

Select a topic

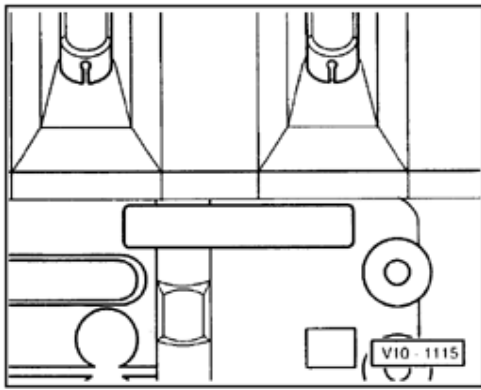
- 00 - General, Technical data
- 10 - Engine - Assembly
- 13 - Engine - Crankshaft, Cylinder block
- 15 - Engine - Cylinder head, Valvetrain
- 17 - Engine - Lubrication
- 19 - Engine - Cooling system
- 20 - Fuel Supply
- 26 - Exhaust system, Emission controls

00-1



Technical data, general

Engine number, location



- The engine number ("Code letters" and "Serial number") is located between cylinders 1 and 3 on the cylinder block.
- There is also a sticker on the toothed belt guard showing the "Engine code" and "Serial number".
- The engine code is also included on the vehicle data plate.

00-2



Engine, technical data table

Engine Code letters	AAF	ACU
Manufactured	12.90 ➤ 02.94	03.94 ➤ 07.96
Cylinder arrangement	In-line	In-line
Displacement ltr.	2.5	2.5
Output kW at rpm	81/4500	81/4500
Torque Nm at rpm	190/2200	190 ¹⁾ /2200
Bore diameter mm	81.0	81.0
Stroke mm	95.5	95.5
Compression ratio :1	8.5:1	10.0:1
Octane (RON) mimum	91 unleaded	91 unleaded ²⁾
Fuel Injection system	Digifant	Digifant
Ignition system	Digifant	Digifant
Firing order	1-2-4-5-3	1-2-4-5-3

¹⁾ 195 Nm when 95 RON premium unleaded fuel is used.

²⁾ Optional with RON 95 unleaded.

00-3



Engine Code letters	AAF	ACU
Knock sensor control	-	x
On Board Diagnostic	x	x

Oxygen sensor control	x	x
Three Way Catalyst	x	x
Turbocharging	-	-
Exhaust Gas Recirculation	-	x
Secondary Air Injection system	-	x



Engine, removing and installing

Special tools, testers and auxiliary items

- ◆ VAG 1921 Pliers for spring type clips
- ◆ 3227 Engine stand
- ◆ VAG 1383 A Engine/transmission jack
- ◆ 2024 A Lifting tackle
- ◆ VW 540 Engine bracket
- ◆ 3250 Support device
- ◆ G 000 100 grease
- ◆ VAG 1331 5 - 50 Nm (3.5 to 37 ft lb) Torque wrench
- ◆ VAG 1332 40 - 200 Nm (30 to 148 ft lb) Torque wrench
- ◆ Cable tie
- ◆ VAG 1306 Drip tray



Engine removal notes

- ◆ *Remove the engine downward together with the transmission.*

- ◆ Obtain the radio security code from the customer, before disconnecting the battery Ground strap.
- ◆ Disconnect battery Ground strap with ignition switched OFF.
- ◆ All cable ties which are opened or cut to remove the engine must be replaced in the same position when re-installing the engine.

WARNING!

Fire hazard! Do NOT have anything in the area that can ignite fuel.

- Insert 3250 left and right support device to support the upper control arm

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

- Removing sound dampening tray:

⇒ [*Repair Manual, Body Exterior, Repair Group 50; General body repairs*](#)

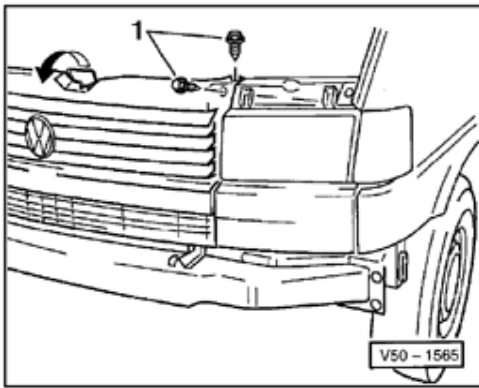
- Drain engine coolant ⇒ [Page 19-16](#)

Vehicles 09.94 ➤

- Radiator grille, removing:

⇒ [*Repair Manual, Body Exterior, Repair Group 66; General body repairs*](#)



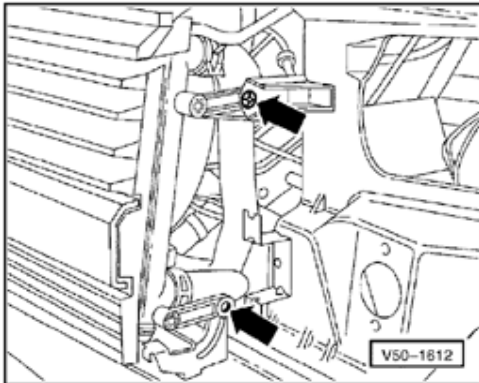


- Unscrew left and right mounting screws -1-.
- Tilt lock carrier and radiator out and forward - arrow-.
- Pull radiator coolant hoses off engine using VAG 1921 hose clip pliers.
- Pull connectors off thermoswitch and radiator fan.

Vehicles ➤12.95



- Drive out left and right spreader clip pins - arrows- and unclip spreader clips from radiator bracket.



All vehicles

- Lift out radiator with fan, air guide and lock carrier.
- Unscrew speedometer drive at transmission.
- Unhook throttle cable from throttle body and support bracket.
- Remove mechanical clutch control cable (or hydraulic clutch slave cylinder)

⇒ *Repair Manual, 5-Speed Manual Transmission, Repair Group 30*

10-4



Vehicles with manual transmission

- Disconnect selector mechanism from transmission.

⇒ *Repair Manual, 5-Speed Manual Transmission, Repair Group 34*

Vehicles with Automatic transmission

- Remove selector lever cable from transmission:

⇒ *Repair Manual, 4 Spd. Automatic Transmission, Repair Group 37,*

Vehicles with A/C

- Observe additional information and work instructions ⇒ [Page 10-11](#)

All vehicles

- Disconnect power steering pump lines from engine, drain fluid

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

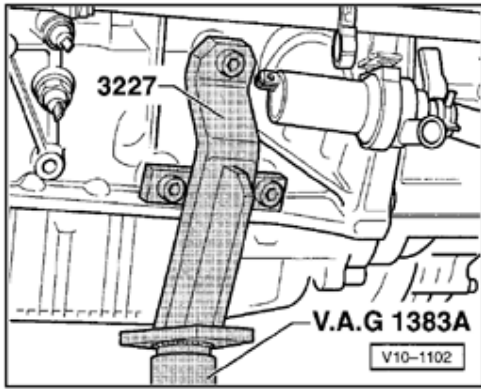
- Remove left-hand drive shaft and disconnect right-hand drive shaft at transmission

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

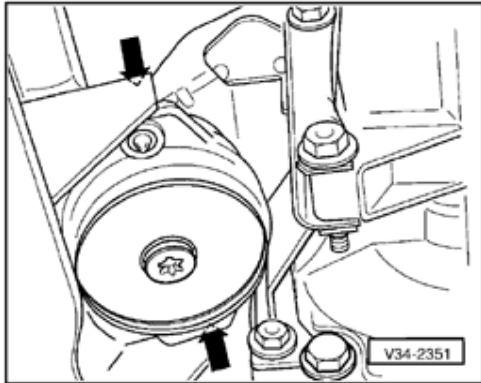
- Remove front exhaust pipe with Oxygen sensor ⇒ [Page 26-1](#)
- Disconnect pressure and return hoses from power steering

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





- Bolt engine stand 3227 with 20 Nm (15 ft lb) to cylinder block
- Carefully lift engine and transmission using VAG 1383 A engine and transmission jack



- Unscrew 2 mounting bolts -arrows- from transmission mounting on sub-frame
- Remove engine and transmission mounting center bolts on right and left in engine compartment.
- Remove engine with transmission downward, guide power steering fluid return hose.

Note:

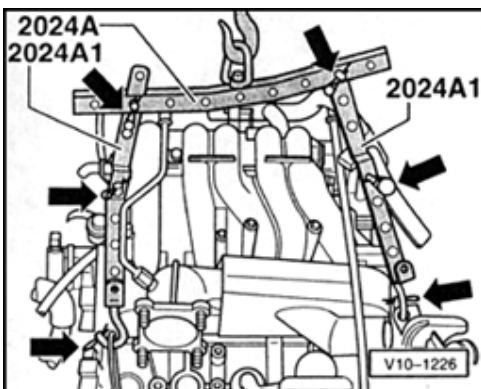
When lowering, carefully guide the engine and transmission assembly to prevent damage to the bodywork.

10-6



Engine/assembly stand, mounting

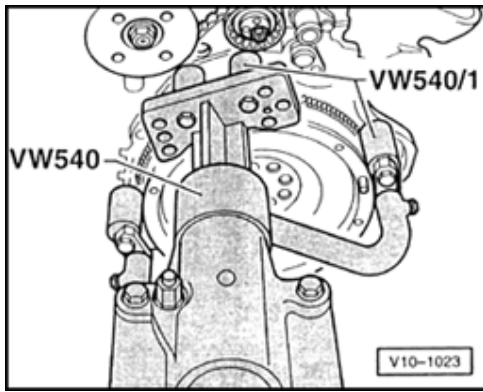
- Remove transmission.



- Attach lifting bar and two lifting bar extensions as shown and lift engine with workshop crane

WARNING!

Secure all hooks and locating pins with locking pins -arrows-.



- Attach engine support bracket VW 540 and secure to engine stand to carry out repairs.

10-7



Notes on installing

Installation is carried out in the reverse of the removal sequence, when installing, note the following:

Vehicles with manual transmission

- Check clutch release bearing for wear, replace if necessary.
- Lightly grease clutch release bearing, release bearing guide sleeve and splines on input shaft with G 000 100.

All vehicles

- Check if dowel sleeves for centering engine and transmission are in the cylinder block, install if necessary.
- Place intermediate plate on dowel sleeves and secure at several points on cylinder block with a small amount of grease.
- Align engine mountings stress-free by rocking.
- Adjust accelerator cable ⇒ [Page 20-23](#)
- Do not interchange fuel supply line (black) on junction piece and return line (blue) on fuel

distributor.

10-8



- Install front exhaust pipe with Oxygen sensor probe and align exhaust system free of tension ⇒ [Page 26-1](#)

- Electrical connections and routing:

⇒ *Repair Manual, Electrical Equipment, Repair Group 97*

- Fill with coolant ⇒ [Page 19-16](#)

Vehicles with manual transmission

- Check selector mechanism adjustment, adjust if necessary

⇒ *Repair Manual, 5 Spd. Manual Transmission, Repair Group 34*

Vehicles with automatic transmission

- Install selector cable on transmission, adjust if necessary:

⇒ [Repair Manual, 4 Spd. Automatic Transmission 098, Repair Group 37](#)

or

⇒ *Repair Manual, 4 Spd. Automatic Transmission 0P1, Repair Group 37*

10-9



All vehicles

- Top off hydraulic oil G 002 000 in reservoir.
- Start engine. Turn steering to full left and right locks. Check fluid level with engine running and wheels in straight-ahead position.
 - ◆ Fluid level: between Max. and Min. marking, if necessary top off hydraulic fluid.
- Check and if necessary adjust ignition timing:

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 28; Injection and ignition system*

- Idle speed checking

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 24; idling check or idling adjustment*

- Check headlight adjustment and adjust if necessary:

⇒ [Maintenance booklet](#)

10-10



Tightening torques

Connection		Tightening torque
Engine to transmission	M12	80 Nm
		59 ft lb

	M10	60 Nm 44 ft lb
	M8	20 Nm 15 ft lb
Console to transmission	M10 x 60	65 Nm 48 ft lb
	M10 x 28	45 Nm 33 ft lb
Engine to transmission	M10	65 Nm 48 ft lb
Drive shaft to flanged shaft		55 Nm 41 ft lb

10-11



Vehicles with A/C, additional information

WARNING!

Do NOT open the A/C refrigerant circuit.

Note:

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

To remove and install the engine without opening the refrigerant circuit:

- Remove A/C compressor and condenser and lay to one side so that the refrigerant lines/hoses are not stressed.

13 - Engine - Crankshaft, Cylinder block

Engine, disassembling and assembling

Part I

Part II > 07.95

Part II, 08.95 >

Part III

Part IV

Ribbed belt, removing and installing

Toothed belt, removing and installing

Generator V-belt tension, adjusting

Ribbed belt tensioner, removing and installing

Crankshaft and flywheel assemblies, disassembling and assembling

Crankshaft oil seal (pulley end), replacing

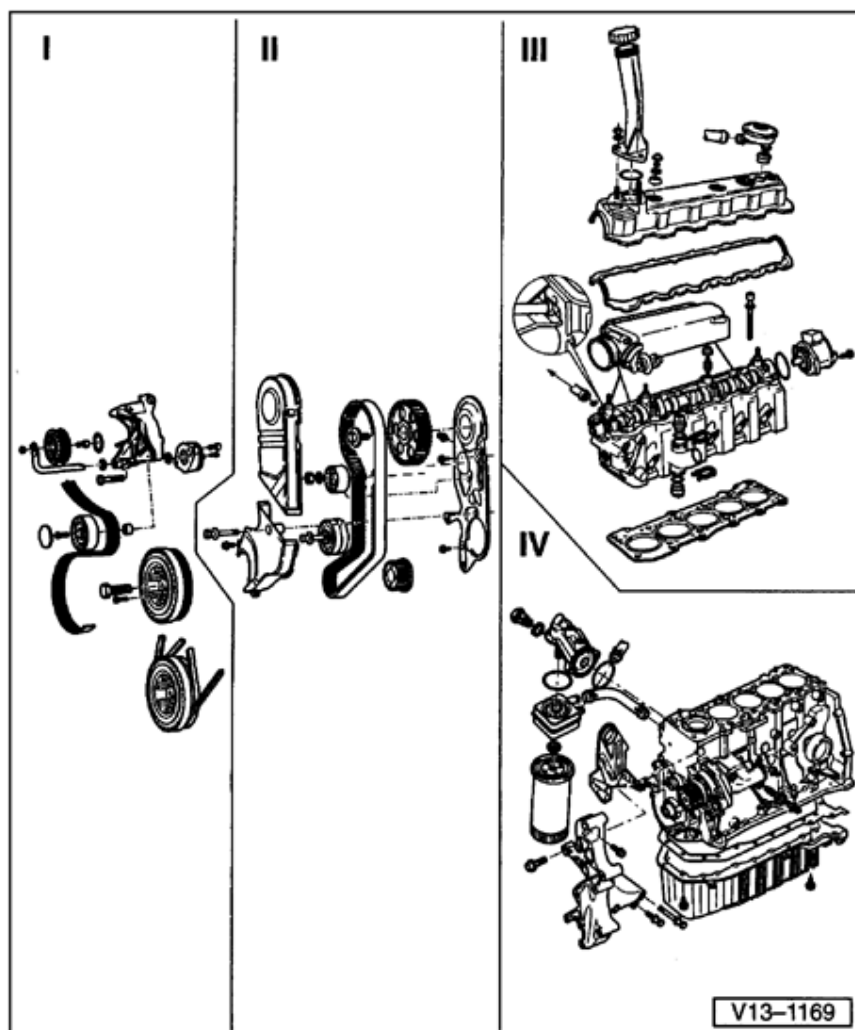
Crankshaft dimensions in millimeters

Drive plate, removing and installing

Pistons and connecting rods, disassembling and assembling

Piston and cylinder, dimensions

13-1



Engine, disassembling and assembling

Notes:

- ◆ Always replace seals and gaskets.
- ◆ If during repair work, metal shavings or large quantities of small metal particles are found in the engine oil - caused, for example, by partial seizure of the crankshaft and connecting rod bearings - then, beside thoroughly cleaning out the oil passages, replace the oil cooler.

I ⇒ [Page 13-2](#)

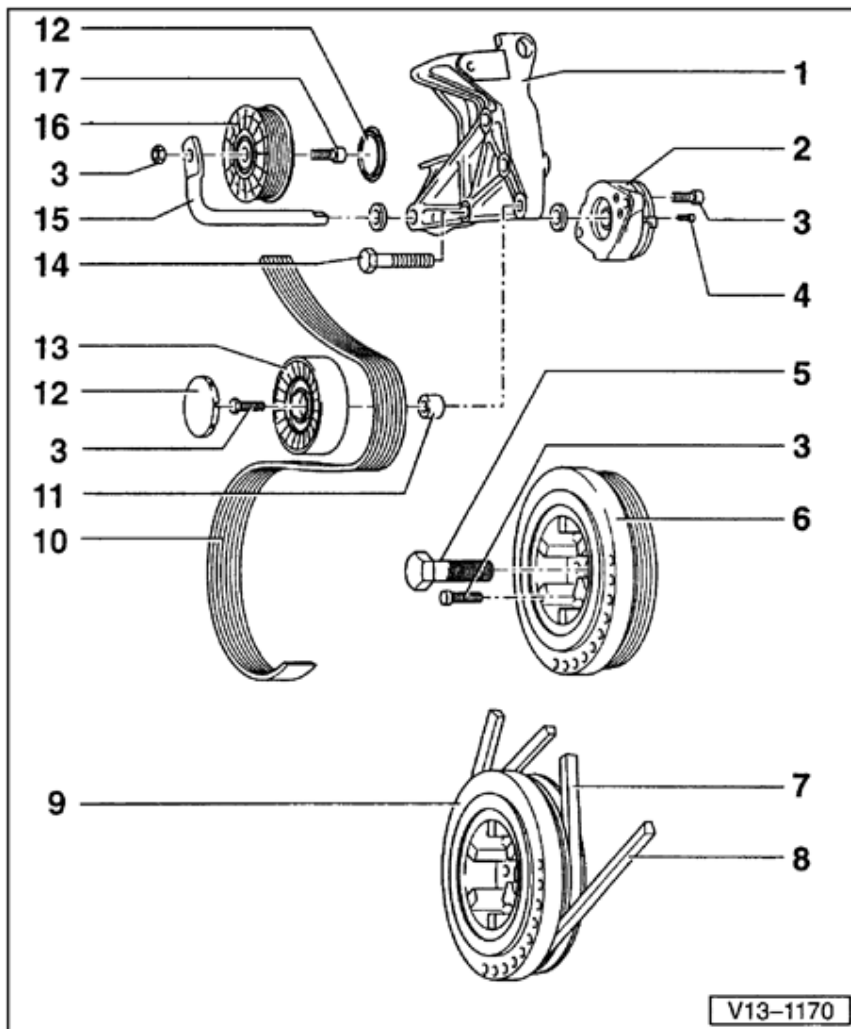
II ⇒ [Page 13-5](#)

III ⇒ [Page 13-9](#)

IV ⇒ [Page 13-12](#)

13-2





Part I

1 - Bracket

- ◆ Removing and installing ribbed belt tensioning device ⇒ [Page 13-26](#)

2 - Tensioning element for tensioning roller

3 - Mounting screw for vibration damper with ribbed belt

- ◆ 20 Nm (15 ft lb)
ribbed belt pulley
- ◆ 20 Nm (15 ft lb)
+ 1/4 turn (90 °)

4 - 10 Nm (7 ft lb)

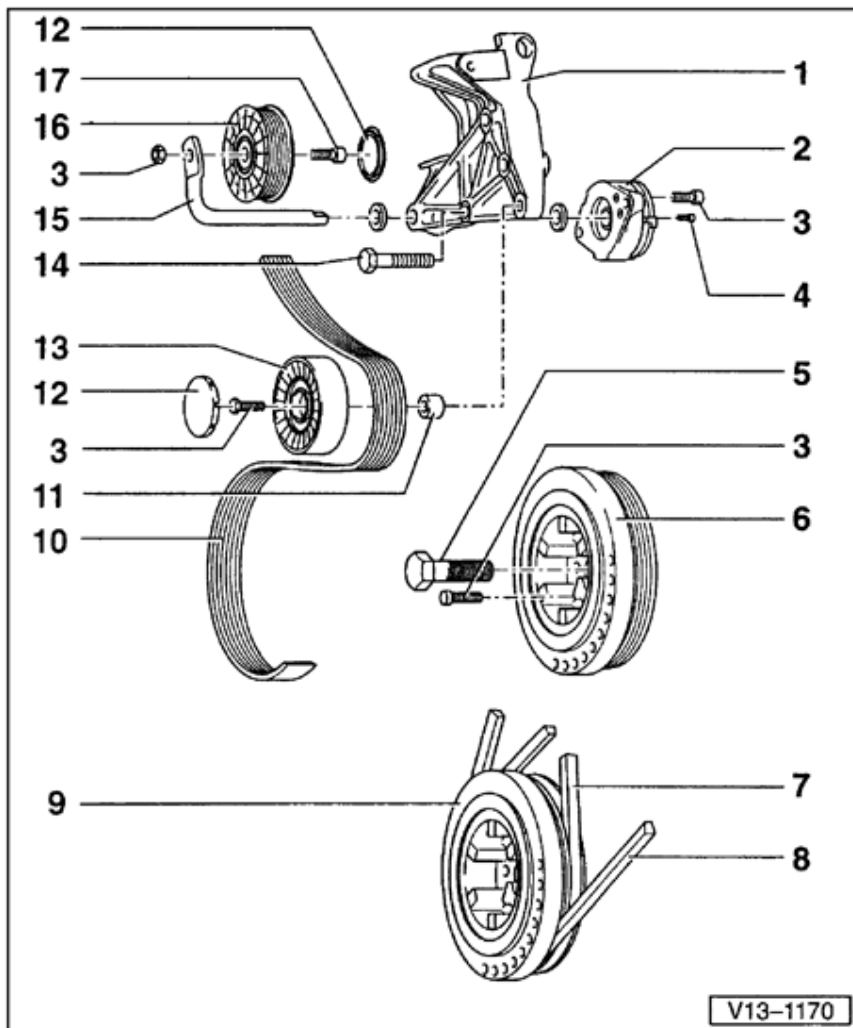
5 - Vibration damper mounting bolt

- ◆ Loosen and tighten using 3419 Counter-hold ⇒ [Page 13-17](#)
Screw length: 65 mm
- ◆ Coat threads and bolt head contact surface with sealing paste: AMV 188 001 02
- ◆ Tightening torque: 460 Nm (340 ft lb)
Screw length: 110 mm
- ◆ Torque: 160 Nm (118 ft lb) + 1/2

turn (180 °)
further

- ◆ 2 x 90 °
additional turns
can be
performed in
stages.

13-3



6 - Vibration damper with ribbed belt pulley

- ◆ 10.91 ➤
- ◆ Damper and
sprocket can
only be installed
in one position

7 - V-belt

- ◆ ➤ 09.91
- ◆ for power
steering pump
- ◆ Check tension
using thumb
Deflection: new
and used V-belts
approx. 5 mm

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

8 - V-belt

- ◆ ➤ 09.91
- ◆ For Generator
- ◆ Check tension
using thumb:
max. deflection:

New ribbed belt

approx. 2 mm

Used ribbed belt
approx. 5 mm

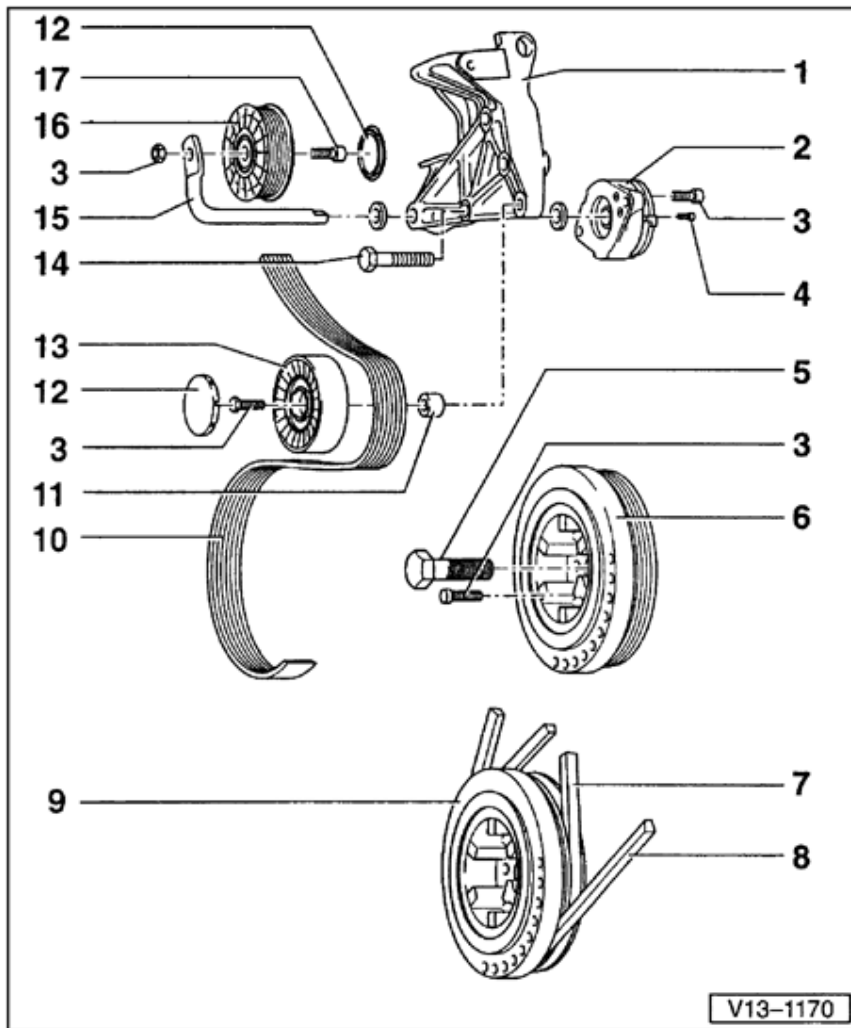
- ◆ Checking V-belt tension: vehicles with toothed rack tensioner ⇒ [Page 13-24](#)

9 - Vibration damper with V-belt pulley

- ◆ ➤09.91
- ◆ Damper and sprocket can only be installed in one position

13-4





10 - Ribbed belt

- ◆ 10.91 ➤
- ◆ Mark direction of rotation before removing
- ◆ Check for wear
- ◆ Remove and install with 3299 lever ⇒ [Page 13-14](#) , Figs. 1 and 2

11 - Spacer sleeve

12 - Cover cap

13 - Idler wheel

14 - 40 Nm (30 ft lb)

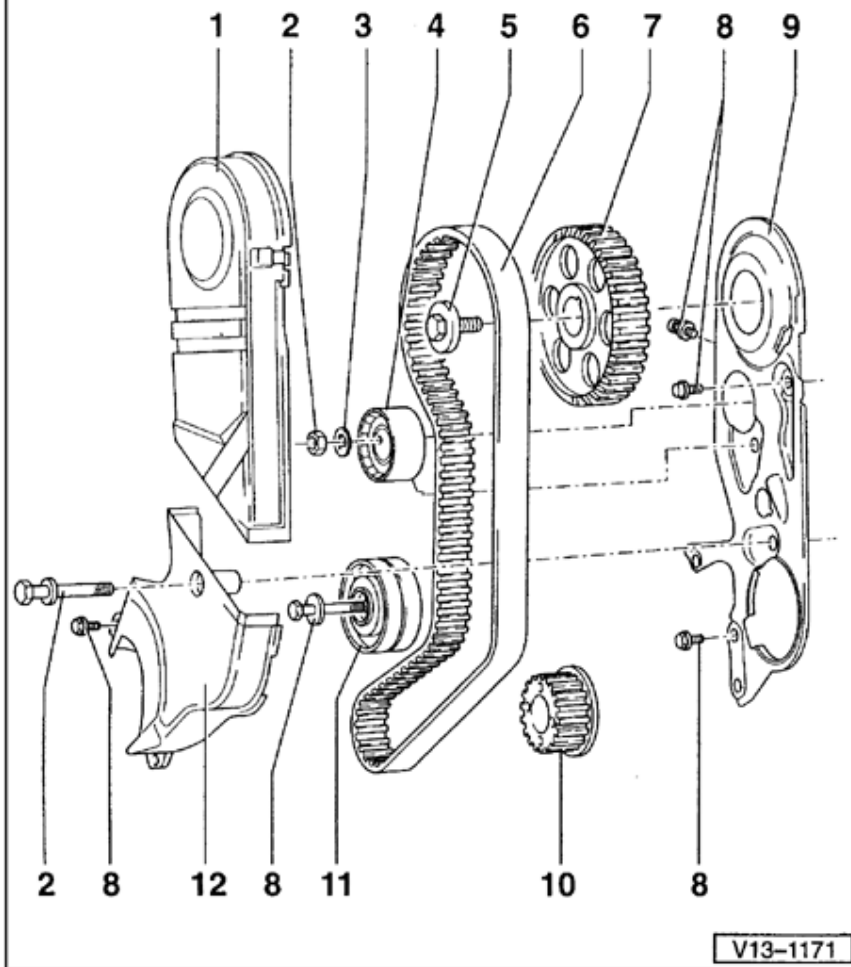
15 - Tensioning lever

16 - Tensioner

17 - Tensioning roller mounting bolt



Part II ➤ 07.95



1 - Front toothed belt guard upper section

2 - 20 Nm (15 ft lb)

- ◆ Tensioning roller mounting nut, 15 Nm (11 ft lb)

3 - Washer

- ◆ With locking tab

4 - Tensioning roller

- ◆ 10.91 ➤
- ◆ Removing, installing, tensioning toothed belt ⇒ [Page 13-17](#)

5 - Camshaft sprocket mounting bolt

- ◆ Observe steel type marking on bolt head:

8.8 = 85 Nm (63 ft lb)

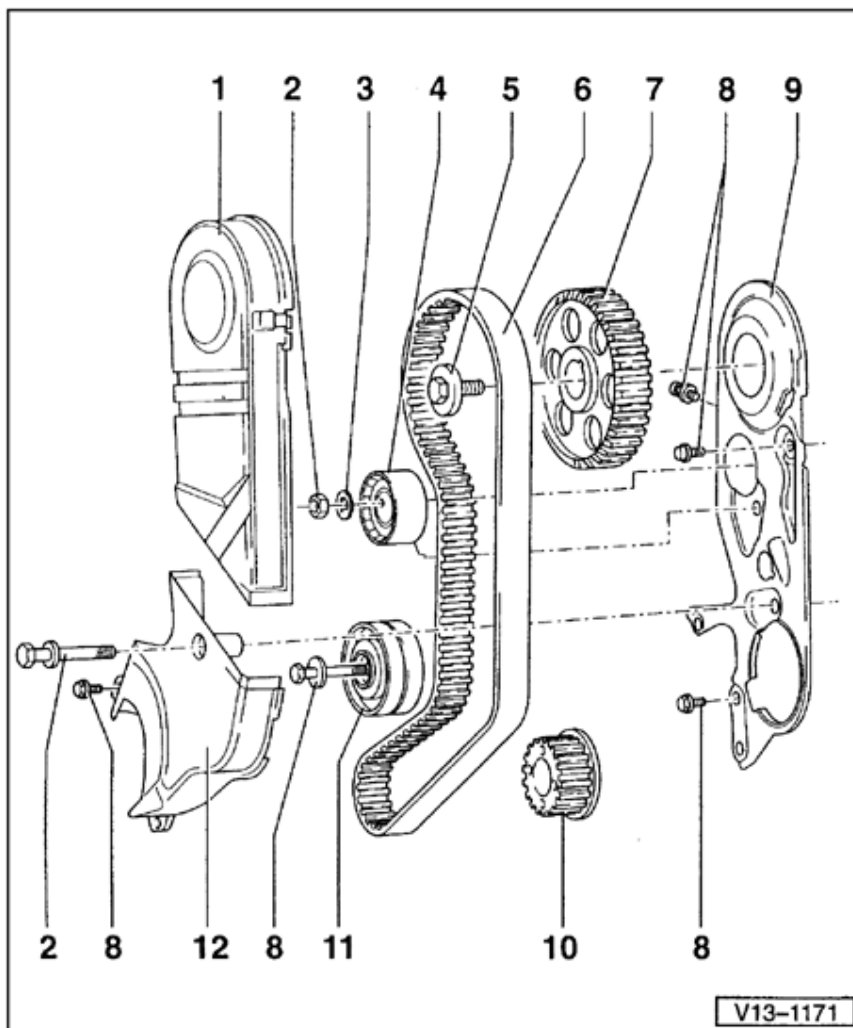
10.9 = 100 Nm (74 ft lb)

- ◆ Loosen and tighten using 3036 counter-hold

6 - Toothed belt

- ◆ Removing and installing ⇒ [Page 13-17](#)





7 - Camshaft sprocket

- ◆ Note position when installing toothed belt ⇒ [Page 13-17](#)

8 - 10 Nm (7 ft lb)

9 - Toothed belt guard - rear

- ◆ To remove: take off vibration damper if necessary

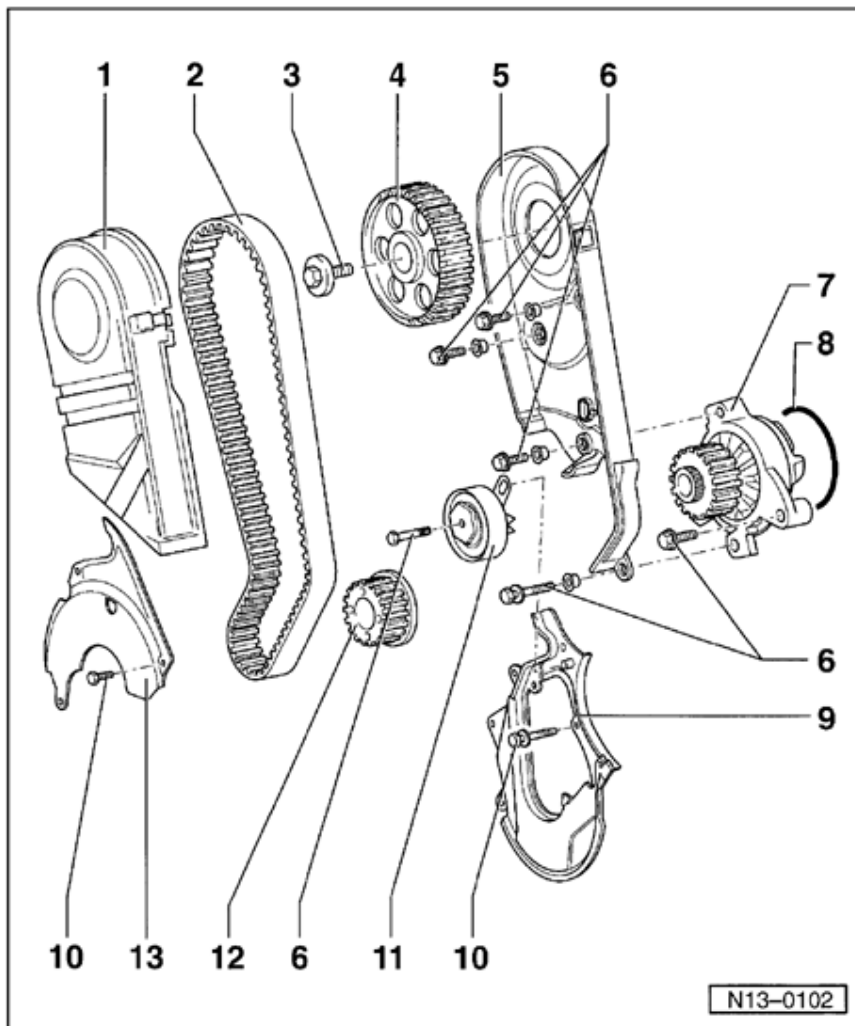
10 - Crankshaft sprocket

11 - Idler wheel

12 - Front toothed belt guard -lower section

- ◆ To remove: take off vibration damper if necessary





1 - Front toothed belt guard, upper section

2 - Toothed belt

- ◆ Mark direction of rotation before removing
- ◆ Check for wear
- ◆ Do not kink
- ◆ Removing and installing ⇒ [Page 13-17](#)

3 - Camshaft sprocket mounting bolt

- ◆ Observe steel type marking on bolt head:

8.8 = 85 Nm (63 ft lb)

10.9 = 100 Nm (74 ft lb)

- ◆ Loosen and tighten using 3036 counter-hold

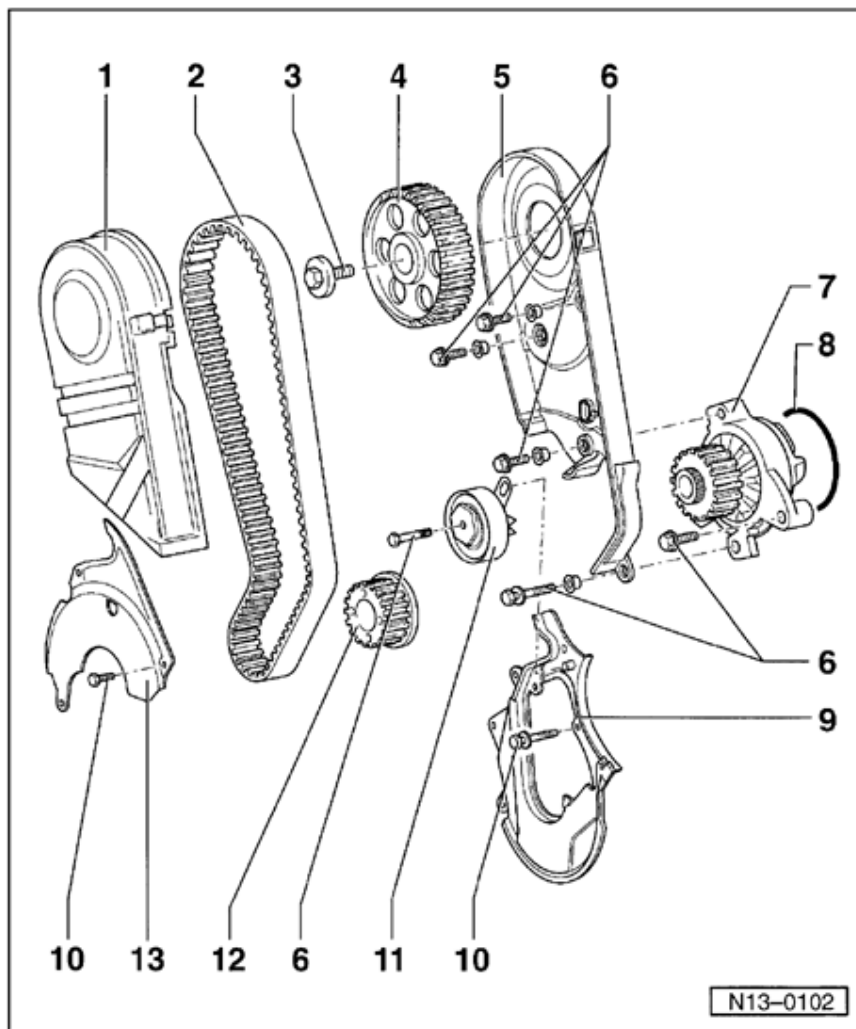
4 - Camshaft sprocket

- ◆ Note position when installing toothed belt ⇒ [Page 13-17](#)

5 - Rear toothed belt guard, upper section

6 - 20 Nm (15 ft lb)





7 - Coolant pump

- ◆ Without elongated holes
- ◆ Check shaft for ease of movement
- ◆ If damaged and leaking, replace assembly

8 - O-ring

- ◆ If leaking and damaged replace

9 - Rear toothed belt guard, lower section

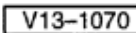
10 - 10 Nm (7 ft lb)

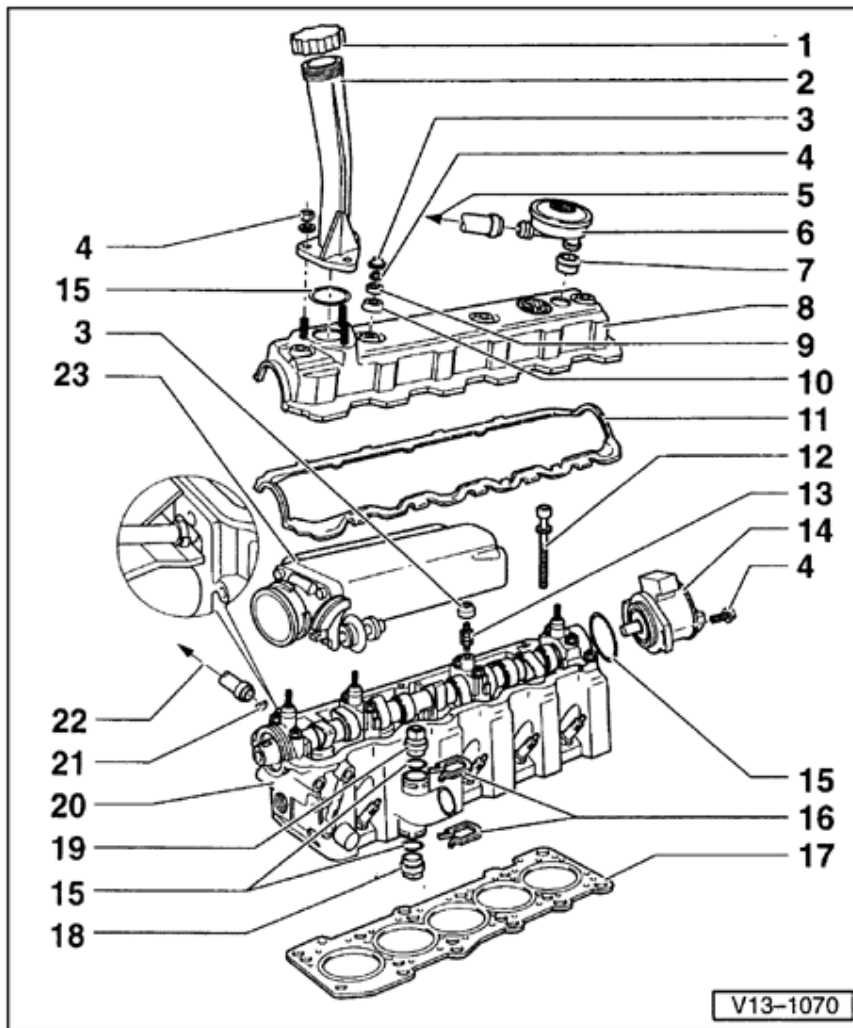
11 - Tensioning roller

12 - Crankshaft sprocket

13 - Toothed belt guard







12 - Cylinder head bolt

- ◆ Sequence when loosening and tightening ⇒ [Page 15-7](#)

13 - 15 Nm (11 ft lb)

14 - Distributor

- ◆ Installing:

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 28*

15 - O-ring

- ◆ Replace if damaged

16 - Retaining clip

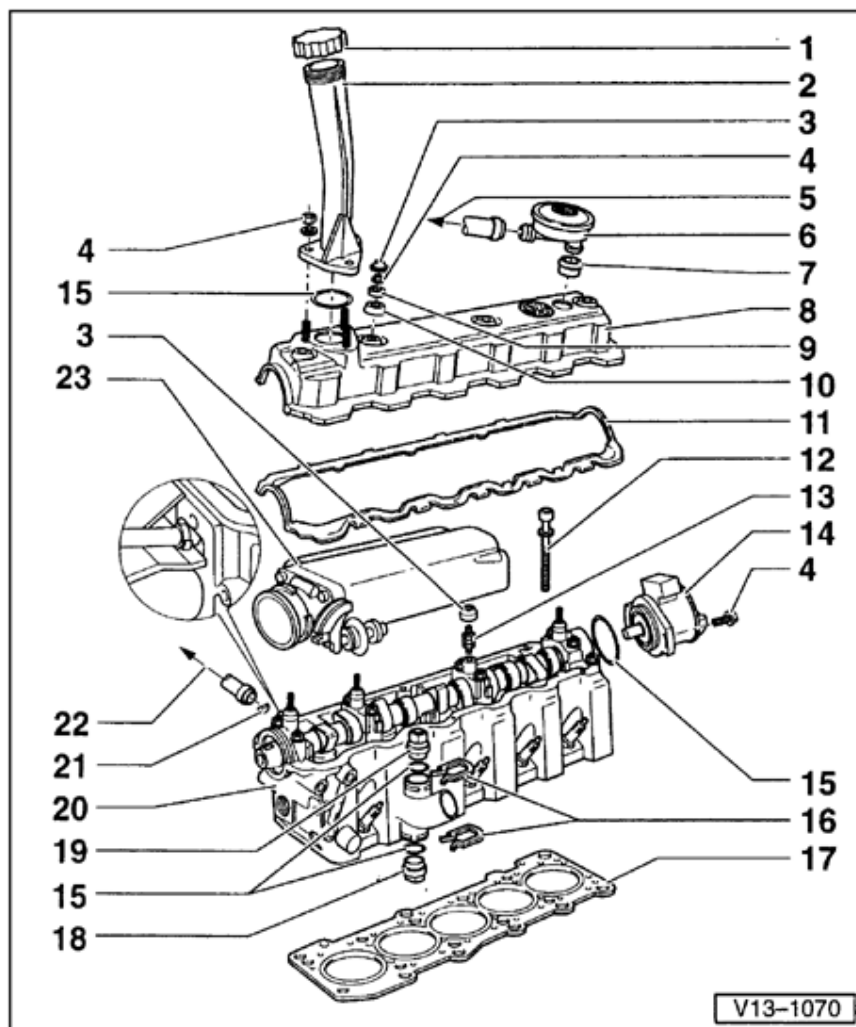
17 - Cylinder head gasket

- ◆ Replace
- ◆ If replaced; completely replace coolant

18 - After-run coolant thermal switch - F95- with Engine Coolant Temperature switch -G2-

- ◆ Yellow, 4-pin
- ◆ -F95- Checking: ⇒ [Page 19-20](#)
- ◆ ECT switch, checking:

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



19 - Engine Coolant Temperature sensor -G62-

- ◆ Blue, 2-pin
- ◆ for Fuel injection and Ignition system:

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 24*

20 - Cylinder head

- ◆ Removing and installing ⇒ [Page 15-7](#)

21 - Woodruff key

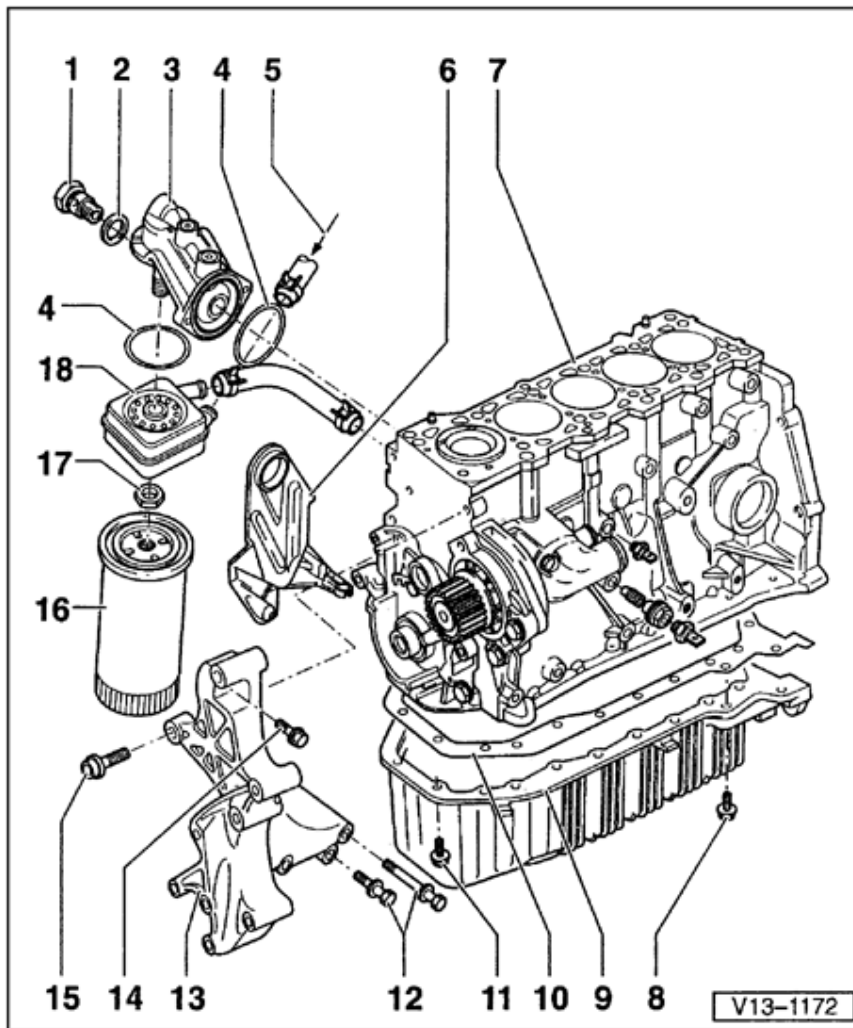
- ◆ Check for tight fit

22 - to junction on coolant expansion tank ⇒ [Page 19-1](#)

23 - Intake manifold

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 24*





Part IV

1 - 70 Nm (52 ft lb)

2 - Sealing ring

◆ Always replace

3 - Oil filter bracket

◆ Installation position determined by fitted pin

◆ With check valve for hydraulic lifters

4 - O-ring

◆ Replace if damaged

5 - From coolant pipe
⇒ [Page 19-1](#)

6 - Oil collector

7 - Cylinder block

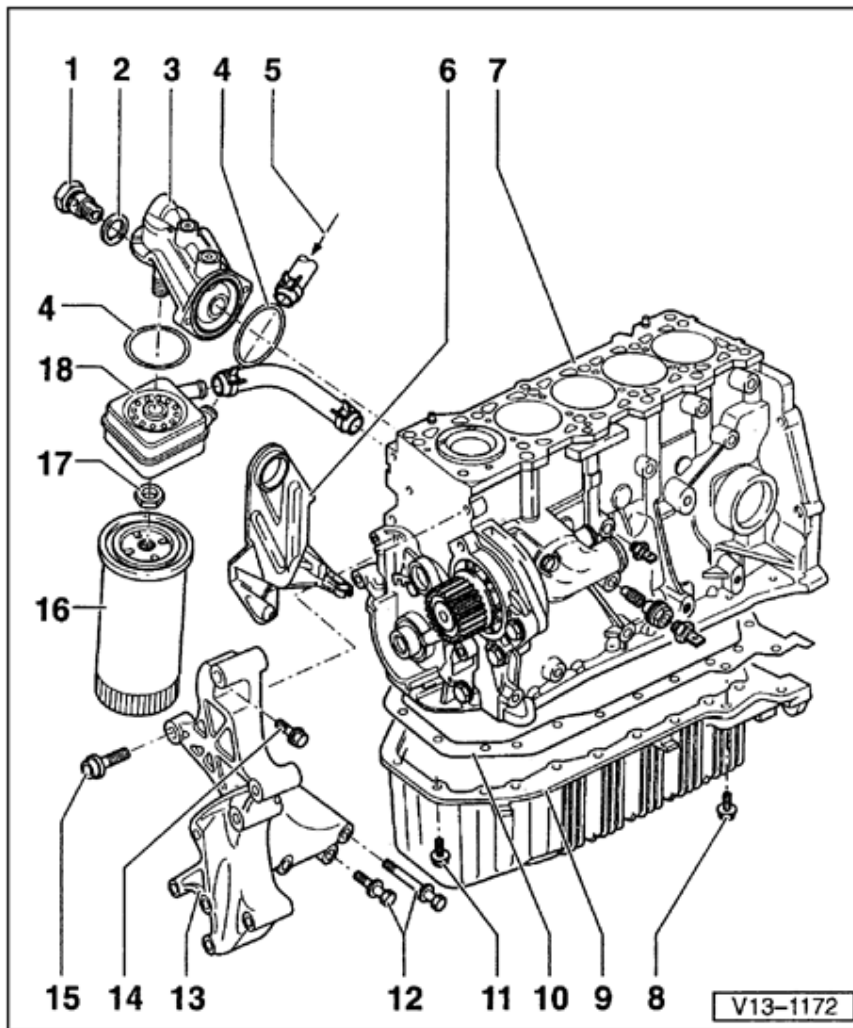
◆ Disassembly and assembly: cylinder block, crankshaft and flywheel ⇒ [Page 13-30](#)

8 - 20 Nm (15 ft lb)
M8

◆ Install bolt with hex head toward transmission side

9 - Oil pan





10 - Oil pan gasket

- ◆ Replace
- ◆ Do not attach with adhesive, make sure positioned correctly

11 - 10 Nm (7 ft lb)

- ◆ Remove and install using socket 3249
- ◆ With flywheel installed: turn flywheel so recess aligns with bolts

12 - 40 Nm (30 ft lb)

13 - Bracket

14 - 20 Nm (15 ft lb)

- ◆ Mounted to cylinder head

15 - 20 Nm (15 ft lb)

16 - Oil filter

- ◆ Loosen with oil filter socket 2067
- ◆ Tighten by hand
- ◆ Note instructions on filter when installing

17 - 25 Nm (18 ft lb)

18 - Oil cooler

- ◆ Coat contact area to flange, outside seal with AMV 188 100 02
- ◆ Make sure clearance to adjacent components



Ribbed belt, removing and installing

Note:

Before removing the ribbed belt, mark the direction of rotation. When installing the belt, make sure it is correctly seated in the pulley.

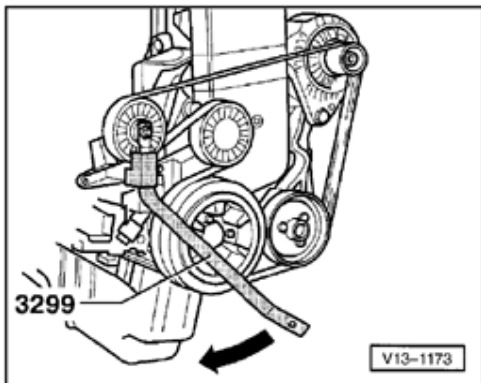
Special tools, testers and auxiliary items

- ◆ 3299 Lever

Ribbed belt, removing

- Remove sound dampener tray

⇒ [Repair Manual, Body Exterior, Repair Group 50](#)



- Lift tensioning roller with lever 3299 and remove ribbed belt from generator pulley.
- Remove ribbed belt.

Ribbed belt, installing

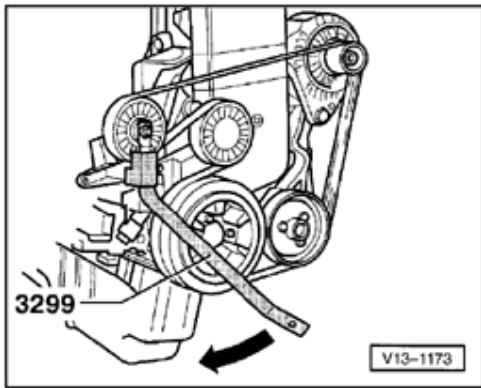
Note:

Before installing the ribbed belt, make sure that all sub-assemblies (generator, A/C compressor, power steering pump) are tight.

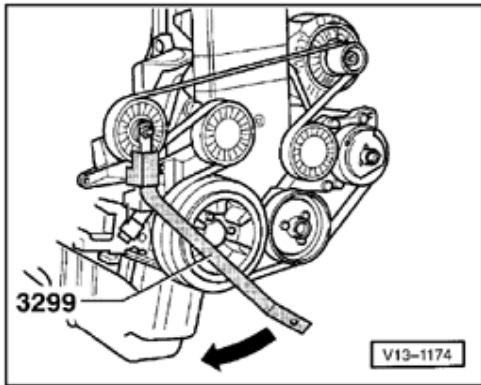


- Place ribbed belt on ribbed belt pulley with vibration damper.
- Lift tensioning roller with 3299 and install

tension ribbed belt.

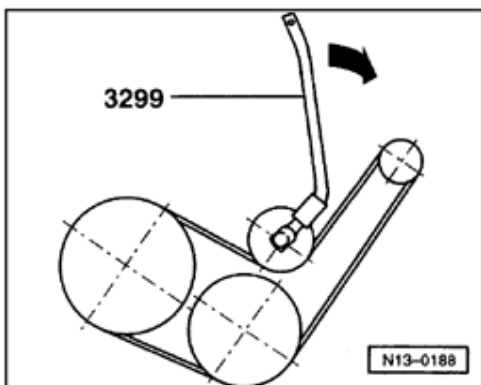


➤ Belt drive without A/C compressor



➤ Belt drive with A/C compressor

13-16



➤ Basic belt drive

- Start engine and check belt running.

13-17



Toothed belt, removing and installing

Adjusting valve timing

Special tools, testers and auxiliary items

- ◆ Ring wrench 3355
- ◆ Counter-hold tool 3248 A
- ◆ Torque wrench VAG 1331 5 to 50 Nm (4 to 40 ft lb)
- ◆ Torque wrench VAG 1601 150 to 800 Nm (100 to 600 ft lb)

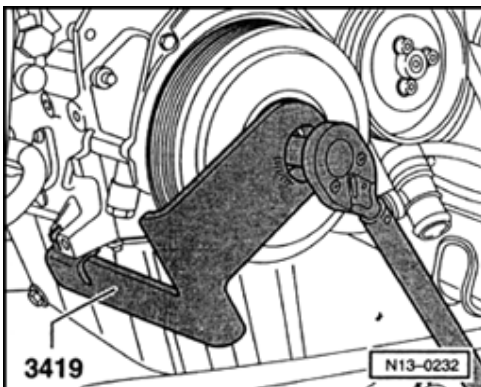
Removing

- Removing sound dampening tray:

⇒ [Repair Manual, Body Exterior, Repair Group 50](#)

- Removing V-belt or ribbed belt ⇒ [Page 13-14](#) .

- Remove front toothed belt guard -upper part-



A

- Fit counterhold tool 3419 and loosen vibration damper and crankshaft sprocket.
- Remove vibration damper center bolt.
- Remove the 4 x M8 crankshaft vibration damper/toothed belt pulley mounting bolts.
- Remove vibration damper.

13-18



- Remove front toothed belt guard -lower part-

- Mark direction of rotation of toothed belt.

- Loosen tensioning roller or coolant pump and remove toothed belt.

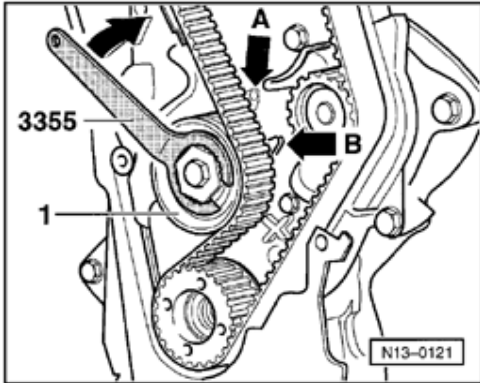
Installing

- Pistons not positioned at TDC

Note:

When turning the camshaft the crankshaft must not be at TDC. Danger of damage to valves/piston crown.

Vehicles 08.95 ➤



- Install tensioning roller -1- so that the tensioning roller tab seats in the toothed belt guard lower section moving pin -arrow A-.
- Tighten tensioning roller mounting bolt hand tight.

Continued for all vehicles

- Place toothed belt on crankshaft sprocket, relay roller or tensioning roller and coolant pump (note direction of rotation).

Vehicles ➤07.95

- Install lower toothed belt guard and install mounting bolt M8 for coolant pump.

13-19



If tensioning roller is installed

- Tighten to 20 Nm (15 ft lb)

Continued for all vehicles

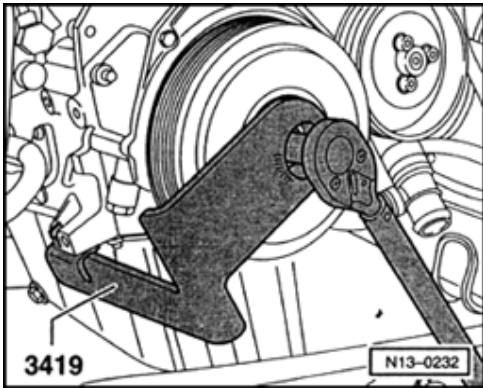
- Torque vibration damper to crankshaft toothed belt sprocket (4 M8 bolts)

◆ V-belt pulley: 20 Nm (15 ft lb)

◆ Ribbed belt pulley: 20 Nm (15 ft lb) + 1/4 turn (90° further)

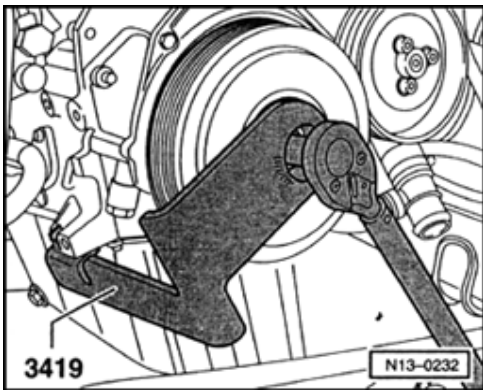
- Install vibration damper center bolt.

Vehicles with long center bolt (110 mm)



- Insert counter-hold tool 3419 and tighten crankshaft vibration damper and crankshaft toothed belt sprocket center bolt
 - ◆ 160 Nm (118 ft lb) plus 180° (1/2 turn additional) the additional 1/2 turn can be completed in several stages.

Vehicles with short center bolt (65 mm)

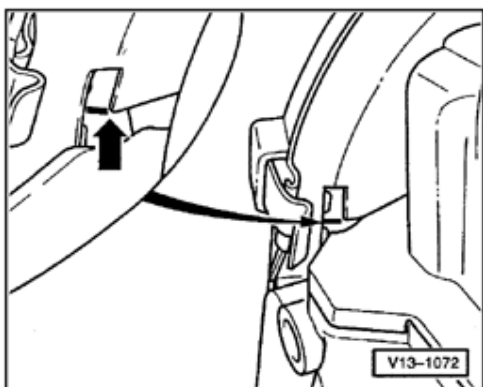


- Coat threads and bolt head contact surface of center bolt with AMV 188 001 02.
- Insert counter-hold 3419 and secure vibration damper and crankshaft sprocket
 - ◆ Tightening torque: 460 Nm (340 ft lb)

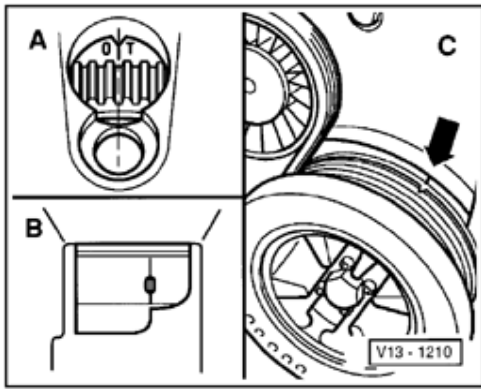
13-20



Continued for all vehicles



- Set camshaft sprocket to marking TDC Cyl. 1. The marking on the camshaft sprocket must align with the mark on the rear toothed belt guard -arrow-.



Engine installed:

- Set flywheel -A- or drive plate -B- to TDC No. 1 cylinder.

Engine removed:

- Bring mark on vibration damper -C- and mark on lower toothed belt guard into alignment.

13-21

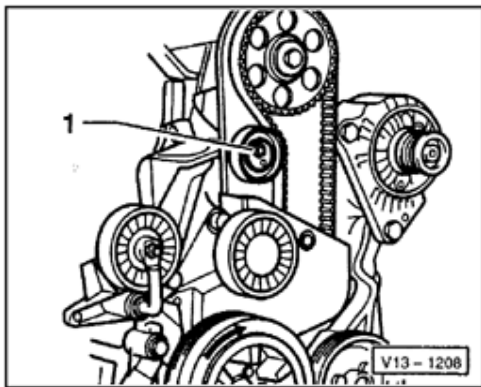


Tensioning toothed belt

Adjustment conditions

- Engine cold

Vehicles with tensioning roller ➤07.95



- Loosen nut -1- and check that tensioning roller moves freely, then place toothed belt on camshaft sprocket (note direction of rotation).
- Tighten tensioning roller mounting bolt hand tight.
- Turn engine approx. 2 turns until just before TDC.
- To tighten toothed belt, turn crankshaft slowly to TDC position (crankshaft must not jump back) tighten tightening roller nut.
- ◆ Tightening torque: 15 Nm (11 ft lb)

13-22



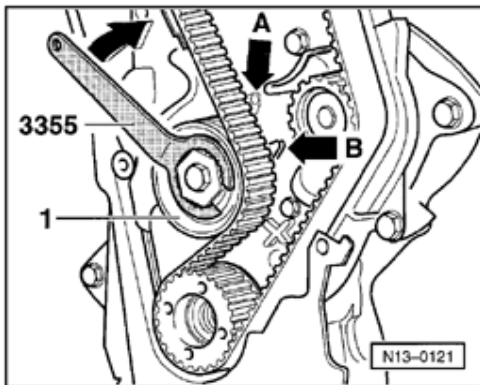
Vehicles with tensioning roller 08.95 ➤

- Place toothed belt on crankshaft sprocket. For used belts note direction of rotation.

Note:

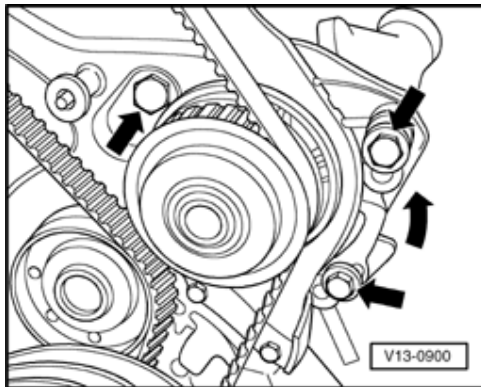
For used belts, note or mark the direction of rotation.

- Tighten tensioning roller mounting bolt hand tight.



- Turn tensioning roller clockwise onto the tensioning roller internal stop using 3355 box wrench. Then turn tensioning roller back until both pointers are aligned -arrow B-.
- Tighten tensioning roller mounting bolt
 - ◆ 20 Nm (15 ft lb)

Vehicles without tensioning roller

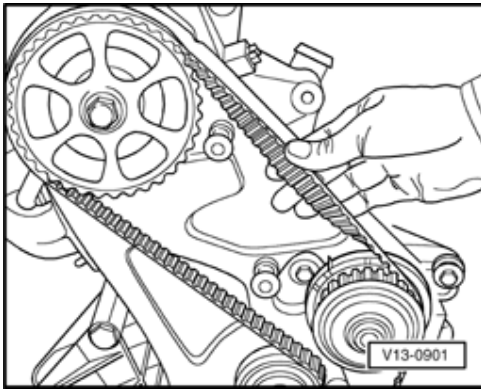


- Place toothed belt on camshaft sprocket.
- Tighten toothed belt by turning loosened coolant pump to left and upward



Note:

On older engines, VW recommends that sealing surfaces be cleaned and the O-ring replaced when loosening the coolant pump.



- ✦ It must be possible to turn the toothed belt 90° with the thumb and forefinger between camshaft and intermediate shaft sprockets.

- Tighten coolant pump mounting bolts

◆ 20 Nm (15 ft lb)

Continued for all vehicles

- Rotate crankshaft two full turns and check adjustment.
- Install upper toothed belt guard.
- Check ignition timing and adjust if necessary

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 28*

- Install ribbed belt ⇒ [Page 13-14](#) .
- Install power steering pump V-belt and adjust ⇒ [Page 13-3](#) , item 17
- Install generator V-belt and adjust ⇒ [Page 13-24](#)

13-24



Generator V-belt tension, adjusting

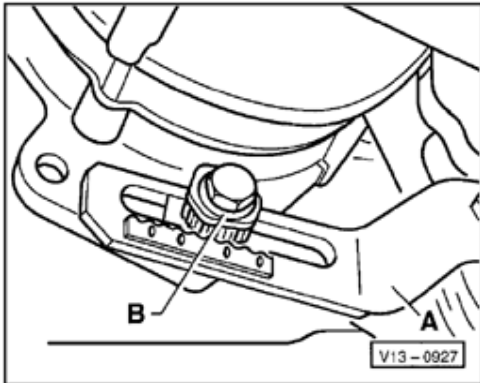
(Only for vehicles with toothed rack tensioner)

Special tools, testers and auxiliary items

- ◆ Ring insert SW 22 -VAG 1410/2
- ◆ Torque wrench VAG 1410 4 to 20 Nm (3 to 15 ft lb)
- ◆ Torque wrench VAG 1331 5 to 50 Nm (3.7 to 37 ft lb)

Work sequence

- Removing sound dampening tray

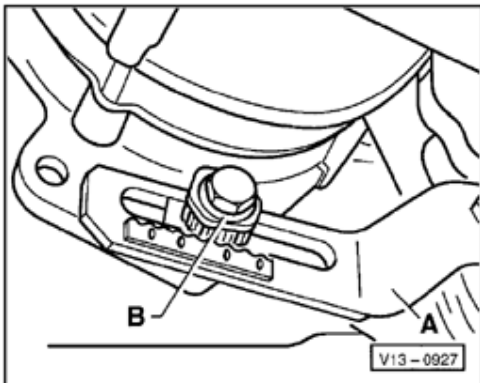


- Loosen all mounting bolts for tensioning bracket -A- and generator at least one turn.

Note:

It must be possible to move the generator by hand.

13-25



- Tension V-belt by turning the tensioning nut - B- with torque wrench.

Specification:

- ◆ New V-belt: 8 Nm (6 ft lb)
- ◆ Used V-belt: 4 Nm (3 ft lb)
- Tighten tensioning nut mounting bolt
 - ◆ 30 Nm (22 ft lb)
- Tighten generator mounting mounting bolt
 - ◆ 35 Nm (26 ft lb)
- Tighten tensioning bracket to cylinder head/lifting eye
 - ◆ 25 Nm (18 ft lb)
- Start engine and let idle for approx. 5 minutes.
- Switch OFF ignition.
- Again tighten V-belt by turning the tensioning nut -B- with torque wrench

Specifications:

- ◆ New V-belt: 8 Nm (6 ft lb)

- ◆ Used V-belt: 4 Nm (3 ft lb)

13-26



Ribbed belt tensioner, removing and installing

Note:

For vehicles with toothed rack generator tension adjuster.

Special tools, testers and auxiliary items

- ◆ VAG 1921 spring clip pliers
- ◆ 3299 Lever
- ◆ 3227 Engine stand
- ◆ VAG 1383 A Engine/transmission jack
- ◆ Wooden wedge

Notes:

- ◆ *When lowering engine, make sure that front exhaust pipe does not lay on steering gear.*
- ◆ *When pushing the engine forward make sure that the pipes and hoses are not stretched or damaged.*

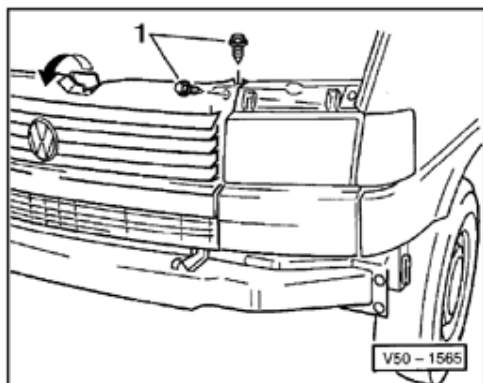
Removing

Vehicles 09.94 ➤

- Remove radiator grille



Continuation for all vehicles

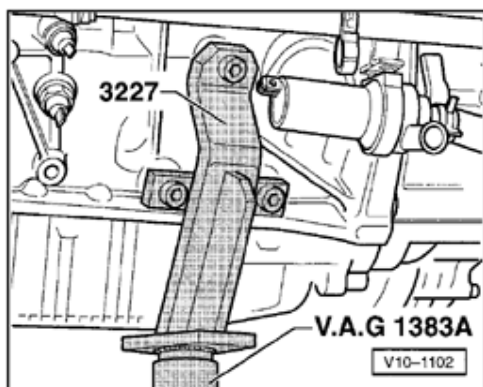


- ✦ - Remove left and right mounting bolts -1-.
- Fold lock carrier and radiator out forward - arrow-.
- Remove air cleaner housing.
- Remove power steering line retainers from tensioner bracket and engine mounting.
- Remove sound dampener tray

⇒ [Repair Manual, Body Exterior, Repair Group 50](#)

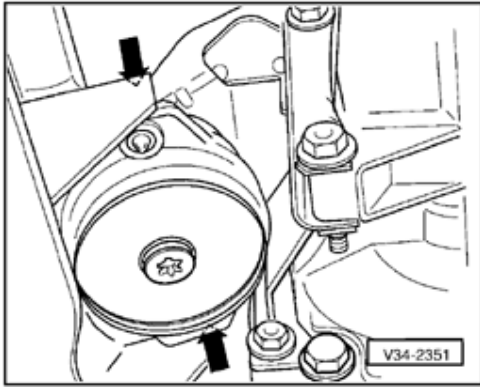
- Remove ribbed belt using 3299 lever ⇒ [Page 13-14](#)
- Unbolt right-hand drive shaft at transmission

⇒ [Repair Manual, Suspension, Wheels, Steering, Repair Group 40](#)

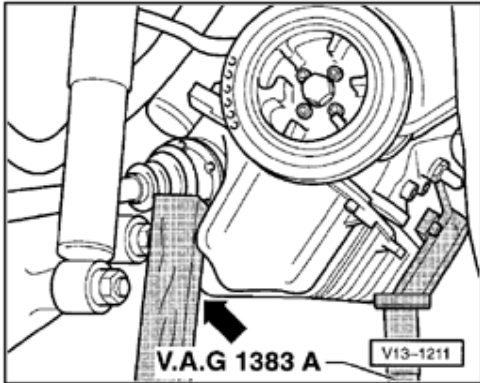


- ✦ - Bolt engine stand 3227 onto cylinder block and tighten
 - ◆ 20 Nm (15 ft lb)
- Slightly raise engine and transmission using VAG 1383 A engine and transmission jack



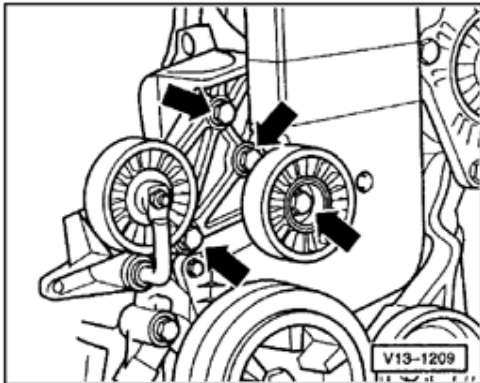


- Unscrew 2 mounting bolts -arrows- from transmission support on sub-frame.
- Loosen engine and transmission mounting center bolt, on left in engine compartment, by 1 turn.
- Remove right-hand engine mount center bolt(s).



- Lower engine using VAG 1383 A engine and transmission jack as far as possible, push forward and prevent from swinging back by mounting with wooden wedge -arrow-.

13-29



- Remove ribbed belt relay roller -arrow-.
- Remove ribbed belt tensioning roller.
- Remove tensioner retainer and engine support assembly complete -arrows-.

Tensioner device, disassembly and assembly ⇒ [Page 13-24](#)

Installing

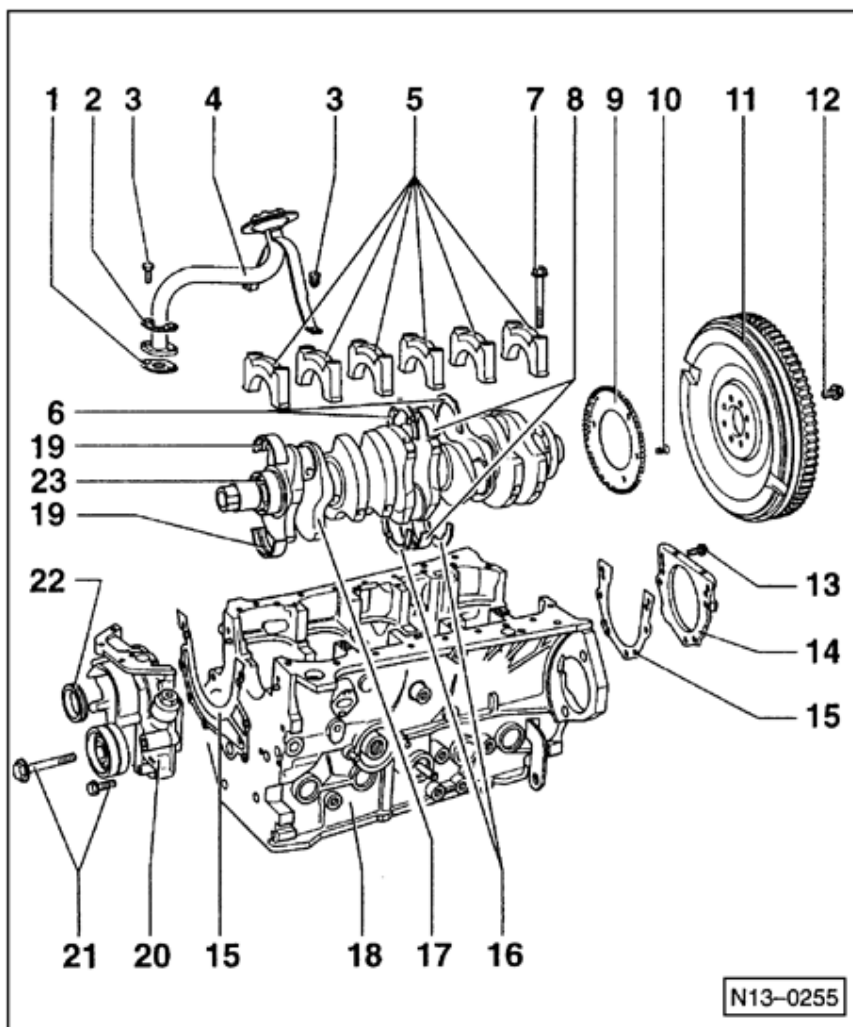
- Install ribbed V-belt tensioner in reverse sequence of removal

Tightening torques

Connection	Tightening torque
Engine mount center bolt	65 Nm

	48 ft lb
Drive shaft to flange shaft	55 Nm 41 ft lb
Transmission mount to sub-frame	45 Nm 33 ft lb
Tensioner device bracket and engine mount to cylinder block	40 Nm 30 ft lb

13-30



Crankshaft and flywheel assemblies, disassembling and assembling

Note:

For clutch repairs:

⇒ [Repair Manual, 5 Spd. Manual Transmission 02B, Repair Group 30.](#)

1 - Gasket

- ◆ Always replace

2 - Securing plate

3 - 10 Nm (7 ft lb)

4 - Suction pipe

5 - Bearing cap

- ◆ Bearing cap 1:
Pulley end
- ◆ Bearing cap 6:
flywheel end
- ◆ Bearing shell
retaining lugs
cylinder

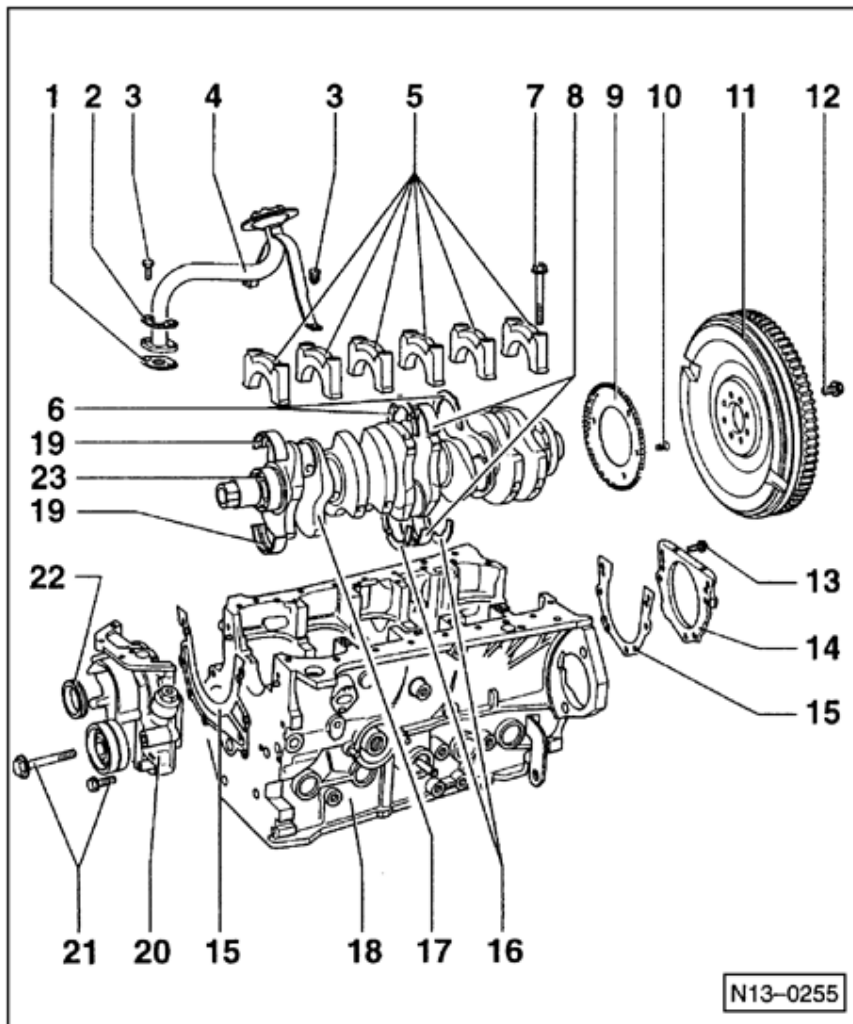
block/bearing
cap must be on
the same side

6 - Thrust washer

- ◆ For bearing cap
- ◆ Note fixing arrangement

7 - 65 Nm (48 ft lb)

13-31



8 - Bearing shell 4

- ◆ For bearing cap without oil groove
- ◆ For cylinder block with oil groove

9 - NOT APPLICABLE

10 - 10 Nm + $\frac{1}{4}$ turn
(90°) further

- ◆ Replace

11 - Flywheel

- ◆ Can be replaced with engine installed; by first removing the transmission

⇒ *Repair Manual, 5 Spd. Manual Transmission, Repair Group 34*

⇒ *Repair Manual, 4 Spd. Automatic Transmission, Repair Group 37*

- ◆ To remove and install flywheel

counter-hold with
3067

- ◆ Removing and installing drive plate (for vehicles with automatic transmission) ⇒

[Page 13-36](#)

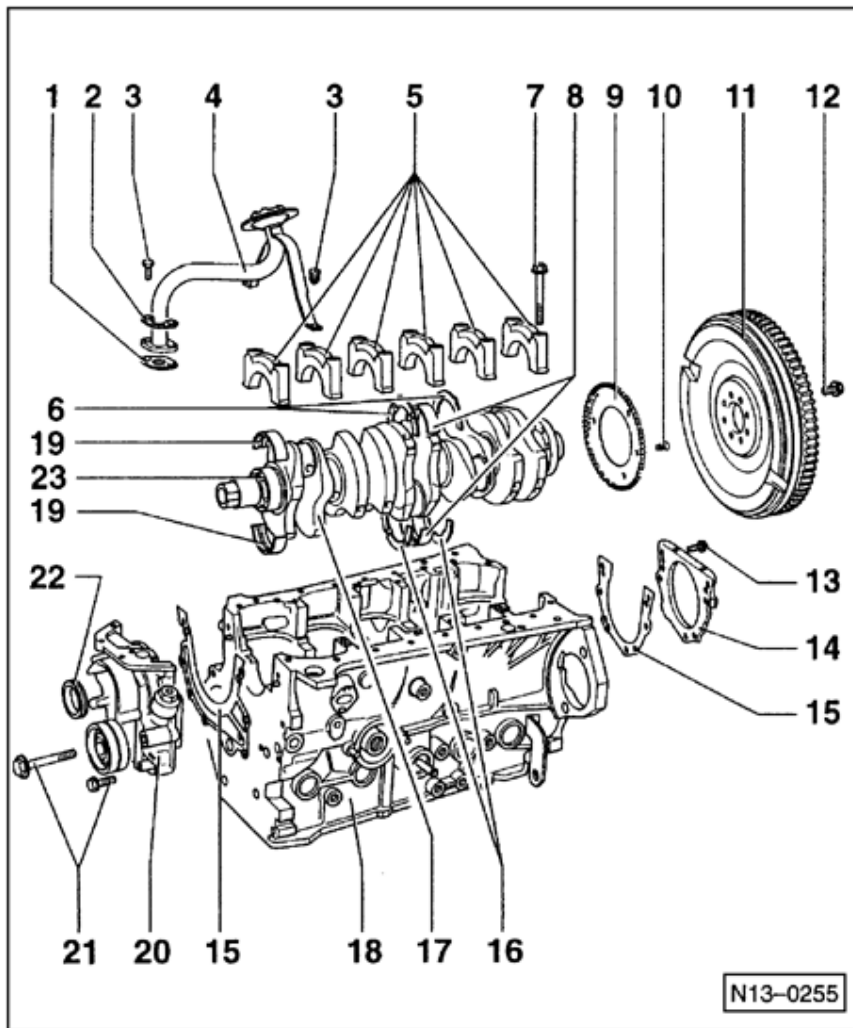
**12 - 60 Nm + $\frac{1}{4}$ turn
(90°) further**

- ◆ Replace
- ◆ Turning 90° further can be carried out in several stages.

13 - 10 Nm (7 ft lb)

13-32





14 - Sealing flange

- ◆ With oil seal, replace assembly

15 - Gasket

- ◆ Always replace

16 - Thrust washer

- ◆ For cylinder block
- ◆ Note installation arrangement

17 - Crankshaft

- ◆ Axial clearance:
New: 0.07 to 0.18 mm

Wear limit: 0.25 mm

- ◆ Check radial clearance using Plastigage

New: 0.016 to 0.075 mm

Wear limit: 0.16 mm

- ◆ Do not rotate crankshaft when checking radial clearance

- ◆ Crankshaft dimensions ⇒ [Page 13-35](#)

18 - Cylinder block

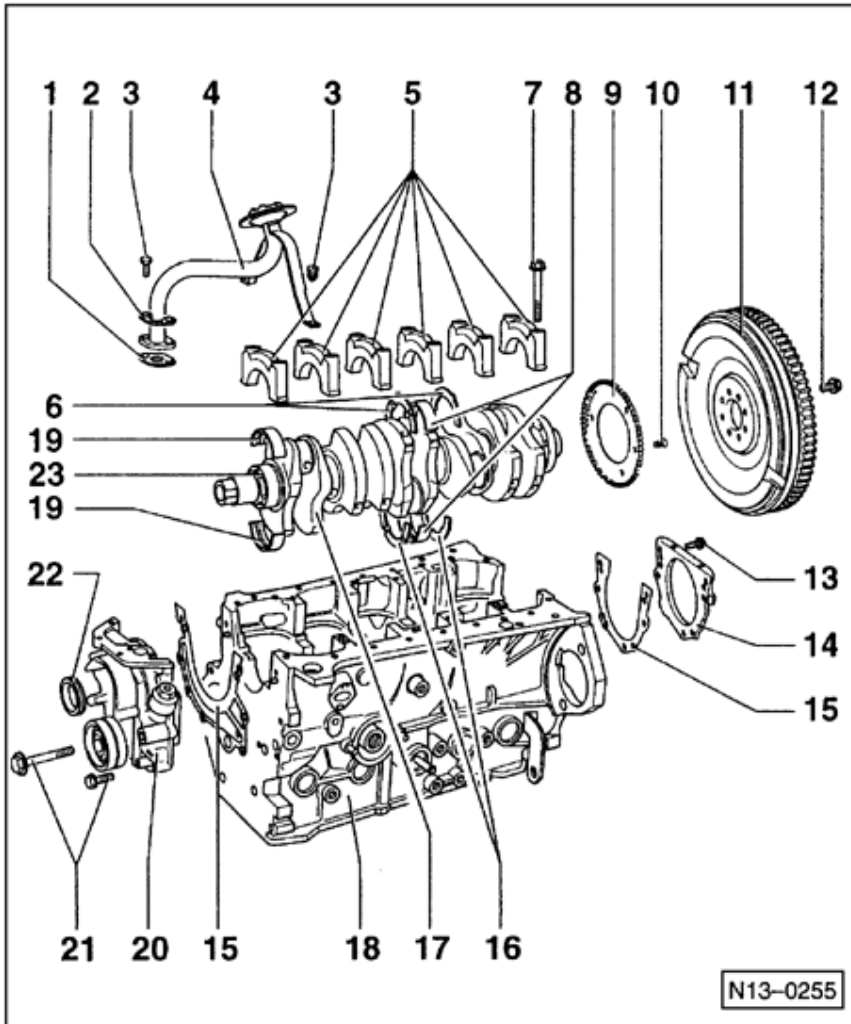
19 - Bearing shell 1, 2, 3, 5 and 6

- ◆ For bearing caps without oil groove
- ◆ For cylinder

block with oil groove

- ◆ Do not interchange used bearing shells (mark)

13-33



20 - Oil pump

- ◆ Only Replace complete
- ◆ When installing note coupling ring (item 23) on crankshaft
- ◆ Disassembling and assembling ⇒ [Page 17-1](#)

21 - M8 = 20 Nm (15 ft lb)

M6 = 10 Nm (7 ft lb)

22 - Oil seal

- ◆ Replace ⇒ [Page 13-34](#)

23 - Oil pump coupling ring

- ◆ With four drive lugs
- ◆ Break open to pull off
- ◆ Heat new coupling ring to 200 ° C (maximum) before installing

13-34



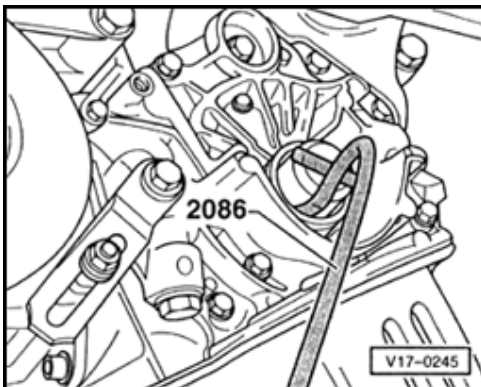
Crankshaft oil seal (pulley end), replacing

Special tools, testers and auxiliary items

- ◆ 3419 Counter-hold tool
- ◆ 2086 Oil seal extractor
- ◆ 2080 A Installing sleeve

Removing

- Remove vibration damper and toothed belt sprocket (use 3419 counter-hold tool to loosen the center bolt).
- Remove toothed belt ⇒ [Page 13-17](#)



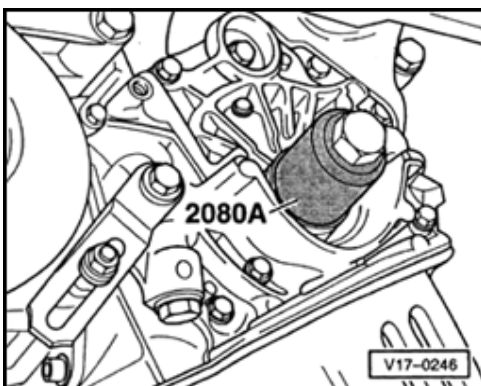
A

- Press out oil seal using 2086 extractor.
- Lightly oil sealing lip and outer edge of oil seal.

Installing

- Slide oil seal over guide sleeve from 2080 A.

13-35



A

- Press in oil seal up to stop using sleeve from 2080 A and center bolt from vibration damper.
- Install and tension toothed belt ⇒ [Page 13-17](#)

Crankshaft dimensions in millimeters

Honing dimension	Main journal -diameter	Connecting rod

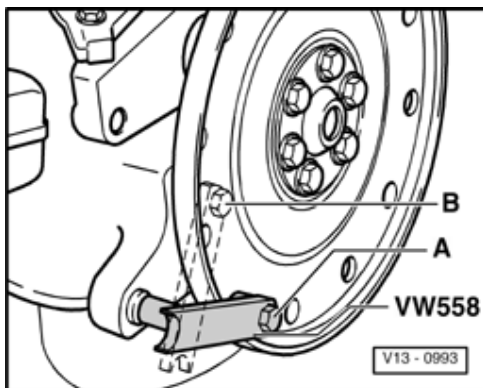
		journal diameter
Basic dimension	-0.022 58.00 -0.042	-0.022 47.80 -0.042
1st undersize	-0.022 57.75 -0.042	-0.022 47.55 -0.042
2nd undersize	-0.022 57.50 -0.042	-0.022 47.30 -0.042
3rd undersize	-0.022 57.25 -0.042	-0.022 47.05 -0.042

13-36



Drive plate, removing and installing

Loosening and tightening drive plate



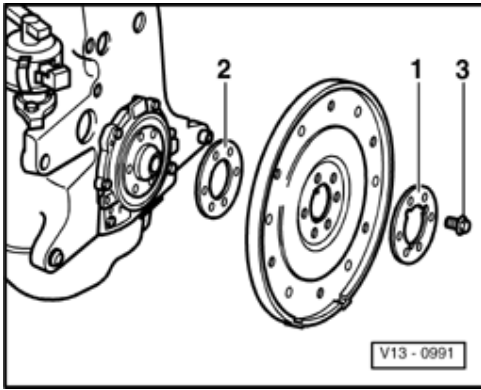
- Secure counter-hold tool VW 558 to drive plate with M8x45 bolt. Place two M10 nuts between counter-hold tool and drive plate.

Position of counter-hold tool:

A - To loosen

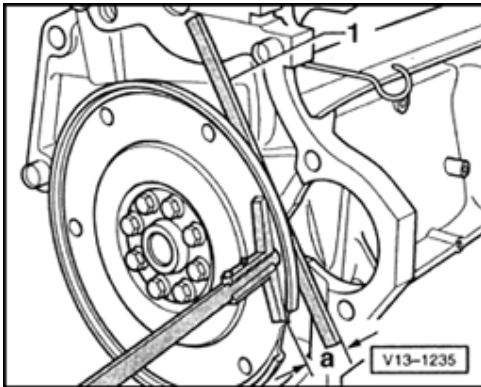
B - To tighten

Installing drive plate



- ✎ - Locate drive plate and packing plate with recesses -1-.
- Install new bolts -3- and tighten
 - ◆ 30 Nm (22 ft lb)

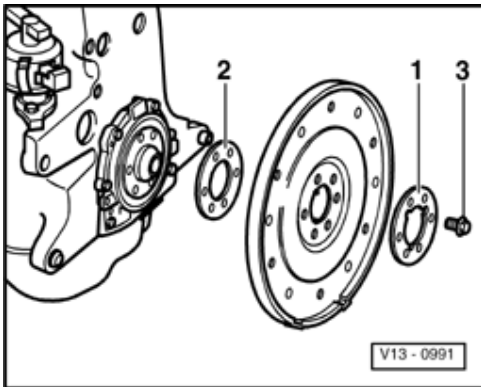
13-37



- ✎ - Check dimension -a- at three points and calculate average.

Specification: 10.7 to 12.3 mm

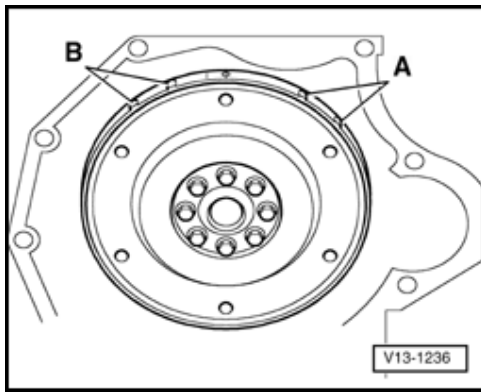
If specification not obtained



- ✎ - Remove drive plate again and install shim -2-.
- Tighten bolts -3-
 - ◆ 30 Nm (22 ft lb)
- Tighten bolts -3- to 60 Nm (44 ft lb) and turn 90° (1/4 turn) further (the additional 1/4 turn can be performed in several stages).

13-38





When Replacing drive plate, note transmission version:

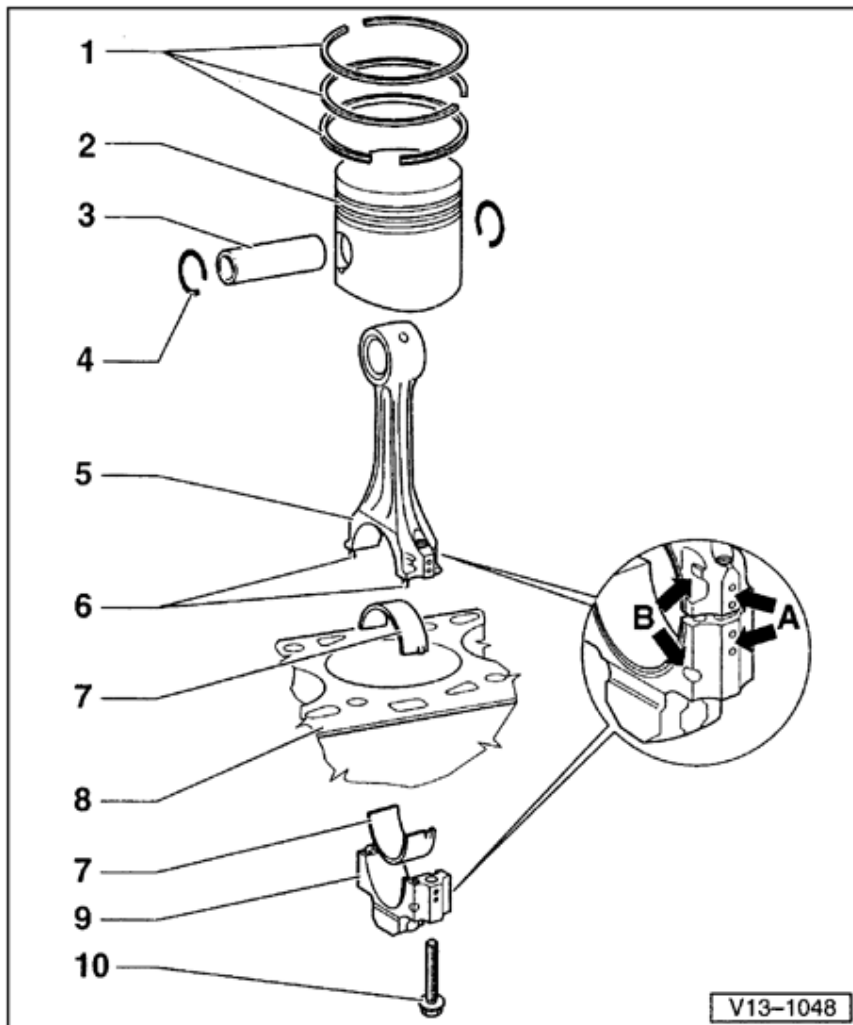
◆ Version -A-:

TDC sensor mounting in upper transmission housing.

◆ Version -B-:

TDC sensor mounting in side of transmission housing.

13-39



Pistons and connecting rods, disassembling and assembling

Note:

Do not rotate crankshaft while measuring radial clearance.

1 - Piston ring

- ◆ Offset gaps by 120°
- ◆ Remove and install using piston ring pliers
- ◆ "TOP" faces toward piston crown
- ◆ Checking ring gap ⇒ Fig. ⇒ [1](#)
- ◆ Checking ring to groove clearance ⇒ Fig. ⇒ [2](#)

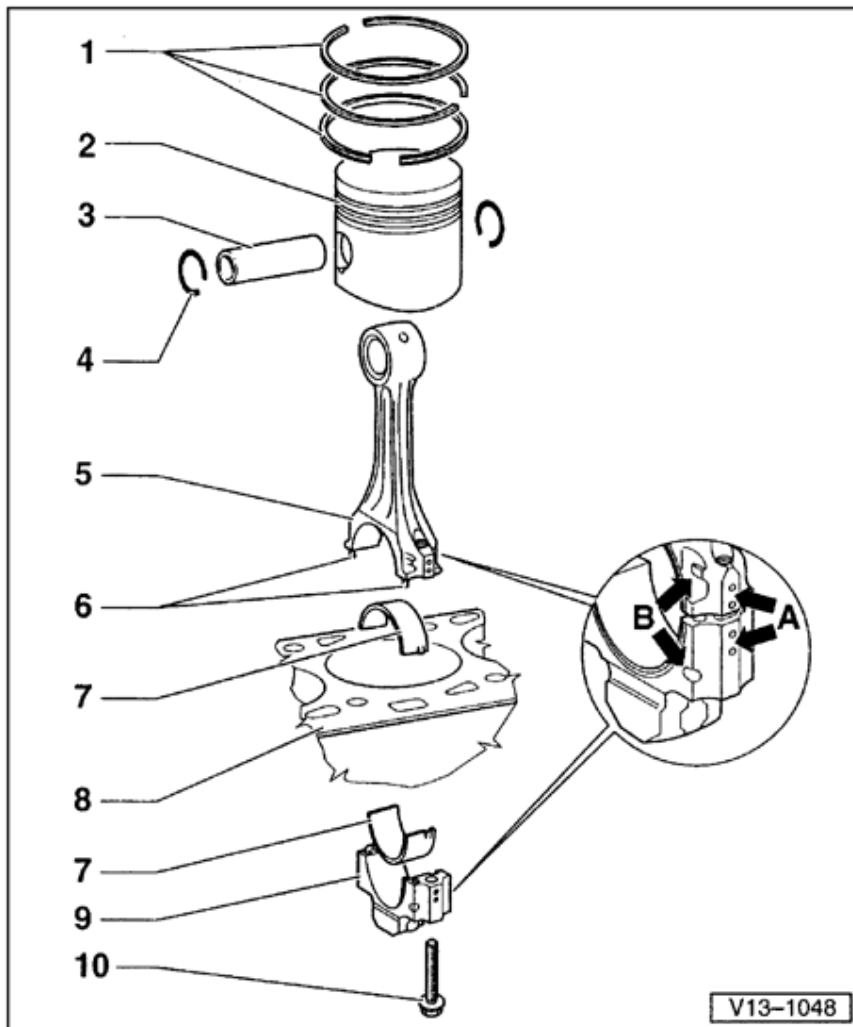
2 - Piston

- ◆ Checking ⇒ Fig.

⇒3

- ◆ Mark installation position and cylinder number
- ◆ Arrow on piston crown points to pulley end
- ◆ Install using piston ring clamp

13-40



3 - Piston pin

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

4 - Circlip

5 - Connecting rod

- ◆ Only replace as a set
- ◆ Mark cylinder number -A-

- ◆ Installation position:

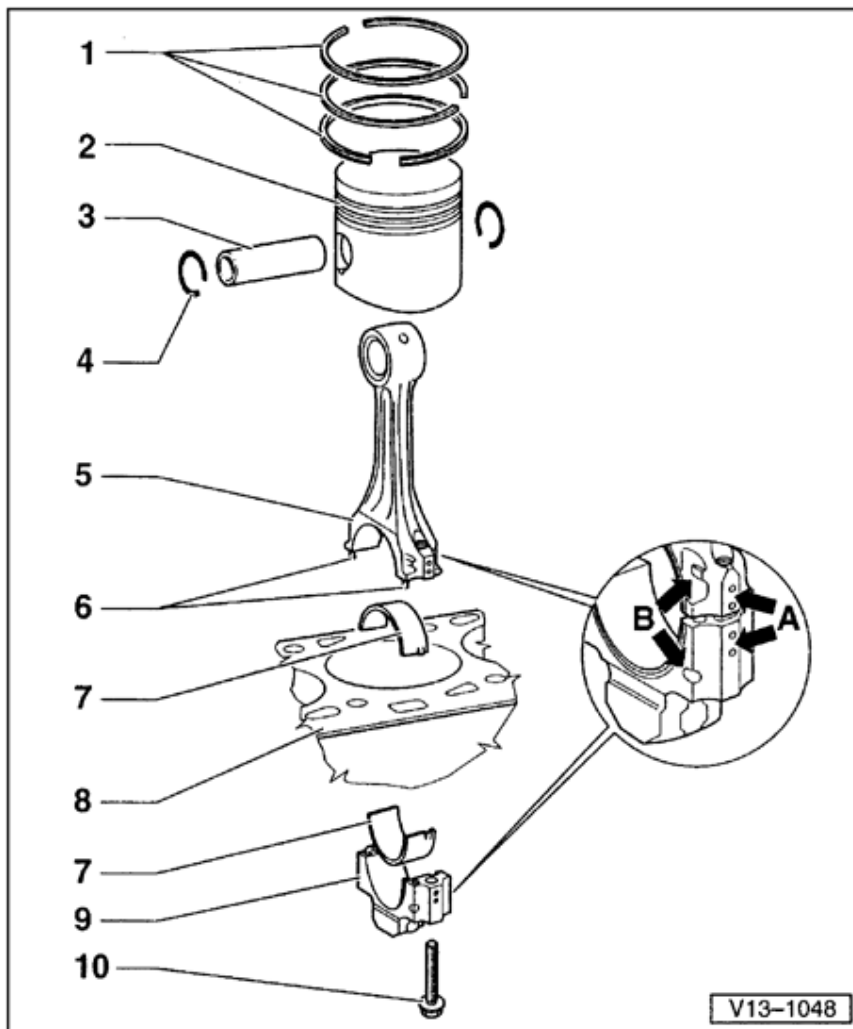
Marking -B- faces toward pulley end

6 - Wrist pin

- ◆ Wrist pin must seat securely in connecting rod, not in bearing cap

13-41





7 - Bearing shell

- ◆ Note installation position
- ◆ Do not interchange used bearing shells
- ◆ Make sure that bearing retaining lugs fit tightly in recesses

◆ Axial clearance

New: 0.05...0.31 mm

Wear limit: 0.37 mm

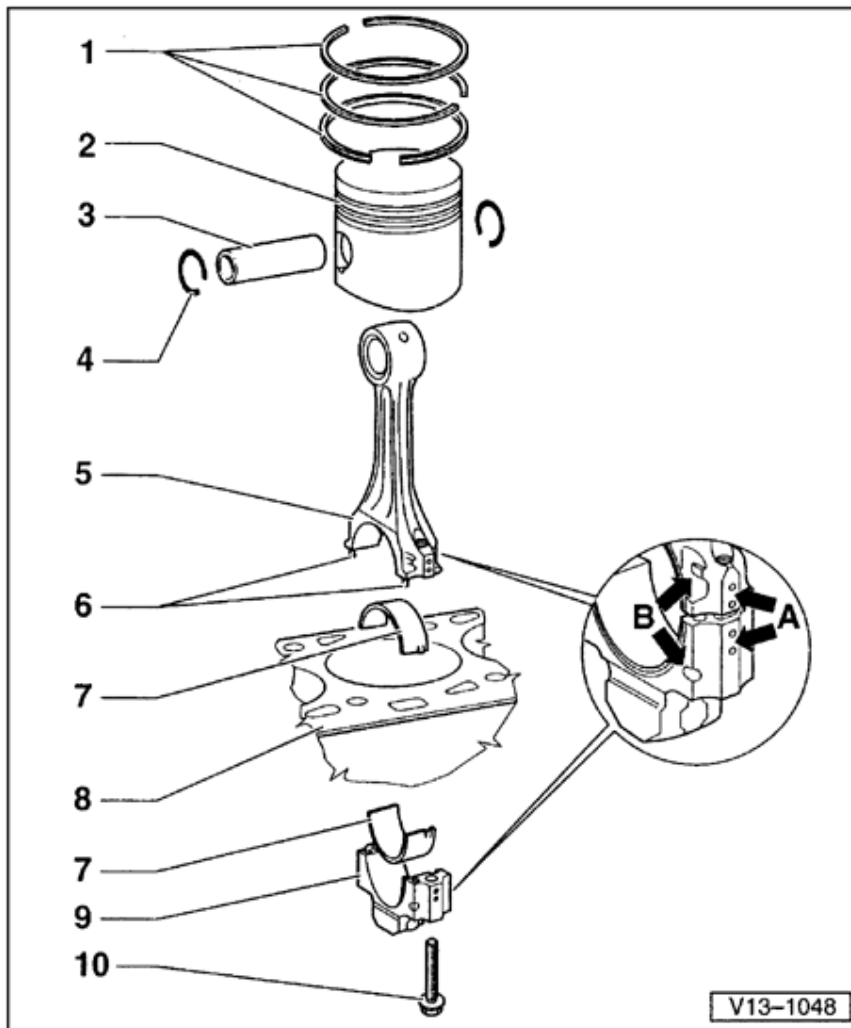
- ◆ Check radial clearance with Plastigage:

New: 0.01...0.06 mm

Wear limit: 0.12 mm

Do not rotate crankshaft when checking radial clearance





8 - Cylinder block

- ◆ Checking cylinder bores ⇒ Fig. ⇒ [4](#)

- ◆ Piston and cylinder dimensions ⇒ [Page 13-46](#)

9 - Connecting rod bearing cap

- ◆ Installation position:

Marking -B- faces toward pulley end

10 - Connecting rod bolt, 30 Nm (22 ft lb) + $\frac{1}{4}$ turn (90°) further

- ◆ Always replace
- ◆ Oil threads and contact surface
- ◆ To measure radial clearance use old bolts and tighten to 30 Nm (22 ft lb) do not turn further

13-43

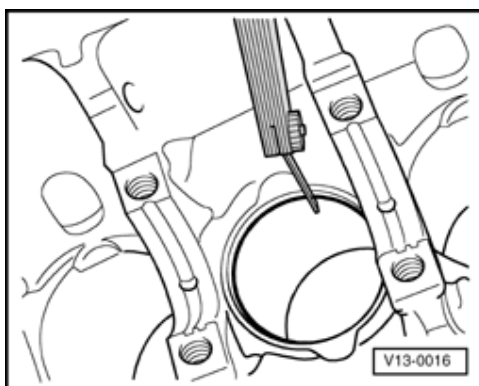


Fig. 1 Piston ring gap, checking

Special tools, testers and auxiliary items

- ◆ Feeler gauge

Test sequence

- Push in ring squarely from above down to approx. 15 mm from bottom end of cylinder.

Piston ring	New	Wear limit
Dimensions in mm		
Compression rings	0.20 to 0.40	1.0
Oil scraper ring	0.25 to 0.50	1.0

13-44

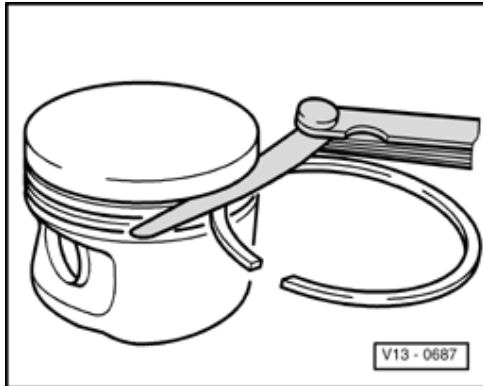


Fig. 2 Ring to groove clearance, checking

Special tools, testers and auxiliary items

- ◆ Feeler gauge

Test sequence

Clean groove before check.

Piston ring	New	Wear limit
Dimensions in mm		
Compression rings	0.02 to 0.05	0.15
Oil scraper ring	0.02 to 0.05	0.15

13-45

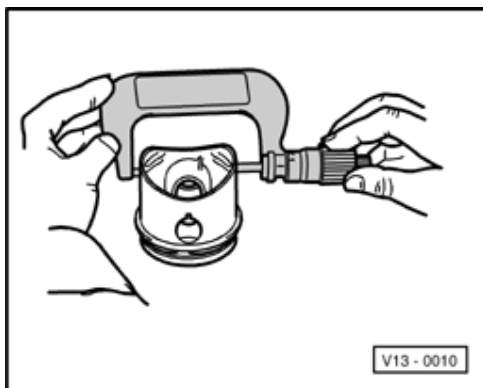


Fig. 3 Piston, checking

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

- ◆ Deviation from nominal dimension 0.04 mm max.

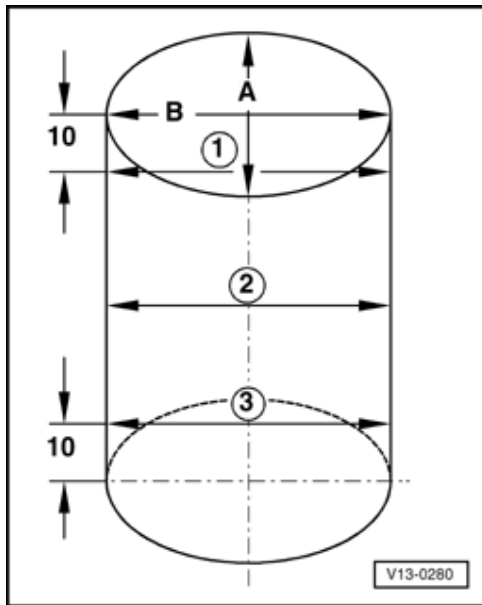


Fig. 4 Cylinder bores, checking

- Measure bores at 3 locations in both directions -A- across the engine and -B- in line with crankshaft.

- ◆ Use 50 to 100 mm inside dial gauge .
- ◆ Deviation from nominal dimension: 0.08 mm max.

Note:

Cylinder bore measurement must not be performed when the block is mounted to a repair stand via VW540 adapter bracket. Incorrect readings will result due to weight distribution and block bending.

13-46



Piston and cylinder, dimensions

Honing dimension		Piston-diameter	Cylinder bore-diameter
Basic dimen.	mm	80.985	81.01
1st oversize	mm	81.235	81.26
2nd oversize	mm	81.485	81.51

Note:

When performing repairs install pistons and piston pins of the same type and pistons with the same weight class in an engine.

15 - Engine - Cylinder head, Valvetrain

Cylinder head, removing and installing

Cylinder head, removing and installing

Compression, checking

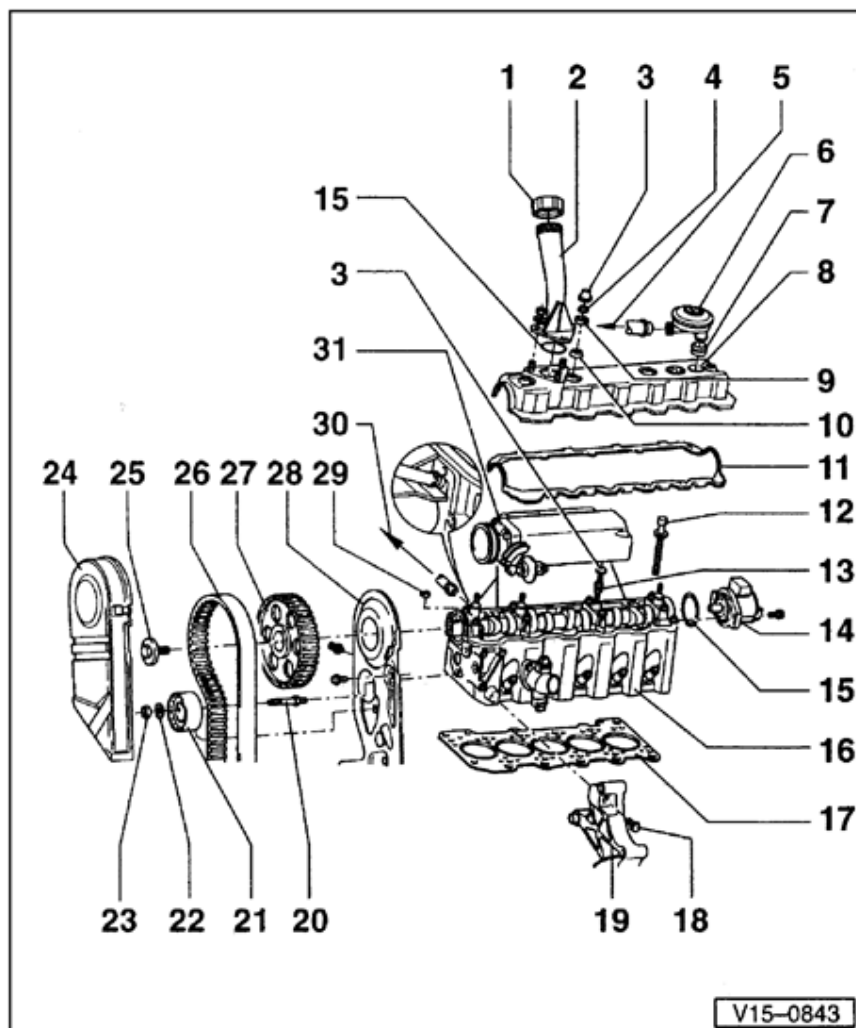
Valve train, servicing

Valve seats, reworking

Hydraulic lifters, checking

Camshaft, removing and installing

Camshaft oil seal, removing and installing



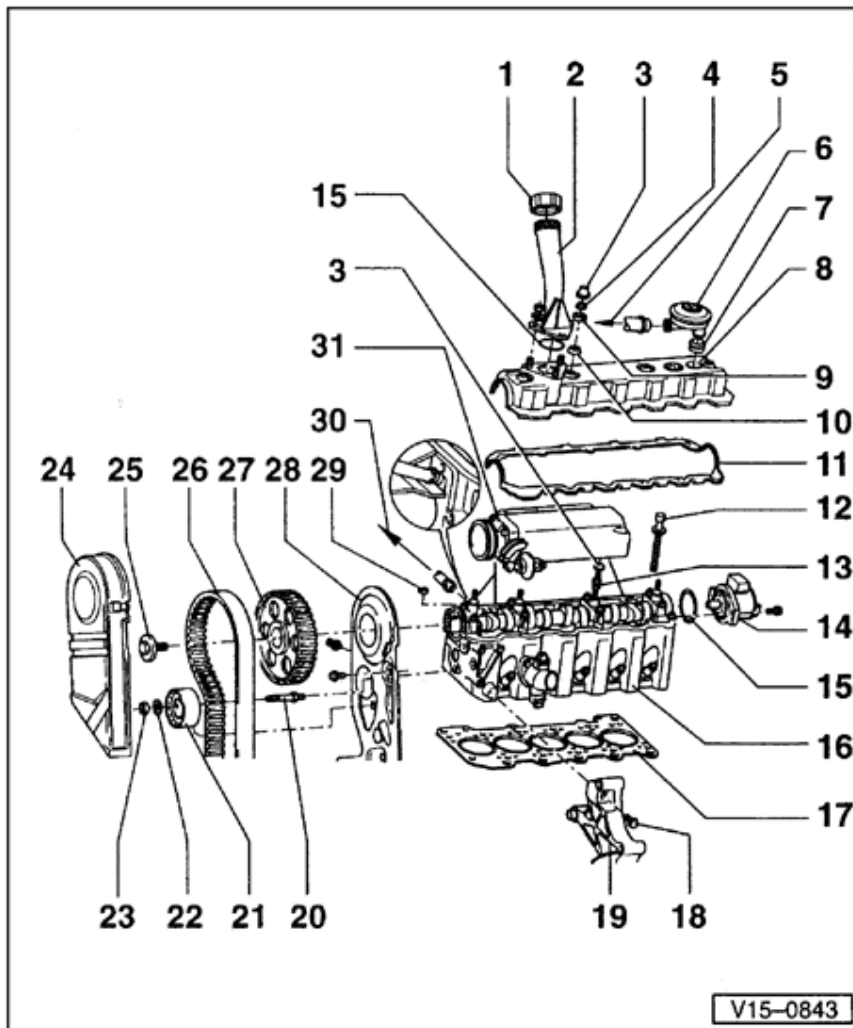
Cylinder head, removing and installing

Compression checking ⇒
[Page 15-10](#)

Notes:

- ◆ The cylinder head can be removed or installed with engine installed.
- ◆ When installing an exchange cylinder head, the contact surfaces between the hydraulic lifter and cam must be oiled after installation.
- ◆ The plastic protectors installed to protect the open valves, remove just before installing the cylinder head.
- ◆ When replacing the cylinder head; replace the complete coolant.





1 - Cap

2 - Oil filler tube

3 - Cover cap

4 - 10 Nm (7 ft lb)

5 - To intake hose

- ◆ Breather hose secured to oil filler tube (item - 2-) with retainer

- ◆ Make sure sufficient clearance to throttle body

6 - Positive Crankcase Ventilation valve

7 - Sealing ring

- ◆ Replace if damaged

8 - Cylinder head cover

- ◆ Replace complete if damaged or leaking
- ◆ With oil deflector

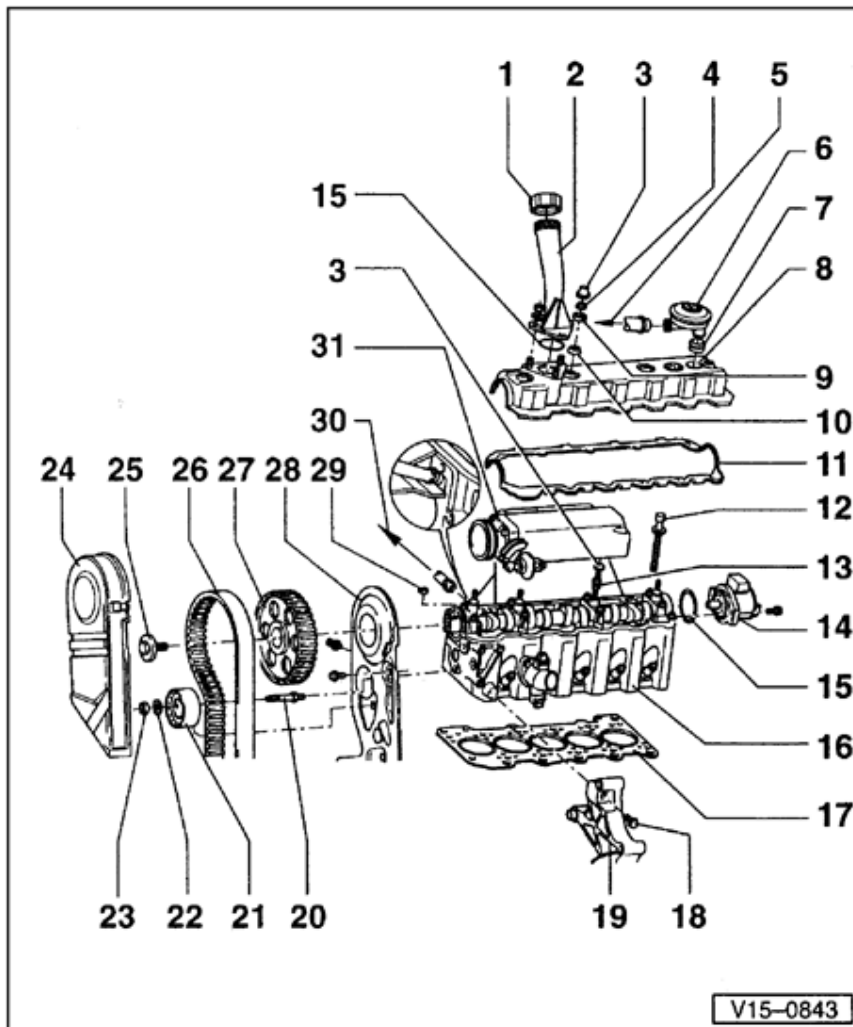
9 - Dished washer

10 - Upper sealing washer

- ◆ Replace if damaged

11 - Valve cover gasket

- ◆ No longer available as a spare part, replace valve cover assembly if leaking



12 - Cylinder head bolt

- ◆ Loosening and tightening sequence ⇒ [Page 15-7](#)

13 - 15 Nm (11 ft lb)

14 - Distributor

- ◆ Installing:

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 28*

15 - O-ring

- ◆ Replace if damaged

16 - Cylinder head

- ◆ Check for distortion ⇒ [Page 15-6](#), Fig. ⇒ 1
- ◆ Removing and installing ⇒ [Page 15-7](#)
- ◆ Valve gear, servicing ⇒ [Page 15-11](#)
- ◆ After replacing, completely replace the coolant

17 - Cylinder head gasket

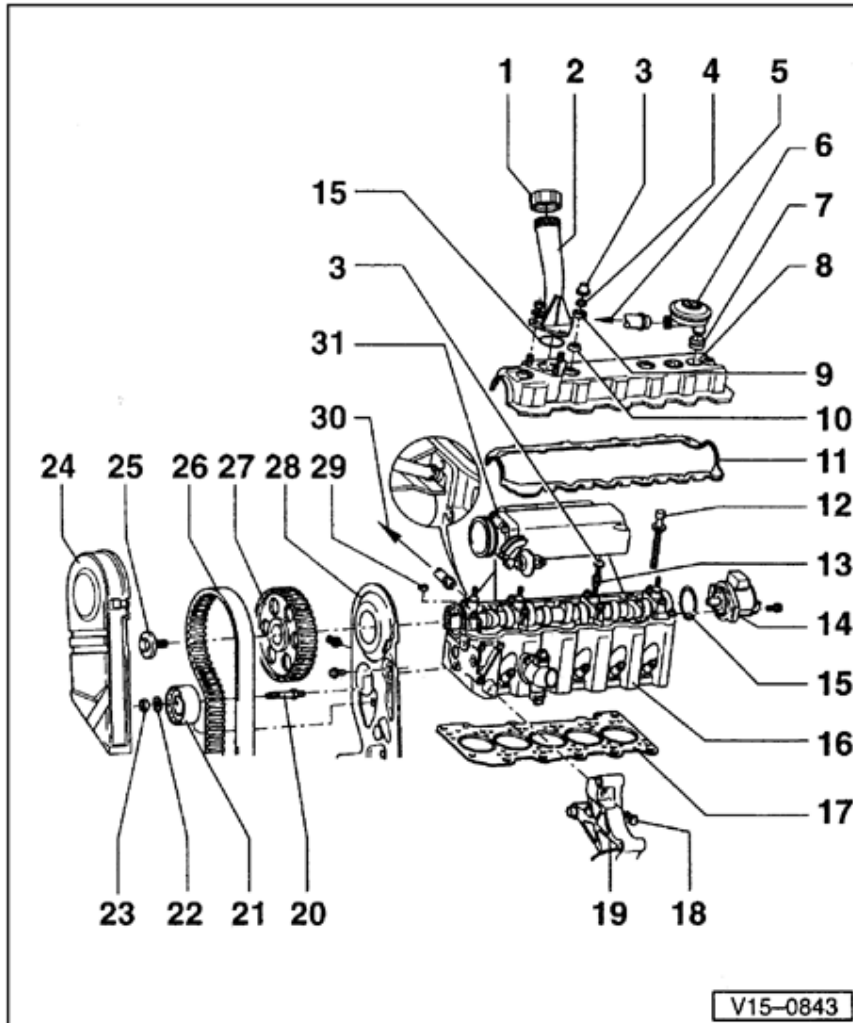
- ◆ Note installation position
- ◆ Always replace
- ◆ After replacing,

completely
replace the
coolant

18 - 20 Nm (15 ft lb)

19 - Bracket

15-4



20 - 20 Nm (15 ft lb)

21 - Tensioner

- ◆ 10.91 ➤
- ◆ Removing, installing and tensioning toothed belt ⇒ [Page 13-17](#)

22 - Washer

- ◆ With locking tab

23 - 15 Nm (11 ft lb)

24 - Front toothed belt guard, upper section

25 - Camshaft sprocket mounting bolt

- ◆ Observe steel type marking on bolt head:

8.8 = 85 Nm (63 ft lb)

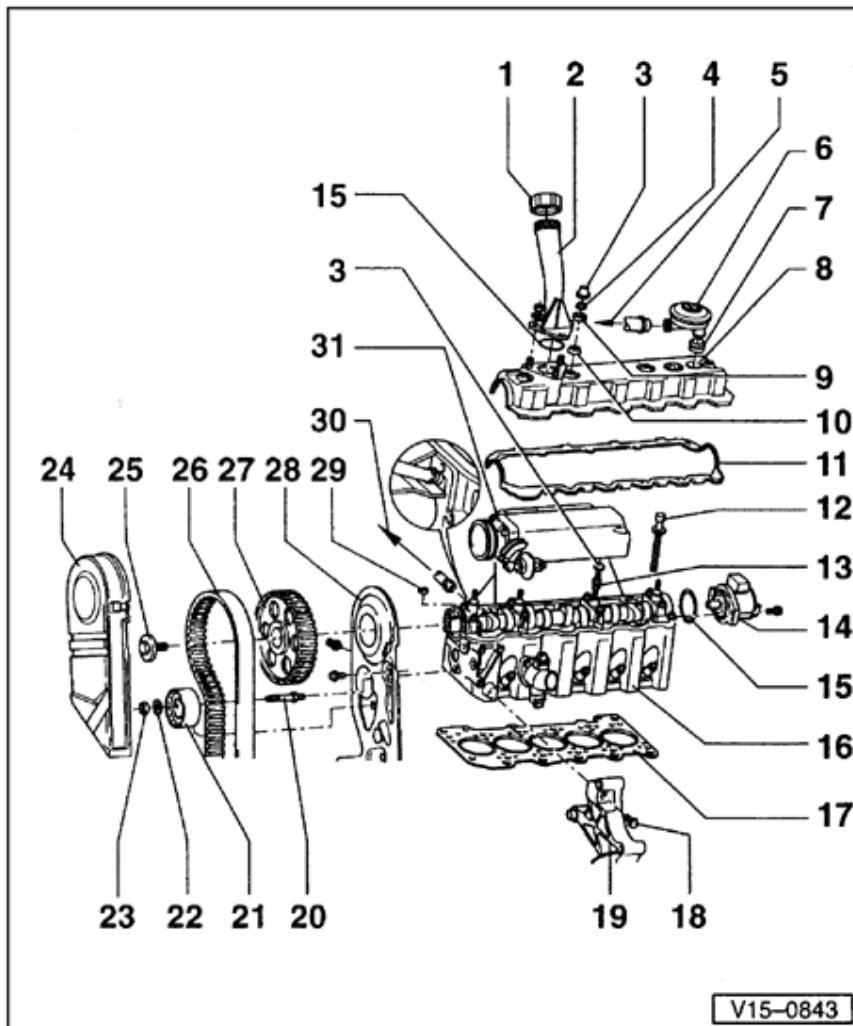
10.9 = 100 Nm (74 ft lb)

- ◆ Counter-hold with 3036 to loosen and tighten

26 - Toothed belt

- ◆ Check for wear
- ◆ Do not kink
- ◆ Removing and installing ⇒ [Page 13-17](#)

15-5



27 - Camshaft sprocket

- ◆ Note position when installing the toothed belt ⇒ [Page 13-17](#)

28 - Toothed belt guard, rear

- ◆ To remove cylinder head loosen mount

29 - Woodruff key

- ◆ Check for tight fit

30 - To junction on Coolant expansion tank ⇒ [Page 19-1](#)

31 - Intake manifold

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 24*

15-6



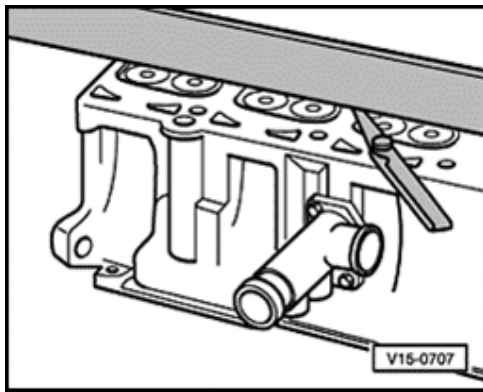


Fig. 1 Cylinder head, distortion checking

- ◆ Max. permissible distortion: 0.1 mm

15-7



Cylinder head, removing and installing

Special tools, testers and auxiliary items

- ◆ VAG 1332 Torque wrench, 40 to 200 Nm (30 to 148 ft lb)
- ◆ 3070 Guide pins
- ◆ Emery paper

Test conditions

- Engine cold
- Pistons NOT at TDC

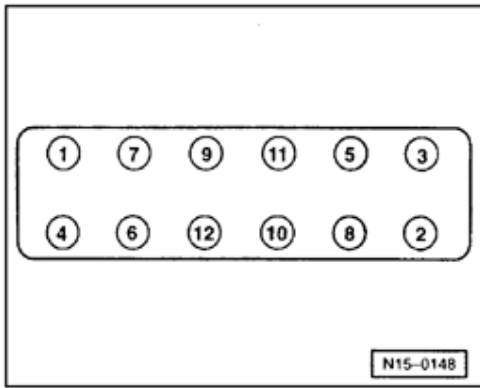
Notes:

- ◆ *Remove the new cylinder head gasket from its packaging just before installing.*
- ◆ *Handle the new gasket with extreme care. Damage to the silicone coating in the beaded area will lead to leaks.*

15-8



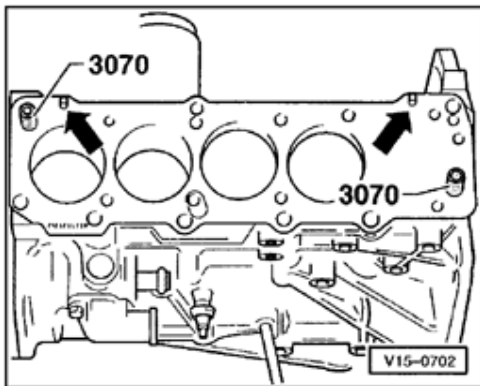
Removing



- Follow sequence when loosening and tightening cylinder head bolts

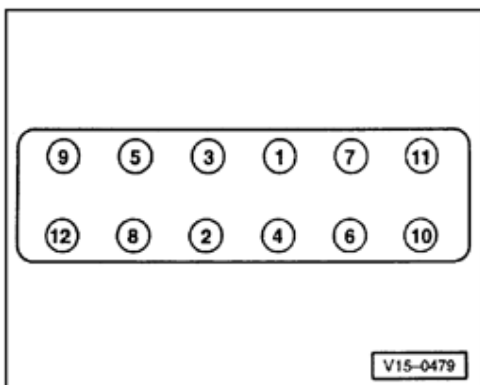
Installing

- Carefully remove any gasket remnants, make sure that no long scores or scratches are formed (do not use a coarser grade of abrasive paper than 100 grit).
- Carefully remove any remaining metal or abrasive particles



- Center the cylinder head by installing the 3070 screw guide pins into cylinder head bolts -9- and -10-.
- Install cylinder head gasket
 - If installed correctly, part number lettering must be readable
- Install cylinder head, screw in 10 remaining cylinder head bolts and tighten by hand.
- Remove guide pins with removal tool from 3070 and install cylinder head bolts.

15-9



- Tighten cylinder head in four stages in sequence shown as follows:
- 1. Tighten initially with torque wrench:
 - Stage I = 40 Nm (30 ft lb)
 - Stage II = 60 Nm (44 ft lb)
- 2. Turn further with normal spanner:
 - Stage III = $\frac{1}{4}$ turn (90 °)
 - Stage IV = $\frac{1}{4}$ turn (90 °)

Notes:

- ◆ *Loosening cylinder head: Reverse sequence of tightening.*

◆ *Re-torquing cylinder head is not necessary.*

15-10



Compression, checking

Special tools, testers and auxiliary items

- ◆ 3122B Spark plug key
- ◆ VAG 1381/1763 Compression tester

Test conditions

- Engine oil temperature min. 30 ° C.

Test sequence

- Disconnect Camshaft Position sensor harness connector
- Open throttle to Wide Open Throttle position
- Check compression using VAG 1381/1763 compression tester.
- ◆ Using compression tester

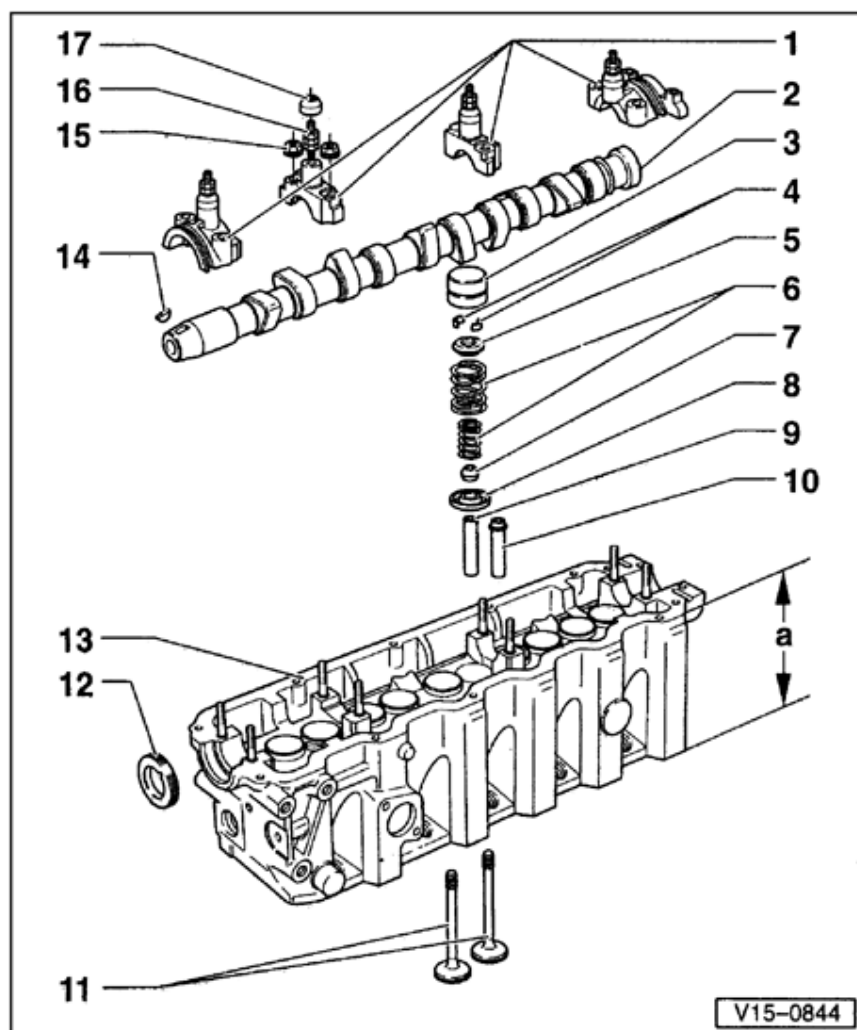
⇒ Operating instructions

- Operate starter until tester shows no further pressure increase.

Compression pressure:

Engine code	new	Wear limit
AAF	9 to 12 bar	7.0 bar
ACU	10 to 13 bar	7.5 bar

Permissible difference between all cylinders: 3 bar



Valve train, servicing

Note:

Cylinder heads which have cracks between the valve seats or between valve seat inserts and the spark plug thread can continue to be used without reducing service life, provided the cracks do not exceed a maximum width of 0.5 mm, or when no more than the first spark plug thread is cracked.

1 - Bearing cap

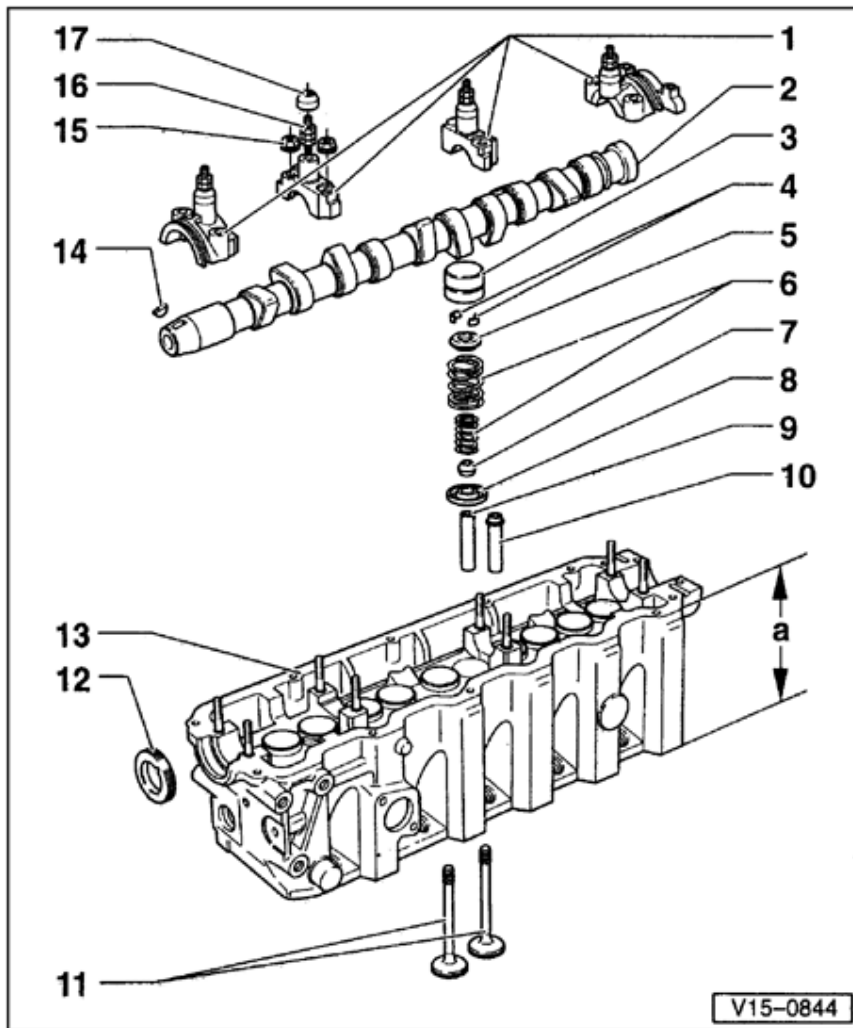
- ◆ Installation position ⇒ [Page 15-15](#) Fig. ⇒ [2](#)
- ◆ Installation sequence ⇒ [Page 15-24](#)

2 - Camshaft

- ◆ Checking axial clearance ⇒ [Page 15-15](#) , Fig. ⇒ [1](#)
- ◆ Removing and installing ⇒ [Page 15-24](#)
- ◆ Checking radial clearance with plastigage

Wear limit: 0.1 mm

- ◆ Run-out: max. 0.01 mm
- ◆ Identification and valve timing ⇒



3 - Hydraulic lifter

- ◆ Do not interchange
- ◆ With hydraulic valve clearance compensation
- ◆ Checking ⇒ [Page 15-23](#)
- ◆ Store with cam contact surface downward
- ◆ Before installing check camshaft axial clearance ⇒ [Page 15-15](#) , Fig. ⇒ [1](#)
- ◆ Oil contact surface

4 - Keepers

5 - Upper valve spring plate

- ◆ Identification:
Wider external chamfer internal chamfer

6 - Valve springs

- ◆ Removing and installing: with Cyl head removed: use 2037 with Cylinder head installed: ⇒ [Page 15-31](#)

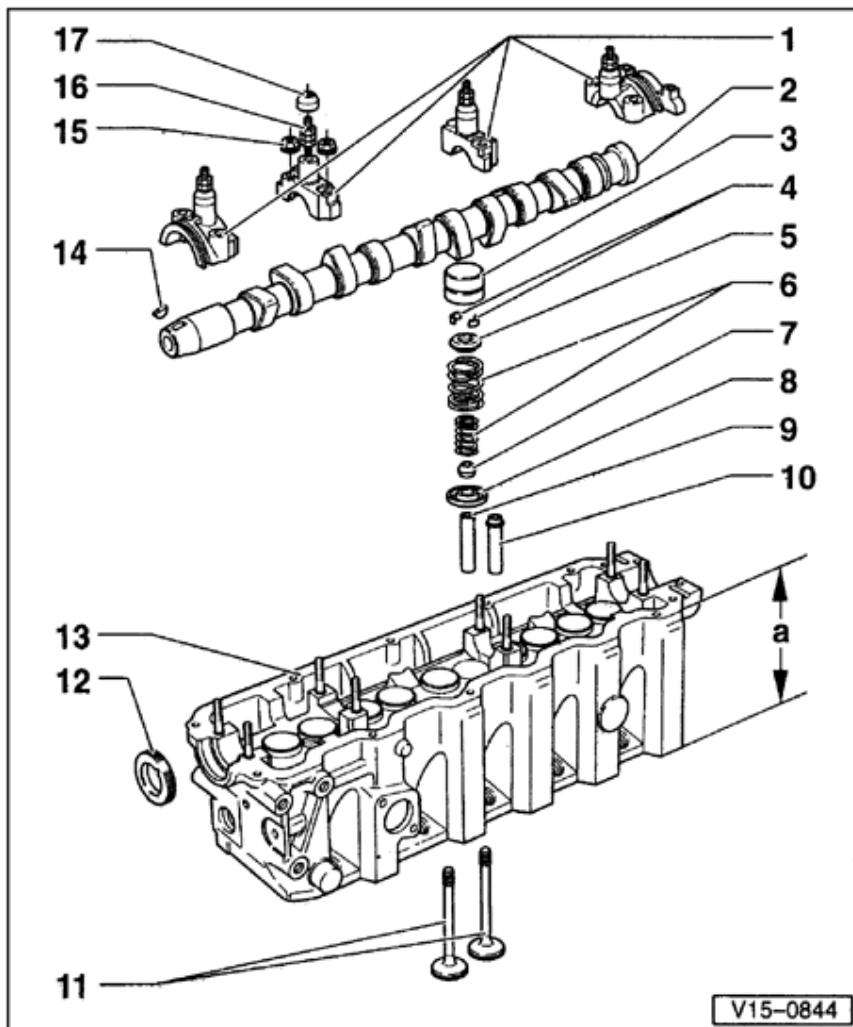
7 - Valve stem seal

- ◆ Replacing ⇒ [Page 15-31](#)

8 - Lower valve spring plate

- ◆ Remove and install with 3047A puller

15-13



9 - Valve guide

- ◆ Checking ⇒ [Page 15-29](#)
- ◆ Replacing ⇒ [Page 15-30](#)

10 - Valve guide, service part

- ◆ Service version with collar

11 - Valves

- ◆ Do not rework! Only lapping is permitted
- ◆ Valve dimensions ⇒ Fig. ⇒ [4](#)

12 - Oil seal

- ◆ Lightly oil sealing lip of oil seal
- ◆ Replacing ⇒ [Page 15-27](#)

13 - Cylinder head

- ◆ Reworking dimension:

Minimum height: a
= 132.6 mm

◆ Reworking valve seats ⇒ [Page 15-19](#)

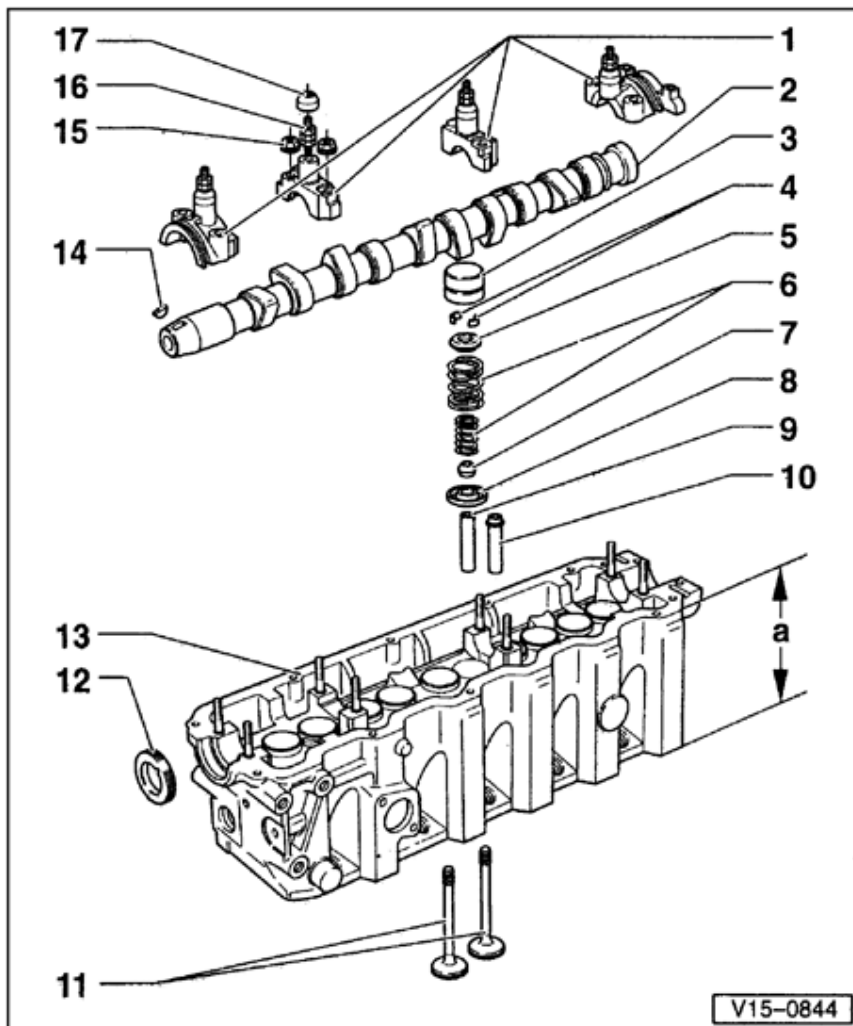
◆ See notes ⇒ [Page 15-1](#) and
⇒ [Page 15-11](#)

14 - Woodruff key

◆ Make sure tight fit

15 - 20 Nm (15 ft lb)

15-14



16 - 15 Nm (11 ft lb)

17 - Cover cap

15-15



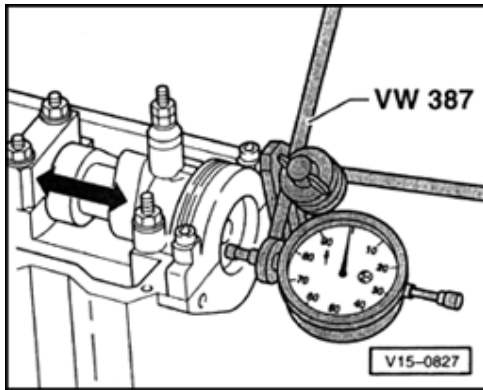


Fig. 1 Camshaft axial clearance, checking

Special tools, testers and auxiliary items

- ◆ VW 387 Universal dial gauge bracket
- ◆ Dial gauge
- Check hydraulic lifters, remove with first and last bearing cap installed.
- Wear limit: max. 0.15 mm

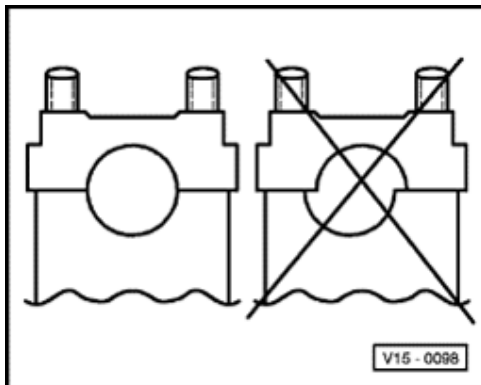


Fig. 2 Camshaft bearing caps, installing

- Note offset. Install bearing caps and determine installation position before installing camshaft.

15-16

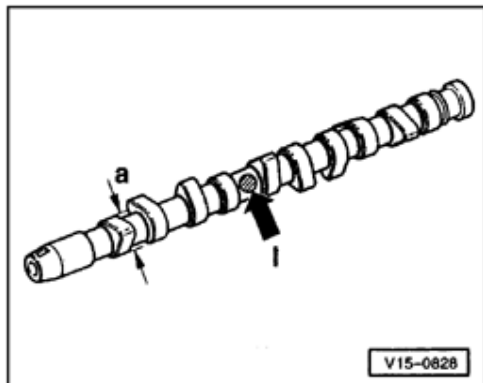


Fig. 3 Camshaft identification, valve timing

15-17



Identification -arrow 1- between cams for cylinders 2 and 3

Code letters	AAF, ACU
Identification	023E
Cam base diameter	34
a = diameter mm	

Valve timing at 1 mm valve lift

Code letters	AAF, ACU
Intake opens ATDC	2.5 °
Intake closes ABDC	32.5 °
Exhaust opens BBDC	32.5 °
Exhaust closes BTDC	2.5 °

15-18

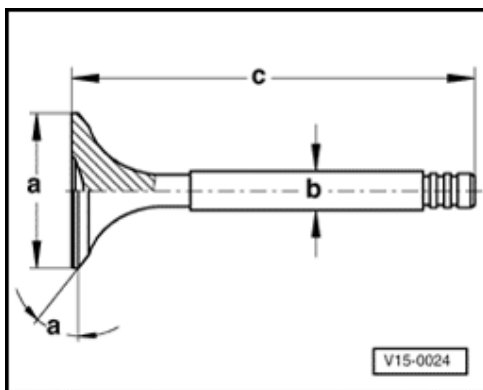


Fig. 4 Valve dimensions

Note:

Valves must not be reworked. Only lapping-in is permitted.

Dimension		Intake valve	Exhaust valve
diameter a	mm	40.00	33.00
diameter b	mm	7.97	7.95
c	mm	91.90 - 0.90	91.20 - 0.40
α	∠ °	45	45

15-19



Valve seats, reworking

Special tools, testers and auxiliary items

◆ Depth gauge

◆ Valve seat refacing tool

Notes:

◆ *When repairing engines with leaking valves, it is not always sufficient to reface or replace valve seats and valves. It is also necessary to check the valve guides for wear. This is particularly important on high mileage engines.*

◆ *Rework valve seats as little as possible to achieve a perfect seating pattern. Calculate the maximum permissible reworking dimension before starting repair. If reworking dimension is exceeded, the function of the hydraulic lifters can no longer be guaranteed and the cylinder head should be replaced.*

15-20

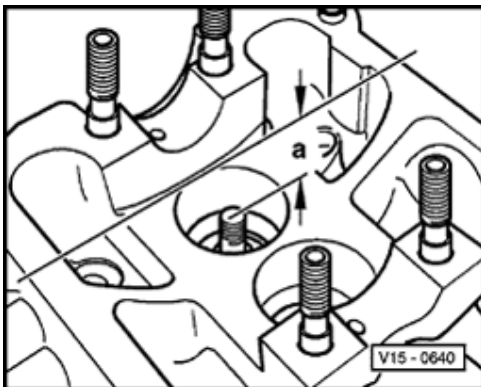


Maximum permissible working dimension, calculating

Note:

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

- Insert valve and press firmly against seat.



△ - Measure distance -a- between end of valve stem and upper edge of cylinder head.

- Calculate max. permissible reworking dimension from measured distance -a- and minimum dimension.

Minimum dimension:

Intake valve 33.8 mm

Exhaust valve 34.1 mm

15-21



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

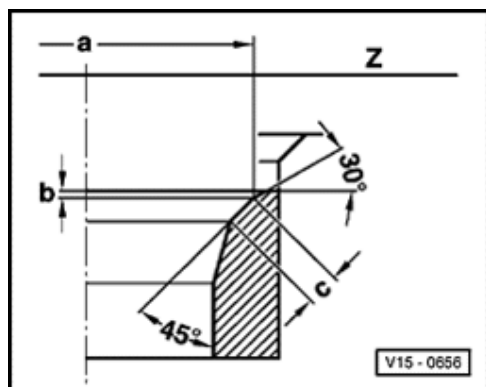
Example:

	Measured distance -a-	35.1	mm
-	Minimum dimension	34.1	mm
=	max. perm. working dimension	0.7	mm

Note:

If the measured distance -a- is smaller than the minimum dimension, repeat measuring process with new valves and if necessary use shorter valves (valve length -c- ⇒ [Page 15-18](#) , Fig. ⇒ [4](#)) or replace cylinder head.

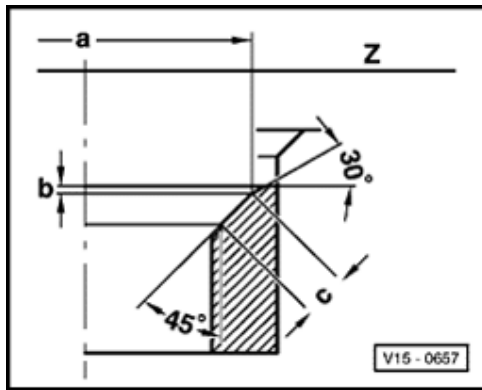
15-22



Intake valve seat, reworking

Dimension		Intake valve seat
diameter a	mm	37.2
diameter b	mm	max. permissible reworking dim.
c	mm	approx. 2.0 ^{**)}
Z		Cylinder head lower edge
45°		Valve seat angle
30°		Upper correction angle

^{**)} if necessary rework valve seat with 75° correction reamer.



Exhaust valve seat, reworking

Dimension		Exhaust valve seat
diameter a	mm	32.4
diameter b	mm	max. permissible working dim.
c	mm	approx. 2.4
Z		Cylinder head lower edge
45°		Valve seat angle
30°		Upper correction angle

Note:

Exhaust valve seat inserts have an additional internal constriction. When reworking, make sure that the radius of the constriction is not damaged.

15-23



Hydraulic lifters, checking

Special tools, testers and auxiliary items

- ◆ Feeler gauge
- ◆ Wood or plastic wedge

Notes:

- ◆ *Replace faulty lifter (cannot be adjusted or repaired).*
- ◆ *Irregular valve noises when starting engine are normal.*

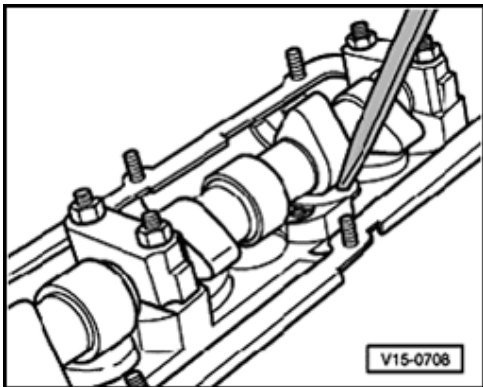
Test sequence

- Start engine and run until radiator fan has switched on once.
- Increase engine speed to about 2500 rpm for 2

minutes.

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

- Remove valve cover.
- Rotate crankshaft clockwise on toothed belt sprocket mounting bolt, until lobe for lifter to be checked is pointing upward.
- Determine play between cam and lifter.



- Press lifter down with wooden or plastic wedge, far enough to insert a 0.2 mm feeler gauge between lobe and lifter. If excess play is present, replace lifter.

Note:

After installing new lifters the engine must not be started for approx. 30 minutes. Hydraulic compensation elements must settle (otherwise valves will strike pistons).

15-24



Camshaft, removing and installing

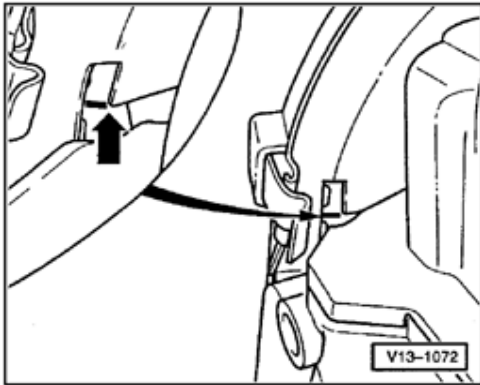
Special tools, testers and auxiliary items

- ◆ Counter-hold tool 3036
- ◆ Torque wrench VAG 1331, 5 - 50 Nm (4 to 37 ft lb)
- ◆ Torque wrench VAG 1332, 40 - 200 Nm (30 to 148 ft lb)

Removing

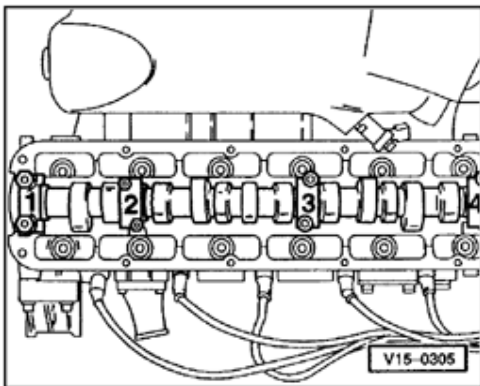
- Remove toothed belt guard upper section.
- Remove cylinder head cover.

- Loosen camshaft sprocket (counter-hold with 3036).



- Set camshaft sprocket to TDC No. 1 cylinder by turning the crankshaft. Mark on camshaft sprocket must align with mark on rear toothed belt guard -arrow-.
- Release tensioning roller or coolant pump and take off toothed belt.
- Pull off camshaft sprocket.
- Remove woodruff key from camshaft.
- Remove distributor.

15-25



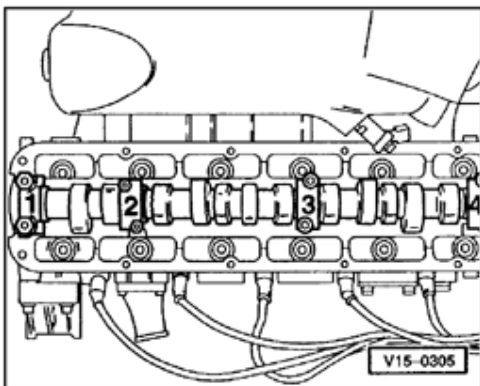
- First remove bearing caps 1 and 3. Loosen bearing caps 2 and 4 alternately and diagonally.

Installing

Notes:

- ◆ When installing the camshaft No. 1 cylinder cams must point upward.
- ◆ When installing the bearing cap note offset, before installing camshaft install bearing caps and determine installation position.

- Oil camshaft running surfaces.



- Tighten bearing caps 2 and 4 alternately and diagonally
 - ◆ 20 Nm (15 ft lb)
- Install bearing caps 1, 3 and 5 and tighten
 - ◆ 20 Nm (15 ft lb)
- Insert woodruff key in camshaft.



- Install camshaft sprocket and tighten (use counter-hold tool 3036).

Tightening torque:

Tensile strength: 8.8 = 85 Nm (63 ft lb)

Tensile strength: 10.9 = 100 Nm (74 ft lb)

- Install distributor (note position of drive dog)
⇒ [Page 13-17](#) , Removing, tensioning and installing toothed belt (adjusting valve timing)

Note:

When new lifters have been installed, the engine must not be started for about 30 minutes. Hydraulic compensation elements must settle (otherwise valves will strike pistons).



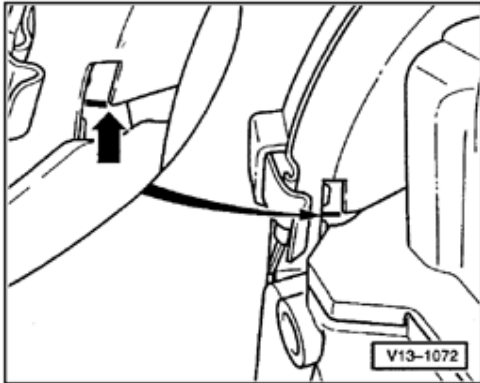
Camshaft oil seal, removing and installing

Special tools, testers and auxiliary items

- ◆ 3036 Counter-hold tool
- ◆ 2085 Oil seal extractor
- ◆ 10-203 Oil seal fitting tool
- ◆ VAG 1332 Torque wrench 40 - 200 Nm (40 to 148 ft lb)

Removing

- Remove front toothed belt guard upper part.
- Loosen camshaft sprocket using 3036 counter-hold



4

- Set camshaft sprocket to TDC cyl. 1 by turning crankshaft.
 - Mark on camshaft sprocket must align with - arrow- on toothed belt guard.
- Release tensioning roller or coolant pump and remove toothed belt.
- Remove camshaft sprocket.
- Remove woodruff key from camshaft.

15-28



- Screw camshaft sprocket mounting bolt w/ washer fully into camshaft
- Unscrew inner part of 2085 oil seal extractor two turns (approx. 3 mm) out of the outer part and lock using knurled screw.
- Lubricate threaded head of oil seal extractor, place in position and while exerting firm pressure, screw 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 vise.
- Remove oil seal with pliers.

Installing

- Lightly lubricate oil seal lip

- Start oil seal with 10-203 sleeve, press in to stop with 10-203.
- Insert woodruff key in camshaft.
- Install camshaft sprocket and tighten using 3036 counterhold tool

◆ Tightening torque:

Tensile strength: 8.8 = 85 Nm (63 ft lb)

Tensile strength: 10.9 = 100 Nm (74 ft lb)

- Removing, installing and tensioning toothed belt ⇒ [Page 13-17](#) .

15-29

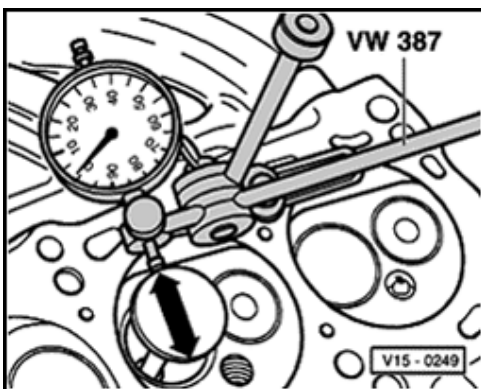


Valve guides, checking

Special tools, testers and auxiliary items

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

Test sequence



- Insert a new valve into guide until end of valve stem is flush with end of guide. Due to the slight difference in stem dimensions, make sure that only an intake valve is used in the intake guide and only an exhaust valve in the exhaust guide.
- Determine amount of rock
 - ◆ Wear limit:
Intake valve guide = 1.0 mm
Exhaust valve guide = 1.3 mm



Valve guides, replacing

Special tools, testers and auxiliary items

- ◆ Drift 10-206
- ◆ 10-215 Hand reamer and cutting fluid

Work sequence

- Clean and check cylinder head. Cylinder heads which the valve seats can no longer be reworked, or cylinder heads which have been machined to the minimum dimension, should not have the valve guides replaced.
- Press out worn valve guides with drift 10-206 from the camshaft side (valve guides with shoulder - repair version - from the combustion chamber side).

Note:

When the valve guide shoulder makes contact, the pressure must not exceed 1.0 ton otherwise shoulder may break off.

- Coat new guides with oil and press in with 10-206 from the camshaft side (cylinder head cold) until shoulder makes contact.
- Ream out guides with hand reamer 10-215 using plenty of cutting fluid.
- Rework valve seats ⇒ [Page 15-19](#)

15-31



Valve stem seals, replacing

(with cylinder head installed)

Special tools, testers and auxiliary items

- ◆ VAG 1202 or VAG 1556/2 Workshop crane
- ◆ VW 653/3 Pressure hose
- ◆ 3047A Puller
- ◆ 2036 Assembly tool
- ◆ VW 541/1A Lever with press piece VW 541/5
- ◆ 10-204 Installation tool
- ◆ 3122B Spark plug wrench

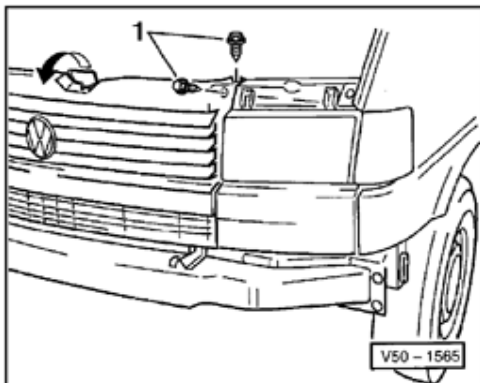
Work sequence

Vehicles 09.94 ➤

- Remove radiator grille

⇒ [Repair Manual, Body Exterior, Repair group 66](#)

15-32

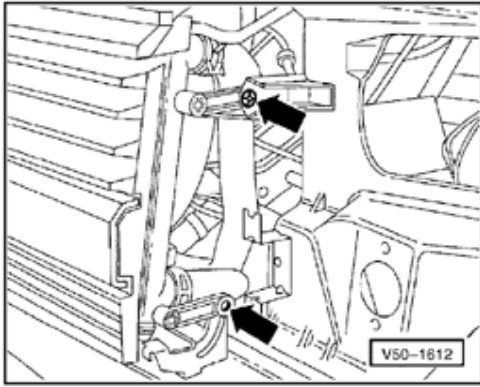


All vehicles



- Remove left and right mounting bolts -1-.
- Tilt lock carrier and radiator out forward -arrow-.
- Attach radiator to workshop crane.

Vehicles ➤12.95



- Drive pins out of spreader clips -arrows- on left and right and unclip spreader clips from the radiator bracket.

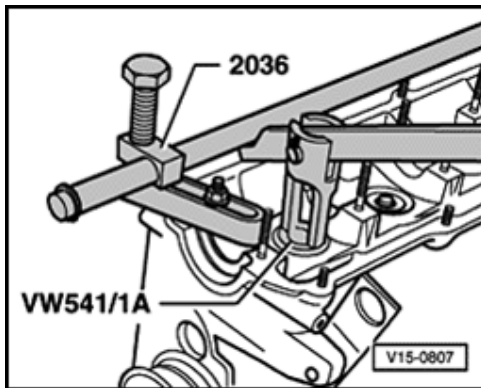
All vehicles

- Lift radiator with workshop crane.
- Remove camshaft ⇒ [Page 15-24](#)
- Remove hydraulic lifters (do not interchange) and store with the contact surface facing downward.

15-33



- Remove spark plugs.
- Set piston of appropriate cylinder to "bottom dead center".

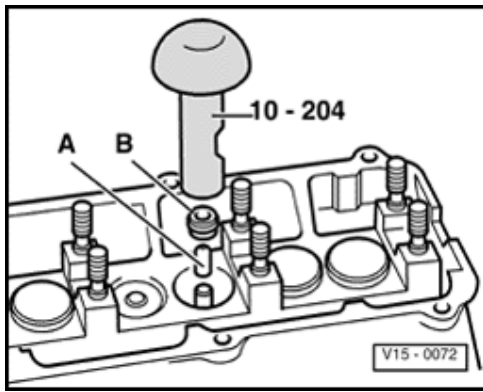


- Install assembly tool 2036 and adjust mountings to height of studs.
- Screw compressed air hose VW 653/3 into spark plug thread and apply a continuous pressure of 6 bar (75 psi) minimum.
- Remove valve springs using VW 541/1A lever and press piece VW 541/5.

Note:

Tight keepers can be loosened by tapping lightly on the lever.

- Remove valve stem seals with 3047A.



- To prevent damage to the new valve stem seals, place plastic sleeve -A- on valve shaft.
- Oil valve stem seal -B-, place it in tool 3129 and push carefully onto the valve guide.

Note:

After installing new lifters, do NOT start the engine for approx. 30 minutes. Hydraulic compensation elements must settle (otherwise the valves will strike the pistons).

17 - Engine - Lubrication

Lubrication system components, removing and installing

Part I

Part II

Oil pressure and oil pressure switch, checking



Lubrication system components, removing and installing

Notes:

- ◆ *When repairing an engine, metal shavings or a large quantity of small metal particles for example, caused by partial seizure of crankshaft and connecting rod bearings, are found in the engine oil, to prevent consequential damage, thoroughly clean oil passages, replace the oil cooler.*
- ◆ *The oil level must not be above the max. mark, otherwise there is danger of catalyst damage!*

Oil pressure, checking ⇒ [Page 17-14](#)

Oil system capacity

- ◆ Without oil filter 5.0 ltrs. (5.3 quarts)
- ◆ With oil filter 5.5 ltrs. (5.8 quarts)

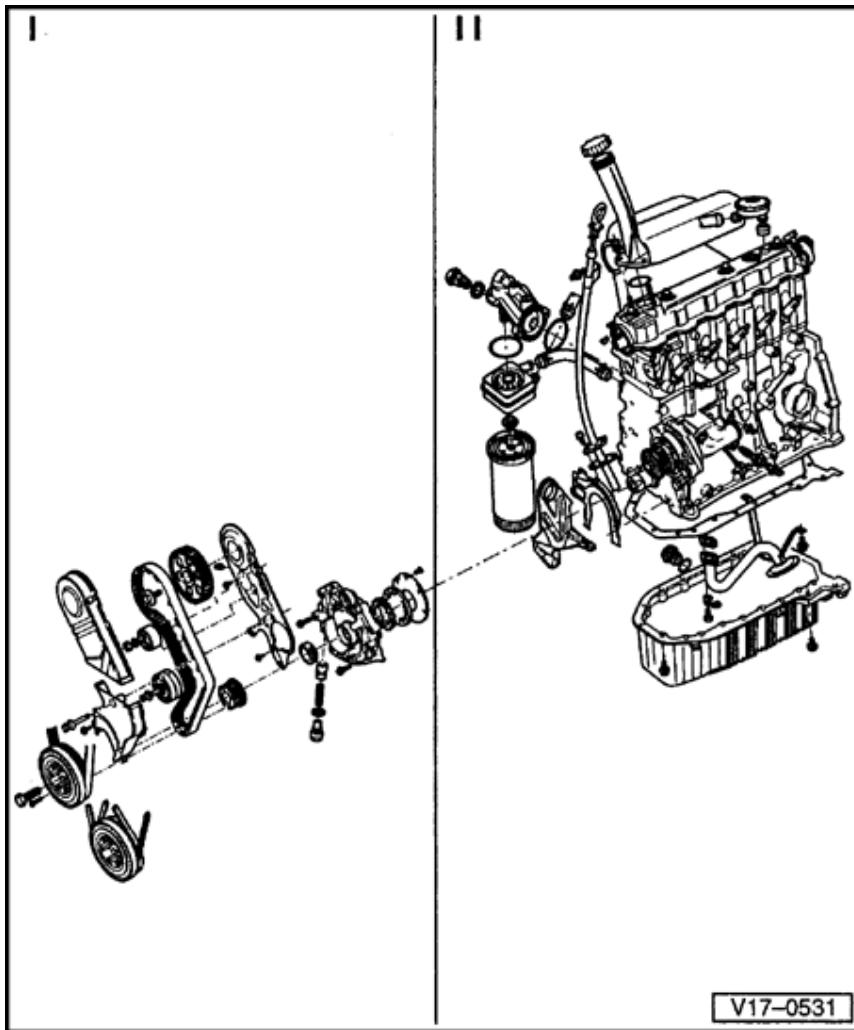


Engine oil specifications:

The following terms must appear on the oil container singly or in combination with other designations: VW 502 00 or VW500 00 or VW501 01, ACEA A2 or ACEA A3, API-SJ, or API-SL.

- ◆ Engine oils are graded according to their viscosity. The proper grade to be used depends on existing climatic or seasonal conditions.
- ◆ The original engine oil has a viscosity grade of SAE 5W-40. This oil can be used over all temperature ranges for normal driving. If engine oil viscosity grade SAE 5W-40 is not available, SAE 5W-30 can also be used.

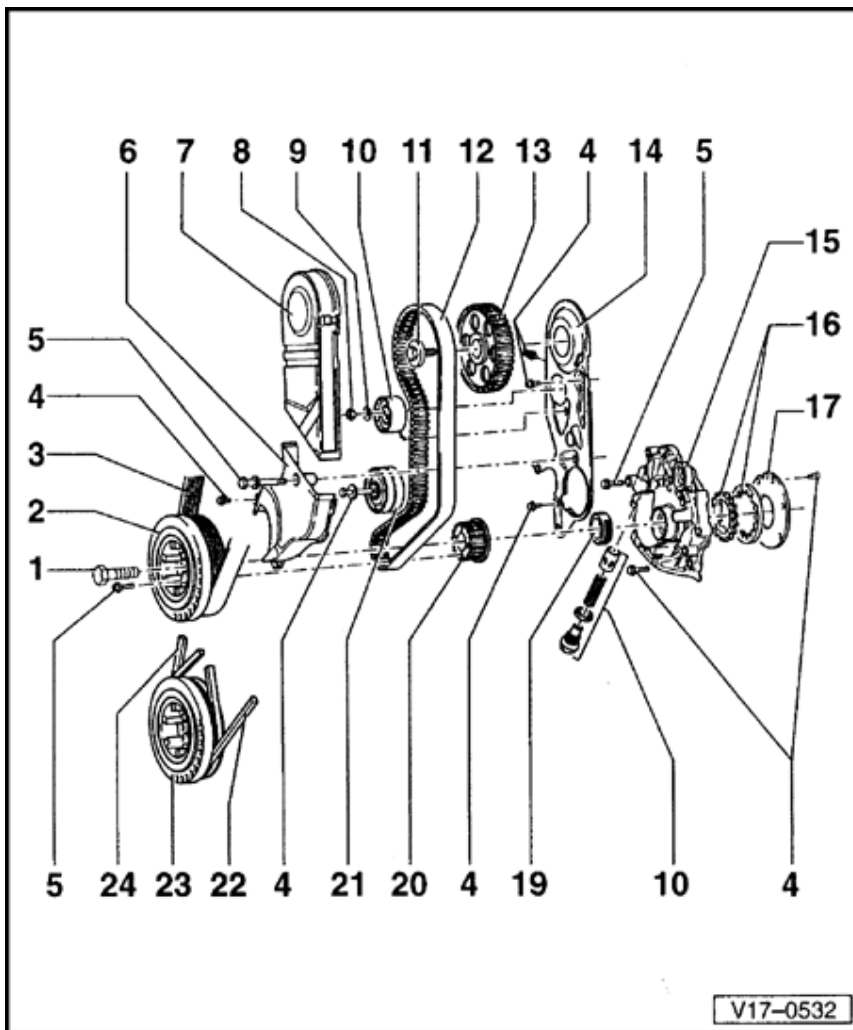




I ⇒ [Page 17-4](#)

II ⇒ [Page 13-5](#)





Part I

1 - Vibration damper center bolt

- ◆ Removing, installing and tensioning toothed belt ⇒ [Page 13-17](#)
- ◆ Loosen and tighten using 3419 counterhold ⇒ [Page 13-17](#)

Screw length: 65 mm

- ◆ Coat threads and bolt head contact surface with sealing paste AMV 188 001 02

- ◆ Tightening torque 460 Nm (340 ft lb)

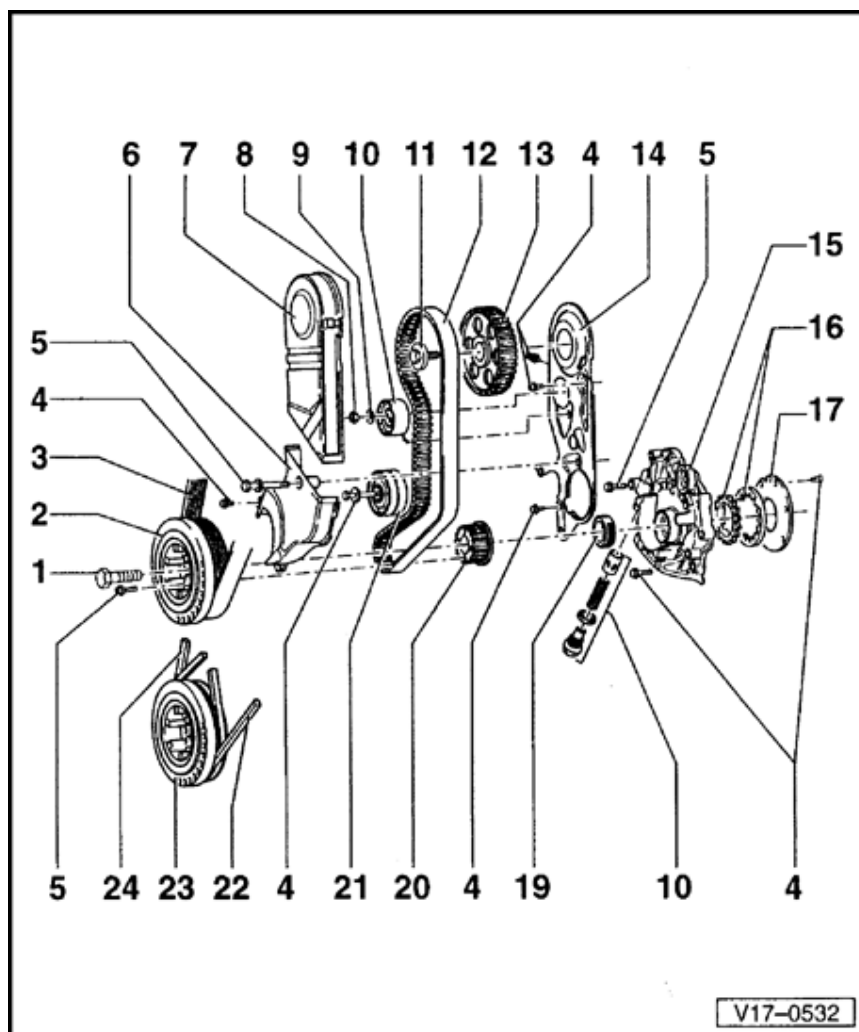
Screw length: 110 mm

- ◆ Tightening torque 160 Nm (118 ft lb) + 1/2 turn (2 x 90 °) further

- ◆ 90 ° additional turn can be carried out in several stages.

2 - Vibration damper with ribbed V-belt pulley

- ◆ 10.91 ➤
- ◆ Vibration damper and crankshaft toothed belt sprocket can only be installed in one position



3 - Ribbed belt

- ◆ 10.91 ➤
- ◆ Mark direction of rotation before removing
- ◆ Check for wear
- ◆ Remove/install with 3299 lever
⇒ [Page 13-14](#)

4 - 10 Nm (7 ft lb)

5 - Mounting screw for vibration damper with ribbed belt

- ◆ 20 Nm (15 ft lb)
- Ribbed belt pulley
- ◆ 20 Nm + 1/4 turn (90 ° further)

6 - Front toothed belt guard -lower part-

- ◆ to remove; remove vibration damper if necessary

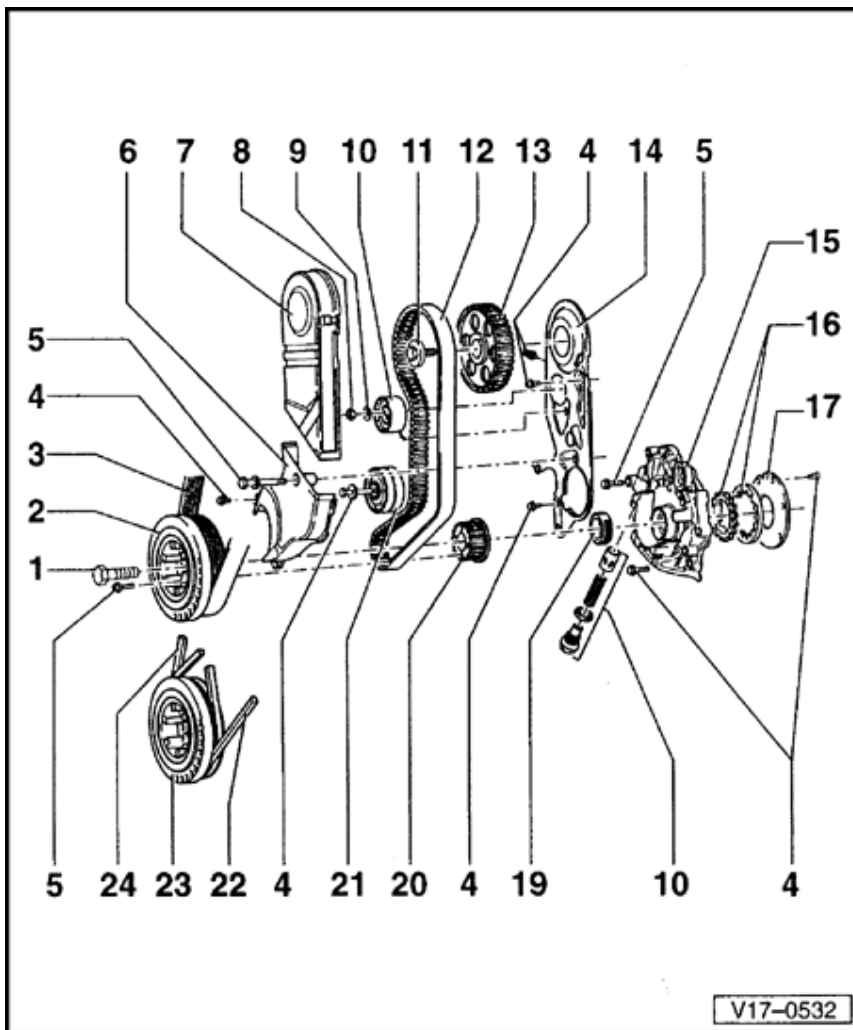
7 - Front toothed belt guard, upper section

8 - 15 Nm (11 ft lb)

9 - Woodruff key

- ◆ with locking tab





10 - Tensioner

- ◆ 10.91 ➤
- ◆ Removing, installing and tensioning toothed belt ⇒ [Page 13-17](#)

11 - Camshaft sprocket securing bolt

- ◆ Observe steel type marking on bolt head:

8.8 = 85 Nm (63 ft lb)

10.9 = 100 Nm (74 ft lb)
- ◆ Loosen and tighten with 3036 counter-hold

12 - Toothed belt

- ◆ Removing and installing ⇒ [Page 13-17](#)

13 - Camshaft sprocket

- ◆ Note position when removing and installing toothed belt ⇒ [Page 13-17](#)

14 - Toothed belt guard - rear

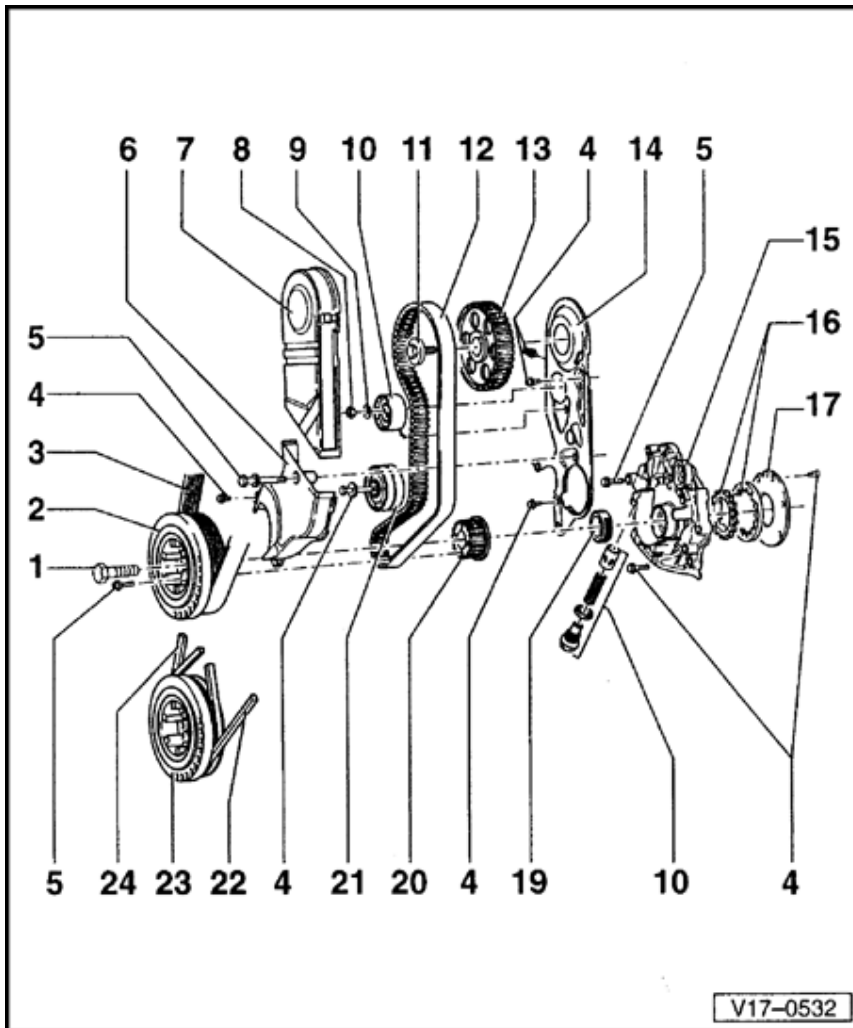
- ◆ To remove, take off vibration damper if necessary

15 - Oil pump housing

- ◆ When installing; note coupling ring on crankshaft ⇒

- ◆ Only replace as an assembly

17-7



16 - Oil pump drive gears

- ◆ Identification mark "D" points in direction of end plate

17 - End plate

18 - Pressure relief valve

- ◆ 40 Nm (30 ft lb)
- ◆ Opening pressure: 5.3 to 6.3 bar

19 - Oil seal

- ◆ Replacing = [Page 13-34](#)

20 - Crankshaft sprocket

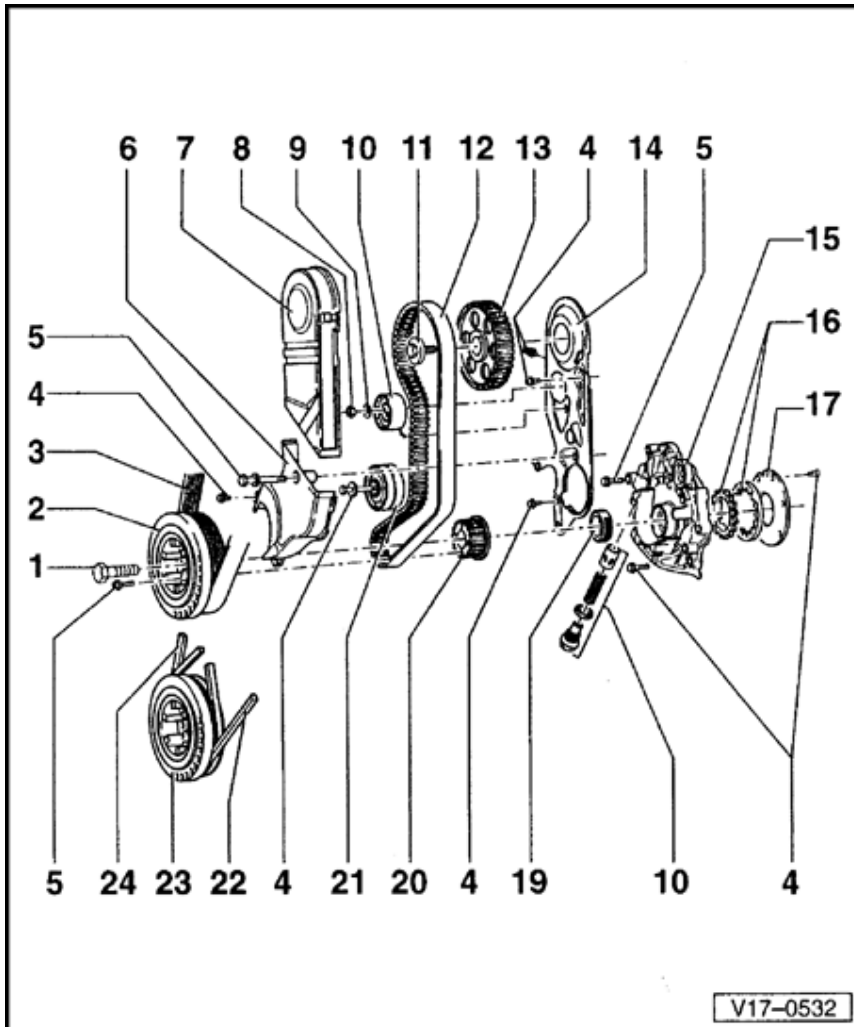
21 - Idler wheel

22 - V-belt

- ◆ ➤ 09.91
- ◆ for generator
- ◆ Check tension using thumb:
Max. deflection:
New V-belt approx. 2 mm
Used V-belt approx. 5 mm

- ◆ Check V-belt tension on vehicles with toothed rack tensioner ⇒ [Page 13-24](#)

17-8



23 - Vibration damper with V-belt pulley

- ◆ ➤09.91
- ◆ Installing vibration damper and crankshaft toothed belt sprocket only possible in one position

24 - V-belt

- ◆ ➤09.91
- ◆ for power steering pump
- ◆ Check tension using thumb

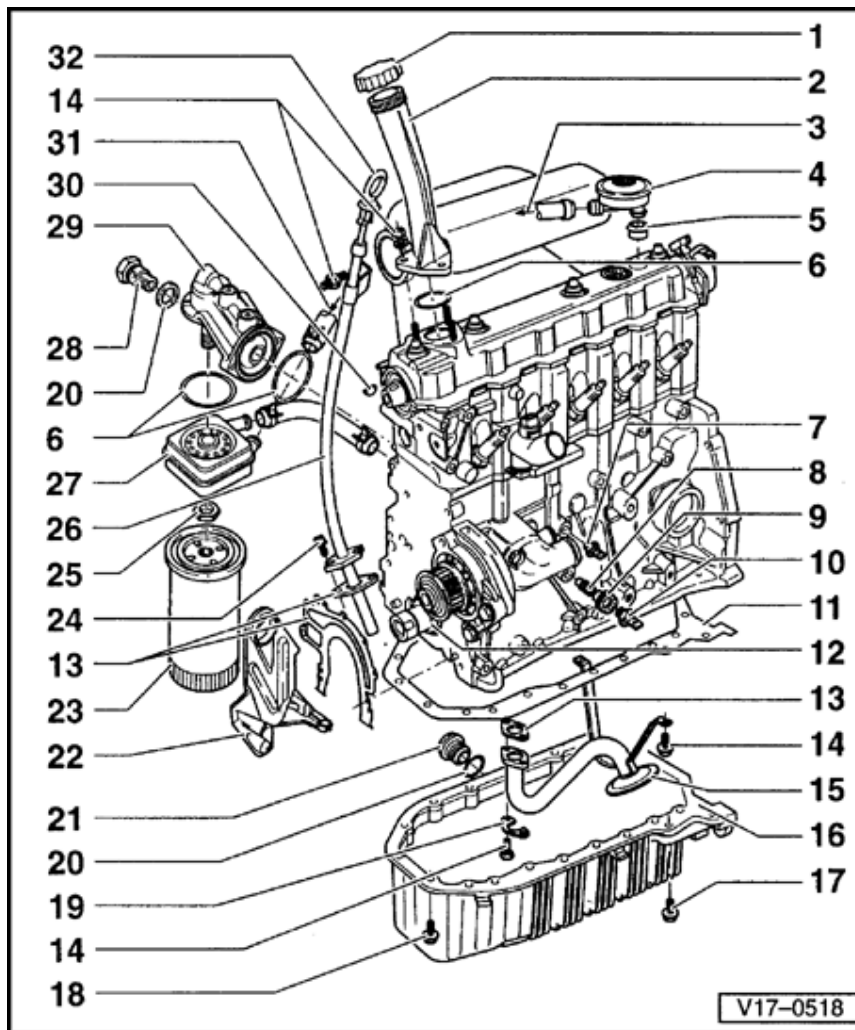
Deflection: approx. 5 mm

(new and used V-belt)

⇒ *Repair Manual, Suspension, Wheels, Steering Repair Group 48; Adjusting V-belt tension*

17-9





Part II

1 - Cap

2 - Oil filler pipe

3 - To Intake hose

- ◆ Breather hose secured with retainer to oil filler pipe item -2-

- ◆ Make sure sufficient clearance to throttle valve housing

4 - Positive Crankcase Ventilation valve

5 - Sealing ring

- ◆ Replace if damaged

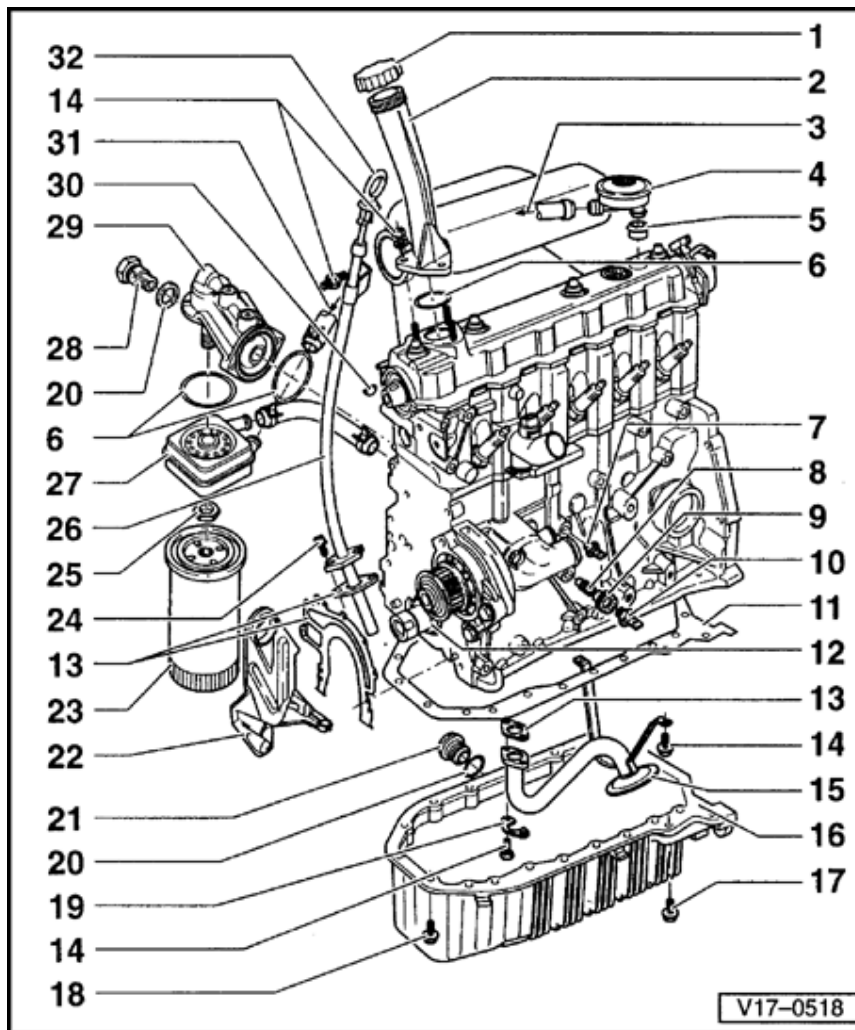
6 - O-ring

- ◆ Replace if damaged

7 - Oil pressure switch -F22-

- ◆ 25 Nm (18 ft lb)
- ◆ 0.3 bar, brown
- ◆ 0.25 bar, blue
- ◆ Checking ⇒ [Page 17-14](#)
- ◆ If sealing ring leaking; nip open and replace.





8 - Oil pressure switch

- ◆ 6 Nm (53 inch lb)
- ◆ Remove and install with commercial type multi-point key 8
- ◆ Coat with -D6- locking fluid when installing

9 - Adapter

- ◆ 50 Nm (37 ft lb)

10 - 1.8 bar oil press. switch -F1-

- ◆ 25 Nm (18 ft lb)
- ◆ White
- ◆ Wire: Yellow
- ◆ Checking ⇒ [Page 17-14](#)

11 - Oil pan gasket

- ◆ Replace
- ◆ Do not stick-on, make sure positioned correctly

12 - Coupling ring

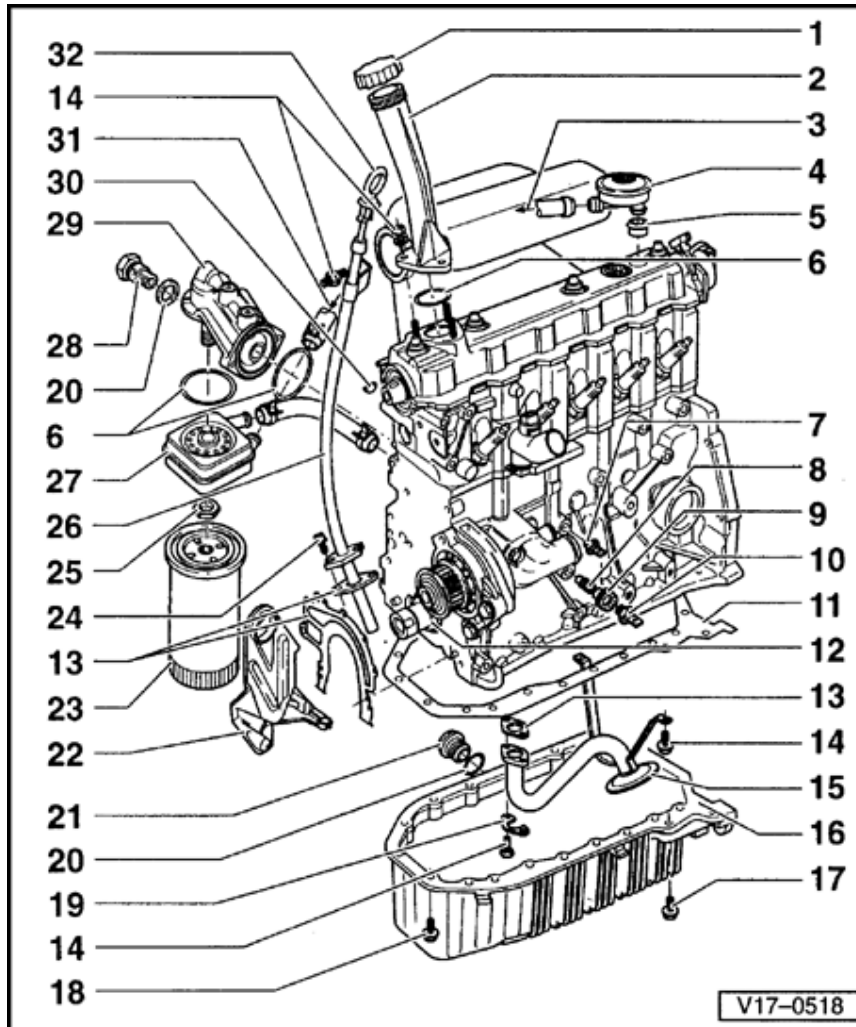
- ◆ for oil pump
- ◆ with four drive lugs
- ◆ Split with chisel to remove
- ◆ Heat new coupling ring to 200 °C max. before fitting

13 - Gasket

- ◆ Always replace

14 - 10 Nm (7 ft lb)

17-11



15 - Suction pipe

16 - Oil pan

17 - 20 Nm (15 ft lb)

- ◆ M8, install bolt with hexagon head to gearbox side

18 - 10 Nm (7 ft lb)

- ◆ Remove and install with 3249 socket
- ◆ With flywheel installed: Turn flywheel so that the recess aligns with bolt

19 - Mounting plate

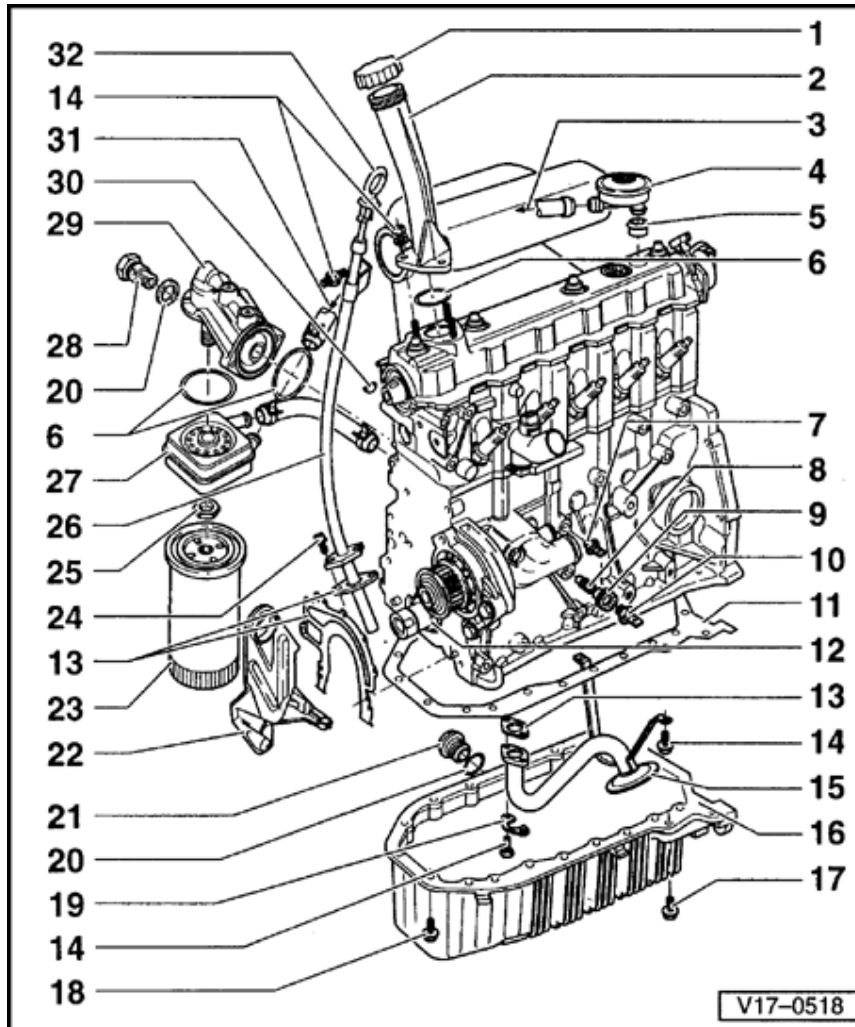
- ◆ Replace

20 - Seal

- ◆ Always replace

21 - Oil drain plug

- ◆ 50 Nm (37 ft lb)
- ◆ Replace if leaking. See Parts Catalog for correct application. In some cases, seal and drain plug are combined; do not interchange with separate seal and drain plug.



23 - Oil filter

- ◆ Loosen with sockets 2067
- ◆ Tighten by hand
- ◆ Observe installation instructions on oil filter

24 - 20 Nm (15 ft lb)

25 - 25 Nm (18 ft lb)

26 - Guide tube

- ◆ for dipstick

27 - Oil cooler

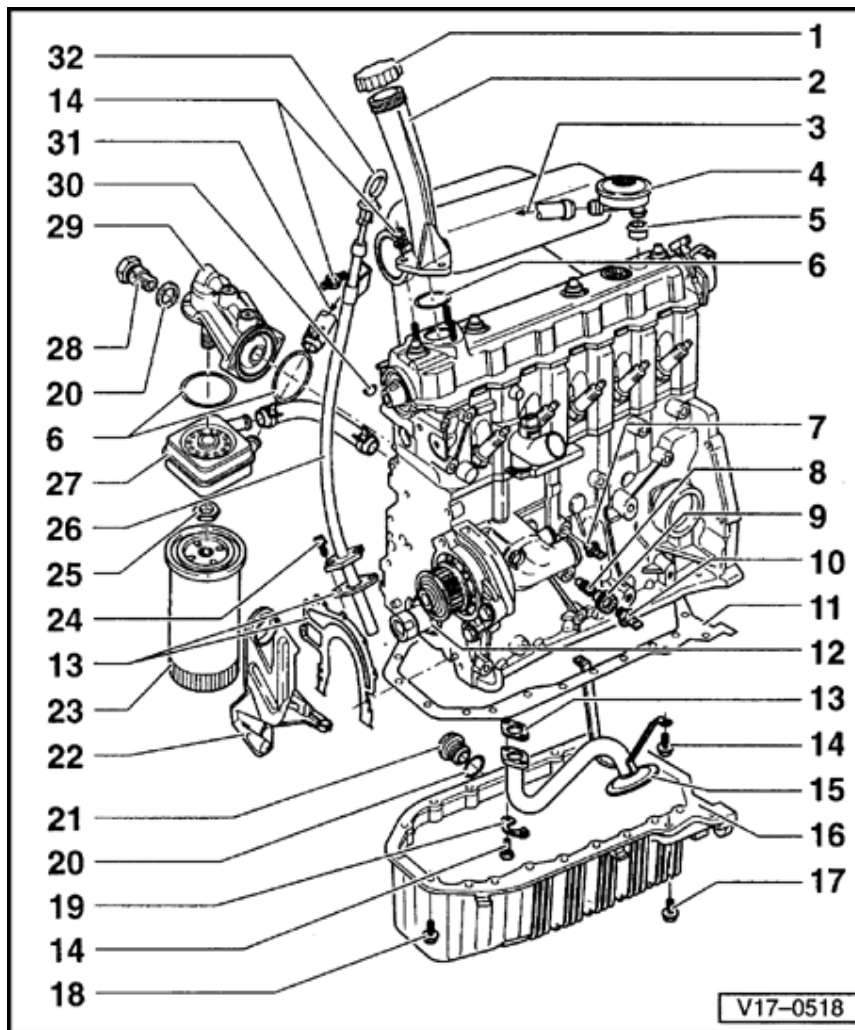
- ◆ Coat contact area to flange, outside the seal, with AMV 188 100 02
- ◆ Make sure clearance to adjacent components

- ◆ See note ⇒ [Page 17-1](#)

28 - Banjo bolt

- ◆ 70 Nm (52 ft lb)





29 - Oil filter bracket

- ◆ Installation position fixed by installed pins
- ◆ With oil non-return valve for hydraulic lifters

30 - Woodruff key

- ◆ Check for tight fit

31 - from coolant pipe

⇒ [Page 19-1](#)

32 - Dipstick

- ◆ Oil level must not be above max. mark!
- ◆ Cap. difference between min. and max. mark: 1.5 liter. (1.6 qts)

17-14



Oil pressure and oil pressure switch, checking

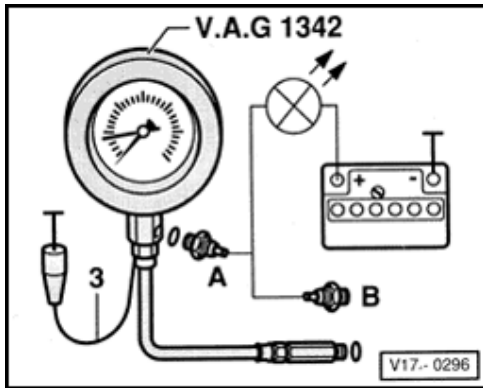
Special tools, testers and auxiliary items

- ◆ VAG 1342 Oil pressure tester
- ◆ VAG 1527B Voltage tester
- ◆ VW 1594 Adapter kit

Note:

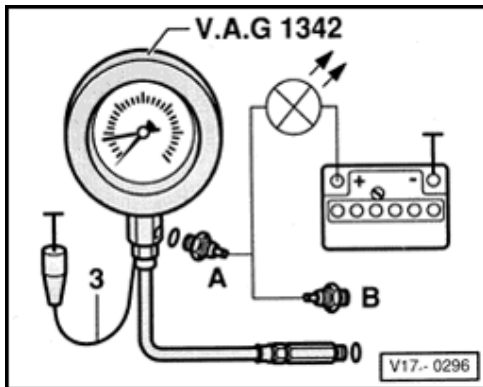
For functional check and oil pressure warning system servicing:

Test sequence



- Remove 0.3 bar oil pressure switch (brown) or 0.25 bar oil pressure switch (blue) -F22- and screw into tester.
- Screw tester VAG 1342 into position for oil pressure switch in cylinder head.
- Connect brown wire -3- of tester to Ground (-).

17-15



- Connect VAG 1527B LED tester between battery positive (+) and 0.3 bar or 0.25 bar oil pressure switch -F22- -A-
 - LED must light up
- Start engine and slowly increase engine speed
 - Brown switch: 0.15 to 0.45 bar
 - Blue switch: 0.15 to 0.35 bar
- LED must go out, otherwise replace oil pressure switch
- Connect LED tester to (white) 1.8 bar oil pressure switch -F1- -B-
 - At 1.6 to 2.0 bar, LED must light up

If NO

- Replace oil pressure switch
- Increase engine speed further
 - At 2000 rpm and an oil temperature of 80 °C oil pressure must be 2.0 bar minimum

Note:

At higher engine speed, oil pressure must not exceed 7.0 bar.

- If necessary, replace oil pressure relief valve (in oil pump) or oil pressure switch ⇒ [Page 17-10](#) , item 8

19 - Engine - Cooling system

Cooling system components, removing and installing

[Cooling system components, body side](#)

[Cooling system components, engine side](#)

[Coolant hose connection, diagram](#)

[Cooling system, draining and filling](#)

[Radiator and radiator fan, removing and installing](#)

[After-run Coolant Thermal switch/Engine Coolant Temperature sensor, checking](#)

19-1



Cooling system components, removing and installing

Notes:

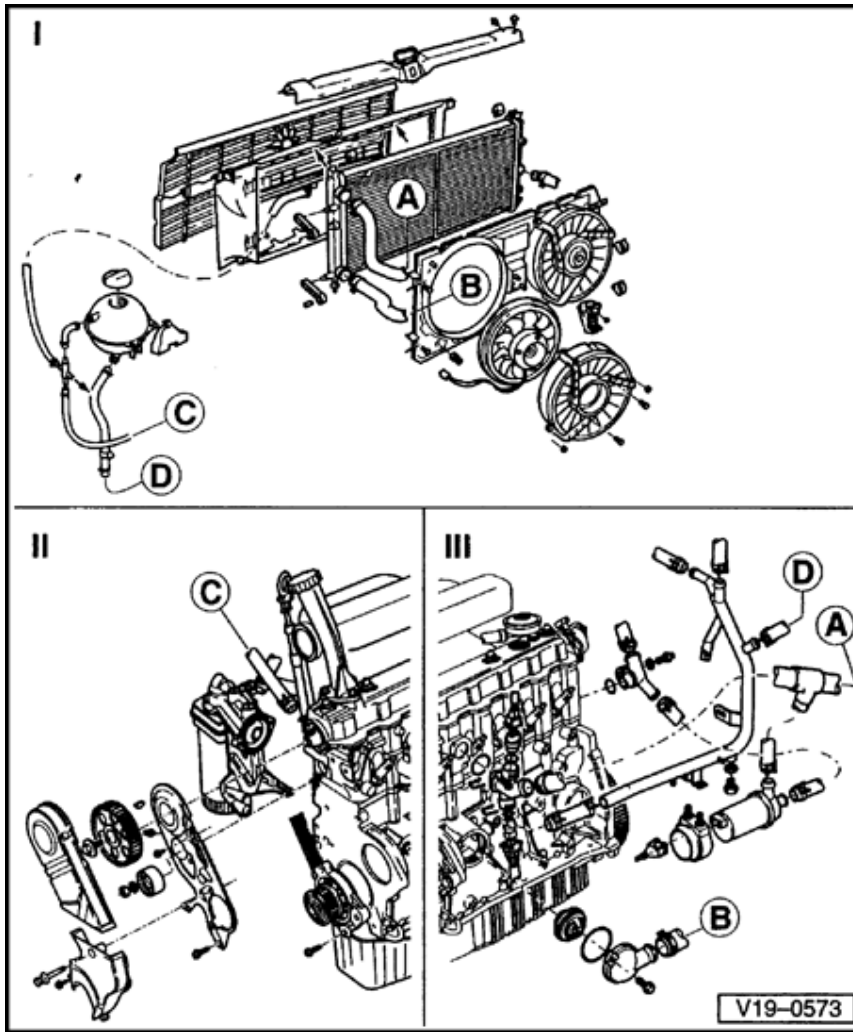
- ◆ *When the engine is warm the cooling system is under pressure. If necessary, release pressure before starting repair work.*
- ◆ *Hoses are secured with spring-type clips. In cases of repair, only use spring-type clips.*
- ◆ *VAG 1921 pliers are recommended to install spring-type clips.*
- Perform cooling system leakage check with cooling system tester VAG 1274 and adapter 1274/3.

Draining and filling with coolant ⇒ [Page 19-16](#)

Coolant mixture ratios ⇒ [Page 19-16](#)

19-2





---- I Parts of cooling system body side:

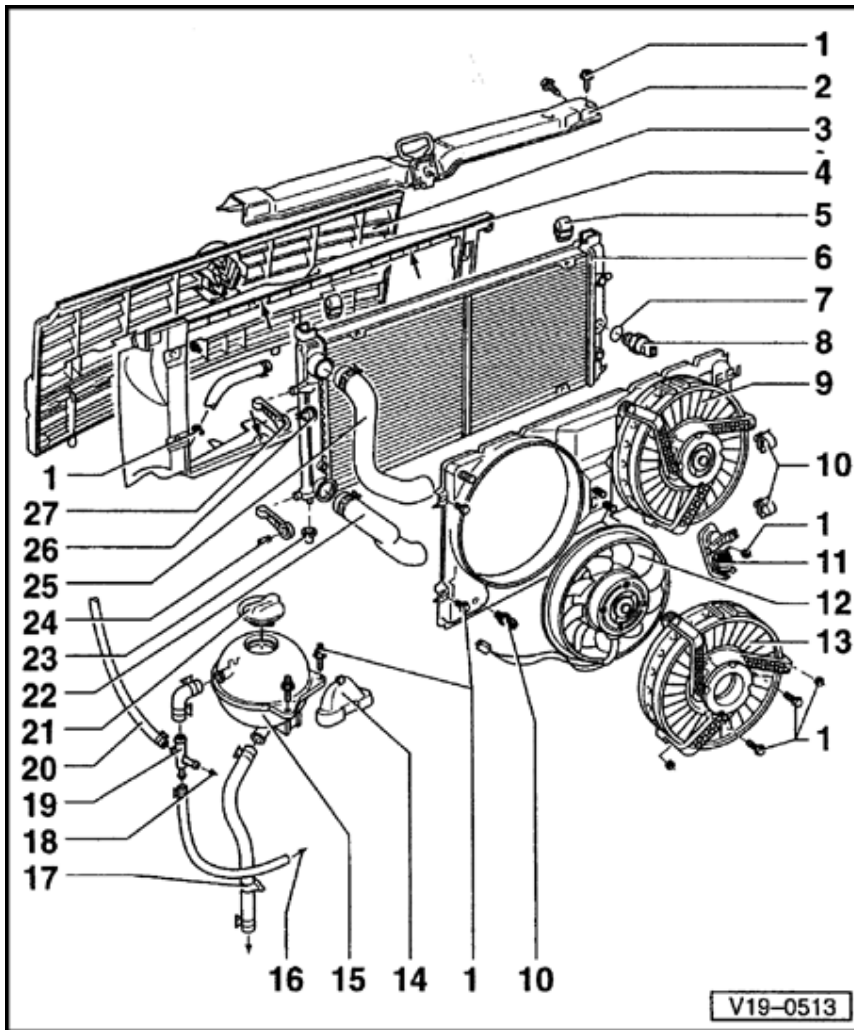
Vehicles ➤ 12.95: ⇒ [Page 19-3](#)

Vehicles 01.96 ➤: ⇒ [Page 19-7](#)

---- II Parts of cooling system engine side ⇒ [Page 19-10](#)

---- III Coolant hoses connection diagram ⇒ [Page 19-13](#)





Cooling system components, body side

Vehicles >12.95

Vehicles 01.96 => [Page 19-7](#)

1 - 10 Nm (7 ft lb)

2 - Lock carrier

3 - Radiator grille

4 - Air ducting

- ◆ Attached at radiator:
Vertically 4 screws,
horizontally 4 rivets or 4 screws -arrows-

5 - Securing rubber

6 - Radiator

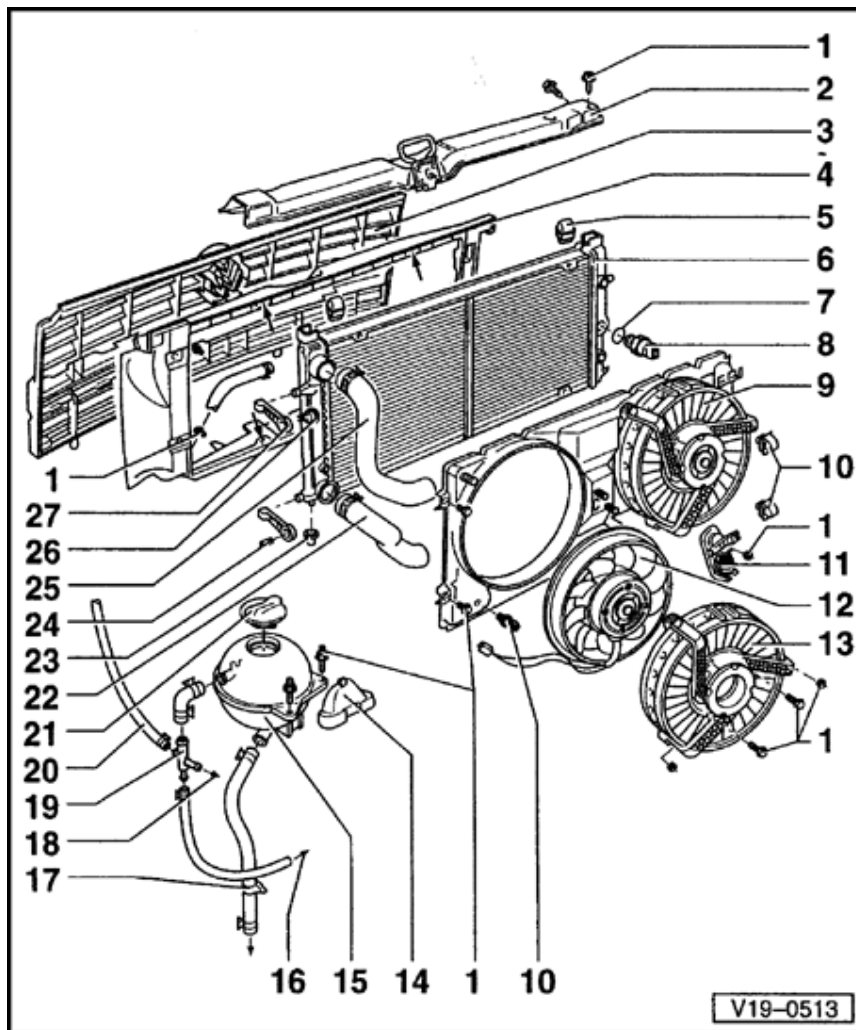
- ◆ Removing and installing => [Page 19-18](#)

- ◆ After replacing, completely replace coolant

7 - Seal

- ◆ Always replace





8 - Coolant Fan Control Thermo switch -F18-

◆ 25 Nm (18 ft lb)

◆ for electric fan

◆ Switching temperatures:

1st speed

on: 84 to 89 °C

off: 76 to 83 °C

2nd speed

on: 90 to 95 °C

off: 82 to 89 °C

9 - Radiator cowl

◆ With electric fan and adjustable shut-off ring (only for vehicles with optional equipment)

10 - Cable clip

11 - Adjusting device

◆ Only for vehicles with optional equipment

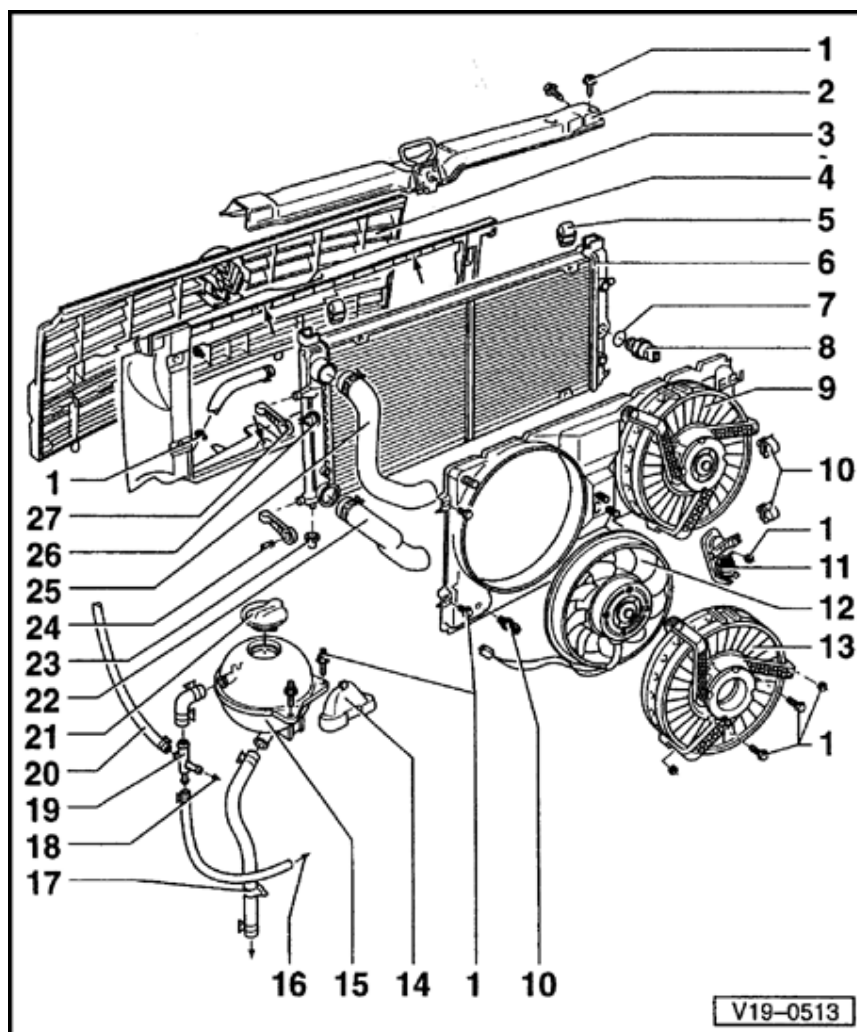
◆ Checking:

Engine cold (coolant temperature below 25 °C) shut-off ring (item - 13 -) closed

12 - Radiator fan

13 - Shut-off ring

◆ Only for vehicles with optional equipment



14 - Cover

15 - Expansion tank

16 - to cylinder head
⇒ [Page 19-11](#) ,
item - 9 -

17 - to coolant pipe ⇒
[Page 19-14](#) , item
- 10 -

18 - to heat exchanger

◆ Only for vehicles
with optional
equipment

19 - Junction piece

20 - Coolant breather
hose

◆ to top of radiator

21 - Cap

◆ Check using
VAG 1274
cooling system
tester and VAG
1274/4 adapter

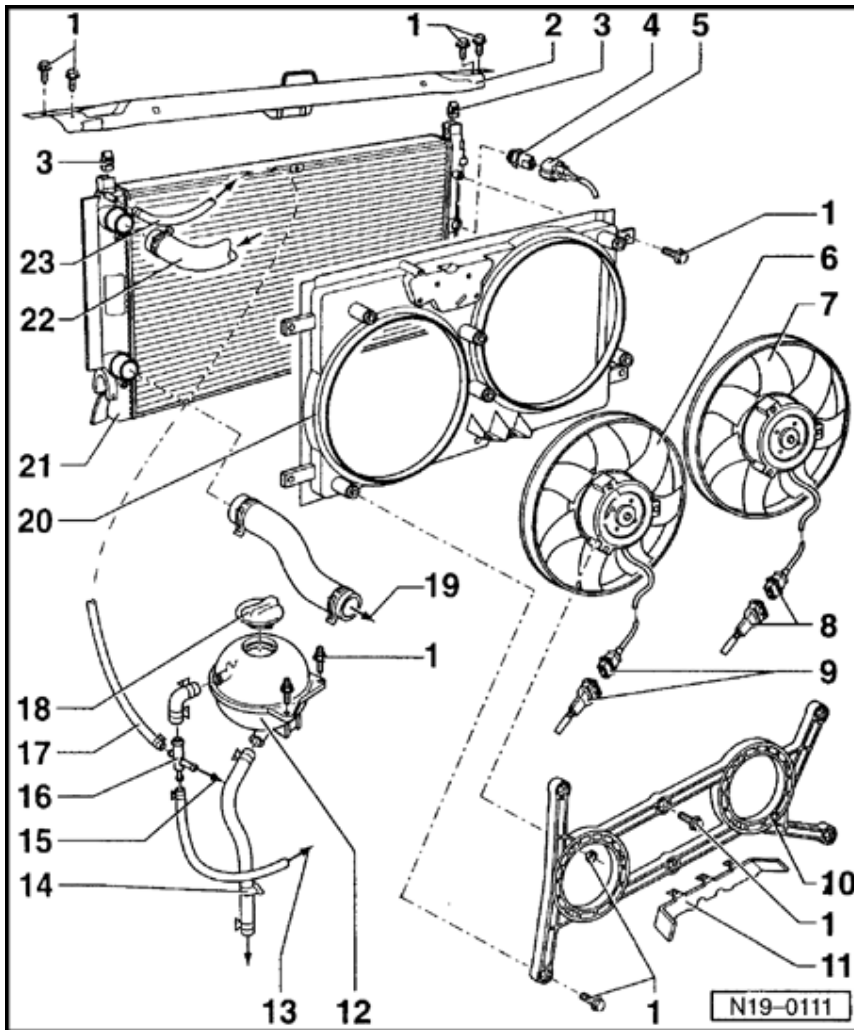
◆ Test pressure
1.3 to 1.5 bar

22 - Coolant hose ⇒
[Page 19-14](#) , item
- 16 -

23 - Rubber washer

24 - Pin





Vehicles 01.96 ➤

1 - 10 Nm (7 ft lb)

2 - Lock carrier

3 - Securing rubber

**4 - Coolant Fan
Control Thermo
switch -F18-**

◆ 35 Nm (26 ft lb)

◆ Switching
temperatures:

1st speed

on: 84 to 89 °C

off: 76 to 83 °C

2nd speed

on: 90 to 95 °C

off: 82 to 89 °C

**5 - 3-pin harness
connector**

◆ for Coolant Fan
Control Thermo
switch

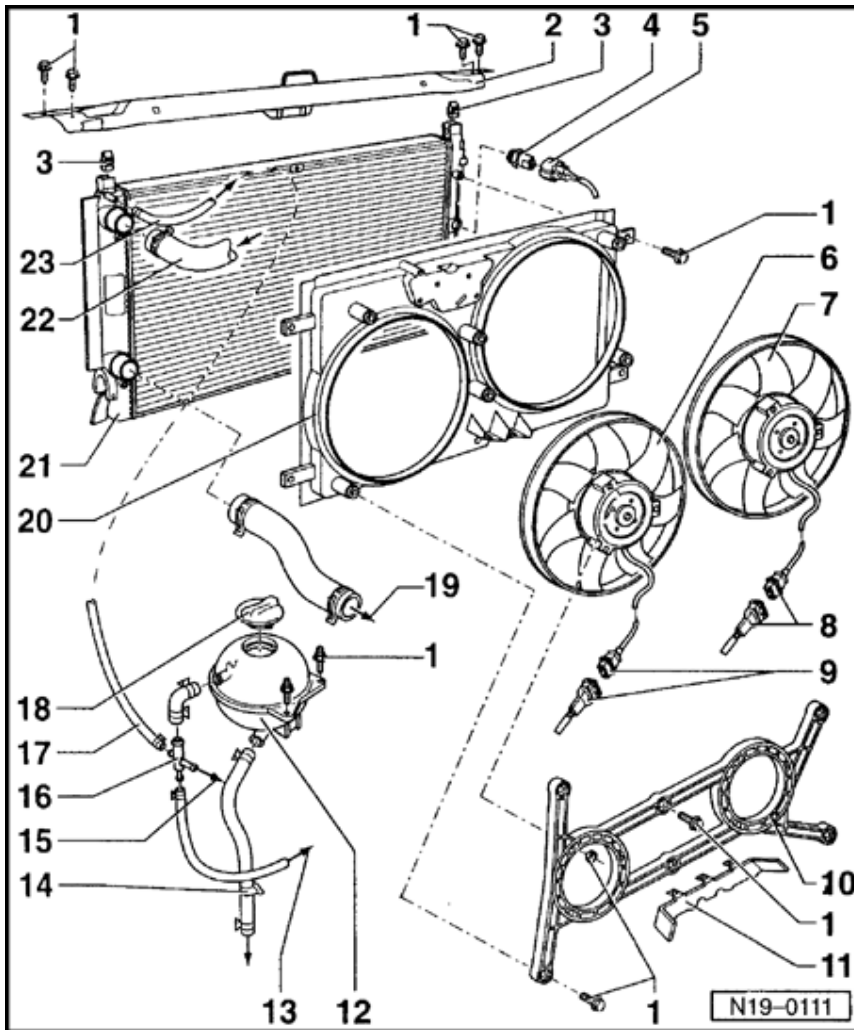
6 - Coolant fan -V7-

◆ Removing and
installing ⇒ [Page
19-18](#)

**7 - Coolant Fan, right
-V35-**

◆ Removing and
installing ⇒ [Page
19-18](#)





8 - 2-pin harness connector

◆ Black

◆ for V35

9 - 2-pin harness connector

◆ Black

◆ for V7

10 - Fan ring

11 - Cable guide

12 - Expansion tank

13 - Coolant hose

Vehicles ➤07.96

⇒ [Page 19-11](#) ,

item - 9 -

◆ to throttle valve control module

Vehicles 08.96 ➤

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 24*

14 - to coolant pipe ⇒ [Page 19-14](#) , item - 10 -

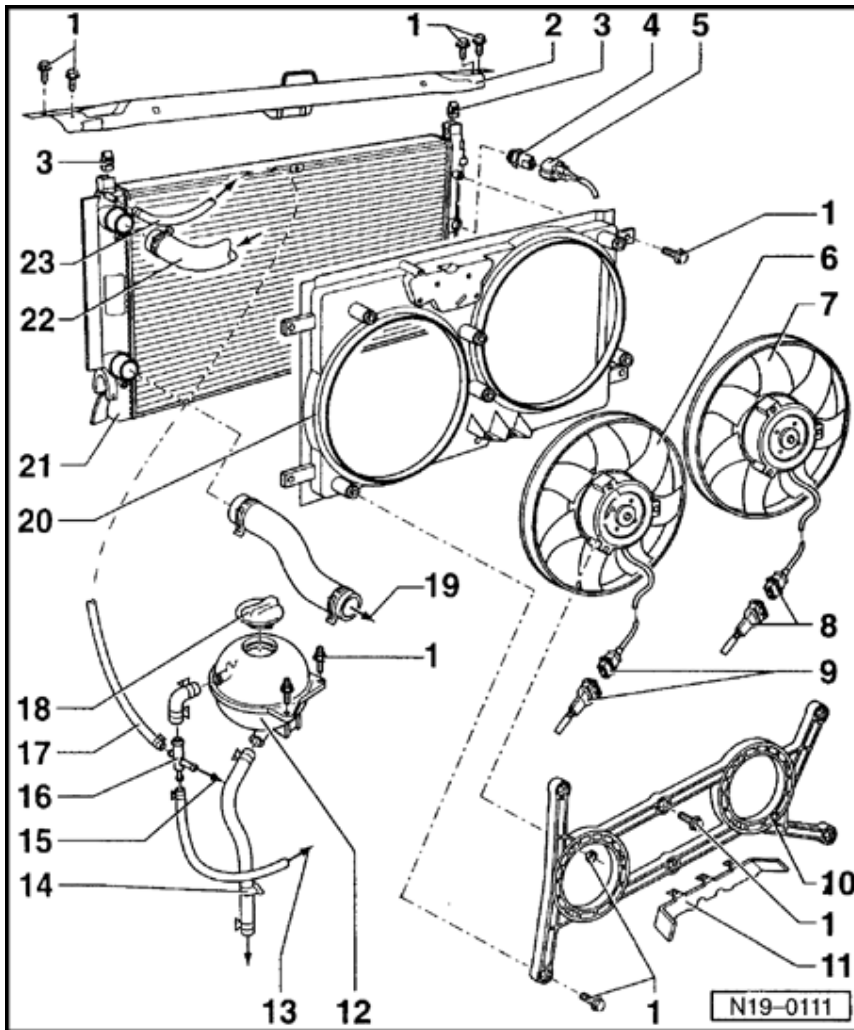
15 - to heat exchanger

◆ Only vehicles with optional equipment

16 - Junction piece

17 - Coolant breather hose





18 - Cap

- ◆ Check using VAG 1274 cooling system tester and VAG 1274/4 adapter

- ◆ Test pressure 1.3 to 1.5 bar

19 - Coolant hose, lower ⇒ [Page 19-14](#), item - 16 -

20 - Air intake ducting

21 - Radiator

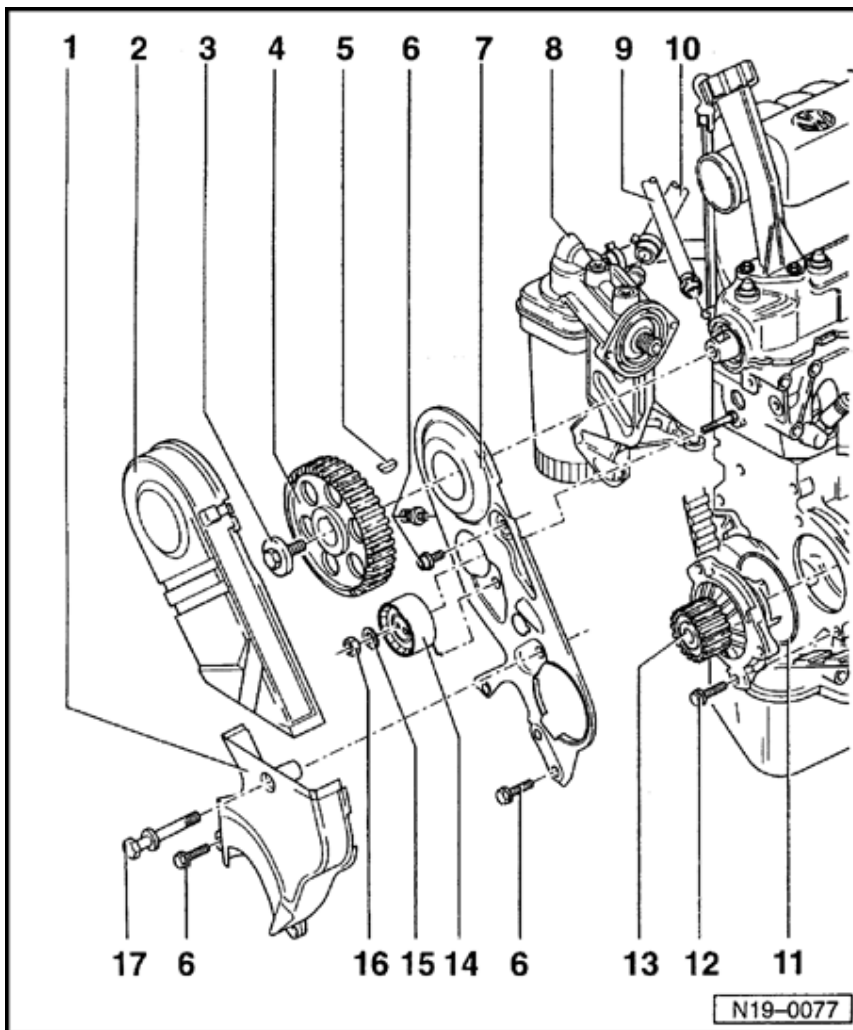
- ◆ Removing and installing ⇒ [Page 19-18](#)

- ◆ After replacing, completely replace engine coolant

22 - Coolant hose, lower ⇒ [Page 19-14](#), item - 11 -

23 - Coolant overflow hose





Cooling system components, engine side

1 - Toothed belt guard, lower section

- ◆ Removing: take off vibration damper (if necessary)

2 - Toothed belt guard, upper section

3 - Camshaft sprocket securing bolt

- ◆ Observe steel type marking on bolt head:

8.8 = 85 Nm (63 ft lb)

10.9 = 100 Nm (74 ft lb)

- ◆ Counter-hold with 3036 to loosen and tighten

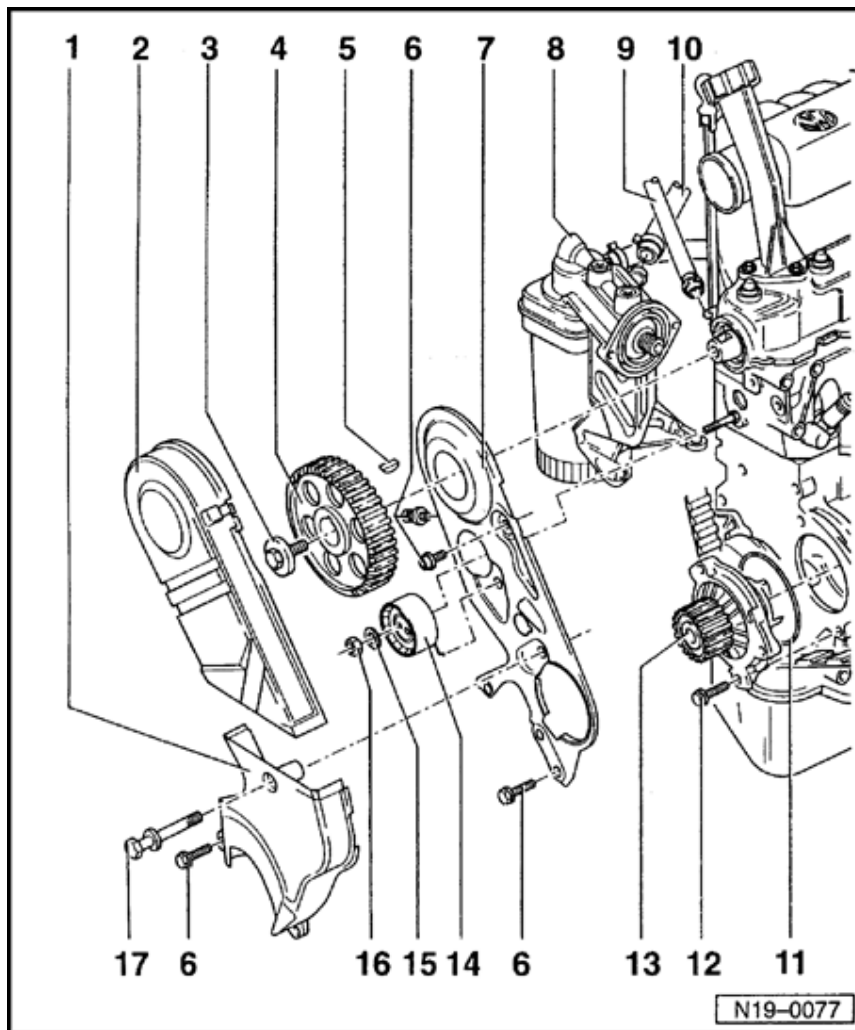
4 - Camshaft sprocket

- ◆ Note position when installing toothed belt ⇒ [Page 13-17](#)

5 - Woodruff key

- ◆ Ensure tight fit





6 - 10 Nm (7 ft lb)

7 - Toothed belt guard, rear

- ◆ to remove, take off vibration damper, if necessary

8 - Oil cooler

- ◆ Removing and installing ⇒ [Page 17-1](#)

9 - Coolant hose

Vehicles ➤ 12.95
⇒ [Page 19-5](#), item - 16 -

Vehicles 01.96 ➤
07.96 ⇒ [Page 19-5](#), item - 16 -

Vehicles 08.96 ➤

To throttle valve control module

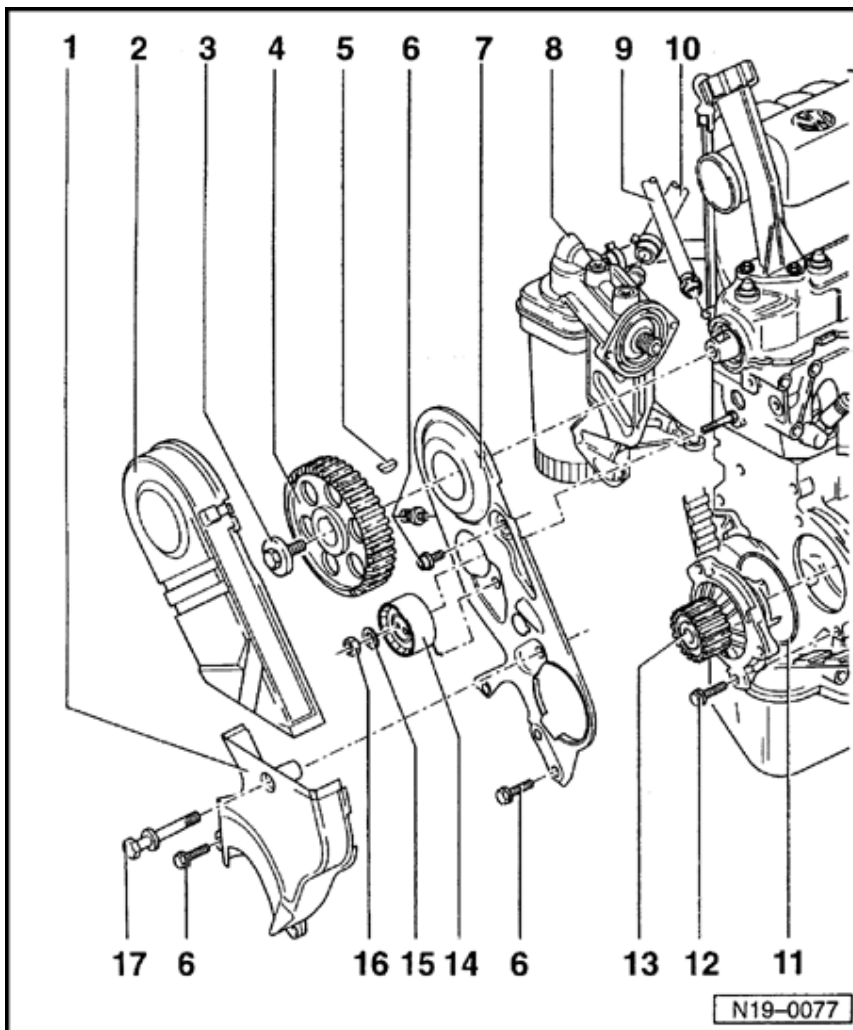
10 - to coolant pipe ⇒ [Page 19-13](#), item - 6 -

11 - O-ring

- ◆ Replace if damaged

12 - 20 Nm (15 ft lb)





13 - Coolant pump

- ◆ Check shaft for ease of movement
- ◆ Replace complete if damaged or leaking
- ◆ ➤09.91 with elongated holes: to tension toothed belt: loosen slightly and turn with screwdriver ⇒ [Page 13-17](#)

14 - Tensioner

- ◆ 10.91 ➤
- ◆ Removing and installing ⇒ [Page 13-17](#)

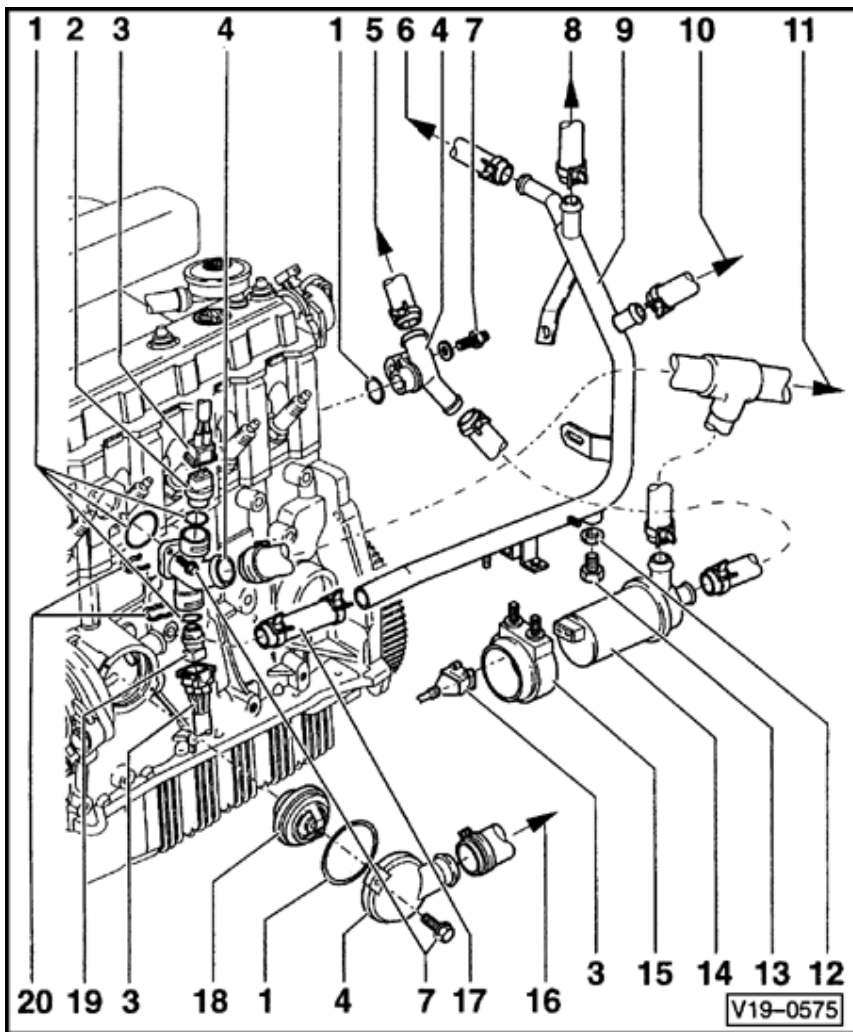
15 - Woodruff key

- ◆ with locking tab

16 - 15 Nm (11 ft lb)

17 - 20 Nm (15 ft lb)





Coolant hose connection, diagram

1 - O-ring

- ◆ Replace if damaged

2 - Coolant temperature sensor -G62-

- ◆ Blue, 2-pin
- ◆ For Injection and ignition system
- ◆ Checking:

⇒ [Repair Manual, 2.5 Liter 5-Cyl. 2V Engine Mechanical, Engine Code\(s\): AAF, ACU, Repair Group 19](#)

3 - Connector

4 - Branch connection

5 - to heat exchanger

6 - to oil cooler ⇒ [Page 19-11](#) , item - 10 -

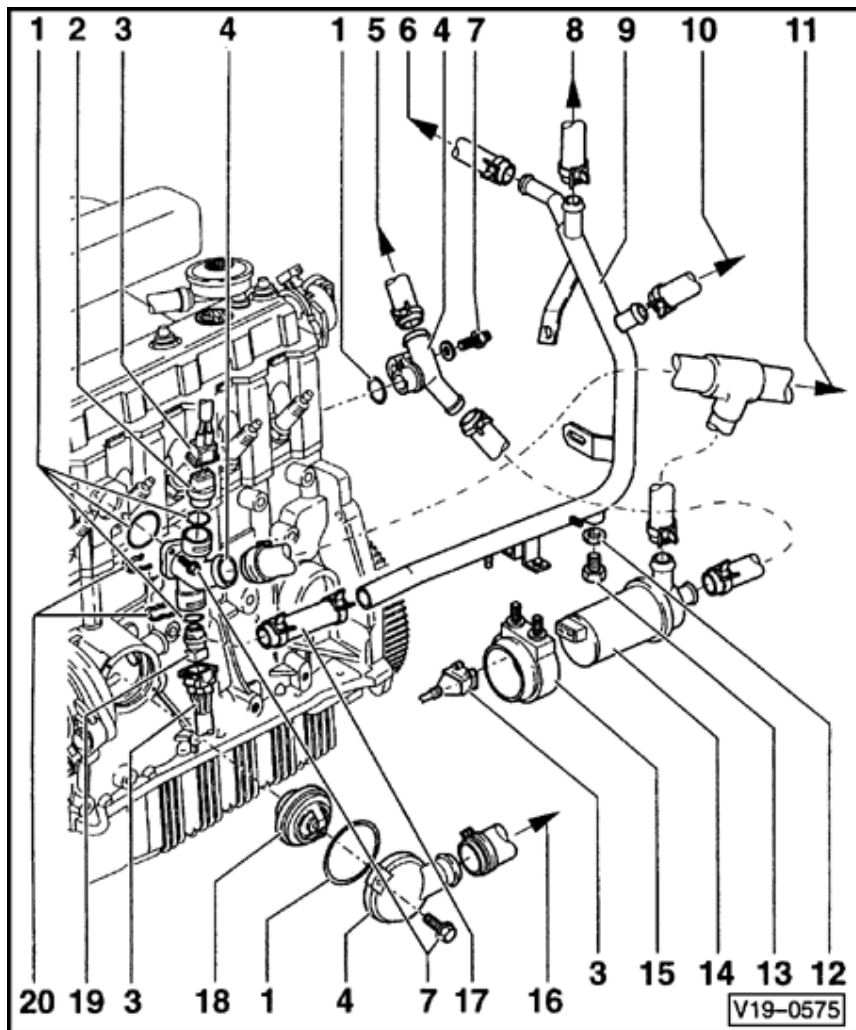
7 - 10 Nm (7 ft lb)

8 - to regulating valve (heat exchanger)

9 - Coolant pipe

- ◆ Secured to starter





10 - to coolant expansion tank

Vehicles ➤12.95
⇒ [Page 19-5](#) , item
- 17 -

Vehicles 01.96 ➤
⇒ [Page 19-8](#) , item
- 14 -

11 - to top of radiator

Vehicles ➤12.95
⇒ [Page 19-6](#) , item
- 25 -

Vehicles 01.96 ➤
⇒ [Page 19-9](#) , item
- 22 -

12 - Sealing ring

- ◆ Replace

13 - Drain screw

- ◆ 10 Nm (7 ft lb)
- ◆ Draining coolant
⇒ [Page 19-16](#)

14 - After-run coolant pump V51

- ◆ Checking: ⇒
[Page 19-20](#)

15 - Retainer

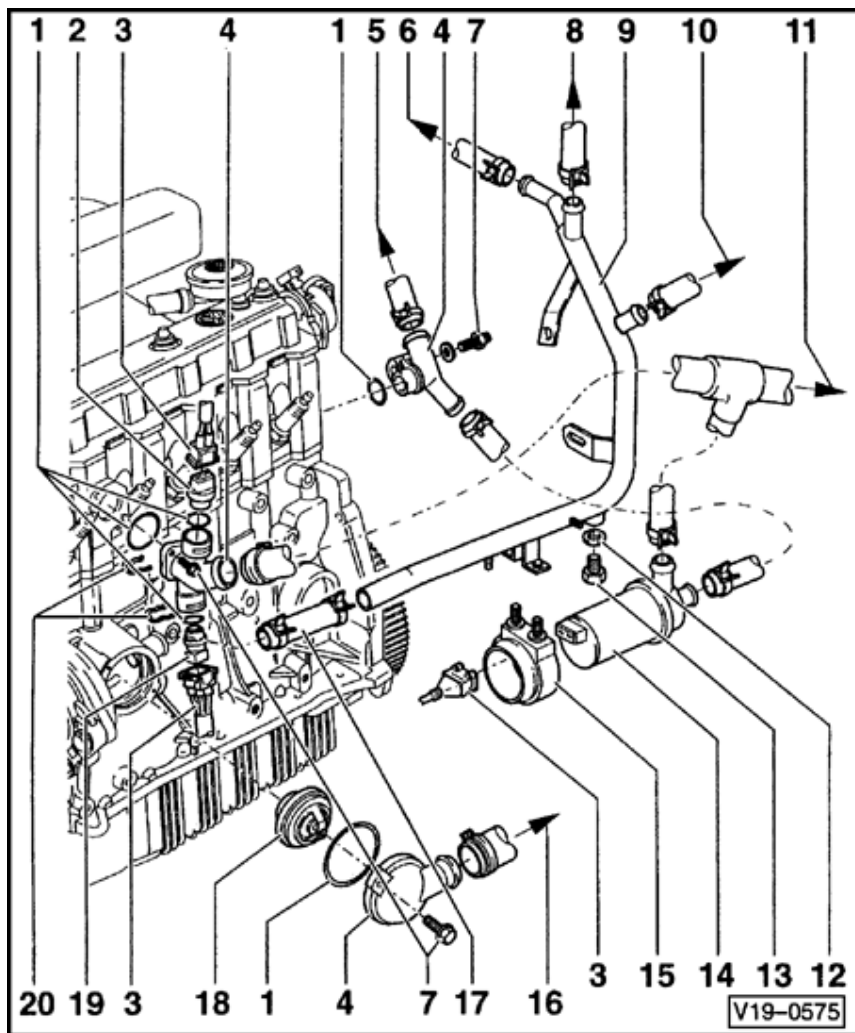
- ◆ for After-run
coolant pump

16 - to bottom of radiator

Vehicles ➤12.95
⇒ [Page 19-5](#) , Item
22

Vehicles 01.96 ➤
⇒ [Page 19-9](#) , item
- 19 -





17 - Connecting hose

18 - Coolant thermostat

- ◆ Checking: heat-up thermostat in water
- ◆ Opening begins approx. 87 °C
- ◆ Closes at approx. approx. 102 °C
- ◆ Opening lift min. 7 mm

19 - After-run coolant thermal switch - F95- with Engine Coolant Temperature sensor -G2-

- ◆ Yellow, 4-pin
- ◆ Checking -F95-:
⇒ [Page 19-20](#)
- ◆ ECT sensor -G2-
checking:

⇒ *Wiring diagrams,
Electrical
Troubleshooting and
Component Locations
binder*

20 - Retaining clip

19-16



Cooling system, draining and filling

Special tools, testers and auxiliary items

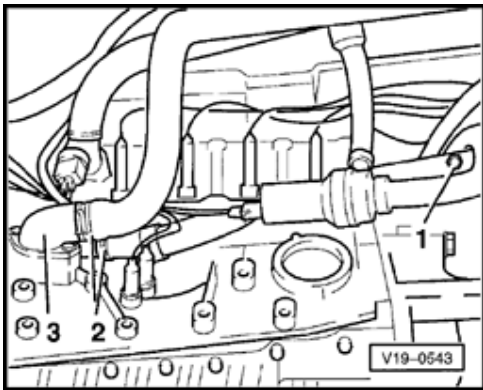
◆ VAG 1921 spring clip pliers

◆ VAG 1306 Drip tray

Draining

- Open heater valve.
- Remove cap from coolant expansion tank.
- Remove sound dampener tray:

⇒ [Repair Manual, Body Exterior, Repair Group 50](#)



- Drain coolant:
 - ◆ Either via drain plug -1- and coolant hose -2- or
 - ◆ Or via the coolant thermostat connection -3-.

Filling

Notes:

- ◆ *The cooling system is filled year-round with a mixture of water, anti-freeze and G11 corrosion protection agent. G 11 plus coolant additives marked as being "in accordance with TL VW 774 C" prevent freezing and corrosion damage, the formation of chalk, raises the coolant boiling point. For these reasons, the cooling system must be filled year-round with anti-freeze and G11. Due to the higher boiling point, the described coolant mixture aids operational efficiency when the engine is operating under high loads, particularly in tropical climates.*



- ◆ *If radiator, heat exchanger, cylinder head or cylinder head gasket has been replaced, do not reuse old coolant.*

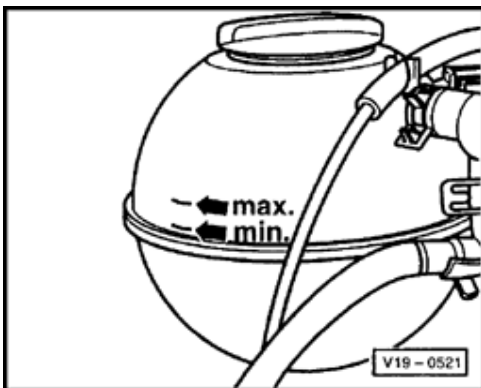
Recommended mixture ratios:

Freeze protection down to:	Anti-freeze amount ¹⁾	G 11 ²⁾	Water ²⁾
-25 °C	40 %	4.6 ltr.	6.9 ltr.
-35 °C	50 %	5.75 ltr.	5.75 ltr.

¹⁾ Amount of anti-freeze must not exceed 60 %; freeze protection and cooling effect will decrease if anti-freeze quantity is too high.

²⁾ Coolant quantity can vary depending upon vehicle equipment.

- Open bleed screw in coolant hose to heat exchanger.



- Slowly fill with coolant up to max. mark on expansion tank (filling time approx. 5 minutes).

- Close bleed screw.

- Start engine and run at approx. 1500 rpm for max. 2 minutes at same time fill with coolant up to over-flow hole on expansion tank.

- Install expansion tank cap.

- Run engine until radiator fan runs.

- Check coolant level and top-off if necessary. When the engine is at normal operating temperature, the coolant level must be on the max. mark, when the engine is cold, between the min. and max. marks.

19-18



Radiator and radiator fan, removing and installing

Special tools, testers and auxiliary items

- ◆ VAG 1921 Pliers for spring type clips

◆ VAG 1306 Drip tray

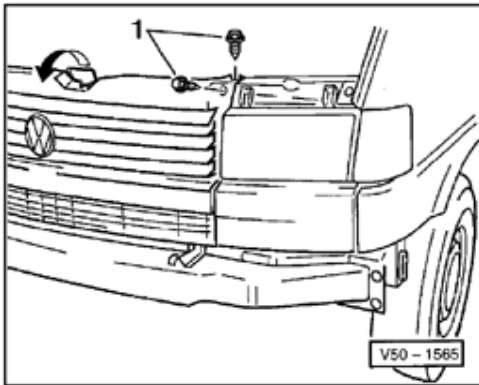
Removing

Vehicles 09.94➤

- Remove radiator grille:

⇒ [Repair Manual, Body Exterior, Repair Group 66](#)

Continuation for all vehicles



- Remove mounting screws -1- on left and right.
- Fold lock carrier and radiator out forward - arrow-.
- Pull connectors off thermo switch and radiator fan.
- Remove sound dampener tray:

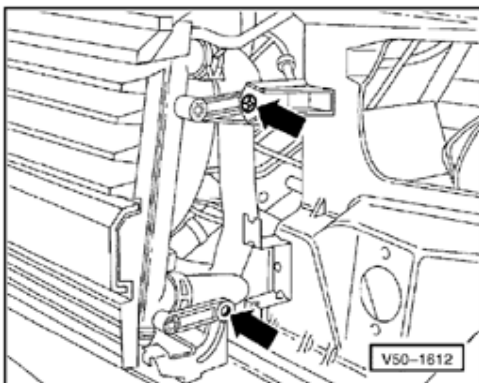
⇒ [Repair Manual, Body Exterior, Repair Group 50](#)

- Drain coolant ⇒ [Page 19-16](#)
- Disconnect all radiator coolant hoses.

19-19



Vehicles ➤12.95



- Drive out left and right spreader clip pins - arrows- and unclip spreader clips from radiator bracket.

Continuation for all vehicles

- Lift out radiator with fan, air guide and lock carrier.

Installing

Installation is carried out in the reverse order of removal, when doing this note the following:

- Filling with coolant ⇒ [Page 19-16](#)
- Electrical connections and routing:

⇒ *Repair Manual, Electrical Equipment, Repair Group 97*

- Check headlight adjustment and adjust if necessary:

⇒ [Maintenance](#)

19-20



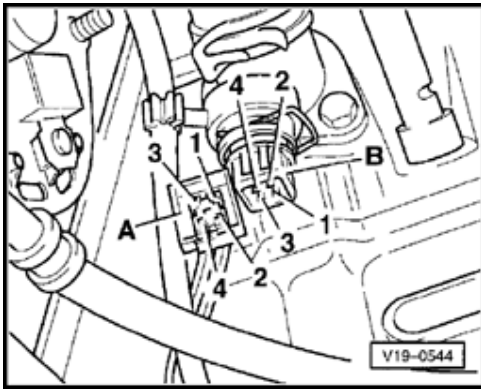
After-run Coolant Thermal switch/Engine Coolant Temperature sensor, checking

Special tools, testers and auxiliary items

- ◆ VW 1594 Adaptor kit
- ◆ VAG 1527B Voltage Tester
- ◆ Fluke 83 multimeter
- ◆ Wiring diagram

Test sequence

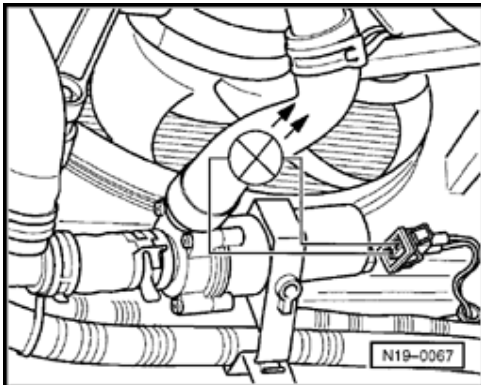
- Disconnect 4-pin harness connector from After-run Coolant thermal switch -F95-/-G2- -yellow-



- ✦ - Bridge connector terminals -1- (grey) and -4- (brown and green) using jumper wires from VW 1594 adaptor kit
- After-run coolant pump must run

If pump does not run

19-21



- ✦ - Disconnect 2-pin harness connector from After-run coolant pump -1- and connect VAG 1527B tester between connector terminals using jumper wires from VW 1594 adaptor kit
- LED must light up

If LED lights up, Voltage supply OK

- Replace After-run coolant pump V51.

If LED does not light up:

- Locate and correct open circuit using Wiring diagram:

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

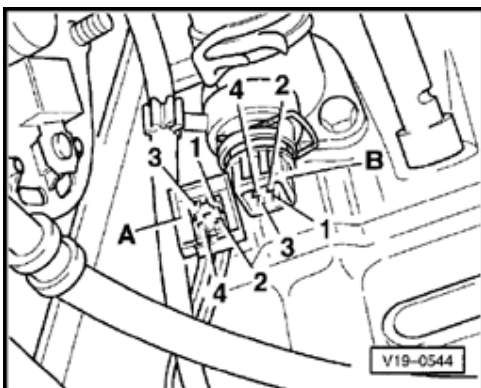
Thermal switch resistance, checking

- ✦ - Connect multimeter between Thermal switch connector -B- terminals -1- and -4- using VW 1594 adaptor kit and measure resistance
- ◆ Specifications:

below approx. 103 °C = ∞ Ω

above approx. 104 °C = 0 Ω

If specifications not obtained



- Replace switch/sensor -F95-/-G2-

20 - Fuel Supply

Fuel supply system components, removing and installing

Fuel supply system components, removing and installing

Fuel delivery unit, removing and installing

Fuel supply system, safety precautions

Rules for cleanliness

Fuel delivery unit, removing and installing

Fuel delivery unit, disassembling and assembling

Fuel pump, checking

Delivery rate, checking

Fuel pump check valve, checking

Fuel tank, removing and installing

Accelerator mechanism, servicing

Accelerator cable, adjusting

Evaporative emissions (EVAP) system, servicing

Evaporative emissions (EVAP) system control, checking

20-1



Fuel supply system components, removing and installing

WARNING!

Fire Hazard. Do NOT have anything in the area that can ignite fuel.

Notes:

- ◆ *Hose connections are secured with either screw, spring or clamp-type clips.*
- ◆ *Always replace clamp-type clips with screw or spring-type clips.*
- ◆ *Fuel hoses in engine compartment must only be secured with spring-type clips. The use of clamp or screw-type clips is not permissible.*
- ◆ *For installing the spring-type clips commercially available pliers e.g. Hazet 798-5 are recommended.*
- ◆ *After all work on the fuel delivery unit or the*

Servicing accelerator mechanism ⇒ [Page 20-23](#)



- ◆ Installed position:
Arrow points in
direction of flow

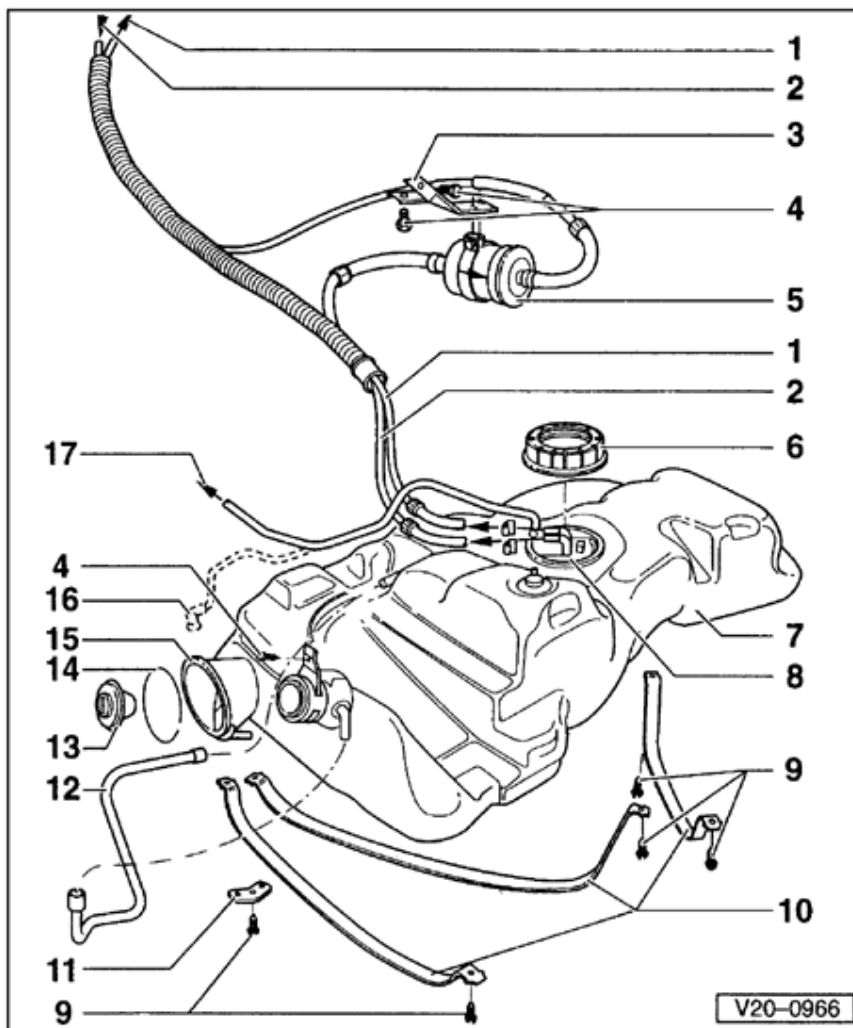
6 - Collar nut

- ◆ Remove and
install with 3217
wrench

7 - Fuel tank

- ◆ Removing and
installing ⇒ [Page
20-21](#)

20-3



8 - Flange

- ◆ Note installed
position on fuel
tank ⇒ Fig. ⇒ [1](#)
- ◆ Removing and
installing fuel
delivery unit ⇒
[Page 20-11](#)
- ◆ Has additional
fuel line
connection, for
vehicles with
additional heater

9 - 25 Nm (18 ft lb)

10 - Securing strap

11 - Bracket

- ◆ For securing
straps

12 - Overflow hose

13 - Cap

14 - Retaining ring

15 - Rubber cup

16 - Vent line

- ◆ On vehicles without EVAP sys.

17 - Breather line

- ◆ On vehicles with EVAP system
- ◆ To EVAP canister T piece
⇒ [Page 20-26](#),
item - 9 -

20-4

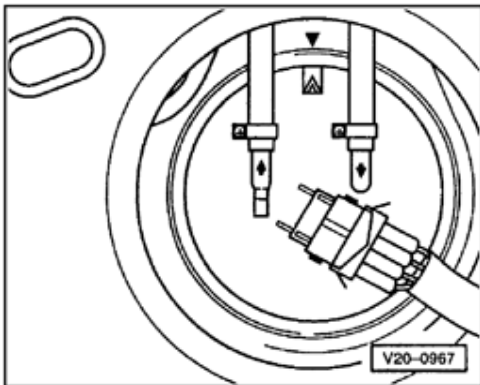


Fig. 1 Fuel delivery unit flange, Installed position

Note:

Marking on flange must align with marking on fuel tank.

WARNING!

Fire Hazard. Do NOT have anything in the area that can ignite fuel.

20-5



Fuel delivery unit, removing and installing

Vehicles ➤07.94

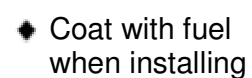
Observe Safety precautions ⇒ [Page 20-9](#)

Observe Cleanliness Rules ⇒ [Page 20-10](#)

Fuel delivery unit, removing and installing ⇒ [Page 20-11](#)

Fuel delivery unit, disassembling and assembling ⇒ [Page 20-13](#)

- ◆ *Hose connections are secured with either screw-type or spring-type clips.*
- ◆ *Always replace spring-type clips with screw-type clips.*



- ◆ Replace if damaged

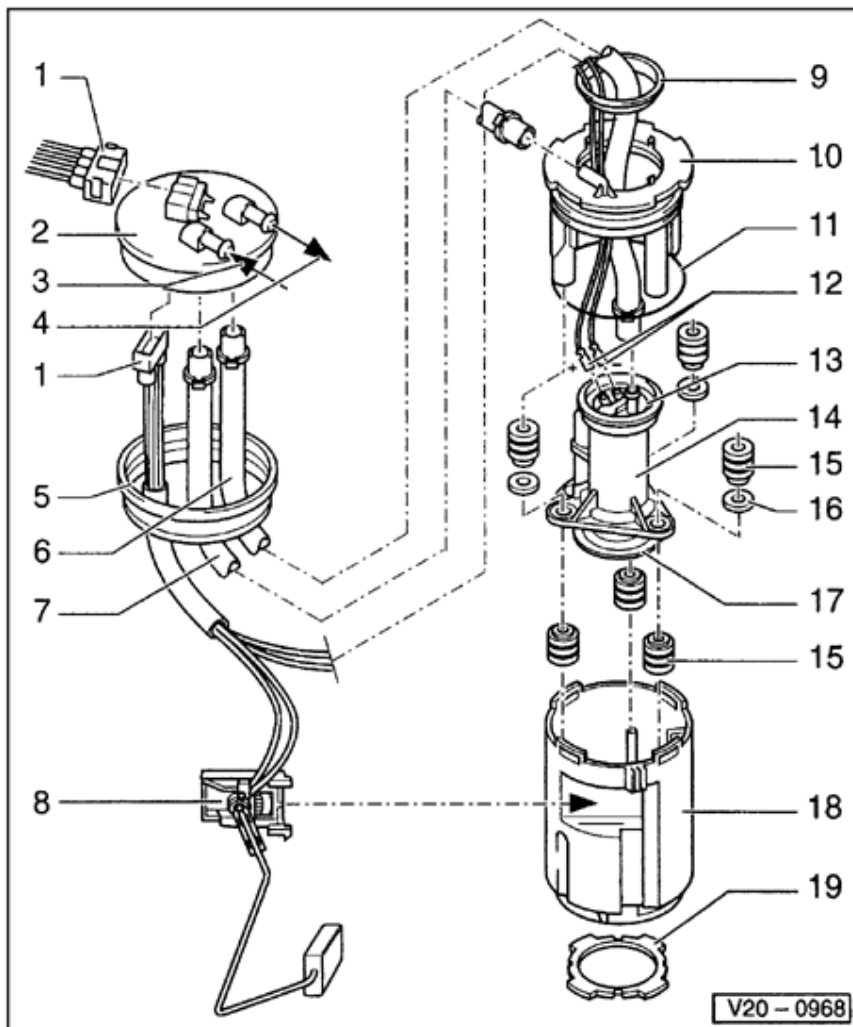
6 - Supply hose

7 - Return hose

8 - Fuel gauge sensor

- ◆ Removing and installing ⇒ [Page 20-11](#)

20-7



9 - Upper support ring

- ◆ Unclip with screwdriver

10 - Housing, upper section

- ◆ Unclip with screwdriver

11 - O-ring

- ◆ Coat with fuel when installing

- ◆ Replace if damaged

12 - Fuel pump connector

13 - Sealing ring, upper

- ◆ When installing pull into housing upper section - item. 10 -

14 - Fuel pump

- ◆ With strainer and non-return valve

◆ Removing and installing ⇒ [Page 20-13](#)

◆ Checking fuel pump ⇒ [Page 20-15](#)

15 - Rubber mounting

◆ Note installation position

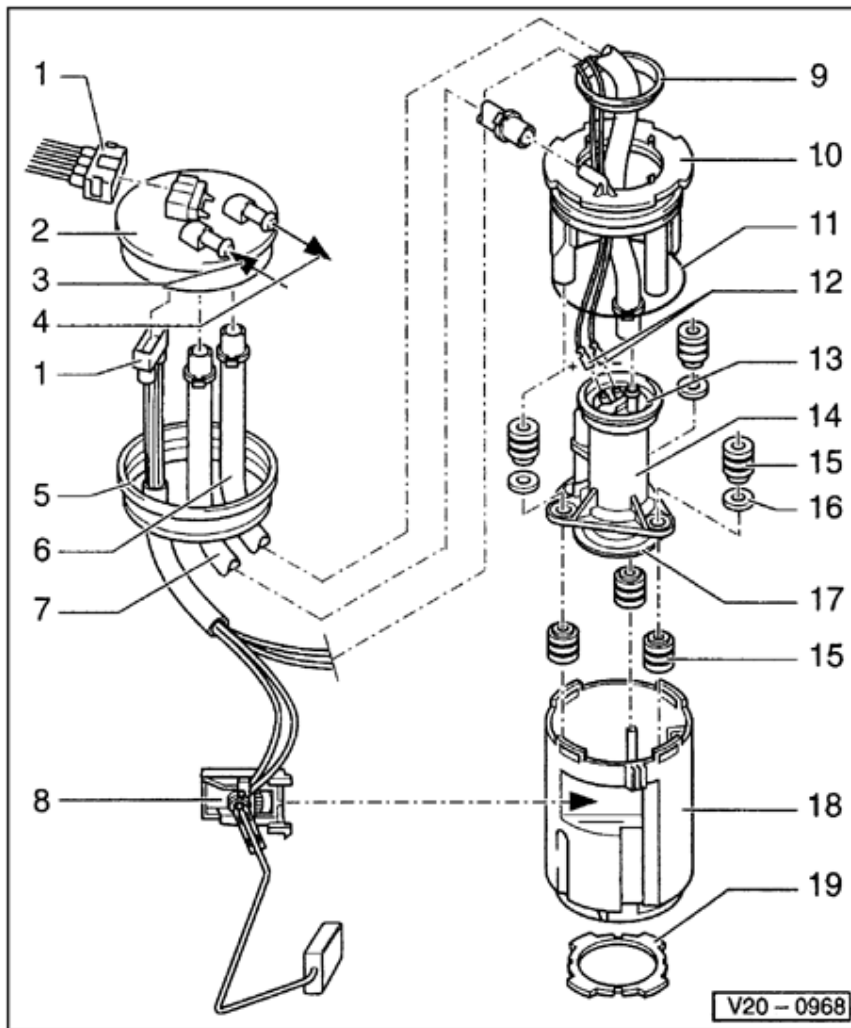
16 - Washer

17 - Lower sealing ring

◆ When installing pull into housing lower section - item 18 -

20-8





18 - Housing - lower section

19 - Bayonet ring

◆ Unclip with screwdriver

20-9



Fuel supply system, safety precautions

WARNING!

Fuel supply lines are under pressure! Before removing from hose connection wrap a cloth around the connection. Then release pressure by carefully pulling hose off connection.

When removing and installing the fuel gauge sensor or fuel pump (fuel delivery unit) from a full or partly full fuel tank; observe the following:

- ◆ Before starting work, switch on an exhaust extraction system and place extraction hose close to the opening in the fuel tank to collect any escaping fumes.
- ◆ A potentially explosive fuel/air mixture environment will be prevented by the high air flow.
- ◆ If no extraction system is available, a radial fan (as long as motor is not in air flow) with a displacement greater than 15 m³/h can be used.
- ◆ Prevent fuel from contacting skin! Wear fuel-resistant gloves!

WARNING!

Fire Hazard. Do NOT have anything in the area that can ignite fuel.

20-10



Rules for cleanliness

When working on the fuel supply and injection system, pay careful attention to the following 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 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.

20-11



Fuel delivery unit, removing and installing

Special tools, testers and auxiliary items

- ◆ 3217 Collar nut wrench

CAUTION!

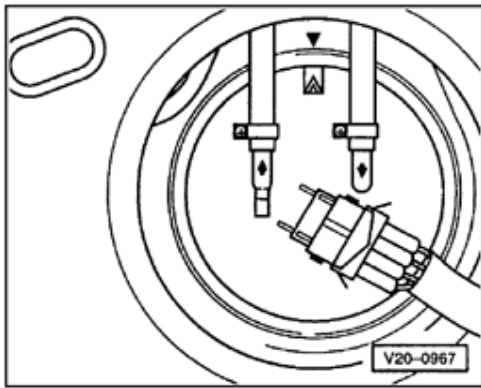
Obtain radio security code from customer before disconnecting battery ground cable.

Removing

- Observe safety precautions ⇒ [Page 20-9](#)
- Make sure ignition is switched OFF
- Disconnect battery Ground cable.
- Cut through carpet at perforation (on right of hand brake lever).
- Remove cover plate.

WARNING!

Fire Hazard. Do NOT have anything in the area that can ignite fuel.



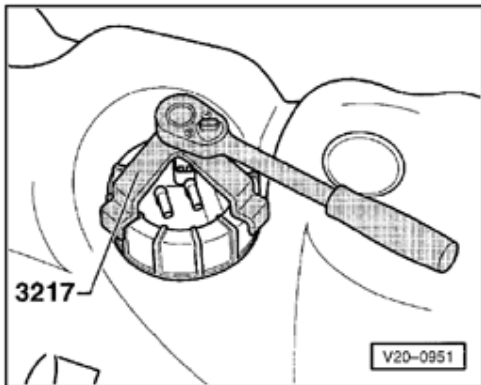
- Disconnect connector and supply and return lines from fuel delivery unit flange.

20-12



Note:

On vehicles with additional heater pull off fuel line between supply and return line.



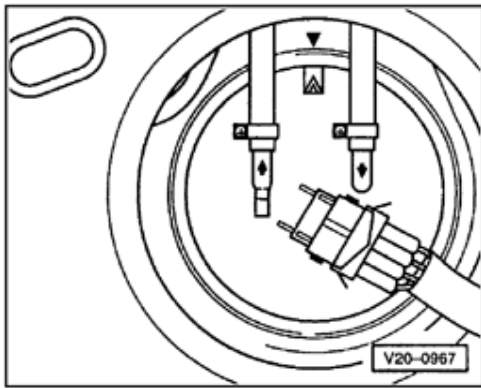
- Remove collar nut using 3217 tool.
- Pull flange and seal out of fuel tank opening.
- Release supply unit from bayonet connection by turning to left and then remove.

Installing

Installing the fuel delivery unit is carried out in the reverse order.

Notes:

- ◆ *When inserting the fuel delivery unit make sure that the fuel gauge sensor is not bent and points approx. 30 ° forward.*
- ◆ *Coat flange seal with fuel when installing.*



◆ Note installed position of fuel delivery unit flange. Mark on flange must align with mark on fuel tank.

- Attach carpeting after installation using glue or Velcro fastener

20-13



Fuel delivery unit, disassembling and assembling

Vehicles ➤ 07.94

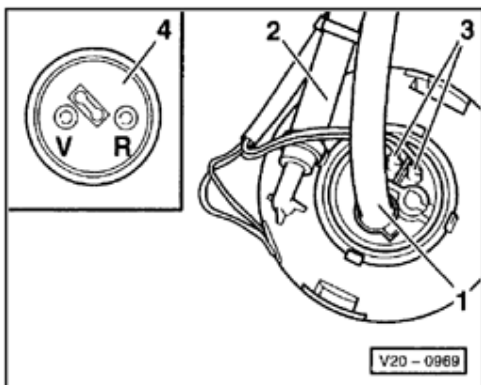
WARNING!

Fire Hazard. Do NOT have anything in the area that can ignite fuel.

- Remove fuel delivery unit ⇒ [Page 20-11](#)

Dismantling

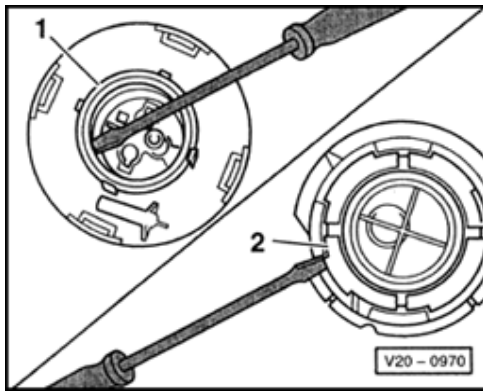
- Unclip fuel gauge sensor from lower section of housing.



- Disconnect supply hose -1-, return hose -2- and fuel pump connector -3-

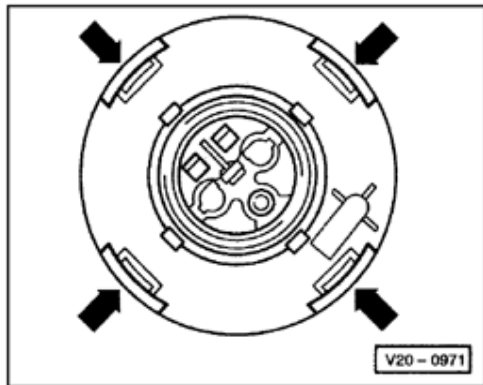
Note:

When assembling, note marking for supply and return hose on underside of flange -4-.



- Unclip upper retaining ring -1- and bayonet ring -2- (on housing lower part) using screwdriver.

20-14



- Unclip upper housing section with screwdriver -arrows- and pull out of lower section.

Note:

When assembling, moisten O-ring for upper housing section with fuel.

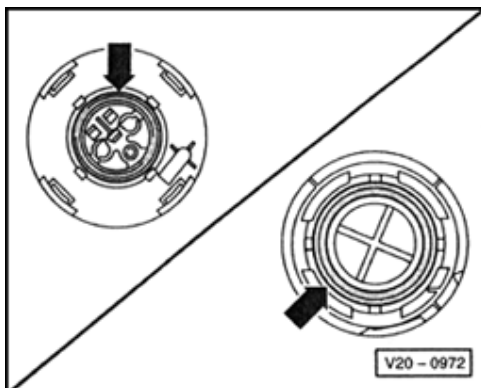
- Pull fuel pump out of housing lower part.

Assembling

- Fuel delivery unit assembly is performed in the reverse order of disassembly

Note:

Carefully pull the fuel pump top and bottom seals -arrows- into the upper and lower housing sections and secure at the top with a retaining ring and the bottom with a bayonet.



20-15



Fuel pump, checking

Special tools, testers and auxiliary items

- ♦ VAG 1348/3A Remote control with adapter cable VAG 1348/3-2
- ♦ 3217 Collar nut wrench

Test conditions

- Battery voltage OK.
- Fuse 18 OK.

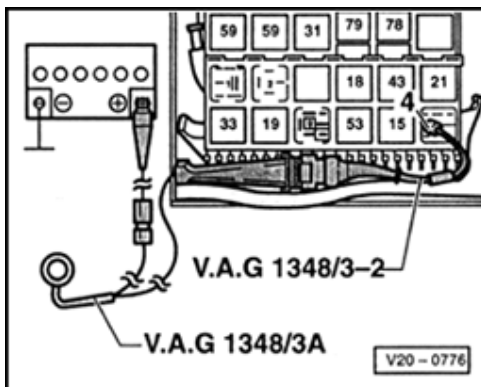
Test sequence

- Switch ON ignition.

- Fuel pump must run briefly but audibly

If fuel pump does not run

- Remove storage tray in front of relay panel



- Remove fuel pump relay -J17- from fuse/relay panel position 12
- Connect remote control VAG 1348/3A to terminal 4 and battery positive (+) using adapter cable VAG 1348/3-2
- Operate remote control.

If fuel pumps run

- Check fuel pump relay activation



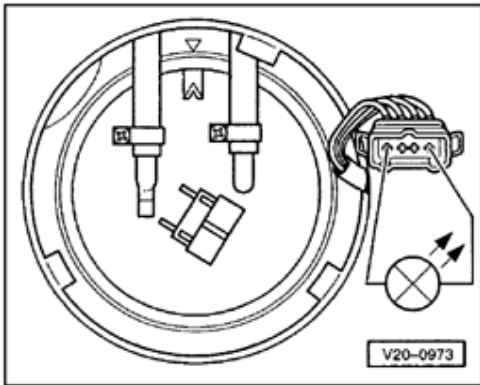
⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01*

Vehicles without Output Diagnostic Test Mode ➤
09.91

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01*

Fuel pump does not run:

- Cut through carpet at perforation (on right of hand brake lever).
- Pull connector off fuel tank flange.



- Connect VAG 1527B LED tester to outer terminals of connector using jumper wires from VW 1594 adaptor kit
- Operate remote control.
 - LED must light up

If LED does not light up:

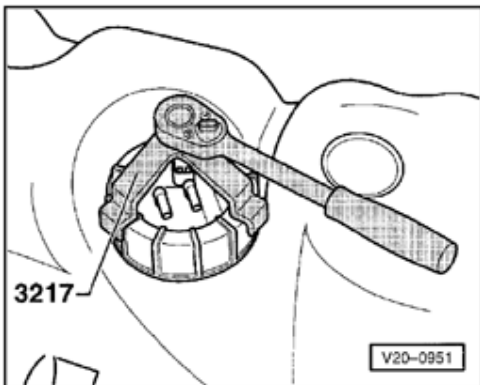
- Locate and eliminate open circuit using wiring diagram

If LED lights up (voltage supply OK)

- Remove union nut using 3217.
- Check if wiring between flange and fuel pump is connected.

If open circuit NOT found:

- Fuel pump faulty, replace fuel delivery unit ⇒ [Page 20-11](#)



Test conditions

- Voltage supply OK.
- VAG 1348/3A Remote control connected

WARNING!

Fire Hazard. Do NOT have anything in the area that can ignite fuel.

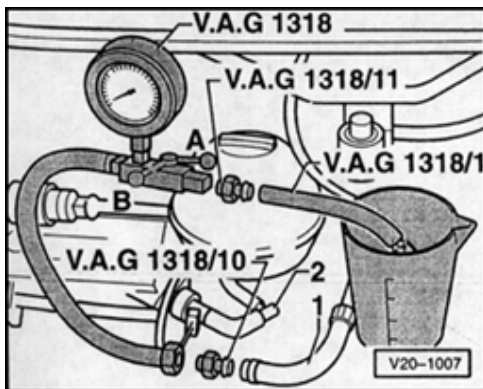
Test sequence

- Remove filler cap from fuel filler neck.

WARNING!

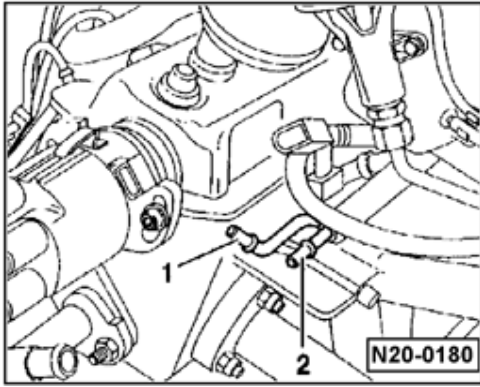
Fuel supply lines are under pressure! Before removing line from hose connection, wrap a cloth around the connection and then release pressure by carefully pulling hose off connection.

Vehicles ➤07.96



- Pull fuel supply line off tee -2-

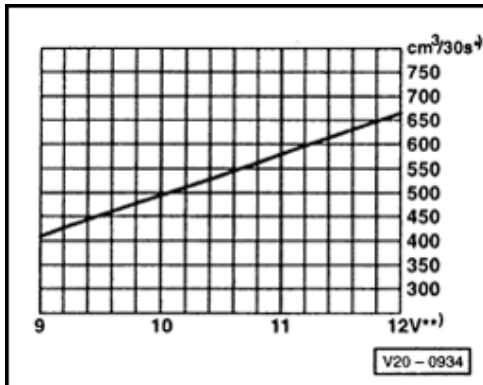




- Pull fuel supply line off connection -1-.

Continued for all vehicles

- Connect pressure gauge VAG 1318 to fuel supply line -1- using 1318/10 adapter
- Push VAG 1318/1 hose onto VAG 1318/11 adapter on pressure gauge and hold hose over a measuring container.
- Open the pressure gauge cut-off tap. The lever then points in the through flow direction -A-.
- Operate remote control VAG 1348/3A. While doing this slowly close shut-off, until gauge shows 3 bar, from this point on do not alter the position of the shut-off
- Empty the measuring container.
- Operate remote control for 30 seconds.



- Compare the quantity of fuel delivered with the specification.

*) Minimum delivery $\text{cm}^3/30$ seconds

**) Voltage at fuel pump with engine stationary and pump running (approx. 2 Volts less than battery voltage).

Example:

During test, 12.5 Volts is measured at battery. Pump voltage is approx. 2 Volts less than the battery equating to a minimum delivery of 500 cc's in 30 seconds

20-19



If minimum delivery rate not obtained:

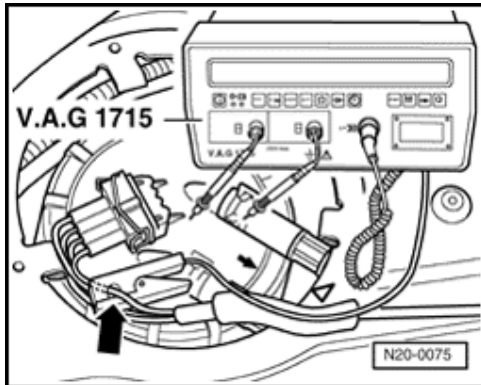
- Check the fuel lines for possible restrictions, kinks or blockage.
- Replace fuel filter if blocked ⇒ [Page 20-2](#) , item - 5 -

- Replace fuel pump if faulty ⇒ [Page 20-13](#)

If delivery rate has been obtained but you still suspect a fuel supply system malfunction, e.g. intermittent fuel supply

- Check the amperage draw of the fuel pump as follows:

- Reconnect all disconnected fuel lines.



- Connect Fluke 83 multimeter to the red/white wire from wiring harness using the amperage adaptor

- Start engine and let idle

- Measure fuel pump amperage draw.

◆ Specification: max. 8 amps

Note:

If the fuel system malfunction is intermittent, you can perform the check during a test drive, using a 2nd person.

If amperage draw is exceeded:

- Replace fuel delivery unit.

20-20



Fuel pump check valve, checking

Test conditions

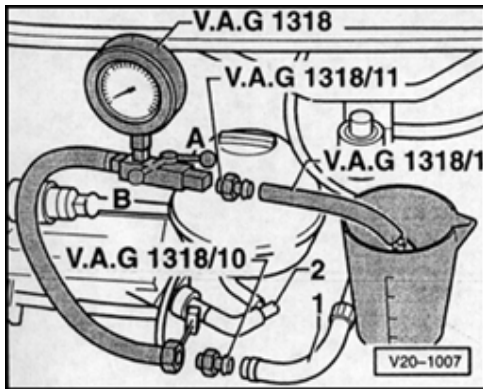
- VAG 1348/3A Remote control connected
- VAG 1318 Pressure gauge connected

WARNING!

Fire Hazard. Do NOT have anything in the area that can ignite fuel.

Note:

The fuel supply line connections between the fuel delivery unit and the pressure gauge will be simultaneously checked for leaks.



- Close pressure gauge shut-off (lever at right angles to direction of flow) -B-.
- Operate remote control for short intervals until pressure of approx. 3 bar has built-up

If pressure builds too high

- Lower excess pressure by carefully opening shut-off

Warning!

Danger of fuel spray when opening cut-offtap, hold container over the pressure gauge open connection.

Note:

If 3 bar has not been attained after one minute, either the line connections or the check valve are leaking.

- Observe pressure drop.
- After 10 minutes, pressure must not drop below 2.0 bar. If necessary check line connections for leaks, replace fuel delivery unit or fuel pump/check valve ⇒ [Page 20-13](#)

20-21



Fuel tank, removing and installing

Special tools, testers and auxiliary items

- ◆ VAG 1383 A Engine/Transmission jack
- ◆ 3217 Collar nut wrench

CAUTION!

Obtain radio security code from customer before disconnecting battery ground.

Removing

Observe safety precautions ⇒ [Page 20-9](#)

WARNING!

Fire Hazard. Do NOT have anything in the area that can ignite fuel.

- Make sure that ignition is switched OFF
- Disconnect battery ground cable.
- Drain fuel tank and clean area around fuel filler neck.
- Remove clamping ring and rubber cup from filler neck and remove mounting bolt.
- Remove tightening strap while supporting fuel tank with VAG 1383 A Engine/Transmission jack.
- Using VAG 1383A engine and transmission jack, lower fuel tank enough to allow supply and return lines and fuel gauge sensor connector to be disconnected.

20-22



Note:

On vehicles with auxiliary heater, pull off fuel lines between supply and return lines.

- Lower fuel tank.

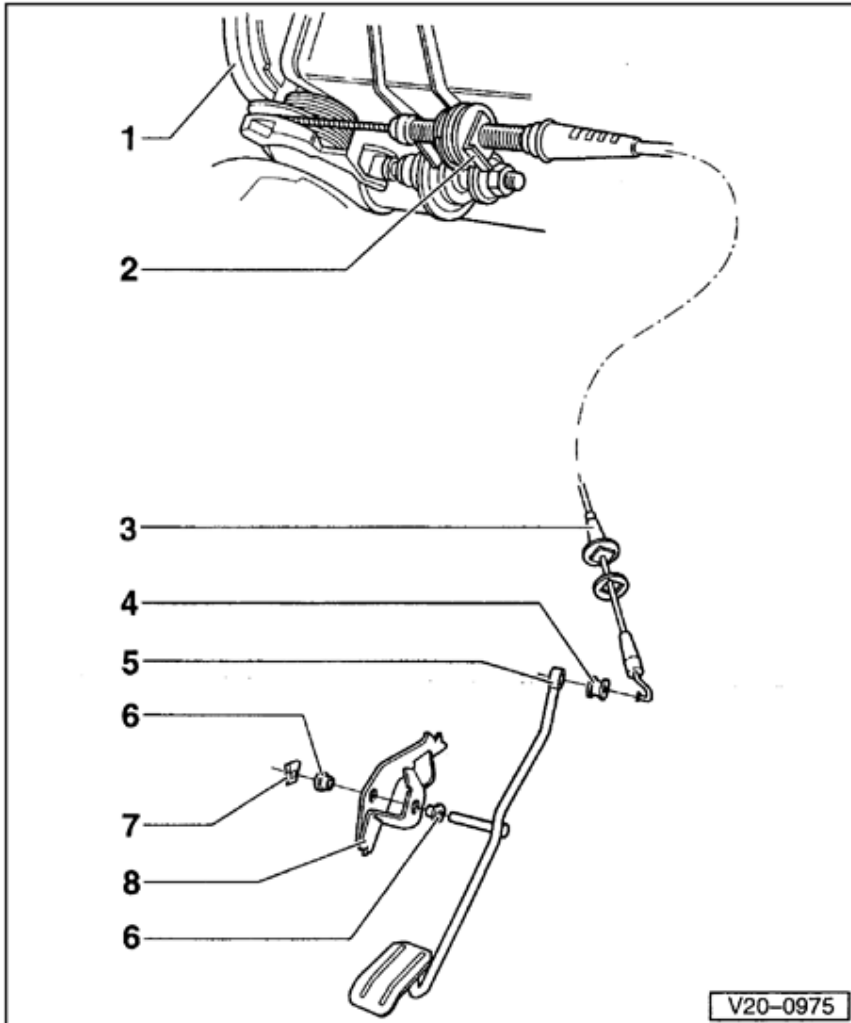
Installing

Install in reverse order but note the following:

- ◆ Route breather hose kink free.
- ◆ Secure fuel hoses with screw-type clamps.

- ◆ Do not interchange supply and return lines (return line -blue-).

20-23



Accelerator mechanism, servicing

1 - Throttle valve housing

Vehicles 08.96 ➤

- ◆ Throttle valve control

2 - Retainer

3 - Accelerator cable

- ◆ Adjusting ⇒ [Page 20-24](#)

- ◆ Removing:
Detach accelerator cable at accelerator pedal, support bracket and throttle valve housing. Break off spreader clips from inside vehicle (do not reuse damaged cable) and pull cable out into engine compartment.

4 - Rubber bush

5 - Accelerator pedal

6 - Bush

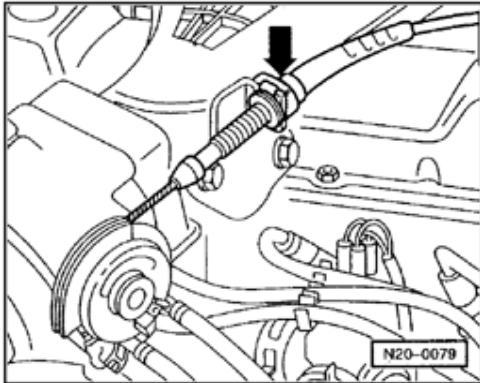
7 - Securing clip

8 - Accelerator pedal carrier



Accelerator cable, adjusting

Vehicles with manual transmission



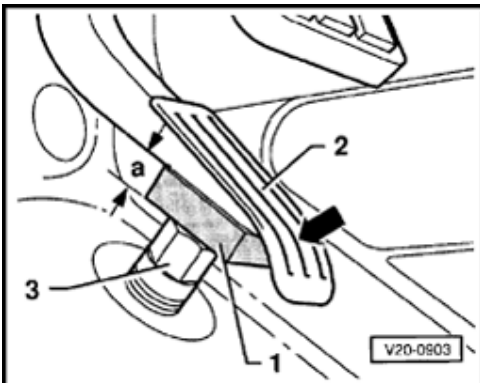
A

- Adjust throttle cable by moving the retainer - arrow- at the support bracket, so that the Wide Open Throttle position is attained at the throttle valve lever.

Vehicles with automatic transmission

Special tools, testers and auxiliary items

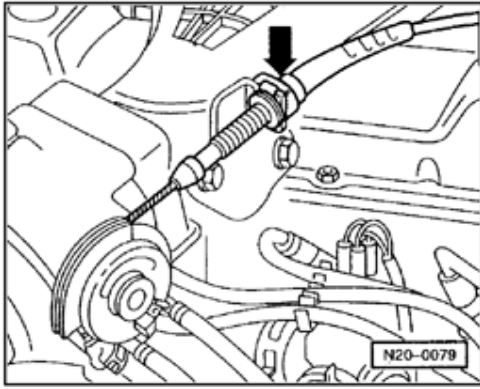
- ◆ Fluke 83 multimeter
- ◆ VW 1594 Adapter kit
- ◆ Distance piece 11 mm



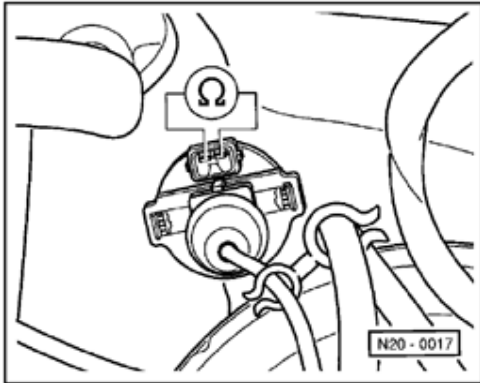
A

- Clamp distance piece -1-.
- ◆ $a = 11 \text{ mm}$, between accelerator pedal -2- and stop -3-, hold accelerator pedal in this position



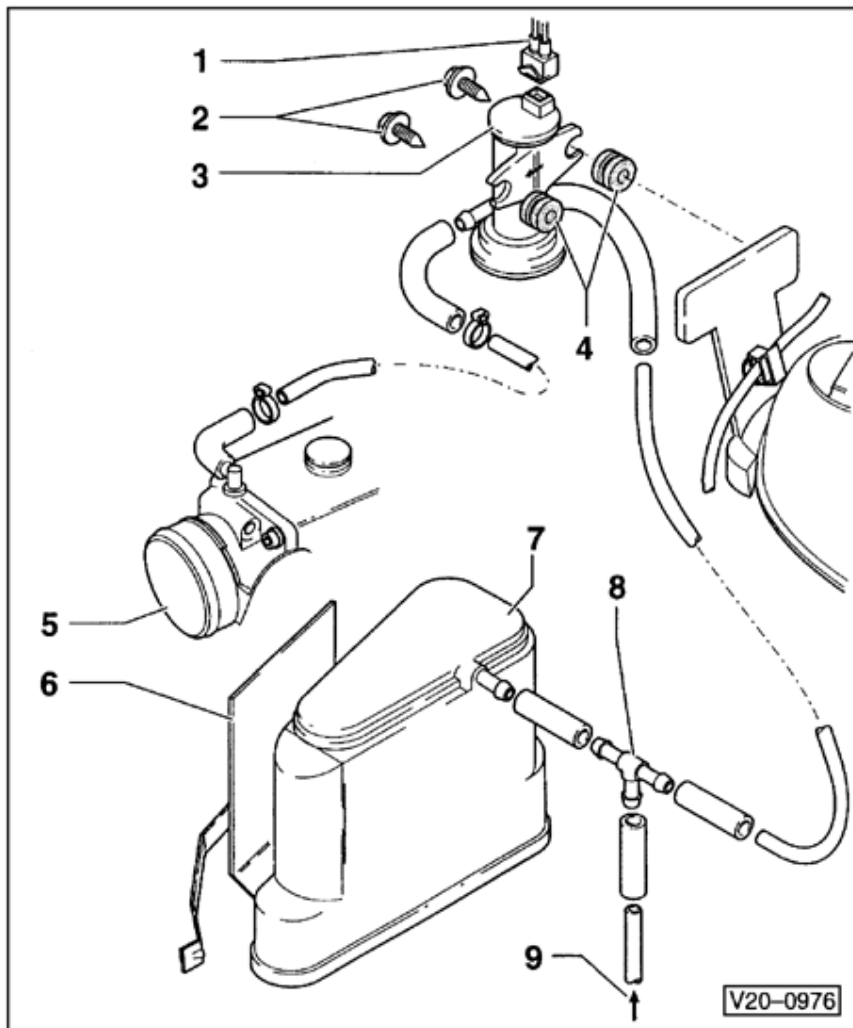


- Fully open throttle valve by pulling on the outer cable and fix in this position with the retainer -arrow-.
- Release accelerator pedal.
- Disconnect 2-pin kick-down switch -F8- harness connector in engine compartment (on the bulkhead).



- Connect Fluke 83 multimeter to kick-down switch using jumper wires from VW 1594 adaptor kit
- Check resistance at switch
 - ◆ Specification: $\infty \Omega$
- Slowly move accelerator pedal in direction of Wide Open Throttle.
 - Shortly after the kick-down point, resistance must drop to 0Ω at which point the accelerator pedal must be just off the stop.





Evaporative emissions (EVAP) system, servicing

1 - Connector

2 - 10 Nm (7 ft lb)

3 - EVAP canister purge regulator valve -N80-

◆ Checking ⇒ [Page 20-27](#)

◆ When engine is warm, valve is pulsed via ECM

◆ Note installed position: Arrow points in direction of flow

4 - Rubber bush

5 - Throttle Body

6 - Bracket

7 - EVAP canister

◆ Installed location: Front left wheel housing

8 - Tee piece

9 - Vent line

◆ From fuel tank ⇒ [Page 20-3](#) , Item 17

20-27



Evaporative emissions (EVAP) system control, checking

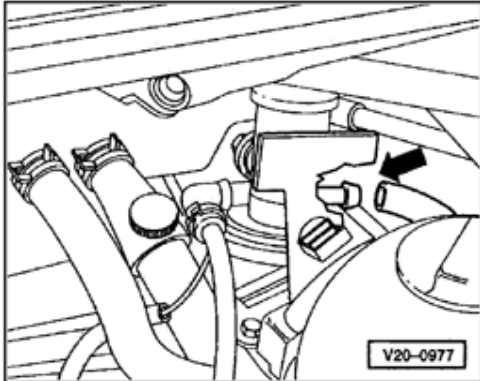
Test conditions

- Oxygen sensor and Oxygen sensor control OK, checking

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 24*

- Engine oil temperature 80 °C minimum

Test sequence



- Pull off hose (from EVAP canister) at purge regulator valve -N80- -arrow-
- Start engine and let idle
 - Valve must NOT pulse and there must NOT be perceptible vacuum at valve connection
- Increase engine speed
 - Valve must pulse periodically and vacuum must be perceptible at connection

Valve does not pulse

Vehicles with Output Diagnostic Test Mode 10.91



⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01*

Vehicles without Output Diagnostic Test Mode 09.91 ➤

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01*



- Switch OFF ignition.
- Disconnect solenoid valve and connect VAG 1527 LED tester to connector using jumper wires from VW 1594 adaptor kit

- Start engine and increase speed.

- LED must flicker briefly

If LED does not flicker:

- Locate and eliminate open circuit to ECM using wiring diagram or replace ECM.

If voltage supply OK

- Replace EVAP canister purge regulator valve
-N80-

26 - Exhaust system, Emission controls

Exhaust system, removing and installing

Part I

Part II

Front exhaust pipe stop plate, retrofitting

Exhaust Gas Recirculation (EGR) system, overview

EGR system components, removing and installing

Exhaust Gas Recirculation (EGR) valve, checking

Secondary Air Injection system, overview

Secondary Air Injection System components, removing and installing

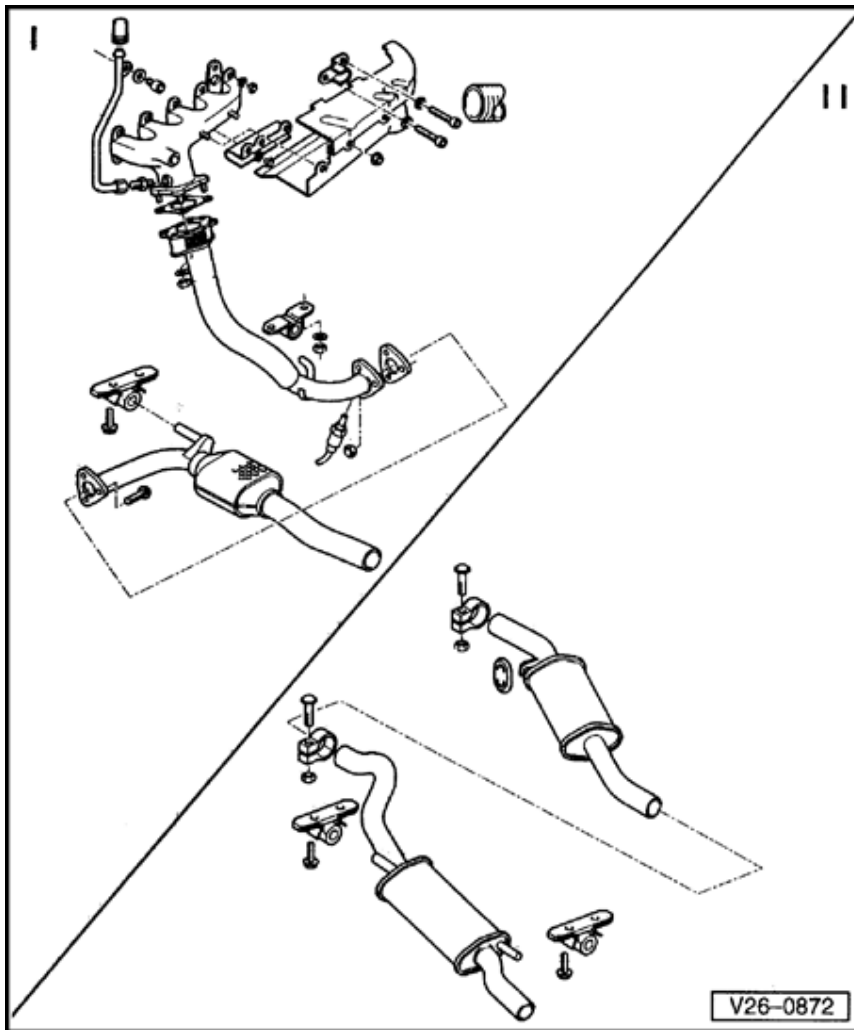
Combi-valve and check valve, checking

Secondary Air Injection pump, checking

Secondary Air Injection solenoid valve, checking

26-1





Exhaust system, removing and installing

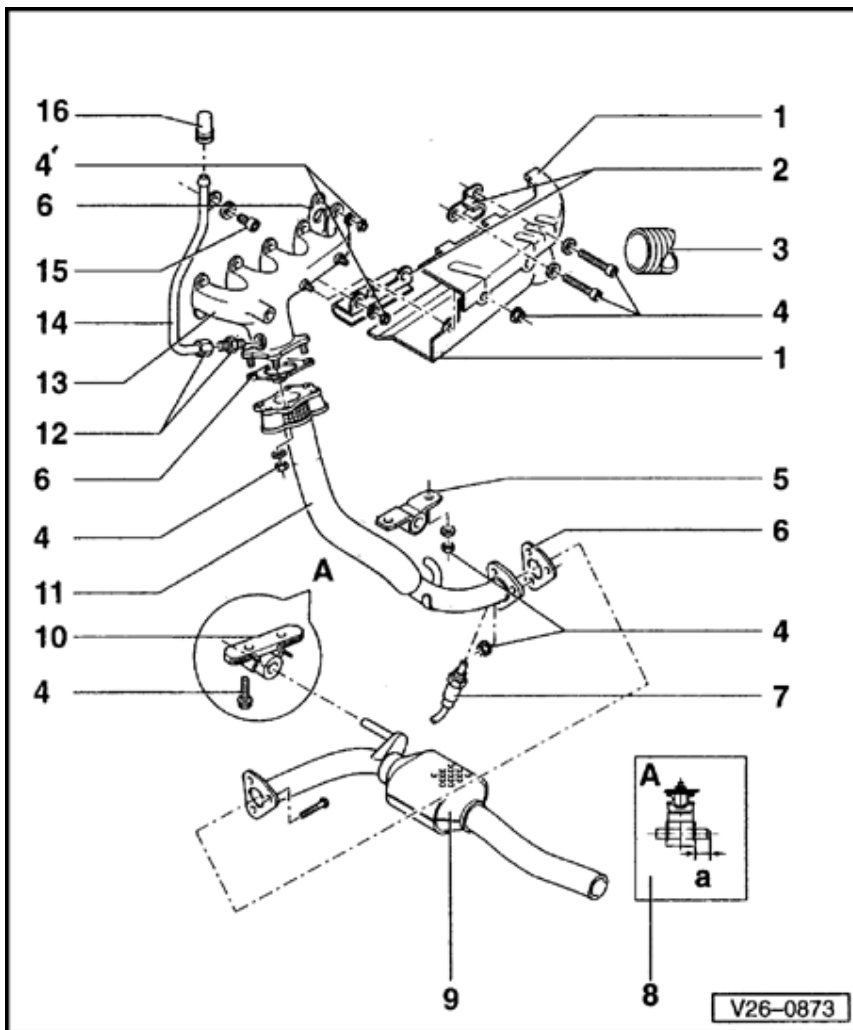
Notes:

- ◆ After working on the exhaust system, make sure that the system is not stressed, and has sufficient clearance from the bodywork. If necessary, loosen clamps and align muffler and front exhaust pipe so that sufficient clearance is maintained from the bodywork and the support rings are evenly loaded.
- ◆ Replace self-locking nuts.

I ⇒ [Page 26-2](#)

II ⇒ [Page 26-4](#)





Part I

1 - Warm air collector plate

2 - Retainer

◆ For warm air collector plate

3 - Hose

◆ To air intake connection on Air Cleaner housing

4 - M6 - 10 Nm (7 ft lb)

M8 - 25 Nm (18 ft lb)

M10 - 40 Nm (30 ft lb)

5 - Mounting

◆ Vehicles ➤ 09.91

6 - Gasket

◆ Always replace

7 - Oxygen sensor

◆ 50 Nm (37 ft lb)

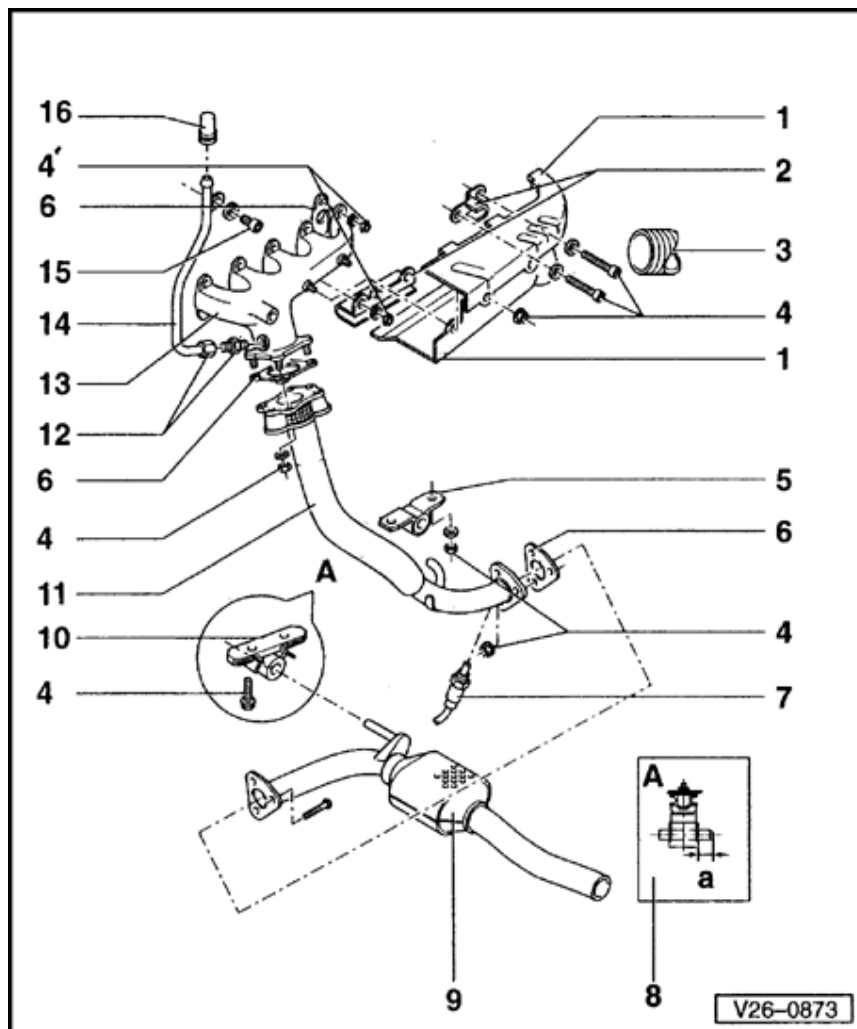
◆ Only grease threads with "G5"; "G5" must not get into slots on sensor body

◆ Checking:

⇒ Repair Group, Fuel Injection & Ignition, Repair, Group 24

8 - Dimension -a- = 50 ± 5 mm

9 - Three Way Catalyst



10 - Mounting

11 - Front exhaust pipe

- ◆ 08.95 ➤ twin pipe

12 - 30 Nm (22 ft lb)

13 - Exhaust manifold

- ◆ AAF engine:
2 piece with
intermediate and
corrugated pipes

14 - CO sampling pipe

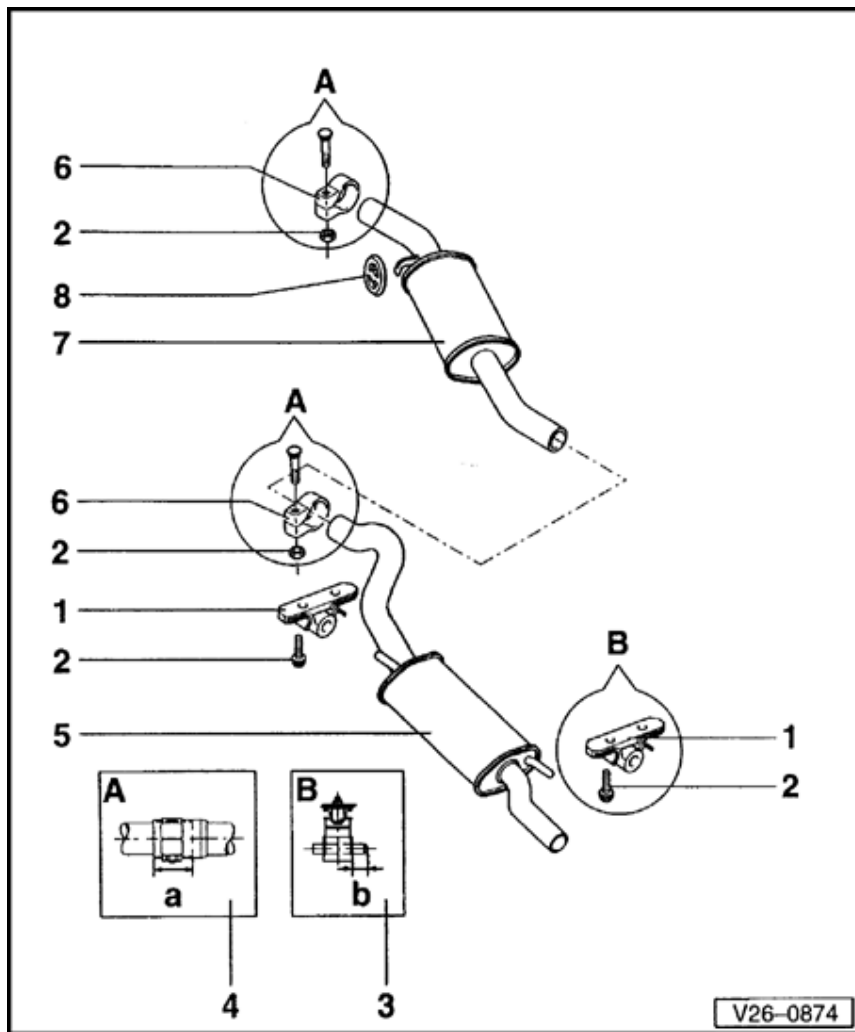
- ◆ ➤ 07.94
- ◆ Additionally
secured to intake
manifold

15 - 15 Nm (11 ft lb)

16 - Plug

- ◆ Make sure it is
tight and leak
free





Part II

1 - Mounting

2 - M6 - 10 Nm (7 ft lb)

M8 - 25 Nm (18 ft lb)

M10 - 40 Nm (30 ft lb)

3 - Dimension -b- = 25 to 35 mm

4 - Dimension -a- = 45 to 55 mm

5 - Rear muffler

6 - Clamp

- ◆ Align exhaust system longitudinally at the clamps, so that the dimensions (items -3- and -4-) are maintained

7 - Center muffler

8 - Retaining ring

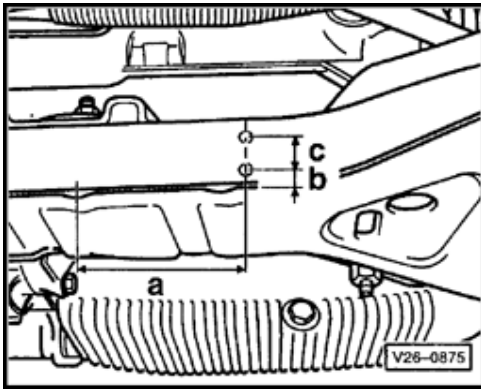
- ◆ Note version

26-5



Front exhaust pipe stop plate, retrofitting

If the front exhaust pipe is replaced on vehicles approx. 09.91, if necessary, a stop plate must be retrofitted. ➤



- Drill holes for pop rivet to secure the stop plate to sub-frame.

♦ diameter: 11 mm

Dimensions:

"a" = 120 mm from the center of the center crimp

"b" = 24 mm from the lower edge of the sub-frame

"c" = 30 mm spacing between holes

- Install pop rivets into the holes with VAG 1765 pop rivet pliers
- Bolt on stop plate.
- ♦ Tightening torque: 20 Nm (15 ft lb)

26-6



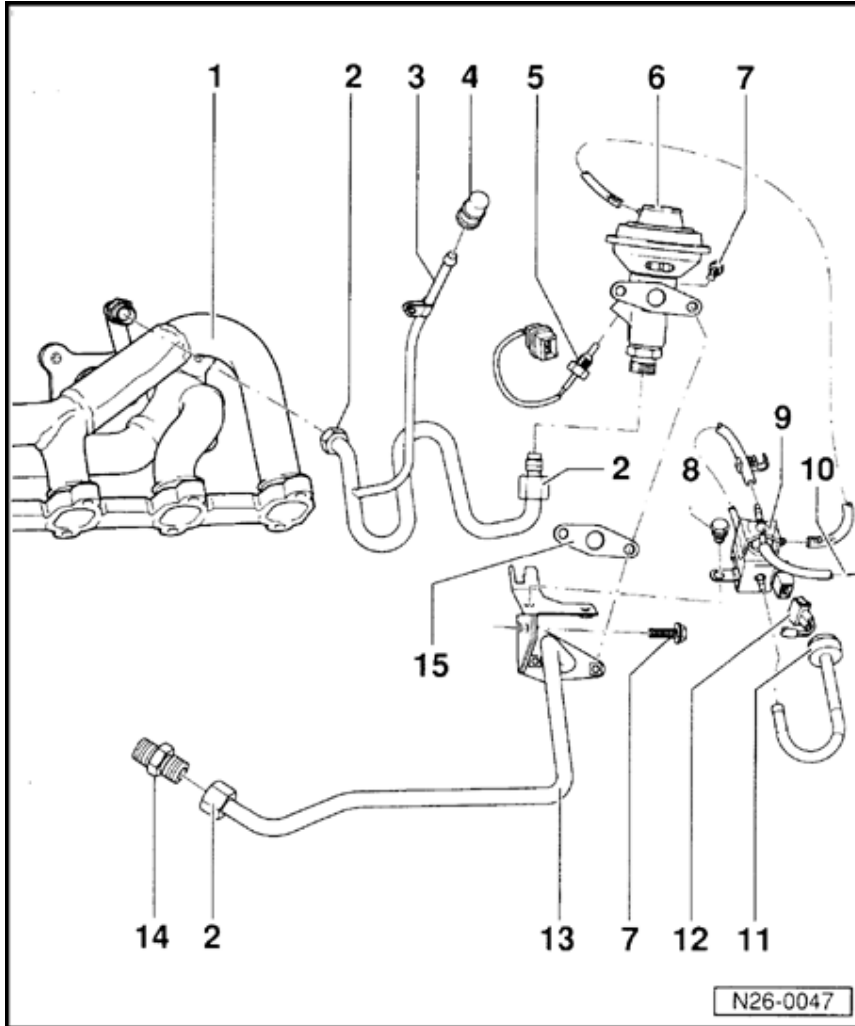
Exhaust Gas Recirculation (EGR) system, overview

Notes:

- ♦ Activation of the EGR system is under the control of the Engine Control Module (ECM) via EGR valve -N18-.
- ♦ The function/control of the EGR system is checked by the ECM On Board Diagnostic

⇒ Repair Group, Fuel Injection & Ignition, Repair Group 01

- ♦ When working on the system always replace seals and gaskets.
- ♦ Vacuum hoses and hose connections must be free of leaks.
- ♦ Vacuum hoses must not be blocked or



EGR system components, removing and installing

➤07.96 only for US vehicles

Vehicles 08.96 ➤ [Page 26-9](#)

1 - Exhaust manifold

- ◆ AAF engine:
2-piece with intermediate and corrugated pipes

2 - 35 Nm (26 ft lb)

3 - CO sampling pipe

- ◆ ➤07.94

4 - Plug

5 - EGR temperature sensor -G98-

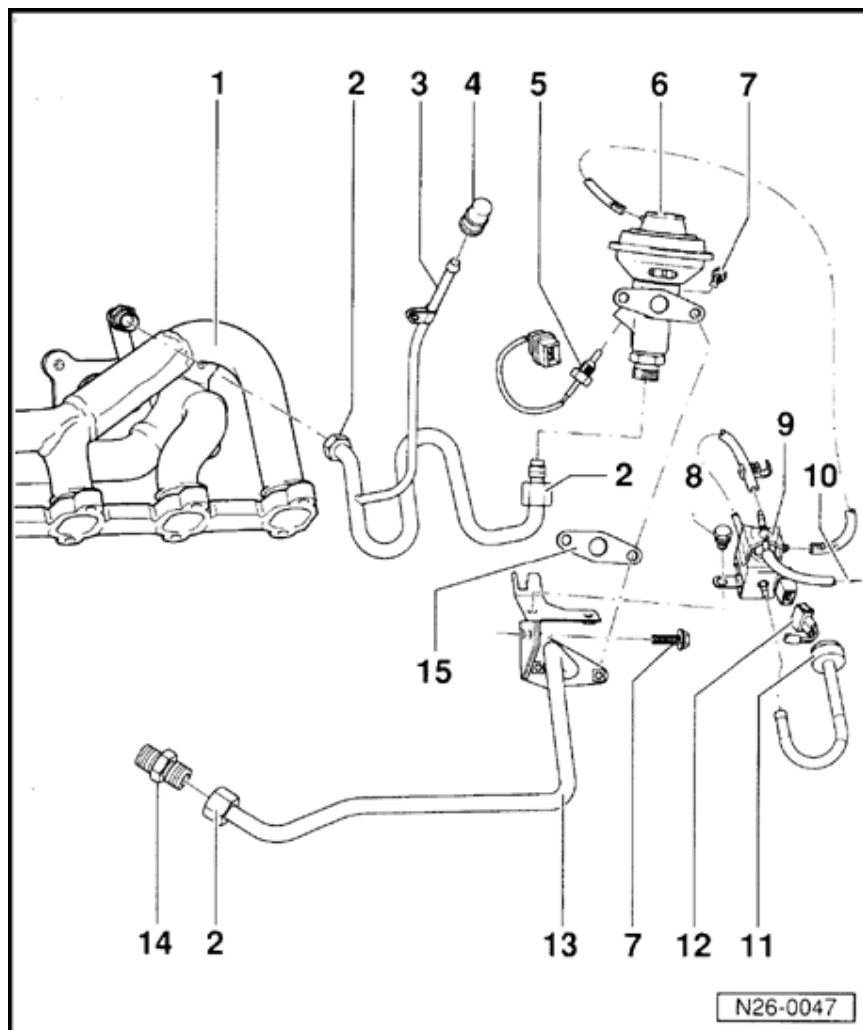
- ◆ 20 Nm (15 ft lb)
- ◆ With 2-pin connector
- ◆ Checking:

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01*

6 - EGR valve

- ◆ Checking ⇒ [Page 26-10](#)

7 - 9 Nm (7 ft lb)



8 - 10 Nm (7 ft lb)

9 - EGR Vacuum Regulator solenoid valve - N18-

◆ Two-way valve

◆ Checking:

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01*

10 - Collective connection

◆ for intake manifold vacuum

11 - Filter

12 - 2-pin harness connector

◆ for EGR Vacuum Regulator solenoid valve - N18-

13 - Pipe

14 - Pipe union

◆ 34 Nm (25 ft lb)

◆ In intake manifold

15 - Gasket

◆ Always replace





- 11 - 30 Nm (22 ft lb)**

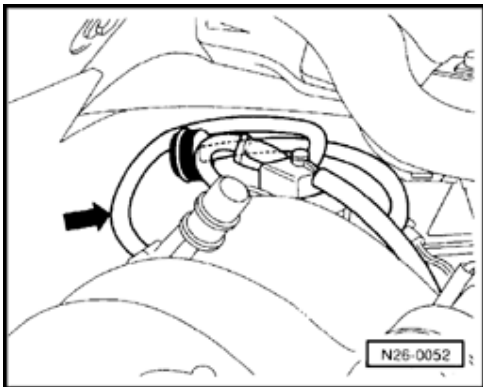
- ◆ US 8012 Hand vacuum pump

Test conditions

- Vacuum lines and hose connections free of leaks.
- Vacuum lines not blocked or kinked.
- Engine oil temperature at least 50 °C

Test sequence

Vehicles ➤07.96

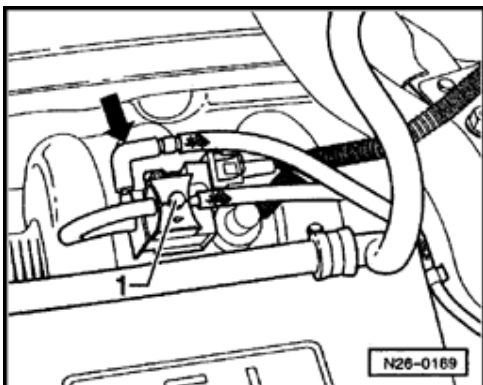


- Disconnect vacuum hose -arrow- from EGR valve.

26-11



Vehicles 08.96 ➤



- Pull vacuum hose -arrow- off EGR valve -N18-1- .

Continued for all vehicles

- Connect hand vacuum pump to valve using extension hose
- Start engine and let idle
- Operate hand vacuum pump.
- ◆ Idle speed behavior must noticeably deteriorate

If the idling characteristics do not deteriorate:

- Remove the EGR valve.
- Operate vacuum pump
 - ◆ valve must open
- Release vacuum again
 - ◆ valve must close again
- Check whether EGR system is blocked.

26-12



Secondary Air Injection system, overview

US vehicles Only ➤07.96

Function

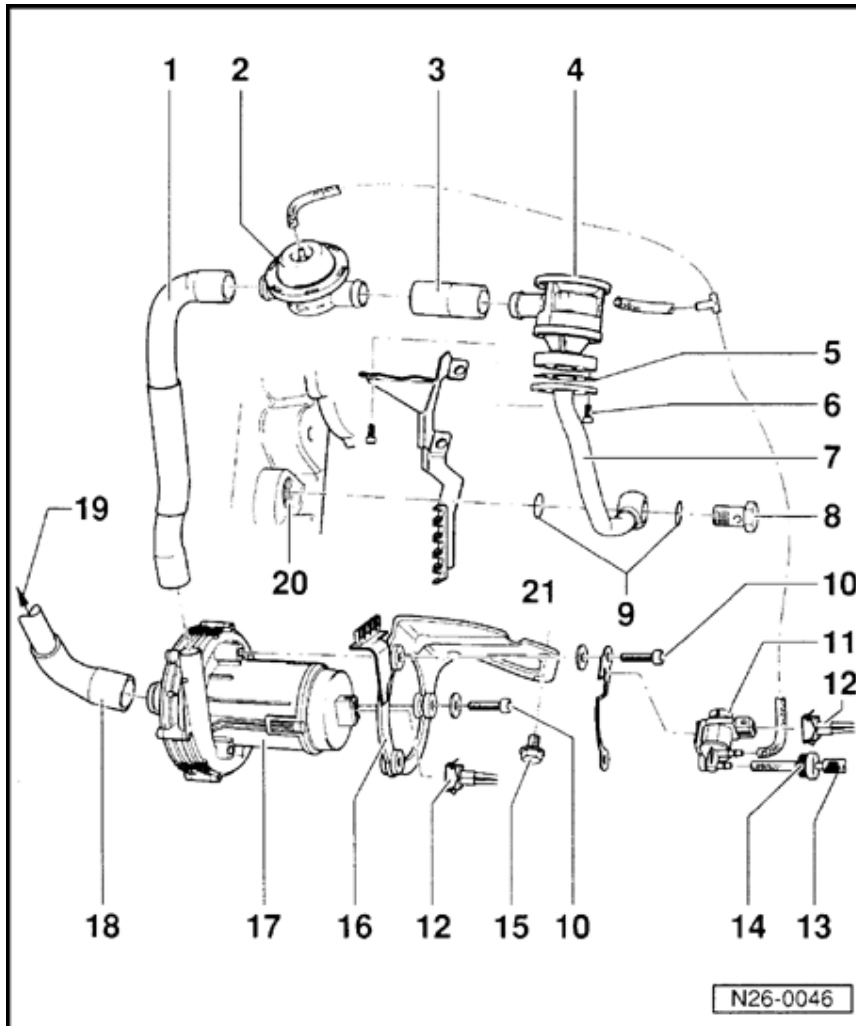
The Secondary Air Injection System blows in air behind the exhaust valve for 97 seconds during a cold start (+15 °C to +35 °C engine coolant temperature). This produces an oxygen rich exhaust, causes afterburning and reduces the heat-up time of the catalyst. Activation is via Engine Control Module -J169- via the Secondary Air Injection pump relay -J299- to Secondary Air Injection valve -N112-, change-over valve, check valve and combi-valve. In addition to the cold start switch-in phase, the Secondary Air Injection System will be switched on during idle (up to max. 85 °C engine coolant temperature) and is checked via On Board Diagnostic II.

Notes:

- ◆ *The system is checked via On Board Diagnostic system:*

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01*

- ◆ *Components marked with ** are checked by*



Secondary Air Injection System components, removing and installing

1 - Pressure hose

- ◆ Make sure seated tightly

2 - Check valve

3 - Connecting hose

- ◆ Make sure seated tightly

4 - Combi-valve

- ◆ Checking ⇒ [Page 26-15](#)

5 - Gasket

- ◆ Always replace

6 - 9 Nm (6 ft lb)

7 - Connecting pipe

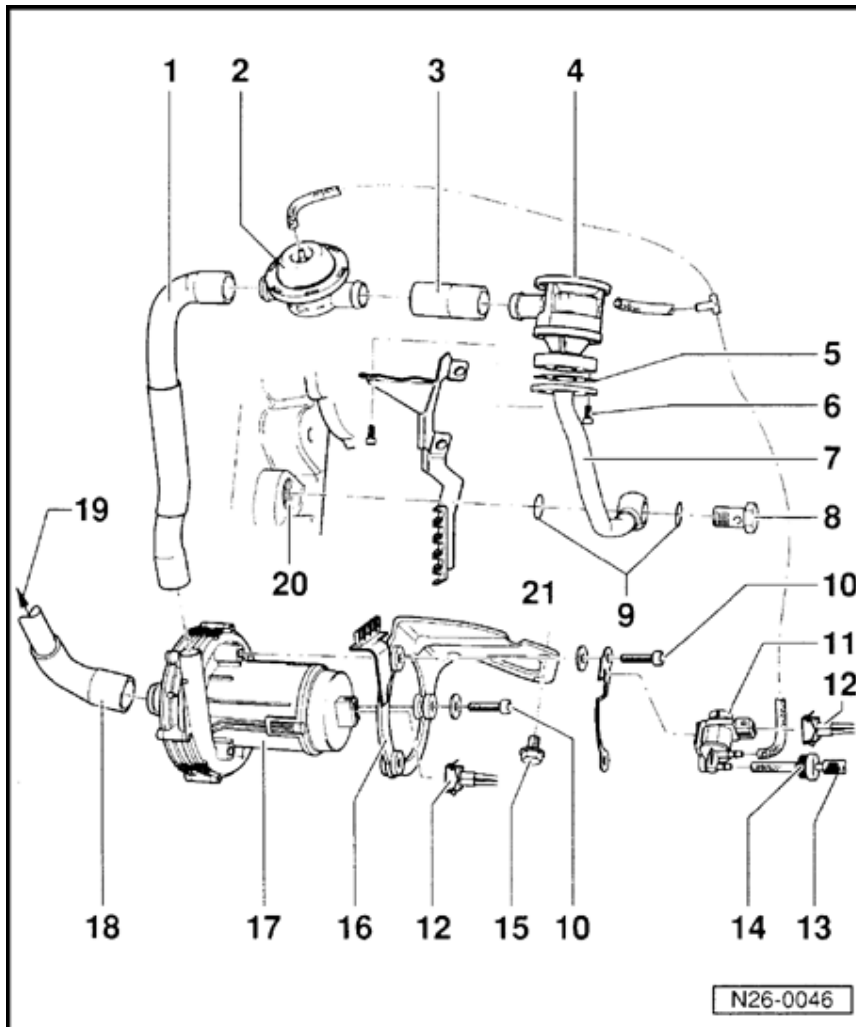
8 - 30 Nm (22 ft lb)

9 - Gasket

- ◆ Always replace

10 - 10 Nm (7 ft lb)

11 - Secondary Air Injection solenoid valve -N112-**



12 - 2-pin harness connector

13 - Vacuum hose

- ◆ to brake servo check valve connection

14 - Check valve

15 - 40 Nm (30 ft lb)

16 - Bracket

- ◆ Secondary Air Injection pump item -17- and Secondary Air Injection solenoid valve, item -11-

17 - Secondary Air Injection pump**

- ◆ with motor V101
- ◆ Checking ⇒ [Page 26-16](#)

18 - Intake hose

- ◆ for Secondary Air Injection pump

19 - To Air Cleaner

- ◆ on intake hose connection

20 - Air channel

- ◆ in cylinder head

21 - Bracket

- ◆ for combi-valve



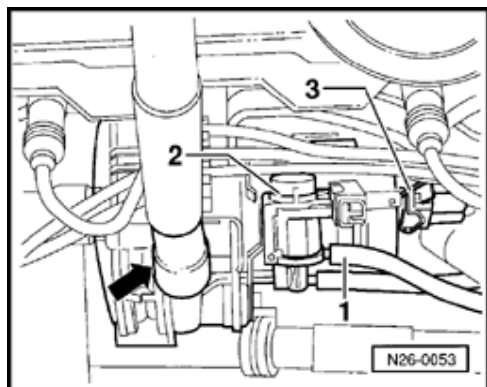
Combi-valve and check valve, checking

Special tools, testers and auxiliary items

- ◆ US 8012 Hand vacuum pump

Test sequence

- Disconnect vacuum hose -1- from Secondary Air Injection valve -N112- -2-.
- Connect hand vacuum pump to vacuum hose -1-.
- ◀ - Disconnect pressure hose -arrow- from Secondary Air Injection pump motor and direct upward.



Note:

Do not use compressed air during the following check!

- If necessary, extend pressure hose with an extension made of scrap hose and blow into it by mouth
 - ◆ Valve must be closed
- Operate hand vacuum pump
 - ◆ Valve must open



Secondary Air Injection pump, checking

Special tools, testers and auxiliary items

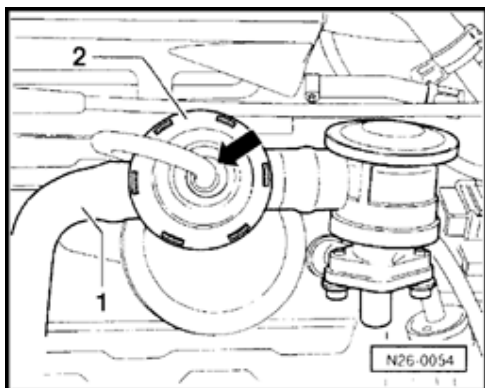
- ◆ VAG 1598/18 Test Box
- ◆ VW 1594 Adaptor kit

◆ VAG 1527B LED Voltage tester

Test conditions

- Secondary Air Injection pump relay -J299- OK
- VAG 1598/18 Test box connected

Test sequence



- Disconnect pressure hose -1- from check valve -2-.
- Bridge Test Box sockets 29 + 42 with jumper wires from VW 1594
 - ◆ Secondary Air Injection pump motor must run and air must exit from pressure hose.

If no air exits pressure hose

- Replace Secondary Air Injection pump.

26-17



If Secondary Air Injection pump motor does NOT run

- Disconnect 2-pin harness connector from Secondary Air Injection pump motor -V101-.
- Connect VAG 1527B Voltage tester to disconnected connector using jumper wires from VW 1594 adaptor kit

◆ LED must light up

If LED lights up (voltage supply OK):

- Replace Secondary Air Injection pump.

If LED does not light up:

- Reconnect 2-pin harness connector.

- Check Secondary Air Injection pump motor activation:

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01; Output Diagnostic Test Mode*

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01; Electrical checks; wiring and component checks using VAG 1598 Test Box*

26-18



If Secondary Air Injection pump motor does not run during electrical check:

- Check Secondary Air Injection pump relay - J299-

⇒ *Wiring diagrams, Electrical troubleshooting and Component locations*

- Check and erase DTC memory

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01; DTC memory, checking*

26-19



Secondary Air Injection solenoid valve, checking

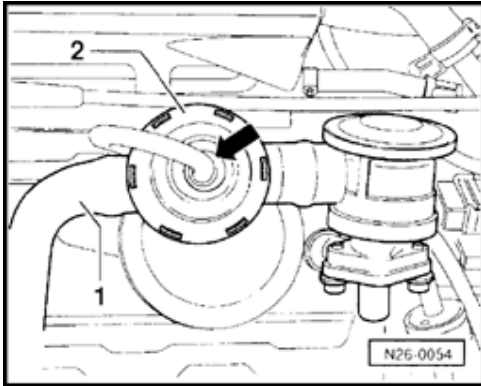
Special tools, testers and auxiliary items

- ◆ VW 1594 Adaptor kit
- ◆ VAG 1527B Voltage tester

Test conditions

- Engine oil temperature 15 to 35 °C
- Secondary Air Injection pump OK

Test sequence



- Disconnect vacuum hose -arrow- from check valve -2-.
- Start engine and let idle

If the Secondary Air Injection pump motor runs

- ◆ vacuum must be perceptible at the vacuum hose

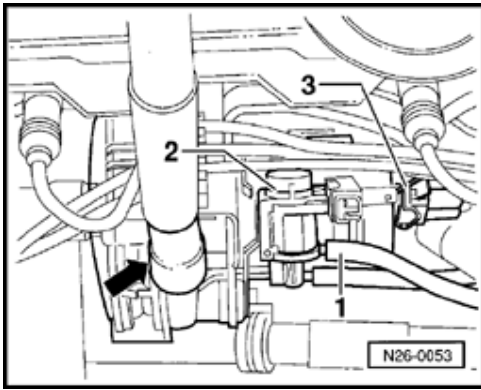
26-20



If vacuum is not perceptible

- Switch OFF ignition
- Disconnect Secondary Air Injection solenoid valve -N112-.
- Connect VAG 1527B Voltage tester to disconnected connector using jumper wires from VW 1594 adaptor kit
- Start engine and let idle
- ◆ LED must light up

If LED lights up (voltage supply OK):



- Replace Secondary Air Injection solenoid valve -2-.

If LED does not light up:

- Re-attach connector.
- Check valve activation

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01*

If Valve operation is not perceptible during electrical check

- Check Secondary Air Injection pump relay - J299-

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

- Check and erase DTC memory

⇒ *Repair Manual, Fuel Injection & Ignition, Repair Group 01; DTC memory, checking*