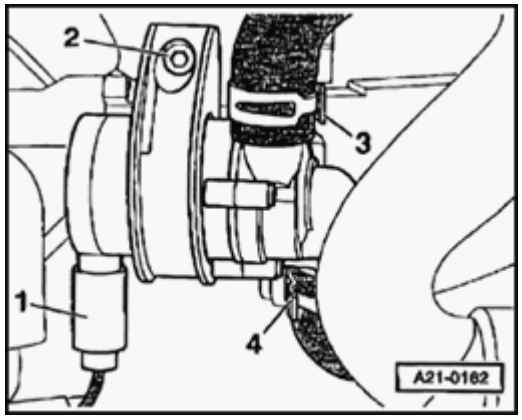


- Remove noise insulation panel.

Note:

The electrical coolant pump is located on the right side behind the generator.

- Drain coolant ⇒ page 19-11 .



- Disconnect connection -1-.
- Disconnect both hoses -3- and -4- from pump.
- Unbolt pump from bracket -2-.

19-1

Cooling system components, removing and installing

WARNING!

Hot steam can escape from the expansion tank when the filler cap is opened. Cover the filler cap with a cloth and unscrew it carefully.

Notes:

- *When the engine is hot the cooling system is under pressure. Carefully open filler cap on expansion tank to release pressure before starting repair work.*
- *Hoses are secured with spring-type clips. When repairing only use spring-type clips.*
- *VAG 1921 pliers are recommended when installing spring-type clips.*
- *The O-rings fitted at the quick-release connections must be replaceed if damaged or leaking.*
- *When installing coolant hoses, ensure that they are free of stress and do not come into contact with other components (observe markings on coolant connection and hose).*

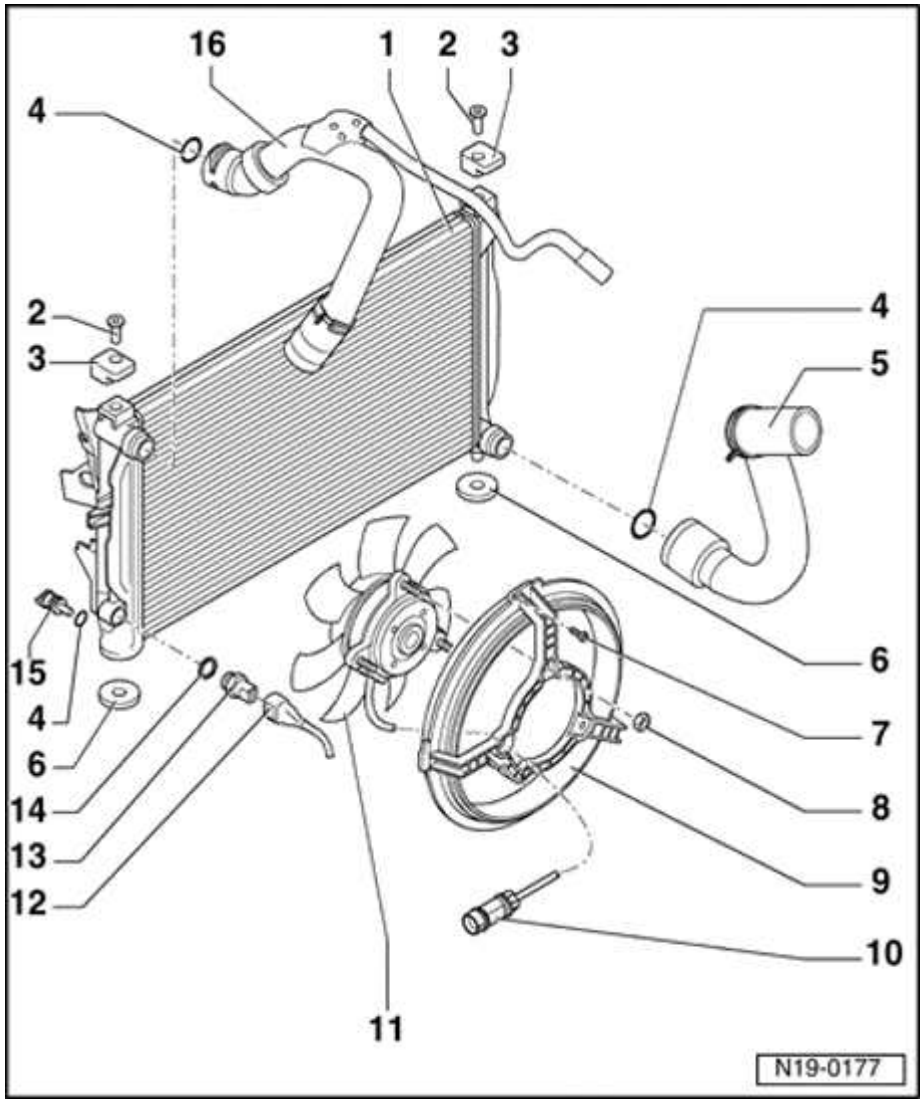
Perform leak test on cooling system with cooling system tester VAG 1274 and adapter VAG 1274/8.

Cooling system components (on body), removing and installing

Notes:

- *Parts of cooling system on engine ⇒ Page 19-8 .*
- *Diagram of coolant hose connections ⇒ Page 19-17 .*
- *Draining and filling with coolant ⇒ Page 19-19 .*
- *Coolant mixture ratios ⇒ Page 19-19 , draining and filling cooling system.*

19-3



1 - Radiator

- Removing and installing ⇒ Page 19-26
- After replacing, replace coolant in complete system

2 - Securing clip

3 - Securing rubber

4 - O-ring

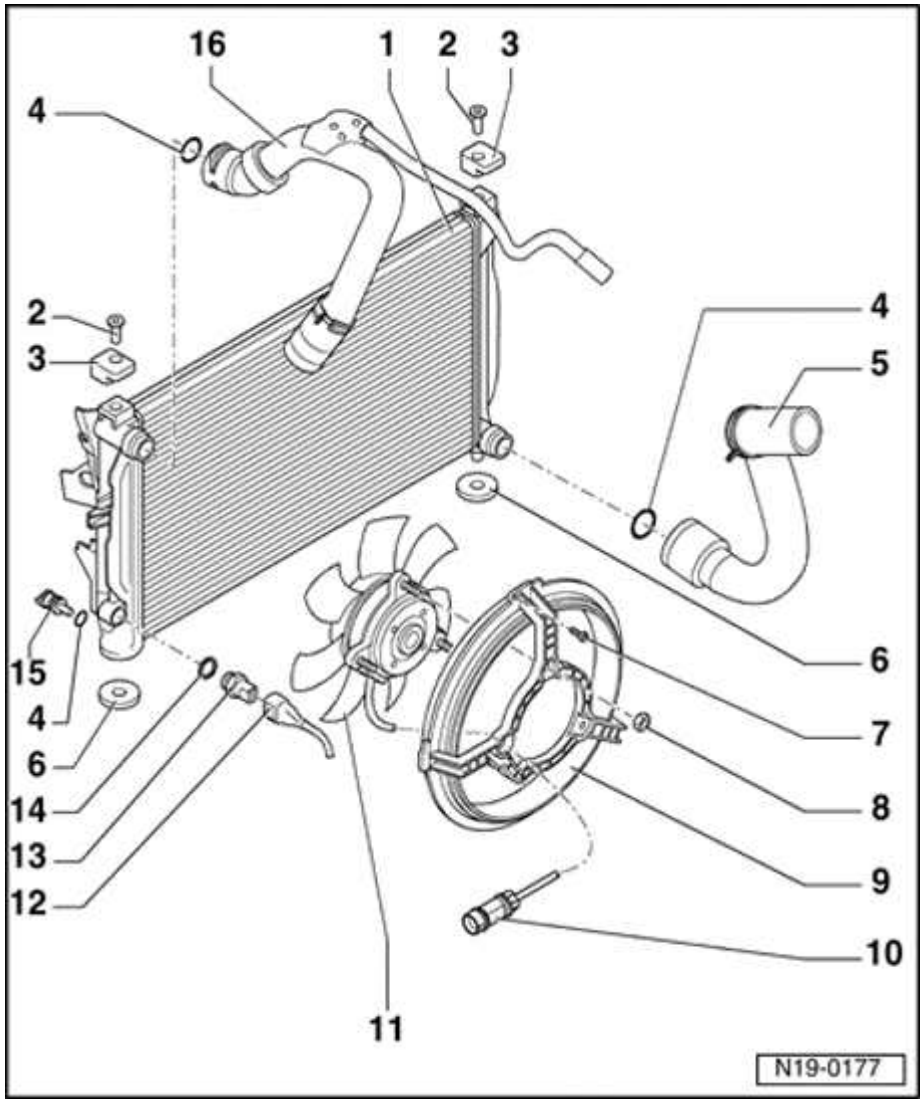
- Replace if damaged

5 - Bottom coolant hose

- Secured to radiator with retaining clip
- Check for secure seating
- Diagram of coolant hose connections ⇒ Page 19-17

6 - Rubber washer

19-4



7 - Retaining bolt

8 - Nut

- Tightening torque: 10 Nm

9 - Fan ring

- Clipped into air ducting and secured with retaining bolt -Item 7 -

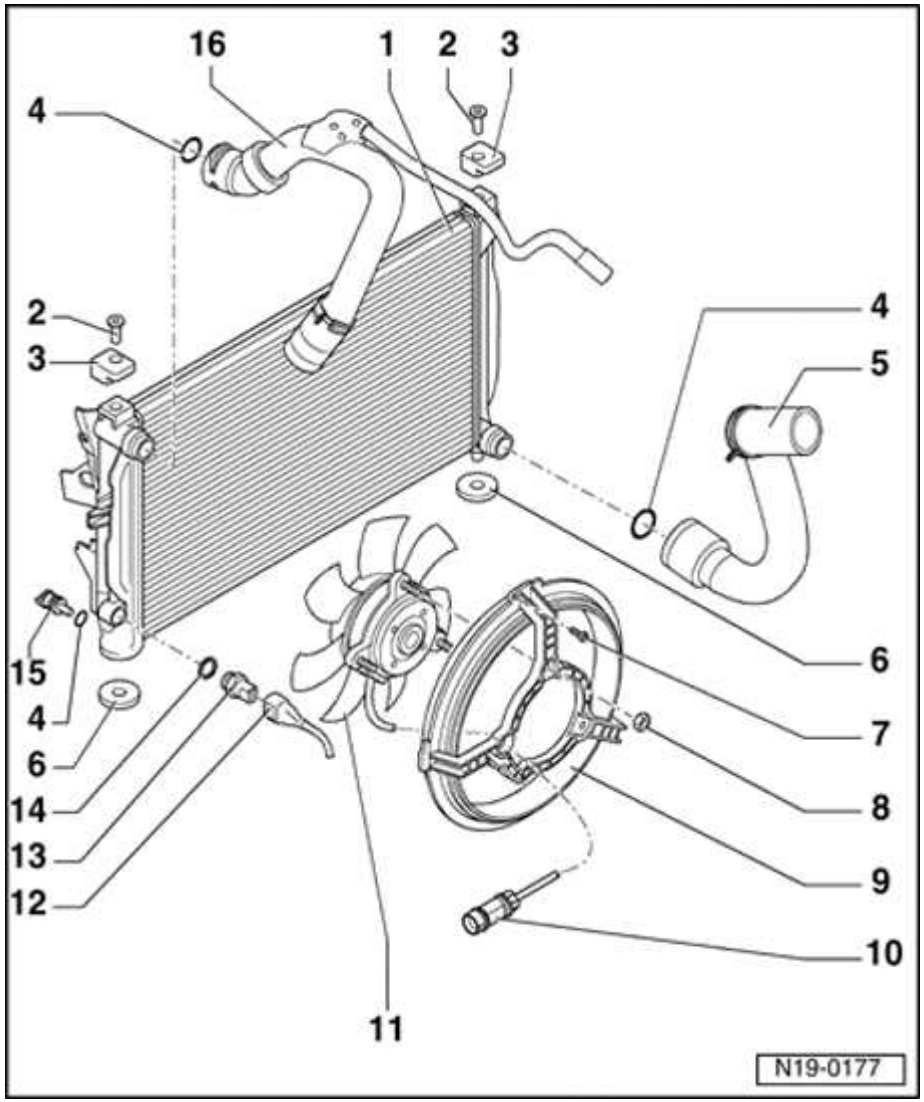
10 - 2-pin connector

11 - Radiator fan (-V7-)

12 - Connector

- Black, 3-pin
- For radiator fan thermoswitch

19-5



13 - Radiator fan thermoswitch (-F18-), 35 Nm

- For electric fan

Switching temperatures: Stage 1

- on: 92...97 °C
- off: 84...91 °C

Switching temperatures: Stage 2

- on: 99...105 °C
- off: 91...98 °C

14 - Seal

- Always replace

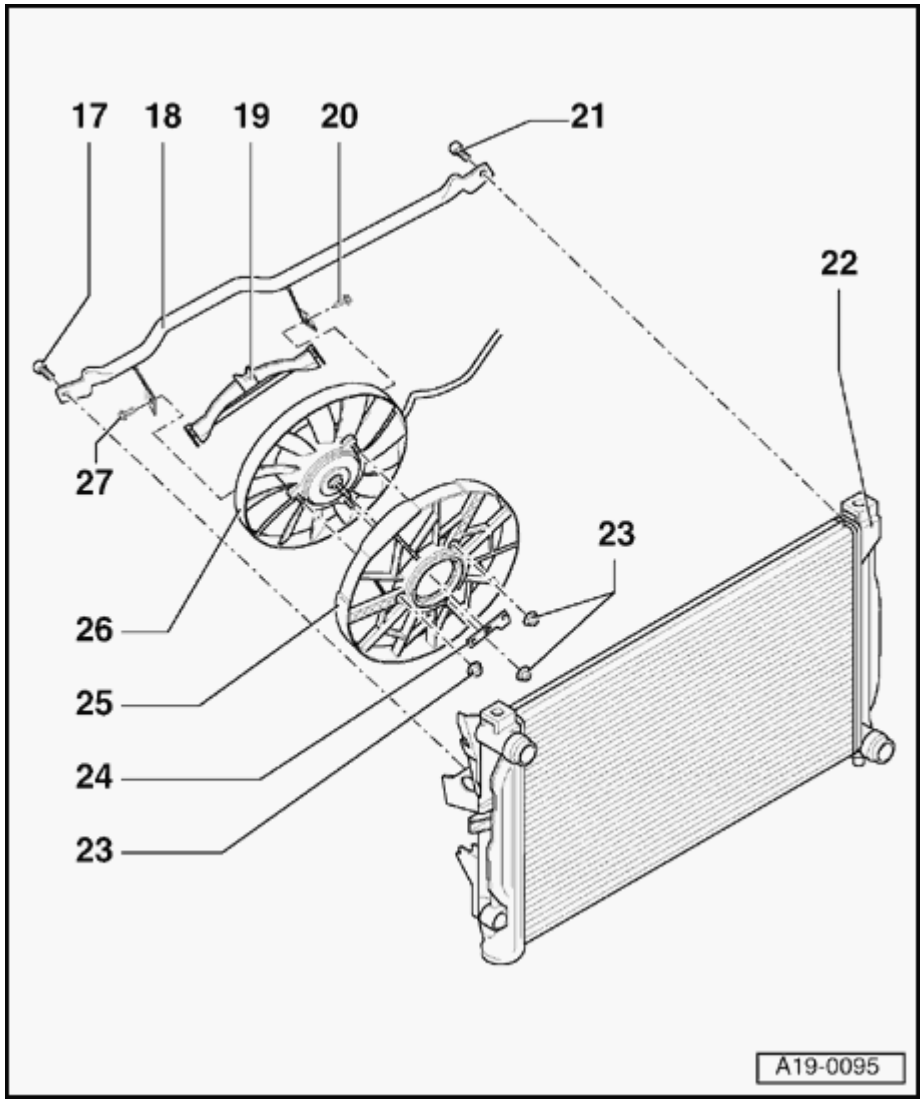
15 - Drain screw

- Tightening torque: 10 Nm

16 - Top coolant hose

- Secured to radiator with retaining clip
- Check for secure seating
- Diagram of coolant hose connections ⇒ Page 19-17

19-6



17 - Bolt

- Tightening torque: 5 Nm

18 - Mounting rod

19 - Guard plate

20 - Bolt

- Tightening torque: 5 Nm

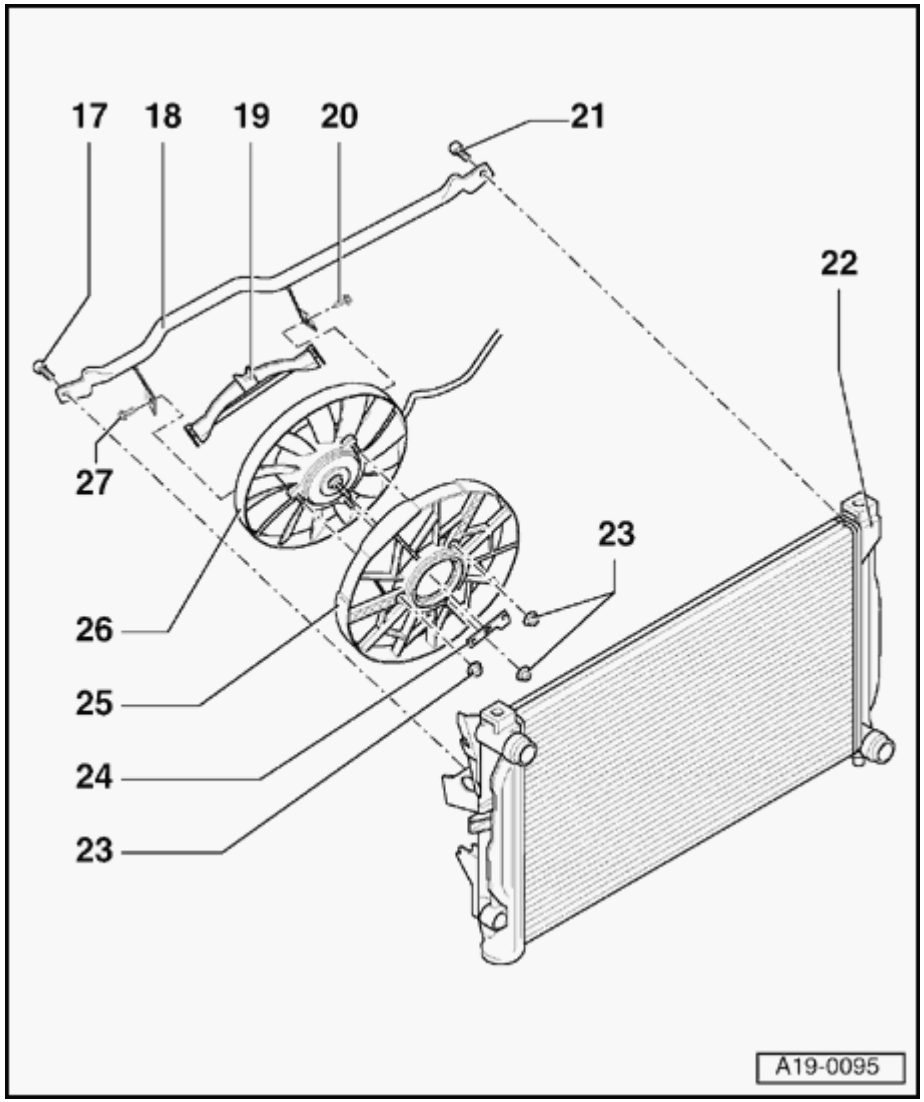
21 - Bolt

- Tightening torque: 5 Nm

22 - Radiator

- Removing and installing ⇒ Page 19-26
- After replacing, replace coolant in complete system

19-7



23 - Nut

- Tightening torque: 5 Nm

24 - Bracket

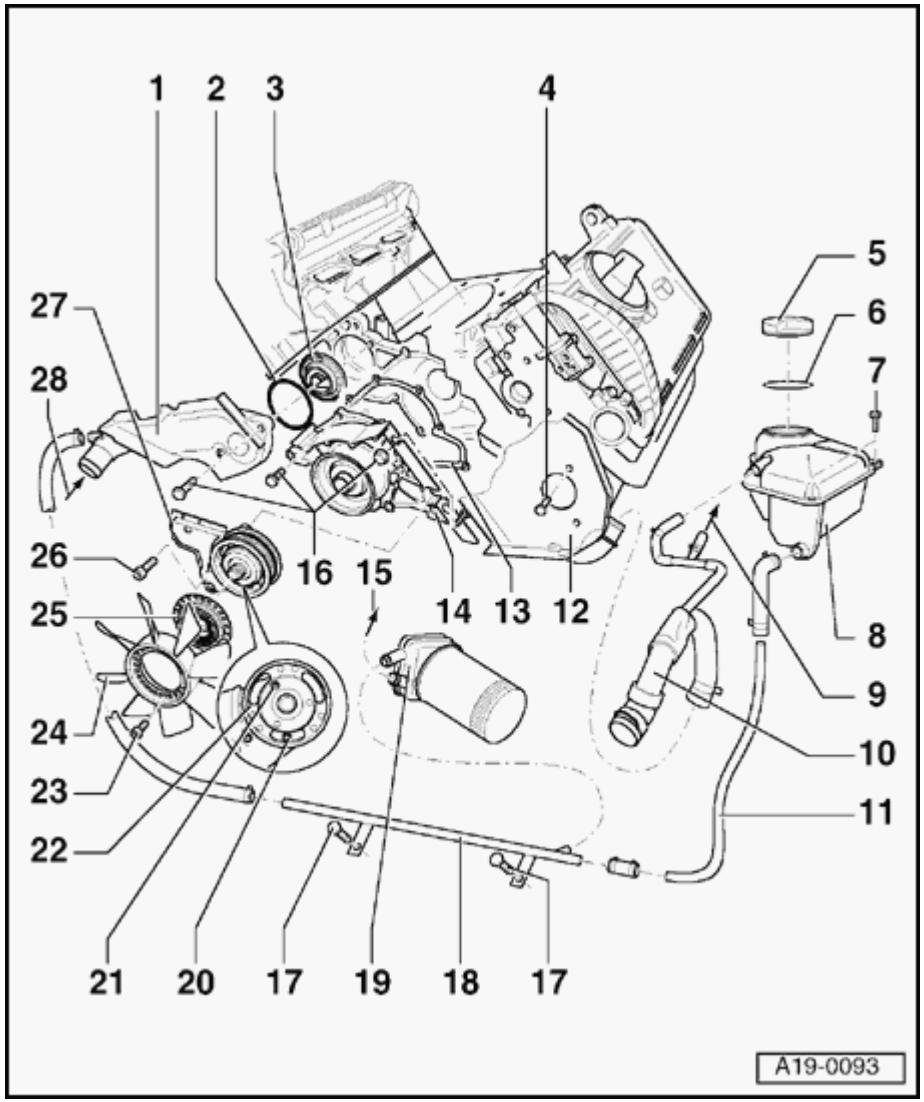
25 - Fan ring

26 - Pressurizing fan

27 - Bolt

- Tightening torque: 5 Nm

19-8



Cooling system components (on engine, front), removing and installing

1 - Connection

- For thermostat

2 - O-ring

- Always replace

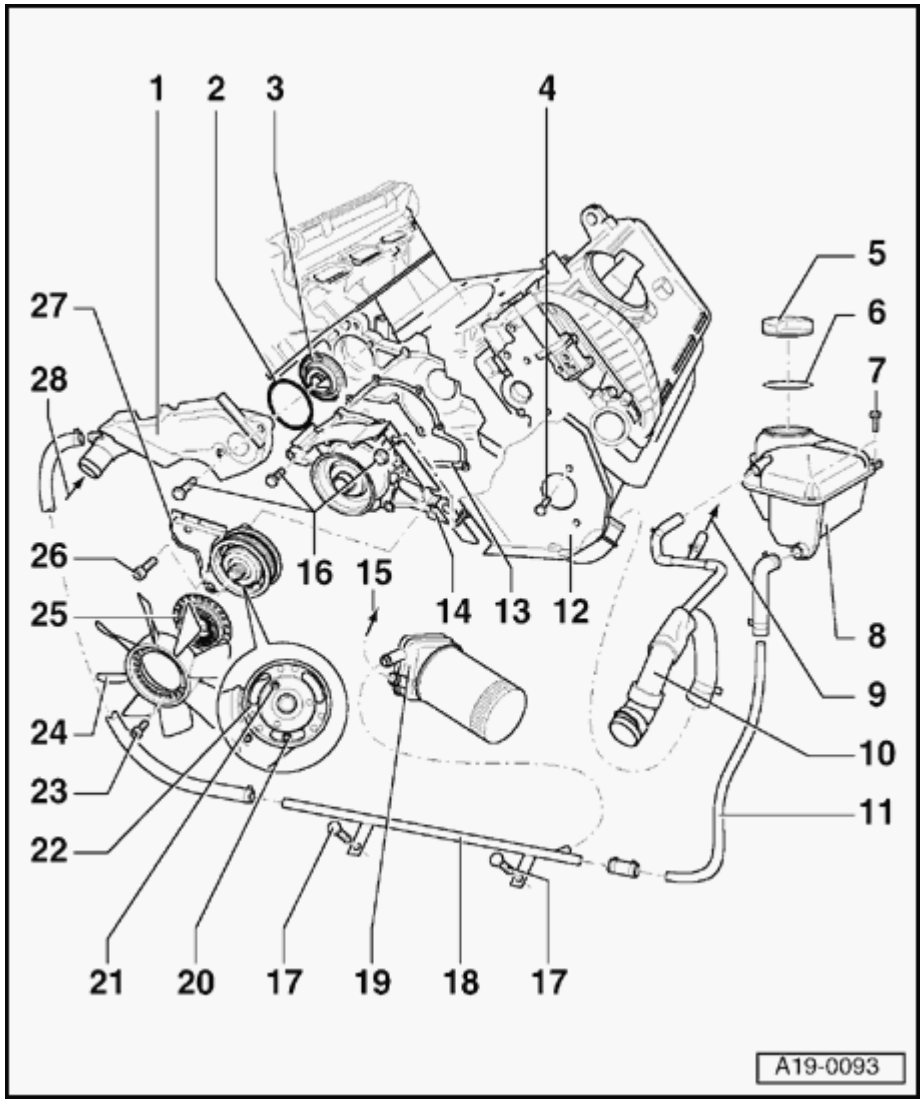
3 - Thermostat

- Checking: heat the thermostat in water
- Starts to open at about 86 ° C
- Opening travel: at least 7 mm

4 - Bolt

- Tightening torque: 10 Nm

19-9



5 - Filler cap

- Test with cooling system tester VAG 1274 and adapter VAG 1274/9
- Test pressure 1.4...1.6 bar

6 - O-ring

- Replace if damaged

7 - Bolt

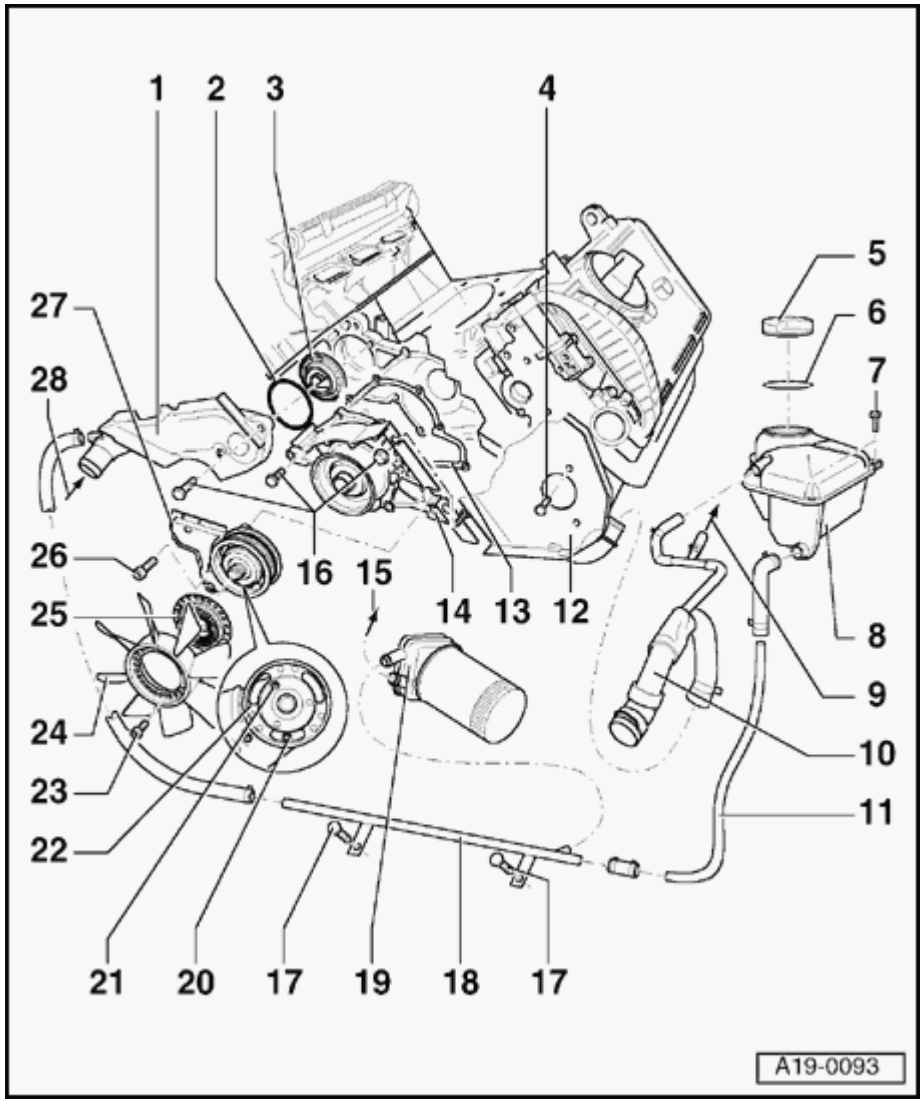
- Tightening torque: 10 Nm

8 - Expansion tank

- Carry out leak test of cooling system with cooling system tester VAG 1274 and adapter VAG 1274/8

9 - To rear water line

- Diagram of coolant hose connections ⇒ Page 19-17



10 - Top coolant hose

- Secured to radiator with retaining clip
- Check for secure seating
- Diagram of coolant hose connections ⇒ Page 19-17

11 - Coolant line

- Diagram of coolant hose connections ⇒ Page 19-17

12 - Rear toothed belt guard

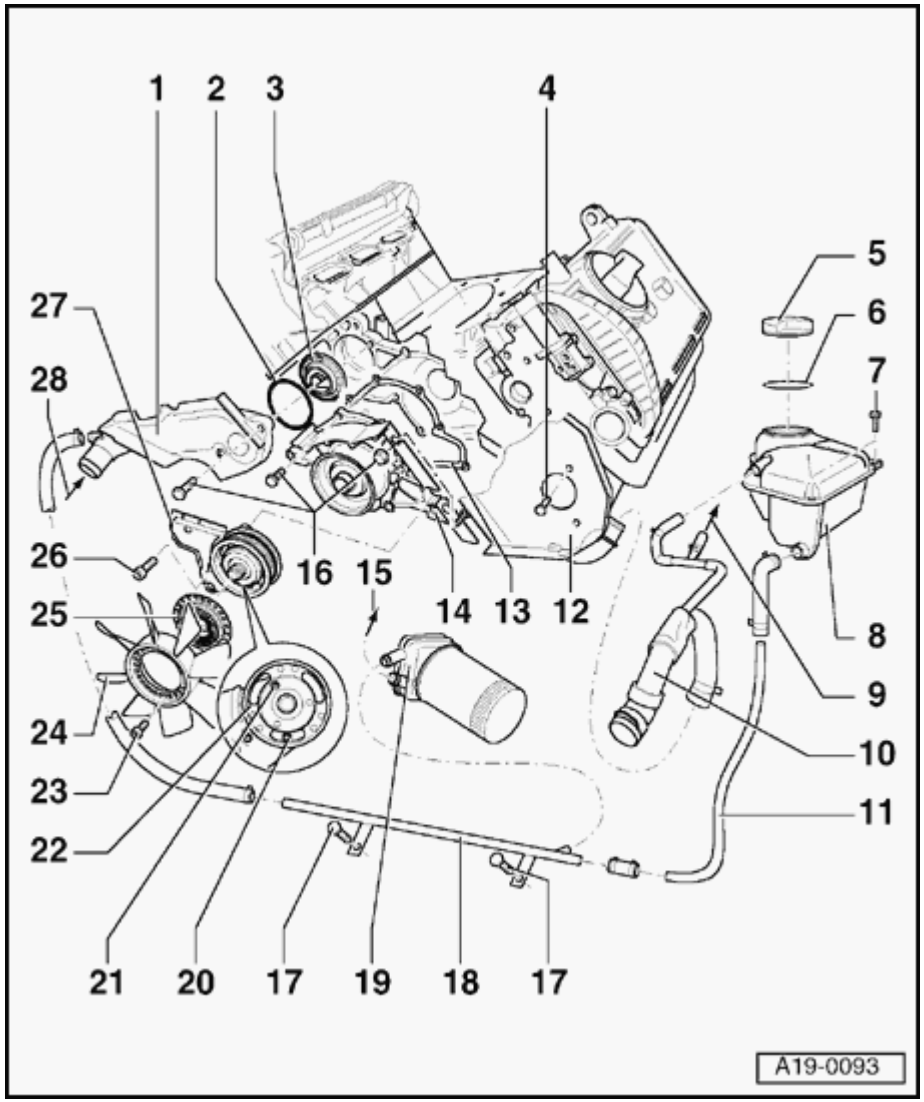
13 - Gasket

- Always replace

14 - Coolant pump

- Check that pump runs freely
- If damaged or leaking replace complete
- Removing and installing ⇒ Page 19-29

19-11



15 - To front coolant line

- Diagram of coolant hose connections ⇒ Page 19-17

16 - Bolt

- Tightening torque: 10 Nm

17 - Bolt

- Tightening torque: 25 Nm

18 - Lower coolant line

- Diagram of coolant hose connections ⇒ Page 19-17

19 - Oil cooler

20 - Bolt

- Tightening torque: 25 Nm

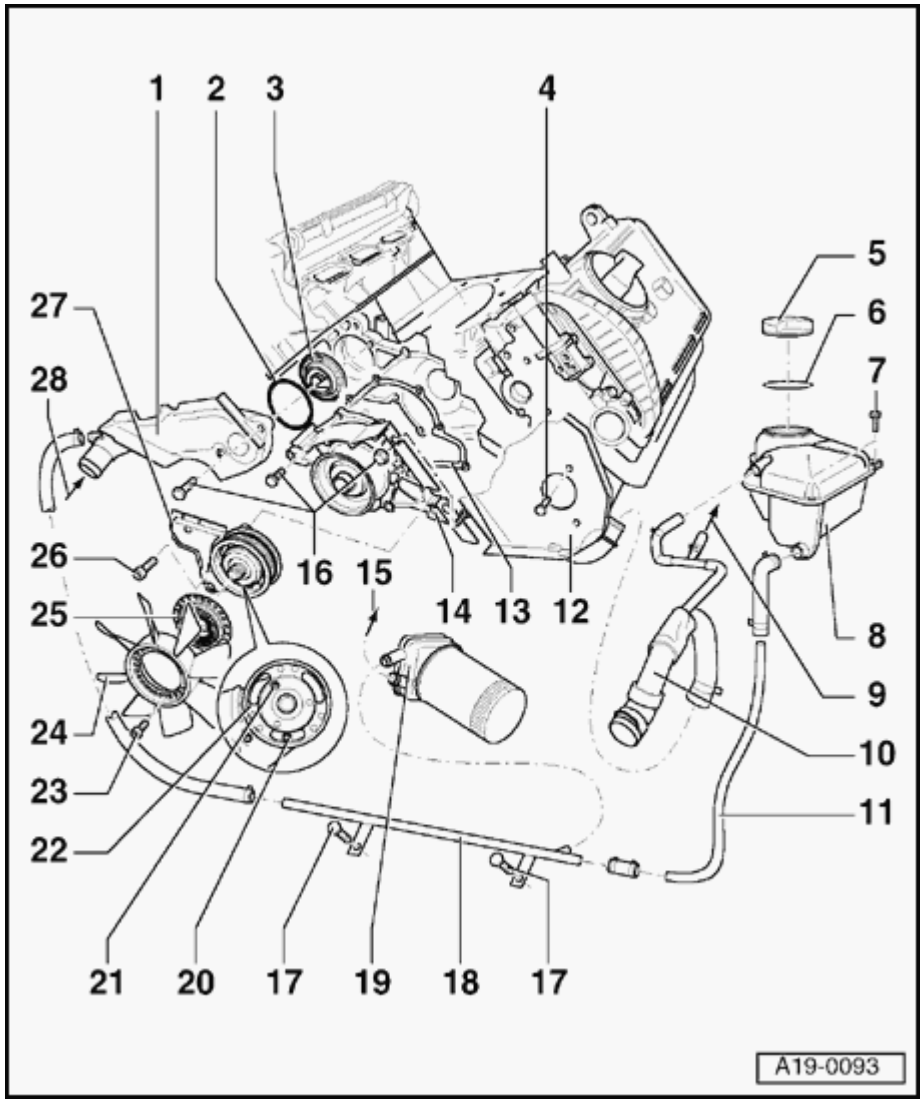
21 - Bolt

- Tightening torque: 10 Nm

22 - Belt pulley

- For viscous fan

19-12



23 - Bolt

- Tightening torque: 10 Nm

24 - Fan wheel for viscous fan

25 - Viscous fan coupling

- Note left-hand thread
- Tightening torque only applicable when using open-end spanner 3312
- Tighten to 37 Nm

26 - Bolt

- Tightening torque: 25 Nm

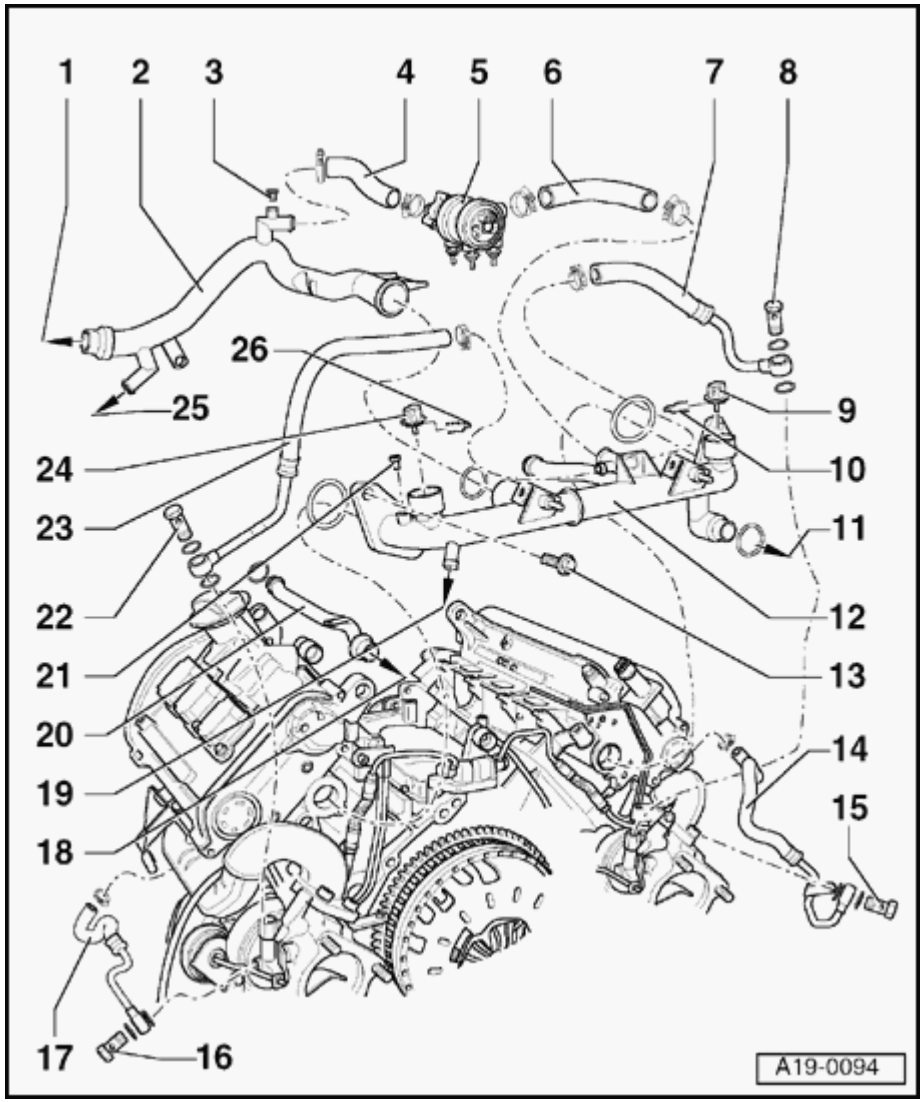
27 - Bracket

- For viscous fan

28 - From bottom of radiator

- Diagram of coolant hose connections ⇒ Page 19-17

19-13



Cooling system components (on engine, rear), removing and installing

1 - To front water hose

2 - Front coolant line

- Diagram of coolant hose connections ⇒ Page 19-17

3 - Bleeder screw

- Tightening torque: 20 Nm

4 - Coolant hose

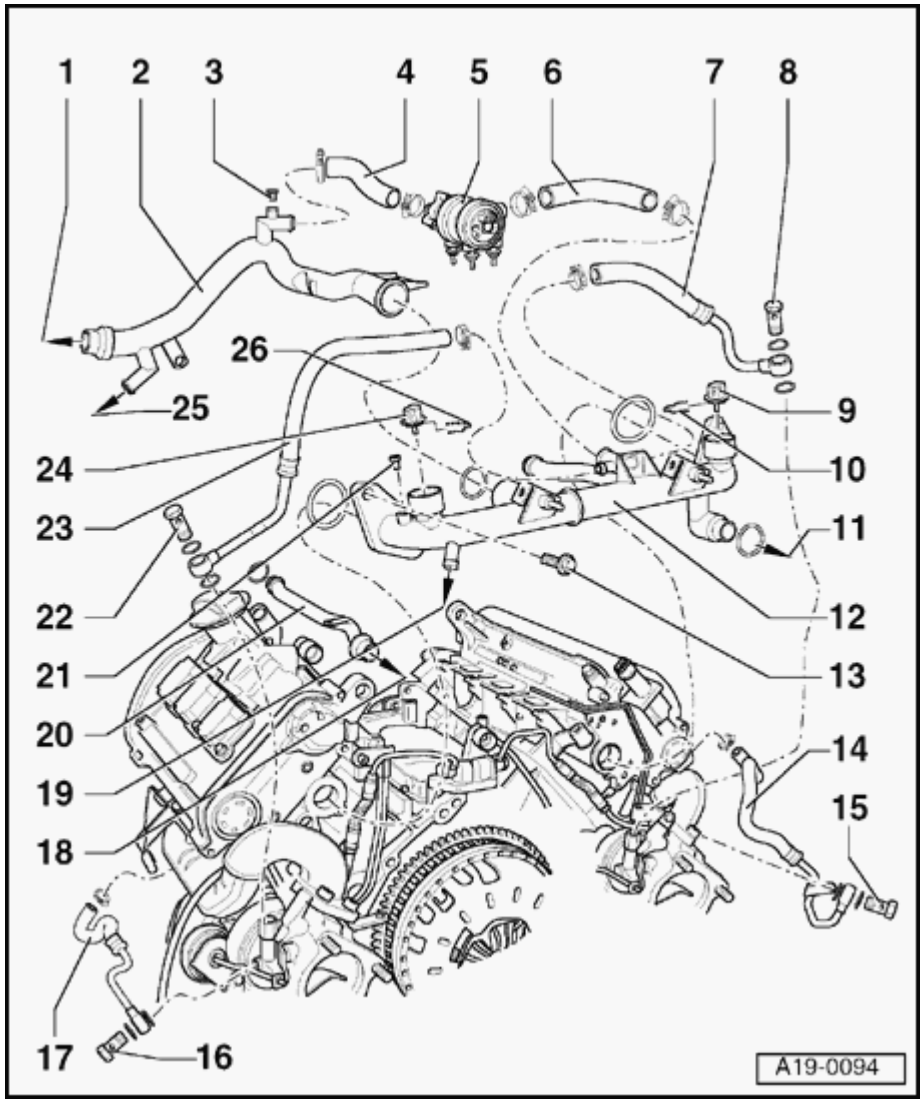
- From auxiliary water pump to front coolant line

5 - Auxiliary water pump

6 - Coolant hose

- From rear coolant line to auxiliary water pump

19-14



7 - Right coolant line

- From turbocharger to rear coolant line

8 - Banjo bolt

- Tightening torque: 35 Nm

9 - Coolant temperature sender (-G62-)

- For engine control module
- If necessary, release pressure in cooling system before removing
- Checking:

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

10 - Retaining clip

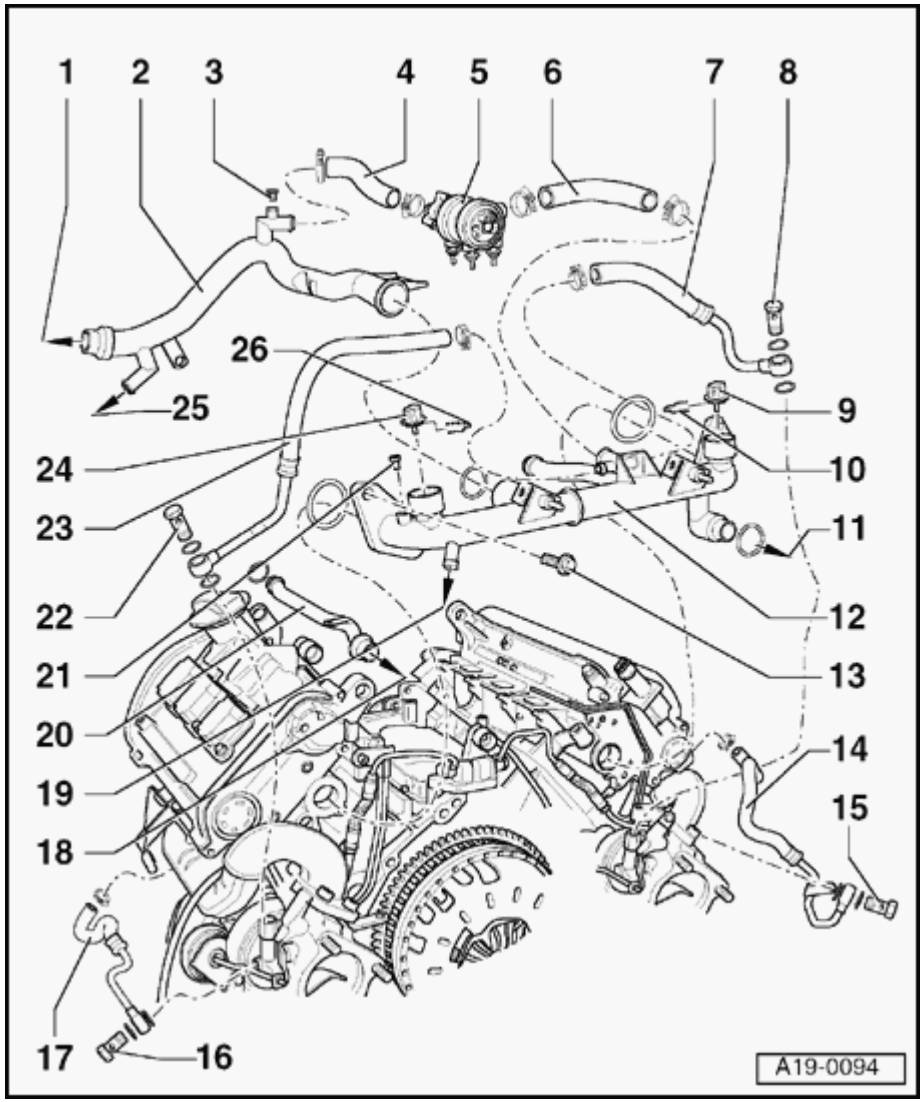
- Check for proper seating

11 - To heat exchanger

12 - Rear coolant line

- Diagram of coolant hose connections ⇒ Page 19-17

19-15



13 - Bolt

- Tightening torque: 10 Nm

14 - Right coolant line

- From engine block to turbocharger

15 - Banjo bolt

- Tightening torque: 35 Nm

16 - Banjo bolt

- Tightening torque: 35 Nm

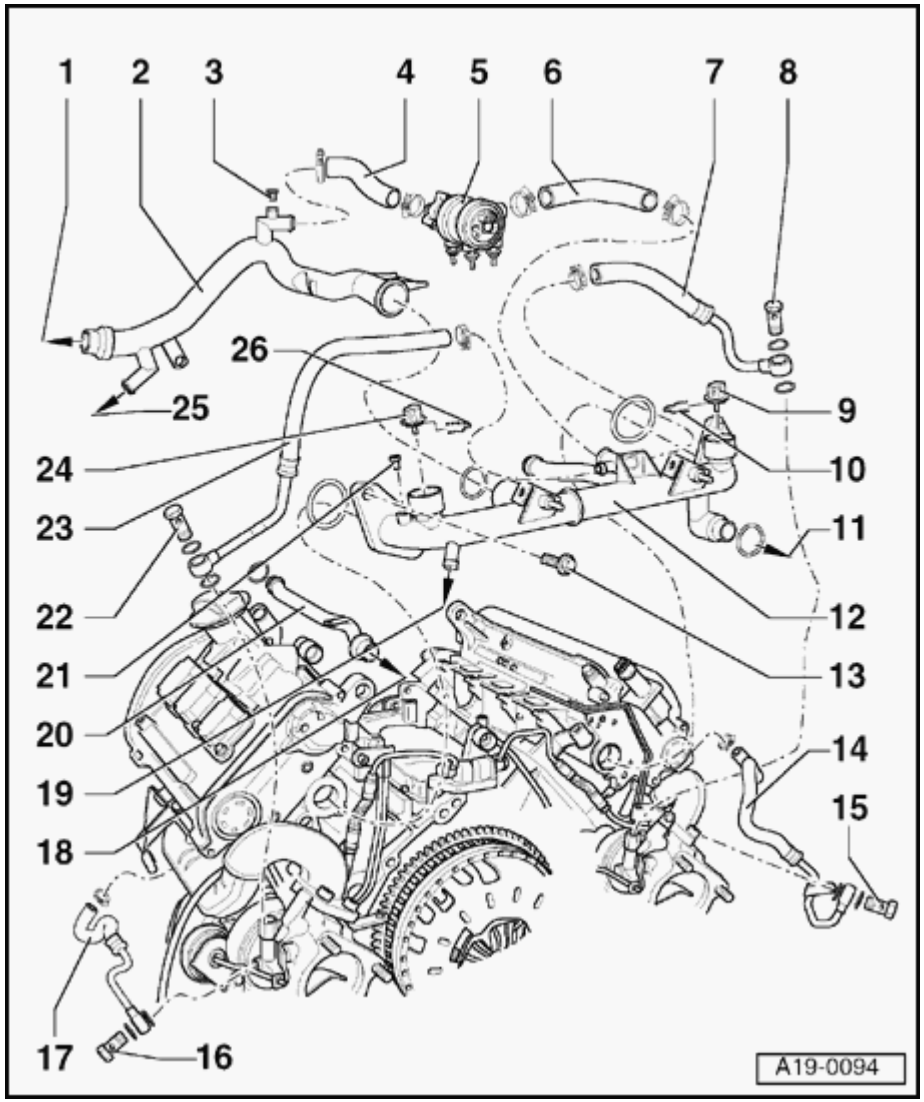
17 - Right coolant line

- From engine block to turbocharger

18 - From heat exchanger

19 - To front coolant hose

19-16



20 - Coolant line

- Diagram of coolant hose connections ⇒ Page 19-17

21 - Bleeder screw

- Tightening torque: 20 Nm

22 - Banjo bolt

- Tightening torque: 35 Nm

23 - Left coolant line

- From turbocharger to rear coolant line

24 - Sender for auxiliary water pump

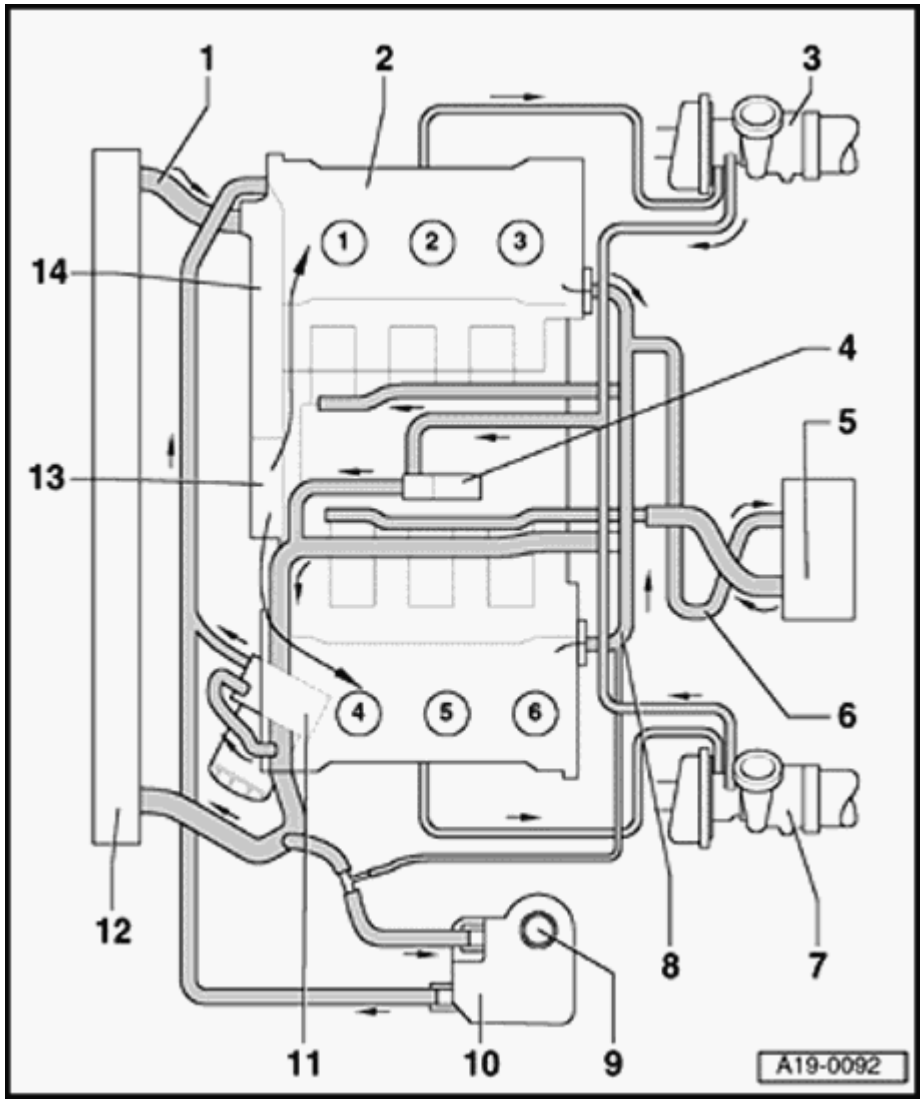
- 2-pin
- If necessary, release pressure in cooling system before removing

25 - To oil cooler

26 - Retaining clip

- Check for proper seating

19-17



Coolant hose connections, diagram

1 - Bottom coolant hose

- From radiator to engine

2 - Cylinder head/ cylinder block

3 - Right turbocharger

4 - Auxiliary water pump

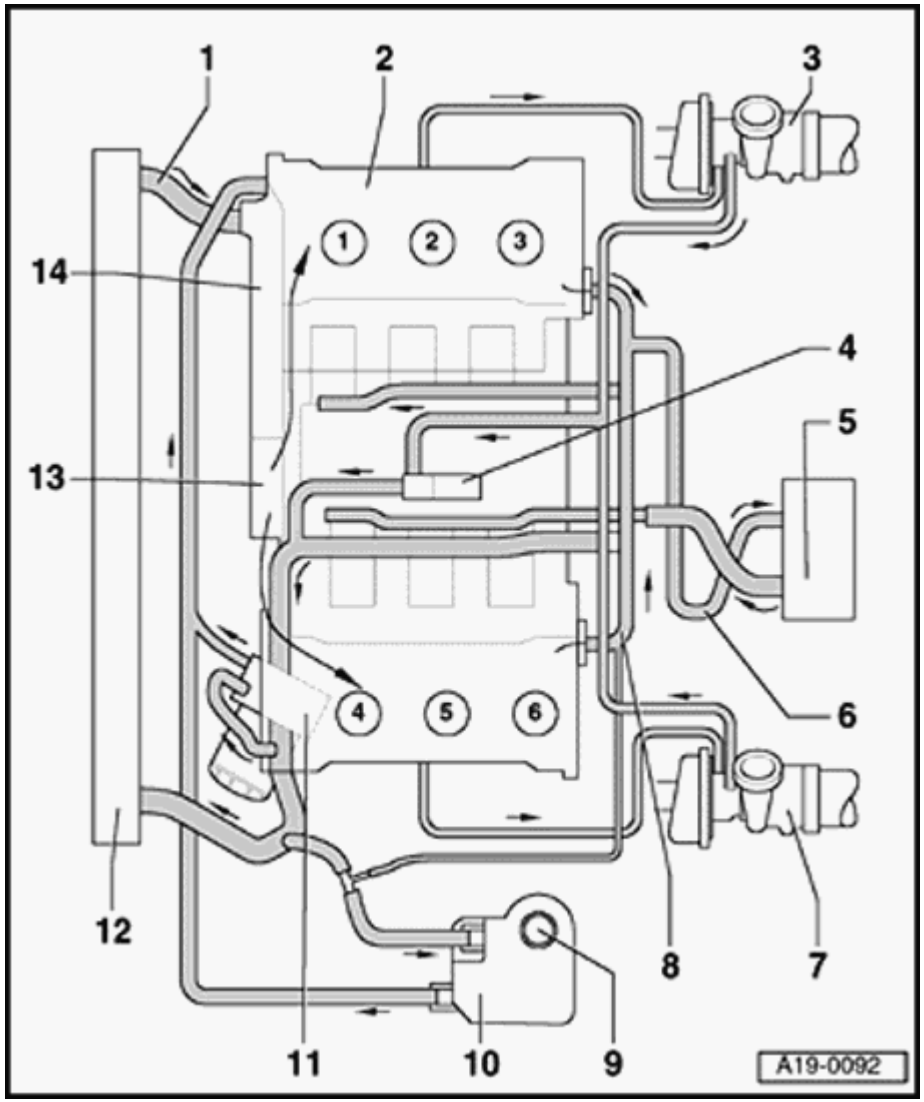
5 - Heat exchanger for heater system

6 - Coolant hose

- To heat exchanger

7 - Left turbocharger

19-18



8 - Rear coolant line

9 - Cap for expansion tank

10 - Expansion tank

11 - Oil cooler

12 - Radiator

- Removing and installing ⇒ Page 19-26
- After replacing, replace coolant in complete system

13 - Coolant pump

14 - Connection

- For thermostat

19-19

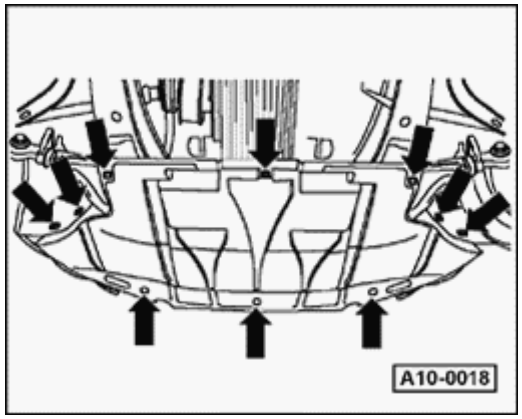
Cooling system, draining and filling

Draining

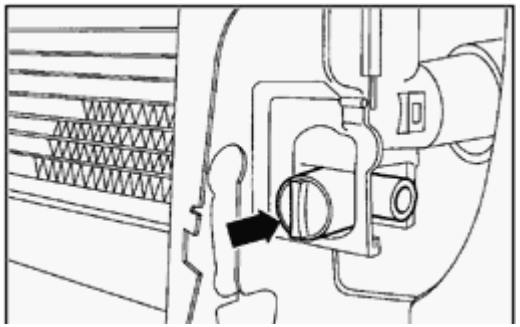
WARNING!

Hot steam can escape from the expansion tank when the filler cap is opened. Cover the filler cap with a cloth and remove it carefully.

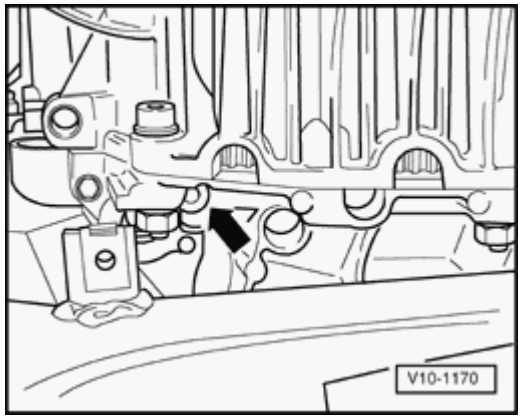
- Remove filler cap on coolant expansion tank.



- Remove noise insulation panel.
- Place drip tray VAG 1306 under the engine.



- If bumper has been removed from vehicle, open drain tap -arrow- on bottom of radiator (left side) by turning anti-clockwise. Fit drain hose on connection if necessary.
- If bumper has not been removed from vehicle, pull out retaining clip on bottom hose going from radiator to engine (right side), and pull hose off radiator.



- Drain coolant from engine at drain screw -arrow-.

Note:

Observe disposal regulations for coolant.

Filling

Notes:

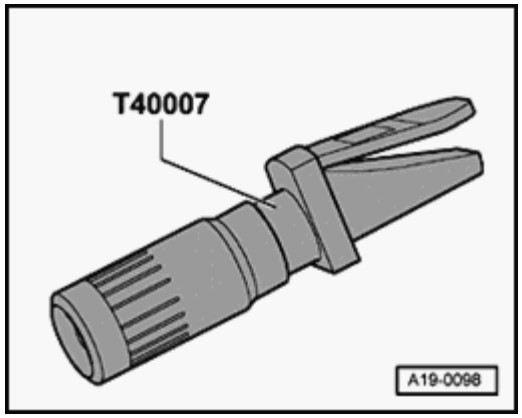
- *Use only coolant additive G 12 - meeting specification VW 774 D. Identification: colored red.*
- *G 12 must not be mixed with any other additives.*
- *If the fluid in the expansion tank is brown, this is an indication that G 12 has been mixed with another type of coolant. In this case the coolant must be changed.*

19-21

- *G 12 and coolant additives complying with specification "VW 774 D" prevent frost and corrosion damage, scaling and also raise the boiling point of the coolant. For this reason the system must be filled all year round with the correct additive for frost and corrosion protection.*

- *Particularly in countries with tropical climates, the higher boiling point of the coolant improves engine reliability when working under heavy load.*

- *The system must be protected against frost to about -25 ° C (in arctic climates to about -35 ° C).*



- *Use special tool T40007 to test coolant concentration and antifreeze protection.*

19-22

- *The coolant concentration should not be reduced by adding plain water, even in warmer seasons and in warmer countries. The concentration must be at least 40 %.*

- *If extra antifreeze protection is required in cold climates, the concentration of G 12 can be increased, but only up to a maximum of 60 % (frost protection to about -40 ° C); if this concentration is exceeded, the antifreeze protection will be reduced again and cooling effectiveness will also be impaired.*

- *Do not reuse the old coolant if the radiator, heat exchanger, cylinder head or cylinder head gasket have been replaced.*

Recommended mixture ratios:

Frost protection to	**Antifreeze concentration**	**G 12[1)]**	**Water[1)]**
-25 ° C	40 %	2.5 ltr.	3.5 ltr.
-35 ° C	50 %	3.0 ltr.	3.0 ltr.

[1)] The capacity of the cooling system can vary depending on the equipment installed on the

vehicle.

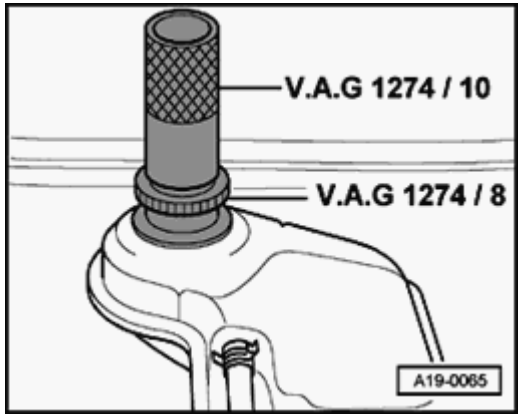
19-23

- Replace O-ring on coolant drain screw and screw drain screw back into engine.

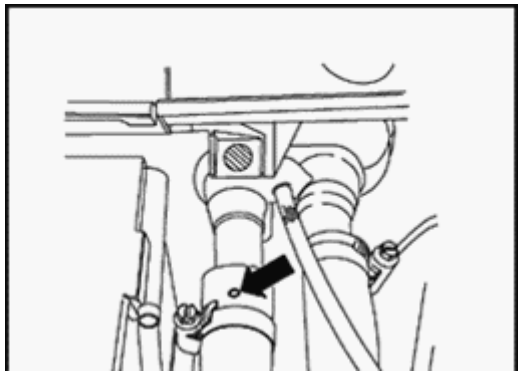
  Tightening torque: 20 Nm

- Install bottom coolant hose and secure.

- Close coolant drain tap on radiator.

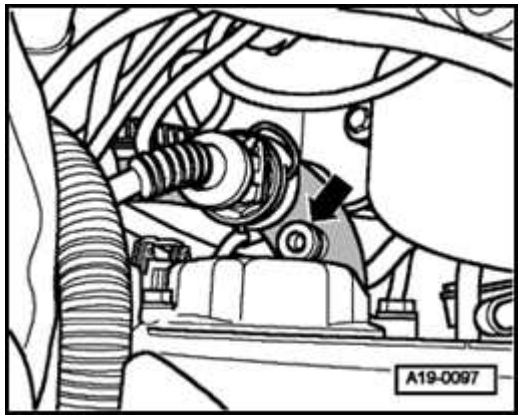


- Screw adapter VAG 1274/8 onto expansion tank and insert extension VAG 1274/10 into the adapter.

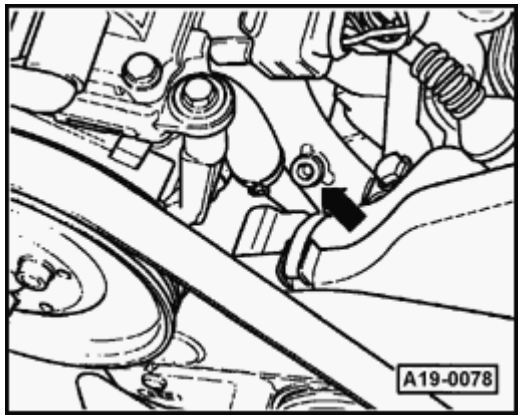


- Loosen coolant hose on heat exchanger and pull back hose far enough so that bleeder hole in hose -arrow- is no longer covered by connection.
- Fill up coolant until it comes out at bleeder hole in coolant hose.
- Push coolant hose onto connection and tighten.

19-24



- Loosen bleeder screw on rear coolant line -arrow- below expansion tank.
- Fill up coolant until it comes out at bleeder screw.
- Screw in bleeder screw (20 Nm).



- Loosen bleeder screw on front coolant line -arrow- between power steering pump and left cylinder head.
- Fill with coolant until it comes out at bleeder screw.
- Screw in bleeder screw (20 Nm).
- Fill coolant up to max. mark.
- Close filler cap on expansion tank.
- Set heater controls to maximum heat setting.

- Start engine and let it idle for about 10 minutes.

- Maintain an engine speed of about 2000 RPM for about 5 minutes.

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

- Check coolant level and top up if necessary. When engine is at normal operating temperature coolant level must be on max. mark, and between min. and max. marks when engine is cold.

Note:

When the engine is hot the cooling system is under pressure. Carefully open filler cap on expansion tank to release pressure before starting repair work.

WARNING!

Hot steam can escape from the expansion tank when the filler cap is opened. Cover the filler cap with a cloth and remove it carefully.

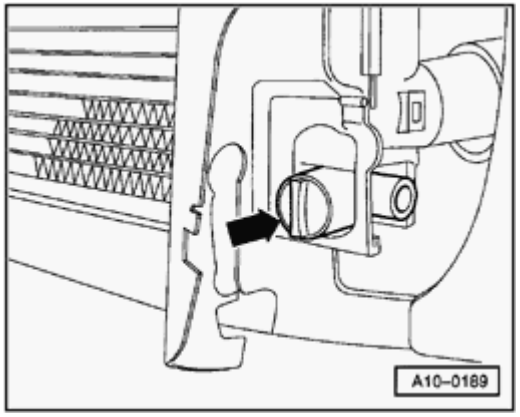
19-26

Radiator, removing and installing

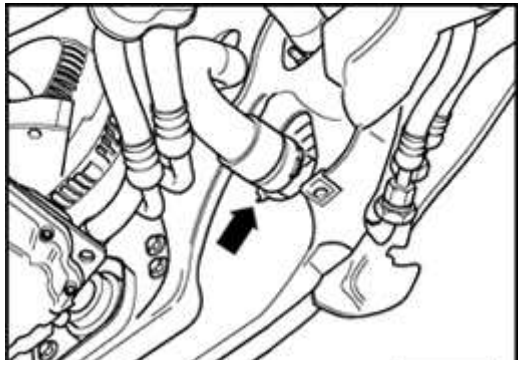
Removing

- Remove front bumper.

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

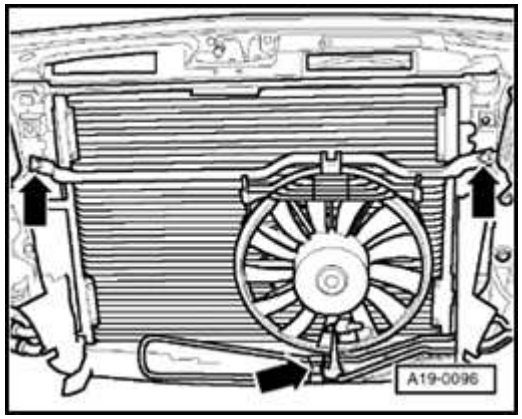


- Drain coolant ⇒ Page 19-19 .



- Disengage retaining clips on connecting flanges -arrow- and pull coolant hoses off radiator.
- Unplug connector from thermoswitch on radiator (bottom left).

19-27



- Unbolt pressurizing fan and detach cooling lines for power steering hydraulic fluid -arrows-.

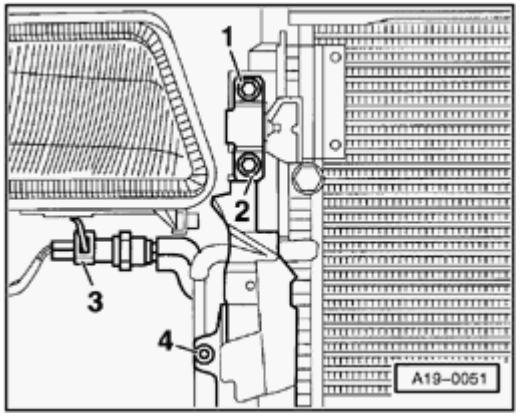
Vehicles with air conditioner

WARNING!

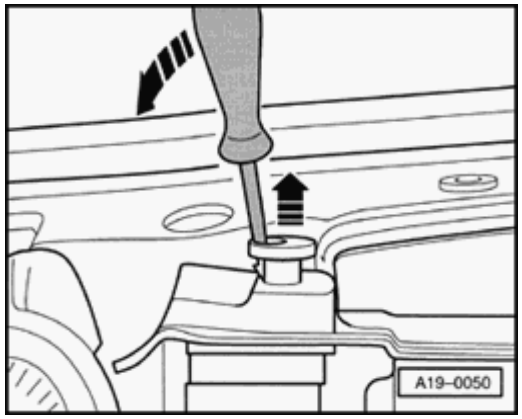
Do not open the air conditioner refrigerant circuit.

Note:

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



- Detach air cowls from radiator -4- (left and right).
- Remove securing bolts -1- and -2- for condenser.
- Unplug connector -3- from air conditioner pressure switch -F129.
- Lift condenser up out of its bracket, turn it towards side and secure to right-hand front wheel with wire.



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

Installing

Install in the opposite order to removing. When installing, note the following points:

- Fill with coolant ⇒ Page 19-19 .

Tightening torques

Component	Nm
Condenser to radiator	10
Cooling lines to radiator	10
Pressurizing fan to radiator	10

19-29

Coolant pump, removing and installing

Notes:

- *Always replace seals and gaskets.*
- *Cover toothed belt with a cloth to protect it from coolant before removing coolant pump.*

Removing

- Remove front bumper.

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

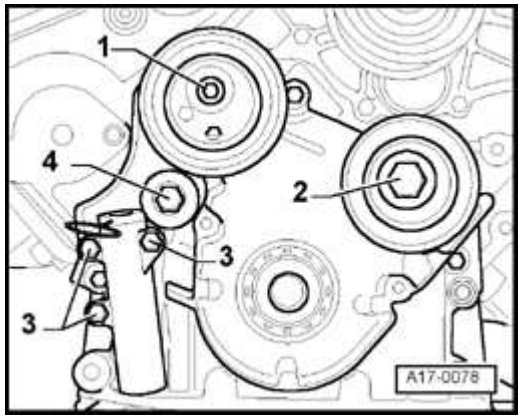
- Move lock carrier to service position.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

- Remove ribbed belt ⇒ Page 13-1 .
- Remove toothed belt ⇒ Page 13-4 .

- Drain coolant ⇒ Page 19-19 .

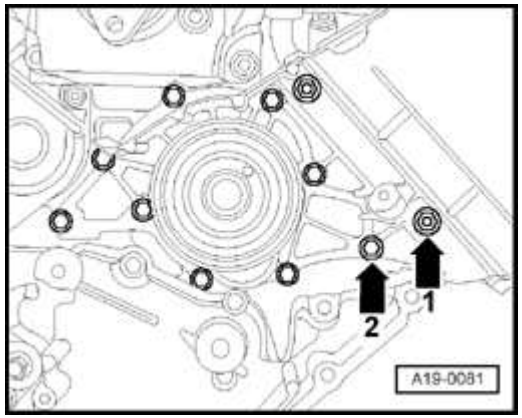
19-30



- Remove following components before unbolting coolant pump:

1 - Tensioning roller for toothed belt: 20 Nm

2 - Idler wheel: 45 Nm



- Unbolt coolant pump from toothed belt guard -1- (2 nuts). Remove securing bolts -2- (9 bolts) for coolant pump and remove coolant pump.

19-31

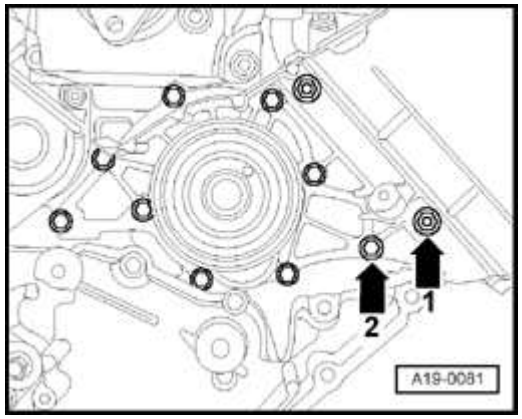
Installing

Install in the opposite order to removing. When installing, note the following points:

- Remove residues of sealant on sealing surfaces of coolant pump and cylinder block.

- Clean sealing surfaces; ensure that they are free of oil and grease.

- Fit new gasket on coolant pump flange.



- Insert coolant pump into cylinder block and tighten all 9 securing bolts -2-.
- Secure rear toothed belt guard at coolant pump housing -1-.

  Tightening torque: 10 Nm.
- Install toothed belt ⇒ Page 13-4 .
- Install ribbed belt ⇒ Page 13-1 .
- Install toothed belt guard.
- Fill cooling system ⇒ Page 19-19 .

19-1

Cooling system components, removing and installing

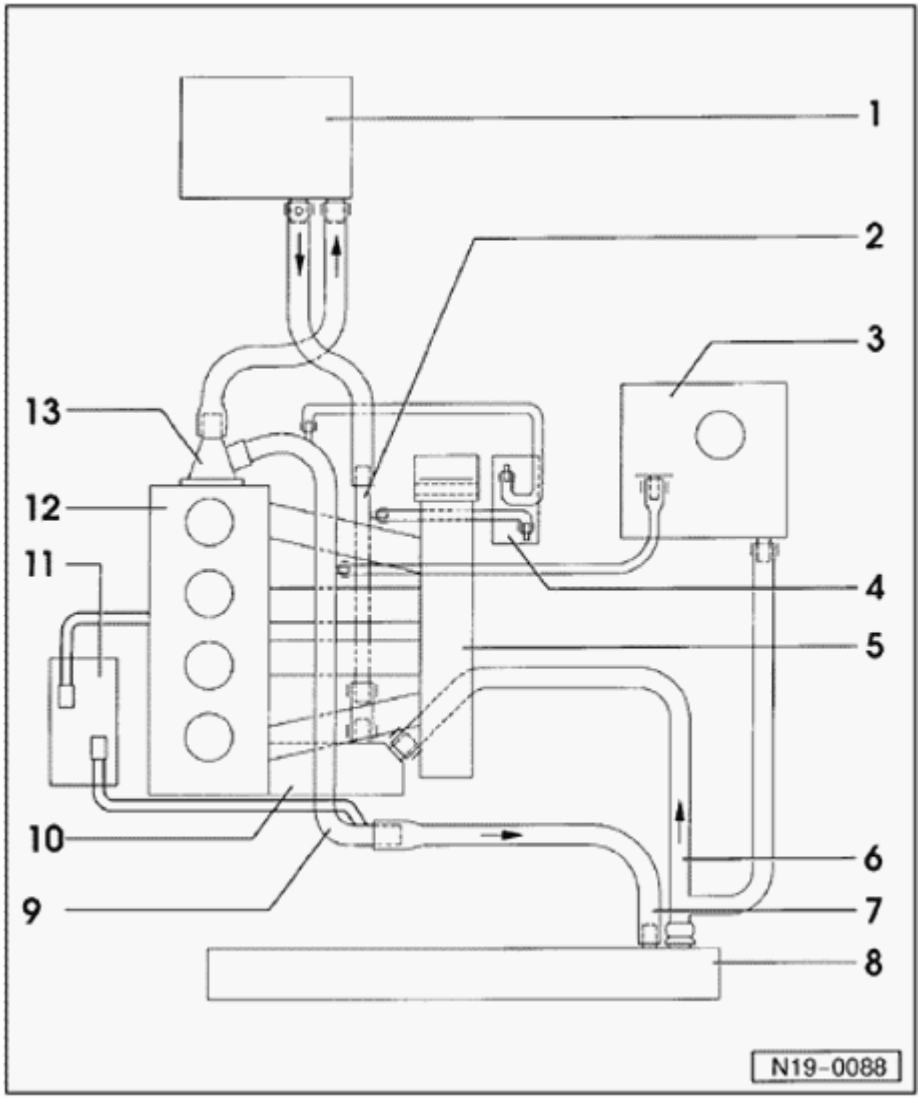
WARNING!

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.*

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

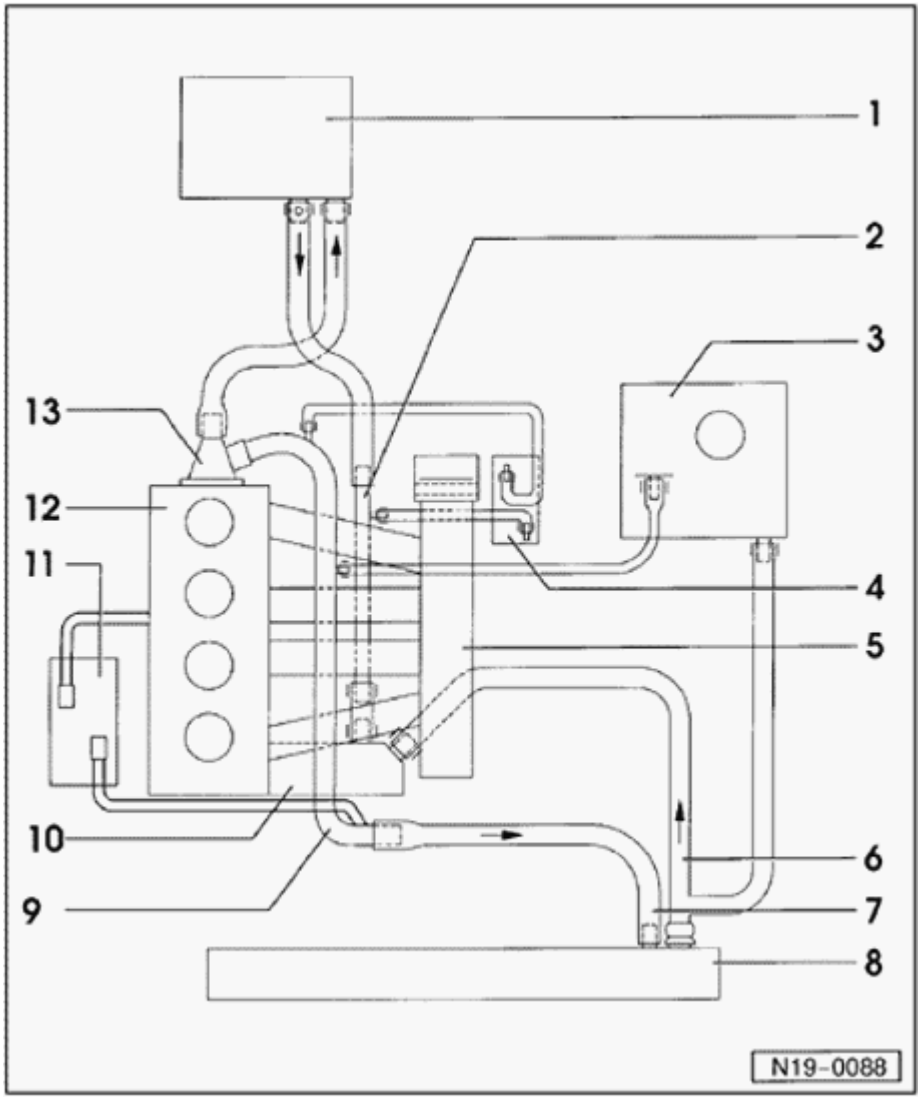
- Removing and installing ⇒ Page 17-7 , item 14

5 - Intake manifold

6 - Lower coolant hose

7 - Upper coolant hose

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

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.

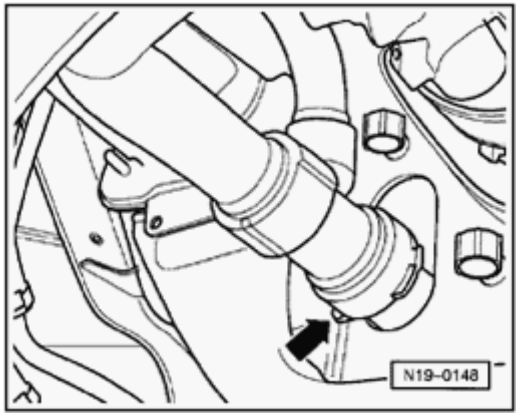


- Remove noise insulation panel (arrows).

- Place VAG1306 drip tray underneath engine.

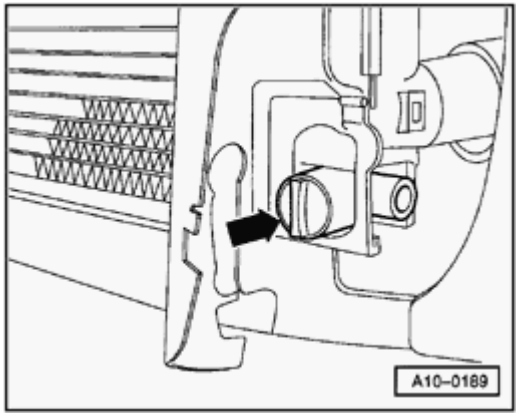
CAUTION!

Observe disposal regulations for coolant!

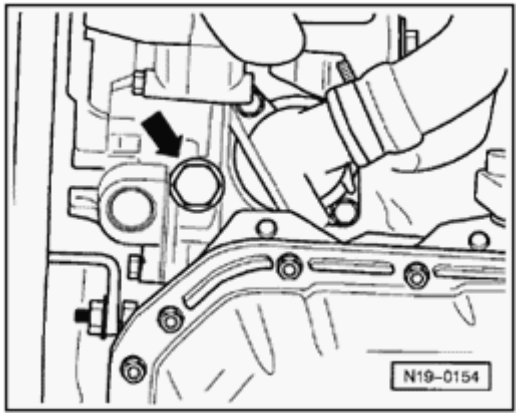


- Remove retaining clip (arrow) from lower coolant hose and remove coolant hose from radiator.

Note:



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



- 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.*

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.*

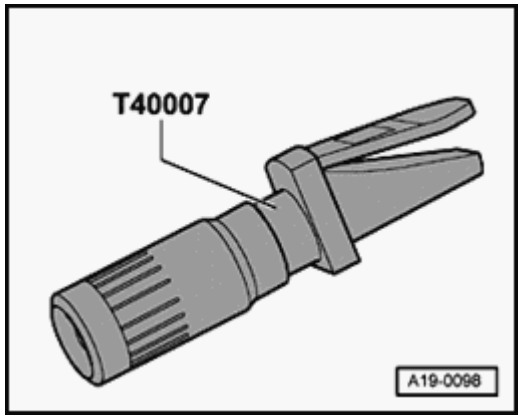
- *Frost protection additives must protect against frost to about -25° C (-13° F) and to about -35° C (-31° F) in arctic climates.*

- *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.*

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

19-8



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

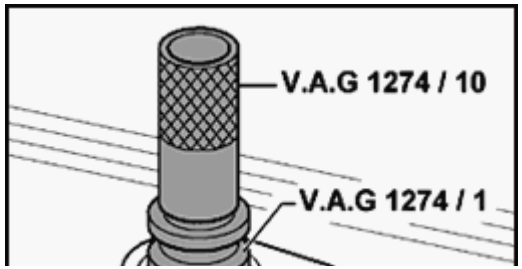
Recommended mixture ratios:

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.			

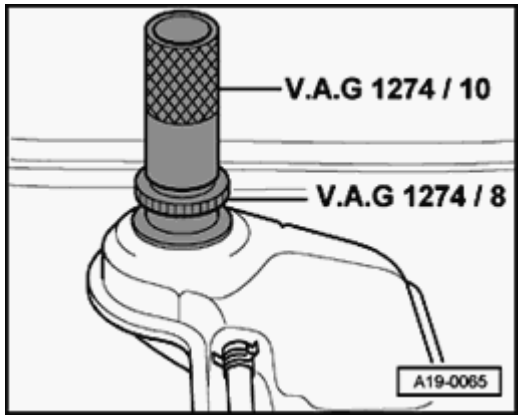
- Install lower radiator hose and secure.
- Replace O-ring and install coolant pump drain plug.

  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.



Vehicles with large cap

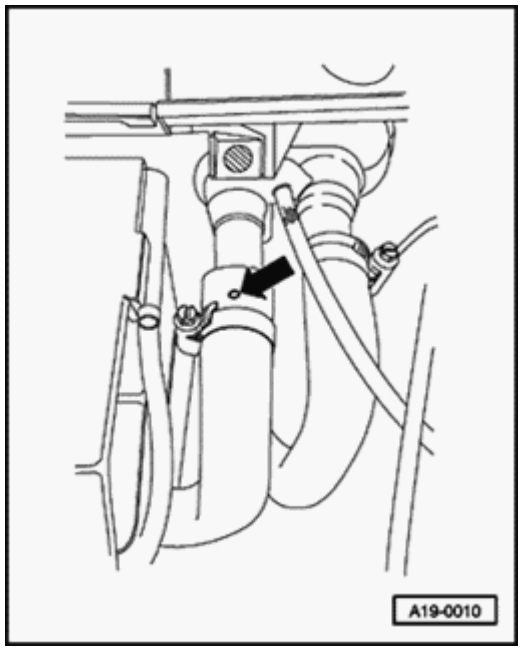
- Screw VAG1274/8 adapter onto coolant expansion tank.
- Attach VAG1274/10 special tool to VAG1274/1 adapter.

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.

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

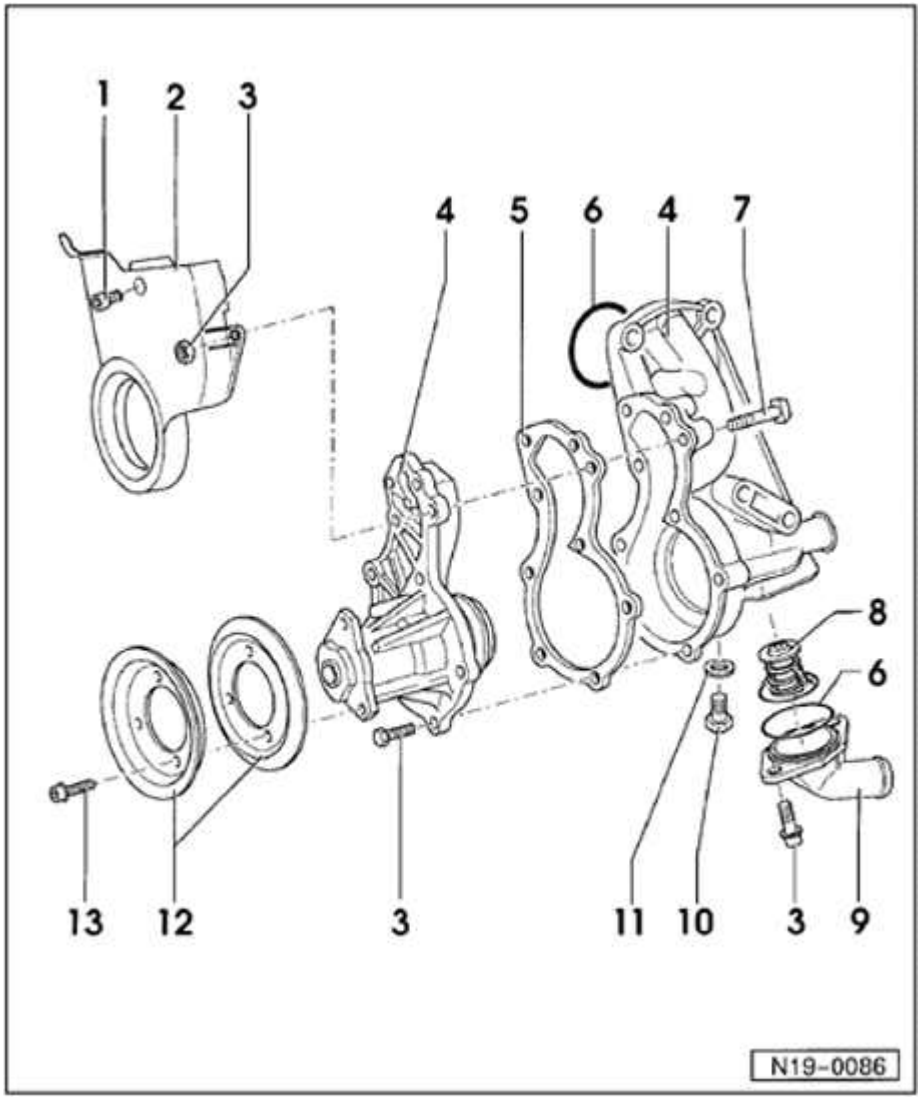
- Allow engine to idle until the lower radiator hose is hot.Check coolant level and top up if necessary. When engine is at normal operating temperature, coolant level must be at max. mark; when engine is cold, between min. and max. marks.

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.

19-11



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

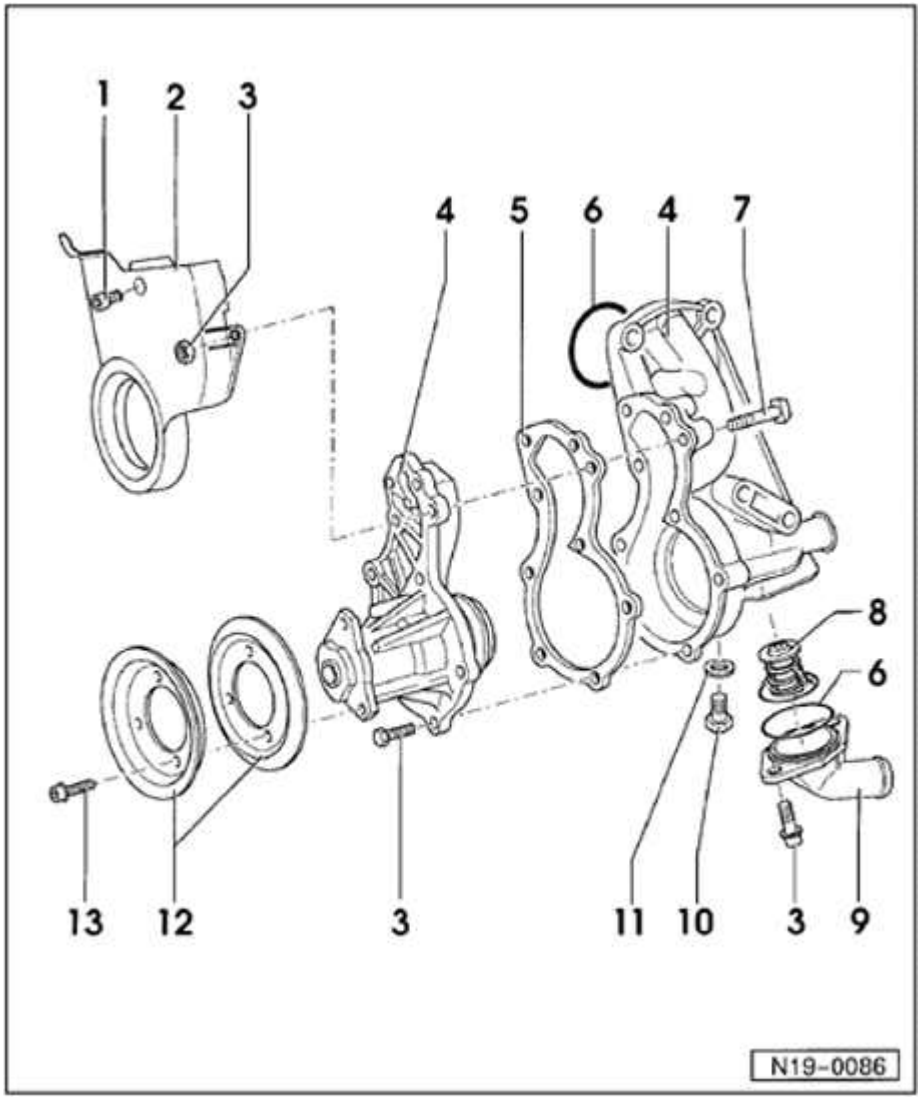
- Removing and installing ⇒ Page 19-13
- Check for ease of movement

5 - Gasket

- Always replace

6 - O-ring

- Always replace



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)

19-13

Coolant pump, removing and installing

Note:

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

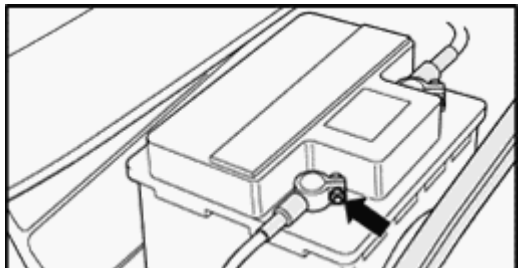
- Lock carrier in service position ⇒ Page 13-1

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).***



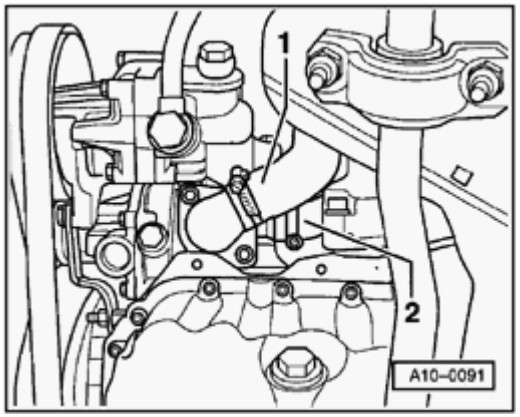
- Switch ignition off and disconnect battery Ground (GND) strap.
- Remove ribbed belt ⇒ Page 13-15 .
- Remove viscous fan (with belt pulley) ⇒ Page 13-14 , Fig. ⇒ 1 .
- Remove V-belt ⇒ Page 13-18 .

Note:

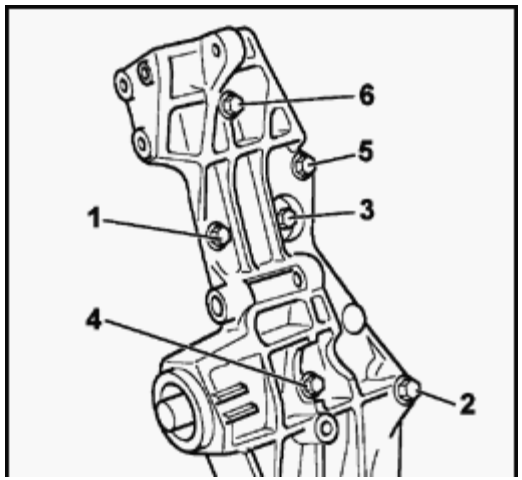
Ribbed belt for A/C compressor and torque support remains installed.

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)



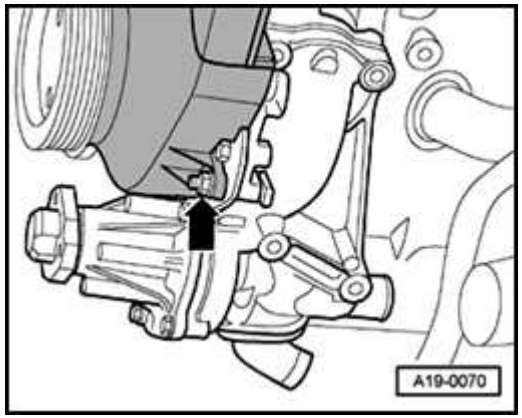
- Remove bracket for generator, power steering pump and viscous fan bolts -1- through -6-.
- Secure bracket for generator, power steering pump and viscous fan to left side using wire.

19-15

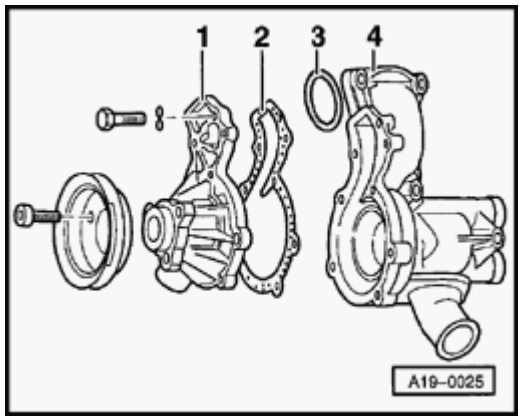
Note:

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.

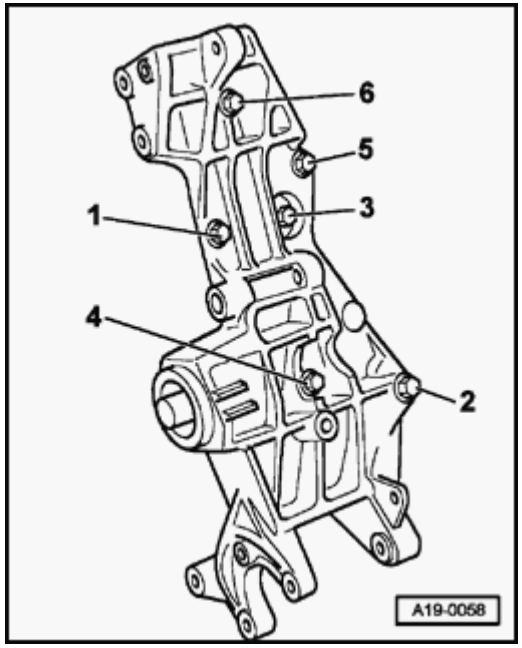


- Unbolt impeller housing -1- from pump housing -4-.

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 .

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.

⇒ *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.

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	

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

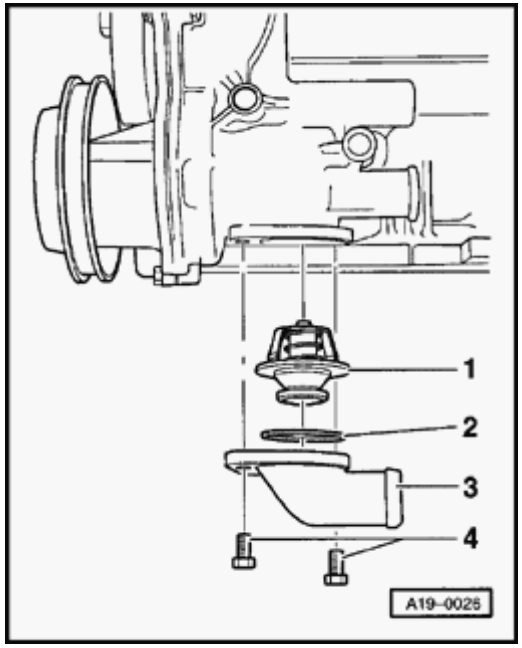
Component	Tightening torques
Generator to bracket for generator, power steering pump and viscous fan	
M8	25 Nm (18 ft lb)
M10	40 Nm (30 ft lb)
Belt pulley to coolant pump	25 Nm (18 ft lb)
Viscous fan to bearing	45 Nm (33 ft lb)

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)

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.		

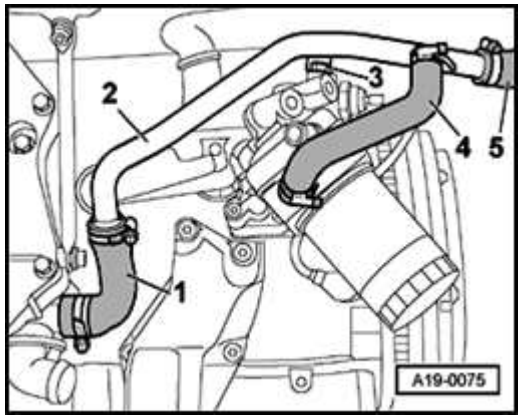
19-22

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-.

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.

19-24

Radiator, removing and installing

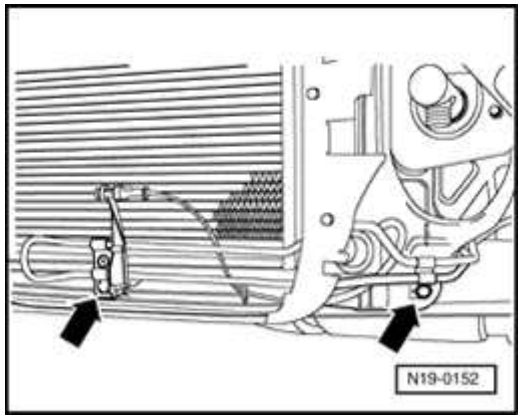
Special tools and equipment

VAG1306 drip tray

Removing

- Remove front bumper.

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



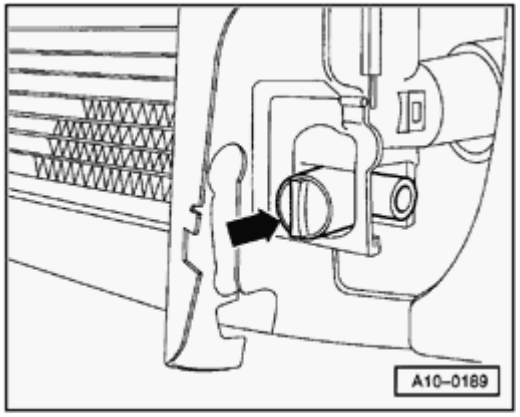
- Unbolt cooling pipe for power steering hydraulic oil (arrows).
- Place VAG1306 drip tray underneath engine.

WARNING!

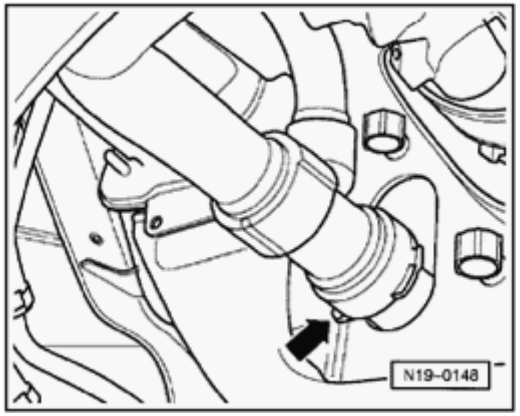
The cooling system is pressurized when the engine is warm. When opening the expansion tank, wear gloves and other appropriate protection, cover the cap using a cloth, and open carefully to relieve system pressure slowly.

- Open coolant expansion tank cap.

19-25



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



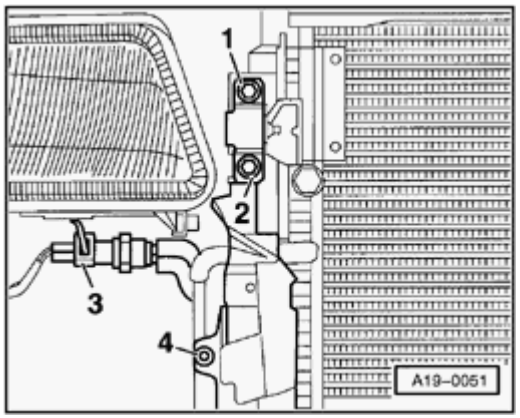
- Remove coolant hoses at radiator and remove clip from connecting flange (arrow).

Vehicles with automatic transmission

- Remove ATF lines from radiator.

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

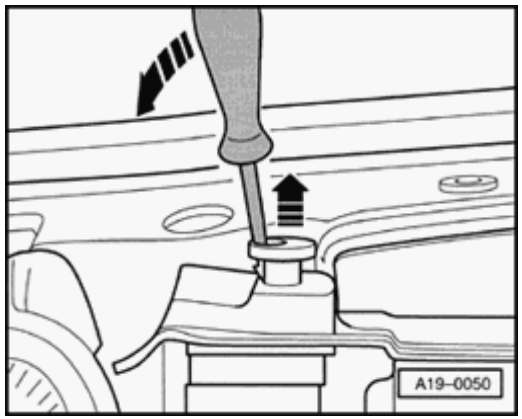
19-26



- 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.

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)

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:

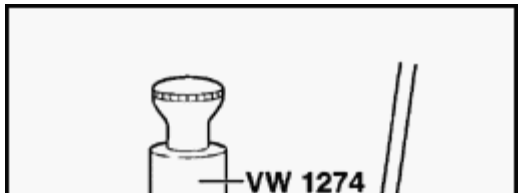
- Engine at operating temperature

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.

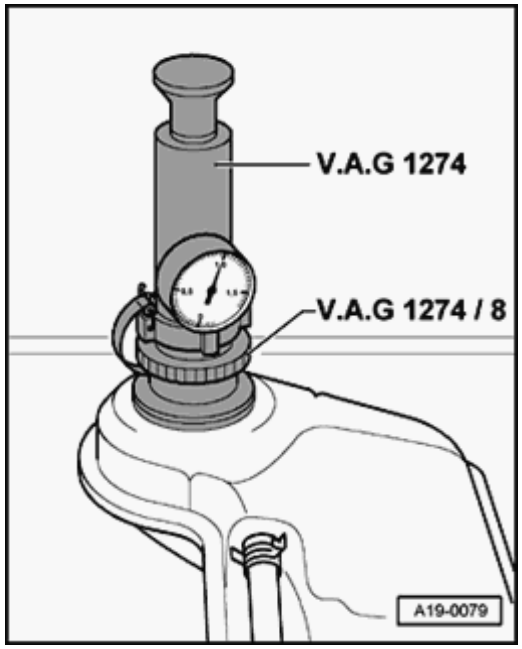
- Open coolant expansion tank cap.

Vehicles with small cap



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

19-29



Vehicles with large cap

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

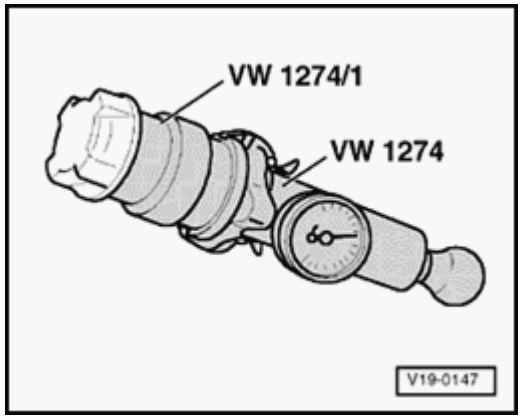
All models

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

19-30

Pressure relief valve in cap, checking

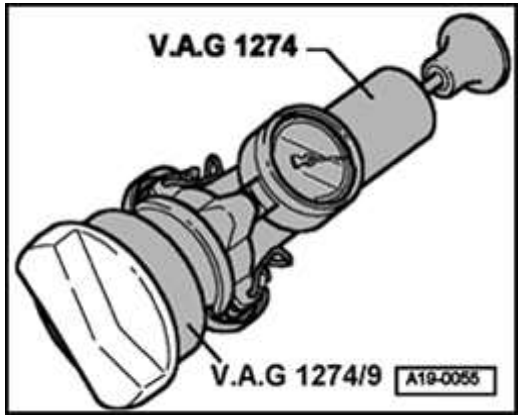
Vehicles with small cap



- 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).

19-1

Cooling system components, removing and installing

WARNING!

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

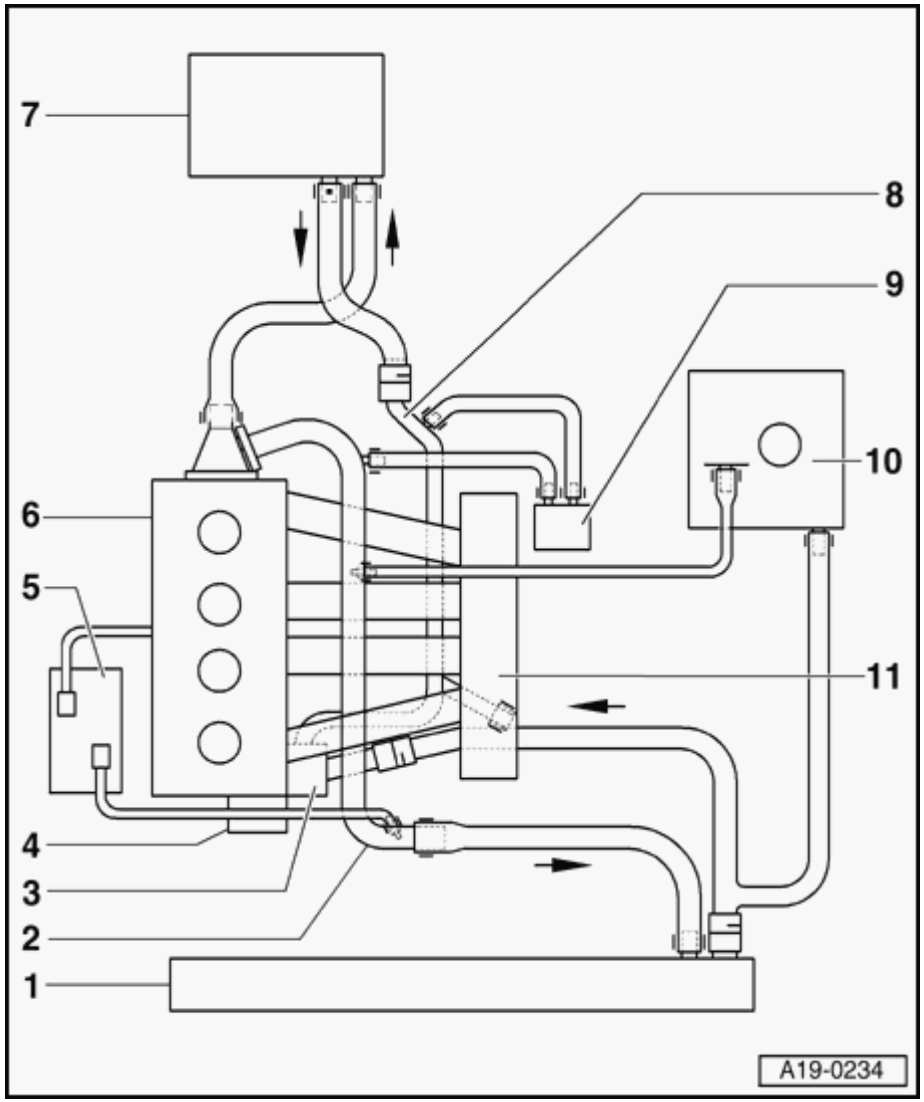
Note:

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

⇒ *Parts Catalog*

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

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



Cooling system diagram

1 - Radiator

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

2 - Upper coolant line

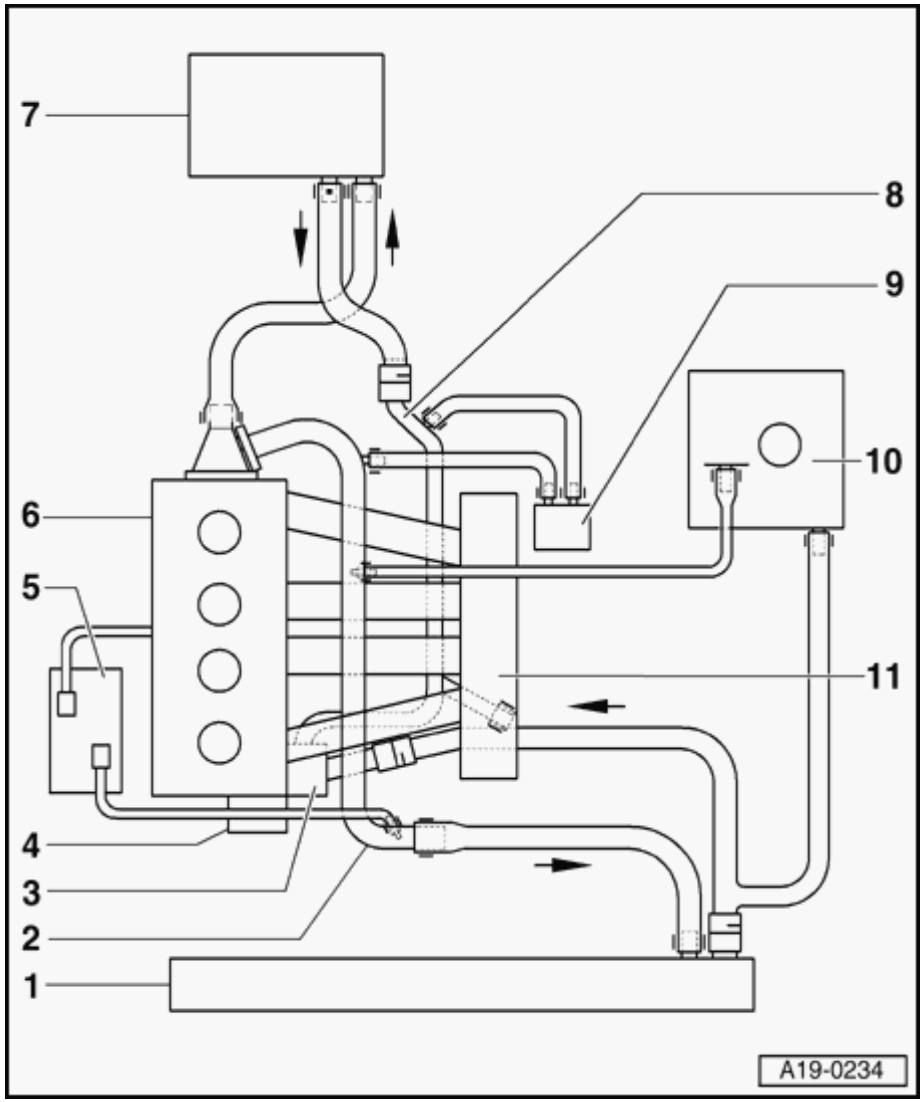
3 - Thermostat

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

4 - Coolant pump

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

5 - Turbocharger



6 - Cylinder head/cylinder block

- After replacing, fill with fresh coolant

7 - Heating system heat exchanger

- After replacing, fill with fresh coolant

8 - Lower coolant line

- Removing and installing ⇒ Page 19-23

9 - Oil cooler

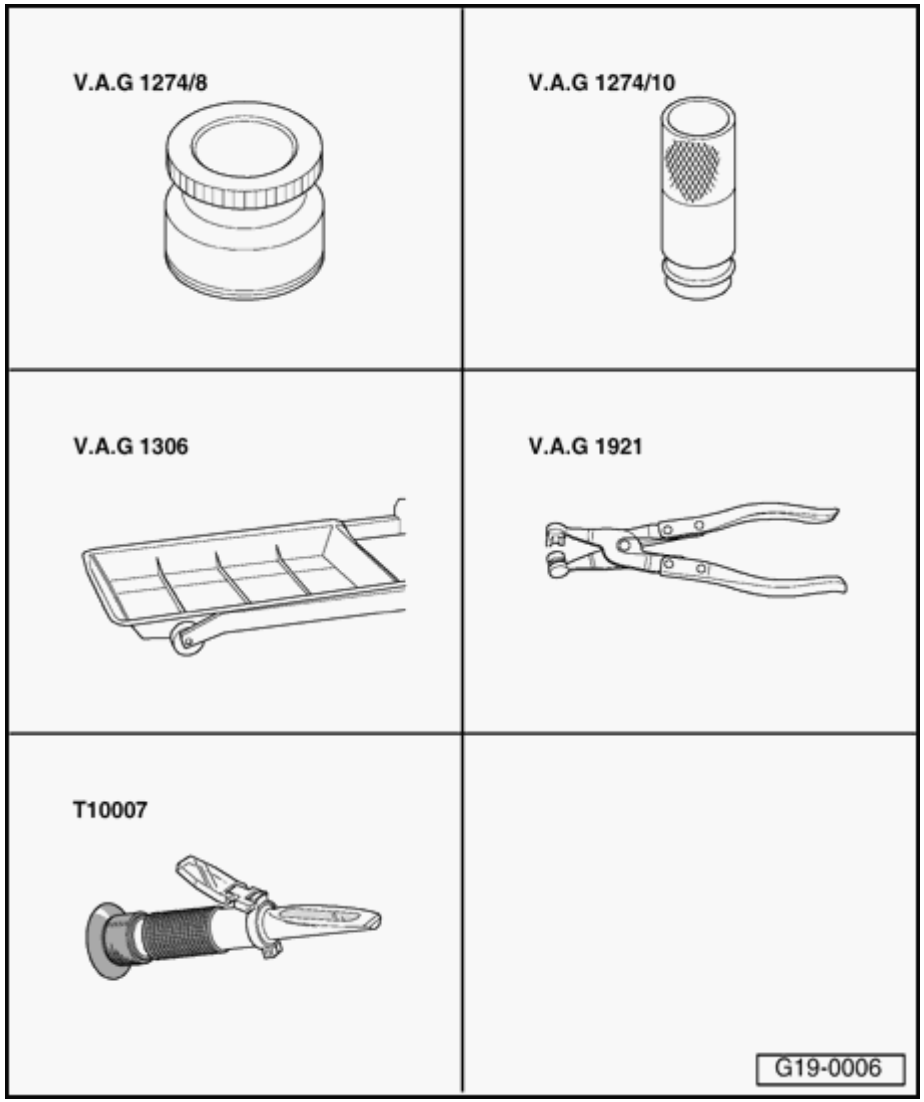
- Removing and installing ⇒Item 23 , ⇒ Page 17-10

10 - Expansion tank

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

11 - Intake manifold

19-4



Cooling system, draining and filling

Special tools and equipment

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

19-5

Draining

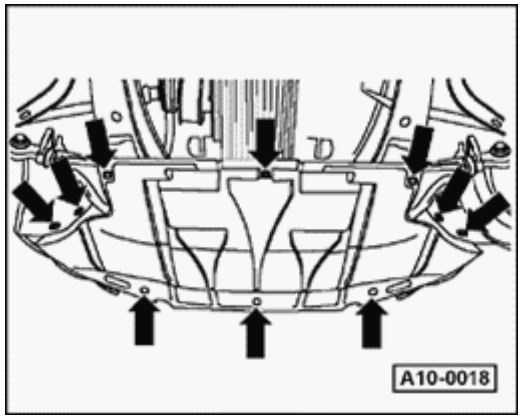
Note:

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

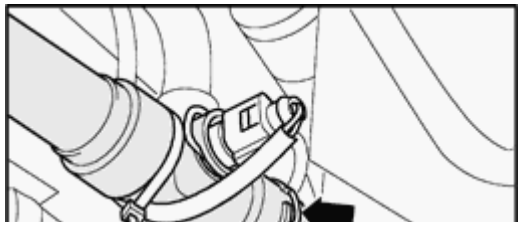
WARNING!

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

- Open cover of coolant expansion tank



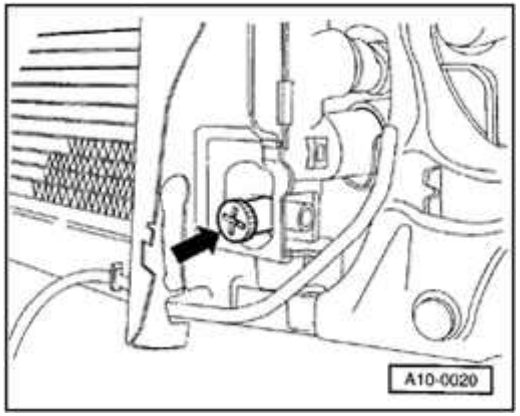
- Remove sound insulation -arrows-.
- Place drip tray VAG 1306 below engine.



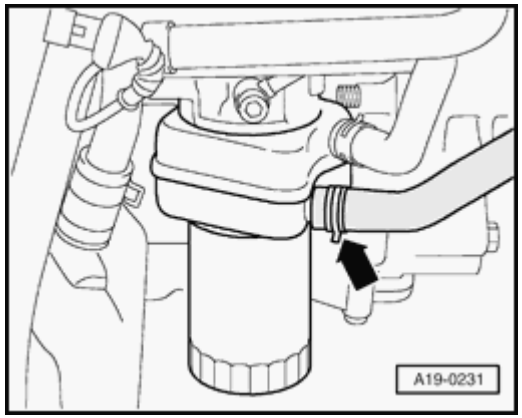
- Remove lower coolant hose retaining clip -arrow- and remove coolant hose from radiator.

19-6

Note:



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



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

Filling

Note:

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

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

CAUTION!

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

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

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

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

19-8

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

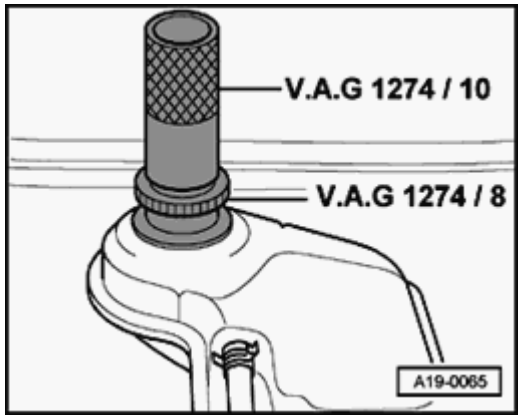
cooling system.

Recommended mixture ratios:

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

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

- Install lower coolant hose and secure.

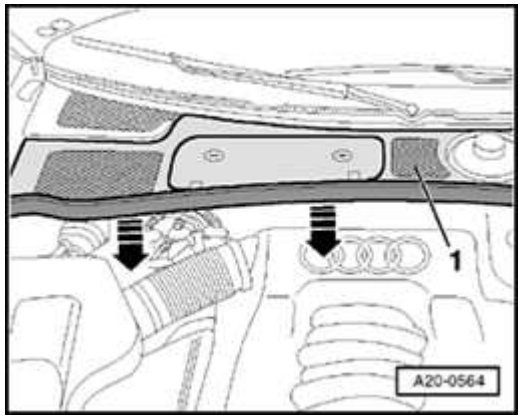


- Screw adapter VAG 1274/8 onto coolant expansion tank.
- Fit special tool VAG 1274/10 onto adapter.

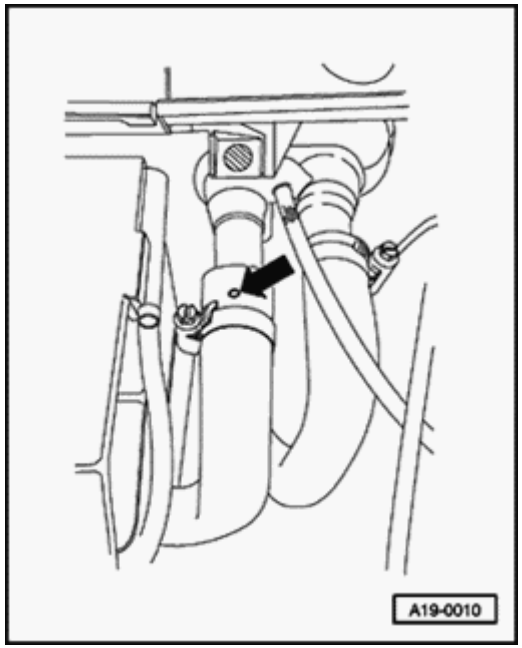
Note:

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

19-10



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



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

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

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

WARNING!

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

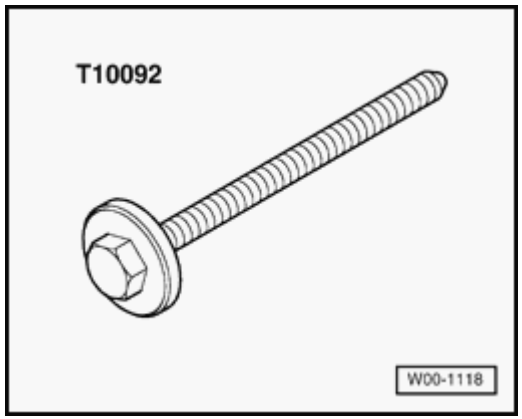
- Check coolant level and top up if necessary. If engine is warm, coolant level must be at max. mark; if cold, between min. and max. marks.

- Stop engine.

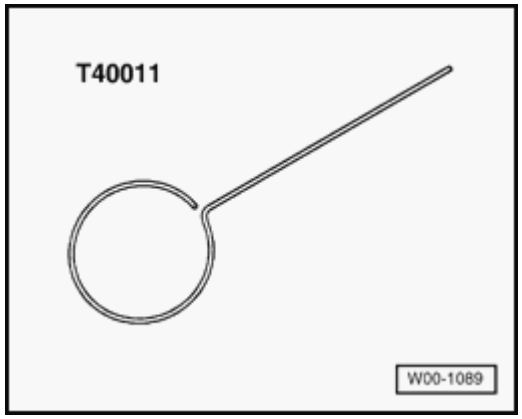
19-12

Coolant pump, removing and installing

Special tools and equipment



- Socket head fastener T10092



- Pin T40011

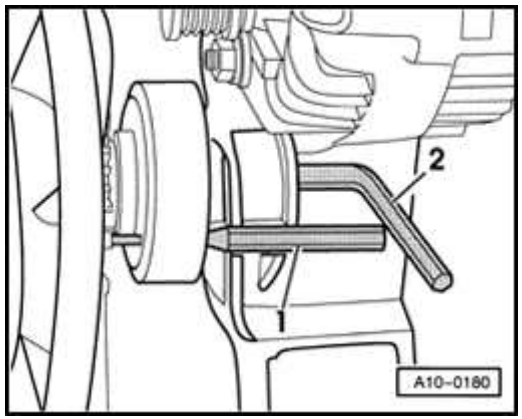
19-13

Removing

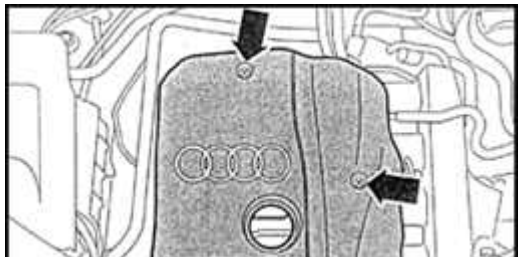
- Engine in vehicle.
- Lock carrier must be in service position ⇒ Page 13-1 .

- Drain coolant ⇒ Page 19-4 .

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



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

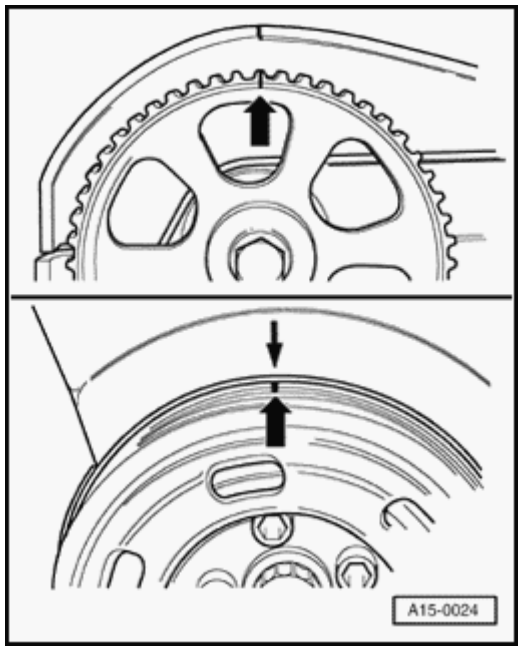


- Remove engine cover -arrows-.

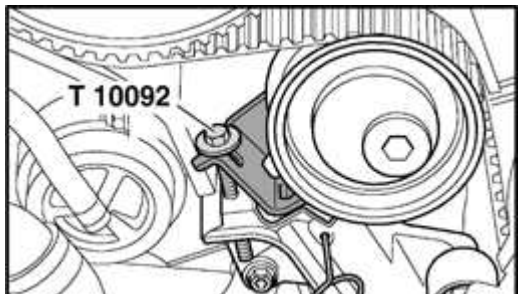
19-14

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

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



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



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

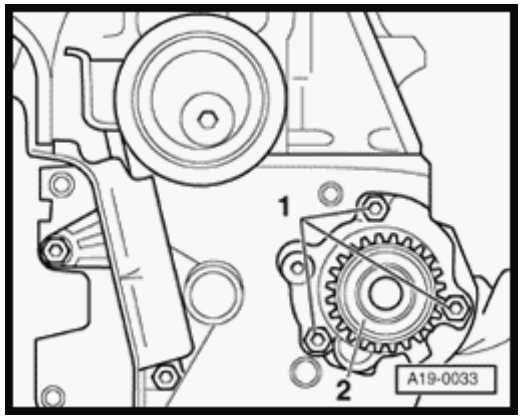
Note:

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

- Take toothed belt off camshaft sprocket and coolant pump.

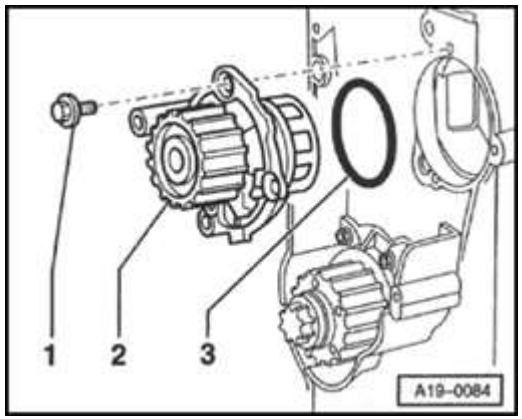
Note:

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



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

19-16



Installing

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

Note:

Always replace seals and gaskets.

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

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

Note:

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

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

- Install viscous fan ⇒ Page 13-21 .

- Install lock carrier ⇒ Page 13-1 .

- Top up coolant ⇒ Page 19-7 .

Tightening torque

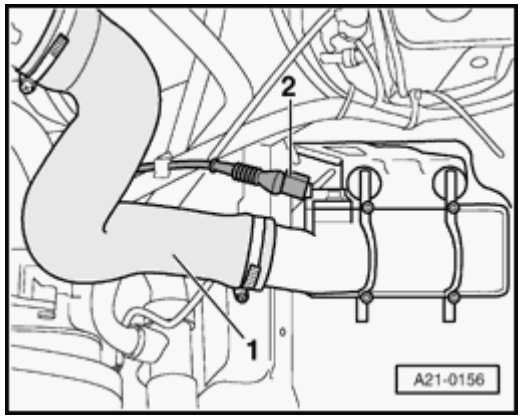
Component	Nm
Coolant pump to cylinder block	15
Center section of toothed belt guard to cylinder block	10 1)
Hose clamps for coolant hoses	2

1) Install with locking fluid D 000 600 A2

Coolant thermostat, removing and installing, checking

Removing

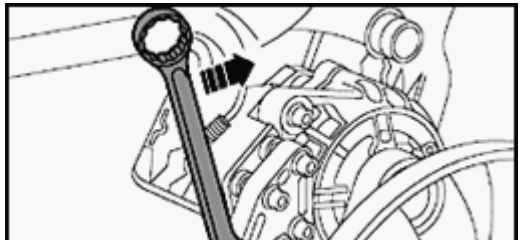
- Observe or obtain radio code on vehicles with coded radio.
- Disconnect Ground strap at battery with ignition switched off.
- Drain coolant ⇒ Page 19-4 .



- Remove air duct hose -1-.

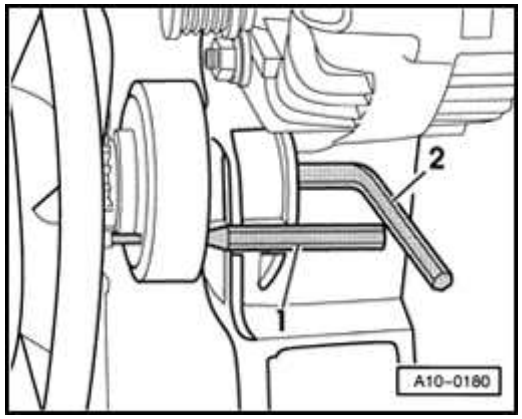
Note:

Connector -2- remains plugged in.

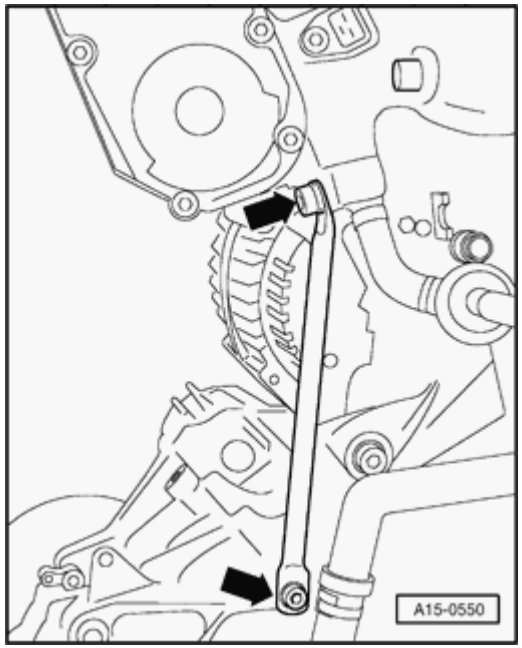


- Loosen ribbed belt by turning tensioner in direction of arrow.
- Remove ribbed belt from Generator pulley.

19-19

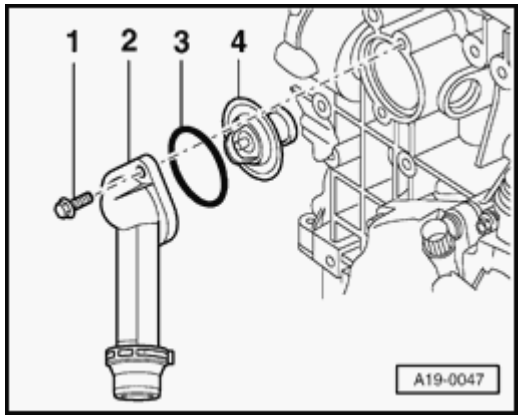


- Secure pulley for viscous fan with pin punch -1- and unfasten using Allen key -2-.
- Remove viscous fan from mounting and place in front of radiator cowl.
- Disconnect wiring from rear of Generator.
- Loosen connections for Generator from top and bottom and remove Generator.



- Remove intake line support -arrows-.

19-20



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

Installing

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

Note:

Always replace seals and gaskets.

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

19-21

- Install viscous fan ⇒ Page 13-21 .

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

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

⇒ *Radio operating instructions*

- Close windows fully using power window switches.

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

- Set clock to correct time.

- Top up coolant ⇒ Page 19-7 .

19-22

Tightening torques

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

Check coolant thermostat

- Heat thermostat in water bath.

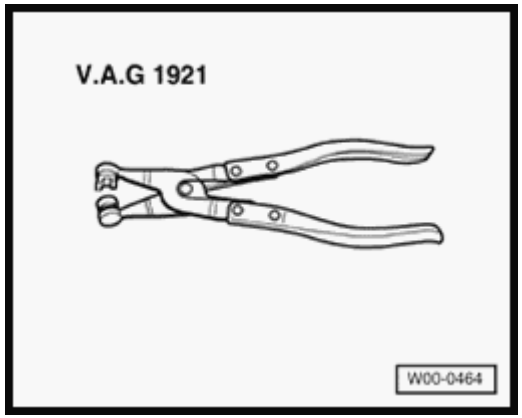
Starts to open	Fully open	Opening travel
approx. 87 ° C	approx. 102 ° C 1)	at least 8 mm

1) cannot be tested

19-23

Lower coolant line, removing and installing

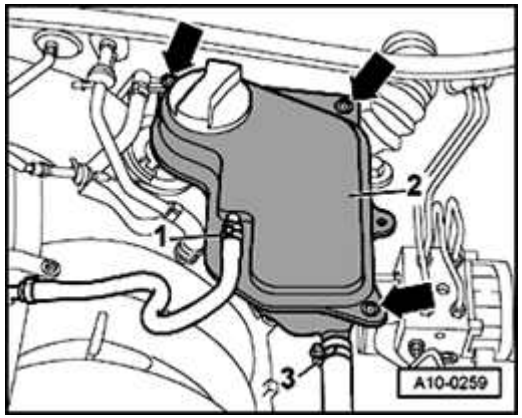
Special tools and equipment



- VAG 1921

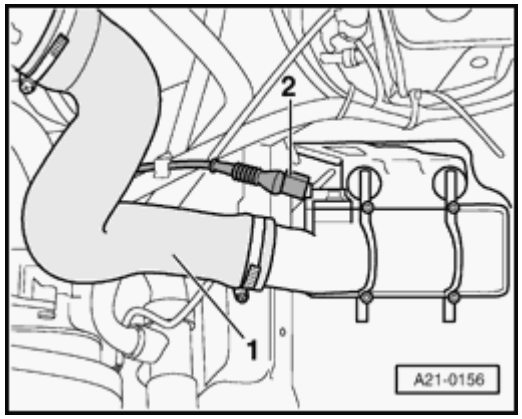
Removing

- Drain coolant ⇒ Page 19-4 .



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

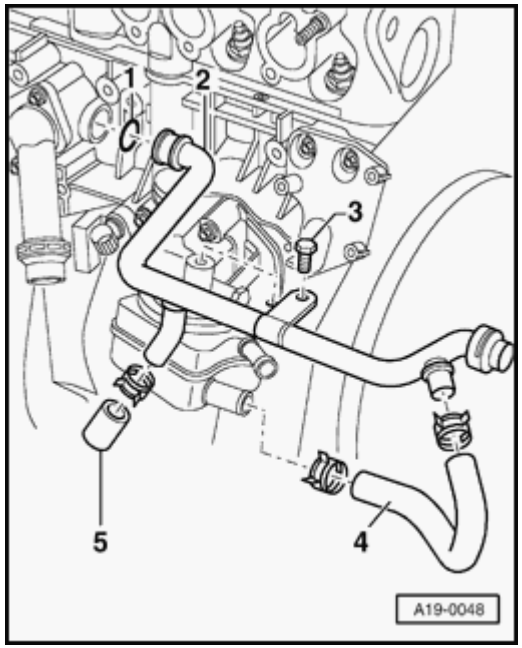
19-24



- Remove air duct hose -1-.

Note:

Connector -2- remains plugged in.



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

19-25

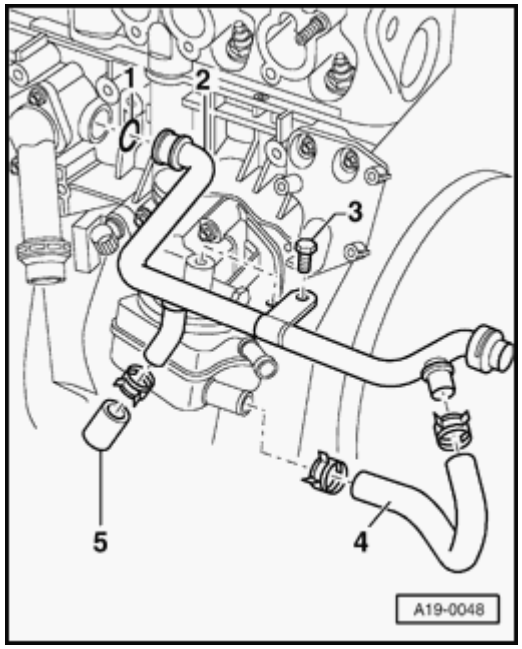
Installing

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

Note:

Always replace seals and gaskets.

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



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

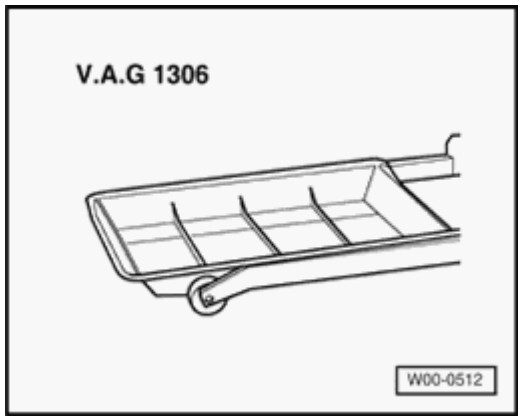
Tightening torques

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

19-26

Radiator, removing and installing

Special tools and equipment

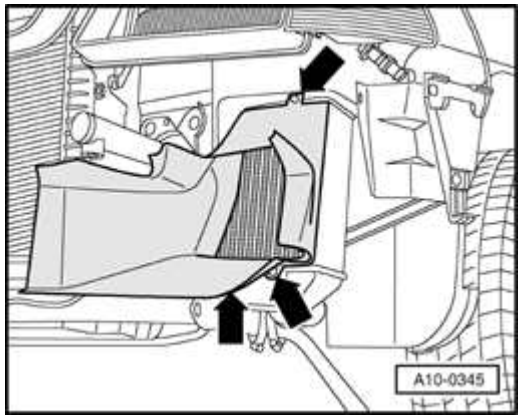


- VAG 1306

Removing

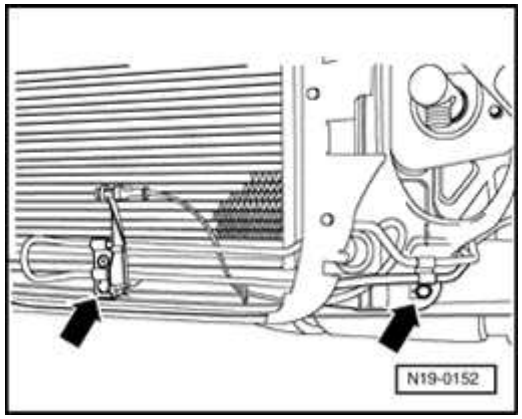
- Remove front bumper:

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



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

19-27

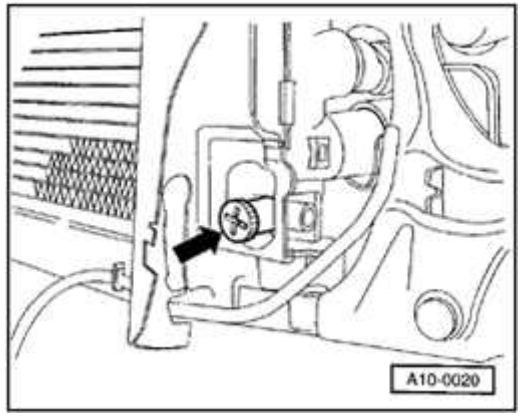


- Disconnect cooling lines for power steering hydraulic fluid -arrows-.

WARNING!

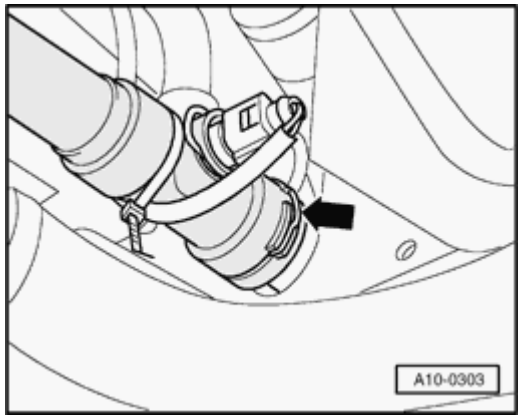
Hot steam can escape when opening the cap on the expansion tank: Cover cap with a cloth and open carefully.

- Open cover of coolant expansion tank
- Place drip tray VAG 1306 below engine.

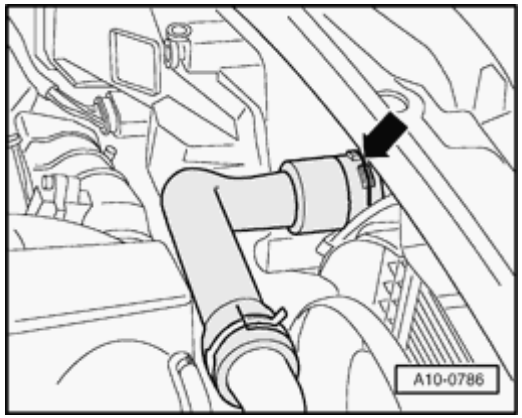


- Turn drain screw -arrow- on radiator counter-clockwise. If necessary, install a drain hose on connection.

19-28

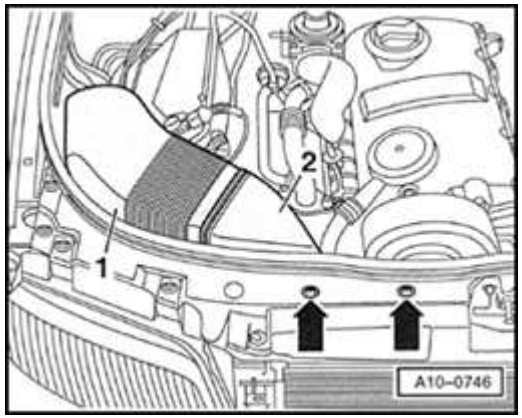


- Release coolant hose retaining clip -arrow- and remove coolant hose from radiator.



- Disconnect coolant hose from top of radiator -arrow-.

19-29



Vehicles with automatic transmission:

- Remove bolts -arrows-.
- Remove air duct -1- and -2-.

Note:

Observe cleanliness rules when working on the automatic transmission:

⇒ *Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37*

- Place drip tray underneath to collect oil.
- Remove ATF lines/hoses from radiator:

⇒ *Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37*

- Tie ATF lines to longitudinal member to avoid leakage of fluids.

All models:

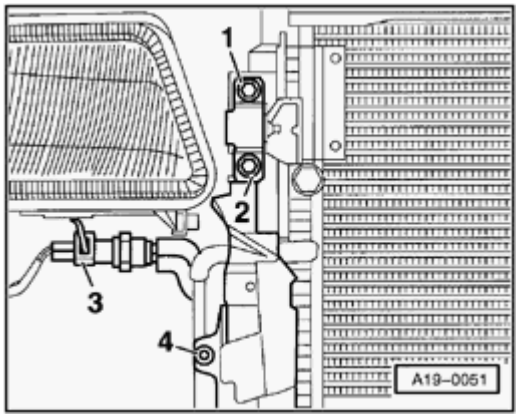
CAUTION!

The air conditioner refrigerant circuit must not be opened.

19-30

Note:

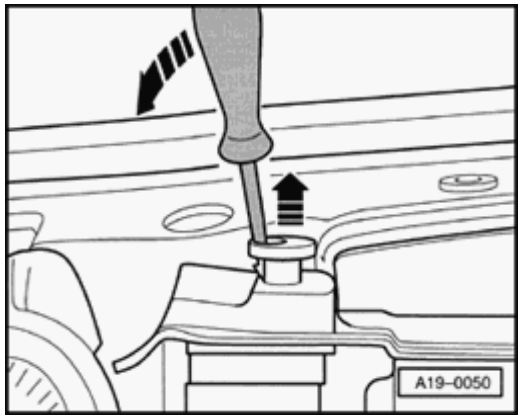
To prevent damage to the condenser and refrigerant lines/hoses, ensure that the lines and hoses are not stretched, kinked or bent.



- Remove air cowls from radiator -4- (left and right).
- Remove securing bolts -1- and -2- for condenser.
- Disconnect connector -3- from air conditioner pressure switch -F129-.
- Pull condenser up out of its bracket, pivot toward side and secure to right-hand front wheel with wire.

Note:

Protect fender panel from damage.



- Release two retaining pins for radiator and pull out upward -arrows-.
- Pivot radiator toward front and lift out.

19-31

Installing

Installation is carried out in the reverse order of removal; note the following:

- Install front bumper:

⇒ *Repair Manual, Body Exterior, Repair Group 63*

- Top up coolant ⇒ Page 19-7 .

Vehicles with automatic transmission:

- Attach ATF lines.

⇒ *Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37*

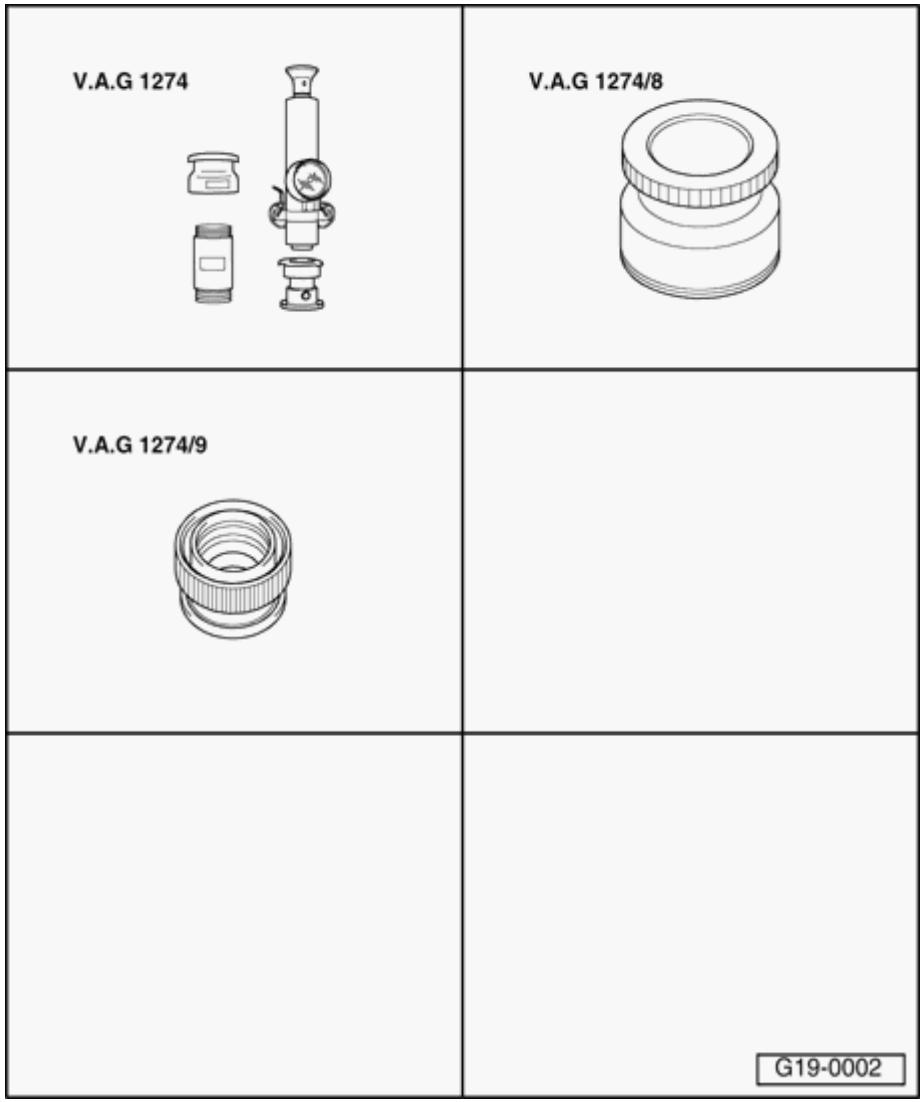
- Check ATF level:

⇒ *Repair Manual, 5 Spd. Automatic Transmission 01V, Repair Group 37*

Tightening torques

Component	Nm
Condenser to radiator	10
Cooling lines to radiator	10
Hose clamps for coolant hoses	2

19-32



Cooling system, checking for leaks

Special tools and equipment

- VAG 1274
- Adapter 1274/8
- Adapter 1274/9

19-33

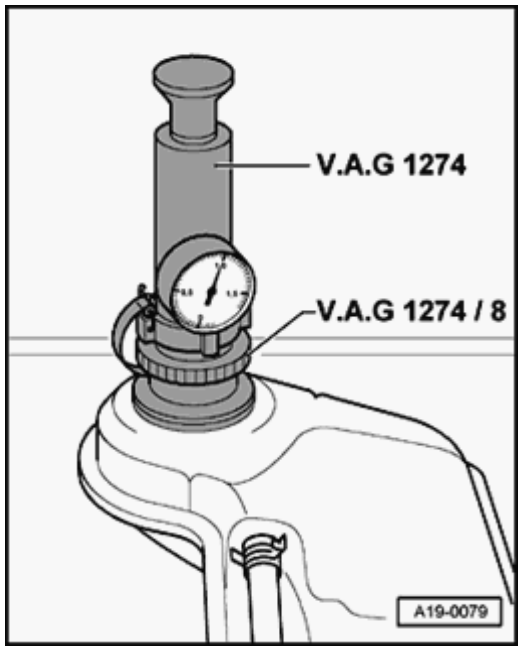
Test requirements:

- Engine at operating temperature.

WARNING!

Hot steam can escape when opening the cap on the expansion tank: Cover cap with a cloth and open carefully.

- Open cover of coolant expansion tank



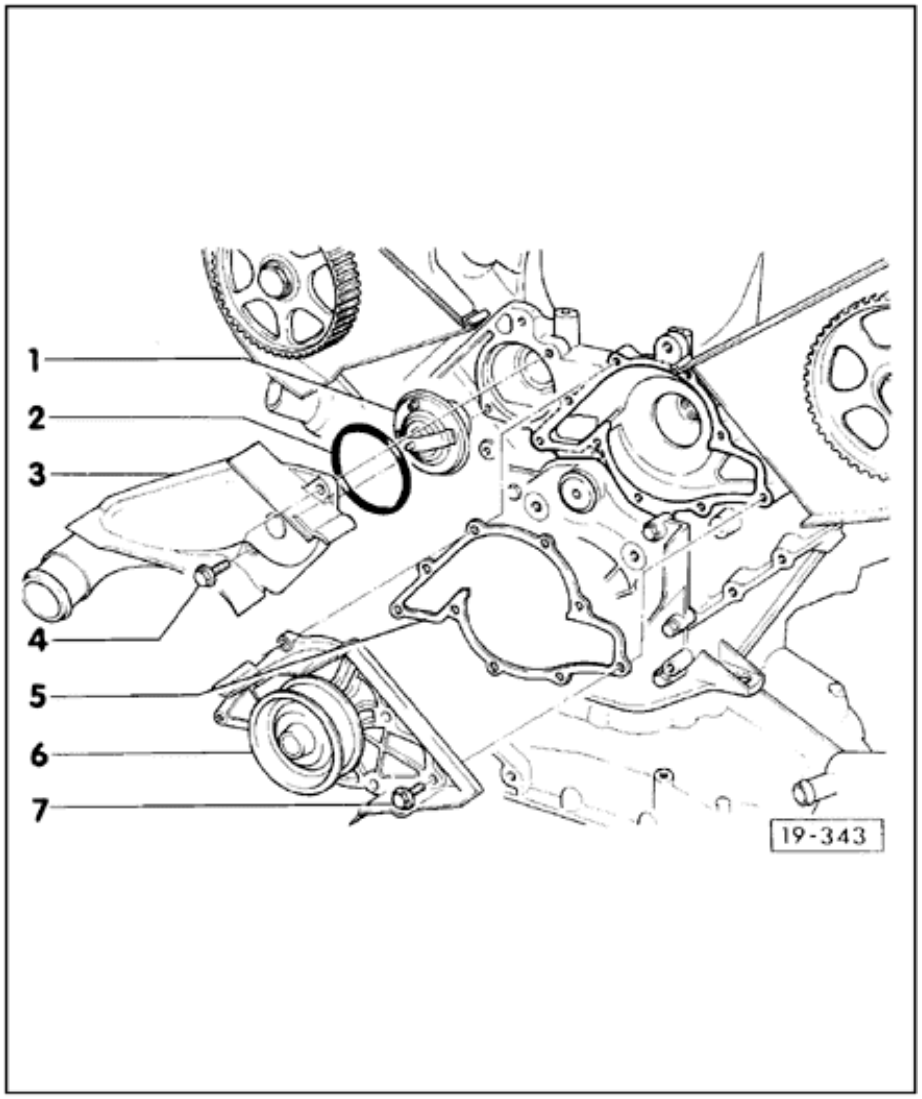
- Install tester VAG 1274 with adapter VAG 1274/8 onto expansion tank.
- Using hand pump on tester, build up a pressure of approx. 1.0 bar.
- If this pressure is not maintained, locate and repair leaks.

Testing pressure relief valve in filler cap



- Install tester VAG 1274 with adapter VAG 1274/9 onto sealing cover.
- Operate hand pump.
  - Pressure relief valve must open at a pressure of 1.4 to 1.6 bar.

19-3



Cooling system, components

Note:

- *Always replace gaskets and seals.*
- *Draining and filling system with coolant* ⇒ *page 19-6* .
- *Testing cooling system for leaks* ⇒ *page 19-11* .

1 - Thermostat

- Replacing ⇒ page 19-4
- Opening and closing temperatures ⇒ page 19-4

2 - Seal

- Always replace

3 - Thermostat housing

4 - 10 Nm (7 ft lb)

5 - Gasket

- Always replace

6 - Coolant pump

- To remove and install, remove ribbed drive belt (⇒ page 13-9) and toothed belt (⇒ page 13-11)

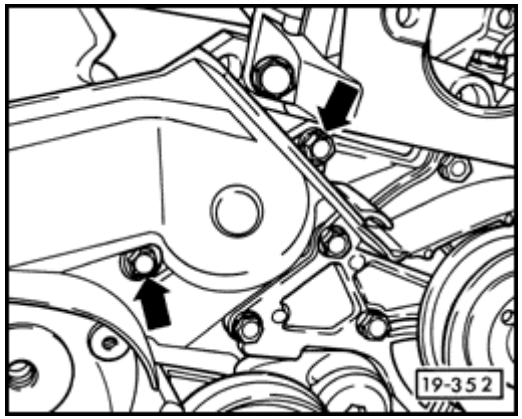
7 - 10 Nm (7 ft lb)

19-4

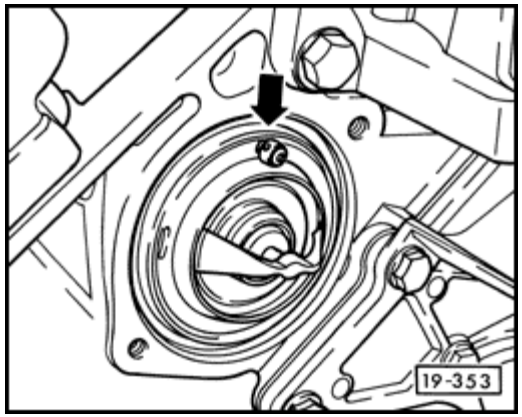
Thermostat, replacing

- Remove ribbed belt ⇒ page 13-9 .

- Adjusting tension of toothed belt ⇒ page 13-13 .



- Unbolt thermostat housing and pull out from below toothed belt.



Installation position of thermostat. The vent valve must be installed facing up (arrow).

- Starts to open at approx. 87 ° C (189 ° F)
- End of opening approx. 102 ° C (216 ° F)
- Stroke: 8.0 mm (5/16 in.)

19-5

Coolant fan control thermal switch, checking

The coolant fan control thermal switch -F54- is located in the lower left part of the radiator.

Terminal assignment 3-pin connector		Switching temperature	
	On	**Off**	
1 =	1st stage	92° - 97° C (198° - 207° F)	approx. 84° C (183° F)
2 =	2nd stage	99° - 105° C (210° - 221° F)	approx. 91° C (196° F)
3 =	Battery positive voltage (B+)		

19-6

Cooling system, draining and filling

Note:

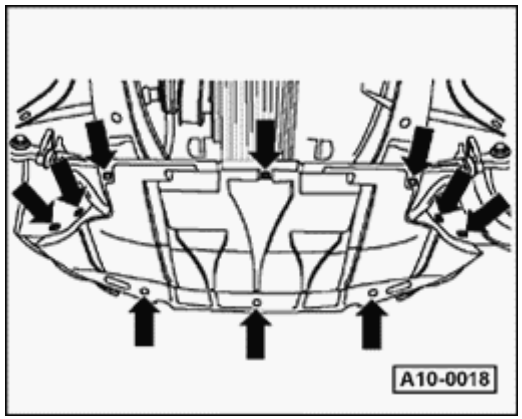
- *The cooling system is filled year round with a mixture of water and anti-freeze and anti-corrosion agent G 011 A8C.*
- *G 011 A8C and coolant additives marked with "conforming to TLVW 774 C" prevents freezing, corrosion damage and scale formation, and raises the coolant boiling point. For these reasons the cooling system must always be filled year-round with G 011 A8C anti-freeze and anti-corrosion agent.*
- *Due to its high boiling point, coolant is an aid to operational efficiency when the engine is operating at full load, particularly in tropical climates.*
- *Coolant must be drained and replaced if either the radiator, heater core, cylinder head or cylinder head gasket have been replaced.*
- *Capacity: approx. 8.5 liters (9 qt.)*

Draining

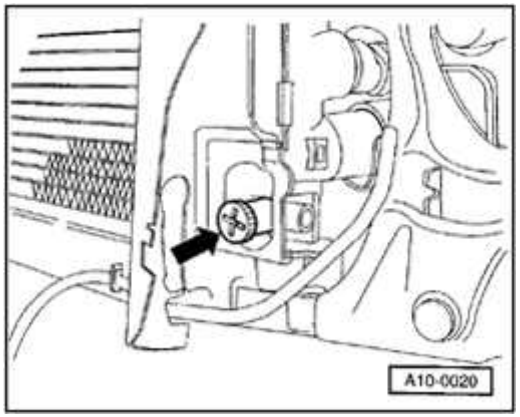
WARNING!

The cooling system is pressurized when the engine is warm. Wear gloves and other appropriate protection, and slowly and carefully release system pressure, if necessary, before performing repairs.

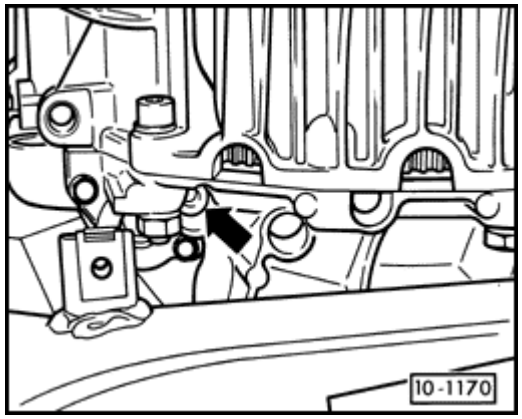
- Open the cap on the coolant expansion tank.



- Remove noise insulation panel below engine.



- Drain coolant at radiator.
- Remove locking plate for connection flange of coolant hose at bottom of radiator, pull off connection flange.



- Using special tool 3247, drain coolant from engine drain plug (arrow) and at drain plug on bottom left of radiator.

Filling

Recommended mixing ratios:

Anti-freeze protection down to:	**Anti-freeze concentration[1)]**	**G 11[2)]**	**Water[2)]**
-25 ° C (-13 ° F)	40%	2.5 liter (2.6 qt.)	3.5 liter (3.7 qt.)
-35 ° C (-31 ° F)	50%	3.0 liter (3.2 qt.)	3.0 liter (3.2 qt.)

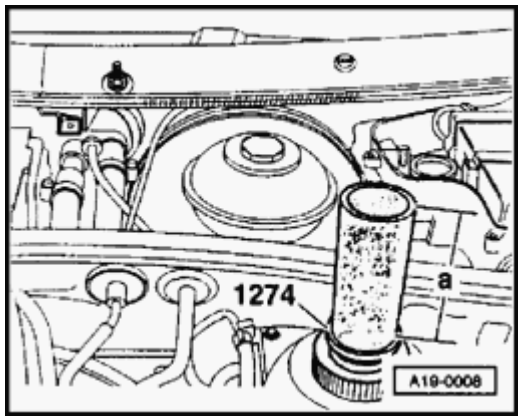
1) Do not exceed an antifreeze concentration of 60%; antifreeze protection and cooling efficiency are reduced if the concentration is higher.

2) The quantity of coolant may differ depending on specific equipment installed in the vehicle.

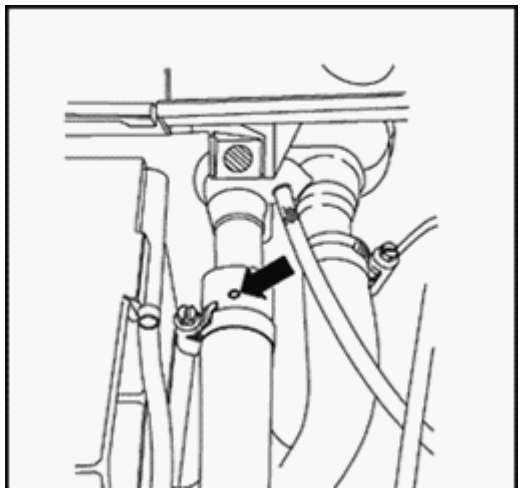
19-9

- Close drain plug at engine block and at bottom left of radiator.

- Push on connection flange of coolant hose at bottom of radiator, and install locking element for connection flange.



- Unscrew cap on expansion tank, screw on adapter VAG 1274/1, and extend with 42mm diameter and 100 mm long auxiliary hose.



- Open hose clamp, pull back coolant hose sufficiently so that vent hole is no longer concealed by connection.
- Open bleed screw at coolant pipe below expansion tank.
- Pour coolant into system until it flows out at bleeder hole, then tighten screw to 15 Nm (11 ft lb).
- Pour in more coolant until it flows out at vent hole, then push on coolant hose and tighten.
- Close cap on expansion tank and set heater controls to hot position.
- Start engine and run at about 2000 RPM for about 3 minutes.

- Continue running engine at idle until radiator becomes hot at the bottom connection.

WARNING!

The cooling system is pressurized when the engine is warm. Wear gloves and other appropriate protection, and slowly and carefully release system pressure, if necessary, before performing repairs.

- Check coolant level in expansion tank and top up if necessary.

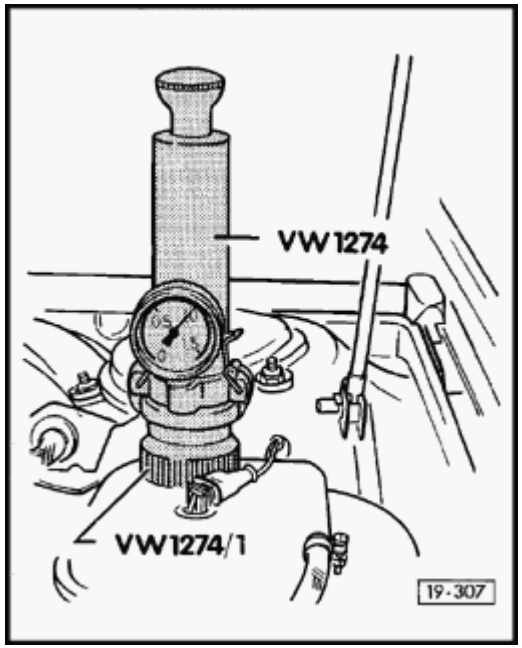
- Stop engine (switch ignition off).

Cooling system leaks, checking

WARNING!

The cooling system is pressurized when the engine is warm. Wear gloves and other appropriate protection, and slowly and carefully release system pressure, if necessary, before performing repairs.

- Engine must be at operating temperature

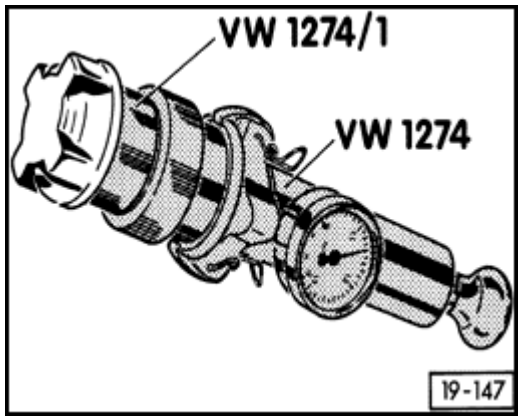


- Connect cooling system tester VW 1274 to expansion tank using adapter VW 1274/1.
- Operate hand pump on tester to create a pressure of approx. 1 bar (15 psi).

If the pressure drops:

- Locate and repair leak in the cooling system.

Expansion tank cap, pressure testing



- Screw cap onto cooling system tester VW 1274 with adapter VW 1274/1.
- Operate hand pump to build pressure.
- Pressure relief valve must open at 1.2-1.5 bar (17-22 psi).

20-1

Fuel supply system components, removing and installing

WARNING!

Always be sure to comply with applicable safety precautions when working on the fuel system ⇒ ***page 20-3*** **.**

Pay attention to rules of cleanliness ⇒ page 20-2 .

Adjusting accelerator pedal cable ⇒ page 20-15 .

Notes:

- *Hose connections are secured with clamp-type, screw-type, spring-type clamps.*
- *Always replace clamp-type with spring-type or screw-type clamps.*

Rules of cleanliness

CAUTION!

Whenever carrying out work on the fuel supply and fuel injection systems, carefully observe the following five 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:

Avoid working with compressed air whenever possible.

Avoid moving the vehicle if possible.

Safety precautions

WARNING!

When removing and installing the fuel pump or fuel level sensor from a filled or partially filled fuel tank:

- ***BEFORE beginning repairs, the suction pipe of an exhaust extraction system must be located near the fuel tank opening so that escaping fuel vapors can be immediately carried away.***
- ***If no exhaust extraction system is available, a radial fan (motor located outside airflow) with volume of at least 15 m3/hr (9 cfm) may be used.***
- ***Wear fuel-resistant gloves whenever working with open parts of the fuel system.***

Be sure the ignition is switched OFF, when:

- ***Disconnecting fuel injection system wiring***
- ***Connecting or disconnecting test equipment leads***

BEFORE cranking the engine at starting RPM

(such as for compression testing) disable the ignition and fuel injection systems:

- ***Disconnect the ignition coil power output stage.***
- ***Disconnect harness connectors from all fuel injectors.***
- ***After the work is completed, erase Diagnostic Trouble Code (DTC) memory.***

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).***
- ***Be sure of the proper radio code (for vehicles equipped with coded anti-theft radio).***

Be sure the battery negative (-) cable is disconnected, when:

- ***Working on the electrical system***
- ***Resistance (spot) welding or electric arc welding anywhere on the vehicle.***

When connecting and disconnecting electrical test equipment (LED voltage tester, multimeter, etc.):

- ***Be sure the ignition is switched OFF.***
- ***Use correct adapters from the VW 1594***

connector test kit.

20-5

Flange and fuel level sensor, removing and installing

- Observe safety measures ⇒ page 20-3
- Pay attention to rules of cleanliness ⇒ page 20-2 .

WARNING!

Fire hazard. DO NOT smoke or work near heaters or have anything in the area that can ignite fuel!

- Switch ignition on.
- Observe fuel gauge.

CAUTION!

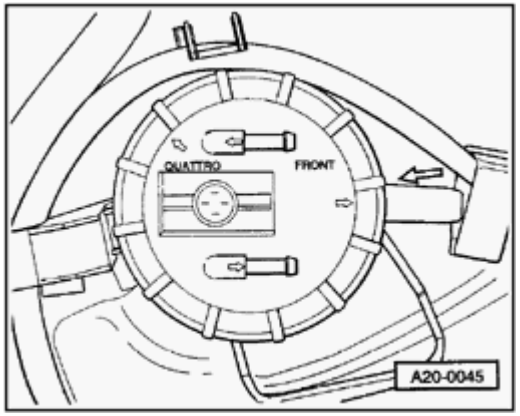
- ***The fuel tank should not be more than 2/3 full. Empty fuel tank, if necessary, using an approved fuel cart.***
- ***Determine correct radio anti-theft coding before disconnecting the battery.***

Removing

- Disconnect battery Ground (GND) strap.

- Remove cover for fuel pump module flange (under luggage compartment trim).

- Disconnect harness connector for fuel level sensor and fuel pump.



- Detach blue return line and feed line.
- Use special tool 3217 to loosen sealing ring.
- Carefully pull flange out and detach.
- Unclip fuel level sensor and remove.

Installing

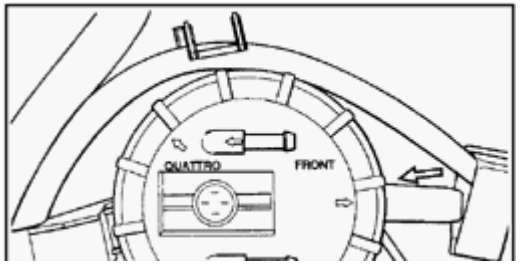
- Installation is in reverse order of removal.

Front-wheel-drive vehicles:

- Fuel level sensor wiring must be routed between return line and fuel tank housing.

All-wheel-drive vehicles:

- Fuel level sensor wiring must be routed between line of fuel transfer pump and fuel tank housing.



- When installing, make sure that arrows are aligned.

  Note different alignment arrows for FRONT-wheel-drive and QUATTRO

20-7

Fuel pump, removing and installing

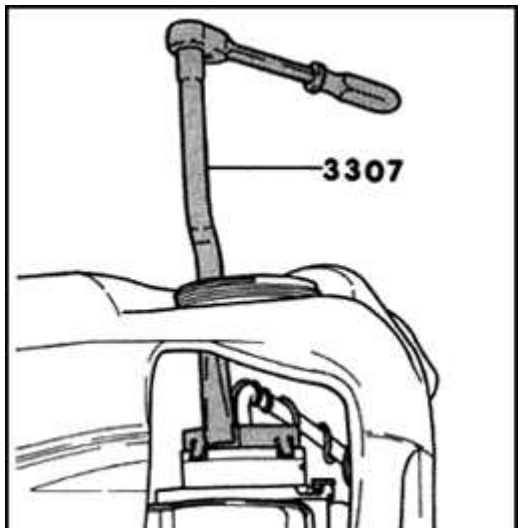
- Observe safety measures ⇒ page 20-3
- Pay attention to rules of cleanliness ⇒ page 20-2 .

Removing and installing sealing flange and fuel level sensor ⇒ page 20-5

WARNING!

Fire hazard. DO NOT smoke or work near heaters or have anything in the area that can ignite fuel!

Removing



- Insert fuel pump wrench 3307 through fuel tank opening and position at inner part of fuel reservoir housing.
- Turn inner part of reservoir housing about 15 ° to left as far as stop and remove fuel pump along with inner part of reservoir housing.

Installing

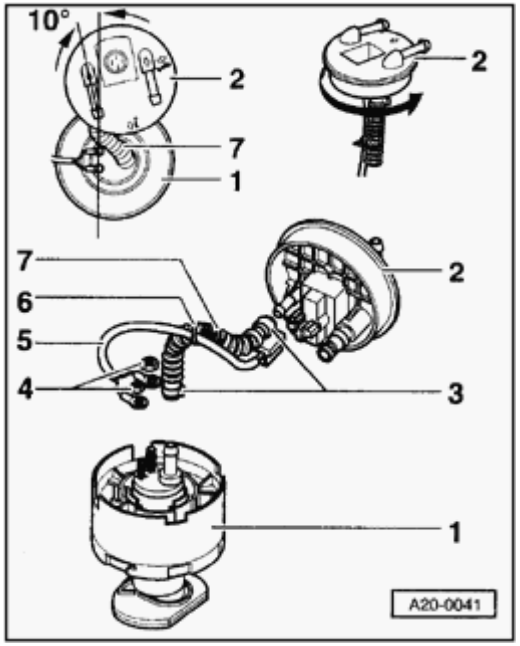
Installation is in reverse order of removal.

Note:

- *Moisten the flange seal with fuel before installing.*

- *Flange installation position* ⇒ *page 20-6* .

Front-wheel-drive vehicles



- Turn hose -7- and wiring harness -5- into position as shown at upper left of illustration; when installing flange, turn in direction of arrow as shown at upper right of illustration.
- Compress clamp -3- with pliers, VAG 1275.

1 - Reservoir housing

2 - Flange

3 - Clamp

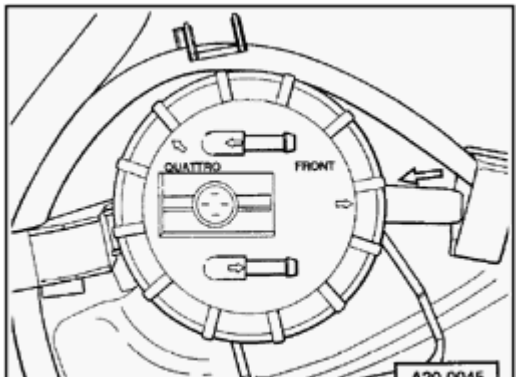
4 - Securing bolt

5 - Wiring

6 - Cable strap

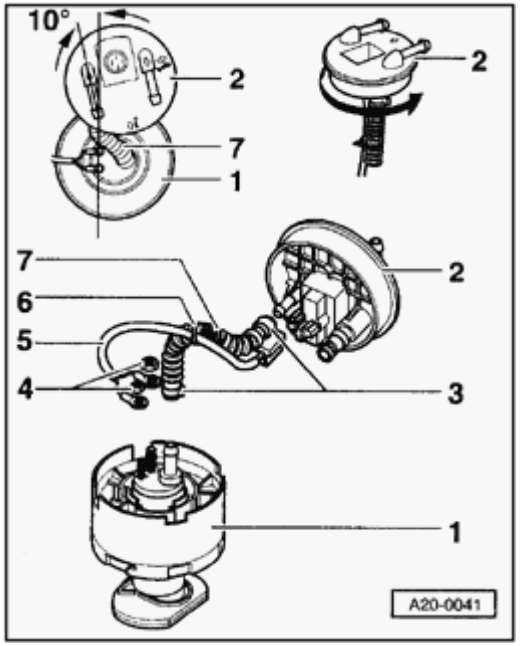
7 - Hose

- Install reservoir housing with flange into fuel tank.
  - Wiring for fuel level sensor must be routed between return line and fuel tank housing.



- Turn flange to left until arrows (FRONT) are aligned.

All wheel-drive-vehicles



- Turn hose -7- and wiring harness -5- into position as shown in upper left of illustration; when installing flange, turn in direction of arrow as shown at upper right of illustration.
- Compress clamp -3- with pliers VAG 1275.

1 - Reservoir housing

2 - Flange

3 - Clamp

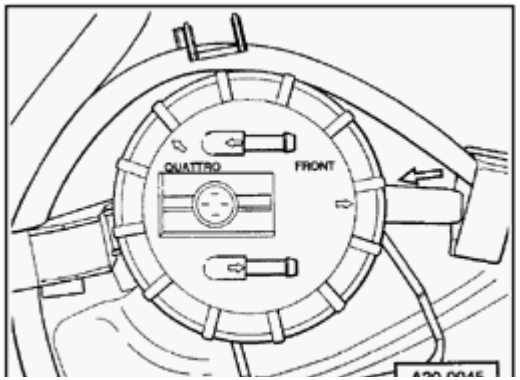
4 - Securing bolt

5 - Wiring

6 - Cable strap

7 - Hose

- Install reservoir housing with flange into fuel tank.
  - Wiring for fuel level sensor must be routed between fuel transfer pump line and fuel tank housing.



- Turn flange to left until arrows (QUATTRO) are aligned.

Fuel pump, testing

WARNING!

Fire hazard! DO NOT smoke or work near heaters or have anything in area that can ignite fuel!

Checking power supply

- Battery fully charged
- Fuse 28 OK
- Test voltage supply to fuse 28 ⇒ Repair Manual, 2.8 Liter V-6 OBD II Fuel Injection and Ignition, Repair Group 24
- Fuel supply OK

- Switch ignition on.

- Fuel pump must be heard to run briefly. (Second person will be required for this if surrounding noise level is too high).

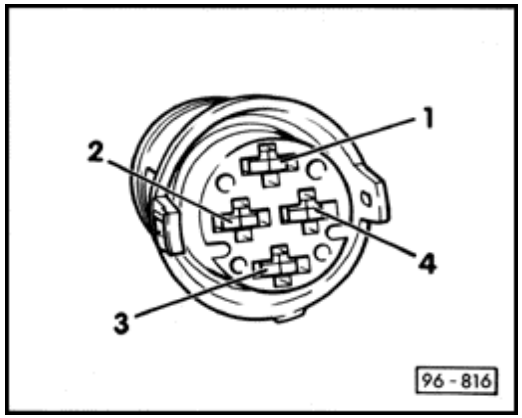
If fuel pump does NOT run:

- Remove cover for fuel pump module (under luggage compartment trim, right rear).

- Disconnect harness connector for fuel pump and fuel level sensor.

20-11

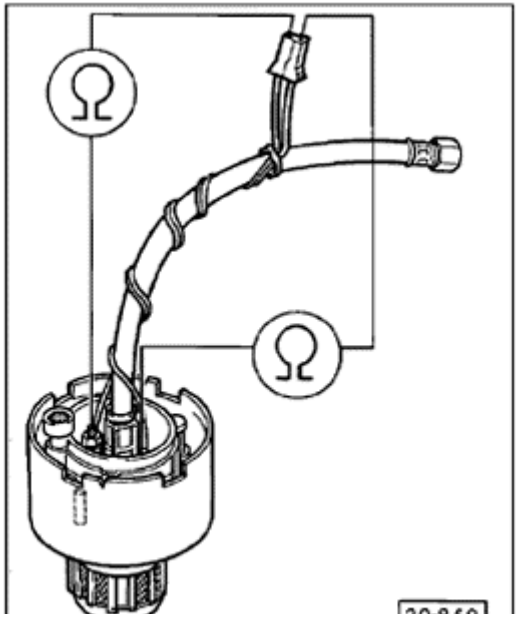
- Supply voltage to fuel pump using VAG 1551 scan tool and "Output Diagnostic Test Mode" function 03.



- Connect multimeter between connector terminal 1 (green wire) and terminal 4 (brown wire) using adapter cables from VW 1594 connector test kit.

  Specified value: approx. battery positive voltage (B+)

- If specified value is obtained, reconnect harness connector.



- Using ohmmeter, check for continuity between connector (outside of housing), harness connector and fuel pump.

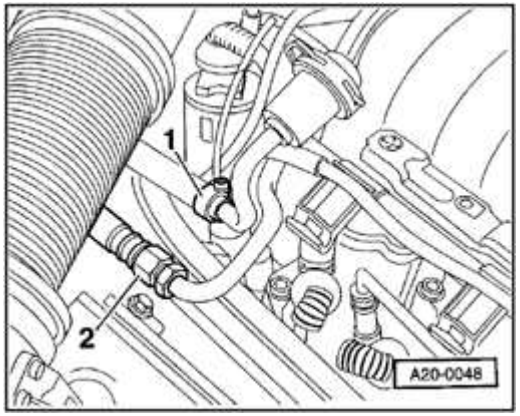
If wiring is OK:

- Replace fuel pump ⇒ page 20-7 .
- Install cover for fuel pump module.

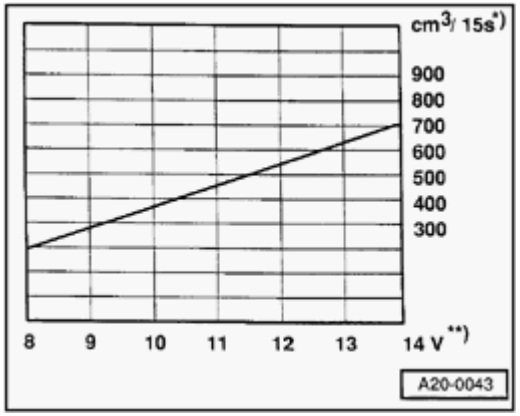
Checking fuel delivery

- Fuse 28 OK
- Relay in relay position 6 OK

- Fuel filter OK
- Battery fully charged



- Disconnect fuel return line -1- at engine compartment bulkhead and hold in measuring container.
- Connect remote control VAG 1348/3A with auxiliary cable VAG 1348/2 to fuse 28, connect positive (+) cable to battery.
- Operate remote control for 15 seconds (hold down button).



- Compare quantity of fuel delivered with specified values for minimum fuel delivery rate in graph, according to actual voltage at fuel pump.

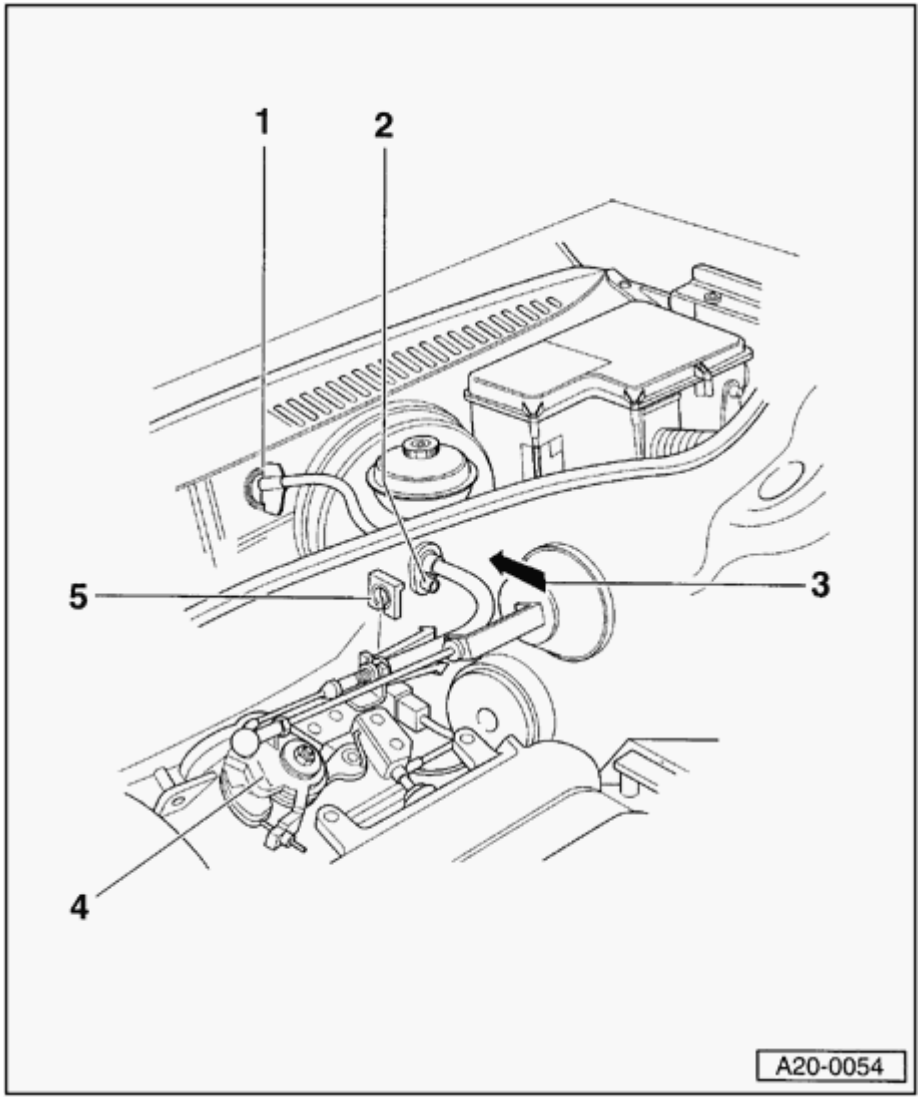
*) - Minimum fuel delivery rate-fuel volume in cm3 (ml) delivered in15 seconds

**) - Voltage (V) at fuel pump with engine stopped, fuel pump running-approx. 2 volts less than battery positive voltage (B+)

Fuel pump check valve, checking

Testing check valve ⇒ Repair Manual, 2.8 Liter V-6 OBD II Fuel Injection & Ignition, Repair Group 24

20-13



Accelerator pedal cable and linkage, servicing

1 - Cable attachment

2 - 10 Nm (7ft lb)

3 - Cable installation direction

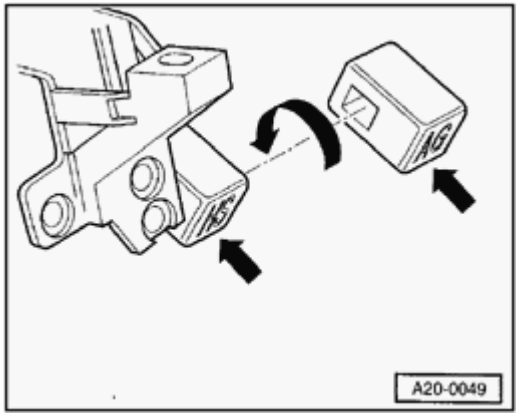
- Arrow

4 - Cam

- Adjusting ⇒ page 20-15

5 - Cable securing clip

20-14



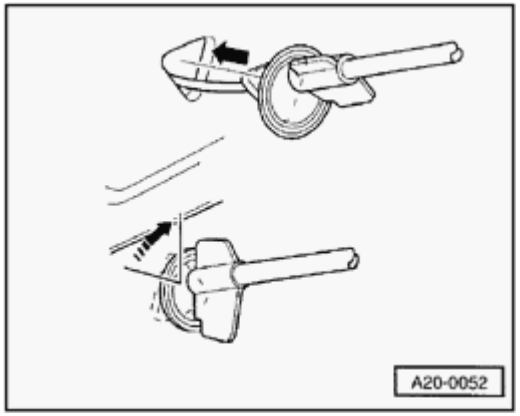
Installation position of stop buffer

Identification:

HS - Manual transmission

AG -Automatic transmission

- Marking -HS- or -AG- must be readable



Attachment of cable sleeve

- Push throttle cable through engine compartment bulkhead.
- Push cable attachment into bulkhead and turn counterclockwise approx. 90°.

Accelerator pedal cable, adjusting

CAUTION!

- ***The accelerator pedal cable is easily damaged (kinked) and therefore must be handled carefully.***
- ***A single slight kink can lead to cable failure while the vehicle is being driven.***
- ***A KINKED CABLE MUST NOT BE INSTALLED.***
- ***When installing the cable, make sure that it is aligned between its supporting mounts and the attachment points.***

- Pull off cable locking plate at throttle body.

- Depress accelerator pedal to wide open throttle position.

Note:

A second person is required for this step.

Vehicles with manual transmission

- Pull cable sleeve away from cam at throttle body until throttle valve has opened fully, then hold tight in this position.

Vehicles with automatic transmission

- Pull cable sleeve back toward wide open throttle position until throttle valve is fully open and kickdown switch is actuated (clicks), then hold tight in this position.

- Insert securing clip for cable sleeve.

- Release accelerator pedal.

Note:

After adjusting the cable, check idle speed and check the wide open throttle stop at the throttle valve.

21-1

Charge air system with turbocharger, checking

Notes:

- *For cleanliness rules, see ⇒ Page 21-44 .*
- *Secure all hose connections with the correct hose clips (same as original equipment):*

⇒ *Parts Catalog*

- *Before performing a check or repair, all hoses and lines must be checked for tight seating and leaks.*
- *Always replace seals, gaskets and self-locking nuts.*

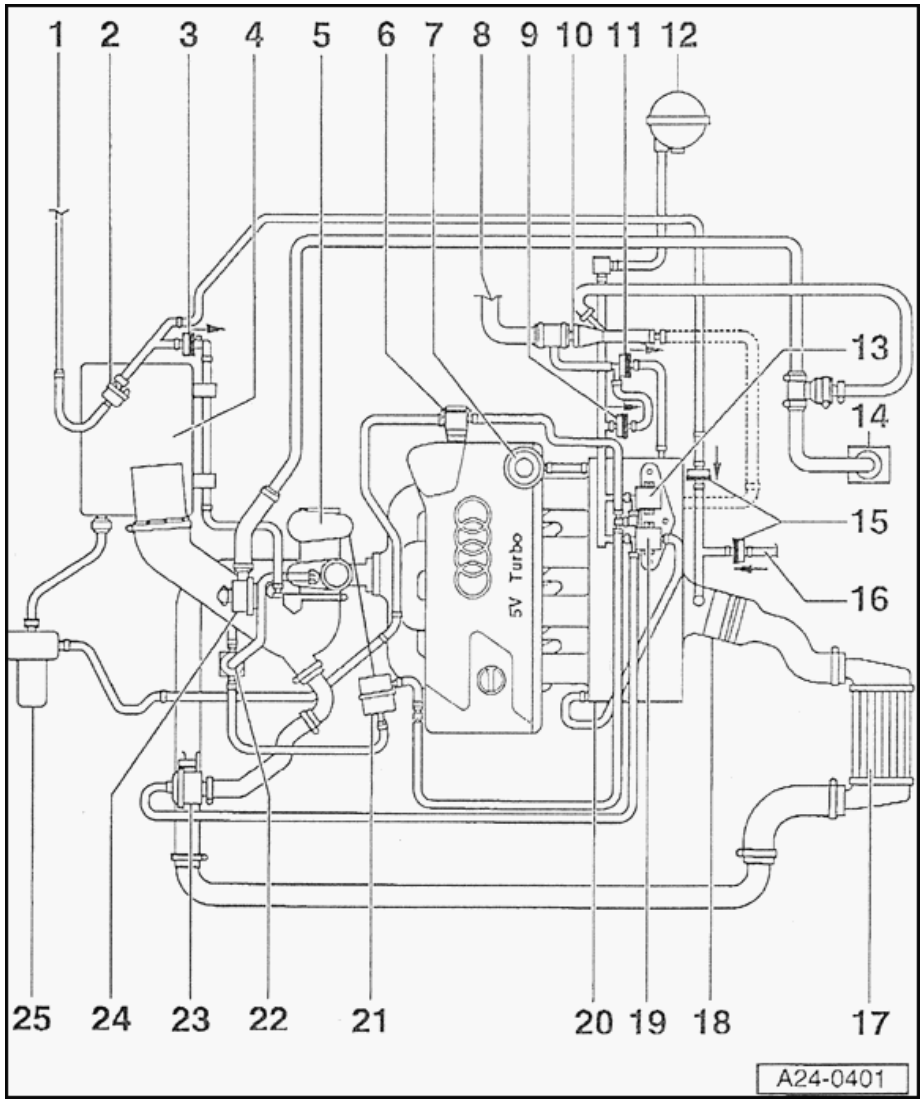
Safety precautions

Note the following points if testers and measuring instruments have to be used during a road test:

WARNING!

- ***Always attach testers and measuring instruments to the back seat and have a second person operate them from there.***

- ***If test equipment were operated from the front passenger seat, the person sitting there could be injured if the front passenger airbag were triggered in the event of an accident.***



Connection diagram for charge air control and vacuum pressure control

1 - Activated charcoal filter (ACF)

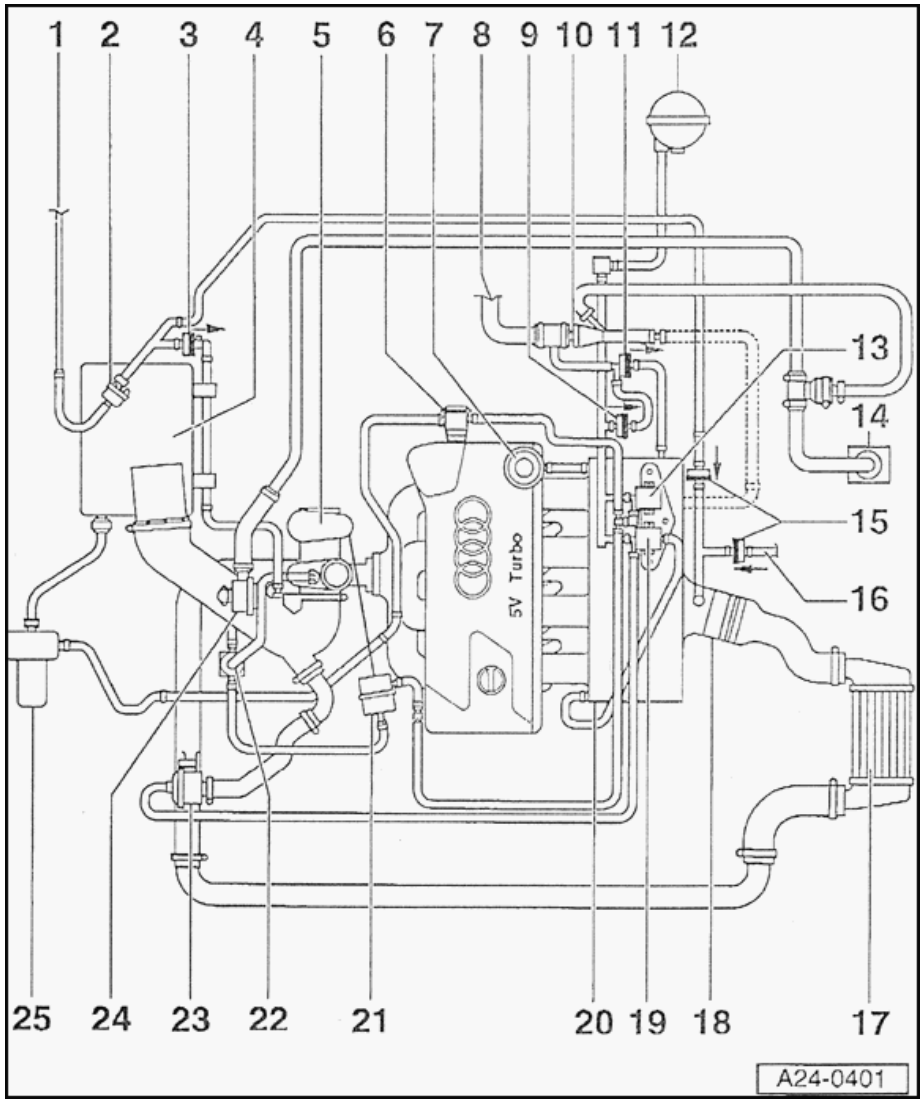
2 - EVAP Canister Purge Regulator valve - N80-

3 - Non return valve for ACF

- Between ACF container and intake line in front of exhaust turbocharger
- Note position (light side/ dark side) as shown in Fig; arrow faces in direction of flow

4 - Air cleaner

- With Mass Air Flow (MAF) sensor -G70-



5 - Turbocharger

- Check charge pressure ⇒ Page 21-8

6 - Combination valve for secondary air inlet

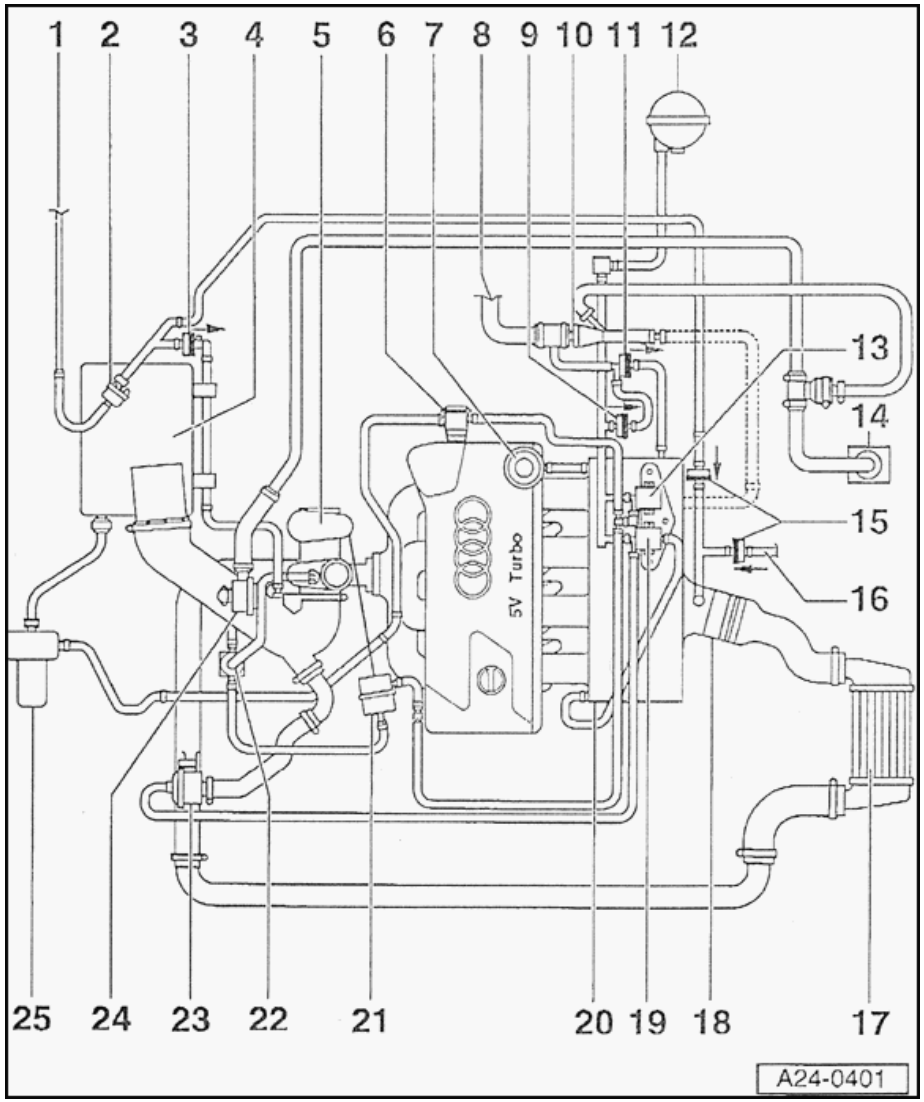
7 - Fuel pressure regulator

8 - To brake servo

9 - Non-return valve

- Between brake servo and intake line
- Note position (light side/ dark side) as shown in Fig; arrow faces in direction of flow

10 - Suction jet pump



11 - Non-return valve

- Between brake servo and intake line
- Note position (light side/ dark side) as shown in Fig; arrow faces in direction of flow

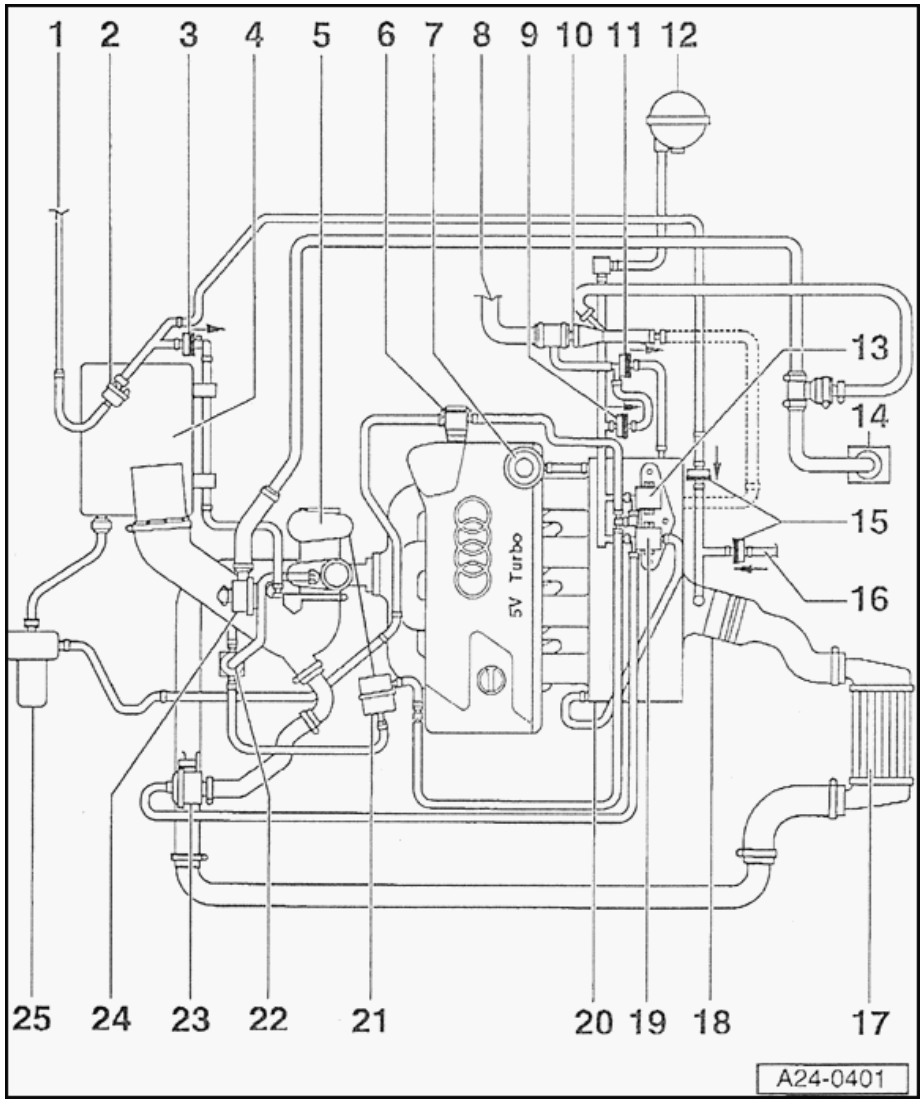
12 - Vacuum reservoir

- Location: In front left wheel housing beneath wheel housing liner

13 - Secondary Air Injection (AIR) Solenoid valve -N112-

- Location: Below intake line

14 - Crankcase breather



15 - Non-return valve

- Between ACF container and intake line
- Note position (light side/ dark side) as shown in Fig; arrow faces in direction of flow

16 - From Leak Detection Pump (LDP) -V144-

17 - Charge air cooler

- With Charge Air Pressure sensor -G31-

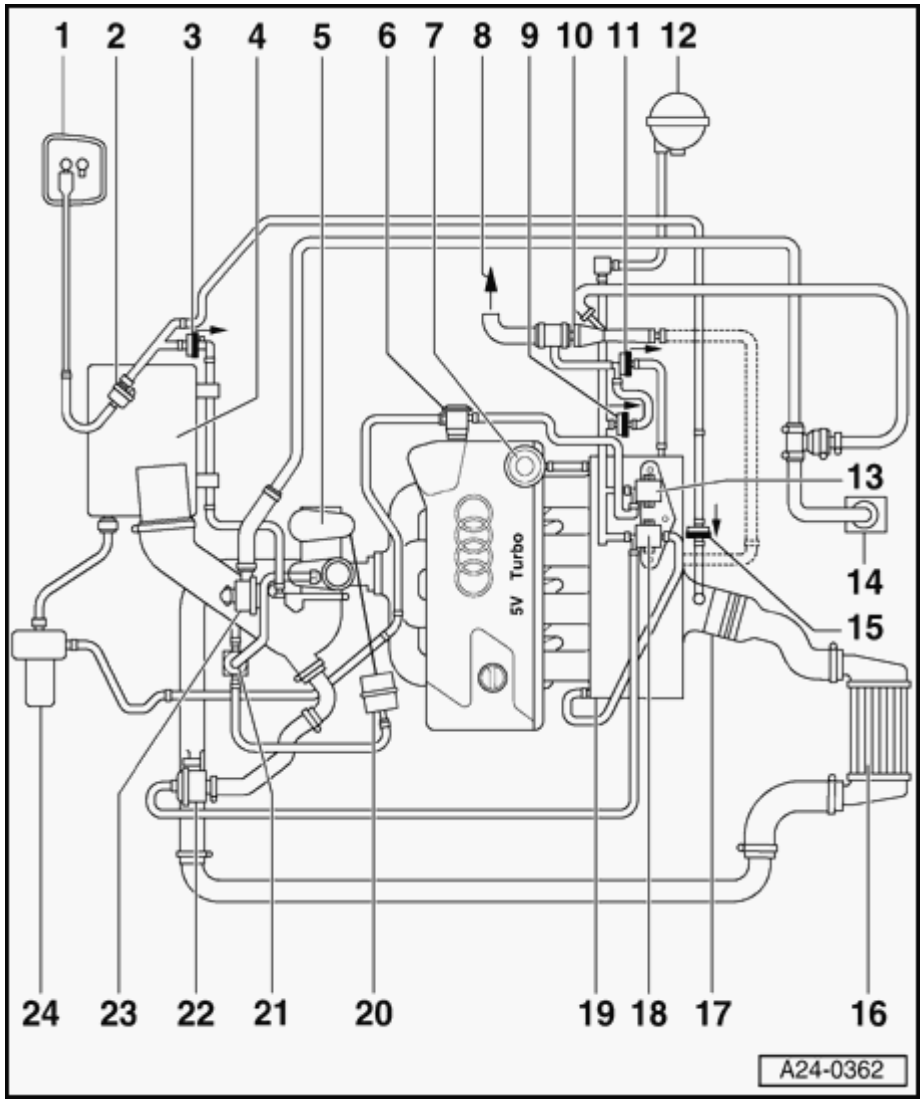
18 - Throttle Valve Control Module -J338-

19 - Recirculating valve for turbocharger - N249-

- Location: below intake line

20 - Intake manifold

- With Intake Air Temperature (IAT) sensor - G42-



21 - Vacuum unit for charge pressure control

22 - Wastegate Bypass Regulator valve -N75-

- Checking ⇒ Page 21-33

23 - Mechanical air recirculation valve

- Checking ⇒ Page 21-24

24 - Crankcase breather pressure regulating valve

25 - Secondary Air Injection (AIR) Pump motor -V101-

Turbocharger and charge pressure regulating valve, checking

Special tools and equipment



- Turbocharger tester VAG 1397 A



- VAS 5051 with VAS 5051/1

or

- VAG 1551 with VAG 1551/3 A

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551 Scan Tool connected.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 01*

- All hoses and lines must be checked for correct seating and leaks.

- Diagnostic Trouble Code (DTC) memory has been checked:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 01*

- Output Diagnostic Test Mode (DTM) has been performed:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM,*

Repair Group 01

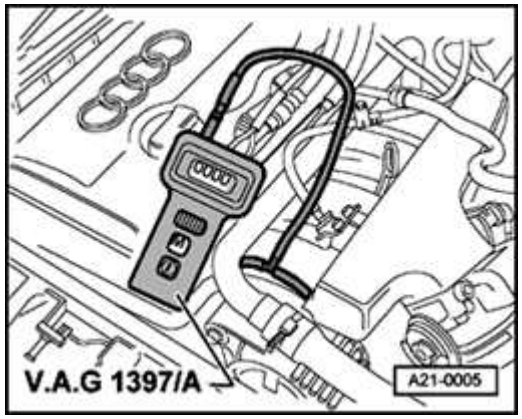
Test sequence

WARNING!

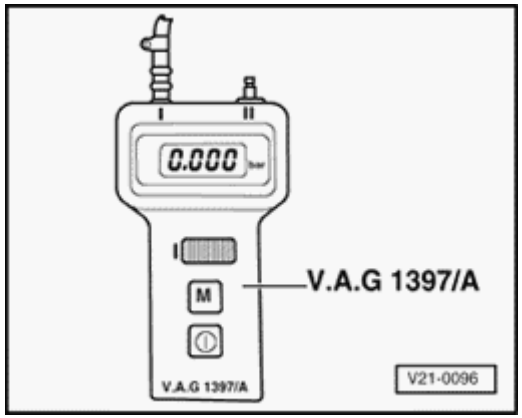
- ***Always attach testers and measuring instruments to the back seat and have a second person operate them from there.***

- ***If test equipment were operated from the front passenger seat, the person sitting there could be injured if the front passenger airbag were triggered in the event of an accident.***

21-10



- Connect T piece and measuring hose of turbocharger tester VAG 1397 A to intake manifold (front).
- Route measuring hose under rear edge of hood and into passenger compartment via right hand window.



- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Connect measuring hose to connection -I-.

21-11

Note:

- *Hose connections must be completely airtight, otherwise measurements will not be correct.*
- *Ensure that measuring hose is not pinched at hood or side window.*
- *Pressing memory key M on turbocharger tester will store the last measured value until memory key M is pressed again or tester is switched off.*
- *The decimal point in the display flashes to indicate that the value is being stored.*
- *If the battery voltage of the turbocharger tester drops below the minimum level, an arrow will appear at the top left of the display.*
- *Before checking, drive vehicle quickly for at least 3 km (choose a safe route that does not include stopping).*
- *A second mechanic is required to note readings with the vehicle moving.*

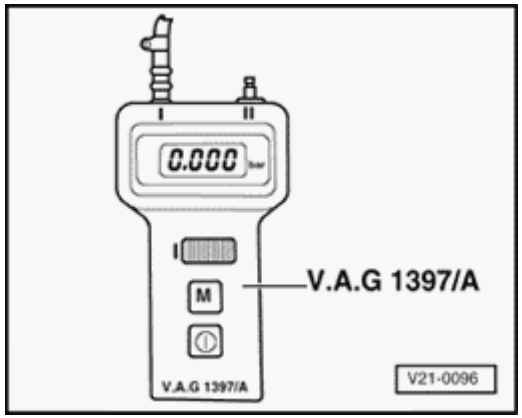
21-12

Read measured value block 115 →
1 2 3 4

- Read measured value block Display group 115, engine idling.
- Accelerate vehicle from 2000 rpm at wide open throttle in third gear, and observe rev counter.
- At approx. 2500 rpm press print key on VAS 5051 or PRINT key on VAG 1551 and at same time press recall button -M- on VAG 1397 A.

Note:

The charge pressure level is measured with turbocharger tester VAG 1397/A. The vehicle diagnostic, measuring and information system VAS 5051 or the VAG 1551 Scan Tool is used to check whether the charge pressure is being registered by the control module.



- Specified value on VAG 1397 A: 1.700 to 1.800 bar

Read measured value block 115 →
1 2 3 4

- Specified value on VAG 1551 or on VAS 5051 in display zone 4: 1700 to 1800 mbar

If specified value not attained ⇒ table, ⇒ Page 21-13

Charge air pressure control malfunctions

Malfunction	Possible causes
Charge air pressure below specified value	♦ Wastegate Bypass Regulator valve -N75- faulty ⇒checking, ⇒ Page 21-33 ♦ Hose connection to Wastegate Bypass Regulator valve -N75- faulty ⇒Connection diagram, ⇒ Page 21-3 ♦ Wastegate bypass regulator valve in turbocharger stuck open ♦ Leak between exhaust turbocharger and intake hose ⇒Effects, ⇒ Page 21-14 ♦ Mechanical air recirculation valve faulty ⇒checking, ⇒ Page 21-24 ♦ Recirculating valve for turbocharger -N249- faulty ⇒checking, ⇒ Page 21-26 ♦ Exhaust turbocharger faulty ⇒replacing, ⇒ Page 21-51
Charge air pressure above specified value [1)]	♦ Vacuum unit for wastegate bypass regulator valve faulty ⇒Replacing exhaust turbocharger, ⇒ Page 21-51 ♦ Hose connection to vacuum unit for charge air pressure limiter (above -N75-) leaks ⇒Connection diagram, ⇒ Page 21-3 ♦ When in closed position wastegate bypass regulator valve in exhaust turbocharger sticks ⇒replacing exhaust turbocharger, ⇒ Page 21-51

1) If the charge air pressure is too high the fuel supply will be interrupted in order to protect the engine. This results in misfiring at high engine speeds.

Effects of leaks in intake or exhaust system

Leak downstream of mass air flow sensor

- Effect: Loss of power

Possible malfunction sources:

1 - Connection hoses between mass air flow sensor and exhaust turbocharger

2 - Connection hose for crankcase vent

3 - Connection hose to mechanical air recirculation valve

Leak downstream of exhaust turbocharger

- Effect: Charge pressure too low

Possible malfunction sources:

1 - Connection hoses and line between exhaust turbocharger and charge air cooler

2 - Hose between charge air cooler and intake line

3 - Charge air cooler

4 - Seal of Charge Air Pressure sensor -G31- (in charge air cooler)

5 - Sealing between throttle valve control module and intake line

6 - Sealing between intake line and cylinder head

Effects of leaks on exhaust side

- Effect: Charge air pressure too low, possible exhaust smell, soot traces in engine compartment

Possible malfunction sources:

1 - Exhaust turbocharger /exhaust manifold connection

2 - Exhaust manifold/cylinder head connection

21-1

Charge air system with turbocharger

Turbocharger, removing and installing

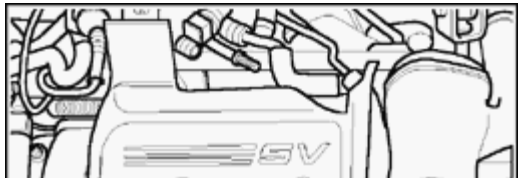
Observe rules for cleanliness ⇒ Page 21-8 .

Notes:

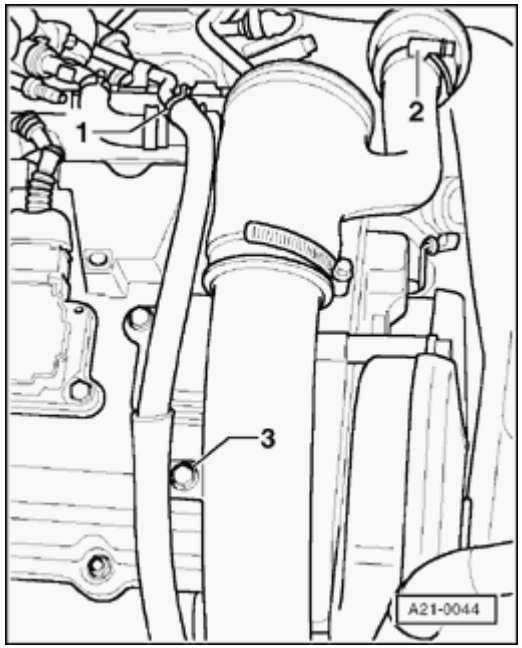
- *Turbochargers must be replaced in pairs. Manufacturing tolerances may prevent matched operation.*
- *All hose connections are secured with clips.*
- *Charge air system must be free of leaks.*
- *Replace self-locking nuts.*
- *Replace all seals and gaskets*

- Remove engine ⇒ Page 10-1 .

Removing right-hand turbocharger



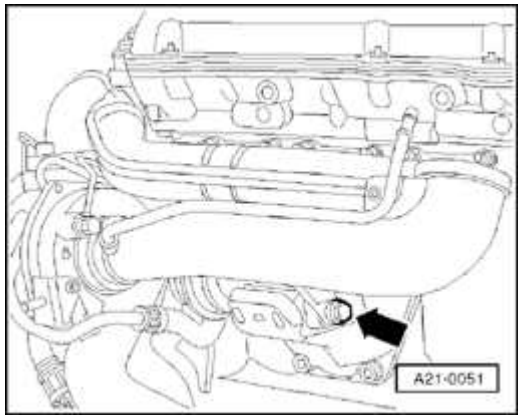
- Remove cover panel from right-hand cylinder head cover -arrows-.



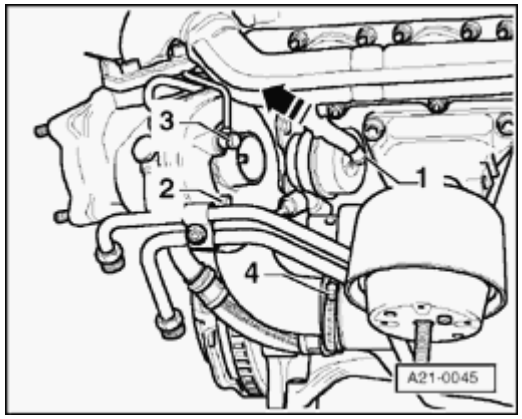
- Disconnect hose -1-.
- Disconnect hose -2-.
- Unbolt upper section of intake line -3-.

Note:

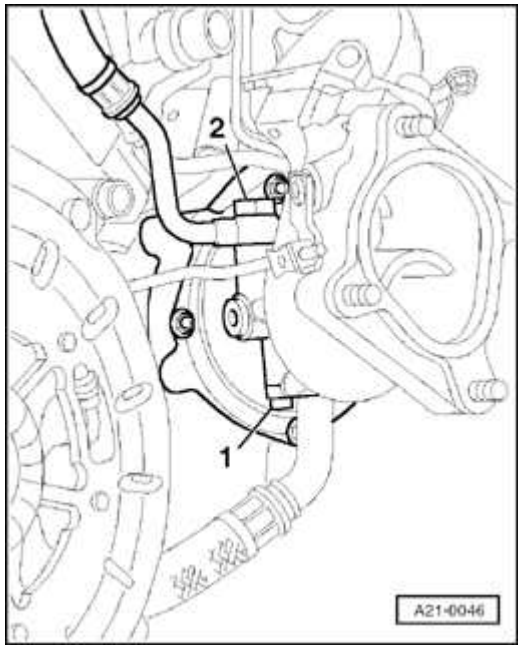
Plug lower section of intake line.



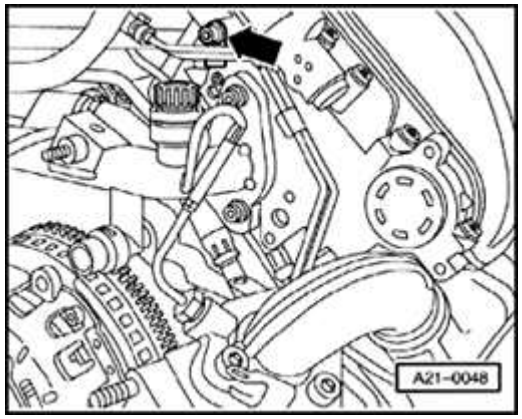
- Remove lower section of intake line -arrow-.



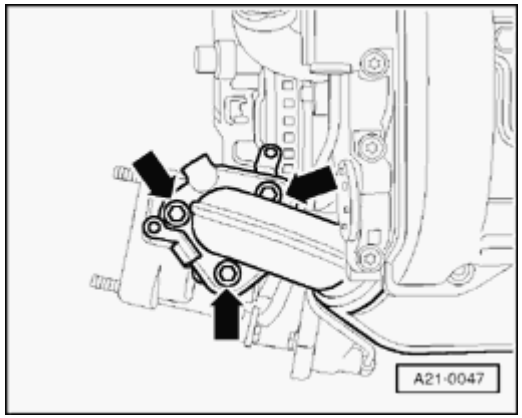
- Push back heat insulation hose in direction of arrow.
- Disconnect vacuum hose -1-.
- Unbolt bracket -2- with gearbox oil lines.
- Disconnect line -3-.
- Disconnect pressure hose -4- from turbocharger.



- Disconnect oil return line -1-.
- Disconnect water line -2-.



- Disconnect hose -arrow- from cylinder head.



- Remove turbocharger -arrows-.

Installing

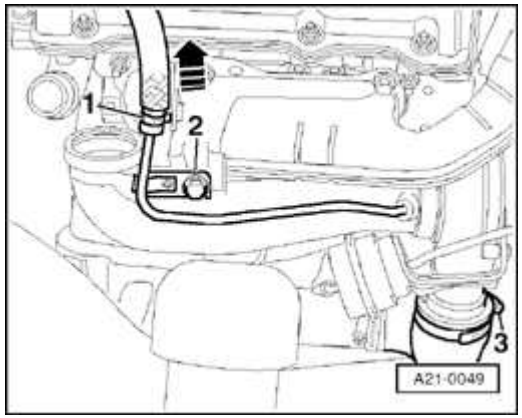
- Install in reverse sequence.

Notes:

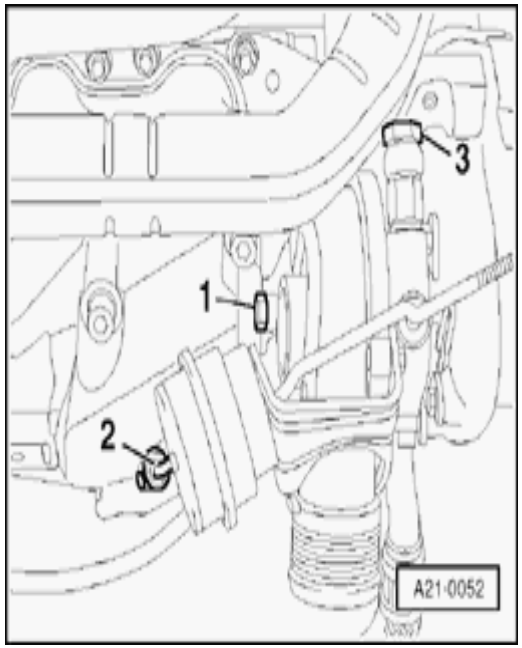
When installing turbocharger, ensure that O-ring for oil return is not damaged.

21-5

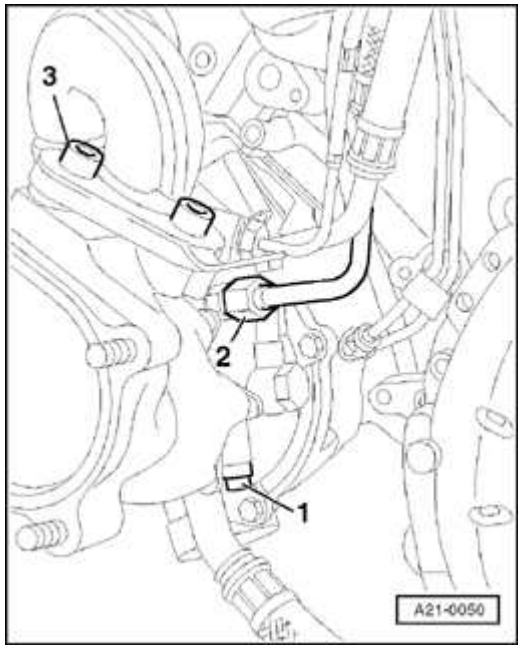
Removing left-hand turbocharger



- Push back heat insulation hose in direction of arrow.
- Disconnect vacuum hose -1-.
- Remove lower section of pressure line -2-.
- Disconnect pressure hose -3- from turbocharger.



- Disconnect vacuum line -1-.
- Disconnect vacuum hose -2-.
- Disconnect line -3- going to right-hand turbocharger.



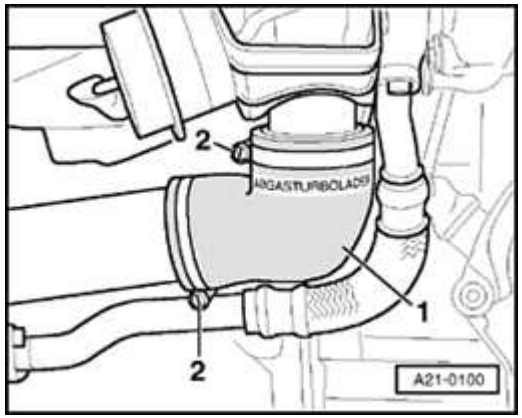
- Disconnect oil return line -1-.
- Disconnect water line -2-.
- Remove turbocharger -3- (3 bolts).

Installing

- Installation is the reverse of removal.

Notes:

When installing turbocharger, be sure that o-ring at connection flange for oil return is not damaged.



The text "Abgasturbocharger" must be readable as shown in illustration, install turbocharger hose -1- properly if necessary.

The hose clamps -2- must be installed as shown in illustration. The bolt-locks on the screw clamps must be placed at the X-marking on the hose.

Tightening torque

Bolted mountings	Tightening torque
Turbocharger	20 Nm
Intake line to cylinder head	10 Nm
Heat shield to turbocharger	10 Nm
Exhaust manifold to exhaust pipe	25 Nm
Injector pipes	30 Nm
Intake pipe to engine support	10 Nm
Oil pipe to turbocharger	15 Nm
Oil pipe to intake manifold	20 Nm

Rules for cleanliness

When working on the exhaust gas turbocharger, pay careful attention to the following 5 rules:

- Thoroughly clean all unions and the adjacent areas before disconnecting.
- Place parts that have been removed on a clean surface and cover. Do not use fluffy cloths!
- Carefully cover opened components or seal, if the repair cannot be carried out immediately.
- Only install clean components: Only unpack replacement parts immediately prior to installation. Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- When the system is open: Do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.

21-9

Turbocharger and charge pressure regulating valve, checking

Safety notes

Note the following points if test equipment has to be used during a road test:

WARNING!

- ***Test equipment must always be secured on the rear seat and operated from there by a second person.***

- ***If test equipment is operated from the front passenger seat, the occupant could be injured by the passenger's airbag in an accident.***

Special tools, testers and auxiliary items

- Turbocharger tester VAG 1397 A

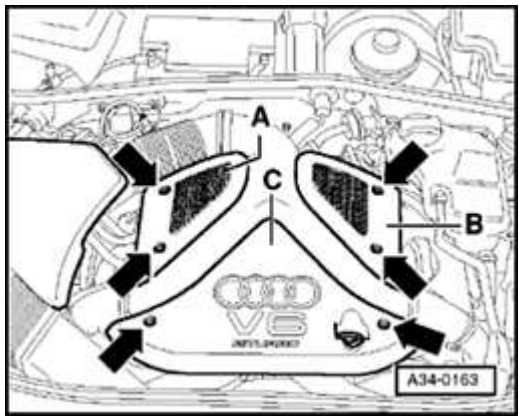
- VAG 1551 Scan Tool or VAG 1552 with cable VAG 1551/3

Requirements for test:

- Diagnostic Trouble Code (DTC) memory has been interrogated

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

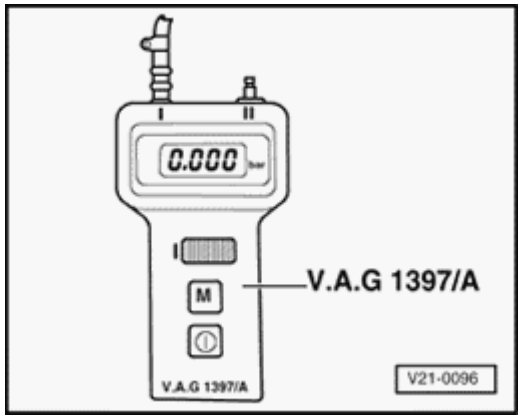
- Output Diagnostic Test Mode (DTM) has been performed
- Engine oil temperature at least 60 ° C
- All vacuum connections airtight



- Loosen bolts -arrows- and remove engine cover panel -B-.

- Connect T-piece with measuring hose of turbocharger tester VAG 1397 A to fuel pressure regulator -arrow-.
- Route measuring hose under rear edge of hood and into passenger compartment via right-hand window.

21-11

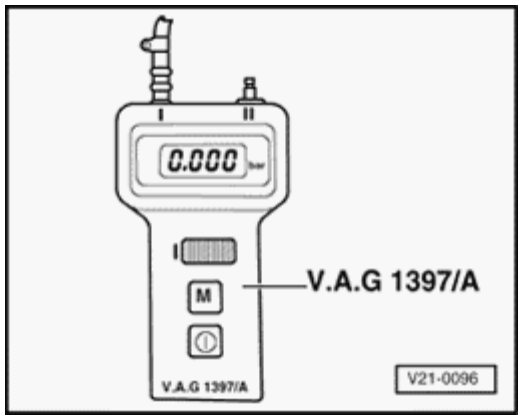


- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Connect measuring hose to connection -I-.

Notes:

- *Hose connections must be completely airtight, otherwise measurements will not be correct.*
- *Ensure that measuring hose is not pinched at hood or side window.*
- *Pressing memory key M on turbocharger tester will store the last measured value until memory key M is pressed again or tester is switched off.*
- *The decimal point in the display flashes to indicate that the value is being stored.*
- *If the battery voltage of the turbocharger tester drops below the minimum level, an arrow will appear at the top left of the display.*
- *Before performing the test, drive the vehicle at a brisk speed for at least 3 km (without stopping at traffic lights etc.).*
- *A second mechanic is required to note the readings on the tester when the vehicle is moving.*
- *Observe safety notes* ⇒ *Page 21-9* .

21-12



- Accelerate vehicle from 2000 RPM at full throttle in fourth gear, and watch rev counter.

- Press memory key -M- on turbocharger tester at 3000 RPM.
  - Specification: 1.550 ... 1.650 bar

Note:

If no charge pressure is obtained and a throbbing noise can be heard in the engine compartment, the causes can be as follows:

- *Air recirculation valve faulty.*
- *Vacuum line to air recirculation valve leaking or has become disconnected.*



Charge air pressure regulation, checking

Special tools and equipment

- VAS 5051 with VAG 5051/1

or

- VAG 1551 with VAG 1551/3A

Test requirement:

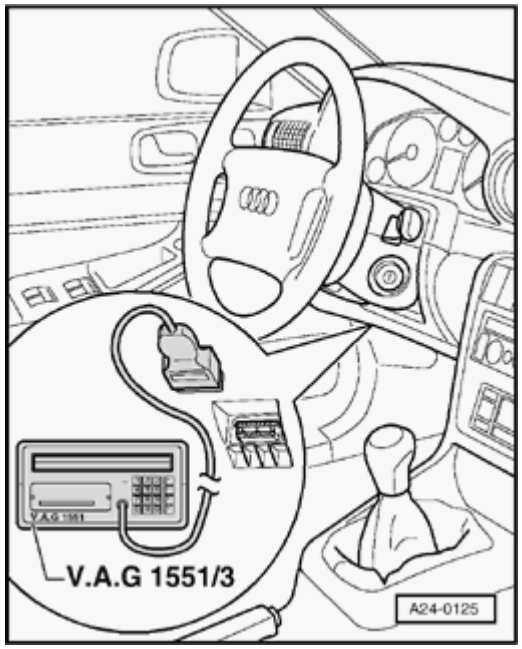
- Coolant Temperature at least 80 ° C.

WARNING!

- ***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.***
- ***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.***

21-14

Test sequence



- Connect VAS 5051 tester or VAG 1551 scan tool and select control module for engine electronics using "address word" 01. Engine must run at idle.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

Rapid data transfer HELP **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 -1-, -1- and -5- to select "display group number 115" and press -Q- button to confirm input.

Read Measuring Value Block 115 →	Indicated on display (1...4 = display fields)

1 2 3 4

- Check charge air pressure regulation.

21-15

- Road test vehicle.

  - Wide Open Throttle (WOT) must be reached

- Measurement must be taken at Wide Open Throttle (WOT).

	Display fields			
	1	2	3	4
Display group 115: Charge air pressure regulation				
Display	1 RPM	%	mbar	mbar
Indicated	Engine speed (RPM)	Actual load	Specified pressure	Actual pressure
Specified value			XXX	Must not deviate more than +/- 20 mbar from specified
Note:				

Actual pressure must not deviate from specified pressure by more than ± 20 mbar.

21-16

- Select measuring value block 117.

- Check function of accelerator pedal in display field 2 by briefly depressing pedal to Wide Open Throttle.

	Display fields			
	1	2	3	4
Display group 117: Charge air pressure regulation				
Display	1 RPM	**%**	%	mbar
Indicated	Engine speed (RPM)	**Accelerator pedal position**	Throttle valve angle	Specified charge air pressure
Specified value		**0...100**		
Note:				

If the specified value 100% is not reached at Wide Open Throttle (WOT):

- Check accelerator pedal.

- Select measuring value block 116.

21-17

- Check correction factors in display fields 2 to 4.

	Display fields			
	1	2	3	4
Display group 116: Charge air pressure regulation				
Display	1 RPM	**%**	%	mbar
Indicated	Engine speed (RPM)	**Correction factor Fuel**	**Correction factor Coolant temp.**	**Correction factor Intake air temp.**
Specified value				
Note:				

If display field 2 indicates a correction factor <0 %, fuel quality is probably incorrect.

- Fill tank with prescribed fuel quality.

If display field 3 indicates a correction factor <0 %, coolant temperature is too high (heat warning lamp lit in instrument cluster) or the Engine Control Module is receiving an incorrect temperature signal from the instrument cluster.

- Check coolant temperature display.

⇒ *Repair Manual, Electrical Equipment, Repair Group 90*

21-18

If display field 4 indicates a correction factor <0 %, intake air is too hot or the sensor for intake air temperature is faulty.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

- Select measuring value block 114.

	Display fields			
	1	2	3	4
Display group 114: Charge air pressure regulation				
Display	**%**	**%**	**%**	%
Indicated	**Specified engine load (without correction)**	**Specified engine load (after correction)**	**Actual load**	Duty cycle CAPR-cyclical valve
Specified value	**136,0**	**134,3**	**137,5**	55,2
Note:				

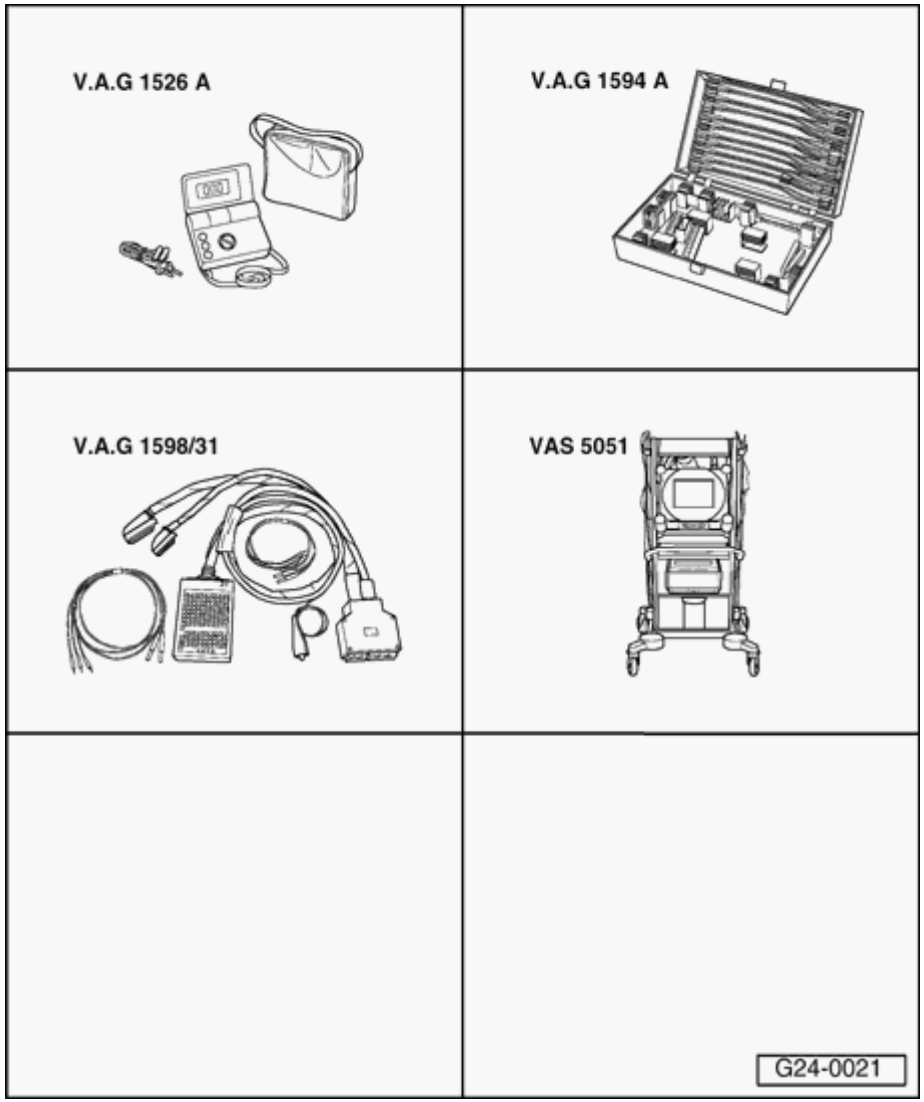
Load values in display fields 1 to 3 can deviate from each other by up to ± 5 %.

If specified values are not achieved in the

measuring value blocks:

- Check the charge air pressure sensor -G31-.

21-19



Recirculating valve for turbocharger - N249-, checking

Special tools and equipment

- VAG 1526A
- VAG 1527B
- VAG 1594A
- VAG 1598/31
- VAS 5051 with VAG 5051/1

- or

- VAG 1551 with VAG 1551/3A

21-20

Note:

The recirculating valve for turbocharger -N249 and wire connections are monitored by the Engine Control Module (ECM).

- Connect VAS 5051 tester or VAG 1551 scan tool and select control module for engine electronics using "address word" 01. Engine must run at idle for this.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

- Check DTC memory of Engine Control Module (ECM).

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

If a Diagnostic Trouble Code (DTC) 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.

21-21

- Initiate output Diagnostic Test Mode (DTM) and activate recirculating valve for turbocharger - N249-.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

Output diagnostic test mode →

Recr. valve for turbocharger -N249

Indicated on display

Valve must click...

...and must open and close (can be tested by blowing into assisting hose).

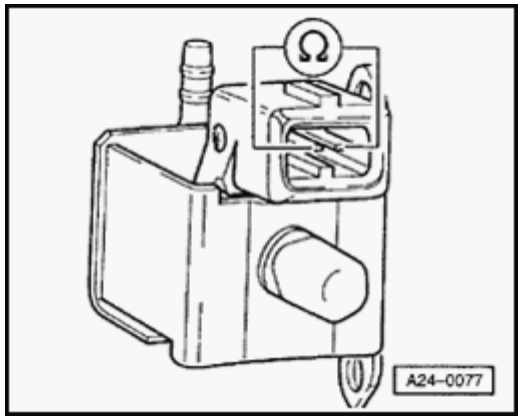
If valve does not click:

- Check internal resistance of valve.

If valve does not open and close properly:

- Replace recirculating valve for turbocharger -N249-.

21-22



Checking internal resistance

- Disconnect connector at valve.

- Connect multimeter at valve for resistance measurement.
  - Specified value: 27 ... 30 Ω

If specified value is not obtained:

- Replace recirculating valve for turbocharger -N249-.

If the specified value is met:

- Check voltage supply

21-23

Checking voltage supply

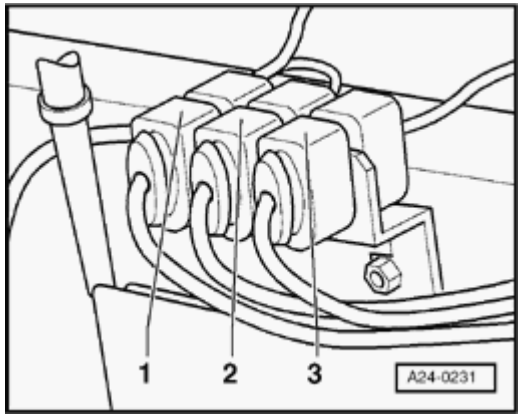
Note:

Voltage is supplied to the recirculation valve via the Fuel Pump (FP) relay.

Test requirement:

- Fuse for recirculation valve OK

- Disconnect connector at valve.



- 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.

If wire connection is OK:

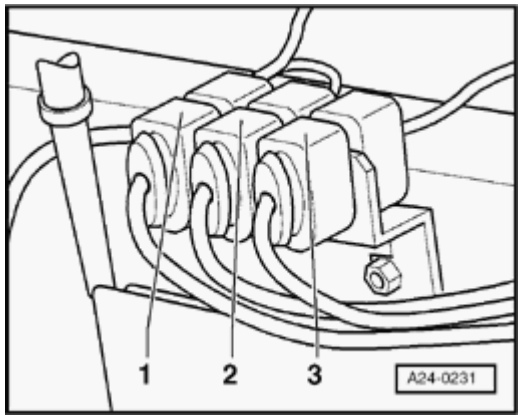
- Check Fuel Pump (FP) relay.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

If LED lights:

- Check activation, ⇒ Page 21-25 .

21-25



Checking activation

- Connect VAG 1527B voltage tester to connector terminals 1 (B+) and 2.
- Initiate output Diagnostic Test Mode (DTM) and activate recirculating valve for turbocharger -N249-.

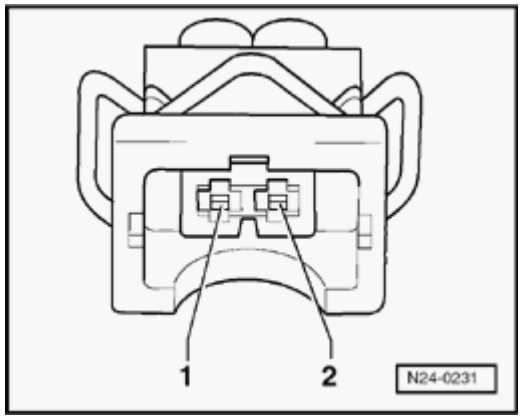
⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

- LED must blink.

If LED does not blink or if it remains constantly lit:

- Connect VAG 1598/31 test box at wiring harness to ECM. Do not connect ECM.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*



- Check the following wire connections for open circuit and short circuit to Ground (GND) and B+:

Harness connector terminal	VAG 1598/31 test box Bushing
2	9

- Repair open circuit or short circuit if necessary.

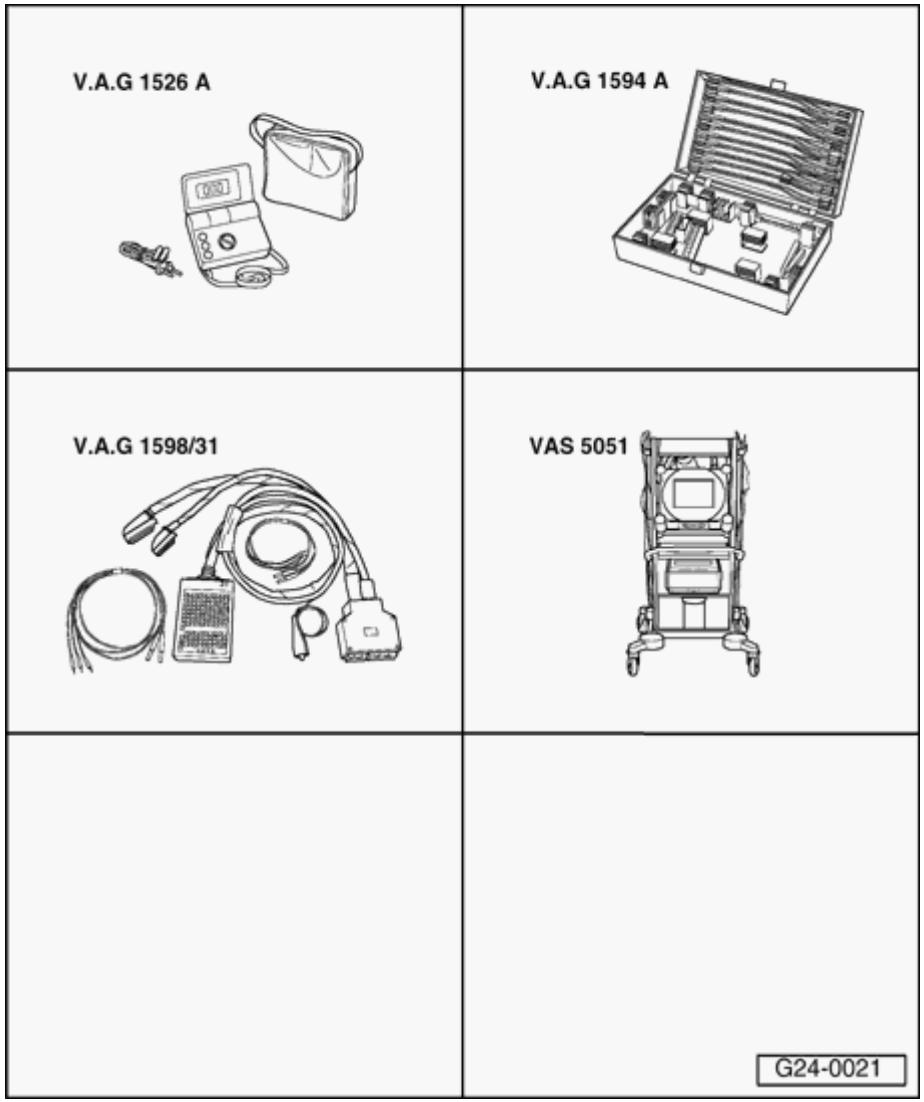
21-26

If wire connection is OK:

- Replace Engine Control Module (ECM).

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

21-27



Charge air pressure sensor -G31-, checking

Special tools and equipment

- VAG 1526A
- VAG 1594A
- VAG 598/31
- VAS 5051 with VAG 5051/1

- or

- VAG 1551 with VAG 1551/3A

21-28

Note:

The charge air pressure sensor -G31- and wire connections are monitored by the Engine Control Module (ECM).

- Connect VAS 5051 tester or VAG 1551 scan tool and select control module for engine electronics using "address word" 01. Engine must run at idle.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

- Check DTC memory of Engine Control Module (ECM).

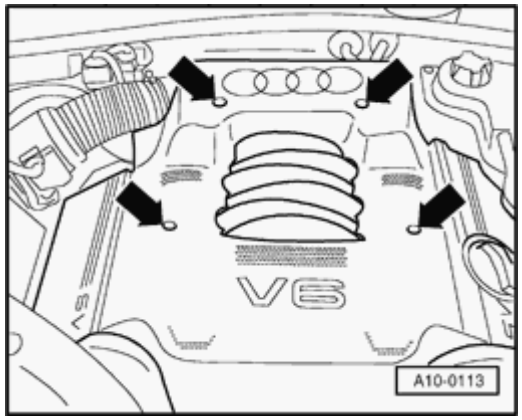
⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

If a Diagnostic Trouble Code (DTC) relating to the charge air pressure sensor -G31- is indicated:

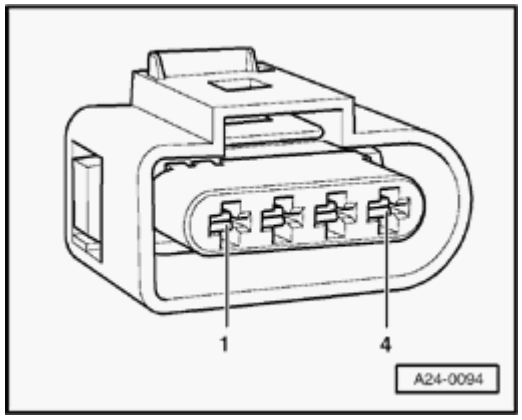
21-29

Checking voltage supply

- Switch ignition off.



- Remove engine cover (arrows).
- Disconnect connector at charge air pressure sensor.



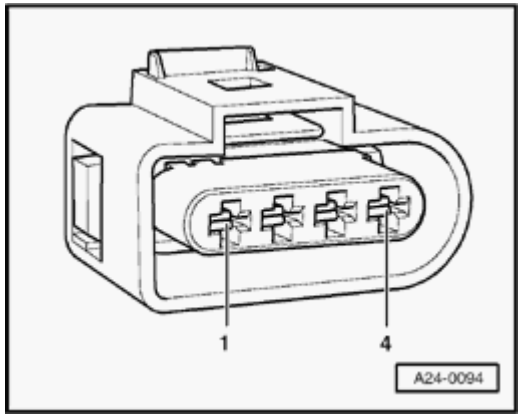
- Connect multimeter between terminal 1 and 3 of harness connector for voltage measurement.
- Switch ignition on.
  - Specification: about 5 V

If specified value is not obtained:

21-30

- Connect VAG 1598/31 test box to wiring harness for Engine Control Module (ECM), also connect ECM -1-.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*



- Check the following wire connections for open circuit and short circuit to Ground (GND) and B+:

Harness connector terminal	VAG 1598/31 or test box Bushing
1	108
3	98

- Repair open circuit or short circuit if necessary.

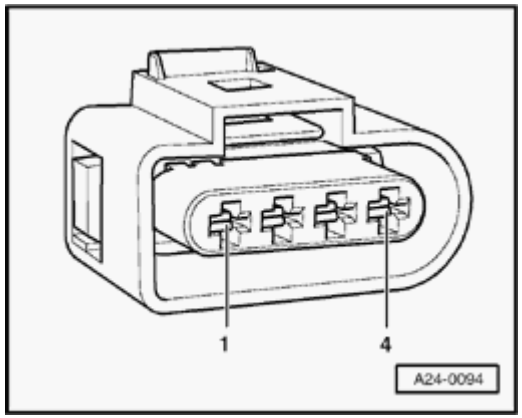
If the specified value is met:

- Check signal wire, ⇒ Page 21-31 .

21-31

Checking signal wire

- Disconnect 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.
  - Specification: about 1.90 V
- Bring engine to RPM by depressing pedal suddenly.
  - Specification: approx. 2.00 ... 3.00 V



If specified values are not obtained:

- Check following wire connection for open circuit and short circuit to Ground (GND) and B+:

Harness connector terminal	VAG 1598/31 or test box Bushing
4	101

- Repair open circuit or short circuit if necessary.

If wire connection is OK:

- Replace charge air pressure sensor -G31-.

21-1

Turbocharger system

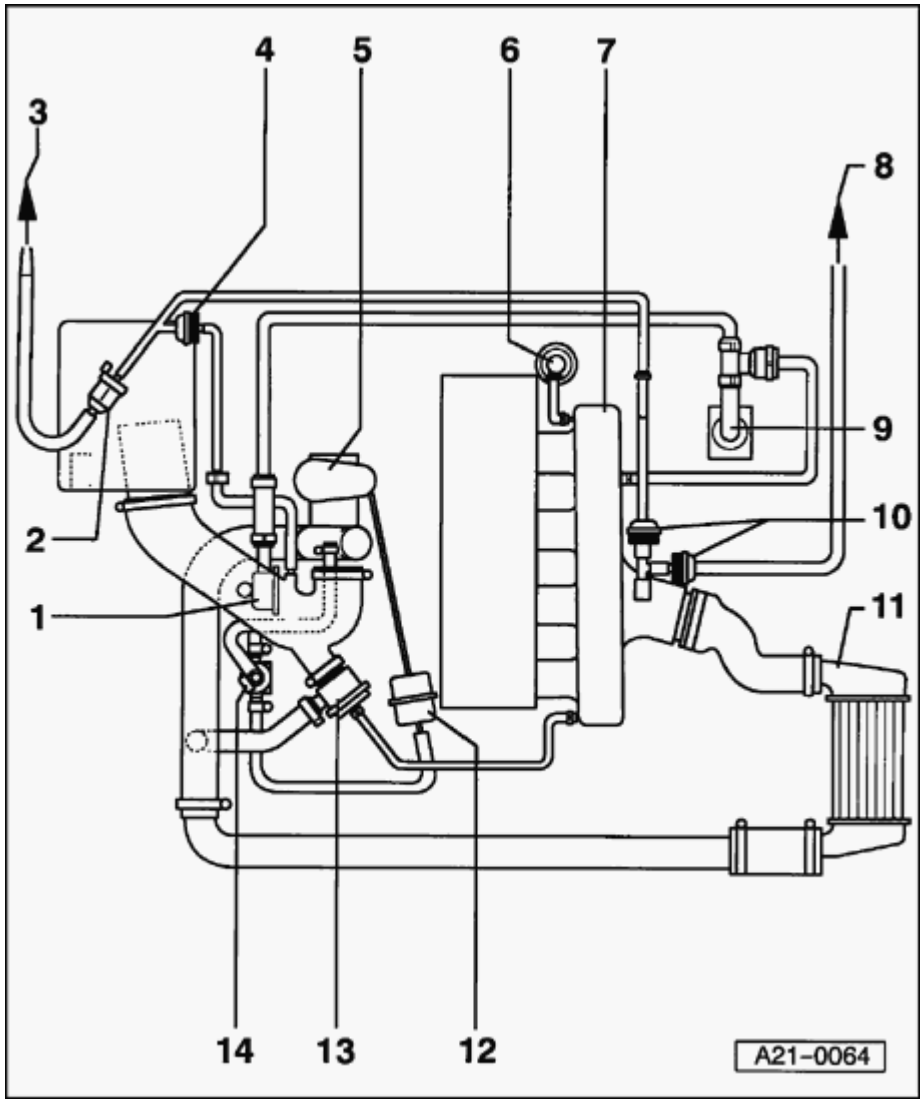
Note:

- *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.*

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

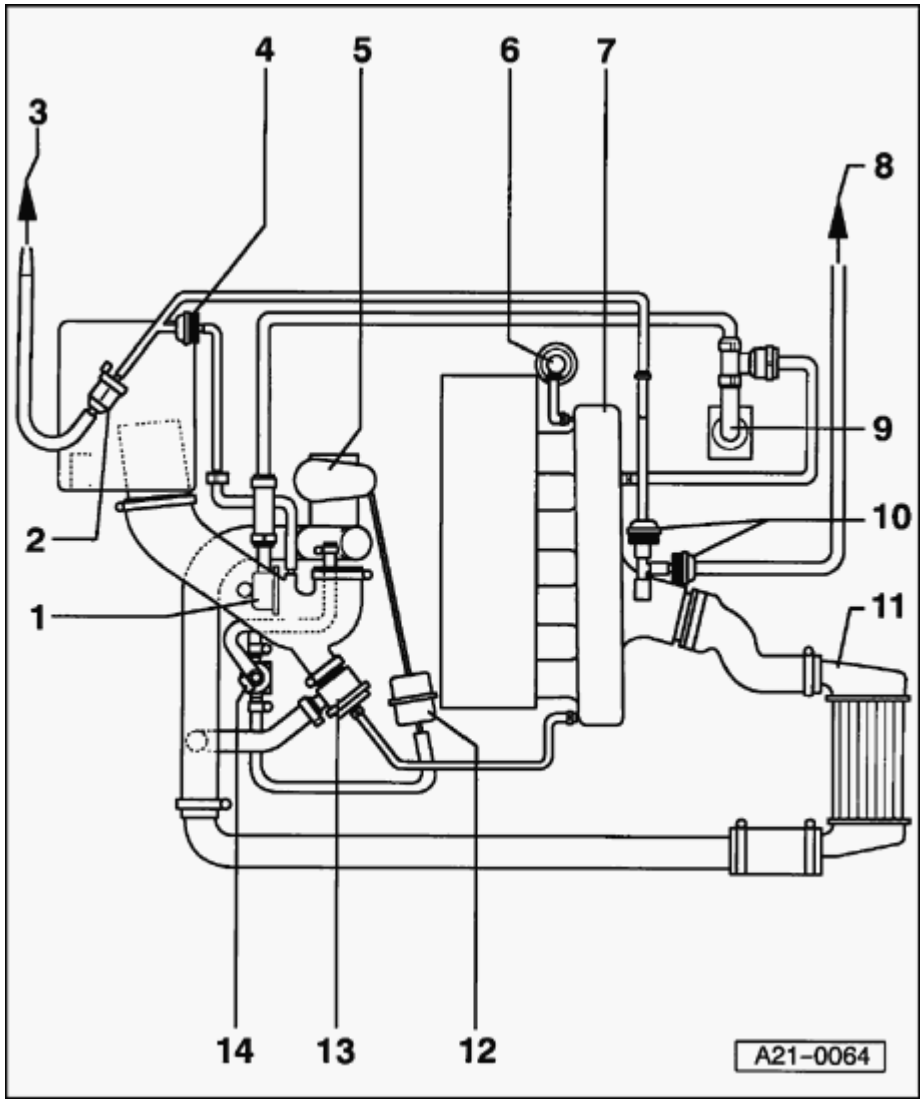
6 - Fuel pressure regulator

7 - Intake manifold

8 - To Leak Detection Pump (LDP) -V144-

9 - Crankcase ventilation

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-

21-4

Charge pressure bypass valve, checking

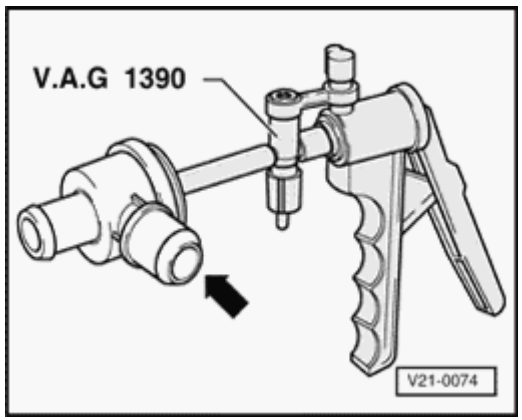
Note:

- *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:

- Replace valve and secure recirculation shut-off valve connections using hose clamps.

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

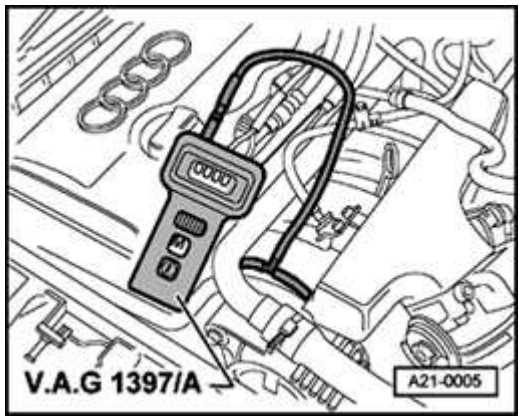
- VAG1551 scan tool with VAG1551/3 adapter

21-6

Test conditions:

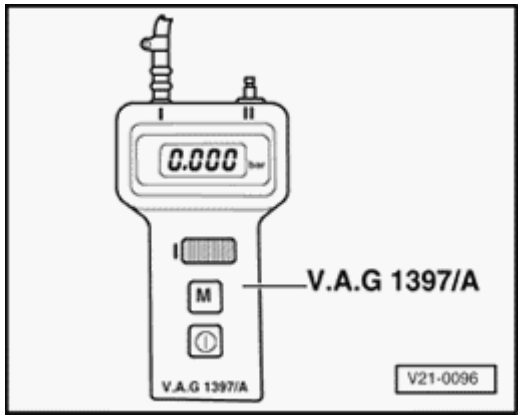
- Check DTC memory Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01
- Perform output diagnostic test mode (function 03)
- Minimum engine oil temperature: 60 ° C (140 ° F)
- All vacuum connections are free of leaks

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.

21-7



- Turn turbocharger tester on and select measuring range -I- (absolute pressure).
- Connect test hose to connection flange -I-.

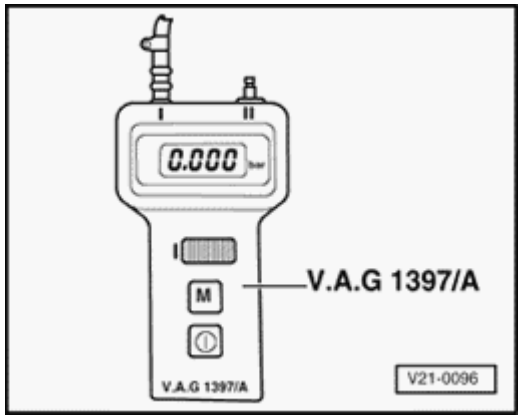
Note:

- *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*** **.**

21-8



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)

21-9

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.*

21-10

Charge air pressure control (via load signal), checking

WARNING!

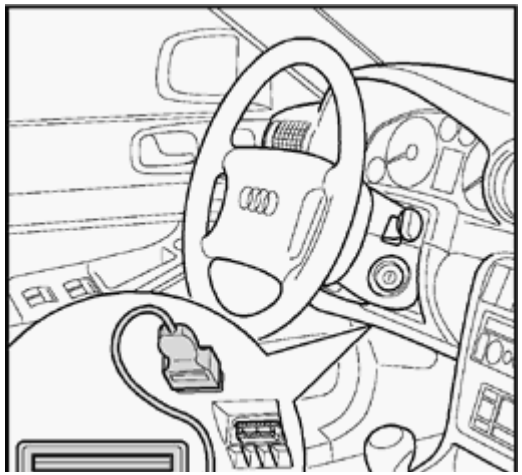
- ***Always use a second technician to take measurements via the VAG1397A turbocharger tester when test-driving vehicle for this test.***

- ***Follow "WARNING!"*** ⇒ ***Page 21-5*** .

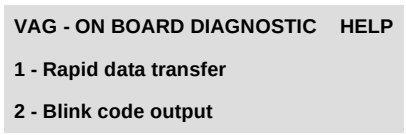
Note:

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.



➢ Indicated on display[1)]

[1)] Operating modes 1 and 2 are displayed alternately

Note:

If nothing appears on display:

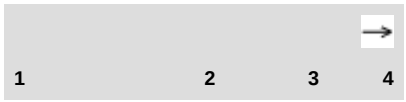
⇒ *Scan tool operating instructions*

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.



Interpreting values 1-4 in each display field ⇒ Page 21-12 .

21-12



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%.

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.

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.

- 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!).

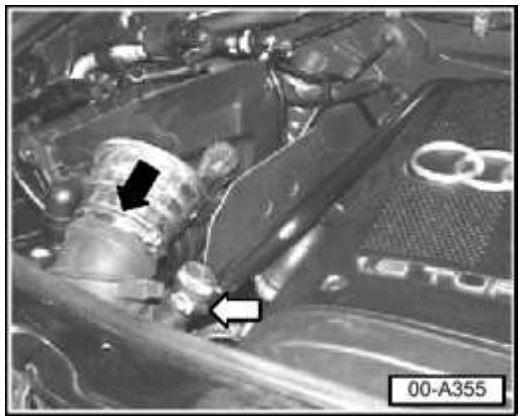
21-15

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

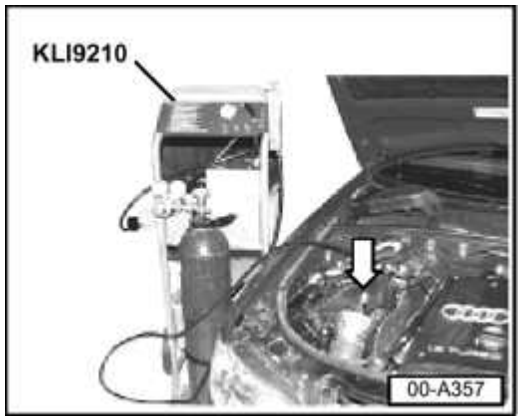
1687/1 special tool kit.

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

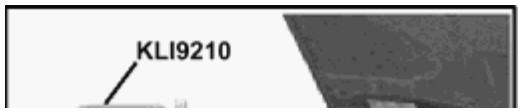
- Install optional fitting LKI9210/50 on hose of special tool KLI9210.



- 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.



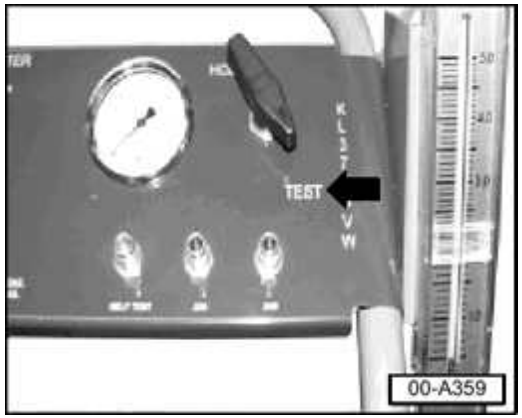
- Connect KLI9210 to VAG 1687/1 adapter (KLI9210 is shown attached

to VAG 1687/1 at arrow on 2.7L BiTurbo).

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).

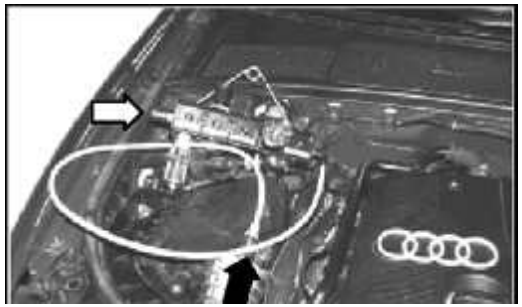
With system filled with smoke:

- 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-

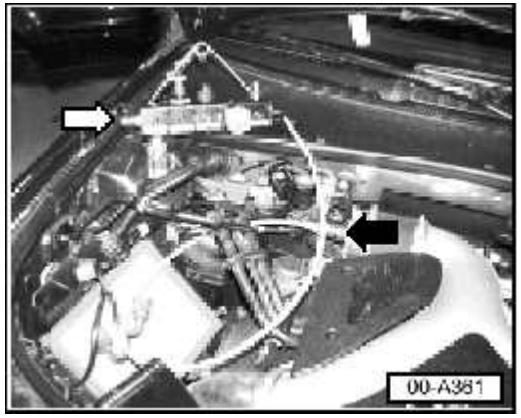
- Perform pressure test ⇒ Page 21-19 .

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.



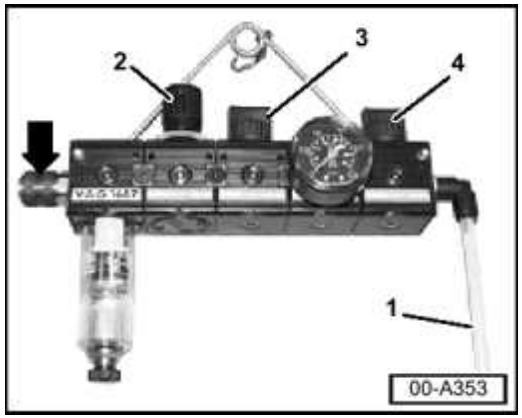
VAG 1687 is shown connected to VAG 1687/1 -black arrow-

Shop air supply will be connected to VAG 1687 -at white arrow-

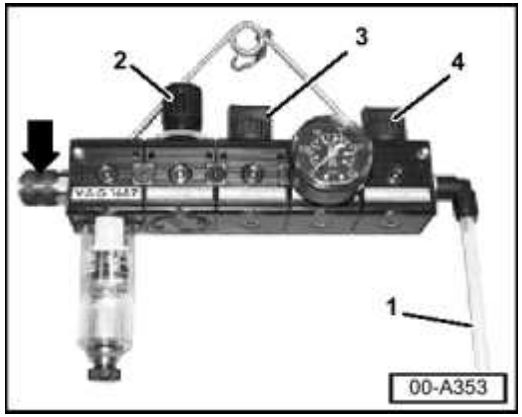
- Perform pressure test ⇒ Page 21-19 .

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.

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.

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.

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.

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:

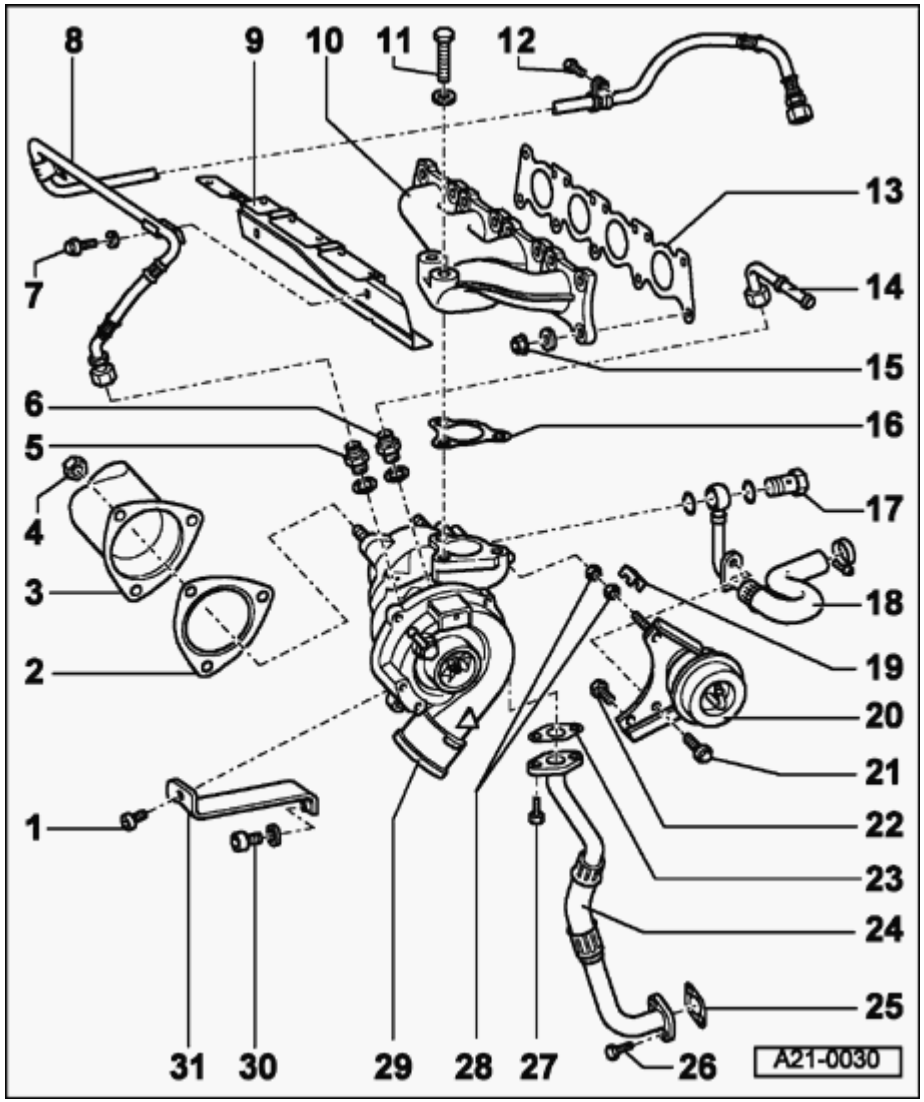
- Avoid working with compressed air whenever possible.
- Avoid moving the vehicle if possible.

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.*

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)

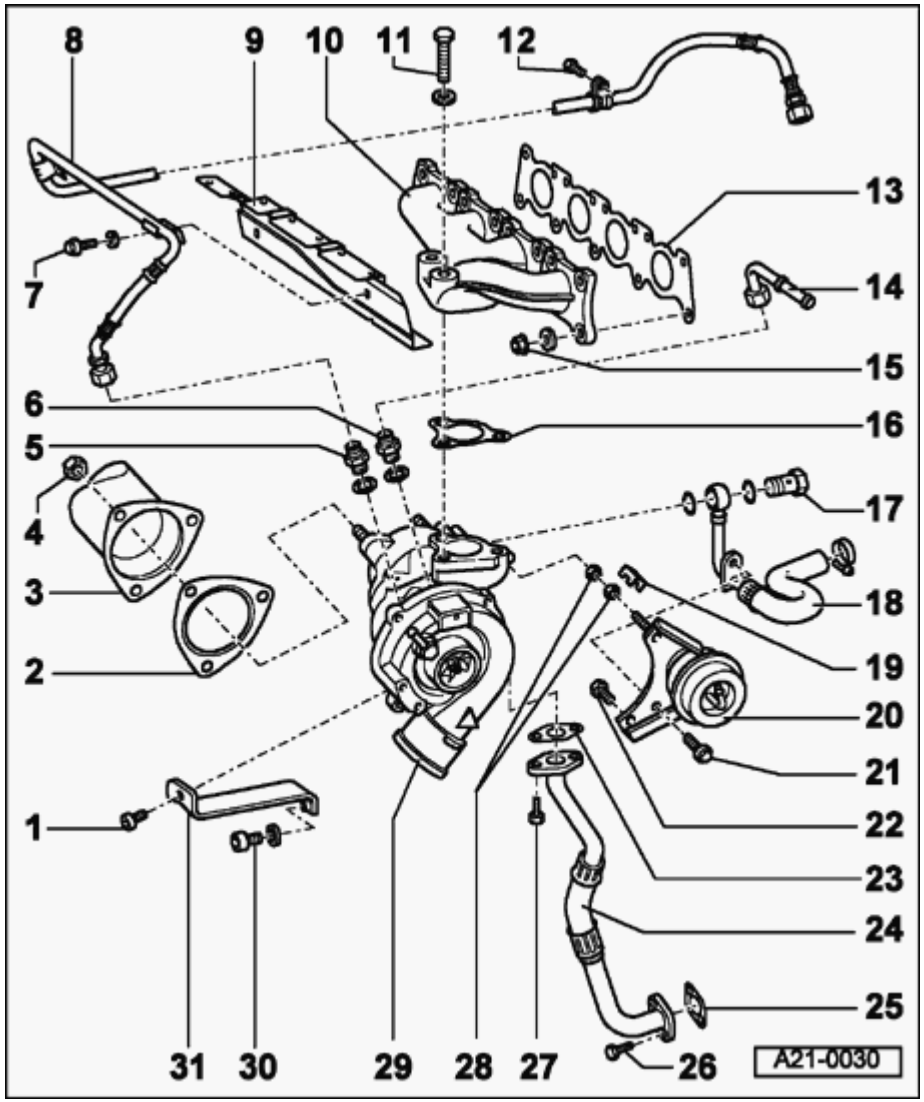
5 - Connection

- 30 Nm (22 ft lb)

6 - Connection

- 35 Nm (26 ft lb)

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.

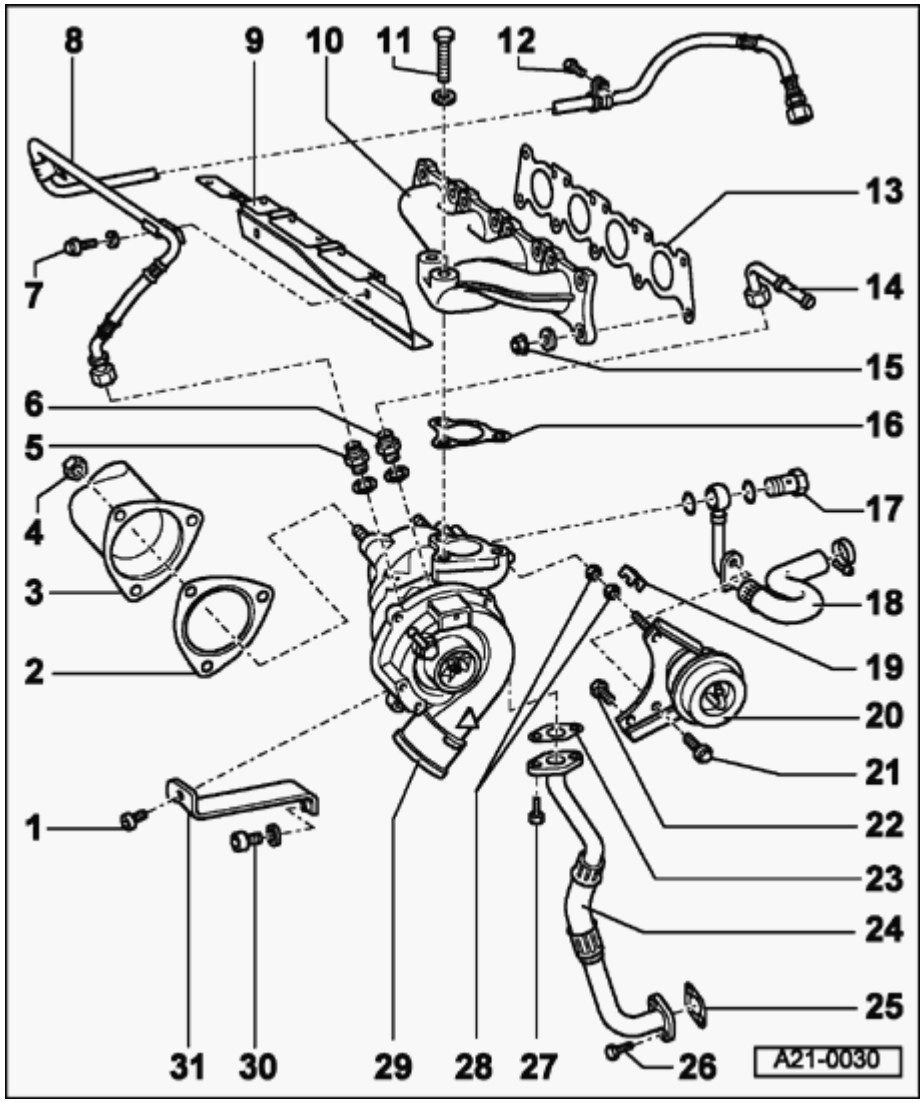
CAUTION!

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)

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

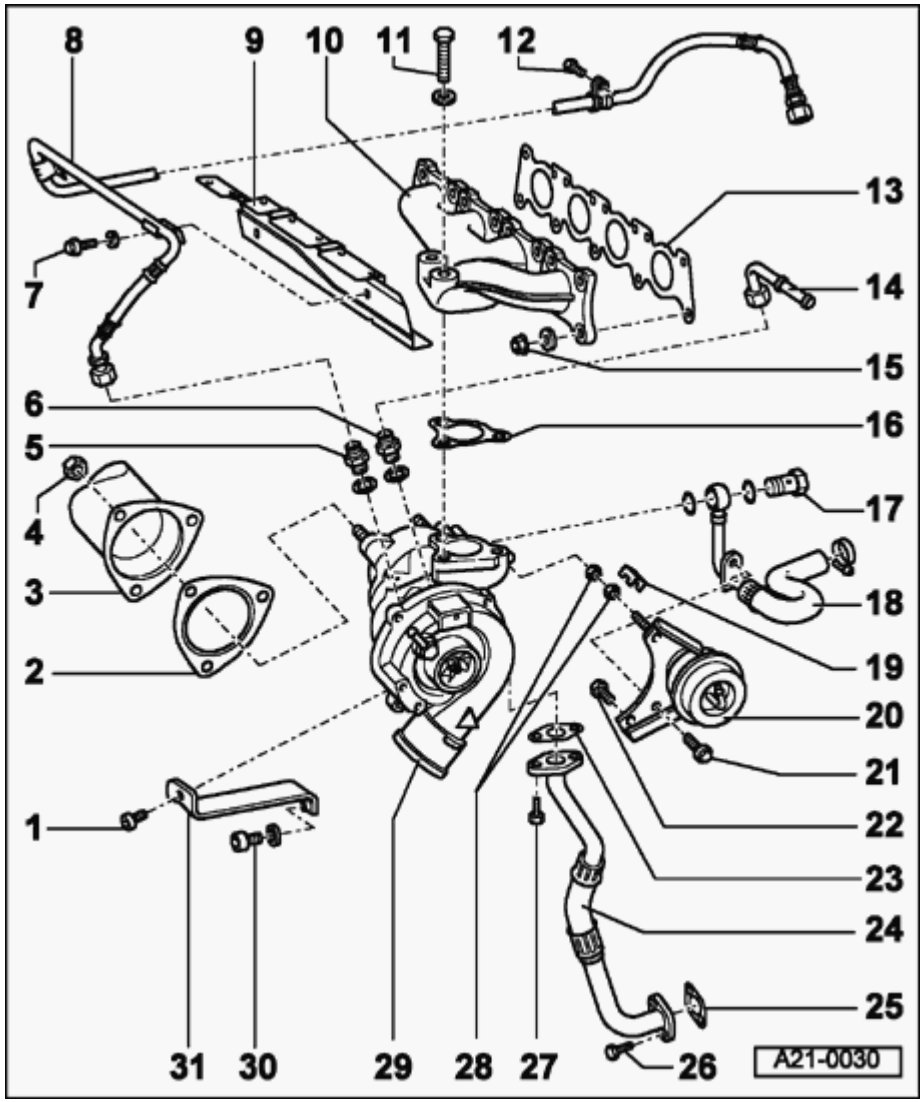
21 - Bolt

- 10 Nm (7 ft lb)

22 - Bolt

- 10 Nm (7 ft lb)
- Install with D 000 600

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

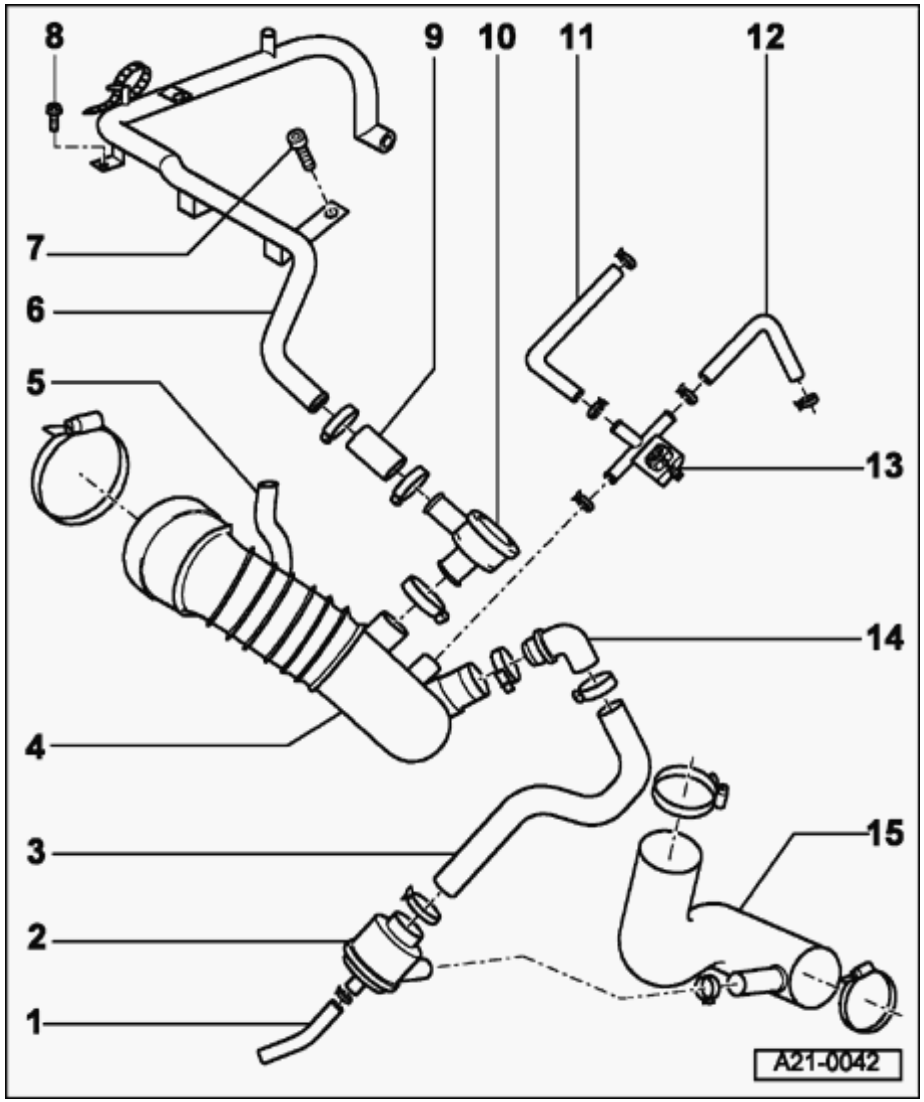
- Check ⇒ Page 21-5

30 - Bolt

- 45 Nm (33 ft lb)

31 - Bracket

21-28



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

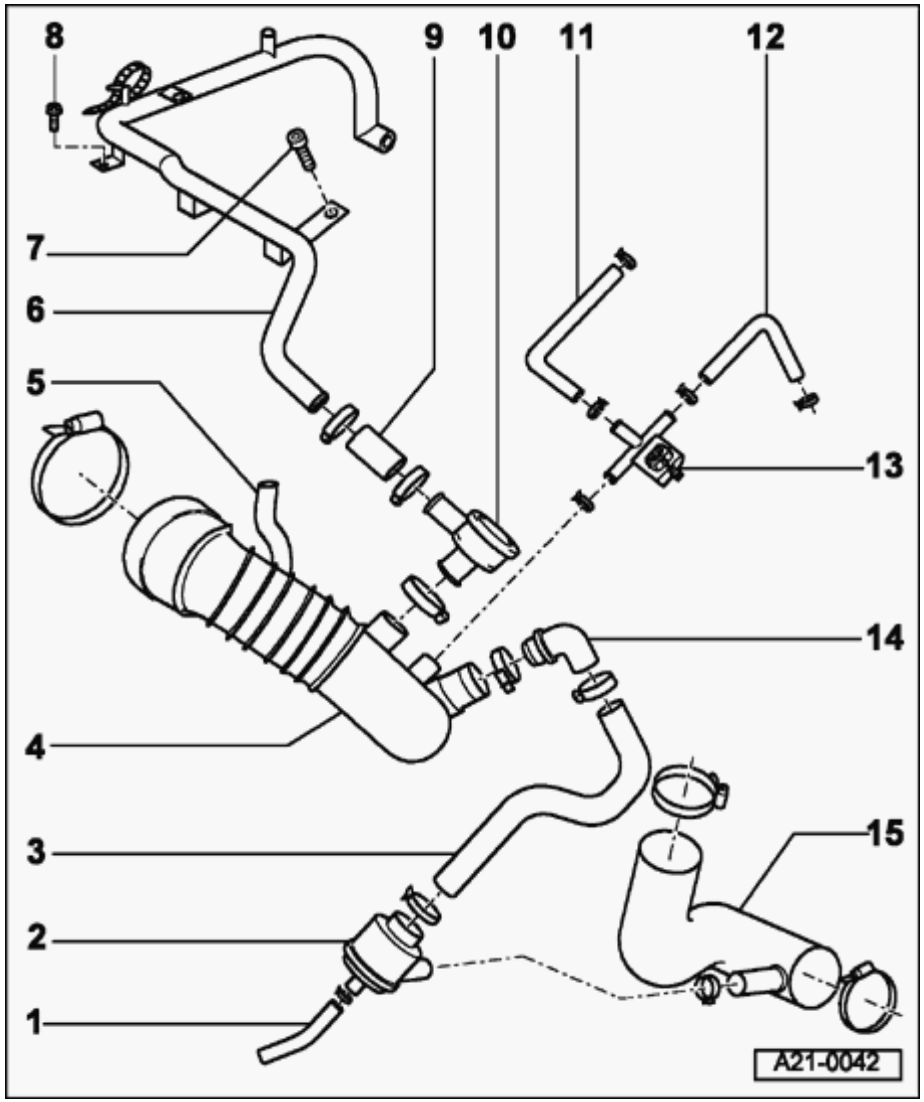
6 - Line

- To crankcase ventilation

7 - Socket-head bolt

- 10 Nm (7 ft lb)

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

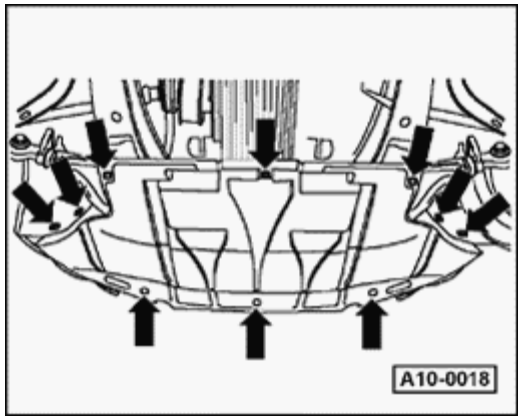
21-30

Turbocharger, removing and installing

Note:

Replace gaskets and self-locking nuts.

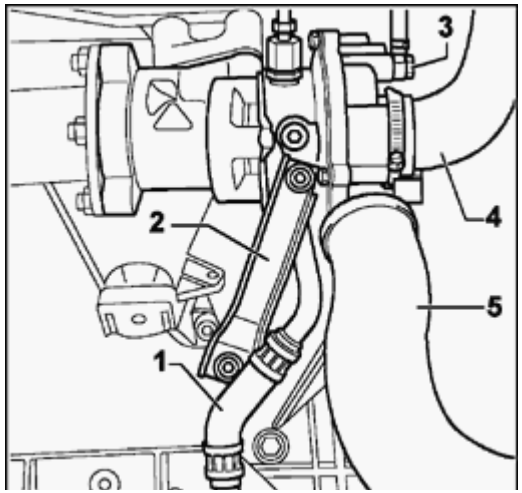
Removing



- Remove noise insulation panel (arrows).
- Unbolt A/C compressor.

WARNING!

Do NOT open A/C refrigerant circuit.



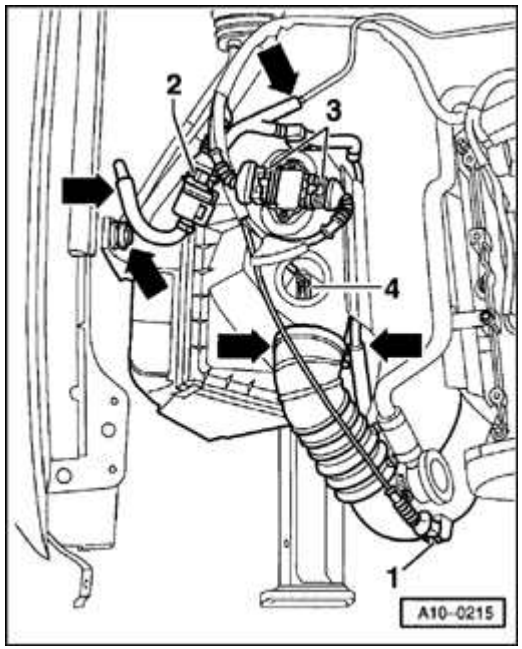
- Unbolt turbocharger bracket -2-.
- Disconnect oil return line -1- at turbocharger and lay aside.
- Remove air guide ducts -4- and -5- at turbocharger.
- Remove pressure line banjo fitting -3-.
- Disconnect hose from support for charge air pressure regulation valve vacuum diaphragm.
- Unbolt bracket for coolant supply line at charge air pressure regulation valve vacuum diaphragm.

- Use 3094 hose clamp to pinch off coolant supply hose.

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-

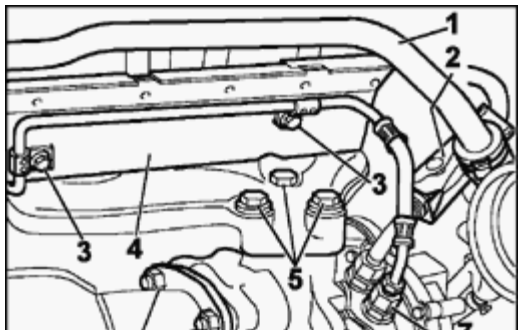
2 - At Evaporative Emissions (EVAP) purge regulator valve -N80-

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.

- Use 3094 hose clamp to pinch off coolant return hose.

- 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:

- 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.

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 .

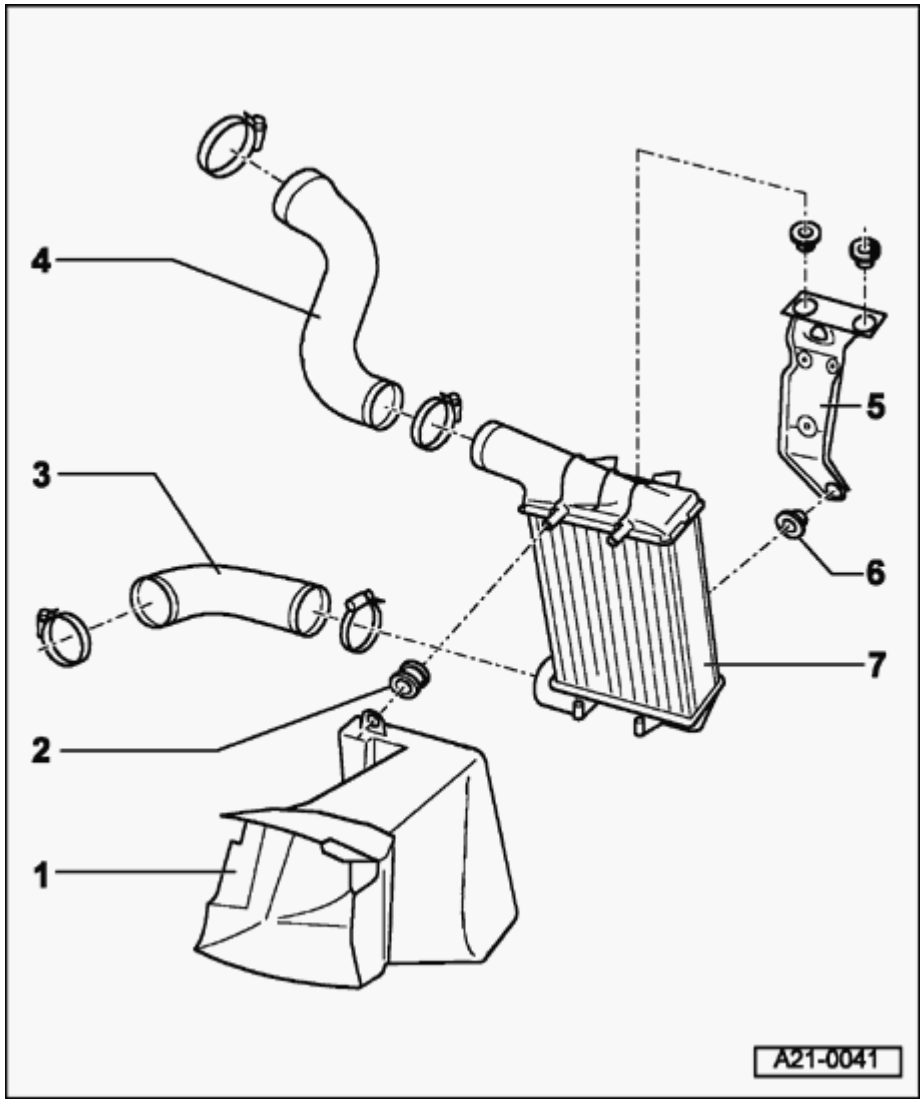
21-34

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

(TWC) to turbocharger	lb)
1) Bolt strength: 10.9	

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

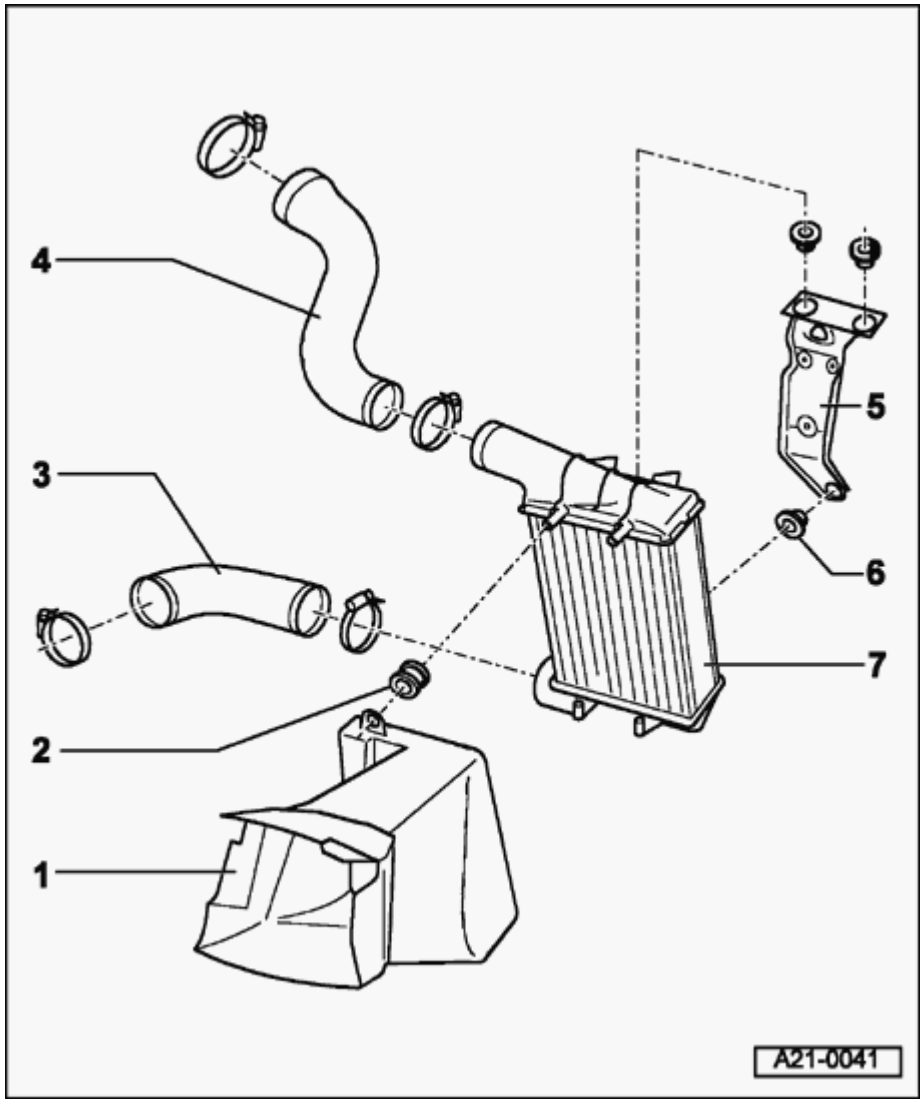
3 - Hose

- Between charge air cooler and air guide in cowl

4 - Hose

- Between intake manifold and charge air cooler

21-36



5 - Bracket

- Riveted to body

6 - Grommet

- With sleeve

7 - Charge air cooler

- Removing and installing ⇒ Page 21-37

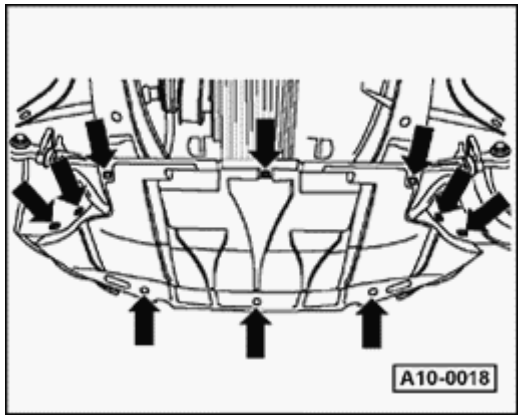
21-37

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.

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.

- 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!).

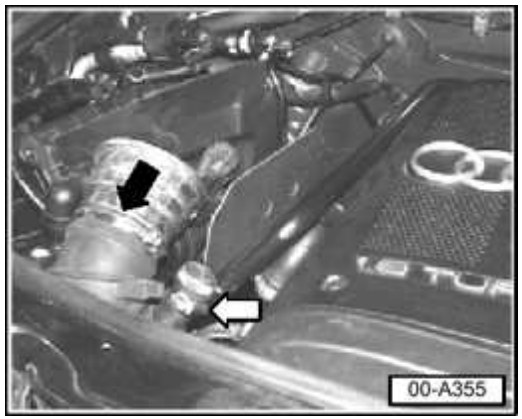
21-17

WARNING!

Use only approved air fittings to adapt shop air supply line to VAG 1687 tester.

Special tool VAG 1687/1 pressure adapter, installing (1.8L Turbo)

- Separate intake hose from Mass Air Flow (MAF) sensor assembly.



- Insert VAG 1687/1 pressure adapter in intake hose -black arrow- using existing clamp (as shown).
- Remove crankcase ventilation tube from intake hose at -white arrow-.

Special tool VAG 1687/1 pressure adapter, installing (2.7L BiTurbo)

- Remove upper air cleaner housing and hoses to intake manifold as necessary

⇒ *Repair Manual, Maintenance; Air cleaner housing, cleaning; Air cleaner element, replacing*



- Insert VAG 1687/1 pressure adapter in intake hose -white arrow- using existing clamp (as shown).
- Disconnect engine crankcase ventilation hose from intake manifold - black arrow-.
- Plug intake manifold fitting (for crankcase ventilation hose) with appropriate hose and metal plug using clamps supplied with VAG

1687/1 special tool kit.

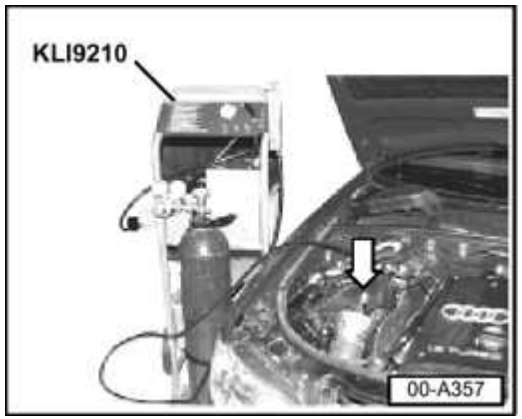
21-18

Note:

- *To help find small leaks, BEFORE pressurizing the system fill system with smoke using special tool KLI9210 and adapter KLI9210/50 as described on ⇒ Page 21-18 .*
- *An ultrasonic detector may also be used to detect extremely small leaks where smoke may not be visible.*

Special tool KLI9210 (Evaporative system leak detector), connecting to 1.8L Turbo

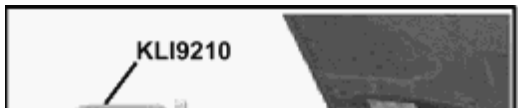
- Install optional fitting LKI9210/50 on hose of special tool KLI9210.



- Connect KLI9210 to VAG 1687/1 adapter (KLI9210 is shown attached to VAG 1687/1 at arrow on 1.8L Turbo).

Special tool KLI9210 (Evaporative system leak detector), connecting to 2.7L BiTurbo

- Install optional fitting LKI9210/50 on hose of special tool KLI9210.



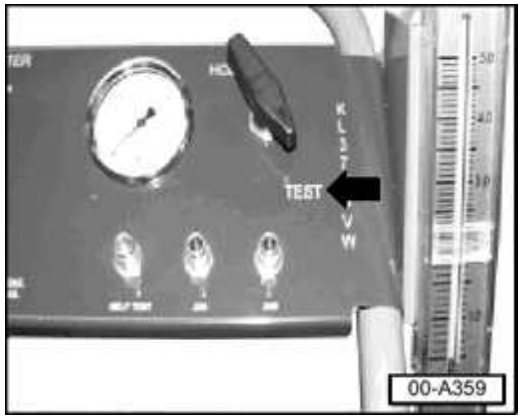
- Connect KLI9210 to VAG 1687/1 adapter (KLI9210 is shown attached

to VAG 1687/1 at arrow on 2.7L BiTurbo).

21-19

Special tool LKI9210 (Evaporative system leak detector), preliminary set-up

- Connect smoke generator leads to vehicle battery.



- Turn valve to test -black arrow-.
- Press smoke generator button to fill system with smoke (see instructions printed on tester).

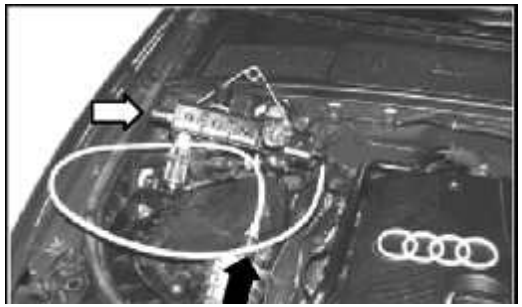
With system filled with smoke:

- Remove smoke generator hose and connect VAG1687 quickly to prevent smoke from leaking out ⇒ Page 21-19 .

Special tool VAG 1687, connecting to pressure adapter VAG 1687/1 (1.8L Turbo)

For illustrations purposes VAG is shown lying in the engine compartment. In practice the tool should be hung from the hood.

- Connect VAG 1687 quickly to prevent smoke from leaking out.



VAG 1687 is shown connected to VAG 1687/1 -black arrow-

Shop air supply will be connected to VAG 1687 -at white arrow-

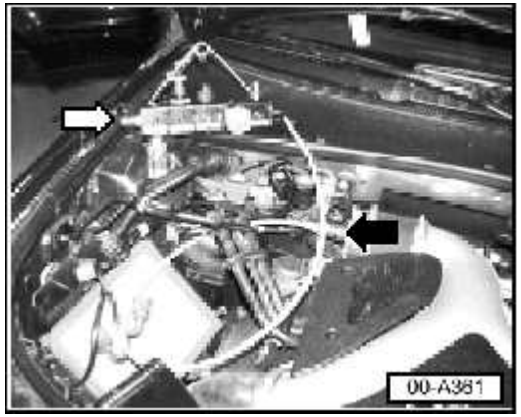
- Perform pressure test ⇒ Page 21-21 .

21-20

Special tool VAG 1687, connecting to pressure adapter VAG 1687/1 (2.7L BiTurbo)

For illustrations purposes VAG is shown lying in the engine compartment. In practice the tool should be hung from the hood.

- Connect VAG 1687 quickly to prevent smoke from leaking out.



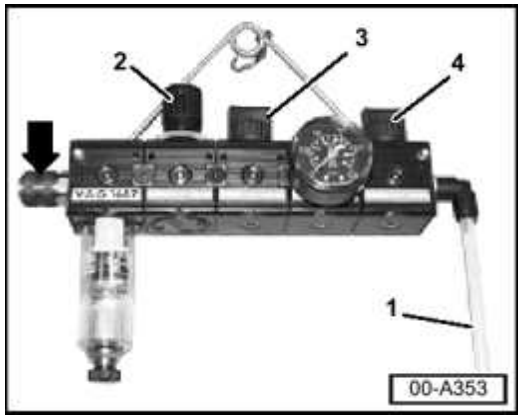
VAG 1687 is shown connected to VAG 1687/1 -black arrow-

Shop air supply will be connected to VAG 1687 -at white arrow-

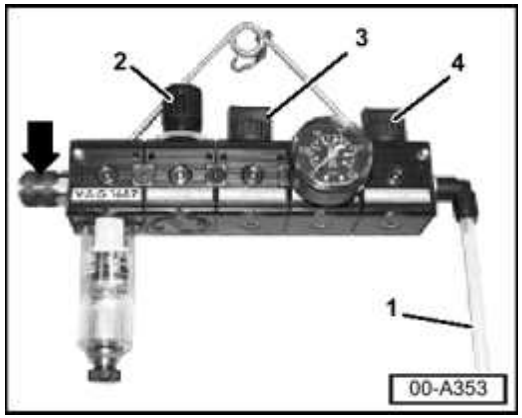
- Perform pressure test ⇒ Page 21-21 .

21-21

Performing pressure test:



- With outlet hose -1- of VAG 1687 connected to air pressure adapter:
- Attach shop air supply line to previously installed male fitting ⇒ Page 21-16 .



- Open valve -3- between regulator valve and gauge.
- Adjust test pressure up to 0.5 bar (⇒CAUTION below) by turning regulator valve -2-.

CAUTION!

- ***DO NOT pressurize the system above 0.5 bar!***
- ***Doing so may force oil into the intake system which can damage the engine.***

- Slowly open outlet valve -4- (after gauge) to test hose connections.
- Observe pressure gauge for a drop in pressure.

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.

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.

21-23

Note:

An ultrasonic detector may also be used to detect extremely small leaks.

- Inspect intake system connections for leaks.
- Repair any leaks found.
- Remove tester.
- Remove plug from crankcase ventilation hose.
- Remove air pressure adapter.

With VAS 5051 diagnostic tool connected:

- Erase DTC memory.

21-24

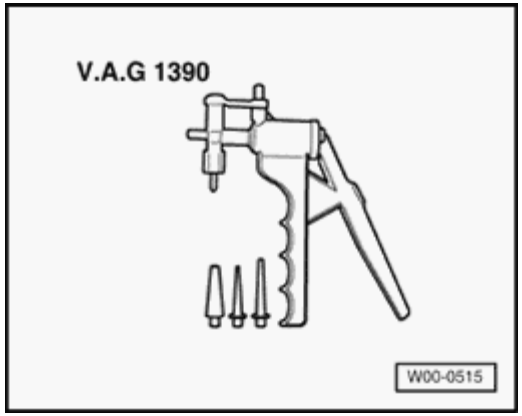
Mechanical air recirculation valve, checking

Note:

- *The mechanical air recirculation valve is upstream of the exhaust turbocharger. It is opened via vacuum by the recirculating valve for turbocharger -N249- under conditions of overrun, idling and partial load. This reduces the charge pressure upstream of the throttle valve. A high turbocharger speed is thus maintained.*

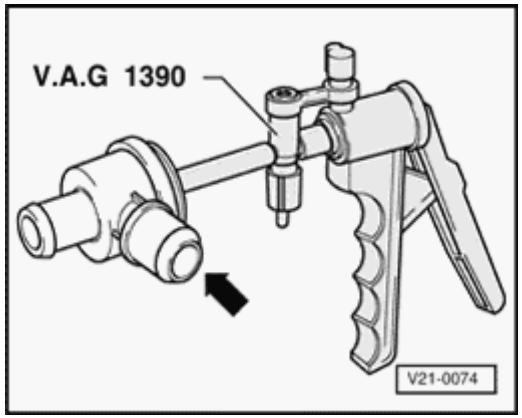
- *Check the air recirculation valve if the engine is not producing full power, or jerking when the throttle is opened and closed.*

Special tools and equipment



- Hand vacuum pump VAG 1390

21-25



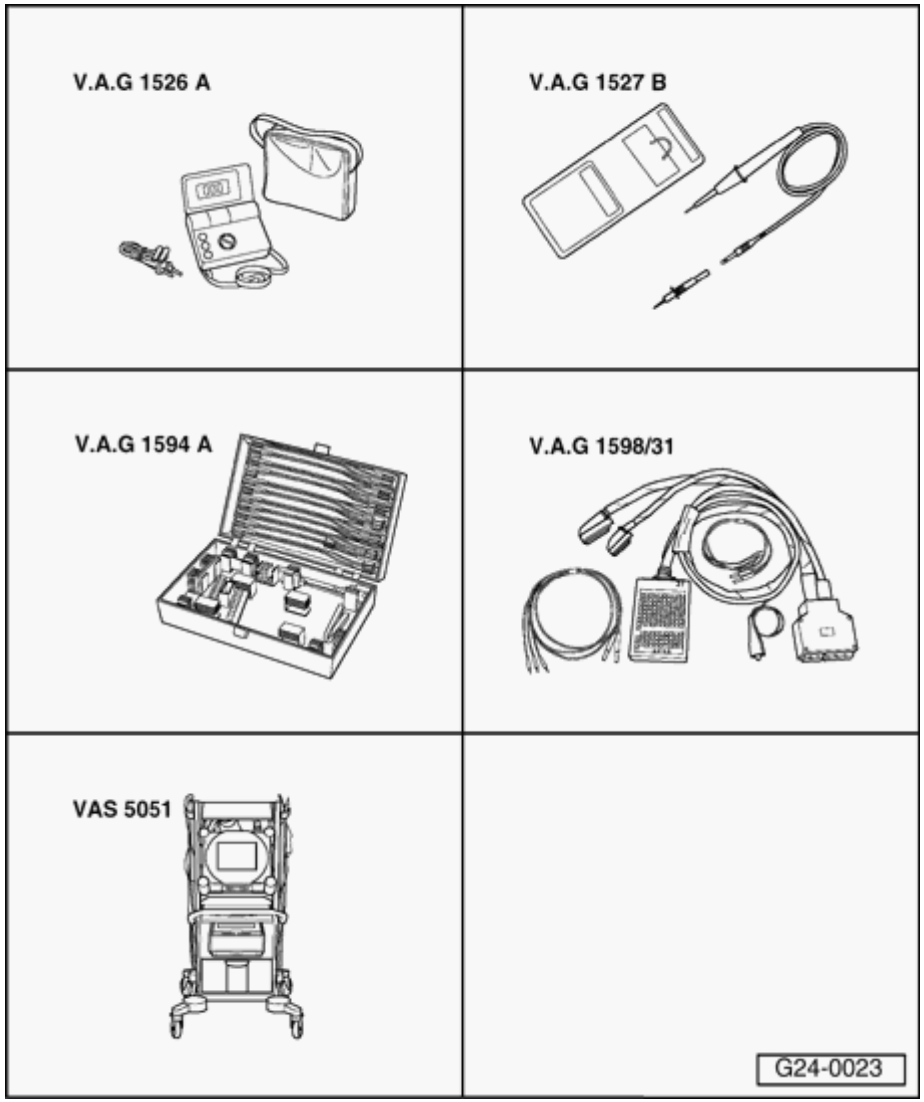
Test sequence

- Attach vacuum pump VAG 1390 to air recirculation valve.
- Actuate hand vacuum pump.
  - Air recirculation valve should open -arrow-
- Operate air vent valve on vacuum pump after about 30 seconds.
  - Air recirculation valve should close -arrow-

If the air recirculation valve does not open and close as specified, or if the valve plate does not seal properly when the valve is closed:

- Replace air recirculation valve and attach hose connections with hose clamps.

21-26



Recirculating valve for turbocharger - N249-, checking

Special tools and equipment

- VAG 1526 A
- VAG 1527 B
- VAG 1594 A
- VAG 1598/31
- VAS 5051 with VAS 5051/1

- or

- VAG 1551 with VAG 1551/3 A

21-27

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551 Scan Tool connected.

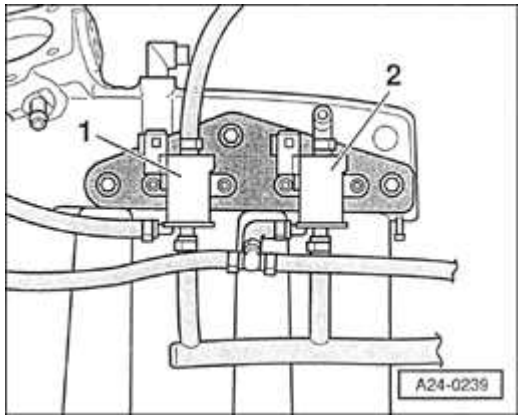
Test sequence

Note:

The recirculating valve for turbocharger -N249- and the wiring connections are monitored by the engine control module.

- Read Diagnostic Trouble Code (DTC) memory of engine control module.

If a DTC relating to the recirculating valve for turbocharger -N249- is displayed:



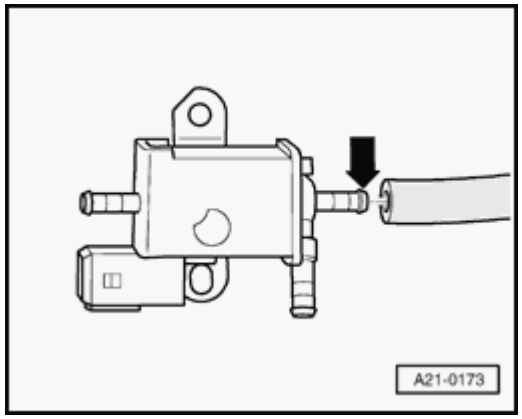
- Remove hoses of recirculating valve for turbocharger -N249- (-1-). The electrical connector remains plugged in.

♦ Location: below intake line

Note:

The illustration shows bottom view of removed intake line.

21-28



Output Diagnostic Test Mode →

Recircul. valve for turbocharger -N249-

- Connect auxiliary hose to valve connector marked with an arrow.
- Initiate output Diagnostic Test Mode (DTM) and activate recirculating valve for turbocharger -N249-.

Display:

- The valve should click ...
- ... and must open and close (check by blowing into the auxiliary hose).

If the injector does not click:

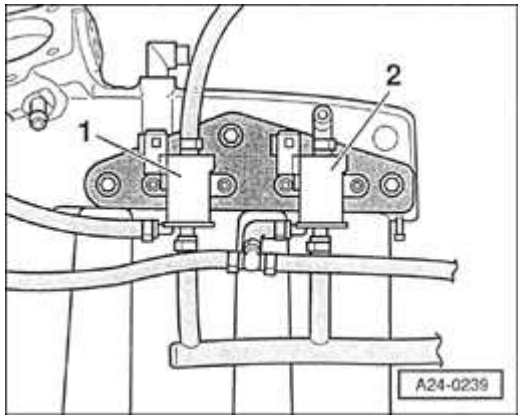
- Check internal resistance of valve.

If valve does not open or close properly:

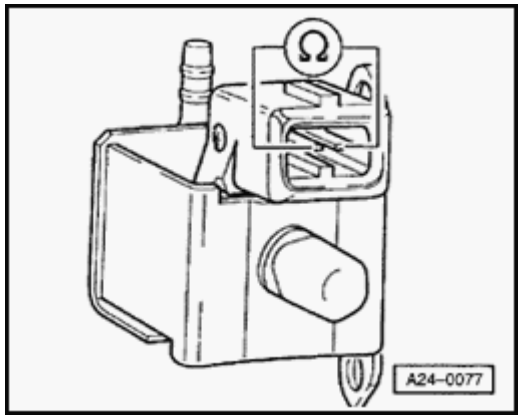
- Replace recirculation valve for turbocharger -N249-.

21-29

Checking internal resistance



- Disconnect connector from recirculation valve for turbocharger -N249- (-1-).



- Connect multimeter to injector to measure resistance.
  - Specified value: 27 to 30 Ω

If specified value is not attained:

- Replace recirculating valve for turbocharger -N249-.

If specified value is attained:

- Check power supply.

21-30

Checking power supply

Note:

The power supply for the recirculating valve is via the fuel pump relay.

Test requirements:

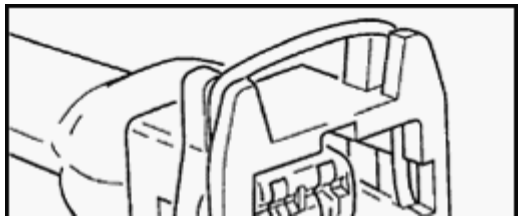
- Fuse for recirculating valve OK.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Fuel pump relay OK.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

- Disconnect wiring connector from valve.



- Connect voltage tester VAG 1527 B as follows:

Connector	Measure to

contact	
1	Engine Ground

- Operate starter briefly.

- The LED must light up.

21-31

If the LED does not light up:

- Check wiring from contact 1 on connector via fuse to fuel pump relay for an open circuit:

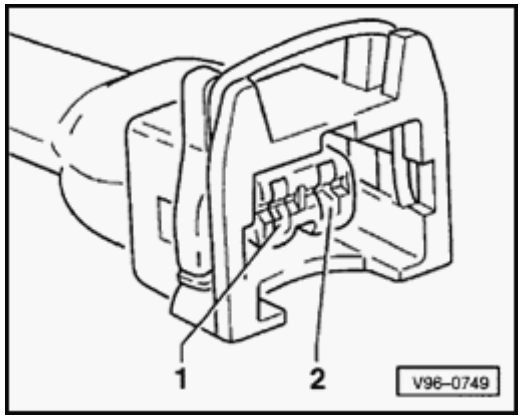
⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Repair open circuit, if necessary.

If the LED lights up:

- Check actuation.

Checking actuation



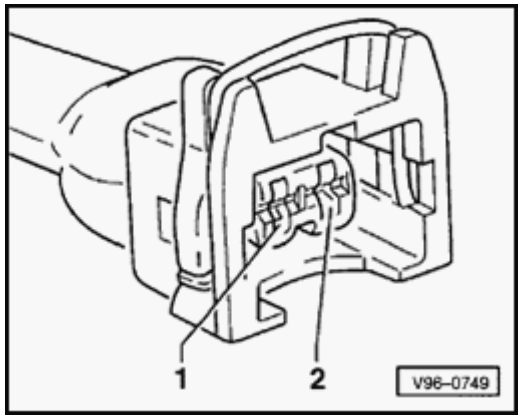
- Connect voltage tester VAG 1527 B to contacts 1 (positive) and 2 of connector.
- Initiate output Diagnostic Test Mode (DTM) and activate recirculatiing valve for turbocharger -N249-.
  - The LED must flash.

21-32

If the LED lamp does not flash or if it lights up continuously:

- Connect VAG 1598/31 test box to wiring harness leading to engine control module; engine control module should not be connected:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



- Check for open circuit and short to positive or Ground in following wiring connection:

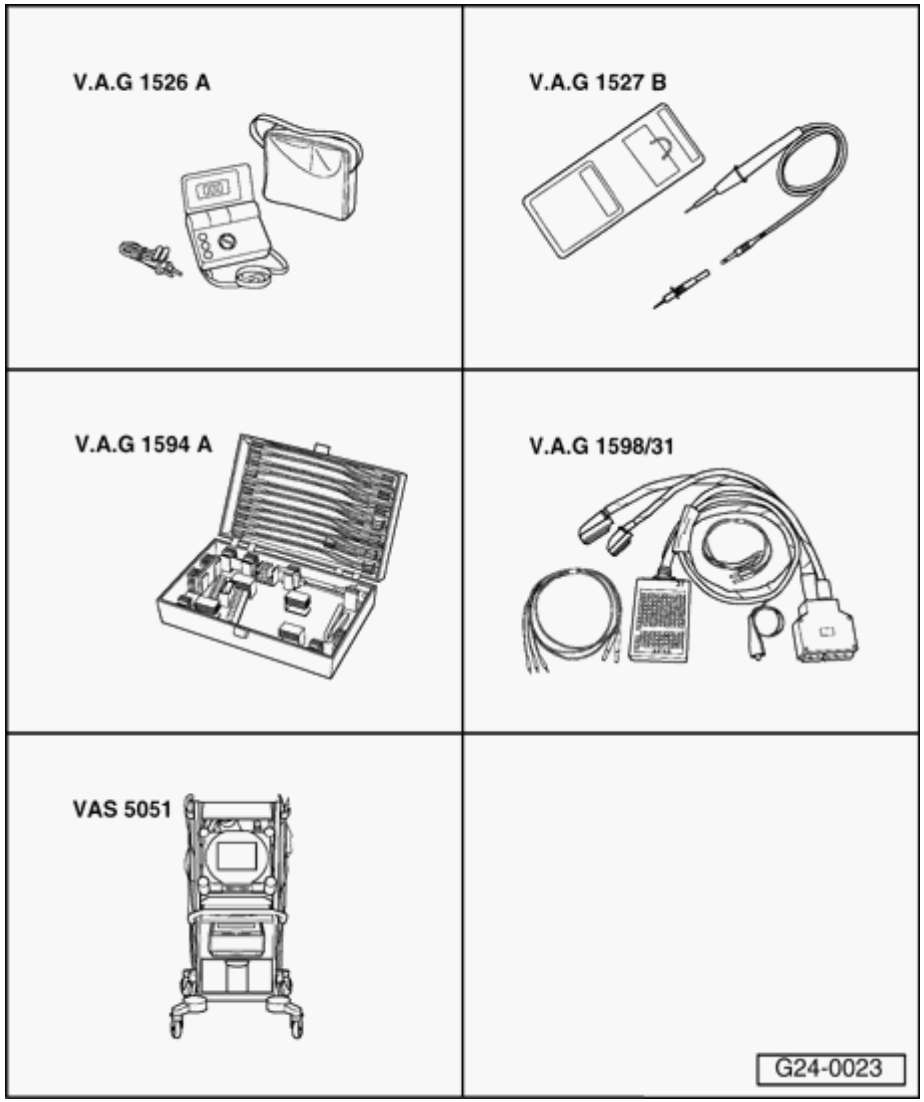
Connector Contact	Test box VAG 1598/31
2	105

- Repair any open/short circuit as necessary.

If the wiring is OK:

- Replace engine control module.

21-33



Wastegate Bypass Regulator valve -N75-, checking

Special tools and equipment

- VAG 1526 A
- VAG 1527 B
- VAG 1594 A
- VAG 1598/31
- VAS 5051 with VAS 5051/1

- or

- VAG 1551 with VAG 1551/3 A

21-34

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551 Scan Tool connected.

Test sequence

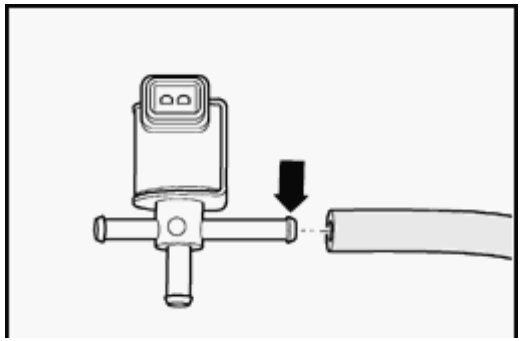
Note:

The Wastegate Bypass Regulator valve -N75- and the wiring connections are monitored by the engine control module.

- Read Diagnostic Trouble Code (DTC) memory of engine control module.

If a DTC relating to the Wastegate Bypass Regulator valve -N75 is displayed:

- Disconnect hoses from valve but leave electrical connector attached.



- Connect auxiliary hose to valve connector marked with an arrow.
- Initiate output Diagnostic Test Mode (DTM) and actuate Wastegate Bypass Regulator valve -N75-.

21-35

Output Diagnostic Test Mode →

-N75- wastegate bypass regulator valve

Display

- The valve must click ...
- ... and must open and close (check by blowing into the auxiliary hose).

If the injector does not click:

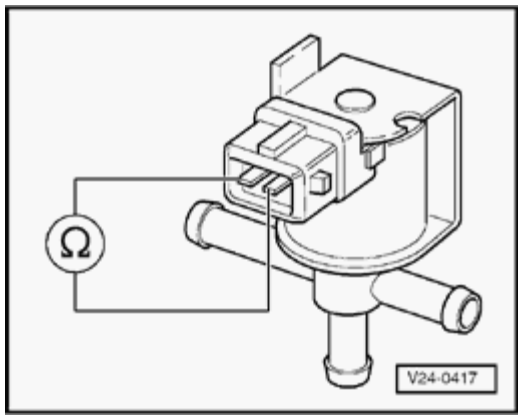
- Check internal resistance of valve.

If valve does not open or close properly:

- Replace Wastegate Bypass Regulator valve -N75-.

Checking internal resistance

- Disconnect connector from valve.



- Connect multimeter to injector to measure resistance.
  - Specified value: 25 to 35 Ω

If specified value is not attained:

- Replace Wastegate Bypass Regulator valve -N75-.

If specified value is attained:

- Check power supply.

21-36

Checking power supply

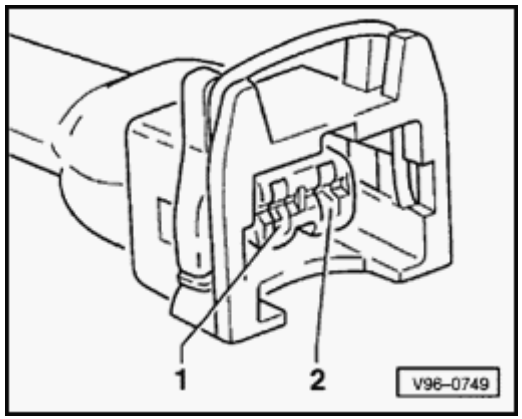
Test requirements:

- Fuse for wastegate bypass regulator valve OK

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Fuel pump relay OK.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



- Connect voltage tester VAG 1527 B as follows:

Connector contact	Measure to
1	Engine Ground

- Operate starter briefly.
  - ♦ LED must light up.

21-37

If the LED does not light up:

- Check wiring from contact 1 on connector via fuse to fuel pump relay for open circuit:

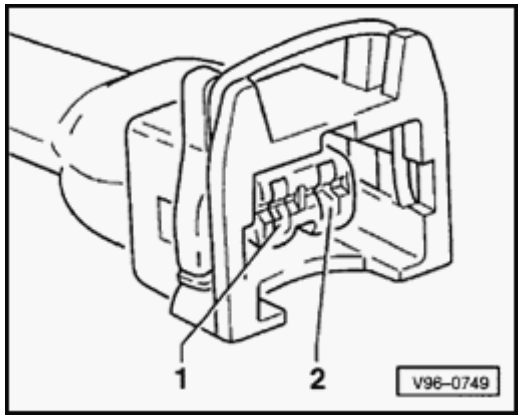
⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Repair open circuit, if necessary

If the LED lights up:

- Check actuation.

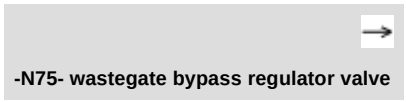
Checking actuation



Output Diagnostic Test Mode

- Connect voltage tester VAG 1527 B to contacts 1 (positive) and 2 of connector.
- Initiate output Diagnostic Test Mode (DTM) and actuate Wastegate Bypass Regulator valve -N75-.

Display



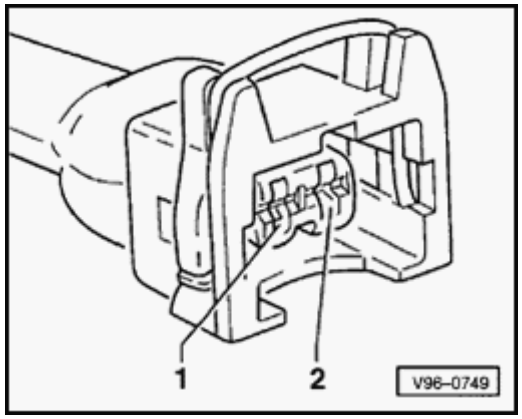
- LED must flash.

21-38

If the LED lamp does not flash or if it lights up continuously:

- Connect VAG 1598/31 test box to wiring harness leading to engine control module; engine control module should not be connected:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



- Check for open circuit and short to positive or Ground in following wiring connection:

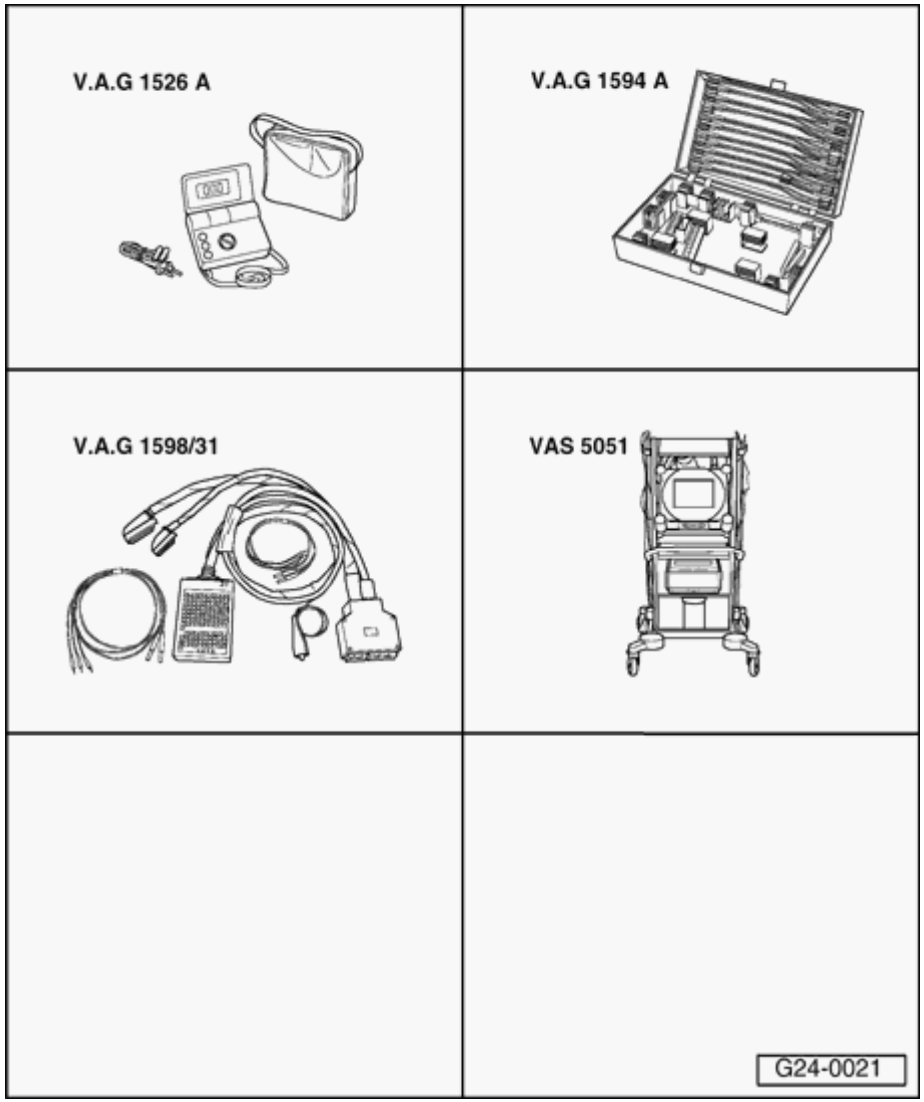
Connector Contact	Test box VAG 1598/31
2	104

- Repair any open/short circuit as necessary.

If the wiring is OK:

- Replace engine control module.

21-39



Charge Air Pressure sensor -G31-, checking

Special tools and equipment

- VAG 1526 A
- VAG 1594 A
- VAG 1598/31
- VAS 5051 with VAS 5051/1

- or

- VAG 1551 with VAG 1551/3 A

21-40

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551Scan Tool connected.

Test sequence

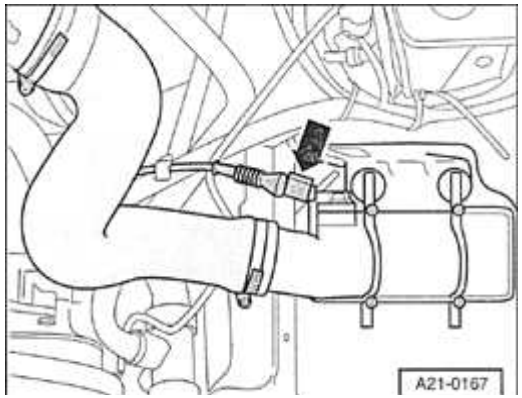
Note:

The Charge Air Pressure sensor -G31- and the wiring connections are monitored by the engine control module.

- Read Diagnostic Trouble Code (DTC) memory of engine control module.

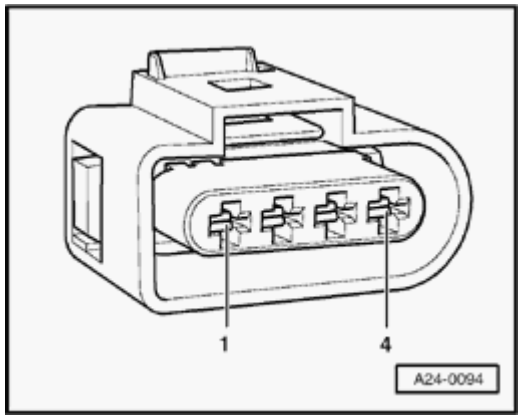
If a DTC relating to the Charge Air Pressure sensor -G31- is displayed:

Checking power supply



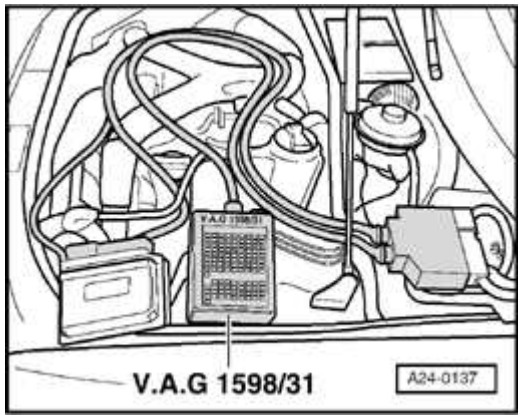
- Disconnect connector -arrow- on charge pressure sender.

21-41



- Connect multimeter between contacts 1 and 3 of connector to measure voltage.
- Switch ignition on.
  - Specified value: approx. 5 V

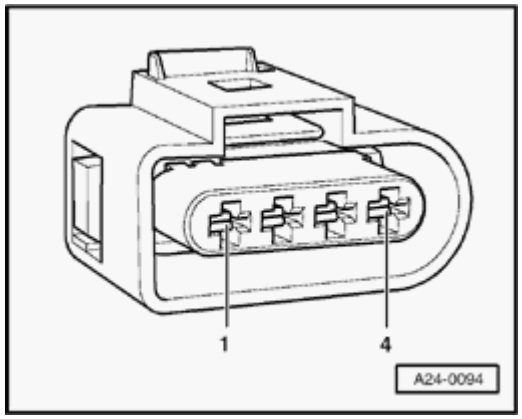
If specified value is not attained:



- Connect VAG 1598/31 test box to wiring harness leading to engine control module; engine control module must also be connected.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

21-42



- Check for open circuit and short to positive or Ground in following wiring connections:

Connector contact	Test box VAG 1598/31
1	108
3	98

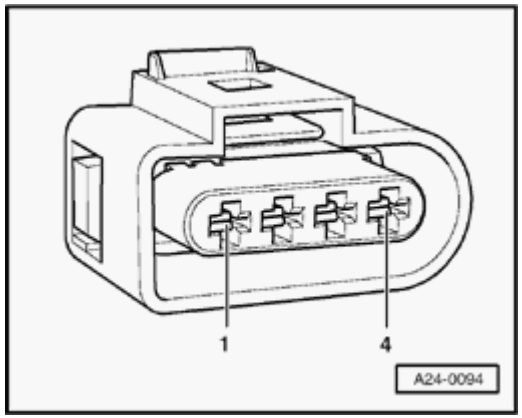
- Repair any open/short circuit as necessary.

If specified value is attained:

Checking signal wire

- Attach connector from charge air pressure sensor.
- Attach multimeter for voltage test to socket 101 and socket 108 of test box.
- Start engine and run at idling speed.
  - Specified value: approx. 1.90 V
- Bring engine to speed by spontaneous acceleration.
  - Specified value: 2.00...3.00 V

21-43



If specified values are not attained:

- Check for open circuit and short to positive or Ground in following wiring connection:

Connector contact	**Test box VAG 1598/31**
4	101

- Repair any open/short circuit as necessary.

If the wiring is OK:

- Replace Charge Air Pressure sensor -G31-.

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.*

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.

Safety precautions

If special testing equipment is required during test drive, note the following:

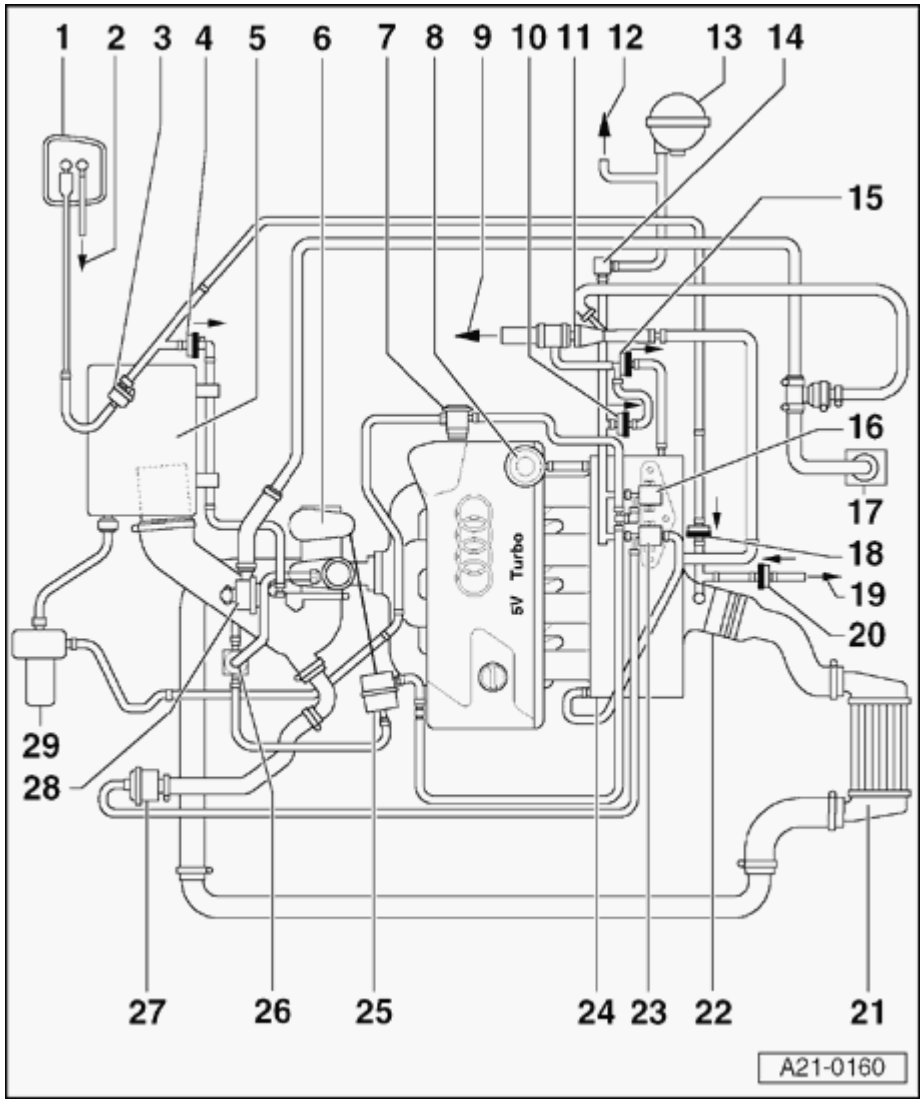
Do not operate test and measuring equipment from the passenger seat. In the event of an accident involving deployment of the passenger-side airbag, the person seated there could be injured.

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.***

21-41



Charge air pressure regulation and secondary air system vacuum control system

1 - EVAP canister

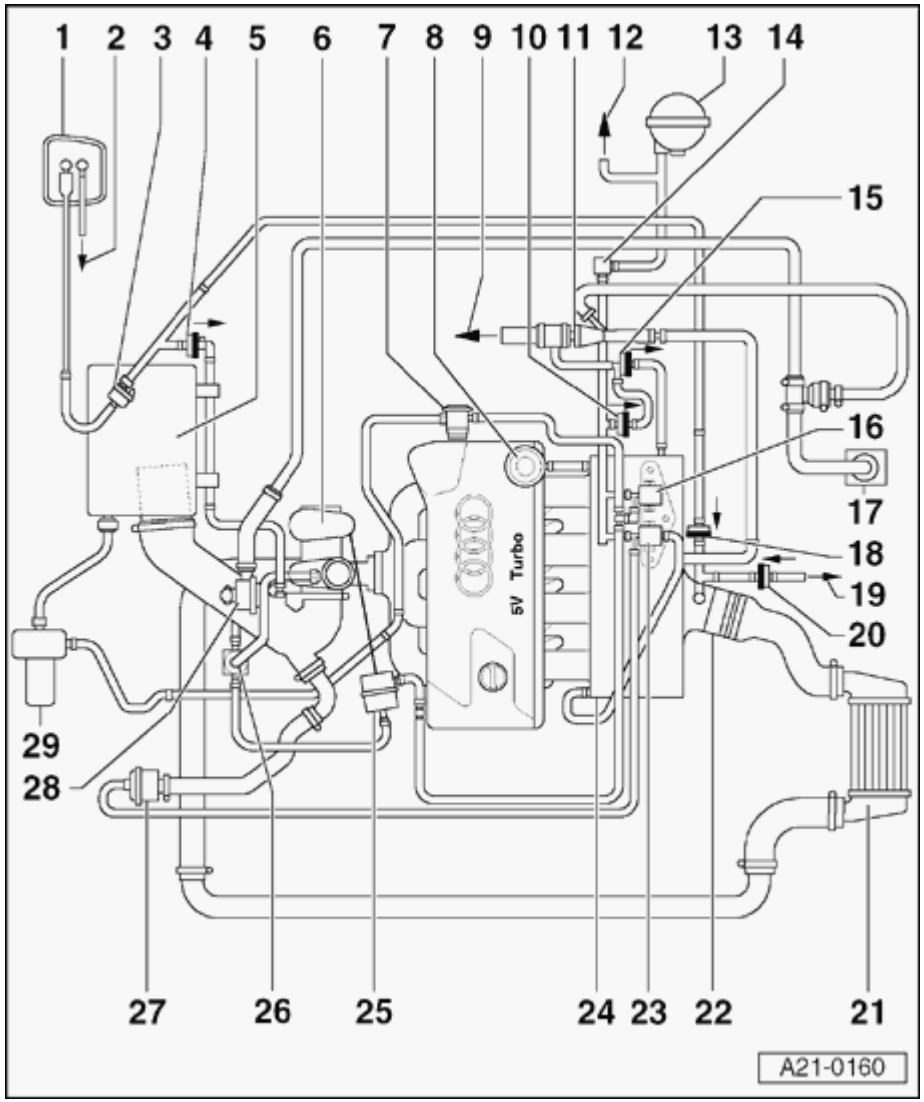
2 - From fuel tank

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



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

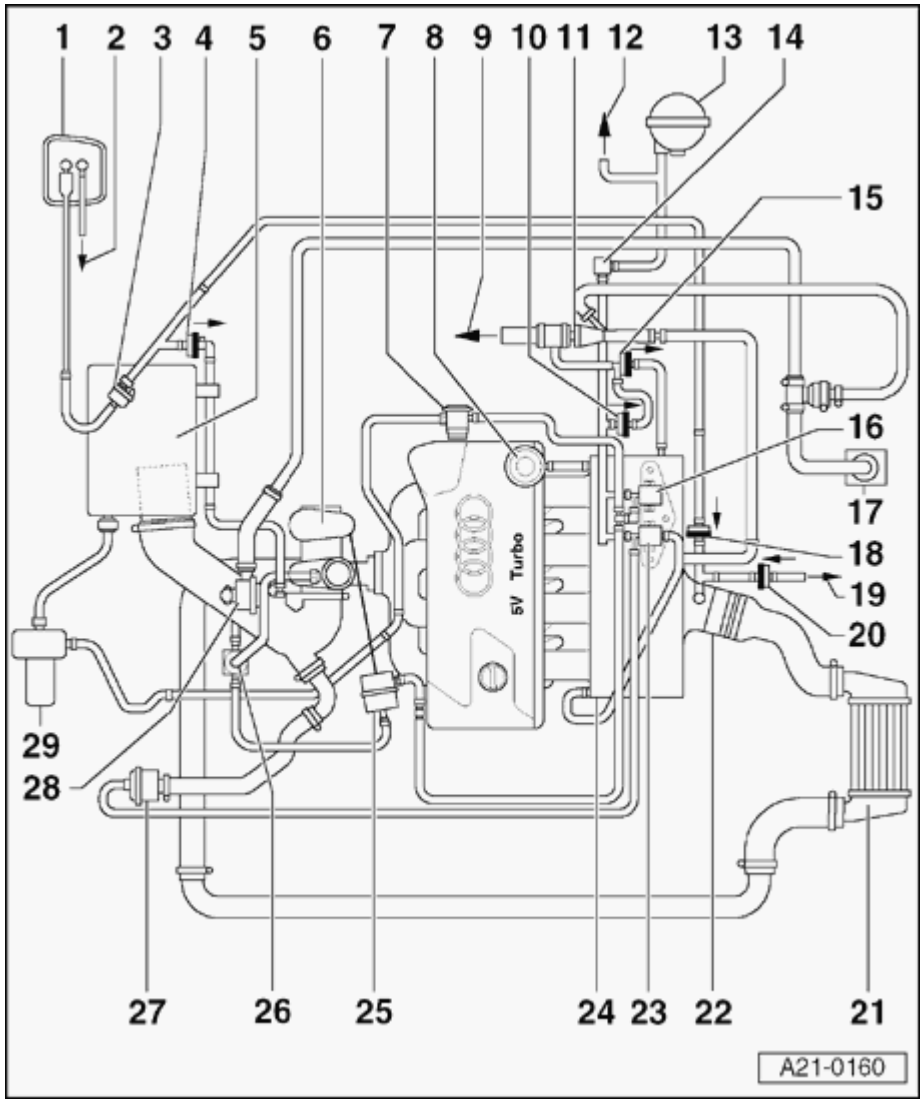
10 - Check valve

- 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



14 - Distributor piece

15 - Check valve

- Installation position (light/dark side): Arrow points in direction of flow, as shown

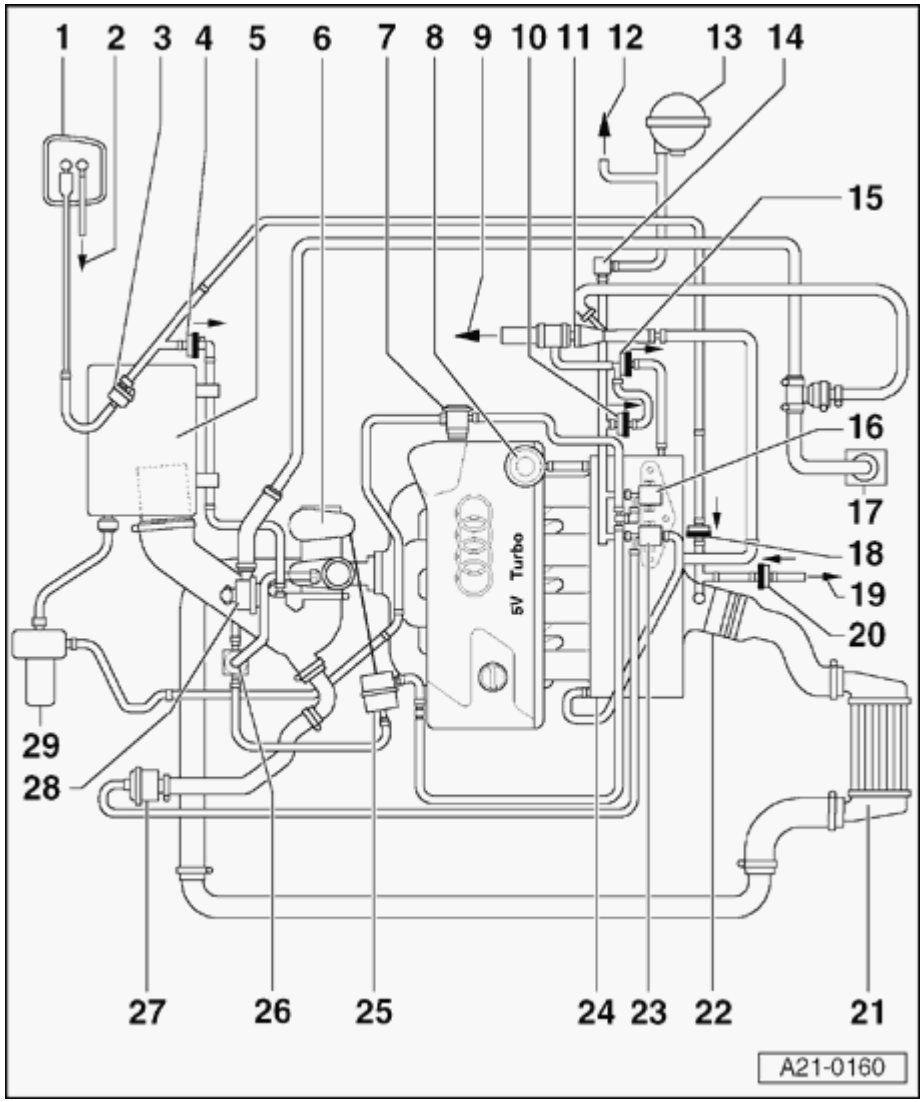
16 - Secondary Air Injection (AIR) solenoid valve -N112-

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-



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-

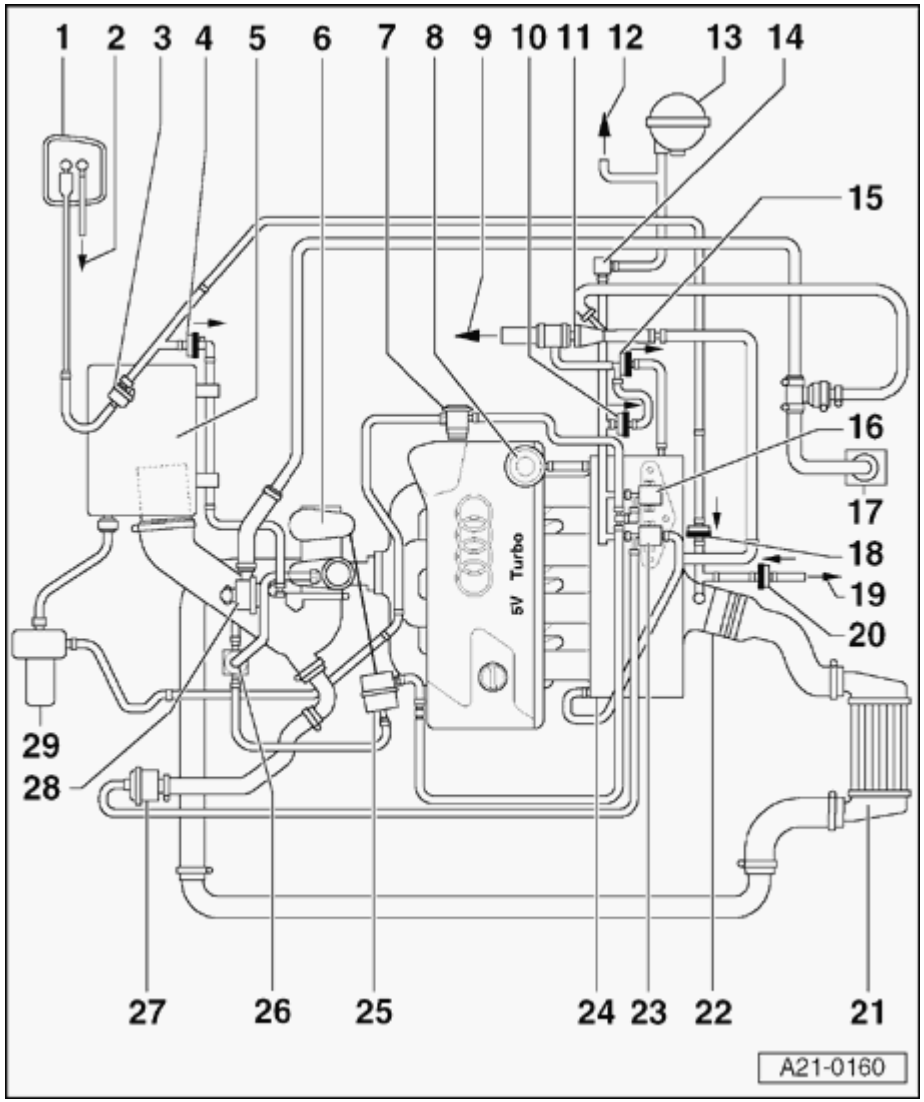
22 - Throttle valve control module -J338-

23 - Recirculating valve for turbocharger - N249-

- Checking ⇒ Page 21-48

24 - Intake manifold

- With Intake Air Temperature (IAT) sensor - G42-



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-

21-44

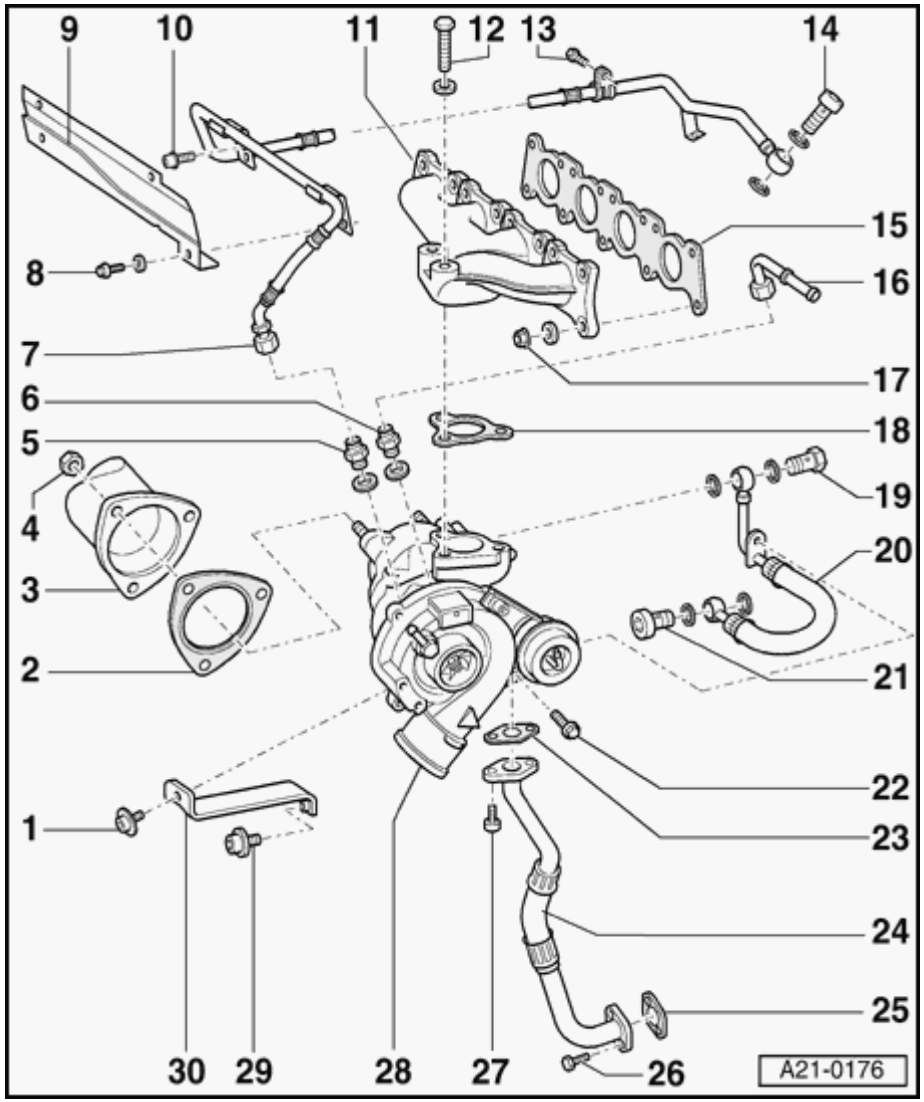
Charge pressure system with exhaust turbocharger, servicing

Rules for cleanliness

When working on the exhaust gas turbocharger, pay careful attention to the following 5 rules:

- Thoroughly clean all unions and the adjacent areas before disconnecting.
- Place removed parts on a clean surface and cover. Use lint-free cloths.
- Carefully cover or seal open components if repairs cannot be carried out immediately.
- Only install clean components: Only remove replacement parts from packaging immediately prior to installation. Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- When the system is open: Do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.

21-45



Turbocharger, removing and installing - Overview

Part I

1 - 30 Nm

- Only use original bolt

⇒ *Parts Catalog*

2 - Gasket

- Always replace

3 - Catalytic converter

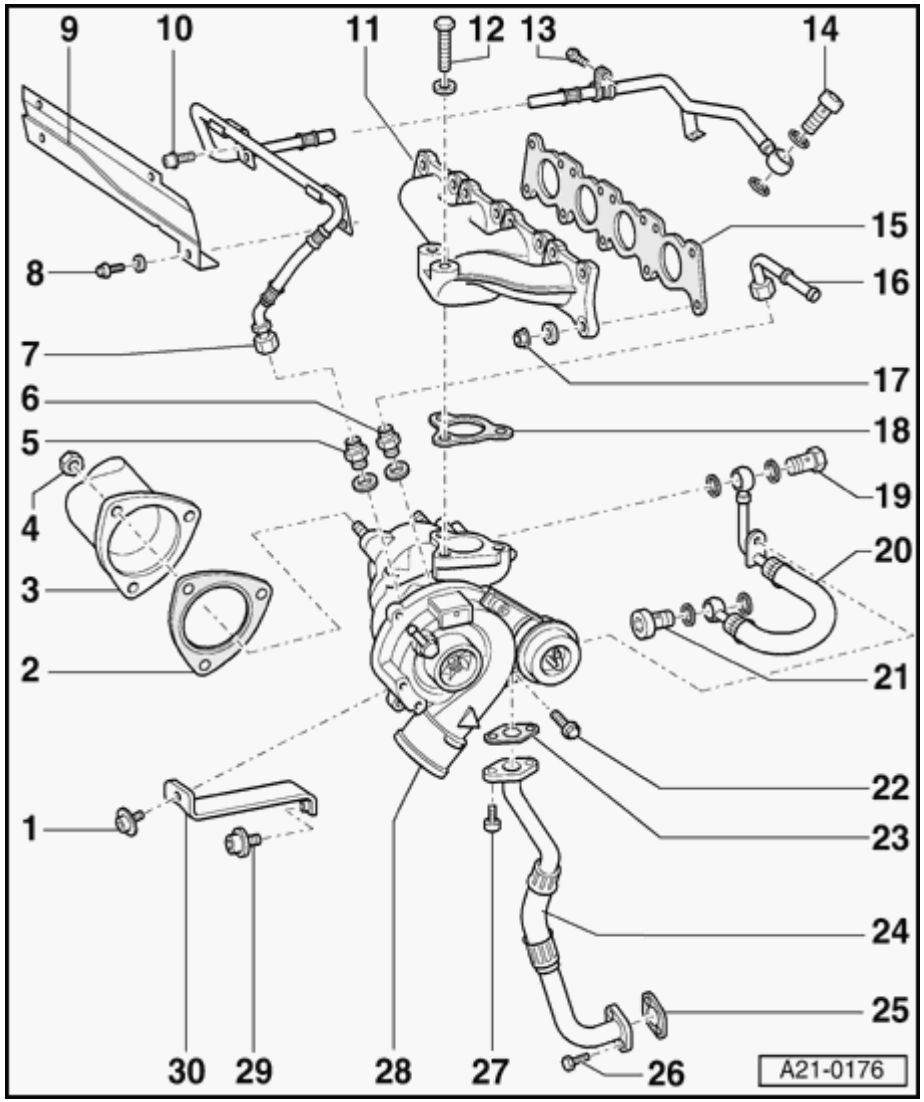
4 - 30 Nm

- Always replace

5 - 30 Nm

6 - 35 Nm

21-46



7 - Oil supply line

- Tighten union nut to 23 Nm
- From oil filter bracket ⇒ -Item 24 -, ⇒ Page 17-10

8 - 3.5 Nm

9 - Heat shield

10 - 23 Nm

11 - Exhaust manifold

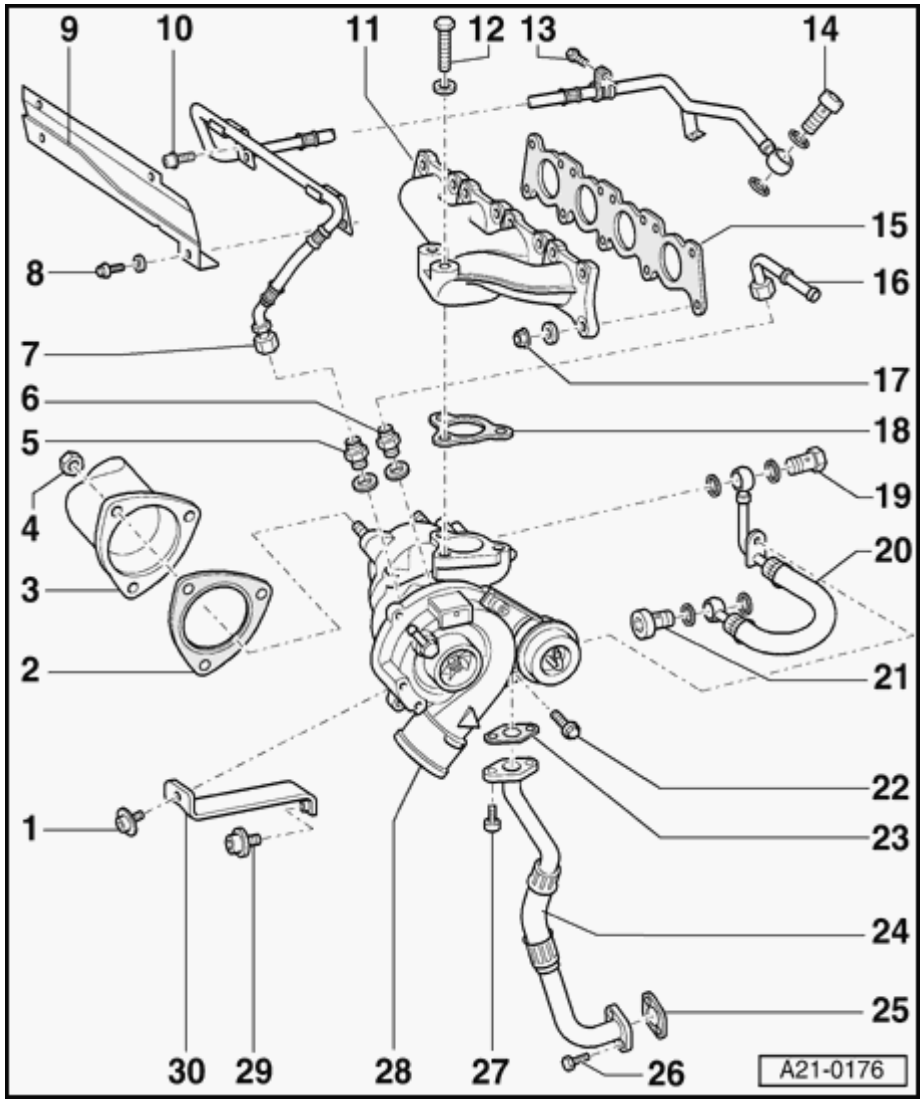
- Removing and installing ⇒ Page 26-21

12 - 35 Nm

- Always replace
- Coat thread and head attachment area with high temperature lubricant G 052 112 A3

13 - 10 Nm

21-47



14 - Banjo bolt - 30 Nm

15 - Gasket

- Always replace
- Note installation position

16 - Coolant return line

- Tighten union nut to 30 Nm

17 - 30 Nm

- Always replace

18 - Gasket

- Always replace
- Note installation position

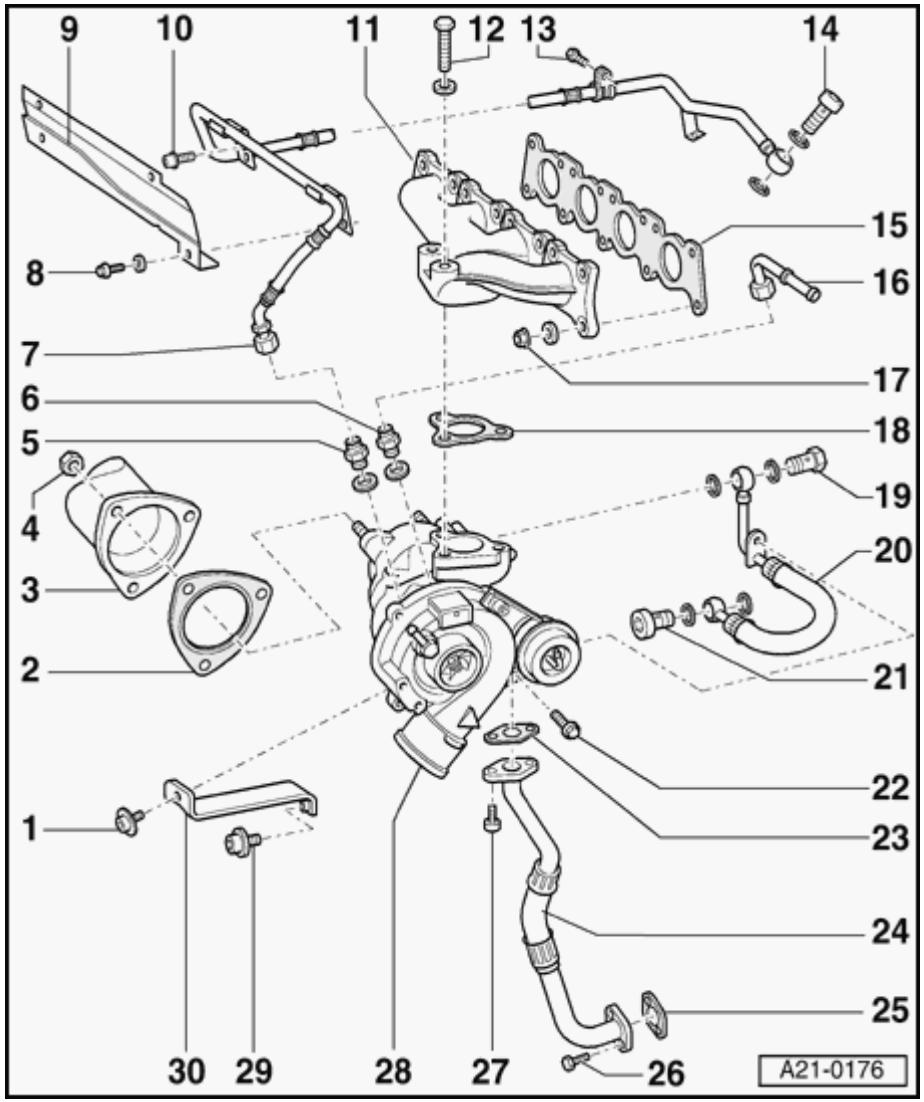
19 - Banjo bolt - 35 Nm

20 - Coolant supply hose/line

21 - Banjo bolt - 35 Nm

- Apply D 000 600 when installing

21-48



22 - 10 Nm

- Apply D 000 600 when installing

23 - Gasket

- Always replace

24 - Oil return line

- To oil pan

25 - Gasket

- Always replace

26 - 10 Nm

27 - 10 Nm

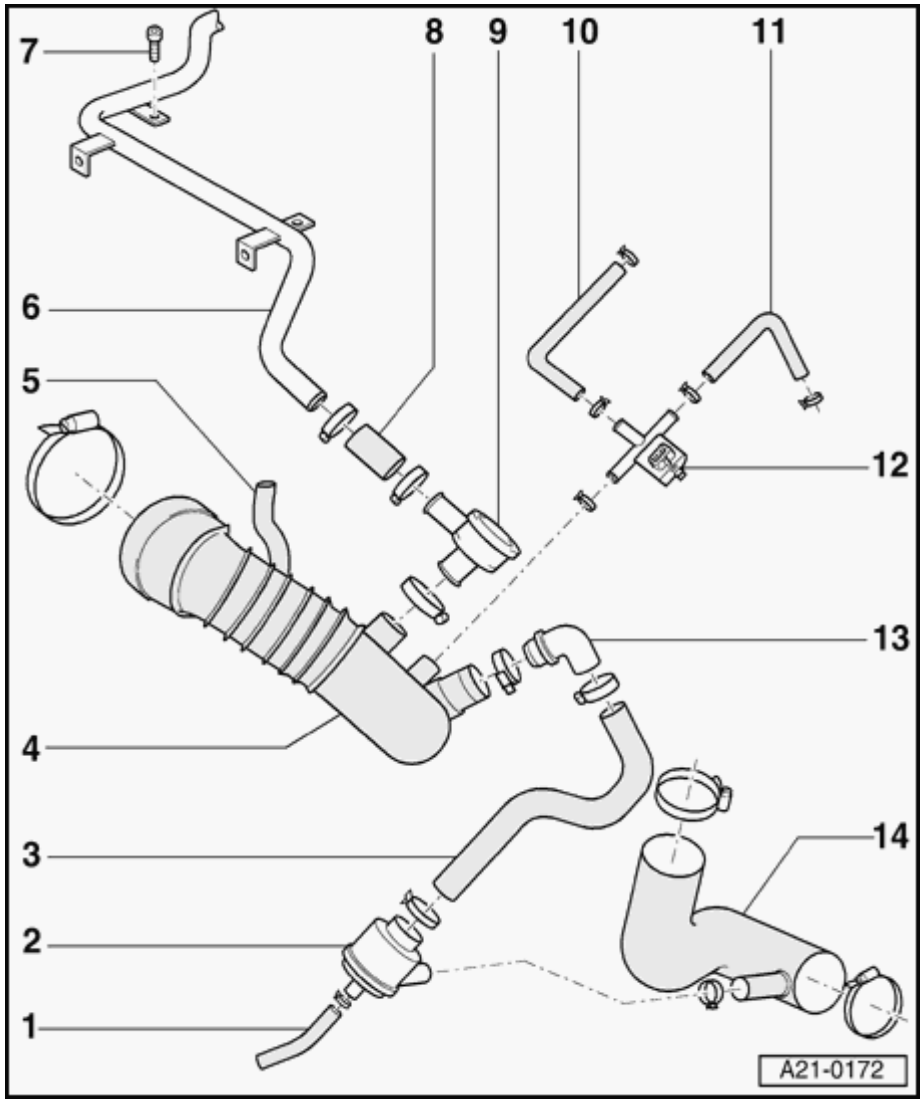
28 - Turbocharger

- Checking ⇒ Page 21-8

29 - 25 Nm

30 - Bracket

21-49



Part II

1 - Vacuum hose

- To Recirculatiing valve for turbocharger - N249-

2 - Recirculating valve

- Checking ⇒ Page 21-24

3 - Hose

- To recirculating valve

4 - Air duct hose

- To connection on turbocharger

5 - Hose

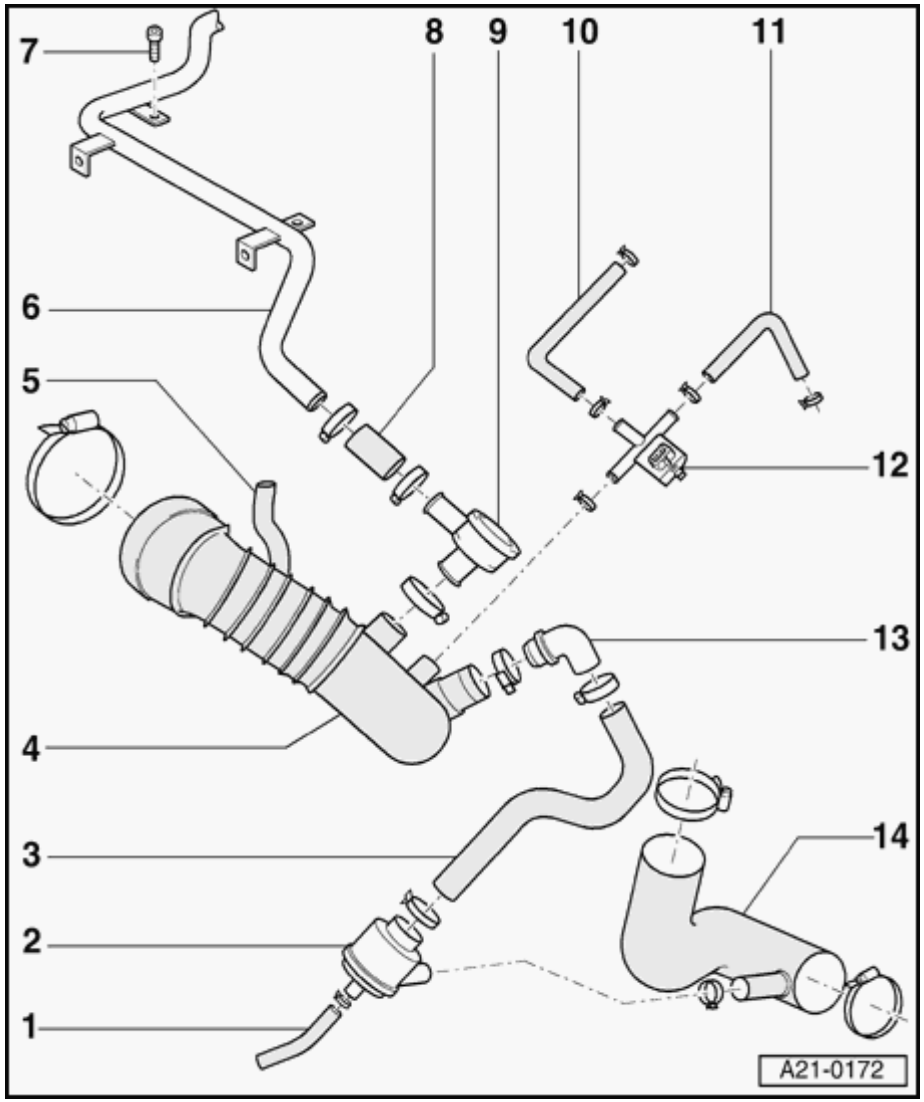
- To ACF valve

6 - line

- To crankcase vent

7 - 10 Nm

21-50



8 - Hose

- To crankcase breather line

9 - Pressure regulating valve

- For crankcase breather

10 - Hose

- To turbocharger

11 - Hose

- To vacuum unit for charge pressure regulating valve

12 - Wastegate Bypass Regulator valve -N75-

13 - Angled connector

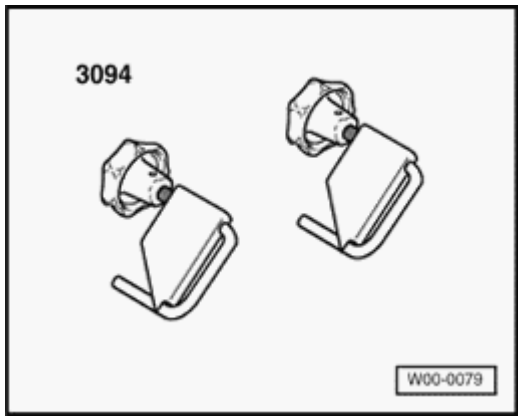
14 - Hose

- To turbocharger

21-51

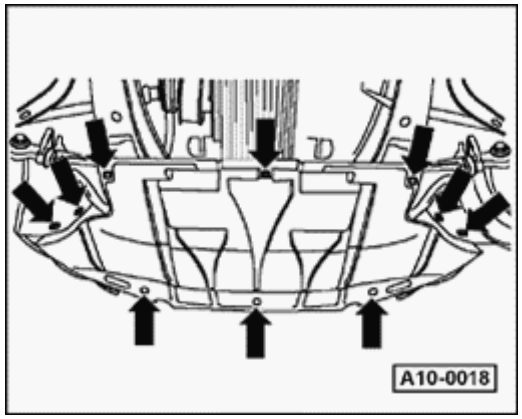
Turbocharger, removing and installing

Special tools and equipment



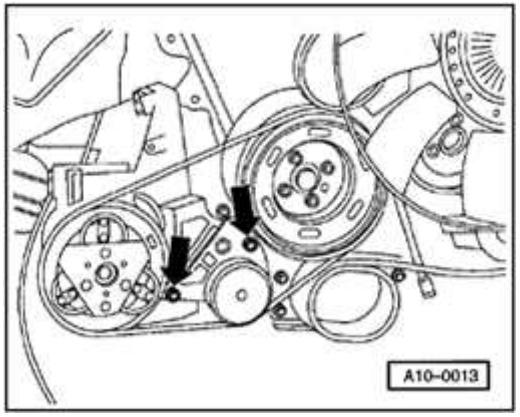
- Hose clamps 3094

Removing



- Remove sound insulation -arrows-.

21-52

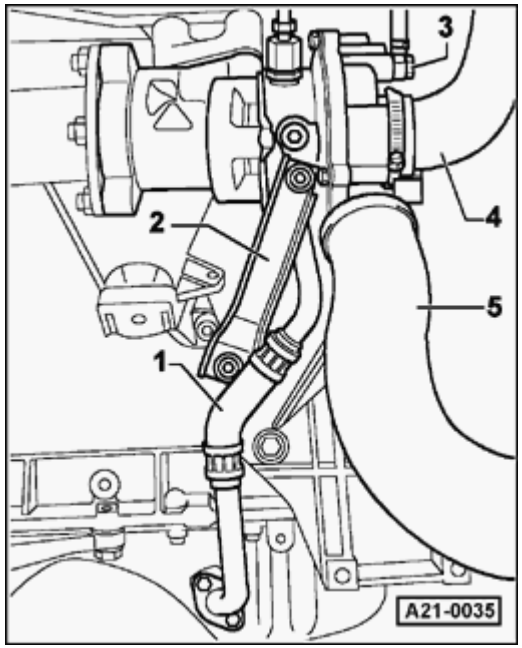


- Loosen bolts securing ribbed belt tensioning roller for A/C compressor -arrows-. Loosen belt and remove.

CAUTION!

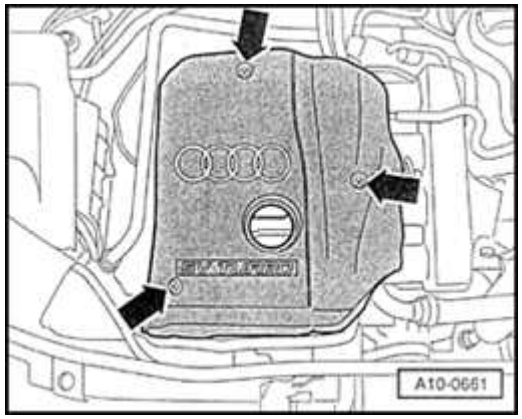
The air conditioner refrigerant circuit must not be opened.

- Disconnect A/C compressor from bracket and secure to body with wire.

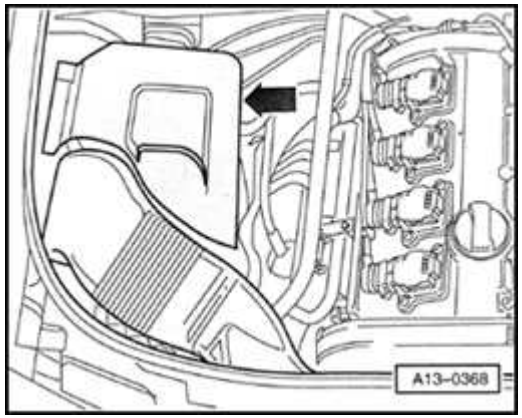


- Remove bracket for exhaust turbocharger -2-.
- Unscrew oil return line -1- from exhaust turbocharger and set aside.
- Loosen air duct hoses -4- and -5- on exhaust turbocharger.
- Remove banjo bolt -3- for pressure line.

21-53

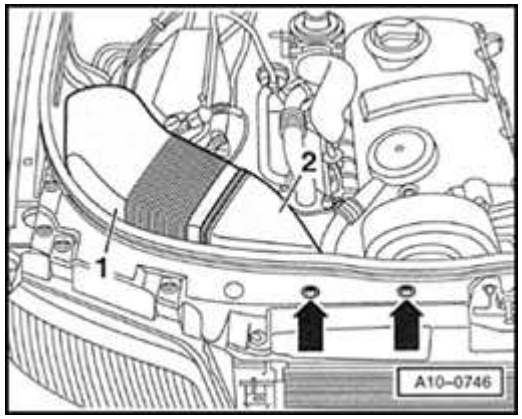


- Remove engine cover -arrows-.

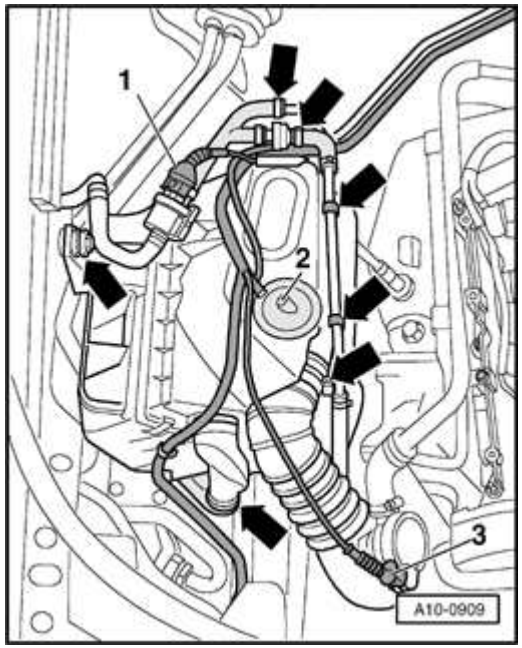


- Remove air filter cover -arrow-.

21-54



- Remove bolts -arrows-.
- Remove air duct -1- and -2-.



- Disconnect wiring connectors as follows:

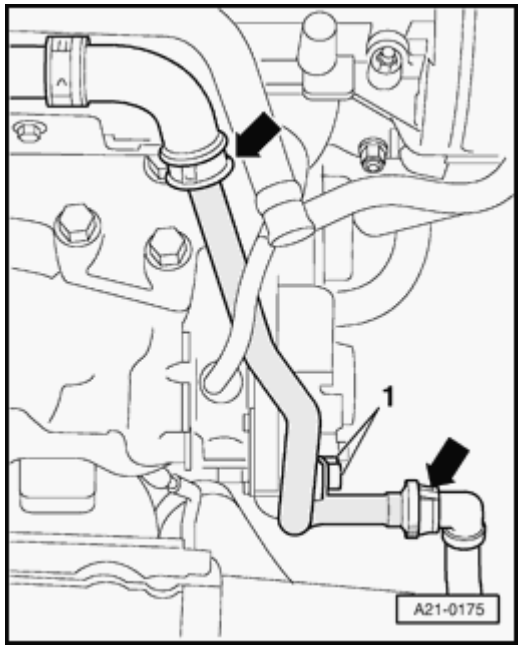
1 - on ACF valve (in addition, remove ACF valve from air filter housing)

2 - on mass air flow sensor

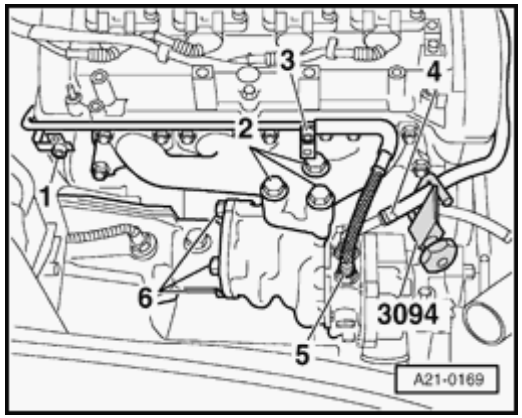
3 - on Wastegate Bypass Regulator valve -N75-

- Move wiring aside and remove air filter housing -arrows-.

21-55

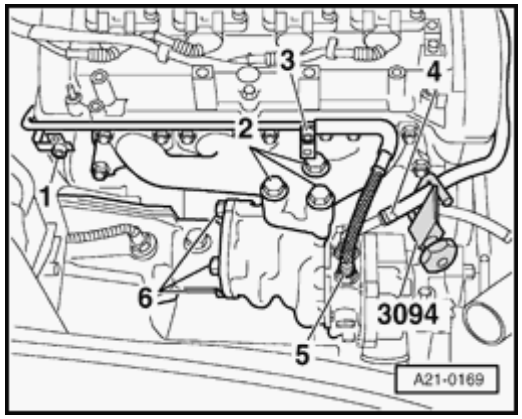


- Remove secondary air inlet line by disconnecting hoses -arrows- and removing bolts -1-.
- Remove right-hand heat shield on cylinder head.
- Remove hose of vacuum unit for wastegate bypass regulator valve - N75- on exhaust turbocharger.
- Unbutton sleeve on coolant return hose.



- Clamp coolant return hose to exhaust turbocharger with hose clamp 3094.
- Loosen hose clamp -4- and remove coolant return hose from exhaust turbocharger line.

21-56



- Loosen bolts -1- and -3- of oil feed line.
- Remove oil feed line -5- at exhaust turbocharger.

Note:

The isolating element in the exhaust system must not be bent more than 10° or it may be damaged.

- Remove catalytic converter from exhaust turbocharger -6-.
- Remove exhaust turbocharger from exhaust manifold -2-.
- Swivel exhaust turbocharger to side, loosen mounting angle and banjo bolt of coolant feed line on exhaust turbocharger.
- Remove exhaust turbocharger.

21-57

Installing

Installation is carried out in the reverse order of removal; note the following:

Note:

- *All cable ties which are released or cut open when removing must be installed in the same position when installing.*
- *Secure all hose connections with the correct hose clips (same as original equipment):*

⇒ *Parts Catalog*

- *The hose connectors and hoses must be free of oil and grease before assembling.*
- *Always replace seals, gaskets and self-locking nuts.*

- Perform following operating steps before tightening exhaust turbocharger:

  - Fasten coolant feed line loosely to bracket on vacuum unit for wastegate bypass regulator

valve.

- Tighten banjo bolt to 35 Nm and then tighten securing bolt of bracket to 10 Nm.

Note:

Fill the exhaust turbocharger with engine oil via the oil supply connection.

- Install ribbed belt for A/C compressor ⇒ Page 13-20 .

- Top up coolant ⇒ Page 19-7 .

- Check oil level ⇒ Page 17-35 .

Note:

After installing the turbocharger, run engine for approx. 1 minute at idling speed; do not rev. up immediately. This ensures the turbocharger is properly lubricated.

Tightening torques

Component	Nm
Coolant feed line to exhaust turbocharger	35
Bracket for coolant feed line to exhaust turbocharger	10
Turbocharger to exhaust manifold	

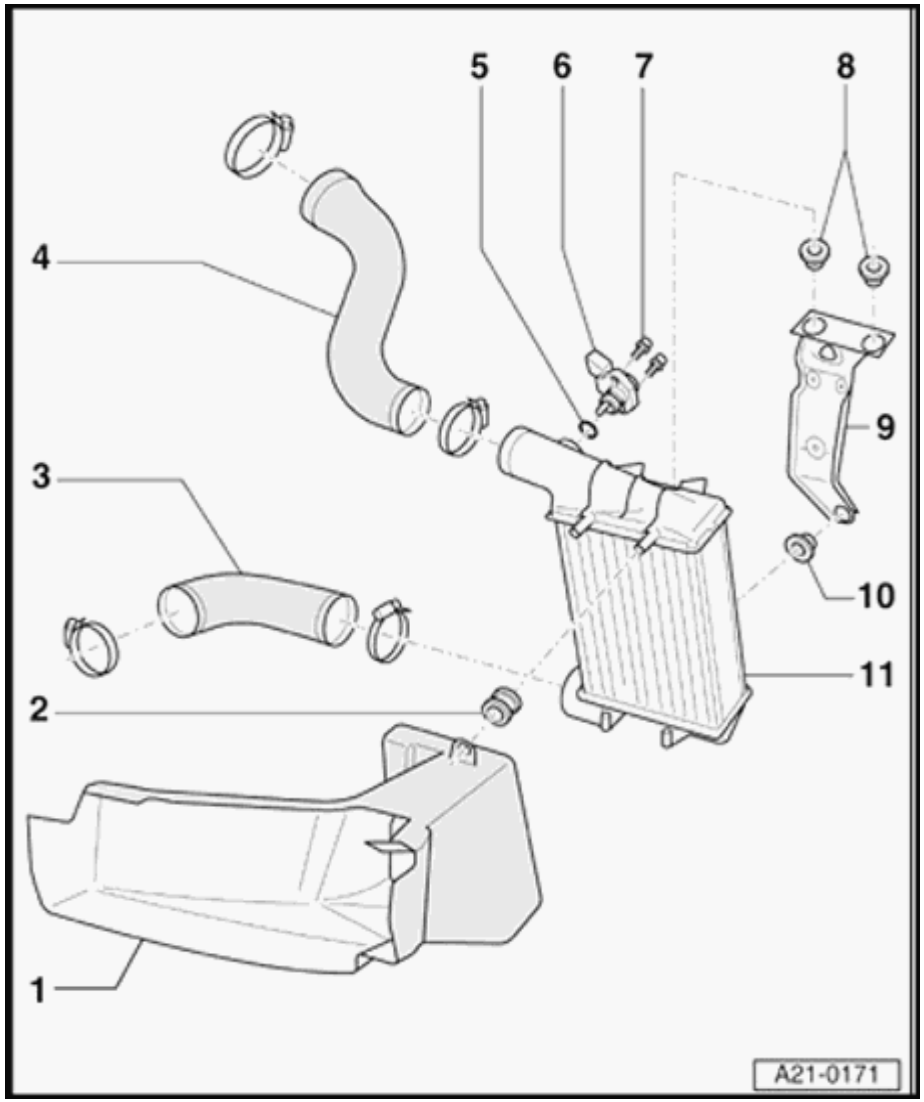
	35 1) 2)

1) Replace bolts

2) Coat thread and head attachment area with high temperature lubricant G 052 112 A3

Component	Nm
Turbocharger bracket to cylinder block	25
Turbocharger bracket to turbocharger	30
Catalytic converter to exhaust turbocharger	30
Oil return line to turbocharger	10
Oil supply line to turbocharger	23
Bracket for oil feed line to cylinder head	23
Heat shield to line for secondary air inlet	3.5
Hose clamps for coolant hoses	2
Hose clamps for air duct hoses	3.5

21-60



Charge air cooling system components, removing and installing

Note:

- *Secure all hose connections with the correct hose clips (same as original equipment):*

⇒ *Parts Catalog*

- *Before a check or repair all hoses and lines must be checked for correct seating and leaks.*

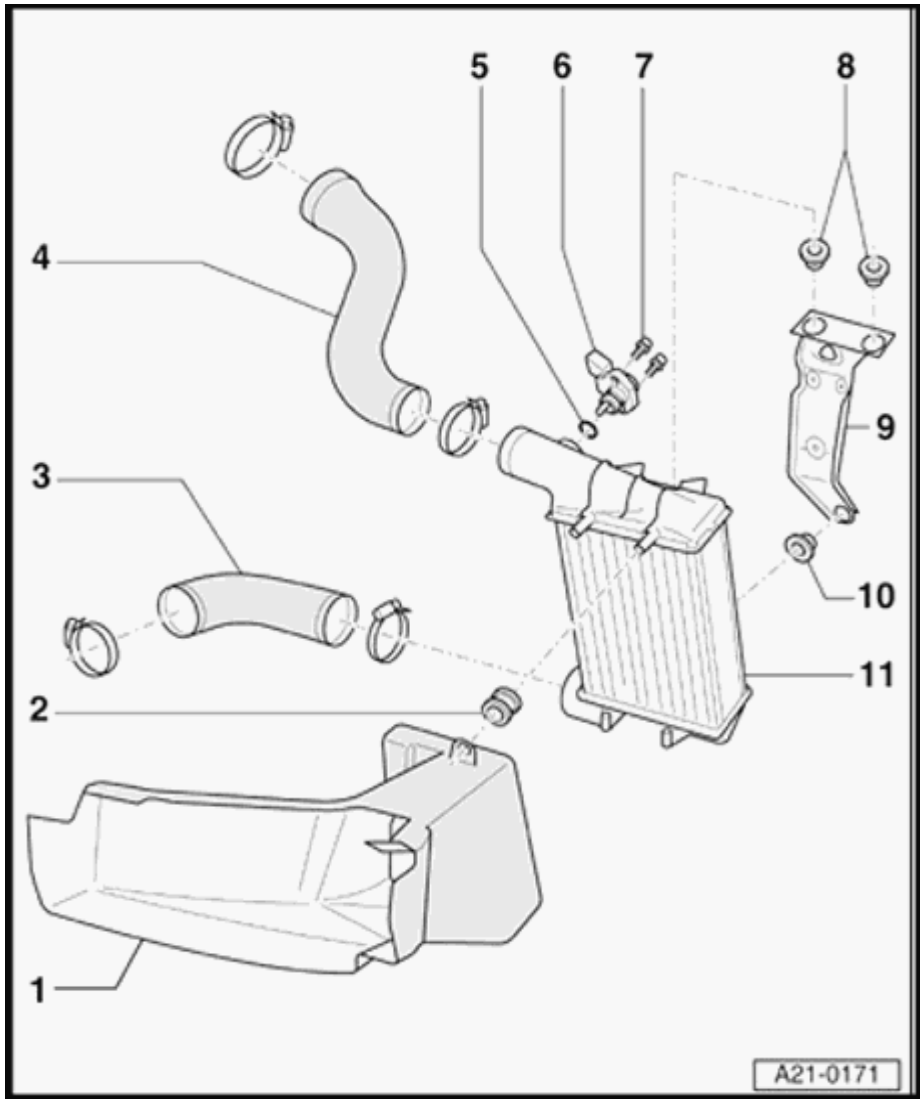
1 - Air duct

2 - Rubber grommet

3 - Hose

- Between charge air cooler and air ducting in front apron

21-61



4 - Air duct hose

- Between intake manifold and charge air cooler (intercooler)

5 - O-ring

- Replace, if damaged

6 - Charge Air Pressure sensor -G31-

7 - 3 Nm

8 - Rubber grommet

9 - Bracket

- Riveted to body

10 - Rubber grommet

11 - Charge air cooler

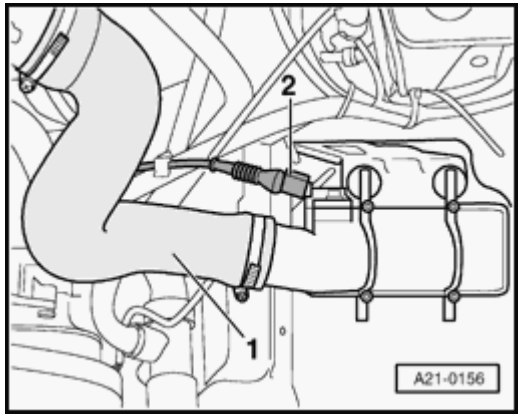
- Removing and installing ⇒ Page 21-62

21-62

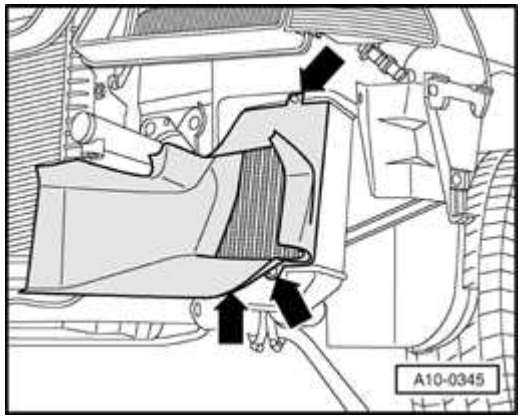
Charge air cooler (intercooler), removing and installing

Removing

- Lock carrier must be in service position ⇒ Page 13-1 .



- Remove air duct hose -1-.
- Disconnect connector -2- at Charge Air Pressure sensor -G31-.



- Remove air cowl in front of charge air cooler -arrows-.

- Remove lower air duct hose to charge air cooler.

- Take out charge air cooler from underneath.

Installing

Installation is carried out in the reverse order of removal; note the following:

- Install lock carrier ⇒ Page 13-1 .

Tightening torque

Component	Nm
Hose clamps for air duct hoses	3.5

Charge air system with turbocharger (engine code ATW)

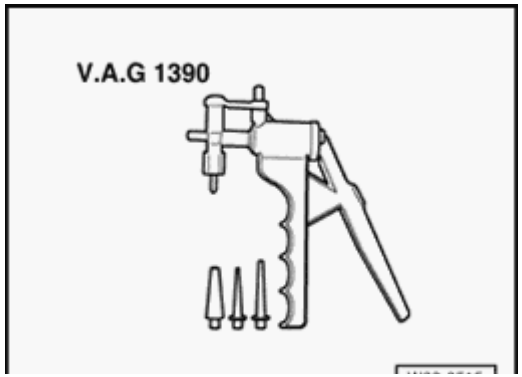
Checking mechanical recirculation valve

Notes:

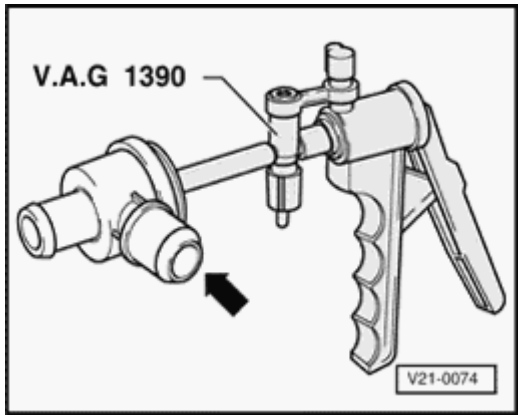
- *The mechanical recirculation valve is located in front of the turbocharger. It is opened by vacuum via the recirculating valve for turbocharger -N249- during deceleration, idle and part throttle. This produces a reduction of the charge air pressure in front of the throttle valve which keeps the turbocharger spinning at a higher RPM.*

- *Check the recirculation valve in case of reduced performance or part throttle hesitation.*

Special tools and equipment



- VAG1390



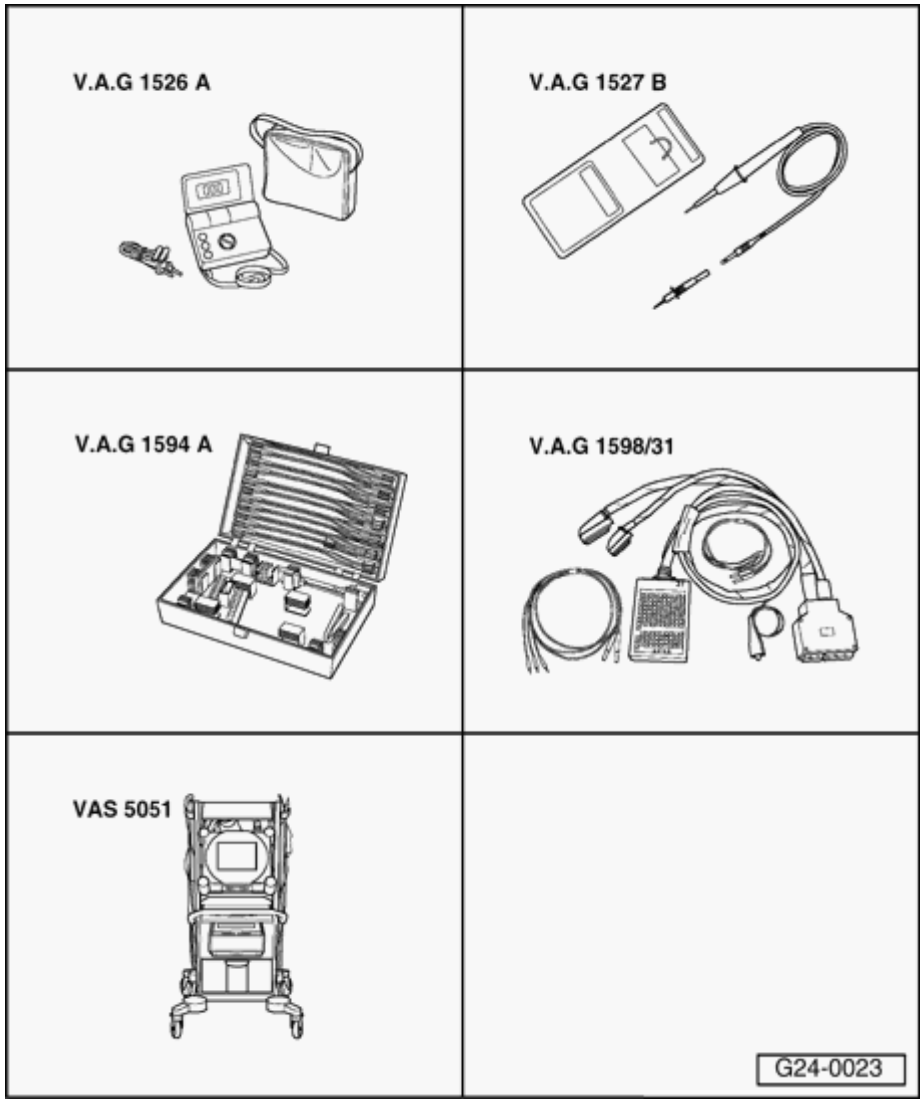
Test sequence

- 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.

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

21-49

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.

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

If specified value is not obtained:

- Replace recirculating valve for turbocharger -N249-.

21-51

If the specified value is attained:

- Check voltage supply

Checking voltage supply

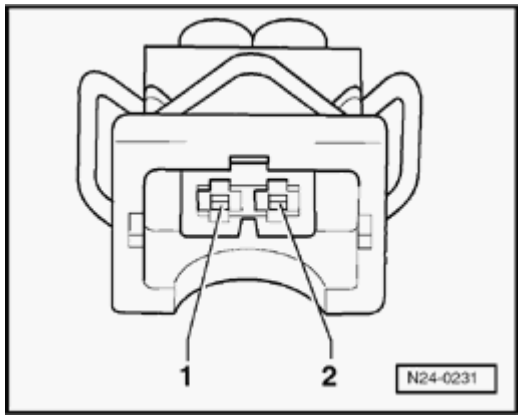
Note:

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.

21-52

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:

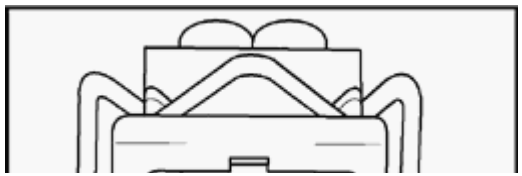
- Check Fuel Pump (FP) relay:

⇒ *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

recirculating valve for turbocharger -N249-:

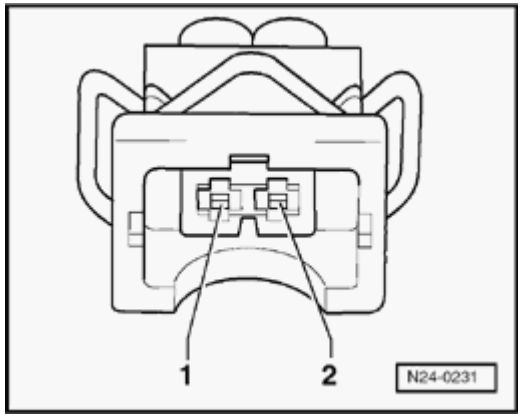
⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

- 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*



- 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*

21-54

Turbocharger and charge air pressure regulator valve, checking

Special tools and equipment



- VAG1397A



- VAS5051 with VAG5051/1

or

- VAG1551 with VAG1551/3A

21-55

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

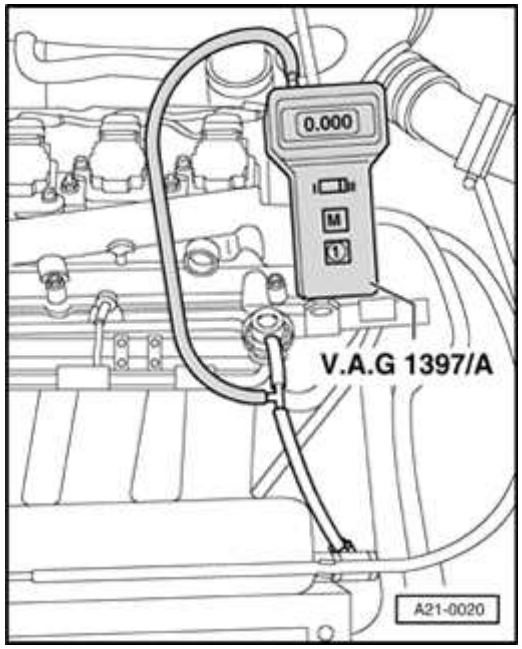
⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

- Vehicle tester VAS 5051 or VAG 1551 connected.

Test sequence

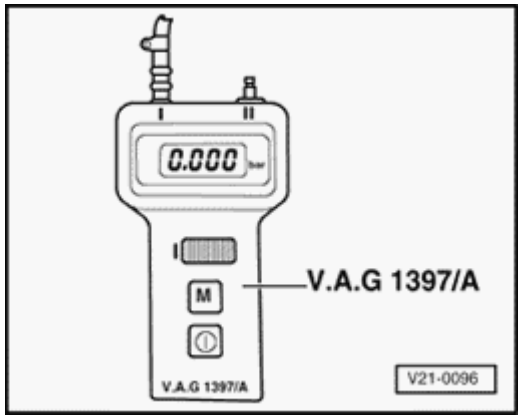
WARNING!

To reduce the risk of accident or injury while carrying out tests and measurements during a road test, observe safety precautions ⇒ ***Page 21-40*** ***.***



- 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.

21-56

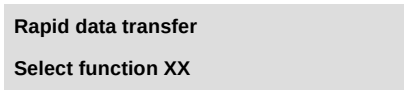


- Turn turbocharger tester on and select measuring range -I- (absolute pressure).
- Connect test hose to connection barb -I-.

Notes:

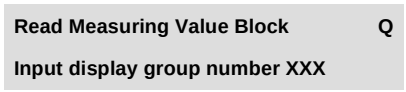
- *Hoses must be properly connected and there must be no possibility of leaks, otherwise incorrect readings may result.*
- *Make sure that the test hose is not pinched at the hood or at the side window.*
- *By pressing memory button "M" on turbocharger tester, the last test value is saved until either 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.*

21-57



When indicated on display:

- Press buttons -0- and -8- to select "Read Measuring Value Block" and press -Q- button to confirm input.



When indicated on display:

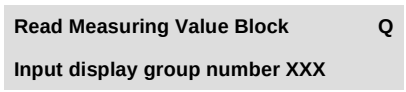
- Press buttons -0-, -0- and -4- to select "display group number 004" and press -Q- button to confirm input.



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.



When indicated on display:

- Press buttons -1-, -1- and -5- to select "display group number 115" and press -Q- button to confirm input.



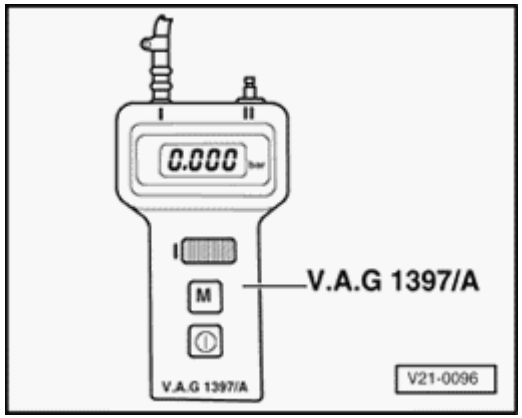
Indicated on display (1-4 = display fields)

- 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.

21-58

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):

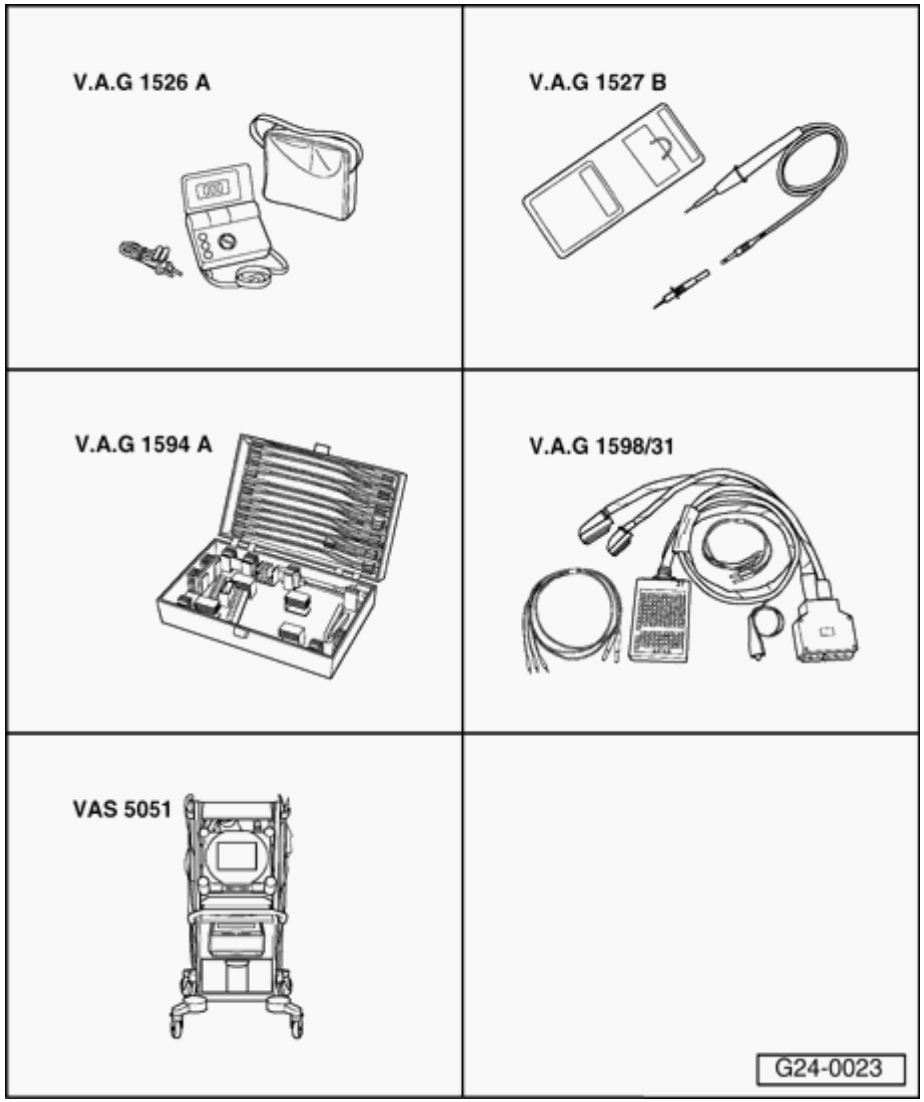
⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Repair Group 01*

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.

21-60



Wastegate bypass regulator valve -N75-, checking

Special tools and equipment

- VAG1526A
- VAG1527B
- VAG1594A
- VAG1598/31
- VAS5051 with VAG5051/1

- or

- VAG1551 with VAG1551/3A

21-61

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

valve.

21-62

- 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:

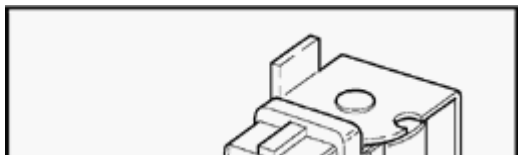
- Check internal resistance of valve.

If valve does not open and close properly:

- Replace wastegate bypass regulator valve -N75-.

Checking internal resistance

- Disconnect harness connector at valve.



➢

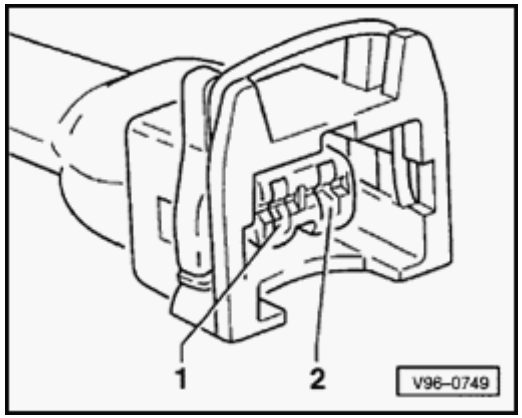
- Connect multimeter at valve for resistance measurement.
  - ♦ Specified value: 25-35 Ω

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.

21-64

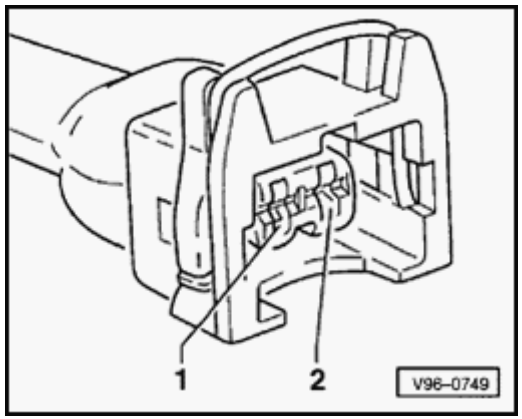
If wire connection is OK:

- 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*

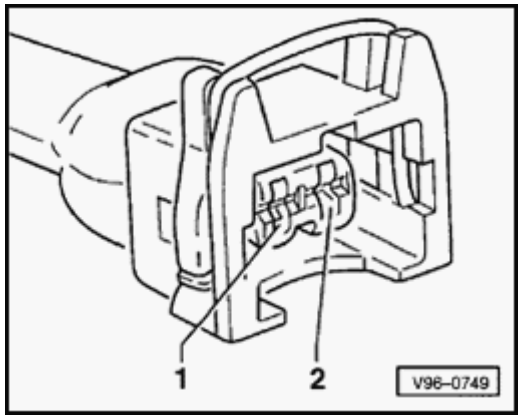
- ♦ LED must blink.

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*

21-65



- 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

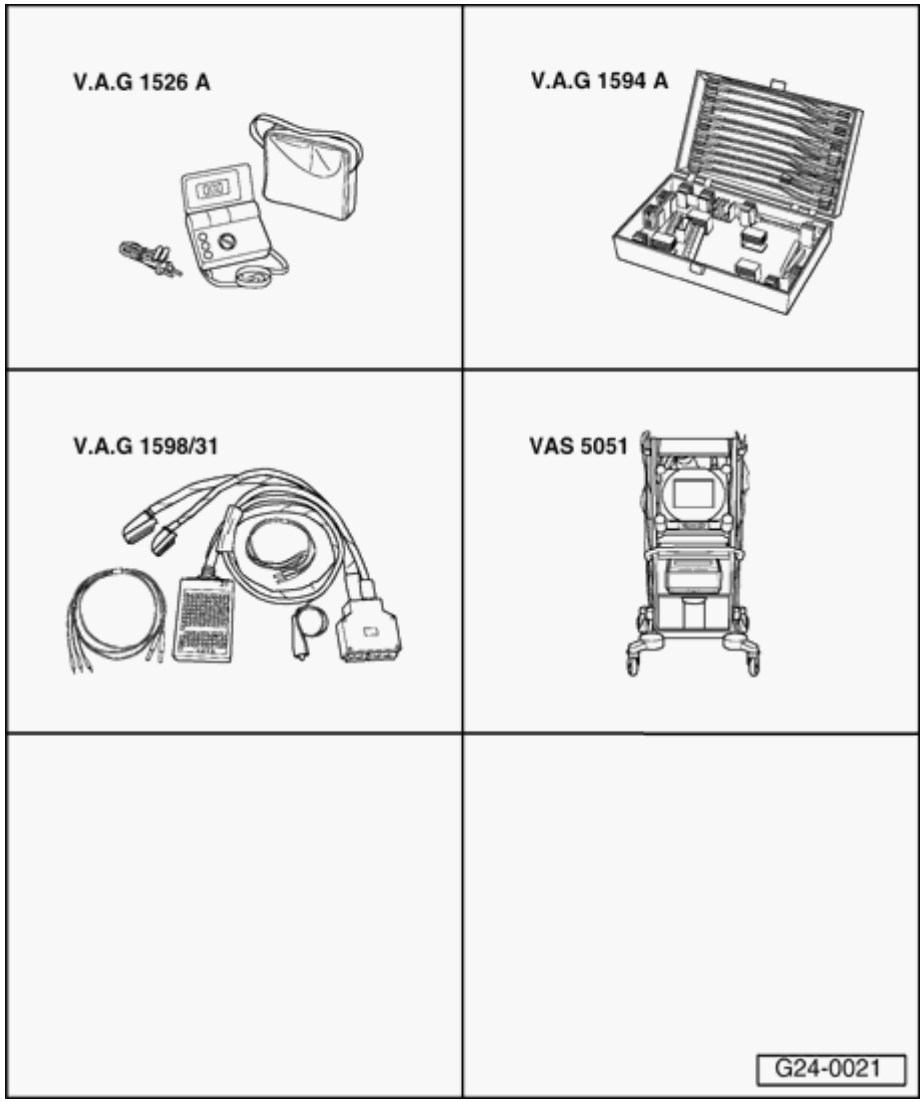
- Repair open circuit or short circuit if necessary.

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*

21-66



Charge air pressure sensor -G31-, checking

Special tools and equipment

- VAG1526A
- VAG1594A
- VAG1598/31
- VAS5051 with VAG5051/1

- or

- VAG1551 with VAG1551/3A

21-67

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

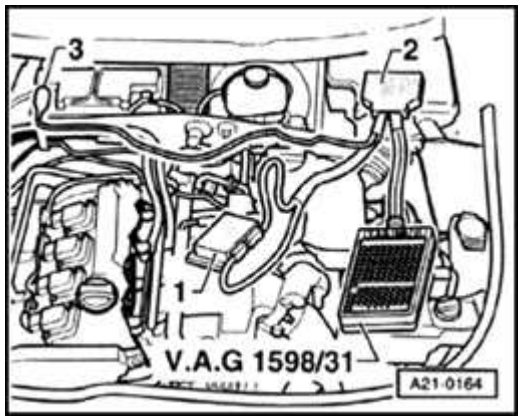
- Disconnect harness connector at charge air pressure sensor.

- Connect multimeter between terminals 1 and 3 of harness connector for voltage measurement.

- Switch ignition on.

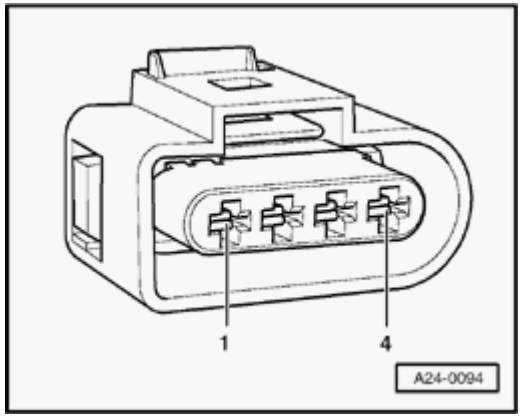
♦ Specified value: approx. 5 V

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:

21-69

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.

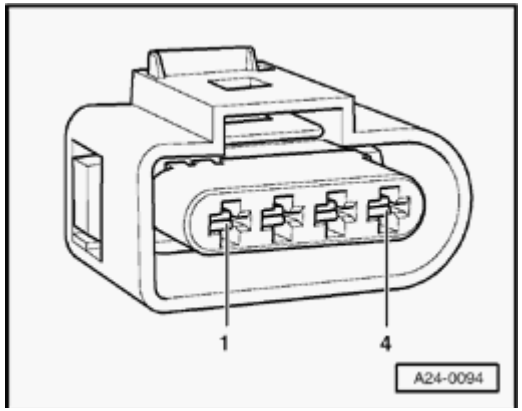
- Start engine and run at idle.

  - 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.

If wire connection is OK:

- Replace charge air pressure sensor -G31-.

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.

- 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.

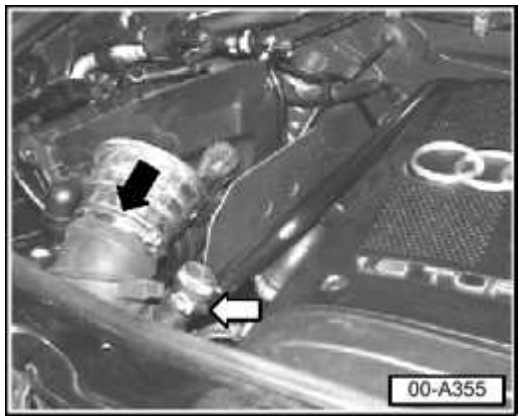
- Remove female fitting from tester (arrow) and install an appropriate "male" air fitting that will connect to your shop air supply line (⇒WARNING!).

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

1687/1 special tool kit.

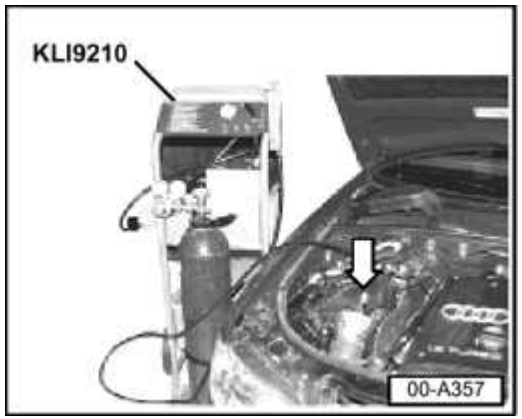
21-72

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

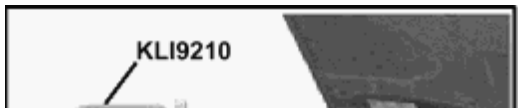
- Install optional fitting LKI9210/50 on hose of special tool KLI9210.



- 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.

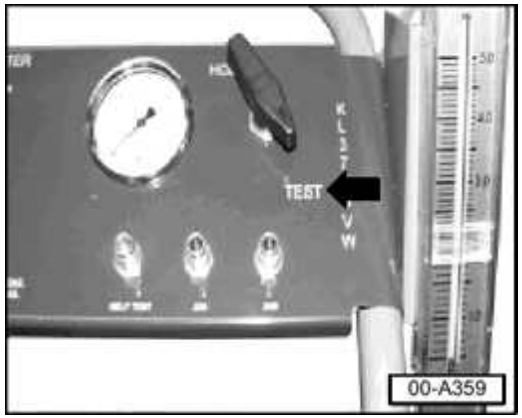


- Connect KLI9210 to VAG 1687/1 adapter (KLI9210 is shown attached

to VAG 1687/1 at arrow on 2.7L BiTurbo).

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).

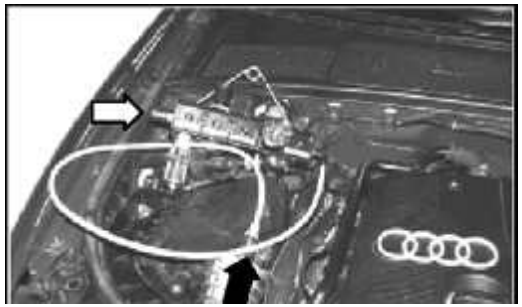
With system filled with smoke:

- 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-

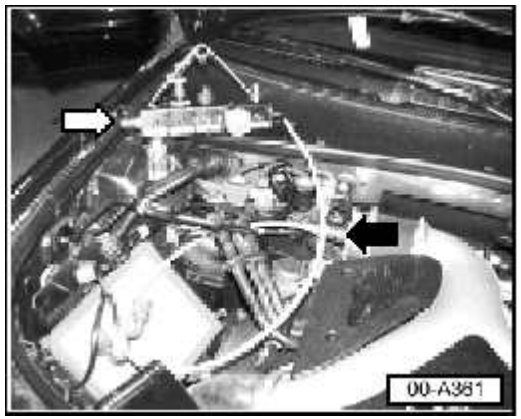
Shop air supply will be connected to VAG 1687 -at white arrow-

- Perform pressure test ⇒ Page 21-75 .

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.



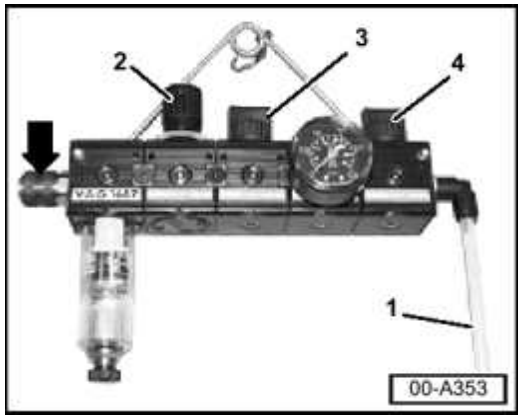
➢ VAG 1687 is shown connected to VAG 1687/1 -black arrow-

Shop air supply will be connected to VAG 1687 -at white arrow-

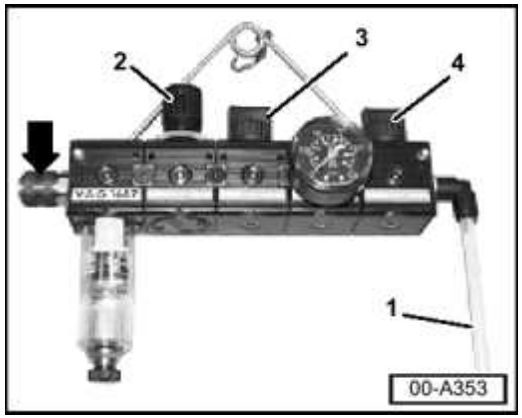
- Perform pressure test ⇒ Page 21-75 .

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.

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.

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.

21-77

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.

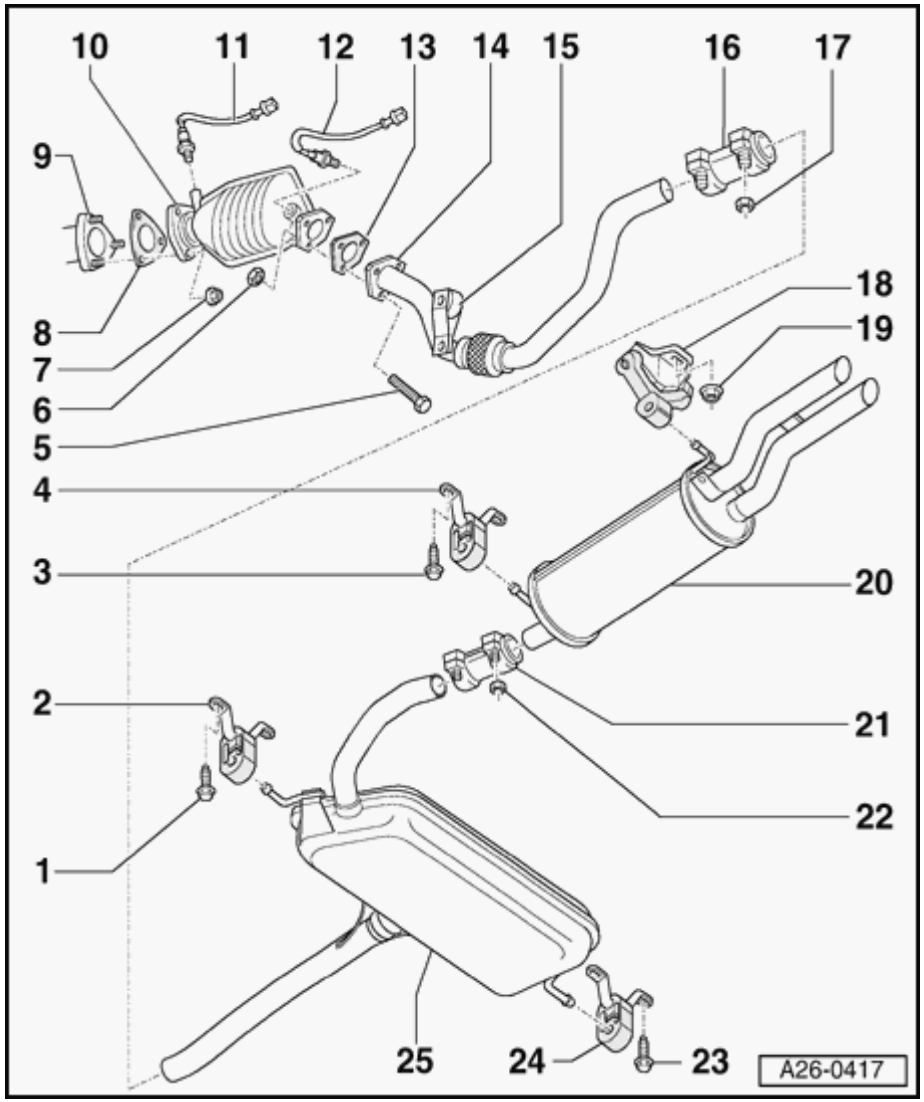
26-1

Exhaust system components, removing and installing

Note:

- *Always replace seals, gaskets and self-locking nuts.*
- *After working on the exhaust system ensure that the system is not under stress, and that it has sufficient clearance from the bodywork. If necessary, loosen clamps and align mufflers and exhaust pipes so that sufficient clearance is maintained to the bodywork at all points and the mountings are evenly loaded.*
- *The flexible connection in the front exhaust pipe must not be deflected more than 10° or it may be damaged..*

26-2



Vehicles with front-wheel drive

1 - 25 Nm

2 - Mounting

3 - 25 Nm

4 - Mounting

5 - 25 Nm

6 - 25 Nm

- Replace

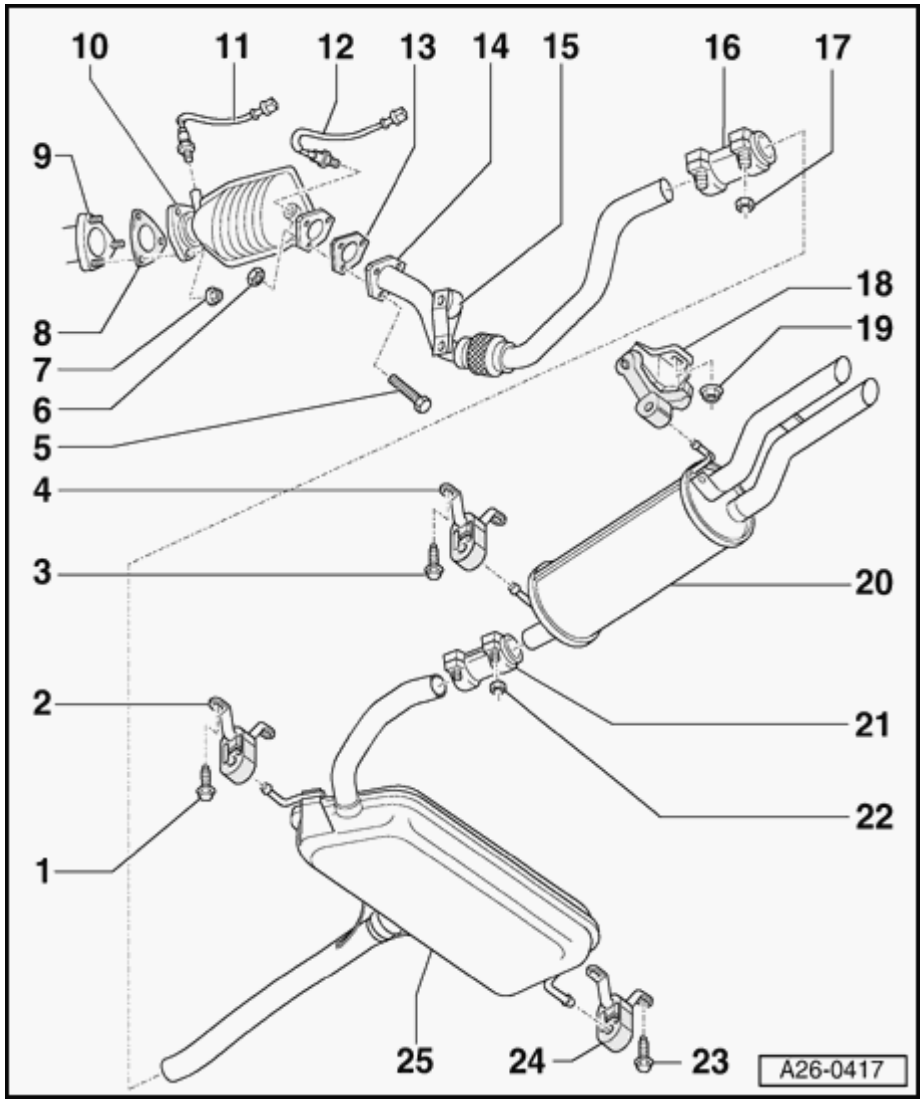
7 - 30 Nm

- Always replace

8 - Gasket

- Always replace

26-3



9 - Turbocharger

- Removing and installing ⇒ Page 21-51

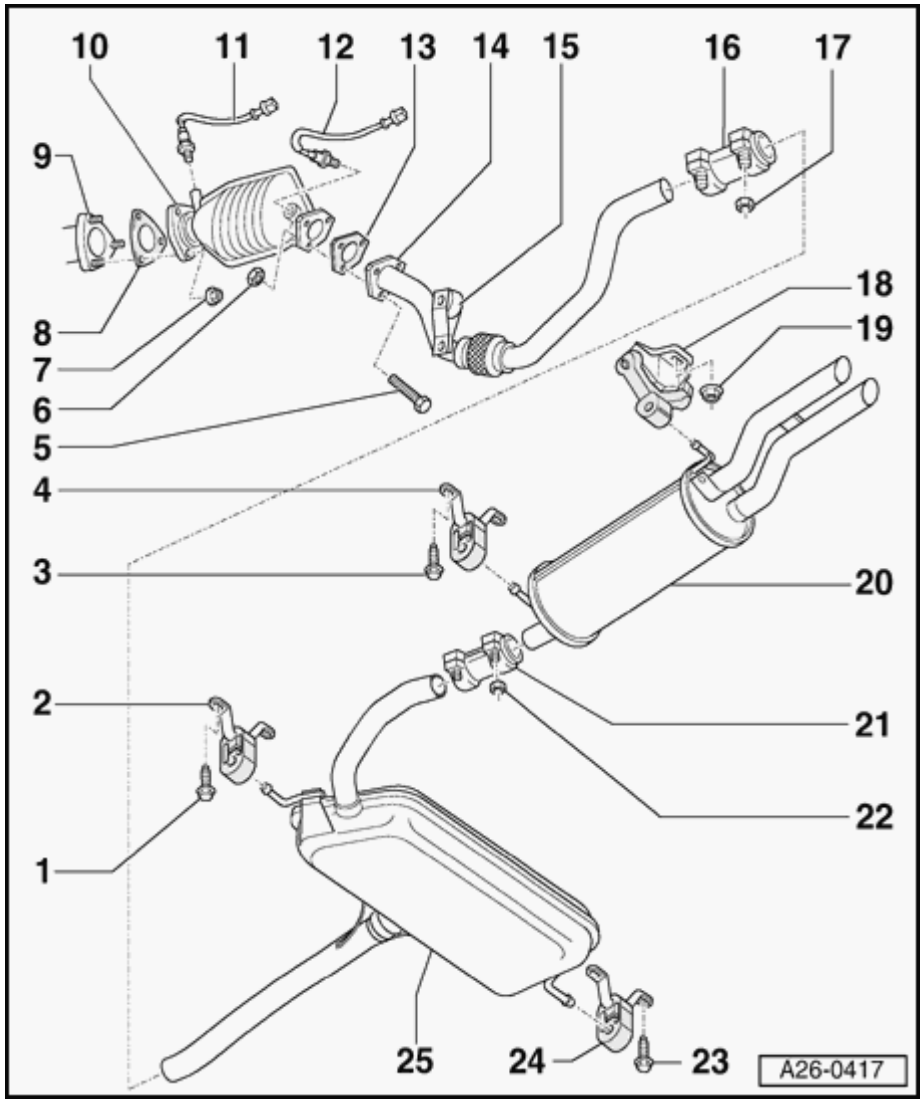
10 - Catalytic converter

- Protect from damage by impact
- Removing and installing ⇒ Page 26-27

11 - Oxygen sensor - 55 Nm

- Upstream of catalytic converter
- Grease only the threads with high-temperature lubricant G 052 112 A3. The lubricant must not get into the slots on the sensor body.
- Checking:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



12 - Oxygen sensor - 55 Nm

- Downstream of catalytic converter
- Grease only the threads with high-temperature lubricant G 052 112 A3. The lubricant must not get into the slots on the sensor body.
- Checking:

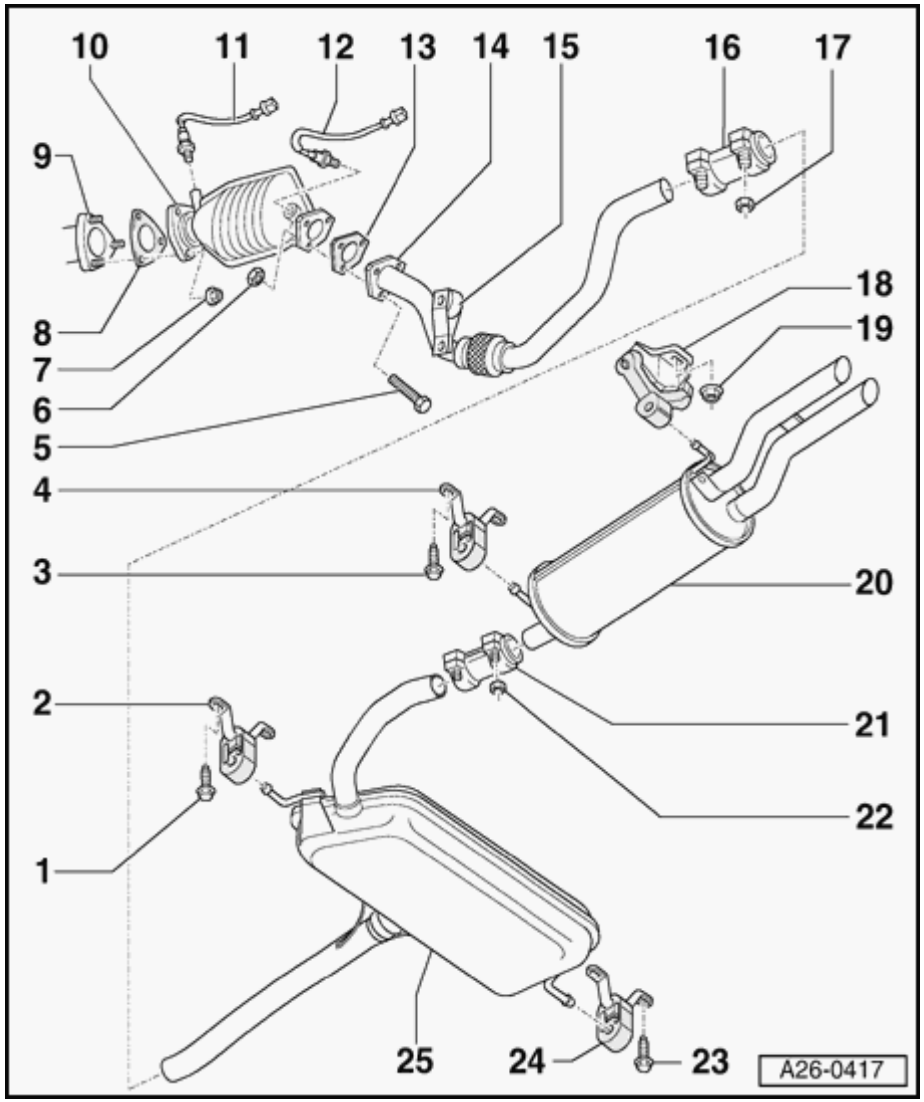
⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

13 - Gasket

- Always replace

14 - Front exhaust pipe

- With flexible connection (de coupling element)
- Do not bend flexible connection more than 10° - otherwise it can be damaged.
- Removing and installing ⇒ Page 26-32
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-34



15 - Mounting

- Individual parts of mounting for manual transmission⇒Fig. ⇒ 3 , ⇒ Page 26-16
- Individual parts of mounting for automatic 5 speed transmission ⇒Fig. ⇒ 4 , ⇒ Page 26-17

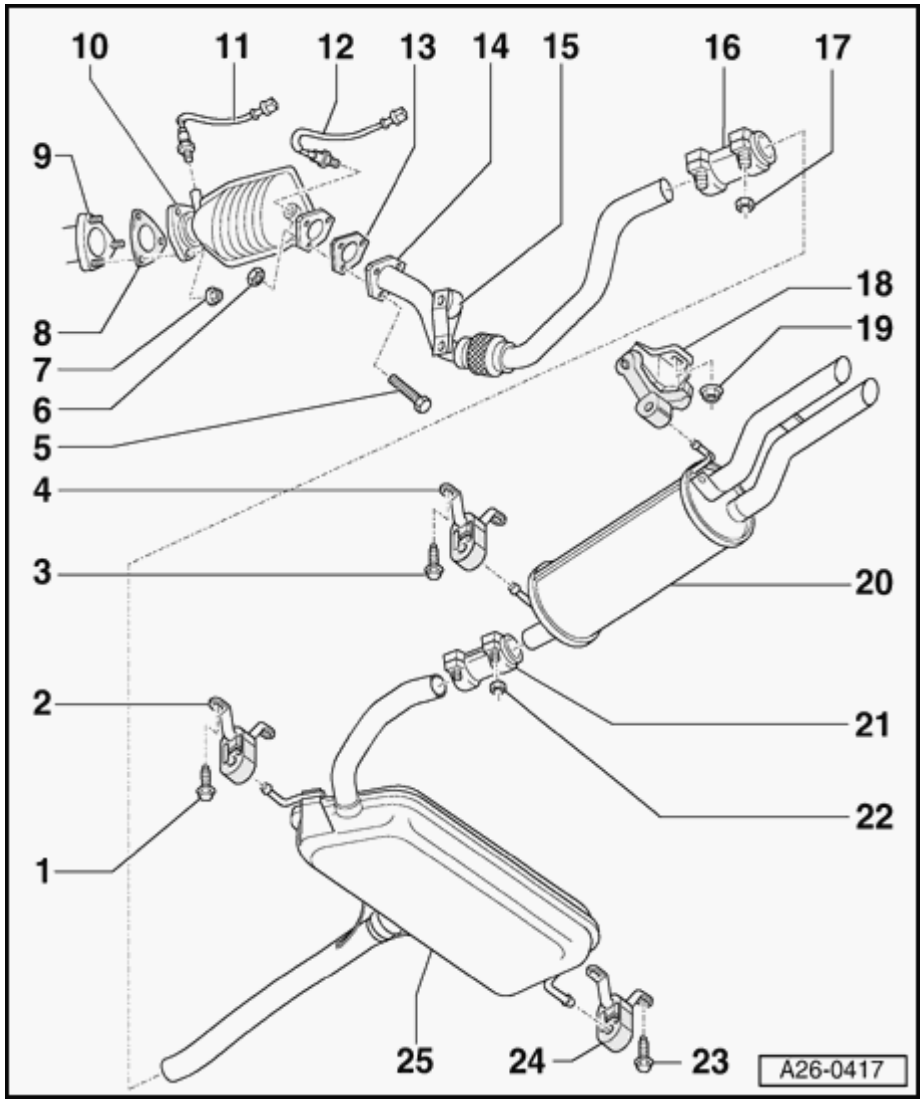
16 - Front clamp

- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-34
- Installation position ⇒Fig. ⇒ 1 , ⇒ Page 26-8
- Tighten bolted connections evenly.

17 - 40 Nm

18 - Mounting

19 - 25 Nm

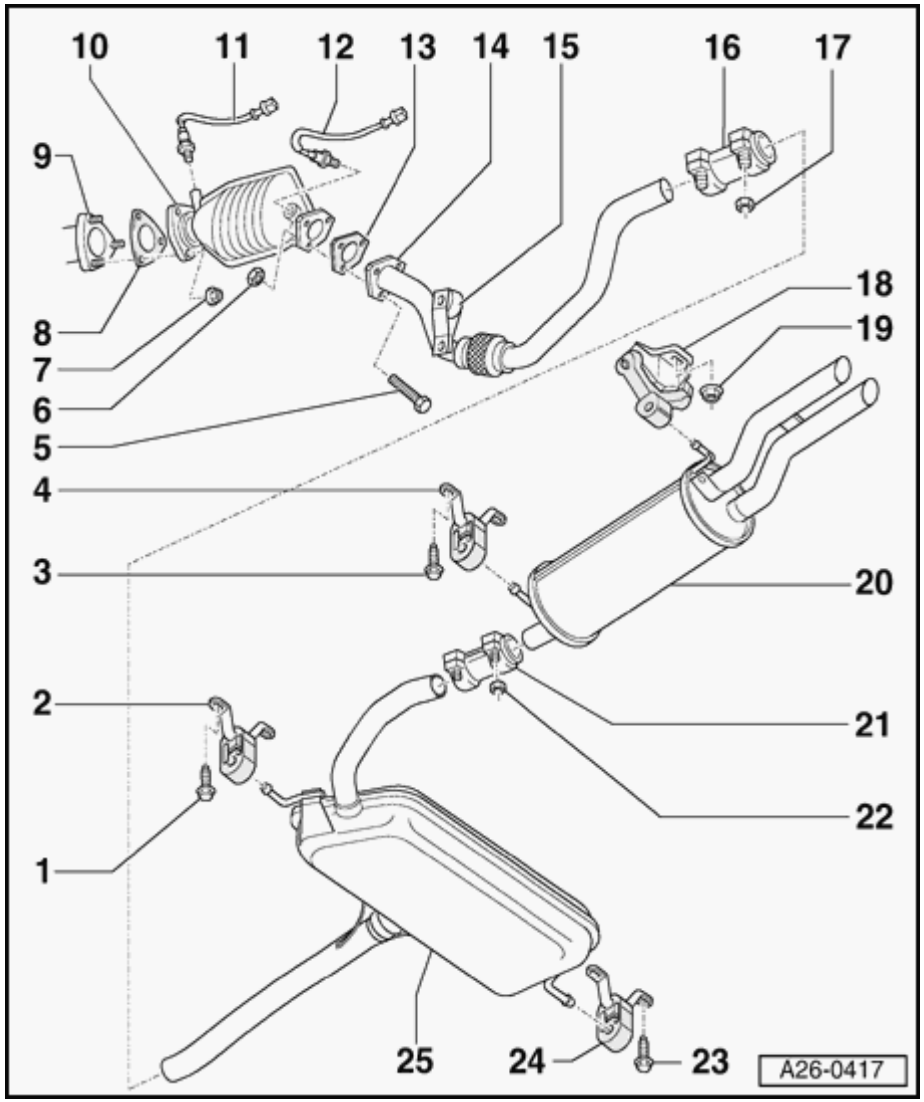


20 - Rear muffler

- Rear and center mufflers are one unit as original equipment. In cases of repair replace individually
- Cutting point ⇒ Page 26-19
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-34

21 - Rear clamp

- For separate replacement of center and rear mufflers
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-34
- Installation position ⇒Fig. ⇒ 2 , ⇒ Page 26-8
- Tighten bolted connections evenly.



22 - 40 Nm

23 - 25 Nm

24 - Mounting

25 - Center muffler

- Center and rear mufflers are one unit as original equipment. In cases of repair replace individually
- Cutting point ⇒ Page 26-19
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-34

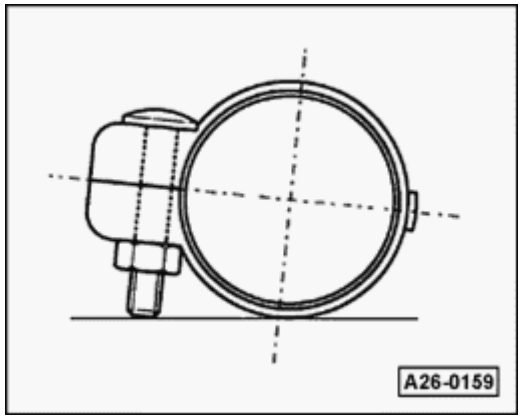


Fig. 1 Installation position of front clamp

- Align clamps so that ends of bolts do not protrude over lower edge of clamp.
  - ♦ Bolted connection facing to the left

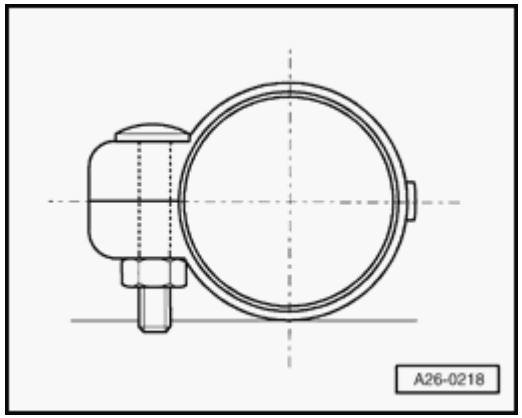
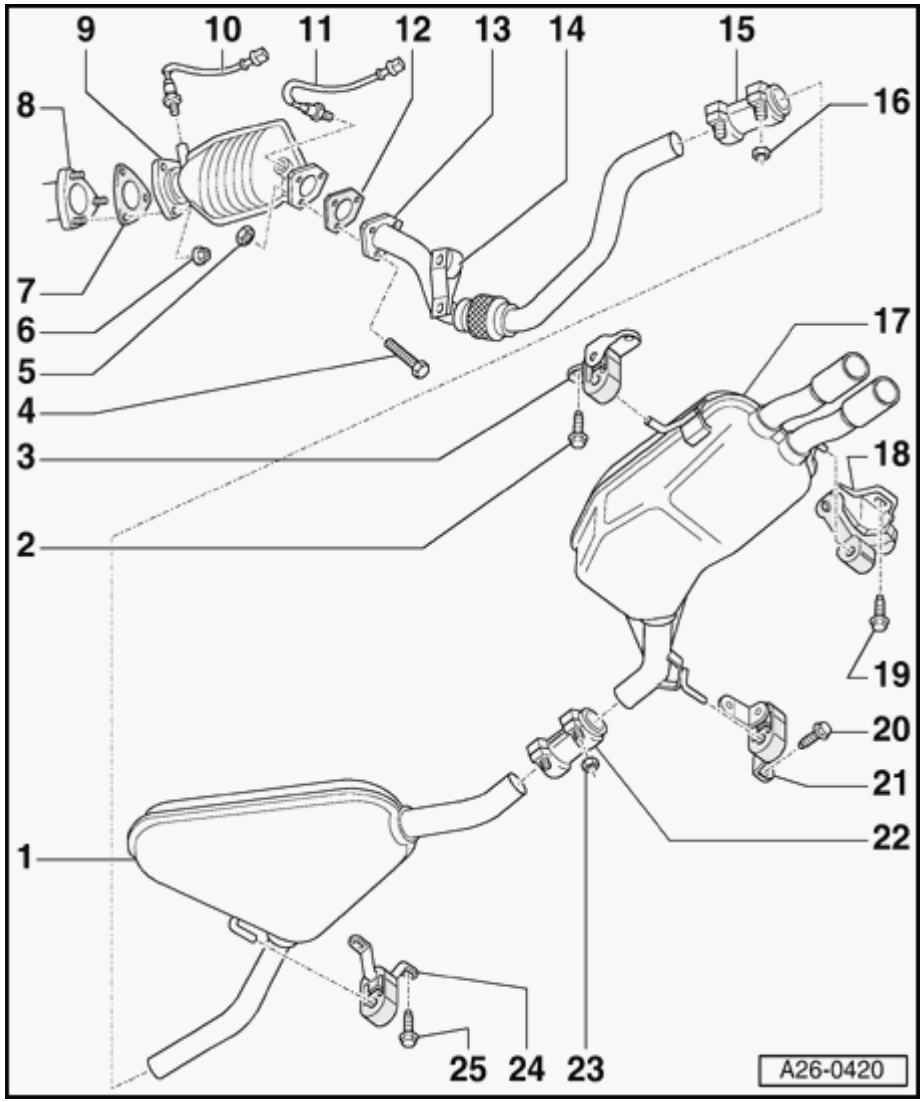


Fig. 2 Installation position of rear clamp

- Install clamp in horizontal position.
  - ♦ Bolted connection facing to the left



Vehicles with all-wheel drive

1 - Center muffler

- Center and rear mufflers are one unit as original equipment. In cases of repair replace individually
- Cutting point ⇒ Page 26-20
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-37

2 - 25 Nm

3 - Mounting

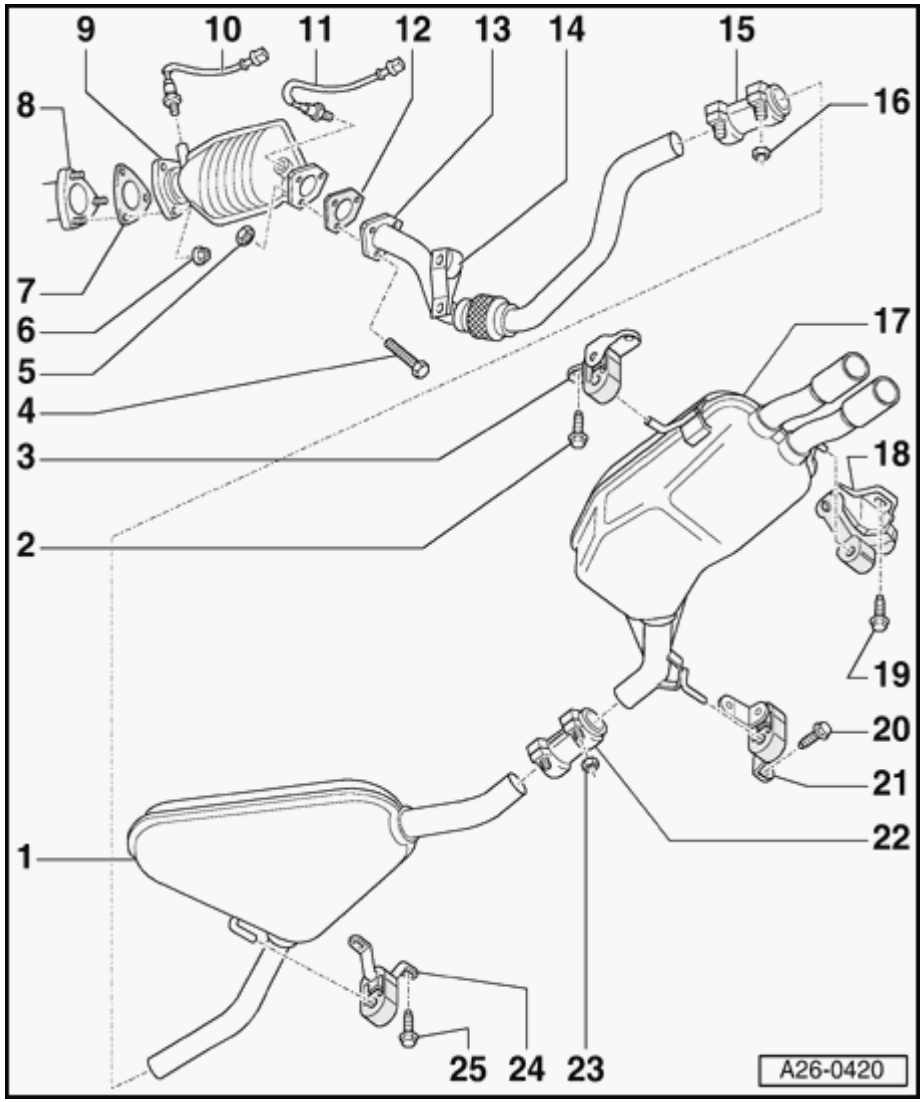
4 - 25 Nm

5 - 25 Nm

- Always replace

6 - 30 Nm

- Always replace



7 - Gasket

- Always replace

8 - Turbocharger

- Removing and installing ⇒ Page 21-51

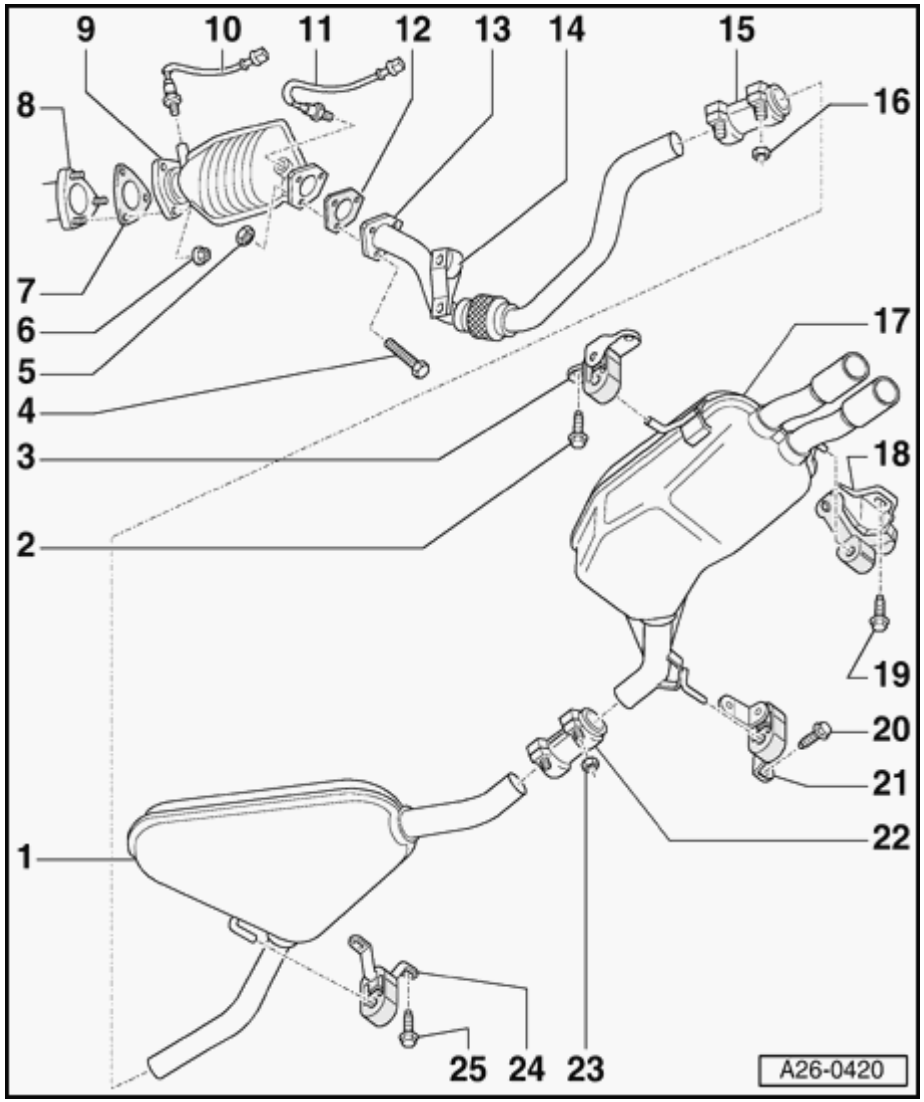
9 - Catalytic converter

- Protect from damage by impact
- Removing and installing ⇒ Page 26-27

10 - Oxygen sensor - 55 Nm

- Upstream of catalytic converter
- Grease only the threads with high-temperature lubricant G 052 112 A3. The lubricant must not get into the slots on the sensor body.
- Checking:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



11 - Oxygen sensor - 55 Nm

- Downstream of catalytic converter
- Grease only the threads with high-temperature lubricant G 052 112 A3. The lubricant must not get into the slots on the sensor body.
- Checking:

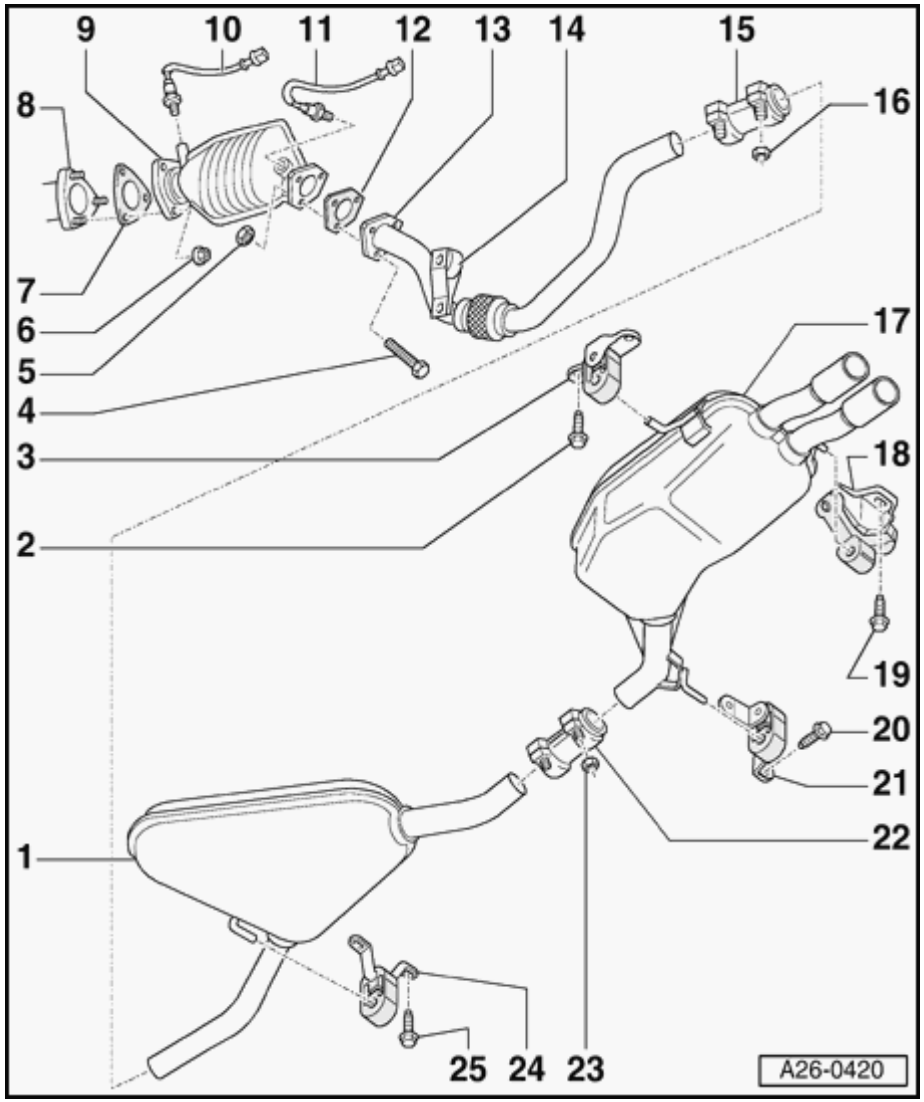
⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

12 - Gasket

- Always replace

13 - Front exhaust pipe

- With flexible connection (de coupling element)
- Do not bend flexible connection more than 10° - otherwise it can be damaged.
- Removing and installing ⇒ Page 26-32
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-37



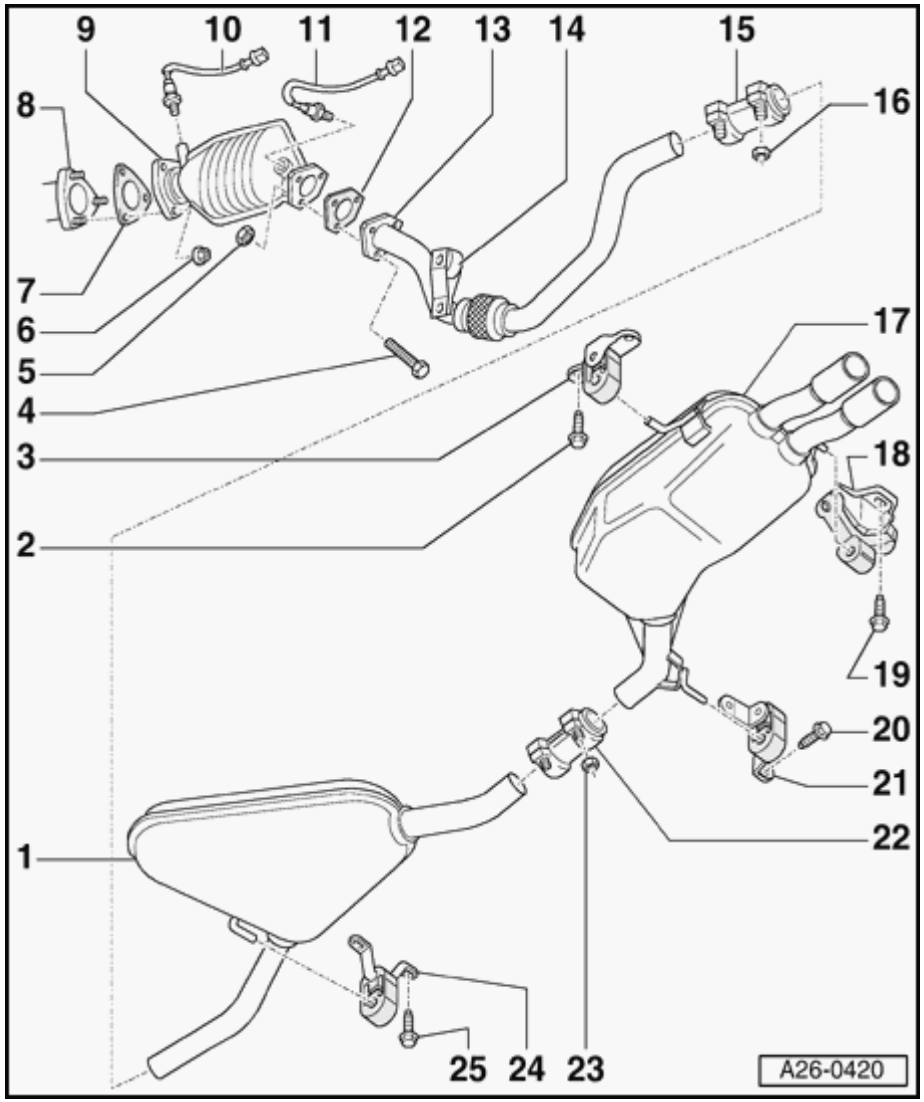
14 - Mounting

- Individual parts of mounting for manual transmission⇒Fig. ⇒ 3 , ⇒ Page 26-16
- Individual parts of mounting for automatic transmission ⇒Fig. ⇒ 4 , ⇒ Page 26-17

15 - Front clamp

- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-37
- Installation position ⇒Fig. ⇒ 1 , ⇒ Page 26-15
- Tighten bolted connections evenly

16 - 40 Nm



17 - Rear muffler

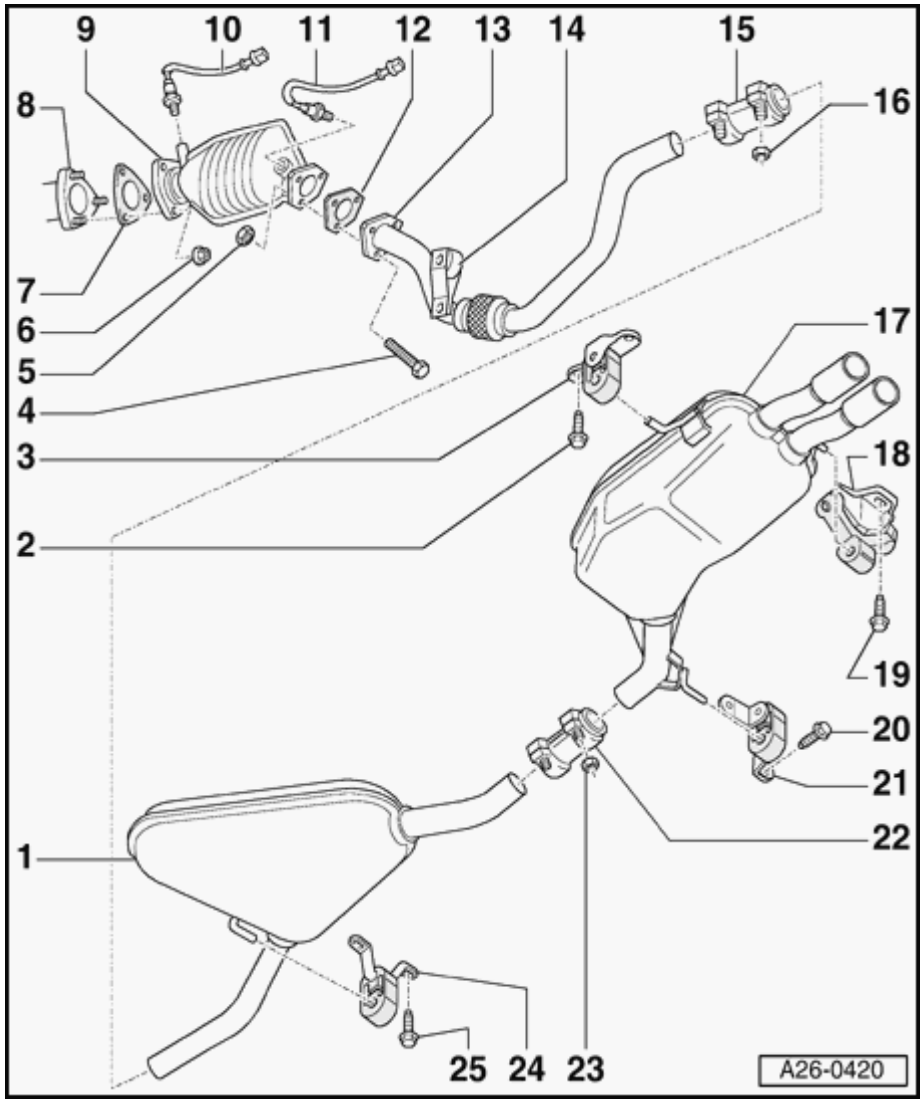
- Rear and center mufflers are one unit as original equipment. In cases of repair replace individually
- Cutting point ⇒ Page 26-20
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-37

18 - Mounting

19 - 25 Nm

20 - 25 Nm

21 - Mounting



22 - Rear clamp

- For separate replacement of center and rear mufflers
- Align exhaust system so it is free of stress before tightening clamp ⇒ Page 26-37
- Installation position ⇒Fig. ⇒ 2 , ⇒ Page 26-15
- Tighten bolted connections evenly

23 - 40 Nm

24 - Mounting

25 - 25 Nm

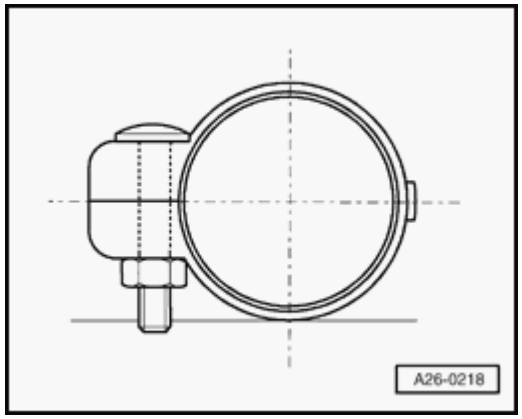


Fig. 1 Installation position of front clamp

- Install clamp in horizontal position.
  - ♦ Bolted connection facing to the left

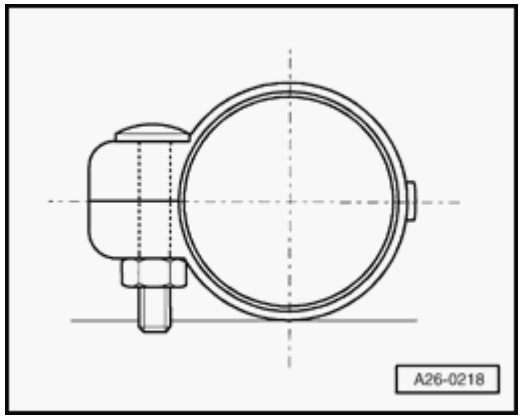


Fig. 2 Installation position of rear clamp

- Install clamp in horizontal position.
  - ♦ Bolted connection facing to the left

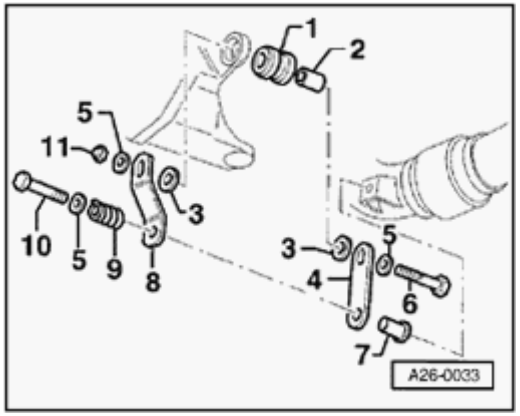


Fig. 3 Individual parts of mounting for vehicles with manual transmission

1 - Buffer

2 - Spacer pipe

3 - Washer

4 - Lug, right

5 - Disc

6 - Bolt - 25 Nm

7 - Spacer

8 - Lug, left

9 - Compression spring

10 - Bolt - 25 Nm

11 - Nut, self-locking - 25 Nm

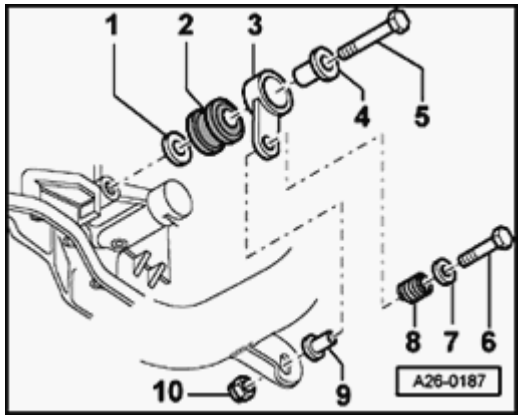


Fig. 4 Individual parts of mounting for vehicles with automatic transmission

1 - Disc

2 - Buffer

3 - Link

4 - Spacer

5 - Bolt - 25 Nm

6 - Bolt

7 - Disc

8 - Compression spring

9 - Spacer

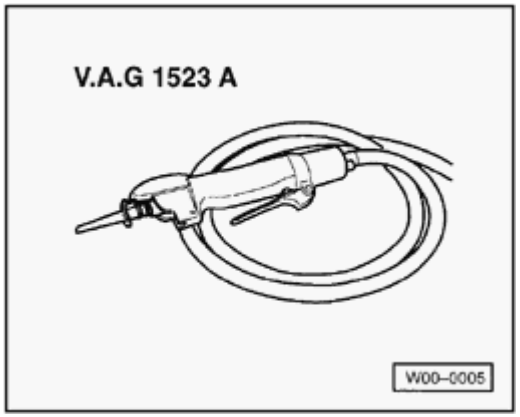
10 - Nut, self-locking - 25 Nm

Center and rear mufflers, separating

For individual replacement of the center or rear muffler, a cutting point is marked on the connecting pipe.

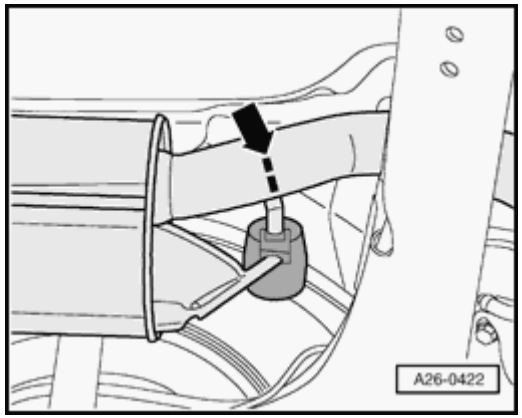
The cutting point is marked with an indentation on the outside of the exhaust pipe.

Special tools and equipment



- Body saw VAG 1523 A
- Protective goggles

Vehicles with front wheel drive:

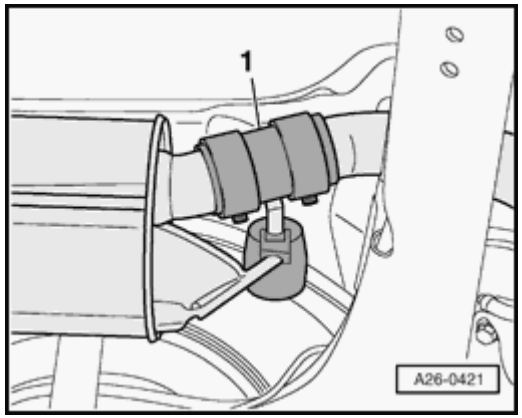


- Cut exhaust pipe at right angles using body saw, e.g. VAG 1523 A, at position marked -arrow-.

WARNING!

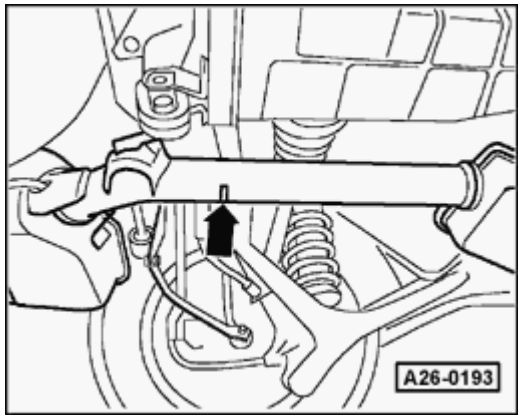
Wear protective goggles.

- When installing, position clamp centrally over saw cut.



- ♦ Installation position of clamp -1-: Horizontally, bolted connections face rear left wheel ⇒ Fig. ⇒ 2 , ⇒ Page 26-8
- Ensure exhaust system is aligned stress-free ⇒ Page 26-34 .
- Tighten bolted connections on clamp evenly to 40 Nm.

Vehicles with all-wheel drive:

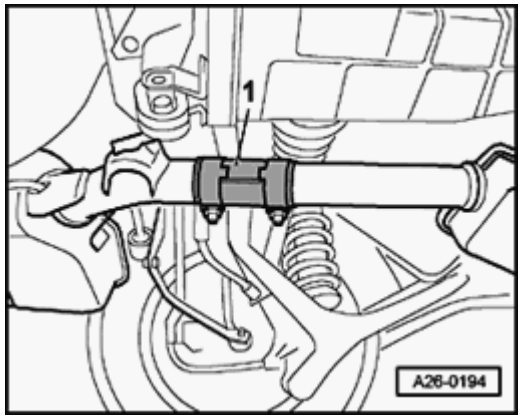


- Cut exhaust pipe at right angles using body saw, e.g. VAG 1523 A, at position marked -arrow-.

WARNING!

Wear protective goggles.

- When installing, position clamp centrally over saw cut.



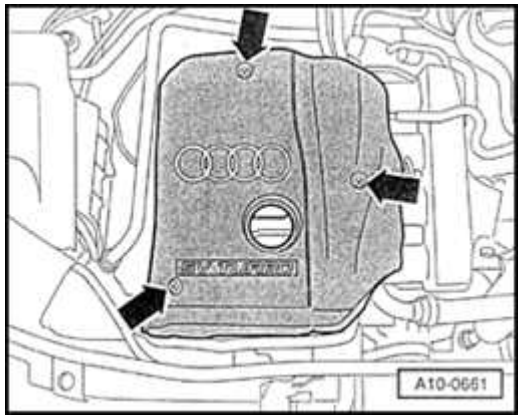
- ♦ Installation position of clamp -1-: Horizontally, bolted connections face rear left wheel ⇒ Fig. ⇒ 2 , ⇒ Page 26-15
- Ensure exhaust system is aligned stress-free ⇒ Page 26-37 .
- Tighten bolted connections on clamp evenly to 40 Nm.

Exhaust manifold, removing and installing

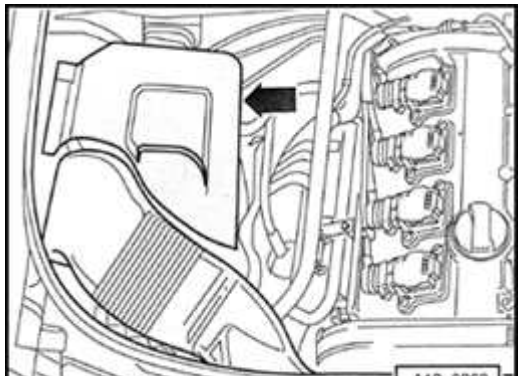
Removing

Note:

The flexible connection in the front exhaust pipe must not be deflected more than 10° or it may be damaged.

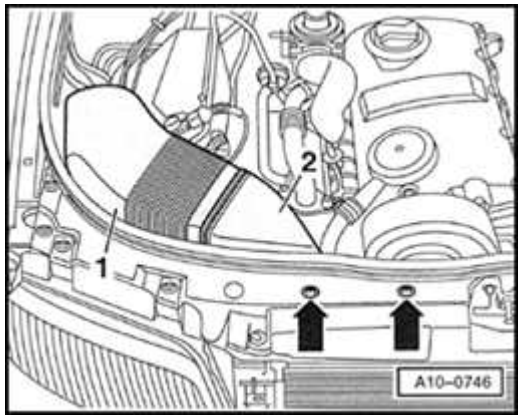


- Remove engine cover panel -arrows-.

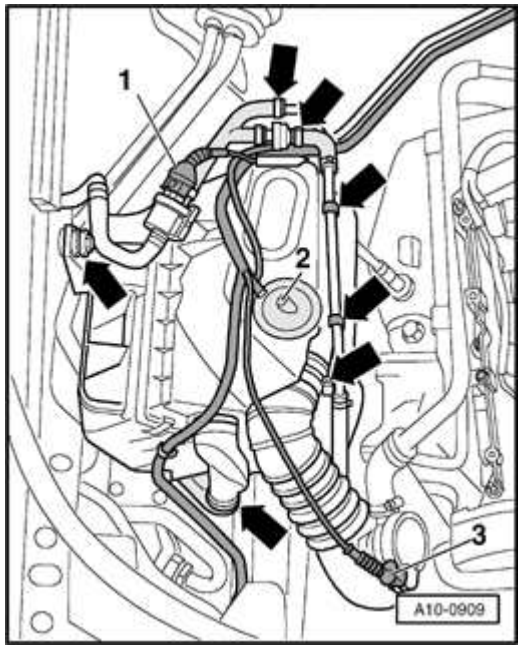


- Remove air filter cover -arrow-.

26-22



- Remove bolts -arrows-.
- Remove air duct -1- and -2-.



- Disconnect wiring connectors as follows:

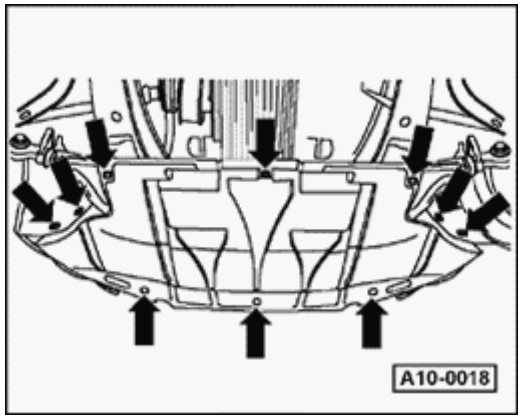
1 - on ACF valve (in addition, remove ACF valve from air filter housing)

2 - on mass air flow sensor

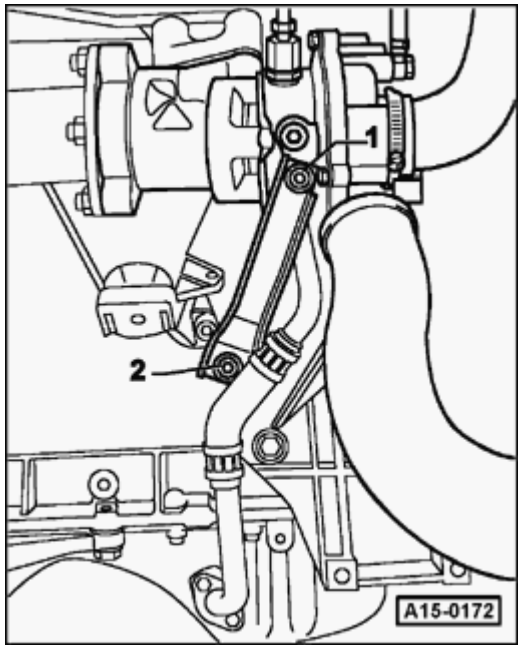
3 - on Wastegate Bypass Regulator valve -N75-

- Remove hose connections, move wiring aside and remove air filter housing -arrows-.

26-23

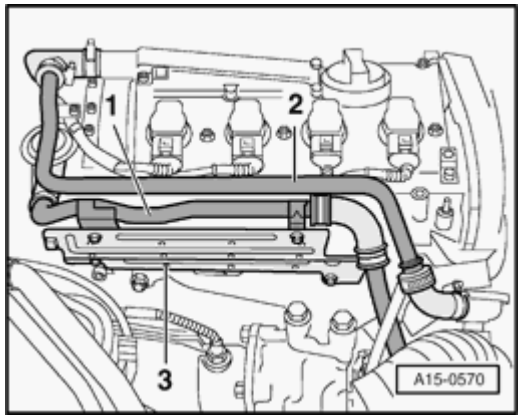


- Remove sound insulation -arrows-.

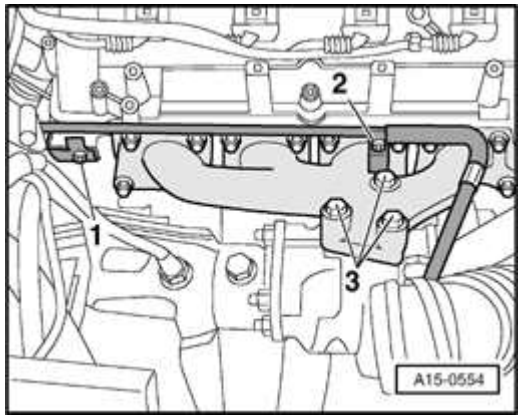


- Loosen bolts -1- and -2- by several turns.

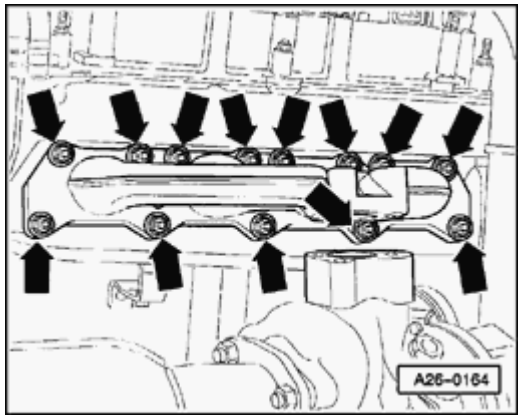
26-24



- Remove front hose from line of crankcase vent -2-.
- Disconnect front hose from line -1- of secondary air inlet.
- Remove heat shield -3-.



- Remove bolts -1- and -2- of oil feed line.
- Remove bolts -3- for exhaust turbocharger.
- Remove seal between exhaust turbocharger and exhaust manifold.
- Plug opening in suction duct of turbocharger with a clean cloth.



- Remove all nuts -arrows- on exhaust manifold.
- Remove washers and exhaust manifold.

Installing

Installation is carried out in the reverse order of removal; note the following:

Note:

Always replace seals, gaskets and self-locking nuts.

- Adhere to the following sequence:
  - Exhaust manifold to cylinder head
  - Exhaust turbocharger on exhaust manifold
  - Turbocharger bracket to cylinder block
  - Turbocharger bracket to turbocharger

Tightening torques

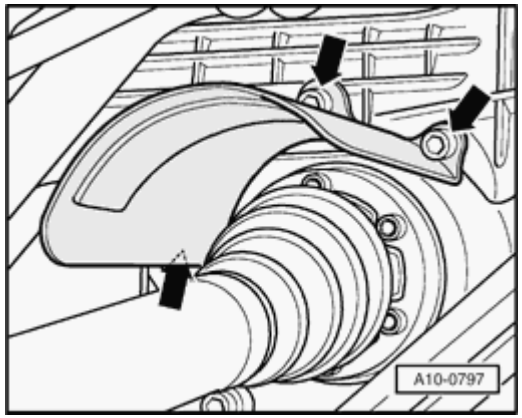
Component	Nm
Exhaust manifold to cylinder head	30
Turbocharger to exhaust manifold	35 1) 2)
Turbocharger bracket to cylinder block	25
Turbocharger bracket to turbocharger	30
Oil feed line to cylinder head	23
Line of crankcase vent to cylinder head	10
Hose clamps for air duct hoses	3.5

1) Replace bolts

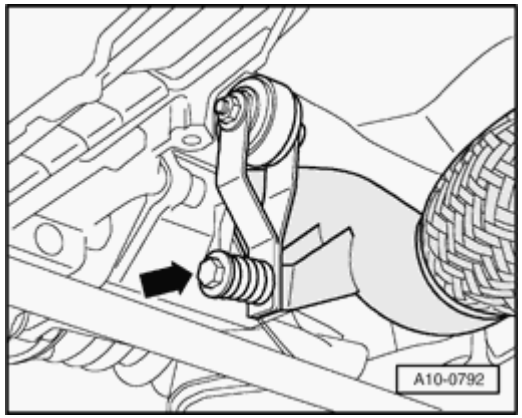
2) Coat thread and head attachment area with high temperature lubricant "G 052 112 A3"

Catalytic converter, removing and installing

Removing



- Remove heat shield -arrows- above right-hand drive shaft.
- Loosen bolted connection front exhaust pipe/catalytic converter accessible from below.

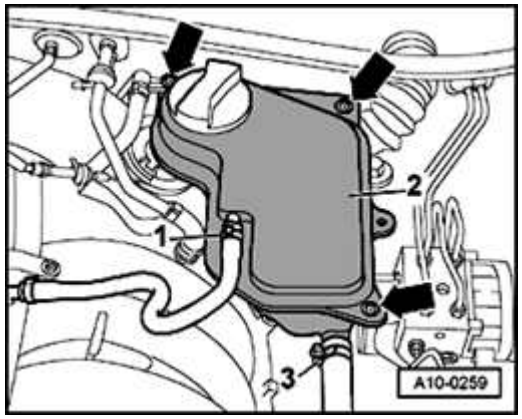


- Remove bolt for transmission bracket to exhaust system -arrow-.

Note:

The flexible connection in the front exhaust pipe must not be deflected more than 10° to avoid damage.

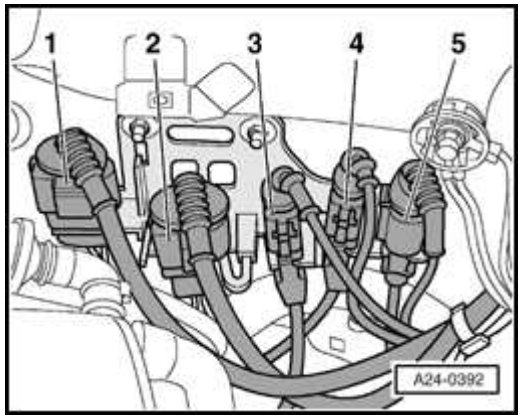
26-28



- Unbolt coolant expansion tank -2-, -arrows-.
- Disconnect wire to Engine Coolant level (ECL) Warning switch -F66- and move coolant expansion tank to one side.

Note:

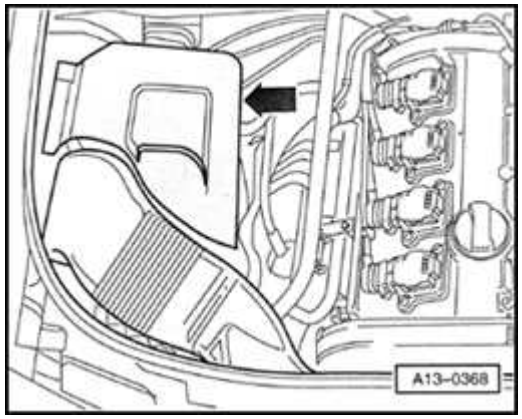
Coolant hoses -1- and -3- do not have to be disconnected.



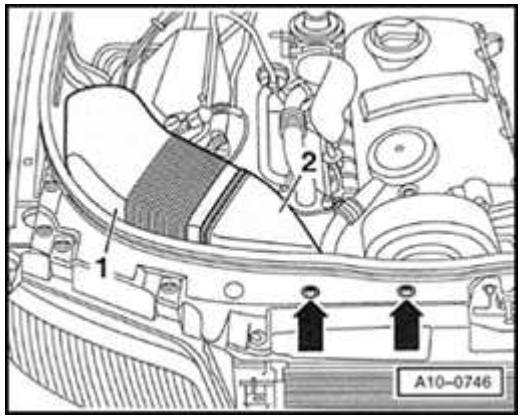
- Disconnect wiring connector for oxygen sensors and move wiring aside.

1 - (brown) to oxygen sensor downstream of catalytic converter -G130-

2 - (black) to oxygen sensor upstream of catalytic converter -G39-

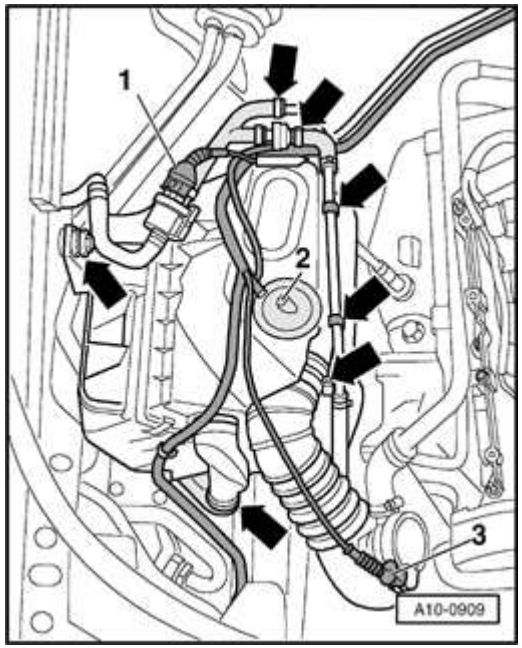


- Remove air filter cover -arrow-.



- Remove bolts -arrows-.
- Remove air duct -1- and -2-.

26-30



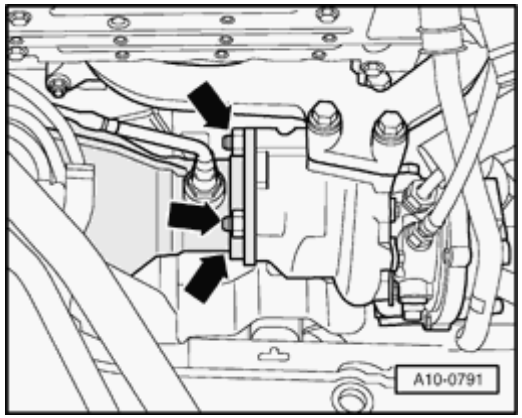
- Disconnect wiring connectors as follows:

1 - on ACF valve (in addition, remove ACF valve from air filter housing)

2 - on mass air flow sensor

3 - on Wastegate Bypass Regulator valve -N75-

- Disconnect hose connections, move wiring aside and remove air filter housing -arrows-.
- Loosen bolted connection of front exhaust pipe/catalytic converter accessible from above.



- Undo bolts -arrows- of exhaust turbocharger/catalytic converter.
- Remove catalytic converter upward.

Installing

Installation is carried out in the reverse order of removal; note the following:

Note:

Always replace seals, gaskets and self-locking nuts.

- Grease threads of oxygen sensors with high temperature lubricant G 052 112 A3. Apply lubricant only to threads of sensors; the lubricant must not get into the slots on the sensor body.

- Align exhaust system stress-free ⇒ Page 26-34 or ⇒ Page 26-37 .

Tightening torques

Components	Nm
Oxygen sensor to catalytic converter	55
Catalytic converter to exhaust turbocharger	30
Front exhaust pipe to catalytic converter	25
Front exhaust pipe to mountings on transmission	25
Heat shield to transmission	23
Hose clamps for air duct hoses	

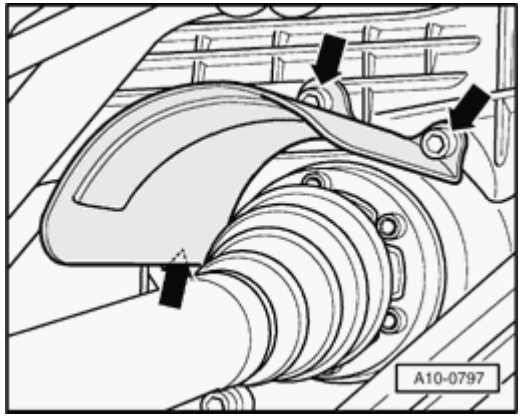
	3.5

26-32

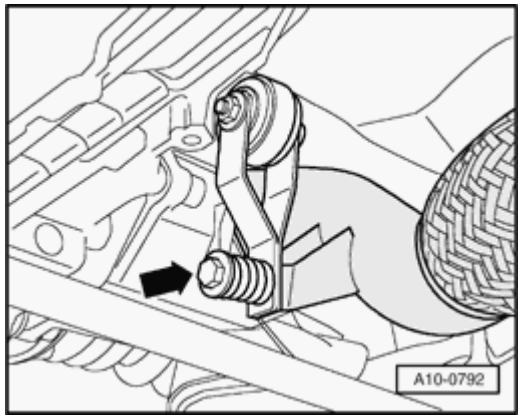
Front exhaust pipe, removing and installing

Removing

- Loosen bolted connection of front exhaust pipe/catalytic converter accessible from above.



- Remove heat shield -arrows- above right-hand drive shaft.
- Remove crosspiece for underfloor.

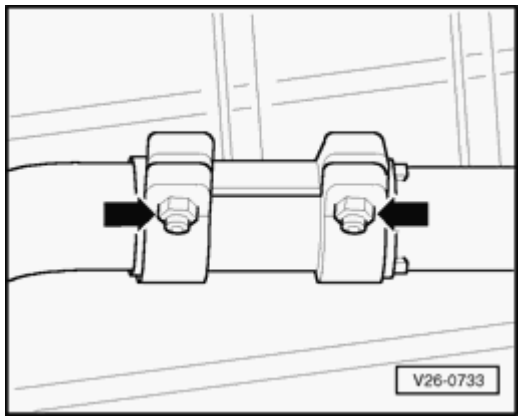


- Unbolt transmission bracket for exhaust system -arrow-.

26-33

Note:

The flexible connection in the front exhaust pipe must not be deflected more than 10° or it may be damaged.



- Separate exhaust system at clamp -arrows-.
- Loosen bolted connection of front exhaust pipe/catalytic converter accessible from below.
- Remove front exhaust pipe.

Installing

Installation is carried out in the reverse order of removal; note the following:

Note:

Always replace seals, gaskets and self-locking nuts.

- Align exhaust system stress-free ⇒ Page 26-34 or ⇒ Page 26-37 .

Tightening torques

Components	Nm
Front exhaust pipe to catalytic converter	25
Crosspiece for underbody to body	20
Heat shield to transmission	23

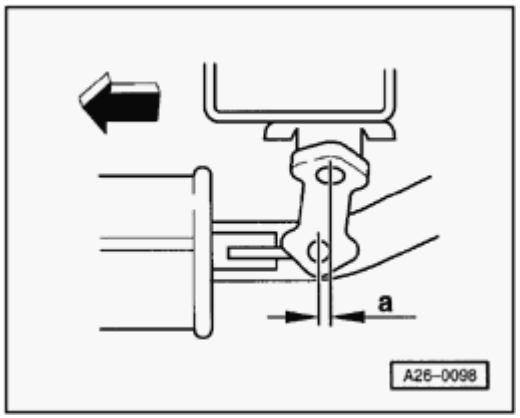
26-34

Stress-free alignment of the exhaust system - Vehicles with front wheel drive

Vehicles without clamp between center muffler and rear muffler

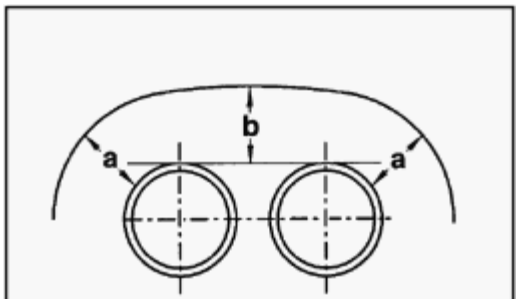
- The exhaust system must be aligned when cold.

- Loosen bolted connections on front clamp -Item 16 -, ⇒ Page 26-5 .



- Push exhaust system toward front of vehicle -arrow- so that rear mounting of rear muffler is pre-loaded by amount -a- = 9 to 11 mm.
- Tighten bolted connections on clamp evenly to 40 Nm.

Aligning tailpipes



Align tailpipes so that the distance -a- is the same on both sides.

At the same time, distance -b- must be obtained between the bumper cut-out and the tailpipe:

- Dimension b = min. 24 mm

26-35

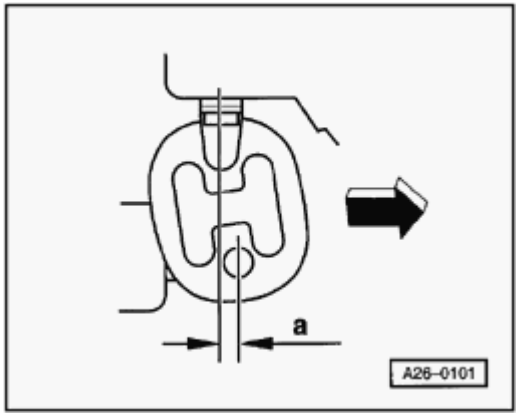
Vehicles with clamp between center muffler and rear muffler

- The exhaust system must be aligned when cold.

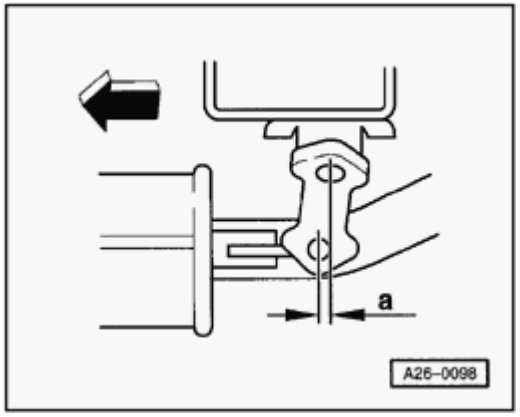
Note:

It is only necessary to additionally align the center muffler on vehicles with a clamp installed between the center and rear mufflers.

- Loosen bolted connections on front -Item 16 -, ⇒ Page 26-5 and rear clamps -Item 21 -, ⇒ Page 26-6 .

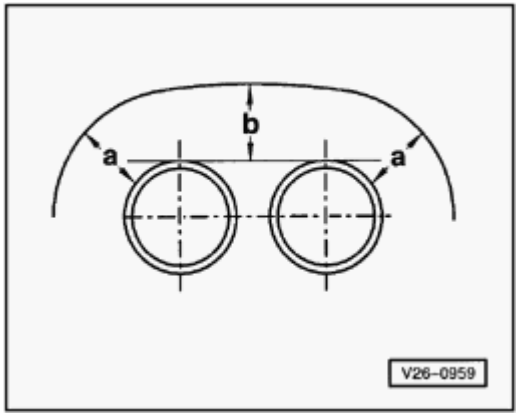


- Push front section of exhaust system toward front of vehicle -arrow- until preloading at right-hand mounting of center muffler is -a- = 7 to 9 mm.
- Tighten bolts on front clamp -Item 16 -, ⇒ Page 26-5 evenly to 40 Nm.



- Push rear part of exhaust system towardsfront of vehicle -arrow- so that rear mounting on rear muffler is preloaded by -a- = 9 to 11 mm.
- Tighten bolts on rear clamp -Item 21 -, ⇒ Page 26-6 evenly to 40 Nm.

Aligning tailpipes



Align tailpipes so that distance -a- is the same on both sides.

At the same time, distance -b- must be obtained between the bumper cut-out and the tailpipe:

- Dimension b = min. 24 mm

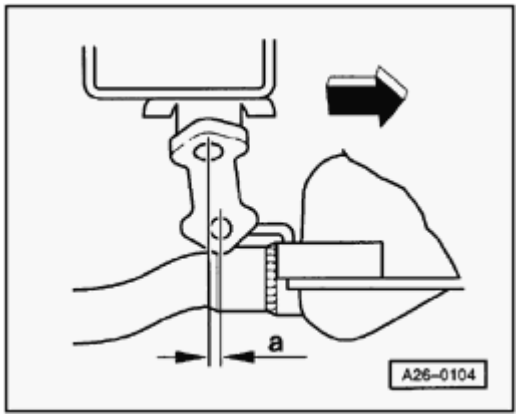
26-37

Stress-free alignment of exhaust system - Vehicles with all-wheel drive

- Vehicles without clamp between centre silencer and rear silencer

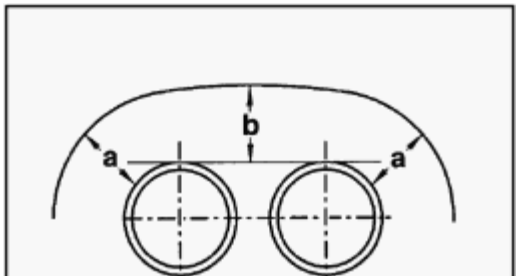
- The exhaust system must be aligned when cold.

- Loosen bolted connections on clamp -Item 15 -, ⇒ Page 26-12



- Push rear silencer towards front of vehicle -arrow- so that rear right mounting on rear silencer is preloaded by a = 9...11 mm.
- Tighten bolted connections on clamp evenly to 40 Nm.

Aligning tailpipes



- Align tailpipes so that distance -a- is the same on both sides.
- At the same time, distance -b- must be obtained between bumper cut-out and tailpipe:
  - Dimension b = min. 24 mm

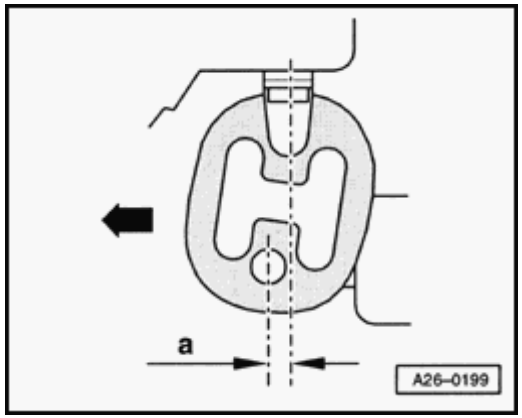
- Vehicles with clamp between centre silencer and rear silencer

- The exhaust system must be aligned when cold.

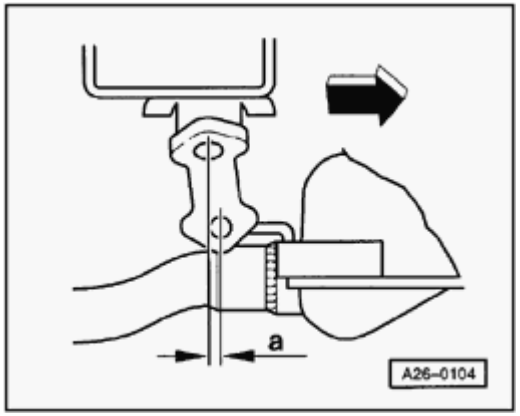
Note:

It is only necessary to additionally align the centre silencer on vehicles with clamp fitted between centre silencer and rear silencer.

- Slacken bolted connections on clamp -Item 15 -, ⇒ Page 26-12 and -Item 22 -, ⇒ Page 26-14 .

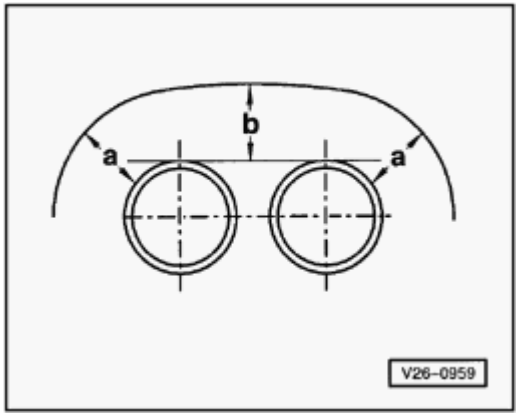


- Push exhaust system towards front of vehicle -arrow- so that rear right mounting on centre silencer is preloaded by a = 7...9 mm.
- Tighten bolts on front clamp -Item 15 -, ⇒ Page 26-12 evenly to 40 Nm.



- Push rear silencer towards front of vehicle -arrow- so that rear right retainer on rear silencer is preloaded by a = 9...11 mm.
- Tighten bolts on rear clamp -Item 22 -, ⇒ Page 26-14 evenly to 40 Nm.

Aligning tailpipes



- Align tailpipes so that distance -a- is the same on both sides.
- At the same time, distance -b- must be obtained between bumper cut-out and tailpipe:
  - Dimension b = min. 24 mm

Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug tailpipes with cloths or stoppers, etc. until leakage check is completed.
- Listen for noise at the connection points (cylinder head/manifold, manifold/turbocharger, turbocharger/catalytic converter, etc.) to locate any leaks.
- Repair any leaks that are found.

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.***

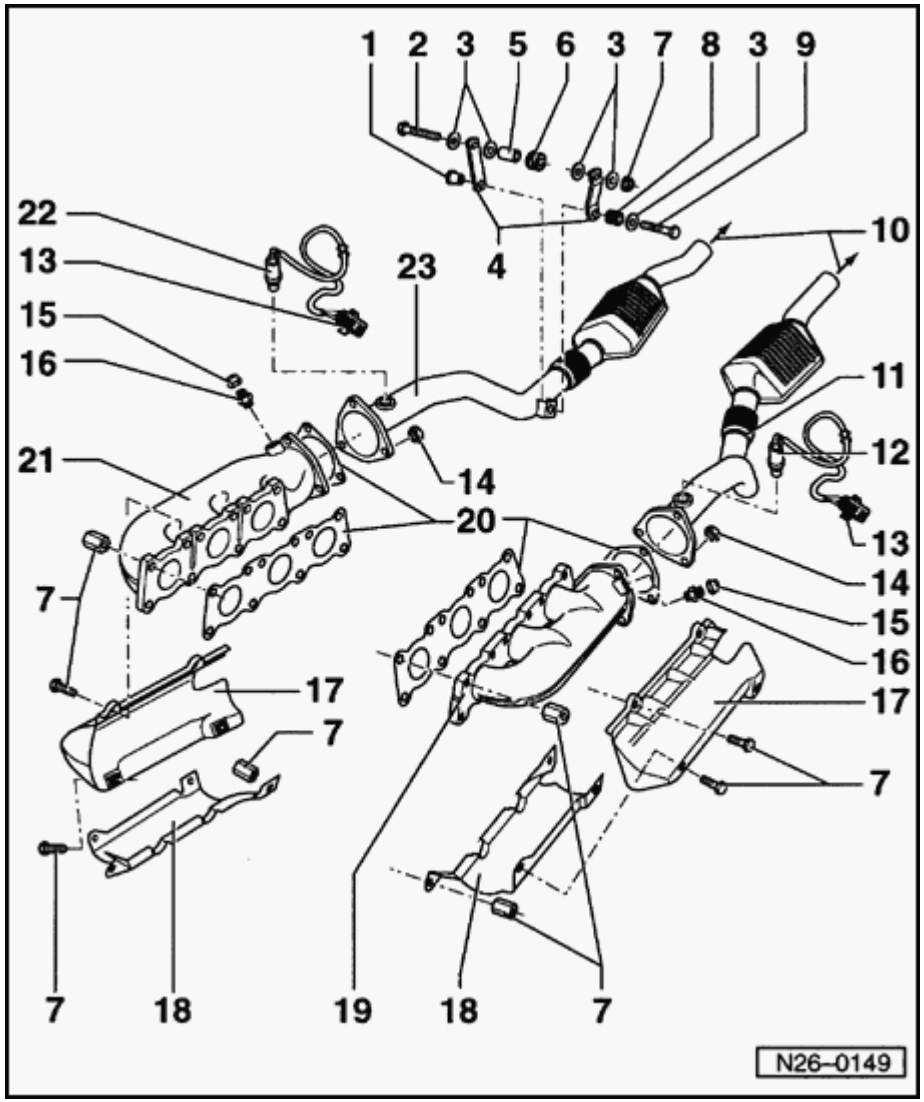
Notes:

- *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 and exhaust pipe so that sufficient clearance is maintained to the bodywork and the support rings are evenly loaded.*

- *The flexpipe in left and right exhaust pipes must not be bent more than 10° , otherwise it may be damaged.*

26-2



Exhaust manifold, front exhaust pipe and Three Way Catalytic Converter (TWC) with attachments

1 - Spacer sleeve

2 - Bolt

3 - Washers

4 - Bracket

5 - Spacer bushing

6 - Rubber bushing

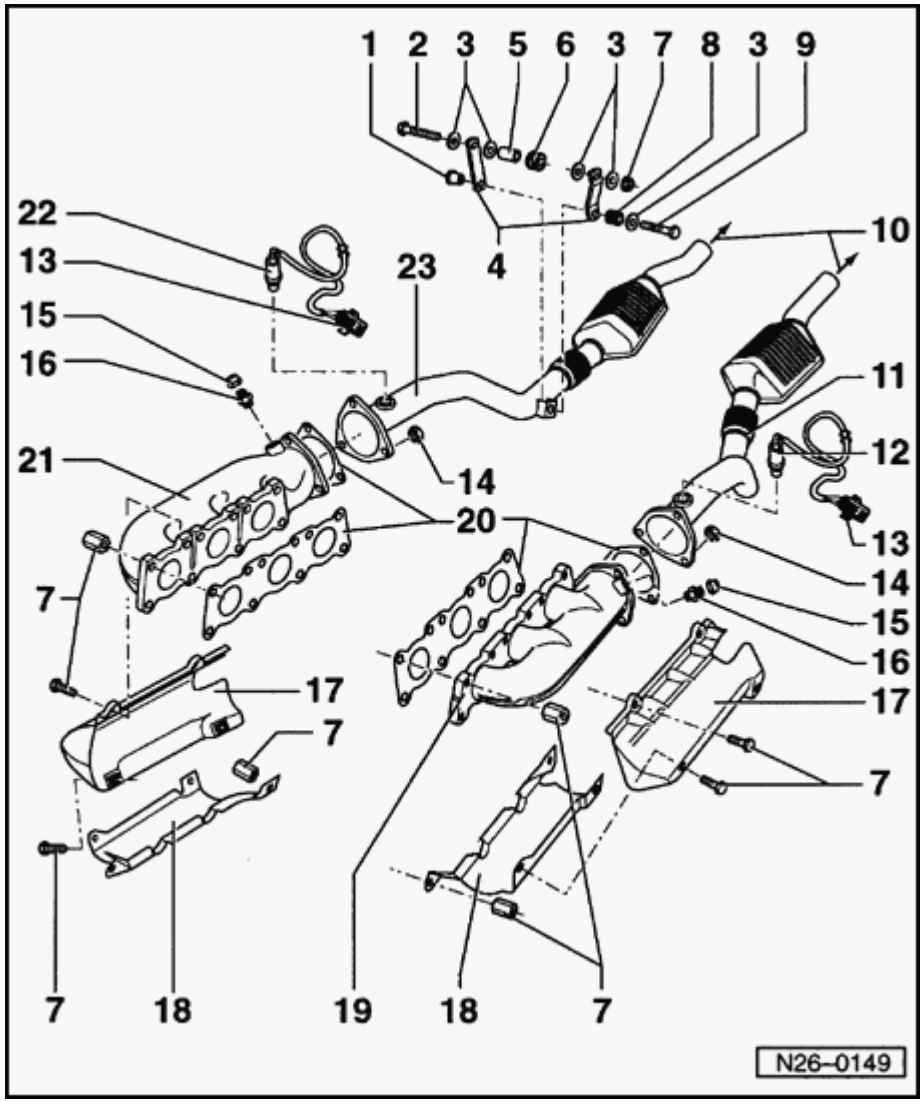
7 - 25 Nm (18 ft lb)

8 - Spring

9 - Bolt

- ♦ 25 Nm (18 ft lb)

10 - To center muffler



11 - Left-front exhaust pipe with Three Way Catalytic Converter (TWC)

- The flexpipe in left and right exhaust pipes must not be bent more than 10°, otherwise it may be damaged

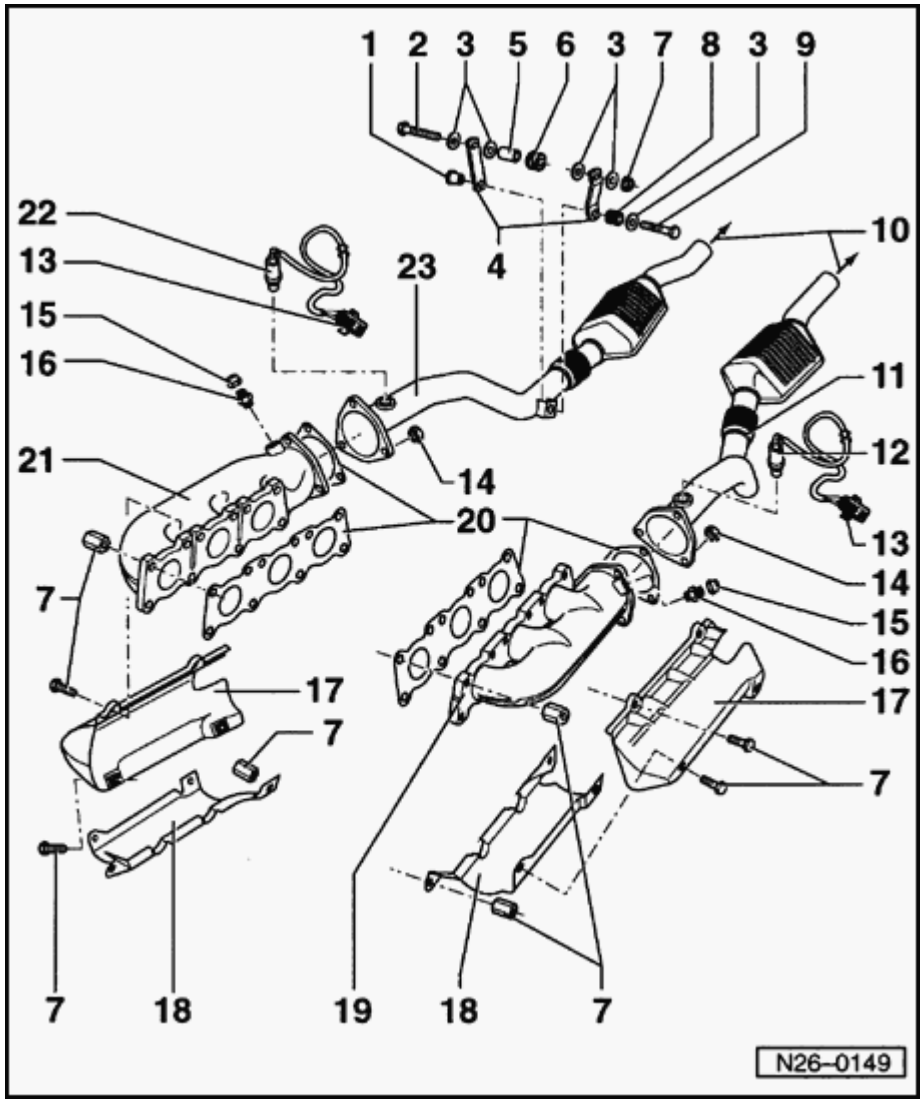
12 - Heated Oxygen Sensor (HO2S) 2 -G108-

- 50 Nm (37 ft lb)
- Only grease threads using "G5" ("G5" must not get into slots on body of sensor)
- Checking DTC memory ⇒ Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01
- Checking components and heating function ⇒ Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 24

CAUTION!

Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

26-4



13 - 4-pin harness connectors

- Black
- Mounted to bulkhead
- For Heated Oxygen Sensors (HO2S) and for heating function

14 - 25 Nm (18 ft lb)

15 - Cover cap

- 10 Nm (7 ft lb)

16 - Connection

17 - Upper heat shield

18 - Lower heat shield

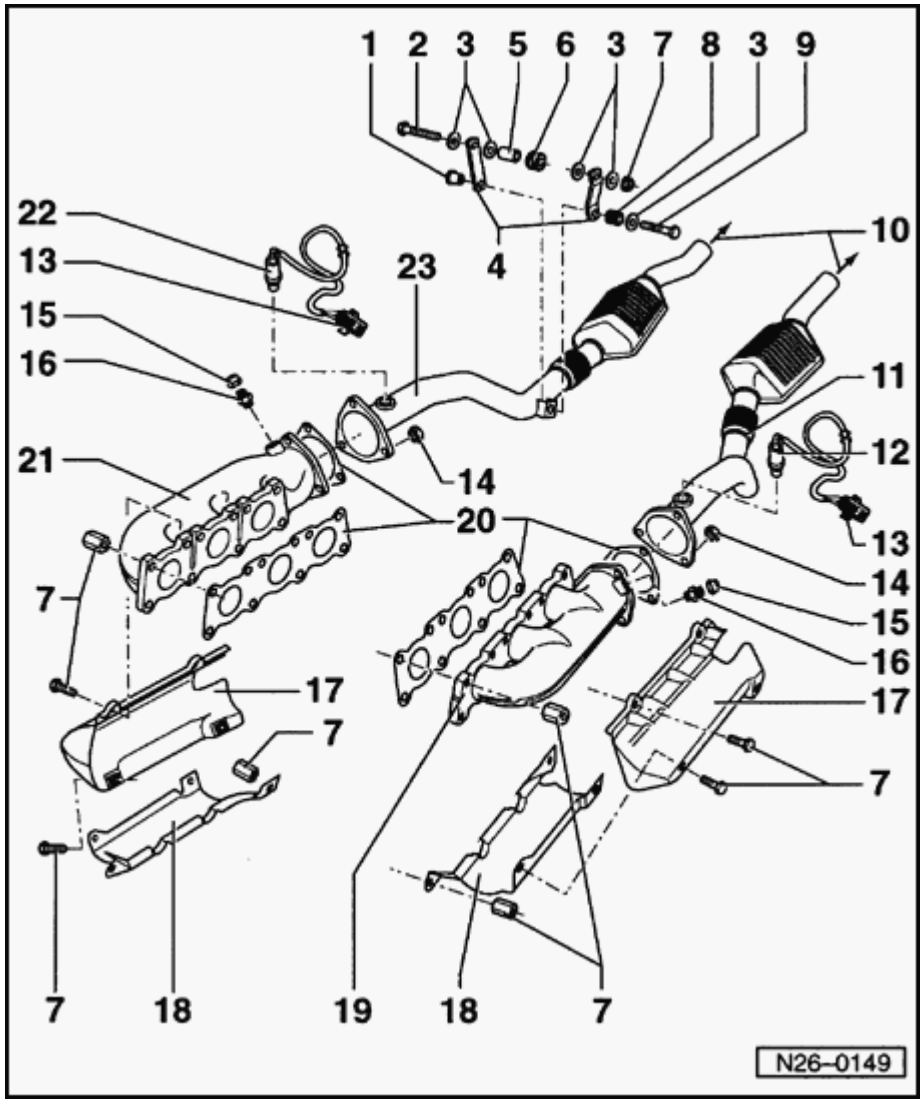
19 - Left-side exhaust manifold

20 - Gaskets

- Always replace

21 - Right-side exhaust manifold

26-5



22 - Heated Oxygen Sensor (HO2S) -G39-

- 50 Nm (37 ft lb)
- Only grease threads with "G5" ("G5" must not get into slots on body of sensor)
- Checking DTC memory ⇒ Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01
- Checking components and heating function⇒ Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 24

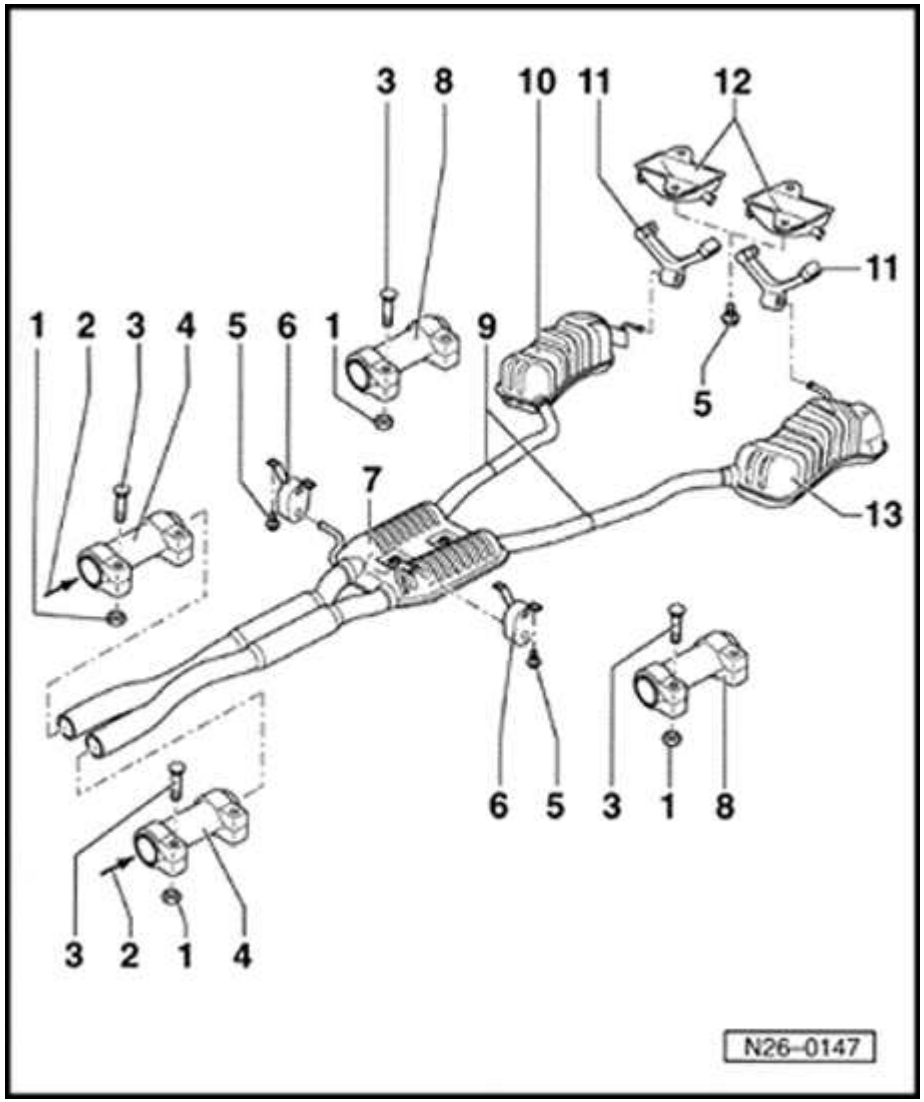
CAUTION!

Part numbers are listed here for reference only. Always check with your Parts department for the latest information.

23 - Right-front exhaust pipe with Three Way Catalytic Converter (TWC)

- The flexpipe in left and right exhaust pipes must not be bent more than 10 ° , otherwise it may be damaged

26-6



Mufflers with mounts

Vehicles with all-wheel drive

Vehicles with front-wheel-drive ⇒ page 26-9 .

1 - 40 Nm (30 ft lb)

2 - From Three Way Catalytic Converter (TWC)

3 - Carriage bolts

4 - Double clamp

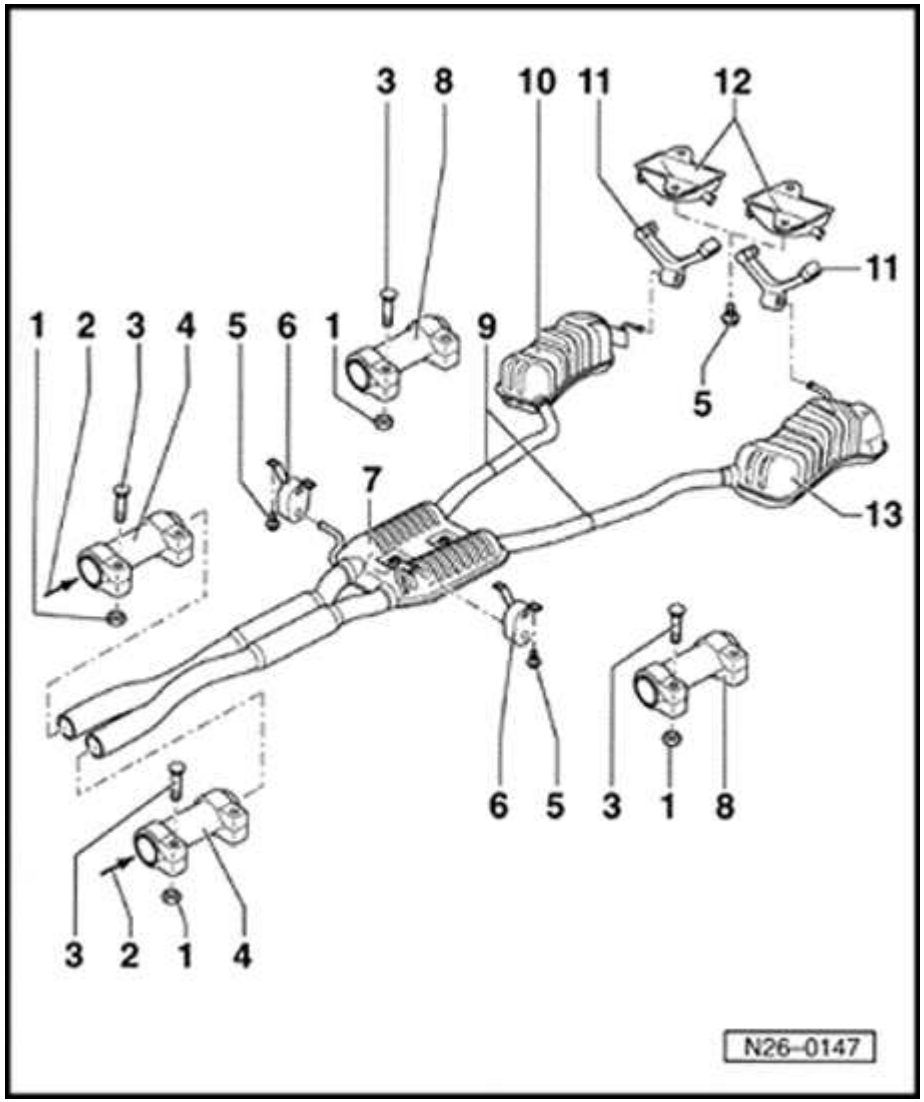
5 - 25 Nm (18 ft lb)

6 - Mounts

- With retaining ring

7 - Center muffler

8 - Double clamp (for repair)



9 - Separating points

- At factory, center and rear mufflers are installed as single component. Replacement center and rear mufflers are supplied separately, with double clamp for connecting joint
- Cutting through at separating point ⇒ Fig. 1

10 - Right-rear muffler

11 - Mounts

12 - Brackets

13 - Left-rear muffler

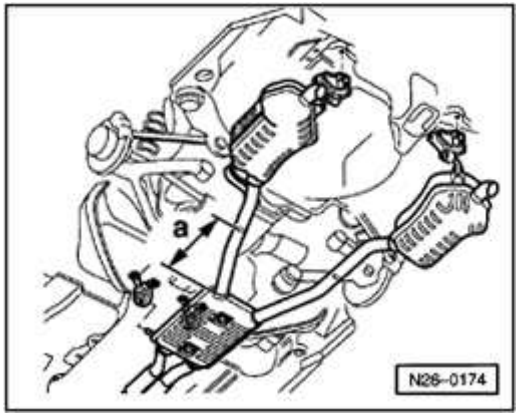
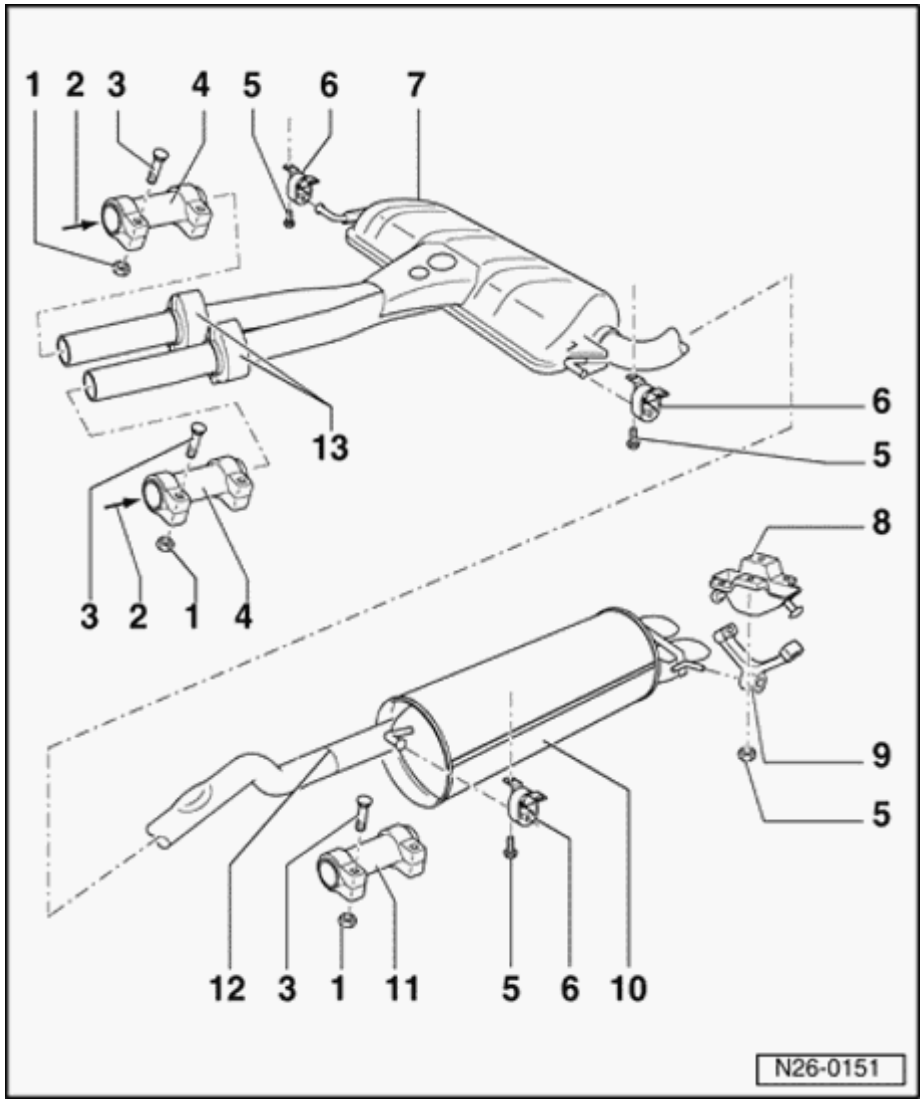


Fig. 1 Separating point between front and rear mufflers

Cutting

- Using VAG1523 body saw, cut through connecting pipe between center muffler and rear muffler at groove.

  Distance -a-: approx. 244 mm (9-1/2 in.).



Vehicles with front wheel drive

1 - 40 Nm (30 ft lb)

2 - From Three Way Catalytic Converter (TWC)

3 - Carriage bolts

4 - Double clamps

5 - 25 Nm (18 ft lb)

6 - Mounts

- With retaining ring

7 - Center muffler

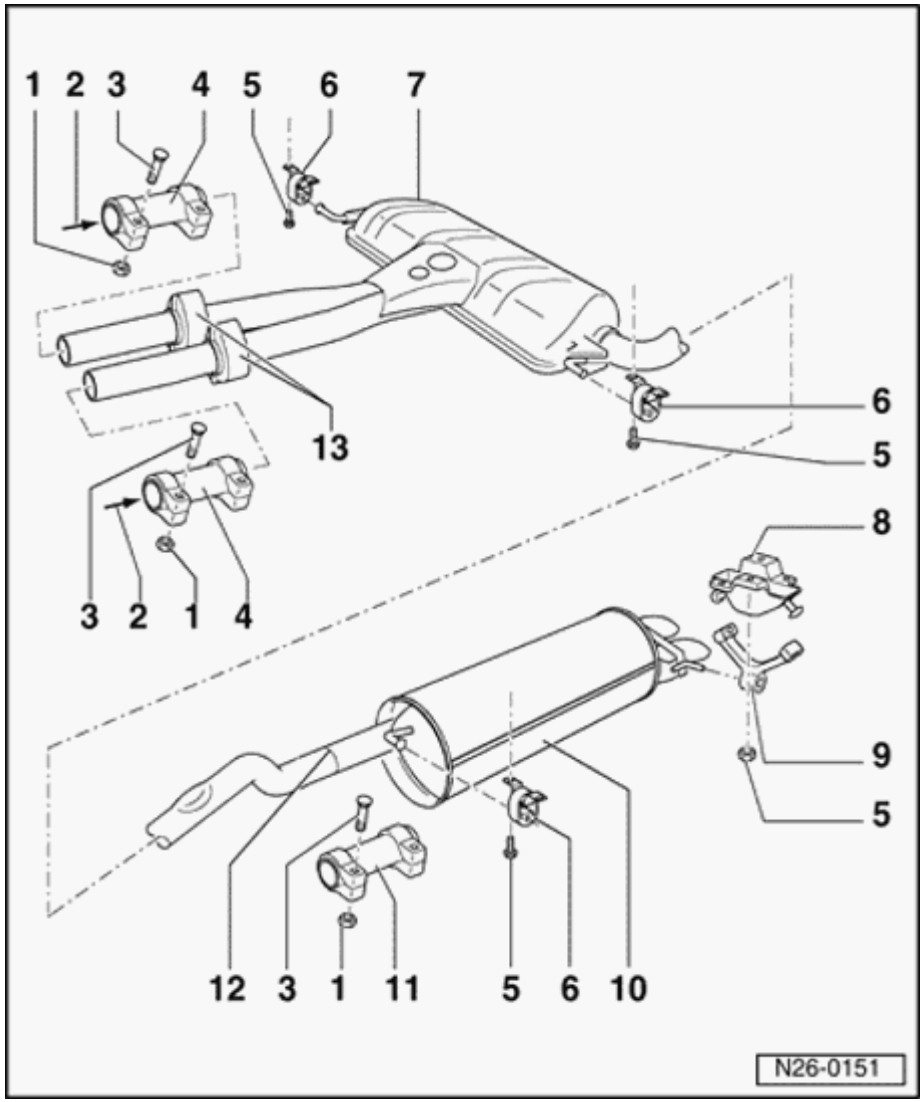
8 - Bracket

9 - Mount

10 - Rear muffler

11 - Double clamp (for repair)

26-10



12 - Separating point

- At factory, center and rear mufflers are installed as single component. Replacement center and rear mufflers are supplied separately, with double clamp for connecting joint
- Cutting through at separating point ⇒ Fig. 1

13 - To front mufflers

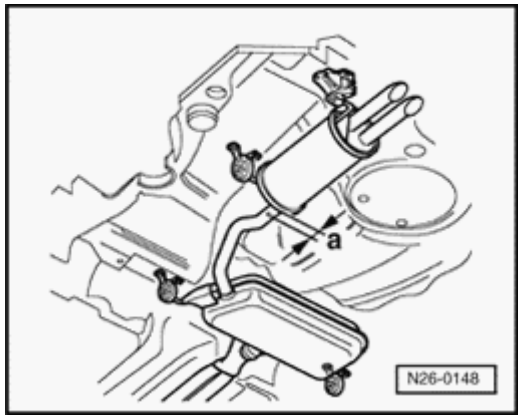


Fig. 1 Separating point between front and rear mufflers

Cutting

- Using VAG1523 body saw, cut through connecting pipe between center muffler and rear muffler at groove.

  Distance -a-: approx. 182 mm (7 in.).

26-1

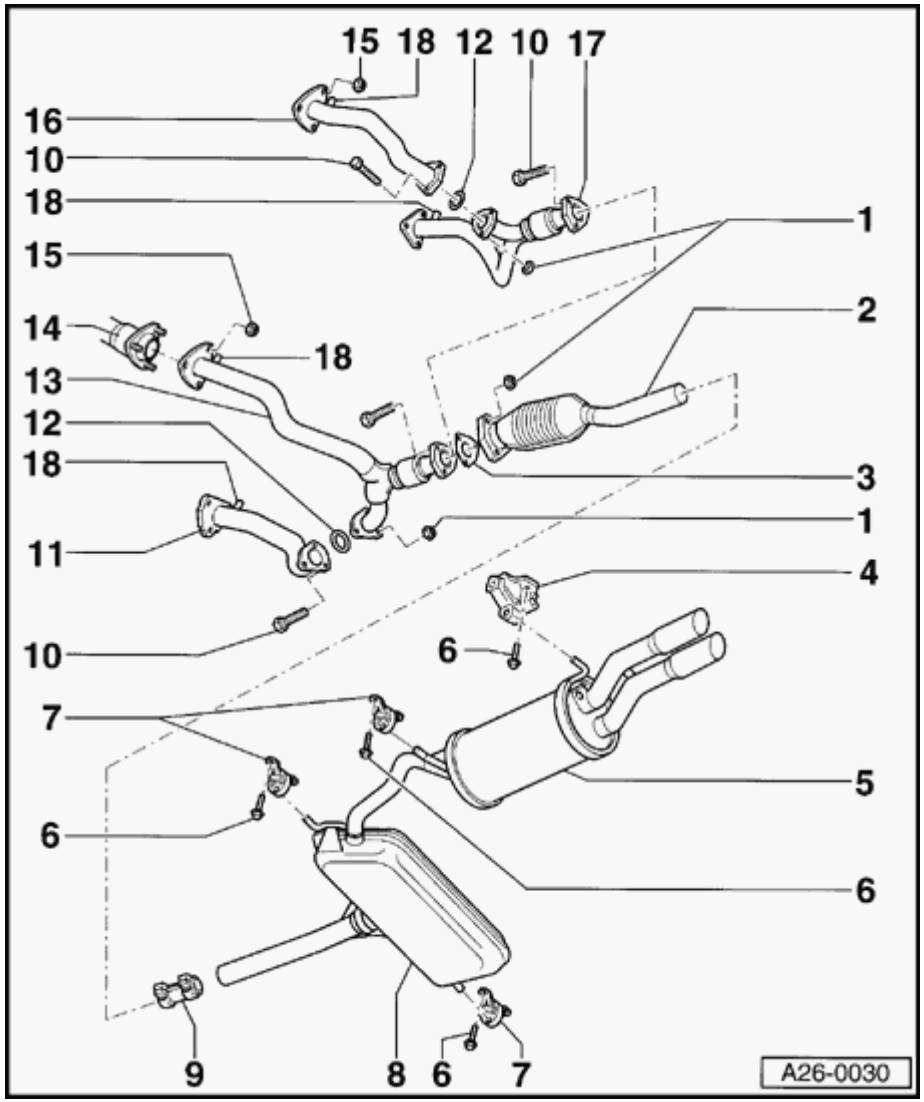
Exhaust system components, removing and installing

Note:

- *As a general rule, always install new seals and gaskets and clamping sleeves.*
- *Always replace self-locking nuts.*
- *Install retaining rings and bolted connections as specified ⇒Parts catalog microfiche.*
- *Make sure that there is adequate clearance between the body and the exhaust system components.*

Instructions for aligning the exhaust system free of stress will be issued in a subsequent Technical Bulletin.

26-2



Front-wheel-drive, engine code AFC

1 - Locking nut

- 25 Nm (18 ft lb)

2 - Three Way Catalytic Converter (TWC)

3 - Gasket

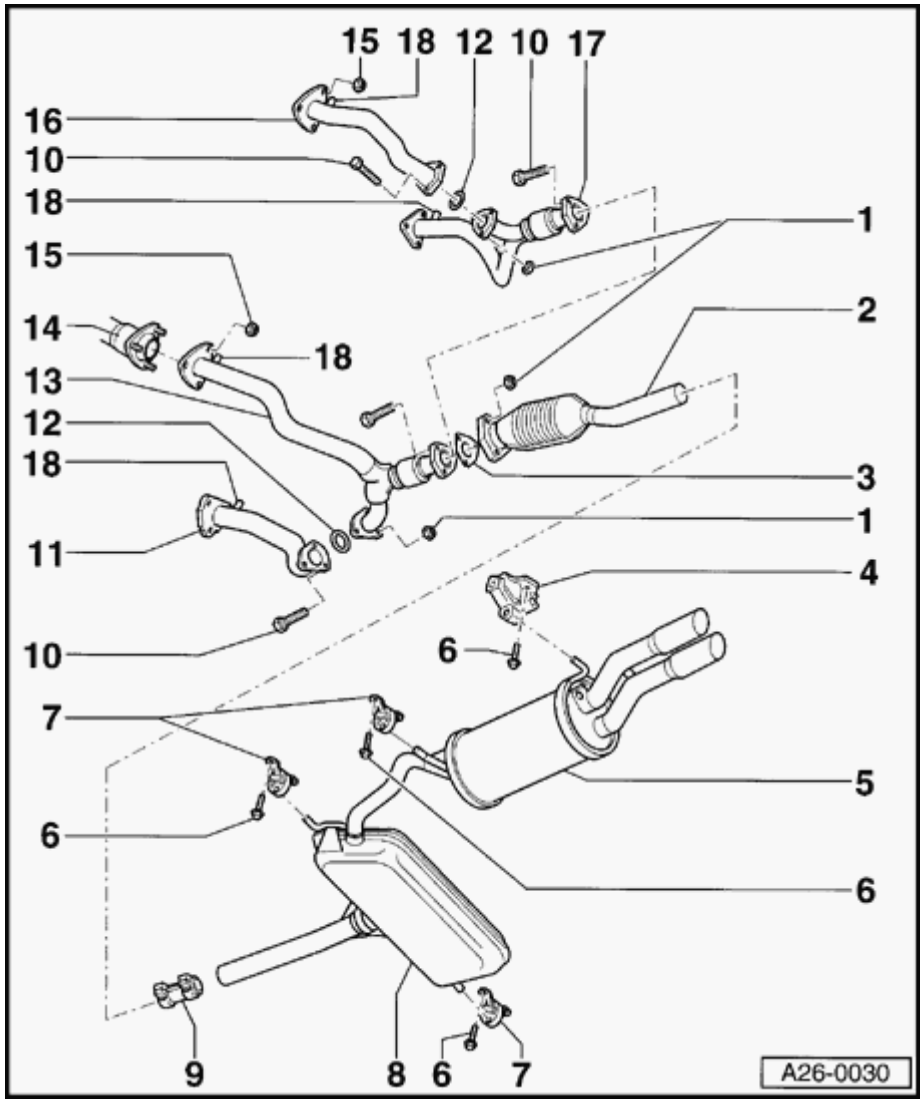
4 - Retaining ring

- When replacing always use a lubricant and avoid damaging the rubber.

5 - Rear muffler

6 - Hex bolt

- 25 Nm (18 ft lb)



7 - Retaining ring

8 - Center muffler

9 - Clamping sleeve

- 40 Nm (30 ft lb)
- Tighten evenly
- Installed horizontally in vehicle

10 - Hex bolt

11 - Exhaust pipe, right front

- Only for models with automatic transmission

12 - Seal

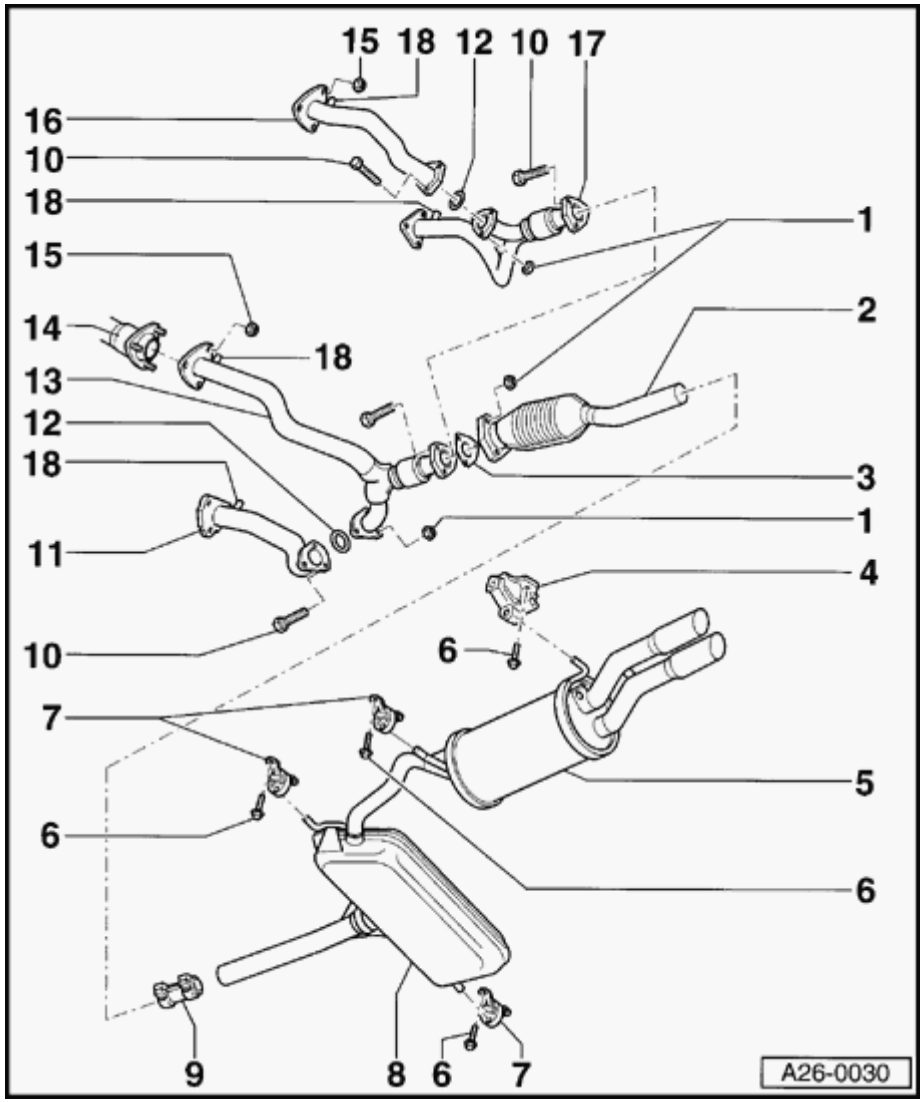
13 - Exhaust pipe with insulating element, left front

- Only for models with automatic transmission

Note:

Handle the insulating elements with care; protect from shock-like stresses and extreme bending. Maximum deflection 10°.

26-4



14 - Exhaust manifold

15 - Hex nut

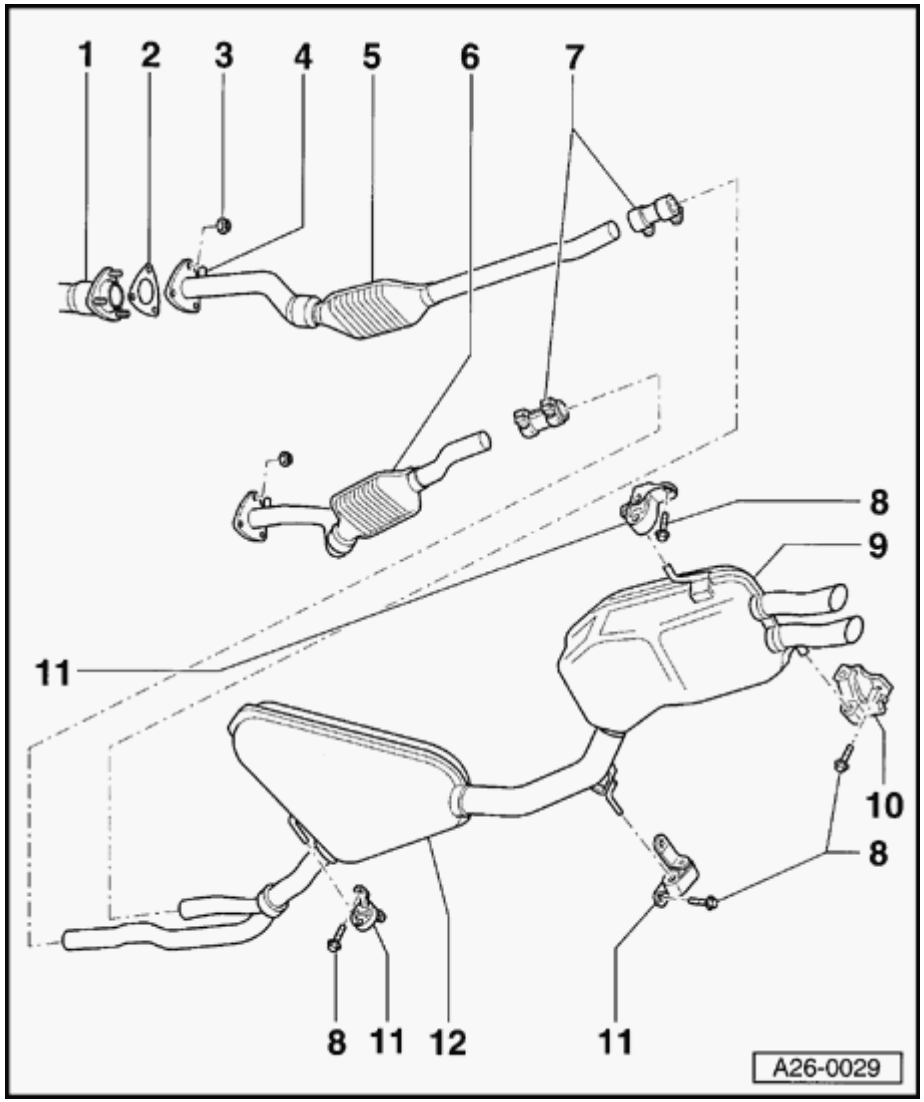
- 30 Nm (22 ft lb)

16 - Exhaust pipe, left front

17 - Exhaust pipe with insulating element, right front

18 - Heated Oxygen Sensor (HO2S)

- 50 Nm (37 ft lb)
- Testing ⇒ Repair Manual, 2.8 Liter V6 OBD II Fuel Injection & Ignition, Repair Group 24
- Lubricate threads with G5
- G5 must not get into slots on HO2S probe body



All-wheel-drive, engine codes AFC

1 - Exhaust manifold

2 - Gasket

3 - Hex nut

- 30 Nm (22 ft lb)

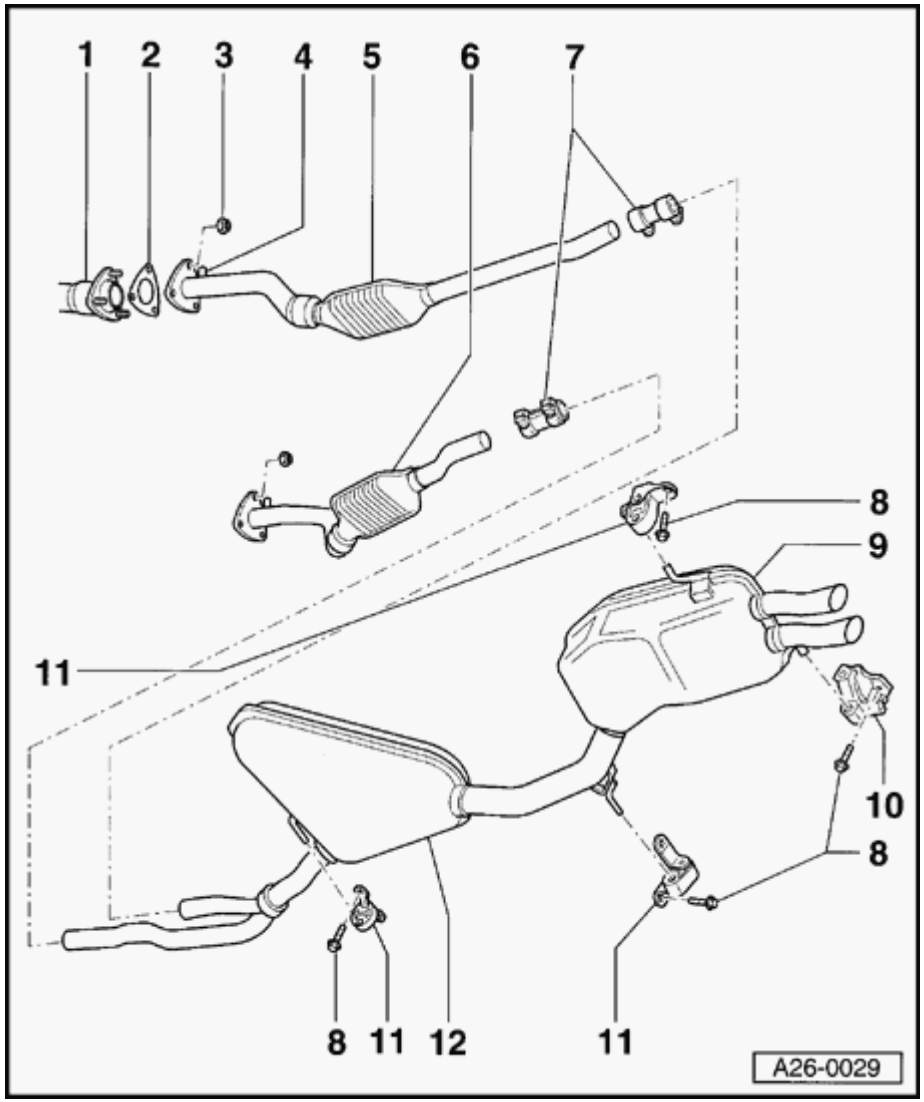
4 - Heated Oxygen Sensor (HO2S)

- 50 Nm (37 ft lb)
- Testing ⇒ Repair Manual, 2.8 Liter V6 OBD II Fuel Injection & Ignition, Repair Group 24
- Lubricate threads with G5
- G5 must not get into slots on HO2S probe body

5 - Three Way Catalytic Converter (TWC) with insulating element, left

Note:

Handle the insulating elements with care; protect from shock-like stresses and extreme bending. Maximum deflection 10° .



6 - Three Way Catalytic Converter (TWC) with insulating element, right

7 - Clip

- 40 Nm (30 ft lb)

8 - Hex bolt

- 25 Nm (18 ft lb)

9 - Rear muffler

10 - Retaining ring

- When replacing always use a lubricant and avoid damaging the rubber.

11 - Retaining ring

- When replacing always use a lubricant and avoid damaging the rubber.

12 - Center muffler

26-1

Exhaust system components, removing and installing

WARNING!

- ***Do not re-use any fasteners that are worn or deformed in normal use.***

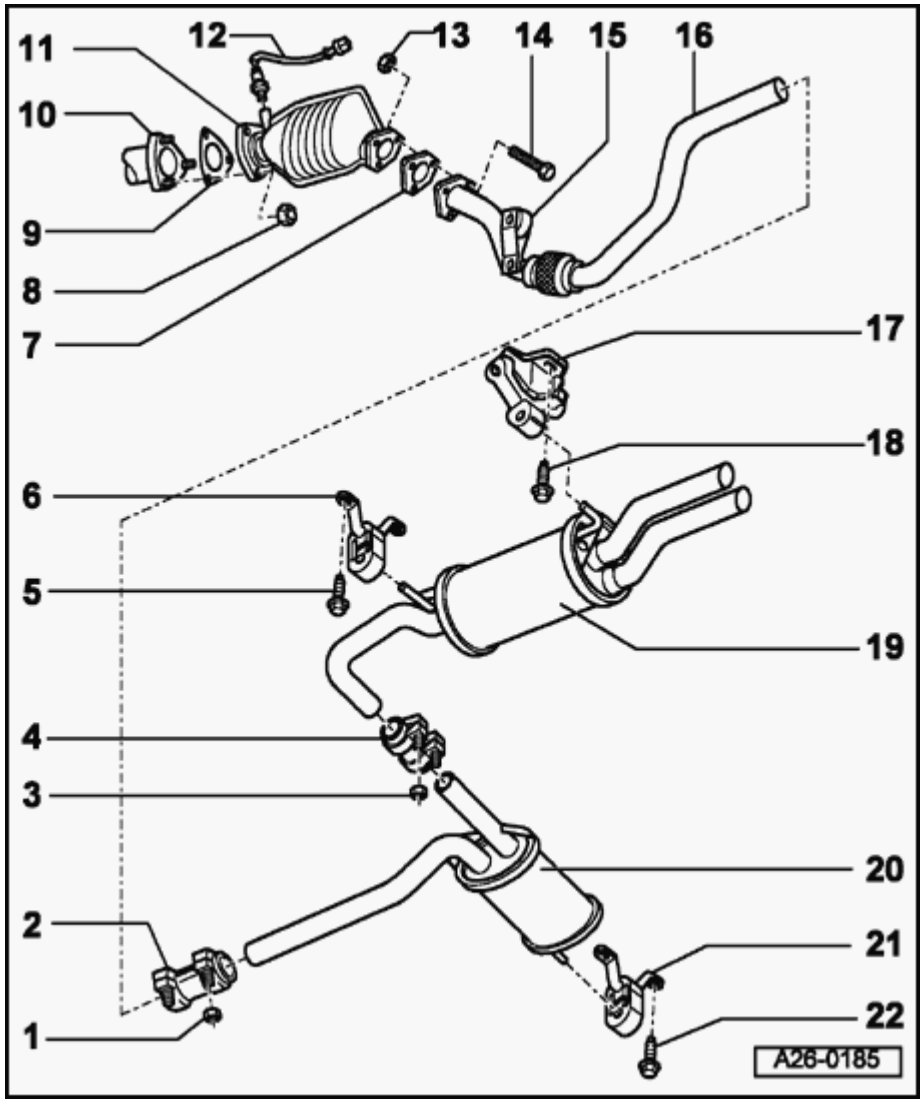
- ***Some fasteners are designed to be used only once, and are unreliable and may fail if used a second time. This includes, but is not limited to, nuts, bolts, washers, circlips and cotter pins. Always follow the recommendations in this manual-replace these fasteners with new parts where indicated, 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.*

- *The exhaust flexpipe must not be bent more than 10° , otherwise it may be damaged.*



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

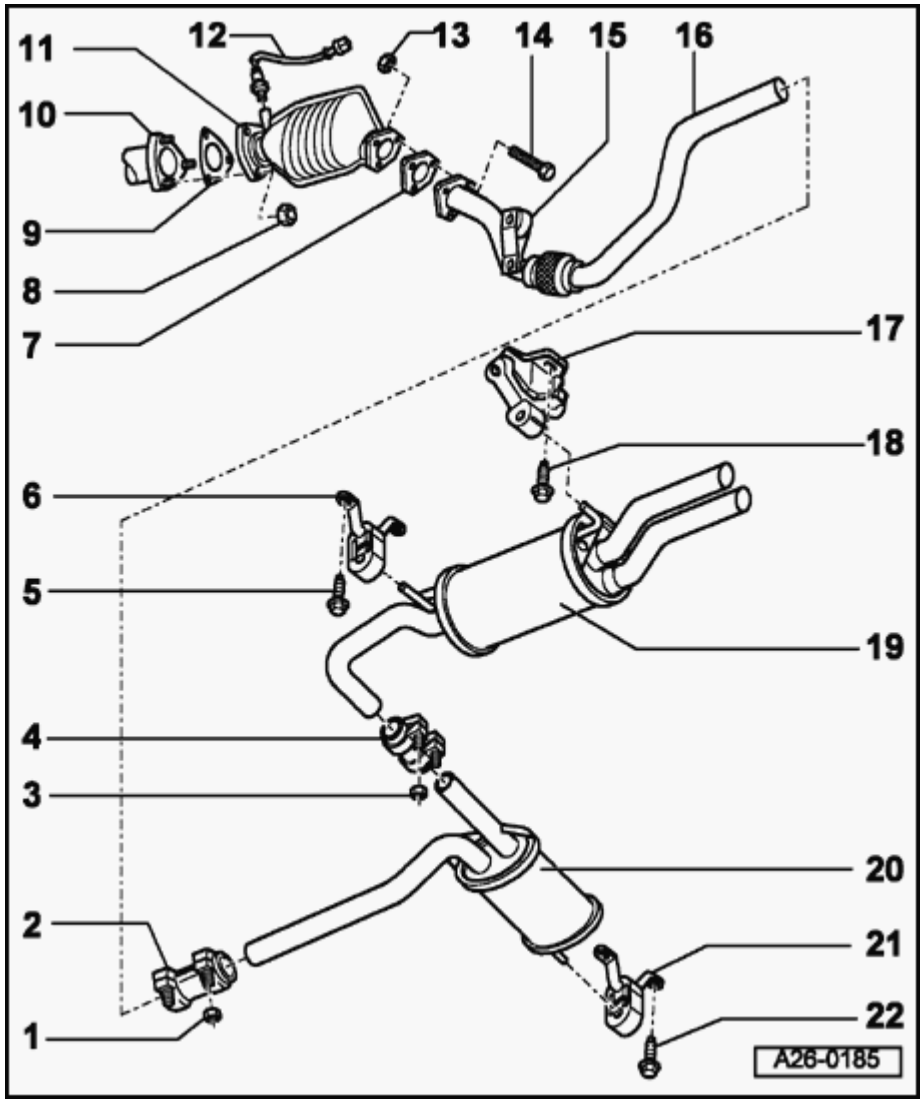
3 - Nut

- 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

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

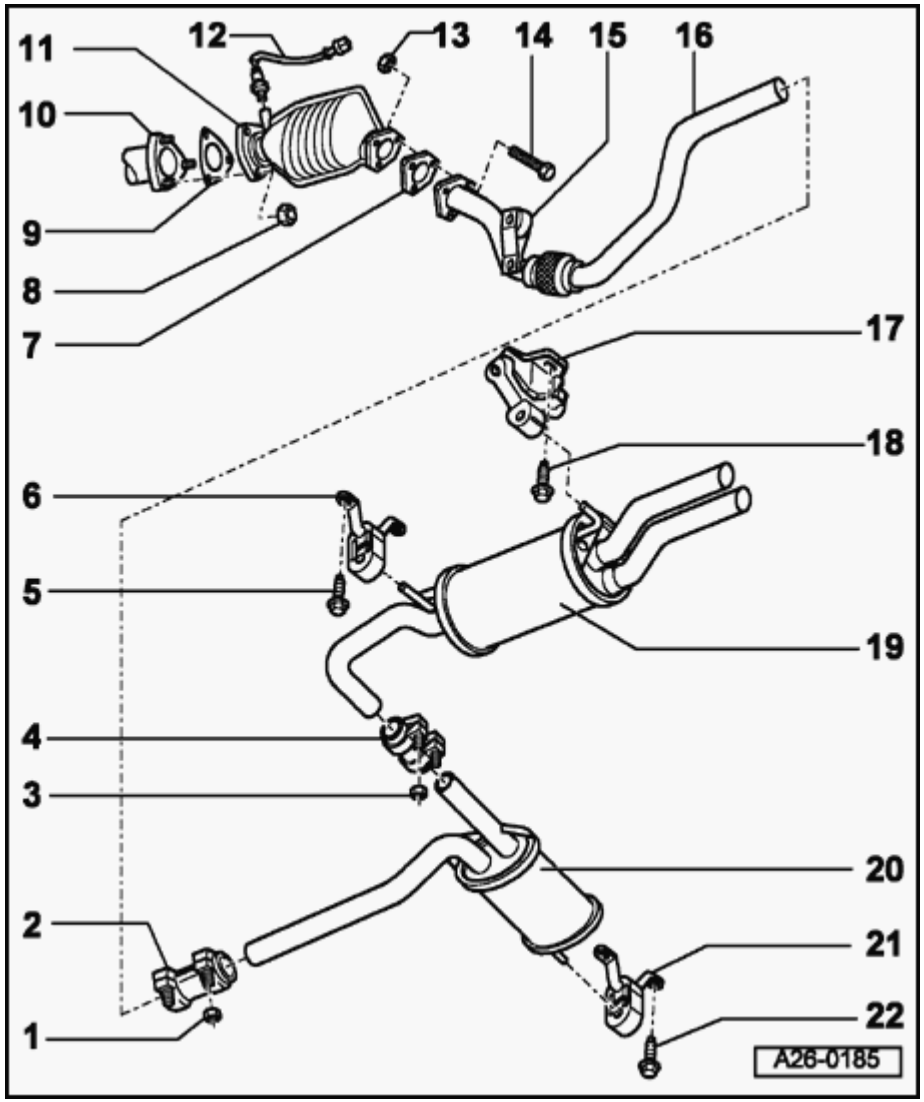
- Always replace

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



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

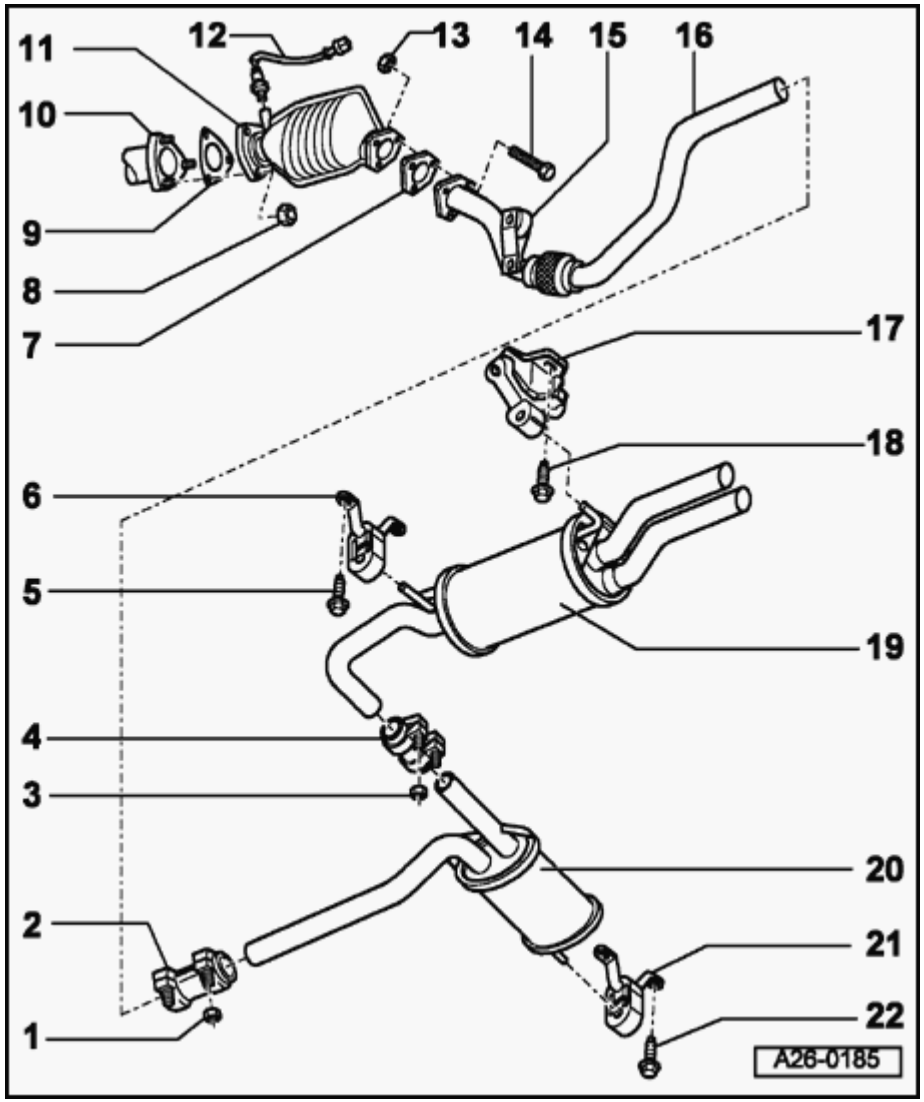
- 25 Nm (18 ft lb)

15 - 16Mount

Different versions for manual and automatic transmissions

- Manual transmission ⇒ Page 26-12 , Fig. ⇒ 1
- Automatic transmission ⇒ Page 26-13 ,

Fig. ⇒ 2



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

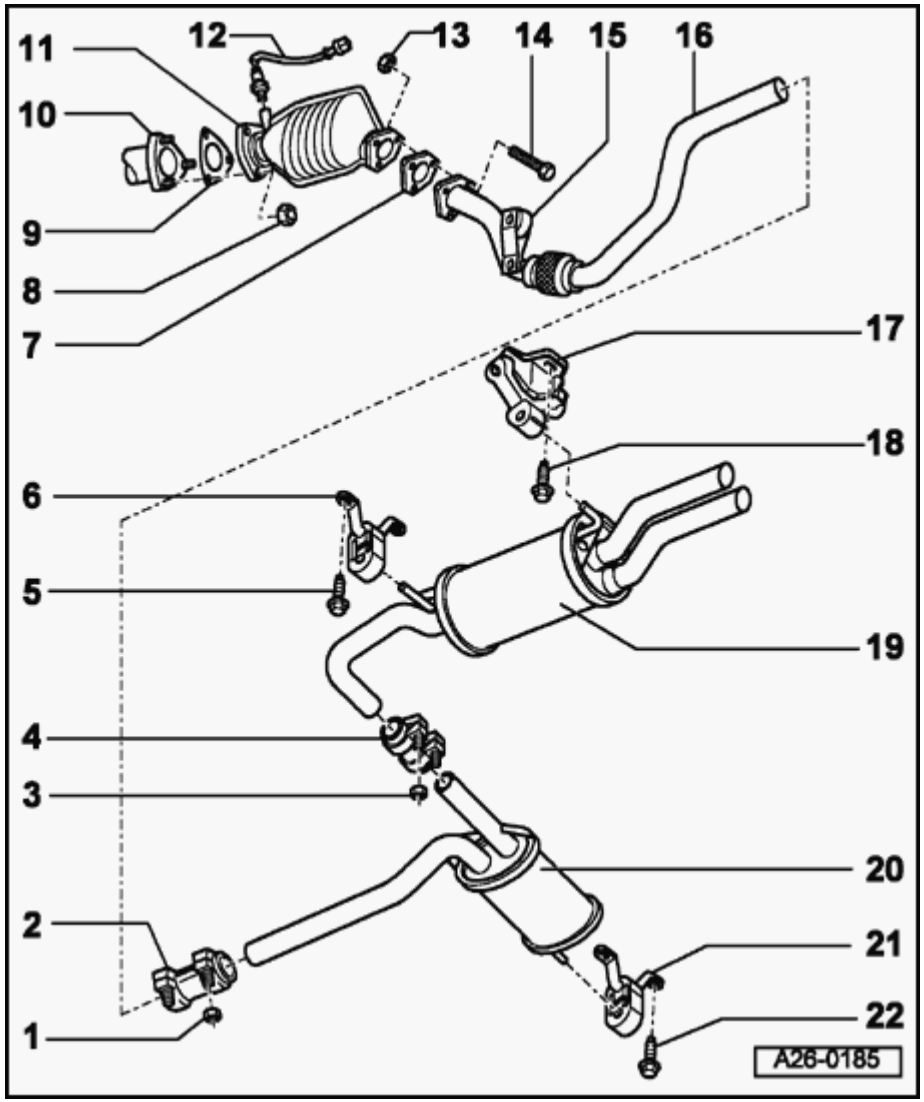
- Factory-installed with front muffler as one unit. If repair is necessary, replace separately
- Separating point ⇒ Page 26-14
- Align exhaust system free of stress ⇒ Page 26-24

21 - Front muffler

- Factory-installed with rear muffler as one unit. If repair is necessary, replace separately
- Separating point ⇒ Page 26-14

- Align exhaust system free of stress ⇒ Page 26-24

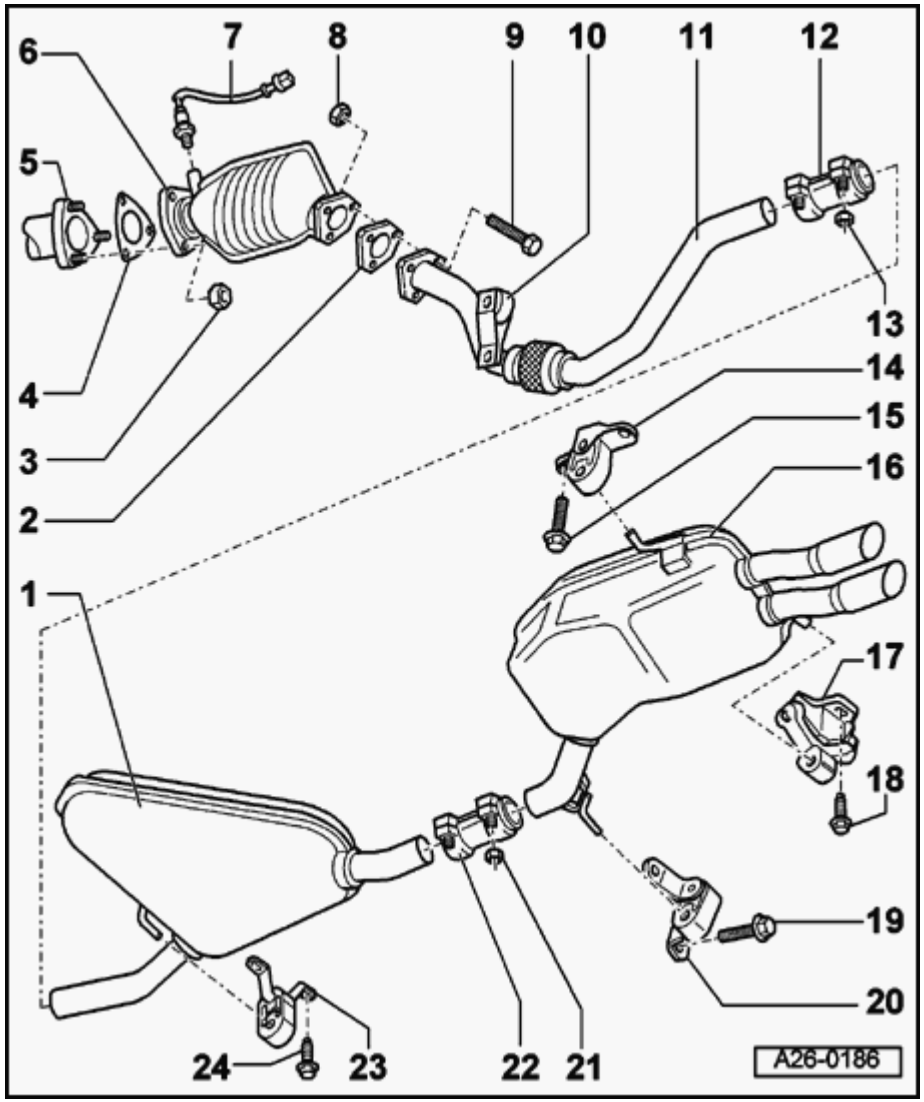
26-6



22 - Support ring

23 - Bolt

- ♦ 25 Nm (18 ft lb)



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

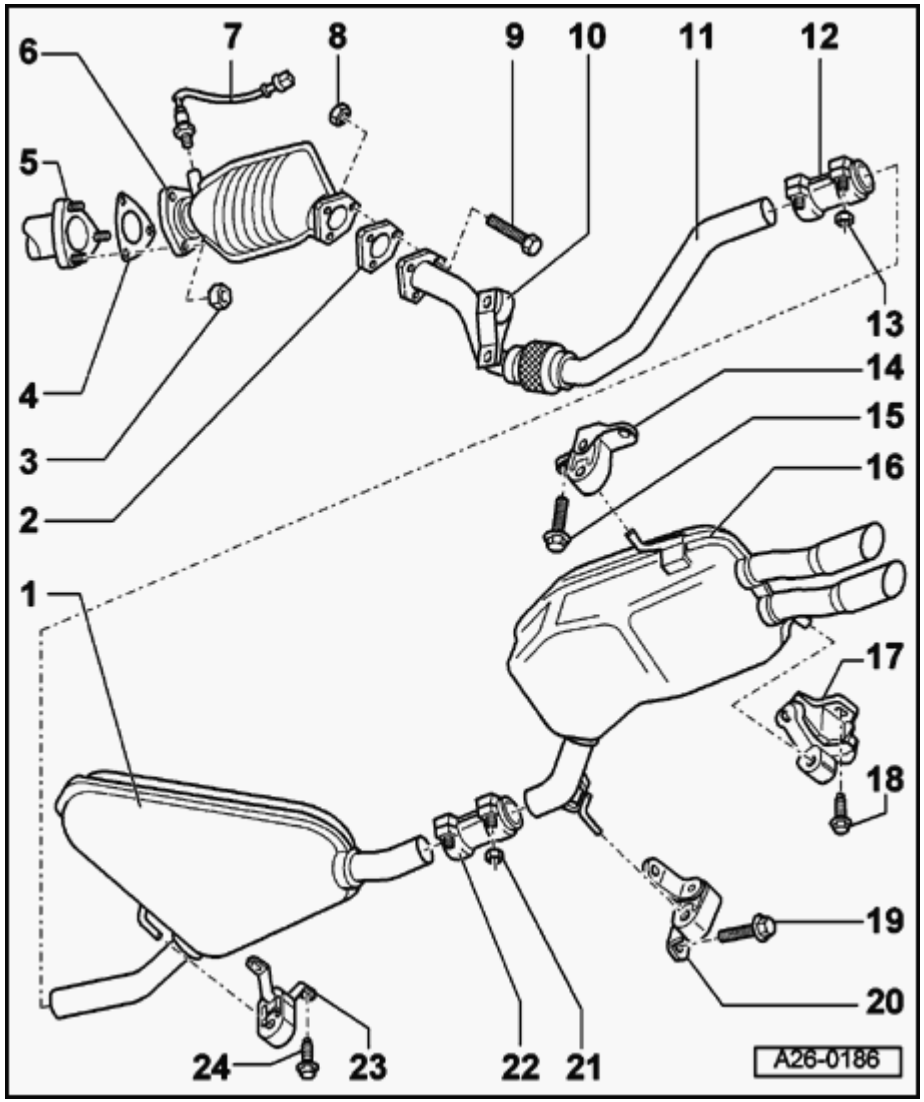
- Always replace

5 - Turbocharger

- Removing and installing ⇒ Page 21-30

6 - Three Way Catalytic Converter (TWC)

- Protect from damage
- Removing and installing ⇒ Page 26-21



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

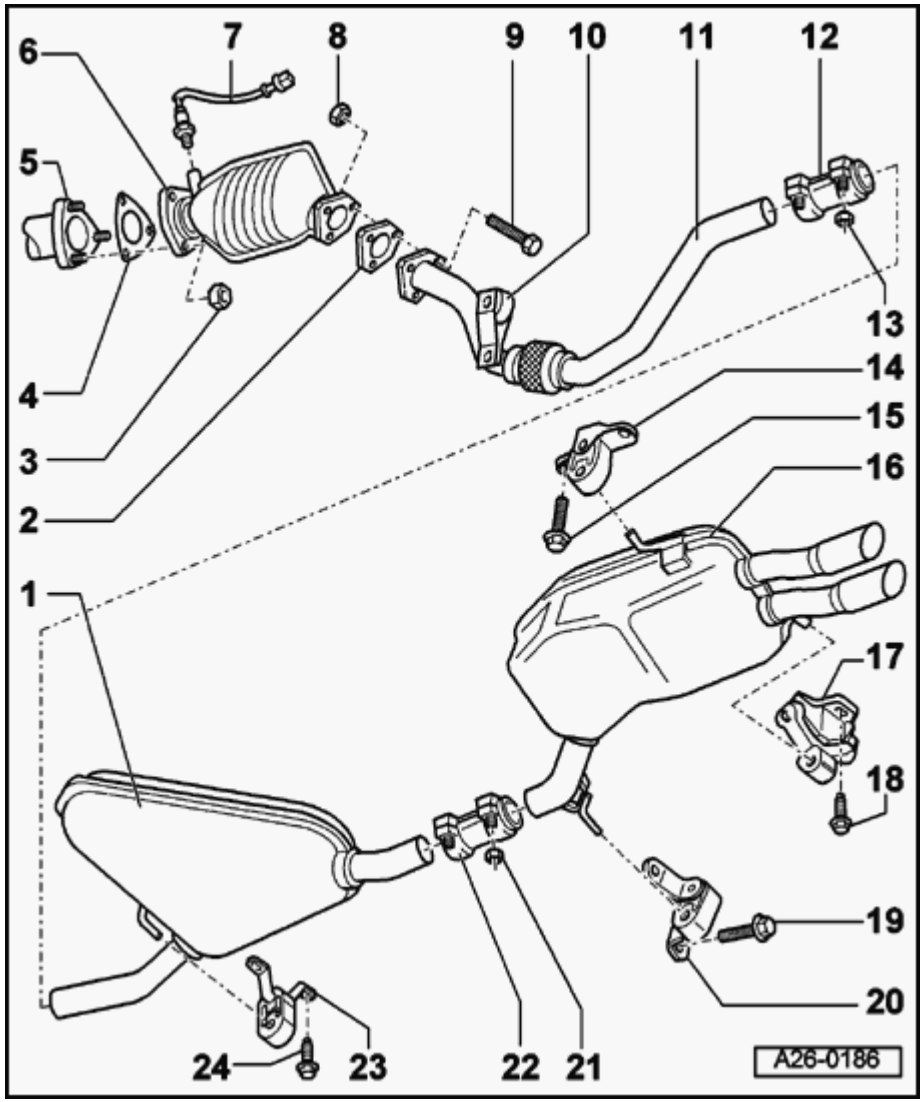
- 25 Nm (18 ft lb)

10 - Mount

Different versions for manual and automatic transmissions

- Manual transmission ⇒ Page 26-12 , Fig. ⇒ 1
- Automatic transmission ⇒ Page 26-13 , Fig. ⇒ 2

26-9



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

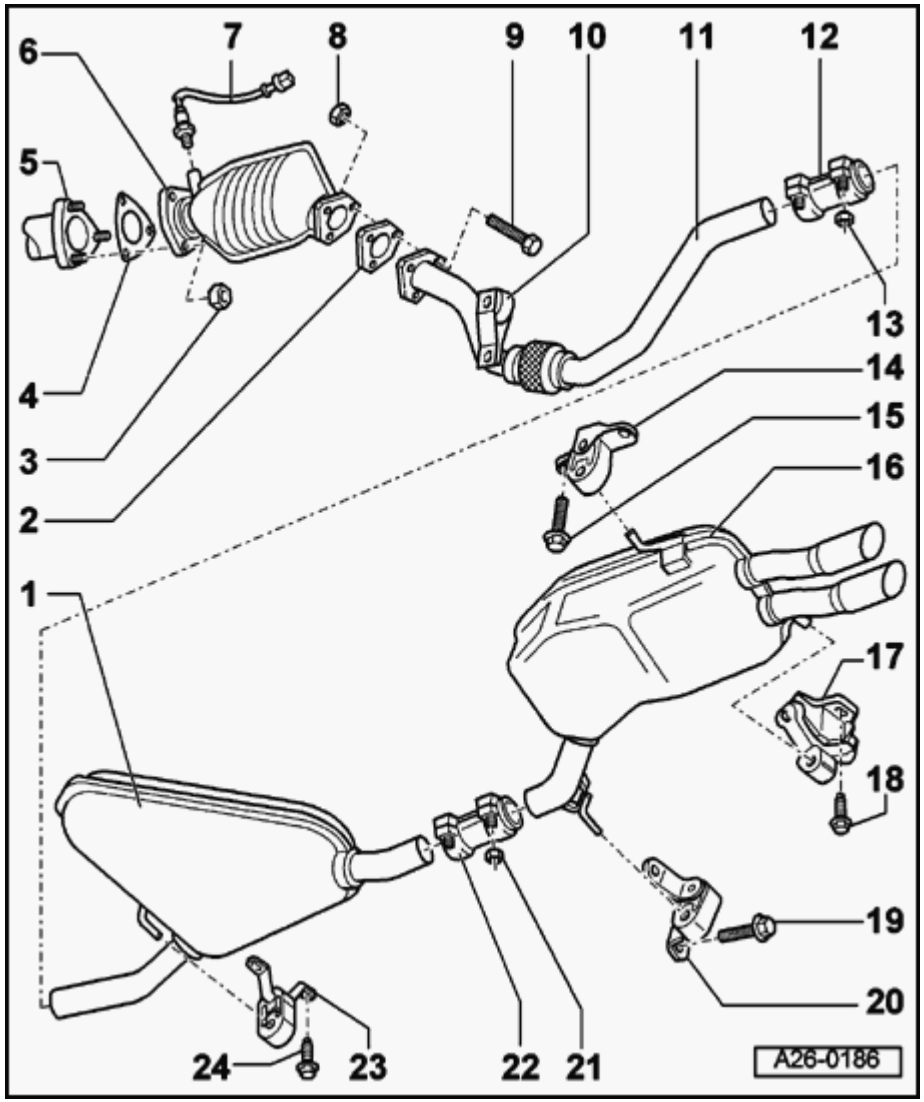
13 - Nut

- 40 Nm (30 ft lb)

14 - Mount

15 - Bolt

- 25 Nm (18 ft lb)



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

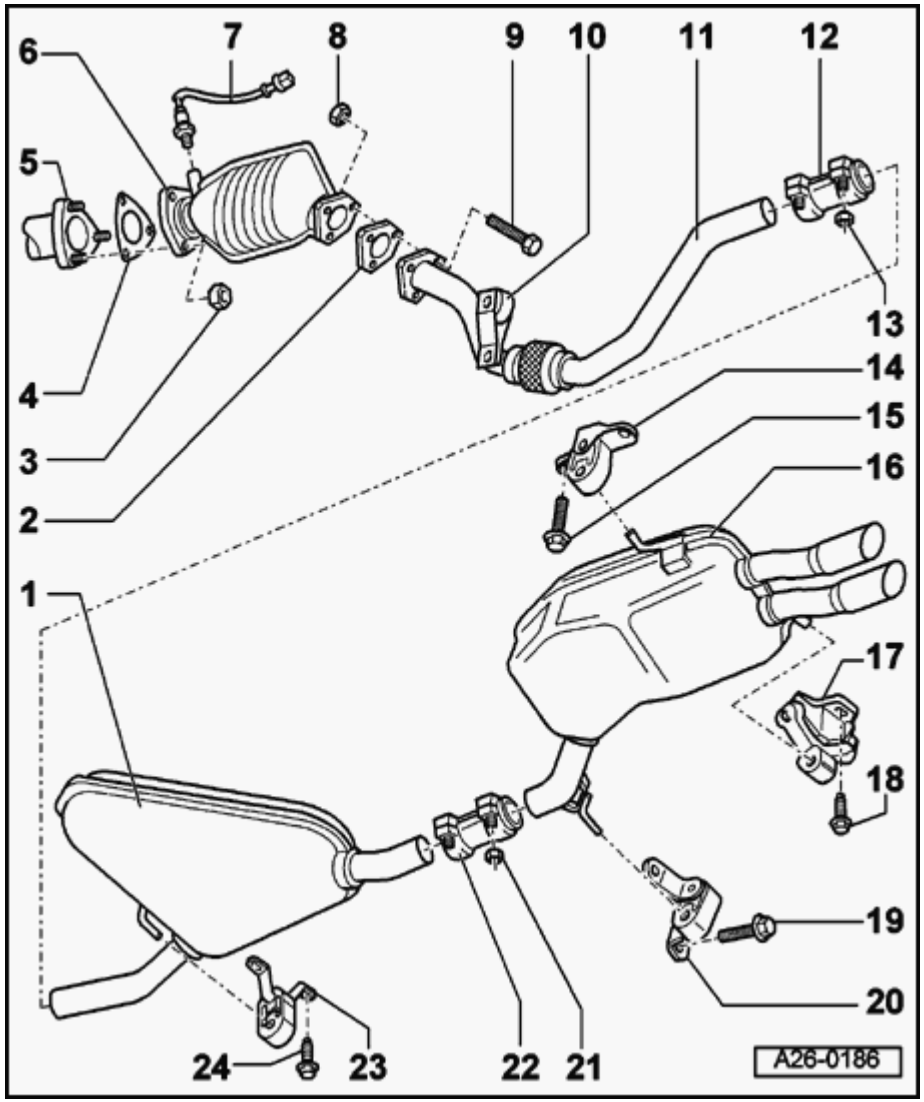
21 - Nut

- 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

- Installation position of bolt ends ⇒ Page 26-13 , Fig. ⇒ 3
- Tighten bolts evenly



23 - Support ring

24 - Bolt

- ♦ 25 Nm (18 ft lb)

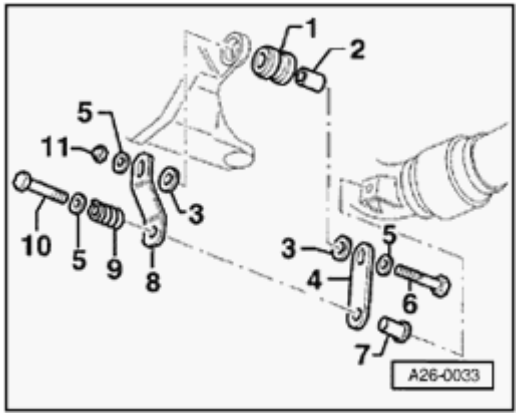


Fig. 1 Individual mounting components for vehicles with manual transmission

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)

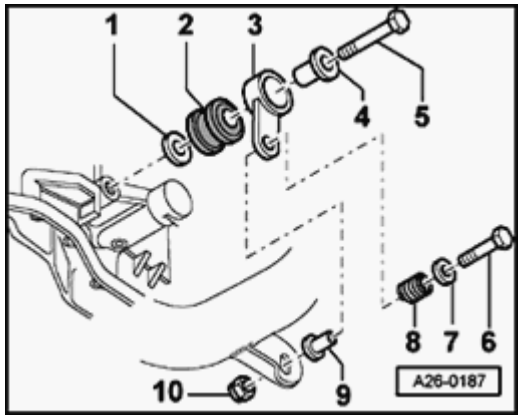


Fig. 2 Individual mounting components for vehicles with automatic transmission

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)

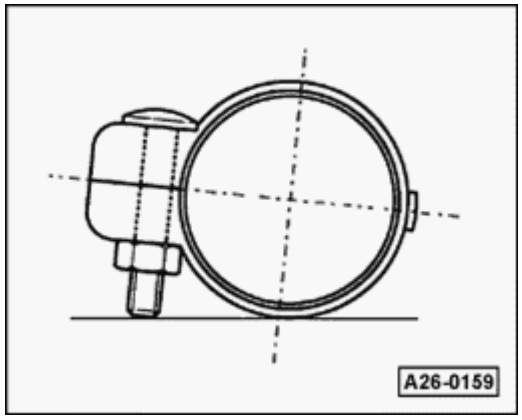


Fig. 3 Double clamp installation position

- Install double clamp so bolt ends do not project over lower edge of double clamp.

26-14

Front and rear muffler, separating

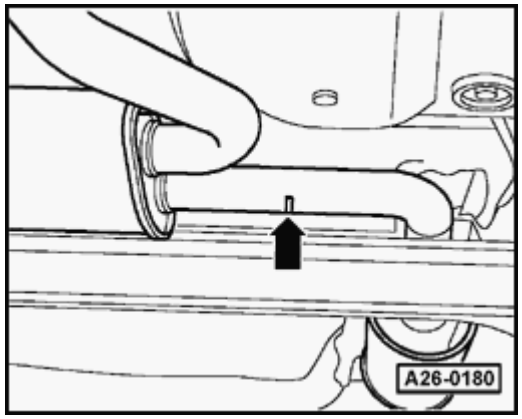
- Connecting pipe has a designated separating point on connecting pipe for separate replacement of front and/or rear muffler.

- Separating point is marked by a depression in the pipe.

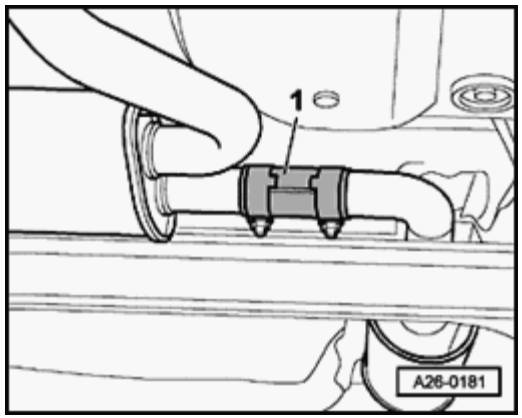
Special tools and equipment

VAG1523 saw

Front-wheel-drive vehicles



- Using VAG1523 saw, cut exhaust pipe at separating point (arrow) at right angle.



- When installing, center double clamp over separating point.

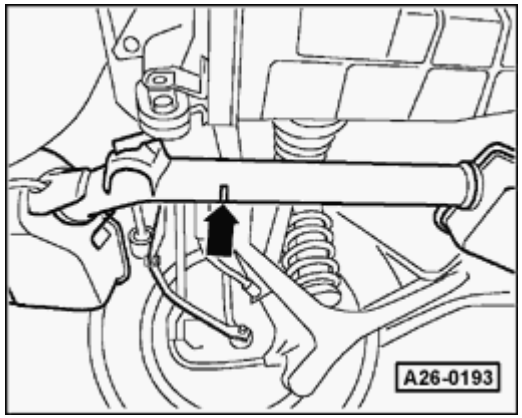
➢

- 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

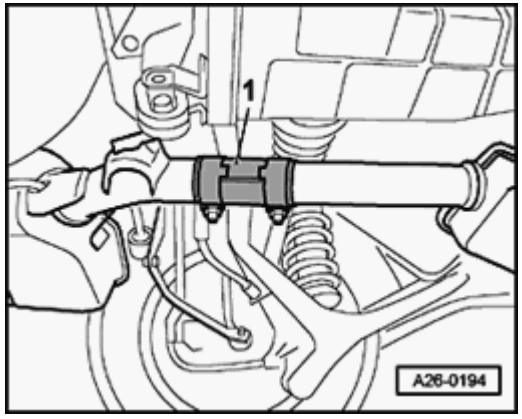
- Install exhaust system free of stress ⇒ Page 26-24 .
- Tighten double clamp bolts evenly to 40 Nm (30 ft lb).

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).

26-17

Exhaust manifold, removing and installing

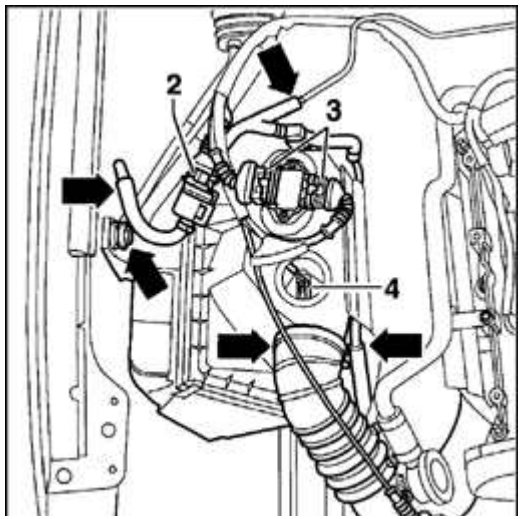
Removing

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-

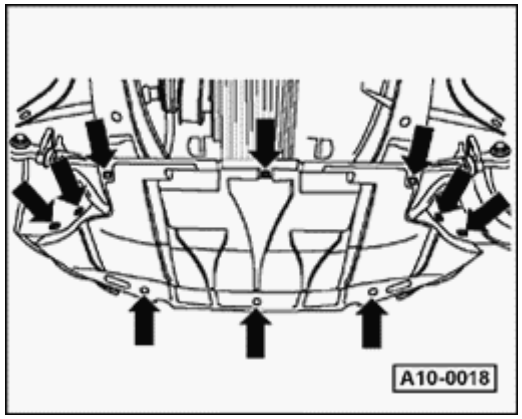
2 - At Evaporative Emissions (EVAP) purge regulator valve -N80-

3 - At power output stage -N122-

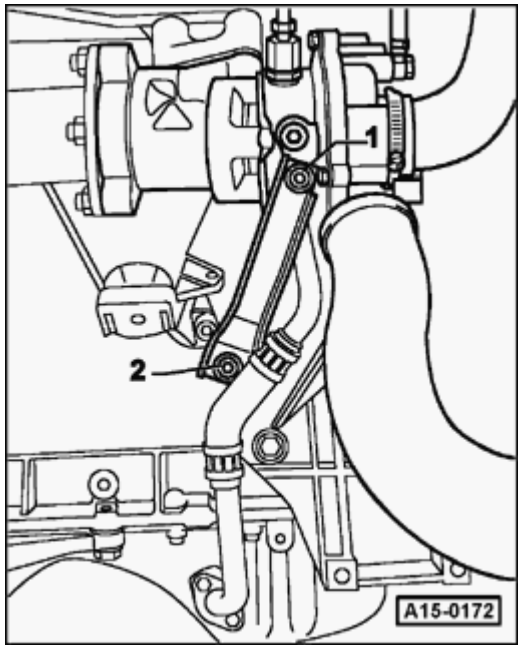
4 - At Mass Air Flow (MAF) sensor -G70-

- Pull off hose connections and remove air cleaner housing (arrows).

26-18



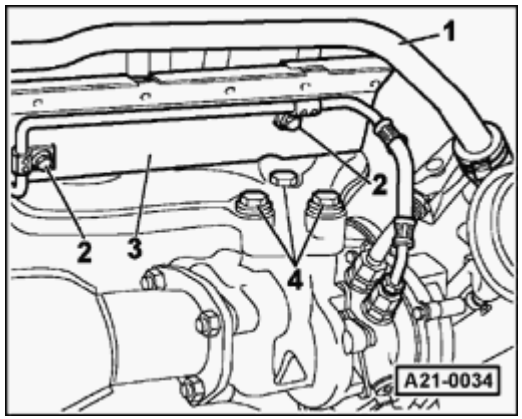
- Remove noise insulation panel (arrows).



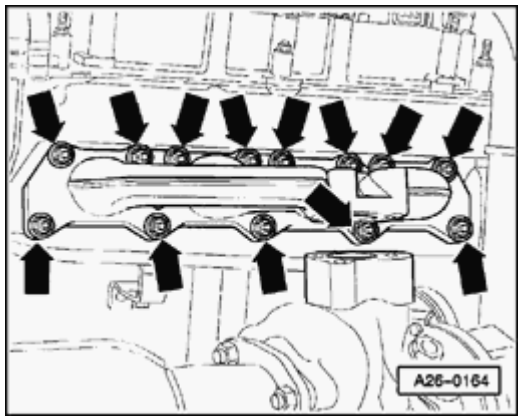
- Unthread bolts -1- and -2- several turns.

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.

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

	lb)
Crankcase ventilation line to cylinder head	10 Nm (7 ft lb)

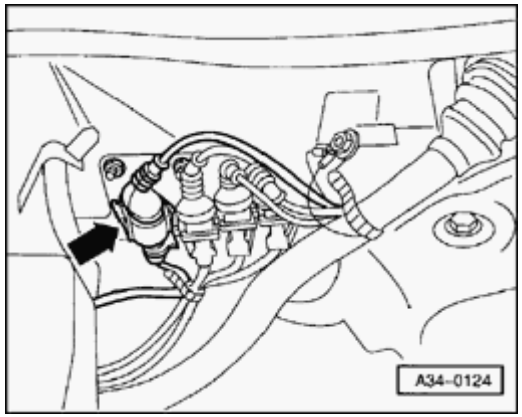
26-21

Three Way Catalytic Converter (TWC), removing and installing

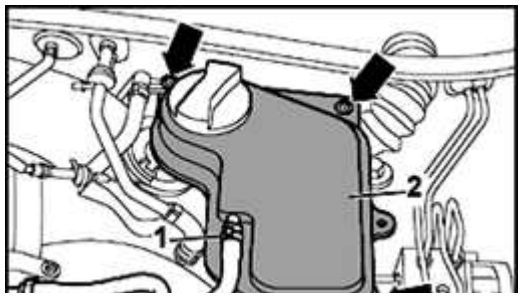
Removing

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.

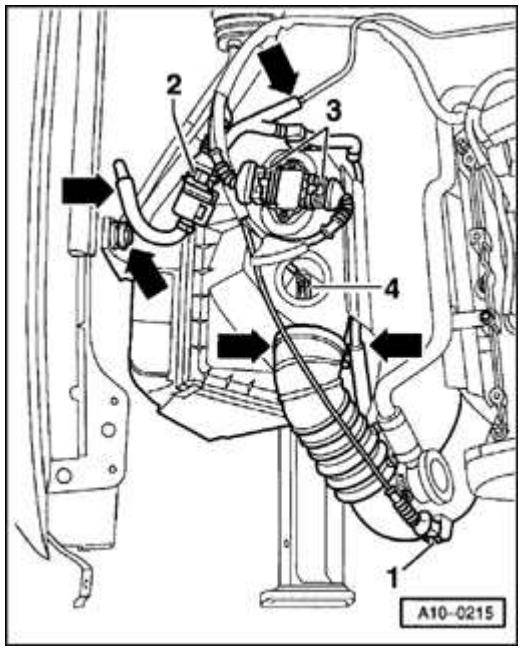
Note:

Coolant hoses -1- and -3- remain connected.

26-22

- 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.

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)

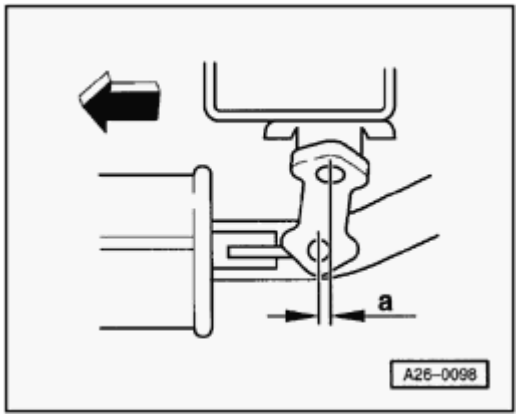
26-24

Exhaust system, aligning free of stress

- Align exhaust system when cold

Front-wheel-drive vehicles

- Remove double clamp bolts ⇒ Page 26-2 , item 2 .

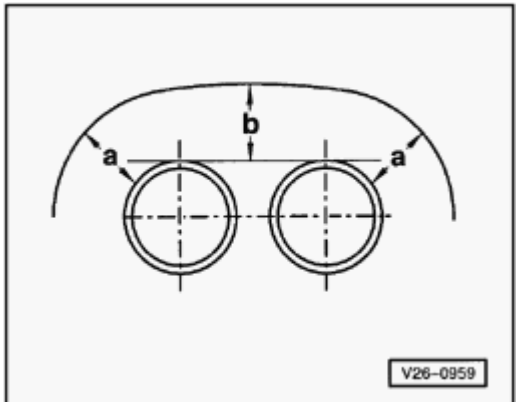


- Push exhaust system forward (arrow) until tension on rear mount equals dimension -a-.

  Dimension -a- = 7-9 mm (0.275-0.354 in.)

- Tighten double clamp bolts evenly to 40 Nm (30 ft lb).

Aligning tailpipes:

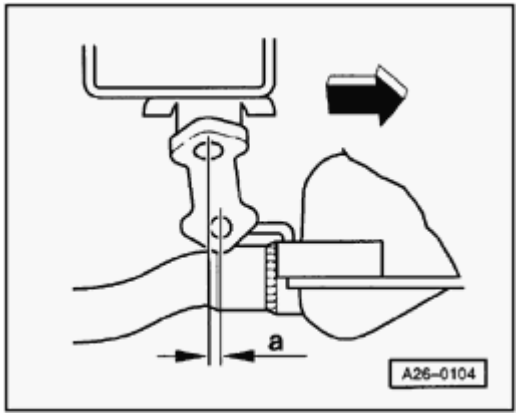


- Align tailpipes so distance -a- on left and right side is equal.
- Distance -b- between bumper cutout and tailpipes must equal specification.

  Distance -b- = 40-46 mm (1.57-1.81 in.)

All-wheel-drive vehicleswithout double clamp between front and rear mufflers

- Remove double clamp bolts ⇒ Page 26-9 , item - 12 -.

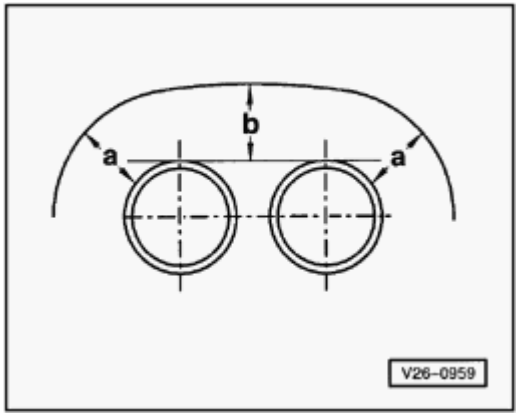


- Push exhaust system forward (arrow) until initial preload on right rear mount equals dimension -a-.

  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.)

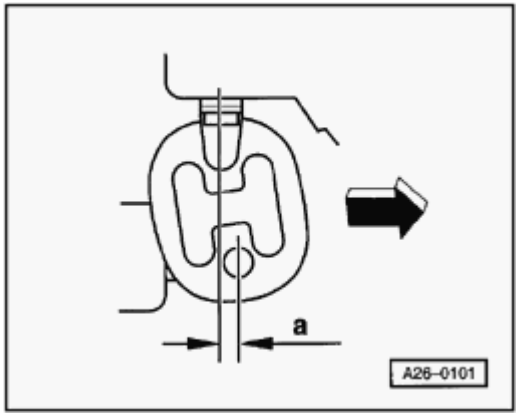
26-26

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 -.

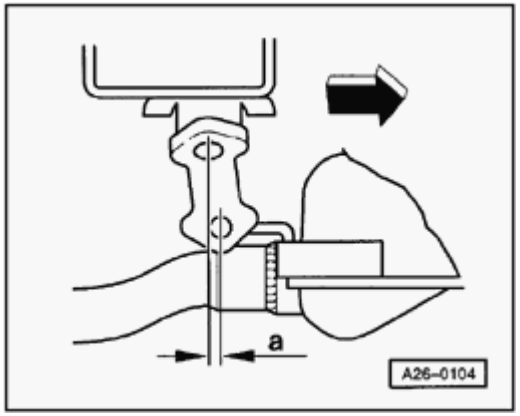


- Push exhaust system forward (arrow) until initial preload on left rear mount equals dimension -a-.

  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 -.

26-27

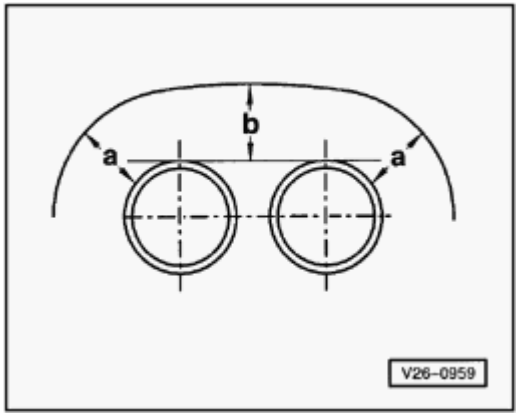


- Push exhaust system forward (arrow) until initial preload on right-rear mount equals dimension -a-.

  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.)

26-28

Exhaust system, checking for leaks

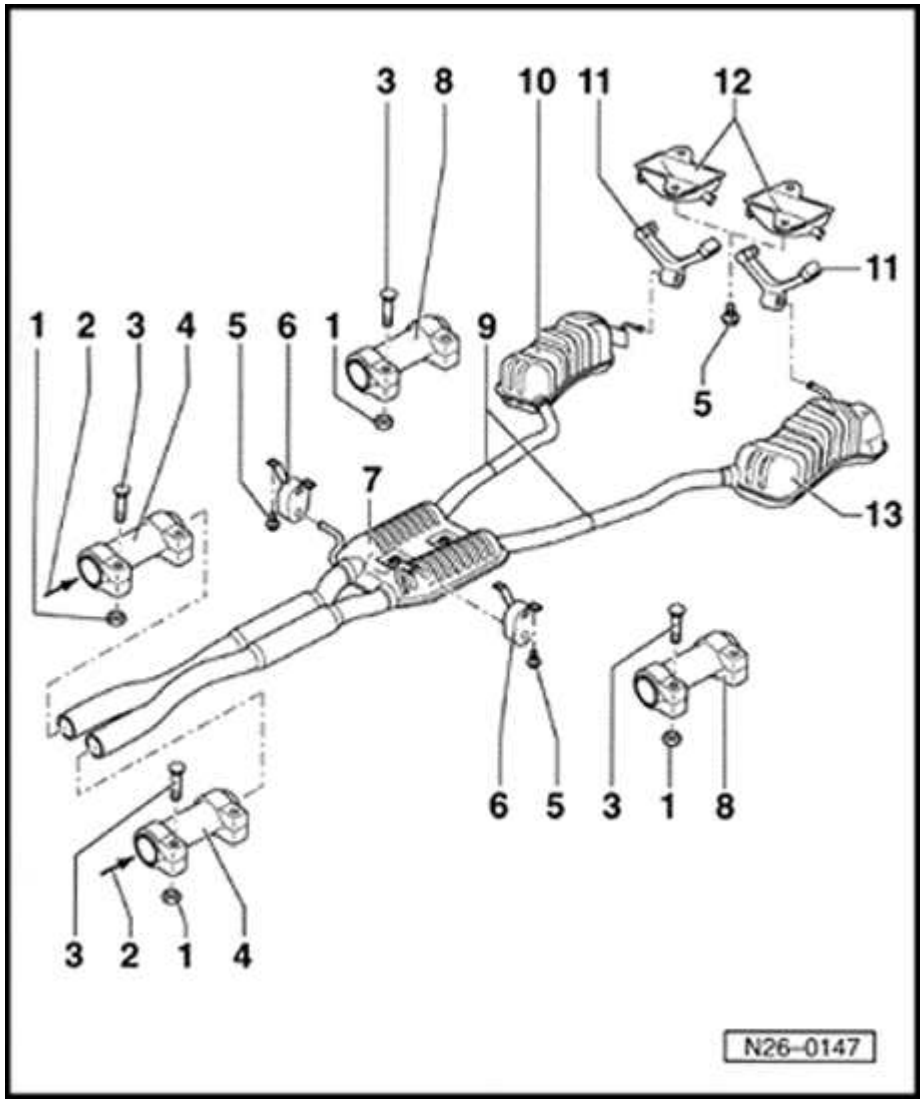
- Start engine and run at idle.
- Seal tailpipes with cloths or equivalent for duration of leak test.
- Listen for leaks at following connections: cylinder head/exhaust manifold, exhaust manifold/turbocharger, turbocharger/Three Way Catalytic Converter (TWC), etc.
- Repair leaks.

26-1

Exhaust system components, removing and installing

Notes:

- *Removing and installing exhaust manifold* ⇒ *Page 26-17*
- *After working on the exhaust system ensure that the system is not under stress, and that it has sufficient clearance from the bodywork. If necessary, loosen double and single clamps and align muffler and exhaust pipe so that sufficient clearance is maintained to the bodywork and the support rings are evenly loaded.*
- *Aligning exhaust system free of stress* ⇒ *Page 26-11*
- *Replace self-locking nuts.*



Mufflers with mountings, removing and installing

1 - 40 Nm

2 - From catalytic converter

3 - Flat-head bolt

4 - Double clamp

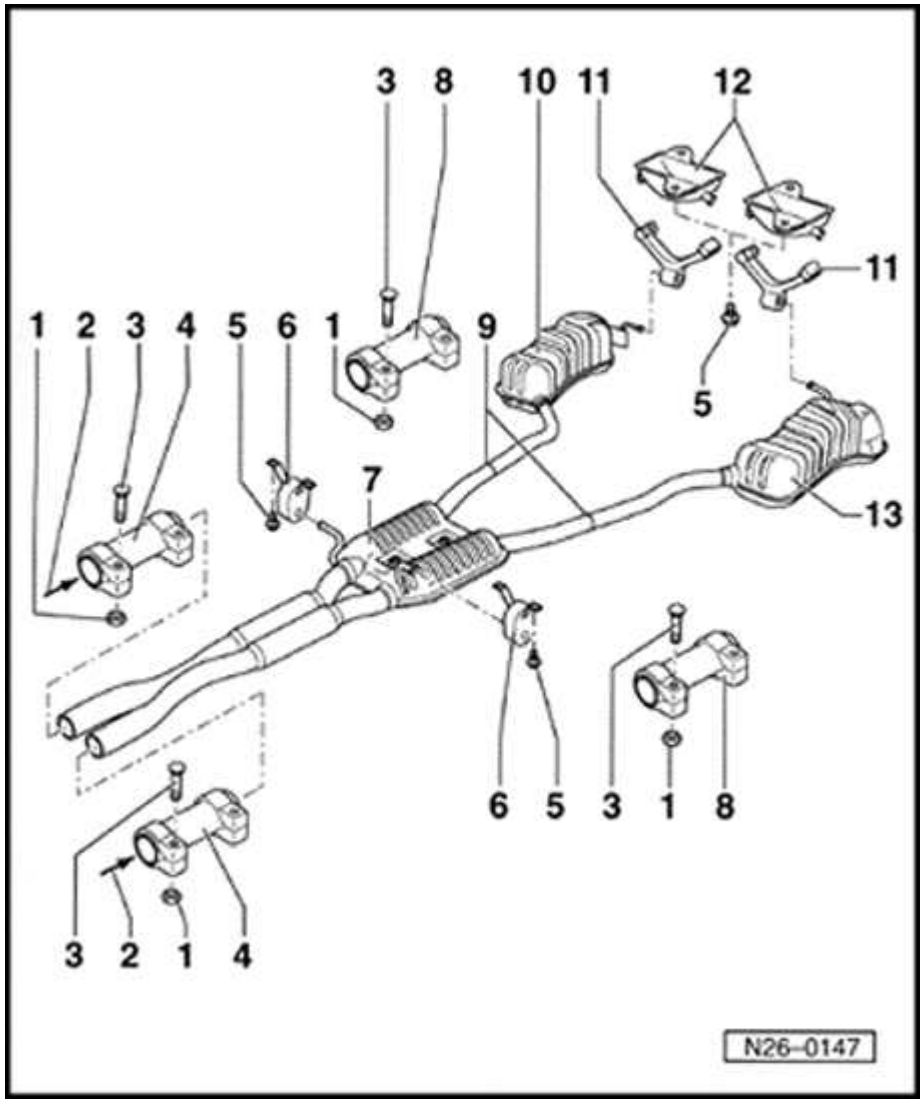
5 - 25 Nm

6 - Mounting

- With retaining ring

7 - Front muffler

8 - Double clamp (for repairs)



9 - Separating point

- Front and rear mufflers are installed as one component when vehicle is built. For repairs, front muffler and rear muffler can be replaced separately and connected with a double clamp.
- Cutting through connecting pipe ⇒Fig. ⇒ 1

10 - Rear muffler (right)

11 - Mounting

12 - Bracket

13 - Rear muffler (left)

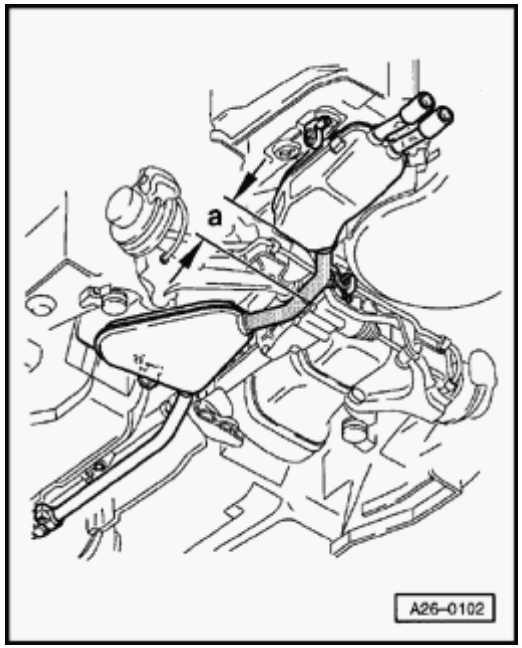


Fig. 1 Separating point between center muffler and rear muffler

Note:

- *A separating point has been provided for replacement of the center muffler or rear muffler in the event that repair work is necessary.*
- *A double clamp is used to attach the center and rear mufflers.*

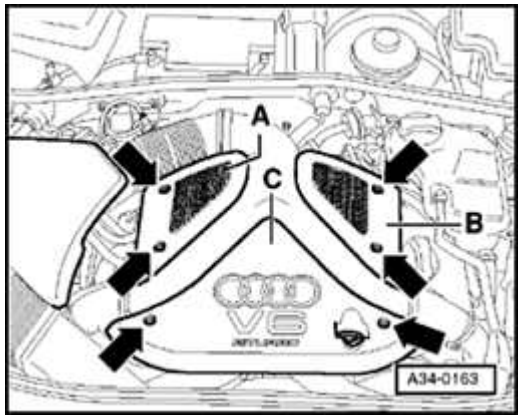
- Separate connecting pipe between center muffler and rear muffler where indicated by groove.

  Dimension - a - approx.160 - 170 mm.

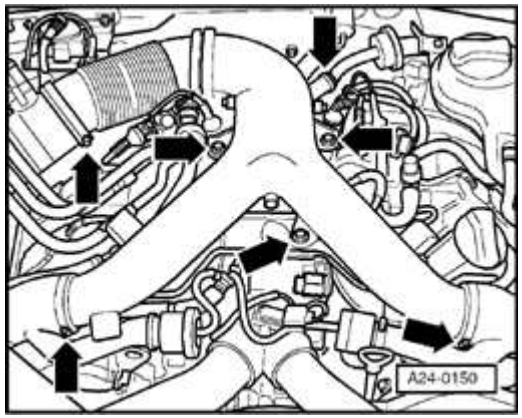
- Adjust exhaust system ⇒ Page 26-11 .

Catalytic converter, removing and installing

Removing

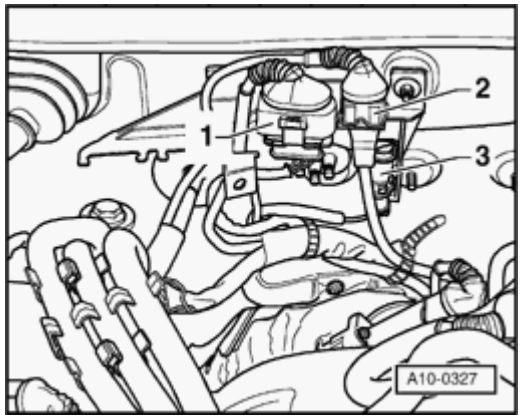


- Remove bolts -arrows- and take off engine cover panels -A ... C-.



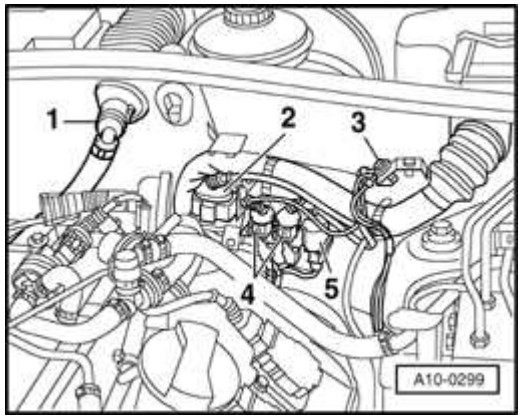
- Remove air distributor component -arrows-.

Right-hand catalytic converter:

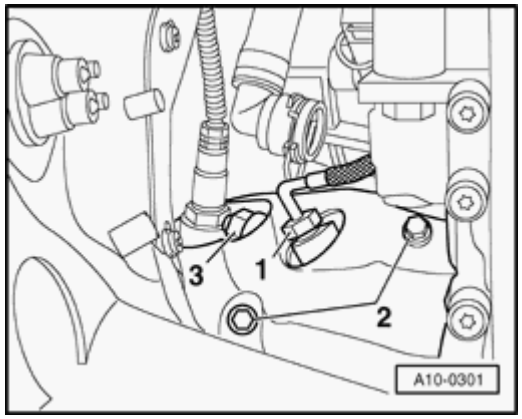


- Disconnect connector -1- for oxygen sensor at bulkhead.

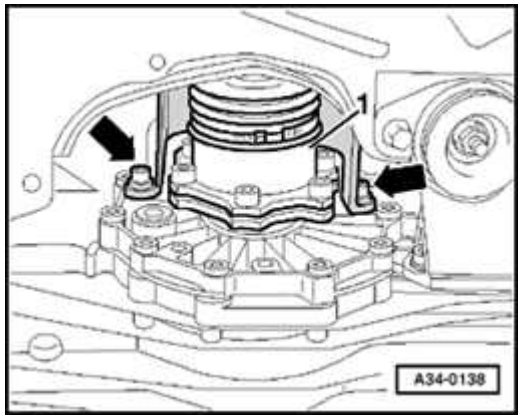
Left-hand catalytic converter:



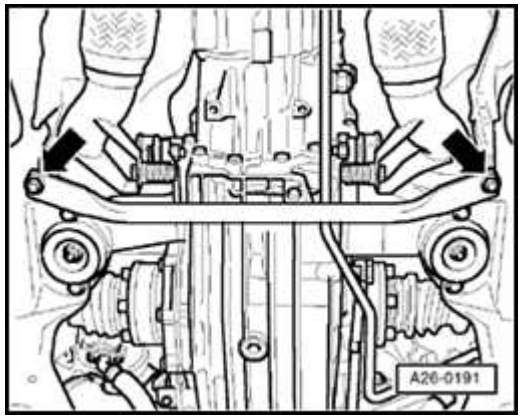
- Disconnect connector -2- for oxygen sensor at bulkhead.



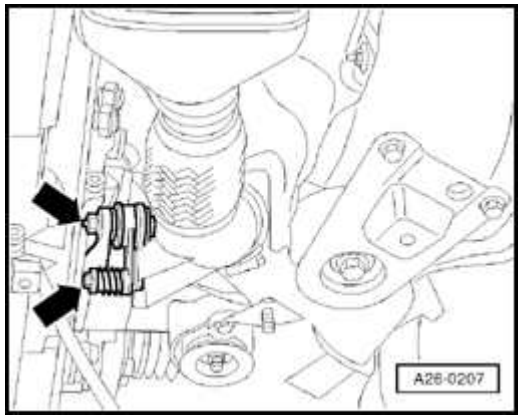
- Unbolt heat shield -2- on turbocharger.
- Remove upper bolt -3- securing front exhaust pipe to turbocharger.



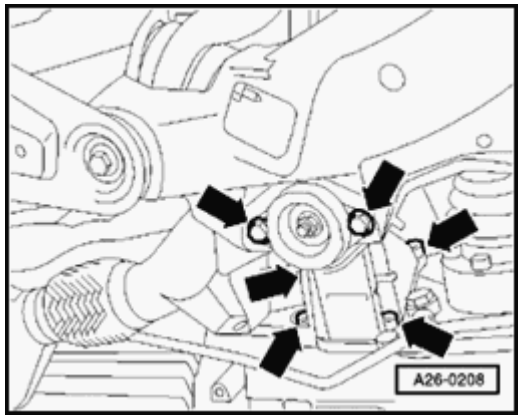
- Unbolt guard plate -arrows- above drive shaft from transmission.
- Unbolt drive shaft -1- at transmission and tie up.



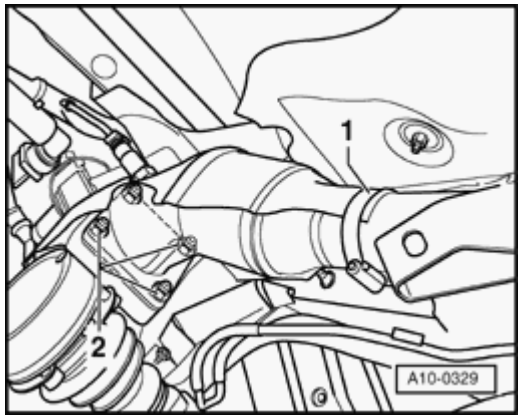
- Remove cross strut -arrows-.



- Remove retainers -arrows-.



- Remove transmission support -arrows-.
- Loosen exhaust system clamp and push clamp towards muffler.



- Loosen hose clamp -1- on turbocharger heat shield.
- Unbolt exhaust pipe -2- from turbocharger.

Note:

Avoid excessive bending of the flexible pipe connection (de-coupling element) on the front exhaust pipe. The angle between the catalytic converter and the front exhaust pipe must not exceed 10° , otherwise the flexible connection will be damaged.

Installing

- Install in reverse order.

Note:

The double clamp must be replaced after removeing the bolted connection.

- Adjust exhaust system ⇒ Page 26-11 .

Exhaust system, aligning free of stress

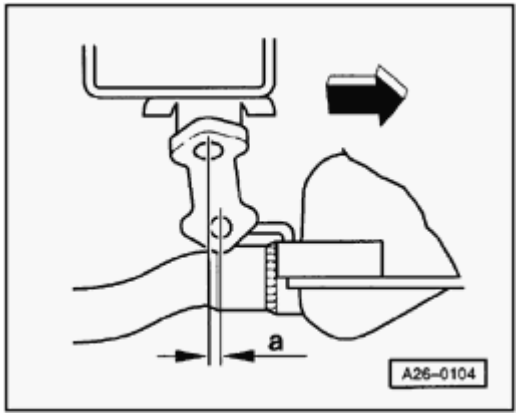
Align the exhaust system as follows to avoid stresses in the system and prevent the transmission of noise into the body:

Notes:

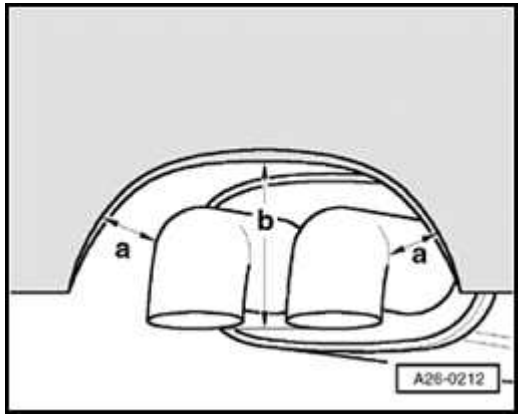
- *Before assembling the exhaust system, the front exhaust pipes and the catalytic converters must be aligned accurately and secured.*
- *Loosen all bolted connections on the exhaust system (except exhaust manifold and flange mountings, catalytic converter/intermediate pipe).*
- *The exhaust system must be aligned when it is cold.*
- *Keep to the sequence described below.*
- *The dimensions in the illustrations are approximate.*

Vehicles without clamp between center and rear muffler

- Loosen screws of front clamp between catalytic converter and center muffler.



- Push exhaust system far enough forward (arrow) so that pre-tension at retaining loop at rear right of rear muffler is -a- = 9 ... 11 mm.
- Tighten screws of front clamp between catalytic converter and main muffler evenly to 40 Nm, installation position ⇒ Page 26-15 .
- Tailpipes, aligning



- Align tailpipes so that distance -a- (left side) is equal to distance -a- (right side).

Dimension -b- between bumper cutout and lower edge of tailpipes must also equal specification.

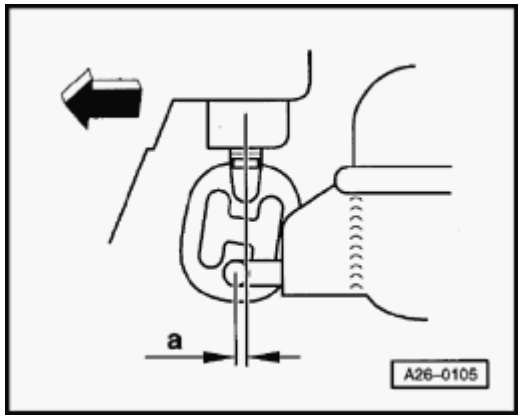
- Dimension b = 97 ... 103 mm

Vehicles with clamp between front muffler and rear muffler

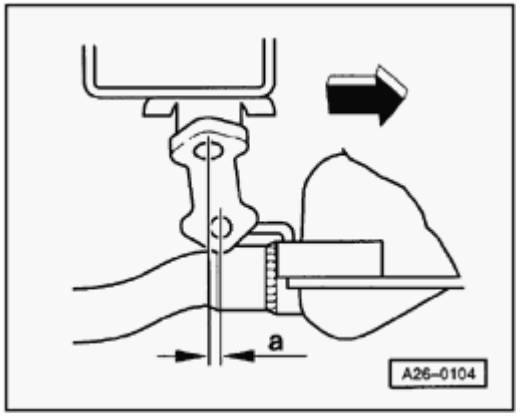
Note:

It is only necessary to additionally align the front muffler on vehicles with clamp fitted between front muffler and rear muffler.

- Loosen bolted connections on front clamps between catalytic converters and front muffler.

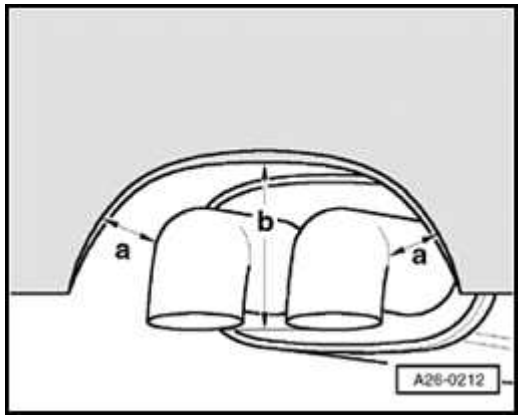


- Push exhaust system towards front of vehicle -arrow- so that rear left mounting on front muffler is pre-loaded by a = 7 - 9 mm.
- Tighten bolts on front clamps between catalytic converters and front muffler evenly to 40 Nm; installation position ⇒ Page 26-15 .



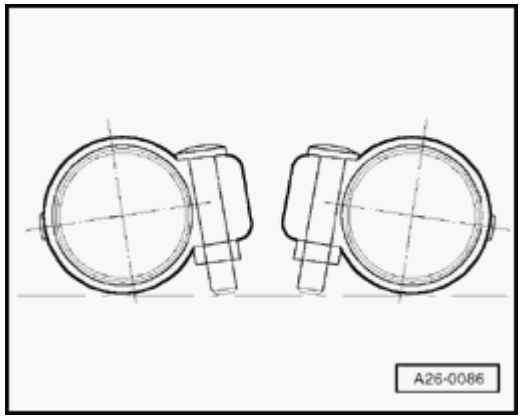
- Push rear muffler toward front of vehicle -arrow- so that rear right mounting on rear muffler is pre-loaded by a = 9 ... 11 mm.
- Tighten bolted connections on rear clamp between front muffler and rear muffler evenly to 40 Nm; installation position ⇒ Page 26-15 .

Aligning tailpipes



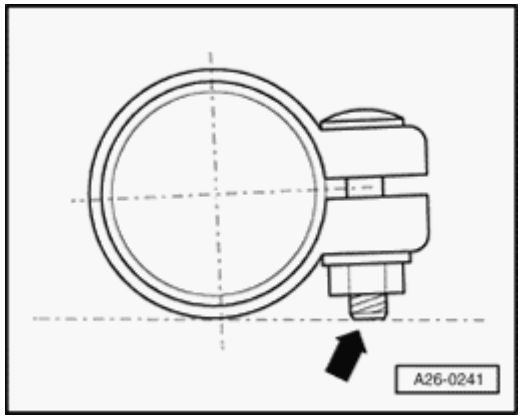
- Align tailpipes so that distance -a- is same on both sides.
- At same time, set distance -b- between bumper cut-out and bottom of tailpipes:
  - Distance b = 97 ... 103 mm

Installation position of double clamp at front



➢ The ends of the bolts must not project below the bottom of the clamp.

Installation position of double clamp at rear



➢ The ends of the bolts must not project below the bottom of the clamp.

Exhaust system, checking for leaks

- Start engine and run at idling speed.
- Plug tailpipe (e. g. with rag or stopper) and leave plugged until check is complete.
- Listen for noise at connection points (cylinder head/manifold, manifold/turbocharger, turbocharger/catalytic converter, etc.) to locate leaks.
- Correct any leaks that are found.

26-17

Exhaust manifold, removing and installing

Removing

- Remove engine ⇒ Page 10-1 .
- Remove turbocharger ⇒ Page 21-1
- Unbolt exhaust manifold.

Installing

Notes:

- *Replace self-locking nuts.*
- *Replace gaskets.*

- Install in reverse sequence.

Tightening torques

Bolted mountings	Tightening torques
Exhaust pipe between exhaust manifold and turbocharger	25 Nm
Exhaust pipe with catalytic converter to turbocharger	25 Nm
Exhaust manifold to cylinder head	25 Nm
Exhaust pipe to transmission	25 Nm
Catalytic converter to front muffler	25 Nm
Heat shield to turbocharger	10 Nm



Exhaust gas temperature sensor, checking for function

Special tools and equipment

- VAS 5051 with VAG 5051/1

or

- VAG 1551 with VAG 1551/3A

Test requirement:

- Coolant Temperature at least 80 ° C.

WARNING!

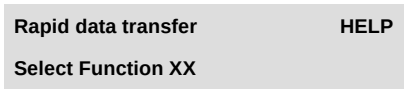
- ***During a road test in an airbag-equipped vehicle, test equipment must always be fastened to and operated from the rear seat by a second technician.***
- ***When driving or riding in an airbag-equipped vehicle, NEVER hold the scan tool or other test equipment in your hands or lap while in motion. Objects between you and the airbag increase the risk of injury in an accident.***

26-20

Test sequence

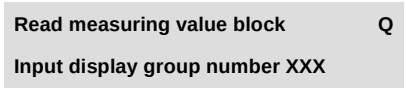
- Connect VAS 5051 tester or VAG 1551 scan tool and select control module for engine electronics using "address word" 01. Engine must run at idle for this.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*



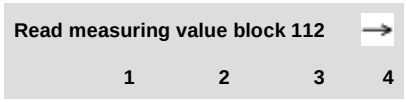
When indicated on display

- Press buttons -0- and -8- to select "Read Measuring Value Block" and press -Q- button to confirm input.



When indicated on display

- Press buttons -1-, -1- and -2- to select "display group number 112" and press -Q- button to confirm input.



Indicated on display (1...4 = display fields)

- Check exhaust gas temperature.

- Road test vehicle.

  - ♦ Wide Open Throttle (WOT) at engine speeds between 5000...6500 RPM must be reached.

Note:

Exhaust gas temperature must rise to above 980 °C so that regulation sets in. Values below 945 °C are displayed as 945 °C.

	Display fields			
	1	2	3	4
Display group 112: Exhaust temperature				
Display	°C	%	°C	%
Indicated	Exhaust temperature, Bank 1	Enrichment factor, Sensor, Bank 1	Exhaust temperature, Bank 2	Enrichment factor, Sensor, Bank 2
Specified value	980 1)	90 ± 5 2)	980	90 ± 5
Note:	Regulation does not begin until temperatures above 980 °C	If the enrichment factor is above 30%, there is a malfunction	Regulation does not begin until temperatures above 945 °C	If the enrichment factor is above 30%, there is a malfunction

1) During oscillation stage, values around 1025 °C may be displayed briefly.

2) During oscillation stage, values of 25 % may be displayed briefly.

26-22

If values above 20 % are displayed constantly, then

- fuel pressure may be too low,
- mass air flow sensor signal may be too small.

- Select measuring value block 220.



Indicated on display (1...4 = display fields)

- Check exhaust temperature regulation.

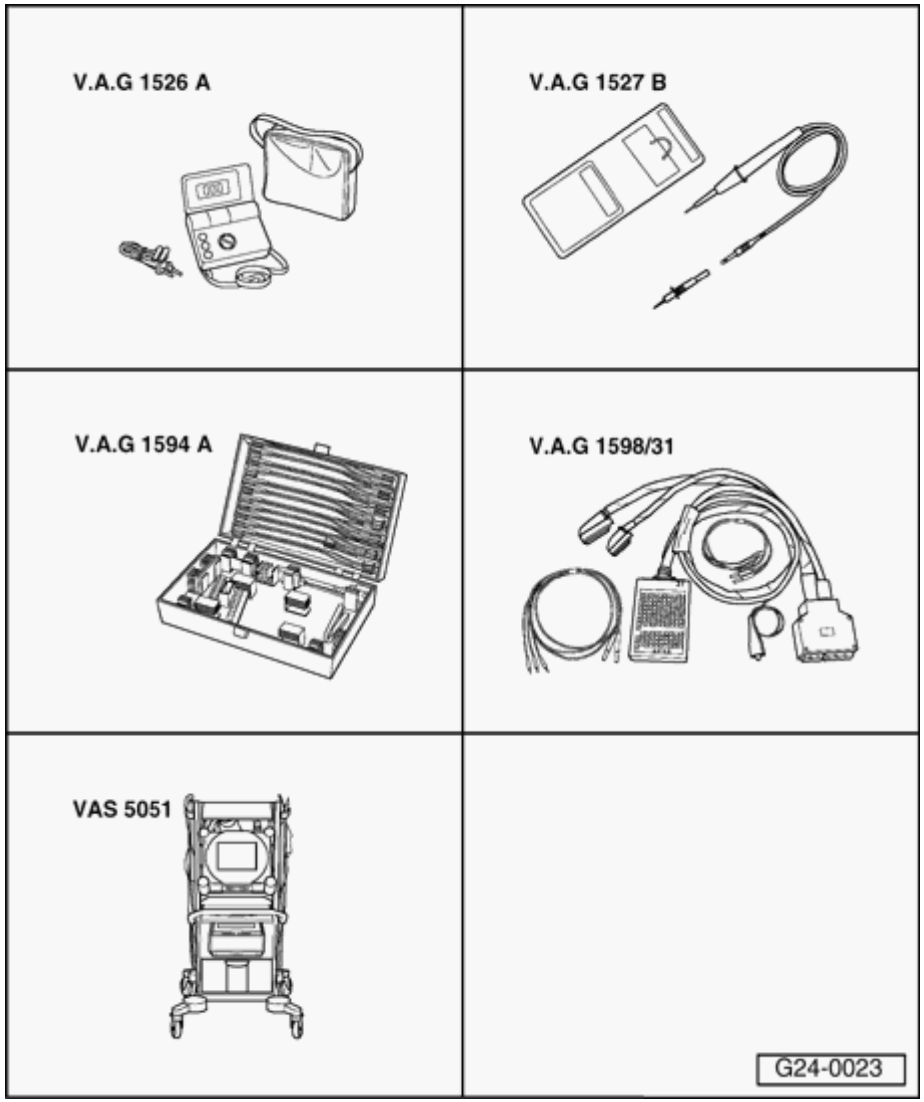
	Display fields			
	1	2	3	4
Display group 220: Exhaust gas temperature regulation				
Display	1 RPM	%	%	Text
Indicated	Engine speed (RPM)	Load	Duty cycle, Sensor, Bank 1	Operating condition, Bank 1
Specified value	> 5000	> 100	42 ± 10	Regulation on
Note:	Increase engine speed and load enough that regulation jumps to "on"			

- Repeat test for bank 2 ⇒measuring value block 221

If specified values are not obtained and there is a malfunction stored in the Diagnostic Trouble Code (DTC) memory:

- Check exhaust gas temperature sensor, ⇒ Page 26-24 .

26-24



Exhaust gas temperature sensor, checking

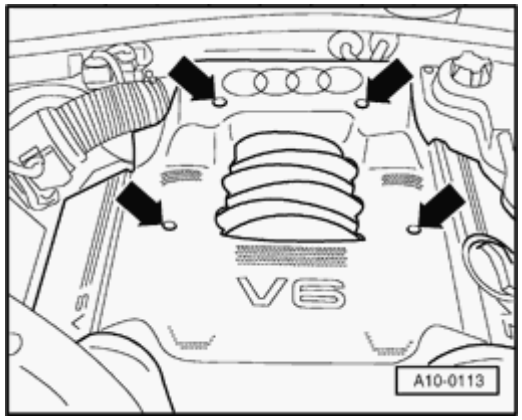
Special tools and equipment

- VAG 1526A
- VAG 1527B
- VAG 1594A
- VAG 1598/31

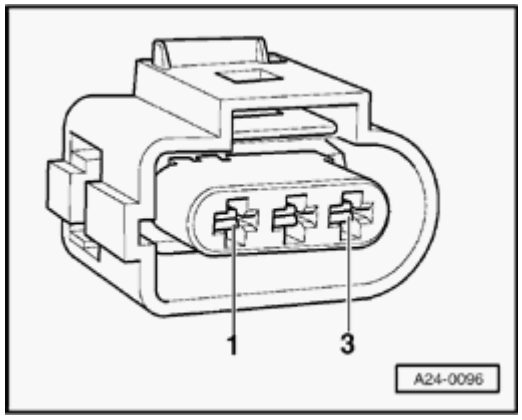
26-25

Checking voltage supply

- Switch ignition off.



- Remove engine cover (arrows).
- Disconnect connector at exhaust gas temperature sensor.

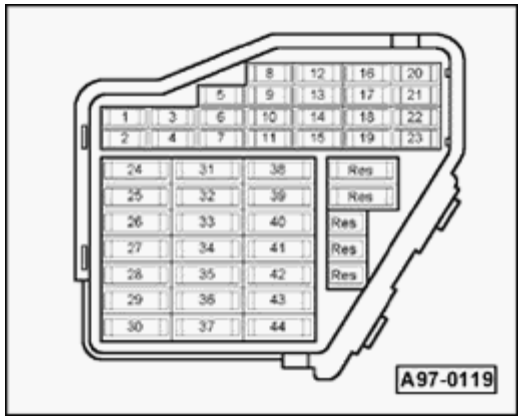


- Connect VAG 1527B voltage tester as follows:

Harness connector terminal	Measure to
3	Engine Ground (GND)

- Operate starter briefly.
  - ♦ LED must light.

26-26



If LED does not light:

- Perform following tests marked with dots:

- Check fuse -S234- (in fuse holder, position 34).
- Check wire connection from exhaust gas temperature sensor via fuse -S234- (in fuse holder, socket 34) to Fuel Pump (FP) relay for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

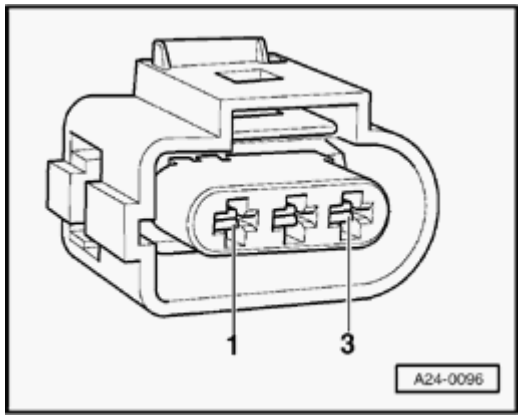
- Check Fuel Pump (FP) relay.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

- Connect VAG 1598/31 test box at wiring harness to ECM. Do not connect ECM.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

26-27



- Check following wire connections for open circuit and short circuit to Ground (GND) and B+:

Harness connector terminal	VAG 1598/31 test box Bushing
1 (Bank 1)	61
1 (Bank 2)	20
2	50

If wire connection is OK:

- Replace exhaust gas temperature sensor.

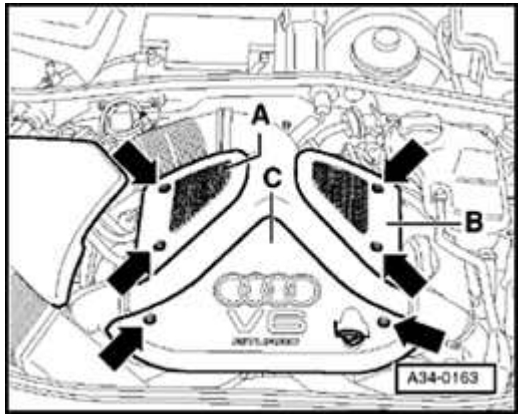
If the same malfunction occurs again after replacing the exhaust gas temperature sensor:

- Replace Engine Control Module (ECM).

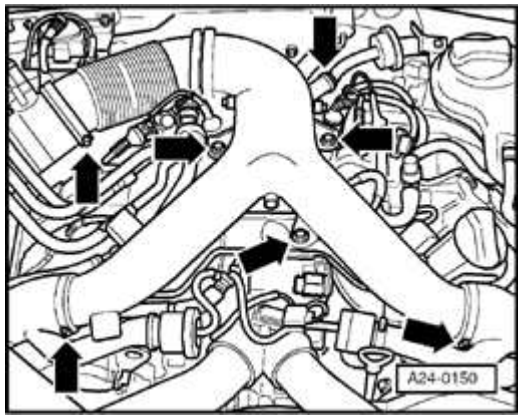
⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

26-28

Exhaust gas temperature sensor, removing and installing

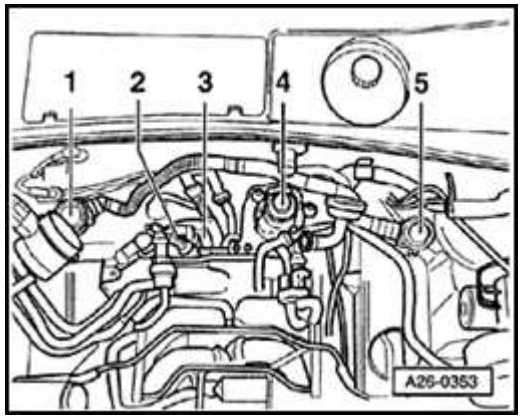


- Remove bolts (arrows) and remove engine covers -A- and -B-.

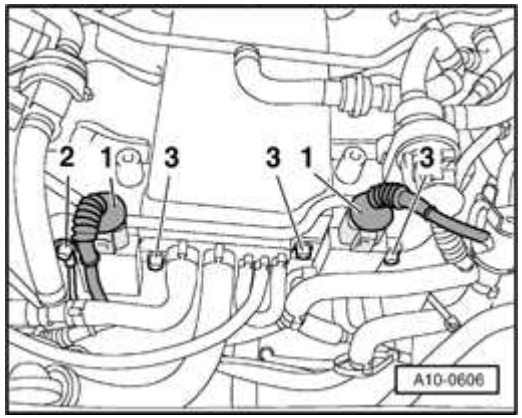


- Remove air distributor (arrows).

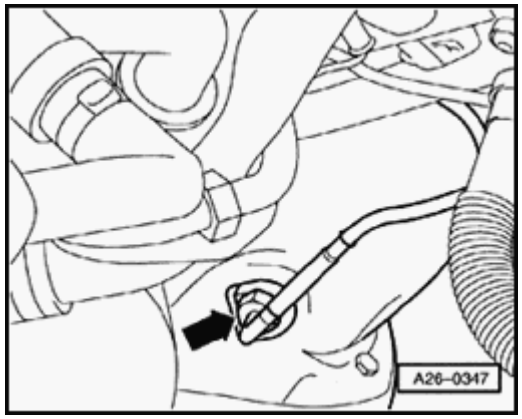
26-29



- Disconnect both connectors -2- from control modules for exhaust gas temperature.
- Remove control module from intake manifold and set wires aside.



For vehicles with manual transmission, the control modules for exhaust gas temperature are at rear of intake manifold, on left and right.



- Remove exhaust gas temperature sensor from exhaust manifold.

Exhaust system, checking for leaks

The exhaust system must be checked for leaks as follows:

- Run engine.
- Seal tail pipes being checked with, for instance, rag or plug.
- Joints: cylinder head/manifold, manifold/front exhaust pipe, etc., check for audible leaks.
- Eliminate any leaks found.

Secondary Air Injection (AIR) system

- Check Diagnostic Trouble Code (DTC) memory.

⇒ *Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01*

- Initiate output Diagnostic Test Mode (DTM).

⇒ *Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01*

- Initiate "Basic Setting" (scan tool function 04).

⇒ *Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 01*

- Check Secondary Air Injection (AIR) valve.

⇒ *Repair Manual, 2.8 Liter V6 5V Fuel Injection*

& Ignition, Repair Group 01

Notes:

- *The secondary air injection system injects air behind the exhaust valves during a cold start. Cold start means engine coolant temperature between 8-65° C (46-149° F). The amount of air injected is temperature dependent.*
- *The need for secondary air is triggered by the Motronic Engine Control Module (ECM) -J220- via the Secondary Air Injection (AIR) Injection pump relay -J299- to the Secondary Air Injection (AIR) solenoid valve -N112- and the two combination valves.*
- *When "Basic Setting" (scan tool function 04) is initiated, a diagnosis for the secondary air injection system can be carried out. The diagnostics consists of a flow test and a leak test.*

Flow test

During the flow test, the oxygen sensor control is switched off (engine runs rich at that time). At the same time the secondary air injection pump is switched on, injecting fresh air into the exhaust manifold which increases the oxygen content in the exhaust gas. The oxygen sensor now measures a lean mixture. To pass the diagnostic test, the oxygen sensor must measure a lean mixture for a certain time. Passing the test means that the secondary air injection system delivers enough air and the secondary air injection system is OK.

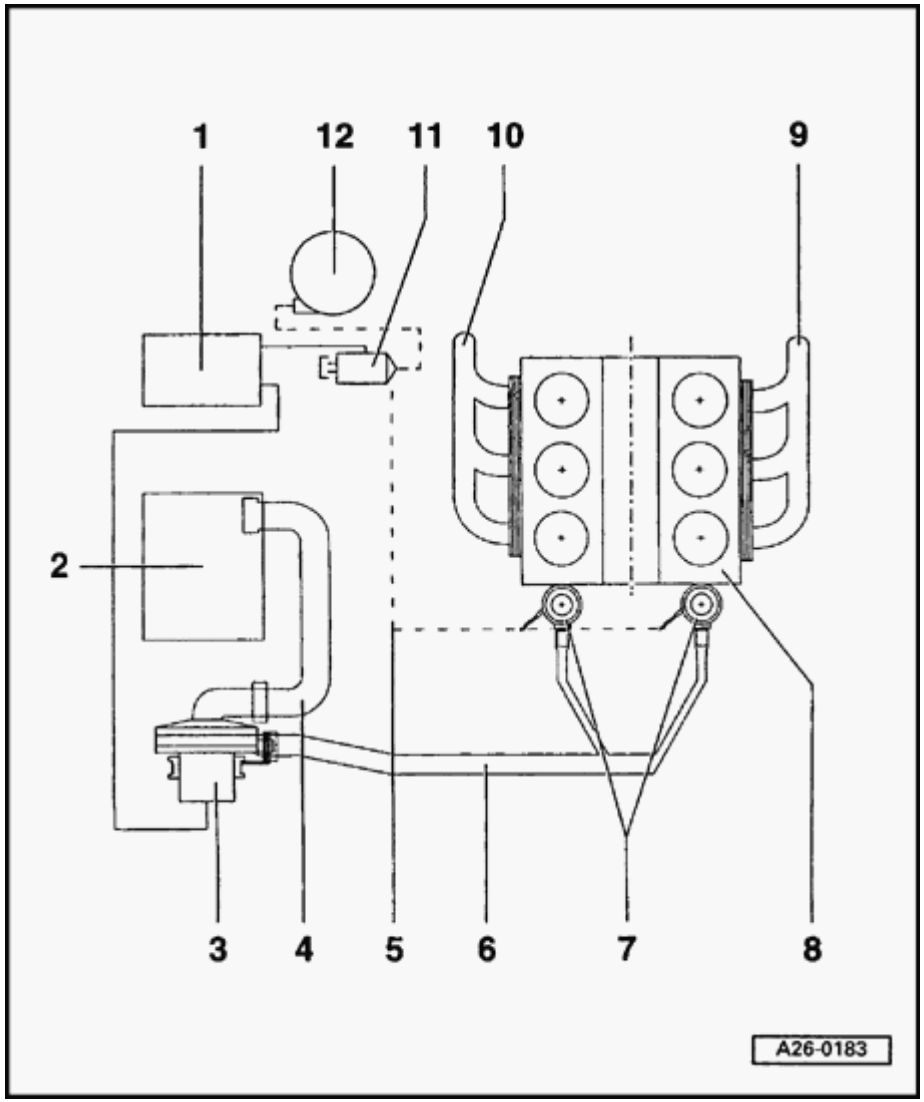
Leak test

- Flow test must check out OK
- Engine at operating temperature

The secondary air injection pump is switched on during idle. Since the combination valves are not triggered by the secondary air injection solenoid valve, they remain closed. When the secondary air injection pump is switched on, the oxygen sensor system is monitored by the ECM. If the system does not leak, fresh air cannot enter the exhaust manifold. If the system is leaking, the oxygen sensor signal will respond to the leaner mixture (caused by the secondary air getting into the exhaust manifold) and cause a noticeable

enrichment. This enrichment is recognized by the ECM.

26-14



Secondary Air Injection (AIR) system, overview

1 - Motronic Engine Control Module (ECM) -J220-

2 - Air cleaner

- Connection for intake air of Secondary Air Injection (AIR) pump

3 - Secondary Air Injection (AIR) pump motor -V101-

4 - Connection

- Between air cleaner and secondary air injection pump
- Removing ⇒ page 26-16

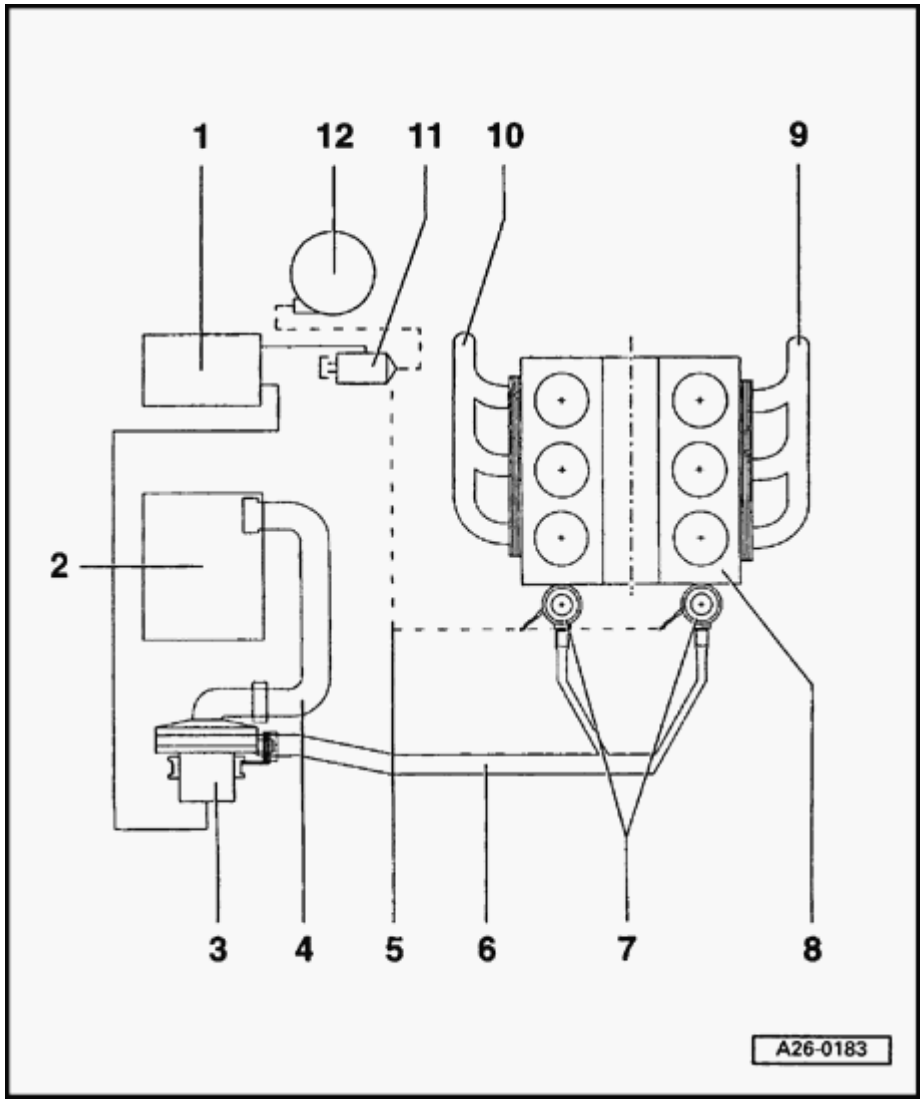
5 - Vacuum line

- Control line between Secondary Air Injection (AIR) solenoid valve -N112- and combination valves

6 - Connection tube

- From secondary air injection pump to combination valves

26-15



7 - Combination valves

- Located at rear of left and right cylinder heads
- Removing and installing ⇒ page 26-16

8 - Engine

9 - Right exhaust manifold

10 - Left exhaust manifold

11 - Secondary Air Injection (AIR) solenoid valve -N112-

12 - Vacuum reservoir

- Located in left-front wheelhousing

26-16

Secondary Air Injection (AIR) system components, removing and installing

Component locations ⇒ page 26-14 .

Fuel injection and ignition components.

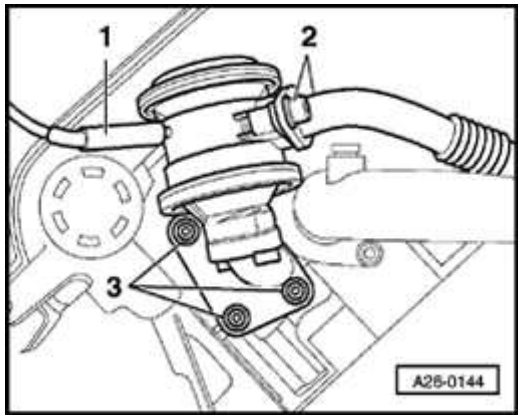
⇒ *Repair Manual, 2.8 Liter V6 5V Fuel Injection & Ignition, Repair Group 24*

Note:

Always replace gaskets and seals.

A - Combination valve, left

- Remove engine coolant expansion tank from bracket.



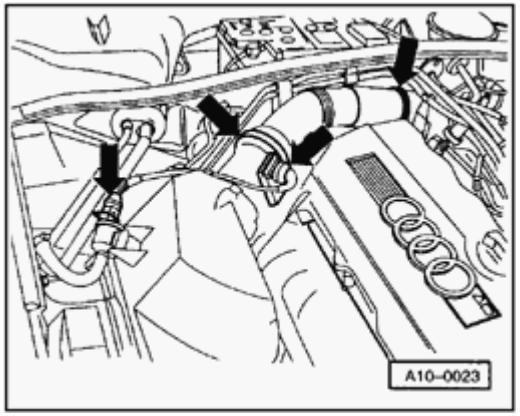
- Disconnect vacuum line -1-.
- Disconnect connection tube -2- from combination valve.

  Tightening torque: 10 Nm (7 ft lb).
- Remove bolts -3- for combination valve from cylinder head and remove valve.

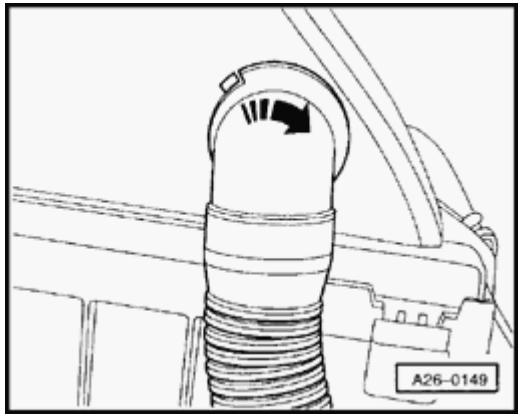
  Tightening torque: 10 Nm (7 ft lb).

26-17

B - Combination valve, right

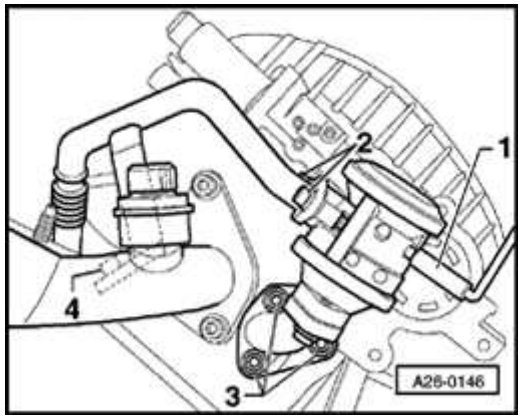


- Remove intake air duct between Mass Air Flow (MAF) sensor and intake air elbow (three -arrows- on right).
- Remove intake air elbow from throttle body connector.
- Disconnect harness connector for Evaporative Emission (EVAP) canister purge regulator valve (left arrow) and pull valve out of bracket.
- Disconnect harness connector at Mass Air Flow (MAF) sensor.



- Turn connector tube for Secondary Air Injection (AIR) pump 1/4-turn (45 °) to right and pull forward off air cleaner.
- Remove air cleaner housing.

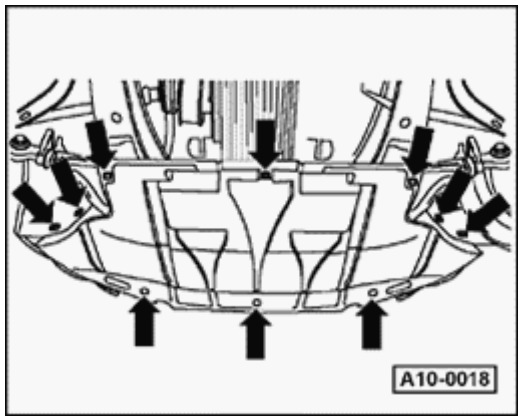
  Tightening torque: 20 Nm (15 ft lb).



- Remove vacuum line -1-.
- Disconnect connection tube -2- from combination valve.

  Tightening torque: 10 Nm (7 ft lb).
- Remove bolts -3- for combination valve from cylinder head and if necessary, remove bracket -4- from cylinder head.
  - Bolt -3- tightening torque: 10 Nm (7 ft lb).
  - Bracket -4- tightening torque: 20 Nm (15 ft lb).
- Remove combination valve.

C - Secondary Air Injection (AIR) pump motor



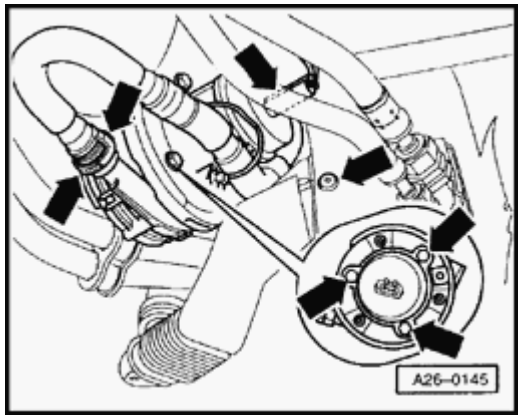
- Remove noise insulation panel (arrows).
- Remove front bumper.

⇒ *Repair Manual, Body Exterior, Repair Group 63*

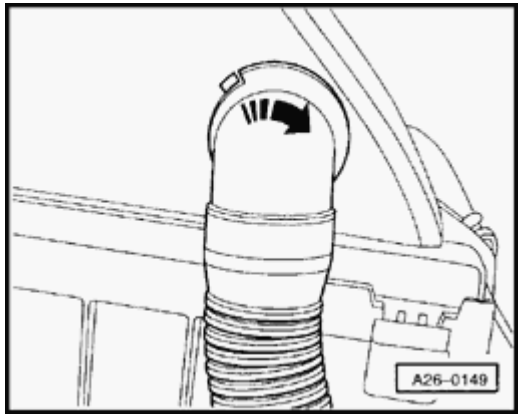
- Move lock carrier into service position.

⇒ *Repair Manual, Body Exterior, Repair Group 50*

26-19



- Remove air duct to generator at front of air shroud.
- Disconnect connection at connector tube to Secondary Air Injection (AIR) pump combination valves (left arrows), pull down to remove and cut tie wraps.
- Remove three bolts on Secondary Air Injection (AIR) pump (lower right arrows) but do not remove nuts.
- Remove pump toward rear from bracket.
- Remove connection line on Secondary Air Injection (AIR) pump to air cleaner.

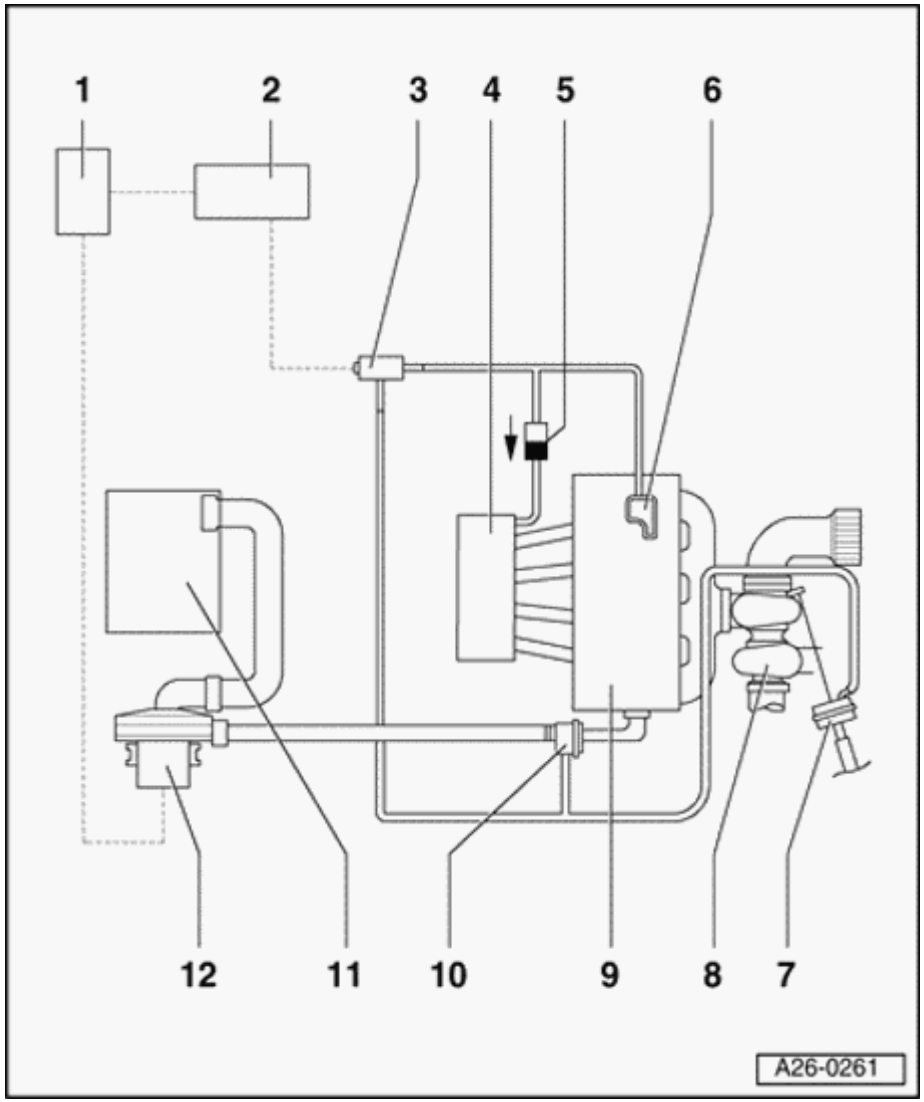


- Turn connector tube for Secondary Air Injection (AIR) pump 45° to right and disconnect.
- Remove air Secondary Air Injection (AIR) pump.

Installing

Installation is the reverse of removal.

26-29



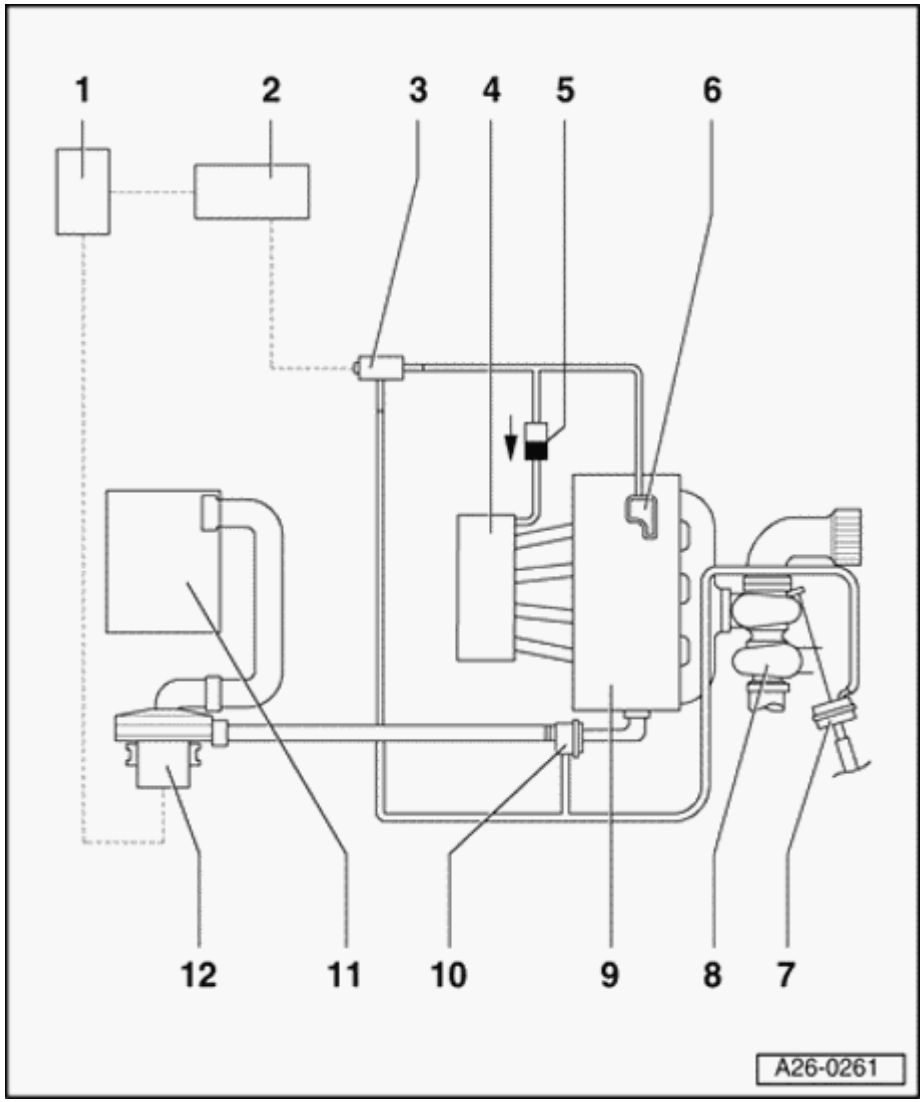
Secondary air system, checking (engine code ATW)

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.

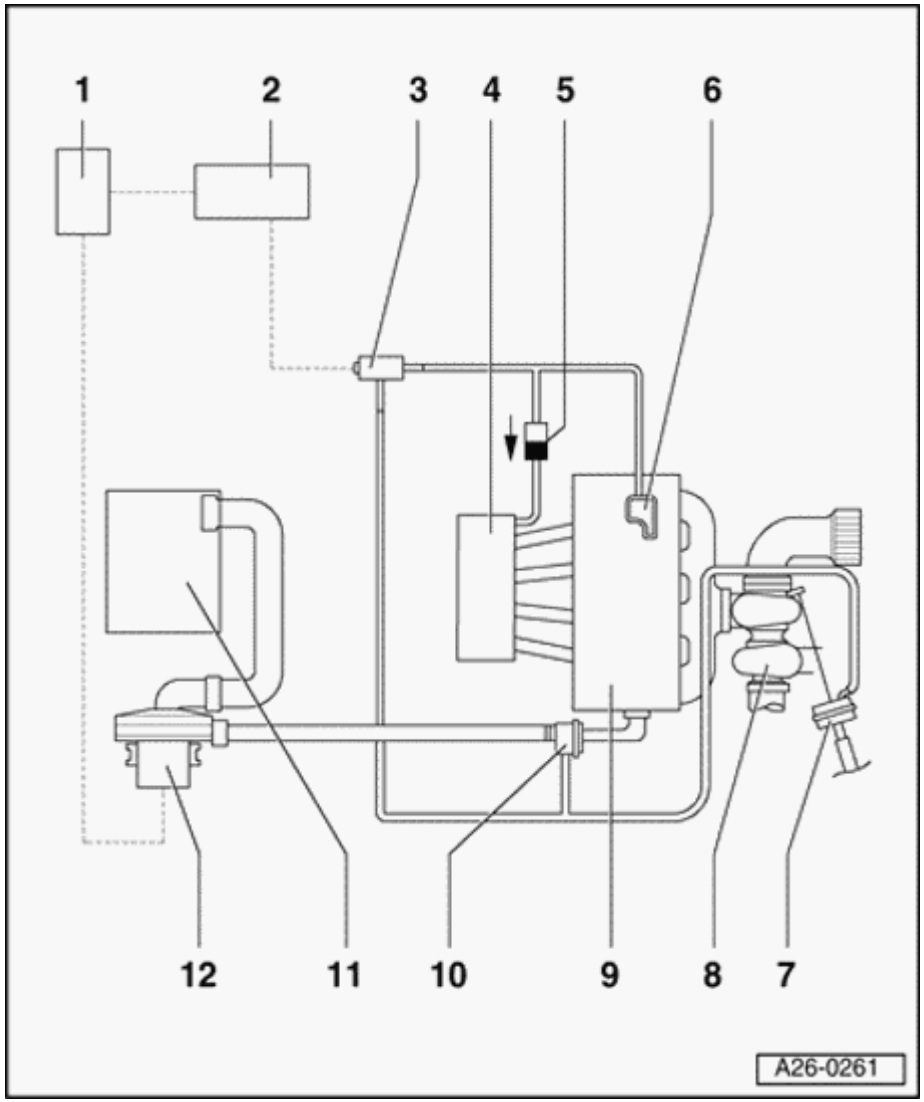
26-30



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.

26-31



- 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-

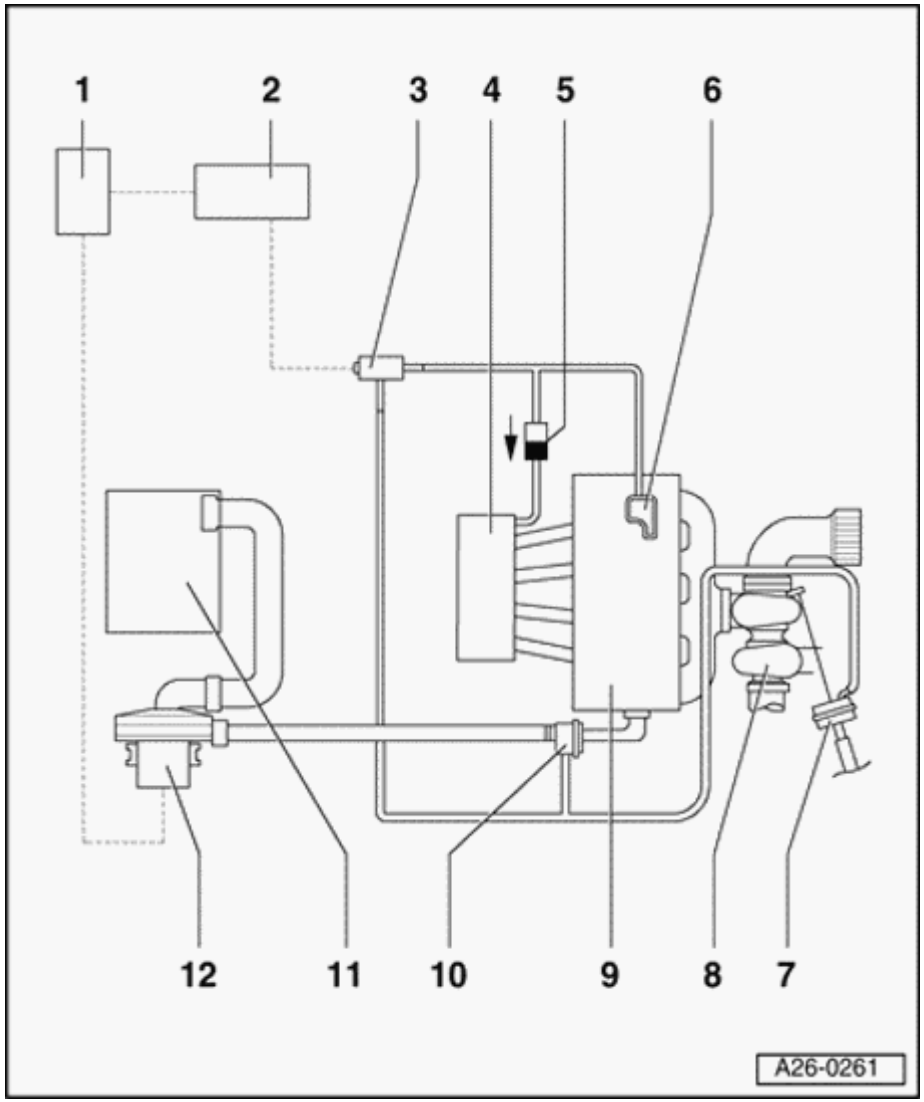
3 - Secondary Air Injection (AIR) solenoid valve -N112-

4 - Intake manifold

5 - Check valve

- Installation position (light/dark side): Arrow points in direction of flow, as shown

26-32



6 - Vacuum reservoir

7 - Pressure unit for charge air pressure regulation

8 - Turbocharger

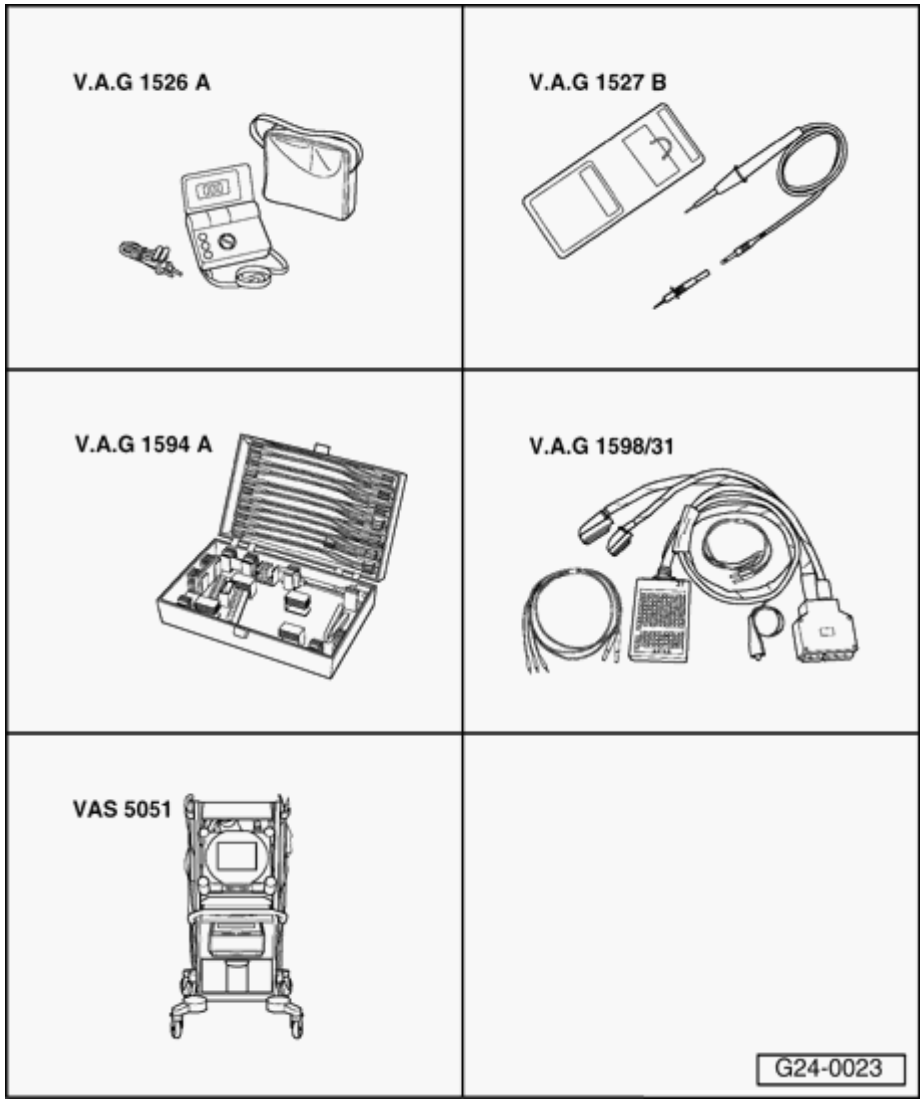
9 - Cylinder head

10 - Combination valve for secondary air injection (AIR)

11 - Air cleaner

12 - Secondary Air Injection (AIR) pump motor -V101-

26-33



Secondary Air Injection (AIR) solenoid valve -N112-, checking

Special tools and equipment

- VAG1526A
- VAG1527B
- VAG1594A
- VAG1598/31
- VAS 5051

- or

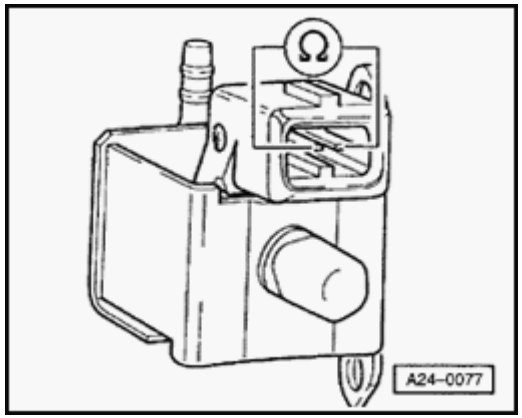
- VAG1551 with VAG1551/3A

Test requirement

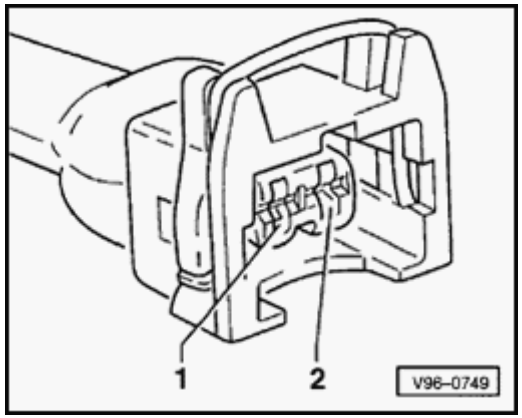
- Output Diagnostic Test Mode (DTM) performed

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-.



Checking voltage supply

- Disconnect harness connector from Secondary Air Injection (AIR) solenoid valve -N112-.

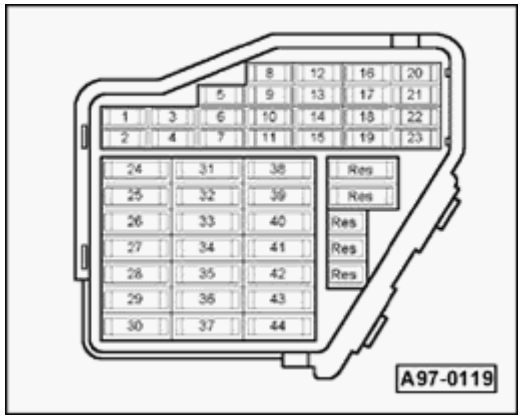
- Connect VAG1527B voltage tester as follows:

Harness connector terminal	Measure to
1	Engine Ground (GND)

- Operate starter briefly.
  - ♦ LED must light.

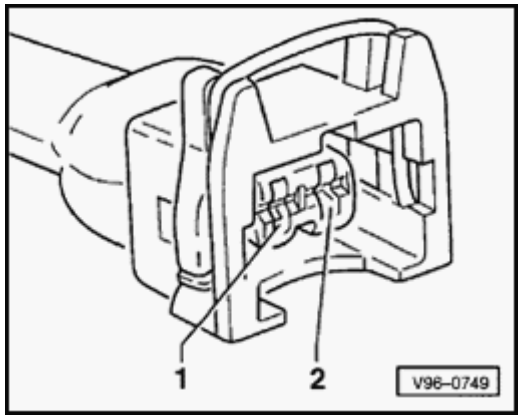
If LED does not light:

- Perform the following tests marked with dots:



- Check fuse S234 (in fuse holder, position 34).

26-36



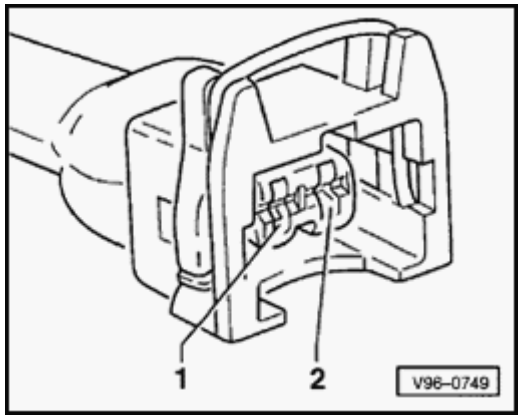
- Check wire connection from terminal 1 of connector via fuse S234 (in fuse holder, socket 34) to Fuel Pump (FP) relay for open circuit:

⇒ *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 →

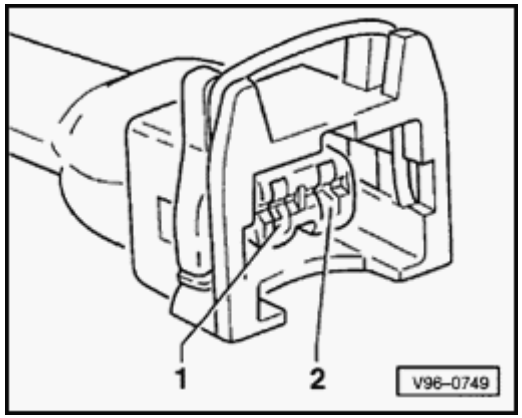
Secondary Air Inj. Solenoid Valve -N112

Indicated on display

- ♦ LED must blink.

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+:

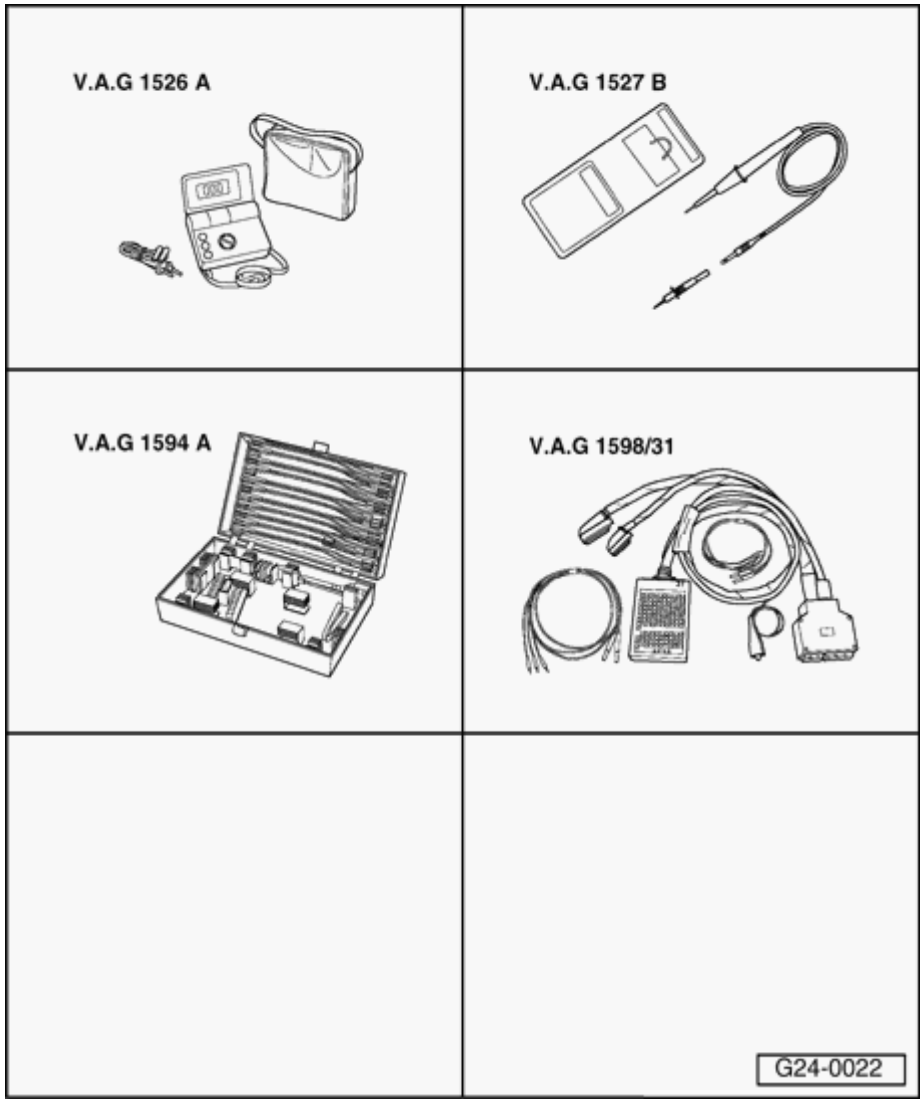
Harness connector terminal	VAG1598/31 test box socket
2	44

- Repair open circuit or short circuit if necessary.

If wire connection is OK:

- Replace Engine Control Module (ECM).

26-38



Secondary Air Injection (AIR) pump relay - J299-, checking activation

Special tools and equipment

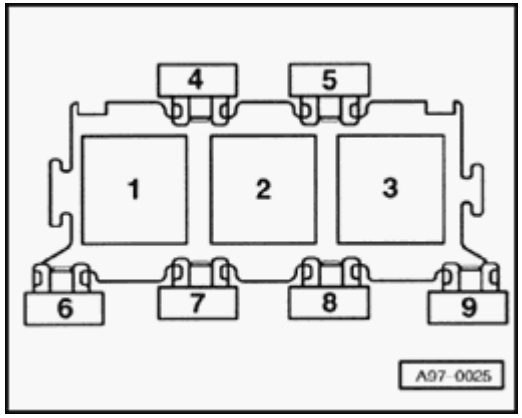
- VAG1526A
- VAG1527B
- VAG1594A
- VAG1598/31

26-39

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 .

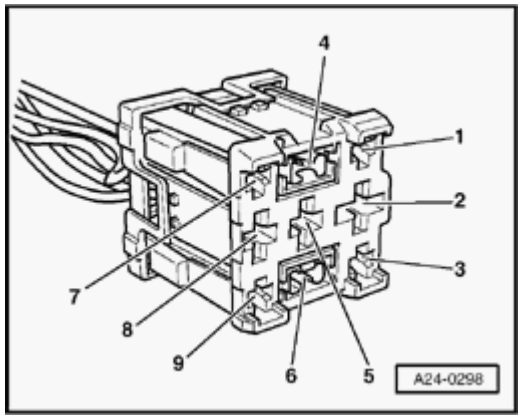
B - If relay triggers, but Secondary Air Injection (AIR) pump does not run:

- Check voltage supply for Secondary Air Injection (AIR) pump ⇒ Page 26-43 .

26-40

Checking voltage supply of Secondary Air Injection (AIR) pump relay

- Remove Secondary Air Injection (AIR) pump relay.



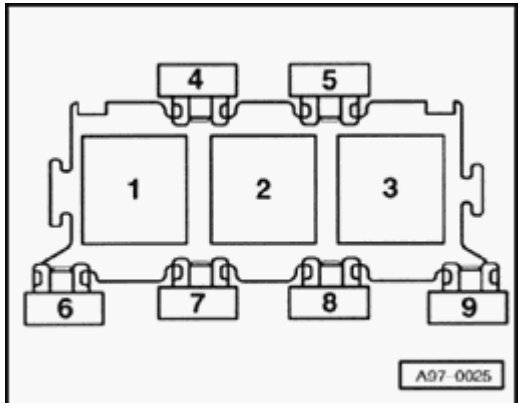
- Connect multimeter for voltage measurement as follows.

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:

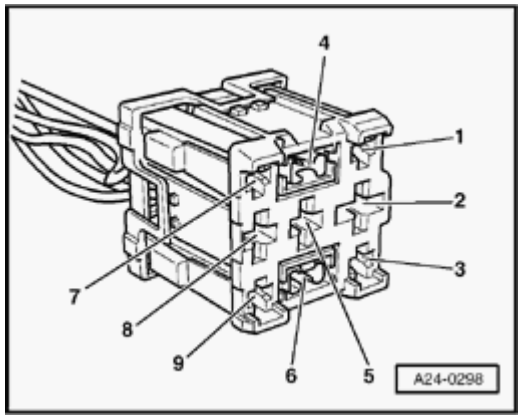
- Perform the following tests marked with dots:



- 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*

26-41



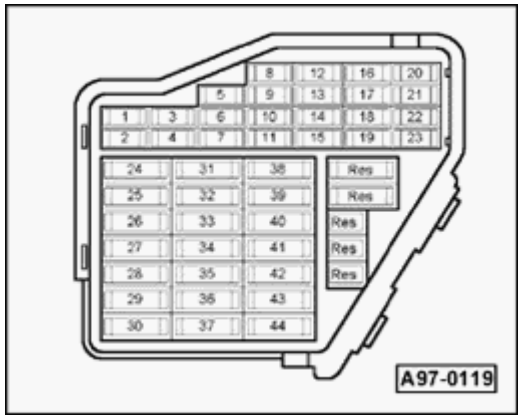
- Connect multimeter for voltage measurement as follows.

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

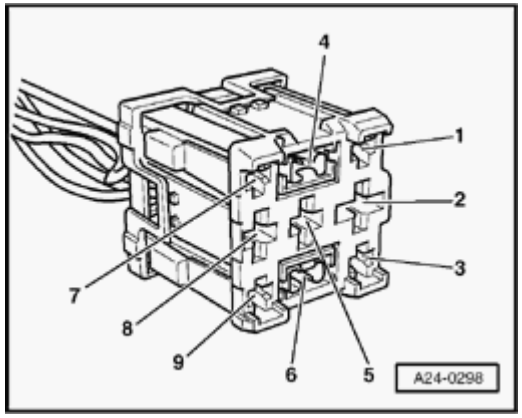
If specified value is not obtained:

- 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*



Checking activation of the Secondary Air Injection (AIR) pump relay

- Switch ignition off.

- Remove Secondary Air Injection (AIR) pump relay.

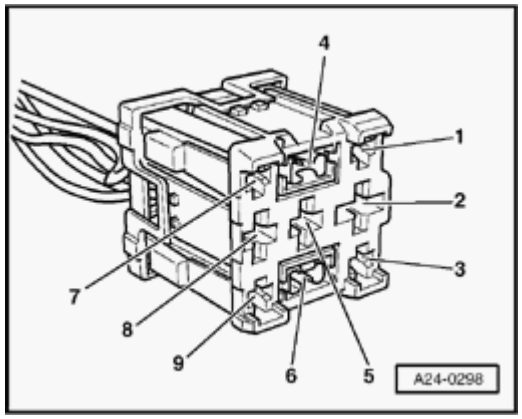
- Connect VAG1527B voltage tester as follows:

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.



- 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.

26-44

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*

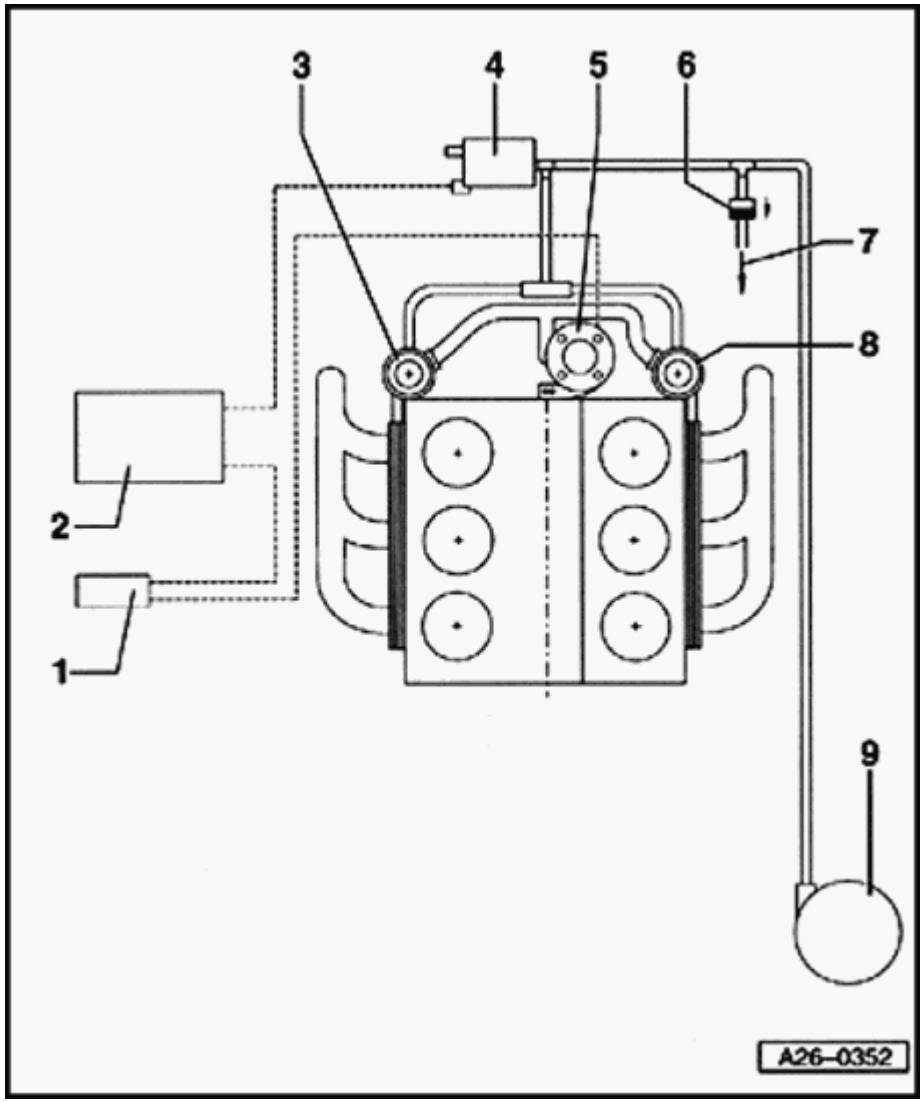
  - Check wire connection from harness connector at Secondary Air Injection (AIR) pump motor -V101- to Ground (GND) connection 1 in engine compartment wiring harness for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

If no malfunctions are detected:

- Replace Secondary Air Injection (AIR) pump motor -V101-.

26-31



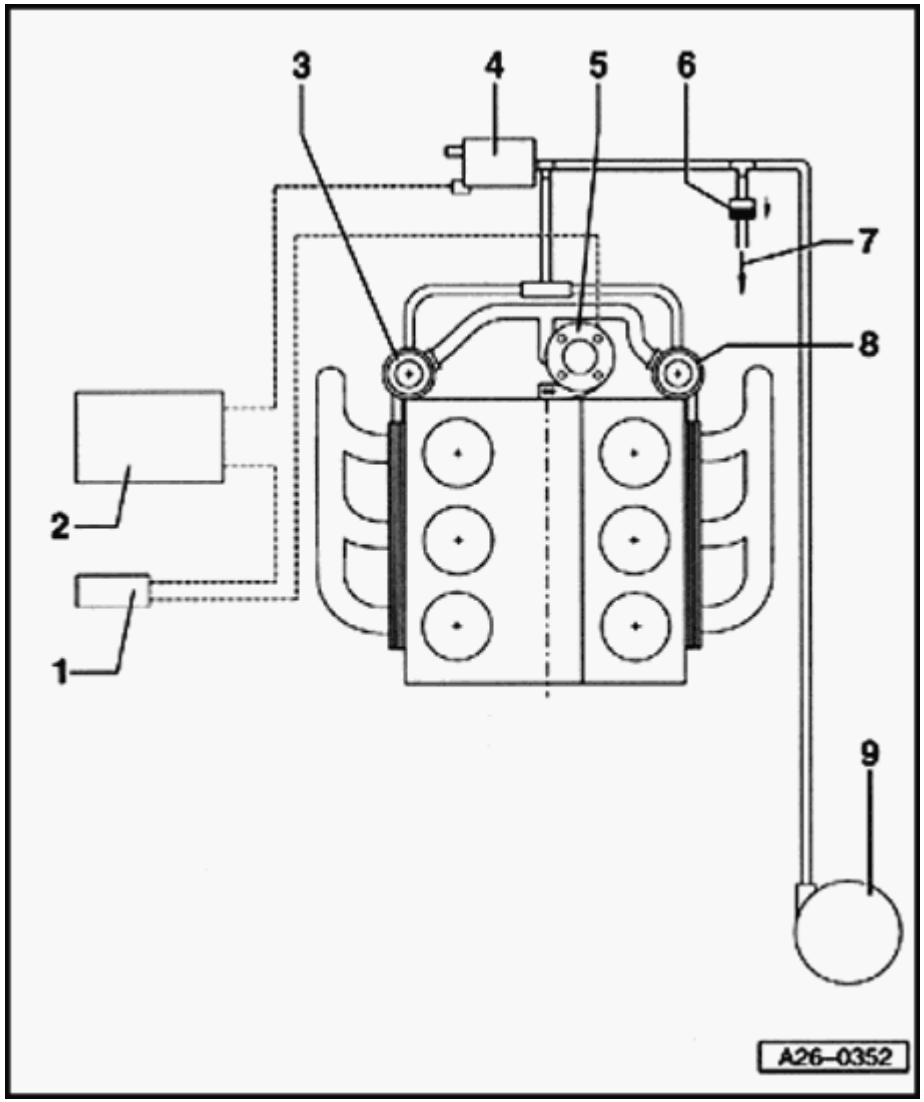
Secondary air system

The secondary air system results in quicker heating and therefore earlier operating readiness of the catalytic converter following cold start.

Principle

Due to over-enrichment of the mixture during the cold start phase, there is an increased amount of un-combusted 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, therefore improving exhaust quality during the cold start phase significantly.

26-32



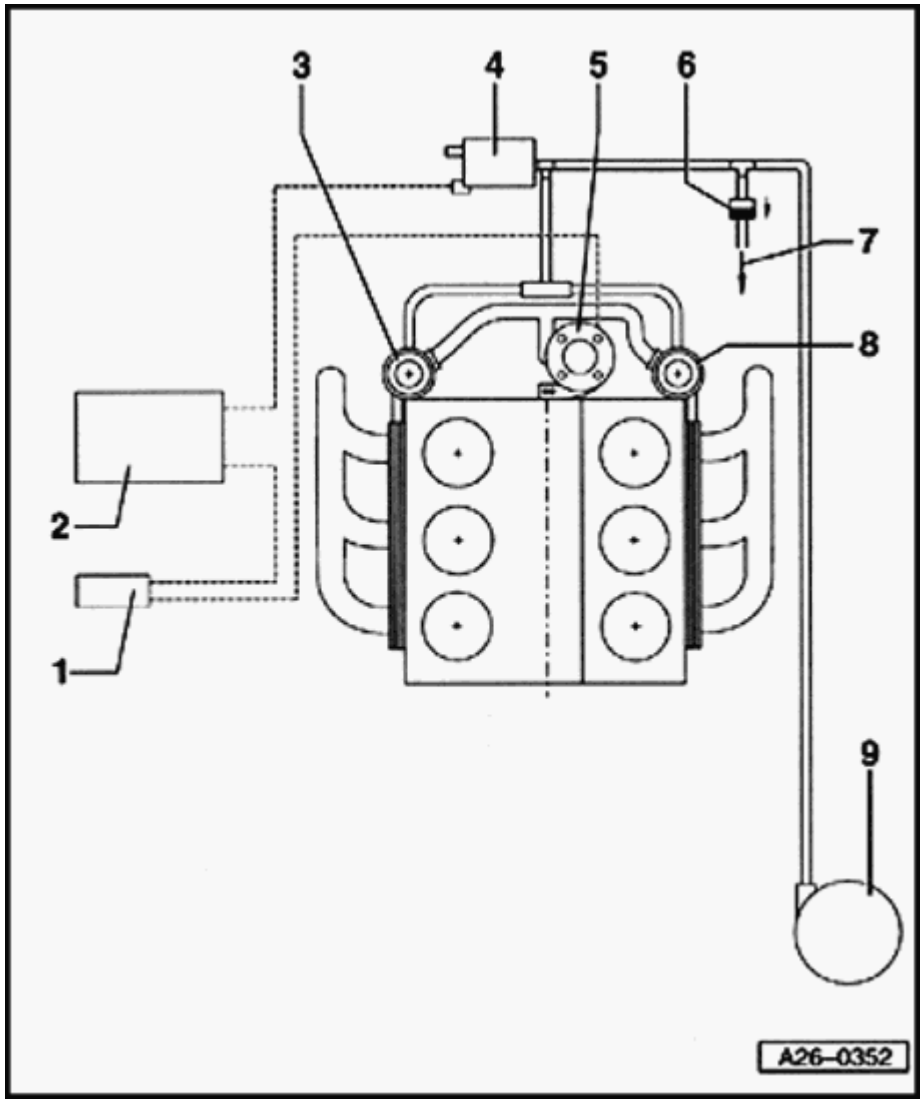
Function:

- In the cold start phase, the ECM -4- activates the secondary air pump -2- via the relay for secondary air pump -3-. Air reaches the combination valves for Secondary Air Injection (AIR) -5- and -9-.
- The Secondary Air Injection (AIR) valve -6- is activated in parallel, which allows the vacuum to reach the combination valves for Secondary Air Injection (AIR) -5- and -9-. The appropriate combination valve for Secondary Air Injection (AIR) thereby opens the path for secondary air to the exhaust channels of the cylinder head.

1 - Secondary Air Injection (AIR) pump relay - J299-

- Removing and installing ⇒ Page 26-37
- checking ⇒ Page 26-45

26-33



2 - Motronic Engine Control Module (ECM) - J220-

3 - Combination valve for secondary air injection (AIR)

4 - Secondary Air Injection (AIR) solenoid valve -N112-

- Installation position ⇒ Fig. ⇒ 1

5 - Secondary Air Injection (AIR) pump motor -V101-

- Installation position ⇒ Fig. ⇒ 2

6 - Check valve

- Installation position (light/dark side): Arrow points in direction of flow, as shown in figure.

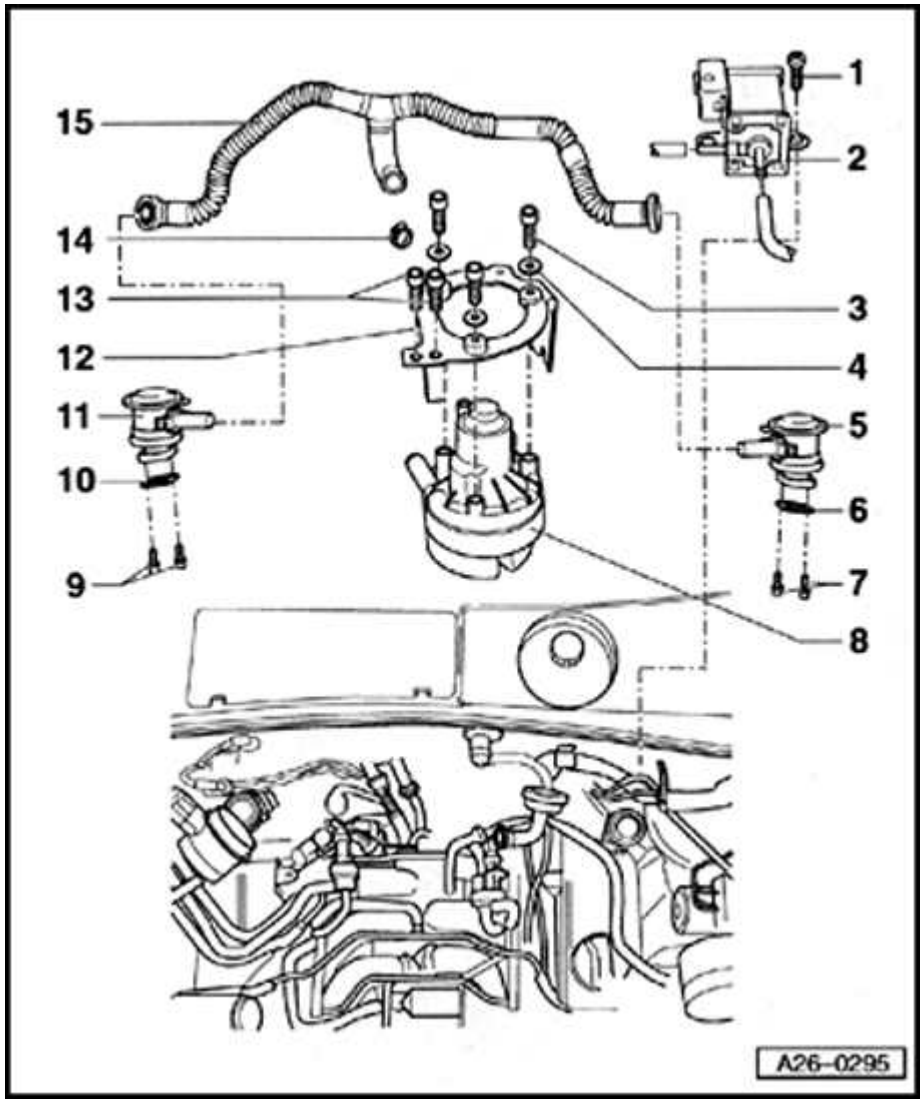
7 - To Intake manifold

8 - Combination valve for secondary air injection (AIR)

9 - Vacuum reservoir

- Installation location: Under wheel housing liner in wheel housing

26-34



Secondary Air Injection (AIR) system components, removing and installing

The components for the Secondary Air Injection (AIR) system are located under the air distributor between the intake manifold and the plenum chamber.

1 - 6 Nm

2 - Secondary Air Injection (AIR) solenoid valve -N112-

3 - 10 Nm

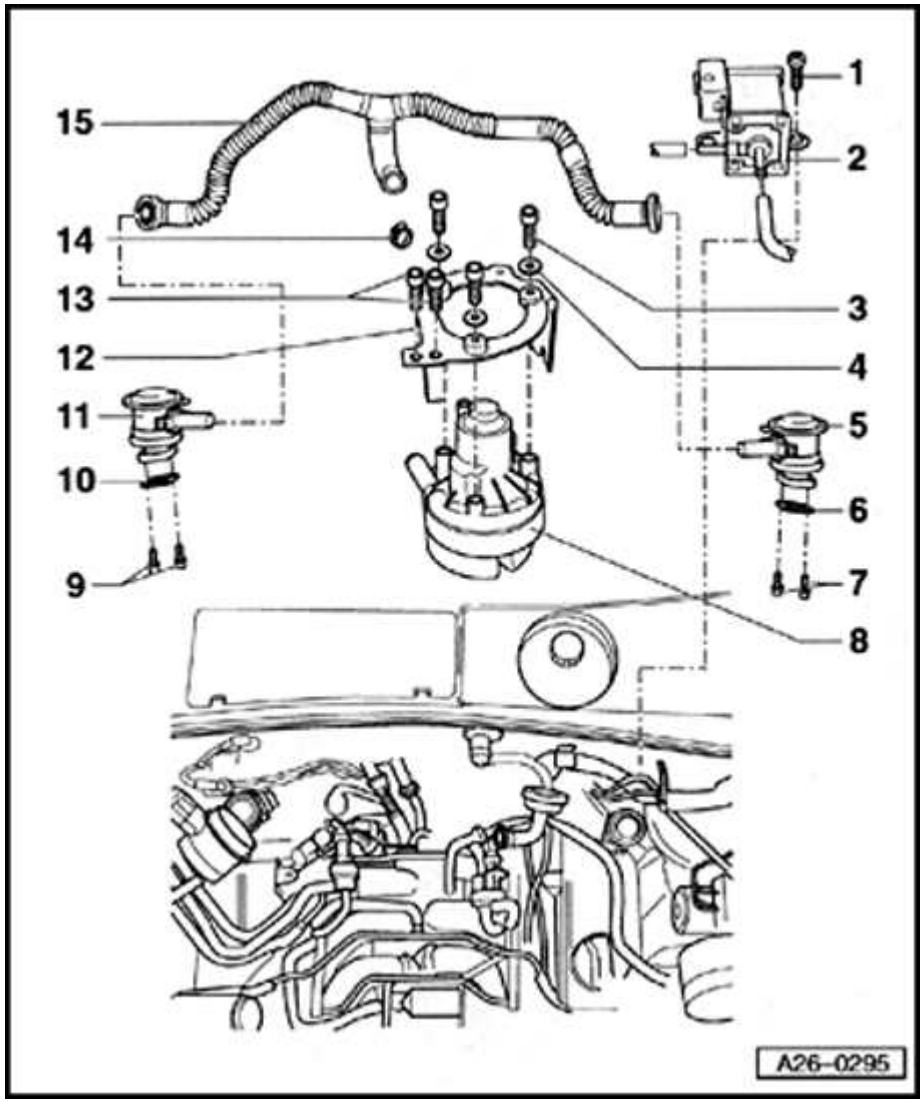
4 - Large shim washer

- For all 3 rubber bonded bushings at bracket for Secondary Air Injection (AIR) pump

5 - Combination valve, left

6 - Seal

26-35



7 - 10 Nm

8 - Secondary Air Injection (AIR) pump with air filter attached

9 - 10 Nm

10 - Seal

11 - Combination valve, right

12 - Bracket for Secondary Air Injection (AIR) pump

- Bolted to rear intake manifold.

13 - 10 Nm

14 - Screw clamp

15 - Connection tube

- Between Secondary Air Injection (AIR) pump and combination valves

26-36

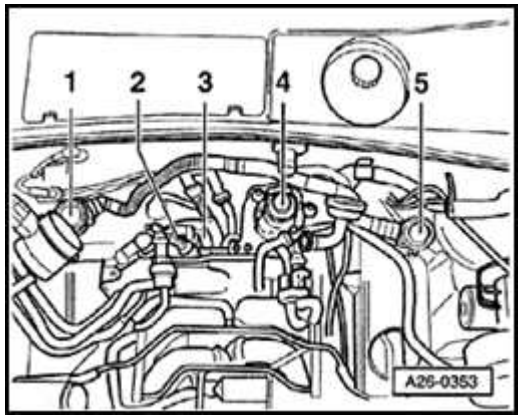


Fig. 1 Installation location of Secondary Air Injection (AIR) solenoid valve -N112-

- Bolted to rear intake manifold at bracket below control modules together with the connector for exhaust gas temperature (to the right of the AIR motor) -3-.

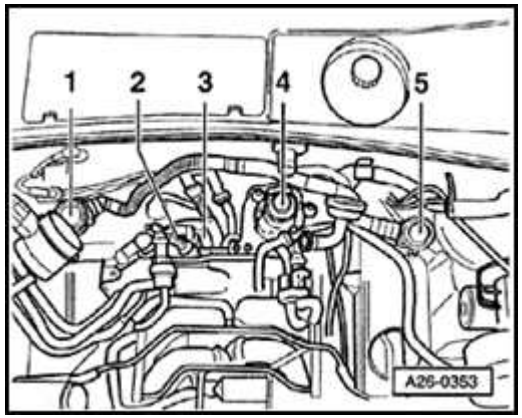
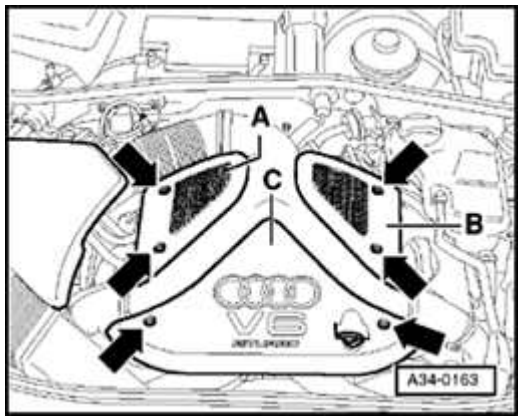


Fig. 2 Installation position of Secondary Air Injection (AIR) pump motor -V101-

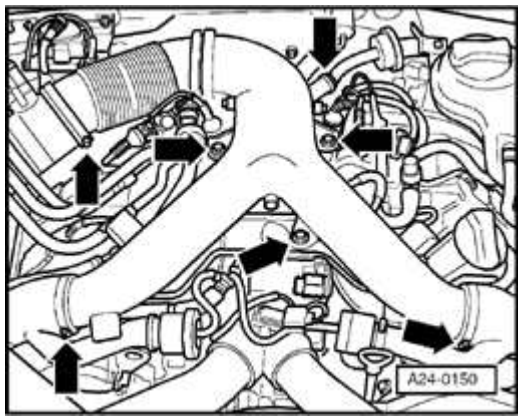
- At intake manifold, rear left -4-.

26-37

Secondary Air Injection (AIR) solenoid valve -N112-, removing and installing

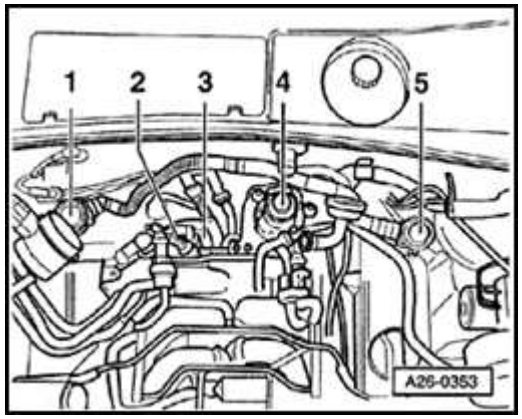


- Remove bolts (arrows) and remove engine covers -A- and -B-.



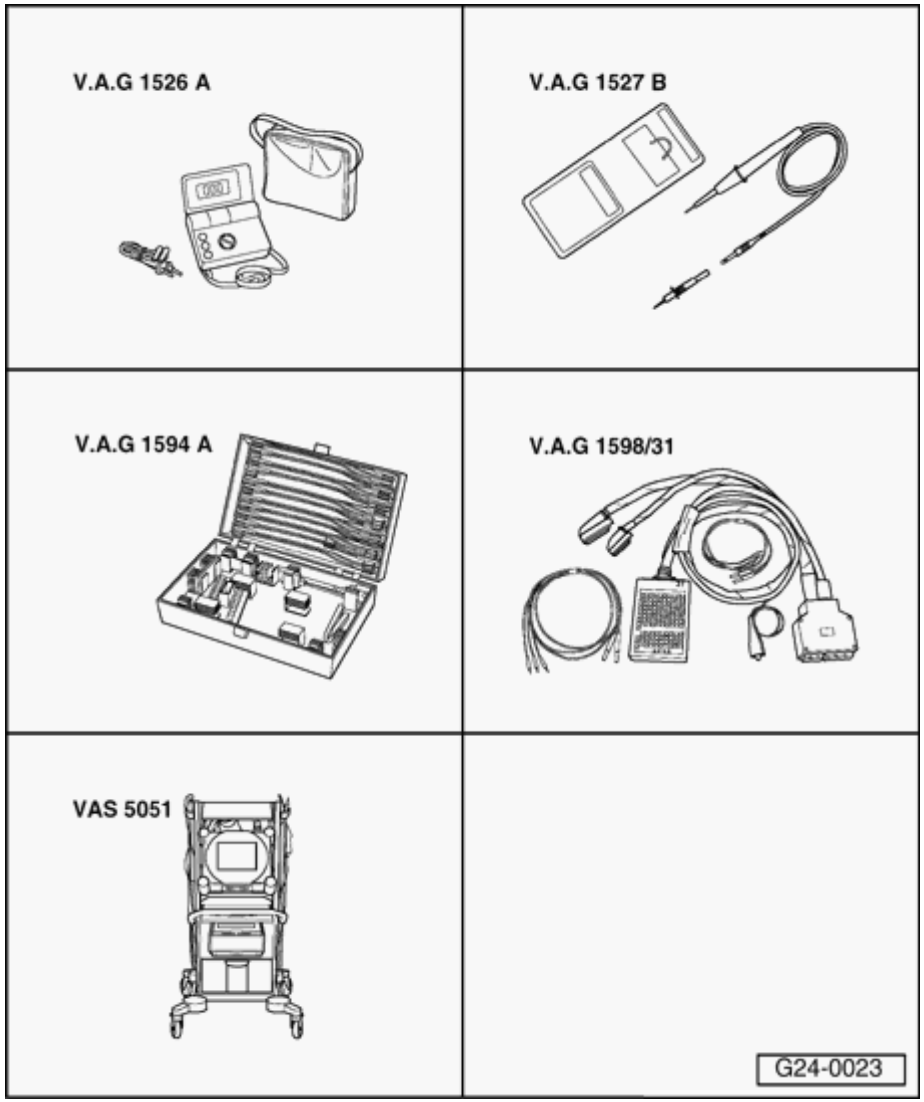
- Remove air distributor (arrows).

26-38



- Disconnect both connectors -2- from control modules for exhaust gas temperature.
- Remove control modules from intake manifold and set wires aside.
- Secondary Air Injection (AIR) solenoid valve -N112- is secured to a bracket below control modules for exhaust gas temperature sensor.
- Disconnect harness connector from valve and slide bracket off studs at intake manifold with vacuum lines connected.
- Disconnect vacuum lines from Secondary Air Injection (AIR) solenoid valve, remove valve from bracket.

26-39



Secondary Air Injection (AIR) solenoid valve -N112-, checking

Special tools and equipment

- VAG 1526A
- VAG 1527B
- VAG 1594A
- VAG 1598/31
- VAS 5051

- or

- VAG 1551 with VAG 1551/3A

26-40

Installation location ⇒ Installation locations-Overview

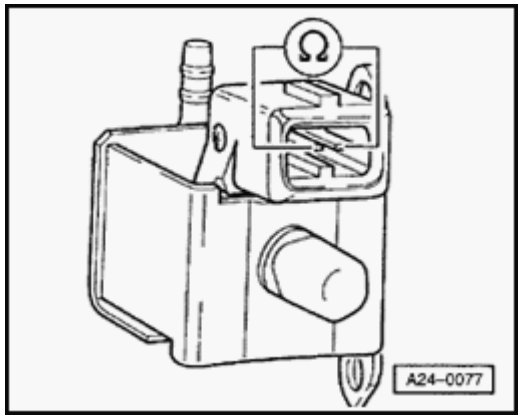
⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

Test requirement:

- Output Diagnostic Test Mode (DTM) performed

Checking internal resistance

- Disconnect harness connector from Secondary Air Injection (AIR) valve -N112-.

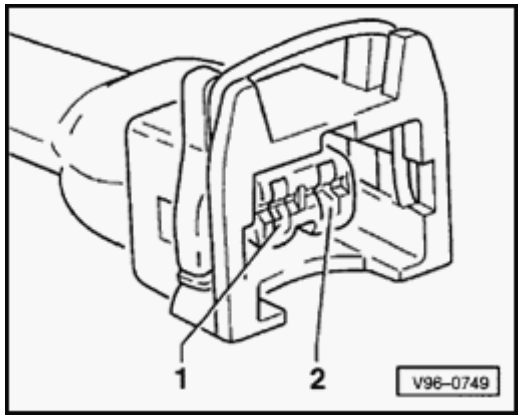


- Connect multimeter at valve for resistance measurement.
  - ♦ Specified value: 25 ... 35 Ω
- If specified value is not obtained, replace Secondary Air Injection (AIR) solenoid valve -N112-.

26-41

Checking voltage supply

- Disconnect connector from Secondary Air Injection (AIR) solenoid valve -N112-.



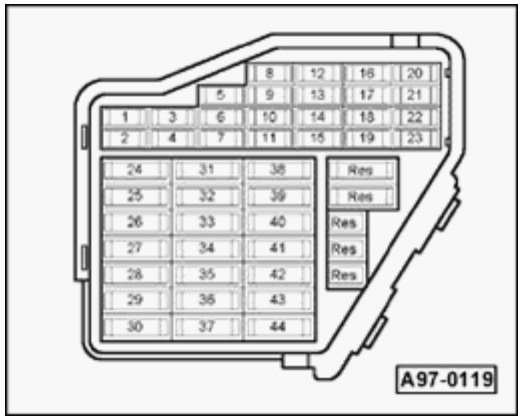
- Connect VAG 1527B voltage tester as follows:

Harness connector terminal	Measure to
1	Engine Ground (GND)

- Operate starter briefly.
  - ♦ LED must light.

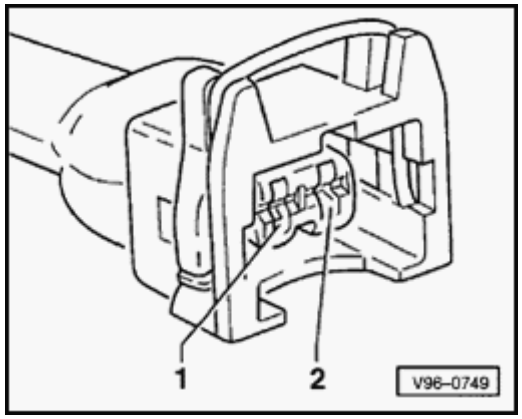
If LED does not light:

- Perform following tests marked with dots:



- Check fuse -S234- (in fuse holder, position 34).

26-42



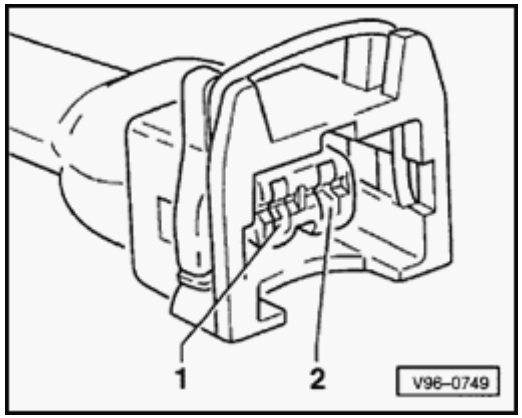
- Check wire connection from terminal 1 of connector via fuse -S234- (in fuse holder, socket 34) to Fuel Pump (FP) relay for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations*

- Check Fuel Pump (FP) relay.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

Checking activation



- Connect VAG 1527B voltage tester between terminal 1 and 2.

26-43

- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection (AIR) solenoid valve -N112

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

Output Diagnostic Test Mode →

Secondary. air. inj. solenoid valve -N112

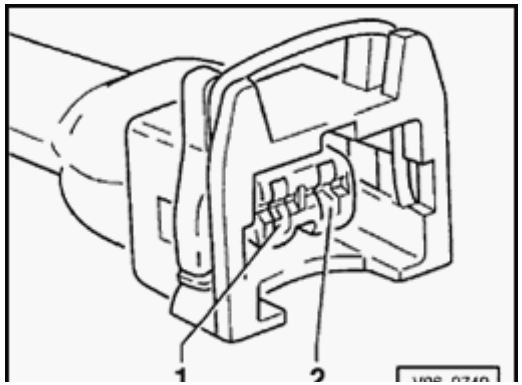
➢ Indicated on display

- ♦ LED must blink.

If LED does not blink or if it remains constantly lit:

- Connect VAG 1598/31 test box at wiring harness to ECM, do not connect ECM.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*



➢ - Check the following wire connections for open circuit and short circuit to Ground (GND) and B+:

Harness connector terminal	VAG 1598/31 test box Bushing
2	44

- Repair open circuit or short circuit if necessary.

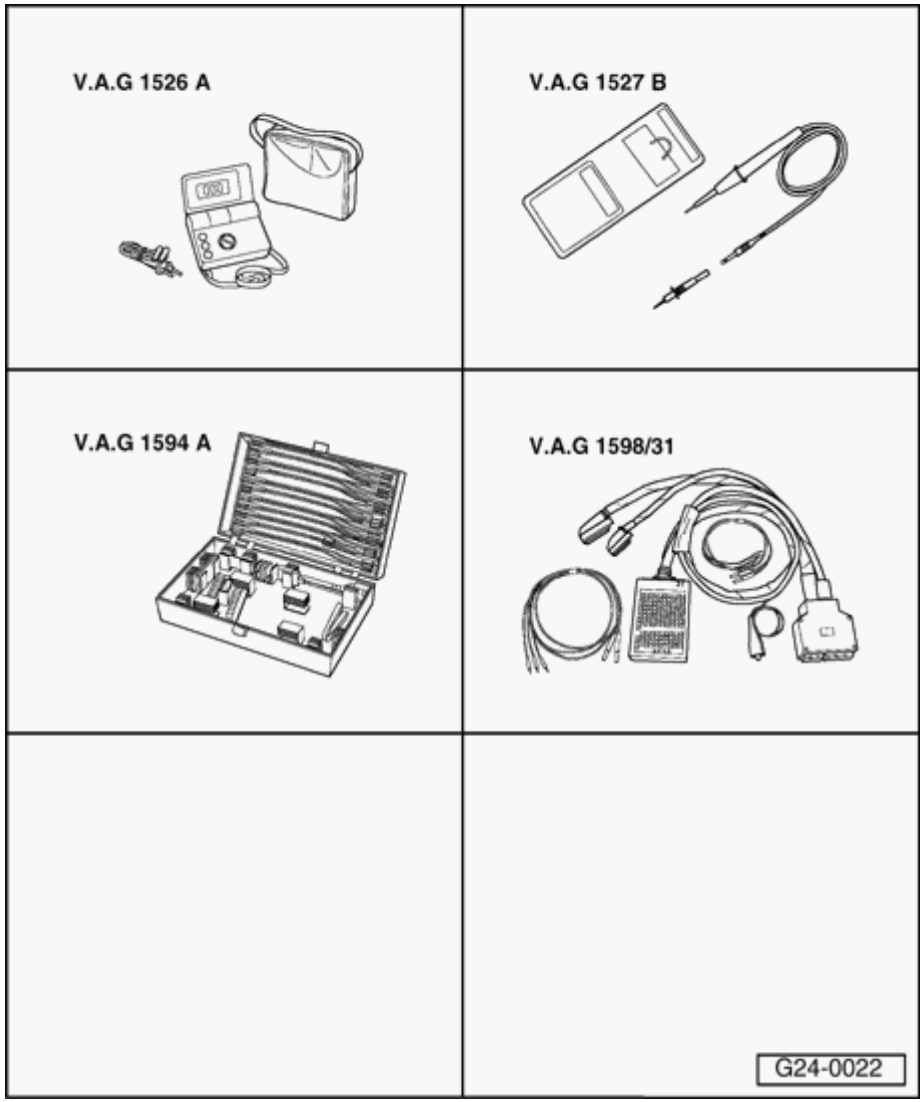
26-44

If wire connection is OK:

- Replace Engine Control Module (ECM).

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

26-45



Secondary Air Injection (AIR) pump relay - J299- and activation, checking

Special tools and equipment

- VAG 1526A
- VAG 1527B
- VAG 1594A
- VAG 1598/31

26-46

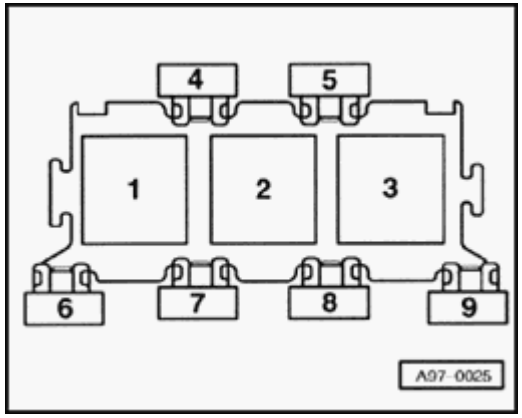
Installation location ⇒ Installation locations-Overview.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

Test sequence

- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection (AIR) pump relay -J299-

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*



- The Secondary Air Injection (AIR) pump relay (in 3-socket relay carrier in the E-box, at left in plenum chamber, position 2) must engage 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) pump relay ⇒ Page 26-47 .
- Check activation of Secondary Air Injection (AIR) pump relay ⇒ Page

26-49 .

B - If relay triggers, but Secondary Air Injection (AIR) pump does not run:

- Check voltage supply of Secondary Air Injection (AIR) pump motor ⇒ Page 26-51 .

26-47

Checking voltage supply of Secondary Air Injection (AIR) pump relay

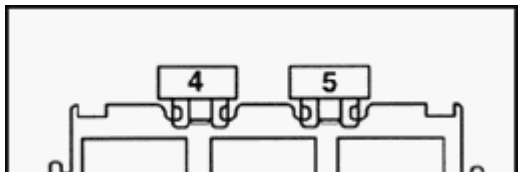
- Switch ignition off.
- Remove Secondary Air Injection (AIR) pump relay
- Connect multimeter for voltage measurement as follows.

3-socket relay carrier in E-box, plenum chamber, position 2 terminal	Measure to
8	Engine Ground (GND)

♦ Specification: approx. battery voltage

If specified value is not obtained:

- Perform 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 + (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*

26-48

- Connect multimeter for voltage measurement as follows:

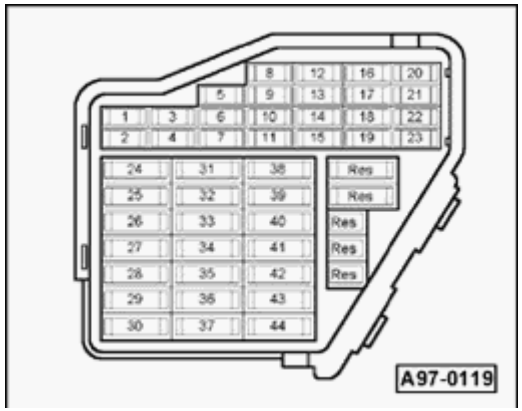
3-socket relay carrier in E-box, plenum chamber, position 2 **terminal**	**Measure to**
4	Engine Ground (GND)

- Operate starter briefly.

  ♦ Specification: approx. battery voltage

If specified value is not obtained:

- Perform 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*

26-49

Check activation of the Secondary Air Injection (AIR) pump relay

- Switch ignition off.
- Remove Secondary Air Injection (AIR) pump relay.
- Connect VAG 1527B voltage tester as follows:

3-socket relay carrier in E-box, plenum chamber, position 2 **terminal**	**Measure to**
6	B+

- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection (AIR) pump relay -J299-.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

- ♦ LED must blink.

If LED does not blink:

- Switch ignition off.

26-50

- Connect VAG 1598/31 test box at wiring harness to ECM, do not connect ECM.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 24*

- Check 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**	**VAG 1598/31 test box** **Bushing**
6	46

- Repair open circuit or short circuit if necessary.

If no malfunctions are detected:

- Replace Secondary Air Injection (AIR) pump relay -J299-.

26-51

Check voltage supply of the Secondary Air Injection (AIR) pump motor

- Remove connector for Secondary Air Injection (AIR) pump motor -V101-.

- Connect VAG 1527B voltage tester between terminals 1 and 2

- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection (AIR) pump relay -J299-.

⇒ *Repair Manual, 2.7 Liter V6 5V BiTurbo Fuel Injection & Ignition, Engine Code(s): APB, Repair Group 01*

- LED must blink

26-52

If LED does not blink:

- Perform following tests marked with dots:

  - Check wire connection from 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 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*

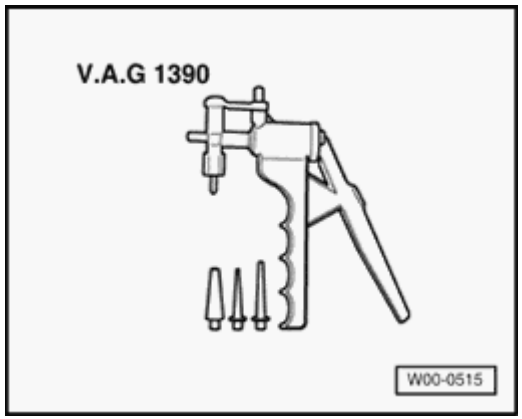
If no malfunctions are detected:

- Replace Secondary Air Injection (AIR) pump motor -V101-.

26-53

Combination valve, checking

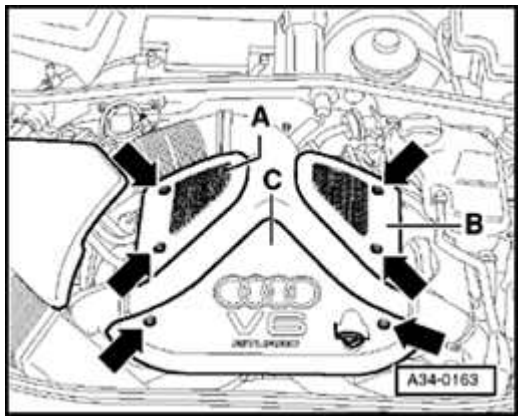
Special tools and equipment



- VAG 1390 Hand Vacuum Pump

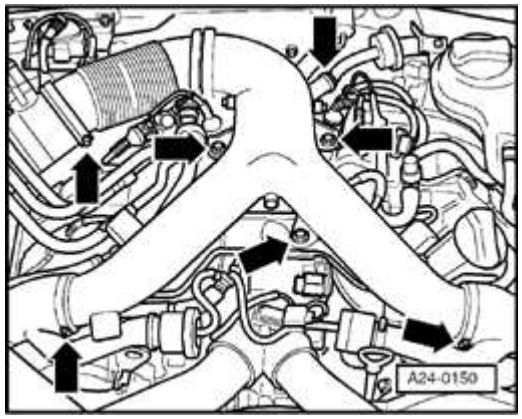
Test requirements:

- No leaks in vacuum lines or hose connections.
- Vacuum lines not clogged.



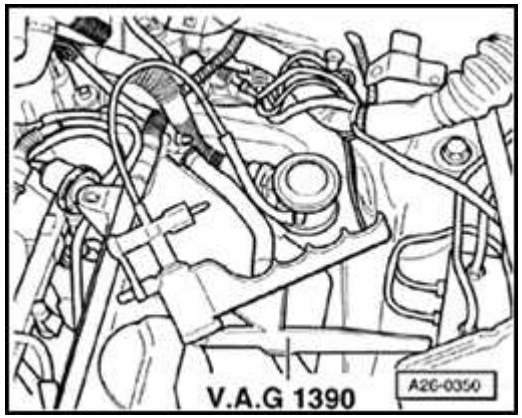
- Remove bolts (arrows) and remove engine covers -A- and -B-.

26-54



- Remove air distributor (arrows).

Leak test



- Pull hose from Secondary Air Injection (AIR) pump motor and blow in with light pressure (do not use pressurized air).

♦ Both combination valves must be closed, it must not be possible to blow through hose

If it is possible to blow through hose:

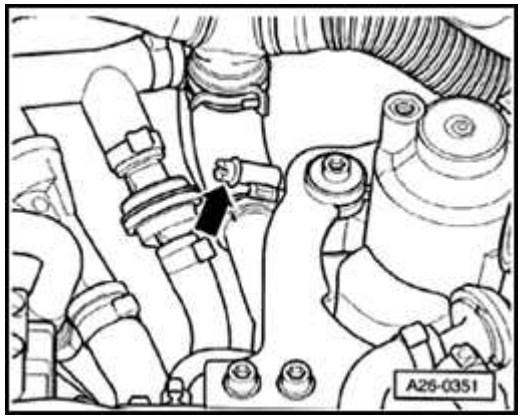
- Disconnect connecting line from Secondary Air Injection (AIR) pump motor to combination valve at one of the combination valves, close connecting line and blow through again.
- Replace combination valve remaining on connecting line

If it is no longer possible to blow through hose:

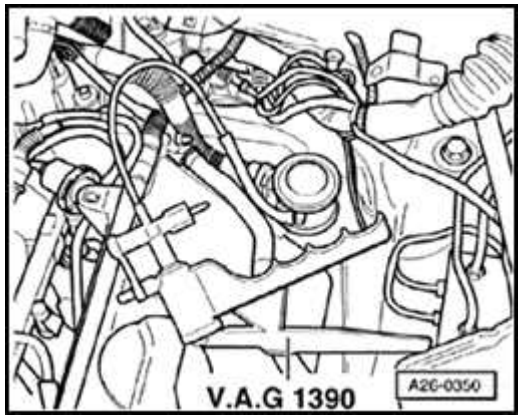
- Replace combination valve that was removed from connecting line.

26-55

Functional check



- Remove vacuum hose of combination valve to be checked and connect VAG 1390 vacuum pump to combination valve.



- Pull hose from Secondary Air Injection (AIR) pump motor and blow in with light pressure (do not use pressurized air).
- Operate hand vacuum pump.

♦ The relevant combination valve must open, it must not be possible to blow through

If the relevant combination valve does not open:

- Replace combination valve.

26-56

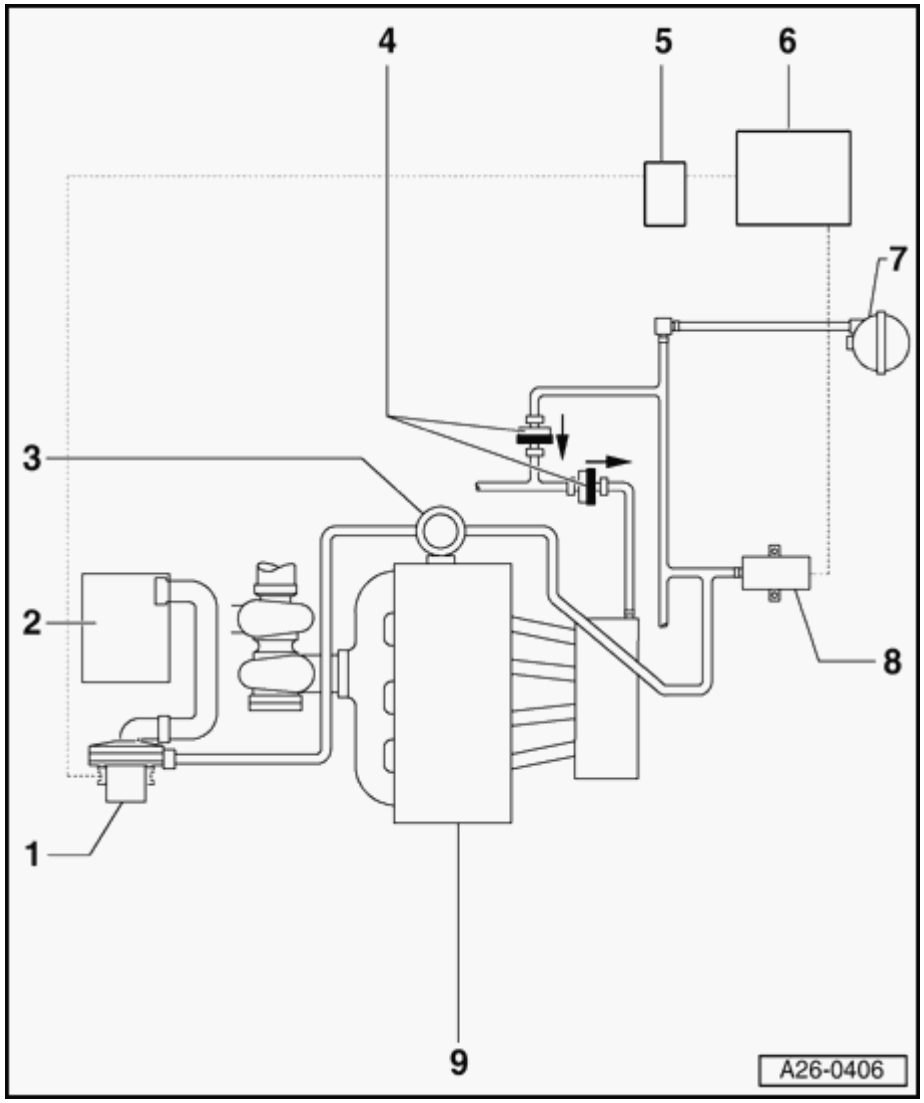
If the relevant combination valve opens:

- Repeat function test at second combination valve.

Note:

- *Use special tool 3231 and the Hazet carburetor adjustment key 4530.*
- *No special tools are necessary for the right combination valve.*

26-41



Secondary air system

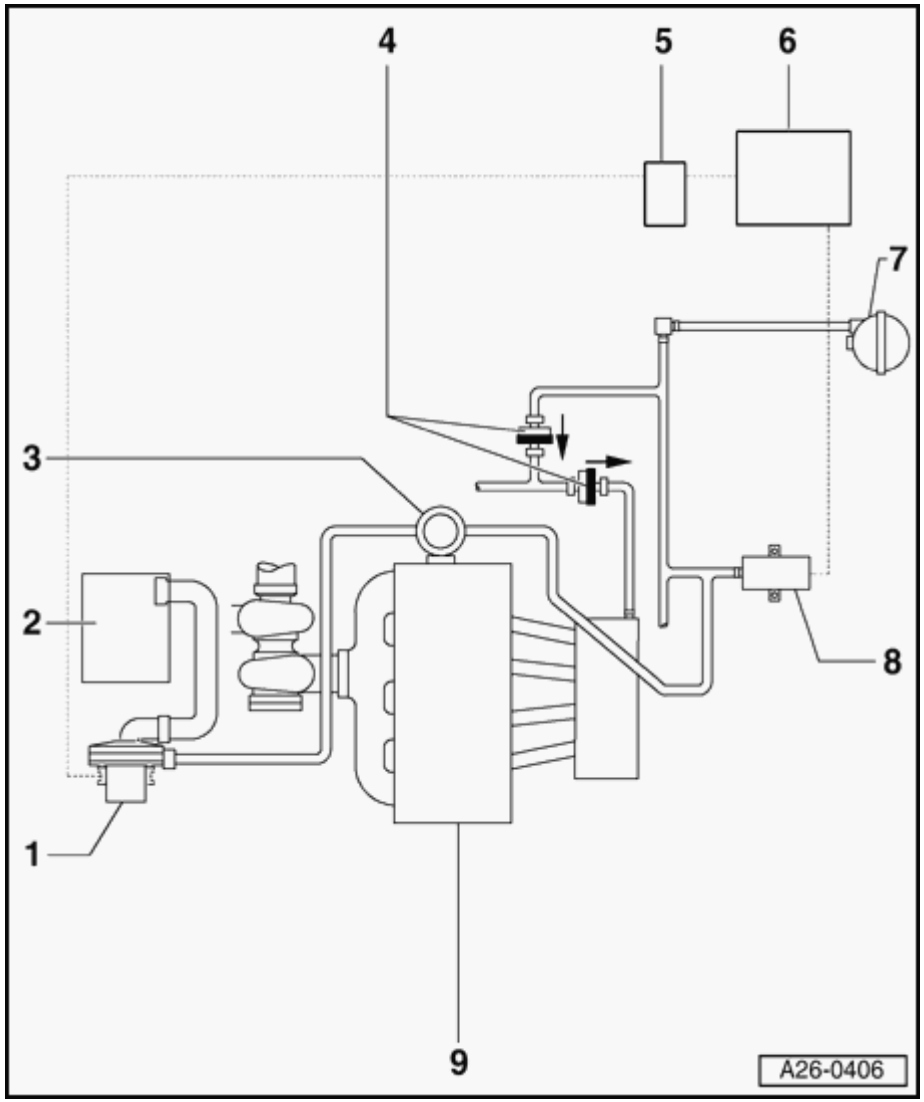
Secondary air system, function/components

The secondary air system permits faster warm-up and thus makes the catalytic converter ready for operation sooner after cold starting.

Principle

Due to over-enrichment of the mixture in the cold start phase, there is an increased amount of unburned hydrocarbons in the exhaust gas. The injection of secondary air improves the oxidation in the catalytic converter and thus reduces emissions. The heat produced by secondary oxidation reduces start-up time for the catalytic converter therefore improving the emission quality in the cold-running phase.

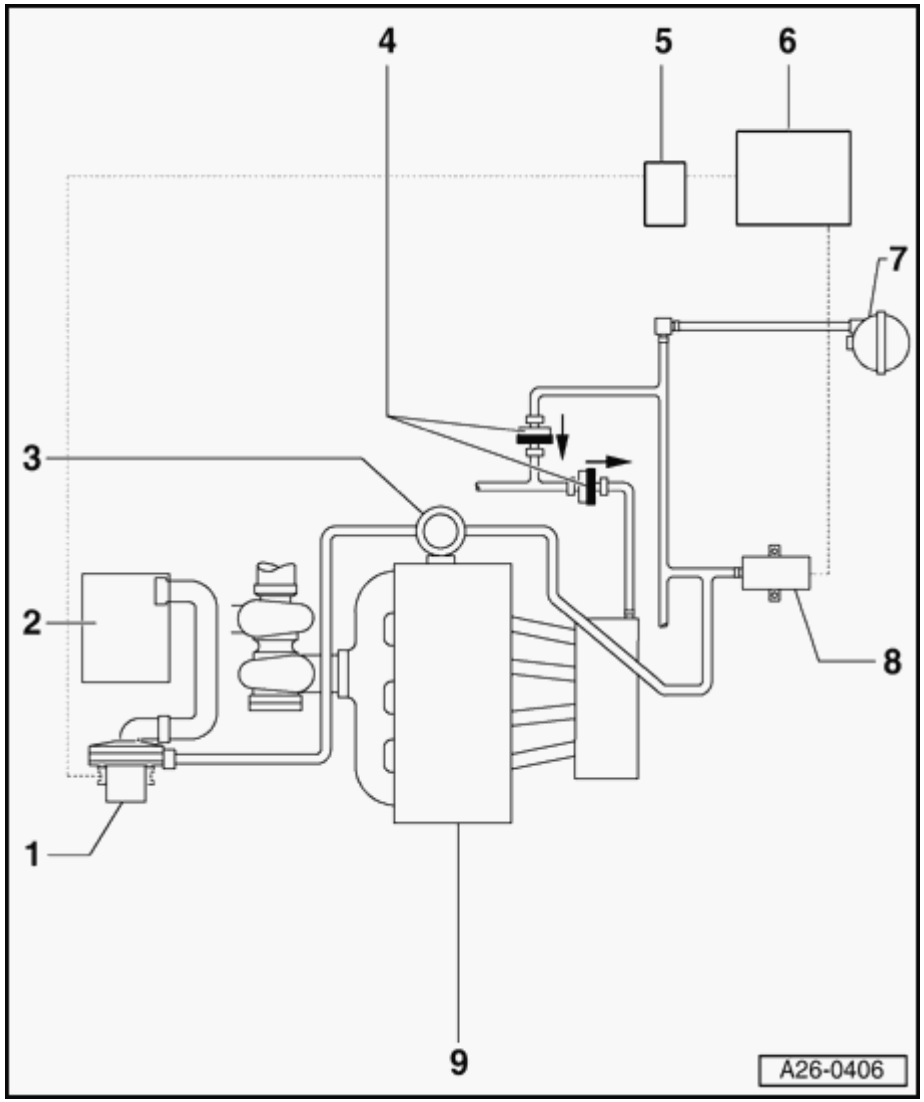
26-42



Function

- During the cold running phase, the engine control module -6- actuates the secondary air injection pump -1- via the secondary air injection pump relay -5-. Air reaches the combination valve for the secondary air inlet -3-.
- Parallel to this the secondary air inlet valve -8- is actuated, which allows the vacuum to reach the combination valve for secondary air inlet -3-. The combination valve for secondary air inlet thus allows the secondary air to enter the exhaust ducts of the cylinder head -9-.

26-43



1 - Secondary Air Injection (AIR) Pump motor -V101-

- Location ⇒Fig. ⇒ 2 , ⇒ Page 26-45

2 - Air cleaner

3 - Combination valve for secondary air inlet

- Location ⇒Fig. ⇒ 4 , ⇒ Page 26-46

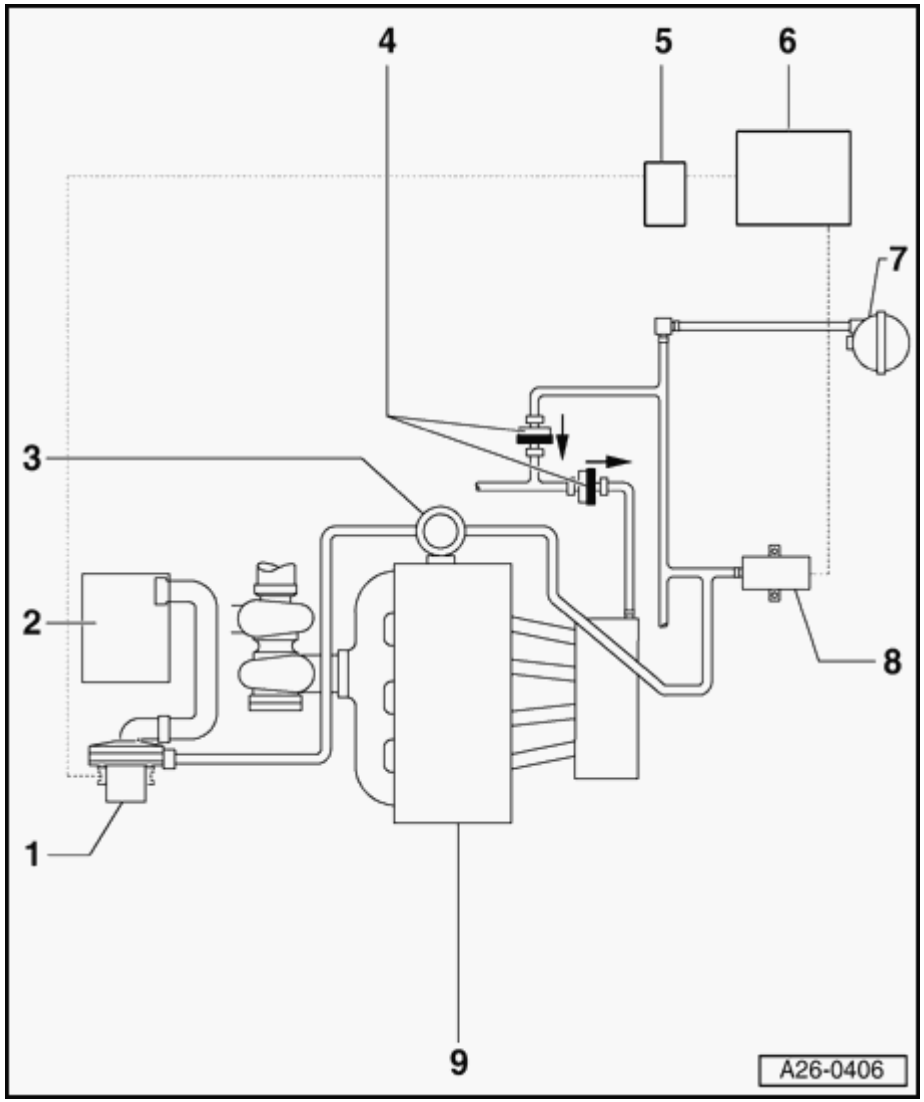
4 - Non-return valve

- Position (light side/ dark side or direction of arrow) as shown in illustration, arrow faces in direction of flow

5 - Secondary Air Injection (AIR) Pump relay -J299-

- Location ⇒Fig. ⇒ 3 , ⇒ Page 26-46

26-44



6 - Engine Control Module -J220-

7 - Vacuum reservoir

- Location: In front left wheel housing beneath wheel housing liner

8 - Secondary Air Injection (AIR) Solenoid valve -N112-

- Location ⇒Fig. ⇒ 1 , ⇒ Page 26-45

9 - Cylinder head

26-45

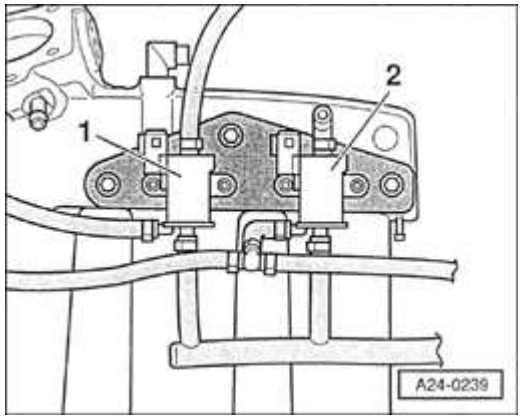


Fig. 1 Installation position Secondary Air Injection (AIR) valve - N112-

- Location: below intake pipe

1 - Recirculating valve for turbocharger -N249- (green connection)

2 - Secondary air injection valve -N112- (brown connection)

Note:

The illustration shows bottom view of intake pipe.

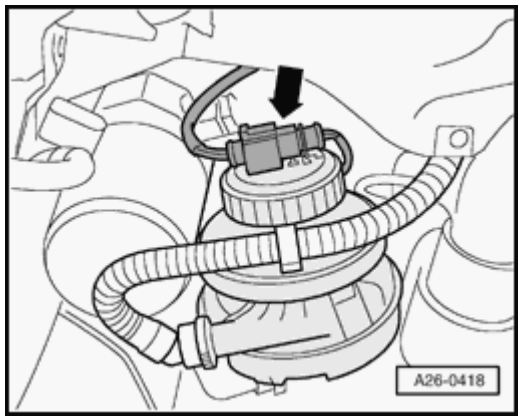


Fig. 2 Installation position for Secondary Air Injection (AIR) Pump motor -V101-

- Front right in engine compartment beneath air filter housing

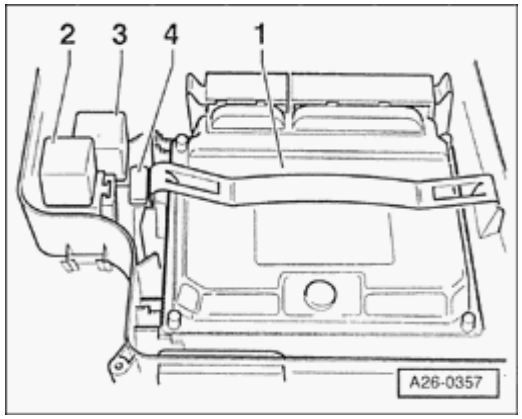


Fig. 3 Installation position Secondary Air Injection (AIR) Pump relay -J299-

- In E-box in plenum chamber

1 - Engine control module

2 - Secondary air pump relay -J299-

3 - Power supply relay for Motronic -J271-

4 - Fuse S130 for secondary air pump

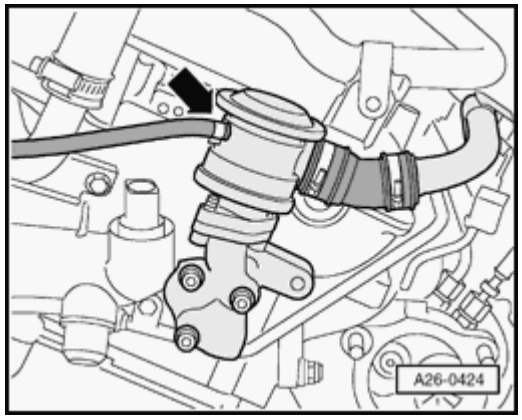
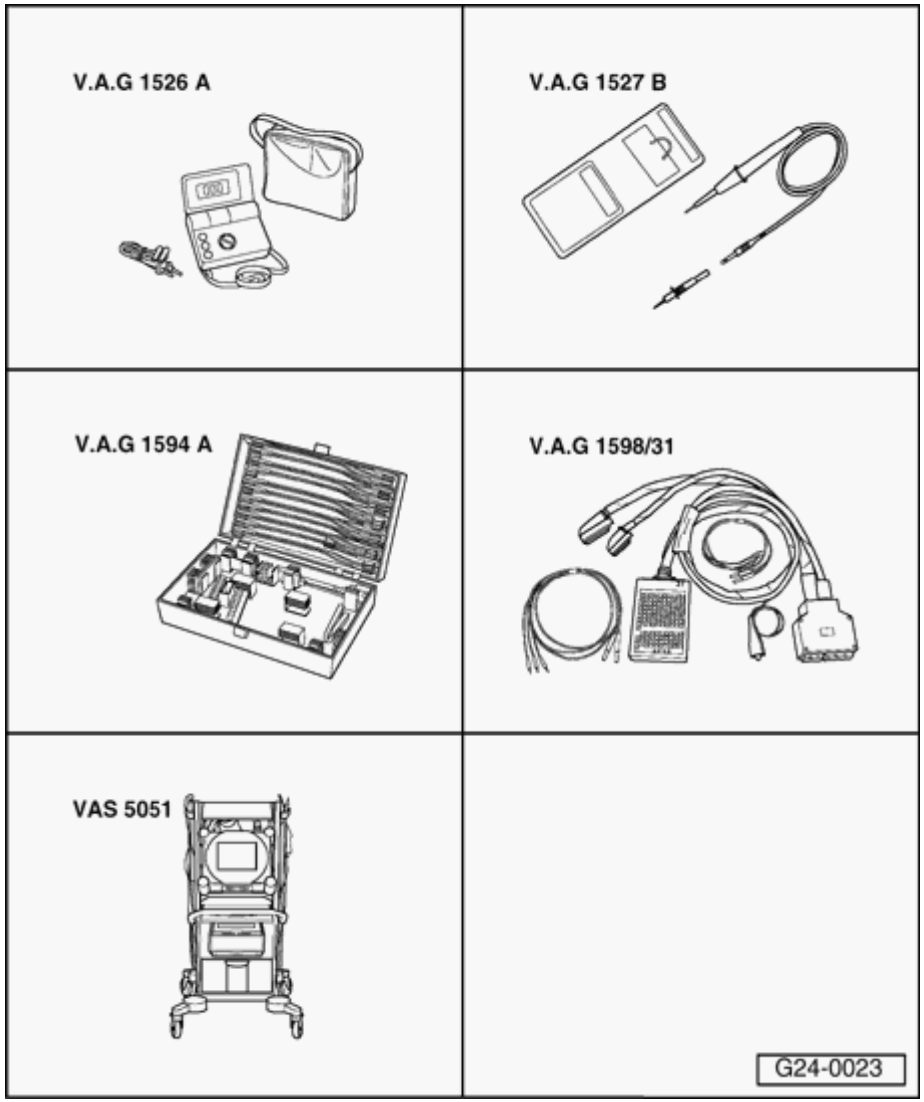


Fig. 4 Combination valve for secondary air injection

- Right rear on cylinder head

26-47



Secondary Air Injection (AIR) Solenoid valve -N112-, checking

Special tools and equipment

- VAG 1526 A
- VAG 1527 B
- VAG 1594 A
- VAG 1598/31
- VAS 5051 with VAS 5051/1

- or

- VAG 1551 with VAG 1551/3 A

26-48

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551 Scan Tool connected.

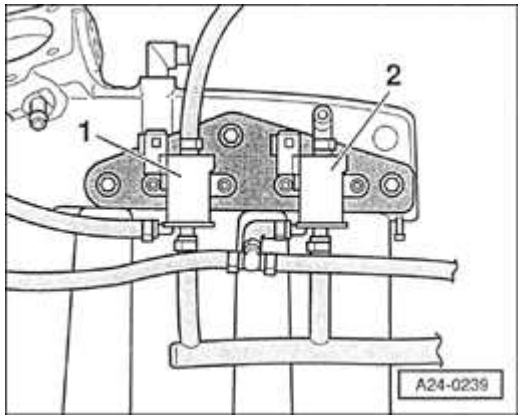
Test sequence

Note:

The secondary air injection solenoid valve - N112- and the wiring connections are monitored by the engine control module.

- Read out Diagnotic Trouble Code (DTC) memory of engine control module.

If a DTC relating to the secondary air injection solenoid valve -N112- is displayed:



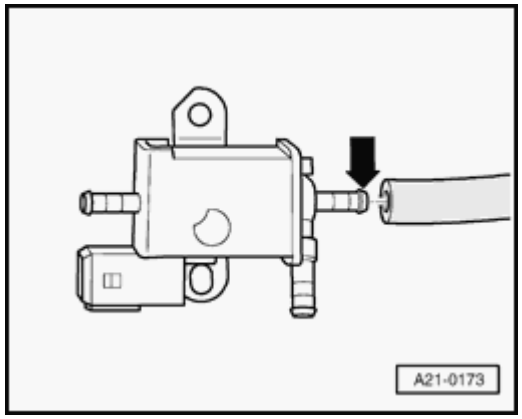
- Remove hoses from secondary air injection solenoid valve -N112- (-2-) but leave electrical connector plugged in.

♦ Location: below intake line

Note:

The illustration shows bottom view of intake line.

26-49



Output Diagnostic Test Mode →

Secondary air injection solenoid valve -N112-

- Connect auxiliary hose to valve connector marked with an arrow.
- Initiate output Diagnostic Test Mode (DTM) and activate secondary air injection solenoid valve -N112-.

Display:

- The valve should click ...
- ... and should open and close (check by blowing into the auxiliary hose).

If the injector does not click:

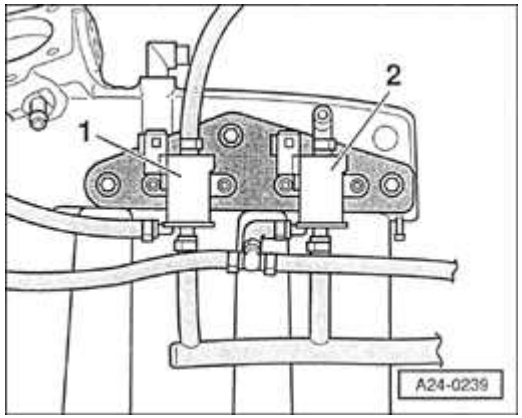
- Check internal resistance of valve.

If valve does not open or close properly:

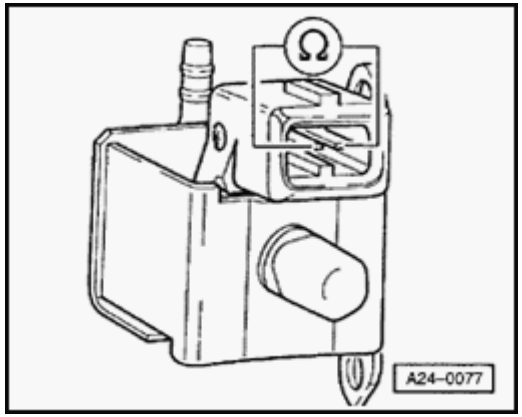
- Replace secondary air injection solenoid valve -N112-.

26-50

Checking internal resistance



- Disconnector connector of secondary air injection solenoid valve -N112- (-Item 2-).



- Connect multimeter to injector to measure resistance.
  - Specified value: 27 to 30 Ω

If specified value is not attained:

- Replace secondary air injection solenoid valve -N112-.

If specified value is attained:

- Check power supply.

26-51

Checking power supply

Note:

The power supply for the secondary air injection solenoid valve -N112- is via the fuel pump relay.

Test requirements:

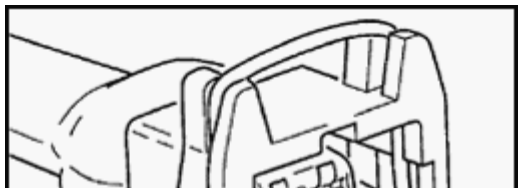
- Fuse for secondary air injection solenoid valve OK.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Fuel pump relay OK.

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*

- Disconnect connector from valve.



- Connect voltage tester VAG 1527 B as follows:

Connector	Measure to

contact	
1	Engine Ground

- Operate starter briefly.

- LED must light up.

26-52

If the LED does not light up:

- Check wiring from contact 1 on the connector via the fuse to the fuel pump relay for an open circuit:

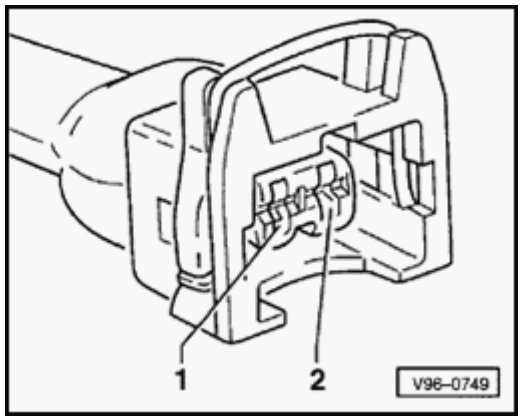
⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Repair open circuit, if necessary

If the LED lights up:

- Check actuation.

Checking actuation



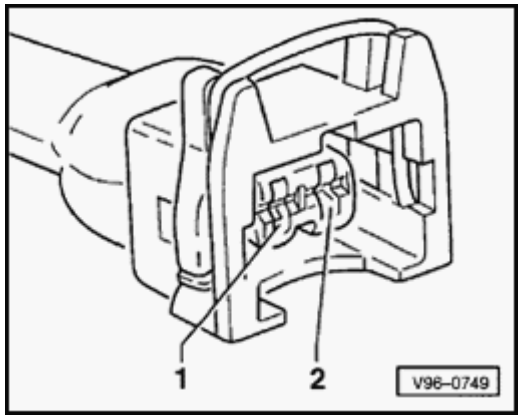
- Connect voltage tester VAG 1527 B to contacts 1 (positive) and 2 of connector.
- Initiate output Diagnostic Test Mode (DTM) and activate secondary air injection solenoid valve -N112-.
  - ♦ LED must flash.

26-53

If the LED lamp does not flash or if it lights up continuously:

- Connect VAG 1598/31 test box to wiring harness leading to engine control module; engine control module should not be connected:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



- Check for open circuit and short to positive or Ground in following wiring connection:

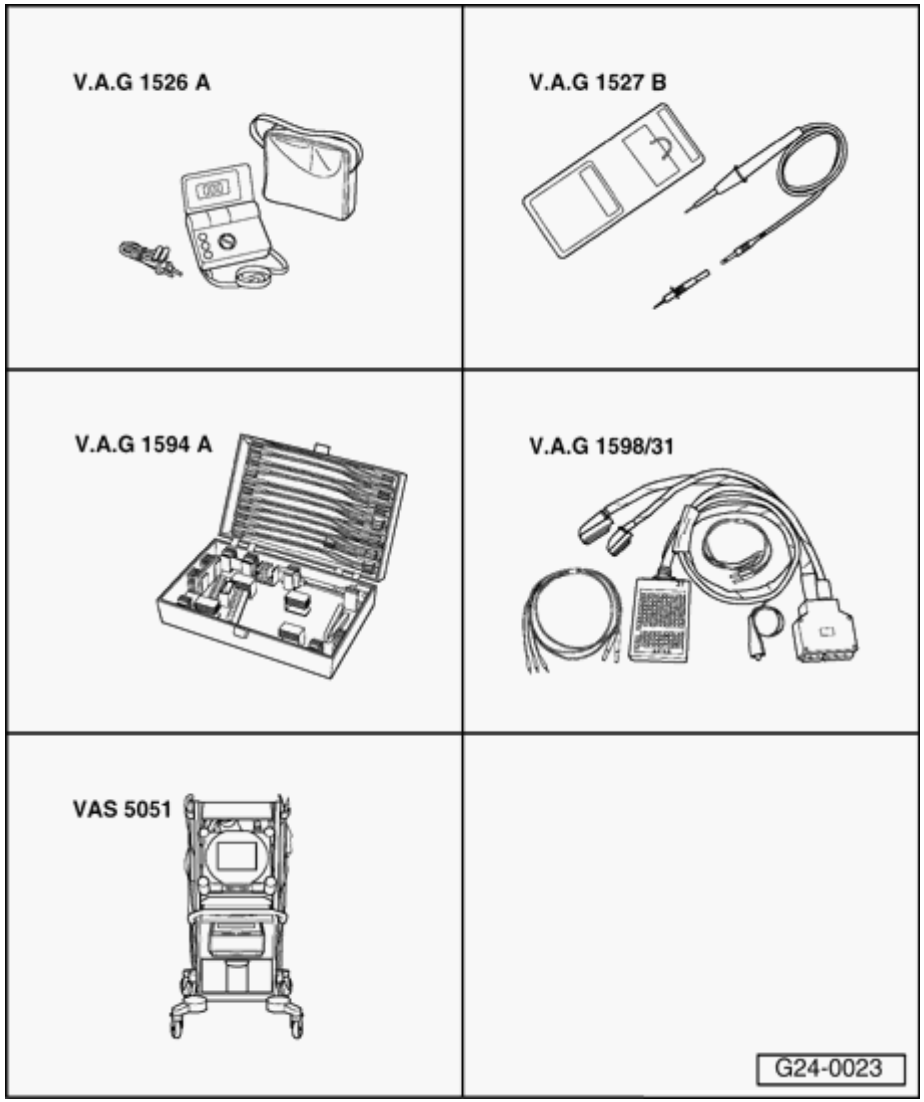
Connector contact	Test box VAG 1598/31
2	9

- Repair any open/short circuit as necessary.

If the wiring is OK:

- Replace engine control module.

26-54



Secondary Air Injection (AIR) Pump relay -J299- / Secondary Air Injection (AIR) Pump motor -V101-, checking

Special tools and equipment

- VAG 1526 A
- VAG 1527 B
- VAG 1594 A
- VAG 1598/31
- VAS 5051 with VAS 5051/1

- or

- VAG 1551 with VAG 1551/3 A

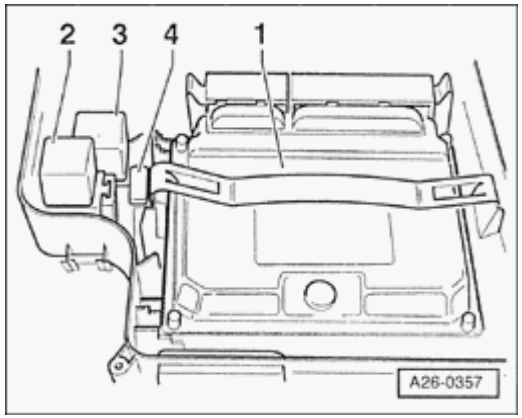
26-55

Test requirements:

- Vehicle diagnostic, testing and information system VAS 5051 or VAG 1551 Scan Tool.

Test sequence

- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection Pump relay -J299-.



- The secondary air injection pump relay-2- (in electronics box of plenum chamber, left) must respond and secondary air injection pump motor -V101- must run intermittently.

A - If relay does not respond:

- Check voltage supply of secondary air pump relay ⇒ Page 26-56 .
- Check actuation of secondary air injection pump relay ⇒ Page 26-58 .

B - If relay responds but secondary air injection pump motor does not run:

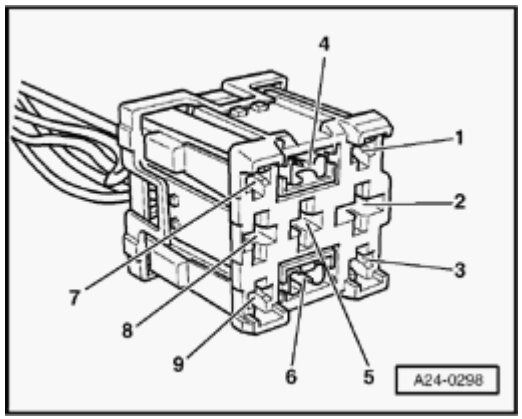
- Check voltage supply of secondary air injection pump motor ⇒ Page 26-60 .

26-56

Check voltage supply of secondary air injection pump relay

- Switch ignition off.

- Remove secondary air injection pump relay.



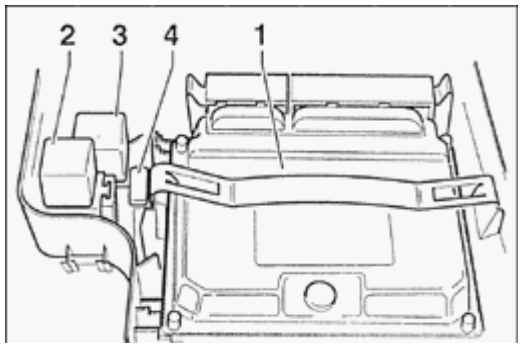
- Connect multimeter as follows to measure voltage.

3-position relay carrier in E-box in plenum chamber, position 2 Contact	Measure to
8	Engine Ground

- Specified value: approx. battery voltage

If specified value is not attained:

- Carry out following tests:

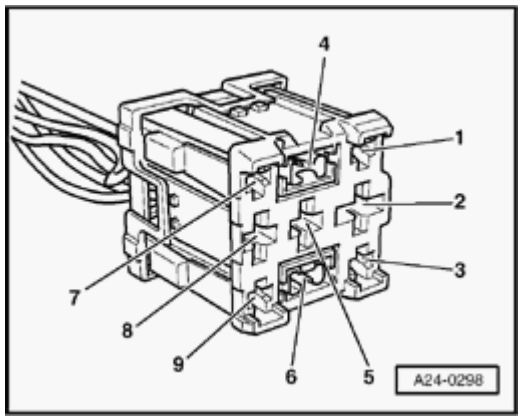


- Check fuse S130 (40 A) in electronics box of plenum chamber, (Pos. 4).

26-57

- Check for open circuit in wiring from battery + (terminal 30) to fuse S130 for secondary air injection pump relay (in 3-position in E-box of plenum chamber, position 2).

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*



- Connect multimeter as follows to measure voltage.

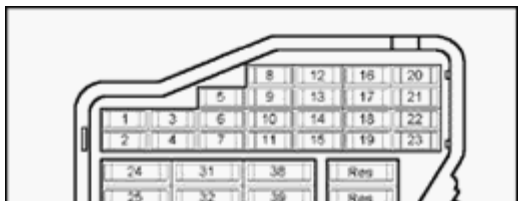
3-position relay carrier in E-box in plenum chamber, position 2 **contact**	**Measure to**
4	Engine Groung

- Operate starter briefly.

• Specified value: approx. battery voltage

If specified value is not attained:

- Carry out following tests:



- Check fuse S234 (in fuse box, position 34).

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

26-58

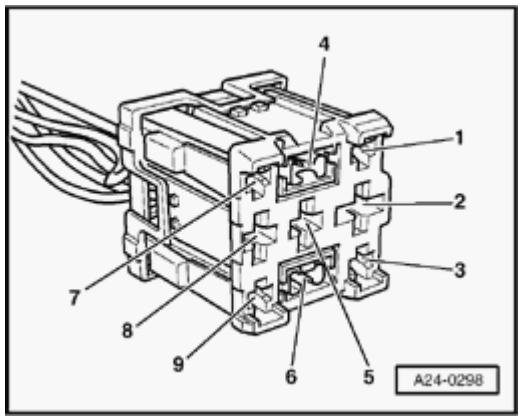
- Check for open circuit in wiring from secondary air injection pump relay (in 3-position relay carrier in E-box of plenum chamber) via fuse S234 (in fuse box, position 34) to fuel pump relay.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

Check actuation of secondary air pump relay

- Switch ignition off.

- Remove secondary air injection pump relay.



- Connect voltage tester VAG 1527 B as follows:

3-position relay carrier in E-box in plenum chamber, position 2 **contact**	**Measure to**
6	Engine Ground

- Initiate output Diagnostic Test Mode (DTM) and activate secondary air injection pump relay.
  - ♦ LED must flash.

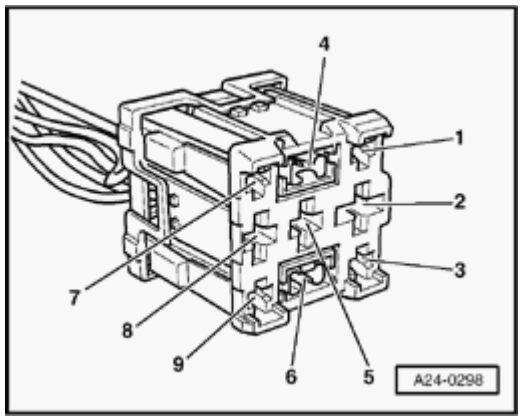
26-59

If LED does not flash:

- Switch ignition off.

- Connect VAG 1598/31 test box to wiring harness leading to engine control module; engine control module should not be connected:

⇒ *Repair Manual, 1.8 Liter 4-Cyl. 5V Turbo Fuel Injection & Ignition, Engine Code(s): AWM, Repair Group 24*



- Check for open circuit and short to positive or Ground in following wiring connection:

3-position relay carrier in E-box in plenum chamber, position 2 **Contact**	**Test box VAG 1598/31**
6	66

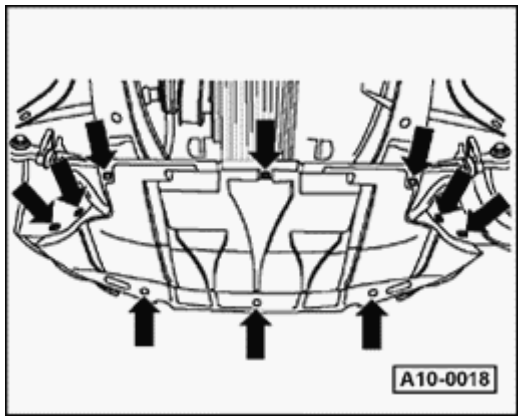
- Repair any open/short circuit as necessary.

If no malfunction is found:

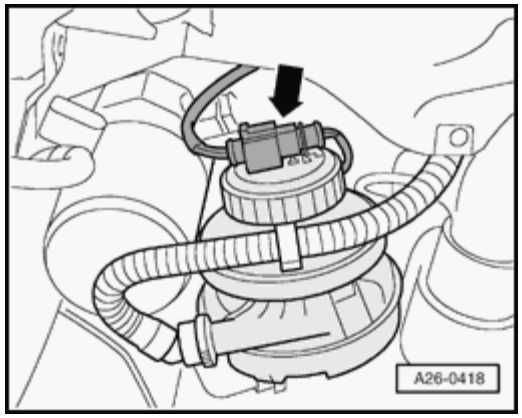
- Replace Secondary Air Injection Pump relay -J299-.

26-60

Check voltage supply for secondary air injection pump motor



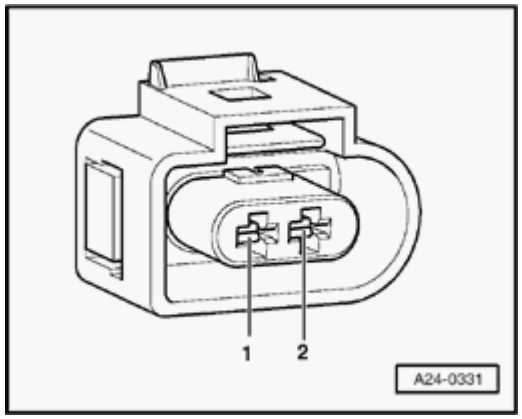
- Remove sound insulation -arrows-.



- Disconnect connector from Secondary Air Injection (AIR) Pump motor - V101- (-arrow-).

◆ Location: Right front in engine compartment below air filter housing

26-61



- Connect voltage tester VAG 1527 B between contacts 1 and 2.
- Initiate output Diagnostic Test Mode (DTM) and activate Secondary Air Injection (AIR) Pump relay -J299-.
  - ♦ LED must flash.

If LED does not flash:

- Carry out following tests:
  - Check wiring connection from contact 1 of connector to secondary air injection pump relay (in 3-pin relay carrier in electronic box (plenum chamber), for open circuit.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

  - Check wiring connection of contact 2 of connector to Ground for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

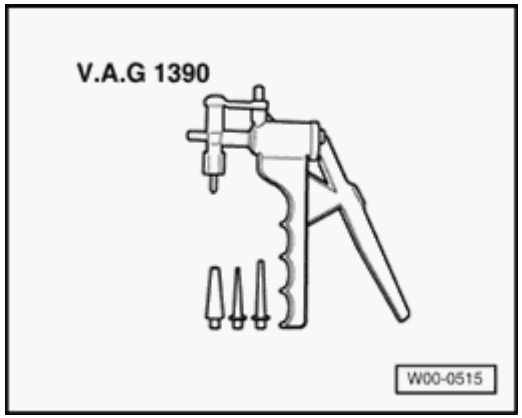
If no malfunction is found:

- Replace Secondary Air Injection (AIR) Pump motor -V101-.

26-62

Combination valve for secondary air inlet, checking function and for leaks

Special tools and equipment

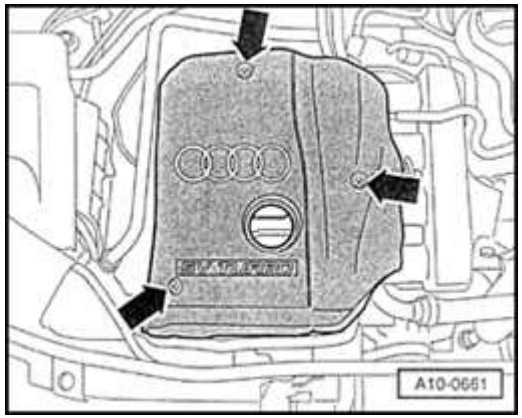


- Vacuum hand pump VAG 1390

Test requirements:

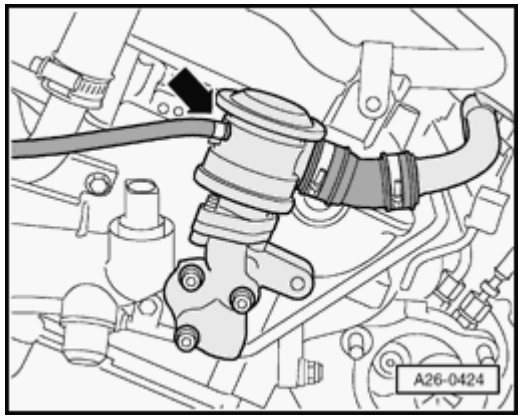
- Vacuum lines and hose connections do not leak.
- Vacuum lines not blocked.

Test sequence

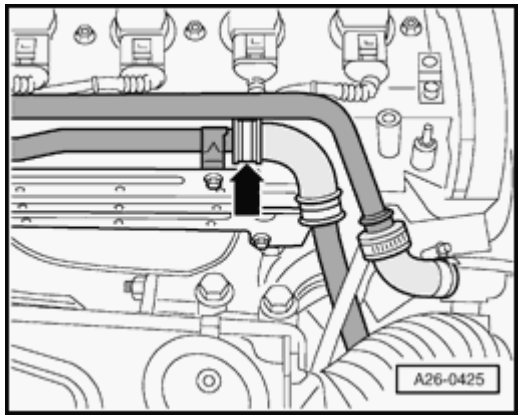


- Remove engine cover -arrows-.

26-63



- Remove vacuum hose -arrow- from combination valve.
- Connect hand vacuum pump VAG 1390 to vacuum unit of combination valve.



- Disconnect hose -arrow- to combination valve for secondary air inlet.
- Blow into line with slight pressure (do not use compressed air).
  - Combi valve must be closed; blowing through must NOT be possible.
- Actuate hand vacuum pump.
  - Combi valve must open; blowing through must be possible

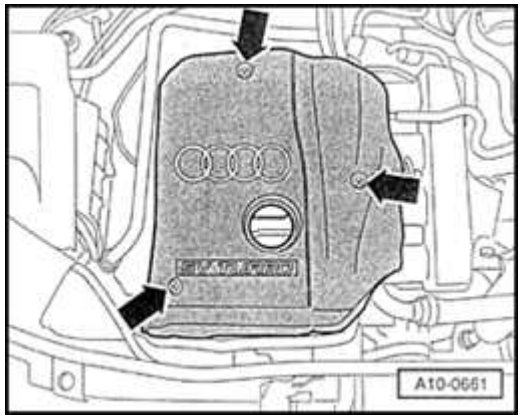
If the combi valve does not open:

- Replace combination valve ⇒ Page 26-64 .

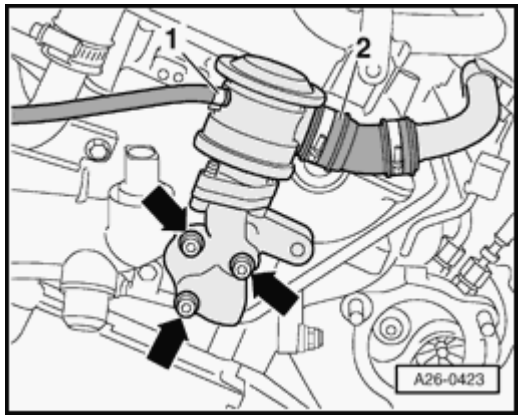
26-64

Combination valve for secondary air inlet, removing and installing

Removing



- Remove engine cover -arrows-.



- Disconnect hoses -1- and -2- from combination valve.
- Unbolt combination valve -arrows-.

26-65

Installing

Installation is carried out in the reverse order of removal; note the following:

Note:

Replace gaskets and seals.

Tightening torque

Component	Nm
Combination valve for secondary air inlet at cylinder head	10